18. Status of Coral Reefs in the Mesoamerican Region

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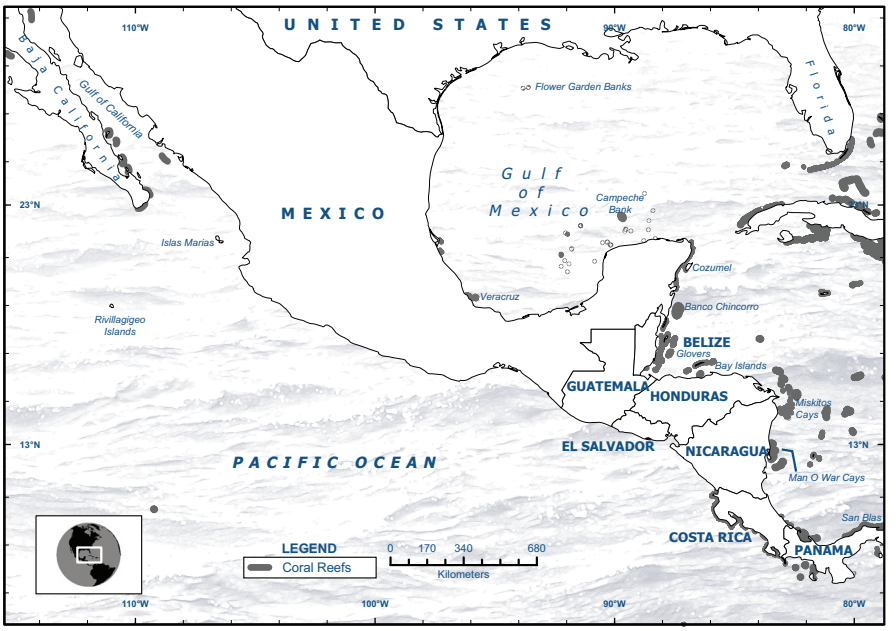
Abstract

- The Mesoamerican Barrier Reef System (MBRS/MAR) region has received increasing recent attention as a priority for international conservation organizations to provide more research and conservation effort;
- Human and natural threats are continuing, resulting in declining reef condition;
- Live coral cover has declined greatly while chronic human stresses escalate, in parallel with environmental changes and natural events. Coral cover on some reefs has declined by more than 50%;
- A 2006 comprehensive survey of 326 representative reefs revealed regional coral cover averaging 11% (11% Belize, 7.5% Mexico Yucatan, and 14.4% Honduras & Guatemala combined); but some sites have higher cover;
- Mesoamerican Barrier Reef System (MBRS) project found coral cover from 11–26% at 13 strategically selected sites from 2004–2005 (most/all within MPAs); 96 new surveys in 2007 to 2008 on shallow fore-reefs (2–5 m) in 6 Belize regions showed coral cover of 13%; total fish biomass had declined (average 49.8g per m^2); coral and fish abundances are below the Caribbean average;
- Low coral cover indicates that reefs have not recovered from the 1998 bleaching and Hurricane Mitch;
- It is urgent to develop measures to increase reef resilience and lobby for stronger protection of reefs in good health.

Introduction

The main feature of this region is the Mesoamerican Reef (MAR), containing the longest barrier reef in the Western Hemisphere (Belize), 4 offshore atolls and several other diverse reef structures, all extending for 1000 km from northern Yucatan in Mexico, through Belize and coastal Guatemala and out to the Bay Islands in Honduras. These reefs help stabilize and protect the coasts, and serve as feeding and nursery habitats for marine mammals, reptiles, fishes and invertebrates; many of which have great commercial importance. Mesoamerican reefs, however, have been significantly damaged recently due to a combination of human and natural perturbations, with threats ranging from fishing, tourism and coastal development, land use and agriculture to global climate change. A number of 'natural' disturbances have threatened the reefs, especially coral bleaching, hurricanes and disease outbreaks; all of which may be accentuated by global climate change and thus not entirely 'natural.' Such events are not readily controllable at the local management level, while other human threats are potentially under local, national, or regional control. Reef managers in the region, however, are often limited by the resources and 'toolbox' methods available to carry out necessary interventions such as fisheries regulation, protection of coastal habitats, agricultural run-off and sewage pollution reduction, as well as possible restorative activities.

In the 1980s reefs within the MAR experienced the first large-scale impacts, diseases became very evident and widespread throughout the Caribbean, and the first mass coral bleaching from elevated sea temperatures destroyed corals across the Caribbean. *Diadema antillarum* (long-spined sea urchin) and *Acropora* species suffered wide-scale mortality from disease in the early 1980s: 95% of *Diadema* died within the region which allowed algal growth to accelerate quickly on many reefs. The MAR were no exception, however, inadequate quantitative data hampered interpretation of the ecological changes. It was recognised that abundant herbivorous fish populations had probably kept algal growth within ecologically tolerable limits.



The first major ocean warming event in 1983 resulted in some bleaching in the MAR, but the effects were not extensive. According to Carilli and Norris, 2008, the stress to MAR reefs was very minimal when compared to that of 1998. MAR had experienced bleaching episodes in 1995, 1998 and 2005, but 1998 had by far the greatest impact when reefs were damaged extensively by the combination of a mass bleaching event and a category 5 hurricane (Mitch). These synergistic events, combined with chronic 'background' stresses, caused dramatic reductions in live coral cover on reefs with 50% or more coral losses. Coral cores taken from 5 locations along the Mesoamerican Reef have proven that no similar wide-spread mortality events occurred before (more details in *Status of Coral Reefs of the World: 2002, 2004* reports, The 2005 Caribbean Bleaching reported in 2008 and on www.mbrs.org.bz).

Increasing attention has been given to MAR since these events, especially on science and conservation by local and international agencies. The increased global significance of MAR reefs is evidenced by the establishment of regionally focused projects and initiatives including the Mesoamerican Barrier Reef System (MBRS) Project, a Global Environment Facility/World Bank project (entering the second 5-year phase); the World Wildlife Fund (WWF) Mesoamerican Reef Ecoregional Program; The Nature Conservancy (TNC) Mesoamerican Reef Program; the Wildlife Conservation Society (WCS) marine program in Belize; the International Coral Reef Action Network Mesoamerican Reef Alliance; and the multi-organizational Healthy Reefs for Healthy People Initiative. Globally, the immense value of coral reefs has recently received increased study and economic analyses, with conservation being only one of many values. Research is increasingly aimed at understanding reef status and condition to support conservation efforts. The MBRS Synoptic Monitoring Program (SMP) is an example of new applications to assess coral reefs and associated ecosystems: this is being applied in MPAs to gather reliable data on reef status based on standardized monitoring methods.

Information is targeted at natural resource managers by reporting on the status and trends in marine and coastal resources. Since inception, the Program has established baseline information for 13 MPAs in 2004–2005 based on research in the MAR. Average live coral cover of these prime sites in 2004 was 23% for the 13 targeted MPAs across the region in Mexico (3), Belize (7), Guatemala (1) and Honduras (2). Maximum coral cover was 50% on deep fore-reef sites while 2% was the minimum cover at shallow fore-reef sites. Average fish density at MBRS sites was 35 fish per $100m^2$ with ranges from 5 to 111 fish/$100m^2$.

A comprehensive study of 326 reefs within the Mesoamerican Reef by WWF and TNC between late 2005 and late 2006 examined different reef habitats, including shallow fore-reef, patch reef, reef pinnacles and back reef/reef flat sites, to offer a snapshot of the ecological health of MAR. The regional average for coral and macro-algae cover was 11% and 18% respectively; total fish biomass was 49.8 g/m^2, with herbivorous fish averaging 26.2 g/m^2 and commercial fish averaging 11.3 g/m^2. Thus reefs within the region have not recovered from the synergistic impacts of the 1998 mass coral bleaching and Hurricane Mitch, and this is worrying when the future may bring increases in storms and coral bleaching associated with climate change and increasing sea surface temperatures. It is urgent that all measures be applied to increase the resilience potential of these reefs and that lobbying be enhanced to gain greater protection for reefs in the best health. The recovery rate of coral populations can be greatly diminished by macro-algal blooms, thus it is very promising that the coral to macro-algal cover ratio remains fairly low.

Also promising is that recent average coral mortality (based on 326 sites) was only 1.2%; which indicates that these reefs were not significantly damaged by the 2005 mass bleaching event, the most severe on record in the Caribbean. Very little residual bleaching was observed in the following year which could indicate the innate potential of these reefs to rebound from large-scale natural stresses. However, many storms passed through the region from June to late October 2005 and these helped increase shallow water circulation thereby reducing water temperatures and enabling corals to recover rapidly. It is very important that research be focused on ascertaining the ability of these reefs to 'bounce back' from such climatic related stress, since no conclusive results could be drawn from the 2005 bleaching event. Furthermore, many in the reef science community consider that continuous monitoring over a series of bleaching events is needed before sound conclusions can be made on the resilience of reefs. Until then, the reference point will be the 'potential' ability of reefs to be resilient. Also monitoring should be complemented with proactive actions to reduce chronic background stresses. Reefs are considered unhealthy if they lack the resilience needed for natural processes of recovery and causes of poor health are often attributed to multiple factors including over-harvesting of herbivores, low coral cover, high macro-algal cover, high sedimentation, and eutrophication.

Based on the WWF and TNC 2006 surveys, no statistically significant difference in average coral cover among reef habitat types (fore-reef, patch reef, reef-flat) was found. Fore-reefs had a mean cover of 9.6%, patch of 8.3% and reef flat of 7.8%, which indicates that fore-reef sites are not necessarily healthier than sites near the shore. In order to have effective management and conservation, there is a need to assimilate the relevant scientific information to determine best management practices for reefs and associated systems.

Historical Context and Status of Reefs in 2008

The major threats in the region are the destruction of natural coastal habitats by increasing coastal and tourism developments, and increased sedimentation from extensive and unsustainable use of watersheds and inland deforestation.

Mexico: The Mexican Caribbean coast consists of partially submerged fringing reefs on the northern Yucatan coast and fully developed fringing reefs, with well developed and extensive spur and groove systems, from Xcalak to Belize. The presence of the Xcalak Trench has fostered the development of twin reef crests and fore-reefs in this area. A wide carbonate shelf, influence from coastal upwelling, and scattered patch reefs characterize the northern section. Offshore are three banks/islands: Arrowsmith Bank, along a submerged platform (ranging from 25–400 m in depth), with patch reefs on its southern section; Cozumel Island with reefs on the windward and leeward side; and the Banco Chinchorro Atoll with highly developed reefs on the windward side with well developed spur and groove systems.

Puerto Morelos and nearby reefs suffered significant coral mortality from Hurricane Gilbert (1988) and the mass bleaching in 1995. Unlike Belize reefs, the 1998 mass bleaching and Hurricane Mitch did not cause widespread coral mortality along the Yucatan coast. Patch reefs at Isla Mujeres and Cancun suffered some mechanical damage and fragmentation from Hurricane Ivan in 2004.

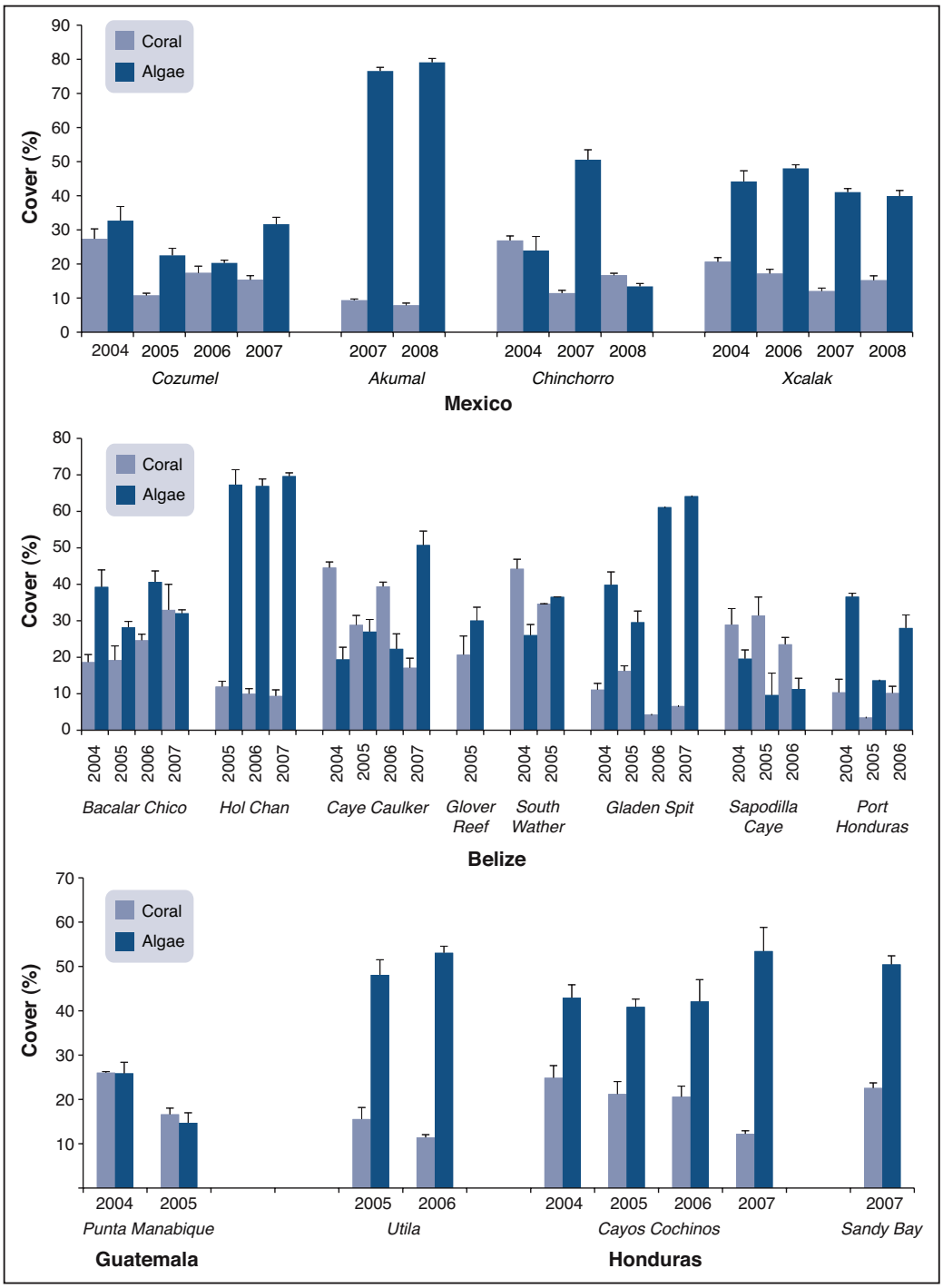
These reefs have suffered from intense fishing activity since the 1960s and increasing pressure from tourism since the mid 1970s. Reef patches at Punta Nizuc and El Garrafon at Isla Mujeres have already been affected by tourism-related activities and the damage appears to be spreading elsewhere to Akumal, Puerto Morelos, Mahahual and Cozumel. Shallow reefs at Cancun, Sian Ka'an and Chinchorro have been affected by boat damage. The reefs just off the northern tip of the Yucatan Peninsula and immediately westward (Punta Mosquito, Boca Nueva, Piedra Corrida) have very little (<2%) coral cover.

The TNC-WWF assessment of 121 reef sites in Mexico from 2005–2006 found average coral cover of 7.5% including shallow fore and patch reefs; reef flats of Sian Ka'an, Cozumel, Isla Contoy, Banco Chinchorro; and some reefs off the Riviera Maya. Total macro-algae cover was 14.9% while fleshy macro-algae cover was 11.5%. Total fish, herbivorous fish and commercial fish biomass was 30.3g/m^2, 14.5g/m^2 and 8.6g/m^2 respectively.

Data from the MBRS Project in 2004 showed 24% average coral cover in the Xcalak, Banco Chinchorro, and Cozumel Island MPAs. The lowest (18%) was in Xcalak with higher algal cover (41%), which indicates 'alert' status similar to that in Cozumel. However, on Banco Chinchorro conditions are better with less than 25% algal abundance and higher coral cover (26%). The most common reef fish species are from Family Pomacentridae, mainly in Banco Cahinchorro and Xcalak. Cozumel had the second highest fish densities for the region, and Banco Chinchorro has the largest algal grazing (herbivore) population living on the deep fore-reef.

Belize: The longest continuous barrier reef system in the western hemisphere extends 260 km along Belize. As well, there are diverse assemblages of lagoonal patch reefs, fringing reefs, faroes and offshore atolls (covering 1400 km^2). The reefs were once considered to be amongst the most flourishing reefs of the Caribbean, but are now generally on par with the rest of the Caribbean with the reefs damaged by a combination of punctuated disturbance events and chronic stressors, leading to declining coral cover and increases in macro-algae. A few reefs appear to have undergone phase-shifts from domination by living corals to macro-algae. Hurricanes and more recent coral bleaching and disease represent the main widespread disturbances.

Belize's reefs became the focus of serious investigation in the 1960s and 1970s and a series of expeditions followed, driven particularly by the development of the Carrie Bow research station by the Smithsonian Natural History Museum. Prior to 1998 Belize reefs were regarded as being in relatively 'good' condition, however, coral bleaching, disease and major Hurricane Mitch in 1998 degraded the majority of reefs. Coral cover was 25% in 1992 on several barrier reef sites off Ambergris Caye (Tackle Box site) and 20% at Gallows Reef. In 1993 there was 84% coral cover on the shallow Mexico Rocks patch reef off Ambergris Caye; this dropped to 66% in 1995 following the 1995 coral bleaching event. Prior to 1998 most reef losses in Belize were probably from diseases, excess nutrients, sedimentation, loss of *Diadema*, moderate over-fishing, and bleaching. The 1998 bleaching and hurricane disturbances amplified these on-going declines.



Coral and algal cover on reefs in Mexico, Belize, Guatemala and Honduras monitoring sites between 2004 and 2008 measured as percent cover of the bottom with standard errors.

While live coral cover is only one measure of ecological status, it is the most commonly used indicator or 'dip-stick' of reef health. Decreased coral cover has occurred in those sites in Belize where long-term data are available. The earliest major declines were on shallow patch reefs in Glover's Reef Atoll from WCS studies which reported 80% coral cover in 1971 then 20% in 1996 and 13% in 1999. The inner fore-reef region at Carrie Bow Caye had 30–35% coral cover in the 1970s and had declined to 12–21% by 1995. The fore-reef at Channel Caye (3–15 m depth), an inner-shelf faroe, declined from 85% live coral in 1986 to 60% in 1996, mainly due to disease and loss of staghorn corals (*A. cervicornis*), with partial replacement by thin leaf lettuce coral (*Agaricia tenuifolia*). Subsequent bleaching in 1998 devastated this reef reducing coral cover to 5% in 1999. Average coral cover in Belize is now slightly less than the Caribbean average in the AGRRA database.

The TNC-WWF 2006 assessment of 140 reef sites in Belize found coral cover of 11% (on average) at diverse sites including barrier, atoll, lagoonal, and faroe reefs, as well as MPAs and non MPA sites. Total macro-algae cover was 16% while fleshy macro-algae cover was recorded at 12%. Total, herbivorous, and commercial fish biomasses were 35.4g/m^{2,} 17.6g/m^2 and 8.6g/m^2 respectively.

The MBRS Project focused on 7 MPAs (Bacalar Chico; Hol Chan; Caye Caulker; Glover's Reef; South Water Caye; Gladden Spit; and Sapodilla Caye) where average coral cover was 26% (an 'acceptable' level) and 50% of sites had low algal cover, although 3 MPAs had more than 40% algal cover. Bacalar Chico was considered to be 'alert' status, with 19% coral cover, and Hol Chan and Gladden Spit were in a 'poor' condition with 11%, the lowest coral cover. The lowest populations of coral reef fishes were found in Caye Caulker and Gladden Spit; whereas Bacalar Chico had the most abundant species of herbivores on the deep fore-reef.

Assessment of 96 reef sites along Glover's Reef Atoll, Half Moon Caye, Laughing Bird, Port Honduras, Sapodilla Cayes and South Water Caye during 2007–2008 found average coral cover of 11.8%, 20.0%, 16.6%, 8.8%, 9.9% and 11.8% respectively. Fleshy algae cover was correspondingly 26.3%, 31.4%, 31.4%, 24.8%, 34.1% and 25.3%. Total fish biomass was 49g/m^2, 34.7g/m^2, 40.5g/m^2, 31g/m^2, 25g/m^2 and 37g/m^2.

Guatemala: There is limited reef development along the Caribbean coast, with the best known being the carbonate banks of Punta Manabique, which are dominated by sediment resistant coral species such as *Siderastrea siderea*, and the isolated coral communities and diminutive patch reefs of the Gulf of Honduras. There has been significant degradation of Guatemalan reefs due to the combined effects of hurricanes, flooding and associated sedimentation, and increases in sea surface temperature. The major threat to the reefs of Punta Manabique is sedimentation from deforestation and soil erosion which bring elevated sediment loads and contaminants onto reefs, causing increased coral mortality and algal proliferation. A study conducted in 2000 recorded live coral cover of less than 9% and non-coralline macroalgal cover of 65%.

Assessment of 5 reef sites in Guatemala in 2006 found an average coral cover of 8.5%. These sites included lagoonal reefs off Kingfish, Bajo del Canal, Montaguilla, Cabo Tres Puntas and Cabo Tres Norte. Total macro-algae cover was 12.5% while fleshy macro-algae cover was 7.5%. Total (31.0g/m^2), herbivorous (8.3g/m^2) and commercial (13.1g/m^2) fish biomasses were much lower than elsewhere in MAR.

Only two sites in the Punta de Manabique MPA were monitored by the MBRS Project. The small reef patches had an average coral cover of 26% with the sediment-resistant species (*Montastraea cavernosa*, *Siderastrea sidereal*, *Agaricia* spp.) being most common. These patches experience high sedimentation and river discharge that impedes coral growth and possibly also reduces algal growth due to poor light penetration: low algal cover of 25% was measured. These patch reefs may also serve as reference sites as the first reefs to be affected by human activities, such as sedimentation, nutrient loading, harmful chemicals, and solid waste.

Honduras: While only small coral reef communities occur on the Caribbean coast of Honduras (Puerto Cortes, La Ceiba and Tujillo), there are well developed reefs on the outer Bay Islands (Utila, Morat, Barbareta, Roatàn, and Guanaja) and Cayos Cochinos. Well developed fringing and patch reefs are also found eastward (Misquitu Cays and Banks) and further north-east of the mainland (Swan Island). The edge of the Honduran continental shelf is almost vertical and has high coral cover. *The Global Coral Reef Atlas* reports average coral cover of 28% on the fore-reefs of the Bay Islands in the early 1990s. A 2001 WWF survey found 12%, average fore-reef coral cover at Roatan/Barbaretta with 8% at Cayos Cochinos, lower than the MAR-wide average of 15%. They also found a slightly higher prevalence of coral disease in Honduras than the MAR-wide average (4.4% versus 3.4%), with recent partial mortality (1.8% versus 1.6%). The Bay Islands reefs were relatively healthy prior to 1998, but bleaching and Hurricane Mitch resulted in 18% coral mortality on shallow reefs and 14% on deep reefs along with an increase in coral diseases. The damage from Hurricane Mitch was due to mechanical damage from waves and terrestrial sediment smothering corals. Hurricane Iris in 2001 also affected Honduran reefs through increased river runoff and sedimentation.

Assessment of 60 reef sites in Honduras by TNC-WWF in 2006 found an average coral cover of 14.8% on various reef types at sites including Barbaretta, Trujillo, Cayo Cochinos, Guanaja, Puerto Cortes, Roatan, Tela and Utila. Total macro-algae cover was 25.3% while fleshy macro-algae cover was 16.5%. Total, herbivorous and commercial fish biomasses were 113.0g/m^2, 72.9g/m^2 and 20.6g/m^2 respectively.

Similar reef structures in the Utila Island and Cayos Cochinos MPAs were monitored by the MBRS Project including island platforms at 5 m depth culminating in a steep slope. Utila Island had a low coral cover (16%), considered as 'alert' status, whereas Cayos Cochinos was in good condition with 24% coral cover and the most abundant herbivore fish species on the deep fore-reef, however, both sites had critical levels of algal cover (> 40%).

Status of Coral Reefs in MPAs: 2008

Coral cover in the MPAs appears to have decreased by 10% in only 4 years, although monitoring is not consistent in all countries with different sample sizes in each MPA. Throughout the region, the most dramatic loss of coral was 7% in 2005, with an average loss of 2% in each of the next 3 years.

All MPAs in Mexico report a decrease in coral cover and an increase of algal cover. These reefs were damaged by hurricanes Emily and Wilma in 2005 and the Beta and Gamma storms, with direct losses of coral cover. Parallel increases in algal cover were variable, for example, in Banco Chinchorro algal cover increased to 50% in 2007 and then dropped to 15% in 2008, possibly as an effect of Hurricane Dean in 2007. The Akumal MPA was added to the monitoring program

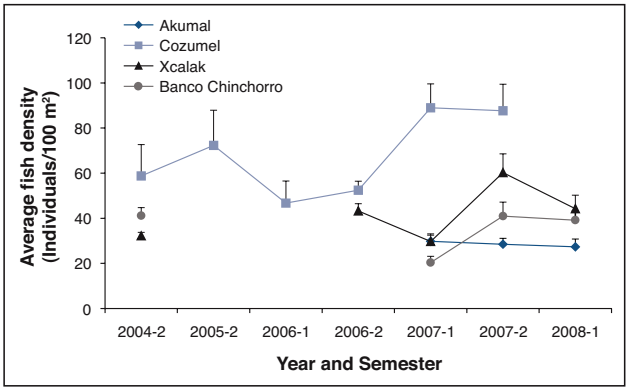
and the first surveys showed low coral cover (mean 10%) and high algal cover (mean 75%); this MPA is considered to be in a 'critical' status.

Coral cover in Bacalar Chico MPA, Belize has increased by 15% (from 2004–2006) with fluctuations in algal coverage. In 2004 this site was considered as 'alert' status; now it is regarded as being in good condition. The other MPAs showed a generalized trend of decreasing coral cover and increasing algal cover. Unfortunately, Hol Chan and Gladden Spit are regarded as being in 'critical' condition.

Monitoring in Guatemala has covered only 2 years with a tendency for a decrease in both coral and algal cover. The Sandy Bay MPA in Honduras was added to the monitoring program in 2007 with coral cover of 22% and algal cover of 50%. Other localities show decreases: coral cover on Cayos Cochinos dropped dramatically by approximately 50% (in 2004 it was 24% and only 12% in 2008).

Status of Adult Fish at MBRS Sites

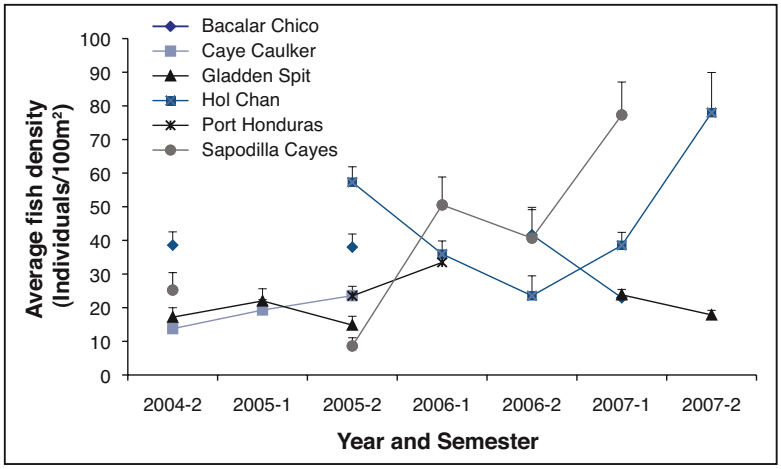
Fish monitoring showed temporal variation between the two semesters of the year along the MBRS region. There were no significant changes since 2006 in Akumal, Mexico which lacks legal protection and shows the lowest fish populations, whereas at Banco Chinchorro there was higher fish abundance with higher densities of families *Acanthuridae*, *Scaridae* and *Serranidae*. In Cozumel, immediately after hurricanes Emily and Wilma (late 2005) densities were above average (72/100 m^2) probably due to reorganization of fish populations among the reef sites, higher activity of the fish and more large carnivores as a consequence of the reduction in refuge sites on the reef. Until 2006 the effects of the storms were evident with a reduction in fish abundance, however, there was an increase in density in the following year (2007) for families *Haemulidae* and *Pomacentridae*. Protection of the National Park in Xcalak had a positive effect on fish populations with increases since the nominal 2004 baseline. After Hurricane Dean (late 2007) hit the southernmost part of Quintana Roo, fish density increased above the average (60/100 m^2) followed by a considerable reduction in early 2008 (44/100 m^2). Values were still above the regional average but carnivores (*Serranidae* and *Lutjanidae*) remained scarce.



Average fish density in Mexican MPAs during 4 years shows considerable variability, even between repeat sampling 6 months apart in the same year (for example, 2007-1 and 2007-2).

The lowest densities of fish were at Gladden Spit and Caye Caulker in Belize with no significant changes in 2007. Nevertheless, at Bacalar Chico fish abundance was above the average during 2004, 2005 and 2006, but dropped in 2007 to less than the baseline average (22/100 m^2).

Hol Chan and Sapodilla Caye had the highest densities in 2007 of 77/100 m^2. These reefs have shown seasonal variations throughout the years with a major decline in fish abundance in late 2006. This reduction was probably due to the 2005 hurricanes and 2006 tropical storms but considerable increases were observed in 2007. Fish populations at Cayo Cochinos in Honduras showed a decreasing trend from 2004 to 2007; there were insufficient data at other Honduras sites for valid comparisons.



Average fish density in Belize shows similar variations between seasons and years, as in Mexico.

Status of Mangroves, Seagrasses and Fisheries

The mangrove forests throughout the MBRS region (7 localities in 4 countries: Banco Chinchorro and Xcalak, Mexico; Bacalar Chico, Belize; Rio Sarstun and Punta Manabique, Guatemala; and Omoa-Baracoa and Nueva Armenia, Honduras) are deteriorating as a result of human activities. The 4 species (*Rhizophora mangle*, *Laguncularia racemosa*, *Avicennia germinans* and the buttonwood *Conocarpus erectus*) are all affected. The highest mangrove density is at Arrecife de Xcalak, and the lowest was observed at Rio Sarstun. Forests across the region vary in maturation level from an average of young (5.8 m tall) to old (19.8 m tall), which reflects the history of hurricanes and storms in 2005. It is now acknowledged that these mangroves are particularly important in the region, especially for fisheries, thus continuing and increased monitoring is essential.

There are 7 seagrass species in the region with the dominant species being turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*), along with *Halodule wrightii*, *Ruppia maritime*, *Halophila decipiens*, *H. englemanni* and *H. baillonis*. The seagrasses have a large distribution range and grow mainly in muddy estuaries, shallow sandy areas close to the coast, reef lagoons and around sand banks. However, distribution and density may vary

with the seasons, for example, seagrass beds are denser during April to June with clear, long days and high temperatures. Biomass, productivity, density, leaf area index, community composition and other related ecological parameters during 2004 and 2005 varied widely between 3 and 1596 g/m^2 in samples taken in different environments. Much of this biomass was below ground (roots + rhizomes) indicating that the beds may be healthy and biologically active, even when there were few shoots and leaves, and able to recover after damaging storms. These values also indicate that there is sufficient light for seagrass growth. However, increasing human coastal populations are threatening seagrass beds, especially coastal development, dredging and marina/jetty construction. Seagrass conservation will require careful management of rivers and estuaries and assessments of the economic and ecological value of these resources. However, management has insufficient information on seagrass beds in the MBRS as monitoring has not been continuous.

Fish resources are coming under greater pressures from increasing tourism development with some species, mainly groupers, snappers, grunts and jacks being targeted by local fishermen. Lobsters and conch are also very valuable fishery resources but information is insufficient for effective management. More research and monitoring on the trends in fishing activities in the MBRS region are required.

Conclusions and Recommendations

The region is showing a general trend of decreasing coral cover in MPAs and elsewhere with the largest changes between 2004 and 2005; there was an average loss of 7% coral cover, followed by annual losses of 2% in subsequent years. These decreases were measured in protected MPAs; which may underestimate more serious coral losses throughout the whole region. Thus management has apparently been insufficient to effectively attenuate the increasing negative stresses to the reefs. Furthermore, the overall reef condition, as measured by large scale assessments in 2006, found most sites in 'poor' to 'fair' condition as evaluated by the Healthy Reef's Initiative's Eco-health report card for the Mesoamerican reef.

While some of the reef declines may be caused by 'natural' factors like climate change and hurricanes, these are compounded by damaging human activities that are within the control of local managers (coastal development, fishing, etc). Management strategies will have to improve and adopt the 'precautionary principle' to prevent further damaging human activities that could push the remaining good and fair reefs over the edge into reef decline. We must manage to improve resilience so that the reefs can possibly recover from climate changes threats.

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UPDATE ON CORAL REEF CONSERVATION AND MANAGEMENT IN BRAZIL

Coral reef protection, management and recovery measures have increased, after in Brazil joined the International Coral Reef Initiative as a country member in 2006. The Ministry of Environment is leading the establishment of a National Coral Reef Initiative with participation of NGOs and research and education institutions and several projects are under way: Coral Vivo project (www.coralvivo.org.br); the MMAS project (www.conservation.org/mmas); and the Recifes Costeiros project (www.recifescosteiros.org.br). The number of monitoring sites have increased with the creation of more fixed reef sites in locations already showing physical, biological and chemical damage, as well as in unaffected reefs. Although the number of protected areas has increased to 18% of the continental shelf, only 1% of these MPAs are fully protected. The Abrolhos National Marine Park (Eastern region), is one of those fully protected areas, including the area of the offshore Brazilian 'chapeirões'. The situation of oceanic reefs is better since Atol das Rocas and Noronha island are both fully protected MPAs (North-eastern region). Recently, the National Commission on Biological Diversity (CONABIO) resolved to increase the national marine and coastal fully protected areas to 10%. CEPENE (the Research Center of the Chico Mendes Brazilian Institute of Biodiversity) has approved a project to establish small no-take areas along the entire Coral Coast MPA based on results from the Projeto Recifes Costeiros; Conservation International Brazil has led similar initiatives in the Itacolomis Reefs. The success of those initiatives will, however, depend on capacity to overcome the chronic lack of enforcement, endless government changes in the environmental administrative bodies and difficulties with practicality of management plans. Destruction of the rainforests and mangroves, along with sedimentation mainly affects coral reefs close to the coast. Thus, recovery for these reefs will ultimately depend on a combination of actions such as recovery of riparian vegetation, conservation of coastal areas and best practices of land use. As overseas and national tourism is now growing in these areas it is hoped that conservation will be considered part of the attraction (from Beatrice Padovani Ferreira, beatrice@ufpe.br, Universidade Federal de Pernambuco, Departamento de Oceanografia/ CTG; Zelinda Leão, zelinda@ufba.br, Ruy Kikuchi, kikuchi@ufba.br, Universidade Federal da Bahia, CPGG/ IGEO).