# PU‘UHONUA
# A PLACE OF SANCTUARY

## The Cultural and Biological Significance of the proposed expansion for the Papahānaumokuākea Marine National Monument

**June 2016**

EXPAND

# PAPAHĀNAUMOKUĀKEA

He Pu'uhonua no Hawai'i A Sanctuary for our Ocean Heritage

*"As reserves grow in size, the diversity of life surviving within them also grows. As reserves are reduced in area, the diversity within them declines to a mathematically predictable degree swiftly – often immediately and, for a large fraction, forever."*

--E.O. Wilson

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# Summary


- The Papahānaumokuākea Marine National Monument was declared in 2006 and was at the time the largest marine protected area in the world.
- There is an opportunity for the Obama Administration to use the Antiquities Act to expand the area of protection nearly 5-fold, thus creating the world's largest marine protected area and leaving a cultural and environmental legacy for future generations.
- Protections would eliminate or reduce impacts of present and future extractive and anthropogenic activities such as commercial fishing as well as those posed by the imminent growth of seabed mining.
- The Northwestern Hawaiian Islands are considered sacred to Native Hawaiians and provides the best contemporary approach to help promote protection of the area.
- The waters around these islands must also be seen as cultural seascapes that have meaning and significance in the formation and perpetuation of Hawaiian and oceanic identity.
- Native Hawaiians genealogically link to all resources as biocultural resources and the region provides the best spiritual connection and experience for practitioners.
- The ocean waters in this region were part of a 400-500 year voyaging sphere in ancient times, and continue to be vital to the survival of the traditional practice of wayfinding and voyaging.
- The Office of Hawaiian Affairs, the formal institution representing the Native Hawaiian people, has requested to be elevated as a co-trustee, giving them an equal role in resource management of the monument.
- The remains of the Battle of Midway, and most notably the wreck of the aircraft carrier USS Yorktown, lie in the area of proposed expansion.
- Key ecosystems that would benefit from expansion include coral reefs, seamounts, pelagic areas, guyots, and abyssal seabed communities.
- Populations of seabirds, turtles, whales, predators such as sharks and tuna, and bottom life associated with seamounts and hydrothermal vents would benefit from the expansion.
- Marine protected areas are most effective when they are large, remote, strongly protected, protected for a long time, and enforced. Expanding the monument would make it even more effective at conserving wildlife, improving ecosystem health, and increasing climate change resiliency.
- The area being proposed for expansion is not a major fishing ground according to publicly available data from NOAA. In fact, log books show that the effort in the region has been dramatically decreasing over the last five years.
- Hawaii longline catch quotas are set by the negotiations that take place at the Western Central Pacific Fisheries Commission, not the placement of marine protected areas. An expanded monument simply displaces fishing effort and will not reduce the overall catch for the Hawaii longline fishery. In fact, the expansion of the monument would therefore have no or only minimal negative impacts on the Hawaiian and US economy.

# Background

The Obama Administration is building towards a legacy of ocean protection unrivaled by any previous president in American history. One of the first acts of his administration was to begin the development of a National Ocean Policy, which began implementation in 2013. In 2014, the president used his authority under the Antiquities Act of 1906 to expand three of the five marine protected areas managed collectively as the Pacific Remote Islands Marine National Monument, enlarging the area under protection from 225,000 square kilometers to 1.2 million square kilometers. The president has the opportunity today to build upon these earlier decisions by expanding the Papahānaumokuākea Marine National Monument, thus creating the world's largest contiguous protected area before he leaves office and protecting more of the Earth's surface than any man or woman in history.

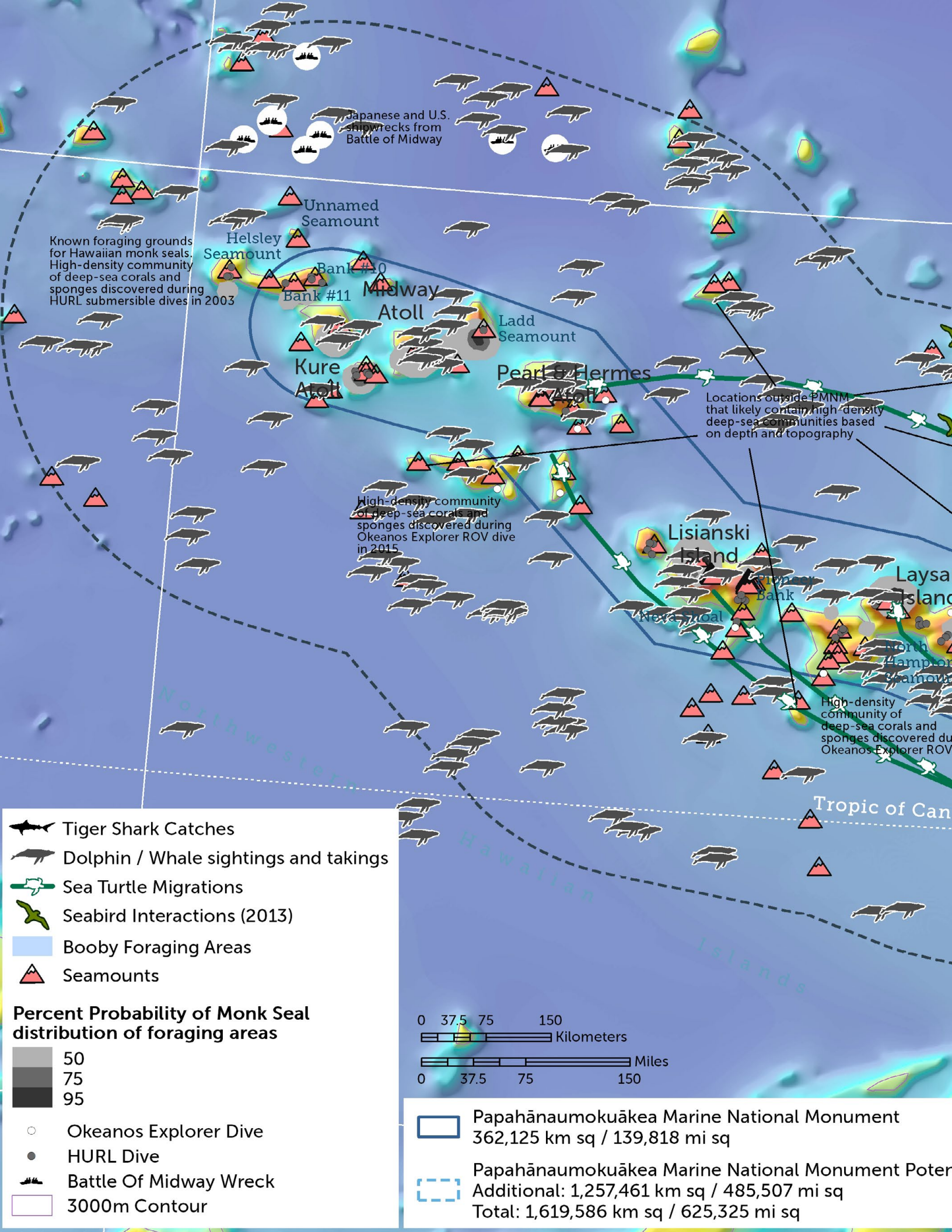
The Papahānaumokuākea Marine National Monument (PMNM) is a U.S. National Monument and UNESCO World Heritage site encompassing 363,000 square kilometers of ocean waters, an area about the size of Germany. The monument currently includes ten islands and atolls that are internationally recognized for their cultural and natural importance.

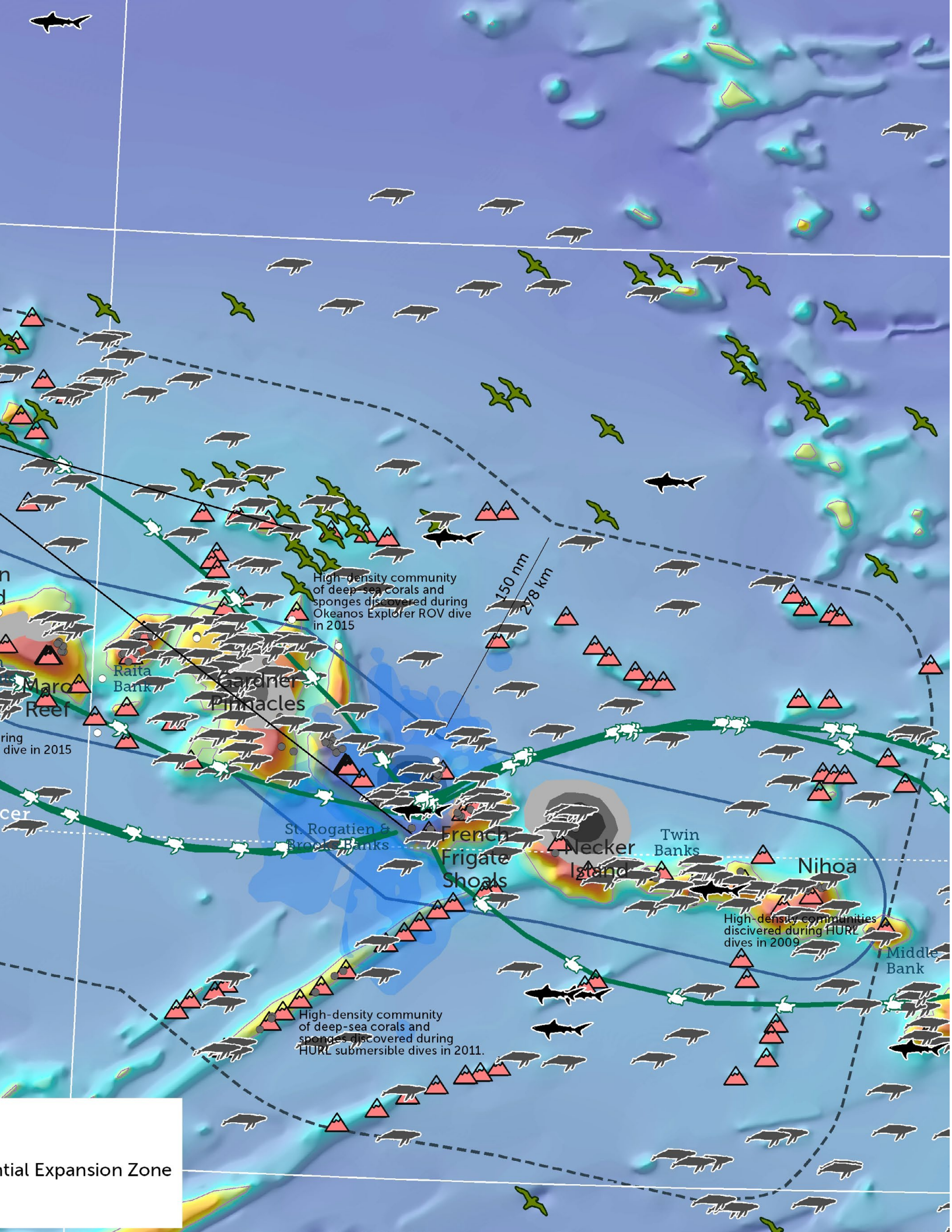
Established by Presidential Proclamation 8031 on June 15, 2006 under the authority of the Antiquities Act (16 U.S.C. 431-433), the Papahānaumokuākea Marine National Monument commemorates the union of two Hawaiian ancestors – Papahānaumoku and Wākea – who gave rise to the Hawaiian Archipelago, the taro plant, and the Hawaiian people. Prior to Papahānaumokuākea, no other ocean territory had been set aside for protection at such a significant level. Upon its creation in 2006, Papahānaumokuākea became the largest strongly protected marine reserve in the world, wherein all commercial activity is prohibited and only light recreational and subsistence fishing is allowed[1].

The monument marked such a critical moment for ocean conservation that it instigated an international movement to create large, strongly-protected marine reserves around the world. As such, the original monument was followed by the establishment of nine marine reserves that are currently larger in size.

The monument area boasts a unique bipartisan conservation legacy. Six U.S. presidents have taken action to protect the unique ecosystems and wildlife of the Northwest Hawaiian Islands. Starting in 1909, President Theodore Roosevelt declared the Hawaiian Islands Bird Reservation to stop sea bird poachers. President Franklin D. Roosevelt broadened the protections to all species in 1940 and formed the Hawaiian Islands National Wildlife Refuge. President Lyndon B. Johnson provided additional protections in 1967. In 1988, President Ronald Reagan created the Midway Atoll National Wildlife Refuge. In 2000, President Bill Clinton established the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, creating the largest single nature preserve in the United States. Most recently, President George W. Bush designated the Papahānaumokuākea Marine National Monument in 2006.

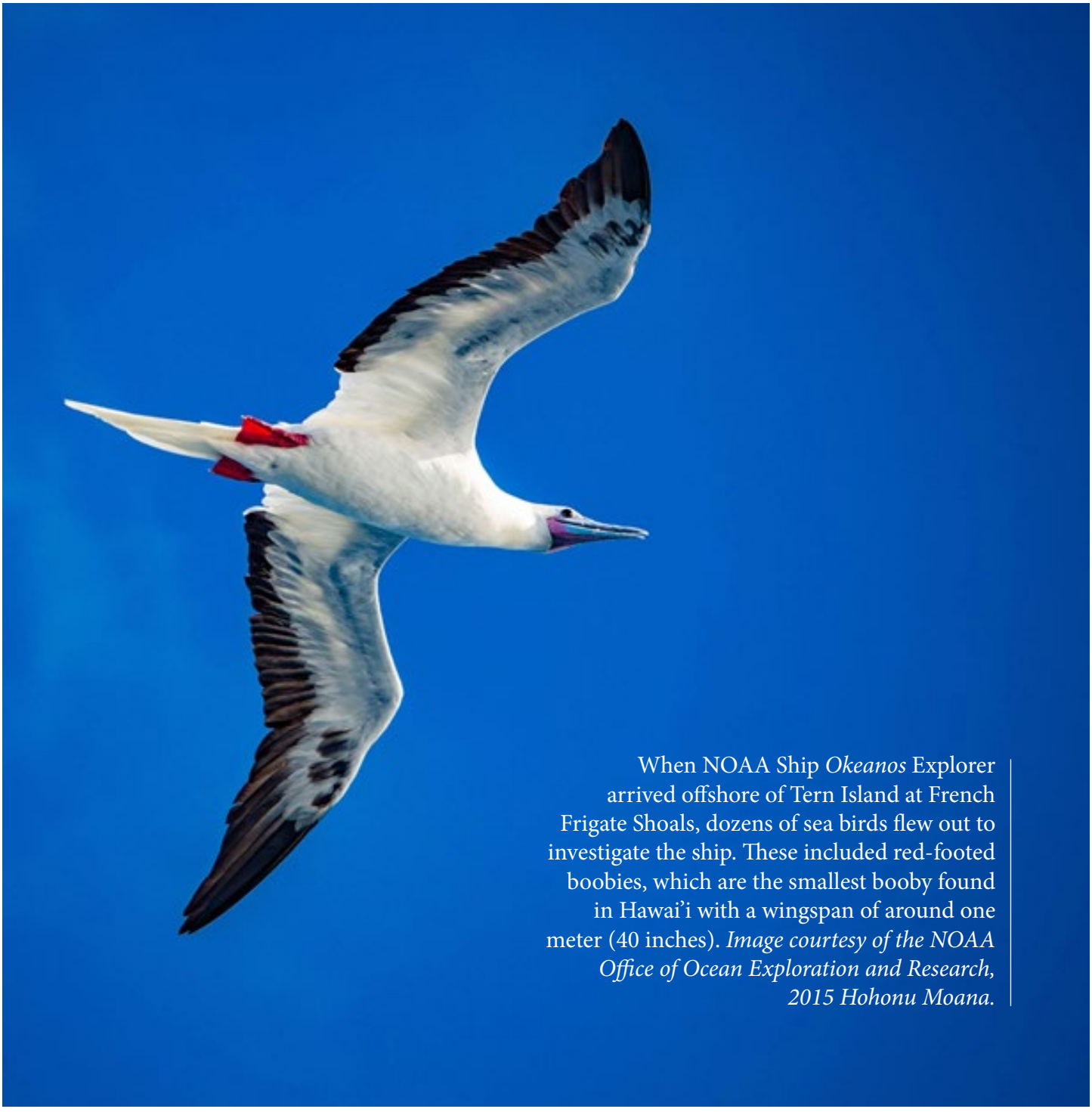
When Papahānaumokuākea was established in 2006, it was a groundbreaking idea that management of a large scale protected area could recognize both natural resources and cultural resources as one and the same. The success of this approach has inspired other native peoples, most recently, the Rapa Nui of Easter Island and Austral Islanders of French Polynesia, that modern management of the ocean can be strengthened if it is informed by traditional approaches and values.


Japanese and U.S. shipwrecks from Battle of Midway
Unnamed Seamount
Helsley Seamount
Known foraging grounds for Hawaiian monk seals. High-density community of deep-sea corals and sponges discovered during HURL submersible dives in 2003
Bank #10
Bank #11
Midway Atoll
Ladd Seamount
Kure Atoll
Pearl & Hermes Atoll
Locations outside PMNM that likely contain high-density deep-sea communities based on depth and topography
High-density community of deep-sea corals and sponges discovered during Okeanos Explorer ROV dive in 2015
Lisianski Island
Laysan Island
Northwestern Hawaiian Islands
Tropic of Can
High-density community of deep-sea corals and sponges discovered du Okeanos Explorer ROV
Tiger Shark Catches
Dolphin / Whale sightings and takings
Sea Turtle Migrations
Seabird Interactions (2013)
Booby Foraging Areas
Seamounts
Percent Probability of Monk Seal distribution of foraging areas
50
75
95
Okeanos Explorer Dive
HURL Dive
Battle Of Midway Wreck
3000m Contour
0 37.5 75 150
Kilometers
Miles
0 37.5 75 150
Papahānaumokuākea Marine National Monument
362,125 km sq / 139,818 mi sq
Papahānaumokuākea Marine National Monument Poten
Additional: 1,257,461 km sq / 485,507 mi sq
Total: 1,619,586 km sq / 625,325 mi sq


High-density community of deep-sea corals and sponges discovered during Okeanos Explorer ROV dive in 2015
150 nm
278 km
Raita Bank
Gardner Pinnacles
Maro Reef
St. Rogatien & Brooks Banks
French Frigate Shoals
Necker Island
Twin Banks
Nihoa
High-density communities discovered during HURL dives in 2009
Middle Bank
High-density community of deep-sea corals and sponges discovered during HURL submersible dives in 2011.
ring dive in 2015
cer
tial Expansion Zone

# Proposed Expansion of the Monument

The Papahānaumokuākea Marine National Monument is described as including the healthiest and least disturbed coral reefs in U.S. waters and is considered the largest tropical seabird rookery on the planet. UNESCO's review of the area identified it as one of the largest and most significant strongholds of tropical seabirds in the world and called the region a global biodiversity conservation priority[2].



When NOAA Ship *Okeanos* Explorer arrived offshore of Tern Island at French Frigate Shoals, dozens of sea birds flew out to investigate the ship. These included red-footed boobies, which are the smallest booby found in Hawai'i with a wingspan of around one meter (40 inches). *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2015 Hohonu Moana.*

This document lays out the cultural and scientific justification for President Barack Obama to use his authority under the Antiquities Act of 1906 to expand the monument from its current borders out to the full extent of the U.S. Exclusive Economic Zone (EEZ) surrounding the Northwest Hawaiian Islands (NWHI). This document makes the argument that the existing borders do not allow for the proper care and management for populations of migratory birds, fish, mammals, and sea turtles, and newly discovered and little understood deep sea ecosystems.

The urgency to expand protection of the ocean stems from overwhelming scientific evidence that overfishing, climate change, ocean acidification, pollution, and development are pushing the ocean toward a point at which it will no longer provide the life-sustaining services upon which we have grown dependent.

Currently only about 2% of the ocean is strongly (all commercial activity prohibited, only light recreational and subsistence fishing allowed) or fully protected (no extractive activities allowed) [3]. The monument, located in the Northwestern Hawaiian Islands, currently strongly protects 363,000 square kilometers of ocean waters, which is about 14 percent of the US EEZ surrounding Hawaii[4]. A recent scientific re-evaluation of coverage targets for marine protected areas showed that protection of at least 30 percent of each marine habitat globally is necessary to achieve conservation goals and broader management targets[5]. One leading scientist recommends as much as 50 percent[6]. Expanding the monument to include the entire U.S. EEZ surrounding the Northwestern Hawaiian Islands would achieve or exceed this 30% goal for the United States, and increase the global strongly protected area up to about 2.3%.

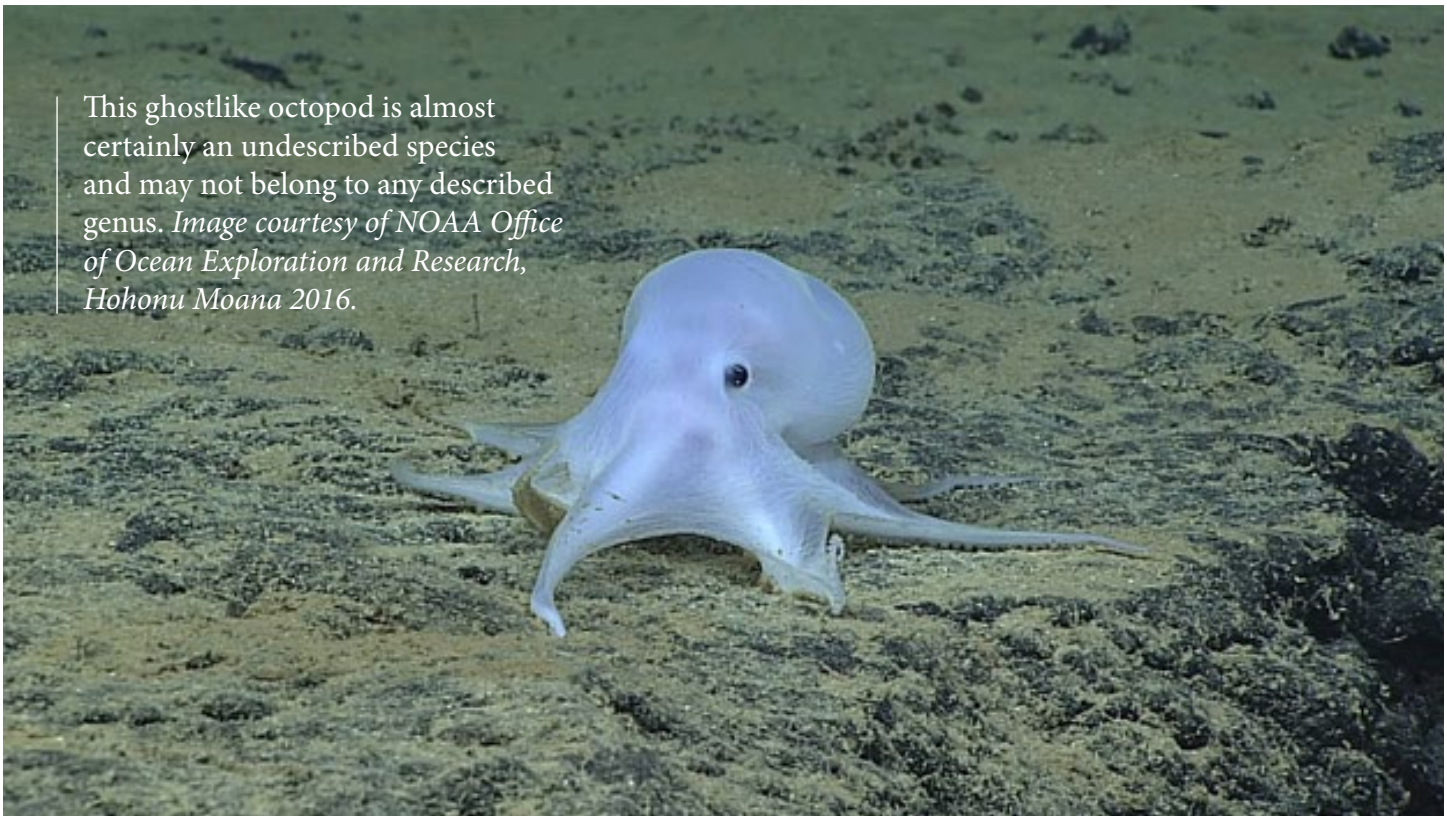
The monument and the current boundaries of the protected area have played a critical role in the protection of the important cultural sites, the integration of science and culture, and establishment of a framework for Native Hawaiian input on management[7]. The proposed expansion of the monument will increase protection to the larger sacred area, acknowledge the region for its important role as a cultural seascape, help protect navigation and voyaging traditions, and for the first time give an equal role in resource management to Native Hawaiians .

Additionally, an expansion of the monument would protect potentially dozens of wrecks from 19th Century whaling and several wars, most notably the wreck of the aircraft carrier *USS Yorktown*.

The expansion will result in a nearly five-fold increase in the area of protection that includes key ecosystems including coral reefs, seamounts, pelagic areas, guyots (flat seamounts), abyssal benthic communities, and organisms ranging from microscopic phytoplankton and zooplankton to large tuna and marine mammals.

In addition to protecting species and ecosystems that are known, expansion will also protect those which are yet to be discovered. It is estimated that ninety-one percent of all species in the ocean are unknown to science[8]. Globally, on both land and sea, scientists have identified 2 million species to date, but as many as 8.7 million are thought to exist, with as many as 2.2 million in the seas alone . Many of these discoveries are likely to be found in the proposed expansion.

New species are discovered nearly every time scientists conduct surveys in the NWHI. Scientific expeditions between 2013 and 2015 yielded several new species of fish, invertebrates, and algae[10], including four algae species found at depths greater than those typically known for marine algae[11]. And in 2016, scientists discovered a new species of octopus that has yet to be described and assigned a scientific name[12]. Scientists have dubbed it the “Casper” octopus, after the popular American cartoon character.



This ghostlike octopod is almost certainly an undescribed species and may not belong to any described genus. *Image courtesy of NOAA Office of Ocean Exploration and Research, Hohonu Moana 2016.*

The expansion will vastly increase the oceanographic habitats and populations of seabirds, fish, marine mammals, and sea turtles that are protected from commercial fishing, as well as decrease the distance from other protected areas. Enhancing the survival of migratory fish increases the marine resource capital from which fishermen can draw the interest in a sustainable manner.

The exanded monument will also build resilience against the effects of climate change, which the Obama Administration has identified as a major threat to National Security[13]. The expanded monument will serve as a refuge for species faced with warming and increasingly acidic seas[14,15]. Furthermore, scientists have suggested that attempts to protect coral reefs from the impacts of climate change by solely reducing emissions have little impact unless protected areas are also established[16].

A 2014 article published in Nature concluded that the effectiveness of marine protected areas (MPAs) yields the greatest conservation benefits when they are large, remote, strongly protected, protected for a long time, and enforced.[17] The authors found that the conservation benefits of marine reserves "increase exponentially" with the accumulation of these features. The most effective reserves had twice as many large fish, five times as much fish biomass, and fourteen times more shark biomass than fished areas. By comparison, those with just one or two of the essential characteristics were ecologically indistinguishable from fished areas.

With the ten year anniversary of the monument declaration occurring in 2016, PMNM meets or exceeds most of these effectiveness criteria, but science shows that bigger is better. There is now an opportunity to expand the existing protection, which will benefit the cultural resources so important to the identity of Hawaiian people, and to ensure the long-term health of this vital ocean habitat and the extraordinary diversity of species that rely on it.

# Unique People, Culture, and History

- **The Northwestern Hawaiian Islands are considered a sacred region for Native Hawaiians.**
- **Large scale marine protected areas provide the best contemporary practice for allowing entire seascapes to be protected and managed through both traditional and conventional approaches.[18]**
- **The current successful management of Papahānaumokuākea is based on traditional Hawaiian values and management.**
- **Expansion will help to support Hawaiian cultural practices and belief systems for future generations through increasing protection of ocean resource on a larger regional scale.**
- **The expansion of the monument boundaries would acknowledge that seascapes can also carry a multitude of cultural meanings and values for indigenous peoples that are often neglected in conservation and resource management.**

The vast expanse of the Northwestern Hawaiian Islands is considered a sacred region from which Native Hawaiians believe all life springs, and to which ancestral spirits return to after death[19]. The cosmological chant, the *Kumulipo* (source of deep darkness), recounts how all life forms came and evolved out of the primordial darkness. It describes the Hawaiian universe as being comprised of two realms: *pō*, a place of deep darkness reserved for the gods and spirits, and *ao* the realm of light where the living resides[20]. Native Hawaiians believe that the latitudinal boundaries between which the sun travels annually, called today the Tropics, were known by the names *Ke Ala Polohiwa a Kāne* (the Tropic of Cancer) and *Ke Ala Polohiwa a Kanaloa* (the Tropic of Capricorn). *Ke Ala Polohiwa a Kāne* was the border between *pō* and *ao*[21,22,23] and it was this traditional understanding of ʻāina akua (sacred area) versus *ʻāina kānaka* (area of the living) that were the foundational tenants of Native Hawaiian culture and tradition[24]. This distinction showed that the Northwestern Hawaiians Islands were one of the most sacred areas of Hawaiʻi.

From the beginning there have been strong cultural components intertwined with the creation and management of the Papahānaumokuākea Marine National Monument[25]. The name itself drew upon the *Kai'aikawaha* genealogy of island names as inspiration. The union of the names *Papahānaumoku* and *[W]ākea* acknowledges the critical role these two ancestors played in the birthing of the entire archipelago, emphasizing the continuity between the past and the present. "*Papa*," means *"foundational earth,"* representing the numerous low, flat islands that stretch into the northwest. *zcv* means *"to birth"* and moku means *"island"*. *"Akea"* means *"expanse of space,"* representing the surrounding ocean. The union of names as *Papahānaumokuākea*, reinforces Hawaii's cultural origins and the place of the islands as the foundation in the genealogy of the archipelago[26].


These series of islands and all of its surrounding ocean waters are considered *'āina akua*[27]. The islands, ocean waters, and all the living things in this region are considered ancestral beings that are higher than man in the ecological hierarchy and order of the Hawaiian universe[28]. Therefore, this interconnection tells Native Hawaiians of their responsibility as guardians of these resources and the importance of keeping this most sacred region and seascape in its natural state and unmarked by man. The expansion of the Monument out to 200 nautical miles allows for the broadest regional and holistic protection of everything that exists in this vast seascape and allows for it to be safeguarded from any extractive, commercial, or industrial activities that are deemed incompatible with their traditional beliefs

The current monument boundary at 50 nautical miles was thought to be sufficiently protective when the monument was established in 2006. In the past decade a growing body of new research has generated scientific and cultural knowledge that has shifted the understanding of management approaches. It is now more widely accepted recognized that effective management of large-scale, highly protected ecosystems has both scientific and cultural benefits. From a Native Hawaiian perspective, the proposed expansion is required because an *'āina akua* should be viewed in the largest region possible.

# Role of NWHI in Hawaiian Renaissance

- **Papahānaumokuākea has helped in the continuation of the Hawaiian Renaissance and has increased understanding of Hawaiian identity in relation to the ocean.**
- **Papahānaumokuākea is one of the few places where nature and culture are being managed together in an integrated manner, helping to bridge the divide between contemporary science and culture, creating a model for broad scale collaborative approaches.**
- **The proposed elevation of the Office of Hawaiian Affairs to the co-trustee level of management within Papahānaumokuākea will be the first time Native Hawaiians have an equal role in resource management.**

*Papahānaumokuākea* has played an important role in the Hawaiian community over the years and the push towards stronger ocean protection in this vast region was in part spurred on by the Hawaiian Renaissance movement – inspired by the traditional values of *mālama ʻāina* (to care for the land, sky, sea) and *aloha ʻāina* (love the land and resources)[29]. Over the past 15 years the Hawaiian community has been one of the key stakeholders driving these protection efforts and has had unprecedented success. The rebirth of traditional voyaging and wayfinding has also played an essential role in this effort with the voyaging *waʻa* (canoes) acting as cultural icons for the Hawaiian people[30]. Since the 1970's, the traditional Hawaiian Voyaging canoe *Hōkūleʻa* travelled around the Pacific reconnecting the peoples of Oceania and inspiring pride within indigenous practices and knowledge. This rebirth of voyaging more recently has helped to make an introspective shift towards exploring and rediscovering the remote parts of Native Hawaiians' own homeland, the Northwestern Hawaiian Islands[31]. The initial voyages that took place in 2003-2005 under the banner of "Navigating Change" brought Native Hawaiians to the realization that ocean protection was essential for the ongoing survival of the people of Hawaiʻi as well as the planet.

This rebirth is particularly exemplified with the Polynesian Voyaging Society's (PVS) *Mālama Honua* Worldwide Voyage, in which *Hōkūleʻa* is currently circumnavigating the globe to spread awareness of the important responsibilities we have to ocean protection. The Hawaiian name for this voyage, *Mālama Honua*, translates "to care for our Earth." In 2013, the voyage began with the Mālama Hawai'i segment with PVS' second *wa'a Hikianalia* voyaging for her first time into Papahānaumokuākea.

QUOTE:

*"No longer do we seek only the knowledge of how to voyage between islands. We seek lessons to carry home to our children – ways to inspire the present generation to love and preserve our Earth as a sanctuary for those who will inherit it."*

--Nainoa Thompson

On board were pwo (master) and apprentice navigators who gained valuable experience in traditional wayfinding. *Hikianalia* then joined *Hōkūleʻa* on the Pacific segments of the voyage. As *Hōkūleʻa* has continued out of the Pacific Ocean for the first time, *Hikianalia* returned to Hawai'i and joined a scientific expedition to continue research activities in Papahānaumokuākea in July 2015. Both waʻa continue to spread the message of mālama honua and the need to have better resource stewardship for sustainability in future generations. As the voyaging canoes continue traveling around the world to get other countries to commit to global ocean protection under *mālama honua*, the proposed expansion of Papahānaumokuākea in Hawaiʻi as a *Puʻuhonua* (sanctuary) is a testament to the Hawaiians' own commitment towards large scale marine protection and ocean heritage.


In 2013, the voyage began with the Mālama Hawai'i segment with PVS' second wa'a Hikianalia voyaging for her first time into Papahānaumokuākea.

When Papahānaumokuākea was established in 2006, it was a groundbreaking idea that management of a large scale protected area could recognize natural resources and cultural resources as one and the same[32]. Papahānaumokuākea's successful co-management structure serves as a model for other conservation areas being established around the world. A critical component of this co-management structure is Native Hawaiian input on all management actions through a Native Hawaiian Cultural Working Group[33]. Composed of kūpuna (elders), researchers, educators and cultural practitioners, the group is in strong support of expanding the Monument. Recognition of nature and culture being one within Papahānaumokuākea has been achieved and there are already examples of the successful integration of traditional knowledge and contemporary science in management activities. Papahānaumokuākea is a place where federal archaeologists join Native Hawaiian researchers and practitioners on trips, traditional voyaging canoes join scientific expeditions, and endangered species researchers embrace cultural protocol[34]. Management activities in Papahānaumokuākea are bridging

a historical divide between traditional and scientific resource management approaches and are proving that while techniques and terminology may differ, the core purpose of enhancing man's knowledge of the environment are the same. The strong cultural component of the management structure is an excellent foundation that can be improved by placing Native Hawaiian interests at the highest level of management. This will assure that the management structure is prepared for an expanded monument that further recognizes and integrates cultural dimensions into its management practice.

In addition, advocates for the proposed expansion of Papahānaumokuākea are asking for the Office of Hawaiian Affairs (OHA) to be elevated from co-manager to the level of co-trustee for the monument. The Office of Hawaiian Affairs, as a recognized institution that is responsible for improving the well-being of Native Hawaiians, is the most appropriate organization to take on this role because of: (1) its existing involvement at the co-manager level; (2) its track record and support for Native Hawaiian initiatives in the region; and (3) its ability to engage and connect the Hawaiian community into management decisions. This recognition will finally acknowledge that the indigenous peoples of Hawai'i are not stakeholders, but rather a people with unique social and political status in these islands. It will also

## Papahānaumokuākea as a Cultural Seascape

- **In the Northwestern Hawaiian Islands, the entire ocean, including the 110 seamounts, open waters, and all life in the proposed expansion are considered biocultural resources and linked to the Hawaiian people through environmental kinship.**
- **The ocean as a cultural seascape is vital to Native Hawaiians' identity and being; it is an essential dimension to their cognitive understanding of the world.**

QUOTE:

*A huge part of Papahānaumokuākea is underwater. When you go up there, you have to shift your mindset from one that is maybe land dominated, to one that is sea dominated. And it changes everything about how you're experiencing the world.*

--Kekuewa Kikiloi

- **The ocean waters in Papahānaumokuākea were an ancient pathway for a voyaging sphere that occurred between this region and the main Hawaiian islands for over 400-500 years (ca. AD 1300-1800).**
- **The practice of traditional wayfinding and voyaging—which is one of the most unique living traditions of the world—requires protection of the entire marine environment and open waters, not just the islands, because it relies on biological signs and natural phenomena, such as winds, waves, currents, and the presence of marine life and birds**

A traditional understanding of oceans as cultural seascapes is a key to understanding the need for the expansion of Papahānaumokuākea. Through cultural seascapes, people can recognize the important link between man and nature and that they cannot be seen as separate entities but rather related parts of a unified whole[35]. In particular, the ocean and open waters are critical to the distinctive identity and heritage of Native Hawaiians and other indigenous peoples in Oceania[36]. In their view, the ocean is not an unknown empty space, a meaningless void, or an obstacle on a map that keep island communities isolated and marginalized, but rather it is conceived as a viable pathway of movement, an access point of mobility, one that minimizes risk, and has allowed them to survive for millennium in the most uncertain of environments that exist on the planet[37].


The ocean as a cultural seascape is vital to Native Hawaiians' identity and being,; it is an essential dimension to their cognitive understanding of the world. It is indeed not an empty space, but a living entity, a godly deity, imbued with cultural meaning and a home for a host of marine and avian life that continue to be connected to them in a genealogical web of ecological kinship[38]. This relationship highlights their duty therefore to protect these biocultural resources and all the places in their homeland including adjacent unprotected seamounts and open ocean areas. The ocean must be understood in the context of its boundless nature, one that must be understood, managed, and protected in its totality and not limited by the current narrow management boundaries and delineations.

Papahānaumokuākea is the only intact cultural voyaging seascape in the Hawaiian Islands[39]. This expansive ocean environment was the setting for ancient Hawaiian chiefs to voyage back and forth between the main Hawaiian Islands and the northwestern islands over the course of a 400 to 500 year period in traditional times. In addition, smaller communities from Niʻihau, Kauaʻi, and Oʻahu have been documented in the post contact period of continuing voyaging into this region well into the 20th century[40].

Today, with the increase of traditional Hawaiian voyaging canoes, this region is critical training ground for the ongoing survival of two major living traditions: Hawaiian voyaging and wayfinding. Hawaiian voyaging and wayfinding evolved from a system of non-instrument navigation used by Polynesian predecessors to make long distant voyages across thousands of miles of open-ocean[41]. This traditional practice and art of wayfinding relied upon observations of the natural environment such as the sun, moon and stars which rise and set in predictable star lines, cloud clusters and movement, wind direction and ocean swells or wave pilots.

Migratory seabirds and/or sea marks provide distinctive natural occurrences at predictable places along sea routes. *Photo credit: Glen Tepke/ Marine Photobank*

In addition, biological indicators such as migratory seabirds and/or sea marks provide distinctive natural occurrences at predictable places along sea routes, including regions where certain fish species leap above the water's surface, or zones of innumerable marine or avian life, all of which help to guide voyagers and expand island targets[42]. There is no other place in Hawai'i where islands are remote enough to simulate these target conditions for young navigating apprentices. The practice of traditional wayfinding requires protection of the entire marine environment, not just the target islands, because it then allows for the full use of biological signs and natural phenomena that help to expand the target island, and training navigators to use the full range of signs needed for the wayfinding to truly survive in Hawai'i and the world.

# Modern History

- **The area of proposed expansion contains the wrecks of numerous whaling vessels from the 1800s and military vessels from several wars.**

- **The USS Yorktown was rediscovered in 1998 and lies outside the current monument boundary.**

The NWHI are also home to a variety of modern historic resources, including wrecks from the Civil War, World War II, and 19th century American and British commercial whaling. Each wreck site is a time capsule, allowing us to glimpse a part of seafaring history[43].

Discovery of these resources often comes after protections are in place. For example, in 2008 the wreck of the Nantucket-based whaling vessel *Two Brothers* was discovered off French Frigate Shoals[44]. The ship was captained by George Pollard, Jr, best known as the captain of the *Essex* and Herman Melville's inspiration for Captain Ahab in *Moby Dick*[46].

Additionally, in 2015 the USNS *Mission San Miguel*, a Type T2-SE-A2 tanker built for the United States Maritime Commission during World War II was rediscovered in the NWHI[46]. She had been lost since she sank on October 8, 1957.

According to the Papahānaumokuākea Marine National Monument Heritage Research, Education, and Management Plan[47] there are also a number of World War II shipwreck sites, particularly those associated with the Battle of Midway, outside the current monument boundary, both undiscovered and rediscovered.

The Battle of Midway was a decisive naval battle in World War II[48]. Between 3 and 7 June 1942[49], only six months after Japan's attack on Pearl Harbor, the United States Navy decisively defeated an attacking fleet of the Imperial Japanese Navy near Midway Atoll, inflicting devastating damage on the Japanese fleet that proved irreparable.

During the battle, all four of Japan's large aircraft carriers—*Akagi, Kaga, Soryu* and *Hiryu*—and the heavy cruiser *Mikuma* were sunk, while the U.S. lost only the carrier Yorktown and the destroyer *Hammann*. 307 American and 3,057 Japanese sailors, marines, and airmen lost their lives during the battle.

In 1998, the wreck of the Yorktown was rediscovered at a depth of almost three miles by Dr. Robert Ballard[50]. No one has visited the wreck since its discovery nearly two decades ago. A section of the *Kaga* was discovered in 1999 by Nauticos Corporation[51]. The other ships, as well as hundreds of planes, remain undiscovered. NOAA Ship *Okeanos Explorer* is currently searching for these wrecks[52].

Efforts to interpret the Battle of Midway are ongoing. Beginning with archival research and oral histories, there is a wealth of relevant information for the monument for scholars and those curious about the monument to explore and develop. If the experience of the first 10 years of Papahānaumokuākea is any indication, expanded protections will lead to increased research and discovery, and ultimately greater connections between people living in Hawaii and around the world to this area.

President Ronald Reagan declared the Midway Atoll National Wildlife Refuge in 1988, which today lies within Papahānaumokuākea Marine National Monument. In 2000, Secretary of the Interior Bruce Babbitt designated Midway Atoll National Wildlife Refuge as the Battle of Midway National Memorial, so "that the heroic courage and sacrifice of those who fought against overwhelming odds to win an incredible victory will never be forgotten." The boundaries of the National Memorial include all lands and waters of the Midway Atoll National Wildlife Refuge to give tribute "to the aircraft and ships, such as the Yorktown and Hammann, that did not return from the Battle and lie beyond these boundaries[53]."

Expanding Papahānaumokuākea to protect additional biological and cultural resources associated with the Battle of Midway not inside the current boundaries would honor the American and Japanese sailors, marines, and airmen who lost their lives and all veterans of World War II in time for the 75th anniversary of the Battle of Midway in 2017.

# Ecosystems & Biodiversity of Proposed Expansion

- **The existing monument protects 7,000 known species of marine and terrestrial life, 25% of which are endemic, found nowhere else on the planet.**
- **Habitats that will gain protections with an expansion include offshore pelagic (open water) areas, seamounts, submerged reefs, guyots (sunken islands), and banks. Nearly 110 seamounts have been identified in the area of proposed expansion.**
- **Each seamount is a magnet for biodiversity, both on the seafloor and in the water column above and around the undersea mountain**
- **Families of species that would benefit from an expansion of the monument include sea turtles, whales, dolphins, seabirds, sharks, billfish and tuna.**
- **An estimated 97% of the remaining 1,100 wild Hawaiian monk seals are found in the Northwestern Hawaiian Islands, as are 90% of Hawaiian green sea turtles and 98% of Laysan albatrosses.**

The waters of PMNM are among the most diverse and productive in the subtropical Pacific. The Hawaiian Islands form one of the most isolated archipelagos in the world, resulting in a distinct and unique flora and fauna when considering both species and genotypic diversity[54,55]. Compared to the coral reefs near the populated Hawaiian Islands, the monument's reefs are considered to be healthy, and contain high fish biomass, diverse species assemblages, and exceptional levels of endemism.[56] Recent scientific surveys reveal that almost 50 percent of monument reef fish are endemic to the Hawaiian archipelago, indicating that this area is a reservoir for unique biodiversity.[57] Moreover, this level of endemism varies across the monument. Researchers found that endemic fish abundance increased with latitude, and exceed 85 percent at the northern three atolls: Pearl and Hermes, Midway, and Kure Atoll. One reef at Kure Atoll was found to have 100% endemic fish species[58]. By expanding the monument these exceptional biodiversity reservoirs to the north can be better protected. Additionally, as fish populations become increasingly impacted by the effects of overfishing: loss of genetic diversity, changes in population age structure, and reduced reproductive rates, it is important to preserve large areas that have maintained diverse and healthy populations.[59,60]

There are significant resources outside of the current monument boundaries that would benefit from expanded protections. In particular, highly migratory or far-ranging species such sea turtles, whales, dolphins, seabirds, sharks, and tuna forage outside of the area of the existing monument and are threatened by longline fishing vessels when they range outside the area of protection.

Silky shark. *Photo credit: Chris and Monique Fallows*

The proposed expansion in the Northwestern Hawaiian Islands is home to diverse range of top predators in high abundance compared the Main Hawaiian Islands , including oceanic whitetip sharks *(Carcharhinus longimanus)*, the giant trevally *(Caranx ignobilis)*, bluefin trevally *(Caranx melampygus)*, green jobfish *(Aprion virescens)*, and the endemic Hawaiian grouper *(Hyporthodus quernus)*. *H. quernus* is a species that has been locally depleted in areas around the Main Hawaiian islands and considered to be particularly prone to overfishing.[62,63] Several of these species and others spend parts of their life histories both inside and outside the borders of the existing monument. Expanding the area of protection will increase survivability of these species.

Photo credit:
John S. Johnson/
Marine Photobank

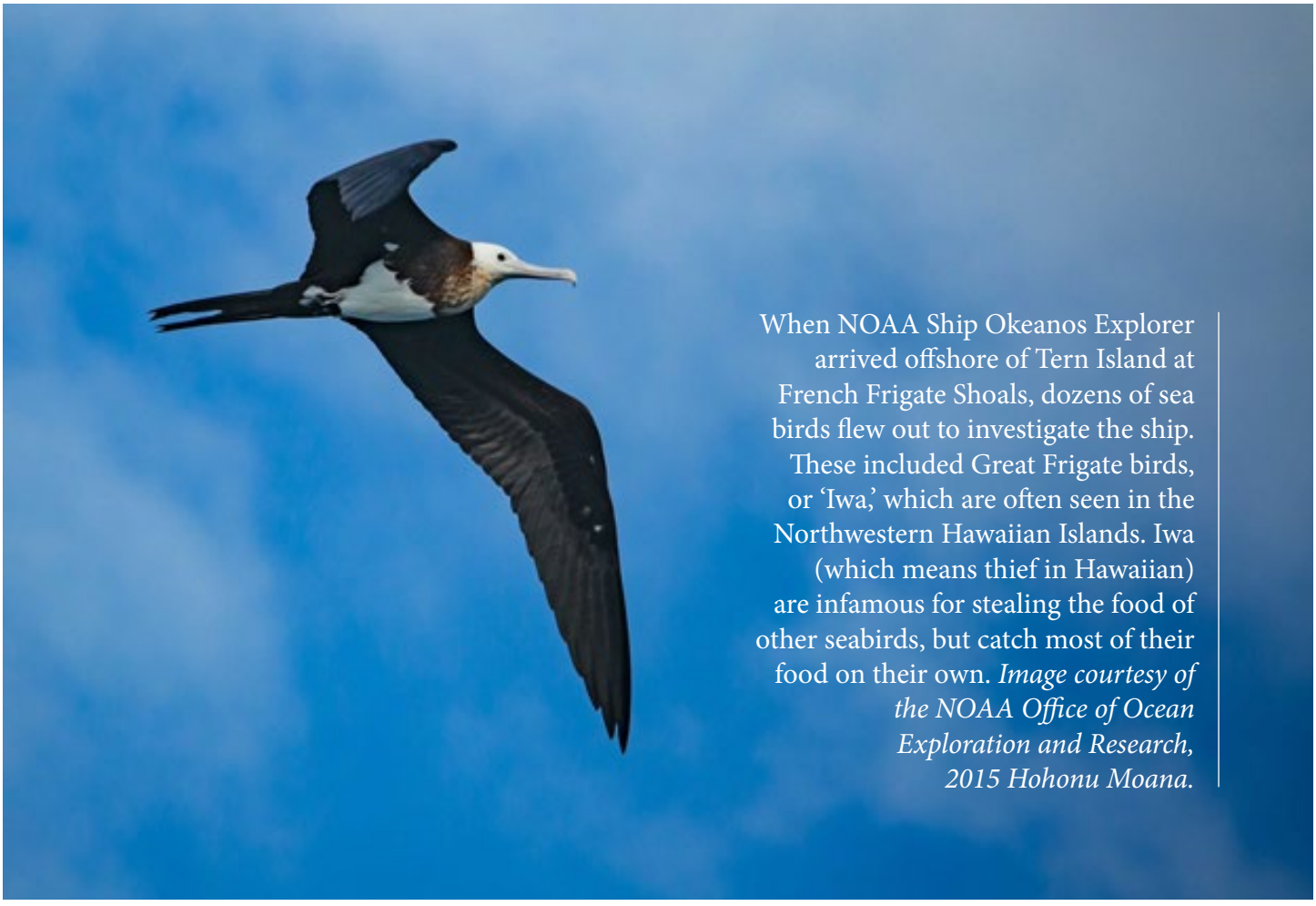
Papahānaumokuākea is also home to several threatened or endangered species such as the Hawaiian monk seal *(Monachus schauinslandi)*, the most endangered pinniped in US waters and one of the most endangered in the world, whose populations have declined since 1950[64], endangered blue whales *(Balaenoptera musculus)* and fin whales *(Balaenoptera physalus)*, and the green sea turtle *(Chelonia mydas)* or honu in Hawaiian[65]. These and other cetacean species foraging ranges that extend beyond 50 miles[66], which is the current boundary of the existing monument. An expansion of PMNM can ensure that these major reservoirs of biodiversity and their populations within are secured.

Ecosystems that would benefit from the expansion include deep water coral reefs, seamounts, guyots, submerged reefs and banks, and abyssal benthic communities. Many of these habitats are understudied, and there are likely others out there that are yet to be discovered.

# Seabirds

- **The EEZ around the NWHI is critical foraging range for numerous species of seabirds.**
- **In particular, birds nesting on the islands, including several species of albatross, boobies, shearwaters, and petrels, are known to forage in the NWHI EEZ beyond 50 nm.**
- **Several hundred seabirds each year are caught as bycatch from longline fishing vessels operating out of Hawaii[67].**
- **There are research opportunities to increase our understanding of the foraging behavior of seabirds breeding in the NWHI.**

Large scale marine protected areas have been shown to protect important habitat for several species of pelagic birds in the central Pacific[68]. The NWHI are home to one of the largest groupings of tropical seabirds in the world, consisting of 14 million birds from 22 different species, 5.5 million of which breed there annually.[69] The largest of these breeding populations are on Midway Atoll, Laysan Island, and Nihoa, however global climate change and invasive species have led to habitat loss and some changes in nesting areas over time.[70] Eleven of the species found in the NWHI are considered imperiled or of high conservation concern, and in particular, six species – the Laysan (near-threatened), black-footed (near-threatened), and short-tailed (endangered) albatrosses, Christmas shearwater, Tristram's storm-petrel (near-threatened) and blue noddy – are of the highest concern for the Pacific Island region as a whole.[71]



When NOAA Ship Okeanos Explorer arrived offshore of Tern Island at French Frigate Shoals, dozens of sea birds flew out to investigate the ship. These included Great Frigate birds, or 'Iwa,' which are often seen in the Northwestern Hawaiian Islands. Iwa (which means thief in Hawaiian) are infamous for stealing the food of other seabirds, but catch most of their food on their own. *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2015 Hohonu Moana.*

Seabirds are some of the most threatened species on the planet and taken as a whole have declined by ~70% since 1950[72]. The largest declines were observed in families containing wide-ranging pelagic species, such as albatross, suggesting that pan-global populations may be more at risk than shorter-ranging coastal populations[73].

Many of these species are truly unique; for example, Laysan albatrosses return to the same areas to nest year after year, where they form monogamous pairs through an intricate mating dance consisting of 25 different dance moves[74].

More than 98 percent of the world's Laysan albatrosses nest on the Northwestern Hawaiian Islands chain.[75] Foraging habitat includes most of the North Pacific, but that range is significantly reduced when birds are feeding chicks. The NWHI EEZ appears critical to the Laysan albatross during that period[76].

Scientists are working increase our understanding of the birds in the NWHI. In 2016, a Laysan albatross named Wisdom, first banded in 1956 by researchers, returned to Midway Atoll and hatched a chick. At least 65 years old, Wisdom is the oldest known bird in the world to successfully hatch a chick.

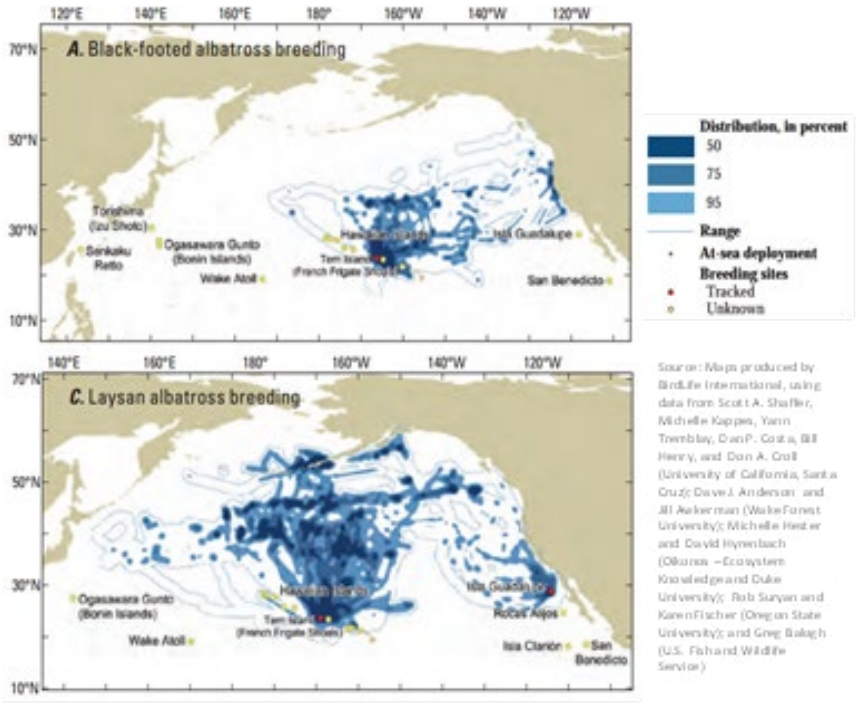



**Figure 1:** Black-footed albatross and Laysan breeding distribution.

In her visit to Midway Atoll in 2007, whose ancient Hawaiian name is *Pihemanu* and means "the loud din of birds," former First Lady Laura Bush remarked upon the many Laysan albatross chicks there during nesting season, and the stresses this species faces.[77] The principal current threats at sea are posed by commercial fisheries (through competition and mortality on fishing gear) and pollution, whereas on land, alien invasive predators, habitat degradation and human disturbance are the main threats[78]. Although an expanded marine monument would do little to buffer seabirds from the impacts of marine debris, the reduction of other stressors would lessen the cumulative impact of these threats on populations. In fact, the most significant cause of population decline for albatross can be attributed to longline fisheries.[79]

Seabirds forage over distances as far as several thousand kilometers, following schools of forage fish.[80] Studies of species' nesting and foraging habitats formed the initial rationale for the monument's current 50 nautical-mile boundary. Seabirds foraging on bait set on longlines for pelagic fisheries, leads to the recorded death of more than 100 birds every year, most of which are species of concern such as the Laysan and black-footed albatrosses.[81] These numbers, for the deep-set fisheries in particular, have increased since 2004.[82]

Many tropical seabird species are unable to dive to great depths. As a result, many species found in the NWHI monument such as noddies, terns, boobies, and frigatebirds are highly dependent on subsurface predators, particularly tunas and dolphins, to drive forage fish to the surface where they are then accessible to seabirds to take as food.[83,84] In some parts of the Pacific, diet estimates from lethally sampled seabirds suggest that greater than 75% of prey consumed by some seabird species may be taken during facilitated foraging[85]. Thus the maintenance of robust fish and dolphin populations is critical for the maintenance of many seabird populations.

Breeding seabirds are likely to forage near to colonies, though the distance they travel to feed varies depending on chick size and dependence. Some studies have shown that booby species range throughout most – though not all – of the NWHI[86]. Furthermore, smaller seabird species have been shown to forage further from breeding colonies than larger birds (likely as a result of interspecies competition). Thus, many species are likely to be foraging well outside the current boundaries of the monument, including white-tailed tropicbirds, red-tailed tropic birds, masked boobies, great frigatebirds, sooty terns, and wedge-tailed shearwaters[87].

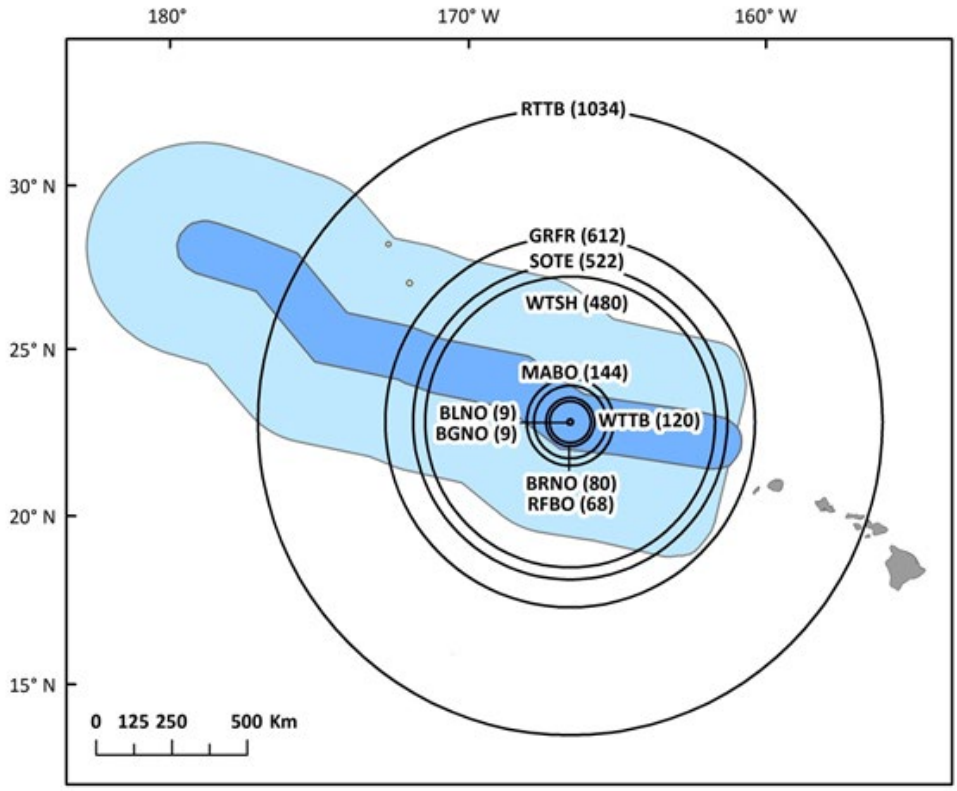



**Figure 2:** Foraging ranges of breeding tropical seabirds, centered around Tern Island in French Frigate Shoals. Maximum foraging ranges are shown in kilometers in brackets following species names. Species abbreviations are as follows: RTTB: red-tailed tropicbird; GRFR: great frigatebird; SOTE: sooty tern; WTSH: wedge-tailed shearwater; MABO: masked booby; WTTB: white-tailed tropicbird; BRNO: brown noddy; RFBO: red-footed booby; BLNO: black noddy; BGNO: blue-grey noddy. Adapted from Maxwell & Morgan 2013 *Marine Ecology Progress Series.*

# Sharks

- **Sharks are slow growing, typically take many years to reach sexual maturity, and produce few young.**

- **Between 5,000 – 28,000 [88] sharks are caught by longline vessels each year in the Northwest Hawaiian Islands, and nearly all are dumped overboard.**

Ocean predators such as sharks are some of the most important species in the marine environment, and now, are among the most threatened. Globally, shark populations have declined, and half of all shark species assessed by scientists are now threatened or near threatened with extinction[89]. Most sharks are unable to withstand pressures from commercial fishing because, like the great whales, they are grow slowly, take many years to reach sexual maturity, and produce few young[90].

Sharks influence the abundance and diversity of the species below them in the food web, and their removal can have severe ecological consequences.[91] They are a keystone species in decline whose protection is required for a functioning reef system[92]. As an area of intrinsic high shark diversity[93], the expansion of the monument would safeguard important priority areas for sharks.

Oceanic whitetip shark.
*Photo credit: David Fleetham*

In the Pacific, oceanic whitetip sharks *(Carcharhinus longimanus)* and silky sharks *(Carcharhinus falciformis)*, highly migratory species that were once categorized as two of the most abundant species of large marine animals, have declined significantly. Populations of these species have dropped to such low levels that fishing vessels are now prohibited from retaining them.[95,96] Despite this ban both species are still incidentally caught and killed on longlines[97]. Since the monument is within the core habitat for both oceanic whitetip and silky shark,[98] an expanded protected area from fishing can ensure that populations of these vulnerable sharks are safeguarded.

Research shows that coral reef habitats within the monument support abundant Galapagos sharks *(Carcharhinus galapagensis)*, tiger sharks *(Galeocerdo cuvier)*, and grey reef sharks *(Carcharhinus amblyrhinchos)*. These species, and others, have been shown to travel outside the boundaries of the existing monument.[99] For example, a combination of fishing data and satellite and acoustic telemetry revealed tiger sharks swim thousands of kilometers along the Hawaiian chain and out into the open ocean[100], with individuals found more than 600 kilometers offshore[101]. In fact, the study showed that 25% of tiger shark mortality occurred between 50-200 nautical miles from shore[102].

Tiger shark.
*Photo credit: Jim Abernethy*

Publicly available longline data from NOAA shows that more than one quarter million sharks have been caught in the Northwestern Hawaiian Islands in the last 25 years[103]. The same data set also shows that the catch per unit effort of sharks in NWHI has dropped considerably from a high of 13.02 sharks/million hooks in 1992 to 2.29 sharks/million hooks in 2014. This suggests an alarming decline in shark populations, and is of concern not only because of the declining numbers, but also because the limited fishery is targeting tuna, not sharks. Sharks are caught as bycatch.

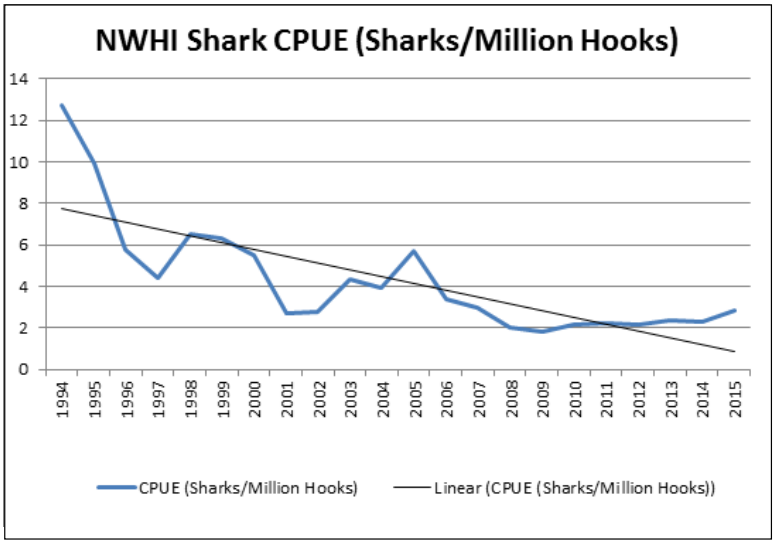



**Figure 3:** Catch Per Unit of Sharks 1994-2015 in sharks per million hooks.

By increasing the size of this protected area, these resident species and other highly migratory sharks that frequent these waters can be protected. The value of large protected areas to sharks has been demonstrated , and expanded protection in this area will be of benefit to multiple threatened shark species.

# Tuna

- **Commercially important tuna species are threatened with extinction[105] and fisheries managers are not following scientific advice[106] to improve stocks.**
- **There is evidence that areas where fishing is limited has resulted in increased size and numbers of tuna.**

The most commercially important fish caught in the NWHI today is bigeye tuna *(Thunnus obesus)*, called *ahi* in Hawaiian. Fishermen also catch smaller amounts of the less valuable albacore *(Thunnus alalunga)*, yellowfin tuna *(Thunnus albacares)* also called ahi in Hawaiian, and skipjack tuna *(Katsuwonus pelamis)* called *aku* in Hawaiian. Publicly available data from NOAA show that nearly all of the effort is located in the eastern quadrant north of the islands[107].


*Photo credit: Angelo Villagomez*

American vessels target large, adult bigeye in the NWHI using longlines; Purse seiners fishing outside of the proposed expansion area are also a significant source of mortality for this species. The purse seiners target skipjack tuna, but juvenile bigeye end up being killed as bycatch. The United States has the largest purse seine fleet in the Western and Central Pacific.

Simultaneously killing the large, productive adult bigeye tuna on longlines and using purse seines to kill the small, juvenile bigeye that have yet to reproduce has caused the population of these fish to crash. Bigeye tuna in the Western and Central Pacific is overfished and overfishing has occurred for many years[108]. The IUCN Red List of Threatened Species has assessed Bigeye as Vulnerable to extinction, and albacore and yellowfin tuna have been assessed as Near Threatened. The 2014 assessment for bigeye tuna found that the stock had declined to 16 per cent of its unfished size[109]. Despite this, fishing pressure for this species continues to increase[110].

Efforts to rebuild the stock of this species by reducing the catch have not followed scientific advice[111] . Hawaii exceeded its quota in 2014 and 2015, and purchased additional quota from Guam, the Northern Mariana Islands, and American Samoa[112].

The benefits of marine protected areas to commercial fish species are well studied. A global analysis of marine reserves found that on average, marine reserves result in higher fish biomass, greater numbers of fish, more species in an ecosystem, and larger fish. Expanding Papahānaumokuākea will create a large sanctuary where the ecosystem can thrive and where these economically important species can be safe from overfishing with the opportunity to mature and reproduce.

Expanding Papahānaumokuākea will create a large sanctuary where the ecosystem can thrive and where these economically important species can be safe from overfishing with the opportunity to mature and reproduce.

While much of the research in this area to date has focused on coastal and bottom habitats, the principle that fish populations rebound when fishing pressure is removed appears to hold true for offshore species, too. For example, Filipino fishermen caught skipjack, yellowfin, and bigeye tuna inside High Seas Pocket 1, an area of high seas between the Philippines and Guam closed to most fishing countries. These fish were on average larger than fish of the same species caught inside the Philippines EEZ[113].

Tagging studies of individual yellowfin tuna in the western and central Pacific have found that most have lifetime movements on the order of hundreds, not thousands of miles, although some individuals do make some very long distance movements[114]. Estimates of median lifetime displacements range from 411-471 nautical miles for skipjack *(Katsuwonus pelamis)* and 337-380 nautical miles for yellowfin *(Thunnus albacares)*[115]. Another study suggests that bigeye and yellowfin tuna are not 'highly migratory' and suggests a high degree of regional residency on the order of several months in the equatorial Pacific Ocean[116].

Most tuna species are assumed to be panmictic, mating randomly across entire ocean basins, but recent studies have shown evidence of site-specific discrete populations[117]. Scientists have found genetically distinct subpopulations of yellowfin tuna in the Pacific Ocean. This result challenges the single stock paradigm for highly migratory species, and for fisheries management suggests that stocks should be assessed and managed at smaller scales.

These findings suggest that individual tuna from different species could spend their entire life history inside the borders of a marine reserve if the area is large enough. It has been shown that female fish that are older and of larger size produce a higher number and a higher quality of eggs[118]. These tuna would grow large and produce exponentially more eggs than smaller, unprotected individuals swimming outside the area of protection. Spillover effects of the fish that do swim outside of the area of protection would benefit fishermen.

# Whales and Dolphins

- **24 species of marine mammal have been identified in Hawaiian waters, 22 of which occur in the proposed expansion.[119]**
- **Recent studies have found distinct sub-populations of several whale species, including false killer whales associated with the Main Hawaiian Islands, Northwestern Hawaiian Islands, and pelagic waters, respectively[120].**

Hawaiian waters support populations of many marine mammals, including cetaceans such as whales, dolphins, and porpoises.[121] In total, 24 species have been documented. The most abundant large whales are sperm whales *(Physeter microcephalus)* and Bryde's whales *(Balaenoptera edeni)*. The most abundant small toothed whales are pilot whales *(Globicephala macrorhynchus)*, rough-toothed dolphins *(Steno bredanensis)*, Fraser's dolphins *(Lagenodelphis hosei)*, spotted dolphins *(Stenella attenuata)*, and striped dolphins *(Stenella coeruleoalba)*. Dwarf and pygmy sperm whales (Kogia sima and Kogia breviceps) and Cuvier's beaked whales *(Ziphius cavirostris)* are also estimated to be quite abundant[122]. Migratory baleen whales such as fin whales *(Balaenoptera physalus)*, sei whales *(Balaenoptera borealis)*, minke whales *(Balaenoptera physalus)*, and humpback whales *(Megaptera novaeangliae)* also spend part of their lives in the area[123].

*Photo credit: © Silke Stuckenbrock/Silke Photo 2008/ Marine Photobank*

There are significant data showing the area of the proposed monument expansion is important habitat for several species, including individuals that frequent the Hawaiian Islands Humpback Whale National Marine Sanctuary[124]. Annual NOAA stock assessment reports show that there are 22 species of cetaceans in the proposed expansion[125]. A soon to be published study of short-finned pilot whales *(Globicephala macrorhynchus)* shows there are linkages between the Main Hawaiian Islands, NWHI, and offshore waters of both regions[126]. Melon headed whales *(Peponocephala electra)* have been shown to travel offshore to forage in convergence areas of both cyclonic and anticyclonic eddies.[127]

*Photo Credit:*
*Peter G. Allinson, M.D. 2009/*
*Marine Photobank*

*Photo credit: Alana Yurkanin/ Marine Photobank*

Blainville's beaked whales *(Mesoplodon densirostris)* range in Hawaiian waters from near-shore areas throughout the EEZ and into adjacent international waters[128]. It is thought that there are two populations, one associated with islands and one that is open-ocean. One individual thought to be of the open-ocean subpopulation was shown to travel 900 kilometers in just 20 days[129]. Scientists have also identified a subpopulation of false killer whales that lives largely, but not entirely within the borders of Papahānaumokuākea[130]. Expanding the borders of the monument would enhance protections for all 22 species.

| Common Name | Scientific Name | IUCN Status |
|---|---|---|
| Rough toothed dolphin | Steno bredanensis | Least Concern |
| Risso's dolphin | Grampus griseus | Least Concern |
| Common bottlenose dolphin | Tursiops truncatus | Least Concern |
| Pantropical spotted dolphin | Stenella attenuate | Least Concern |
| Striped dolphin | Stenella coeruleoalba | Least Concern |
| Fraser's dolphin | Lagenodelphis hosei | Least Concern |
| Melon headed whale | Peponocephala electra | Least Concern |
| False killer whale | Pseudorca crassidens | Data Deficient |
| Killer whale | Orcinus orca | Data Deficient |
| Short finned pilot whale | Globicephala macrorhynchus | Data Deficient |
| Blainville's beaked whale | Mesoplodon densirostris | Data Deficient |
| Cuvier's beaked whale | Ziphius cavirostris | Least Concern |
| Longman's beaked whale | Indopacetus pacificus | Data Deficient |
| Pygmy sperm whale | Kogia breviceps | Data Deficient |
| Dwarf sperm whale | Kogia sima | Data Deficient |
| Sperm whale | Physeter microcephalus | Vulnerable |
| Blue whale | Balaenoptera musculus | Endangered |
| Fin whale | Balaenoptera physalus | Endangered |
| Bryde's whale | Balaenoptera edeni | Data Deficient |
| Sei whale | Balaenoptera borealis | Endangered |
| Minke whale | Balaenoptera acutorostrata | Least Concern |
| Humpback whale | Megaptera novaeangliae | Least Concern |

**Figure 4:** Species of marine mammals in Hawaiian waters

# Sea Turtles

- **90% of green sea turtles in Hawaii nest in the Northwestern Hawaiian Islands.[131]**
- **Fives species of sea turtle have been identified in Hawaii, and all are threatened with extinction.[132]**

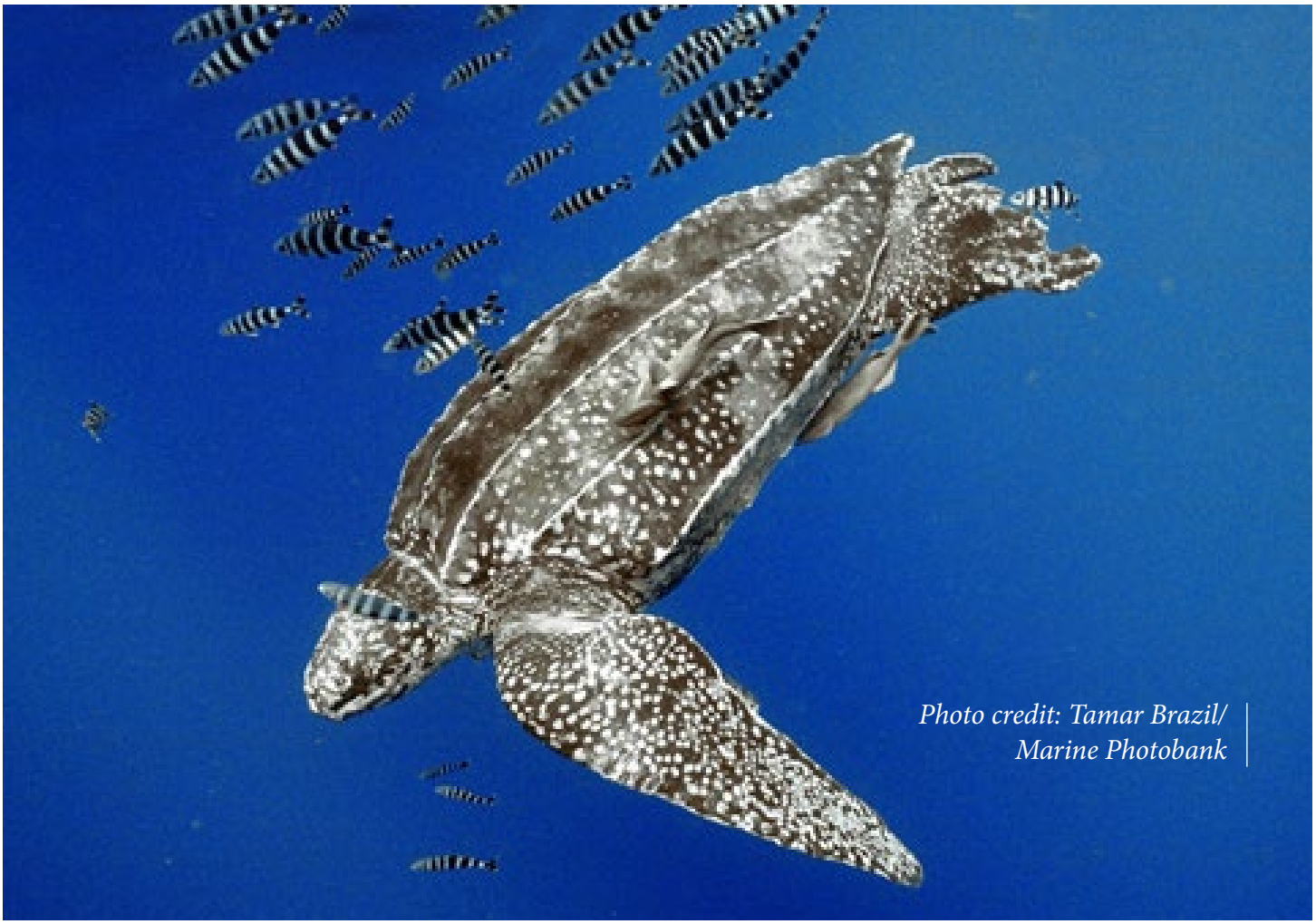


*Photo credit: Tamar Brazil/ Marine Photobank*

More than 90% of green sea turtles *(Chelonia mydas)* or *Honu* in Hawaii nest in the NWHI[133]. Individuals tagged at French Frigate Shoals have been identified near Kauai, Oahu, and Maui to the southwest and near Lisianski Island, and Pearl and Hermes Reef to the northwest[134]. This is a flagship species for Hawaii's tourism industry, with numerous businesses catering to tourists who wish to observe these endangered animals. They are also an iconic Hawaiian species of great cultural importance[135].

Two other species of sea turtle, the loggerhead *(Caretta caretta)* and leatherback *(Dermochelys coriacea)*, have been identified as being at particular risk of population decline as a result of incidental take by longline pelagic fisheries.[136] In fact, fisheries are considered to be one of the main causes of anthropogenic mortality for sea turtles.[137] Nesting populations of Pacific leatherbacks have experienced a 95% decline in just two decades.[138] Loggerhead turtles showed an 80% population decline in the same period.[139]

Because of high bycatch rates of sea turtles, particularly loggerheads, the Hawaiian swordfish fishery was closed by court order from 2000-2004[140]. The Hawaiian tuna fishery was seasonally restricted by the same order due to high bycatch rates of olive ridley sea turtles. Both fisheries also caught substantial numbers of leatherback sea turtles. After longliners incorporated measures to reduce sea turtle bycatch, the Hawaiian swordfish fishery reopened in 2004. However, the fishery was closed in 2006 and again in 2011 due to fishermen exceeding the allowable limits on the number of loggerheads and leatherbacks caught as bycatch. Loggerhead and leatherback populations continue to decline in the Pacific[141], despite measures to protect them. Without stronger protections, a 100 million year evolutionary legacy represented by these ancient creatures could be wiped out in the space of one human generation.

| Common Name | Scientific Name | IUCN Status |
|---|---|---|
| Loggerhead | Caretta caretta | Vulnerable |
| Leatherback | Dermochelys coriacea | Vulnerable |
| Green | Chelonia mydas | Endangered |
| Hawksbill | Eretmochelys imbricata | Critically Endangered |
| Olive Ridley | Lepidochelys olivacea | Vulnerable |

**Figure 5:** Species of sea turtle in Hawaiian waters.

# Coral Reefs

- **The oldest living animals on Earth, black corals (Leiopathes sp.) as old as 4,000 years, live in deep sea habitat in the proposed expansion.**
- **Deep sea corals are enigmatic and understudied, but highly vulnerable to human impact.**

The existing monument has extensive coral reefs that provide habitat for over 7,000 known marine species, a quarter of which occur only in the Hawaiian Archipelago.[142] The proposed expansion of the Papahānaumokuākea Marine National Monument would better ensure the resiliency for these reefs, reducing one stressor -- fishing -- facing reefs in this multi-stressor situation. The species assemblage that resides among the coral is still being studied. Coral reef assessments conducted between 2000 and 2006 through the Census of Coral Reefs and Northwestern Hawaiian Islands Reef Assessment and Monitoring Program discovered many previously unreported and undescribed species of corals and other invertebrates.[143] The extensive coral cover forms a network of essential fish nursery habitat that is critical for many endemic fish species. Additionally, this network of coral habitats supports a diverse range of marine mammals, sea turtles, invertebrates, and seabirds.

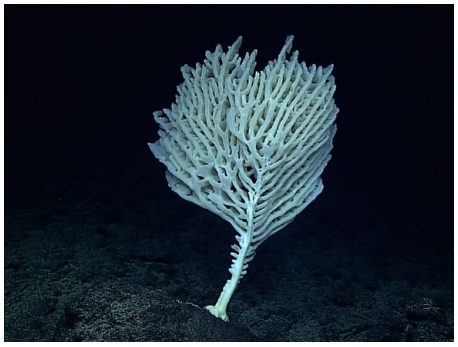


*Image courtesy of the NOAA Office of Ocean Exploration and Research, 2015 Hohonu Moana*

*Image courtesy of NOAA Office of Ocean Exploration and Research, Hohonu Moana 2016.*

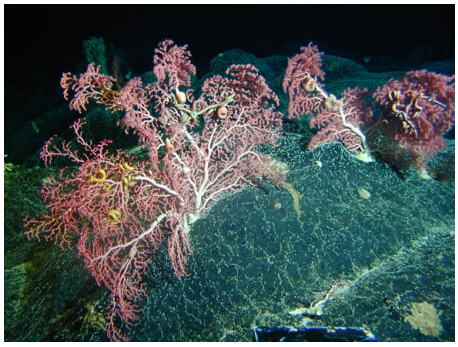


*Image courtesy of NOAA-HURL Archives*

Gold coral (yellow) in the process of overgrowing a bamboo coral colony (orange) that it will eventually completely cover. *Image courtesy of NOAA-HURL Archives*

Deep coral reefs in PMNM may contain the highest percentage of fish species found nowhere else on Earth, according to a study by NOAA scientists published in the *Bulletin of Marine Science*[144]. The islands, atolls and submerged habitats of the NWHI harbor unprecedented levels of biological diversity. While the existing monument contains 95 seamounts, an additional 110 seamounts have been identified inside the area of the proposed expansion. Since there are high levels of biodiversity and endemism on seamounts that have been studied to date, it is assumed that unexplored seamounts contain similar amounts of biodiversity and endemism and likely hold great opportunity for future scientific discoveries, including new species.

Hawaii is known for its high abundance of endemic species. Previous studies, based on scuba surveys in water less than 100 feet deep, determined that on average 21 percent of coral reef fish species in Hawaii are unique to the Hawaiian Archipelago[145]. However, in waters 100 to 300 feet deep, nearly 50 percent of the fish that scientists observed over a two-year period in the monument were unique to Hawaii, a level higher than any other marine ecosystem in the world[146]. The study also found that on some of PMNM's deeper reefs, more than 90 percent of fish were unique to the region[147]. These habitats can only be accessed by highly trained divers using advanced technical diving methods.

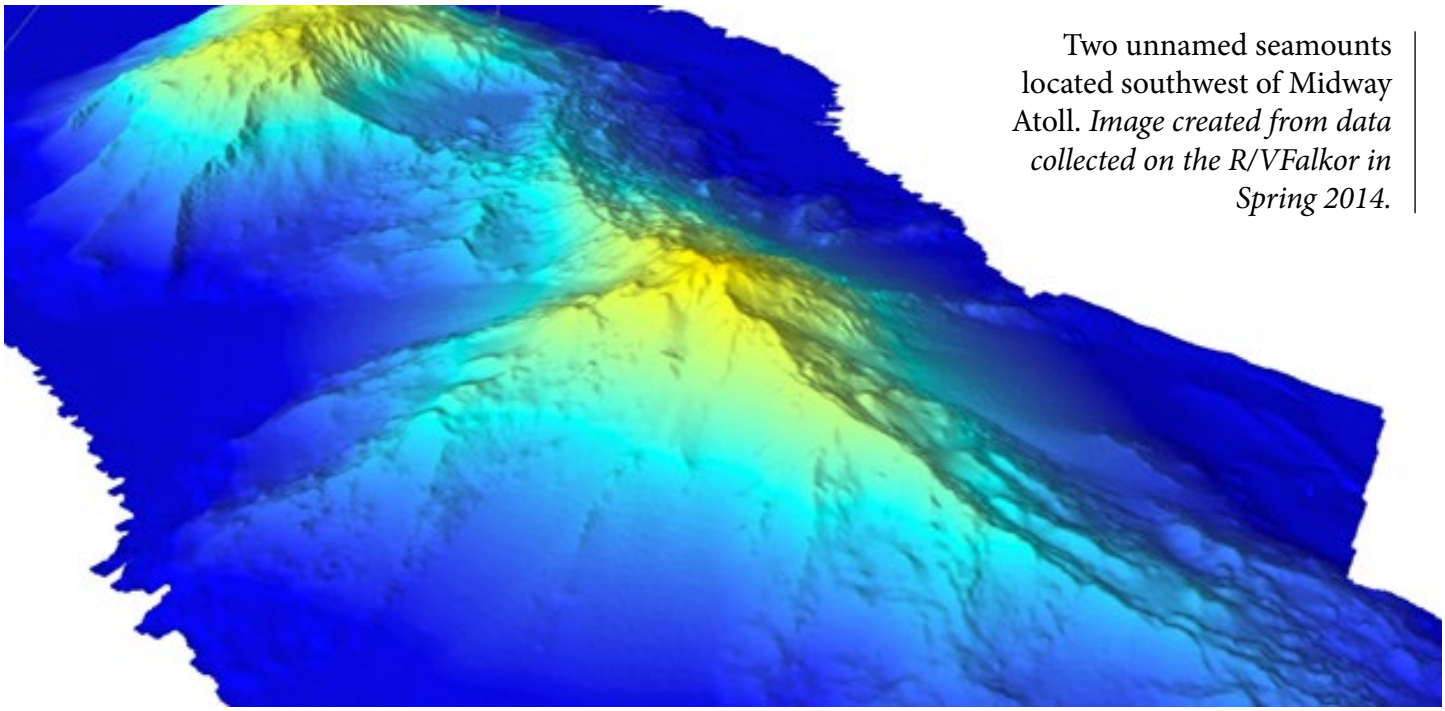
The deep sea is also home to remarkably rich coral systems. While more is known about shallow coral ecosystems, it is now thought that there are more coral species living at great ocean depths than in tropical shallows[148]. These ancient corals, black corals *(Leiopathes sp.)* and gold corals *(Gerardia sp.)*, found to be as old as 4,265 and 2,742 years[149], respectively, create ornate, forest-like structures that would take hundreds or thousands of years to recover if disturbed by destructive fishing activities such as bottom-trawling.[150] They are thought to be the oldest living organisms on the planet[151].

# Seamounts

- **The proposed expansion of the Monument would protect approximately 110 additional seamounts from the irreversible effects of deep water trawling and the immeasurable damage of deep water mining.**

- **The biodiversity on these seamounts is high and virtually unstudied, but every other seamount investigated has yielded astounding discoveries. The potential for new discovery is high.**

Seamounts, underwater mountains, host some of the most ecologically interesting and unique species in the ocean[152]. Unique deep water corals and sponges are frequently found on seamounts and serve as habitat and nursery sources for a myriad of species. Within PMNM's waters there is a high diversity of gorgonian coral, and one species observed on Twin Banks, *Iridogorgia magnispiralis*, measured almost seven meters in height, the largest gorgonian ever seen.[153] The proposed expansion of the Monument would protect approximately 110 additional seamounts from the irreversible effects of deep water trawling and the immeasurable damage of deep water mining.



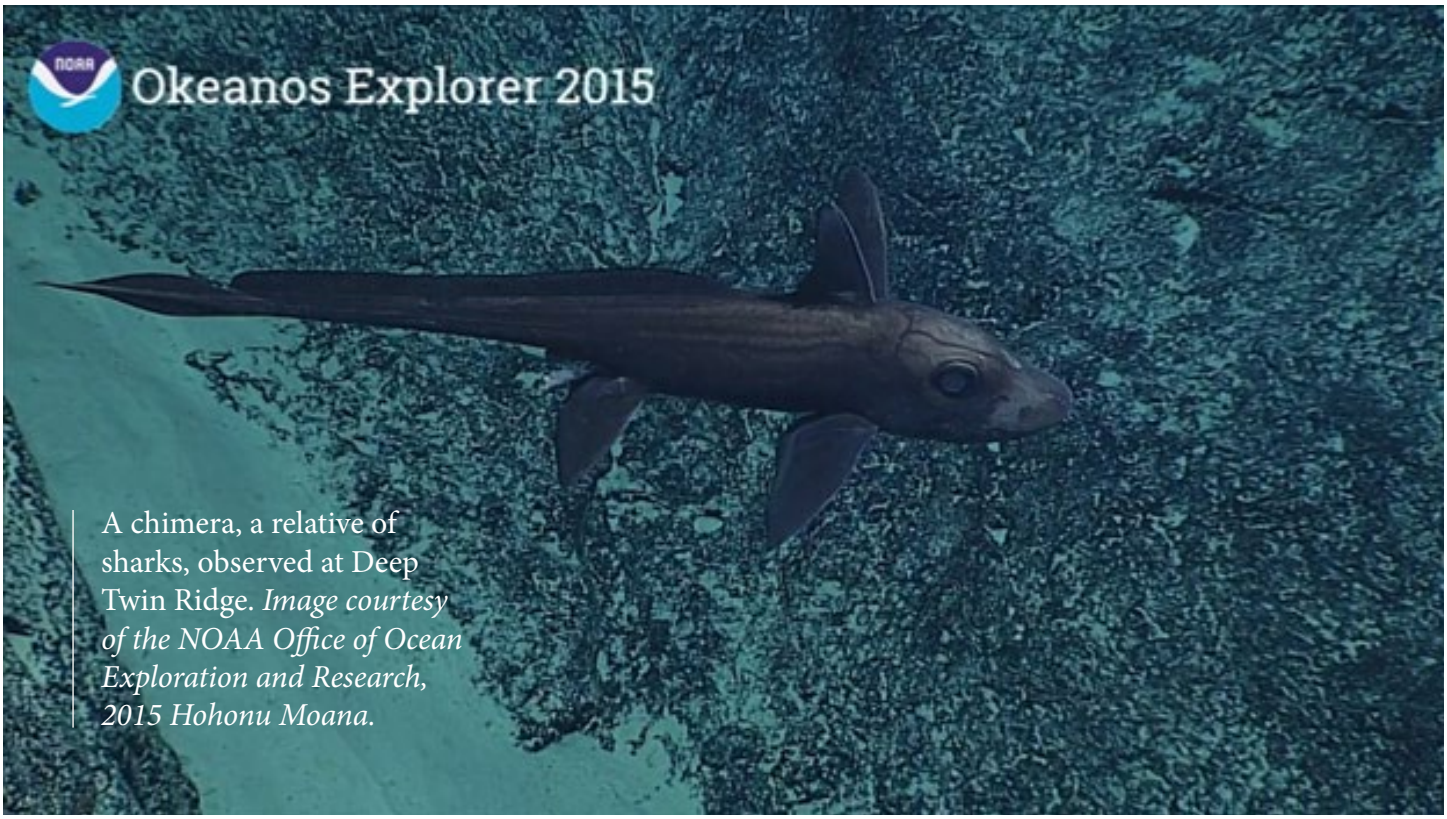
Two unnamed seamounts located southwest of Midway Atoll. *Image created from data collected on the R/VFalkor in Spring 2014.*

Monument seamounts host a rich benthic community and include polychaetes, echinoderms, crustaceans, sipunculids, nemertean worms, and molluscs. Many of the deepwater communities of PMNM remain unknown with recent expeditions in the nearby waters revealing several previously undiscovered species along the Necker Ridge[154].

The monument is laced with volcanic platforms terraced with drowned fossil coral reefs that provide a detailed record of the formation of the Hawaiian Archipelago and tracks the movement pattern of the Pacific plate over millions of years. Many of the roughly 52 volcanoes in the archipelago are capped by drowned reefs that have recorded the subsidence history of the volcanoes[155]. In addition to Hawaiian age seamounts that are 20-30 million years old, the monument contains much older volcanoes of Cretaceous origins, dating back 82-92 million years.

A marine ecologist at the University of Hawaii noted that new species remain to be discovered in the waters of the NWHI and he currently houses a collection of new species from this region awaiting scientific description at his research lab.[156] The proposed expansion will include Necker Ridge, protecting the unexplored diversity of this area and connecting to the protected waters near Johnston Atoll and the Central Pacific.

The vast majority of the seamounts in the waters surrounding Hawaii are virtually unexplored, supporting biodiversity-rich communities that are some of the most poorly understood in the world.[157] Every research expedition in these waters discovers large numbers of new species,[158] such as previously unrecorded species of deep-water algae, coral, and fish.[159] During the summer of 2016, another scientific research expedition on NOAA's Okeanos Explorer research vessel is investigating the megafauna communities residing on seamounts within and around the monument[160].




A chimera, a relative of sharks, observed at Deep Twin Ridge. *Image courtesy of the NOAA Office of Ocean Exploration and Research, 2015 Hohonu Moana.*

Scientists estimate that there are upwards of two million species inhabiting the sea-- biodiversity comparable to the world's richest tropical rainforests[161,162]. Much of this diversity is unknown at this time as science has only identified 240,172 known marine species[163]. In fact, only about two million species have even been described by scientists globally, most of them terrestrial[164]. There is much yet to be discovered. For example, on a recent research cruise found a new species of pigmentless octopus near Necker Ridge at depths of 4290 meters (2.5 miles). The ghostly animal was previously unknown and is thought to a new species, and might represent a new genus[165]. Scientists have dubbed it the "Casper" octopus, after the popular American cartoon character.

Deep-sea species tend to be slow growing, late maturing and endemic, making them particularly vulnerable to extinction. Much of the biodiversity in the deep sea is concentrated around seamounts. They are home to cold-water coral reefs, sponge beds, and hydrothermal vents, as well as large marine mammals, such as dolphins and whales, and an extraordinary diversity of fish, creating one of the world's greatest unexplored marine-biological treasures.

These remote underwater "islands" provide an important source of food to species due to their associated nutrient-rich upwellings and strong localized currents, which promote growth of massive quantities of plankton[166]. At the base of the food web, these plankton hotspots are prime deep-sea feeding and spawning grounds, providing a pit stop for various pelagic species as they migrate through the vast open ocean.[167]

Hawaiian monk seals have been found to range away from barrier reefs along the Hawaiian Islands Archipelago submarine ridge to nearby seamounts and submerged reefs and banks[168]. Core foraging areas of these endangered animals are generally centered over areas of high bathymetric relief such as submerged banks and seamounts[169].

# Threats Facing the NWHI

- **Immediate threats to the ecosystem and biodiversity include commercial fishing and plastic pollution.**
- **Potential future threats include deep sea mining and the effects of climate change, in particular acidification, deoxygenation, and sea level rise.**

In simplistic terms, human threats to the ocean can be placed into two broad categories: extraction and pollution. We take out too many fish and other marine life, and dump too many pollutants into the water and too many greenhouse gases into the atmosphere. This is beginning to affect the health of the ocean. On the horizon is the threat of seabed mining.

Today, the main extractive threat to the area of the proposed expansion of PMNM is longline fishing, especially for the thousands of individual sharks, turtles, seabirds, and marine mammals caught as bycatch. In 2014, 2.5 million hooks were set inside the proposed expansion, catching 11,000 tuna, 5,000 sharks, 4,000 billfish, as well as large numbers of seabirds, sea turtles, and marine mammals[170].

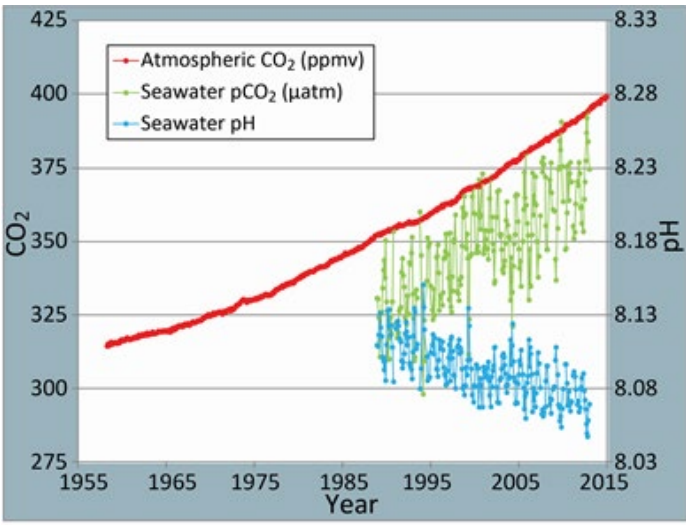
Plastic pollution and marine debris entangles and chokes wildlife. Derelict fishing gear is the main type of submerged marine debris[171], and it can continue killing animals long after it has been lost. Fishing gear also becomes entangled on and damages coral reefs and it plastic components have toxic properties[172] that can disrupt the hormone systems of animals and people. Reducing the fishing vessels in the region will help reduce pollution and ghost fishing by lost gear.

Deep sea mining will not become a threat to marine ecosystems for a few years, but the threat is imminent, and an opportunity exists to protect the fragile area from any future mining. The deep sea ecosystems that are threatened by mining are some of the least studied and understood on Earth. It should also be noted that a tailings from any mining operations will likely also affect the pelagic realm as well.

The amount of carbon in the atmosphere is higher today than at any time in the last 400,000 years [173]. The global concentration of carbon dioxide in the atmosphere surpassed 400 parts per million in 2013[174]. Monthly average data from Mauna Loa over the past five years show the steadily increasing concentration of atmospheric carbon dioxide (figure fr. Mauna Loa, NOAA)[175]. Further, the atmospheric partial pressure of carbon dioxide, or $pCO_2$ correlates with a decrease in pH, or increase in acidity of the ocean[176]. Estimates vary, but the ocean absorbs between twenty six percent[177] to half[178] of all carbon dioxide released into the atmosphere.

The chemistry of carbon dioxide dissolving into the ocean is affected by local conditions of temperature, nutrients, ocean circulation and the surrounding biogeochemical community[179,180]. Determining exactly what happens in a particular area is complicated and of course depends on species composition and resilience[115], however, both field and laboratory experiments point to acidification as responsible for reducing the availability of carbonate to organisms that produce calcium carbonate structures including corals, molluscs, coccolithophores, and calcareous seaweeds[181].

Ocean acidification is the insidious side effect of excess atmospheric carbon dioxide. It promises to disrupt formation of coral reefs and stability of food webs, resulting ecosystem damage and food security issues[182]. Immediately taking steps to decrease the concentration of atmospheric carbon dioxide is practically the only way to slow the effects of ocean acidification, however, protecting large expanses of reefs from fishing and other extraction activities would also help maintain the biodiversity needed to buffer or ameliorate the effects of ocean acidification[183].




This graph shows the correlation between rising levels of carbon dioxide ($CO_2$) in the atmosphere at Mauna Loa with rising $CO_2$ levels in the nearby ocean at Station Aloha. As more $CO_2$ accumulates in the ocean, the pH of the ocean decreases. (modified after R. A. Feely, Bulletin of the American Meteorological Society, July 2008).

**Figure 7:** Amount of carbon dioxide in the atmosphere

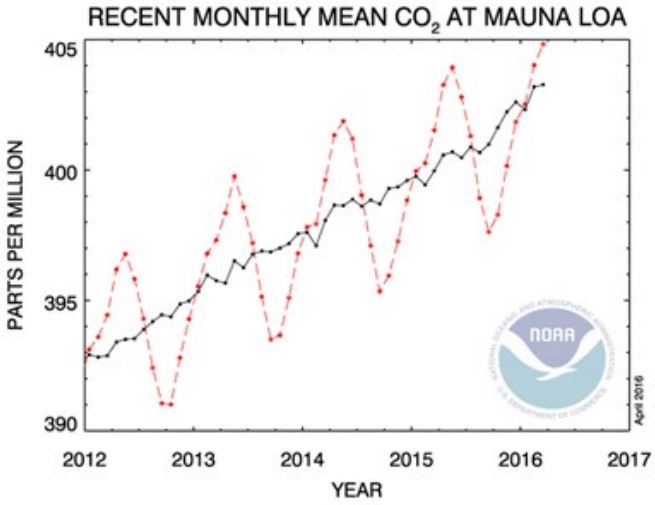



**Figure 8:** Amount of carbon dioxide in the atmosphere.

# Commercial Fishing

*"Given the huge scale of fishing impacts, the rate of fish extinctions is likely to increase greatly through this century unless a refugial network of effective MPAs exists to allow persistence of large-bodied species and associated predator-dominated food webs, and broad-scale fisheries management practices significantly improve"* [184] *Professor Graham Edgar, University of Tasmania Institute of Marine and Antarctic Studies.*

- **Historically, commercial fishing has had a dramatic effect on the NWHI. Abundant populations of black-lipped pearl oysters were virtually wiped out by commercial fishing between 1929 and 1931 and remain rare today[185].**
- **An aggressive lobster fishery in the 1980s and 1990s drove down lobster numbers to a fraction of their original population and years after a court-ordered ban on lobster fishing little recovery is evident[186].**
- **Juvenile endangered Hawaiian monk seals are believed to have relied heavily on lobsters for food. Starvation among juvenile seals is now common and populations of this animal continue to slip toward extinction[187].**
- **The area proposed for expansion is not a major fishing ground according to publicly available data from NOAA[188]. In fact, log books show that the effort in the region has been dramatically decreasing over the last five years.**
- **Hawaii longline catch quotas are set by the negotiations that take place at the Western Central Pacific Fisheries Commission, not the placement of marine protected areas. An expanded monument simply displaces fishing effort but will not reduce the overall catch for the Hawaii longline fishery and therefore it will have no, or only minimal, negative impacts on the Hawaiian and US economy.**
- **Removing the threats from fishing will protect important populations of monk seals, sea turtles, whales, dolphins, seabirds, sharks, and tuna.**

*Photo credit: Maximilian Hirschfeld 2010/ Marine Photobank*

While some Pacific areas and species have seen an increase in longline fishing, the NWHI has seen a decrease.[189] Only 5 % of the fleet's hooks were deployed in the Northwestern Hawaiian Islands' EEZ in 2014.[190]

In 2014, the longline fishery within the NWHI included 89 active vessels, taking 144 trips with 1044 sets. This shows a steady decline – in 2013, there were 95 active vessels, taking 204 trips with 1427 sets. In 2012, there were 113 active vessels, taking 281 trips with 1771 sets.[191]

The NWHI fleet caught 11,727 bigeye tuna in 2014, down from 14,247 in 2013. The albacore catch was 1898 in 2013 and decreased to 1052 in 2014. The catch of yellowfin tuna also decreased in 2014 to 1723 from 2394 in 2013.[192]

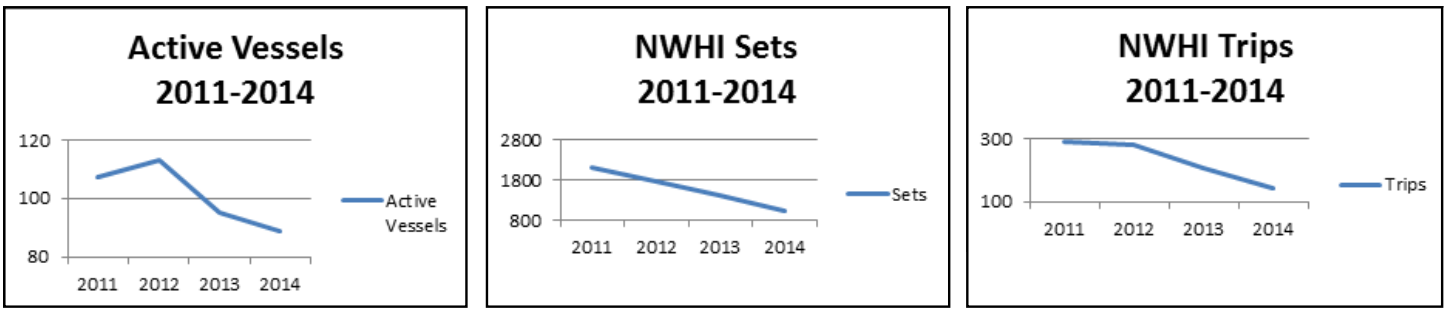



**Figure 9:**
Fishing effort in the Northwestern Hawaiian Islands 2011-2014.

A growing number of hooks are being set outside the U.S. EEZ with this area comprising 75% of the total hooks set in 2014.[193] Data shows that the catch per unit effort (CPUE) outside the EEZ is higher than in the Main Hawaiian Islands. A fishing ground with higher CPUE provides more return on investment for fishermen, so these areas are more attractive to them, which is why we see so much of the fishery moving into the high seas.

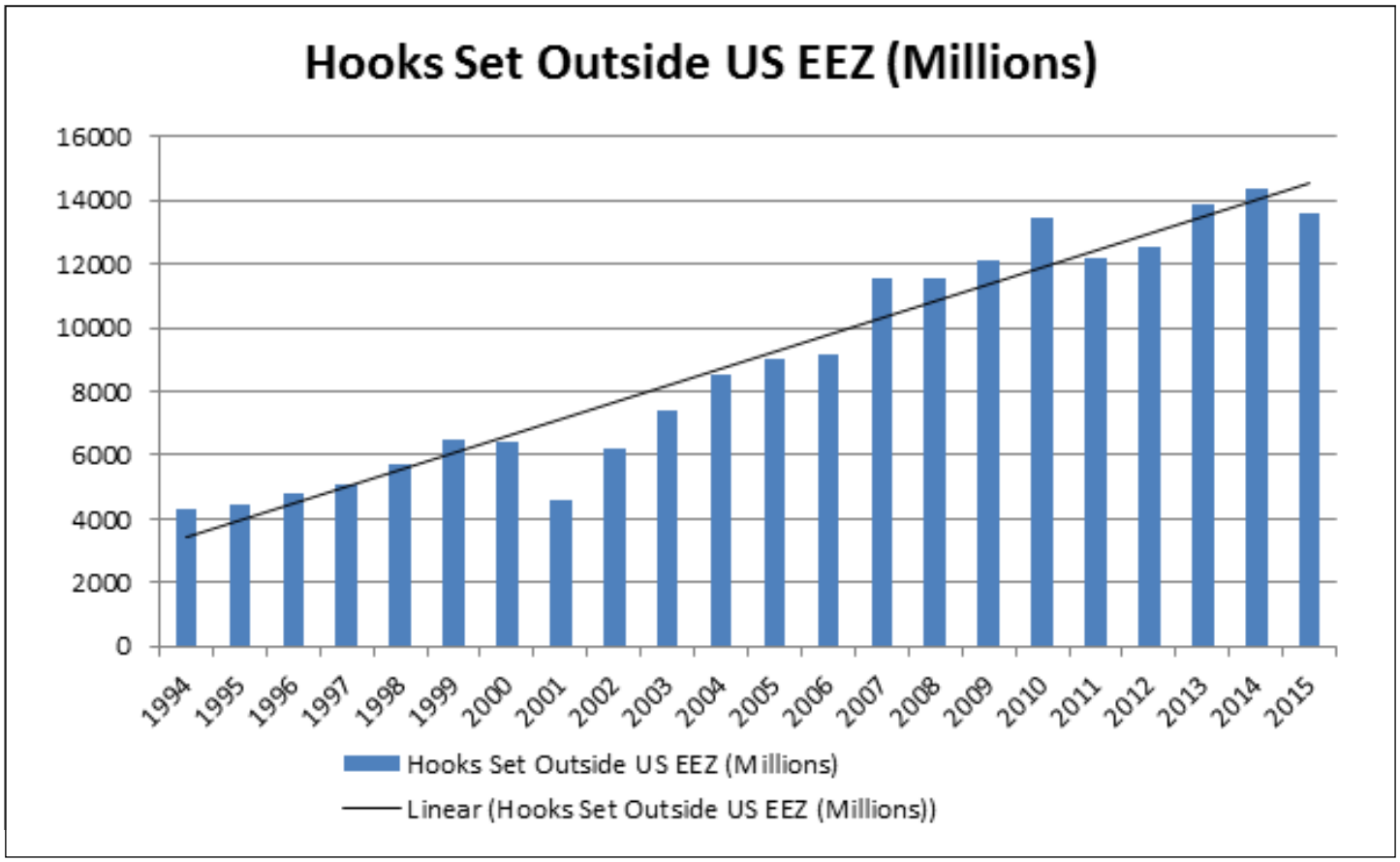



**Figure 10:** Number of hooks (in millions) set by Hawaiian based longliners 1994-2015.

Also of note, the catch per unit effort for bigeye tuna *(Thunnus obesus)* inside the EEZ around the Main Hawaiian Islands has been declining for decades. This brings into question claims that the Hawaiian longline fishery is sustainable. As stated previously in this report, bigeye tuna is overfished and overfishing has been occurring for years. This report has also shown that tropical tuna, including bigeye, are not highly migratory and most individuals spend much of their life in one area of the Pacific. The data plainly shows that as the longline industry has fished out the tuna resources inside the EEZ, it has increasingly gone outside the EEZ where there are more fish and the CPUE is higher.

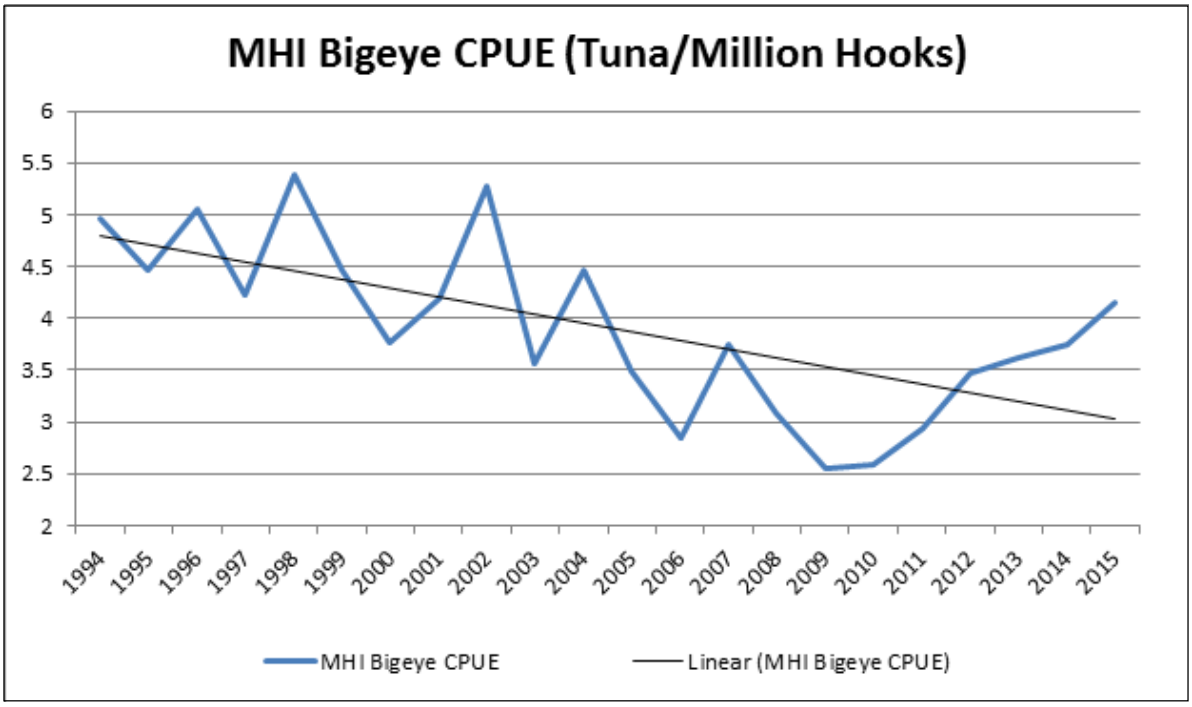



**Figure 11:** Catch Per Unit of bigeye tuna *(Thunnus obesus)* 1994-2015 in tuna per million hooks.

Despite the limited fishing taking place in the area, the amount of bycatch is of concern. Reports have shown that the hooking and entanglement of 20 false killer whales *(Pseudorca crassidens)* is an unsustainable level of take[194,195]. The total annual estimated mortality and serious injury of the Hawaiian stock of false killer has exceeded the level allowable under the Marine Mammal Protection Act (MMPA), and this stock has been considered strategic under the MMPA since 2000[196].

*Photo credit:*
*Jim Abernethy*

In 2015, the Hawaii longline fleet caught nearly 6,600 sharks in the NWHI alone, nearly all of which were discarded. Since 1991, more than one quarter million sharks have been caught in the area proposed for monument expansion. The catch included oceanic whitetip sharks, thresher, and silky sharks. Thresher sharks and silky sharks are both up for listing on Appendix I of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2016 because of their reduced numbers.[197]; Oceanic whitetip sharks were listed on CITES in 2013. According to publicly available NOAA data, longline fishermen in the area targeting bigeye tuna but then catch one shark for every two of the target species[198].

Marine reserves like an expanded PMNM hold even greater benefits for top predators, such as sharks and tunas. Studies have shown biomass continuing to increase exponentially in predatory fish populations in coastal reserves for up to 18 years after protection was established.[199] Emerging science also highlights the critical role that healthy populations of large predators play in maintaining ecosystem balance[200,201] and how rebuilding their numbers leads to healthy and more complex food webs.[202] There is evidence that healthy ecosystems, often demonstrating healthy populations of predators, are better able to cope with, and recover from, unexpected environmental changes, including those from climate change.

# Deep Sea Mining

- **We know very little about the deep ocean that could be open to mining. It is critical to learn more about these ocean areas before potentially harmful activities could have a detrimental impact on their ecosystems, habitat, and species.**

- **The deep seafloor and water column are unique landscapes, similar to mountain ranges and canyons on land that are just as vital to biodiversity and are in need of conservation.**

Areas within the proposed expansion have been identified as potential sites for deep sea mining[203]. Cobalt rich manganese crusts have been discovered along Necker Ridge, an area in the proposed expansion[204]. There are likely other minerals associated with benthic habitats in the area of proposed expansion due to the large number of seamounts and vents. Past extraction of resources in the NWHI, from mining guano on the islands to different types of fishing, has harmed this fragile ecosystem, so the possibility of future deep sea mining must be of concern.

Seafloor massive sulfides (SMS) are found around volcanic hot spring hydrothermal vent communities, and are formed when metal-rich minerals are deposited as a result of natural mixing of super-heated mineral-rich water with cold seawater at the bottom of the ocean[205]. Hydrothermal vents support tremendous productivity, endemism, and unique biological communities. Mining SMS minerals has yet to be tested at full capacity.

The environmental effects of deep-sea mining could be significant and have been classified into five general categories: 1) direct physical disturbance; 2) sediment plumes; 3) acoustic impacts; 4) waste water disposal; and 5) machinery leaks or malfunctions. SMS extraction is anticipated to have considerable impacts on ecosystems, including habitat destruction and species mortality around the impacted hydrothermal vent area.[206]

There is currently no deep sea mining taking place in the NWHI or in any area under American jurisdiction; however, mineral extraction is planned for other areas in the Pacific. Nautilus Minerals was granted a mining lease in Papua New Guinea in 2011 and preparations are nearing completion for seafloor mining to commence shortly. In the United States, development of environmental regulations and awarding of mineral claims rests with the Office of Ocean Minerals and Energy, a part of NOAA.

Mining of areas we know little about could cause irreversible damage, and therefore we need to be particularly careful about where mining is allowed to occur. Direct and indirect impacts on benthic life are likely to be significant and poorly understood, as we know so little about these ecosystems to begin with. According to one estimate, one fifth of all known hydrothermal vents are threatened by deep sea mining and only 8% of known hydrothermal vent fields fall within a marine protected area .

# Plastics

- **Albatross mistake floating plastic debris for potential food, ingest it as food, or regurgitate it for their chicks to eat. This can cause mortality.[207]**
- **57 tons of fishing nets and plastic litter were removed from the monument in 2014.**

*Photo credit: Claire Fackler, NOAA National Marine Sanctuaries/ Marine Photoba*

Marine debris is a severe and chronic threat to the NWHI wildlife and marine habitats. Ocean currents carry a wide array of marine debris, including derelict fishing nets and other gear, household plastics, hazardous materials, and shore-based debris[208]. Most plastic pollution originates from outside the monument, however, commercial fishing boats, recreational fishing boats, and military, merchant, and research vessels in the area of the proposed expansion likely contribute. 88% of marine debris is thought to originate from such ocean-based sources[209]. A study published in 2014 estimated 298,940 tons of plastic floating in the ocean[210].

Animals can become entangled in marine debris, such as derelict fishing gear, while other animals can ingest small bits of plastic. For example, monk seals have the highest entanglement rate of any seal in the world. Between 1982 and 2003 there were 238 documented seal entanglements, though many more likely occurred.

Up to 60% of the content in seabirds stomachs' is plastic, depending on the species[211]. Eleven of the twenty two species found here are considered imperiled or of high conservation concern. 267 unique species worldwide are known to have suffered from entanglement or ingestion of plastic[212].

Plastics are considered to be biochemically inert, however many chemical additives in plastics are thought to be toxic including lead and chromium. Several additives have been shown to include endocrine disruptors that affect the function of the hormone system.

*Photo credit: Camden Howitt, Sustainable Coastlines/Marine Photobank*

Plastic marine debris can act as magnets for persistent organic pollutants in the ocean such as PCBs (polychlorinated biphenyls) and PAHs (polycyclic aromatic hydrocarbons). Both of these chemicals have been linked to adverse human health impacts including cancer and endocrine disruption and are likely to damage the health of marine life as well. The hydrophobic nature of these molecules allows them to adhere to the surface of some plastics at levels up to one million times the concentration of surrounding seawater[213]. The longer plastics persist in the marine environment, the higher the toxin accumulation[214]. These toxins can potentially enter the food chain when consumed by fish and seabirds.

*Photo credit: ©Frank Baensch-bluereefphoto.org/Marine Photobank*

Fishing gear that is lost, discarded, or abandoned can cause damage to coral reefs when it becomes entangled on coral heads. Subsequent wave action can cause the coral to break off at points where the debris was attached, and the process is repeated until it is removed or becomes weighted down and sinks. Eventually, derelict fishing gear may become a part of the reef structure[215]. Derelict fishing gear can also continue to catch fish and entangle other wildlife for many years after it is lost, especially in the deep sea.

# Climate Change

- **The Obama Administration has identified climate change as a major threat to national security.[216]**
- **Protected areas act as an ocean refuge for fish, including those displaced by climate change. As ocean temperatures rise, migratory fish populations will move toward cooler waters affecting fisheries and food security.**
- **There are a multitude of threats to the oceans that work in combination with and as a result of climate change, including acidification, deoxygenation and sea level rise.**
- **The most up-to-date science shows that marine reserves are an essential means to bolster climate resilience; strongly protected areas that safeguard species and ecosystem functions have proven to be six times more resilient to the impacts of climate change than unprotected areas.[217]**

*Pelagic seabirds are impacted by marine debris, although they are in the Papahānaumokuākea Marine National Monument located in the remote Northwestern Hawaiian Islands. Photo Credit: Claire Fackler, NOAA National Marine Sanctuaries/Marine Photobank*

Large, strongly protected marine reserves have emerged as important policy solutions which carry the dual benefit of being both marine climate change mitigation and adaptation strategies. By increasing ocean health, marine reserves are one of the most efficient means to protect Earth and its climate. Fully-intact marine ecosystems, such as those protected by marine reserves, are healthy and resilient,

better able to withstand the impacts of climate change. On the other hand, damaged ecosystems are weak and susceptible to further destruction and disease.

Scientists have suggested that attempts to spare coral reefs from the impacts of climate change by solely reducing emissions have little impact unless protected areas are also established in lockstep with policies that guard essential fish communities, and thus protect healthy reef functioning[218]. For example, in the large, fully-protected reserve in the Indian Ocean around the Chagos Islands, healthy lagoon habitat was critical to coral reef resilience to a large-scale warming event, enabling these ecosystems to recover from this unanticipated environmental shock.[219]

While the NWHI's coral habitats are isolated and still healthy, they are threatened by the effects of climate change. The tropical Pacific has warmed substantially over the past 50 years and the intensified hydrological cycle has reduced the salinity of an area in the Central Pacific Ocean called the Pacific Warming Pool,[220] posing a considerable threat to the corals of the monument.[221]

Additionally, as surface water temperatures and environmental conditions change, we tend to see the ranges of fish and fisheries shift toward cooler waters[222,223,224,225,226] affecting fishery health[227], food security, and the economics of fishing[228]. In a study conducted in 2012, scientists observed a northward range shift in various species of fish in the northeastern U.S. with increases in surface water temperature.[229] In the Pacific, the expansion of the Pacific Warming Pool due to climate change is expected to push fish north and east[230]. Given this observed relationship, climate change can pose a huge threat to species that need very specific environmental conditions (e.g. temperature, prey availability, mates) in order to survive, therefore shifting their ranges could prove disastrous if they are being heavily fished.[231] With these temperature and environmental perturbations expected to intensify in the Pacific,[232] an expansion of the PMNM could provide a sanctuary for these marine species.

It is also important to note that it will take between 25-50 years for ocean chemistry to reach equilibrium with atmospheric carbon emissions, and that there will be a "stopping distance" between when we curb our carbon emissions and when coral reefs start getting healthier[233]. If we wait until the problems in PMNM are visible and acute, they may become irreversible. We should protect the ecosystem now to the greatest extent possible.

Temperature anomalies present another significant threat to the marine environment. Elevated sea surface temperatures may be linked to coral bleaching events reported in the NWHI in recent years. These bleaching events place stress on corals, making them more susceptible to disease.

An additional concern is that the species that inhabit the NWHI are particularly vulnerable to sea level rise. In a 2012 USGS report, models predicted a rise of approximately one meter in global sea level by 2100, which would result in a loss of 4% of the total land area in the NWHI. In an even more severe scenario, the NWHI would lose up to 26% of land with a two meter increase in global sea level, land which various species of albatrosses depend on as breeding colonies.[234] Additionally, the NWHI have on record experienced two episodes of coral bleaching.[235] Threats such as these are a major source of concern in maintaining biodiversity in this area.

Seventy one percent of the Earth's surface is covered by ocean. It is the planet's largest ecosystem and plays a crucial role as a climate regulator. The ocean's role in the global carbon cycle is critical - it is by far the biggest carbon sink in the world; over the past 200 years the ocean has accumulated twenty six percent[236] to half[237] of atmospheric carbon emissions. While it has suffered some damage as a result, the ocean has significantly reduced, and mitigated, the impacts of increasing concentrations of atmospheric carbon dioxide.

To an extent, the impacts of climate change have been set in motion, and will continue to affect the ocean and its ability to withstand environmental stress for years to come. However, scientists are discovering that marine life acts as the "biological pump" of the ocean – converting carbon dioxide into living matter – and could serve just as important of a role as a carbon sink as the physical and chemical marine processes that drive the solubility of atmospheric carbon dioxide.[238] In fact, this biological pump accounts for about two-thirds of the flux of carbon within the ocean.[239]

A new study focuses specifically on the role of marine life in the carbon cycle. The study identifies eight key ways that life ranging from photosynthetic primary producers – that convert sunlight into essential building blocks – to the top predators of marine ecosystems act as carbon sinks. Most notably, this work highlights the role of food web dynamics and marine life biomass in carbon storage.[240] In addition, this study and others have demonstrated that the ability of bony fish to metabolize carbon into calcium carbonate provides a much needed buffer against ocean acidification, accounting for as much as 45 percent of surface ocean carbonate.[241] There is also evidence to suggest that intact predator populations are critical to maintaining or growing reserves of carbon stored in coastal or marine ecosystems, and policy and management need to be improved to reflect these realities[242]. Therefore, using marine reserves as a tool to protect marine life appears to better support the ocean's ability to combat, and recover from, climate change. By keeping marine life in the water, marine reserves also support the ocean's continued role as a biological pump in the carbon cycle.

# Economics of Marine Protected Areas

- **The social and economic benefits of marine protected areas have been shown to exceed their costs.**
- **Marine protected areas offer many benefits beyond improving fish stocks, including contributing to climate change adaptation, coastal protection, ecosystem services, cultural preservation, and benefiting ecotourism.**

## Benefits of Marine Protected Areas

Marine protected areas (MPA) deliver substantial benefits to people and the global economy. It is widely established through numerous studies and peer-reviewed publications that the social and economic benefits of establishing and operating MPAs exceed their costs, from 3:1 for 10% protection, up to 20:1 for 30% protection[243].

*Photo credit: Chris Pincetich/Marine Photobank*

For example, in Hawaii, a review of six marine protected areas showed that they generated benefit-cost ratios ranging from 3.8 to 41.5[244]. Another example from Vanuatu showed a mean return on investment of 1.8 was achieved for five MPAs only five years after the initial investment[245]. Another study demonstrated that economic benefits from establishing new MPAs can offset costs in as few as five years[246].

MPAs contribute to climate change adaptation and to some extent mitigation. Investing in MPAs can reduce community, national, and global vulnerability by increasing resilience and reducing risk[247]. It can support adaptation efforts against climate-related impacts at various scales, and contribute somewhat to climate change mitigation via the maintenance of healthy oceans[248].

Investments in MPAs can provide direct benefits such as coastal protection, including the protection or restoration of mangroves and coral reefs. These investments will enhance resilience by protecting ecosystems, and thus improving food security and securing livelihoods options[249]. This will be increasingly important in helping communities adapt to climate change and in minimizing damages and losses.

MPAs can strengthen the provision of marine ecosystem services. As marine biodiversity loss disproportionately affects vulnerable populations, investments in MPAs, by helping to protect biodiversity, will help secure the long-term provisioning of key services and access to essential marine resources that support food security, economic opportunities, and human well-being of the world's poor populations[250].

MPAs provide insurance and protection from risk. MPAs as the 'conservative' part of our ocean portfolio serve as insurance against our mistakes in management[251]. Investments in MPAs can provide insurance against uncertain and accelerating future marine ecosystem change, and maintain and enhance future development options. Investments made now will reduce future costs and preserve opportunities for current and future generations.

MPAs are also a way to share ocean values with future generations. Effective MPAs are a powerful mechanism for delivering sustainable fisheries objectives for coastal marine ecosystems at varying scales, including sustainable food security, livelihoods, climate change, and disaster risk reduction, far into the future. The sections of this report on the *Role of the NWHI in the Hawaiian Renaissance and Papahānaumokuākea as a Cultural Landscape* discuss these issues as they relate to Native Hawaiian culture in great depth.

# Economic Impacts of Papahānaumokuākea Expansion

- **There are very high economic and social benefits to expanding Papahānaumokuākea, and very limited costs.**
- **The expansion of the monument does not affect the fishing quota of the Hawaiian longline fishery. Effort will shift to the 98% of the ocean that is open to fishing.**

*Photo credit: Danny Bergeron/Marine Photobank*

A key obstacle to establishing MPAs is the fact that in most cases the fisheries costs of MPA establishment are realized in the short term while the fisheries benefits come later. Thus, the short term fisheries costs prevent the realization of the expected much larger benefits. The challenge therefore is to find ways to mitigate the short term costs to fishers of MPA establishment.

The good news in the situation of the expansion of Papahānaumokuākea is that it is unlikely that the Hawaiian longline fishery would be significantly affected by the larger marine protected area. The most likely response to the expansion of the PMNM is for fishing effort to shift beyond the newly closed area. This is possible because the Hawaii longline catch quotas are set by the negotiations that take place at the Western Central Pacific Fisheries Commission, so an expanded monument will not reduce catch.

Assuming effort shifts to outside the area, the industry is unlikely to be affected by the expansion of the monument. With 90% of the fleet based in Honolulu Harbor and almost all landings are offloaded there, the

wider Hawaii fishing industry, including wholesalers, retailers, fish cutters, equipment operators, provisioners, etc., would be unaffected by the proposed expansion.

It is worth noting that NOAA data show that both the landings and landed values of the longline fleet active in these waters remained the same after the expansion of the Pacific Remote Islands Marine National Monument (PRIMNM) in 2014[252]. The effort was displaced out of the newly created marine protected area on April 25, 2015 after regulations were published in the Federal Register[253], but fishermen were still able to reach their annual quota on August 5, 2015[254] by fishing elsewhere, fully five months before the end of the year. Furthermore, fishermen were able to keep fishing through the end of the year by fishing in the East Pacific, an area not subject to the quota, or by purchasing quota from the U.S. territories of American Samoa, Guam, and the Northern Mariana Islands[255].

The area in the Northwestern Hawaiian Islands under consideration for expansion is not a major fishing ground according to publicly available data from NOAA[256]. Historically, less than 10% of the fleet's landings have been caught in this area, dipping down to 5% of total landings in 2014 and 2015. Meanwhile, approximately 70% of the catch (79% in 2014) has historically been caught entirely outside of the EEZ[257]. The implications of the points made here is that the catch and revenues currently being generated by the fishery are not likely to be affected with the expansion, similar to the situation with PRIMNM. Hence, the added value and contribution of the fisheries sector to the GDP of Hawaii and the fish supply would remain at or close to current levels.

On the other hand, the cost of fishing is likely to increase slightly with the expansion of the PMNM mostly due to an increase in fuel costs as vessels would need to travel farther to fish. The current low oil prices combined with the fleet's preference for these distant fishing grounds (as indicated by NOAA effort data[258]) indicate that these costs would likely be negligible. It is also possible that higher fuel costs would be offset by the higher catch per unit effort for target species found outside the U.S. EEZ.

# Conclusion

*"As a Native Hawaiian, we have a concept called Malama 'aina, which teaches us that we must care for the land and nature, so it can continue to care for and sustain us – and our future generations. It means that the relationship between man and environment is a reciprocal one."*

U.S. Sen. Daniel K. Akaka, Native Hawaiian

*Photo credit: Paulo Maurin/Marine Photobank*

President Barack Obama has a unique opportunity to set a new global standard of marine protection by using his authority under the Antiquities Act to expand the Papahānaumokuākea Marine National Monument to include habitats and ecosystems outside the monument's current borders. This document has shown that the smallest area compatible with proper care and management of this unique cultural and scientific treasure is the full U.S. EEZ of the Northwestern Hawaiian Islands.

The proposed expansion contains assets of considerable cultural and scientific value, from native Hawaiian biocultural resources to the unprotected remains of the Battle of Midway. The area is also critical foraging habitat for 22 species of seabirds, 22 species of whales, at least a dozen species of sharks, four commercially important species of tuna, five species of threatened sea turtles, and endangered monk seals. The bottom of the sea holds staggering amounts of unstudied benthic life. 110 seamounts are unexplored and awaiting discovery in this area.

These protections can be put in place with minimal disruptions to the commercial fishing industry. There is no evidence that an expanded marine protected area will reduce fish catches of longline vessels because they can fish throughout most of the Pacific. These boats typically travel thousands of miles in a single trip. They are targeting migratory fish, not fish associated with benthic habitats like seamounts. NOAA data supports this claim; there was no change in the catch of bigeye tuna when the Pacific Remote Islands Marine National Monument was expanded in 2014. Effort shifted to the 98% of the ocean that is open to fishing.

It is important to note that the fishery in Hawaii is carefully regulated and the amount of fish caught by Hawaii-based longline vessels is determined by international negotiations and scientific recommendations at the Western Central Pacific Fisheries Commission, not the placement of marine protected areas. If there is no change in quota when the monument is expanded, then there is going to be no change in the number of fish caught or the amount of money fishermen make, and therefore, no negative effect on the economy. There is, however, a positive effect on a fragile and culturally important ecosystem. The economic and social benefits of the expansion far outweigh any potential costs.

The science behind the need to enlarge the protections is sound and solid; the arguments against expanded protection are not based on science, but the politics and financial gain of a few who benefit now at the expense of many including future generations of Hawaiians and other stakeholders.

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