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

Summary of Bonaire Surveys January 2011

www.force-project.eu

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.

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 seven locations in Bonaire (Fig. 1). At each location surveys were conducted at 10-15 m between January 21 and January 28, 2011.

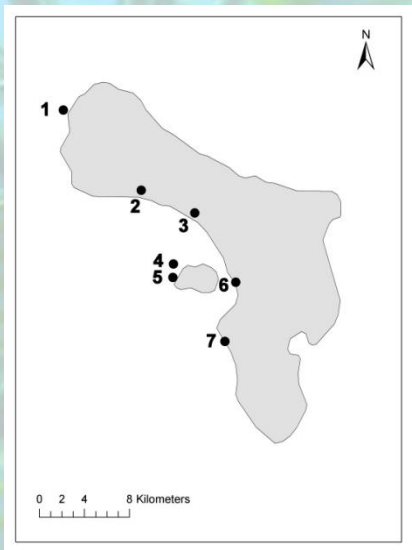

Fig. 1 Study sites in Bonaire (black dots), site numbers correspond to locations: 1) Play'I Funchi, 2) Karpata, 3) Oil Slick Leap, 4) Mi Dushi, 5) Forest, 6) Calabash, and 7) Aquarius.

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

1) Benthic (bottom) assessments were conducted on six 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 1 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.

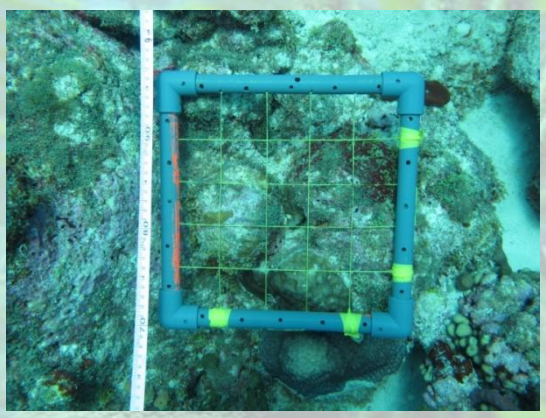

Fig. 2 Picture of 25 cm^2 quadrat next to transect.

2) Reef structure can provide prey with refuge and by predators for ambushing. A reef structure with lots of small holes could provide 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). Counts of holes of different sizes, angle of reef slope, and vertical relief were recorded every 2.5 m along four 10 m transects.

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 low in Bonaire than other countries surveyed during this project. For example. there were a total of 23 hard coral, 9 soft coral, 26 sponge and 4 sessile invertebrate species, and 17 algal genera identified in Bonaire. The dominate benthic substrates at all sites were algae (37%) and coral (34%). Overall, mean soft coral, sponge and invertebrate cover were very low (3%, 5%, and 4%, respectively, Fig. 3).

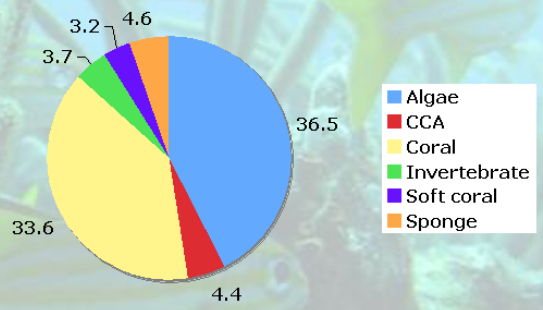

Fig. 3 Mean bottom cover across all locations in Bonaire.

The highest mean coral cover was found at Forest (44%) and Mi Dushi (41%), both sites are off Klein Bonaire. While the lowest mean coral cover found was observed at Calabash (18%). Cover of soft coral and sponge was very low at each site (Fig. 4). The highest invertebrate cover was recorded at Karpata (Fig. 4). *Trididemnum solidum* constituted 66% of the invertebrate cover at this site.

The most common coral species at all three locations were mountainous star coral (*Montastrea faveolata),* lettuce coral (*Agaricia*

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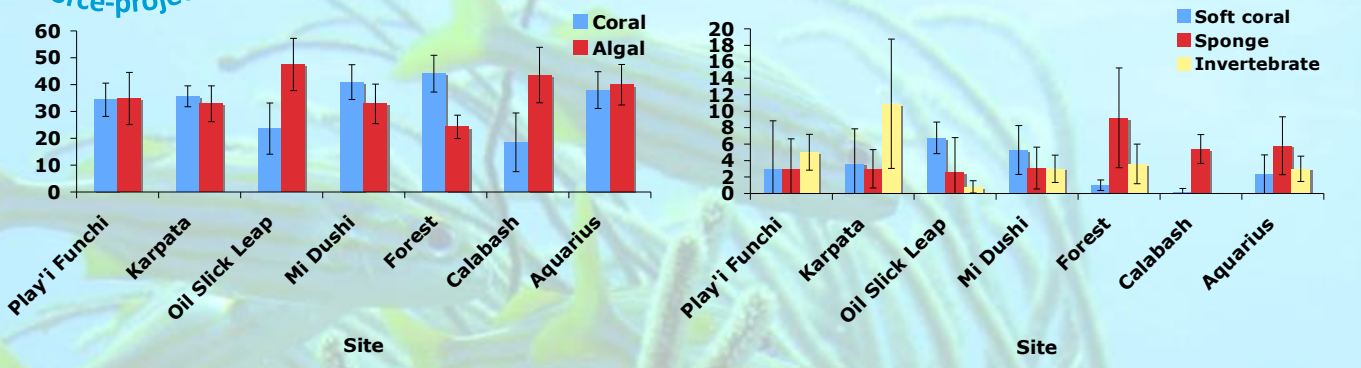

Fig. 4 Benthic cover of coral, algal, soft coral, sponge, and other invertebrates at each location in Bonaire. Bars represent standard deviations.

agaricites), and boulder star coral (*M. annularis,* Fig. 5). *Montastrea faveolata* and *M. annularis* are important reef building species. Out of total corals counted, 28% were observed bleached.

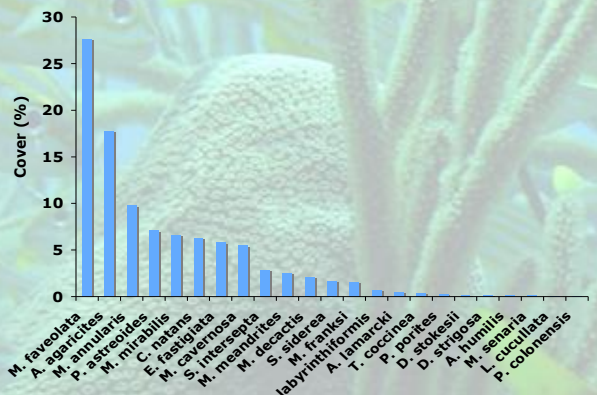

Fig. 5 Mean cover of coral species in Bonaire.

Montastrea faveolata was the coral species most bleached (18%). The sites that contained the most bleached corals were Play'I Funshi (7%) and Karpata (6%). However, most bleached corals seemed to be recovering. Disease incidence was relatively 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 Bonaire (3.1 recruits/m^2) was lower than Bay Islands, Honduras, Belize, Curaçao, Barbados and Jamaica. The available substrate for corals to recruit was second highest of six countries (41.9%).

Only one individual of the long-spined sea urchin (*Diadema antillarum)* was recorded at our sites in Bonaire. This sea urchin consumes and controls algal cover. Its low densities could explain the relatively high algal cover on reefs in Bonaire.

Reef Complexity & Fish Communities

Just over 1 ½ kilometers of reef were surveyed by 56 fish transects in the Bonaire. In total 95 species of fish were identified, with on average 24 species on each transect. Fish communities were characterised by very high abundances of parrotfish, graysbys and chromis. Large individuals were present for most species except groupers. Karpata had the highest fish abundance (Fig. 6), but also the lowest fish diversity alongside oil slick. Playa Funchi had the lowest abundance of fish (Fig. 6). Reef complexity was assessed through 28 transects along the east coast of Bonaire and Klein Bonaire. On the mainland Karpata was the most complex, while Calabash reef, the only site in front of the main town centre, had the lowest complexity. The highest overall complexity was at Forest on Klein Bonaire. Hole sizes followed a similar pattern, however the

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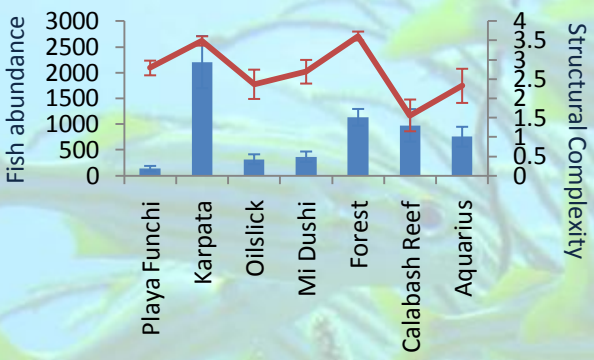

Fig. 6 Variation in reef complexity (red line) and fish abundance (blue bars) in Bonaire.

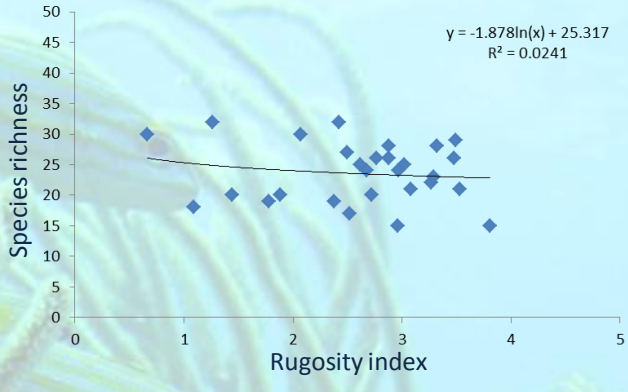

Fig. 7 Relationship between reef complexity and fish diversity

largest average hole size was at the northern most site, Playa Funchi (16.50cm) and Karpata second (15.99cm). The smallest average size was at Calabash reef (12.18cm). The was no positive relationship with fish diversity and reef complexity as expected (Fig. 7), with high levels of species richness regardless of reef structure in Bonaire.

What this Means

The reefs in Bonaire were relatively healthy with high coral cover, parrotfish abundance and diversity. The mean coral cover was the highest recorded by FORCE to date (Honduras, Belize, Jamaica, Curaçao and Barbados), however coral recruitment and species diversity of benthic organisms were the lowest. The reefs in Bonaire had a high diversity of parrots, but snapper and grouper diversity was relatively low. Despite this, the densities of groupers and parrotfish in Bonaire were the highest recorded in the Caribbean by FORCE to date. With approximately 260 groupers and 394 kg of parrotfish per 100m^2 of reef in Bonaire, these surveys suggest that Bonaire's reefs have some of the healthiest fish stocks in the Caribbean. The ecological data we have collected will be used to increase understanding of how different scenarios of climate change may affect Caribbean reefs in the future. In addition, data that is 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.

People We Thank

Bonaire National Marine Park (STINAPA- Ramon de Leon
Dive Friends Bonaire

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

Our project partners:

- Alterra
- Bar-Ilan University
- Caribbean Research & Management of Biodiversity -CARMABI
- El Colegio de la Frontera Sur - ECOSUR
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