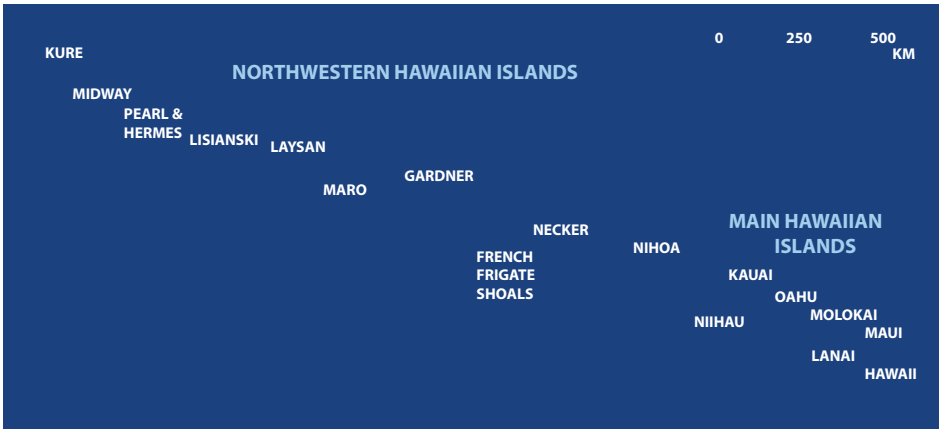
RESTORING CORAL REEFS:

removing marine debris in the northwestern hawaiian islands

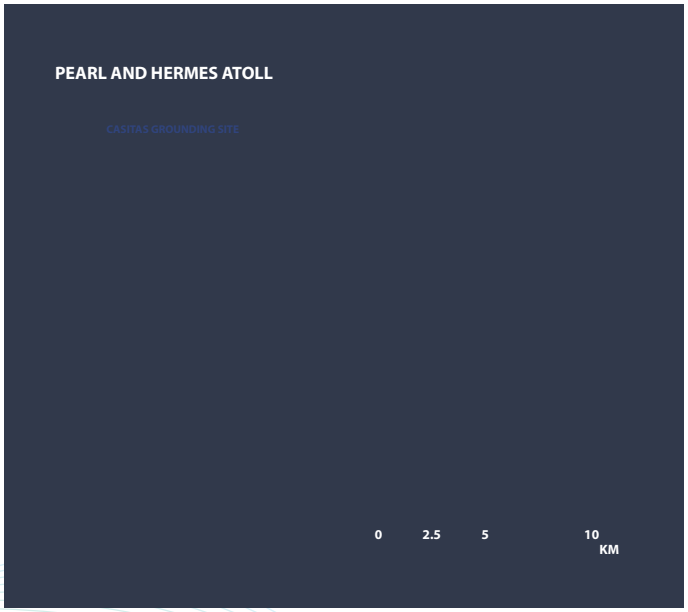
Six years ago, the research vessel M/V *Casitas* ran aground at Pearl and Hermes Atoll, damaging the coral reefs at the northeastern end of this large atoll in the remote Northwestern Hawaiian Islands. This spring, as part of a plan to restore natural resources there, a joint cleanup project supported by NOAA's Damage Assessment, Remediation, and Restoration Program and the NOAA Pacific Islands Fisheries Science Center resulted in the removal of 15 metric tons of marine debris from Pearl and Hermes Atoll, Midway Atoll, and other areas in what is now the Papahānaumokuākea Marine National Monument.

When the M/V *Casitas* struck the reef at Pearl and Hermes Atoll in the Hawaiian Islands National Wildlife Refuge on July 2, 2005, the 145-ft vessel carried approximately 1850 gallons of gasoline, 30,000 gallons of diesel, and 200 gallons of lubricating oils. Because the grounding created a substantial threat of release of fuels and oils, the U.S. Coast Guard and other federal and state agencies immediately began operations to prevent or minimize any discharge into the environment. All parties agreed that the *Casitas* should be removed from the reef before further injuries to the coral reef ecosystem occurred. The vessel was extracted from the reef on August 4, 2005.



Map showing the islands and atolls of the Hawaiian Archipelago and the boundary of the Papahānaumokuākea Marine National Monument.

Pearl and Hermes Atoll, located at 27°57'41" N, 175°46'19" W, has an oval shape with a string of seven small, low islets around a large lagoon. The land area is a mere 0.36 km^2 (88 acres), but the coral reef environment is extensive with 1166 km^2 (288,125 acres) of shallow banks at depths less than 100 m. Pearl and Hermes is the second largest atoll in the Hawaiian Islands National Wildlife Refuge, which became part of the Papahānaumokuākea Marine National Monument (PMNM) in 2006. This protected region supports thousands of marine species as well as endangered seabirds and the endangered Hawaiian monk seal.



Satellite image of Pearl and Hermes Atoll, showing the reef, lagoon, and land areas, and the *Casitas* grounding location.

The first step in restoring these unique resources was to perform a damage assessment. In November 2005, the natural resource trustees for the injured area—NOAA, the U.S. Fish and Wildlife Service, and the state of Hawai`i—and the responsible party collaboratively prepared a field report that provided an estimate of the reef injuries caused by the grounding and vessel removal operations. In addition to the scar from the initial ship impact, removal activities caused much more extensive physical injuries, such as breakage of coral heads, scouring of the substrate, and damage to the reef structure. These injuries were caused by the M/V *Casitas* as it was towed off the reef and by the anchors, chain, and cables attached to the barge that was used to remove the

grounded vessel. The total area of injured reef was estimated at 1700 m^2 (0.42 acres), including 445 m^2 (0.11 acres) of corals. Physical damage to the reef represented lost ecological services, and this information was used to develop a restoration plan.

In forming the restoration plan, the trustees determined that marine debris removal could provide services of the same type and quality, and of comparable value, to the lost ecological services by preventing coral and substrate injury at Pearl and Hermes Atoll and nearby reefs. Marine debris, particularly derelict fishing gear, is a substantial source of coral damage in the PMNM. Fishing nets frequently get lodged on corals and smother or break the corals underneath them. Removal of nets from coral reefs in this area compensates for coral reef injuries incurred during the M/V *Casitas* vessel grounding and subsequent response.

An endangered Hawaiian monk seal lies on the beach surrounded by glass fishing floats that have washed up on the shore.

Removing derelict nets and other marine debris has the following benefits that directly restore injury on a resource-to-resource basis:

1. Preventing further mortality of coral colonies under net debris
2. Preventing further coral mortality by abrasion of nearby coral colonies as nets sway with water motion
3. Preventing further injury to other areas that would occur if a net or other debris breaks loose and settles in a new, undamaged area
4. Enhancing coral recruitment by removing debris that would inhibit, through abrasion, settlement and growth of juvenile corals
5. Reducing the probability of entanglement of other natural resources, such as the endangered Hawaiian monk seal, the threatened green sea turtle, fishes, and endangered birds

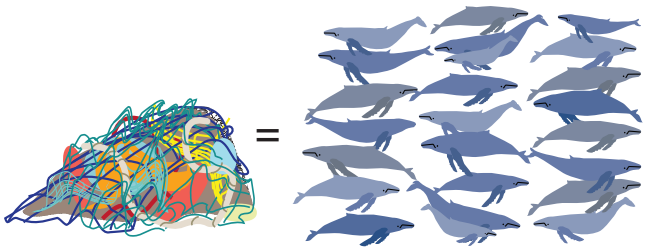
In March and April 2011, a marine debris cleanup effort began to implement the restoration plan. The 23-day project was conducted jointly by NOAA's Damage Assessment, Remediation, and Restoration Program with *Casitas* settlement funds and by the NOAA Pacific Islands Fisheries Science Center (PIFSC) with additional support from the PMNM and the NOAA Marine Debris Program.

CRED NOAA diver removing debris from a coral reef at Midway Atoll in the Northwestern Hawaiian Islands.

Led by the Marine Debris Project of the PIFSC Coral Reef Ecosystem Division (CRED), the cleanup had two parts. During the period of March 31–April 9, 2011, CRED's Marine Debris Project completed a 10-day operation of marine debris survey and removal in nearshore waters and on beaches at Midway Atoll. Diving personnel with specialized dive training conducted in-water surveys and removed derelict fishing gear from reefs.

The second part of the cleanup consisted of in-water and shoreline surveys and removal at other atolls and islands. On April 10, Marine Debris Project staff boarded the NOAA Ship *Oscar Elton Sette*, joining the monk seal camp cruise led by the PIFSC Protected Species Division. On April 11–18, CRED personnel opportunistically surveyed and removed derelict fishing gear from Pearl and Hermes Atoll, Kure Atoll, Lisianski Island, Laysan Island, and French Frigate Shoals.

Marine debris tends to collect on some reefs more than others. CRED has identified reefs in the PMNM that are predisposed to high levels of debris accumulation using survey data collected during its previous field work. PIFSC, in collaboration with several organizations, has conducted marine debris efforts on a regular basis for 15 years in the Northwestern Hawaiian Islands, removing nearly 703 metric tons (MT) of derelict fishing gear there from 1996 to 2011 (see figure below). To maximize effectiveness, removal operations during the latest cleanup focused on hot spots identified as areas of known concentration. Future restoration projects also will target those general areas.



703 METRIC TONS WEIGHS THE SAME AS 24 HUMPBACK WHALES

Annual and cummulative weight (MT) of derelict fishing gear removed from the Northwestern Hawaiian Islands between 1996 and 2011.

RESULTS

During the April 2–9 period, Marine Debris Project staff surveyed 0.63 km^2 (155 acres) of shallow backreef habitat in the north, northeast, and southwest regions of Midway Atoll (see map at right). Unfortunately, on April 3–5, high winds prohibited in-water operations, so activities at Sand Island, the largest of three islands at Midway Atoll, focused on surveys and removal of land debris on the shoreline near the cargo pier and North, West, and South Beaches. During these three days, personnel surveyed 0.17 km^2 of coastline and removed more than 4 MT (4052 kg), of derelict fishing gear (see map at right). With only five days of in-water operations at Midway Atoll, the team removed 46 net clusters of derelict fishing gear weighing1.5 MT (1468 kg).

Satellite image of Midway Atoll showing area surveyed and sites where derelict fishing gear was removed.

Following these land-based operations, CRED staff departed Midway Atoll and embarked on the NOAA Ship *Oscar Elton Sette* on April 10 to opportunistically conduct marine debris survey and removal operations. Operating off the *Oscar Elton Sette*, survey and removal activities were conducted at Kure Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, and French Frigate Shoals (see table below).

The two parts of this cleanup effort—the land-based Midway operations and the activities during the *Oscar Elton Sette* cruise—together resulted in the identification of 82 net clusters of derelict fishing gear in the 2.45 km^2 of total area surveyed and the removal of 15 MT (15,016 kg) of derelict fishing gear from the six islands and atolls visited.

ISLAND	DATE	IN-WATER AREA SURVEYED (KM^2)	SHORELINE AREA SURVEYED (KM^2)	SOURCE OF DEBRIS		DAILY TOTAL (KG)
				LAND (KG)	WATER (KG)	
MIDWAY	4/02/11	0.14	0.00	0	296	296
MIDWAY	4/03/11	0.00	0.06	794	0	794
MIDWAY	4/04/11	0.00	0.11	62	0	62
MIDWAY	4/05/11	0.00	0.00	2038	0	2038
MIDWAY	4/06/11	0.02	0.00	972	316	1288
MIDWAY	4/07/11	0.15	0.00	186	240	426
MIDWAY	4/08/11	0.17	0.00	0	454	454
MIDWAY	4/09/11	0.14	0.00	0	162	162
KURE	4/11/11	0.00	0.00	1180	0	1180
KURE	4/12/11	0.30	0.00	370	288	658
PEARL & HERMES	4/13/11	0.00	0.07	400	1082	1482
PEARL & HERMES	4/14/11	0.13	0.16	236	420	656
LISIANSKI	4/15/11	0.00	0.22	1412	0	1412
LAYSAN	4/16/11	0.00	0.60	2110	0	2110
FRENCH FRIGATE SHOALS	4/18/11	0.18	0.00	1648	350	1998

Back: Members of the CRED Marine Debris Project during the most recent mission. Photo by C. VanDerlip of Hawai`i Department of Land and Natural Resources. All other photos courtesy of NOAA. Satellite images (Landsat) available from United States Geological Survey.

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