

## **Theme 4: “Monitor the state of reefs in order to better manage them”**

*The ICRI member’s report outlines the activities of ICRI members; their progress and contributions towards the ICRI Plan of Action 2016-18. The contributions detailed below are taken from written responses by Brazil; Japan; Indonesia; Malaysia; Maldives; Monaco; UK; and the USA. The member report also includes responses from the Central Caribbean Marine Institute; Coastal Oceans Research and Development in the Indian Ocean; Fondation pour la Protection de la Biodiversité Marine; Great Barrier Reef Foundation; International Society for Coral Reef Studies; Reef-world Foundation; Science and Conservation of Fish Aggregations; The Nature Conservancy; UNEP Caribbean Environment Program; and the UN Environment World Conservation Monitoring Centre (as of December 1<sup>st</sup>, 2017). For more information, you can check directly the member report.*

*To address theme four, ICRI members were asked how they encourage regional reports to be carried out on coral reef health; and how they are monitoring and addressing the issue of coral reef bleaching. Contributions to theme four included the publication of new academic research on coral bleaching and the creation of large-scale monitoring networks. Multiple contributions discussed the role of modelling future weather patterns to help manage the effects of climate change on coral reefs and related ecosystems.*

### **Goal 4-1: promote regional reports on the health of coral reefs**

#### **Brazil**

Brazilian National Coral Reefs Monitoring Program has been underway since 2002, covering 7 MPAs, with a methodology compatible with Reef Check, but more comprehensive, thus gathering more detailed data. The program is conducted as a partnership between the Brazilian Institute of Environment (ICMBIO)/Ministry of Environment and the Federal University of Pernambuco, with local support from other Universities, NGOs, Dive operators and volunteers. The program is funded by the GEF-Mar project. Other coral reef research programs, conducted by University research groups, NGOs and collaborators also include monitoring activities on specific sites along the distribution of coral reefs in Brazil.

Results from the National Coral Reef Monitoring Program and other initiatives have been previously reported on the global status of the Reef Series during the previous GCRMN phase, when Brazil was part of the SA node. Under the new phase, in which the publication of regional reports is prioritized, Brazil is not yet part of any regional network and thus not featured on the 2014 publication of the Status and Trends of Caribbean Coral Reefs.



As part of the ICRI plan of action, "the Secretariat will encourage the publication of reports for regions in which work has not yet begun or is underway." A manual of methods and a report on the results of Brazilian coral reef monitoring program is under preparation at the moment to be released in 2018 during the IYOR. Therefore, Brazil would like to line up with the GCRMN in order to:

- Line up this initiative with the UNEP Coral Reef Unit guidelines
- Align with the Caribbean coral reef monitoring network for sharing and interchange of methods and expertise.

The methods proposed by the GCRMN-CARIBBEAN GUIDELINES FOR CORAL REEF BIOPHYSICAL MONITORING are compatible with the protocols adopted in Brazil and further collaboration and networking with the present GCRMN coordination and the Caribbean coordinators will certainly improve the effectiveness of actions along the region.

## **UNEP Caribbean Environment Program, Jamaica**

### GCRMN-Caribbean

The Global Coral Reef Monitoring Network (GCRMN) was established to support the ICRI's Call to Action and Framework for Action in 1994. This network works through regional networks, comprising a variety of institutions, with the aim of strengthening the provision of the best available scientific information and communication on the status and trends of coral reef ecosystems, for their conservation and management.

The regional GCRMN network for the Caribbean region (GCRMN-Caribbean) is an open and growing network of coral reef scientists and managers involved with coral reef monitoring in the wider Caribbean region. Coordinated by the UN Environment-CEP and its Regional Activity Center, the SPAW-RAC, it is led by a Steering Committee composed of fifteen regional experts, assisted by Members-at-large. Currently, more than 100 Members are sharing experiences, information and knowledge within this network.

To address the findings of the State of Caribbean Coral report, UN Environment-CEP / SPAW-RAC and the Dutch Ministry of Economic Affairs organized a workshop, from 6 to 8<sup>th</sup> August 2014 in Curaçao with the objectives of "Reviewing, improving and revitalizing the network and the nodes for a more effective coral reef monitoring and data management". UN Environment-CEP led the re- launching of the GCRMN-Caribbean which had suffered reduced functionality in data collection, information archiving and disseminating. SPAW-RAC is engaged in strengthening coral reef monitoring to ensure the collection of useful and accessible data that can effectively reveal the status and trends of the coral reefs in the region.

To this end, the GCRMN-Caribbean published minimum as well as preferred coral reef

monitoring guidelines for ecological and socio-economic data collection, to be disseminated within the Caribbean region (the “GCRMN-Caribbean baseline scientific monitoring guidelines for Biophysical Monitoring” and the “GCRMN-Caribbean guidelines for integrated coral reef monitoring”). These guidelines were drafted using the experience and lessons learned from long term and well vetted scientific protocols, and seek to provide a compromise between practical applicability and ease of comparison between existing methods and long-term datasets (kindly refer to “Publications” for more details).

In this context, UN Environment-CEP / SPAW-RAC coordinated the first GCRMN-Caribbean Integrated Coral Reef Monitoring Workshop (Discover Bay Marine Laboratory, Jamaica, April 2016). The scientific capacity building event, “GCRMN-Caribbean Guidelines Capacity Building Workshop: Towards comprehensive coral reef monitoring” integrated the newly endorsed biophysical and socio-economic guidelines to the training programs.

In 2016, following the First Integrated Coral Reef Monitoring Workshop, GCRMN-Caribbean coral reef monitoring guidelines were implemented in Cuba, Jamaica, Bermuda, the French and Dutch Antilles and in over 55 sites including reefs located within the limits of SPAW-listed Marine Protected Areas (St Eustatius Marine Park, Man O War Shoal National Marine Park).

Subsequently, with partial sponsorship generously provided by The National Fish and Wildlife Foundation (NFWF), the GCRMN-Caribbean guidelines are being implemented, in the framework of the project “Capacity Building for Coral Reef and Human Dimensions Monitoring within the Wider Caribbean”. A training workshop took place (Port Royal Marine Laboratory, Jamaica, October 2017) with participants from Jamaica and Cuba, and a second workshop will be held in Saint Martin in 2018, with participants from Saint Martin, Sint Marteen, Saba, Sint Eustatius, and Saint Barthélémy. As a follow-up to the workshops, a grant will be allocated for biophysical and socio-economic monitoring activities based on capacity and resource needs. Such undertaking will result in the first complete integrated coral reef and human dimensions assessment carried out under GCRMN-Caribbean.

The GCRMN-Caribbean will continue to promote harmonized data collection through the implementation of guidelines in additional sites and member countries, as well as promoting the standardization of data analysis and reporting within the region.

## **Goal 4-2: better monitor the phenomena of coral bleaching**

### **Brazil**

Coral bleaching monitoring is conducted under the National Coral Reef Monitoring Program, and by many research groups and collaborators working on specific sites along

the distribution of coral reefs in Brazil. Among those, there are four Long Term Ecological Projects (PELD) linked to the ILTER network and financed by the Brazilian National Research Council that monitor Brazilian coral reef sites and report bleaching events. Bleaching events synchronized with global climate related bleaching have been registered for Brazilian reefs since the 90's. In 2016, a large-scale bleaching event, of moderate intensity, was observed in several sites along 2000 km of coast and in Oceanic islands. Coral bleaching has been surveyed using different methods compatible with both Reef Check and AGGRA protocols. Preliminary results did not detect mass coral mortality in Brazil post 2016 bleaching event, corroborating with Leão et al. (2016) findings for previous bleaching episodes that did not report mass coral mortality on Brazilian reefs since 1998.

## **Japan**

Last year, Japan confirmed a large-scale bleaching event of coral reefs in Japan. In response to this event, Japan held a Conference on Emergency Countermeasures for Large-scale Coral Bleaching in this April. There, Japan shared the latest information on current situation and measures against the bleaching, and “Emergency Declaration of the Large-scale Coral Bleaching Event” was made. This declaration leads us to promote future measures against the bleaching. On the other hand, the Ministry of the Environment is monitoring bleaching event through the implementation of Monitoring Sites 1000. In addition, the Ministry of the Environment has also been undertaking spot surveys in Sekisei Lagoon. Furthermore, from this year, Japan is considering possible adaptation measures of coral reef ecosystems by conducting impact assessments of climate change (climate-change vulnerability assessment) as well as forecasting in Kerama and other locations.

## **Malaysia**

Malaysia have been actively monitoring reefs in their waters since 2007 in collaboration with Reef Check Malaysia. To date, they have only experienced one mass coral bleaching event in 2010 aside from the earlier bleaching event in 1998. During the 3<sup>rd</sup> global bleaching event in 2014-2017, Malaysia was not significantly affected. However, the country has developed Coral Reef Bleaching Response Plan 2013 and a second edition of the Response Plan 2016-2020. The Plan includes recommendation on continuous monitoring programs, coral restoration programs on degraded reef areas, restriction of human activities on reefs affected by the bleaching event and chain of communication to spread information and status updates to stakeholders and the public.

## **The Republic of Maldives**



Marine Research Centre is working on a National Bleach Response Plan to strengthen the data collection and the procedures to follow in an event of bleaching. Under this response plan, focal points from the relevant ministries will be selected and strategic plans and ways to proceed with a bleaching event will be decided.

### **United States of America (USA)**

The NOAA Coral Reef Conservation Program is actively working with its partners to address the impacts of climate change and ocean acidification on coral reef ecosystems. The Coral Program promotes resilience-based management (RBM) as the best strategy to achieve management goals in a changing climate. Resilience refers to the capacity of a system to resist and/or recover from a disturbance event and maintain structure and function to allow the continued provision of ecosystem goods and services. It is important to understand this is not the system's ability to “bounce back” to a single state but rather the ability of an ever-changing system to return to a healthy state after these impacts.

Resilience-based management (RBM) involves using knowledge of current and future drivers of ecosystem condition and function to identify, prioritize, and adapt management actions that sustain ecosystem resilience and human well-being. RBM actions are those that reduce stressors on the ecosystem, reduce the exposure to stressors, build or maintain system resistance and promote recovery after disturbance. This can include direct interventions to reduce stress and proactive and/or reactive restoration activities. A key aspect of RBM is using the best available knowledge to identify sites that contribute disproportionately to system resilience and prioritize actions that maintain and/or build that resilience at those sites. This requires a dynamic understanding of the system and agility to adaptively manage these systems as conditions change.

In order to provide support to the jurisdictions to implement RBM, there are three areas of focus for the program; to provide an understanding of past, present and projected future impacts to coral reefs caused by coral bleaching and other climate impacts; to assess and understand likely social and ecological responses to climate change; and to support the identification and prioritization of management actions to support ecosystem resilience and human well-being. The RBM approach unifies the work under all the pillars of the program and will assist the program and its partners in being strategic about how the U.S. invest in conservation.

**Climate Strategy:** Increase coral reef resilience to climate change and ocean acidification.

To achieve this, the U.S. will:

- Provide enabling conditions for resilience-based management by supporting an ongoing dialogue with jurisdictional partners on the approach and benefits and the

necessary training and capacity on the principles of RBM and tools that support the approach.

- Ensure that jurisdictions have climate change vulnerability assessments, including periodic reassessments and the understanding of how to use that information in planning.
- Support the integration of multiple types of monitoring and modelling to provide a dynamic understanding of the system to inform decisions and allow for adaptive management.
- Support research at the national and jurisdictional level to answer key research questions to validate and improve upon the RBM approach.
- Support and encourage jurisdictional partners to use RBM to apply the climate lens to planning efforts and to prioritize and tailor management actions to increase resistance and support recovery in an effort to increase resilience of coral reef ecosystems.

### **Central Caribbean Marine Institute, Jamaica**

CCMI maintain an annual reef monitoring program which encompasses bleaching surveys. Researchers at CCMI are studying resilience in staghorn coral which was reared in the coral nursery and has since been planted on the neighboring reef. CCMI scientists are aiming to better understand the nature of resilience among some of the coral and causes of mortality among others.

### **Coastal Oceans Research and Development in the Indian Ocean (CORDIO)**

#### Project 1: 2017 WIO GCRMN Coral status report

The 2016 coral bleaching event affected the whole Western Indian Ocean, and as in past years since 1999, CORDIO has been active in both direct monitoring and coordinating general action. This activity was undertaken as part of the regional reporting on the status and health of Western Indian Ocean coral reefs with support from the Indian Ocean Commission Biodiversity Project and implementing the strategy of the Nairobi Convention Coral Reef Task Force.

Regional report on the health of coral reefs in the Western Indian Ocean: CORDIO has been contracted by the Indian Ocean Commission under its Biodiversity Project to be the Technical Lead on the regional GCRMN reporting process for 2017. This report will be launched by the Indian Ocean Commission and the Nairobi Convention (UNEP) at the ICRI General Meeting in Nairobi in 2017.

CORDIO wrote a chapter in the coral status report on the 2016 bleaching event in the WIO, using data collected from a regional initiative to collect real-time reports of bleaching and mortality between January and September 2016.

### Project 2: 2017 WIO post-bleaching assessment

In order to get a full picture of the impact of the 2016 bleaching event on the Western Indian Ocean, the Biodiversity Project is supporting the reef network to conduct a post bleaching assessment in six countries in the region (Comoros, Kenya, Madagascar, Mauritius, Seychelles, Tanzania). Under the Coral Reef Task Force – WIO countries which do not fall within the scope of the Biodiversity Project (France, South Africa, Mozambique, Somalia), will also be included in this data sharing joint output. CORDIO is leading the regional coordination of the project with the assistance of national coordinators from each country. The assignment will build on the regional coral reef health dataset developed for the 2017 Regional Coral Reef Status Report.

Provided an updated training on coral reef monitoring methods specifically for the post-bleaching assessment.

Held a meeting of participants at the 10<sup>th</sup> WIOMSA Scientific Symposium in November 2017, to provide a progress update on the project.

### Project 3: Coral bleaching alerts

Each year during the regional (Western Indian Ocean) summer (January – May), CORDIO produces a coral bleaching alert on a two-weekly basis, using the bleaching satellite products of the US National Oceanic and Atmospheric Administration (NOAA) Coral Reef Watch in conjunction with other regional and global climate information.

### Project 4: Global GCRMN Implementation and Governance Plan

Implementing the decision taken at ICRI GM31 to develop an Implementation and Governance Plan for the GCRMN for the period 2017-2020 CORDIO has signed a contract with UN Environment to finalize this plan between November 2017 and February 2018, in cooperation with the GOOS Biology and Ecosystems Panel, GEOBON Marine Biodiversity Observation Network and the Ocean Biogeographic Information System (OBIS).

### Project 5: Coral reef ecosystem and coral species Red List Assessments

As the Chair of the IUCN Coral Specialist Group, CORDIO has developed a parallel project to Project 4, to undertake Red List assessments of coral species and coral reef ecosystems, using the GCRMN reporting framework as the primary data infrastructure and feeding GCRMN data into societal benefit areas for the Aichi Targets and Sustainable Development Goals.

## **Fondation pour la Protection de la Biodiversité Marine (FoProBiM)**

FoProBiM have begun monitoring certain reefs using AGRRA protocols.



## **Great Barrier Reef Foundation (GBRF), Australia**

The Great Barrier Reef Foundation is funding an initiative aimed directly at reducing the impact of coral bleaching through local scale environmental adjustments. GBRF have piloted a surface film technology and shown it can reduce light entering the water by 30%. The film has just undergone environmental impact assessments and mechanical testing at the Australian Institute of Marine Science and has been demonstrated to be safe and effective. This could be a potential tool in the bleaching toolkit for application at highly valuable reef sites such as those that are vital for reseeding other reef areas.

GBRF are also funding many initiatives aimed at boosting the resilience of the Great Barrier Reef. This includes a resilience mapping tool which uses a combination of monitoring and modelling to identify the reefs most important for resilience of the system. GBRF have also funded, in partnership with CSIRO, AIMS, the Queensland Government and Australian Government, the development of the eReefs modelling tools which are critical diagnostic tools for predicting coral bleaching in the short term (ReefTemp tool) and long term (eReefs scenario modelling suite). The model outputs were recently assessed against the in-water bleaching survey data from the 2016 bleaching event on the GBR and the model outputs performed with a high degree of accuracy against the monitoring data. The three-dimensional nature of the model allows it to also model the likely impacts of coral bleaching at a range of depths, making it a powerful tool to complement in-water surveys. GBRF have also funded work testing the feasibility of using remote sensing satellite technology to monitor the impacts of coral bleaching.

GBRF has also ramped up its focus on reef restoration science and practice in light of the last two years of catastrophic bleaching and extreme weather on the GBR. GBRF have just completed the first successful trial of larval reseeding on the Great Barrier Reef, and in October 2017 released the first coral genome library to the world enabling researchers from around the globe to better understand the adaptability of corals and their symbionts. GBRF are also working closely with DFAT to explore innovative new solutions (via DFAT's recently announced \$5m Reef Innovation Fund) for building the health and resilience of coral reefs in the face of ever increasing climate impacts.

## **Reef-World Foundation**

Green Fins members are provided with an annual in-house training session for all staff involved in diving and snorkelling operations. As part of this training, they receive information on what coral bleaching is, how to report it via the use of existing mechanisms and provided with information on how to avoid encouraging bleaching through site specific



best practice such as alternatives to chemical cleaning products, actions to reduce deliberate and accidental contact and alternatives to other negatively impacting actions from divers and snorkelers that could reduce the resilience of coral reefs to coral bleaching events.

### **The Nature Conservancy**

Completed more than 230 coral reef surveys to monitor and assess bleaching as part of the Florida Reef Tract Coral Bleaching Response Plan.

Conducted coral bleaching monitoring on Maui island, Hawaii. This data collection has helped to monitor the health of corals at Polanui, Maui. In order to better understand the changes in coral health at Polanui, TNC set up comparable sites across leeward Maui to determine which other contributing factors might lead to changes in coral health. The results of these surveys will assist in determining which interventions can be made to reduce other stresses. The products of this project include a Coral Bleaching Monitoring Protocol, guidance for future training sessions, guidelines for adding sites in the future, and a preliminary ArcGIS interface for photo accessibility. These products will serve as tools and offer a step-by-step process to add other sites and their associated interested community participants.

Continued coordination of the BleachWatch Virgin Islands program, developed as a part of the US Virgin Islands Reef Resilience Plan to assess the impacts to corals from mass bleaching events and support effective management responses. The program approaches the problem with a two-tier strategy:

- Tier 1 - the BleachWatch Virgin Islands community monitoring network is an early warning system to provide a rapid report of the distribution and intensity of coral bleaching at the onset of a bleaching event.
- Tier 2 - a network of USVI scientific divers from TNC, the University of the Virgin Islands, the National Park Service, and the US Geological Survey mobilized during mass bleaching events to conduct bleaching and post-bleaching monitoring. In 2017 40 new volunteers were trained.

### **UNEP Caribbean Environment Program, Jamaica**

Within the Teamwork platform, discussion occurred between members on the theme of “Coral Bleaching Response Plan and Protocols”, with exchanges of relevant material from their national legislations on this issue. Moreover, in the framework of the NOAA initiative “Coral Reef Watch”, Teamwork members gathered coral bleaching data from their countries, to be shared with NOAA.