

Measuring the Health of the Mesoamerican Reef Through Ecosystem Health Indicators

Midiendo la Salud del Arrecife Mesoamericano a través de Indicadores de Salud del Ecosistema

La Mesure de la Santé du Récif Mésoaméricain par des Indicateurs de Santé de l'Écosystème

PATRICIA KRAMER, MELANIE MCFIELD, LORENZO ÁLVAREZ FILIP, IAN DRYSDALE,
MARISOL RUEDA FLORES, ANA GIRÓ*, and ROBERTO POTT

Healthy Reefs Initiative
17 Calle A 7-03, zona 10, Guatemala City, Guatemala.

*anagiro@gmail.com

EXTENDED ABSTRACT

The Healthy Reefs Initiative (HRI) is a multinational effort of over 60 NGOs, research institutions, donor organizations and government departments collaborating to enhance conservation efforts in the Mesoamerican Reef. HRI generates biennial, user-friendly Report Cards on the health of the reef and Eco-Audits that evaluate each country's degree of implementation of management actions.

The 2015 Report Card data were collected by 12 partner organizations and the HRI team. Surveying a total of 248 sites 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. 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') (Table 1). 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').

The majority of the 248 reefs surveyed in the 2015 Report were found to be in poor (40%) or critical (17%) condition, mainly due to the low biomass of commercially important fishes and high fleshy macroalgae cover. Only 9% of sites, mainly in the Bay Islands (Honduras), ranked as good or very good. The simplified reef health index is based on ranked values for *coral cover*, *fleshy macroalgal cover*, *herbivorous fish biomass* and *commercial fish biomass*.

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

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

Table 1. Reef Health Index

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. Of concern is that fleshy macroalgal cover was the only indicator to remain 'poor' over time.

Trends in the Mesoamerican Reef

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 m²), but increased over the years. Honduras had biomass twice as high (4,483 g/100 m²). 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 m² (except one) were within MPAs, suggesting protection allows parrotfish to grow large.

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 m²) increased slightly since 2006, but is still at functionally low levels. Mexico's high biomass (1,387 g/100 m²) 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 repeat 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.

The majority of reefs throughout the Mesoamerican Reef were found to be in poor (40%) or critical (24%) condition, with only 10% ranked as good or very good, and 25% in fair condition. However, this report did measure a slight improvement in the overall reef health when taking in account only reef sites that were monitored in previous assessments (Report Cards of 2008 and 2010). In light of global coral reef declines, even such a slight improvement is noteworthy and encouraging. While the RHI is useful for summarizing the complexity of coral reefs, taking a closer look at individual indicators is needed to understand the sources of declines and fine-tuning management actions.

KEYWORDS: Replenishment zones, reef, health

LITERATURE CITED

Kramer, P., M. McField, L. Álvarez Filip, I. Drysdale, M. Rueda Flores, A. Giró, and R. Pott. 2015. *2015 Report Card for the Mesoamerican Reef*. Healthy Reefs Initiative (www.healthyreefs.org).

Melanie McField – Director, Healthy Reefs Initiative, Smithsonian Institution.

mcfield@healthyreefs.org

Marisol Rueda Flores – HRI Coordinator for Mexico.

rueda@healthyreefs.org

Ian Drysdale – HRI Coordinator for Honduras.

drysdale@healthyreefs.org

Ana Giró Petersen – HRI Coordinator for Guatemala

giro@healthyreefs.org

Roberto Pott - HRI Coordinator for Belize

pott@healthyreefs.org

Patricia Kramer- Science and communications

p_kramer@bellsouth.net