

## **The Hidden Jewel of the Caribbean: The Cayman Crown Reef**

### ***Discovery of the Cayman Crown Reef and Brief Summary of its Importance***

In the heart of the Mesoamerican Reef (MAR), a remarkable discovery reshaped our understanding of coral reefs in Guatemala and Southern Belize. It was during 2013 when Ana Giró from Healthy Reefs for Healthy People (HRHP, previously HRI), engaged with local fishermen who ventured into the deeper waters fishing for sharks. It was during these interactions that one fisherman mentioned spotting what he colloquially referred to as "rocks" (local slang for coral reefs) upon returning from his fishing trips.

Intrigued by this revelation, Ana and her team initiated exploratory efforts in the area and began to map the uncharted waters between Guatemala and Belize, stumbling upon unusual underwater formations. Fascinated by this discovery, they decided to investigate further. What they found was nothing short of spectacular: a reef with complex geomorphology of crown-like structures and dramatic walls that seemed to dive straight into the abyss of the Cayman Trench. Inspired by its distinctive crown-like shape and location, they named it the Cayman Crown Reef.

Realizing the significance of their discovery, the team documented the location, depths, structure, and the diverse marine life that thrived in this previously unknown ecosystem. They conducted bathymetric mapping, revealing the reef's (shallow and deep) dimensions—15 km long by 6 km wide. Their recordings showed that the Cayman Crown Reef was not just another coral reef but a vital part of the underwater landscape linking the Guatemala and Belize shallows with the depths of the Cayman Trench. Its significance extends beyond local boundaries, fostering connections with reefs throughout the Trench, including those in the Cayman Islands and the wider Caribbean. The currents in this region enhance the connectivity between these areas, which well-managed, may promote both biodiversity and ecological resilience. The discovery of this reef system is not only a testament to the persistence and curiosity of scientists but also a reminder of the many mysteries still hidden beneath the ocean's surface, waiting to be uncovered.

Over the last years, there have been numerous expeditions to this site, each uncovering more details about its uniqueness. The geomorphology of the reef system is composed of spur and groove reefs with steep walls that drop vertically from the shelf edge at 30 m to waters that are over 300 m deep; the shallow coral reef areas are between 10-15m deep. Notably, the reef boasts a remarkable live coral cover exceeding 50.3% (as of 2023), far surpassing the MAR average of 17%. Moreover, the area hosts multiple Fish Spawning Aggregation (FSA) sites vital for the reproductive cycles of numerous commercially important fish species, like snappers and groupers.

It was during these findings that the urgency to protect the reef became evident given its crucial ecological significance and valuable connectivity for the Mesoamerican Reef.

### ***Scientific exploration of the Cayman Crown reef***

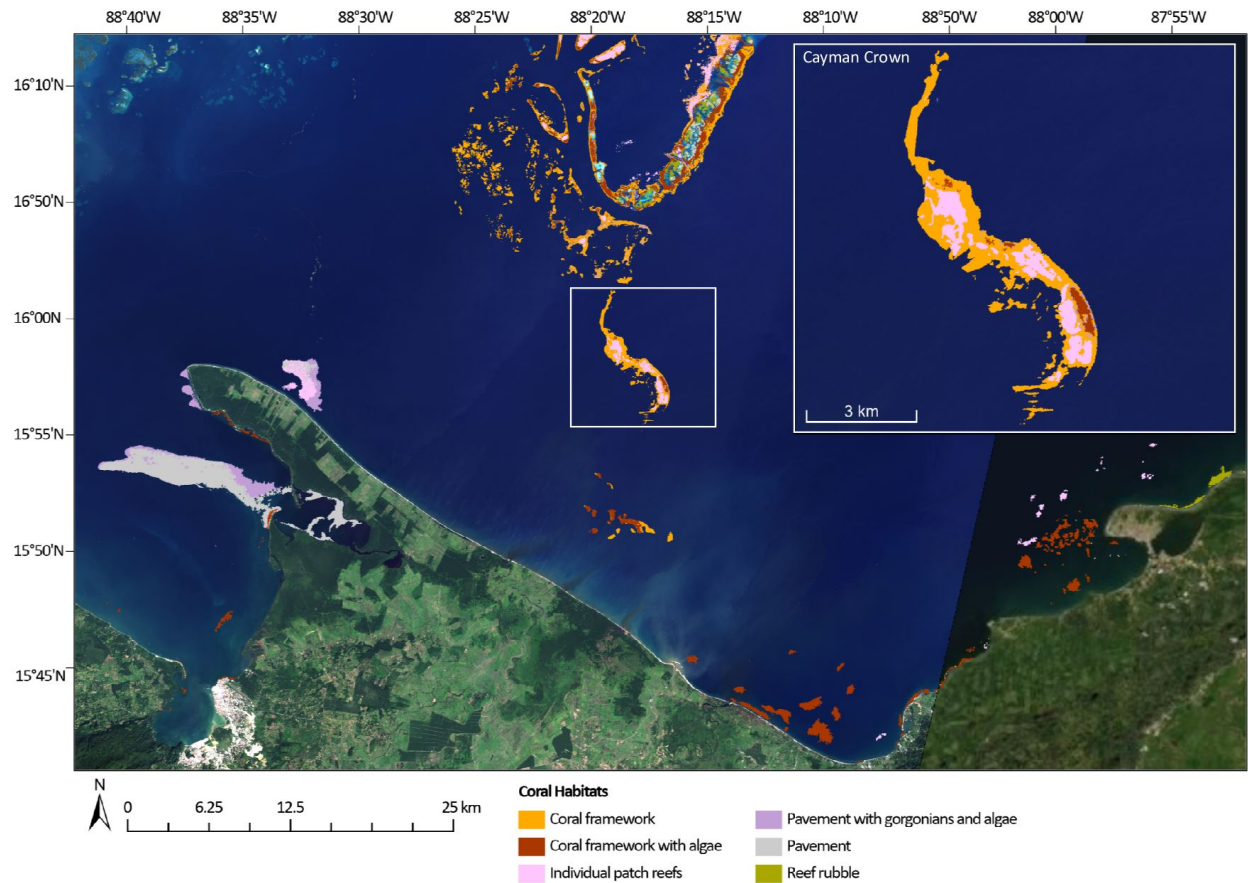
The Cayman Crown Reef isn't just a stunning natural wonder—it's a vital ecosystem that sustains marine life and local communities alike.

Since initial explorations began in 2013, HRHP has played a pivotal role in gathering scientific data: mapping the area, characterizing the reef through exploratory dives, monitoring reef health (Atlantic and Gulf Rapid Reef Assessment - AGRRA), bleaching and disease (particularly Stony Coral Tissue Loss Disease) as well as analyzing temperature recordings. HRHP has also centered their work on the deeper areas of the reef, focusing on identifying FSA through the analysis of acoustic data from hydrophone recordings. These studies have contributed to the regional Reef Health Report Card of the Mesoamerican Reef as well as to its protection and management.

#### - ***Mapping***

Following the reef's discovery and initial exploration, bathymetric mapping was conducted to reveal its underwater structure, which is otherwise hidden from view on the surface. These initial maps provided a foundation for continued research across both shallow and deep reef zones. HRHP collaborated with Lotte Purkis to create detailed habitat maps for southern Belize and Guatemala, including the Cayman Crown Reef, using remote sensing satellite images combined with bathymetric data.

To validate the habitat maps, in-situ ground-truthing was conducted at 144 sites using scuba diving, snorkeling, and camera drops to document the seabed at specific areas. Based on these maps, the shallow reef areas (less than 15 m depth) of the Cayman Crown Reef, which include coral framework, coral framework with algae, and individual patch reefs, cover an estimated 9.64 km<sup>2</sup>. For reefs reaching depths of up to 50 m, the mapped area extends to approximately 9.92 km<sup>2</sup>. However, further exploration is ongoing to assess the full extent of deeper reef areas, as current satellite imagery limitations have restricted detailed mapping at these depths. Initial estimates suggest that these deeper reefs may span an additional 20 km<sup>2</sup>, containing diverse reef structures and other areas with rubble. However, other reef habitats have not been fully explored nor captured in the initial mapping, making its extension larger than the nearly 40 km<sup>2</sup> studied so far.



**Fig. 1.** Map of the coral habitats of the Cayman Crown reef, part of the Sapodilla Cayes Marine Reserve and the Punta de Manabique Wildlife Refuge.

#### - *Reef health, bleaching and disease*

Reef health has been greatly affected over the last years in the Caribbean due to high water temperatures and diseases affecting corals such as Stony Coral Tissue Loss Disease (SCTLD). Ongoing monitoring of the Cayman Crown reef has been essential to understand how the reef is responding to these threats. The scientific data collected is integral to the regional reef health report cards, providing valuable insights into the overall health and resilience of the reef ecosystem. This ongoing research and monitoring are necessary for informing conservation strategies and promoting sustainable management practices to protect this vital marine habitat.

Consistent monitoring of the reef using the AGRR methodology was carried out in 2019, 2021 and 2023. To ensure a comprehensive representation of the reef, four core sites were selected and monitored over time. This long-term data collection is crucial, as it reveals trends and changes in reef health that might not be evident in shorter studies. For Southern Belize and Guatemala data shows that they remain with no recorded cases of SCTLD, which is a positive finding.

However, during recent years there has been a decline in live coral cover at three of the sites, with one particularly emblematic site dropping from 77% in 2019 to 50.3% by 2023. This reduction is largely attributed to prolonged exposure to elevated water temperature, which causes stress on the corals and leads to bleaching.

HRHP has been monitoring bleaching impacts on the Cayman Crown reef for several years (2016, 2017, 2019, 2021, 2022, 2023 and 2024). Old mortality, defined by coral colonies that have died and become overgrown by other organisms, was particularly high in 2024, with 20% recorded. New mortality, marked at 8% for 2024, further highlights the ongoing stress due to the prolonged exposure to elevated water temperatures, with a notable portion of the reef still bleached (2%), partially bleached (7%), and pale (10%) as of March 2024. These findings underscore the persistent threat that climate change poses to coral reefs, not just in Cayman Crown but across the entire Mesoamerican Reef and Caribbean regions. The species most affected by mortality in the Cayman Crown have been the Agaricids. Nevertheless, this site still remains as one of the top 6 highest live coral cover sites within the MAR (2023 data), underscoring its critical ecological value even amid challenging conditions (Annex 1).

Nevertheless, there are encouraging results for fish biomass. While herbivorous fish biomass remained stable at three sites, one site recorded a remarkable increase, rising from 261 g/m<sup>2</sup> in 2021 to 1,983 g/m<sup>2</sup> in 2023. Commercial fish biomass, including species like groupers and snappers, showed minimal change, with overall fish biomass across sites still reflecting poor conditions.

- ***Fish Spawning Aggregation Monitoring using Acoustic Data and Underwater Visual Surveys***

Fish Spawning Aggregations (FSA) are vital for the sustainability and recovery of fish populations, making them a cornerstone of marine conservation efforts. These natural gatherings, where fish come together to reproduce, are crucial for replenishing fish stocks, particularly for commercially important species like groupers and snappers. Understanding the dynamics of FSA can guide conservation strategies, ensuring that these species continue to thrive and support both ecosystems and local economies.

Both HRHP and TIDE have conducted monitoring efforts at the deeper areas of the Cayman Crown reef in search for FSA. These efforts have combined acoustic data collection and underwater visual surveys to increase understanding of fish populations and their behavior during these aggregations. This comprehensive approach has provided valuable insights into the reef's complex structure and identified key biodiversity hotspots. Notably, the geomorphology of these deeper areas features striking vertical walls and isolated pinnacles that rise from the deep ocean and are covered with barrel sponges. These unique geological formations not only shape the reef's habitat but also create critical environments for diverse marine life

Underwater visual surveys done by TIDE have confirmed the presence of three multispecies aggregation sites called The Jewel Wall, West Bezel Fisher Marker and Omoa Fisher Anchor. Despite challenges such as the remoteness of these sites, the transboundary nature of the area, and insufficient enforcement to effectively control illegal fishing activities, the surveys documented 38 commercially important fish species. Evidence of spawning was observed, including gravid females

and changes in coloration patterns in species such as Black, Nassau, and Tiger groupers. During the monitoring seasons from December 2021 to April 2023, 21 dives across four sites provided critical observations, noting the presence of gravid Nassau and Tiger groupers at two of these locations.

Preliminary results from HRHPs acoustic data analysis at the Sassy Wrasse site in Cayman Crown, collected via a SNAP hydrophone, have further enriched these findings. Analysis using FADAR data from December 2021 to March 2022 indicated low detections of species such as Red Hind, Nassau grouper, Yellowfin grouper, and Black grouper (Annex 2). However, there was a substantial increase in the detections of Yellowfin grouper from April to July 2022, suggesting seasonal patterns in their spawning behavior.

These results show the importance of protecting the Cayman Crown reef to ensure the continued recovery and sustainability of fish populations and connectivity within the MAR and across the wider Caribbean. The data collected from these monitoring efforts are instrumental in shaping future marine conservation strategies, including the need for effective enforcement in critical areas.

### ***The Protection of the Cayman Crown Reef***

Even though the Cayman Crown Reef's ecological importance was quickly recognized, sparking concerted efforts to safeguard this important ecosystem, the results of the field expeditions, monitoring efforts, mapping and reef characterization was initially only made public to a handful of people. However, after years of collaboration with various organizations, including government authorities and local communities, a significant milestone was achieved in 2020: the Cayman Crown Reef was officially protected in both Belize and Guatemala. First, Guatemala declared the area a spatial closed zone for 10 years through the Ministerial Agreement 85-2020, meaning that it is a fully protected area. No fishing, no extraction and no damaging activities are allowed. Shortly afterwards, Belize expanded the Sapodilla Cayes Marine Reserve to include the Cayman Crown reef through a statutory instrument that declared the area a Conservation Zone IV, meaning that it is a highly protected area. Some regulated fishing (eg. catch and release, seasonal closures, special permits) and minimal extractions are allowed, but no damaging activities (McField *et al.*, 2022).

It is important to emphasize that this was a great accomplishment for Guatemala, as it is the first fully protected area declared on a coral reef. The newly declared area totals 202 km<sup>2</sup> which raises the percentage of full protection of Guatemala's territorial sea from a low 0.6% to 13.1%. In Belize, all of the expanded reserve now covers over 1,294 km<sup>2</sup>. This victory underscored the commitment of diverse organizations and local communities recognizing the reef not merely as a resource, but as a legacy to be safeguarded for future generations. Further conservation efforts are ongoing in both countries; Guatemala is working to expand the Punta de Manabique Wildlife Refuge to include the Cayman Crown Reef, while Belize is working towards fully protecting the reef.

A vital aspect of protecting the Cayman Crown Reef and other critical marine areas is the rigorous enforcement of conservation legislation. To bolster this effort, organizations are focusing on strengthening the capacity of judicial officers responsible for upholding these regulations. A successful in-person meeting was recently held in Puerto Barrios, setting the stage for ongoing workshops tailored to judicial officers throughout the Mesoamerican Reef (MAR) region. These

workshops are designed to deepen the understanding of marine conservation laws and improve their enforcement.

### ***Initial management of Cayman Crown- TIDE and FUNDAECO***

The initial management efforts to protect the Cayman Crown Reef reflect a story of dedication and collaboration across borders. In Belize, the Toledo Institute for Development and Environment (TIDE) has spearheaded efforts by providing essential resources, such as fuel, to the Belize Coast Guard for patrols, ensuring the reef's protection was not just a plan, but a reality. A Memorandum of Understanding (MoU) was signed between TIDE and the Belize Coast Guard, solidifying their partnership in joint patrols. The station at Hunting Caye was upgraded, enhancing the operational capacity of the enforcement team. The newly established team, comprising a site manager, head ranger, and three rangers, have received extensive training, covering crucial skills like boat handling, drone operations, and the use of the SMART app for monitoring. TIDE's commitment to the reef's conservation was further strengthened by signing a co-management agreement for the Sapodilla Cayes Marine Reserve with the Ministry of Blue Economy and Disaster Risk Management, marking a critical step in bolstering the reef's protection.

Meanwhile, in Guatemala, the Fundación para el Ecodesarrollo y la Conservación (FUNDAECO) has been working to integrate the Cayman Crown Reef area into the Punta de Manabique Wildlife Refuge Reserve. They have had several meetings with the Coastal Marine Alliance to include Cayman Crown's no-take zone in their annual work plan, ensuring its conservation is a priority. A diagnostic study of the coastal marine zone of Punta de Manabique was completed and submitted to the fisheries authority (DIPESCA) and the National Protected Areas Council (CONAP), laying the groundwork for informed decision-making. FUNDAECO also strengthened relations with local fishers through workshops on conflict resolution and the 2023 fishing closed season calendar meeting, fostering a cooperative approach to conservation.

### ***Community Engagement***

Engaging local fishing communities is not just an aspect of conservation efforts; it is the heart of sustainable marine management. Organizations like TIDE (Belize), FUNDAECO (Guatemala), and the Coral Reef Alliance (CORAL, Honduras) have recognized the critical role that fishermen and their communities play in protecting marine ecosystems. By actively involving them in conservation initiatives, these organizations are fostering a sense of stewardship that is vital for the long-term health of the reefs and the communities that depend on them.

TIDE's work in Belize exemplifies this approach. Collaborating closely with local fishing communities, like Monkey River Village, Riversdale Village and Punta Gorda town. TIDE has been instrumental in promoting sustainable fishing practices. Through educational workshops, fishermen have become active participants in safeguarding the marine resources that are essential to their livelihoods.

In Guatemala, FUNDAECO has taken a similar path, engaging communities through environmental education and capacity-building workshops. FUNDAECO has empowered local communities to take an active role in preserving their environment and this approach has strengthened the connection between ecosystem health and community well-being, demonstrating that effective conservation

requires an integration of both ecological and socio-economic considerations. FUNDAECO signed a conservation agreement in April 2024 with the community of San Francisco del Mar to protect the Cayman Crown no-fishing zone, providing support with fishing equipment and boat reconstruction. Additionally, an agreement was signed with the community of Quetzalito in September 2024, in which FUNDAECO agreed to support the construction of a bungalow.

CORAL's initiatives in Honduras further illustrate the importance of community engagement. Partnering with fishermen, CORAL has focused on enhancing sustainable livelihoods while reducing the impact of fishing on the reef. Workshops on the importance of the Cayman Crown Reef and alternative economic opportunities have opened new pathways for communities, helping them to see the value in conservation efforts. It is important to highlight that CORAL has also let the Honduran fishermen know that they are illegally fishing in Cayman Crown as it is out of their territorial waters and that the reef has been highly and fully protected in both Belize and Guatemala, respectively. These initiatives are crucial to creating a lasting commitment to protecting the reef, ensuring that local populations continue to benefit from its resources in a sustainable manner.

The importance of these efforts cannot be overstated. By involving fishermen and their communities in conservation work, these organizations are not only protecting marine ecosystems but also ensuring that the benefits of these efforts are shared with those who rely on them the most. This collaborative approach builds trust, enhances the effectiveness of conservation strategies, and fosters a culture of stewardship that will be essential in the years to come.

Diversifying income sources for fishing communities is a key strategy in reducing pressure on marine resources. CORAL, FUNDAECO, and TIDE are all actively developing projects aimed at providing alternative livelihoods for fishermen who depend on the Cayman Crown Reef. In Honduras, CORAL has initiated an income diversification project; they have signed agreements with three communities—Triunfo de la Cruz, Unión, and Pelicano—through fishing associations in each community to support tourism activities. The project includes crafting key documents, such as a stakeholder map, communication plan, and risk mitigation strategy. Two consultants have been hired to develop the livelihood diversification strategy and support the legalization of fisher associations. Workshops on sustainable tourism and leadership capacity building have also been conducted to empower local fisher associations.

In Guatemala, FUNDAECO is piloting an income diversification project in a community that fishes in Cayman Crown. A consultant has developed a participatory work plan that includes a key stakeholder map, economic development initiatives, and prioritization of viable economic alternatives. Next steps involve preparing a public-private investment plan, sourcing financing for the identified economic alternatives, and implementing a pilot project through a conservation agreement. TIDE, meanwhile, is conducting a feasibility study for income diversification strategies for at least three target fisher communities.

By engaging communities in these ways, these organizations are not only advancing marine conservation but also ensuring that the benefits of these efforts are felt by the people who depend on the ocean the most. This holistic approach to conservation recognizes that healthy ecosystems and healthy communities are inextricably linked, and that protecting one requires supporting the other.

## ***Partnerships***

Given the Cayman Crown's unique location spanning across borders, collaboration between organizations has been essential for its protection. The combined efforts of HRHP, TIDE and FUNDAECO have led to significant advancements in conservation. Their unified approach, formalized through a Memorandum of Understanding (MoU), emphasizes research, communication, enforcement, and community engagement.

## ***Current Threats***

The Cayman Crown Reef, despite its protected status and ecological significance, faces several ongoing threats that jeopardize its health and sustainability. Overfishing has led to the depletion of key commercial fish species that play vital roles in the reef's ecosystem, such as groupers and snappers. While protections are now in place, enforcement remains a challenge in both countries, and illegal fishing activities continue to pose a risk.

Climate change is another pressing threat, contributing to rising sea temperatures and increased frequency of coral bleaching events. Severe bleaching in 2023 served as a stark reminder of the reef's vulnerability to thermal stress, highlighting the urgent need for ongoing monitoring and deployment of feasible interventions.

Pollution from land-based sources adds another layer of threat to the Cayman Crown Reef. Nutrient runoff and sedimentation degrade water quality and increase macroalgal growth that competes with corals and further reduces their health.

Without continued funding and support for conservation efforts, these threats could lead to significant degradation of the Cayman Crown Reef. Ongoing monitoring, community engagement, wastewater treatment, and enforcement regulations are crucial to safeguarding this vital marine ecosystem.

## ***Next steps***

### ***Charting the Future***

As we look to the future, the Cayman Crown Reef remains a symbol of what can be achieved through collaboration and unwavering commitment. However, the work is far from complete. To sustain and expand the progress made, it is crucial to secure ongoing funding and support to maintain rigorous monitoring, patrols, and enforcement at a scale that matches the reef's ecological importance.

The Cayman Crown Reef stands as a beacon of marine conservation success, demonstrating the power of collaborative efforts in protecting and understanding one of the world's most delicate and vital ecosystems. Its story is one of beauty, biodiversity, and a continued commitment to the ocean and its inhabitants.



As we look to the future, the Cayman Crown Reef remains not only a symbol of collaboration and dedication but also an ecologically significant area within the MAR. Like many reefs across the region, it has been affected by rising ocean temperatures and the resulting widespread coral bleaching, underscoring the urgent need for ongoing climate resilience efforts. However, despite these challenges, the Cayman Crown Reef stands among the top six reefs in the MAR with the highest live coral cover, highlighting its ecological importance as one of the healthier coral habitats within an increasingly stressed marine environment.

### ***Call to Action- Safeguarding the Cayman Crown Reef***

The Cayman Crown Reef represents a beacon of hope in the global conservation story. This remarkable ecosystem, straddling Belize and Guatemala, showcases the powerful impact of dedicated conservation efforts and collaboration by organizations like HRHP, TIDE, FUNDAECO, and CORAL. However, to ensure its continued survival and resilience, we must intensify our commitment.

For Belize: Fully protect the Cayman Crown Reef area by establishing comprehensive marine protected areas that encompass its entire ecological range. This step is crucial in safeguarding its biodiversity and maintaining the delicate balance of its marine ecosystems.

For Guatemala: Continue and strengthen the protective measures already in place. Work on the expansion of the Wildlife Refuge Punta de Manabique to include the Cayman Crown reef area. Ensure robust enforcement and adaptive management strategies to counteract the threats facing this vital reef.

Ongoing monitoring and research will be critical to understanding its health and resilience, particularly in the face of climate change. Advanced programs, such as deploying sensors, applying AGRRA protocols, and using novel techniques like photogrammetry, will enable detailed tracking of coral cover, macroalgal growth, fish biomass, water temperature, pH levels, and potential disease outbreaks such as SCTLD. These efforts will provide valuable insights into how the reef is evolving and inform adaptive management strategies to address environmental changes effectively.

Continued engagement with local communities and fishers is critical to ensure that conservation efforts are sustainable. It is important to strengthen relationships and work closely with these stakeholders to promote awareness about the importance of sustainable fishing practices and marine resource management. Through education, workshops, and involvement in monitoring activities, local fishers can be empowered to take an active role in reef conservation, sustainable fishing and protection of FSA.

Effective control and surveillance measures are also necessary to safeguard the reef. This will include monitoring boat activity, particularly around key areas such as FSA sites, to prevent illegal fishing and unsustainable practices. The use of technology, such as hydrophones for acoustic surveillance, can assist in tracking boat presence and ensuring compliance with no-take zones. Collaboration with local authorities and enforcement agencies will be essential to ensure that regulations are properly enforced to maintain the integrity of the Cayman Crown Reef.

Address Climate Change by supporting and advocating for climate action initiatives aimed at mitigating the impacts of global warming on marine environments. This includes advocating for reduced carbon emissions, promoting blue carbon solutions to enhance carbon sequestration, and alleviating local stressors such as overfishing. Establishing MPAs with climate-resilient designs, like incorporating cooler, deeper reef zones, can offer refuges for sensitive species during thermal stress events. Additionally, coral restoration efforts should focus on selective breeding of heat-tolerant corals to boost reef resilience under rising temperatures.

Reduce pollution through promotion and enforcement of policies that limit pollution from land-based sources and maritime activities.

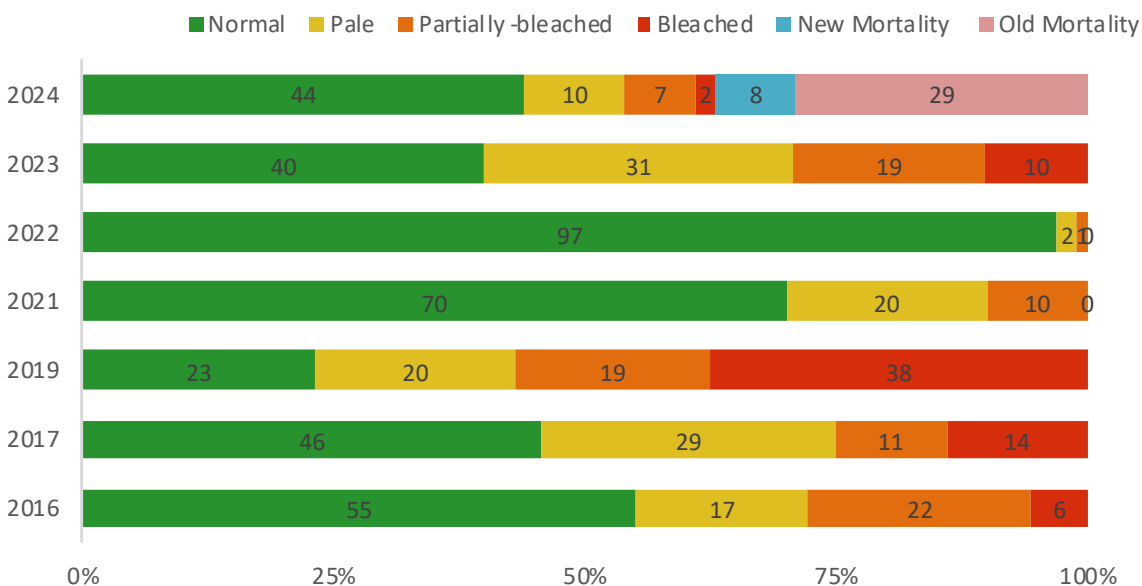
Increase public awareness by educating local communities and the global public about the importance of the Cayman Crown Reef and the actions needed to protect it.

Together, let's champion the Cayman Crown Reef and ensure that its legacy of resilience and beauty continues to inspire future generations.

***Thank you, Your Support is Key to the Cayman Crown Reef's Conservation Success***

We extend our heartfelt gratitude to the French Facility for the Global Environment (FFEM), the Summit Foundation and Oceans 5, for their unwavering support of the conservation efforts at the Cayman Crown Reef. Their generous contributions have been instrumental to advancing our work, enabling us to learn and safeguard this vital marine ecosystem and address the critical challenges it faces. Thanks to your commitment, we have made significant strides in preserving the reef's rich biodiversity and enhancing its resilience. Your support not only fosters hope for the future of the Cayman Crown Reef but also sets a powerful example of international cooperation in environmental conservation. We deeply appreciate your dedication and look forward to continuing this essential partnership to ensure the reef's long-term protection and sustainability. Thank you for believing in our mission and for your ongoing investment in the future of our oceans.

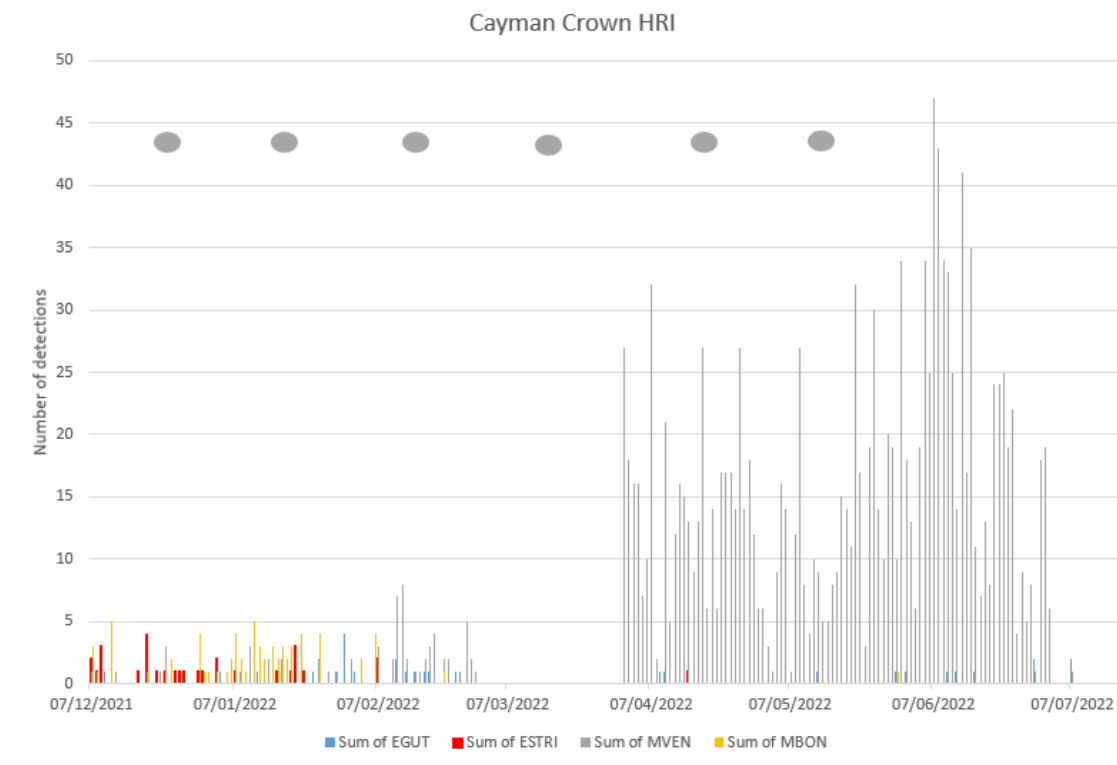
## Annex 1. Percentage of corals affected by bleaching on the Cayman Crown reef



The photos and videos of monitoring can be found in the following link to Dropbox

<https://www.dropbox.com/scl/fo/ixmdj8uhcp34znsfa1878/h?rlkey=5edovqog9iw27zxagtwbftsr4&dl=0>

## Annex 2. Hydrophone recordings of groupers, analysis using FADAR.



The HRHP collected data for fish noise mapping using a hydrophone deployed at the Sassy Wrasse site, where fish spawning behavior had been previously documented. The acoustic recordings proved essential for identifying fish species, particularly groupers, and estimating their abundance. By analyzing the unique sounds produced by different species, we created spectrograms to visualize these acoustic signatures. Acoustic data collected between December 7, 2021, and July 7, 2022, was analyzed in collaboration with Comunidad y Biodiversidad (COBI) using the Fish Acoustic Detection Algorithm Research (FADAR) software. Results focusing on groupers revealed a relatively quiet initial period with low detections of *Epinephelus gutatus*, *Epinephelus striatus*, *Mycteroperca venenosa*, and *Mycteroperca bonaci*. However, there was a notable increase in *Mycteroperca venenosa* detections from April to July 2022.