PAPAHĀNAUMOKUĀKEA
Marine National Monument

PERMITTED ACTIVITIES 2017 ANNUAL REPORT

Contents

Hawaiian monk seal or ʻilioholoikauaua (*Neomonachus schauinslandi*) rests on a beach on Tern Island, French Frigate Shoals. Photo by Mark Sullivan/NOAA Fisheries

Introduction

On June 15, 2006, the Northwestern Hawaiian Islands Marine National Monument was established by Presidential Proclamation 8031, establishing not only the largest marine protected area in the world at the time, but also a site created expressly to protect ecological and cultural integrity. A year later, it was given its Hawaiian name, Papahānaumokuākea, which honors the union of Papahānaumoku and Wākea, two ancestral gods believed to be the progenitors of the Hawaiian Islands, as well as the Native Hawaiian people. The combination of "Papa" (earth mother, foundation), "hānau" (birth), "moku" (islands) and "ākea" (wide) suggests a fertile woman giving birth to a wide stretch of islands beneath a benevolent sky.

Papahānaumokuākea Marine National Monument ("PMNM" or "Monument") is administered jointly by four Co-Trustee agencies – the Department of Commerce through the National Oceanic and Atmospheric Administration (NOAA), the Department of Interior through the U.S. Fish and Wildlife Service (USFWS), the State of Hawai'i through the Department of Land and Natural Resources (DLNR), and the Office of Hawaiian Affairs (OHA) (collectively, the "Co-Trustees"). The Co-Trustees work in close collaboration to ensure that both cultural and natural resources are protected. The day-to-day management of the Monument is overseen by a seven-member Monument Management Board (MMB or Co-Managers) comprised of OHA and two sub-agencies each of NOAA, USFWS and DLNR. This unique management partnership of PMNM allows for the protection of the entire ecosystem, from remote sub-tropical islands to the deep sea, as well as areas of great archaeological and historic significance.

The Monument includes a number of existing federal conservation areas: the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (NWHI CRER), managed by the U.S. Department of Commerce through NOAA; Hawaiian Islands National Wildlife Refuge (HINWR), Midway Atoll National Wildlife Refuge (MANWR) and the Battle of Midway National Memorial, managed by the U.S. Department of Interior through the USFWS. These designated areas remain in place within the Monument, subject to their applicable laws and regulations in addition to the provisions of the Proclamation. The Monument also includes State of Hawai'i lands and waters, managed by the State through the DLNR. There are two State-designated conservation areas that predate Monument designation: the Northwestern Hawaiian Islands Marine Refuge and the Kure Atoll State Wildlife Sanctuary, which remain subject to their applicable State laws and regulations.

In 2010, Papahānaumokuākea was inscribed as a UNESCO World Heritage site in recognition of both its exceptional natural and cultural attributes. It is the only mixed natural/cultural site in the United States. This honor cumulates over one hundred years of safeguarding the area, starting with protections of Midway Atoll in 1903, when President Theodore Roosevelt sent the U.S. Marines to stop the slaughter of seabirds at Midway Atoll (see timeline of protection, pg. 8-9). It is important to note that historically, Native Hawaiians have regarded the region as sacred and, as such, this served as a form of human protection.

On August 26, 2016, President Obama signed Proclamation 9478 expanding Papahānaumokuākea to include the waters and submerged lands to the extent of the seaward limit of the United States Exclusive Economic Zone (U.S. EEZ) west of 163° West Longitude, and extending from the boundaries depicted on the map accompanying Proclamation 8031. At the time of its creation a decade prior, PMNM was the largest contiguous fully-protected conservation area in the United States at 139,797 square miles (362,073 km^2). The expanded boundaries make it once again the largest fully-protected permanent conservation area on the planet at 582,578 square miles (1,508,870 km^2), nearly the size of the Gulf of Mexico, where all commercial extraction is prohibited.

Papahānaumokuākea Marine National Monument

Northwestern Hawaiian Islands

Manawai
Holoikauaua
Pearl & Hermes Atoll

Hōlanikū
Mokupāpapa
Kure Atoll

Kamole
Kauō
Laysan Island

Kuaihelani
Pihemanu
Midway Atoll

ʻŌnūnui, ʻŌnūiki
Pūhāhonu
Gardner Pinnacles

Mokumanamana
Necker Island

Nihoa

Kapou
Papaʻāpoho
Lisianski Island

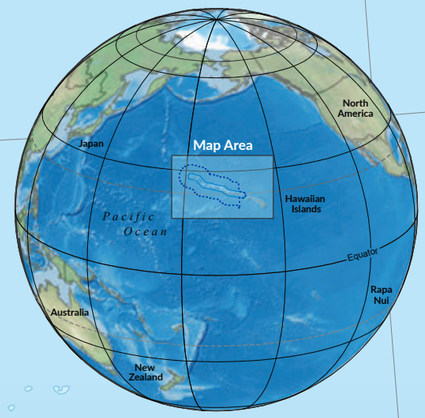
Kamokuokamohoaliʻi
Koʻanakoʻa
Maro Reef

Lalo
Kānemilohaʻi
French Frigate Shoals

International Dateline

Ke Ala Polohiwa a Kāne
Tropic of Cancer

Kauaʻi
Niʻihau
Oʻahu
Molokaʻi
Maui
Lānaʻi
Kahoʻolawe
Hawaiʻi



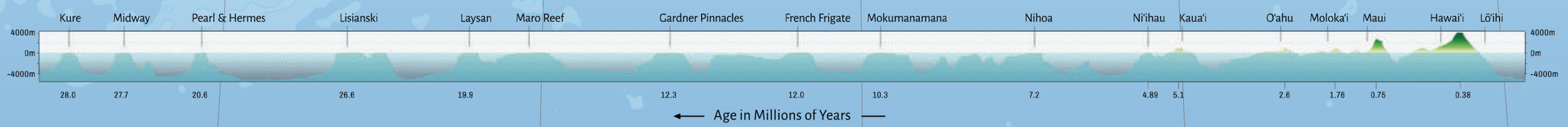
Original boundary

Expanded boundary

Kaiʻaikawaha Genealogy Names*

Hawaiian Lexicon Committee Names*

Western Names



Kilometers 0 100 200
Miles 0 100 200

N

* Nogelmeier, P. (1995, December). He mau inoa kahiko paha i nalo a hoea hou mai? [Ancient names that have disappeared and been recovered?]. *Ka ʻĀhaʻi ʻŌlelo*, Puke VIII: III.

Kikiloi, Kekuewa. *"Rebirth of an Archipelago: Sustaining a Hawaiian Cultural Identify for People and Homeland."* Honolulu: Kamehameha Schools, 2010. Print.

* Kimura,L.L. 1998. Hawaiian names for the Northwestern Hawaiian Islands. Page 27 in S.P. Juvik and J.O.Juvik (eds.), *Atlas of Hawai'i*, 3rd ed. University of Hawai'i Press, Honolulu.

Timeline of Protections

1900s 1910s 1920s 1930s 1940s 1950s 1960s 1970s 1980s 1990s 2000s 2010s

1903
In response to U.S. Navy reports that large numbers of seabirds were being slaughtered for feathers and eggs, President Theodore Roosevelt signs Executive Order No. 199A, placing Midway Atoll under control of the Navy.

1909
President Theodore Roosevelt issues Executive Order No. 1019, creating the Hawaiian Islands Bird Reservation around islands from Nihoa to Kure Atoll to further protect these islands and their resources.

1940
President Franklin D. Roosevelt signs Presidential Proclamation No. 2416, changing the name of the Hawaiian Islands Bird Reservation to the Hawaiian Islands National Wildlife Refuge - managed by the U.S. Fish & Wildlife Service - and broadening refuge purposes to protect all wildlife.

1988
President Ronald Reagan signs legislation assigning stewardship responsibilities for Midway Atoll to the U.S. Fish & Wildlife Service.

1993
The State of Hawai'i Board of Land and Natural Resources designates Kure Atoll a State Seabird Sanctuary, now the Kure Atoll State Wildlife Sanctuary.

1996
President William Clinton issues Executive Order No. 13022, transferring Midway Atoll management responsibilities from the U.S. Navy to the U.S. Fish & Wildlife Service.

2000 and 2001
President William J. Clinton issues Executive Order No. 13158, directing the development of a plan to protect the NWHI coral reef ecosystem, and calls for public participation in the design of additional protection measures for the NWHI. As a result of public comments and negotiations between President Clinton and Congress, the 2000 Amendments to the National Marine Sanctuaries Act authorizes the creation of a NWHI Reserve. President Clinton issues Executive Orders No. 13178 and No. 13196 in December 2000 and January 2001, creating the NWHI Coral Reef Ecosystem Reserve, to include areas adjacent to state waters extending seaward to approximately 50 nautical miles.

2005
Hawai'i State Governor Linda Lingle signs regulations establishing the NWHI Marine Refuge, which includes all state waters extending three miles seaward from any coastline between and including Nihoa and Kure Atoll, but excluding Midway Atoll. This designation allows for the management and long-term conservation of marine resources within state waters.

2006
President George W. Bush signs Presidential Proclamation 8031, establishing the NWHI Marine National Monument with contiguous boundaries to include the NWHI Coral Reef Ecosystem Reserve, the Midway Atoll National Wildlife Refuge, the Hawaiian Islands National Wildlife Refuge, the Battle of Midway National Memorial, Kure Atoll Wildlife Sanctuary, and the Hawai'i State NWHI Marine Refuge. The monument designation promotes coordinated management of the unique resources within the NWHI region.

2010
Delegates to the United Nations Educational, Scientific and Cultural Organization's (UNESCO) 34th World Heritage Convention in Brasilia, Brazil unanimously vote to inscribe the Monument as one of only 26 (now 32) mixed (natural and cultural) World Heritage Sites in the world.

2016
On Friday, August 26, 2016, President Barack Obama signs Presidential Proclamation 9478, expanding PMNM to 582,578 square miles (1,508,870 km^2), nearly the size of the Gulf of Mexico, making it once again the biggest permanent fully-protected area - terrestrial or marine - on the planet.

1976
The tripartite agreement among the State of Hawai'i, U.S. Fish & Wildlife Service, and NOAA Fisheries provides a framework for extensive ecological research in the NWHI beginning in 1976. From October 1976 to September 1981, the agencies, along with the University of Hawai'i Sea Grant Program, survey the islands, banks, reefs, shelves, seamounts and overlying waters within the 200-nautical mile Fishery Conservation Zone and amass data on the various marine and land inhabitants. Two major symposia covering the joint efforts are held at the University of Hawai'i at Manoa in 1979 and 1983. The proceedings of these symposia contain the results of more than 100 research projects.

2008
The International Maritime Organization (IMO), a specialized agency of the United Nations, designates the Monument as a Particularly Sensitive Sea Area (PSSA). This designation allows for the implementation of a ship reporting system, called CORAL SHIPREP, requiring all transiting vessels with the intent to enter a U.S. port or place of a certain size to notify when entering and exiting Monument boundaries; other international transiting vessels are recommended by the IMO to avoid Monument waters or participate in the reporting system. The Monument is the second marine protected area in the United States to receive PSSA designation. It joins ten (now 14) other PSSAs worldwide, including the Florida Keys, the Great Barrier Reef and the Galapagos.

Monument Permitting Program

Overview

Despite the continued protection of PMNM and the area's relative isolation in the Pacific, significant global threats to the Monument's ecosystem exist. Many of these threats are a direct result of human activities occurring beyond Monument boundaries. These include sea level rise and ocean acidification, as well as marine and terrestrial alien and invasive species, marine debris and vessel groundings. The Monument's stringent permitting process is the first line of defense against many of these threats. The permitting process allows for managing, monitoring and reporting activities to evaluate and mitigate cumulative impacts. Similarly, this process enables scientists, managers, educators and cultural practitioners to accomplish a number of activities. These activities are focused on resource protection, habitat conservation, management, and further integration of Hawaiian cultural knowledge and practices with mainstream research and management approaches.

Above Laysan finches or ʻainohu kauo (*Telespiza cantans*) play among glass fishing floats that washed up on the shores in the Monument. Photo by Koa Matsuoka/NOAA Fisheries

Presidential Proclamation 8031

PMNM's permitting program is designed to manage and minimize human impact, ensuring the protection of the Monument's natural, cultural and historic resources. In accordance with Presidential Proclamation 8031 and codifying regulations in 50 CFR Part 404, all activities in the Monument, with limited exceptions, require a permit. Activities are either prohibited (not allowed), exempted (no permit is needed) or regulated (must be considered through the Monument's joint-permitting process).

Prohibited activities include:

- Exploring for, developing, or producing oil, gas or minerals within the Monument
- Using or attempting to use poisons, electrical charges or explosives in the collection or harvest of a Monument resource
- Introducing or otherwise releasing an introduced species from within or into the Monument
- Anchoring on or having a vessel anchored on any living or dead coral with an anchor, anchor chain, or anchor rope

Exempted activities include:

- Response to emergencies threatening life, property or the environment
- Law enforcement purposes
- Activities and exercises of the Armed Forces (including the U.S. Coast Guard)
- Passage without interruption

Any vessel or persons passing through PMNM without interruption does not constitute a permitted activity, however domestic vessels must provide notification prior to entering and leaving the Monument. For U.S. flag vessels with onboard email capability, notification is required upon entering and exiting the reporting area (area extending 10 miles out and entirely around the Monument boundary). For domestic vessels less than 300 gross tons without email capability, entry notification must be provided at least 72 hours, but not more than one month, prior to entering PMNM, and notification of departure from the Monument must be provided within 12 hours of leaving. For more information regarding the Monument's ship reporting requirements, please see http://www.papahanaumokuakea.gov/resource/ship_reporting.html.

In addition to the Monument's ship reporting requirements, all activities and exercises of the Armed Forces must be carried out in a manner that avoids, to

Above A dramatic view of the cliffs of Mokumanamana. Photo by Brad Kaʻaleleo Wong/OHA

the extent practicable and consistent with operational requirements, adverse impacts on Monument resources and qualities.

All other activities not prohibited or exempted must be authorized by a signed Monument permit. Permit applications are reviewed by managers, scientists and other experts within the Co-Trustee agencies and by Native Hawaiian cultural specialists through an agency review process. In order to inform the public about activities proposed within the NWHI, permit applications are posted on the Monument website (http://www.papahanaumokuakea.gov/permit/applicationrev.html) for public review. In addition to agency review, all permit applications must meet applicable Findings (i.e., permit criteria) listed in Proclamation 8031 in order to be approved by the Co-Trustees. For a list of all Findings in the Proclamation, please see the inset box on the next page. For activities proposed within the NWHI State Marine Refuge, permit applications must also be approved by the State of Hawai'i Board of Land and Natural Resources.

All issued permits contain a permitted activity description, including information on the number of permitted personnel, permitted activity locations, and general terms and conditions that satisfy Proclamation 8031, Monument regulations, and MMB agency mandates and policies. Issued permits also specify the requirements for compliance with quarantine protocols to avoid introduction of alien species, and list prohibited activities such as the disturbance of cultural sites or historic artifacts. Special conditions may also be applied to particular permits, placing additional restrictions on activities in order to minimize impacts to Monument resources.

Permitting Criteria

The Monument's permitting criteria are the Findings defined in Proclamation 8031. All permit applications must meet the applicable Findings prior to the issuance of a permit:

- The activity can be conducted with adequate safeguards for the resources and ecological integrity of the Monument.
- The activity will be conducted in a manner compatible with the management direction of the Proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument resources, qualities and ecological integrity; any indirect, secondary or cumulative effects of the activity; and the duration of such effects.
- There is no practicable alternative to conducting the activity within the Monument.
- The end value of the activity outweighs its adverse impacts on Monument resources, qualities and ecological integrity.
- The duration of the activity is no longer than necessary to achieve its stated purpose.
- The applicant is qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
- The applicant has adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
- The methods and procedures proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument resources, qualities and ecological integrity.
- The applicant's vessel has been outfitted with a mobile transceiver unit approved by NOAA Office of Law Enforcement and complies with the requirements of Proclamation 8031.
- There are no other factors that would make the issuance of a permit for the activity inappropriate.

In addition to the ten general Findings above, there are additional specific Findings that are required for Special Ocean Use, Native Hawaiian practices, and Recreation permit applications.

Types of Permits

Permit applications may be issued in one of six permit categories if Co-Managers find that the activity: 1) is research designed to further the understanding of Monument resources and qualities; 2) will further the educational value of the Monument; 3) will assist in the conservation and management of the Monument; 4) will allow Native Hawaiian practices; 5) will allow a special ocean use; or 6) will allow recreational activities.

Research

Research permits are for activities that enhance the understanding of PMNM's resources and improve resource management decision-making. The types of activities that may be conducted under research permits include biological inventories, ecosystem-based research, habitat characterization, and archaeological research.

Education

Education permits are for activities that further the educational value of the Monument. These activities may assist a broader audience in understanding the ecosystems within the Monument, share lessons learned in resource management with outside partners, promote Native Hawaiian knowledge and values, or aid in outreach with schools and community groups. Permits are considered for activities that have clear educational or public outreach benefits and that aim to "bring the place to the people," rather than the people to the place. Examples of education projects include teacher-at-sea programs, distance learning projects, and university field classes.

Conservation and Management

Conservation and Management permits are for activities that enable the general management of PMNM. These activities may include field station operations, marine debris removal, development and maintenance of infrastructure, and long-term resource monitoring programs such as monitoring of endangered species, seabird populations, and terrestrial native plant communities. Conservation and Management permits also provide a mechanism for response and follow-up to urgent events in the Monument that may not have been anticipated, such as vessel groundings, coral bleaching episodes, and invasive species outbreaks.

Native Hawaiian Practices

Native Hawaiian Practices permits are for activities that constitute Native Hawaiian cultural practices. Activities under this permit must be noncommercial, deemed appropriate and necessary by traditional standards, benefit the NWHI and Native Hawaiian community, perpetuate traditional knowledge, and restrict the consumption of harvested resources from the Monument. Examples of permitted activities include application of traditional non-instrument navigation techniques on Native Hawaiian voyaging canoes and conducting ceremonies at historic cultural sites on Nihoa and Mokumanamana. Permit conditions and guidelines are developed by the Co-Trustees in consultation with the Native Hawaiian Cultural Working Group and the broader Native Hawaiian community.

Special Ocean Use

Special Ocean Use permits are for activities related to commercial uses, including ecotourism or documentary filmmaking. Special ocean use is defined as any activity or use of the Monument to generate revenue or profits for one or more of the persons associated with the proposed activity, and will not destroy, cause the loss of, or injure Monument resources.

Recreation

Recreation permits are for activities conducted for personal enjoyment and are limited to occur only within the Midway Atoll Special Management Area (MASMA). Recreation activities must not result in the extraction of Monument resources or be involved in a fee-for-service transaction. Examples of activities that may be permitted include snorkeling, wildlife viewing, and kayaking. Restrictions may be placed on recreation permits in accordance with the MANWR Visitor Services Plan.

Left The NOAA marine debris team poses with the results of their annual clean-up efforts at Midway Atoll. Photo by NOAA

Below Biologists Randy Kosaki and Pelika Andrade conduct intertidal surveys of Hawaiian limpets or ʻopihi (*Cellana spp.*) and algae or limu at Nihoa during the 2017 Intertidal Monitoring Cruise. Photo by Kanoe Morishige/University of Hawaiʻi

2017 Permitted Activities

Above From Left to Right

A Galapagos shark or manō (*Carcharhinus galapagensis*) approaches NOAA scientist Randy Kosaki and team as they slowly decompress on their way to the surface from a 300 foot dive at Pioneer Bank. Photo by Richard Pyle/Bishop Museum and NOAA

White tern or manuokū (*Gygis alba*) nests at French Frigate Shoals. Photo by Mark Sullivan/NOAA Fisheries

Colony of Laysan albatross or mōlī (*Phoebastria immutabilis*) nest among the World War II relics at Midway Atoll. Photo by Dan Clark/USFWS

In 2017, a suite of activities was conducted by managers, cultural practitioners, community members and researchers in continuing ongoing collaborative research, looking to the past for sources of knowledge, and embarking on new paths to discovery. A common theme of activities conducted in the Monument in 2017 may be captured in the Hawaiian proverb (reflected on the cover) " ʻAʻohe pau ka ʻike i ka hālau hoʻokahi," translated to mean "all knowledge is not learned in just one school." The following projects from 2017 illustrate just a few of the many activities that occurred:

Marine Predators

Scientists study the diversity and abundance of sharks and eels in the Monument.

The Last Wild Place

Honolulu Civil Beat reporter captures the raw nature, beauty, culture and spirit of PMNM in an in-depth multimedia piece.

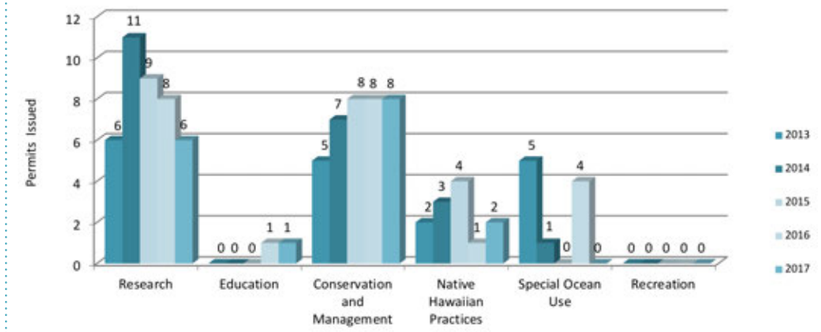
Monument Research and Conservation

Honoring those lost during the 75th Anniversary of the Battle of Midway and seeking to identify additional wrecks from this historic battle that connect people to place.

Permits Issued in 2017

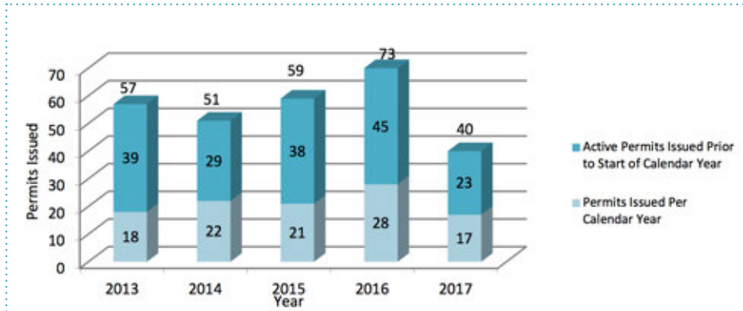
In 2017, 31 permit applications were received and 17 permits were issued. All permit applications must complete a rigorous process of environmental and cultural review and documentation of meeting the applicable permitting criteria, which include the Findings in Proclamation 8031. As permit applications are reviewed and processed, individual applicants may elect to withdraw a permit application. This year, seven applications were withdrawn and four were not issued and instead continued processing in 2018. Figure 1 displays a comparison of the number of permits by type issued from 2013 - 2017.

Figure 1. Number of Monument permits issued from 2013-2017 by permit type.



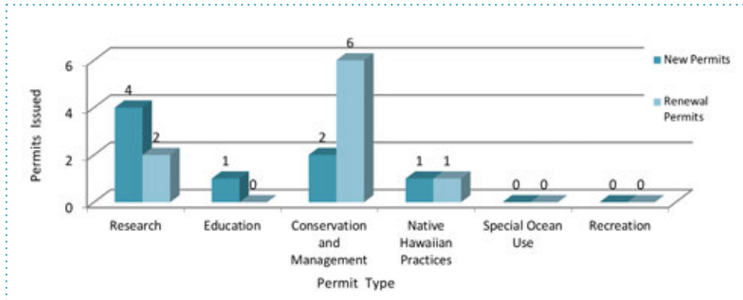
The Monument Co-Trustees grant both single- and multi-year permits. In calendar year 2017, the Monument Permitting Team tracked 40 permits, 23 of which were issued and active prior to 2017 (Figure 2). All active permits, regardless of year issued, were monitored for permitting and reporting requirements in 2017. Multi-year permits are issued specifically for projects that span two or more calendar years. In accordance with Hawaiʻi Administrative Rules, the duration for a Monument permit in State waters is limited to no longer than one year from the date of issuance (HAR Title 13 § 60.5-6). Multi-year permits may be issued for activities that occur outside of State of Hawaiʻi waters (defined as 0-3 nautical miles from emergent land, excluding Midway Atoll) for up to five years.

Figure 2. Number of Monument permitted activities per calendar year 2013-2017.



Since 2011, the number of new and renewal permits issued has been reported and tracked by the MMB (Figure 3 below). In order for a permit application to be considered a renewal, the proposed activity must have been a previously permitted project activity in the NWHI. This metric provides a quick estimate of the number of new projects permitted (note that permits requesting renewal of activities with a new principal investigator are counted as "new" permits). Both new and renewal applications undergo the same rigorous joint-permitting review process. Single-year, multi-year, new and renewal metrics are used to summarize and track Monument permits.

Figure 3. New and renewal permits in 2017 by permit category.



Levels of Human Presence

Human presence is necessary to carry out resource management objectives and conduct necessary scientific and cultural research. Effectively tracking Monument permits and the associated number of permitted vessel and permit related aircraft entries within the Monument allows for accurate reporting of levels of human presence. The level of human presence in the Monument is strictly managed and continually evaluated to monitor and mitigate for cumulative impacts.

The only location equipped to accept aircraft within the Monument is Midway Atoll. Since 2013, there has been a seven percent increase in flights to and from the Monument.

Table 1. The number of permit associated flights to and from the Monument from 2013 - 2017.

Airport/Airstrip Location	*2013*	*2014*	*2015*	*2016*	*2017*
Midway Atoll	38	22	26	33	41

Permitted vessel entries and exits are defined as any instance in which a vessel is permitted to enter the Monument to conduct authorized activities and subsequently exits the Monument. For reporting purposes, any further authorized entry of the same vessel is counted as a second vessel entry.

Table 2. The number of permitted vessel entries into the Monument from 2013 - 2017.

	2013	*2014*	*2015*	*2016*	*2017*
Vessel Entries and Exits	16	16	19	18	18
Individual Vessels Used	6	8	9	10	8

The Monument permitting system ensures all commanding officers/captains and crew of permitted vessels are well versed in vessel compliance measures and rules to protect the Monument. In accordance with Monument regulations, vessel discharge and anchoring is highly regulated within the Monument and, in many areas, prohibited. Authorized vessels must have a NOAA Office of Law Enforcement operating type-approved vessel monitoring system on board at all times within the Monument to pinpoint the vessel's location for law enforcement officers if needed. Vessels are also required to successfully complete a hull and rodent inspection prior to accessing the Monument to prevent the unwanted introduction of non-native species. Permits for authorized vessels may place special conditions on activities including restrictions on speed and limitations on authorized locations to anchor.

Another metric to account for the level of human presence is the number of people on land. Due to the fragility and remote nature of these islands and atolls, any human presence has the potential to impact resources. Table 3.1 indicates the minimum, maximum and average number of people recorded on land per day on each island or atoll in the Monument from 2013 - 2017[1]. The total number of person-use days measures individual presence per island or atoll in the Monument and is shown in Table 3.2. Person-use days are calculated based

[1] Data presented in all tables and figures reflects only information from permit reports submitted to PMNM upon completion of a PMNM access and/or project. Not all permit reports have been received for activities that occurred in 2017 at the time of publication.

on the number of individuals on site each day. For example, five authorized personnel staying for three nights on Nihoa would equal 15 total person-use days at Nihoa. Midway Atoll continues to have the highest level of human presence, sustaining an average population of 50 individuals necessary to operate Midway facilities and contract workers for environmental remediation.

Table 3.1. The minimum, maximum and average person-use days at each island and atoll in 2013-2017.

	2013			*2014*			*2015*			*2016*			*2017*		
Island / Atoll	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
Nihoa	0	12	<1	0	13	<1	0	10	<1	0	12	<1	0	5	<1
Mokumanamana	0	4	<1	0	3	<1	0	11	<1	0	5	<1	0	3	<1
French Frigate Shoals	0	16	3	0	17	1	0	22	2	0	20	2	0	16	2
Laysan Island	0	27	5	0	14	1	0	25	<1	0	11	1	0	13	<1
Lisianski Island	0	7	<1	0	14	<1	0	23	<1	0	16	<1	0	8	<1
Pearl and Hermes Atoll	0	7	<1	0	10	<1	0	17	<1	0	17	1	0	8	1
Midway Atoll	43	69	55	41	48	46	43	60	51	39	64	49	43	65	50
Kure Atoll	6	13	7	6	15	6	6	17	7	6	6	6	6	11	6
Total			**70**			**54**			**60**			**59**			**59**

Table 3.2. Total amount of person-use days for each island and atoll in 2013-2017.

Island / Atoll	*2013*	*2014*	*2015*	*2016*	*2017*
Nihoa	91	110	39	52	9
Mokumanamana	8	3	48	8	3
French Frigate Shoals	1,283	472	1,045	776	590
Laysan Island	1,850	446	321	400	315
Lisianski Island	86	113	251	270	200
Pearl and Hermes Atoll	233	159	322	427	369
Midway Atoll	20,254	17,421	18,518	17,918	18,104
Kure Atoll	2,797	2,558*	2,773*	2,190*	2,518*
Total	**26,602**	**21,282**	**23,317**	**22,041**	**22,108**

*Total person-use-days for Kure Atoll are estimated based on project activity dates.

Locations of Permitted Activities

The map in Figure 4 indicates locations at which permitted activities occurred in 2017. Of the 40 active permits, many authorized activities were conducted at multiple locations. Thus, for example, a single permit may have allowed activities only at French Frigate Shoals, or a permit may authorize activities at all islands and atolls.

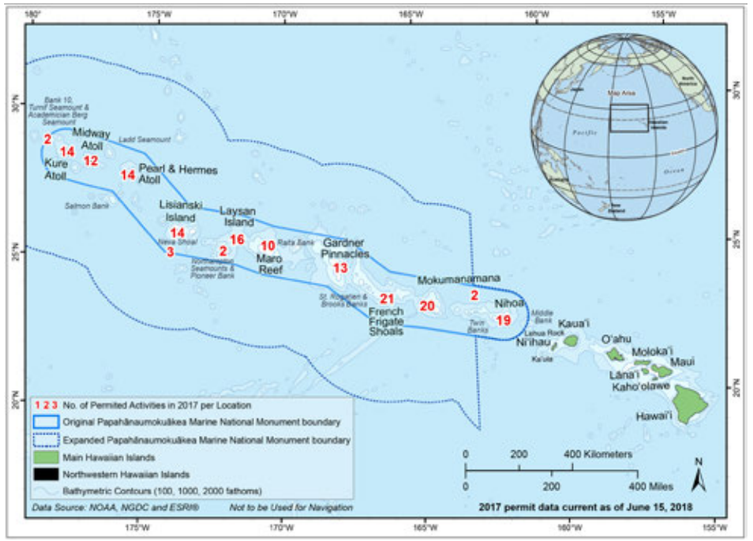


Figure 4. Locations of 2017 permitted activities. The number of permitted projects at each location is indicated in red.

Permitted Versus Actual Visitation Records

The number of individuals permitted to access the Monument and conduct activities is often not reflective of the actual number of people who conducted work in the Monument. For example, PMNM permits authorize limited access to personnel qualified to conduct specific activities; however the actual number of individuals who access the Monument is often less than the number permitted due to scheduling conflicts and other logistical complications that necessitate flexibility when selecting a team to conduct permitted activities. In other instances, permits that are active for more than one calendar year are included in the total count of permitted individuals but may not utilize their permit each year due to scheduling conflicts, lack of funding, or focus on other priorities. Table 4 shows the difference in the number of permitted individuals compared to the actual number of individuals who took part in a permitted activity.

Table 4. Number of individuals permitted in 2017, compared to the actual number of people who conducted permitted activities in the Monument by permit type.

Permit Type	**Number of People Permitted**	**Actual Number of People Who Performed Permitted Activities**
Research	79	87
Education	2	2
Conservation & Management	1,004	100
Native Hawaiian Practices	122	9
Special Ocean Use	0	0
Recreation	0	0
Total	**1,207**	**198**

Details of 2017 Permitted Activities

RESEARCH

Of the nine research applications received, six were issued and three were withdrawn. Research permits were issued to Co-Trustee agency personnel, university researchers and other research organizations in Hawai'i to conduct work on fish, corals, marine mammals, algae, nearshore and deep ocean areas within PMNM. Table 5 lists research permits issued for each organization or institution, together with project titles. Information gained from annual research expeditions continues to inform scientists, managers and others on the NWHI terrestrial and ocean ecosystems and their inhabitants, and aids in overall management and evaluation of ecosystem health.

Research projects permitted in 2017 included a variety of activities aimed at understanding the marine environment and the species that live there. While six new research permits were issued in 2017, 11 permits issued in prior years and remained valid. Of these, seven involved collection activities. Collection activities requiring the removal of whole specimens (as opposed to extracting tissue and leaving the organism in situ) utilized the minimum sample size necessary in order to complete the project and satisfy statistical significance. Table 6 describes these observational, catch and release, and collection activities.

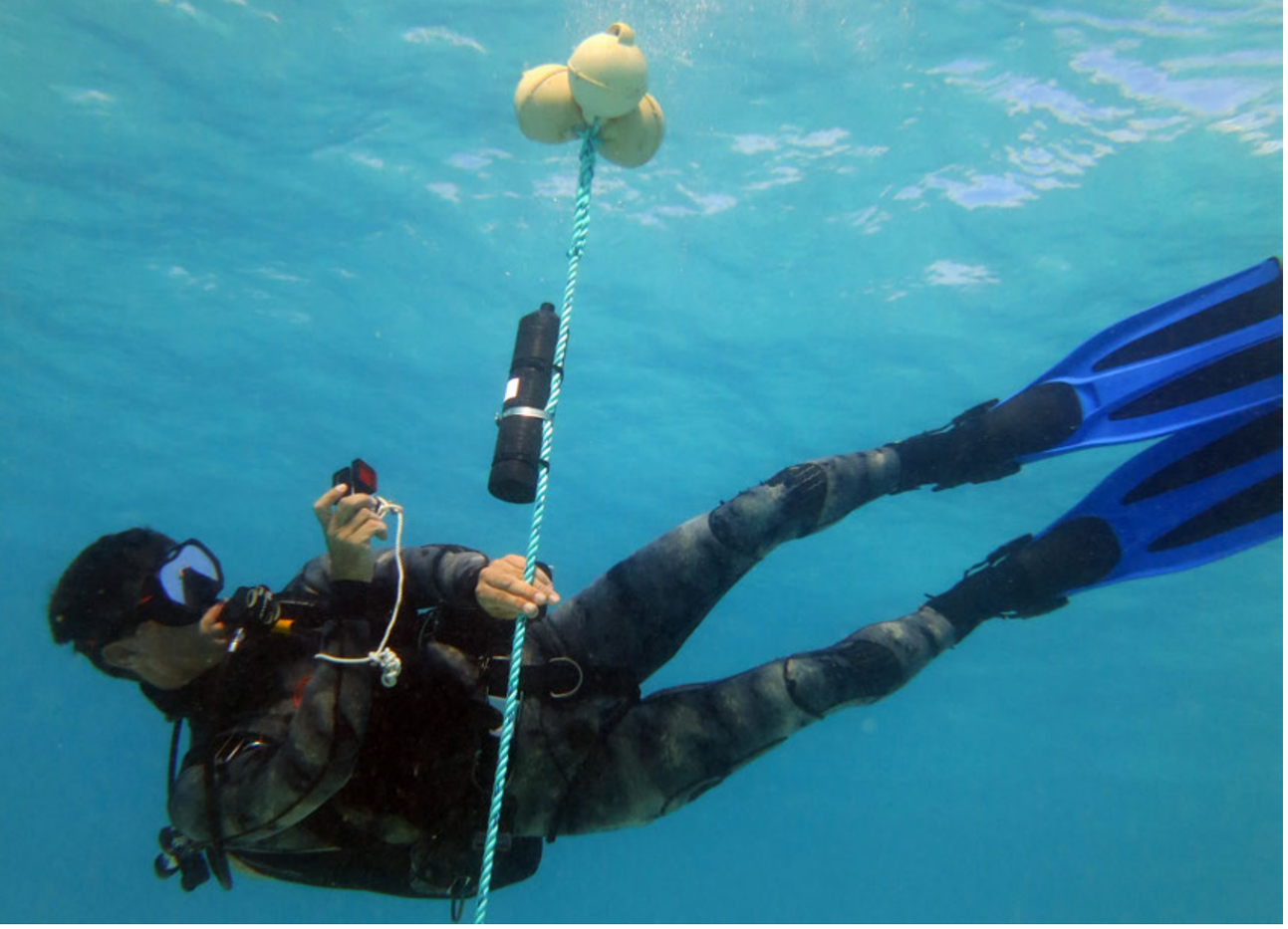
Table 5. Affiliations of Research permittees and permitted projects in 2017.

Research Permittee Affiliation	Number of Permits Issued	Permitted Research Projects
NOAA, National Marine Fisheries Service, Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Program	1	• Characterization of Hawaiian Jack Species
University of Hawai'i	1	• Acoustic Study of Humpback Whales
University of Hawai'i, Hawai'i Institute of Marine Biology	1	• Quantifying the Movements and Ecology of Top Predators
Australian Institute of Marine Science	1	• Baited Remote Underwater Video Surveys of Elasmobrach
NOAA, Office of Oceanic and Atmospheric Research, Office of Exploration and Research	1	• Deep Sea Mapping in Papahānaumokuākea Marine
Texas A&M University - Corpus Christi & University of Hawai'i, Hawai'i Institute of Marine Biology	1	• Documenting the Biodiversity and Ecology of Nearshore Basaltic Reefs

Left NOAA scientist Randy Kosaki dives a closed-circuit rebreather at 280 feet, Laysan Island. Photo by Richard Pyle/Bishop Museum and NOAA

Table 6. Observational, catch and release, and collection activities that occurred under research permits in 2017.

Permitted Research Project	Catch and Release or Observational Research	Biological or Physical Samples Collected
Characterization of Hawaiian Jack Species	• 32-15m cylinder surveys • 20-10x1m transects	• none
Acoustic Study of Humpback Whales	• none	• 186 hours passive acoustic monitoring
Baited Remote Underwater Video Surveys of Elasmobrach	• 72 hours of video recodings via	• none
Deep Sea Mapping in Papahānaumokuākea Marine National Monument	• approximately 25000 km^2 hours of bathymetric mapping	• none
Documenting the Biodiversity and Ecology of Nearshore Basaltic Reefs	• none	• 60 helmet urchin or ha'uke'uke (*Colobocentrotus atratus*) • 20 thin-shelled rock crab or 'a'ama (*Grapsus tenuicrustatus*)



Above Research diver Mark Deakos photo-documents an acoustic monitoring receiver installed at French Frigate Shoals to track the movements of previously tagged sharks. Photo by Karen Bryan/Hawai'i Institute of Marine Biology

Table 6 Continued. Observational, catch and release and collection activities that occurred under research permits in 2017.

Permitted Research Project	Catch and Release or Observational Research	Biological or Physical Samples Collected
Comprehensive Test Ban Treaty, Infrasound Station Installation and Monitoring at Midway Atoll	• none	• 365 air filter samples
Understanding Recovery Potential for Deep-sea Coral and Sponge Communities Impacted by Trawling	• 19 submersible dives • 266 kilometers distance of video transect surveys	• *

*Observational, catch and release, and collection activities data current as of time of publication.

Other research activities involved the use of temporary devices to remotely monitor habitat variations, such as temperature, salinity, changes in sedimentation, and organism recruitment. These instruments are essential to obtaining long-term ecological data necessary for effective resource management in the face of climate change and other global threats to the Monument. Table 7 describes the temporary instruments installed or deployed in 2017.

Table 7. Remote monitoring instruments installed under research permits in 2017.

Permitted Research Project	Instruments Installed for Remote Monitoring
Acoustic Study of Humpback Whales	• 2 autonomous passive acoustic monitoring recorders

Left A great frigatebird or 'iwa (*Fregata minor palmerstoni*) swoops down over a raft of Laysan ducks or koloa pōhaka (*Anas laysanensis*) at Laysan Island. Photo by Amanda Boyd/USFWS

Above Australian Institute of Marine Science researcher Audrey Schlaff prepares to lower a BRUVS from a NOAA tender vessel. Photo by Australian Institute of Marine Science

Research Highlights

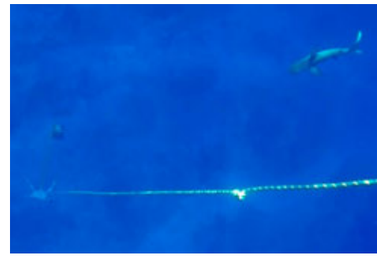
Caught in the Act: Baited Remote Underwater Video Systems Portray World of Sharks, Rays and others Marine Life

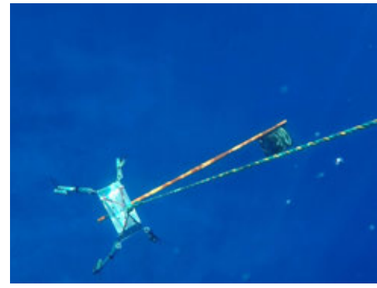
During the annual Reef Assessment and Monitoring Program (RAMP) research expedition in September 2017, researchers from the Australian Institute of Marine Science utilized a unique remote sensing survey to capture video of sharks, rays and other marine life in shallow marine habitats (less than 100 meters) in Papahānaumokuākea. Though Principal Investigator Dr. Michelle Heupel did not access PMNM, she assigned her field PI, Audrey Schlaff and two technicians to deploy baited platforms outfitted with a high definition video camera for capturing wildlife imagery. Known as Baited Remote Underwater Video Systems, or BRUVS, these units were used to determine the diversity and abundance of sharks and eels in the Monument.

"The use of BRUVS provides a non-invasive and standardized way to measure the relative abundance of populations," explained Dr. Heupel. "These systems are especially effective for predators such as sharks, eels and large fish, but also capture individuals that are moving through the area and provide an indication of the type and quality of the habitat at the deployment site. Sampling conducted in the NWHI will be used in regional comparisons with other sites sampled in the Pacific Ocean to help define patterns of shark and ray occurrence and abundance."

BRUVS were baited with crushed tuna and deployed manually by lowering them by rope from small boats at various sites around French Frigate Shoals and Midway Atoll. Each BRUVS would record one hour of video before being retrieved. The research resulted in 72 BRUVS deployments.

While data analysis is still ongoing, a full report is expected in Summer 2018. In the meantime, Dr. Heupel provided a highlight video that shares some of the species encountered during the surveys which includes tiger sharks, octopus, and a sea turtle, to name a few. This important work is part of the Global FinPrint Project (www.globalfinprint.org) that aims to produce the world's first standardized survey of shark and ray abundance and diversity in coral reef environments.





Below Left Galapagos sharks or manō (*Carcharhinus galapagensis*) teem in the waters of Kure Atoll. Photo by Andrew Gray/NOAA

Below Right A shark approaches a BRUVS as it is lowered to the seafloor via rope. Photo by Australian Institute of Marine Science

Bottom Right BRUVS is lowered to the seafloor via rope. Photo by Australian Institute of Marine Science

Above Sooty terns or ʻewaʻewa (*Sterna fuscata*) soar over Nihoa's rugged landscape. Photo by Brad Kaʻaleleo Wong/OHA

EDUCATION

There was one application for education permits in 2017. This permit brought Honolulu Civil Beat reporter, Nathan Eagle, to the Monument to cover the inspiring stories of conservation, research and the countless species that call Papahānaumokuākea home. While there was only one education permit issued, efforts have continued with schools in the main Hawaiian Islands on Kauaʻi, Oʻahu and Hawaiʻi Island with in-classroom presentations by PMNM staff.

Table 8. Affiliations of Education permittees and permitted projects in 2017.

Education Permittee Affiliation	Number of Permits Issued	Permitted Education Projects
Honolulu Civil Beat	1	• Honolulu Civil Beat Visits Papahānaumokuākea Marine National Monument

Education Highlights

Papahānaumokuākea... The Last Wild Place

In August 2017, Honolulu Civil Beat reporter Nathan Eagle and videographer Alana Eagle voyaged to PMNM to produce an online interactive special report on the Monument. After months of collaboration among co-managing agencies, the team spent two weeks traveling aboard the M/V *Kahana* through the Monument, stopping at Laysan Island, Kure Atoll and Midway Atoll to explore and interview field staff and crew working in the islands before flying back to Honolulu.

One of the more memorable moments from his time in the Monument even provided a perfect photo opportunity. “Sometimes the unexpected happens when you're out in the field reporting, in this case at Laysan Island in Papahānaumokuākea Marine National Monument,” writes Nathan. “This juvenile red-footed booby[2] landed on my head as we were walking back from "The Desert," which is full of marine debris. I decided to do an impromptu (and very windy) interview about the bird with Amanda Boyd of the USFWS.”

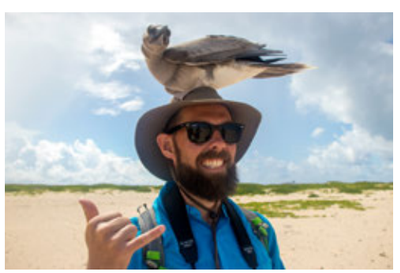
In a special multimedia project entitled “The Last Wild Place” (http://www.civilbeat.org/projects/the-last-wild-place/), Nathan weaves together pieces of Papahānaumokuākea’s history and ecology, with photos, audio recording and imagery. The site features an interactive map as well as photos, video and audio of researchers and cultural practitioners working in PMNM. Going online in December, the report received 52,000 page views within the first two weeks of publication, was shared hundreds of times on Twitter, Facebook and Instagram, and liked thousands of times. The project has since been awarded first place in the Society for Features Journalism Excellence-In-Features Award, a prestigious national media competition for Integrated Storytelling, out-competing both the Los Angeles Times and Oregonian.

Nathan and Alana Eagle have helped PMNM in its efforts to “bring the place to the people” by bringing Papahānaumokuākea to thousands of people globally. Nathan and Alana are scheduled to return to the Monument in 2018 to revisit a few familiar places and explore new ones as well. They will hopefully meet the world-famous and oldest known wild bird, a Laysan albatross or mōli (*Phoebastria immutabilis*) named Wisdom and her mate Akeakamai.

Below From Left to Right
Wisdom preens her new chick on Midway Atoll. Photo by Naomi Blinick/USFWS Volunteer

Red-footed booby or ʻā (*Sula sula rubripes*) welcomes Civil Beat reporter Nathan Eagle to Laysan Island. Photo by Amanda Boyd/USFWS

USFWS demobilization team at work on Laysan Island. Photo by Dan Link/USFWS



[2] red-footed booby or ʻā (*Sula sula rubripes*)

CONSERVATION AND MANAGEMENT

A total of twelve conservation and management permit applications were submitted in 2017 of which 10 were issued and two were withdrawn by the applicant. These permits issued to the Co-Trustee agencies and others covered a range of conservation and management activities in the Monument that included field camps, vessel operations, protected species monitoring, coral reef monitor habitat restoration, and maritime heritage surveys (Table 9).

Table 9. Affiliations of conservation and management permittees and permitted projects in 2017.

Conservation and Management Permittee Affiliation	Number of Permits Issued	Permitted Conservation and Management Projects
Monument Co-Trustees	2	• Monument Co-Trustees
NOAA, Office of Marine and Aviation Operations (OMAO)	3	• Support for permitted activities aboard NOAA Ship *Oscar Elton Sette* • Support for permitted activities aboard NOAA Ship *Hi'ialakai* • Support for permitted activities aboard NOAA Ship *Reuben Lasker*
NOAA, National Marine Fisheries Service, Pacific Islands Regional Office & Pacific Islands Fisheries Science Center	2	• Hawaiian Monk Seal Conservation and Management Activities • Sea Turtle Surveying and Tagging at French Frigate Shoals
NOAA, National Marine Fisheries Service, Pacific Islands Regional Office & Pacific Islands Fisheries Science Center And NOAA, National Marine Fisheries Service, Southwest Fisheries Science Center	1	• Hawaiian Islands Cetacean and Ecosystem Assessment Survey
University of Hawai'i Marine Center	1	• Support for Permitted Activities Using the R/V *Kilo Moana*
NOAA, National Ocean Service, Office of National Marine Sanctuaries, Papahānaumokuākea Marine National Monument	1	• Maritime Heritage Conservation and Management Activities

Table 10 below outlines activities that occurred in 2017, which were permitted under the Conservation and Management Monument Co-Trustee permit. Reports of activities conducted under this permit are logged and monitored in the same manner as activities conducted under separate permits, and all reports are shared among Co-Trustee agencies in order to facilitate cooperative management of all Monument resources. A conservation and management permit of this nature is necessary for coordinated conservation and management of Monument resources.

Table 10. Activities conducted under the conservation and management Monument Co-Trustee permit in 2017, for NOAA, USFWS and DLNR.

Co-Managing Agency	Activities Conducted
USFWS, National Wildlife Refuge System	• Management, operation and maintenance of Midway Atoll facilities • Demobilization of Laysan Island and facilities • Laysan botanical collections • *Verbesina* removal at Midway Atoll • Habitat restoration activities • Bulky dump restoration at Midway Atoll • Lead-based paint remediation at Midway Atoll • Seabird Tissue Archiving and Monitoring Project (STAMP) • M/V *Kahana* field support missions • Translocation of Black-footed Albatross chicks from Midway Atoll National Wildlife Refuge to James Campbell National Wildlife Refuge • Environmental Protection Agency and USFWS site visit at Tern Island, French Frigate Shoals • Marine debris removal • Monitor wildlife populations
USFWS, Pacific Islands Fish and Wildlife Office	• Nihoa Millerbird population monitoring at Laysan Island and Nihoa • M/V *Searcher* field support missions • SSV *Makani 'Olu* field support missions
NOAA, National Marine Fisheries Service	• Marine debris removal • Sea turtle monitoring at French Frigate Shoals
NOAA, Office of National Marine Sanctuaries	• Vessel support for conservation and management activities aboard M/V *Searcher* • Assessing Health and Community Structure of Corals on Shallow-water Reefs • Pacific Reef Assessment and Monitoring Program • Documenting the Effects of Traditional SCUBA on Fish Assemblages
State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife	• Management, operation and maintenance of Kure Atoll facilities • Removal of *Verbesina* • Habitat Restoration efforts • Monitor Seabird and Laysan duck populations
Office of Hawaiian Affairs	• Collection of hulu manu in partnership with the NOAA, NMFS, Hawaiian monk seal field camps; State of Hawai'i, Kure Atoll field camp; and USFWS Midway Atoll National Wildlife Refuge and Laysan Atoll field station demobilization team

Table 11. Observational, catch and release, and collection activities that occurred under Conservation and Management permits in 2017.

Permitted Research Project	Catch and Release or Observational Research	Biological or Physical Samples Collected
Assessing Health and Community Structure of Corals on Shallow-water Reefs	• 36-10x10m plot surveys, each survey consists of 300-500 images for 3D reconstruction	• none
Pacific Reef Assessment and Monitoring Program	• 92-10x1m transect surveys • 180-15m cylinder plot surveys	• 11-whole (1 oz.) *Halimeda spp.* • 11-whole (¼ oz.) *Asparagopsis spp.* • 110-30 cm pieces of driftwood
Documenting the Effects of Traditional SCUBA on Fish Assemblages	• 68-30m transect surveys	• none
Collection of hulu manu in partnership with the NOAA, NMFS, Hawaiian monk seal field camps	• none	• 1 Laysan albatross or mōlī (*Phoebastria immutabilis*) feathers • 100 red-tailed tropicbird or koaʻe ʻula (*Phaethon rubricauda*) feathers • 3 great frigatebird or iwa (*Fregata minor palmerstoni*) feathers • 2 black-footed albatross or ka'upu (*Phoebastria nigripes*) feathers • 1 whole black-footed albatross or ka'upu (*Phoebastria nigripes*) • 10 whole laysan albatross or mōlī (*P. immutabilis*)
Sea turtle monitoring at French Frigate Shoals	• 711 island perimeter surveys for green sea turtle or honu (*Chelonia mydas*) nests • 4 satellite tags deployed	• 306 - 6mm biopsy punch from green sea turtle or honu (*Chelonia mydas*) from tagging • 1 deceased green sea turtle or honu (*C. mydas*) • 65 whole failed green sea turtle or honu (*C. mydas*) nests
Nihoa Millerbird population monitoring at Laysan Island and Nihoa	• *	• *
Marine debris removal	• none	• *

*Observational, catch and release, and collection activities data current as of time of publication.

Table 11. Observational, catch and release, and collection activities that occurred under Conservation and Management permits in 2017.

Permitted Research Project	Catch and Release or Observational Research	Biological or Physical Samples Collected
Seabird Tissue Archiving and Monitoring Project (STAMP)	• none	• 10 non-viable Laysan albatross or mōli (*P. immutabilis*) eggs • 6 non-viable black-footed albatross or kaʻupu (*P. nigripes*) eggs
Hawaiian Islands Cetacean and Ecosystem Assessment Survey	• 59 Conductivity, Temperature, Depth (CTD) casts • 3,219 photographs • 44 days of ship transect survey • 1 small boat operation for ~3 hours • 58 sonobuoys deployed • 69 sightings of cetaceans	• 1 small plug of skin and blubber humpback whale or koholā (*Megaptera novaeangliae*) • 3 small plugs of skin and blubber false killer whale (*Pseudorca crassidens*) • 1 small plug of skin and blubber bottlenose dolphin or naiʻa (*Tursiops truncatus*)
Hawaiian Monk Seal Conservation and Management Activities	• 1 female weaned Hawaiian monk seal or ʻīlioholoikauaua (*Neomonachus schauinslandi*) pup for health assessment • 171 Hawaiian monk seal or ʻīlioholoikauaua flipper tagging • 1 Hawaiian monk seal or ʻīlioholoikauaua mother/pup reunite • 5 Hawaiian monk seal or ʻīlioholoikauaua necropsies • 1 Hawaiian monk seal or ʻīlioholoikauaua released from rehabilitation • 167 Hawaiian monk seal or ʻīlioholoikauaua tagged • 2 Hawaiian monk seal or ʻīlioholoikauaua removed from wavewash 4 times • 2 interventions • 26 islet surveys • 28 interatoll translocations • 29 partial island surveys • 3 Hawaiian monk seal or ʻīlioholoikauaua forced weaning • 3 Hawaiian monk seal or ʻīlioholoikauaua umbilical snip • 49 surveys • 5 doses of antibiotics administered • 5 lake survey • 510 observations of 418 bleach marked Hawaiian monk seals or ʻīlioholoikauaua • 512 vaccinations administered • 72 whole atoll surveys • 8 disentanglements	• 211- 40 cc Hawaiian monk seal or ʻīlioholoikauaua (*Neomonachus schauinslandi*) blood • 3 Hawaiian monk seal or ʻīlioholoikauaua for rehabilitation at Ke Kai Ola Rehabilitation Facility • 3 Hawaiian monk seal or ʻīlioholoikauaua molts • 11 Hawaiian monk seal or ʻīlioholoikauaua placentae • 9 samples of Hawaiian monk seal or ʻīlioholoikauaua scat • 22 samples of Hawaiian monk seal or ʻīlioholoikauaua spew • 5 biopsy swabs from Hawaiian monk seal or ʻīlioholoikauaua captured for rehabilitation • 71 – 2mm x 2mm cylinder tissue plugs from Hawaiian monk seal or ʻīlioholoikauaua flipper tagging • 3 Hawaiian monk seal or ʻīlioholoikauaua tissue samples • 1 liver sample Galapagos shark or manō (*Carcharhinus glapagenesis*) • 1 muscle sample (Galapagos shark or manō (*C. glapagenesis*) • 22 cubic yards of marine debris (weight unknown)

Above NOAA diver Jason Leonard documents the wreckage of the *Brewster F2A-3 Buffalo* within the Midway lagoon. This site, discovered in 2012, was surveyed again in 2017 for invasive species and photographed for the creation of 3D photogrammetry outreach products. Photo by NOAA

Below Maritime heritage team members battle the elements in search of sunken relics at Midway Atoll. Photo by NOAA

Conservation and Management Highlights

Exploring the WWII Heritage of Midway Atoll: Searching for Sunken Relics from the Battle of Midway

In May 2017, a multi-agency team explored the shallow waters of Midway Atoll for reported and probable aircraft lost during World War II's momentous Battle of Midway. This year marked the 75th Anniversary of this significant event, and researchers aimed to increase understanding of this battle and to raise awareness and honor the legacy of the brave men who helped to turn the tide in the Pacific in favor of the Allied Forces.

Led by NOAA's Office of National Marine Sanctuaries (Principal Investigator Dr. Kelly Keogh) with collaborators from National Park Service's Submerged Resources Center (NPS/SRC), East Carolina University (ECU) and the USFWS, the project included remote sensing surveys for sunken aircraft sites in and around Midway lagoon using a magnetometer – a towed instrument that detects iron anomalies indicative of potential aircraft wrecks. The project also called for surveys of marine alien species on maritime heritage sites and collection of photo and video in order to create 3D images (or photogrammetry) of maritime heritage sites.

"This project to survey the sunken heritage of Midway Atoll was an incredible multidisciplinary and multi-agency effort," said Keogh. "The surveys demonstrated how successful collaborative efforts can be as a way to explore and share our collective history."

The six-person field team, led by co-PI Bert Ho of NPS's Submerged Resources Center, spent two weeks working at Midway Atoll. The magnetometer surveys amassed over 200 linear nautical miles of data that produced 137 magnetic anomalies, or targets – potential wreckage sites. Divers then visually investigated 102 of these sites and had positive findings on 86 of them, including: debris piles of discarded metals; dump sites with hundreds of glass bottles; I-beams from day markers; building scrap; telegraph cables; listening stations cables; wire rope and 12 anchors found ranging from the late 19th century to more modern Navy anchors of various sizes. In addition, on each of the 102 dives, a marine biologist evaluated and documented the presence or absence of four invasive species currently believed to be in the Monument that often grow on man-made structures and ships' hulls. Findings will help managers make decisions to better prevent the inadvertent transport of these species.

While it was not expected to find a fully-intact airplane sitting in the lagoon, Dr. Keogh explained, "We were cautiously optimistic that we would find something, anything, due to the massive amount of material found on the seafloor." The field team documented several of the known WWII-era aircraft sites at Midway, such as the F2A Brewster Buffalo and the Corsair, as well as a newly located engine believed to be a Pratt and Whitney Twin Wasp. "It is most likely part of an aircraft, we believe of the WWII-era, as it is located in an area that corroborates with witness accounts of downed planes during the Battle of Midway. As scientists we want to be conclusive, and to be so, we always need more data!"

Reflecting on a successful survey, Ho says that this survey and documentation "is the best way for us to honor those who fought and lost their lives in the battle. As archaeologists and historians, we strive to tell the whole history accurately with as many tangible artifacts to guide us to that goal. We also need to show the public what we find in a meaningful way that not only corroborates the history we are telling, but hopefully in a way that enriches their knowledge of the past with visuals from the present."

Dr. Keogh and her team continue to analyze, compare and consult with colleagues and subject experts on all the data that was collected from this expedition.

Top Left NOAA diver Brian Hauk surveys for marine alien species on and around WWII wreck sites at Midway Atoll. Photo by Jason Leonard/NOAA

Top Right NOAA diver Jason Leonard dives on one of several historic anchors discovered and documented during a remote sensing survey at Midway Atoll. Photo by Brett Seymour, NPS/SRC

Above Right The six-person field team surveying for Midway's sunken heritage pose with Refuge Manager Robert Peyton. Photo by NOAA

Battle of Midway 75th Anniversary Commemoration Ceremony Honors American Service and Sacrifice in the Pacific

On June 5, 2017, the USFWS, U.S. Navy and the National Park Service commemorated the 75th anniversary of the Battle of Midway, and honored the veterans of the battle in ceremonies and activities at MANWR and Battle of Midway National Memorial in PMNM; the World War II Valor in the Pacific National Monument in Honolulu, HI; the USS Midway in San Diego, CA; the U.S. Navy Memorial in Washington, D.C.; the National World War II Museum in New Orleans, LA; the National Naval Aviation Museum in Pensacola, FL; and the Mokupāpapa Discovery Center in Hilo, HI. The American victory at Midway was a turning point of the war in the Pacific. The U.S. Navy recognizes the Battle of Midway as one of the most significant events in naval history.

The early morning ceremony at World War II Valor in the Pacific National Monument on O'ahu in the main Hawaiian Islands honored the many veterans whose determination and sacrifice led to the U.S. and allied forces victory in the war in the Pacific. The ceremony featured remarks from Rear Admiral Andrew Singer (U.S. Navy, retired), Deputy Director for Intelligence, U.S. Pacific Command, USFWS Pacific Regional Director Robyn Thorson, and World War II Valor in the Pacific National Monument Superintendent Jacqueline Ashwell.

"We commemorate this event in history to give honor to those who carried it out and to those who continue to carry forth the American spirit of sacrifice, service, duty and overcoming adversity with honor, courage and commitment," said Rear Admiral Singer.

Below Left American Battle Monuments Commission Memorial stands as a reminder of the sacrifices made during the historic Battle of Midway 75 years ago. Photo by USFWS

Bottom Left Sailors carry the remembrance wreath during the 75th Battle of Midway commemoration at World War II Valor in the Pacific National Monument. Photo by Amy Olliffe/USFWS

Bottom Right Sailors form two columns and render a rolling salute as the ceremonial remembrance wreath passes down the line. Photo by Amy Olliffe/USFWS

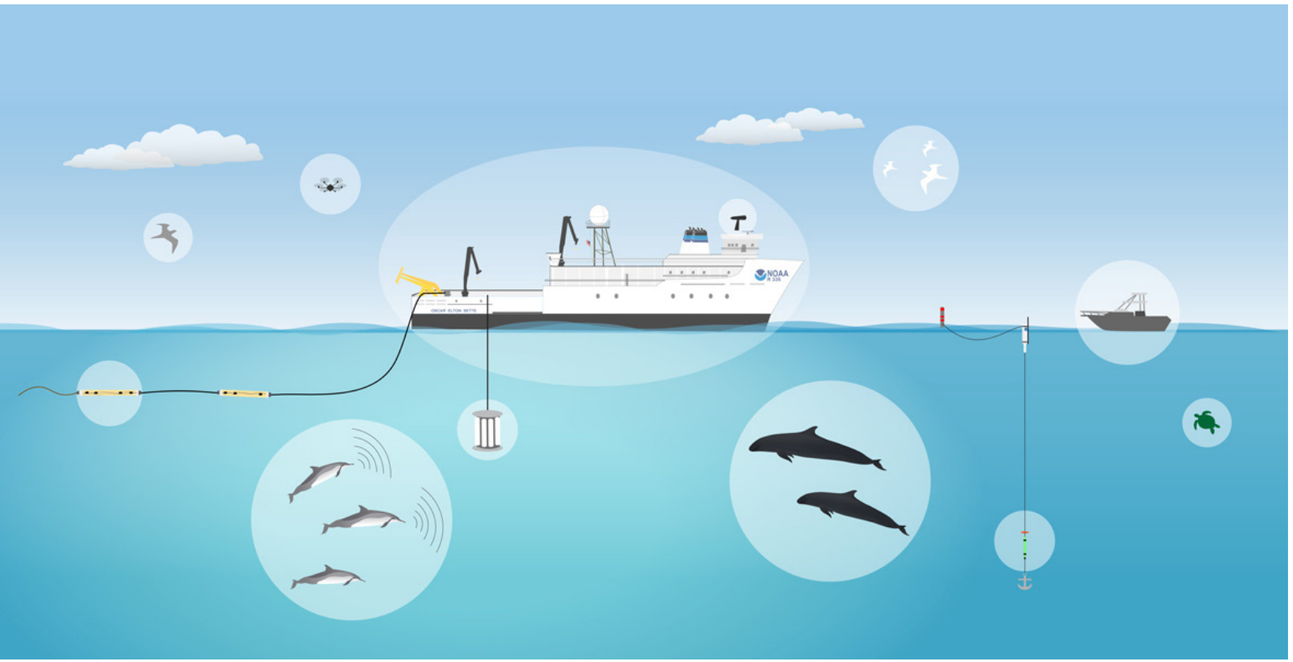
The ceremony included a live video stream of a joint U.S. Navy and USFWS commemoration that took place on MANWR and Battle of Midway National Memorial in the Monument. Two veterans of the Battle of Midway, Colonel John F. Miniclier and Sergeant First Class Edgar R. Fox, were present at the ceremony on Midway to represent the remaining survivors of the historic battle. Colonel Miniclier and Sergeant Fox were among the sailors, aviators and Marines who laid their lives on the line against the Japanese attack, triumphing against all odds during the three-day assault in which the Americans were outnumbered and outgunned.

"There are moments of history that are stunningly singular and stand out as pivotal where destiny does turn on a moment; such was the Battle of Midway," said Pacific Regional Director Thorson. She also stated that the battle merits our attention, respect, and remembrance by paying tribute and continuing to tell its story. "Thank you to the veterans of all branches of the service, including those at today's ceremony and those on active duty; our American lives and livelihood stands on your shoulders."

The MANWR and Battle of Midway National Memorial preserve the memory of those who gave their all at Midway. The USFWS staff, volunteers and partners work together to conserve and protect this significant historical site. "I really can't think of a better use of the place," Sgt. Fox stated. "The Refuge is a great monument to the people who passed here."

The ceremony concluded with sailors from the U.S. Navy conducting a ceremonial salute and wreath-laying. The U.S. Pacific Fleet Band and a joint color guard representing all military branches contributed to the solemnity of the day.

Above Navy personnel and Battle of Midway veterans Colonel John F. Miniclier and Sergeant First Class Edgar R. Fox stand at attention during remembrance wreath ceremony at Battle of Midway National Memorial. Photo by Kristy Lapenta/USFWS



Above There are four major research components to HICEAS: visual observations for cetaceans, including photo-identification, biopsy sampling, and satellite tagging; passive acoustic monitoring using towed hydrophone arrays and other tools; ecosystem assessment, including visual surveys for seabirds and measurement of oceanographic variables; and other ancillary projects, such as aerial photogrammetry using a hexacopter, testing of new passive acoustic tools, and other projects that support and augment the assessment mission. Graphic by NOAA

Dolphins, Porpoises and Whales, Oh My! Partners Survey for Cetaceans in the Waters of Hawai'i

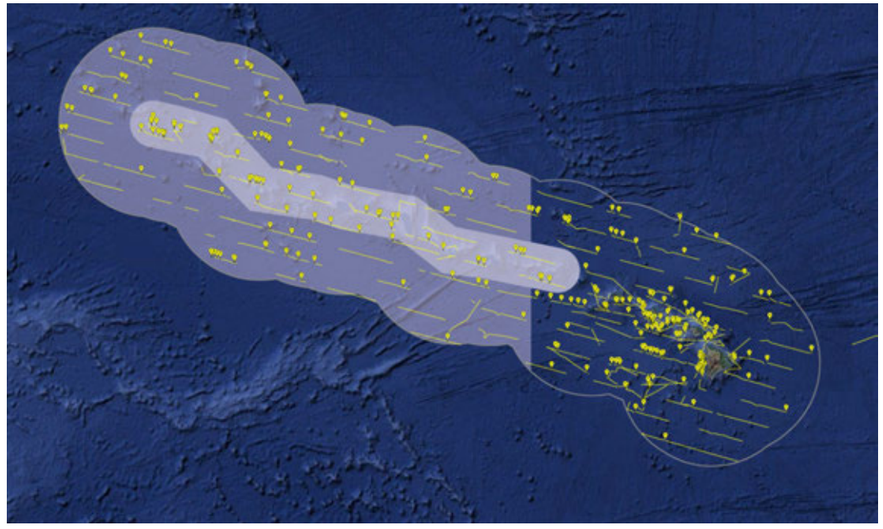
The Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS) is a large-scale ship-based survey of cetaceans (dolphins, porpoises and whales) and seabirds, with the primary goals of: collecting data to estimate the abundance and distribution of cetaceans and seabirds within Hawaiian waters; examining their population structure; and understanding their habitat. The study area includes waters surrounding all Hawaiian Islands, from the Big Island to Kure Atoll, out to the EEZ, 200 nautical miles offshore.

In 2017, HICEAS was carried out as a collaboration between the Pacific Islands and Southwest Fisheries Science Centers. From 2 July to 1 December, researchers conducted surveys aboard NOAA Ships *Oscar Elton Sette* and *Reuben Lasker*, spanning 179 days-at-sea across both ships. During this time, there were 345 sightings and 766 acoustic detections of at least 23 cetacean species, and several thousand sightings of at least 45 species of seabirds.

"Considered collectively, the cetacean sightings illustrate the boom-or-bust pattern in the study area quite nicely," said Karin Forney HICEAS Cruise Leader. "Some survey transects had no sightings at all, and some had many groups of different species. This result underscores the - often hidden - features of our ocean ecosystems that determine species distribution and abundance. Over the next several months, we'll be working to derive new abundance estimates for the cetacean species we detected."

The HICEAS effort in 2017 represented the first Cetacean and Ecosystem Assessment Survey within the Pacific Marine Assessment Program for Protected Species (PacMAPPS), a partnership between NOAA Fisheries, the U.S. Navy, the Bureau of Ocean Energy Management, and USFWS. PacMAPPS includes rotational surveys throughout the Pacific in regions of joint interest to assess the abundance of cetacean and seabird species and their ecosystems.

The HICEAS effort was also conducted in 2002 and 2010 using many of the same methods and encompassing the same study area. Visual sighting and acoustic recording data are being processed (quality checked, analyzed, and summarized); photographs are being incorporated into photo identification catalogs; tissue samples are being processed for genetic information; satellite tag data continues to be collected in real-time and will be analyzed after the last satellite tag ends transmission; visual sighting data for seabirds are being summarized and quality checked; and ecosystem measurements are being analyzed by oceanographic scientists. The collective HICEAS 2017 effort is being compiled into a NOAA Technical Memorandum at PIFSC planned to be submitted for in-house publication review in March 2018.



Below Left Daytime survey efforts (yellow lines) and cetacean sightings (yellow map markers) within the Hawaiian EEZ (outer grey line) during HICEAS 2017 aboard NOAA Ships *Oscar Elton Sette* and *Reuben Lasker*. The area shaded in grey is the Papahānaumokuākea Marine National Monument, and the lighter shaded area shows where the Monument was expanded in 2016. Graphic by NOAA

Below Right Spinner dolphin or naiʻa (*Stenella longirostris*). Photo by Paula Olson/NOAA

Bottom Right False killer whale or nuʻao (*Pseudorca crassidens*). Photo by Mark Cotter/NOAA

Black-footed Albatross Chicks Welcomed to New Home

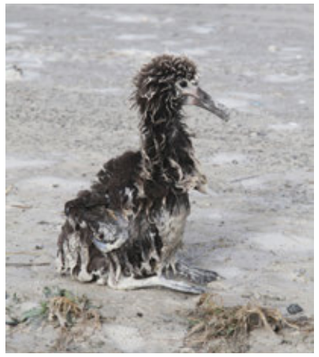
Late at night on February 16, fifteen black-footed albatross or ka'upu (*Phoebastria nigripes*) chicks made a special landing at Honolulu International Airport. These former residents of Midway Atoll were flown from their remote birth place and transported to their new home at James Campbell National Wildlife Refuge (JCNWR) on the north shore of O'ahu. The translocation of these small, fluffy chicks are part of a pioneering effort to establish a new albatross colony in the main Hawaiian Islands. Large waves associated with winter and spring storms cause a disproportionately greater loss in nests for birds nesting along the outer, more exposed sandy beaches of islands and atolls. Black-footed albatrosses generally nest in higher densities along outer sandy beaches and thus may be more vulnerable to the negative impacts of rising sea levels and storm surges.

"Midway Atoll is home to one of the largest black-footed albatross populations in the world. As conservation managers, it is important we use good science to evaluate other options that might protect these seabirds into the future," said Midway Atoll Refuge Manager Bob Peyton. "Refuges like Midway Atoll and James Campbell provide the healthy habitat that black-footed albatross, and other seabirds, need to thrive."

Black-footed albatross currently have a few small colonies on volcanically active islands near Japan and one colony on the small islet of Lehua near Kaua'i. The remaining 90% of the world's breeding population reside within PMNM on Tern Island, an islet in French Frigate Shoals, Laysan Island, Midway Atoll, and Kure Atoll and. These areas have very low elevations and are predicted to be highly susceptible to sea level rise and storm surges in the coming century.

Below An albatross chick (*Phoebastria sp.*) after being overwashed by the tide on Midway Atoll. Photo by Pete Leary/USFWS

Right Biologist Eric VanderWerf carefully moves the black-footed albatross or ka'upu (*Phoebastria nigripes*) chicks from their nest sites into carriers for the ride to their new home. Photo by Lindsay Young/Pacific Rim Conservation



"We know that sea level rise and increased storm surges are a threat to this species, and many others. We have an opportunity to do something to mitigate that threat now, before it becomes an emergency," said Eric VanderWerf of Pacific Rim Conservation.

The chosen translocation site at JCNWR is high enough that they are less at risk from rising sea levels and increasing storm surges. Additionally, birds nesting within the predator-proof enclosure are protected from non-native predators that are prevalent in the main islands such as mongooses, rats, and feral cats and dogs.

"We are thrilled that the Refuge can provide a safe place and a new home for this species on O'ahu," said Joseph Schwagerl, JCNWR refuge manager. "This translocation is the first step toward creating a new colony of black-footed albatross in the main Hawaiian Islands and ensuring the albatross will be protected for future generations."

The three-week-old chicks were hand fed a diet of fish and squid and closely monitored by biologists for four to five months until they were able to fly out to sea and feed themselves. Black-footed albatross chicks imprint on their birth colony at about one month of age and will return as adults to breed at the same colony. By moving the chicks during this critical one-month period, they will imprint on their new home at JCNWR and plant the seeds of a new colony when they return as adults to raise their own chicks.

Above The black-footed albatross or ka'upu (*Phoebastria nigripes*) chicks with Laysan albatross or mōlī (*Phoebastria immutabilis*) at their new home at James Campbell National Wildlife Refuge on O'ahu. Photo by Lindsay Young/Pacific Rim Conservation

Top Long shadows after a long day of work. Laysan Island demobilization team heads back to base camp. Photo by Dan Link/USFWS

Above USFWS staff carry 50 gallon drums that were used for the former native plant nursery. Photo by Dan Link/USFWS

Laysan Island: A Conservation Success Story

Laysan Island is located in the HINWR within the Monument approximately 800 miles NW of O'ahu. In the late 19th and early 20th centuries Laysan was the site of guano mining operations, leading to the introduction of invasive species and the extinction of several endemic species. The introduction of rabbits in particular caused a near complete loss of vegetation and thus food supply for many Laysan endemics. By the time the Tanager Expedition arrived in 1923, the majority of the island, once a forested oasis, had become desert-like; only four native plant species were documented. Restoration efforts began during that trip and continue today.

The USFWS maintained a year-round field camp from 1989 to 2013 where scientists conducted resource management programs including habitat restoration, wildlife surveys and monitoring, species translocations, and hazard mitigations. This effort resulted in many success stories including the eradication of sandbur (*Cenchrus echinatus*), the re-introduction of a number of extirpated plant species and the introduction of Nihoa millerbirds or ulūlu niau (*Acrocephalus familiaris kingi*)[3] to fill a niche that had been empty for nearly a century. Several crucial lessons in invasive species prevention and control were learned on Laysan, which have since been applied to other Pacific islands.

In 2017, the success of past conservation efforts was marked with the removal of the last of the USFWS camp facilities from the island. The final step in demobilizing the human footprint on Laysan required a crew of 11 spending four weeks dismantling infrastructure, removing old plant nurseries and water catchment systems and deconstructing a hurricane shelter. The task involved many hours of careful digging, dismantling, lifting and carrying years of accumulated infrastructure off the island with minimal amount of disturbance to island wildlife. Lots of meticulous planning and preparation went into the success of removing the human footprint from Laysan. The only items left that show any past human activity (besides guano piles and marine debris) are tent platforms left in the previous campsite. The tent platforms were left in place for the benefit of the wildlife, as a place for biologists and researchers to camp without disturbing the ground nesting seabirds during future trips to Laysan.

After years of restoration efforts, we now look back on both our accomplishments and lessons learned to guide us forward in determining the future direction of invasive species management and habitat restoration in PMNM. Laysan biological programs will continue to monitor status and trends of wildlife by using Rapid Ecological Assessment methods that can be performed during short visits to the island. The USFWS along with its partners will continue to monitor the success story of Laysan Island for years to come.

[3] Nihoa Millerbirds (*Acrocephalus familiaris kingi*) Hawaiian name is ulūlu, whereas a population of ulūlu established on Laysan Island are called ulūlu niau, signifying the smooth translocation efforts.

Bottom Left Laysan Island demobilization team. Photo by Joseph Kaye/USFWS

Below Right USFWS staff remove the human footprint from Laysan Island. Photo by Dan Link/USFWS

Bottom Right Laysan Island temporary field camps at dusk. Photo by Amanda Boyd/USFWS

Above Black-footed albatross or kaʻupu (*Phoebastria nigripes*) and Laysan albatross or mōlī (*Phoebastria immutabilis*) portray an idyllic scene on Midway Atoll. Photo by Kristy Lapenta/USFWS

Perpetuating Traditions

During August 2017, the USFWS completed the removal of the old base camp located on Laysan Island. Eleven volunteers assisted in the work, staying on island for a month, breaking down structures and tents, and moving gear to be easily taken off island. During this trip, and also under the Co-Trustee's Conservation and Management permit, volunteer Hōkū Cody collected hulu manu (bird feathers) to be used in making lei hulu (feather garland) for the makahiki[4] ceremonies on the islands of Molokaʻi and Kahoʻolawe. Feathers from black-footed albatross or kaʻupu (*Phoebastria nigripes*) were specifically gathered, as they are a kinolau (many bodily forms) of the Hawaiian god Lono, whom the makahiki ceremonies recognize. Deceased birds and feathers from deceased birds found on-island, were collected through a Migratory Bird Treaty Act permit administered by OHA. Collections of these birds and their feathers give them new life through the cultural practices they are used for.

Over the course of the past several years, Hōkū has learned the art of lei hulu through various kupuna (elders) and her own practices. Hōkū had previously spent significant time on both Kure Atoll and Midway Atoll through various field camps. During that time, she garnered the interest in collecting birds and feathers for various cultural practices and continues to work with field staff stationed in the Monument on culturally appropriate, practical and sustainable collection methods.

Cody went through the process of selecting, then carefully de-feathering the birds, and cleaning, preserving and storing the kaʻupu feathers, refining her process along the way. Lei hulu were made by lashing on individual feathers to a line in a spiral-like fashion, giving the three foot long lei (garland) a full appearance. Once complete, lei for Kahoʻolawe were transported on the voyaging canoe Hōkūleʻa for the start of the ceremonies. Members of the Protect Kahoʻolawe ʻOhana expressed gratitude for the efforts of Cody and the process of obtaining the feathers, saying that the experience has helped to elevate the mana or spiritual power of their practices.

Below Hōkū Cody holds lei hulu or feather lei made of Laysan albatross or mōlī (*Phoebastria immutabilis*) and Black-footed albatross or kaʻupu (*Phoebastria nigripes*) feathers for Makahiki ceremonies. Photo by Erin Pickett

Bottom Makahiki ceremony on Kahoʻolawe. Akua loa (an instrument of worship representing the Hawaiian god Lonomākua) with lei hulu in the background. Photo by Hōkū Cody

[4] Native Hawaiian festival beginning at the time of year when the constellation Makaliʻi or Pleiades rises during the setting of the sun and lasts about four months. This period of time was designated as a time of peace and was celebrated with sports and religious festivities.

NATIVE HAWAIIAN PRACTICES

In 2017, there were three Native Hawaiian Practices permit issued. One permit was issued to OHA for archaeological studies on the islands of Mokumanamana and Nihoa. Another permit was for a long-term project that uses traditional ecological knowledge to examine nearshore ecosystems. This project is now in its ninth continuous year of research. The Polynesian Voyaging Society was again awarded a permit to access the Monument for novice apprentice training sails on traditional voyaging canoes including the world-famous Hōkūleʻa.

Table 12. Affiliations of Native Hawaiian Practice permittees and permitted projects in 2017.

Native Hawaiian Practices Permittee Affiliation	Number of Permits Issued	Permitted Native Hawaiian Practices Projects
Office of Hawiian Affiairs	1	• Archaeological Surveys of Mokumanamana (Necker) and Nihoa Islands
Nā Maka o Papahānaumokuākea & Conservation International	1	• Using Traditional Ecological Knowledge to Examine Nearshore Ecosystems for Collections of Additional Intertidal Marine Invertebrates
Polynesian Voyaging Society	1	• Apprentice Navigator Training Sails Aboard Traditional Voyaging Canoes

Right Crew aboard the SSV *Makani ʻOlu* enjoy a view of the prominent cliffs of Nihoa. Photo by Brad Kaʻaleleo Wong/OHA

Native Hawaiian Practices Highlights

Kaulana e ka holo – A Celebrated Voyage

In March 2017, a team of researchers from various backgrounds and agencies embarked on a trip aboard the sailing school vessel SSV *Makani ʻOlu* to the islands of Nihoa and Mokumanamana. Their objectives were to continue the archaeological work started by Dr. Kekuewa Kikiloi and to assist the USFWS with invasive species removal.

The ship arrived at Nihoa on a beautiful sunny day with calm winds, perfect for landing at that location. However, a large northwest swell began to arrive a few days early and sizable surf had started to pound the shorelines. Captain Kalei Velasco, a veteran captain of the region, made the call that the conditions were

Above SSV *Makani ʻOlu* crew conduct ceremony upon a sunrise arrival at Mokumanamana. Photo by Brad Kaʻaleleo Wong/OHA

Top Left Kepoʻo Keliʻipaʻakaua enjoys a view of Nihoa from the bowsprit of the SSV *Makani ʻOlu*. Photo by Brad Kaʻaleleo Wong/OHA

Above Left Red-footed booby or ʻā (*Sula sula rubripes*) hitches a ride on the boom of the SSV *Makani ʻOlu*. Photo by Brad Kaʻaleleo Wong/OHA

Top Right The late afternoon sun illuminates Nihoa. Photo by Brad Kaʻaleleo Wong/OHA

too dangerous to land, as the swell would again increase the next few days. The decision was the correct one, as the swell continued to build through the day and surf could be heard through the night as they left Nihoa and headed for Mokumanamana.

The vessel and crew were greeted at Mokumanamana by flocks of boobies or manu ʻā (*Sula sp.*) and great frigatebirds or ʻiwa (*Fregata minor palmerstoni*) soaring above as the sun began to rise. The crew had prepared several oli (traditional chants) and ʻawa (kava, ceremonial drink and an offering for the place) for this immensely sacred island. Everyone understood that the north swell would be even more intense at Mokumanamana and a landing was highly unlikely. Sure enough, Kanaloa the Hawaiian god of the ocean was on full display, large waves crashing upon the island spraying high up the cliffside. Hazy ʻehukai (sea spray), could be seen through the shining sunlight, making the island appear as if it were draped in mist.

In the end, landfall was not possible at either island location and none of the planned on-island objectives could be accomplished due to adverse ocean conditions. However, there were no complaints or what-ifs as there was more to be learned from each other and from the experiences of seeing the islands in a different way. Not every expedition needs to go according to plan to be considered a success.

"It's amazing when you live the words of your kūpuna: He aliʻi ka ʻāina, he kauwā ke kanaka; the land is a chief, man is its servant,"[5] said expedition participant Kalani Quiocho.

[5] Hawaiian phrase from Mary Kawena Pukuʻs ʻŌlelo Noʻeau Hawaiian Proverbs and Poetical Sayings (Bishop Museum Press, 1983).

SPECIAL OCEAN USE

In 2017, three Special Ocean Use (SOU) permit applications were received and processed. Of the three received; one was withdrawn and two were rolled over to continue processing in 2018.

Special Ocean Use Revenue Reported

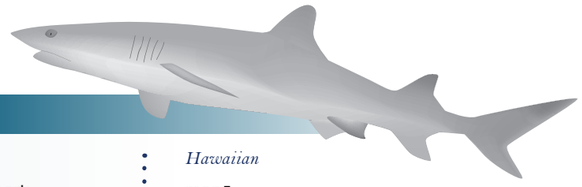
Each permittee with an SOU permit is required to "submit an annual report not later than December 31 of each year that describes activities conducted under that permit and revenues derived from such activities during the year" (50 CFR 404.11.f). In 2017 no SOU revenue was reportedly generated from activities in the Monument.

RECREATION

While recreation activities are permitted only in PMNM within Midway Atoll Special Management Area as per federal regulations for PMNM (50 CFR Part 404), no recreation permits were issued in 2017. Access for general visitation purposes was previously allowed at Midway Atoll National Wildlife Refuge; however, due to reductions in refuge staff and operational capacity, historical and eco-tour access is not currently offered. USFWS is considering visitation options in the future if operational support becomes available.

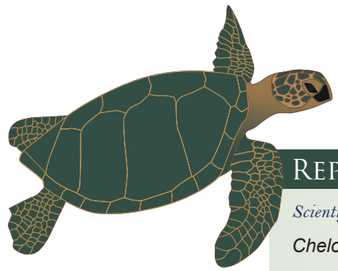
Left USFWS Biological Technician Greg Schubert guides a group through Hale O Lāʻau Kamaʻāina, Midway Atoll National Wildlife Refuge's native plant nursery. Photo by Pua Kamaka/NOAA

*Species Mentioned in the Permitted Activities 2017 Annual Report**



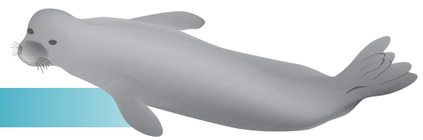
Fish

Scientific	*Common*	*Hawaiian*
Carcharhinus galapagensis	Galapagos shark	manō



Reptiles

Scientific	*Common*	*Hawaiian*
Chelonia mydas	Hawaiian green sea turtle	honu

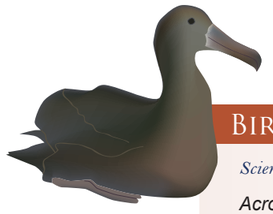


Marine Mammals

Scientific	*Common*	*Hawaiian*
Megaptera novaeangliae	humpback whale	koholā
Neomonachus schauinslandi	Hawaiian monk seal	‘īlioholoikauaua
Pseudorca crassidens	false killer whale	nu‘ao
Stenella longirostris	spinner dolphin	nai‘a
Tursiops truncatus	bottlenose dolphin	nai‘a

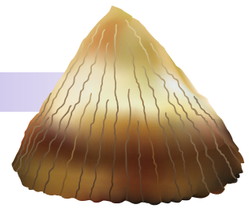
*Hawaiian naming practices differ from Western taxonomic nomenclature. Hawaiian names may be specific to a species or a group of organisms based on similar characteristics such as appearance, physiology, ecological function and habitat. For example, pipipi is the general name for a group of intertidal snails (e.g., *Echinolittorina hawaiiensis* and *Nerita picea*) and the name pipipi kōlea refers to the species *Littorina pintado*.

*Nihoa Millerbirds (*Acrocephalus familiaris kingi*) Hawaiian name is ulūlu whereas a population of ulūlu established on Laysan Island are called ulūlu niau, signifying the smooth translocation efforts..



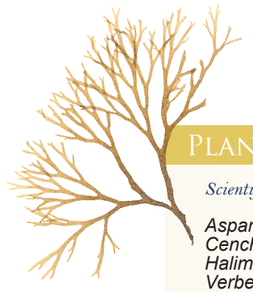
Birds

Scientific	*Common*	*Hawaiian*
Acrocephalus familiaris kingi	Nihoa Millerbird*	ulūlu
Acrocephalus familiaris kingi	Nihoa Millerbird	ulūlu niau
Anas laysanensis	Laysan duck	koloa pōhaka
Fregata minor palmerstoni	great frigate bird	‘iwa
Gygis alba	white tern	manuokū
Onychoprion fuscatus	sooty terns	‘ewa‘ewa
Phaethon rubricauda	red-tailed tropicbird	koa‘e‘ula
Phoebastria immutabilis	Laysan albatross	mōlī
Phoebastria nigripes	black-footed albatross	ka‘upu
Sula sp.	boobies	‘ā
Sula sula rubripes	red-footed booby	‘ā
Telespiza cantans	Laysan finch	‘ainohu kauo



Invertebrates/Corals

Scientific	*Common*	*Hawaiian*
Cellana sp.	limpet	‘opihi
Colobocentrotus atratus	shingle urchin	hā‘uke‘uke
Grapsus tenuicrustatus	rock crab	a‘ama



Plants

Scientific	*Common*	*Hawaiian*
Asparagopsis spp.		limu kohu
Cenchrus echinatus	sandbur	
Halimeda spp.		limu
Verbesina encelioides	golden crown beard	

Front cover photo by Greg McFall/NOAA Office of National Marine Sanctuaries. Back cover photo by Kekuewa Kikiloi.