Future Of Reefs in a Changing Environment: *considering people, corals & marine life in finding the best ways to manage Caribbean coral reefs.*

Summary of Belize Surveys November 2010

The overall aim of FORCE is to provide coral reef managers with a toolbox of sustainable management practices that minimize the loss of coral reef health and biodiversity. So far, the ecological team, consisting of scientists from University of Newcastle (England) and the University of Costa Rica have surveyed coral reef communities in Honduras, Belize, Curaçao, Bonaire, Jamaica and Barbados. This report summarizes the project work on describing the ecological status of coral reefs in Belize.

Why This Study Is Important

Coral reefs provide many ecosystem services to coastal communities including the support of fisheries, tourism, coastal protection from storms, generation of sand and building materials, pharmacological products and the highest marine biodiversity on Earth. Despite their great value, the ecological state of Caribbean reefs has deteriorated rapidly in the last few decades. As the human population increases in the wider Caribbean, the demand for reef-based resources will likely increase. The decline in coral cover poses a real threat for human societies: corals provide complex structures that influence biodiversity, fisheries production and the provision of a structural barrier to wave energy.

The FORCE project uses an ecosystem approach that links the health of the ecosystem with the livelihoods of dependent communities, and identifies the governance structures needed to implement sustainable development. This project plays an important and measurable role in helping communities adapt to climate change in the Caribbean.

What We Did & How We Did It

Reef communities were surveyed at 15 locations in Belize (Fig. 1). At each location surveys were conducted at two depths: 5-10 m and 15-20 m between November 9 and December 5, 2010.

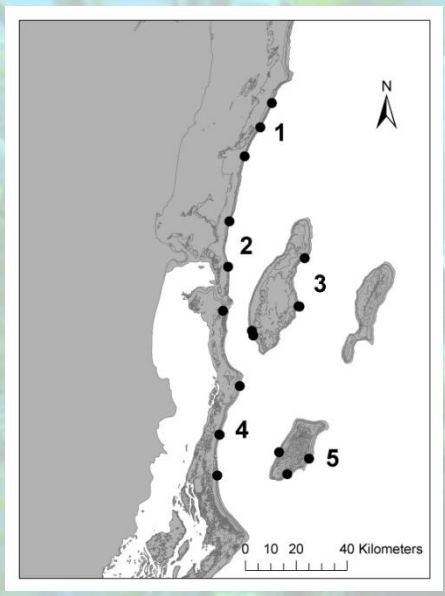

Fig. 1 Study sites in Belize (black dots), site numbers correspond to locations: 1) Ambergris Caye, 2) Central Caye, 3) Turneffe Island, 4) South Central caye, and 5) Glovers reef.

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Visual surveys along transect lines (Fig. 2) recorded the following information:

1) Benthic assessments were conducted on three 10 m transects at each site. Benthic cover (coral, octocoral, sponge, algae, rock, sand etc.) was recorded every 10 cm, and coral recruits and algal biomass were measured every 2 m in a 25 cm^2 quadrat. Incidence of disease and bleaching to determine coral health were also recorded, as were counts of the of the important long-spined black urchin (*Diadema antillarum*) within 1 metre either side of the transect.

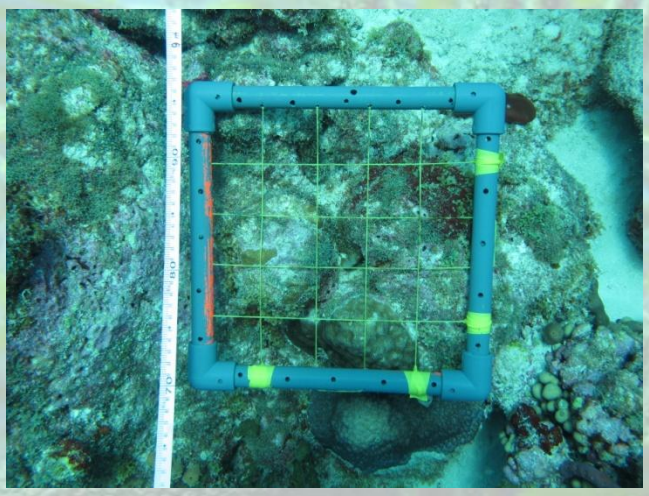

Fig. 2 Picture of 25 cm^2 quadrat next to transect.

2) Reef structure is very important for sustaining the ecosystem. A reef structure with lots of small holes provides refuge for many small fish (e.g. damsels). However, fish too big for these holes may be at risk from predators. Reef structure was visually assessed (on a scale of 0-5), and measured by draping a 10 m chain over the reef contour and measuring the actual distance covered. Counts of holes of different sizes, angle of reef slope, and vertical relief were also measured every 2.5 m along a 10 m transect were recorded.

3) All fish within two 30 m by 4 m transects at each depth were identified to species, counted, and size estimated.

What We Found

Bottom Communities

The cover of bottom-dwelling organisms (coral, algae, sponges etc.), coral recruitment, and species diversity are widely utilized measurements in identifying the current state of a coral reef in particular site/region. We found the diversity of bottom-dwelling organisms to be higher in Belize than other countries surveyed during this project. For example, there were a total of 44 hard coral, 39 soft coral, 49 sponge and 11 sessile invertebrate species, and 17 algal genera identified in Belize. Reef communities in Belize were very similar to Bay Islands (Honduras). Algae were the dominant benthic substrate (39%). Overall, mean hard and soft coral and sponge cover were low (16%, 14%, and 5%, respectively).

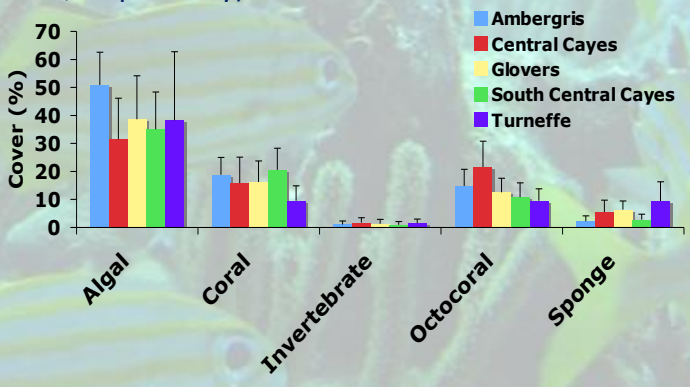

Fig. 3 Bottom cover at each of the locations in Belize.

Coral cover at Ambergris Caye and South Central Cayes was higher than at Central, Turneffe island and Glovers reef (Fig. 3). The highest coral cover was found at one of the South Central Caye reefs (22.3%).

While the lowest coral cover found was observed at two Turneffe reefs (8.3%).

No significant difference in coral cover was observed at different depths. The most dominant coral species at all three locations were tan lettuce-leaf coral (*Agaricia agaricites*), mustard hill coral (*Porites astreoides*), and massive starlet coral (*Siderastrea siderea*). Glovers and South Central Caye reefs had the highest diversity of coral species in Belize. Bleaching and disease incidence was low at all locations.

Coral Recruitment

Measurements of coral recruitment help managers and scientists better understand the resilience potential of coral reefs. Coral recruitment in Belize (Table 1; 6.1 recruits/m^2) was higher than Curaçao and Bonaire, but lower than Bay Islands, Honduras, Barbados and Jamaica. The available substrate for corals to recruit was the second lowest of six countries (35.9%, Table 1).

Table 1. Recruits and substrate availability in all locations, Belize.

Location	Recruits (#)	Substrate available (%)	Density (ind m^{-2})
Ambergris	13	39.2	5.9
Central Cayes	8	46.2	3.1
Glovers	15	30.6	8.7
South Central Cayes	15	36.4	7.3
Turneffe	11	27.1	7.2

Species of coral recruits varied between locations. The most common recruits at all cayes were *Agaricia* spp. and *S. siderea.*

Density of the sea urchin *Diadema antillarum* was low (0.005 m^{-2}) at all locations in Belize. Since it consumes algae cover, its low densities could explain the high algal cover on reefs in Belize.

Reef Complexity & Fish Communities

Almost two kilometers of reef were surveyed by 60 fish transects in Belize. In total 132 species of fish were identified, with on average 29 species on each transect. Fish communities were characterised by a high abundance of jacks, snappers, grunts, yellowheaded wrasses, redband parrots and bicolour damselfishes.

Sites near Turneffe Island had the highest fish abundance (Fig. 4), while the central cayes had the highest diversity of fishes. Reefs at Ambergris Caye had the lowest diversity and abundance of fish (Fig 4). No significant difference in fish abundance was recorded at different depths.

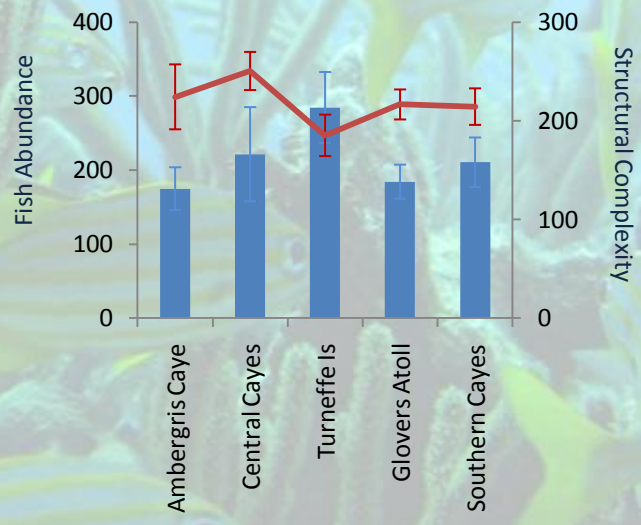

Fig. 4 Reef complexity (red line) and fish abundance (blue bars) at five locations in Belize

Reef complexity was assessed by 60 transects. The reefs at the central cayes had the highest measures of complexity, while those around Turneffe Island were lower in complexity (Fig. 4 – red line).

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Average hole sizes followed a similar trend where the largest average hole size was found in the central cayes (21.2 cm) and the smallest in the south cayes (12.9 cm).

Fish diversity had a positive relationship with reef complexity (Fig. 5), although the tendency to lower values at higher reef complexities suggests an intermediate level of reef complexity supported the highest fish community diversity.

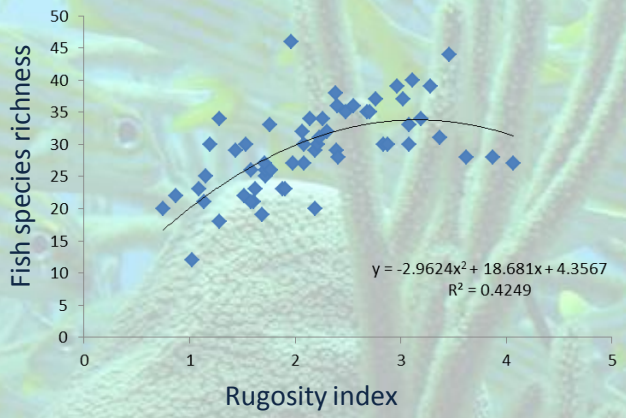

Fig. 5 Relationship between reef complexity and fish diversity

What this Means

In conclusion, the mean coral cover found in Belize was comparatively lower (16%) than that measured in a neighboring reef system, Bay Islands of Honduras (26%).

Also, coral cover observed in this study was slightly lower than that reported in 2010 Healthy Reefs Report Card (18%). However, our study included 15 sites while Healthy Reef initiative surveyed 36 sites. Interestingly, Turneffe Island had some of the highest fish densities but the lowest reef complexity. This may well be due to the close proximity of mangroves, which can act as a nursery for fish resulting in healthier fish populations on reefs.

Social scientists from FORCE will in due course be interviewing stakeholders in Belize to identify the present economic status, governance structure, and social composition. This will be used in combination with the ecological data to improve understanding of how different scenarios of climate change and governance could affect reefs and livelihoods in the Belize region. In addition, data that are collected in the field will be reviewed in a published document describing the geographical differences of benthic and fish communities in the greater Caribbean region.

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For more information please visit www.force-project.eu

Our project partners:

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