The Mesoamerican Reef Ecoregional Assessment: Setting Priorities for Marine Conservation

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ABSTRACT

The Mesoamerican Reef (MAR) Program of TNC conducted an ecoregional assessment of the MAR ecoregion (Western Caribbean), using a systematic, science-based approach. This process analyzed current levels of biodiversity in the major habitat types of the ecoregion. The assessment team involved biodiversity experts and local and regional conservation partners, and produced a "blueprint" of priority conservation sites and strategies to guide conservation investments. The assessments also promoted knowledge sharing and participatory threat analysis, as key components for long-term conservation success.

Steps involved included identification and revision of available information and gaps, and the development of a list of information sources, institutions, and programs. The assessment identified important conservation targets with information on location and condition from a variety of sources, including partner organizations and the 2002 Mesoamerican Caribbean ecoregional plan (Kramer and Kramer 2002). Conservation goals were set for each target, and the selection of the portfolio of sites was achieved with the support of the MARXAN program.

The results from the ecoregional assessment will benefit the government members of the Tulum Agreement, Mexico, Belize, Guatemala and Honduras, in the development of the MAR action plan. Conservation agencies could also use the results in their processes of defining priorities for marine areas.

KEY WORDS: Ecoregional assessment; coral reefs; MARXAN analysis; marine conservation

La Evaluación Ecoregional del Arrecife Mesoamericano: Definiendo Prioridades para la Conservación Marina

El programa del Arrecife Mesoamericano (MAR) de TNC condujo una evaluación ecoregional de la ecoregion MAR (Caribe Oriental), utilizando un enfoque basado en ciencia. Este proceso analizo los niveles actuales de la biodiversidad en los principales tipos de hábitat en la ecoregion. El equipo evaluador involucró expertos en biodiversidad y aliados en conservación locales y regionales quienes elaboraron un portafolio de sitios de conservación prioritarios y las estrategias para guiar las inversiones en conservación. La evaluación además sirvió para promover el intercambio de conocimientos y la conducción de un análisis participatorio de amenazas, como elementos clave para el éxito a largo plazo a la conservación.

Los pasos desarrollados incluyeron la identificación y revisión de información disponible y los vacíos en la misma, y el desarrollo de una lista de fuentes de información, instituciones y programas. La evaluación identifico los elementos de conservación de importancia con información sobre su localización y condición de una gran variedad de fuentes, incluyendo organizaciones aliadas y el plan ecoregional del caribe mesoamericano (Kramer y Kramer 2002). Se fijaron tambien metas de conservación para cada elemento y se procedió a la selección del portafolio de sitios prioritarios a través del uso del programa MARXAN.

Los resultados del análisis ecoregional serán de beneficio para los gobiernos miembros del acuerdo de Tulúm, México, Belize, Guatemala y Honduras, en el desarrollo del plan de acción del MAR. Las agencias de conservación tambien podrán hacer uso de los resultados en sus procesos de definición de prioridades para la zona marina.

PALABRAS CLAVES: Evaluación ecoregional; arrecifes de coral; análisis MARXAN; conservación marina.

INTRODUCTION

The Mesoamerican 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. It is also home to close to 2 million people that depend, to a large extent, on the reef and associated resources. The MAR region has been identified as a global conservation priority by several agencies and is a region of high marine productivity & biodiversity (Arrivillaga and Garcia 2004).

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

The Nature Conservancy has set as a goal in the Mesoamerican Reef of promoting a network of effectively conserved coastal and marine managed areas that confers resilience to the region's resources in the face of global change, and that is compatible with human needs. The development of the 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. We have concentrated our initial efforts on the elements of representation
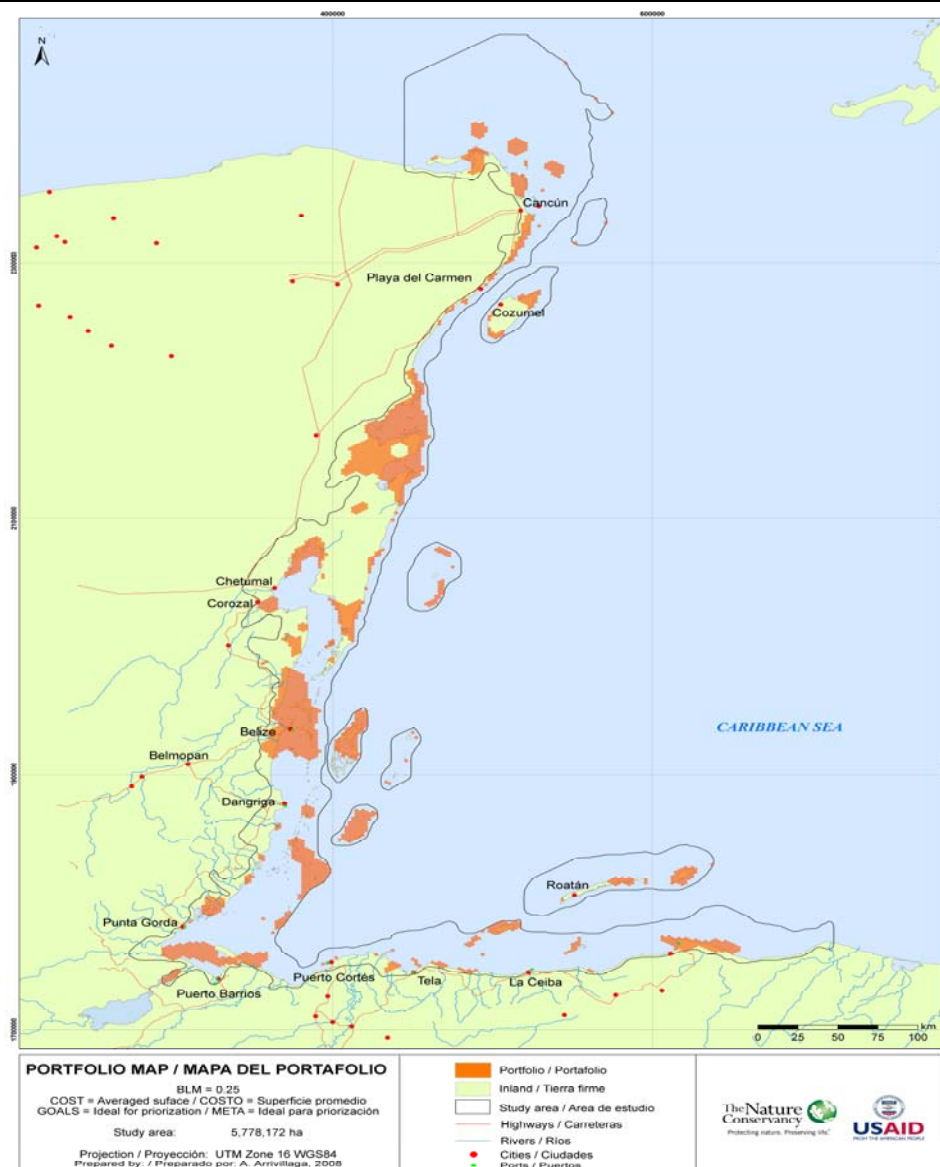
Figure 1. Mesoamerican Reef ecoregional Assessment

and replication through the development of an ecoregional assessment for the identification of priority conservation sites.

METHODS

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

Table 1. Conservation goals for targets at each different stratum.

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	-	-

Ecoregional Conservation Planning for the Mesoamerican Caribbean Reef, developed by Kramer and Kramer (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 involved the participation of scientists and local experts, government agencies and key stakeholders. It constituted 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.

RESULTS
The boundaries for the planning unit were set inside the ecoregion boundaries identified in 2002. 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 the prioritization goals appear in Table 1.

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 Figure 1.

The following step consisted of a threat analysis that focused on the same conservation targets used in the development of the portfolio. The main threats to the conservation in the MAR ecoregion are listed in Table 2.

DISCUSSION
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

Table 2. Summary of the threats analysis.

Threats	Reef	Sea grass	Beach & dune	Mangrove	Estuaries & coastal lagoons	SPAGS	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	-	-

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.

Some of the main challenges with the ecoregional assessment included working in a large multi-national (four countries) 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.

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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