

Coral Reef Monitoring for the Organization of Eastern Caribbean States (OECS) and Tobago

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Abstract. The objective of this project was to expand the coral reef monitoring programme started under the CPACC (Caribbean Planning for Global Climate Change) Project to the countries of the Eastern Caribbean. The Centre for Marine Sciences (CMS) of the University of the West Indies (UWI) Jamaica was contracted by the MACC (Mainstreaming Adaptation to Climate Change) Project to oversee this process. Sixteen participants from seven Eastern Caribbean countries (Antigua & Barbuda, Dominica, Grenada, St Kitts & Nevis, Saint Lucia, St Vincent & the Grenadines and Tobago) were trained in the coral reef video monitoring protocol developed under CPACC in Saint Lucia during September 2007. Following the training, each country selected a monitoring site and monitoring was conducted (during the period September to April 2008) at these sites under the supervision of resources persons from the CMS. The videotapes were processed and analyzed at the CMS. This paper will discuss the results of the monitoring exercise for each of the countries and will highlight the challenges encountered in establishing a regional monitoring programme that meets the needs of the participating countries

Key words: Eastern Caribbean, coral monitoring, video monitoring, climate change

Introduction

The Caribbean Community Climate Change Centre (CCCC) was established by regional governments to coordinate the Caribbean's response to climate change. One of the projects being executed by the CCCC is the Mainstreaming Adaptation to Climate Change (MACC) Project which aims to mainstream adaptation to climate change into national development planning through technical support and capacity building. Included in the capacity building programme was the strengthening of the climate and coral reef monitoring networks in the region.

The Centre for Marine Sciences (CMS) under a Memorandum of Understanding with the CCCC for MACC Project was tasked with leading the coordination and expansion of the regional coral reef monitoring programme to the OECS (Antigua & Barbuda, Dominica, Grenada, St Kitts & Nevis, Saint Lucia, St Vincent & the Grenadines) and Tobago (Fig. 1). This expansion follows up on the recommendations made at the conclusion of the Caribbean Planning for Adaptation to Global Climate Change (CPACC) project based on pilot studies carried out in The Bahamas Belize and Jamaica (Lawrence & Edwards, 2001).

This monitoring programme was implemented by providing technical support in the areas of training, monitoring, data analysis and report preparation. The data collected and reported on in this study is intended to represent the start of a coral reef monitoring programme for the OECS and Tobago which will assist

in documenting the changes taking place on the coral reefs over time and will attempt to determine the reasons for the observed changes.

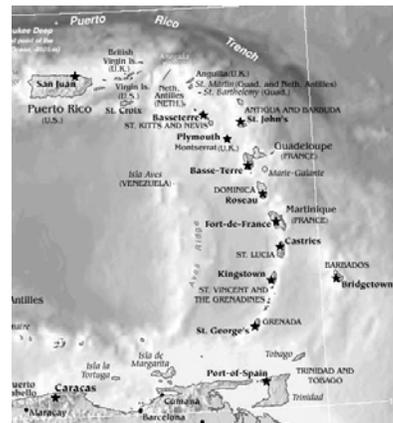


Figure 1: Map of the Eastern Caribbean showing the location of the seven countries (Antigua & Barbuda, Dominica, Grenada, St Kitts & Nevis, Saint Lucia, St Vincent & the Grenadines and Tobago) took part in the coral reef monitoring programme.

Methodology

Training

Training took place during the period September 10-13, 2007 in St Lucia and involved 16 participants from 7 countries. The participants were trained in the CPACC video monitoring protocol which involved site selection,

video monitoring, benthic substrate identification, data processing, data analysis and report preparation (Woodley 1999; Miller 2000; Miller and Roger 2002). At the end of the training workshop one set of video monitoring equipment, provided by the MACC project, was handed over to each of participating countries (Creary 2007).

Monitoring

Following the training workshop the participants returned to their respect countries and selected coral reef areas for monitoring (Operational Area) based on the guidelines outlined in the site selection protocol (Woodley, 1999) which took into consideration the use to which the data would be put, the peculiarities of the area and logistical constraints. Each country was required to establish 20 permanent transects, each 20m long, within the Operational Area selected.

The video monitoring method used was based on the Aronson method that was adapted by Jeff Miller (US GS Biological Division, USVI) for Component 5 of the CPACC project - *Coral Reef Monitoring for Climate Change Impact* (Miller 2000) and with additional modifications included in this monitoring exercise (Miller and Rogers 2002).

A resource person from the CMS led the local teams on the monitoring exercises. The high resolution video cameras provided for each country were used to video tape the individual 20m transects. Approximately 20 transects were recorded for each country. Monitoring was carried out during the period September to November 2007 for all the countries except for Antigua. Field works was started in Antigua during October 2007 (four transects were video taped) but was not completed due to several delays resulting from technical difficulties and poor weather conditions. Because of the long delay in completing the monitoring the entire exercise was repeated in April 2008. Both sets of data are presented in this paper. The monitoring dates along with the locations of the Operational Areas and monitoring sites are provided in Table 1.

Data processing and analysis

The videotapes were catalogued and delivered to the Caribbean Coastal Data Centre (CCDC) of the CMS for processing and analysis. A Sony Mini DV player, connected to a computer and using the Pinnacle Studio™ software, was used to capture non-overlapping adjacent images from the video tapes. The CPCe (Coral Point Count with Excel) programme (Kohler & Gill 2006) was used to randomly overlay 10 points on each image from which the benthic species or substrate category lying under each point was identified. Codes were entered directly into the associate Microsoft Excel spreadsheet which automatically generated statistical parameter for each species/substrate category (relative

abundance, mean, standard deviation, standard error and the Shannon–Weaver diversity index).

Country /Dates	Operational Area/ Monitoring Site(s)
Antigua & Barbuda Oct 16, 2007 April 9-11, 2008	Little Bird Island
Dominica Nov 13- 15, 2007	Soufriere/Scott's Head Marine Reserve (SSMR) <ul style="list-style-type: none"> • Soufriere Pinnacle • Danglebens • Point Guignard • Champagne
Grenada Oct 31-Nov 2, 2007	Grand Anse reef system <ul style="list-style-type: none"> • Boss Reef • Middle Boss Reef • Bottom Boss Reef • Northern Exposure
St Kitts & Nevis Nov 4-9, 2007	Sandy Point <ul style="list-style-type: none"> • Paradise Reef
Saint Lucia Sep 12-14, 2007	Soufriere Marine Management Area (SMMA) <ul style="list-style-type: none"> • Turtle Reef • Anse Chastanet Reef, • Grand Caille, • Coral Gardens, • Malgretoute
St Vincent & the Grenadines Oct 23-24, 2007	Castle Bay
Tobago Oct 16-17, 2007	Speyside, Tobago <ul style="list-style-type: none"> • Japanese Gardens • Angel Reef

Table 1: Monitoring dates, Operational Areas and monitoring sites

Results

The results of the monitoring programme (Fig. 2 and 3) shows that the sites selected in each country had varying levels of coral cover ranging from 3.8% in Antigua (2008) to 29.2% in St Vincent & Grenadines. Dominica, Grenada, St Kitts and Saint Lucia had coral cover at about 10% while Tobago had 15.9%. Gorgonians were not very abundant in all the islands ranging from 1% to 3.6% with the exception of Tobago which had 16.8% cover. Sponges were also found in the highest abundance in Tobago with 21.2%, St Vincent had a little over half that amount with 12.1%, while St Kitts and Saint Lucia had 7.5% and 7.1% respectively. The other three countries had less than 4% gorgonians. The zoanthids represented a very small proportion of the benthic cover in all the countries ranging from 0% to 0.9%. Also not well represented were the coralline algae which ranged from 0% to 0.9% for all countries except Tobago which had a higher cover of 2.1%. Disease corals were observed in limited amounts in Antigua (2007), Dominica, St Kitts and St Vincent.

It was observed that for all the countries there was a high level of macroalgae combined with dead coral and

algae found on the reefs with Antigua (2007) having a combined value of 56.2%, Dominica having 66.6%, Grenada with the highest at 84.2% and St Kitts at 76.0%. Not unexpected was that Tobago (25.9%) and St Vincent (39.6%) exhibited the lowest levels of macroalgae combine with dead coral and algae, while Antigua – 2008 (44.9%) and Saint Lucia (44.4%) had intermediate levels.

During the monitoring exercise a total of 41 coral species were observed in addition to other unidentified coral species and coral juveniles. The most widely distributed species were *Diploria strigosa*, *Montastraea annularis*, *M. cavernosa*, *Porites astreoides* and *Siderastrea siderea*, which were found in all countries and *Agaricia agaricites*, *Meandrina meandrites*, *Millipora complanata* and *P. porities* which occurred in six of the seven countries. Just under half (18) of the species identified were found in only one or two countries, with the remaining 15 species occurring in 3-5 countries.

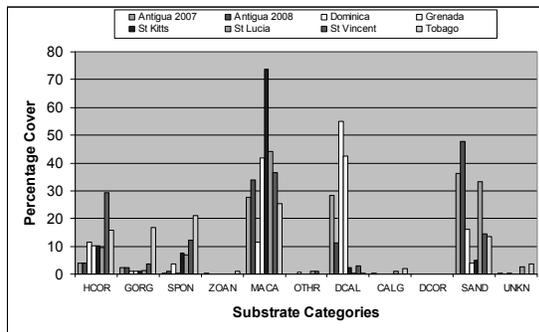


Figure 2: Graph illustrating the mean percentage cover for the different substrate categories found at the coral reefs sites in Antigua, Dominica, Grenada, St Kitts, Saint Lucia, St Vincent and Tobago monitored during the period September 2007 to April 2008. (Substrate categories: HCOR - Hard coral; GORG - Gorgonians; SPON - Sponge; ZOAN - Zoanthids; MACA- Macroalgae; OTHR - Other, live; DCAL - Dead coral with algae; CALG - Coralline algae; DCOR- Diseased coral; SAND - Sand, rubble, rock and boulder; UNKN - Unknown.)

Fig. 3 provides a summary of the hard coral data collected during this study. In Antigua the site selected for monitoring had the lowest percentage cover (4% and 3.8%) when compared to the other islands and also the lowest number of coral species (9 and 13). St Vincent on the other had the highest percentage cover (29.2%) and the highest number (29) of species.

Discussion

The coral reef monitoring programme was successfully implemented in seven countries in the Eastern Caribbean and plans are currently being formulated to conduct the second round of monitoring.

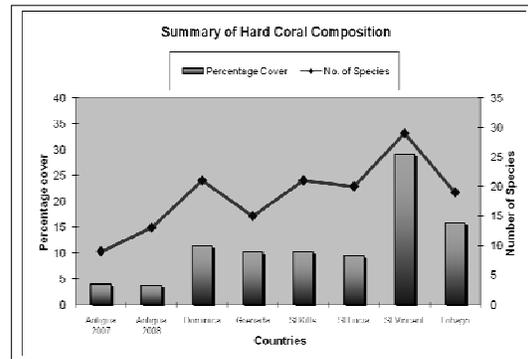


Figure 3: Graph summarising the hard coral composition (percentage cover and number of species) at the monitoring sites in Antigua, Dominica, Grenada, St Kitts, Saint Lucia, St Vincent and Tobago for the period September 2007 to April 2008.

The reefs in the Eastern Caribbean have been exposed to a variety of local (eg pollution and sedimentation from run offs) and regional (eg increase sea surface temperatures) threats, the impacts of which are different for each country. This monitoring programme provides the opportunity to establish a long term programme to assess changes in reef health over the long term. For some countries this monitoring programme would form the basis of the comprehensive reef health assessment while for others the data provided would support existing programmes.

In Antigua, although *Acropora palmata* beds were previously reported to be extensive at Little Bird Island in Antigua no colonies were observed during this assessment and the area appeared to have experienced significant disturbance which supports the observations of Bouchon et al (2004) particularly with respect to the low hard coral (4%) and high algal cover.

In the case of Dominica, it was felt that the 11.6% coral cover and the 21 hard coral species identified were not indicative of the full coral biodiversity within the SSMR (per com Fisheries Department Representative). Bouchon et al (2004) describe the reefs in Dominica as having “high hard and soft coral abundance, very low algal cover, no observable disease, no bleaching”. The results from the four sites monitored did not reflect this therefore work is needed for a more accurate assessment of reef health in Dominica.

The Fisheries Department of Grenada has proposed a system of marine protected areas for Grenada (Burke & Maidens, 2004) and it is expected that the results from this monitoring exercise will be used in conjunction with previously collected data to support this proposal.

Paradise Reefs, the monitoring site selected in St Kitts is located within the designated National Marine Park at Sandy Point and features giant basket sponges as part of the coral assemblage. Although this area is well used

by divers, its designation as a protected area prevents boats from anchoring and damaging the reefs.

The fringing reef communities along parts of the west coast of St Lucia are under pressure from tourism and coastal development (Burke and Maidens 2004). The SMMA has a comprehensive monitoring programme which provides data on a variety of coastal and marine parameters and the data collected from this monitoring exercise will be incorporated into their database.

For St Vincent & the Grenadines the monitoring site selected at Castle Bay had the highest coral cover and number of coral species despite its close proximity to the capital, Kingstown, and the impacts of runoff and discharges from the nearby rivers.

For Tobago it was felt that the results of the monitoring did not reflected the results of previous studies using photo quadrat surveys carried out in the area by Laydoo (1985) (per com IMA Representative). The main difference cited were the number of coral species found and the actual species identified. A more detailed evaluation of the studies, along with any other additional data that might be available, needs to be carried out before a conclusion can be drawn about these results.

There were a number of challenges faced in the implementation of this monitoring programme which have also served as a learning experience for all those participating in the effort. The most significant challenge was that of adequate numbers of personnel to carry out the preparatory work (site selection, marking of transects), monitoring and data analysis. This was partially overcome by having resources persons from the CMS leading the monitoring in each country and having the videotapes processed and analyzed by the CMS. More time was required for the training of the participants especially with respect to the data processing and analysis component to facilitate the carrying out of in-country analysis. There were also some logistical (e.g. boat availability, access to sites) and equipments problems (e.g. fogging and flooding of camera housings) and the issue of weather played a significant part in the delays experienced in completing the monitoring especially for Antigua.

Recommendations

These recommendations are based on the experience of this first monitoring exercise and should be considered for incorporation in the overall monitoring programme.

Representatives from the participating countries should together review and discuss the technical and logistical challenges of this programme with a view to refining the monitoring process. A review of the training should also be carried with the persons who participated in the training workshop to fine-tune and clarify the video monitoring protocol with specific emphasis on the data processing and analysis

components. Training should also be provided to additional persons in the countries that request this, focusing on their specific areas of need. Proposed solutions should then be incorporated into the program for future monitoring.

Each country should review the site selected to ensure, based on the experience of the first monitoring exercise, that these sites are representative of the area being studied and are suitable for the long term monitoring programme. Once suitable sites have been decided on, permanent transects should be established where these have not been done to ensure that the same transects are monitoring over the long term. These sites should be geo-referenced.

There should be an increased focus on in-country coral species identification and data analysis particularly by the persons knowledgeable about the specific monitoring sites. This is presently carried out by the CMS, UWI in Jamaica. Each country should gather all other relevant data related to the site selected on anthropogenic issues such as pollution, over-fishing, sedimentation, turbidity and physical damage, which interact with climate factors and affect the status of the coral reefs.

Provision in the programme should be made carry out monitoring during coral bleaching events to determine the extent of bleaching and the rate and nature of recovery. The CREWS network in the Caribbean provides the information which allows predictions of potential bleaching events. Closely associated to coral bleaching are the increase incidences of coral diseases which are now being linked indirectly to increased sea surface temperatures. Provision should also be made to include the monitoring of coral diseases if they occur. Where possible, other indicators used for assessing and monitoring coral reef status should be incorporated in the monitoring programme, such as but not limited to, coral recruitment, coral size distribution, fish species and abundance, abundance of herbivores and physical parameters.

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