# Restoring viable coral populations: Performance results and highlights for fiscal years 2021–2026

The 2018 Coral Reef Conservation Program strategic plan includes a pillar of work dedicated to coral restoration, in response to recent losses of coral from increasing threats. During the performance period, this body of work aimed to restore viable coral populations and currently represents our largest portfolio of projects, across four strategies, including efforts to *improve coral recruitment habitat quality, prevent avoidable losses, enhance population resilience*, and *improve coral health and survival*. These strategies were developed to catalyze partnerships needed to conduct coral restoration at ecologically relevant scales and advance resilience-based management. To accomplish this our efforts aimed to integrate restoration tools into coral reef management to enhance reef recovery after disturbances and restore vital structure and function to provide valuable ecosystem services to coastal communities.

NOAA's Coral Reef Conservation Program (the Coral Program) invests in supporting capacity, technical assistance, and science products, enabling managers to make informed decisions about coral restoration and disturbance response to improve coral reefs in their jurisdiction. Since 2020, activities and products contributing to our efforts to restore viable coral populations have been tracked to document progress toward the strategies' objectives. Information was collected by Coral Program staff members who had direct knowledge of these activities and products. During this performance period, NOAA's capabilities aligned well with the strategies to *enhance population resilience* and *improve coral health and survival*. Below, the progress of these strategies is presented with corresponding objective performance targets and results, a progress bar, and brief description of progress.

## *Enhance population resilience*

**Objective 1: By 2024, the Coral Restoration Consortium produces a series of "best-practice" and "scaling-up" guidance documents within the following specific areas of restoration practice and science: land-based propagation, in-water propagation, larval propagation, outplanting, monitoring, restoration as coastal protection, and restoration genetics.**

Target exceeded; Multiple projects directly produced or supported eight guidance documents during the implementation period. The target was exceeded beyond the seven listed in the objective, as more areas of restoration practice were identified after 2018.

**Objective 2: By 2023, NOAA and partners have pilot projects underway for at least four (4) interventions identified as high priority, recommended, and ready for testing according to the National Academy of Sciences review, "Interventions to Increase the Resilience of Coral Reefs."**

Target exceeded; By fiscal year 2023, the Coral Program funded 11 projects that supported most of the high priority, recommended, and ready-for-testing interventions identified in NOAA's Action Plan on Coral Interventions. The only area that didn't receive support is to develop a framework for coral epidemiology.

**Objective 3: By 2024, proven techniques exist to increase post-settlement survival of larval-reared corals to warrant moving forward with demonstration projects.**

Target met; During the implementation period, the Coral Program funded seven studies to address this objective, and three of them successfully identified proven techniques to increase post-settlement survival of corals. Ongoing projects are testing more techniques and their effectiveness has not yet been determined.

**Objective 4: Within 5-7 years of proving techniques to increase post-settlement survival, small-scale projects are implemented that demonstrate both restoration success and resilience to stress events.**

On track; Five projects contributing to this objective have been either lab-based or are still underway. These projects have examined aspects of both coral biology and various methodologies to gain knowledge of the underlying processes to contribute to advances in post-settlement survival.

**Objective 5: Between 2019 and 2029, the (a) average annual rate of efficiency in nursery-assisted, asexual reproduction techniques increases, and (b) the average annual percentage of nursery-assisted, sexual recruits surviving to sexual maturity increases.**

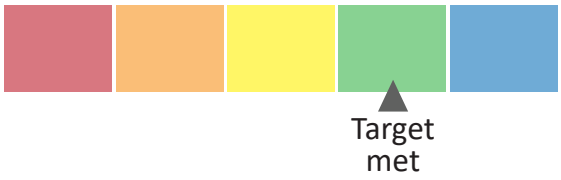
Ongoing; Coral Program-led projects are addressing objective 5(a) by increasing nursery-based asexual coral reproduction. Partners outside of Coral Program-led projects (e.g., Mote Marine Lab) are focusing on measuring efficiency rates of asexual coral reproduction techniques. Six projects contributing to 5(b) have been done in Florida and the U.S. Virgin Islands. In Florida, the Mission: Iconic Reefs work continues to track the survival of outplants. The Florida Aquarium may be better able to address survivorship of nursery-assisted sexual coral recruits through their ongoing work. Notably, much of this work had permitting hurdles in Florida, leading to delays in implementation.

## *Progress and next steps*

During the fiscal year 2021 to 2026 implementation period, the Coral Restoration Consortium (CRC), which received seed funding from the Coral Program, has matured into a thriving community of practice that assists restoration practitioners on a variety of topics, convenes annual Reef Futures conferences, and hosts education resources designed, created, and shared by CRC groups and collaborators. The Coral Program has met or exceeded our targets related to enhancing population resilience by investing in activities to develop guidance documents, support interventions, and identify proven restoration techniques. However, there is a lot more work to do, and this body of work will continue under *Coral Restoration Strategy 2, Enhance population resilience*, within the coral restoration focus area of the National Coral Reef Resilience Strategy. The Coral Program will build upon these results and expand partnerships to leverage the resources across the coral conservation community to increase the reach and effectiveness of coral restoration efforts.

# *Improve coral health and survival*

**Objective 1: By 2024, at least one new control technique for both disease and corallivore control is developed and demonstrated to be effective at the scale of key reef sites.**




Target met; Important progress has been made and amoxicillin was identified as a successful treatment through the Coral Health and Disease Consortium, which is funded by the Coral Program. This led to the development of a mechanism to apply the amoxicillin treatment to affected coral colonies during an outbreak. Additionally, evidence showed corallivorous snail removal was a successful control technique at coral restoration sites.

**Objective 2: By 2029, projects will work to reduce disease incidence or corallivore prevalence to natural levels at 50 percent of key reef sites.**

Ongoing; In late 2020, the NOAA Strategy for Stony Coral Tissue Loss Disease Response and Prevention was published and activities in the Atlantic and U.S. Caribbean supporting the corresponding implementation plan have been underway during this implementation period, including studies to better understand disease transmission pathways. Dedicated capacity-building efforts in the region to address stony coral tissue loss disease have been leveraged to respond to new priorities (i.e. coral bleaching), demonstrating how investments in regional coordination create lasting benefits that extend beyond a single disturbance event. Annual disturbance workshops foster relationships among partners and have accelerated the adoption of best practices for coral disease response, as well as bleaching preparedness, restoration, monitoring, and emerging threats.

# *Progress and next steps*

Between fiscal years 2021 and 2026, the stony coral tissue loss disease outbreak continued to impact coral reefs throughout Florida and the U.S. Caribbean. The discovery that amoxicillin effectively treats the disease was a major milestone and became the universal treatment across the Florida Reef Tract and the wider Caribbean. The Coral Program's capacity-building efforts supported national and regional coral disease coordinators and provided technical and scientific support enabling management partners to make better-informed conservation decisions. This capacity to address coral disease outbreaks has served as a model for management coordination and collaboration during other disturbances, such as invasive species and marine heatwaves. Future work related to coral disease and disturbances will move to the Disturbance Prevention, Preparedness, and Response focus area in the National Coral Reef Resilience Strategy.

# On-the-ground impacts

The following projects highlight how scientists and managers are addressing priority needs across the Pacific and Atlantic basins to restore viable coral populations.

## Coral Disease Response in the U.S. Caribbean

Support from NOAA's Coral Program strengthened coral disturbance preparedness and response in the U.S. Caribbean. Annual workshops connected managers, researchers, and practitioners across Puerto Rico, the U.S. Virgin Islands, and Florida to share management approaches, identify threats, and coordinate strategies. By fostering relationships among partners who face similar challenges, these workshops accelerated the adoption of best practices for coral disease response, bleaching preparedness, restoration, monitoring, and emerging threats, resulting in more coordinated and effective management across the region.

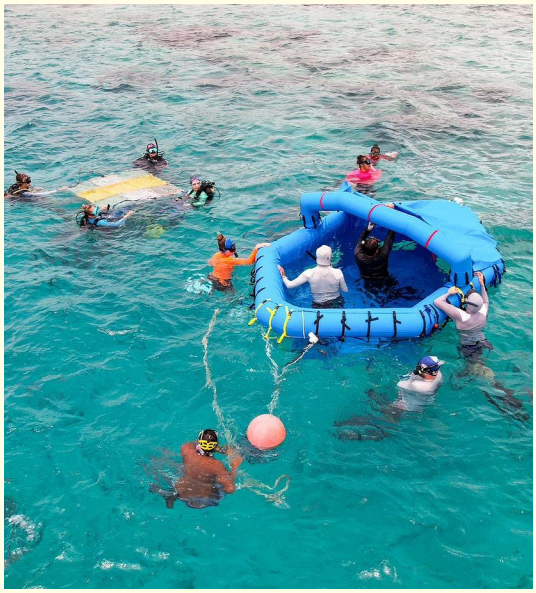
A key outcome was the U.S. Caribbean Coral Rescue Initiative, which protects coral genetic diversity through a coordinated regional approach. The initiative added two part-time Coral Rescue Coordinators, initiated a regional Coral Rescue Plan, and established a growing Coral Rescue Network connecting more than 100 practitioners and organizations.

Caribbean Oceanic Restoration And Education (CORE) Foundation Strike Team member treats star coral infected with SCTLD in the U.S. Virgin Islands. Credit: CORE Foundation.

## Coral restoration planning and capacity building in the Pacific

Active coral restoration is relatively new in the Pacific, where management has historically focused on reducing local stressors to help reefs resist and recover from impacts. The four U.S. Pacific jurisdictions (American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and Hawai'i) started a coral restoration planning process in 2020 that led to the development of a draft action plan for each jurisdiction for one priority restoration goal. The project then developed additional capacity to help transition jurisdictions from planning into implementation, which will help to restore the ecological function of prioritized reefs and the benefits they provide to local communities. There are two components to implementation:

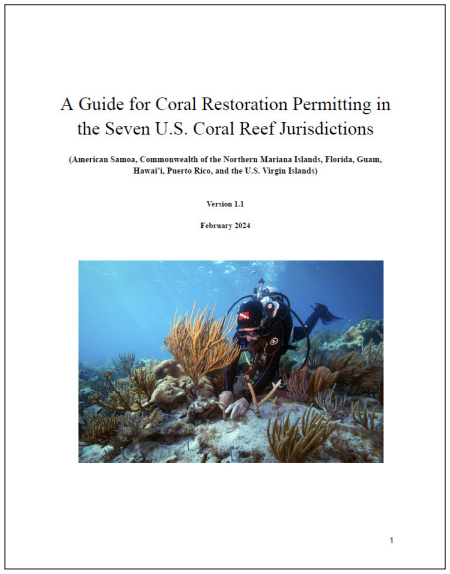
1. Awarding grants in partnership with NOAA Restoration Center and National Marine Sanctuary Foundation for jurisdictional partners to build their restoration capacity and
2. Providing additional training to develop coral restoration skills and expertise in the U.S. Pacific Islands.



SECORE International provided support and training to expand the coral larval propagation capacity across the Pacific Island jurisdictions. Credit: Jonathan Casey.

# Products

The featured publications below highlight Coral Program projects supporting coral restoration during the implementation period. Our work documents the advancement of coral restoration and provides managers with the science, tools, and technical assistance needed to inform their decisions.



Looking ahead, the Coral Program will build off the progress made during this time as we align our program capacity and capabilities to carry out the National Coral Reef Resilience Strategy with our partners.

For more information about NOAA's Coral Reef Conservation Program, visit coralreef.noaa.gov and coralref.noaa.gov/digital-corals, or contact us at coralreef@noaa.gov.