

Coral reef condition:
A status report for the

PACIFIC REMOTE ISLANDS

2018



NOAA
CORAL REEF
CONSERVATION PROGRAM



CORAL REEFS ARE IMPORTANT

Healthy coral reefs are among the most biologically diverse, culturally significant, and economically valuable ecosystems on Earth. They are **nursery grounds for fish and other organisms**, provide **food and jobs for people**, and **protect coasts against erosion** around the world.

The U.S. Pacific Remote Islands encompass seven islands and atolls scattered across the central Pacific Ocean that represent relatively pristine, beautiful, and wild coral reef ecosystems. Howland, Baker, and Jarvis Islands are geographically situated near the equator. Kingman Reef and Palmyra Atoll are north of Jarvis Island, and Wake Atoll and Johnston Atoll are farther north and west of Kingman Reef.

Each of the islands has a different land area, reef area, and population (see figure below). In general, the **Pacific Remote Islands** are just that—remote, **relatively unimpacted islands with diverse coral and fish populations and low human influence**. The condition of the reefs can be used as a baseline from which to draw conclusions about potential impacts, such as coral bleaching, overfishing, and climate change. These islands present an opportunity to study how sea level rise, ocean acidification, and warming waters affect coral reefs in the absence of substantial human influence.

Biodiversity is a measure of the variety of living organisms. High biodiversity of corals, fish, and other organisms helps keep the ecosystem in balance and makes it resilient to environmental impacts. Although we measure biodiversity, the science is not yet mature enough to score biodiversity in an area. As the science and analysis progress, we will look to include biodiversity scores in future status reports.



Coral and fish on the reef at Baker Island. Photo: Kevin Lino (NOAA PIFSC).

ISLAND	BAKER	HOWLAND	JARVIS	KINGMAN	PALMYRA	JOHNSTON	WAKE
Relative Shape and Size Coral reef							
Land Area (mi ²)	0.77	0.77	1.5	0	0.77	1.16	2.7
Seafloor Area 0-100 ft (mi ²)	1.5	1.16	1.5	18.5	20.5	74.9	7.3
Reef Area 0-100 ft (mi ²)	1.5	0.77	1.5	14.3	16.2	36.3	5.0
Seafloor Area 100-500 ft (mi ²)	0.77	0.77	1.16	14.3	3.5	18.9	1.16
Monument Area (mi ²)	19,945		121,655	20,658		170,830	157,447
Population	0	0	0	0	4-25	0	100
Ecological Grouping	Equatorial Upwelling Island	Equatorial Upwelling Island	Equatorial Upwelling Island	Central Transition Island	Central Transition Island	Northernmost Oligotrophic Island	Northernmost Oligotrophic Island
Island Chain	Phoenix Islands	Phoenix Islands	Line Islands	Line Islands	Line Islands	Line Islands	Marshall Islands

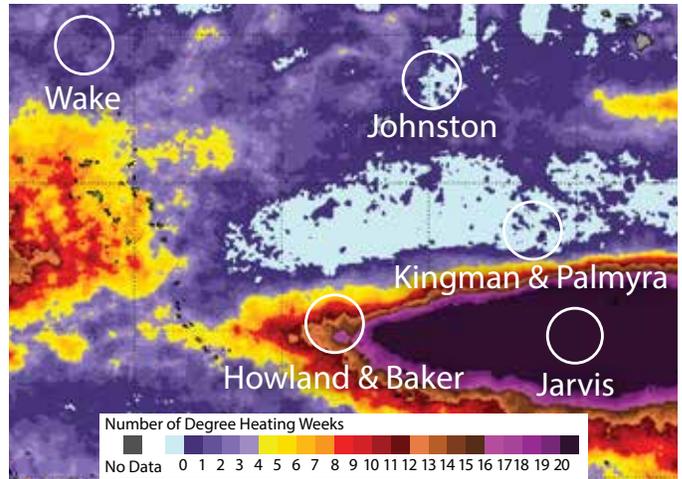
The key attributes of each of the islands. Figure adapted from *Coral reef ecosystems of the Pacific Remote Islands Marine National Monument: A 2000–2016 overview* by the NOAA Pacific Islands Fisheries Science Center.

REEFS ARE UNDER THREAT

Coral reefs are sensitive ecosystems that thrive when conditions are right—warm, clear, shallow waters that contain low nutrients. However, factors at both local and global scales can disrupt these conditions. For the Pacific Remote Islands, the main threat is global climate change including warming waters that lead to coral bleaching and ocean acidification that leads to slower coral growth. Another threat is illegal fishing by international fishing boats. While not a current threat, some islands were used for military exercises in the past and have highly altered landscapes.

The extreme isolation of reefs in the Pacific Remote Islands and the low elevation of their islets/atolls make them easy targets for ship groundings. Grounded vessels can physically reduce large areas of healthy reef to rubble when they run aground. In addition, shifts from healthy hard-coral-dominated reefs to those dominated by fleshy algae, cyanobacterial mats, and corallimorphs (black reefs) have been linked to iron leaching from wrecks. Recent shipwreck extraction projects on Palmyra Atoll and Kingman Reef have been successful at safely removing several grounded vessels, though at great monetary expense (\$5.5 million). Current efforts are focused on methods of eradicating black reef from affected areas and restoring hard corals.

Management of the Pacific Remote Islands has had positive outcomes due to their protected status. However, the scale and scope of the islands, their remoteness, and limited resources and staff presents challenges to management.



Bleached coral at Jarvis Island (top). Photo: Nadiera McCarthy. The Degree Heating Week map during the 2016 El Niño event shows very bad conditions in Jarvis (bottom). Figure: NOAA.



Left to right: Johnston Atoll was used as a Chemical Agent Disposal System, U.S. Army Chemical Materials Agency. Shipwrecks in Palmyra Atoll, Thierry Work (USGS). Workers remove a shipwreck from Palmyra Atoll, Susan White (USFWS).

WHAT YOU CAN DO TO HELP

Even though you probably won't visit the Pacific Remote Islands, there are things you can do to help protect this important place:



Educate yourself about coral reefs and the creatures they support.



Reduce energy use and your carbon footprint.



Support initiatives to preserve and protect coral reefs.



CORALS & ALGAE



CLIMATE

Corals & algae make up the base of the coral reef ecosystem, providing food and shelter for fish, shellfish, and marine mammals. The five indicators for corals & algae are:

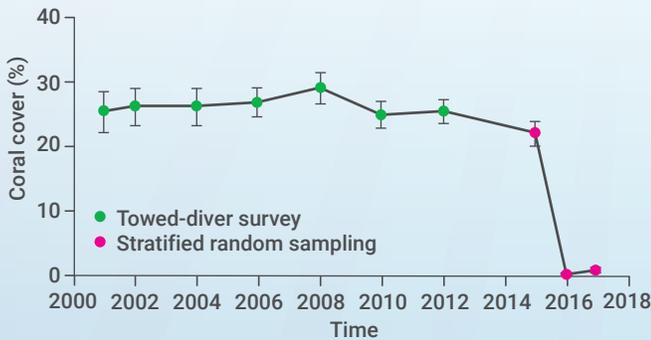
- **Coral reef cover**, which includes corals, algae, and crustose coralline algae.
- **Coral populations**, a measure of the population's ability to reproduce and sustain itself.
- **Herbivory**, a measure of the level of grazing pressure by fish on corals and algae.
- **Mortality**, which measures the amount of recently dead coral.
- **Diversity**, a measure of the number of different species of coral present.

Climate affects all components of a reef system, from the building blocks of coral to the reproductive success of fish. Climate change and ocean acidification influence reefs across the globe, but conditions vary at the regional and local level. The three climate indicators are:

- **Temperature stress**, which evaluates the frequency and severity of high temperature events.
- **Ocean acidification**, indicating if the water chemistry is suitable for the growth of corals and other calcifiers.
- **Reef material growth**, which directly measures the increase in reef skeletal material in a particular place.

Widespread and catastrophic coral mortality was reported at Jarvis Island in the aftermath of the exceptionally strong 2015–2016 El Niño warm event. Hard coral cover declined from 17.8% in April 2015 (pre-bleaching) to 0.31% in May 2016 (post-bleaching), representing a catastrophic decline of 98% across all coral taxa, reef habitats, and depths.

JARVIS CORAL COVER DECLINED



Coral cover on Jarvis declined due to climate change impacts. Photos: Paula Ayotte (NOAA), Cohen Lab (Woods Hole), & Bernardo Vargas-Angel (NOAA).

Climate change is having a large impact, even in these extremely remote islands. Hot water temperatures have caused coral bleaching and death, and ocean acidification can erode the reef. In the 2015–2016 El Niño, Jarvis Island experienced the greatest coral reef thermal stress recorded since the beginning of the satellite era (1985), leading to near-complete death of corals at Jarvis.

Even with these threats, the Pacific Remote Islands might have an ace up their sleeve. The remoteness and lack of current local impacts on the islands could increase the pace of their recovery. Since they are not stressed by land based sources of pollution, human population growth, industrial development, tourism pressure, and resource overuse, they could be better able to rebound after climate events.



Coral and fish at Palmyra Atoll (top). Photo: NOAA PIFSC. Palmyra Atoll is only lightly populated which could help it be more resilient to climate (bottom). Photo: Erik Oberg (Island Conservation).

PACIFIC REMOTE ISLANDS CORAL REEFS ARE IN GOOD CONDITION

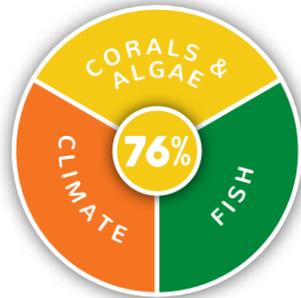
PACIFIC REMOTE ISLANDS

The Pacific Remote Islands are a group of unincorporated United States territories spread over hundreds of miles in the Pacific Ocean. They consist of three islands, three atolls, and one reef, which are each national wildlife refuges. These refuges make up the core of the Pacific Remote Islands Marine National Monument. The Pacific Remote Islands were divided into five sub-regions to evaluate condition of three categories—corals & algae, fish, and climate. There are no human connections indicators as the islands do not have permanent residents. Pacific Remote Islands coral reefs are in good condition overall. Benthic cover is lightly impacted, and coral populations are good. Fish are lightly impacted and are in very good condition. Climate is a major factor negatively affecting coral reefs around these islands and atolls; overall climate conditions are fair. Ocean acidification is severely impacting the islands, and conditions are impaired. Reef material growth is fair. These conditions show that the Pacific Remote Islands are lightly impacted, and overall the coral reefs on these islands are good. The key threat to the islands is climate change.



WAKE ATOLL

Wake Atoll is the westernmost atoll in the Pacific Remote Islands. Wake is one of the most isolated places in the world, consisting of 2.7 square miles of land and 2 square miles of lagoon. The atoll is administered by the United States military and has been impacted by military activities. Wake Atoll's coral reefs are in fair condition. While fish had a very good score, climate had an impaired score, and corals & algae had a fair score.



HOWLAND & BAKER ISLANDS

Howland and Baker are uninhabited islands just north of the equator in the central Pacific Ocean. The islands are 42 miles apart, and are in the Phoenix Islands group. Howland Island consists of 2.4 square miles of land, and Baker Island consists of 0.8 square miles of land. Both are surrounded by fringing reefs and have no lagoons. Howland and Baker Islands' coral reefs are moderately impacted. While corals & algae and fish had a good and very good score, respectively, climate had an impaired score. Temperature stress is a threat to these islands.



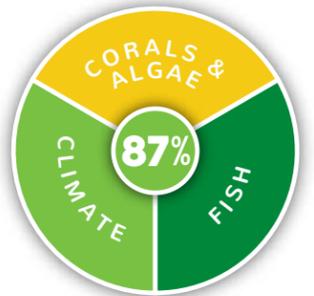
JOHNSTON ATOLL

Johnston Atoll is a deserted atoll in the North Pacific Ocean. The atoll consists of four islands, two natural and two artificial islands formed by coral dredging. The total land area is 1.03 square miles. There is a reef crest in the northwest portion of the atoll and a shallow lagoon. The atoll was used by the United States military in the past and has a history of chemical contamination and environmental degradation. Johnston Atoll's coral reefs are in good condition. This region had the lowest fish score of all the islands because sharks and other predators are slightly impacted, but the score is still good.



KINGMAN REEF & PALMYRA ATOLL

Kingman Reef and Palmyra Atoll are uninhabited areas 36 miles apart in the Line Islands of the Pacific Ocean. Kingman Reef consists of a triangular shaped reef 11 miles from east to west and 6 miles north to south, almost always completely submerged. Palmyra Atoll consists of about 50 islets, two lagoons, and an extensive reef. The areas of Kingman Reef and Palmyra Atoll are a coral reef conservation area and national wildlife refuge. Kingman Reef and Palmyra Atoll's coral reefs are in good condition. This region had the highest overall score of all the regions. This region also had the highest fish score (a perfect score) and the highest climate score.



JARVIS ISLAND

Jarvis Island is an uninhabited 1.75-square-mile coral island in the South Pacific Ocean. In the center of Jarvis is a dry lagoon, and the island is surrounded by fringing reefs. The island is located 25 miles south of the equator and is a National Wildlife Refuge. Jarvis Island's coral reefs are in an impaired condition. Fish are unimpacted and had a very good score. Serious coral bleaching events occurred in 2016 and 2017, resulting in high coral mortality. As a result the corals & algae score is critical and is the lowest for all the regions.



What do the scores mean?

90–100% Very good	80–89% Good	70–79% Fair	60–69% Impaired	0–59% Critical
All or almost all indicators meet reference values. Conditions in these locations are unimpacted, or minimally impacted or have not declined.	Most indicators meet reference values. Conditions in these locations are lightly impacted or have lightly declined.	Some indicators meet reference values. Conditions in these locations are moderately impacted or have declined moderately.	Few indicators meet reference values. Conditions in these locations are very impacted or have declined considerably.	Very few or no indicators meet reference values. Conditions in these locations are severely impacted or have declined substantially.

Insufficient data, not scored





FISH

Coral reefs serve as habitat and food for many fish species. These fish are important to the ecology of the reef.

The four indicators chosen for fish were:

- **Reef fish**, a measure of the amount of fish present.
- **Sustainability**, which is indicative of whether fishery stocks still have abundant large breeding-sized fishes.
- **Sharks and other predators**, a measure of the amount of fish that eat other fish.
- **Diversity**, a measure of the number of different types, or species, of fish present.

By virtue of their isolation from direct human impacts, reef fish communities are relatively intact. Unlike most reefs near human population centers, large roving predators such as gray reef sharks are a conspicuous presence in the Pacific Remote Islands. When that isolation is combined with high oceanic productivity, as occurs at Jarvis and others of the equatorial islands, reefs are able to support huge populations of reef fishes.



Abundant sharks and thick clouds of planktivores are indicative of healthy and highly productive reef systems. Photo: NOAA PIFSC.



Large schools of herbivores help maintain resilient reefs by controlling growth of reef algae that can otherwise inhibit coral settlement and growth. Photo: NOAA PIFSC.

HUMAN CONNECTIONS

While there are no Human Connections indicators in this status report, humans do have an impact on the Pacific Remote Islands. There are no permanent residents of these islands, but past and current use, including illegal fishing pressure, has an effect on reefs. Due to their remoteness, stopping illicit activities within the Pacific Remote Island Monument Exclusive Economic Zone (EEZ) is challenging. During a routine inspection of a foreign vessel in 2010, NOAA agents found evidence of illegal fishing activities in the Howland/Baker EEZ that were cleverly hidden from vessel tracking systems. This resulted in a \$5M settlement. Unauthorized entry (without illegal fishing) is also a problem due to the introduction of invasive species from ship hulls or ballast water.



The U.S. Coast Guard stops unauthorized ships and illicit activities. Photo: NOAA.

HUMPHEAD WRASSE

Humphead wrasse, which can grow to five feet long and live more than 30 years, are often prized fishery targets. As a consequence, their populations are significantly depleted in many areas. They are classified as endangered by the International Union for Conservation of Nature and are currently on the U.S. National Marine Fisheries Service's Species of Concern list. Protecting populations of these charismatic and impressive fishes is one important function of the Pacific Remote Islands Marine National Monument.

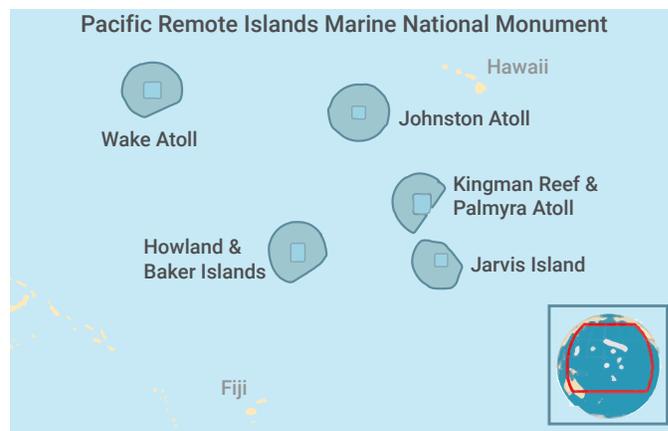


A humphead wrasse and two raccoon butterflyfish at Wake Atoll. Photo: Kevin Lino (NOAA).

MARINE NATIONAL MONUMENT

The Pacific Remote Islands Marine National Monument covers seamounts and deep sea corals to shallow coral areas with rich fish assemblages. Palmyra Atoll is the only refuge open for general public visitation (by special-use-permit only). The entire monument is closed to commercial fishing and other resource extraction activities, such as deep sea mining. Altogether, these areas create protection for exceptional levels of biomass and diversity. This is particularly evident in Kingman Reef, which has the greatest known fish biomass and apex predators of any coral reef ecosystem in the world. Seven National Wildlife Refuges are at the heart of the monument. Though the land mass area is relatively small, they are the only atolls found for thousands of miles, making them essential nesting sites and foraging areas for seabird colonies.

The importance and uniqueness of these islands were formally recognized via a presidential proclamation in 2009 that established the Marine National Monument, and a second proclamation in 2014 that expanded the marine monument to a total area of 370,000 square nautical miles (1,270,000 square kilometers). At almost twice the size of Texas, it is among the largest marine protected areas in the world. The monument designation provided additional levels of protection for the species and special ecosystems found within it.



The Monument spans 370,000 square nautical miles.

WHY A STATUS REPORT?

Effective coral reef conservation cannot be accomplished without an informed and engaged public. This status report is part of an ongoing series of documents to track the status and trends of coral reefs across the U.S. and its territories.

The Pacific Remote Islands coral status report is part of a larger effort to provide the public and decision-makers with information about managing and conserving coral reef ecosystems.

This status report provides a geographically specific assessment of Pacific Remote Islands coral reef condition for the period 2012–2016. Pacific Remote Islands were divided into five sub-regions based on data resolution, geographical features, and impacts to the ecosystem. Data were collected by NOAA's National Coral Reef Monitoring Program. For more detailed information on methodologies, indicators, thresholds, and grading, visit <http://www.coris.noaa.gov> (keyword: status reports).



Coral and fish at Wake Atoll. Photo: Kevin Lino (NOAA).

Status report working group

Rusty Brainard, Kauaoo Fraiola, Erick Geiger, Richard Hall, Adel Heenan, Heidi Hirsh, Justine Kimball, Arielle Levine, Ian Longer, Tom Oliver, Frank Parrish, Jason Philibotte, Bob Schroeder, Dione Swanson, Bernardo Vargas-Angel, Ivor Williams, & Chip Young.

For more information, visit coralreef.noaa.gov.

About this status report

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Cover photo on Kingman Reef by Kevin Gorospe (NOAA PIFSC).



University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE



The status report working group during the workshop in Honolulu, Hawai'i, January 2017.