

Marine Heatwave and Coral Bleaching Response FAQs

Florida Keys National Marine Sanctuary and *Mission: Iconic Reefs*

What are the average South Florida sea temperatures?

Average South Florida sea temperatures are 69.8°F -86°F (21°C - 30°C). In July 2023, water temperatures throughout the Gulf of Mexico and in the Caribbean Sea were approximately 2°F - 4.5°F (1-3°C) warmer than average, which are typically 82.4°F -86°F (28°C - 30°C) for this time of year.

What is a marine heat wave and how frequent are they?

Any time the ocean temperature is above the 90th percentile for a specific length of time— meaning that the temperatures are warmer than 90% of the previous observations for a given time of year— you've got a marine heat wave.

Heatwaves can last for weeks, months, or years and are monitored by [NOAA's Physical Sciences Laboratory](#) and [NOAA Coral Reef Watch](#).

How long have South Florida sea temperatures been elevated?

Higher-than-average warm water temperatures have been recorded since February 2023. This marine heat wave event is the longest-lasting in the region since 1991.

What happens to corals in extreme sea temperatures?

73.4°F - 84.2°F (23°C - 29°C) is the optimal temperature range for reef-building corals. A 2°F (or 1°C) rise in temperature can [cause a coral to bleach](#), meaning the coral expels its [symbiotic algae](#), which provides the coral with its color and nutrients. It can take several weeks of stress before corals pale and/or turn white.

Coral bleaching does not always lead to death. The elevated temperatures as well as the duration of the elevated temperatures are critical factors in the difference between coral bleaching and coral mortality.

Severe bleaching and significant mortality will continue if the marine heat wave persists.

How long will this marine heat wave last?

NOAA experimental forecast models indicate a 70-80% chance that extreme ocean temperatures will persist until November 2023.

When were marine heat wave impacts first observed in Florida Keys National Marine Sanctuary?

Despite weeks of higher temperatures, assessments in mid-July indicated reef-building coral colonies were just starting to pale. Over the course of four weeks, bleaching was widespread. Some *Mission: Iconic Reefs* partners reported 100% mortality of the corals at their nurseries (Looe Key and Sombrero Reef), with tissue damage indicating that the coral died immediately from the elevated heat and not over a period of time of bleaching.

Other nurseries that have not experienced extremely high temperatures are faring well, as of late July.

How frequently has coral bleaching occurred in Florida Keys National Marine Sanctuary?

Mild bleaching in Florida Keys National Marine Sanctuary has occurred annually since 2011 typically at its extreme in early to mid-August. The last severe bleaching event was 2014-2015.

The [BleachWatch Current Conditions Report](#) (distributed July 28) issued an Alert Level 2, indicating significant bleaching expected; mortality likely.

Did the corals spawn this year?

Corals undergo gametogenesis (egg and sperm creation) starting approximately 8 to 10 months before the actual spawning event, which was predicted for after the August 1 full moon. The heat stress can make the coral divert energy from gametogenesis to dealing with the stress. When corals are heat-stressed they are more susceptible to coral diseases. Despite observing high levels of disease at many reefs, there have been many reports of coral spawning. There are also reports of spawning from corals

evacuated from nurseries to partner aquariums during the late July during the BleachWatch Alert Level 2.

What is *Mission: Iconic Reefs*?

Mission: Iconic Reefs is a large-scale NOAA-led coral restoration initiative within Florida Keys National Marine Sanctuary to restore seven ecologically and culturally significant coral reefs to self-sustaining levels by 2040. Launched in late 2019, the unprecedented effort is a collaboration with world-renowned scientists, local restoration partners, academia, industry, and federal and state agencies.



FLORIDA KEYS NATIONAL MARINE SANCTUARY

Who are the *Mission: Iconic Reef* partners?

Mission: Iconic Reefs is a massive undertaking that would not be possible without the

commitment and collaboration of our many partners, in and outside of NOAA.

ACROSS NOAA

Florida Keys National Marine Sanctuary
Office of Habitat Conservation
Office of National Marine Sanctuaries

National Centers for Coastal Ocean Science
Coral Reef Conservation Program
Southeast Regional Office - NOAA Fisheries

OUTSIDE OF NOAA

Coral Restoration Foundation
The Florida Aquarium
Florida Department of Environmental Protection
Florida Fish and Wildlife Conservation Commission
Mote Marine Laboratory & Aquarium
The Nature Conservancy
University of Florida
United Way of Collier & the Florida Keys
National Marine Sanctuary Foundation

Florida Keys Marine Preservation Society
Reef Renewal
Reef Institute
Keys Marine Lab
Florida Keys Tourist Development Council
Jay Clue Photography
Aquarium and Zoos Association

Why is coral restoration important to the Florida Keys?

In the Florida Keys, the reef forms the foundation of the region's identity, providing habitat for ecologically and economically important species and drawing visitors seeking to dive, snorkel, and fish. All of these benefits rely on healthy coral reef ecosystems that are currently challenged by pollution, climate change, coral disease, and more.

In response, *Mission: Iconic Reefs* is underway to change the trajectory of the health of seven iconic coral reefs in Florida. Restoration is key to making sure we actually have

corals to rebuild our reefs and is crucial to building resilient coral reef ecosystems. As we continue to research the mechanisms for resilience to stressors, we can apply those discoveries through restoration.

A new socioeconomic monitoring program is assessing the effects of coral restoration on reef users, human communities, and ecosystem services.

How are Florida Keys National Marine Sanctuary managers and *Mission: Iconic Reefs* partners responding to the marine heat wave?

Restoration efforts continue but may not be as obvious to the onlooker. At the onset of bleaching, *Mission: Iconic Reefs* partners incorporated bleaching threshold data into their adaptive management plans, voluntarily scaling back their coral outplant efforts and focusing on nursery and outplant site coral care to reduce stressors—cleaning nursery and structures, culling diseased pieces of coral, and general maintenance to improve conditions.

On July 21, 2023, Florida Fish and Wildlife Conservation Commission and Florida Keys National Marine Sanctuary released “Interim Protocols for Management of In-Water Nurseries, Coral Transport and Coral Outplanting” for the summer and fall of 2023. These protocols establish temperature and disease thresholds in nurseries and at outplant sites plus transport limitations.

When elevated temperature duration leading to widespread bleaching and mortality became obvious, *Mission: Iconic Reefs* managers and partners collaborated to quickly evacuate portions of their stock to their land-based facilities. Five thousand coral specimens were harvested and relocated to Keys Marine Lab by *Mission: Iconic Reefs* partners from offshore nurseries and parent colonies. Keys Marine Lab has 60 tanks ranging from 40 to 1,000 gallons, and is currently at max capacity.

With permits in process and the support of the *Mission: Iconic Reefs* Field Team and managers at Florida Keys National Marine Sanctuary, *Mission: Iconic Reefs* partners have moved many remaining nursery structures to deeper (cooler) water.

Other interventions, such as shading nurseries on high-value reef sites and feeding nursery or wild corals to help maintain their nutritional needs, are also in discussion.

What other adaptive management strategies are in place to protect the coral reef?

In mid-July 2023, NOAA and *Mission: Iconic Reefs* partners— Mote Marine Laboratory, Nova Southeastern University, Coral Restoration Foundation, Keys Marine Laboratory, Reef Renewal USA, The Florida Aquarium, The Reef Institute, and University of Miami— worked to preserve the last remaining live elkhorn and staghorn corals from Florida’s Coral Reef.

The NOAA Coral Rescue Project gene-banked two fragments from each unique genetic individual of staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmata*) corals, which are listed as threatened under the Endangered Species Act. One fragment was placed at Mote Marine Laboratory in Sarasota and the other at the Reef Institute in West Palm Beach.

Why is the NOAA Coral Rescue Project important?

Less than 150 unique individuals of elkhorn and 300 of staghorn corals remain alive on Florida’s Coral Reef -- 1% of their former abundance. Should major mortality occur on the reef and in coral nurseries, rescued corals can serve as the broodstock for propagating the corals that can restore Florida’s Coral Reef in the future.

Does research on heat tolerant corals show any promise?

Multiple *Mission: Iconic Reefs* partners, as well as scientists at the University of Miami and Nova Southeastern University, are researching the identification of higher temperature-tolerating corals by setting up in-water coral nurseries in very stressful nearshore environments and testing if certain genetic strains can resist bleaching or recover from bleaching.

Researchers are manipulating coral algal symbionts, rearing corals under more stressful conditions so they can adapt/ stress-harden. Researchers are also collecting wild corals that grow in stressful environments and propagating them with the assumption that unique genetic adaptations supported their survival. The idea is that by propagating more of these corals that came from stressful environments into restoration areas, their unique genetic adaptations may be passed onto offspring, thus rearing a next generation that is more stress-tolerant.

If corals that are naturally more tolerant are used in restoration, it will take approximately four years for a small elkhorn coral plug or fragment to grow to a sexually

mature colony. Restoration that focuses on genetically-diverse corals that reproduce will ultimately produce new genetic crosses that may be more tolerant to some stressors. These current efforts can jump-start the reef and potentially help mitigate future bleaching impacts.

What is fate tracking?

Florida Keys National Marine Sanctuary staff, with assistance from *Mission: Iconic Reefs* partners, are monitoring the reefs to observe which corals bleach and which do not to further understand exactly how corals respond to elevated temperatures. The information can be used in coral restoration incorporating heat-tolerant corals.

Is Florida Keys National Marine Sanctuary and *Mission: Iconic Reefs* working with agencies outside of the Florida Keys?

Yes! Florida's resource managers have learned from previous challenges and know that collaboration is key to better leveraging our resources, implementing novel solutions, and speaking with a unified voice. We are efficient and organized, with an amazing network of managers, researchers, conservation and restoration practitioners, aquarists, and engaged citizens who monitor, research, and respond to this event.

Florida's Coral Reef Resilience Program – a merger of the Stony Coral Tissue Loss Disease Response and the Florida Reef Resilience Program and comprised of representatives from the Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, National Oceanic and Atmospheric Administration, and National Park Service – collaboratively address coral reef disturbances and ecosystem recovery.

What can I do to help?

Climate change is increasingly impacting national marine sanctuaries, the underwater resources they protect, and the communities they support. The problem is enormous, but change happens when people come together and take action. The choices we make today make a difference.

You can support coral conservation and restoration in Florida Keys National Marine Sanctuary either through financial support to one of the many *Mission: Iconic Reefs* partners [[anchor link to the FAQ "Who are the Mission: Iconic Reef partners?"](#)] or by volunteering.

If you're out on Florida's Coral Reef, you can report bleaching (or lack thereof) through [Southeast Florida Action Network \(SEAFAN\) BleachWatch](#) and/or [NOAA Coral Reef Watch. Florida Keys BleachWatch](#) is a community-based reporting program initiated by Florida Keys National Marine Sanctuary in coordination with Mote Marine Lab in 2005 to serve as an early warning network for bleaching events in the sanctuary. A large network of trained observers provide regular reports of actual coral conditions on the reefs.

Workshops are held throughout the year for certified divers to monitor and report reef conditions before, during, and after bleaching events. BleachWatch volunteers help scientists understand where bleaching is occurring, what coral species are more vulnerable, the length and severity of the event, and the potential for recovery.

Observers can also help identify individual corals that aren't bleaching, especially in areas where bleaching is occurring. This can help point restoration practitioners to corals that are possibly more heat tolerant and useful for propagation and other restoration efforts. Observation data is integrated with existing NOAA satellite analysis to provide a comprehensive overview of current conditions throughout the sanctuary.

To discover how climate change is affecting our nation's underwater treasures, what NOAA's Office of National Marine Sanctuaries is doing about it, and how you can help, sign up for the [MPA Connections Newsletter here.](#)

What is the worst-case scenario?

If a marine heatwave persists for long enough, it can lead to significant coral mortality on reefs. Corals are a foundation species that provide vital ecosystem services to other organisms, including humans. Healthy coral reefs are magnets for marine life and provide food and shelter for thousands of marine species. Without live coral, there is subsequent erosion of coral reef habitat and ultimately the loss of fishing and food, storm protection, tourism, and biodiversity.

The impacts of this would directly affect the Florida Keys' Blue Economy and leave the Keys more vulnerable to storm damage.

How do Marine Protected Areas in Florida Keys National Marine Sanctuary contribute to the climate solution?

We all rely on healthy marine ecosystems to support life on this planet. National marine sanctuaries and [marine protected areas](#) are a nature-based solution in the fight against climate change. They help build climate resilience and store carbon while conserving biodiversity by protecting depleted, threatened, rare, and endangered species and populations. They mitigate and promote adaptation to climate change by protecting areas from damage and degradation to allow for the recovery of ecosystems.

Through its [Restoration Blueprint](#) and [Mission: Iconic Reefs](#) coral restoration initiative, Florida Keys National Marine Sanctuary is actively safeguarding essential ecosystems responsible for local and global contributions to biodiversity, carbon storage, livelihoods, coastal security, and cultural heritage.