



The Mesoamerican Reef: A Cornerstone *of* Sustainable Development

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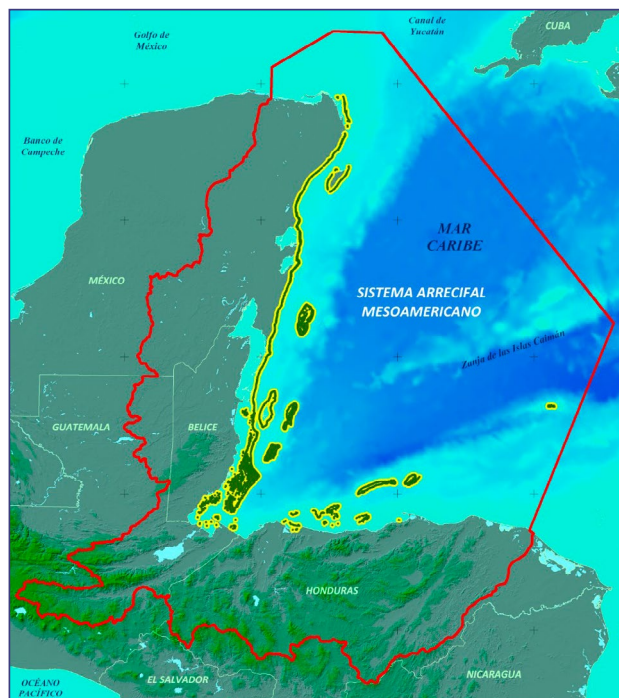
Willis Towers Watson 

The Mesoamerican Reef (MAR) is a high-value natural asset. Stretching over 1,000 kilometres along the coast of Mexico, Belize, Guatemala, and Honduras, it is poised to play a starring role in the sustainable development of the region.

The MAR is a phenomenal public good, with a mosaic of distinctive coral reef types—including elkhorn (*Acropora palmata*)—seagrasses, mangroves, and lagoons capturing carbon and providing a home to many endangered and charismatic species, including manatees, whale sharks, groupers, and parrot fish. It is this ecology, and the reef ecosystem’s health and resilience, that secures its place as an internationally recognised treasure, securing the sustainable economy of the MAR region.

A healthy Mesoamerican Reef delivers economic benefits of USD 4.5 billion every year to key sectors, securing resilient and sustainable lives and livelihoods for millions of people.¹

The MAR provides abundant ecosystem services that underpin the products and services of coastal enterprises, enabling a dynamic blue economy. From fisherfolk dependent on a reliable catch to attractive seascapes stimulating new opportunities for tourism and recreational businesses, reef ecosystem services are the cornerstone of a myriad of diverse livelihoods. The MAR is also a nature-based solution to one of the most significant challenges facing the MAR region—the physical and economic impacts of climate change—as it protects against coastal hazards such as sea level rise, storm surges, beach erosion, and wave-induced damage. In the face of the global climate



and biodiversity crises, and the global cry for a regenerative transformation, the MAR is a significant advantage to the region’s sustainable development.

Securing the biodiversity, cultural, and economic value of the MAR is the focus of the Reef Rescue Initiative (RRI), which aims to support the long-term ecologic and economic viability of the MAR and the environmental services it provides by helping to develop the human capacity, local economic incentives, and financial sustainability required to carry out sound, effective, and timely science-based coral reef conservation and restoration.² This work provides a strong environmental and financial backbone to the blue economy in the MAR region.

The MAR’s care and maintenance is critical to sustaining its value—and the value of the economies it supports.

The Reef Recue Initiative aims to support communities—working across the public and private sectors—to build reef resilience, sustaining the value of the Mesoamerican Reef and the environmental and cultural services it provides.

¹ Economic valuation of the ecosystem services of the Mesoamerican Reef, and the allocation and distribution of these values / Itziar Ruiz de Gauna, Anil Markandya, Laura Onofri, Francisco (Patxi) Greño, Javier Warman, Norma Arce, Alejandra Navarrete, Marisol Rivera, Rebeca Kobelkowsky, Mayela Vargas, Marisol Hernández; editors, Santiago Bucaraman, Gregory Watson. (IDB Working Paper Series: 1214)

² The RRI is carried out by the MAR Fund and CCAD, with the participation of the four MAR countries and the generous support of the German Government through KfW.

The Reef Rescue Initiative: A Holistic Strategy for Ecosystem and Community Resilience

Like roads, ports, and other grey infrastructure, the MAR can be thought of as public infrastructure, and revenue streams depend on its presence and continued health. However, this natural infrastructure does not feature explicitly on public or private asset lists or balance sheets, making the responsibility for its maintenance relatively implicit, spread across many reef users and beneficiaries. The MAR Fund is the regional private environmental fund that supports the MAR and the communities who depend on its ecosystem services, providing a platform for collective management and financing of reef risk reduction and resilience.

The RRI's holistic strategy addresses the complex risk, response, and resilience landscape of the MAR through the development of instruments for reef risk management, and the human capacity and financial sustainability required for their effective implementation.

KEY ACTIVITIES TO BUILD MAR RESILIENCE



Instruments for risk management

- ▶ Engagement to build the enabling environment for reef risk management and financing, including legal and policy analysis
- ▶ Development and roll-out of reef response protocols and emergency response plans



Capacity building

- ▶ Engagement and support of local institutional capacity to implement rapid reef response to hazard impacts
- ▶ Organisation and provision of reef response training and equipment
- ▶ Regional platforms to coordinate ongoing reef restoration



Financial sustainability

- ▶ Two financial mechanisms disburse rapid funds for reef restoration:
 - *The Emergency Fund responds to natural and man-made events*
 - *The MAR Insurance Programme responds to hurricane damage*

A growing challenge: Hurricane risk to the MAR

- While the MAR has faced, and survived, the impacts of hurricanes for eons, the effects of climate change and other stressors exert increasing pressure on the reef, and the risk of a hurricane impact leading to irreversible coral degradation and mortality has grown ever more rapidly. Hurricanes are now a key threat to the MAR and a leading driver of live coral cover loss. High winds generate heavy seas and produce debris which ends up on reefs—both directly damage coral reef ecosystems through impacts like breakage, dislodgment, and sand and debris burial.
- Countries and local communities can significantly reduce the negative impacts of hurricanes on coral reefs by implementing damage assessments and response activities such as removing debris and re-planting coral species, immediately after the storm passes.
- Since reefs are often not a priority in the immediate aftermath of hurricanes, the RRI supports communities to develop integrated plans and programmes for immediate post-hurricane reef response, as well as the human capacity and financial sustainability to implement them.

The RRI builds the resilience of the MAR to the negative impacts of extreme and slow-onset events, including natural and man-made hazards. The main threats to the MAR include increases in ocean temperature and marine heat-waves, ocean acidification, hurricanes, rising sea level, and disease (all directly or indirectly linked to anthropogenic greenhouse gas emissions and the resultant changing climate), and other direct human impacts including the negative ecological effects of poor fishing practices, unsustainable coastal development, and pollution. It is across this landscape that the RRI supports communities and governments in the region to integrate the MAR into planning and financial decision-making—recognising it as an asset they depend on and must maintain and protect—providing a platform, framework, and collaborative partnerships to manage and finance reef risk and resilience.

The MAR Insurance Programme: A Practical Solution to Hurricane Risk to the MAR

In order to build the financial sustainability of post-hurricane reef response on the MAR, the RRI and Wills Towers Watson (WTW) are partnered to implement the MAR Insurance Programme—a bespoke parametric insurance programme covering hurricane risk to the MAR. This insurance will complement and support the holistic strategy of the RRI by scaling the funds available through the Emergency Fund after hurricanes, leveraging risk markets to pre-arrange additional, predictable, and timely funding for pre-planned reef response activities.

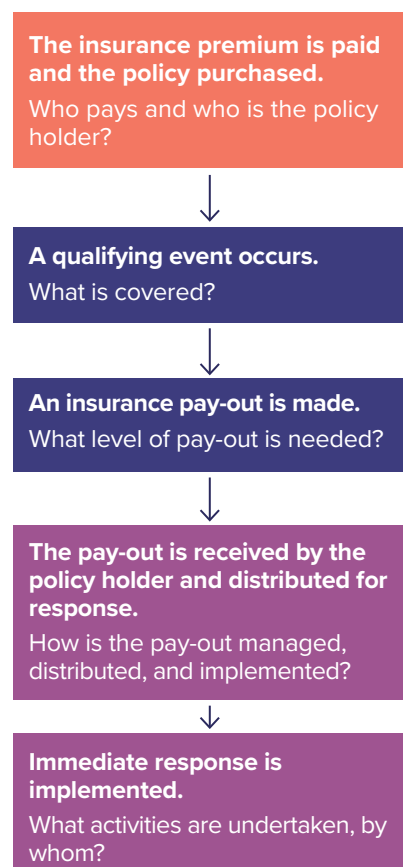
What is parametric insurance?

Parametric insurance is a type of insurance that pays out a pre-agreed amount to a policyholder according to pre-defined event characteristics (e.g., peak storm wind speed).

- The pre-defined event characteristics are selected such that they effectively proxy impact / need.
- Thresholds are set to “trigger” pay-outs if pre-agreed event parameters are met.
- Pay-outs are made within days of an event, as they are based on pre-agreed, objective, independent, and rapidly verified event parameters.

How does the MAR Insurance Programme work?

STEP BY STEP



Premium Financing

- The insurance policy is purchased by the MAR Fund, as the regional environmental fund with strong governance and administration, and relationships, processes, and protocols already established to pre-plan and distribute predictable and timely funds for reef response.

- Short-term “proof of concept” premium financing support is in place from the InsuResilience Solutions Fund, and a sustainable premium financing strategy—engaging the public and private sectors—is under development for long-term cover for the MAR.
- Insurance design and coverage characteristics are informed by the premium budget available.

Insurance Design

- The MAR Insurance Programme is underpinned by a parametric insurance instrument that is designed to “trigger” pay-outs to cover the cost of post-hurricane reef response at impacted, pre-selected reef sites.
- If a hurricane passes near a covered site above an intensity threshold where reef damage occurs, a pay-out is made.

- The pay-out amount is determined by the location and intensity of the storm—as hurricanes intensify nearer to covered reef sites, reef damage and response costs grow, so pay-outs correspondingly increase.
- The pay-out amount is also informed by the different reef response needs at different reef sites, depending on the baseline amount of live coral cover and local response costs.

Reef Response Preparedness and Implementation

- When a pay-out is made, it is rapidly disbursed to affected sites to undertake reef response activities—preparedness is essential to connect the insurance instrument to concrete reef resilience outcomes.
- Pay-outs are received by the MAR Fund’s Emergency Fund, which provides existing

financial infrastructure and fund distribution processes and protocols to implement hurricane response. Local NGOs receive funds for response from the Emergency Fund.

- With the funds, immediate reef response activities are implemented by Emergency Response Groups at affected reef sites, which are formed, trained, and equipped so they are ready to implement response plans.³

³ For details of the response and protocols adopted, please see the *Early Warning and Rapid Response Protocol* from The Nature Conservancy.

The insurance programme currently in place for the 2021 Atlantic hurricane season covers four pilot reef sites and has many benefits.

The bespoke insurance programme structure and product design responds to the specific needs of the reef response groups at selected priority reef sites, as well as the premium financing available to purchase the insurance policy.

The reef insurance policy currently in place for **four pilot reef sites**—Banco Chinchorro, Arrecifes de Xcalak, Hol Chan, and Turneffe Atoll—directly protects more than **4,500 hectares of live coral cover**, providing up to **USD 2,500,000 in funding for reef response**.

↳ *The execution of this Agreement shall not have any effect with respect to, or in connection with, any sovereignty claims over any territory (land, insular and maritime) claimed by the Republic of Guatemala and/or Belize; nor shall it have any effect over the rights and/or claims of either country over such territory.*

There are many direct and indirect beneficiaries of the MAR Insurance Programme, from the organisations and individuals involved in the response, including local NGOs, businesses that supply equipment, and the reef brigades themselves—as insurance pay-outs provides a source of shock-responsive income—to the governments, individuals, and businesses that face a much shorter period of degraded ecosystem service benefits in the near-term and enhanced benefits of a healthier reef in the long term.

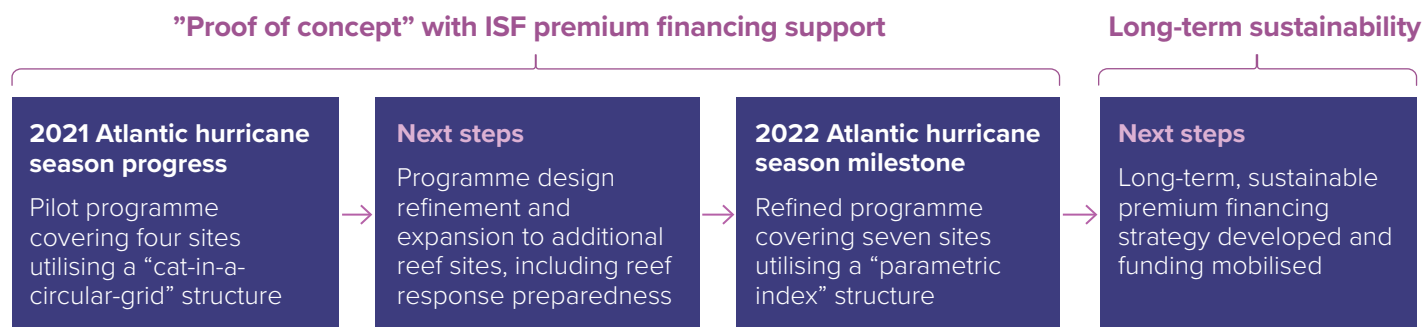
The implementation of this pilot insurance cover is supported by extensive work carried out to date including policy analysis, feasibility studies, reef response preparedness and training, and insurance product design and insurance programme structuring—including the development of a bespoke cyclone reef damage model—all underpinned by extensive multi-stakeholder engagement and consultation.

The resilience and sustainable livelihoods of more than 2 million local people,⁴ and **USD 4.5 billion per year in economic value to key Blue Economy sectors**, are supported by the MAR Insurance Programme.

NEXT STEPS

Next steps for the MAR Insurance Programme include the refinement of the insurance design and expansion to additional reef sites on the MAR. The insurance in place covering four reef sites for the 2021 Atlantic hurricane season utilises a “cat-in-nested-circles” structure, in which bespoke pay-out structures at each reef site are based on the spatial distribution of hurricane intensity. This product will be refined—and expanded to cover seven sites—for the 2022 Atlantic hurricane season, utilising a “parametric index” structure, in which

pay-out structures capture the reef response costs based on the spatial distribution of reef damage, which will be calculated using a bespoke cyclone reef damage model. Next steps entail the further development of the cyclone reef damage model—including discussions with risk markets to establish understanding and appetite to underwrite—and reef response preparedness at the priority sites. Finally, a premium financing strategy will be developed for the implementation of the MAR Insurance Programme in the long-term.



⁴ Beneficiaries of Rapid Response Reef Risk Financing in the MAR Region

WHAT DOES THE MAR INSURANCE PROGRAMME MEAN FOR YOU?

I am a coastal resident in the MAR region

- You benefit from a more resilient reef and reduced disruption to ecosystem services such as protection from coastal hazards, fisheries productivity, and recreation.
- You can participate in the reef response activities if you receive proper training—as a diver, snorkeler, or preparer of the cement used to re-attach broken corals.

I am a MAR country government

- Your tax revenues, GDP growth, and employment are supported by a more resilient reef, which underpins tourism, fisheries, and sustainable coastal development.
- Food security and informal livelihoods are made more resilient by the maintenance and restoration of the MAR's ecosystem services.
- Your sustainable development gains along the MAR are protected by the MAR Insurance Programme, which de-risks investments in the blue economy in the region.
- You can integrate the reef—as natural infrastructure—into your hurricane response plans, policies, and risk management strategies, and support long-term premium financing of the programme.

I am a local business

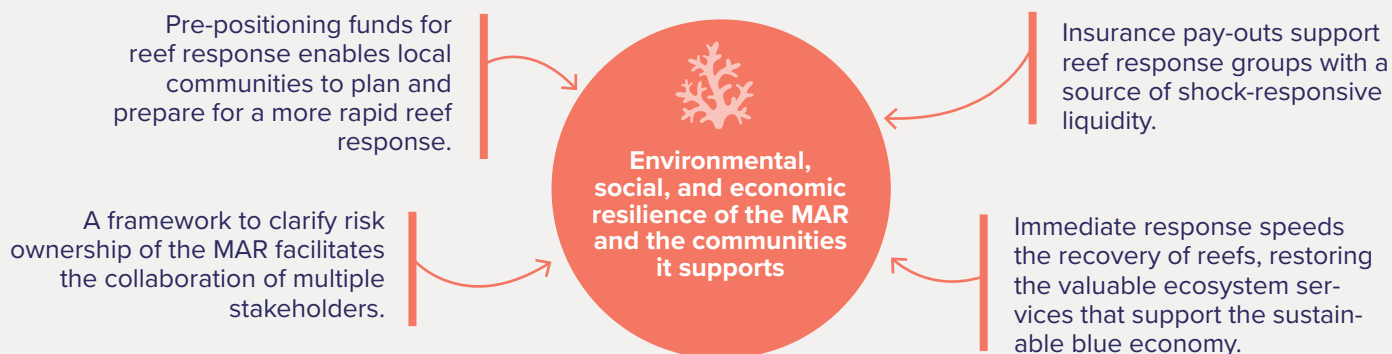
- Your risk profile is reduced by a more resilient reef—especially if your business is in the fishing and/or tourism sectors.
- You can provide equipment and/or participate in reef response activities—e.g., boat rental, diving equipment.
- You can support long-term premium financing of the programme—demonstrating your environmental and social responsibility and/or in collaboration with others in industry (e.g., through associations) who want to come together to protect the natural assets you depend on without compromising competitiveness.
- Separate from the MAR Insurance Programme, you may be able to smooth shocks to your income from hurricane impacts by purchasing an additional business interruption cover to provide post-event liquidity.

I am a reef manager in the MAR region

- You are supported—through capacity building and with financial sustainability—to carry out immediate, post-hurricane reef response activities.
- Separate from the MAR Insurance Programme, you may be able to smooth shocks to user fees and other income from hurricane impacts by purchasing an additional business interruption cover to provide post-event liquidity.

I am a global citizen

- You benefit from the global biodiversity value of the reef.
- Coral reefs represent the most obviously demonstrated link between anthropogenic carbon pollution, ocean warming, and biodiversity loss. You can contribute premium financing to build as much reef resilience as possible in the face of climate risk.





Technical Annex: The MAR Insurance Programme Structure and Product Design

The MAR Insurance Programme has been designed by Willis Towers Watson and the MAR Fund to complement the holistic reef conservation and restoration approach of the RRI, so the insurance is designed to pay out to cover the cost of rapid reef response after hurricane impacts at covered reef sites.

The optimal insurance product covers the costs of post-hurricane reef response as efficiently as possible by triggering pay-outs when they are needed at covered reef sites. We have developed two suitable parametric insurance design options, which appropriately capture the relationship between hurricane intensity and reef response needs. Final coverage is informed by the premium budget available, and more targeted products ensure that premium is spent covering meaningful risk of negative impacts—providing relevant and material pay-outs.

- ▶ Both product design options utilise peak wind speed as the fundamental hazard parameter to proxy hurricane intensity, with response needs—and therefore pay-outs—captured as a function of peak wind speed.
- ▶ Reef response needs are distributed with spatial variations in coral cover and peak wind speed / impacts.
- ▶ The options differ in how and at what resolution they capture the spatial distribution and impacts of hurricanes.

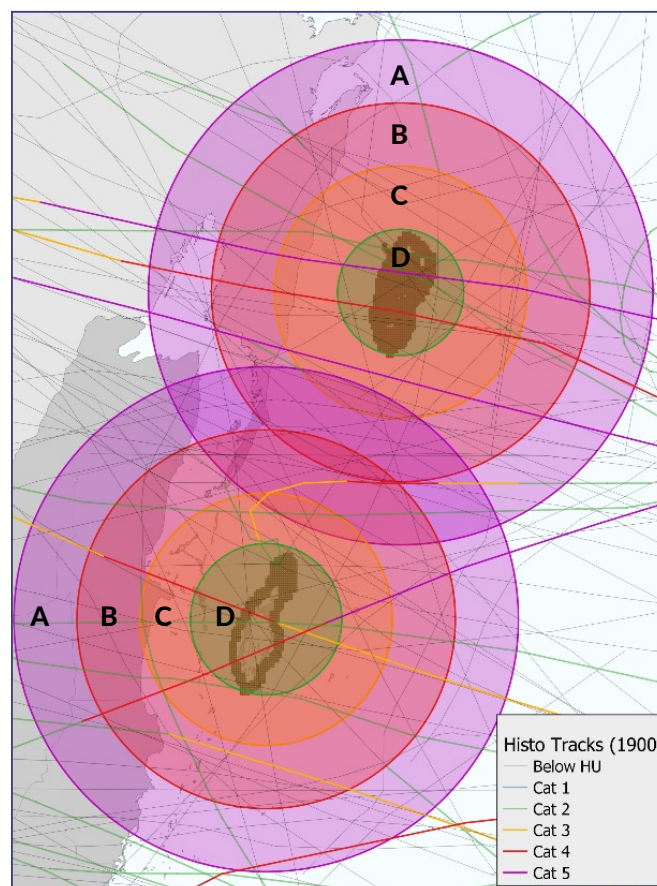
A gridded parametric product—a “cat-in-nested-circles” structure—is in place for four pilot reef sites of the MAR for the 2021 Atlantic hurricane season.

Gridded parametric

- Pay-out rates account for the spatial distribution of event intensity across a covered geography.
- For each covered reef site, pay-outs are triggered at pre-agreed windspeed thresholds that are “gridded” across the covered site, e.g.:

HAZARD INTENSITY		PAY-OUT RATE FOR REEF SITE X			
Wind Speed (kn)	Hurricane Category	Zone A (purple)	Zone B (red)	Zone C (orange)	Zone D (green)
0 – 63	0	0%	0%	0%	0%
64 – 82	1	0%	0%	5%	10%
83 – 95	2	0%	5%	10%	20%
96 – 112	3	5%	10%	20%	40%
113 – 136	4	10%	20%	40%	80%
≥ 137	5	20%	40%	80%	100%

- Maximum pay-out amounts (i.e., limits) are determined for each site—and the overall programme— based on reef response needs and capacities at each site and on the premium budget available.
- Each covered reef site has a bespoke pay-out structure—with stepped pay-out rates triggered at set hazard intensity thresholds—based on the cost of response at that site, which varies with the area covered and the amount of live coral cover.
- If a hurricane passes over the covered geography (the “circular-grid”) a pay-out is made. For example, if the maximum pay-out amount (i.e., limit) for Reef Site X is set at USD 2.5m, and a hurricane with a peak wind



speed of 130kn (Category 4) passes over that site’s pre-defined Zone D (the green circle encompassing the reef site), a pay-out of USD 2m (80% * USD 2.5m) is made.

- This product is currently in place for the 2021 Atlantic hurricane season, purchased by the MAR Fund with financial support from the InsuResilience Solutions Fund.

A parametric index has been developed and will underpin refined and expanded coverage for additional reef sites for the 2022 Atlantic hurricane season.

Parametric Index

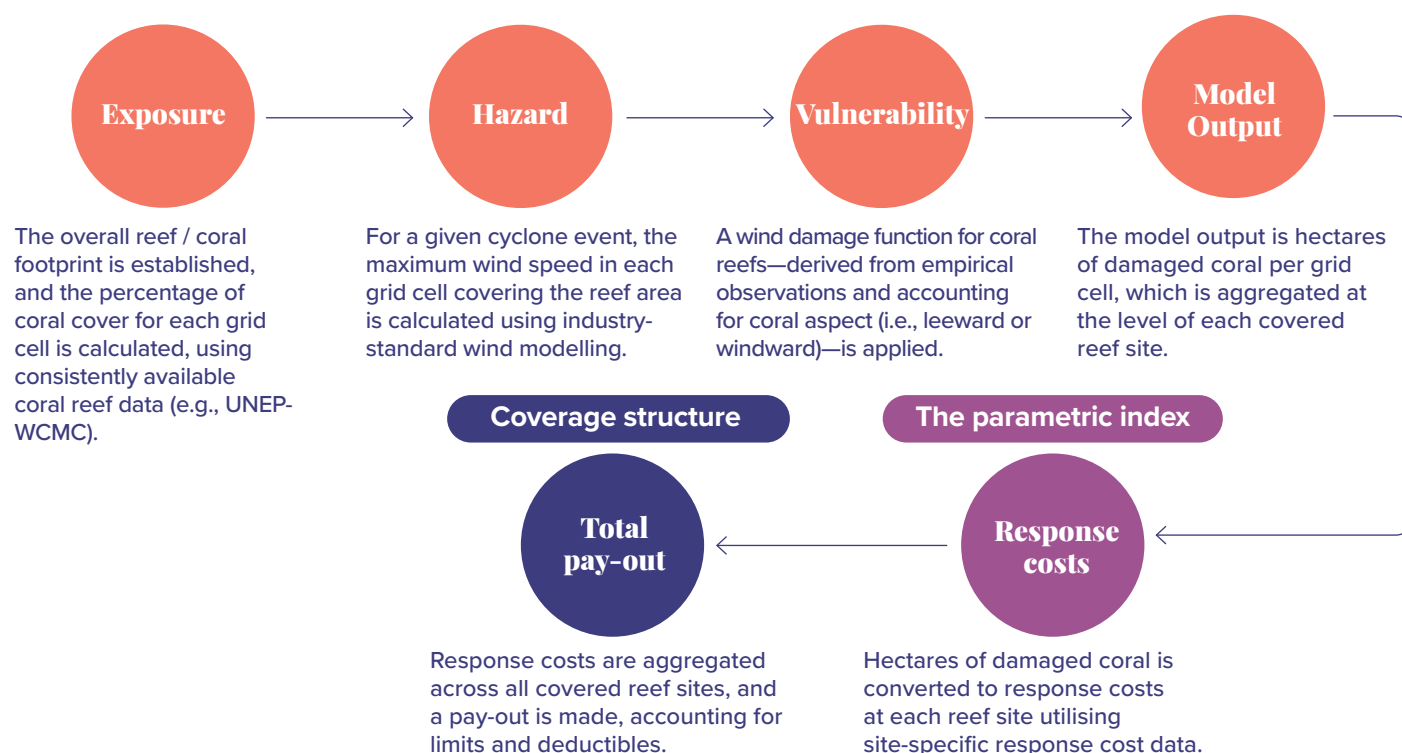
- Pay-out rates account for the spatial distribution of the impacts of event intensity across a covered geography.
- For each covered reef site, pay-outs are triggered according to movements in a parametric index that captures reef response costs as a function of reef damage, which is calculated using a bespoke cyclone reef damage model.

This product design was developed under the **Ocean Risk and Resilience Action Alliance (ORRAA)** project, *Financing Mesoamerican Reef Resilience to Extreme Climatic Events* with the financial contribution of **Global Affairs Canada**.

HOW DOES IT WORK?

- 1 The cyclone reef damage model** captures the relationship between the spatially distributed wind speed of a hurricane and reef damage, with a model output of hectares of damaged coral per grid cell at a base resolution (grid cell size) of 30 arcseconds (~1km).
- 2 The parametric index** then captures response costs for each reef site, as a function of hectares of damaged coral.
- 3 Coverage structure** (i.e., limits and deductibles) are determined for each site—and at the programme level—based on reef response needs and capacities at each site and on the premium budget available.

The cyclone reef damage model





Annex to the Mesoamerican Reef Insurance Programme

Brief: **Frequently Asked Questions**

What is the flow of funds? Who pays—and who is paid—for what?

SHORT ANSWER

MAR Fund pays the insurance premium so that in the event of a qualifying hurricane, the insurance company pays for immediate reef response, which is implemented by local response groups with funds distributed through the MAR Fund's Emergency Fund.

DETAILED ANSWER

The insurance premiums for the coverage currently in place for four pilot reef sites are being supported by the InsuResilience Solutions Fund (ISF) through a grant to the MAR Fund. The MAR Fund then pays the premiums, through their broker, Willis Towers Watson (WTW), to the insurer. If a qualifying hurricane occurs at any of the four covered reef sites, a pay-out will be made within days to the MAR Fund's Emergency Fund. Local, eligible, NGOs at the affected reef sites will then receive funds from the Emergency Fund—based on a pre-agreed process—to implement reef response. Local NGOs will then pay for the response, including payment to local reef response brigades, who have been trained and equipped by the MAR Fund, and are ready to implement response plans.

ISF will continue to provide financial support for insurance premiums covering the 2022 and 2023 Atlantic hurricane seasons. During this “proof of concept” phase, the MAR fund will consult and engage with the universe of reef users and beneficiaries—including MAR country governments, local communities, tourists and recreational users, businesses (e.g., in the tourism and fishing sectors), and global citizens—to develop and implement a sustainable, long-term premium financing strategy. The study [Sustainability of Rapid Response Reef Risk Financing in the MAR Region](#) indicates an approach to securing long-term funding of premium for the MAR Insurance Programme.

What are the different insurance product design options and how do you choose what is appropriate?

SHORT ANSWER

It is critical to consult directly with an impartial risk management and insurance expert to determine the optimal risk management and financing strategy for your specific context, risk, and needs.

DETAILED ANSWER

Broadly speaking, there are two types of insurance: traditional indemnity insurance and parametric insurance. In traditional **indemnity insurance**, the financial amount of the insurance claim (aka pay-out) is dictated by the size of the actual loss, so that, for example, the cost of repairing a damaged building to its prior state is paid. In **parametric** (also called **index-based**) **insurance**, the amount of the pay-out is dictated by an objective measure of the causal event (e.g., the peak wind speed of a hurricane).

Indemnity insurance is designed to ‘make the policy holder whole’ following physical damage, whereas parametric insurance is designed to provide liquidity when it is needed. This makes indemnity insurance particularly well suited as the instrument to finance the replacement / rebuilding of fixed, built assets such as property and some grey infrastructure. Parametric insurance, on the other hand, is designed to smooth the financial impacts of shock events. Therefore, parametric insurance is particularly useful to finance the risks to financial flows from external conditions, including response costs and income replacement. Put differently, parametric insurance is an option to finance costs rather than losses, or liquidity shocks rather than damage.

When it comes to reef insurance covering hurricane response costs for reefs, the first three of these parametric insurance design options can be used to capture the relationship between hurricane intensity and reef response needs.

Each option utilises peak wind speed as the fundamental hazard parameter to proxy hurricane intensity, with response needs—and therefore pay-outs—captured as a function of peak wind speed. The options differ in how and at what resolution they capture the spatial distribution and impacts of peak wind speed on the reef. The optimal insurance product covers the costs of post-hurricane reef response as efficiently as possible by triggering pay-outs when they are needed at covered reef sites. As reef response needs are spatially distributed over the MAR and variable for different events with different “windprints”—since variations in coral cover across and within reef sites, along with distributed peak wind speeds, lead to spatially variable degrees of impact—the optimal insurance product will capture the spatial distribution of hurricane impacts to the reef within and between reef sites. More targeted product design that is sensitive to the spatial distribution of hurricane impacts—and therefore on-the-ground response needs—provides more targeted pay-outs when they are needed, which constrains premium costs and increases insurance affordability.

The figure on the next page illustrates the different parametric insurance design options to cover rapid post-hurricane reef response.

There are four general types of parametric insurance products, each appropriate for different end-uses:

PURE PARAMETRIC

- ▶ Pay-outs based on event intensity in a covered geography.
- ▶ Very simple and easy to understand, often with large basis risk (i.e., the risk that event-triggered pay-outs may not relate accurately to actual loss).

GRIDDED PARAMETRIC

- ▶ Pay-outs based on the spatial distribution of event intensity across a covered geography.
- ▶ Good to account for mixed impacts, as relationship between event intensity and pay-out is flexible.

PARAMETRIC INDEX

- ▶ Pay-outs based on the spatial distribution of the impacts of event intensity across a covered geography.
- ▶ Good for covers where there is a robust relationship between event intensity (i.e., hazard parameters) and detailed impacts (i.e., losses / costs).

MODELLED LOSS

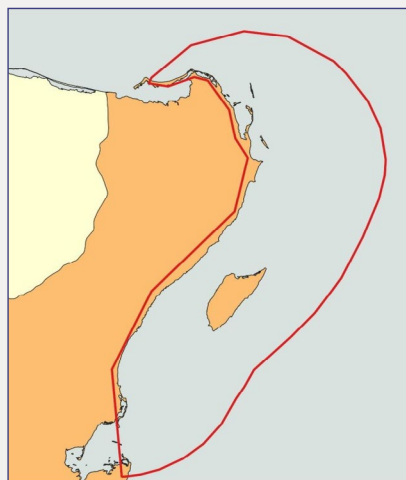
- ▶ Pay-outs based on estimated loss from a catastrophe risk model.
- ▶ Good to cover homogeneous fixed assets where there is a scientifically robust relationship between hazard parameters and physical damage (e.g., property).

Optimal insurance design to cover rapid post-hurricane reef response

Most Basic

PURE PARAMETRIC

- Pay-outs based on event intensity in a covered geography.
- Very simple and easy to understand.
- Often with large basis risk, since pay-out structure does not take the spatial distribution of the hazard or impacts into account.
- Pay-outs triggered at pre-agreed windspeed thresholds that are the same for the entire covered geography, e.g.:



Hazard intensity	Pay-out rate
Wind Speed (kn)	% of Limit
96 – 99	20%
100 – 103	30%
104 – 108	40%
109 – 112	50%
113 – 116	60%
117 – 121	70%
122 – 125	80%
≥ 126	100%

Source: IBANQROO, 2021

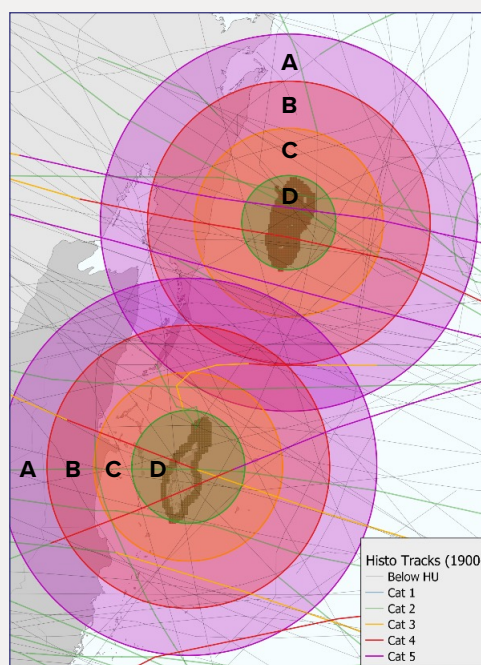
This product is currently in place for reefs and beaches in Quintana Roo, purchased by the State of Quintana Roo.

Improved

GRIDDED PARAMETRIC

- Pay-outs based on the spatial distribution of event intensity across a covered geography.
- Good to account for mixed impacts, as relationship between event intensity and pay-out is flexible.
- Pay-outs triggered at pre-agreed windspeed thresholds that are "gridded" across the covered geography, e.g.:

Hazard intensity		Pay-out rate for Reef Site X			
Wind Speed (kn)	Hurricane Category	Zone A (purple)	Zone B (red)	Zone C (orange)	Zone D (green)
0 – 63	0	0%	0%	0%	0%
64 – 82	1	0%	0%	5%	10%
83 – 95	2	0%	5%	10%	20%
96 – 112	3	5%	10%	20%	40%
113 – 136	4	10%	20%	40%	80%
≥ 137	5	20%	40%	80%	100%



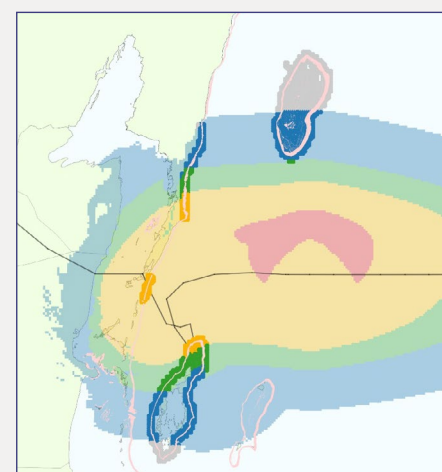
This product is currently in place for the 2021 Atlantic hurricane season, covering post-hurricane reef response costs—utilising bespoke pay-out structures for each of four covered MAR reef sites—purchased by the MAR Fund with financial support from the InsuResilience Solutions Fund.

Most Sophisticated

PARAMETRIC INDEX

- Pay-outs based on the spatial distribution of the impacts of event intensity across a covered geography.
- Good for covers where there is a robust relationship between event intensity (i.e., hazard parameters) and detailed impacts (i.e., costs).
- Pay-outs triggered according to movements in a parametric index that captures reef response costs as a function of reef damage, which is calculated using a bespoke cyclone reef damage model.

Parametric index capturing impact as a function of hazard intensity



Hurricane Keith (2000) / Peak Intensity

● Sub-Hurricane ● Hurricane-1 ● Hurricane-2
● Hurricane-3 ● Hurricane-4 ● Hurricane-5

The parametric index and cyclone reef damage model were developed by WTW under the ORRAA project.

This product design will be finalised and expanded to cover additional priority reef sites of the MAR Insurance Programme for the 2022 Atlantic hurricane season, under the InsuResilience Solutions Fund project.

Who are in the reef response groups?

Response will be implemented through Emergency Response Groups made up of the Coordinating Committee, Operations Committee, and Response Brigades. These groups include protected area managers, reef restoration practitioners, tour operators, dive operators, biologists, and fisherfolk, and are open to all others interested in reef health and conservation. Each Response Brigade will include at least six expert divers, four snorkelers, a boat captain, and logistics expert. All of these responders can include local community members, for example fisherfolk and tourism operators.

How quickly is the reef response implemented?

The reef response is implemented immediately after the storm recedes and it is safe to enter the water to assess damage and start to repair the reef. The speed of response is critical to enable reattachment of corals when they are still viable and restoration of disrupted ecosystem services as quickly as possible. An initial damage assessment will be done within two weeks of the hurricane receding, with the full initial response completed within two months.

What is the ‘insurable interest’ of the MAR Fund?

SHORT ANSWER

The financial requirements of immediate reef response activities on the MAR.

DETAILED ANSWER

The MAR Fund is the regional financing mechanism for large scale maintenance, conservation, and restoration of the Mesoamerican Reef, and the Reef Rescue Initiative (RRI) has been working with local authorities, reef managers, communities, and the private sector in all four MAR countries to build the resilience of the reef—and the ecosystem services it provides to the multitude of reef users. Rapid reef response is a central pillar of the RRI’s holistic strategy, and as an environmental fund with strong governance and administration, it has built the local and regional capacities to plan and implement immediate response activities on the MAR. The MAR Fund has initiated collaboration agreements with local authorities in each MAR country to create and support the reef response capac-

ities at the country level, and at each covered reef site (which were selected for insurance coverage in consultation with local stakeholders, including the national authorities of the MAR countries). The RRI has also established the Emergency Fund, which is designed to provide rapid funding for emergency reef response activities. For example, the Emergency Fund was triggered by Hurricanes Gamma, Delta, and Zeta in 2020 and provided funds for CONANP-led immediate reef response at three sites within Puerto Morelos National Park—with these funds, 2,152 coral colonies were stabilised, 5,143 fragments were cemented, and 8,428 fragments were propped.

The MAR Insurance Programme will secure the financial sustainability of these response activities, gearing up the Emergency Fund with additional post-hurricane funding, and providing that rapid funding through the distribution processes and protocols that are already in place at covered reef sites. Moreover, the MAR Fund Board has confirmed that the MAR Fund is able to act as the insurance policyholder and purchase the insurance.

Therefore, the RRI has an established interest in funding reef response activities at the covered reef sites. Since, in parametric insurance, insurable interest is established by the relationship between the independent “triggering” event and a financial impact to the insured, the MAR Fund’s insurable interest in reef response activities is established by the emergency response protocol and fund distribution processes set up at each of the reef sites, with the local Emergency Response Groups.

How does this relate to the reef insurance in the State of Quintana Roo?

SHORT ANSWER

The MAR Insurance Programme is complementary, and different, to the reef and beach insurance purchased by the State of Quintana Roo.

DETAILED ANSWER

The MAR Insurance Programme is complementary to the reef and beach insurance purchased by the State of Quintana Roo in the sense that it provides hurricane coverage to additional reef sites across the entire MAR region, leveraging the regional approach of the MAR Fund and the RRI. This allows the MAR Insurance Programme to realise the benefits of pooling the risk of multiple reef sites under a single insurance policy.

Key benefits of pooling the risk of multiple reef sites under a single insurance policy:

- ✓ Minimise insurance cost by reducing annual volatility in pay-outs, which reduces the amount of capital risk-takers need to allocate to cover the extreme years which, in turn, reduces the premium price.
- ✓ Minimise frictional costs with a single insurance policy placement and administration process.
- ✓ Maximise operational efficiency with a coherent regional pay-out governance and distribution process, which increases the predictability of post-event response funding and incentivises more robust contingency planning.
- ✓ Streamline implementation of reef response by maximising collaborative action and peer learning, contributing to stronger regional conservation outcomes.
- ✓ Enable a regional premium financing strategy that recognises the MAR as a global public good.

It is also complementary because of key differences:

1. The MAR Insurance Programme is integrated within the RRI's holistic strategy for Mesoamerican Reef resilience. This means the finance instrument is directly connected to reef response plans and pre-arranged fund distribution processes and protocols to rapidly disperse pay-outs to the Emergency Response Groups at each of the covered reef sites. This established governance and administration is critical to ensure reef resilience outcomes, as it facilitates speed and incentivises contingency planning across the region. In contrast, the reef and beach cover in place for the State of Quintana Roo covers impacts to the beaches and reefs of the Quintana Roo coast in a more general way, with a wide variety of potential uses for any insurance pay-out.

2. As illustrated in the above figure on optimal insurance design, the MAR Insurance Programme is underpinned by a more sophisticated parametric insurance product that is suited to a regional approach that supports locally differentiated reef response needs and characteristics. The insurance product is more sensitive to the spatial distribution of hurricane intensity, reef impacts, and response costs, so it targets premium budget where it is needed for reef response, ultimately reducing the cost of reef insurance across the region.

How easy is this to scale?

SHORT ANSWER

Parametric insurance that covers the cost of immediate response activities to maintain ecosystems damaged by natural hazards is extremely scalable. And, from a product design perspective, insurance covering immediate reef response to hurricane impacts could be scaled immediately across any hurricane basin globally.

DETAILED ANSWER

There are three key technical insurance design requirements to fulfil in order to scale parametric insurance:

- 1 Establish the relationship between hazard intensity and response costs, which can be relatively simple or more sophisticated, mostly depending on response capacities and plans, but also ecosystem data availability (e.g. reef / coral footprint);
- 2 Determine a pay-out structure that captures response costs as a function of hazard intensity, including identifying target minimum and maximum pay-out amounts (i.e., deductibles and limits, respectively) and associated hazard intensity parameters (i.e., attachment and exhaustion points, respectively); and
- 3 Quantify the probability of pay-outs being made, i.e., the expected frequency and intensity of hazard parameters.

However, there is a critical step before technical insurance design: establishing demand from a policyholder with the objective and ability to implement the pay-out. Given demand for insurance coverage from an end-user, establishing a budget for premium is a good next step in determining feasibility, as insurance coverage characteristics are ultimately dependent on the premium available.

Parametric insurance is also scalable beyond reef insurance for hurricane risk. As long as there is a quantifiable relationship between hazard parameters—which are independent, objective, and reliably available historically and in real-time or near real-time—and financial impacts (e.g., response costs, liquidity needs), parametric insurance can be designed to provide pay-outs to smooth financial risk associated with that hazard. For example, parametric insurance could provide pay-outs to maintain / replant mangroves following hurricane damage; it could cover business interruption risk to businesses impacted by hurricane-related reductions in

trade; or it could cover other natural hazards with response plans in place. The key requirement is demand from a policyholder with a budget available for premium.

Why should these funds go toward insurance, rather than more traditional conservation?

SHORT ANSWER

The short answer is that funding the MAR Insurance Programme is traditional conservation. Since immediate reef response to hurricane impacts is critical to maintaining a healthy reef, there is a requirement for predictable funding, and insurance is an efficient financial instrument to pre-position this funding.

DETAILED ANSWER

The detailed answer is in three parts:

1 Immediate reef response to hurricane impacts is critical to maintaining a healthy reef and the ecosystem services it provides, and, therefore, the resilience and prosperity of the communities it supports.

The Mesoamerican Reef, along with all the warm-water coral reef systems of the world, is in existential crisis. The reefs of the MAR have faced, and survived, the impacts of tropical cyclones for eons, but as the effects of anthropogenic climate change, as well as overfishing and pollution, exert rapidly increasing pressure on the reef ecosystems, the risk of a hurricane impact leading to coral mortality has grown exponentially. When hurricanes occur, reefs that are already affected by other factors are more likely to suffer degradation and mortality from the heavy seas that directly damage coral reef ecosystems, causing impacts from breakage of coral colony tips and branches, sand burial, and dislodgement of large colonies. Such impacts in turn affect the ecosystem services the reefs provide.⁵ At the same time, the science of reef repair and recovery, and locking in reef resilience through active intervention (through, for example, planting coral species resilient to rising ocean temperatures and acidity), has developed rapidly, and provides an opportunity to actively reduce, dramatically, the negative impacts of hurricanes on coral reefs. This, in turn,



Photo: Juan Carlos Huitrón

greatly increases the ability of the reef to withstand the anthropogenic threats, alongside complementary conservation actions such as are implemented under the RRI.

The hurricane risk to the MAR is particularly significant, and acts to exacerbate all other risks. But emergency response and early recovery action to address reef damage is highly cost-effective. Evaluation of damages, debris clean-up, and salvaging and reattaching dislodged corals following a damaging event has been shown to have positive impacts on coral survival and recovery, and therefore the reef ecosystem's health and ability to recover, withstand future threats, and improve communities' and reef resilience. A simple cost benefit analysis shows, with a recovery time that is twice as fast, a potential benefit to cost ratio of close to 10:1.⁶

2 Immediate reef response to hurricane impacts requires funding.

Despite their local, national, and global importance, and the potential benefits of rapid emergency response following hurricane damage, coral reefs are often overlooked or underappreciated in policy decisions, investment, and risk management frameworks. Regional and by-country analysis of the existing regulatory framework for reef restoration and dedicated financing mechanisms demonstrates a lack of any structured risk management plans or financing for the MAR in the wake of extreme events such as hurricanes.

⁵ Coastal communities are disproportionately affected by degradation or damage to the reef. For communities in the MAR region, the threat of hurricanes is twofold; they inflict direct damage on lives and property (which is lessened by the very presence of a coral reef) and damage to the reef, which is a critical natural infrastructure asset underpinning livelihoods and food security.

⁶ *Beneficiaries of Rapid Response Risk Financing in the MAR Region*

The restoration of natural ecosystems, and particularly those that support vulnerable communities, is rarely a governmental priority in the aftermath of extreme events, as resources are focused mainly on grey infrastructure and property (after live-saving actions are completed). This leaves hurricane risk to the MAR implicitly spread across the multitude of reef users, without any common mechanism to organise and fund response. And when emergency response, clean-up, and restoration is not rapidly implemented after a hurricane, broken corals die and the time it takes for reefs to recover is significantly extended (if, indeed, they do recover). This is exactly the response planning and funding gap the RRI is addressing through the development of reef response protocols, capacity building and training, and sustainable financing through the Emergency Fund and the MAR Insurance Programme.

3 Insurance is an efficient financial instrument to finance immediate reef response to hurricane impacts.

The MAR Insurance Programme is designed to build the financial sustainability of the RRI and reef response activities in the region by leveraging private risk markets to underwrite risk for which they are most efficient and provide the most value for money. Hurricane risk is a very well understood hazard in the insurance industry, and risk in the MAR region is diversifying to the portfolios of many risk markets, which means insurance is relatively competitively priced for hurricane risk to the MAR.

Additionally, when compared to other options to finance reef response costs to hurricane impacts, insurance is an efficient option.

- **Raising funds (e.g., through grants and/or debt)** after a hurricane diverts energy away from reef response in the crucial time for immediate action, and funds arrive late. Additionally, this ex post approach to risk financing discourages contingency planning, as funds are uncertain and responsibility is unclear.
- **Maintaining a contingency fund** has an opportunity cost (as those funds could be used now), and reserve funds are difficult to defend for specific uses—especially infrequent but severe hazard events. Raising a large amount of money to sit in a contingency fund—and preserving it over time—can be much more difficult than regularly paying a relatively smaller amount in premium to secure access to that larger amount when it is needed.

Furthermore, the MAR Insurance Programme complements the Emergency Fund, which is a contingency fund maintained by the RRI. The insurance instrument “gears up” that fund, meaning that those resources are available to respond to threats that are more frequent, less predictable, and/or have some moral hazard associated with them—from man-made emergencies like ship groundings and oil spills to natural impacts from diseases.

This insurance-supported approach to sustainable, integrated, pre-positioned reef risk financing ultimately enables local communities to plan and implement a more rapid reef response, speeding the recovery of reefs and the valuable ecosystem services it provides.

Partners of the Mesoamerican Reef Insurance Programme



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THE MESOAMERICAN REEF: A Cornerstone of Sustainable Development

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Photo: Carlos Gereda

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