MEXICO

BELIZE

GUATEMALA

HONDURAS

Mesoamerican Reef

An Evaluation of Ecosystem Health

Healthy Reefs
for healthy people

2015
Report Card

Executive Summary

Coral reefs are one of the planet's most threatened and diverse ecosystems, making their conservation of utmost global significance. Maintaining a healthy and diverse coral reef ecosystem is especially important to the four countries of Mexico, Belize, Guatemala, and Honduras as they are home to the Western Hemisphere's longest coral reef system. The Mesoamerican Reef (MAR) spans more than 1,000 km along the coasts of these four countries and supports the local economies and culturally rich livelihoods of nearly two million people. The Healthy Reefs Initiative (HRI), through a precedent-setting conservation partnership of more than 60 partners, is working to improve the health and management of this diverse ecosystem.

The Healthy Reefs Initiative is one of the first efforts globally to develop measurable ranking criteria for indicators of coral reef health. The Reef Health Index (RHI) evaluates the ecological condition of the MAR according to four key indicators vital to the structure and functioning of healthy coral reef ecosystems – the change or decline in the status of one of these indicators can have a cascading or domino effect on the entire ecosystem. Over the past 10 years, HRI and partners have collaborated to facilitate data sharing and promote adaptive management by producing three previous Report Cards on ecosystem health and two Eco-Audits of management effectiveness.

In 2013 and 2014, HRI and partners systematically measured the health of 248 reef sites across 1,000 km of the four countries. This 2015 Report Card represents the first year that HRI has calculated and presented more detailed maps of coral reef condition on a variety of spatial scales – from regional to local. Regional scale data provide insight on larger scale reef health patterns that can help identify transboundary issues, while subregional and local data help detect finer-scale patterns of reef condition. The country-focused maps provide individual indicator scores at the site level. These new data maps provide guidance for partners on where to focus conservation actions at the most appropriate, effective management scale.

The new Country Profiles of this Report Card are based on contributions from >60 partners who attended the Fall 2014 Regional Partners meeting. Partners from each country identified the greatest threats their reefs will face over the next two years, recommended specific management responses and drafted the conceptual diagrams (infographics) shown in the report. They developed a timeline of key events influencing reef health, but equally important, they set forth a vision of conservation goals to achieve over the next 5 years. Partners also selected the success stories highlighted for each country and prioritized one management recommendation for each of the seven Eco-Audit themes. Partners committed to collaboratively work over the next two years to help implement these actions.

KEY FINDINGS

Status and Trends. The overall 2015 Reef Health Index score is 'fair', with encouraging improvements at both the regional level and of individual indicators. Corals – the architects of the reef – have improved since 2006, increasing from 10%-16% cover. Fleshy macroalgae, the main competitors with corals for open reef space, have increased. Key herbivorous fish continue to increase in numbers and are needed to reduce this macroalgae. Commercial fish have also increased in biomass, which is an encouraging sign, although large groupers are rare and mainly found in fully protected zones of MPAs.

Marine Protected Areas (MPAs) help reefs recover. The MAR retains its global position as a leader in MPA declaration – all four countries have achieved the target of protecting 20% of its territorial sea. The 45 MPAs in the MAR protect 23,492 km^2 of marine area. Only 7% of that marine area is under full protection, including large areas in Banco Chinchorro and Swan Islands. Five new MPAs have been designated since 2011, including a new community supported MPA in Tela, Honduras and an expansion of Hol Chan Marine Reserve from 55 km^2 to 441 km^2. Guatemala recently (2015) passed legislation to ban the fishing of parrotfish. Based on HRI data of 43 long-term survey sites, fully protected areas had 10 times more snapper and grouper biomass than those within general areas of designated MPAs or reefs with no protection. More large groupers were found in long-established MPAs or MPAs with additional protection measures. Given the

projected long recovery periods expected for coral reef ecosystems, even within MPAs, implementing additional fishery restrictions can complement and improve the effectiveness of marine protected areas. Both full-protection and gear restrictions (no spearfishing and fish traps) are helping groupers and parrotfish grow larger and become more plentiful.

Coral cover is increasing, although slowly. Coral cover remained at ~16-18% over the past five years, higher than the 10% reported in 2006. Reefs with highest coral cover (e.g., 20-40% in Honduras, Guatemala, Cozumel) may serve as important sources of coral larvae for other reefs. The positive, although slow, increasing trend in coral cover is encouraging; however, increases in fleshy macroalgal cover, lack of *Diadema* urchin recovery, fishing pressure on parrotfish, and poor water quality are limiting coral recovery.

Fleshy macroalgal dominance is widespread. Fleshy macroalgae have nearly doubled since 2006. Some reefs with abundant herbivorous fish also had 'critically' high levels of macroalgae. Offshore reefs (e.g., Glover's Reef, Swan Islands, Lighthouse Reef) had the highest algal cover (>30%) despite being far from land. Identifying direct causes of increased macroalgal dominance is difficult due to variations of natural factors (e.g., seasonal) and human impacts (e.g., sewage). Minimizing localized land-based pollution and reducing overfishing, especially of key herbivores, can reduce macroalgae and promote coral growth.

Herbivory is important for reducing macroalgae. Herbivorous fish biomass had a 'fair' score (2,605 g/100 m^2), but increased over the years. More large parrotfish were found in MPAs, suggesting protection allows parrotfish to grow large. The sea urchin, *Diadema antillarum*, also a key algal grazer, is still uncommon. Reefs with abundant (>1 urchin/m^2) *Diadema* had less fleshy macroalgae (<5%) (e.g., Tela, Honduras). Protecting sufficient numbers of herbivores can increase grazing intensity to levels that can shift the balance towards more coral-dominated reefs. Recent regulations protecting parrotfish (e.g., Guatemala, Belize, Bay Islands) are important especially as parrotfish are being targeted for food as other fish stocks decline.

Snappers & groupers have increased locally, but few large groupers remain. Commercial fish biomass has increased slightly (1,023 g/100 m^2) since 2006, but is still at functionally low levels. Most surprising was the lack of large groupers – of the 700 groupers counted in 149 HRI sites, only 4% were >40 cm and only 11% of sites had large groupers present. Protecting large fish is important as bigger fish produce more eggs and more eggs produce more fish.

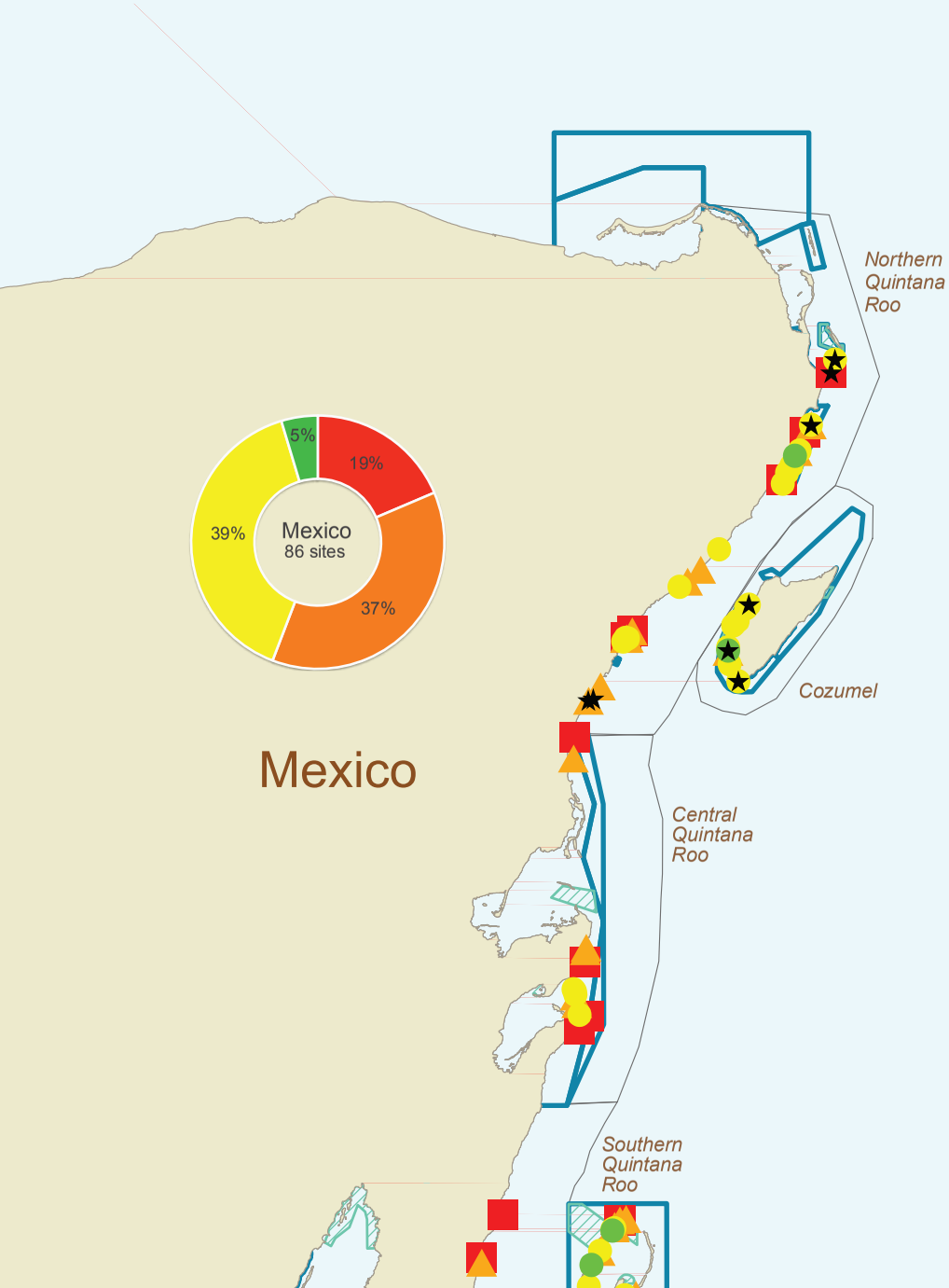
Healthy Reefs
for healthy people

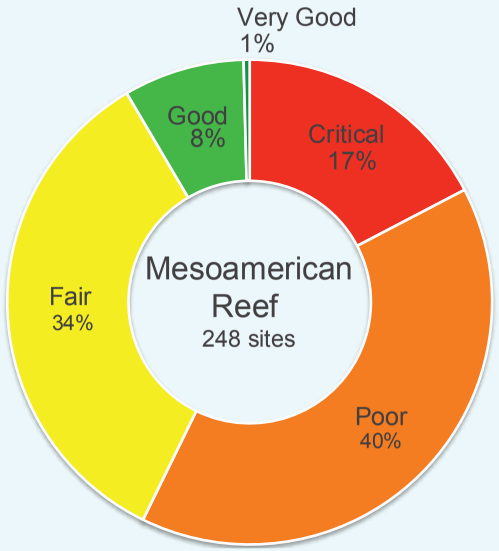
This 2015 Report Card includes:

Together, we will save this Meso-Amazing Reef

Cover:
Edita Pariente - cover design
Baruch Figueroa Zavala - parrotfish graphic
Keith Ellenbogen - background and Mexico photo
Catlin Seaview Survey - Belize photo
Ana Giró - Guatemala photo
Francesca Diaco - Honduras photo

Mesoamerican Reef Health

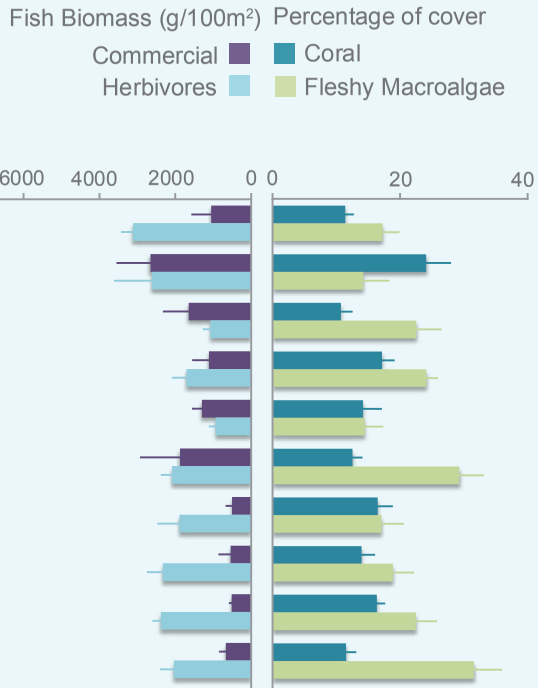


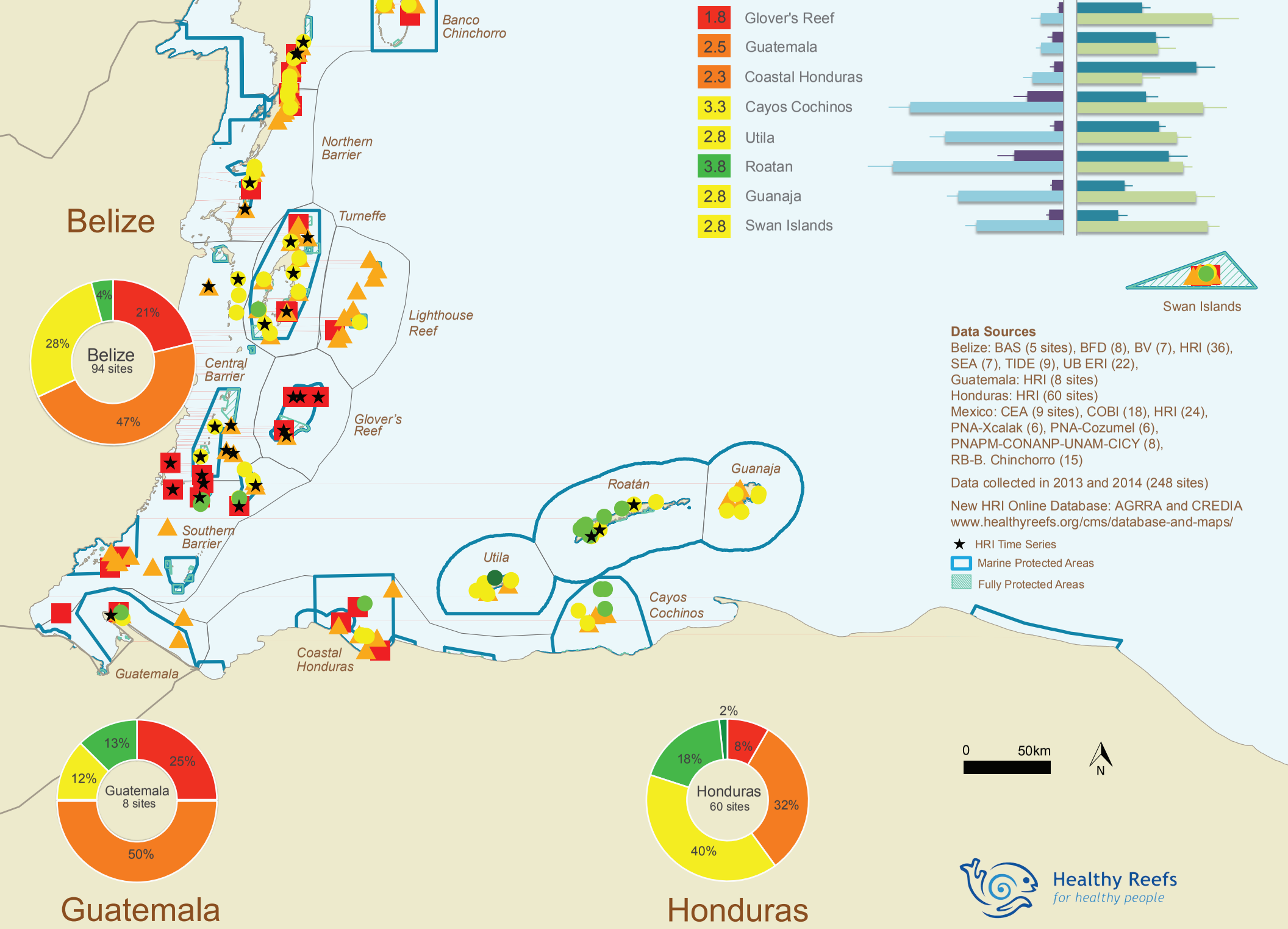


Reef Health Index (RHI)

Very Good	<4.2 - 5
Good	>3.4 - 4.2
Fair	>2.6 - 3.4
Poor	>1.8 - 2.6
Critical	1 - 1.8

RHI	Subregions
3.0	Northern Quintana Roo
3.5	Cozumel
2.8	Central Quintana Roo
2.5	Southern Quintana Roo
2.5	Banco Chinchorro
3.0	Northern Barrier
2.3	Central Barrier
2.5	Southern Barrier
2.5	Turneffe
2.3	Lighthouse Reef





Data Sources
Belize: BAS (5 sites), BFD (8), BV (7), HRI (36), SEA (7), TIDE (9), UB ERI (22),
Guatemala: HRI (8 sites)
Honduras: HRI (60 sites)
Mexico: CEA (9 sites), COBI (18), HRI (24), PNA-Xcalak (6), PNA-Cozumel (6), PNAPM-CONANP-UNAM-CICY (8),
RB-B. Chinchorro (15)

Data collected in 2013 and 2014 (248 sites)

New HRI Online Database: AGRRA and CREDIA
www.healthyreefs.org/cms/database-and-maps/

★ HRI Time Series
Marine Protected Areas
Fully Protected Areas

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A full list of data contributors can be found online in the 2015 Report Card supplement. See www.healthyreefs.org

Reef Health Index (RHI)

Data Collection

Evaluating reef health on a large scale requires a collaborative and coordinated effort among all partners in the MAR region. The 2015 Report Card data were collected by 12 partner organizations and the HRI team. Of the 248 sites monitored in 2013/2014, 148 were surveyed by HRI and 100 sites by partners including 86 sites in Mexico, 94 in Belize, 8 in Guatemala, and 60 in Honduras. Data were collected using the Atlantic and Gulf Rapid Reef Assessment Protocol (AGRRA) which uses 6 benthic transects (10 m each) and 10 fish transects (30 m each) (www.agrra.org). Some partners used comparable survey methods. HRI data are available on HRI's online database (www.healthyreefs.org). Data are presented at several spatial scales: regional, subregional and site level. There are 18 subregional divisions based on natural geomorphologic and socio-political features. HRI sites were independently selected to be representative of the entire region, while sites monitored by our partners were chosen with local expert knowledge, often in response to research or management considerations.

Reef Health Index (RHI)

The Healthy Reefs Initiative is one of the first efforts globally to develop measurable ranking criteria for indicators of coral reef health. The development of a single index, the Reef Health Index (RHI), facilitates the mapping and reporting on reef health for a "big picture" snapshot of the MAR. Indicators are parameters or metrics of an ecosystem that relay relevant information on the condition of the ecosystem. They help translate the complex concept of ecosystem health into tangible, rigorously defined quantities by which changes in condition can be assessed over time. The mean value of each indicator is compared to the following thresholds and given a grade from one ('critical') to five ('very good'). The four grades are averaged to obtain the RHI score for each site. It is important to highlight that a site with a given RHI score (e.g., 'fair') may have some indicator(s) ranking in different conditions (e.g., 'good').

Reef Health Index (RHI)

Reef Health Index Indicators	Very Good (5)	Good (4)	Fair (3)	Poor (2)	Critical (1)
Coral Cover (%)	≥40	20.0-39.9	10.0-19.9	5.0-9.9	<5
Fleshy Macroalgal Cover (%)	0-0.9	1.0-5.0	5.1-12.0	12.1-25	>25.0
Key Herbivorous Fish (g/100m^2) *(only parrotfish and surgeonfish)*	≥3480	2880-3479	1920-2879	960-1919	<960
Key Commercial Fish (g/100m^2) *(only snappers and groupers)*	≥1680	1260-1679	840-1259	420-839	<420

The RHI index is based on these four indicators, which are then combined and equally weighted:

- Coral cover is the amount of reef surface covered by live stony corals, contributing to its three-dimensional framework.
- Fleshy macroalgae cover is the proportion of reef covered by fleshy algae.
- Herbivorous fish is a measure of the biomass of important grazers on plants that could overgrow the reef.
- Commercial fish is a measure of the biomass of fish species commercially important to people.

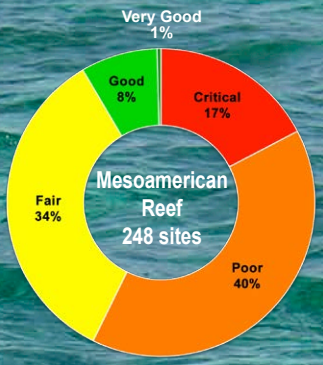
Maps Overview

1. **MAR Reef Health Index Map:** Pie graphs with RHI MAR and Country scores show % of sites by condition category. Survey sites have RHI scores by color. Table shows subregion RHI scores. Graph has subregion indicator data.
2. **Marine Protected Areas Map:** Table gives names of MPAs and the total area (km^2) of protected and fully protected area (no take zones). RHI score shown by subregion (shaded areas). MPA and fully protected area boundaries shown.
3. **Status of Herbivorous Fish and Large Parrotfish:** 1) Herbivorous fish biomass by subregion (shaded areas) based on 248 sites. 2) Large parrotfish >20 cm (point data by site) from 149 HRI sites. Graph 1 - size class of parrotfish from 149 HRI sites. Graph 2 - relationship of *Diadema* density vs. Fleshy macroalgal cover from 126 HRI sites.
4. **Status of Commercial Fish and Large Groupers:** 1) Commercial fish biomass by subregion (shaded areas) based on 248 sites. 2) Large groupers >40 cm (point data by site) at 149 HRI sites. Graph 1 - commercial fish biomass by a) reefs with full protection (no take areas), b) reefs with some protection (MPA), and c) reefs with no protection. Data from 43 sites available for all four time periods. Graph 2 - number of groupers by size class from 149 HRI sites.
5. **Country Level Indicator Maps:** One map for each of the four countries. Each map shows the overall RHI (pie diagram) for that country and individual site level data with RHI and scores for each of the four indicators.

State of the Mesoamerican Reef

Overall Reef Condition

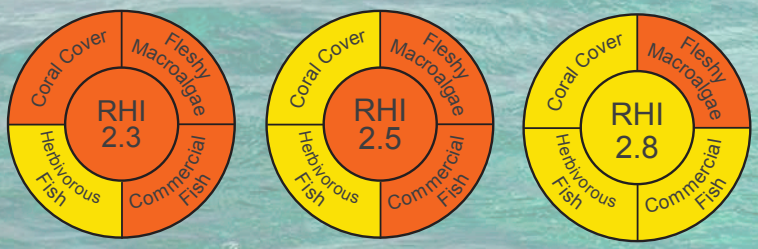
The overall 2015 MAR Reef Health Index score was 'fair' (2.8), on a scale of 'critical' (1) to 'very good' (5). At the regional scale, coral cover has improved, increasing from 10%-16%, yet fleshy macroalgae have increased. Herbivorous fish have continued to increase and are needed to reduce macroalgae. More herbivores and higher grazing intensity may create more favorable conditions for corals to grow. Commercial fish biomass is higher than 2006, although large groupers were rare, found mainly in fully protected zones of MPAs.



Reef condition varied at the site level:

- **9% of the reefs were in 'good' or 'very good' condition. These reefs have structural and functional components intact and are likely to be more resilient to future disturbances. They warrant special protection as they can serve as sources of larvae for other reefs.**
- **34% of the reefs were in 'fair' condition. These reefs were functional, yet have the potential to shift either towards a trajectory of recovery or decline, depending on future disturbances and our ability to minimize human impacts.**
- **40% of the reefs were in 'poor' condition. These reefs were functional but may be missing key processes, preventing them from fully recovering. They will require management intervention to reduce human impacts.**
- **17% of the reefs were in 'critical' condition. These reefs were missing structural and functional components and are less likely to recover from future disturbances. They will require management intervention and likely proactive restoration to prevent them from shifting towards irreversible decline.**

Regional Change Over Time

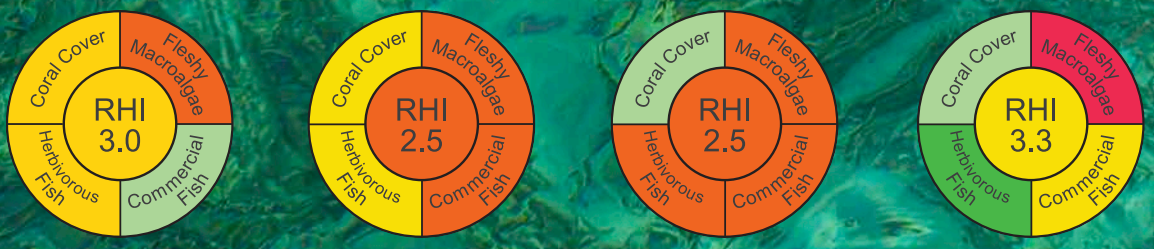


Improvements in the RHI and individual indicator scores over time are encouraging, suggesting recovery is possible. The RHI improved from 'poor' in 2006 to 'fair' in 2014. Low coral cover, few commercial fish and abundant macroalgae contributed to the 'poor' score in 2006. In 2011, the RHI score was 'poor', but coral cover increased. Commercial fish biomass was higher in 2014 than 2006, contributing to a higher RHI.

Of concern is that fleshy macroalgal cover was the only indicator to remain 'poor' over time. Herbivorous fish biomass has remained constant, but if herbivores increase, they can reduce algae. Recovery of fish populations takes time, yet it is expected they will increase due to additional parrotfish bans in Guatemala, Belize, and the Bay Islands.

Reef Health Index (RHI) by Country

At the country level, Honduras had the highest overall RHI score (3.3) followed by Mexico (3.0), while Belize and Guatemala both had a 'poor' score (2.5). Mexico's reefs were in 'fair' condition, coral cover increased over time, but fleshy macroalgae was high. Commercial fish biomass had a 'good' score due to a large number of snappers, but large groupers were found mostly in fully protected zones of MPAs. Belize's reefs were in 'poor' condition due to high levels of fleshy macroalgal cover and low commercial fish biomass. Coral cover and herbivorous fish biomass scored 'fair' suggesting these reefs may improve with increased management. Guatemala's reefs were in 'poor' condition due to low herbivorous and commercial fish biomass and high fleshy macroalgal cover. Coral cover was quite high and the condition of these reefs can recover with more sustainable fishing practices and improvements in water quality. Honduras had the best score due to abundant herbivorous fish and high coral cover, although fleshy macroalgae was the highest in the region. Herbivorous fish biomass, especially large parrotfish, is high due to better enforcement of fishing regulations, although commercial fish biomass has declined.



Marine Protected Areas

- The MAR has protected >20% of its territorial seas.
- Five new MPAs have been designated since 2011.
- Only 3% of the territorial seas are under full protection from fishing.

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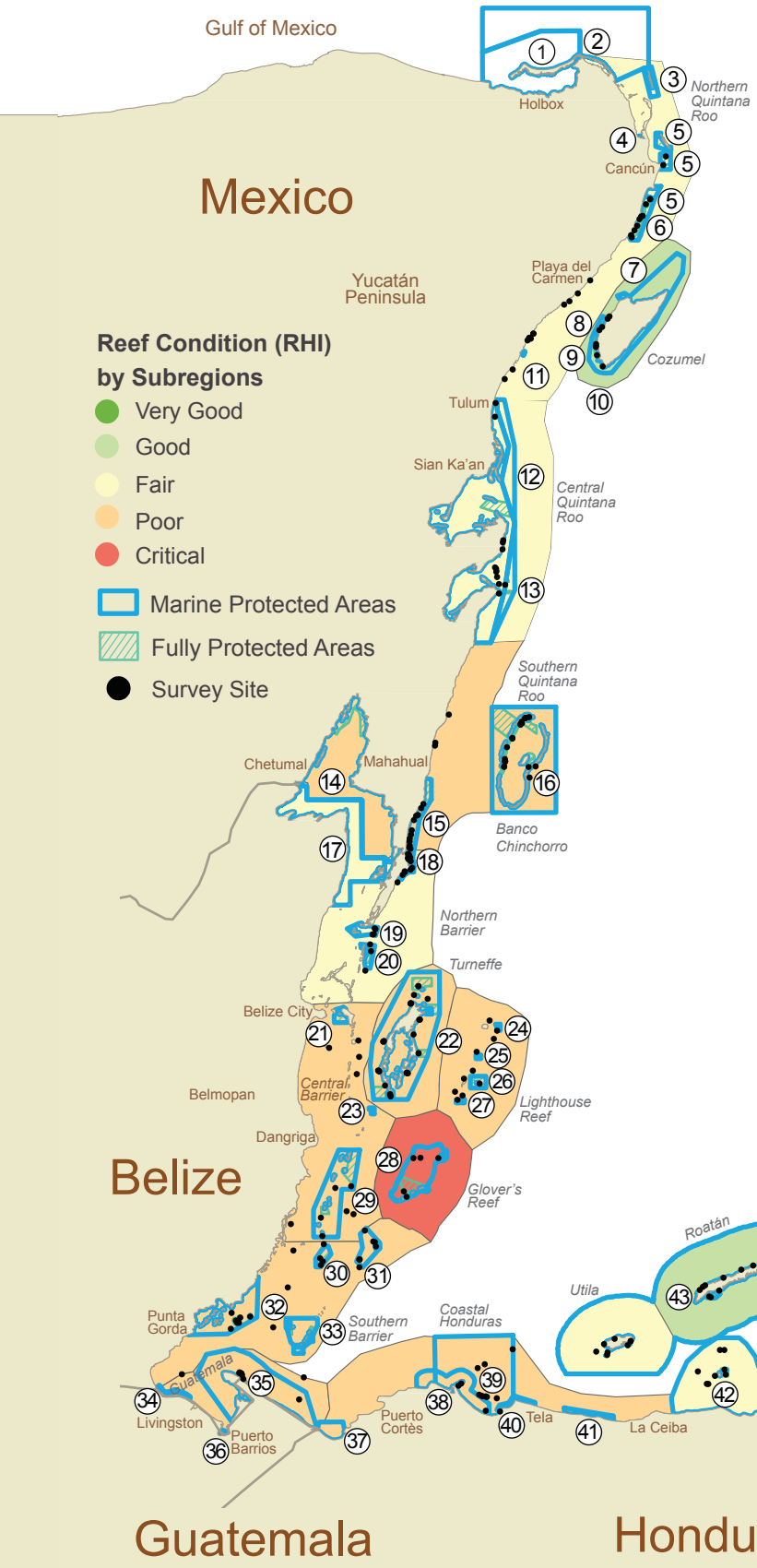
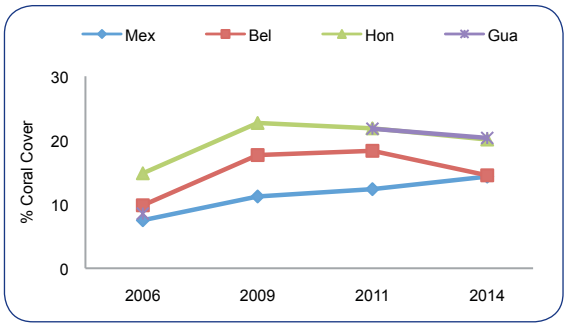


	Marine Protected Area	Year	Marine Area (km²)	Fully Protected (km²)
MEXICO	(1) Yum Balam	1994	1013	0
	(2) RB Tiburón Ballena	2009	1460	0
	(3) PN Isla Contoy	1998	49	0
	(4) R. Lagunar Chacmochuch	1999	2	0
	(5) PN CO Isla Mujeres, Cancún y Nizuc	1996	87	50
	(6) PN Arrecifes de Puerto Morelos	1998	90	23
	(7) Nte y Franja Costera Oriental, Coz.	2012	321	5
	(8) Laguna de Chancanaab	1983	0.1	0
	(9) PN Arrecifes de Cozumel	1996	137	40
	(10) R. Laguna Colombia	1999	5	0
	(11) S.Tortuga Marina Xcacel - Xcacelito	1998	3	0
	(12) Arrecifes de Sian Ka'an	1998	335	5
	(13) RB Sian Ka'an	1986	1515	70
	(14) Santuario del Manatí	1996	1304	113
	(15) Arrecifes de Xcalak	2000	134	61
	(16) Banco Chinchorro	1996	1404	183
BELIZE	(17) Corozal Bay WS	1998	716	0
	(18) Bacalar Chico MR	1996	62	15
	(19) Hol Chan MR	1987	52	4
	(20) Caye Caulker MR	2008	39	14
	(21) Swallow Caye WS	2002	32	32
	(22) Turneffe Atoll MR	2012	1176	152
	(23) Caye Glory SPAG MR	2003	5	5
	(24) Sandbore SPAG MR	2003	4	4
	(25) Blue Hole NM	1996	4	4
	(26) Halfmoon Caye NM	1982	39	39
	(27) South Point SPAG MR	2003	5	5
	(28) Glovers Reef MR	1996	349	79
	(29) South Water Caye MR	1996	470	86
	(30) Laughing Bird Caye NP	1991	41	41
	(31) Gladden Spit-SC MR	2000	105	2
	(32) Port Honduras MR	2000	397	13
	(33) Sapodila Cayes MR	1996	156	35
GUATEMALA	(34) Área de Uso Múltiple Río Sarstún	2005	37	0
	(35) RVS Punta de Manabique	2005	891	2
	(36) Bahía Santo Tomás	1956	7	7
HONDURAS	(37) PN Cuyamel Omoa	2011	85	0
	(38) PN Jeannette Kawas	1994	279	0
	(39) SIPVS Tela	2012	1124	0
	(40) PN Punta Izopo	2000	37	0
	(41) RVS Cuero y Salado	1987	49	2
	(42) MNMA Cayos Cochinos	2003	1208	13
	(43) PNM Islas de la Bahia	2010	6449	30
	(44) Biósfera del Río Plátano	1980	329	0
	(45) PNM Islas del Cisne	1991	484	484

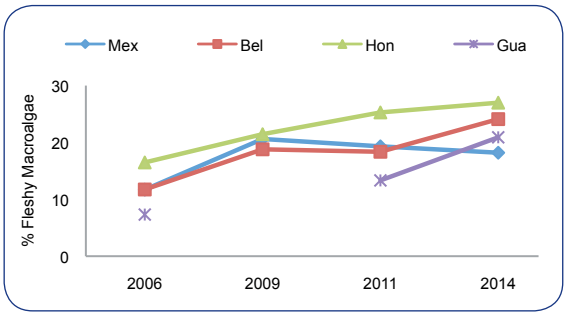
Note: Shaded areas represent Reef Health Index (RHI) condition score by subregion. Marine Protected Areas (MPAs) and No Take Zones (NTZ) totals were calculated from GIS shape files using the most updated information available from each MPA. Calculations may have slight differences from official figures because the information was standardized in order to do calculations at regional level. Also the land portion was removed using the HRI land base map, which may have resulted in the removal of some wetlands such as mangroves and marshes. Glover's Reef 'critical' score may be partly due to low sample size (N=5) and depths <10 m.

Trends

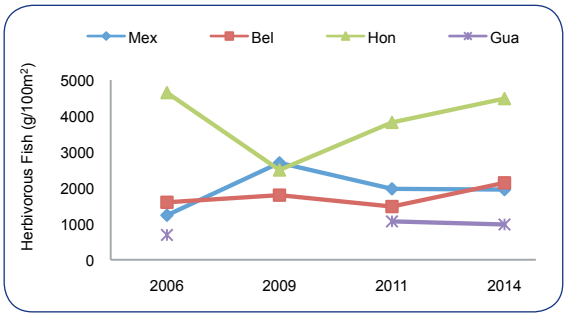
Coral cover is increasing, although slowly. Coral cover is a measure of the proportion of reef surface covered by live corals. Coral cover regionally remained at 16-18% over the past five years. Mexico was the only country with increases each year. Coral cover has not declined more than 5% elsewhere since 2006. Cozumel, Guatemala, Roatan, Utila and Coastal Honduras had the highest coral cover (20-40%) and may serve as potential sources of coral larvae. The positive, albeit slow, increasing trend in coral cover is encouraging and probably due to the lack of large-scale disturbance events (e.g., bleaching, hurricanes) within this timeframe. Coral declines (e.g., mortality) can be rapid and dramatic, but regrowth (e.g., recruitment, growth) can be very slow. Coral recovery is being limited by increases in fleshy macroalgae, lack of *Diadema*, greater fishing pressure on parrotfish, declining water quality, and impacts associated with global climate change.



Fleshy macroalgal dominance is widespread. Fleshy macroalgae often overgrow corals or occupy space where coral recruits might settle. Fleshy macroalgal cover remained high for the region and increased from 13% to 23% between 2006 and 2014. Only two subregions had a higher proportion of live coral than algae, Cozumel and Coastal Honduras, suggesting coral reefs in nearly all other subregions had more macroalgae, regardless if there was low or high coral cover. Glover's Reef, Swan Islands, Lighthouse Reef and Guanaja subregions had the highest fleshy macroalgal cover (>30%). These reefs are far from the mainland, but may still be affected by regional nutrient enrichment. Pinpointing the direct cause of increased macroalgal cover is difficult due to variations of natural factors (e.g., seasonal, upwelling nutrients) and human impacts (e.g., sediments, sewage). Reducing localized land-based pollution and overfishing of key herbivorous fish can improve reef recovery.

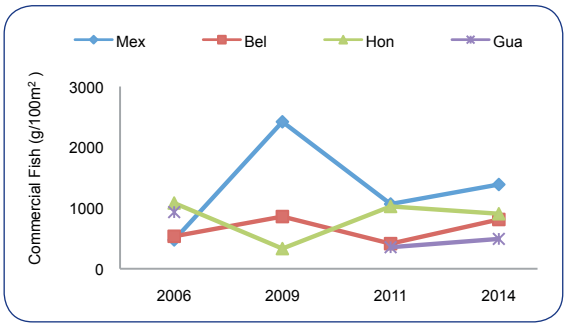


Herbivory is important for reducing macroalgae. Parrotfish, especially large parrotfish, are particularly effective at grazing macroalgae and keeping the reef clear for coral growth. Regional herbivorous fish biomass had a 'fair' score (2,605 g/100 m^2), but increased over the years. Honduras had biomass twice as high (4,483 g/100 m^2). Northern Quintana Roo, the Bay and Swan Islands had the greatest subregional biomass, while Banco Chinchorro had the lowest. Higher levels were likely due to measures protecting fish that have been in place for years. Most parrotfish (>78%) in the MAR were small (<20 cm). Large parrotfish, although not abundant, were seen at 95% of the sites. Reefs with more than 6 large parrotfish/100 m^2 (except one) were within MPAs, suggesting protection allows parrotfish to grow large.



Total reef herbivory is also influenced by *Diadema antillarum*, the long-spined sea urchin, whose populations experienced a mass die-off across the entire Caribbean in the early 1980s. *Diadema* were found at few sites in the MAR and often were low in abundance. Seven of the 10 sites with >0.5 urchins/m^2 were found in Tela, Honduras, an area with high coral cover and low fish biomass. When abundant, *Diadema* were effective at reducing algae – all sites with >1 urchin/m^2 had <5% fleshy macroalgae. The lack of a region-wide recovery in the MAR may be due to low adult abundances, lack of larvae or connectivity, high predation or poor habitat. Protecting sufficient numbers of herbivores can increase grazing intensity to levels that can shift the balance towards more coral-dominated reefs. Recent regulations to protect parrotfish (e.g., Guatemala, Belize, Bay Islands) are important especially as these fish are now targeted for food as other fish stocks decline.

Snappers & groupers have increased locally, but few large groupers remain. Abundant groupers and snappers, especially large ones, are indicators of the status of commercial species and effectiveness of fishing regulations. Commercial fish biomass (1,023 g/100 m^2) increased slightly since 2006, but is still at functionally low levels. Mexico's high biomass (1,387 g/100 m^2) was due to abundant snappers, as large groupers were scarce. Honduras was the only country where fish biomass declined. Most surprising was the lack of large groupers – of the 700 groupers counted in 149 HRI sites, only 4% were >40 cm and only 11% of sites had large groupers present. Protecting large fish is important as bigger fish produce more eggs and more eggs produce more fish. Based on data of 43 HRI repeated sites, coral reefs with full protection (=no take) had 10 times more snapper and grouper biomass than MPAs and reefs with no protection. This suggests fully protected areas are most effective at increasing populations of highly fished species. Protection and gear restrictions (bans on spearfishing) are also helping groupers to grow larger and become more plentiful.



Status of Herbivores and Large Parrotfish

Healthy reefs need grazers to keep algae from overgrowing and killing coral.

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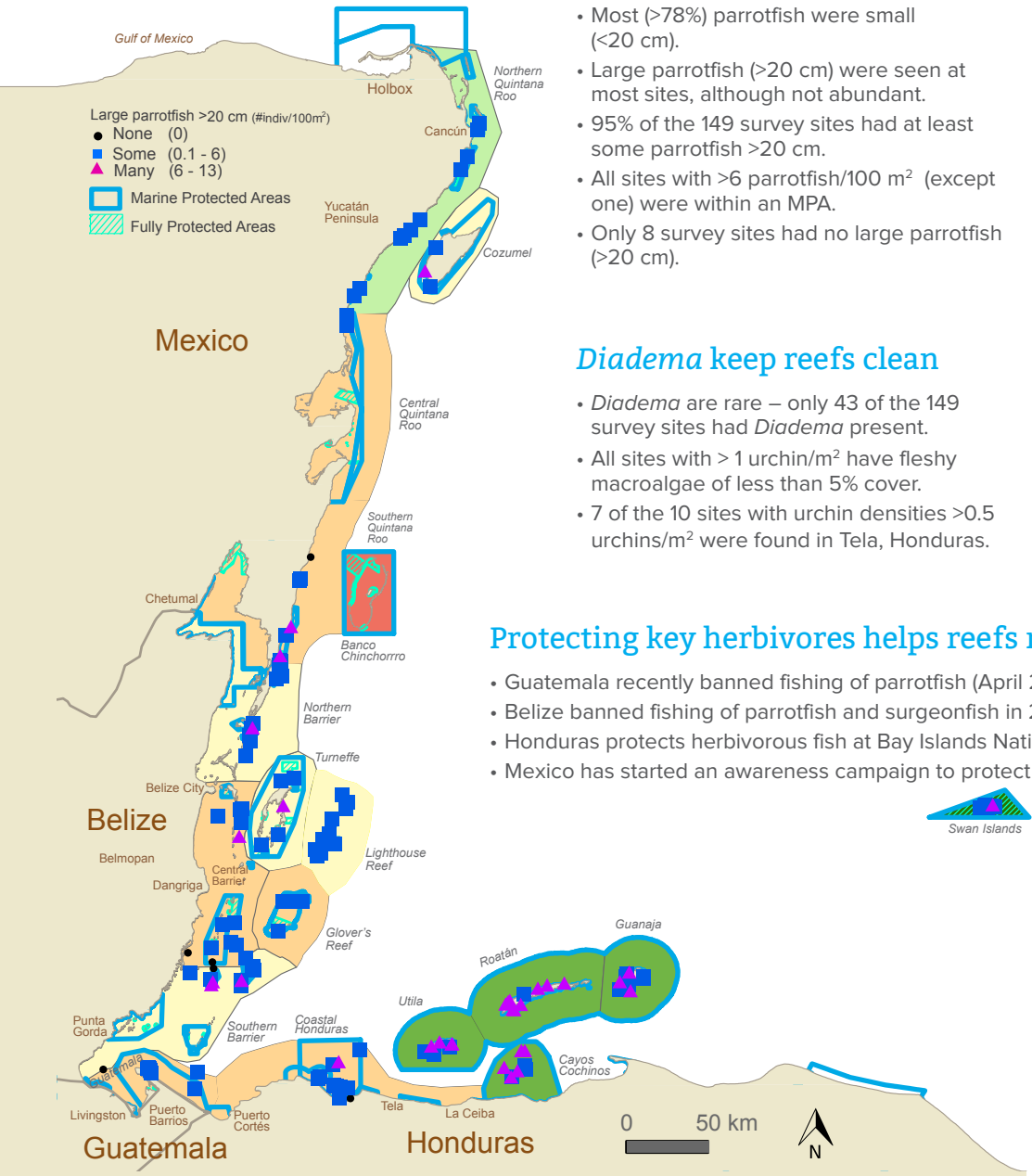
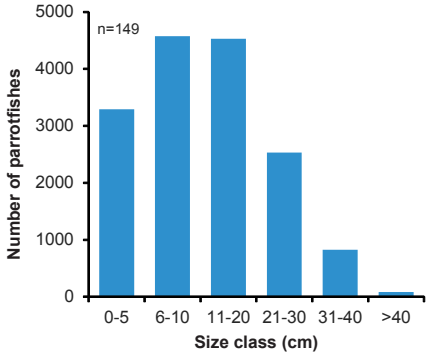


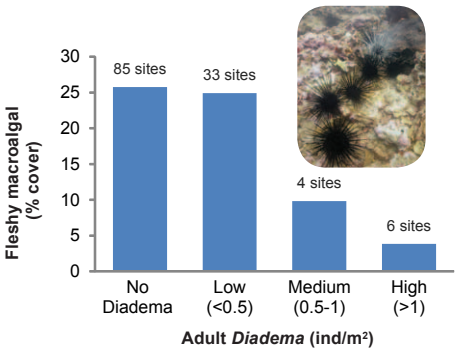
Few large parrotfish

- Most (>78%) parrotfish were small (<20 cm).
- Large parrotfish (>20 cm) were seen at most sites, although not abundant.
- 95% of the 149 survey sites had at least some parrotfish >20 cm.
- All sites with >6 parrotfish/100 m² (except one) were within an MPA.
- Only 8 survey sites had no large parrotfish (>20 cm).



Diadema keep reefs clean

- *Diadema* are rare – only 43 of the 149 survey sites had *Diadema* present.
- All sites with > 1 urchin/m² have fleshy macroalgae of less than 5% cover.
- 7 of the 10 sites with urchin densities >0.5 urchins/m² were found in Tela, Honduras.



Protecting key herbivores helps reefs recover

- Guatemala recently banned fishing of parrotfish (April 2015).
- Belize banned fishing of parrotfish and surgeonfish in 2009.
- Honduras protects herbivorous fish at Bay Islands National Marine Park.
- Mexico has started an awareness campaign to protect parrotfish.

Herbivorous Fish Status by Subregions
(parrotfish/surgeonfish biomass g/100 m²)

- Very Good (≥3480)
- Good (2880-3479)
- Fair (1920-2879)
- Poor (960-1919)
- Critical (<960)

Note:

Data for herbivorous fish (parrotfish and surgeonfish) biomass are presented by subregion (shaded area) and based on all 248 sites.

Data to map density of parrotfish >20cm (indiv/100 m²) at each site are based on a subsample of 149 of the 248 sites that had full size data available and are included in the HRI online database. Some areas did not have size data available (e.g., Banco Chinchorro).

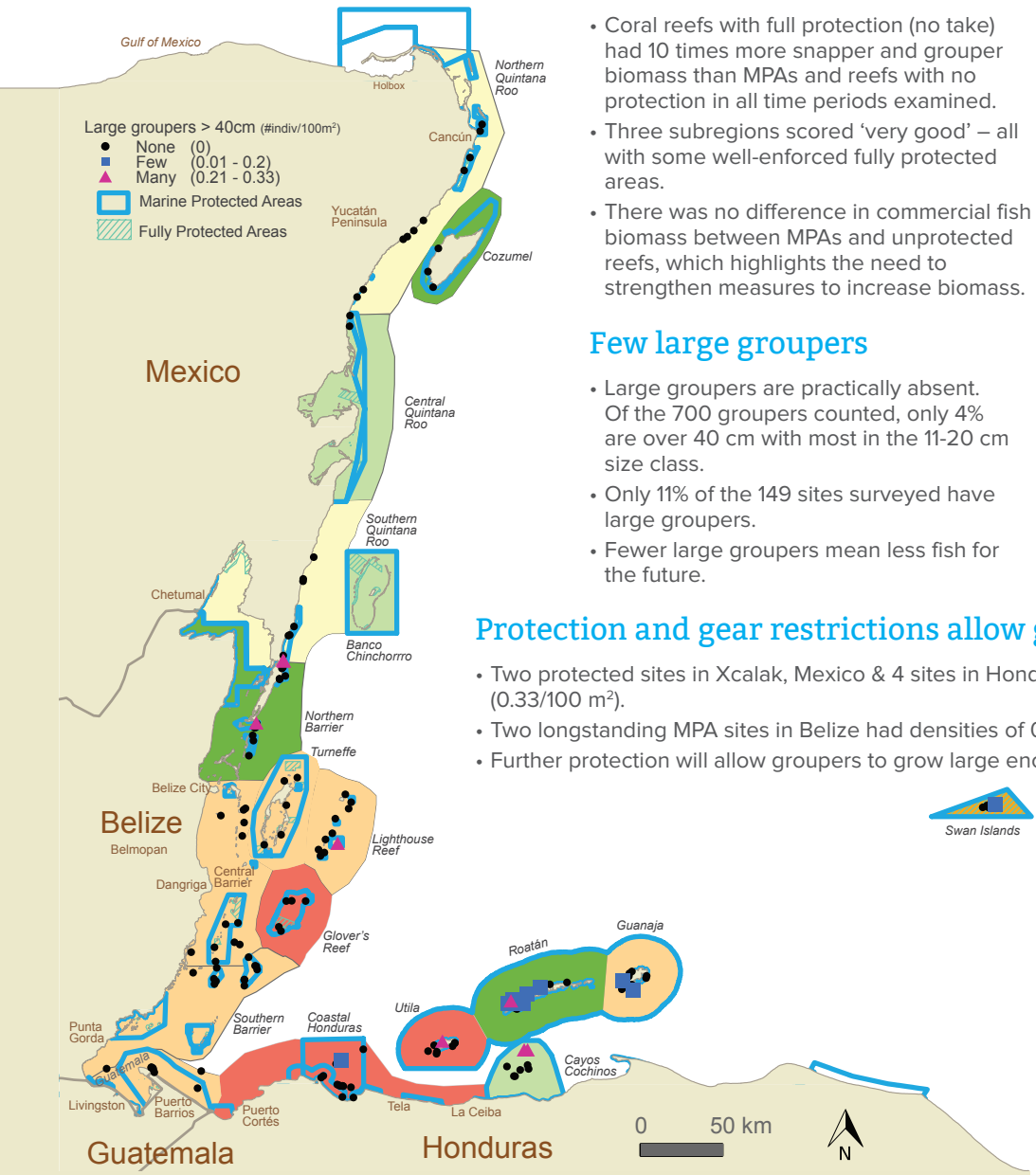
Parrotfish are now being targeted by fishers as other fish stocks decline.

Larger-sized parrotfish (>20 cm) remove more seaweed and keep reefs clean.

Status of Commercial Fish and Large Groupers

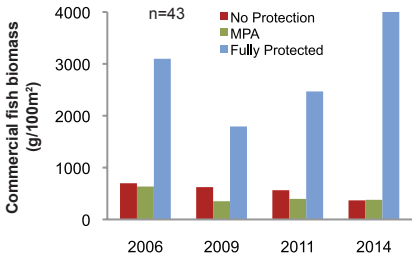
Healthy reefs need abundant large groupers and snappers.

Healthy Reefs for healthy people



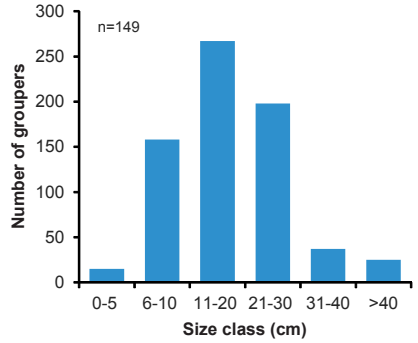
Fully protected areas have more fish

- Coral reefs with full protection (no take) had 10 times more snapper and grouper biomass than MPAs and reefs with no protection in all time periods examined.
- Three subregions scored 'very good' – all with some well-enforced fully protected areas.
- There was no difference in commercial fish biomass between MPAs and unprotected reefs, which highlights the need to strengthen measures to increase biomass.



Few large groupers

- Large groupers are practically absent. Of the 700 groupers counted, only 4% are over 40 cm with most in the 11-20 cm size class.
- Only 11% of the 149 sites surveyed have large groupers.
- Fewer large groupers mean less fish for the future.



Protection and gear restrictions allow groupers to grow larger

- Two protected sites in Xcalak, Mexico & 4 sites in Honduras had highest densities of large grouper (0.33/100 m²).
- Two longstanding MPA sites in Belize had densities of 0.21 groupers/100 m².
- Further protection will allow groupers to grow large enough to reproduce.

Commercial Fish Status by Subregion
(snapper/grouper biomass g/100 m²)
- Very Good (≥1680)
- Good (1260-1679)
- Fair (840-1259)
- Poor (420-839)
- Critical (<420)

Note:

Data for commercial fish biomass are presented by subregion (shaded areas) and based on all 248 sites.

Data to map individual large grouper at each site are based on a subsample of 149 of the 248 sites that had full size data available and are included in the HRI online database. MPA graph is based on 43 repeated sites. Not all sites had size data available.

Yellowfin grouper caught by fish trap.

Groupers are important for ecotourism.

Mexico

On the eastern side of Mexico's Yucatan Peninsula, a fringing reef extends along nearly 350 km of coastline from Isla Contoy south to Xcalak, including offshore islands like Cozumel and Banco Chinchorro atoll. Reef development along coastal Quintana Roo naturally varies, is often discontinuous and can be divided into 3 zones: north, central and southern. Reefs in the north have shallow, partial reef developments with low diversities and numerous stands of *Acropora palmata* (elkhorn coral). The central and southern areas contain more continuous shallow reefs and better-developed fringing reefs. Banco Chinchorro is a large (644 km^2) atoll with well-developed reefs on both the broad windward shelf and narrow leeward shelf.

Coral reef fisheries include snappers, groupers and lobsters. Numerous grouper spawning aggregations have been commercially fished for over 50 years, most of these aggregations may be over-fished. The collapse of conch stocks due to over-exploitation in the late 1970s led to fishery closures. Coral reefs provide commercial, recreational and tourism value for coastal communities. Tourism is the major economic activity in Quintana Roo, especially at Cancun, Playa del Carmen, Cozumel and Tulum, and tourism growth is expanding rapidly both to the north and south of the state. There is extensive legislation and solid institutional capacity to manage natural resources.

HRI and partners surveyed 86 sites in 2013/2014. The overall Reef Health Index (RHI) score was 'fair' due primarily to high fleshy macroalgal cover and moderate coral cover and herbivorous fish biomass. Mexico was the only country in the MAR to have coral cover increase over time – from 8% in 2006 to 14% in 2014. The Cozumel subregion had the highest coral cover (24%) and was one of the few subregions in the MAR to have more live coral than algae.

Limones Reef in Puerto Morelos Reef National Park has one of the largest healthy elkhorn coral stands in the MAR. Mexico's fleshy macroalgal cover was the lowest in the MAR region (18%), although it has been increasing since 2006. Central and Southern Quintana Roo subregions had the highest fleshy macroalgal cover within Mexico.

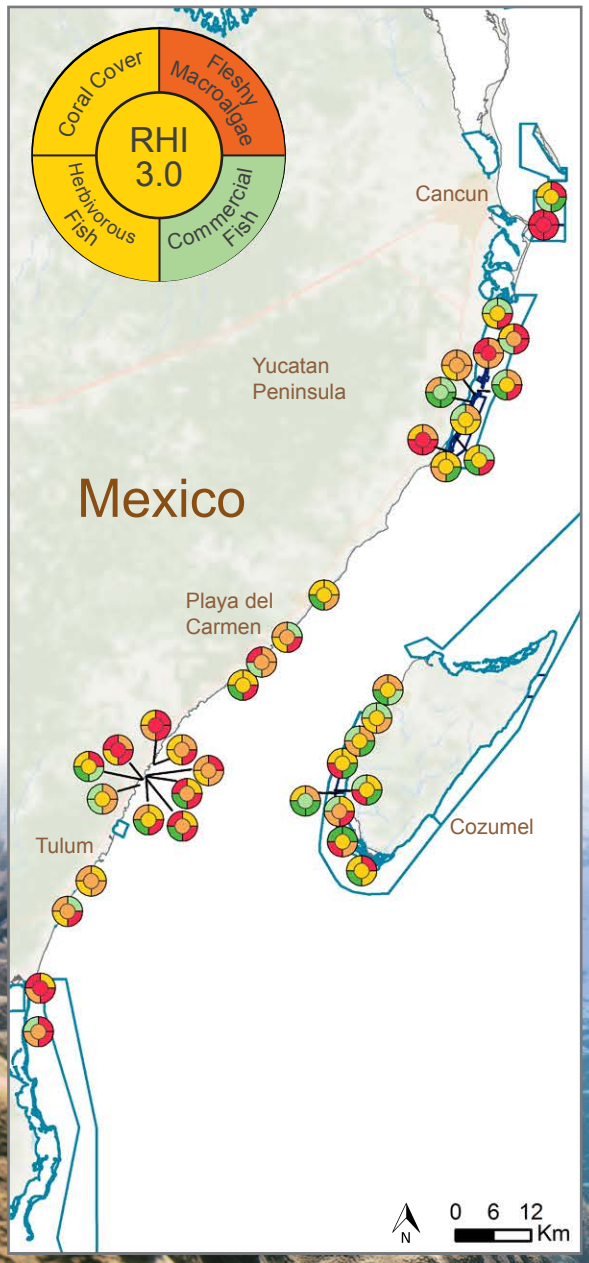
Herbivorous fish biomass was higher (1,952 g/100m^2) in 2014 than 2006. Northern Quintana Roo was the Mexican subregion with the highest surgeonfish and parrotfish biomass (3,117 g/100 m^2); whereas Banco Chinchorro had the lowest in the MAR region (938 g/100 m^2). More parrotfish, larger than 20 cm, were found within MPAs (e.g., Cozumel, Xcalak). Mexico was the only country in the MAR to have a 'good' score for commercial fish (1,387 g/100 m^2). Two protected sites in Xcalak had the highest number of larger-sized groupers (0.33 indiv/100m^2).

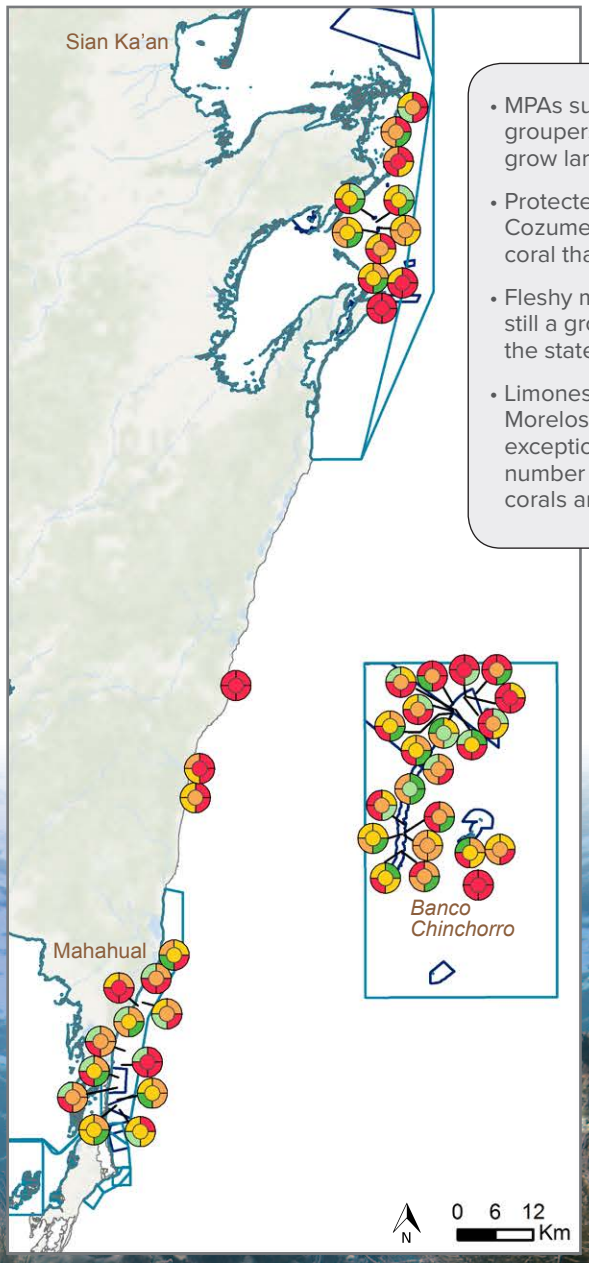
HRI is collaborating with 16 partners to protect the coral reefs of Mexico.

Grunts and snappers at Puerto Morelos.

Mexico has a variety of reef types.

State of Mexico Reefs



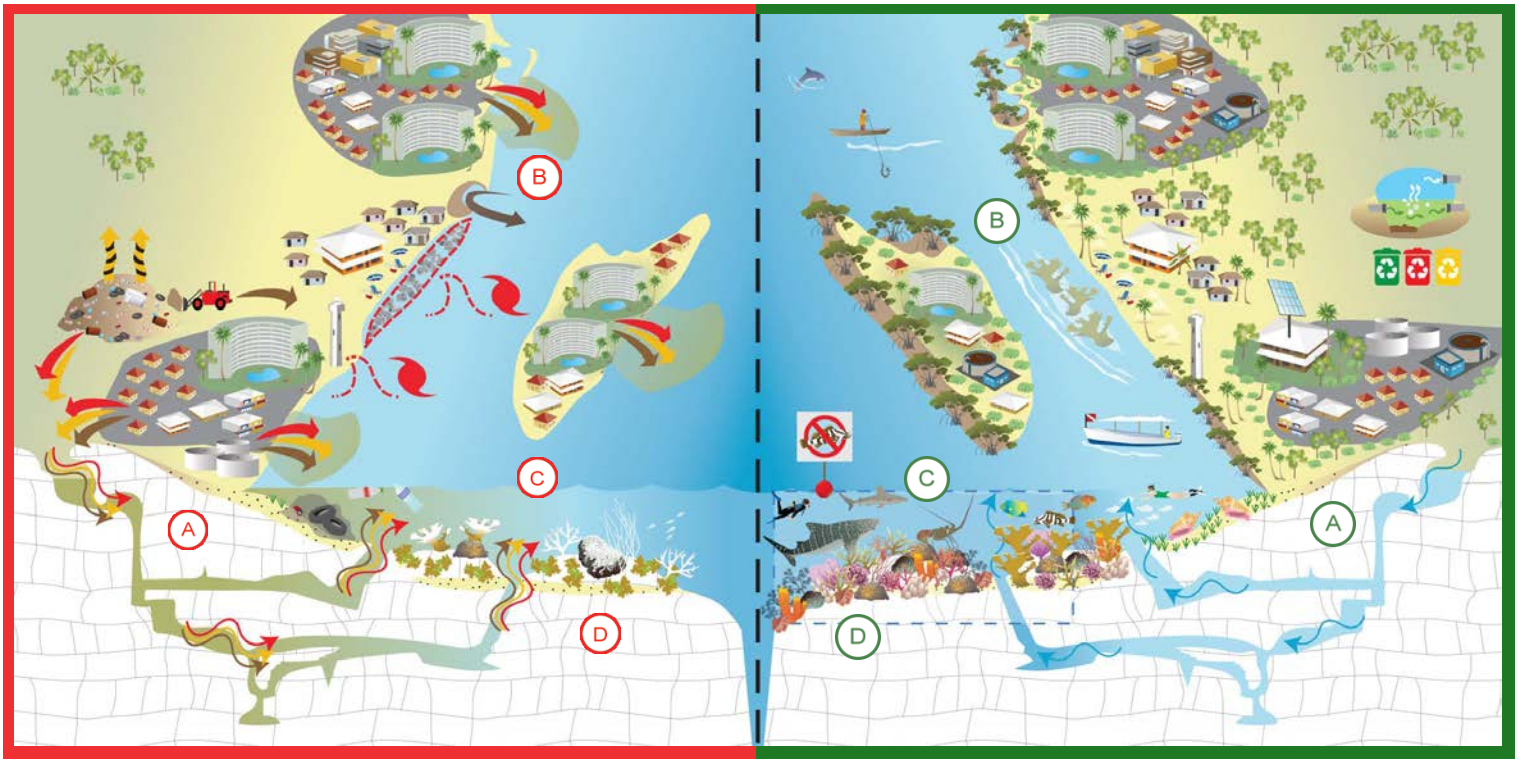


- MPAs such as Xcalak help groupers and parrotfishes grow larger.
- Protected areas in Cozumel have more coral than fleshy algae.
- Fleshy macroalgal cover is still a growing concern in the state of Quintana Roo.
- Limones Reef at Puerto Morelos is considered an exceptional site due to the number of healthy elkhorn corals and numerous fish.

Lorenzo Álvarez Filip/UNAM

Large healthy star corals, Puerto Morelos.

Coral reefs need clean, clear water to survive.



Threats & Human Impacts

A. Inadequate Sewage & Waste Control. Water treatment plants not meeting Cartagena Standards release nutrients which filter through the porous limestone, causing algal blooms that harm coral reefs. Poor solid waste disposal results in toxins and trash pollution.

B. Unregulated Coastal Development. The growing tourism industry along the Quintana Roo coast is increasing demand for development. Illegal and improper building design destroys mangroves, wetlands, and beach dunes.

C. Unsustainable Fishing. Years of over fishing and increasing demand have resulted in reductions or collapses of some fish, lobster and conch stocks. Illegal fishing and lack of enforcement of existing regulations is a problem. No protection of parrotfish exists.

D. Insufficient Enforcement & Growing Demand. Lack of regulation enforcement and increasing human threats reduce MPA effectiveness, causing reef conditions to decline. Unhealthy reefs provide less food resources, lower tourism value and reduced coastal protection from hurricanes and storms.

Best Management Practices

A. Effective Sewage & Waste Control. Implementing an effective regional regulatory framework for tertiary wastewater treatment and proper solid waste management (e.g., recycling) will result in cleaner, healthier water for reefs and people to thrive.

B. Effective Coastal Zone Management. Enforcing Coastal Zone Management Plans will promote sustainable development while conserving sensitive natural habitats. Integrating new green building designs and renewable energies will further protect coastal areas.

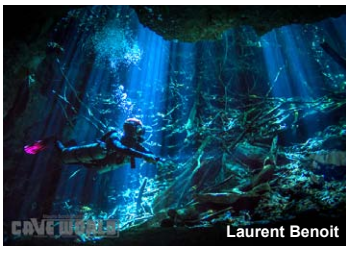
C. Effective Partnerships. Establishing an effective fish refuge network through partnerships can contribute to the replenishment of traditional fishery stocks. Protection of parrotfish will benefit reefs.

D. Proactive Restoration. Improved management of human impacts and proactive restoration can enhance corals, fish, and wetlands. Healthy reefs provide higher tourism and ecosystem services, greater food sources, human health benefits and increased coastal protection from hurricanes and storms.

Cancun tourism continues to increase.

Overturned dead elkhorn coral provides less habitat and protection.

Healthy elkhorn coral, Puerto Morelos.



Cenotes – underground water caves connect to the sea.

1974 Quintana Roo State established

Fisheries Cooperatives created

1985 Cancun adopts Urban development plan

1986 Sian Ka'an Biosphere Reserve (RBSK) established

1988 Ecological Balance & Environmental Protection General Law established

1970s - 1980s

1994 Program of Ecological Territorial management (POET)

1997 Tulum Declaration

1990s

1993 Solidaridad municipality created

1998 Massive coral bleaching

1998 Cancun has 22,000 hotel rooms

2009 Reform to the conch ban

2009 Article 60-TER on mangrove protection included at LGVS

2000s

2000 White plague coral disease

2000 Mahahual dock constructed over reef

2005 Hurricane Emily & Wilma

2008 First lionfish reports

2011 > 130 hotels have good environmental practices by MARTI

Fishermen seek greater protection for conch

Banco Chinchorro Biosphere Reserve was once home to one of the largest queen conch (*Strombus gigas*) populations in the MAR. Long treasured for their edible meat and beautiful shell, queen conch stocks have been overharvested and now few large-sized, reproductive adult conch are left. Responding to a potential population collapse, members of three fishing cooperatives – Andres Quintana Roo, Banco Chinchorro and Langosteros del Caribe – hope to restore conch by changing their fishing activities and reducing illegal poaching.

The fishermen started a voluntary 5-year fishing ban in November 2012 at the largest (> 7,000 individuals), most critical conch ground. They teamed up with local managers to track the recovery of this population through regular field surveys, reduced illegal fishing by educating the community, conducted surveillance and inspections to reduce poaching and have requested authorities to increase monitoring regulation compliance.

A five-fold increase in enforcement resulted in the arrest of 10 poachers and confiscated equipment worth more than USD $300,000. The fishermen also recently requested the Senate increase sanctions for illegal fishing from 3 to 9 years in prison, and prohibit the commercialization of conch. As a result, conch censuses show an increase of 2.5% annually since the ban was started. The will, commitment and partnerships between fishermen and managers are key elements that increase the hope of long-term conch recovery.

More queen conch now protected in Banco Chinchorro.

"To know and respect the natural order of the sea, is now a necessity for every fisherman"
– JAIME MEDINA FLORES, local fisherman of the Cooperative Langosteros del Caribe Society

Bringing back populations of threatened corals

Elkhorn (*Acropora palmata*) and staghorn corals (*A. cervicornis*) – the main builders of shallow coral reefs – protect coastlines from waves and serve as a refuge for other animals. Dramatic population declines of these corals over the past three decades have made protecting them a high conservation priority. Partners in Mexico are leading restoration programs, researching new coral enhancement techniques, and searching the Yucatan Penisula coastline for any last remaining elkhorn and staghorn stands.

Oceanus, A.C. leads a restoration program to install nurseries of elkhorn and staghorn fragments and transplant selected colonies. Over 8,000 colonies have been transplanted in 6 Marine Protected Areas since 2007. The successful program includes local communities and MPA staff who form teams to scale up restoration efforts.[1]

In Puerto Morelos, Anastazia Banaszak from UNAM's Reef Systems Academic Unit is developing new techniques to cultivate corals from fertilized eggs and transplant colonies to restore damaged areas. About 4,000 sexual recruits of three different coral species are stocked in nurseries.[2]

Efforts to locate and genetically identify remaining elkhorn populations in Mexico are underway. Limones Reef has one of the largest healthy elkhorn stands left in the MAR. A recent study of HRI data found >30% of Limones Reef is covered by live healthy elkhorn coral, with little disease. Limones Reef, located in Puerto Morelos Reef National Park, has been designated Critical Habitat and is closed to tourism and fishing.[3]

2011 Marine management legislation -Gulf of Mexico & Mexican Caribbean

2011 Solid waste management law

2012 COBI-Alianza Kanan Kay establishes first fish refuge

2013 CORAL trains 97 tourist providers in good environmental practices for snorkel and scuba diving

2014 Maya Ka'an brand for sustainable tourism created

2014 Cozumel MPA begins World Heritage Site process

2010s

2010 36,872 hotel rooms at Cancun

2010 83,000 hotel rooms in the state of Q. Roo

2011 Amigos de Sian Ka'an reports coral loss

Climate change - Program for payment for environmental services from the coral reef and associated ecosystems (mangroves and sea grasses)

Wastewater - Establish a regulatory framework for wastewater management in Yucatán Peninsula through the Watershed Council

Climate change - Incorporate energy efficient and sustainable building codes or regulations

Species protection - Community-supported parrotfish protection regulations
Regional invasive lionfish control strategy

Solid waste - Norm for a regional regulatory framework for solid waste in the Yucatán Peninsula with at least two cases working: Xcalak and Punta Allen

Habitat restoration - Implement 4 restoration programs for corals, fish, nursery areas and wetlands

VISION 2015 - 2020

Belize

The Belize Barrier Reef Complex spans nearly the entire country's continental shelf and includes mid-shelf, barrier and atoll reefs, interspersed with fringing, patch and pinnacle reefs. The wide Belize shelf contains an impressive assemblage of coral reef, seagrass, mangrove and lagoonal habitats, all of which contribute to the region's high biodiversity. The most unique feature is the barrier reef, the longest and best-developed in the Western Hemisphere. Also exceptional are the offshore atolls of Lighthouse, Turneffe, and Glover's Reef, which contain shallow lagoons encircled by a halo of coral reef. Unique mid-shelf reefs and drowned reefs are also found in the deeper southern lagoon where the influence of coastal mountains and rivers becomes more evident.

Overall reef health in Belize remains in 'poor' condition with a RHI score of 2.5. Coral cover in Belize is scored 'fair' (15%) but has declined slightly since the last Report Card (18%) likely related to increases in macroalgal cover and declining water clarity. An unprecedented phytoplankton bloom occurred in summer 2011, extending all along the barrier reef from Belize City southward past Placencia. It lasted for months and was followed by anoxic mass mortalities of benthic and less mobile species. The bloom was thought to be related to high nutrient loading following forest fires resulting from forest destruction from Hurricane Richard in 2010. This hurricane also damaged reefs in Turneffe and the Central Barrier Reef. Fortunately, there have been no major hurricanes since then.

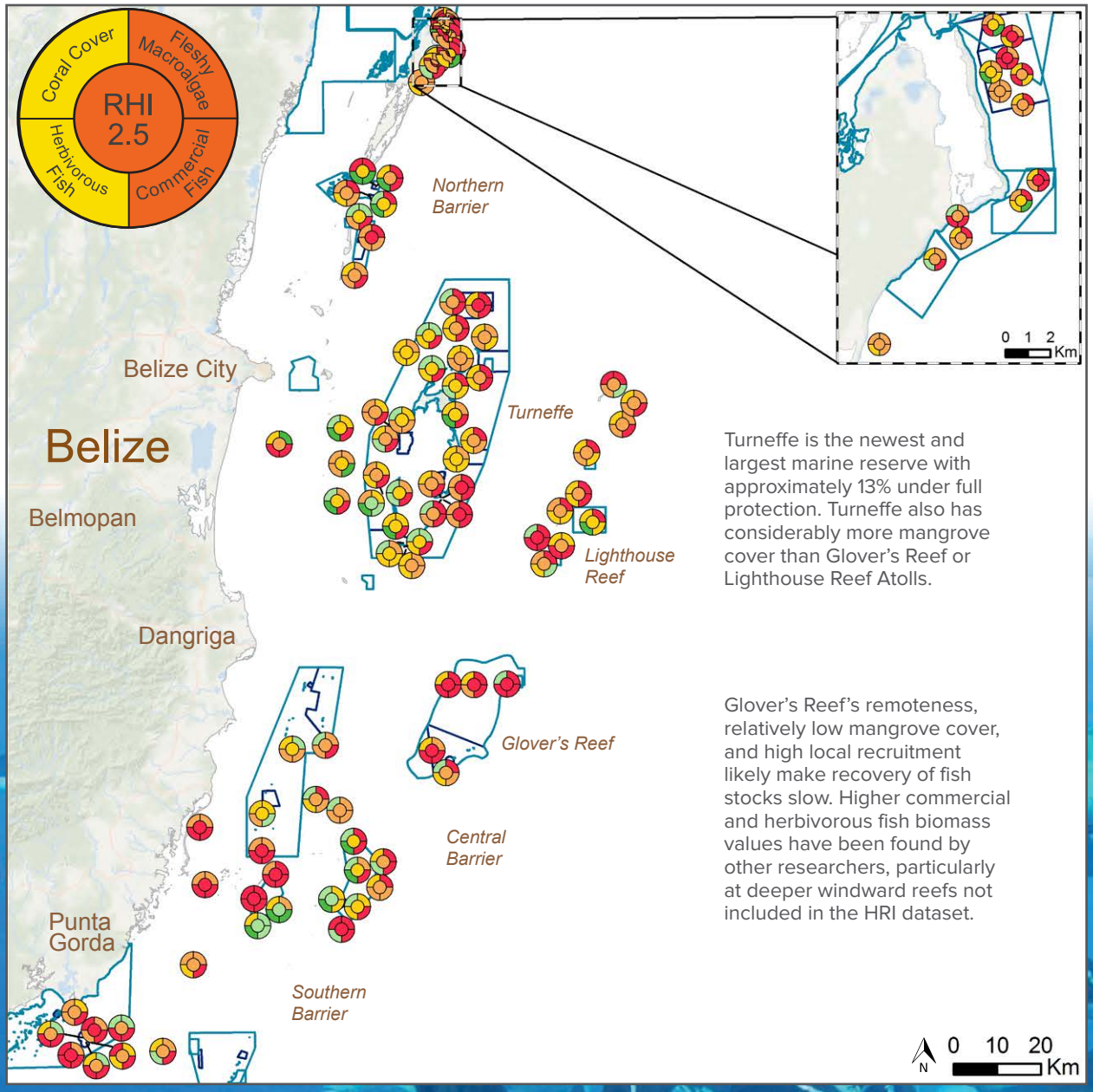
Glover's Reef. Turneffe and Central Barrier Reef have some of the highest coral cover in Belize – all above 16%. Belize has the second highest fleshy macroalgal cover (24%), which scores as 'poor', even bordering on 'critical'. Cover at two of Belize's atolls, Lighthouse Reef and Glovers, is >30%. This is particularly interesting because they are Belize's most oceanic and remote reefs. Fleshy macroalgal cover increased about 60% since the last survey (2011).

Herbivorous biomass is 'fair' (>1,920 g/100 m^2) at most subregions and has been increasing since the 2009 protection of parrotfish. However, herbivore biomass in the Central Barrier Complex is scored as 'poor'. Considering the increases in fleshy macroalgal cover, increasing parrotfish biomass is crucial to restoring reef health. Turneffe has the highest herbivore biomass by sub-region at 2,383 g/100 m^2. The biomass of commercial fish species remains in 'poor' condition at 811 g/100 m^2, with persistent overfishing and lack of finfish regulations (except for Nassau grouper) as probable main causes. The Northern Barrier reef scored 'good' for commercial species and has the highest percent of its reef area under full protection, with good long-term enforcement.

Belize's 2003 full protection of almost all known fish spawning sites was a landmark legislation, and has surely helped prevent more rapid depletion of species that aggregate to spawn. Belize's early move to fully protect grazers (2009) make it a global leader in this respect. The growing pressure of big coastal developments is making it more challenging for Belize to manage its marine resources and realize its sustainable development potential. HRI is collaborating with 13 partners to improve reef health in Belize.

Caitlin Seaview Survey – Glover's Reef. Other MAR images at globalreefrecord.org.

Hol Chan Marine Reserve was expanded in 2015 from 55 to 441 km^2.



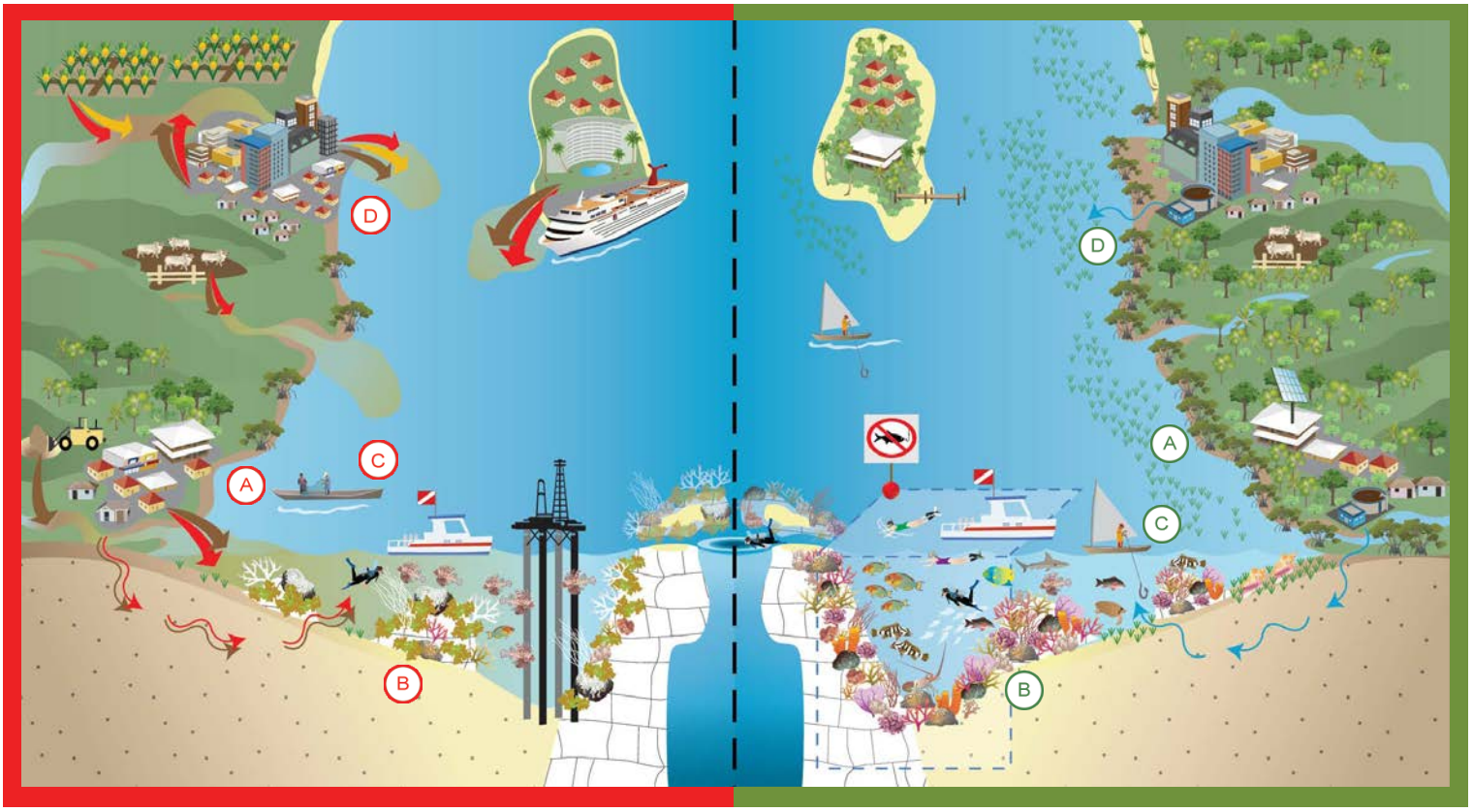
Turneffe is the newest and largest marine reserve with approximately 13% under full protection. Turneffe also has considerably more mangrove cover than Glover's Reef or Lighthouse Reef Atolls.

Glover's Reef's remoteness, relatively low mangrove cover, and high local recruitment likely make recovery of fish stocks slow. Higher commercial and herbivorous fish biomass values have been found by other researchers, particularly at deeper windward reefs not included in the HRI dataset.

Alex Tewfik/WCS

Aggregating Nassau Grouper preparing to spawn at northeast Glover's Reef Atoll.

Unsustainable development & overfishing threaten Belize's reefs.



Threats & Human Impacts

A. Habitat Destruction. Over 90% of Belize's mangrove areas are intact but unregulated development is destroying coastal habitat. Offshore areas are vulnerable to potential oil exploration and spills.

B. Ineffective MPAs. With only 3% of Belize waters under full protection, there is not enough area for heavily exploited fish, lobster and conch stocks to replenish.

C. Unsustainable Fishing. Reduced fish stocks, open access fisheries and illegal exploitation have contributed to conflict among fishers for limited resources.

D. Nutrients & Contaminants. Elevated nutrients and chemical contaminants from sewage outflows and agricultural runoff decrease water quality, impacting marine life and fueling algal blooms. Existing treatment systems (e.g., Belize City, San Pedro) do not meet Effluent Standards.

Best Management Practices

A. Smart Urban Growth. Implementing a legislated Coastal Zone Management (CZM) plan will promote sustainable development while conserving sensitive natural habitats. Banning offshore oil extraction will protect coral reefs and coastal habitats.

B. National Protected Area Plan. Expanding fully-protected replenishment zones, (e.g., Central, Southern Barrier Reef), will allow fish stocks to recover and conserve critical habitats.

C. Fisheries Bill. Bans on parrotfish fishing and shrimp trawlers are protecting these stocks. Belize's new Managed Access program is reducing conflict and fostering stewardship towards sustainable and legal fisheries.

D. Removal of Nutrients & Contaminants. Tertiary sewage treatment removes harmful nutrients from wastewater. A sewage treatment system for Placencia is underway, but additional systems for other coastal areas are needed. Integrated Pest Management and more sustainable agricultural practices can reduce impacts.

Large area of mangrove and upland vegetation totally cleared prior to construction of tourism facility, Rope Walk, Turneffe Atoll.

Large areas of healthy mangroves at Turneffe Atoll provide critical habitat and nursery areas.

Fisheries Cooperatives movement produce pro-active and organized fisher coops

Smithsonian Research Station established

1981 Belize gains Independence

National Protected Areas System Act passed

1982 Half Moon Caye-1st MPA declared

1987 Hol Chan-1st Marine Reserve established

1996 World Heritage Site-Belize Barrier Reserve System declared

1998 CZMA Act passed

2000 SPAGS monitoring established

2001 MBRS project initiated

Pre 1970s | **1970s** | **1980s** | **1990s**

1961 Hurricane Hattie

Intensive fishing of Caye Glory grouper SPAG

White band coral disease detected and die off

1982 Tourism and real estate speculation begins in San Pedro

Diadema urchin die-off

1995 Mass bleaching and coral die-off

1998 Mass coral bleaching coincides with Hurricane Mitch; ~50% decline in coral cover

2000 Hurricane Keith devastates Belize

2000's Major growth and expansion in aquaculture industry

Managed Access: Scaling reef ecosystem recovery by empowering fishermen

Fisherman collecting catch data.

Open-access fishing has negatively impacted Belize's reef health because it encourages overfishing, illegal fishing, and a lack of stewardship. An ambitious effort involving 250 fishers (8% of all fishers) is underway to permanently end the threat of overfishing. The strategy is to sustain and rebuild fisheries by empowering fishermen to be stewards of their resource.

Giving fishermen a stake in their fishery through a process called "Managed Access" (MA) provides them better fishing opportunities while also allowing fisheries to recover. The Belize Fisheries Department, Wildlife Conservation Society, Toledo Institute for Development and Environment, and Environmental Defense Fund have successfully trialed MA at two locations since 2011 – Port Honduras Marine Reserve (PHMR) and Glover's Reef Marine Reserve (GRMR). At these pilot sites, by resetting fishermen's incentives through MA, Belize is catalyzing an upward spiral for stewardship, livelihoods, and healthy coral reefs.

Fishermen have increased their compliance with fisheries regulations, such as respecting replenishment zones and size minimums. More than 90% of fishermen are submitting their catch data, which is being used in management decisions. Fishermen are actively participating through local co-management bodies, MA Committees and they areww abiding by fishing rules.

The success stories at GRMR and PHMR are inspiring fishermen across Belize to call for a national roll-out of MA. Within two years, MA will become a national fisheries management program scaled-up to a national level, bringing social and economic benefits to the 15,000 Belizeans who depend on fisheries for livelihoods, and allow the barrier reef ecosystem to recover its magnificent biodiversity.

"Fishermen are saying that they want Managed Access in their fishing area. When we started MA at Glover's Reef, lots of fishermen said that it would fail but we were persistent, now they see that it is working for us and now they are screaming for Managed Access in their areas."

– Glover's Reef Fisher

Major victory to protect Belize Barrier Reef

96% voted against offshore drilling.

Following the 2010 Gulf Horizon Oil spill in the Gulf of Mexico, news leaked that the Belize government had leased rights to drill for oil along its entire coastal waters. The news led to an intense national debate with the Belize Coalition to Save Our Natural Heritage (BCSONH) – an alliance of over 40 groups – calling on the government to change its oil exploitation policy. They sponsored a "People's Referendum" the week before the 2013 elections where, ~30,000 Belizeans turned out to cast their votes – with 96% voting AGAINST offshore drilling.

The Belize government continued to allow companies to move forward with pursuing oil and divided the entire Belizean waters into 7 potential oil drilling blocks with permission to begin exploratory drilling in 2012. In response, Oceana and its allies filed a court case challenging the government's actions, which the Belize Supreme Court then declared the offshore oil concessions "null and void". The Court said that to allow oil exploration before any assessment of its effects on the environment is "not only irresponsible, but reckless", especially considering Belize may not be fully capable of effectively handling oil spills.

While this Supreme Court decision is a major victory for the people and the environment by halting the Belizean government's immediate effort to allow offshore oil drilling, the government is appealing the decision and also retains the ability to issue new leases in Belize's reef. To safeguard the fragile marine environment, a national ban on offshore oil drilling in Belize will safeguard the coral reefs for future generations.

2000s

2001 Hurricane Iris

2003 Regulations to protect spawning aggregations

2005 Oil discovered and onshore oil production begins

2006 Cobia cage culture introduced

2007 BBRS -WHS placed on danger list

2008 Lionfish detected

2009 Size limits regulation for Nassau Grouper passed

2009 Spear fishing banned within MPAs

2009 Herbivorous fish protection and sportfishing protection enacted

2010s

2010 BCSONH Coalition forms

2010 Offshore oil exploration an issue

2011 Managed Access piloted

2011 Trawling banned

2011 People Referendum conducted

2010 Hurricane Richard

2012 Turneffe Atoll Marine Reserve- Largest MPA declared

Vision 2015 - 2020

- Fisheries Bill
- CZM plan
- Ban on Offshore Oil
- Mangrove legislation
- ASC for shrimp farms
- Updated National Protected Areas System Plan

Guatemala

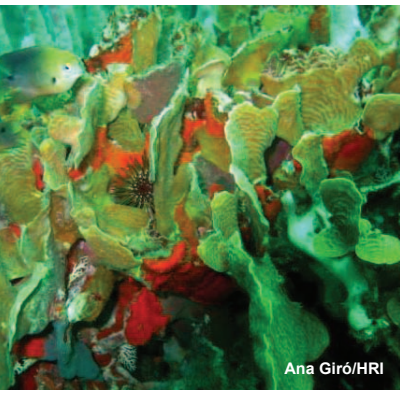
Guatemala's Caribbean coast stretches for 150 km along the Gulf of Honduras and contains tropical wet forests, extensive mangroves lining Graciosa Bay and the Dulce, Temash, and Sarstun rivers, seagrass beds around the Bay of Amatique, coastal lagoons, sandy beaches and, surprisingly, well-developed coral reefs. Endangered manatee populations thrive and green and hawksbill turtles nest on Punta Manabique's beaches. Guatemala takes up a small coastal portion of the MAR, but large flows of water from the Motagua, Sarstun and Dulce rivers influence the entire region.

Two of Guatemala's largest ports (Santo Tomas and Puerto Barrios) are located in Amatique Bay. Deforestation and large-scale farming in the rich alluvial Motagua and Ulua basins threaten the region by contaminating waterways with sediment, pesticides, and fertilizers. The town of Livingston is located at the mouth of the Dulce River, and there are numerous small villages and developments along the coastline. Small-scale fishers use gill nets, small trawls and longlines. The main impacts to the area are coastal development, water pollution and solid wastes, unsustainable agricultural farming practices, deforestation and commercial ports. The creation of new watershed management programs and fishery regulations will help reduce human impacts.

Turbid, sediment-laden waters in Guatemala's coast are not likely areas for corals to grow; yet several coral reef types have been found. HRI has monitored the Guatemalan reefs since 2006. In 2014, 8 sites were monitored – six within its MPA and two outside. Isolated nearshore patch reefs were found along Punta Manabique, especially the westernmost end. Deeper spur and groove reefs separated by sand channels were found further offshore. Seven of the 8 sites were 10-13 m deep.

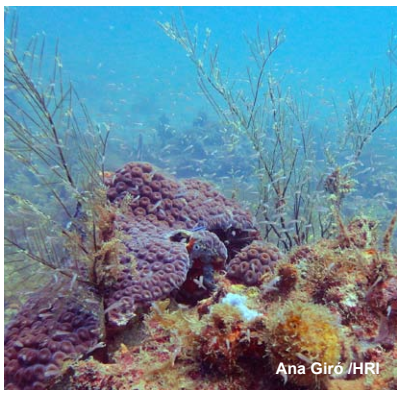
The overall Reef Health Index (RHI) score was 'poor' due to low abundance of herbivorous and commercial fish and high macroalgal cover. Coral cover was scored as 'good' and averaged 20%, which is fairly high compared to other areas in the Caribbean. Fleshy macroalgal cover is high due to few herbivores and nutrient-rich water from rivers. The three sites with highest algal cover were located close to the Motagua and Sarstun rivers. *Diadema* sea urchins were found in low densities in only 3 of the 8 sites (<0.1 urchin/m^2). Parrotfish, doctorfish and surgeonfish were the most abundant herbivores. Parrotfish biomass ranged from 46 to 1,384 g/100 m^2. White grunts and snappers, the most dominant commercial species, were small in size (6 to 20 cm); their biomass ranged from 14 to 1,633 g/100 m^2.

While these reefs have adapted to growing in semi-turbid water and variable salinities, increased pollution, nutrients and sediments from major rivers, a lack of herbivory, and growing demand for fish are adversely affecting reef condition. Reef condition can be improved with more sustainable fishing practices, by creating fully protected zones, and improving river water quality. The new parrotfish ban will help increase herbivorous fish populations, especially at vulnerable reefs along Punta Manabique, as long as it is enforced. Regulating fishing practices, watershed management and expanding the MPA will benefit reefs like Bajon and King Fish. The good news for Guatemalan reefs is that coral cover remains high, thus the foundation is there to support larger fish populations.

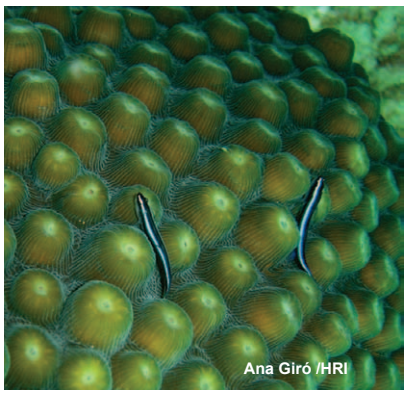


Offshore reef, healthy lettuce coral (*Undaria tenuifolia*).

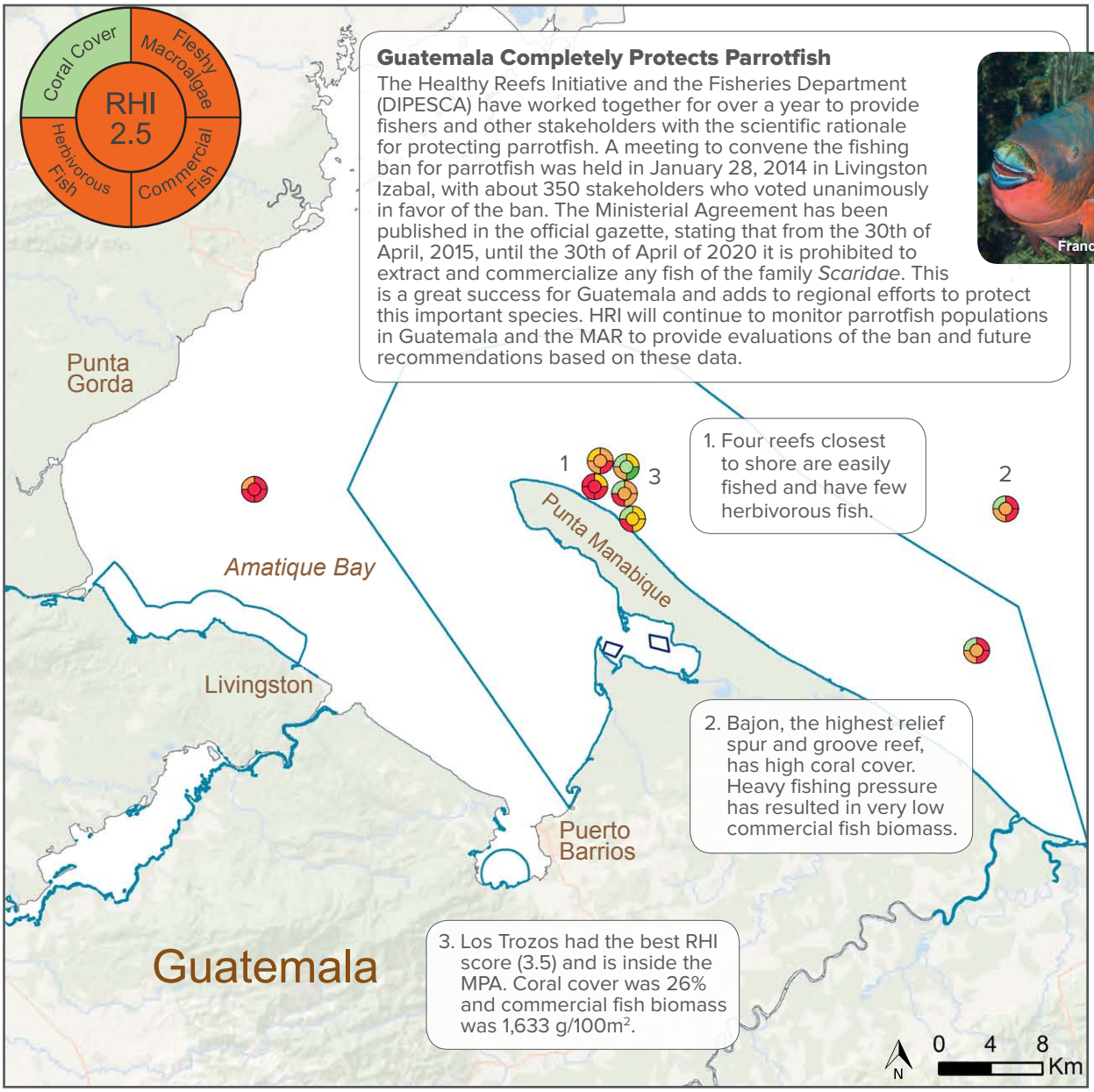
School of grunts.



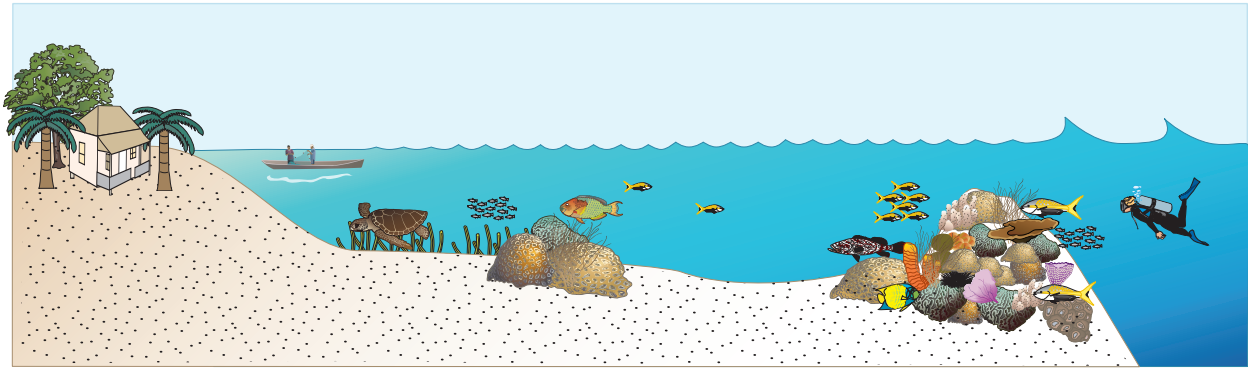
Cabos Tres Puntas patch reef.



Nearshore patch reef, healthy coral (*Montastraea* sp).

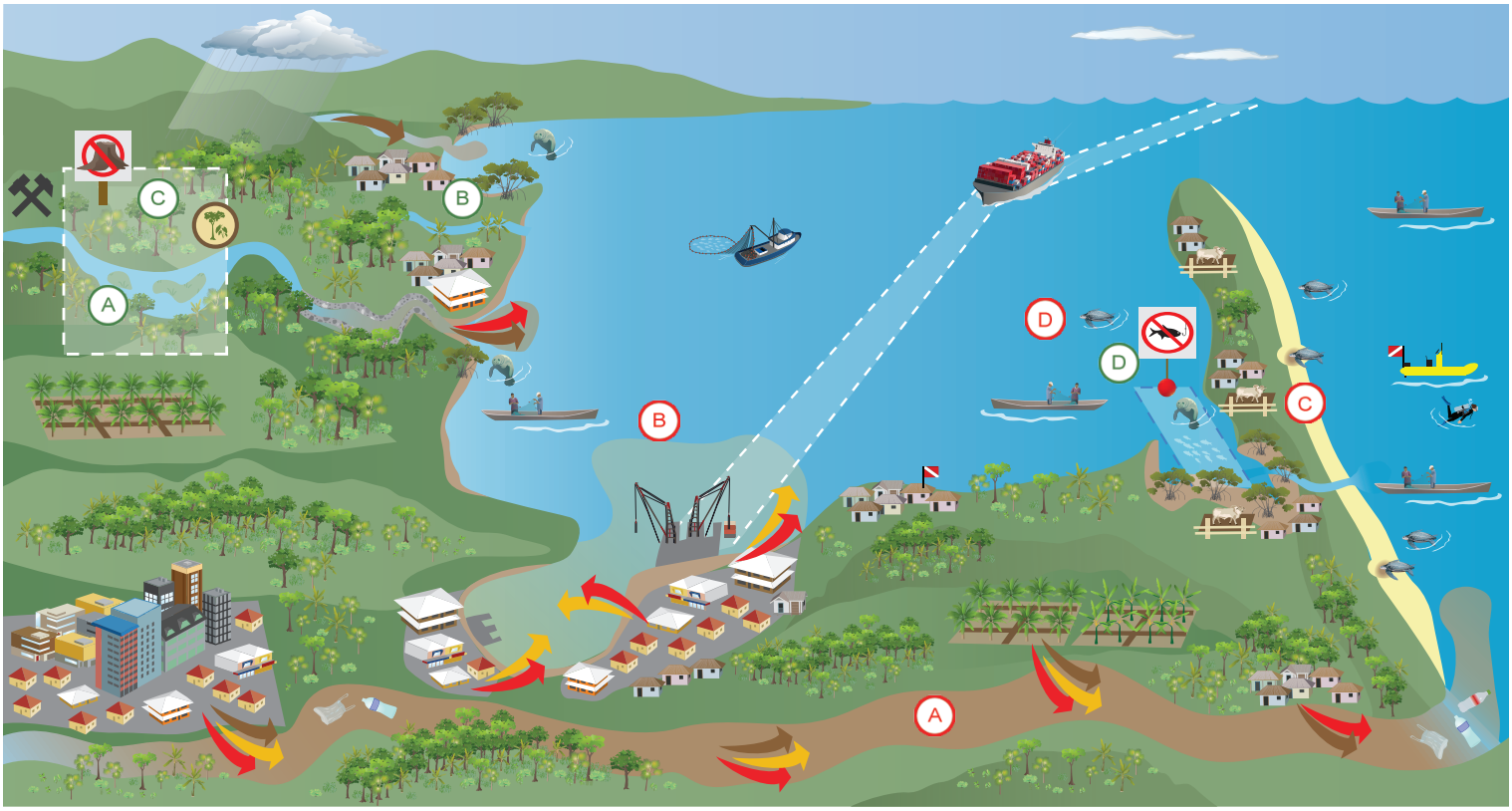


HRI works closely with partner organizations in Guatemala. This work is a joint effort, a special thanks to: CONAP, FUNDAECO, DIPESCA, MARN, CEMA-USAC, ADA2, Fundación Mundo Azul and ABIMA.



Two types of coral reefs occur along the coast of Punta Manabique. Isolated nearshore patch reefs with mound corals and offshore deeper spur and groove reefs separated by sand channels (depths 10 m - >30 m). Numerous sea turtles nest on sandy beaches. Fishermen use nets to catch fish on the reef. Onshore, native forest land is being converted to farm land and palm oil plantations.

Ridge to reef management, for healthy reefs & social wellbeing.



Threats & Human Impacts

A. Sanitation, Pollution & Watershed Management. The Motagua River carries untreated sewage from Guatemala City and other towns, as well as agrochemicals and trash pollution directly into the Caribbean Sea, causing poor water quality, damage to nearshore habitats and risks to human health. Sewage treatment plants in Puerto Barrios and Livingston are now abandoned.

B. Lack of Coastal Zone Management. Puerto Barrios and Santo Tomas, main industrial ports for oil tankers and cargo ships, are sources of pollution and navigational hazards. Increasing growth without adequate CZM is removing natural forests and decreasing water quality.

C. Habitat Destruction. Converting protected forests to farm land has destroyed natural vegetation, increased erosion and sedimentation, and polluted waterways with pesticides and fertilizers. These activities are negatively impacting adjacent habitats and coral reefs.

D. Ineffective MPAs and Growing Demand. Over 68% of Guatemala's territorial sea are under protection, but only 0.6% are fully protected and 0% of reef habitats are under full protection. Lack of enforcement and increasing pressures are reducing MPA effectiveness and causing coral reefs and fish stocks to decline.

Best Management Practices

A. Nutrient Reduction, Pollution Control & Effective Watershed Management. Establishing tertiary sewage treatment plants along the Motagua River and coastal towns of Amatique Bay will remove harmful wastewater. Implementing the Cartagena Protocol and enforcing national effluent/pollution regulations will improve water quality, coastal areas and ultimately human health.

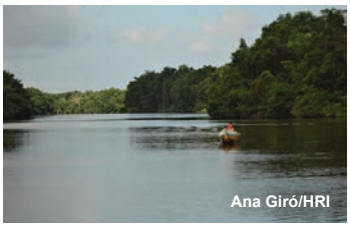
B. Effective Coastal Zone Management. Implementing an effective CZM plan will promote responsible development while conserving natural resources. Management actions are needed to reduce oil spills, improve navigational safety and promote sustainable growth.

C. Habitat Protection and Restoration. Tracking and halting the conversion of forests and enforcing regulations, will protect remaining forests. Developing sustainable agricultural practices and restoring deforested lands will improve water quality and costal habitats.

D. Effective MPAs and Fishing Regulations. Expanding fully-protected replenishment zones to include key coral reef and nursery areas will allow fish stocks to recover. Guatemala's recent parrotfish ban is a leading example for the Caribbean Region.

Polluted water from the Motagua River.

Plastic & trash affect all living animals.



Fishermen led the creation of the first NTZ.

Intact Sarstun forests protect watersheds.

1989 National Protected Areas Law

1997 Tulum Declaration (MBRS)

1998 Regulation for the sustainable use of mangroves

2000 Punta de Manabique declared a RAMSAR site

2002 General Law on Fisheries and Aquaculture

2004 Reef exploration and MBRS reef monitoring project

2005 RVS Punta de Manabique declared

2005 AUM River Sarstun declared

2006 First AGRRA monitoring

2007 AUM River Sarstun declared a RAMSAR site

2007 Gulf of Honduras Project

2009 Integrated CZM Policy

1980s | **1990s** | **2000s**

1983 *Diadema* urchin die-off due to disease

1998 Hurricane Mitch

2000 High deforestation in the Wildlife Refuge Punta Manabique due mostly to agriculture

2009 Lionfish first recorded

Local fishermen become guardians of the reef

Reef monitoring training with local fishermen.

Few people have seen Guatemala's coral reefs, although fishing communities have lived along the coastal area for generations. To track reef condition, the Healthy Reefs Initiative has monitored the reefs since 2006. In an effort to better understand these reefs and to share experiences, HRI met with local fishing communities to discuss the need to protect them – who better to protect the reefs than those who rely on them most.

Scientists from HRI, FUNDAECO, Fundación Mundo Azul, DIPESCA and the Roatan Marine Park hosted the first training in reef monitoring for Sarstun and Livingston fishers. They saw firsthand how their reefs varied – some had a few small fish while others were covered with 30% living coral and abundant fish. "It was interesting to see how fishermen first referred to corals as rocks, whereas after the training, they understood that corals were actually living animals, part of an ecosystem", said Ana Giró, HRI Guatemalan Coordinator.

Monitoring information generated by fishermen can be shared with others in a more direct manner, strengthening behavioral changes in the rest of the community. "This activity in the long run can help in the management and protection of coastal marine resources and is a great accomplishment for the Guatemalan Caribbean", said FUNDAECO's Silja Ramirez.

The training helped raise awareness about the importance of preserving and protecting coral reefs for their sustainable livelihoods, while scientists learned about the resources the communities rely on. Most important of all, this was a unique opportunity for both groups to gain mutual respect and together find solutions and a balance between people and the sea.

Community forest concessions, a model for management and conservation

Xate, palm leaves, sustainably harvested in the MBR.

The 2 million ha of tropical forests in Guatemala's Maya Biosphere Reserve (MBR) are a premium source of high in-demand timber products. These high biodiversity forests are also rich in stored carbon.

CONAP began a program in 1996 that allows limited forest concessions to local communities in the MBR, and today nearly 500,000 acres are being sustainably managed. In 2012, CONAP in association with REDD, developed a system of financial incentives to halt forest destruction by enabling communities to invest in forests as offsets for carbon emissions. The basic goal is to preserve trees by making them more valuable alive. Without offset incentives, the demand would continue to drive communities in the Maya Biosphere Reserve to convert precious living forests into timber, charcoal, pasture and cropland.

This program contributes to climate change adaptation and food security while involving communities in forest management. In the program's first two years, one of the four projects is estimated to have reduced 2.5 million tons of CO_2 – the same as reducing emissions from 500,000 vehicles a year. These actions will reduce about 20 million tons of CO_2 over the next 10 years. This program is already showing success in reducing carbon emissions from deforestation, supporting sustainable livelihoods for local communities, and conserving tropical biodiversity.

"This program serves as a role model since it has achieved a dynamic equilibrium combining social, ecological, and economical factors and allows us as a government agency to envision how the Guatemalan System of Protected Areas can be managed under strategic areas of sustainable development." Benedicto Lucas- Director of the National Council of Protected Areas of Guatemala.

2012 Creation of the first No Take Zone

2013 Regional lobster fishing moratorium

2010s

2011 Record high pollution from the Motagua River seen in satellite MODIS

2012 Tiger shrimp first recorded

2013 Nickel mining in Lake Izabal is approved

- Increase number of water treatment plants in the Motagua River basin by 30%.
- New water treatment plants in Puerto Barrios, Santo Tomas de Castilla and Livingston.
- New NTZ on reefs & monitor success
- Strengthen governance
- Improved maritime management
- Water Law
- Regulate all the activities with an EIA
- National Strategy on climate change adaptation.
- Create Management Authority for the Motagua River
- Environmental monitoring programs –Ridge to Reef
- Involve fishermen in management and monitoring
- Implement regional/national lionfish control strategy
- Create online watershed management data portal
- Economic valuation
- Fisheries management

Vision 2015 - 2020

Honduras

The northern coast of Honduras extends from Guatemala to Nicaragua and includes the offshore Bay Islands. Located at the "headwaters" of the MAR Region, nearshore and oceanic currents play an important role in connectivity with the rest of the region. Sandy beaches, large rivers, bays, and lagoons characterize the mountainous northern coast. The Bay Islands, with 60 minor islands and several larger islands, have shallow fringing crest reefs, patch reefs, and shelf-edge reefs.

HRI surveyed 60 sites and Honduras has the best RHI with a 'fair' score (3.3) due to high live coral cover and herbivorous fish biomass, although fleshy macroalgal abundance was highest in the MAR region. Coral cover (20%) was the highest in the MAR. Literature suggests coral growth along the mainland would be limited due to turbid, sediment-laden waters, but recent surveys (2011) have identified two areas of unusually high coral cover. In Tela Bay there are two sites where, combined, over >800 healthy elkhorn (*Acropora palmata*) coral were counted; and in Capiro Banks, a unique reef with >60% healthy coral cover including lettuce coral (*Undaria tenuifolia*) was found. Coastal Honduras' reefs were the only ones having more living coral than fleshy macroalgae (31% vs. 17%).

Honduras was the only country to score 'critical' for fleshy macroalgal cover, which ranged from 17% along Coastal Honduras to 34% in the Swan Islands. The reason for such high macroalgal abundance on Honduras' offshore islands is not well understood, especially as these areas had the greatest herbivorous fish biomass. Impacts such as nutrient enriched waters from untreated sewage or agricultural runoff may be influencing algal cover. *Diadema* urchins were low at most sites, except along the mainland where they may be playing a more prominent role than herbivorous fish. Five of the six sites with urchin densities >1.0 urchins/m^2 were found in Tela, an area with high coral cover.

Honduras had the highest herbivorous fish biomass in the region (4,493 g/100 m^2). The Bay Islands, Cayos Cochinos and Swan Islands were the only subregions to have a 'very good' score. Nearly every survey site had large parrotfish present. Honduras' ban on spear and trap fishing in all the Bay Islands since 2004 seems to be effectively protecting parrotfish. Honduras scored 'poor' overall for commercial fish biomass – having the lowest (491 g/100 m^2) in the region and was the only country where biomass declined. However, Roatan and Cayos Cochinos had higher biomass and many large groupers, where long standing MPA protection, gear restrictions and effective enforcement have contributed to groupers recovering. Increased protection for commercial fish, especially large fish will allow them to grow bigger and produce more offspring.

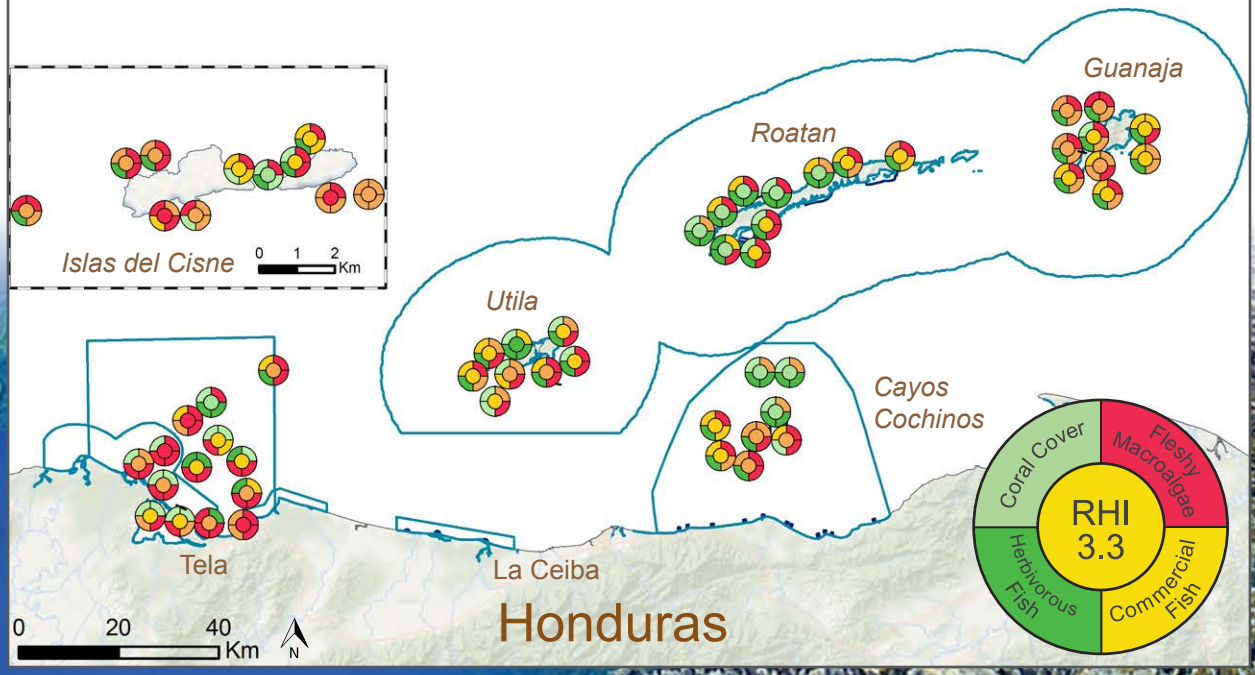
Survey results suggest that proper management of MPAs generates increased fish biomass, high coral cover provides the structure to support more fish, but increased protection is needed; and by following fisheries rules and regulations, reefs and fishermen have more fish. HRI is collaborating with 18 partners to improve reef health in Honduras.

Frequent patrolling in Roatan has reduced illegal fishing, allowing more groupers to grow large.

Tela – Reducing fishing pressure will help protect these high coral cover reefs.

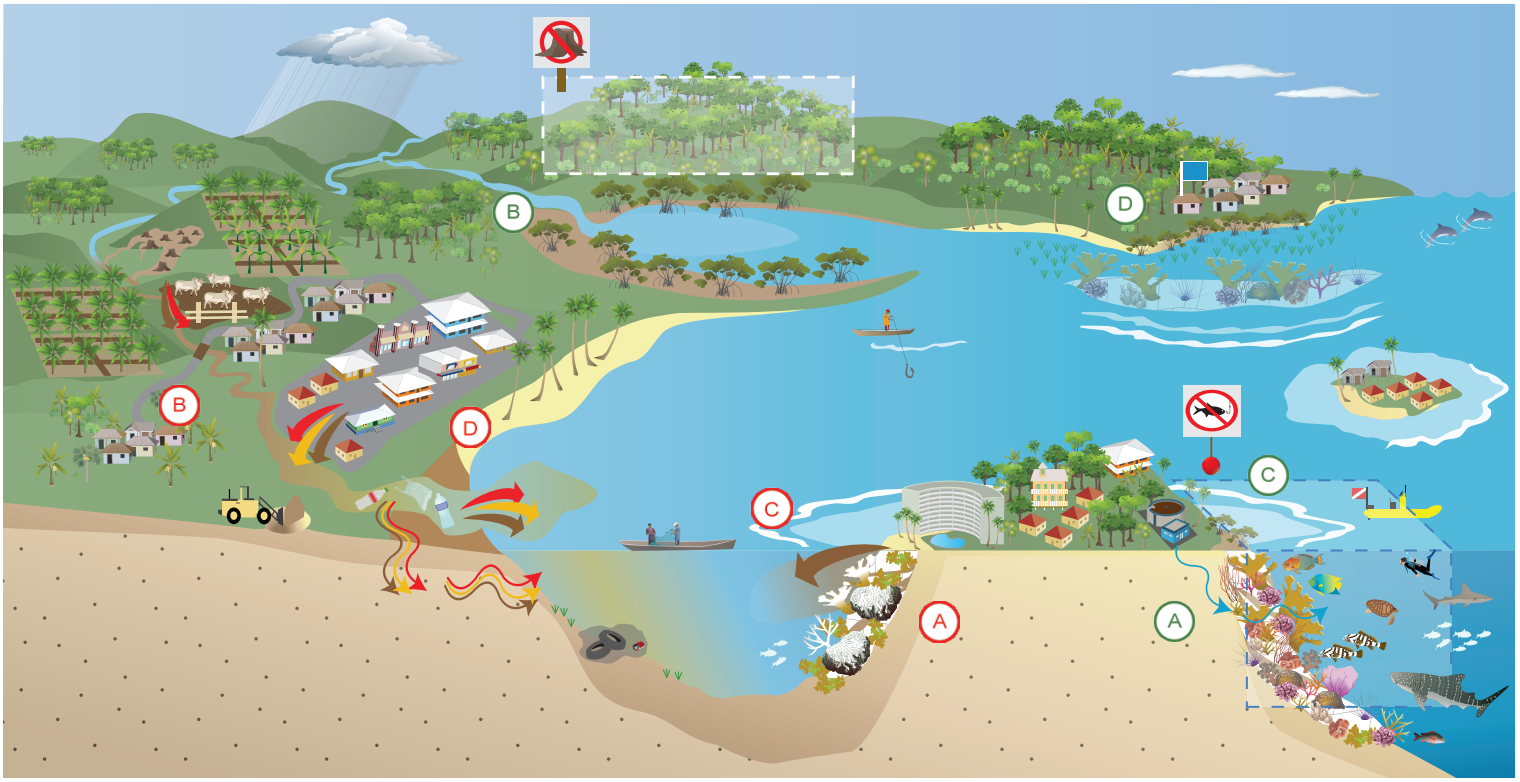
Healthy elkhorn coral in Guanaja.

60 reefs were surveyed.



Healthy lettuce coral, Cordelia Banks, Roatan.

Reducing impacts and threats benefits humans & coral reefs.



Threats & Human Impacts

A. Inadequate Sewage & Waste Control. Coastal pollution due to inadequate treatment of waste waters not meeting Cartagena LBSMP Standards harm coral reefs. Poor management and funding at existing treatment facilities hinder effectiveness. Poor solid waste disposal results in toxins and trash pollution.

B. Poor Watershed & Coastal Zone Management. Upstream watershed pollution and poor management are degrading downstream environments. Growing coastal populations and tourism are leading to unsustainable development practices.

C. Ineffective MPAs and growing demand. Over 40% of Honduras' territorial seas are protected, but only 2% are fully protected and 8% of reef habitats are fully protected. Insufficient MPA funding, poor enforcement of regulations and increasing resource demands reduce MPA effectiveness. Parrotfish are not protected country wide.

D. Rapid tourism growth & unsustainable practices. The rapid pace of tourism growth in Honduras is increasing demands on natural resources. Infrastructure needed to support a growing population and market competition has led to unsustainable practices that deplete resources and destroy important habitats.

Best Management Practices

A. Effective Sewage & Waste Control. Implementing an effective regulatory framework for tertiary wastewater treatment and proper solid waste management will result in cleaner, healthier water for reefs and people to thrive. Well managed sewage treatment facilities at 6 sites in Bay Islands and coastal Honduras are a priority.

B. Effective Watershed & Coastal Zone Management. Reduce upstream watershed pollution through better management practices. Enforcing CZM Plans and promoting sustainable development will conserve sensitive natural habitats.

C. Effective MPAs and Fishing Regulations. Improving MPA effectiveness and expanding fully-protected replenishment zones to include key coral reef and nursery areas will allow fish stocks to recover. Reducing human impacts and proactive restoration can further improve nearshore waters. Protection of parrotfish will benefit reefs.

D. Sustainable tourism growth. Shifting incentives to encourage conservation and engaging the private sector to adopt environmentally friendly practices will improve management, reduce human impacts, and increase eco-tourism. Healthy reefs provide more food, higher tourism value, human health benefits and better storn protection.

Direct discharge of waste into sea.

Nutrient rich waters cause cyanobacterial blooms.

Water quality monitoring.

Fish biomass is increasing.

1980 Beginning of recreational tourism in the Bay Islands

Cloud forest protection declaration

1992 First MPAs established (Tutle Harbour, Utila & Sandy Bay, Roatan)

1993 Environmental Law decreed

1997 The National System for Protected Areas is established

2004 National Tourism Strategy decreed

2006 First AGRRA monitoring training

2008 HRI 1st Report Card

2010 Bay Islands National Marine Park decreed

1980s

1990s

2000s

1980 Coral disease

1983 *Diadema* urchin die-off

1990 Lethal yellowing hits coconut trees

1998 Hurricane Mitch, subsequent coral bleaching and disease

2008 Lionfish invasion began

2008 Third unplanned tourism boom

From discovery to protection – a success story of coral reefs and people

Community votes in favor of Tela MPA.

Corals often grow best in clear water, but along the sediment-laden waters of Honduras' northern coast, an area of healthy reefs has recently been discovered – Capiro Banks, in the Bay of Tela. While many Caribbean coral reefs have declined over the past 30 years, this reef is surprisingly healthy and an important larval source for the rest of the MAR. Within three years and with community, scientist, and government support, these reefs have gone from "unknown" to marine protected areas.

During a 2011 HRI-AGRRA training workshop, local stakeholders showed the trainers some spots identified by fisherman. To their surprise, scientists found unique offshore coral reefs at >10 m depths covered with >60% healthy coral – four times as much live coral found on many Caribbean reefs today. In Tela Bay's nearshore shallow waters, vast stands of >800 healthy elkhorn corals were found and surveyed. Elkhorn corals are listed as critically endangered on IUCN's Red List. The scientists shared their findings with the community and local governments.

An MPA declaration is usually a very long process, but within a year of being first presented with survey data, the Municipality of Tela took quick action and declared 111,000 hectares a municipal MPA. Using this momentum, conservation partners created the paperwork to elevate this Municipal Decree to a Ministerial Decree – all within a year. To provide the highest protection, the Municipality hosted public meetings with fishermen and local stakeholders who voiced their concerns on declining fish stocks due to unsustainable and illegal fishing. All who attended these meetings were in favor of moving forward with the declaration of Tela as a Marine Wildlife Refuge that spans over 87,000 hectares.

Local and international partners are all working together to provide MPA guidelines including fishing gear permitted, species size and catch limits, and regulation enforcement. Working as a united front, all these conservation partners are setting the pace for adequate MPA management and hope to see fish stocks recover in the future.

A creative service model yields successful results for clean water

West End Treatment Facility – 2012.

Creating cleaner waters is an important goal for West End – the tourism heart of Roatan. Water treatment technologies exist, but the greatest challenge is long-term management. To facilitate the success of the West End Treatment Facility built in 2012, Polo's Water Board (Polo's) has provided efficient management, community involvement and innovative financing. Polo's service model can easily be replicated in other sites and is an effective example of protecting water sources and coral reefs.

Polo's success comes from working with the entire community, fostering transparent management of funds and recognizing that clean, healthy waters are needed to support tourism. Polo's offered innovative financing mechanisms by providing interest free loans to buy water tanks and easier methods to pay bills. One-third of the houses were connected to the system within a year. Installing water meters to track water usage and pay only what is used instead of flat monthly fees reduced wasted water by 25%. Polo's customer service and accounting transparency has increased trust within the community.

The goal is to have all customers in West End connected by end of 2015, although remote houses will require building new infrastructure. The board plans to address leakage from decommissioned septic systems and is seeking funding to clean them. Longer-term goals are to seek alternative energy sources and replicate this model to six other coastal communities.

Marine water quality monitoring is being conducted by local partners – BICA Roatan, CORAL, MAR Fund and KfW. By identifying contaminant sources, they will be able to implement actions to reduce and remove these contaminants. As more houses are connected to the facility, the hope is that near-shore water quality will improve – providing healthier waters for both people and coral reefs.

"We have seen an amazing improvement in water quality near West End as fewer septic tanks are in use and waste water is directed to adequate facilities for treatment."

– Gisselle Brady, BICA Roatan

2011 Shark Sanctuary decreed

2011 IDB economic valuation of Bay Islands natural resources

2011 Responsible Seafood Guide created and launched

2012 Cordelia Banks declared MPA

2014 Tela Bay MPA (Ministerial Decree

2010s

Sea cucumber fisheries without regulations

Oil exploration concessions awarded

2015

- Unsustainable fishing practices banned
- Waste water treatment plants installed and operating at each coastal town with a population larger than 1,000
- LBS Protocol for waste water (Cartagena Convention) adopted and in full effect

2016 All north coast and Bay Islands restaurants adhere to Responsible Sustainable Seafood Guide

2017 Oil exploration banned in the entire Honduran Caribbean

Vision 2015 - 2020

Healthy Reefs
for healthy people

The Healthy Reefs Initiative (HRI) has forged a unique and strong alliance of over 60 partner organizations, each working in their own way to safeguard this reef, while also joining forces through the initiative to evaluate the health of the reef and measure our collective progress in managing it. Through the production of routine report cards on the health of the reef, followed by detailed evaluation of management actions in the eco-audits, HRI provides valuable tools for catalyzing public awareness and swifter, more comprehensive reef management actions on a large scale.

Overall reef condition

The Mesoamerican Reef is in fair condition, with encouraging improvements of indicator scores at regional and local scales. Some of the main findings of the report include:

- Coral cover is increasing, although slowly. Reducing local threats can give corals time to recover.
- Fleshy macroalgal dominance is widespread. Improving water quality will benefit reefs.
- Herbivory is key to controlling macroalgae. Protecting herbivores will reduce seaweed.
- Snappers & groupers have increased locally. Creating more fully protected areas will allow them to grow larger and produce more fish for the future.

Managing coral reefs for a healthier future

The Mesoamerican Reef region is a global leader in the conservation and management of coral reef ecosystems. All four countries have achieved the targeted 20% of territorial sea under protection and progress is being made declaring more fully protected zones. Many MPAs are managed through innovative collaborations between government, communities and conservation organizations – with growing private sector support and recognition of the economic value of MPAs. The existing fully protected areas are successfully protecting some of the last large groupers.

The MAR is facing growing stressors of increasing population, sewage, coastal development, overfishing and climate change. This Report Card demonstrates that there are resilient reefs often in unexpected places and protected reefs with some underlying ecological issues that may be preventing recovery of health. The data collected in these report cards are being used by managers to refine management actions that are then evaluated through the Eco-Audit process. The seven priority management recommendations included in this report will be a particular focus of >60 partners in the Healthy Reefs Initiative.

The 2016 Eco-Audit will evaluate each country's degree of implementation of the management recommendations offered in this and previous Report Cards. Together, this collaborative process of reef monitoring, reporting, recommending, evaluating and refining management actions represents the adaptive management cycle in action. Over the last decade the HRI and its partners have evolved and made measurable progress in protecting coral reefs for a healthier future.

Together, we will save this Meso-Amazing Reef.

Healthy reefs are built by thousands of tiny coral animals.

Healthy reefs provide shelter for rich seagrass meadows to grow.

Healthy reefs support ecotourism.

Healthy reefs have abundant grazers.

Healthy reefs provide habitat for commercial species.

Heatlhy reefs rely on healthy watersheds.

Healthy reefs protect our shorelines from waves.

Healthy reefs have fish for future generations.

Healthy reefs inspire us.

Recommendations

At the Fall 2014 Regional Meeting, HRI partners developed the following recommendations to improve reef health. They identified one top priority action for each of the seven themes being evaluated and tracked through HRI's Eco-Audit. Partners committed to work over the next two years to help implement these actions.

Marine Protected Areas

Increase the area under full protection by 5% in each MAR country by 2016. The long-term (2020) target remains at 20% under full protection.

Ecosystem-based Fisheries Management

Protect parrotfish – the main reef grazers throughout the Mesoamerican Reef (becoming the first international ecoregion to do so).

Coastal Zone Management

Update, fully implement and evaluate the application of coastal zone plans with a vision towards ecosystem management.

Sanitation and Sewage Treatment

Demonstrate that the implementation of watershed and wastewater management plans improves water quality in at least one location per country.

Research, Education and Awareness

Expand outreach network to educate, inform and share research information among managers, policy makers, government leaders, stakeholders and communities through effective use of the media.

Sustainability in the Private Sector

Promote a regional sustainable seafood guide with fiscal incentives, either being developed or in effect, throughout the region by 2017.

Global Issues

Reduce emissions associated with annual operations by 15% through partnerships with Governments, NGOs and private sector businesses, using 2015 as base year. Ensure that all HRI partners fulfill their pledge to buy carbon offsets for all travel.

Recomendaciones

En la Reunión Regional de Octubre de 2014, los socios de HRI desarrollaron las siguientes recomendaciones para mejorar la salud arrecifal. Identificaron una acción prioritaria para cada uno de los siete temas que se evalúan y monitorean a través del Informe de Avances de HRI. Los socios se comprometieron a trabajar en la implementación de estas acciones durante los próximos dos años.

Áreas Marinas Protegidas

Aumentar el área de protección total en un 5% en cada país del SAM para el 2016. El objetivo de crear áreas de protección total se mantiene en un 20% para un plazo más largo (2020).

Manejo de Pesquerías basado en el Ecosistema

Proteger los peces loro – principales herbívoros del Arrecife Mesoamericano (convirtiéndose en la primera ecoregión internacional en lograrlo).

Manejo de la Zona Costera

Actualizar y aplicar instrumentos de planeación costera con una visión ecosistémica y evaluar la aplicación de estos planes.

Saneamiento y Tratamiento de Aguas Residuales

Demostrar que la aplicación de un plan de manejo de la cuenca y aguas residuales mejora la calidad del agua en al menos un sitio por país.

Investigación, Educación y Concientización

Expandir la red de colaboración con el fin de educar, informar y compartir información de investigaciones con los manejadores, tomadores de decisiones, líderes gubernamentales, actores clave y las comunidades, por medio del uso efectivo de los medios de comunicación.

Sostenibilidad en el Sector Privado

Para el 2017, la región promueve un programa de consumo sustentable de mariscos que incluye incentivos fiscales, ya sea que se encuentre en desarrollo o esté siendo aplicado.

Temas Marinos Globales

Reducir las emisiones asociadas con las operaciones anuales en un 15% a través de asociaciones con los gobiernos, ONGs y empresas del sector privado, utilizando el 2015 como año base. Asegurar que todos los socios de HRI cumplan su compromiso de comprar compensaciones de carbono para todos los viajes.

Healthy Reefs Initiative Regional Partners Meeting.
Tela, Honduras, October, 2014.

Regional experts in marine conservation developed the prioritized reef management recommendations presented in this report.
The 2016 Eco-Audit will evaluate each country's progress in implementing them.

Results of previous Report Cards and Eco-Audits can be found at www.healthyreefs.org

Citation: Patricia Kramer, Melanie McField, Lorenzo Álvarez Filip, Ian Drysdale, Marisol Rueda Flores, Ana Giró, and Roberto Pott. (2015). 2015 Report Card for the Mesoamerican Reef. Healthy Reefs Initiative (www.healthyreefs.org).

Taller Regional de la Iniciativa Arrecifes Saludables.
Tela, Honduras, Octubre, 2014.

Expertos regionales en conservación marina desarrollaron y priorizaron las recomendaciones para el manejo del arrecife.
El Informe de Avances 2016 evaluará el progreso de cada país en implementarlas.

Los resultados de los Reportes de Salud e Informes de Avances previos pueden encontrarse en www.arrecifessaludables.org

Cita: Patricia Kramer, Melanie McField, Lorenzo Álvarez Filip, Ian Drysdale, Marisol Rueda Flores, Ana Giró, and Roberto Pott. (2015). Reporte de la Salud Ecológica del Arrecife Mesoamericano 2015. Iniciativa Arrecifes Saludables (www.arrecifessaludables.org).

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