



# REEF CORALS



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# HOPE SPOT

Refuge, recovery, and optimism in the wake of catastrophic bleaching events

article & images by Andrew Bruckner, Ph.D., and Georgia Coward



A field of staghorn coral with a school of plankton-feeding Yellowback Fusiliers (*Caesio xanthonota*) at the edge of a sand channel.

# REEFS




In recent years, there has been considerable discouraging publicity about the accelerating rates of demise of the world's coral reefs. By some estimates, we lost 20 percent of all coral globally in the last three years, and nearly 50 percent over the last 40 years. Most of the decline is related to climate change—specifically warming of the oceans, which triggers coral bleaching. Localized losses are compounded by coral-eating predators (Crown-of-Thorns Starfish, or COTS) and direct human impacts such as overfishing, land-based pollution, and coastal development. According to most of these reports, the future looks increasingly gloomy, with predictions of annual bleaching by 2025 and possible losses of up to 90 percent of the world's reefs by 2050.



Above: A bleaching refuge on the northwestern edge of Ari Atoll has high numbers of healthy acroporid corals.

Right: Juvenile corals and new recruits are common on dead coral skeletons in areas of the southern Maldives that were damaged by bleaching.





A large stand of staghorn coral and mounding *Porites* (left side of photo) at 23 feet (7 m) of depth on a lagoonal reef on Gaafu Alifu atoll.

### PROMISING INITIATIVES

There is still hope, however. Dozens of new initiatives are being promoted as solutions to avoid a total collapse of the world's reefs, at least in the short term. One such effort seeks to minimize the severity of coral bleaching by deploying floating shade cloth to reduce harmful ultraviolet radiation reaching the corals, while another proposes the pumping of cool water up from the depths. Scientists are selectively breeding corals and using genetic engineering to produce "super corals" that are more tolerant of higher temperatures. There are even new robots being used on reefs, such as the underwater autonomous vehicle COTSbot, which is programmed to search for destructive Crown-of-Thorns Starfish and kill them by lethal injection. Cost-effective strategies to minimize localized human impacts provide another key conservation opportunity. When we reduce anthropogenic stressors, coral reefs are likely to better cope with climate change stressors through adaptation and enhanced resilience.

Concurrently, various groups are searching for coral reefs that naturally exhibit greater resilience to climate change and ocean warming and working to protect them for future generations. These special regions include designated Marine Protected Areas, as well as new locations chosen for their contributions to biodiversity, importance as carbon sinks, connectivity to other locations, and significance as habitat for threatened species. Termed Hope Spots by Mission Blue (the Sylvia Earle Alliance, see link below), they are biologically valuable because they contain an abundance and diversity of species, populations of rare, threatened, or endemic species, and unusual habitats. They show minimal damage from negative human impacts and have significant historical and cultural value and economic importance to local communities. Reefs that exhibit physical and environmental factors that minimize stresses from climate change, and are connected to adjacent environments through major migration corridors and serve as spawning grounds to provide important sources of larvae to reseed adjacent reefs following catastrophic disturbances, are also Hope Spots.

### CHARISMATIC MALDIVIAN FAUNA

The Maldives is listed as a Hope Spot by Mission Blue. Home to more coral reefs than any other place in the Indian Ocean, Maldivian reefs form a vast network interconnected by water currents and serving as a bridge between reef organisms from Africa and Indone-



Georgia Coward swimming along the reef slope on a lagoonal patch reef on Gaafu Alifu Atoll. High cover of acroporids and plating *Porites* covers the reef slope.



A large school of Humpback Snappers (*Lutjanus gibbus*) among cauliflower corals (*Pocillopora*) on the reef flat.

sia and southeast Asia. The reefs are spread over an extensive area—35,000 square miles (90,000 km<sup>2</sup>), about the size of the state of Maryland—and are surrounded by deep, productive oceanic waters. Most locations are affected minimally by direct human impacts due to the relatively small and dispersed human population, and the government of the Maldives recognizes the importance of these reefs by providing protection for the five species of turtle, whales and dolphins, Manta Rays, Whale Sharks, predatory shark species, other reef fishes, and several invertebrate species. Many of these animals, especially the charismatic megafauna, are what draw recreational divers to the Maldives.

Sadly, we've witnessed accelerating signs of degradation throughout the Maldives since 2015. We have documented the collapse of dozens of reef systems following the bleaching event, reef-wide losses of corals from Crown-of-Thorns Starfish, and reefs buried under sediment to construct artificial islands. But we've also found key reef environments that have survived mass bleaching and are unaffected by coral predators and human impacts. Many of these are in the remote northern and southern Maldives, making them worthy of protection before development encroaches.

Coral survival following the severe bleaching event in 2016 was greatest on the deeper reefs, but areas of high water currents around channels and at the edges of the atolls, as well as the reefs in more turbid waters, also fared better. Typically the submerged reef systems, known locally as *thilas* and *farus*, tended to have more remaining



Close-up of a single 40-inch (1-m) high staghorn coral colony.

coral than emergent fringing reefs, partly because they experience much greater water circulation due to tidal flow and currents. Small corals, both juveniles and newly settled recruits, also exhibited higher survival, while the large conspecific adults perished. These corals provided the seed stock to rebuild the reef and have continued to grow, and after two years many are now large enough to reproduce, spreading their offspring to other areas that were devastated by bleaching.

#### BLEACH-RESISTANT REEFS

This past January, while assessing the habitats surrounding a new resort in the southern Maldives on Gaafu Alifu Atoll, we found a high number of intact reefs that resisted bleaching and contain thriving coral communities dominated by many species of coral that are rare

Large groupers are abundant on lagoonal reefs on Gaafu Alifu Atoll. The Squaretail Grouper (*Plectropomus areolatus*) shown here is swimming among foliaceous *Echinopora* coral that survived bleaching.



Juvenile Napoleon Wrasse are extremely abundant on Gaafu Alifu Atoll and are fully protected in the Maldives. This species is rare in other countries due to intensive harvesting to support the live reef fish food trade.

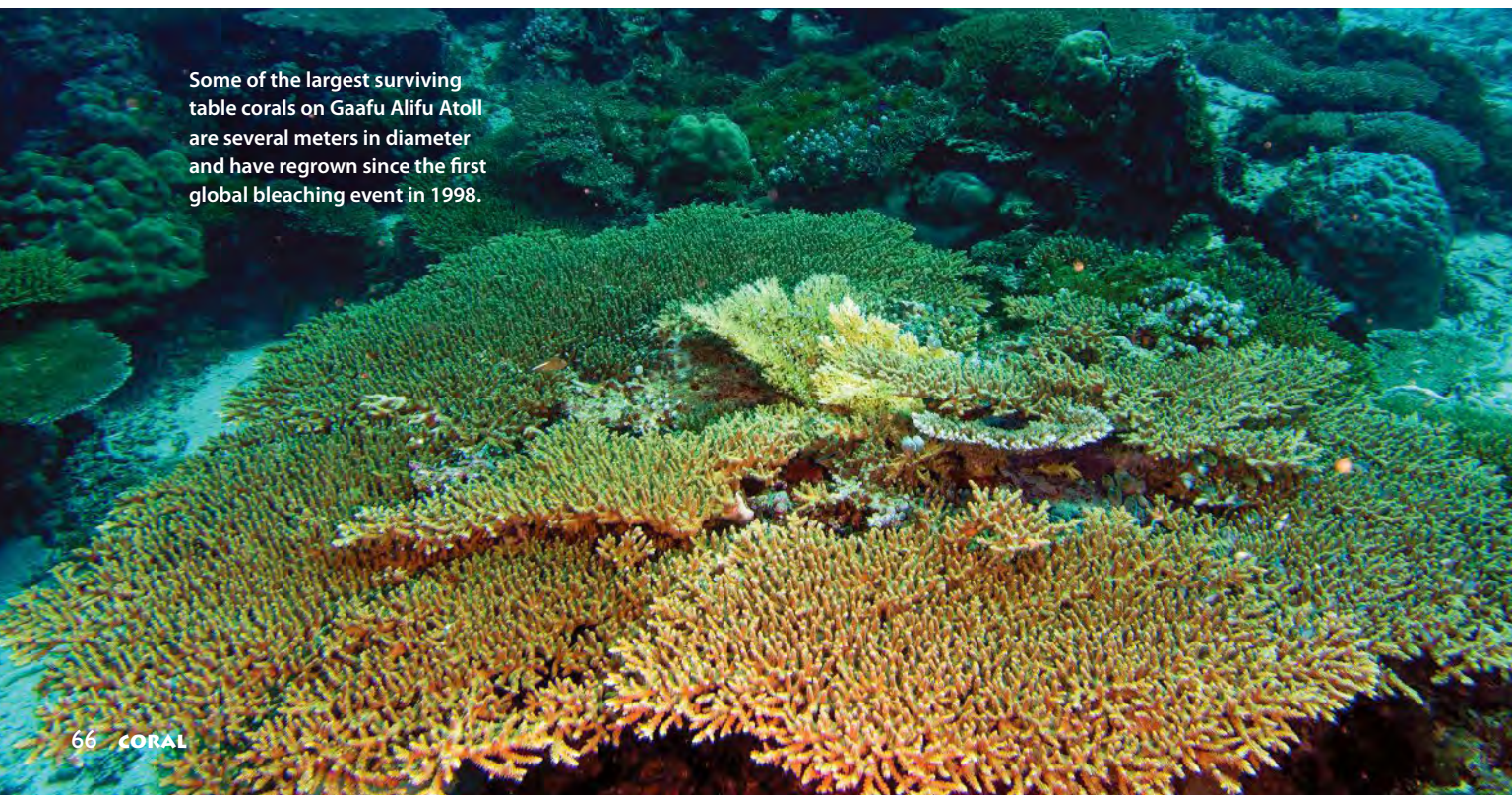


elsewhere. They exhibit good water quality and the reef substrates have remained clean of fleshy macroalgae, due to an abundance of herbivorous reef fishes that keep it under control. There is also a high cover of red crustose coralline algae, which is essential for the settlement and growth of new corals. These reefs support large numbers of endangered Napoleon Wrasse (*Cheilinus undulatus*), as well as healthy populations of predatory groupers, snappers, and sharks, including rare species such as the Spinner Shark (*Carcharhinus brevipinna*) and the Tiger Shark (*Galeocerdo cuvier*). On both outer, exposed fore reef environments and lagoonal patch reefs, we've found thriving stands of staghorn coral, acres of table acroporids, and fields of foliaceous lettuce corals. Wherever there is a dead coral, its skeleton has been colonized by other corals, especially the genus *Acropora*, which sustained the greatest mortality elsewhere in the Maldives.

Since the 2016 bleaching event, Coral Reef CPR scientists have surveyed over 150 reefs in the Maldives and

have identified key ecological, biological, environmental, and human factors that must be considered when selecting and protecting Hope Spots. The most resilient reefs are those exposed to strong currents, tidal flow, and good water exchange and those found on the outer edges of the atolls, where upwelling and influx of nutrients associated with the winter and summer monsoons are greatest. Most of these are in the remote northern and southern unpopulated, unfished regions of the Maldives. Healthy reefs also occur in the central Maldives, and even many of the reefs that were damaged by Crown-of-Thorns Starfish and coral bleaching show signs of hope. But the survival of these reefs and other reefs around the world requires more conservation support, expanded local engagement in resource management, greater dependence on and recognition of the importance of local marine resources as a draw for tourism and not for extraction, and protective cultural taboos. There are many bright spots that offer hope for the future, but social

Some of the largest surviving table corals on Gaafu Alifu Atoll are several meters in diameter and have regrown since the first global bleaching event in 1998.







A diverse assemblage of acroporid corals on the reef slope on the outer edge of Gaafu Alifu atoll.



A thicket of black coral (*Antipatharia* spp.) on the edge of a deep thila.

factors, behavioral changes, and innovative governance are key to the long-term survival of coral reefs.



**Andrew Bruckner, Ph.D.**, is a former coral ecologist for NOAA, former chief scientist for the six-year Global Reef Expedition, and currently director of the non-profit Coral Reef CPR, based in Sandy Spring, Maryland. **Georgia Coward** is a British fisheries biologist and program manager of Coral Reef CPR in the Maldives.

**REFERENCES**

Coral Reef CPR: <http://www.coralreefcpr.org>

Mission Blue, Sylvia Earle Alliance: <https://mission-blue.org>

A shark in the sea is worth 100 times more than a shark in our soup



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