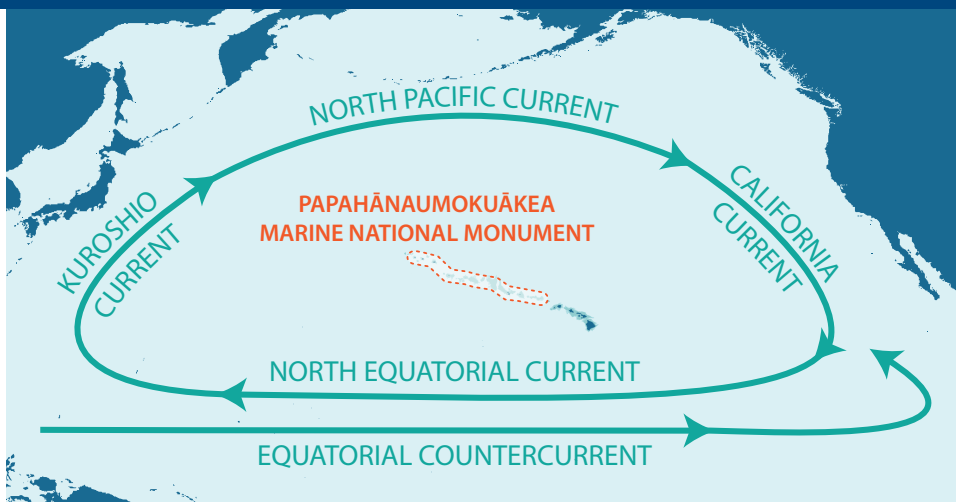


MARINE DEBRIS 2014

REMOVAL AND ASSESSMENT IN THE NORTHWESTERN HAWAIIAN ISLANDS



Marine debris and derelict fishing gear affect the entire Hawaiian Archipelago and all the people and wildlife living in it. Whether entangling marine animals (seals, turtles, whales, fish, and invertebrates), or destroying corals as giant derelict fishing nets roll across reefs, marine debris is a detriment to fragile coral reef ecosystems—some of the most biologically diverse and economically valuable ecosystems on earth (Bryant et. al., 1997).



North Pacific Gyre

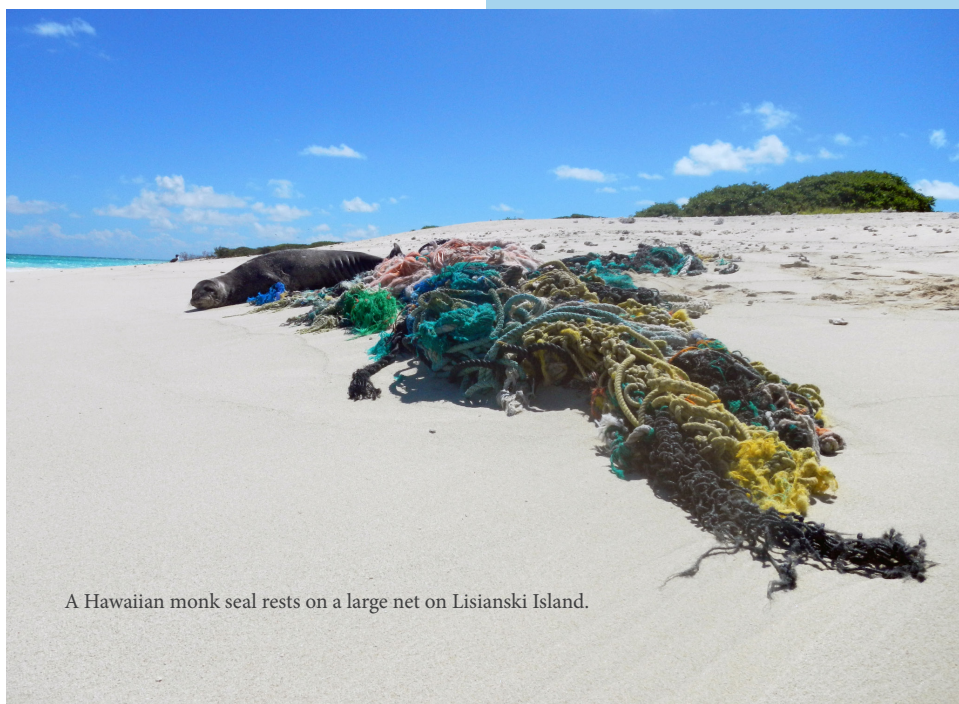
The islands and atolls of the Hawaiian Archipelago, stretching from 19°N to 28°N latitude (including the PMNM), are particularly prone to marine debris accumulation because of their central location within the North Pacific Gyre. The gyre is a clockwise circular pattern of the prevailing ocean currents between 8°N and 50°N latitude, covering approximately 34 million km² (10 million mi²), in which debris from around the North Pacific Rim gathers and circulates. The NWHI reefs and islands, in particular, amass marine debris that presents potentially lethal entanglement hazards and ingestion threats to numerous marine and bird species (Donahue et al., 2001). Other potential effects of marine debris include habitat degradation in coral reef ecosystems, introduction of non-native species, and hazards to boat navigation.

PAPAHĀNAUMOKUĀKEA MARINE NATIONAL MONUMENT

Stretching for 1900 km (1200 mi) northwest of the eight main Hawaiian Islands is a chain of mostly uninhabited islands and atolls collectively known as the Northwestern Hawaiian Islands (NWHI). These islands and the unique area surrounding them encompass 362,073 km² (139,797 mi²) of the North Pacific Ocean and were designated the Papahānaumokuākea Marine National Monument (PMNM) in 2006 and a World Heritage Site in 2010.

Inside the boundaries of the PMNM are reefs, atolls, and shallow and deep-sea habitats, including extensive tropical, shallow-water (< 200 m) coral reef habitat (Friedlander et al., 2008). The extensive coral reefs found in the PMNM are home to more than 7000 known marine species, one quarter of which are found only in the Hawaiian Archipelago. The relatively small emergent land areas of these islands, a combined 15 km², provide breeding and nesting habitat for 14 million seabirds representing 22 species. Four of these bird species are found nowhere else in the world, including the world's most endangered duck, the Laysan duck (*Anas laysanensis*).

Since 1996, NOAA Fisheries and multiple agency partners have conducted surveys and removal of marine debris in the Northwestern Hawaiian Islands on a nearly annual basis. In the 18 years since these efforts began, nearly 822 metric tons (1.8 million lbs) of debris—primarily derelict fishing gear—have been removed from the shallow reefs and shorelines.



A Hawaiian monk seal rests on a large net on Lisianski Island.

Annual Surveys

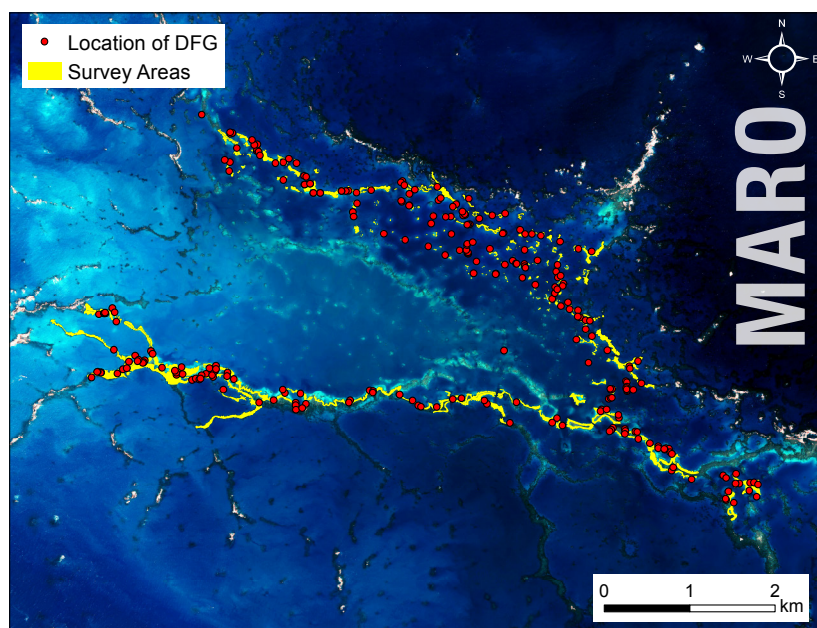
From 1996 to 2005, the marine debris team of the NOAA Pacific Islands Fisheries Science Center's (PIFSC) Coral Reef Ecosystem Division (CRED) focused on large-scale survey and clean-up efforts across the entirety of the shallow reef environments of the NWHI. In 2006, operations were scaled back to a "maintenance" level aimed at keeping pace with new accumulation by resurveying areas historically shown to have high densities of derelict fishing gear (DFG). DFG continues to accumulate at an estimated 52 metric tons per year in the NWHI (Dameron et al., 2007).



A diver carefully removes a derelict fishing net from the shallow-water coral reef at Pearl and Hermes Atoll.

2014 MISSION

From September 25 to October 27, 2014, a team of 17 specialized divers from the NOAA PIFSC CRED conducted a 33-day operation off the NOAA Ship *Oscar Elton Sette* to survey and remove marine debris at Maro Reef, Lisianski Island, Midway Atoll, and Pearl and Hermes Reef in the NWHI. Over the course of 21 operational days, the marine debris team successfully removed more than 51 metric tons (51,626 kg) of DFG and plastics from the environment.



Survey area and location of derelict fishing gear (DFG) removed at Maro Reef.

MARO REEF

Maro Reef is the largest coral reef in the NWHI, with more than 1934 km² of reef area, composed of an intricate network of reef crests and surrounding lagoons. The complexity of Maro's shallow reticulated reefs necessitated swim-survey techniques, using free divers to methodically swim the perimeter of the reefs and carefully remove nets found while minimizing environmental impacts. From a surveyed area of 0.95 km², nearly 14.5 metric tons (14,495 kg) of DFG were removed.

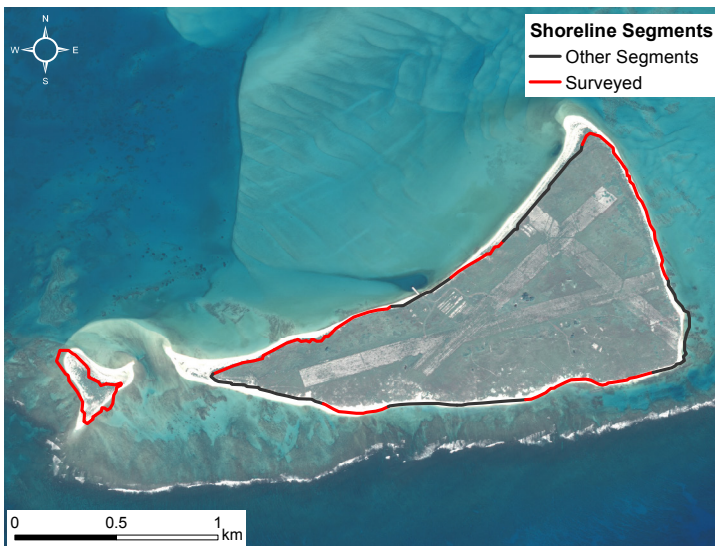
LISIANSKI ISLAND

Lisianski Island is a low, flat, sand and coral island, with an area of approximately 1.5 km². The island is encircled by a white sand beach and most of the interior is covered by native plants. With the fourth largest Hawaiian monk seal population in all of the Hawaiian Islands (NOAA Fisheries, 2014), removal efforts were focused on removing DFG entanglement hazards from Lisianski's shorelines. In one day, the entire 0.09 km² shoreline of the island was surveyed and 3095 kg of DFG was removed.

MIDWAY ATOLL

Midway Atoll is a critical habitat for a number of native species that rely on the three islets (Sand, Eastern, and Spit) for nesting areas. These three islets support nearly 3 million birds, including ~70% of the world's Laysan Albatross population and ~39% of the Black-footed Albatross population. Of the ~1.5 million Laysan Albatrosses that inhabit Midway, nearly all are estimated to have plastic in their digestive systems, and roughly one-third of the chicks die due to plastic ingestion (Jordan, 2009).

In addition to DFG removal from the shorelines of Midway, all plastic items with a longest dimension > 10 cm were removed from randomly selected shoreline areas on Eastern and Spit Island. In addition, bottle caps and cigarette lighters were removed to mitigate the ingestion hazard they posed to seabirds. These surveys were conducted using a slightly modified version of the existing shoreline monitoring protocols established by the NOAA Marine Debris Program (Lippiatt et. al., 2013). In total, 21,127 pieces of debris and plastics that weighed more than five metric tons (5698 kg) were removed from Eastern and Spit shorelines.



| | |
|------|--------------------------------------|
| 7436 | hard plastic fragments |
| 3748 | bottle caps |
| 2884 | buoys/floats |
| 1469 | beverage bottles |
| 1372 | oyster aquaculture spacers |
| 567 | slippers and shoes |
| 477 | cigarette lighters |
| 342 | toothbrushes and personal care items |
| 226 | eel cone traps |

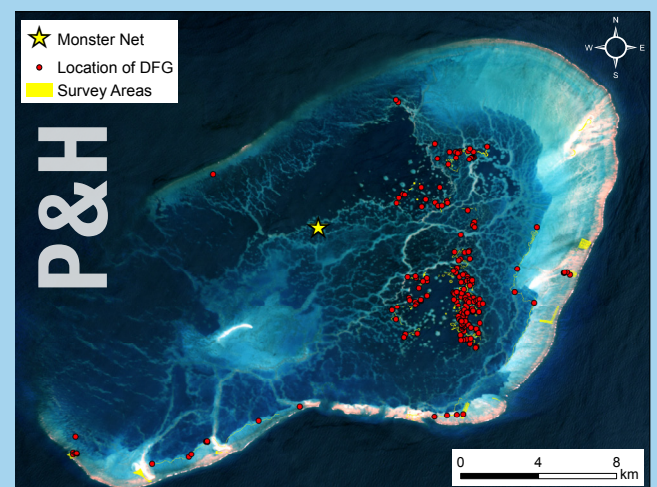
MIDWAY



PEARL AND HERMES REEF

Pearl and Hermes Reef (PHR) is an atoll with seven small islets and a large, complex reef area termed the “maze” spreading over 1165 km² (450 mi²). Manta tow-boarding techniques (*shown above*) were utilized along the interior of the fringing reef and along the sand margins. This unique method allows divers to visually survey the shallow reefs while being towed behind an inflatable motor boat. Swim-survey techniques were used in the complicated interior reefs of the “maze.”

The greatest number of operational days (10) were spent at PHR because it has historically accumulated the highest density of marine debris in the NWHI. More than 2.53 km² of reef area was surveyed, resulting in 25,189 kg of DFG removed. In addition, 2824 kg of DFG was removed from the shorelines of the seven islets (Southeast, North, Little North, Bird, Grass, Little Grass, and Seal-Kittery Island) covering nearly 0.25 km². More than 14 metric tons (28,013 kg) total was removed from PHR in 2014.



THE MONSTER NET

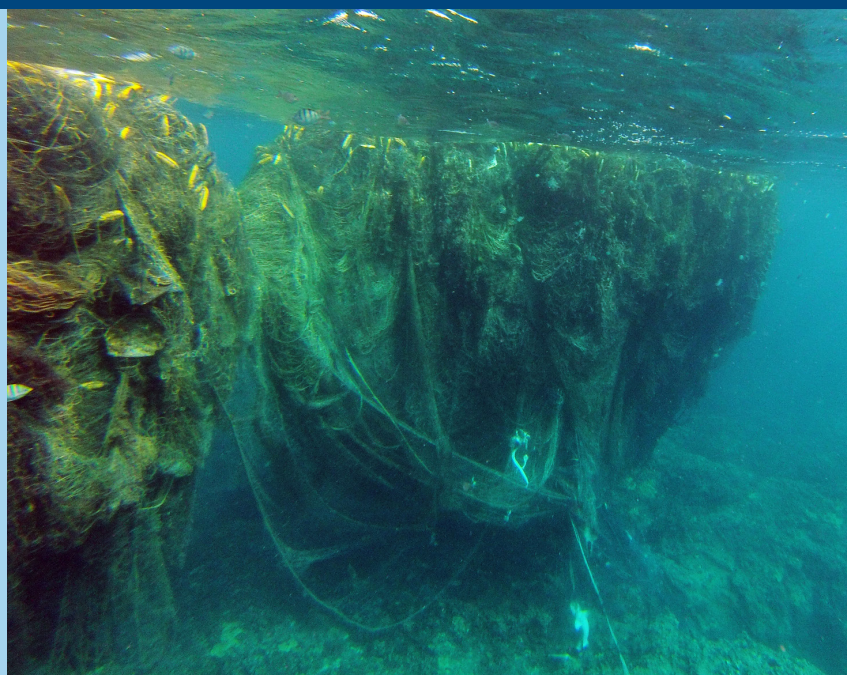
The marine debris team battled a derelict fishing net in 2014 that was so big, they called it “the monster net.”

In the Northwestern Hawaiian Islands, derelict fishing gear and nets are often torn into smaller pieces by the strong surf, high waves, reef abrasion, and sun damage. Therefore, the nets found on marine debris removal missions are almost always pieces of a larger whole or a conglomeration of different nets. Usually, the maximum weight of a derelict fishing net is around one ton. Occasionally, there are exceptions, such as the ten-ton “monster” discovered at Pearl and Hermes Reef.

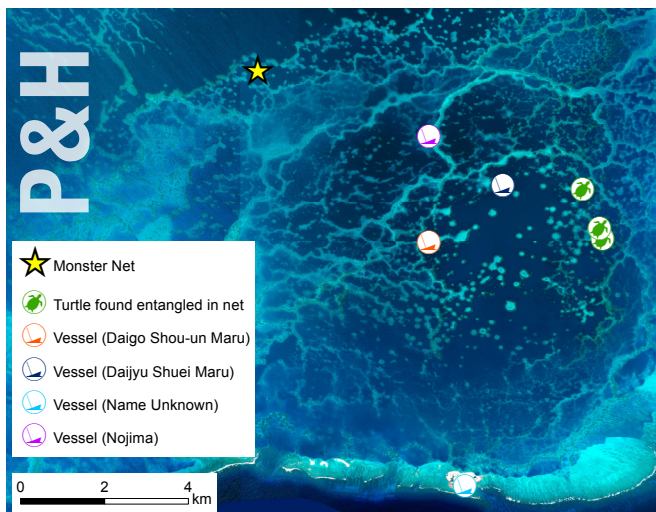
The net was first found by PIFSC CRED scuba divers, from the NOAA Ship *Hi‘ialakai*, engaged in an ongoing coral reef monitoring mission at PHR in 2013. The net was located on the northwest outer reef slope of the atoll, approximately 100 m outside the barrier reef, snagged tenuously to the bottom by only a few strands of net. The net spanned close to 12 m long, and according to witnesses, “could fill an entire 20-ft shipping container by itself.” The divers freed an entangled green sea turtle, but did not have the equipment necessary to remove the net at that time. The location of the net was marked with a Global Positioning System unit and the wildlife entanglement was documented.

NOAA officials were contacted in Honolulu and the NOAA Ship *Oscar Elton Sette*, also headed to the area on a separate mission, was notified. The crew aboard *Oscar Elton Sette* found the net 3 weeks later in the same location, but also decided it was too large to remove with the personnel and equipment available. To aid in future removal efforts, the researchers attached a satellite tracking tag to monitor its movements in the likely event that it broke free from the reef during the upcoming high energy winter swell period.

A year later, during the 2014 marine debris removal effort, after much searching by the CRED team, the monster net was finally located 5 km from its original location. After strategizing and spending 4 labor-intensive dive days on the net, the team of specialized marine debris divers was able to completely remove the 10.4 metric ton (10,431 kg) net by cutting it into separate pieces and towing each section back to the ship through a maze of reefs. This feat concluded the team’s record-breaking season, bringing their grand total up to 51 metric tons (51,626 kg).



The human-created problem of marine debris continues to threaten the fragile, vital, and valuable coral reef ecosystems across the Hawaiian Archipelago. Fortunately, we can each do our part every day to help protect our environment and wildlife from the effects of marine debris. From recycling and reusing materials to participating in beach cleanups, working together, we can make a difference.



JAPAN TSUNAMI BOATS

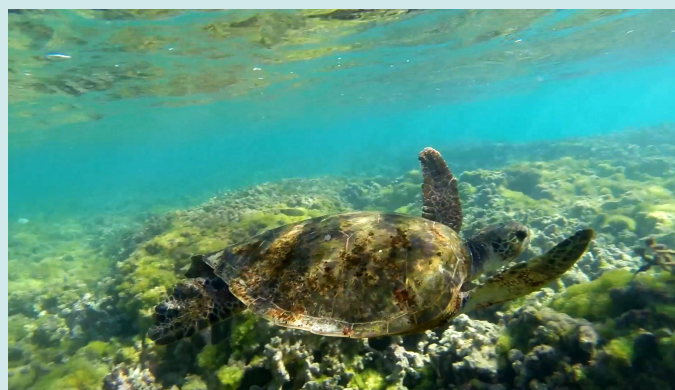
On March 11, 2011, a devastating 9.0 earthquake shook the country of Japan, triggering a tsunami with waves up to 130 feet high. As the tsunami receded, it pulled wreckage and debris from the land into the ocean. Heavier materials sank closer to shore while buoyant materials entered into ocean circulation.

In 2014, four boats that were potentially part of the tsunami debris were discovered grounded on coral patch reefs at Pearl and Hermes Reef. Swept away from their owners in the Tohoku region of northern Japan, these vessels spent years drifting across the North Pacific Ocean. The marine debris team was able to safely remove two of the four boats, the *Daigo Shou-un Maru* (6.7 m) and the *Daijyu Shuei Maru* (7.3 m). They were confirmed to be derelict as a result of the tsunami by the Consulate-General of Japan.



SEA TURTLE RESCUES

Marine debris, particularly DFG, poses a serious and potentially lethal entanglement hazard to the critically endangered Hawaiian monk seal (*Monachus schauinslandi*), threatened green sea turtle (*Chelonia mydas*), and endangered humpback whale (*Megaptera novaeangliae*). Once entangled, these animals have trouble eating, breathing, or swimming, all of which can have fatal results. At PHR, the 2014 marine debris team removed DFG from beaches inhabited by monk seals and successfully disentangled and released three green sea turtles. Most of the debris causing entanglements is from fisheries sources in the Pacific, however the types of fishing gear used in Hawai'i-based fisheries are rarely seen.





The marine debris team proudly stands on top of the derelict fishing gear collected in 2014 aboard the NOAA Ship *Oscar Elton Sette*.



The team works together to remove a large derelict fishing net from the beach at Lisianski Island.

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All photos courtesy of NOAA.



Partners

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CORAL REEF ECOSYSTEM DIVISION PACIFIC ISLANDS FISHERIES SCIENCE CENTER

www.pifsc.noaa.gov/cred/marine_debris.php

NOAA DAMAGE ASSESSMENT REMEDIATION AND RESTORATION PROGRAM PACIFIC ISLANDS REGIONAL OFFICE

www.darrp.noaa.gov

NOAA MARINE DEBRIS PROGRAM OFFICE OF RESPONSE AND RESTORATION

<http://marinedebris.noaa.gov>

PAPAHANAUMOKUAKEA MARINE NATIONAL MONUMENT OFFICE OF NATIONAL MARINE SANCTUARIES

www.papahanaumokuakea.gov

MIDWAY ATOLL NATIONAL WILDLIFE REFUGE U.S. FISH AND WILDLIFE SERVICE

http://www.fws.gov/refuge/midway_atoll

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES

<http://dlnr.hawaii.gov>

