Coral Reef Targeted Research and Capacity Building

Disease Surveys in Curacao - 2005

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Coral reefs are undergoing significant changes due to the synergistic effects of natural and anthropogenic factors. During the 80's, live coral cover in Caribbean reefs ranged from 30 up to 70% and macroalgae (a strong competitor for substrate) rarely exceeded 10%. Then, two major epizootic events affected three keystone species in the region, the black sea urchin *Diadema antillarum* (Lessios et al. 1984) and the important reefbuilding corals *Acropora palmata* and *A. cervicornis* (Gladfelter 1982, Aronson & Precht 2001). These events brought about severe ecological changes including a face shift from coral-dominated to algal-dominated reefs in many regions of the wider Caribbean (Hughes 1994). Further deterioration of the reefs environment and frequent impacts of bleaching and disease over the last 25 years have compounded the problem with an increased loss of coral cover and biodiversity at local and regional scales (Weil 2004). Many new diseases and syndromes have mainly affected the major reef building genera in the wider Caribbean (*Montastraea* spp, *Colpophyllia* spp, *Diploria* spp, *Porites* spp and others). The high number, their rapid emergence, wide distribution and prevalence of coral diseases, their wide host ranges and frequent epizootic events characterize the Caribbean as a "Disease Hot Spot" (Weil 2004).

In 2004, the Global Environment (GEF) Facility of the World Bank funded a project entitled "Coral Reef Targeted Research and Capacity Building" (CRTR) to assess the current status and future of these important communities. The project includes six groups of researchers looking at different aspects of the dynamics and degradation of coral reefs worldwide (i.e. Coral diseases, bleaching, connectivity, remote sensing, etc) and four centers of excellence located in the major ocean basins (Atlantic, Pacific, and Indian ocean). The Coral Disease Working Group (CDWG) has eight PI's from

different institutions in different countries. The goal of our program is to fill critical information gaps about coral reef disease to assist in the development of management and conservation strategies that protect reef ecosystems from damage due to disease. The five priorities of the Disease Working Group are:

1) conducting a global assessment of coral diseases and anthropogenic facilitators,
2) pinpointing the ongoing impacts of coral disease on coral biodiversity, coral community diversity and population growth.
3) advancing understanding of epidemiology (origins, vectors and spread rates) of coral diseases,
4) evaluating major mechanisms of coral disease resistance,
5) training and educating managers, students and others on different aspects of coral reef diseases**.**

Within the Disease group, we are responsible for the assessment of the number, prevalence, distribution, impacts and host range of coral diseases and their spatial and temporal variability in the wider Caribbean. Because we can not survey all reefs in the region, we have selected six widely separated localities that are distributed in a north-to-south and east-to-west transects to try to cover all major gradients (Fig. 1 – Table 1). In each geographic locality, two reef sites have been selected. When possible, these reefs represent a gradient of human impact within each locality. Survey methods were the same for all localities. Is a nested design that includes depths within reefs, reefs within localities and zones. In each reef sites three depth intervals are surveyed (0-5, 5-12 and >15 m). Five 10 x 2 m long band transects (20 m^2 each) are permanently marked (rebars and numbered tags) in each depth interval (= 100 m^2 per depth interval and 300 m^2 per reef). The sampling protocol follows the one developed by CARICOMP (Weil 1999) with few modifications. All colonies of corals, octocorals, sponges and crustose algae are counted and checked for their conditions (healthy, diseases, injured, bleached, etc) along each band transect. Only corals and few octocorals are identified to species level. In each reef site at least one temperature logger is set to continuously (every hour) record temperature regimes over time. This report only includes the information for your locality of interests and manuscripts are being prepared to be sent out to peer-reviewed journals.

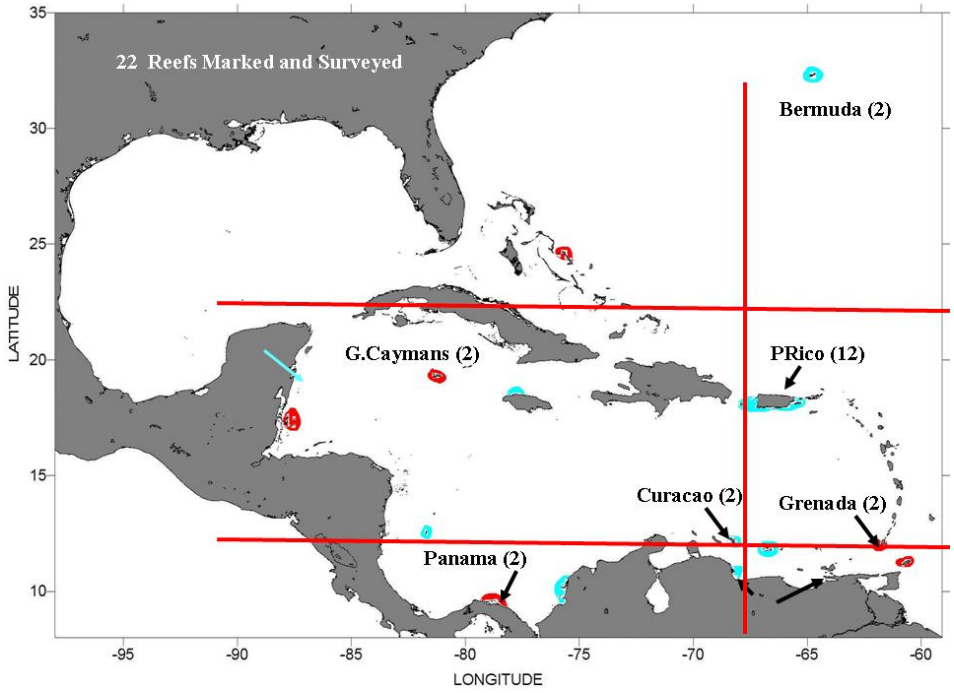

Figure 1. Map of the wider Caribbean showing survey localities.

Table 1: Geographic locations and reefs surveyed in the Caribbean in 2005

Locality	Reef	latitude	Longitude	Observations	Max. depth
Bermuda	Rita Wreck	32° 21.484'	64° 38.486'	Fringing	22
	Chub-Cut	32° 20.820'	64° 55.671'	Large patch reef	17
Puerto Rico	Guánica			Fringing	20
	Culebrita			Fringing	16
Curacao	Aquarium	12° 05.039'	68° 53.693'	Fringing	45
	Habitat	12° 11.899'	69° 04.733'	Fringing	45
Grenada	Flamingo	12° 05.517'	61° 45.544'	Fringing	25
	Valleys	12° 01.618'	061° 47.060'	Fringing-Bank	25
Grand Cayman	Andes	19° 21.830'	81° 15.239'	Fringing-Bank	25
	South Reef	19° 15.792'	81° 23.010'	Spur-groove	22
Panamá	Isla Colón	9º 20’58”	82º15’48”	Fringing-Bank	17
	Cayo Roldán	9º 13’11”	82º19’31”	Fringing-Bank	17

Curacao is one of the two southern localities surveyed and is characterized by well-developed coral reefs. Few studies conducted in Curacao have shown that coral and octocoral diseases are wide-spread among conspicuous corals such as *Montastraea* spp and *Gorgonia ventalina* (Nagelkerken et al.

1997a,b; Goreau et al. 1998). Disease surveys have been conducted around Curacao at different reef sites; nevertheless much of these data have not been published yet (Nugues personal communication). During this trip we surveyed two reef sites: (1) fringing reef in front of the Sea Aquarium and (2) the fringing reef off the Habitat Hotel.

Figure 2. Survey sites in Curacao during the summer of 2005: (1) Sea Aquarium is on the south-west section of the island. The Habitat is north of Willemstad.

Five 10x2m ($20m^2$) permanent transects were marked with rebars and numbered tags at each of three depth intervals (0-5, 5-10 and >15 m) in each of the two sites selected. Within each of these belt-transects we counted and identified every single colony of coral and hydrocoral to the species level, other important reef organisms such as sponges, octocorals, crustose algae, and zoanthids were not identified ti the species level. Every single colony was checked for their health status (healthy, disease,

bleached and/or injured (predation and physical damage). Preliminary results are presented below and a spreadsheet with the raw data is attached to this report.

Preliminary results

Data shown in this report is presented as percentage of diseased colonies (prevalence) in relation to total population size. Overall, coral diseases in these sites had on average, a relatively low prevalence (5.74 ± 3.7%) at the community level (all colonies from all species included). Curacao was the second country with higher disease prevalence of the 6 countries visited across the Caribbean during the Summer-Fall of 2005, the weight of this prevalence comes from the Habitat locality. During our surveys we found a particular distribution of coral diseases, both across and within sites (among habitats). The most common diseases observed were dark spots syndrome (DSS) in both localities (Sea aquarium and Habitat), white plague type II (WP-II) and secondary infections by ciliates at the Habitat (Fig 3).

Dark spots disease (DSD) was reported in the mid 90's (Garzón-Ferreira and Gil-Agudelo 2001) and its etiology remains obscure. White plague disease (WPD) is one of the most widespread and virulent syndromes in the wider Caribbean (Richardson et al. 1998a,b, Weil 2004). It had an averagel prevalence of 1.1 ± 0.64%, but it was more prevalent at Habitat (1.6 ± 2.4%) compared to Sea Aquarium (0.66 ± 0.74%). In Habitat, WPD (Fig. 3) was the major cause of coral tissue loss in the *Montastraea* species complex (*M. faveolata*, *M. annularis* and *M. franksi*) (14.11 ± 15.2%),, the most important reef building group in Curacao and the Caribbean. A high proportion of colonies with active infections and extensive areas of recently dead tissue most likely produced by WPD were observed in the Habitat reef. This disease had significantly lower prevalence in deeper (1.24 ± 2.11 %) than at intermediate (3.76 ± 6.66 %) and shallow habitats (5.13 ± 5.86 %) habitats in this locality. WPD affects more than 30 coral species in the Caribbean, is a fast moving infection that might be regulated by high water temperatures. The *Montastraea* species complex is the most affected group on a local and regional basis. The dominance of *Montastraea faveolata* in deep and intermediate depths seems to be a common feature of many Curacao reef localities, sharing dominance with another important group, *Diploria*, which is also highly susceptible to WPD. From our preliminary results it seems that the species composition of each particular site may be correlated with the prevalence and different types of coral diseases that occurs there.

The higher prevalence of ciliate infections was observed also at the Habitat reef (5 ± 1.05%) compared to all other sites that we surveyed across the Caribbean. As for DSS, its prevalence varied from 1.97 ± 0.4% - 2.66 ± 1.33% in deeper habitats and from 0 - 1.03 ± 0.38% in shallow habitats. The prevalence of DSS did not change across sites, having an overall mean prevalence below 1.5%.

Noteworthy was the lack of bleaching in these two reef localities and in general, in the Netherland Antilles when most of the eastern, northern and western were suffering the worst bleaching event on record for the Caribbean. Bleached colonies were only mild paling patterns and the overall prevalence was below 1.0 %. Octocoral diseases were almost two times more prevalent (9.6 ± 16.9%) than coral diseases in Curacao. More octocorals were showing disease/syndrome signs at Habitat Hotel (16.4 ± 34.3%) compared with Sea Aquarium (6.3 ± 8.03). Besides aspergillosis, all other syndromes affecting octocorals have not been characterized (pathology and etiology) and mostly looked like necrotic areas along the branch and at the tip of the branches. Aspergillosis, a common and wide-spread disease produced by a terrestrial fungus (*Aspegillus sidowii*) that affects a broad range of octocorals (Weil et al. 2001), had a higher prevalence at the Habitat reef (6.7 ± 25.8%) compared to the Sea Aquarium reef (2.4 ± 5.44%) (Table 2). This was significantly lower than the 15-30 % reported for the many sites surveyed between 1999 and 2001 in Bermuda (Weil et al. 2001, 2002). Habitat was one of the sites with higher prevalence of aspergiliosis that we observed across the Caribbean in 2005.

Table 2. Mean prevalence of coral and octocoral diseases at Bermuda reefs during October 2005. BBD = Black Band Disease, YBD = Yellow Blotch Disease, WPD = White Plague Disease, CILI = ciliates, DSD = Dark Spot Disease, BLC = Bleached colonies, OTHR = Other syndromes, PRED = predation, ASP = Aspergiliosis and TUM = Tumors.

	Sea Aquarium			Habitat Hotel		
Coral diseases	Mean	SD	SE	Mean	SD	SE
BBD	**0.57**	**1.01**	**0.26**	1.05	2.19	0.57
YBD	0.59	1.1	0.29	**0.45**	**1.47**	**0.38**
WPD	0.66	0.74	0.18	1.57	2.42	0.63
CILI	0.25	0.44	0.11	2.4	2.5	0.65
DSD	1.2	1.4	0.37	1.06	2.01	0.52
BLC	0.61	0.73	0.19	0.53	0.73	0.18
OTHR	0.8	1.15	0.28	0.31	0.78	0.2
PRED	0.32	0.82	0.21	0.19	0.31	0.08
TUM	0	0	0	0	0	0
Total diseases	**4.45**	**2.8**	**0.72**	**7.01**	**4.21**	**1.08**
Octocoral Diseases	Mean	SD	SE	Mean	SD	SE
ASP	2.4	5.43	1.4	6.66	25.8	6.66
TUM	1.24	2.80	0.72	1.56	4.23	1.09
OTHR	2.58	5.64	1.45	8.17	25.7	6.63
Total Diseases	6.22	8.03	2.07	16.4	34.34	8.86

What next?

Results presented here represent our preliminary approach and surveys in Curacao. More analyses are being conducted at the species-population levels to assess the overall impact of diseases/syndromes on the reefs. Same information is being processed for the other five geographic localities (10 reef sites) to compare and assess the local and geographic patterns in the wider Caribbean. Such a regional approach will allow us to better understand the patterns of prevalence and distribution of coral diseases as potential factors related to coral reef deterioration. We will be conducting our surveys again this year (Fall of 2006) and in 2007. We are planning to add another reef site to increase the replication within geographic localities. The temporal sampling will allow the characterization of temporal variability and patterns from year to year and to asses the relationship of coral diseases with environmental correlates.

Figure 3. Different diseases affecting corals in Curacao. White plague affects a wide variety of species (A,C), black band disease affecting *C.natans*, *M. annularis* and *U. danae* (D, F), Yellow blotch infecting *M. annularis* and *M. faveolata* (G, I), dark band on S. sidereal (K, L) and two diseases affecting other important reef organisms, tumors in *G. ventalina* (m) and crustose coralline algae white band (o).

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