Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals

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Preface

The primary purpose of this document is to provide updated information and practical guidance to authorities charged with protecting, assessing, and restoring marine mammals injured by oil spills, primarily for Natural Resources Damage Assessments (NRDA) conducted under the Oil Pollution Act (OPA).

This document was prepared as a follow-up from a NOAA workshop on marine mammal oil spill assessments, which took place during August 2015, in Seattle, Washington. The focus of the workshop was the exposure and injury assessment phases of a Natural Resource Damage Assessment (NRDA), driven largely by the emerging scientific findings from the Deepwater Horizon Oil Spill NRDA. Participants discussed the scientific strategies for addressing marine mammal effects within the constraints and framework of NRDA. Information from this workshop, discussions among NRDA participants following the completion of the Deepwater Horizon Oil Spill Programmatic Damage Assessment and Restoration Plan, and input from reviewers, were used to prepare these guidelines.

Because of the wide variety of species, habitats, and varied circumstances around individual spills, information and methodologies are presented as summaries and not as detailed standard operating procedures. NOAA staff and marine mammal scientists involved with oil spills should use this document as a starting place for regional-based planning, where region-specific issues and species can be addressed and where necessary regional-specific standard operating procedures can be developed.

In addition, this document does not address NRDA restoration, nor does it address scaling methods available for injury and restoration scaling. Although critically important for a future revision or as a separate guidelines document, restoration was not addressed at the August 2015 workshop because of logistic constraints. It is also therefore not addressed in this document.

Much of the information here for oil spills, such as trustee responsibilities and basic NRDA processes, is also applicable to assessments involving the release of other hazardous substances (under Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)). However, given that NRDAs conducted under CERCLA often evaluate contaminants of greatly different properties than oil, with exposure occurring across longer timeframes, the NRDA methodologies discussed in this document may not apply in those circumstances. Therefore these marine mammal guidelines should not be considered as entirely applicable for CERCLA cases. These guidelines are intended to address activities involving marine mammals under NOAA jurisdiction (pursuant to the Marine Mammal Protection Act and Endangered Species Act).

Acknowledgments: Authors wish to thank the workshop participants and other reviewers for their input and comments to this document. The list of participants can be found at Appendix L.

Disclaimer: This report has been reviewed by the National Marine Fisheries Service and National Ocean Service of the National Oceanographic and Atmospheric Administration (NOAA) and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for their use by the United States Government.

Acronym List

ACP	Area Contingency Plan
ARD	Assessment and Restoration Division
BMP	Best Management Practices
BSE	Bays, Sounds and Estuaries
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DARRP	Damage Assessment, Remediation and Restoration Program
ERD	Emergency Response Division
FOSC	Federal On-Scene Coordinator
GCNR	Natural Resources Section of the NOAA General Counsel's Office
HAB	Harmful algal bloom
HQ	Headquarters
ICS	Incident Command System
LOA	Letter of Authorization
MMHSRP	Marine Mammal Health and Stranding Response Program
MMPA	Marine Mammal Protection Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NPFC	National Pollution Fund Center
NRDA	Natural Resource Damage Assessment
OHC	Office of Habitat Conservation
ONMS	Office of National Marine Sanctuaries
OPA	Oil Pollution Act of 1990
OPR	Office of Protected Resources
OR&R	Office of Response and Restoration
PAH	Polycyclic Aromatic Hydrocarbon
PAM	Passive Acoustic Monitoring
POP	Persistent Organic Pollutant
PRD	Protected Resources Division
RC	Restoration Center
RP	Responsible Party
RRC	Regional Resources Coordinator (NOAA Assessment and Restoration Division)
UAS	Unmanned Aerial Systems
SSC	Scientific Support Coordinator (NOAA Emergency Response Division)
UME	Unusual Mortality Event
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

Executive Summary

In August 2015, NOAA scientists convened a workshop to discuss, develop, and document methods and processes to conduct assessments and investigations to evaluate the nature and extent of potential injuries to marine mammals from oil spills, emphasizing needs specific to NRDA. These guidelines are a direct result of workshop discussions, experience with recent oil spills, and the desire to clarify techniques available and constraints we work under during oil spills. The guidelines are intended to address species under NOAA jurisdiction.

The document describes: (1) primary statutory authorities and responsibilities for NOAA's response and assessment activities for marine mammals due to oil spills; (2) brief descriptions of routes of oil exposure and potential injury; and (3) summaries of methods and approaches currently available for marine mammal assessment.

The methods and approaches are listed as a lookup table in Table 1 for pinnipeds and cetaceans by habitat and are identified as suitable for exposure evaluations or injury determination. The methodologies are also linked to the accompanying text in the document for easier access. Each methodology entry in this document serves as a quick reference with a summary of the method, utility for NRDA, baseline considerations, and other factors (such as cost and time).

The document also provides appendices with brief summary information useful in NRDA planning for marine mammal scientists to have access to NRDA information, such as contact lists, information on safety, data management, and some information about how NRDA work gets approved and funded during a spill. For NRDA case leads, the document includes brief descriptions of Endangered Species Act and Marine Mammal Protection Act permitting, NMFS contact lists, and a description of the stranding program and marine mammal stranding networks. Although not the purpose of these guidelines, the assessment methods and planning components of this document may also be useful for NRDA for hazardous waste sites.

This document is not a compendium of standard operating procedures, since the needs of individual assessments can vary widely across species, geography, oil type, and the circumstances of individual spills. Rather, this is intended as a planning tool for identifying NRDA tools and considerations for marine mammals under NOAA jurisdiction.

Table 1 Summary of field tools for collecting evidence of exposure and/or injury for cetaceans and pinnipeds under NOAA jurisdiction
Column headings correspond to subsequent sections of this document where the method is described in more detail. The utility of these methods may vary by region and by species. The case team and marine mammal experts should use this as a starting point and communication tool for assessment planning.

Habitats	Species groups	Photographic or video documentation	Photographic Identification (Photo-ID)	Visual Health Assessment	Remote Biopsy	Sampling of breath condensate and exudate ("blow") in cetaceans	Passive Acoustic Monitoring	Capture-release (Health Assessment)	Tagging (remote and applied)	Aerial and Vessel Surveys	Stranding Response	Other remote sample collection	Sampling of air	Sampling of oil in surface slicks, water column, sediment, and stranded on shore	Sampling of prey	Review response data and records for mammal assessments
On Land and on ice	Pinniped	E[1] I[2]	E I	I	E	N[3]	N	E I	E	E I	E I	E I	E	E	E	E I
Nearshore	Small cetaceans	E I	E I	I	I	E I	E I	I	E	E	E I	I	E	E	E	E I
	Deep-diving whales	E	N	N	I	N	E I	N	E	E	E I	I	E	E	E	E I
	Other large whales	E I	E	I	I	E I	E I	N	E	E	E I	I	E	E	E	E I
	Pinnipeds	E	N	N	I	N	E I	I	N	E	N	N	E	E	E	E I
Offshore	Small cetaceans	E I	N	I	I	E I	E I	I	E	E I	E I	I	E	E	E	E I
	Deep-diving whales	E	N	N	I	N	E I	N	E	E I	E I	I	E	E	E	E I
	Other large whales	E I	E I	I	I	E I	E I	N	E	E I	E I	I	E	E	E	E I
	Pinnipeds	E	N	N	N	N	E I	N	N	N	N	N	E	E	E	E I

[1] 'E' denotes the study may generate data for exposure information
[2] 'I' denotes the study may generate data for injury information
[3] 'N' denotes the study is likely not suitable for NRDA purposes for this group of species.

1. Introduction

Summary: *Compared to other marine and estuarine wildlife such as birds, assessing impacts of oil spills to marine mammals has been infrequent and challenging. Recent studies from the Deepwater Horizon Oil Spill highlight the sensitivity of marine mammals to oil and prompted us to review and summarize the current assessment approaches. This document provides guidance for assessing exposure to oil and resulting injury to marine mammal species under NOAA management.*

Marine mammals are morphologically adapted to primarily inhabit the marine environment. All species in U.S. waters are protected by the Marine Mammal Protection Act (MMPA). NOAA manages cetaceans (dolphins, porpoises, whales) and most pinnipeds – phocids (seals) and otariids (sea lions and fur seals). Department of the Interior U.S. Fish and Wildlife Service (USFWS) manages odobenid pinnipeds (walruses), polar bears, otters, manatees, and dugong. Marine mammals occupy a wide range of habitats, from mid and deep water areas to rocky shores, beaches, and sea ice. Oil spills can occur in all of these habitats.

Thousands of oil spills occur in U.S. waters each year. While most are small (less than one barrel e.g. 42 gallons of oil), there have been at least 44 oil spills over 10,000 barrels (420,000 gallons) since 1969 affecting U.S. coastal waters (Figure 1). Large and even relatively small spills can cause major environmental and economic harm, depending on location, season, sensitivity of environmental resources, amount and type of oil, duration of the release, and effectiveness of response (i.e., cleanup or containment). A wide variety of wildlife, including marine mammals, may be adversely affected by these spills. Potential injuries include effects from direct exposure of the animal, habitat contamination and impairment (through cleanup activities), and effects to prey quality and abundance.

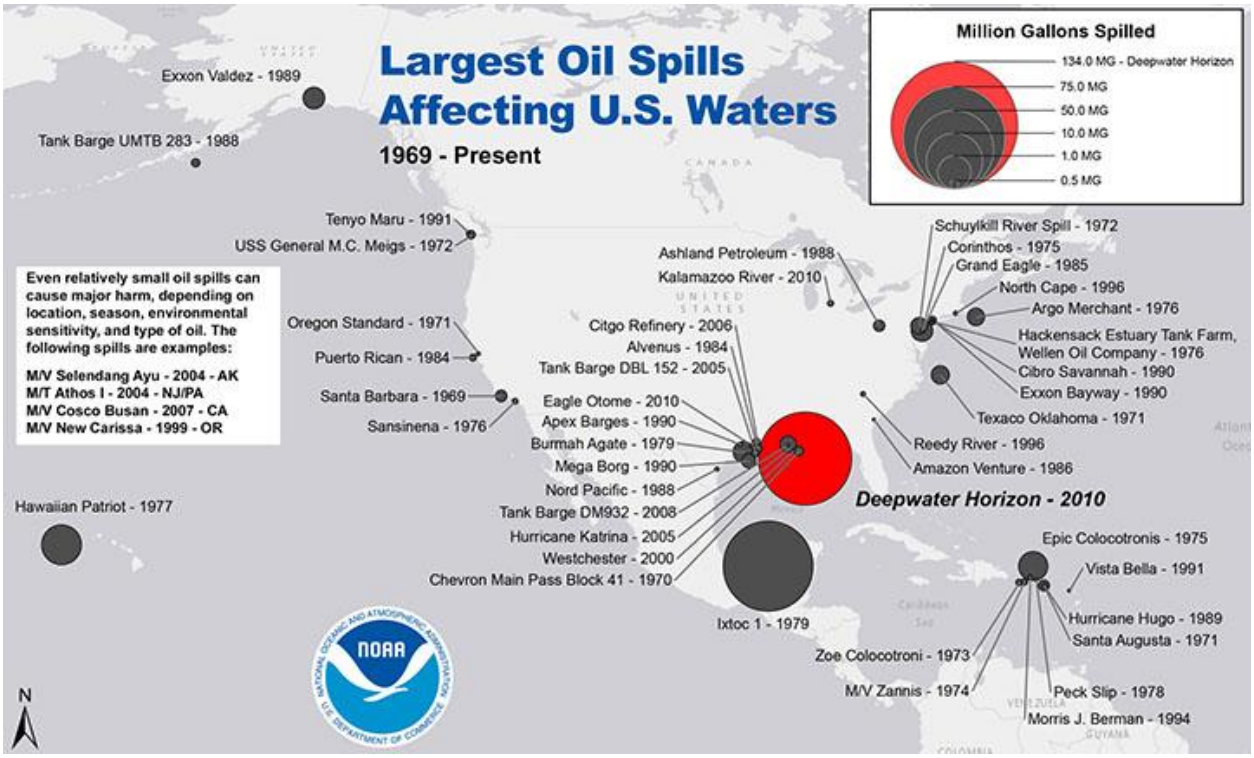

Figure 1 Significant oil spills (>10,000 barrels (420,000 gallons)) affecting U.S. waters since 1969. Source: http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/largest-oil-spills-affecting-us-waters-1969.html

NOAA has responded to oil spills for over 25 years under a variety of authorities (see Section 2 below). NOAA protects and restores injured natural resources by providing scientific support during the cleanup, recommending mitigation measures to reduce response impacts, conducting injury assessments, and planning and implementing restoration. However, NOAA's response to and assessment of potential injuries caused by oil spills to marine mammals is relatively limited compared to our experience assessing impacts to other resources such as fish, shellfish, birds, corals, and wetlands. An important reason for this limited experience is the challenge of documenting exposure to and impacts of oil on marine mammals in the wild, as well as the obvious lack of laboratory studies of marine mammals exposed to oil.

Recent assessments conducted under the *Deepwater Horizon* Natural Resource Damage Assessment (NRDA) and the Northern Gulf of Mexico Unusual Mortality Event (UME) of 2010-2014, as well as independent research, have revealed insights into the potential sensitivity of marine mammals to oil and identified methods to assess exposure and impacts to cetaceans. In recent years, NOAA's National Marine Fisheries Service (NMFS) Office of Protected Resources (OPR) updated their Pinniped and Cetacean Response Oil Spill Response Guidelines as a result (Ziccardi et al., 2015).

In August 2015, NOAA scientists from across the agency met to discuss insights gained from the recent *Deepwater Horizon* NRDA Assessment and discuss assessment approaches and methodologies that should be considered for future oil spills involving cetaceans and pinnipeds under NOAA management. Further discussions after the conclusion of the assessment phase of the *Deepwater Horizon* NRDA helped provide further insights into methodologies to be considered. This document is the outcome of these workshops and discussions.

2. NOAA Authorities Regarding Marine Mammals and Oil Spills

Summary: *During an oil spill, NOAA operates under multiple authorities, including the Oil Pollution Act, Endangered Species Act, Marine Mammal Protection Act, and National Marine Sanctuaries Act.*

During an oil spill, NOAA operates under multiple authorities. NOAA's primary authorities during an oil spill, relevant to marine mammals, are the Oil Pollution Act, Endangered Species Act, Marine Mammal Protection Act, and National Marine Sanctuaries Act. Other authorities may be relied on during a spill, such as the Clean Water Act, Magnuson–Stevens Fishery Conservation and Management Act, and the Coastal Zone Management Act. However, these are unlikely to have relevance for marine mammal assessment and so are not considered further in this document. Other non-Federal authorities may be relevant at the individual spill level, but are also not discussed here.

As this document is primarily intended to provide information for NRDA assessments, more detail is given in this document regarding the NRDA process than other authorities. Information on NOAA's roles in the response and cleanup process are noted briefly below and can be found at NOAA's Office of Response and Restoration website[4].

For all statutes described here, these brief descriptions are for the purposes of achieving basic understanding by NOAA staff, contractors and others unfamiliar with that statute. These descriptions are not substitutions for trainings, handbooks, or guidance sponsored by the specific programs.

2.1. Oil Pollution Act of 1990

The Oil Pollution Act of 1990 (OPA), was enacted largely in response to the *Exxon Valdez* oil spill (Prince William Sound, AK, 1989) and worked to strengthen the Nation's ability to prevent and respond to oil spills. OPA provides three key planning and response elements: (a) requirements for contingency planning by government and industry, (b) the creation of the Oil

[4] https://response.restoration.noaa.gov/

Spill Liability Trust Fund, which is managed by the U.S. Coast Guard (USCG) National Pollution Funds Center (NPFC) and, (c) an increase in the penalties for regulatory noncompliance and an extensive liability scheme that was designed to ensure that, in the event of a spill or discharge of oil, the responsible parties are liable for the response costs and damages that result from the incident.

Under OPA, NOAA has three critical roles as outlined in the National Oil and Hazardous Substances Pollution Contingency Plan[5] (NCP, 40 CFR § 300.145):

- NOAA serves as a scientific advisor to the USCG Federal On-Scene Coordinator (FOSC), with duties including oil trajectory predictions, overflight observations of oil on water, identification of high value or sensitive habitats or resources, and shoreline surveys of oil to determine clean-up priorities;
- NOAA represents the interests of the Department of Commerce in oil spill response planning and decision-making through the National Response Team and Regional Response Teams. Through this process, NOAA is involved in the development of oil spill response planning documents, such as Regional and Area Contingency Plans (including Wildlife Response Plans including sea turtle and marine mammal response considerations), at both Regional and Area levels; and
- NOAA serves as a Natural Resource Trustee on behalf of the public and may conduct a NRDA, jointly with other trustees, with the goal of recovering damages to restore ocean and coastal resources harmed by a spill.

These roles are discussed in more detail below:

2.1.1. Oil Spill Emergency Response

The USCG's FOSC oversees responses to oil spills and chemical accidents in U.S. navigable waters. Oil spill response activities follow the Incident Command System (ICS) structure specified by the National Incident Management System[6], modified for oil and hazardous substance spill response by the National Response Team, and are coordinated by the Unified Command (UC). The UC is a structure that brings together the Incident Commanders of all major organizations involved in the incident in order to coordinate an effective response, while at the same time allowing each to carry out their own jurisdictional, legal, and functional responsibilities. For a spill where NOAA is likely to be involved, the UC would minimally comprise of the USCG, the affected state or states, and the Responsible Party (RP).

[5] https://www.ecfr.gov/cgi-bin/text-idx?SID=f7cd5cf77fe84292d78d1ac1edf92a95&mc=true&node=pt40.28.300&rgn=div5
[6] https://www.fema.gov/national-incident-management-system

When spills occur, NOAA Scientific Support Coordinators (SSCs) from NOAA's Office of Response and Restoration (OR&R) Emergency Response Division (ERD) provide scientific information to the FOSC and may conduct shoreline assessments, aerial overflights, and trajectory modeling and identify resources at risk. These activities are critical to the decision-making by the Incident Commander or UC. Prior to a spill the SSCs also participate in National and Regional Response Team planning activities, assist in the development of area contingency plans (ACP), develop tools for local decision makers, and provide training to promote more efficient planning and spill response.

For spills that may impact marine mammals, the FOSC, generally through the NOAA SSC, requests NMFS to work within the Wildlife Branch under Operations of the UC for stranding response, rescue, and rehabilitation of marine mammals (and sea turtles) under NOAA's jurisdiction. Local stranding networks (discussed further in Section 5.2.105.2.10) may also be included in the Wildlife Branch under Operations of the UC, either through NMFS or other arrangements. NMFS' funding for this work is approved through NOAA ERD (Appendix D). NOAA NMFS' Marine Mammal Oil Spill Response Guidelines (Ziccardi et al., 2015) provide guidance and protocols for marine mammal responders (specifically for cetaceans, phocids, and otariids) and improve communication and coordination between the National Marine Mammal Health and Stranding Response Program (MMHSRP)[7] participants and other state and federal governmental agencies involved in oil spill response and marine mammal conservation and protection in the case of an oil spill. For spills that may impact marine mammals through response activities, the FOSC, generally working through the NOAA SSC, may request the development of best management practices from the Trustee Agencies to reduce the potential impacts of response activities on listed and non-listed marine mammals. This might be done through the Environmental Unit or provided remotely by resource experts offsite to ensure that MMPA and ESA concerns addressed.

2.1.2. Natural Resource Damage Assessment

Under OPA, responsibility for acting on behalf of the public lies with designated federal, state, tribal, and foreign natural resource trustees. Through the NRDA process, the trustees are authorized to assess and restore natural resource injuries resulting from: (a) discharges of oil or the substantial threat of such a discharge, and (b) associated response activities. Under the NCP[8], NOAA is designated as a trustee on behalf of the public for a wide variety of coastal and ocean resources, including fisheries, protected species, and habitats (e.g., wetlands, mangroves, mudflats, beaches, water column, and shallow and deep reefs).

[7] https://www.fisheries.noaa.gov/national/marine-life-distress/marine-mammal-health-and-stranding-response-program
[8] https://darrp.noaa.gov/legal-context

Within NOAA, NRDA is conducted by the Damage Assessment, Remediation and Restoration Program (DARRP), comprised of OR&R's Assessment and Restoration Division (ARD), NMFS Restoration Center (RC), and the Natural Resources Section of the NOAA Office of the General Counsel. Typically, ARD leads the injury assessment process, while RC leads the restoration phase. ARD and RC will coordinate with resource experts within NOAA as well as outside NOAA as appropriate to provide technical expertise in developing the assessment and scaling the restoration. More information on the DARRP, including information on current and past cases can be found at the DARRP website[9]. For the assessment phase, the regional ARD contacts are found in Appendix I. Information on data management for a NRDA can be found in Appendix F.

The end goal of the OPA NRDA[10] regulations is to make the environment and public whole for injuries to natural resources and services. OPA directs trustees to conduct a NRDA to: (1) return injured natural resources and services to the condition they would have been in if the incident had not occurred, and (2) implement additional restoration to compensate for interim losses of such natural resources and services (15 CFR § 990.10). Thus, it is important to plan injury determination and quantification with restoration endpoints in mind.

The trustees accomplish those directives by: (1) assessing natural resource injuries and lost services caused by an oil spill; (2) determining the appropriate type and amount of restoration that would make the environment and public whole (i.e., compensate) for these injuries; and (3) ensuring that RPs implement or fund the appropriate type of restoration as determined by the trustees and also reimburse the costs of the assessment.

Trustees make NRDA decisions through consensus. The RP may participate in the assessment (Box 1), which may allow the NRDA to be conducted in a more efficient and cost-effective manner (Appendix C). The NRDA process is not punitive and damages (i.e., funds recovered in a settlement or through litigation) are used only to restore resources injured and services lost as a result of an oil spill and for the assessment costs. If an RP is not cooperative or there is no viable RP, assessment and restoration funds may be secured through the Coast Guard-administered NPFC funding process (Appendix D). In the case of an uncooperative RP, the NPFC will then pursue reimbursement from the RP.

Box 1. Cooperative Assessment: Under OPA NRDA regulations, Trustees are required to invite the RP to participate in the NRDA. The degree of participation varies from case to case, depending on the agreements reached between the parties. In addition to RP funding, elements of a cooperative assessment might include RP review/comment of work plans, joint participation in field work, and sharing of the NRDA data collected.

[9] https://darrp.noaa.gov/

[10] *SUBCHAPTER E - OIL POLLUTION ACT REGULATIONS*. 33 U.S.C. 2701 Et Seq. 5 Jan. 1996, darrp.noaa.gov/sites/default/files/OPA_CFR-1999-title15-vol3-part990.pdf.

The three phases of NRDA, as described in the OPA regulations, are illustrated in Figure 2. These are identified in the blue box as Preassessment, Restoration Planning (which includes injury assessment, quantification, restoration identification, and scaling), and Restoration Implementation. Funding requests and legal documents will generally refer to these phases. However, for NRDA assessment planning purposes, and for simplicity for this document, trustees typically refer to the injury assessment elements (Discharge-Pathway-Exposure-Injury) that need to be documented to support a NRDA claim (left side of Figure 2).

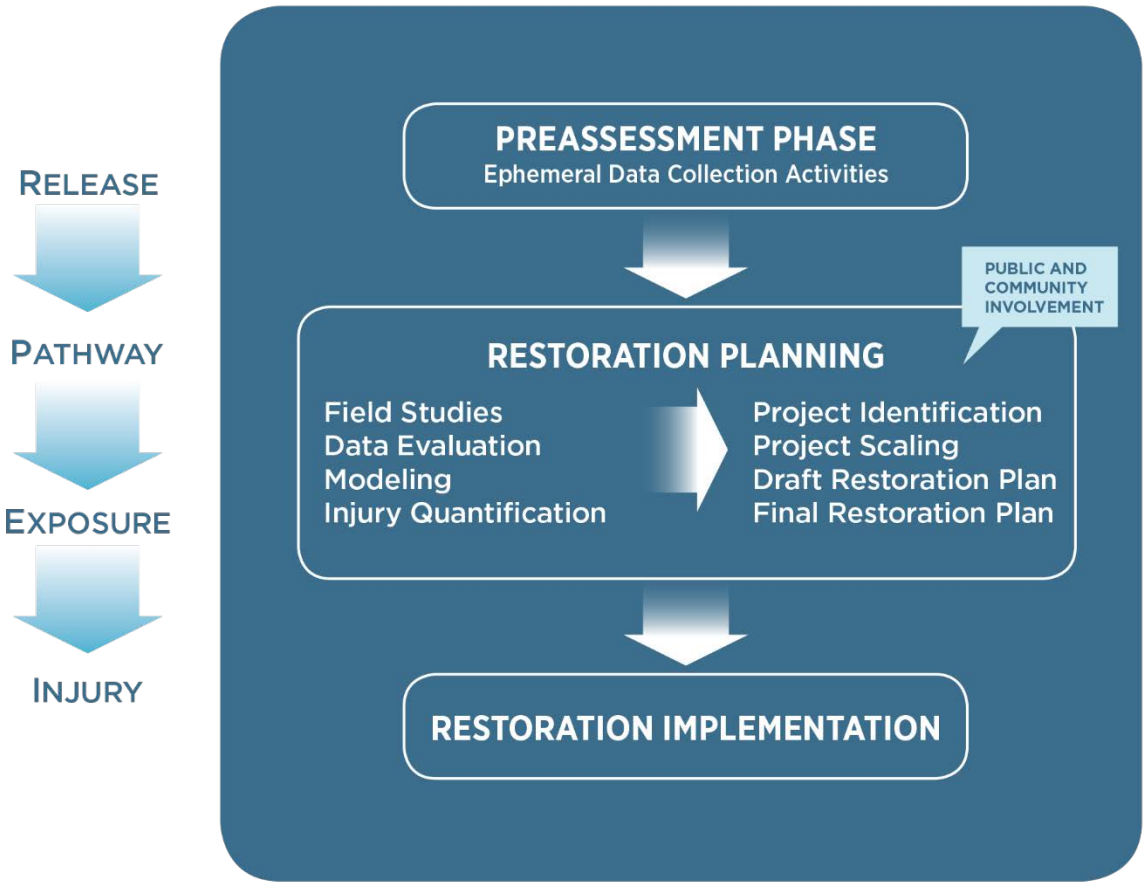

Figure 2 NRDA Framework under OPA. The box on the right side of the figure illustrates the NRDA process as described in the OPA NRDA regulations (15 CFR Part 990). The simplified arrows on the left summarize the exposure and injury assessment elements that are embedded in the NRDA framework in the box. Note the simplified arrows do not carry through to injury quantification (i.e., determining the degree, spatial and temporal extent of injuries) and restoration.

Restoration should be a major consideration from the start of a NRDA since restoration is the ultimate goal of the NRDA process (Box 2). Once the assessment is complete, recovered funds or damages are used by the trustees to restore, rehabilitate, replace, or acquire the equivalent of injured or lost resources and services of those resources. NRDA assessment requires not only determining injury, but quantifying the injury, identifying restoration that addresses specific injuries and scaling the restoration to compensate for that injury (i.e., to make the environment and public whole). For brevity, this document does not address restoration activities for marine

Box 2. Early Planning for Restoration: The OPA NRDA regulations require Trustees to evaluate and select restoration alternatives that address one or more specific injuries and are technically feasible. Thus, trustees and NRDA participants must consider restoration early in injury assessment planning to ensure lines of injury can be addressed by feasible restoration alternatives and that metrics used to measure and qualtify injury can be connected to restoration. Including restoration experts early in the NRDA process and using tools like conceptual models to logically map injury to restoration can help promote success in meeting these obligations.

mammals, nor does it discuss the various approaches for quantifying the degree and extent of injury, as these are highly dependent on the particular scenarios of each case. However, it is critically important to consider restoration options early in a case, and to select assessment endpoints and/or quantification approaches that can inform the degree and extent (or amount) of a documented injury in order to develop restoration plans. For example, if a documented injury is mortality, the restoration can be scaled to improving survivorship. However, sublethal injuries may be more difficult to quantify for restoration. For that reason, it is advised that a conceptual model (discussed in the Conceptual Models section and Appendix H) be developed for the case early on to help frame the questions and potential outcomes so that identified injury can be mapped to restoration alternatives.

If the DARRP decides to undertake a NRDA for a spill (after having determined there is jurisdiction under OPA), NRDA preassessment activities may commence during the response (control or cleanup) phase of the spill, but the entire NRDA assessment process may take months to years, depending on the complexity of the case and other factors (Figure 1). A NRDA begins with preassessment activities to collect ephemeral (i.e., time-sensitive) data often during active response phases (first few days of a spill). During this phase, the trustees also determine whether injuries have resulted (or are likely) and whether feasible restoration actions exist to address the potential injuries. A trustee NRDA liaison will work with the UC for coordination, site access, and safety and to ensure the NRDA work is not interfering with response activities. As cleanup endpoints are achieved (weeks to months, usually), site restrictions and safety concerns ease, and the response phase comes to an end. NRDA injury assessment activities continue as needed to determine whether injury occurred, to quantify injury and to scale appropriate restoration. Planning for compensatory restoration (to compensate for the interim loss of natural resources and services) can commence any time after the spill begins, but often isn't fully mature until injury studies are underway (weeks to months after a spill). See Appendix A for an example discussion about the early days of a spill for NRDA, as it may pertain to marine mammal assessment.

Figure 3 Timeline of response, assessment and restoration during an oil spill. Emergency response and natural resource damage assessment begins very shortly after a spill. The collection of ephemeral data or pre-assessment activities, which may be simultaneous with response, are included in the NRDA timeline noted here. Restoration, including emergency restoration and compensatory restoration planning and implementation often begins with and continues beyond response and assessment.

2.2.Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (MMPA)[11] was enacted in response to increasing concerns among scientists and the public that significant declines in some species of marine mammals were caused by human activities. "The primary objective of this management must be to maintain the health and stability of the marine ecosystem; this in theory indicates that animals must be managed for their benefit and not for the benefit of commercial exploitation. The effect of this set of requirements is to insist that the management of animal populations be carried out with the interest of the animals as the prime consideration." – House of Representatives, No. 707, 92nd Congress, 1st Session, 18, 22 [December 4, 1971]. The MMPA established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. The Department of Commerce through the NOAA NMFS is charged with protecting whales, dolphins, porpoises, seals, and sea lions. Walrus, manatees, otters, and polar bears are protected by the Department of the Interior through the U.S. Fish and Wildlife Service. All marine mammal species and their animal parts, regardless of population status, are protected under the MMPA.

The MMPA provides protection for population stocks in addition to species and subspecies; a population stock is "a group of marine mammals of the same species or smaller taxa in a common spatial arrangement that interbreed when mature." The MMPA established a moratorium on the "taking", and the import and export of marine mammals in U.S jurisdictions (see Box 3). Exceptions to the moratorium are allowed through permits for take incidental to commercial fishing and other non-fishing activities under MMPA Section 101, and for directed take activities such as scientific research and enhancement purposes under MMPA Section 104 (see Appendix B).

Although the MMPA does not identify an emergency permit option, 50 CFR 216.33 allows NMFS to expedite the processing of requests in emergency situations if delaying issuance could result in injury to a species, stock, or individual, or in loss of unique research opportunities. The MMPA also allows for the taking of marine mammals in a humane manner (including euthanasia) by Federal, State, or local government official or employee or a person

Box 3. "Take" under the MMPA and Endangered Species Act (ESA) are defined similarly.

Under the MMPA "take" is defined as "to harass, hunt, capture, or kill any marine mammal or attempt to do so."

Under the ESA, take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

Take is prohibited under both statutes with some exceptions, including for permitted activities.

[11] https://www.fisheries.noaa.gov/topic/laws-policies#marine-mammal-protection-act

designated under section 112(c) (stranding agreement holders) in the course of his or her duties as an official, employee, or designee, if such taking is for the protection or welfare of the animal, the protection of the public health and welfare, or the nonlethal removal of nuisance animals.

The 1992 amendments to the MMPA authorized the Secretary of Commerce in consultation with the Marine Mammal Commission and the Secretary of the Interior to establish the MMHSRP. The purposes of this program are to: (1) facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild; (2) correlate the health of marine mammals and marine mammal populations, in the wild, with available data on physical, chemical, and biological environmental parameters; and (3) coordinate effective responses to unusual mortality events.

The MMHSRP provides oversight of the nationwide stranding program (Appendix E), development of protocols, procedures and quality assurance standards for data, samples, and analyses, establishment of the National Marine Mammal Tissue Bank, establishment of a data management and dissemination system, and an Unusual Mortality Event program including an advisory group and a contingency plan. The MMHSRP maintains an ESA/MMPA permit for emergency response and research related to response and health parameters including health impacts. In many cases, response and oil spill injury assessment activities may be covered under the MMHSRP's ESA/MMPA scientific research and enhancement permit.

During an oil spill where marine mammals may be affected, NOAA NMFS staff and stranding networks will participate in the response/cleanup through the Wildlife Branch (under Operations in the ICS) to rescue and rehabilitate live animals affected by the spill and/or to necropsy and sample dead animals in the spill area. In limited circumstances, pre-emptive capture and holding of marine mammals is appropriate to minimize or prevent exposures. Lastly, NOAA NMFS staff provide advice and best management practices for response and the NRDA to follow in their operations to avoid or minimize take in the course of response activities and may be requested to provide Section 7 or Marine Mammal Specialist to consult on resources at risk in the Planning Section..

NOAA Fisheries Office of Law Enforcement (OLE) is authorized to enforce the MMPA and is responsible for investigating violations, including those involving unauthorized take. OLE has the authority to seize all marine mammal and marine mammal products taken or retained in violation of the Act. Cases are generally referred to the NOAA Office of General Counsel Enforcement Section (GCES) for civil administrative prosecution; criminal cases are referred to the Department of Justice. Enforcement actions under the MMPA are performed and funded separately from both the OPA response and the NRDA, although some coordination and data exchange may take place.

2.3.Endangered Species Act

The Endangered Species Act (ESA; 16 U.S.C. §1531 et seq.) of 1973[12] provides for the conservation and management of animals that are endangered or threatened and the conservation of the ecosystems on which they depend. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. If a species is likely to become endangered in the foreseeable future it is labeled as threatened.

ESA mandates include a process for listing, down-listing, and delisting species; designation of critical habitat; and recovery planning. There are approximately 2,095 species listed globally under the ESA with 1,475 found within the United States. NMFS has authority for all ESA-listed marine and anadromous species with the exception of sea otters, polar bears, manatees, and walrus (which are under the jurisdiction of the USFWS); NMFS and USFWS have joint jurisdiction over sea turtles through a Memorandum of Understanding[13], which was last updated in 2015.

The listing of a species as endangered makes it illegal to "take", import, or export that species (16 USC § 1532 (19)) (Box 3). The agency may extend the ESA's prohibitions to threatened species by regulation. Notably, the ESA protects against the adverse modification of critical habitat (§ 4), which includes lands, water, and air necessary to recover endangered species. NMFS and the USFWS are charged with consulting with federal agencies on the impact of agency actions on listed species and critical habitat (§7); the agencies may also issue permits for incidental and, in more limited circumstances, directed take of endangered species (§10). In some cases, Federal agencies may be allowed limited take of species through the ESA Section 7 process with NMFS or USFWS. In addition, Federal and non-federal individuals, agencies, or organizations may be allowed limited take through special exemption permits under ESA section 10 for directed research or enhancement or the incidental take of listed species during other activities (Appendix B).

The ESA recognizes the need to respond immediately to emergencies. Section 7 consultation during emergencies is expedited so Federal agencies can complete their critical missions in a timely manner while still providing protections to listed species. Where emergency actions are required that may affect listed species and/or their critical habitats, a Federal agency may not have the time for the administrative work required by normal consultation procedures under non-emergency conditions. Emergency consultation expedites communication and allows agencies to incorporate endangered species concerns into their emergency response. Effects to the listed species must be minimized and in some cases conservation efforts may be required to offset the take.

[12] http://www.nmfs.noaa.gov/pr/laws/esa/
[13] https://www.fisheries.noaa.gov/protecting-marine-life

Under the ESA, an emergency is a situation involving an act of God, disasters, casualties, national defense or security emergencies, etc., and includes response activities that must be taken to prevent imminent loss of human life or property. During any emergency, the primary objective for the ESA is to provide technical assistance and recommendations for minimizing adverse effects to listed species during the emergency response activities.

Oil spill planning and response duties under the ESA are addressed specifically in a Memorandum of Agreement[14] (MOA, 2001) among the USCG, EPA, FWS, and NOAA (NMFS and NOS). Guidance documents and training opportunities have been developed by the ESA Working Group and are available on the National Response Team website. The intent of this information is to provide some pre-planning assessment to identify potential impacts prior to a spill and to develop potential Best Management Practices (BMPs) that might be used to mitigate additional impacts to ESA listed species. The Trustees encourage the Action Agencies to conduct comprehensive pre-planning activities to reduce the need for emergency consultation as much as possible.

During an oil spill where marine mammals may be affected, NMFS staff and stranding networks will be included in Wildlife Response as indicated in the MMPA section of this document. Both the spill response and the NRDA are responsible for initiating section 7 consultation (including emergency consultation) where needed with NMFS for work with or that might affect threatened and endangered marine mammals. Funding for NMFS for wildlife response and Section 7 activities may be covered through a Pollution Removal Funding Authorization working through OR&R ERD

NOAA OLE is authorized to enforce the ESA and is responsible for investigating violations, including those involving unauthorized take. OLE has the authority to seize all marine mammals and marine mammal products taken or retained in violation of the Act. Cases are generally referred to GCES for civil administrative prosecution; criminal cases are referred to the Department of Justice. Enforcement actions under the ESA are performed and funded separately from both the OPA response and the NRDA, although some coordination and data exchange may take place.

[14] http://environmentalunit.com/Documentation/11%20ESA%20Section%207/MoA%20info.pdf

2.4.National Marine Sanctuary Act

The National Marine Sanctuaries Act[15] (NMSA) gives the Secretary of Commerce the authority to designate and protect areas of the coastal and marine environment with special national significance due to their: conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities. Both living marine resources and historical/cultural resources are protected under the NMSA.

Sites designated as national marine sanctuaries are managed by NOAA's Office of National Marine Sanctuaries (ONMS). ONMS also manages/co-manages 2 of 4 Marine National Monuments designated under the Antiquities Act and the Coral Reef Ecosystem Reserve.

The NMSA provides for regulations at each site and the entire system that specify what activities are and are not allowed. The NMSA has a consultation requirement under §304(d) for any federal activity that could impact site resources. The NMS provides NOAA with enforcement authority under §307 (with civil penalties up to $140,000 per violation). OLE is authorized to enforce the NMSA and is responsible for investigating violations; cases are generally referred to GCES for civil administrative prosecution. The NMSA also provides authority to conduct a NRDA for any injuries to sanctuary resources under §312. The NRDA authority parallels those found in OPA, CERCLA and Park System Resource Protection Act (PSRPA).

Under §310, NMSA permits are issued for otherwise prohibited activities. Sanctuary Superintendents hold permits that provide for a range of activities within sites that generally include those that may occur during a response event.

It is unlawful to destroy, cause the loss of, or injure any sanctuary resource. Site-specific regulations may include "enter and injure" provisions. Federal agencies are required to consult on actions that would harm sanctuary resources under §304(d). Site-specific exemptions are found in site regulations. Emergency response activities are generally exempt.

During oil spills that affect marine sanctuaries, ONMS personnel are active in the planning and operations section of a UC to provide information to avoid or minimize harm to sanctuary resources. ONMS may also participate as part of the NRDA, depending on the complexity of the spill, resources affected, and expertise available. However, if marine mammals are involved in a spill that affects a Sanctuary, NMFS is the lead for marine mammal response operations, consulting with Sanctuary staff. Marine sanctuaries are often desirable areas for NRDA restoration.

[15] https://sanctuaries.noaa.gov/about/legislation/

Under NMSA, NOAA Enforcement may bring civil or criminal charges and penalties against an RP for an oil spill. Investigations for NMSA claims are performed and funded separately from both the OPA response and the NRDA, although some coordination and data exchange may take place.

Marine Mammals have been observed in thirteen of the fourteen sites in the National Marine Sanctuary System[16], and twelve of those fourteen sites feature marine mammals as significant resources within the site.

3. NOAA Roles and Responsibilities Regarding Marine Mammals and Oil Spills

As summarized in Section 2, NOAA addresses threats and adverse effects to marine mammals from oil spills under several major statutes and working across several line offices. NOAA's responsibilities include providing scientific support to the USCG for cleanup (response); coordinating rescue and rehabilitation of marine mammals; collecting evidence for civil and criminal cases under MMPA, ESA, and NMSA; and collecting information to determine whether an injury has occurred and, if so, quantify injuries and identify restoration options for pursuing a NRDA claim as a natural resource trustee under OPA.

Some NOAA data or sample collection activities can inform multiple responsibilities, making it important for NOAA staff working on an oil spill (whether response or NRDA) to understand the different, and sometimes potentially competing, needs among programs. Table 2 summarizes some of these activities with respect to marine mammals listed by NOAA office or program and by phase of a spill. The table, while not exhaustive, is intended to promote better understanding of different NOAA program activities and responsibilities with respect to marine mammals during an oil spill, as well as to improve cooperation and coordination among those programs during assessments and investigations.

[16] https://sanctuaries.noaa.gov/

Table 2 Summary of NOAA office and program roles and responsibilities related to marine mammals during operational phases of oil spills and NRDA under OPA. "Response" means response conducted under OPA, led for NOAA by OR&R Emergency Response Division with participation by ONMS and NMFS where applicable.

"NRDA" means activities conducted under OPA, led for NOAA by the Damage Assessment, Remediation, and Restoration Program (DARRP) with participation by ONMS and NMFS-OPR where applicable.

"Enforcement" means activities conducted for civil or/criminal enforcement under MMPA, ESA or NMSA, led by NMFS or GCES, respectively.

NOAA Office/Program Roles and Responsibilities for Marine Mammals during different phases of oil spill response/NRDA								
			Pre-Incident Planning (no active case)	Oil spill- active response phase	Oil spill- NRDA injury assessment (response is done)	Resolution of liability (settlement or litigation) (multiple statutes, OPA, MMPA, ESA, NMSA, Clean Water Act)	Preparation and completion of Damage Assessment and Restoration Plan (NRDA only)	Restoration Implementation
NOS OR&R	Emergency Response Division		**Response:** Area Contingency Plan work, prepare job aids, ESIs, leads Coast Guard/industry drills for NOAA response, liaison to Coast Guard	**Response:** SSC is lead NOAA responder; **NRDA:** Coordination with NRDA lead; **Enforcement:** Coordination where necessary	**NRDA:** Some coordination with NRDA lead; **Enforcement:** Coordination where necessary	**NRDA, Enforcement:** May provide depositions, testimony in litigation	Usually no role	Usually no role
	Assessment & Restoration Division	Damage Assessment Remediation and Restoration Program	**NRDA:** Lead NRDA drills, tools and techniques development	**Response:** Coordination with SSC; **NRDA:** ARD is the NRDA lead through case resolution (settlement/consent decree), coordinate with trustees to scope the extent of the assessment. Work with co-trustees GC/NR to establish cooperative assessment, if RP is willing. Consult with NMFS/OPR or Regional PRD for all NRDA activities that could impact marine mammals; **Enforcement:** Coordination where necessary	**NRDA:** NRDA lead for injury assessment phase of NRDA, coordinate with trustees and RP (assuming cooperative assessment) in conducting assessment. Responsible for NOAA funding and tracking funding whether through NPFC or RP funding. Consult with NMFSOPR or Regional PRD for all NRDA activities that could impact marine mammals; **Enforcement:** Coordination where necessary	**NRDA:** oversee putting together settlement positions with RC and other NOAA participants, co-trustees, coordinate with RPs and participate in negotiations with RPs. In litigation will work with attorneys and experts to prepare for litigation. **Enforcement:** Coordination through GCNR where necessary	**NRDA:** Lead in Damage Assessment and Restoration Plan (DARP) writing and reviewing with co-trustees. NRDA lead transfers to RC post settlement.	Participation level varies by case.

NOAA Office/Program Roles and Responsibilities for Marine Mammals during different phases of oil spill response/NRDA							
		Pre-Incident Planning (no active case)	Oil spill- active response phase	Oil spill- NRDA injury assessment (response is done)	Resolution of liability (settlement or litigation) (multiple statutes, OPA, MMPA, ESA, NMSA, Clean Water Act)	Preparation and completion of Damage Assessment and Restoration Plan (NRDA only)	Restoration Implementation
NMFS Office of Habitat Conserv.	Restoration Center	Participate in some NRDA drills, restoration techniques development	**Response:** Usually no role; **NRDA**: as NRDA case team member, advise on emergency restoration and early restoration, if necessary; in some cases, participate in injury assessment; advise on restoration options and restoration scaling **Enforcement**: Usually no role	**NRDA** restoration planning, including early restoration; in some regions are actively involved with assessment phase; **Enforcement:** usually no role	**NRDA**: In coordination with ARD, develop settlement positions, often participating in negotiations with RPs. In litigation will work with attorneys and experts to prepare for litigation.	**NRDA**: Writes and reviews DARP content with co-trustees. NRDA lead transfers to RC after resolution of the claim.	**NRDA**: RC is the lead for restoration for DARRP cases
Office of General Counsel	General Counsel for Natural Resources	Advice during NRDA drills	**Response**: No role; **NRDA**: Legal lead for NRDA; **Enforcement**: Coordination between NRDA and Enforcement where needed	**NRDA**: Provides legal advice for NRDA; **Enforcement**: Coordination between NRDA and Enforcement where needed	**NRDA**: Put together and review settlement positions; RP negotiations. Primary preparation for litigation, POC with DOJ. **Enforcement:** Coordination with DOJ or other Federal/state entities where needed	**NRDA**: Review and comment for DARP	**NRDA:** Legal counsel as needed.
	Enforcement Section	Usually no role	**Enforcement:** Legal lead for enforcement; advice to and coordination with NMFS and ONMS as needed.	**Enforcement:** Legal lead for enforcement; advice to and coordination with NMFS and ONMS as needed.	**Enforcement:** Legal lead for enforcement; advice to and coordination with NMFS and ONMS as needed. Lead on ESA/MMPA/NMSA civil litigation; coordination with DOJ on criminal litigation as needed.	Usually no role	Usually no role

NOAA Office/Program Roles and Responsibilities for Marine Mammals during different phases of oil spill response/NRDA							
		Pre-Incident Planning (no active case)	**Oil spill- active response phase**	**Oil spill- NRDA injury assessment (response is done)**	**Resolution of liability (settlement or litigation) (multiple statutes, OPA, MMPA, ESA, NMSA, Clean Water Act)**	**Preparation and completion of Damage Assessment and Restoration Plan (NRDA only)**	**Restoration Implementation**
NMFS Office of Protected Resources	**Marine Mammal Health and Stranding Response Program**	**Response: Advise on ACPs, participate in developing job aids with SSC, participate in some drills, may conduct NMFS-only planning exercises.** **NRDA: may participate in some NRDA drills. Participate in other planning activities as needed**	**Response: wildlife operations;** **NRDA: Mammal expert and early NRDA planning;** **Enforcement: Mammal expert**	**NRDA: Through ARD request, may serve as mammal expert for injury assessment and through RC request, may be mammal expert for restoration. Activities for both include conducting studies for assessment, identifying and scoping restoration projects).** **Enforcement: Mammal expert, prepare take evaluation memo**	**NRDA and Enforcement: In coordination with DARRP case team, prepare technical reports. Assist case team in preparing mammal technical positions for injury and restoration, prepare presentations. If litigation, participate in depositions, and other litigation activities as requested by NOAA/GC or DOJ.**	**As needed and in coordination with the DARRP case team, contribute to mammal chapter of DARP, including assessment and restoration (depending on effort during assessment phase), respond to co-trustee and public comments**	**Depending on projects selected, may be part of implementation or monitoring**
NMFS	**Fisheries Science Centers**	**Participate in some drills**	**Response: wildlife operations;** **NRDA: Mammal expert and early NRDA planning;** **Enforcement: Mammal expert**	**NRDA: Through ARD request, may serve as mammal expert for injury assessment and through RC request, may be mammal expert for restoration. Activities for both include conducting studies for assessment, identifying and scoping restoration projects).** **Enforcement: Mammal expert, prepare take evaluation memo**	**NRDA and Enforcement: In coordination with DARRP case team, prepare technical reports. Assist to prepare mammal technical positions for injury and restoration, prepare presentations. If litigation, participate in depositions, and other litigation activities as requested by NOAA/GC or DOJ**	**As needed and in coordination with the DARRP case team, contribute to mammal chapter of DARP, including assessment and restoration planning (depending on effort during assessment phase), respond to co-trustee and public comments**	**Depending on projects selected, may be part of implementation or monitoring**

NOAA Office/Program Roles and Responsibilities for Marine Mammals during different phases of oil spill response/NRDA							
		Pre-Incident Planning (no active case)	**Oil spill- active response phase**	**Oil spill- NRDA injury assessment (response is done)**	**Resolution of liability (settlement or litigation) (multiple statutes, OPA, MMPA, ESA, NMSA, Clean Water Act)**	**Preparation and completion of Damage Assessment and Restoration Plan (NRDA only)**	**Restoration Implementation**
NMFS Headquarters and Regions	**NMFS Region Protected Resources Division or HQ Office of Protected Resources**	**Response: Advise on ACPs, participate in developing job aids with SSC, participate in some drills, may conduct NMFS-led planning exercises. May work on BMPs for spill practices. ESA Section 7 consultation for other planning activities. NRDA: may participate in some NRDA drills. Participate in other planning activities as needed. BMPs and Section 7 POC for planning.**	**Response: Section 7 emergency consultation; MMPA BMPs; MMPA/ESA/CITES Permits; NRDA: Mammal expert; Section 7 consultation (emergency or otherwise), MMPA BMPs, permits; Enforcement; Mammal expert**	**NRDA Through ARD request, may serve as mammal expert for injury assessment and through RC request, may be mammal expert for restoration. Activities for both include conducting studies for assessment, identifying and scoping restoration projects). Enforcement; Mammal expert**	**NRDA and Enforcement: In coordination with DARRP case team, prepare technical reports. Assist to prepare mammal technical positions for injury and restoration, prepare presentations. If litigation, participate in depositions, and other litigation activities as requested by NOAA/GC or DOJ.**	**As needed and in coordination with the DARRP case team, contribute to mammal chapter of DARP, including assessment and restoration (depending on effort during assessment phase), respond to co-trustee and public comments. Work with DARP on any permitting, BMPs, consultation needed as part of restoration planning**	**Depending on projects selected, may be part of implementation or monitoring. POC for any permitting, BMPs, ESA Section 7 consultation needed for all restoration projects (not just mammal projects)**
NMFS	**Office of Law Enforcement**	**Usually no role**	**Response: Coordination with SSC; NRDA: Coordination with NRDA lead and GCNR; Enforcement: NOAA lead for investigating criminal or civil violations**	**NRDA: Coordination with NRDA lead and GCNR; Enforcement: NOAA lead for investigation criminal or civil violations**	**NRDA: Coordination with NRDA as needed. Enforcement: Prepare case packages for referral to GCES or DOJ, as appropriate; support civil and criminal litigation under MMPA/ESA and NMSA.**	**Usually, no role**	**Usually no role**
NOS	**National Center for Coastal and Ocean Science**	**Provide research results to inform response and restoration**	**Response: Usually no role; NRDA: Mammal expert; Enforcement: Usually no role**	**NRDA Through ARD request, may serve as mammal expert for injury assessment and through RC request, may be mammal expert for restoration. Activities for both include conducting studies for assessment, identifying and scoping restoration projects). Enforcement: Usually no role**	**NRDA and Enforcement: In coordination with DARRP case team, prepare technical reports. Assist to prepare mammal technical positions for injury and restoration, prepare presentations. If litigation, participate in depositions, and other litigation activities as requested by NOAA/GC or DOJ.**	**As needed and in coordination with the DARRP case team, contribute to mammal chapter of DARP, including assessment and restoration (depending on effort during assessment phase), respond to co-trustee and public comments**	**Depending on projects selected, may be part of implementation or monitoring**

NOAA Office/Program Roles and Responsibilities for Marine Mammals during different phases of oil spill response/NRDA							
		Pre-Incident Planning (no active case)	**Oil spill- active response phase**	**Oil spill- NRDA injury assessment (response is done)**	**Resolution of liability (settlement or litigation) (multiple statutes, OPA, MMPA, ESA, NMSA, Clean Water Act)**	**Preparation and completion of Damage Assessment and Restoration Plan (NRDA only)**	**Restoration Implementation**
NOS	**Office of National Marine Sanctuaries**	**Advise on ACPs, , participate in some drills (both response and NRDA) and Net Environmental Benefits Analysis review**	**Response: Active in planning and operations units of Incident Command. May pursue penalties; NRDA: Provide NMS expertise and be active mammal participant, depending on expertise; Enforcement: Coordination with other litigation**	**Response: May pursue penalties/other litigation under NMSA for mammals; NRDA: Provide NMS expertise, including information for assessment and restoration; Enforcement: Coordination with other litigation**	**NRDA and Enforcement: If the NMS has mammal expertise and in coordination with DARRP case team, ONMS may prepare technical reports. Assist to prepare mammal technical positions for injury and restoration, prepare presentations. If litigation, participate in depositions, and other litigation activities as requested by NOAA/GC or DOJ.**	**As needed and in coordination with the DARRP case team, contribute to mammal chapter of DARP, including assessment and restoration (depending on effort during assessment phase), respond to co-trustee and public comments**	**Depending on projects selected, may be part of implementation or monitoring if project with NMS. POC for any permits needed**

4. Vulnerabilities of Marine Mammals to Oil, Oil-related Contaminants, and Response Activities

Summary: To successfully conduct a NRDA for marine mammals, the trustees must demonstrate (a) that there was a source and discharge (or substantial threat of a discharge) of petroleum; (b) that marine mammals or their habitats or prey were exposed to the discharged oil and a pathway exists to link the discharge to the exposed natural resources;(c) that exposure caused injury to marine mammals; and (d) that feasible restoration actions exist to address injuries to marine mammals. The trustees then quantify the injury and scale restoration to compensate for that injury. Although this sequence may not be required for other investigations related to the oil spill, the data collected and used to document the NRDA components are likely to be useful for other investigations. This section briefly describes properties of oil relevant to marine mammal exposure, then summarizes where exposure and injury have occurred in marine mammals.

4.1. Properties of oil relevant to marine mammal exposure

Petroleum products are extremely complex mixtures, and a wide variety of effects have been noted in exposed organisms. Crude oils contain thousands of different organic and inorganic compounds (Scholz et al., 1999) and can vary widely depending on the geographic areas, depths and methods used to extract them (Neff, 1990a). Once extracted, crude oils can be highly manipulated or distilled in order to be reformulated into different end products (Barber et al., 1996), making the understanding of the associated toxicity and the determination of the source of releases difficult.

Aromatic compounds (containing one or more rings of six carbons each connected by alternating carbon-carbon double bonds) are generally considered the most harmful compounds in oil (Neff, 1979), with smaller single ring aromatics, such as benzene, strongly associated with carcinogenicity, organ damage, and even death at high exposure levels in vertebrates (ATSDR, 1995a). These single-ring compounds are also readily available to biological systems due to their relatively high water solubility and volatility in air; however, they are often not found in large concentrations except immediately following a spill.

Conversely, compounds containing two or more aromatic rings (also called polycyclic aromatic hydrocarbons (PAHs)) can be carcinogenic and cause reproductive failure, organ damage, and immunotoxicity in laboratory and field settings (ATSDR, 1995b; Collier et al., 2014) and are less volatile. Thus, while they may be found at comparatively low concentrations in oil products and have low solubility in water, they can persist and potentially cause a wide range of adverse effects. The PAHs present in petroleum products generally are highly alkylated, however most

studies of PAH toxicity have been done with non-alkylated PAHs- this needs to be considered in assessing the toxicity of PAHs from oil spills.

4.2. Oil exposure to marine mammals

Marine mammals can be exposed to oil via dermal (e.g., skin, mucous membranes) contact, grooming (in fur seals), water and prey ingestion, inhalation, and/or aspiration. Given the weathering of oil and the ability of vertebrates to metabolize oil constituents, determining exposure of marine mammals through chemical analyses of fish prey or of marine mammal tissue can be uncertain. The best chance to detect any prey-based oil contamination is very shortly after exposure and capture or discovery (of prey or marine mammal carcasses).

Metabolism of PAHs in vertebrates, including fish and marine mammals, is fast and efficient, whereas it is slow in crustaceans and cephalopods. PAH metabolites are primarily excreted via bile, urine, or feces. Tissues generally contain low concentrations of PAHs and their metabolites. Marine mammal tissues and fluids including skin/fur, blubber, liver, bile, stomach contents, muscle, lung, urine, feces, and blood can be analyzed for oil-related compounds and their metabolites, although timing of the sample collection should be an important consideration in deciding whether to conduct the analyses. The most useful matrices for determining exposure of marine mammals to petroleum, in approximate order of importance, are external swabs of skin/fur (parent compounds), blowhole (parent compounds and metabolites), stomach contents (parent compounds), bile (metabolites), urine (metabolites), and feces (parent compounds and metabolites). An additional matrix that may be useful is lung tissues from stranded animals. During the *Deepwater Horizon* oil spill, there was one example of a stranded dolphin within the oil footprint whose lung tissue suggested exposure to volatile petroleum components (PDARP, 2016). However, few lung tissue samples have ever been analyzed for chemical evidence of petroleum exposure.

Further, chemically analyzing water, oil slick, sediment, and air samples may be useful to determine exposure when paired with observation of mammals swimming in oil or a history of residence in the area. Photographic evidence of marine mammals swimming in or hauled out near visible oil is strong qualitative evidence of exposure, particularly if the subject population has known, identifiable animals where follow-up for observation of potential injuries is possible. Components of oil may become buried in sediment where they may persist for an extended period of time and as such can represent an avenue of periodic re-exposure or continued exposure especially for species that dig while foraging (e.g., gray whale, bottlenose dolphins, and walrus) or in areas of frequent disturbance of sediments; chemical analysis of sediment would be particularly important in these cases.

4.3. Known risks of oil exposure to marine mammals

Although studies on marine mammals following oil spills are limited, both laboratory and field studies, including research conducted in the wake of the *Exxon Valdez* oil spill, documented adverse effects of oil to marine mammals and their habitats (Peterson, 2001; Peterson et al., 2003; ESR 2017). More recently, a comprehensive set of studies on marine mammal impacts were conducted for the *Deepwater Horizon* oil spill NRDA and recently published in a dedicated issue of *Endangered Species Research* (ESR 2017).

4.3.1. Cetaceans

There are a handful of studies that report on the health or survival of cetaceans following oil spills. Most notably, in the 18 months following the 1989 *Exxon Valdez* oil spill, one resident pod and one transient pod of killer whales present in Prince William Sound at the time of the spill experienced an unprecedented number of deaths (30 to 40 percent mortality; Matkin et al., 2008). None of the killer whale carcasses were recovered. As of 2012, NOAA concluded that the pod of resident killer whales still had not reached its pre-spill numbers, while the oil-exposed transient pod numbers have continued to decrease– so much so that they have been listed as a "depleted stock" under the MMPA. The 2017 Stock Assessment Report for the AT1 Transient stock of killer whales (https://www.fisheries.noaa.gov/webdam/download/82960324) notes that the population abundance estimate as of the summer of 2016 remains at seven whales with no recruitment in this population since 1984 (Matkin et al., 2012). Meanwhile, other killer whale populations in Southeast Alaska have grown since the mid-1980s (Matkin et al., 2008). In addition, in the approximately 6 months following the *Exxon Valdez* oil spill, 37 carcasses of other cetaceans were found, which represented the largest number of cetacean strandings ever observed in the region. The cause of death of these stranded animals could not be determined, and the extent to which increased vessel activity might have contributed to increased observations of stranded cetaceans is not known.

Studies of cetaceans following the *Deepwater Horizon* oil spill provide very strong evidence supporting the adverse effects of oil exposure on cetaceans (Kellar et al., 2017; Smith et al., 2017; Takeshita et al., 2017). Resident common bottlenose dolphins from areas contaminated with *Deepwater Horizon* oil suffered from lung disease, adrenal disease, poor body condition, and a suite of other adverse health effects attributed to exposure to oil. Moreover, more than 80 percent of common bottlenose dolphin pregnancies in Barataria Bay and Mississippi Sound (both heavily oil-impacted areas) were unsuccessful in the years following the spill. Models of the post-spill population trajectories predict that these stocks will be reduced by 51% and 62% respectively as compared to what the trajectories would have been had the spill not occurred. It is estimated that recovery will take approximately 40 years, absent any active restoration efforts (PDARP, 2016; Schwacke et al., 2017).

There are also a few additional studies reporting effects of oil in cetaceans. One study reported that gray whales showed altered respiratory behavior (increased blow rates) in the presence of surface oiling off the coast of California (Geraci & St. Aubin, 1982; Geraci & St. Aubin, 1985). A small number of studies have exposed cetaceans to oil (reviewed in Englehardt, 1983). Effects from these exposures included the following: (a) liver damage in captive bottlenose dolphins that had crude oil added to their tank; (b) skin lesions in a number of captive delphinid species where oil was applied to the skin; and (c) skin lesions after oil was applied to the skin of a live, stranded sperm whale. A recent review chapter gives more detail on the effects of oil exposure to cetaceans (Goddard-Codding and Collier, 2018).

4.3.2. Pinnipeds

Studies in which pinnipeds were exposed to oil via ingestion, inhalation, or application to their fur have shown a wide range of effects, including lung inflammation, increased respiratory rates, respiratory failure, abnormal nervous system function, liver and kidney damage, reproductive impairment, and death (reviewed in Englehardt, 1983). Controlled oil exposure studies with mink (as a surrogate for pinnipeds) documented liver, adrenal, and hematological effects over several months (Mazet et al., 2000; Schwartz et al., 2004). Pregnant mink exposed to oil also had a decrease in the number of live-born offspring (Mazet et al., 2000; Mazet et al., 2001). Subsequent studies confirmed findings of adrenal effects and also determined that the adrenal stress response was impaired in mink that were chronically exposed to oil (Mohr et al., 2008).

4.4. Impact of Response Activities on Marine Mammals, Including Potential Indirect Effects

In addition to direct effects of oil to marine mammals and their habitats, oil spill response activities may also result in adverse impacts. Response actions, including the physical removal of oil from the environment (e.g., by skimming), or less common remedial actions such as the use of chemical dispersants or in-situ burning, can also impact marine mammals, their prey, and the marine habitats they frequent. In addition, support and response vessel activity, shoreline oil assessments, or actions related to operational shoreline protection may have unintended negative consequences for marine mammal habitats and the marine mammals themselves. For example, marine mammals near response activities could be at risk for:

- Disturbance by increased vessel and aircraft (both manned and drone-type) traffic, shore-based response operations, and noise associated with response operations;
- Inhalation of smoke from in-situ burning;
- Physical or sensory-based exclusion from accustomed (physiologically suitable) habitats and feeding areas due to booming and other response operations;
- Entrapment in nearshore oiled zones because of booming and other response operations;
- Entrapment in offshore skimming or in-situ burning operations;
- Potential enhancement of respiratory oil exposure via dispersant treatments;

- Potential adverse effects of direct inhalation and dermal exposure to dispersants;
- Perturbation of reproductive behaviors or maternal care activities;
- Disturbance of shallow feeding and resting habitat by deployment and maintenance of containment booms and other nearshore response activities.

ACPs contain measures for the UC to respond to wildlife during spill cleanup operations and measures to mitigate impacts from response activities. The UC will also identify and implement incident-specific measures to reduce or eliminate impacts to marine mammals and their habitats from response-related injury. Despite these efforts, some adverse impacts are still possible and should be monitored and evaluated. Evaluation and training tools to address the potential adverse effects of response activities on marine mammals are available through the National Response Team website under ESA consultations.

5. Available methodologies for assessing exposure and adverse effects on cetaceans and pinnipeds

This section provides guidance on presently available methodologies for assessing exposure and adverse effects of oil spills on cetaceans and pinnipeds under NOAA's trusteeship.

Because the circumstances of each oil spill vary significantly (type of oil, size, duration, location, resources at risk, etc.) the information in this section is intended to serve as a starting point for the development of conceptual models and sampling plans in coordination with marine mammal experts and NRDA case teams.

Assessment methods presented here are not exhaustive, but should serve as a starting point. Case teams should consider the merits of other methodologies that may be available, emerging methodologies, or refinements to existing methodologies. These should be evaluated given the circumstances of individual spills, the species potentially affected, and/or the desired metric. Table 1 in the Executive Summary of this document is a lookup table summarizing the methods discussed in this document. It is organized by NRDA component (Exposure or Injury) and species group.

5.1 Conceptual Models

For NRDA, it is useful to first develop a conceptual model or models outlining the exposure pathways and possible injuries to assist in case planning. Depending on the case and the response activities the conceptual model may include injuries associated with response activities taking into account compliance with best management practices. The trustee scientific team and technical workgroup should first develop the conceptual model to understand and agree to the technical approach to the case, including recommended studies. Conceptual models can then be

used to communicate this approach to case team leads, responsible parties, and the National Pollution Fund Center for acceptance and funding of studies. For marine mammals, the ARD case lead would work with NOAA marine mammal experts and consultants to develop a marine mammal conceptual model or models specific to the circumstances of the case. A conceptual model, at minimum, should follow the NRDA process (source → pathway → exposure → injury). Ideally, a conceptual model will include logical connections between injury and restoration. The conceptual model can be narrative, as a table, flow chart or drawing, depending on individual preferences or case-specific needs or preferences of the team. Appendix H provides more information and some examples.

Some examples for generic marine mammal conceptual models of varying degrees of specificity can be found in Figures 4-7. All of these conceptual models focus on exposure and injury assessment but do not carry into restoration.

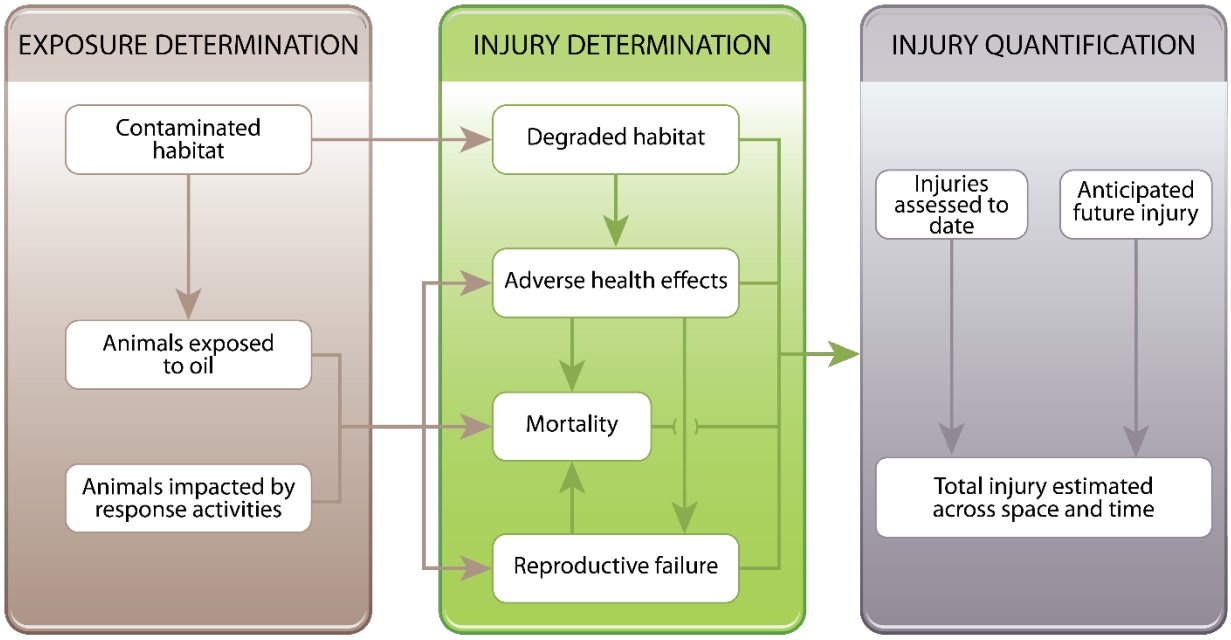

Figure 4 A generalized conceptual model for marine mammals (DWH NRDA Trustees 2016).

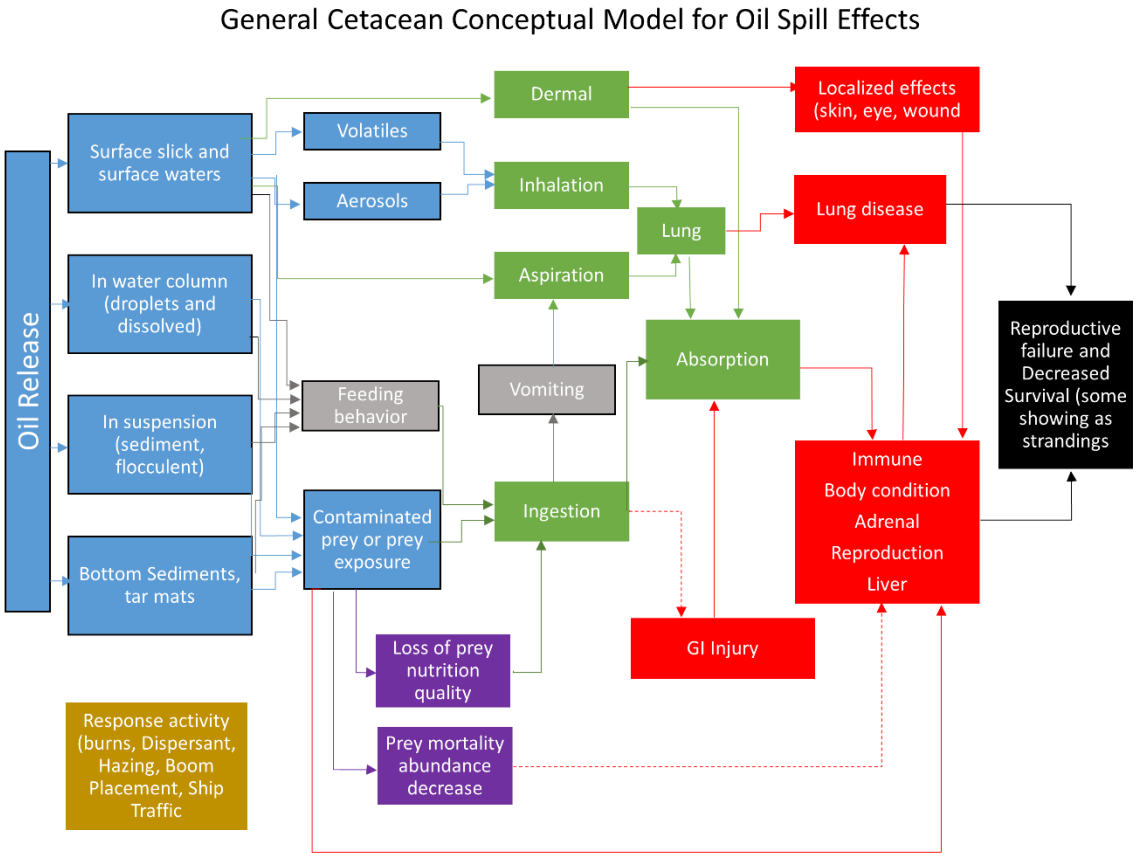

Figure 5 General cetacean oil spill conceptual model. This can be adapted for pinnipeds with addition of pathways for haulout areas.

The example in Figure 5 is a generalized oil effects conceptual model for cetaceans which can be adapted to specific cetacean species as needed. For pinnipeds, additional pathways may be added to account for additional exposure pathways and effects for pinnipeds.

Reading the figure from left to right, the blue boxes indicate primary/secondary exposure sources of oil, the grey boxes indicate behaviors or animal responses affecting exposure, and the green boxes indicate exposure pathway to the animal. For effects leading to injury, the purple boxes indicate indirect effects (i.e., prey base) and the red boxes indicate injury direct injury endpoints. Black boxes indicate endpoints for quantification. The gold box is a place holder for effects from response that would feed into these or other injury routes, but has not been linked up to effects in this example.

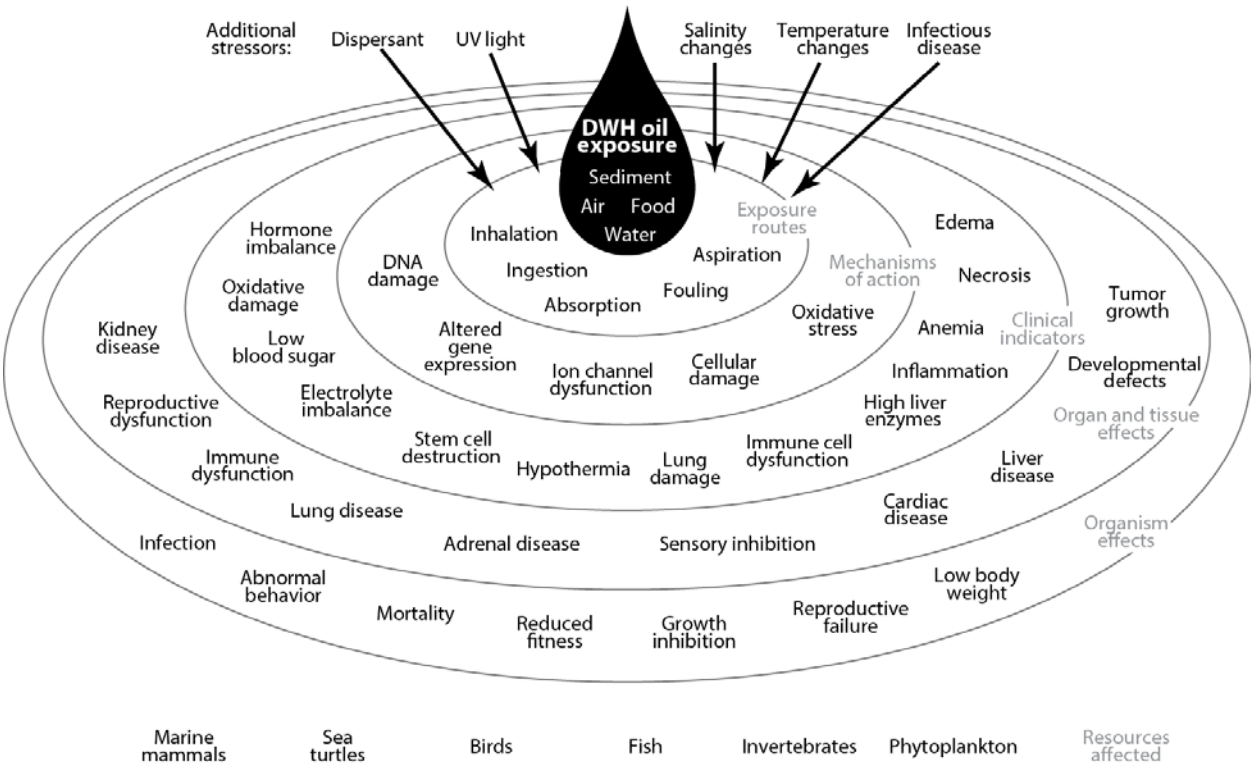

Figure 6 "Constellation of Effects" conceptual model for cetaceans from Deepwater Horizon NRDA (DWH NRDA Trustees 2016). This model visualizes the cascading effects from oil spill exposure, from the cellular to the organismal level.

For Deepwater Horizon NRDA, the "constellation of effects" conceptual model seen in Figure 6 was useful to describe the layered health and population effects seen in dolphins as a result of oil exposure.

5.2. Methods and Available Tools

During the August 2015 Marine Mammal Assessment Workshop, NOAA scientists used case studies and scenarios to discuss the available methodologies that could inform exposure or injury assessment for future oil spills across the country. Following the 2015 workshop and completion of the injury assessment and Programmatic Damage Assessment and Restoration Plan for the *Deepwater Horizon* Oil Spill, as well as publications arising from the NRDA work[17], NOAA marine mammal scientists assembled the following summaries of available methods to assist future NRDA managers and marine mammal scientists in developing a defensible scientific approach to an assessment. Figure 7 presents a marine mammal conceptual model of potential exposure and injuries with numbers corresponding to the different numbered methodologies included in the text of this document.

[17] https://response.restoration.noaa.gov/deepwater-horizon-oil-spill/noaa-studies-documenting-impacts-deepwater-horizon-oil-spill.html

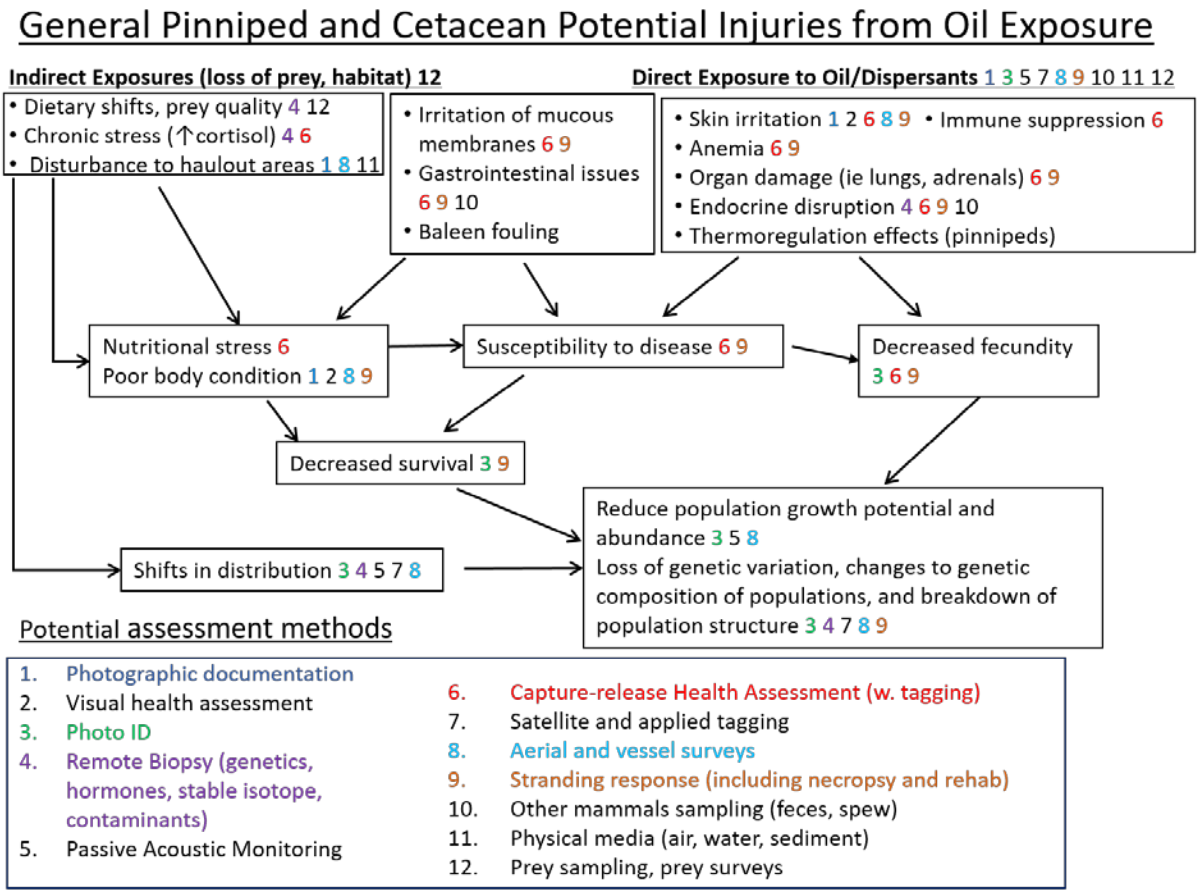

Figure 7 A generalized conceptual model of cetacean and pinniped injury from oil exposure. This figure highlights studies (described later in this document) that can be undertaken to address potential injuries.

In the following subsections, the subheadings under each method/tool briefly summarize points or questions that may come up when planning a NRDA for marine mammals with a cooperative RP, co-trustees, and/or the National Pollution Fund Center. For each method/tool:

1. "Overview" is a brief description of the tool/method.
2. "Utility of the method for NRDA" and "Baseline considerations" are starting points to discuss where the data generated from this study would fit in the NRDA framework.
3. "Ephemeral Data considerations" discusses how quickly a team needs to mobilize to get this information.
4. "Other considerations" discusses how long it takes to get data back as well as some species or other limitations.
5. "References and examples" presents starting points to demonstrate the methods established for at least some species of marine mammals as part of regular marine mammal population or health monitoring or used for other NRDAs.

Although not discussed in the summaries for each tool, available restoration and injury metrics that can scale from injury to restoration should be part of the discussion when planning NRDA studies.

The following section discusses these methods (Figure 7; Table 1) that are good candidates to consider when planning a marine mammal oil spill assessment. There may be other approaches that may be appropriate for specific regions or species and with specialized laboratories, or are developed over time, so the following summaries should be considered as starting points.

All field methods that involve approaching, handling, or sampling marine mammals (live or dead) require permits or authorizations from NMFS under the MMPA (for all marine mammals) and ESA (for threatened and endangered marine mammals).

All field data collected for these assessments should follow NOAA Environmental Data Management procedural directives[18] and be managed appropriately for potential litigation. More information on data management tools and requirements for NRDA are found in Appendix F. Sample forms, chain of custody documents, and other guidelines that may help in planning NRDA studies can be found in NOAA ARD NRDA's Arctic guidelines[19] (Bejarano *et al.*, 2014) and NOAA DIVER Templates and Forms[20].

5.2.1 Photographic or video documentation

Context: Photographs and/or videos of cetaceans and pinnipeds during an oil spill may be collected as a dedicated effort for NRDA documentation, in conjunction with spill response operations and stranding response, or incidental to other NRDA studies. Most marine mammal scientists are familiar with basic or specialty photography and have existing protocols for photographic data collection. For NRDA, high quality, properly managed, and geo-referenced photographs of marine animals with oil visible on them, swimming in oil, or interacting with response operations are powerful pieces of evidence for a case. Other photos/videos of interest include documentation of specific behaviors that may affect exposure or sensitivity to oil or response activities. For example, documenting local feeding behavior, such as "crater feeding" in common bottlenose dolphins, may provide additional insight into exposure mechanisms (Rossbach and Herzing 1997).

Any photos collected for NRDA must meet case requirements for handling as data evidence. The NRDA case lead or data manager will have direction specific for the individual spill. Specific guidelines for NRDA on photo and video data handling can be found in NOAA ARD NRDA's Arctic Guidelines (Bejarano *et al.*, 2014). These guidelines include examples of Chain of

[18] https://nosc.noaa.gov/EDMC/PD.all.php
[19] https://response.restoration.noaa.gov/sites/default/files/NOAA-guidelines-ephemeral-data-collection_Arctic_December2014.pdf
[20] https://www.diver.orr.noaa.gov/field-forms-and-templates

Custody forms to maintain a record of the photos being obtained from the camera through their final inclusion into a designated archive.

Utility to NRDA and circumstances of use*:* High quality, geo-referenced photographic documentation of animals swimming in or near oil or interacting with response operations or of oiled haulout areas is powerful information that can be used qualitatively (in most circumstances) to document *exposure.* Information from photogrammetry to assess body condition can contribute to assessment of *injury*.

Ephemeral data considerations: Photographs and videos of marine mammals with oil on them, or swimming or hauling out in oil, or exhibiting behaviors that demonstrate their susceptibility to exposure or injury from oil should be a priority for collection, if possible, while oil is easily visible on the surface of the water. Depending on the species considered for assessment, it may be advisable to photograph or videotape particular local behaviors that could affect exposure, interaction with response activities, or enhance injuries.

Box 4. Under OPA NRDA regulations, the public is compensated for the injury by performing restoration to return natural resources to **baseline** conditions. "Baseline", in NRDA, means "the condition of the natural resources and services that would have existed had the incident not occurred." Baseline data may be estimated using historical data, reference data, control data, or data on incremental changes (e.g., number of dead animals), alone or in combination, as appropriate.

Baseline considerations (Box 4): No baseline data are necessary for basic photographs of animals in oil or around response operations. If the spill occurs in an area of oil seep activity, it might be advisable to document the relative amount of oil during the spill versus typical seep activity. In such cases the team should discuss collecting sheen or oil samples for fingerprinting in conjunction with photographs.

Other considerations*:* Photographs are powerful in that they are available for use almost immediately. However, even in small spills, the number of photos for the case to manage can be challenging (because we are unable to delete any photos for a case for legal reasons). It is important for the photographer to work with the NRDA data manager and to spend the time to identify the quality photos, and provide descriptive logs to optimize the use of these photos, both for later review, and for potential litigation. See the Pinniped and Cetacean Oil Spill Response Guidelines for an example of descriptive logs (Ziccardi et al., 2015). If animals are to be approached officially for photographing then appropriate authorization (e.g., under MMPA Section 109(h), 112 (c), or a research permit) is required. Photos or images submitted by the public may also be informative if they can be confirmed, however the public should not pursue or harass marine mammals.

References and example applications: Photographic information from aircraft, vessels, and shore from both general response and wildlife response was used to help establish exposure of marine mammals for the *DWH* NRDA (Aichinger Dias et al., 2017; PDARP, 2016).

5.2.2 Photographic Identification (Photo-ID)

Context: Many marine mammals naturally have distinctive coloration patterns or fin/fluke shapes, or they acquire distinctive markings (e.g., nicks, notches, scars) on their bodies, dorsal fins, or flukes that can be used to identify individual animals. For some species, artificial markings (e.g., bleach patterns, freeze brands, flipper tags) have also been used to make individuals recognizable. Photo-identification (photo-ID) studies use photographs, generally obtained from boat-based surveys, to recognize and track individual animals over time and space. The data from photo-ID studies can be used to document mortality (by identifying carcasses) or reproductive events. In addition, a variety of mark-recapture modeling approaches using photo-ID have been developed to estimate population survival rates and/or density and abundance.

Utility to NRDA and circumstances of use: Photo-ID field methods and associated statistical modeling approaches are well established, and studies (some long-term over decades) have been conducted for many species of marine mammals, particularly cetaceans. Photo-ID may be helpful in documenting the occurrence, distribution, and movement of animals relative to oiling to characterize *exposure*. Survival analysis and monitoring of reproductive events can help to quantify *injury*, and may be particularly important when sub-lethal effects are suspected. Depending on life history status, many pinnipeds would be expected to come and go from haulouts regularly. Any that are photo documented as remaining on shore could indicate lethargic behavior, and may be useful in an injury assessment especially if that individual ultimately dies or disappears. The estimation of density and abundance through mark-recapture analysis can aid in establishing the number of animals at risk, contributing to *quantification* of injury. Abundance estimates are particularly important to obtain when current information on stock size is limited.

Photo-ID studies should be considered as a high priority as an assessment tool where appropriate species or stocks are present and the logistics allow. It is important to note that case teams should assume that photo-ID studies will require multi-year repeat surveys in order to detect change over time.

Ephemeral data and baseline considerations (Box 4): Photo-ID studies for the appropriate species during a spill should be considered a high priority for early ephemeral data collection. If an appropriate photo-ID catalog has not been established or is not up-to-date for the area and species, then photo-ID surveys should be initiated as soon as possible (preferably during response and reconnaissance) to document the presence of individuals in the area, and to aid in accurate estimation of post-spill survival for species amenable to photo-ID mark-recapture techniques. A photo-ID database should be maintained by NMFS or a NMFS partner, consistent

with NOAA data management standards. While baseline data from the specific stock of concern are not absolutely necessary, some reference for expected survival and reproductive rates will be needed for comparison. Such reference rates could be based on what is known about the species from prior studies in other similar sites/habitats.

Other considerations: While photo-ID surveys to estimate density and abundance are conducted over relatively short time periods (generally weeks), longitudinal studies for documenting population vital rates generally require much longer (> 1 year) to obtain survival estimates with the needed precision for comparison against a reference population. The time/effort needed to sort and match photos to a catalog of identifiable individuals also can be extensive, particularly if it is a large population (e.g., greater than a few hundred catalog individuals), and this can be a major drawback for photo-ID studies. Automated recognition software is being tested and refined by some researchers and may alleviate this problem in the near future.

References and example applications: Longitudinal photo-ID studies were conducted for bay, sound, and estuary (BSE) common bottlenose dolphins following the *DWH* oil spill (McDonald et al., 2017; DWH NRDA Trustees 2016). *DWH* photo-ID workplans are also available for reference regarding injury assessment plans. Information on field laboratory protocols for some photo-ID mark-recapture can be found in (Melancon et al., 2011) and (Rosel et al., 2011). However, local and regional expertise is preferred at specific spills for more complete and up-to-date information on mark/recapture studies done in the area.

5.2.3 Visual Health Assessment

Context: Visual health assessment techniques may be appropriate for some species, particularly where live capture-release is not possible, and where baseline visual health assessments have been done or are possible in the early days of a spill. Specialized photographic techniques, which can include automated photo-monitoring, videography, or collection of images via unmanned aircraft systems (UAS) may be used for photogrammetry. Experts review photographs to evaluate skin condition, scarring, presence of calves (or pups), possible pregnancy, and body condition. Visual health assessments have been performed and described for right whales, gray whales, killer whales, humpback whales, and leopard seals (Pettis et al., 2004; Bradford et al., 2012). Other species, such as Steller sea lions and Hawaiian monk seals have also undergone some photogrammetry or videography work and should be considered as visual health assessment candidates for oil spills within their range.

Utility to NRDA and circumstances of use*:* Information from visual health assessment or photogrammetry to assess body condition can contribute to assessment of *injury*, in evaluating body condition changes, especially for chronic exposure, but, depending on the rate at which body condition deteriorates, it may only be useful to detect longer-term change, over months and years.

Ephemeral data considerations: If visual health assessment is being considered as an assessment tool, documentation of exposure of known (or identifiable) individuals should be done as early as possible. If no baseline assessment exists for a particular area or is outdated, but the species or stock has protocols in place, the assessment team should consider undertaking a baseline assessment, including identification of a reference population (if warranted) for longer-term parameters very early in an incident.

Baseline considerations (Box 4): For long-term changes, it is ideal to have previously known individuals with a visual health assessment history (and pre-spill photos to support it).

Other considerations*:* Visual health assessment as a NRDA assessment tool, at the writing of this document, is likely confined to a small number of well-studied species and requires specialized expertise. Typically, a team of experts agrees on the criteria for the assessment, and the conclusions may take months to several years.

References and example applications: Visual health assessment techniques have been described for right whales (Pettis et al., 2004), where body condition from visual health assessment was shown to be an indicator of future loss/death. Photogrammetry techniques using UAS have been developed for killer whales and blue whales (Durban et al., 2016).

5.2.4 Remote Biopsy

Context*:* Remote biopsy collection is a sampling technique used to collect skin and blubber samples using a pneumatic rifle, pole spear, or crossbow. Untethered or tethered darts collect and hold the sample of interest until it can be collected for processing. This allows a skin and blubber sample to be collected from a free-swimming cetacean, with minimal disturbance to the individual animal and nearby animals, and allows for sampling of otherwise inaccessible individuals. Multiple types of analyses can be performed, including genetic, genomic, and stable isotope analyses on skin; and contaminant concentration and hormone analysis on blubber. However, measurement of oil-derived contaminants in blubber is not considered to be a reliable method for determining oil exposure in marine mammals (Table 3). Rather, analyses for other more bioaccumulative contaminants (e.g., persistent organic pollutants (POP) such as organochlorine pesticides, polychlorinated biphenyls) can be made on blubber samples to help to rule out those contaminants as confounding factors. Skin and blubber may also be analyzed to measure cytochrome P4501A (CYP1A) expression as a biomarker for PAH or other contaminant exposure. However, the utility of this biomarker from skin and blubber samples requires further research and validation before being fully recommended for use during an oil spill assessment.

Table 3 Summary of potential analyses for marine mammal remote biopsies for a NRDA.

Lab analyses	Exposure/Injury/Quantification	Comments
Persistent Organic Pollutants	Exposure	Potentially useful where organochlorine contamination may be a confounding factor for effects seen.
PAH/oil chemistry	Exposure—NOT recommended	Since PAHs are rapidly metabolized by mammals, PAH exposure is not likely to be documented through blubber analysis particularly in cetaceans, however since marine mammals are food resources for Alaska native communities, there may be need for assessment for food safety.
Genetics	Exposure, Quantification	Helps understand stock structure, species identification, sex, stock assignment, individual identification, reproductive history.
Genomics	Exposure, Injury	May help in identifying exposure and injury by determining genes and/or gene networks responsive in each species. For example, CYP1a expression is often raised as a potential marker for PAH exposure; however this response can be induced by many stressors. Further, genomic responses are both species and tissue specific and it is likely that many other non-classical genes and pathways may be more appropriate and/or specific indicators of exposure or injury. Because of the rapidly evolving nature of the field, the merits and availability of genomic tools should be reviewed for each spill. In the absence of pre-existing genomics data, transcriptome-wide assessment or investigation of multi-gene pathways or networks may be more informative than examination of a limited number of classical response genes.
Stable isotopes (CNS)	Exposure, Injury, Quantification	May inform stock structure and dietary shifts, where pre- spill data exist, and identify trophic level to link to prey exposure.
Hormone analysis	Injury, Quantification,	May inform pregnancy rates and other endocrine indicators. For pregnancy, follow-up surveys are needed to determine reproductive success.

Utility to NRDA and circumstances of use: Remote biopsy is of use when: (a) little information exists on stock genetics, (b) other confounding contaminants are a concern, and (c) if reproductive effects and status are a concern. This tool can be used to inform exposure (for bioaccumulative contaminants), injury assessment, and quantification. Stable isotope and genomic analyses can identify injury, but is not yet a reliable way to detect exposure to PAHs. Remote biopsy provides data on genetic stock structure, may be used to identify stock membership of injured animals, estimate pregnancy rate, and can be followed up with photo-ID for reproductive outcomes.

Ephemeral data considerations: Collection of remote biopsy should be considered a relatively high priority for early collection in order to best detect change. Skin and blubber samples need to be properly preserved immediately upon collection to maintain their efficacy for different assays. The method of preservation is dependent on the assay or analyses needed. See the Pinniped and Cetacean Oil Spill Response Guidelines for an example of preservation for PAH analyses (Ziccardi et al., 2015).

Baseline considerations (Box 4): Baseline data are available for genetics, genomics, stable isotopes POPs, and reproductive success rates in some areas, and are beginning to be collected for genomic and stable isotope analyses. Baseline may be addressed via collecting biopsies in reference areas if no pre-spill data exist.

Other considerations: Depending on the analyte, results are often ready and validated in weeks to months. There may be some risk to the animals being sampled, especially if their health is compromised. A direct mortality was observed following remote biopsy of a short-beaked common dolphin in the Mediterranean Sea (Bearzi, 2000). Field costs may be high, but most analytical costs can be deferred as samples can be banked. Specialized expertise and training are needed for collecting biopsies and laboratories with expertise in running the analyses in marine mammals using standardized methods with quality assurance should be used. The MMHSRP may have a list of laboratories being used for surveillance and other investigations.

References and example applications: Remote biopsy is one of the most common collection methods for obtaining biological tissue samples from free-ranging cetaceans, and has been widely used for killer whales, beluga whales, gray whales, other large whales, and small cetaceans (see Hunt et al., 2013 for review). Remote biopsy was employed as part of the NRDA of the *DWH* oil spill on common bottlenose dolphins in the Gulf of Mexico. Workplans from the *DWH* NRDA can be found on the Gulf Spill Restoration[21] website. Remote biopsy has also been successfully applied for sampling pinnipeds.

[21] https://www.gulfspillrestoration.noaa.gov/

5.2.5 Sampling of breath condensate and exudate ("blow") in cetaceans

Context: Cetaceans are surface breathers who inhale large volumes of air and exhale clouds of "blow" (exhaled droplets of condensed respiratory vapor and mucosal discharge). They may produce multiple blows during a surfacing interval and are often approachable by boat with the use of a long pole or UAS to collect blow. Current assessment methods of potential application to oil spill injury are to remotely sample the breath and the cells or exudate in breath in large whales to evaluate hormones, microbes, cells (cytology), health, and immunological status. Breath (exhaled breath condensate) samples may also be taken from small cetaceans during a live animal health assessment to measure chemicals (including PAHs) and metabolites, however techniques for collection in free swimming animals are not yet available.

Utility to NRDA and circumstances of use: Remote breath collection is currently only useful for large cetaceans that produce large volumes of blow and may be approached close for collection using either small vessel with pole or UAS technology. Currently remote blow or breath sampling would provide evidence on *injury assessment*, however breath condensate might provide evidence of exposure. Blow analyses may provide information for use in quantification when integrated with other data. This would provide information on lung health in free-swimming cetaceans using standardized methods. The methods for hormone analyses from mucus are well documented, however validation for quantification of the hormones relative to the volume of water in the sample are currently in development.

Ephemeral data considerations: Currently, remote blow or breath sampling provides evidence for *injury*. The changes identified by this method are likely to be chronic in nature. If blow/condensate is being considered as an assessment tool, documentation of exposure of known (or identifiable) individuals should be done as early as possible. If no baseline assessment exists for a particular area or is outdated, but the species or stock has protocols in place, the assessment team should consider undertaking a baseline assessment, including identification of a reference population (if warranted) for longer-term parameters very early in an incident.

Baseline considerations (Box 4): Baseline information on measures in specific species is important for interpretation of hormone and lung health data.

Other considerations: Sample collection requires specific skills and equipment. Blow sample analysis is still in its infancy for most of the measures described, and many validation questions remain to be addressed. Sampling methodology may require detailed pilot studies, (e.g., determination of the best method for droplet collection, studies of possible interference by sampling materials, development of possible methods to acquire gaseous samples, and addressing potential variation in biomarker content of the sample). Sample collection has been successful in whales, but has not occurred widely in dolphins and porpoises or pinnipeds. The collection technique is not expensive, but fieldwork and analyses may be somewhat costly, with the results for hormones and microbiology/genomics available in several months.

References and example applications: Remote blow collection for microbiology has been used in killer whales, and large whales such as humpbacks, gray, right, and blue whales. Blow collection of mucus for hormones has been used successfully in right, blue, and humpback whales (Acevedo-Whitehouse et al., 2010; see Noren et al., 2012 for review).

5.2.6 Passive Acoustic Monitoring

Context: Marine mammals, particularly cetaceans, produce underwater sounds varying from low frequency calls (e.g., from baleen whales) to high frequency echolocation clicks (e.g., from bottlenose dolphins). Passive acoustic monitoring (PAM) is being increasingly used to study these vocally-active species, particularly those species which are easier to hear than to visually observe (e.g., *Kogia* species or other deep divers such as beaked whales).

Utility to NRDA and circumstances of use: Passive acoustic monitoring can be used to confirm the presence of animals in the area of the spill inferring potential *exposure*, or to characterize spatial and temporal distribution of animals using relative indices such as vocalizations detected per day (aids in characterization/quantification of *exposure*). Development of methods for estimating density/abundance of certain species from passive acoustics is a growing field of research and acoustics-based density estimates have been successfully derived for some species (Marques et al., 2013). Longitudinal monitoring over time following the spill could help to detect shifts in distribution or declines in abundance, inferring loss of individuals and thus *injury*, although such inferences are complicated for species/stocks that migrate seasonally or whose range includes areas outside of the spill footprint.

Ephemeral data and baseline considerations (Box 4): It is desirable to have an established acoustic signal processing method for the specific species of interest and, if being used to estimate density/abundance rather than simple presence, baseline (pre-spill) estimates of density for comparison are also important. It may be important to deploy acoustic arrays as soon as possible after a spill, but it is not practical for fast turnaround assessment decisions.

Other considerations: PAM requires specialized expertise for deployment of technology, as well as for processing of acoustic data, which can impact the timeliness of receiving results. Storage and management of the large volumes of data generated from PAM needs to be considered early in study planning, particularly with respect to data sharing agreements among and between trustees and RPs. Due to the relatively new application and emerging nature of PAM technology for marine mammals, such expertise is specialized.

Multiple deployments are required to triangulate and locate individuals and perform abundance and distribution estimates. Not all baleen whales vocalize at a frequency adequate to detect abundance and distribution. Receivers must be deployed and recovered at an accelerated interval to provide timely reports.

References and example applications: Passive acoustic monitoring was used following the *DWH* oil spill to confirm the presence and estimate density (Hildebrand et al., 2012) of several oceanic cetacean species in the Gulf of Mexico. Work plans including PAM for *DWH* can be found on the Gulf Spill Restoration website[22].

5.2.7 Capture-release (Health Assessment)

Context: Hands-on sampling of animals for evaluating health status (e.g., through hematology, blood chemistry, physical examination, ultrasound, or other medical diagnostics), marking (e.g., by freeze-branding, hot-branding, bleaching, or tagging), or for attachment of telemetry tags (see Tagging section), can be conducted for a limited group of pinniped and small cetacean species. A number of capture-release studies have been conducted for BSE common bottlenose dolphins, using a large mesh seine net to encircle and catch the dolphins in shallow water where they can be restrained, sampled, and released (Wells et al., 2004, Loughlin et al., 2010, Schwacke et al., 2014). Similarly, capture-release has been used to study phocids (seals) and otariids (sea lions) such as Hawaiian monk seals, California sea lions, harbor seals, and ice seals using a variety of capture net techniques either close to shore or while the animals are hauled out on land.

Utility to NRDA and circumstances of use: Information obtained from capture-release, such as prevalence of disease conditions, specific physiological abnormalities, reproductive status of females, metrics on fetal health, or poor body condition, can be invaluable for documenting *injury* from oil exposure or other environmental factors. For example, harmful algal bloom (HAB) toxins and morbillivirus are common causes of mortality and sublethal health effects for many marine mammal stocks, and should be assessed as potential causal factors for observed injuries. During capture-release, a suite of tissues, as well as urine and feces, can be sampled and analyzed for the presence of HAB toxins, other chemical contaminants (e.g., persistent organochlorines), and pathogens or antibodies to those pathogens that would suggest recent exposure. This comprehensive diagnostic approach aids in establishing the causal link between the oil exposure and specific injury by ruling out alternative causal factors. A primary advantage of the capture-release approach is that animals can be randomly sampled (to some degree) as compared to sampling of stranded animals which is opportunistic and can introduce bias by only sampling sick/dead animals. Unbiased sampling is particularly useful for *quantification* of injuries.

Marking and tagging of animals from capture-release studies allows for follow-up of individual animals for longer-term sublethal injuries or reproductive effects. In addition, follow up surveys allows assessment of reproductive success and survival over time.

Ephemeral data considerations: Capture-release health assessment is unlikely to be available as an assessment tool early in a spill due to safety or other logistics.

[22] https://www.gulfspillrestoration.noaa.gov/

Baseline considerations (Box 4): Baseline information on expected ranges for health measures or similar measures from a reference population is necessary for proper interpretation of health assessment findings. Reference ranges for many health measures have been established for common bottlenose dolphins and some commonly sampled pinnipeds (Schwacke et al., 2009, Greig et al., 2010, Hart et al., 2013, Hart et al., 2015).

Other considerations: Capture-release sampling requires relatively large teams of experienced researchers (e.g., 10-15 for pinniped studies, 40-50 for capture-release of BSE bottlenose dolphins). Comprehensive sample analyses can be costly.

References and example applications: Capture-release studies of BSE dolphins were conducted for the *DWH* NRDA and included attachment of satellite tags to establish movements, comprehensive health evaluations, and photo-ID follow-up to assess reproductive success rates (Schwacke et al., 2014, Lane et al., 2015, Kellar et al., 2017; Smith et al., 2017). *DWH* workplans can be found on the Gulf Spill Restoration[23] website.

5.2.8 Tagging (remote and applied)

Context: Application of tags can be useful for identification purposes, or for gathering additional data through telemetry. Telemetry is the automated communication process by which measurements and other data are collected from remote points and transmitted to receiving equipment for monitoring. Sensors can measure parameters such as location, temperature, dive depth, duration and speed. VHF tags transmit information via radio. Satellite-linked tags transmit a signal to a satellite, and position data are then relayed to the researcher. The tag emits a signal when the animal is at the water's surface. In cetaceans, tags can be placed through the dorsal fin, or into the blubber on the back using pins, or can be attached via a suction cup. The tags eventually fall off of the body, leaving a small hole and scar. Tags may last anywhere from days to months to a year, depending on the type of attachment system, battery life, and other placement factors. In pinnipeds, tags are glued onto the hair, and can stay attached for a maximum of one year, which is roughly the length of time between molts (which cause the tags to detach). Tags are applied when the animals are on land and transmit data when the animal is at sea. In pinnipeds, plastic tags are often applied through the webbing of flippers to identify individual animals.

Utility to NRDA and circumstances of use: Tagging is used to answer questions about movement, distribution and home range of animals. Tagging can be useful to inform *exposure* when used immediately following an event, and potentially injury depending on the tag's life. Tags can assist with establishing home ranges for animals, which may help to inform exposure, even if used after an event. Tags can be used to inform quantification of *injury* by determining

[23] https://www.gulfspillrestoration.noaa.gov/

the percentage of animals exposed and the overall survival rate when combined with photo-ID of individual tagged animals.

Ephemeral data considerations: Tags should be placed as soon as possible if questions of exposure are being investigated. Longer-term questions about movement and distribution are more common uses for tags.

Baseline considerations (Box 4): Baseline distribution and movement data are available for certain populations from ongoing research, and should be identified for the area and species affected by the spill. Depending on the purpose of the tagging for the assessment, baseline data may not be necessary, but this should be discussed in the context of the conceptual model for the case

Other considerations: Depending on the tag type and settings, tags can provide a near real-time data stream. This method requires capture for small cetaceans and most pinnipeds, so additional costs and considerations are involved. There is some risk to animals, especially if compromised. There is also risk to people, and capture requires extensive safety procedures, personnel with experience, and a large field team. Tags are manufactured upon command and rarely are available for timely orders during emergency response. Tags may be available from active researchers and would be replaced. Analyses of the data and interpretation requires special skills and may be dependent on the tag type and species.

References and example applications: Satellite-linked tags are commonly used in a variety of species, including killer whales, Hawaiian monk seals, delphinids in Hawaii[24], harbor seals, and Steller sea lions. Suction-cup VHF tags have been used in beluga whales. Tagging was employed as part of the NRDA of the *DWH* oil spill for common bottlenose dolphins, sperm whales, and sea turtles in the Gulf of Mexico. Workplans can be found on the NOAA Gulf Spill Restoration websites including the dolphin health assessment[25] (Schwacke et al., 2014) (which includes telemetry) and sperm whales.[26] Best practices guidelines for tagging cetaceans are currently being developed (Andrews et al., in press).

5.2.9 Aerial and Vessel Surveys

Context: Aerial and vessel surveys use trained visual observers to search for, identify, and tabulate marine mammals. Data are collected that allow for the estimation of detection probability, and ultimately density and abundance, using distance sampling analysis (Thomas et al., 2010). Spatial and temporal patterns of animal density can also be determined, which then can be combined with analyses of oiling to quantify *exposure*. UAS may also be used to collect

[24] http://www.cascadiaresearch.org/projects/hawaii
[25] https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2011/05/Assessing-Potential-SublethalChronic-Health-Impacts-on-CoastalEstuarine-Dolphins4-1-2011.redacted.pdf
[26] https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2012/05/Endangered_Protected_Marine_Mammals_AllSigned2-22-11_Redacted2.pdf

these data in some circumstances. Vessel surveys also allow for the possibility of obtaining biopsy samples.

Utility to NRDA and circumstances of use: Aerial and vessel surveys are most useful for documenting *exposure* in coastal, continental shelf, or oceanic waters. Such surveys are also the primary means for estimating density and abundance of coastal, shelf, or oceanic cetaceans, and for obtaining counts of pinnipeds at haulout sites. It may be useful to repeat surveys some period following the event to detect changes in abundance or distribution (to infer *injury*); although it is important to note that abundance estimates from aerial surveys may only be able to detect the most extreme changes in abundance.

Ephemeral data and baseline considerations (Box 4): Surveys to document exposure must be initiated immediately following an event and should continue at least as long as there is visible oil present. If vessel or boat surveys are used for detecting changes in abundance as part of an injury study, an approach to evaluate baseline estimates is needed. Surveys need to be conducted in a scientific rigorous and standardized manner if they are being used for exposure assessment and quantification.

Other considerations: If surveys are being conducted during the active spill response where air operations are underway, operations need to be coordinated with response activities through the Unified Command. It is possible that such a survey could be done in conjunction with the spill response activities, saving resources and lowering costs. However, Incident Commands for oil spills may deny these dual-use surveys if it distracts from their mission. In addition, since a response survey takes precedence, it may be that NRDA activities get sidelined due to the priority of response activities in such cases. The NRDA teams should make sure to have backup options for the survey independent of the response so that the NRDA team obtains the data required.

References and example applications: Aerial and vessel surveys were used for the *DWH* NRDA to document exposure of coastal, continental shelf, and oceanic cetacean species, and to produce abundance estimates that were used for injury *quantification* (PDARP, 2016). The vessel survey workplan[27] for *DWH* can be found on the NOAA Gulf Spill Restoration website. Helicopter and fixed wing surveys[28] were also done both in conjunction with response and as sole NRDA surveys[29] (Garrison et al., 2011).

[27] https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2012/05/Endangered_Protected_Marine_Mammals_AllSigned2-22-11_Redacted2.pdf
[28] https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2010/10/2010_05_15_MMAMMAL_Overflights.pdf
[29] https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2012/05/Mammals_Assessing_Pop_Size_Spatial_Distribution_la_Redacted2.pdf

5.2.10 Stranding Response

Context: NOAA NMFS MMHSRP is designated as the lead agency to coordinate marine mammal stranding-related activities under the MMPA (Box 5). The MMHSRP oversees all stranding network members who are authorized through stranding agreements from the NMFS regional offices or as government officials under MMPA section 109(h). Members of the stranding network voluntarily respond to live and dead stranded pinnipeds and cetaceans. Certain network members have the capacity to respond to and rehabilitate live sick and injured marine mammals, while other network members specialize in necropsy and sampling of dead marine mammals. Depending on how long an animal has been dead, data collected can range from visual observations and body measurements to a complete suite of gross and histopathologic analysis and sampling. Stranding networks may be included as part of the oil spill response, either through NMFS or by separate arrangement through the responsible party or other party.

Box 5. What is a stranding?
A cetacean (whale, dolphin, or porpoise) is considered stranded when it is on the beach, dead or alive, or in need of medical attention while free swimming in U.S. waters. A pinniped (seal or sea lion) is considered to be stranded either when dead or when in distress on the beach and not displaying normal haul-out behaviors. Live-stranded animals are usually in need of medical attention or free swimming, but cannot return to their natural habitat without assistance (Stranding Fact Sheet).

Utility to NRDA and circumstances of use: Stranding response can provide NRDA with data on *exposure*, *injury*, and *quantification.* Stranded animals may exhibit direct evidence of exposure. Evaluation of clinical findings in live animals, or pathologic findings in dead animals, contributes to assessment of injury. Identification of carcasses to species (or stock) visually or via genetic analysis provides information on what species or stocks were impacted. Understanding the percentage of stranded animals with a given pathology or the mortality rate in a population contributes to quantification.

Stranding response is often part of the wildlife response early in an oil spill, but stranding data may be critically important to a NRDA case. National guidelines on oil spill stranding response provide information on SOPs for marine mammal responders during an oil spill (Ziccardi et al., 2015). As of the writing of this document, NMFS is developing regional guidelines as well. Establishing the relationship between stranding networks, oil spill response, and the NRDA case team with an understanding of potential funding, science needs, sample collection, and data sharing should be established as a high priority for a case team. A commitment to use OPA funds to reimburse stranding network participants for activities in support of a NRDA is determined solely by the natural resource trustees (e.g., NOAA and DOI).

Ephemeral data considerations: Observations and samples from stranded animals that are directly exposed to oil, with either visible oiling or assessable pathology are vital as ephemeral

data. As a carcass degrades, the amount of information that can be gained is reduced. Thus, it is important to collect data and samples from a carcass as quickly as possible, with a focus on the freshest carcasses and those with evidence of oiling. However, other information, including documenting mortality and genetic information, may be collected from carcasses that are less fresh. Additional data such as long-term effects and injury can be collected from animals that strand months and even years following an event.

Stranding network members come from varying backgrounds, affiliations, and expertise. Training and supplying of stranding network members for evidentiary sample collection, data entry and data management, sample storage, chain of custody, and shipping is important for planning for spill readiness and safety.

Stranding response may or may not be considered part of the oil spill response in early stages of a spill. If marine mammal stranding data are potentially part of the NRDA, confirming details regarding stranding data collection should be considered a high priority early in a spill. This includes agreements to reimburse certain costs of the stranding networks associated with stranding response activities or other funding arrangements with stranding networks, and also includes data collection, sharing and management considerations. Where an oil spill stranding response is underway, the transition from response to NRDA activities needs to be coordinated within NOAA. NRDA case leads, GCNR, SSC, NMFS POC, and NMFS MMSHRP all need to be involved. If an enforcement action is being considered, OLE will also be involved.

Baseline considerations (Box 4): Baseline data are necessary to compare changes in stranding rates and prevalence of disease states, but this information could potentially be extrapolated from unaffected areas or from pre-spill time periods. Baseline data may be limited depending on the capacity and focus of the stranding network in a particular region prior to the event.

Other considerations: Carcasses are obtained opportunistically, so it is difficult to design a prospective study. Pathology generally requires additional knowledge for complete interpretation. Stranding networks should use chain of custody for carcasses, data sheets, samples and photographs which takes significant effort (See the Pinniped and Cetacean Oil Spill Response Guidelines for an example of preservation for PAH analyses (Ziccardi et al., 2015)).

When working with samples from stranded animals, planning for using stranding response needs to occur quickly. This includes contracting with laboratories for collecting stranding-related information (e.g., biotoxins, disease indicators,) in ways that work for the case.

References and example applications: Refer to Appendix E for further information on the U.S. Stranding Networks. Increased stranding rates and necropsies of dead stranded dolphins provided important pathologic information for the NRDA investigation of the *Deepwater Horizon* oil spill (Litz et al., 2014, Venn-Watson et al., 2015, Colegrove et al., 2016). For more general marine mammals strandings, rescue and rehabilitation issues, please see *Marine Mammals Ashore* (Geraci et al., 2005) and the *CRC Handbook of Marine Mammal Medicine* (Gulland et al., 2018).

5.2.11 Other remote sample collection

Context: Feces and vomitus (spew) can be collected from a surface where an individual or group of pinnipeds has been resting, or feces from the water in the case of samples that float or are collected immediately following expulsion. Fecal samples from large whales can be encountered opportunistically, or via focal follows or trained dogs. Feces from both pinnipeds and cetaceans can also be obtained during capture release activities. Fecal samples have long been studied for information specific to intestinal parasitology, cytology, and diet analysis, but have also been shown to contain high concentrations of steroid hormones. When paired with other directed sampling (such as remote biopsy or breath), fecal hormone analysis can provide more robust data on injury.

Utility to NRDA and circumstances of use: When combined with blubber and blow samples, feces can provide information on a variety of time frames (i.e., days to weeks to months) for acute versus chronic endocrine changes, which would be important to determine injury and quantification. Sampling immediately following a spill may provide direct evidence of exposure if petroleum has been ingested, but this has not been used yet in a NRDA context.

Ephemeral data considerations: If ephemeral data are desired from the samples (i.e., direct oil in the gastrointestinal tract) then immediate sampling is critical. Immediate collection for fecal hormone analysis is less critical, on the order of weeks following an event.

Baseline considerations (Box 4): Baseline data exist with regard to intestinal parasite presence by species and region. Less information exists, but is growing, on baseline hormone concentrations in feces across species, seasons, and age classes.

Other considerations: Results can be obtained quickly— on the order of weeks— given the availability of labs. Costs are similar to other chemical analyses. Feces and spew samples are not considered a marine mammal part, and so permits for their collection are not required. Permits for incidental take or disturbance are required if collection occurs in the presence of the animals.

References and example applications: Fecal and spew samples are routinely collected from pinniped haulouts and have been collected successfully from multiple species of large whales, including North Atlantic right whales, sperm whales, killer whales, humpback whales, and blue whales.

5.2.12 Sampling of air

Context: Marine mammals breathe very close to the water surface, where it is expected that volatile compounds and aerosolized petroleum will be at their highest concentrations. However, most air sampling conducted after oil spills has focused on assessing risks to human health, and samples are generally taken at least several feet above the surface. There is a general sense that it may be important to get information about the levels of oil-derived volatiles and aerosols just

above (i.e., within 25 cm) the water surface. However, such measures have not been made consistently, we have limited understanding of the relationship between measurements near the water surface and measurements made higher in the air column, and we have limited understanding of the relationship between surface slick and volatile/aerosols just above the water. As of the writing of this document NOAA has no recommended air sampling methods or procedures that are known to address this important data gap and it is included here to highlight its importance for further investigation.

Utility to NRDA and circumstances of use: Direct measurements of exposure of marine mammals to oil-derived compounds are difficult to obtain, given the protected status of all species. Moreover, evidence collected after the *DWH* spill showed lung injury as a major effect of oil exposure in bottlenose dolphins. If data could be collected to show levels of oil-derived compounds and aerosols that are likely to be inhaled by marine mammals breathing at the water surface, this would provide an important indicator of *exposure*, to support subsequent indicators of injury. Such measures of air concentrations would be appropriate to make across the spatial and temporal extent of a spill in areas where marine mammals are likely to be present.

Ephemeral data considerations: It would be important to collect air samples while oil is still fresh, as air concentrations of volatile compounds are expected to rapidly decrease after an oil release occurs. Aerosol composition would also be expected to change as oil weathers.

Baseline considerations (Box 4): Baseline information is not critical, but would be useful. Baseline information can be collected well after a spill occurs, or from areas that were outside of the spill area.

Other considerations: Results can be obtained quickly, on the order of weeks, given availability of labs. Costs are similar to other chemical analyses. No permitting is required specifically for marine mammals, as long as environmental samples are not collected in close proximity to marine mammals (e.g., following NMFS' guidelines for viewing marine mammals: http://www.nmfs.noaa.gov/pr/viewing.htm). Logistics may well be problematic, because response operations will be occurring at the same time that air samples need to be collected. Ideally, protocols and sampling equipment can be coordinated and perhaps provided to whatever entities are already sampling air for human health consideration.

References and example applications: While there are examples of volatiles and aerosols being measured on ships and on shore during an oil spill for human safety, there are currently no available examples of oil-derived compounds or aerosols being measured at locations relevant for marine mammals (i.e. within 25 cm of the water surface). Overall this is currently considered experimental, but highly desired for inclusion for documenting exposure. Methodologies need to be continually evaluated as techniques are better understood.

5.3 Sampling of oil in surface slicks, water column, sediment, and stranded on shore

Context: Many marine mammals ingest water during prey capture and consumption, and may also ingest sediments as they feed on benthic prey. Marine mammals can be externally exposed to surface oil or may aspirate surface oil due to their often highly energetic respiration at the air-water interface. Pinnipeds can also be externally exposed to stranded oil as they come ashore and in their haulout areas and rookeries.

Utility to NRDA and circumstances of use: Measurements of internal exposure of marine mammals to oil-derived compounds are difficult to obtain, given the protected status of all species. If data could be collected to show levels of oil-derived compounds in water and sediments that may be incidentally ingested by marine mammals, this may provide an important indicator of *exposure*, to support subsequent indicators of injury. Such measures of water and sediment contamination may be appropriate to make across the spatial extent of a spill in areas where marine mammals are likely to be present. Analyses of surface oil and stranded oil would be useful to characterize external exposure of marine mammals, especially in areas where marine mammals are observed swimming in oil or where pinnipeds cross oiled shorelines or their haulouts or rookeries are contaminated by oil. Surface and stranded oil information can also be used to match oil on stranded animals to the source. Finally, analyses of surface oil may be useful for estimating *exposure* via inhalation, especially if lung injuries are seen later.

Ephemeral data considerations: Collection of water samples and surface oil samples are time critical while collections of sediments and stranded oil generally are less time critical. Water samples generally are not stable and need to be extracted within 7 days. Samples of sediments and oil are stable for long periods of time if properly stored.

Baseline considerations (Box 4): If samples cannot be collected ahead of the oil, baseline (or reference) information for water can be collected well after a spill occurs, or from areas that were outside of the spill area. Sediments can be collected from comparable areas outside of the spill area to provide reference information. There is no baseline for surface or stranded oil, except possibly in areas of active seep activity.

Other considerations: Results can be obtained quickly, on the order of weeks, given availability of labs. Costs are similar to other chemical analyses. No permitting is generally required, because environmental samples do not need to be collected in close proximity to marine mammals (e.g., following NMFS' guidelines for viewing marine mammals: http://www.nmfs.noaa.gov/pr/viewing.htm). However, permits might be needed for collections of stranded oil from haulouts or rookeries if pinnipeds are present when collections are made. Logistics should be straightforward, as water, sediment, and surface/stranded oil samples are usually already being collected for other purposes of the NRDA or the response. Additional specific collections focused on marine mammal habitats may be appropriate.

References and Example Applications: Currently, we are not aware of any examples of water or sediment chemistry data being used to estimate exposure of marine mammals via incidental ingestion. Methods for collection and chemical analyses of water, sediment, surface and stranded oil, and petroleum fingerprinting are well established, but marine mammal assessors will need to work with the case team's chemistry experts to determine the methods used for the specific case.

5.3.1 Sampling of prey for oil

Context: Marine mammals prey on a wide variety of species, from plankton to invertebrates such as molluscs, cephalopods, crustaceans, fish, and even other marine mammals. Ingestion of oil-contaminated prey may be an important route of oil exposure for some marine mammals. Sampling of prey can occur through normal prey assessment techniques and identifying prey types for pinnipeds or cetaceans may be possible through sampling stomach contents during capture release or stranding evaluations.

Utility to NRDA and circumstances of use: Measurements of internal exposure of marine mammals to oil-derived compounds are difficult to obtain, given the protected status of all species. If data could be collected to show levels of oil-derived compounds in prey species consumed by marine mammals, this would provide an important indicator of *exposure*, to support subsequent indicators of injury. Prey contamination would be appropriate to measure across the spatial extent of a spill in areas where marine mammals are likely to be present, but should be undertaken with caution, given that vertebrates and many crustaceans quickly metabolize oil constituents. Undertaking a prey collection too long after an exposure could lead to a false negative conclusion of no exposure via prey. Prey collections and analyses should focus on non-crustacean invertebrate species, because crustaceans generally have a higher ability to metabolize oil-derived compounds compared to molluscs (but there is considerable variability in this regard among crustacean species). Vertebrates such as fish should only be analyzed if they show evidence of external oil. For purposes of determining dietary exposure, all prey samples should be analyzed whole, including any external oil that might adhere to them. If the purpose of such sampling is to demonstrate that the fish prey base was exposed, we should consider collecting fish bile to analyze for PAH metabolites, as this is a well-established method for determining exposure of fish to oil (Beyer et al., 2010). Stomach contents may be sampled during

Ephemeral data considerations: Invertebrate species such as molluscs and cephalopods can retain oil-derived compounds for weeks or longer. Thus time is not as critical as for other exposure measures. If oil reaches and is retained in sediments, benthic invertebrates can serve as exposure vectors for months to years after an oil spill.

Baseline considerations (Box 4): If pre-spill oil chemistry data are not available, baseline (or reference) information can usually be collected well after a spill occurs, or from comparable areas that were definitely outside of the spill area.

Other considerations: Results can usually be obtained within weeks. Costs are similar to chemical analyses for water and sediment. No permitting is required specifically for marine mammals, because environmental samples are not collected in close proximity to marine mammals (e.g., following NMFS' guidelines for viewing marine mammals: http://www.nmfs.noaa.gov/pr/viewing.htm). If prey species are being assessed for exposure and injury in their own right, logistics may be quite simple and analyses can meet the needs of NRDA for both mammal and fish assessment. In addition, studies to evaluate impacts to Essential Fish Habitat may also be useful in determining additional injuries to marine mammals.

References and example applications: Marine mammal prey species were collected[30] (Garrison, et al., 2011) and analyzed for PAHs following *DWH*, both on the shelf and in the embayments. However, both sampling efforts took place for months to over a year after the well was capped (November 2010 for the shelf collection; September 2011-January 2012 for Barataria Bay), and results showed fairly low levels of PAHs in biota. Because prey species had long since metabolized PAHs, those low levels in tissues were not surprising.

5.3.2 Spill response data and records for mammal assessments

Context*:* The oil spill response, led by the Federal or State On-Scene Coordinator, is charged to protect human health and the environment through cleanup, containment, and other mitigation measures. Depending on the size of the spill, the spill response teams may collect samples of oil, water, sediment, biota, or air, conduct aerial surveys to track and predict oil movement, conduct shoreline cleanup, conduct skimming operations, apply dispersants, deploy booms, conduct controlled burns, and do investigations to determine the type and magnitude of cleanup and protection required. Under oil spill response, the Wildlife Branch rescues wildlife impacted by the spill or by response activities, and/or conducts operations to deter animals from entering the spill area. As part of these operations, valuable data, samples, and photographs are gathered generally for the immediate purposes of the response, and, in the past, were not necessarily collected or archived in a way for easy retrieval once the spill response ended.

If NOAA's OR&R is the response Data Management Lead under the Planning Section, we can work with the USCG in the Documentation Unit to ensure that these data are collected, shared, and archived in a manner that both meets federal data requirements and ensures the longevity and access of the data during and after the response. Spill response in the future should include a response Data Sharing Plan to ensure this happens and should include all response marine mammal data, as well as other records of interest.

Utility to NRDA and circumstances of use*:* Photographs, observer notes, data sheets, records of response activities (such as burns, dispersant application, boom placement, skimming), and

[30] https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/2011_07_07_MMAMMALS_Prey-Species-NOAA-BP-Signed_LA-signature.redacted2.pdf2011_07_07_MMAMMALS_Prey-Species-NOAA-BP-Signed_LA-signature.redacted2.pdf

samples collected during the response can be a rich source of information about *exposure* and *injury* during the height of a spill from both the oil and from response activities. Of particular interest for NRDA in this category is to document, if present, any injury due to response activities as well as from the oil itself.

Other information that should be considered in this category includes information and quantification about the level of search effort for any stranding response undertaken as part of oil spill response. These data are useful for understanding potential differences in reporting and response to strandings during a spill versus outside a spill period. This is an example of data that the NRDA team should identify as a need early and undertake the organization and collection of during the response, if possible.

Ephemeral data considerations: Records, information about activities, and even detailed information about sample collection and wildlife interactions can be very difficult to reconstruct once response concludes. As early as possible in the incident and while oil spill response is still active, the NRDA marine mammal team should get familiar with the data types that may be available through the response activities and work with a NRDA data manager to ensure that response data and records of interest to the mammal assessment are being collected and retained. If response activities are thought to be an important component of the NRDA, the case team, scientists, and data managers need to plan for this early in a NRDA response.

Baseline considerations (Box 4): The category of response data mining is broad and the needs are based on the circumstances of the individual case. When using response data, the case team should evaluate what baseline data may exist or may need to be collected for each data type.

Other considerations: After the response is largely over, and in the absence of an enforceable data sharing and management plan, it can be very difficult to track down response data. Reconstructing records can end up taking a significant amount of time, yet may be the only option if the case lead does not have dedicated personnel collecting and uploading records, or if the locations of records are not included in NRDA data management systems during the response.

References and example applications: Samples taken under the Marine Mammal Oil Spill Response Guidelines –including intake logs, lab results, medical records, release disposition, and stranding observation sheets— are all examples of data mining that would likely be used as part of a NRDA (Ziccardi et al., 2015). Another example of using response data for mammal assessment would be to document the number of overflights that had a trained mammal observer versus those without a marine mammal observer to better estimate the observer effort during oil overflights and thus derive better estimates of exposure.

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7. Appendices

Appendix A: First days of a spill—An Example

Every spill is different, so developing a prescriptive cookbook of what will or should happen with respect to marine mammals is not helpful. However, given NOAA's various responsibilities under OPA, MMPA, ESA, and NMSA, certain activities are common to most spills, although each may have unique challenges. This section is meant to help NOAA staff understand other needs across NOAA, focusing on marine mammal-related activities.

Notification: NOAA is informed to activate for a spill in several ways:

a. OR&R/ERD is generally activated by the Coast Guard or EPA to provide scientific support to the Federal response to a spill or grounding. ERD opens an incident in ResponseLink for information sharing of the response.

b. ARD, ONMS, and NMFS are most often informed of a spill through the ResponseLink emails or from separate communication from the SSC. However, if the Coast Guard is not involved or ERD is not activated, NOAA staff sometimes also find out about developing incidents from state or local colleagues, other federal colleagues, academics, or even the local news.

During the first day or so, all NOAA offices will decide on the level of effort for the incident. Initial reports of volume and severity can change dramatically as more information is gathered. For oil spill response (including marine mammal response), the level of involvement depends on the size and complexity of the FOSC response, and the need for SSC involvement. For NRDA (including marine mammal assessment), decisions regarding level of effort are made based on size and severity of the spill, experience and needs of co-trustees, the potential for severity of injury to NOAA resources, NOAA's existing workload and priorities, cost, and likely availability of restoration. For these reasons, many NRDAs end at this case evaluation phase.

Ramp up (up to roughly first week):

Response: ERD is most likely staffing the Incident Command and working with NMFS and other wildlife response organizations to establish the mammal wildlife response. ERD will also work with ONMS to coordinate any response activities. A Data Management Lead will begin the effort of instituting data management, sharing, and archiving protocols.

NRDA: In the first few days to a week, the ARD NRDA lead is information gathering—is this an incident that NOAA should take on? Two key questions NOAA is seeking to answer are: (i) do we have jurisdiction under OPA to pursue restoration; and (ii) do we

proceed with preassessment? The specific items to consider are specified in the OPA regulations (15 CFR 990.41 and .42).

We may be assembling field teams to collect source oil, establishing a NRDA command post, establishing contact with the responsible party, getting contracts in place for assessment support, establishing data management procedures, and getting logistics in place. Marine mammals will be one of several natural resource groups to consider.

For the ARD lead, if marine mammals are of concern for a spill, during the first week or so of a spill, the ARD lead should: (a) determine and contact the NMFS POC for mammals for this potential case; (b) provide NMFS with what is known about the oil, trajectories, etc.; (c) work in conjunction with NMFS staff on developing a conceptual model for marine mammals potentially injured by the spill; (d) work with GCNR, NMFS and co-trustees (and RP in a cooperative assessment) to prioritize marine mammal ephemeral data collection and prepare workplans for approval (see Tools section); (e) assist NMFS with logistics for approved ephemeral data collection plans including coordination with response efforts; (f) work with NMFS on ESA/MMPA permitting and budgeting for all assessment activities prior to conducting field activity; (g) work with NMFS and others on appropriate emergency restoration, where applicable. Other NRDA activities (injury quantification, restoration planning) are important activities, but not likely to occur in the first week of a spill.

For the NMFS POC, if marine mammals are of concern for a spill during the first week or so, the NMFS POC (contacted by ARD) should: (a) work within NMFS responders and others (science center, HQ, regional office) to identify species of concern (and prioritize an indicator or surrogates if necessary); (b) work with the NRDA/ARD lead on developing a conceptual model for marine mammals at the appropriate taxonomic level; (c) work with ARD, co trustees, GCNR, and RP to *prioritize ephemeral data collection* (see Tools section) based on specific need for marine mammal exposure, injury, or other assessment data; (d) prepare budgets for ephemeral data or other preassessment activities; (e) help identify NMFS contacts or other assets and logistics to expedite ephemeral data collection; (f) assist ARD with ESA/MMPA permitting and/or consultation if necessary.

As soon as possible, NMFS and ARD leads or managers should discuss expectations with respect to budgets, spend plans, and contracting, and data availability and management issues.

NRDA managers should not automatically expect that stranding data and samples adequate for NRDA will be collected and should plan for agreements with stranding networks to facilitate obtaining samples and data for a NRDA for marine mammals.

Enforcement Actions under the MMPA/ESA/NMSA:

OLE should be notified so that investigation of any civil or criminal violations of the MMPA, ESA or NMSA can be initiated and coordination can begin on issues related to evidence collection, forensics (e.g., which labs to use), and information sharing. In particular, it is important for everyone to understand limitations on access to evidence in criminal cases.

NMS investigations (aside from response and NRDA)
ONMS personnel work within the regional ACPs to plan for and train in the execution of both response and NRDA activities. Baseline data often can be provided by NMSs that can be used to develop a Net Environmental Benefits Analysis, provide local expertise on access, sensitive species and habitats, as well as provide staffing and pre-spill data during the first few days or hours of a spill.

2 weeks to a month:

Response: The response should be mature (or even ramping down), fully staffed, data sharing agreements in place.

NRDA: At this point, for a medium or larger spill, there should be a general conceptual model understood among the trustees, more detailed conceptual models developed by a working group, and NRDA organization should be understood and in place for collecting and managing preassessment and other ephemeral data. NRDA activities should be well-coordinated with response. For cooperative assessment, the RP should be meeting with the trustees regularly, funding agreements should be in place or well in process, and the RP may be participating in field teams (where agreed) and/or receiving and sharing cooperative data. For non-cooperative assessments, the Trustees should have obtained or be close to obtaining initiate or preassessment funding from the NPFC or for the ARD, or from the DARRF (in some cases). In the case of smaller spills, the trustees should be evaluating the need for further data collection. There should be regular communication within the NRDA team for case progress, science, and budgets, and an understanding about time commitments. For a marine mammal assessment, where strandings are likely part of the NRDA data collection, there should be agreements either in place or well underway for funding/reimbursement (e.g., stranding network activities eligible for reimbursement under OPA). Also, NOAA requirements with respect to samples (including disposition), data availability and confidentiality of information should be confirmed in writing with the stranding networks. NRDA case leads, GCNR, and NMFS MMSHRP should be involved.

Beyond a month:

The NRDA process should be maturing and NOAA staff should be planning for longer term time commitments for completing a case.

Appendix B. MMPA and ESA Permits

For assessment activities that have the potential to "take" marine mammals or endangered and threatened species, a permit may be required. NMFS' Office of Protected Resources issues MMPA and ESA permits and authorizations based on the type and manner of take, the length of the project, and the stock status (e.g., "depleted") or ESA status (whether it is threatened or endangered) of the species.

For a mammal assessment, we expect a NRDA or other assessment lead will be working closely with NMFS PR or a NMFS science center who can help navigate the permit system. However, if the length of time to get a new permit precludes getting one in time for the time-critical nature of NRDA work, we would seek to work with already-permitted individuals for the NRDA work.

To identify existing NMFS permit holders who hold research or enhancement permits or authorizations for NMFS species, NRDA practitioners may search NMFS online permitting database, Authorizations for and Permits for Protected Species (APPS), at https://apps.nmfs.noaa.gov/search/search.cfm.

On this page, under 'Which Records', select 'Active Permits' and then choose the species or stocks of interest. You can narrow your search for permits by selecting more options such as 'Capture method', 'Procedures', or 'Region'.

MMPA Incidental Take Authorizations: The Office of Protected Resources Incidental Take Program (ITP) issues incidental take authorizations and Letters of Authorization for NMFS marine mammal species under the MMPA if an otherwise lawful activity has the potential to either injure, disturb, or kill marine mammals. The former involves an expedited process (~6 months), may be valid for a maximum of one year, and cannot authorize lethal take. The latter requires a rulemaking process (~18 months), can be valid for up to five years, and may be used to authorize mortality. The ITP may authorize incidental take of small numbers of marine mammals for specific activities provided that the take will have a negligible impact on the species or stocks and no immitigable adverse impact (for subsistence uses). Typical types of activities include oil and gas exploration, seismic surveys, construction projects, and military exercises. Contact the ITP in the Permits and Conservation Division at 301-427-8401 for more information.

Whether directed or incidental, if NMFS proposes to authorize take of any ESA listed species, NMFS must engage in consultation under Section 7 of the ESA. More information on directed and incidental take permits is found at the NMFS Office of Protected Resources web site (http://www.nmfs.noaa.gov/pr/permits/).

If performing NRDA work under an existing permit, it is important for the NRDA case lead and attorney to understand the terms and conditions of the permit with respect to sample ownership or disposition, data sharing, publication, and confidentiality.

It is also important to remind response teams and NRDA technical working groups of the need to avoid take of marine mammals and endangered species and provide NMFS points of contact for consultation or permitting.

Appendix C. Data Availability, Publication and Cooperative Assessment

Under OPA regulations, the trustees are required to invite the responsible party to participate in a "cooperative assessment". What this means can vary from case to case, but at minimum, from a practical perspective, it means the responsible party has access to any data for which the RP funds collection. It may also mean that the responsible party reviews workplans and participates in field work, depending on the agreements worked out for the individual case. In return, the responsible party either forward-funds the assessment or agrees to reimburse NOAA on some regular basis based on cost documentation. The cooperative assessment process can save the responsible party money and fund the trustee's NRDA work more quickly than if NOAA relies on the Coast Guard National Pollution Funds Center.

In general, data that are collected or paid for by the NRDA for a case belong to the trustees. In most cases, data are shared with co-trustees[31] and, in the case of a cooperative assessment, with the responsible party. However, case data are often NOT available for other purposes, or to be shared outside the case without the consent of case leads and attorneys.

Data (including field sheets, notes, photos, GPS coordinates, samples, sample results) must be provided in raw form to the data management team for archiving. Please see Appendix F for more information on this.

NOAA does encourage publication of NRDA results, but it may take time for additional review. Researchers working on the NRDA should be aware of this up front and work with the NOAA case lead and attorneys to resolve issues and conflicts as early as possible.

In the case where a NOAA office or program has standing agreements or contracts to collect environmental data (for example, monitoring data or stranding data) that may be of use for the NRDA, data management and sharing issues should be raised as soon as possible so program managers, case leads, and attorneys can resolve those issues as soon as possible.

[31] There may be exceptions in instances where a co-trustee is unable to protect from disclosure litigation-sensitive data.

Appendix D. Funding

1. Oil Spill Federal (Coast Guard or EPA) Response:

ERD leads the overall NOAA response activities for oil spills. For the response, the USCG has established a Pollution Removal Funding Authorization (PRFA) with NOAA that authorizes and provides reimbursement for specific scientific support services. No work will be reimbursed pursuant to the PRFA without the approval of the NOAA SSC in advance. EPA-led oil spills are not common for NOAA involvement, but the process should be similar.

For response, the categories of activities addressed by the PRFA include: (a) providing information and analysis pertaining to environmental chemistry, oil slick tracking, pollutant transport modeling, resources at risk, environmental tradeoffs of countermeasures and cleanup, and information management; (b)leading the scientific support team; (c) coordinating on-scene scientific activity; and (d)integrating expertise from a variety of sources including other government agencies, universities, community representatives and industry. The ultimate authority for whether an activity is covered by the PRFA rests with the USCG Federal On-Scene Coordinator (FOSC).

For pre-approval of a proposed activity, the ORR will need a:

- Statement of work for the type of services you or your staff will perform
- A cost estimate for the funds you are requesting to include
- Hourly rate of personnel to be covered
- Estimated # of hours/days this person will be supporting the incident
- Travel estimates (per diem, airfare, car rental, etc.)
- An estimate for supplies/equipment and usage rates for aircraft/vessels

The incident's NOAA SSC should be consulted to determine where required documents should be submitted.

The SSCs are acting as ORR gatekeepers for accessing funding for travel, purchases, leasing and so forth. You must contact them before you undertake any work or the costs may not be reimbursable. Once approved, ORR will transfer funding authority via direct cite or BOP. If a BOP transfer is used, the receiving office must immediately prepare a spend plan and monitor its obligations against the plan.

2. NRDA

ORR ARD manages the overall activities for OPA cases, including assessment and field planning and budget preparation and approval for all assessment work. For oil spills, the assessment is preferably conducted cooperatively with the responsible party ("cooperative assessment") where the responsible party agrees to fund up front or reimburse all costs. Alternatively, if there is no cooperative or viable responsible party, NRDA may be funded through the Coast Guard National Pollution Funds Center, through a fairly simple (for preassessment work) to lengthy (for full assessment work) process (https://www.uscg.mil/npfc/nrd/).

Similar to the ERD PRFA, NRDA work may not be funded without prior approval by the NOAA NRDA case lead and ORR Business Services. Work that cannot be performed with existing agency and contract personnel will be performed through a task order to one of our support contractors.

To obtain funding for NRDA studies led by NOAA scientists, the NOAA PI needs to prepare a workplan (including labor, travel, supplies, contract, and equipment costs) for review by co-trustees and RP (for cooperative assessments) and approval by the case lead and ORR BSG prior to funding. If an RP is not cooperating on the workplan, NOAA ARD will likely seek funding through the NPFC.

Once approved, the NOAA PI will need to submit a spend plan to the ARD case lead or designee. OR&R will transfer funding authority via direct cite or BOP. All activities must have appropriate cost documentation in order to be fully reimbursed and may be subject to audit. Contact OR&R Business Services Division for further details on Cost Documentation needs for work plans.

3. Enforcement Actions under ESA, MMPA or NMSA

Investigations and other work for these cases is not covered by NRDA or the Response, and as such is paid by separate funds.

4. NMSA

For oil spills, the NMSA works through ERD and ARD for funding for their response and NRDA work respectively.

Appendix E. General Description of Marine Mammal Stranding Networks

Marine mammal stranding networks have been recovering, rehabilitating, and releasing marine mammals for several decades. The Marine Mammal Health and Stranding Response Program was formalized by the 1992 Amendments to the Marine Mammal Protection Act, and NOAA's National Marine Fisheries Service (NMFS) was designated as the lead agency to coordinate related activities. The program has the following components: 1) stranding networks, 2) response and investigation of mortality events, 3) biomonitoring, 4) tissue/serum banking, and 5) analytical quality assurance.

To respond to marine mammal strandings, volunteer stranding networks were established in all coastal states and are authorized through Letters of Authority from the NMFS regional offices[32]. Through a National Coordinator and Regional Coordinators, NMFS oversees, coordinates, and authorizes these activities and provides training to personnel.

There are currently 32 facilities that can rehabilitate stranded marine mammals under NMFS jurisdiction. In all, there are over 120 organizations or stranding network participants authorized by NMFS to respond to marine mammal strandings. There are many organizations/stranding network participants who are strictly first responders on the beach (i.e., they rescue the animal, but don't have adequate facilities to rehabilitate marine mammals).

Some network participants respond only to dead marine mammal strandings. Responders to dead strandings make up the vast majority of responders and may include Federal, state, and local governmental entities, non-profit organizations, academic institutions, museums, scientists, and managers, among others.

NMFS oversees marine mammal stranding response through Regional Stranding Coordinators in all 6 of NMFS' regions (see Appendix J for a list of NMFS Regional Contacts).

A list of stranding network participants can be found at: https://www.fisheries.noaa.gov/report

In many stranding cases, the cause of stranding is unknown, but some identified causes include:

- Disease
- Parasite infestation
- Harmful algal blooms
- Injuries due to ship strikes
- Fishery entanglements
- Pollution exposure
- Trauma
- Starvation
- Abandonment or premature separation from its mother

In addition, strandings often occur after unusual weather or oceanographic events.

[32] While some of these volunteer stranding networks may also respond to stranded sea turtles, there is a different program within NMFS OPR, the Sea Turtle Stranding and Salvage Network (https://www.sefsc.noaa.gov/species/turtles/strandings.htm),that coordinates stranding response to sea turtles.

In the past few years, increased effort in examining carcasses and live stranded animals has improved our knowledge of mortality rates and causes, allowing us to better understand population threats and pressures.

A significant amount of information can be gathered from a stranded marine mammal that has recently died. For example, a complete pathologic investigation can provide information on diseases and parasites, reproductive biology data, life history (what the animal eats, how long they live, how many calves they have, how old they are when they first reproduce), pollution, and normal biology and physiology parameters.

Through necropsies, we have learned a significant amount about the basic physiology and biology of animals that are not accessible in the wild or through any other means. These types of sampling opportunities also help validate and increase understanding and interpretation of data collected from wild populations. Necropsies have also provided data on the incidence of human interactions including ship strikes, entanglements, hooks, and marine debris ingestions. These data help us to make better management decisions about these stocks of marine mammals.

In the event of an oil spill, information from necropsies (past and during a spill) can be important to the natural resource damage assessment by helping identify and evaluate alternative hypotheses (to oil) for causes of injury, as well as provide direct indication of exposure (e.g., samples of oil in lungs or in gut, esophagus) or injury (e.g., lung or liver lesions). Be sure to check with GCNR for any preservation obligations or other requirements that may apply to samples collected for a NRDA.

More information can be found at: http://www.nmfs.noaa.gov/pr/health/MMHSRP.html

Appendix F. Data Management

To meet current standards of data integrity, public access, and metadata and to meet the needs for potential litigation, ARD keeps unaltered original raw data, data sheets, and laboratory data deliverables for all NRDA cases. ARD's Spatial Data Branch (SDB) has extensive experience in the protocols and tools used to meet federal data requirements and to preserve appropriately documented data. Early in an incident, the NRDA Data Management Lead, typically from the OR&R's Spatial Data Branch, should meet with case leads, principal investigators, and work group leads to discuss these protocols, data needs for the case, and expectations for data handling and management. Some of the key tools used by the Data Management Lead for a NRDA case are discussed below.

1. **NRDA Data Sharing Plan**– A data sharing plan (examples available through ARD) may be developed cooperatively and signed by the Trustees and RP to ensure that all cooperatively collected data are shared appropriately during the incident and afterward. This includes not only RP data, but data collected by NOAA line offices, states, and other federal agencies so that all staff working on the NRDA have the required data readily available. The plan, developed in consultation with GCNR, includes details such as the names of the data providers, delivery schedule, file type, archive repository, common operational pictures, access restraints, etc. A NRDA plan for an incident will be developed in conjunction with the response Data Sharing Plan so that cooperatively collected response datasets are represented in the NRDA Plan. This ensures that the response agrees to the needs of NRDA data access and integrity. It is important to note that both the response and NRDA plans meet federal data management requirements so the tenets of these plans are not to be altered.
2. DIVER forms and templates[33] – ARD's Field Assessment and Support Techniques team has established protocols, field forms, and templates for field data collection such as photos, GPS, sampling, chain of custody, electronic data delivery, data intake, data archiving, etc.
3. DIVER[34] – ARD uses the DIVER portal for all the management, querying, and archiving of NRDA data such as contaminant chemistry, field observations, and biological data. DIVER also provides a means for data managers to track the process of QA/QC-ing and validating the data. At an incident, ERD will also use DIVER for immediately archiving data such as sampling, field observations, and SCAT. If outside agencies or the RP have their own database, DIVER is designed to be interoperable and can import their data for querying once a common data model has been established. Access to DIVER requires an approved account and permissions are granted based on the users' roles to protect the confidentiality of some datasets. For instance, a Trustee and RP could have access to the same incident workspace in DIVER, but to different data, such as data collected that the RP wants to support, or data that were collected with other funds.
4. ERMA[35] – ARD uses the Environmental Response Management Application (ERMA) as the data visualization and common operational picture for the NRDA. ERD, NOAA's

[33] https://www.diver.orr.noaa.gov/field-forms-and-templates
[34] https://portal.diver.orr.noaa.gov/group/national/home
[35] https://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma

Office of Homeland Security, and USCG may also use ERMA for visualizing response data and making operational decisions. There are 8 regional ERMAs across the country and each contains the same base datasets that are important early in an incident, such as Environmental Sensitivity Atlases, Critical Habitat, Weather and Ocean Observations, Environmental Chemistry, and Satellite Imagery. As spatial data are created during an incident they can easily be brought into ERMA by NOAA staff. Data from DIVER can also be brought into ERMA.

5. Photologger – One of the established data management methods that OR&R has practiced for almost 10 years is appropriate management of photos and their associated metadata. The FAST website outlines protocols such as taking appropriately documented photos, ensuring that the photos are able to be georeferenced, logging critical metadata and keeping a chain of custody, and managing the photos in the data archive once they have been released by the photographer. GCNR recently reviewed these protocols for compliance with requirements.

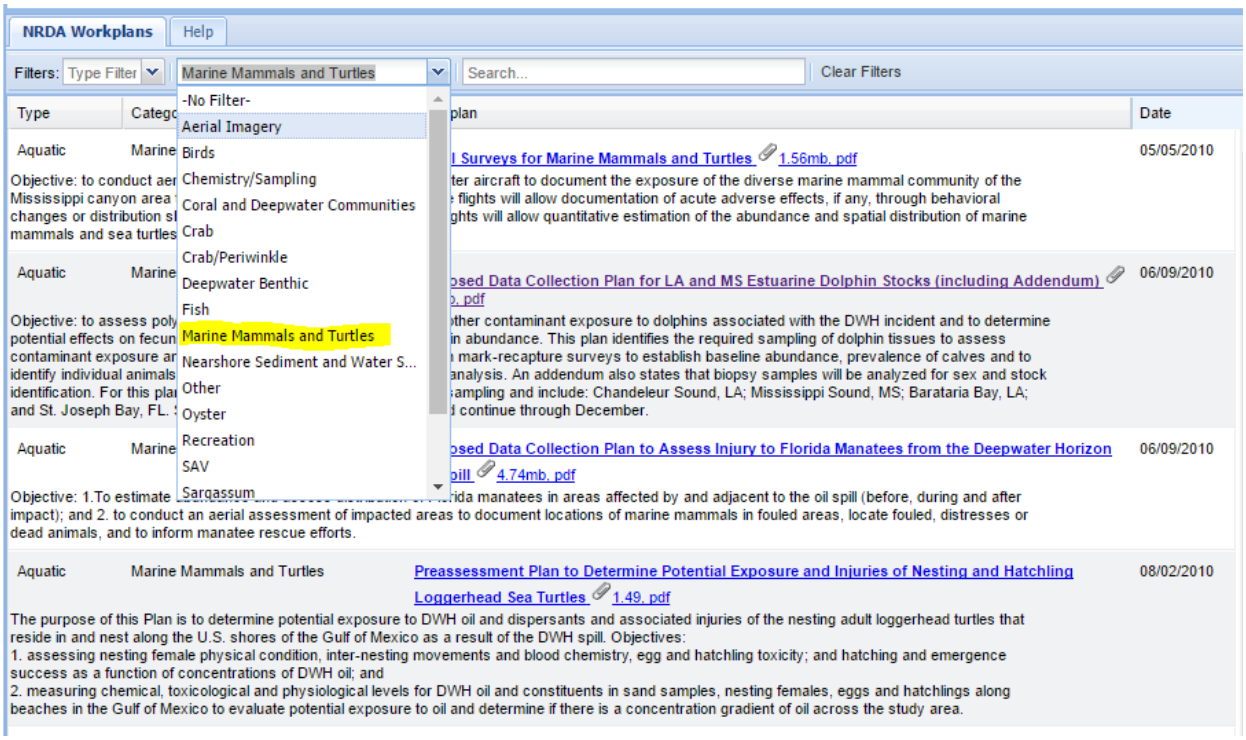
NRDA data management requirements (related to potential litigation) may require coordinating practices for data collected pursuant to other NOAA programs (e.g., NMFS or ONMS). Data managers, case leads and attorneys should meet as soon as possible in an oil spill case to ensure all NOAA obligations are met.

Appendix G. Workplan Template Examples

When conducting NRDA studies on exposure and injury assessment and quantification, it is appropriate to document the planned study in a workplan that documents, among other things, the intent of the study and how the findings might be used for injury assessment, study approach and design, sampling methods, laboratory analyses, how the data will be managed, QA/QC, safety considerations, and costs.

There is no one-size-fits-all workplan. Plan formats and contents may vary depending on the size and type of study, or if it is being done cooperatively with the responsible party or as part of an NPFC claim, etc.

Several workplans for marine mammals were developed for the *Deepwater Horizon* NRDA which can be considered as examples, although each NRDA case may develop its own template or workplan requirement. To access the *Deepwater Horizon* template, go to: http://www.gulfspillrestoration.noaa.gov/workplans and filter for Marine Mammals as shown:



Appendix H. Conceptual Models

Guidance for developing Conceptual Models for oil spills

By Rob Ricker, NOAA

The guidance in this document is intended to assist construction of conceptual models for use in damage assessment activities. Fieldwork and damage assessment activities should begin with a conceptual model, which can be brief and clearly lay out the mental model of what is believed to have happened or expected to happen as a result of the oil spill. Depending upon scale, an overall model can be developed and presented to give a big picture view, with supporting sub-models providing greater detail about events and hypothesized interactions and results following the spill. The models should address one or more of the five (5) main steps of the natural resource damage assessment (NRDA) process [i.e., (1) documentation of release; (2) demonstrating pathway of the contaminants to the resource; (3) documenting exposure of resources to the contaminants; (4) quantifying injury caused by the exposures; and (5) identifying and scaling relevant restoration options). Studies proposed in the work plan should focus on testing the working hypotheses that follow from the conceptual model. Our ultimate goal is to gather sufficient information to evaluate various potential hypotheses, rule out less viable hypotheses, and identify one that is more credible based on its greater compliance with the data that we collect. This process of hypothesis testing and refining our conceptual model is only as good as the questions we ask and the types of studies that we implement.

Damage assessments, as with most activities, have finite resources that constrain us and can help us focus on key issues and ask better questions. Simply collecting more data on a spill can consume these resources at an incredible rate. We are better served by starting with a well-defined conceptual model of what we think happened or might happen, asking good questions, thinking about the types of data that we could collect to answer these questions, and ruling out studies that are likely to produce equivocal data that won't help us answer questions and eliminate competing hypotheses.

The following text provides: (1) a phased approach for undertaking assessment activities; (2) guidance on the overall time frame for studies; (3) an example of a conceptual model; (4) background information about the general steps in a NRDA; and (5) some examples of types of study activities proposed or already underway for this incident.

PHASED APPROACH: Activities proposed as part of the assessment studies should pertain to one or more of the five NRDA steps and be undertaken in phases dependent upon information gathered from preceding phases. In most instances, we try to show release, pathway, and exposure before we undertake the more time consuming, costly, and quantitative injury studies. In some situations, we may have a preponderance of evidence demonstrating pathways of contaminant movement into surrounding environments and habitats that support credible exposure scenarios in areas not yet studied – such that it makes sense to undertake exposure and injury assessment activities simultaneously to expedite work, efficiently utilize personnel and equipment, and save time and money. In all instances, we want assessment personnel to plan and implement their proposed activities understanding the burdens of proof needed for each of these steps. For example, documenting injury to a resource without the ability to clearly demonstrate a

pathway and exposure to the oil is likely to fail when trying to draw a causal linkage to the oil spill. Similarly, documenting an injury caused by oil is not enough to say that the injury was caused by the specific incident without getting additional data to demonstrate temporal and spatial consistency with the spill or a chemical fingerprint that matches the source oil from the incident.

Collection of information about pre-spill conditions can begin at any time. Although this information is rarely considered ephemeral and may be viewed as less urgent to collect, it is valuable to assemble these facts as soon as possible to understand potentially confounding issues such as pre-existing contaminant concentrations, natural rates of mortality, and other factors that might support alternate hypotheses.

TIME FRAME FOR STUDIES: There is no absolute science-driven deadline at the outset for concluding assessment activities. However, a damage assessment, which is based on the potential need to litigate, may have deadlines dictated by legal schedules or potential opportunities to resolve claims and reach settlement. As such, durations for proposed studies should be considered in light of the various case deadlines and needs to provide analyzed and interpreted data at intermediate points throughout the assessment. Oil spill cases can vary greatly in magnitude and complexity, with some assessments completed and settled in principle within a year of the spill and other more complex cases extending for years. Based on personal experiences, it is reasonable to consider a timeframe of 2-3 years for proposed studies that would allow completion of work and preliminary or final interpretation of assessment study results. Results from studies that extend beyond this time frame may not be used if the resolution of the case is expedited. Consequently, we should consider what information will be available within a 2-3 year period to support and scale injury claims and restoration compensation, and what other consequences of oil exposure are unlikely to be confirmed within the 2-3 year period but may be credible if we had time for longer term assessments. This latter category is important to understand because there may be funds from other sources outside of the assessment to evaluate these potential longer term impacts. There may also be restoration options that could compensate for the longer term injuries even if we do not have adequate time to quantify and scale them prior to resolving the case.

CONCEPTUAL MODEL EXAMPLE FOR PELAGIC FISH: There can be multiple parts to a conceptual model. The first part pertains to the release and pathway. Another part of the model might pertain to the route of exposure. Another might pertain to the type of injuries expected from the oil exposure. Based on the type of injury and the resource impacted, a relevant restoration project could be designed to replace the resource or services from the impacted resource. The following example is similar to events in the Deepwater Horizon oils spill in the Gulf of Mexico.

- *Release and Pathway:* Oil was released from a broken well head at great depth, traveled vertically through nearly a mile of water column, changed form and composition from a gas-liquid mixture of petroleum products into a variety of forms – some dissolved in water, some as whole oil in liquid drops, some mixed with other constituents such as dispersants, methanol, and anti-foaming additives, and some enriched primarily as paraffins. In addition to this, some oil that made it to the surface picked up water, sediments, and other particulate material and became neutrally or slightly negative buoyant, sinking to various depths.

- *Route of Exposure*: Fish get exposed to contaminants by swimming through the water column and drinking water as part of feeding and respiration. Additionally, sensitive life stages of pelagic fish come in direct contact with oil slicks that cover the neuston layer where the fish spawn and embryos develop.
- *Injuries caused by oil exposure*: Juvenile and adult fish, while swimming through the oil-contaminated water, are exposed to dissolved and particulate oil. Both types of oil foul the gills, decrease respiratory function of the gills, and have a negative effect on the overall physiology of the fish that translates to a reduction in fitness and increased susceptibility to predation and mortality. The most significant impact to adult and juvenile fish is caused by physical fouling of the gill surface. Developing embryos, when exposed to oil, exhibit genetic, physiological, metabolic, and developmental problems that lead to reduced fitness and mortality. Cardiac edema, reduced heart rate and blood flow, and spinal deformations are likely impacts, contributing to an overall increase in mortality. Impacts to the eggs and developing embryos are a function of both physical fouling with oil and the toxicity of oil constituents.

Each of these conceptual models, for release, pathway, and injury, can be evaluated and tested by collecting specific types of information. Based on the study findings, the hypotheses can be refined or ruled out. For example, a flume study that exposes fish to strictly dissolved oil might reveal one type of symptom or injury, and a flume study conducted with particulate oil might yield a completely different result, possibly showing no effect. To extrapolate from either study and assert that similar injuries are occurring in the field, we would try to document (1) the presence of the particular type of oil (dissolved vs. particulate) in the field; (2) show the presence of the species coincident spatially with the oil; (3) provide evidence of comparable duration of exposure; and (4) ideally show field caught fish with either the oiling or the injuries. Each study that is proposed should target a testable part of the hypothesis.

GENERAL BACKGROUND INFORMATION FOR NRDA PROCESS:

Procedure	Steps*
Document release of spilled contaminants and exposure of natural resources.	Collect information, photographs, and samples to document contaminant release and pathways of contaminant movement in the environment. Document presence and location of natural resources in the vicinity of spill pathways. Collect samples of natural resources potentially exposed to assess contaminant levels in or on natural resources. Produce summary reports to document contaminant pathways and exposure of biota and habitats. Collect samples of oil in relevant environmental media to fingerprint to source and/or document weathering and associated changes in toxicological parameters as appropriate.
Document injuries to natural resources and losses in services provided by the resources.	Compile records of exposed, impacted, and dead organisms in spill exposure zones. Compile records of closures and other losses of human uses of publicly held natural resources. Compile records of past releases, impacts, and baseline conditions that might address things like seasonal die back of vegetation, stranding rates, migration and spawning patterns, long term trends in species abundance. Review literature and/or conduct toxicity tests to evaluate and determine injury thresholds.
Conduct or evaluate ecological risk assessments.	Document risks and actual impacts to natural resources and public uses of resources.
Assess damages for spill related injuries and losses.	Use various economic methods (e.g., survey techniques, habitat equivalency analysis, replacement costs) to assess appropriate levels of compensation for losses to publicly held resources. Identify restoration options and determine associated project costs.
Identify, evaluate, plan, and implement remediation and restoration alternatives for fish, wildlife, and habitats.	Participate in Trustee Councils or other groups to identify, evaluate, and select remediation and restoration options. Participate in public workshops to solicit and evaluate restoration options. Design, conduct, oversee, or manage projects for restoration of impacted natural resources. Work with legal counsel to secure protection (e.g., through easements, acquisition, or other means) of natural resources proposed for restoration.

* The listed steps are intended to be illustrative. For individual injuries, the specifics of the type and quantity of evidence needed for each part of the process will be made in consultation with case attorneys.

EXAMPLES OF ACTIVITIES PROPOSED FOR A SPILL INCIDENT:

Think about how you would categorize a particular study activity for addressing one or more of the five main steps in the NRDA, and then think about how the study results might be variously interpreted.

Consider whether a tool or indicator proposed for a particular use, such as documenting exposure or injury, is specific in its response to the contaminant of interest. For example, the term "biomarker" represents a broad category of indicators that may reflect chemical, physiological, metabolic, genetic, tissue, and other endpoints that are often considered diagnostic for a certain exposure. Many, but not all, "biomarkers" can be induced by multiple agents. We need to understand how specific the induction process is before we can assert causal linkages – especially if there are potentially multiple inducers at play in the environment where we are conducting our assessment. With mortality counts, how much do we know about baseline conditions of mortality or wildlife stranding? How are we going to separate increased mortality findings for this spill from increased search effort over past years? Think about the designs of your studies to rule out competing interpretations of the results. Consider also the intent of the study. Is it to simply document a change, or is it to document an injury that you can describe and define its significance? Be prepared for the "so what" question and focus on injuries that you consider to be biologically and functionally important.

ACTIVITY	**STEPS IN NRDA PROCESS** (release, pathway, exposure, injury, restoration)
• Collection of sediment & water samples • Collection of tissues • Deployment of "oil mop" sentinels • Deployment of SPMDs • Measurements of stem densities, degree of oiling, vegetation chlorosis • Mortality counts • Petroleum burdens in tissues • Presence, absence and abundance of organisms • Tagging and tracking animals • Tissue biomarkers • Toxicity Tests • Wipes of animal and plant surfaces •	

Appendix I. List of NRDA Contacts-- NOAA ARD

This list is current, as of November 2018. Current contacts can be found at:
https://response.restoration.noaa.gov/about/orr-field-staff.html

West Coast/Pacific	Alaska	Sarah Allan Sarah.Allan@noaa.gov Office: 907-271-5146; Cell: 907-202-1859
	Washington, Oregon Idaho	Marla Steinhoff Marla.Stienhoff@noaa.gov Office: 206-526-6341; Cell: 206-295-1594
	California, Hawaii, Pacific Islands	Laurie Sullivan Laurie.Sullivan@noaa.gov Office: 707-570-1762; Cell: 707-320-7232
	Backup, entire region	Rebecca Hoff Rebecca.Hoff@noaa.gov Office: 206-526-6276; Cell: 206-719-7445
Southeast/Gulf	North Carolina, South Carolina, Georgia, Texas	Liza Hernandez Liza.Hernandez@noaa.gov Office: 727-824-5382; Cell: 727-430-5336
	Florida, Alabama, Mississippi, Louisiana, Puerto Rico, Caribbean	Dan Hahn Daniel.Hahn@noaa.gov Office: 727-551-5715; Cell: 727-421-0724
Northeast/Atlantic	Maine, New Hampshire, Rhode Island Massachusetts, Connecticut, New York (no Staten Island); Great Lakes states (Wisconsin Minnesota, Michigan, Ohio, Indiana, Illinois, New York, Pennsylvania)	Ken Finkelstein Ken.Finkelstein@noaa.gov
	Staten Island, New Jersey, Pennsylvania, (no Great Lakes), Delaware, Maryland, District of Columbia, Virginia	Simeon Hahn Simeon.Hahn@noaa.gov Office: 215-814-5419; Cell: 206-617-543
	Back-up, entire region	Greg Baker Greg.Baker@noaa.gov Office: 650-329-5190; Cell: 206-409-0248

Appendix J. List of NMFS Marine Mammal Contacts for Marine Mammal Health and Stranding Response Program

(Updated July 2016) Up-to-date contact information can be found at:
https://www.fisheries.noaa.gov/report#alaska-alaska-partners

National Program

Dr. Teri Rowles (Teri.Rowles@noaa.gov)
Coordinator, Marine Mammal Health and Stranding Program (MMHSRP)

Sarah Wilkin (Sarah.Wilkin@noaa.gov)
National Stranding and Emergency Response Coordinator

Dr. Deborah Fauquier (Deborah.Fauquier@noaa.gov)
Veterinary Medical Officer

National Marine Fisheries Service
Office of Protected Resources
1315 East-West Highway
Silver Spring, MD 20910
Phone: 301-427-8402
Fax 301-713-4060 or 301-713-0376

Alaska (AK)

Barb Mahoney (Barbara.Mahoney@noaa.gov), Acting Stranding Coordinator
Phone: (907) 271-3448

National Marine Fisheries Service
222 West 7th Avenue, Box 43
Anchorage, AK 99513

Greater Atlantic (ME, NH, MA, RI, CT, NY, NJ, PA, DE, MD, VA)

Mendy Garron (Mendy.Garron@noaa.gov), Stranding Coordinator

National Marine Fisheries Service
55 Great Republic Drive
Gloucester, MA 01930
Phone: (978) 282-8478

Stranding and Entanglement Hotline: (866) 755-NOAA (866-755-6622)
Southeast (NC, SC, GA, FL, AL, MS, LA, TX, PR, VI)

Blair Mase-Guthrie (Blair.Mase@noaa.gov), Stranding Coordinator

National Marine Fisheries Service
75 Virginia Beach Drive
Miami, FL 33149
Phone: (305) 361-4586

Erin Fougeres (Erin.Fougeres@noaa.gov), Stranding Program Administrator

National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, FL 33701
Phone: (727) 824-5312

West Coast (WA, OR, CA)

Kristin Wilkinson (Kristin.Wilkinson@noaa.gov), Stranding Coordinator (WA/OR)

National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115
Phone: (206) 526-4747

Justin Viezbicke (Justin.Viezbicke@noaa.gov), Stranding Coordinator (CA)
Phone: (562) 980-3230

Justin Greenman (Justin.Greenman@noaa.gov), Assistant Stranding Coordinator (CA)
Phone: (562) 980-3264

National Marine Fisheries Service
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802
Phone: (562) 980-3230
Large Whale Entanglement Hotline: 1-877-SOS-WHALE (1-877-767-9425)

Pacific Islands (HI, Guam, American Samoa, Commonwealth of the Northern Mariana Islands)

David Schofield (David.Schofield@noaa.gov), Stranding Coordinator
Phone: (808) 725-5161

Aliza Milette-Winfree (Aliza.milette@noaa.gov), Assistant Stranding Coordinator
Phone: (808) 725-5157

1845 Wasp Blvd., Building 176 Honolulu, HI 96818

Appendix K. Safety

During Response:
During the response phase of an oil spill, any NOAA staff or contractors in the field or at Incident Command need to have their OSHA Hazwoper training. Each incident has different requirements, but the 24-hour training is a common level of training for working in the field. In some incidents, they require one person on the team have the 40-hour training. To keep the certification current, all employees have to have an annual 8-hour refresher (which can be done at low cost online). If you do not carry proof of Hazwoper certification you may be denied entry to the field.

In addition, during the response, the overall safety in the incident zone (as determined by the Incident Safety officer) is under the Incident Command, including scientists and staff working on the NRDA or other cases. The Incident Safety officer can shut any operation or study down by any agency due to safety concerns.

During the response phase, the SSC is overall responsible for all NOAA staff and contractors, whether working on the response or not.

In addition, the NRDA will also have a safety plan that all NRDA participants will need to sign and comply with. Additional safety measures and plans will be added as the scope of the assessment unfolds.

In addition, NOAA staff need to comply with their line office safety plans and other overall NOAA safety directives (such as boating safety, diving, driving, etc.).

After Incident Command stands down

For each case, the NRDA case team will prepare a safety plan for all to follow (consistent with agencies' standing safety requirements) which should be circulated early in the case and posted in DIVER or other case-specific electronic repository.

In some cases, each work plan will need its own safety plan, but that requirement varies widely from case to case.

Appendix L. Marine Mammal Assessment Workshop Participants, August 2015

Seattle, Washington

Organizers: Maggie Broadwater, NCCOS; Tom Brosnan, OR&R; Stephen Manley, NMFS; Teri Rowles, NMFS; Lori Schwacke, NCCOS; Laurie Sullivan, OR&R

First	Last	Organization	Location	Email
Sarah	Allan	NOAA ARD	Anchorage, AK	Sarah.Allan@noaa.gov
Michelle	Barbieri	NOAA Fisheries/TMMC	Honolulu,HI	michelle.barbieri@noaa.gov
Lynne	Barre	NOAA Fisheries	Seattle, WA	lynne.barre@noaa.gov
Maggie	Broadwater	NCCOS	Charleston, SC	maggie.broadwater@noaa.gov
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