

Coral reef condition: A status report for the



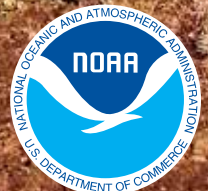
Northwestern
Islands



Main Islands

HAWAIIAN ARCHIPELAGO

NOAA
CORAL REEF
CONSERVATION PROGRAM



CORAL REEFS ARE IMPORTANT

Hawai'i is the most isolated archipelago in the world, resulting in coral reef ecosystems with a quarter of all its life found nowhere else. This means Hawai'i has a high rate of endemism. Corals and fishes here create a marine assemblage that is uniquely distinct from those found elsewhere.

Corals hold a special place in Hawaiian culture: the first epoch in the Kumulipo, the Hawaiian creation chant, speaks of the coral as the first life form created.

"Born was the coral polyp, born was the coral, came forth"

This cultural connection continues to this day, with local communities involved with, depending on, and caring for their marine resources. Coral reefs also play a critical role in the modern economy of Hawai'i. Tourism is the single largest economic segment in the state, and a large portion of tourists come to enjoy the marine environment, making coral reefs important job creators.

The Hawaiian chain can be divided into two areas: **the Main Hawaiian Islands**, home to over a million residents and welcoming more than eight million tourists a year, making these local reefs heavily used; and **the Northwestern Hawaiian Islands**, a collection of protected and mostly uninhabited atolls, islands, and banks that provide critical habitat to seabirds, monk seals, sea turtles, and coral reef communities.

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. Threats such as **fishing impacts** and **land-based sources of pollution** can be managed at a local level, while coral reefs will also benefit from the reduction of greenhouse gases that fuel **climate change and ocean acidification**.

Over-fishing leads to a reduction in the amount of reef fish species in many locations, which can disrupt the delicate ecological balance on the reef. Destructive fishing practices can also damage coral reefs. Additionally, marine debris, such as derelict fishing gear and trash, and invasive species, such as marine algae, negatively impact coral reefs.

Land-based sources of pollution can result from agriculture, deforestation, land clearing, storm water transport by impervious surfaces, and coastal development. This pollution impacts coral reefs in many ways, including 1) sedimentation, which smothers corals, 2) nutrient enrichment, which can lead to overgrowth by seaweeds, and 3) the introduction of toxins and diseases into the system. These pollutants can directly harm or kill corals, and also indirectly affect reefs by disrupting critical ecological functions, food webs, and fish populations.

Northwestern Hawaiian Islands



The Northwestern Hawaiian islands are spread over a wide area and are unpopulated islands in the archipelago. The biggest threats these areas face are from climate change impacts, including increasing sea surface temperature 🌡️, ocean acidification 📉, sea level rise 📈, and increased severity and frequency of storms 🌀. There are a few human impacts on the reef environment, including marine debris 🗑️.

Climate change and ocean acidification impacts threaten coral reefs through sea-level rise, mass coral bleaching, disease outbreak, and reduced coral growth resulting from increasing temperatures and ocean acidification.

While multiple bleaching events have occurred in the *Northwestern* Hawaiian Islands in the past, the only prior recorded widespread bleaching in the *Main* Hawaiian Islands occurred in 1996. Then in 2014 and 2015, coral reefs in Hawai'i experienced significant bleaching, resulting in high mortality in important reef areas (see Climate section). In the long term, failure to reduce carbon dioxide and other heat-trapping gases that cause ocean acidification and rising temperatures may make management efforts futile.

Rising to this challenge, there are promising management measures being implemented across the state to prevent further decline of reefs, backed by solid monitoring and science, and involving local communities. This status report synthesizes the rich scientific data available on coral reefs in Hawai'i on corals & algae, fish, and climate, and highlights recent efforts to protect these reefs for future generations.

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 Hawaiian Islands coral status report is part of a larger effort to provide communities and decision-makers with information about managing and conserving coral reef ecosystems.

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.

This status report provides a geographically specific assessment of Hawaiian coral reef condition for the period 2012–2016. The Hawaiian Archipelago was 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 report).

Main Hawaiian Islands



The Main Hawaiian Islands are the largest and most populous islands in the Hawaiian Archipelago. Human populations of O'ahu, Hawai'i Island, Maui-Nui, and Kaua'i lead to human impacts on the reef environment, including nutrient and sediment inputs , marine debris , and invasive species . Their impacts result in reduced and

HUMAN CONNECTIONS

Coral reef management agencies in the Hawaiian Islands work to protect coral reef resources through management plans, public education, and actively involving local communities in managing their resources. The three indicators for human connections are:

- **Awareness**, an indicator of residents' familiarity with
- **Support for management actions**, an indicator of support for reef management activities.
- **Pro-environmental behavior**, an indicator of residents'

Coral reefs in Hawai'i provide economic value by supporting fisheries and tourism. In 2014, the commercial fishery harvest value for coral reef species was over \$3.2 million (NOAA PIFSC Western Pacific Fisheries Information Network). The tourism industry produced about \$6.5 billion, which is 8% of the Hawai'i total gross domestic product (NOAA OCM Economics National Ocean Watch).

Coral reefs provide cultural value, with surveys finding 94% of residents agree that reefs are important to Hawaiian culture. The total annual value (fishing, food, and cultural) of the nearshore fishery is estimated to be \$10.3-\$16.4 million (Grafeld et al. 2017).

COMMERCIAL REEF FISHERY HARVEST



Coral reefs provide economic value by supporting commercial fisheries. Data from Hawai'i Division of Aquatic Resources.



Tourists at Hanauma Bay on O'ahu. Tourism is a key part of the Hawaiian economy. Photo: Maria Dillard.

FISH

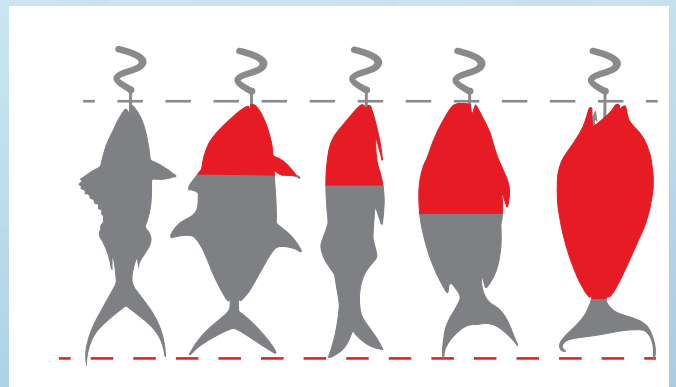
Coral reefs serve as habitat and food for many fish species. These fish are important to the ecology of the reef, national and global economies, and the livelihoods of local communities. The four indicators chosen for fish are:

- **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.

Sustainable fisheries support a variety of uses, including commercial and recreational fishing, tourism, and sustenance. Traditional fishing practices are still in use around the Hawaiian islands, a cultural heritage that can only continue if reef fish populations remain intact.



Native fishermen use a surround net to catch fish. Photo: Hawai'i State Archives.



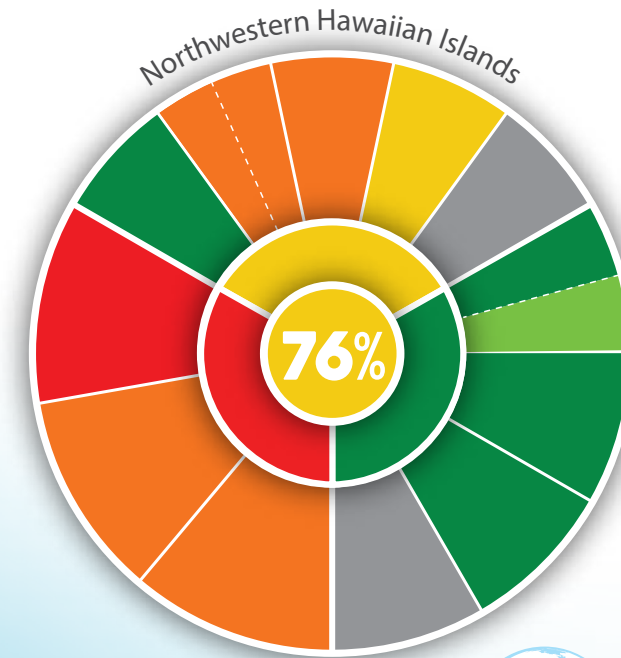
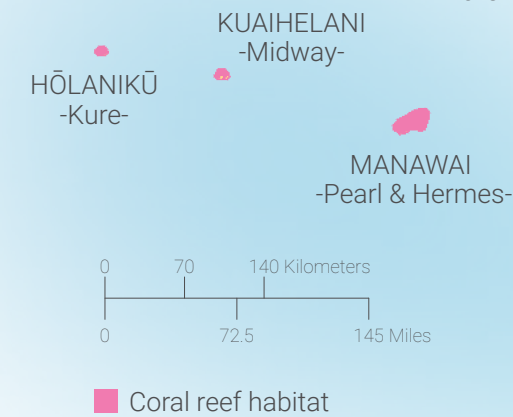
Fishing pressure has a direct impact on sustainability of reef fish. Different fish species are depleted at different rates based on how desirable they are. Surgeonfish are the most depleted, while Snapper fishing is sustainable. Data from PIFSC 2016 MHI reef fish stock assessment.

CORAL REEFS IN HAWAI'I ARE IN FAIR CONDITION



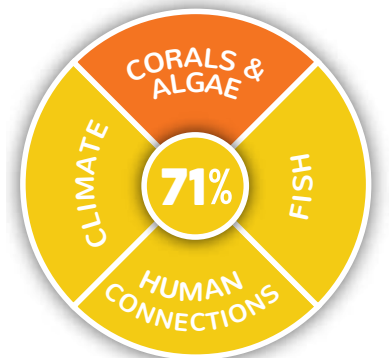
NORTHWESTERN HAWAIIAN ISLANDS

The Northwestern Hawaiian Islands are the mostly uninhabited northwestern three quarters of the Hawaiian Archipelago stretching 1,350 miles. They are completely encompassed within the Papahānaumokuākea Marine National Monument and include coral islands, seamounts, banks, and shoals. This vast seascape supports a diversity of coral, fish, birds, marine mammals, and other flora and fauna, many unique to the Hawaiian Island chain. They are at the lower range of temperature for coral reef development. This natural occurrence results in reefs around Midway Atoll and Kure Atoll having less corals. The Northwestern Hawaiian Islands is a sub-region of the Hawaiian Archipelago, divided to evaluate condition of three categories—corals & algae, fish, and climate. There are no human connections indicators assessed as the islands are uninhabited. The coral reefs are in fair condition overall. Benthic cover has declined moderately and coral populations are fair. Populations of reef fish and sharks are in very good condition. Coral reefs in the Northwestern Hawaiian Islands have experienced temperature stress and ocean acidification, and reef material growth is impaired. The overall climate condition is assessed as critical. These results show that coral reefs in the Northwestern Hawaiian Islands are in fair condition overall.



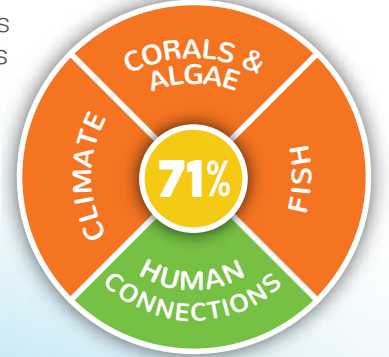
KAUA'I & NI'HAU

Kaua'i and Ni'ihau are the westernmost islands in the Main Hawaiian Islands. The combined population is 67,000, with the majority on Kaua'i. Overall, the coral reefs in Kaua'i and Ni'ihau are in fair condition. This region had the highest fish score and the lowest human connections score.



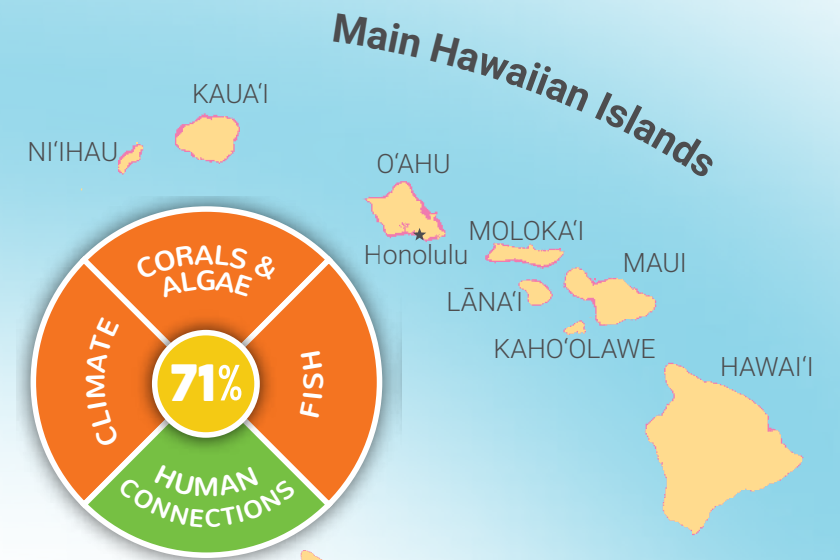
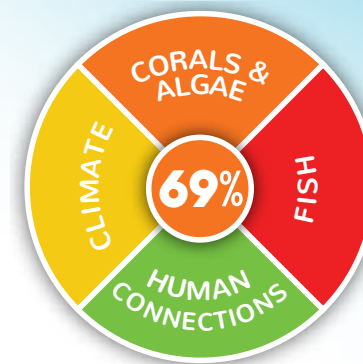
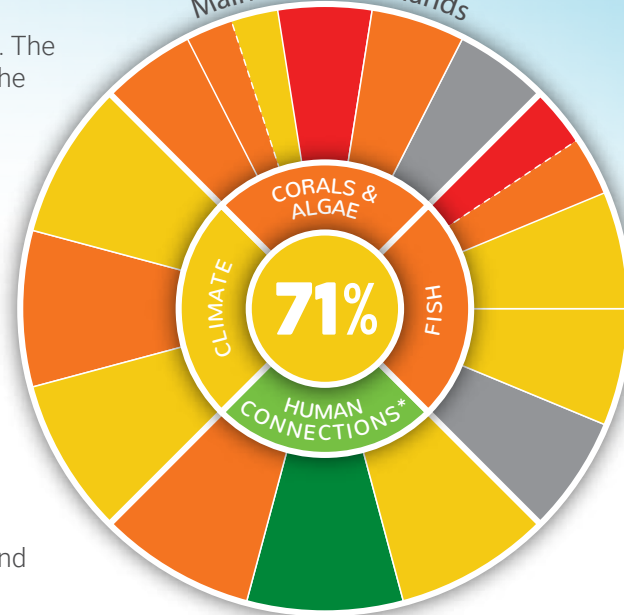
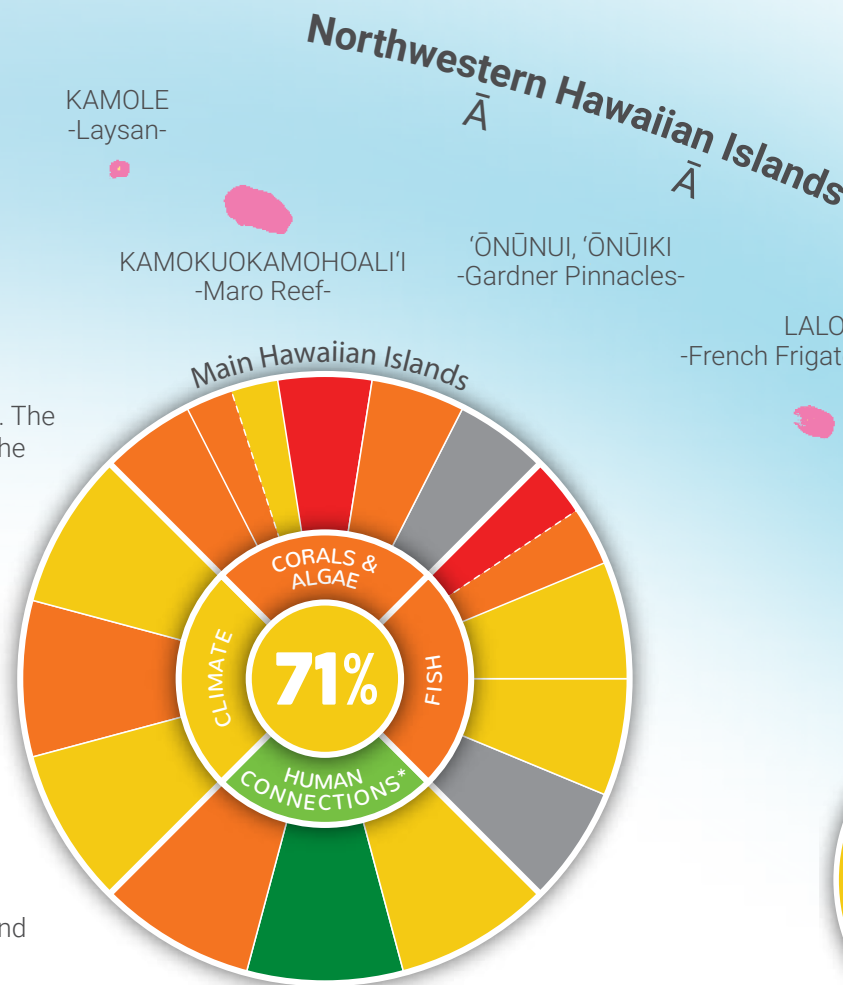
MAUI NUI

Maui Nui includes four islands that were one when sea levels were lower; Maui, Moloka'i, Lāna'i, and Kaho'olawe. This group of islands lies between O'ahu to the west and Hawai'i to the east. Overall, the coral reefs in Maui Nui are fair, but corals & algae, fish, and climate conditions are impaired.



MAIN HAWAIIAN ISLANDS

The Main Hawaiian Islands are inhabited islands in the Pacific Ocean. The Islands consist of eight volcanic islands surrounded by coral reefs. The Main Hawaiian Islands are a sub-region of the Hawaiian Archipelago divided to evaluate condition of four categories—corals & algae, fish, climate, and human connections. The Main Hawaiian Islands coral reefs are in fair condition overall. Benthic cover is very impacted, and coral populations are impaired. Fish are moderately to very impacted as well. As is common in populated areas, reef fish populations are depleted, indicated by relatively small sizes of fishery species and low overall fish biomass. Climate is also a factor negatively affecting the Islands. Temperature stress and ocean acidification are moderately impacting the islands. Climate conditions are fair. Human connections are good, which means communities have awareness about the reefs and engage in behaviors that protect reef ecosystems. These conditions show that the Main Hawaiian Islands are moderately impacted overall, and the Islands are struggling against threats like pollution, overfishing, and climate change.



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. *Human connections are very high.	Most indicators meet reference values. Conditions in these locations are lightly impacted or have lightly declined. *Human connections are high.	Some indicators meet reference values. Conditions in these locations are moderately impacted or have declined moderately. *Human connections are moderate.	Few indicators meet reference values. Conditions in these locations are very impacted or have declined considerably. *Human connections are lacking.	Very few or no indicators meet reference values. Conditions in these locations are severely impacted or have declined substantially. *Human connections are severely lacking.

*Human connections data are only collected in the Main Hawaiian islands, not the Northwestern Hawaiian Islands.



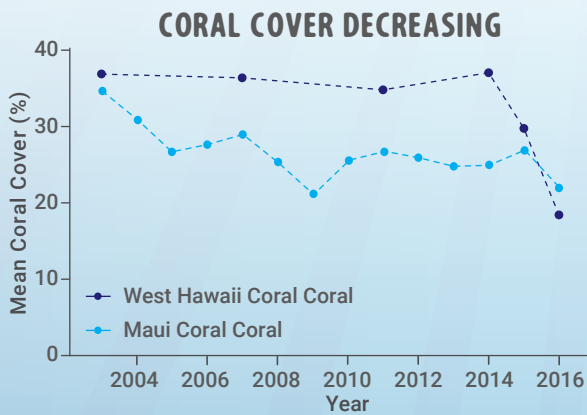
CORALS & ALGAE

Corals & algae make up the base of the coral reef ecosystem, providing food and shelter for fish, shellfish, and marine

resources. 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
- **Herbivory**, a measure of the level of grazing pressure by fish on corals and algae.
- **Mortality**, which measures the amount of recently
- **Diversity**, a measure of the number of different

Localized sources of pollution and global impacts are affecting West Maui and West Hawai'i coral reefs. Both areas have experienced extensive coral bleaching starting in 2014, that has sharply decreased coral cover. Coral bleaching combined with stress from land based sources of pollution makes coral reefs less resilient.



Coral cover has declined on Maui and West Hawai'i after coral bleaching in 2014 and 2015. Data from Hawai'i Division of Aquatic Resources.

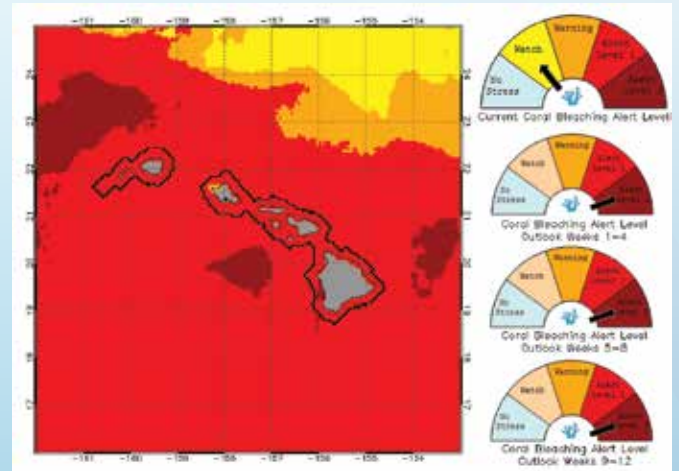


CLIMATE

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 were:

- **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

The Main Hawaiian islands experienced back-to-back severe coral bleaching in 2014 and 2015, while parts of the Northwestern Hawaiian Islands experienced severe bleaching in 2014. Frequent and severe bleaching events greatly harm coral reef ecosystems. Climate models show that this will continue, with consecutive coral bleaching events expected every year by 2055.



Coral bleaching alert map during September 2015. From NOAA Coral Reef Watch.

Land-based sources of pollution are a leading cause of coral reef degradation in the Main Hawaiian Islands. Water quality is impacted by urban runoff, failing sewage systems, unpaved roads, farms, land clearing, and development. Surface and groundwater carry sediment and excess nutrients, which smother coral and cause algal blooms, severely compromising reef health and resilience, to the reefs. Communities in Hawai'i are particularly interested in how their actions affect reefs and are working to improve infrastructure to reduce pollution. Improving water quality on reefs can improve resilience to other threats, such as climate events.

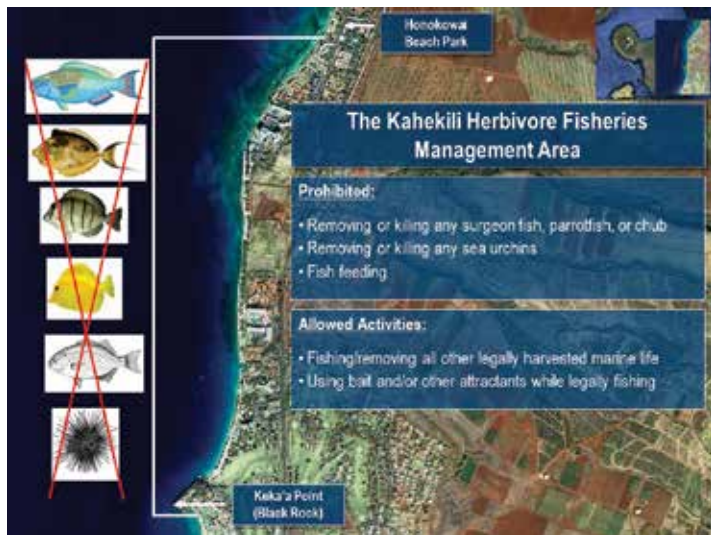
Runoff carries sediment and pollutants to coral reefs off the coast of Hawai'i. Photo: Bill Rathfon.



PEOPLE ARE DOING GREAT WORK

In 2009, a new form of fisheries management went into effect along a two-mile section of West Maui. The Kahekili Herbivore Fisheries Management Area is the first place in Hawai'i where fish stocks are managed with the specific goal of improving the health and resiliency of the coral reef itself—not just the fish. Before the establishment of the area, state monitoring results showed that coral cover in reefs along this section of coastline had declined dramatically and that reefs were being periodically overgrown by blooms of seaweed.

The project is having promising results. Eight years following the management area designation, important grazing fishes have increased in size and numbers. Surgeonfish biomass increased 40% and parrotfish biomass nearly tripled by 2017. Coral cover has stabilized within the protected area, and there has been a more than five-fold increase in crustose algae and a decrease in macroalgae. Conditions at Kahekili are now much more suitable for coral survival and growth.



Established in 2009 on West Maui, the Kahekili Herbivore Fisheries Management Area prohibits the removal of rudderfish, parrotfish, surgeonfish, and sea urchin from the reserve area.

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:



Educate yourself about coral reefs and the creatures they support.



Only catch enough fish for you and your family and be aware of fisheries regulations.



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



Do not drop your anchor in reef areas, rather use sandy bottom areas.



Be responsible for fishing nets and gear you use, and clean your boat and gear to prevent invasive species.



Help protect wetlands from filling and construction activities.



Plant native vegetation to prevent sediment and pollutants from reaching the reef.



Don't dump household chemicals into streams, gutters, or drains.



Reduce energy use and your carbon footprint.



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



Support initiatives to preserve and protect coral reefs.



Support the perpetuation of Hawaiian culture.

Status report working group

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About this status report

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Acknowledgements

The CRCP supports effective management and sound science to preserve, sustain, and restore valuable coral reef ecosystems for future generations.

For more information, visit coralreef.noaa.gov.

Cover photo by Kanaka Rastamon.

References

Grafeld S, Oleson KLL, Teneva L, Kittinger, JN. 2017. "Follow That Fish: Uncovering the Hidden Blue Economy in Coral Reef Fisheries." Plos ONE 12(8): e0182104. <https://doi.org/10.1371/journal.pone.0182104>.



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

