Building a Resilient Network of MPAs in the Mesoamerican Reef

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Abstract

The Meso-American Reef (MAR) region, also known as the Western Caribbean, is comprised of the coast of the Mexican State of Quintana Roo and the national coasts of Belize and Guatemala and the central and eastern coast and the Bay Islands of Honduras. The region includes the second largest barrier reef in the world and the largest in the Western hemisphere. The region is home to close to 2 million people that depend, to a large extent, on the reef and associated resources. The Nature Conservancy's MAR Program and local partners have made substantial efforts to identify and advance the development of a network of resilient reefs in the region. Based on the TNC reef resilience toolkit and model, we have concentrated our initial efforts on the elements of representation and replication and refugia through a region-wide rapid reef assessment and the development of an ecoregional assessment for the identification of priority conservation sites.

We have primarily identified different reef habitats using the Millennium Project Maps, and randomly selected survey sites to conduct a rapid reef assessment using the Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol. We are working to produce a classification scheme of reef types and major reef zones that will ensure a more complete representation of biodiversity protection. We are applying a range of factors to help identify potentially resilient reefs including: high ratio of live to dead coral, a broad range of coral colony size and age distribution, reefs that survived previous high temperature or bleaching events and reefs with overall high coral species diversity. Lastly, a MAR ecoregional assessment is focusing on the development of a portfolio of priority conservation sites, based on the geographic distribution of conservation targets that are functionally linked to reefs by physical and ecological processes. Finally, designing conservation strategies in an ecoregion that includes four countries presents a suite of challenges. During the ecoregional assessment process, the participation of local stakeholders and governments has helped bring knowledge and the necessary political support to the process.

Background

The Meso-American Reef (MAR) region, also known as the Western Caribbean, is comprised of the coast of the Mexican State of Quitana Roo and the national coasts of Belize and Guatemala and the central and eastern coast and the Bay Islands of Honduras. The region includes the second largest barrier reef in the world and the largest in the Western hemisphere. The region is home to close to 2 million people that depend, to a large extent, on the reef and associated resources.

The MAR ecoregion possess several outstanding features. The region includes a great diversity of barrier, patch and fringing coral reefs in a relatively small area. There are also an abundance of coastal elements such as estuaries, coastal lagoons, mangrove forests, and seagrass beds. Several flagship species like marine turtles, crocodiles, dolphins, whale sharks, and over 500 fish species inhabit the area. This area also holds

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the largest population of manatees in the western Caribbean. In addition to the rich marine biodiverisity, more than 2 million people live in coastal area, including Creole, Garifuna, Maya, Ladino, and immigrants.

The MAR Program has set as a goal the development of a network of MPA that are resilient to bleaching events through representation and replication and conservation of key biological processes. Marine practitioners have struggled with the challenge of applying the principles of resilience to de development of a resilient network of MPAs in the MAR region. The Nature Conservancy's MAR Program and local partners have spent substantial efforts trying to identify and then advance the conservation of a network of resilient reefs in the region. Based on the TNC reef resilience toolkit and model, we have concentrated our initial efforts on the elements of representation and replication, and refugia through a region-wide rapid reef assessment and the development of an ecoregional assessment for the identification of priority conservation sites.

Rapid Reef Assessment for the Identification of Resilient Reefs

The rapid reef assessment constitutes the first effort in its scope for the Mesoamerican reef, covering close to 475 sites distributed along the region. The assessment is designed to complement other long-term monitoring efforts such as the MBRS synoptic monitoring system and the CARICOMP program which are normally focused on MPAs.

Representation and replication are understood as the protection of representative habitat types at multiple locations to spread the risk of total loss. Distinct reef habitat types are related to geomorphology, latitude, distance from shore, land influences (turbidity, salinity and pollution), and exposure to wave energy and ocean currents. We have primarily identified different reef habitats in the region from the Millennium Project Maps, and then conducted a rapid reef assessment at randomly selected survey sites using the AGRRA protocol. Through this survey, we are identifying distinct reef habitat types and communities of corals, and associated organisms to produce a good classification scheme of reef types and major reef zones that would ensure a more complete representation of biodiversity protection.

We are applying a range of factors to help identify potentially resilient reefs including: high ratio of live to dead coral, a broad range of coral colony size and age distribution, reefs that survived previous high temperature or bleaching events and reefs with overall high coral species diversity. Reefs with strong recruitment potential are identified as those with high abundance of coral recruits, high density of herbivores and/or low macroalgal cover. The combination of these factors is considered critical to prepare the substrate for successful coral larval recruitment. Other refugia we have invested in are reef fish spawning aggregations. Most of the better known SPAG sites in the region have been validated and are under some form of protection.

Due to the extent of the rapid reef assessment effort, a partnership was developed to accomplish it. In the partnership both international NGOs (TNC, WWF, GVI) and national NGOs (FoN, ASK, HCRF, UNAH, University of Costa Rica, Fundary, Fundaeco, SERNA- DIBIO) participated. The financial support of projects and foundations such as Summit Fund and USAID was crucial for the assessment.

The rapid reef assessment fulfills the need for better data and design. For this purpose, we used a randomized rapid assessment to measure baseline condition. The baseline information will also help with the design of a rapid response plan for future bleaching events. The spatial sampling design is simple, random, systematic, and spatially balanced and it guarantees that samples are distributed across the resource (target population). The sampling design uses the Generalized Random Tessellation Stratified (GRTS) design, based on the reef maps produced by the Millennium Reef Maps Project http://oceancolor.gsfc.nasa.gov/cgi/landsat.pl and uses the field protocols of the Atlantic and Gulf Rapid Reef Assessment – AGRRA - http://www.agrra.org/method/methodology.htm.

Ecoregional Assessment: Establishing Priorities in a Network of Marine Protected Areas

An ecoregional assessment focuses on two main objectives, the development of a portfolio of priority conservation sites and the identification of strategies to counteract the threats to the biodiversity in the region. The MAR ecoregional assessment is focusing on the development of a portfolio of priority conservation sites, based on the geographic distribution of conservation targets that are functionally linked to reefs by physical and ecological processes such as nurseries, feeding areas, or by transport of nutrients by currents or tides. The process includes steps such as the identification of priority conservation targets, and conservation goals for each one, the identification of main threats to the biodiversity, the ecosystem services provided by the natural resources, and the development of key processes and the strategies.

Most MPAs are often selected for the protection of a few flagship species, for political or economic opportunities, or for scenic beauty, cultural significance, and low economic interest. However it is recognized that a system or network of MPAs should be representative of the full range of biodiversity. This situation forces the conservation planning process to use selection techniques that not only can be repeatable but that are also quantifiable. The current process of ecoregional assessment is based on the Ecoregional Conservation Planning for the Mesoamerican Caribbean Reef, developed by WWF (2002) based on a consultation workshop conducted in 2000. Therefore, the new process constitutes a second iteration of the previous plan that is incorporating new information and, most importantly is using Marxan, a decision support tool.

The assessment process involves the participation of scientists and local experts, government agencies and key stakeholders. It constitutes a regional effort that goes beyond the limits of local work areas and national borders of the participants, and that seeks to identify in a participatory process, the conservation priorities at a regional level. The process took three participatory workshops and one meeting of the strategies committee. The process involved revision of the planning unit limits and stratification, the identification of key conservation targets and the revision of available geographic distribution information and baseline data of conservation targets, the definition of conservation goals for each target and the analysis of threats to the conservation targets.

The boundaries for the planning unit were set inside the ecoregion boundaries identified in 2002, by the World Wildlife Fund (WWF). The planning unit extends from the coast line (including all mangroves, coastal lagoons, river mouths, manatee habitats) to the ocean down to the 200 meter depth contour, an area of 58,000 km^2. The continental borders were set at the western border of Yum Balam Flora and Fauna Reserve, Mexico to Cabo Camaron, in Honduras. The rest of the ecoregion territory, including the watersheds draining into the Caribbean and the oceanic waters in the four countries economic exclusive zone surrounding the planning unit, were considered to be the area of influence affecting the planning unit for threats analysis purposes. The planning unit was subdivided into seven strata. The first strata coincided roughly with the coast of Quintana Roo, the second to the Belize Barrier Reef and coast, the third to the Gulf of Honduras, the fourth to the northern coast of Honduras, the fifth to Cozumel Island and Arrowsmith Bank in Mexico, the sixth to the Belize Atolls plus Banco Chichorro, and the seventh strata included Honduras' Bay Islands and Cayos Cochinos.

Conservation targets included reefs, mangroves, seagrassess, SPAGS, manatee habitat, turtle nesting beaches, estuaries and bird sites and prioritization goals were assessed for each target. During the ecoregional assessment process, the participation of local stakeholders and governments has helped bring knowledge and the necessary political support to the process. The final conservation targets and their prioritization goals set were:

Conservation target	Goals by target and by stratum			
	1 & 5	2 & 6	4 & 7	3
Spawning aggregations	80	80	80	80
Sea turtle nesting beaches	50	50	60	50
Manatee habitat	70	75	80	60
Estuaries and coastal lagoons	30	50	60	50
Mangroves	55	55	65	55
Reefs	65	50	60	50
Sandy beaches	60	30	30	30
Seagrass beds	70	50	70	60
Sea bird nesting sites	60	50	40	40
Whale shark sites	80	80	80	-
Crocodile nesting sites	-	70	-	-

A geographic cover layer was developed to represent the factors that may reduce the viability of the conservation targets where they occur. This is the cost surface employed in the Marxan analysis. The human activities listed as threats included

agriculture, aquaculture, urban areas, roads, seaports, airports. Also, as mitigating factors, the presence of forests, shrub lands, and wetlands were included.

With the conservation targets and goals and the cost surface, the Marxan analysis was conducted and produced a portfolio of priority conservation sites. The portfolio of priority sites is presented in a map.

Discussion

The main goals for the rapid reef assessment were the creation of a robust ecoregional baseline of representative samples for MAR reefs and the identification of potentially resilient areas. The information gathered will also help identify gaps in existing protected areas (National Gap Analysis), and the results can be used in the future to improve the MAR ecoregional planning. Finally, the information will help develop a sampling plan for future disturbance events.

There are many geopolitical challenges in an ecoregion that includes four countries, and designing conservation strategies presents a suite of trials. Conservation goals are established based on relative importance of the targets and the proportion and abundance of each target in the ecoregion. However, workshop participants, in a true conservation spirit, first set conservation goals close to one hundred percent for all targets. This created problems in trying to identify priority sites. As a solution, the group implemented a second goal setting exercise to set prioritization goals. With this the new goals were substantially lower than the former goals.

Final steps in the ecoregional assessment included the analysis of threats to the conservation targets. When the threats were identified, the process of developing strategies to mitigate those threats was initiated.

Summary of the Threats Analysis

Threats	Reef	Sea grass	Beach & dune	Mangrove	Estuaries & coastal lagoons	Spawning aggr.	Whale shark
Global Climate Change (sea level and temperature rise)	Very high	Medium	Low	High	Medium	-	-
Inadequate aquatic tourism activities	Very high	Low	-	-	Medium	Low	High
Sewage discharge	High	High	-	Low	High	Medium	Low
Tourism infrastructure development	Medium	High	High	High	-	-	-
Sedimentation	High	High	-	Low	High	-	-

Coastal urban development	-	-	High	High	High	-	-
Overfishing and inadequate fishing practices (spear fishing, trawling, scuba)	High	Medium	-	-	Medium	High	-
Agrochemicals (pesticides and fertilizers)	High	High	Low	Low	Medium	-	-

Challenges

Some of the main challenges with the ecoregional assessment included working in a large multi-national (4 country) network, where numerous partners (State, Federal, BINGO, local NGO's) have a direct role. With our partners, we struggled with the question of how we can ensure that the network of MPA will be resilient to global climate change. Another challenge we face is how to find effective ways to influence government's agendas. At the local level, challenges include finding ways to relate ecoregional to local conservation planning, and the need to develop tools that work both at ecoregional and local levels. To effectively implement the results of the assessments, we need to ensure that our ecoregional vision is relevant at the local level and also keep local partners interested in the ecoregional process. The effective conservation of many targets is directly threatened by the exponential growth of tourism and the related coastal development. We recognize that it is not enough to promote "ecotourism" ventures – but rather that we need to influence the financial drivers of and governmental incentives for tourism-related development, such as infrastructure, to confront this challenge. To convince decision makers of the need to conserve the MAR biodiversity, we need to be able to put an economic value on healthy mangroves, seagrass beds, and coal reefs, so that they will recognize these ecosystems as natural capital.

Challenges associated with the rapid reef assessment included both understanding and communicating concepts of resilience to partners and local communities. A limitation identified was that the rapid assessment can only identify "potential" resistant or resilient sites that still need to be validated.

Lessons Learned

Some of the most important lessons learned include the need to build capacity within lead organization and not rely on consultants. Also, during the ecoregional assessment process, the participation of local stakeholders and governments has helped bring knowledge and the necessary political support to the process. And finally, Marxan outputs only provide a starting point for the development of the portfolio of priority sites. Local input at workshops is necessary to refine practical MPA design solutions.

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