The Nature Conservancy

GUIDE ON HOW TO INSURE A NATURAL ASSET

MSC. FERNANDO SECAIRA, KATHY BAUGHMAN MCLEOD AND BESS TASSOULAS

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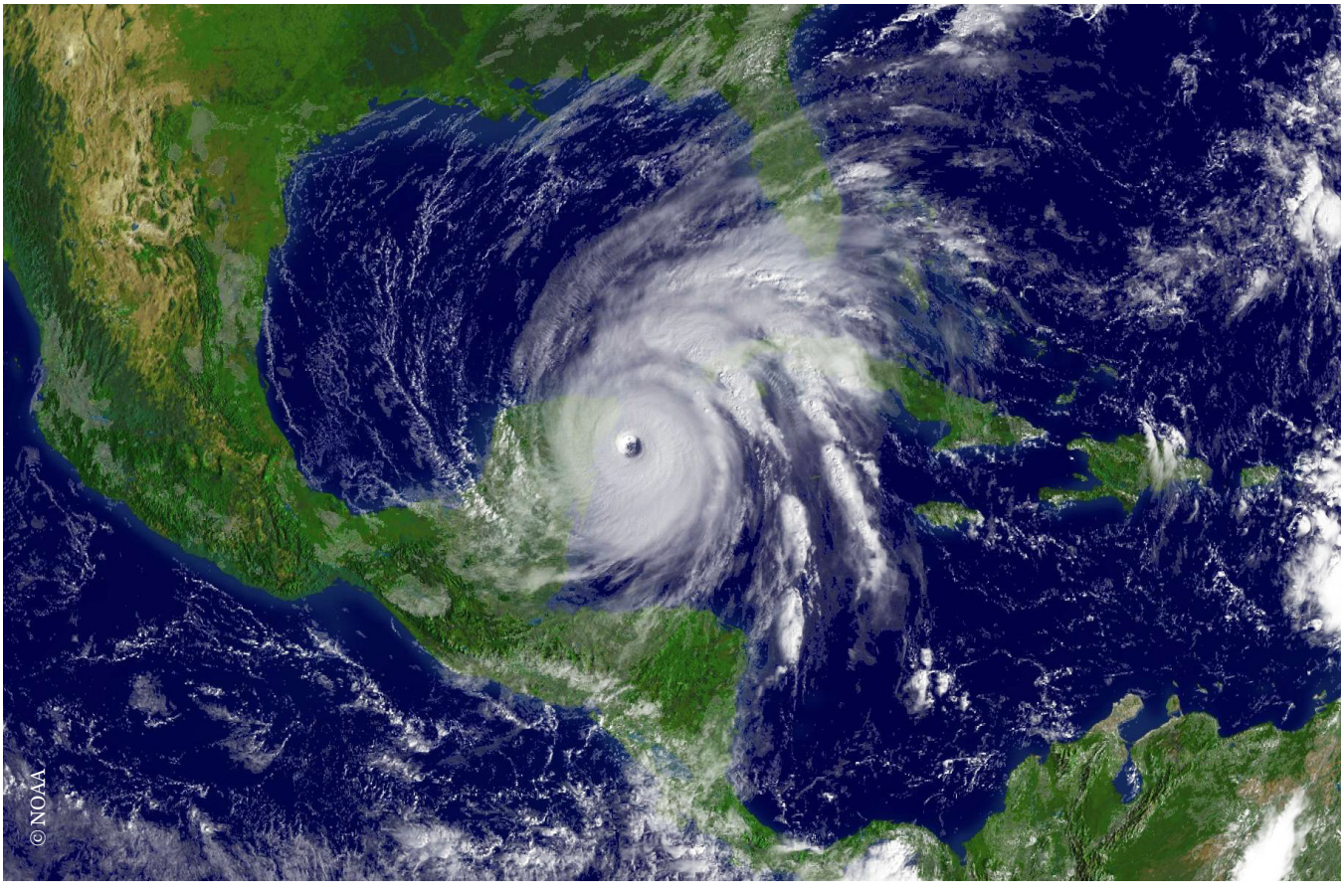

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Kathy Baughman McLeod envisioned this innovative concept[1], and supported the overall implementation of the Mexico's pilot project.
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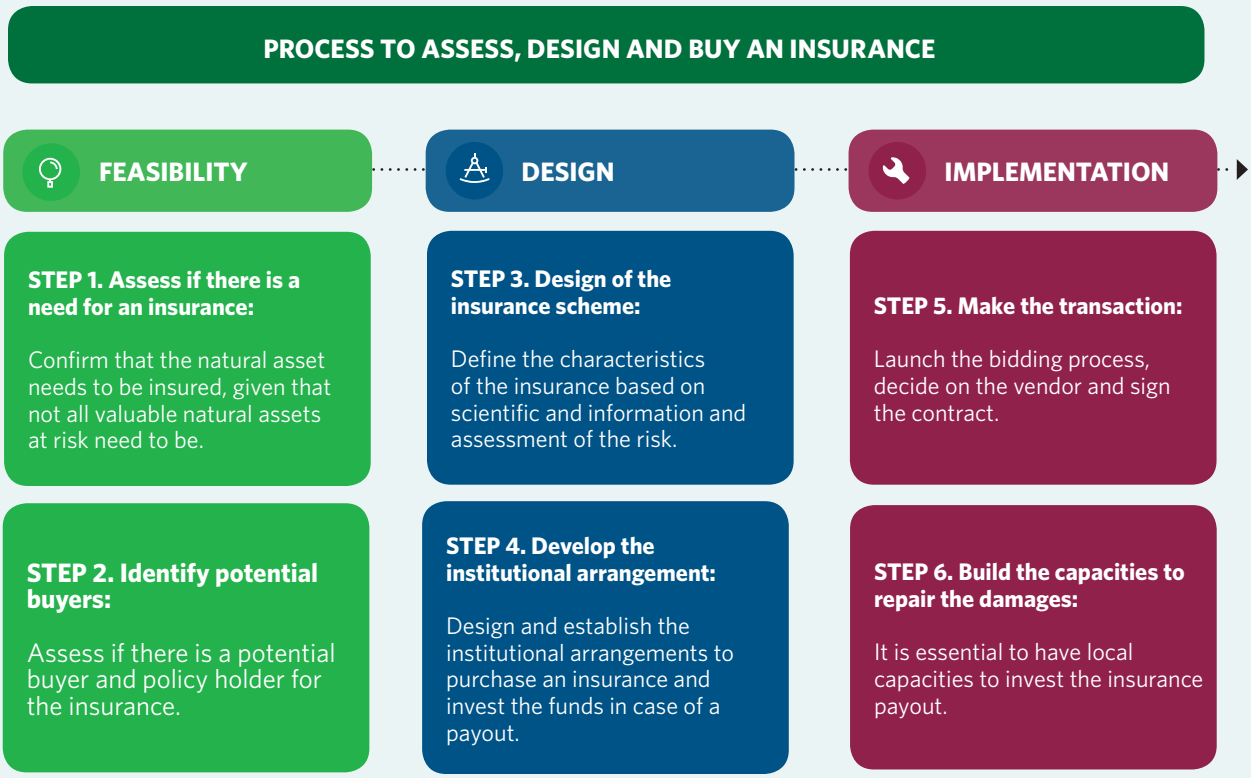
NATURE IS AN ASSET THAT DESERVES FINANCIAL PROTECTION

Nature sustains livelihoods and economies, reduces risk to people and infrastructure and help us to adapt to climate change (Renaud et al., 2013; Ferrario et al., 2014; Spalding et al., 2014a, b). Nature and the ecosystem services provided constitute an asset for people and the economy. However, nature is also at risk and can suffer severe damages from hurricanes, fires, droughts, oil spills and other natural and anthropogenic events. Sometimes damages can be reversed and repaired, bringing back the ecosystem services that nature provides, but immediate funds and response are required. Transferring the risk of restoring the damages to nature is a sound financial strategy for the beneficiaries and entities responsible for the natural asset.

This guide describes the phases and steps to design an insurance for natural assets at risk.



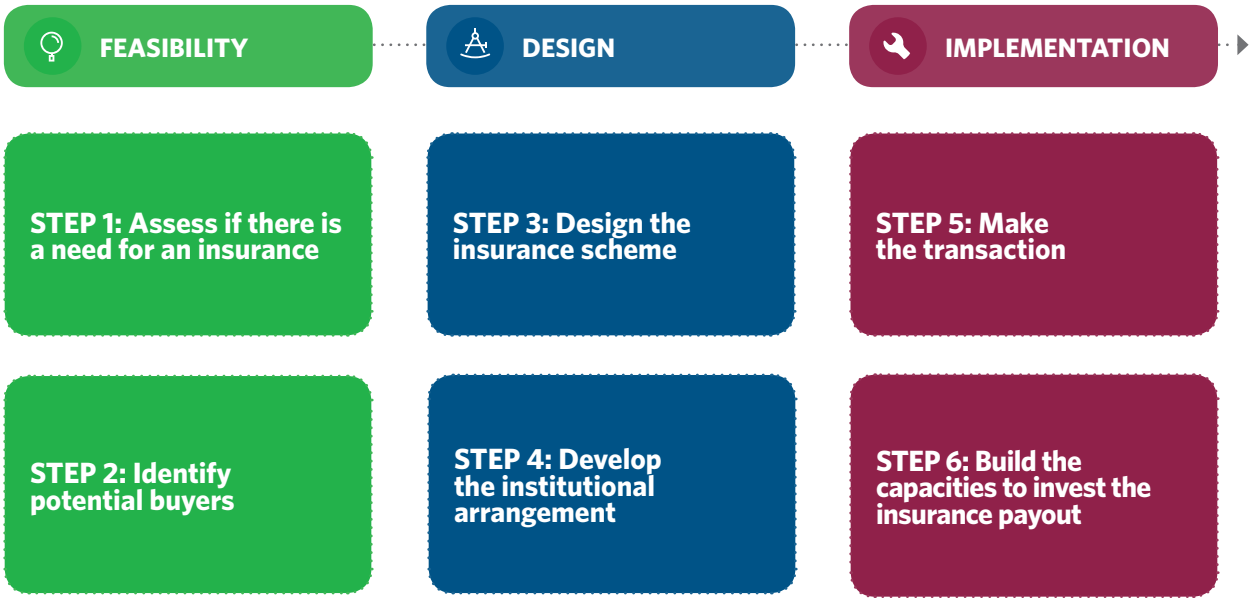
This guide is based on the experience of The Nature Conservancy and partners in developing an insurance for the reef and beaches along the Mexican Caribbean between 2016 and 2018, as part of the Coastal Risk and Resilience (CRR) Initiative. The CRR Initiative aims to reduce risk to people, the economy and infrastructure in the Mexican Caribbean through mainstreaming the use of natural solutions and financial instruments.

GLOSSARY OF TERMS USED IN THIS GUIDE

Ecosystem Services	Benefits obtained by people from ecosystems, which can be provisioning services such as food and water; regulating services such as flood and disease control; economic and livelihood services such as fishing and tourism; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth (Millennium Ecosystems 2003).
Event	The actual occurrence of a hazardous phenomenon such as a hurricane, flood, fire, and the like.
Hazard	Any substance, phenomenon or catastrophe, which has the potential to cause disruption or damage to people, their property, their services and their environment.
Immediate Response	Actions conducted in the aftermath of the event with the intent to reduce the impacts and damages to the natural asset caused by the event. It can include activities such as cleaning and removing debris in reef and consolidating broken pieces of coral to avoid further damage.
Insurance	It is a contract between two parties (the insurer and the insured), in which the insured pays the insurer an amount (premium), and in exchange the insurer agrees to compensate the insured an amount (payout) when an event has occurred and fits the parameters to be paid out. The insured transfers the risk to the insurer of the potential damages that the event could cause to the natural asset.
Natural asset	Ecosystems, habitats or places that provide valuable ecosystem services for people or have value by itself. Under this concept, we include mangroves, wetlands, forests, reefs, rivers, lagoons, etc., or any other element of nature that provides tangible benefits to people and the economy. In financial terms, an asset is defined as a resource with economic value for an individual, corporation, or country because it provides tangible benefits or income (Business Dictionary, Investopedia).
Restoration of natural asset	Actions with the intent to bring back the natural asset after to the conditions that it had prior to the event. It is used as the equivalent to repair of damages.
Risk	The probability that negative consequences may arise when hazards impact either people, property, and nature.

CHECK-LIST OF QUESTIONS AND ACTIONS TO INSURE NATURE

The three phases to insure nature are:



FEASIBILITY PHASE

1	**DOES THE NATURAL ASSET NEED AN INSURANCE?**
1.1	Does the natural asset provide valuable ecosystems services? Are they tangible and quantifiable services and with economic data?
1.2	Is the natural asset at risk from a catastrophic event? Do damages caused by the event diminish its value and services?
1.3	Is the risk of the event insurable? Do catastrophe risk modelers have information to estimate its probability?
1.4	Is it possible to repair the damages to the natural asset, so the services it provides can remain functional or be recovered?
1.5	Is the cost of repairing the asset lower than the avoided losses?

2	ARE THERE POTENTIAL BUYERS OF THE INSURANCE?
2.1	Are there stakeholders who value or benefit from the natural asset?
2.2	Are there stakeholders interested in repairing the damages after an event?
2.3	Would they be interested in transferring the risk and not bear the cost of repair?
2.4	Do stakeholders have the capacity to pay an insurance premium? Is there an appropriate institutional or financial arrangement that convenes beneficiaries to buy the insurance?
2.5	Are the stakeholders entitled (legal capacity) to buy the insurance?

DESIGN PHASE

3	DESIGN THE INSURANCE
3.1	Select the type of insurance needed: compensatory or parametric.
3.2	Select the parameter that could trigger the insurance.
3.3	Define the polygon where the parameter should be met.
3.4	Estimate the funds needed after an event.
3.5	Define the how much risk the potential buyer needs to transfer.
3.6	Define the parameter's threshold to trigger the insurance that is aligned with the risk to be transferred.
3.7	Assess if there is a financial case for the insurance, vis a vis, losses are higher than the cost of repair, and the price of the insurance is reasonable.

4	DEFINE AND DEVELOP THE INSTITUTIONAL ARRANGEMENT TO MANAGE THE INSURANCE
4.1	Define who pays for the insurance.
4.2	Define who is the policy holder of the insurance.
4.3	Identify who receives the payout in case of an event.
4.4	Define the governance to manage the payout and the distribution of funds after an event.

IMPLEMENTATION PHASE

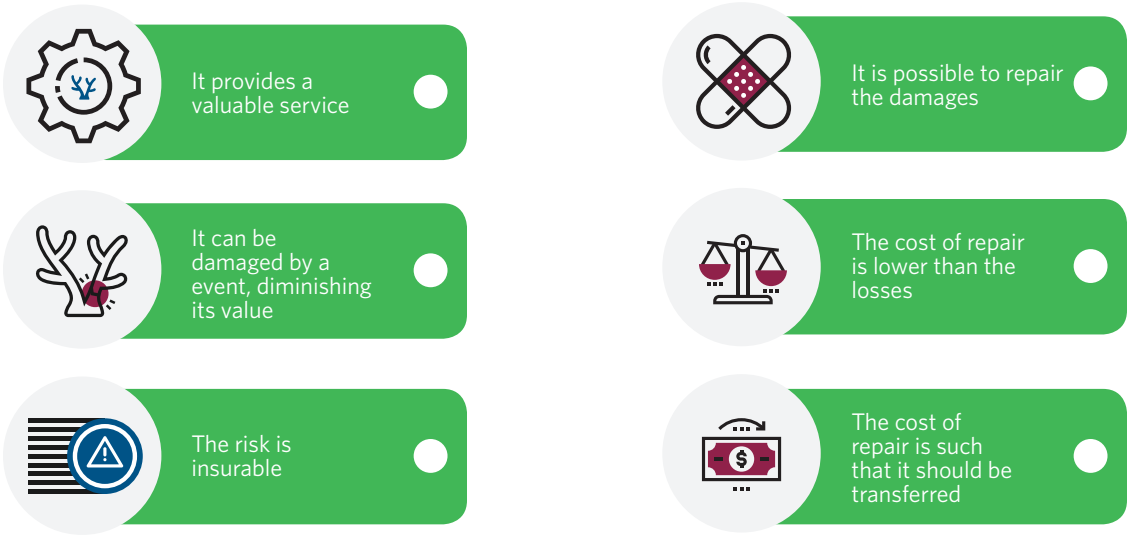
5	**MAKE THE TRANSACTION: SELL-BUY THE INSURANCE-**
5.1	Define the terms of coverage.
5.2	Open a procurement process to buy the insurance.
5.3	Negotiate the terms of the policy.

6	**BUILD THE CAPACITIES TO INVEST THE FUNDS FROM THE INSURANCE**
6.1	Develop a protocol that describes the activities, resources and responsibilities needed to respond after an event.
6.2	Build the capacities and have the resources available to respond.
6.3	Obtain the permits and licenses required to implement the response.

1 ASSESS IF A NATURAL ASSET NEEDS INSURANCE

The first step is to assess if the natural asset needs to be insured. Not all assets need insurance, and not all risks are insurable. There are 6 conditions that the natural asset must fulfill to be insurable:

A NATURAL ASSET IS INSURABLE IF:



1.1 DOES THE NATURAL ASSET PROVIDE A VALUABLE SERVICE?

A natural asset will be worth and viable to protect if a stakeholder considers it valuable given the ecosystem services provided. The first action is to assess the economic benefits for people, businesses, and the economy provided by the natural asset, such as fisheries, tourism and coastal protection. The asset can provide non-economic benefits, such as biodiversity, beauty, recreation or spiritual. It is advisable to estimate economic benefits to be able to make a financial or economic case to finance the repair of the damages after a disaster and incentivize the need of insurance to transfer the risk.

EXAMPLE

Reefs provide coastal protection. A reef crest reduces 60% of wave energy under normal conditions in the Puerto Morelos National Park (Mariño I, and Acevedo, C, 2017, see Figure 2) reducing sediment transportation and beach erosion. Healthy reefs also reduce up to 97% of wave height from storms (Ferrario, et. al., 2014). TNC and partners estimated the economic benefits from coastal protection and tourism services provided by coral reefs in Quintana Roo. Coastal protection benefits were quantified by modeling the damages that hurricanes may cause to people and capital (such as hotels and housing) under two scenarios: 1) under the current conditions of the reef crest and 2) with a loss of 1 meter in the reef crest[4]. The model showed that a loss of 1 meter of reef crest could result in an increase in damages to infrastructure of USD 9 million in the stretch of reef in Puerto Morelos during a storm with a 10-year return period (see Figure 3). The analysis also shows annual avoided losses of USD 1.8 million (Reguero, et al, 2018).

Figure 1: Wave breaking over a coral reef crest in Puerto Morelos National Park, shows the coastal protection service provided by reefs. Photo: Jennifer Adler, TNC

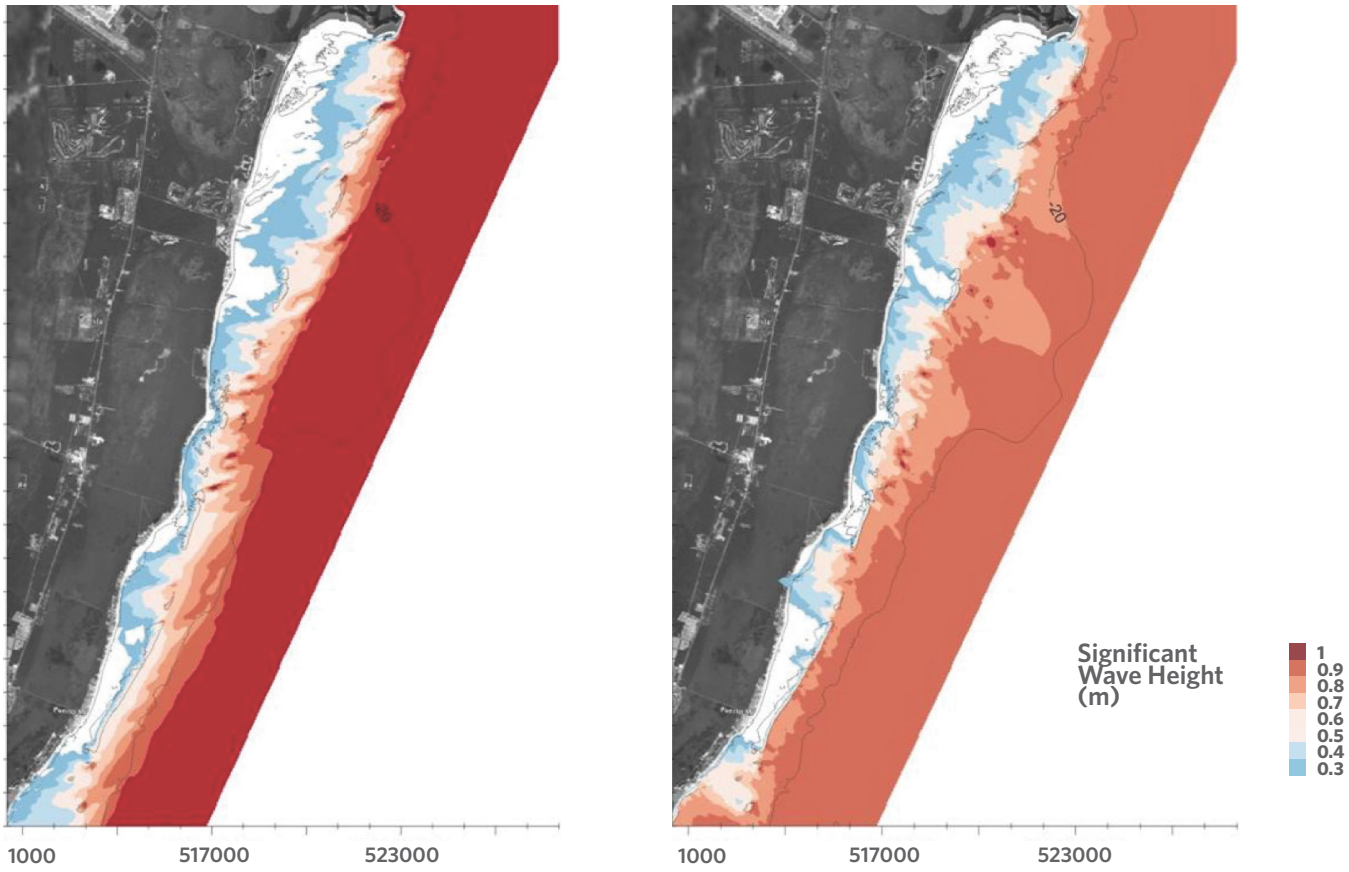


Figure 2: Oceanographic model shows how Puerto Morelos Reef reduces wave height under normal conditions: a) Northeastern winds, winter storms; Map b) Southeastern winds, dominant through the year (Mariño, I, y Acevedo, C., 2017).

[4]. The model estimated a loss of 1 meter of reef crest as a proxy of damages from storms and coral degradation.

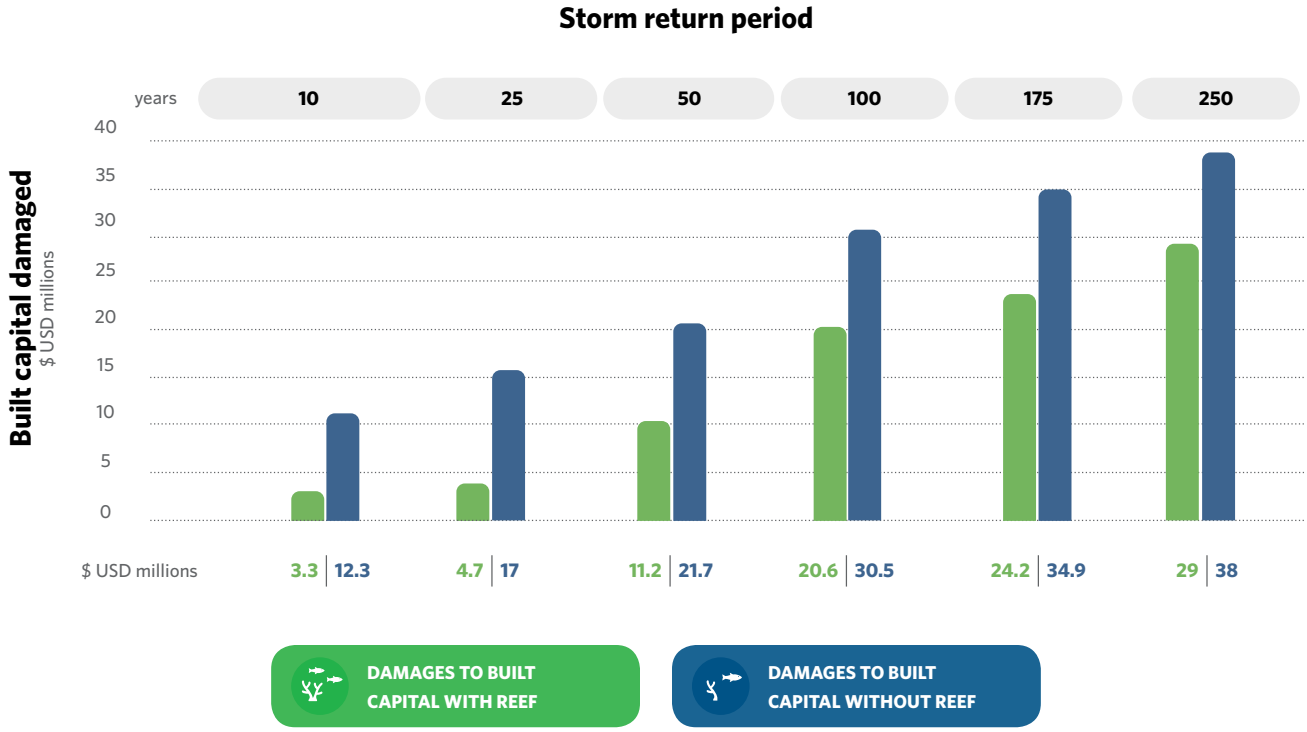


Figure 3: Model showing potential damages to capital with the presence (green) and absence (blue) of healthy coral reefs, demonstrating that damage would be higher after the loss of 1 meter of reef crest height (Reguero, et. al, 2018).

Continue Example: TNC also estimated the economic benefits provided by reefs to tour operators in Puerto Morelos National Park. More than 200,000 tourists dive and snorkel there every year, each paying between USD 80-100 per visit, generating nearly USD 20 million in direct revenues to tour operators. TNC did not estimate the indirect economic benefits, such as income to restaurants, hotels, souvenir shops, transportation and the like, which would increase the benefit to the economy and people.

These evaluations further demonstrate that coral reefs provide tangible and measurable economic benefits for people and the economy in Quintana Roo, and particularly in the Puerto Morelos Reefs National Park.

1.2 IS THE NATURAL ASSET AT RISK? CAN AN EVENT SEVERELY DAMAGE IT AND IMPAIR THEIR ECOSYSTEM SERVICES?

Insurance is needed if the natural asset is at risk of being affected by a catastrophic event which will impair or hinder the functionality, the value and the ecosystem services the asset provides. Events can be of natural or anthropogenic origin. Forests are exposed to fires, coastal ecosystems are exposed to tropical storms, wetlands are exposed to oil spills, terrestrial ecosystems are exposed to droughts or landslides. Climate change is not considered an event or a risk by itself, but the fires, droughts, storms or intense rains that it exacerbates, are. Changes in characteristics of those events exacerbated by climate change are already accounted for by risk modelers assessing risks for the global insurance industry. The interested insurance buyer does not need to estimate an increase in risk to design the insurance policy as this is the role of risk modelers. However, it may be helpful to understand how risk has increased or will increase due to climate change to build a solid financial case for buying it.

Stakeholders need to understand how the event could damage the natural asset and how it impairs the services it provides. If the damages caused by the event do not reduce the services and the value of the natural asset, there is no need to repair the damages, and even less of a need to buy an insurance.

EXAMPLE

Hurricanes severely damage coral reefs, breaking and uprooting coral colonies, collapsing structures, reducing crest height and rugosity and wiping-out live coral cover. Gardner et al. (2005) found that coral reefs lose an average of 25% of live coral cover after winds with 110 knots or 208 km/h (category 4 hurricanes) and up to 60% with winds above 160 knots (approx. category 5 hurricane).

Knots	miles/h	km/h
110	126.588	203.72
130	149.604	240.76
160	184.128	296.32

Table 1: Wind speed conversion

Coral reef would lose its biodiversity value and diminish the ecosystem services it provides after the impact of hurricanes with wind speeds above 110 knots. Tourism would collapse if coral cover is severely damaged as healthy corals and diverse sea life are the main attraction for diving and snorkeling. Coastal protection service will also be diminished if the reef loses crest height and rugosity, allowing stronger waves and storm surge to affect beaches and coastal areas through increased erosion and flooding. Given the severity of the damage caused by hurricanes to coral reefs and the negative impact on the ecosystem services they provide, beneficiaries and entities responsible for the reefs have high stakes in repairing the damages.

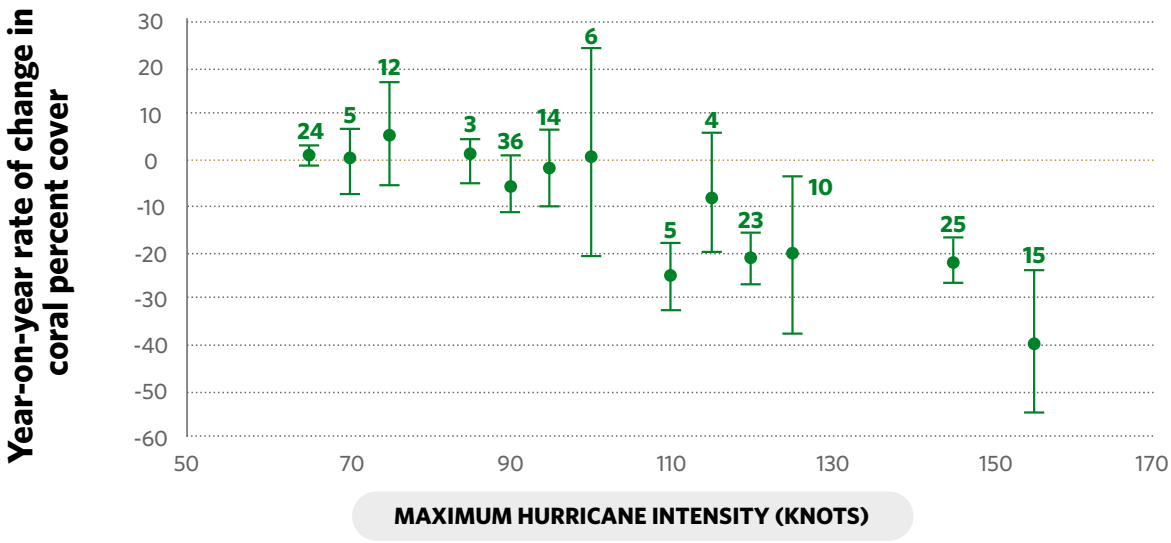


Figure 4: Loss of live coral cover one year after the impact of a hurricane varies according with wind speed. Meta-analysis covering near 200 sites throughout the Caribbean with data collected for +20 years. (Gardner, et al, 2005). The numbers on top of the lines indicate the number of sites in that category. The black dot indicates the median value. The vertical line indicates the spread of data.

1.3 IS THE RISK INSURABLE?

Insurance companies rely on verified, long term data and statistical analysis to determine the probability of occurrence of an event, so they can generate risk models. Therefore, not all events faced by natural assets are insurable. Fires, flooding and hurricanes are common events already modeled by risk modelers and insurance companies offer policies for these events. There are other types of events that are not covered so far, such as diseases in natural systems, the arrival of Sargasso and coral bleaching. In such cases, even if a natural system is valuable and at risk, it will not be possible to design and offer policies to cover those events.

EXAMPLE

In the Mexican Caribbean, hurricanes are the greatest hazard to reefs, and are a well-structured risk in the insurance industry. Another common event that affect reefs is ship groundings. This is also an insurable risk but given the lesser extent of the damage to reef, TNC and its partners focused on the threat of hurricanes. The tourism industry of Quintana Roo was primarily interested in insurance to recover from the impacts of Sargasso, but such events are new and there are not enough statistics to predict the probability of the event, therefore making it not viable insurance in this pilot.

1.4 IS IT POSSIBLE TO REPAIR THE DAMAGES TO THE NATURAL ASSET, SO THE SERVICES IT PROVIDES CAN REMAIN FUNCTIONAL OR BE RECOVERED?

The objective of the insurance policy is to provide funds to repair the damage or to compensate the beneficiaries for the loss of the ecosystem services. Therefore, the next consideration in the feasibility assessment is to determine if the asset can be repaired from the impact of the event and recover its functions to provide the ecosystem services. It is important to be certain that the techniques, equipment and capacities for repair exist, or will be feasible to deploy at the time and scale required.

EXAMPLE

Impacts of hurricanes on coral reefs are well documented. Coral colonies are broken and uprooted. Debris from mainland and sand can cover and further damage coral colonies. Post-storm responses have been proven and are well documented, such as removing debris generated by the hurricane, repositioning upturned, detached, buried and fragmented corals, to prevent tissue loss, abrasion, and death. The success of a timely response after a hurricane is essential to minimize the impact on coral reefs and a step to restore reef function and structure. Reef restoration techniques are varied and have been proven world-wide. In particular, several research institutions and experts have been testing and implementing them in the Mexican Caribbean.

TNC and partners developed the Early Warning and Immediate Response Protocol (Zepeda, C. et al, 2018) to guide park managers in Puerto Morelos Reefs National Park and trained and equipped First-Response Brigades which will implement the response. TNC and partners also developed a Guide to Restore Reef Protection Services (Zepeda, C. et al, 2019) to guide post-storm restoration efforts. Therefore, techniques, equipment and capacities are in place in the Mexican Caribbean to respond after a storm and effectively invest the funds from an insurance payout.

Figure 5: Divers repair broken coral colonies after a storm with proven techniques. Photo: Jennifer Adler, The Nature Conservancy

1.5 IS THE COST OF REPAIRING THE ASSET LOWER THAN THE AVOIDED LOSSES?

The cost of repairing the natural asset must be lower than the economic losses caused by the diminished ecosystem services. If the cost of repair is higher than the losses, there is no economic argument to restore the asset. Three economic analyses are needed to make an informed decision on repairing a natural asset after it is damaged:

1. An economic estimation of the benefits from ecosystem services, such as business revenues from fisheries and tourism, the value of coastal protection provided by reefs, or the value of water supplied by forest in a watershed (section 1.1).
2. An estimation of the economic losses associated with the damages to the asset, such as diminished revenues or the increase in risk from a degraded reef after a storm.
3. An estimation of the cost of repairing the damages to the asset caused by a storm to reduce or prevent the loss of environmental services.

It is important to consider that the cost of repairs will vary a lot as they depend on a) the extent and severity of the damages and b) the scope of the repair efforts. To answer this question, it is recommended to create scenarios of damages and scenarios of repair, which will depend on the asset to be repaired.

SCENARIOS OF DAMAGES

1. MINOR
2. MODERATE
3. SEVERE
4. CATASTROPHIC

SCENARIOS OF SCOPE OF REPAIR

1. **Minimum repair**, to allow the system to recover by itself.
2. **Intermediate repair**, to recover the capacity to provide key ecosystem services, albeit not all biodiversity or functions.
3. **Fully repair** the damage, to the condition prior to the event.

EXAMPLE

People diving and snorkeling on the reef will diminish, or even stop, if corals are severely damaged by a storm. In Puerto Morelos Reef National Park, the losses could range from USD 2 million per year (based on an estimated reduction of visitors of 10% until reefs are recovered), to USD 20 million (business closure if reefs are severely damaged and are no longer tourist attractions). If Puerto Morelos' reef crests are severely damaged, the annualized losses to coastal infrastructure would increase by USD 9 million (Reguero, et. al., 2019). In contrast, the cost of repairing 28 km of reef in Puerto Morelos varies from less than USD 1 million (severe damages) to USD 4 million (catastrophic damages and ambitious scope), both of which are lower than the losses.

A matrix of scenarios of damages and intervention was developed for the reef in the Mexican Caribbean. TNC and partners costed out each action and adjusted the cost to the extent (a few meters or several kilometers) and scope of the intervention (basic or comprehensive intervention).

LEVEL OF DAMAGE	IMPACT ON HARD CORALS	REPAIR ACTION RECOMMENDED
MINOR	Minor destruction of colonies. Reef structure not impacted (rugosity/complexity not impacted)	Assess damages Fix broken structures Clean debris
MODERATE	Destruction of colonies. Reef structure mildly impacted (rugosity/complexity not impacted)	All of the above, but larger area.
SEVERE	Destruction of colonies in many areas. Reef structure (rugosity/complexity) impacted.	All of the above, but larger area Reproduction of coral colonies
CATASTROPHIC	Extensive and widespread destruction of colonies. Reef structure (rugosity/complexity) highly impacted.	All of the above, but larger area Limited or ambitious structural restoration

1.6 CONCLUSION: IS INSURANCE NEEDED FOR THE NATURAL ASSET?

Examples of how conditions were met in the Mexican Caribbean.

Condition

The natural asset is valuable.

Coral reefs provide protection to coastal infrastructure, people and beaches. In Puerto Morelos, tour operators generate USD 20 million per year. Losses from hurricanes are reduced by at least USD 9 million during a 10-year return period storm. Wave energy is reduced by up to 60% with healthy reef, reducing beach erosion and flooding.

The natural asset is at risk and reduces its value.

It has been determined that damages from major hurricanes have reduced live coral cover between 20% and 60%, severely reducing reef's capacity to provide coastal protection from hurricanes, regulate beach erosion and remain a tourist attraction.

The risk is insurable.

Hurricanes are one of the most common risks managed by the insurance industry.

It is possible to restore the natural asset.

A variety of reef restoration techniques have been developed. There are government agencies, research institutions and practitioners in the Mexican Caribbean with the experience and capacity to implement them.

The cost of restoration is lower than the losses

Repairing damages in 28 km of reef in Puerto Morelos would cost between USD 1 to USD 4 million after an event. If Puerto Morelos' reef crests are severely damaged, the annualized losses to coastal infrastructure would increase by USD 9 million (Reguero, et. al., 2019). Tour operators could lose USD 2 million per year due to decrease in tourists.

Summary	There is a strong case to insure the reefs in the Mexican Caribbean to reduce risk to the coastal communities and economy, because reefs are important for the communities, they are damaged by hurricanes, they can be repaired, and the economic losses would be high. Finally, the costs of repair are also too high, but less than the economic losses.

Table 2: Summary of the answer to key questions in the Mexican Caribbean.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2 ARE THERE STAKEHOLDERS WHO CAN BUY THE INSURANCE?

After assessing and confirming that the asset needs insurance, the next step is to identify stakeholders who would be willing and able to buy the insurance. The stakeholders should meet the following criteria:

- They value the ecosystem services provided by the natural asset.
- They cannot afford the cost of repair after an event or they prefer to transfer the financial risk.
- They are interested in repairing the damage.
- They have the financial capacity to pay the premium.

2.1 ARE THERE STAKEHOLDERS WHO VALUE THE NATURAL ASSET?

There are two types of potential stakeholders who could be interested:

1 THE OWNER OR THE ENTITY LEGALLY RESPONSIBLE OF THE NATURAL ASSET.

Identify the person or entity who owns the asset or is legally responsible for it. Ranchers, farmers, cities or state governments often own grasslands and forests. Ownership of freshwater and coastal and marine natural assets are, in most cases, public and communal goods. Environmental and protected areas agencies (such as national park services) are often responsible for natural assets, despite their ownership.

2 THE BENEFICIARY OF ECOSYSTEM SERVICES PROVIDED BY THE NATURAL ASSET.

There are many stakeholders who receive benefits from the natural asset who could be interested in maintaining the services they provide, and to invest to repair damages and eventually, purchase insurance. Beneficiaries will be more incentivized to engage if there is evidence of:

1. Ecosystem services critical to the continuity of their business, livelihoods or even comfort, better if quantified in economic terms.

2. The cost of repairing the damages is less than the losses they would suffer if the ecosystem services are reduced after an event.

EXAMPLE

Coral reefs provide ecosystem services to coastal communities, hotel owners, commercial and artisanal fisheries, tourism companies, and others. In Quintana Roo, there are several potentially interested parties:

1. The Federal Environmental Ministry (SEMARNAT) is responsible for reefs, which are considered a natural public good. The National Commission of Protected Areas (CONANP), a branch of SEMARNAT, is charged with the management of these natural assets.
2. Some hotel owners with properties along the Mexican Caribbean coast have high interest to repair beaches and reefs after a hurricane. Hotel owners are organized in hotel associations.
3. Snorkel and dive tour operators in Puerto Morelos and Cancun depend on healthy reefs. Company owners and operators are aware of the need to repair the reef after a hurricane to reduce business disruption.
4. The Quintana Roo State Government is interested in reducing damages to the economy of the State and to the local population. Tourism in this state is fully dependent on the quality of beaches and reefs, and if they are damaged by a hurricane, the economy and social wellbeing collapses.
5. Other interested parties are the local fishing industry and the communities who live on the coast or depend on tourism but are not considered potential buyers.

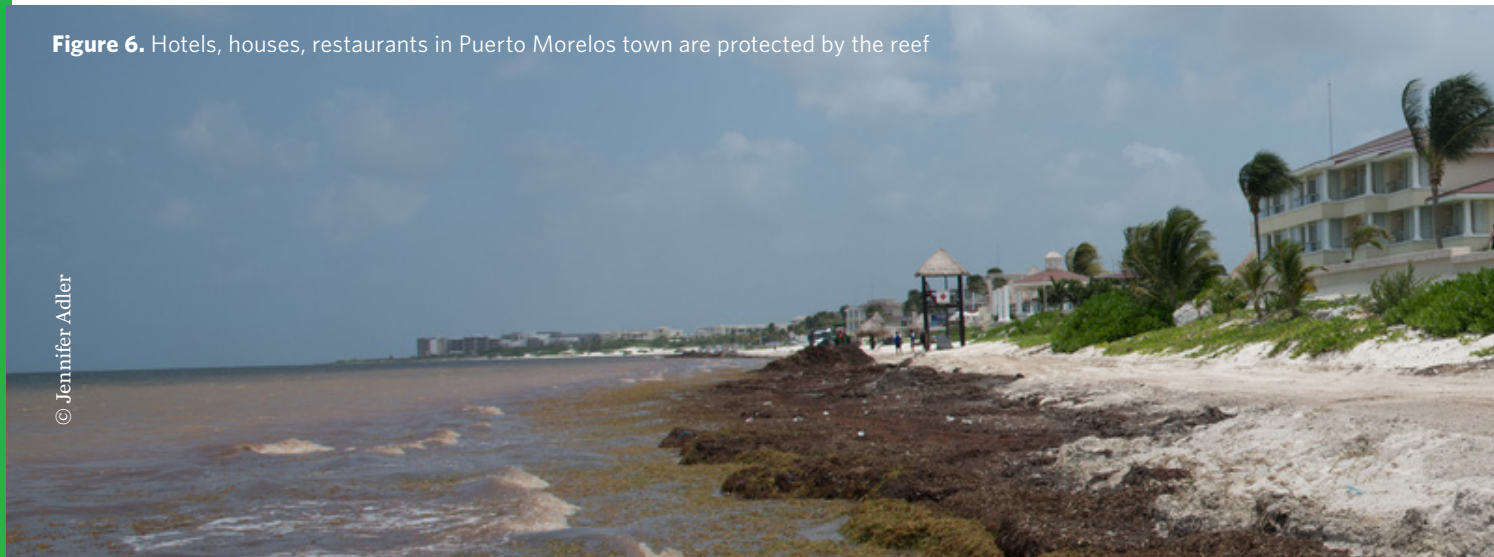
TNC conducted three analyses to identify the most relevant beneficiaries and their needs and expectations, as well as the institutions responsible for managing the reef: *1) A Stakeholders Assessment and Map* (Secaira, Fernando, 2017a) to identify beneficiaries of the environmental services from reefs, entities responsible for managing the reef, and experts with knowledge on reef restoration[5]. 2) An *In-depth Qualitative Analysis* of the perception and understanding of stakeholders towards the coastal protection services provided by reefs (APCO and TNC, 2017). 3) *An analysis of the Insurance Market in the Mexican Caribbean*, identifying the needs of beneficiaries (demand side) and the current instruments in the market (supply side), (Ambroise, L. and Secaira F., 2016).

2.2 ARE THERE STAKEHOLDERS INTERESTED IN REPAIRING THE DAMAGES?

Beneficiaries must recognize the consequences of the damages to the natural asset after an event and the losses they may suffer if the ecosystem services are impaired. An estimation of the economic losses is essential to obtain support from beneficiaries. They will be incentivized to repair the damages when the cost of repair is lower than the losses. This step is dependent on the information generated in section 1.5 (cost of repair and losses) in order to assess the interest of stakeholders.

[5] www.stakeholderanalysismap.com

Figure 6. Hotels, houses, restaurants in Puerto Morelos town are protected by the reef



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2.3 IS THE COST OF RESTORATION ABOVE THE FINANCIAL CAPACITY OF STAKE-HOLDERS AND/OR WILL THEY PREFER TO TRANSFER THE RISK?

If the total cost of the response and restoration is higher than the financial capacity of the stakeholder, it is advisable to transfer the risk through insurance. Even if the cost of response is affordable to the stakeholder, it may still be a reasonable financial option to buy insurance if the cost of the premium is much lower than the cost of repair.

EXAMPLE

Jointly, CONANP (National Commission for Natural Protected Areas), the State Government of Quintana Roo and the beneficiaries of the reef such as hoteliers and tour operators, have the financial capacity to pay for the repair of the reef. However, they may not have access to the funds required immediately after a storm, especially with other losses and damage to people and property to consider. The Federal Program for Natural Disasters requests that responsible entities buy insurance to share the costs to repair the damages caused by disasters. Therefore, stakeholders agreed to transfer the financial risk via insurance and establish a mechanism which can quickly and efficiently manage the funds.

2.4 DO THE INTERESTED STAKEHOLDERS HAVE THE CAPACITY TO PAY THE PREMIUM?

Identify sources of funding to purchase insurance by assessing the financial capacity of each stakeholder who value the natural asset. At this point, a rough estimation of the cost of the premium is needed; reasonable costs varies from 8% to 16% of the needed payout. In other words, if a payout of USD 1 million is needed after an event, the annual cost of the insurance would range from USD 80,000 to USD 160,000, roughly. Another consideration is that the source of funding to pay for the insurance premium should be available in the long term, as buying an insurance should be a long term commitment.

EXAMPLE

The cost of insuring the 28 km of reefs in Puerto Morelos ranges from USD 80,000 to USD 160,000. As mentioned, tour operators receive USD20 million per year from the 200,000 tourists who visit in Puerto Morelos; the cost of the insurance could be covered with USD 0.80 per tourist compared with the USD 80 to 100 charged. Similarly, the cost of the insurance is a fraction of funds collected from beach concessions which sum up around USD 4 million per year in Puerto Morelos.

2.5 WHO IS THE ENTITLED TO BUY INSURANCE FOR THE NATURAL ASSET?

The insurance industry is strictly regulated in most countries. Laws define what can be insured, who can buy and who can sell insurance and how to settle disagreements. Natural assets are generally public goods and laws define who can buy an insurance. Therefore, it is critical, from the beginning, to conduct a legal assessment of the applicable regulations.

EXAMPLE

TNC conducted an assessment to understand the insurance market in Mexico, both the supply side and the demand side. On the supply side, TNC assessed who can buy an insurance, what assets and risks can be insured, which types of insurance are sold and cost of premiums. On the demand side, TNC found out what type of risks are relevant to stakeholders, what they need or want, what are the gaps and how much are they willing to pay. Some of the key findings were:

- Laws define that the buyer of the insurance must have a "genuine interest" in the good to be insured.
- A Hydrometeorological Endorsement was developed by Mexican Association of Insurance (AMIS) and Mexico's National Commission of Insurance (CNSF) which details risks included and excluded, precise asset location, construction materials and corresponding premiums for assets and business operations of enterprises located in climate-risk areas.
- Insurance companies must be registered and approved to sell insurance.
- Hotel owners have comprehensive insurance coverage of their physical assets and are often unaware or undervalue the protective service of the reef. However, beaches are not insured and at high risk of erosion, and as they are protected by the reefs, informed hotel owners now recognize the importance to repair the reef.
- The Mexico´s National Fund for Disasters (FONDEN) finance reconstruction of public goods (Federal and State) and low-income people, which includes reefs. The Mexican Government has purchased parametric insurances to cover risks from major hurricanes and earthquakes.
- FONDEN regulations mandate that State and Federal entities acquire insurance for their assets. FONDEN may finance 100% of the repair of an asset the first time it is impacted by a disaster; then, the support is reduced to 50% the second time they are impacted and there will no funding the third time.

2.6 CONCLUSIONS: ARE THERE POTENTIAL BUYERS?

If potential buyers are identified through this assessment, the next phase is designing the insurance. Stakeholders will make a final decision to buy insurance once the design and costs have been determined.
The conclusions of this phase in the Mexican Caribbean were:

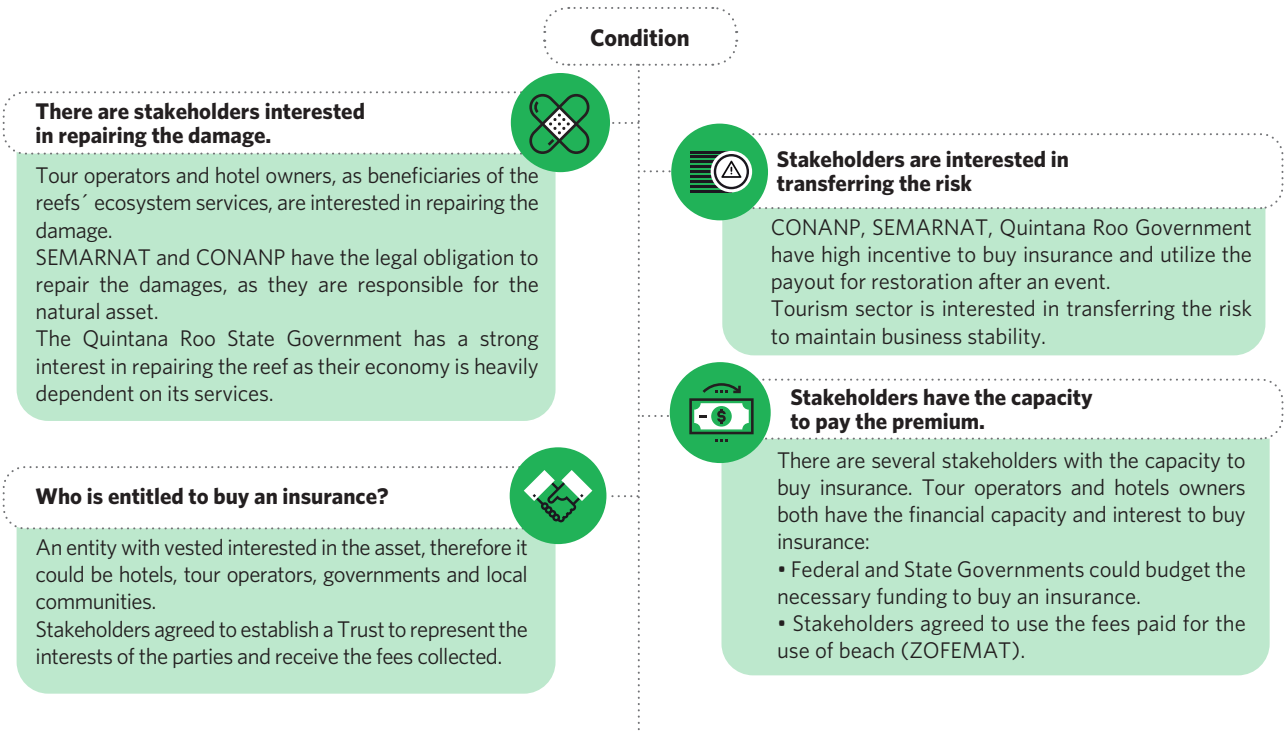


Table 3. Summary of the answer to key questions in the Mexican Caribbean

3 DESIGN THE INSURANCE

If a valuable natural asset has been identified as at risk, can be repaired and there are potential buyers of insurance, the proceeding phase is the design of the insurance. During the design phase it is necessary to have an expert in parametric insurance (see next section), and to involve the stakeholders responsible for the natural asset, the beneficiaries of the ecosystem services and the experts who know how to repair it. The process needs a lead who can coordinate each stage of the design of the insurance and the different expertise and responsible parties.

3.1 SELECT THE TYPE OF INSURANCE: COMPENSATORY OR PARAMETRIC

There are two main types of insurance schemes: compensatory and parametric.

Compensatory insurance pays to the insured based on the extent of the damages to the asset and the cost to repair them. This type of insurance is most commonly used to cover health care, home and automobile. A compensatory insurance scheme must assess the damages, estimate the costs of repair or the cost of replacement. Conventions are used, such as standards for health costs, bills from doctors and hospitals, approved repair shops for automobiles, etc. These processes are expedite when conventions are used, but may require extensive time for assessment and approvals if not. In cases in which the parties do not agree on the payout, a litigation and settlement process will likely take place.

There are three caveats when using compensatory scheme to insure natural assets: 1) insurance companies do not have conventions or standards to estimate the cost of repair or replace natural assets, 2) insurance companies need to compare the condition of asset at the time of purchase of the insurance to conditions after the event to estimate the damages to natural assets, increasing the cost of the scheme, and 3) the payout may take many weeks, and funds are needed soon after the event for repair to be effective, if at all possible.

Parametric insurance is designed to pay a pre-determined amount of money when a specific condition of the event is met, agreed upon by both parties. This type of insurance has a quicker and straightforward payout, since the payout is not subject to assessment of damages and costs of repair. A quick payout allows for a prompt response to the damage. Some events required immediate actions, such as fires and clearing debris from reefs after a storm. With this timely need of funds after an event, natural assets are best insured via a parametric insurance.

Parametric insurance has three components:

1. A parameter and a threshold that will trigger the insurance.
2. A polygon that defines the limits where the parameter should occur.
3. An amount that will be paid out.

3.2 SELECT THE PARAMETER

Payout is triggered when the condition is met, conversely, when a selected parameter surpasses an agreed threshold in a specified location. Common examples of parameters for non-catastrophe related schemes are unemployment insurances (if you are laid off, you receive a pre-determined amount), life insurance (a death certificate, and the full amount is paid), price guarantees (if oil prices drop below an agreed limit, insurance pays) and so forth.

The parameter is a characteristic of the event that can be correlated to the damages caused to the asset. An assessment must find the relationship between the characteristics of the hazard (fire, hurricane, oil spill, coral bleaching) and the damages to the natural asset. In the case of hurricanes, parameters could be barometric pressure, storm surge, duration of the storm, or wind speed and the damages to reef can be loss of live coral cover, structure and rugosity.

Some sophisticated insurance schemes can be related to more than one parameter. For example, it has been proposed that parametric insurance that cover hurricanes combine wind speed and duration of the event within the polygon, because, when combined, the correlation with damages to corals is higher.

An essential characteristic of parametric insurance is that there has to be an independent and reliable party that measures the parameter. It can neither be the insurer nor the insured as both have vested interests. Natural phenomena are monitored and measured by independent meteorological institutions and academic institutions. Re-insurers generally use the United States National Oceanographic and Atmospheric Agency (NOAA) to measure climate-related parameters in the Western Hemisphere.

EXAMPLE

Figure 7 shows that the loss of coral cover is correlated to hurricanes´ wind speed , according to Gardner, et al. (2005) who conducted a meta-analysis of more than 200 sites studied for 20 years across the Caribbean. Lesser wind speed results in lesser loss of coral cover. Stronger wind speed results in higher loss of coral cover.

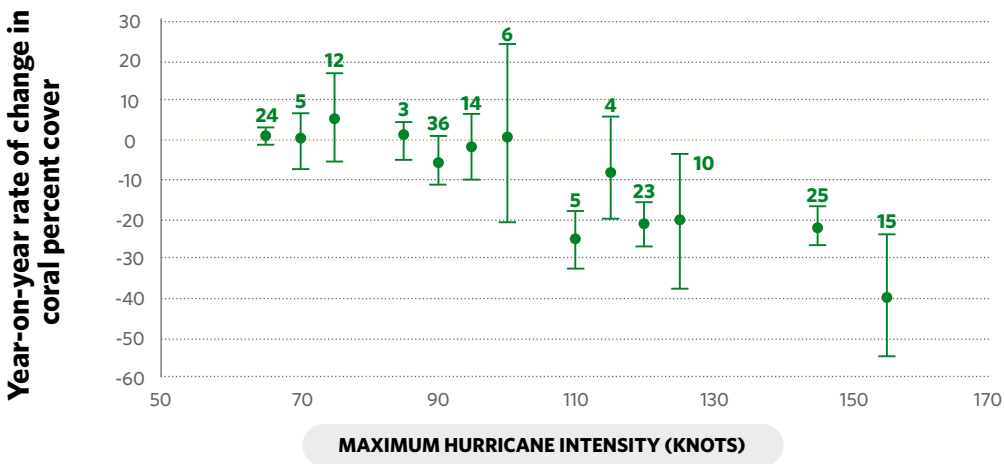


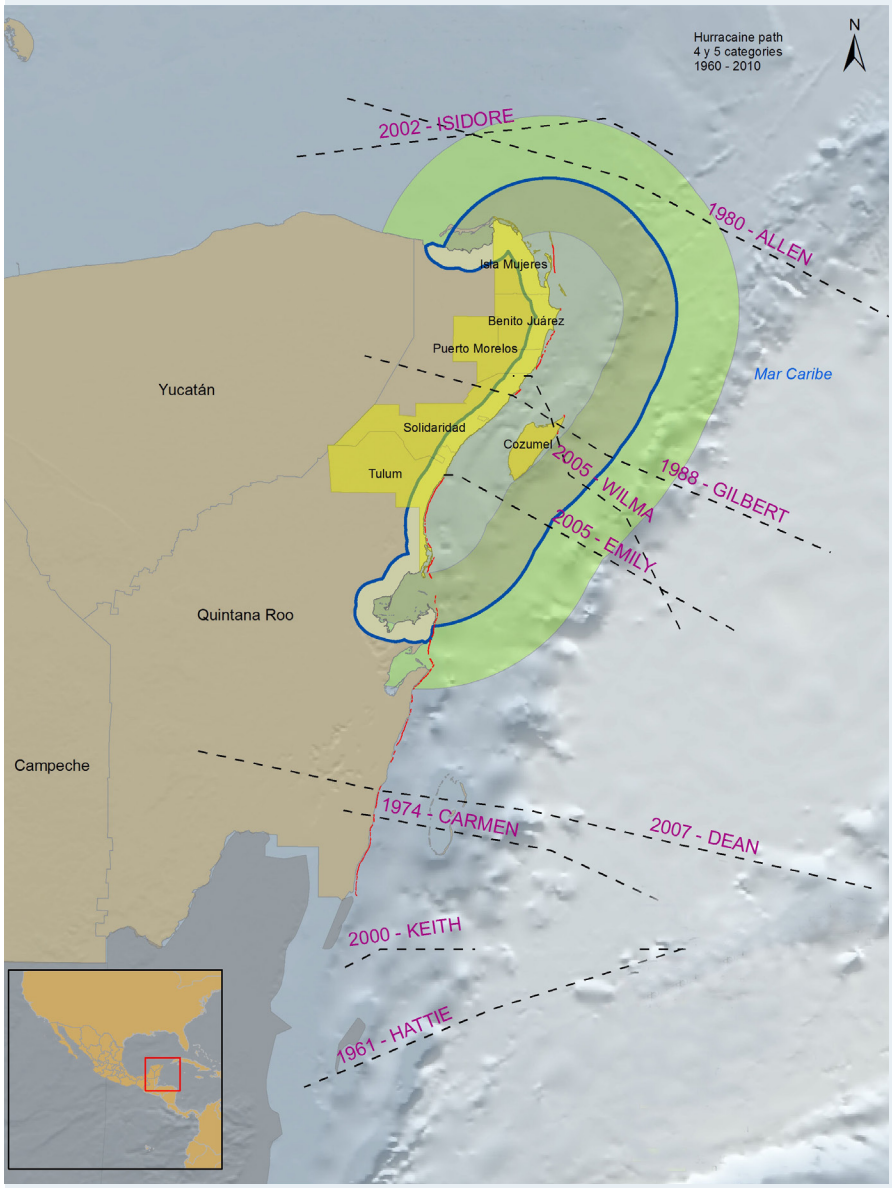
Figure 7. Loss of live coral cover one year after the impact of a hurricane varies according to wind speed. (Gardner, et al, 2005). The numbers in parentheses indicate the number of sites in that category. The black dot indicates the median value. The vertical line indicates the spread of data.

After identifying the parameter, the insurance designer shall define the threshold. This is the value of the parameter at which the insurance payout is triggered. The threshold is related to the extent of the damages that, in turn, is related to an amount of funding that the insurance buyer considers too high to hold the risk. This step is explained in section 3.4.

3.3 DEFINE THE POLYGON

The polygon is a geographical delimitation where, if the event occurs and the parameter meets the threshold, the payout is triggered. The design of the polygon is based on the area or distance where the event can happen and damage the natural asset. The polygon must encompasses all events that would damage the asset. However, the larger the polygon, the higher the chances of an event, therefore the higher the price of the insurance.

EXAMPLE OF A POLYGON FOR A REEF AND BEACHES PARAMETRIC INSURANCE



EXAMPLE

In order to define a polygon, TNC and partners consulted experts to find out which past storms damaged the reefs in Puerto Morelos in the last 40 years. The events were mapped and the distance from the reef was measured. TNC also analyzed the buffers of 35, 65 and 100km proposed by Alvarez-Filip et al. (2009) used in a meta-analysis that measured the impact of hurricanes on reefs in the Caribbean. This assessment concluded that a buffer of 65km offshore from the reef would include all hurricanes that damaged the reefs as reported by experts (see figure 8).

Figure 8: The polygon for the insurance was defined at a distance of 65km from the covered reefs. Maps shows the trajectory of Allen and Isidore hurricanes outside the polygon, as they did not caused any severe damages to the reef.

Legend

- Parametric insurance polygon
- Hurracaine Path
- Reef Crests
- Municipalities
- Inland buffer 0-10 km

Marine Buffer

- 0-35 km
- 35- 65 km
- 65-100 km

3.4 ESTIMATE THE FUNDS NEEDED AFTER A STORM

Parametric insurance policies do not compensate for the actual damages or costs to repair the asset. Instead, the insurance company and the insured agree on an amount to be paid. The entity buying the insurance has the responsibility to define the amount that will cover its needs. This amount should not be so high that the insurance premium becomes costly, nor so low that it does not cover the required expenses. It is critical to have a good understanding of the extent of repair that can be done with different amounts of funds in order to agree on a payout. However, consider that the final and agreed payout might be limited by the purchasing capacity of the buyer, which might be lower than the amount needed.

First, the purpose of the payout must be defined by the buyer. Funds can be used for post-event response, for repair of the damages to the asset or to compensate beneficiaries for the loss of services during a certain period. Then, the interested buyer estimates the funds required. A recommended approach is to create scenarios of post-event intervention and repair and calculate the associated costs. Scenarios should consider two variables:

1. The extent and severity of the **damage to the natural asset.** Damages will vary depending on the strength and distance of the event from the natural asset, and on the current condition of the natural asset.

2. The extent and scope of the **intervention** that the interested parties wish to pursue. The aim of the recovery can be to bring the asset back to its previous condition or to reduce the impact of the damage in order to facilitate natural recovery of the asset

EXAMPLE

Category 5 hurricanes passing directly over reefs and remaining for an extended duration will cause severe damages, far more than a Category 1 hurricane passing 100 km away. A reef within a bay is less exposed than a reef in open waters, which are more exposed to wave energy. A well-developed coral reef with tall, branched colonies is more likely to break, than compact or degraded coral colonies. Additionally, a reef that has been recently impacted will suffer less than a reef impacted 10-20 years before. We used information from Alvarez-Fillip et al. 2009 and Gardner et al. 2005, to estimate the percentage of live coral cover that would be lost after a hurricane (see Figure 9).

EXAMPLE

Reef restoration can vary from:

a. Cleaning debris and consolidating broken colonies during a 60-day period after the storm (post-storm rapid response) to allow natural long-term recovery;
b. A comprehensive restoration program where coral colonies, sexually reproduced or fragments, are collected, grown and out-planted in the reef to bring it back to the condition prior to the event, and even to
c. Build artificial structures to recover height, complexity and rugosity in reef crests that might have been lost due to the hurricane.

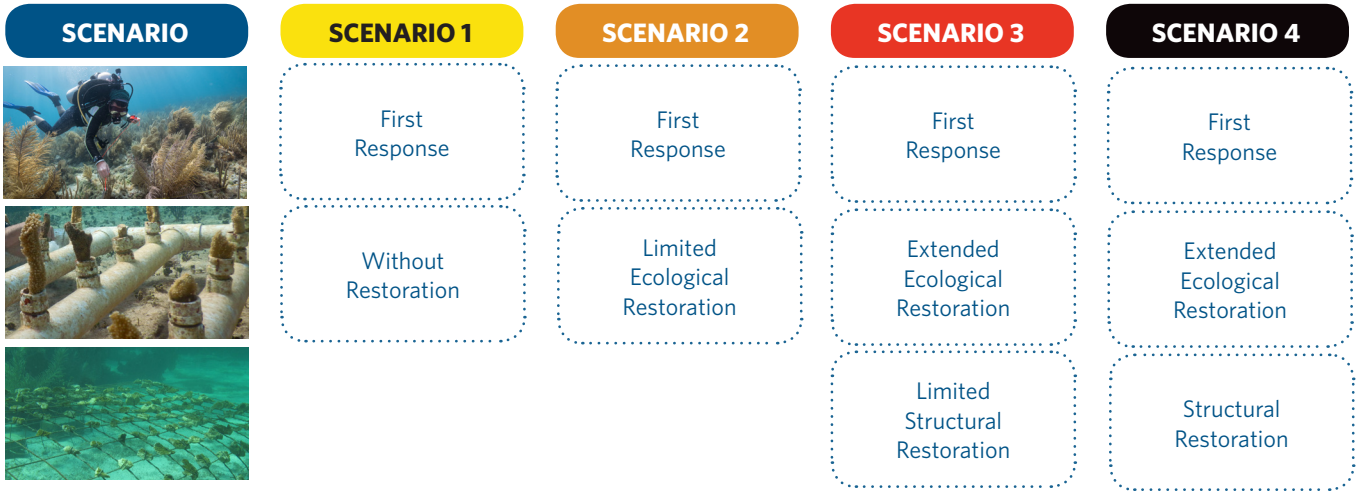


Figure 9: Scenarios of damage and intervention proposed for the Mexican Caribbean and used to estimate the cost of the response and repair after a hurricane

EXAMPLE

Scenarios developed to estimate the costs of post-storm response and repair activities in the 28km stretch between Punta Nizuc and Puerto Morelos town, in the Mexican Caribbean. Scenarios consider four levels of damage and three types of interventions (see Figure 9):

SCENARIO 1

Damages to the reef are minor, caused by a minor storm nearby or by a strong storm that took place at a farther distance. Actions proposed are limited to first response, such as assessment of the damages, debris collection and broken coral consolidation.

SCENARIO 2

Damages to the reef are moderate (loss of 10-20% of live coral cover) and caused by a stronger storm. Actions proposed are full first response followed by implementing a repair program.

SCENARIO 3

Damages to the reef are severe (loss of 20-40% of live coral cover) and caused by a nearby strong storm. In addition to first response, extensive ecological repair actions for 2-3 years and some structural restoration are required. This scenario estimates higher density of coral colonies and twice the area needed to be repaired than scenario 2. This scenario includes limited artificial structural restoration in reef crests assuming several big colonies are broken, which would require 10 years to recover.

SCENARIO 4

Damages to the reef are catastrophic (loss of 60% live coral) and caused by a storm that either was very strong or stayed for a longer period causing significantly more damage. This scenario estimates that the first response will require twice as many resources as previous scenarios. It will be followed by a full and extensive repair program to plant new coral colonies. Structural restoration would be required to recover the reef's ability to provide coastal protection services.

PHASES	SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4
Hurricane wind speed in knots	50 to 90	110	130	160 or more
Category of damages	Minor damages	Moderate	Severe	Catastrophic
% loss of live coral cover	Less than 10%	20-30%	Around 30-40%	More than 50%
Structural damage	No	No	Moderate	Severe
ESTIMATED COSTS				
Post storm response	USD 60,000	USD 100,000	USD 140,000	USD 140,000
Ecological repair and structural restoration	No need.	USD 1,000,000	USD 2,000,000	USD 4,000,000

Table 4: Estimated costs that each level of intervention would require according to the hypothetical extent of the damages. This is information to estimate the financial needs of the interested parties to allow them to decide on how to cover those expenses: with own funding, with donations, insurance or bear the losses. These amounts are not necessarily the payout.

3.5 DETERMINE THE AMOUNT OF FUNDS REQUIRED TO TRANSFER THE RISK

The buyer has to determine how much it can spend on its own to cover the post-event response and restoration actions without a heavy burden on its finances. Above such a figure, the buyer should transfer the financial burden via insurance. This is the financial threshold. This amount fully depends on the financial capacity of the party/buyer and the options it has to cover those expenses.

EXAMPLE

Post-storm response and repair costs scenarios ranged from an USD 140,000 to USD 4 million (Table 3). The costs of a post-storm response in scenario 1 can be covered by federal emergency programs already in place in Mexico. Scenarios 2, 3 and 4, cannot currently be afforded and the financial burden should be transferred via insurance. Stakeholders determined that the financial risk of USD 1 million (scenario 2) and above should be transferred.

3.6 DEFINE THE PARAMETER'S THRESHOLD

The interested buyer of an insurance has to define a threshold (amount of money needed for repair the damages), below which the buyer can use its own funds—known as "risk to be held"- and above that amount, it will require financial support—known as "risk to be transferred". Precisely, insurances are "risk transfer mechanisms." Then, the insurance designer must relate the threshold with a value of the parameter selected beforehand. As discussed, the cost of repair is related to the damage to the asset, which in turn are correlated to values of the parameter. This relationship is known as the damage curve in the insurance industry. The value of the parameter that is related with the threshold between "risk to be held" and "risk to be transferred," is the parameters´ threshold.

EXAMPLE

Stakeholders in the Mexican Caribbean interested in repairing the reef considered that expenses ranging up to USD 150,000 could be covered with their own funding. The damage curve also shows a sharp increase in cost of repair when a storm with 110 knots impact the reef, jumping to USD 1 million or more. Repair expenses of USD 1 million is a risk that must be transferred, therefore the correlated with wind speed of 110 knots became the parameter´s threshold. Table 4 shows an empirical relationship between wind-speed, damage to the reef and the cost of restoration developed by TNC.

Table 5. Cost of restoration related to wind speed

SCENARIOS OR RESTORATION EFFORT	WIND SPEED IN KNOTS	LOSS OF LIVE CORAL COVER	COSTS IN USD
SCENARIO 1	50-90	Less than 10%	140,000
SCENARIO 2	110	10-20%	1,000,000
SCENARIO 3	130	30-40%	2,000,000
SCENARIO 4	160	More than 40%	4,000,000

-- The red line shows the divide between an scenario whose financial burden can be held (scenario 1) and scenarios whose burden is to high and the risk shoud be transfered (scenrios 2 and above).

Given that restoration costs will increase as the hurricane speed increases, the insurance scheme proposes that the payout would increase if winds are stronger, to receive more funds to cover the increase in costs.

3.7 IS THERE A BUSINESS CASE?

A financial case summarizes and explains why it is advisable to the beneficiaries of the services provided by the natural asset to buy insurance to repair the damages. A financial case compares the potential losses for the beneficiary when the natural asset is damaged with the cost of repairing the damages and with the cost of buying the insurance. To justify the purchase of the insurance, the following conditions must be met:

1. The cost of repair is higher than the economic losses, making a valid case to repair the asset.
2. The cost of repair is such, that the stakeholder interested in repairing the damages is also interested in transferring the financial burden, such as buying insurance.
3. The cost of the premium is reasonable compared to the cost of repair, incentivizing the stakeholder to buy the insurance rather than paying for the repair (or holding the risk).

ILLUSTRATIVE EXAMPLE

TNC estimated the potential economic losses if reefs are damaged, the cost of repairing the damages and the cost of the insurance. The cost of the premium of the insurance was estimated between 8% to 16% of the insured amount, based on the proposed polygon and the 110 knots threshold. Table 7 shows that it is financially sound to invest between USD 50,000 to 100,000 annually to buy insurance and avoid a potential loss from tourism of at least USD 4 million per year if a hurricane hits, and to avoid damages to coastal infrastructure of USD 3,5 million annually.

Table 6. Financial case in different scenarios for the 28kms stretch between Punta Nizuc and Puerto Morelos.

CONCEPT	AMOUNT USD
LOSSES	
Annual losses in tour operations -20% decrease	4,000,000
Annual increase in damages to coastal infrastructure	3,500,000
COST OF REPAIR	
Cost of post-storm rapid response	140,000
Cost of post-storm restoration (lower coverage)	1,000,000
Cost of post-storm restoration (good coverage)	2,000,000
COST OF INSURANCE	
Annual cost of insurance policy of USD 2 million	160,000

3.8 CONCLUSION

Table 7. Summary of the proposed characteristics for the Mexican Caribbean.

	Characteristics of the insurance	Mexican Caribbean Example
1	**Type of insurance**	Parametric
2	**Polygon**	A buffer of 65kms offshore, towards the East, North and South.
3	**Response and repair costs**	From USD 140,00 up to USD 2 million.
4	**Parameter and threshold**	Wind speed and 110 knots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4 DEFINE AND DEVELOP THE INSTITUTIONAL ARRANGEMENT TO BUY AND MANAGE THE INSURANCE

The scheme must clearly identify the sources of funding to purchase insurance, the policy-holder of the insurance, the entity who will receive the payout and entity who will implement the post-event response and repair. This clarity of roles and capacities is called the institutional arrangement. There may be many stakeholders involved, depending on the complexity of their interests and ownership of the natural asset. It can vary from a single entity, as the owner of the asset who buys the insurance and implements the post-event response, to a complex arrangement, as in the case of the Mexican Caribbean, where the Quintana Roo State Government established a new entity, the Coastal Zone Management Trust. The institutional arrangement encompasses the following elements:

4.1 DEFINE WHO PAYS FOR THE INSURANCE

The entities legally responsible for the care of the natural asset, or those who receive benefits from the ecosystem service, can provide the funding to buy the insurance. As stated in phase 2, making the economic case for their contribution is essential and must be well documented.

EXAMPLE

The hotel owners with properties along the coast are the most interested in having an insurance to cover damages to their beaches and reefs. Coastal property owners pay a concession fee to the Mexican Federal Government to use the beaches, known as ZOFEMAT, a portion of which must be transferred to a trust fund for beach maintenance. ZOFEMAT payers and the recently created Trust agreed to contribute to the purchase of insurance. as it would serve the same purpose for beach maintenance.

4.2 DEFINE WHO BUYS THE INSURANCE

Identify the entity who can buy the insurance and be the policy holder considering that it has the interest and the legal authority. This entity must have financial capacity to buy it or collect funding from other interested parties. Generally, only one entity can buy an insurance policy.

EXAMPLE

In Mexico, several entities could be the buyers (Hotel Owners, Federal and State government, Civil Society) as they are legally responsible, are beneficiaries or have an interest in the asset, and all are interested in transferring the risk. The challenge is to collect the funding from different parties and ensure that the payout will be used for the collective objectives. Under the leadership of the Quintana Roo State Government, stakeholders agreed to establish the Coastal Zone Management Trust. The Trust will collect fees and other contributions from the tourism industry and local municipal governments to fund projects for managing and conserving the coastal zone and buy the insurance.

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4.3 IDENTIFY WHO RECEIVES THE PAYOUT

The next step is to identify the beneficiary of the insurance, conversely who receives the payout. The beneficiary of the insurance must have the capacity to manage the funds with transparency and accountability to all the involved stakeholders and ensure that they are used for the intended purpose. The beneficiary of the payout does not need to be the same entity as the buyer of the insurance.

EXAMPLE

The Coastal Zone Management Trust has been formed by public entities, including institutions in charge of managing protected areas, public works, tourism and others. Other sectors participate, such as the hotel owners, TNC and academic institutions. The Trust has a governing Board and an Advisory Committee, to ensure transparency and provide technical guidance on how to manage reefs and beaches and how to implement the restoration activities. The Trust has an arrangement to ensure accountability in the use of the payout, and that funds will be effectively invested to repair reefs and beaches.

4.4 DEFINE THE GOVERNANCE AND PROCESS TO MANAGE THE PAYOUT

There must be governance that defines procedures to decide on the use of the payout, how projects will be approved, funded and monitored. Without this oversight, the process to utilize the payout may prove to be ineffective and inefficient.

EXAMPLE

The Coastal Zone Management Trust has an Advisory Committee made up of experts in various disciplines, including oceanography, reef ecologists, coastal engineers and others, who can provide technical guidance on how to manage the coral reef and to conduct the restoration activities. The bylaws of the Trust define how to contract the vendors for projects and make payments. In addition to the institutional arrangement and bylaws, TNC and its partners developed the Early Warning and Rapid Response Protocol and the Reef Restoration Guidance, both technical documents that lay out the activities and methods to implement a post storm response and to restore the reef.

4.5 | CONCLUSION

Table 8. Institutional arrangement in the Mexican Caribbean

Institutional arrangement	Mexican Caribbean Example
1 **Who pays the insurance**	Hotel owners via ZOFEMAT fees, and government agencies.
2 **Insurance buyer**	Coastal Zone Management Trust
3 **Insurance beneficiary**	Coastal Zone Management Trust, with a Board and an Advisory Committee.
4 **Rules to manage the payout**	Coastal Zone Management Trust bylaws, Post Storm Protocol, Reef Restoration Guide

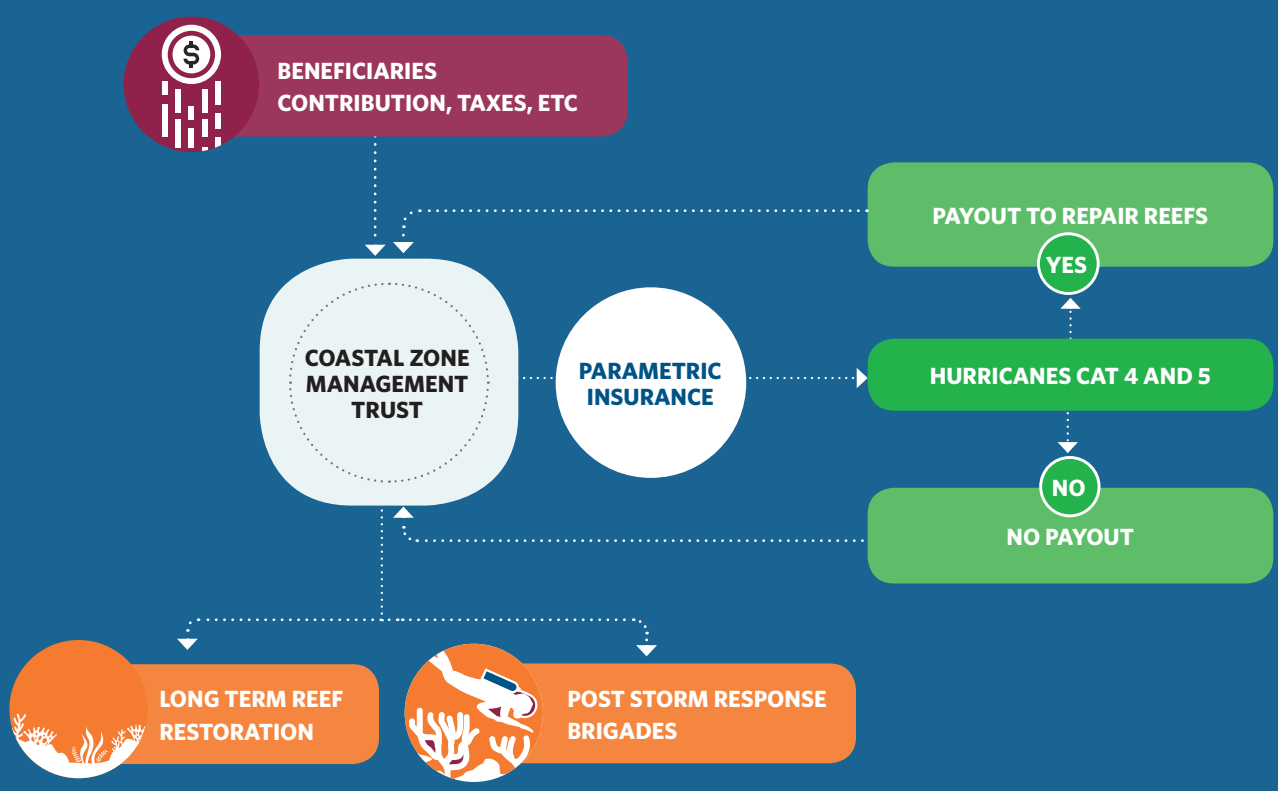


Figure 10: Institutional arrangement and operation of the Coastal Zone Management Trust and insurance in the Mexican Caribbean.

5 MAKE THE TRANSACTION: BUY THE INSURANCE

5.1 DEVELOP TERMS OF COVERAGE

Once studies, modeling and metrics have been identified, stakeholders will need to agree on the conditions of the policy and develop the Terms of Coverage. This is a technical document to be used to procure quotes from insurers. This document is equivalent to a Request for Proposal (RFP) or Terms of Reference (TOR) to hire services.
Example of Terms of Coverage proposed for the Mexican Caribbean.

	TERMS OF COVERAGE	EXAMPLE
1	Contracting party	Coastal Zone Management Trust.
2	Beneficiary of the payout	Coastal Zone Management Trust.
3	Assets covered	Reefs and beaches
4	Risks covered	Hurricanes
5	Parameter and threshold to trigger the insurance	Wind speed at 110 knots
6	Third party that measures the parameter	Hurricane Center NOAA
7	Insured amount of maximum liability.	USD 2 million (hypothetical value)
8	Escalated payout in relation to values of the parameter	110 knots 40% of the Maximum Liability 130 knots 60% of the Maximum Liability 160 knots 100% of the Maximum Liability
9	Polygon of coverage	Defined in a map with geographic coordinates.
10	Period or term of the coverage	1 year
11	Coverage type: parametric or compensatory	Parametric
12	Currency of transaction and payments	Values stated in USD, payments made in Mexican Pesos.
13	Terms of payment	One exhibition and installaments.

5.2 OPEN A PROCUREMENT PROCESS TO BUY THE INSURANCE

An open procurement process is strongly recommended to ensure that stakeholders receive several offerings from credible insurers to meet their premium and payout terms. The buyer shall define the criteria to select the insurer, including premium cost and payout terms, as well as the company's financial capacity, track record and performance in past relationships.

5.3 NEGOTIATE THE TERMS

As with any contract of services, the final terms of the transaction can be negotiated with the selected seller. Once the seller develops a proposal, the buyer can determine whether the proposed terms, including payments and coverage, fulfill their needs. The payout may be reassessed after consulting the final polygon and threshold, and the buyer may propose to increase the coverage or reduce the premium.

6 BUILD THE CAPACITIES TO INVEST THE FUNDS FROM INSURANCE

Funding from the insurance will only be effective and impactful if stakeholders have, or have access to, the technical and human capacities, the equipment and resources needed to respond after an event. There is no reason to have an insurance and funding if there is no capacity to use them properly. There are three main aspects to consider for capacity needs: What needs to be done? Who will do it? And, do they have the legal authority or permission to do it?

6.1 AGREE ON A POST-DISASTER RESPONSE. WHAT NEEDS TO BE DONE?

The entities responsible for managing the natural asset, in consultation with experts in ecological restoration, must agree on post-disaster response and restoration actions, the technical capacities and the resources needed to implement them. It is advisable to develop a post-disaster emergency protocol that describes the response activities clearly, and the roles and responsibilities of the different stakeholders. Bear in mind that the immediate response is after a disaster and that there will be several demands on resources, both on people and equipment. It is essential to plan in advance and ensure that roles and responsibilities are defined clearly.

EXAMPLE

TNC and partners developed a Early Warning and Rapid Response Protocol (Zepeda, et al, 2019), which includes a description of the organization required to coordinate the response, a detailed description of the activities and the resources needed. The National Commission of Natural Protected Areas (CONANP) will implement the Protocol in all protected areas with reefs to respond after a storm. It encompasses the following phases:

1. **Planning and preparation:** Conducted every year before the hurricane season, this phase includes annual training or re-freshing courses, assessment of equipment and renewal of permits.
2. **Early warning:** Required to notify team members when a hurricane is approaching. It is implemented when there is a hurricane warning.
3. **Rapid evaluation of damages after a storm:** The methods and roles to conduct a rapid assessment of the damages in order to plan the response.
4. **Primary response:** Cleaning debris and stabilization of broken coral colonies, implemented a few days after the storm and can last up to 60 days.
5. **Secondary response:** Setting up nurseries with coral fragments, thorough evaluation of damages to the reef and the design of the repair activities.

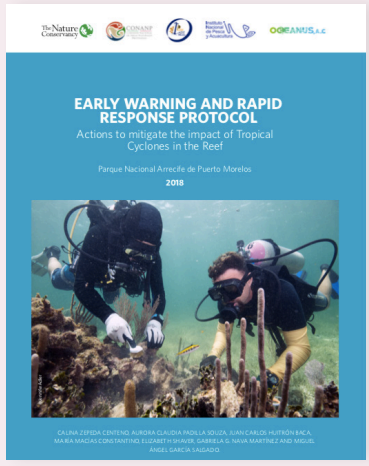
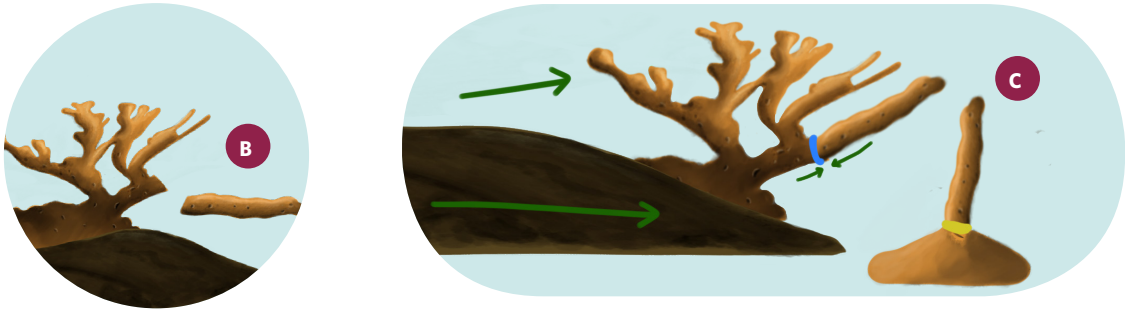


Figure 11: Early Warning and Rapid Response Protocol for the Mexican Caribbean.

Figure 12: Post-storm Immediate Responses for the Mexican Caribbean. Diagram elaborated by OCEANUS A.C.

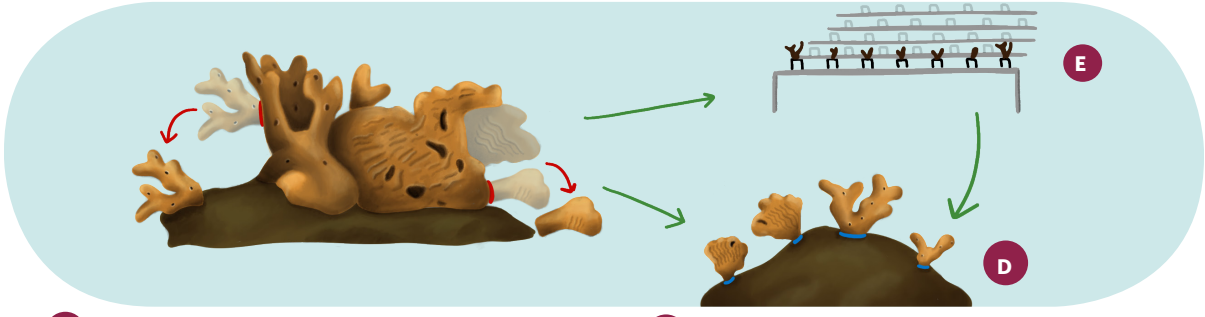
PRIMARY ACTIONS

A Large **live** and complete colonies may be reattached/cemented



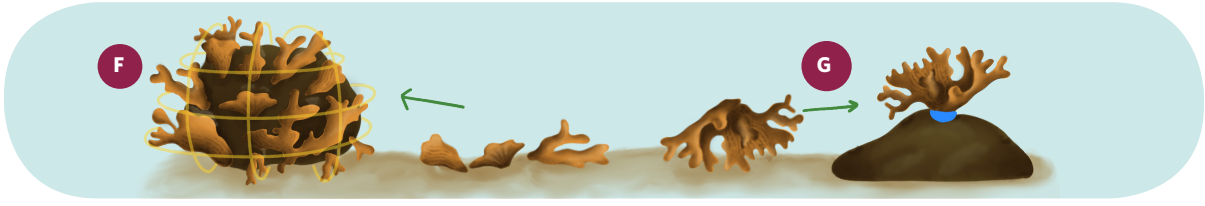
B Large **live** fragments may be reattached to original colony

C Cemented in a new location



D Small **live** fragments may be cemented directly into holes or special bases

E Attached in nurseries for recovery and posterior relocation



F Small **dead** fragments may be collected to form a conglomerate glued together with cement, isolated with special netting and attached to the bottom

G Large **dead** colonies may be cemented to the substrate to avoid dragging and abrasion

6.2 BUILD THE CAPACITIES AND HAVE THE RESOURCES AVAILABLE TO RESPOND. WHO WILL DO IT?

Stakeholders must ensure that there are teams with the required skills and equipment to implement post-event response and restoration. Stakeholders must build and train response teams, procure equipment and supplies in advance, establish agreements with suppliers to quickly engage them after the event.

EXAMPLE

In the Mexican Caribbean, TNC and partners implemented the following actions to build local capacities:

1. CONANP set up a Post-Storm Committee for the Puerto Morelos Reef National Park.
2. TNC, CONANP, CRIAP (Fisheries and Acualture Research Center) and local experts trained 33 volunteers (tourism operators, fishermen, scientists, park managers, etc.) to form Reef Response Brigades for the Puerto Morelos Reef National Park, but that can work along the Mexican Caribbean.
3. TNC and CONANP procured the equipment needed for the immediate response, which is managed and stored in the park´s facilities.
4. Local boat owners and gasoline suppliers have agreed to support post-storm immediate response needs.

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6.3 OBTAIN THE PERMITS AND LICENSES REQUIRED TO IMPLEMENT THE RESPONSE

Stakeholders must identify which response and restoration actions require government oversight or permits, and obtain them in advance, along with the purchase of the insurance so they can be in place if and when an event occurs. Permits should be obtained in advance to avoid any disruption post-event to begin response and restoration. Funding, resources, capacities and permits are all essential to implement an effective and efficient response after an event.

EXAMPLE

CONANP, a government agency, has permits to implement post-storm response and restoration actions within the Puerto Morelos Reef National Park.

EXPERTISE NEEDED

Insuring a natural asset is a newly explored concept and this guide aims to provide context and guidance for what is a complex process. A variety of expertise is needed, a summary of which is presented here:

STEP 1: Assess the need for an insurance

- Expertise in ecology of the asset to assess how the natural asset is damaged by climate events, how it can be repaired and how much it would cost.
- Expertise in economic valuation, to define the ecosystem services provided and to estimate the economic benefits.

STEP 2: Identify potential buyers.

- Knowledge and relationship with the stakeholders or responsible entity of the natural asset, beneficiaries of the service provided, a map of stakeholders and assessment of interest and willingness to buy.

STEP 3: Design the insurance

- Expertise in risk transfer and insurance mechanisms. Knowledge in building a damage curve, defining parameter and threshold, payouts, legal framework to develop and buy insurance.
- Expertise in ecology of the asset to evaluate damages, define repair activities and the cost of repair.

STEP 4: Develop the institutional arrangement

- Expertise in negotiation and engagement of stakeholders, including governments.
- Expertise in legal and institutional arrangements.
- Expertise in legal aspects of the insurance market.

STEP5: Buy insurance

- Expertise in developing the terms of coverage and coordinating the essential enabling conditions: ecological information, repair costs, beneficiaries' interests, potential losses, institutional arrangements, financial capacity of the buyer, potential credible insurers.
- Expertise on procurement processes.

OVERALL PROJECT MANAGEMENT:

- Expertise in managing complex processes and workflows, a wide variety of stakeholders, experts, consultants, budgeting, contracting, etc.
- Fundraising capacity to effectively run the process.

RECOMMENDATIONS

1. **ECONOMIC CASE:** Make a strong case about why the beneficiary of the services provided by the natural asset needs insurance to repair the damages from catastrophic events (see section 3.7). Estimate and relate the potential losses to the beneficiary when the reef is damaged by an event and compare them with cost of repair and the cost of buying an insurance.

2. **INSURANCE DESIGN:** To design a sound insurance, aka the polygon, the parameter and threshold to trigger it, it is critical to establish the relationship between the characteristic of the catastrophic events and the damages to the natural asset. Finally, to estimate the payout, you need to know the cost of repairs.

3. **INSTITUTIONAL ARRANGEMENT:** Developing a reliable mechanism that can buy the insurance and manage the payout is the most complicated step in the process.

4. **VARIED EXPERTISE:** Varied expertise is needed and may change during the process. You will need to involve expert in ecology of the natural asset, catastrophic events, insurance, finance and institutional arrangement.

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