A POST-STORM RESPONSE AND REEF INSURANCE PRIMER

Building the response capacity to repair reefs damaged by hurricanes

2021

FIGURE 1: Healthy colony of *Acropora palmata* uprooted by Hurricane Delta. Photo: ©Daniela Zambrano

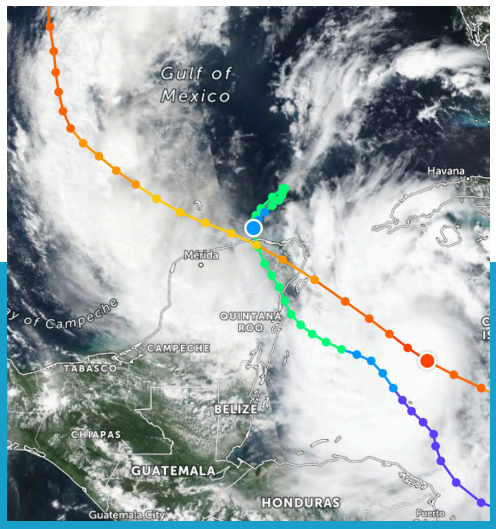


FIGURE 2: Satellite image on October 6th, showing Tropical Storm Gamma (blue-green track) and Hurricane Delta (orange-yellow track) over the Yucatan Península. Photo: ©Zoom Earth

2020: IN THE EYE OF THE STORMS

Three tropical cyclones hit the Mexican Caribbean and Yucatan Peninsula in October 2020—Gamma on October 3-5, Hurricane Delta on October 7, and Hurricane Zeta on October 27—uprooting, displacing, and breaking coral colonies in the reefs located off the coast of the Mexican State of Quintana Roo. Assessments in Punta Nizuc and Isla Mujeres found that 5% of the reef´s coral colonies suffered severe damage and up to 20% suffered moderate damage. The storms particularly impacted populations of Acropora, hard corals located on reef crests that are critical for coastal protection.

The combination of an insurance policy for the coral reef and a well-organized post-storm response capacity proved a highly successful approach to help the reef recover. The impact of Hurricane Delta triggered a USD 850,000 insurance payout to the Quintana Roo Government; this payout was the first ever insurance payment to repair and restore a coral reef. Highly trained reef brigades responded soon after Hurricane Delta had passed. Over the next three months, the brigades stabilized 2,152 coral colonies that were uprooted and displaced and reattached 13,570 coral fragments. The effort to repair and restore the damaged coral will enhance the reef's resilience and ability to continue protecting coastal communities.

The Quintana Roo Government, the National Commission of Natural Protected Areas (CONANP), the Center for Research on Aquaculture and Fisheries (CRIAP-INAPESCA) and the local community established the response capacity in 2017-2018 with technical and funding support from The Nature Conservancy (TNC). The response capacity encompasses the response brigades (80 community divers and snorkelers), a response protocol, a financial mechanism, a parametric insurance policy, and a governance system.

WHY ARE CORAL REEFS SO IMPORTANT?

- The reef and beaches sustain the USD 12 billion tourist economy of Quintana Roo. Reefs are the most important tourism attraction in Cozumel, Puerto Morelos, Punta Nizuc, and Punta Cancun, attracting more than one million visitors per year who pay approximately USD 60 million to local tour operators alone. Moreover, the reefs protect the beaches from coastal erosion.
- In Puerto Morelos, reefs reduce 60% of wave height under normal weather conditions (Mariño, I. and Acevedo C., 2017), protecting the beaches from erosion. If reefs were degraded, losses to infrastructure from a storm could triple (Beck et al., 2017. Reguero, B., et al., 2018).
- Covering less than one percent of the ocean floor, coral reefs support an estimated 25 percent of all known marine species (NOAA 2020). The reef in Quintana Roo is part of the Mesoamerican Reef, the longest barrier reef in the western hemisphere, and home to 70 species of coral and 500 species of fish.

HOW DO HURRICANES IMPACT CORAL REEFS?

Although reefs are affected by several threats, such as diseases, water pollution, bleaching, and diving, hurricanes can diminish live coral cover and reef complexity in only a few hours. A meta-analysis (Gardner et al., 2005) of more than 200 sites and 20 years of data found the following:

- Hurricane wind speeds between 50 to 100 knots caused losses of live coral cover ranging from 0% to 10%, with an average loss of around 2% to 3%.
- Hurricanes with wind speed above 110 knots caused severe or catastrophic damage to coral reefs. Loss of live coral cover ranged from approximately 10% to 30% at 110 knots and 20% to 50% at 160 knots. See Figure 5 below (Gardner et al., 2005).
- Sites impacted by hurricanes show an annualized loss of live coral cover of 6.7%, which is three times more than the annual loss of 2.6% for sites impacted by the other stressors.

A recent analysis of hurricane impacts on reefs indicates that hurricane wind speeds above 100 knots may damage a reef when the center of the hurricane passes less than 65 km from the reef (Perez, E. et al., 2020).

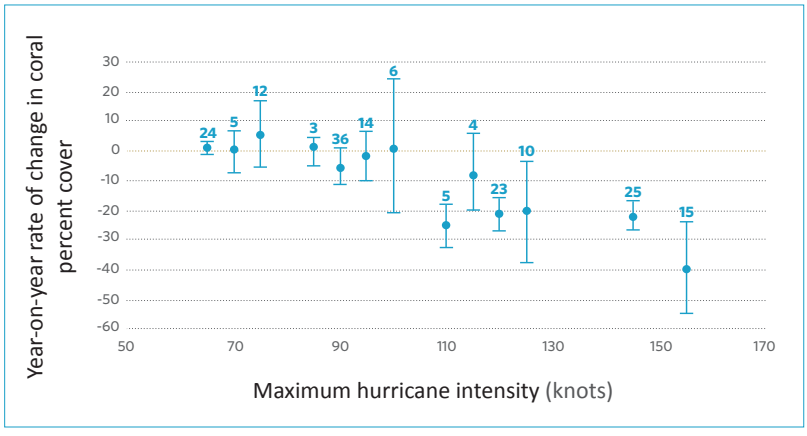
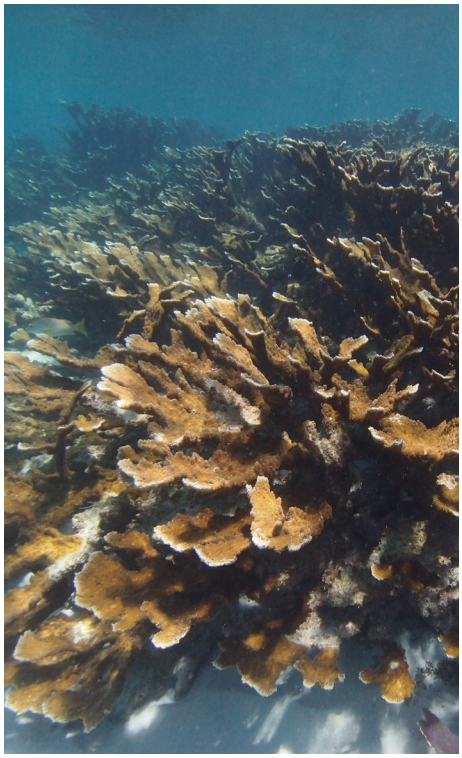


FIGURE 5:
Damage to coral cover by maximum wind speed in more than 200 sites in the Caribbean. The number of sites documented for each wind speed is indicated on top of each bar (Gardner et al. 2005).

FIGURE 3: A well-developed and healthy colony of *Acropora palmata* in a protected area. Photo: ©Lorenzo Alvarez

FIGURE 4: Broken and displaced coral colonies after a storm. Photo: ©Jennifer Adler/TNC



IS IT POSSIBLE TO REDUCE THE DAMAGE CAUSED BY HURRICANES?

It is critical to repair damage to reefs after a storm. To reduce damage, CONANP, CRIAP-INAPESCA, and TNC initially developed a Post-Storm Protocol (Zepeda, C. et al., 2019) to guide reef repair efforts. Then they organized, trained, and equipped reef brigades—80 local residents who serve as "first responders"—to conduct post-storm response in Cancún, Contoy Island, Isla Mujeres and Puerto Morelos national parks. The brigades:

- Remove from reefs debris such as articles pulled from shore (e.g. beach chairs), sand, loose stones, or broken corals to prevent further damage.
- Fix and consolidate loose colonies and broken coral fragments.
- Collect broken pieces of coral and grow them in nurseries for future transplanting.

Implementing these actions within 90 days of the storm greatly increases the chance that coral will recover and survive, thus reducing the overall storm damage.

FIGURE 6:
A brigade member learns to use a drill underwater during rapid response training. Following a hurricane, brigade members use drills to secure corals and repair the reef in the Mesoamerican Barrier Reef at Puerto Morelos National Marine Park. Puerto Morelos, Mexico. June 2018
Photo: ©Jennifer Adler/TNC

FIGURE 7:
Nursery with *Acropora palmata* coral colonies.
Photo: ©Oceanus A.C.

MEDIUM TO LONG-TERM RESTORATION AFTER THE INITIAL POST-STORM RESPONSE

Damage caused by major hurricanes might be so severe that reefs require restoration efforts 2 to 5 years post-storm. Restoration encompasses sexual and fragment-based reproduction of coral colonies, consolidation of broken reef structures, and managing critical stressors to coral such as snorkelers, divers, water pollution, and fishing.

Reef building species, such as *Acropora palmata* and *Acropora cervicornis*, are the main focus of reef repair activities in Quintana Roo because their presence on the reef crest is critical for reducing wave energy.

FIGURE 8:
Reef crest covered with dead coral.
Photo: CRIAP-INAPESCA.

WHY BUY INSURANCE?

The economic cost of not repairing the damage to the coral reef would be much higher to the local economy of Puerto Morelos than paying for the restoration of the reef. Transferring the cost of restoration to the market via an insurance policy reduces the burden even further.

TNC estimated that the cost of the immediate response could range from USD 40,000 to USD 200,000 in Puerto Morelos Reef National Park depending on the severity of the damage. The cost of a mid-term response could range from USD 500,000 to USD 2 million during the next one to three years. The estimated economic loss to the local economy of Puerto Morelos could be between USD 3.2 and USD 7.2 million per year, caused by a decrease in revenues from diving and snorkeling on the reef (Secaira, F., 2017) and reduced coastal protection provided by reefs (Borja, et al., 2018). The annual cost of such an insurance policy for Puerto Morelos was estimated at 10 to 13 percent of the maximum payout.

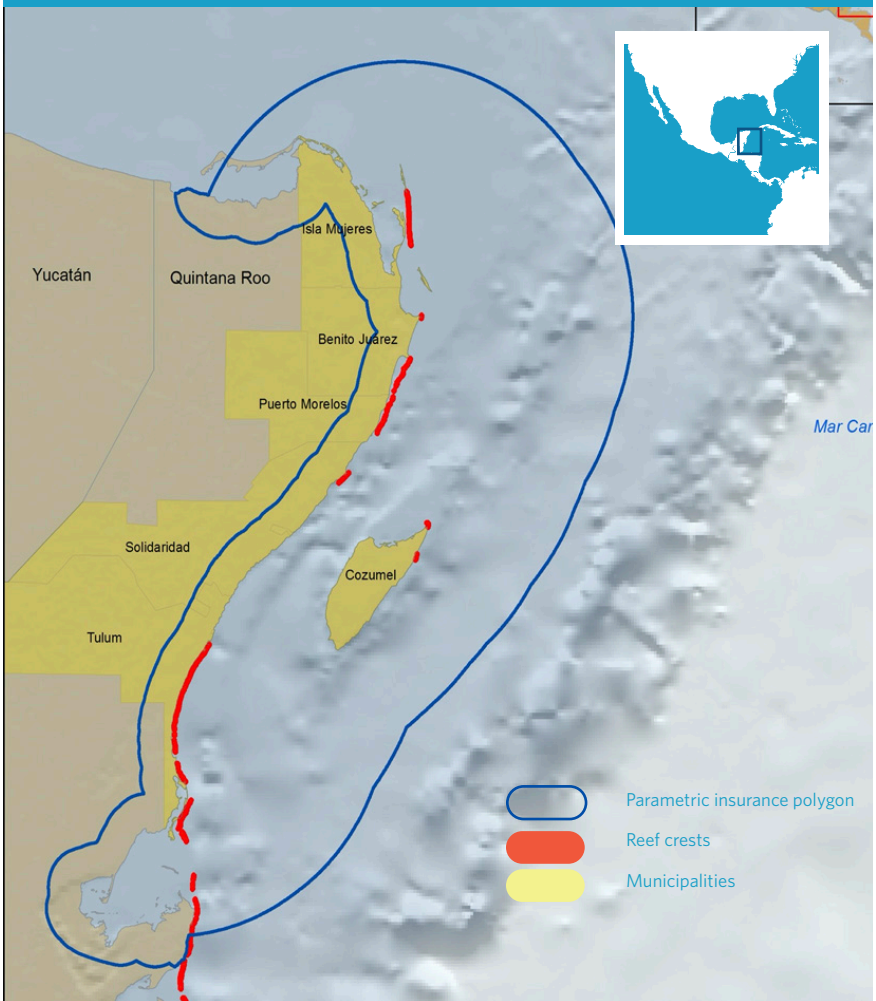
Since neither CONANP or the Quintana Roo Government can afford to cover the costs of repairing the reef after a major storm, the response would be very limited and the reef would remain mostly unattended. However, an insurance policy can be a cost-effective financial investment to guarantee the availability of funding to implement a post-storm response.

WHO BUYS THE INSURANCE AND DECIDES HOW TO USE THE INSURANCE PAYOUTS?

Insurance could be purchased by private or public customers. The entity that receives the greatest protective benefit from a healthy reef would be most likely to purchase the insurance policy. In cases with multiple beneficiaries, it may be necessary to establish an institutional arrangement to represent them, collect their contributions, purchase the insurance, and manage the funds. For example, the Quintana Roo Government established the Trust for Coastal Zone Management, Social Development, and Security in 2018 to secure long-term funding from private and public sectors for coastal zone management activities and response to emergencies and natural disasters. Starting in 2019, the Trust bought the insurance on behalf of the State of Quintana Roo and it is the beneficiary of the policy.

The Trust is managed by the Technical Committee—essentially a board of directors—with representation from the State of Quintana Roo, local municipalities, hotel associations, nongovernmental organizations, as well as the Secretaries of the Environment, Tourism, Finance and Planning, Public Safety, and Social Development. The Technical Committee has two subcommittees: the Coastal Zone Management Subcommittee and the Social Development and Security Subcommittee. Each subcommittee has an advisory council. The councils draw on the expertise of the members to advise the subcommittee and, ultimately, the Technical Committee in its decision making. For example, the Coastal Zone Advisory Council, made up from coastal and marine experts, provides guidance on reef repair and restoration projects.

FIGURE 9: Polygon for parametric insurance in Quintana Roo.



HOW DOES PARAMETRIC INSURANCE WORK?

Parametric insurance has three elements:

1. A parameter (wind speed in this case) and the threshold that would trigger the insurance.
2. A geographic area where the measurement of the parameter (wind speed) must meet the threshold to trigger a payout.
3. The payout to the policy holder.

The parametric insurance in Quintana Roo is triggered if wind speed within the polygon is greater than 100 knots (see Figure 9). The payout increases according to the maximum sustained wind speed since stronger winds result in greater damage and expenses (see Table 1).

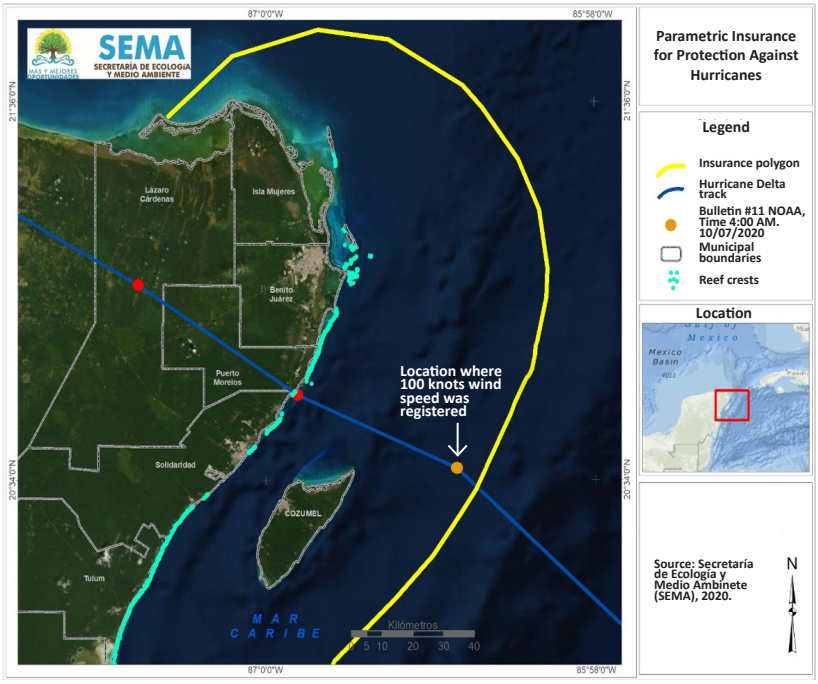
HURRICANE DELTA TRIGGERS A PAYOUT

On October 7, 2020, Hurricane Delta entered the polygon defined in the insurance policy and registered windspeeds of 100 knots five kilometers inside the polygon (see Figure 10). This triggered a payout of USD 850,000 that will be invested in a large-scale restoration effort over the next 2 to 3 years. CONANP, CRIAP-INAPESCA, TNC and the Quintana Roo Secretary of Ecology and Environment (SEMA) are planning the repair and restoration projects that will be implemented.

INSURANCE POLICY COST AND PAYOUT STRUCTURE IN USD AND MEXICAN PESO		
CHARACTERISTICS OF 2020 INSURANCE POLICY	USD	MEXICAN PESOS
Cost of the policy	250,000	4,995,000
Payout at 100 knots (40%)	850,000	17,000,000
Payout at 130 knots (80%)	1,700,000	34,000,000
Maximum payout at 160 knots or more (100%)	2,125,000	42,500,000

TABLE 1:
The insurance payout increases according to the windspeeds documented within the boundaries of the polygon.

FIGURE 10:
Hurricane Delta's track through the polygon of the parametric insurance in Quintana Roo, Mexico. Source: Secretary of Ecology and Environment, Government of Quintana Roo, Mexico.



WHAT IS NEXT?

Based on the successful implementation of the concept in Quintana Roo, TNC is collaborating with the Mesoamerican Reef Fund to replicate this approach in Belize, Guatemala, and Honduras. Additionally, TNC is exploring the application of insurance to other risks (e.g. coral bleaching) and other ecosystems (e.g. mangrove forests) in the United States, Caribbean, and Asia Pacific. The Climate Risk and Resilience program has been generously funded by the Rockefeller Foundation, Bank of America Charitable Foundation, and Swiss Re Foundation.

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