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CASE STUDY

Restoring Coral Reefs in the Face of Climate Change in the Seychelles

An Ecosystem-based Adaptation Approach



PHOTO: ANDREI PAVLOV

Project at a Glance

Coral reefs are critically important to the Seychelles, which is highly dependent on these ecosystems for food security, local livelihoods and economic growth. Importantly, coral reefs also serve as natural physical buffers that reduce wave energy and thus protect coastal communities from sea level rise and extreme weather events, such as storms and wave-induced floods. At the same time, coral reefs are highly vulnerable to increasing temperatures and carbon dioxide emissions, which contribute to coral bleaching and reef damage. The USAID/Southern Africa Regional Mission's Reef Rescuers Project is implemented by the non-governmental organization, Nature Seychelles. It focuses on restoring damaged coral reefs in the Seychelles to increase their resilience and reduce the vulnerability of coastal communities to storms, floods and sea level rise.



Project Donors: United States Agency for International Development (USAID), Global Environment Facility (GEF) and the United Nations Development Programme (UNDP)

Funding: \$1,014,000

Period of Performance: 2011-2016 (extended to 2019)

Implementing Partner: Nature Seychelles

Climate Stressors: Sea level rise and extreme weather events such as storms and wave-induced floods

Ecosystem Services: Maintenance of coral reef ecosystem services, including coastal protection, fisheries habitat and tourism sites

Project Focal Areas: Coral reefs around Cousin and Praslin islands

What's the Situation?

Coral reefs are among the most productive and biologically diverse ecosystems in the world; they provide goods and services such as fish habitat and coastal protection that contribute to food security, livelihoods and sustainable economic growth for about 500 million people. For the people of the Seychelles, fish is a significant source of protein. In fact, the Seychelles has the third highest per-capita consumption of fish globally. Tourism and wild fisheries are the two primary sources of foreign revenue. Tourists from all over the world visit the Seychelles to experience its coral reefs and diverse marine life, providing direct revenue and supporting a host of commercial enterprises, such as hotels and dive operators.

Coral reefs also provide coastal communities in the Seychelles protection from sea level rise and extreme weather events, such as storms and wave-induced floods, by serving as natural physical buffers. One recent meta-analysis found that coral reefs can reduce wave energy by more than 95 percent, comparable to the attenuation benefits of hard infrastructure defenses such as seawalls (Ferrario et al. 2014). As such, coral reefs can form the basis of an **ecosystem-based adaptation (EbA)** approach to the impacts of climate change.

Coral reefs are highly vulnerable to increasing temperatures and carbon dioxide emissions. Higher ocean temperatures increase the prevalence of coral diseases and the frequency of coral bleaching events. This can result in coral mortality over large areas when corals expel the algae that normally live in their tissue and provide them with food and energy. Additionally, increased amounts of carbon dioxide dissolving in the water results in ocean acidification. In combination with elevated temperatures, ocean acidification reduces the ability of corals to produce their calcium carbonate skeletons, thus weakening their ability to recover from bleaching events and provide coastal protection for local communities.

In 1998, unusually hot ocean temperatures from El Niño brought on a global mass coral bleaching event. In the Seychelles, this event caused an 85 to 95 percent decline in coral cover. In the decade following this bleaching event, some of the Seychelles' coral reef ecosystems experienced very little natural recovery, in part due to ocean current patterns that limited the dispersal of coral larvae to certain areas. Given the country's dependence on coral reefs, their deterioration and poor recovery present a significant threat to the well-being and livelihoods of local communities.

In response, the Reef Rescuers Project is piloting an EbA approach to reduce the vulnerability of coastal communities to sea level rise and extreme weather events by improving the resilience of coral reefs. Specifically, the project is developing, testing and implementing coral reef rehabilitation techniques by collecting coral fragments from reefs that survived past bleaching events, cultivating these in coral nurseries and transplanting them onto degraded sites to restore reef structure. The Praslin and Cousin islands were chosen as project sites because non-climate threats to coral reefs, such as pollution and overfishing, were minimal in these areas and would not undermine the restoration efforts.

By restoring coral reefs and the important ecosystem goods and services they provide — including fish and coastal protection — the project is enhancing the resilience of local communities. Compared with hard infrastructure solutions for coastal protection, such as the construction of seawalls, this EbA approach also provides biodiversity and livelihood benefits through the conservation of fisheries habitat and tourism sites.

Project Extension

The project was scheduled to end in 2014 and was initially extended through 2016. This was in part to allow time to document the effectiveness of coral restoration as a tool to enhance coral reef resilience to bleaching, as a weak-to-moderately strong El Niño event was projected to start during late 2014 and extend through 2016. During 2015, the restored reefs showed high resilience to bleaching with survival rates in the range of 90 to 100 percent despite the negative effects of El Niño. However, as El Niño persisted through 2016, bleaching and mortality rates were similar to the natural sites. (A new scientific paper on these findings is being prepared.) This project has now been extended through 2019 to continue to monitor reef sites and be able to fully analyze the interim results. The extension will also identify the “super corals” that have been resistant to bleaching. Since October 2016, approximately 3,750 fragments of “super corals” have been grown in net nurseries to supply future transplantations.



Small fragments of coral from healthy sites are grown in coral gardens, like the one above. Once they are larger, the fragments are transplanted onto damaged reefs. Photo: Nature Seychelles

Key Ecosystem-based Adaptation Activities

- Harvest small, healthy coral fragments from reefs that survived the 1998 bleaching event without high coral mortality, create stocks of healthy coral colonies on suspended rope nurseries and transplant them to degraded areas once they reach an appropriate size.
- Monitor coral bleaching and fish populations to compare the resilience of transplanted areas with control areas and to evaluate project impacts on biodiversity and ecosystem services.
- Train stakeholders, including marine protected area managers, on the principles of reef restoration, how to build mid-water nurseries and how to transplant corals onto degraded sites.

Maximizing the Effectiveness of Coral Reef Restoration

Not all coral reef transplantation projects enhance the resilience of coastal communities and marine ecosystems to climate stressors. This project features several innovative approaches that are important to their combined effectiveness as a climate change adaptation strategy:

- **Work at a meaningful scale:** This project transplanted reefs at a large, ecologically meaningful scale (~5,200 m² transplantation area) to recover important ecosystem services such as coastal protection.
- **Design pilots to minimize outside threats:** The project sites were chosen to minimize risks from other threats to coral reefs that interfere with coral recovery, such as overfishing and pollution.
- **Maximize opportunity for resilience:** The project tested the hypothesis that transplanting coral fragments that displayed resilience to the 1998 El Niño-related bleaching event will improve the resilience of the transplanted area.
- **Allow adequate time for assessment and validation:** The project invested considerable resources to monitor the effectiveness of the transplantation process on reef resilience and requested an extension to assess the impacts of a 2014-2016 regional bleaching event on the transplanted sites.

Key Project Results and Impacts

12

Mid-water nurseries built and cultivated with ~40,000 coral fragments from 32 species

5x

Increase in fish abundance and three-fold increase in fish species diversity was noted in project sites as compared with baseline

5,225 m²

Of coral reef transplanted with cultivated coral colonies

11,000

Coral colonies transplanted onto degraded sites*

~700%

Increase in coral cover in transplanted sites, up from about 2 percent in 2012 to 16 percent by end of 2014**

40+

People certified in coral reef restoration techniques

9

Scientific manuscripts in development from data collected during the project

7

Stakeholder groups implementing risk-reducing practices to improve climate resilience

PHOTO: BLUEORANGE STUDIO

* The project's new techniques for establishing coral nurseries and transplanting coral to degraded sites at a large scale have become recognized as state-of-the-art models for the Western Indian Ocean.

** The project continues to monitor how much of this coral cover is maintained, but newer data are not yet available.

Strategies to Support and Sustain Ecosystem-based Adaptation

Expand EbA application through targeted private sector engagement: The project identified private sector stakeholders, particularly those engaged in tourism activities, as key stakeholders for ensuring the sustainability of EbA approaches. For example, the project is working closely with hotels to raise awareness of the benefits of coral reef transplantation, such as decreasing beach erosion and supporting the marine ecosystems that are critical to local tourism. As a complement to the USAID-supported efforts, Nature Seychelles secured funding in 2014 from the Seychelles government, the United Nations Development Programme and the Global Environment Facility to work with the Constance Lemuria Resort on Praslin Island to restore coral reefs around the resort. The project also has an agreement with the Octopus Diving Center to train local diving instructors in coral restoration and is actively pursuing other private sector partnerships.

Promote knowledge transfer through strong communications efforts: From its inception, the project sought to raise awareness among government, private sector and community stakeholders about its approach through a multi-pronged communications strategy. This included publication in peer-reviewed literature, development of a dynamic online platform targeting a non-technical audience, outreach campaigns to raise public awareness, presentations at scientific conferences and a six-week course on coral reef transplantation aimed at government institutions, conservation practitioners and coastal zone managers. This comprehensive communications strategy has been successful in highlighting the role of the project's approach in addressing threats to coastal communities and coral reef ecosystems, not just in the

Seychelles but internationally. For example, CNN recently highlighted the project in a [segment](#)* of its Inside Africa program.

Support relevant policy processes: In 2016, there was a surge in interest in the Seychelles related to the governance of coral reefs, indicating strong political will for protecting natural assets. USAID supported the presentation of key lessons learned at national, regional and international symposia, including the first national workshop on science and technology hosted by the government of Seychelles. Reef Rescuer's approach was included in the report "Developing a Blue Economy Roadmap in the Republic of Seychelles: Contribution of New and Emerging Marine Sectors," which offers a strategic plan of action for the Ministry of Finance, Trade and the Blue Economy. As a result of USAID support, the Seychelles government increasingly acknowledges that coral reefs are vital to the national economy, development and food security.

Develop a business model to support the sustainability of restoration efforts: Nature Seychelles is implementing a green business plan that seeks to develop a number of marketable products and services that generate support and funding to sustain coral reef restoration. These include day tours for tourists to see active reef restoration, a two-week program for volunteers to participate in active reef restoration and training programs on coral reef restoration for conservation practitioners. The project extension will allow Nature Seychelles to assess the effectiveness of these efforts in supporting financial sustainability of restoration efforts.

*To view the Inside Africa segment on the Seychelles, visit: <http://tinyurl.com/reefrescue>

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About This Series

This case study is part of a series of products highlighting the potential role of biodiversity conservation and ecosystem-based adaptation in addressing climate vulnerability. This series is produced by USAID's Biodiversity Results and Integrated Development Gains Enhanced (BRIDGE) project and can be found here: <https://rportal.net/biodiversityconservation-gateway/resources/projects/bridge>

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October 2017