Mariana Trench
Marine National Monument

Management Plan

May 2024

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Mariana Trench Marine National Monument

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A Vision for the Mariana Trench Marine National Monument

Rising from the abyss is a primal frontier that speaks to the wonder of existence. Vibrant and diverse ecosystems, fueled by unique bio-geochemical processes, are conserved in perpetuity for the benefit of present and future generations.

Ginen I mas taddung na tasi gi enterui tanu', kumahulu' ginen i tasin i islas Marianas un primet na lugat, anai bula sifia ha' sangani-hit put lina'la gi fondun i tasi. Manla'la' yan meggai siha na klasin fotman lina'la' naturat manggaigi guini na taddung tasi; ya ginen esti na grasia na pusipbli ha kunsetba anakku' na tiempu, para benifisiun i taotao-ta pa'gu yan i manmamamaila' siha na henerasión.

Yé é ughak té mé lól lóllólul sáát élo yéél falew, bweletál lól sáátal isla Marianas ghommw nge leeway. Ssogh yaasch ira nge malway ilól faal sáát. Ssogh me malaway nge uulul malaw naturat lól lóllólul sáát. me mille grasia emmwel ebwe sóbweeytá tiempol ngali benifisuol we yaasch aramas ighila me ráágh kka ebwe tooto ngáliir masamasal aramasal.

This plan details program planning levels that are substantially above current budget allocations and, as such, is primarily for strategic planning and program prioritization purposes. This plan does not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

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Gasses spew from the high-temperature white smokers at Champagne Vent site, NW Eifuku volcano. Photo: NOAA

Chapter 1. Introduction

1.1 Monument Features Overview

Enormous submarine mud volcanoes, underwater pools of liquid sulfur, dense apex predator populations, and spectacular coral reef systems … these are but some of the distinctive characteristics of the Mariana[‡] Trench Marine National Monument (Monument). Monument features are marked by the region's complex geological processes in the Earth's most active volcanic system, the Pacific Ring of Fire. These geological phenomena create unique underwater environments that support dynamic biological ecosystems. Spectacular volcanic undersea hydrothermal vents support a wide variety of marine life, including some of the earliest known microbial life forms on Earth. The Mariana Trench is the world's deepest trench, in which Mount Everest could fit with a mile of water to spare.[1, 2]

Spanning 95,216 mi^2 of submerged lands and waters, the Monument is located on the western edge of the Pacific Ocean and east of the Philippines in the vicinity of the Mariana Archipelago of islands, the historic and ancestral homelands and home-waters of the Chamorro[*] and Carolinian[†] people. A great diversity of physical and chemical environments hosts unusual species that make a living in seemingly extreme settings. The world's first discovery of hydrothermal vent fish was made in a boiling undersea lake of liquid sulfur on one of the Monument's seamounts. The submerged caldera at Maug is one of the few places on Earth where photosynthetic and chemosynthetic communities of life are known to exist together, fueling a microbial biodiversity hotspot of extraordinary complexity. This area provides a natural laboratory for studying ocean acidification and a potential coral refuge for climate change.

[‡] This plan uses the official Geographic Names Server feature name "Mariana Trench," correcting the "Marianas" spelling.
[*] Guam recognizes a different spelling, "CHamoru." "Chamorro" is the spelling used in the Northern Mariana Islands.

[†] The language of the Carolinian people is known as Refaluwasch by native speakers.

The waters surrounding these islands are home to sharks, whales, dolphins, and fish, along with several species of threatened and endangered (T&E) sea turtles. Sharks and other apex predators drive smaller fish to the surface, creating the bait balls upon which many seabirds feed. More than two dozen seabird species inhabit the area and enrich the nutrient load of coral reefs, fertilizing the shores with energy from the sea. The Monument complements the protections of adjacent wildlife conservation reserves in the three northernmost islands of the U.S. Commonwealth of the Northern Mariana Islands (CNMI) and presents a remarkable opportunity to protect every link in this complex and fragile chain—birds, seamounts, predatory fish, and corals—as an integrated ecosystem.

The Monument consists of three units: Trench, Volcanic, and Islands. Two of these units have also been designated as national wildlife refuges. The Trench Unit and Volcanic Unit are managed both as part of the Monument and as the "Mariana Trench National Wildlife Refuge" and "Mariana Arc of Fire National Wildlife Refuge." This document identifies these areas as the Trench Unit/Refuge and Volcanic Unit/Arc of Fire Refuge. The Islands Unit is also managed as a part of the National Wildlife Refuge System (NWRS). We have used these names throughout this plan in accordance with their legal and regulatory structure.

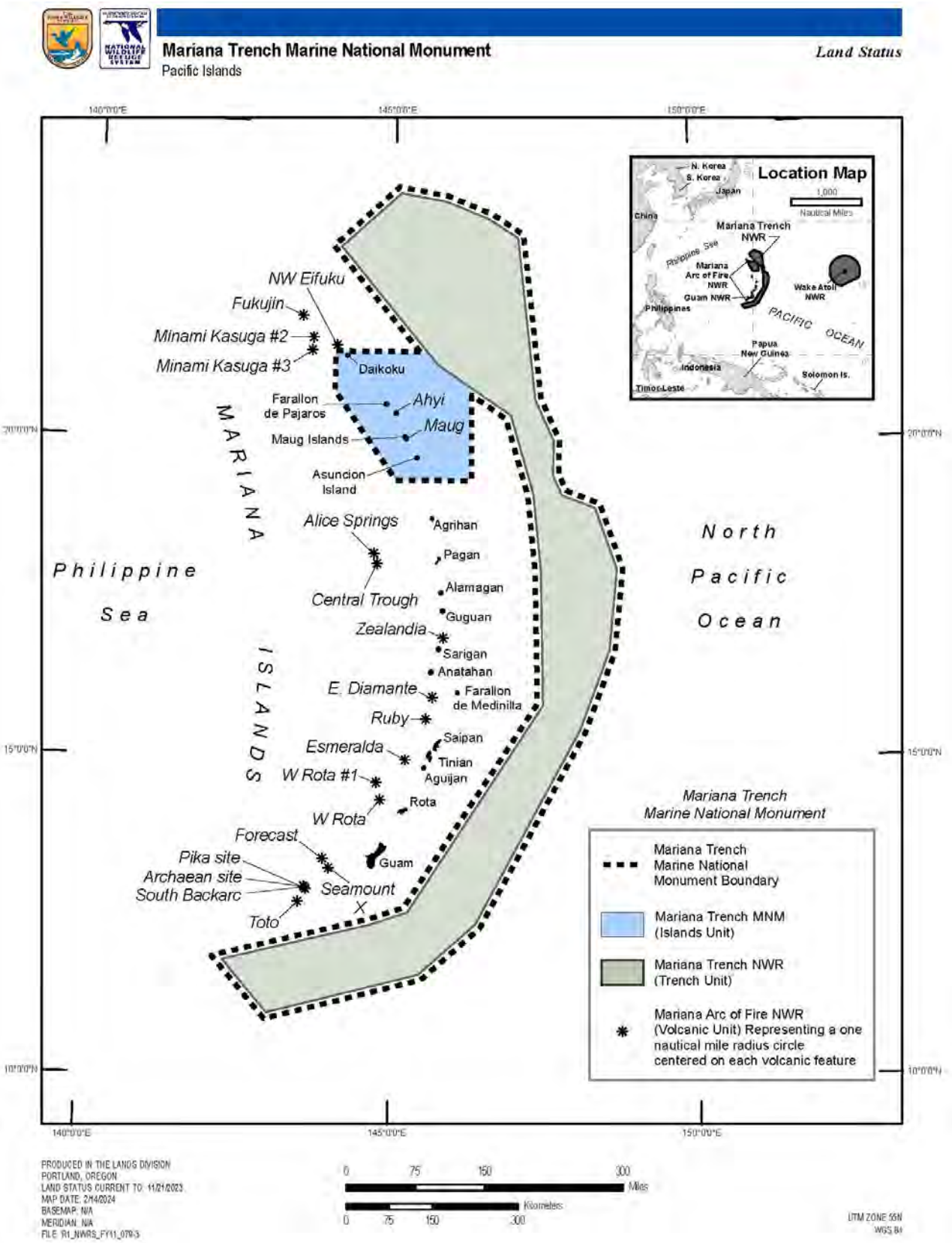
The **Trench Unit/Refuge** stretches approximately 940 nautical miles (nmi)[‡] long and 38 nmi wide along the Mariana Trench seafloor and includes Sirena Deep the third deepest point on Earth at about 35,000 feet (ft)—remarkable for its steep walls, distinctive geologic features, and deep ocean life forms. Xenophyophores resembling giant amoebae, deep-sea jellyfish, shrimplike amphipods, and translucent sea cucumbers have found a home in this harsh environment amid shaggy bacterial mats. The ocean floor at such depth consists of a biogenous ooze composed of microscopic plankton shells from both animal and plant plankton. The deepest areas of the Mariana Trench are likened to an inverted chain of islands, where each peak points downward but, like islands, each feature can be geologically and biologically unique.

Xenophyophores in the Trench Unit/Refuge. Photo: NOAA

The **Volcanic Unit/Arc of Fire Refuge**—an arc of 21 undersea volcanoes and thermal vents—sustains life under some of the harshest conditions on the planet. Here, species survive amid hydrothermal vents that produce highly acidic and super-heated water. Vent communities include squat lobsters, tubeworms, clams, and mussels that have developed a symbiotic relationship with chemosynthetic bacteria. The Champagne vent at NW Eifuku produces almost pure liquid carbon dioxide. Photosynthetic and chemosynthetic communities of life coexist in the caldera of Maug. The Daikoku submarine volcano has pools of liquid sulfur.

The **Islands Unit** encompasses both the waters and submerged lands surrounding the three northernmost Mariana Islands and includes healthy coral reefs made up of roughly 300 different coral species. One of the coral reef sites has the highest density of sharks anywhere in the Pacific. The reefs and waters also include a great diversity of seamount and hydrothermal vent life. Unusual reef habitats support marine biological communities dependent on basalt rock foundations.

[‡]A nautical mile is a unit of distance used on ocean and coastal waters that is approximately one minute of arc measured along any meridian. By international agreement, it has been set at 1,852 meters exactly or 1.15078 statute miles.


Mariana Trench Marine National Monument
Pacific Islands
Land Status
Location Map
N. Korea
S. Korea
Japan
China
Philippines
Mariana Trench NWR
Mariana Arc of Fire NWR
Guam NWR
Wake Atoll NWR
Philippine Sea
PACIFIC OCEAN
Papua New Guinea
Indonesia
Timor-Leste
Solomon Is.
1,000
Nautical Miles
NW Eifuku
Fukujin
Minami Kasuga #2
Minami Kasuga #3
Daikoku
Farallon de Pajaros
Ahyi
Maug
Maug Islands
Asuncion Island
MARIANA ISLANDS
Alice Springs
Central Trough
Zealandia
E. Diamante
Ruby
Esmeralda
W Rota #1
W Rota
Forecast
Pika site
Archaean site
South Backarc
Seamount X
Toto
Agrihan
Pagan
Alamagan
Guguan
Sarigan
Anatahan
Farallon de Medinilla
Saipan
Tinian
Aguijan
Rota
Guam
Philippine Sea
North Pacific Ocean
Mariana Trench Marine National Monument
Mariana Trench Marine National Monument Boundary
Mariana Trench MNM (Islands Unit)
Mariana Trench NWR (Trench Unit)
Mariana Arc of Fire NWR (Volcanic Unit) Representing a one nautical mile radius circle centered on each volcanic feature
140°0'0"E
145°0'0"E
150°0'0"E
20°0'0"N
15°0'0"N
10°0'0"N
PRODUCED IN THE LANDS DIVISION
PORTLAND, OREGON
LAND STATUS CURRENT TO: 11/21/2023
MAP DATE: 2/14/2024
BASEMAP: N/A
MERIDIAN: N/A
FILE: R1_NWRS_FY11_079.3
0 75 150 300
Miles
Kilometers
0 75 150 300
UTM ZONE 55N
WGS 84

1.2 Monument Establishment

On June 6, 2009, President George W. Bush issued Presidential Proclamation 8335 (Proclamation) establishing the Mariana Trench Marine National Monument under the authority of the Antiquities Act of 1906. The Monument was established for the purpose of protecting objects of scientific interest such as the subduction system in the Trench, submerged volcanoes, hydrothermal vents (including the Champagne Vent and Sulfur Cauldron), coral reef ecosystems, and biologically diverse ecosystems where chemosynthetic and photosynthetic organisms exist side by side.

The Islands Unit boundaries comprise both the waters and submerged lands up to the mean low water line around the islands of Farallon de Pajaros (also known as Uracas[§]), Maug, and Asuncion, while the Volcanic Unit/Arc of Fire Refuge and the Trench Unit/Refuge consist of only the submerged lands and features therein (not the overlying water column) within their specified boundaries. The boundaries of the Monument's Volcanic Unit/Arc of Fire Refuge include the submerged lands extending 1 nmi circle drawn from the center of each of the 21 active submarine volcanoes and hydrothermal vents. The boundary of the Trench Unit/Refuge extends from the northern limit of the Exclusive Economic Zone (EEZ) of the United States adjacent to CNMI to the southern limit of the EEZ adjacent to the U.S. Territory of Guam.

1.3 Global and Regional Significance

Rare and unique geology, geochemistry, rare biological conditions, and healthy ecosystems provide an ideal location for interdisciplinary research. Because the area has a distinct position in the biogeography of the Pacific as a place where a high number of regional endemic and unusual species assemblages thrive, the Monument holds outstanding potential for globally significant social and scholarly contributions. Monument management activities can foster a greater understanding of issues related to climate change, fisheries systems upon which international food markets rely, Pacific navigational and trade routes, geological processes and global events, and the interconnectivity between humans and the natural world.

This national marine monument is part of a growing global network of marine protected areas (MPAs) linked by a shared concern for society's relationship with marine wildlife and the marine environment. The Monument is one of the largest MPAs in the world and is poised to host research pursuits and ecotourism ventures that are consistent with marine conservation, noncommercial fisheries activities, and cultural endeavors. This Monument management plan (MMP) was developed with consideration toward other regional conservation plans and MPA initiatives to augment, not duplicate, existing efforts that apply to the Monument.

Regional ecosystem planning efforts include *Comprehensive Wildlife Conservation Strategies* and *Wildlife Action Plans* for CNMI and Guam, the Pacific Islands Fisheries Science Center (PIFSC) Monument Program's *Marianas Trench Marine National Monument Science Plan for 2021-2026*, the Western Pacific Regional Fishery Management Council's *Mariana Archipelago Fishery Ecosystem Plan*, and the *Regional Biosecurity Plan* for Micronesia and Hawai'i. Existing recovery plans for T&E species and critical habitat in the Monument are also incorporated as applicable in this MMP.

[§] Farallon de Pajaros (from Spanish *Farallón de los pájaros*, meaning "cliffs of the birds") is also known locally as Uracus (from Spanish *urracas*, meaning "magpies").

1.4 Purpose and Need for a Management Plan

The Proclamation tasked the Secretaries of Commerce and Interior, in cooperation with the CNMI Government, to prepare management plans for the proper care and management of the Monument. The U.S. Fish and Wildlife Service (USFWS), National Ocean and Atmospheric Administration (NOAA), and CNMI Monument managers collaborated to prepare this management plan to fulfill the directives set forth in the Proclamation, planning requirements of the National Wildlife Refuge System Administration Act (Administration Act) and other applicable directives. This MMP meets the Administration Act requirement to develop Comprehensive Conservation Plans for all Refuge System units, NOAA's National Environmental Policy Act requirements, and CNMI's Northern Islands Submerged Lands (NISL) management plan requirement.

The purpose of the MMP is to provide a blueprint for managing Monument activities and resources in accordance with the conservation direction of its establishment with consideration for the history of the region, the remote location of the Monument, and the logistics associated with both. The goals and objectives are derived from the Proclamation, applicable implementing laws, regulations and policies, public input, stakeholder concerns, and endeavor to represent the diverse stakeholders. The strategies and activities carry forward the directives outlined in the Proclamation and are aligned with federal and territorial mandates.

1.5 Management Framework

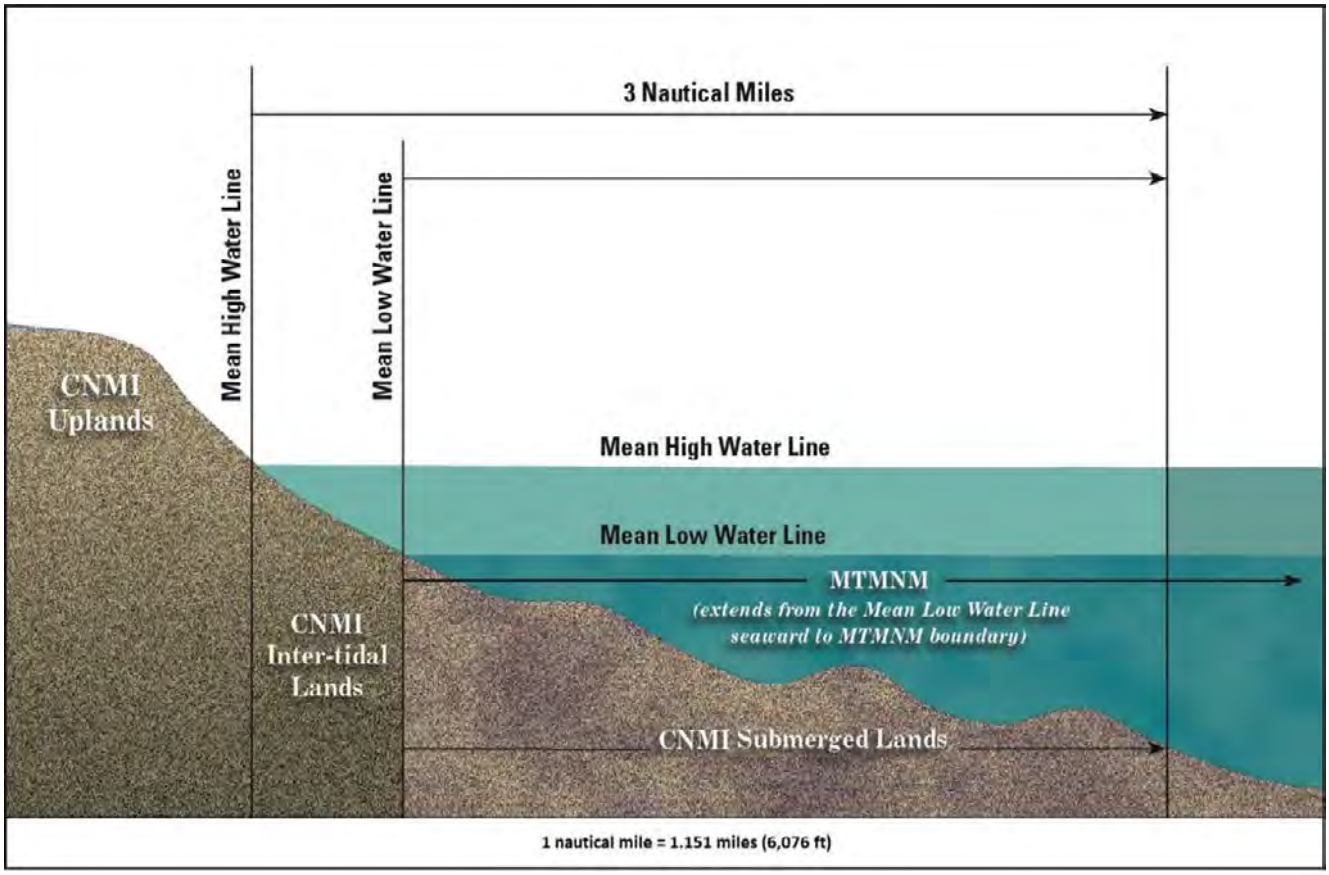
1.5.1 Background

President George W. Bush assigned management responsibility for the Monument to the Secretary of the Interior, in consultation with the Secretary of Commerce, except that the Secretary of Commerce, in consultation with the Secretary of the Interior, has the primary responsibility with respect to fishery-related activities regulated pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.) and any other applicable authorities. The Secretaries of the Interior and Commerce were directed to involve the Department of Defense (DOD) and Department of State (DOS) as cooperating agencies and treat as a cooperating agency the Government of the CNMI in developing management plans and regulations. The Proclamation specified that monument management plans shall ensure that the Monument will be administered in accordance with the Proclamation and shall provide for ensuring traditional access by indigenous persons for culturally significant subsistence and cultural and religious uses, promoting scientific exploration and research, and providing public education and outreach programs.

To carry out the President's direction, Department of the Interior (DOI) Secretary Dirk Kempthorne was obligated to determine which DOI bureau could best implement the entirety of the Proclamation provisions. On January 16, 2009, Secretarial Order 3284 delegated management responsibility to the USFWS and designated the Volcanic and Trench Units as units of the NWRS, subject to provisions of the Proclamation. On October 8, 2009, those units were officially named "Mariana Arc of Fire National Wildlife Refuge" and "Mariana Trench National Wildlife Refuge," respectively. Refuge designation immediately applied the authorities of laws, regulations, and policies of the NWRS within the entirety of those units' boundaries. The Islands Unit was managed by USFWS under the authority of the Refuge Recreation Act of 1962 until it was included as a unit of the NWRS. On September 11, 2023, after consultation with NOAA and CNMI, Secretarial Order 3284 was amended to include the Islands Unit under the Administration Act, subject to the terms of the Memorandum of Agreement (MOA) for *Coordination of the Management of the Monument's Submerged Lands*.

Similarly, acting Secretary of Commerce Otto J. Wolff delegated his management responsibility for the Monument to NOAA through the National Marine Fisheries Service. Monument fishing regulations were published on June 3, 2013 (50 CFR part 665) to define the terms used in Proclamation 8335 and to further articulate the intention and scope of regulated activities in the Monument.

The territorial submerged land around Maug, Farallon de Pajaros, and Asuncion was transferred from federal authority to the CNMI on September 22, 2016, providing new opportunities for the coordination of management between areas of CNMI jurisdiction and areas of federal jurisdiction. Within the Islands Unit/Arc of Fire Refuge, the CNMI territorial sea extends from the low water line of the three northernmost islands seaward 3 nmi and the federal area extends from the CNMI boundary out seaward roughly 50 nmi. Both the Volcanic Unit/Arc of Fire Refuge and the Trench Unit/Refuge are under federal jurisdiction.



CNMI jurisdiction area 0–3 nmi around Maug, Farallon de Pajaros, and Asuncion. Image: Glenda French/USFWS

1.5.2 Management Roles and Responsibilities

As directed in the Proclamation, the protection of different resources in the Monument is delegated to multiple government agencies and legal mechanisms. The Secretaries of Commerce (through NOAA) and the Interior (through USFWS) manage the Monument pursuant to applicable legal authorities and in consultation with the Secretary of Defense. The USFWS and NOAA also receive advice and recommendations from the DOD, the U.S. Coast Guard (USCG) and the Government of the CNMI through the Mariana Trench Monument Advisory Council (MTMAC). The CNMI has management authority within the NISL boundaries. Under the terms of the transfer Memorandum of Agreement (signed by CNMI, DOI, and Department of Commerce (DoC) on September 22, 2016), USFWS and NOAA manage the conveyed submerged lands for the benefit of the CNMI people in consultation with the CNMI Government. The "Monument managers" referred to in this MMP include USFWS, NOAA, and CNMI. A brief description of each agency follows.

U.S. Fish & Wildlife Service

The U.S. Fish and Wildlife Service, an agency within the Department of the Interior, is the principal federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife populations and their habitats. The mission of the USFWS is "working with others, to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people." National natural resources entrusted to the Service for conservation and protection include migratory birds, endangered and threatened species, interjurisdictional fish, wetlands, and certain marine mammals. The agency seeks to provide and enhance opportunities to participate in compatible wildlife-dependent recreation and foster understanding and instill the appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

Monument management is coordinated by the Monument Superintendent with an office on Saipan. The USFWS Pacific Islands Fish and Wildlife Office (PIFWO) has field offices located in CNMI, Guam, and Hawai'i, with conservation oversight for seabirds in the Monument and shared responsibility for administration of the Endangered Species Act (ESA) with the NOAA National Marine Fisheries Service (NMFS). The PIFWO also administers coastal conservation and conservation partnership programs through its Habitat Conservation Division and aids with invasive species issues and emergency response throughout the Pacific islands. The USFWS Science Applications program facilitates partnerships that address shared conservation challenges to create a network of healthy lands and waters where fish, wildlife, plants, and people thrive by promoting an inclusive approach to conservation; fostering science excellence, integrity, and innovation; and developing data-driven decision support tools that make collaborative conservation achievable.

National Ocean and Atmospheric Administration

The Pacific Marine National Monument Program is part of the Pacific Islands Regional Office, Habitat Conservation Division. NOAA has delegated NMFS to be the lead line office for coordinating management and conducting research in the Monument with support from other NOAA line offices. The Monument Program works closely with the NMFS PIFSC through an integrated program to promote science-based management of the Monument's resources. Other NOAA line offices that support Monument management include the Office of Law Enforcement (OLE); National Ocean Service (NOS); National Environmental Satellite, Data and Information Services; National Weather Service, Program, Planning, and Integration; and the Office of Oceanic and Atmospheric Research (OAR). The Marine National Monument Program also collaborates with federal agencies, territorial governments, universities, and nongovernmental peers to implement Monument activities, engage the public, and fulfill its responsibilities under the Monument management arrangement.

In addition to shared responsibility for administration of the ESA, the NMFS PIRO administers the Marine Mammal Protection Act (MMPA) and the Magnuson-Stevens Act (MSA). The PIRO NMFS supports both domestic and international marine resource management within the Pacific and is responsible for assisting the Western Pacific Regional Fishery Management Council in the development of fishery management plans and amendments, drafting, and implementing federal fishery regulations, issuing federal fishing permits, and monitoring fisheries stocks. Other major NOAA responsibilities include exploration and research, ocean literacy, recovering protected species, maintaining resilient marine habitats, and monitoring compliance with fishery agreements and treaties.

U.S. Commonwealth of the Northern Mariana Islands

The CNMI Department of Land and Natural Resources (DLNR) and Bureau of Environmental and Coastal Quality (BECQ) are responsible for coordinating activities and managing natural resources for the CNMI Government. The DLNR has primary responsibility for managing submerged lands and fisheries, and BECQ has primary responsibility for managing coastal resources and water quality. The CNMI territorial sea extends from the low water line at Maug, Farallon de Pajaros, and Asuncion, seaward 3 nmi within the Islands Unit. These three islands are constitutionally designated wildlife sanctuaries managed by the DLNR Division of Fish and Wildlife (DFW). The DFW performs a wide range of duties associated with fisheries management and the protection and conservation of marine resources in the CNMI. Programs within DFW focus on research and monitoring fish and their essential habitats, managing and monitoring all marine protected and conservation areas, fisheries permitting and enforcement, and community outreach and education.

The BECQ is responsible for managing coastal resources of the CNMI, including coral reef and associated habitats and water quality. The BECQ regulates commercial tourism and recreation activities (i.e., marine sports operators), coastal and submerged earth moving activities, and coastal development and resource use. Actions carried out comprise permitting and associated monitoring and enforcement, research and monitoring of marine habitats and communities, water quality monitoring, and community outreach and education. The Division of Coastal Resources Management, under the BECQ, is mandated to manage coastal resources of the CNMI. The Division of Environmental Quality, under the BECQ, manages water quality.

1.5.3 Other Coordinating Agencies and Departments

Department of Defense

The Department of Defense is directed under the Proclamation to be involved as a cooperating agency in developing and implementing any management plans, rules, and regulations. The mission of the DOD is to provide the military forces needed to deter war and to protect the security of our country. The boundaries of the Monument fall within the jurisdiction of DOD's Joint Region Marianas, whose mission is to provide executive-level installation management support to all DOD components and tenants through assigned regional installations on Guam and CNMI in support of training in the Marianas; to act as the interface between the military and the civilian community; to ensure compliance with all environmental laws and regulations, safety procedures, and equal opportunity policy; and to perform other functions and tasks as may be assigned. The Proclamation states that the prohibitions outlined by the Proclamation do not apply to the activities and exercises of the Armed Forces. However, the Proclamation also states, "The Armed Forces shall ensure, by the adoption of appropriate measures not impairing operations or operational capabilities, that its vessels and aircraft act in a manner consistent, so far as is reasonable and practicable, with this proclamation." A DOD official is one of five representatives on the MTMAC advisory body.

U.S. Coast Guard

The U.S. Coast Guard, an agency within the Department of Homeland Security, also has a representative on the MTMAC. For over two centuries, the USCG has safeguarded our Nation's maritime interests in the heartland, in the ports, at sea, and around the globe. Coast Guard Sector Guam's area of responsibility includes Guam, CNMI, the Republic of Palau, the Republic of the Marshall Islands, and the Federated States of Micronesia (Kosrae, Pohnpei, Chuuk, and Yap). The Coast Guard has 11 missions covering responsibilities in: ports, waterways, and coastal security; drug interdiction; aids to navigation; search and rescue; living marine resources; marine safety; defense readiness; migrant interdiction; marine environmental protection; ice operations; and other law enforcement. Monument regulation enforcement will be conducted primarily by the USCG, working in close association with NOAA Office of Law Enforcement, USFWS OLE, Refuge Law Enforcement (LE), and CNMI LE personnel.

Office of Oceans and Polar Affairs

The Office of Oceans and Polar Affairs (OPA), within the DOS, is responsible for formulating and implementing U.S. policy on international issues concerning the oceans, the Arctic, and Antarctica. In coordination with USFWS and NOAA, OPA promotes marine scientific research with an efficient authorization process and through support of several international scientific organizations. Its responsibilities at the international level include protection of the marine environment from pollution and other anthropogenic threats, through the International Maritime Organization, Regional Seas Programme, oil spill response, control of invasive species, and other means; conservation of marine biodiversity, including whales and other cetaceans, sea birds, and coral reefs; improvement of maritime security to protect the United States from terrorism and other criminal threats and to protect freedom of navigation and maritime commerce; and protection of underwater cultural heritage through participation in bilateral and multilateral international agreements, as well as through domestic policies.

Foreign-based researchers wishing to access and/or conduct research activities in the Monument must apply through the OPA Marine Science Research Application Tracking System[**] (RATS), an online data management system designed to improve the transparency and efficiency of the implementation of the marine scientific research consent regime established by the Law of the Sea Convention. Either the chief scientist or their sponsoring organization is responsible for seeking consent through the office of their nation's Science Attaché to the United States in a timely fashion; the Law of the Sea Convention states that applications must be received no later than six months prior to the expected starting date of the marine scientific research.

Office of Insular Affairs

The Office of Insular Affairs (OIA), an agency within the Department of the Interior, has responsibility for coordinating federal policy with respect to the territories of American Samoa, Guam, the U.S. Virgin Islands, and CNMI. The OIA reviews and advises the DOI on Monument policies and advisory council appointments. Guam does not currently have a seat on the intergovernmental advisory council, and the OIA helps to facilitate government-to-government coordination for Guam's interests in the Monument.

1.5.4 Monument Management Coordination Team

This MMP includes the creation of a Monument Management Coordination Team (MMCT), comprising representatives from USFWS, NOAA, and CNMI within one year of publication, to facilitate the coordinated management of the Monument. Coordination of management is prescribed in the Proclamation, in particular for the Islands Unit/Arc of Fire Refuge. The agencies will create and operate a MMCT that will meet routinely on a fixed schedule to promote communication and coordination (i.e., consultation), joint permitting activities, etc. Technical advisors and/or other federal and local agencies may be consulted as needed to aid in the decision-making process.

1.5.5 Mariana Trench Monument Advisory Council

The Proclamation tasked the Secretaries of Commerce and Interior to establish a Monument Advisory Council to provide advice and recommendations on the development of management plans and management of the Monument. The first term of the Mariana Trench Monument Advisory Council (MTMAC) was appointed by the Secretaries in September 2010 after considering nominations from the Governor of the CNMI, the Secretary of Defense, and the Secretary of Homeland Security. MTMAC membership includes

[**] http://www.state.gov/e/oes/ocns/opa/rvc/rats/

three officials of the CNMI Government, one from the DOD, and one from the USCG, who each serve a three-year term. Bylaws for the MTMAC were first established at the seventh MTMAC meeting on Saipan in September 2013 (Appendix G). It is envisioned that the MTMAC will continue to provide advice and recommendations on Monument management to the new MMCT on a regular basis. Subject to the bylaws, the MTMAC may form subcommittees to fulfill specific project needs. The first subcommittee was a Mariana Trench Monument visitor facility working group, formed to research and recommend specifications for a proposed multipurpose visitor facility.

1.6 Scope of the Management Plan and Review Process

1.6.1 Scope of the Plan

With consideration for public input, this MMP is designed to meet the requirements of the Proclamation, Secretarial Order 8234, the Administration Act, the National Environmental Policy Act (NEPA), existing NOAA/USFWS management responsibilities for the area, and the NISL Memorandum of Agreement. Action plans address conservation priorities such as resource protection, traditional access by indigenous persons, exploration and research, ocean literacy and outreach. Activities occurring beyond the Monument boundaries such as commercial fishing and deep-sea mining, all proposed military training within the Navy's Mariana Islands Training and Testing program, and right-of-way permits and associated environmental assessments to install submarine fiber optic telecommunications cables are beyond the scope of this plan. These activities may require separate NEPA processes.

1.6.2 Review Process

The MMP review process followed NEPA and applicable NOAA, USFWS, and CNMI policies. A joint USFWS-NOAA *Federal Register* "Notice of Intent" to prepare a Monument Management Plan and Environmental Assessment (MMP/EA) was published in 2011.[3] Monument-related workshops were held annually on Saipan, Tinian, Rota, and Guam from 2010 to 2013 to identify concerns from diverse stakeholders and identify research initiatives that would provide the maximum benefit for regional and global communities. Public scoping meetings were held on Saipan, Tinian, Rota, and Guam in 2012 to gather information and encourage public participation regarding management activities and issues. Meaningful public involvement and access to the Monument for a multitude of uses were acknowledged as high priorities. Public comments clarified the goals for the MMP and were considered in the development of management strategies.

As required by NEPA, funding or permitting decisions will be made with full consideration of the impact to the natural and human environment; federal agencies must disclose these impacts to interested parties and the public. The central element in the environmental review process was an evaluation of alternatives including the "no action" alternative. The Draft MMP/EA proposed a series of 11 Action Plans for managing the Monument with a range of three implementation alternatives. This MMP describes the selected alternative, Prioritized Implementation of Action Plans.

An effects analysis of the proposed management actions was developed by identifying resources associated with the physical, biological, and human environment that may be impacted by the proposed strategies. The Draft MMP/EA was open to the public for a 150-day public comment period from February 24 to July 26, 2021. Four virtual public meetings were hosted by USFWS and NOAA in June 2021 to provide community-focused opportunities to ask questions. CNMI Government partners were invited to participate. Public comments helped managers select the preferred alternative to guide Monument management. Public comments and the agency responses were consolidated and are provided in the final Environmental Assessment.

The MMP is a strategic planning document, to be reviewed by Monument managers annually. Specific activities may be revised when needed to reflect new or changing resource conditions. The MMP is scheduled for a major review every 15 years to determine whether a revision is necessary. Significant updates will be coordinated through a formal planning process and made available for public review.

1.7 References

1. Frensley, C. 2008. The Highest and Deepest Points on Earth, Sciences 360 (online publication).
2. Gallo, N.D., J. Cameron, K. Hardy, P. Fryer, D.H. Bartlett, and L.A. Levin. 2015. Submersible-and lander-observed community patterns in the Mariana and New Britain trenches: influence of productivity and depth on epibenthic and scavenging communities. Deep Sea Research Part I: Oceanographic Research Papers 99:119–133.
3. *Federal Register*. Vol. 76, No. 65. Tuesday, April 5, 2011. Notices.

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Vibrant coral reef community in the Islands Unit. Photo: Jean Kenyon/USFWS

Chapter 2. Action Plans

2.1 Management Goals

Goals are the unifying elements of successful management. They identify and focus priorities and set targets to work towards. Six goals have been developed in accordance with the Proclamation:

1. Conserve and protect the marine ecosystems around the islands of Farallon de Pajaros, Maug, and Asuncion; 21 of the Mariana Ridge undersea volcanoes and thermal vents (as identified in the Proclamation); and the geologic features and life forms in the Mariana Trench.
2. Provide for traditional access to the Monument by the indigenous people of CNMI and Guam for culturally significant, subsistence, and religious uses.
3. Develop education, interpretation, and outreach programs to enhance the understanding and appreciation of Monument resources and efforts to conserve them.
4. Assess and promote scientific exploration and research opportunities, and adopt measures to ensure that the Monument's ecosystems, marine resources, and other objects of scientific interest are not degraded.
5. Assess and provide opportunities for tourism, recreation, and economic ventures that are compatible with the Monument's ecosystem, marine resources, and other objects of scientific interest.
6. Contribute to the recovery and protection of all native species with special consideration for threatened and endangered species and species of management concern.

2.2 Program Area Action Plans

The objectives to meet the management goals have been divided into 11 program area Action Plans. Each Action Plan includes a series of strategies and activities designed to help meet the objectives to address the management goals. Some activities are designed to help meet multiple goals. Goal order does not imply any priority in this MMP. Table 2.1 demonstrates the linkage between management goals and Action Plans. The 11 Action Plans are as follows:

1. Marine Resource Conservation and Monitoring
2. Coordination of Management, Access and Permitting
3. Sustainable Noncommercial Fishing
4. Surveillance and Enforcement
5. Marine Invasive Species Control
6. Marine Debris
7. Emergency Response and Natural Resource Damage Assessment
8. Exploration and Research
9. Cultural and Maritime Heritage
10. Ocean Literacy, Environmental Education, and Public Outreach
11. International Collaboration

2.2.1 Considerations in MMP Development

The interagency planning team of agency staff from USFWS, NOAA, and CNMI considered a variety of social, economic, and organizational aspects essential for effectively managing the Monument. The team reviewed scientific reports and studies to better understand ecosystem traits and the latest scientific recommendations for species and habitats. Managers met with elected officials and staff from territorial and federal agencies to ascertain priorities and problems as perceived by others. The MTMAC provided advice and recommendations in developing a range of alternatives to be responsive to the CNMI, USFWS, and NOAA's priorities, in addition to reviewing draft documents. Staff members held public workshops and met with nongovernmental organizations (NGOs), academic personnel, and community groups to ensure that their comments and ideas were considered during MMP development. Community input was also gathered through public scoping meetings.

2.2.2 Elements Common to All Action Plans

All Action Plans contain several common features:

a) **Implementation subject to funding availability**
Action Plans describe what is needed to effectively manage the Monument. Activities will be implemented as funding becomes available. Funding initiatives, unforeseen issues, and annual budget allocations will vary from year to year.

b) **Federal agency and Territory coordination**
The Monument managers will continue to coordinate relevant management activities with the DOS, DOD, USCG, the Government of the CNMI, and the Government of Guam. All preexisting policies, agreements, and partnerships for federal agency and territory coordination remain in effect.

c) **Appropriateness and compatibility**
Each new proposed activity not described in these Action Plans must be found appropriate and consistent with relevant laws, regulations, and policies prior to allowing any new public or commercial use of the Monument. Compatibility determinations for activities occurring in the Trench Unit/Refuge and the Volcanic Unit/Arc of Fire Refuge are made by the USFWS (16 USC 668dd-668ee; 50 CFR 25, 26, 29; and 603 FW 1, 2). Compatibility determinations are in Appendix B.

d) **Threatened and Endangered species protection and recovery**
The protection of T&E species is mandated through Section 7 of the ESA. Federal agencies must ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. To ensure adequate protection, managers are required to review all activities, programs, and projects occurring within the Monument to determine if they may affect listed species. If the determination is that an action may affect an endangered species, then a formal review and/or consultation will be conducted to identify those effects and means to mitigate those effects.

e) **Climate change**
Monument managers will participate in climate change assessment efforts and will consider the potential effects of a proposed activity on climate changes as indicated by associated greenhouse gas emissions (GHG) and the effects of climate change on a proposed action and its environmental impact. When possible, measures to minimize GHG output and the potential effects on the species and their habitats will be incorporated into project plans. Monument managers will work with PIFSC and USFWS Science Applications staff as needed for science applications or modeling support.

f) **Management approach**
The management approach is based on three key frameworks: adaptive management; ecosystem-based management; and multiple objective planning. The MMP will be modified to produce improved results as new information becomes available, as stakeholder concerns become better understood, and as management objectives or funding resources respond to human and ecological shifts. Table 2.2 and Figure 2.1 provide additional information.

g) **Regulatory compliance**
The activities listed in all Action Plans will be reviewed prior to approval and implementation to ensure compliance with legal and policy requirements. These reviews will include appropriate evaluations and documentation under NEPA and evaluation and consultation as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to include Essential Fish Habitat, Section 7 of the ESA, and Section 106 of the National Historic Preservation Act of 1966 (NHPA). A description of relevant legal mandates, policies, executive orders, and other regulatory requirements is provided in Appendix I.

2.2.3 Prioritization and Annual Review

The MMCT (USFWS, NOAA, and CNMI) will conduct a coordinated annual review of the Action Plan activities to determine funding priorities for implementation. Prioritization will be based on a set ranking system. Action Plan activities will be given a score using seven criteria: 1) the capacity to implement the activity, 2) the authority to implement the activity, 3) the funding availability and existing means to implement the activity, 4) the level of partner support in carrying-out the activity, 5) the number of threats that would be curtailed or minimized by the executing the activity, 6) the number of target resources that would positively affected by implementing the activity, and 7) the level of urgency to implement the activity. Activities that Monument managers determine no longer meet the management objectives will be deprioritized.

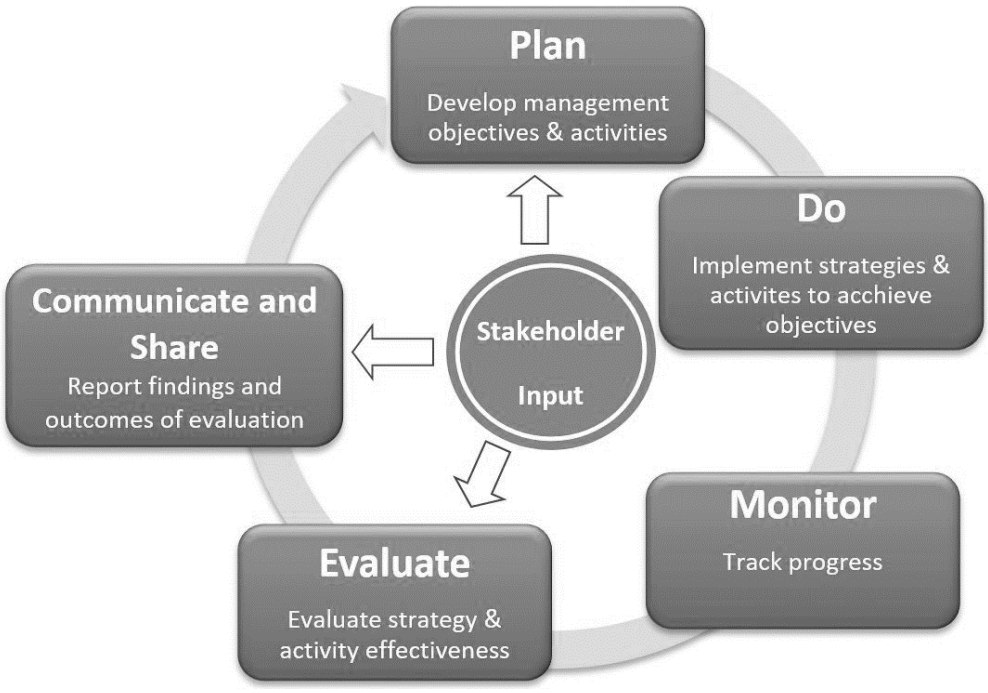
Table 2.1. Relationship between MMP Goals and Action Plans.

MMP Goal	Related Action Plans
1. Conserve and protect the marine ecosystems around the islands of Farallon de Pajaros, Maug, and Asuncion; 21 of the Mariana Ridge undersea volcanoes and thermal vents; and the geologic features and life forms in the Mariana Trench.	Marine Resources Conservation & Monitoring Coordination of Management, Access & Permitting Surveillance & Enforcement Marine Invasive Species Control Marine Debris Emergency Response & Natural Resource Damage Assessment
2. Provide for traditional access to the Monument by indigenous persons for culturally significant subsistence and other cultural and religious uses.	Cultural & Maritime Heritage Coordination of Management, Access & Permitting
3. Develop education, interpretation, and outreach programs to enhance the understanding and appreciation of Monument resources and efforts to conserve them.	Ocean Literacy, Environmental Education & Public Outreach Marine Resources Conservation & Monitoring Coordination of Management, Access & Permitting Surveillance & Enforcement Marine Invasive Species Control Marine Debris Cultural & Maritime Heritage
4. Assess and promote scientific exploration and research opportunities and adopt measures to ensure that the Monument's ecosystem, marine resources or species, or other objects of scientific interest are not degraded.	Exploration & Research Coordination of Management, Access & Permitting Marine Debris Ocean Literacy, Environmental Education & Public Outreach
5. Assess and provide opportunities for tourism, recreation, and economic ventures that do not harm the Monument's ecosystem, marine resources or species, or other objects of scientific interest.	Ocean Literacy, Environmental Education & Public Outreach Coordination of Management, Access & Permitting
6. Contribute to the recovery and protection of all native species with special consideration for threatened and endangered species and species of management concern.	Ocean Literacy, Environmental Education and Public Outreach Marine Resources Conservation & Monitoring Surveillance and Enforcement Marine Invasive Species Control Marine Debris International Collaboration Exploration and Research

Table 2.2. Monument management approach.

Approach	Key Concepts
Adaptive management	Adaptive management involves exploring alternate ways to meet objectives, predicting outcomes based on the best available information, implementing one or more alternatives, monitoring the impacts of these actions, and then using the results to adjust management actions. Adaptive management focuses on learning and adapting through the partnerships of managers, scientists, and stakeholders to create and maintain sustainable resource systems.
Ecosystem-based management	Ecosystem-based management considers the whole ecosystem (including humans) rather than managing for one species or resource in isolation. Key aspects regarding Monument management include the following: • integrates ecological, social, and sustainable socioeconomic goals, recognizing humans as components of the ecosystem • considers ecological (not political) boundaries • accounts for the complexity of natural processes and social system and uses an adaptive management approach in the face of uncertainty • engages multiple stakeholders in a collaborative process to define problems and find solutions • focuses on the ecological integrity of coastal-marine systems and the sustainability of both human and ecological systems
Multiple objective planning	Recognizing the shortcomings of single sector management, the goal of multiple objective planning is to think holistically across management sectors. Similar objectives among sectors can be identified and addressed for a mutually beneficial outcome. Multiple management objectives can be jointly addressed and interagency management tools and resources can be pooled to achieve maximize benefit while minimizing costs.

The adaptive management cycle



2.2.4 Marine Resources Conservation and Monitoring Action Plan

Introduction

Curious humpback whale inspecting diver.
Photo: NOAA

Many of the Monument features and resources are unique to the region, and others once ranged across the Pacific Ocean but have since been depleted. These resources hold historical and cultural meaning to the Chamorro and Carolinian people. The Marine Resources Conservation and Monitoring (MRCM) strategies and activities that are addressed in this Action Plan consider T&E species, the CNMI and Guam Species of Concern, fisheries resources, marine mammals, and habitats in the Monument.

Need for Action

Marine species and the habitats they depend on are under increasing pressure from various threats such as rising ocean temperatures and ocean acidification; illegal, unreported, and unregulated fishing; and other natural and anthropogenic events that often lead to habitat loss. While the impacts of these threats individually can be severe, when they occur simultaneously it can have a devastating impact on an ecosystem.

Habitat loss frequently results in the fragmentation of suitable habitats for a species, although the degree of impact will depend on the life history of individual species. Increasing the distance between suitable habitats may cause isolation of smaller populations and put them at greater risk of genetic drift, inbreeding depression, and increased mutations.[1, 2] Fragmentation of feeding grounds has an energetic cost, as individuals must range farther to find the required food sources, potentially reducing the overall fitness of individuals.[3] Individuals transiting between fragmented habitats are also at greater risk to predation. Habitat loss and/or fragmentation are likely to have a disproportionally greater impact on T&E species.

The MRCM Action Plan addresses data deficiencies and the identification and mitigation of threats by building on the activities in other Action Plans. There are clear overlaps between this plan and other plans designed to address specific threats, but this plan concentrates on T&E species and the analysis of fisheries data for conservation needs and considers important habitats, physical or biological features essential to conservation, and those features that may require special management considerations or protection—whereas the other Action Plans address species, fisheries, and habitats more broadly. Activities described under each strategy are the methods used to produce the desirable outcome for the marine resources.

MRCM Objectives:

- **Threatened and endangered species and regional species of concern:** Protect and recover T&E species and species of concern, as identified by the Guam and CNMI Governments, that are found in the Monument and the habitats they depend on.
- **Marine mammals:** Assess and protect the marine mammal species that occur within the Monument and the habitats they depend on.
- **Fisheries:** Manage the fisheries resources to maintain healthy populations, while providing access for subsistence, recreational, and traditional indigenous fishing for the residents of the Mariana Archipelago.
- **Habitats:** Preserve or restore the natural ecosystems within the Monument.
- **Migratory birds:** Assess and protect the bird species that are found in the Monument, and protect the habitats and resources they depend on.

MRCM Strategy 1: Coordinate and promote Monument-related noncommercial fishing and scientific research. The Proclamation directs Monument managers to establish a program for assessing and promoting monument-related noncommercial fishing and scientific research. This strategy and its associated activities will ensure that fishing and research efforts can be accomplished in a sustainable manner and will contribute to the protection and understanding of the Monument's unique ecosystems.

> **MRCM Activity 1.1: Work with partners to provide access for activities related to sustainable noncommercial fishing and exploration and research that preserves the marine resources of the Monument.** Monument managers will assist with permit coordination and maintain current best management practices (BMP) guidelines. Information will be shared across NOAA and USFWS programs to ensure all permits reflect current standards for the conservation of Monument resources.
>
> **MRCM Activity 1.2: Work with partners and the scientific and local communities to monitor and assess the impacts from authorized Monument activities.** Monument managers will track the locations and activities authorized in the Monument through databases and logbooks. Data collected will be cross-referenced with marine resource conservation research results to ensure that activities and regulations are consistent with conservation needs. Alternatives for reducing impacts from the authorized activities will be guided by the precautionary approach, "*first, do no harm*."
>
> **MRCM Activity 1.3: Review the data and records from authorized fishing activities in the Monument and assess compliance with marine resource conservation needs.** Monument managers will track authorized fishery landings from fishing trips conducted in the Monument. This data will be analyzed to ensure that activities and regulations are applicable and consistent with Proclamation directives.

MRCM Strategy 2: Assess the status of endangered species, fisheries, habitats, and geologic features of the Monument based on results from authorized research cruises and permitted scientific exploration. Past research efforts have underscored the need for continued marine resource assessments in the Mariana Archipelago, as they have typically only partially recorded the number of protected species (turtles or cetaceans), fisheries, habitat types, and features. Monument managers will assist with and permit further research, inventories, and monitoring activities to gain a greater understanding of the marine resources.

> **MRCM Activity 2.1: Work with partners to conduct population studies for marine mammals, T&E species, and species of concern identified by CNMI and Guam.** Accurate population estimates of marine mammals, protected species, and species of concern are required to determine the best course of action in helping to sustain healthy populations or help species recovery. The assessments of marine mammals and protected species populations and their abundance and distribution will continue to determine which species are most at risk and to adjust management priorities as needed.
>
> **MRCM Activity 2.2: Work with partners to continue assessments of coral reef communities and other benthic habitats in the Monument.** Monument managers will work with scientists to develop a better understanding of coral reef communities, benthic habitats, and geologic features in the Monument. This process will include documenting temporal and spatial variability of species in coral reef ecosystems and other habitat types. Monument ecosystems have not been heavily impacted by fishing or other human activities and can serve as healthy ecosystem models.
>
> **MRCM Activity 2.3: Identify management options to maintain ecological integrity for species and systems considered vulnerable to climate change.** Climate change may impact the biological diversity, abundance, and distribution of the Monument's living marine resources. We will seek to maintain the ecosystem, while considering future changes and maintaining ecological integrity, defined as "*the ability of an ecological system to support and maintain a community of organisms*

that has a species composition, diversity, and functional organization comparable to those of natural habitats within a region."[4]

MRCM Strategy 3: Identify threats to endangered species, fisheries, habitats, and geologic features found in the Monument. Effective management of the marine resources requires a greater knowledge of potential threats. By providing access to the Monument, the threats from fishing-related damage (ship groundings, oil spills, and marine debris) will increase. These threats and others will have to be identified for the MMCT to develop new BMPs to mitigate their impacts.

MRCM Activity 3.1: Identify key species or functional groups on which to focus management efforts. Although conservation targets have been identified in Chapter 4, certain species or functional groups within a community are at greater ecological risk because of circumstances such as late maturation or lower fecundity. Monument managers will work with our partners to identify which species or functional groups are at greatest risk and, therefore, require a more directed management effort to ensure their health and the health of the ecosystem.

MRCM Activity 3.2: Work with partners to develop long-term monitoring projects to determine how natural and anthropogenic events outside of the Monument impact the resources over time. Monument managers will work with the scientific community to monitor Monument ecosystems long term to determine how natural and anthropogenic events outside of the Monument impact resources inside the Monument and to identify species that have greatest resilience or vulnerability to these disturbances.

MRCM Strategy 4: Identify measures to minimize threats to the Monument resources. Monument managers will research threat reduction measures that sustain healthy ecosystems and processes that enhance the prospects for natural recovery and replenishment in ways that are appropriate for the context and conditions of the local environment. Measures may include restricting access to sensitive areas and enforcing more stringent biosecurity protocols. Current BMPs are provided in Appendix E.

MRCM Activity 4.1: Implement and refine BMPs to protect T&E marine species, habitats, and geologic features. Protected species are at risk from many anthropogenic and environmental threats. Monument managers will research threats impacting Monument species and determine the most effective mitigation strategies. Actions will be developed to provide immediate help address long-term protection of the most vulnerable species. Critical habitat for corals will likely be designated within the Monument.

MRCM Activity 4.2: Investigate the feasibility and necessity of deploying remote surveillance technologies to aid in resource protection. If deemed necessary and feasible, Monument managers will develop a proposal to cover all aspects of acquiring these tools, from acquisition to deployment and monitoring costs. A dual benefit technology that may be feasible is the possible modification of Ecosystem Acoustic Recorders (EARs), currently used by NMFS to monitor real-time vessel and animal activities.

MRCM Activity 4.3: Facilitate efforts to reduce and minimize fishery bycatch and incidental mortality in the Islands Unit. Monument managers will research new fisheries gear technology and/or methods to minimize the bycatch of seabirds, turtles, cetaceans, and other marine resources. Managers will assist in the analysisof the bycatch threat and to determine measures that will minimize fishing gear interactions.

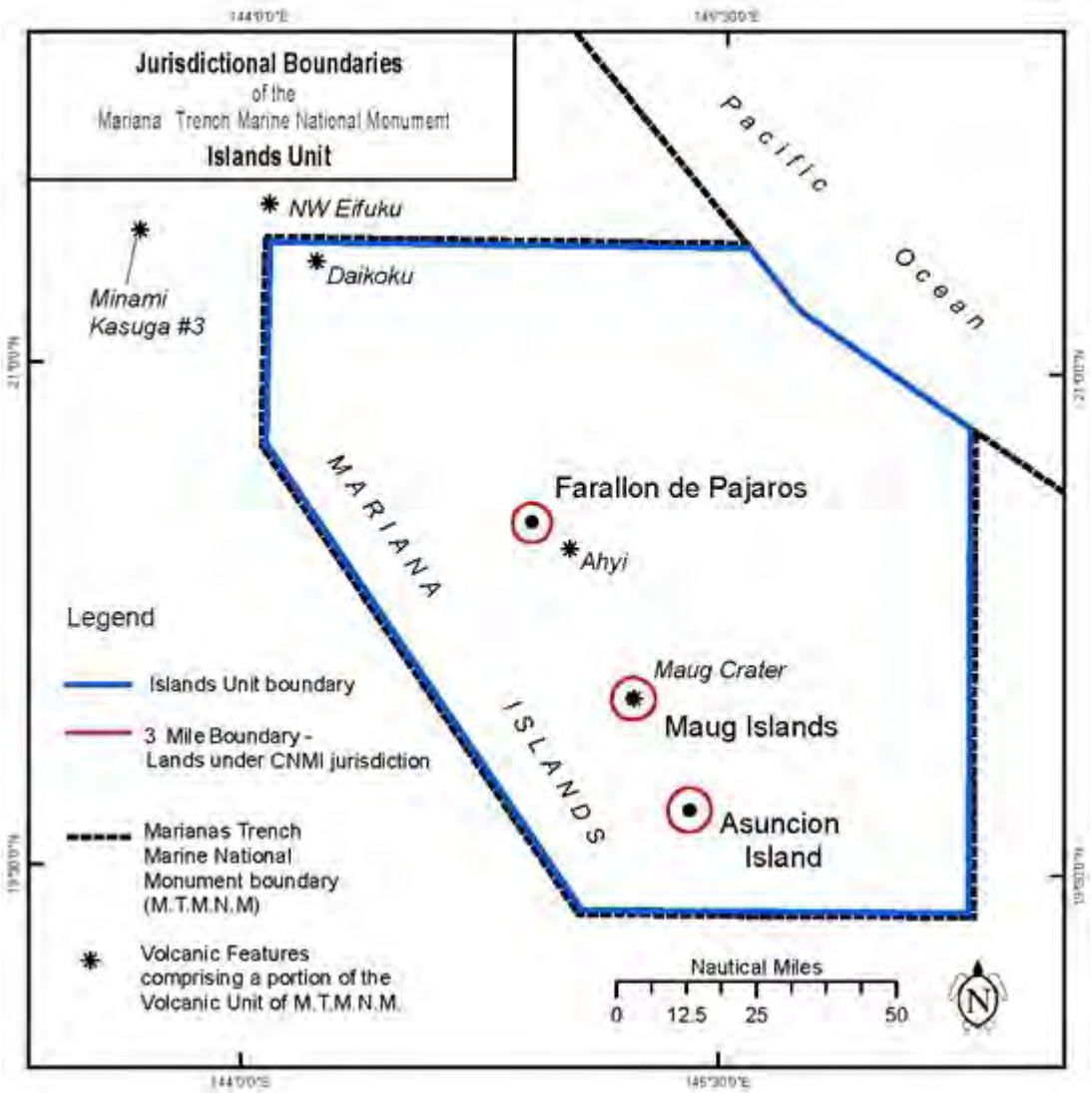
MRCM Strategy 5: Incorporate traditional knowledge and local indigenous perspectives into Monument management. Traditional ecological knowledge is gained by centuries of firsthand observation and experience and can augment western scientific data.

> **MRCM Activity 5.1: Solicit advice from State Historic Preservation Officer (SHPO) and cultural groups on traditional knowledge pertaining management of marine resources.** Monument managers will work with the MTMAC to engage the SHPO and local community for their input and involvement in marine resource conservation to include traditional knowledge to inform the decision-making process and ongoing management.

2.2.5 Coordination of Management, Access, and Permitting Action Plan

Introduction

Managing a protected area as large as the Monument requires innovative approaches to protected area governance. The Monument is not only exceptionally large and deep, but also segmented and widespread and contains arguably the most diverse features and ecosystems of any marine protected area in the world—with a conservation purpose and requirements to facilitate scientific exploration, as well as traditional cultural uses. To meet this governance need, the Proclamation describes and lays out the federal management roles and responsibilities in the Monument, including provisions for consultation within the federal agencies, as well as consultation with the CNMI Government. The territorial submerged lands around Maug, Farallon de Pajaros, and Asuncion (also known as the NISL) are under CNMI authority, with management responsibility delegated to USFWS and NOAA. Within the Islands Unit, the Commonwealth territorial sea extends from the low water line at the three northern islands, seaward 3 nmi. The federal area of the Islands Unit extends from the CNMI boundary, out seaward covering approximately 12,367 mi^2, and includes the Daikoku and Ahyi seamounts. Both the Volcanic Unit/Marina Arc of Fire Refuge and Trench Unit/Refuge are under federal jurisdiction.



Need for Action

Marine Protected Area management entails various actions and management tools to meet the purposes of the designation. Direct management actions may include restoring habitats after some type of degradation or injury, manipulation of habitats to provide desired conditions for enhanced conservation benefit, endemic or native species reintroductions after overharvest or extirpation, and regulating and permitting public use of resources to ensure the uses support or comply with management conservation mandates. Management tools that are used to inform, support, or augment conservation management may not have a "direct" effect on Monument features or resources but often have greater "indirect" effects and conservation benefit. For example, outreach and education programs create an informed constituency which may improve compliance with regulations and can teach the next generation about the protected resources, thus creating an informed public who is actively engaged in stewardship of their Monument. Scientific exploration, research, inventories, and monitoring provide necessary science to track the status, condition, and trends of resources and processes while also informing sound management decisions and protection. Administration and maintenance are necessary to pay the bills and keep equipment operational.

The direct management actions and indirect management tools are also opportunities for the agencies to coordinate between their respective jurisdictions. This Coordination of Management, Access, and Permitting (CMAP) Action Plan lays out activities and strategies to develop coordination of management between USFWS, NOAA, and CNMI, as well as consultation with other federal agencies and nonfederal partners. The CNMI is referred to as a coordinating "agency" in this CMAP Action Plan.

Coordination of Management

The Proclamation calls for the coordination of management between the federal and territorial government for the areas transferred around the three northern islands. As such, we are considering "coordination of management" to mean that CNMI, NOAA, and USFWS will coordinate with each other and harmonize existing agency statutes, rules, regulations, and directives to create a single approach to managing this water and landscape. Weaving together unique agency authorities in a comprehensive yet complimentary manner requires a higher degree of engagement than simple consultation. Agencies will coordinate and synergize efforts to achieve a higher degree of efficiency wherever possible while respecting and maintaining each agency authority and responsibilities. Coordination of federal and territorial management can be complex and will require a clear and transparent process so the public can understand how to remain involved in co--stewardship of the Monument.

The MTMAC is an intergovernmental group chartered through the Proclamation to "provide advice and recommendations on the development of management plans and management of the Monument." As specified in the Proclamation, the MTMAC comprises five members: three representatives of the government of the CNMI and one representative each from the DOD and USCG. The MTMAC participated in the development of this MMP and will continue advising on Monument management to reflect local community and coordinating agency input to inform the MMCT.

The MMCT will form a Mariana Trench Working Group (MTWG) to enhance coordination, cooperation, and communication among diverse interest groups involved in the Monument and associated refuges. The MTWG will function as a partnership where a variety of partners help further the goals and objectives of the Monument through citizen science projects, outreach, environmental education and providing connections to cultural heritage. Bringing together public, nonprofit, research-oriented, culturally based, and private interests, the MTWG will provide a forum for interested partners and local stakeholders to exchange ideas and coordinate and integrate day-to-day outreach activities.

Clearinghouse

The American public expects its government to be user-friendly, efficient, and cost-effective. The Monument will be managed to meet these expectations. In establishing the Monument, the President assigned

management responsibilities to the Departments of the Interior and Commerce (delegated to the USFWS and NOAA, respectively). CNMI has a lead role in management within 3 nmi of Maug, Asuncion, and Farallon de Pajaros. The CNMI Government may assume full or partial management responsibility for these waters in accordance with the *MOA for Coordination of the Management of the Monument's Submerged Lands.*[1] The land areas of these islands are wildlife sanctuaries managed by the CNMI DLNR.

For those who would like to visit the Monument, the USFWS will serve as the clearinghouse for information and lead a coordinated review process with NOAA and CNMI. The primary public interface with the Monument will be a single website managed by the USFWS. In addition to providing the greatest clarity to the public, a single point of contact for the Monument is the most cost-effective approach. Although permitting is the emphasis of this Action Plan, information requests may also include inquiries from elected officials, the media, students, etc.

Joint Permitting

The goal of the three agencies is to issue a single joint Monument permit (JMP) package to cover all aspects of the requested activity (e.g., access, sustenance fishing, and the primary activity), even though technically, multiple agencies may have unique authorities that apply to the requested activity. The clearinghouse website will contain a JMP application that will cover the needs of all three agencies. This one-step process with agency processes occurring seamlessly behind-the-scenes is the most user-friendly.

Once received, requests for permits or other information will be automatically shared by the USFWS with NOAA and CNMI. Depending on the nature of the request, the appropriate agency will lead the review and processing of the JMP on behalf of all three agencies. This will provide requesters with a single point of contact throughout the process, with all interagency work coordinated internally by the lead agency. The USFWS will permit activities with Special Use Permits (SUP). NOAA Fisheries will issue Monument fishing permits. CNMI will authorize access to Maug, Farallon de Pajaros, and Asuncion Islands. All approved activities will be included in the JMP package issued to the applicant.

The USFWS, NOAA, and CNMI will modify and adapt the NWRS Special Use Permit application to create a joint permit application template for the Monument. The application will include questions pertaining to whether any noncommercial fishing activity is proposed and about where the activity is proposed (e.g., in CNMI waters) and will contain all required stipulations, conditions, and BMPs. The form will include appropriate approvals and signature lines for each agency. A permit application guidance document will be created to answer commonly asked questions and include all required conditions and BMPs. The prospective Monument user will be required to comply with the BMPs to minimize the risk of invasive species introductions. The current recommended BMPs are identified in Appendix E.

Activities that Don't Require Permits

Innocent passage (expeditious transit through the Monument) is authorized under the Proclamation, and so no permit is required for expeditious transit through any portion of the Monument. Expeditious transit does not include stopping or using any gear (e.g., fishing, scuba diving, in-water scientific or sampling instruments, out-of-water scientific or sampling instruments such as LiDAR, etc.).

Per the Proclamation, no permit is required for responding to emergencies or for conducting national security or law enforcement activities. This includes DOD and USCG activities to fulfill their respective agency missions, activities, and responses being led or coordinated by the USCG acting on its own authorities or as part of a larger Unified Command (for multiagency response) structure. Similarly, the Proclamation does not

[1] Upon assuming such management responsibilities, the CNMI Government agrees to manage the Northern Islands Submerged Lands in accordance with the MOA for the Coordination of the Management of the Monument's Submerged Lands and consistent with the purposes and requirements of Proclamations 8335 and 9077, the Commonwealth Constitution, other applicable laws, and provisions of the Patent.

restrict scientific exploration or research activities by or for the USFWS or NOAA, relying on consultation within the federal agencies, so permits are not required for these activities. As part of a proposed Memorandum of Understanding (MOU), permits would not be required for collecting film footage for educational purposes by or for the USFWS, NOAA, or CNMI Government, and the agencies will comply with all applicable laws and mandates (i.e., ESA, MSA, etc.) and with the BMPs contained within this management plan.

CMAP OBJECTIVE: Provide coordination of management between jurisdictions to emphasize good government ethos: management will be efficient, cost-effective, and user-friendly.

CMAP Strategy 1: Establish a Monument Management Coordination Team to facilitate coordinated management of the Monument within one year of MMP publication. Coordination of management is prescribed in the Proclamation, in particular, for the Islands Unit. The USFWS and NOAA are required to consult with each other for their respective management responsibilities. The agencies will create a Monument Management Coordination Team (MMCT) comprised of Monument managers who will meet on a regular schedule to promote communication and coordination. The meetings are for intergovernmental discussions and are not intended to be public meetings.

> **CMAP Activity 1.1: Prepare and sign a MOU for management roles and responsibilities shared between the USFWS, NOAA, and CNMI.** Within six months of completing the final MMP, the agencies will craft a MOU that identifies their respective roles as provided in the Proclamation, the management role of the CNMI for its territorial waters in the Islands Unit, a communication process and protocol for responding to access requests, and coordination with the MTMAC.
>
> **CMAP Activity 1.2: Prepare an annual "State of the Monument" report.** By March of each year, the MMCT will prepare a concise report that summarizes the past calendar year's major accomplishments and challenges. This report will be used to keep senior agency personnel, elected officials, and the public informed about the status of the Monument and MMP implementation.
>
> **CMAP Activity 1.3: Assess and determine format and frequency of MTMAC meetings with the MMCT.** The MMCT will establish the frequency of routine meetings with the MTMAC and consider whether to recommend additional members to the MTMAC who represent other federal agencies and/or territorial governments.

CMAP Strategy 2: Develop a JMP package and a single permit application for all Monument activities. For all Monument-specific activities that require a permit, the public will only fill out a single application and will receive a complete JMP package that covers all the proposed activities.

> **CMAP Activity 2.1: In consultation with NOAA and CNMI, the USFWS will modify the existing approved SUP application to serve as the JMP application.** The agencies will set a fee schedule for the JMP as allowed by their respective authorities.

CMAP Strategy 3: Develop a single public portal (website) to eliminate duplication of effort within one year of MMP publication. In consultation with NOAA and CNMI, the USFWS will develop a Monument website and "How to Contact Us" information as the public interface that equally represents NOAA and the CNMI.

> **CMAP Activity 3.1: Work with the USFWS Office of Communications to modify the existing website to include NOAA and CNMI logos.** The website link will be added to the NOAA and CNMI websites so that all prospective Monument visitors are directed to the same JMP application.

CMAP Activity 3.2: Develop a web page to post information on noncommercial fishing, research, and other permitted uses. Permit data will be consolidated and posted on the Monument website to ensure accountability and transparency by affording people easy access to information such as permits.

CMAP Strategy 4: Form a Mariana Trench Working Group (MTWG. The MMCT will form a MTWG to enhance coordination, cooperation and communication among diverse interest groups involved in the Monument and associated refuges.

CMAP Activity 4.1: Work with the MTMAC to develop MTWG invitation letter and group operating norms. The MMCT and MTMAC will collaborate to develop the structure of the MTWG and invite membership.

2.2.6 Sustainable Noncommercial Fishing Action Plan

Introduction

Mixed catch of Onaga and Gindai.
Photo: M. Trianni/NOAA

Fishing plays an important role in the daily lives of Pacific Islanders for sustenance, commerce, recreation, and cultural purposes. The Proclamation acknowledges the important connection between the Pacific Island fishing community and the Islands Unit. It states that Monument management plans shall provide for "*traditional access by indigenous persons*" and that subsistence, recreational, and traditional fishing shall be managed as a sustainable activity but that commercial fishing is prohibited within the Islands Unit. In addition to fish, the collection or harvest of crustaceans (e.g., crabs, lobsters, shrimp) or mollusks (e.g., snails, octopus, clams) is also considered "fishing."

Sustainable fishing is defined as "*fishing activities that do not cause or lead to undesirable changesin the biological and economic productivity, biological diversity, or ecosystem structure and functioning from one human generation to the next*."[5] By limiting fishing activities to noncommercial ventures and by granting fishing permits only to the residents and businesses of the CNMI and Guam, permitted fishing activities within the Islands Unit will not cause undesirable changes to Monument ecosystems. The difficulty in reaching such remote fishing locations, and the cost-prohibitive nature of traveling to the Islands Unit, considered with the infrequent amount of noncommercial fishing travel that has occurred in the recent past, indicates that noncommercial fishing within the Monument will be a sustainable activity for generations to come.

Subsistence fishing has many definitions. One provided by the Western Pacific Fishery Management Council (WPFMC) is "*fishing to obtain food for personal and/or community use rather than for profit sales or recreation*."[6] Schumann and Macinko provide another definition: "*subsistence activities are those actions that contribute to the continued functioning of various essentially non-material aspects of everyday life*" and also includes the cultural values that contribute to a way of life.[7] Although "tradition" and "traditional" are words used to describe practices rooted in the past, these practices may undergo modifications over time and do not exactly mirror the past in terms of contemporary materials or methods. This is the nature of culture and its associated traditions as an evolving aspect of society. Traditional activities in the Monument might be enabled by contemporary fishing gear; however, the way the gear is used often relates to fishing practices that were developed over the course of centuries spent interacting with a particular environment.

Parameters for subsistence, recreational, and traditional fishing activities within the Monument were developed by the WPFMC. The WPFMC assists NOAA Fisheries in managing fisheries in the Pacific Ocean EEZs for Hawai‘i, American Samoa, Guam, and CNMI, in accordance with the MSA, hence their role in regulatory development. The WPFMC adopted an ecosystem approach in developing the Mariana Archipelago Fishery Ecosystem Plan (FEP) to manage fishery resources around the CNMI and Guam. Ecosystem management recognizes the interconnectivity of organisms within an ecosystem, including the link between ecosystems and humans. When implemented effectively, this form of management maintains or improves the overall health ofthe ecosystem rather than individual elements within it and contributes to a resilient, diverse, and abundant marine environment.

The regulatory development process for sustainable noncommercial fishing in the Monument began in 2009. In 2010, the WPFMC held public meetings on Saipan, Rota, and Tinian to help develop the rules for sustainable fishing activities as described in the Proclamation. Amendment 3 to the Mariana Archipelago FEP was finalized in 2013 and published in the *Federal Register*, 50 CFR Part 665, which defines management measures for sustainable noncommercial fishing in the Islands Unit.

Need for Action

A Sustainable Noncommercial Fishing Action Plan guides the protection of marine resources while facilitating continued connections between the people of the Mariana Archipelago and the Monument. Fishers have long been held in high esteem in Guam and CNMI communities, and their catch frequently plays an important role in ceremonies and cultural festivities. The practice of sharing one's catch with family and friends is common throughout the Pacific. It maintains connections among family members and the larger community and links present day activities to deeply rooted cultural values. One Mariana fisher explains that visits to the waters around Maug, Asuncion, and Farallon de Pajaros and the fishing legacies that keep these places alive in the minds of people today "*makes you feel like you are actually an islander*."

Fishing traditions associated with the Monument are summarized in a PISFC report, *Traditional Fishing Patterns in the Marianas Trench Marine National Monument*. Trips to the waters in the Islands Unit are not profit-making ventures, according to oral history interviews with fishers living in the Mariana Archipelago. Instead, they go to the waters around Maug, Asuncion, and Farallon de Pajaros to maintain the cultural tradition of fish sharing among the fishing crew, their families and friends, and community members. The waters around the northern islands are abundant with resources, and most activities in the Islands Unit involve fishing. Even if fishing is not the primary purpose for going (i.e., research trip), fishing occurs on almost every trip for personal consumption while out at sea.

Fishing Permit Process

A fishing permit is required to fish in the Islands Unit. When a JMP process is in place, BMPs will be included with the JMP package. Until then, a fishing permit may be obtained through NMFS. To apply for a fishing permit, applicants go online to http://www.fisheries.noaa.gov/permit/marine-national-monument-fishing-permit and follow the instructions under "How to Apply." After NMFS approves the application, the permit and a logbook are mailed to the applicant. *A Compliance Guide for Fishing in in the Mariana Trench, Pacific Remote Islands, and Rose Atoll Marine National Monuments* is available for download at http://www.fisheries.noaa.gov//pacific-islands/resources-fishing/regulation-summaries-and-compliance-guides-pacific-islands.

SNF Objective: Manage fisheries resources to maintain healthy populations, while permitting sustainable noncommercial fishing (identified as recreational, subsistence, or traditional indigenous fishing) in the Islands Unit.

SNF Strategy 1: Improve information about fisheries stocks status within the Monument. It is important for Monument managers to have baseline information on fisheries stocks because, to date, little is known about the number of fish that exist in the Islands Unit where people will be conducting sustainable noncommercial fishing. This baseline data will also be useful for other areas of resource management, including research and exploration, climate change data, and the creation of education and outreach materials.

> **SNF Activity 1.1: Acquire baseline data about fishery populations.** Monument managers will partner with the PIFSC to conduct research and determine baseline data aboutfishery populations that inhabit the submerged lands and water column.

SNF Strategy 2: Assess fisheries landings from the Islands Unit to ensure sustainable harvests and maintain effective regulations. 50 CFR Part 665.14 explains that the vessel owner of vessels engaged in fishing in the Islands Unit of the Monument are required to keep a logbook with a complete record of catch, effort, and other data and that the logbook must be submitted to the Regional Administrator within 30 days of the end of each fishing trip.

SNF Activity 2.1: Track the landings and species from submitted logbooks to better inform management decision-making. Data on all fish species and fish quantities caught in the Islands Unit will be entered into a spreadsheet to track fishing patterns over time. The logbooks will be reviewed by Monument managers and fisheries data will be updated on an annual basis.

SNF Strategy 3: Identify threats to fisheries resources and develop management actions in the Islands Unit to ensure sustainable, healthy fish stocks are maintained. The purpose for gathering fisheries baseline data in the Islands Unit and for monitoring the catch data is to determine if any fisheries resources are at risk from non-fishing-related issues (such as climate change) or at risk from overfishing. This information will assist resource managers in developing management actions that will maintain or improve the status of fisheries resources.

SNF Activity 3.1: Analyze fisheries data to guide management actions for sustainable fishery stocks. Data gathered in SNCF Activities 1.1 and 2.1 will be analyzed to extrapolate trends in fisheries resources, identify any associated threats to the maintenance of fisheries populations, and assess the resilience of fisheries stocks in the Monument. Monument managers will work with researchers to accomplish a comprehensive data analysis.

SNF Strategy 4: Provide the residents of CNMI and Guam with easy access to permit applications, record forms, logbooks, and other federal fisheries information. Currently, information related to fishing within the Monument can be found online at the Pacific Islands Regional Office (PIRO) Sustainable Fisheries Division website. This website is an essential resource for fishing in the Monument.

SNF Activity 4.1: Incorporate the sustainable noncommercial fishing permit application into the new JMP application. All proposed Monument uses will becovered under a single application within one year of MMP publication.

SNF Activity 4.2: Establish locations in the CNMI and Guam where fishers can go to find JMP applications and Monument-related fishing information. The MMCT will identify locations where permit applications and other fisheries information can be obtained, in addition to online access. Monument managers will partner with government agencies in the CNMI and Guam to have Monument fishing information available at their offices.

SNF Strategy 5: Solicit input through forums and workshops to include indigenous experts and local fishing groups on traditional fishing methods in the region.

USCG Cutter *Assateague*. Photo: USCG

2.2.7 Surveillance and Enforcement Action Plan

Introduction

Education and public outreach are the primary methods to achieve compliance with regulations. However, surveillance and law enforcement are needed to ensure protection of Monument resources. The NOAA OLE, USFWS OLE, and CNMI LE personnel work in collaboration with the USCG to ensure compliance with applicable laws in Monument waters. Satellite imagery and vessel monitoring systems (VMS) are used to monitor U.S. EEZs in the Pacific for violations of U.S. fisheries; illegal, unreported, and unregulated fishing; livingmarine resources; T&E species; and marine mammal regulations.

All large-scale U.S. vessels fishing in the EEZ must install a VMS device that transmits the vessel's movement and global position coordinates to a monitoring center via secure satellite communication channels. Travel patterns are tracked by the NOAA OLE Pacific Division. This real-time data is received and jointly monitored by the USCG. This information is also available to U.S. vessel owners in the Mariana Islands to encourage voluntary compliance with fishing regulations. Vessel owners can see near real-time positional data for their vessels in relation to the boundaries of the Monument and fishery closure areas using a secure internet connection through Google Earth™ mapping software, modified to include VMS data. Both USFWS and NOAA OLE participate in a Dark Vessel Detection program that uses satellite technology to locate and track vessels whose location transmitting devices have been switched off, sometimes to evade monitoring, control, and surveillance.

Need for Action

The USCG is the principal agency with aircraft and vessels capable patrolling the Monument and responding to violations of federal maritime laws. With the USCG assets based in Guam, the response time to reach Monument waters is greatly extended. The logistical constraints associated with reaching the most remote areas of the Monument was one of the issues which prompted the DOD to enter into a MOU that allows NOAA and USCG law enforcement boarding teams to travel on U.S. Navy ships. This enhances the teams' ability to make direct contact with vessels conducting unauthorized activities in these remote waters. Maximizing the OLE's regional surveillance capabilities would provide the most efficient and feasible methods to monitor and enforce the laws within the Monument.

The first step toward regulation compliance requires that the public have access to accurate Monument boundary information. Existing resources used by vessel owners and vessel captains must be updated to include information about the Monument to achieve increased compliance with regulations. This will allow vessel owners to self-regulate their activities and voluntarily avoid violating protected marine areas. The

Monument boundaries are shown in U.S. Coast Pilot®10[2] and Electronic Navigation Charts (ENCs)[3]. Both chart systems require a certain level of technology to be accessed. To expand the user base and deter unintended illegal activities within the Monument, other widely available navigational formats should be identified and Monument boundaries verified.

SAE Objective: Ensure compliance with environmental laws and regulations for the protection of marine resources within the Monument.

SAE Strategy 1: Incorporate Monument information and regulations into existing interagency agreements and integrate Monument-specific protections into mapping tools. The Monument will be integrated into existing interagency agreements so that all agencies are clear on their roles and responsibilities. Additional interagency agreements may become necessary to adequately regulate Monument activity.

> **SAE Activity 1.1: Integrate the Monument into interagency agreements and evaluate the necessity for additional interagency agreements.** Monument managers, incollaboration with OLE personnel, will review existing interagency agreements and determine the need to establish additional formal agreements between agencies to enhance the effectiveness of law enforcement in the Monument.
>
> **SAE Activity 1.2: Ensure that Monument boundaries are accurately depicted on official nautical charts and investigate the availability of additional formats.** The Monument boundaries and regulatory information will be verified when official ENCs and U.S. Coast Pilot®10 nautical guides are updated. We will explore the feasibility of modifying other navigational tools to include Monument boundaries.

SAE Strategy 2: Analyze vessel traffic data to assess the need for additional surveillance within the Monument. Existing data about vessel traffic in the region will be analyzed to anticipate travel patterns and identify unauthorized activity. The cost and benefits of a data analysis will be shared across multiple aspects of Monument management.

> **SAE Activity 2.1: Conduct a ship travel assessment to inform compliance and enforcement needs in Monument waters.** U.S. and foreign ship travel assessments are needed to determine the location of origin, frequency, purpose, and type of vessels that travel to and/or through the Monument. A vessel traffic analysis will aid enforcement agencies in prioritizing enforcement needs, utilizing resources, and locating areas where increased monitoring could curb illegal activity in the Monument.
>
> **SAE Activity 2.2: Assess effectiveness of Google Earth™ VMS data sharing.** Real-time location information is provided to U.S. vessel owners to encourage voluntarycompliance with fishing regulations. This Google Earth™ initiative will be evaluated to determine if it helped reduce violations and if the tool's current format for describing prohibited areas and other regulations is useful and clear. The data will inform future enforcement operations and will aid in determining if improvements are needed for surveillance and monitoring of vessel activity.

[2] https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html
[3] https://www.nauticalcharts.noaa.gov/charts/noaa-enc.html

SAE Strategy 3: Consider suitable programs, tools, and technologies to augment effective law enforcement. Monument managers seek to find common ground among agencies, communities, and industries to foster a sense of stewardship toward Monument ecosystems. A variety of advanced technologies are available to augment the USCG air, ship, and OLE VMS operations in a wide range of costs and could be managed cooperatively between partnering agencies.

> **SAE Activity 3.1: Investigate the feasibility and necessity of deploying remote surveillance technologies to aid in resource protection.** This activity applies to both the SAE and MRCM Action Plans. Monument managers and law enforcement partners will identify emerging tools and identify when the acquisition of new remote technologies is necessary. A dual benefit technology that may be feasible is the potential modification of EARs currently used by PIFSC to monitor real-time vessel and animal activities.

2.2.8 Marine Invasive Species Control Action Plan

Introduction

An invasive species is defined as an organism that is introduced to and established in a new environment where it is not native or outside its normal range and whose presence is likely to cause economic, human health, or environmental damage in that ecosystem.[8] A species must become established, not merely introduced, in a new location for it to be considered invasive. Common attributes of invasive species include fast growth, rapid reproduction, lack of natural predators in thenew environment, high dispersal ability, and the ability to adapt to changing environmental conditions that allow them to establish in new habitats and often displace native species. To date, invasive species have caused unprecedented impacts to economic development and the health, agriculture, trade and tourism industries, with an estimated global cost of about $1.4 trillion annually,which represents 5% of the economy.[9]

Governments around the world address marine invasive species in different ways. Australia is a leader in marine invasive species control. Their multiagency programs cooperate to exclude unwanted organisms at the border and control incursions within the country via a rapid detection anderadication program. The United States is in the process of developing an assessment and regulation plan. Prompted by the military buildup on Guam, the DOD leads development of the *Regional Biosecurity Plan* (RBP) for Micronesia and Hawai‘i to assess potentially invasive species that could enter new habitats through U.S. military vectors and pathways. The RBP is a comprehensive analysis of transportation mechanisms and species movement between Guam, the CNMI, the Federated States of Micronesia, the Republic of the Marshall Islands, Palau, and Hawai‘i. The RBP notes an overall lackof marine system biosecurity regulations and capacity, resulting in a minimal likelihood of intercepting marine risks at ports of entry. Resolving the current lack of attention to marine system biosecurity across the region should be a high priority each of the individual jurisdictions to address threats from marine biological invasions.

Pathways and Vectors

Pathways are the routes by which species are transported from one location to another. Vectors are the modes by which species are transported, such as boats, planes, and livestock. Invasive species dispersal can occur via 1) natural movements (e.g., carried by fish, algae, marine mammals, and ocean and wind currents); 2) anthropogenic transfer through ship ballast water, sediments, hull fouling, marine debris; and 3) fisheries-related items and activities such as docks, grounded or abandoned vessels, yachts, kayaks, and recreational gear. Once invasive species are established in marine ecosystems, they can be nearly impossible to eliminate.[10] The most effective strategies for preventing impacts are interception or removal of the vector.

The primary pathways and vectors for invasive species introductions to the Monument are aircraft and water vessels transiting from one location to another across the Pacific and marine debris floating along currents. Helicopters and fixed-wing aircraft are used by biologists and members of military to travel in and around the Mariana Archipelago as they conduct surveys and transport equipment and supplies. Vessels including cargo ships, supply vessels, research ships, military ships, cruise ships, yachts, and fishing boats pass through Monument waters. These aircraft and vessels can carry marine invasive species, inadvertently distributing organisms to other Pacific Islands and the Monument via ballast water, sediments, hull fouling, and fishing gear.

Marine biological invasions can also be caused by changing local conditions. Across the Pacific, shipwrecks have been found to spur the growth of invasive organisms. For example, decomposition of sunken steel fishing vessels at Palmyra Atoll enriched the surrounding the seawater with iron, leading to the growth of a the corallimorph *Rhodactis howseii*.[13] Although *R.howseii* is a native species, it can take advantage of human-altered habitat and significantly change the natural habitat by aggressively outcompeting native corals with a smothering growth that leads to the phenomenon known as black reef. Black reef, if unchecked, can completely suffocate other coral species and eventually destroy the reef.

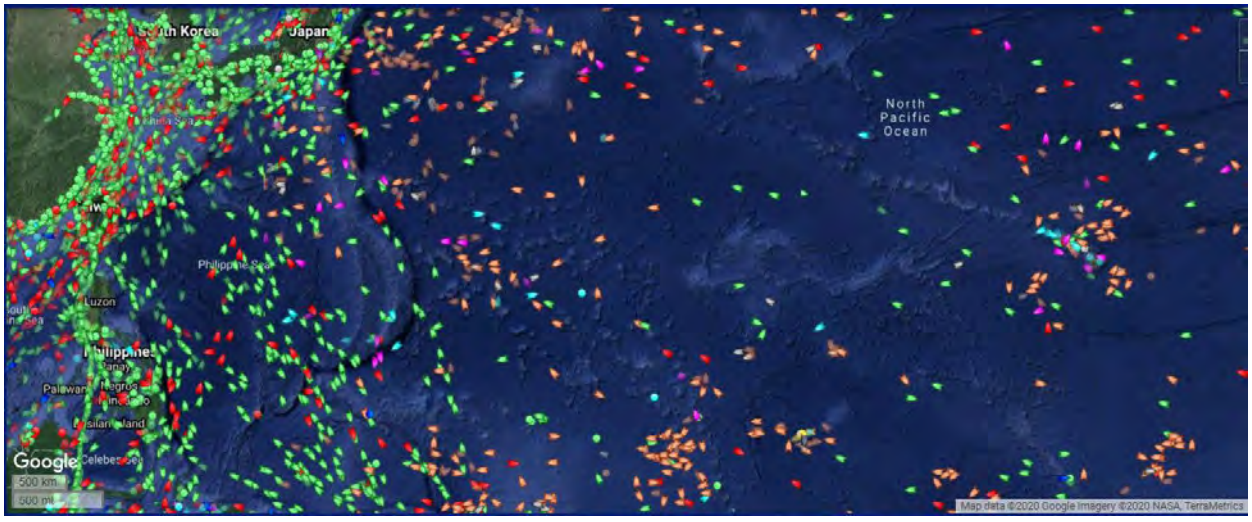
The 2011 Japan Tsunami and the 2013 Hurricane Sandy demonstrated that natural disasters also facilitate the creation and movement of marine debris with the associated potential for invasive species transfer. A Regional Preparedness and Response Workshop held in August 2012 addressed biofouling and invasive species pertaining to Japan Tsunami Marine Debris (JTMD). *Response Protocols for Biofouled Debris and Invasive Species Generated by the 2011 Japan Tsunami* were developed from the multiagency and stakeholder discussions. The response protocols include public communication materials about JTMD, a reporting system so information across states and countries is shared, risk assessment guidelines to assist with decision-making and response efforts, and management options that clarify agency jurisdictional roles and responsibilities.

Deep ocean research submersibles and remotely operated vehicles (ROV) used for research and exploration are another potential vector for invasive species in the Trench Unit/Refuge, Volcanic Unit/Arc of Fire Refuge, and Islands Unit of the Monument. One could easily assume that life forms are unable to survive the extreme pressure change from the sea surface to the ocean floor or vice versa, but in June 2012, the National Science Foundation reported otherwise. The submersible vehicle *Alvin* transferred *Lepetodrilus gordensis*, a type of marine snail, from a deep hydrothermal vent habitat. During a research expedition in the deep-water vents of the Gorda Ridge, located off the coast of Oregon and California, 38 limpets attached themselves onto the *Alvin*. The limpets were not discovered until after another deep-sea dive into a non-limpet habitat further north in the Juan de Fuca Ridge, almost 400 miles away.[11]

Scientists concluded that the limpets survived the inadvertent transfer from one extreme environment to another. Biologist Janet Voight explained that diseases specific to biological communities at hydrothermal vents are not well studied, and the implications for invasive species from vent environments are unknown. “It is clearly possible to accidentally introduce a species – and any potential diseases it may carry—from a deep-sea vent to a new location,” says Voight, “It reveals the potential risk of human-driven change to ecosystems, even those ecosystems most of us will never see.”[11]

Need for Action

The United Nations Conference on Trade and Development (UNCTAD) reports that there were 102,899 registered commercial ships transporting about 11 billion tons of cargo across the global ocean in 2022.[12] This underscores the risk of invasive species transport from shipping related vectors, particularly via ballast water and hull fouling. Add the number of ferries, cruise vessels, military ships, yachts, pleasure craft and fishing vessels and the risk of transport escalates.



Commercial marine traffic in the Pacific, live marine traffic.com screenshot captured July 7, 2020.
Source: MarineTraffic

Current data on the status of marine invasive species (MIS) in the Monument is limited to surveys conducted through the Marianas Archipelago Rapid Assessment and Monitoring Program (MARAMP). Six expeditions from 2003 to 2017 documented the conditions and processes influencing coral reef ecosystems at Asuncion, Farallon de Pajaros, and Maug. The MARAMP observations indicate that no introduced coral, invertebrate, algae or fish species were found in the Monument. Strategies to assess the presence of MIS and to assess the pathways, vectors, and prevention methodsfor species introductions are identified below. Results will enable managers to identify the most appropriate prevention protocols and if feasible, response and research initiatives.

MIS Objective: Prevent the establishment of invasive species by protecting the Monument from species introductions and rapidly respond in the event of a new invasive species introduction to the Monument.

MIS Strategy 1: Maintain current marine invasive species prevention BMPs and biosecurity protocols for all Monument visitors. Due to the remote location of the Monument, eradicating an introduced marine species would be extremely costly, if not impossible. Thus, preventing species introduction is crucial for the maintenance of healthy monument ecosystems. Best management practices and biosecurity protocols will provide Monument visitors with the necessary information and thorough instructions to prevent MIS introductions.

> **MIS Activity 1.1: Review existing marine invasive species prevention measures and BMPs to update standard protocols when needed.** MIS prevention methods and BMPs for ballast water, hull fouling, and gear sterilization are currently in use by NOAA and other visiting vessels when conducting activities in all the Pacific Monuments. The BMP examples and references included do not preclude Monument users from using other technically sound practices. New MIS prevention protocols and BMPs will be examined to determine the utility and effectiveness for application in the Monument.
>
> **MIS Activity 1.2: Develop a reference guide for Monument visitors that explains BMPs developed in MIS Activity 1.1.** Inform all potential Monument visitors about the BMPs and biosecurity protocols by providing them with a reference guide about maintaining a clean hull, fishing gear, and research instrument cleaning and sterilization procedures in a simple and concise manner.

MIS Strategy 2: Assess the number of vessels transiting the Monument waters, the purpose of their passage, travel patterns and primary pathways, and isolate potential vectors for species introductions. U.S. and international ship travel assessments to determine the location of origin, frequency, purpose, and type of vessels that travel to the Monument are needed to ascertain potential MIS pathways and levels of risk for introductions. Common vessel characteristics will be identified using spatial data and maps to enable analysis of common vessel corridors and temporal patterns of activity in the Pacific region.

> **MIS Activity 2.1: Identify vector pathways and assess spatial and temporal water vessel and aircraft traffic patterns.** Monument managers will identify potential harbors and airports of origin for water vessels and aircraft and analyze the pathways that approach Monument boundaries. These sites of origin and vectors will be assessed for invasive speciesoccurrence and then prioritized by risk based on probable vessel travel to the Monument. Possible data sources include the USCG, the International Comprehensive Ocean-Atmospheric Data Set and the WPFMC, and DOD Micronesia Biosecurity Plans.

MIS Strategy 3: Assess the need for a vessel inspection process in Guam and CNMI for invasive species. Monument managers will consider the need for and logistical feasibility of establishing an inspection process. If the vessels conducting these activities are not identified as threats to Monument resources, this strategy and corresponding activity will be disregarded. Any inspection process will be tailored for effectiveness in the areas threatened by activity based on theconditions that are deemed appropriate.

> **MIS Activity 3.1: Review trip data and determine whether the Monument would benefit from vessel inspections for Guam and CNMI boaters.** If vessels conducting sustainable noncommercial fishing, exploration and research, or other permitted activities in the Monument are identified as MIS threats to Monument resources, Monument managers will determine whether a vessel inspection program can be implemented in CNMI and Guam.

MIS Strategy 4: Confirm the presence or absence of invasive species in the Monument. Preliminary results from past MARAMP surveys have not identified the presence of MIS in the Monument. However, the data collected and reviewed to make this determination is a snapshot in time—the time and date of the observation cruise. Also, a review of existing reports, surveys, and relevant peer-reviewed and gray literature is needed to determine the presence or absence of MIS in other areas of the Monument. This will provide a robust baseline for long-term management from which coral reef status and trend analyses can be implemented.

> **MIS Activity 4.1: Analyze the MARAMP towed-diver survey data to verify the presenceor absence of invasive species and establish a baseline for marine invasive species in the Monument.** Results from MARAMP archived benthic towed-diver surveys will be analyzed in detail to confirm the absence of MIS in the Monument. To preserve the ecosystems, Monument managers need to know which resources are resilient, which ones are vulnerable to MIS and/or introduced disease, and whether invasive species are a problem that already exists in the Monument. A comprehensive analysis of existing survey data will be conducted to inform management actions to promote resilience and assess feasible response options, where possible.

> **MIS Activity 4.2: Develop a database that identifies marine species in the Monument, prioritizing known invaders in the tropical and subtropical Pacific marine environment.** Monument managers will develop a database where MIS Monument data (including marine alga and microorganisms) will be entered. This database will be compatible with the global invasive species database developed by The Nature Conservancy, making it searchable online and widely accessible through well-known forums once complete. Monument managers will concentrate efforts on identifying any known invaders in the tropical and subtropical Pacific marine environment.

MIS Strategy 5: Develop a marine invasive species observation plan and support existing observation activities. An observation program is necessary to detect MIS introductions, assess impacts, and identify potential methods for containment and eradication in the case of species introduction. Monument managers will work with the PIFSC staff to consider expanding the MARAMP surveys to include more detailed MIS surveillance and enlist the voluntary assistance of Monument visitors who can perform MIS observations.

> **MIS Activity 5.1: Create a marine invasive species observation program for researchers to aid in detecting potential introductions.** Monument managers will collaborate with researchers who are going to the Monument, and request that they make select observations based on the type of project being executed, to supplement the MARAMP observation cruises. Observations made by as many trained researchers as possible will enable early detection, increasing the potential for effective containment and eradication of introduced species before they become established.

MIS Activity 5.2: Develop a response plan if a species introduction is identified. Monument managers will research and develop a possible course of action in the event an invasive marine species introduction is identified. This will entail collaborating with local and national agencies to pool resources and address the issue.

MIS Strategy 6: Continue to research initiatives across the Pacific to achieve marine invasive species prevention. New tools or methods may be required to effectively prevent the spread of invasive species. Resource managers will identify gaps in available MIS prevention and response BMPs and technologies as they arise and work with partners to conduct research and implement management actions.

MIS Activity 6.1: Maintain communication with partners and remain informed of global marine invasive species developments. Monument managers will remain in correspondence with scientists and advocacy and community groups to participate in the prevention of MIS globally. Learned lessons from relevant Pacific initiatives will be considered for application in the Monument as part of an adaptive management approach toward MIS prevention.

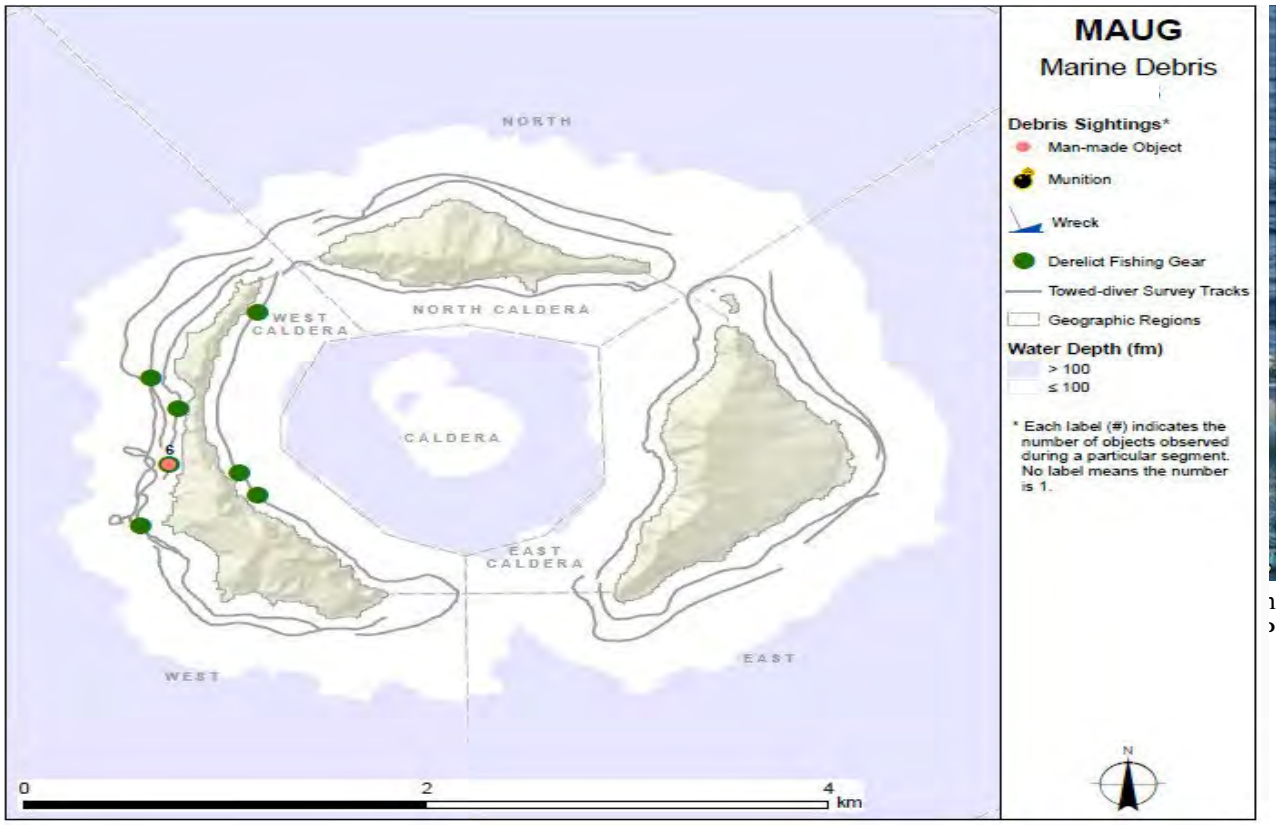
2.2.9 Marine Debris Action Plan

Introduction

Marine debris on Maug shoreline.
Photo: Angelo Villagomez

Marine debris is an ongoing global issue and one of the most widespread pollution problems facing the oceans and waterways. Marine debris is defined as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned in the marine environment. Plastics, derelict fishing gear, Styrofoam™, and derelict vessels are common types of nonbiodegradable debris that litter marine ecosystems.

Marine debris is not just an unsightly problem; it causes damage to coral reefs and other marine habitats. Injuries and the deaths of numerous marine mammals and birds are caused ever year by marine debris, either because the animals become entangled in it or mistakenly eat it as food. Most marine debris is so small it is not visible floating on the water surface. Small, suspended pieces of plastic are easily ingested by animals in the ocean or on the coast once the debris reaches shore. Plastics are especially troublesome because the synthetic material can absorb, concentrate, and deliver toxic compounds to the animals that ingest them. The map below shows known areas of concern for marine debris on the shores of the West Island of Maug, on the boundary of the Monument and the wildlife conservation reserve. Derelict fishing gear is a dominant form of marine debris in the Islands Unit.



Source: NOAA

Need for Action

Marine debris is a potential transport mechanism for nonnative species and chemical hazards; a threat to human health and safety; and has economic impacts on navigation, tourism, and marine resources. The

purpose of the Marine Debris Action Plan is to establish a framework for activities that will reduce the impacts of marine debris within the Monument. Physical entanglement in nets and plastic objects threaten marine animals and coral habitats. Ingested marine debris, particularly plastics, is found during necropsies performed on birds, turtles, marine mammals, and fish.

Natural disasters, such as typhoons, tropical storms, and tsunamis, have the potential to generate a tremendous amount of marine debris. The high winds, heavy rains, storm surge, and flooding associated with these disasters can pull large structures, household articles, and outdoor items into surrounding waters. Winds and ocean currents play a dynamic role in circulating debris around the globe. Once a slowly degrading and highly buoyant item such as a food wrapper or plastic bottle enters the ocean, it can travel thousands of miles along wind and water currents. Large ocean current systems that flow around a central point are called gyres, which circle around huge areas of the ocean following along the continental coastlines. The gyres pull debris into one location, often the gyre's center, forming "patches." The Great Pacific Garbage Patch spans waters from the West Coast of North America to Japan. The patch comprises the Western Garbage Patch, located near Japan, and the Eastern Garbage Patch, located between the U.S. States of Hawai'i and California.

Since the Monument areas are uninhabited, marine debris found there mainly originates from fishing fleets, maritime transportation, former military activities, and land-based debris from populated areas of neighboring countries. Advancing stewardship among members of the commercial and recreational fishing and cruise line industries requires the provision of relevant information and incentives.

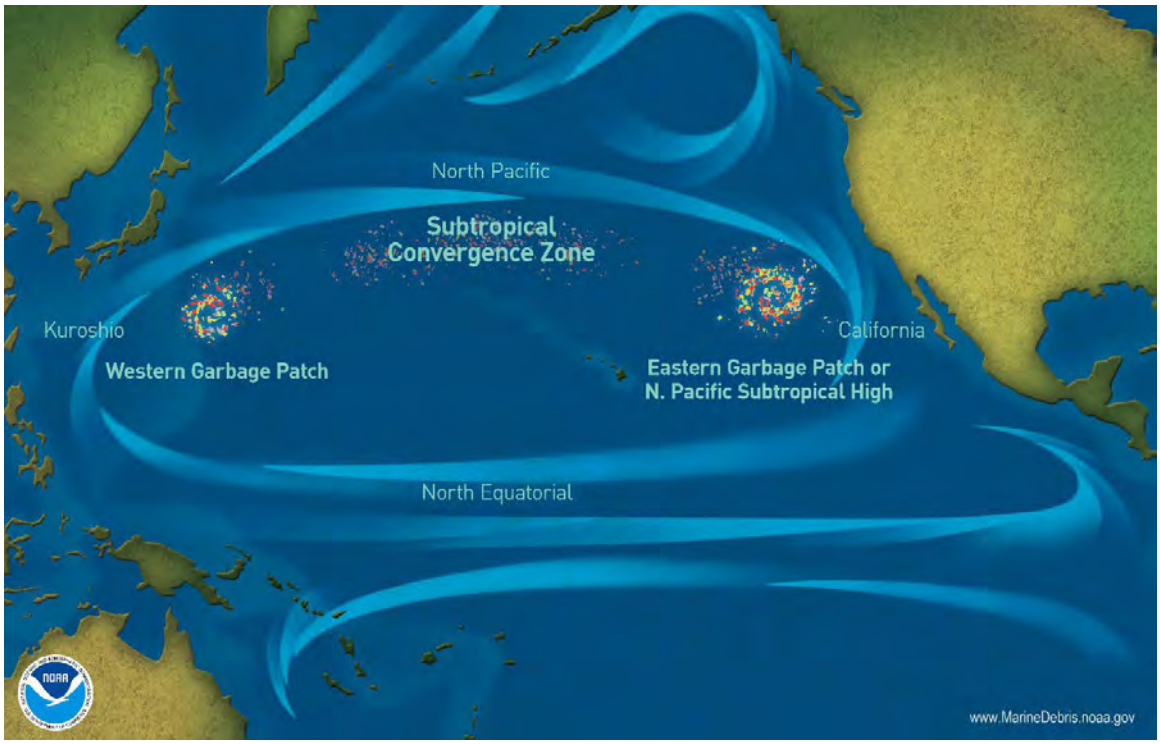


Image: NOAA

MD Objective: Remove existing debris and reduce the likelihood of additional debris from entering the Monument.

MD Strategy 1: Decrease potential incidences of grounded and abandoned vessels in the Monument. Grounded vessels cause physical damage to coral reefs and chemical damage from the release of oil, fuel, and other hazardous materials. Abandoned vessels cause reef abrasion and chemical impacts due to metal corrosion, iron deposition, and other chemical by-products. Because of the Islands Unit's remote location,

vessels abandoned there may be stranded for long periods of time until resources for removal are available, which only exacerbates the impact of derelict vessels upon the marine habitats. One way to reduce the risk of vessel groundings is to develop navigation aids that pinpoint the location of Monument features on navigation charts.

MD Activity 1.1: Update navigation aids with Monument boundary and feature information. Monument managers, along with partner agencies, will work to continually update the Ocean Coast Survey Electronic Navigation Charts and the Coast Pilot®10 to include Monument boundaries and information about potential navigational hazards located within the Monument. This activity will increase mariner awareness about vessel hazards in the Monument so vessel grounding can be avoided.

MD Activity 1.2: Assess the need and value of establishing International Maritime Organization protection measures for the Islands Unit. Based on findings of the threats, ship traffic analysis, accidents and incidents, Monument managers will determine whether to submit a proposal to the International Maritime Organization (IMO) to establish Particularly Sensitive Sea Areas and associated protective measures. Such measures fall into two general categories: 1) navigational aids (ship routing and reporting systems) and 2) discharge restrictions (special areas and emission control areas).

MD Strategy 2: Decrease incidences of fishing gear and solid waste disposal in the Mariana Archipelago that could drift into Monument waters. Ocean-based sources of debris include fishing gear and solid waste from maritime activities and the commercial and recreational fishing industries. Nets, monofilament, fishing lures, plastic bags, and galley waste are examples of common items that deliberately or accidently become marine debris from vessels. Best management practices can prevent most items from going overboard and are easily incorporated into boating regiments.

MD Activity 2.1: Modify and circulate waste management education materials to Monument visitors. Informing mariners about fishing materials and BMPs designed to reduce the impact on ocean resources and providing incentives for proper gear disposal on land are needed to prevent gear from being disposed at sea. This will be accomplished through an outreach project, conducted in coordination with regional resource management agencies, that emphasizes BMPs for waste minimization and proper waste management. Existing materials in the *Marine Debris 101* series include:

- The Boaters Guidebook to Marine Debris and Conservation
- Marine Debris Legislation and Policy
- Reeling in Marine Debris

MD Activity 2.2: Conduct outreach workshops in the CNMI and Guam about fishing gear loss solutions. This activity encourages fishers to adopt fishing practices and gear that reduce the risk of gear loss. Many people are aware of the problems associated with derelict gear but do not know where to locate on-land disposal facilities or recognize the value in alternative low-impact fishing gear. Monument managers will work with community partners to conduct workshops with commercial and recreational fishers covering gear loss issues, providing information about where to purchase alternative supplies and where to recycle potential debris items.

MD Activity 2.3: Develop protocols to prevent marine debris from fishing fleets that fish in the CNMI and Guam EEZs and partner with them for removal incentives. Monument managers will develop an inventory of commercial fishing vessels operating in waters adjacent to the Monument that will include vessel size, gear used, and home port. The inventory and MD Activity 2.2 workshops will be used to identify feasible options to monitor and prevent loss of gear, such as permanent identification of fishing gear, incentive programs for recovered debris, and the disposal

and recycling programs at ports. Monument managers will partner with other marine debris organizations to formulate incentives for vessels to participate in marine debris removal (if the item is identifiable and not hazardous to remove) and disposal programs in compliance with transport regulations.

MD Strategy 3: Develop a process to inventory and remove marine debris in the Islands Unit. Effective reporting systems are needed to increase the ability for visitors to report the location of marine debris accumulations to inform managers on quantity, type, and location of marine debris observed. Managers will establish a marine debris data detection and reporting system for Monument visitors including scientists, USCG, researchers, and fishers. An inventory of marine debris will be maintained and prioritized for removal.

MD Activity 3.1: Establish a marine debris data gathering procedure for the Islands Unit. A specific form will be developed for the Islands Unit using the NOAA *Marine Debris Shoreline Survey Field Guide* as a model. The marine debris identification guide and form would be supplied to visitors as part of their JMP.

MD Activity 3.2: Consider using remote monitoring technology to address marine debris. Monument managers will work with partners to explore the efficiency and effectiveness of remote sensing marine debris at sea, near shore, and shoreline environments. Using remote sensing for marine debris surveys may reduce surveillance costs, but testing and evaluation work is needed to determine if this technology is a viable option to address the issue. A cost analysis will be conducted to determine feasibility of using this technology in the Monument for marine debris surveillance.

MD Activity 3.3: Work with partners to establish a centralized, interagency marine debris inventory and response fund. Monument managers will work in collaboration with local and national partners to acquire funding to have the marine debris surveys reinstated during the MARAMP cruises and to remove marine debris in locations where it’s identified as a priority.

2.2.10 Emergency Response and Natural Resource Damage Assessment Action Plan

Introduction

In the event of an emergency or natural disaster in the Monument, the response must be aligned with the National Response Framework (NRF), which guides the United States' approach to all types of disasters and emergencies. The NRF is built on scalable, flexible, and adaptable concepts to align key roles and responsibilities across the United States. This NRF describes specific authorities and best practices for managing incidents that range from local emergencies to large-scale events or catastrophic natural disasters. The NRF outlines the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The response scenarios described in this section all correspond with the NRF. If the emergency is an oil or chemical spill from plane crashes, offshore shipping traffic, grounded vessels, or other events, the response will be conducted in accordance with the National Contingency Plan (NCP). The NRF incorporates the NCP for spill responses. In marine oil spill events, the USCG will lead the response.

Oil and chemical spills can affect hundreds of miles of ocean or coastlines and potentially threaten the survival of coral, fish, seabirds, and other marine resources. Impacts to resources may worsen over time and cause further environmental consequences if there isn't an emergency response to remove oil, hazardous substances, and debris. Natural Resource Damage Assessment may also be conducted by the Natural Resource Trustees to determine the amount of injury to resources from oil or hazardous substances and any appropriate restoration actions to compensate for injuries to those resources.

The USCG uses special skimmers to contain and recapture fuel spills. Photo: LCDR John S. Stewart /USCG

A USCG Federal On-Scene Coordinator (FOSC) responds to marine oil and chemical spills and is given authority to complete the emergency response. The Natural Resource Trustees (including the USFWS and NOAA) have authority over natural resources impacted by the spill. The FOSC will determine applicable authorities, the action needed, funding sources that can be used, and methods of pollution mitigation that are appropriate under the circumstances. It is important for the agency Trustees to provide timely advice on recommended actions concerning trustee resources that are potentially affected by a discharge of oil and any appropriate input into the plans to minimize injuries to natural resources. Once a course of action is determined, managers work closely with their respective agency Trustees who may help the FOSC to execute the incident action plan.[§]

In certain situations, oil pollution may not be the primary environmental concern. For example, grounded vessels may damage coral, sea grass, other sensitive marine habitats, and irreplaceable historical and cultural resources. Threats from abandoned vessels include antifouling paints, nutrient enrichment from rusting steel, the introduction of marine invasive species, and fouling organisms on the hull. Fishing gear or other marine debris that could entangle marine life may be hazards if the vessel is allowed to deteriorate in place.

[§] Guidance documents to help deal with spills of oil and petroleum products are available at https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/fosc-guide.html.

Key response priorities for Monument managers in the case of grounded vessel include the following:

- Identify and prioritize resources at risk.
- Evaluate protective measures and cleanup strategies.
- Facilitate post-cleanup evaluations.
- Manage ESA consultation and essential fish habitat issues.
- Ensure that consultation requirements for the ESA, MMPA, MSA, and NHPA are met.
- Ensure the enforcement of the Migratory Bird Treaty Act to protect seabirds and other protected species.

Natural Resource Damage Assessment

In the event of an oil or chemical spill, the Natural Resource Trustees may assemble a team of scientists, economists, and attorneys to conduct a Natural Resource Damage Assessment (NRDA). The NRDA process is used to assess injuries to marine and terrestrial resources and develop a restoration plan to compensate for injuries to the resources. The NRDA team will coordinate with the emergency response agencies and Monument managers. The NRDA process includes the following:

- **Preliminary Assessment**, where the natural resource managers collect time-sensitive data and review scientific literature about the released substance and its potential extent, severity, and effect on the resources.
- **Injury Assessment and Restoration Planning**, where economic and scientific studies are conducted to quantify the injuries to natural resources and identify potential restoration projects. The studies are also used to prepare alternative approaches to speed the recovery of damaged resources, including compensation for their loss until recovery as part of the restoration plan.
- **Restoration Implementation**, where the NOAA Damage Assessment, Remediation, and Restoration Program |(DARRP), USFWS, and CNMI agencies work with the public to select and implement the appropriate restoration project(s). Examples of restoration include coral transplantation and restocking to accelerate recovery of coral reef habitats, replanting wetlands, or species recovery and monitoring.

The NRDA process may sound simple but understanding the complex natural ecosystems, the services they provide, and extent of resource damage, followed by the development of feasible andeffective restoration plans can be a challenge.

Need for Action

Grounded vessels typically threaten to or spill oil, fuels, and/or other hazardous substances that may cause harm to human safety and the environment. The health of coral reefs, fishes, seabirds, cetaceans, turtles, and protected species are threatened until the vessel and associated materials are removed. In addition to accidental vessel groundings, devastating natural disasters call for emergency response teams to intervene. A local response and assessment strategy should be developed to identify regional response funding sources, trained personnel, and other resources for the Monument in the event of an emergency or natural disaster. This Action Plan must align with the existing NRF.

Remote MPAs are at a high risk for vessel groundings due to the lack of lighting, aids to navigation, or other indications that signal shallowdepths or coral reefs in the vicinity. A 1991 shipwreck on the remote Palmyra Atoll NWR released iron minerals causing an outbreak of *Rhodactis howesii* to spread over a 650 ft radius of coral reef. The shipwreck was removed in 2014. Although the corallimorph is gone from the original infestation area where the wreck was removed at Palmyra, it continues to spread to other reefs around the atoll. That event underscores the need to respond, assess, and address the environmental consequences of catastrophe before those consequences compound.[13]

ERDA Objective: Respond effectively to emergencies under the National Response Framework and assess and restore any damages to Monument resources.

ERDA Strategy 1: Provide the USCG with a Monument Contingency Plan and additional tools to enable a streamlined response and damage assessment in the event of an emergency in the Monument. Monument managers will collaborate with agencies and organizations involved in emergency response in the Pacific region, including Mariana Islands Area Committee (responsible for emergency response planning regarding spill preparedness and consists of industry, federal, and local agency representatives); the FOSC, who coordinates the activities of the Area Committee and assists in the development of a comprehensive Area Contingency Plan; the USFWS; and the NOAA DARRP. Together, an ERDA protocol and Monument Contingency Plan will be developed and added to the USCG Marianas Islands Area Contingency Plan (MIACP).

ERDA Activity 1.1: Prepare a Monument Contingency Plan to supplement the MIACP. The MIACP functions as the master plan for response and planning coordination regarding discharges of oil and releases of hazardous substances in CNMI and Guam. Monument managers will draft a Contingency Plan containing a Monument ERDA protocol according to the USCG MIACP format sections 1000–9000 and include the following:

- Mission, execution, planning, logistics, finances, etc.
- Preparation of Environmental Sensitivity Indices for the waters around Maug, Asuncion, and Farallon de Pajaros
- Response drills and training plans for emergency response personnel

This Monument Contingency Plan will then be submitted as an appendix to the MIACP.

ERDA Activity 1.2: Prepare an Environmental Sensitivity Index (ESI) for the Islands Unit. ESI maps are important tools used in assessing potential damage to resources. They provide a concise summary of coastal resources that are at risk during an emergency or natural disaster. Examples of at-risk resources include birds, shellfish beds, and coral reefs. Additionally, ESI maps can be used by planners before an accident happens to identify vulnerable locations, establish protection priorities, and identify cleanup strategies. ESI atlases are available for most of the coastal regions of the United States, including Saipan, Tinian, Rota, Aguijan, and Guam.[14] Monument managers will prepare ESI maps for the waters and submerged lands that constitute the Islands Unit as part of the Monument Contingency Plan.

ERDA Activity1.3: Prepare a NRDA representative contact list. NRDA representatives for the Monument will be identified, along with their contact information, roles, and responsibilities. Monument managers will prepare a NRDA contact list, update it annually, and have it available for the USCG.

ERDA Strategy 2: Ensure preparation, response, and training needs are met for ERDA protocol in the Monument. Monument managers will consult emergency response agencies to accomplish the following tasks:

- Identify training resources, including personnel, distance learning capabilities, and equipment.
- Promote appropriate trainings by using local examples and by working with diverse organizations and agencies with intimate knowledge about the Monument region.
- Encourage collaborative training efforts within agencies and across organizations through the sharing of regional training opportunities.

ERDA Activity 2.1: Monument managers will collaborate with the PRiMO coalition to identify training and funding needs associated with the ERDA protocol. The Pacific Risk Management ‘Ohana (PRiMO), a coalition of organizations with a role in hazard risk management in the Pacific region, are leading discussions to address issues pertaining to funding sources, training requirements, and other ocean policy issues in the Pacific Region. Monument managers will work with the PRiMO team to ensure that emergency response and preparedness requirements are met in the event of a natural or human-induced hazard in the Monument.[5]

[5] https://coast.noaa.gov/primo/

2.2.11 Exploration and Research Action Plan

Introduction

The oceans cover more than 70% of the Earth's surface, carry about 50% of the global primary production, and support the greatest biodiversity on the planet. Events in the open ocean affect humans everywhere daily. By heat transfer, ocean currents regulate global weather patterns that influence living conditions both at sea and on land. The ocean is one of the first places where changing temperatures, sea level rise (SLR), and ocean pH provided evidence of Earth's changing climate. Marine habitats rank among the most intense carbon sinks in the biosphere, holding up to 54 times more carbon that the atmosphere. This marine-stored carbon is called blue carbon. If degraded, blue carbon ecosystems can become sources of carbon, releasing stored carbon back to the atmosphere in the form of CO_2.

Many major environmental events, such as earthquakes and tsunamis, originate on the seafloor,sometimes with disastrous effects on human communities along the coastal zone. Oceans supply us with resources from fisheries to marine biotechnology to minerals and renewable energy. Oceans provide social and economic goods and services, marine transportation and security, and coastal protection, as well as the economic services from tourism and recreation. The oceans may provide answers about the origin of life on Earth and the possibility of life elsewhere.

Only an estimated 5% of the global oceans has been explored, with most of this research comprising studies on the upper photic zone of the ocean's water column and along the coastlines. With an average depth of 2.36 miles, the ocean floor is generally inaccessible except with advanced technology, which often comes with a high cost. Despite the obstacles, scientists and explorers identify a pressing need to study the deep portions of the ocean. Research and exploration allow scientists to make better predictions about weather events, climactic changes, and the future of marine resources, which inform management actions for resource conservation and fishing policies. Better knowledge of climate impacts on the marine environment is vital for improved forecasts. This is essential for broader economic prosperity, security, and well-being. It also allows communities to prepare for future environmental scenarios.

Research, scientific collecting, and surveys (collectively called "research") may be conducted throughout the Monument by independent researchers, partnering agencies, and educational groups. Research is defined as follows:

- Research: Planned, organized, and systematic investigation of a scientific nature
- Scientific collecting: Gathering of natural resources or cultural artifacts for scientific purposes
- Surveys: Scientific inventory or monitoring

R/V Onnuri researchers with USFWS Resource Monitor. Photo: USFWS

Exploration in the Mariana Arc System

Exploration and research into the deep ocean of the Mariana arc system gained momentum during the1980s with the production of large-scale mapping using multibeam and side-scan sonar, and human-occupied underwater vehicles. Research operations had a subduction zone emphasis in the 1990s, followed by both crewed and remotely-guided submersible dives as technological innovations enabled unprecedented excursions into the ocean depths.[15] Today, research in the Mariana arc system is conducted by many entities, including NOAA's Pacific Marine Environmental Laboratories (PMEL), the USGS, several universities, and foreign institutions and agencies.

Research on the namesake feature of the Monument, the Mariana Trench, has been limited due to the extreme pressure that occurs in the ocean depths, the technological constraints of equipment, and the high cost of working in these extreme conditions. The first trip to Challenger Deep was in January 1960 by the bathyscaphe *Trieste*, which was crewed by Lt. Don Walsh of the U.S. Navy and Jacques Piccard.[16] Film director and inventor James Cameron made the descent in 2012 aboard the *Deepsea Challenger*. Caladan Oceanic explorer Victor Vescovo piloted a series of expeditions on the *Limiting Factor* in 2019–21, including dives by the first woman, astronaut, and oceanographer Kathy Sullivan; Kelly Walsh, the son of Lt. Don Walsh; and Micronesian scientist Nicole Yamase, the first Pacific Islander to visit Challenger Deep. Caladan Oceanic is a private company dedicated to the advancement of undersea technology and supporting expeditions to increase the understanding of the oceans. Other expeditions have occurred in the Trench via remotely operated vehicles and unmanned landers that reach the seafloor and can collect data with automated instruments.

Research covering other areas of the Mariana arc system (i.e., magmatic arc, back-arc, forearc) spans a variety of subjects, from the geology of vents and seeps to the composition of chemosynthetic biological communities. Trench research includes geological aspects and processes, as well as recent increased interest in bacterial life forms that support chemosynthetic communities and may hold answers about the origins of life. The waters of the Mariana Arc are unique among ocean ecosystems and offer immense opportunities for new knowledge to emerge across disciplines.

Quest 4000 ROV for deep-sea exploration. Photo: NOAA

Multibeam mapping and 41 ROV surveys were conducted in 2016 from NOAA ship *Okeanos Explorer* during three legs of the "Deepwater Exploration of the Marianas." The dives included the exploration of hydrothermal vents, extinct calderas, and deep-sea coral habitats. This cruise also investigated previously unexplored areas in the northern part of the trench. Collections targeted specimens that were potential new species and/or new records expanding the range of existing species, such as a new species of primnoid coral, *Macroprimnoa ornata* and seven new carnivorous sponges.[17, 18] The records of observations of deep-sea corals and sponges and other findings are published in the *Deep-Sea Coral Research and Technology Program 2020 Report to Congress*.

Need for Action

The need for exploration and research (E&R) in the Monument stems from the need to understand the natural processes at work and how these processes will affect Monument resources. Research can inform management actions, assist in tracking resilience of the Monument resources, and help coastal communities prepare adaptive mitigation measures to protect their coastlines. The oceans are negatively impacted by rising temperatures, SLR, and changes in the physical and chemical composition. Researchers recording marine species' responses to a rapidly changing environment have observed shifts in the ranges and

numbers of certain marine species populations.[19] These trends are expected to increase as ocean temperatures rise and cause greater variation in migration patterns, isolation of population segments, and even elimination of species from parts of their range.

Coral reef ecosystems appear to be particularly vulnerable to the rapid changes occurring in the ocean. Research indicates that rising ocean temperatures are responsible for coral bleaching events, which have significantly affected coral habitats worldwide. The vulnerability of coral reefs is important because they are the foundation of tropical nearshore ecosystems and protect islands from the surrounding ocean. Protecting coastlines will become an even bigger problem as the ocean continues to warm. It is likely that warmer ocean temperatures will result in an increase in the frequency and intensity of tropical storms. Powerful, more frequent storms, coupled with SLR, may have potentially devastating impacts on coastal communities because of the damage from strong winds, storm surges, and the beach erosion that generally accompanies these events.

Rising sea levels have begun to inundate low-lying areas around the world, displacing residents of coastal communities and causing the loss of unique coastal habitats. Another likely effect of SLR is the "drowning" of many coral reefs. Most coral species have a narrow depth tolerance, the depth that provides the optimum wavelength of light for their life-sustaining photosynthetic algae. If sea levels rise faster than corals can grow, they may find themselves in depths where the wavelength of available light is insufficient for photosynthetic activity.

Globally, fish provide 3 billion people with nearly 20% of their daily protein intake and 4.3 billion people with approximately 15% of their daily protein intake.[23] Much of the protein consumed around the world comes from nearshore coral reef habitats, especially reefs that sustain subsistence-based communities. When a coral reef dies, there is always a corresponding loss in the associated marine life. This loss results in a reduction in resources available to those most vulnerable people, fishing communities whose diets, traditions, and economies are integrally tied to coral reefs.

Association with Other Regional Science and Management Plans

The *Comprehensive Wildlife Conservation Strategies* and subsequent *Wildlife Action Plans* for CNMI and Guam identify the species of greatest conservation need in the region of the Monument from a local perspective. The marine environment is of utmost importance to the residents of CNMI and Guam. Many of the species appearing on the list of species of special concern are there at the request of the public. These species, along with T&E species, have been identified as conservation targets for the Monument.

Many of the strategies and activities in this Action Plan are designed to understand the changing marine environment and complement coordination efforts with the PIFSC and local government agencies in CNMI and Guam. The PIFSC regularly prepares five-year science plans, which have the goal of describing and prioritizing research needs for the Mariana Archipelago. In addition, the PIFSC prepares regional science implementation plans. The *Marianas Archipelago Ecosystem Action Plan 2014–2019* and the *Marianas Trench Marine National Monument Ecosystem Implementation Plan* addressed science needs and support management decisions throughout the Mariana Islands.

The activities in this plan are consistent with the PIFSC science plans to assist with managementdecisions guidance. Common research themes between the PIFSC plans include collecting oceanographic, biological, and geochemical data; conducting assessments and surveys of the marine resources in the Monument; identifying and implementing novel approaches to research or management; and identifying opportunities to partner with the scientific community and the public.

E&R Objective: Offer society a deeper understanding and breadth of knowledge about the complex ecosystems and physical, geological, and biochemical processes of the Mariana Trench Marine National Monument through scientific exploration and research, while ensuring Monument resources are not degraded.

E&R Strategy 1: Work with partners to assess the current state of knowledge about the resources in the Monument and prioritize research to fill in the gaps. An assessment will be performed to determine data currently available on the resources in the Monument, and to identify areas where information may be missing. By gaining an understanding of the information available currently, Monument managers will be better equipped to manage the resources of the Monument and will be able to identify areas to focus efforts on filling information gaps.

E&R Activity 1.1: Complete a review of the current scientific literature for research that has occurred in the Monument and make it available to the public on an appropriate internet site(s). A literature review will help to guide future research by allowing Monument managers to determine where exploration and research has taken place in the past. This understanding will also help to protect the resources by identifying those areas that have been the subject of repeated efforts and those areas where information is lacking.

E&R Activity 1.2: Review current data to determine the abundance and distribution of marine resources and the location of geological features found in the Monument. Accurate data on the abundance and distribution of marine resources and the geological features of the Monument will help guide future management efforts by identifying those resources or areas that are at greater risk from permitted activities or from outside influences. Hydrothermal sites, in particular, need consideration for protection from potentially destructive sampling activities.

E&R Activity 1.3: Collect available spatial data sources to determine the distribution of the habitats, geological features, and biological resources. The available spatial data on the Monument's resources and features will be collected and made accessible to the scientific community and the public through an appropriate website. Spatial information is a valuable tool in resource management since it is readily understandable and transferable. Long-term spatial data sets provide insights to trends on expansion or contraction of the distribution patterns of habitats and biological resources in the Monument.

E&R Activity 1.4: Conduct a vulnerability assessment to understand potential climate change scenarios. A basic vulnerability assessment will be performed for the Monument, where the sensitivity, exposure, and adaptive capacity of species and systems are examined. *A Framework for Vulnerability Analysis in Sustainability Science* provides a basic outline for an assessment and pinpoints the essential components that should be analyzed to determine vulnerabilities in an ecosystem.[20] This document will be used as a template to inform the assessment. Identifying vulnerabilities is important, as they are likely to occur, will occur in the shortest timeframe, and can lead the loss of key ecosystem structures or function.

E&R Strategy 2: Work with partners to study, explore, and conserve the features and resources of the Monument. Future exploration and research in the Monument will be essential for the proper care and management of its resources and features. Monument managers will assist with the efforts of our partners to study and explore the Monument and then use that data and information to direct our efforts at conservation and preservation of the resources and features within its boundaries.

E&R Activity 2.1: Work with partners to conduct scientific studies on the characteristics of the Monument's unique processes and resources. Many of the features and resources of the Monument are rare outside its boundaries, so data is limited. This lack of data can make it difficult to properly manage these features and resources. Because many of these features are inaccessible (depth) or isolated (distance), future research will require careful planning. Hadal exploration is dependent on the availability of specialized deep-sea underwater vehicles. Monument managers will identify ways to assist efforts to study and explore within the Monument.

E&R Activity 2.2: Work with partners to characterize the ocean basins and resources in the Monument. Ocean basins are the section of the seafloor that extends seaward from continental margins. Ocean basins make up about 70% of the seafloor and cover about half of Earth's surface. Because of their distance from shore, and the depth below sea level, the basins house much of the unexplored parts of the ocean. Likewise, the resources that exist there are largely unknown. However, exploration in these deeper environments is becoming more frequent as technological advances make it feasible. Monument managers will work with partners and researchers to identify features and resources in the seafloor.

E&R Activity 2.3: Characterize geological, physical, chemical, and biological ocean processes, communities, and environments. One primary condition for successful resource management is that managers must clearly understand the extent of the resources for which they are responsible, the environments that are present for those resources, and the factors that impact both. Research that investigates the Monument's biological and physical environments will be prioritized so that managers can make informed decisions regarding Monument resources living at various ocean depths.

E&R Activity 2.4: Develop a georeferenced system of documentation that tracks the locations and types of exploration and research activities in the Monument. Tracking the location and type of activities through a georeferenced database will aid in the management, monitoring, and coordination of scientific exploration and research. In particular, the datasetscould be quickly sourced, areas of potential duplicate effort identified, and cumulative impacts evaluated over time. Data obtained will provide information on the nature, extent, and location of research projects. Such a database could also be used to inform outreach activities through the generation of summary reports and maps.

E&R Activity 2.5: Identify and establish long-term study sites at appropriate locations within the Monument. Monument managers will work with researchers to establish appropriate study sites and assist in efforts to conduct consistent observation and data collection over long periods of time. Long-term data series are important in identifyingenvironmental trends, especially as they relate to large-scale events such as global warming and ocean acidification. The remote ecosystems in the Monument can serve as baseline study sites against which other more heavily impacted areas can be compared.

E&R Activity 2.6: Locate areas within the Monument that demonstrate the potential for climate change resilience. Some areas of the Monument may be less affected by climate change. The lack of human presence there contrasts with the neighboring, more populous southern islands. Thus, the Monument may serve as a comparative example of a healthy ecosystem or a potential bank of resources.

E&R Strategy 3: Work with partners to identify opportunities to implement novel approaches to manage the Monument and find ways to further collaboration with the scientific community and the public. Properly exploring, monitoring, and conserving the features and resources of the Monument will require adopting new or novel approaches, continuing our collaboration with existing partners, and cultivating new ones. Monument managers will identify and implement ways to use innovative technology, traditional knowledge, or any other viable method that can be used to successfully manage the Monument.

E&R Activity 3.1: Convene a team of technical advisors who can aid Monument managers in the evaluation of research proposals and management activities. Much of the scientific research in the Monument is cutting edge; never-before explored sites in the Trench Unit/Refuge and Volcanic Unit/Arc of Fire Refuge are being researched using advanced technology. To evaluate potential impacts and better understand management applications, the MMCT will convene a team of technical experts.

E&R Activity 3.2: Convene a working group to identify key climate change research questions. Research and monitoring data needed to effectively plan for climate change will be identified through a working group that will identify key research questions. A potential question for the working group to address is whether the proper climate change indicators are being measured at the needed intervals and locations.

E&R Activity 3.3: Consider establishing sites where only low-impact research would be conducted to maintain ecosystem integrity. Monument managers, in conjunction with the team of technical experts, may determine that setting aside certain areas (such as a vent site in the Volcanic Unit/Arc of Fire Refuge) for low-impact research is optimal for conservation and sustainable-use purposes. Setting aside certain areas would apply the precautionary approach (that is, erring on the side of caution) to preserving these unique ecosystems.

E&R Activity 3.4: Identify opportunities to use advanced underwater technologies such as ROVs, autonomous underwater vehicles, and ocean gliders to increase the pace, scope, and efficiency of exploration and research. Although research ships are the most recognizable platforms for accessing isolated sites; cost-effective technological innovations are providing researchers with unprecedented access and allow for long-term observation. Some of these innovations include stationary observation systems (moorings and bottom-supported platforms) and mobile observation systems (ROVs, autonomous underwater vehicles, drifters, gliders). These cutting-edge technologies are alternatives to the standard platforms commonly used for research purposes in the past.

E&R Activity 3.5: Pursue opportunities to support marine science career paths for local students. The monument managers will pursue opportunities in collaboration with the CNMI Government and MTMAC to assist with meeting research goals and supporting a marine biology career path, building local capacity to become future resource managers.

Mural at Tanapag Elementary School, Saipan, depicting Carolinian culture. Photo: Pacific Worlds

2.2.12 Cultural and Maritime Heritage Action Plan

Introduction

Cultural and maritime heritage are a legacy of the connection between people and the ocean. Cultural and Maritime Heritage (CMH) activities seek to preserve and protect valuable historical, cultural, and archeological resources within the marine environment. Cultural and maritime heritage encompasses not only physical resources, such as historic shipwrecks and prehistoric archeological sites, but also archival documents and oral histories. It includes the stories of indigenous peoples who have lived and used the ocean for thousands of years. The study of CMH adds an important dimension to the understanding and appreciation of historic and present-day ocean customs in the CNMI and Guam.

A brief overview of cultural and maritime history of the CNMI and Guam is included in Chapter 5. More detailed reports are available in other reference documents. *Maritime History and Archaeology of the Commonwealth of the Northern Mariana Islands* was prepared under contract for the CNMI Government in 2009.[3] Funding was provided by a Historic Preservation Fund Grant, administered by the National Park Service (NPS). *Micronesia: Submerged Cultural Resources Assessment* documents these resources across the Mariana Archipelago. Additional research is needed for us to better understand the CMH specific to the Monument. To assist with the MCH analysis and surveys, the NOAA Office of National Marine Sanctuaries, Maritime Heritage Program staff will provide expertise and support. The program staff provide stewardship and maritime heritage resource compliance at 13 National Marine Sanctuaries and will work in partnership with Monument managers to implement the management strategies and activities.

Need for Action

Fishing traditions associated with the Monument waters are well documented and actively practiced among the CNMI and Guam communities.[25] Threats to maritime cultural resources include both inadvertent damage (e.g., accidental anchor damage) and intentional damage (looting, theft). Monument managers need to identify activities that have the potential to harm, destroy, or diminish the value of these resources and take steps to ensure that activities are managed to protect and preserve the Monument's heritage resources. There is also a need to encourage traditional knowledge of maritime heritage among the Chamorro and Carolinian communities in the CNMI and Guam so that the unique characteristics of a long and rich CMH are maintained.

CMH Objective: Protect and preserve historic resources and encourage the continuation of maritime cultural connections to the Monument.

CMH Strategy 1: Collaborate with Chamorro and Carolinian communities, the CNMI Division of Historic Preservation Office, the Guam Historic Resources Division, and other interested groups to identify the indigenous and colonial CMH resources related to the Monument. In close coordination with the SHPOs for CNMI and Guam, Monument managers will work with cultural practitioners and scholars to identify and characterize the CMH of the Monument. This research will be used to assess the potential locations of submerged vessels, aircraft, and artifacts that may exist in the Monument. Field surveys to document and inventory the physical maritime heritage sites will be conducted to evaluate the condition of identified resources. These physical site surveys will be planned in conjunction with other research operations in the Monument. Oral histories and interviews may be conducted to learn more about the maritime heritage of the Monument region.

CMH Activity 1.1: Establish partnerships with indigenous communities to conduct culturally appropriate maritime heritage research and activities. In close coordination with the SHPOs for CNMI and Guam, a partnership will be proposed with the indigenous communities to jointly identify and characterize the cultural heritage resources within the boundaries of the Monument. Should these communities agree to engage with Monument managers in such a partnership, information collected through this collaborative effort regarding places with indigenous cultural significance will be subject to plans or agreements that address public access, confidential treatment of certain information (which will be reflected in the publicly available inventory and characterization), and cultural proprietary information belonging to the indigenous communities. This collaborative process will guide and inform preservation and management decisions.

CMH Activity 1.2: Connect with agencies managing the Maritime Heritage Grants program to determine eligibility for funding and seek out nonfederal interest groups (NGOs and universities) for potential research projects. The U.S. Maritime Administration (an agency of the U.S. Department of Transportation) and the NPS administer the National Maritime Heritage Grants Program within the DOI. The agency provides funding for education and projects designed to preserve historic maritime resources and to increase public awareness and appreciation for the maritime heritage of the United States. The grant is funded through a percentage of the proceeds from the sale or scrapping of obsolete vessels of the National Defense Reserve Fleet. All grants awarded must be matched on a 1-to-1 basis with nonfederal assets.

CMH Activity 1.3: Identify, characterize, and inventory CMH resources located in the Monument using a GIS-based inventory program. Monument managers will partner with interested parties to conduct an in-depth literature review of documents that cite shipwrecks, historical voyages, and ocean trade routes where maritime heritage sites might be partially or completely submerged within the Monument boundaries. This process entails a review of oral history accounts and seabed mapping and/or other remote survey information that has been collected for the submerged lands. The University of Guam (UOG) and other institutions with a Marine Archeology program may be a good source for enthusiastic researchers.

A study of seafaring voyages throughout the Pre-Latte, Latte, Spanish, German, Japanese, and American periods to identify migration patterns and navigational methods associated with the Monument waters will be conducted in close collaboration with the SHPOs for CNMI and Guam, researchers, and cultural experts. This process will include archival research; a literature review; and oral history interviews with elders, scholars, practitioners, and navigators, with a particular emphasis on Chamorro and Carolinian voyage routes that may have included passage through what is now the Monument.

CMH Activity 1.4: Develop a CMH preservation and protection program for the Monument. Following the identification and characterization of maritime heritage resource sites, a program plan will be developed in close coordination with the SHPOs for CNMI and Guam. Collaboration with the indigenous communities to establish policies and strategies for the preservation, protection, and management of these resources will be vital. The program plan will include, but not be limited to, an analysis to determine if the resources are historic and eligible for listing in the National Register of Historic Places. The preferred policy option will be preservation in situ, as recommended by the United Nations Organization for Education, Science and Culture (UNESCO) Convention on the Protection of the Underwater Cultural Heritage (2001), which defines in situ protection as "the preservation of underwater cultural heritage sites in its original location."

Research will be planned to determine whether the site should be preserved in situ or whether all or portions of the site should be subject to recovery in accordance with federal archaeological program standards and requirements. This will be consistent with Section 110 of the NHPA, and the analysis will comply with 36 CFR Part 800 "Protection of Historic Properties" and include cultural consultations with Chamorro and Carolinian community members so that cultural protocol is followed, and indigenous points of view guide the process of handling items of material culture if any are in the Monument. If the analysis finds that a portion of these resources are suitable for recovery, plans and cost estimates to carry out retrieval work will be prepared.

CMH Activity 1.5: Develop a culturally appropriate and inclusive naming process. In coordination with the local community and cultural experts, Monument managers will develop a process to consider and officially designate a culturally appropriate name for the Islands Unit and work with both scientists and the community to name new features discovered within the Monument boundaries.

CMH Strategy 2: Facilitate the development of interpretive programs on cultural and maritime heritage. In close coordination with the SHPOs for CNMI and Guam, Monument managers will collaborate with scholars and navigators who know the Mariana waters, as well as educators in the Mariana Archipelago, to develop a CMH interpretive program featuring a range of education materials and outreach events about the Monument's maritime traditions. The interpretive program will be made available to the visitor contact stations.

CMH Activity 2.1: Prepare educational materials to augment CMH programs. Monument managers will facilitate the development of educational materials featuring the maritime heritage associated with the Monument to augment existing National Maritime Heritage programs. Cultural connections such as the navigational history, migration patterns, fishing patterns and ocean-related material culture between the residents of the Mariana Archipelago and the Monument region will be highlighted.

CMH Activity 2.2: Coordinate CMH outreach programswith educators and community organizations. Monument managers will collaborate with educators and community organizations in the development of CMH outreach programs for audiences of all ages. The purpose of this activity is to engage diverse Mariana communities in the maritime heritage of their region.

2.2.13 Ocean Literacy, Environmental Education, and Public Outreach Action Plan

Introduction

Ocean literacy is defined as an understanding of the ocean's influence on you and your influence on the ocean. Developing ocean literacy requires a place-based approach that highlights existing ocean knowledge within a community and offers new knowledge about the ocean to be discovered through intergenerational and interdisciplinary engagement. Ocean literacy encourages localized public involvement, supports existing connections held by a community to the ocean, and aims to strengthen those connections to the ocean through education and outreach programs.

Environmental education is defined as a process designed to teach citizens and visitors the history and importance of conservation and the biological and the scientific aspects of our nation's natural resources. Environmental education can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively towards the conservation of the Nation's environmental resources.

Public outreach is two-way communication between Monument managers and the public to promote involvement and influence attitudes and actions with the objective of improving joint stewardship of our natural and cultural resources. Outreach includes but is not limited to the following:

- Community relations and public involvement
- Local government relations (including territorial wildlife agencies)
- Relations with federal partner agencies
- Congressional relations
- News media relations
- NGOs and corporate relations
- Relations with constituent groups
- Environmental education and interpretive activities
- Traditional public information activities such as workshops and open houses
- Information products such as brochures, leaflets, exhibits, and videos
- Websites, distance learning programs, and social media

Monument managers have an important role as facilitators in the exchange of interdisciplinary knowledge through a variety of programs that benefit CNMI, Guam, and the broader Pacific region. While the Monument is part of national heritage, the Monument is also part of local communities. Monument staff, volunteers, and partners should design programs to reflect community values and traditions that align with and/or complement agency missions. What connects one person or a small group to the natural world might not hold true for others. The need to respond to how people want to learn about ocean stewardship should include the use of new technologies to complement the program effectiveness.

Formal and informal education coupled with outreach opportunities for people of all ages is instrumental to cultivating ocean literacy among members of the public so they can make informed decisions specific to their region. Much can be learned from the time-tested ocean knowledge held by the people of the Mariana Archipelago, as well as the scientists conducting research. Creating the space for diverse communities to come together and exchange knowledge about the ocean will open a dialogue for collaborative resource management. A shared motivation to interact sustainably with the marine environment can serve as a foundation for new partnerships and community-driven initiatives. Additionally, Monument programs should build relevant connections to people within their communities.

Need for Action

In addition to public scoping sessions held on Guam, Rota, Tinian, and Saipan in 2012, several teacher workshops and virtual community meetings held in 2021 confirmed the local interest in participating in management decisions and activities. They want to see increased dialogue between management agencies, NGOs, and community members. This requires Monument managers to engage with other natural resource managers, environmental advocacy groups, and educators in the development of public materials and programs and to use visitor contact stations or "informational hubs" to offer public ocean literacy programs, environmental education, and interpretive information.

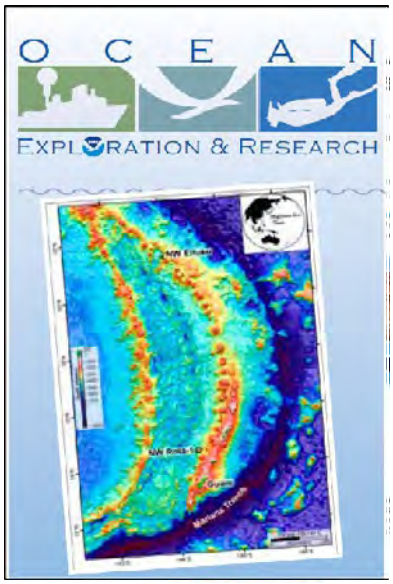
Although physical access to the Monument is logistically challenging, access to information about the Monument region should be available to link the Monument to the nearby communities. The Mariana Archipelago's inhabitants have a long history with the Monument region, and it should remain a part of their cultural heritage. Monument managers can contribute to this process by providing meaningful information to the public and engaging the public in research endeavors. The health of Monument ecosystems depends on healthy interactions between humans and the natural environment. It is crucial for Monument visitors, such as fishers, tourists, water sport enthusiasts, and researchers, to be aware they are in a national marine monument and to know appropriate and prohibited activities. One effective way to achieve voluntary compliance is to provide people with enough information to make responsible environmental decisions.

The Ocean Literacy Campaign

Along with economic potential, ocean literacy programs contribute to the diversification of ocean sciences through the inclusion of multiple perspectives. The Ocean Literacy Campaign began with a collaboration between hundreds of scientists and educators and has published a collection of educational resources for grades K–12.[30] Coastal communities in the United States have assumed the responsibility of producing localized resources for students growing up around specific ocean environments. Because the frame of reference for islanders in CNMI and Guam will be different than that of people in the continental United States, there is a need to embrace local ocean knowledge and support the continued application and evolution of indigenous knowledge for the success of an ocean literacy program in the region.

Environmental Education

A quality environmental education program is a vital component of achieving the Monument's goals. Inviting the public to learn more about wildlife conservation and ocean stewardship helps them become better stewards wherever they reside. Environmental education programs are designed using the foundation of a course of study, such as several lectures about a subject, or a series of such courses constituting a curriculum. Examples of courses of study that will meet the education objectives of the Monument and students may include, but are not limited to, teacher professional development, community-based service organization programs, youth group merit/activity badge requirements, summer camp themes, and adult lifelong learner seminars. Environmental education is integrated with formal school curricula that achieve specific commonwealth, territory, state, and district standards, including a plan of instruction that details what students need to know, how they will learn the material, what the instructor's role is, and the context in which the teaching and learning take place.



Ironman Expedition Education Module, Submarine Ring of Fire 2014.

Public Outreach

Monument managers will seek to connect local communities, visitors, and the public to the natural and cultural resources of the Monument to foster appreciation and understanding. The most significant challenge is to adapt programs and delivery modes to the continually changing cultural demography. Programs and materials should be relevant to diverse audiences with varied values, beliefs, and attitudes about wildlife conservation. Public outreach efforts should facilitate awareness and provocation on many levels, from complex topics like climate change to more basic concepts, such as how healthy oceans matter to us as individuals and as a nation. The use of indigenous language in reporting, planning, place names, and other documents will help to weave co-stewardship into public outreach.

OEP Objective: In collaboration with partners, develop high-quality ocean literacy, environmental education, and interpretive programs to share information about the Monument ecosystems and geologic features to diverse audiences locally and across the Nation.

OEP Strategy 1: Engage educators and organizations in the CNMI and Guam to support ocean literacy. Pooling available resources between multiple agencies and organizations is the most feasible method to support an ocean literacy program. This approach will eliminate duplicate efforts and increase the momentum of existing initiatives. The UOG Sea Grant, in partnership with the Western Pacific Coral Reef Institute, has developed a cross-disciplinary education curriculum for ocean and environmental literacy for the Guam Department of Education. Monument managers will work in tandem with existing programs at the National Sea Grant Office and the Northern Marianas College to maximize resource efficiency.

> **OEP Activity 1.1: Identify potential CNMI and Guam-based educators to establish a network of ocean literacy products and material contributors.** Monument managers will identify potential education and outreach partners, including organizations based in the CNMI and Guam, keeping in mind the need to attract diverse skill sets and funding sources to the program. Then, agency staff will engage potential partners, such as the International Pacific Marine Educators Association and Island Earth, to design a network of ocean literacyand environmental education contributors.
>
> **OEP Activity 1.2: Identify gaps in ocean literacy and ocean resource-related environmental education programs and seek ways to contribute resources to existing programs.** This will be a collaborative effort with regional educators to assemble an inventory of ocean literacy and environmental education activities already available in CNMI and Guam. Based on the inventory, Monument managers and partners can assess information gaps and propose a course of action to address the gaps and seek ways to contribute resources to existing programs.

OEP Strategy 2: Collaboratively develop curriculum for the Monument and Mariana Archipelago that incorporates traditional knowledge of the Carolinian and Chamorro communities. Ocean literacy proponent Craig Strang describes the need for ocean science disciplines and materials to embrace indigenous perspectives: "*Ocean Literacy needs to be redefined to include Traditional Knowledge and youthful perspectives about the ocean. By 'Traditional Knowledge' I do not mean the secret and private knowledge that indigenous people may not want to share with outsiders, but rather I mean the universal and transcendent knowledge that indigenous people wish that all people could understand – the essential things critical to sustaining the ocean and us*."[32] This strategy focuses on the development of curriculum using and/or modifying existing resources and producing new resources that accurately incorporate Chamorro and Carolinian ocean knowledge.

OEP Activity 2.1: Determine which materials should be incorporated into ocean literacy, environmental education, and public outreach programs. This means identifying existing materials and determining which ones need modification to include the Mariana Archipelago and Monument references and which new education and outreach products should be developed. Educational materials have been developed for grade levels 5–12 on climate change, energy, and marine ecosystem health with the *Okeanos Explorer* expedition findings.

OEP Activity 2.2: Increase collaboration and indigenous language usage through the use of indigenous place names, planning, and outreach. The *Okeanos Explorer*, *Ocean Literacy Essential Principles and Fundamental Concepts* will be adapted to reflect indigenous associations with the ocean and allow learners to communicate about the ocean in meaningful ways through Chamorro and Refaluwasch references. Monument managers will engage educators, Chamorro, Refaluwasch, and Tagalog language experts, and cultural advisors in the local communities for their guidance and content expertise to meet the needs of local residents.

OEP Activity 2.3: Develop educational products featuring the Monument's unique resources to bring the Monument to the CNMI and Guam communities. Future exploration and research will reveal new information about the mysteries of the Mariana Trench and seamounts. Findings such as these will increase collective knowledge about ocean, marine life, and climate phenomena. In collaboration with stakeholders and research partners, a variety of media will be developed to share information about Monument resources and provide access to findings from research conducted throughout the Monument.

OEP Strategy 3: Provide quality environmental education and ocean literacy programs for Mariana Islands residents and visitors, complemented with distance learning tools and novel delivery tools.

OEP Activity 3.1. Identify where ocean literacy programs should be targeted to maximize community participation. Monument managers and educator partners will identify audiences where environmental education and ocean literacy programming efforts should be emphasized and provide or develop appropriate programs to reach these audiences. Monument staff will invest in training and professional development opportunities for local educators, staff, and volunteers to strengthen the quality of programs offered.

OEP Activity 3.2: Identify appropriate distance learning tools and integrate new media/ technology delivery methods. A variety of delivery modes will be offered to maximize program reach, designing products to be accessible to the broadest range of users, including virtual fieldtrips, podcasts, interactive webcams, and social media apps. Due to the remote location of the Monument, web-based and mobile platforms are a critical component to reach multiple audiences effectively. Interactive kiosks will reach distant audiences. Initial locations for information delivery will include the Monument visitor contact stations on Saipan and Guam.

OEP Strategy 4: Establish a visitor contact station where the collective story of the Monument ecosystem is told through imagery, sounds, artifacts and scheduled programming developed for educators, students, residents, and visitors. Visitor contact stations should provide outlets for Monument-related information. Stations will provide the opportunity for people to learn about the unique cultural, geological, volcanic, and biological features of the Mariana Archipelago and the Monument.

OEP Activity 4.1: Monument managers will continue to grow/expand Monument visitor contact station(s) in the CNMI and Guam and provide support and guidance as resources permit. Monument support staff will provide technical expertise to establish training for Monument visitor contact station staff and volunteers. Sustainable funding options will be explored for ocean literacy and environmental education programs to be conducted by volunteers and local educators.

OEP Activity 4.2: Develop an education and outreach ocean literacy program in partnership with Monument managers and local community experts. Incorporate multimedia formats, such as three-dimensional models of Monument areas, educational DVDs, historical photographs, artifacts, and TED-style talks as part of an interpretive exhibition program. Programs and materials will be provided in the languages spoken locally in the CNMI and Guam.

OEP Strategy 5: Promote ecotourism, recreational, and economic ventures that are compatible with Monument ecosystems in collaboration with the Marianas Visitors Authority, Northern Islands Mayor's Office, and other partners. The Proclamation directs Monument managers to assess tourism, recreational, and economic opportunities. No extractive practices that result in appropriation, injury, destruction, or removal of any feature of the Monument are allowed except for scientific exploration and research, where incidental appropriation, injury, destruction, or removal of features may be permitted.

OEP Activity 5.1: Establish guidelines and protocols for sustainable tourism and related economic ventures within the Monument. Monument managers will develop protocols for business operators, so business activities do not adversely affect Monument ecosystems. Once developed, these guidelines and protocols will be available on agency websites and at CNMI and Guam visitor contact station locations. The purpose of providing guidelines and protocols is to enable public and private sector industries an opportunity to create sustainable business models that are consistent with marine conservation and ocean literacy and to stimulate and support viable, sustainable economic ventures that are compatible with the Monument.

2.2.14 International Collaboration

Introduction

Oceans cover nearly three-fourths of Earth's surface; moderate climate, weather, and atmospheric conditions; produce food to feed people; and support economies around the world. Governments collaborate on ocean policy and resource management issues for the sustainable use and protection of the ocean for future generations. International conservation efforts are important to U.S. national security and economic interests because a degraded environment weakens communities and sets the stage for political instability and conflict. The United States participates in several international initiatives that are committed to marine and coastal resource protection. These initiatives include the following.

Our Ocean, Our Future: Call for Action

The 2017 United Nations Ocean Conference was held at U.N. headquarters in New York. The outcome document, *Our Ocean, Our Future: Call for Action*, set a global path to sustainable management and conservation of our oceans, seas, and marine resources. There are nine Communities of Ocean Action:

- Coral reefs
- Implementation of international law, as reflected in United Nations Convention on the Law of the Sea
- Mangroves
- Marine and coastal ecosystems management
- Marine pollution
- Ocean acidification
- Scientific knowledge, research capacity development and transfer of marine technology
- Sustainable blue economy
- Sustainable fisheries

The Secretariat of the Pacific Regional Environment Programme

The "Pacific Ocean Research Alliance" focuses on coastal and pelagic oceans with an aim to source and provide marine data for decision makers, build Pacific capacity, and strengthen ocean-expert networks for Pacific Island members. The increase in knowledge, data, and capacity will help informed decision-making when it comes to ocean health in the region. The Secretariat of the Pacific Regional Environment Programme is also leading partner efforts on *Marine and Coastal Biodiversity Management in Pacific Island Countries and Atolls*.

Big Ocean

A network of large-scale marine protected area managers, Big Ocean's goal is to improve the effectiveness of large-scale ocean management efforts by sharing information, expertise, technologies, and resources. The 17 member sites of Big Ocean represent 10 countries and protect over 4 million mi^2 of marine space, or more than 3% of the total global ocean. The sites range from the 56,370 mi^2 Argo-Rowley Terrace Commonwealth Marine Reserve (Australia) to the 733,594 mi^2 Marae Moana marine park in the Cook Islands.

The Micronesia Challenge

This initiative was launched in 2006 by the Chief Executives of the Republic of Palau, the Republic of the Marshall Islands, the Federated States of Micronesia, the CNMI, and Guam. The Micronesia Challenge goal is to effectively manage 50% of marine resources and 30% of terrestrial resources by 2030 across Micronesia.

United States Coral Reef Task Force

The Coral Reef Task Force was established by President Clinton in 1998 through Executive Order13089 to protect, restore, and sustainably use coral reef ecosystems. The Task Force includes 12 federal agencies, seven U.S. States, Territories, and Commonwealths, and three Freely Associated States.

Submarine Telecommunications

Over 95% of international data and voice transfers are currently routed through the many fiber-optic cables that crisscross the world's seafloors. The earliest submarine cables carried telegraphic traffic. The first successful trans-Atlantic submarine cable—a simple copper wire—became operational in 1866, delivering about 12 telegraphed words per minute. As technology and laying techniques improved, the submarine network expanded greatly. In September 1956, the era of submarine coaxial telephone communication began when two coaxial cables capable of carrying multiple voice channels came into service linking London and North America. Finally, in 1988, the first transoceanic fiber-optic cable was installed linking the United States, the United Kingdom, and France. Thereafter, the number of submarine fiber-option cables proliferated, as they rapidly outperformed satellites in terms of the volume, speed and economics of data, and voice communication.

Submarine cables clearly play a critical role in global communications. For the United States, they provide connectivity between the contiguous United States and Alaska, Hawai‘i, American Samoa, Guam, the CNMI, Puerto Rico, and the U.S. Virgin Islands—as well as connectivity with the rest of the world. Submarine cables also support critical commercial, economic, and national security endeavors, and they carry a majority of civilian, military, and government offshore communications traffic. The success of submarine cables owes much to international treaties that have been negotiated since 1884. Submarine cables are also subject to domestic regulations by most nations, including the United States, which has a broad suite of domestic regulations applicable to cable laying, maintenance, repair, and removal operations.

Need for Action

The Monument protects approximately 95,216 mi^2 of submerged lands and waters. Habitats include coral reef ecosystems, volcanic islands, submarine volcanoes, geologic features, and the some of the planet's deepest ocean trenches. Diverse fisheries resources, rare and threatened marine species, corals, marine mammals, sea turtles, and seabird populations inhabit these ecosystems. The animals inhabiting this region are not confined by the Monument boundaries, which drives the need for cooperation across jurisdictions for the protection, management, and sustainable use of marine resources. Managers of MPAs everywhere are challenged with common issues such as biological monitoring, limited law enforcement, unsustainable fisheries practices, understanding ecosystem connectivity and larval distribution, marine invasive species control, marine debris removal, ecotourism development, and research and exploration. These challenges are more easily met when scientific results, problems and solutions, resources, and knowledge are shared with other ocean management practitioners and international communities.

Monument managers face many of these global MPA issues. International collaboration has the potential to improve collective knowledge about Monument ecosystems and inform management decisions to meet these global concerns. Greater collaboration between Monument managers and inter/multinational organizations will broaden our understanding of the ecosystem functions for which we are responsible, and, therefore, improve our ability to effectively manage the Monument and inform resource managers elsewhere.

IC Objective: Promote the long-term conservation of Monument resources through national and international collaboration.

IC Strategy 1: Routinely participate in national and international ocean stewardship forums to exchange knowledge and learn new MPA policies, methods, and technologies. Monument managers will participate in international professional conferences to learn about ocean management issues, methods for combatting threats, and understanding emerging technologies. By participating in international forums, Monument managers will have the opportunity to share lessons learned. Likewise, managers will gain exposure to new and diverse management approaches that maybe relevant for application in the Monument.

IC Activity 1.1: Participate in the Big Ocean network to incorporate relevant MPA management methods into Monument activities. Special expertise and experiences, emerging science, and large-scale management challenges, such as law enforcement, are common issues among the large-scale managers of the Big Ocean Network and directly applicable to effective Monument management. Sharing professional knowledge can improve management technique results.

IC Activity 1.2: Participate in the Micronesian Challenge, Coral Reef Conservation Program, Big Ocean, and other international organizations' activities. Monument managers will participate in the Coral Reef Task Force, the Micronesia Challenge, the Coral Reef Conservation Program, Big Ocean network, and other international organizations' activities (funding and travel authorizations permitting) to exchange information and promote the application of multidisciplinary approaches in MPA management.

IC Activity 1.3: Improve the coordination of environmental reviews in relation to submarine cable licenses and Rights-of-Way through the Monument across the Federal Government and, as appropriate, engage with the local community to provide comment opportunities.

IC Strategy 2: Identify international collaboration opportunities that will assist managers in maintaining or improving Monument resilience. Monument managers will investigate and pursue opportunities for collaborative research and fisheries-related activities with international agencies and organizations that may improve Monument ecosystem resilience.

IC Activity 2.1: Collaborate with international agencies that are conducting research and fisheries-related activities in and near the Monument. Monument managers will work with OPA, PIFSC, and the NOAA Office of Exploration and Research to identify international conservation projects and collaborations pertaining to the Monument. Monument managers will then engage international entities for possible research collaboration opportunities.

IC Activity 2.2: Collaborate with national research firms who partner with international research institutions. Monument managers will pursue collaborations with national ocean stewardship firms, such as Woods Hole and the National Science Foundation, that are working with international firms to expand opportunities for collaborative research and fisheries-related activities that may improve Monument ecosystem resilience.

IC Activity 2.3: Improve coordination of seabird protections in relation to fisheries management across the Federal Government and, as appropriate, engage with the international community to provide improved seabird protection in the Monument. Monument managers will engage with the international community through the following actions: 1) provide seabird population monitoring and distribution data and information regarding bycatch avoidance to fishery management partners in the U.S. Government and to other fishing nations in the region; 2) participate in multilateral organizations, such as the Agreement on the Conservation of Albatrosses and Petrels (ACAP), that engage with fishing nations and those that have breeding colonies of species listed under the agreement to coordinate activity to mitigate known threats to albatrosses and

petrels; 3) participate in the Short-tailedAlbatross Recovery Team, which has members from the United States, Japan, and Canada to disseminate information about best practices for bycatch avoidance in fisheries in the areas adjacent to the Monument; 5) participate in scientific meetings and conferences that present scientific information about the effects of climate change on marine communities that will have an impact on seabird foraging conditions in the Monument.

IC Activity 2.4: In coordination with the USCG, develop Japanese language Monument information guides for boaters and Japanese Search and Rescue units responsible for emergency response within the Islands Unit. Monument managers will work with the USCG to have boater information guides available to Japanese Search and Rescue units in the Japanese language.

IC Activity 2.5: Monitor the evolution of international treaties and BMPs for cable installation, protection, and maintenance. Monument managers will coordinate reviews and consultations for new cable installation requests. Right-of-way permits and associated environmental assessments to install submarine fiber-optic telecommunications cables require a separate NEPA process and are evaluated on a case-by-case basis.

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Carbon dioxide bubbles and a sulfur-rich cloudy plume released from a vent at NW Rota-1.
Photo: NOAA/PMEL

Chapter 3. Physical Environment

The Mariana Islands are formed by the summits of 15 volcanoes that sit atop the Mariana Ridge in the Northwestern Pacific Ocean between the 12th and 21st parallels north and along the 145th meridian east. South of Japan and north of New Guinea, they form the eastern limit of the Philippine Sea. The Mariana Volcanic Arc is part of a subduction system in which the Pacific Plate plunges beneath the Philippine Sea Plate and into Earth's mantle, creating the Mariana Trench. Six of the northern islands were volcanically active in historic times, and numerous seamounts along the Mariana Ridge are currently volcanically or hydrothermally active. The Monument includes three distinct units covering 96,714 mi^2 of submerged lands and waters in and adjacent to the Mariana Archipelago: Trench Unit/Refuge, Volcanic Unit/Arc of Fire Refuge, and the Islands Unit.

Trench Unit/Refuge. The portion of the Trench that lies within the Monument is 940 nm long and about 38 nm wide (35,720 nm^2—about the same size as the State of Mississippi). The Trench Unit/Refuge does not include the water column, consisting solely of the submerged lands that extend from the northern limit of the U.S. EEZ in the CNMI to the southern limit of the U.S. EEZ in Guam. The entire Mariana Trench stretches 1,580 miles and contains the deepest known points in the ocean. Sirena Deep is the deepest point within the Monument, measuring 6.66 miles below the ocean surface about 90 miles south of Guam.

Volcanic Unit/Arc of Fire Refuge. The Volcanic Unit/Arc of Fire Refuge in the Philippine Sea includes 21 hydrothermally active seamounts and the submerged lands in a 1 nm radius from the center of each. This Unit has intriguing environmental phenomena associated with its hydrothermal vents and is part of the "Ring of Fire," a circle of active volcanoes outlining the Pacific Ocean basin.

Islands Unit. The Islands Unit includes both the submerged lands and waters out to 50 nm adjacent to the three northernmost Mariana Islands: Farallon de Pajaros, Maug, and Asuncion. The terrestrial lands of these islands are designated as wildlife conservation areas under the jurisdiction of the CNMI Government. Three Volcanic Unit/Arc of Fire Refuge volcanoes are also within this unit: Maug, Ahyi, and Daikoku.

3.1 Geology

The Monument consists of four geological provinces with distinctive attributes: Trench, Forearc, Volcanic Arc, and Back-arc.

3.1.1 Plate Tectonics and the Mariana Trench

The Monument is in the Izu-Bonin Mariana subduction system, where the Mesozoic Pacific Plate is being subducted under the Philippine Sea Plate into Earth's mantle at a rate of approximately 1.2 inches per year.[1] These two plates form the seabed. When two ocean plates converge, the oldest, densest plate will bend beneath the edge of the younger, less dense plate and thrust downward into the asthenosphere layer of the earth's mantle toward the earth's center in a process called subduction. The older, denser Pacific Plate subducted under the edge of the Philippine Sea Plate 43 million years ago, forming the Mariana Trench, which cuts alongthe boundary between them.[2] The deepest point in the Trench is just outside the Monument boundary within the Federated States of Micronesia's EEZ, where Challenger Deep has been measured at an astonishing depth of 6.67 miles below sea level.[3]

3.1.2 Plate tectonics and the initial process of subduction

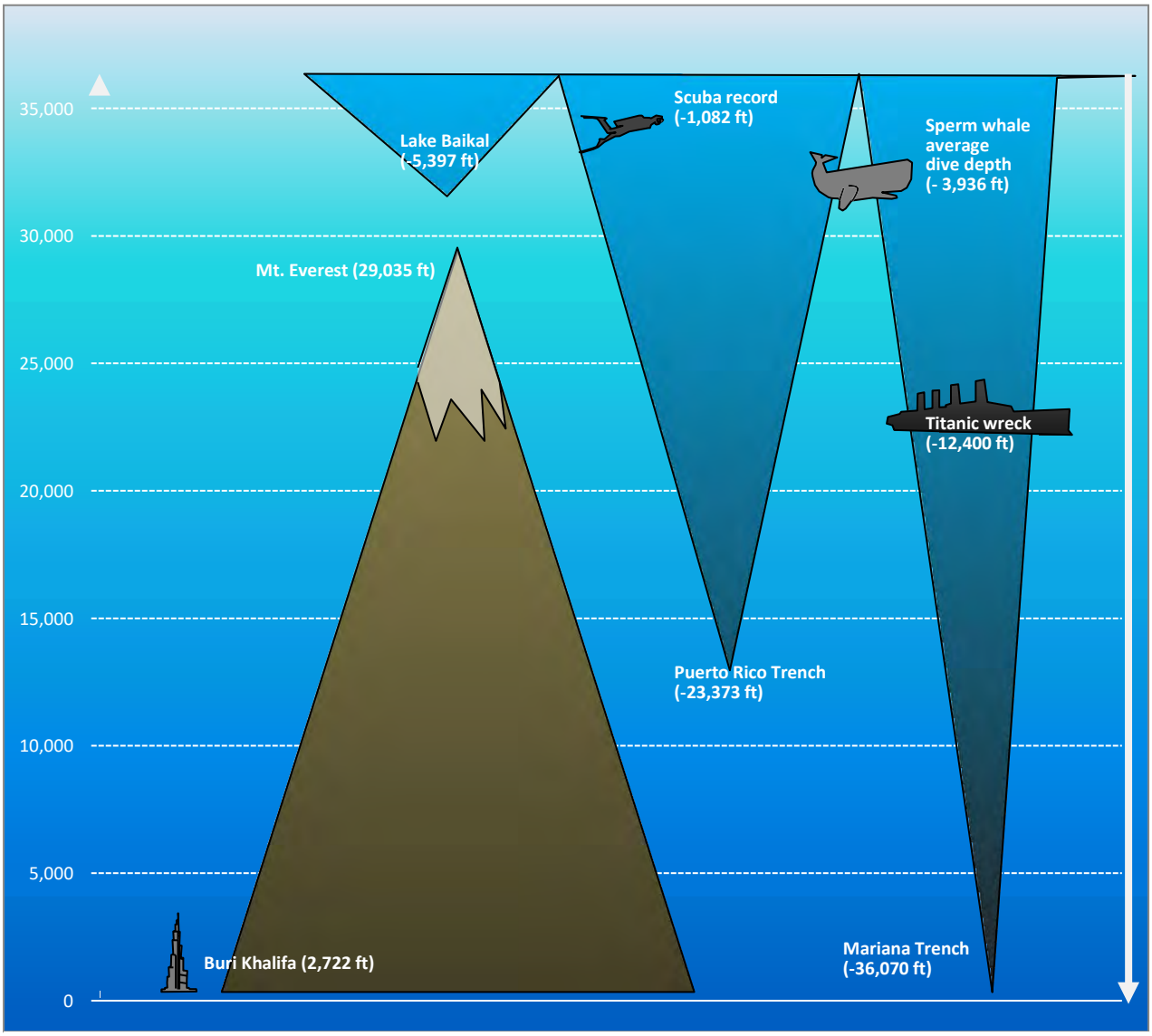
The Mariana Trench is a non-accretionary convergent plate margin, meaning the bottom of the overriding plate is in direct contact with the subducting plate, and no materials fall into the chasm—thus the Trench is not filled in by accumulating sediments. This, along with the fact that the Trench was created by the oldest Pacific Plate, helps to explain why it is the deepest of all oceanic trenches. Although very deep where the two plates collide, its deepest points occur at the junction between the Trench and the Caroline Ridge, a much younger portion of the seafloor lying to the southwest. To explain this conundrum, Fryer et al. proposed that extreme depths found in the Trench are due to a tear in the adjacent subducting Caroline Plate, causing deformation in the Pacific Plate.[4] They suggest that the subsurface tear causes unusual regional tectonics, compounding the extreme depths in the Trench.

The Mariana Trench was first identified and sampled by the *H.M.S. Challenger* expedition in 1875, producing the earliest bathymetry (underwater topography) information about the Trench.[*]

This was the first British expedition devoted to the purpose of scientific exploration. Their mission was to:

- Investigate the physical conditions of the deep-sea regarding depth, temperature, circulation, gravity, and penetration of light.
- Determine the chemical composition of seawater at various depths, the organic matter in solution, and the particles in suspension.
- Ascertain the physical and chemical character of deep-sea deposits and the sources of these deposits.
- Investigate the distribution of organic life at different depths and on the deep seafloor.[5]

[*] H.M.S. in the name "*H.M.S. Challenger*" stands for "Her/His Majesty's Ship" and is a prefix attached to all ships in the British Royal Navy fleet.



Depth of the Mariana Trench compared to other records: the deepest depth reached by humans using scuba, the deepest diving marine mammal, the wreck of the Titanic, the Puerto Rico Trench, the deepest fresh-water lake (Baikal), the highest mountains on Earth, and the tallest human-made structure. Source: NOAA

The *H.M.S. Challenger* used three data gathering techniques: sounding, dredging, and temperature reading. The crew documented an unprecedented ocean depth of 4,475 fathoms (roughly 5 mi) in the Trench on March 23, 1875.[6] The survey site was initially named the Swire Deep after Herbert Swire, a navigating sublieutenant aboard the *H.M.S. Challenger*, until the crew returned to England when the site was later renamed the "Challenger Deep" after the ship.[7] Since 1875, researchers have plummeted to even greater depths. Bathymetry maps have generated a clearer picture of the submerged lands within the Monument and its surrounding areas. Challenger Deep, which is just outside the Monument, has been recorded at varying measurements both for its depth and exact location. A recent bathymetric survey measured Challenger Deep at 6.67 mi below sea level at latitude 11°22.927" N and longitude 142°26.258" E. Sirena Deep is 6.66 mi below sea level.[3] Because of these extremely deep features and the rugged terrain, the Mariana Trench is considered "one of the roughest patches on the Earth's skin."[8]

Sirena Deep was initially named HMRG Deep after the Hawai'i Mapping Research Group team that first identified it on research cruises from 1997–2001. Marine geologist Dr. Patricia Fryer held a competition

among students from Guam and CNMI to rename the HMRG Deep, with the winning name submittedby Jermaine Sanders and John Meno. It was officially renamed Sirena Deep after a legendary figure in Mariana history who was transformed into a mermaid (and is believed by some to still inhabit the deepest parts of the ocean).[9]

In 2016, NOAA's *Okeanos Explorer "*Deepwater Exploration of the Marianas" encompassed bottomfish habitats, new hydrothermal vent sites, mud volcanoes, deep-sea coral and sponge communities, seamounts, subduction zone, and Trench areas. New seamounts and geologic features were mapped and explored, hundreds of different species and dozens of potential new species were observed, and many new records were set for the region.

3.1.3 Geology of the Mariana Forearc

The portion of the subduction zone located immediately to the west of the Mariana Trench between the Trench and the Volcanic Arc is called the Mariana Forearc. Forearcs are often characterized by fracturing, serpentization, and erosion. This is the case for the eastern one-third portion of the Mariana Forearc seafloor, where it is the most rugged; the western two-thirds portion of the Forearc is comparatively smoother.[10] The Mariana Forearc is split into northern and southern sections by the West Santa Rosa Bank Fault. Faults develop in this portion of the subduction zone because the middle of the Mariana Forearc is bowing more quickly than the ends, creating an eastward bulge.[11]

As the bulge pushes outward, the trailing portions of the Forearc must stretch to fill the gap. The stretching creates faults that extend down into the earth's mantle. As the Pacific Plate is subducted, the motion creates heat and pressure, which drives out water stored in seafloor sediments. The expelled water then rises through the faults, where it reacts with certain minerals, creating a mineral called "serpentine." Serpentine is less dense than the surrounding rocks, allowing it to rise through faults until it reaches the surface and spills onto the seafloor. Over time, the oozing serpentine buildsand creates a mud volcano.

3.1.4 Serpentine Mud Volcanoes

The serpentinite mud volcanoes of the Mariana Forearc can grow to be the largest mud volcanoes on the planet and can measure 18 mi or more in diameter and upwards of 1.24 mi in height—roughly 10 times taller and up to 100 times greater in diameter than the largest (Java) sedimentary mud volcano known.[12]

Serpentinite mud extruding from a gravity corer barrel. Photo: MARUM-Center for Marine Environmental Sciences

The serpentine, as it first forms from peridotite deep beneath the seafloor, is blue. It changes color to green as it seeps closer to the summit and interacts with seawater. Mud volcanoes are of particular interest to scientists, both for the biological communities that inhabit them and because they provide a window into processes occurring deep below the surface within the subduction zone. Microorganisms that inhabit these extreme environments support their growth by using chemical elements present in the slab fluids. New active volcanoes with flowing serpentinized peridotite mud and dunite rocks are still being discovered.[10, 13, 85]

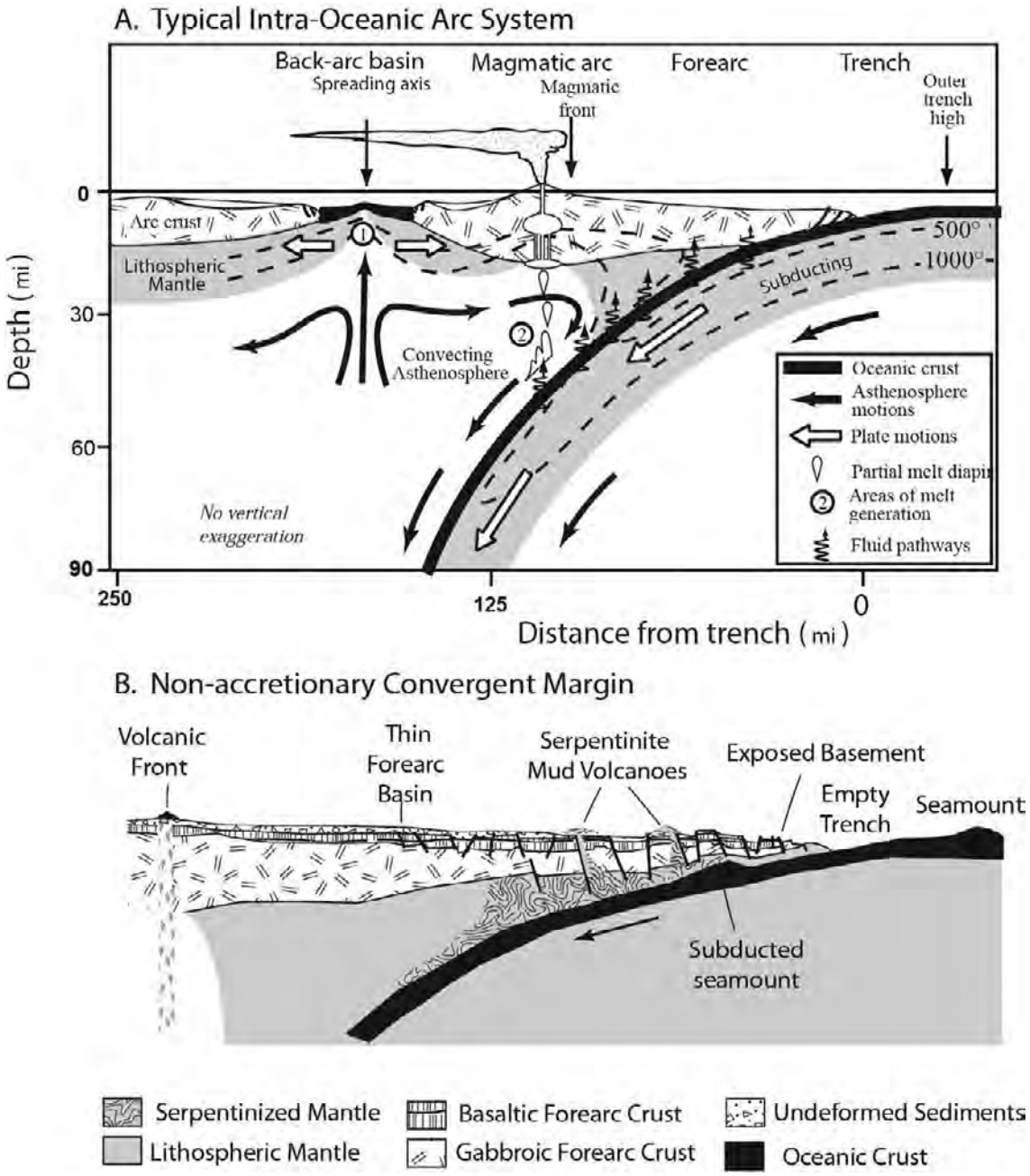
3.1.5 Mariana Volcanic Arc

The Volcanic Arc extends from 23° N to 13° N. It spans 620 nm and includes 9 active island volcanoes and more than 50 active underwatervolcanoes, making it one of the most volcanically active places on Earth.[15] Most volcanoes and earthquakes occur along the boundaries where tectonic plates are colliding or shifting

apart.[16] When two plates collide, the plate being subducted causes melting in the overlying plate, which creates molten rock. Molten rock then rises back up to the surface as magma, creating volcanoes through which to erupt. The chain of volcanoes in the Mariana Arc mirrors the crescent shape of the Trench because both features result from the same tectonic plate subduction.

From a geological perspective, the Mariana Arc can be divided into three parts: the Southern Seamount Province lies to the west of the older islands of Guam, Rota, Tinian, and Saipan; the Central Island Province includes the volcanically active emergent islands from Anatahan to Farallon de Pajaros, as well as several seamounts; and the Northern Seamount Province extends north of Farallon de Pajaros, encompassing several more seamounts within Monument boundaries.[17]

The Mariana region formed at the eastern edge of the Philippine Sea Plate, where subduction first began 50 million years ago. The region underwent three stages of island arc volcanism and two stages of breakup.



Source: NOAA

During each phase of breakup, there was a period of cessation of volcanism above sea level. The most recent breakup began 10 million years ago and forms the Back-arc basin west of the Mariana Archipelago.[18]

The northern islands—Farallon de Pajaros, Maug, Asuncion, Argihan, Pagan, Alamagan, Guguan, Sarigan, and Anatahan—were formed in a more recent phase of subduction than islands to the south, and they are no older than 4 million years.[19] These nine islands are stratovolcanoes, meaning they are active volcanoes composed of alternating layers of lava and ash. Since 1883, six islands have experienced volcanic eruptions, including Anatahan, Pagan, Farallon de Pajaros and Asuncion.[20] We also know that several of the submarine volcanoes have erupted recently, including NW Rota-1, Ahyi, South Sarigan, and Daikoku. The southernmost islands (Saipan, Rota, Tinian, and Guam) are much older and inactive and primarily comprise thick limestone caps formed by the growth of coral reefs atop volcanic rock over at least several million years. The largest island in the arc is Guam, and it exposes some excellent examples of the volcanic underpinnings of these islands. The southern end of the island has the oldest volcanic rocks exposed above sea level of all the Mariana islands. These represent remnants of earlier stages of eruption of lava on the seafloor (the Alutom formation), and some are as old as 44 million years.[18]

3.1.6 Mariana Back-arc

The Mariana Back-arc stretches 800 nm from north to south between the Volcanic Arc and West Mariana Ridge, a portion of the ocean floor that is actively spreading. The southernmost portion of the Back-arc where it converges with the Volcanic Arc is considered the most rapidly deforming part of the arc system.[1] Behind the arc is a region where the upper plate is spreading along a linear zone. It is thought that Back-arc spreading is caused by roll-back of the subduction zone. Effectively, the trench is moving to the east and the upper plate must spread to keep in contact with the subducting plate. In the southern end of the Mariana Back-arc, where it has a higher magma supply, the Back-arc looks like a narrow ridge that is higher than the adjacent topography (about 9,000 ft deep). However, further north, where the magma supply is lower, the axis of spreading on the Back-arc is along a series of deep basins, some 16,000 ft deep. The Back-arc is a zone of submarine volcanism, which provides the heat for hydrothermal vents.[83]

3.1.7 Hydrothermal Vents

Sulfur marbles, NW Rota volcano. Photo: NOAA

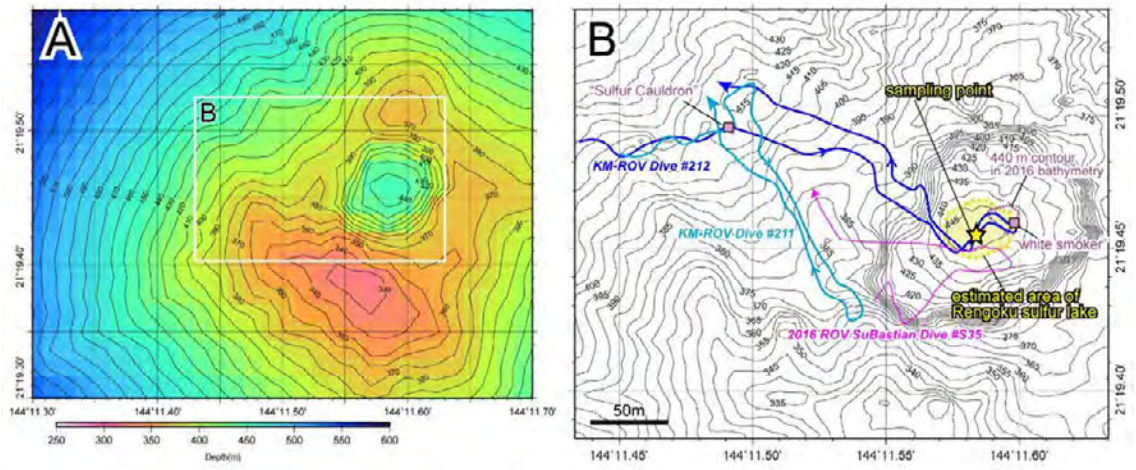
Hydrothermal vents are like geothermal hot springs that occur on land, except that they can reach much higher temperatures due to the high pressure in the deep ocean. Marine hydrothermal systems develop where seawater circulates deep within the ocean crust. The magmatic system acts as a heat source for the water that enters the cracks. This hot fluid reaches temperatures of up to 750°F, becomes highly buoyant as the temperature rises, and quickly moves back up through available fractures. When the hot fluid (>239°F) escapes from the seafloor and hits the cold ocean water, it precipitates metals that can form chimneys at black smoker vents and cloudy plumes of particles in the water column, particularly in the Back-arc. In the Volcanic Arc, hydrothermal vents can also contain gases extracted from the magmatic systems, mainly CO_2 and SO_2. The SO_2 can form droplets of molten sulfur, which can solidify and drop to the ocean floor as tiny sulfur "marbles." The hydrothermal fluid provides chemical compounds that provide an energy source to microbes and forms the basis for diverse chemosynthetic ecosystems.

During the 2004 Pacific Marine Environmental Laboratory (PMEL) cruise, extreme cases of magmatic gas saturating the chemical composition of hot vents in the Mariana Arc were found.[14] Magmatic sulfur dioxide (SO_2) present in fluids from the erupting vent at NW Rota was mixing with seawater within the volcano. SO_2 reacts with water to form sulfuric acid, which is so corrosive it can dissolve the surrounding rock.

Hot spring fluids on NW Rota had a pH of 2.0 or less.† This is 10 times more acidic than other mid-ocean ridge sites, which typically have a pH value of 3.5–4.5. At NW Eifuku, liquid CO_2 was observed being emitted from the seafloor. Some Volcanic Arc sites and most Back-arc hydrothermal sites produce sulfide precipitated at high temperatures, and the remainder have lower temperature deposits of iron, manganese, and sulfur.[15]

3.1.8 Islands Unit Features

Daikoku 144° 11’39” E, 21° 19’27” N
Summit Elevation: -1,059 ft



A: 2023 Daikoku bathymetry. B: The same bathymetry overlaid with key sites of interest, dive tracks of the 2023 KM-ROV dives #211 and #212, as well as the 2016 ROV *SuBastian* S#35, and the estimated extent of the Rengoku sulfur lake. Image: X-Star/JAMSTEC

Daikoku‡ is an active composite cone volcano characterized by robust magmatic degassing of CO_2 and SO_2 from its summit crater and surrounding areas. It is located ~370 nm north-northwest of Saipan. It is famous for hosting lakes of molten sulfur, specifically the “Sulfur Cauldron,” discovered in 2006, and an eruption event in 2014 lead to the formation of a larger lake, “Rengoku.”§ Molten sulfur lakes support the planktonic, benthic, and subseafloor microbial and faunal communities at this seamount. [15, 22, 23, 24, 84]

Daikoku was erupting during the 2014 Submarine Ring of Fire expedition, and CTD** tows showed very strong plumes coming from the top of the seamount. A large new crater 500 ft across and 330 ft deep was found at the summit of the cone. The *Okeanos Explorer* ROV *Deep Discoverer* (*D2*) dove at Daikoku in 2016 to assess the eruption impacts on the local ecosystem. The seamount was covered with volcanic ash and volcaniclastics. Tube worms and anemones were observed, as well as a high density of flat fish specialized in living on the sulfur-rich ground. As *D2* moved around the crater rim, barnacles, anemones, and tubeworms were documented. The bottom of the crater showed active venting, angular cobbles and boulders, and some irregular-shaped pieces of solid sulfur. A Schmidt Ocean Institute expedition led by

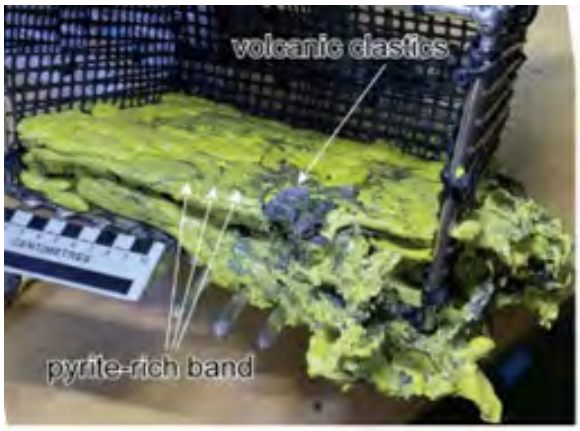
† pH is a measure of the acidity of an aqueous solution. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are alkaline. Pure water has a pH very close to 7.

‡ Daikoku was named by Japanese fishers for the god of earth, agriculture, farmers, the kitchen, and wealth.

§ Rengoku is Japanese for Purgatory, the place of atonement.

** CTD is an instrument package with sensors for measuring the **c**onductivity, **t**emperature and depth of seawater.

NOAA/PMEL also visited in 2016. The *ROV SuBastian* found molten sulfur, and plumes of CO_2 bubbles were still being emitted from the summit crater.

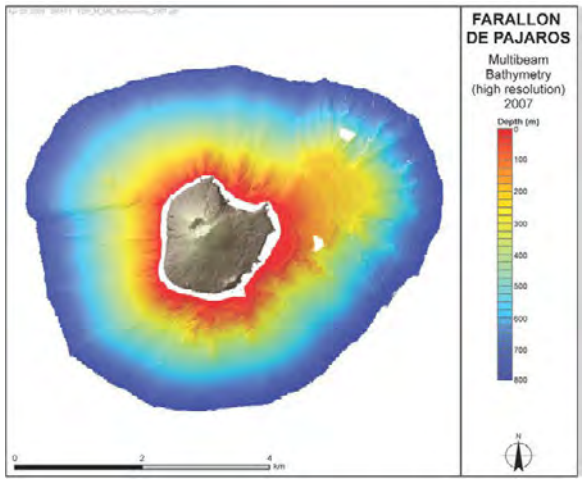


Fresh yellow sulfur cake sampled by the scoop sampler at Rengoku. Photo: X-star/JAMSTEC

The most recent expedition occurred in 2023 aboard the *RV Kamei* and was led by the Institute for Extra-cutting-edge Science and Technology Avant-garde Research (X-star), Japan Agency for Marine-Earth Science and Technology (JAMSTEC). Researchers successfully gathered liquid/supercritical CO_2 containing other volatiles, directly derived from the pristine magmatic degassing, at the seafloor and measured the composition by in situ Raman spectroscopy. The Raman spectrometry was the world's first example obtained from genuine liquid/supercritical CO_2 without the contamination of hydrothermal fluids and seawater. During this latest cruise, X-star surveyed the new Rengoku sulfur lake.[84]

Farallon de Pajaros 144° 54' E, 20° 31' N
Summit Elevation: 1,180 ft

Farallon de Pajaros is an island with a high volcanic cone located 315 nm north of Saipan. The island is about 1 mi^2. It earned the nickname "*Lighthouse of the Western Pacific*" for being the most active volcanic island in the Mariana archipelago, having erupted at least 16 times since 1864, most recently in 1978.[27] The island's steep slopes are formed by frequent lava and ash flows.



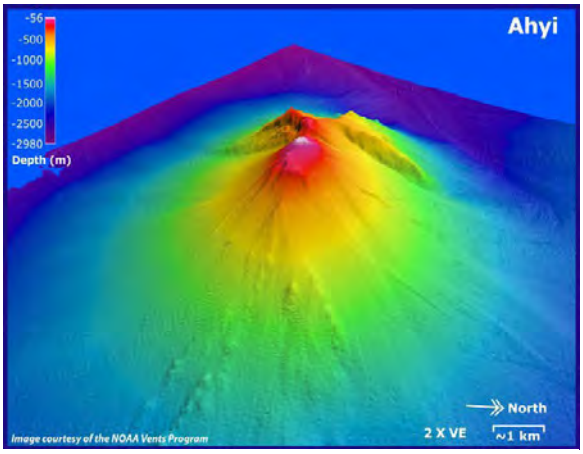
Farallon de Pajaros bathymetry. Image: NOAA

The symmetrical summit is formed by a central cone within a small crater cutting an older edifice, remnants of which are seen on the southeast and southern sides near the coast. Lava poured not only from the summit, but also from fissures on the volcano flanks, which created platforms along the coast. Both summit and flank vents have been active at Farallon de Pajaros in recent history, and much of the island is covered in lava, cinders, and ash.

Coral community on the slopes of Farallon de Pajaros. Photo: NOAA

USGS reported "vigorous fuming" during a 1994 overflight but no eruptive activity. Similar observations were made by volcanologists from the University of California during a 2009 visit.[28] Bathymetric data indicates the steep slopes continue into the submarine zone, over 1 mi deep. Ridges radiate perpendicular to the island, with few flat areas. Shelf areas occur at 30–130 ft and approximately at 500-, 800-, and 1,000 ft depths. Ridges and channels descend from the steep shelf slopes.

Ahyi 145° 1’45” E, 29° 26’15” N
Summit Elevation: -200 ft



Ahyi bathymetry. Image: NOAA Vents Program

Ahyi is a young, very shallow, active submarine volcano about 11 nm southeast of Farallon de Pajaros and 370 nm north of Saipan. The summit rises to just 200 ft below the surface.[25] Water discoloration has been observed over the seamount associated with eruptive activity.

In 1979, the crew of a fishing boat felt shocks over the summit area and then observed upwelling of sulfur-bearing water. Explosive eruptions were seismically detected in 2001 and continuously from 2022 to 2023. Starting in mid-October 2022, hydroacoustic sensors at Wake Island, 1,410 nm east of Ahyi, began recording signals consistent with activity from an undersea volcanic source. In collaboration with the Laboratoire de Geophysique in Tahiti, a combined analysis of the hydroacoustic signals and data from seismic stations located at Guam and Chichijima Island, Japan, confirmed that the source of this activity was at or near Ahyi seamount. Signs of unrest diminished in April 2023.

The *Okeanos Explorer* crew madeone ROV dive at Ahyi in June 2016 to investigate marine life in the area surrounding the summit and hydrothermal vents. The goals of this dive were to explore and characterize any evidence of change since the last eruption, sample any new lava, and assess the impacts of the eruption on the local marine ecosystem.[26]

The exploration started at a depth of 1,175 ft and found mostly fragmental material thrown out by the volcano; white sulfur mats and yellow iron mats; animals associated with hydrothermal vent environments, suggesting a vent may be nearby; and massive cliffs that form the seamounts. Interesting animal sightings included two octopuses moving across the seafloor, a deep-water sand tiger shark, a snake mackerel (a new record of occurrence in the Marianas), a cusk eel, a duckbill, aflatfish, and a colony of shrimp. Sessile organisms encountered included benthic ctenophores, a rare anemone, and a sea slug.[26]


A curious octopus greets the ROV at Ahyi Seamount. Photo: NOAA

Supply Reef 145.1° E, 20.13° N
Summit Elevation: -26 ft

Supply Reef is an andesitic seamount that lies about 6 mi NW of Maug Islands, approximately 340 mi north of Saipan. It is an active volcano, with confirmed eruptions in 1969 and 1989. A 2003 NOAA expedition detected possible evidence of submarine geothermal activity.

The *Okeanos Explorer* visited the site in 2016. Divers found two types of rock: dark gray, coarse-grained layered sections of volcaniclastics and a very fine-grained, brown ash. The light volcaniclastics were very strikingly layered, and some of the layers are heavily pockmarked on the exposed surface. Large "lithistid" sponges were the dominant fauna, and several different species of smaller demosponges were abundant.

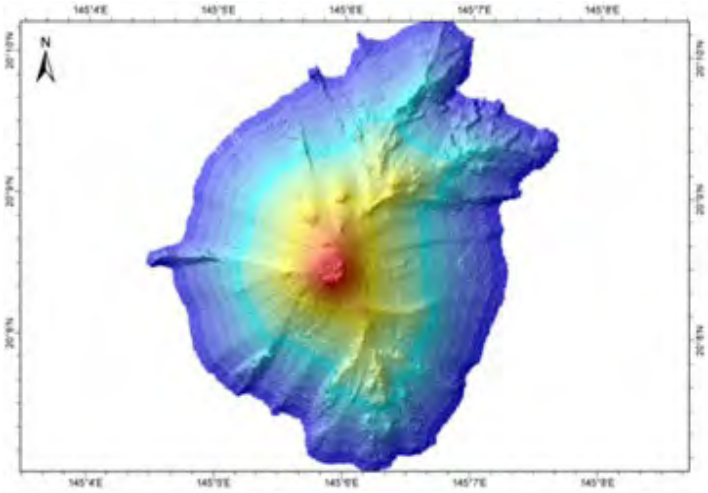
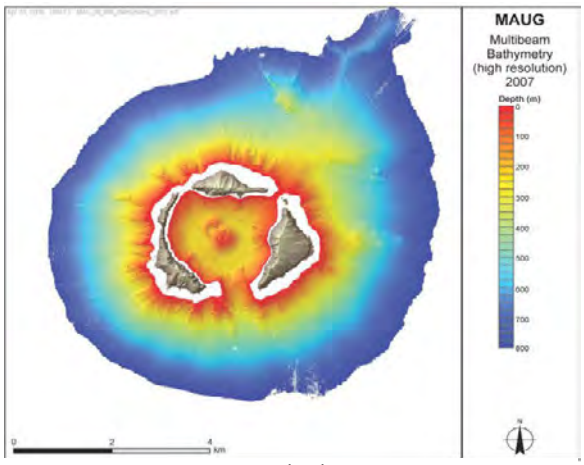


Image: NOAA/CRED

A grey reef shark cruises amongst a school of fusilier at Supply Reef. Photo: Oliver Vetter/NOAA

Moray eel among the rocks at Supply Reef. Photo: NOAA

Maug 145° 13’E, 20° 2’ N
Summit Elevation: 744 ft



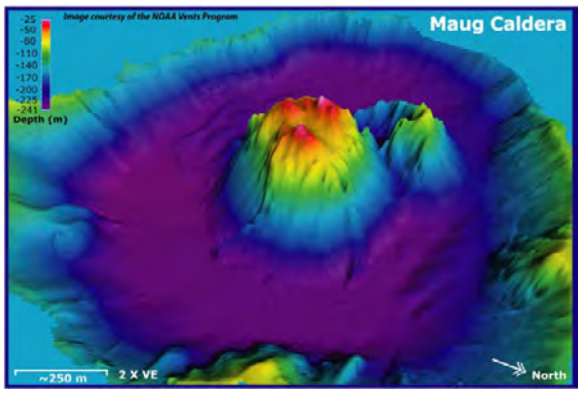
Maug bathymetry. Image: NOAA

Maug is located 329 nm north of Saipan and consists of three steep-sided, exposed islets separated by shallow-water channels. The islets are the above sea-level remnants of the circular rim of what is now a largely submerged caldera at the center. The islets are individually named and go by English and Japanese names: “North” or “Kita-shima”; “East” or “Higashi-shima”; and “West” or “Nishi-shima.” The three islets have a total area of approximately 0.8 mi^2. The outer shore of the three islets’ diameter is 2.1 mi while the inner diameter of the submerged caldera is about 1.4 mi.

A caldera is formed when a volcano collapses inward after an eruption, resulting in a bowl-shaped depression at the top of a volcano. In the case of Maug, the caldera depression is flooded by sea water, creating the illusion of separate land masses above sea level. Maug’s caldera-islet structure is unique in the Mariana Islands. Each islet remnant has steep cliffs made of columnar basalt. A submerged coral limestone terrace occurs at 82 ft below sea level off West Island. Inside the submerged caldera are extensive coral reefs along the shorelines and on a conical dome at the center of the depression.

Volcanic eruptions have not been recorded for Maug since the first Western sighting of the islands by Espinosa in 1522, and recent USGS overflights have not observed geothermal activity above the ocean surface. However, NOAA expeditions have discovered hydrothermal venting on the dacite dome in the center of the caldera and along the inner shoreline of the eastern island. Those hydrothermal vents release CO_2 bubbles, which creates acidic waters in the immediate vicinity of the vents (e.g., a pH of 6.07 has been measured near the vents, versus 8.13 for the surrounding region).

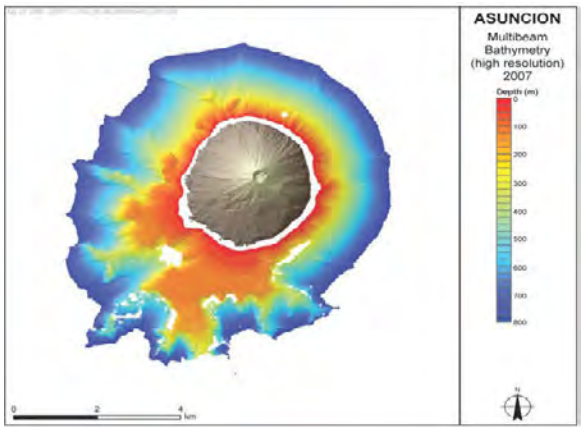
Fluids exiting the seafloor at the hydrothermal vents had temperatures of 60–93°F during the *Hi‘ialakai* expedition in May 2014. The coral reefs in the immediate vicinity of the hydrothermal vents and CO_2 emissions are adversely affected by the locally acidified conditions, but the surrounding areas have healthy coral cover ranging from 67–100%. This makes Maug a valuable natural laboratory for the study of ocean acidification on coral reef ecosystems.[28, 29, 30]



Maug Caldera bathymetry. Image: NOAA Vents Program


CO_2 bubbles rising from Maug caldera. Image: NOAA

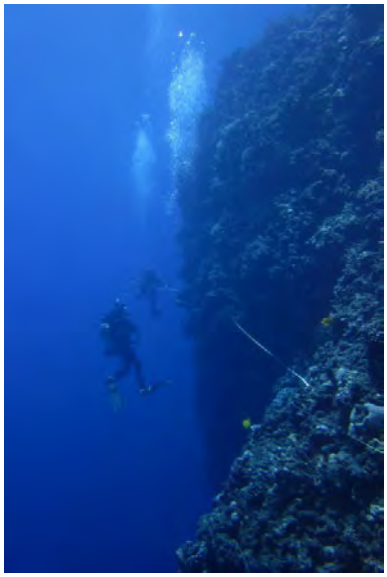
Asuncion 145° 14’ E, 19° 41’ N
Summit Elevation: 2,812 ft



Asuncion bathymetry. Image: NOAA

Asuncion is a high volcanic cone island 300 nm north of Saipan, with an area of 2.8 mi^2. Erosion and landslides have carved into Asuncion, producing gentle slopes on the southwestern side and steep cliffs on the northeastern side. Steep flanks consisting of several terraces, broken with ridges and channels, continue into the ocean to depths of about 1.4 mi. Asuncion had a confirmed minor eruption in the 1920s, preceded by a major eruption in 1906.[27, 28]

White gas plumes occasionally emerge from the top and the slopes of Asuncion. Low-level activitywas observed by volcanologists in 1992 by the appearance of active fumaroles (volcanic gas vents). In 1995, USGS overflights were able to document steam rising from the summit. Several other unverified eruptions have been reported. Coral colonies and benthic community functional groups are surveyed during NOAA expeditions at Rapid Ecological Assessment (REA) sites selected using a stratified random sampling design.


Vertical benthic REA site at Asuncion. Photo: Russell Reardon/NOAA

3.1.9 Volcanic Unit/Arc of Fire Refuge Features

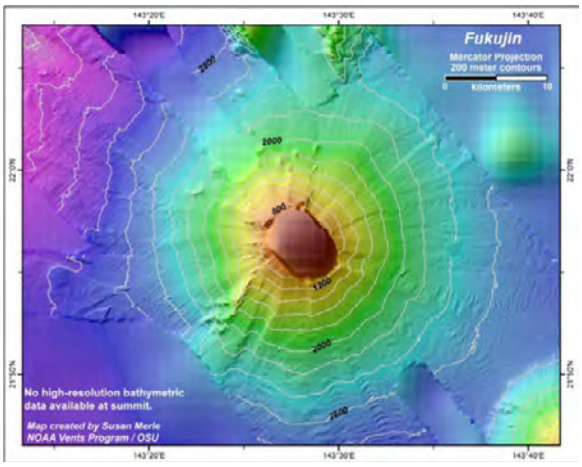
The Volcanic Unit/Arc of Fire Refuge is comprised of the submerged lands extending in a 1 nm circle surrounding 21 hydrothermally active seamounts and vent sites in the Mariana Back-arc spreading center (three of the sites are also within the Islands Unit). Rare phenomena within this Unit include:

- The Champagne Vent – a hydrothermal vent field located about a mile deep at the Northwest Eifuku submarinevolcano that emits droplets of liquid CO_2
- NW Rota-1 – where the first underwater volcanic eruption was directly observed during ROV dives in 2004
- East Diamante caldera – the site of the shallowest black smoker[††]

Brief descriptions of each site are provided and expanded with permission from Embley et al, 2007, and more recent expeditions. Eruptions and seismic activity affect the temperature and chemistry of hydrothermal sites, which in turn affect the specialized ecosystems living on them. Monitoring these sites and learning from the gathered data about interactions between biotic and abiotic conditions is an important priority for future research. Most of the bathymetry maps presented below are developed from multi-beam sonar mapping conducted during NOAA's Submarine Ring of Fire cruises. The maps are mostly based on EM300 bathymetry data at 30 m resolution, overlaid on satellite altimetry data, although some 3-D images are used. Note that images with features in profile are two times vertically exaggerated. United States customary units of measure are used in this document, however, many of the scientific images retain the original metric system of measurement.

Fukujin 143° 27'30" E, 21° 56'30" N[‡‡]
Summit Elevation: -712 ft

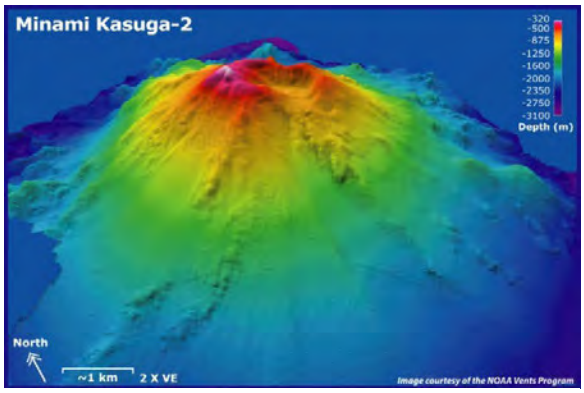
A large, shallow volcano, Fukujin seamount has risen on occasion to just beneath the sea surface. Intermittent periods of water discoloration have been observed since the mid-20th century, and the last known eruption was in 1973. It has a cone-shaped morphology and contains andesite and basaltic-andesite rock types. The summit of the volcano has not been well mapped (the summit elevation may not be exact), largely because it is shallow and uncharted, and, therefore, hazardous to ships. Little or no exploration has been conducted here in the last 20 years, and so it is relatively poorly characterized.



Fukujin bathymetry. Image: NOAA Vents Program

[††] "Black smokers" are chimneys formed from deposits of iron sulfide, which is black and emits black smoke. Likewise, "white smokers" are chimneys formed from deposits of barium, calcium, and silicon, which are white and produce white smoke.
[‡‡] Positions given are the center of the 1 nmi circle that encompasses the vent site and defines the boundary for that feature.

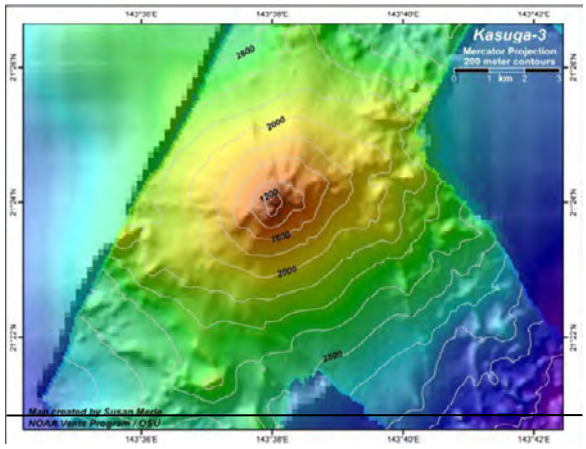
Minami Kasuga 2 143° 38’30” E, 21° 36’36” N
Summit Elevation: -567 ft



Bathymetric data is overlaid on SeaBat data courtesy of Ko-ichi Nakamura, NIAST, Japan

Minami[§§] Kasuga 2 submarine volcano is seen in this bathymetric view, with two times vertical exaggeration. It is the middle of three seamounts in a north-to-south row (Kasuga 1, 2, and 3). Its highest cone rises to within 567 ft of the sea surface. Two subsidiary cones are located low on the eastern flank. Active hydrothermal vent fields are located at the summit crater, the base of summit ridges, and the lower flanks. Heavily eroded, these vents were discovered in 1987[30] and revisited by PMEL in 2004.

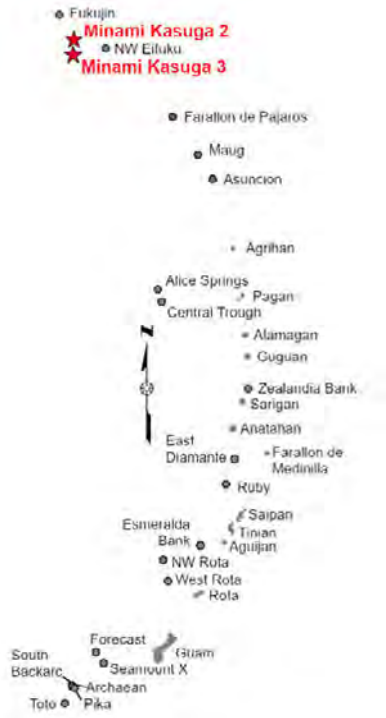
Radionuclide decay rates indicate an age of less than 8,000 years and probably less than 1,000 years for Minami Kasuga 2. Radium/thorium disequilibrium ratios suggest the flows may be only a few centuries old.[31] Rock types found include basalt/picro-basalt, andesite/basaltic-andesite, and trachyandesite/basaltic-trachyandesite.



Minami Kasuga 3 bathymetry. Image: NOAA Vents Program

Minami Kasuga 3 143° 38’0” E, 21° 24’0” N
Summit Elevation: -3675 ft

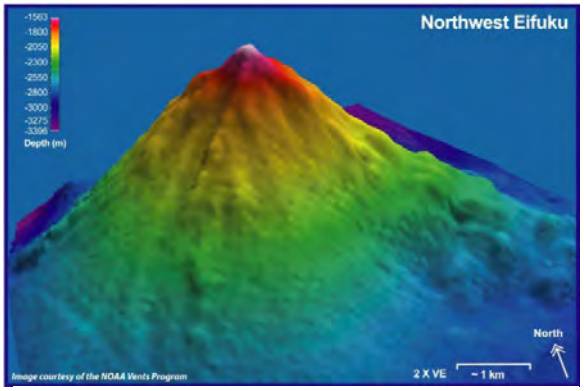
Minami Kasuga 3 is the smallest and most southwestern member of the Kasuga cross chain. It has a cone-shaped morphology and contains basalt rock types. A diffuse hydrothermal vent was discovered there in 1987 on a DSRV *Alvin* submersible dive.[31] Warm hydrothermal fluids were recovered from the summit areas of both seamounts Minami Kasuga 2 and 3, as well as hydrothermal deposits of elemental sulfur, iron- and manganese-oxides, and nontronite. Fluid collected from Minami Kasuga 3 is compositionally close to ambient seawater and shows possible evidence of both high- and low-temperature seawater-rock reaction (48.7°F).



The site was revisited during the PMEL Submarine Ring of Fire 2003 and 2004 cruises. These latter visits could not confirm continuing hydrothermal activity at Minami Kasuga 3.

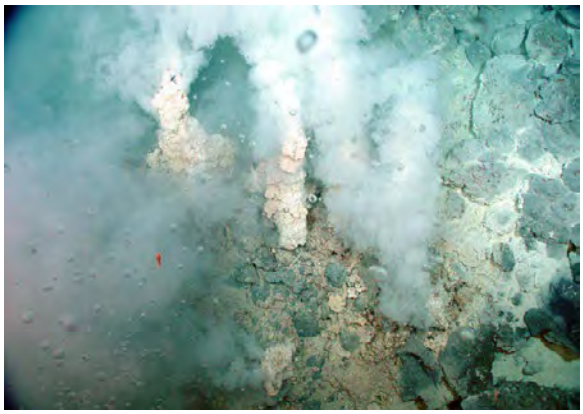
[§§] Minami is a Japanese word meaning “south”.

Northwest Eifuku 144° 2'36" E, 21° 29'15" N
Summit Elevation: -5,035 ft



NW Eifuku bathymetry.
Image: NOAA Vents Program

Northwest (NW) Eifuku is a small submarine volcano with a deep summit that displays vigorous hydrothermal activity. It has cone-shaped morphology and contains basalt rock types. Hydrothermal fluid emission at NW Eifuku includes liquid CO_2 droplets venting from white smokers that vent fluid up to 215°F. The CO_2 is cooler and is in a liquid state due to the high pressure at this depth.


Droplets of liquid CO_2 escape from white chimneys at the Champagne Vent on NW Eifuku. Photo: NOAA

The mile-deep Champagne Vent releases very high levels of evanescent CO_2 and provides a rare opportunity to explore the local effects of ocean acidification on marine ecosystems. Hydrothermal mussels, shrimp, squat lobsters, and tonguefish have been observed in the acidic waters at this site.[32]

NW Eifuku was visited in March 2023 by X-star (JAMSTEC) and the RV *Kaimei*. One research topic was whether a true active subseafloor microbial ecosystem was present in the extreme alkaline and reductive subseafloor environments of the Mariana Forearc serpentinite seamounts or not. The other one was to validate that the hydrothermal liquid supercritical carbon dioxide (sCO_2)*** pools host a diversity of feedstock inorganic compounds and building block organic molecules, and abiotic chemical evolution, as hatchery places for generation of primordial life. During 3 ROV dives, they successfully gathered sCO_2 containing other volatiles directly derived from the pristine magmatic degassing at the seafloor and measured the composition by in situ Raman spectroscopy.††† The laboratory measurements of the detailed volatile composition will clarify what kinds of chemical species, especially feedstock inorganic compounds and building block organic molecules for prebiotic chemical evolution, are preserved in the genuine sCO_2 of this seamount.

The knowledge gained from the laboratory analysis of these samples will augment broader studies. The geological and geochemical environments of hydrothermal systems between the Okinawa Trough and Mariana Volcanic Arc are quite different. Thus, a future comparative study of the chemical composition and isotopic properties between the Okinawa Trough and Mariana Volcanic Arc hydrothermal systems will provide much deeper insight into previously unknown properties and roles of seafloor sCO_2 pools in the primordial ocean and even in the modern ocean.[84]

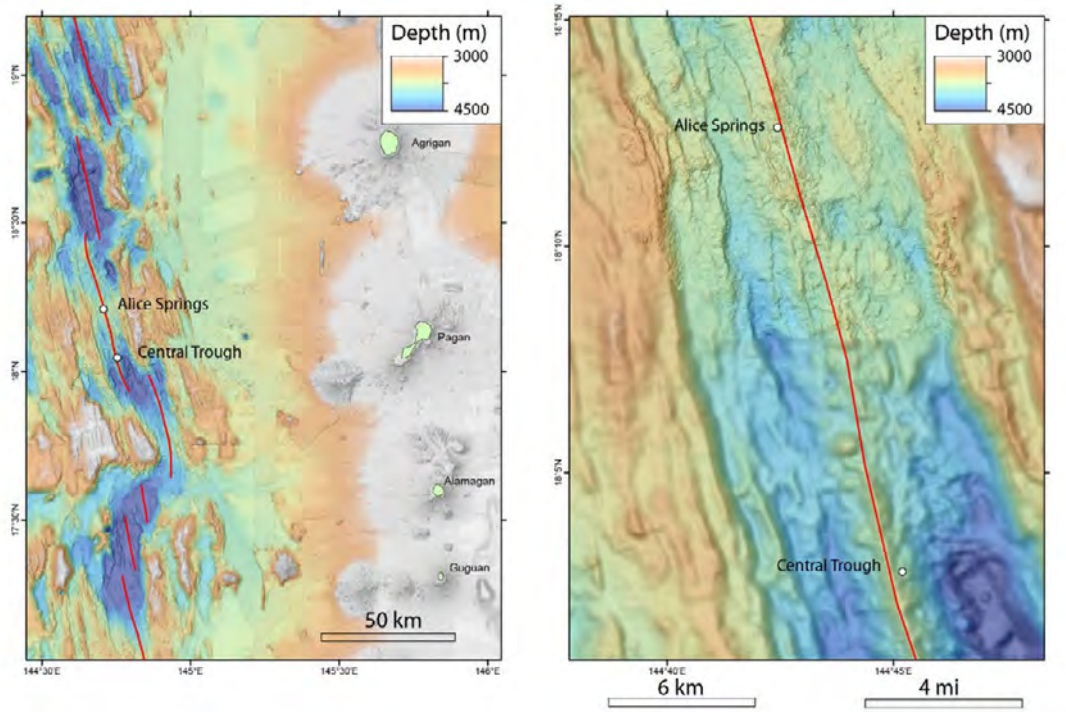
*** Supercritical carbon dioxide (sCO_2) is a fluid state of carbon dioxide where it is held at or above its critical temperature (87.8°F/31°C) and critical pressure (74 bar).
††† Raman spectroscopy is a nondestructive chemical analysis technique that provides detailed information about chemical structure, phase and polymorphy, crystallinity, and molecular interactions. It is based upon the interaction of light with the chemical bonds within a material.

Alice Springs 144° 70’73” E, 18° 21’03” N
Minimum Depth: -2.23 mi

The Alice Springs hydrothermal vent fields, located west of Pagan Island, were discovered in 1987. The vents have active sulfide deposits, low-temperature ironoxide, barite, silica chimneys, and associated iron and manganese deposits on an axial volcano. Despite active hydrothermal venting with temperatures reaching 535°F, over 30 different species have been identified at this site, including hairy gastropods, shrimp, brachyuran crabs, barnacles, polychaetes, and limpets.[33, 34] Chemosynthetic bacteria appear to be the primary producersat these vents. Symbiotic chemoautotrophic bacteria have been found in the gills of the hairy gastropod.‡‡‡

Central Trough 144° 45’0” E, 18° 1’0” N
Minimum Depth: -2.28 mi

This location represents another hydrothermal vent site in the Mariana Back-arc spreading center, originally discovered in 1987 and located approximately 63 mi west of Pagan.[35] The rocks are composed of basaltic andesite.

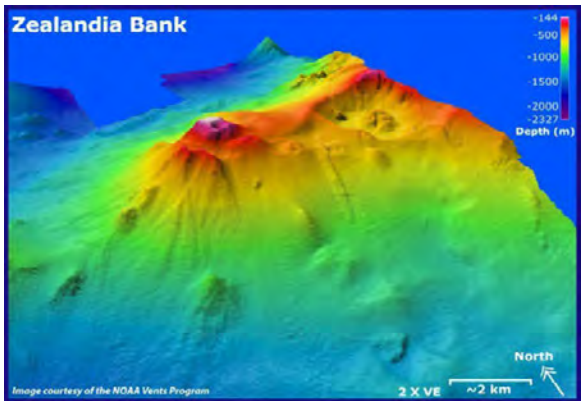


Alice Springs and Central Trough hydrothermal vent fields. Image courtesy of William Chadwick.

‡‡‡ Chemotrophs are organisms that obtain energy by the oxidation of electron donors in their environments. These molecules can be organic or inorganic. The chemotroph designation is in contrast to phototrophs, which use solar energy. Chemotrophs can be either autotrophic or heterotrophic.

Zealandia Bank 51’4” E, 16° 52’57” N
Summit Elevation: 3 ft

Zealandia Bank is a composite structure of several overlapping volcanoes. Located 11 nm north-northeast from Sarigan, it consists of two pinnacles about 3280 ft apart rising from a submerged bank to the sea surface. One pinnacle reaches over 3 ft above water at low tide. Andesitic rocks were dredged at the southern peak, which showed some evidence of coral growth. Freshly broken pahoehoe basaltic rocks have been recovered on the western flank of Zealandia Bank.



Zealandia Bank bathymetry.
Image: NOAA Vents Program


Papaugan emerges above Zealandia Bank.
Photo: AQUASMITH

The age of the most recent eruptive activity at Zealandia Bank is not known, but a NOAA bathymetric survey in 2004 detected hydrothermal activity. However, ROV dives in 2009 did not observe any active venting.[23] Zealandia Bank was named in 1858 after the British sailing vessel *Zealandia*. It is also known as “*Piedras de Torres*” in Spanish (towers of stones), or “*Papaungan*” (sunken) in Chamorro.

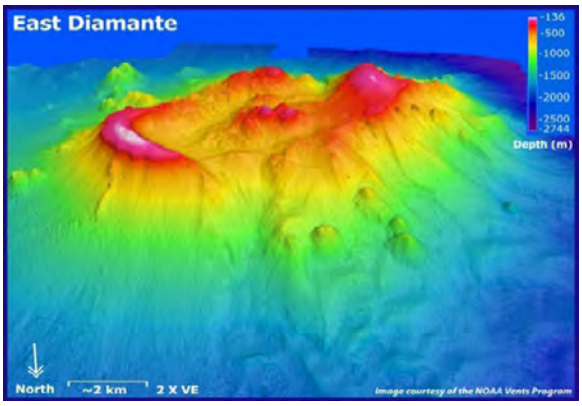

Sand tiger shark 1,200 ft deep at Zealandia Bank.
Photo: Capstone: NOAA ROV Exploration of the MTMNM


Corals on Zealandia Bank rock outcrop 1800 ft deep.
Photo: Capstone: NOAA ROV Exploration of the MTMNM

East Diamante 145° 40’47” E, 15° 56’31” N
Summit Elevation: -416 ft

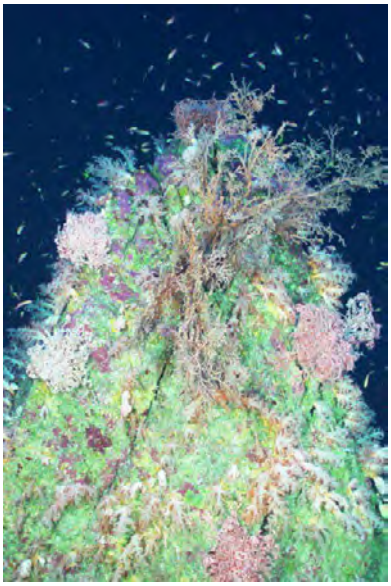
East Diamante is composed of younger central cones within an old caldera that is 5 x 3 mi in size. This is the only site in the Mariana Volcanic Arc front discovered to date where actively forming sulfide chimneys have been found.

This dacitic submarine volcano contains an elongated NE-SW-trending caldera with a pronounced rim on the NE side. A large post-caldera cone lies on the SW caldera rim, and acomplex of lava domes was constructed in the center of the caldera.

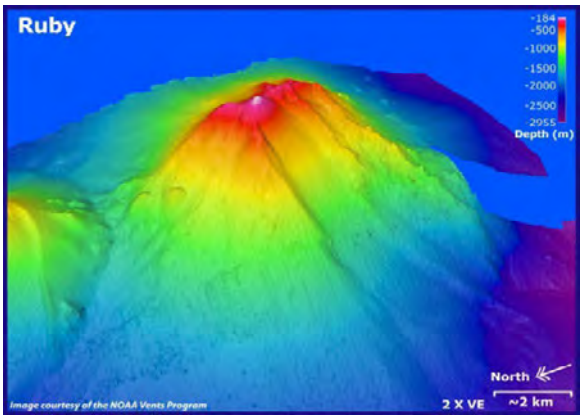


East Diamante bathymetry. Image: NOAA

Several areas of hydrothermal activity including black smoker sulfide chimneys at a site called “Black Forest” are the shallowest black smokers yet discovered. Thesummit of the submarine volcano extends to within 416 ft of the sea surface and some sites have an overlap of photosynthetic and chemosynthetic ecosystems.[36]


Turbulence around the top of Pinnacle Cone attracts suspension feeders that feed on plankton. Photo: NOAA

Ruby 145° 34’24” E, 15° 36’15” N
Summit Elevation: -754 ft



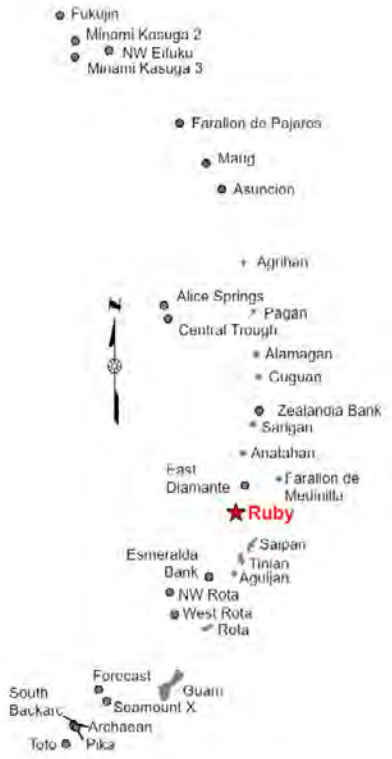
Ruby bathymetry. Image: NOAA

Ruby, a conical basaltic submarine volcano that lies 22 nm northwest of Saipan, was detected in eruption in 1966 by sonar signals.[37] In 1995, submarine explosions were heard and were accompanied by a fish kill, sulfurous odors, bubbling water, and the detection of volcanic tremor. During an ROV dive in 2006, diffuse venting, extensive iron-oxide crusts, and a unique biological community were discovered near the summit.[23]

A submarine eruption occurred at Ruby seamount September 14–15, 2023, and was detected in satellite imagery and seismo-acoustic signals. No volcanic gas emissions were detected in satellite data associated with the eruption or in the days after. A plume of discolored water from the eruption drifted slowly east and was visible in satellite imagery in the ocean between Saipan and Anatahan. A local fisherman reported: “I was on top of Ruby (Malakes reef) with no visible activity. I ran thru the greenish/ yellow discoloration 10 miles north of Ruby. Discoloration went north/northeast roughly 25 miles south of Anatahan.”

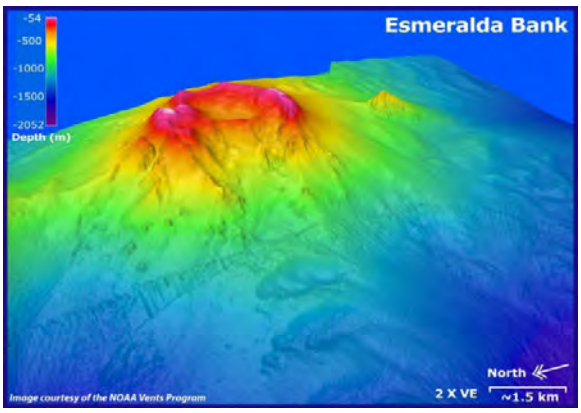
Further eruptive activity could occur at Ruby. The volcano is monitored by a regional geophysical monitoring network, including a station at Saipan, as well as others in Guam, Japan, and an underwater pressure sensor at Wake Atoll.


Stalked crinoids cling to the steep, basaltic terrain at Ruby volcano. These crinoids can slowly crawl around on the rocks but cannot swim. Photo: NOAA



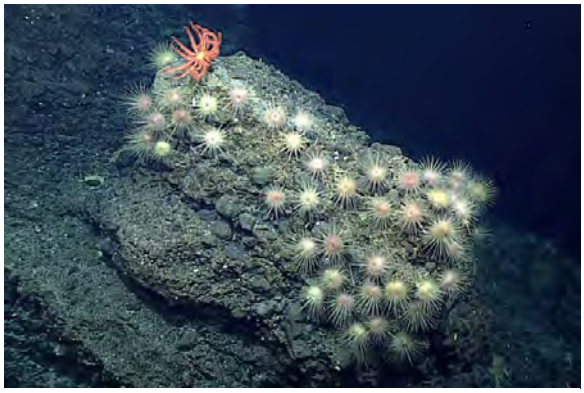
Esmeralda Bank 145° 14’45” E, 14° 47’30” N
Summit Elevation: -141 ft

Located approximately 19 nm west of Tinian, Esmeralda Bank has been the site of frequent reports of sulfur boils and water discoloration observed on the surface water over the years. It was found to be hydrothermally active in 1990 and again in 2003. One ROV dive was made at the site in 2006, but the visibility was poor inside the caldera. Hydrothermal venting occurs on the inner calderawall and caldera rim. The Bank appears to have experienced recent volcanic activity and shows signs of current hydrothermal circulation. The rock types are basaltic andesite.

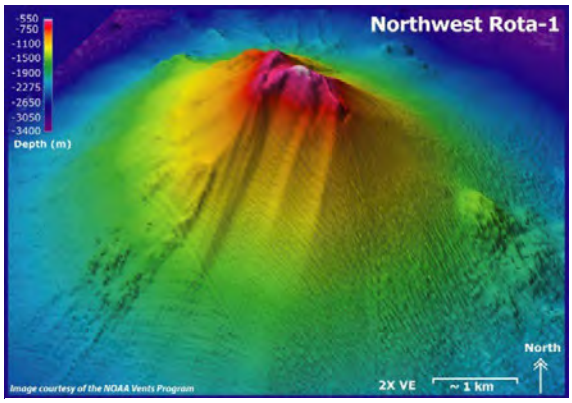


Esmeralda Bank bathymetry. Image: NOAA

A variety of marine life congregates here and there is asignificant amount of bottom fishing occurring in the area. The *Okeanos Explorer* 2016 expedition found dense communities of corals and sponges, as well as high numbers of urchins on the outer slopes at Esmeralda Bank.


A cluster of sea urchins and a single crinoid, living on an elevated rocky feature. Photo: NOAA

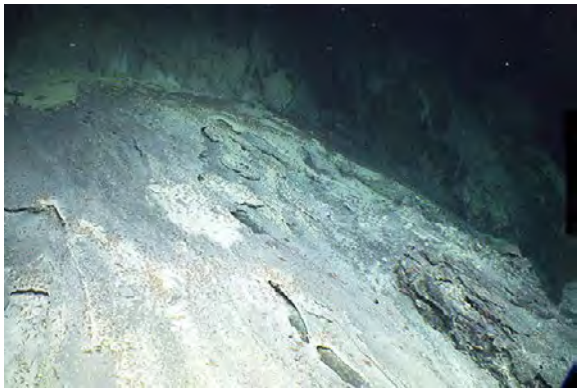
Northwest Rota-1 144° 46’30” E, 14° 36’0” N
Summit Elevation: -1,696 ft



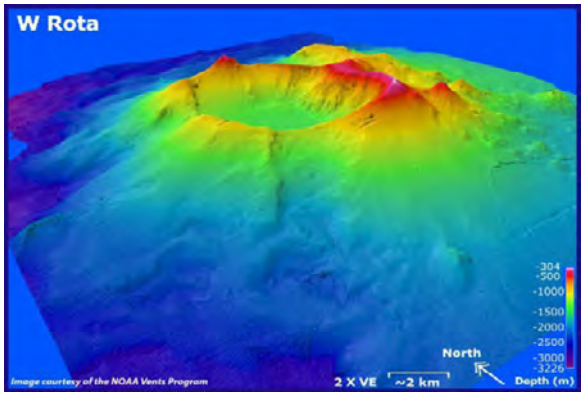
NW Rota bathymetry. Image: NOAA

Northwest (NW) Rota-1 is one of the most dynamic sites in the Volcanic Unit/Arc of Fire Refuge and is the location of the first witnessed underwater eruption at a submarine volcano, including glowing red lava at “Brimstone Pit.” The basaltic to basaltic-andesite seamount is southwest of Esmeralda Bank and lies 33 nm northwest of Rota Island.

When NOAA/PMEL visited NW Rota-1 in 2004, the vent on the upper south flank about 130 ft below the summit intermittently ejected a plume almost 1000 ft high containing ash, rock particles, and molten sulfur droplets that adhered to the surface of the ROV. Hydrothermal vents exist around the volcano summit and support a chemosynthetic ecosystem, including shrimp, limpets, barnacles, crabs, and scale worms. There was an active eruption from 2003–2010,[38] but the activity appears to have stopped in 2010, and no evidence of active volcanic activity was found during NOAA’s most recent visits in 2014–2016. However, the hydrothermal vents are still considered active.


A slope covered with sulfur crusts and tiny shrimp near the formerly active eruptive vents.
Photo: WHOI

West Rota 144° 50’0” E, 14° 19’30” N
Summit Elevation: -984 ft



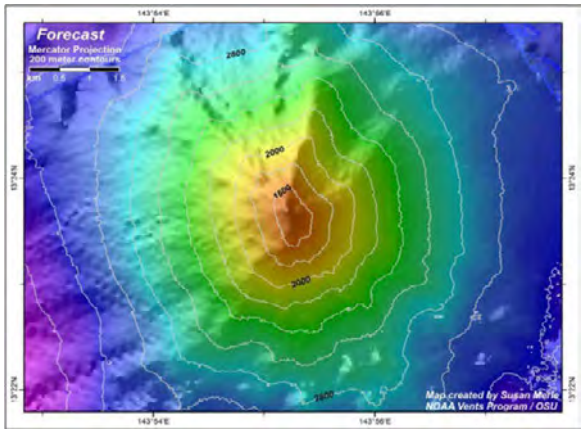
West Rota bathymetry. Image: NOAA

West Rota is a large dormant volcano on the scale of Crater Lake, with a caldera 3.72 x 6.2 mi indicating a huge explosive eruption (estimated at 37,000–51,000 years ago).[39] The ROV *Ropos* was sent down to investigate in 2004.[40] The mission log reported:

> “While moving across the caldera floor, we saw little but pumice that ranged in size from tiny pebbles to boulders. At about -2,460 ft depth, we encountereda basaltic lava, exposed in the vertical cliffs. We were looking at the insides of the volcano, unveiled by the explosive eruption that produced the caldera. We ascended the cliff and watched as the history of the volcano was revealed, beginning with mafic lavas with high concentrations of magnesium and iron and then basaltic ash layers that were succeeded upwards by felsicash deposits. These ash deposits became thicker and coarser as we ascended the cliffs until we reached the top, where the products of the final eruption were located. These huge pumice boulders were up to 9 ft in diameter!” [40]


A 6-ft outcrop shows contact between the lower basaltic and upper felsic ash units in the wall of the West Rota caldera. Photo: NOAA

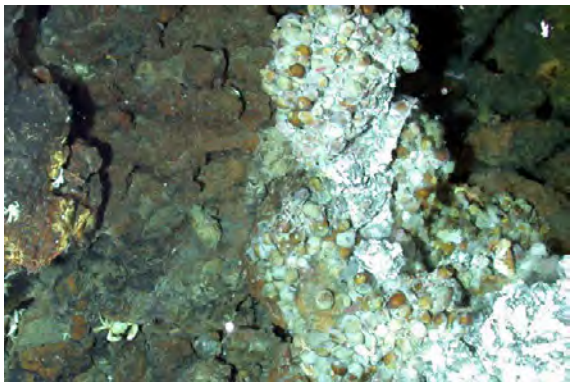
Forecast 143° 55’12” E, 13° 23’30” N
Summit Elevation: - 4,816 ft



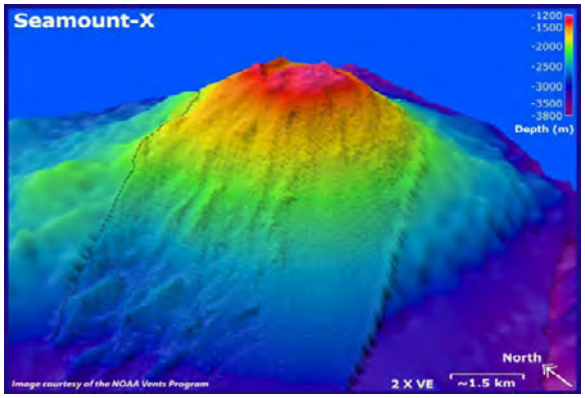
Forecast bathymetry. Image: NOAA

Forecast seamount is in the southern Mariana Back-arc, lying just east of the Back-arc spreading axis, and 43.4 nm west of Guam. The highlight of this site is the occurrence of hydrothermal fluid temperatures up to 392°F, one of the highest-temperature vent systems known in the Mariana Arc. Forecast contains a small vent field with active sulfide-bearing chimneys.[35]

Vent community species that occur at Forecast include shrimp, snails, limpets, crabs, sulfide worms, and scale worms, and they differ from those further to the north in the Marianas Arc. Scientists with the Submarine Ring of Fire 2006 cruise noted the animals found at Forecast are more similar to those at Alice Springs — 290 nm to the north—than they are to Seamount X, NW Rota volcano, and the rest of the arc volcanoes. This observation supports the idea that the differing chemical environments at arc and Back-arc vent sites support fundamentally different ecosystems.

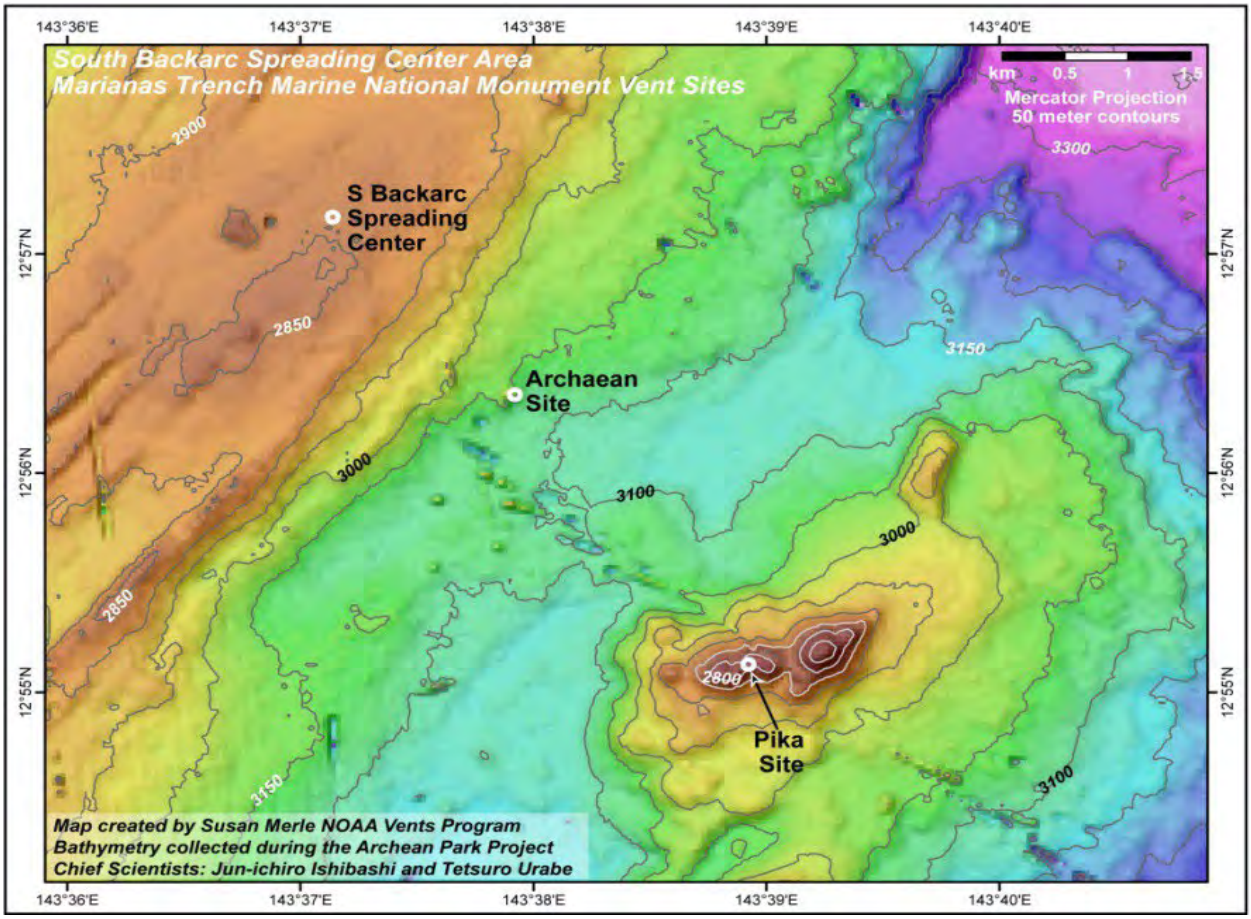

A glimpse of a biological community at a Forecast vent site. Photo: NOAA

Seamount X 144° 1’0” E, 13° 14’48” N
Summit Elevation: -4,084 ft



Seamount X bathymetry. Image: NOAA

Diffuse venting occurs at Seamount X, located 35.6 nm west-southwest of Guam. The summit of the volcano is cut by an elongated caldera. Hydrothermal activity was detected during a 2003 NOAA expedition at Seamount X, 4035 ft below the sea surface. Diffuse sites of thermal venting colonized by shrimps, crabs, and scale worms were found near the summit during a 2006 NOAA expedition, and thick deposits of sulfur flows originating from the hydrothermal vent were observed that were covered with thousands of squat lobsters. The thick sulfur deposit had clearly been formed by innumerable flows of molten sulfur coming out of the hydrothermal system. Basaltic rocks were recovered along with sulfur samples.[22]



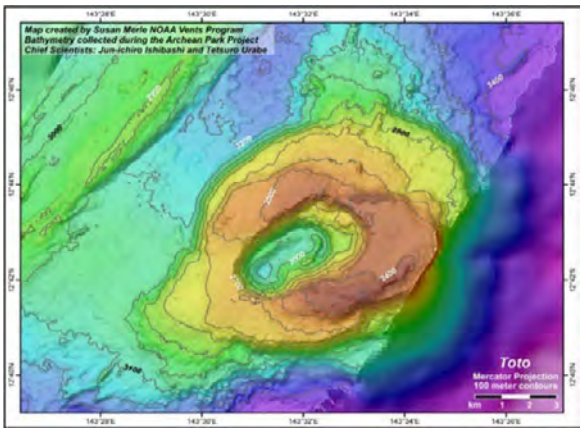
Map created by Susan Merle, NOAA Vents Program.

South Back-arc	143° 37’8” E, 12° 57’12” N	Maximum Depth: -1.77 mi
Archaean	143° 37’8” E, 12° 56’23” N	Maximum Depth: -1.9 mi
Pika	143° 38’55” E, 12° 55’7” N	Maximum Depth: -1.72 mi

The Southern Mariana Back-arc spreading ridge is also known as the Malaguana-Gadao Ridge. Several hydrothermal sites are known to occur along the axis of the spreading center,[40] which is the location of the Monument feature. In addition to rather large deep-sea vent snails (*Phymorhynchus* and *Alviniconcha* species), there are also large patches of iron-based microbial mats.

Archaean is an active hydrothermal site on the eastern flank of the spreading ridge ~1.24 mi from the axis. The Pika site is located ~3.1 mi off-axis of the back-arc spreading center (to the east). It is also an active vent sitewith black smokers.[41]

Toto 143° 31’42” E, 12° 42’48” N
Maximum Depth: -1.88 mi



Map created by Susan Merle, NOAA Vents Program

The southernmost site in the Volcanic Unit /Arc of Fire Refuge, Toto’s large caldera spans 3.1x 1.8 mi rim to rim. Extensive venting was discovered within the caldera by the JAMSTEC ROV *Kaiko* during the R/V *Kairei* cruise in 2000.[41] *Kaiko* landed on the bottom of a talus field.

Visibility was poor due to the plume coming from hydrothermal vents. Shimmering fluids were alsoobserved together with vent communities of tube worms, shrimp, and galatheid crabs. Several chimneys were found at the bottom, vigorously venting white smoke.[41]

3.1.10 Trench Unit/Refuge Features

The Mariana Trench is in the hadal zone, at depths 20,000–35,000 ft deep. The world’s deepest ocean trench is characterized by complete lack of sunlight, low temperatures, nutrient scarcity, and extremely high hydrostatic pressures. The major sources of nutrients and carbon are fallout from upper layers, drifts of fine sediment, and landslides.[86]

Sirena Deep 144°34.868’ E, 12°3.924’ N
Maximum depth: -35,151 ft

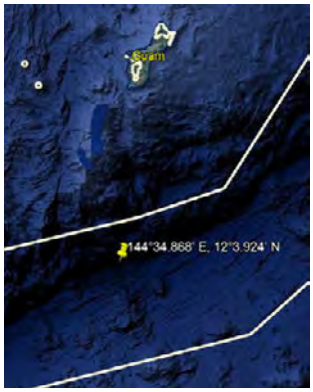


Image: Google Earth

The deepest point in the Trench Refuge/Unit is Sirena Deep, discovered in 1997 by the Hawai‘i Mapping Research Group. It lies at the intersection of the East Santa Rosa Bank Fault and a trench axis south of Guam. Victor Vescovo and Alan Jamieson made the first crewed descent to the bottom of the Sirena Deep in the Deep-Submergence Vehicle *Limiting Factor* (a Triton 36000/2 model submersible). They spent 176 minutes on the bottom and collected the deepest piece of mantle rock ever recovered from the western slope of the Trench.[87]

Haga’ I Tasi 147° 00.51’ E, 14° 35.10’ N
Summit elevation: -19,455 ft

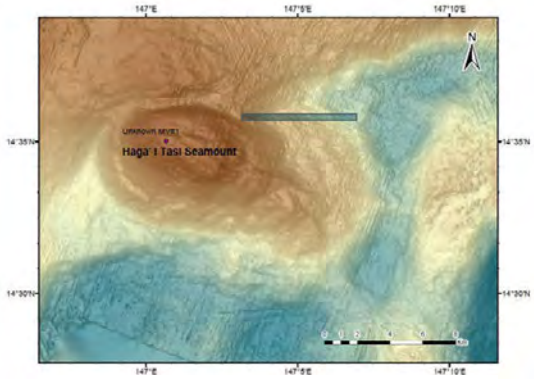
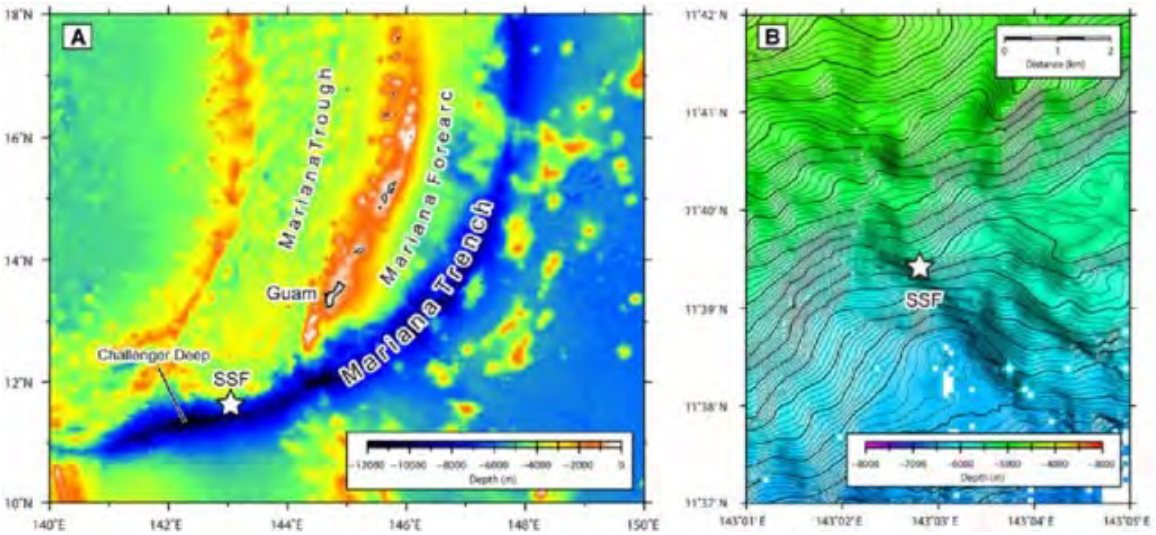


Image courtesy of Walter Menapace

Walter Menapace discovered this massive mud volcano during a *RV Sonne* cruise in 2022. Haga’ I Tasi Seamount has a prominent blue mud flow emanating from the summit, parallel to the major axis of the elliptical shape, branching in several smaller lobes. Two main edifices are detectable, one on top of the other on the SW flank. Kayli Salas and Shelina Beltran of Saipan submitted the name Haga’ I Tasi, Chamorro for “blood of the ocean.” “… to represent the blood that our waters have carried from generations of indigenous Chamorros.”



(A) index map indicating the SSF by an asterisk; (B) detailed bathymetry of the SSF area (after Ohara et al., 2012). Images: JAMSTEC

Shinkai Seep Field 143°2.93' E, 11°39.23' N
~ -18,200 to -19,200 ft

Brucite-carbonate chimneys support the deepest known serpentinite-hosted ecosystem—the Shinkai Seep Field (SSF) in the southern Mariana forearc. The SSF was discovered by a *Shinkai 6500* dive in the inner trench slope of the southern Mariana Trench, during a cruise of *R/V Yokosuka* in 2010. Some reaching >15 ft high, most chimneys have cylindrical or sword-like shapes. The chimneys are subdivided into three types (I–III) based on color, texture, and biology:

Type I. Bright white to light yellow colored, spiky crystalline surface texture, with bushy white-gray, mushroom-shaped microbial mats

Type II. White to dull brown colored, with tuberous textures such as vascular bundles, and grayish microbial mat with a dense population of polychaetes

Type III. Ivory colored, smooth surface with hollows and lacking microbial mat or animals

3.2 Marine Environment

3.2.1 Surface Currents

Surface currents flow through the Monument are the Kuroshiro Current, the North Pacific Counter Current (NPCC), and the North Equatorial Current (NEC) and the Subtropical Counter Current (SCC).[42,43] The flow of these currents creates a circulation pattern referred to as the North Pacific gyre. The NEC, which flows east to west, is the prevailing oceanic circulation pattern influencing the Marianas with the SCC (which flows west to east) seasonally flowing around the Northern Islands.[44] The NEC has a surface speed as great as 11.8 in/s^{-1} when measured at latitude 21°and 23° N, longitude 142-143° E.[27] Recent work has recorded mean flow speeds of 9.8 in/s^{-1}, with decreasing flow speeds recorded around the Islands Unit.[45] Towards the northern end of the archipelago, the current moves somewhat to the north and turns into the Kuroshio Current.[27, 45]

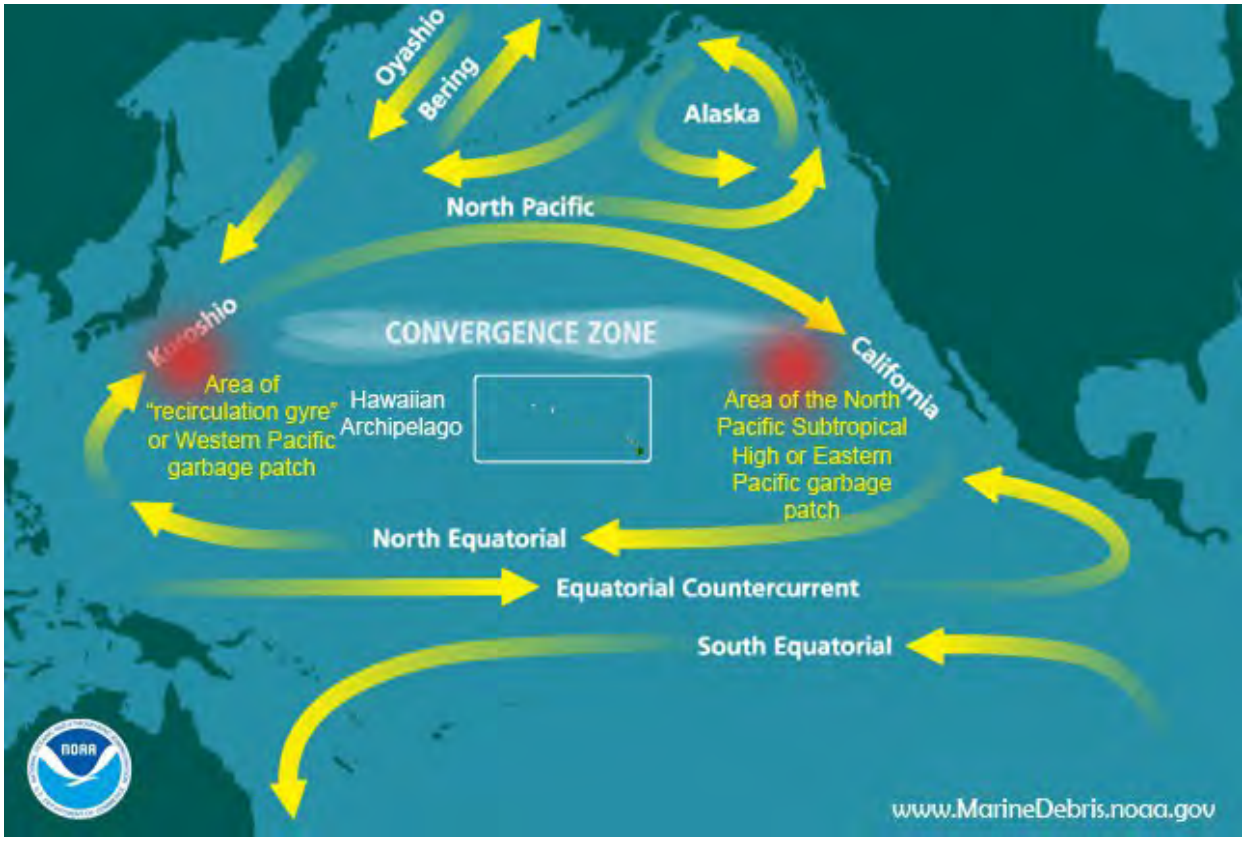
The seasonal influence (June–September) of the SCC on the northern part of the Mariana Archipelago is a result of weaker trade winds. This significantly impacts the region during coral bleaching events.[27, 46] During the months when trade winds are strong, northeast swells are generated by moving cold fronts from the Asian continent, the NEC prevails, and water temperatures remain at cool, safe temperatures for corals.

Current flow is typically north to northeast around each island, except for tropical storm events, which can cause a reversal in direction.[27, 43] These current patterns substantially impact the ecology of the Mariana archipelago. For example, the coral composition in the Mariana region more closely resembles that of the Marshall Islands versus that of Palau, even though Palau is geographically closer.[43,47]

The North Equatorial Counter Current, flowing west to east just south of the island chain, seems to influence the southern portion of the archipelago.[44] The interaction of the NEC with the island topography generates eddies west of the island chain.[44] Current patterns create ecologically significant habitats, such as the transition zone Chl-a front (TZCF), which occurs at the interface of the low-surface Chl-a subtropical gyre and the high-surface Chl-a subarctic gyre.[48]

3.2.2 Mid- to Deep Water Currents

Deep water currents that flow through the Monument are the Lower Circumpolar Pacific Water (LCPW) and the North Pacific Deep Water (NPDW). The LCPW has a westward propagation flowing in through the East Mariana Basin (EMB) and out to the West Mariana Basin (WMB).[49] The LCPW does not flow directly into the Monument from the east because of ocean bottom topography that blocks its entrance. At 13° N, the LCPW arrives from the North and then flows from the EMB through the Yap-Mariana Junction into the WMB and through the East Fayu junction on the Carolineridge into the EMB. The NPDW flows from the east into the EMB and then turns and flows south into the east Carolinian Basin.[50] Information on flows deeper than 3.7 mi in the Mariana Trench is limited due to the technical and logistical challenges associated with these depths.[50] Deep and bottomcurrent information collected from within the Challenger Deep section of the trench showed current speeds to be generally small with the fastest currents of 3.1 in s^{-1} occurring at the deepest stations.[51]



Simplified map of current patterns in the North Pacific Ocean. Image Source: NOAA Debris Program

3.3 Marine Chemistry – Regional Overview

3.3.1 Ocean Water

The Mariana Trench is an open ocean environment, and its water chemistry changes at different depths. Surface waters around the Mariana archipelago are oligotrophic, meaning that they lack plant nutrients and have a large amount of dissolved oxygen throughout. Water in this region is among the clearest in the Pacific because it does not have high concentrations of Chl-a or colored dissolved organic matter.

3.3.2 Sea Surface Temperature

Sea-surface temperatures in the Mariana Archipelago are generally constant throughout the year, ranging between 77°F and 86°F. The lowest temperatures typically occur January – March (77–80°F), and the highest temperatures usually occur July – September (84–86°F). Available data indicate temperatures in Trench waters decrease with depth to a minimum temperature of 35°F below the thermocline at 4,500 db,[§§§] and then increase slightly in the deep layers due to adiabatic compression.[****]

3.3.3 Salinity

An increase in salinity occurs along the latitudinal gradient of the Mariana archipelago, ranging from ~34.0 psu[††††] near Guam to ~35.0 psu in the Islands Unit of the Monument.[45] Salinity increases with depth, reaching a maximum of 35 psu around 492 ft. Within the Trench, salinity at the surface has been recorded at 34.48 psu compared to a regional average of 35 psu.[52] There is limited information on the temperature and salinity profile due to the difficulty in deploying standard instrumentation into extreme depths. One study of the Mariana Trench noted that salinity increased with depth to 34.699 psu 6,020–6,320 db, then remained constant to around 9,500 db.[53] The fact that the salinity remains constant over depth indicates little mixing is occurring beyond that depth.

3.3.4 Dissolved Oxygen

Dissolved oxygen values measured during the RAMP cruises in 2005 were uniform throughout the water column, measured at around 4 mL L^{-1} (a metric unit of volume). The oxygen values measured during the RAMP cruises of 2007 were low in the surface waters (2 mL L^{-1}) but increased with depth to 4 mL L^{-1}. Dissolved oxygen concentrations are much lower in the deep waters of the Mariana Trench compared to dissolved oxygen concentrations measured in deep waters under the oligotrophic North Pacific gyre.[45]

3.3.5 Nutrients

The waters around the Islands Unit are located about 20° S of the TZCF. In the North Pacific, this front is about 4,970 nm long and migrates about 620 nm north and south seasonally. The TZCF is recognized as the boundary between the low Chl-a subtropical gyres in the south Pacific and the high Chl-a subarctic gyres in the north Pacific. Mean climatological surface Chl-a concentrations show strong seasonal variability in the Mariana Archipelago, with the lowest concentrations occurring in the summer and fall seasons, and the highest concentrations observed in the spring and winter. A seasonal latitudinal gradient of increasing Chl-a concentrations that occurs from south to north suggests the southern islands are surrounded by oligotrophic (i.e., nutrient poor) waters throughout the year, while the northernmost islands experience a much greater seasonal variability.[54] These areashave the potential to be more nutrient-rich due to mixing.

[§§§] The unit "db" is decibars, a measure of pressure. Because depth and pressure are directly related, a pressure measurement can be converted to depth.

[****] An adiabatic process occurs without transfer of heat or matter between a system and its surroundings.

[††††] A Practical Salinity Unit (psu) is a standard measurement for salinity based on the properties of sea-water conductivity.

3.4 Environmental Contaminants

A history of military activity in the region left unexploded ordinance and World War II debris in the Monument areas. As with most Pacific islands, marine debris is present on the islands' beaches and entangled in the reefs. Towed-diver surveys of forereef habitats around Maug, Asuncion, and Farallon de Pajaros have identified derelict fishing gear such as old lines, nets, floats, and traps. Results of the surveys are available in the *PIFSC Coral Reef Ecosystem Monitoring Report of theMariana Archipelago: 2003-2007*.[55]

Corroding World War II-era munitions are still found throughout the CNI and Guam. Photo: EPA

The level of dumping-at-sea by transiting vessels is unknown. This practice is regulated under the Ocean Dumping Act and by international agreements. The International Convention for the Prevention of Pollution from Ships (MARPOL) is the primary agreement aimed at the prevention ofpollution from ships caused by operational or accidental causes. The International Maritime Organization adopted MARPOL in 1973.

Plastic bag at the bottom of the Trench Unit/Refuge. Photo: JAMSTEC

3.5 Climate

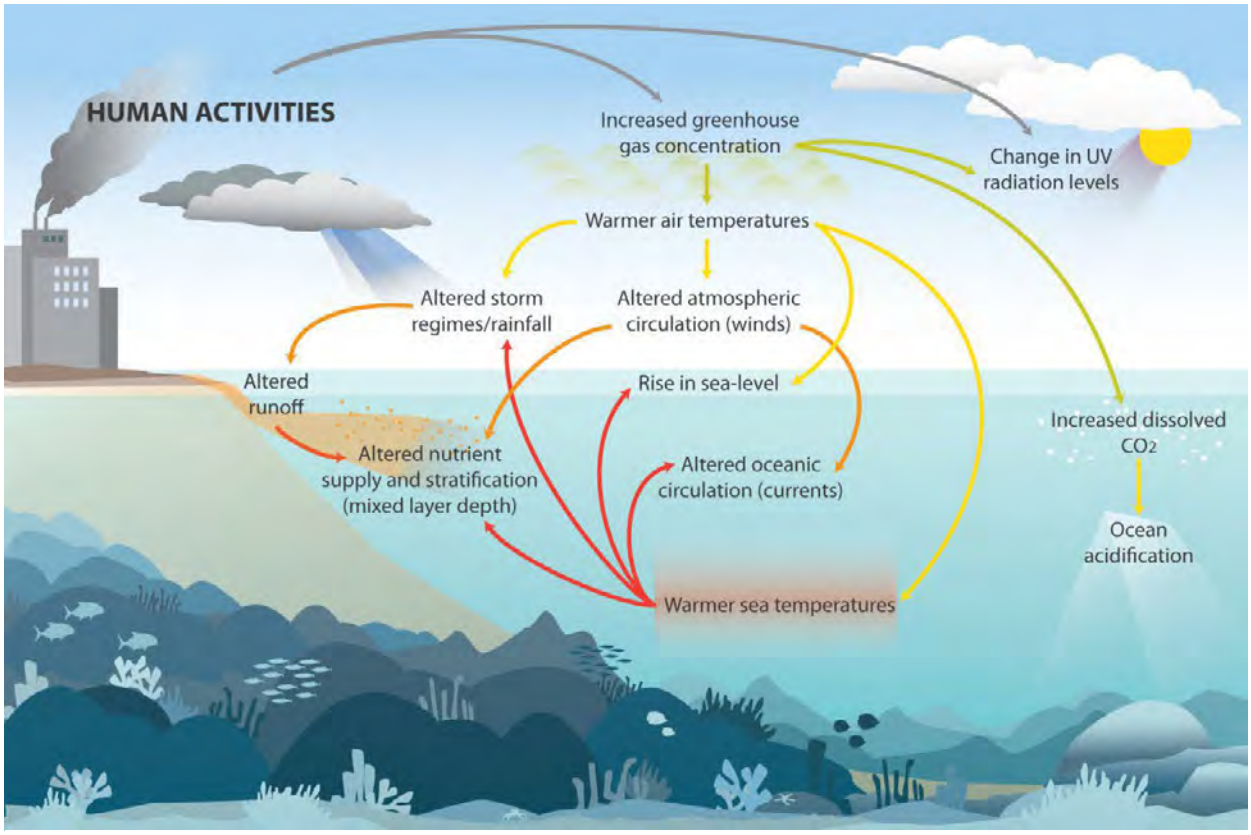
The Mariana Archipelago climate is classified as **maritime tropical**: humid with moderate temperatures, with day-night temperature differences that are greater than seasonal temperature differences and wet and dry seasons with spring and fall transitions. Air temperatures average 81°F, with a daily fluctuation of ~43°F. Relative humidity ranges between 65 and 80% during the day and between 85 and 100% at night. The Archipelago has distinct wet (August–December) and dry (January–July) seasons, with an average rainfall of 72 inches/year. About 70% of rainfall occurs during the wet season.[56] The region has a transitional monsoon regime and is susceptible to typhoons and monsoons. The influence of El Niño and La Niña events (together, the El Niño Southern Oscillation, or ENSO) can be extreme. El Niño patterns enhance westerly winds along the equator, resulting in increased monsoon activity, bringing episodes of heavy rain followed by a drought if the El Niño event is especially strong. The archipelago typically experiences a dry year about every four years due to ENSO.

Northeasterly trade winds cool the Western Pacific most of the year, except June–September when the Subtropical Counter Current prevails.[57] The Islands Unit experiences northeast and easterly winds about 47% of the time and a mean wind velocity of 10.1 knots, with speeds of more than 10 knots occurring eight months of the year.[57] Winds in the northernmost islands come from the east May–July, and from the west the rest of the year.[58] The Archipelago averages one to two typhoons per year during the wet season, and a super typhoon hits one of the islands approximately every 10 years.[58]

3.5.1 Climate Change

Climate change is " … any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer."[59] Anthropogenic inputs to the atmosphere since the industrial revolution are widely recognized as the primary reason for global climate change.[60] Atmospheric CO_2 has increased from its preindustrial levels of 280 ppm to over 395 ppm.[61] These GHG come primarily from the consumption of fossil fuels such as coal, oil, and gas but also stem from timber harvest, farming and agricultural practices, and other human activities.The impacts of climate change are far reaching, with effects on sea and air temperatures; oceanic andatmospheric chemistry; sea levels; ocean currents; and climate, weather, and storm patterns.

Some ecosystems or species may be adaptable to climate change. Large-scale marine protected areas support resiliency and allow for the natural adaptation of species and ecosystem functions. For example, the growth of healthy corals may outpace SLR. Because fish and plankton distributions within the ocean are climate driven, changes in their distribution patterns within the Monument are expected. It is anticipated that climate change will cause an eastward shift in warm water pools and a subsequent shift in the location of Pacific tuna stocks. Distribution shifts in both warm- and cold-water species have already been observed.



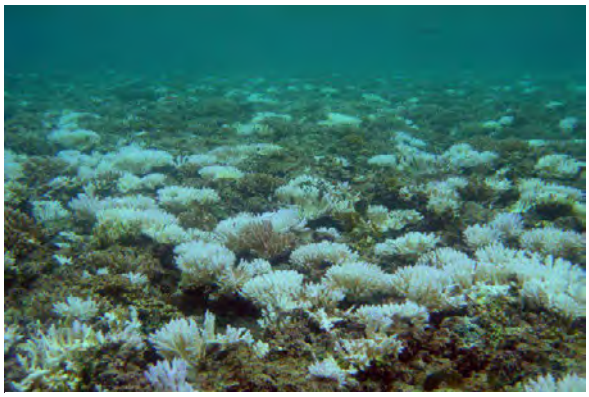
Impact of human activities on marine systems. Image: Amanda Dillon, NOAA (adapted from "Human activities' impact on marine systems" by Poloczanska, et al., 2007)

Because the Monument is uninhabited, it experiences minimal anthropogenic stressors such as runoff, harvest, and other aspects of human presence. This relatively pristine marine environment can provide researchers with a venue to measure environmental shifts related to climate change by comparing conditions in the Monument with areas with human occupation. The changing global environment and the implications this may have for ecosystems in the Pacific are important considerations in management actions.

Global Temperature Increases

The global mean surface temperature has increased by 1.53°F since the mid-19th century. Surface ocean water temperatures (0–246 ft) have increased 0.126°F per decade over the past 100 years and 0.198°F per decade for the most recent half century. The waters around many coral reefs are warming even faster, at a rate of 0.2-0.4°F per decade.[62] Data from the Agrigan SST buoy indicate an average SST change of 0.432 ± 0.018 (°F/decade) since 1982.[63] Although temperature has increased slightly over time, the timing of seasonal warming patterns has not changed.

One of the most obvious indications of thermal impacts is coral bleaching. Bleaching occurs when coral polyps expel essential symbiotic algae called zooxanthellae from their tissues, resulting in the loss of photosynthetic pigments. Increased water temperature is the primary cause of bleaching. If temperatures return to normal and bleached corals can reacquire their symbiotic algae in time, they may recover from a bleaching event. Coral mortality occurs with prolonged periods of elevated temperatures, and there is insufficient data to determine the time interval between bleaching episodes needed to recover. Corals have been dying worldwide under current warming conditions.



Bleached corals here have lost photosynthetic pigment. Photo: David Burdick/UOGML

Bleaching level temperatures are defined as 1.8-3.6°F above the monthly maximum climatological mean for the region and have already been recorded in the Northern Mariana Islands. Water temperatures around the Islands Unit have reached bleaching levels. Several bleaching events have occurred since 2001 in the Southern Mariana Islands, significantly affecting shallow-water corals. At Farallon de Pajaros, the sea surface temperature (SST) has exceeded 86˚F in multiple years (2001, 2003, 2005, 2009, 2013), crossing the bleaching threshold SST for up to 14 weeks. The SST around Maug also exceeded 86˚F in 2001 and 2003. Thermal stress affects all aspects of coral life, from fertilization to development to settlement, and of course, mortality.

Ocean Acidification

Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of CO_2 from the atmosphere, and it can affect the life cycle of many organisms found in the Monument. Rising atmospheric CO_2 levels will lead to additional CO_2 in the ocean. When CO_2 dissolves, it forms carbonic acid, a weak acid that releases additional hydrogen ions as it stabilizes into bicarbonate. The increase in hydrogen ions increases the acidity of the ocean. Since preindustrial levels, ocean pH has already decreased by 0.1 on the pH logarithmic scale.[66] As ocean temperature and atmospheric CO_2 concentrations change, there is an associated change in the amount of carbon sequestered in the ocean.[67] This is predicted to decrease the average ocean pH by 0.4–0.5 points compared with preindustrial levels by the year 2100.[68] If this hypothesis proves correct, the oceans will become more acidic than at any time in the past 400,000 years.[69]

A decrease in ocean pH causes a change in the aragonite saturation point, making it more difficult for many calcifiers (those species that create skeletons or shells out of calcium carbonate) to incorporate calcium carbonate.[70] Marine organisms such as these derive calcium carbonate minerals from the ocean to build their skeletons and shells. As ocean water becomes more acidic, it will become less saturated with calcium carbonate, which will pose a challenge for organisms to maintain perhaps leading to regional variation in ocean pH. CO_2 may be absorbed in one region and then their shells. Ocean pH also varies by depth; deeper waters tend to have higher CO_2 levels than surface waters. Processes influencing temporal and spatial

variation in CO_2 levels include upwelling, photosynthesis, respiration, calcification, temperature, and circulation patterns.

Changing pH levels may affect organisms differently. Crustose coralline algae may experience greater challenges in calcifying under a decreasing pH regime than will corals.[71] Corals may grow at slower rates, or be more fragile, although some recent studies suggest coral species can compensate for changes in pH.[72] However, a significant decrease in pH may reach levels where corals actually begin to erode, resulting in a net loss of coral to the ecosystem. There is evidence that ocean acidification will impact non-calcifiers, as well. Studies on fish have demonstrated negative acidification effects on growth, development, and mortality.[73] Other species such as sea grasses and phytoplankton may benefit, causing overproduction at certain trophic levels in the food web and disruption to the balance and functions of healthy ecosystems.[74]

Water samples from the caldera at Maug indicate pH values much more acidic than the surrounding waters and higher water temperature. The conditions are highly corrosive to calcifying organisms based on the calcite and aragonite saturation of undiluted vent water. No calcium-carbonate producing organisms have been observed within the vent system. A CRED team found coral cover of 67% only 50 ft away from the vents, approaching nearly 100% coral cover in one area. This site provides the only known example of volcano-induced ocean acidification within a coral reef ecosystem. These unique conditions make Maug an important site for studying the ecological and biological processes of climate change.

Sea Level Rise

The rate of sea level rise (SLR) varies regionally, primarily due to variations in plate tectonic activity. The global average sea level has risen ~7 inches since 1901 and is predicted to rise 10–32 inches by 2100.[75] These estimates do not consider variation in the rates of melting for ice sheets and glaciers, which recent studies indicate could dramatically accelerate SLR.[76] In 2007, the IPCC predicted a rate of 0.047–0.078 inches SLR per year in the equatorial Pacific. To date, observed rates of SLR have continually outpaced the IPCC's previous worst-case scenario models.[77] Despite the slowing rate of ocean warming, there is no evidence for a slowdown in SLR.

Inundation of low-lying island areas, coastal erosion, and saltwater intrusion into freshwater aquifersare of concern for many Pacific islands with rising sea levels. High seasonal and storm waves will travel further inland as sea level increases, creating new wetlands and causing changes to existing waterways, such as streams and estuaries, surface drainage, and increasing likelihood for flooding if high tide coincides with heavy rainfall. Coastal erosion may increase the introduction of sedimentsinto the marine environment, decreasing overall water quality. The degree of vulnerability of high islands like Asuncion, Maug, and Farallon de Pajaros is uncertain because these islands have rocky volcanic slopes and limited sandy shorelines.

Storm Patterns

The IPCC predicts extreme weather events for the Pacific, including the possibility of increased droughts and floods, shifts in tropical cyclone tracks associated with El Niño, more intense rainfall events, and an increase in tropical cyclone peak wind intensity.[78] These rates are likely to rise with continued increases in temperature. Combined with SLR, this could result in higher storm surges causing reef and coastline damage. The intensity of regional weather patterns is expected to escalate, and the number of storm events is predicted to increase.

3.6 Scenario Building

Monument managers seek understanding of what the future may look like for the Monument ecosystems. Science-based predictions help shape decisions and regulations in the present. Resilience to climate change depends in part on the presence of other stressors. Detailed baseline data is needed for the creation of accurate models to help managers assess future scenarios and predict how climate change might impact the Monument's resources. Integrating global climate change predictions with regional dynamic information can help produce regionally specific forecasts. Vulnerability assessments can prepare Monument managers for potential impacts by anticipating environmental shifts and providing the basis for informed management plans on climate resiliency.

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Hydromedusa in the genus Crossota, 12,000 ft deep. Photo: NOAA OER/2016 Deepwater Exploration of the Marianas

Chapter 4. Biological Environment

The ecosystems in and around the Monument are among the most biologically diverse in the Western Pacific. This area features a great diversity of seamount and hydrothermal vent life and provides opportunities for research that exist nowhere else. Extreme underwater conditions in the deepest portions of the Monument were considered inhospitable until the past few decades, when, in fact, these environments are home to rare biological communities. Extreme pressure and heat, toxic levels of dissolved metals and gases, and extreme reducing conditions are found at many Monument features. Despite these conditions, life not only exists, but thrives, albeit in forms that are uniquely suited for these specific locations.

Because sunlight can only reach 3,000 ft below sea level in ideal conditions, organisms living in the deepest parts of the ocean rely on chemosynthetic energy instead of photosynthetic energy for survival. Chemosynthesis is the utilization of chemical energy (hydrogen, methane, hydrogen sulfide, and iron) rather than sunlight to convert carbon into organic compounds in a process known as carbon dioxide fixation. Chemosynthetic ecosystems develop in places where chemical energy formed by geological processes below the ocean floor is released into the ocean and becomes available as an energy source for benthic organisms. Organisms in chemosynthetic habitats require distinct conditions, such as the presence of sulfide and methane, to maintain their populations. The life cycle and evolutionary history of organisms adapted to these isolated and dynamic ecosystems remains an active area of research.

4.1 Biological Environment – Trench Unit/Refuge

4.1.1 Seafloor

In contrast to the extremely dynamic environment of a mud mountain or active marine volcano, the floor of the Mariana Trench has developed a quasi-stationary equilibrium and is inhabited by biological communities with a tolerance for extremely high hydrostatic pressure (e.g., pressure exerted on an object at depth).

Hydrostatic pressure increases proportionally at deeper depths because of the increasing weight of water exerting a downward force. James Cameron's 2012 expedition into the Mariana Trench produced a wealth of new biological observations. Scripps Ocean Institute analyzed the megafaunal community data and revealed vibrant groups of organisms living in the ocean's deepest regions.[1] The Mariana Trench hosts large single-cell amoebas called "xenophyophores," giant sea cucumbers, and giant shrimp-like crustaceans called "amphipods." These 2-inch-long amphipods (*Hirondellea gigas*) survive by eating woodfall—tree and plant debris swept into the ocean that sinks to the bottom. Sea cucumbers dominate the Trench's biological communities. Different species of sea cucumbers exist at the various points of the Trench, and they each have adaptations to survive in these depths.[2]

4.1.2 Mariana Forearc Mud Volcanoes

The boundaries of the Trench Unit/Refuge include some of the Mariana Forearc. Above the Mariana subduction zone, the down-going Pacific Plate releases fluids into the overlying mantle, as temperatures and pressures increase with depth. The fluids rise along the deep faults in the deformed forearc to hydrate the mantle minerals (olivine and pyroxene) and form the mineral serpentine. The resulting serpentinite/fluid mud is less dense than the surrounding rock, so it rises to the seafloor in the forearc. This fluid serves as the basis for biological communities in the forearc region.

The Mariana Forearc is home to several serpentinite volcanoes (also called mud volcanoes), some that rise as high as over a mile tall and spread over 18 miles in diameter.[3] These seep fluids are high pH (highly alkaline) and are high in inorganic compounds, which provide a source of nutrition for chemosynthetic microorganisms at the baseof the food chain. Mud volcano biological communities often include several trophic levels but tend to be dominated by species in symbiotic relationships with chemosynthetic organisms. For example, the South Chamorro Seamount, located in the northern Mariana Forearc, hosts mussel communities nourished by bacteria that get energy from chemicals in the fluid.

The Shinkai Seep Field in the Southern Mariana Forearc supports a community of vesicomyid clams* that live on serpentinized peridotite released on the seafloor.[4] This is an important finding because if serpentinized peridotite hosts large communities of clams, and peridotite is present on the Trench inner wall, then it is possible more clam communities will be discovered. Other megafauna found around mud volcanoes include gastropods, tubeworms, and galatheid crabs.[5]

4.2 Biological Environment – Volcanic Unit/Arc of Fire Refuge

4.2.1 Mariana Volcanic Arc and Mariana Back-arc

When molten rock generated in Earth's mantle pushes upward through the ocean floor, it creates prominent geologic features such as seamounts, which are often isolated relief in an otherwise flat ocean plain. Seamounts form in various sizes and shapes. Their physical structure dictates the surrounding hydrodynamic characteristics. The movement of water around seamounts determines the biological communities associated with them. Most seamounts have a volcanic origin and are also sites of hydrothermal venting.[6] There are two different volcanic and hydrothermal environments in the Marianas: the Arc (seamounts) and the Back-arc (along a linear zone of seafloor spreading on ridges in the south and in deep rift basins in the middle and north). The Volcanic Unit/Arc of Fire Refuge includes sites in both.

4.2.2 Seamounts

Seamounts are defined as large underwater mountains rising at least 280 ft above the seafloor. The determining factors for flora and fauna include light level, the productivity of the overlying water, the

* Vesicomyid clams are heterodont bivalve mollusks that live worldwide from 300- to 32,000 ft depths and commonly colonize hydrothermal vents, cold seeps, and whale falls.

hydrodynamics of the surrounding water column, geomorphology, geological origin and age, and hydrothermal activity.[32] Seamounts, along volcanic arcs, facilitate species dispersal by acting as stepping stones across the open ocean, thereby extending a species' distribution.[7] Currents, pelagic larval duration,[†] and adult mobility are also important dispersal factors in a species' ability to colonize available seamounts.

Seamounts can be important fish habitat, supporting sizeable stocks of seamount-associated species such as alfonsino, pelagic armorhead, orange roughy, and toothfish.[8] If seamounts are not properly managed, stocks associated with these features can be quickly depleted and take a long time to recover due to their isolation and limited larval influx. Whereas productivity around the seamount dictates the fish assemblage, temperature, oxygen concentration, and pressure determine the benthic community composition.[9] Filter feeders such as sponges, corals, and crinoids tend to dominate the benthic invertebrate assemblages.[12]

4.2.3 Hydrothermal Vents

The first biological hydrothermal vent community was discovered in 1977 on the Galapagos rift near Ecuador.[13] Since then, vent communities have been documented around the world.[14] The majority of known vent species are associated exclusively with hydrothermal vents. The base of the food chain at these communities is chemosynthetic bacteria. The effluent emitted from vent chimneys is rich in reduced chemicals, which are used by these autotrophic bacteria to convert CO_2, water, and nitrate into organic substances.[15] The unique chemical composition of the fluids at hydrothermal vents and methane seeps provides microorganisms with chemical energy needed to synthesize organic compounds.[16]

Champagne vent site, NW Eifuku volcano, venting hydrothermal fluids at 217ºF. Photo: NOAA/PMEL

Microbial communities living in vent ecosystems are called "extremophiles" because of their tolerance for extremely harsh conditions. Extremophiles live at extreme temperatures and depths, have diverse metabolisms, and some can process hydrogen sulfide (a gas that is toxic to most animals) as an energy source. Although a limited number of species are adapted to the extreme habitats of hydrothermal vents, the biomass found on these features can be extensive. The nutrient-rich vents often support crowded biological communities 500–1,000 times denser than non-vent deep sea areas.[16, 18]

Biological community of mussels and galathied crabs at NW Eifuku volcano Photo: NOAA/PMEL

Vent community composition varies from location to location due to isolation and surrounding ocean currents, as well as the local chemical environment. Similar to mud volcanoes, they are usually dominated by organisms in a symbiotic relationship with chemosynthetic microbes.[19] Animals living on the periphery of hydrothermal vents consume other organisms. Polychaete worms, shrimp, crabs, and a few fish species have adapted to these environments.[20] The composition of hydrothermal vent communities in the Mariana Arc demonstrates a strong genetic relationship to vent species found along the mid-ocean ridge; 59% of the species are common to both areas, while 25% are unique to Western Pacific vents.[21] These communities in the Mariana Arc are largely populated by snails,

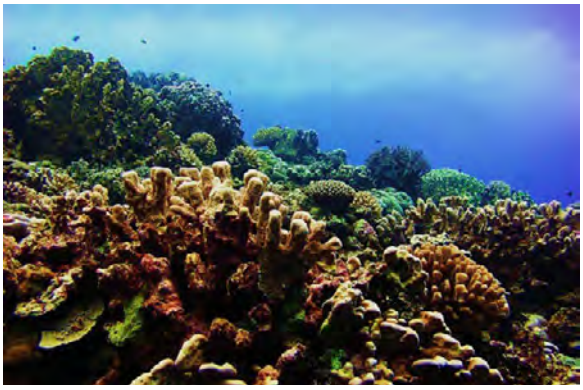
[†] Pelagic larval duration is the time an aquatic larva spends in the water column.

shrimp, crabs, limpets, mussels, and barnacles, whereas other species commonly found at vents around the world (such as tubeworms) are poorly represented or absent altogether.[19, 20, 21, 22]

4.3 Biological Environment – Islands Unit

4.3.1 Coral Reefs

Coral reefs are the building blocks of coastal marine ecosystems. Found in the upper portions of the ocean where light can penetrate, coral reefs serve as habitat for a vast number of marine species. Although there is less coral diversity in the northern islands, the coral health in the Islands Unit is better than that of the southern islands. Coral reef conditions in the southern islands vary due to human-induced stressors such as fishing, sedimentation, and nutrient loading.[23] By contrast, the isolation of the northern islands allows the coral reefs to remain in overall good condition.[24]



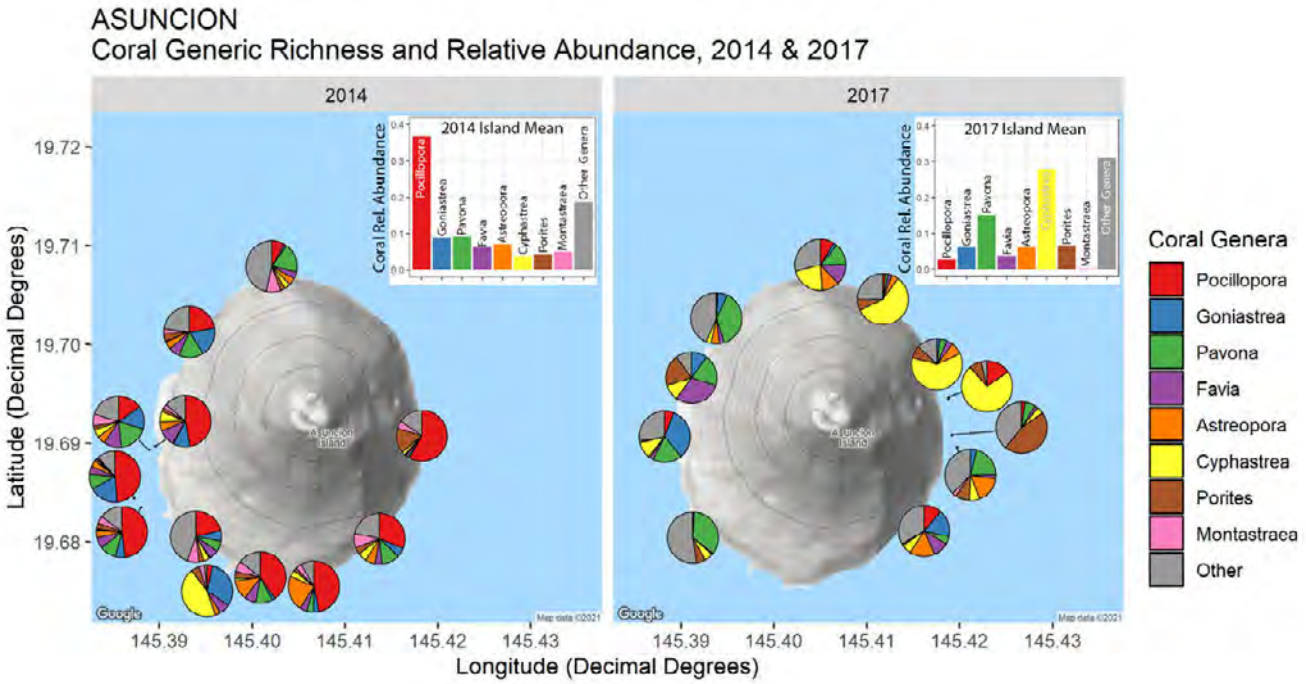
Coral reef community at Maug. Photo: Jean Kenyon/USFWS

Coral reef surveys around Asuncion, Farallon de Pajaros, and Maug in 2014 and 2017 indicate that coral cover varies from island to island, as well as across different regions of each island. The average coral cover is considerably higher at Maug and Asuncion than the average coral cover at Farallon de Pajaros. Coral diversity is also significantly greater around Maug and Asuncion (29 genera) than around Farallon de Pajaros (17 genera). Coral diversity across the Pacific varies greatly due to several factors, including water temperature and clarity, geology, and the presence/absence of human influences. In general, coral diversity decreases as you move away from main centers of diversity in the Coral Triangle (Papua New Guinea, Philippines, and Indonesia) and the Great Barrier Reef. For example, the Coral Triangle hosts 581 species and 81 genera of reef-building scleractinian corals, whereas French Polynesia hosts 163 species and 38 genera, and the eastern Pacific and the coast of Mexico hosts 49 species and 12 genera.[25, 26]

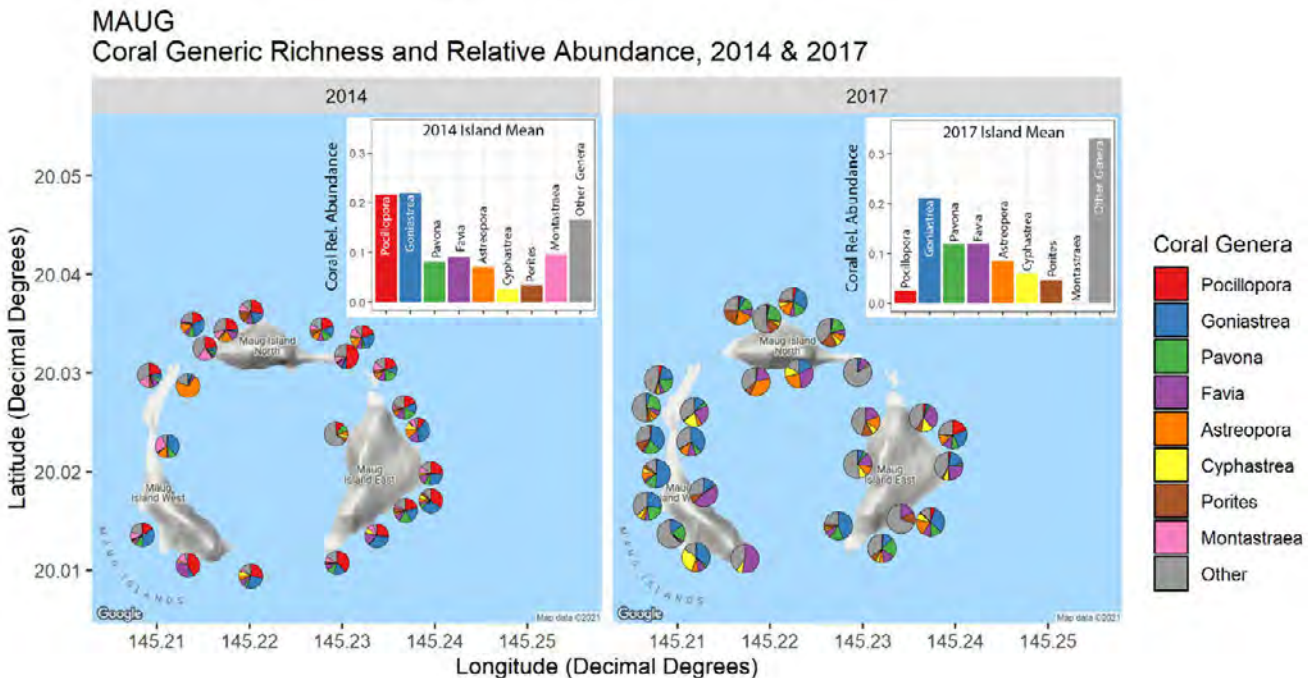
The major threat to corals is global climate change. Temperature extremes lead to bleaching, increased susceptibility to disease, increased severity of ENSO events and storms, and ocean acidification. Another potential threat to Monument corals is the crown-of-thorns starfish (*Acanthaster planci)*, known to be an avid predator of reef-building corals with a preference for branching and tabular corals such as *Acropora* species. The major coral disease occurring at Asuncion was fungal infections. The major coral diseases recorded around Maug were fungal infection, tube worm infestations, and bleaching. Fungal infections and bleaching were the two major diseases recorded at Farallon de Pajaros.[27, 28] Survey data for each of these islands follows.

Corals at Asuncion. Photo: Jean Kenyon/USFWS

Benthic cover at Asuncion. Photo: Jean Kenyon/USFWS



Source: NOAA



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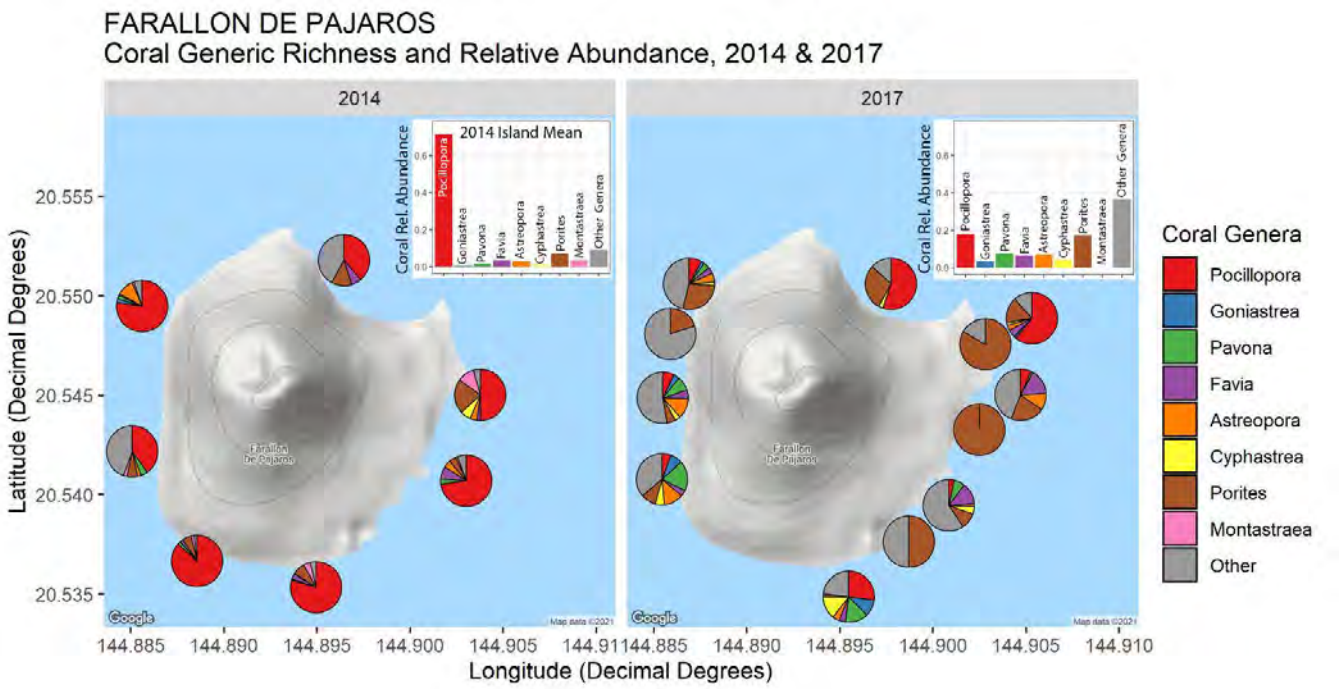

Source: NOAA

4.3.2 Other Habitat Types

Benthic refers to anything associated with or occurring on the bottom of a body of water, in this case, the ocean floor. Emphasis is placed on coral reefs; however, other substrates are also important components of the marine environment. These benthic habitats are particularly important in the Islands Unit, where coral cover is relatively sparse. Habitat surveys from the MARAMP cruises show varying amounts of sand, macroalgae, and crustose coralline algae around the islands of Maug, Asuncion, and Farallon de Pajaros.

Macroalgae is an important part of benthic habitats, as it is a major food source for many herbivorous fish. Macroalgae comprised a significant portion of the benthic substrate at both Maug and Asuncion (>12%) but is much less common (<4%) at Farallon de Pajaros. Although there was a significant difference in diversity, the most common species at all three islands were the brown algae *Lobophora* and the green algae *Halimeda*.[101] Other important habitat types include sand and coralline algae. Sand cover was highly variable, making up the entire habitat in some sites and altogether absent in others. Sand cover was generally present in the highest percentages on the outer flanks and shelves on the southeast sides of the islands. Across all MARAMP surveys, crustose coralline algae cover averaged 8% of the substrate and existed in highest concentrations on the south and westsides of the islands. [29]

Diver documents the benthic habitat at Maug.
Photo: Stefani Gordon

Coral seascape at Maug.
Photo: Jean Kenyon/USFWS

4.4 Fauna

4.4.1 Fish

Tonguefish swims by at NW Eifuku. Photo: NOAA

Coral reefs and other benthic substrates are important habitats for a variety of fish species. The reef fish found around the Mariana Archipelago are representative of the wider Indo-Pacific fauna. Over 427 reef fish species have been documented in the northern islands of the Mariana Archipelago.[30] The most common reef fish families in the northern islands are tangs, damsels, wrasses, and butterfly fish.[31] Sharks, snappers, and jacks are found in abundance around the islands of Asuncion, Maug, and Farallon de Pajaros.

Although species diversity is lower in the northern islands than the southern islands, the total fish biomass across all trophic levels is three times greater and the biomass of large predators is 13 times greater than in the southern islands.[30] Typical of many isolated islands, the number and size of apex predators per unit area is much higher in the Islands Unit than in the waters around the inhabited southern islands. Large numbers of apex predators indicate a flourishing ecosystem at every trophic level in the food chain.

4.4.2 Macroinvertebrates

Giant clam decorates the reef at Maug. Photo: NOAA

Invertebrates such as clams, sea cucumbers, and sea urchins are an important group of reef-associated species. The invertebrate fauna across the Mariana Archipelago is quite diverse, with over 500 species of marine mollusks, numerous species of crustaceans, and many species of echinoderms.[32] Macroinvertebrates exist in relatively low numbers across the Islands Unit, compared to their abundance around the other islands in the archipelago. The giant clam is the lone exception—it thrives along the southern coast of Maug.[30] Macroinvertebrate fauna around Maug is typical of the macroinvertebrate composite in Indo-Pacific waters.

4.4.3 Marine Mammals

Marine mammals are vertebrates who have adapted to life in the ocean. Many marine mammals are able to remain submerged for a long time but must surface for air. To stay underwater for long periods, they store extra oxygen in their muscles and blood than do land mammals. Marine mammals can direct their blood flow to feed only their vital organs to conserve oxygen and can slow their heart rate as a measure to use less oxygen on deep or extended dives. They are relatively large mammals characterized by streamlined bodies that glide easily through water.

All marine mammals are protected in U.S. waters by the ESA and/or the MMPA. ESA-listed marine mammals that may occur in the Islands Unit are the blue whale, fin whale, sperm whale, humpback whale, and sei whale. Other whale species documented in the Mariana Archipelago include short-finned pilot whales, pygmy killer whales, Bryde's whales, Cuvier's beaked whales, melon-headed whales, pygmy sperm whales and dwarf sperm whales. Other cetaceans encountered in the archipelago include spinner dolphins, bottlenose dolphins, pantropical spotted dolphins, striped dolphins, Risso's dolphins, and rough-toothed

dolphins.[31,32] These animals are threatened by a multitude of hazards, including marine debris, entanglement in fishing gear, caught as by-catch in nets and on longlines, collision with large vessels, and sonar operations. Marine pollution, including microplastics, oil spills, and the dumping of industrial wastes into waterways and the sea, can lead to bioaccumulation of toxic substances in body tissues. Overfishing of prey species, particularly commercial species such as anchovy, delete their food supply. Targeted pursuits include striped dolphin drive hunts in Japan; the Caribbean and Sri Lanka; and Risso's dolphin hunted for meat and oil in Indonesia, Japan, the Lesser Antilles, and the Solomon Islands. Fisheries that specifically target pilot whales still exist in Japan and the Lesser Antilles.

4.4.4 Sea Turtles

All sea turtle species are listed as either threatened or endangered under the Endangered Species Act. Although there are no records of turtles nesting in the Islands Unit, it falls within the geographic migration range of five turtle species. They are the green turtle, leatherback, hawksbill, and loggerhead, which are all listed as endangered in the Marianas, and the olive Ridley turtle, which is listed as threatened.

4.4.5 Vent Fauna

The deep-sea hydrothermal vents are populated with a unique array of animals capable of existing in these extreme environments. In addition to the extreme pressure, low temperatures, and lack of light, the hydrothermal vent regions show extremes in temperature, areas of very low oxygen, and the presence of toxic hydrogen sulfide and heavy metals. The vent communities contain specially adapted animals that not only tolerate these conditions but often flourish under them. They have evolved mechanisms for detoxifying heavy metals and hydrogen sulfide. Squat lobsters and limpets occur throughout the region, and tube worms, polychaete worms, crabs, and shrimp are found in mostareas. Snail Vent in the Toto caldera is named after the rather large, hairy vent snails (*Phymorhynchus* and *Alviniconcha* species) that live there.

Snails, crabs, shrimp, and anemones compete for space at Snail Vent hydrothermal site. Photo: NOAA

A stalked crinoid (~5 inches across) rests on the caldera seafloor at West Rota volcano. Crinoids are suspension feeders, using their crown, which is covered with sticky pinnules, to capture zooplankton. Photo: NOAA

4.4.6 Seabirds

Migratory bird species (including most seabirds) are protected by the Migratory Bird Treaty Act, which prohibits the take of protected species, their nests, and eggs. Three of the seabirds that may occur in the Islands Unit are also listed under the ESA as threatened or endangered (Hawaiian Petrel, Newell's Shearwater, and Short-tailed Albatross). Human-induced threats include hooking and drowning on commercial long-line gear; entanglement in derelict fishing gear; ingestion of plastic debris; and contamination from oil spills. Over-fishing directly impacts seabirds, forcing them to fly further in search of food. Of the seabird species that may be found in the Islands Unit, some are considered residents while others are transient visitors. Resident species include black noddy, brown noddy, great frigatebird, white tern, white-tailed tropicbird, red-tailed tropicbird, wedge-tailed shearwater, sooty tern, maskedbooby, brown

booby, and red-footed booby. Seabird species that are considered visitors include Hawaiian Petrel, Newell's shearwater, Leach's storm-petrel, Matsudaira's storm-petrel, short-tailed shearwater, and Audubon's shearwater.

4.5 Conservation Targets

Conservation targets are those species that are given special consideration in the management of the Monument because they have been identified by one or more of the Monument managers. Management for these focal species and the habitats that support them will benefit other native species that are present. Table 4.1 identifies these priority species of concern. This designation is meant to encourage further research and monitoring of these species to aid in management decisions.

4.5.1 Conservation Target Selection

The CNMI Division of Fish and Wildlife and the Guam Division of Aquatic and Wildlife Resources each developed a Strategic Wildlife Action Plan (SWAP) for their respective jurisdictions. These strategies include a determination of species of greatest conservation need in the region, along with recommended conservation actions. Broad public participation was an essential element in developing and implementing these conservation plans. Those marine species and seabirds identifiedin the SWAP as Species of Greatest Conservation Need (SGCN) for CNMI and Guam that occur within the Monument are recognized as conservation targets for the Monument. For each SGCN, CNMI and Guam have identified one or more clear objectives that, when met, will contribute to the overall goal of species and habitat conservation.

Special consideration will also be given to species that may occur within Monument boundaries that are listed as endangered or threatened under the Endangered Species Act. Some conservation targets fall under all three categories. Management of these target species and the habitats that support them will benefit many of the other native and migratory species that are present in the Monument.

Table 4.1. Mariana Trench Marine National Monument conservation targets.

Common Name	Scientific Name	Chamorro	Refaluwasch	ESA status	CNMI *SGCN*	Guam *SGCN*
Seabirds						
Brown booby	*Sula leucogaster*	Lu'ao	O'mwo'o'bwesch			X
Great frigatebird	*Fregata minor palmerstoni*	Paya'ya	Asaf		X	
Hawaiian petrel	*Pterodroma sandwichensis*		Séfföl/Sapaal Mesaang	E		
Masked booby	*Sula dactylatra*	Lu'ao	Amwo		X	
Newell's shearwater	*Puffinus auricularis*			T		
Short-tailed albatross	*Phoebastria albatrus*			E		
Wedge-tailed	*Puffinus pacificus*	Lifa'ru	Lifo'ro		X	
White-tailed tropicbird	*Phaethon lepturusi*	Utak, Fagpi a'paka'	Su'ghu'bwesch			X
Marine Mammals						
Blue whale	*Balaenoptera musculus*	Bayena		E		
Bryde's whale	*Balaenoptera edeni*	Bayena				X
Cuvier's beaked whale	*Ziphius cavirostris*	Bayena				X
Dwarf sperm whale	*Kogia sima*	Bayena				X
Fin whale	*Balaenoptera physalus*	Bayena		E		
Humpback whale	*Megaptera novaeangliae*	Bayena		E		X
Killer whale	*Orcinus orca*	Bayena				X
Melonheaded whale	*Peponocephala electra*	Bayena				X
Pygmy sperm whale	*Kogia breviceps*	Bayena				X
Risso's dolphin	*Grampus griseus*	Toninos				X
Sei whale	*Balaenoptera borealis*	Bayena		E		X
Shortfinned pilot whale	*Globicephala macrorhynchus*	Bayena				X
Sperm whale	*Physeter macrocephalus*	Bayena		E		X
Spinner dolphin	*Stenella longirostris*	Toninos	Dofen, Ghu		X	X
Striped dolphin	*Stenella coeruleoalba*	Toninos				X
Reptiles						
Green sea turtle	*Chelonia mydas*	Haggan bed'di	Wong mool	E	X	X
Hawksbill turtle	*Eretmochelys imbricata*	Haggan karai	Wong maaw	E	X	X
Leatherback turtle	*Dermochelys coriacea*	Hagan tasi	Wong raaw	E		
Loggerhead sea turtle	*Caretta*	Hagan tasi	Wong	E		
Olive Ridley sea turtle	*Lepidochelys olivacea*	Haggan	Wong	T		
Fish						
Angelfish	Pomacanthidae	Ababang				X
Bumphead parrotfish	*Bolbometopon muricatum*	Pachak (juvenile) Fohmo (mid-sized) Atuhong (large)	Roow, ghúúm		X	X
Butterflyfish	Chaetodontidae	Ababang				X
Emperors	Lethrinidae	Mafute, lililuk, Matan hagon				X
Giant manta ray	*Mobula birostris*	Fanihin tasi		T		
Goatfish	Mullidae	Ti'ao (juvenile) Samoneti (adult)				X
Grey reef shark	*Carcharhinus amblyrhynchos*	Katsensitu (juvenile) Halu'on unai	Limwe		X	
Groupers	Serranidae	Gådau				X
Hawkfish	Cirrhitidae	Aluda				
Napoleon wrasse	*Cheilinus undulatus*	Tanguisson	Mem		X	X
Oceanic whitetip shark	*Carcharhinus longimanus*	Halu'u		T		
Rabbitfish	Siganidae	Mañåhakhiteng	Umwaiyé			X
Scalloped hammerhead	*Sphyrna lewini*	Kilu'us		T*		
Snappers	Lutjanidae	Tagafi, fafaet				X
Steephead Parrotfish	*Chlorus microrhinus*	Laggua	Igan-wosh		X	X
Surgeonfish	Acanthuridae	Hugupau, tataga				X

Common Name	Scientific Name	Chamorro	Refaluwasch	ESA status	CNMI *SGCN*	Guam *SGCN*
Fish						
Trevallies	Carangidae	I'e' < 10 cm Mamulan > 90 cm Tarakitiyu 10-25 cm Tarakitu 25-90 cm Tarakituyan 10-25 cm				**X**
Wrasse	Labridae	Ga'das, palaksi				**X**
Invertebrates						
Bear paw clam	*Hippopus*	Hima	Shiim, tto			**X**
Branched murex	*Chicoreus ramosus*	Do'gas	Abwel		**X**	
Collector urchin	*Tripneustes gratilla*	Nufu, Laun	Larr		**X**	
Common spider conch	*Lambis*	Toro	Li'yang		**X**	
Day octopus	*Octopus cyanea*	Gamson	Ghuus		**X**	
Elongate giant clam	*Tridacna maxima*	Hima	Shiim; tto		**X**	**X**
Fluted giant clam	*Tridacna squamosa*	Hima	Shiim, tto		**X**	**X**
Horned helmet shell	*Cassis cornuta*	Kulu prensa	Sa'wi, schap		**X**	
Pectinate venus, Lala clam	*Gafrarium pectinatum*	Tapon, Amsun	Ai'mett, ghatil		**X**	
Southern giant clam	*Tridacna derasa*	Hima	Shiim, tto			**X**
Spiny lobster	*Panulirus penicillatus* *P. versicolor* *P. longipes*	Mahonggang,Gupo'alao	Yuurr		**X**	**X**
Trumpet triton	*Charonia tritonis*	Kulu	Sa'wi		**X**	**X**
Turban shell	*Turbo petholatus* *T. setosus* *T. argyrostomus*	Aliling pulan	Lifott maram		**X**	
Corals						
Acroporid coral	*Acropora globiceps*	Kuraling	Yeal	**T**	**X**	
Hard Coral	Scleractinia	Cho'cho'				**X**
Soft Coral	Octocorallia					**X**

Rough-toothed and bottlenose dolphins off Aguijan.
Photo: D. Webster NOAA/NMFS/ PIFSC

4.5.2 Conservation Targets – Seabirds

Brown Booby (*Sula leucogaster*) Status: **Guam SGCN**

Most brown boobies are brown all over, with a white underside. They dive for fish and squid from heights up to 100 ft and they also skim low over the ocean surface looking for flying fish, which they catch in midair. They often fly in front of ships, watching for fish caught up in the bow-waves. The Brown booby is known to breed on Farallon de Pajaros, Maug, and Asuncion. It is the most common booby in the CNMI but was extirpated in Guam by the brown tree snake. Maintaining a healthy population in CNMI will aid in efforts to eventually restore a population in Guam when suitable predator-free habitat is available.

Great Frigatebird (*Fregata minor palmerstoni*) Status: **CNMI SGCN**

Great Frigatebirds are large, with long, slender wings, deeply forked tail, and a long, pale blue grey-to-blackish hooked bill. Adults have mostly black plumage. Adult males have a red inflatable throat pouch. Females have white breasts and on average are larger than males.

Hawaiian Petrel (*Pterodroma sandwichensis)* Status: **Endangered**

The Hawaiian petrel has a dark gray head, wings, and tail and a white forehead and belly. It has a stout grayish-black bill that is hooked at the tip, with pink and black feet. Although it only nests in the Hawaiian Islands, the Hawaiian petrel is a bird of the open Pacific seas, feeding on squid, fish, and crustaceans. It is an occasional visitor to the waters of the Monument.

Masked Booby (*Sula dactylatra)* Status: **CNMI SGCN**

The masked booby is the largest of all the boobies, with a wingspan over 5 ft. It is white with a brown or black edge on the wing feathers and a yellow bill. Masked boobies forage in offshore and pelagic waters of the Islands Unit. They are known to breed on the islands of Farallon de Pajaros and Maug and venture out at as far as 1,200 nmi from breeding colonies during nonbreeding season.[34] Further research is needed to determine the current population status and distribution of this species in the Mariana Archipelago.

Newell's Shearwater (*Puffinus auricularis newelli)* Status: **Threatened**

The Newell's shearwater has a glossy black top, a white underside, and a black bill that is sharply hooked at the tip. Shearwaters tend to be sociable at sea, and the Newell's shearwater is known to occasionally follow ships. Shearwaters feed by surface seizing and pursuit plunging. Often, shearwaters will dip their heads under the water to sight their prey before submerging. Although they are believed to breed only in the Hawaiian Islands, Newell's shearwaters occasionally visit the CNMI.

Short-tailed Albatross (*Phoebastria albatrus*) Status: **Endangered**

With a wingspan of >7 ft, the short-tailed albatross is the largest seabird in the North Pacific. Its long, narrow wings are adapted to soaring low over the ocean. It is best distinguished from other albatrosses by its large, bubblegum-pink bill. Adults have an entirely white back, white or light gold head and back of neck, with black and white wings. Young birds also have the large pink bill, but their feathers are dark chocolate brown, gradually turning white as the bird ages. After breeding, short-tailed albatrosses move to feeding areas in the North Pacific, intermittently including the waters of the Monument. When feeding, albatrosses alight on the ocean surface to seize their prey, including squid, fish, and shrimp.

Wedge-tailed Shearwater (*Puffinus pacificus*) Status: **CNMI SGCN**

Wedge-tailed shearwaters are brownish gray on their backs and tails with light gray on their chests. This bird is about the size of a pigeon. Wedge-tailed shearwaters can stay at sea for years. Their webbed feet make it possible for them to kick off from the surface of the water or from the crest of a wave. Although they have been sighted in flight around several of the northern islands, wedge-tailed shearwaters are only known to nest on Mañagaha Island in the CNMI.

White-tailed tropicbird (*Phaethon lepturus)* Status: **Guam SGCN**

Resident seabirds on Farallon de Pajaros, Maug, and Asuncion, white-tailed tropicbirds are white with black markings and yellow bills with notches in them to help them hold their slippery prey. They have sharply pointed wings and two long, white feathers streaming from their tails. Tropicbirds hover over the water to catch flying fish, their main prey item. They can also dive from high up in the air to catch smaller fish and squid. Maintaining a healthy white-tailed tropicbird population in CNMI will help Guam's efforts to eventually restore a nesting population in northern Guam.

White-tailed tropicbird. Photo: USFWS

4.5.3 Conservation Targets – Marine Mammals

Whale (*Balaenoptera musculus)* Status: **Endangered**

The blue whale has a long body and comparatively slender shape, a broad, flat rostrum when viewed from above, a proportionately smaller dorsal fin than other baleen whales, and a mottled gray color pattern that appears light blue when seen through the water. At 98 ft in length and 210 tons or more in weight, it is the largest existing animal and the heaviest that ever existed. They primarily feed on zooplankton, especially krill. The blue whale inhabits all oceans and may travel through Monument waters during the winter months.

Bryde's Whale (*Balaenoptera edeni)* Status: **Guam SGCN**

Bryde's whales are members of the baleen whale family and are considered one of the "great whales" that can reach lengths of 40–55 ft and weigh up to 45 tons. They have a sleek body that is dark gray in color and white underneath. They can be distinguished from sei whales by three distinct prominent longitudinal ridges located on the animal's rostrum in front of the blowhole. Bryde's whales are the most common baleen whales likely to occur in the Islands Unit.

Cuvier's Beaked Whale (*Ziphius cavirostris)* Status: **Guam SGCN**

Cuvier's beaked whale, also known as the goosebeak whale, has a robust body weighing 5,500 pounds and reaching as long as 23 ft, with a small head which is about 10% of its body length. Its forehead slopes to a short beak, and its mouth turns upward. They prefer deep-water habitats over 3,300 ft deep. A recent study of tagged Cuvier's beaked whales discovered they perform some of the deepest and longest dives of any mammal at nearly 10,000 ft Squid are its primary food, augmented with fish or crustaceans.[35]

Dwarf Sperm Whale (*Kogia sima)* Status: **Guam SGCN**

The dwarf sperm whale can reach lengths of up to 9 ft and weigh between 300 and 600 pounds. They are similar in appearance to the pygmy sperm whale but have a larger dorsal fin, generally set nearer the middle of the back. Also, the dwarf sperm whale's blowhole is positioned further forward. Similar to squid, dwarf sperm whales use an ink-like liquid to evade and deter predators.

Fin Whale (*Balaenoptera physalus)* Status: **Endangered**

The fin whale is long, sleek, and streamlined, with a V-shaped head that is flat on top. It is the second-largest animal after the blue whale, growing to 90 ft long and weighing nearly 82 tons. Among the fastest of the great whales, it is capable of bursts of speed of up to 23 mph leading to its nickname the "greyhound of the sea." Its most unusual characteristic is the asymmetrical coloring of the lower jaw, which is white or creamy yellow on the right side and mottled black on the left side.[836]

Humpback Whale (*Megaptera novaeangliae)* Status: **Endangered, Guam SGCN**

Reaching between 40 and 50 ft in length, a humpback whale can weigh up to 48 tons. They are identified from other whales due to their large flippers, almost one-third of their body size, and the hump on their backs. Humpback whales eat fish and krill. In 2016, NMFS issued a final determination to revise the listing status of the humpback whale under the ESA and divided the globally listed endangered species into 14 distinct population segments (DPSs). The endangered Western North Pacific DPS of the humpback whale migrates into the Mariana Archipelago region every winter.[57]

Killer Whale (*Orcinus orca)* Status: **Guam SGCN**

Killer whales, also known as Orcas, have a distinctive color pattern, with a black back and white belly. They have a conspicuous white patch above and behind the eye and a gray or white saddle behind the dorsal fin. They can grow as long as 32 ft and can weigh as much as 11 tons. With no known natural predators, the killer whale is considered to be the top predator of the oceans.[58]

Melon-headed Whale (*Peponocephala electra)* Status: **Guam SGCN**

Melon-headed whales can reach a length of 9 ft and weight of 460 pounds. They have a small head with a rounded melon and no discernable beak. Melon-headed whales make fast, low leaps from the water as they swim. They prey on squid, fishes, and occasionally crustaceans.

Pygmy Sperm Whale (*Kogia breviceps*) Status: **Guam SGCN**

Like the sperm whales they are named after, pygmy sperm whales have teeth in the lower jaw only. They grow to a maximum length of 14 ft and weigh up to 900 pounds. Pygmy sperm whales are often confused with sharks because the head and lower jaw are somewhat shark-like in appearance. On each side of its head is a light, bracket-shaped line called a “false gill” that resembles the gill slits of fish. Similar to dwarf sperm whales, they have the ability to use an ink-like liquid to evade and deter predators.

Risso’s Dolphin (*Grampus griseus*) Status: **Guam SGCN**

Risso’s dolphins are medium-size cetaceans that can reach lengths of 13 ft and weigh up to 1,100 pounds. They have a bulbous head with a vertical crease and an indistinguishable beak. Calves have a dark cape and saddle; however, as Risso's dolphins age, their coloration lightens from black, dark gray or brown to pale gray or almost white. They feed on fish, krill, squid, octopus and cuttlefish, mainly at night when their prey is closer to the surface. Historically, large numbers of Risso’s dolphins were killed incidental to tuna purse-seine fishing in the eastern tropical Pacific Ocean.

Sei Whale (*Balaenoptera borealis*) Status: **Endangered, Guam SGCN**

Sei whales are considered the fastest-swimming cetaceans, reaching top speeds of 34.5 mph. These large animals can reach lengths of 60 ft and weigh 50 tons. Sei whales have a long, sleek body that is dark bluish gray to black in color and pale underneath. During the 19th and 20th centuries, sei whales were targeted and greatly depleted by commercial hunting and whaling, with an estimated 300,000 animals killed for their meat and oil. Two sei whales have been sighted and tagged in the vicinity of the Mariana Islands. Although sei whales are distributed throughout the world’s oceans, they are one of the least-studied whale species.

Short-finned Pilot Whale (*Globicephala macrorhynchus*) Status: **Guam SGCN**

Short-finned pilot whales seen spy-hopping during Marianas Cetacean Survey. Photo: Adam Ü/NOAA

Short-finned pilot whales are the second-largest species in the dolphin family after killer whales with a maximum male size of 24 ft and 6,600 pounds. They are black or dark grey with a grey or white cape. They have grey or almost white patches on their bellies and throats and a grey or white stripe, which goes diagonally upwards from behind each eye. Short-finned pilot whales are long-lived, slow to reproduce, and highly social. They live in stable groups of 15 to 30 animals composed of close family relatives and tend to live in localized, resident populations, although some populations have wider ranges. Their diet consists primarily of squid, with a small number of fish.

Sperm Whale (*Physeter macrocephalus*) Status: **Endangered, Guam SGCN**

Sperm whales are the largest of the toothed whales and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 36 ft and weigh 15 tons. Adult males, however, reach about 52 ft and may weigh as much as 45 tons. Because sperm whales spend most of their time in deep waters, their diet consists of many larger organisms that also occupy deep waters of the ocean. Their main prey is large squid, but they will also eat sharks, skates, and fishes. Dives may last over an hour and reach depths over 3,280 ft. Sperm whales are widely distributed in the global ocean. In the Pacific Ocean, sperm whales are divided into three stocks. The stock that occurs in the Mariana Archipelago is part of the Asian stock.[34]

Spinner Dolphin (*Stenella longirostris*) Status: **CNMI/Guam SGCN**

The spinner dolphin is the only cetacean species that is known to be a year-round coastal resident in the CNMI and Guam. They are relatively small, reaching lengths of 7 ft and weighing up to 170 pounds. Spinner dolphins are best known for their above-water displays of leaping and spinning several times on their body axis. A single spinning leap can include as many as four body revolutions. Historically, the presence of dolphins was used by the tuna purse-seine fishery to find tuna. Dolphins could become trapped in the nets and drown. Stress from being encircled in purse-seines has been documented as a very serious threat to dolphins. Currently, tuna imported into the United States under the Dolphin-Safe program does not allow the practice of setting on dolphins.

Striped Dolphin (*Stenella coeruleoalba*) Status: **Guam SGCN**

Striped dolphins' scientific name comes from the Latin words *caeruleus* and *albus*, which mean "sky blue" and "white," respectively, referring to the animal's distinct color pattern on the dorsal and lateral portions of their body. They can reach 9 ft and weigh up to 285 pounds. Striped dolphins are usually found in tight, cohesive groups of about 25 to 100 individuals and have been observed breaching, jumping, and leaping over 20 ft above the surface of the water. Striped dolphins display a unique behavior called "roto-tailing," which is when the animal leaps high out of the water and while in the air it vigorously rotates its tail. They prefer deep tropical to warm temperate oceanic waters and are attracted to upwelling areas, where deep, cold, nutrient-rich water rises toward the surface, and convergence zones, where ocean currents meet.

4.5.4 Conservation Targets – Marine Turtles

Green Turtle (*Chelonia mydas*) Status: **Endangered, CNMI/Guam SGCN**

Green turtles have been split into 11 DPS under the ESA. The Central West Pacific DPS‡ was listed as endangered in 2016. A cooperative study of isolated reefs provided a resident population estimate in the Mariana Archipelago at somewhere between 1,000 and 2,000 turtles. Adults can weigh up to 500 pounds. Adult turtles residing near shore are herbivorous, feeding primarily on macroalgae and sea grasses. Hatchlings and juveniles living in pelagic habitats are most likely to eat soft-bodied invertebrates, jellyfish, and fish eggs. The common name "green sea turtle" is derived from the color of their body fat, which is green from the algae they eat.[39]

Hawksbill Turtle (*Eretmochelys imbricate*) Status: **Endangered, CNMI/Guam SGCN**

The hawksbill is one of the smaller sea turtles. It takes its common name from the shape of its hooked jaw. Its narrow head and jaws allow it to eat sponges, anemones, and shrimp from coral crevices.[40] Although uncommon in the Mariana Archipelago, hawksbill nesting has been documented in Guam. The hawksbill turtle used to be fished commercially in the CNMI. Both CNMI and Guam wildlife management agencies ask that this species be given careful consideration in developing conservation measures and included in any research project addressing sea turtles.

Leatherback Turtle (*Dermochelys coriacea*) Status: **Endangered**

The leatherback is the largest, deepest diving, and most migratory and wide-ranging of all sea turtles.An adult can reach up to 8 ft in length and 500–2000 pounds. The skin is predominantly black with pale spotting, including a notable pink spot on the dorsal surface of the head in adults. The paddle-like, clawless limbs are black with white margins and pale spotting. The leatherback is the only sea turtle without a hard bony shell. Instead, its top shell consists of leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. Although there are no reports of leatherback turtles nesting in the Mariana Archipelago, they are known to occur in both the CNMI and Guam.

Loggerhead Sea Turtle (*Caretta caretta*) ***North Pacific Ocean DPS*** Status: **Endangered**

Loggerhead turtles have large heads that support powerful jaws and enable them to feed on hard-shelled prey. Although the only known nesting areas in the North Pacific are found in Japan, loggerheads are famed for vast migrations between foraging areas and nesting beaches. Guam and the CNMI are within the species' overall range. The westward-flowing current of the North Pacific Subtropical Gyre system, which late juvenile stage loggerheads use when returning to the Western Pacific, passes through the Marianas region.[44] The North Pacific Ocean DPS of the loggerhead sea turtle was listed as endangered in 2011. NOAA initiated a five-year review in 2016, which underwent peer review and is based on the best available data through March 2020 and found no change to the listing status of the DPS was warranted.

Olive Ridley Sea Turtle (*Lepidochelys olivacea*) Status: **Threatened**

The olive Ridley was named for the olive color of its heart-shaped shell. It is one of the smallest of the sea turtles, with adults reaching 2.5 ft in length. Although there is only one report of olive Ridley turtles in waters around the Mariana Archipelago (an alleged capture near Saipan), they lead a highly pelagic existence, and it is possible they could occur in the Islands Unit. They consume a variety of prey in the water column and on the seafloor, including snails, clams, tunicates,fish, fish eggs, crabs, oysters, sea urchins, shrimp, and jellyfish.[97]

‡ The range of the Central West Pacific DPS encompasses the Republic of Palau, Federated States of Micronesia, New Guinea, Solomon Islands, Marshall Islands, Guam, the CNMI, and the Ogasawara Islands of Japan.

4.5.5 Conservation Targets – Fish

Angelfish (Pomacanthidae) Status: **Guam SGCN**

The Pomacanthidae family of angelfish are extremely flat bodied with high dorsal and anal fins. They have long and flowing pelvic fins and a large, fan-shaped caudal fin. Angelfish can be distinguished from butterflyfish by the presence of a spine on each side of the body.[58] In the 1980s–90s, Guam was a major source for aquarium fish. Outside of the Monument, angelfish are threatenedby overfishing by the aquarium trade and loss of habitat.

Bumphead Parrotfish (*Bolbometopon muricatum)* Status: **CNMI/Guam SGCN**

The bumphead parrotfish is a highly prized food fish. They reach over 3 ft in length and are usually dark green except for the leading edge of the head, which is light green to pink. They feed on live coral and will ram corals to break them up into smaller pieces for eating. [59] Dulvy and Polunin[46] report they are rare and possibly extirpated in Guam. Anecdotal evidence indicates that population levels have declined substantially around the more populated southern islands of the CNMI.[1]

Butterflyfish (Chaetodontidae) Status: **Guam SGCN**

Chaetodontidae is a family of coral reef fishes also popular in the aquarium trade, although many species do poorly in captivity. There are more than 100 different species of butterflyfish, called so due to the bright and colorful patterns on its body. These fish often travel in schools and a solitary traveling fish is usually in search of a mate. When the fish finds a mate, they remain together for years, if not for life.[58]

Emperors (Lethrinidae) Status: **Guam SGCN**

The Lethrinidae family of fish includes about 20 different species of emperors. Features common to all species include thick lips, strong jaws, and cheeks without scales. This family is heavily fished using a number of techniques, including gill nets, spearfishing, and hook and line. Most species of emperors begin life as females and change sex to become males as they grow.[59]

Goatfish (Mullidae) Status: **Guam SGCN**

Goatfish have a streamlined body with two dorsal fins, a forked tail, slightly inferior mouth suited for bottom-feeding, and a pair of chin whiskers called barbels. These barbels are used to actively probe, excavate, and detect hidden invertebrates and small fish. Most species are capable of changing color rapidly and often assume a mottled or barred pattern at night. Goatfish are commercially important because their flesh tastes like shrimp and red fish are a symbol of good luck to Asian cultures.

Hawkfish (Cirrhitidae) Status: **Guam SGCN**

Hawkfish have large heads with thick, somewhat elongated bodies. Their dorsal fins are merged, with the first consisting of 10 connected spines. At the tip of each spine are several trailing filaments. The family name Cirrhitidae is from the Latin *cirrus* meaning “fringe.” Threats include overfishing, aquarium collection and loss of habitat. Collection of these species for the aquarium trade often leads to the destruction of the corals they inhabit.

Black-sided hawkfish. Photo: USFWS/L. Beauregard

Giant Manta Ray (*Mobula birostris*) Status: **Threatened**

The giant manta ray is the world's largest ray with a wingspan of up to 29 ft. They are filter feeders and eat large quantities of zooplankton. Giant manta rays are slow-growing, migratory animals with small, highly fragmented populations that are sparsely distributed across the world. The main threat to the giant manta ray is commercial fishing, with the species both targeted and caught as bycatch in a number of fisheries throughout its range. NOAA Fisheries listed the species as threatened under the ESA in 2018.

Grey Reef Shark (*Carcharhinus amblyrhynchos)* Status: **CNMI SGCN**

The grey reef shark can be distinguished from similar species by the plain or white-tipped first dorsal fin, the dark tips on the other fins, the broad, black rear margin on the tail fin, and the lack of a ridge between the dorsal fins. Most individuals are less than 6.2 ft long. This species is most often seen in shallow water near the drop-offs of coral reefs. They are considered a nuisance species by some local fishers who will first fish the sharks out of an area before commencing bottom fishing. Small litter size, late onset of maturity, restricted habitat choice throughout its distribution, site fidelity, inshore distribution, and willingness to take a baited hook make the gray reef shark especially vulnerable.[9]

Groupers (Serranidae) Status: **Guam SGCN**

At least 41 species of groupers occur in the Marianas. They are robust-bodied, bottom-oriented carnivores with representatives on shallow reef flats to depths of 600 ft or more. Many are hermaphrodites, starting their mature life as females before changing to males. They are slow growing, with maturity coming after several years for most species. Groupers are voracious ambush predators and will readily strike at lures or bait. They form seasonal spawning aggregations, based on a lunar cycle, and individuals may migrate for miles to congregate in favored sites.[9]

Napoleon Wrasse (*Cheilinus undulatus*) Status: **CNMI/Guam SGCN**

Napoleon Wrasse. Photo: Patryk Krzyzak

Napoleon Wrasse are distinguished by a prominent bulbous hump on the forehead and thick, fleshy lips. Adult males have blue to blue-green heads, bodies and fins, a yellow posterior margin to the tail and may have a red margin to the rayed portion of the dorsal fin. One of the largest reef-associated fish, a male Napoleon wrasse can reach over 7 ft long and weigh over 400 pounds.[9] Females rarely grow larger than 3 ft long.

Oceanic Whitetip Shark (*Carcharhinus longimanus*) Status: **Threatened**

Oceanic whitetip sharks grow to 11 ft and have a distinctive pattern of mottled white markings on the tips of their dorsal, pectoral, and tail fins. Their dorsal fins are rounded and their pectoral fins are long and paddle-like. Their populations have declined due to bycatch in commercial fisheries combined with the rise in demand for shark fins. NOAA Fisheries listed the species as threatened under the ESA in 2018.

Rabbitfish (Siganidae) Status: **Guam SGCN**

A popular food fish, the Siganidae family includes 28 species commonly called rabbitfish. They have small mouths, and many species are covered in maze-like patterns. The fin spines are equipped with poison glands that are capable of giving a painful wound. [9]

Scalloped Hammerhead Shark (*Sphyrna lewini*) **– Indo-West Pacific DPS** Status: **Threatened**

Scalloped hammerhead sharks are moderately large sharks with a global distribution. The flat, extended head is characterized by an indentation located centrally on the front margin of the broadly arched head. Two more indentations flank the main central indentation, giving this hammerhead a "scalloped" appearance. They feed on crustaceans, fish, cephalopods and rays. The Indo-West Pacific DPS of scalloped hammerhead shark was determined to be a threatened species under the ESA in 2014. This species is targeted for the shark fin trade because of its fin size and high fin ray count. The Eastern Pacific DPS and Eastern Atlantic DPS are listed as endangered.

Scalloped hammerhead shark. Photo: Kevin Lino NOAA/PIFSC

Snappers (Lutjanidae) Status: **Guam SGCN**

Snappers are perch-like fishes with a continuous dorsal fin, elongated bodies, large mouths, sharp canine teeth, and blunt or forked tails. They can grow to a length of 2–3 ft. [9] Some species are the primary fisheries species taken from deep reefs (>500 ft). In Guam they are threatened by overfishing and loss of habitat.

Steephead Parrotfish (*Chlorus microrhinos*) Status: **CNMI SGCN**

Parrotfish get their common name from their beak-like teeth and bright colors. Most eat the thin algal film on bare coral rock and their constant scraping creates much of the sediment on coral reefs.[8] They are a popular food fish in the region. Steephead parrotfish are greenish blue, with a brilliant blue band behind the corner of the mouth and a wide blue patch along the head.

Surgeonfish (Acanthuridae) Status: **Guam SGCN**

The family of Surgeonfish are popular food fish threatened by loss of habitat and overfishing. They have tough skin with rough scales and a single scalpel-like dorsal spine which folds into a groove. Many are brightly colored and popular in the aquarium trade. [9]

Trevalley (Carangidae) Status: **Guam SGCN**

Another popular food fish threatened by loss of habitat and overfishing, most Trevalley species are fast-swimming predatory fishes that hunt in the waters above reefs and in the open sea. All have streamlined bodies, with two separate dorsal fins and a forked tail. Juveniles are found on reef flatsor around floating objects such as buoys and floating debris. Adults are found on reef flats and seaward reefs to a depth of at least 300 ft.[9]

Wrasse (Labridae) Status: **Guam SGCN**

Wrasses are also popular food fish threatened by loss of habitat and overfishing. The species in this family are very diverse in size and form, most with complex colorful patterns that change as they grow and vary by sex. Wrasses are found in almost all coral reef habitats, from sandy reef flats to seaward reef slopes and deep reefs (>500 ft).[9]

4.5.6 Conservation Targets – Invertebrates

Bear Paw Clam (*Hippopus hippopus*) Status: **Guam SGCN**

Bear paw clams are a bivalve mollusk in the giant clam family. Reaching 15 inches in size, they have a brownish mantle with thin white lines across the surface. Clams first become sexually mature as males and then later become hermaphrodites releasing both sperm and egg at separate times during spawning events. Bear paw clams have been collected for their meat, as well as their shells.[53]

Branched Murex (*Chicoreus ramosus*) Status: **CNMI SGCN**

The branched murex is a predatory sea snail, feeding on other mollusks and barnacles. Its shell is whitish, sometimes stained rusty pink near sutures and along spiral lines, and it has leaf-like spines on the axial varices. The margin of the outer lip is pink and has a prominent tooth-like process. It is considered an economically important species in the Indo-West Pacific.[53]

Collector Urchin (*Tripneustes gratilla*) Status: **CNMI SGCN**

This shallow water macroinvertebrate has historical ties with commercial exploitation in other areasof the Indo-Pacific. The roe is considered a delicacy in Asia. The internal organs are surrounded by a rigid skeletal shell, and its moveable spines provide protection against predators. Collector urchins grow up to 6 inches in size. It often collects rocks, sponges, shells, or algae to provide camouflage for itself. The slow-moving urchin utilizes soft tubed feet with suction cups to graze along the substrate feeding on seagrasses, algae, and various detritus.

Common Spider Conch (*Lambis lambis*) Status: **CNMI SGCN**

The common spider conch is a large marine snail collected for both consumption and ornamentation. Common spider conch shells have a flared outer lip ornamented with six elongate spines extending from the edge. They are herbivorous, usually feeding on red algae.

Day Octopus (*Octopus cyanea)* Status: **CNMI /Guam SGCN**

Several octopus species are sought for food in the CNMI and Guam. The day octopus is gray to brown, with arms three times the head length. It is active during the day, foraging on large crabs and fish, including moray eels, to depths of about 150 ft. Its preferred habitat includes coral reefs, reef flats and other rocky substrata. It can be recognized by a black spot surrounded by another black ring on the base of the arm web. Living as it does on coral reefs and hunting by day, the day octopus is adept at camouflage and not only can change color frequently, but also can change the patterns on and texture of its skin.

Day octopus on the side of a fault scarp. Photo: NOAA

Elongate Giant Clam (*Tridacna maxima)* Status: **CNMI SGCN**

Elongate giant clams are the most widespread species of giant clam, found from intertidal reef flats to a 30-ft depth. This species has well developed concentric growth folds and may reach 13 inches in length. The mantles are usually brightly colored, and it is popular in the aquarium trade, as well as for consumption.[53]

Fluted Giant Clam (*Tridacna squamosa*) Status: **CNMI SGCN**

The fluted giant clam can be recognized by the rows of large leaf-life flutes on the surface of the shell. It may reach 15 inches in length and inhabits shallow reef flats to depths of 60 ft. The mantle tissues act as a habitat for symbiotic single-celled algae from which it gets a major portion of its nutrition. By day, the clam spreads out its mantle tissue so that the algae receive the sunlight they need to photosynthesize. [53]

Horned Helmet Shell (*Cassis cornuta)* Status: **CNMI SGCN**

The horned helmet shell is hunted for meat and is also a very popular collector's item. The length of the shell varies between 2 and 5 inches. It is the largest of all helmet shells with a heavy, rotund shell with large, horn-like knobs and a wide, flat base. The shell has a dorsally pale orange color, its base vivid orange, faintly marked with white and brown.[53]

Pectinate Venus (*Gafrarium pectinatum*) Status: **CNMI SGCN**

Pectinate venus are small bivalves that are harvested for consumption purposes from intertidal and shallow water, although its habitat ranges to a 60 ft depth in sand and gravel bottoms. The shell can reach 2 inches in length, is white to cream-colored on the outside, and occasionally spotted upon the radial ribs with brown.[53]

Southern Giant Clam (*Tridacna derasa*) Status: **Guam SGCN**

The southern giant clam reaches up to 2 ft in length, The species is also known as the smooth giant clam because of the relative lack of ribbing and scales on its thick shell. *Tridacna* clams have muscles for opening and closing their shell and a foot for attaching themselves to rocks. They breathe through gills and feed through a mouth. Most clams fulfill their nutritional requirements by filter feeding and absorbing dissolved organic compounds from the water, but tridacnid clams have gone further than this by using zooxanthellae algae in their tissue to manufacture food for them. They usually appear blue or greenish.[53] Populations have been reintroduced after extirpation in Guam and the CNMI.

Spiny Lobster (*Panulirus penicillatus, P. versicolor, P. longipes*) Status: **CNMI /and Guam SGCN**

There are several species of spiny lobsters in the Monument waters. Lobsters are opportunistic and omnivorous scavengers with food items being consumed, including mollusks, crustaceans, echinoderms, seagrass, and algae. They are nocturnal foragers with *Panulirus penicillatus*, moving through the spur and groove channels to the reef crest and reef flat.[52] The spiny lobster is a high value commodity in the CNMI, with a local commercial market that supports both island residents and the restaurant industry.

Trumpet Triton (*Charonia tritonis*) Status: **CNMI /Guam SGCN**

The trumpet triton has a mottled brown and white shell with encircling ribs, a long spire, and can reach 19 inches in length.[53] Locomotion is achieved by a strong, muscular foot, which this snail uses to pursue such prey as sea urchins and sea stars. The trumpet triton is the major predator of the crown-of-thorns, which is notorious for feeding on and destroying corals. Over collection of the beautiful triton shells is suspected as one cause in crown-of-thorns infestations.

Turban Shell (*Turbo petholatus, T. setosus, T. argyrostoma*) Status: **CNMI SGCN**

The thick, chalky operculum resembles a cat's eye. In some species, the shell does resemble an elegant turban. The Latin "turbo" refers to a top, the spinning toy. Species of this family are herbivores. Females lay gelatinous egg masses and the eggs hatch as free-swimming larvae.[57] The most serious threat to the turban shell populations in the CNMI is overexploitation of the resources. In addition to collection for decoration, turban shells are locally consumed as a food source throughout the Indo-Pacific region.

4.5.7 Conservation Targets – Corals

Guam's SWAP covers all hard and soft corals. *Acropora globicep was* federally protected with a "threatened" listing under the ESA in August 2014 and identified in the CNMI SWAP as SGCN. The Marine Resources Conservation and Monitoring Action Plan proposes managers work with partners to conduct population studies of T&E species to determine their presence/absence in the Monument to help determine the best course of action in helping to sustain healthy populations or help those species recover.

Acropora globiceps. Photo: Douglas Fenner

Acroporid coral (*Acropora globiceps)* Status: **Threatened, CNMI SGCN**

Staghorn coral colonies are digitate and usually small. The size and appearance of branches depends on degree of exposure to wave action but are always short and closely compacted. This species is susceptible to bleaching, disease, crown-of-thorns starfish predation, and loss of habitat. [44] Critical habitat for *Acropora globiceps* has been proposed/designated for water depths of 1–12 ft around Maug and Farallon de Pajaros.

Hard Corals (Scleractinia) Status: **Guam SGCN**

Hard corals have calcium carbonate skeletons, grow in colonies, and are reef-building animals that live in symbiosis with phytoplankton called zooxanthellae. Colonial corals consist of large numbers of polyps, cemented together by the calcium carbonate that they secrete. Reef biologists in Guam have noted a distressing indicator of the health of Guam's coral reefs in the marked decrease in rates of coral recruitment. Studies of hard corals in the Monument will add to the scientific knowledge needed to make management decisions throughout the archipelago.

Soft Corals (Octocorallia) Status: **Guam SGCN**

Soft corals are flexible, have calcareous particles in their body walls for structural support, can be found in both tropical and cold ocean waters, do not grow in colonies or build reefs, and do not always contain zooxanthellae. Although commonly called "soft corals," the Octocorallia are not close relatives of the Scleractinia or hard corals living today. Unlike hard corals, which have hexaradial symmetry, octocorals have eightfold radial symmetry. All octocorals are colonial polyps, and in some, such as the Pennatulacea or sea pens, the polyps are specialized for various functions. Octocorals are traditionally divided into six orders:

Sea fans in the Marianas. Photo: Rachel Rounds /USFWS

Telestacea and **Alcyonacea** are two types of soft coral
Stolonifera organ-pipe corals
Gorgonacea sea fans and sea whips
Pennatulacea sea pens and sea pansies
Helioporacea blue coral

Populations of soft corals seem to be declining in the Mariana Archipelago at present. These corals serve as important habitat for a number of marine invertebrates. Studies of soft corals in the Monument will add to the scientific knowledge needed to make management decisions throughout the archipelago.

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Chamorro Flying Proa. Photo: Marianas Visitors Authority

Chapter 5. Cultural and Socioeconomic Resources

5.1 Introduction

Cultural perspectives, sense of place, values about natural resources, and views about connections between humans and the environment influence how groups of people in diverse communities resolve resource management issues. The Mariana Islands are politically divided between the U.S. Territory of Guam and the U.S. Commonwealth of the Northern Mariana Islands. Home to two indigenous people, the Chamorro and Carolinians, the CNMI and Guam host a rich diversity of heritage today. Because the Monument area and its marine ecosystems hold a longstanding place in the culture of archipelago residents, the region's history and cultural composite are important elements to integrate into resource management efforts.

The creation of the Mariana Islands is taught in different ways, one of which is in geological terms. Another explanation is provided in the origin story of the Mariana Archipelago and its people, as documented by Bo Flood, author of *Marianas Island Legends, Myths and Magic*.[1] As the story goes, the universe began with emptiness. The caretakers of the deep emptiness were a brother and sister named Puntan and Fu'uña. Puntan saw his own life drawing to an end but did not want to leave his sister alone in the emptiness. He devised a plan, shared it with Fu'uña, and asked that she promise to fulfill his wishes. Dr. Flood describes the first moments of creation on the following page.

Chamorro Creation Legend

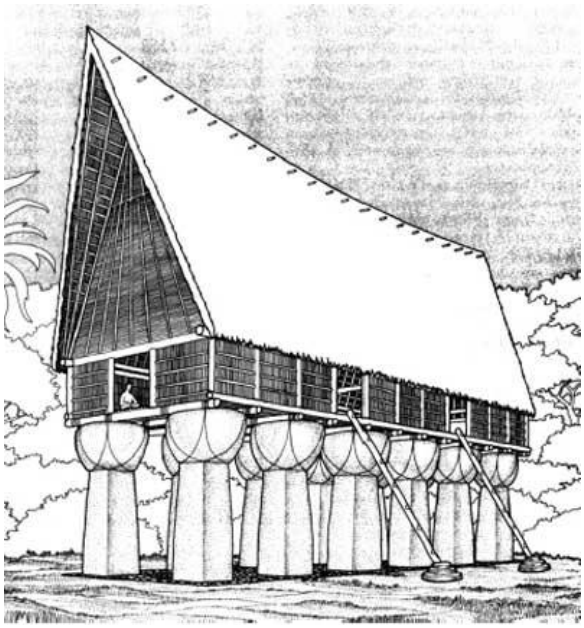
As Puntan's last breath left his body, Fu'uña held her brother and wailed woman's first birth song. She lifted his head upward and let life flow into the emptiness. Then Fu'uña plucked out her brother's eyes and flung them high above her. Their brightness became the sun and moon. Up, up she pushed his heavy breast until it arched across the heavens and became the sky. The drumming of his heart continued to beat the rhythm of night following day, turning, season turning – day following night.

Fu'uña laid Puntan's back along the emptiness to form the earth. She prepared and tilled his back so out of it, taro and other essential plants could grow. Coconut trees spouted, vegetation grew plentiful, and the ocean expanded. Fu'uña cast Puntan's eyebrows into the sky, refracting the sun's bright light into a colorful rainbow.

She [Fu'uña] swam with the sharks and followed the whales until she reached a string of lovely islands. She walked their beaches chasing ghost crabs, collecting shells, watching tropic birds soar between clouds. She laughed as hermit crabs scampered sideways and sea cucumbers spat out sand. She watched as fish nibbled on coral, amazed at their colors and shapes. Her brother had planned well. The earth was a beautiful place. But still she was lonely.

Fu'uña stood where the surf rolled back into the sea and thought, "I need people." Then Fu'uña walked into the sea, and there near the southern part of Guahan she became a rock. As the sea crashed over her, she broke into many pieces. Each new stone held her spirit. Each new stone was transformed into a new kind of people. As the great rock of Fu'uña dissolved, the grains of sand were carried throughout the world, giving birth to all humankind.[2]

5.2 Archaeological Record and Maritime Zone



Artistic rendering of Lattes with wood and thatch structure. Source: NPS, Drawing from Morgan (1988) in Rogers (1995)

Archaeologic accounts establish that the Chamorro people traveled to the Marianas from Southeast Asia 3,500 years ago. Chamorro are most closely related to other Austronesian-speaking peoples to the west in the Philippines and Taiwan, as well as the Caroline Islands to the south. They were expert seafarers and skilled craftspeople familiar with intricate weaving and detailed pottery making. Early Chamorro were in contact with one another across the Mariana Archipelago and engaged in commerce with far reaching islands across Oceania. All of the Mariana Islanders share cultural and linguistic characteristics, and archaeologic findings show continuity in ceramic production on the different islands until the Latte Period (900–1700 CE). Similarity in early ceramic styles, decoration, and technique are indicative of areas with "strong inter-community and inter-island ties."[3]

Ceramic remnants suggest that people on Agrihan, a northern island, were in contact with people on Guam, the southernmost island. Clay and ceramic pots were moving between settlements, as were production techniques. Burial practices, rock art, archaeological remains, and evidence of resource propagation, in addition to the Chamorro villages that populated Guam, Tinian, and Rota prior to Spanish arrival, indicate that islands across the Mariana Archipelago were used for various reasons. Archaeological research indicates that caves on Asuncion may have been used as mortuary areas.[4]
It is likely that support from the larger, resource-rich islands to the south was needed to sustain intermittent settlements on the remote northern islands of Maug, Asuncion, and Farallon de Pajaros. All three islands are seabird nesting areas, and people harvested, salted, and distributed seabirds from the northern islands to people living on the other islands.[5]

Archaeologic structures found on many of the Mariana Islands have similar features. Latte stones, or simply "Lattes," are the pillars and capstones used in building designs during the Latte period. The 1565 Legaspi expedition report provides a description of these structures in the Marianas: "Their houses are high, well kept, and well made. They stand at the height of a man off the ground, atop large stone pillars, upon which they lay the flooring."[5] Wood and thatched coconut leaves were lashed together with coconut fiber to form a vaulted roof house supported by the pillar and capstone Lattes. The megalithic Latte architecture was capable of withstanding the tropical climate and seismic activity that produce typhoons, high winds, flooding, and landslides in the Pacific region. Researchers have suggested that the Latte design is a direct adaptation to these physical phenomena. The oldest forms of this architectural concept can be traced to various parts of Insular Southeast Asia.[6]

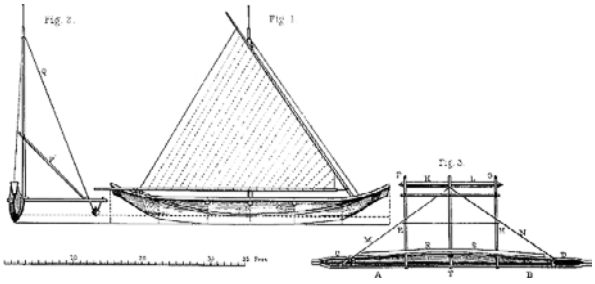
Lattes are important links for the Chamorro to their ancestors and rich history. Kurashina explains: "According to many Chamorro, the taotaomona (the Ancient Ones) have never departed, but remain close to their places of origin, in order to keep an eye on their descendants and on their properties. Taotaomona might reside near banyan trees, or even in the vicinity of ancient villages, where the presence of latte stones may be the only above-ground sign of a village of long ago."[5] Additional archaeological and archival research is needed to determine the potential for Latte structures and other physical records of human habitation on the northern islands abutting the Islands Unit. The islands of Maug, Farallon de Pajaros, Asuncion, and Guguan

were set aside in 1978 under the CNMI Constitution to be maintained as uninhabited places and used only for the preservation and protection of natural resources. No people live there today.

Shared architectural and agricultural techniques in the Western Pacific and insular Southeast Asia provide evidence for a longstanding maritime zone that facilitated interisland connections between Micronesia and Southeast Asia. Advanced navigational skills provided Austronesian people with the means to traverse the Western Pacific and develop the earliest settlements in Micronesia. Those maritime skills evolved in local contexts over time and constitute what is now a rich navigational legacy in the Mariana Archipelago. Maintaining ancient maritime skill sets, including navigation by the stars, has become a source of pride amongst Pacific Islanders everywhere and has spurred Epeli Hau'ofa's theories about the great ocean networks that bridge the Pacific.[7]

5.3 Global Encounters

Encounters between the Chamorro people and other islanders across Oceania, in particular the people of the Philippines, Yap, Palau, the Caroline Islands, and Southeast Asia, precede interaction with the Spanish by many centuries. The first documented interaction between Chamorro and Spaniards took place in the 16th century. Ferdinand Magellan, a Portuguese explorer employed by the King of Spain, arrived in the Mariana Islands in 1521, and Miguel Lopez de Legaspi claimed the islands for Spain in 1565. Of note, Magellan visited the island of Maug during the 16th century, finding approximately 20 residents and limited fresh water and sugarcane. Several European crew members abandoned ship and one, Gonzalo de Vigo, lived for several years among the Chamorro residents.[4,8]



The Chamorro "Flying Proa" was named by Magellan in 1521 when he arrived in the islands. These canoes could sail circles around the slower Magellan fleet. Drawing by Baron George Anson in "The sailing boat: a description of English and foreign boats," by Henry Coleman Folkard (1870)

At the time of Magellan's arrival to the Mariana Archipelago, Chamorro society was stratified into tiers: the matao class of high-status positions, the atcha'ot or middle group consisting of relatives of the matao, and at the base of the hierarchy was the manachang.[3] The matao were quick to exchange food and water for iron goods brought by sailors. Many ships anchored in Mariana waters in the years following Magellan's arrival, which spurred the iron trade between the Chamorro population and foreign sailors in the economic system known as "hierro commerce." Iron was fashioned into tools for canoe production and fishing equipment. Seventeenth-century reports describe Chamorro toolmakers on Rota who could sharpen metal pieces using cobblestones and shape iron nails into fishhooks.[9]

Amicable relations shifted soon after the Spanish mission was established on Guam. The islands became a colony of Spain in 1668, at which time they were named after the Spanish Queen Mariana of Austria.[10] From 1671 to 1685, the Spanish-Chamorro Wars compounded disease-induced population decline among the Chamorro. Multiple battles ensued, as Chamorro warriors fought against foreign governance and a high number of Chamorro died during three battles against the Agaña forts: the first in 1671–72, the second in 1676–77, and again in 1684.[11] Guam became the Spanish colony's main outpost in the archipelago. Residents from across the archipelago were forcibly relocated from their home islands to the island of Guam in order for the government to manage the population. Although Rota was never completely depopulated, the rest of the Northern Mariana Islands were scarcely inhabited from 1740 to 1815.

Latte structures are depicted in the far-left corner of bas relief stone panel from the Borobudur Temple in Central Java, Indonesia, built during the 8th and 9th centuries. Similarities in architectural developments between the Pacific and Southeast Asia provide evidence for cultural encounters across the region over the centuries. Source: Laguana et al. 2012

Word of the Spanish–Chamorro wars traveled across the Pacific on trade routes and via Chamorro refugees. The wars discouraged travel to the islands amongst Carolinians until Carolinian navigator Luito sailed to Guam in 1778. According to Dr. Darcy, "Luito's voyage restored the old links along Mutau-uol, a seaway between Gaferut and Guam that was remembered in a navigational chant." The Spanish colonial administration welcomed Luito, encouraged him to commence trade in the Marianas, and ensured that Luito's crew obtained goods such as iron. The ancient sea lane between the Mariana and Caroline Islands proved to be a beneficial route for 18th-century commerce, as well. Guam became popular among the Carolinians as a place to locate iron, copper, and other resources.[4]

Spanish administrators began employing Carolinian voyagers to transport food between islands within the Mariana Archipelago. Vegetables grown on Rota and dried pork and beef from animals raised on Tinian were ferried across the water to feed the population on Guam.[25] The Carolinian sailors became well acquainted with the Mariana Islands and learned that the northern islands had been almost entirely vacated. When a typhoon hit the Caroline Islands in 1815, 120 canoes filled with about 900 people set sail for Guam from the Caroline island of Lamotrek. Although the majority of the fleet was lost in a storm en route, some Carolinians did survive the journey and settled on the Island of Saipan.[12]

In 1818, the Spanish granted Carolinians official permission to settle on the island of Saipan as long as the immigrants converted to Catholicism. Waves of immigration continued through the 19th century as tsunamis and typhoons caused destruction to the low-lying Caroline Islands. The development of plantations on the Mariana Islands also prompted the migration of Carolinian workers to Rota, Tinian, and Pagan. Movement between Guam and other islands in the archipelago allowed Chamorro people to slowly repopulate the Northern Mariana Islands, and the Spanish relocation efforts that moved the Chamorro population to Guam eventually eased. Diaz and Kauanui note that today, "Chamorros of the Mariana Islands refer to themselves as *Taotao Tano* (people of the land) while residents of the Caroline atolls refer to themselves as *Re Metau* (people of the sea). … Among the *Re Metau* there is a distinction between those who have "remained" [in the Caroline Islands] … and the *Refaluwasch,* who have settled the islands of the Northern Marianas since the 18th and 19th centuries."[13]

The city of Hagåtña (La Ciudad de Hagåtña), on the island of Guam, was the first city of European governance in the Pacific during the Spanish colonial period. This is where Sirena lived, the mythological maiden after whom the Sirena Deep is named (the deepest point of the Trench Unit/Refuge). The following account is derived from a manuscript, titled *I Tetehnan*. This manuscript was the third part of a series of Chamorro proverbs that were translated and published in 1978 by Anthony J. Rameriz. Her story is considered a proverb rather than a legend and likely adapted into the Chamorro culture by missionaries, Spanish government officials, or native mariners in the late 1700s.

The Tale of Sirena

A playful young girl named Sirena once lived near the Hagåtña River, at the place where fresh spring waters dividing the city met the ocean at the river's mouth. Sirena loved the water and she used all of her free time for swimming in the sea or river.

One day, Sirena's nana (mother) sent her to gather coconut shells so she could make coal for the clothes iron. While gathering the shells Sirena couldn't resist the refreshing river. There she swam for a long time, paying little attention to anything else while her nana called for her impatiently.

Sirena's matlina (godmother) happened to come by for a visit while Sirena's nana waited for her daughter to return. Sirena's nana began complaining about her daughter, becoming angrier the more she spoke. She knew Sirena was probably swimming in the river rather than completing her chores. In irritation, Sirena's nana angrily cursed her daughter with the words, "Since Sirena loves the water more than anything, she should become a fish!" However, her matlina, realizing the harshness and power of the woman's words, quickly interjected, "Leave the part of her that belongs to me as human".

Suddenly, Sirena, still swimming in the river, began to feel a change coming over her. To her surprise and dismay, the lower half of her body transformed into the tail of a fish! She had fins like a fish, and her skin was covered with scales! However, from the waist up, she remained a girl. She was transformed into a mermaid!

In her new form, Sirena was unable to leave the water. Her nana soon saw what had happened to her daughter. Regretful of her curse, she tried to take back her harsh words, but she could not undo Sirena's fate. So as not be seen or caught by any passerby Sirena gave a final farewell to her mother before she swam out to sea:

"Oh Nana, do not worry about me, for I am a mistress of the sea, which I love so much. I would rather be back home with you. I know you were angry when you cursed me, but I wish you had punished me some other way. I would rather you had whipped me with your strap than to be the way I am now. Nana, take a good look at me, for this will be the last time we will see each other."

With these words, Sirena disappeared among the waves. To this day, sailors and others still report sightings of the mermaid, forever watching their shores and protecting them. It is said that she can only be captured with a net of human hair.

This photograph from the German era captures the two cultural groups of CNMI. To the left, Chamorros reflect the Spanish impact; to the right, Carolinians wear traditional dress. Photo courtesy of CNMI Historic Preservation Office

5.4 Governance and Militarization of the Mariana Islands

The Mariana Islands have been governed by four different countries since the 17th century: Spain, (1668–1898), Germany (1899–1914), Japan (in CNMI 1914–1945, in Guam 1941–1944), and United States (in the CNMI 1945–present; in Guam 1898–1941, 1944–present). Guam was ceded to the United States in 1898 after the Spanish-American War, and in 1899 Germany purchased the Mariana Islands north of Guam from Spain. This divided governance in the archipelago. Germany governed what is now the CNMI (all islands north of Guam) as part of German New Guinea, and the United States governed Guam.

During the 1890s, Japan ran guano mining and copra-making operations at Asuncion and Farallon de Pajaros.[4] In 1903, Asuncion and Farallon de Pajaros were leased to another Japanese company to hunt birds for their feathers to meet fashion demands for feather hats, garments, and accessories. At the turn of the 20th century, European millinery trade drastically increased harvest rates of seabirds throughout the Pacific. Under the German administration, islands were leased to a German company for seabird plumage in 1909.[12] Primary targets included tropicbirds, terns, and brown boobies.[12] After just three years, bird populations had been reduced to levels such that further exploitation was deemed uneconomical.[14]

Saipan was seized by Japan in 1914 at the onset of World War I (WWI) and the Northern Mariana Islands became one of six Japanese naval districts of Micronesia. Between WWI and WWII, Japanese military vessels sailed from Saipan to Asuncion moving people and supplies between islands. Oral histories have confirmed photographic evidence that Okinawan employees of the Japanese military processed fish while living on Maug.[15] By the late 1930s, Japan was increasing its military capacity in the Northern Mariana Islands.

Japanese forces bombed Guam on December 8, 1941. This attack was simultaneous with attacks against other U.S. possessions around the Pacific (including Hawai‘i and U.S. bases in the Philippines), bringing the United States into WWII.[16] The aerial assault was followed by an invasion by 5,400 Japanese troops. The American force at Guam was small: just 274 sailors and 153 Marines supported by about 80 Insular Force Guard Chamorro militiamen. On December 10, 1941, the Naval Governor of Guam George McMillin surrendered the island to Japan. Imperial Japanese forces occupied Guam during WWII and renamed the

island Ōmiya-Jima (Great Shrine Island). As the largest island in Micronesia, it served as a supply base for transiting Japanese military ships throughout the occupation. Chamorros endured many hardships during that time from forced labor to rapes, executions, and massacres.[16]

From 1941 to 1944, the United States fought against Germany and Italy as an ally of England until it could reorient its focus from a defensive to an offensive posture in the Pacific. The United States attacked Japanese forces on Saipan and Tinian in June of 1944 and invaded Guam on July 21, 1944. There was tremendous loss of life in the battles; 252 of the 9,000 Japanese troops defending Tinian became prisoners of war; the rest died in battle or committed suicide to avoid capture. An unknown number of Chamorro and Carolinian people were killed or maimed in the war; 60,000 Japanese nationals died, and 5,000 Americans died during these battles.[16]

The United States officially occupied Tinian on August 1, 1944, and recaptured Guam on August 10, 1944. Rota and the islands north of Saipan were governed by Japan until September 2, 1945, when the United States assumed control. The U.S. Naval Military Government administered the Northern Mariana Islands until 1947. From 1947 to 1975, the Northern Mariana Islands were part of the United Nations' Trust Territory of the Pacific Islands and were administered by the United States under a United Nations mandate. The Trusteeship Agreement was intended to assist the Trust Territories, all former colonies, in a movement toward self-governance.

Large-scale amphibious attack at the beaches of Tinian Island in 1944. Photo: National Archives and Records

In 1975, the people of the Northern Mariana Islands and the United States entered a political Covenant that established a Commonwealth under the sovereignty of the United States. The Covenant was put to vote in a plebiscite on June 17, 1975, and approved by the U.S. House of Representatives through a joint resolution July 21, 1975.[17] On March 6, 1977, CNMI voters ratified the Commonwealth Constitution, which took effect on January 9, 1978.

Guam, unlike its neighboring islands in Micronesia, was not assigned to the United States under the Trusteeship Agreement. The Guam Organic Act of 1950 established Guam as an unincorporated organized territory of the United States, which provided for a civilian government. The Immigration and Nationality Act of 1952 granted U.S. citizenship to all persons born on Guam on or after April 11, 1899.[18]

5.5 Joint Region Marianas and Coast Guard Sector Guam

USCG provides law enforcement in the Monument. Photo: USCG

United States military presence in the Mariana Archipelago persisted after WWII, continuing through the Vietnam War and Cold War operations. Naval Base Guam and Andersen Air Force Base merged in 2009 to create Joint Region Marianas. Andersen Air Force Base on Guam is considered one of two critical bases in the Asia Pacific region (the other location is Diego Garcia in the Indian Ocean). Naval Base Guam is home of Commander Submarine Squadron 15, Coast Guard Sector Guam and Naval Special Warfare Unit One and supports 28 other tenant commands. It is the home base of dozens of Pacific Command, Pacific Fleet, and Seventh Fleet units. Coast Guard Sector Guam's area of

responsibility includes Guam, the CNMI, the Republic of Palau, and the Federated States of Micronesia (Kosrae, Pohnpei, Chuuk, and Yap).

When he established the Mariana Trench Marine National Monument, President George W. Bush publicly stated that "the policy of the United States shall be to continue measures established in the Papahānaumokuākea Marine National Monument to protect the training, readiness, and global mobility of U.S. Armed Forces, and ensure protection of navigation rights and high seas freedoms under the law of the sea, which are essential to the peace and prosperity of civilized nations." He further noted that "the security of America, the prosperity of its citizens, and the protection of the ocean environment are complementary and reinforcing priorities. As the United States takes measures to conserve and protect the living and non-living resources of the ocean, it shall ensure preservation of the navigation rights and high seas freedoms enjoyed by all nations under the law of the sea …"

The DOD will continue to conduct exercises in the region and has committed to adopting appropriate measures to minimize impacts on natural resources within the Monument. The 2020 Mariana Islands Training and Testing Final Supplemental Environmental Impact Statement addresses ongoing and proposed military training activities within the Mariana Islands Range Complex, which includes portions of the Monument. A description of military training activities and potential effects are addressed in these documents and may be viewed on-line at http://mitt-eis.com.

5.6 Demographic and Economic Setting in Guam and the CNMI

5.6.1 Population

According to the 2020 U.S. Census, the Mariana Archipelago had a total population of 201,165 residents: 153,836 in Guam and 47,329 in the CNMI. The ethnic composition of the archipelago is diverse, with the majority of the population identifying themselves as Pacific Islander, Chamorro, Carolinian, Asian, Filipino, or mixed ethnic background. In the 2020 Census, 80,198 residents of Guam and the CNMI identified themselves as Chamorro and 2,363 identified as Carolinian.[19]

5.6.2 Guam

Guam has two official languages: Chamorro and English. Pacific Islanders are the largest ethnic group at 46% of the total population. This category is further divided to include Carolinian, Chamorro, Chuukese, Kosraean, Marshallese, Palauan, Pohnpeian, Yapese, and Other Native Hawaiian and Other Pacific Islander. Chamorro has the largest representation, with 33% of the population. Asians account for 35% of the total population with this category further divided into Chinese, Filipino, Japanese, Korean, Taiwanese, Thai, Vietnamese, and Other Asian. Filipinos comprise the majority of this category, with 29% of the population. Rounding out the ethnicities for Guam are Mixed Ethnicity, 10%,; White, 7%,; Black, 1%, Hispanic 3%.[19]

5.6.3 CNMI

Three official languages are observed in the CNMI: Chamorro, Carolinian (Refaluwasch), and English. Of the 47,329 residents recorded in the 2020 Census, Asians comprised the ethnic majority, with 47% of the population. Filipinos lead this category, with 33% of the total CNMI population, with Tagalog as their first language. The Asian group also includes Bangladeshi, Chinese, Japanese, Korean, Nepalese, Thai, and Other Asian. The next largest group are Pacific Islanders, with 44%. This category is further divided to include Carolinian, Chamorro, Chuukese, Kosraean, Marshallese, Palauan, Pohnpeian, Yapese, and Native Hawaiian and Other Pacific Islander. Chamorro are the largest group in this category, with 25% of the CNMI residents. The remaining ethnicities are White, 2%, Black <1%, American Indian <1%, and Other Ethnic Origin <1%.[19]

5.6.4 Education

The percentage of the population who were high school graduates or higher was 79.4 for Guam and 82.4 for CNMI. Persons with a bachelor's degree or higher were 20.4% for Guam and 20.2% for CNMI. There is one public four-year college, University of Guam, one public two-year institution, Guam Community College, and a private institution, Pacific Island Bible College, on Guam. The Northern Marianas College on Saipan is a two-year college with satellite campuses on Tinian and Rota.[19]

5.6.5 Income

As of the 2020 U.S. Census, the median household income in CNMI was $31,362 and in Guam $58,289.[19] National defense spending comprises a large part of the economy in Guam, and to a lesser extent in the CNMI. Tourism is also a primary industry on Guam, second to the military. Most visitors to Guam arrive by air from Japan (78%) and Korea (10%). Aquatic wildlife from the marine environment supports tourism in the form of snorkeling, scuba diving, and recreational fishing. Other industries include transshipment services, concrete products, printing and publishing, food processing, and textiles.[20]

Although the CNMI economy benefits substantially from U.S. financial assistance, tourism remains the main form of industry. Geographic location and historic linkages tie CNMI tourism to the economic shifts of Japan, Korea, and China. As a share of total arrivals, the Japanese tourists comprise a little less than one-half, while Korean visitors account for roughly one-third. The current agriculture sector consists of cattle ranches and small farms producing coconuts, breadfruit, tomatoes, and melons.[20]

5.7 Cultural and Socioeconomic Importance of Fishing

Fishermen are held in high esteem in the CNMI and Guam, and their catch frequently plays an important role in ceremonies and cultural festivities. The practice of sharing one's catch with family and friends is common throughout the Pacific; it maintains connections within the family and across the community and links present-day activities to deeply rooted cultural values. One Mariana fisherman explains that fishing legacies and visits to the waters around Maug, Asuncion, and Farallon de Pajaros keep these places alive in the minds of people today: "… it makes you feel like you are actually an islander." The waters around the northern islands are considered to be abundant with resources, indicative of island life, and free. They are intimately connected with generations of ancestors who also fished in these waters.[23]

A 2012 survey of people who have fished in what now constitutes the Islands Unit shows that from 1979 to 2010, an average of 2.3 trips per year were made to this area for the purpose of fishing.[24] Other trips were made for the purpose of research, charter, visitation/exploratory trips but included fishing for food. For example, almost all (98%) of the reported trips included fishing, regardless of the stated primary purpose of the trip (129 total trips from 1939 to 2010). Recent research also found that the formal and informal exchange of marine resources from the Islands Unit provides a food source for residents; maintains an important connection between residents and this culturally significant place; and allows for gift giving, trade, and monetary transactions independent of commercial markets. The nonmarket transactions between fishermen and other members of their community make it financially feasible for fishing to occur in the Islands Unit through monetary cost recovery and resource sharing.[23]

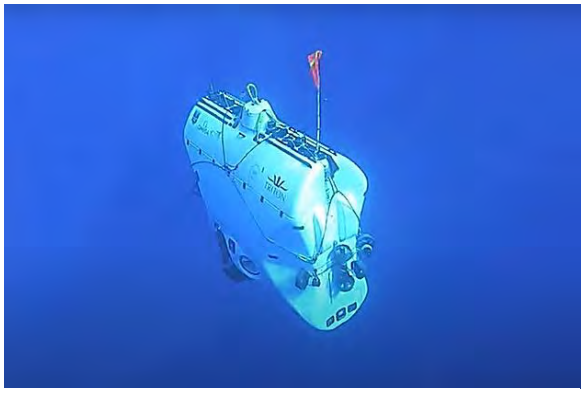
5.8 Ecotourism

Ecotourism is defined as "responsible travel to natural areas that conserves the environment and improves the well-being of local people."[21] This approach to tourism has gained momentum for its potential to coexist with the natural and sociocultural environment of a destination.

All participants in a 2010 Visitor Exit Survey ranked "nature and scenic activities" in their top 10 reasons for traveling to the CNMI.[22] This statistic has encouraged the Mariana Visitors Authority to develop their islands' niche ecotourism market with a focus on historic sites, snorkeling and scuba excursions, bird watching tours, and tourism that can support the production of aquaculture and agriculture.

The *Guam Tourism 2020 Plan* suggested a focus on accurately representing Chamorro culture in the tourism industry through museum exhibitions and live performances, shaping the identity of Guam as a visitor destination around the unique identity of the Chamorro people and their cultural values, and the development of nature-based tourism to support aquaculture and agricultural production. Just prior to the global pandemic that shut down travel around the world, Guam saw 1.63 million visitors in 2019, marking it as the best fiscal year to date for the island's tourism industry, according to Guam Visitors Bureau. Tourists from Japan had grown by 25.4% compared with fiscal 2018. The bureau is now working on a Tourism 2025 Strategic Plan.

A few cruise ships have obtained permits and authorization to conduct ecotourism visits to Maug in the Islands Unit, and Caladan Oceanic was permitted for extreme ecotourism, taking visitors all the way down to Sirena Deep in the Trench Unit/Refuge.



Limiting Factor dropping down to Sirena Deep. Photo: Caladan Oceanic

The lagoon of Maug in the Islands Unit. Photo: Stephani Gordon/Open Boat Films

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Appendix A. Known Species List

The list of known species is continuously growing. New species are discovered during most expeditions to explore the depths of the Monument.
*Newly described species

Fish Species

SCIENTIFIC NAME	COMMON NAME
Abudefduf septemfasciatus	Banded sergeant
Abudefduf sexfasciatus	Scissortail sergeant
Abudefduf vaigiensis	Indo-Pacific sergeant
Acanthocybium solandri	Wahoo
Acanthurus achilles	Achilles tang
Acanthurus blochii	Ringtail surgeonfish
Acanthurus dussumieri	Eyestripe surgeonfish
Acanthurus guttatus	Whitespotted surgeonfish
Acanthurus leucopareius	Whitebar surgeonfish
Acanthurus lineatus	Lined surgeonfish
Acanthurus mata	Elongate surgeonfish
Acanthurus nigricans	Whitecheek surgeonfish
Acanthurus nigrofuscus	Brown surgeonfish
Acanthurus nigroris	Bluelined surgeonfish
Acanthurus nubilus	Bluelinedsurgeon
Acanthurus olivaceus	Orangespot surgeonfish
Acanthurus pyroferus	Chocolate surgeonfish
Acanthurus thompsoni	Thompson's surgeonfish
Acanthurus triostegus	Convict surgeonfish
Acanthurus xanthopterus	Yellowfin surgeonfish
Aethaloperca rogaa	Redmouth grouper
Aetobatus narinari	Spotted eagle ray
Alectis ciliaris	African pompano
Alticus saliens	Leaping blenny
Aluterus scriptus	Scrawled filefish
Amanses scopas	Broom filefish
Amblycirrhitus bimacula	Twinspot hawkfish
Amblyeleotris fasciata	Red-banded prawn goby
Amphiprion chrysopterus	Orangefin anemonefish
Amphiprion clarkii	Yellowtail clownfish
Amphiprion melanopus	Fire clownfish
Anampses caeruleopunctatus	Bluespotted wrasse
Anampses meleagrides	Spotted wrasse
Anampses sp.	Wrasse
Anthias sp.	Anthias
Aphareus furca	Small toothed jobfish
Apogon angustatus	Broadstriped cardinalfish
Apogon novemfasciatus	Sevenstriped cardinalfish
Apogon sp.	cardinalfish
Apogonidae	Apogonidae species
Apolemichthys trimaculatus	Threespot angelfish
Aprion virescens	Green jobfish
Argyropelecus sladeni	Sladen's hatchetfish
Arothron meleagris	Guineafowl puffer
Arothron nigropunctatus	Blackspotted puffer
Arothron stellatus	Starry toadfish
Aspidontus taeniatus	False cleanerfish
Aulostomus chinensis	Chinese trumpetfish
Balistapus undulatus	Orange-lined triggerfish
Balistoides conspicillum	Clown triggerfish
Balistoides viridescens	Titan triggerfish
Barathrites sp.	Cusk-eel
Bassozetus sp.	Cusk-eel
Belonoperca chabanaudi	Arrowhead soapfish
Blenniidae	Blenny species

SCIENTIFIC NAME	COMMON NAME
Bodianus anthioides	Lyretail hogfish
Bodianus axillaris	Axilspot hogfish
Bodianus bilunulatus	Tarry hogfish
Bodianus loxozonus	Blackfin hogfish
Bolinichthys longipes	Popeye lanternfish
Bothus mancus	Flowery flounder
Bothus pantherinus	Leopard flounder
Caesio teres	Yellow-and-blueback fusilier
Calotomus carolinus	Carolines parrotfish
Cantherhines dumerilii	Whitespotted filefish
Cantherhines pardalis	Honeycomb filefish
Canthigaster amboinensis	Spider-eye puffer
Canthigaster coronata	Crowned puffer
Canthigaster janthinoptera	Honeycomb toby
Canthigaster solandri	Spotted sharpnose
Canthigaster valentini	Valentinni's sharpnosepuffer
Caracanthus maculatus	Spotted coral croucher
Carangoides ferdau	Blue trevally
Carangoides orthogrammus	Island trevally
Caranx ignobilis	Giant trevally
Caranx lugubris	Black jack
Caranx melampygus	Bluefin trevally
Caranx sexfasciatus	Bigeye trevally
Carcharhinus amblyrhynchos	Grey reef shark
Carcharhinus melanopterus	Blacktip reef shark
Centropyge bispinosa	Twospined angelfish
Centropyge fisheri	Orange angelfish
Centropyge flavissima	Lemonpeel angelfish
Centropyge heraldi	Yellow angelfish
Centropyge multifasciata	Barred angelfish
Centropyge shepardi	Mango angelfish
Cephalopholis argus	Peacock hind
Cephalopholis leopardus	Leopard hind
Cephalopholis miniata	Coral hind
Cephalopholis sexmaculata	Sixblotch hind
Cephalopholis sonnerati	Tomato hind
Cephalopholis spiloparaea	Strawberry hind
Cephalopholis urodeta	Darkfin hind
Ceratoscopelus warmingii	Warming's lantern fish
Chaetodon auriga	Threadfin butterflyfish
Chaetodon citrinellus	Speckled butterflyfish
Chaetodon ephippium	Saddle butterflyfish
Chaetodon flavocoronatus	Yellow-crowned butterflyfish
Chaetodon lunula	Raccoon butterflyfish
Chaetodon lunulatus	Oval butterflyfish
Chaetodon mertensii	Atoll butterflyfish
Chaetodon meyeri	Scrawled butterflyfish
Chaetodon ornatissimus	Ornate butterflyfish
Chaetodon punctatofasciatus	Spotband butterflyfish
Chaetodon quadrimaculatus	Fourspot butterflyfish
Chaetodon reticulatus	Mailed butterflyfish
Chaetodon trifascialis	Chevron butterflyfish
Chaetodon unimaculatus	Teardrop butterflyfish
Cheilinus chlorourus	Floral wrasse
Cheilinus fasciatus	Redbreast wrasse
Cheilinus oxycephalus	Snooty wrasse
Cheilinus trilobatus	Tripletail wrasse
Cheilodipterus artus	Wolf cardinalfish
Cheilodipterus macrodon	Large toothed cardinalfish
Cheilodipterus quinquelineatus	Five-lined cardinalfish
Cheilopogon exsiliens	Bandwing flyingfish
Cheilopogon nigricans	Blacksail flyingfish
Cheilopogon spilonotopterus	Stained flyingfish
Chlorurus frontalis	Tan-faced parrotfish
Chlorurus microrhinos	Steephead parrots
Chlorurus sordidus	Daisy parrotfish
Chlorurus spilurus	Daisy parrotfish
Chromis acares	Midget chromis
Chromis agilis	Agile chromis
Chromis alpha	Yellow-speckled chromis
Chromis amboinensis	Ambon chromis
Chromis margaritifer	Bicolor chromis

SCIENTIFIC NAME	COMMON NAME
Chromis vanderbilti	Vanderbilt's chromis
Chromis viridis	Blue green damselfish
Chromis xanthura	Paletail chromis
Chrysiptera brownriggii	Surge damselfish
Chrysiptera traceyi	Tracey's demoiselle
Cirrhilabrus katherinae	Katherine's wrasse
Cirrhilabrus sp.	Fairy wrasse
Cirrhitichthys falco	Dwarf hawkfish
Cirrhitus pinnulatus	Stocky hawkfish
Cirripectes variolosus	Red-speckled blenny
Coris aygula	Clown coris
Coris gaimard	Yellowtail coris
Coryphaenoides sp.	Rattail
Coryphaenoides yaquinae	Abyssal grenadier
Ctenochaetus binotatus	Twospot surgeonfish
Ctenochaetus cyanocheilus	Bluelip bristletooth
Ctenochaetus hawaiiensis	Chevron tang
Ctenochaetus sp.	Bristletooth tang
Ctenochaetus striatus	Striated surgeonfish
Ctenochaetus strigosus	Kole tang
Ctenogobiops sp.	Goby
Dascyllus aruanus	Whitetail dascyllus
Dascyllus reticulatus	Reticulate dascyllus
Dascyllus trimaculatus	Threespot dascyllus
Dasyatidae	Stingray species
Decapterus macarellus	Mackerel scad
Diagramma pictum	Painted sweetlips
Diaphus schmidti	Schmidt's headlightfish
Diodon hystrix	Spot-fin porcupinefish
Ecsenius bicolor	Bicolor blenny
Elagatis bipinnulata	Rainbow runner
Epinephelus fasciatus	Blacktip grouper
Epinephelus hexagonatus	Starspotted grouper
Epinephelus howlandi	Blacksaddle grouper
Epinephelus lanceolatus	Giant grouper
Epinephelus macrospilos	Snubnose grouper
Epinephelus maculatus	Highfin grouper
Epinephelus melanostigma	One-blotch grouper
Epinephelus merra	Honeycomb grouper
Epinephelus socialis	Surge grouper
Epinephelus tauvina	Greasy grouper
Eustomias gibbsi	Dragonfish
Euthynnus affinis	Kawakawa
Eviota melasma	Headspot eviota
Exallias brevis	Leopard blenny
Exocoetus monocirrhus	Barbel flyingfish
Exocoetus volitans	Blue flyingfish
Ferdauia orthogrammus	Island trevally
Fistularia commersonii	Bluespotted cornetfish
Forcipiger flavissimus	Longnose butterfly fish
Forcipiger longirostris	Longnose butterflyfish
Genicanthus takeuchii	Swallowtail angelfish
Genicanthus watanabei	Blackedged angelfish
Gnathodentex aureolineatus	Striped large-eye bream
Gomphosus varius	Bird wrasse
Gracila albomarginata	Masked grouper
Grammistes sexlineatus	Sixline soapfish
Gymnosarda unicolor	Dogtooth tuna
Gymnothorax flavimarginatus	Yellow-edged moray
Gymnothorax javanicus	Giant moray
Gymnothorax meleagris	Turkey moray
Gymnothorax undulatus	Undulated moray
Halichoeres biocellatus	Red-lined wrasse
Halichoeres hortulanus	Checkerboard wrasse
Halichoeres margaritaceus	Pink-belly wrasse
Halichoeres marginatus	Dusky wrasse
Halichoeres melasmapomus	Cheekspot wrasse
Halichoeres ornatissimus	Ornamented wrasse
Hemigymnus fasciatus	Barred thicklip
Hemigymnus melapterus	Blackeye thicklip
Hemitaurichthys polylepis	Pyramid butterflyfish
Hemitaurichthys thompsoni	Thompson's butterflyfish
Heniochus chrysostomus	Threeband pennantfish
Heniochus monoceros	Masked bannerfish

SCIENTIFIC NAME	COMMON NAME
Heteropriacanthus cruentatus	Glasseye
Himantura fai	Pink whipray
Hirundichthys albimaculatus	Whitespot flyingfish
Hologymnosus annulatus	Ring wrasse
Hologymnosus doliatus	Pastel ringwrasse
Istigobius decoratus	Decorated goby
Kajikia audax	striped marlin
Katsuwonus pelamis	Skipjack tuna
Kyphosus cinerascens	Blue seachub
Kyphosus pacificus	Grey sea chub
Kyphosus vaigiensis	Brassy chub
Labrichthys unilineatus	Tubelip wrasse
Labroides bicolor	Bicolor cleaner wrasse
Labroides dimidiatus	Bluestreak cleaner wrasse
Labroides pectoralis	Blackspot cleaner wrasse
Labroides rubrolabiatus	Redlip cleaner wrasse
Labropsis xanthonota	Yellowback tubelip
Lepidozygus tapeinosoma	Fusilier damselfish
Lethrinus olivaceus	Longface emperor
Liparid spp.	Snailfish
Lotilia graciliosa	Whitecap goby
Lutjanus bohar	Two-spot red snapper
Lutjanus fulvus	Blacktail snapper
Lutjanus gibbus	Humpback red snapper
Lutjanus kasmira	Common bluestripe snapper
Lutjanus monostigma	Onespot snapper
Macolor macularis	Midnight snapper
Macolor niger	Black and white snapper
Macropharyngodon meleagris	Blackspotted wrasse
Makaira sp.	Blue marlin
Malacanthus brevirostris	Quakerfish
Malacanthus latovittatus	Blue blanquillo
Meiacanthus atrodorsalis	Forktail blenny
Melichthys niger	Black triggerfish
Melichthys vidua	Pinktail triggerfish
Monotaxis grandoculis	Humpnose big-eye bream
Mulloidichthys flavolineatus	Yellowstripe goatfish
Mulloidichthys vanicolensis	Yellowfin goatfish
Myctophum lychnobium	Lanternfish
Myripristis amaena	Brick soldierfish
Myripristis berndti	Blotcheye soldierfish
Myripristis kuntee	Shoulderbar soldierfish
Myripristis murdjan	Pinecone soldierfish
Myripristis vittata	Whitetip soldierfish
Naso annulatus	Whitemargin unicornfish
Naso brevirostris	Spotted unicornfish
Naso caesius	Gray unicornfish
Naso hexacanthus	Sleek unicornfish
Naso lituratus	Orangespine unicornfish
Naso thynnoides	Oneknife unicornfish
Naso tonganus	Bulbnose unicornfish
Naso unicornis	Bluespine unicornfish
Naso vlamingii	Bignose unicornfish
Nebrius ferrugineus	Tawny nurse shark
Nemateleotris magnifica	Fire goby
Neocirrhites armatus	Flame hawkfish
Neoniphon argenteus	Clearfin squirrelfish
Neoniphon opercularis	Blackfin squirrelfish
Neoniphon sammara	Sammara squirrelfish
Novaculichthys taeniourus	Rockmover wrasse
Odontaspis ferox	Smalltoothed sand tiger
Odonus niger	Redtoothed triggerfish
Oplegnathus punctatus	Spotted knifejaw
Ostorhinchus angustatus	Broadstriped cardinalfish
Ostorhinchus apogonoides	Short-tooth cardinal
Ostorhinchus novemfasciatus	Sevenstriped cardinalfish
Ostracion cubicum	Yellow boxfish
Ostracion cubicus	Yellow boxfish
Ostracion meleagris	Whitespotted boxfish
Oxycheilinus digramma	Cheeklined wrasse
Oxycheilinus unifasciatus	Ringtail maori wrasse
Oxyporhamphus micropterus	Halfbeak
Pachycara sp.	Eelpout
Paracanthurus hepatus	Palette surgeonfish

SCIENTIFIC NAME	COMMON NAME
Paracentropyge multifasciata	Barred angelfish
Paracirrhites arcatus	Arc-eye hawkfish
Paracirrhites forsteri	Blackside hawkfish
Paracirrhites hemistictus	Whitespot hawkfish
Parapercis clathrata	Latticed sandperch
Parapercis millepunctata	Black dotted sand perch
Parapercis sp	Sandperch species
Parupeneus cyclostomus	Goldsaddle goatfish
Parupeneus insularis	Twosaddle goatfish
Parupeneus multifasciatus	Manybar goatfish
Parupeneus pleurostigma	Sidespot goatfish
Pateobatis fai	Pink whipray
Pempheris oualensis	Silver sweeper
Pervagor janthinosoma	Blackbar filefish
Pervagor melanocephalus	Redtail filefish
Pervagor sp.	Filefish
Plagiotremus rhinorhynchos	Bluestriped fangblenny
Plagiotremus tapeinosoma	Piano fangblenny
Platax teira	Tiera batfish
Plectorhinchus picus	Painted sweetlip
Plectranthias nanus	Bownband perchlet
Plectroglyphidodon dickii	Blackbar devil
Plectroglyphidodon fasciolatus	Pacific gregory
Plectroglyphidodon imparipennis	Brighteye damselfish
Plectroglyphidodon johnstonianus	Johnston Island damsel
Plectroglyphidodon lacrymatus	Whitespotted devil
Plectroglyphidodon leucozonus	Singlebar devil
Plectroglyphidodon phoenixensis	Phoenix devil
Pogonoperca punctata	Spotted soapfish
Pomacanthus imperator	Emperor angelfish
Pomacentrus vaiuli	Ocellate damselfish
Pomachromis guamensis	Guam damsel
Priacanthus hamrur	Moontail bullseye
Priacanthus sp.	Bigeye
Prognichthys sp.	Flyingfish
Psenes cyanophrys	Freckled driftfish
Pseudanthias cooperi	Red-bar anthias
Pseudanthias pascalus	Amethyst anthias
Pseudobalistes flavimarginatus	Yellowmargin triggerfish
Pseudocheilinus evanidus	Striated wrasse
Pseudocheilinus hexataenia	Sixline wrasse
Pseudocheilinus octotaenia	Eight-lined wrasse
Pseudocheilinus tetrataenia	Four-lined wrasse
Pseudocoris aurantiofasciata	Rust-banded wrasse
Pseudocoris heteroptera	Torpedo wrasse
Pseudocoris yamashiroi	Redspot wrasse
Pseudodax moluccanus	Chiseltooth wrasse
Pseudojuloides atavai	Polynesian wrasse
Pseudojuloides cerasinus	Smalltail wrasse
Ptereleotris evides	Blackfin dartfish
Ptereleotris heteroptera	Blacktail goby
Ptereleotris zebra	Chinese zebra goby
Pterocaesio marri	Marr's fusilier
Pterocaesio tile	Dark-banded fusilier
Pterois antennata	Broadbarred firefish
Pycnochromis acares	Midget chromis
Pycnochromis agilis	Agile chromis
Pycnochromis amboinensis	Ambon chromis
Pycnochromis margaritifer	Bicolor chromis
Pycnochromis vanderbilti	Vanderbilt's chromis
Pygoplites diacanthus	Royal angelfish
Rhinecanthus rectangulus	Wedge-tail triggerfish
Sargocentron caudimaculatum	Silverspot squirrelfish
Sargocentron diadema	Crown squirrelfish
Sargocentron microstoma	Smallmouth squirrelfish
Sargocentron spiniferum	Sabre squirrelfish
Sargocentron tiere	Blue lined squirrelfish
Saurida gracilis	Gracile lizardfish
Scarus altipinnis	Filament-finned parrotfish
Scarus forsteni	Forsten's parrotfish
Scarus frenatus	Bridled parrotfish
Scarus ghobban	Blue-barred parrotfish
Scarus oviceps	Dark capped parrotfish
Scarus psittacus	Common parrotfish

SCIENTIFIC NAME	COMMON NAME
Scarus rubroviolaceus	Ember parrotfish
Scarus schlegeli	Yellowband parrotfish
Scomberoides lysan	Doublespotted queenfish
Scombridae	Tuna species
Seriola dumerili	Greater amberjack
Serrivomer beanii	Bean's sawtooth eel
Sphyraena barracuda	Great barracuda
Sphyraena helleri	Heller's barracuda
Sphyraena qenie	Blackfin barracuda
Sphyraenidae	Barracuda species
Spratelloides delicatulus	Delicate round herring
Stegastes fasciolatus	Pacific gregory
Stegastes lacrymatus	Whitespotted devil
Stegastes nigricans	Dusky farmerfish
Stethojulis bandanensis	Red shoulder wrasse
Stethojulis strigiventer	Stripebelly Wrasse
Sufflamen bursa	Boomerang triggerfish
Sufflamen chrysopterum	Halfmoon triggerfish
Sufflamen fraenatum	Masked triggerfish
Symbolophorus evermanni	Evermann's lantern fish
Symphurus thermophilus	Tonguefish
Synodontidae	Lizardfish species
Synodus binotatus	Two-spot lizard fish
Synodus variegatus	Variegated lizardfish
Taeniura meyeni	Blotched fantail ray
Taeniurops meyeni	Blotched fantail ray
Tetrapturus angustirostris	shortbill spearfish
Thalassoma amblycephalum	Bluntheaded wrasse
Thalassoma lunare	Moon wrasse
Thalassoma lutescens	Yellow-brown wrasse
Thalassoma purpureum	Surge wrasse
Thalassoma quinquevittatum	Fivestripe wrasse
Thalassoma trilobatum	Christmas wrasse
Thunnus alalunga	Albacore tuna
Thunnus albacares	Yellowfin tuna
Thysanophrys chiltonae	Longsnout flathead
Triaenodon obesus	Whitetip reef shark
Tylosurus crocodilus	Houndneedlefish
Tylosurus crocodilus crocodilus	Houndneedlefish
Valenciennea strigata	Blueband goby
Variola louti	Yellow-edged lyretail
Wetmorella nigropinnata	Sharpnose wrasse
Xanthichthys auromarginatus	Gilded triggerfish
Xanthichthys caeruleolineatus	Bluelined triggerfish
Xanthichthys mento	Redtail triggerfish
Xenobalistes tumidipectoris	Marianas triggerfish
Xiphias gladius	Swordfish
Zanclus cornutus	Moorish idol
Zebrasoma flavescens	Yellow tang

Marine Mammals

SCIENTIFIC NAME	COMMON NAME
Balaenoptera borealis	Sei whale
Balaenoptera edeni brydei	Bryde's whale
Balaenoptera musculus	Blue whale
Balaenoptera physalus	Fin whale
Feresa attenuata	Pygmy killer whale
Globicephala macrorhynchus	Short-finned pilot whale
Grampus griseus	Risso's dolphin
Kogia sima	Dwarf sperm whale
Megaptera novaeangliae	Humpback whale
Mesoplodon densirostris	Blainville's beaked whale
Mesoplodon sp.	Mesoplodon sp.
Peponocephala electra	Melon-headed whale
Physeter macrocephalus	Sperm whale
Pseudorca crassidens	False killer whale
Stenella attenuata	Pantropical spotted dolphin
Stenella longirostris	Spinner dolphin
Steno bredanensis	Rough-toothed dolphin
Tursiops sp.	Bottlenose dolphin
Ziphius cavirostris	Cuvier's beaked whale

Marine Reptiles

SCIENTIFIC NAME	COMMON NAME
Chelonia mydas	Green turtle
Dermochelys coriacea	Leatherback turtle
Eretmochelys imbricata	Hawksbill turtle

Seabirds

SCIENTIFIC NAME	COMMON NAME
Anous minutus	Black noody
Anous stolidus	Brown noddy
Fregata minor	Great frigatebird
Gygis alba	White tern
Oceanodroma leucorhoa	Leach's storm-petrel
Oceanodroma matsudairae	Matsudaira's storm-petrel
Phaethon lepturus	White-tailed tropicbird
Phaethon rubricauda	Red-tailed tropicbird
Pluvialis fulva	Newell's shearwater
Pterodroma sandwichensis	Hawaiian Petrel
Puffinus auricularis	Short-tailed shearwater
Puffinus Iherminieri	Audubon's shearwater
Puffinus pacificus	Wedge-tailed shearwater
Sterna fuscata	Sooty tern

Marine Plants

SCIENTIFIC NAME	COMMON NAME
Caulerpa sp.	Seaweed
Chondria polyrhiza	Red algae
Dictyosphaeria cavernosa	Green bubble seaweed
Dictyota bartayresiana	Forded sea tumbleweed
Halimeda sp.	Green macroalgae
Lobophora sp.	Thalloid brown algae
Lobophora variegata	Thalloid brown algae
Nemomeris sp.	Taugeh seaweed
Padina sp.	Brown macroalgae

Invertebrates

SCIENTIFIC NAME	COMMON NAME	SCIENTIFIC NAME	COMMON NAME
Abyssocladia marianensis	Carnivorous sponge	*Astrosclera willeyana*	Encrusting orange sponge
Abyssogena mariana	Vesicomyid clam	*Auloplax sp.*	Glass sponge
Abyssorchomene sp.	Scavenging amphipod	*Bathymodiolus septemdierum*	Deep-sea mussel
Acanthaster planci	Crown-of-thorns starfish	*Benthesicymus crenatus*	Deep-sea prawn
Acar plicata	Miniature ark	*Bohadschia argus*	Leopard sea cucumber
Acrocalanus gibber	Gibber	*Bolosoma sp.*	Glass sponge
Acrocalanus gracilis	Copepod	*Bolosominae*	Glass sponge
Acrocalanus monachus	Copepod	*Brachyura*	Crab
Acteocina hawaiensis	Sea slug	*Branchinotogluma sp.*	Scale worm
Acteocina spp.	Sea slug	*Bythograeidae*	Blind vent crab
Actiniidae	Sea anemone	*Calcinus elegans*	Blue line hermit crab
Actinopyga mauritiana	Surf redfish	*Calcinus hazletti*	Whitefoot hermit crab
Actinopyga obesa	Plump sea cucumber	*Calcinus isabellae*	Isabelle's hermit crab
Actinopyga sp.	Sea cucumber	*Calcinus latens*	Hidden hermit crab
Actinopyga varians	White-spotted sea cucumber	*Calcinus lineapropodus*	Striped leg hermit crab
Agetus flaccus	Copepod	*Calcinus minutus*	Small white hermit crab
Aidanosagitta regularis	Chaetognath	*Calcinus morgani*	Morgan's hermit crab
Alicella gigantea	Supergiant amphipod	*Calcinus sp.*	Hermit crab
Aliculastrum sp.	Bubble snail	*Calcinus vachoni*	Hermit crab
Alomasoma nordpacificum	Segmented worm	*Calyptogena sp.*	Giant white clam
Alpheus deuteropus	Petroglyph shrimp	*Candacia bispinosa*	Candacia
Alpheus lottini	Pacific snapping shrimp	*Candacia curta*	Candacia
Alviniconcha hessleri	Deep water sea snail	*Candacia ethiopica*	Candacia
Alvinocaris sp.	Deep sea shrimp	*Candacia simplex*	Candacia
Ampharetidae	Bristle worm	*Candacia truncata*	Candacia
Amphisamytha sp.	Deep-sea polychaete	*Capitellidae*	Polychaete worm
Anatoma sp.	Snail	*Carpilius convexus*	Marbled stone crab
Aplysia parvula	Dwarf sea hare	*Carupa tenuipes*	Violet-eyed swimming crab
Argonauta sp.	Paper nautilus	*Caulophacus (Caulophacus)*	Glass sponge
Asbestopluma (Asbestopluma)	Sponge	*Caulophacus (Oxydiscus)*	Glass sponge
Ascidiacea	Sea squirt	*Caulophacus sp.*	Glass sponge
Asterina sp.	Starfish	*Cellana sp.*	Limpet
Asterinidae	Sea star	*Centropages calaninus*	Copepod
Astralium sp.	Star snail	*Centropages elongatus*	Copepod

SCIENTIFIC NAME	COMMON NAME
Centropages gracilis	Copepod
Centropages longicornis	Copepod
Ceraesignum maximum	Great worm shell
Cerithium echinatum	Prickly Horn
Cerithium sp.	Cerith snail
Chama sp.	Jewel box clam
Charonia sp.	Triton
Chelidonura hirundinina	Aglajid sea slug
Chiridota stuhlmanni	Sea cucumber
Chlorodiella laevissima	Stone crab
Chondrocladia (Symmetrocladia) lyra	Lyre sponge
Chromodoris sp.	Nudibranch
Chrysopetalidae	Polychaete worms
Ciliopagurus strigatus	Halloween hermit crab
Cirripedia	Barnacle
Cladorhizidae	Carnivorous demosponge
Clathria (Microciona) mima	Veined sponge
Clathria mima	Encrusting red sponge
Clausocalanus furcatus	Copepod
Cliona sp.	Sponge
Colobocentrotus mertensii	Japanese shingle urchin
Conus chaldaeus	Chaldean cone
Conus lividus	Livid cone
Conus miles	Soldier cone
Conus miliaris	Thousand-spot cone
Conus moreleti	Moreleti cone
Conus nanus	Nanus cone
Conus obscurus	Obscure cone
Conus sp.	Cone snail
Copilia mirabilis	Copepod
Copilia quadrata	Copepod
Coralliophila violacea	Violet coral shell
Corallistes sp.	Demosponge
Corbitella sp.	Glass sponge
Corbitellinae	Glass sponge
Coronididae	Mantis shrimp
Corticium sp.	Sponge
Cosmocalanus darwinii darwinii	Copepod
Crinoidea	Crinoid
Cryptodendrum adhaesivum	Pizza anemone
Cyerce kikutarobabai	Sacoglossan sea slug
Cymatium sp.	Triton snail
Cymo quadrilobatus	Blue-eyed coral crab
Cypraea annularis	Ring cowrie
Cypraea helvola	Star cowrie
Cypraea isabella	Cone snail
Cyrtomaia sp.	Deep-sea spider crab
Daira perlata sp.	Crab
Dardanus deformis	Pale anemone hermit
Dardanus guttatus	Blue-spotted hermit crab
Dardanus lagopodes	Hairy red hermit crab
Dardanus sanguinocarpus	Bloody hermit
Dasybranchus caducus	Segmented worm
Dermatobranchus sagamianis	Sea slug
Desbruyeresia sp.	Hydrothermal vent snail
Diadema sp.	Sea urchin
Dictyaulus sp.	Nematode
Dictyocalyx sp.	Glass sponge
Didemnum sp.	Tunicate
Diniatys dentifer	Toothed bubble snail
Diogenidae	Left-handed hermit crabs
Dolabrifera dolabrifera	Sea hare
Doriprismatica atromarginata	Sea slug
Drupa grossularia	Finger drupe
Drupa ricina	Prickly spotted drupe
Drupa sp.	Murex
Dysidea granulosa	Hard sponge
Dysidea sp.	Marine sponge
Echinolittorina cinerea	Periwinkle
Echinometra mathaei	Rock boring urchin
Echinometra sp.	Rock burrowing Urchin
Echinostrephus aciculatus	Needle-spined urchin
Echinostrephus molaris	Burrowing urchin
Echinothrix calamaris	Banded sea urchin

SCIENTIFIC NAME	COMMON NAME
Echinothrix diadema	Diadema urchin
Elysia pusilla	Sea slug
Ercolania spp.	Sacoglossan sea slug
Euchaeta sp.	Copepod
Euchirella amoena	Copepod
Euphausia krohnii	Copepod
Euphausia tenera	Copepod
Euplectellidae	Glass sponge
Eurythenes sp.	Deep-sea amphipod
Eurythoe complanata	Iridescent fireworm
Farrea occa erecta	Glass sponge
Farreidae	Glass sponge
Fasciolariidae	Tulip snail
Ferosagitta robusta	Copepod
Filograna sp.	Tube worm
Flaccisagitta enflata	Copepod
Flaccisagitta hexaptera	Copepod
Foraminiferida	Amoeboid protist
Furtipodia petrosa	Rock elbow crab
Gandalfus yunohana	Blind vent crab
Garthiella aberrans	Crab
Geodia sp.	Sea sponge
Glossodoris sp.	Nudibranch
Glyceridae	Bloodworm
Gonioinfradens	Swimming crab
Gonioinfradens paucidentatus	Red swimming crab
Grapsidae	Talon crab
Gymnodoris sp.	Nudibranch
Haliclona sp.	Demosponge
Haloptilus longicornis	Copepod
Haminoea cymbalum	Cymbal bubble snail
Haminoea sp.	Bubble snail
Harpa harpa	Harp snail
Hesionidae	Bristle worm
Heteractis crispa	Sebae anemone
Heteractis sp.	Sea anemone
Heterorhabdus papilliger	Copepod
Holothuria (Halodeima) atra	Black sea cucumber
Holothuria (Halodeima) edulis	Edible sea cucumber
Holothuria (Halodeima) signata	Sea cucumber
Holothuria (Microthele) whitmaei	Black teatfish
Holothuria sp.	Sea cucumber
Homalocantha zamboi	Zambo's murex
Hyalonema (Cyliconemaoida)	Sponge
Hyalonema sp.	Sponge
Hyalostylus sp.	Glass sponge
Hydroidolina	Hydroid
Hydrondellea sp.	Deep-sea Amphipod
Hyperioides sibaginis	Deep-sea Amphipod
Ijimalophus sp.	Isao Ijima sponge
Ilbia mariana	Sea slug
Inachidae	Crab
Iphionidae	Scale worm
Ircinia sp.	Sponge
Jorunna funebris	Dotted nudibranch
Julia exquisita	Sea snail
Krohnitta pacifica	Arrow worm
Labidocera detruncata	Copepod
Lambis lambis	Common spider conch
Lambis sp.	Spider conch
Lamellibrachia satsuma	Tube worm
Lamellodysidea herbacea	Silvery blue sponge
Lamprohaminoea cymbalum	Cymbal bubble snail
Lamprophaminoea ovalis	Sea slug
Latirus barclayi	Barclay's latirus shell
Leiaster sp.	Sea Star
Lepetodrilidae	Hydrothermal vent limpet
Lepetodrilus sp.	Hydrothermal vent limpet
Leucetta chagosensis	Lemon sponge
Leusolepas longa	Barnacle
Linckia guildingi	Common comet star
Linckia laevigata	Blue sea star
Linckia multifora	Dalmation linckia star
Liomera stimpsonii	Round crab

SCIENTIFIC NAME	COMMON NAME
Liomera tristis	Round crab
Loimia medusa	Lemon sponge
Lonchiphora sp.	Deep-sea glass sponge
Lubbockia squillimana	Copepod
Lucicutia flavicornis	Copepod
Lucicutia ovalis	Copepod
Lucifer typus	Copepod
Lupocyclus quinquedentatus	5-spine swimming crab
Luria isabella	Isabella cowry
Lybia sp.	Pom-pom crab
Lybia tessellata	Mosaic boxer crab
Lycopodina subtilis	Carnivorous sponge
Macromedaeus nudipes	Crab
Macrophiothrix	Brittle star
Macrophiothrix propinqua	Brittle star
Macrorhynchia philippina	Common comet star
Majidae	Spider crab
Malacoceros indicus	Worm
Medaeops granulosus	Crab
Menaethius orientalis	Red spider crab
Mesocalanus tenuicornis	Copepod
Millepora platyphylla	Blue sea star
Mirocaris sp.	Shrimp
Mithrodia clavigera	Nail sea star
Monetaria caputserpentis	Snakehead cowry
Monetaria moneta	Money cowry
Moorea bouillonii	Cyanobacteria
Munidopsis gracilis	Squat lobster
Munidopsis myojinensis	Squat lobster
Munidopsis sp.	Squat lobster
Mysid sp.	Opossum shrimp
Nannocalanus minor	Copepod
Nanocassiope tridentata	Mud crab
Naria helvola	Honey cowry
Naria poraria	Porous cowry
Nassarius sp.	Spaghetti worm
Neocalanus robustior	Copepod
Neocalanus tonsus	Copepod
Neopetrosia chaliniformis	Sponge
Nicomache sp.	Tube worm
Notopoides latus	Crab
Oceanapia sp.	Sponge
Octopoda	Octopus
Oncaea venusta	Copepod
Opaepele loihi	Hydrothermal vent shrimp
Ophiodermatidae	Brittle star
Ophionereis porrecta	Long arm brittle star
Ophiuroidea	Brittle star
Ostreoida	Oyster
Pachastrellidae	Sponge
Pachos dentatum	Copepod
Pachycheles sp.	Porcelain crab
Paguridae	Hermit crab
Paguristes jalur	Hermit crab
Paguritta kroppi	Kropp's coral hermit crab
Paguritta sp.	Mud snail
Paguropsis sp.	Hermit crab
Palythoa sp.	Moon polyps
Paracalanus aculeatus aculeatus	Copepod
Paraglypturus calderus	Ghost shrimp
Paralicella sp.	Brittle star
Paralvinella sp.	Sulfide worm
Pareucalanus attenuatus	Copepod
**Paronesimoides calceolus*	Tryphosid amphipod
Parthenopidae	Elbow crab
Patellidae	Limpet
Pearsonothuria graeffei	Graeffe's sea cucumber
Pectinariidae	Trumpet worm
Pectinidae	Scallop
Pedum sp.	Oyster
Pedum spondyloideum	Coral clam
Pennaria sp.	Hydroid
Percnon planissimum	Flat rock crab
Periclimenes cannaphilus	Cleaner shrimp

SCIENTIFIC NAME	COMMON NAME
Perinia tumida	Little seaweed crab
Petrolisthes carinipes	Porcelain crab
Petrolisthes coccineus	Red porcelain crab
Petrolisthes heterochrous	Mariana porcelain crab
Petrolisthes scabriculus	Porcelain crab
Phanogenia gracilis	Feather star
Pherecardia striata	Lined fireworm
Pheronematidae	Sponge
Phyllacanthus imperialis	Pencil urchin
Phylladiorhynchus orpheus	Squat lobster
Phylladiorhynchus priasus	Squat lobster
Phyllidia annulata	Dorid nudibranch
Phyllidia carlsonhoffi	Sea slug
Phyllidia guamensis	Sea slug
Phyllidia pustulosa	Pustulose wart slug
Phyllidia rueppellii	Wart slug
Phyllidia tula	Sea slug
Phyllidiella pustulosa	Pustulose wart slug
Phymorhynchus	Deep-sea snail
Phymorhynchus sp.	Sea snail
Pinctada margaritifera	Black -lip pearl oyster
Placopegma sp.	Glass sponge
Plagusia squamosa	Scaly rock crab
Platyozius laevis	Crab
Plesiopenaeus armatus	Deep-water shrimp
Pleuromamma abdominalis abdominalis	Copepod
Pleuromamma gracilis gracilis	Copepod
Pleuroploca sp.	Horse conch
Polycarpa cryptocarpa	Showy xanthid crab
Polychaeta	Polychaete worm
Polynoidae	Scale worm
Pontellina plumata	Copepod
Porifera	Sponge
Princaxelia sp.	Deep-sea amphipod
Protula sp.	Tube worm
**Provanna cingulata*	Provannid snail
**Provanna exqusita*	Provannid snail
Provanna sp.	Provannid snail
Pseudocalanus elongatus	Copepod
Pseudoceros paralaticlavus	Goldrim flatworm
Pseudoliomera speciosa	Showy xanthid crab
**Pseudoliparis swirei*	Mariana snailfish
Pseudorimula sp.	Slit-limpet
Pteraeolidia ianthina	Blue dragon nudibranch
Pterosagitta draco	Arrow worm
Pyloderma sp.	Sponge
Pyura sp.	Tunicate
Quoyula madreporarum	Coral snail
Raoulserenea komaii	Mantis shrimp
Regadrella sp.	Glass sponge
Roboastra gracilis	Sea slug
Rochia nilotica	Commercial top shell
Sabellidae	Christmas tree worm
Saccocalyx sp.	Glass sponge
Sagitta bipunctata	Arrow worm
Sapphirina auronitens	Copepod
Sapphirina gastrica	Copepod
Sapphirina nigromaculata	Copepod
Sapphirina scarlata	Copepod
Sapphirina stellata	Copepod
Saron sp.	Common marble shrimp
Schizophrys aspera	Common decorator crab
Schizothrix calcicola	Cyanobacteria
Scolecithricella minor minor	Copepod
Scolecithrix danae	Copepod
Scopelocheirus sp.	Lysianassid amphipod
Scottocalanus helenae	Copepod
Scutellastra sp.	Limpet
Semperella sp.	Scoop sponge
Serpulidae	Annelid worm
Siphonodictyon sp.	Burrowing sponge
Siphopteron flavum	Sea slug
Siphopteron sp.	Sea slug
Smaragdinella calyculata	Bubble-shelled slugs

SCIENTIFIC NAME	COMMON NAME
Solanderia secunda	Hydrozoan
Soliella flava	Mud crab
Spionidae sp.	Polychaete worm
Spirobranchus giganteus	Horned feather worm
Spirobranchus sp.	Christmas tree worm
Spirorbis sp.	Polychaete worm
Spondylus sp.	Spondylus
Spongosorites siliquaria	Sponge
Stelodoryx sp.	Sponge
Stenopus hispidus	Banded coral shrimp
Stenopus sp.	Boxer shrimp
Stenopus zanzibaricus	Banded coral shrimp
Stichopus chloronotus	Greenfish sea cucumber
Stomatella sp.	Stomatella snail
Stylissa massa	Commercial top shell
Stylocheilus striatus	Sea hare
Stylocheiron suhmii	Krill
Tectus pyramis	Pyram top shell
Terebella sp.	Feather duster worm
Terpios sp.	Demosponge
Thalamita sp.	Mottled swimming crab
Thalamitoides quadridens	Crab
Thalamitoides sp.	Crab
Thelenota ananas	Pineapple sea cucumber
Thermopolynoe sp.	Scale worm
Thermosipho sp.	Bacteria
Thuridilla bayeri	Sea slug
Thuridilla flavomaculata	Sea slug
Thuridilla vatae	Sea slug
Thysanopoda obtusifrons	Krill
Tonna perdix	Partridge tun
Trapezia ferruginea	Rusty guard crab
Trapezia flavopunctata	Yellow-spotted guard crab
Trapezia lutea	Red coral crab
Trapezia sp.	Guard crab
Tridacna crocea	Boring clam
Tridacna maxima	Small giant clam
Tridacna sp.	Giant clam
Tripneustes gratilla	Collector urchin
Trizopagurus sp.	Halloween hermit crab
Trochus niloticus	Commercial top shell
Turbo argyrostomus	Silver-mouthed turban
Turbo sp.	Turbo snail
Tweedieia odhneri	Crab
Tylocarcinus styx	Underworld spider crab
Urocorycaeus lautus	Copepod
Valonia ventricosa	Bubble algae
Vasum sp.	Vase snail
Vayssierea felis	Sea slug
Ventsia sp.	Sea snail
Viaderiana typica	Crab
Xanthias lamarckii	Rubble crab

Coral Species

SCIENTIFIC NAMES

Acanella sp.
Acanthastrea echinata
Acropora abrotanoides
Acropora cerealis
Acropora digitifera
Acropora diversa
Acropora gemmifera
Acropora globiceps
Acropora humilis
Acropora monticulosa
Acropora nasuta
Acropora paniculata
Acropora samoensis
Acropora secale
Acropora surculosa
Acropora tenuis
Acropora verweyi
Alternatipathes sp.
Anthomastus sp.
Anthoptilum sp.
Astreopora gracilis
Astreopora myriophthalma
Astreopora randalli
Bebryce sp.
Calibelemnon sp.
Calibelemnon symmetricum
Calyptopora sp.
Calyptrophora distolos
Coscinaraea exesa
Crypthelia sp.
Cyphastrea agassizi
Cyphastrea chalcidicum
Distichopora violacea
Dysidea herbacea
Euphyllia glabrescens
Favia danae
Favia favus
Favia helianthoides
Favia matthaii
Favia pallida
Favia stelligera
Favites abdita
Favites pentagona
Favites russelli
Galaxea fascicularis
Goniastrea edwardsi
Goniastrea pectinata
Goniastrea retiformis
Goniopora fruticosa
Goniopora lobata
Goniopora minor
Gymnangium sp.
Heliopora coerulea
Hydnophora exesa
Hydnophora microconos
Isopora palifera
Keratoisidinae
Kulamanamana haumeaae
Leptastrea bewickensis
Leptastrea pruinosa
Leptastrea purpurea
Leptastrea transversa
Leptoria phrygia
Leptoseris incrustans
Leptoseris mycetoseroides
Lobactis scutaria
Lobophyllia corymbosa
Lobophyllia hemprichii
Macroprimnoa ornata
Merulina ampliata
Metallogorgia melanotrichos
Millepora cylindrica
Millepora sp.
Millepora tuberosa
Montastraea curta
Montastraea valenciennesi
Montipora caliculata
Montipora foveolata
Montipora grisea
Montipora hoffmeisteri
Montipora incrassata
Montipora lobulata
Montipora nodosa
Montipora socialis
Montipora tinian
Montipora verrucosa
Palythoa sp.
Pavona bipartita
Pavona clavus
Pavona duerdeni
Pavona explanulata
Pavona maldivensis
Pavona minuta
Pennaria sp.
Pennatula sp.
Pocillopora ankeli
Pocillopora damicornis
Pocillopora elegans
Pocillopora eydouxi
Pocillopora meandrina
Pocillopora setchelli
Pocillopora verrucosa
Porites australiensis
Porites densa
Porites lobata
Porites lutea
Porites monticulosa
Porites rus
Porites solida
Porites vaughani
Protopalythoa sp.
Protoptilum sp.
Psammocora contigua
Psammocora digitata
Psammocora haimeana
Psammocora nierstraszi
Psammocora superficialis
Ramuligorgia militaris
Sarcophyton sp.
Scapophyllia cylindrica
Scleracis sp.
Scolymia australis
Sinularia sp.
Solanderia secunda
Stylaster sp.
Stylasteridae
Stylocoeniella armata
Stylocoeniella guentheri
Stylophora mordax
Stylophora pistillata
Swiftia sp.
Turbinaria irregularis
Turbinaria reniformis
Turbinaria stellulata
Umbellula
Zoanthus sp.

Appendix B. USFWS Compatibility Determinations

B.1 Uses Evaluated

The following section includes Compatibility Determinations (CD)s for existing Refuge uses. According to USFWS policy, CDs will be completed for all uses proposed within a national wildlife refuge that have been determined to be appropriate. Per national CD guidance, there can only be one Refuge per CD and only one use-category per CD. The following CDs are specific to the individual refuges within the Monument:

Table B.1 Summary of Compatibility Determinations.

Refuge	Refuge Use Category	Page	Compatible	Year Due for Re-evaluation
Mariana Arc of Fire	Wildlife Observation and Photography	B-3	yes	2037
Mariana Arc of Fire	Research and Surveys	B-16	yes	2032
Mariana Trench	Wildlife Observation and Photography	B-29	yes	2037
Mariana Trench	Research and Surveys	B-41	yes	2032

B.1.1 Compatibility – Legal and Historical Context

Compatibility is a tool refuge managers use to ensure that recreational and other uses do not interfere with wildlife conservation, the primary focus of refuges. Compatibility is not new to the Refuge System and dates back to 1918 as a concept. As policy, it has been used since 1962. The Refuge Recreation Act of 1962 directed the Secretary of the Interior to allow only those public uses of Refuge lands that were "compatible with the primary purposes for which the area was established."

Legally, Refuges are closed to all public uses until officially opened. Regulations require that adequate funds be available for administration and protection of refuges before opening them to any public uses. However, wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education and interpretation) are to receive enhanced consideration and cannot be rejected simply for lack of funding resources unless the refuge has made a concerted effort to seek out funds from all potential partners. Once found compatible, wildlife-dependent recreational uses are deemed the priority public uses at the refuge. If a proposed use is found not compatible, the refuge manager is legally precluded from approving it. Economic uses that are conducted by or authorized by the refuge also require CDs.

Under compatibility policy, uses are defined as recreational, economic/commercial, or management use of a refuge by the public or a non-Refuge System entity. Uses generally providing an economic return (even if conducted for the purposes of habitat management) are also subject to CDs. The USFWS does not prepare CDs for uses when the USFWS does not have jurisdiction. For example, the USFWS may have limited jurisdiction over Refuge areas where property rights are vested by others; or where legally binding agreements exist. In addition, aircraft over-flights, emergency actions, some activities on navigable waters, and activities by other Federal agencies are exempt from the compatibility review process.

Compatibility regulations require that a use must be compatible with both the Refuge System mission and the purpose(s) of the individual Refuge. This standard helps to ensure consistency in application across the Refuge System. The Administration Act also requires that CDs be in writing and that the public have an opportunity to comment on most use evaluations.

The NWRS mission emphasizes that the needs of fish, wildlife, and plants must be of primary consideration. The Improvement Act defined a compatible use as one that ". . . in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge." Sound professional judgment is defined under the Improvement Act as ". . . a finding, determination, or decision, that is consistent with principles of sound fish and wildlife management and administration, available science and resources . . ." Compatibility for wildlife-dependent uses may depend on the level or extent of a use.

Court interpretations of the compatibility standard have found that compatibility is a biological standard and cannot be used to balance or weigh economic, political, or recreational interests against the primary purpose of the refuge. The USFWS recognizes that CDs are complex. For this reason, refuge managers are required to consider principles of sound fish and wildlife management and best available science in making these determinations. Evaluations of the existing uses on the Monument/Refuge units are based on the professional judgment of USFWS and planning personnel including reviews of relevant scientific literature.

Compatibility Determination

Title

Compatibility Determination for Photography, Mariana Arc of Fire National Wildlife Refuge within the Mariana Trench Marine National Monument.

Refuge Use Category

Wildlife Observation and Photography

Refuge Use Type(s)

Photography. Refuge visitation for the purpose of photographing refuge natural or cultural resources (including fish, wildlife, plants, and their habitats) or public uses of those resources. Includes still photography, photography, videography, filming, or other recording of sight or sound.

Refuge

Mariana Arc of Fire National Wildlife Refuge

Refuge Purpose(s) and Establishing and Acquisition Authority(ies)

Mariana Arc of Fire NWR:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ... 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956).

"... conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act).

"... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).

Mariana Trench Marine National Monument:

"...for the purpose of protecting the objects identified above..." "... [Interior

Secretary] shall not allow or permit any appropriation, injury, destruction, or removal of any feature of this monument except as provided for by this proclamation or as otherwise provided for by law". (Presidential Proclamation 8335)

"…Regulation of Scientific Exploration and Research…Subject to such terms and conditions as the Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study…" (Presidential Proclamation 8335)

"…For each of the areas subject to this delegation, the Director of the [USFWS] shall provide for the proper care and management of the monument, including all objects of scientific and historic interest therein; the conservation of fish and wildlife; and the development of programs to assess and promote national and international monument-related scientific exploration and research." (Section 4.a.(2) . . . subject to the provisions of the proclamation [8335] establishing this Monument. . ."). " (Secretarial Order 3284).

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System, otherwise known as Refuge System, is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife,and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (Pub. L. 105-57; 111 Stat. 1252).

Description of Use

Is this an existing use?

Yes.

This use was reevaluated concurrently with the preparation of the Draft Mariana Trench Marine National Monument Management Plan and Environmental Assessment (USFWS 2020).

What is the use?

We propose to allow Refuge visitation for the purpose of photographing refuge natural or cultural resources (including fish, wildlife, plants, and their habitats) or public uses of those resources. "Photography" includes still photography videography, filming, or other recording of sight or sound to be made within the Refuge. The Service and the Department of the Interior do not distinguish between different types of filming activity (e.g. filming for personal, commercial, news, or educational purposes).

Any photography or other recording activities conducted in the extreme environment of the Mariana Arc of Fire NWR are 1) functionally the same; and 2) limited to a few individuals and institutions that have the fiscal and technical capability to access deep-sea areas. For example, the permittee may film the ocean floor, record the sounds of venting from white smokers, and video explorers and scientists in their work.

It is likely that such photographs, video, or audio recordings would have commercial value and there would be intentions of some commercial use. However, the Service and the Department of the Interior do not distinguish between different types of filming activity and do not regulate commercial filming or videography specifically. Commercial still photography and audio recordings may be regulated, however we expect that the primary activity being permitted would be video recording.

Because recordings of extreme deep-sea environments are novel and exceptional throughout the world, they would be of immense interest to schools and educational institutions, news media, and both commercial and public broadcasting organizations. Recordings may be included in a live "virtual classroom" event, be broadcast through news media, and be the subject of a documentary. Recordings of deep-sea environments are appealing to the general public because they expose an exceptional environment, representing some of the last frontiers of discovery on Earth. They are also captivating because deep-sea environments have been inaccessible to humans for most of our history, and even today are accessible only with the help of highly specialized equipment.

Filming, video, photography or audio recording that are not related to natural, historic, or cultural subjects of the Refuge is not covered under this CD (e.g., extreme sports photography, filming a movie unrelated to the Monument or Refuge mission, etc.). All recording proposals are anticipated to coincide with other projects for exploration, research, survey or scientific collecting; however, these scientific activities are considered in a separate CD. This CD only covers the acquisition of digital or photographic information and does not consider or include any sampling or specimen collections. Recording may be conducted in the Refuge benthic environments as long as it meets the criteria of being related to natural, historic, or cultural features. To ensure that the natural and cultural resources of the Refuge are protected, proposals must also specify how they plan to contribute to the achievement of the Refuge System mission and Monument and Refuge purposes.

Is the use a priority public use?

Yes

Where would the use be conducted?

Recording would be conducted within any benthic environment of the Mariana Arc of Fire NWR covering 46,780 acres of submerged lands. The Refuge includes the

following 18 units in the Philippine Sea, comprised of the submerged lands in a 1 mile radius from the center of each listed volcano or hydrothermal vent field. The Refuge includes unique geology, hydrothermal vent ecosystems, bottomfish habitats, and deep-sea coral and sponge communities. Vibrant groups of organisms thrive in these isolated benthic environments despite extreme pressure and heat, little to no sunlight, and toxic levels of dissolved metals and gases. Vent communities include squat lobsters as well as tubeworms, clams, and mussels that have developed a symbiotic relationship with chemosynthetic bacteria. The Refuge does not include the overlying water column. There are no USFWS facilities in this extreme environment.

Unit	Location	Summit Elevation
Fukujin (volcano)	143° 27'30" E, 21° 56'30" N	-712 ft
Minami Kasuga 2 (volcano)	143° 38'30" E, 21° 36'36" N	-567 ft
Minami Kasuga 3 (volcano)	143° 38'0" E, 21° 24'0" N	-3675 ft
Northwest Eifuku (volcano)	144° 2'36" E, 21° 29'15" N	-5035 ft
Alice Springs (hydrothermal vent field)	144° 70'73" E, 18° 21'03" N	-2.23 mi
Central Trough (hydrothermal vent field)	144° 45'0" E, 18° 1'0" N	-2.28 mi
Zealandia Bank (overlapping volcanoes)	145° 51'4" E, 16° 52'57" N	3 ft
East Diamante (volcano)	145° 40'47" E, 15° 56'31" N	-416 ft
Ruby (volcano)	145° 34'24" E, 15° 36'15" N	-754 ft
Esmeralda Bank (volcano)	145° 14'45" E, 14° 47'30" N	-141 ft
Northwest Rota-1 (volcano)	144° 46'30" E, 14° 36'0" N	-1696 ft
West Rota (volcano)	144° 50'0" E, 14° 19'30" N	-984 ft
Forecast (volcano)	143° 55'12" E, 13° 23'30" N	-4816 ft
Seamount X (volcano)	144° 1'0" E, 13° 14'48" N	-4084 ft
South Backarc (hydrothermal vent field)	143° 37'8" E, 12° 57'12" N	-1.77 mi
Archaean (hydrothermal vent field)	143° 37'8" E, 12° 56'23" N	-1.9 mi
Pika (hydrothermal vent field)	143° 38'55" E, 12° 55'7" N	-1.72 mi
Toto (volcano)	143° 31'42" E, 12° 42'48" N	-1.88 mi

When would the use be conducted?

Recordings may occur any time of the year and for any bottom area of the Mariana Arc of Fire NWR. The USFWS in consultation with NOAA and others, as applicable, will evaluate each proposal and may put limits on the activities in an effort to ensure that negative impacts to resources are avoided or limited. All approved projects would be required to have a Special Use Permit (SUP). It is estimated that no more than 3 photography, filming, video, and audio recording SUPs would be issued in a calendar year.

How would the use be conducted?

The use may be conducted by recording equipment attached to manned submersibles, remotely operated vehicles, or stationary observation systems. This equipment may have lighting adequate for navigation and illuminating subjects and provisions for luring marine organisms using bait.

All recording proposals are anticipated to coincide with other projects for exploration, research, survey or scientific collecting; however, these scientific activities are considered in a separate CD. This recordings CD only covers the acquisition of digital or photographic information and does not consider or include any sampling or specimen collections. Recordings of Refuge benthic environments may be conducted as long as they meet the criteria of being related to natural, historic, or cultural features. Recording proposals must also specify how they plan to contribute to the achievement of the Refuge System mission and Monument and Refuge purposes.

Recording projects involving video, filming, photography or sound would likely have different protocols and methods for recording the bottom environments and species of the Refuge as well as different strategies for reaching diverse audiences. Therefore, each proposal necessitates its own management review during the permitting process. Each project would be carefully reviewed to prevent any significant short-term, long-term, or cumulative impacts to Refuge resources. Proposals would be evaluated by USFWS staff, applicable partners at the NOAA, experts with the USGS, as well as other subject-matter experts as determined necessary by the USFWS. Evaluations and reviews would be conducted to determine if the species recorded, methods used, or habitat type and locations affected may lead to undesirable cumulative impacts. All projects would be required to have a Refuge Special Use Permit (SUP). This degree of review would help ensure numerous levels and types of impacts are carefully considered before any recording permit is issued. Within the SUP, conditions would be clearly defined to protect and conserve the existing resources found within the Refuge. Some of the standard and specific conditions are included in this CD under Stipulations Necessary to Ensure Compatibility.

Per Presidential Proclamation 8335, and relying on consultation between the federal agencies, nothing in this CD shall restrict scientific exploration or research activities by or for the Secretary of Commerce, and nothing shall be construed to require a permit or authorization for the Secretary of Commerce or his respective scientific activities.

Why is this use being proposed or reevaluated?

This use has been reevaluated concurrently with the preparation of the Draft Mariana Trench Marine National Monument Management Plan and Environmental Assessment (USFWS 2020). Due to the extreme depths and sophisticated technological capability needed to access the Mariana Arc of Fire NWR; photography,

video, filming, and audio recording ("recording") are the primary ways that the USFWS and others may gain access to and information about the area.

Availability of Resources

Due to the complex nature of accessing the extreme depths and environments of the Refuge for recordings, only a handful of entities have the technology and capability to access their benthic environments. It is estimated that no more than three photography, filming, video, and audio recording SUPs would be issued in a calendar year. The bulk of the cost for this SUP is incurred in staff time to review proposals, coordinate with applicants, ensure recording activity contributes to the achievement of the Refuge System mission and Monument/Refuge purposes, write SUPs, oversee on-going projects, and review the project post-recording development and results. Law enforcement and dissemination of information about the projects in the Monument are not included in these cost estimates. We project that administering a single recording project SUP may require four weeks of intermittent staff time.

The protected area of the Refuge includes only the submerged lands and benthic resources of submarine volcanoes and hydrothermal vent fields; and does not include the overlying water column. Access to it is through remotely operated vehicles or manned submersibles. There are no USFWS facilities in this extreme environment. Permittees would pay the cost of all their actions related to the Refuge. Permittees working in the Refuge units would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits needed for their actions. Any accidents or responses involving the permittees will be their sole financial responsibility. Any funds expended by the USFWS above general SUP administration, or as a result of an accident or response, will be reimbursed by the permittee. At this time, the Service does not require liability insurance or bonds for any filming activity. However, permittees would be liable for damages to Service resources during filming activities.

Table 1. Annual costs to Administer and Manage photography, video, filming, or audio recording

Category and Itemization	Recurring Annual Expenses
Staff time (LE, administration, and management)	$4,700
Monitoring	$4,600
Total expenses	**$9,300**

The numbers above reflect the estimated cost for three permits per year. Estimated costs were calculated using 5% of the 2022 base cost of a GS12/5 biologist, 2% cost of a GS13/5 Refuge Manager, and 5% of a GS7/5 biological technician assuming this use would use that "portion of a year" to administer.

Anticipated Impacts of the Use

Potential impacts of a proposed use on the refuge's purpose(s) and the Refuge System mission

The effects and impacts of the proposed use to refuge resources, whether adverse or beneficial, are those that are reasonably foreseeable and have a reasonably close causal relationship to the proposed use. This CD includes the written analyses of the environmental consequences on a resource only when the impacts on that resource could be more than negligible and therefore considered an “affected resource.” Water and air quality, geology and soils, floodplains, wilderness, environmental justice, and climate change will not be more than negligibly impacted by the action and have been dismissed from further analyses.

Most of the possible impacts recognized are over or within the water column, and therefore outside the boundary of the Refuge (the Mariana Arc of Fire NWR includes only submerged lands). These impacts may include: (1) disturbance of foraging sea birds and pelagic fish; (2) disturbance of marine mammals; (3) disturbance of endangered and threatened sea turtles; (4) release of pollution and contaminants; (5) disturbance and damage to fish, invertebrates, and algae.

Possible impacts to the bottom community of Mariana Arc of Fire NWR may include (1) disturbance to benthic marine organisms; (2) introduction of metals and other materials or equipment that are needed to travel to the bottom, and then discarded into the Refuge unit in order to return to the surface; and (3) accidental introduction of non-native extremophile species or contaminants from equipment used during the operations.

Each submarine volcano is likewise a submerged island of biodiversity. Each may hold unique biological communities from feature to feature and could potentially be susceptible to invasions by organisms that are not native to that feature. Possible impacts affecting the Refuge, or the water column and surface above the Refuge, include: (1) disturbance of foraging sea birds and pelagic fish; (2) disturbance of marine mammals; (3) disturbance of endangered and threatened sea turtles; (4) release of pollution and contaminants; (5) disturbance and damage to invertebrates and algae; (6) disturbance to benthic marine organisms; (7) introduction of metals and other equipment needed to travel to the bottom and then discarded in order to return to the surface; and, (8) accidental introduction of non-native extremophile species from equipment used during the operations.

Accidental introduction of non-native species between deep sites has been documented at other deep-sea locations. A submersible transferred 38 limpets from the Gorda Ridge at 7,457 feet depth to the Juan de Fuca Ridge after a 2-day journey of 394 miles. When the samples from this site were analyzed, the limpets were determined to be alive, having survived the time and depth of decompression and re-compression between the two sites. As a precaution, permits will require disinfection

of hard equipment surfaces (i.e., with diluted bleach solution) before deploying to other locations.

Exploration vehicles can introduce vast quantities of single-use, plastic-coated tether that have been deliberately discarded as observed at the deepest site of all Earth's oceans. Manned submersible dives to Challenger Deep (10,925 m deep) in the Mariana Trench in 2019 and 2020 revealed hundreds of meters of yellow and white tether strewn across the seafloor (Vescovo et al. 2021). Due to its composition, these fiber-optic tethers will not only persist environmentally but form a significant risk to equipment and life should unmanned and manned craft become entangled. Therefore, the deliberate abandonment or discarding of nondegradable tethers is prohibited.

Short-term impacts

Short-term impacts to refuge resources are expected to occur as a result of permitted activities. Anticipated short-term impacts include the disturbance of bottom sediments by submersible propellers that may impact nearby coral and sponge communities, the interaction with turtles and marine mammals in the water column above the Refuge, as well as the potential introduction of invasive species.

Incidental discharge of materials, oil, or ballast water from surface vessels or submersibles has the potential to impact threatened and endangered species that may be present at or near the ocean floor or passing through the water column above the Refuge. Since it is estimated that no more than three recording SUPs would be issued in a calendar year, the presence of vessels or submersibles would be intermittent and limited in duration. With adherence to US Coast Guard and IMO ballast water requirements, the Best Management Practices (BMPs) included within each SUP, and the stipulations contained herein, recording activities are expected to have a negligible, short-term impact to threatened and endangered species.

Bright lights on surface vessels above the Refuge units have the potential to impact seabirds if present. Seabirds may be attracted to bright lights at night, which could cause disorientation, disruption of migratory routes, and pose a collision risk with a lighted structure. Since no more than three recording SUPs would be issued per calendar year, the presence of vessels in or above the Refuge for recording would be intermittent and limited in duration. Vessels may be required to dim the lights every night, and those operating near seabird breeding islands and atolls at night would be required to black out all but the most essential lights. Coupled with BMPs included within each SUP, these stipulations would ensure bright lights from surface vessels would have a negligible, short-term impact to seabirds.

Long-term impacts

Potential long-term impacts include damage to geologic features, corals and coral reef ecosystems, deep-sea hydrothermal vent and sponge communities, and other

benthic animal communities. Repetitive sedimentation could smother corals, causing stress and preventing reproduction and growth. Permittees will minimize these effects by photographing animals and bottom features at different areas in the Refuge units, minimizing multiple visits to one area. Damage done directly to coral animals can have long-term impacts on the survival of the animal. Invasive species may be introduced to the Refuge unintentionally from contaminated surfaces on the ROV or its components. A robust biosecurity plan must be approved prior to permitted activities to assure that long-term impacts from invasive species introductions does not occur.

Public Review and Comment

The draft of this CD was included in the November 2020 Mariana Trench MNM Draft MMP/EA. The official public comment period for the MMP/EA was from February 24 – July 26, 2021. Comments were submitted to regulations.gov. The Draft MMP/EA was available on the web at multiple URLs including the Refuge Web pages. Hard copies were sent to public libraries in CNMI and Guam and available on request. A hard copy was also available at the Guam NWR Nature Center. In addition, FWS held four virtual public meetings in June 2021 to provide community-focused opportunities for the public to ask questions. Changes were made to the Draft CD in response to public comment, current guidance on the preparation of Compatibility Determinations, and current Department of the Interior and U.S. Fish & Wildlife guidance on the regulation of photography and other recording activities on National Wildlife Refuges and other public lands.

Determination

Is the use compatible?

Yes

Stipulations Necessary to Ensure Compatibility

1. Applicants for recording would be required to obtain a USFWS SUP. These permits may stipulate more detailed access restrictions and regulations to protect wildlife or Refuge integrity from anticipated site-specific negative effects caused by the project.
2. At the discretion of the Refuge Manager/ Superintendent, USFWS-approved staff may be assigned to accompany filming expeditions.
3. The USFWS encourages and supports compatible filming and photography in order to acquire information upon which decisions regarding management of

units of the Refuge System may be based and to provide access to this remote area to the public through the products of this work. Priority will be given to projects that contribute to the knowledge base of and management for biodiversity, enhancement, protection, use, preservation, and management of native wildlife populations and their habitat. Filming and photography must contribute to the achievement of the Refuge System mission and Refuge purpose (50 CFR 29.1).

4. In accordance with Department of the Interior filming regulations (43 CFR Part 5.1), utmost care will be exercised to see that no natural features are injured, and after completion of the work the area will, as required by the official in charge, either be cleaned up and restored to its prior condition or left, after clean-up, in a condition satisfactory to the official in charge.
5. Credit will be given to the U.S. Fish & Wildlife Service and the Department of the Interior through the use of an appropriate title or announcement (43 CFR Part 5.1).
6. Pictures will be taken of wildlife only when such wildlife will be shown in its natural state or under approved management conditions if such wildlife is confined (43 CFR Part 5.1).
7. Constant vigilance is kept for the presence of Federally listed species. When piloting vessels, vessel operators alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles.
8. Unless specifically covered under a separate permit that allows activity within proximity to protected species, all in-water work is postponed when whales are within 100 yards or other protected species are within 50 yards. Activity recommences only after the animal(s) depart the area. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s); and no attempts are made to feed, touch, ride, or otherwise intentionally interact with any protected species.
9. Any special instructions received from the official in charge of the area will be complied with (43 CFR Part 5.1).
10. Any additional information relating to the privilege applied for by this application will be furnished upon request of the official in charge (43 CFR Part 5.1).
11. If the proposed methods would materially impact, appropriate, injure, destroy, or remove any Refuge resource, the permittee must identify the issues in advance. Highly intrusive or manipulative photography or recording is generally not permitted. As much of these recordings will be experimental due to the extreme environment, any non-anticipated disturbance would immediately be brought to the attention of the Refuge Manager/ Superintendent.

12. Permittees are responsible for acquiring and/or renewing any necessary additional permits prior to beginning or continuing their project.
13. Permittee would be responsible to cover all Refuge costs associated with the recording activity beyond what is predicted in this CD.
14. The Refuge Manager/ Superintendent or designated representative can suspend or modify conditions or terminate research that is already permitted and in progress should unacceptable, unforeseen, or unexpected impacts or issues arise or be noted.
15. Discarding or abandonment of non-degradable umbilicals from deep-sea exploration vehicles is prohibited.
16. Permittees will inspect all equipment prior to beginning work each day to ensure the equipment is in good working condition, and there are no contaminant (oil, fuel, etc.) leaks. All equipment found to be leaking contaminants must be removed from service until repaired.
17. All fueling or repairs to equipment must be done in a location with the appropriate controls that prevents the introduction of contaminants to the marine environment. Ship crews will prevent discharges of chemicals and other fluids dissimilar from seawater into the water column.
18. Permittees will follow the USFWS-provided Best Management Practices for Deep-Sea Research Marine Invasive Species Prevention or provide their own bio-security plan with their SUP application for review and approval to ensure that invasive species will not be inadvertently introduced into the Refuge.
19. All photography, filming, video, and audio recording permit holders would be required to submit an annual report to the Refuge Manager/ Superintendent that summarizes their activities for a given year and a final report when the project is completed. The report would include at a minimum the following: project title, SUP number, calendar year, progress, important findings, and problems encountered, proposed resolution to problems, preparer, and date prepared. The report and all publications and products derived from the SUP will appropriately acknowledge the activities were conducted with permission of the U.S. Fish & Wildlife Service under a National Wildlife Refuge System permit. Appropriate acknowledgment should also be given to the National Oceanic and Atmospheric Administration, when applicable. All reports, publications, or products will reference the Mariana Trench Marine National Monument.
20. Permittee must provide USFWS with at least one free copy of all products, commercial or otherwise, generated in the Refuge units for the non-commercial, governmental use of informing people about the Monument, Refuge, and the National Wildlife Refuge System.

Justification

Photography, videography, filming, and audio-visual recordings in the Mariana Arc of Fire NWR are inherently valuable to the USFWS, governmental partners, and the public and are a necessary tool to further the aims of public education programs and public outreach as well as the primary method for gathering scientific information. The permitting of these pursuits supports the Presidential directive to study and protect this sensitive area. This is particularly true in this case where many of the resources remain undiscovered, unknown, and presumably in pristine or relatively pristine condition. By allowing recordings in conjunction with other uses (e.g., exploration, scientific collection, and surveys) proposed for the area we are encouraging a use that will have minimal impact but enormous reward in the form of information and inspiration. Thus, by effectively administering, tracking, and managing proposed uses through SUPs, the use would not materially interfere with or detract from the fulfillment of Proclamation 8335, the Refuge System mission, or the purposes for which the Refuge and Monument were established.

Signature of Determination

Tammy Summers 7/27/2022

Refuge Manager Signature and Date

Signature of Concurrence

CHRISTINE OGURA Digitally signed by CHRISTINE OGURA
Date: 2022.08.31 15:20:26 -07'00'

Acting Regional Refuge Chief Signature and Date

Mandatory Reevaluation Date

2037

12

Literature Cited/References

Draft Mariana Trench National Monument Management Plan and Environmental Assessment, 2020.

Vescovo, Victor L., Jamieson, Alan J., Lahey, Patrick, McCallum, Rob, Stewart, Heather A., and Machado, Casey. 2021. Safety and conservation at the deepest place on Earth: A call for prohibiting the deliberate discarding of nondegradable umbilicals from deep-sea exploration vehicles, Marine Policy, Volume 128, 2021, 104463, ISSN 0308-597X. Available at: https://doi.org/10.1016/j.marpol.2021.104463 (https://www.sciencedirect.com/science/article/pii/S0308597X21000749)

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Compatibility Determination

Title

Compatibility Determination for Research, Exploration, Scientific Collections, and Surveys, Mariana Arc of Fire National Wildlife Refuge within the Mariana Trench Marine National Monument.

Refuge Use Category

Research and Surveys

Refuge Use Type(s)

Research, Exploration, Scientific Collections, and Surveys.

Refuge

Mariana Arc of Fire National Wildlife Refuge

Refuge Purpose(s) and Establishing and Acquisition Authority(ies)

Mariana Arc of Fire NWR:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ... 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956).

"... conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act).

"... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).

Mariana Trench Marine National Monument:

"...for the purpose of protecting the objects identified above..." "... [Interior Secretary] shall not allow or permit any appropriation, injury, destruction, or removal of any feature of this monument except as provided for by this proclamation or as

otherwise provided for by law". (Presidential Proclamation 8335)

"…Regulation of Scientific Exploration and Research…Subject to such terms and conditions as the Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study…" (Presidential Proclamation 8335)

"…For each of the areas subject to this delegation, the Director of the [USFWS] shall provide for the proper care and management of the monument, including all objects of scientific and historic interest therein; the conservation of fish and wildlife; and the development of programs to assess and promote national and international monument-related scientific exploration and research." (Section 4.a.(2) . . . subject to the provisions of the proclamation [8335] establishing this Monument. . ."). (Secretarial Order 3284).

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System, otherwise known as Refuge System, is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife,and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (Pub. L. 105-57; 111 Stat. 1252).

Description of Use

Is this an existing use?

Yes

What is the use?

When determined compatible on a refuge-specific basis, research, scientific collecting, and surveys (research) are allowable uses and are conducted on refuges by independent researchers, partnering agencies, and educational groups. Scientific exploration, as a directive of the Monument's Presidential Proclamation 8335 and Secretarial Order 3284, are further allowable uses for the Monument and Refuge units. The USFWS defines the research uses as:

• Research: Planned, organized, and systematic investigation of a scientific nature.

• Scientific collecting: Gathering of refuge natural resources or cultural artifacts for scientific purposes.

• Surveys: Scientific inventory and monitoring.

Research and exploration may be conducted from research vessels, manned submersibles, or remotely operated vehicles. This equipment may have lighting adequate for navigation and illuminating subjects and provisions for luring marine organisms using bait. The purposes of research and exploration are to further the understanding of the natural resources and processes and to improve the management of such resources. The types of research and exploration are predicted to revolve around fundamental exploration; discovering, characterizing, and understanding bottom-dwelling eukaryotes, bacteria, and archaea; discovering, characterizing, and understanding geologic features and habitats; as well as characterizing and understanding geologic, biologic, oceanographic, physical, and chemical processes.

All projects would be required to have a Special Use Permit (SUP). The USFWS, in consultation with NOAA and others as applicable, will evaluate each proposal and may put limits on the activities to ensure that negative impacts to resources are avoided or limited. Each research or exploration project would likely have different protocols and methods; therefore, each study necessitates its own scientific review. Each project would be carefully reviewed to prevent any significant short-term, long-term, or cumulative impacts. Evaluations and reviews would determine if the species studied, methods used, or habitat type and locations affected may lead to undesirable cumulative impacts. This degree of review would help ensure numerous levels and types of impacts are carefully considered before any permit for research or exploration is issued. Within the SUP, conditions would be clearly defined to protect and conserve the existing resources found within the Refuge. Some of the standard and specific conditions are included in this CD under Stipulations Necessary to Ensure Compatibility.

Collections of scientific specimens would be closely monitored and tracked as donations or loans to the permittee. Donations or loans of collections would be managed in accordance with Title 50 of the Code of Federal Regulations, sections 12.35 – 12.38, FWS Manual 701 FW 5, and Director's Order No. 109, as amended.

This use has been proposed because the collecting and analyzing scientific data is extremely valuable to the USFWS for its ongoing management of the Refuge units and helps to fulfill direction given in Presidential Proclamation 8335. The data gathered would be used by scientists and teachers around the world. The published reports from this research help to disseminate the USFWS mission and the significance of the Refuge and its resources to other researchers and the public.

Per Presidential Proclamation 8335, and relying on consultation between the federal agencies, nothing in this CD shall restrict scientific exploration or research activities by or for the Secretary of Commerce, and nothing shall be construed to require a permit or authorization for the Secretary of Commerce or his respective scientific activities.

Is the use a priority public use?

No

Where would the use be conducted?

The Mariana Arc of Fire NWR includes the following 18 units in the Philippine Sea, comprised of the submerged lands in a 1-mile radius from the center of each seamount/volcano or hydrothermal vent field. The Refuge includes unique geology, hydrothermal vent ecosystems, bottomfish habitats, and deep-sea coral and sponge communities. Vibrant groups of organisms thrive in these isolated benthic environments despite extreme pressure and heat, little to no sunlight, and toxic levels of dissolved metals and gases. Vent communities include squat lobsters as well as tubeworms, clams, and mussels that have developed a symbiotic relationship with chemosynthetic bacteria. The Refuge does not include the overlying water column. There are no USFWS facilities in this extreme environment.

Unit	Location	Summit Elevation
Fukujin (volcano)	143° 27'30" E, 21° 56'30" N	-712 ft
Minami Kasuga 2 (volcano)	143° 38'30" E, 21° 36'36" N	-567 ft
Minami Kasuga 3 (volcano)	143° 38'0" E, 21° 24'0" N	-3675 ft
Northwest Eifuku (volcano)	144° 2'36" E, 21° 29'15" N	-5035 ft
Alice Springs (hydrothermal vent field)	144° 70'73" E, 18° 21'03" N	-2.23 mi
Central Trough (hydrothermal vent field)	144° 45'0" E, 18° 1'0" N	-2.28 mi
Zealandia Bank (overlapping volcanoes)	145° 51'4" E, 16° 52'57" N	3 ft
East Diamante (volcano)	145° 40'47" E, 15° 56'31" N	-416 ft
Ruby (volcano)	145° 34'24" E, 15° 36'15" N	-754 ft
Esmeralda Bank (volcano)	145° 14'45" E, 14° 47'30" N	-141 ft
Northwest Rota-1 (volcano)	144° 46'30" E, 14° 36'0" N	-1696 ft
West Rota (volcano)	144° 50'0" E, 14° 19'30" N	-984 ft
Forecast (volcano)	143° 55'12" E, 13° 23'30" N	-4816 ft
Seamount X (volcano)	144° 1'0" E, 13° 14'48" N	-4084 ft
South Backarc (hydrothermal vent field)	143° 37'8" E, 12° 57'12" N	-1.77 mi
Archaean (hydrothermal vent field)	143° 37'8" E, 12° 56'23" N	-1.9 mi
Pika (hydrothermal vent field)	143° 38'55" E, 12° 55'7" N	-1.72 mi
Toto (volcano)	143° 31'42" E, 12° 42'48" N	-1.88 mi

When would the use be conducted?

Research is expected to take place at any time of year or day, dependent on researcher availability and access to the site.

How would the use be conducted?

Although research ships are the most recognizable platforms for accessing isolated sites; cost effective technological innovations are providing researchers with unprecedented access and allow for long-term observation. Some of these innovations include both stationary observation systems (moorings and bottom-supported platforms) and mobile observation systems (ROVs, autonomous underwater vehicles, drifters, gliders). Access to most of the Refuge units is by remotely operated vehicles or manned submersibles. There are no USFWS facilities in this extreme environment. Permittees would pay the cost of all their actions related to the research. Researchers would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits for their actions.

Why is this use being proposed or reevaluated?

The need for exploration and research stems from the need to understand the natural processes at work, and how these processes will affect Refuge resources. Research can inform management actions, assist in tracking resilience of the resources, and offer society a deeper understanding and breadth of knowledge about the complex ecosystems and physical, geological, and biochemical processes of the region. The abyssal zone habitat and its organisms can only be studied in place. Study of the submarine vents are important in understanding the physical, chemical, and geological factors that contributes to high levels of biodiversity found within these Refuge sites. No other sites with similar depth and pressure gradients are known to exist currently.

Availability of Resources

The analysis of cost for administering and managing each use will only include the incremental increase above general operational costs that we can show as being directly caused by the proposed use. Due to the complex nature of the research and exploration at the extreme depths and environments of the Refuge, only a handful of entities have the technology and capability to access their benthic environments.

During the period of this CD, it is estimated that no more than three science SUPs would be issued in a calendar year. We can manage this use at the projected level with current capabilities. We do so because the research and exploration of these units cannot currently be accomplished by the USFWS, so little is known about these areas, and all science investigations will expand knowledge of these deep sites – also benefitting management of them. (See Table 1).

Table 1. Annual Costs to Administer and Manage Research

Category and Itemization	Recurring Annual Expenses
Administration and Management	$4,700
Monitoring and Adaptive Management	$4,600
Total	**$9,300**

The numbers above reflect the estimated cost for three permits per year. Estimated costs were calculated using 5% of the 2022 base cost of a GS-12/5 biologist, 2% cost of a GS-13/5 Refuge Manager, and 5% of a GS-7/5 biological technician assuming this use would use that "portion of a year" to administer.

Proposed use beyond three SUPs in a calendar year would require an application fee. The bulk of the cost for research SUPs is incurred in staff time to review scientific proposals, coordinate with researchers, write SUPs, oversee on-going research projects, and review the research results. Law enforcement and dissemination of information about research in the monument are not included in these cost estimates. We project that administering a research project SUP may require four weeks of intermittent staff time. Any accidents or responses involving the permittees will be their sole financial responsibility. Any funds expended by the USFWS as a result of an accident or response will be reimbursed by the permittee (see Table 2).

Table 2. Projected Costs to Applicants

Category and Itemization	One-Time Expenses
SUP Application Fee for first 3 permit applicants for research in the Mariana Trench NWR per calendar year	waived
SUP Application Fee for permit applicants #4 and up for research in the Mariana Arc of Fire NWR per calendar year	$1,800*
Reimbursement for accident or response costs incurred by USFWS	Actual cost TBD after event

** Based on FY22 GS-12/5 basic salary for 40 hours*

Anticipated Impacts of the Use

Potential impacts of a proposed use on the refuge's purpose(s) and the Refuge System mission

Most of the possible impacts recognized are over or within the water column, and therefore outside the boundaries of the 18 Refuge units (which cover only the seafloor). These impacts may include: (1) disturbance of foraging sea birds and pelagic fish; (2) disturbance of marine mammals; (3) disturbance of endangered and threatened sea turtles; (4) release of pollution and contaminants; (5) disturbance and damage to fish, invertebrates, and algae. Possible impacts to the Refuge may include (1) disturbance to benthic marine organisms; (2) introduction of metals and other materials or equipment that are needed to travel to the bottom, and then discarded into the Refuge in order to return to the surface; and (3) accidental introduction of non-native extremophile species or contaminants from equipment used during the operations.

Accidental introduction of non-native species between deep sites has been documented at other deep-sea locations. A submersible transferred 38 limpets from the Gorda Ridge at 7457 feet depth to the Juan de Fuca Ridge after a 2-day journey of 394 miles. When the samples from this site were analyzed, the limpets were determined to be alive, having survived the time and depth of decompression and re-compression between the two sites. As a precaution, permits will require disinfection of hard equipment surfaces (i.e., with diluted bleach solution) before deploying to other locations.

All research would be designed and managed in a fashion using best management practices to eliminate or minimize these impacts. However, even with proper management and execution of a well-planned project, so little is known about the Refuge units that certain responses may occur that could not be predicted or are not easily recognized. Although a single research or exploration project within a single year may cause few, if any, negative resource impacts, it may cause cumulative impacts over multiple years or when considered additively with all research and exploration projects to occur within the site. Therefore, it is critical for refuge managers to examine all projects with a multi-year timeframe in mind and consider all research that is planned concurrently in the Refuge unit(s) before approval is granted. It may be appropriate to set a limit to the number of research or exploration projects occurring in a particular habitat or relative to a single species or species group.

Short-term impacts

Short-term impacts to Refuge resources are expected to occur as a result of permitted activities including the disturbance of bottom sediments by ROV propellers

that may impact nearby coral and sponge communities, the interaction with turtles and marine mammals in the water column above the Refuge units, as well as the potential introduction of invasive species. Harm to geologic features or animals such as deep-sea corals and sponges may occur if specimens are not carefully collected, resulting in damage.

Long-term impacts

Potential long-term impacts include damage to geologic features, corals and coral reef ecosystems, and deep-sea hydrothermal vent and sponge communities. Repetitive sedimentation could smother corals, causing stress and preventing reproduction and growth. Permittees will minimize these effects by photographing and sampling animals and bottom features at different areas in the site, minimizing multiple visits to one area. Collection of deep-sea corals should be done with care and only on specimens where damage to the remaining colony can be minimized. Because of the depths at which these corals are found, corals will typically only grow a few millimeters per year. Damage done directly to coral animals can have long-term impacts on the survival of the animal. Invasive species may be introduced to the Refuge unintentionally from contaminated surfaces on the ROV or its components. A robust biosecurity plan must be approved prior to permitted activities to assure that invasive species introductions do not occur.

Public Review and Comment

The draft of this CD was included in the November 2020 Marianas Trench MNM Draft MMP/EA. The official public comment period for the MMP/EA was from February 24 – July 26, 2021. Comments were submitted to regulations.gov. The Draft MMP/EA was available on the web at multiple URLs including the Refuge Web pages. Hard copies were sent to public libraries in CNMI and Guam and available on request. A hard copy was also available at the Guam NWR Nature Center. In addition, FWS held four virtual public meetings in June 2021 to provide community-focused opportunities for the public to ask questions. Changes were made to the Draft CD in response to public comment, and current guidance on the preparation of Compatibility Determinations.

Determination

Is the use compatible?

Yes

Stipulations Necessary to Ensure Compatibility

1. Applicants for conducting research on the Refuge would be required to obtain a USFWS SUP. These permits may stipulate more detailed access restrictions and regulations to protect wildlife or Refuge integrity from anticipated site-specific negative effects caused by the project.
2. Up to three SUPs annually would be permitted free of charge. Research proposals beyond three in any given calendar year would require SUP application fees of $1,800.
3. At the discretion of the Refuge Manager/ Superintendent, USFWS-approved staff may be assigned to accompany research expeditions.
4. If the proposed methods would materially impact, appropriate, injure, destroy, or remove any Refuge resource, the permittee must identify the issues in advance. Highly intrusive or manipulative research, survey, or collection techniques are generally not permitted. As many research, survey, or collection techniques will be experimental due to the extreme environment, any non-anticipated disturbance would immediately be brought to the attention of the Refuge Manager/ Superintendent.
5. Permittees are responsible for acquiring and/or renewing any necessary additional permits prior to beginning or continuing their project.
6. Permittee would be responsible to cover all Refuge costs associated with the research activity beyond what is predicted in this CD.
7. The Refuge Manager/ Superintendent or designated representative can suspend or modify conditions or terminate research that is already permitted and in progress should unacceptable, unforeseen, or unexpected impacts or issues arise or be noted.
8. Constant vigilance is kept for the presence of Federally listed species. When piloting vessels, vessel operators alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles.
9. Unless specifically covered under a separate permit that allows activity within proximity to protected species, all in-water work is postponed when whales are within 100 yards or other protected species are within 50 yards. Activity recommences only after the animal(s) depart the area. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s); and no attempts are made to feed, touch, ride, or otherwise intentionally interact with any protected species.
10. Collection/survey sites should be staggered to prevent long-term damage to Refuge resources.

11. Collections of scientific specimens would be closely monitored and tracked as donations or loans to the permittee. Donations or loans of collections would be managed in accordance with Title 50 of the Code of Federal Regulations, sections 12.35 – 12.38, FWS Manual 701 FW 5, and Director's Order No. 109, as amended.
12. Discarding or abandonment of nondegradable umbilicals from deep-sea exploration vehicles is prohibited.
13. Permittees will follow the USFWS-provided Best Management Practices for Deep-Sea Research Marine Invasive Species Prevention or provide their own biosecurity plan with their SUP application for review and approval to ensure that invasive species will not be inadvertently introduced into the Refuge.
14. Permittees will inspect all equipment prior to beginning work each day to ensure the equipment is in good working condition, and there are no contaminant (oil, fuel, etc.) leaks. All equipment found to be leaking contaminants must be removed from service until repaired.
15. All fueling or repairs to equipment must be done in a location with the appropriate controls that prevents the introduction of contaminants to the marine environment
16. Ship crews will prevent discharges of chemicals and other fluids dissimilar from seawater into the water column.
17. Researchers will use materials that are nontoxic to aquatic organisms, such as untreated wood, concrete, or steel (avoid pressure treated lumber).
18. All permit holders would be required to submit an annual report to the Refuge Manager/ Superintendent that summarizes their activities for a given year and a final report when the project is completed. The report would include at a minimum the following: project title, SUP number, fiscal year, progress, important findings, and problems encountered, proposed resolution to problems, preparer, and date prepared. The report and all publications and products derived from the SUP will appropriately acknowledge the U.S. Fish & Wildlife Service and those activities were conducted under a National Wildlife Refuge System permit. Appropriate acknowledgement should also be given to the National Oceanic and Atmospheric Administration, when applicable. All reports, publications, or products will reference the Mariana Arc of Fire National Wildlife Refuge and Mariana Trench Marine National Monument.

Justification

The stipulations outlined above would help ensure that the use is compatible at the Mariana Arc of Fire NWR. Scientific research, collection, and surveys, as outlined in this compatibility determination, would not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Based on available science and best professional judgement, the Service has determined that the scientific research, collection, and surveys within the Mariana Arc of Fire NWR, in accordance with the stipulations provided here, would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the Refuge and the Mariana Trench Marine National Monument. Rather, appropriate and compatible scientific research, collection, and surveys would be the use of the Refuge through which the public can develop an appreciation for wildlife and wild lands.

Signature of Determination

Tammy Summers 7/27/2022

Refuge Manager Signature and Date

Signature of Concurrence

CHRISTINE OGURA Digitally signed by CHRISTINE OGURA Date: 2022.09.06 08:40:48 -07'00'

Acting Regional Refuge Chief Signature and Date

Mandatory Reevaluation Date

2032

Literature Cited/References

Draft Mariana Trench National Monument Management Plan and Environmental Assessment, 2020.

Vescovo, Victor L., Jamieson, Alan J., Lahey, Patrick, McCallum, Rob, Stewart, Heather A., and Machado, Casey. 2021. Safety and conservation at the deepest place on Earth: A call for prohibiting the deliberate discarding of nondegradable umbilicals from deep-sea exploration vehicles, Marine Policy, Volume 128, 2021, 104463, ISSN 0308-597X. Available at: https://doi.org/10.1016/j.marpol.2021.104463 (https://www.sciencedirect.com/science/article/pii/S0308597X21000749)

Compatibility Determination

Title

Compatibility Determination for Photography, Mariana Trench National Wildlife Refuge within the Mariana Trench Marine National Monument.

Refuge Use Category

Wildlife Observation and Photography

Refuge Use Type(s)

Photography. Refuge visitation for the purpose of photographing refuge natural or cultural resources (including fish, wildlife, plants, and their habitats) or public uses of those resources. Includes still photography, photography, videography, filming, or other recording of sight or sound.

Refuge

Mariana Trench National Wildlife Refuge

Refuge Purpose(s) and Establishing and Acquisition Authority(ies)

Mariana Trench NWR:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ... 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956).

"... conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act).

"... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).

Mariana Trench Marine National Monument:

"...for the purpose of protecting the objects identified above..." "... [Interior

Secretary] shall not allow or permit any appropriation, injury, destruction, or removal of any feature of this monument except as provided for by this proclamation or as otherwise provided for by law". (Presidential Proclamation 8335)

"…Regulation of Scientific Exploration and Research…Subject to such terms and conditions as the Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study…" (Presidential Proclamation 8335)

"…For each of the areas subject to this delegation, the Director of the [USFWS] shall provide for the proper care and management of the monument, including all objects of scientific and historic interest therein; the conservation of fish and wildlife; and the development of programs to assess and promote national and international monument-related scientific exploration and research." (Section 4.a.(2) . . . subject to the provisions of the proclamation [8335] establishing this Monument. . ."). " (Secretarial Order 3284).

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System, otherwise known as Refuge System, is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife,and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (Pub. L. 105-57; 111 Stat. 1252).

Description of Use

Is this an existing use?

Yes.

This use has been reevaluated concurrently with the preparation of the Draft Marianas Trench Marine National Monument Management Plan and Environmental Assessment (USFWS 2020).

What is the use?

We propose to allow Refuge visitation for the purpose of photographing refuge natural or cultural resources (including fish, wildlife, plants, and their habitats) or public uses of those resources. "Photography" includes still photography videography, filming, or other recording of sight or sound to be made within the Refuge. The Service and the Department of the Interior do not distinguish between different types of filming activity (e.g., filming for personal, commercial, news, or educational purposes).

Any photography activities conducted in the extreme environment of the Mariana Trench NWR are 1) functionally the same; and 2) limited to a few individuals and institutions that have the fiscal and technical capability to access the deep areas. For example, the permittee may film the Trench floor, record sounds associated with geologic activity, and video explorers and scientists in their work.

It is likely that such photographs, video, or audio recordings would have commercial value and there would be intentions of some commercial use. However, the Service and the Department of the Interior do not distinguish between different types of filming activity and does not regulate commercial filming or videography specifically. Commercial still photography and audio recordings may be regulated, however we expect that the primary activity being permitted would be video recording.

Because recordings of extreme deep-sea environments are novel and exceptional throughout the world, they would be of immense interest to schools and educational institutions, news media, and both commercial and public broadcasting organizations. Recordings may be included in a live “virtual classroom” event, be broadcast through news media, and be the subject of a documentary. Recordings of deep-sea environments are appealing to the general public because they expose an exceptional environment, representing some of the last frontiers of discovery on Earth. They are also captivating because deep-sea environments have been inaccessible to humans for most of our history, and even today are accessible only with the help of highly specialized equipment.

Filming, video, photography or audio recording that are not related to natural, historic, or cultural subjects of the Refuge is not covered under this CD (e.g., extreme sports photography, filming a movie unrelated to the Refuge mission, etc.). All recording proposals are anticipated to coincide with other projects for exploration, research, survey or scientific collecting; however, these scientific activities are considered in a separate CD. This CD only covers the acquisition of digital or photographic information does not consider or include any sampling or specimen collections. Recording may be conducted in the Refuge benthic environments as long as it meets the criteria of being related to natural, historic, or cultural features. To ensure that the natural and cultural resources of the Refuge are protected, proposals must also specify how they plan to contribute to the achievement of the Refuge System mission and Monument or Refuge purposes.

Is the use a priority public use?

Yes

Where would the use be conducted?

Recordings would be conducted within any benthic environment of the Mariana Trench NWR covering 50,532,102 acres of submerged lands. The Refuge includes some of the deepest known points in the ocean, subduction zone areas, submarine

mud volcanoes, and benthic life communities. The protected area of the Refuge is on the seafloor (the submerged lands and benthic resources) of the Mariana Trench and does not include the overlying water column. There are no USFWS facilities in this extreme environment. Permittees working in the Mariana Trench NWR would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits needed for actions within the Exclusive Economic Zone (EEZ) of the United States.

When would the use be conducted?

Recordings may occur any time of the year and for any bottom area of the Mariana Trench NWR. The USFWS, in consultation with NOAA and others as applicable, will evaluate each proposal and may put limits on the activities in an effort to ensure that negative impacts to resources are avoided or limited. All approved projects would be required to have a Refuge Special Use Permit (SUP). It is estimated that no more than three photography, filming, video, and audio recording SUPs would be issued in a calendar year.

How would the use be conducted?

Due to the extreme depths and sophisticated technological capability needed to access the Mariana Trench NWR; photography, video, filming, and audio recording ("recording") are the primary ways that the USFWS and others may gain access to and information about the area. The use may be conducted by recording equipment attached to manned submersibles, remotely operated vehicles, or stationary observation systems. This equipment may have lighting adequate for navigation and illuminating subjects and provisions for luring marine organisms using bait.

All recording proposals are anticipated to coincide with other projects for exploration, research, survey or scientific collecting; however, these scientific activities are considered in a separate CD. This CD only covers the acquisition of digital or photographic information does not consider or include any sampling or specimen collections. Recordings of Refuge benthic environments may be conducted as long as they meet the criteria of being related to natural, historic, or cultural features. Recording proposals must also specify how they plan to contribute to the achievement of the Refuge System mission and Monument or Refuge purposes.

Recording projects involving video, filming, photography or sound would likely have different protocols and methods for recording the bottom environments and species of the Refuge as well as different strategies for reaching diverse audiences. Therefore, each proposal necessitates its own management review during the permitting process. Each project would be carefully reviewed to prevent any significant short-term, long-term, or cumulative impacts to Refuge resources. Proposals would be evaluated by USFWS staff, applicable partners at the NOAA, experts with the USGS, as well as other subject-matter experts as determined necessary by the USFWS.

Evaluations and reviews would be conducted to determine if the species recorded, methods used, or habitat type and locations affected may lead to undesirable cumulative impacts. All projects would be required to have a Refuge Special Use Permit (SUP). This degree of review would help ensure numerous levels and types of impacts are carefully considered before any recording permit is issued. Within the SUP, conditions would be clearly defined so as to protect and conserve the existing resources found within the Refuge. Some of the standard and specific conditions are included in this CD under Stipulations Necessary to Ensure Compatibility. Per Presidential Proclamation 8335, nothing in this CD shall restrict scientific exploration or research activities by or for the Secretary of Commerce, and nothing shall be construed to require a permit or authorization for the Secretary of Commerce or his respective scientific activities.

Why is this use being proposed or reevaluated?

This use has been reevaluated concurrently with the preparation of the Draft Mariana Trench Marine National Monument Management Plan and Environmental Assessment (USFWS 2020). The Refuge includes some of the deepest known points in the ocean, subduction zone areas, submarine mud volcanoes, and benthic life communities. Due to the extreme depths and sophisticated technological capability needed to access the Mariana Trench NWR; photography, video, filming, and audio recording ("recording") are the primary ways that the USFWS and others may gain access to and information about the area.

Availability of Resources

Due to the complex nature of accessing the extreme depths and environments of the Refuge for recordings, only a handful of entities have the technology and capability to access their benthic environments. It is estimated that no more than three photography, filming, video, and audio recording SUPs would be issued in a calendar year. The bulk of the cost for this SUP is incurred in staff time to review proposals, coordinate with applicants, ensure recording activity contributes to the achievement of the Refuge System mission and Monument/Refuge purposes, write SUPs, oversee on-going projects, and review the project post-recording development and results. Law enforcement and dissemination of information about the projects in the Monument are not included in these cost estimates. We project that administering a single recording project SUP may require four weeks of intermittent staff time.

The protected area of the Refuge is at the bottom (the submerged lands and benthic resources) of the Mariana Trench and does not include the overlying water column. Access to it is through remotely operated vehicles or manned submersibles. There are no USFWS facilities in this extreme environment. Permittees would pay the cost of all their actions related to the Refuge. Permittees working in the Refuge would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits needed for their actions. Any accidents or responses involving the

permittees will be their sole financial responsibility. Any funds expended by the USFWS above general SUP administration, or as a result of an accident or response, will be reimbursed by the permittee. At this time, the Service does not require liability insurance or bonds for any filming activity. However, permittees would be liable for damages to Service resources during filming activities.

Table 1. Annual costs to Administer and Manage photography, video, filming, or audio recording

Category and Itemization	Recurring Annual Expenses
Staff time (administration and management)	$4,700
Monitoring	$4,600
Total expenses	**$9,300**

The numbers above reflect the estimated cost for three permits per year. Estimated costs were calculated using 5% of the 2022 base cost of a GS12/5 biologist, 2% cost of a GS13/5 Refuge Manager, and 5% of a GS7/5 biological technician assuming this use would use that "portion of a year" to administer.

Anticipated Impacts of the Use

Potential impacts of a proposed use on the refuge's purpose(s) and the Refuge System mission

The effects and impacts of the proposed use to refuge resources, whether adverse or beneficial, are those that are reasonably foreseeable and have a reasonably close causal relationship to the proposed use. This CD includes the written analyses of the environmental consequences on a resource only when the impacts on that resource could be more than negligible and therefore considered an "affected resource." Water and air quality, geology and soils, floodplains, wilderness, environmental justice, and climate change will not be more than negligibly impacted by the action and have been dismissed from further analyses.

Most of the possible impacts recognized are over or within the water column, and therefore outside the boundary of the Refuge (the Mariana Trench NWR includes only submerged lands). These impacts may include: (1) disturbance of foraging sea birds and pelagic fish; (2) disturbance of marine mammals; (3) disturbance of endangered and threatened sea turtles; (4) release of pollution and contaminants; (5) disturbance and damage to fish, invertebrates, and algae.

Possible impacts to the bottom communities of Mariana Trench NWR may include (1) disturbance to benthic marine organisms; (2) introduction of metals and other materials or equipment that are needed to travel to the bottom, and then discarded into the Refuge in order to return to the surface; and (3) accidental introduction of

non-native extremophile species or contaminants from equipment used during the operations.

Accidental introduction of non-native species between deep sites has been documented at other deep-sea locations. A submersible transferred 38 limpets from the Gorda Ridge at 7,457 feet depth to the Juan de Fuca Ridge after a 2-day journey of 394 miles. When the samples from this site were analyzed, the limpets were determined to be alive, having survived the time and depth of decompression and re-compression between the two sites. As a precaution, permits will require disinfection of hard equipment surfaces (i.e., with diluted bleach solution) before deploying to other locations.

Exploration vehicles can introduce vast quantities of single-use, plastic-coated tether that have been deliberately discarded as observed at the deepest site of all Earth's oceans. Manned submersible dives to Challenger Deep (10,925 m deep) in the Mariana Trench in 2019 and 2020 revealed hundreds of meters of yellow and white tether strewn across the seafloor (Vescovo et al. 2021). Due to its composition, these fiber-optic tethers will not only persist environmentally but form a significant risk to equipment and life should unmanned and manned craft become entangled. Therefore, the deliberate abandonment or discarding of nondegradable tethers is prohibited.

Short-term impacts

Short-term impacts to refuge resources are expected to occur as a result of permitted activities. Anticipated short-term impacts include the disturbance of bottom sediments by submersible propellers that may impact nearby coral and sponge communities, the interaction with turtles and marine mammals in the water column above the Refuge, as well as the potential introduction of invasive species.

Incidental discharge of materials, oil, or ballast water from surface vessels or submersibles has the potential to impact threatened and endangered species that may be present at or near the ocean floor or passing through the water column above the Refuge. Since it is estimated that no more than three recording SUPs would be issued in a calendar year, the presence of vessels or submersibles would be intermittent and limited in duration. With adherence to US Coast Guard and IMO ballast water requirements, the Best Management Practices (BMPs) included within each SUP, and the stipulations contained herein, recording activities are expected to have a negligible, short-term impact to threatened and endangered species.

Bright lights on surface vessels above the Refuge have the potential to impact seabirds if present. Seabirds may be attracted to bright lights at night, which could cause disorientation, disruption of migratory routes, and pose a collision risk with a lighted structure. Since no more than three recording SUPs would be issued per calendar year, the presence of vessels in or above the Refuge for recording would be intermittent and limited in duration. Vessels may be required to dim the lights every

night, and those operating near seabird breeding islands and atolls at night would be required to black out all but the most essential lights. Coupled with BMPs included within each SUP, these stipulations would ensure bright lights from surface vessels would have a negligible, short-term impact to seabirds.

Long-term impacts

Potential long-term impacts to Monument include damage to corals and coral reef ecosystems, deep-sea coral and sponge communities, and other benthic animal communities. Repetitive sedimentation could smother corals, causing stress and preventing reproduction and growth. Permittees will minimize these effects by photographing animals and bottom features at different areas in the monument, minimizing multiple visits to one area. Damage done directly to coral animals can have long-term impacts on the survival of the animal. Invasive species may be introduced to the trench unintentionally from contaminated surfaces on the ROV or its components. A robust biosecurity plan must be submitted prior to permitted activities to assure that long-term impacts from invasive species introductions does not occur. Ship traffic may interfere with migration patterns of migratory mammals such as whales. To assure that no long-term impacts to marine mammals occur, permittees should avoid migratory seasons or stagger trips so that mammals do not alter their migratory routes as a result.

Public Review and Comment

This draft CD was included in the November 2020 Marianas Trench MNM Draft MMP/EA. The official public comment period for the MMP/EA was from February 24 – July 26, 2021. Comments were submitted to regulations.gov. The Draft MMP/EA was available on the web at multiple URLs including the Refuge Web pages. Hard copies were sent to public libraries in CNMI and Guam and available on request. A hard copy was also available at the Guam NWR Nature Center. In addition, FWS held four virtual public meetings in June 2021 to provide community-focused opportunities for the public to ask questions. Changes were made to the Draft CD in response to public comment, current guidance on the preparation of Compatibility Determinations, and current Department of the Interior and U.S. Fish and Wildlife guidance on the regulation of photography and other recording activities on National Wildlife Refuges and other public lands.

Determination

Is the use compatible?

Yes

Stipulations Necessary to Ensure Compatibility

1. Applicants for recording would be required to obtain a USFWS SUP. These permits may stipulate more detailed access restrictions and regulations to protect wildlife or Refuge integrity from anticipated site-specific negative effects caused by the project.
2. At the discretion of the Refuge Manager, USFWS-approved staff may be assigned to accompany filming expeditions.
3. The USFWS encourages and supports compatible filming and photography in order to acquire information upon which decisions regarding management of units of the Refuge System may be based and to provide access to this remote area to the public through the products of this work. Priority will be given to projects that contribute to the knowledge base of and management for biodiversity, enhancement, protection, use, preservation, and management of native wildlife populations and their habitat. Filming and photography must contribute to the achievement of the Refuge System mission and Refuge or Monument purpose (50 CFR 29.1).
4. In accordance with Department of the Interior filming regulations (43 CFR Part 5.1), utmost care will be exercised to see that no natural features are injured, and after completion of the work the area will, as required by the official in charge, either be cleaned up and restored to its prior condition or left, after clean-up, in a condition satisfactory to the official in charge.
5. Credit will be given to the U.S. Fish & Wildlife Service and the Department of the Interior through the use of an appropriate title or announcement (43 CFR Part 5.1).
6. Pictures will be taken of wildlife only when such wildlife will be shown in its natural state or under approved management conditions if such wildlife is confined (43 CFR Part 5.1).
7. Constant vigilance is kept for the presence of Federally listed species. When piloting vessels, vessel operators alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles.
8. Unless specifically covered under a separate permit that allows activity within proximity to protected species, all in-water work is postponed when whales are within 100 yards or other protected species are within 50 yards. Activity recommences only after the animal(s) depart the area. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s); and no attempts are made to feed, touch, ride, or otherwise intentionally interact with any protected species.
9. Any special instructions received from the official in charge of the area will be

complied with (43 CFR Part 5.1).

10. Any additional information relating to the privilege applied for by this application will be furnished upon request of the official in charge (43 CFR Part 5.1).
11. If the proposed methods would materially impact, appropriate, injure, destroy, or remove any Refuge resource, the permittee must identify the issues in advance. Highly intrusive or manipulative photography or recording is generally not permitted. As much of these recordings will be experimental due to the extreme environment, any non-anticipated disturbance would immediately be brought to the attention of the Refuge Manager/ Superintendent.
12. Permittees are responsible for acquiring and/or renewing any necessary additional permits prior to beginning or continuing their project.
13. Permittee would be responsible to cover all Refuge costs associated with the recording activity beyond what is predicted in this CD.
14. The Monument Superintendent, Refuge Manager, or designee can suspend or modify conditions or terminate research that is already permitted and in progress should unacceptable, unforeseen, or unexpected impacts or issues arise or be noted.
15. Discarding or abandonment of nondegradable umbilicals from deep-sea exploration vehicles is prohibited.
16. Permittees will inspect all equipment prior to beginning work each day to ensure the equipment is in good working condition, and there are no contaminant (oil, fuel, etc.) leaks. All equipment found to be leaking contaminants must be removed from service until repaired.
17. All fueling or repairs to equipment must be done in a location with the appropriate controls that prevents the introduction of contaminants to the marine environment. Ship crews will prevent discharges of chemicals and other fluids dissimilar from seawater into the water column.
18. Permittees will follow the USFWS-provided Best Management Practices for Deep-Sea Research Marine Invasive Species Prevention or provide their own biosecurity plan with their SUP application for review and approval to ensure that invasive species will not be inadvertently introduced into the Refuge.
19. All photography, filming, video, and audio recording permit holders would be required to submit an annual report to the Monument Superintendent that summarizes their activities for a given year and a final report when the project is completed. The report would include at a minimum the following: project title, SUP number, calendar year, progress, important findings, and problems encountered, proposed resolution to problems, preparer, and date prepared.

The report and all publications and products derived from the SUP will appropriately acknowledge the activities were conducted with permission of the U.S. Fish & Wildlife Service under a Refuge System permit. Appropriate acknowledgement should also be given to the National Oceanic and Atmospheric Administration, when applicable. All reports, publications, or products will reference the Mariana Trench Marine National Monument.

20. Permittee must provide USFWS with at least one free copy of all products, commercial or otherwise, generated in the Refuge for the non-commercial, governmental use of informing people about the Monument, Refuge, and the National Wildlife Refuge System.

Justification

Photography, videography, filming, and audio-visual recordings in the Mariana Trench NWR are inherently valuable to the USFWS, governmental partners, and the public and are a necessary tool to further the aims of public education programs and public outreach as well as the primary method for gathering scientific information. The permitting of these pursuits supports the Presidential directive to study and protect this sensitive area. This is particularly true in this case where many of the resources remain undiscovered, unknown, and presumably in pristine or relatively pristine condition. By allowing recordings in conjunction with other uses (e.g., exploration, scientific collection, and surveys) proposed for the area we are encouraging a use that will have minimal impact but enormous reward in the form of information and inspiration. Thus, by effectively administering, tracking, and managing proposed uses through SUPs, the use would not materially interfere with or detract from the fulfillment of Proclamation 8335, the Refuge System mission, or the purposes for which the Refuge and Monument were established.

Signature of Determination

Tammy Summers 7/27/2022

Refuge Manager Signature and Date

Signature of Concurrence

CHRISTINE OGURA Digitally signed by CHRISTINE OGURA
Date: 2022.08.31 15:32:56 -07'00'

Acting Regional Refuge Chief Signature and Date

Mandatory Reevaluation Date

2037

Literature Cited/References

Draft Mariana Trench Marine National Monument Management Plan and Environmental Assessment, 2020.

Vescovo, Victor L., Jamieson, Alan J., Lahey, Patrick, McCallum, Rob, Stewart, Heather A., and Machado, Casey. 2021. Safety and conservation at the deepest place on Earth: A call for prohibiting the deliberate discarding of nondegradable umbilicals from deep-sea exploration vehicles, Marine Policy, Volume 128, 2021, 104463, ISSN 0308-597X. Available at: https://doi.org/10.1016/j.marpol.2021.104463 (https://www.sciencedirect.com/science/article/pii/S0308597X21000749)

Compatibility Determination

Title

Compatibility Determination for Research, Exploration, Scientific Collections, and Surveys in the Mariana Trench National Wildlife Refuge within the Mariana Trench Marine National Monument.

Refuge Use Category

Research and Surveys

Refuge Use Type(s)

Research, Exploration, Scientific Collections, and Surveys.

Refuge

Mariana Trench National Wildlife Refuge

Refuge Purpose(s) and Establishing and Acquisition Authority(ies)

Mariana Trench NWR:

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ... 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956).

"... conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act).

"... suitable for— (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ..." 16 U.S.C. § 460k-1 "... the Secretary ... may accept and use ... real ... property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors ..." 16 U.S.C. § 460k-2 (Refuge Recreation Act (16 U.S.C. § 460k-460k-4), as amended).

Mariana Trench Marine National Monument:

"...for the purpose of protecting the objects identified above..." "... [Interior Secretary] shall not allow or permit any appropriation, injury, destruction, or removal of any feature of this monument except as provided for by this proclamation or as

otherwise provided for by law". (Presidential Proclamation 8335)

"…Regulation of Scientific Exploration and Research…Subject to such terms and conditions as the Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study…" (Presidential Proclamation 8335)

"…For each of the areas subject to this delegation, the Director of the [USFWS] shall provide for the proper care and management of the monument, including all objects of scientific and historic interest therein; the conservation of fish and wildlife; and the development of programs to assess and promote national and international monument-related scientific exploration and research." (Section 4.a.(2) . . . subject to the provisions of the proclamation [8335] establishing this Monument. . ."). (Secretarial Order 3284).

National Wildlife Refuge System Mission

The mission of the National Wildlife Refuge System, otherwise known as Refuge System, is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife,and plant resources and their habitats within the United States for the benefit of present and future generations of Americans (Pub. L. 105-57; 111 Stat. 1252).

Description of Use

Is this an existing use?

Yes

What is the use?

When determined compatible on a refuge-specific basis research, scientific collecting, and surveys (research) are allowable uses and are conducted on refuges by independent researchers, partnering agencies, and educational groups. Scientific exploration, as a directive of the Monument's Presidential Proclamation 8335 and Secretarial Order 3284, are further allowable uses for the Monument and Refuge units within the Monument. The USFWS defines the research uses as:

• Research: Planned, organized, and systematic investigation of a scientific nature.

• Scientific collecting: Gathering of refuge natural resources or cultural artifacts for scientific purposes.

• Surveys: Scientific inventory and monitoring.

Research and exploration may be conducted from manned submersibles, remotely operated unmanned vehicles (ROV), or landers. This equipment may have lighting adequate for navigation and illuminating subjects and provisions for luring marine organisms using bait. The purposes of research and exploration are to further the understanding of the Earth, its natural resources and processes and to improve the management of such resources. Because of the extreme environments of the Refuge, and their relative inaccessibility, very little is known about these areas. Much of the science is, therefore, essentially innovative exploration. The types of research and exploration will vary greatly but are predicted to mainly revolve around fundamental exploration and characterization; discovering, characterizing, and understanding bottom-dwelling eukaryotes, bacteria, and archaea; discovering, characterizing, and understanding geologic features and habitats; as well as characterizing and understanding geologic, biologic, oceanographic, physical, and chemical processes.

Research and exploration proposals may be for any time of the year and may be requested for any bottom area of the Mariana Trench NWR. The USFWS in consultation with NOAA and others, as applicable, will evaluate each proposal and may put limits on the activities to ensure that negative impacts to resources are avoided or limited. Each research or exploration project would likely have different protocols and methods; therefore, each study necessitates its own scientific review. Each project would be carefully reviewed to prevent any significant short-term, long-term, or cumulative impacts. Evaluations and reviews would be conducted to determine if the species studied, methods used, or habitat type and locations affected may lead to undesirable cumulative impacts. All projects would be required to have a Refuge Special Use Permit (SUP). This degree of review would help ensure numerous levels and types of impacts are carefully considered before any permit for research or exploration is issued. Within the SUP, conditions would be clearly defined so as to protect and conserve the existing resources found within the Refuge. Some of the standard and specific conditions are included in this CD under Stipulations Necessary to Ensure Compatibility.

Collections of scientific specimens would be closely monitored and tracked as donations or loans to the permittee. Donations or loans of collections would be managed in accordance with Title 50 of the Code of Federal Regulations, sections 12.35 – 12.38, FWS Manual 701 FW 5, and Director's Order No. 109, as amended.

This use was proposed because the collecting and analyzing scientific data is extremely valuable to the USFWS for its ongoing management of the Refuge and helps to fulfill direction given in Presidential Proclamation 8335. The gathered information would also be used by other scientists, managers, decision-makers, and teachers around the world. The published reports from this research help to disseminate the USFWS mission and the significance of the Monument/Refuge and its resources to other researchers and the public.

Per Presidential Proclamation 8335, and relying on consultation between the federal agencies, nothing in this CD shall restrict scientific exploration or research activities by or for the Secretary of Commerce, and nothing shall be construed to require a permit or authorization for the Secretary of Commerce or her respective scientific activities.

Is the use a priority public use?

No

Where would the use be conducted?

Research, exploration, scientific collections, and surveys would be conducted within any benthic environment of the Mariana Trench NWR, covering 50,532,102 acres of submerged lands. The Refuge includes some of the deepest known points in the ocean, subduction zone areas, submarine mud volcanoes, and benthic life communities. The protected area of the Refuge is on the seafloor (the submerged lands and benthic resources) of the Mariana Trench and does not include the overlying water column. There are no USFWS facilities in this extreme environment. Permittees working in the Mariana Trench NWR would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits needed for actions within the Exclusive Economic Zone (EEZ) of the United States.

When would the use be conducted?

Research is expected to take place at any time or year or day, dependent on researcher availability and access to the site.

How would the use be conducted?

The protected area of the Refuge at the bottom (the submerged lands and benthic resources) of the Mariana Trench and does not include the overlying water column. Access to it is through remotely operated vehicles (ROV), manned-submersibles or Deep Submergence Vehicles (DSV). There are no USFWS facilities in this extreme environment. Researchers working in the Refuge would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits for their actions.

Why is this use being proposed or reevaluated?

The Mariana Trench is formed where tectonic plates run into each other, with one being subducted underneath the other. That process, along with associated microbial activity, plays important roles in the release and consumption of carbon and minerals. Such cycling is a critical factor in the ocean's ability to absorb carbon dioxide from the atmosphere. Much of our understanding of these processes, despite their

importance, remains theoretical because they occur so deep that opportunities for study have been extremely rare. Rock and sediment sample analyses could either confirm some of the current understanding of these processes or reveal new questions scientists need to ask. Trench subduction zones are also the sites of earthquakes that at times spawn devastating tsunamis. Observations and sample analyses could also help scientists better understand factors tied to these events. Study of submarine vents is important for understanding the physical, chemical, and geological factors that contribute to high levels of biodiversity found within these Refuge sites.

Availability of Resources

The analysis of cost for administering and managing each use will only include the incremental increase above general operational costs that we can show as being directly caused by the proposed use. Due to the complex nature of the research and exploration at the extreme depths and environments of the Refuge, only a handful of entities have the technology and capability to access their benthic environments. During the period of this CD, it is estimated that no more than three (3) science SUPs would be issued in a calendar year. We can manage this use at the projected level with current capabilities. We do so because the research and exploration of these units cannot currently be accomplished by the USFWS, so little is known about these areas, and all science investigations will expand knowledge of these deep sites – also benefitting management of them (see Table 1).

Table 1. Projected Annual Costs to Administer and Manage Research

Category and Itemization	Recurring Annual Expenses
Administration and Management	$4,700
Monitoring and Adaptive Management	$4,600
Total	**$9,300**

The numbers above reflect the estimated cost for three permits per year. Estimated costs were calculated using 5% of the 2022 base cost of a GS-12/5 biologist, 2% cost of a GS-13/5 Refuge Manager, and 5% of a GS-7/5 biological technician assuming this use would use that "portion of a year" to administer.

Proposed use beyond three SUPs would require SUP application fees. The bulk of the cost for research SUPs is incurred in staff time to review scientific proposals, coordinate with researchers, write SUPs, oversee on-going research projects, and review the research results. Law enforcement and dissemination of information about research and surveys in the Refuge are not included in these cost estimates. We project that administering a research project SUP may require four weeks of

intermittent staff time.

The protected area of the Refuge is at the bottom (the submerged lands and benthic resources) of the Mariana Trench and does not include the overlying water column. Access to it is through unmanned, remotely operated vehicles or manned submersibles. There are no USFWS facilities in this extreme environment. Permittees would pay the cost of all their actions related to the Refuge. Researchers working in the Refuge would have to be self-sufficient for safely accessing the Refuge and would be required to obtain any additional permits for the actions. Any accidents or responses involving the permittees will their sole financial responsibility. Any funds expended by the USFWS because of an accident or response will be reimbursed by the permittee (see Table 2).

Table 2. Projected Costs to Applicants

Category and Itemization	One-Time Expenses
SUP Application Fee for first 3 permit applicants for research in the Mariana Trench NWR per calendar year	waived
SUP Application Fee for permit applicants #4 and up for research in the Mariana Trench NWR per calendar year	$1,800*
Reimbursement for accident or response costs incurred by USFWS	Actual cost TBD after event

** Based on FY22 GS-12/5 basic salary for 40 hours*

Anticipated Impacts of the Use

Potential impacts of a proposed use on the refuge's purpose(s) and the Refuge System mission

Most of the possible impacts recognized are over or within the water column, and therefore outside the boundary of the Refuge (which covers only the seafloor). These impacts may include: (1) disturbance of foraging sea birds and pelagic fish; (2) disturbance of marine mammals; (3) disturbance of endangered and threatened sea turtles; (4) release of pollution and contaminants; (5) disturbance and damage to fish, invertebrates, and algae.

Possible impacts to the Refuge's bottom community may include (1) disturbance to benthic marine organisms; (2) introduction of metals and other materials or equipment that are needed to travel to the bottom, and then discarded into the Refuge in order to return to the surface; and (3) accidental introduction of contaminants or non-native extremophile species from equipment used during the operations, (4) disturbance and damage to invertebrates and algae.

The bottom features of the trench are likened to inverted islands of biodiversity. Each may hold unique biological communities from feature to feature and could potentially be susceptible to invasions by organisms not native to that feature. Accidental introduction of non-native species between deep sites has been documented at other deep-sea locations. A submersible transferred 38 limpets from the Gorda Ridge at 7,457 feet depth to the Juan de Fuca Ridge after a 2-day journey of 394 miles. When the samples from this site were analyzed, the limpets were determined to be alive, having survived the time and depth of decompression and re-compression between the two sites. As a precaution, permits will require disinfection of hard equipment surfaces (i.e., with diluted bleach solution) before deploying to other locations.

All research would be designed and managed in a fashion using best management practices to eliminate or minimize these impacts. However, even with proper management and execution of a well-planned project, so little is known about the Mariana Trench NWR that certain responses may occur that could not be predicted or are not easily recognized. Although a single research or exploration project within a single year may cause few, if any, negative resource impacts, it may in fact cause cumulative impacts over multiple years or when considered additively with all research and exploration projects to occur within the Refuge. Therefore, it is critical for refuge managers to examine all projects with a multi-year timeframe in mind and consider all research that is planned concurrently in the Refuge before approval is granted. It may be appropriate to set a limit to the number of research or exploration projects occurring in a particular habitat or relative to a single species or species group.

Short-term impacts

Short-term impacts to Refuge resources are expected to occur as a result of permitted activities. Anticipated short-term impacts include the disturbance of bottom sediments by ROV propellers that may impact nearby coral, sponge, or vent communities, the interaction with turtles and marine mammals in the water column above the Refuge, as well as the potential introduction of invasive species. Harm to benthic life forms may occur if specimens are not carefully collected, resulting in damage to the benthic communities.

Long-term impacts

Potential long-term impacts to Refuge resources include damage to hydrothermal vent communities, corals and coral reef ecosystems, and deep-sea coral and sponge communities. Repetitive sedimentation could smother corals, causing stress and preventing reproduction and growth. Permittees will minimize these effects by photographing and sampling animals and bottom features at different areas in the Refuge, minimizing multiple visits to one area. Collection of deep-sea corals should be done with care and only on specimens where damage to the remaining colony can be minimized. Because of the depths at which these corals are found, corals will typically only grow a few millimeters per year. Damage done directly to coral animals can have long-term impacts on the survival of the animal. Invasive species may be introduced to the Refuge unintentionally from contaminated surfaces on the ROV or its components. A robust biosecurity plan must be submitted prior to permitted activities to assure that long-term impacts from invasive species introductions do not occur.

Public Review and Comment

This draft CD was included in the November 2020 Marianas Trench MNM Draft MMP/EA. The official public comment period for the MMP/EA was from February 24 – July 26, 2021. Comments were submitted to regulations.gov. The Draft MMP/EA was available on the web at multiple URLs including the Refuge Web pages. Hard copies were sent to public libraries in CNMI and Guam and available on request. A hard copy was also available at the Guam NWR Nature Center. In addition, FWS held four virtual public meetings in June 2021 to provide community-focused opportunities for the public to ask questions. Changes were made to the Draft CD in response to public comment, and current guidance on the preparation of Compatibility Determinations.

Determination

Is the use compatible?

Yes

Stipulations Necessary to Ensure Compatibility

1. Applicants for conducting research on the Refuge would be required to obtain a USFWS SUP. These permits may stipulate more detailed access restrictions and regulations to protect wildlife or Refuge integrity from anticipated site-specific negative effects caused by the project.
2. Up to three SUPs annually would be permitted free of charge. Research proposals beyond three in any given calendar year would require SUP application fees of $1,800.
3. At the discretion of the Refuge Manager/ Superintendent, USFWS-approved staff may be assigned to accompany research expeditions.
4. If the proposed methods would materially impact, appropriate, injure, destroy, or remove any Refuge resource, the permittee must identify the issues in advance. Highly intrusive or manipulative research, survey, or collection techniques are generally not permitted. As many research, survey, or collection techniques will be experimental due to the extreme environment, any non-anticipated disturbance would immediately be brought to the attention of the Refuge Manager/ Superintendent.
5. Permittees are responsible for acquiring and/or renewing any necessary additional permits prior to beginning or continuing their project.
6. Permittee would be responsible to cover all Refuge costs associated with the research activity beyond what is predicted in this CD.
7. The Refuge Manager/ Superintendent or designated representative can suspend or modify conditions or terminate research that is already permitted and in progress should unacceptable, unforeseen, or unexpected impacts or issues arise or be noted.
8. Constant vigilance is kept for the presence of Federally listed species. When piloting vessels, vessel operators alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles.
9. Unless specifically covered under a separate permit that allows activity within proximity to protected species, all in-water work is postponed when whales are within 100 yards or other protected species are within 50 yards. Activity recommences only after the animal(s) depart the area. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s); and no attempts are made to feed, touch, ride, or otherwise intentionally interact with any protected species.
10. Collection/survey sites should be staggered to prevent long-term damage to Refuge resources.

11. Collections of scientific specimens would be closely monitored and tracked as donations or loans to the permittee. Donations or loans of collections would be managed in accordance with Title 50 of the Code of Federal Regulations, sections 12.35 – 12.38, FWS Manual 701 FW 5, and Director's Order No. 109, as amended.
12. Discarding or abandonment of nondegradable umbilicals from deep-sea exploration vehicles is prohibited.
13. Permittees will follow the USFWS-provided Best Management Practices for Deep-Sea Research Marine Invasive Species Prevention or provide their own biosecurity plan with their SUP application for review and approval to ensure that invasive species will not be inadvertently introduced into the Refuge.
14. Inspect all equipment prior to beginning work each day to ensure the equipment is in good working condition, and there are no contaminant (oil, fuel, etc.) leaks. All equipment found to be leaking contaminants must be removed from service until repaired.
15. All fueling or repairs to equipment must be done in a location with the appropriate controls that prevents the introduction of contaminants to the marine environment
16. Ship crews will prevent discharges of chemicals and other fluids dissimilar from seawater into the water column.
17. Researchers will use materials that are nontoxic to aquatic organisms, such as untreated wood, concrete, or steel (avoid pressure treated lumber).
18. All permit holders would be required to submit an annual report to the Monument Superintendent that summarizes their activities for a given year and a final report when the project is completed. The report would include at a minimum the following: project title, SUP number, fiscal year, progress, important findings, and problems encountered, proposed resolution to problems, preparer, and date prepared. The report and all publications and products derived from the SUP will appropriately acknowledge the U.S. Fish & Wildlife Service and those activities were conducted under a National Wildlife Refuge System permit. Appropriate acknowledgement should also be given to the National Oceanic and Atmospheric Administration, when applicable. All reports, publications, or products will reference the Mariana Trench National Wildlife Refuge and Mariana Trench Marine National Monument.

Justification

The stipulations outlined above would help ensure that the use is compatible at the Mariana Trench National Wildlife Refuge. Scientific research, collection, and surveys, as outlined in this compatibility determination, would not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge. Based on available science and best professional judgement, the Service has determined that the scientific research, collection, and surveys within the Mariana Trench NWR, in accordance with the stipulations provided here, would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose of the Refuge and the Mariana Trench Marine National Monument. Rather, appropriate and compatible scientific research, collection, and surveys would be the use of the Refuge through which the public can develop an appreciation for wildlife and wild lands.

Signature of Determination

Tammy Summers 7/27/2022

Refuge Manager Signature and Date

Signature of Concurrence

CHRISTINE OGURA Digitally signed by CHRISTINE OGURA
Date: 2022.09.01 09:56:53 -07'00'

Acting Regional Refuge Chief Signature and Date

Mandatory Reevaluation Date

2032

Literature Cited/References

Draft Marianas Trench National Monument Management Plan and Environmental Assessment, 2020.

Vescovo, Victor L., Jamieson, Alan J., Lahey, Patrick, McCallum, Rob, Stewart, Heather A., and Machado, Casey. 2021. Safety and conservation at the deepest place on Earth: A call for prohibiting the deliberate discarding of nondegradable umbilicals from deep-sea exploration vehicles, Marine Policy, Volume 128, 2021, 104463, ISSN 0308-597X. Available at: https://doi.org/10.1016/j.marpol.2021.104463 (https://www.sciencedirect.com/science/article/pii/S0308597X21000749)

Appendix C. Implementation Plan

C.1 Overview

The MMP provides long-term guidance for management decisions over a 15-year horizon and sets forth desired outcomes, with strategies and activities to reach those outcomes. Implementation of the MMP will require additional funding, which will be sought from a variety of sources. This plan will depend on Congressional allocations, partnerships, grants, and other means. For some projects, nonfederal sources of funds will need to be obtained (both public and private) by partners. Activities and projects identified will be implemented as funds become available.

In USFWS-required Comprehensive Conservation Plans (CCPs), the agency identifies financial, and staffing needs to implement the CCP. Because the Marianas Trench MMP is fulfilling USFWS CCP requirements and is also a coordinated document between USFWS, NOAA, and the CNMI government, this task becomes significantly more complex with multiple programs within each agency engaged in implementing the MMP and multiple methodologies for agencies to develop budget projections for that implementation. As a result, this Appendix presents a range of costs and staffing for implementation. Each agency will work within its individual budgetary processes to identify budget proposals and funding opportunities. This estimate does not include costs for the PIFSC or other NOAA offices to conduct research activities nor does it include operational costs of the Government of CNMI.

This MMP does not imply a commitment of funds by the federal agencies. All funding for current and future Monument activities is subject to the budgeting and appropriations process of the federal government. Each agency develops annual budget projections and priorities separately, and allocates funds based on its own programmatic, legal, and policy requirements. The cycle and timelines for funding and planning vary.

C.2 Costs to Implement the Monument Management Plan

Staffing and operational costs reflect management spending of base funds allocated each year. These are considered recurring costs and are usually associated with day-to-day operations and projects that last longer than three years. The USFWS Monument office on Saipan receives a portion of the annual agency "monuments" funding for five Marine National Monuments, which covers two dedicated Monument employees and shared support staff. The NOAA PIRO receives annual funding to manage the four Pacific Marine National Monuments with its partners. Projects and grants have been awarded to implement the strategies in the Marianas and will continue to do so when funding is available. Currently, there are no agency personnel within the CNMI government tasked solely with management responsibilities of the Monument.

Depending on degrees of involvement, timelines, expertise, and other factors, management of the Monument across all agencies is projected to entail between 5–15 full time equivalent employees (FTE) with expertise in resource management, biology, geology, cultural practitioners, planners, outreach and education, law enforcement, administration, maintenance, and vessel operations. Partnerships with other institutions could supplement government employees. Based on current salary rates and estimated benefits at 30%, recurring costs to staff the Monument at the span of staffing identified (5–15 FTEs) would range from $455,000 to $1,365,000 per year. For the Pacific Islands stations, operational costs to fund general management capacity in the FWS Refuge System are calculated at 35% of staff salaries. Operational funds are necessary for basic management costs such as rent, utilities, office equipment, trainings, general printing, and supplies. These

recurring operational costs are estimated from $160,000 to $3,200,000 annually. Additional implementation costs would be developed by Monument managers as we move closer to understanding needs for specific activities.

C.3 Additional Planning Required

This Monument management plan provides guidance for nearly all the management strategies, but further specifics are needed to meet the Administration Act requirements. The Volcanic Unit/Arc of Fire Refuge and Trench Unit/Refuge are exempt from the step-down Inventory and Monitoring Plan requirement. A step-down Visitor Services Plan is currently in development, with a target completion by 2025.

C.4 Implementation

Within the MMP, a 15-year implementation design was prepared to carry out the action plan strategies for the fiscal years 2024–2039. The Monument Management Coordination Team (MMCT) will select the activities to be implemented annually based on priority. The strategies and activities build upon one another to achieve the management goals for the 15-year period.

The MMCT will meet annually, at a minimum, to evaluate the progress and effectiveness of the previous year strategies and activities performed. Based on sufficient resources, funding availability, capacity, and partners support, they will develop a work strategy to plan for the upcoming year's activities. This process is based on three key management frameworks: adaptive management, ecosystem-based management, and multiple objectives planning, as described in Chapter 2, Section 2.2.2 (f) and Table 2.1 This approach allows Monument managers to consider new or changing resource conditions and adjust accordingly within actual funding allocations.

As the planning process for the follow-up management plan is expected to take two years, public scoping for the next plan would be initiated in the year 2037. Monument managers will provide an assessment of progress and accomplishment of the existing management strategies and begin the formal planning process for the next 15-year plan. A compilation of activities for all the action plans follows.

Mariana Trench MNM – Summary of Activities

Marine Resource Conservation and Monitoring Action Plan (MRCM)

MRCM Strategy 1: Coordinate and promote Monument-related noncommercial fishing and scientific research.

Activity 1.1: Provide access for activities related to sustainable noncommercial fishing and exploration and research that preserves the marine resources of the Monument.

Activity 1.2: Work with partners and the scientific and local communities to monitor and assess the impacts from authorized Monument activities.

Activity 1.3: Review the data and records from authorized fishing activities in the Monument and assess compliance with marine resource conservation needs.

MRCM Strategy 2: Assess the status of endangered species, fisheries, habitats, and geologic features of the Monument.

Activity 2.1: Work with partners to conduct population studies for marine mammals, T&E species, and CNMI species of concern.

Activity 2.2: Work with partners to continue the assessments of coral reef communities and other benthic habitats in the Monument.

Activity 2.3: Identify management options to maintain ecological integrity for species and systems considered vulnerable to climate change.

MRCM Strategy 3: Identify threats to endangered species, fisheries, habitats, and geologic features found in the Monument.

Activity 3.1: Identify key species or functional groups on which to focus management efforts.

Activity 3.2: Work with partners to develop long-term monitoring projects to determine how natural and anthropogenic events outside of the Monument impact the resources over time.

MRCM Strategy 4: Identify measures to reduce or minimize threats to the Monument resources.

Activity 4.1: Implement and refine BMPs to protect endangered and threatened marine species, habitats, and geologic features.

Activity 4.2: Investigate the feasibility and necessity of deploying remote surveillance technologies to aid in resource protection.

Activity 4.3: Facilitate efforts to reduce and minimize fishery bycatch and incidental mortality.

MRCM Strategy 5: Incorporate traditional knowledge and local indigenous perspectives into Monument management.

Activity 5.1: Solicit advice from SHPO and cultural groups on traditional knowledge pertaining to management of marine resources.

Coordination of Management, Access, and Permitting Action Plan (CMAP)

CMAP Strategy 1: Establish a Monument Management Coordination Team to facilitate coordinated management of the Monument.

Activity 1.1: Prepare and sign a MOU for management roles and responsibilities shared between the USFWS, NOAA, and CNMI.

Activity 1.2: Prepare an annual "State of the Monument" report.

Activity 1.3: Assess and determine format and frequency of MTMAC meetings with the MMCT.

CMAP Strategy 2: Develop a Joint Monument Permit package and a single permit application for all Monument activities.

Activity 2.1: In consultation with NOAA and the CNMI, the USFWS will modify the existing approved SUP application to serve as the JMP application.

CMAP Strategy 3: Develop a single public portal (website) to eliminate duplication of effort within one year of MMP publication.

Activity 3.1: Work with the USFWS Office of Communications to modify existing website to include NOAA and CNMI logos.

Activity 3.2: Develop a web page to post information on noncommercial fishing, research, and other permitted uses.

CMAP Strategy 4: Form a Mariana Trench Working Group (MTWG).

Activity 4.1: Work with MTMAC to develop MTWG invitation letter and group operating norms.

Sustainable Noncommercial Fishing Action Plan (SNF)

SNF Strategy 1: Improve information about fisheries stocks status within the Monument.

Activity 1.1: Acquire baseline data about fishery populations.

SNF Strategy 2: Assess fisheries landings from the Islands Unit to ensure sustainable harvests and maintain effective regulations.

Activity 2.1: Track the landings and species from submitted logbooks to better inform management decision-making.

SNF Strategy 3: Identify threats to fisheries resources and develop management actions in the Islands Unit to ensure sustainable, healthy fish stocks are maintained.

Activity 3.1: Analyze fisheries data to guide management actions for sustainable fishery stocks.

SNF Strategy 4: Provide the residents of CNMI and Guam easy access to permit applications, record forms, logbooks, and other Federal fisheries information.

Activity 4.1: Incorporate the sustainable noncommercial fishing permit application into the new JMP permit application.

Activity 4.2: Establish locations in the CNMI and Guam where fishers can find JMP applications and Monument-related fishing information.

SNF Strategy 5: Solicit input through forums and workshops to include indigenous experts and local fishing groups on traditional fishing methods in the region.

Surveillance and Enforcement Action Plan (SAE)

SAE Strategy 1: Incorporate Monument information and regulations to existing interagency agreements and integrate Monument-specific protections into existing boundary and mapping tools.

Activity 1.1: Integrate the Monument into interagency agreements and evaluate the necessity for additional interagency agreements.

Activity 1.2: Ensure that Monument boundaries are updated on official NOAA nautical charts and U.S. Coast Pilot® 10.

SAE Strategy 2: Analyze vessel traffic data to assess the need for additional surveillance within the Monument.

Activity 2.1: Conduct a ship travel assessment to inform compliance and enforcement needs in Monument waters.

Activity 2.2: Assess effectiveness of Google Earth™ VMS data sharing.

SAE Strategy 3: Consider suitable programs, tools, and technologies to augment effective law enforcement.

Activity 3.1: Investigate the feasibility and necessity of deploying remote surveillance technologies to aid in resource protection.

Marine Invasive Species Control Action Plan (MIS)

MIS Strategy 1: Maintain current marine invasive species prevention BMPs and Biosecurity protocols for all Monument visitors.

Activity 1.1: Review existing marine invasive species prevention measures and BMPs to establish standard protocols.

Activity 1.2: Develop a reference guide for Monument visitors that explains BMPs developed in MIS Activity 1.1.

MIS Strategy 2: Assess the number of vessels transiting Monument waters, the purpose of their passage, travel patterns and primary pathways, and isolate potential vectors for species introductions.

Activity 2.1: Identify vector pathways and assess spatial and temporal water vessel and aircraft traffic patterns.

MIS Strategy 3: Assess the need for a vessel inspection process in Guam and CNMI for invasive species.

Activity 3.1: Review trip data and determine whether the Monument would benefit from vessel inspections for Guam and CNMI boaters.

MIS Strategy 4: Confirm the presence or absence of invasive species in the Monument.

Activity 4.1: Analyze the MARAMP towed-diver survey data to verify the presence or absence of invasive species and establish a baseline for marine invasive species in the Monument.

Activity 4.2: Develop database that identifies marine species in the Monument, prioritizing known invaders in the tropical and subtropical Pacific marine environment.

MIS Strategy 5: Develop a marine invasive species observation plan and support existing observation activities.

Activity 5.1: Create a marine invasive species observation program for researchers to assist with detecting potential introductions.

Activity 5.2: Develop a response plan if a species introduction is identified.

MIS Strategy 6: Continue to research initiatives across the Pacific to achieve marine invasive species prevention.

Activity 6.1: Maintain communication with partners and remain informed of global marine invasive species developments.

Marine Debris Action Plan (MD)

MD Strategy 1: Decrease potential incidences of grounded and abandoned vessels in the Monument.

Activity 1.1: Update navigation aids with Monument boundary and feature information.

Activity 1.2: Assess the need and value of establishing International Maritime Organization Protection Measures for the Islands Unit.

MD Strategy 2: Decrease incidences of fishing gear and solid waste disposal in the Mariana Archipelago that could drift into Monument waters.

Activity 2.1: Modify and circulate waste management education materials to Monument visitors.

Activity 2.2: Conduct outreach workshops in the CNMI and Guam about fishing gear loss solutions.

Activity 2.3: Develop protocols to prevent marine debris from fishing fleets that fish in the CNMI and Guam EEZs and partner with them for removal incentives.

MD Strategy 3: Develop a process to inventory and remove marine debris in the Islands Unit.

Activity 3.1: Establish a marine debris data gathering procedure for the Islands Unit.

Activity 3.2: Consider using remote monitoring technology to address marine debris.

Activity 3.3: Work with partners to establish a centralized, inter-agency marine debris inventory and response fund.

Emergency Response and Natural Resource Damage Assessment Action Plan (ERDA)

ERDA Strategy 1: Provide the USCG with a Monument Contingency Plan to enable a streamlined response and damage assessment in the event of emergencies in the Monument.

Activity 1.1: Prepare a Monument Contingency Plan to supplement the MIACP.

Activity 1.2: Prepare an Environmental Sensitivity Index (ESI) for the Monument's Islands Unit.

Activity 1.3: Prepare a NRDA representative contact list.

ERDA Strategy 2: Ensure preparation, response, and training needs are met for ERDA protocol in the Monument.

Activity 2.1: Collaborate with the PRiMO coalition to identify training and funding needs associated with the ERDA protocol.

Exploration and Research Action Plan (E&R)

E&R Strategy 1: Work with partners to assess the current state of knowledge about the resources in the Monument, and to prioritize research to fill in the gaps.

Activity 1.1: Complete a review of the current scientific literature of research that has occurred in the Monument and make it available to the public on an appropriate internet site(s).

Activity 1.2: Review current data to determine the abundance and distribution of the marine resources in the monument and the location of geological features found in the Monument.

Activity 1.3: Collect available spatial data sources to determine the distribution of the various habitats, geological features, and biological resources.

Activity 1.4: Conduct a vulnerability assessment to understand potential climate change scenarios.

E&R Strategy 2: Work with partners to study, explore, and conserve the features and resources of the Monument.

Activity 2.1: Work with partners to conduct scientific studies on the characteristics of the Monument's unique processes and resources.

Activity 2.2: Work with partners to characterize the ocean basins and resources in the Monument.

Activity 2.3: Characterize geological, physical, chemical, and biological ocean processes, communities, and environments.

Activity 2.4: Develop a georeferenced system of documentation that tracks locations and types of exploration and research activities in the Monument.

Activity 2.5: Identify and establish long-term study sites at appropriate locations within the Monument.

Activity 2.6: Locate areas within the Monument that demonstrate potential for climate change resilience.

E&R Strategy 3: Identify opportunities to implement novel approaches to management of the Monument and to find ways to further collaboration with the scientific community and the public.

Activity 3.1: Convene a team of technical advisors who can aid Monument managers in evaluation of research proposals and management activities.

Activity 3.2: Convene a working group to identify key climate change research questions.

Activity 3.3: Consider establishing sites where only low-impact research would be conducted to maintain ecosystem integrity.

Activity 3.4: Identify opportunities to use advanced underwater technologies such as ROVs; autonomous underwater vehicles; and ocean gliders to increase the pace, scope, and efficiency of exploration and research.

Activity 3.5: Pursue opportunities to support marine science career paths for local students.

Cultural and Maritime Heritage Action Plan (CMH)

CMH Strategy 1: Collaborate with Chamorro and Carolinian communities, the CNMI Historic Preservation Office, the Guam Historic Resources Division, and other interested groups to identify the indigenous and colonial cultural and maritime heritage resources related to the Monument.

Activity 1.1: Establish partnerships with indigenous communities to conduct culturally appropriate maritime heritage research and activities

Activity 1.2: Connect with agencies managing the Maritime Heritage Grants program to determine eligibility for funding and seek out nonfederal interest groups (NGOs and universities) for potential research projects.

Activity 1.3: Identify, characterize, and inventory Cultural and Maritime Heritage resources located in the Monument using a GIS-based inventory program.

Activity 1.4: Develop a Cultural and Maritime Heritage preservation and protection program for historic resources in the Monument.

Activity 1.5: Develop a culturally appropriate and inclusive naming process.

CMH Strategy 2: Facilitate development of interpretive programs for the Monument's Cultural and Maritime Heritage.

Activity 2.1: Prepare Educational materials to augment Cultural and Maritime Heritage programs.

Activity 2.2: Coordinate Cultural and Maritime Heritage outreach programs with educators and community organizations.

Ocean Literacy, Environmental Education, and Public Outreach Action Plan (OEP)

OEP Strategy 1: Engage educators and organizations in the CNMI and Guam to support ocean literacy.

Activity 1.1: Identify potential CNMI and Guam-based educators to establish a network of ocean literacy products and material contributors.

Activity 1.2: Identify gaps in ocean literacy and ocean resource-related environmental education programs and seek ways to contribute resources to existing programs.

OEP Strategy 2: Collaboratively develop curriculum for the Mariana Archipelago that incorporates traditional knowledge of the Carolinian and Chamorro communities.

Activity 2.1: Determine which materials should be incorporated into ocean literacy, environmental education, and public outreach programs.

Activity 2.2: Increase collaboration and indigenous language usage through the use of indigenous place names, planning, and outreach.

Activity 2.3: Develop educational products featuring the Monument's unique resources to bring the Monument to the CNMI and Guam communities.

OEP Strategy 3: Provide quality environmental education and ocean literacy programs for Mariana Islands residents and visitors complimented with distance learning tools and novel delivery tools.

Activity 3.1: Identify where ocean literacy programs should be targeted to maximize community participation.

Activity 3.2: Identify appropriate distance learning tools and integrate new media/technology.

OEP Strategy 4: Establish a visitor contact station where the collective story of the Monument ecosystem is told through imagery, sounds, artifacts and scheduled programming developed for educators, students, residents, and visitors.

Activity 4.1: Continue to grow/expand Monument visitor contact station(s) in the CNMI and Guam and provide support and guidance as resources permit.

Activity 4.2: Develop an education and outreach ocean literacy program in partnership with Monument managers and local community experts.

OEP Strategy 5: Promote ecotourism, recreational, and economic ventures that are compatible with Monument ecosystems in collaboration with the Marianas Visitors Authority, Northern Islands Mayor's Office, and other partners.

Activity 5.1: Establish guidelines and protocols for sustainable tourism and related economic ventures within the Monument.

International Collaboration Action Plan (IC)

IC Strategy 1: Routinely participate in national and international ocean stewardship forums to exchange knowledge and learn new marine protected area policies, methods, and technologies.

Activity 1.1: Participate in the Big Ocean network to incorporate relevant MPA management methods into Monument activities.

Activity 1.2: Participate in SPREP, Micronesian Challenge, Coral Triangle Initiative, Coral Reef Conservation Program, and other international organizations' activities.

Activity 1.3: Improve coordination of environmental reviews in relation to submarine cable licenses and Right of Ways through the Monument across the Federal Government and, as appropriate, engage with the local community to provide comment opportunities.

IC Strategy 2: Identify collaboration opportunities that will assist managers in maintaining or improving Monument resilience.

Activity 2.1: Collaborate with international agencies who are conducting research and fisheries-related activities in and near the Monument.

Activity 2.2: Collaborate with national research firms who partner with international research institutions.

Activity 2.3: Improve coordination of seabird protections and fisheries management across the Federal Government and, as appropriate, engage with the international community through agreements, conferences, and one-on-one.

Activity 2.4: In coordination with the USCG, develop Japanese language Monument information guides for boaters and Search and Rescue units for emergency response within the Islands Unit.

Activity 2.5: Monitor the evolution of international treaties and BMPs for cable installation, protection and maintenance.

USFWS Wilderness Review

Completed October 2017 L. Beauregard, B. Stieglitz

General Information on Wilderness Reviews

Wilderness review is the process used to determine whether or not to recommend lands or waters in the Refuge System to the Congress for designation as wilderness. Planning policy for the Refuge System (602 FW 3) mandates conducting wilderness reviews every 15 years. The wilderness review process has three phases: inventory, study, and recommendation. After first identifying lands and waters that meet the minimum criteria for wilderness, the resulting wilderness study areas (WSA) are further evaluated to determine if they merit recommendation from the Service to the Secretary of the Interior for inclusion in the National Wilderness Preservation System (NWPS). Areas recommended for designation are managed to maintain wilderness character in accordance with management goals, objectives, and strategies outlined in a Comprehensive Conservation Plan (CCP) until Congress makes a decision or the CCP is amended to modify or remove the wilderness proposal. This Monument Management Plan meets the requirements of a CCP.

Wilderness Inventory

The wilderness inventory consists of identifying areas that minimally meet the requirements for wilderness as defined in the Wilderness Act of 1964 (Wilderness Act). Wilderness is defined as an area which:

- Has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition, or be capable of restoration to wilderness character through appropriate management at the time of review, or be a roadless island;
- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation; and
- May also contain ecological, geological, or other features of scientific, educational, scenic, or historic value. These features and values, though desirable, are not necessary for an area to qualify as a wilderness.

Wilderness Study

During the study phase, lands and waters qualifying for wilderness as a result of the inventory are studied to analyze values (ecological, recreational, cultural, spiritual), resources (wildlife, water, vegetation, minerals, soils), and uses (habitat management, public use) within the area. The findings of the study help determine whether to recommend the area for designation as wilderness.

Wilderness Recommendation

Once a wilderness study determines that a WSA meets the requirements for inclusion in the NWPS, a wilderness study report that presents the results of the wilderness review, accompanied by a Legislative Environmental Impact Statement (LEIS), is prepared. The wilderness study report and LEIS that support wilderness designation are then transmitted through the Secretary of the Interior to the President of the United States, and ultimately to the Congress for approval.

The following section summarizes the inventory phase of the wilderness review for the **Mariana Trench NWR** (Trench Unit/Refuge) and **Mariana Arc of Fire NWR** (Volcanic Unit/Arc of Fire Refuge). The Islands Unit is not managed as a refuge and therefore exempt from the wilderness review requirement.

Wilderness Inventory Summary

The wilderness inventory is a broad look at the planning area to identify WSAs. These WSAs are roadless areas within refuge boundaries, including submerged lands and their associated water column, that meet the minimum criteria for wilderness identified in Sect. 2. (c) of the Wilderness Act. A WSA must meet the minimum size criteria (or be a roadless island), appear natural, and provide outstanding opportunities for solitude or primitive recreation. Other supplemental values are evaluated, but not required.

Size

Inventory units meet the size criteria for a WSA if any one of the following standards applies:

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency.

The Trench Unit/Refuge is comprised of more than 50.5 million acres which meets the size criteria. The Volcanic Unit/Arc of Fire Refuge covers 46,779 acres, which also meets the size criteria.

Naturalness

A WSA must meet the naturalness criteria. Section 2.(c) of the Wilderness Act defines wilderness as an area that "…generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear natural to the average visitor rather than "pristine." The presence of ecologically accurate, historical landscape conditions is not required. An area may include some manmade features and human impacts provided they are substantially unnoticeable in the unit as a whole. Human-caused hazards, such as the presence of unexploded ordnance from military activity, and the physical impacts of refuge management facilities and activities are also considered in the evaluation of the naturalness criteria. An area may not be considered unnatural in appearance solely on the basis of "sights and sounds" of human impacts and activities outside the boundary of the unit. The cumulative effects of these factors were considered in the evaluation of naturalness for each wilderness inventory unit.

In the wilderness inventory, specific manmade features and other human impacts need to be identified that affect the overall apparent naturalness of the tract. There is a high probability of unexploded ordnance, wreckage of ship and aircraft, and other man-made debris lying in the submerged lands of the Trench Unit/Refuge. The Mariana Trench contains some of the deepest known points in the global ocean and due to its inaccessibility, the region is virtually unexplored, and much remains to be learned. A

naturalness evaluation is being deferred until a time when technological capabilities allow for a viable assessment of wilderness criteria.

As a volcanic arc deep within the Pacific Ocean, the Volcanic Unit/Arc of Fire Refuge continues to exist in a completely natural state. No known factors within the refuge serve to detract from its natural character. The Volcanic Unit/Arc of Fire Refuge meets the minimum criteria for naturalness.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
In addition to meeting the size and naturalness criteria, a WSA must provide outstanding opportunities for solitude or primitive recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under these criteria. Congress has designated several wilderness areas in the NWPS that are closed to public access to protect ecological resource values.

"Opportunities for solitude" refers to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk, self-reliance, and adventure.

Most of the area of both inventory units lie beyond the depths of current technical diving limits. Only a single pinnacle of the Zealandia Bank unit of the Volcanic Unit/Arc of Fire Refuge is readily accessible to recreational divers. Due to the extreme pressure at depth, humans cannot readily visit either refuge without the aid of submersible mechanical transport. As such, neither the Trench Unit/Refuge nor Volcanic Unit/Arc of Fire Refuge meets the minimum criteria for outstanding opportunities for solitude or primitive and unconfined recreation.

Evaluation of Supplemental Values
Supplemental values are defined by the Wilderness Act as "ecological, geological, or other features of scientific, educational, scenic, or historic value." Based upon the findings of the required components for WSA designation, supplemental values were not evaluated.

Findings
Under present conditions, neither the Trench Unit/Refuge nor Volcanic Unit/Arc of Fire Refuge meets the minimum criteria for consideration as WSA.

Mariana Trench NWR (Trench Unit/Refuge)	
Required Components	
(1) Has at least 5,000 ac of land or is of sufficient size to make practicable its preservation and use in an unconfined condition, or is a roadless island.	Yes. Contains over 50.5 million acres of submerged lands.
(2) Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.	Unknown.
(3a) Has outstanding opportunities for solitude.	No. Refuge is too deep for technical divers to visit without submersible mechanical transport.
(3b) Has outstanding opportunities for a primitive and unconfined type of recreation.	No. Refuge is too deep for technical divers to visit without submersible mechanical transport.
Other Components	
(4) Contains ecological, geological or other features of scientific, educational, scenic, or historic value.	Not evaluated.
Summary	
Parcel qualifies as a wilderness study area	No.
Mariana Arc of Fire NWR (Volcanic Unit/Arc of Fire Refuge)	
Required Components	
(1) Has at least 5,000 ac of land or is of sufficient size to make practicable its preservation and use in an unconfined condition, or is a roadless island.	Yes. Contains 46,779 acres of submerged lands.
(2) Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.	Yes. Completely natural submarine volcanic arc. No diminishing factors.
(3a) Has outstanding opportunities for solitude.	No. Most portions of Refuge are too deep for divers to visit without submersible mechanical transport.
(3b) Has outstanding opportunities for a primitive and unconfined type of recreation.	No. Most portions of Refuge are too deep for divers to visit without submersible mechanical transport.
Other Components	
(4) Contains ecological, geological or other features of scientific, educational, scenic, or historic value.	Not evaluated.
Summary	
Parcel qualifies as a wilderness study area	No.

Wilderness Inventory Summary

Appendix E. Best Management Practices and Biosecurity

These Best Management Practices (BMPs) are provided to Monument visitors to minimize the potential introductions of marine invasive species (MIS) in the Marianas Trench Marine National Monument.

Portions of the recommended BMPs provided below, currently being used and considered effective, are taken from the CRED Programmatic Environmental Assessment for conducting research activities in the central and western Pacific Ocean, and the Papahānaumokuākea Marine National Monument Management Plan.

1. Marine Invasive Species Prevention Measures for Vessels

Shipboard Operations

The following ship maintenance protocols are applied to the NOAA ships, whereas similar procedures are recommended to be applied to other ships and small boats that are to access the Monument waters:

Ships should be dry docked every two years and the bottom and sides cleaned using a high-pressure water system to remove dirt and growth on the hull. The bottom will be repainted with an EPA-approved, anti-fouling paint that retards marine growth and preserves the bottom surface. The hull is to be painted with a marine paint for protection in the saltwater environment. Vessels will have a USCG type II approved Marine Sanitation Device aboard and a holding tank capable of holding and treating sewage, gray water, and other waste generated aboard the ship. Ships will be capable of holding wastewater for approximately two days before the holding tank reaches capacity and grey water must be discharged. For operations within the Monument, all sewage would be treated and the grey water retained until the ship is outside of all Monument boundaries.

Small Boats

Small boats that have been deployed from the main ship are to be cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, is physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external surfaces of vessels are rinsed daily with freshwater and always rinsed between islands before transits. Vessels are allowed to dry before redeployment the following day.

Equipment and Gear

The following actions are routinely required while conducting work to minimize the spread of diseases to coral reef organisms and spreading invasive species on equipment and vessels.

Equipment (e.g., gloves, forceps, shears) in direct contact with potential invasive species, diseased coral tissues, or diseased organisms are soaked in a freshwater 1:32 dilution with commercial bleach for at least 10 minutes, and only a disinfected set of equipment is used at each dive site.

All samples of potentially invasive species, diseased coral tissues, or diseased organisms are collected and sealed in at least two of a combination of bags or jars underwater on-site and secured into a holding container until processing.

Dive Gear

Dive gear (e.g., wetsuit, mask, fins, snorkel, buoyancy compensator, regulator, weight belt, booties) is disinfected by one of the following ways: a 1:52 dilution of commercial bleach in freshwater, a 3% free chlorine solution, or a manufacturer's recommended disinfectant-strength dilution of a quaternary ammonium compound in "soft" (low concentration of calcium or magnesium ions) freshwater. Used dive gear is disinfected daily by performing the following steps: 1) physical removal of any organic matter and 2) submersion for a minimum of 10 minutes in an acceptable disinfection solution, followed by a thorough freshwater rinse and hanging to air dry. All gear in close proximity to the face or skin, such as masks, regulators, and gloves, are additionally rinsed thoroughly with potable water following disinfection.

Ballast Water

Vessels must have a U.S. Coast Guard and/or International Maritime Organization ballast water management plan on board. The records of ballast water operations for the previous month with source locations must be made available at the time of inspection. If inspectors have concerns, access to saltwater ballast tanks must be provided to allow water sampling. If any saltwater ballast on board is deemed unacceptable, the vessels master must employ the ballast water management practices, described in 33 CFR § 151.1510, prior to entry in the Monument. No ballast water discharge is allowed within the boundaries of the Monument except in the case of emergencies as defined by the U.S. Coast Guard (33 CFR § 151.1512).

Biofouling

All submerged and waterline surfaces must be free of macroscale biofouling consisting of marine plants and animals. Surfaces must be free of any Chlorophyta (green-algae), Phaeophyta (brown algae), and Rhodophyta (red-algae) macroalgal species. Additionally, surfaces must be free of macroinvertebrate biofouling communities consisting of cnidarians (anemones and hydroids), arthropods (barnacles and macro-crustaceans), annelids (mobile and tube-dwelling worms), bryozoans, mollusks (clams, mussels and snails), and tunicates (sea squirts).

Live Organism Transport

There can be no transport of live or recently alive marine organisms associated with food stores, aquaculture/aquarium broodstock, or research activities aboard vessels departing for operations within the Monument.

Ballast Metals

Submersible operators should survey their surroundings visually and have access to detailed maps to avoid sensitive areas such as hydrothermal vents, coral colonies, and unique geologic features of scientific interest. All ballast would be dropped in the aphotic zone.

2. MIS Prevention for Deep-Sea Hydrothermal Vents Research

Education and Awareness

Remotely operated vehicle pilots should be educated about the potential for invasive species transport in order to make sound decisions regarding the deployment and decontamination of their ROVs.

Visual Inspection

Prior to any deployment, ROVs should be inspected to determine whether any visibly observable biological material is present on the vehicle. Users should pay extra attention to the o-ring seals (where tiny grains can become lodged); around the thrusters where sea grass and other filamentous organic matter can become entangled; and inside motor bells, where any material is hard to detect. After each dive, users should perform the same visual inspection, returning any organic matter to its place of origin to prevent secondary uptake (secondary uptake occurs when material that has been removed from the ROV is subsequently attached to other objects, such as clothing, shoes, or equipment). Users should also inspect their shoes, clothing, and any gear to confirm that no organic material will be transmitted between sites.

Freshwater Soak and Rinse

Good ROV maintenance already includes a freshwater soak prior to beginning an expedition and rinsing ROVs in clean, freshwater following each dive. This practice will help remove salt and minimize corrosion of critical components. A freshwater rinse can also help remove any organic matter and dislodge potential invasive vectors. Freshwater is also lethal to many marine species, including microscopic organisms that cannot be detected during visual inspection. As transportation of rinse water can serve as a potential source of secondary uptake, water for rinses should be prepared as close to the dive site as possible and disposed of at the same location.

Following a successful series of dives at a discrete site, and after examining submersible elements and providing a sterile rinse, ROVs should be thoroughly washed using a weak bleach solution (1/3 cup household bleach per gallon of water) or other readily available sanitizing agent. This will kill many microbial and viral vectors that could be transported between sites. This step is particularly important when ROVs will be deployed in different biomes or in different geographic regions.

3. Procedures for Ecosystem and Protected Species Threat Reduction

Researchers should follow these guidelines while conducting deep-sea exploration and research:

- Avoid activities that will have deleterious impacts on the sustainability of populations of hydrothermal vent organisms.
- Avoid activities that lead to long-lasting and significant alteration and/or visual degradation of vent sites.
- Avoid collections that are not essential to the conduct of scientific research.
- Avoid transplanting biota or geological material between sites.
- Be aware of the status of current and planned research in an area and avoid activities that will compromise experiments or observation of other researchers. Assure that the research activities and plans are known to the rest of the international research community through public domain databases.

- Facilitate the fullest possible use of all biological, chemical and geological samples collected through collaborations wand cooperation among the global community of scientists.

Ecosystem Protection

During marine debris removal operations, vessels often anchor in areas where they will be working for extended periods. All vessels must anchor in areas with low coral cover to minimize impacts at each site before launching small boats for day-to-day operations. Acceptable anchoring sites are also used repeatedly on an annual basis, whenever possible, to minimize damage. Divers, spotters, and coxswains take every precaution during operations to avoid interactions with any listed species by following the best management practices for boat operations and diving activities, including but not limited to the following practices:

- Constant vigilance is kept for the presence of federally listed species.
- When piloting vessels, vessel operators, or coxswains, alter course to remain at least 100 yards from whales and at least 50 yards from other marine mammals and sea turtles.
- Vessel speed is reduced to 10 knots (kn) or less when piloting vessels in the proximity of marine mammals.
- Vessel speed is reduced to 5 kn or less when piloting vessels in areas of known or suspected turtle activity.
- Marine mammals and sea turtles are not encircled or trapped between multiple vessels or between vessels and the shore whenever possible.
- If a vessel is approached by a marine mammal or turtle, the engine is put into neutral and the animal allowed to pass.
- Unless specifically covered under a separate permit that allows activity within proximity to protected species, all in-water work is postponed when whales are within 100 yards or other protected species are within 50 yards. Activity recommences only after the animal(s) depart the area.
- Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s).
- Attempts are not made to feed, touch, ride, or otherwise intentionally interact with any protected species.

Procedures for Reducing Threats During Monitoring Activities

Monitoring is conducted in shallow (<115 ft) water using scuba gear. Research dives focus on the goal of data collection for research and monitoring purposes, as follows:

- The anchor is used on sand or rubble substrate to minimize disturbance of sensitive benthic areas and prevent coral damage. The anchor is always lowered rather than thrown overboard, and a diver checks the anchor to make sure it does not drag or entangle any fauna.
- The operational area is continuously monitored for protected species, with dive surveys being altered, postponed, or canceled and small boats being put on standby or in neutral or relocating to minimize disturbances or interactions.
- To avoid interactions with listed species during surveys and operations, team members and small boat coxswains monitor areas while in transit to and from work sites. If a listed species is sighted, the vessel alters course in the opposite direction. If unable to change course, the vessel is slowed or stopped until the animal is clear of the boat, as long as diver, coxswain, and passenger safety are not compromised.

- Protected species monitoring continues throughout all dive operations by at least one team member aboard each boat and two divers working underwater.
- Mechanical equipment, such as float lines, transect lines, or stabilization lines for oceanographic equipment, is monitored to ensure no entanglements occur with protected species.
- Team members immediately respond to an entangled animal, halting operations and providing an on-site assessment and an appropriate response. This response could include allowing the animal to disentangle itself or assisting with disentanglement unless doing so would put divers, coxswains, or other staff at risk of injury.
- Before approaching any shorelines or exposed reefs, all observers examine the shoreline, reef areas, and any other visible land areas within the line of sight for marine mammals and sea turtles. The monitoring teams typically do not participate in terrestrial surveys/operations as part of their responsibilities, which minimizes the potential for the disturbance of resting protected animals along shorelines.
- Follow all federal and local laws pertaining to marine mammal, sea turtle, seabird, and other resources protected by the ESA and Marine Mammal Protection Act when completing occasional requests for assistance with terrestrial surveys.
- The humphead wrasse (*Cheilinus undulatusi*) and the green bumphead parrotfish (*Bolbometopon muricatums*) are considered species of concern and are of great importance to the health of coral reef ecosystems. During all research activities, these species are only observed and recorded, and they are never collected, harassed, or sampled. Exact locations of these species are not released to avoid contributing further to overfishing.
- Avoid seabird nesting colonies.
- Avoid marine turtles and marine mammals.
- Only disinfected equipment and gear are transported between the cruise point of origin to destination and return. Protocols are carefully followed to avoid transport of diseased or invasive materials between sites.

4. General Storage and Transport Protocols for Collected Samples

This protocol applies to the storage and transport of commonly collected samples (i.e., terrestrial samples, coral, fish, and invertebrates) in the Monument. It was developed to ensure proper precautions in the handling of biological samples under the International Air Transport Association (IATA) and Department of Transportation (DOT) federal guidelines for safe transport of biological material (Packing Instruction 650). Separate protocols may exist for individual species or activities.

A. Diseased Metazoan Samples

- Diseased samples or those in which a parasite or pathogen is suspected will be collected and placed into individual plastic Ziploc® or Whirl-Pak® bags and sealed until return to base station (research vessel or field camp). Bags will be immediately labeled, or pre-labeled bags will be used.
- Separate equipment will be used to sample health-compromised versus healthy organisms, and these tools will be soaked in a freshwater bleach solution for at least 10 minutes and rinsed in fresh water between dives.
- Sealed plastic bags with diseased samples will be processed immediately or stored on ice in a cooler or other leak-proof container until return to base station.
- Specimens will not be released or exposed to environments beyond the collection location.

- Upon return to the ship, collection tools used for diseased samples will be disinfected with 10% bleach by soaking in a freshly made solution for a minimum of 10 minutes, followed by a thorough freshwater rinse and air drying.
- Collected specimens will be processed as soon as possible and placed in a clearly labeled primary storage container. Processing and storage containers are dependent on preservation method:

Chemically Preserved (Diseased Sample)

- Specimens will be chemically fixed or preserved in one of the following (in sufficient concentration to fix all tissues):

  Ethyl alcohol
  Isopropyl alcohol
  Methyl alcohol
  DMSO
  DNA extraction buffer Z-fix Formaldehyde/formalin Glutaraldehyde Acetone
  Bouin's fixative Helly's fix

- Specimens in primary containers (the first Ziploc® or Whirl-Pak® bag) will be double contained in an additional Whirl-Pak® bag, Ziploc® bag, or plastic jar with a label identifying the collector, site and contents between the primary and secondary containers.
- Double-contained samples will then be placed in ActionPacker® , cooler, or other leak-proof packaging (providing triple containment) capable of surviving a 1.2 m drop without rupture, and clearly labeled on the outside as to the PI and contents for future transport off the ship.
- This leak-proof packaging must have sufficient absorbent material to contain the entire fluid volume contained in the cumulative sample volume if a leak should occur.
- Specimens will be preserved and stored in primary and secondary containment, as outlined above, as soon as possible upon return to the ship or field camp, and will remain in preservative in unopened secondary containment until return into a BSL-2 facility. All sample containers will be sealed and the outside surface of the leak-proof cooler or ActionPacker® will be decontaminated with bleach solution prior to transport off the ship directly to the receiving laboratory.

Frozen (Diseased Sample)

- Immediately upon returning to the base station, seawater remaining in Whirl-Pak® bags will be decanted into a container. This water will be processed by an MSD or similar sewage treatment process.
- The specimens will not be removed from the Whirl-Pak® bag. Instead, the bag will be resealed, disinfected, clearly labeled, and placed in secondary containment such as Ziploc® freezer bags. The secondary containers will also be clearly labeled.
- Samples will be stored frozen in the absence of any buffer aboard the research vessel. The work area will be decontaminated with a 10% bleach solution. After freezing, samples will not be removed, thawed, or opened while aboard the research vessel.
- When it is time for transport from base station, the samples (still in secondary containment) will be placed in a cooler loaded with icepacks in order to keep them frozen. The cooler will then be sealed for transport. All coolers outside surfaces will be decontaminated with bleach solution prior to transport off the ship to the receiving laboratory.

B. Non-Diseased Metazoan or Other Multicellular Samples

Processing and storage containers are dependent on the preservation method, as described below.

Chemically Preserved (Non-Diseased Sample)

- Specimens will be chemically preserved in one of the following:

  Ethyl alcohol
  Isopropyl alcohol
  Methyl alcohol
  DMSO
  DNA extraction buffer
  Z-fix
  Formaldehyde/formalin
  Glutaraldehyde
  Acetone
  Bouin's fixative
  Helly's fixative

- Specimens will be double contained in plastic vials or bottles, glass bottles, Whirl-Pak® or Ziploc® bags and placed in ActionPacker® or cooler. Blood or blood components should be contained using a primary container, absorbent material, a secondary container, and an outer container that is leak-proof.
- Specimens will be preserved and stored prior to leaving the collection location and will remain in preservative until returning from the Monument.

Frozen (Non-Diseased Sample)

- Specimens (tissues or whole organisms) will be double contained in plastic bottles, glass bottles, or Whirl-Pak® bags or larger plastic bags and placed in ActionPacker®, cooler, or other leak-proof packaging.

Dried (Non-Diseased Sample)

- Terrestrial plants or their parts may be pressed and dried and then transported in a closed container.
- When appropriate, terrestrial arthropods may be pinned and dried and transported in appropriate closed containers.
- Coral skeletal samples (e.g., for taxonomic verification studies) will be soaked in commercial bleach solution to remove tissues, air dried, stored in Whirl-Pak® bags, and placed in ActionPacker® or a cooler.
- Remaining bleach solution should not be discarded but stored in plastic or glass bottles, properly labeled as "waste."

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Appendix F. Legal Documents

Proclamation,
Secretarial Order,
Lands Transfer Patent and MOA

Federal Register

Monday,
January 12, 2009

Part V

The President

Federal Register
Vol. 74, No. 7
Monday, January 12, 2009

Presidential Documents

Title 3—

The President

Proclamation 8335 of January 6, 2009

Establishment of the Marianas Trench Marine National Monument

By the President of the United States of America

A Proclamation

Over approximately 480 nautical miles, the Mariana Archipelago encompasses the 14 islands of the United States Commonwealth of the Northern Mariana Islands and the United States Territory of Guam that sit atop the Mariana Ridge in an area known as the Mariana Volcanic Arc. The Mariana Volcanic Arc is part of a subduction system in which the Pacific Plate plunges beneath the Philippine Sea Plate and into the Earth's mantle, creating the Mariana Trench. Six of the archipelago's islands have been volcanically active in historic times, and numerous seamounts along the Mariana Ridge are volcanically or hydrothermically active. The Mariana Trench is approximately 940 nautical miles long and 38 nautical miles wide within the United States Exclusive Economic Zone and contains the deepest known points in the global ocean.

The Mariana Volcanic Arc contains objects of scientific interest, including the largest active mud volcanoes on Earth. The Champagne vent, located at the Eifuku submarine volcano, produces almost pure liquid carbon dioxide. This phenomenon has only been observed at one other site in the world. The Sulfur Cauldron, a pool of liquid sulfur, is found at the Daikoku submarine volcano. The only other known location of molten sulfur is on Io, a moon of Jupiter. Unlike other reefs across the Pacific, the northernmost Mariana reefs provide unique volcanic habitats that support marine biological communities requiring basalt. Maug Crater represents one of only a handful of places on Earth where photosynthetic and chemosynthetic communities of life are known to come together.

The waters of the archipelago's northern islands are among the most biologically diverse in the Western Pacific and include the greatest diversity of seamount and hydrothermal vent life yet discovered. These volcanic islands are ringed by coral ecosystems with very high numbers of apex predators, including large numbers of sharks. They also contain one of the most diverse collections of stony corals in the Western Pacific. The northern islands and shoals in the archipelago have substantially higher large fish biomass, including apex predators, than the southern islands and Guam. The waters of Farallon de Pajaros (also known as Uracas), Maug, and Asuncion support some of the largest biomass of reef fishes in the Mariana Archipelago. These relatively pristine coral reef ecosystems are objects of scientific interest and essential to the long-term study of tropical marine ecosystems.

WHEREAS the submerged volcanic areas of the Mariana Ridge, the coral reef ecosystems of the waters surrounding the islands of Farallon de Pajaros, Maug, and Asuncion in the Commonwealth of the Northern Mariana Islands, and the Mariana Trench contain objects of scientific interest that are situated upon lands owned or controlled by the Government of the United States;

WHEREAS the United States continues to act in accordance with the balance of interests relating to traditional uses of the oceans recognizing freedom

of navigation and overflight and other internationally recognized lawful uses of the sea;

WHEREAS the islands, waters, and airspace of the Mariana Ridge are of particular importance to the national security of the United States;

WHEREAS section 2 of the Act of June 8, 1906 (34 Stat. 225, 16 U.S.C. 431) (the ''Antiquities Act'') authorizes the President, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon lands owned or controlled by the Government of the United States to be national monuments, and to reserve as a part thereof parcels of land, the limits of which in all cases shall be confined to the smallest area compatible with the proper care and management of the objects to be protected;

WHEREAS it is in the public interest to preserve the known volcanic areas of the Mariana Ridge, the marine environment around the islands of Farallon de Pajaros, Maug, and Asuncion in the Commonwealth of the Northern Mariana Islands, and the Mariana Trench for the care and management of the scientific objects therein:

NOW, THEREFORE, I, GEORGE W. BUSH, President of the United States of America, by the authority vested in me by section 2 of the Antiquities Act do proclaim that there are hereby set apart and reserved as the Marianas Trench Marine National Monument (the ''monument'' or ''marine national monument'') for the purpose of protecting the objects identified above, all lands and interests in lands owned or controlled by the Government of the United States within the boundaries described below and depicted on the accompanying map entitled ''Marianas Trench Marine National Monument'' attached to and forming a part of this proclamation. The monument includes the waters and submerged lands of the three northernmost Mariana Islands (the ''Islands Unit'') and only the submerged lands of designated volcanic sites (the ''Volcanic Unit'') and the Mariana Trench (the ''Trench Unit'') to the extent described as follows: The seaward boundaries of the Islands Unit of the monument extend to the lines of latitude and longitude depicted on the accompanying map, which lie approximately 50 nautical miles from the mean low water line of Farallon de Pajaros (Uracas), Maug, and Asuncion. The inland boundary of the Islands Unit of the monument is the mean low water line. The boundary of the Trench Unit of the monument extends from the northern limit of the Exclusive Economic Zone of the United States in the Commonwealth of the Northern Mariana Islands to the southern limit of the Exclusive Economic Zone of the United States in Guam approximately following the points of latitude and longitude identified on the accompanying map. The boundaries of the Volcanic Unit of the monument include a circle drawn with a 1 nautical mile radius centered on each of the volcanic features identified on the accompanying map and its legend. The Federal land and interests in land reserved consists of approximately 95,216 square miles of submerged lands and waters of the Mariana Archipelago, which is the smallest area compatible with the proper care and management of the objects to be protected.

Submerged lands that by legislation are subsequently granted by the United States to the Commonwealth of the Northern Mariana Islands but remain controlled by the United States under the Antiquities Act may remain part of the monument, for coordination of management with the Government of the Commonwealth of the Northern Mariana Islands. Any submerged lands and interests in submerged lands within the monument not owned or controlled by the United States shall be reserved as a part of the monument upon acquisition of title or control by the United States.

Management of the Marine National Monument

The Secretaries of Commerce, through the National Oceanic and Atmospheric Administration, and the Interior, shall manage the monument pursuant to applicable legal authorities and in consultation with the Secretary of Defense.

The Secretary of the Interior shall have management responsibility for the monument, in consultation with the Secretary of Commerce, except that the Secretary of Commerce shall have the primary management responsibility, in consultation with the Secretary of the Interior, with respect to fishery-related activities regulated pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 *et seq.*) and any other applicable authorities. The Secretaries of the Interior and Commerce shall not allow or permit any appropriation, injury, destruction, or removal of any feature of this monument except as provided for by this proclamation or as otherwise provided for by law.

The Secretaries of the Interior and Commerce shall take appropriate action pursuant to their respective authorities under the Antiquities Act and the Magnuson-Stevens Fishery Conservation and Management Act, and such other authorities as may be available to implement this proclamation, to regulate fisheries, and to ensure proper care and management of the monument.

Regulation of Scientific Exploration and Research

Subject to such terms and conditions as the Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study, and the Secretary of Commerce may permit fishing within the monument for scientific exploration and research purposes to the extent authorized by the Magnuson-Stevens Fishery Conservation and Management Act. The prohibitions required by this proclamation shall not restrict scientific exploration or research activities by or for the Secretaries, and nothing in this proclamation shall be construed to require a permit or other authorization from the other Secretary for their respective scientific activities.

Regulation of Fishing and Management of Fishery Resources

Within the Islands Unit of the monument, the Secretary of Commerce shall prohibit commercial fishing. Subject to such terms and conditions as the Secretary of Commerce deems necessary for the care and management of the objects of the Islands Unit, the Secretary, consistent with Executive Order 12962 of June 7, 1995, as amended, shall ensure that sustenance, recreational, and traditional indigenous fishing shall be managed as a sustainable activity consistent with other applicable law and after due consideration with respect to traditional indigenous fishing of any determination by the Government of the Commonwealth of the Northern Mariana Islands.

Monument Management Planning

The Secretaries of the Interior and Commerce shall, within 2 years of the date of this proclamation, prepare management plans within their respective authorities and promulgate implementing regulations that address any further specific actions necessary for the proper care and management of the objects identified in this proclamation. In developing and implementing any management plans and any management rules and regulations, the Secretaries shall designate and involve as cooperating agencies the agencies with jurisdiction or special expertise, including the Department of Defense, the Department of State, and other agencies through scoping in accordance with the National Environmental Policy Act (42 U.S.C. 4321 *et seq.*), its implementing regulations and with Executive Order 13352 of August 26, 2004, Facilitation of Cooperative Conservation, and shall treat as a cooperating agency the Government of the Commonwealth of the Northern Mariana Islands, consistent with these authorities. The monument management plans shall ensure that the monument will be administered in accordance with this proclamation, and shall, as appropriate to their respective authorities, provide for:

1. management of the Islands Unit of the monument, in consultation with the Government of the Commonwealth of the Northern Mariana Islands, including designation of specific roles and responsibilities and the means

of consultation on management decisions as appropriate, without affecting the respective authorities or jurisdictions of the Commonwealth of the Northern Mariana Islands or the Secretaries of the Interior or of Commerce;

2. public education programs and public outreach regarding the coral reef ecosystem and related marine resources and species of the monument and efforts to conserve them;

3. traditional access by indigenous persons, as identified by the Secretaries in consultation with the Government of the Commonwealth of the Northern Mariana Islands, for culturally significant subsistence, cultural and religious uses within the monument;

4. a program to assess and promote monument-related scientific exploration and research, tourism, and recreational and economic activities and opportunities in the Commonwealth of the Northern Mariana Islands;

5. a process to consider requests for recreational fishing permits in certain areas of the Islands Unit, based on an analysis of the likely effects of such fishing on the marine ecosystems of these areas, sound professional judgment that such fishing will not materially interfere with or detract from the fulfillment of the purposes of this proclamation, and the extent to which such recreational fishing shall be managed as a sustainable activity consistent with Executive Order 12962, as amended, and other applicable law; and

6. programs for monitoring and enforcement necessary to ensure that scientific exploration and research, tourism, and recreational and commercial activities do not degrade the monument's coral reef ecosystem or related marine resources or species or diminish the monument's natural character.

The management plans and their implementing regulations shall impose no restrictions on innocent passage in the territorial sea or otherwise restrict navigation, overflight, and other internationally recognized lawful uses of the sea, and shall incorporate the provisions of this proclamation regarding Armed Forces actions and compliance with international law.

This proclamation shall be applied in accordance with international law. No restrictions shall apply to or be enforced against a person who is not a citizen, national, or resident alien of the United States (including foreign flag vessels) unless in accordance with international law.

Nothing in this proclamation shall be deemed to diminish or enlarge the jurisdiction of the Commonwealth of the Northern Mariana Islands.

Advisory Council

The Secretaries of the Interior and Commerce, within 3 months of the date of this proclamation and after considering recommendations from the Governor of the Commonwealth of the Northern Mariana Islands, the Secretary of Defense, and the Secretary of Homeland Security, shall establish the Mariana Monument Advisory Council to provide advice and recommendations on the development of management plans and management of the monument. The Advisory Council shall consist of three officials of the Government of the Commonwealth of the Northern Mariana Islands and one representative each from the Department of Defense and the United States Coast Guard.

Members of the Advisory Council will be appointed for a term of 3 years by the Secretaries of the Interior and Commerce after nomination by the head of the pertinent executive branch agency or, with respect to the officials of the Government of the Commonwealth of the Northern Mariana Islands, by the Governor of the Commonwealth of the Northern Mariana Islands. The Advisory Council will adopt such procedures as it deems necessary to govern its activities. Each participating agency shall be responsible for the expenses of its representative and the Departments of the Interior and Commerce shall be equally responsible for the costs of the Advisory Council.

Emergencies, National Security, and Law Enforcement Activities

1. The prohibitions required by this proclamation shall not apply to activities necessary to respond to emergencies threatening life, property, or the environment, or to activities necessary for national security or law enforcement purposes.

2. Nothing in this proclamation shall limit agency actions to respond to emergencies posing an unacceptable threat to human health or safety or to the marine environment and admitting of no other feasible solution.

Armed Forces Actions

1. The prohibitions required by this proclamation shall not apply to activities and exercises of the Armed Forces (including those carried out by the United States Coast Guard).

2. The Armed Forces shall ensure, by the adoption of appropriate measures not impairing operations or operational capabilities, that its vessels and aircraft act in a manner consistent, so far as is reasonable and practicable, with this proclamation.

3. In the event of threatened or actual destruction of, loss of, or injury to a monument living marine resource resulting from an incident, including but not limited to spills and groundings, caused by a component of the Department of Defense or the United States Coast Guard, the cognizant component shall promptly coordinate with the Secretary of the Interior or Commerce, as appropriate, for the purpose of taking appropriate actions to respond to and mitigate any actual harm and, if possible, restore or replace the monument resource or quality.

4. Nothing in this proclamation or any regulation implementing it shall limit or otherwise affect the Armed Forces' discretion to use, maintain, improve, manage, or control any property under the administrative control of a Military Department or otherwise limit the availability of such property for military mission purposes.

This proclamation is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity, by any party against the United States, its agencies, instrumentalities, or entities, its officers, employees, agents, or any other person.

All Federal lands and interests in lands within the boundaries of this monument are hereby withdrawn from all forms of entry, location, selection, sale, or leasing or other disposition under the public land laws, to the extent that those laws apply.

The establishment of this monument is subject to valid existing rights.

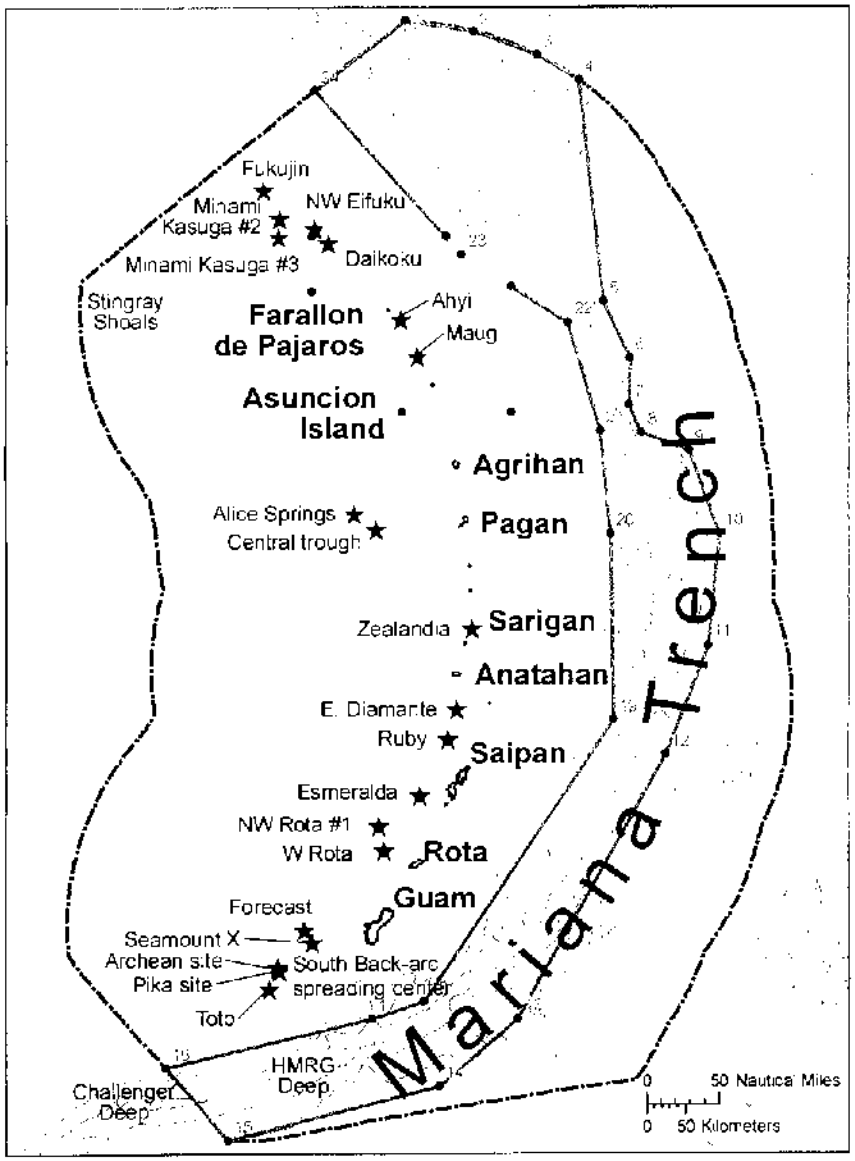
Nothing in this proclamation shall be deemed to revoke any existing withdrawal, reservation, or appropriation; however, the national monument shall be dominant over any other existing Federal withdrawal, reservation, or appropriation.

Warning is hereby given to all unauthorized persons not to appropriate, excavate, injure, destroy, or remove any feature of this monument and not to locate or settle upon any lands thereof.

IN WITNESS WHEREOF, I have hereunto set my hand this sixth day of January, in the year of our Lord two thousand nine, and of the Independence of the United States of America the two hundred and thirty-third.

Billing code 3195–W9–P

Marianas Trench Marine National Monument



Trench Unit

Id	Longitude	Latitude
1	145° 5' 40" E	23° 53' 35" N
2	145° 52' 27.18" E	23° 45' 50.54" N
3	146° 36' 18.91" E	23° 29' 18.93" N
4	147° 5' 15.84" E	23° 11' 43.62" N
5	147° 22' 31.43" E	20° 38' 41.35" N
6	147° 40' 48.31" E	19° 59' 23.30" N
7	147° 39' 59.51" E	19° 27' 2.96" N
8	147° 48' 54.61" E	19° 8' 18.74" N
9	148° 21' 47.20" E	18° 56' 8.46" N
10	148° 42' 50.50" E	17° 58' 2.20" N
11	148° 34' 47.12" E	16° 40' 59.86" N
12	148° 5' 39.95" E	15° 25' 51.09" N
13	146° 22' 24.98" E	12° 21' 38.98" N
14	145° 28' 33.28" E	11° 34' 7.84" N
15	143° 3' 9" E	10° 57' 30" N
16	142° 10' 54.58" E	11° 47' 24.63" N
17	144° 42' 31.24" E	12° 21' 24.65" N
18	145° 17' 58.93" E	12° 39' 5.95" N
19	147° 28' 02.24" L	15° 49' 25.53" N
20	147° 27' 32.35" E	17° 57' 52.76" N
21	147° 20' 18.58" E	19° 9' 19.41" N
22	146° 57' 55.31" E	20° 23' 58.80" N
23	145° 44' 31.14" E	21° 11' 14.60" N
24	144° 5' 27.55" E	23° 2' 28.67" N

Islands Unit

Id	Longitude	Latitude
1	144° 1' 22.97" E	21° 23' 42.40" N
2	146° 33' 25.20" E	21° 23' 42.40" N
3	145° 44' 31.14" E	21° 11' 14.60" N
4	146° 18' 36.75" E	20° 49' 17.40" N
5	146° 18' 36.75" E	18° 22' 0.00" N
6	145° 3' 12.22" E	18° 22' 0.00" N
7	144° 1' 22.97" E	20° 45' 44.11" N

Vents Unit

Volcano	Longitude	Latitude
Fukujin	143° 27' 30" E	21° 56' 30" N
Minami Kasuga #2	143° 38' 30" E	21° 36' 36" N
NW Eifuku	144° 2' 35" E	21° 29' 15" N
Minami Kasuga #3	143° 36' 0" E	21° 24' 0" N
Daikoku	144° 11' 39" E	21° 15' 27" N
Ahyi	145° 11' 48" E	20° 26' 15" N
Maug	145° 13' 18" E	20° 1' 15" N
Alice Springs	144° 30' 0" E	18° 12' 0" N
Central trough	144° 45' 0" E	18° 1' 0" N
Zealandia	145° 51' 4" E	16° 52' 57" N
L. Diamante	145° 40' 47" E	15° 56' 31" N
Ruby	145° 34' 24" E	15° 36' 15" N
Esmeralda	145° 14' 45" E	14° 57' 37" N
NW Rota #1	144° 48' 30" E	14° 36' 0" N
W Rota	144° 50' 0" E	14° 15' 30" N
Forecast	143° 55' 12" E	13° 23' 30" N
Seamount X	144° 1' 0" E	13° 14' 48" N
South Backarc	143° 37' 8" E	12° 57' 17" N
Archaean site	143° 37' 55" E	12° 50' 23" N
Pika site	143° 36' 55" E	12° 55' 7" N
Toto	143° 31' 42" E	12° 42' 48" N

Sources:
NOAA Coral Reef Conservation Program
NMFS Coral Reef Ecosystem Division
NESDIS NGDC
NOS/CCMA Biogeography Branch
OAR Pacific Marine Environmental Lab

-10000 m
-8000 m
-6000 m
-4000 m
-2000 m

★ Active Hydrothermal Submarine Volcanoes

Trench Unit (59,732 nm²)

Islands Unit (12,388 nm²)

EEZ

[FR Doc. E9–496

Filed 1–9–09; 8:45 am]

BILLING CODE 4310–10–C

Secretarial Order

THE SECRETARY OF THE INTERIOR
WASHINGTON

ORDER NO. 3284, ***Amendment No. 2*** *(Amended material italicized and in bold)*

Subject: Delegation of Management Responsibility for the Pacific Remote Islands Marine National Monument, Rose Atoll Marine National Monument, and the Marianas Trench Marine National Monument

Sec. 1 **Purpose**. Secretary's Order 3284***,*** *as amended****,*** is further amended to delegate the Secretary of the Interior's (Secretary) management responsibilities for the Monuments established under the four Proclamations cited in Section 2, and to provide new management directions with respect thereto*,* to the Director of the United States Fish and Wildlife Service (Service).

Sec. 2 **Background**. On January 6, 2009, the President issued Presidential Proclamations 8335, 8336 and 8337, and on September 25, 2014, Presidential Proclamation 9173 (Proclamations), collectively establishing the Pacific Remote Islands Marine National Monument, the Pacific Remote Islands Marine National Monument Expansion (Monument Expansion)*,* Rose Atoll Marine National Monument, and the Marianas Trench Marine National Monument (Monuments). While these Monuments include unique scientific and historic features that warrant their protection by the President under the Antiquities Act, (54 U.S.C. 320301), they also include some of the most unique and diverse terrestrial and marine habitat on earth, supporting numerous species of corals, fish, shellfish, marine mammals, water birds, land birds, insects, and vegetation, many of which are threatened or endangered. In each of these Proclamations the President directed that the Secretary of the Interior assume specific management responsibilities*,* in consultation with the Secretary of Commerce*,* at each Monument. The President further directed that the Secretary of Commerce, through the National Oceanic and Atmospheric Administration (NOAA) has primary management responsibility for fishery-related activities within certain areas of the Monuments and the entirety of the Monument Expansion.

Within the boundaries of the Monuments, the Service currently administers ***the following*** National Wildlife Refuges: Baker, Howland, and Jarvis Islands; Palmyra Atoll; ***Wake Atoll;*** Kingman Reef; Johnston Atoll; ***Mariana Trench, Mariana Arc of Fire;*** and Rose Atoll.

Sec. 3 **Authority**. This Order is issued pursuant to the following authorities:

a. Presidential Proclamations 8335, 8336, and 8337, dated January 6, 2009, and 9173, dated September 25, 2014;

b. Section 2 of Reorganization Plan No. 3 of 1950 (64 Stat. 1262), as amended;

c. The Fish and Wildlife Act of 1956, 16 U.S.C. 742a**, as amended**;

d. The National Wildlife Refuge System Administration Act of 1966, as amended, 16 U.S.C. 668dd-ee; and

e. 16 U.S.C. 460k-3.

Sec. 4 **Delegation**. The responsibilities given the Secretary by the President over the emergent and submerged lands and waters of the Monuments are delegated through the Assistant Secretary for Fish and Wildlife and Parks (Assistant Secretary) to the Director of the Service, to be administered subject to the specific provisions of this section as set out below.

a. For each of the areas subject to this delegation, the Director of the Service shall provide for the proper care and management of the Monument**s**, including all objects of scientific and historic interest therein; the conservation of fish and wildlife; and the development of programs to assess and promote national and international monument-related scientific exploration and research.

b. In exercising management authority over these areas of the Monuments, the Director of the Service shall consult, as appropriate, with the National Park Service, the U.S. Geological Survey, and other appropriate Bureaus and Offices of the Department, to draw upon their respective expertise with respect to marine science and encourage these Bureaus and Offices to undertake coordinated research and educational projects therein.

Sec. 5 **Management and Administration**.

a. Pacific Remote Islands Marine National Monument and Monument Expansion.

(1) Howland Island, Baker Island and Jarvis Island Units. The Director shall manage the emergent and submerged lands and waters of the Howland, Baker, and Jarvis Islands units of the Pacific Remote Islands Marine National Monument and the waters and submerged lands of the Jarvis Island unit of the Monument Expansion as units of the National Wildlife Refuge System.

(2) Palmyra Atoll Unit. The Director shall manage the emergent and submerged lands and waters of the Palmyra Atoll unit of the Pacific Remote Islands Marine National Monument as a unit of the National Wildlife Refuge System*,* except that those areas subject to the exclusions defined in Secretary's Order 3224 of January 18, 2001, shall remain in the Office of Insular Affairs, subject to the terms of that Order. The Director shall continue to manage Palmyra Atoll, including the area out to 12 nautical miles from such mean low water line subject to Secretary's Order 3224.

(3) Kingman Reef Unit. The Director shall manage the emergent and submerged lands and waters of the Kingman Reef unit of the Pacific Remote Islands Marine National Monument as a unit of the National Wildlife Refuge System. The Director shall

continue to manage Kingman Reef, including the area out to 12 nautical miles from such mean low water line, subject to the provisions of Secretary's Order 3223 of January 18, 2001.

(4) Johnston Atoll Unit. The Director shall manage the emergent and submerged lands and waters of the Johnston Atoll unit of the Pacific Remote Islands Marine National Monument and the waters and submerged lands of the Johnston Atoll unit of the Monument Expansion as units of the National Wildlife Refuge System. However, those portions of the emergent lands at Johnston Atoll that are currently under the administrative jurisdiction of the Department of the Air Force will continue to be managed by the Air Force until such administrative jurisdiction is terminated, at which time those emergent lands shall be administered as part of the expanded wildlife refuge.

(5) Wake Island Unit. The Director shall manage the emergent and submerged lands and waters of the Wake Island unit of the Pacific Remote Islands Marine National Monument and the waters and submerged lands of the Wake Island unit of the Monument expansion as units of the National Wildlife Refuge System. The Director shall manage the emergent and submerged lands and waters of Wake Island out to 12 nautical miles from such mean low water lines as a unit of the National Wildlife Refuge System; except in accordance with Proclamation No. 8336, the Director shall not commence management of the emergent lands at Wake Island, and the Department of the Air Force shall continue to manage such emergent lands, according to the terms and conditions of the Agreement between the Secretary of the Air Force and the Secretary of the Interior, unless and until such agreement is terminated.

b. Rose Atoll Marine National Monument. The Director shall manage the emergent and submerged lands and waters out to 50 nautical miles from the mean low water line at Rose Atoll as the Rose Atoll Marine National Monument. The Director shall continue to manage the existing wildlife refuge at Rose Atoll within the boundaries set forth in the Notice of Establishment, 71 F.R. 13183 (April 5, 1974). Those areas beyond such mean low water line for which NOAA has primary management responsibility for fishery-related activities ***shall be*** included in the National Wildlife Refuge System and which, consistent with Proclamation 8337, ***will continue to be*** administered by NOAA as the Muliāva Unit of the National Marine Sanctuary of American Samoa.

c. The Marianas Trench Marine National Monument. The Director shall manage the "Trench Unit"***, "Islands Unit",*** and the "Volcanic Unit" of the Marianas Trench Marine National Monument as ***units of the National Wildlife Refuge System, subject to the provisions of the proclamation establishing*** this Monument. ***The Director's continued management of the "Islands Unit," shall be subject to the terms of the November 29, 2016 Patent transferring certain submerged lands within the "Islands Unit" to the government of the Commonwealth of the Northern Mariana Islands, and the September 2016 Agreement referenced in that Patent.***

Sec. 6 **Expiration Date**. This amended Order is effective immediately. It will remain in effect until amended, superseded, or revoked.

Secretary of the Interior

Date: **September 11, 2023**

Lands Transfer Patent

The United States of America
To all to whom these presents shall come, Greeting:

WHEREAS, the submerged lands surrounding the islands of Farallon de Pajaros (Uracas), Maug, and Asuncion in the Commonwealth of the Northern Mariana Islands (CNMI), which include lands permanently or periodically covered by tidal waters up to but not above the line of mean low tide and seaward to a line three geographical miles distant from the coastlines of each of these islands, which were included in the Marianas Trench Marine National Monument (Monument), established by Presidential Proclamation 8335 of January 6, 2009, pursuant to Section 2 of the Antiquities Act of June 8, 1906 (now codified at 54 U.S.C. 320301);

WHEREAS, the CNMI Constitution recognizes that the islands of Maug, Uracas, Asuncion, Guguan, and other islands specified by law shall be maintained as uninhabited places and used only for the preservation and protection of natural resources, including but not limited to bird, wildlife, and plant species;

WHEREAS, pursuant to Public Law 93-435, as amended by Public Law 113-34 (taken together, the Act), "the submerged lands adjacent to the islands of Farallon de Pajaros (Uracas), Maug, and Asuncion permanently covered by tidal waters up to the mean low water line and extending three geographical miles seaward from the mean high tide line" (Excepted Lands) were excepted from conveyance to CNMI by Presidential Proclamation 9077 (Proclamation), of January 15, 2014, by virtue of the authority vested in the President of the United States by Section 1(b)(vii) of the Act;

WHEREAS, Proclamation 9077 included a provision allowing the Secretary of the Interior to subsequently transfer the Excepted Lands to CNMI under Section 1(b) of the Act, at such time as the Secretary of the Interior, the Secretary of Commerce, and the Government of CNMI have entered into an agreement for the coordination of management that ensures the protection of the Monument within the area to be conveyed (Agreement), and that such Agreement has now been entered into;

NOW THEREFORE, KNOW YE, that the UNITED STATES, in consideration of the premises, and in conformity with said Acts and Presidential Proclamations, HAS GIVEN AND GRANTED, and by these presents DOES GIVE AND GRANT unto the Government of CNMI, the Excepted Lands; TO HAVE AND TO HOLD the same, together with all the rights, privileges, immunities, and appurtenances, of whatsoever nature, thereunto belonging, unto the same Government of CNMI, its successors and assigns, forever; and,

EXCEPTING AND RESERVING TO THE UNITED STATES:
An Easement in perpetuity for the United States to ensure that the Excepted Lands, and the resources associated with such lands and as set forth herein, herewith conveyed to the Government of CNMI are forever managed and maintained for the protection of the Monument or other Federal conservation status, unless such conservation status is withdrawn hereafter by an Act of Congress. The Grantor and Grantee (Parties) shall be bound by the terms of said Reserved Easement in that:

1. The Excepted Lands and associated natural resources shall be managed and maintained by the Government of CNMI consistent with the Monument or other Federal conservation status of the adjacent Federal submerged lands. In doing so, the Government of the CNMI shall not authorize or allow commercial fishing or development on such lands or in the navigable waters overlaying such lands.

2. Nothing in this Easement shall be construed to limit the rights of (a) the Government of CNMI to manage sustenance, recreational, and traditional indigenous fishing in such area as a sustainable activity; (b) the Government of CNMI to conduct or to authorize third parties to undertake bona fide scientific research in such area; (c) the Government of CNMI and the Departments of the Interior and Commerce for coordinated management as set forth in the Agreement or any successor to the Agreement then in effect; or (d) the reserved rights of the United States set forth in the Act. In addition, nothing in this Easement shall be construed or applied to require the Government of CNMI to manage or maintain a more protective conservation regime with respect to the Excepted Lands and associated natural resources than that regime authorized by applicable Federal law for the adjacent Federal submerged lands and associated natural resources.

3. After advance notice to the Government of CNMI, persons duly authorized by the Secretary of the Interior or the Secretary of Commerce shall be allowed reasonable access to the area covered by this easement to ensure compliance with its terms.

4. If a dispute arises between the Parties concerning the interpretation or operation of this Reserved Easement, either Party may request mediation by providing the other Party with written notice of such request. Neither Party is obligated to enter mediation. Nevertheless, if the Parties mutually agree to enter mediation, the Parties shall attempt to agree upon a single mediator, and the cost of mediation shall be borne by the United States Government, subject to the availability of funds. Any efforts at mediation shall conclude within ninety (90) days after the written notice, unless the Parties mutually agree to extend the time period for the mediation.

5. The United States expressly reserves the right to enforce the provisions of this Reserved Easement in any court of competent jurisdiction.

IN TESTIMONY WHEREOF, the undersigned Secretary of the Interior, in the name of the United States, caused these letters to be made Patent, and the Seal of the Department to be hereunto affixed.

GIVEN under my hand, in the CITY OF WASHINGTON, DISTRICT OF COLUMBIA the 29 day of November in the year of our Lord two thousand and sixteen and of the Independence of the United States the two hundred and thirty-eighth.

By Sally Jewell

IN TESTIMONY WHEREOF, the undersigned Governor of the Northern Mariana Islands, in the name of the Commonwealth of the Northern Mariana Islands, accepts these letters to be made Patent.

GIVEN under my hand, on the ISLAND OF SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS the 21st day of December in the year of our Lord two thousand and sixteen.

By _____.

Patent Number 2016-1

MEMORANDUM OF AGREEMENT
between
the Commonwealth of the Northern Mariana Islands and
the U.S. Department of Commerce and
the U.S. Department of the Interior
for
Coordination of the Management of the
Marianas Trench Marine National Monument's Submerged Lands Located Adjacent to the Islands of Farallon De Pajaros, Maug, and Asuncion

This Memorandum of Agreement ("MOA") is entered into by and between the Commonwealth of the Northern Mariana Islands ("the CNMI" or "Commonwealth") Government, the United States Department of Commerce, and the United States Department of the Interior, to establish an agreement for the coordination of management, consistent with Proclamations 8335 and 9077, of submerged lands located adjacent to the islands of Farallon de Pajaros, Maug, and Asuncion, that the United States intends to convey to the CNMI Government.

RECITALS

WHEREAS, on January 6, 2009, Proclamation 8335 established the Marianas Trench Marine National Monument (Monument) (Figures 1-5) for the purpose of protecting the submerged volcanic areas of the Mariana Ridge; the marine environment around the islands of Farallon de Pajaros (Uracas), Maug, and Asuncion in the CNMI; and the Mariana Trench; and

WHEREAS, Proclamation 8335 sets forth the purposes and management regime for the Monument, and restricts and prohibits certain activities in the Monument; and

WHEREAS, Proclamation 8335 directs the Secretary of Commerce, through the National Oceanic and Atmospheric Administration (NOAA), and the Secretary of the Interior, to manage the Monument pursuant to applicable legal authorities and in consultation with the Secretary of Defense; and

WHEREAS, the Secretary of the Interior has delegated management authority for the Monument to the U.S. Fish and Wildlife Service (USFWS); and

WHEREAS, Proclamation 8335 directs the Secretaries of Commerce and the Interior to prepare management plans for the proper care and management of the objects identified in the Proclamation and to treat the CNMI Government as a cooperating agency; and

WHEREAS, on September 18, 2013, by Public Law 113-34, Congress enacted an amendment to Public Law 93-435, the Territorial Submerged Lands Act of 1974, as amended (referred to hereafter as "TSLA"), to convey to the CNMI Government certain submerged lands and associated mineral rights permanently or periodically covered by tidal waters up to but not above the line of mean high tide, located seaward to a line three geographical miles distant from the coastlines of the CNMI; and

WHEREAS, on January 15, 2014, pursuant to section 1(b)(vii) of the TSLA, Proclamation 9077 excepted from the conveyance certain submerged lands adjacent to the islands of Farallon de Pajaros, Maug, and Asuncion (the "Northern Islands Submerged Lands"); and

WHEREAS, on January 16, 2014, and March 13, 2014, respectively, the United States conveyed to the CNMI (1) by operation of law, the submerged lands identified in the Act and not excepted by Proclamation 9077, and (2) by patent, the mineral rights associated with those submerged lands; and

WHEREAS, Proclamation 9077 also recognized the authority of the Secretary of the Interior under the TSLA to convey the excepted lands to CNMI when the Secretaries of Commerce and the Interior, and the CNMI Government entered into an MOA for coordination of management that ensures the protection of the Monument within the Northern Islands Submerged Lands; and

NOW, THEREFORE, in view of the above recitals, the Government of the Commonwealth, the Department of Commerce, and the Department of the Interior (the "Signatories") enter into this MOA to establish the terms and conditions for the coordination of management of the Northern Islands Submerged Lands and subsequent to its execution, the Secretary of the Interior will continue the process to convey the Northern Islands Submerged Lands and associated mineral rights to the CNMI. This MOA shall be subject to the following terms and conditions.

I. Purpose, Scope, Authorities, and Guiding Principles

1.1 Purpose

Recognizing the commitment herein of the CNMI Government to manage the conveyed submerged lands consistent with the purposes and requirements of Proclamations 8335 and 9077, the purpose of this MOA is to provide a cooperative framework for the coordination of resource management to ensure the long-term, comprehensive conservation and protection of the Monument within the Northern Islands Submerged Lands. This MOA establishes functional relationships, processes, and general terms and conditions under which the Signatories will cooperate to effectively coordinate management of the Monument within the Northern Islands Submerged Lands.

1.2 Scope

The areas subject to this MOA are those within the boundary of the Northern Islands Submerged Lands—the submerged lands and associated waters adjacent to the islands of Farallon de Pajaros (Uracas), Maug, and Asuncion, identified in Proclamation 9077—which are part of the Islands Unit of the Monument (Figure 2). The boundaries of the Northern Islands Submerged Lands are contained in the Patent and shown in the attached maps (Figures 3-5). The boundaries of the Monument are described in Proclamation 8335 and shown in Figure 1.

1.3 Authorities

The Signatories are authorized to enter into and implement this MOA under various authorities including the following:

Antiquities Act, 54 USC 320301 et seq;

The Covenant to Establish a Commonwealth of the Northern Mariana Islands in Political Union with the United States of America, 48 U.S.C. § 1801 note;

The Commonwealth Constitution, Articles III and XIV;

Coastal Zone Management Act, 16 U.S.C. § 1451, et seq.;

Coral Reef Conservation Act, 16 U.S.C. § 6401, et seq.;

Endangered Species Act, 16 U.S.C. § 1531 et seq.;

Fish and Wildlife Act, 16 U.S.C. § 742;

Fish and Wildlife Coordination Act, 16 U.S.C. § 661 et seq.;

Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. §1801 et seq.;

Marine Mammal Protection Act, 16 U.S.C. § 1361, et seq.;

National Wildlife Refuge System Administration Act of 1966, as amended, 16 U.S.C. §§ 688dd-ee;

Proclamation 9077 (January 15, 2014), 79 Fed. Reg. 3479 (January 21, 2014);

Proclamation 8335 (January 6, 2009), 74 Fed. Reg. 1557 (January 12, 2009);

Refuge Recreation Act, 16 U.S.C. § 460k-3; and

Territorial Submerged Lands Act of 1974, as amended, 48 U.S.C. § 1705 et seq.

1.4 Guiding Principles

Upon conveyance by the United States of the Northern Islands Submerged Lands to the CNMI Government, the USFWS and NOAA agree to continue management responsibilities for the conveyed submerged lands, in consultation with the CNMI Government, until such time that the CNMI Government notifies in writing the other signatories of its intent to assume all or a portion of the management responsibilities of the conveyed submerged lands, and the effective date of such assumption. During this interim period, USFWS and NOAA will continue to consult with the CNMI Government on management of the conveyed submerged lands.

Upon assuming such management responsibilities, the CNMI Government agrees to manage the Northern Islands Submerged Lands, in coordination with NOAA and FWS, consistent with the purposes and requirements of Proclamations 8335 and 9077, the Commonwealth Constitution, other applicable laws, and provisions of the Patent, and, in a manner that:

A. Preserves and protects natural resources, including, but not limited to bird, wildlife, and plant species as required by Section 2 of Article XIV of the Commonwealth Constitution;

B. Recognizes that the Monument is a place of maritime cultural significance for the Chamorro and Carolinian residents with cultural connections throughout the Mariana Islands by managing, to the extent compatible with the conservation and management goals of Proclamation 8335, the Monument resources within the Northern Islands Submerged Lands in a manner that honors the unique heritage of the indigenous cultures;

C. Provides protections for resources when there is uncertainty regarding impacts of activities that are to be permitted in the Northern Islands Submerged Lands;

D. Prohibits the appropriation, injury, destruction, or removal of any Monument object or resource within the Northern Islands Submerged Lands area, except as may be allowed under Proclamation 8335;

E. Permits scientific exploration and research within the Monument in a manner consistent with Proclamation 8335;

F. Permits sustenance, recreational, and traditional indigenous fishing in a sustainable fashion consistent with Proclamation 8335 and applicable laws;

G. Prohibits commercial fishing and mineral extraction;

H. Adopts best practices for an adaptive management approach that incorporates conservation management strategies, scientific principles, and traditional ecological knowledge;

I. Considers scientific exploration, research advances, and technology to learn about and develop greater understanding of the Monument objects and resources;

J. Enhances public appreciation of the unique character and environment of the Monument, and promotes conservation management of these areas through outreach and education activities;

K. Establishes effective monitoring of and enforcement for permitted activities;

L. Allows for innocent passage in the Northern Islands Submerged Lands and does not otherwise restrict navigation, overflight, and other internationally recognized lawful uses of the sea; and

M. Maintains consistency with provisions of Proclamation 8335 regarding actions of the Armed Forces and international law and the provisions of Sec. 2 of the TSLA (48 U.S.C. 1706).

II. Management Officials

2.1 The Government of the Commonwealth of the Northern Mariana Islands

The CNMI Government's management functions under this MOA shall be carried out by designees from: (1) the Department of Land and Natural Resources; and (2) the Bureau of Environmental and Coastal Quality.

2.2 The U.S. Department of Commerce

The Department of Commerce's management functions under this MOA shall be carried out by a designee from NOAA's National Marine Fisheries Service, Pacific Islands Regional Office.

2.3 The U.S. Department of the Interior

The Department of the Interior's management functions under this MOA shall be carried out by a designee from the USFWS, Pacific Islands Refuges and Monuments Office.

2.4. Management Officials

The designees under sections 2.1, 2.2, and 2.3 shall be collectively referred to as the "Management Officials."

III. Coordination of Management

3.1 General Coordination of Management

A. The Signatories will coordinate management of the Northern Islands Submerged Lands in accordance with the Guiding Principles set forth in Section 1.4, applicable legal authorities, and this article. The Parties to this MOA agree to utilize their respective authorities to carry out the purposes and requirements of this MOA.

B. Management Officials will ensure that the jurisdictional responsibilities of each Signatory are respected and maintained, while endeavoring to (1) reduce duplication of effort; (2) streamline processes for public use and involvement when it is advantageous to the protection of Monument objects and resources and logistically feasible; and (3) capitalize upon the authorities, strengths, and capabilities of the Signatories' programs to further the conservation management of the Monument as directed by Proclamation 8335.

C. Each Management Official will endeavor to provide reasonable advance notice to the other Management Officials prior to conducting activities supporting Monument purposes in the Northern Islands Submerged Lands area. Nothing in this MOA shall be construed to alter, diminish, or enlarge any rights, powers of regulation, or control over lands and navigable waters reserved to the United States by the Constitution or Federal law. To the maximum extent practicable, NOAA and USFWS will also provide the CNMI Government with reasonable notice and an opportunity to participate in all scientific research either agency conducts in the Northern Islands Submerged Lands area. At the conclusion of such research, Management Officials will share all data to the extent allowed by law.

D. As directed by Proclamation 8335, NOAA and USFWS shall prepare a Monument Management Plan (MMP) for the proper care and management of the objects identified in the Proclamation and invite the CNMI Government to participate as a cooperating agency in developing the plan.

3.2 Monument Management Plan ("MMP")

A. The Secretaries of Commerce and the Interior will incorporate into the MMP provisions for coordination of management in protecting the coral reef ecosystems and related marine, cultural and historic resources, and objects of historic or scientific interest of the Monument.

B. Consistent with Proclamation 8335, the MMP currently in preparation includes provisions addressing:

(1) Management of the Islands Unit, in consultation with the CNMI, including designation of specific roles and responsibilities and the means for consultations on management decisions as appropriate, consistent with the respective authorities of the CNMI Government and Secretaries of Commerce and the Interior;

(2) Public education and outreach programs about coral reef ecosystems and other Monument resources and species, and efforts to conserve them;

(3) Traditional access by indigenous persons for culturally significant subsistence, cultural and religious purposes;

(4) A program to assess and promote Monument-related scientific exploration and research, tourism, and recreational and economic activities and opportunities in the CNMI;

(5) A mechanism to permit recreational fishing as a sustainable activity consistent with the purposes, terms and objectives of Proclamation 8335, upon consideration of the best scientific information available; and

(6) Programs for monitoring and enforcement to ensure scientific exploration and research, tourism, and recreational and economic activities do not degrade Monument coral reef ecosystems or related marine resources and species, or diminish the Monument's natural character.

3.3 Dispute Resolution

The Management Officials shall cooperate with each other in good faith and make reasonable efforts to carry out the provisions of this MOA. The Management Officials agree to respect the authorities, jurisdictions, and views of the respective parties and to make all efforts to keep an open mind when a dispute arises. If a dispute arises as to whether a proposed action is consistent with this MOA, Management Officials will first have an informal discussion of the matter with particular focus on the Guiding Principles of this MOA. If the Management Officials cannot reach a resolution, the following procedure shall apply.

A. The proponent of the proposed action shall prepare a written "opening statement" on the proposed action and provide a copy of the statement to the other Management Officials. The opening statement shall specifically address whether the proposed action is consistent with Proclamations 8335 and 9077, CNMI sovereignty, the MMP, the CSLMP, and any other relevant authority, laws and regulations; any relevant economic, cultural, historical, or recreational factors that will be affected by the proposed action; and the impact the proposed action may have on conservation efforts.

B. If Management Officials concur with the opening statement then the proponent may proceed with the proposed action.

C. If a Management Official does not concur with the opening statement or the proposed action in general, the official shall prepare a written "opposition statement" and provide a copy of it to the other Management Officials within 7 days of receipt of the

opening statement. The opposition statement shall specifically address whether the proposed action is inconsistent with Proclamations 8335 or 9077, CNMI sovereignty, the MMP, the CSLMP, and any other relevant authority, laws and regulations; any relevant economic, cultural, historical, or recreational factors that would be affected by the proposed action; and the impact the proposed action may have on conservation efforts.

D. The Management Officials shall convene a special meeting within 7 days of receipt of the opposition statement(s) to discuss the proposed action. The Management Officials shall consider Proclamations 8335 and 9077 and any other relevant authority, laws and regulations, the MMP, and the CSLMP; the economic, cultural, historical, and recreational factors that will be affected by the proposed action; and the impact the proposed action may have on conservation efforts and furthering the goals and objectives of Proclamation 8335. If they cannot agree, the respective management officials will forward the dispute to the NOAA Administrator, Director of the U.S. Fish and Wildlife Service, and the Governor of CNMI. If these officials are unable to promptly reach a unanimous decision, the agencies will make their decisions, which will be the final agency action for purposes of the issue in dispute.

E. A Management Official or Signatory may call for a mutually agreed upon third party to be brought in at any stage of the dispute resolution process to help facilitate an agreement. The cost of mediation shall be shared equally between the Secretary of Commerce, the Secretary of the Interior, and the CNMI Government.

F. Nothing in this section or in this MOA in general, shall constitute authority for any proponent to undertake activities in the Northern Islands Submerged Lands that are inconsistent with Proclamations 8335 and 9077, any Patent issued by the Secretary of the Interior in furtherance of this MOA, or applicable law and regulations.

IV. Conveyance of Submerged Lands

4.1 Upon execution of this MOA, the Secretary of the Interior will continue the process provided under sections 1(b) and (c) of the TSLA to transfer the Northern Islands Submerged Lands (as described above) and associated mineral rights to the CNMI Government. The transfer shall be accomplished by the execution of a Patent.

V. Period of MOA, Modification, or Termination

5.1 Term

The MOA is effective when signed by all of the Signatories and shall remain in effect unless terminated under section 5.3.

5.2 Review and Modification

The Signatories may modify this MOA by written amendment with the concurrence of all Signatories. The Signatories shall review the MOA every 10 years and make amendments as needed to promote the conservation of the Northern Islands Submerged Lands, consistent with Proclamation 8335.

5.3 Termination

Any Party may terminate this MOA after providing 30-day advance written notice to the other Parties. Termination of this MOA shall not affect the enforcement of rights in, access to, or use of the Northern Islands Submerged Lands, including as provided in any Patent issued by the Secretary of the Interior pursuant to the TSLA.

VI. General Conditions

6.1 Consistent with Federal and CNMI Laws

A. Nothing in this MOA shall be construed to supersede or otherwise diminish authorities vested in the Signatories under applicable Federal laws or the laws of the CNMI Government. Any such conflicting term in this MOA shall be given no effect by the Signatories, but the remainder of the MOA shall remain in effect.

B. If a term is nullified due to conflict with law, the Signatories shall immediately review the MOA and determine whether action (including, but not limited to, an amendment) is necessary to address the nullification of the term.

6.2 No Financial Obligation

A. This MOA defines in general terms the basis on which the Signatories will cooperate, and as such, does not constitute a financial obligation or an authorization for particular expenditures. Expenditures of funds, human resources and technical expertise are intended to be provided by each signatory to the extent that their participation is authorized by law and resources are available.

B. Nothing in this MOA is intended to require the expenditure of funds in excess or advance of applicable appropriations. This MOA is not a fiscal or funds obligation document. Any activities involving reimbursement or contribution of funds between Signatories to the MOA will be handled in accordance with applicable laws, regulations, and procedures.

6.3 Counterparts

This MOA may be executed in any number of counterparts, each of which will be deemed an original, but all of which when taken together will constitute one and the same instrument. The signature page of any counterpart may be detached therefrom without impairing the legal effect of the signature(s) thereon, provided such signature page is attached to any other counterpart identical thereto except having additional signature pages executed by other parties to this MOA attached thereto.

VII. CNMI Legal Certification

I hereby certify that this agreement has been reviewed and approved as to form and legal capacity for the Commonwealth of the Northern Mariana Islands.

9-23-16

Attorney General, Commonwealth of the Northern Mariana Islands — Date

VIII. Co-signers

By signing below, each Party's representative is affirming his or her authorization to bind that Party to the terms and conditions of this MOA.

9/22/16

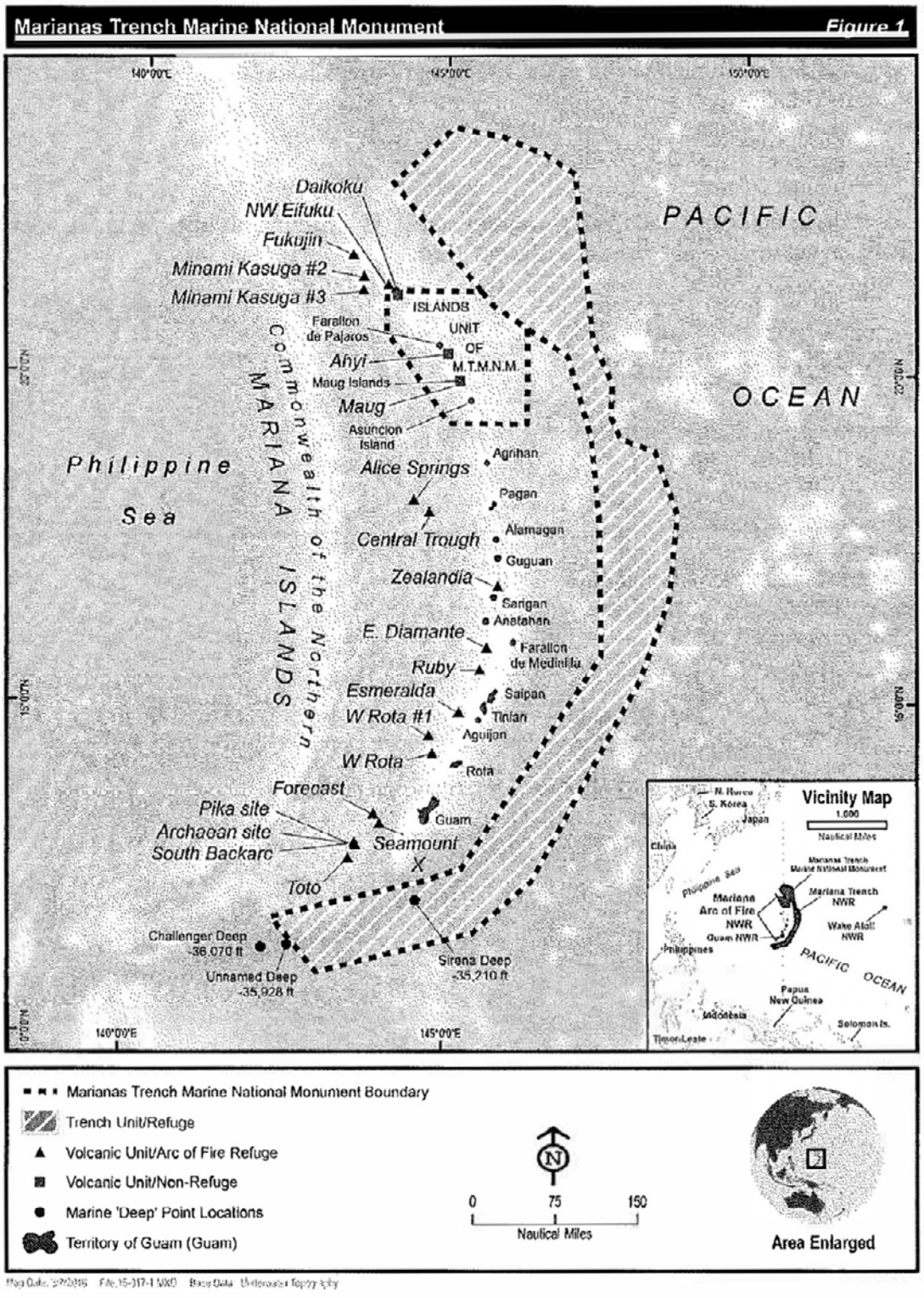
Ralph Deleon Guerrero Torres — Date
Governor
Commonwealth of the Northern Mariana Islands

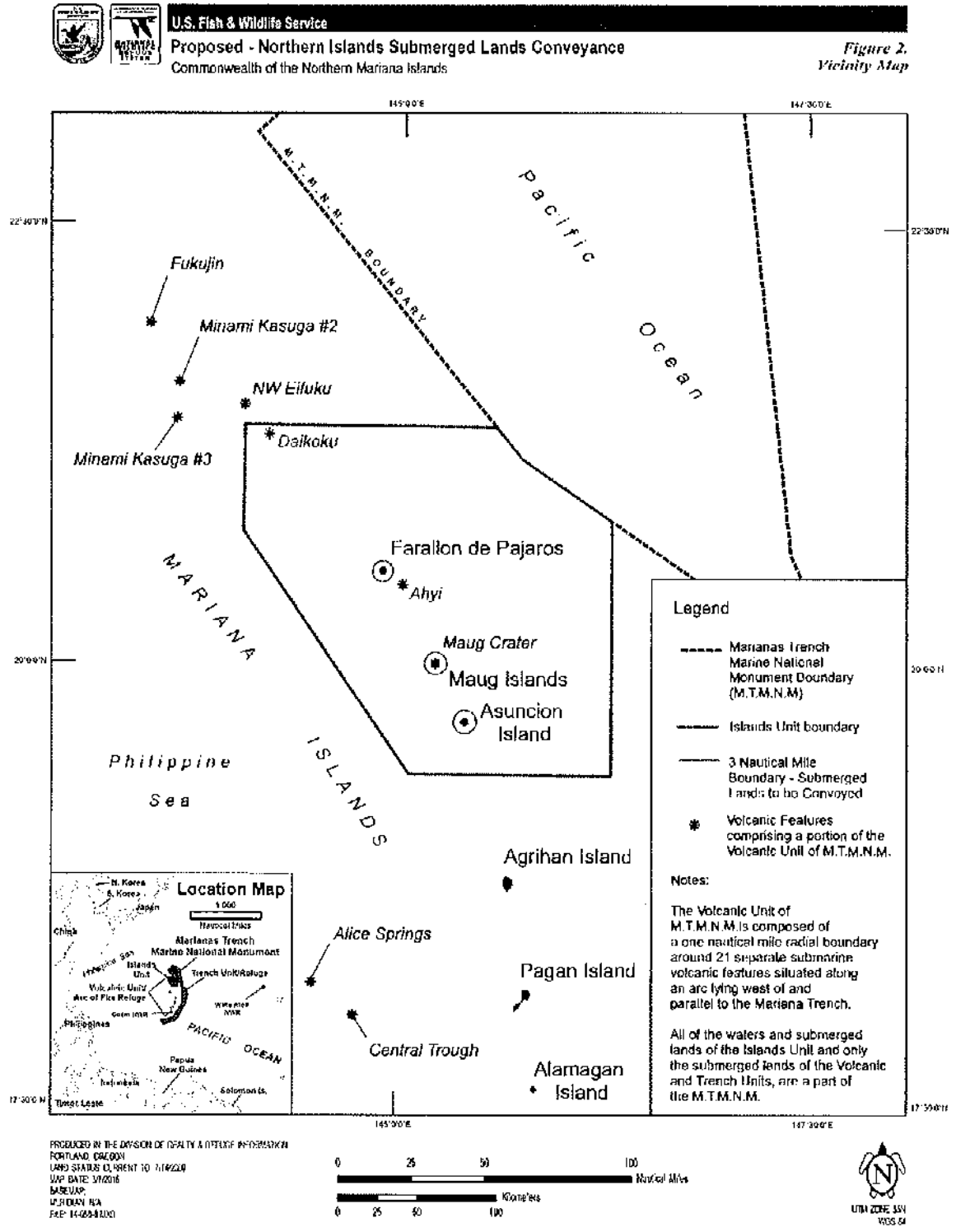
9/22/2016

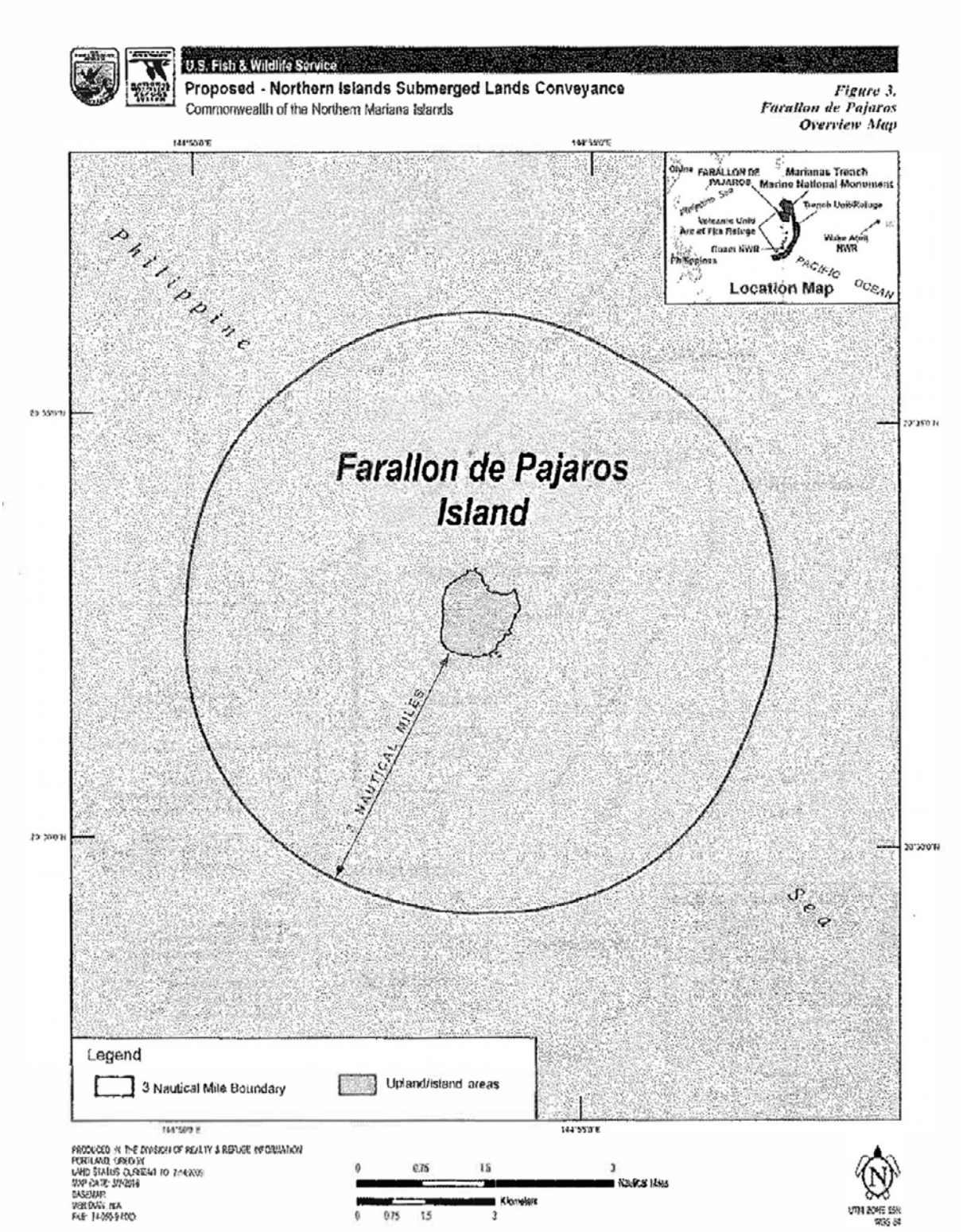
Eileen Sobeck — Date
Assistant Administrator for Fisheries
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

9/22/16

Lori Faeth — Date
Deputy Assistant Secretary for Policy and International Affairs
U.S. Department of the Interior


Marianas Trench Marine National Monument
Figure 1
PACIFIC
OCEAN
Philippine
Sea
Commonwealth of the Northern
MARIANA
ISLANDS
Daikoku
NW Eifuku
Fukujin
Minami Kasuga #2
Minami Kasuga #3
ISLANDS
UNIT
OF
M.T.M.N.M.
Farallon de Pajaros
Ahyi
Maug Islands
Maug
Asuncion Island
Alice Springs
Central Trough
Zealandia
E. Diamante
Ruby
Esmeralda
W Rota #1
W Rota
Forecast
Pika site
Archaean site
South Backarc
Seamount X
Toto
Challenger Deep
-36,070 ft
Unnamed Deep
-35,928 ft
Sirena Deep
-35,210 ft
Agrihan
Pagan
Alamagan
Guguan
Sarigan
Anatahan
Farallon de Medinilla
Saipan
Tinian
Aguijan
Rota
Guam
140°00'E
145°00'E
150°00'E
Vicinity Map
Japan
Philippines
Marianas Trench Marine National Monument
Marianas Trench NWR
Mariana Arc of Fire NWR
Guam NWR
Wake Atoll NWR
PACIFIC OCEAN
Papua New Guinea
Indonesia
Solomon Is.
Timor-Leste
Marianas Trench Marine National Monument Boundary
Trench Unit/Refuge
Volcanic Unit/Arc of Fire Refuge
Volcanic Unit/Non-Refuge
Marine 'Deep' Point Locations
Territory of Guam (Guam)
0
75
150
Nautical Miles
Area Enlarged


U.S. Fish & Wildlife Service
Proposed - Northern Islands Submerged Lands Conveyance
Commonwealth of the Northern Mariana Islands
Figure 2.
Vicinity Map
M.T.M.N.M. BOUNDARY
Pacific
Ocean
Fukujin
Minami Kasuga #2
NW Eifuku
Minami Kasuga #3
Daikoku
Farallon de Pajaros
Ahyi
Maug Crater
Maug Islands
Asuncion Island
MARIANA
ISLANDS
Philippine
Sea
Agrihan Island
Alice Springs
Pagan Island
Central Trough
Alamagan Island
Location Map
Marianas Trench Marine National Monument
Islands Unit
Trench Unit/Refuge
Volcanic Unit/ Arc of Fire Refuge
PACIFIC OCEAN
Legend
Marianas Trench Marine National Monument Boundary (M.T.M.N.M)
Islands Unit boundary
3 Nautical Mile Boundary - Submerged Lands to be Conveyed
Volcanic Features comprising a portion of the Volcanic Unit of M.T.M.N.M.
Notes:
The Volcanic Unit of M.T.M.N.M.is composed of a one nautical mile radial boundary around 21 separate submarine volcanic features situated along an arc lying west of and parallel to the Mariana Trench.
All of the waters and submerged lands of the Islands Unit and only the submerged lands of the Volcanic and Trench Units, are a part of the M.T.M.N.M.
Nautical Miles
Kilometers
UTM ZONE 55N
WGS 84


U.S. Fish & Wildlife Service
Proposed - Northern Islands Submerged Lands Conveyance
Commonwealth of the Northern Mariana Islands
Figure 3.
Farallon de Pajaros
Overview Map
Location Map
Marianas Trench
Marine National Monument
FARALLON DE PAJAROS
Philippine Sea
PACIFIC OCEAN
Farallon de Pajaros Island
3 NAUTICAL MILES
Sea
Legend
3 Nautical Mile Boundary
Upland/island areas
Nautical Miles
Kilometers

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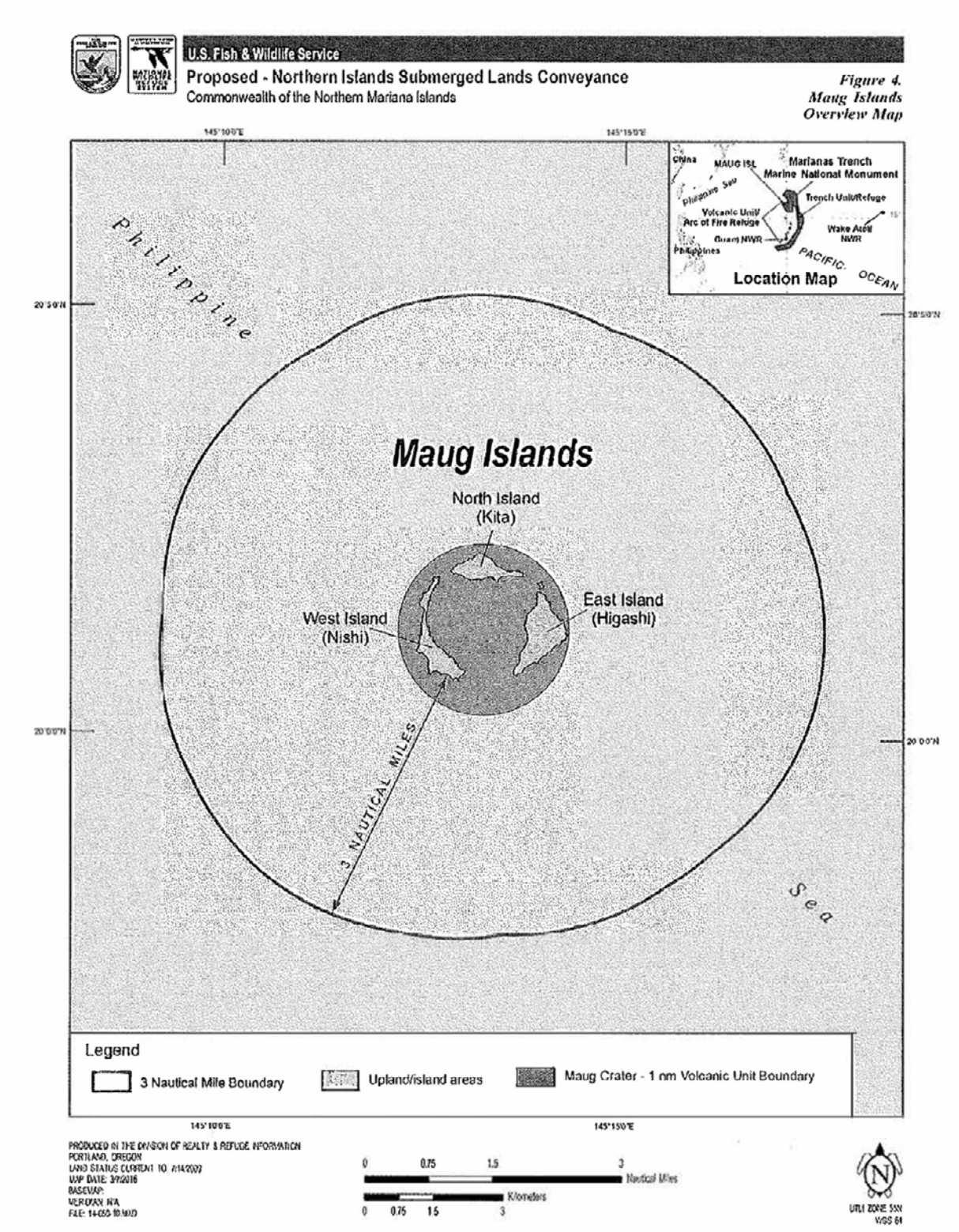
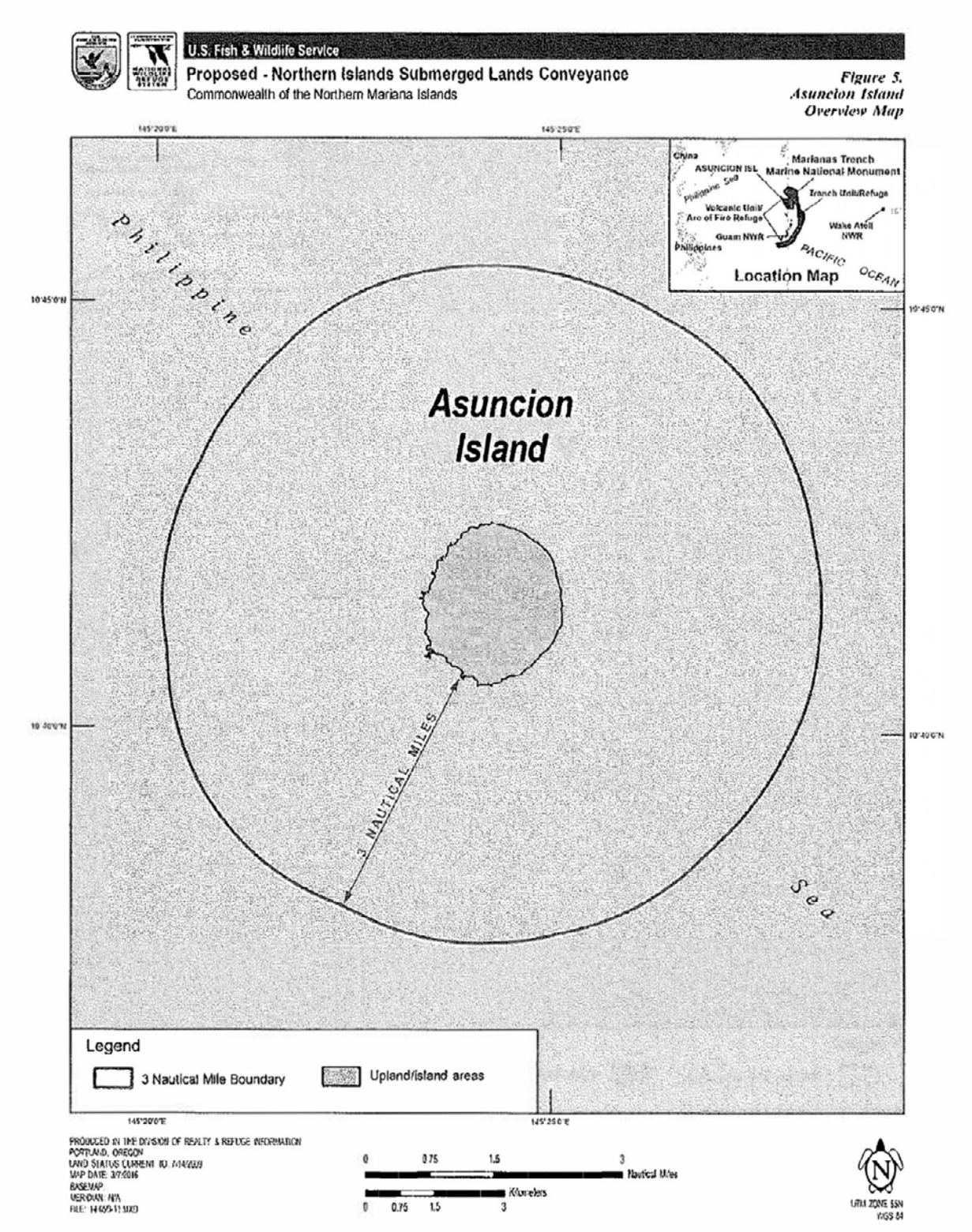

U.S. Fish & Wildlife Service
Proposed - Northern Islands Submerged Lands Conveyance
Commonwealth of the Northern Mariana Islands
Figure 4.
Maug Islands
Overview Map
Location Map
Marianas Trench
Marine National Monument
Trench Unit/Refuge
Volcanic Unit/
Arc of Fire Refuge
Guam NWR
Wake Atoll
NWR
MAUG ISL
China
Philippine Sea
Philippines
PACIFIC
OCEAN
Philippine
Maug Islands
North Island
(Kita)
West Island
(Nishi)
East Island
(Higashi)
3 NAUTICAL MILES
Sea
Legend
3 Nautical Mile Boundary
Upland/island areas
Maug Crater - 1 nm Volcanic Unit Boundary
145°10'0"E
145°15'0"E
20°5'0"N
20°0'0"N
PRODUCED IN THE DIVISION OF REALTY & REFUGE INFORMATION
PORTLAND, OREGON
LAND STATUS CURRENT TO 7/14/2003
MAP DATE: 3/9/2016
BASEMAP:
VERIDIAN WA
FILE: 14-055 10.MXD
0 0.75 1.5 3
Nautical Miles
Kilometers
0 0.75 1.5 3
N
UTM ZONE 55N
WGS 84


U.S. Fish & Wildlife Service
Proposed - Northern Islands Submerged Lands Conveyance
Commonwealth of the Northern Mariana Islands
Figure 5.
Asuncion Island
Overview Map
145°20'0"E
145°25'0"E
10°45'0"N
10°40'0"N
Philippine Sea
Asuncion Island
3 NAUTICAL MILES
Sea
China
ASUNCION ISL
Marianas Trench
Marine National Monument
Philippine Sea
Trench UnitRefuge
Volcanic Unit/
Arc of Fire Refuge
Wake Atoll
NWR
Guam NWR
Philippines
PACIFIC
OCEAN
Location Map
Legend
3 Nautical Mile Boundary
Upland/island areas
PRODUCED IN THE DIVISION OF REALTY & REFUGE INFORMATION
PORTLAND, OREGON
LAND STATUS CURRENT AS OF 7/14/2009
MAP DATE: 3/7/2016
BASEMAP:
MERIDIAN: N/A
FILE: 14-099-11.MXD
0 0.75 1.5 3
Nautical Miles
Kilometers
0 0.75 1.5 3
N
UTM ZONE 55N
WGS 84

F-34

Appendix G. Mariana Trench Monument Advisory Council

Charge Document

Mariana Trench Monument Advisory Council

The purpose of the advisory council document is to specify the committee's mission or charge and general operational characteristics (not membership behavior).

1. **Council's Official Designation –** Mariana Trench Monument Advisory Council (MTMAC)
2. **Authority.** The MTMAC is organized as directed by Presidential Proclamation 8335, establishing the Mariana Trench Marine National Monument (Monument). The MTMAC is exempt from provisions of the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C. App. 2, as an intergovernmental committee, in accordance with 41 CFR Part §102-3.40 (g).
3. **Objectives and Scope of Activities –** The objectives of the MTMAC shall be for each member to provide intergovernmental advice and recommendations on the development of management plans and management of the Monument. The scope of the MTMAC is solely to exchange individual member's views, information, or advice relating to the management planning or implementation of Federal programs established pursuant to statute, that explicitly or inherently share intergovernmental responsibilities or administration.
4. **Description of Duties –** MTMAC members shall provide advice and recommendations to the Department of the Interior (DOI) through the U.S. Fish & Wildlife Service (USFWS) and the Department of Commerce (DOC), through the National Oceanic and Atmospheric Administration (NOAA). Recommendations on overall management of the Monument will be made to USFWS, and advice and recommendations on fisheries-related activities in the Islands Unit of the Trench Monument shall be provided to NOAA Fisheries Service. USFWS and NOAA will consult with each other on their management. The MTMAC will adopt such procedures as it deems necessary to govern its activities.
5. **Agency or Official to Whom the Committee Reports –** The MTMAC members will provide advice on Monument management to the USFWS Monument Superintendent and to the NOAA Fisheries Service, Pacific Monuments Program Manager.
6. **Support.** Each participating agency in the MTMAC shall be responsible for the expenses of its representative and the Departments of the Interior and Commerce shall be equally responsible for the costs of the Advisory Council.
7. **Designated Federal Officer (DFO) –** The USFWS Monument Superintendent, Mariana Trench MNM, or his/her appointed designee shall serve as the DFO for the MTMAC, in consultation with NOAA. The NOAA Pacific Monuments Program Manager shall be an alternate DFO for the MTMAC. The DFO will work in cooperation with NOAA to approve or call all of the advisory committee's meetings, prepare and approve all meeting agendas and minutes, attend all meetings, adjourn any meeting when determined adjournment to be in the public interest, and chair meetings when directed to do so by the USFWS official to whom the MTMAC reports.
8. **Estimated Number and Frequency of Meetings –** The MTMAC shall meet in person at least once per fiscal year and may schedule additional teleconference or video conference meetings approximately every four months, or as deemed necessary by the DFO. The frequency of meetings needed will be reconsidered every three years.

9. **Duration –** The MTMAC shall exist for the duration of development and implementation of the Monument Management Plan.

10. **Termination –** The MTMAC may be terminated following completion of the Mariana Trench Monument Management Plan, if agreed to by the DOI/USFWS and DOC/NOAA, in consultation with the CNMI Government.

11. **Membership and Designation –** The MTMAC shall consist of three officials of the Government of the Commonwealth of the Northern Mariana Islands and one representative each from the Department of Defense and the United States Coast Guard. Members of the MTMAC will be appointed for a term of 3 years in accordance with provisions of Presidential Proclamation 8335. Additional MTMAC membership may be considered upon MTMAC recommendation to DOI/USFWS and DOC/NOAA Officials. Recognizing there may be times when MTMAC members won't be available for scheduled MTMAC meetings, an alternate for each MTMAC member shall be named by the respective government entity (CNMI, DOD, and USCG). Alternates are required to complete the same vetting and appointment process as primary representatives. The designation of an approved alternate must be in writing and presented to the Chairperson at any time before the commencement of a MTMAC scheduled meeting. Alternates must be fully briefed and be prepared to provide their government's advice, and will have equal delegated authorities as the primary member from the respective governmental entity.

12. **Subcommittees –** The MTMAC DFO has the authority to create subcommittees. Any subcommittees developed must report back to the MTMAC, and must not provide advice or work products directly to the USFWS or NOAA.

13. **Record-Keeping –** Records of the MTMAC, formally and informally established subcommittees, or other subgroups of the committee, shall be documented and reported to the USFWS and NOAA MTMAC representatives. These records shall be available for public inspection and copying, subject to the Freedom of Information Act, 5 U.S.C. 552.

Appendix H. Acronyms and Abbreviations

Administration Act	National Wildlife Refuge System Administration Act
Arc of Fire Refuge	Mariana Arc of Fire National Wildlife Refuge
BMPs	best management practices
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CNMI	U.S. Commonwealth of the Northern Mariana Islands
DLNR	CNMI Department of Land and Natural Resources
DOD	Department of Defense
DOI	Department of the Interior
DOS	Department of State
EA	Environmental Assessment
EARs	Ecosystem Acoustic Recorders
EEZ	Exclusive Economic Zone
E&R	Exploration and Research (action plan)
EBM	Ecosystem Based Management
EEZ	Exclusive Economic Zone
EMB	East Mariana Basin
EO	Presidential Executive Order
ESA	Endangered Species Act
FADs	fish aggregating devices
FEP	Fishery Ecosystem Plan
FOSC	Federal on Scene Coordinator
FRS	DLNR Fisheries Research Section
GHG	greenhouse gas
IATA	International Air Transport Association
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
JTMD	Japan Tsunami Marine Debris
kn	knots

LCPW	Lower Circumpolar Pacific Water
LE	Law Enforcement
LiDAR	Light Detection and Ranging (a remote sensing method)
LME	Large Marine Ecosystems
MARAMP	Marianas Archipelago Rapid Assessment and Monitoring Program
MIACP	Marianas Islands Area Contingency Plan
MIS	Marine Invasive Species (action plan)
MMCT	Monument Management Coordination Team
MMP	Monument management plan
MMPA	Marine Mammal Protection Act
Monument	Marianas Trench Marine National Monument
MOU	Memorandum of Understanding
MPA	marine protected area
MRCM	Marine Resources Conservation and Monitoring (action plan)
MSA	Magnuson-Stevens Act
MTMAC	Mariana Trench Monument Advisory Council
NEC	North Equatorial Current
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966
NISL	Northern Islands Submerged Lands
nmi	nautical miles
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Ocean and Atmospheric Administration
NOC	National Ocean Council
NOS	National Ocean Service
NPCC	North Pacific Counter Current
NPDW	North Pacific Deep Water
NRDA	Natural Resource Damage Assessment
NRF	National Response Framework
NWR	National Wildlife Refuge

NWRS	National Wildlife Refuge System
OAR	Office of Oceanic and Atmospheric Research
OIA	Office of Insular Affairs
OLE	Office of Law Enforcement
OPA	DOS Office of Oceans and Polar Affairs
PIFSC	Pacific Islands Fisheries Science Center
PIFWO	Pacific Islands Fish and Wildlife Office
PIRO	Pacific Islands Region Office
PRiMO	Pacific Risk Management ‘Ohana
Proclamation	Presidential Proclamation 8335
ROV	remotely operated vehicles
SAE	Surveillance and Enforcement (action plan)
SCC	Subtropical Counter Current
SFD	Sustainable Fisheries Division
SHPO	State Historic Preservation Officer
SLR	sea level rise
SNF	Sustainable Noncommercial Fishing (action plan)
SPREP	Pacific Regional Environmental Programme
SUP	Special Use Permit
T&E	threatened and endangered
Trench Unit/Refuge	Mariana Trench National Wildlife Refuge
TZCF	transition zone chlorophyll front
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VMS	vessel monitoring systems
WMB	West Mariana Basin
WPFMC	Western Pacific Fishery Management Council

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Appendix I. Mandates

I.1 Acts of Congress

America COMPETES Act of 2007 – directs Federal agencies to invest in innovation through research and development, and to improve the competitiveness of the United States.

Antiquities Act of 1906 – provides the basis for U.S. management of national marine monuments. This law gives the President of the United States the authority to, by Presidential Proclamation, restrict the use of particular public land owned by the Federal government.

Archeological and Historic Preservation Act of 1974 – requires Federal agencies provide for "... the preservation of historical and archeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of ... any alteration of the terrain caused as a result of any Federal construction project of federally licensed activity or program."

Clean Water Act of 1972 – establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

Coastal Zone Management Act of 1972 – provides for the management of the nation's coastal resources to preserve, protect, develop, and where possible, to restore or enhance the resources of the Nation's coastal zone.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 – provides broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

Coral Reef Conservation Act of 2000 – enacted to preserve coral reef ecosystems; to promote the wise management and sustainable use; to develop sound science on the condition of coral reef ecosystems and the threats to such ecosystems; to support conservation programs; and to provide financial resources.

Endangered Species Act of 1973 – the basis for U.S. conservation of species that are endangered or threatened with extinction throughout all or a significant portion of their range and the conservation of the ecosystems on which they depend.

Federal Ocean Acidification Research and Monitoring Act of 2009 – outlines a coordinated process for federal agencies to create a plan for effective monitoring of processes and consequences of ocean acidification on marine organisms and ecosystems. Agencies are required to develop adaptation strategies to conserve ecosystems vulnerable to the effects of ocean acidification.

Lacey Act of 1900 – prohibits trade in wildlife, fish, and plants that have been illegally taken, possessed, transported, or sold. It also regulates the introduction of birds and other animals to places where they have never existed before.

Magnuson-Stevens Fishery Conservation and Management Act of 1976 – the basis for U.S. management of fisheries within the EEZ, this act was adopted to create a U.S. fishery conservation zone out to 200 nautical miles off the U.S. coast; to phase out foreign fishing activities within this zone; to prevent overfishing; to allow overfished stocks to recover; and to conserve and manage fishery resources. It has since been amended several times, most recently in 2006.

Mandatory Ballast Water Management Program for U.S. Waters (2004) – protects U.S. waters against the unintentional introduction of nonindigenous species via ballast water discharges.

Marine Debris Research, Prevention, and Reduction Act of 2006 – established programs to help identify, determine sources of, assess, reduce, and prevent marine debris and its adverse impacts on the marine environment and navigation safety.

Marine Mammal Protection Act of 1972 – prohibits the taking of marine mammals, and enacts a moratorium on the import, export, and sale of any marine mammal, along with any marine mammal part or product within the United States.

Marine Plastic Pollution Research and Control Act of 1987 – aims to reduce the amount of garbage—both plastics and other persistent wastes—that ships dump into the oceans. It also prohibits all ships from dumping plastics into the sea.

Marine Protection, Research, and Sanctuaries Act of 1972 (aka the Ocean Dumping Act) **–** the basis for U.S. management of dumping of materials into the ocean. The Act regulates the ocean dumping of all material beyond the territorial limit (3 miles from shore) and prevents or strictly limits dumping material that would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities.

Migratory Bird Treaty Act of 1918 – The original 1918 statute implemented the 1916 Convention between the U.S. and Great Britain (for Canada) for the protection of migratory birds. Later amendments implemented treaties between the United States and Mexico, the United States and Japan, and the United States and the Soviet Union (now Russia) for the protection of migratory birds.

National Environmental Policy Act of 1969 – requires Federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions.

National Historic Preservation Act of 1966 – requires Federal agencies to evaluate the impact of all federally funded or permitted projects on historic properties (buildings, archaeological sites, etc.) through a process known as Section 106 Review.

National Wildlife Refuge System Administration Act of 1966 – provides for the conservation of fish, wildlife, plants, and their habitats within the Refuge System and ensures that the biological integrity, diversity, and environmental health of the Refuge System are maintained.

National Wildlife Refuge System Improvement Act of 1997 – The Administration Act was amended by the Improvement Act. The Improvement Act includes a unifying mission for all national wildlife refuges, a new process for determining compatible uses on refuges, and a requirement that each refuge will be managed under a CCP developed in an open public process.

Refuge Recreation Act of 1962 – authorized the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. The Act provides for public use fees and permits, and penalties for violation of regulations.

Shark Conservation Act of 2010 – prohibits any person from cutting the fins of a shark at sea and from possessing, transferring, and landing shark fins (including the tail) that are not naturally attached to the corresponding carcass. In addition, the Act prohibits any person from landing a shark carcass without its corresponding fins being naturally attached.

Vessel Incidental Discharge Act of 2018 – establishes new responsibilities for the USCG to enforce EPA performance standards for marine pollution control devices (both equipment and management practices) that control discharges incidental to the normal operation of a vessel. The Act retains authority of the Secretary of Interior to regulate discharge on areas under DOI jurisdiction.

Volunteer and Community Partnership Enhancement Act of 1998 – directs the USFWS to promote volunteer programs, facilitate nonfederal partnerships, and encourage donations by organizations for the benefit of national wildlife refuges. Congress reauthorized the Act in 2004 and again in 2010, affirming its desire to involve Americans as stewards of the Nation's natural resources and wildlife. Refuge Friends groups are authorized by this Act.

Whale Conservation and Protection Study Act of 1976 – directs the Secretary of Commerce to conduct comprehensive studies of all whales found in waters subject to the jurisdiction of the United States.

I.2 Executive Orders

Executive Order 12372 – Intergovernmental Review of Federal Programs. Structures the federal government's system of consultation with state and local governments on its decisions involving grants, other forms of financial assistance, and direct development.

Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. All Federal actions must address and identify, as appropriate, disproportionally high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Indian Tribes in the United States.

Executive Order 13112 – Invasive Species – established the National Invasive Species Council. The Executive Order requires that a Council of Departments dealing with invasive species be created. Currently, there are 13 Departments and Agencies on the Council.

Executive Order 13166 – Improving Access to Services for Persons with Limited English Proficiency – requires Federal agencies to ensure that written materials routinely provided in English also are provided in regularly encountered languages other than English, identify any need for services to those with limited English proficiency (LEP), and develop and implement a system to provide those services so LEP persons can have meaningful access to them.

Executive Order 13653 – Preparing the United States for the Impacts of Climate Change – enacted to prepare the Nation for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience. The EO outlines Federal agency responsibilities in the areas of supporting climate resilient investment; managing lands and waters for climate preparedness and resilience; providing information, data, and tools for climate change preparedness and resilience; and planning.

Executive Order 13840 – Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States – enacted on June 19, 2018. The order established an Ocean Policy Committee and delineates seven policy priorities: 1) coordinating departments' ocean management; 2) promoting the lawful use of the ocean; 3) exercising rights and jurisdiction over the ocean; 4) facilitating economic growth; 5) ensuring that policies do not prevent the sustainable use of the marine ecosystems; 6) modernizing the attainment and use of best available science; and 7) facilitating collaboration among government entities, industry, the science community, and other stakeholders.

Executive Order 14096 – Revitalizing Our Nation's Commitment to Environmental Justice for All – signed April 21, 2023. This EO establishes the policy to pursue a whole-of-government approach to environmental justice and directs the federal government to address inequities in environmental hazards through community engagement, interagency coordination, advancement in science, data, and research.

I.3 International Treaties

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – an international treaty to prevent species from becoming endangered or extinct because of international trade. Under this treaty, countries work together to regulate the international trade of animal and plant species and ensure that this trade is not detrimental to the survival of wild populations.

Convention on the Conservation of Migratory Species of Wild Animals (more commonly abbreviated to the Convention on Migratory Species [CMS]) **–** aims to conserve terrestrial, marine, and avian migratory species throughout their range. It is an intergovernmental treaty concerned with the conservation of wildlife and habitats on a global scale.

International Convention on the Protection of Submarine Cables – The Convention was concluded at Paris on March 14, 1884, ratified by the United States in 1885, and entered into force on May 1, 1888. It is currently in force for 36 States Parties, including the United States, who are obligated by its terms to protect submarine cables. The coastal State is obliged to permit the laying of cables and pipelines on the floor of its submerged lands, but it can impose conditions as to the route to be followed, to prevent undue interference with the natural resources of the seabed and subsoil.

Law of the Sea Treaty – defines the rights and responsibilities of nations in their use of the world’s oceans and establishes guidelines for businesses, the environment, and the management of marine natural resources. Although the United States now recognizes the treaty as a codification of customary international law, it has not ratified it.