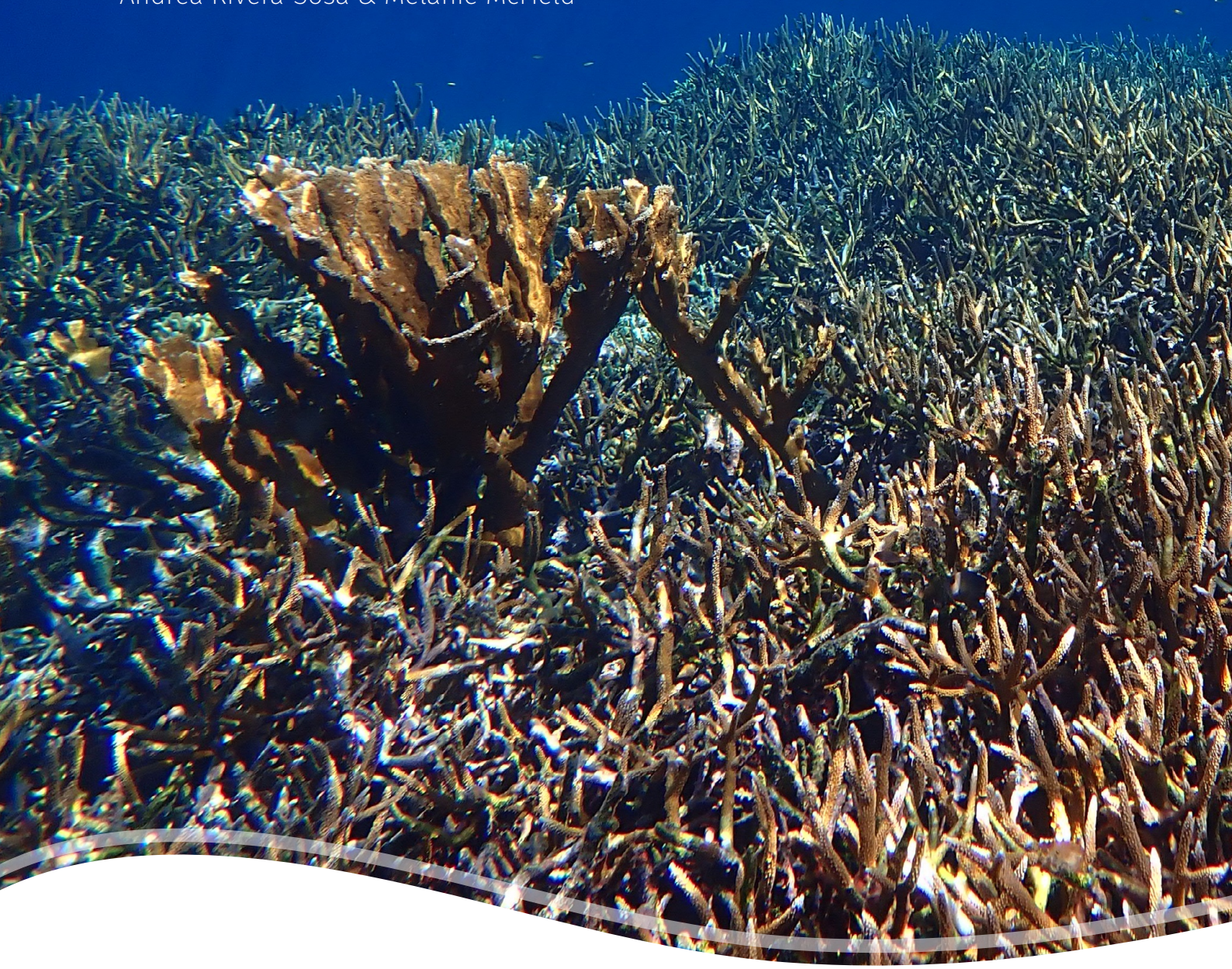
GCRMN
Global Coral Reef Monitoring Network

ICRI
International Coral Reef Initiative

STATUS & TRENDS OF **CARIBBEAN** CORAL REEFS: 1970 - 2024

Executive summary

Edited by Jérémy Wicquart,
Laëtitia Mathon, Auriane Petit,
Andrea Rivera-Sosa & Melanie McField



UN environment programme

Caribbean Environment Programme

SPAW • RAC

Healthy Reefs for healthy people

Global Fund for Coral Reefs

DEDICATION

This report is dedicated to the numerous individuals who have worked to study, conserve and protect our coral reefs. We also recognize the International Coral Reef Initiative and partners, and particularly the people of all territories and nations throughout the Wider Caribbean region who continue to strive for the existence of healthy coral reefs for future generations.

CITATION

Wicquart, J., Mathon, L., Petit, A., Rivera-Sosa, A., and McField, M. (eds.), 2025. Status and Trends of Caribbean Coral Reefs: 1970 – 2024. Global Coral Reef Monitoring Network (GCRMN) and International Coral Reef Initiative (ICRI). DOI: https://doi.org/10.59387/BDHF9180

CITATION FOR INDIVIDUAL CHAPTERS

Authors. Chapter title. In Wicquart, J., Mathon, L., Petit, A., Rivera-Sosa, A., & McField, M. (eds.), 2025. Status and Trends of Caribbean Coral Reefs: 1970 – 2024. Global Coral Reef Monitoring Network (GCRMN) and International Coral Reef Initiative (ICRI). DOI: https://doi.org/10.59387/BDHF9180

DOI

https://doi.org/10.59387/BDHF9180

FRONT COVER

Healthy reef community of *Acropora cervicornis*, Roatan, Honduras, 2019.
© Melina Soto / Healthy Reefs for Healthy People

GRAPHIC DESIGN

Julia Bos - Ecodyssey

GCRMN
Global Coral Reef Monitoring Network

ICRI
International Coral Reef Initiative

GCRMN Global Coral Reef Monitoring Network
www.gcrmn.net

ICRI International Coral Reef Initiative
www.icriforum.org

KEY POINTS

- Coral reefs of the GCRMN Caribbean region cover **24,230 km²,** which represent **9.7%** of the world's coral reef extent.
- Hard coral cover **declined by 48%** from 1980 to 2024, meaning that hard corals now occupy half of the benthic cover they occupied in 1980.
- Hard coral cover **declined** sharply in **1998** (-9.0%), **2005** (-17.1%), and **2023** (-16.9%) due to bleaching events induced by thermal stress, and coral disease.
- *Acropora* cover remained low between 1980 and 2024, averaging around **1.8%**, far below the values of the early 1970s, which were closer to **16%**. In contrast to these branching species, the benthic cover of *Orbicella* and *Porites*, which encompass more massive hard corals, has remained stable or even increased over the same period. This shift in hard coral species dominance has likely reduced the **structural complexity** of Caribbean coral reefs.
- Macroalgae cover **increased by 84.8%** from 1980 to 2024 likely due to the decline in herbivorous species (*e.g.* parrotfish, sea urchins) and the increase in nutrients.
- Mean sea surface temperature over coral reef areas across the Caribbean **increased by +1.07°C** between 1985 and 2024, driven by climate change, representing a warming rate of **0.27°C** per decade.
- The number of people living within 20 km from coral reefs increased by **27.6%** from 2000 to 2020 at the regional scale, representing an increase of **13 million people**.

Introduction

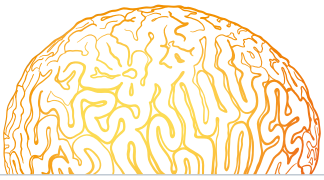
Coral reefs are among the most diverse ecosystems on Earth, supporting around one third of all named marine species[1]. Beyond their ecological importance, they provide essential ecosystem services to human societies, protecting coastlines from storms, supporting food security through fisheries, and generating income from tourism. However, coral reefs are increasingly threatened by a range of direct and indirect human pressures, including climate change, pollution, and unsustainable fishing practices.

Recognizing the urgency of these threats, global, regional, and national frameworks, such as the Kunming–Montreal Global Biodiversity Framework, must be implemented to ensure the effective conservation and sustainable management of coral reef ecosystems. Measuring progress toward these goals, and adjusting strategies where necessary, requires robust quantitative syntheses conducted at large spatial scales.

Established in 1995 as an operational network of the International Coral Reef Initiative (ICRI), the Global Coral Reef Monitoring Network (GCRMN) plays a central role in this effort. By providing the best available scientific data, the GCRMN informs policy, strengthens management, and strengthens capacity for coral reef conservation worldwide. Organized through ten regional nodes, including the Caribbean, the network regularly publishes global and regional assessments on the status and trends of coral reefs.

The previous regional assessment for the Caribbean, "*Status and Trends of Caribbean Coral Reefs: 1970–2012*", was published in 2014 and incorporated data up to 2012. Since then, numerous local studies have documented ongoing coral reef degradation across the region. More recently, the *Status of Coral Reefs of the World – 2020* report confirmed the continued decline of Caribbean reefs. In response to these alarming observations, the Specially Protected Areas and Wildlife - Regional Activity Center (SPAW-RAC) and the United Nations Environment Programme (UNEP) initiated the development of a new regional assessment, supported by the Global Fund for Coral Reefs (GFCR).

The present report, "*Status and Trends of Caribbean Coral Reefs: 1970–2024*", is the culmination of nearly two years of collaborative work involving nearly 300 contributors across the region. It provides an updated, comprehensive overview of the evolution of key threats affecting Caribbean coral reefs and examines the major changes observed in benthic community composition over the past four decades. This report also highlights urgent priorities for conservation and management across the Caribbean.



[1] Fisher, R., O'Leary, R. A., Low-Choy, S., Mengersen, K., Knowlton, N., Brainard, R. E., & Caley, M. J. (2015). Species richness on coral reefs and the pursuit of convergent global estimates. Current Biology, 25(4), 500-505.

Regional context

The GCRMN Caribbean region hosts 24,230 km² of coral reefs, which represent 9.7% of the world's coral reef extent. The coral reefs in this region fall under the jurisdiction of 44 different countries and territories, with coral reef extent varying significantly from 4 km² in Sint Maarten to 4,931 km² in Cuba.

We estimated that 47 million inhabitants lived within 20 km from a coral reef in the Caribbean in 2020. Many eastern Caribbean island nations, like Barbados, Antigua and Barbuda, or Saint Lucia, have nearly their entire populations living within 20 km from a coral reef. On the contrary, in continental countries like Mexico, Honduras, and Venezuela, only a small percentage of the total population lives close to the sea, and therefore to the reefs. From 2000 to 2020, the number of people living within 20 km of a coral reef of the Caribbean grew by 27.6%, representing 13 million additional people.

Coral reefs in the Caribbean provide multiple ecosystem services, and are valued at $6.2 billion annually in fisheries and tourism benefits. Along with adjacent coastal ecosystems (mangroves, seagrass), their value can increase to $15 billion annually. These reefs support diverse fisheries, including species like snappers, groupers, and spiny lobsters, that are essential sources of protein and micronutrients, particularly in small island developing states. Coral reefs also act as natural barriers that mitigate the impacts of wave energy and storm surges, thereby protecting coastal communities and ecosystems. Finally, by stimulating tourism and sometimes even being the driving force behind it, coral reefs provide significant economic benefits to coastal populations. Coral reefs are also important from a social and cultural perspective, influencing how people throughout the region rely on and connect with the marine environment.

Methods used

We estimated the temporal trends in five major benthic categories (hard coral, macroalgae, turf algae, coralline algae, and other fauna), and three hard coral genera (*Acropora*, *Orbicella*, *Porites*), through the integration of 72 datasets. Together, these datasets represent a total of 13,864 monitoring sites, on which 23,742 surveys were conducted between 1973 and 2024. The temporal trends were estimated using machine learning models to take the bias of the non-homogeneous distribution of monitoring data over space and time into account.

Results

Decrease in hard coral cover

Early monitoring data indicate that hard coral cover across the Caribbean ranged between 29% and 38% before 1983[2]. While higher than present hard coral cover, these values do not represent pristine coral reef conditions in the region, as human stressors were already affecting these ecosystems at that time. Between 1983 and 2024, our analyses reveal that hard coral cover has declined by half, from 28.1% in 1980–1985 to 14.6% in 2019–2024. Major declines coincided with region-wide mass bleaching events driven by thermal stress, notably in 1998 (-9%), 2005 (-17.1%), and 2023–2024 (-16.9%)[3]. Given the limited data available for 2024, the impact of the most recent, and continuing, fourth global bleaching event[4], is likely underestimated in this assessment. In addition, hard coral diseases such as white band disease and stony coral tissue loss disease have contributed to the long-term decline in hard coral cover, with more chronic and spatially variable impacts than bleaching events.

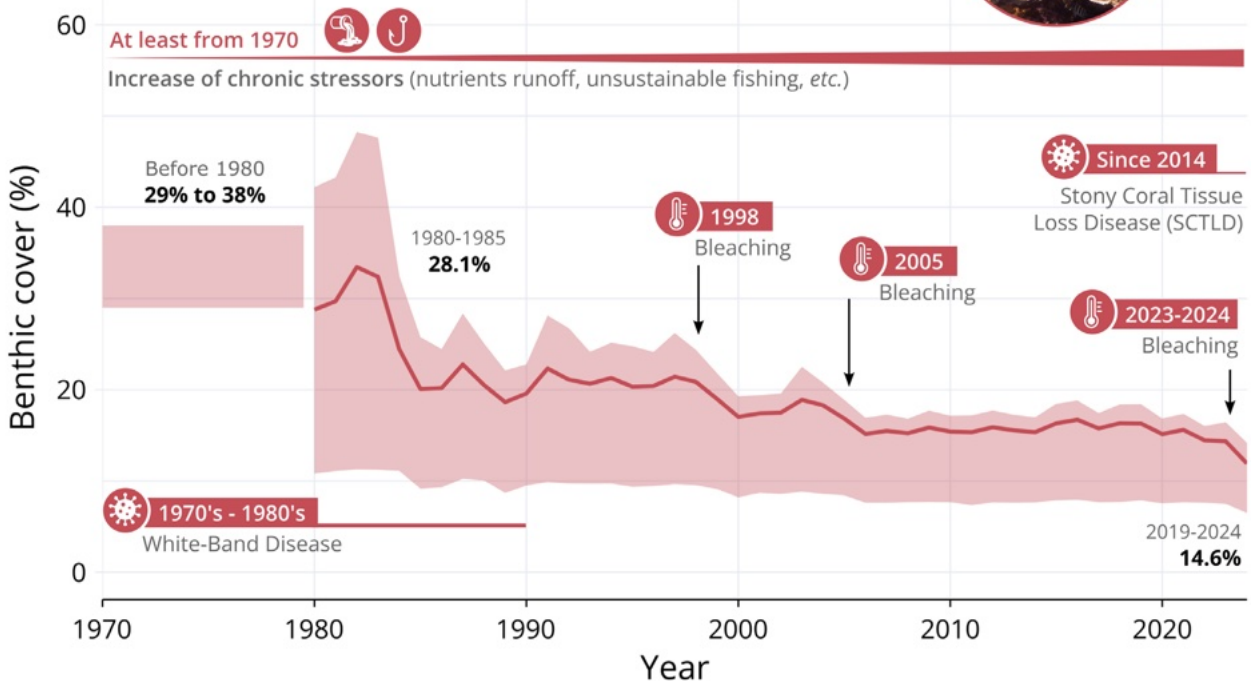
[2] Jackson, J. B. C., Donovan, M. K., Cramer, K. L., & Lam, V. V. (Eds.) (2014). Status and Trends of Caribbean Coral Reefs: 1970–2012. Global Coral Reef Monitoring Network.

[3] The percentages indicate the relative decline, not the absolute decline, in hard coral cover.

[4] Reimer, J. D., Peixoto, R. S., Davies, S. W., Traylor-Knowles, N., Short, M. L., Cabral-Tena, R. A., ... & Voolstra, C. R. (2024). The fourth global coral bleaching event: where do we go from here?. *Coral Reefs, 43*(4), 1121-1125.

Changes in hard coral cover in the Caribbean from 1970 to 2024

The bold line represents the average, while the ribbon indicates the confidence interval at 95%



Change in hard coral assemblage

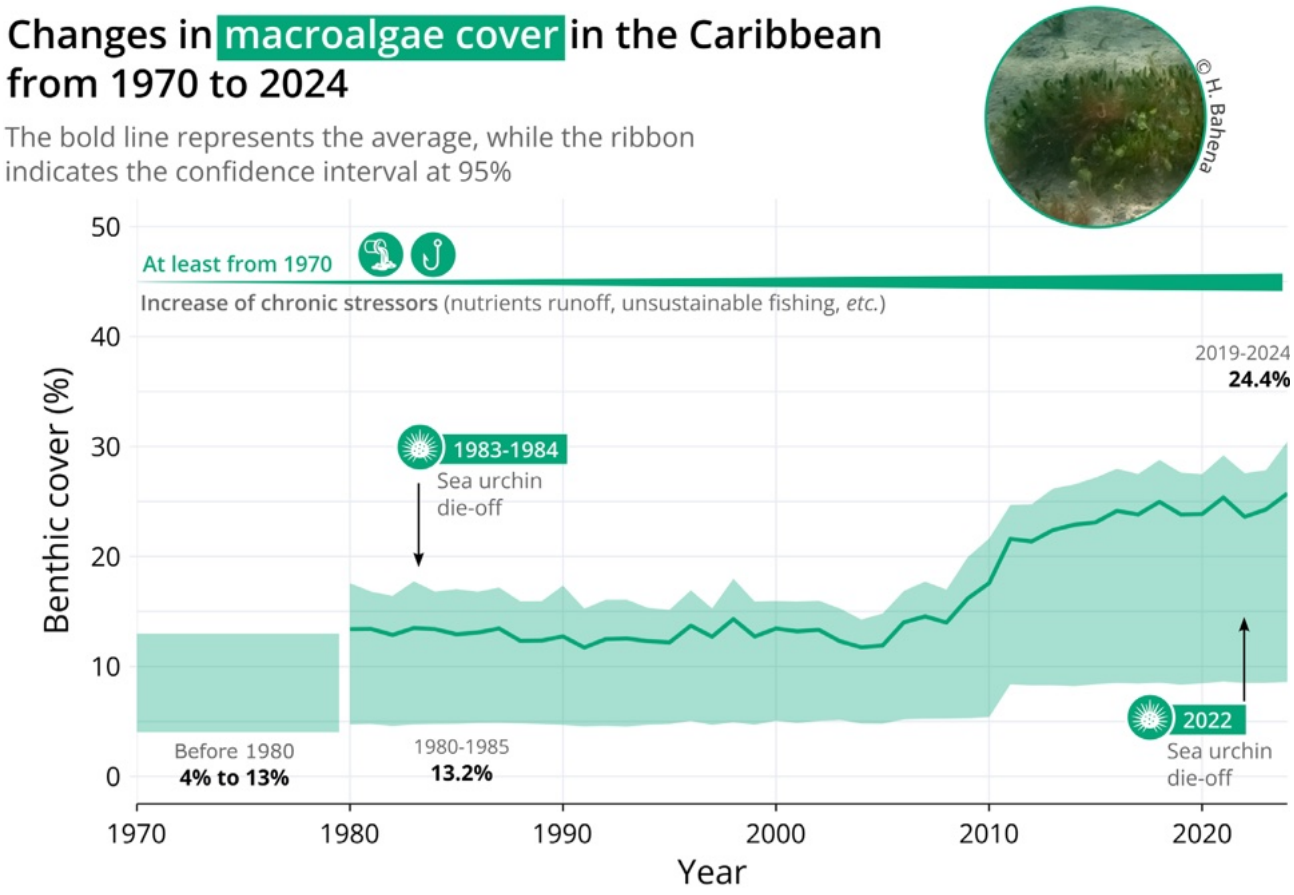
The overall decline in hard coral cover observed over the study period conceals contrasting trajectories among the major hard coral genera in the region. Previous studies have shown that *Acropora* spp., which represented approximately 16% of the benthic cover in the 1970s, declined sharply before 1980 due to anthropogenic stressors and widespread outbreaks of white band disease[5]. Since then, our results indicate that the benthic cover of these branching hard coral species has remained low since 1980, averaging around 1.8%. *Orbicella* spp. cover, which includes massive hard coral species, declined following the 1998 bleaching event and stabilized from 2009 onward at approximately 5%. In contrast, *Porites* spp. cover increased by 164% between 1980 and 2024, reaching an average percentage cover of 3.7% in 2019-2024. Together, these trends suggest a profound reorganization of hard coral assemblages over the past decades, marked by the loss of branching species and the relative rise of more stress-tolerant, massive forms. This compositional shift toward stress-tolerant massive hard corals likely reduced habitat complexity and biodiversity, thus affecting ecosystem services.

Increase in macroalgae cover

Early monitoring data indicate that macroalgae covered between 4% and 13% of Caribbean reefs before 1983[6]. In contrast to hard corals, macroalgal cover has increased by 84.8% between 1980 and 2024. After a period of high variability in the first two decades of monitoring, turf algae also expanded, rising by 64.7% since 2001. Two main factors have been suggested to explain these trends. First, the loss of herbivory following the decline of parrotfish and surgeonfish populations, coupled with mass die-offs of the long-spined sea urchin (*Diadema antillarum*) in 1983-1984 and again in 2022. Second, declining water quality, reflected in increased nutrient loads, sedimentation, and turbidity, has further favored macroalgae and turf algae proliferation. Together, these processes have reduced grazing pressure while stimulating algal growth, leading to sustained increases in macroalgae and turf algae cover. Because these algae compete directly with hard corals for space, this expansion further limits coral recruitment and growth, hindering hard coral cover recovery across the Caribbean.

[5] Cramer, K. L., Jackson, J. B., Donovan, M. K., Greenstein, B. J., Korpanty, C. A., Cook, G. M., & Pandolfi, J. M. (2020). Widespread loss of Caribbean acroporid corals was underway before coral bleaching and disease outbreaks. *Science Advances, 6*(17), eaax9395.

[6] Jackson, J. B. C., Donovan, M. K., Cramer, K. L., & Lam, V. V. (Eds.) (2014). Status and Trends of Caribbean Coral Reefs: 1970–2012. Global Coral Reef Monitoring Network.



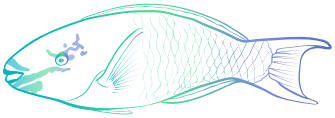
Increase of threats

Climate change

Climate change is an escalating threat to Caribbean coral reefs, driven by rising atmospheric greenhouse gas concentrations over the past century. Between 1985 and 2024, sea surface temperatures across Caribbean coral reefs increased by an average of 1.07°C, representing a warming rate of 0.27°C per decade. Coral reefs from all countries and territories in the region experienced this warming, with the largest long-term increases recorded in Mexico (Gulf of Mexico), Guatemala, and the Flower Garden Banks National Marine Sanctuary, where sea surface temperatures rose by about 1.4°C.

In parallel, marine heatwaves—periods of unusually high and prolonged sea surface temperatures—have become more frequent, intense, and longer-lasting under climate change. These events, especially those in 1987, 1998, 2005, 2010, 2015–2017, 2020, and 2023–2024, have led to bleaching events.

Caribbean coral reefs have also been exposed to more intense hurricanes as a consequence of climate change. From 1980 to 2024, we estimated that 171 hurricanes passed within 100 km of coral reef systems, with notable peaks in 1995 (11 hurricanes), 2005 (15), and 2017 (10). While the impacts of these storms vary by intensity and location, they often result in severe structural damage to coral reefs. Climate projections indicate that while the overall frequency of hurricanes may remain stable toward the end of the century, their intensity is expected to increase, potentially leading to increased damage of coral reefs.



Water quality

Beyond the global impacts of climate change, Caribbean coral reefs have been increasingly threatened by local and direct human activities. The significant increase in human population throughout the region in the last decades has led to greater pressure on coastal ecosystems. Nutrient and sediment inputs from agriculture and coastal development have increased substantially, contributing to a decline in water quality and a widespread rise in macroalgae cover. Chemical and plastic pollution have increased significantly, with microplastic densities in oceans doubling each decade since 1970. This pollution poses a serious threat to coral reefs by exacerbating bleaching and diseases. In parallel, the expansion of maritime traffic, including cargo and cruise shipping, has increased physical damage while contributing to the degradation of water quality.

Diseases

Caribbean coral reefs have faced increasing frequency and severity of disease outbreaks in recent decades, driving widespread mortality among hard corals and reef organisms. Linked to rising sea temperatures, pollution, and other human impacts, these diseases are accelerating reef degradation and biodiversity loss. During the 1990s, several diseases emerged in the Caribbean: the yellow-band disease led to massive loss of *Orbicella* spp., the white-band disease affected acroporids massively, while the white plague led to the loss of multiple species. Stony Coral Tissue Loss Disease (SCTLD), first detected by the Port of Miami, Florida in 2014, is the latest disease affecting over 30 species of corals in at least 30 Caribbean countries, with extremely high mortality. It is considered the most devastating coral disease ever recorded, as even minimal infection can trigger outbreaks and threaten long-term coral recovery by affecting coral recruits. Populations of the sea urchin *Diadema antillarum,* once the most abundant herbivore whose grazing reduces turf and macroalgae, have collapsed due to two extreme mortality events, in 1983-84 and 2022, leading to a severe reduction in grazing pressure across the Caribbean.

Unsustainable fishing

Coral reefs across the Caribbean are increasingly threatened by unsustainable fisheries targeting carnivorous fish, herbivores, and invertebrates. Overfishing of top predators like groupers, snappers, and sharks has disrupted food webs and reduced reef resilience. Herbivorous fish, such as parrotfish and surgeonfish, are essential to maintain a low algal cover and enhance coral recruitment. However, they have been increasingly targeted by small-scale fisheries, exacerbating algal overgrowth. Key invertebrate species, including spiny lobsters and queen conch, also face steep declines due to intense fishing, habitat degradation, pollution and weak regulations and enforcement. These combined impacts threaten marine biodiversity, ecosystem functions, and the livelihoods and food security of coastal communities throughout the region.

Invasive species

Finally, Caribbean coral reefs are under threats of invasive species, notably Lionfish (*Pterois volitans*), for almost two decades, and more recently of soft coral species *Unomia stolonifera* (first recorded in Venezuela in 2014), *Xenia umbellata* (first reported in Puerto Rico in 2023) and *Latissimia ningalooensis* (reported in Puerto Rico in 2025). These soft coral invasions have caused major ecological disruptions on Caribbean reefs by overgrowing hard corals and shifting benthic community structure, due to their resilience and rapid growth. The rapid expansion of these species might have unforeseen negative consequences for coral conservation/restoration efforts.

Recommendations

To reverse the decline of Caribbean coral reefs, coordinated action is urgently required across five key areas: integrating coral reefs into national and regional strategies, reducing local and global threats, strengthening protection and management of protected areas, maintaining and improving monitoring systems, and scaling up restoration efforts.

1. Integrate coral reef protection and restoration into climate and biodiversity strategies

Coral reefs must be embedded in global and national climate and biodiversity frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC) and Convention on Biological Diversity, by supporting Governments to incorporate reefs into Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs), National Biodiversity Strategies and Action Plans (NBSAPs), and National Biodiversity Finance Plans (BFPs). As natural infrastructure and nature-based solutions, reefs provide mitigation, adaptation, and biodiversity benefits. A stronger regional and global collective effort including climate and biodiversity finance, and targeted capacity development is needed to support Caribbean states, which are composed of ⅔ of Small Island Developing States, in protecting biodiversity, reducing pollution (Cartagena Convention), strengthening regional cooperation (CARICOM, OECS, OCM, ACS), and advancing blue economy strategies that translate these commitments into tangible projects.

2. Reduce local threats and greenhouse gas emissions

Countries must focus on reducing the threats affecting coral reefs. According to global climate commitments under the UNFCCC and the Paris Agreement, all countries share responsibility for accelerating the transition to renewable energy, reducing reliance on fossil fuels, and protecting key carbon sinks such as mangroves and seagrasses. While Caribbean nations are among the least responsible for historical greenhouse gas emissions, they have nonetheless committed to advancing these goals through their own nationally determined contributions and regional initiatives. Reducing local pressures requires sustainable coastal development through Integrated Coastal Zone Management, Marine Spatial Planning, strong environmental impact assessments, and improved wastewater and solid waste management to prevent eutrophication and pollution. The spread of invasive species could be curbed by strengthening the legal and regulatory framework governing the aquarium trade. Sustainable fisheries should be promoted through seasonal closures, catch limits, and herbivore protection, while tourism must transition toward low-impact, certified sustainable models. Blended-finance initiatives, such as those under the Global Fund for Coral Reefs, can support these transitions.

3. Strengthen protection through effective area-based management tools

Achieving the Kunming–Montreal Global Biodiversity Framework "30x30" target is essential to ensure a sustainable future for coral reefs, and will require expanding and effectively managing ecologically connected Area-based Management Tools, including marine protected areas (MPAs), with enforced fully-protected zones and co-managed areas. Strengthened governance, stakeholder engagement, and community-based management are critical for long-term success. Governments should prioritize integrated management plans, ensure robust enforcement, and secure sustainable funding through partnerships. Capacity-development, educational programs and cooperation networks (*e.g.*, SPAW protected area manager network, MPA Connect, Red Golfo) should be strengthened to improve management effectiveness across the region.

4. Maintain and enhance coral reef monitoring

Comprehensive and long-term monitoring is essential for understanding reef trajectories and guiding adaptive management, including restoration. Monitoring should be spatially representative and standardized across the region, encompassing indicators such as hard coral cover by species, hard coral demography, abundance and size of key functional fish groups, water quality, invasive species, and disease prevalence. Decision-oriented monitoring frameworks should link data to management actions. Data sharing should follow FAIR (Findable, Accessible, Interoperable, Reusable) data principles, using platforms like AGRRA, ReefCloud, and MERMAID, and capacity should be built for local and citizen-led data collection. Developing or improving analytical tools that allow more straightforward analysis of the data collected would be helpful for future region-wide assessments.

5. Scale up restoration to enhance resilience

Restoration has matured into a vital tool for boosting reef recovery. Restoration efforts should be embedded in wider management plans and not implemented independently. Enhancing sexual reproduction, genetic diversity and thermotolerance and improving key ecological processes that increase early-stage coral survival can strengthen ecosystem resilience to stress. Efforts could also focus on expanding coral gardening and larval propagation, deploying artificial reefs aligned with marine spatial planning, and enhancing herbivore populations—particularly *Diadema antillarum* and alternative grazers. Partnerships with the tourism sector and innovative financing models such as "Restoration-as-a-Service" can align ecological goals with economic benefits. Scaling up these initiatives requires long-term financing, standardized monitoring, and regional collaboration to maximize ecological, social, and economic outcomes.

GCRMN

Global Coral Reef Monitoring Network

Global Coral Reef Monitoring Network
GCRMN Caribbean
gcrmn.net/caribbean

UN environment programme

Caribbean Environment Programme

Global Fund for Coral Reefs

UNDP

UNCDF

An initiative of the African, Caribbean and Pacific Group of States funded by the European Union

ACP MEAs 3

Proyecto PAE GEM Golfo de México

UNOPS

NOAA

gef

Medio Ambiente
Secretaría de Medio Ambiente y Recursos Naturales

République Française
Liberté
Égalité
Fraternité

Gouvernement Princier
Principauté de Monaco