

10 Years of Collaboration & Conservation

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MESOAMERICAN REEF REPORT CARD

AN EVALUATION OF ECOSYSTEM HEALTH







Photo © Claudio Contreras Koob/ILCP

A DECADE OF MAKING A DIFFERENCE

The Mesoamerican Reef (MAR) supports our culture, fisheries, tourism, coastal protection and biodiversity. The Healthy Reefs Initiative (HRI) collectively and quantitatively assesses reef health and informs science-based management recommendations.

Over the past 10 years, we have conducted rigorous science in support of management. Our reliable measures of reef condition allow us to identify the most urgent threats and responses. HRI training workshops continue to strengthen scientific capacity. Our partners are scaling-up and improving management in 47 MPAs spanning almost 60,000 km². Through our Regional Coral BleachWatch Network, we have quickly mobilized and supported teams of partners across the region to monitor coral bleaching. HRI convenes annual partner meetings, enabling us to achieve a common voice and collectively accelerate conservation action. Together, we have shaped policy, such as protecting herbivorous fish in 3 of 4 countries. It has been 20 years since the four country leaders signed the historic Tulum Declaration, committing to protect the MAR's shared resources. Our science-based knowledge and collective management efforts need to be accelerated-particularly to reduce pollution and increase replenishment zones. Our 2018 Coral Reef Report Card includes a 10-year perspective on reef health and conservation aimed to ensure our reefs will endure and thrive into the future.

KEY FINDINGS

Overall, the Mesoamerican Reef is in 'fair' condition with a reef health index score of 2.8 out of 5.

We evaluated 319 sites for reef condition, finding 1% very good, 13% good, 32% fair, 37% poor, and 17% critical.

Reef health has improved from poor in 2006 (2.3) to fair (2.8) in 2016, as in 2014.

Honduras has the highest Reef Health Index (3.0) followed by Belize and Mexico (2.8) and Guatemala (2.0).

Three of the four indicators improved over the decade, including coral cover (18%), herbivorous fish (2,731 g/100m²) and commercial fish (909g/100m²).

The only indicator with no improvement and a 'poor' ranking is fleshy macroalgae now 23%—up from 12% in 2006.

The increase in coral cover included coral species important for reef building and coastal protection.

21% of corals bleached in 2015/16, with no mortality noted, although higher bleaching in 2017 is a concern.

Coral recruitment has remained stable, but overabundant reef competitors are a concern.

We now have 47 marine protected areas, covering 57% of the territorial sea, but only 3% of the sea is fully protected from fishing.

Fully-protected replenishment zones (RZs) are working, with a doubling of commercial fish over the past decade. Big reproductive fish are primarily in the RZs and are critical to replenishment.

New management interventions are being piloted to restore herbivory. Stronger efforts are needed to reduce nutrient pollution to combat macroalgae proliferation.

REEF HEALTH BY SUBREGION AND COUNTRY



SUBREGIONAL ANALYSIS

Commercial

(g/100m²)

3,226 •

Fish

665

988

572

1.590

1.139

1,194

139

2,002

585

1,746

363

876

43 •

452

683

1,467

688

481

675

909

Herbivorous

(g/100m²)

2521

2,851

1.555

1,738

1.438

2.092

3,104

978

4,194

2,063

2,441

2.173

2,384

433 🜒

2976

5,662 ●

4,233

5,453

4,138

4474

2,731

SWAN ISLANDS

5/16 SUBREGIONS

4/16 SUBREGIONS DECLINED

N

50

100km

Healthy Reefs for healthy people

0

Fish



TEN YEARS OF CHANGE

Analysis by country provides insight and a call to action

The Reef Health Index improved from 2.3 to 2.8 over the past decade. Compared to global trends of widespread reef decline, these encouraging results of recovery are a testament to the benefits of collaborative management. Each country's unique history and management efforts affect the status of the four reef indicators. These trends are an urgent Call to Action for country specific management responses. *Note different axis values*.



Fish Biomass (g/100m²)



Mexico shows a slow, steady increase in coral cover since 2005. Commercial fish biomass, highest in the region, has fluctuated but increased 140% over the past decade. Sustained enforcement and more replenishment zones are needed. Fleshy macroalgae remain an intensifying problem, with accelerated growth in the past two years.

Call to Actions: Protect herbivorous fish and improve sewage treatment.



BELIZE



In Belize, parrotfish biomass continues to increase (postprotection), with the first indication of a slight decline in fleshy macroalgae noted this year. Coral cover has varied year to year but has increased overall since 2006. Commercial fish biomass has fluctuated over the past decade but generally increased. **Call to Actions: Increase replenishment zones to 10% by 2018; ban gill nets and fish traps.**







Coral cover is higher and macroalgae is lower, mainly due to the inclusion of newly discovered reefs influencing trends. With time and enforcement, the 2015 regulation protecting parrotfish should help reverse the decline in herbivorous fish. Commercial fish biomass is the lowest in the region, with a 95% decrease since 2006. **Call to Actions: Create replenishment zones on reefs; restrict gillnets and trawling.**



HONDURAS



In Honduras, relatively high coral cover has been stable or increasing over the past decade. Commercial fish biomass has remained constant, although the value is poor and would benefit from more replenishment zones. Despite having the highest herbivorous fish biomass, fleshy macroalgae is still the highest in the region.

Call to Actions: Reduce contaminants from land run-off, improve sewage treatment and create more replenishment zones.





VALUE OF TIME SERIES DATA

The country graphs (p. 4) include all available data from HRI and partners, with reef survey sites varying each sampling period depending on funding or other constraints. Below, we examine the same 104 sites Heathy Reefs Initiative monitored in both 2006 and 2016. This perspective provides more confidence in specific changes for each indicator, although the results could be less representative of the region as a whole.

A CLOSER LOOK AT KEY INDICATORS

Coral Cover | Corals recovering slowly

Coral cover increased by 38% at these repeated sites, similar to the overall regional dataset, with greater increases in Guatemala and Mexico. The inaugural 2006 survey followed hurricane and bleaching damage. Given the slow growth rate of dominant reef-building corals, we expected recovery to be slow. Even though coral bleaching events are predicted to be more frequent, we look forward to continued gradual increases in coral due to our management actions (see p. 6).

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Fleshy Macroalgae | New interventions needed

Fleshy macroalgal biomass has nearly doubled across the region, with significant increases in all four countries. Given their rapid growth, fleshy macroalgae can quickly overgrow a reef. Urgent actions are needed to reduce coastal and watershed nutrient and sewage contamination, along with interventions to increase herbivory. If these actions are taken, we expect a gradual algal reduction—if not, the proliferation will continue (see p. 8).

Herbivorous Fish | Protection measures working

Herbivorous fish biomass varies reef to reef, yet has remained stable in the last decade. The MAR-wide average shows a slow, but positive increase, likely due to management actions. Honduras has noticeably higher biomass. Parrotfish are now protected in Guatemala, Belize and the Bay Islands of Honduras, with efforts underway in Mexico; thus, we expect their numbers to continue to increase (see p. 11).

Commercial Fish | Declines of concern

Commercial fish biomass declined 23% at these repeated sites, which do not include data from many protected replenishment zones (RZs). Guatemala had the greatest decrease, while Mexico showed an increase, especially for snappers. This result differs from the overall increase found in the full analysis, because it includes fewer RZs. This indicator is responsive to management, so adding more effectively managed RZs will allow populations to increase in the future (see p. 11).

COMPARISON OF 104 REPEATED SITES



CHANGES



TINY CORAL ANIMALS BUILD MASSIVE REEF STRUCTURES. Reef-building corals, like this mountainous star coral in the Swan Islands, are keystone species—without them the system can collapse The ideal reef has enough builders to continue positive net growth.





Photo © Ken Marks/AGRB4



Not all corals are created equal, some coral species construct the majority of the 3-D structure (reefbuilders); others contribute less (reef-contributors). Coral cover has increased over the past 10 years, but based on a subsample of 104 reefs resurveyed, the ratio of reef-building to reef contributing corals varies. Increases in reef-building coral cover occurred in Mexico and Honduras, while increases in Belize and Guatemala were due to non-reef building species.

PROTECT CORAL REFUGIA

Recovery of elkhorn (Acropora palmata) and staghorn (A. cervicornis) corals has been slow, compared to their rapid decline in the 1980s. Elkhorn corals were found at 14 of 104 sites and staghorn at 16, with increases in Mexico and Belize. The region's largest elkhorn stand (35% cover), near Puerto Morelos, Mexico is threatened by coastal development. Unique, dense staghorn thickets are found in Cordelia Banks, Honduras. Mountainous star coral (Orbicella species) has suffered declines due to bleaching and disease. Star corals were found at 73 of 104 sites in 2016; Turneffe, Belize had the site with the highest cover (18%). Orbicella declined overall in Honduras, likely resulting from its susceptibility to bleaching and disease. Lettuce coral (Undaria tenuifolia) are important reef builders in the MAR. Lettuce corals were found at 61 of the 104 sites: reefs in Bay Islands, Honduras had highest cover (10 to 35%). Recently, new reefs with abundant lettuce coral were discovered at Capiro Banks in Honduras (>50% cover) and on reefs of Cayman Crown (Guatemala/Belize).

SHIFTING THE BALANCE: PROMOTERS VS COMPETITORS

Mountainous Star coral

Numerous plants and animals, on and inside the reef, compete for limited benthic space. Corals, crustose coralline algae, and sparse turf algae are "promoters" of reef growth; others are "competitors" capable of overgrowing and displacing corals. The MAR has fewer promoters (43%) than competitors (57%), yet it varies by country. Fleshy macroalgae are the main competitor, but in Mexico dense algal turf mats that trap sediment sometimes dominate. These are avoided by herbivorous fish but removed by urchins. Thus, shifting the balance to more promoters may require a targeted approach that selects the best herbivore for each site.



For more: Lang et al 2016 (agrra.org/wp-content/uploads/2016/08/ ICRS-poster-compact.pdf)

REEFS IN A CHANGING SEA

Continuous coral bleach events put MAR at high risk

The Mesoamerican Reef has bleached at least seven times since 1995. Coral bleaching is a general stress response where the coral expels its beneficial symbionts due to stress, such as elevated temperatures. Healthy Reefs led a regional Coral BleachWatch in partnership with 19 partner organizations. Throughout the four countries, 68 sites were surveyed in 2015 and 107 in 2016, evaluating a total of 33,890 corals (photo at right).



BLEACHING BUT NOT MORTALITY IN 2015–16

The 2015/16 bleaching event moderately affected the MAR with 3% of corals fully bleached, 18% partially bleached and 22% pale. 2016 was worse than 2015, with little to no recorded mortality.

Spatial patterns vary

Overall, bleaching was highest in Honduras (73%) then Mexico (47%), Guatemala (33%) and Belize (23%). Bleaching also varied by habitat, from most to least affected: patch reefs > fore reef > back reef > reef flat. Similarly, in 1998 the worst bleaching (with mortality) was in patch reefs.

Susceptibility by species

The most affected included slow-growing reef-builders (*Orbicella spp, P. strigosa*) and fast growing *Undaria* and *Porites* species. Environmental stressors, including temperature, light, and water motion, contributed to bleaching and affected species differently.

BLEACHING SEVERITY INDEX



¹Muñiz-Castillo et al. in prep



Na Data 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20DHW

²www.coralreefwatch.noaa.gov/ ³van Hooidonk, R., et al (2015)

TRACKING THE HEAT TO PREDICT BLEACHING RISK

Our ability to respond to coral bleaching events has improved with advancements in tracking tools. Degree Heating Weeks (DHW) are a measure of the severity and length of heat stress—with severe bleaching occurring at >8DHW (orange)². Each warm water event has affected the region differently. The past three years have had increasing stress each year—but not surpassing the impacts of the 1998 event. Coral bleaching events are predicted to increase in frequency and severity, with bleaching events expected to occur in the MAR region on an annual basis by 2030– 2060³. Restoring bleach-resistant corals is one component of reef restoration programs currently underway—some of which actively seek to propagate more resistant corals. Over 135,000 corals have been planted in the MAR to date.

WHAT CAUSES MACROALGAE PROLIFERATION?

Macroalgae are plant-like marine organisms that were historically in rather low abundance on Caribbean reefs. Today most of these reefs are overrun with macroalgae, which outcompetes coral for space, reduces coral recruitment success and inhibits coral growth. Fleshy macroalgae increased from 12 to 23% over the past decade. Photo © Brian E. Lapointe



Excess Nutrients

Originating from inadequate sewage treatment, agricultural and industrial run-off, land clearing and coastal development (including dredging).



Habitat Destruction

Direct loss of mangroves and seagrass beds from coastal development and related activities reduces the capacity to absorb nutrients and other pollutants.

OUR REEFS NEED CLEANER WATER & MORE HERBIVORES TO THRIVE Threats are from many sources





DEVELOPMENT

The growing tourism industry is increasing demand for development. Poor development practices destroy mangroves, seagrasses, wetlands, and beach dunes. These ecosystems normally filter nutrients and pathogens before they reach coral reefs.

2016 Eco-Audit Score 70% CZM Planning 50% Mangrove Protection

UNSUSTAINABLE FISHING

Years of over-fishing, illegal fishing, lack of enforcement of existing regulations, and increasing demand have resulted in reductions or collapses of target species and increasing fishing of herbivorous fish.

60% 2016 Eco-Audit Score

POOR WATERSHED MANAGEMENT

Central America's rivers also carry high loads of nutrients, contaminants and sediments into coastal waters, caused by poor agricultural and land management practices.

60% 2016 Eco-Audit Score

See full Eco-Audit details at: http://eco-audits.healthyreefs.org/

ROOT PROBLEMS

Lack of regulation enforcement, increasing human population (including tourists) and demand for resources are underlying problems in all issues.

MANAGEMENT INTERVENTIONS

1999 1997

Reducing nutrient pollution + increasing herbivory = Healthier Reefs

The excessive nutrient contamination in the MAR, overfishing of herbivorous fish and the current low abundance of other herbivores has allowed macroalgae to grow unimpeded. We URGENTLY need to REDUCE nutrient pollution and INCREASE herbivory. We also require more consistent, comprehensive water quality monitoring in order to better understand and correct this problem.

INADEQUATE SEWAGE AND WASTE CONTROL

Poor sewage treatment releases more nutrients and pathogens which filter through porous limestone, causing algal blooms and diseases that harm coral reefs. Poor solid waste disposal results in chemical contaminants and trash pollution, particularly plastics.

46% 2016 Eco-Audit Score

8

ste ical stics.

RESTORE KEY HERBIVORES TO REDUCE MACROALGAE

HRI and partners are continuing efforts to have region-wide protection of parrotfish, while also beginning pilot projects to evaluate the potential for restoring urchin and king crab populations in key protected areas, in order to restore herbivory and reduce macroalgae.



Photo © Brian Skerry/National Geographic

Protect Parrotfish

Our main efforts to increase herbivory have focused on protecting herbivorous fish. This was achieved in Belize (2009), Bay Islands, Honduras (2010) & Guatemala (2015). Protection is being drafted in Quintana Roo, Mexico, leaving the Caribbean coast of Honduras as the only gap to achieving MAR-wide protection.



Photo © callieoldfield

Caribbean King Crab

The importance of crabs in controlling macroalgae has been largely overlooked. Research in Florida has demonstrated crabs are efficient herbivores. HRI and partners will implement a pilot study and encourage private sector aquaculture, which could be a source for population enhancement efforts.



Photo © Michael Webster

Long-spined Sea Urchin (Diadema)

In the 35 years since the mass mortality of *Diadema* urchins, little natural recovery has occurred in the MAR (0.12 to 0.16/m² from 2006 to 2016). HRI and partners will study urchin larval recruitment, lab rearing and translocation techniques in an effort to aid their recovery.



Photo © State of Hawaii DLNR

Reef Weeding

Direct removal of macroalgae by trained divers can jumpstart their reduction, which can then be maintained by more efficient marine herbivores. In Hawaii, managers experimented with a reef vacuum to remove harmful algae. HRI and partners will implement a manual algal removal project next year.

REDUCE NUTRIENT POLLUTION TO IMPROVE WATER QUALITY

Improve Sewage Treatment

Nutrient pollution is the key driver of macroalgae proliferation. HRI continues our commitment to reduce the sources of nutrient pollution, including:

- Work with regulatory agencies to reduce fecal bacteria in sewage effluents to levels that comply with Class 1 waters in the Cartagena Convention. Honduras is the only country yet to sign this convention and Belize is the only country that has fully ratified it.
- Build or modernize treatment plants, strengthen local water boards and assist residents in getting connected, as demonstrated in Roatan.
- Explore new innovative technologies such as Omega Global Initiative's closed systems that turns sewage waste into biofuel, capturing CO₂ (http://omegaglobal.org/).

Reduce Land-based Run-off

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

Restore Natural Filtration

- Stop mangrove clearance by enforcing existing regulations and prosecuting offenders.
- Prevent direct and indirect loss of seagrass from dredging operations.
- Implement mangrove reforestation and seagrass restoration efforts.
- Conduct pilot studies for enhancing populations of sponges, bivalves and other natural filtering species.

MARINE PROTECTED AREAS



(sexually mature) in 2016

¹ Just Released: "Biophysical Principles for Designing a Network of Replenishment Zones for the Mesoamerican Reef System". Download at healthyreefs.org/cms/mpa/² http://eco-audits.healthyreefs.org/

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Fish Biomass (g/100m²)

REPLENISHMENT ZONES ARE WORKING TO RESTORE POPULATIONS

Our data clearly show fish have increased within the RZs in the past decade, but not in open fished areas. These RZs are replenishing some fishing areas, but 3% is not sufficient to reseed the remaining 97%. By increasing the amount and monitoring the results, we can determine the optimal RZ design needed for an effective network that maximizes fisheries production and conservation.

ACTIONS

FOR ENHANCING OUR RZ NETWORK

- Represent 20–30% of key habitat types in RZs
- Reduce risk by replicating RZs in each subregion
- Protect critical and unique areas
- Incorporate connectivity among RZs

Photo © A. Tewfik / WCS

Allow time for recovery

RZs BENEFIT COMMERCIAL FISH



Mexico's RZs are working, as shown by the significant increases in commercial fish. RZs were established, enforced and monitored in collaboration with local fishers. While some poaching exists, fisher patrols and tourism presence in other closed areas help deter poaching.

RZs BENEFIT HERBIVOROUS FISH



Belize fully protected herbivorous fish in 2009, a global milestone in ecosystem-based fisheries management. As a result, herbivorous fish have increased overall, particularly inside the RZs. Some poaching outside of RZs still occurs and requires better enforcement.

NO RZs NO BENEFITS



Guatemala's decline in fish biomass corresponds to its lack of any RZs in coral reef habitat to help restore populations. Biomass values are the lowest in the region. Urgent action is needed to create RZs and limit destructive fishing gear.

BIG FISH HAVE BIGGER RISK

69,830 fish counted in 148 sites Over 88,800m² • 13 tiger grouper 0 Goliath grouper (largest)

Different species of fish become mature (able to reproduce) at very different sizes (ages). The larger fish are more likely to be overfished due to the time it takes to reach maturity. Most of the reproductive fish surveyed were found inside the fully protected replenishment zones. Bigger fish have more offspring, enhancing replenishment.





16cm Graysby 457 fish 29% mature



67.7cm Black Grouper 13 fish 8% mature

COLLABORATING FOR CONSERVATION

Healthy reefs are essential to sustaining our cultural identity, tourism-based economies, traditional fisheries and our future.

HRI's partners have ongoing conservation strategies aimed at sustaining fisheries and restoring the health of the coral reef, seagrass and mangrove ecosystems that support them. Together, we are rebuilding reef health through community-led management, reducing harmful fishing methods, and harmonizing fisheries regulations. Transitioning fisheries toward sustainability will take time, but our collective efforts are already having positive benefits for our communities and reef. The diagram below illustrates our key strategies to restoring fish populations, with examples of success on the following page.



ACHIEVING MORE TOGETHER

Today 69 local, national and international conservation, research, private and government agencies are collaborating within the Healthy Reefs for Healthy People Initiative—the first effort of its kind to collectively and qualitatively assess reef health in biennial Report Cards with science-based management recommendations, followed by Eco-Audits that track their implementation. (Photo: Partners at our 5th Regional Partner Meeting). www.healthyreefs.org



SUCCESS STORIES **BRINGING BACK OUR FISH**



MARINE REFUGES IN AKUMAL

In 2015, the Federal government established the Fish Refuge Zone in Akumal, comprising an area of 9.88 km²—first refuge out of the limits of a natural protected area. In 2016, the Refuge Area for Aquatic Species Protection in Akumal was decreed.



PROTECTION OF NASSAU GROUPER IN SIAN KA'AN

In 2013, the first fish refuge (4.28 km²) on a fish spawning aggregation in Mexico was created in Sian Ka'an. In 2016, two 15 km² fish refuges were created. All the known Nassau Grouper spawning sites in the Sian Ka'an region are now protected.



AGING ACCESS TO EMPOWER FISHERS AS STEWARDS

In June 2016, Belize inaugurated its national managed access system, ending open access fishing for its 3,000 fishers, now limited to 1 of 9 zones. Each zone is managed by elected fishers, increasing accountability, data availability, and incentives to reduce illegal fishing.



SPAWNING FOR SUSTAINABILITY

Belize's Spawning Aggregation (SPAG) Working Group has met and monitored the 13 fully protected SPAG sites since establishment in 2003. Several of these SPAG sites have active enforcement and show signs of recovery and fairly stable populations (1,000-3,000 fish).



COLLABORATIVE AGREEMENTS FOR CLOSED FISHING SEASONS GENERATE WIDER SUPPORT AND COMPLIANCE

Since 2006, refining the closed season calendar has been one of the most dynamic, participatory and successful fisheries management tools in Guatemala. Fishermen, academics, government and non-governmental organizations come together to review and set the closures each year.



MOTAGUA RIVER FORUM: WORKING TOWARDS THE PROTECTION OF NATURAL RESOURCES

Organizations are focusing on solutions to the political, economic, social, cultural and environmental problems affecting Izabal. A recent action will focus on diminishing solid waste coming from the river to the ocean.

PRIVATE SECTOR PROVIDES

The private sector in Guanaja is helping

"Environmental Fund" was created through

manage fish replenishment zones. An

a \$10 voluntary donation from visitors,

A HELPING HAND



RIGHTS-BASED FISHERY FIRST FOR HONDURAS

In April 2017, three local communities near Tela agreed to implement a managed access fishery and have stricter regulations in Micos Lagoon. This is now the first rights-based fishery implemented in a coastal lagoon in Honduras.

RECOMMENDATIONS

HRI partners have recommended management solutions for over a decade. Some of the 28 actions measured in our Eco-Audits have been implemented fully, whereas some partially and others not at all. Overall, these recommendations have been 62% implemented, across the 4 countries (see eco-audits.healthyreefs.org). This year we highlight these three top priorities for immediate action:

Marine Protected Areas

Increase the area under full protection to 20% by 2020.

Ecosystem-based Fisheries Management

Protect parrotfish throughout the entire Mesoamerican Reef.

Sanitation and Sewage Treatment

Demonstrate improvement in sewage treatment in at least one additional location per country.

RECOMENDACIONES

Los socios de HRI han recomendado soluciones para mejorar la gestión durante más de una década. Algunas de las 28 acciones medidas en nuestros Informes de Avances han sido implementadas completamente, mientras que algunas parcialmente y otras no han sido implementadas. En general, estas recomendaciones han sido implementadas en un 62%, en los 4 países (ver http://www.healthyreefs.org/cms/es/informe-deavances/). Este año destacamos estas tres prioridades principales que requieren acción inmediata:

Áreas Marinas Protegidas

Aumentar la cobertura de áreas protegidas en un 20% para el 2020.

Gestión de Pesquerías

Basada en el Ecosistema

Proteger a los peces loro en todo el Arrecife Mesoamericano.

Saneamiento y Tratamiento

de Aguas Residuales

Demostrar mejoras en la calidad del agua asociadas con la mejora en el tratamiento de aguas residuales, en al menos un sitio adicional por país.



Download additional resources and spanish graphics



for Healthy People



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