

MESOAMERICAN REEF FUND FINAL TECHNICAL REPORT



Healthy Reefs
for healthy people

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Executive Summary

Healthy Reefs for Healthy People Initiative (HRI) is a globally unique international collaborative program of coral reef-focused organizations dedicated to safeguarding the Mesoamerican Reef (MAR). HRI now includes 74 local, national and international partner organizations, including all of the region's MPA managers, the main research and conservation organizations as well as relevant government departments. HRI's work is largely focused on using science to help enhance the "boots on the ground – or fins in the water" direct management efforts of these partners. By incorporating sound scientific evaluations into a collaborative process of establishing management recommendations, we are fully implementing the [adaptive management cycle](#) on a grand scale within the Mesoamerican Reef. HRI developed two innovative evaluation tools to enable quantification of this management cycle. During this grant cycle (October 2016 to December 2020), HRI produced and launched two reef health-focused [Report Cards](#) (2018 and 2020) and one governance focused [Eco-Audit](#).

Both Report Card launches were held simultaneously in all four countries, included the participation of key partners (NGOs, academia and government officials), and garnered substantial press coverage - all highlighting the importance of the report cards as a management tool and calling for specific actions, such as the creation of more fish replenishment zones on the reefs and the need to enhance sewage treatment and sanitation.

During Mesoamerican Reef Day on March 10th, 2021 [HRI launched its fourth Eco-Audit](#), a systematic and transparent evaluation of the degree of implementation of 28 recommended reef management actions. This Audit measured actions completed through December 2020 and found the regional score had improved from 54% in the first Eco-Audit of 2011, to 62% in 2016 and 66% now. While this does demonstrate some progress, increasing the implementation by 1.2% per year on average over the last decade is far too slow. This year Belize again had the highest score (71%), but the smallest increase in score (5% since 2011). Honduras had the second highest score (66% with a 12% increase overall). Mexico is close behind with the third highest score (64%), scoring a 10% increase since 2011. Guatemala maintains the lowest overall score (62%) but has recorded the largest overall progress (18%). The Regional overall Eco-Audit score increased by 2% per year from 2011-2016 but slowed to 1% per year thereafter, despite our urgent calls in every Eco-Audit and Report Card to implement these needed management actions if we are serious about protecting the reef. <https://eco-audits.healthyreefs.org/>

Although the overall progress is not as swift as we expected, several management recommendations which HRI set as our priority focus have been implemented or progressed substantially, including: the protection of parrotfish in each of the four countries of the MAR; the increase in fully protected replenishment zones in each country, and the increased awareness and improvement of regulation of sewage and sanitation including the signing of Cartagena Convention by Honduras in 2019. HRI's core efforts of convening standardized quantitative evaluations and public reporting on reef health have been fully achieved. In addition, HRI has maintained its leading regional communications role, participating in over 150 (video, television and print media) within this grant cycle. These

efforts have raised the alarm on new threats such as the Stony Coral Tissue Loss Disease (SCTLD) and helped HRI convene region-wide monitoring and public reporting efforts for both coral bleaching and disease which can now be tracked with a new online tool, co-developed with partner AGRRA ([https://www.agrra.org/coral-bleaching/add link to coral disease watch](https://www.agrra.org/coral-bleaching/add-link-to-coral-disease-watch)). This promotes a unity of vision and strategic purpose for reef health through the MAR. HRI has continually improved and expanded the partnership and products over the last 14 years.

Key Collaborative Achievements in the MAR include:

- The MAR has 58% of its territorial sea within MPAs, but only 3% in fully-protected Replenishment Zones (RZs).
- Since 2011, six new MPAs have been designated. Mexico: Mexican Caribbean Biosphere Reserve (2016) and North Cozumel Flora and Fauna Protection Area (2012). Belize: Turneffe Atoll Marine Reserve (2012). Honduras: Refugio de Vida Silvestre Laguna de Guaimoreto (2016), Refugio de Vida Silvestre Cuyamel (2016), Refugio de Vida Silvestre Marino Bahía de Tela (2017).
- Fully-protected Replenishment Zones (RZs) have increased from 1610km² (2011 Eco-Audit) to 2020 km² in this study, but as a percent of the territorial sea it remains at 3%.
- 15% of the MAR's coral reef area is now fully protected in Replenishment Zones (RZs).
- Parrotfish are now fully protected in Belize, Guatemala, all of the Bay Islands in Honduras, and the Mexican Caribbean.
- The Cartagena Convention's Land Based Sources of Marine Pollution protocol has now been ratified by Belize and Honduras, and several new or improved sewage treatment facilities have been installed in Guatemala and Honduras within the last four years.
- Regular standardized coral reef monitoring is conducted at least every 2 years and is used to guide management and recommendations promoted in widely accessible Report Cards.
- All data are open-access online at www.healthyreefs.org.

The HRI regional team has been a consistent voice for marine conservation across the region, participating in at least 200 national or regional meetings since 2016. We are also taking the innovative success stories from the MAR on the road internationally – to expand awareness and hopefully the donor interest. In addition to presenting in over 40 international conferences, we quickly adapted to digital outreach during the COVID19-restrictions of 2020, and [convened 6 of our own webinars](#), organized a special Mesoamerican Reef session for the [virtual Global Coral Reef Week](#) and participated in at least 30 others of partners and international groups. HRI also leveraged the opportunity presented by COVID19-cessation of tourism to develop a water quality monitoring program linked to tourism-sewage inputs along with partner, CORAL, which has started in Mexico with 2 sampling efforts and is now underway in Honduras and Belize. Our planned reef training and monitoring season of 2020 was moved to 2021 due to COVID19.

3. Objectives: as established in the approved proposal.

- Convene and Coordinate the region's collaborative monitoring and communication about the overall health of the Mesoamerican Reef and our efforts to manage it.
- Healthy Watersheds: Working alongside existing local and national water entities, HRI will promote the adoption and replication of effective management schemes

that will allow better management of potable and waste water in coastal communities improving reef health (and community health).

- Healthy Fisheries: HRI aims to advance the network of scientifically justified replenishment zones or no-take fish refuges, protecting at least 10% of territorial sea by 2020, including 75% of the known fish spawning sites. Increase herbivory and reef health by protecting parrotfish region wide by 2018.
- Healthy Communities: Convey consistent, scientific information and recommendations to policymakers, decision-makers and the public, such that the connections between reef health, human health and socioeconomic sustainability, result in effective conservation action at an unprecedented scale.
- Healthy Futures: Expand HRI science to address main impediments to reef health by exploring management interventions and monitoring specific responses including emergency bleach watch monitoring if needed to improve our understanding of reef resiliency.

4. Project progress:

The originally planned methodology for each of the objectives still applies. Each of the objectives and accomplishments is explained in the following paragraphs.

A. Convene and Coordinate the region's collaborative monitoring and communication about the overall health of the Mesoamerican Reef and our efforts to manage it.

- ***Collaborative training and reef monitoring with partners***

A total of 126 people have been certified in AGRRA through 8 training sessions conducted during this granting period: 2016 - 1 training in Honduras, 2 Mexico; 2017- 1 Turks and Caicos; 2018- 1 training Belize, 1 Mexico, 1 Honduras and 1 in Bahamas. Specifically in the MAR region a total of 97 field biologists have been trained and certified by HRI in AGRRA HRI's Ana Giro helped in the training of 15 biologists in Turks and Caicos and 14 people in the Bahamas and also introduced them to the concepts of reef health and report cards. This brings our 12-year total to 19 training courses and 250 field biologists trained by HRI in the MAR.

Reef health monitoring was successfully carried out in the 4 MAR countries during 2016 and 2018, the data collected was included in our reef health Report Cards (2018 and 2020). A total of 319 sites were monitored and evaluated in 2016 and 286 sites in 2018. COVID19 restrictions postponed the planned 2020 training and monitoring. HRI and AGRRA have developed more online digital training tools available at www.agrra.org.

In 2018, Belize officially adopted AGRRA to replace the MBRS methodology, after HRI made a successful argument to support the switch and fully integrate these important data collecting partners into our database. This change allows greater reef health monitoring data comparison between the four MAR countries.

- ***Enhance partner capacity and participation with HRI***

In addition to the core AGRRA reef monitoring training, HRI has organized training sessions in Mexico, Belize, Guatemala and Honduras (virtually in 2020) regarding the stony coral tissue loss disease (SCTLD) identification, actions needed monitoring and treatment.

These trainings enhanced partner capacity and participation with HRI during our monitoring season.

With additional funds leveraged through Smithsonian we are awaiting COVID19 travel restriction lifting to begin a research project exploring the development of potential coral probiotic treatments using Belizean coral biomes.

- ***Regional Meetings with Partners:***

HRI hosted two Regional Partner meetings during this granting period time frame:

- December 2016 in Playa del Carmen, Mexico where we reviewed data and outlined the 2018 Report Card.
- October 2018 in Caye Caulker, Belize where we reviewed data and outlined the 2020 Report Card.

The HRI regional team has been a consistent voice for marine conservation across the region, participating in at least 200 national or regional meetings since 2016. We are also taking the innovative success stories from the MAR on the road internationally – to expand awareness and hopefully the donor interest. In addition to presenting in over 40 international conferences, we quickly adapted to digital outreach during the COVID19-restrictions of 2020, and [convened 6 of our own webinars](#), organized a special Mesoamerican Reef session for the [virtual Global Coral Reef Week](#) and participated in at least 30 others of partners and international groups.

Examples from 2019 include:

- Mesoamerican Region Stony Coral Tissue Loss Disease Meeting (October 8, 2019)
- Mesoamerican Reef Rescue Initiative Meeting (October 9-10, 2019)
- MAR Fish Network Workshop – Fish Spawning Aggregation Monitoring (November 21-22, 2019)
- SOCMON social indicators workshop in Roatan, HN. (December 2019)

Due to the pandemic restrictions, the HRI team postponed other planned in-person regional meetings in 2020, but we plan to reschedule them in 2021 or when possible.

- ***Supporting Action-specific Networks***

HRI's Guatemala country coordinator, Ana Giró is the current president of the MAR Reef Restoration Network and has been actively involved in fundraising for the network through the writing of proposals presented to the MAR2R project. She has also written reports for the network and ToR for the network's consultancies. Ana is also the country representative for the MAR Sustainable Fisheries Network and has been actively involved in meetings and workshop planning.

HRI's Belize coordinator, Nicole Craig, sits on the Coastal Advisory Committee for the Turneffe Atoll Region and the Belize's Spawning Aggregation Monitoring network. She is also a member of the National Coral Reef Monitoring Network and in this capacity, she serves as one of the core SCTLTD response personnel. Both Belize and Mexico coordinators are members of the SCTLTD Caribbean Cooperation Team.

Mexico's Coordinator, Melina Soto, is a member of the selection committee for the Mesoamerican Reef Leadership Program, of the Mexican SCTLTD Action Plan, the National Wetland Committee, the Fish Replenishment Zones promoting initiative "Alianza Kanan Kay" and the Yucatan Peninsula Watershed Committee. HRI holds a seat in Quintana Roo's state coral restoration program technical committee, overseeing the parametric

insurance funds allowance. HRI is also participating in the elaboration of the first Report Card for the Mexican Pacific Reefs with Wildcoast and CONANP.

In Honduras, HRI's Coordinator Ian Drysdale is overseeing the implementation of the Polo's Water Board (and sanitation system) improvements through several projects and grants, including MAR Fund and CORAL grants. They also submitted a new proposal to continue making improvements to the plant and the wastewater system in West End, which was recently approved. HRI is an important member of GIZ's 4-country project "Application of innovative tools for the conservation and restoration of coral reefs in Honduras", where HRI was a co-author of the approved proposal. Also, HRI is co-author of the Bay Islands National Marine Park's updated management plan.

- ***Enhance public awareness and support for marine conservation***

The HRI Country Coordinators are seen as key marine conservation leaders in their respective countries, with capacity and ability to disseminate information clearly on key marine issues, reef health and conservation. We have continued to work with the media and have news being published regularly in Mexico and Guatemala. All the public dissemination of information is essential to build an informed electorate that will support stronger regulations.

We continue to share information through our Regional Partner Meetings, Report Cards, Eco-Audits, Monitoring Trainings, open access data portal and social media. Special events for Mesoamerican Reef Day, World Ocean Day, Earth Day and Smithsonian's #Earth Optimism has been held most years. Experts presented their work and reached the general public.

Issue-based video campaigns were developed for different reef themes, along with Mar Sustentable, for our social media outlets Facebook, Instagram, Twitter and YouTube. A few examples on each theme as follows:

- [Sea turtles](#)
- [Sharks](#)
- [Ocean microorganisms](#)

Successful Launches of the 2018 Report Card in all four countries on January 10th, 2018, as an opening to the International Year of the Reef.

Our total media coverage included over 72 media stories in different media outlets. During this granting period, HRI also launched its 2020 Mesoamerican Reef Health Report Card. The report was launched simultaneously on all four countries on February 13th, 2020.

The 2020 Report Card not only includes valuable rigorous scientific analysis and information on the state of the reefs, but it also includes information on important reef conservation efforts and measures such as the new Stony Coral Tissue Loss Disease (SCTLD) outbreak, scaling up restoration in the MAR, sustaining connectivity through mangroves and fish spawning aggregations, how our human footprint is affecting oceans and how the countries have committed to achieving the SDGs by 2030. The launch events garnered substantial press coverage in-country as well as international media, with over 60 stories found in print, TV, radio and online. All 4 launch events included at least 60 guests and had the participation of key partners (NGOs, academia and government) in each country, all highlighting the importance of the Report Cards as management tools and calling for specific actions, such as the creation of more fish replenishment zones on the reefs and the need to enhance sewage and sanitation efforts. This Report Card also

garnered substantial media coverage with over 50 stories, as shown in the launches reports.

● **Major 2020 Reef Health Report Card findings:**

- The Reef Health Index (RHI) has decreased for the first time in 12 years, from 2.8 in 2016 to 2.5 in 2018.
- Belize obtained the highest RHI and the only improvement from 2.8 to 3.0.
- Mexico's and Guatemala's RHI remained at 2.8 and 2.0, respectively.
- Honduras' RHI declined from 3.0 to 2.5, mainly from dramatic reductions in fish.
- Fleshy macroalgal cover declined (23% to 20%), reducing competition with coral.
- Parrotfish are now protected across the region, except for Honduras, where parrotfish are protected only in the Bay Islands.
- Stony coral tissue loss disease severely affected the Mexican portion of the MAR in July 2018 and reached northern Belize in July 2019. The disease removed over 30% of 22 affected species in Mexico in about one year
- Ecosystem restoration efforts, such as enhancing populations of key herbivores and reef-building corals are underway but need massive scaling up.
- Expanding the amount of fully protected areas (including fish spawning sites) and increasing enforcement of fishing regulations are needed to reverse the declines in fish populations.
- Improving sewage treatment throughout the region is necessary to protect human and reef health. The pathogens and other contaminants in wastewater or septic leachate, can fuel both diseases and algal proliferation, reducing coral growth, recruitment and survival.
- Climate change impacts (ocean warming, acidification and sea level rise) are increasing.

As mentioned in the summary of the report, during Mesoamerican Reef Day on March 10th, 2021 [HRI launched its fourth Eco-Audit](https://eco-audits.healthyreefs.org/), a systematic and transparent evaluation of the degree of implementation of 28 recommended reef management actions (all data gathering, workshops and analysis were held during 2020). The overall regional Eco-Audit score improved from 54% in the first Eco-Audit of 2011, to 62% in 2016 and 66% now. While this does demonstrate some progress, increasing the implementation by 1.2% per year on average over the last decade is far too slow (just 4% since 2011). This year, Honduras has achieved the second highest score (66% with a 12% increase overall). Mexico is close behind with the third highest score (64%), scoring a 10% increase since 2011. Guatemala maintains the lowest overall score (62%) but has recorded the largest overall progress (18%). The Eco-Audit is grouped into seven general themes: Marine Protected Areas, Ecosystem-based Fisheries Management, Coastal Zone Management, Sanitation and Sewage Treatment, Research, Education and Awareness, Sustainability in the Private Sector, and Global Issues: <https://eco-audits.healthyreefs.org/>

While our primary efforts are focused on effectively communicating scientific information with partners and policy makers in the Mesoamerican Region, our reef conservation efforts also extend beyond our MAR borders with the aim of raising global awareness and donor interest in the Mesoamerican Reef.

In 2018, National Geographic's Encounter Exhibit in the heart of New York's Times Square, now features Melanie's voice in a lively poem message about loving corals. The permanent exhibit featured 100 plastic bottles transformed into inspirational art by Asher Jay, each with a recorded message about ocean conservation from 100 global ocean leaders. [Access web version.](#)

Healthy Reefs was also a part of a Smithsonian Institution funded filming of the coral disease outbreak in Belize and a German television and film documentary filming (October 2019) that will bring Belize's work with SCTLD and the repercussions of the disease to a global stage. Additionally, Healthy Reefs has presented at the workshop hosted by the Earth Journalism Network that focused on improving environmental journalism in Belize. Local journalists were taught about the reef report card and how to translate its key messages to their readers, as well as how to spot environmental stories and issues that need to be shared.

Webinars organized or led by HRI to enhance public awareness and support for marine conservation during the 2020 COVID19 Pandemic

- **“Global Coral Reef Week Virtual Conference Session: “Solutions from the MAR”**: Session of presentations organized by HRI team focused on the main topics on reef health and some solutions implemented in the MAR by HRI partners such as water treatment, coral and mangrove restoration, fish replenishment zones, etc.:
- **Reef Health and the importance of international commitments for adequate water treatment. Toward the publication of the contaminants limit law in Mexico.** Two sets of Webinars organized by partners Centinelas del Agua, Amigos de Sian Kaan and CEMDA to [raise awareness about the urgent need for law actualization](#) and adequate limits to [protect karst and reefs](#).
- **Reef Health and Climate Change Impacts on Coral Reefs.**
- This webinar was led by HRI and Pixan'Ja with the support of AGRRA, NOAA Coral Reef Watch, Perry Institute of Marine Science and UNEP. The webinar addressed the latest perspectives on coral bleaching for 2020, new technologies, heat tolerant reefs, photogrammetry, and weather models applied to coral reefs.
- **Fish Spawning Aggregations monitoring**
- This webinar was led by CORAL and HRI, Ana Giró was invited to give a presentation on FSA monitoring, technologies including bathymetric mapping and the monitoring protocol. The webinar was given to specific organizations working in Honduras.
- **The Mesoamerican Reef and us-** Month of the Ocean of the Mexican Planetarium Network. Webinar on the importance of the MAR, the main 2020 RC results, the threats and what can be done to save it, to save us. These presentations include: [How to take care of this shared jewel](#).
- **Coral Rescue and Beyond. Hawaii, Florida and MAR experts on how to tackle SCTLD and prepare for the future**.
- Webinar Series on **Herbivory Restoration** via [Parrotfish](#), [Diadema](#) and the [Caribbean King Crab](#).
- **SCTLD**, general overview of the disease, its impacts on coral reefs, actions needed for Guatemala. [Link to the webinar recording](#)

- **HRI & Partners get royal recognition**

HRI was honored to be recognized by His Royal Highness the Prince of Wales at an inaugural International Year of the Reef Symposium (January 2018), as one of two exemplary collaborative coral reef initiatives that warrant increased support in order to help



protect reefs from the effects of climate change. [See full speech](#). HRH The Prince of Wales said, "We must strenuously augment those initiatives that can provide platforms for future action; such as the Coral Triangle Initiative, a partnership of six countries in South East Asia working together to sustain the extraordinary marine diversity in that incredibly rich area of ocean; or, the Healthy Reefs for Healthy People Initiative, that works with over 50 partner organizations to track and improve the health of the Mesoamerican Barrier Reef".

All coordinators have given talks and conferences in national meetings about HRI work, Report Cards and Eco Audits after the official launch event, these meetings have helped enhance public awareness and support for marine conservation in the MAR. HRI has been presenting in regional and international conferences such as GCFI, AMLC, Mexican Society for Coral Reefs, European Society of Reef Studies symposium, International Society for Conservation Biology, and the International Coral Reef Symposium - where we organized an entire session.

The HRI team also published a case study of Collaborative Adaptive Management in the Mesoamerican reef, in a UNEP book entitled "Handbook on the Economics and Management of the Sustainable Oceans.

Social media is a great tool used by HRI to enhance public awareness. In the last couple of years, HRI's social media programming (for Facebook, Twitter, Instagram and YouTube) included at least one 'institutional' or original content publication per week. Previously, the institutionally produced content happened only once a month. By following the plan at least once a week, we have increased our institutional content a minimum of 400% up to 800% in some months.

- **Mesoamerican Reef Data Explorer Platform Launch**

In commemoration of the Mesoamerican Reef Day (March 10, 2020), HRI launched its Mesoamerican Reef Data Explorer Platform in collaboration with Atlantic and Gulf Rapid Reef Assessment (AGRRA). The Launch was made via Facebook Live on March 11th, 2020 (since March 10th was a Sunday and for media traffic it was better to have the launch on a weekday). One stream was made in [Spanish](#) and one in [English](#).

Users were able to visualize the change on reef health data collected over 10 years, between 2006 and 2016, through interactive maps and pictures. Data is accessible by site and by indicator used to determine the Reef Health Index: coral cover, macroalgae cover, herbivorous and commercial fish biomass.

The major threats such as coral bleaching and the new stony coral tissue loss disease are also available in the Mesoamerican Reef Data Explorer Platform.

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.

[Link to the Data Explorer](#)

B. Healthy Waters

- ***Effective management of wastewater in the West End community improves local water quality and reef health.***

HRI's direct involvement with West End's water management entity, Polo's Water Association has been a success helping secure a donation of two 20' containers, which were moved to the treatment plant to be transformed into Polo's new office and a storage facility. This new office and storage space will translate into monthly savings of \$900. There have been several grants for needed improvements to the wastewater system and treatment plant including increasing the solar panels to continue reducing electric costs at the plant, installing new pumps at three pump stations: Casa Calico, Coconut Tree and Toucan, this work was carried out in October and November 2020. With support from CORAL, a new pump station was built in the area of Miller Ave. This new infrastructure, when completed, will allow connecting 22 more houses and businesses to the treatment system. Polo's currently fundraising to build and install the secondary and tertiary lines to connect these clients.

Until March of 2021, the treatment plant in West End has treated nearly 140,000,000 gallons of sewage. The local water management entity, Polo's Water Association, has been spearheaded by HRI's Honduras Coordinator and his collaboration has led to acquiring grants to better improve and increase treatment.

The West Bay treatment plant committee, called Asociación de Servicios para el Desarrollo de la Comunidad de West Bay de Roatan (ASPWEST) has been created in January 2017 to manage the trust fund responsible for funding the construction of the new treatment plant. ZOLITUR, IHT and Instituto de Desarrollo Comunitario, Agua y Saneamiento (IDECOAS) have all signed the agreement and are awaiting final approval from the Ministry of Finance. Honduran President, Mr. Hernandez, publicly stated that the West Bay treatment plant will be built.

One of the programs where HRI was involved was generating a public awareness campaign about the links between wastewater, public health and reef health. Now >70% of households in West End have connected to the treatment system, with over 8 million additional gallons of sewage being properly treated per year as a result of these efforts. Polo's incorporated a neighboring failing water board (Half Moon Bay Water) and is assisting two additional water boards on Roatán (Los Fuertes and Los Maestros) in improving their collection and treatment systems. This work is expensive and incremental but it is progressing, with measured decreases in contaminants.

[Honduras' signing and ratification of the Cartagena Convention's](#) protocol on Land-based sources of Marine pollution - is paving the way for strengthened wastewater treatment in that country, one of the greatest achievements on this theme.

- ***Replicate successful Water Board management scheme in two more areas by 2020***

Over the last few years, HRI has helped provide a successful example and pilot program of improved water and sanitation management in the town of West End, Roatan, Honduras. Our direct involvement has led to having 98% of the community connected to the local wastewater treatment plant: 284 connections out of a possible 290 without major

infrastructure built. Polo's Water has a total of 370 potable water connections, but not all of these can be connected to the treatment system without investing in major infrastructure.

Two other local water boards have reached out to Polo's Water for assistance. These boards are struggling to provide safe drinking water, with sewage treatment beyond their scope due to their inadequate billing and funding situations. Meetings were held with both Los Maestros and Los Fuertes water boards, where general guidelines of our management were shared. The two boards were tasked with creating an inventory of connections, in order to have accurate numbers. These will allow us to work towards securing grants or donations to purchase water meters, the first and most important step in creating an efficient management scheme.

To date, these two water boards have not responded to calls about their progress, so the expected result was not achieved. They are not yet in a position to use Polo's water management scheme: from conversations with community members at Los Fuertes, the Board of Directors that runs the Patronato and Water Board is very complicated. They have been in power for many years, some of the members are also political figures in Roatan. The community members we spoke to expressed that they have been wanting to elect a new board, but the current one does not want to let elections happen. The Patronato that runs the water board in Los Maestros feel overwhelmed with a large debt towards the electrical company (RECO). This debt was created for many reasons: 1. They were not using water meters to charge for water and sanitation; 2. The Roatan Municipality was paying 50% of the electrical monthly costs. Back in 2017, the Municipality decided to stop these payments, and so far, Los Fuertes has not been able to regain this payment or pay the entire operational monthly costs. Due to these reasons, Polo's/HRI cannot continue forward in helping them implement an adequate management scheme. Both boards have been told that Polo's/HRI will support them whenever they feel they are ready, even if it is outside the scope of this project.

A document was created with MAR Fund's support which delineates how Polo's Water Association has carried out the proper management of water resources, which can be found here in English and here in Spanish.

- ***8 coastal municipalities are improving sanitation***

IDB has created a study that identifies the water and sanitation needs for 8 coastal municipalities. The sites that are priority at the moment are Coxen Hole and West Bay in Roatan. IDB will soon invest \$600,000 in technical collaboration for these two sites. The plan was originally scheduled for 2020 but has been delayed due to COVID-19 restrictions.

- ***Identify new water-treatment technologies to improve wastewater treatment in the MAR***

Polo's water has identified micro-bubble diffusers as an alternative option for air blowers at the local treatment plant. This technology is seldom used in Municipal or "package" treatment plants, and although the initial investment can be substantial, in the long-run this technology pays off as it is easier to maintain, lower electrical and pump replacement costs. Polo's Water will now install this infrastructure thanks to a MAR Fund awarded grant in their 13th project cycle.

At the residential level, Polo's Water is offering on-site treatment of sewage in certain septic tanks. The technology is called Pirana and is built in California. This technology converts a sealed septic tank into a facultative treatment system, where air and bacteria are injected into the first tank where oxidation achieves breakdown of organic material. The anaerobic section occurs once the treated effluent leaves the first tank and continues through the

second anaerobic tank and all the way through the leach field and final in-ground disposal. More info can be found at: <http://www.pirana.biz>

- ***Cartagena Convention ratified by Honduras***

After many years of meetings and emails and letters and more meetings, HRI and its partners were able to celebrate that Honduras has ratified the Cartagena Convention and its 3 related protocols. The ratification was published in the Diario Oficial “La Gaceta” on the 16th of May of 2018

(https://www.dropbox.com/s/w80aufkc78q6nm7/HN3b.22%20Decreto%20No_%209-2018%20Convenio%20de%20Cartagena.pdf?dl=0). This ratification now paves the road for stricter parameters in the treatment and discharge of wastewater, and also allows for the Honduran Government to access international funding related to wastewater treatment.

- ***Working to Improve Waste Water Management in Mexico***

In Mexico, HRI's coordinator has consistently participated in the Yucatan Peninsula, and each municipality of Quintana Roo, Watershed Committee sessions, participating in recommendations and giving talks presenting the RC and Eco Audit. With partners Amigos de Sian Ka'an, Centinelas del Agua and CEMDA, we have continued to provide scientific information through the official watershed committee about the importance of the improving water quality in the karst aquifer and its impact on reef health. We have also combined our efforts to submit a proposal for the Water quality standards law actualization (NOM-001, which has been delayed for more than 20 years) as well as recommendations for the inclusion of karstic aquifer and its special needs into the general Water Law, based on the Cartagena Convention LBS protocol criteria. The definition of karstic aquifer is now included in the State Ecological Equilibrium Law and the federal Rights Law. Several forums and webinars have also been organized (see links in the communication section) to reach a broader audience and strengthen the advocacy. As part of the National Wetland Committee, the HRI Mexican coordinator has assisted several extraordinary meetings for the special case of an emblematic Ramsar wetland protection. In Puerto Morelos, thanks to the meetings held with the Ecology committee, a communication campaign to promote drainage [connection](#) was launched. Partner Amigos de Sian Ka'an has been elected as Yucatan Peninsula Watershed Committee President and HRI renewed its participation and collaboration. In addition, a water quality project was quickly organized with partners Amigos de Sian Ka'an, Centinelas del Agua, CORAL and HRI in order to monitor the effect of the drop of tourism occupation on the coastal water quality of Quintana Roo. This project is being financed by Fundación Gonzalo Río Arronte. A communication campaign, “[Water, our right](#)”, was launched during the pandemic in Mexico, to broadcast the access to water human right and some important facts about water, laws and policies and ecosystem connectivity with partners CdA, CEMDA and ELAW. This campaign rapidly gained momentum and is being launched at the MAR level, with regional HRI partners.

C. Healthy Fisheries

- ***Increase herbivory and reef health by protecting parrotfish region wide by 2018***

The Healthy Reefs Initiative has engaged and spearheaded a vast number of complementary activities supporting ecosystem-based fisheries management including the protection of parrotfish.

Belize has protected parrotfish since 2009, Guatemala first protected parrotfish in 2015 and in 2020 the ban was extended five more years to 2025.

After several years of intense communication efforts and advocacy, the revision process to add species to the Mexican Federal List was opened and HRI, with partners COBI and CEMDA, developed the technical files for 10 species of parrotfish and provided information for 2 species of corals. Meanwhile, based on the information provided by HRI and those federal list technical files, parrotfish protection was included in the management program of the newly created Mexican Caribbean Biosphere Reserve. With delays due to government changes, the Federal Protect Species list (NOM 059) was finally [published](#), including all HRI's proposition, giving parrotfish the higher protection a species can get in the country.

HRI signed a collaboration agreement with the Mancomunidad de Municipios del Golfo de Honduras (Gulf of Honduras Municipalities Conglomerate), which brings together 21 mayors from the Honduran north coast and 1 from Guatemala: Puerto Barrios. This agreement has allowed HRI's Ian Drysdale to propose the protection of herbivores at the municipal level. This proposal was well received and approved by the attending mayors. Next steps are to train local Environmental Municipal Units on the importance of protecting herbivores and helping them draft the adequate legislation, this is still underway and was postponed due to COVID19.

HRI has collaborated with the Interamerican Association for Environmental Defense (AIDA) to enhance public awareness about the importance of protecting parrotfish and assist other countries in the Caribbean to follow the MAR's leadership in this area. Two fact sheets have been made to highlight parrotfish, their importance and why we need to protect them, as well as other herbivore fishes. [The factsheets](#) also highlight coral reef ecosystems and their current threats. HRI participated in a webinar focused on the wider Caribbean describing the [benefits of herbivore protection](#).

- ***Enhance commercial fish biomass and reef health by protecting spawning aggregation sites.***

HRI is working closely with strategic partners within key organizations and continues to push for more conservation science and funding for management in the Cayman Crown reef and other important fish spawning aggregation sites, such as Gladden Spit in Belize; Punta Herrero and Punta Allen in Mexico; Caldera del Diablo and Roatan Banks in Honduras. This will be done through the MAR Fish project, a project awarded to MAR Fund from the French Fund for the Environment (FFEM), in which HRI is a partner and was a coauthor of the grant proposal and has been a strategic partner in the project. The project strives to advance science, conservation and MPA establishment in the Cayman Crown reef. HRI's main objectives are to generate a detailed map of the Cayman Crown reef area, conduct ecological characterization of the reef and monitor the reef health near seven of the fish spawning aggregation sites selected by the project (Gladden Spit, Punta Herrero, Punta Allen, Cayman Crown, Caldera del Diablo and Roatan Banks). The HRI Coordinators and Director are part of the MAR Fish Spawning Aggregations project and also part of the Fish Spawning Aggregation MAR Network. HRI has participated in several meetings as part of a regional project to improve knowledge, monitoring and protection of the Mesoamerican Reef's Fish Spawning Aggregations. In Mexico, COVID restrictions for COBI and the Alianza Kanan Kay work have not permitted to follow with field work and gather the much needed data to build the justification files for FSA protection submission. However, 2 potential sites are being studied: Punta Pájaros near Punta Allen and Cayo Norte in Banco Chinchorro. As soon as field work is permitted within these organizations, the study will follow its course.

The COVID pandemic has also delayed and completely stalled the field work and gathering of data at both Caldera del Diablo and Roatan Banks. Soon, both places will be visited and the needed data gathered.

- ***Increase the percent of sea within fully protected zones to 10% by 2020***

HRI continues to work to increase the percentage of sea within fully protected Replenishment Zones. HRI's six-year effort leading to the protection of the trans-border Cayman Crown Reef in Guatemala and Belize has secured Guatemala's first reef under full protection (no fishing) and the expansion of Sapodilla Cayes Marine reserve, to cover this recently discovered reef.

A technical justification document detailing the need for protection, was first presented in November 2019 to DIPESCA, with a final document (drafted by the HRI with the support of FUNMZ) presented in February 2020. After several follow-up meetings with authorities the [Ministerial Agreement 85-2020](#) was published in the official gazette on May 22, 2020. The agreement highlights the importance of the Cayman Crown Reef and justifies its protection. The agreement declares the Cayman Crown Reef as a temporal space closure zone (No-take zone) for 10 years, prohibiting any kind of fishing in these waters. It is important to highlight that this is a remarkable accomplishment for Guatemala, as it is the first No-take zone declared on a reef area and the biggest replenishment area within the country. The newly declared area totals 202 km² which rises the percent of full protection of Guatemala's territorial sea from a low 0.6% to 12%.

In Belize, the minister of fisheries, forestry, environment and sustainable development, Omar Figueroa, signed a statutory instrument that expands the Sapodilla Cayes Marine Reserve to include the Cayman Crown reef ecosystem in July 2020. The newly expanded Sapodilla Cayes reserve now totals an area covering more than 500 square miles, with a highly protected (but not fully protected replenishment zone due to recreational fishing being allowed) area in Belize's deep-sea (an under-represented habitat in the MPA Network) totaling more than 350 square miles.

HRI data and collaborative conservation efforts were instrumental in gaining these difficult (politically) protections in this trans-boundary reef ecosystem on both sides of the disputed international border.

HRI is an active member of the coalition to promote the design and implementation of fish replenishment zones in Quintana Roo, Mexico, Alianza Kanan Kay, being part of its technical committee, focusing on RZ's and training. Two RZs including spawning aggregation were established in Niche Habin and San Juan in Punta Allen, one in Akumal and another one in Punta Nizuc which are preparing their renewal process and 2 renewed their permit in Punta Herrero and Chinchorro during the grant period (see list here). Based on its great results from Quintana Roo and the growing expressed interest from other states, the Alliance is now expanding across the whole Yucatan Peninsula. AKK's coordinator, HRI's Mexico Coordinator and COBI have designed a quick guide to the design and implementation of Fish Replenishment Zones in Mexico, along with an [explanatory video](#), 18% of Mexico's coral reefs are now under NTZ.

HRI's Director and Guatemalan Coordinator were part of the core team for designing a network of replenishment zones in the MAR, an initiative led by The Nature Conservancy (TNC). They have provided scientific input and collaborated as co-authors in the recently published document named "Biophysical Principles for Designing a Network of

Replenishment Zones for the Mesoamerican Reef System, [the final document](#) was published on February 14th (English) and February 19th (Spanish) 2018.

D. Healthy Communities

- ***Demonstrate the linkages between human, economic and reef health***

Our human communities in the Mesoamerican Region depend on productive coastal ecosystems. HRI is improving the understanding of the linkages between human and ecological health and promoting sustainable development alternatives. This strategy is closely linked with healthy watersheds and fisheries; we need healthy waters and sustainable fisheries in order to have healthy communities. HRI in collaboration with the Global Coral Reef Monitoring Network (GCRMN) with the support of the National Fish and Wildlife Service, is supporting the development of the project: Coral Reef and Human Dimensions Monitoring in the Mesoamerican Reef. A Socio-Economic Assessment Workshop (SocMon) was held on December 9th - 13th 2019, in Roatan, Honduras and aimed to increase capacity for effective integrated coral reef monitoring among GCRMN-Caribbean countries, through the use of socio-economic data for improved standardized and strategic reporting at the regional level. Workshop training was conducted by Arie Sanders and Sara Bonilla (both from the University of Zamorano in Honduras) with 15 participants, including all four HRI coordinators and other key resource managers and practitioners from Belize, Guatemala, Honduras and Mexico. The workshop explained and helped each country plan for the implementation of GCRMN-Caribbean socio-economic guidelines (formerly SocMon), for application in the following MPAs: • Turneffe Atoll Marine Reserve (TAMR), Belize • Parque Nacional Arrecife de Puerto Morelos, Mexico • Punta de Manabique Wildlife Refuge, Guatemala • Bahía de Tela Marine Wildlife Refuge, Honduras.

During the workshop, each country developed a proposal for their communities, the proposal includes the location of the communities, a description of each community that will be assessed, objectives, variables that will be measured and what methodology will be used, based on the SocMon Manual.

For Guatemala the communities selected are within the Wildlife Refuge Punta de Manabique and include: Quetzalito, Estero Lagarto and Graciosa. SocMon assessments began in Graciosa and Estero Lagarto (with the help of FUNDAECO), however they were only able to survey 6 fishermen (they haven't shared their results because the assessments were not finalized). The other community selected was Quetzalito (with the help of Fundación Mundo Azul). Due to COVID19 pandemic the assessments were halted and were not finalized. This preliminary work (community selection, format and questions for the interview, written proposal for Guatemala) was finalized, which is an estimate of 50% of the work that has been finalized.

For Honduras, the site selected is Tela Bay, where there are 2 terrestrial and coastal protected areas: Jeannette Kawas and Punta Izopo National Parks, and 1 MPA: Tela Bay Marine Wildlife Refuge. There are several communities where fishers live that depend on lagoon and marine fish for their livelihoods, such as Miami, Tornabé, La Ensenada and Cocalito.

CORAL fully completed these polls in Tela before and during the pandemic, while some other polls, at Utila and Cuero y Salado, were carried out during the pandemic. The polling tool used, replied to many information needs for CORAL, and followed suit to a former series of polls they had carried out. When compared to the SocMon poll, some gaps appeared that related to tourism. These gaps were mentioned to the SocMon Honduras

team, but it never reached a consensus on how to include this data. CORAL went on ahead with their polls in order to compile the much needed information.

In Mexico, the community of Puerto Morelos has been chosen to be part of the SocMon effort focusing on 2 main MPA user groups: fishers and tourism operators. A background and context study has been carried out in order to analyze and design a series of surveys and interviews, which will also be complemented by workshops involving stakeholders. Preliminary work, which is estimated at 50%, is available here. Following work is pending on the pandemic evolution, response from the consultants as well as the funds being made available. Some of the missing data gathering will be included into the field work of Mauricio Clorio's thesis (Lorenzo Alvarez's student-UNAM-GEO).

In Belize, efforts are focused on informing management decisions of the Turneffe Atoll Marine Reserve and extended monitoring of the fishing community both based on socioeconomic indicators. The overall objective of this study is to measure change in attitudes or perceptions regarding reef health conditions by interviewing a sample of 90-100 fishermen actively working in the atoll.

HRI's Mexico team are members of the Land2Coast (L2C) project, composed of representatives from UNAM, ECOSUR and Cardiff University. A workshop was held in late February 2108, in Q. Roo, called Sustainable Futures Workshop: Co-Development of Ecotourism Proposals with Women from the Communities of the Maya Forest Alliance, at the Sihil Noh Ha Ecotourism Centre, Felipe Carrillo Puerto, Quintana Roo. Twelve women attended this workshop, representing four of the five ejidos from the Maya Forest Alliance. The workshop focused on tourism activities as a means for sustainable development. Parallel to this one in early March 2018, a second workshop was held in Playa del Carmen, Q. Roo among members of the government, private sector, academia, and NGOs, to present results from the research project, which has focused on investigating the impacts of land use change on the marine environment in Quintana Roo and the institutional arrangements governing these processes. It also served to have a discussion on how we can begin to advance new approaches to addressing governance gaps in relation to land use impacts on the state's important marine ecosystems. Finally, a public presentation in early March 2018, was given at Sayab Planetarium (Playa del Carmen) to inform the general public of this project, its results and how they can help in making the needed changes for having healthier ecosystems.

Assessment Coastal Poverty Index

The original idea of using Coastal Poverty Index to assess social well-being in coastal communities was envisioned to use the 2020 SocMon census data. However, due to COIVD19 the census has not been completed and the data is not available. P Kramer's SI contract was realigned to other database needs. A Smithsonian Conservation Commons Post-Doc, a social scientists and several other SI scientists (including M McField and S Canty) have completed a draft manuscript to be submitted soon that uses other socio-economic data collected by USAID in Honduras and Guatemala and compares it to HRI's reef health data and MPA and replenishment zones - resulting in an encouraging validation that these replenishment zones do contribute to both reef health and social well-being. The manuscript is still a draft.

E. Healthy Futures

- ***HRI leads the incorporation of the latest reef science into reef management testing out new theories to improve reef management***

A MAR-wide Coral Bleaching emergency response plan was developed and put into operation, with an established protocol. The HRI has been leading a MAR-wide Coral Bleach Watch Network since 2015, mobilizing a coordinated network of trained surveyor teams to evaluate the extent of bleaching throughout the Mesoamerican Reef by using a systematic rapid protocol called the Bar-Drop methodology. The BleachWatch monitoring network activates once there is an alert issued by NOAA through the Coral Reef Watch, mainly due to the increase in water temperature due to heat stress (usually happens in October-November).

The third mass global coral reef bleaching event began in 2015 and persisted until the end of 2017 (during each summer/autumn). The 2017 event produced the strongest overall bleaching response, but still not reaching the intensity of the record 1997-98 bleaching. HRI and its partners have conducted BleachWatch monitoring in the years 2015, 2016, 2017, 2019 and 2020, with data still being analyzed for the latter years.

Given the devastating impact of SCTLD in Mexico, coral diseases have been added to the bleach watch protocol and the new [Coral Health Watch](#) tool that we developed with AGRRA. Mexico's main efforts are summarized here. In Belize, Honduras and Guatemala (even though there have been no SCTLD sightings in Guatemala), SCTLD has also been added to the bleach watch protocol, and training has been provided.

- ***Restoring herbivory***

The ongoing project entitled “Enhancing herbivory to improve the resilience of Belize’s reefs and coastal communities” began in Summer of 2018, when HRI partnered with Fragments of Hope to launch a pilot study testing the herbivory potential of the Caribbean King Crab. This experiment proved successful by demonstrating notable reductions in fleshy macroalgae and turf algae on experiment patches where crabs were present. The study included a total of 12 crabs which were translocated to patch reefs within a no take zone near Silk Cayes, the percent macroalgal cover was monitored prior to placement of the crabs, and then again 4 months later after crabs were placed on the patch reefs. During this time, a reduction in fleshy macroalgae and turf algae was observed, as well as an increase in crustose coralline algae - both positive indicator trends. Due to the number of crabs, size at translocation and length of study, HRI proposed a mariculture project to expand on the limitations of this experiment in the second phase.

The second phase of the experiment tested an in situ low-tech method of rearing juvenile crabs from berried females with the ultimate goal of translocating the juvenile cultured crabs onto reefs with elevated macroalgal cover in order to reduce macroalgal proliferation through their grazing activity. It also seeks to provide an opportunity for sustainable alternative livelihoods for fishers. The project had to be relocated due to coronavirus but our previous field experiment at Tobacco Caye made valuable discoveries and contributions that will allow the second attempt to be more successful. The project is funded by the Smithsonian and National Geographic – Lindblad Expeditions.

In Mexico, a similar pilot study focused on reseeding king crabs was carried out in patch reefs within Cancun’s MPA, in the area known as Manchones, from September 2018 to January 2019. In collaboration with the Fisheries Department and MPA authorities, 24 previously caught King Crabs were introduced in order to follow their impact on macroalgae

cover. The detailed methodology and results are in the report. After 5 months, a clear impact on the benthic community was observed with a decrease of 50% turf algae and 45% macroalgae followed by an increase of about 50% for both calcareous and crustose algae; which are encouraging results as turfs tend to overgrow and asphyxiate corals, while crustose algae favor the settlement of coral recruits. The second phase of the King crab project has seen some difficulties due to COVID19 and the changes in routines from the staff, and several storms/hurricanes. Nonetheless, most of the crabs are healthy and 3 male and 8 females are currently taking part in the experiment as reproducers. Even more, crabs produced during the first batch of reproduction, less than a year ago, have reached maturity and reproduced. To date, about 100 juveniles have been produced. Molts are still a very delicate moment and we register lower survival rates than expected (which were relatively ambitious at 30%). Some adaptations to the technique are being tested in order to increase the number of juveniles produced, in order to achieve the reef restoration goal in selected sites.

Mexico's main results:

- preliminary study lead to a decrease of 50% and 45% of turf and macroalgae
- increase of crustose algae (coral larvae settlement precursor)
- adult crabs collected from wild mating regularly
- crab larvae cultivated and metamorphosis
- adaptation of handling from box to tanks, use of mesocosmos for adults and young
- juveniles crabs born in captivity (G1) growing and now reaching maturity and reproducing
- juveniles obtained from G1 (G2)
- Restoration sites selected

- ***Restore key herbivorous *Diadema* populations***

Over the last decade, *Diadema* densities have slightly increased an average of 0.04 ind/m² in the MAR region. The highest change observed for Guatemala is mainly due to the inclusion of a higher number of monitoring sites, some of them showing high densities of *Diadema*. Mexico shows a decrease of 0.05 ind/m², going against the regional tendency. Regional densities of *Diadema* are still about 6 times lower than densities reported before the 1980's mass mortality event

Recovery of *Diadema* populations is still slow more than 30 years after the die off. The need for effective herbivory to counteract macroalgae proliferation in the region is a strong argument to develop and strengthen *Diadema* reproduction and restoration programs. Several sites in the MAR region have very high densities of *Diadema* and could serve as potential collecting sites to supply larvae to restore neighboring reefs with low or no *Diadema*. This is the case for Honduras where 5 sites (Kisci's Garden, Penny Lane, Capiro Alegria, Jeannette's Reef and Judy's Place, all in Tela Bay) have been located to have densities higher than 1.5 ind/m² of *Diadema*.

A research pilot was initiated in September 2019 with HRI, RMP, Roatan Coral Restoration Foundation (CRF), Roatan Institute for Marine Sciences (RIMS) and CORAL encompassing a coral and *Diadema* restoration project in Half Moon Bay. The project has been halted due to permitting and COVID19 restrictions.

HRI is also collaborating with the Mahogany Bay Cruise Ship Port, as they have identified a possible site for *Diadema* relocation. All permits are still pending by the Protected Areas Department. We are now looking to work through RMP and their permits, in order to finally get this project underway. We estimate this will be carried out as soon as the new management plan for the protected area is approved and published, which will have a section on *Diadema* urchins, and COVID-19 restrictions allow carrying out the project.

Honduras' main results:

- Urchins did not remain in the intended and created artificial habitats
- Enclosures need to be placed to ensure that urchins remain in the area and become acclimated to their new homes on the reef
- The entire experiment needs to be carried out without a pandemic to interrupt it

We organized and held a webinar series on *Herbivory Restoration* via [Parrotfish](#), [Diadema](#) and the [Caribbean King Crab to show the importance of herbivory on the reefs](#).

- **Reef Restoration Network**

HRI's Guatemala continues serving as the President of the Steering Committee of the MAR Reef Restoration Network. HRI plays a crucial role in promoting the Network's best practices, experimental designs and recommendations. Numerous projects in the region participate in coral nursery efforts, either through raising nursery corals or out-planting nursery corals onto the reef. HRI plays an important role in the success of these restoration efforts through the coordination and exchange of reef health information regionally.

As shown previously, HRI is also expanding reef restoration to focus on critical ecosystem functions like herbivory, in addition to coral propagation. This new restoration work is aimed at directly addressing the macroalgal proliferation problem highlighted in our Report Cards, as parrotfish alone cannot contain their growth and water quality improvements require longer time-frames and substantially more financial resources to implement on a regional scale. Thus, this additional layer of active management through the restoration of other herbivores will further enhance the reefs health and resiliency in light of growing stress from climate change and disease.

- **Coral disease outbreak in the Caribbean**

- **Stony Coral Tissue Loss Disease (SCTLD) Response**

HRI's regional team has been instrumental in alerting and organizing response to this deadly new coral disease. Belize Coordinator, Nicole Craig, is actively involved in SCTLD response in Belize, and leads the development of the national response plan, including a successful funding grant (from the Belize Marine Fund) for treatment. HRI's Mexican Coordinator, represents Mexico on the SCTLD Caribbean working group, relaying information among all partners. She also shared her experience and the [Mexico action plan](#) with MPA managers in Belize, Guatemala and Roatan (a few weeks before the first sighting of the disease on the island).

- **Monitoring**

SCTLD outbreak first began in the MAR in the coast of Mexico during the 2018 HRI monitoring season. In an attempt to record this phenomenon, the number of coral transects were increased and bleaching bar drop methodology was adapted to include coral diseases, which were then included in the subsequent [Bleach Watch efforts](#).

The Belizean Country Coordinator has assisted the Hol Chan and Bacalar Chico marine reserve staff in monitoring and treating SCTLD outbreak first noted in Northern Ambergris Caye in summer 2019. The Belize Audubon Society confirmed SCTLD on Lighthouse Reef Atoll in September, 2020. In 2020, Ms. Craig conducted monitoring of the Turneffe Atoll Marine Reserve (No SCTLD was detected) along with staff of the University of Belize

Environmental Research Institute. The AGRRA has a [database updated to reflect disease presence](#).

Bleach & Disease Watch small grants were organized by HRI and implemented by partners in Mexico, Belize, and Honduras through small grants to local partners with ongoing field activities. The MAR experienced a Level 2 Bleaching alert in September – with some of the highest “Degree Heating Weeks” recorded in the region. The new [online reporting and visualization tool](#) is now available.

- **SCTLD Treatment and Response**

Treatment trials with Amoxicillin, shea butter and coreRx have been supported in Puerto Morelos and Cozumel and constant communication has been held with the Florida experts. However, given the low success rate and lack of funding, it has been decided to focus only on large, reef building, colonies of higher importance. Other responses have focused on management. HRI has been closely involved in the organization of a strategic meeting to design Quintana Roo's SCTLD action plan, involving all stakeholders. Core actions are focused on improving wastewater treatment, best practices and communication among all stakeholders. Pairing both of these initiatives, HRI's Coordinator is leading the coastal development working group and has presented the action plan and the urgent need to improve waste water treatment at numerous forums. In addition, meetings with the municipality of Puerto Morelos and the local water company have led to a communications campaign urging houses to connect to the existing sewage system.

Treatment is currently being conducted within the Bacalar Chico, Caye Caulker and Hol Chan Marine Reserves in Belize. CoreRx has shown to be effective in slowing the spread of lesions caused by SCTLD. Preliminary results from Bacalar Chico show that of 15 colonies treated, 13 saw a cessation in lesion spread. In order to continue these treatments, a Duty-Free Exemption from the Customs Department (for CoreRx) and approval from the Ministry of Health (for antibiotics) are both needed (and pending). Network member and HRI partner Fragments of Hope has constructed two rescue tables placed away from the main reef (Hol Chan and Bacalar Chico Marine Reserves) that house coral fragments from vulnerable sites. These tables will serve as a ‘bank’ of colonies to outplant when conditions are more favorable. (Image attached). Nicole also participated in a meeting with Belize Fisheries Department, Hol Chan Marine Reserve, HRI and Belize Audubon Society on September 23rd to discuss appropriate responses to disease confirmation. Without additional CoreRx and antibiotics, Belize Audubon Society cannot conduct treatment at Lighthouse Reef Atoll.

- **Rescue and gamete cryopreservation**

In Mexico, due to the extensive spread of the disease, the few successes of treatment, and the near extinction of some of the most susceptible species, a coral rescue pilot project was designed and is being coordinated by the HRI coordinator. The project, a collaboration with UNAM- Coralium, CRIAP-INAPESCA, CONANP, Amigos de Isla Contoy, Xcaret Aquarium and funded by MAR Fund, seeks to rescue healthy colonies of *Diploria labyrinthiformis* (DLAB), *Meandrina meandrites* (MMEA) and *Dendrogyra cylindrus* (DCYL), in order to save their genetic information and cryopreserve their gametes for future generations and possible restoration. All of the objectives have been reached and the team is seeking to expand its scope through an funding approved second phase of the project. Furthermore, DLAB colonies held in captivity have spawned, leading to the first generation of DLAB recruits obtained from a laboratory in Mexico.

- **Education and Outreach**

HRI's Belize coordinator has also represented HRI and Belize in 2 [webinars](#) to help raise disease awareness and inform other countries on Belize's treatment efforts.

HRI's Guatemala coordinator organized a webinar with Pixan'Ja on November the 19th, 2020. This webinar focused on SCTLD, general overview of the disease, its impacts on coral reefs, what the MAR and Caribbean regions are doing to address this new threat and what are the actions needed for Guatemala. We had a very high attendance with over 90 participants from Guatemala and the region. The main speakers of the webinar were Emma Doyle from MPA Connect, Melina Soto from HRI Mexico, Angela Mojica from Pixan'Ja and Ana Giró from HRI Guatemala. [Link to the webinar recording](#)

- **Stony Coral Tissue Loss Disease confirmed in Honduras**

The official statement confirming SCTLD on Roatan was issued on September 27th, 2020 which set actions in motion to respond to the disease. The affected area in Flowers Bay (southern coast of Roatan) expanded from 6 km² to 12 km², as it has now also been recorded on the West Bay point. HRI collaborated with RMP, BICA and the Bay Islands National Marine Park Technical Committee in drafting the document that requests permission to apply antibiotic treatments to infected colonies, but the permitting required multiple revisions. HRI is coordinating with RMP the creation of response teams among the diving community on Roatan. The plans include training divers from Roatan and Utila on the response and treatment protocol, as well as using these same divers to help carry out BleachWatch monitoring combined with searching for disease in other areas of the island.

BleachWatch/SCTLD search has been carried out in Guanaja at 8 sites, where only bleaching has been observed so far. Monitoring was carried out in Utila, with support from CORAL and local volunteers. Tela, Cayos Cochinos, and Roatan were also monitored, with Roatan being the only island to show SCTLD to date.

5. Obstacles: Indicate if there have been any obstacles to the development of the project that have prevented achieving the planned goals or complying with the timetable, and how you have solved or plan to solve the situation.

The COVID19 restrictions prevented timely execution of planned training, research and monitoring activities of 2020. We have rescheduled these activities for summer 2021. We also developed some training videos and are working with AGRRA on a partial digital certification program. The HRI team focused on the compilation of management data through December 2020 for the 2021 EcoAudit. Our partners that rely on MPA visitor fees are extremely limited in capacity now and may have difficulty participating in field programs. We are reducing the number of sampling sites and securing small but effective teams.

Prior to 2020's COVID19 issues, our main obstacles were in scheduling coordinated monitoring among many partner groups with different work plans and schedules. This has resulted in monitoring often taking longer than planned or desired (keeping it within one 'season'). We are having partners sign work plans as part of their training agreements.

Waning political will has also been a fluctuating obstacle or opportunity. It aligns with each country's political cycle and the HRI team continually assesses their national and



local situation and works with partners to maximize opportunities and address obstacles head on in alignment with partners.

6. Links with other organizations: Describe any alliances established as a result of the project development.

HRI is a partnership Initiative, so links with other organizations are integral to all of the activities previously described. Here we just highlight a few of the main additional program linkages by country:

In Belize, HRI explored new administrative partnership roles with both Fragments of Hope and World Wildlife Fund. Fragments of Hope is also a research partner on the Restoring Herbivory Project.

Guatemala has partnered with Pixan'Ja a new (2018) organization that focuses on coastal and marine ecosystem conservation. Jointly HRI and Pixan'Ja have successfully attained 2 research grants to help characterize the Cayman Crown reef area in preparation for protection and have also been working together to inform about SCTLD to partner organizations in Guatemala.

In Honduras, HRI is collaborating with RIMS and RMP to replant corals in Half Moon Bay. A project is also underway to establish a Coral Reef Restoration Facility (similar to an aquarium) at either the local school in West End or in Sandy Bay. This project is being spearheaded by HRI, RMP, DiBIO, and ICF, with funding from a GIZ project and national government funds as well. With support from RMP, who "adopted" our urchin relocation project, two sites were identified and the first phase of the project was carried out. The follow-up dives have been postponed until COVID19 restrictions are lifted, as well as acquiring proper permits.

In Mexico, HRI and the CORAL reef alliance, have helped to bring together two NGOs with some working difficulties into a new (2020) collaboration over water quality monitoring during COVID19 travel restrictions. Both of these NGOs (Amigos de Isla Contoy A.C. and Centinelas del Agua A.C) are HRI partners, and this diplomatic effort has demonstrated our value in serving a bridging role for more collaborative successful work in evaluating water pollution in Mexico. In addition, this coordinating/diplomatic aspect of our position has also been a key component for the rescue and cryopreservation project with UNAM-Coralium, CRIAP-INAPESCA, Amigos de Isla Contoy and Xcaret's Aquarium. We have also been involved with other organizations such as Wildcoast in the Pacific to help replicate our RC model.

HRI has a leadership role and core participation in several other regional committees and networks such as the MAR coral restoration, mangrove and sustainable fisheries networks. In the Wider Caribbean, the HRI Director still serves on the Steering Committee of the International Coral Reef Monitoring Network and has provided advice and assistance towards the development of a regional Caribbean Report Card. HRI also participates in the Caribbean Coral Restoration Consortium, CampAM and the Gulf and Caribbean Fisheries Institute. Internationally we have led science for management sessions in the International Coral Reef Symposium (in 2016; 2020 (virtual webinar) and now 2021 (also virtual). HRI's Director is the co-leader of Smithsonian Institution's Working Land and Seascapes program in the Conservation Commons where our integrated collaborative science-based management framework is also promoted.

7. **Project development table:** See Appendix 1. Complete the project development table for the period being reported by indicating percentage of accomplishment of indicators/products. Please add any new activities and their indicators/products.
8. **Lessons learned:** Emphasize, besides the technical issues, the social and administrative aspects that may be useful in future projects regarding the same topic or developed under similar conditions.

The Mesoamerican Reef faces both environmental and social challenges, but with the right partnerships that HRI brings together, including researchers, managers and conservation innovators, the reef has a chance to recover and/or maintain its health. Over the last fourteen years we have worked side-by-side with partners to inform and discuss the latest scientific knowledge, technological advances and the recommended reef management priorities.

Our expertise and network have allowed us to address a myriad of challenges facing coral reefs; including the overabundance of macroalgae that stifles coral growth, coral bleaching, coral disease, and management actions based on the scientific data, which we have collected with our partners over the past fourteen years.

HRI serves as the living bridge for scientific information from the latest research (“heads in the sky”) to the practical application and implementation of resulting management recommendations (“fins in the water”). The communities on the coast of Mesoamerica need the reef, and right now the reef needs them to get back to a healthy and flourishing ecosystem that can support exquisite biodiversity, ecosystem services and livelihoods.

One of the lessons learned in 2019 regarded difficulties in getting timely and accurate data compilations from partners for the Report Card. We experienced delays and found some errors in partner data. We think this has now been addressed with all of the Belize partners agreeing in a National Reef Monitoring Network Meeting (spring 2019) to switch their national protocol over to AGRRA (from the MBRS project protocol). The methodologies are similar but now these partners can share into our database streamlining data sharing, accuracy and analysis. Both training workshops (in reef monitoring and data entry) and partner meetings have proven to be efficient tools that have served to motivate partners. We will continue to do this and hopefully see more partners directly entering their data to our online data portal.

There are two limiting factors in Honduras that have hindered the development and successful completion of our deliverables, and both are related to the government. The permitting process for scientific experiments, as well as AGRRA surveys, is at a standstill. As of March 2020, HRI Honduras has not yet received their permit for AGRRA data gathering in 2018, which was requested at the beginning of 2018. In order to carry out the urchin experiment, HRI teamed up with RMP and they “adopted” our experiment under their official management activities. The local ICF representative is aware of these challenges and understands that we will carry out our data and experiments without permits, but within the framework of another organization. The second challenge has been with the Environmental Municipal Units (UMA in Spanish) of the different municipalities within the Mancomunidad de Municipios del Golfo de Honduras in order to create legal protection for herbivores. The respective mayors have approved to move forward with the protection, but the UMA staff have not wanted to move this forward. We believe HRI will have to visit each UMA and work alongside them (holding hands) to get this protection under way.

Our growing network of partners and projects means we also need to grow our funding support - which is an ongoing challenge. We also face administrative challenges from not

being our own legal institution, in order to build on all these great achievements and keep spearheading innovation and change under our Healthy Reefs brand.

9. Effects of the project: Have the results of the project promoted environmental, social or economic changes? How was this determined/measured?

- ***Conservation achievements in the MAR that have been lead or strongly supported by HRI and our data collection, analyses and recommendations:***

Parrotfish are now fully protected in Mexico (Caribbean coast), Belize, Guatemala and the Bay Islands, Honduras. HRI has focused on this recommendation and provided supporting scientific data which led to the MAR becoming the first international region to fully protect these key grazers as one critical strategy for improving reef health and resiliency. In Belize (the longest protected) this has led to their increase from 1870 g/100m² in 2010 to 2744 g/100m² in 2018. Guatemala's protection in 2015 led to an increase from 433 g/100 m² in 2013 to 873 g/100m² in 2018

The amount of fully protected areas (also called fish replenishment zones), has increased from 1,182 km² in 2011 to 2,020 km² in 2020, with Guatemala being the only country to meet the Convention on Biological Diversity 10% target this year (with 12% territorial sea) although our HRI target is 20% under full protection, with the regional average seemingly stuck at 3%. HRI is committed to continuing efforts to increase this fully protected area to at least 20%.

HRI's discovery, monitoring, mapping and communications about the amazing transboundary Cayman Crown reef - in both Guatemala and Belize contributed to the expansion of existing MPAs in both countries to include this reef area. Guatemala now has its first coral reefs with full protection in Cayman Crown. Belize's expansion of Sapodilla Cayes Marine Reserve to include Cayman Crown is a good first step and we will continue to work to get this area fully protected.

HRI has built lasting scientific capacity within the MAR. Over 250 field biologists have been trained in reef monitoring in the last 14 years (97 within this grant). Our collaborations with some of the world's top reef scientists has also created lasting benefits and opportunities for numerous individual scientists from the MAR to participate in innovative research and restoration techniques.

HRI supports the largest regional open-access online interactive database of all coral reef monitoring data that we are aware of globally. This data continues to be used to guide management actions as well as provide guidance on the socioeconomic importance of the region's reefs. This is evident through the publications and collaborations with other organizations.

HRI is leading collaborative efforts to track and respond to SCTLD, including monitoring, treatments of affected corals, rescue efforts and new cryopreservation efforts.

Our successful pilot projects in Mexico and Belize testing the ability of translocated king crabs to reduce macroalgae (2018) paved the way for the next phase which has also successfully reared juveniles from broodstock (in Mexico). Over 50 juveniles are now being prepared for seeding onto reefs to evaluate their ability to reduce macroalgae. This research has built on international partnerships with Smithsonian and Florida-based scientists and is poised to receive additional funding to scale up efforts regionally. This project also has great potential for improving fisher livelihoods given the value and marketability of these crabs.

Coral reef 'literacy' and interest has increased within the MAR as evidenced through the number of outreach events, increased participation, and increased participation in HRI's social media programming (for Facebook, Twitter, Instagram and YouTube).

10. Communication of results: What mechanisms have been used or will be used to communicate the results, and to what audiences?

Communication has been tackled in different ways:

- Participated in personal meetings (previous to COVID19 pandemic) with stakeholders and partners, to convene collaboration such as Watershed Committees, and Education, Communication and Culture of Water, where attendees constituted all sectors: government, academia, NGOs and private sector.
- We had been able to reach high officials such as the Mexican President Enrique Peña Nieto in 2016 by Marisol Rueda our former Mexican Coordinator at the time, during COP 13 where he announced the decree of the biggest natural protected area in the country Mexican Caribbean Biosphere Reserve (Document: RBCM Peña News Final). She also participated in her new position at the Congress in 2019 in a special forum where NGOs and other high government officials were gathered to present some of the biggest threats Q. Roo is facing problems such as plastic pollution, water pollution and lack of inclusion of the karstic system in the law, sargassum overgrowth and the importance of parrotfishes to have healthy reefs ([PDF Memorias CI:63](#)).
- Documentaries have also been one of our biggest tools to reach out to the public and even government officials, such as Flows, launched in 2017. It was presented at Films for the Earth and was also made available at [Vimeo](#). We accompanied the outreach of this film with [local presentations](#) in Q. Roo and the government requested to show this film in the Municipal Theatre at Playa del Carmen, where the general public attended besides government officials in charge of managing and protecting the natural resources. We also presented this film at an [Earth X](#) event in 2019 with a [spot at Cinopolis](#) in Mexico city. An [Ocean Story](#) was also filmed in 2019, by Netherlands' producers and only screened there. We are still waiting to have the documentary released for public use after participating in film contests. Mexico's HRI Team also participated in the film Más Allá de la Herencia, which was launched in 2020 in the United States, and is still waiting to be available in Mexico. This film will address the plastic pollution and HRI Mexico Team participated in interviews that will be used to create a documentary from this film that will be called [La Ola Rota](#).
- Participated in public spaces such as planetariums, fairs, partner's events on environmental celebrations, and others to communicate to the general public. Each of our 5 staff members participates in at least 12 events per year to raise reef awareness and share the Report Card and Eco Audit results with the general public, giving a total estimate of 300 talks in different forums.
- We use our website and database to have all the reports and data available, as well as press releases.
- We use social media to promote general awareness and our results and actions, as well as the ones from partners with whom we work closely. We specially use: Facebook, Instagram, Twitter and YouTube. Previously, the institutionally produced content happened only once a month. By following the plan of at least once a week, we have increased our institutional content a minimum of 400% up to 800% in some months, having more than 6,000 people reached with HRI's publications.
- Members of the different media outlets (TV, Radio, Blogs, Newspapers and other social media outlets), have been key to the dissemination of our work in the 4 countries. In the last 4 years we had produced around 60 media news in each HRI annual launch (Report Cards and Eco Audit), and around 40 other stories related

to reef health during a year. Making a total of around 350 medio stories in this period grant.

- During the COVID19 pandemic we started creating all our events in a virtual mode with meetings and webinars. See section “Enhance public awareness and support for marine conservation” and “Healthy Futures.”

In addition to these more popular and policy-oriented communications, HRI also communicates with other scientists through scientific conferences and publications. HRI staff and data have contributed to numerous scientific publications, including the following: *Notable is the lead authorship by Mesoamerican country nationals (mostly graduate students) in half of these publications.*

- Twenty years of change in benthic communities across the Belizean Barrier Reef. Catherine Alves, Richard B. Aronson, Nadia Bood, Karl D. Castillo, Courtney Cox, Clare Fieseler, Zachary Locklear, Melanie McField, Laura Mude, James Umbanhowar, Abel Valdivia, John F. Bruno. bioRxiv 2021.03.15.435443; doi: <https://doi.org/10.1101/2021.03.15.435443>
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11. Project continuity: Will the processes established by this project continue operating? How will it be done? Who will provide follow-up?

The Healthy Reefs Initiative provides a critical essential ecological and evaluation service for the entire Mesoamerican Reef; thus, it is intended to persist as long as the reefs and communities depending upon reef persist. The reef Report Cards we developed have now been emulated in over 13 other coral reef countries for which we are aware. The whole HRI team is providing follow-up as we continue garnering financial support for our endeavors. Two new private sector agreements have just been signed to essentially share revenues to support HRI. Of course, our efforts to attract new private donors continues and has been successful in keeping the program maintained and growing over the last 15 years. Longer term financial sustainability endowment funds are also being sought in collaboration with the MAR Fund. As one of the key “seascapes” within the Smithsonian’s Working Land and Seascapes theme of the Conservation Commons - we are well poised to also identify new potential funding to the region through this ongoing effort.