

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 past 19 years, nearly 837 metric tons (1.8 million pounds) of debris—primarily derelict fishing gear—have been removed from the shallow reefs and shorelines.

Partners

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CORAL REEF ECOSYSTEM PROGRAM 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>

PAPAHĀNAUMOKUĀKEA MARINE NATIONAL MONUMENT OFFICE OF NATIONAL MARINE SANCTUARIES

www.papahanaumokuakea.gov

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

www.fws.gov/refuge/midway_atoll

STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES

<http://dlnr.hawaii.gov>



MARINE DEBRIS

REMOVAL AND ASSESSMENT IN THE NORTHWESTERN HAWAIIAN ISLANDS



2015

Microplastic (< 5mm) fibers and fragments collected in surface water trawl survey at Midway Atoll.

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Sooty terns (*Onychoprion fuscatus*) swoop above Lisianski Island, Papahānaumokuākea Marine National Monument.

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) and designated as the Papahānaumokuākea Marine National Monument (PMNM). The reefs of these islands and atolls include ~ 70% of all tropical, shallow-water (< 200 m) coral reef habitat in the United States.

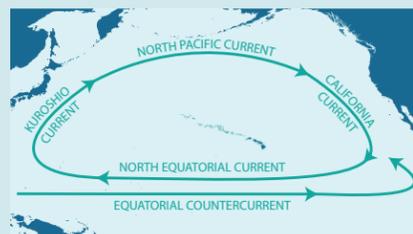
Inside the boundaries of the PMNM are reefs, atolls, and shallow and deep-sea habitats that are home to more than 7,000 marine species, one-quarter of which are found only in the Hawaiian Archipelago, such as the critically endangered Hawaiian monk seal (*Neomonachus schauinslandi*), threatened green sea turtle (*Chelonia mydas*), and protected humpback whale (*Megaptera novaeangliae*). 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.



Derelict vessel from 2011 tsunami in Japan.

North Pacific Gyre

The islands and atolls of the Hawaiian Archipelago are centrally located in the North Pacific Gyre, making the PMNM particularly prone to marine debris accumulation. The Gyre is a clockwise circular pattern of four prevailing ocean currents (North Pacific, California, North Equatorial, and Kuroshio currents) where debris from around the North Pacific Rim gathers and circulates. The reefs and islands of Northwestern Hawaiian Islands, in particular, act as a filter amassing marine debris that presents potentially lethal entanglement hazards and ingestion threats to numerous birds and marine animals (Donahue et al., 2001). Other potential effects of marine debris include habitat degradation to coral reef ecosystems, introduction of non-native species, and hazards to boat navigation.



Fisheries Debris

The marine debris team focuses on collecting fisheries-specific debris—derelict fishing nets, buoys and floats, eel cone traps, and oyster spacer tubes—that damage reefs and create entanglement hazards for animals. Typically used in aquaculture, hundreds of plastic oyster spacers are found on the shores of the Northwestern Hawaiian Islands. Circular plastic eel cone traps also wash up on beaches where they can trap animals, such as green sea turtles and sea birds. Along with oyster spacers and eel cone traps, thousands of fishing buoys and floats continually wash ashore, littering the coastline as far as the eye can see.

Midway Atoll 2015

- 14,542** hard plastic fragments
- 9,923** bottle caps
- 4,365** hard plastic buoys & floats
- 3,576** beverage bottles
- 1,533** plastic foam buoys & floats
- 1,106** rubber slippers
- 997** cigarette lighters
- 811** oyster aquaculture spacers
- 705** toothbrushes & personal care items
- 280** plastic toys
- 74** eel cone traps



The marine debris team surrounded by the 14,606 kg (32,201 lbs) of debris they removed from the shores and backreef of Midway Atoll in 2015.

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MICRO-PLASTIC TRAWL SURVEYS

To begin calculating the concentration of micro-plastics inside Midway Atoll, a micro-plastics trawl pilot study was established. Using a standard manta trawl technique while utilizing a flow-meter to more accurately assess the volume of seawater filtered, the team completed eight 30-min trawls. The samples are being processed by external partners for further laboratory analysis, and the results of this study will be produced after analysis of the data has been completed.



MESO-PLASTIC SHORELINE SURVEYS

The meso-plastics (5mm–2.5cm) pilot study divided survey areas on each of the three islands (Sand, Eastern, and Spit) into four geographic zones (north, east, south, west) based on shoreline orientation. Each geographic zone was assigned ten random survey locations, each divided into three survey areas (1 m from the vegetation line, wrack line, and low-tide line). A total of 54 shoreline samples (three samples from eighteen different survey locations) were collected.



STANDING-STOCK SURVEYS

As part of the nationwide effort by the NOAA Marine Debris Program to compare debris sources, amounts, locations, movement, and effects of marine debris, a set of standardized shoreline surveys was developed. These surveys are conducted by scientists, non-profit organizations, and other environmental agencies. To add debris information representing Midway Atoll to the national database, the 2015 mission included one NOAA MDP standing-stock survey on the northern shore of each island within three pre-selected 100 m transects. These surveys, which involve tallying shoreline debris types and sizes, were done in such a way that it did not compromise the data collected for CREP's data set.

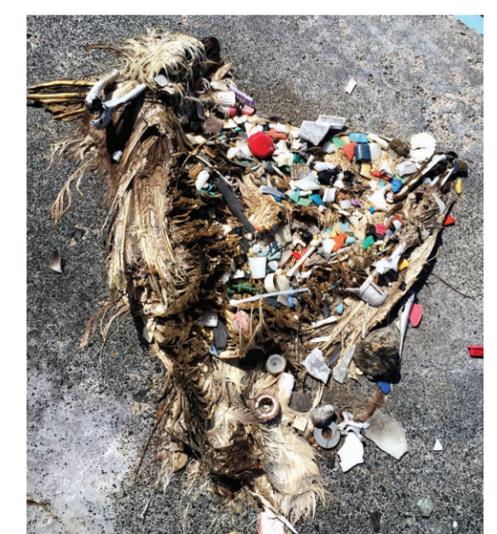
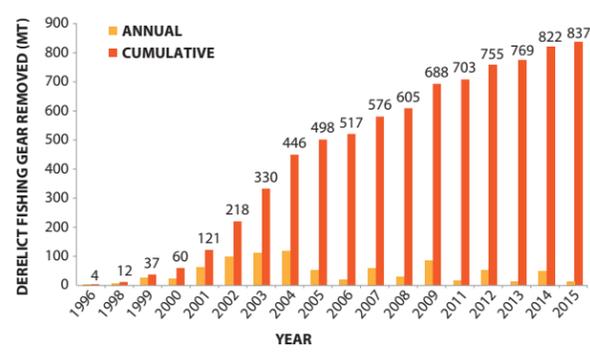
MIDWAY ATOLL

Midway Atoll, located at the far northwestern end of the Hawaiian Archipelago, provides nesting habitat for more than three million birds—including the world's largest population of albatrosses, Bonin petrels (*Pterodroma hypoleuca*), and endangered Laysan ducks (*Anas laysanensis*). Of the approximately 1.5 million Laysan Albatrosses (*Phoebastria immutabilis*) that inhabit Midway, nearly all have plastic in their digestive systems and roughly one-third of the chicks die (Jordan, 2009), largely due to plastic ingestion.

An estimated 20 tons of marine debris (~ 90% plastics) is brought to Midway Atoll each year (Klavitter, 2012), a quarter of which is flown in, regurgitated, and fed to Albatross chicks by their parents. These birds, which normally feed on squid and other marine species that swim near the surface of the water at night, swallow pieces of floating plastic that now litter the world's oceans. These plastics, which often act as a magnet for toxins and contaminants, threaten the lives of millions of seabirds.

Annual Surveys

From 1996 to 2005, the Marine Debris team of the NOAA Pacific Islands Fisheries Science Center's Coral Reef Ecosystem Program (CREP) 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. Derelict fishing gear continues to accumulate at an estimated 52 metric tons per year in the NWHI (Dameron et al., 2007).



Albatross found deceased on Midway Atoll with its stomach full of plastic debris.



Marine debris on Eastern Island, Midway Atoll.

2015 MISSION

From August 11 to September 8, 2015, a team of nine specialized divers from the NOAA PIFSC Coral Reef Ecosystem Program conducted a 28-day operation for the survey and removal of marine debris at Midway Atoll. Survey and removal of derelict fishing gear (DFG) from shallow reef and shoreline environments remained the primary objective of operations; however, the scope was broadened to include various scientific objectives, in particular, the study of debris accumulation (along the backreef and shorelines) and the study of micro-plastic (< 5mm) and meso-plastic (5mm–2.5cm) concentrations in the water and along the shoreline.



Aerial image of Midway Atoll showing surveyed backreef and coastline (identified in yellow).



NOAA diver surveys backreef using free dive manta towboard technique.

SURVEY AND REMOVAL

The marine debris removal work was divided into two components: in-water survey and removal of DFG from Midway's backreef, and shoreline survey and removal of DFG and plastic from the beaches of all three of Midway's islands (Sand Island, Eastern Island, and Spit Island). Over the course of 25 operational days, the Marine Debris team successfully removed 14,606 kg (32,201 lbs) of DFG and plastics from the environment.

ACCUMULATION STUDY

The Marine Debris team continued a study to quantify marine debris accumulation at Midway Atoll for the third straight year. This study began in June 2012, with a complete survey and removal of DFG and plastics from all surveyable backreef and shoreline areas at Midway Atoll. This represented a zero baseline for measuring debris accumulation during subsequent survey efforts. The goal is to determine the amount of debris that accumulates after the baseline was established in 2012.

IN-WATER COMPONENT

To assess in-water accumulations, the backreef area that was surveyed in 2012, was divided into 35 individual polygons, which were then grouped into five geographical zones (A, B, C, D, and E) on the basis of their directional aspect around the barrier reef. Using a stratified random sampling method across these five zones, 15 polygons (three from each geographical zone) were surveyed. From a backreef area of 2.62 km², the team removed 848 kg of DFG. The average density of accumulated DFG within sampled polygons was calculated at 323.7 kg/km². Complete accumulation results will be published at a later date.

SHORELINE COMPONENT

For each of the three islands of Midway Atoll, the shoreline area (from the vegetation line to the water's edge) was divided into 300-m linear segments. These segments were then grouped into three geographical zones per island on the basis of the directional aspect of the beach. Because of marine debris removal efforts by the U.S. Fish and Wildlife Service on Sand Island's shorelines, survey efforts were focused on Eastern and Spit Islands.

For shoreline marine debris surveys, the Marine Debris team used a slightly modified version of the standardized shoreline survey implemented nationally by the NOAA Marine Debris Program. The team tailored the study to emphasize the abundance of North Pacific fisheries-specific debris that accumulates in the Hawaiian Archipelago. They also targeted all plastic items longer than 10 cm, including bottle caps and cigarette lighters (< 10 cm), to mitigate ingestion hazards to seabirds. By collecting, categorizing, and counting all of the debris removed from the environment, the Marine Debris team hopes to raise public awareness about the items that accumulate on the beaches, specifically every-day consumer products.

In 2015, all 23 shoreline segments of Eastern and Spit Islands were successfully surveyed, and all DFG and plastics were removed. In total, 44,345 individual pieces of debris—weighing 13,758 kg—were removed from the shorelines (0.15 km²) of Midway Atoll. Year after year, plastic pollution dominates the marine debris found along the shorelines. Through outreach and education, the Marine Debris team hopes to raise awareness about plastic pollution and open the eyes of the everyday consumer.



BEFORE



AFTER

Eastern Island, Midway Atoll.