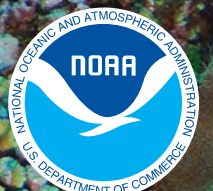


Coral reef condition:
A status report for
**PUERTO
RICO**

2020



NOAA
CORAL REEF
CONSERVATION PROGRAM

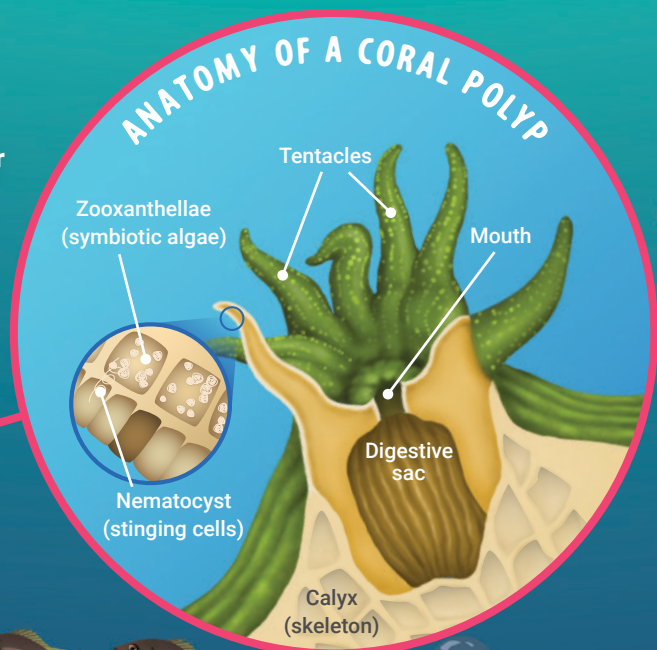


WHAT MAKES A CORAL REEF?

Corals are living, ocean-dwelling animals. Each individual coral exists as a colony consisting of multiple small, identical coral polyps. Wherever corals make up the foundation of an underwater habitat, a coral reef occurs. Coral reefs are complex marine ecosystems that include diverse collections of colorful fish and other sea creatures. But what is it that allows corals to grow and support so much wildlife?

1. ONE CORAL IS MADE OF MANY POLYPS

Polyps are the basic building block for all coral colonies. They are small, colorful, and essential for corals to grow, eat, reproduce, and recover if ever injured.



2. CORALS BUILD CORAL REEFS

Corals build their skeleton from calcium and carbonate in seawater. This skeleton not only gives corals their structure, but also provides the architecture for the coral reef overall.

3. CORAL REEFS PROVIDE FOOD AND SHELTER

With small animals seeking shelter in the coral—and herbivorous fish keeping corals clean of nuisance algae—corals lie at the heart of a complex food web system that allows marine life to thrive in a coral reef.

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 to track the status and trends of coral reefs across the U.S. and its territories. **The Puerto Rico coral reef status report is part of a larger effort to provide communities and decision-makers with information about managing and conserving coral reef ecosystems.**

This status report provides a geographically specific assessment of Puerto Rico coral reef conditions for the period 2014–2017. Data were collected by NOAA's National Coral Reef Monitoring Program (NCRMP). For more detailed information on methodologies, indicators, thresholds, and scoring, visit <http://www.coris.noaa.gov> (keyword: status report).

CORAL REEFS ARE IMPORTANT...

Coral reefs are among the most diverse ecosystems on earth and home to a wide variety of fish and marine invertebrates. Reefs are built by colonies of tiny reef-building coral polyps (see figure, facing page). Each polyp contains thousands of symbiotic algae called zooxanthellae. These symbiotic algae provide corals with food by converting sunlight into sugar via photosynthesis. In turn, the corals provide shelter for zooxanthellae. Because sunlight is critical to this cooperation, many tropical coral reefs occur in shallow coastal waters (<30m depth).

Coral reefs are an essential part of Puerto Rico's marine ecosystem. They reduce the intensity of breaking waves, working alongside mangroves, dunes, and seagrass beds to protect the coastline. Other reef creatures, like sponges, provide ecological services such as filtering seawater, which reduces bacteria concentrations and keeps coastal waters around the island cleaner and clearer.

Puerto Rico's reef fisheries are a significant economic and food resource, and coral reef-derived tourism generates nearly \$2 billion in income and regional domestic product. There are broad social, environmental, and financial benefits of healthy coral reefs for Puerto Rico. If reefs aren't healthy, the repercussions could be devastating.










AND THEY ARE UNDER THREAT

Coral reefs have the capacity to endure and recover from naturally-occurring climate-related events such as hurricanes, bleaching, and disease outbreaks. However, intensive human impacts have tested reef resilience. In Puerto Rico, deforestation, soil erosion, wastewater discharge, unsustainable fishing, pollution, recreational impacts, and seasonal natural disasters, have led to coral reef degradation.

While small-scale artisanal fishing has long been a part of life in Puerto Rico, more recent overfishing of targeted species has hurt coral reefs. The decline of large predators and herbivorous fish, along with poor water quality, can contribute to increased macroalgae. Macroalgae compete with corals for space and sunlight. When highly abundant, macroalgae overrun corals, and alter ecosystem and food web dynamics.

Warming waters due to climate change make corals more vulnerable to bleaching, a potentially lethal event where heat stress triggers corals to expel the zooxanthellae that provide their food. Degraded coral reefs are not as effective at protecting shorelines against hurricanes, nor can they adequately provide other ecosystem services, like habitat for fish and other animals.



Reef-building corals provide the foundational architecture for coral reefs . These colorful reefs provide critical habitat to a variety of commercially and ecologically important marine fishes and invertebrates . The abundance of marine resources and beauty sustain local economies  and enable eco-tourism . Their capacity to buffer intense wave energy  during severe weather makes coral reefs critical to disaster preparedness as well. Despite their importance, coral reefs are subject to degradation via pollution runoff from land  and overfishing . Warming water  due to climate change also makes Puerto Rico's corals more vulnerable to bleaching .

RESTORING OUR REEFS

On their own, reef-forming corals grow slowly. That's why in 2000, graduate students from the University of Puerto Rico received funding from the Sea Grant College Program to accelerate reef restoration using coral fragmentation. Living coral segments, fragmented from one individual, are capable of taking root and regenerating in the wild. The first project consisted of fragmenting staghorn corals (*Acropora cervicornis*) and transplanting segments to various reefs within La Parguera Natural Reserve. This approach to reef restoration has expanded into a network of coral nurseries in Puerto Rico, where dedicated teams cultivate juvenile corals before planting them on a reef. The nurseries are operated by public agencies, private enterprises, and nongovernmental organizations. So far, over 100,000 farmed corals have been planted to increase coral populations on Puerto Rico's reefs. Because juvenile mortality for farmed corals has been low in the wild, coral nurseries have helped reefs recover more quickly from both human impacts and natural disasters. This restoration also helps preserve the ecological services that coral reefs provide to Puerto Rico.



A submerged nursery of growing corals (top). A diver assesses recently planted corals (bottom). Photos: Hector Ruiz for HJR Reefscaping.

PREPARING FOR THE NEXT HURRICANE

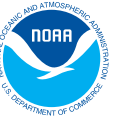


Scattered corals broken by 2017 hurricanes (left). A coral colony is reattached to the reef with cement (right). Photos: NOAA.

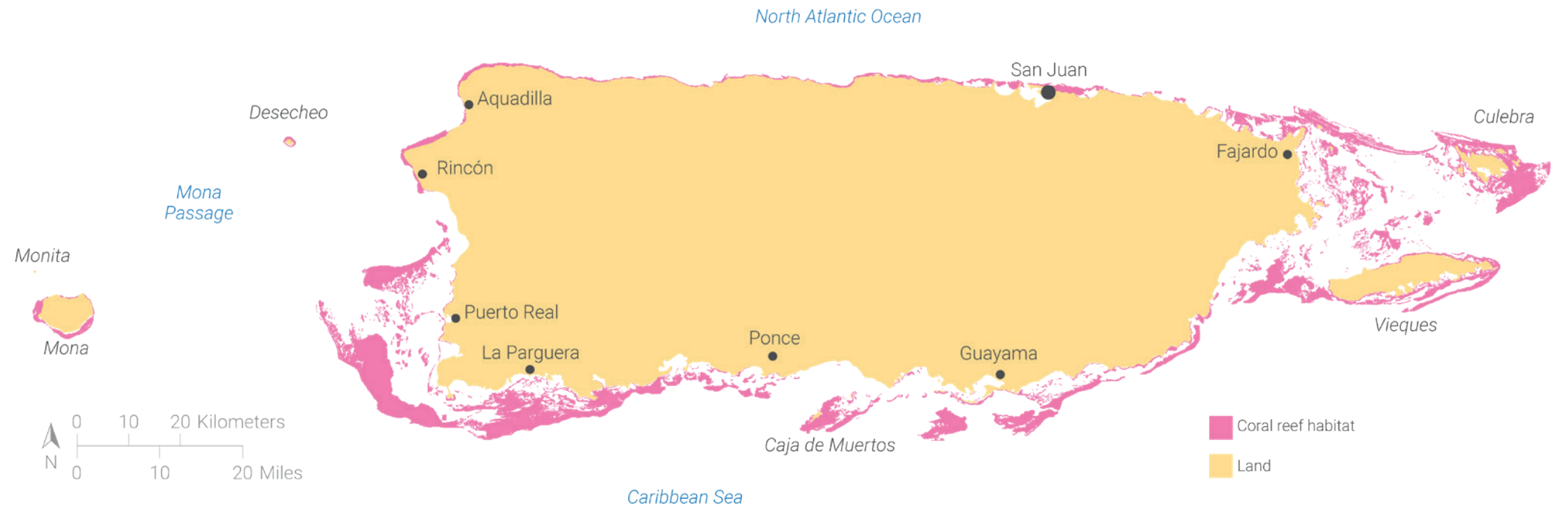
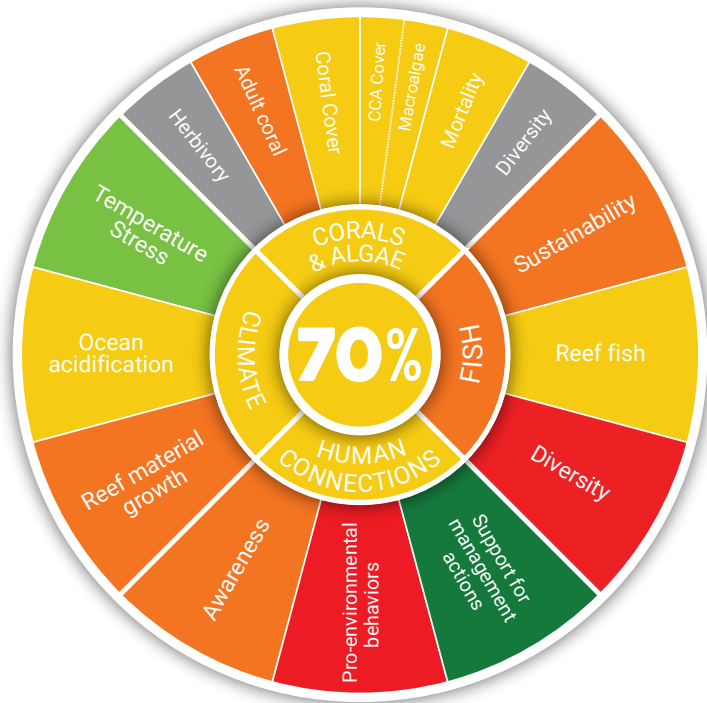
The same reefs that protect the coast during a hurricane are also subject to storm damage themselves. In 2017, Hurricane Maria struck Puerto Rico's coral reefs with devastating force. After the storm passed, two teams of National Oceanic and Atmospheric Administration (NOAA) scientists and local partners went out to the reefs—one team to assess reef damage, and another to re-attach broken coral colonies. This effort focused on reefs that bore the greatest brunt of the storm. From February to June 2018, the teams surveyed over 86,000 corals

and re-attached over 15,000 coral colonies. Restoration projects led by NOAA, the Puerto Rico Department of Natural and Environmental Resources, and other partners are ongoing. Restoring Puerto Rico's coral reefs promote both conservation and public safety. Healthy coral reefs can absorb up to 97% of oncoming wave energy, potentially reducing the impacts of storm surges and flooding during a hurricane. Rehabilitating Puerto Rico's damaged coral reefs is an important component of any future disaster readiness strategy.

CORAL REEFS IN PUERTO RICO ARE IN **FAIR CONDITION**



PUERTO RICO



Puerto Rico is an archipelago of islands in the Greater Antilles, located in the north central Caribbean between the U.S. Virgin Islands to the east and the island of Hispaniola to the west. In addition to the main island, the islands of Mona, Monito, Desecheo, Caja de Muertos, Vieques, and Culebra make up the Commonwealth of Puerto Rico. The main island has a linear coastline of 620 km (385 mi), surrounded by over 5,000 km² (1930 mi²) of shallow coral reef ecosystems. Colonized by Spain in the early 1500's, it became a U.S. territory in 1898.

Puerto Rico's coral reef condition was evaluated under four categories—corals & algae, fish, climate, and human connections (see Key Themes & Indicators for descriptions). Puerto Rico's coral reefs are in fair condition overall. Corals & algae are moderately impacted to very impacted. Fish

are moderately to severely impacted. Diversity of fish populations is in critical condition. Climate is also a factor negatively affecting coral reefs. Ocean acidification is a global problem with regional impacts occurring in the Caribbean. However, temperature stress from warming waters is not as bad in Puerto Rico compared to other jurisdictions for the time period assessed. Island-wide surveys show that while support for management actions is very good, pro-environmental behavior and awareness are critical and impaired, respectively. More work needs to be done to both raise awareness and improve personal actions that protect and restore coral reefs. The coral reefs of Puerto Rico experience moderate impacts from human activities and development and are struggling against threats such as pollution, overfishing, and global climate change.



A good reference area is a vital component of the NCRM status report process. It is the area (or specific years and area) that all biological samples are compared against. The ideal reference area would be one that is large enough in spatial scale to encompass representative habitats and depths. It would also have sufficient sampling and be an area that is unaffected by anthropogenic forces like fishing pressure, and land based sources of pollution. Most often, a region does not have an ideal reference area, and we must instead choose the best possible area given the circumstances. In Puerto Rico, three separate smaller areas were initially chosen as the fish reference based on local stakeholder and expert opinion. Mona, Desecheo, and the western portion of La Parguera were thought to be the best possible reference areas; however, after our initial analysis of the data, it was clear that these areas were too impacted and could not represent the best possible reference area on their own for Puerto Rico's fish communities. To optimize the reference area for this status report, two federal national parks located in the U.S. Virgin Islands were included: Buck Island Reef National Monument in St. Croix and the Virgin Islands Coral Reef National Monument in St. John. Together, the five areas combined better represent a reference area to evaluate the fish communities of Puerto Rico.

What do the scores mean?

90–100% Very Good

All or almost all indicators meet reference values. Conditions in these locations are unimpacted, or minimally impacted or have not declined. Human connections are very high.

80–89% Good

Most indicators meet reference values. Conditions in these locations are lightly impacted or have lightly declined. Human connections are high.

70–79% Fair

Some indicators meet reference values. Conditions in these locations are moderately impacted or have declined moderately. Human connections are moderate.

60–69% Impaired

Few indicators meet reference values. Conditions in these locations are very impacted or have declined considerably. Human connections are lacking.

0–59% Critical

Very few or no indicators meet reference values. Conditions in these locations are severely impacted or have declined substantially. Human connections are severely lacking.

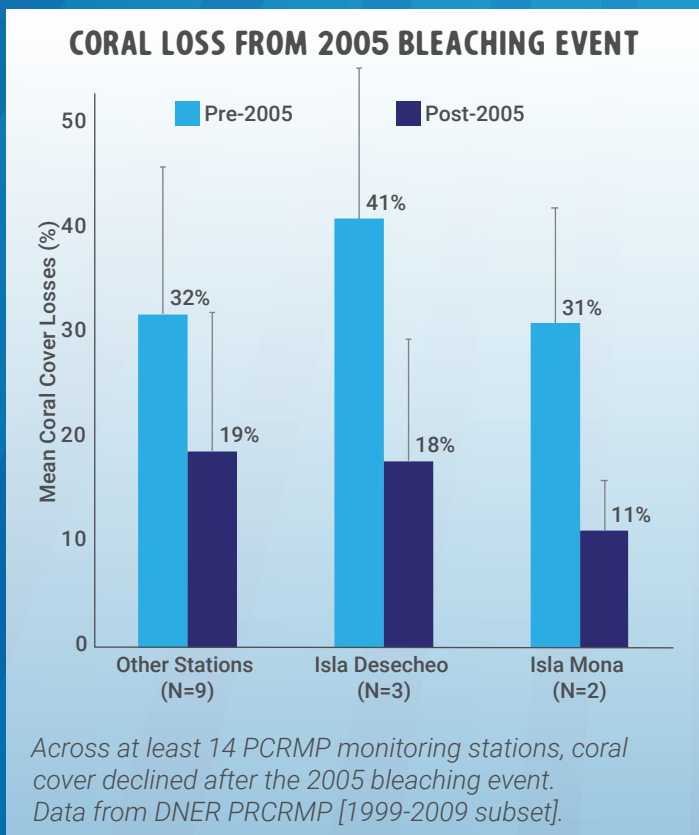
Insufficient Data

Not scored.

TRACKING LONG-TERM CHANGES TO CORAL COVER

Marine Protected Areas (MPAs) are designated marine regions with set geographical boundaries designed to conserve marine life and critical ecosystem services. The level of protection depends on an MPA's designation status. Some MPAs are Natural Reserves, where multiple activities are permitted, while others are Marine Reserves, where all resource extraction is prohibited either seasonally or year-round. Puerto Rico has approximately 30 MPAs. For example, the Desecheo Island Marine Reserve is a small no-take MPA that sustains some of the best-developed nearshore and deep water coral reefs in Puerto Rico.

MPAs play a critical role in Puerto Rico's Coral Reef Monitoring Program. Since 1999, the program has surveyed reefs with high coral cover to detect changes in benthic and fish communities over time. Since 2015, 42 coral reef stations have been surveyed biannually, 26 of which are within designated MPAs. The most recent data show an average coral cover of 23% within and 25% outside of MPAs. Long-term PRCRMP data indicate that a massive 2005 coral bleaching event was a pivotal moment of change for Puerto Rican coral reefs. By 2006, live coral cover at 14 monitoring stations had declined by an average of 40%. Within the Desecheo Island Marine Reserve, live coral cover declined by as much as 53%. At Mona and Monito Islands Natural Reserve, Puerto Rico's largest MPA, coral cover fell by 63%. A few sites have seen some recovery in live coral coverage; however, most PRCRMP sites have not rebounded to pre-2005 levels.



KEY THEMES & INDICATORS



CORALS & ALGAE

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

- **Coral cover**, a measure of what percentage of the bottom (benthos) is living stony coral.
- **Macroalgae cover**, a measure of what percentage of the bottom (benthos) is macroalgae.
- **Crustose coralline algae (CCA) cover**, a measure of what percentage of the bottom (benthos) is crustose coralline algae.
- **Adult coral**, a measure of the density of reproductive age coral species.
- **Herbivory**, a measure of the level of grazing pressure by fish on corals and algae.
- **Mortality**, a measure of the amount of old dead coral skeleton exposed as scars on live coral colonies.
- **Diversity**, a measure of unique coral species present.



FISH

Coral reefs serve a vital ecological role for fish species. Fish are important to the ecology of the reef, the economy, and the livelihoods of local communities. The indicators for fish are:

- **Reef fish**, a region-specific measure of density for selected fish species.
- **Sustainability**, a measure of human-related fish mortality relative to natural fish mortality.
- **Diversity**, a measure of unique fish species present.



CLIMATE

Climate affects all components of a reef system. Climate change and ocean acidification influence reefs across the globe, but conditions vary at the regional and local level. The climate indicators are:

- **Temperature stress**, which evaluates the frequency and severity of high temperature events.
- **Ocean acidification**, which indicates if the water chemistry is suitable for the growth of corals and other calcifiers.
- **Reef material growth**, which is a calculated measurement of the yearly gain or loss of three-dimensional reef habitat.



HUMAN CONNECTIONS

Coral reef management agencies protect reef resources through management plans, public education, and involving communities in managing their resources. The indicators for human connections are:

- **Awareness**, an indicator of residents' familiarity with threats to and the importance of reefs.
- **Support for management actions**, an indicator of support for reef management activities.
- **Pro-environmental behavior**, an indicator of residents' participation in activities to protect the environment.

HEALTHY CORALS ENRICH LIFE IN PUERTO RICO



A reef scene at Desecheo Island Marine Reserve. Photo: JP Zegarra.

People living in Puerto Rico have a diversity of livelihoods and experiences, which depend on the benefits provided by healthy coral reef systems. The beaches and coral reefs of the offshore islands, including Culebra, Vieques, Caja de Muertos, Mona, and Desecheo, attract divers, snorkelers, and boaters from around the world. Marine tourism generates an important source of employment and income for dive operators, tour boats, marinas, fishing charters, and the service industry, all of which support the regional economy. White sands in areas such as Flamenco Beach in Culebra are made of fine grain sands produced by sea urchins and parrotfishes that graze on the algae of coral reefs.

Cities and towns such as San Juan in the northeast and La Parguera in the southwest are protected from swells and storm impacts by nearshore, shallow reefs. Tourists flock to the shores of Aguadilla and Rincón to experience the renowned surf breaks that occur when oncoming swells crest over nearshore coral reefs. Many fishing ports such as Puerto Real, La Parguera, Peñuelas, Guayama, Naguabo and others have historically depended on sales of fresh seafood caught in extensive areas of shallow coral reef habitat.

WHAT YOU CAN DO TO HELP

There are many threats to coral reefs. Here are a few actions YOU can take to help conserve coral reefs:



Pick up your own trash and the trash that others have left behind.



Obey all natural reserve regulations, and do not drop your anchor in reef areas. Instead, use designated mooring buoys, or drop anchor on sandy bottom areas.



Support initiatives that protect and preserve coral reefs.



Be responsible for the fishing nets and other gear you use.



Only catch enough fish for you and your family. If you don't fish, choose seafood that is sustainably harvested.



Educate yourself about coral reefs and the creatures they support.



Don't stand on or touch live coral. Don't take pieces of corals home with you.



Participate in volunteer-based/citizen science initiatives aimed at coral conservation.

Status report working group

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About this status report

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more information, visit coralreef.noaa.gov. Cover photographed at Mona and Monito Islands Natural Reserve in April 2012 by JP Zegarra.

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The status report working group during the workshop in San Juan, Puerto Rico, May 2019.



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