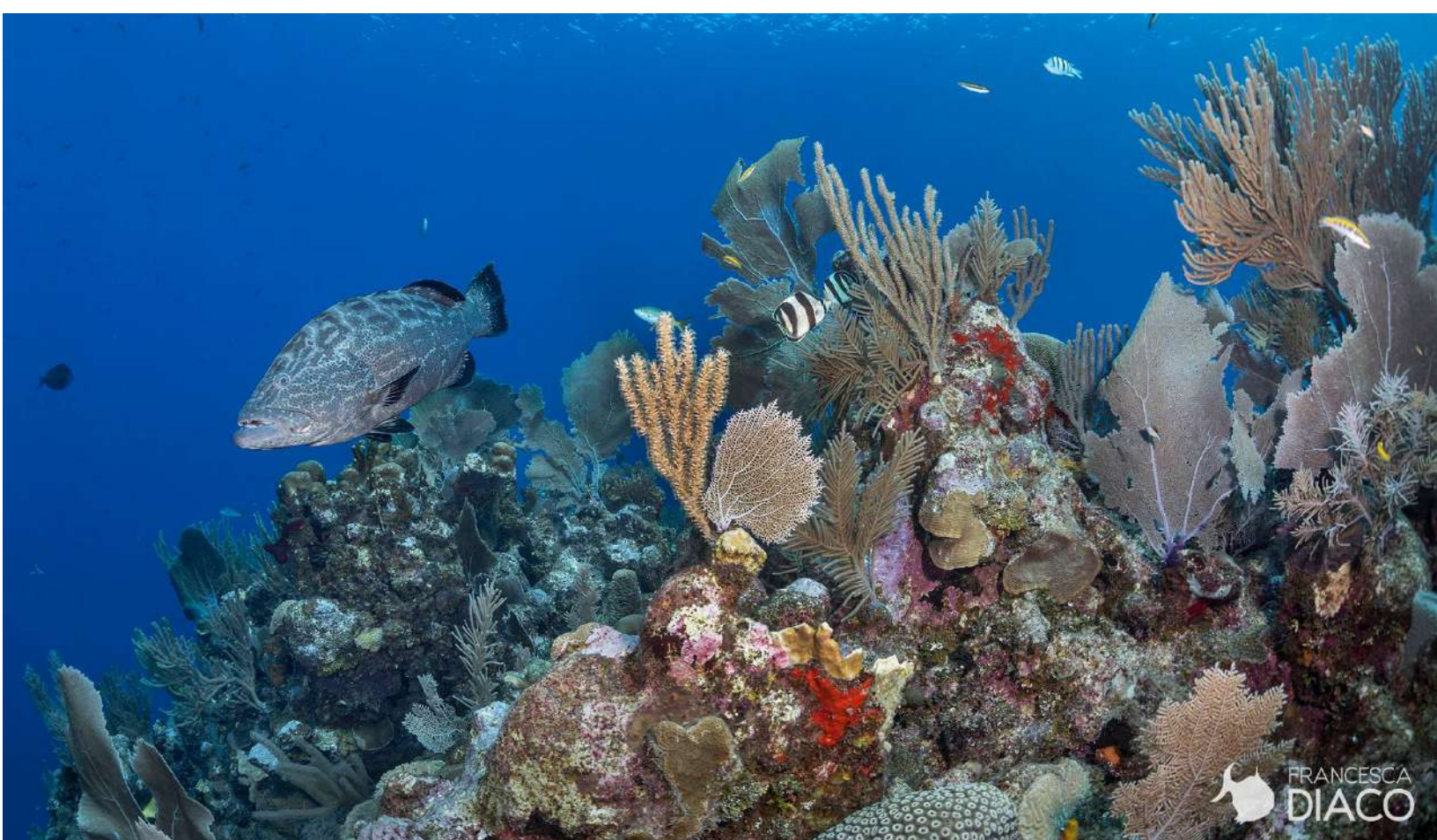




Eco Audit 2021
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Description of Indicators



2021 Eco Audit of the Mesoamerican Reef Countries: Description of Indicators

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Overview

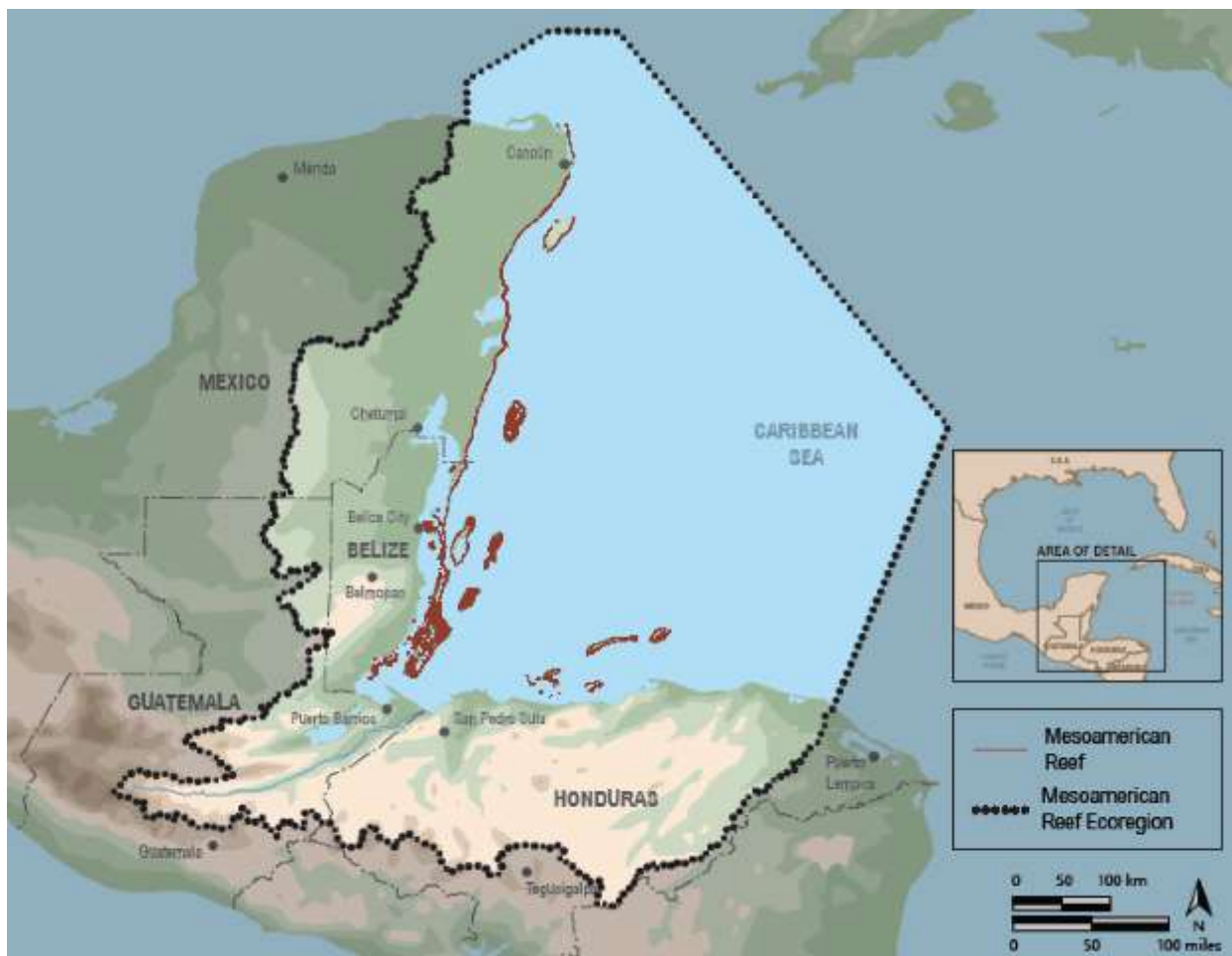
The Healthy Reefs Initiative (HRI) recently implemented the fourth Eco-Audit of the Mesoamerican Reef (MAR). The audit evaluates the collective efforts of Belize, Guatemala, Honduras, and Mexico to protect and sustainably manage the region's coral reefs. This audit is a follow-up of previous Eco-Audits published in 2011, 2014 and 2016 and will continue to be implemented every 4-5 years. The process has been reviewed by PriceWaterhouseCoopers Costa Rica (PwC). (see acknowledgments for further details). The audit's process, indicators, and criteria also are presented in this document. Detailed worksheets of Eco-Audit results, observations and verification documentation for each country are available online. These products, along with additional information about the Eco-Audit, are all available online at www.healthyreefs.org

Authors.....	2
Citation.....	2
McField et. al. 2021. 2021 Eco-Audit of the Mesoamerican Reef Countries: Description of Indicators. Healthy Reefs Initiative.....	2
An Innovative, Rigorous Process.....	5
1a. Percent of a country's territorial sea included in gazetted MPAs.....	7
1b. Percent of a country's territorial sea included in fully protected zones.....	7
1c. Percent of mapped coral reef area included in fully protected zones.....	8
1d. Percent of MPAs with good management.....	9
1e. Percent of MPAs with good enforcement.....	9
THEME 2. ECOSYSTEM-BASED FISHERIES MANAGEMENT	10
2a. Harmonizing fisheries regulations among countries (regional indicator).....	11
2b. Special regulations for grouper / spawning sites.....	11
2c. Protection of key grazers (parrotfish)	12
THEME 3. COASTAL ZONE MANAGEMENT.....	13
3a. Coastal zone planning regulations	13
3b. Watershed management plans related to coastal zone planning.....	13
4a. Standards for wastewater management/sewage treatment.....	15
4b. New infrastructure for sewage treatment (in the last 5 years).....	15
THEME 5. RESEARCH, EDUCATION, AND AWARENESS	16
5a. Standardized monitoring of coral reef health and information management (regional indicator)	16
5b. Economic valuation of coral reefs.....	17
5d. Interdisciplinary partnerships combine social and ecological research for management	18
THEME 6. SUSTAINABILITY IN THE PRIVATE SECTOR	18
6a. Voluntary eco-standards program for marine recreation providers.....	18
6b. Participation of coastal hotels in eco-certification schemes.....	19
6c. Adoption of seafood eco-labeling programs	19
6d. Government incentives for conservation and sustainable businesses.....	20
6e. Private sector assistance to MPAs	20
THEME 7. GLOBAL ISSUES	21
7a. Mapping of potentially resilient reefs to warming seas / coral bleaching (regional indicator).....	21
7b. Engagement in international/regional treaties that support conservation.....	22

Introduction

The Mesoamerican Reef (MAR) provides a diverse array of goods and services to the people of Belize, Guatemala, Honduras, and Mexico, including habitat for commercial, artisanal, and sport fisheries; shoreline protection; recreation and tourism; and food (Map 1). In particular, the region's economies are highly dependent on marine resources to sustain the tourism and fishing industries. Unfortunately, the intensity and range of threats to the region's coral reefs—including overfishing, climate change, runoff from land, coastal development, and tourism, among others—have increased rapidly, much faster than efforts to manage them. What has led to a deterioration of the reefs in the Mesoamerican Reef. In our 2020 Mesoamerican Reef Health Report Card, we have reported that, for the first time in 12 years of tracking the health of the largest barrier reef in the Western Hemisphere, the overall condition of this vital ecosystem has deteriorated. The Reef Health Index (RHI), which synthesizes ecological data into a “Dow Jones” style index, decreased from 2.8 in 2016 to 2.5 in 2018. Despite the recent decline, reef health still shows improvement compared to 2006 when the HRI monitoring efforts began. A similar report released last summer for Australia's Great Barrier Reef also marked a dramatic reduction in reef condition, signaling a worrisome outlook for two of the world's most important reef systems in different hemispheres of the globe. It is therefore urgent to better coastal zone management and fisheries to reduce pressures and allow recovery resulting in a healthy and sustainable reef system.

Map 1. Mesoamerican Reef Eco-region



An Innovative, Rigorous Process

HRI collaborated with WRI staff and local partners in 2011 to develop management indicators, standardized ranking criteria, and means of verification (documentation) to understand the collective effort that national governments, NGOs, and the private sector are making towards achieving the regional recommendations made in the HRI Reef Report Cards¹.¹⁾ These recommendations have been implemented to varying degrees across the four countries. Just as the Reef Report Cards measure key indicators of biophysical reef health, measured against regionally standardized grading criteria, the Eco-Audit has developed standardized management indicators to understand the effort each country is making to improve its coastal, fisheries, and coral reef management.

Twenty-eight standardized management indicators were developed across seven themes:

- marine protected areas
- ecosystem-based fisheries management
- coastal zone management
- sanitation and sewage treatment
- research, education, and awareness
- sustainability in the private sector
- global issues

The ranking system uses a simple schematic: 1=very poor, 2=poor, 3=fair, 4=good, and 5=very good. Rankings are determined based on the standardized grading criteria and are verified by documentation attached to the audit results for each country. Three of the management indicators (2a, 5a, and 7a) are regional in scope.

The Eco-Audit has been a collaborative effort, drawing on input from partners, stakeholders, and key experts throughout its implementation. To develop each management indicator, HRI has solicited feedback from partners. Their input was incorporated through meetings, workshops and communication with HRI staff and consultants. Nearly 50 organizations and 100 people participated in this Eco-Audit. At these workshops, participants ranked each management indicator and compiled documents to verify the rankings.

To the best of our knowledge, this approach is innovative. While some individual organizations and private corporations have undertaken programmatic evaluations or environmental sustainability audits, we are not aware of any other multinational audit of conservation management actions that includes a variety of collaborating NGOs, government agencies, researchers, and the private sector, including transparently verified and publicly available results. To ensure the quality of our results, we engaged the financial and management auditing firm of PricewaterhouseCoopers Costa Rica (PwC) to review the methodology and provide feedback on the processes, indicators, and the quality of the verification

¹ This Eco-Audit has focused only on the regional recommendations presented in Healthy Reefs Initiative's 2008, 2010 and 2012 Reef Report Cards, and not the national recommendations. The recommendations from the Reef Report Cards were developed through national workshops in each country, representing a significant step toward building consensus on prioritizing management actions for MAR. We decided to evaluate only the regional recommendations for this assessment, as partners in each country had not formally agreed to the national recommendations of other countries. However, these regional recommendations were most often evaluated at the national level. In the future, HRI plans to convene a regional workshop to establish recommendations for the Reef Report Card, which will be evaluated in subsequent Eco-Audits. It should be determined in this workshop if recommendations will be national, regional, or both

documentation². PwC Costa Rica has not evaluated any individual organization, partner, or country, and has only assessed how well the Eco-Audit has been developed and implemented by HRI and WRI, in order to validate the findings and provide recommendations for strengthening future assessments.

Box 1: Indicators and criteria

General guidelines for indicators and ranking criteria:

- *Indicators were evaluated at the national level except where noted.*
- *For all percentages in the document, we applied a standard rounding at .5, going up to the next whole number, and less than .5 going down to the whole number.*
- *Indicators were ranked “1” if there were no documents available that demonstrate effort.*
- *If a specific criterion could not be completely satisfied, the indicator ranking dropped to the next lowest ranking.*

Indicator Themes

- *Marine Protected Areas*
- *Ecosystem-Based Fisheries Management*
- *Coastal Zone Management*
- *Sanitation and Sewage Treatment*
- *Research, Education, and Awareness*
- *Sustainability in the Private Sector*
- *Global Issues*

Eco-Audit Rankings

5 = Very Good (VG)

4 = Good (G)

3 = Fair (F)

2 = Poor (P)

² PricewaterhouseCoopers Costa Rica (PwC) is not executing this audit process, therefore PwC is not expressing an opinion, attestation, or other assurance regarding the results of the MAR Eco-Audit. PwC has revised and given recommendations on the Eco-Audit process, ensuring that it is sufficiently robust, replicable year after year, and consistent in order to be seen as credible for the intended users. Furthermore, recommendations made by PwC have focused only on the audit process and not on the selection of indicators.

THEME 1. MARINE PROTECTED AREAS

Marine Protected Areas (MPAs) are one of the most widely used management tools in reef conservation. MPAs help to foster reef resilience, allowing coral reefs to recover more quickly from a variety of threats, including diseases and coral bleaching.³ Within this evaluation, we used the International Union for the Conservation of Nature's (IUCN) definition of an MPA: "Any area of intertidal or subtidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by legislation or other effective means to protect part or all of the enclosed environment."⁴

These indicators explore the spatial extent of MPAs and the degree of management and enforcement capacity in those MPAs. The evaluation of MPAs focuses exclusively on the MAR region. In the case of MPAs with both marine and terrestrial territory, this assessment was limited to marine territory only. A list of MPAs for each country included in the assessment is provided in Appendix III.

1a. Percent of a country's territorial sea included in gazetted MPAs

Justification: In order to be effective, networks of MPAs must cover an adequate percentage of the sea. Globally, scientists have estimated that between 20–40 percent of the sea should be protected.^{5, 6}

Ranking Criteria

- 5 – At least 20 percent of territorial sea is inside MPAs
- 4 – At least 15 percent of territorial sea is inside MPAs
- 3 – At least 10 percent of territorial sea is inside MPAs
- 2 – At least 5 percent of territorial sea is inside MPAs
- 1 – Less than 5 percent of territorial sea is inside MPAs

Means of Verification: MPA boundary maps and regulations (includes management plans). Additionally, HRI and AGRRA, with the support of partners, agreed on data sets to distinguish land vs. water; MPA boundaries; coral reef locations; and maritime (territorial sea) boundaries. The evaluation was implemented using a Geographical Information System (GIS) with ArcView 10.0. See Appendix 1 for the complete 2021 EcoAudit Geospatial results and metadata.

Calculation: (Area of MPAs (marine area only)/area of territorial sea) X 100).

1b. Percent of a country's territorial sea included in fully protected zones

Justification: While MPAs in general offer a variety of conservation measures, the fully protected (non-extractive) zones or reserves (fisheries replenishment zones) provide the maximum benefits, allowing the replenishment of fisheries and restoration of ecosystem balance. Globally, scientists have called for between 10–40 percent of the ocean to be under full protection.^{iv}

The 2008 Report Card recommended 20% of all marine and coastal areas to be under full protection. Recognizing that this would require substantial social and political effort – a short term target was established in 2011 and used in the first 3

³ Mumby, P.J., and A.R. Harborne. 2010. "Marine Reserves Enhance the Recovery of Corals on Caribbean Reefs." *PLoS ONE* 5:e8657.

⁴ International Union for the Conservation of Nature. November 25, 2011. *Marine Protected Areas-Why Have Them?* Accessible at <http://www.iucn.org/about/work/programmes/pa/pa_what/?4646/Marine-Protected-Areas--Why-have-them>

⁵ IUCN. 2003. *Recommendations of the Vth IUCN World Parks Congress. Recommendation 22:* 56-60.

⁶ "Nature Needs Half." November 30, 2011. Protection of the Seas and Oceans. Accessible at <<http://natureneedshalf.org/protection-of-the-seas-and-oceans/>>

Eco-Audits with the “original grading criteria’ listed below. The longer-term target of 20% percent of territorial sea under full protection/fisheries replenishment zones was used in this Eco-Audit. The original 2011 Eco Audit stated the following: “Future Eco-Audits will gradually increase the level of protection to meet this target (of 20%)”.

Original Ranking Criteria

- 5 – At least 5 percent of territorial sea is fully protected (fisheries replenishment zones)
- 4 – At least 4 percent of territorial sea is fully protected (fisheries replenishment zones)
- 3 – At least 3 percent of territorial sea is fully protected (fisheries replenishment zones)
- 2 – At least 2 percent of territorial sea is fully protected (fisheries replenishment zones)
- 1 – Less than 2 percent of territorial sea is fully protected (fisheries replenishment zones)

2021 Ranking Criteria

- 5 – At least 20 percent of territorial sea is fully protected (fisheries replenishment zones)
- 4 – At least 15 percent of territorial sea is fully protected (fisheries replenishment zones)
- 3 – At least 10 percent of territorial sea is fully protected (fisheries replenishment zones)
- 2 – At least 5 percent of territorial sea is fully protected (fisheries replenishment zones)
- 1 – Less than 5 percent of territorial sea is fully protected (fisheries replenishment zones)

Means of Verification: MPA boundary maps and regulations (includes management plans). Additionally, HRI and AGRRA with the support of partners agreed on data sets to distinguish land vs. water; MPA boundaries; coral reef locations; and maritime (territorial sea) boundaries. The evaluation was implemented using a Geographical Information System (GIS) with ArcView 10.0. See Appendix 1 for the complete 2021 EcoAudit Geospatial results and metadata.

Calculation: ((Area of fully protected marine zones/Area of territorial sea) X 100).

1c. Percent of mapped coral reef area included in fully protected zones

Justification: Ideally, the amount of sea under full protection will be representative of each habitat or ecosystem type, including seagrass beds, mangroves, sand flats, etc. Given the historical conservation focus and high value of coral reefs, this indicator specifically measures efforts in fully protecting a target portion of this critical ecosystem. Like indicator 1b, this indicator was assessed with a benchmark target criteria for the first 3 Audits – increasing to the actual 20% target in 2021.

Note: this original indicator (2011) stated: “The longer-term target is 20 percent of coral reef under full protection/fisheries replenishment zones.⁷ Future Eco-Audits will gradually increase the level of protection to meet this target”.

Original Ranking Criteria

- 5 – At least 10 percent of coral reefs are inside full protection/fisheries replenishment zones
- 4 – At least 8 percent of coral reefs are inside full protection/fisheries replenishment zones
- 3 – At least 6 percent of coral reefs are inside full protection/fisheries replenishment zones
- 2 – At least 4 percent of coral reefs are inside full protection/fisheries replenishment zones
- 1 – Less than 4 percent of coral reefs are inside full protection/fisheries replenishment zones

2021 Ranking Criteria

- 5 – At least 20 percent of coral reefs are inside full protection/fisheries replenishment zones
- 4 – At least 15 percent of coral reefs are inside full protection/fisheries replenishment zones
- 3 – At least 10 percent of coral reefs are inside full protection/fisheries replenishment zones

⁷ The 20 percent conservation target applies to each major habitat, including coral reefs. Given that the main focus of existing MPAs is on coral reefs, the current percentage under full protection is already closer to the 20 percent target, and as a result has been adjusted upward, as compared to the current percent of territorial sea.

- 2 – At least 5 percent of coral reefs are inside full protection/fisheries replenishment zones
- 1 – Less than 5 percent of coral reefs are inside full protection/fisheries replenishment zones

Means of Verification: MPA boundary maps and regulations (includes management plans). Additionally, HRI and AGRRA with the support of partners agreed on data sets to distinguish land vs. water; MPA boundaries; coral reef locations; and maritime (territorial sea) boundaries. The evaluation was implemented using a Geographical Information System (GIS) with ArcView 10.0. See Appendix 1 for the complete 2021 EcoAudit Geospatial results and metadata.

Calculation: ((Area of coral reef in fully protected zones/Area of coral reef) X 100).

1d. Percent of MPAs with good management

Justification: The legal establishment of MPAs is an important milestone, but the attainment of conservation and management goals is only achieved through sound management. This indicator measures management capacity, which serves as a proxy for the overall quality of management. Management capacity is evaluated based on the existence of management plans, staff, and equipment.

Ranking Criteria

- 5 – At least 75 percent of MPAs must have a current management plan and adequate staff and equipment; and the remaining 25 percent should not be classified as having “no current management plan” or “no staff and equipment” or “inadequate staff and equipment”⁸
- 4 – At least 60 percent of MPAs have a current management plan and adequate staff and equipment; and from the remaining MPAs no more than 10 percent are classified as having “no current management plan” or “no staff and equipment” or “inadequate staff and equipment”
- 3 – At least 50 percent of MPAs have a current management plan and at least 50 percent have nearly adequate staff and equipment
- 2 – At least 25 percent of MPAs have a current management plan and at least 25 percent have nearly adequate staff and equipment
- 1 – Does not meet any of the above targets

Means of Verification: management plans, and MPA original data collection survey of managers to rate MPAs based on the existence of an up-to-date management plan and whether or not there is adequate, nearly adequate, inadequate, or no staff and equipment.

Calculation: ((Total # of MPAs with current management plans or adequate staff/Total # of MPAs) X 100); ((Total # of MPAs with no current management plan or no staff and equipment or inadequate staff and equipment/Total # of MPAs) X 100).

1e. Percent of MPAs with good enforcement

⁸ Criteria for rating the management of MPAs are based on the following:

- Existence of an up-to-date management plan for the MPA updated within the past five years (**Yes**-updated management plan within the past 5 years, or a legally binding current mgt plan exists; **Partial**-updated more than 5 years or an unapproved draft; **No**-no plan).
- Does the MPA have staff and equipment (**Adequate**-Optimal # of staff and equipment are covered; **Nearly Adequate**-At least 75 percent of optimal # of staff and equipment are covered; **Inadequate**- At least 50 percent of optimal # of staff and equipment are covered; **None**-there is no staff or equipment).

Justification: Sound management of MPAs requires both the capacity and political will to enforce regulations.⁹ This indicator measures the degree of enforcement in each MPA. We recognize that both enforcement and compliance are important issues and coming up with a system to track this in MPAs is a recognized data gap.

Ranking Criteria

- 5 – At least 75 percent of MPAs have good enforcement and the remaining 25 percent have moderate enforcement³
- 4 – At least 60 percent of MPAs have good enforcement and the remaining 40 percent have moderate enforcement
- 3 – At least 50 percent of MPAs have at least moderate enforcement
- 2 – At least 25 percent of MPAs have at least moderate enforcement
- 1 – Fewer than 25 percent of MPAs have at least moderate enforcement

Means of Verification: MPA original data collection survey of managers to rate MPAs as having good, moderate, low, or no enforcement. Also includes enforcement or patrol reports, and annual reports for rankings of 4 and higher.

Calculation: ((Total # of MPAs with good enforcement or moderate enforcement/Total # of MPAs) X 100).

1f. Generation of alternatives for fishers within the network of MPAs

Justification: Fisheries management strategies should provide alternative livelihoods for fishers and other communities whose income may be affected by the establishment of “**Fully Protected (Replenishment) Zones**” which prohibit fishing. Alternative income programs can assist fishers in fishing fewer days per year, while maintaining or increasing their total income from other diversified sources.

Ranking Criteria

- 5 – A national-level strategy to provide fishers with sustainable livelihoods alternatives generated by the recovery of ecosystems through productive activities and/or payment of ecosystem services exists and is being implemented in between 85-100% of MPAs
- 4 – A national-level strategy to provide fishers with sustainable livelihoods alternatives generated by the recovery of ecosystems through productive activities and/or payment of ecosystem services exists with implementation in between 50-84% of MPAs
- 3 – A national-level strategy to provide fishers with sustainable livelihoods alternatives generated by the recovery of ecosystems through productive activities and/or payment of ecosystem services is being developed, with some alternative or sustainable livelihoods programs being implemented in between 20-49% of MPAs
- 2 – At least one program exists (in one MPA) that provides fishers in at least one locality with sustainable livelihoods alternatives through productive activities and/or payment of ecosystem services
- 1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: copy of documents, publications, grant and project reports from the government or any other institution presenting an incentive program.

THEME 2. ECOSYSTEM-BASED FISHERIES MANAGEMENT

⁹ Criteria for rating the enforcement of MPAs, Spawning Aggregation Sites (SPAGs), and parrotfish regulations are based on the following:

- How would you rate the level of enforcement? (**Good**-regular patrols, overall satisfactory compliance and ecological integrity is thought to be maintained; **Moderate**-regular patrols conducted, but poaching persists, legal outcomes are insufficient, and ecological integrity is impacted; **Inadequate**-irregular patrols conducted, poaching persists, legal outcomes are insufficient, ecological integrity is impacted, and local community feedback demonstrates a high level of concern). Creating an official list of quantifiable ranges for “regular patrols,” “legal outcomes” (enforcement action), “poaching,” and “ecological integrity” represents a data gap that must be addressed in subsequent audits.

Overfishing and destructive fishing are the most widespread threats to coral reefs. More than 80% of the world's fisheries are overexploited or have collapsed.¹⁰ The continued collapse of global fisheries will have far-reaching economic and ecological consequences. Recovery of fisheries requires the appropriate management of fishing areas and practices, as well as efforts to identify and address underlying social and economic factors leading to overharvesting.

2a. Harmonizing fisheries regulations among countries (regional indicator)

Justification: Over the past few years a number of regional initiatives have attempted to harmonize fisheries regulations for economically important fisheries such as lobster and conch. This indicator measures the extent of harmonization of regulations on size limits and closed seasons. Differences in these two regulations across countries have been shown to lead to substantial transboundary illegal and unreported fishing.¹¹

Ranking Criteria

- 5 – Regulations for closed seasons and size limits are fully harmonized among the four countries and two commercial fisheries
- 4 – Regulations for closed seasons and size limits are fully harmonized among three countries and two commercial fisheries
- 3 – Regulations for closed seasons and size limits are fully harmonized among three countries and one commercial fishery
- 2 – There has been some effort at harmonizing regulations (draft regulations, project planning, or joint research)
- 1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: copies of regulations or draft regulations, results of joint research, and project or consultation reports for initial efforts toward harmonization.

2b. Special regulations for grouper / spawning sites

Justification: The reef food web is highly complex. The removal of just one group of fish from the food web can have widespread effects throughout the reef ecosystem, ultimately weakening and destabilizing it. The reproductive behavior of groupers makes them particularly vulnerable during spawning, and many fish spawning aggregation sites (FSAs) have already been overfished and depleted of grouper. This indicator measures efforts to protect these sites and species.

Ranking Criteria

- 5 – At least 90 percent of known grouper FSAs are fully protected (year-round in MPAs) with legal regulations and at least 50 percent of these have good enforcement³
- 4 – At least 75 percent of known grouper FSAs are fully protected (inside MPAs) and at least 20 percent have at least moderate enforcement³
- 3 – There are closed seasons, size limits, or catch limits specific for grouper
- 2 – There has been some effort at drafting regulations, research, or a public campaign on the topic
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: list and location of grouper FSA sites by country, official MPA list, copy or draft of fishery or MPA legislation, copy of consultation reports, number of enforcement actions, MPA original data collection as to the degree of enforcement at each FSA site, and campaign strategies for conservation.

Calculation: Grouper FSAs fully protected=((Total # of fully protected SPAGs/Total # of FSAs) X 100); percentage with at least good enforcement=((Total # of FSAs with good enforcement/Total # of fully protected FSAs) X 100) and percentage with at least moderate enforcement=((Total # of FSAs with good enforcement + moderate enforcement)/Total # of fully protected FSAs) X 100).

¹⁰ Mora, C., R.A. Myers, M. Coll, S. Libralato, T. Pitcher, et al. 2009. "Management Effectiveness of the World's Marine Fisheries." *PLoS Biol* 7(6): e1000131. doi:10.1371/journal.pbio.1000131

¹¹ The harmonization of fishery regulations refers to regulations that are equivalent.

2c. Protection of key grazers (parrotfish)

Justification: As the number of large predatory species declines due to overfishing, fishers often target smaller herbivorous fish. The removal of herbivorous fish results in increased algal overgrowth, and ultimately decreased resilience of the reef ecosystem. This indicator measures the degree of protection for parrotfish—the most significant family of herbivores due to their size and abundance—among the four countries.

Ranking Criteria

5 – Parrotfish are fully protected through regulations with at least good enforcement ³

4 – Parrotfish are fully protected through regulations with at least moderate enforcement ³

3 – There exist draft regulations or a public campaign on the topic

2 – There has been some effort (strategic plans or consultation reports) at drafting regulations and/or educational outreach (development of educational brochures or pamphlets)

1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: evidence of enforcement (patrol logs and fish file tissues analysis results to determine species), copy of legislation or draft legislation, copy of consultation reports, advertisements, strategic plans, and educational materials.

2d. Transform all open-access fisheries to rights-based sustainable fisheries management systems

Justification: Throughout the MAR region, fisheries management has not achieved sustainability, in large part due to reliance on open access and traditional management approaches and the inability to control illegal fishing, especially in remote areas. The lack of a clear allocation of fishing rights is a major factor contributing to overfishing and tends to encourage unsustainable fishing practices such as the race-to-fish and illegal fishing. Open access also fuels conflict for fishing areas. Transforming fisheries management to a rights-based approach in the MAR region will promote better management of the fisheries stocks by fostering stewardship by fishers of designated fishing areas, facilitating the regulation of fishing through sustainable catch limits, and promoting community-based management of fisheries in the region.

Ranking Criteria

5 – More than 90% of total catch* is under a form of regulated rights-based fisheries management (RBM) covering at least three of the most economically valuable species/taxonomic groups

4 – 26-50% of total catch is under a form of regulated rights-based fisheries management, covering at least two of the most valuable species/taxonomic groups

3 – At least two fisheries and/or 25% of fishing communities is under a form of regulated rights-based fisheries management, covering at least one of the most valuable species/taxonomic groups

2 – At least one fishery and/or one community is implementing regulated sustainable rights-based fisheries management

1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: Fisheries management plans with areas recognized under a form of right-based fisheries; case studies of managed access or ITQ's that demonstrate with at least one component of RBM in place (limited access, catch limits, community-based committee, etc).

* Rights-based management includes any system of allocating exclusive fishing rights to fishers, fishing vessels, enterprises, cooperatives or fishing communities (including managed access systems and ITQ's). Such systems, which exist in many fisheries management regimes in one form or another, basically define the rights to use fisheries resources. Fishing rights have a value and may be traded. ¹²

¹² http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/rbm/index_en.htm

THEME 3. COASTAL ZONE MANAGEMENT

Coastal development—including human settlements, industry, aquaculture, or infrastructure—can dramatically alter nearshore ecosystems. Direct physical damage such as dredging or land filling, or indirect damage through increased runoff of sediment, pollution, and sewage, can greatly impact the health of a reef.

3a. Coastal zone planning regulations

Justification: Effective, integrated coastal planning emphasizing sustainable development, alongside enforcement of coastal development regulations, can greatly reduce the pressures of coastal development. This indicator measures the spatial extent of such plans or steps toward developing such plans.

Having a well-designed coastal zone plan is only the first step toward achieving successful coastal zone management. Effective enforcement of these plans is also essential. Due to a lack of data and record-keeping on enforcement of zoning and other regulations, it was not possible to define quantifiable ranges to assess the level and impact of enforcement efforts

Ranking Criteria

- 5 – A spatially comprehensive¹³ coastal zone plan or zoning regulations¹⁴ exist for the country (or state within the MAR area) and have been legally adopted
- 4 – There is a coastal zone plan or zoning regulations (not spatially comprehensive) and they have been legally adopted for some areas
- 3 – A spatially comprehensive coastal zone plan or zoning regulations have been completed (drafted) for the country (or MAR area) and submitted for approval
- 2 – There is work (drafts in progress, consultation reports, research or strategic plans) at drafting a spatially comprehensive coastal zone plan or zoning regulations
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: copies of zoning plans (table of contents, legislation #), documentation of planning ordinances and regulations (includes drafts), and consultation reports, research and strategic plans relevant to coastal planning.

3b. Watershed management plans¹⁵ related to coastal zone planning

Justification: Effective, integrated land-use planning inside the watersheds of the MAR is essential to preventing erosion, sedimentation, and nutrient pollution into coastal and marine waters. In particular, nutrients are a major cause of the overgrowth of algae which can kill corals. Nutrients cause major damage in reefs and benthic ecosystems. High water quality standards help to maintain coral reefs. Proper watershed management includes appropriate land-use practices in erosion-prone areas and is essential for preserving water quality and ensuring that the transport of sediment, nutrients, and other pollutants to coral reefs is minimized. If sound watershed management plans are implemented, nutrient and sediment delivery are likely to be reduced, promoting recovery of degraded reefs. Watershed-based management plans foster sustainable development, and compliment similar coastal development plans along the coastline. This indicator measures the spatial extent and development of such plans or steps toward developing them.

Ranking Criteria

¹³ Spatially comprehensive refers to coverage of the entire coastline.

¹⁴ Coastal regulations may include setbacks, restrictions on mangrove removal, sea walls, or permissible land use and development densities.

¹⁵ Must include water quality monitoring.

- 5 – A spatially comprehensive¹⁶ and integrated watershed management plan(s) that regulate the coastal and marine resources, exists for the country (or state within the MAR area) and have been legally adopted
- 4 – A spatially comprehensive and integrated watershed management plan(s) that regulate the coastal and marine resources management, exists for the country (or state within the MAR area) but has (have) not been legally adopted; or have at least 50% of watershed area within plan(s) or zoning regulations that are legally adopted
- 3 – There is work (monitoring water quality programs, drafts in progress, consultation reports, research or strategic plans) leading to an integrated watershed plan(s) in at least 50% of watershed area
- 2 – There is work (monitoring water quality programs, drafts in progress, consultation reports, research or strategic plans) leading to an integrated watershed management plan(s) in at least 10% of watershed area
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: copies of zoning plans (table of contents, legislation #), documentation of planning ordinances and regulations (includes drafts), and consultation reports, research and strategic plans relevant to coastal planning and watershed planning and use.

3c. Mangrove extent as an indicator of the effectiveness of the coastal zone management plan implementation.

Justification: Mangroves are regionally ‘protected’ on different levels through regulations requiring permits for their removal. However, even with the strictest regulations, many illegal clearings occur. Ultimately, we need to track the remaining extent of mangroves in order to help protect their critical ecosystem functions, which include shoreline protection, provision of fisheries habitat, and biodiversity.

Ranking Criteria

- 5 – A spatially comprehensive and integrated plan or mangrove regulations, that contribute to the objectives of the coastal zone management plans, exist for the country (or state within the MAR area) and has been legally adopted, having mangrove coverage preserved in 90% from baseline status (probably 1990). Or more than 90% of the mangroves in the country or state are legally and effectively protected.
- 4 – A spatially comprehensive and integrated plan or mangrove regulations that contributes to the objectives of the coastal zone management plans, exist for the country (or state within the MAR area) but have not been legally adopted, having mangrove coverage preserved in 70% from original status. Or more than 70% of the mangroves in the country or state are legally and effectively protected.
- 3 – There is work (monitoring mangrove extent, drafts in progress, consultation reports, research or strategic plans) leading to a spatially comprehensive and integrated plan or mangrove regulations, or at least 50% of original mangrove cover is maintained or legally protected.
- 2 – A plan or strong mangrove regulations exist but doesn’t contribute to the objectives of the coastal zone management plan or are poorly enforced, with many public records of illegal activity.
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available.

Means of Verification: copies of zoning plans (table of contents, legislation #), documentation of planning ordinances and regulations (includes drafts), and consultation reports, research and strategic plans relevant to coastal planning and mangrove protection and use, historical maps of mangrove coverage from the coastline to inland.

THEME 4. SANITATION AND SEWAGE TREATMENT

The high level of nutrients present in sewage can result in blooms of plankton that block light and encourage the growth of algae that compete for space on the reef. Sewage also contains bacteria and viruses known to harm marine life, including corals. Wastewater (including sewage and industrial effluent) must be treated and controlled to reduce the nutrients and toxins that reach coral reefs.

¹⁶ Spatially comprehensive refers to coverage of the entire coastline.

These indicators explore the extent to which regional standards for wastewater management and sewage treatment have been developed, adopted by countries, and applied to the construction of new sewage treatment infrastructure. In this audit, we are specifically considering biochemical oxygen demand (BOD) and total suspended solids (TSS). Ideally, we would have preferred to measure the percent of the coastal population, including tourists, connected to sewage treatment facilities, but data are not currently available. As a result, the indicators below have been developed as a proxy for sanitation and sewage treatment.

4a. Standards for wastewater management/sewage treatment

Justification: International efforts to improve sanitation, particularly near sensitive ecosystems such as coral reefs and seagrass (e.g. Class I waters), have evolved, specifically through the creation of regional standards for sewage treatment.¹⁷ This indicator measures the extent of each country's adoption and implementation of these regional standards within the [Cartagena Convention's Protocol Concerning Pollution from Land-Based Sources and Activities](#) (LBSMP Protocol).

Ranking Criteria - based on national regulations

5 – LBSMP Protocol for Class I waters are legally adopted and there is good implementation by the country¹⁸

4 – LBSMP standards for Class I waters are legally adopted but there is inadequate implementation by the country¹⁹

3 – LBSMP standards for Class II waters have been legally adopted and there is good implementation by the country

2 – LBSMP standards for Class II waters are legally adopted, but there is inadequate implementation by the country

1 – No standards or standards below Class II

Means of Verification: LBSMP Protocol and ratification map, copy of water quality reports documenting degree of implementation and compliance, national regulations/standards, and records from public service agencies showing testing that water quality meets standards.

4b. New infrastructure for sewage treatment (in the last 5 years)

Justification: In order to meet the LBSMP standards, new and improved sewage treatment facilities are typically required. Given the high cost of this infrastructure, change is likely to be incremental. This indicator measures the effort (relative to population size) in installing such facilities. The target of 5 percent of the coastal population refers to the additional population serviced by the installation of new infrastructure, and not the total population with sewage service (which would be much higher).

Ranking Criteria

5 – New coastal municipal sewage treatment plant(s), which meets the LBSMP standards for Class I waters, exists (serving at least 5 percent of the coastal population)

4 – New coastal municipal sewage treatment plant(s) for coastal population, which meets the LBSMP standards for Class I waters, is under construction, or approved (serving at least 5 percent of the coastal population)

¹⁷ "Class II waters" means waters in the Wider Caribbean, other than Class I waters, that due to oceanographic, hydrologic, climatic or other factors are less sensitive to the impacts of domestic wastewater and where humans or living resources that are likely to be adversely affected by the discharges are not exposed to such discharges. "Class I waters" means waters in the Wider Caribbean area that, due to inherent or unique environmental characteristics or fragile biological or ecological characteristics or human use, are particularly sensitive to the impacts of domestic wastewater. Class I waters include, but are not limited to: (a) waters containing coral reefs, seagrass beds, or mangroves; (b) critical breeding, nursery, or forage areas for aquatic and terrestrial life; (c) areas that provide habitat for species protected under the Protocol Concerning Specially Protected Areas and Wildlife to the Cartagena Convention (the SPAW Protocol); (d) protected areas listed in the SPAW Protocol; and (e) waters used for recreation.

¹⁸ Good implementation occurs when water quality meets the designated standards.

¹⁹ Inadequate implementation occurs when water quality does not meet the designated standards.

- 3 – New coastal municipal sewage treatment plant(s), which meets LBSMP standards for Class I waters exists, is under construction, or approved (serving less than 5 percent of the coastal population)
- 2 – New coastal municipal sewage treatment plant(s), which meets at least LBSMP standards for Class II waters exists, is under construction or approved
- 1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: records of new facilities in existence or under construction, including effluent specifications, a copy of the LBSMP Protocol, and census data for records of coastal population.

Calculation: Percentage of coastal population served = population served/ total coastal population.

Please refer to Appendix IV for the Regional Standards for Sewage Treatment from the Cartagena Convention's [Protocol Concerning Pollution from Land-Based Sources and Activities](#). In this report, we are specifically considering biochemical oxygen demand (BOD) and total suspended solids (TSS).

4c. Reduce upstream watershed pollution sources (agriculture, livestock, urban/tourism, industrial, rural, deforestation) through better management practices, action plans and regulations in each sector

Justification: The high level of nutrients, pesticides and other agro-chemicals used can result in pollution downstream. Sewage also contains bacteria and viruses known to harm marine life, including corals. Wastewater (including sewage and industrial effluent) must be treated and controlled to reduce the nutrients and toxins that reach coral reefs.

Ranking Criteria

- 5 – “Better management practices”, action plans and/or regulations exist and are under implementation, addressing 80% of the pollution sources occurring in the watersheds (agriculture, livestock, urban/tourism, industrial, rural, deforestation -those which occur in an analyzed watershed- not all occur in all watersheds) covering at least 80% of watershed areas, with demonstrated water quality improvements
- 4- “Better management practices”, action plans and/or regulations exist for at least 4 of the 6 pollution sources (agriculture, livestock, urban/tourism, industrial, rural, deforestation) covering 50% of watershed areas, with some demonstrated water quality improvements
- 3- “Better management practices”, action plans and regulations exist for at least 2 of the 6 pollution sources (agriculture, livestock, urban/tourism, industrial, rural, deforestation) covering 30% of watershed areas, with some demonstrated water quality monitoring
- 2- “Better management practices”, action plans and regulations for 1 of the 6 pollution sources (agriculture, livestock, urban/tourism, industrial, rural, deforestation) covering at least 10% of the watershed area
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of verification: “better management practices” reports, action plans, copies of regulations, water quality monitoring results.

THEME 5. RESEARCH, EDUCATION, AND AWARENESS

The number of decision makers that understand reef ecosystems, threats, values, and management approaches has greatly increased in recent years. This knowledge has provided tools to better recognize problems, address threats, and gain political, financial, and public support for reef management and conservation. Nevertheless, a gap remains between our existing knowledge and measurable improvements in reef management. Closing this gap depends on implementing more actions to promote research, education, and awareness, and on developing opinion surveys and other instruments to measure the impact of this information.

5a. Standardized monitoring of coral reef health and information management (regional indicator)

Justification: This indicator measures the efforts of researchers and managers to standardize monitoring methods, apply them in regular monitoring of representative sites (those selected based on unbiased sampling of different habitat types), and share the information in a publicly accessible and up-to-date database.

Ranking Criteria

- 5 – A regional standardized monitoring program of coral reef health and a database with routine, up-to-date, and representative data both exist^{20, 21}
- 4 – A regional standardized monitoring program exists, and assessments have been performed for representative sites (at least once)
- 3 – Representative data have been collected on coral reef health
- 2 – Plans to develop a regional standardized monitoring program and database are well under way (draft documents exist)
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: link to database, MBRS and AGRAA Methodology, Rapid Reef Assessment document, country map of AGRAA representative sites, and HRI 2008, 2010, 2012, 2015, 2018 and 2020 *Reef Report Cards*.

5b. Economic valuation of coral reefs

Justification: Economic valuation is a tool that can aid decision making by quantifying ecosystem services provided by coral reefs in monetary terms. Valuation also provides a tool for evaluating the costs and benefits of management and economic development options, with an emphasis on long-term benefits, which can help avoid short-sighted development.

Ranking Criteria

- 5 – A national valuation of coral reefs or valuation of selected ecosystem services associated with 50 percent of MPAs has been completed and is regularly updated
- 4 – A valuation of two or more MPAs has been completed
- 3 – A valuation of one MPA has been completed
- 2 – Assessments of coral reef economic contributions are currently being implemented
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: copy of valuation assessment reports (key findings), MPAs included in assessment, and project or consultation reports of valuations currently (or recently) implemented in MAR.

Calculation: ((Total number of MPAs having completed a valuation/Total # of MPAs) X 100).

5c. Availability of understandable information on reef condition and threats that respond to question posed by resource and protected areas managers and reef stakeholders

Justification: Identifying the reef condition and threats is essential for protected area managers as well as stakeholders. The public dissemination of information on reef condition and threats is essential to build an informed electorate that will support stronger reef protection regulations. This indicator measures the extent of these efforts through various media formats.

Due to statistical limitations we were unable to develop an indicator that specifically gauges impact.

Ranking Criteria

- 5 – Documents presenting scientific findings on coral reef condition and threats geared toward a general audience are widely available (print, television, social media, radio, and online)

²⁰ An up-to-date database has monitoring data that is collected at least biennially.

²¹ Representative data is based on the total area of different habitat types selected in a proportional, unbiased (randomized) sampling scheme, as described in AGRAA Protocol Version 5.4, which includes a discussion on how to select representative sites on pp. 3-4.

- 4 – Documents presenting scientific findings on coral reef condition and threats geared toward a general audience are generally available (via three media types from the list above)
- 3 – Documents presenting scientific findings on coral reef condition and threats geared toward a general audience are available (for at least one media type from above) and more are being developed (strategic plans or outreach)
- 2 – Scientific findings have been collated and there are plans to develop accessible products from this information
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: copy of documents, publications, media reports or video, records and compilation of reports and links, and strategic plans.

5d. Interdisciplinary partnerships combine social and ecological research for management

Justification: Humans are an integral part of an ecosystem, with social sciences being increasingly integrated into ecological research. This indicator measures the application of these social-ecological integrated studies to the improved management of coral reefs and coastal zones within the MAR region.

Ranking Criteria

- 5 – Findings of integrated social/ecological research have resulted in significant management action (e.g. a change in legislation) (can include both formal and informal partnerships)
- 4 – Two or more formal interdisciplinary partnerships exist, which integrate social and ecological research, and have published results
- 3 – One or more informal interdisciplinary partnerships exist, and they are currently implementing joint integrated social/ecological research; or one formal interdisciplinary partnership exists and has published results
- 2 – Groups working on integrated social/ecological research have begun to plan joint work (work plans, research proposals, or grant applications)
- 1 – No documentation of actions that meets the criteria to achieve a higher score is available

Means of Verification: copy of agreements, number of collaborative papers published, and copies of research reports, proposals, and work plans.

THEME 6. SUSTAINABILITY IN THE PRIVATE SECTOR

Partnerships between the private sector and governments or NGOs can facilitate information exchange, training in best environmental practices, and collaborative efforts to find solutions to issues of shared concern. Such partnerships can also be beneficial for tourism and marine recreation providers, as well as the seafood industry, by increasing their attractiveness to tourists, operators, restaurants and consumers who prefer environmentally responsible options.

6a. Voluntary eco-standards program for marine recreation providers

Justification: Marine recreation providers depend on healthy marine ecosystems, especially reefs. Voluntary programs have been developed to help them be better stewards in their use of the reef for recreation. This indicator measures the degree of participation of marine recreation providers in programs that promote environmental sustainability.

Ranking Criteria

- 5 – A regional or national voluntary eco-standards program for marine recreation providers exists and more than 50 percent of all providers are participating
- 4 – A regional or national voluntary eco-standards program for marine recreation providers is developed and more than 25 percent all providers are fully participating
- 3 – A regional or national voluntary eco-standards program for marine recreation providers is developed and at least 10 percent of operators are participating

- 2 – There has been some effort to create standards and at least 3-4 marine recreation providers are participating in these efforts (data collection, improved practices, or strategic plans)
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: official list of marine recreation providers from government agencies (if available), list of participating marine recreation providers from organizations working on this issue, project or consultation reports, copy of national voluntary eco-standards, and manuals and training materials about how to achieve voluntary eco-standards.

Calculation: ((Total # of providers that participate/Total # of providers) X 100).

6b. Participation of coastal hotels in eco-certification schemes

Justification: Several eco-certification programs for coastal hotels have been initiated in the MAR area.²² If designed and implemented well, these programs have the potential to reduce negative impacts on coastal ecosystems and promote environmental sustainability. This indicator measures the industry's extent of participation in these programs.

Ranking Criteria

- 5 – Over 25 percent of coastal hotels participate in one of the recognized eco-certification²³ schemes
- 4 – 15–24 percent of hotels participate in eco-certification schemes
- 3 – 5–14 percent of hotels participate in eco-certification schemes
- 2 – Less than 5 percent of hotels participate in eco-certification schemes
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: official list of total coastal hotels from government agencies (if available), or unofficial list from recognized organizations (if official list does not exist), official list of eco-certification schemes/standards and participating hotels.

Calculation: ((# of coastal hotels participating in eco-certification/Total # of coastal hotels) X 100).

6c. Adoption of seafood eco-labeling programs

Justification: Several different seafood-labeling programs exist that promote sustainability.²⁴ The Marine Stewardship Council (MSC) is the most advanced and environmentally robust.²⁵ Several local eco-labeling efforts also promote sustainable seafood. This indicator measures the effort to develop and adopt these programs in the MAR region.

Ranking Criteria

- 5 – There exists a national seafood eco-labeling program, and at least one fishery in the country is certified by the MSC or equivalent high standard
- 4 – There exists a national seafood eco-labeling program (within the MAR region), and at least one fishery has completed a full MSC assessment

²² "Coastal hotels" refers to hotels located within 5 km of the coastline.

²³ Eco-certification refers to a recognized certification program, including environmental criteria for hotels.

²⁴ Seafood eco-labeling refers to a program for seafood products intended to account for environmental concerns. Ideally, we would have a record of all restaurants and the percent that are participating in the eco-label program in order to quantitatively calculate the percentage.

²⁵ According to its website, The Marine Stewardship Council's mission "is to use our eco-label and fishery certification program to contribute to the health of the world's oceans by recognizing and rewarding sustainable fishing practices, influencing the choices people make when buying seafood, and working with our partners to transform the seafood market to a sustainable basis." Found online at <<http://www.msc.org/>>.

- 3 – Better management practices have been developed and agreed upon for the seafood industry, and a lead agency is developing the eco-labeling program²⁶
- 2 – Better management practices have been developed, but not agreed upon, or no national lead agency has been identified to develop the eco-labeling program
- 1 – No documentation of actions that meet the criteria to achieve a higher score is available

Means of Verification: MSC certification and/or assessment reports, copies of eco-labeling materials (environmental requirements for sustainability, lists of eco-friendly seafood, restaurants), copies of best management practices manual, memorandum of understanding/agreement where better management practices have been adopted, and workshop notes and work plans for developing better management practices.

6d. Government incentives for conservation and sustainable businesses

Justification: Government tax and other incentives can provide an important stimulus for the private sector to adopt environmentally friendly practices and technologies. This indicator measures the degree to which each government in the MAR area has applied such incentives for conservation.

Ranking Criteria

- 5 – The national or provincial government provides incentives for four of the following: improvements in energy efficiency, improvements in the treatment of wastewater, reductions in waste production or recycling, alternative energy options, the adoption of four-stroke outboard engines, and land tax incentives for conservation ²⁷
- 4 – Governments offer incentives for at least three of the above
- 3 – Governments offer incentives for at least two of the above
- 2 – Governments offer incentives for at least one of the above
- 1 – No government incentives were identified

Means of Verification: copies of relevant legislation or regulations.

6e. Private sector assistance to MPAs

Justification: Incorporating private sector assistance for local MPAs is an important component in their sustained success. This indicator assesses the degree of local business assistance as reported by MPA managers. Private sector assistance is evaluated based on the existence of financial, in-kind, or technical assistance.

Ranking Criteria

- 5 – At least 50 percent of marine protected areas have high levels of private sector support²⁸
- 4 – At least 50 percent of marine protected areas have at least moderate private sector support and at least 25 percent have high private sector support ²¹
- 3 – At least 50 percent of marine protected areas have at least moderate private sector support

²⁶ Better management practices (BMPs) are tools that protect the environment by helping to measurably reduce major impacts of growing or harvesting commodities. Examples of BMPs include limiting the catch and sale of fish based on size, season, and species. More information can be found online at http://www.panda.org/what_we_do/how_we_work/businesses/transforming_markets/solutions/methodology/better_management_practices/.

²⁷ The use of four-stroke outboard engines represents an important conservation measure, as these engines have higher fuel efficiency and pollute less oil than alternative two-stroke engines.

²⁸ Criteria for rating private sector support of MPAs is based on the following:

- How would you rate the level of private sector assistance? **High** (formal agreement with regular assistance); **Moderate** (regular assistance, but no formal agreement); **Low** (occasional assistance, typically low value); and **None** (no assistance). Includes the provision of financial, staff, or material assistance. Creating an official list of quantifiable ranges for “regular assistance” represents a data gap that should be addressed.

2 – At least 50 percent of marine protected areas have at least low private sector support

1 – At least 50 percent of marine protected areas have no private sector support

Means of Verification: MPA original data collection to rate private sector support of MPAs as having high, moderate, low, or none.

Calculation: percent of MPAs with high private sector support: ((Total # of MPAs with high private sector support/Total # of MPAs) X 100); percent of MPAs with at least moderate private sector support: (Total # of MPAs with high + moderate private sector support); percent of MPAs with at least low private sector support: (Total # of MPAs with high + moderate + low private sector support); and percent of MPAs with no private sector support: (Total # of MPAs with no private sector support/Total # of MPAs) X 100).

THEME 7. GLOBAL ISSUES

A global approach to protect coral reef ecosystems is essential to achieve meaningful action. We must work internationally, drawing on existing international frameworks and conventions, and also sharing knowledge, experience, and ideas to achieve solutions to global-scale threats such as climate change.

7a. Mapping of potentially resilient reefs to warming seas / coral bleaching (regional indicator)

Justification: Corals are highly sensitive to changes in temperature, resulting in bleaching. However, some species appear to be more tolerant, and some individual corals appear better adapted as a result of past exposure to stresses. Reefs that are better suited to avoid or tolerate bleaching are termed “resistant.” Reefs that are affected but then recover to their original state are termed “resilient.” Factors that appear to improve the resilience of a coral reef include minimizing local stressors, maintaining good connectivity to un-impacted or resistant reef areas, and enabling coral larvae to move in and establish the coral population. This indicator measures the extent to which a regionally accepted map of potentially resilient reefs has been adopted and utilized in the region.

Ranking Criteria

5 – Existence of an accepted regional map that identifies reefs most likely to be resilient and is integrated into two national-level plans and into at least 50 percent of MPA plans in those countries^{29, 30, 31}

4 – Existence of an accepted regional map that identifies reefs most likely to be resilient and is integrated into at least one national-level plan and into at least 25 percent of MPAs in that country

3 – Existence of a draft MAR regional map of reef resilience using a regionally accepted method and is under review

2 – National work to develop regionally standardized resilience indicators is under way (data have been collected to identify resilient sites) and has been applied to create a regional map

1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: copy of resilience map, list of MPAs by country, copies of national and MPA plans that incorporate resilience, draft methodology to rank reefs based on resilience, reef resilience and workshop reports.

Calculation: ((Total # of MPAs with integrated plans/Total # of MPAs) X 100).

²⁹ National-level plans include national development strategies, trade and industry plans, strategic plans, business plans, work plans, or management plans. Examples include a national biodiversity strategy, a national development strategy, a protected area network strategy, or a climate adaptation strategy.

³⁰ MPA plans include marine protected area management plans or work plans.

³¹ A reef resiliency map is considered regionally accepted if it has been approved by at least three out of the four MAR countries.

7b. Engagement in international/regional treaties that support conservation

Justification: The following international treaties and conventions address solutions to issues relevant to marine conservation in the MAR area. This indicator measures the number of these treaties that have been ratified by each of the countries in the MAR area.³²

Ranking Criteria

- 5 – At least 95 percent and higher score
- 4 – Score of at least 85 percent
- 3 – Score of at least 75 percent
- 2 – Score of at least 65 percent
- 1 – Score less than 64 percent

Means of Verification: list of countries ratifying the stated treaties / protocols, verified by the national department or ministry responsible for international treaties.

Calculation: ((Total # of ratified treaties/Total # of relevant treaties by country) X 100).

7c. Develop incentive for carbon sequestration programs.

Justification: As human populations grow, so do the resource demands imposed on ecosystems. The environmental impacts of anthropogenic actions, which are processes or materials derived from human activities, are becoming more apparent. This indicator measures the application and progress of an incentive program of ecosystem services for carbon sequestration.

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- ³² [1982 United Nations Convention on the Law of the Sea](#). The Law of the Sea Convention defines the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.
 - [1986 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region](#). A comprehensive, umbrella agreement for the protection and development of the marine environment. This regional environmental convention provides the legal framework for cooperative regional and national actions in the Wider Caribbean Region.
 - [1983 Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region](#). The objective of the Protocol is to strengthen national and regional preparedness and response capacity in combating oil spills of the nations and territories of the region.
 - [1990 Protocol Concerning Specially Protected Areas and Wildlife to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region](#). The objective of the Protocol is to protect rare and fragile ecosystems and habitats, thereby protecting the endangered and threatened species residing therein.
 - [2010 Protocol Concerning Pollution from Land-Based Sources and Activities](#). Perhaps the most significant agreement of its kind with the inclusion of regional effluent limitations for domestic wastewater (sewage) and requiring specific plans to address agricultural nonpoint sources.
 - [1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat](#). An intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their wetlands of international importance and to plan for the "wise" or sustainable use of all of the wetlands in their territories.
 - [1992 United Nations Framework Convention on Climate Change](#). The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
 - [1992 Convention on Biological Diversity](#). A global agreement addressing all aspects of biological diversity: genetic resources, species, and ecosystems.
 - [1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora](#). An international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Ranking Criteria

- 5 – An incentive program of ecosystem services for carbon sequestration exists with 10 % of the MAR land area
- 4 – An incentive program of ecosystem services for carbon sequestration exists with 10 % of the MAR land area
- 3 – An incentive program of ecosystem services for carbon sequestration does exist but is not being applied
- 2 – There are plans to develop an incentive program of ecosystem services for carbon sequestration
- 1 – No documented action that meets the criteria to achieve a higher score is available

Means of Verification: copy of documents, publications, reports from the government or any other institution presenting an incentive program of ecosystem services for carbon sequestration.

Appendix 1. 2021 EcoAudit Geospatial results and metadata

2021 Eco-Audit GIS Data Layers:

Calculations and Verification of Marine Protected Area Indicators

Prepared by Atlantic and Gulf Rapid Reef Assessment Program (AGRRA) and Healthy Reefs Initiative (HRI)

Introduction

In Healthy Reef Initiative's Eco-Audit, the Marine Protected Area theme includes seven indicators. Three of these indicators, which are listed below, were verified through spatial analysis for the 2021 Eco-Audit.

Of these seven indicators, three indicators were updated with more current information:

- 1a. Percent of a country's territorial sea included in gazetted MPAs. It is calculated as: $((\text{Area of MPAs (marine area only)} / \text{Area of territorial sea}) \times 100)$.
- 1b. Percent of a country's territorial sea included in fully protected zones. It is calculated as: $((\text{Area of fully protected marine zones} / \text{Area of territorial sea}) \times 100)$.
- 1c. Percent of mapped coral reef area included in fully protected zones. It is calculated as: $((\text{Area of coral reef in fully protected zones} / \text{Area of coral reef}) \times 100)$.

Means of Verification

A spatial analysis using ArcView Geographical Information System (GIS) was done to compile, calculate and verify the above indicators by AGRRA and HRI:

- 1. Exclusive Economic Zones (EEZ)
- 2. Territorial Seas (TS)
- 3. Coral Reef Layers
- 4. Marine Protected Areas (MPAs)
- 5. Fully Protected Replenishment Zones (RZs), also known as "no-take" areas either within larger MPAs or independent.

An overview of the spatial analysis methods and updates on spatial layers is provided below. Whereas calculations for the above indicators are provided in a separate Excel worksheet.

1. Exclusive Economic Zone (EEZ):

An Exclusive Economic Zone (EEZ) is a concept adopted at the Third United Nations Conference on the Law of the Sea (1982), whereby a coastal country assumes jurisdiction over the exploration and exploitation of marine resources in its adjacent section of the continental shelf, taken to be a band extending 200 nautical miles (nm) from the shore (370.4 km / 230.2 mi).

This dataset builds on previous versions of the world's EEZ. In version 9, the 200 nautical miles outer limit was completely recalculated using a higher resolution coastline as a normal baseline (ESRI Countries 2014) and straight baselines, where available.

For the Mesoamerican Reef Region (MAR), the EEZ of each of the four countries of Mexico, Belize, Guatemala, and Honduras are based on internationally published EEZ boundaries found at: Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200 nm), version 11. Available online at <https://www.marineregions.org/>. <https://doi.org/10.14284/386>. We recognize this may differ from individual country EEZ

layers, but we used this source as it provided a regional data layer and is being used here for research and documentation purposes.

Updates to the EEZ layer included edits at the Mexico and Belize border to follow existing MPA boundaries.



Fig. 1. Exclusive Economic Zones (EEZs) of the four countries of the Mesoamerican Reef (MAR) region (Mexico, Belize, Guatemala, and Honduras).

2. Territorial Seas (TS):

Territorial Sea, as defined by the 1982 United Nations Convention on the Law of the Sea, is a belt of coastal waters extending at most 12 nm (22 km/14 mi) from the baseline (usually the mean low-water mark) of a coastal country. We created a new 12 nm Territorial Sea layer for the Mesoamerican Region for the 2021 Eco-Audit calculations. The MAR_Land_2020.shp file was used to remove the coastline and islands from the territorial sea to include only water in each calculation. The TS layer includes these updates:

- Mexico: The same Territorial Sea file was used as in the 2016 Eco-Audit. It is similar to the Marine Regions file except around Banco Chinchorro where a different land/coastline layer was used. It also covers the Chetumal Bay by the Belize border. This area includes only the portion of Mexico's Territorial Sea that lies within the State of Quintana Roo, as per previous Eco-Audits and the TNC Replenishment Zone Network analysis.
- Belize: While previous Eco-Audits have used the reduced Territorial Sea in Southern Belize as described in the Belize Maritime Areas Act of 1992, the SI 107 of 2019 repealed this Act and reverted Belize's Territorial Sea to the standard international conventions. Thus, we are using the internationally published territorial sea outer boundaries found at: Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Territorial Seas (12nm), version 3. Available online at <https://www.marineregions.org/>. <https://doi.org/10.14284/387>. This file was then back filled to cover all waters between the coastline (MAR_Land_2020.shp) and the Marine Regions outer boundary.
- Guatemala: All of Guatemala's territorial waters fall within the 12 nm limit; therefore, the entire EEZ is included in the Territorial Sea file. The EEZ of Guatemala is based on internationally published EEZ boundaries found at: Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200 nm), version 11. Available online at <https://www.marineregions.org/>. <https://doi.org/10.14284/386>. We recognize this may differ from individual country EEZ layers, but we used this source as it provided a regional data layer and is being used here for research and documentation purposes.
- Honduras: The old 2016 file was a 12 nm buffer of all coastline and islands. This did not follow the "LIMITS IN THE SEAS No. 124 STRAIGHT BASELINE CLAIM" found at <https://2009-2017.state.gov/documents/organization/57676.pdf>. To

rectify this, we are using the Internationally published territorial sea outer boundaries found at: Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Territorial Seas (12 nm), version 3. Available online at <https://www.marineregions.org/>. <https://doi.org/10.14284/387>. This file was then back filled to cover all waters between the coastline (MAR_Land_2020.shp) and the Marine Regions outer boundary.

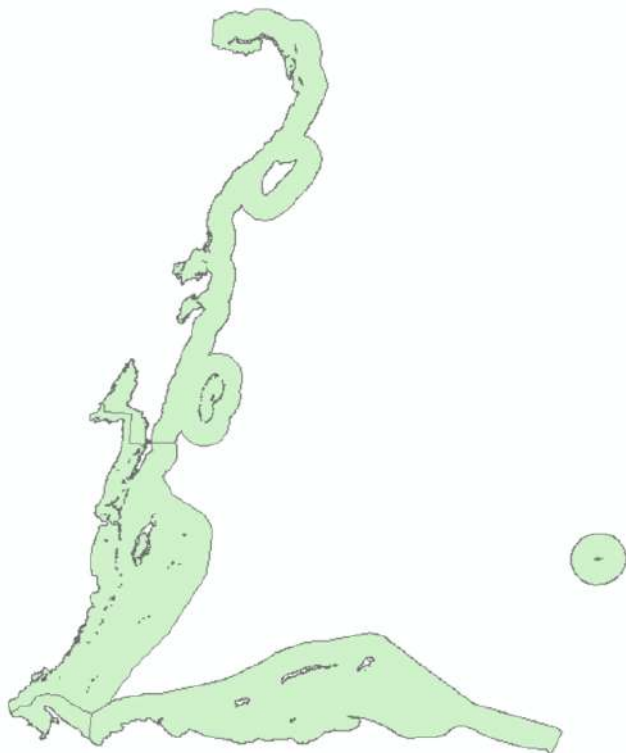


Fig. 2. Territorial Seas (TS) of the Mesoamerican Reef (MAR).

3. Coral Reef Layer:

The Coral Reef Layer includes the amount of coral reef present in the MAR region. The data layers were collated by AGRRA and HRI. This represents the coral reef layer used for calculations in the 2021 Eco-Audit. The original layer was based partly on the 2016 Eco-Audit with the following adjustments:

- Mexico: Two options were calculated for Mexico for comparisons. Option 1 calculated coral reef area using the first 2016 data from Millennium Coral Reef Mapping Project for consistency with past Eco-Audits. Option 2 calculated coral reef area based on a) the Millennium Reef data for Banco Chinchorro and Cozumel and b) a new higher resolution coral reef layer from CONABIO for the main coastline area (file named MAR_reefs_2020_MXnew.shp). It was decided to use Option 2 for the new 2021 Eco-Audit calculations. This improvement in resolution decreased the total reef area from 491 to 317 km².
- Belize: The Coral Reef layer includes the 2016 Eco-Audit file where coral reef polygons were based on the Millennium Coral Reef Mapping Project, with the addition of a new large polygon for the Belize portion of the newly described Cayman Crown Coral Reef.
- Guatemala: The coral reef layer includes the same 2016 Eco-Audit coral reef file (which was not the Millennium Maps, which showed no coral reef in Guatemala – thus a map was made based on coral reef monitoring, field observations and bathymetry), with the addition of a new large polygon for the Guatemala portion of the newly described Cayman Crown Coral Reef. The Cayman Crown Coral Reef layer was provided by Ana Giro (HRI Guatemala) from field data collections. A new benthic habitat mapping effort is underway for Guatemala through HRI/Smithsonian/Purkis Partnership.

- Honduras: The coral reef layer includes the same 2016 Eco-Audit file based on the Millennium Coral Reef Mapping Project for consistency. A new coral reef layer recently produced for Smithsonian Institution by the Purkis Partnership is available, but not included for the 2021 Eco-Audit calculations, in order to have consistent comparisons to the 2016 Eco-Audit. It will be used in future Eco-Audits along with the ongoing other habitat mapping revisions.



Fig. 3. Coral Reefs of the Mesoamerican Region (MAR).

4. Marine Protected Areas (MPAs):

Marine Protected Areas (MPAs) are defined by the World Conservation Union (IUCN) as parts of intertidal or subtidal environments, together with their overlying waters, flora and fauna and other features, that have been reserved and protected by law or other effective means (IUCN-WCPA, 2008). The Mesoamerican MPA Database was collated by HRI and AGRRA. This represents the most updated version of Marine Protected Areas as of Feb 2021 for the Mesoamerican Reef system. For calculations, the MPAs were clipped by the MAR_Land_2020.shp to only include area over water, and all MPA area that extended over the EEZ boundary line was excluded from that country's area total, thus only the MPA area within a country's EEZ were calculated.

- Mexico: MPAs were not changed from the 2016 Eco-Audit, although Replenishment Zones (RZs) were updated in a separate file. These MPA polygons are published in the Federal Official Diary.
- Belize: The MPA layer was updated using data provided by the Coastal Zone Management Authority and Institute (CZMAI, 2021). New additions since the 2016 Eco-Audit were the expansions to Hol Chan Marine Reserve (2015) and Sapodilla Cayes Marine Reserve (2019). Cayman Crown Coral Reef falls within the newly expanded reserve and includes an area known as Conservation Zone IV in which commercial fishing is prohibited, but allows for recreational, sport and tournament fishing.
- Guatemala: The MPA boundary layer was updated including a) a new boundary for Cayman Crown Replenishment Zone, b) a refined boundary of Refugio de Vida Silvestre Punta de Manabique (RVSPM) (provided by FUNDAECO/Ana Giró and checked by CONAP) to align with the new Cayman Crown Replenishment Zone boundary, and c) two MPA polygons within the RVSPM were updated to align adjacent to land. No updates were made to Área de Usos Múltiples Río Sarstún. On May 21, 2020, the Ministry of Agriculture, Livestock and Food declared a special 10-year fish replenishment zone (temporal and spatial no-take zone) for Cayman Crown, through Ministerial Agreement No. 85-2020. Healthy Reefs Initiative and FUNDAECO worked together to accomplish this declaration. While Cayman Crown's RZ is not designated as

a marine protected area under Guatemala's nomenclature, for the purposes of the 2021 Eco-Audit, it is included in the MPA and RZ layers and calculations, as it is a fully protected no fishing no extractive zone.

- Honduras: MPA's were updated based on GIS shape files created for the 2021 Eco-Audit (see documentation compiled by HRI (Ian Drysdale and Angela Randazzo). Available fields were adjusted to fit into this existing layer. For full attribute information, see BEL_MPA's_2020.shp, HON_MPA's_2020.

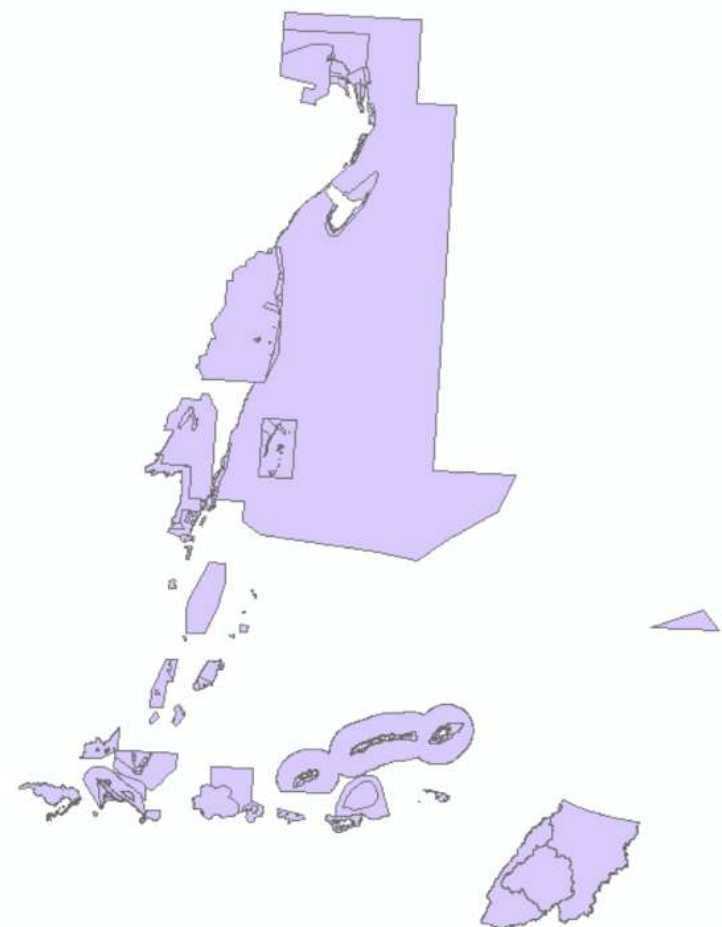


Fig. 4. Marine Protected Areas (MPAs) of the Mesoamerican Reef (MAR) (the map includes land portions, but for the calculations, the land was clipped out).

5. Fully Protected Replenishment Zones (RZs):

Fully Protected Replenishment Zones (RZs) are areas of the ocean protected from all extractive and destructive activities. The RZs layer produced for the 2021 Eco-Audit is based on the original file from the 2016 Eco-Audit, with the following updates:

- Mexico: This RZs layer was provided by Stuart Fulton from Comunidad y Biodiversidad (COBI). The declared fish RZs and the fully protected (no fishing, nucleus areas and fish refuge) polygons of MPAs including the whole water column and effective the whole year (not seasonal) were considered as "Fully protected RZ". For example, the deep no fishing areas of the Reserva de la Biosfera Caribe Mexicano (Mexican Caribbean Biosphere Reserve, RBCM) were hence not considered in that calculation since fishing is allowed from the surface to a depth of 100m.
- Belize: The RZs layer was updated based on data from CZMAI (2021).
- Guatemala: The RZs layer is based on data from the 2016 Eco-Audit layer with two updates including a) a new boundary for Cayman Crown Replenishment Zone, and b) two Replenishment Zone polygons within the RVSPM that were manually adjusted based on coordinates provided in a paper map from CONAP (National Council of Protected Areas).
- Honduras: The RZs layer was a new updated file provided by Angela Randazzo and Ian Drysdale (see Honduras Eco-Audit 2021 documentation).



Fig. 5. Replenishment Zones (RZs) of the Mesoamerican Reef (MAR).