

Office of Response and Restoration

NOAA's Office of Response and Restoration (OR&R) is a center of expertise in preparing for, evaluating, and responding to threats to coastal environments, including oil and chemical spills, releases from hazardous waste sites, and marine debris. OR&R's mission is to develop scientific solutions to keep the coasts clean from threats of oil, chemicals, and marine debris. To fulfill its mission of protecting and restoring NOAA trust resources, OR&R provides scientific and technical support to prepare for and respond to oil and chemical releases; determines

damage to natural resources from these releases; protects and restores marine and coastal ecosystems, including coral reefs; and works with communities to address critical local and regional coastal challenges. OR&R comprises four divisions: Emergency Response, Assessment and Restoration, Marine Debris, and the Disaster Preparedness Program. Collectively, OR&R provides comprehensive solutions to marine pollution. Below are eight highlighted scientific projects by OR&R researchers and their partners.

Using Uncrewed Platforms to Characterize Oil in the Water

The ability to rapidly characterize oil dispersed in the water column and floating on the water surface during and after an oil spill is a primary need of oil spill response teams, and is an important objective of natural resource damage assessments (NRDAs). OR&R worked with multiple partners to develop and test a novel autonomous underwater vehicle (AUV) platform and multispectral uncrewed aircraft systems (UAS) for characterizing oil in the water after oil spills. Rapid characterization of oil in the water column and floating on the water surface during and after oil spills is critical information for both oil spill response and natural resource damage assessments. Testing from a U.S. Coast Guard (USCG) vessel at the Coal Point oil seep site near Santa Barbara, CA, demonstrated how these systems have advanced the ability to respond to and assess impacts from oil spills. The AUV REMUS 600 and sensor/sampling systems conducted three-dimensional mapping of dissolved hydrocarbons and oil droplets in the water column beneath the oil slick while the UAS conducted surface mapping of the oil slick. These data can be provided to spill responders for situational awareness and rapid response decision-making. The project was conducted by a partnership that includes NOAA, Woods Hole Oceanographic Institute, the Bureau of Safety and Environmental Enforcement, the Environmental Protection Agency, the USCG, Water Mapping LLC, and the NOAA/University of New Hampshire Coastal Response Research Center (CRRC).



Recovery of the AUV REMUS 600. Image credit: Dipinto 2019. NOAA ORR.

FY20 Accomplishment(s): Results of this project are publicly available on the CRRC website and have been presented at multiple scientific venues.

Project Final Report: DiPinto 2019 Report to the Bureau of Safety and Environmental Enforcement: <https://unh.app.box.com/s/ctjc6ipuzrm4fs0iqnnd0z4gv26wrsga>

Fishing for Marine Debris

In the same way as bycatch and incidental species catch are modeled, OR&R's Marine Debris Program (MDP), the NOAA Pacific Islands Fisheries Science Center and Walsh Analytical Service estimated the relative abundance of marine debris "caught" by Hawaii-based pelagic longlines as reported by fisheries observers. Nine years of observer data from this fishery were analyzed and modeled. The snagged debris was dominated by derelict fishing gear (~90%) from other fisheries operating in the North Pacific Ocean. Modeling revealed that the relative abundance of derelict fishing gear "caught" by the Hawaii longlines has declined by two thirds (~66%) in less than a decade (2008-2016).



Fishery observers from the Hawaii-based pelagic longline fishery haul in marine debris that has been snagged. Image credit: NOAA.

FY20 Accomplishment(s): Results of this project were published in the online open access journal, *Scientific Reports*.

Peer reviewed journal article URL: Uhrin et al. 2020 *Scientific Reports*
<https://www.nature.com/articles/s41598-020-64771-1>

Nature Sustainability Community invited blog article:
<https://sustainabilitycommunity.springernature.com/posts/fishing-for-marine-debris>

Examining Observer Bias in Marine Debris Data Collected by Citizen Scientists

OR&R's Marine Debris Program (MDP) collaborated with the University of Washington's Coastal Observation and Seabird Survey Team (COASST) to evaluate and identify ways to correct for observer bias in shoreline monitoring protocols developed as part of MDP's Marine Debris Monitoring and Assessment Project (MDMAP). MDMAP is a citizen science initiative that engages both domestic and international volunteers in conducting standardized shoreline surveys for marine debris



MDP and COASST staff together with volunteers conduct a shoreline monitoring field trial. Image credit: COASST.

items larger than 2.5 cm. These monitoring surveys help us answer fundamental questions about the types and distribution of debris on shorelines, such as where debris originates, what beaches accumulate the most debris, how debris patterns change over time, and if preventative measures lead to debris reductions. A series of field trials were conducted on a handful of beaches across Washington State. Findings show there are ways to improve the MDMAP protocols and the quality of data being collected by observers which will strengthen debris density estimates generated from MDMAP data. Protocol improvements include, streamlining walking patterns to search for marine debris, limiting the number of people actively searching for debris during a transect, adding an option to remove debris during all surveys, and providing more detailed information on the debris within the back barrier of the beach.

FY20 Accomplishment(s): Results of this project are publicly available in the Marine Debris Clearinghouse; the project team is drafting a publication to be submitted to the journal, *Citizen Science Theory & Practice*; MDP is currently updating MDMAP protocols based on these findings

Project Final Report: Burgess et al. 2020, Report for the NOAA Marine Debris Program: <https://clearinghouse.marinedebris.noaa.gov/project?mode=View&projectId=838>

Using Invasive Mussels as Sentinel Organisms for Monitoring Microplastic Pollution in the Great Lakes: A Case Study

OR&R's Marine Debris Program (MDP) collaborated with the National Centers for Coastal and Ocean Science (NCCOS) Great Lakes Mussel Watch Program, and Loyola University Chicago to understand the distribution and abundance of microplastics across the Milwaukee Estuary, WI. This project took advantage of the Great Lakes Mussel Watch Program (GLMWP) by sampling additional mussels to assess whether those same invasive freshwater mussels may be good candidates as biomonitors for microplastic occurrence. Mussels were collected from relatively clean reference sites in Lake Michigan and deployed for 1 and 2 months in experimental cages near the outfall of a WWTP and at the confluence of two rivers that drain the Milwaukee metro area and empty into Milwaukee Bay. The amount of microplastic found in mussel tissue was very different among different sizes of mussels and very different between sampling months. There was partial evidence for greater microplastic ingestion near a wastewater outfall, but only for larger mussels. There was no clear relationship between presence of microplastics and legacy contaminants in mussels.



NCCOS staff deploy a mussel cage at one of the study sites in the Milwaukee Estuary, WI. Image credit: NOAA

FY20 Accomplishment(s): Results of this project are publicly available in the Marine Debris Clearinghouse and have been presented at a number of scientific conferences; the project team is drafting a publication to be submitted to the journal, *Frontiers in Marine Science*

Project Final Report: Hoellein & Rovegno 2020, Final Report for the NOAA Marine Debris and NOAA Mussel Watch Programs:

<https://clearinghouse.marinedebris.noaa.gov/project?mode=View&projectId=839>

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

OR&R's Assessment and Restoration Division (ARD) partnered with NOAA Fisheries Office of Protected Resources and external partners to publish a NOAA Technical Memo on Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals. These guidelines were developed from a workshop that was held to discuss, develop, and document methods and processes to evaluate the nature and



Mother sea lion and pup. Image credit: NOAA.

extent of potential injuries to marine mammals from oil spills. The technical memo and its guidelines provide a review of considerations for marine mammals under NOAA's jurisdiction, incorporating knowledge gained from previous oil spills, especially the 2010 Deepwater Horizon spill. The report describes NOAA's response and assessment activities for marine mammals due to oil spills, descriptions of oil exposure and potential injury, and summaries of methods and approaches currently available for marine mammal assessment. This guidance will help NOAA and co-trustees to implement effective studies for assessing exposure and impacts to marine mammals affected by spills.

FY20 Accomplishment(s): Results of this project were published as a NOAA Technical Memo.

Technical Memorandum: Sullivan et al. 2019 *NOAA Tech Memo* NMFS-OPR-62
<https://repository.library.noaa.gov/view/noaa/22425>

Oil Spill Assessment for Marine Mammals Story Map:
<https://storymaps.arcgis.com/stories/867559ca52cd43a6b347ca13f0c4bff9>

Publication to Support Natural Resource Damage Assessment



OR&R worked with NOAA Fisheries Office of Habitat Conservation (OHC), the Office of General Council for Natural Resources (GCNR), and external partners to publish a new, rigorous, and more legally defensible method for scaling habitat injury that supports NOAA’s most challenging damage assessment cases. The team introduced the new method, Habitat Based Resource Equivalency Method (HaBREM), that evaluates injury by relating the biomass of organisms that use specific habitats to the ecological functions of that habitat. By focusing on organism-based metrics HaBREM removes subjective aspects of traditional methods and increases both repeatability and defensibility.

FY20 Accomplishment(s): Results of this project were published in a peer reviewed article in the journal *Environmental Management*.

Peer reviewed journal article: Baker et al. 2020 *Environmental Management*
<https://doi.org/10.1007/s00267-019-01245-9>

Project URL:

<https://response.restoration.noaa.gov/new-publication-habitat-based-resource-equivalency-method-habrem>

Detection and Removal of Sunken Oil Mats (SOMs)

Available information on the processes that influence the formation of submerged and buried oil mats along sand beaches following an oil spill was reviewed and synthesized. This included a review of case histories, field-collected datasets (particularly the extensive field data and modeling studies of the submerged oil mats at the Deepwater Horizon spill), as well as recent publications on sand beach geomorphology and sediment dynamics and interactions with oil. Simplified response guidelines were then developed for: 1) when buried and submerged oil mats and deposits are (and are not) likely to form and persist; 2) the best survey methods to detect them; and 3) removal methods that are most effective and minimize environmental impact. This project was carried out by OR&R's Emergency Response Division in partnership with the Canada Department of Fisheries and Oceans.



OR&R responders gather oil samples as part of a Shoreline Cleanup and Assessment Technique (SCAT) operation along the west shore of the Mississippi River, following a 2008 vessel collision near New Orleans, La. Observations and data from SCAT surveys are critical to the decision-making process for shoreline cleanup at oil spills. Image Credit: ORR, NOAA.

FY20 Accomplishment(s): Results of this project were used to develop a Response Guide for Sunken Oil Mats (SOMs), which is available online.

Project URL:

<https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/shoreline-cleanup-and-assessment-technique-scat.html>

Assessing the Effectiveness of Repair and Stabilization Actions Conducted in Damaged Seagrass Beds



A survey being conducted by OR&R researchers in turtle grass (Thalassia testudinum) to evaluate repair and stabilization efforts in St. Croix.

Response activities in the aftermath of Hurricane Maria caused damage to seagrass beds in St Croix, U.S. Virgin Islands. Repair and stabilization activities were conducted to limit further damage due to scour, erosion, and/or sediment migration and to allow seagrass re-growth and recovery. Recent snorkel surveys of the affected areas by OR&R's Emergency Response Division revealed that repair and stabilization activities resulted in enhanced seagrass recovery and recolonization as measured by seagrass species composition (dominant, co-dominant, secondary), cover class, and canopy height, as well as the bottom elevation differential between the scarred areas and adjacent undamaged areas.

FY20 Accomplishment(s): Results of this project will inform future repair and stabilization activities in seagrass habitats.

Project URL:

<https://response.restoration.noaa.gov/hurricane-maria-sea-grass-bed-damage>