Inter-American Development Bank

Economic Valuation of Reef Ecosystems in the MAR Region and the Goods and Services they Provide

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FINAL REPORT

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1. INTRODUCTION

The forests of the sea are coral reefs at the bottom of the sea. The Mesoamerican region (MAR) encompasses the largest barrier reef in the Northern Hemisphere. However, marine habitats, such as coral reefs and mangroves, are degrading and, without appropriate conservation actions, they will continue to degrade. The health of the Mesoamerican reef is threatened, so improving their management and sustainable conservation by assessing the status and trends in the reefs and how people value and use the resources is key.

Value information can be used in different policy-making contexts, including the determination of investments in reef health, compensation payments for damage, and cost-benefit analysis of conservation measures. In this context, the results of this study will provide information to encourage the governments of Belize, Guatemala, Honduras and Mexico to increase budgetary resources for reef conservation and management. It will also be helpful for raising local to global awareness on the economic importance of coral reefs as natural infrastructure, and will open the door to discussions with the private sector (e.g. tourism, fisheries) on how they can protect their business interests by investing in the health of the reefs on which their industries depend. The economic valuation also identifies and generates economic arguments to support policies that help ensure healthy coastal ecosystems and sustainable economies.

Having said that, the objective of the study is to understand the value of the coral reef ecosystems in the MAR region, and the importance of their conservation in order to better inform decision-makers. To achieve this objective, an **economic valuation analysis** of the goods and services provided by coral reefs in the region has been conducted.

This overall objective has been met through seven more specific objectives:

1. Provide a review of other economic valuation projects/initiatives currently ongoing in the Mesoamerican Reef region, the wider Caribbean and the Pacific. Review historical work on economic valuation of reefs (Section 2);
2. Critically assess the methods available for estimating the value of the coral reef ecosystem, health, biodiversity, goods and services associated with coral reefs, at a minimum for fisheries, tourism, and shoreline protection (Section 2);
3. Select the sites to be valued (Section 3);
4. Provide a clear justification for the economic method being selected and its alignment with those being discussed in the context of the System of Environmental Economic Accounting (SEEA) Ecosystem service accounts (Section 4);
5. Conduct primary data collection through stated preference techniques (survey-based methods) (Section 5);
6. Estimate the value of the goods (considering the health of the coral, biodiversity) and services of coral reefs in the MAR, with special attention to the sites prioritized for

the insurance pilot model and evaluate scenarios under 1.5 ºC change and 2 ºC change (Section 5);

7. Determine the allocation and distribution of the value of the goods among stakeholders (public sector, private sector, etc.) and willingness to pay for insurance of the coral reefs (Section 6);
8. Assess the policy framework (environmental, economic) to identify gaps or deficiencies with regards to the recognition of the value of reefs (Section 6); and
9. Make some recommendations for reef protection and restoration (Section 7).

In order to achieve these objectives, the study has been built on **grey and scientific literature** and a range of publicly available **data sources**. These studies were complemented by gathering **new evidence from a survey** of residents of the MAR region and other countries world-wide selected based on their visitation rates to the MAR region.

Final report consists of the following parts:

- Section 2. Literature review. It includes an in-depth literature review on the ecosystem services provided by coral reefs, threats they are exposed to, social and economic implications of these ecosystems, as well as policy instruments to protect them. It also addresses the concept of Total Economic Value, the existing valuation methods to estimate the monetary value of ecosystem services and previous studies calculating the economic value of coral reefs worldwide and in the Caribbean context.
- Section 3. Sites selection and characteristics: It shows the indicators used to identify the sites, the methodology for the determination of the study sites, the sites selection and the description of sites and changes in ecosystem services.
- Section 4. Selected methodology and alignment with the SEEA. It provides a justification for the economic method being selected (for tourism, fisheries, shoreline protection and non-use values) and its alignment with those being discussed in the context of the SEEA Ecosystem service accounts.
- Section 5. Economic valuation results. It is divided into two parts:
    - *Data collection and analysis*. It explains the procedure for obtaining the information needed to estimate the monetary values and the procedure for analyzing the information obtained through the previous methodology.
    - *Results* of the economic valuation exercise for the following goods and services provided by coral reefs: fisheries, tourism, shoreline protection and non-use values.
- Section 6. Engaging beneficiaries and other stakeholders: It is divided into three parts:
    - *Beneficiaries and Stakeholders*: it identifies and characterizes the beneficiaries and other stakeholders of the ecosystem services provided

by coral reefs in order to understand the distribution of benefits and costs of actions that protect or damage them.
    - *Allocation and distribution of the value* of the goods among stakeholders (public sector, private sector, etc.) and willingness to pay for *coral reef insurance*.

- Section 7. Recommendations for reef protection and restoration to overcome hurricanes impacts, in recognition of the value of the reefs and the services they provide, both for the public and private sectors in the four of MAR countries.
- Section 8. Work sessions: It includes a summary of the work sessions that were held online on 6, 7, 13 and 15 October in México, Guatemala, Honduras and Belize, respectively.
- Section 9. Bibliography
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2. LITERATURE REVIEW

Environmental Economics relies on valuation to provide society with information about the relative level of resource scarcity (Markandya & Richardson, 1993). Economic valuation can make explicit to society and policy makers that environmental and natural resources are scarce and that their conservation has associated benefits. If these benefits are not accounted for policy will be misguided and society will be worse off due to misallocation of resources. Therefore, valuing natural resources and the environment (i.e. measuring 'economic values' of environmental and natural resources) can support decision making that has a positive effect environmental and natural resources.

The value of coral reefs reflects what we, as a society, are willing to pay to conserve these natural resources (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field & Field, 2017). Putting a monetary value on natural resources and the environment involves two steps. Step 1 consists in identifying the ecosystem services (ES) provided. Step 2 is to estimate them in monetary units.

This literature review addresses both issues and, moreover, a third aspect related to instruments to protect coral reefs such as reef insurance.

2.1 STEP I. CORAL REEFS: ECOSYSTEM SERVICES, THREATS, AND IMPLICATIONS

2.1.1 Introduction

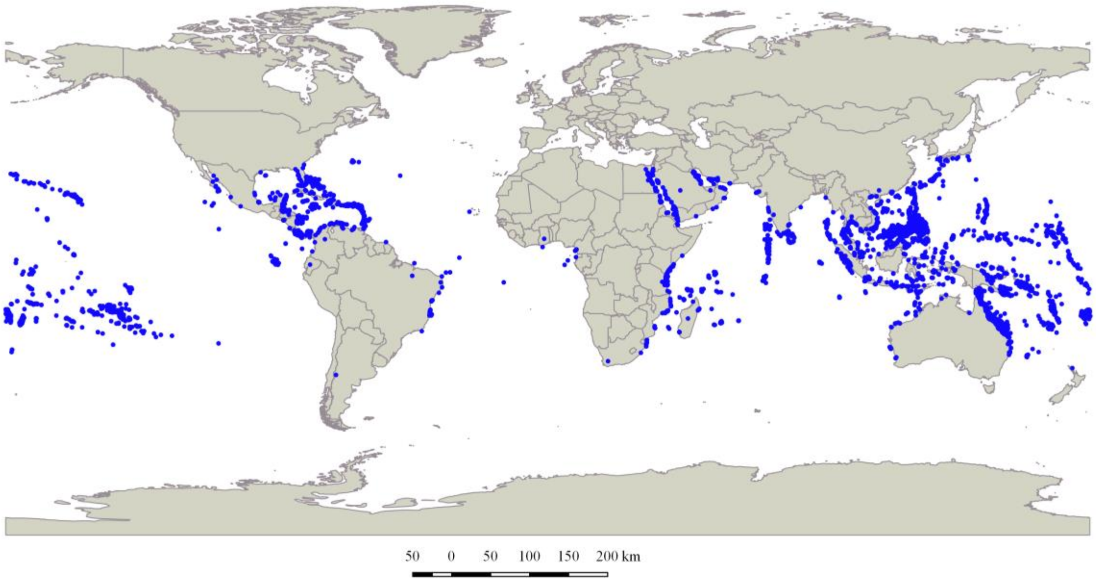
Coral reefs are one of the most diverse and valuable ecosystems on Earth (Grigg et al., 1984). They are highly economically and biologically productive ecosystems providing a wide range of benefits to coastal populations in particular and to society in general. They are thus essential for the livelihood of many inhabitants in the territories on which they are located, as well as to visitors from outside, and recognized as globally fundamental ecosystems.

Although coral reefs cover less than 0.2 percent of the oceans – 249,713 km^2 – (Burke et al. 2011a), they support an estimated one quarter of all marine life, including about 4,000 species of fish and 800 species of hard corals. Not only that, but researchers also point out that they are the habitats for a very high number of undocumented species of organisms (Reaka-Kudla, 1997)[1]. Thus, coral reefs and their associated marine life are considered as one of the main global assets because of their richness and uniqueness.

Corals are found all over the world's oceans, from the Coral Triangle[2] and Oceania to the Caribbean Sea, going through Madagascar and the Red Sea, as shown in Figure 1.

[1] The Great Barrier Reef (northeastern Australia) is home to 1,500 species of fish and 4,000 species of mollusks.
[2] Waters of Malaysia, Papua New Guinea, Indonesia, the Philippines, Timor-Leste, and Solomon Islands.

Figure 1. Distribution of coral reefs around the world



Source: own elaboration based on data from ReefBase

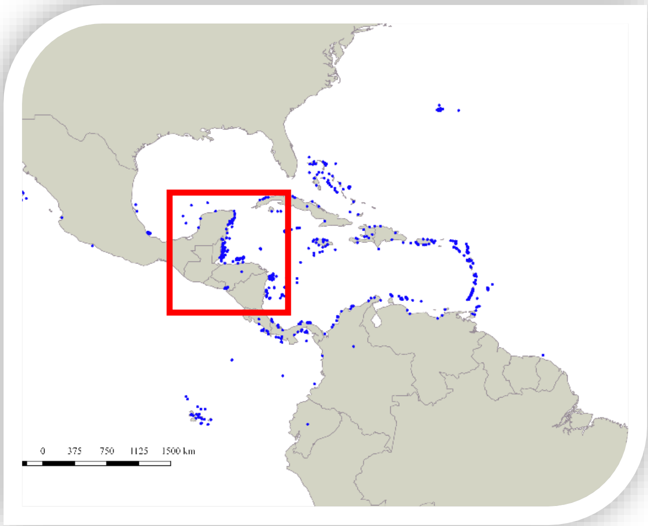
They are found in the shallow waters of the tropics and subtropics due both to their intolerance to water temperatures below 18 degrees Celsius and to their requirement for high light[3]. Most of them can only inhabit waters at a temperature of between 18 and 30 degrees Celsius. However, although there is a tendency towards thinking that coral reefs only live close to the surface of the sea, the reality is quite different: the ones we can see when snorkeling are just one minimum part of the complete picture. Light-dependent corals that can live in deeper waters (30-40 meters) are known as mesophotic coral ecosystems. They function as refuges for shallow-water coral reefs and provide a source of larvae to repopulate adjacent reefs (Baker et al. (2016) for a more comprehensive study). This reflects the connectivity among reefs in the ocean[4].

Among all the coral reef systems, the Great Barrier reef is the largest one in the world – more than 1,400 miles long (around 2,300 kilometers)–, comprising about 2,900 individual reefs, 600 continental islands and 200 coral cays. It is, in fact, the only living structure that can be seen from the moon. This system is therefore unique because of its rich biodiversity[5]. However, there are also other valuable coral reefs in other parts of the planet, as in the case of the Caribbean region (Figure 2) – 25,960 km^2, an area equivalent to the Bahamas, Trinidad and Tobago and Puerto Rico – (Burke & Maidens, 2004;

[3] That is why most reef-building species are found in the topmost layer of the ocean –euphotic zone – (Lalli & Parsons, 1995).
[4] See e.g. the possibility of using benthic/seafloor habitat maps to determine the areas to be protected and managed (Mumby et al., 1997; Brown et al., 2011; Walker, 2012, Cochran et al., 2014; Zhang, 2015). National Centers for Coastal Ocean Science (NCCOS) is producing, since 1999, benthic seafloor habitat maps for coral reefs in Florida, Caribbean, and the Pacific.
[5] Around 30 species of whales and dolphins, 133 species of sharks, 1,625 species of bony fish, more than 400 species of hard coral, over 150 species of soft coral, 22 seabird species, 3,000 species of mollusks, around 1,300 species of crustaceans, 6 of the world's 7 species of marine turtles coexist in this ecosystem.

Maldonado, 2020). Types include fringing and bank reefs, as well as some long barriers, especially around Cuba and off the coast of Belize (Burke et al., 2011a).

Figure 2. Distribution of coral reefs in the Caribbean region



Source: own elaboration based on data from ReefBase

It is composed of a wide variety of reefs, such as long barrier reefs, nearshore fringing reefs, offshore atolls, and patch reefs by the hundreds, especially around Cuba and off the coast of Belize (McField & Kramer, 2007). Although the diversity of reef species in this area is lower than that in the Pacific and Indian Oceans (65 species of reef-building corals against 750), species of fish, corals and crustaceans living in these waters are unique: 90 percent of these species cannot be found anywhere else in the world (Burke et al., 2011a).

It is worth mentioning that, in 2018, scientists discovered an 85-mile-long coral reef in the Atlantic Ocean, near the southeastern U.S. (South Carolina)[6]. This treasure had remained hidden from humanity for thousands (or possibly hundreds of thousands) of years.

2.1.2 Ecosystem services provided by coral reefs

Ecosystem services refer to the wide range of benefits derived from the resources and processes provided by nature (Daily, 1997). Research on this topic has become an important field of investigation, mainly since the 1990s (e.g. Costanza et al. 1997; Daily 1997; Daily et al. 2000; de Groot et al. 2002). Since then, much of the debate about ecosystem accounting has focused on the pioneering classification of ecosystems services (Figure 3) in the Millennium Ecosystem Assessment (MA)[7] (MA, 2005).

[6] It was uncovered within the scope of the project *Deep Search* involving the research vessel Atlantis.
[7] Following Daily, MA (2005) refers to 'ecosystem services' instead of ecosystem goods and services, as it is not always easy to determine whether a benefit is a 'good' or a 'service'. Likewise, when people refer to 'ecosystem goods and

Figure 3. Ecosystem services

Source: MA (2005)

Provisioning services cover the products of renewable biotic resources including foods and fibers (products derived from plants, animals, and microbes, as well as materials such as jute, hemp, silk), fuel (wood, dung, etc.), fresh water, ornamental resources, bio-chemicals, medicines, pharmaceuticals, as well as the genetic material of interest to the Convention on Biological Diversity (CBD)[8].

Cultural services cover a wide range of non-consumptive uses of the environment: cultural diversity (heritage values, sense of place, social relations and the influence of ecosystem on the knowledge system developed by different cultures), the spiritual, religious, aesthetic, and inspirational wellbeing that people derive from the 'natural' world; the opportunity for science and education to study and learn from them; and the market benefits of recreation and tourism.

Regulating services comprise air quality maintenance, climate regulation, water regulation, erosion control or soil stabilization, hydrological regulation, water purification and waste treatment, human disease regulation, pests, biological control, and regulation of natural hazards, such as storms[9]. More generally, they refer to the benefits of biodiversity in moderating the effects of environmental variation on the production of those things that people care about directly. They limit the effect of stresses and shocks to the system.

Finally, **supporting services** include the main ecosystem processes that underpin all other services, such as soil formation, production of oxygen gas through photosynthesis, primary production, nutrient, and water cycling. Unlike the other three types of services, the impacts of supporting services on people are often indirect and take place over a long period of time.

services', cultural values and other intangible benefits are sometimes obviated. In line with the above, in this study all these benefits will be considered together as 'ecosystem services'

[8] Even though the Convention was opened for signature in 1992 at the Rio 'Earth Summit', it entered into force in 1993 with the goal of: (i) conserving biological diversity, (ii) using suitably components of this diversity, and (iii) sharing the benefits from genetic resources in a fair and equitable way. It is made up of 196 parties, including all the countries belonging to the MAR region.

[9] This is especially relevant for coral reefs and mangroves, as their presence helps protect the coastline and minimize the damage caused by hurricanes or large waves.

However, this figure does not mean that ecosystem services should be divided into watertight compartments, as ecosystems are not static structures, but rather complex systems[10]. There are many linkages between the four categories. See, e.g. the case of ornamental resources, which could also be considered as part of cultural services, or erosion control, which could be categorized as both supporting and regulating service.

The MA (2005) approach also include both natural and man-made ecosystems as sources of ecosystem services because humans interact with the environment in many ways, sometimes improving some services at the expense of others. In any case, this integrated assessment framework is helpful for stakeholders (governments, the private sector, nongovernmental organizations, insurance companies, etc.) to rely on a broader picture of the functioning of ecosystems, the linkages between people and their environment and the possible actions and policies to enhance the conservation of these natural systems.

Tropical coral reefs supply many goods and services to coastal populations in particular and to society in general, such as fish and tourism. Moreover, they provide biodiversity, scientific and educational value, among other services (Moberg & Folke, 1999).

Some of the most well studied **provisioning services** refer to commercial food (fish and shellfish), mariculture, aquarium fish[11], genetic resources, pharmaceutical ingredients[12], ornamental corals, raw materials limestone and building materials from reefs (Bruckner,

[10] Systems in which the many parts that compose it interact with each other and with their environment forming a whole, which is different from the sum of its components, and whose links give rise to new behaviors that could not be explained by analyzing each element separately. For this reason, analyzing the behavior of the whole system (in this coral reef ecosystems and their services) implies a complexity that is difficult to handle, considering the large number of interrelated factors.
[11] The global marine aquarium trade involves some 1000 fish species, 2000 coral species, live rock, and other reef invertebrates (clams, worms, and sea feathers). Indonesia is the main exporter (Cesar, 2003).
[12] In 2013, BBC Future promoted a four-minute video called *Coral reefs: Underwater pharmacies* explaining the role of coral reefs as suppliers of pharmaceutical ingredients.
https://www.bbc.com/future/article/20130319-underwater-pharmacies [visited 05/05/2020]

2001, 2002; Cesar, 2003: Brown, 2011; Leal et al., 2013; Waite et al., 2014; Cooper et al., 2014; Albert et al., 2015; Golden et al., 2016; Grafeld et al., 2017). For instance, many reef-dwelling species develop complex chemical compounds (venoms and chemical defenses) that can not only help them survive, but also serve as the basis for medicines for treating cancer, HIV, malaria, among other diseases (Burke et al., 2011a, 12).

Cultural services are recreational and outdoor activities (e.g. snorkeling, scuba diving or birdwatching), tourism and sightseeing tours (aesthetic values) and research, knowledge, and education (Pendleton, 1994; Green & Donnelly, 2003; Ngazy et al., 2004; Brander et al., 2007; Uyarra et al., 2009; Spalding et al., 2017). Note that, sometimes, recreational and tourism activities are combined under the name of 'coral reef related tourism' (Spalding et al., 2017). Tourism is one of the world's largest industries, being a driver of growth for the Caribbean countries and supporting the livelihoods of people through, for example, tourist consumption of local produce. This is especially relevant for developing countries and small island depending to a large extent on coral-based recreation opportunities, such as Belize. Cruise industry, sport fishing and diving are high-value industries that contribute millions of dollars to the Belize's economy – USD 135-176 million (in 2007 prices)[13] – (Cooper et al., 2009).

Regulating services include physical protection to other coastal ecosystems (erosion control and storm/flood protection), water quality, climate regulation, processing of nutrients and biochemical cycling (Bellwood, 1996; Wild et al., 2004; Hart & Kench, 2007; Vila-Concejo et al., 2013; de Goeij et al., 2013; van Zanten et al., 2014; Spalding et al., 2014; Perry et al., 2015; Archer et al., 2017; Elliff & Silva, 2017; Reguero et al., 2018). Coral reefs can naturally protect shorelines from tropical cyclones and storms due to their capacity to dissipate wave energy through breaking, thereby reducing the impact of large waves and avoiding floods. Caribbean's coral reefs provide protection for an estimated 20 percent of the region's coastline, with a value (in 2000 prices) of USD 750 and UD 2,180 million in the Wider Caribbean (Burke & Maidens, 2004). Likewise, Belize Barrier Reef can, for example, mitigate over three quarters of wave energy, avoiding annually damages valued at between USD 120 and USD 180 million[14] (Cooper et al., 2009). Coral reefs will be all the more necessary in the future because more intense storms and sea level rise are likely to occur.

Supporting services refer to the habitat and biodiversity services for both the reef itself and the related marine ecosystems: photosynthesis, sand formation, primary production, species/ecosystem protection, maintenance of a genetic library, biological support to sea birds and turtles[15] and global life-support in terms of carbon storage, among others (Moberg & Folke, 1999; Loreau, 2010; Perry et al., 2011; Ortiz & Tissot, 2012; Graham

[13] If mangroves (USD 60-78 million) were also considered, the combined contribution will be of USD 150-196 million, amounting 12 to 15 percent of GDP.
[14] If mangroves (USD 111-167 million) were also considered, the combined contribution will be of USD 231-247 million.
[15] Tropical coral reefs contain around 830,000 species worldwide (Fisher et al., 2015).

& Nash, 2013; Gillis et al., 2014; Fisher et al., 2015). For example, coral reefs are spawning grounds, nursery, breeding and feeding areas for many living organisms. Furthermore, they provide habitats for fisheries, which are vital for nutrition and food security, especially within the Caribbean region (Burke et al., 2008).

The reciprocal relationships among marine ecosystems (and between marine ecosystems and land) make them be an interconnected whole affecting multiple factors and being affected by the same (or others) factors. Fluxes among these ecosystems, therefore, affect their functioning and management. Coral reefs are not an exception: for instance, the presence of white sands beaches generated by reef processes (in particular, by limestone from dead coral) is closely linked to reef tourism (Burke et al., 2008; Spalding et al., 2017). Likewise, although at the first glance agriculture and forestry sector seem not to be related to coral reef, the fact remains that activities of these two sectors (e.g. forest clearing, crop cultivation or intensive livestock farming) cause stress in the latter through sedimentation (Burke et al., 2011a; UN Environment, ISU, ICRI & Trucost 2018). Knowing the role of complexity in reef ecosystems is, thus, essential for any analysis (Graham & Nash, 2013).

All in all, coral reefs contribute to achieve what has been dubbed the ‘triple bottom line’ – *people, planet, and profit* – and the goal of sustainability. These unique ecosystems make it possible for inhabitants of the regions they are located on to establish a relationship with nature, while also containing the largest reservoirs of biodiversity on Earth and being economically beneficial for many countries, especially small island developing states heavily dependent upon coral reefs services, such as Belize. More specifically, they are a source of food, livelihoods, and economic opportunities to people in more than 100 countries around the world.

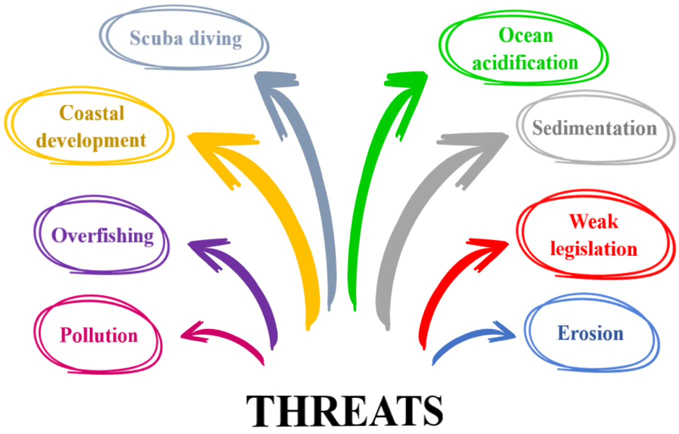
Over the past decades many attempts have been made to link biological aspects of ecosystems with human benefits through the notion of ecosystem services. It will help stakeholders consistently figure out the trade-offs between ecological, economic, monetary, and social perspectives involved in the loss of biodiversity and ecosystem degradation (de Groot et al., 2010).

Nevertheless, contribution of ecosystems in general and coral reefs in particular is progressively being eroded by the many threats affecting coral reefs.

2.1.3 Threats to coral reefs

Knowing the environmental challenges facing coral reef systems is the first step in becoming aware of the urgent need to change the course of things. Otherwise, there will come a time when it will no longer be possible to apply ‘magic formula’ to solve. To quote Alexander von Humboldt, *“the most dangerous worldview is the worldview of those who have not viewed the world”*.

Climate change is the main and most urgent environmental problem. Having in mind that the process of change has acquired a greater dimension than until the mid-20th century and has unprecedented characteristics in ancient civilizations, we could be walking the path that leads us to a world unknown until now. What seems to be clear, however, is that tropical coral reefs in the Anthropocene[16] are functioning differently from reefs in the past (Harvell et al, 1999; Hoegh-Guldberg, 2011; Liu et al., 2012; Birkeland, 2015; Hughes et al., 2017; Woodhead et al., 2019).

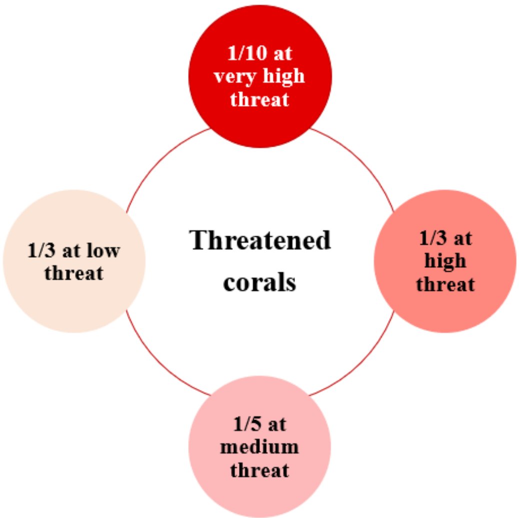


Unfortunately, climate change is not the only phenomenon that coral reefs have to face. There are other threats: marine heatwaves, overfishing, ocean acidification, scuba diving activities[17], pollution, coastal engineering and land filling, sedimentation and erosion and a weak legislation to protect them, among others. In any case, it should be pointed out that not all species are equally vulnerable to the impacts, such as heat stress (Loya et al., 2001; Yadav et al., 2018).

Coral reefs are among the most vulnerable ecosystems on Earth and many of them are already degraded. Degradation began centuries ago, while it is difficult to have a global picture of the magnitude of change. Although trajectories of decline in abundance, diversity and habitat structure were similar in all parts of the world, not all coral reefs started declining at the same time. Atlantic reefs declined before those in the Red Sea and Australia (Pandolfi et al., 2003; Riegl et al, 2009). These losses have been further aggravated over the last decades by coral bleaching[18] – expulsion of the symbiotic algae living in their tissues – (Miller et al., 2006) and high mortality rates (Harvell et al., 1999) associated, e.g. to diseases caused by plastic waste (Lamb et al., 2018) or by metal pollution (Biscéré et al., 2017; Tracy et al., 2019). So much so that more than 60 percent

[16] A group of scientists confirmed, in 2016, that a new era marked by the humans' imprint had begun: the Anthropocene (Crutzen & Stoermer, 2000; Crutzen, 2002, 2006; Rockström et al., 2009; Steffen et al., 2015, 2018). The key question was to determine when the Earth had passed to the next screen of the geological calendar. Conditions were met after the Second World War, after which the Great Acceleration started (Lewis & Maslin, 2015; McNeill & Engelke, 2016). Liu et al. (2012) analyzed the anthropogenic impacts on the coral reefs of Kenting National Park (Taiwan), concluding that the seawater was polluted by sewage discharge and that higher levels of nutrient and suspended sediment had given rise to algal blooms and sediment smothering of shallow water corals. Tourism had also negatively affected coral cover.
[17] Hawkins & Roberts, 1992, 1993; Hawkins et al. 1999; Tratalos & Austin, 2001; Zakai & Chadwick-Furman, 2002; Hasler & Ott, 2008.
[18] Climate change is seriously threatening these ecosystems, as global warming has multiplied by five their bleaching processes, thereby making it impossible for corals to feed and show off their original color .The 1998 coral bleaching was the most geographically extensive and severe in recent memory (Wilkinson et al., 1999; Baird & Marshall, 1998). In 2020, Australia's Great Barrier Reef has experienced the third mass bleaching event in just the last 5 years as a consequence of the rise in emissions of heat-trapping gases.

of world's coral reefs are under immediate and direct threat. This figure rises to 75 percent when recent thermal stress is considered (Burke et al., 2011a).



In the **Caribbean** region, there has been a massive loss of corals: habitats have declined by more than 50 percent since the 1970s and 75 percent of coral reefs are at risk from overfishing and pollution (Waite et al., 2014). According to a report published by the International Union for the Conservation of Nature (IUCN) in 2014, most of the Caribbean coral reefs could disappear in the next 20 years. This process began to be more dramatic since the 1980s (Gardner et al., 2003; Bruno et al., 2007), as a consequence of overfishing (Jackson et al., 2001), explosive human population growth, coastal pollution, invasive species and diseases mostly affecting species such as long-spined sea urchins (*Diadema antillarum*). Their ecological importance lies in their capacity to make space for corals. In areas where overfishing led to the disappearance of many grazing fishes, the role played by urchins was even more relevant (Burke et al., 2011a). This species underwent mass mortality in 1982 (Jackson et al., 2014), giving rise to a loss of 97 percent of the urchins throughout the Caribbean, Florida, and Bermuda (Lessios et al., 1984, 1988). Since then, there has been moderate recovery (Lessios, 2016). Coral diseases also caused the loss of staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmata)*, the main features of which are reef accretion and the maintenance of healthy structures functioning habitats for fishes and other organisms (Rodríguez-Martínez et al., 2014). Large species of *Acropara* corals dominated shallow reefs for at least half a million years until the eighties, especially in Belize (Hughes, 1994; Aronson et al., 1998). These are but a few of the major reasons why these species have been declining since the 1980s: extreme events such as hurricanes (Bender et al., 2010), worse water quality, diseases (Harvell et al. 2007; Reed et al. 2010; Palmer et al. 2011; Peters 2016), increased predation pressure, boat anchors and chains damaging the seabed, hyper- and hypothermic stress and overgrowth by macroalgae (Precht, 2002).

Hard corals coverage on reefs has also declined about 80 percent since the eighties: from 50 percent to 10 percent in three decades (Gardner et al., 2003). Paleoecological evidence suggests an historical collapse in many areas of the Caribbean and around the world, which is unprecedented in the past few millennia (Pandolfi, 2001, Pandolfi et al., 2003; Pandolfi & Jackson, 2006; Roff et al., 2013).

In short, coral bleaching caused declines in coral reefs across the world (remember the massive bleaching occurred in 2005)[19], but a particular feature of this devastation in the Caribbean region is the combination of bleaching with overfishing (it threatens over 60 percent of corals), invasive species[20], costal development (1/3 of the coral reefs have died because of sewage discharge, urban runoff, construction, and tourist development) (Burke & Maidens, 2004), diseases, rising sea temperatures, hurricanes, erosion[21], and sediment and pollution (20 percent of coral reefs at high threat and about 15 percent at medium threat as a result of this): in 2005, for example, there were 13 hurricanes and 26 storms (Wilkinson & Souter, 2008). Belize also suffered a 50 percent reduction in live coral cover in 1997 and 1998 on account to both a sedimentation process from the hurricane Mitch and the 1998 coral bleaching event. The latter event coincided with long periods of drought and higher than average warming sea surface temperatures linked with the El Niño phenomenon (Cesar et al., 2003; Guzmán & Cortés, 2007; Baker et al., 2016). It primarily impact corals by inducing coral bleaching and mortality (see Claar et al. (2018) for a meta-analysis of the impacts of this event on coral reefs).

Future prospects are not very encouraging either. By 2030, the increased in threat associated with global warming and ocean acidification will be a reality around the world. In the Caribbean region, the mainland coast from Mexico to Colombia will suffer climate-related threats to a greater extent than other areas. Nevertheless, there will continue to be some regions where coral reefs will maintain a low threat, such as the Bahamas in the Caribbean. However, this situation will change by 2050, when all the signs are that no reefs will be under low threat and only ¼ will be under medium threat, as a consequence of a higher thermal and acidification stressors (Burke et al., 2011a). A report by the Intergovernmental Panel on Climate Change published in October 2018 warns that, even if we collectively manage to stabilize global surface temperatures to 1.5°C above pre-industrial levels, 70 to 90 percent of coral reefs will be lost by the middle of this century.

In a nutshell, despite the growing awareness of the importance of coral ecosystems to human welfare, their degradation still continues and will continue on a large scale. In Rockström et al. (2009) one can found a framework based on the ‘planetary boundaries’ in which they define security thresholds associated with the biophysical processes of the planet. Taken together, they represent a ‘safe operating space’ for humanity. They identified a set of 9 processes or boundaries within which humans can continue to develop and thrive for generations to come: climate change, novel entities, stratospheric ozone depletion, atmospheric aerosol loading, ocean acidification, biochemical flows (phosphorus and nitrogen), freshwater use, land-system change and biosphere integrity (functional diversity and genetic diversity). For each one, a ‘zone of uncertainty’ and a ‘high-risk zone’. Researchers point out that the reaction of many subsystems of the planet

[19] In Jackson et al. (2014), a list of the different bleach events occurred on a country basis can be found.
[20] There is evidence that the *Diadema* disease was introduced by shipping (Jackson et al., 2014).
[21] Between the mid-1980s and 2000, beaches in several Eastern Caribbean countries eroded at a rate of half a meter per year (Waite et al., 2014).

is not linear – almost the reverse is the case: small changes in the levels of certain variables can trigger abrupt responses, even making certain biomes 'disappear' (Steffen et al., 2018). Thus, crossing these boundaries increases the risk of heading towards an uncertain path with consequences that can certainly go beyond those expected. In a recent update of the analysis, Steffen et al. (2015) concluded that four of these planetary boundaries had already been crossed: loss of biodiversity, damage to phosphorous and nitrogen cycles, climate change and land use have entered in the 'zone of uncertainty'. From that perspective, it can be said thar coral reef ecosystems have transitioned from 'safe operating spaces' towards the 'zone of uncertainty'.

There are, however, also causes for hope. Researchers and conservationists from all over the world are taking actions and testing strategies (in the wild and in the lab) to save coral reefs for the future. One of the most widespread initiative consists of growing and replanting corals in damaged reefs with best natural chances of survival. Since 2008, for instance, Mote's International Center for Coral Reef Research and Restoration have planted 76,000 corals of five native species of the Florida Keys. In 2019, the National Oceanic and Atmospheric Administration (NOAA) launched one of the largest investments in reef restoration of seven iconic reef sites in Florida Keys National Marine Sanctuary. Other strategies that could be applied refer to the possibility of sprinkling reefs with beneficial microbes or using genetically modified corals increasingly resistant to climate change. However, these proposals have only been tested in labs.

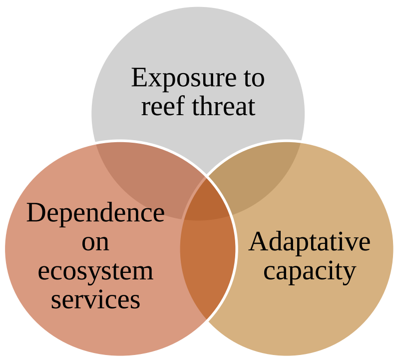
2.1.4 Social and Economic implications of coral reefs

Understanding the socio-economic and cultural uses of coral reefs is key to design and support local communities and management initiatives (Aswani, 2015). These ecosystems underpin many millions of people with food, income, and employment, and contribute significant export and tourism revenues to national economies. For instance, the ornamental coral reef fishery is a multi-million-dollar industry supporting thousands of fishers in developing countries. Since 1987, live coral trade has been annually increasing, although exports in the Caribbean region are lower than elsewhere such as Sri Lanka, the Philippines, or the Indo-Pacific (Wood, 2001; Bruckner 2003, 2005).

At least 500 million people rely on coral reefs for food, shoreline protection, and livelihoods (Wilkinson, 2004). For its part, the Great Barrier Reef supports 64,000 jobs (39,000 of which are direct jobs) and contributes USD 6.4 billion to the Australian economy (Deloitte, 2017). Tourist sector is the major employer, followed by fishing, recreational and scientific activities.

Although these are important benefits there are others that do not have direct economic returns; in total social co-benefits of coral reefs exceed private gains, thus contributing to the achievement of 2030 Development Agenda and Sustainable Development Goals (SDGs) [22] . Certain interventions to, for example, treat wastewater, help not only recover coral reefs, but also improve sanitation systems of local communities. Likewise, better erosion management is beneficial for farmers and the same is true with regard to afforestation of coastal land for the forestry sector (UN Environment, ISU, ICRI & Trucost, 2018).

Note that many reef-dependent people live in developing countries with vulnerable economies and low income. Poverty is, thus, the order of the day. Furthermore, 49 reef countries are small island developing states characterized by high population densities, geographic isolation, limited resources and more vulnerability to weather and climate extreme events, such as hurricanes and tsunamis. Therefore, the loss of coral reefs represents a high-risk situation for these communities. Vulnerability can be seen from three inter-related perspectives (Burke et al., 2011a).



Reef-associated population and fisheries employment are one of the most direct form of dependence, while at the same time being a driver for reducing poverty rates. Most of reef fisheries are open-access systems that allow poor people to carry out this activity. They tend to be small-scale and artisanal. However, the Caribbean region, and more specifically the Mesoamerican region, is not the geographical setting with a higher dependence in this regard. Any country of this region is among the first ten countries with higher dependence, whereas Indonesia and the Philippines are at the top of the list. When it comes to the reef-derived nutrition, reefs provide a great variety of inexpensive food high in proteins, thereby becoming the basic diet for thousands of people. Another percentage of foods are exported, as is the case of the spiny lobsters in the Caribbean. Finally, tourism represents another important livelihood for many communities, for example, in Belize.

Adaptative capacity refers to the ability of human systems to adjust to potential damages (e.g. climate change), cope with the consequences and take advantage of the

[22] That is why it is so important to tackle the ecosystem management with an interdisciplinary vision, bringing together ecology, economics, and other development science. A set of contributions from experts in these fields can be found in Nunes et al. (2017) with the goal of providing policy relevant scientific information for effective management of coastal ecosystems.

opportunities. It requires resources, skills and tools for planning and managing the effects of the losses. Mesoamerican countries have low or low-medium adaptative capacity, based on economic, education, health, and agricultural resources, as well as on governance and access to markets.

The combination of the three components gives rise to ranking of countries and territories with the highest vulnerability to reef threats. Most of them are located on the tropics, being the Caribbean region the one with the highest exposure and one of the most reef-dependence. By contrast, it is well positioned from the standpoint of adaptative capacity. Only Nicaragua is in a list of countries with low adaptative capacity (Burke et al., 2011a).

2.1.5 Policy instruments to protect coral reefs

This vulnerable situation may lead to inefficient management practices, putting even more pressure on coral reef systems. There are, however, financial tools for coral reef conservation such as payment for ecosystem services or reef insurances[23].

One possible finance tool for promoting 'best practices' is through payment for ecosystem services (PES) schemes, enabling changes in the behavior of individuals. Note that incentives are offered in exchange for managing the ecosystem in a more ecological way. More specifically, they are defined as *"a transparent system for the additional provision of environmental services through conditional payments to voluntary providers"* (Tacconi, 2012, 35). In this way, they have become a means to promote biodiversity conservation, as well as local and rural development. National or regional PES programs have been implemented in Latin America (Alix-Garcia et al. 2009; Martín-Ortega et al., 2013) and within the MAR region (Costa Rica and Mexico). Small-scale PES projects have also developed worldwide under the umbrella of the United Nations Framework Convention on Climate Change (Calver-Mir et al., 2015). It will not only benefit ecosystems, but also poor resource managers (Pagiola et al., 2005). The beneficiaries may be individuals, communities, businesses, or public bodies.

Reef insurance is another tool. It can be used to share risks to coral reefs, generating revenues for preservation or restoration. This tool is particularly useful for the Caribbean countries because, as explained above, reefs are buffers for hurricane damages and extreme climate events that are especially hitting this region. These countries have, therefore, more financial incentives for conserving reefs with the goal of reducing future costs. This financial instrument is relatively new but has a great potential for supporting a move to a much more sustainable (ecologically, socially, and economically healthy) world. This instrument is under development, for example, in Mexico: the country is attempting to finance maintenance programs and restoration processes to deal with the

[23] There are other tools such as charges and access fees, special use permits, green taxation systems, biodiversity offsets, conservation trust funds, green and blue bonds, among others (Iyer et al., 2018).

aftermath of the Hurricanes Wilma and Emily in 2005 (Iyer et al., 2018). These events caused a damage of over USD 17 billion, mainly affecting infrastructures and tourism.

The Mesoamerican Reef Rescue Initiative (RRI)[24] is allowing the recovery damaged and degraded coral reefs in the MAR region by increasing their resilience and recovery ability. Generating long-term sustainable funds to finance restoration and recuperation efforts requires capacity building, regulation, economic incentives, and financial sustainability. Governments' commitment to enable legislation, regulation, policies, protocols and permits for interventions by rapid response teams is needed. At the same time, alternative co-financing mechanisms for restoration activities should be in place. In pursuit of that goal, private partnerships and investment are required. For instance, the tourism sector could contribute, as it will benefit in the future from the existence of healthy coral reefs attracting tourists from across the globe. New tourism products (tours to coral reef nurseries and restoration areas), volunteer conservation programs for divers and the development of training and certification programs would be additional mechanisms for reef restoration. A plan, including costs and timeline, must also be designed.

A pilot model was designed for 7 reef sites (4 in Mexico, 2 in Belize, in Honduras and 1 in Guatemala). More specifically, the places selected are:

- Cayos Cochinos natural marine environment
- Guanaja (Bay islands national marine park)
- Hol-Chan marine reserve
- Corona Cayman (Punta de Manabique wildlife refuge)
- Roatán (Bay island national marine park)
- Turneffe atoll marine reserve
- Uitla (Bay island national marine park)
- Las Pozas (Xcalak reef national park)

Three feasibility studies for the insurance were carried out.

- Risk assessment and vulnerability of the sites was analyzed, setting the scientific basis for the creation of the insurance. The probability of risk, the parameters that would trigger the payment from insurance, and the different levels of damages caused by hurricanes in terms of coral cover and complexity change were identified. Historical data before and after the hurricane impact were first collected to later perform a statistical analysis towards studying the effect of 14 variables (initial coral cover, initial rugosity, reef type, reef zone, depth, exposure, reef size, open water distance over which wind can blow along a given direction, wind speed, central pressure, duration of the affectation, distance between the hurricane and the coral reef, hurricane intensity, maximum wind speed at impact and storm surge. Coral cover,

[24] This initiative is being implemented by the MAR Fund and the Central American Commission on Environment and Development. The 4 countries sharing the MAR reef systems participate in it. Apart from building innovative financing mechanisms, an emergency fund has been established. It is hoped it will reach USD 1,000,000.

reef exposure and the maximum wind speed at impact were the variables that significantly explain coral cover loss (Pérez & Pardo, 2019).

- A pay out and restoration cost analysis for emergency response actions was done. Interviews, surveys, and consultations with local people were conducted. Accessibility to all inputs was also required to create a detailed database, including the intervention parameters and the cost function. This was helpful in prioritizing actions. Three restoration scenarios were considered (minimum, intermediate and optimum) and a cost function designed. Roatán, followed by Cozumel, were the localities with the highest cost; while the opposite was true for Punta de Manabique because of the lower live coral cover. Human resources and rental costs of boast and diving gear were the costliest inputs (Villegas, 2019).
- A preliminary insurance model was presented (Perez & Pardo, 2019), including pay-out options per site based on different polygons and parameters, as well as on policy scenarios. Five criteria were used to select the right option: cost of the policy (percentage of pay-out), limit of liability enough to cover the needs, easiness to distribute the cost and funds among stakeholders, probability of a triggering event and the mutualization of risk.

Willis Towers Watson and the MAR fund, with the support of the InsuResilience Fund[25], conducted, in 2019, two further studies on the potential beneficiaries of insurance in the 7 pilot reef sites listed above, as well as on the financial sustainability of the insurance instrument. Fishing and tourism sectors were the direct beneficiaries. By contrast, it was unlikely that low-income households purchase hurricane risk insurances. Policy holders and emergency responders were the direct beneficiaries of insurance pay-outs. For their part, local communities (1,978,539 people[26]), the tourism and fishing sectors and the national and local governments were the indirect beneficiaries.

It is in this context that the present project is framed. Economic valuation involves knowing the value of ecosystem services. In this way, it is a very useful tool for adequately designing economic instruments and insurance, as it makes possible to determine what the losses would be in the event coral reefs are damaged or in the extreme case if they would disappear. It also identifies which parties suffer what losses. On that basis, designing different risk strategies and discerning how risks are distributed among the main stakeholders involved would be feasible. Only this process may make the insurance tool more effective.

[25] It is an initiative created by the German Development Bank to contribute to climate change adaptation by improving access to and the use of insurance by micro, small and medium enterprises and, low-income households in developing countries.
[26] 92.77 percent of the beneficiaries live in Honduras, followed by Guatemala (6.55 percent), Belize (0.61 percent) and Mexico (0.065 percent). 63.65 percent of the total live in poverty and 40.45 percent live in extreme poverty.

2.2 STEP II. ECONOMIC VALUATION OF CORAL REEFS

2.2.1 Background

Mainstreaming the value of natural capital into policy decision-making is vital, as the consumption and enjoyment of goods and services that nature provides contribute directly and indirectly to human well-being. The growing interest among economists in environmental matters has manifested itself in the application of economics to the environment. The field of Environmental Economics has gone a long way in that regard.

Valuing natural resources and the environment (i.e. measuring the economic values of 'nature') can contribute (Cesar, 2000; Waite et al., 2014), among other things, to:

- Developing a holistic picture of their current state and changes,
- Better evaluating economic, environmental, and social impacts (e.g. to know the extent of poverty and income loss due to coral reef degradation),
- Identifying opportunities for conservation practices and sustainable uses, as well as developing climate adaptation strategies and marine spatial plans,
- Justifying and supporting restoration policies,
- Analyzing which groups win and loss from threats and management actions,
- Establishing levels of damage compensation, and
- Raising awareness of the value of 'nature'.

Economic valuation of ecosystem services is, thus, a tool that is increasingly being applied worldwide because it gives an advantage of including the concept of ecosystem value in policy and decision-making processes (van Beukering & Slootweg, 2009).

Given the ecosystem services provided by coral reefs and the serious nature of threats to their ecological integrity, there is demand for information on the value of welfare losses associated with a decline in the provision of ecosystem services (MA, 2005).

As mentioned above, putting a monetary value on ecosystems involves two steps. The first one aims to identify the ecosystem services provided (it has already been done in the previous section). The second one is to estimate theses services in monetary units.

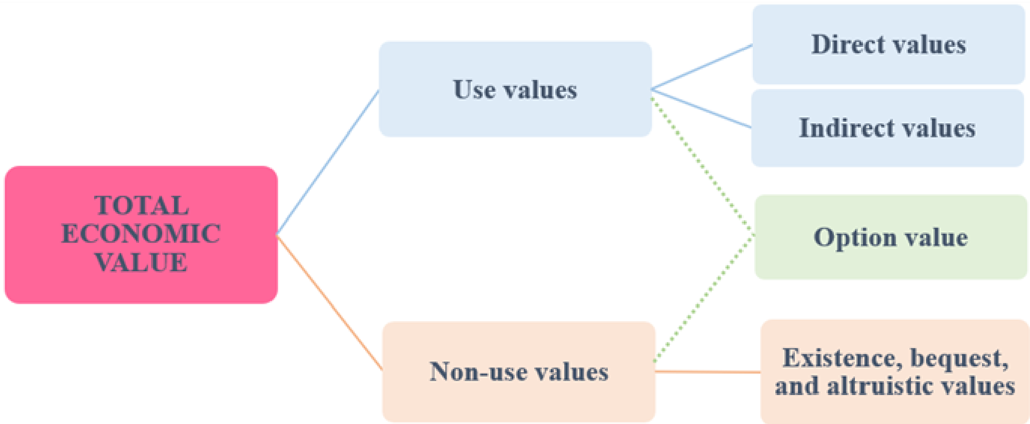
In this section, the first steps towards the achievement of the second phase are taken. To that end, the key concept of Total Economic Value has been explored first and then existing methods for estimating it have been discussed. An in-depth review of previous literature on coral reefs around the world, in the Caribbean and in the Mesoamerican region has also been conducted.

2.2.2 Total Economic Value

The value of environmental and natural resources reflects what we, as a society, are willing to pay to conserve these natural resources (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field & Field, 2017). In this context, two concepts emerge: willingness to pay (WTP)[27] and willingness to accept (WTA). The former represents the maximum amount of money that an individual is willing to pay for a marginal change in the provision of a good or service (Atkinson, 2010). The latter is the minimum amount of compensation that an individual is willing to accept to forego a marginal change. Both are monetary measures of welfare changes and reflect individuals' preferences (Kriström & Johansson, 2015). That is why it is so important to know the changes suffered by coral reefs.

It is important to be aware, however, that individuals not only derived utility for the mere fact of using the good or service at the current moment, but also for knowing that they will have the possibility of using it in the future. *Total Economic Value (TEV)* is the most widely accepted framework in cost-benefit analysis for valuation of ecosystem services as a whole (see Figure 4). It consists of aggregating all values provided by ecosystems, in this case, coral reefs.

Figure 4. Total Economic Value



Source: own elaboration based on Pearce & Turner (1990); Ledoux & Turner (2002)

USE VALUES (or active values) are those derived from the actual use of ecosystem services (Sarkis et al., 2013).

- **DIRECT VALUES** involve an actual consumption (fish, timber, etc.) or a direct non-consumptive use (recreation, research, etc.). That is why it is often divided into extractive and non-extractive values.
- **INDIRECT VALUES** refer to the functional benefits of the ecosystems, such as biological support for species, clean air, or soil quality, among others.

[27] Hicks (1941, 1943) proposed two WTP measures to estimate welfare changes in monetary terms: Equivalent Variation (EV) and Compensating Variation (CV). The former refers to the change in consumers' income that would lead them to the same utility level as that generated by a change in market prices. The latter estimates how much consumers' income need to increase (or decrease) in order to get them back to the same utility that they had before a change in market prices (compensation takes place after the price change, so CV uses the existing prices after the change). Another tool for measuring welfare changes is consumer surplus, i.e. the difference between consumers' WTP and the price they actually pay.

OPTION VALUES express the WTP of individuals for the conservation of the environment so as to keep open the possibility of being a user in the future, i.e. wildlife, water quality or scenery (Bishop, 1982; Walsh et al., 1984; Freeman, 1985). It is related to their responses to uncertainty: considering that people are unsure about both their possible future demand of certain ecosystem good or service and the future implications of a current decision, they are willing to pay to keep open the option of using it in the future or to secure insurance against possible future losses (SEEA-Experimental Ecosystems Accounting, 2012, 110). It can thus cover direct and indirect uses.

NON-USE VALUES (or passive values) are derived from the own features (attributes inherent) of the ecosystem itself (Krutilla, 1967; Carson et al., 1992; Hanley et al., 1998; Adamowicz et al., 1998; Windle & Rolfe, 2005):

- **EXISTENCE VALUES** are the amount of money individuals decide to pay for knowing an ecosystem (or an environmental feature) will continue to exist in the future, irrespective of any prospect of actual use (McConnell, 1983; Randall & Stoll, 1983; Walsh et al., 1984; Stevens et al., 1991; Silberman et al., 1992; Pearce & Turner, 1995).
- **BEQUEST VALUES** are based on the utility derived (individuals' WTP) from knowing that future generations may enjoy ecosystems (McConnell, 1983; Walsh et al., 1984; Aldred, 1994; Loomis, 1988; O'Garra, 2009). Note, however, that it is sometimes treated as a form of future use value.
- **ALTRUISTIC VALUES** are related to the utility derived (individuals' WTP) for ecosystem services may be for the benefit of somebody else (Aldred, 1994; Ojea & Loureiro, 2009).

The three categories of non-use values are often difficult to separate them from each other and from option values, both conceptually and empirically (Hein, 2010, 36). Another reflection about non-use values suggests that not all individuals are motivated by their own interest. When it comes to goods and services that affect only the own wellbeing of the respondent, it is likely that he/she is acting as consumer; while when asked about pure public goods, it is not clear if the respondent is acting as a consumer or as a citizen also pursuing the wellbeing of other citizens. They may also be willing to pay if this payment allows environmental goods or services to persist (Krutilla, 1967; Andreoni, 1990) and respond as they think that society should act. Hence, altruistic preferences (Edwards, 1986; Andreoni, 1990; Holmes, 1990; Johansson, 1993, Arrow et al., 1993; Crowards, 1997; Curtis & McConnell, 2002) represent an important part of total WTP (Johansson, 1993).

TEV of coral reefs ecosystems are as follows (see Table 1):

Table 1. Linking ecosystem services and total economic value for coral reefs[28]

	USE VALUES		OPTION VALUES	NON-USE VALUES
	Direct use[29]	Indirect use		
Provisioning services				
Cultural services				
Regulating services				
Supporting services	Valued through the other three categories of ecosystem services			

Source: own elaboration based on MA (2005) and Christie et al. (2012)

Traditional cost-benefit analysis often fails to fully consider benefits provided by coastal ecosystems, in general, and coral reefs, in particular. This is the case if the benefits that are not bought and sold in markets such as those provided by shoreline protection or biodiversity and coral reef conservation (Spurgeon, 2004; O'Garra, 2009; Sarkis et al., 2013; Laurans et al., 2013; Waite et al., 2014; Schumann, 2015).

For that reason, in order to identify the economic value of ecosystem services, it is necessary to distinguish between those goods and services that have market prices and those that do not have market prices (called non-market ecosystem services). Valuation of goods and services with a market price whose use is excludable (e.g. commercial fisheries) is quite straightforward. By contrast, it is more technically complex to place a value on goods and services that do not have market prices (e.g. endangered species or threatened reef habitats). Non-market valuation techniques are used for that purpose.

2.2.3 Valuation methods

Economists interested in environmental management have been developing a range of techniques to assign monetary values to the environment. Considering that economic valuation techniques are intended to assess whether the costs of certain project or policy are justified in terms of the benefits generated, the main purpose of environmental valuation consists in including environmental concern in the cost-benefit analysis from a monetary point of view.

A distinction has been drawn between market-based and non-market techniques.

[28] Color blue refers to use (direct and indirect) values, color green refers to option values and color orange refers to non-use values.
[29] Direct use values can be divided into extractive (commercial fisheries, mariculture, aquarium fish, pharmaceutical ingredients, raw materials limestone and building materials, ornamental corals) and non-extractive values (recreation and outdoor activities, tourism, research, knowledge, and education).

MARKET-BASED TECHNIQUES			
Market price approaches	Market cost approaches		
Market prices	Replacement cost	Damage cost avoided	Production function

Market prices: it uses prices from actual markets related to the ecosystem. Some examples are as follows (Christie et al., 2012):

- Local trading prices,
- Revenues from tourists to areas of high biodiversity,
- Value of bio-prospecting contracts.

It is usually applied to provisioning services such as commercial food (fish and shellfish), aquarium fish, ornamental corals, raw materials limestone and building materials coming from reefs.

Replacement cost: it uses the cost of replacing ecosystems (or ecosystem services) or the cost paid for substitute services providing the same functions and benefits. It thus assess ecosystem services at the expense of the marketed inputs that would be required in their absence – e.g. expenditure on irrigation systems to replace the hydrological services that a wetland has for agriculture can be used to estimate the cost of degradation of a wetland.

Damage cost avoided: the cost that people are willing to pay to avoid damaged or lost services[30]. It captures direct and indirect uses.

Replacement cost and damage cost avoided methods are usually applied to ecological services, such as buffering climate change impacts (wave attenuation), shoreline protection against storms and erosion, flood impact reduction, water purification and carbon storage (i.e. regulating services).

Production function: it can be applied when market goods and services are produced with man-made and ecosystem *inputs*. It therefore focuses on the input costs contributing to the production of commercially marketed goods (Christie et al., 2012). Common examples include oxygen production, CO_2 absorption, carbon storage, providing fish nurseries, water purification and shoreline protection (i.e. regulating services).

Users are the only affected population captured by these methods.

[30] Defensive expenditures are often considered another method consisting of estimating the costs incurred in mitigating the effects of reduced environmental quality. It is useful for calculating indirect values.

NON-MARKET VALUATION TECHNIQUES			
Revealed preference methods		Stated preference methods	
Travel cost	Hedonic pricing	Contingent valuation	Choice modeling

Revealed preference methods

Samuelson (1938) pioneered the revealed preference theory by which individuals' behavior may be observed so that their utility function may also be derived. Revealed preference techniques were developed on the basis of this theory. They observe consumers' preferences through their purchasing (actual) behavior. In doing so, expenditures on markets associated with environmental goods or ecosystem services are examined. Data on people's behavior is thus used to impute a value for non-market services that are directly linked to market commodities (Baker & Ruting, 2014).

If appropriate data are available, values are reliable estimates of the service. However, they do not allow estimating values for levels of quality not revealed by the market (Atkinson & Mourato, 2008) as only use values are estimated.

Considering that revealed preference techniques are based on actual behavior, they enjoy greater credibility among policy makers. They are thus widely accepted and have mostly been applied to outdoor recreation. There are different variants, depending on whether these non-market goods and services and the related market goods are substitutes, complementary, or one is an attribute of the other (Atkinson et al., 2012).

The main methods within this group are **travel cost method** and **hedonic pricing**. These methods are explained below.

Travel cost method

It is the oldest technique of those trying to determine the value of non-market ecosystem services. The first variant of the method was possible by a request made by the U.S. National Park Service (NPS), which showed interested in assessing the value of the parks under its management in order to improve recreational experiences for the general public. Note that, at that time, all parks were only a source of recreation, leaving aside their conservation (this would change in the 60th, 70th and 80th). NPS asked several professors at university and, in 1947, Prof. Harold Hotelling reacted to the demand for estimating recreation benefits in economic terms, answering this request in a letter that laid the foundation of this method. He related average frequency of visitors to a park to the average cost of the visit, the latter depending on the distance to the park.

As it is not possible to directly infer preferences at observed prices, inferences from the costs that exist for using alternative sites are made (Diamond & Hausman, 1993, 6). Hotelling's original idea was aimed at relating the average frequency of visitors to a park to the average cost of the visit, the latter depending on the distance to the park. Parks have direct (gasoline or entrance fee) and indirect expenditures (travel time[31]) associated to the recreational use, so the higher the travel costs, the more unlikely possibilities to visit the park. In this way, visitors' preferences are revealed through the analysis of other markets (Pearce, 2002). The idea would then be to collect data on the travel costs associated with accessing the park: knowing the amount of time and money that a person uses to visit the area and the number of visits made, a demand function can be estimated[32] from which the WTP by visitors is determined. The resulting area under the demand curve provides total consumer surplus[33] generated by visitors.

Since then, it became one of the most widely applied methods for estimating the social value of natural spaces that fulfil some recreational function. However, several limitations and challenges must be kept in mind in this respect: the cost attributed to the visitor for having accessed the space and how they are computed, particularly the travel time; the unit of measure to reflect the demand; the different behavior of those who frequently visit the site and occasional visitors; the treatment of visitors who visit several places during the same trip, or the way of considering the effect of competition between local recreational spaces (Amorós, 2004).

Hedonic pricing

On the basis of Lancaster's approach (1966) on combinable and no combinable goods, hedonic pricing method estimates the value of environmental goods and services by observing their characteristics. This means that the economic value of an ecosystem service can be estimated by observing how WTP changes when its characteristics change. This requires people to have perfect information on attributes, although this is not always be possible, as external uncontrollable influences may affect the market. This technique has been typically applied to calculate the value of environmental goods and services such as the noise level near airports and transport, the urban air quality, or the proximity to natural areas, like wetlands. Housing is the market good which is often used. Let us take an example: the establishment of a new polluting factory in a residential area reduces housing prices, whereas the existence of a park near increases them. For this method to function feasibly, individuals are required to perceive differences in attributes so that the effects of attributes on prices can be isolated and the implicit price of each attribute

[31] Costs associated with travel time are not generally observed, and it is not always easy to attribute these costs to the recreational area, as visitors may travel for different reasons (Baker & Ruting, 2014). The quality loss caused by the increase in visitors might also be an important issue if it would not be considered constant (Bishop & Heberlein, 1979).
[32] Trips to the park from each distance would correspond to a point on the demand curve, whereas prices would be determined by travel distance (Bazhaf, 2010). Therefore, discerning how visitors choose between different sites and costs, one can estimate how quality and cost variables contribute to the utility of the visit (Atkinson & Mourato, 2008).
[33] Consumer surplus may be affected depending on the existence of substitutes or on the functional form of the demand function (Baker & Ruting, 2014).

estimated. Otherwise, the value of the attributes is not reflected in the price of the house and WTP for the 'environmental' feature cannot be captured[34] (Atkinson & Mourato, 2008). Multivariate regression analysis is commonly used to do so. In order to avoid bias when estimating implicit prices, one should have no doubt that attributes are not correlated to each other. As in the case of travel cost method, hedonic pricing estimates values on actual choices, so only use values can be calculated.

Both methods are widely accepted and enjoy greater credibility among policy makers because they are based on actual behavior, thus avoiding the potential problem associated with hypothetical choices. **Non-use values cannot be estimated**, however. Thus, users are the only affected population captured by these methods. The difficulty in obtaining future estimates for non-revealed values also raises the question of their reliability. Values at the present time can easily be calculated, but it is not possible to estimate future changes in value (Baker & Ruting, 2014).

Stated preference methods

These methods emerged from the need to incorporate **non-use values** into cost-benefit analysis. Thus, users and **non-users** are the affected population captured by these methods.

The economic value of non-market ecosystem services is obtained by asking people directly, via questionnaires, how much they are willing to pay to change the condition of the good or service in question or to preserve it, rather than by looking at its influence on actual markets for some other goods or services (Bateman et al., 2002). Hypothetical markets are used to analyze intended behavior, thus allowing ex-ante judgments to be made (Mitchell & Carson, 1989, 89). The valuation is done either using a dichotomous format where the respondent has to answer whether or not he/she is willing to pay a given amount of money (in this case the method is called contingent valuation) to change the condition of an ecosystem service or to preserve it, or requesting respondents to choose one alternative out of a set of, generally, two to four alternatives (in this case the method is called choice modeling). Both statistical methods are based on random utility theory to estimate average WTP[35] and its influence in income and other factors.

Contingent valuation

This method was set up in mid-1970s[36], and since then has become the most applied technique (Hanley et al., 2007, 332; Atkinson & Mourato, 2008) due to its flexibility. In fact, many handbooks have been written on this method (see, e.g. Mitchell & Carson (1989); Hausman (1993); Bjornstad & Kahn (1996); Bateman et al. (2002); Alberini &

[34] Implicit price equals their marginal WTP (Baker & Ruting, 2014, 28).
[35] They provide average per capita estimates, which can later be extrapolated to total population.
[36] The theoretical proposal of using a survey method was first introduced by Ciriacy-Wantrup in 1951. It was not, however, until 1963 when R. David empirically implemented the contingent valuation method for the first time.

Kahn (2006); Carson (2011)) and a large body of empirical and methodological research developed (Nyborg, 1996; Hanley et al., 2007).

Questionnaire survey may be conducted using questions asked in open-ended or closed-ended formats. The former implies that respondents do not have to choose a predetermined amount of money; whereas the latter asks respondents whether they are willing to pay a certain amount of money, and 'yes' or 'no' are the only possibilities of response (Hanemann & Kannninen, 1999). In earlier versions, the open-ended format was the most common option, but afterwards the closed-ended format has been gaining popularity among researchers. For the latter format, the questionnaire starts asking whether he/she is willing to pay a certain amount of money. If so, question may be repeated increasing the amount. If not, a lower amount is offered (Hanemann & Kannninen, 1999). Finally, it is often asked what the maximum price that he/she would be willing to pay would be, considering previous responses.

The main difference between the situation faced by the respondent in a contingent valuation scenario or in a real market is that in the former case the market is hypothetical so that he/she does not have to pay the stated price.

Choice modeling

Choice modeling –also known as conjoint analysis – (Louviere & Hensher, 1982; Louviere & Woodworth, 1983; Louviere et al., 2000) offers respondents the opportunity to choose among different alternatives described by a set of attributes, including a payment vehicle (e.g. a fee, a contribution to a fund or a tax increase) that they would have to pay. Given that respondents may evaluate attributes separately, choice modeling is more appropriate for valuing specific attributes (Hanley et al., 1998a,b; Morrison et al., 2002); whereas contingent valuation is better suited to analyze the general result of a change in the non-market ecosystem service (Baker & Ruting, 2014).

It uses a range of formats, including **rating, ranking and choice**. The last two formats (albeit ranking in a lesser degree) tend to be preferred, as they are more readily interpreted in terms of random utility (Roe et al., 1996).

In choice experiments, respondents are requested to choose one alternative out of a set; while in rankings they are requested to rank the options offered (Hoyos, 2012). Accordingly, contingent valuation can be seen as a subtype within choice modelling. The Box below gives examples of a ranking set (left) and a choice set (right).

	RANKING SET			
	Option A	Option B	Option C	Option D
Type of coral	Hermatypic	Ahermatypic	Hermatypic	I prefer to stay at home
Infrastructures for recreation	No	Yes	No	
Wildlife sighting	Yes	Yes	No	
White sand beach	Yes	No	Yes	
Increase in gas expenses	$7	$17	$12	
Entrance fee for accessing the marine park	$12	$2	$17	
RANK THE FOUR OPTIONS	OPTION A 1☐ 2☐3☐ 4☐	OPTION B 1☐2☐3☐ 4☐	OPTION C 1☐2☐ 3☐ 4☐	OPTION D 1☐ 2☐ 3☐ 4☐

	CHOICE SET			
	Option A	Option B	Option C	Option D
Type of coral	Hermatypic	Ahermatypic	Hermatypic	I prefer to stay at home
Infrastructures for recreation	No	Yes	No	
Wildlife sighting	Yes	Yes	No	
White sand beach	Yes	No	Yes	
Increase in gas expenses	$7	$17	$12	
Entrance fee for accessing the marine park	$12	$2	$17	
MARK ONLY ONE OPTION (A, B, C or D)	OPTION A ☐	OPTION B ☐	OPTION C ☐	OPTION D ☐

Choice experiments are increasingly used in research, as they estimate the value of non-market goods and services by making separate assessment of the respondents' preferences for the attributes of the good or service.

Contingent valuation and choice modelling

Contingent valuation was originally the most widely used of all these methods, but **choice experiments** have attracted attention as an alternative due to the advantages associated with multi-attribute valuation. Although these methods are mainly applied to extended cost-benefit analysis, which uses Hicksian variation measures, there is an increasing interest in their use for national and ecosystem accounting, which require exchange values (Campos & Caparrós, 2016; Obst et al., 2016). Hence, the answer given by respondents is interpreted as Hicksian compensated variation (Diamond & Hausman, 1993, 12).

The validity of these techniques has generated debates and enriched the discussions: as far as back as the 1970s, relevant improvements were made to the reliability of these methods, especially contingent valuation (Bohm, 1972; Randall et al., 1974; Brookshire et al., 1976; Rowe et al., 1980; Schulze et al., 1981). These advances boosted its popularity. Nevertheless, it was in the 80's when contingent valuation gained ground after the publication of the works of Cummings et al. (1986) and Mitchell & Carson (1989). Both studies brought together practitioners, economists, and psychologists to place this technique in a broader and more multidisciplinary context than that of environmental economics (Hanemann, 1994; Riera, 1994). Despite that, the massive 1989 Exxon Valdez oil spill off the Alaska coast was the turning point in the acceptance of the method. Government agencies realized that the compensation of damaged included non-use values. In fact, one clear advantage of this method, and of stated preference techniques in general, is that, unlike revealed preference techniques, they can be used to estimate non-use values, which are likely to be important when it comes to non-market ecosystem services such as biodiversity conservation. In order to economically evaluate the damaged caused by the oil spill, contingent valuation method was therefore proposed[37]. While

[37] Since then, it is even accepted in trials. For example, it was used to determine compensations after the Prestige oil spill in Spain (Loureiro et al., 2009).

objections were raised, the NOAA panel's report (1993) rejected the criticisms expressed and ruled in favor of the use of this method. Since then, contingent valuation, but also choice modeling, has become increasingly widespread amongst researchers.

Regarding the hypothetical nature of these techniques, there is one way to validate them: testing their internal consistency by targeting the key elements in the valuation scenarios that guarantee a realistic market simulation. This means testing for construct validity, which includes theoretical and convergent validity (Whitehead, et al., 1995; Whitehead, et al., 1998). Theoretical validity (also termed internal validity) refers to the extent to which the findings of the study (the measure of WTP) are consistent with theoretical predictions and *a priori* expectations (Schläpfer, 2008); while convergent validity assesses whether two measures of WTP from different methods or choice techniques are correlated and therefore converge to similar estimates (Diamond & Hausman, 1993)[38].
In many contexts, different techniques are likely to be combined to assess the various ecosystem services of a habitat (see, for example, the example of The Economics of Ecosystems and Biodiversity (TEEB, 2010).

Benefit transfer

Benefit transfer is not a specific valuation technique, but a method that estimates the economic value for ecosystem services (or an ecosystem) using information from other ecosystems. It takes available value estimates from one or more studies and transfers them to a new context after making some adjustments (Hanley et al., 2007, 358). That is why it is needed to conduct a process of homogenization in terms of comparable units. In order to make this technique consistent, the difference between the current context and that of the primary source should be relatively small (Baker & Ruting, 2014).

There are two general approaches: unit value transfer and value function transfer. Meta-analysis is often also included. It is common to refer to the environmental policy being evaluated as the 'policy site' and the source of the values being used as the 'study site'. Unit value transfer uses values for the service at a study site (usually values per unit) and combine them with information on the quantity of units at the policy site. In this way, unit values from the study site are multiplied by the number of units at the policy site (Brander, 2015). Value function transfer uses a value function (usually the demand function estimated by different techniques such as revealed preference or stated preference) and combines these values with information on parameters values for the policy site. Meta-analysis makes a review of the quantitative estimations obtained by similar studies about a certain effect. As this method evaluates separately studies, it is a good tool for summing

[38] This has mainly been assessed by comparing contingent valuation and choice experiments with revealed preference and actual market decisions (Hanley, 1989; Cameron, 1992; Adamowicz et al., 1994, 1997; Haener et al., 2001; Boxall et al., 2003; Whitehead et al., 2008), different elicitation formats (Boyle et al., 2001; Mogas & Riera, 2001; Caparrós et al., 2008; Akaichi et al., 2013) and different payment vehicles (Champ et al., 2002; Biénabe & Hearne, 2006; Swallow & McGonagle, 2006; Campos et al., 2007; Nunes et al., 2008; Baranzini et al., 2010; Stithou & Scarpa, 2012; Rai & Scarborough, 2012; Kaczan et al., 2013), obtaining mixed results in all cases.

up a set of indicators and values of these empirical studies (van den Bergh, et al., 1997), and for giving an overall result of all the studies incorporated in the analysis.

Several reasons make these methods widely used in providing information to policy makers. They are consistent in estimating values across policy sites and are less expensive in terms of time and money (European Environment Agency, 2010). However, primary studies need to be of high quality. Even then, not all estimates ought to be precise if there are not enough similarities between studies and policy contexts. One of main difficulties of meta-analysis is to choose the correct analytical technique to run the model. One possibility is to compare different techniques, although literature is not conclusive. The validity of these methods can be evaluated by conducting new studies and comparing the resulting estimates, while repeated studies have found statistically significant errors.

Information on values in decision making

Value information can be used in different policy-making contexts, including the determination of investment in reef health, and compensation payments for damage and cost-benefit analysis of conservation measures. In this context, the results of this study provides information to make the case for the governments of Belize, Guatemala, Honduras, and Mexico to increase budgetary resources for reef conservation and management. It may also raise local to global awareness on the economic importance of coral reefs as natural infrastructure, and open the door to discussions with the private sector (e.g. tourism, fisheries) on how they can protect their business interests by investing in the health of the reefs on which their industries depend. Finally, by identifying the beneficiaries for specific services from coral reefs it helps in designing measures to recover the costs of maintaining the reefs from external damages. Overall, economic valuation identifies and generates economic arguments to support policies that help ensure healthy coastal ecosystems and sustainable economies

2.2.4 Economic valuation of the Caribbean coral reefs: a review of historical work

The goal of this section is to conduct a deep review of the previous and ongoing economic valuation projects/initiatives on coral reefs in the Mesoamerican Reef region, the wider Caribbean and the Pacific at the site, national, and regional level. This literature review has allowed the study group to assess the evidence available.

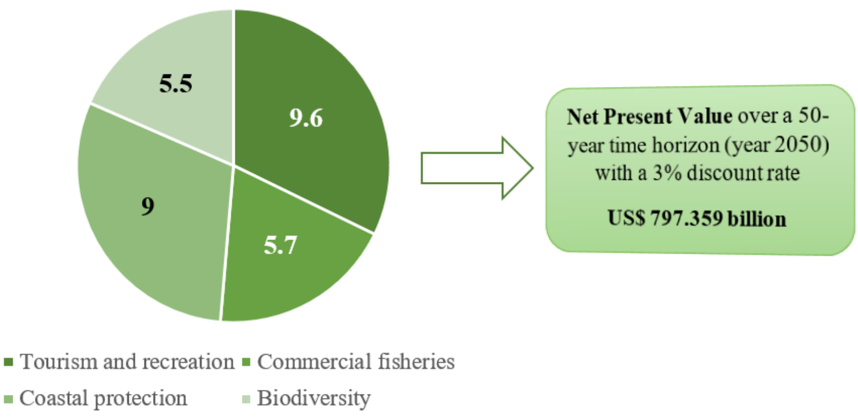
Much has been written about the need to assign monetary values to the coral reef ecosystems. So much so that a Committee on Economic Valuation of Coral Reef Ecosystems was established by the International Coral Reef Initiative (ICRI) in 2008. This Committee was originally co-chaired by Mexico, the United States, the World Resources Institute (WRI) and the ICRI Secretariat.

Thanks to the large body of literature available since the last three decades on the economic valuation of the Caribbean's coastal and ocean ecosystems, new opportunities keep opening up for the application of knowledge in the formulation of more efficient and effective policies, strategies, and programs for action. However, some recent reviews of literature highlight the challenges related to integrating valuation results into decision making (Kushner et al., 2012; Waite et al., 2014). Tens of projects and studies have been done, employing different valuation methods: market-based techniques, non-market valuation techniques, and benefit transfer.

2.2.4.1 Economic valuation of coral reefs around the world

Estimations made by Cesar et al. (2003) revealed that coral reefs would provide USD 29.83 billion per year in net benefits in goods and services to world economies, including, tourism, fisheries, shoreline protection, and biodiversity (see Figure 5).

Figure 5. Net benefit streams per year and Net Present Value of coral reefs (USD Bn.)



Source: own elaboration based on Cesar et al. (2003)

By regions[39], even though Southeast Asia and Pacific (excluding United States) are the largest reef areas (km^2) in the world, Southeast Asia and Australia would obtain the higher potential net benefits stream per year, as shown in Table 2.

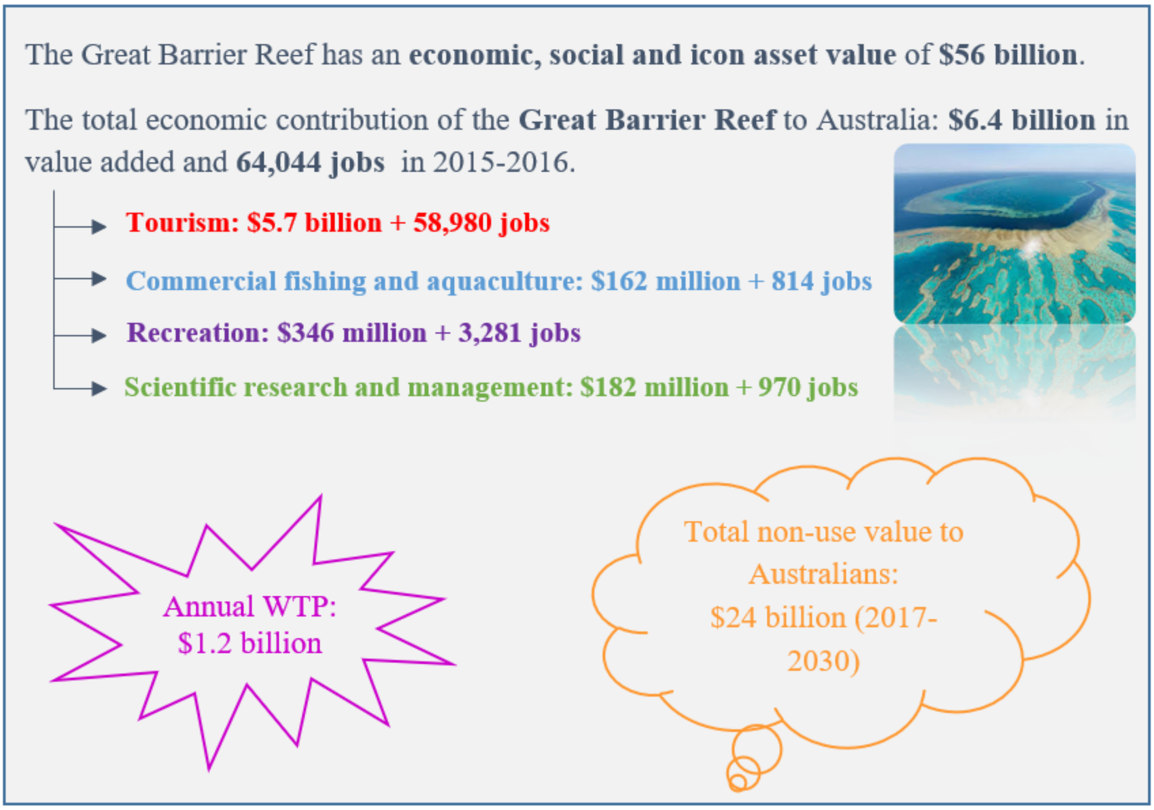
Table 2. Net benefit streams per year of coral reefs per region (USD Mn.. 2003 prices)

	Southeast Asia	Caribbean (ex. USA)	Indian Ocean	Pacific (ex. USA)	Japan	USA	Australia
Fisheries	**2,281**	391	969	1,060	89	70	858
Tourism/recreation	**4,872**	663	1,408	269	779	483	1,147
Shoreline protection[40]	**5,047**	720	1,595	579	268	172	629
Biodiversity	458	79	199	172	529	401	**3,645**
TOTAL	**12,658**	**1,853**	**4,171**	**2,079**	**1,665**	**1,126**	**6,278**

Source: own elaboration based on Cesar et al. (2003)

[39] In Conservation International (2008), a more detailed review can be found. Different regions (Atlantic Ocean, Indian Ocean, and Pacific Ocean) and countries are considered. Several references are given.
[40] This represents, over 50 years, a net present value of USD 240 billion, considering a 3percent discount rate.

Especially noteworthy is the biodiversity value for Australia. The Great Barrier Reef plays a key role in this respect. It is the largest living structure on Earth, with almost the size of Japan and bigger than United Kingdom, Switzerland, and the Netherlands together (Deloitte, 2017). Around 1,700 species of fish and other aquatic animals live in this ecosystem, so its biological diversity is beyond any doubt.



Source: own elaboration based on Deloitte (2017). 2017 prices

In 2012, a further detailed study was undertaken (de Groot et al., 2012) and more services were estimated in monetary terms. To that end, the authors took the Ecosystem Service Value Database (ESVD)[41] as a basis. Results are shown in Table 3.

[41] In order to provide information on the economic benefits of ecosystems and biodiversity, as well as on the costs of their loss, a database was developed for *The Economics of Ecosystems & Biodiversity* (TEEB) study. On this basis, ESVD was developed as an updated database. TEEB is a global study inspired by the Stern Review on the Economics of Climate Change and by the proposals of the Intergovernmental Panel on Climate Change (IPCC). It provides more and better data, and puts into practice political actions to move forward, although no specific methodological proposal has emerged in relation to ecosystem accounts. It applies the concept of TEV and recognizes the importance of non-market values when it comes to design public policies. It was in 2010 when study reports were accomplished, allowing several countries to join the initiative and to seek assistance to gather information to improve their own national systems. Some countries and international institutions, including the European Commission and the United Nations Environment Programme (UNEP), set in motion this initiative (TEEB, 2009, 2010).

Table 3. Monetary values for world's coral reefs (Int.$/ha/year. 2007 prices) and comparison with other coastal ecosystems

	CORAL REEFS	Coastal systems	Coastal wetlands
Food	0.68	2.38	1.11
Water			1.22
Raw materials	21.53	0,012	0.36
Genetic resources	33.05		0.01
Medicinal resources			0.30
Ornamental resources	0.47		
PROVISIONING SERVICES	**55.73**	**2.40**	**3.00**
Climate regulation	1.19	0.48	0.065
Disturbance moderation	16.99		5.35
Waste treatment	0.085		162.12
Erosion prevention	153.21	25.37	3,93
Nutrient cycling			0.045
REGULATING SERVICES	**171.47**	**25.85**	**171.51**
Nursery services		0,19	10.65
Genetic diversity	16.21	0,18	6.49
SUPPORTING SERVICES	**16.21**	**0.37**	**17.14**
Aesthetic	11.39		
Recreation	96.30	0.26	2.19
Spiritual experience		0.021	
Cognitive development	1.14	0.022	
CULTURAL SERVICES	**108.83**	**0.30**	**2.19**
TEV	**352.24**	**28.92**	**193.84**

Source: own elaboration based on de Groot et al. (2012)

Coral reefs are the most highly valued coastal ecosystems. Regulating (49 percent) and cultural services (31 percent) are the major contributors to this value, followed by provisioning (16 percent) and supporting services, respectively.

When comparing the TEV of world's coral reefs with the value of terrestrial and marine ecosystems, results lead in the same line. The gap between the value of coral reefs and these ecosystems even widens in comparison with coastal ecosystems (see Table 4).

Table 4. Comparison between the TEV of world's coral reefs and other marine and terrestrial ecosystems (Int.$/ha/year. 2007 prices)

	Marine	Inland wetlands	Fresh water (rivers/lakes)	Tropical forests	Temperature forests	Woodland s	Grassland	**CORAL REEFS**
TEV	0.49	25.68	4.27	5.26	3.01	1.59	2.87	**352.24**

Source: own elaboration based on de Groot et al. (2012)

Many other studies have been developed for certain non-Caribbean countries. In Table 5, a list of studies can be found. The large number of studies point to the following:

1. Tourism is most frequently the highest value item, followed by shoreline protection.
2. The WTP for tourist activities exceeds actual payments made, such as fees for diving, etc.
3. The social costs activities, such as coral mining, are much higher than the direct benefits of these activities to those conducting them.
4. Value of damages done by tourists and fishers to coral reefs can be significant if regulations are inadequate.
5. 1998 coral bleaching mainly affected tourism and costal development, especially in the Indian Ocean.
6. Non-market values are important and represent a considerable part of total economic values. In some cases, they even exceed the value for fisheries.

Table 5. Economic valuation of coral reefs in non-Caribbean countries/regions

Paper	Ecosystem service	Country/region	Results
Spurgeon 1992	Review TEV (direct uses values, indirect values, social services, non-use values)	World	He carried out a review of previous studies on coral reef valuation.
Cesar 1996	Fishery, tourism, and shoreline protection	Indonesia	This study compares total net benefits to individuals and losses to society (in terms of fisheries, shoreline protection, tourism, food security, biodiversity and others) due to threats of coral reefs (NPV with a 10 percent discount rate and 25-year horizon, per km2): - Poison fishing: net benefits (USD 33,300) vs. loss (USD 42,800-475,600 for fisheries and tourism). - Blast fishing: net benefits (USD 14,600) vs. loss (USD 98,100-761,200 for fisheries, tourism, and shoreline protection). - Coral mining: net benefits (USD 121,000) vs. loss (USD 175,500-902,500 for fisheries, tourism, and shoreline protection). - Sedimentation and logging: net benefits (USD 98,000) vs. loss (USD 273,000). - Overfishing: net benefits (USD 38,500) vs. loss (USD 108,900 for fisheries).
Berg, et al. 1998	Coral reef destruction	Sri Lanka	The economic benefits derived from coral reefs have been calculated. The minimum economic value of coral reefs: USD 140,000 over a 20-year period. The economic consequences of coral mining were analyzed: highest costs were associated with decreased tourism – USD 2-3 million and increased erosion – USD 1-4 million. Net financial benefit from coral mining is as much as USD 6,615,000 lower compared to the lost value of goods and services provided by the function of a properly managed coral reef over a 20-year period.
Wilkinson et al. 1999	Economic impacts of 1998 coral mortality	Indian Ocean	Net present value of the economic damage of 1998 bleaching over a 20-year horizon with a 10 percent discount rate (USD Mn.): - Fisheries: 260 (optimistic scenario) –1,361 (pessimistic scenario) - Tourism & recreation: 332 (optimistic scenario) –3,477 (pessimistic scenario) - Shoreline protection: 0 (optimistic scenario) –2,152 (pessimistic scenario) - Other services: 114 (optimistic scenario) –1,200 (pessimistic scenario) TOTAL = 706 (optimistic scenario) –8,190 (pessimistic scenario)

Mathieu et al. 2003	Marine Parks	Seychelles	A contingent valuation study has been conducted to determine tourist WTP for visits to Seychelles' marine national parks. Average value for WTP = USD 12.2, which exceeds USD 10 fee instituted in 1997. The difference between these two amounts is the consumer surplus. The average consumer surplus per tourist was USD 2.2, given an estimate of the total consumer surplus of USD 88,000.
Carr & Mendelsohn, 2003	Tourism & recreation	Great Barrier Reef	They examined domestic and international travel to the reef with the goal of estimating the benefits the reef provides to the visitors. Annual recreational benefits ranged between USD 700 million to USD 1.6 billion. Given the estimated two million visitors each year, this gave an average value of between USD 350 and 800 per visit. The domestic value to Australia was about USD 400 million. The travel cost method was applied.
Wielgus et al. 2003	Tourism & recreation	Israel (Red Sea)	Economic valuation of coral reef degradation at Eilat, Israeli Red Sea. Marginal prices of coral and fish diversity and water visibility: USD 2.60 and USD 1.20 per dive, respectively. For recreational diving welfare, the annual social costs of activities contributing to coral reef degradation are approximately USD 2.86 million. Choice modelling was applied.
Cesar & van Beukering, 2004	TEV (recreation, beachfront property and amenities, fisheries, biodiversity, non-use values)	Hawaii	Net benefits are estimated at USD 363.5 million per year (net present value with a 3 percent discount rate = USD 9,700 million) for the economy, and the overall asset value of Hawaii's reef area is estimated at nearly USD 10 billion (2001 USD Mn./year): - Tourism (304.2): it considers snorkeling (264) and diving (40.2) - Reef-related property value: 40 (0.23 percent of total value of Hawai'i property) - Fishery: 2.5 - Biodiversity: 17
Ngazy et al. 2004	Tourism & recreation	Zanzibar	Contingent valuation method was conducted to analyze the impact of coral bleaching on tourism. The majority of the respondents perceived the coral reef condition to be good and the average WTP for experiencing high quality reefs was USD 84.7 annually over and above what they had already paid for the experience.
Cesar & Chong, 2005	Review	Jamaica, Indonesia, and Indian Ocean	They gave an overview of economic valuation and the techniques supporting it. On the basis of previous studies, three case study examples were also explored.
van Beukering et al., 2006a	TEV (fisheries, diving & snorkeling, tourism, amenity, shoreline protection, biodiversity)	South Pacific (Northern Mariana Islands)	TEV = USD 61.16 million/per year (market value = 44.69 + non-market value = 16.48): - Fisheries: 1.25 (market value = 0.43 + non-market value = 0.83) - Diving & snorkeling: 5.77 (market value = 5.77) - Tourism: 42.31 (market value = 37.7 + non-market value = 4.61) - Amenity: 3 (non-market value = 3) - Shoreline protection: 8.04 (non-market value = 8.04) - Biodiversity: 0.79 (market value = 0.79)

van Beukering et al., 2006b	TEV (fisheries, tourism, diving & snorkeling, biodiversity, amenity, shoreline protection)	Guam	TEV (USD Mn. per year): 127.28 (market value = 96.18 + non-market value = 31.10) - Fisheries: 3.96 (market value = 0.54 + non-market value = 3.42) - Tourism: 94.63 (market value = 85.40 + non-market value = 0.45) - Diving & snorkeling: 8.69 (market value = 8.24 + non-market value = 3.42) - Biodiversity: 2 (market value = 2) - Amenity: 9.6 (non-market value = 9.6) - Shoreline protection: 8.4 (non-market value = 8.4)
Subade, 2007	TEV (use and non-use value)	Philippines	Economic valuation and values of marine biodiversity (coral reefs) are offered (USD 6,331,000). - Direct use values: Fish catch (1 million) and tourism (2.531.000) - Indirect values: (2.8 million) Non-use values (social WTP) ranged between USD 2.5 million and USD 4.8 million
Brander et al. 2007	Tourism & recreation	World	A meta-analysis (using a multilevel modelling approach) was conducted in order to calculate the recreational value of coral reefs (they collected 166 coral reef valuation studies, 52 of which provided sufficient information for a statistical meta-analysis). USD per visit was the dependent variable.
Andersson, 2007	Tourism & recreation	Western Indian Ocean (Zanzibar and Mafia)	The recreational cost of coral bleaching (the welfare loss of the ecological damage) was estimated through stated and revealed preference techniques. A person is willing to pay about USD 300 less for access to Zanzibar after the bleaching of the reefs. The WTA compensation for the reefs on Zanzibar is positive but not significant. For Mafia, all relative values for bleaching are negative and significant especially for the reefs. The WTP for access to Mafia is reduced by USD 110 after the bleaching and the WTA compensation by USD 555.
Ahmed et al. 2007	Tourism & recreation	Philippines	The value of recreational and conservation benefits of coral reefs along the Lingayen Gulf, Bolinao, was evaluated. The travel cost method and contingent valuation method have been applied to do so. Travel cost results indicated that consumer surplus (benefit) was USD 229 per person per annum or, equivalently, that potential net annual revenues to the local economy were USD 4.8 million from an estimated 21,042 visitors to Bolinao in 2000. Contingent valuation results concluded that the WTP attached to reef quality improvements valued at USD 0.45 per individual per visit (or USD 33,696 per year, probably due to the low socio-economic status of respondents and the free rider problem attached to public goods.

O'Garra. 2009, 2012	TEV (fisheries, bequest value, shoreline protection)	South Pacific (Fiji)	TEV = USD 1,794,673/per year (NPV over 99-year period with a 10 percent discount rate = USD 19,739,968) - Fisheries: 790,266/per year (NPV = 8,692,298) - Shoreline protection: 990,721/per year (NPV = 10,897,140) - Bequest value: 13,685/per year (NPV = 150,530) Economic estimates of bequest value have been calculated by using two different payment vehicles: a time-based payment vehicle and a monetary payment vehicle. Respondents' WTP to contribute towards conserving the *iqoliqoli* for future generations are: USD 0.64 (WTP time)/USD 0.73 (WTP monetary) per capita per week (or USD 106.91 per household per year).
Pascal et al. 2010	TEV (tourism, fisheries, shoreline protection, carbon sequestration, biomass)	South Pacific (Guadeloupe, Martinique, Mayotte, New Caledonia, French Polynesia, La Réunion, Saint-Barthelemy)	Annual value of the services provided by coral reefs: - Guadeloupe: tourism (€ 62 million), commercial fisheries (€ 25 million), shoreline protection (€ 17 million), carbon sequestration (€ 10 million) - Martinique: tourism (€ 67 million), commercial fisheries (€ 28 million), shoreline protection (€ 66 million), carbon sequestration (€ 8 million) - Mayotte: biomass (€ 9 million), tourism (€ 6 million), shoreline protection (€ 11 million), carbon sequestration (€ 2 million) - New Caledonia: tourism (€ 26 million), commercial fisheries (€ 62 million), shoreline protection (€ 168 million), carbon sequestration (€ 149 million) - French Polynesia: tourism (€ 80 million), biomass (€ 44 million), shoreline protection (€305 million), cultured pearl (€ 33 million) - La Réunion: tourism (€ 28 million), commercial fisheries (€ 9 million), shoreline protection (€ 12 million) - Saint-Barthelemy: tourism (€ 27 million), commercial fisheries (€ 2.5 million), shoreline protection (€ 3 million)
Sarkis et al. 2010, 2013	TEV (tourism, commercial fisheries, amenity, shoreline protection, recreational & cultural; research & education)	Bermudas	This study estimates the value of various ecosystem services. Lower and upper bound are determined (2007 USD Mn./year). - Tourism (56 percent of TEV): 405.9 [324.7 – 487.1] - Fisheries (0.7 percent): 4.9 [4.3 – 5.6] - Amenity (1 percent): 6.8 [5.5 – 8.2] - Shoreline protection (37 percent): 265.9 [133.9 – 531.8] - Recreational & cultural (5 percent): 36.5 [17.2 – 66.0] - Research & education (0,3 percent): 2.3 [2.1 – 2.5] The average annual value (TEV) of the coral reef ecosystem amounts to USD 722.4 million [488 million to 1.1 billion].

Pascal, 2011	TEV (subsisting fishing, commercial fishing, associated tourism, social capital, shoreline protection, bequest value)	South Pacific (Vanuatu)	Marine Protected Areas economic valuation of impacts = € 8,858/per capita (year 2009) - Subsistence fishing: 1,340/per capita - Commercial fishing: 928/per capita - Associated tourism: 2,286/per capita - Social capital: 359/per capita - Shoreline protection: 626/per capita - Bequest value: 656/per capita
Burke et al. 2011b	Tourism and shoreline protection	Coral Triangle (Solomon Islands, Timor-Leste, Papua New Guinea, Malaysia, Philippines, Indonesia)	- Tourism: in 2009, it represented 9 percent of GDP in Malaysia and Solomon Islands, 3 percent in Timor-Leste, 2 percent in the Philippines, 1 percent in Indonesia and less than 1 percent in Papua New Guinea. - Shoreline protection: across the Coral Triangle region, about 45 percent of shorelines are protected by coral reefs, this percentage being higher in Solomon Islands (70 percent) and the Philippines (65 percent). The annual net economic benefits of shoreline protection from reefs was estimated at USD 387 million for Indonesia and USD 400 million for the Philippines in 2000 (USD 2010).
Grabowski et al. 2012	Ecosystem services provided by oyster reefs	World	The economic value of oyster reef services, excluding oyster harvesting, was between USD 5500 and USD 99,000 per hectare per year. Total annual average value of ecosystem services provided by oyster reefs (2011 USD per hectare per year): - Oyster habitat state: 17,952 - Finfish and mobile crustacean value: 4,123 - Water quality: 5,342 - Shoreline protection: 860 - Landscape processes: 10,325
Laurans et al. 2013	Review	South Pacific	A review of estimates of coral reef economic values in the South Pacific was developed.
Chen et al. 2013	Tourism & recreation	Taiwan	The recreational value of artificial reefs in Penghu (Taiwan) was estimated. The travel cost method and contingent valuation method have been applied to do so. Estimations based on the travel cost method results showed that boat anglers' recreational benefit (consumer surplus) was USD 281.9 per trip and that scuba divers' recreational benefit was USD 348.5 per dive. The contingent valuation results indicated that the projected ticket fares were USD 13 and USD 12.7 for boat fishing and scuba diving, respectively. When the yearly tourist numbers were considered, yearly revenues of approximately USD 1.7 million and USD 1.9 million were estimated from ticket sales, whereas the yearly economic values of boat fishing and scuba diving were USD 37 million and USD 52 million, respectively.

Madani et al. 2013	Conservation value	Iran	Contingent valuation approach to estimate the economic value assigned to Iranian households for the preservation of coral reefs at Kish Island. Total WTP for five years of services provided by these ecosystems = USD 20 –155 million (USD 1.21 – 9.13 on a per-household basis)
Marre et al. 2015	Non-use values	New Caledonia	A choice experiment was conducted on coral reef ecosystem protection in two coastal areas to derive individual non-use values. Results indicate that estimates of non- use values may comprise between 25 and 40 percent of the mean WTP for ecosystem preservation.
van Zanten et al. 2014	Shoreline protection	United States Virgin Islands	The shoreline protection value of coral reef ecosystems is estimated at an annual value (short-term) of USD 1.23 million attributed to friction of coral structures. If long-term were also considered, the annual shoreline protection value would be of USD 8.87 million.
Albert et al. 2015	Provisioning services	Solomon Islands	Economic assessments of coral reef provisioning services afforded to rural communities identified a diverse range of fisheries-based and coral-based products. TEV = USD 7,386 - Fisheries: 5,173 annually per respondent (fish, seaweed, clam, trochus, crayfish, shell, turtle, shark, shark fin and shell money) - Corals: 2,213 annually per respondent (sand, rubble, stone, lime, curio, and aquarium)
Robles et al. 2016	Recreational use value	Oaxaca (Mexico)	Using the contingent valuation method, WTP for conservation activities was USD 48.4. Likewise, the net annual benefit from the reef was of USD 18,243,629
Grafeld et al. 2017	Fisheries	Hawaii	They estimate the value chain for nearshore Hawaiian coral reef fisheries: USD 10.3-16.4 million, differentiating between commercial (2.97 million licensed plus 148,500-445,500 unlicensed) and non-commercial (7.2-12.9 million) catch.
Beck et al. 2018	Global flood protection savings due to coral reefs	Global	Reefs reduce the annual expected damages from storms by more than USD 4 billion. Without reefs, annual damages would more than double, and the flooding of land would increase by 69 percent. For 100-year storm events, flood damages would increase by 91 percent to USD 272 billion without reefs. The countries with most to gain are Indonesia, Philippines, Malaysia, Mexico, and Cuba.

2.2.4.2 Economic valuation of the Caribbean coral reefs

The Caribbean is more dependent on the travel and tourism sector than any other region across the globe, contributing to over 15 percent of GDP and 13.2 percent of jobs in the region. This sector mainly relies on beach-based activities, cruise tourism and in-water activities related to the existence of coral reefs (Spalding et al., 2018). The value directly associated with the latter activities (sailing, snorkeling, and diving) may be referred to as 'on-reef' value. Nevertheless, understanding the full value of coral reefs to tourism implies an awareness of the range of other benefits: sandy beaches, sheltered and calm waters or attractive views, among others. These are often known as 'reef-adjacent' values (Spalding et al., 2017). Fisheries also represent an important sector in the region, from the perspective of both economy and nutrition: it provides billions of dollars and supply more than half of the protein consumed by people. Shoreline protection is another essential benefit of coral reefs – by helping avoid damages from hurricanes and other extreme events. Finally, there are also benefits derived from coral reefs and the support they provide for marine life to people who never visit the sites (the non-use value). Most studies on economic valuation of coral reefs have failed to estimate all these components to obtain the total economic value. Non-use values are often not taken into consideration.

In the first part, we set out the most relevant studies evaluating the economic value of Caribbean coral reefs as a whole, namely Burke & Maidens (2004) and a recent report made by UN Environment, ISU, ICRI & Trucost (2018). In the second part, we look at studies focusing on regional and sector-specific values[42].

BELIZE: Cooper, E., Burke, L., Bood, N. (2009).

JAMAICA: Edwards, P. (2009a, b); Kushner, B., Edwards, P., Burke, L., Cooper, E. (2011); Waite R., Cooper, E., Zenny, N., Burke, L. (2011).

TOBAGO and ST LUCIA: Burke, L., Greenhalgh, S., Prager, D., Cooper, E. (2008).

DOMINICAN REPUBLIC: Wielgus, J., Cooper, E., Torres, R., Burke, L. (2010).

BONAIRE: van Zanten, B., van Beukering, P. (2012); Schep, S., van Beukering, P., Brander, L., Wolfs, E. (2013).

BARBADOS, THE BAY ISLANDS, HONDURAS, and ST. KINNES & NEVIS: Gill et al. (2015).

WIDER CARIBBEAN & PACIIFIC COAST CENTRAL AMERICA: Green et al. 2003.

QUINTANA ROO (MEXICO): Reguero, B. et al. (2019).

[42] World Resource Institute developed an economic methodology to help decision-makers in the Caribbean better understand the economic value of coral reefs and use this data to make better-informed coastal policy. In the context of this initiative (Burke, 2010) the coastal capital series was launched in 2005. Studies on the economic valuation of reefs were conducted in Tobago, St. Lucia, Belize, the Dominican Republic, and Jamaica (see the papers in the Box). Building on these studies, the guidebook by Waite et al. was published.

Caribbean coral reefs[43]

As mentioned above, tourism lies is the main economic sector in the generation of value for the national economies of the Caribbean region. Out of the annual net benefits (USD 3.11-4.61 billion), tourism contributes to 45.55 - 67.52 percent (see Table 6).

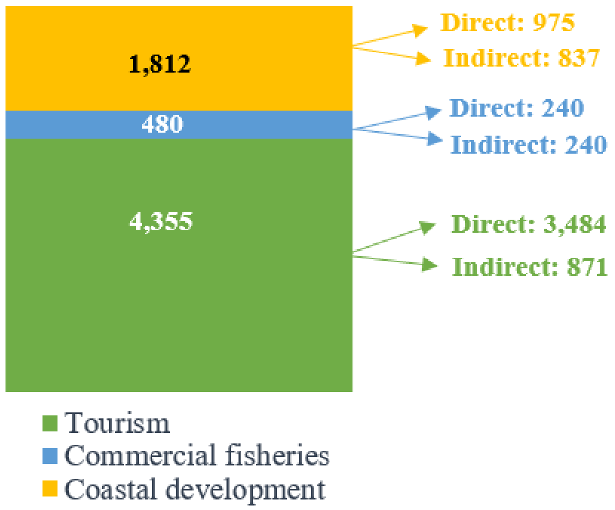
Table 6. Annual net benefits (USD Bn., 2000 prices)

	Caribbean	Method
Fisheries[44]	0.31	Market prices
Dive tourism[45]	2.1	Damage cost avoided
Shoreline protection	[0.7-2.2]	Replacement cost
TOTAL	**[3.11 – 4.61]**	

Source: own elaboration based on Burke & Maidens (2004)

More recently, a new report was published focusing on the Mesoamerican region. According to it, the economic returns of coral reefs to tourism, commercial fisheries, and coastal development sectors equal USD 6.647 million per annum (in 2017 prices), with tourism again as the main contributor (70 percent), as shown in Figure 6.

Figure 6. Economic returns from coral reefs in the MAR region (USD Mn., 2017 prices)



Source: own elaboration based on UN Environment, ISU, ICRI & Trucost (2018)

[43] The Caribbean Large Marine Ecosystem project launched, in 2012, the Information Management System (IMS). It, along with the Regional Environmental Monitoring Programme (REMP), offers references and links to updated information on ecosystems, environment, and related issues

[44] For tourism and habitat support, values are projected by 2015; for coastal protection is on an annual basis.

[45] Note that this value is different from that in Table 2. This difference may be due to two factors: one the one hand, dive tourism is high value tourism, with divers typically spending 60–80 percent more than other tourists. On the other hand, in Table 2, U.S. Caribbean region is excluded. In any case, these are data from different studies, so it is more likely that there will be differences in the results.

Regional studies

BELIZE

The value of coral reef- and mangrove-related fisheries, tourism, and shoreline protection services is estimated to be USD 395-559 million per year (see Table 7).

Table 7. Estimated coral reef and mangroves contribution (USD Mn.)

	Tourism[46]	**Fisheries**[47]	**Shoreline protection**[48]
Coral reefs	135-176	13-14	120-180
Mangroves	60-78	3-4	111-167
Combined contribution [49]	**149.9-195.7**[50]	**14.2-15.9**	**231-347**
TOTAL (tou+fish+shore)		**395.1 – 558.6**	

Source: own elaboration based on Cooper et al. (2009)

Tourism. In 2007, tourist spent:

USD 149.9 – 195.7 million on accommodation, reef recreation, and other expenses (12-15 percent of Belize's GDP)
+
USD 26.1 – 68.9 million of indirect benefits
=
USD 176 – 264.6 million from coral reef- and mangrove-associated tourism


+

=
US$30–$37 million on sport fishing and diving (not counting accommodation, etc.)

These are high value industries in comparison, e.g. with the cruise industry, which contributes less to Belize's economy (USD 5.3 – 6.4 million in revenues and taxes). This is in spite of the fact that cruises mobilized around 620,000 tourists in 2007 (Cooper et al., 2009).

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[46] This value was calculated by estimating gross revenues and taxes from marine recreation and revenues from accommodation and other tourist spending. However, this method underestimates tourism-related value, as non-use values have been omitted (i.e. consumer surplus: the additional welfare of tourists beyond what they have paid).
[47] Gross revenues from commercial fishing and processing activities has been estimated. Species considered are snappers (*lutjanidae*), groupers (*serranidae*), parrotfish (*scaridae*), squirrelfish (*holocentridae*), and lobster (*panularius argus*).
[48] Damage cost avoided method has been applied.
[49] Note that mangrove and coral reef fisheries and tourism values are not additive, as they include revenues that rely on both habitats (Copper et al., 2009).
[50] Associated accommodation: USD 56.3–75.4; Recreation: USD 37.5–46.5 (Diving: USD 20.1–25.1; Snorkeling: USD 10.1–12.6; Sport fishing: USD 7.2–8.5; Other recreation: USD 0.2–0.3); Other visitor expenses: USD 31.8–44.7; Cruise tourism: USD 4.6–5.7; Taxes and fees: USD 19.6–23.4 (Cooper et al., 2009).

Fishing is not only a source of food and livelihood for Belizeans, but also a cultural tradition. Fishermen's cooperatives are the most relevant stakeholder taking part in this activity: 1.2 million pounds of fish were sold by them, 80 percent of them being exported (earning USD 11.2 million in gross revenue)[51]. Fisheries in general are threatened, and this is even more dramatic in the case of species such as grouper and snapper.

Shoreline protection. The average annual avoided damage by coral reefs is estimated at USD 120–180 million per year. Mangroves offer protection for a value of USD 111–167 million. These values have been calculated on the basis of the value of property in vulnerable land protected by these ecosystems.

Belize also has 13 marine protected areas (MPAs)[52] that received, in 2007, around 115,000 visitors who directly spent over USD 17 million. To this must be added USD 3.5 to 6.9 million indirect benefits. Therefore, MPAs generate economic benefits beyond the amount invested in their protection.

JAMAICA

Tourism. Jamaica has the fourth largest tourism economy in the Caribbean: however, most tourists are largely concentrated in three beach destinations: Montego Bay, Ocho Rios and Negri. Tourism sector is, at the same time, the largest contributor to national GDP: it directly amounted USD 1 billion in 2011 – 7.4 percent of GDP. If indirect benefits were included, this figure would be of USD 4 billion – 24 percent of GDP. In terms of employment, total number of jobs reached 23 percent of employment – 262,000 jobs (7 percent were directly employed in 2011 – 82,000 jobs). Likewise, tourist spending generated USD 2 billion in foreign exchange (Kushner et al., 2011).

Furthermore, Edwards (2009a) conducted two studies applying stated preference techniques in order to estimate the recreational value stated (WTP) by tourist visiting the island for the presence of beaches and nearshore coastal waters. i.e. the value of compensating tourists if there were a total loss of the beach in such a way that they could not either visit it or enjoy coral reef recreational services[53].

If coral reefs quality were to decline from current conditions, respondents will experience a welfare loss of around USD 97, whereas the welfare gain linked to an improvement from the current situation was USD 22 per person.

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[51] Exports and local sales by cooperatives: USD 11.2 and 1.0; other local sales (sales to local markets and restaurants and share with family/friends): USD 1.9–3.5; local fish cleaning: USD 0.8–0.12 (Cooper et al., 2009).
[52] 8 fisheries MPAs, 2 joint fisheries/forestry MPAs, 5 forestry MPAs and 3 Government Paper Parks.
[53] It refers to the loss of consumer surplus stemming from a change in the quality of beaches.

He also analyzed the feasibility of implementing two funding mechanism for ocean and coastal management through a contingent valuation study. Results indicate that tourists are more willing to pay for an environmental tax than for a tourist development tax and that coastal management activities could be financed from the introduction of an extra USD 2 per person environmental tax to the existing tourism tax (Edward, 2009b).

Fishing. There are 15,000-20,000 active fishermen in Jamaica, while in some areas, such as Negril, more than three-quarters of households derive their livelihoods from artisanal fishing. The average annual gross revenues from reef-related fisheries (2001 to 2005) was USD 33.1 million from which USD 8.9 million were exported and US 24.2 million were locally sold. Finfish, conch, lobster, and shrimp were considered (Waite et al., 2011).

TOBAGO AND ST. LUCIA

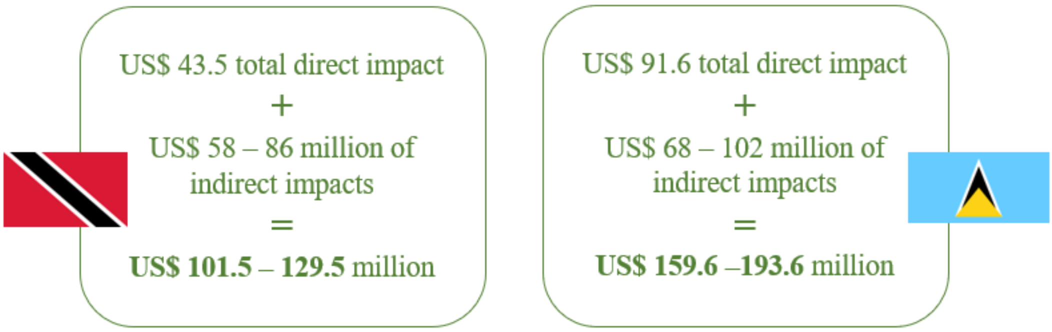
The value of coral reef-related fisheries, tourism, and shoreline protection services is estimated to be USD 375.33 – 565.37 million per year (see Table 8).

Table 8. Estimated coral reef and mangroves contribution (USD Mn.)

	Tourism[54]	Fisheries[55]	Shoreline protection[56]
Tobago (2006 prices)	114.1-174.6	0.76-1.14	18-33
St. Lucia (2005 prices)	213.8 – 305	0.67-1.63	28-50

Source: own elaboration based on Burke et al. (2008)

Tourism. In 2005, tourist spent[57]:



[54] This value was calculated by calculating the gross revenue of tourism and recreation and subtracting operating costs to arrive at net revenue.
[55] This value was calculated by calculating the gross revenue of commercial fishing and processing activities and subtracting operating costs to arrive at net revenue. Species considered are: snappers (*Lutjanidae*), groupers (*Serranidae*), parrotfish (*Scaridae*), squirrelfish (*Holocentridae*), lobsters (*Panularius argus*), and sea urchins (*Echinoidea*).
[56] A modified damage cost avoided method was applied. This approach has a GIS analytical modelling and an economic component, as reliable estimates of the replacement cost by manmade structures were limited.
[57] Direct values include: Tobago [Accommodation: USD 24.7; Diving: USD 1.3; Snorkeling and glass-bottom boats: USD 1.5; miscellaneous visitor expenses: USD 16]; St. Lucia [Accommodation: USD 64.7; Diving: USD 4.9; Snorkeling and glass-bottom boats: USD 0.8; marine park revenues: USD 0.05; miscellaneous visitor expenses: USD 21.1] (Burke et al, 2008).

Unlike in the study for Belize, in this case, non-use values are included: USD 1.1 billion for Tobago and from USD 2.2 to USD 2.4 for St. Lucia. Annual value of local residents' use of the reefs and coralline beaches is also estimated: USD 13–44 million in Tobago and USD 52–109 million in St. Lucia.

US$ 101.5 – 129.5 million
(direct +indirect)
+
Consumer surplus (non-use values) US$ 1.1
+
Local use US$ 13– 44
=
US$ 114.1 – 174.6

US$ 159.6 –193.6 million
(direct +indirect)
+
Consumer surplus (non-use values) US$ 2.2 – 2.4
+
Local use US$ 52– 109
=
US$ 213.8 – 305

Fishing. As in the other cases, fisheries have a much smaller economic impact than tourism and shoreline protection. In any case, they provide other important values, including jobs, cultural services, etc. Fishery industry is predominantly artisanal (small-scale and traditional) and operates seasonally. In fact, pirogue is the most common use boat (Burke et al., 2008). In Tobago, direct impacts are between USD 0.64 and USD 0.91 million per year[58], and indirect impacts are estimated to be between USD 0.12 and USD 0.23 million per year. In St. Lucia, direct impacts are about USD 0.44 and USD 0.66 million per year[59], indirect impacts are estimated to be between USD 0.082 and USD 0.18 million per year and local (non-commercial) fishing are between USD 0.15 and USD 0.79 million per year.

Local use (non-commercial) fishing is also incorporated. Especially relevant is the case of the Sea Turtles, as they are object of consumptive (turtle hunting is legal in Tobago from October to February) and non-consumptive use (viewing).

Shoreline protection. Coral reefs contribute to the protection of over 40 percent of the shoreline of both islands (50 percent in Tobago and 44 percent in St. Lucia). The potentially avoided damaged (over 25 years) was, for Tobago, between USD 450 and USD 825 million. However, the potentially avoided damaged (annual value for 2007) was USD 18 and USD 33 million. For St. Lucia, the potentially avoided damaged (over 25 years) was between USD 0.7 and USD 1.2 billion; while the potentially avoided damaged (annual value for 2007) was USD 28 and USD 50 million.

[58] Estimated net revenues from commercial fisheries: USD 0.55-0.73; net revenues from fish cleaning and processing: USD 0.088-0.18.
[59] Estimated net revenues from commercial fisheries: USD 0.39-0.58; net revenues from fish cleaning and processing: USD 0.051-0.077.

DOMINICAN REPUBLIC

Tourism. A study (Wielgus et al. 2010) to assess the WTP of dive tourists for a dive trip in La Caleta National Marine Park concluded that the revenue maximizing fee would be USD 53 per two-dive trip for local visitors and USD 59 per two-dive trip for international visitors.

Likewise, Dominican tourists spend over USD 1 million per year in roadside communities (food, gas, lodging expenses, etc.) while traveling to the Jaragua-Sierra de Bahoruco-Lago Enriquillo Biosphere Reserve in southwestern Dominican Republic.

Fisheries. Almost 99 percent of the marine resources caught in Dominican waters are consumed, whereas 60 percent of the seafood consumed is imported. Gross national income from reef-dependent fisheries has decreased by nearly 60 percent over the past decade (from over USD 41 million to under USD 17 million) because of overfishing, especially in La Caleta Marine Park. However, considering that tourists in the park are willing to pay USD 59 for a two-dive trip, fishermen have incentives to become dive tourism operators. In this way, the problem of overfishing could improve.

Beach erosion. Current rates of beach erosion could result in revenue losses of USD 52 – USD 100 million over the next ten years to the hotel industry. Note that a loss of 0.5 meters in beach width would involve an annual gross-revenue loss of USD 160,000 for an average-size resort.

BONAIRE

Tourism. Although only 16,000 inhabitants live in the island, it receives 270,000 tourists annually (70,000 by plane and 200,000 by cruise ships). Bonairean ecosystems support touristic activities, such as diving, snorkeling, kayaking, boating, enjoying beaches, and participating in land activities. Tourists spending up around USD 125 million annually, and an estimated welfare of around USD 46.80 million dollars is contributed by Bonaire’s nature to tourism (Schep et al., 2013). These values have been obtained through a combination of two tourist surveys (face-to-face and online) that were conducted in 2012. It differentiates between the WTP for a stay-over tourist (USD 36.47 million) and for a cruise tourist (USD 10.32 million).

Shoreline protection. The annual shoreline protection values of the coral reefs are (van Zanten & van Beukering, 2012):

- Short-term (within 10 years): USD 33,000
- Long-term (beyond 10 years): USD 70,000

BARBADOS, THE BAY ISLANDS, HONDURAS, and ST. KINNES & NEVIS

Tourism. Gill et al. (2015) quantified the potential effects of changes in reef fish populations on recreational divers' consumer surplus (benefits) through a choice modelling exercise. Over five hundred surveys were conducted in seven sites across three

Caribbean countries: Barbados, Honduras, and St. Kinnes & Nevis. The sample of interviewees included tourist scuba divers. WTP has been defined as a function of the abundance and size of reef fishes, the presence of fishing activity/gear, and dive price. Overall, the study found that future declines in the abundance of the large fishes that can be seen when enjoying recreational diving activities would reduce diver consumer surplus. More specifically, divers would be willing to pay USD 74.43 for a two-tank dive where 10–25 percent of the fish are large as compared to 1–10 percent, the latter percentage being the status quo. Moreover, negative values were found for fishing activity/gear encounters and dives with low numbers of large fish (divers' WTP to avoid such trips was over USD 100).

Country by country, the highest aversion to fishing activity/gear took place in Barbados, where divers were willing to pay over USD 170 to avoid encounters on every dive. St. Kitts & Nevis divers were almost always willing to pay more than divers in other countries for better fish attributes. In the case of the Bay Islands, the WTP values for most attribute levels were approximately half that of the other countries.

Hence, encouraging the increase in the number of fish (especially of large fish) and the reduction in fishing activity/gear encounters would result in greater gains in consumer surplus. By contrast, if fish abundance were to decline, losses could be expected to be high: e.g. in St. Kitts and Nevis and Barbados sites, annual losses would reach up to USD 1.2 and USD 2.1 million, respectively. In the Bay Islands sites, where there is higher diver traffic, total losses for similar declines could be as high as USD 7.9 million annually.

WIDER CARIBBEAN & PACIFIC COAST OF CENTRAL AMERICA

Tourism. Green & Donnelly (2003) analyzed recreational scuba diving in Caribbean Marine Protected Areas (MPA). Note that there are more than two hundred MPA in the region containing coral reefs. This makes them a tourist center for scuba divers of all over the world. In this study, 20 percent of dive operators in 30 countries were interviewed (respondents reported that they used 74 MPAs throughout the region).

It should also be pointed out that only 25 percent of MPAs with coral reefs charge an entry or user fee to access the area. This fee is most usually USD 2–3 levied per dive or per diver, whereas survey indicate that tourist would be willing to pay a fee of around USD 25 per person in Curacao, Jamaica, and Bonaire. This results in a revenue of around USD 1–2 million annually. This figure could be even higher due to their great potential to generate income.

Results also show that 3.75 million divers visit the Caribbean region (excluding Florida) every year and that these tourists would be willing to pay user fees of around USD 25 per person. Considering that MPAs are under-resourced by USD 120 million, these fees may generate USD 93 million, thereby reducing this shortfall by around 78 percent.

In tables 9 and 10, a summary of results for the Caribbean region can be found.

Table 9. Summary of results for tourism, fisheries, and shoreline protection (USD Mn.)

	Tourism	Fisheries	Shoreline protection[60]
Belize: coral reefs + mangroves (2007 prices)	176-264.6	14.2-15.9	231-347
Jamaica (2011 prices)	5,000	33.1[61]	
Tobago (2006 prices)	114.1-174.6	0.76-1.14	18-33
St. Lucia (2005 prices)	213.8 – 305	0.67-1.63	28-50
Dominican Republic (2009 prices)			52-100
Bonaire (2012 prices)	125[62]		Short-term: 0.033 Long-term: 0.07
Wider Caribbean	93[63]		

Source: own elaboration based on previous studies

Table 10. Summary of WTP for tourism activities

COUNTRY	RESULT
Jamaica	USD 128 per visitor/per trip[64]
Dominican Republic	USD 53 per two-dive trip for local visitors and USD 59 per two-dive trip for international visitors [La Caleta Marine Park]
Barbados, the Bay Island and St. Kinnes & Nevis	USD 74.43 for a two-tank dive if abundance of large fish increases
Wider Caribbean	USD 25 per person (user fee). They may generate USD 93 million

Source: own elaboration based on previous studies

QUINTANA ROO (MEXICO)

Shoreline protection: The increase in risk from environmental degradation is the same as seen the risk reduction benefits of the protection that coral reefs offer. This study spatially and economically quantifies the risk reduction benefits of the Mesoamerican Reef in Quintana Roo for people, buildings, and hotel infrastructure. According to the study by Reguero et al. (2019), the annual benefits are estimated in 4,600 people, 42 million USD damage prevention for buildings per year (16 million USD in direct avoided flood damages and 26 million USD in averted indirect losses), and 20.8 million USD for hotel infrastructure per year in direct averted flood damages (indirect damages were not accounted for).

The study also compares the risk reduction of coral reefs with (i) the protection offered by dunes and (ii) the increase in coastal risk from sea level rise (SLR). They demonstrate

[60] It refers to the annual avoided damage, except for Dominican Republic, where beach losses over the next ten years are provided.
[61] Average annual gross revenues from 2001 to 2005.
[62] It refers to tourists' expenditures. It gives an estimated welfare of around USD 46.80 million dollars.
[63] Contributions resulting from a potential charge of user fees.
[64] If coral reefs quality were to decline, welfare loss of around USD 97, whereas the welfare gain linked to an improvement from the current situation was USD 22 per person.

that the contribution of reef degradation to coastal risk is larger than the expected increase in risk from SLR (Tables 11 and 12):

Table 11. Population, built capital, and hotel infrastructure protected by reefs

Risk reduction offered by the mesoamerican reef	Annual expected damage	Storm return period					
		10 years	25 years	50 years	100 years	250 years	500 years
Risk reduction benefit offered by reefs							
Population (#)	4,586	2,677	5,140	6,941	8,796	10,784	13,478
Built capital (million USD)	16.3	13.8	33.8	56.8	100.7	130.7	171.7
Hotel infrastructure (million USD)	20.8	20.8	58.4	130.5	262.6	332.1	431.5
Percentage increase in risk compared to baseline risk							
Population	195.5%	74.4%	81.1%	57.9%	41.7%	33.5%	37.8%
Built capital	178.2%	96.9%	111.7%	91.4%	74.0%	56.0%	57.5%
Hotel Infrastructure	173.3%	123.8%	139.2%	131.0%	91.2%	65.6%	60.0%
Percentage increase in risk compared to the total exposure in the coastal zone							
Population (*)	4.3%	2.5%	4.9%	6.6%	8.3%	10.2%	12.7%
Built capital (**)	1.9%	1.5%	3.8%	6.5%	11.6%	15.1%	19.8%
Hotel infrastructure (**)	2.4%	2.4%	6.7%	15.0%	30.2%	38.2%	49.7%

Annual Expected Damage is calculated as the probability of each storm and the associated losses. Disaggregated figures and damages with current reef condition and with degraded reefs for population, built capital and hotels can be found in ***Supplementary Tables 1–3****, respectively. (*) Population living behind reefs: 105,800; (**) Built capital behind reefs: 858 million USD.*

Table 12. Increase in risk for built capital from reef degradation and sea level rise.

Built capital (million USD) protected in sections with reefs	Annual expected damage	Storm return period					
		10 years	25 years	50 years	100 years	250 years	500 years
Damage with current reef condition (baseline)	12.0	16.8	41.9	99.6	287.8	506.0	719.2
Contribution of losing the reef	20.8	20.8	58.4	130.5	262.6	332.1	431.5
Contribution of sea level rise	32.5	16.0	28.8	59.1	129.1	162.6	201.9
Contribution of reef degradation and sea level rise	74.0	49.0	122.5	219.9	431.1	533.5	667.9

Source: Reguero et al. (2019)

They also show that the spatial distribution of the risk reduction benefits from reefs differs for people and infrastructure, and in particular for hotels, which receive the most protection from reefs.

2.2.4.3 The cost of coral reef degradation

As explained throughout the study, corals are under threat, in some cases to the extent that their very survival is being a source of concern. Bleaching is one of the most serious risk affecting these ecosystems, with all that implies for the coral reef-dependent economies. Cesar et al. (2003) estimated the costs arising from bleaching processes at global level, giving rise to a net present value (at the horizon of 50 years) of USD 23-85 billion, depending on whether the bleaching process is moderate or severe (see Table 13).

Table 13. Cost of bleaching (Net Present Value: 50-year time horizon with a 3 percent discount rate) (USD Bn.)

	Moderate scenario	Severe scenario
Fisheries	7	23
Tourism/recreation	10	40
Biodiversity	6	22
TOTAL	23	85

Source: own elaboration based on Cesar et al. (2003)

Southeast Asia (38.55 percent of total costs – USD 38.3 billion) and Australia (27.1 percent of total costs – USD 28.4 billion) are the regions with the highest costs in case of severe bleaching, followed by Indian Ocean (including the Rea Sea) and Pacific (excluding Hawaii). In the Caribbean (excluding tropical marine waters of the United States), the total cost of severe bleaching is USD 5.7 billion (Cesar et al., 2003).

Burke & Maidens (2004) estimated annual losses generated as a result of the Caribbean coral reef degradation for tourism and fisheries by 2015 and the net value of lost benefits from reef-associated shoreline protection within the next 50 years (see Table 14).

Table 14. Annual losses by 2015 for tourism and fisheries due to degraded reefs and net value of lost benefits from shoreline protection within the next 50 years in the Caribbean region (USD Mn.*)*

	Tourism	**Fisheries**	**Shoreline protection**
Degradation cost	100-300	95-139	140-420
TOTAL (tou+fish+shore)	**335 – 859**		

Source: own elaboration based on Burke & Maidens (2004)

Another threat is the loss of beaches, especially for the tourist sector. This is a special challenge for Jamaica, as tourism is concentrated on three locations: Montego Bay, Ocho Rios and Negri. Kushner et al. (2011) determined the loss tourists' satisfaction associated with a decline in beach quality because of the erosion arising from reef degradation (after 10 years of erosion).

Loss in value due to **current** rates of beach erosion: **US$ 19.2 million**

Loss in value if the beach erodes **faster** due to reef degradation: **US$ 32.7 million**

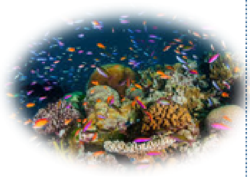
DIFFERENCE due to further reef degradation: **US$ 13.5 million**

This loss of value (USD 13.5 million of annual losses during the tenth years of erosion) has knock-on impacts in the tourist sector: less visitors (a reduction of between 9,000 and 18,000 tourists annually), resulting in an estimated cost of between USD 9 and USD 19 million per year for the tourist industry and of between USD 11 and USD 23 million per year for the whole national economy (Kushner et al., 2011).

If current erosion rate is sustained, losses will be higher for Montego Bay; whereas if coral reef degradation results in a faster beach erosion, Ocho Rios will be the worst affected. However, there are not great difference among beaches.

Focusing now on the Mesoamerican Reef, UN Environment, ISU, ICRI & Trucost (2018) carried out an estimation of the economic returns from the reef between 2017 and 2030 under a healthy and a degraded scenario (see Figure 7).

Figure 7. Present Value of Economic Returns: Estimated 2030 and Annualized 2017-2030 (USD Mn., 2017 Prices)



Present value of economic returns: Estimated 2030 (US$ million, 2017 values)

- **Tourism:** $7,110
- **Fisheries:** $490
- **Coastal development:** $2,645

TOTAL = $10,245

Present value of economic returns: Annualized 2017-2030 (US$ million, 2017 values)

- **Tourism:** $5,153
- **Fisheries:** $484
- **Coastal development:** $2,047

TOTAL = $7,685

—

Present value of economic returns: Estimated 2030 (US$ million, 2017 values)

- **Tourism:** $2,069
- **Fisheries:** $459
- **Coastal development:** $1,068

TOTAL = $3,596

Present value of economic returns: Annualized 2017-2030 (US$ million, 2017 values)

- **Tourism:** $3,279
- **Fisheries:** $469
- **Coastal development:** $1,461

TOTAL = $5,209

=

Net benefit from healthy reef

Net benefit: Estimated 2030 (US$ million, 2017 values)

- **Tourism:** $5,041
- **Fisheries:** $31
- **Coastal development:** $1,577

TOTAL = $6,649

Net benefit: Annualized 2017-2030 (US$ million, 2017 values)

- **Tourism:** $1,976
- **Fisheries:** $15
- **Coastal development:** $586

TOTAL = $2,475

Source: own elaboration based on UN Environment, ISU, ICRI & Trucost (2018)

3. SITES SELECTION AND CHARACTERISTICS

3.1 INDICATORS USED TO IDENTIFY SITES

Before conducting the economic valuation analysis, it is essential to identify the potential sites to be valued. In this work, a decision making framework has been proposed. It combines three tools: the first one is the expert knowledge of the MAR Region and a literature review that provides the site selection criteria (e.g., physical, environmental, geographical, non-spatial criteria, etc.); the second one is the GIS used to perform the spatial data analysis necessary to identify possible candidate sites; and the third one is the multi-criteria analysis to select the most suitable sites considering the expert prioritization of the different criteria (Eldrandaly & Khalid, 2014).

The first step is to define the site selection criteria. This involves covering the ecosystem services to be valued and presented in section 1.2.1. The key elements for site selection (for which each site should contain two or more) include:

- Sites are within or near Marine Protected Areas (including the economic benefits to be derived from protecting or enhancing the resources within the sanctuary).
- Sites are near tourism areas (an area of exceptional recreational opportunity related to its distinctive marine characteristics).
- Sites where reef ecosystems may be providing contributions to shoreline protection, including wave attenuation for coastal human habitations.
- A marine ecosystem of exceptional productivity, especially sites where reef ecosystems may be contributing to food security, or where there is substantial coral cover.
- Important habitat.
- Historic or cultural remains of widespread public interest.
- Distinctive or fragile ecological or geologic features of exceptional scientific research or educational value (including CITES-listed coral species).
- The ability of existing regulatory mechanisms to protect the values of the site.
- The aesthetic qualities of the area.
- Sites that have a strong governance and enforcement of the law.
- Sites with data availability

Selection criteria has to break down in qualitative or quantitative indicators to obtain the ranking values. The list was presented to experts to obtain their feedback.

After defining the criteria, an attribute can be represented in a GIS database as an attribute (criterion) map layer. A criterion map represents the spatial distribution of an attribute, which helps measure the degree to which its associated objective is achieved. This step needs a review of GIS databases such as the MAR REGION sites, Healthy Reefs Initiative, Marine Protected Areas, Ocean Wealth Explorer, as well as an expert survey to identify the research groups or non-governmental organization that collected data for the region. The last step is to use a multi criteria analysis for ranking the alternatives sites according to the project objectives.

Thus, a long list of sites was prepared for each country including a brief description of each site. A map was also developed in order to visually recognize the places. The final selection was presented in the stakeholders' workshop to receive feedback.

We sourced geo-referenced information on the indicated criteria and found the following sources of data:

- For sites in, or near marine protected areas, the governmental databases of each country were used and a criterion of closeness to the protected area when the site would be in the same reef habitat stated.
- For the identification of the sites close to tourist areas (as an area of exceptional recreational opportunities related to their distinctive marine characteristics) The Nature Conservancy's Atlas of Ocean Wealth Toolkit, specifically the Coral Reef Tourism project's data (Spalding et al., 2017), was used.
- For the selection of sites where reef ecosystems can contribute to shoreline protection, including wave attenuation for inhabited sites, the Atlas of Ocean Wealth Toolkit was used.
- For the criterion of marine ecosystem of exceptional productivity, especially sites where reef ecosystems can contribute to food security or where there is substantial coral coverage, the Healthy Reefs Initiative's indicators provided by Dr. Patricia Kramer and Dr. Melanie McField were used.
- The criterion of important habitat is included in other indicators, so we covered it in the other criteria included in this list.
- For the criterion of historical or cultural remains of wide public interest, the list of World Heritage Sites of UNESCO was used.
- For the criterion of distinctive, fragility or geological characteristics of exceptional scientific or educational value (including CITES-listed coral species), the Healthy Reefs Initiative's indicators provided by Dr. Patricia Kramer and Dr. Melanie McField that include coral coverage, abundance of commercial and herbivorous fish and coverage of fleshy algae were used.
- For the ability to have regulatory mechanisms to protect site values and level of governance, we decided to use the Protected Areas as a measure unit as the information may had not been aggregated to a level that we can work on.

3.2 METHODOLOGY FOR THE DETERMINATION OF STUDY SITES

The following methodology was followed for the determination of study sites:

1. Databases containing the information relevant to the project were selected.
2. A mathematical model was built to obtain a site selection estimator.
3. The model was run on existing data kindly provided by *Healthy Reefs Initiative* and supplemented with information provided by *Ocean Wealth Project*, which would allow the classification of sites by category of value for the project.
4. The model was run and sites that met the selected parameters by country were selected and categorized according to their value.
5. Maps were generated, thus allowing the geographical representation of the map.

For the generation of the model that would allow the selection of sites for sampling, the databases developed by AGRRA for *Healthy Reefs Initiative* (www.healthyreefs.org) were used. In the geographic information system, georeferenced sites were evaluated based on four criteria: coral coverage, coverage of fleshy macroalgae, herbivorous fish biomass and commercial fish biomass. This work determines the conservation value of the reef, based on (i) the coral cover – in percentage – (McField et al., 2018), (ii) the density of herbivorous fish (g/Hm^2), (iii) the degree of disturbance determined by the coverage of fleshy algae in percentage and (iv) the economic value in terms of biomass of fishing species (g/Hm^2).

ESTIMATORS. Parameters used for evaluation:

- *Fleshy macroalgae*: the coverage of fleshy brown algae on the reef was used as an indicator of reef disturbance and consequently of the quality of its conservation status. For this disturbance indicator purpose 5 categories were generated according to the following criterion: if the coverage is less than 0.9 percent of the total area of the reef, a value of 5 was assigned; if it is less than or equal to 5 percent a value of 4 was assigned, with coverage less than or equal to 12 percent the category was 3; coverages less or equal to 25 percent were classified as 2 and a meaty algae coverage greater than 25 percent of the site corresponded to category 1.
- *Commercial fish biomass* as an indicator of reef productivity and economic value. It is worth mentioning that it was not disaggregated to allow homogeneous assessment between sites. This biomass was quantitatively classified into five categories with a value from 1 to 5: for sites with abundance greater than 1620 individuals, a value of 5 was assigned, for greater than or equal to 1210, a value of 4 was assigned, for greater than or equal to 880, a value of 3 was assigned, for greater than or equal to 390, a value of 2 was assigned and for less than 390, a value of 1 was assigned.

- *Herbivorous fish*: the abundance of herbivorous fish was used as an indication of the health of the reef community. It was also quantitatively classified into five categories (from 1 to 5) with the following criterion: for abundance greater than or equal to 3290 individuals, the value was 5, for greater than or equal to 2740, the value was 4, for greater than or equal to 1860, the value was 3, for greater than or equal to 990, the value was 2 and for less than that, the value was 1.
- *Coral coverage*: it is an indicator of reef conservation. It was also classified into 5 categories, which were based on the following average coral coverage: 40 percent or more of the coral-covered sites classified in category 5, coverage of 20 percent or more corresponded to category 4, coverage greater than 10 percent corresponded to category 3, coverage of 5 percent or more corresponded to category 2 and finally, coverage less than 5 percent corresponded to category 1.

Data for 2016 and 2018 were analyzed, and sites that were evaluated in both years were selected, with an analysis of change in the reef conservation value through a differential category change analysis.

This data generated a preliminary database that was modified to add the columns of economic values for tourism per hectare provided by Ocean Wealth Project (Spalding et al., 2017) of sites defined by the Office of the United Nations Office for Education, Science and Culture as a World Heritage Site, as well as the proximity or presence in marine areas (biologial-diversity.info, 2016; IDEG, 2020; CONABIO-SNIB, 2020; UNESCO, 2020; Instituto Nacional de Conservación y Desarrollo Forestal, 2020).

An analysis of available geographic information regarding wrecks in the study area was made and no historically valued following were found, such as wrecks or archaeological sites, and only information about the Ship Halliburton (latitude: 16th 5,065’ N, longitude: 86th 53,809’ W) sunk to create an artificial reef on the island of Utila was found (Wannasurf.com, 2020).

As for the reef’s tourism value index, there are 29 sites with a value of 0, including almost all of those corresponding to the Chinchorro Bank area, where we found inconsistent with the analysis of interest; there are also 24 sites from Dr. Kramer to which economic value cannot be assigned, based on the information provided by TNC.

It should be noted that in this index the extreme values are 0 USD/ha for the 29 sites mentioned and 968,800 USD/ha corresponding to Punta Cancun Nizuc; the rest of data are distributed between 387,960 UDs/ha. Thus, the decision was made to obtain the logarithmic value of the economic value estimate per hectare in order to obtain an estimator of quintiles with numerical value from 1 to 5.

The presence in world heritage sites and in protected natural areas was classified as 1 for presence or proximity and 0 for absence.

3.3 SITE SELECTION

From the application of the model, we obtained a total of 246 sites (see Figure 8). As the information available for the estimation of the economic value was collected through interviews or experts at a point level, we decided to build polygons from those points, thus obtaining 30 polygons in the study area: 9 in Mexico, 12 in Belize, 1 in Guatemala and 8 in Honduras (Figure 9).

Figure 8. Sites selected by the estimator

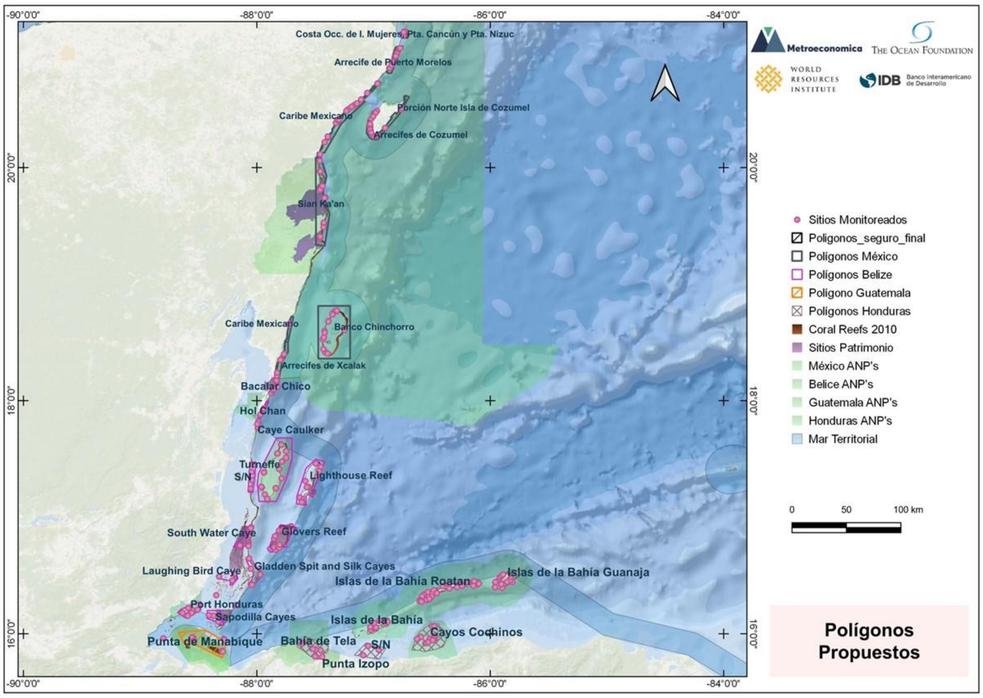
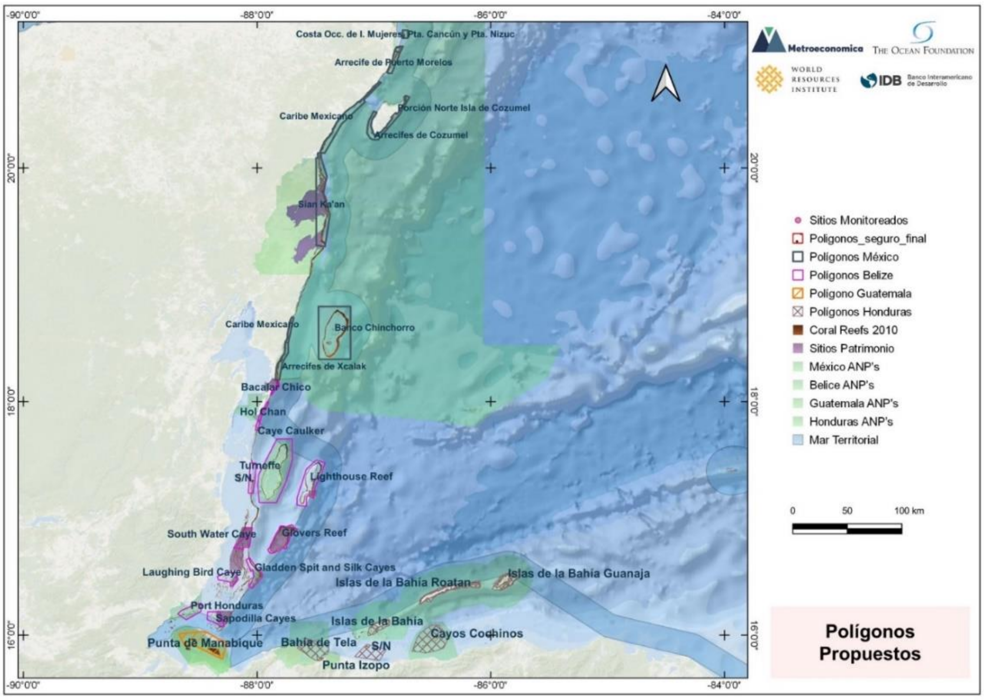


Figure 9. Polygons built from the points selected



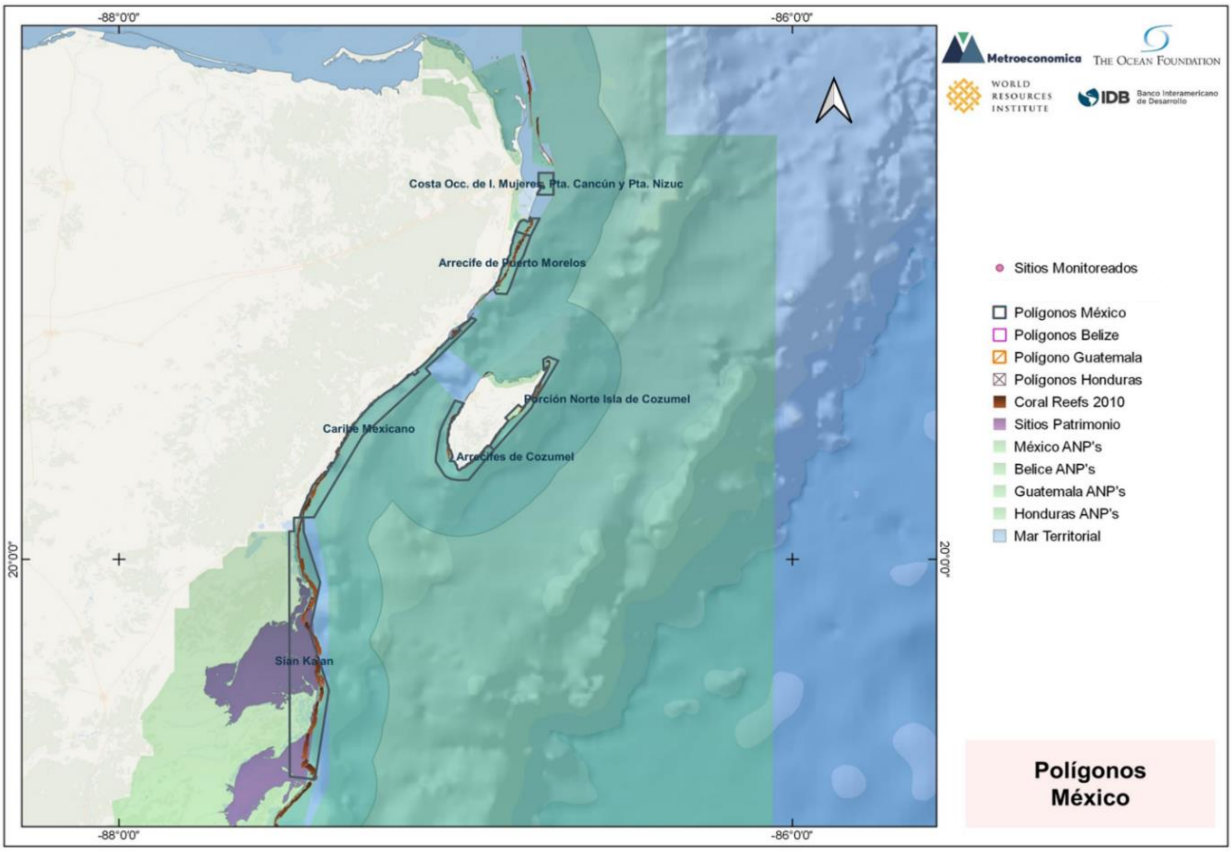
3.3.1 Mexico

The polygons built in Mexico are 8, all of them corresponding to Protected Areas (Table 15 and Figure 10):

Table 15. Mexico polygons

Name	Surface (Ha)
Costa Occidental de Isla Mujeres, Punta Cancún y Punta Nizuc	5944.55
Arrecifes de Cozumel	13853.74
Banco Chinchorro	144476.48
La porción norte y la franja costera oriental, terrestres y marinas de la Isla de Cozumel	8993.07
Arrecife de Puerto Morelos	9133.68
Sian Ka’an	75062.57
Caribe Mexicano	5724465.87
Arrecifes de Xcalak	12929.88

Figure 10. Polygons in Mexico



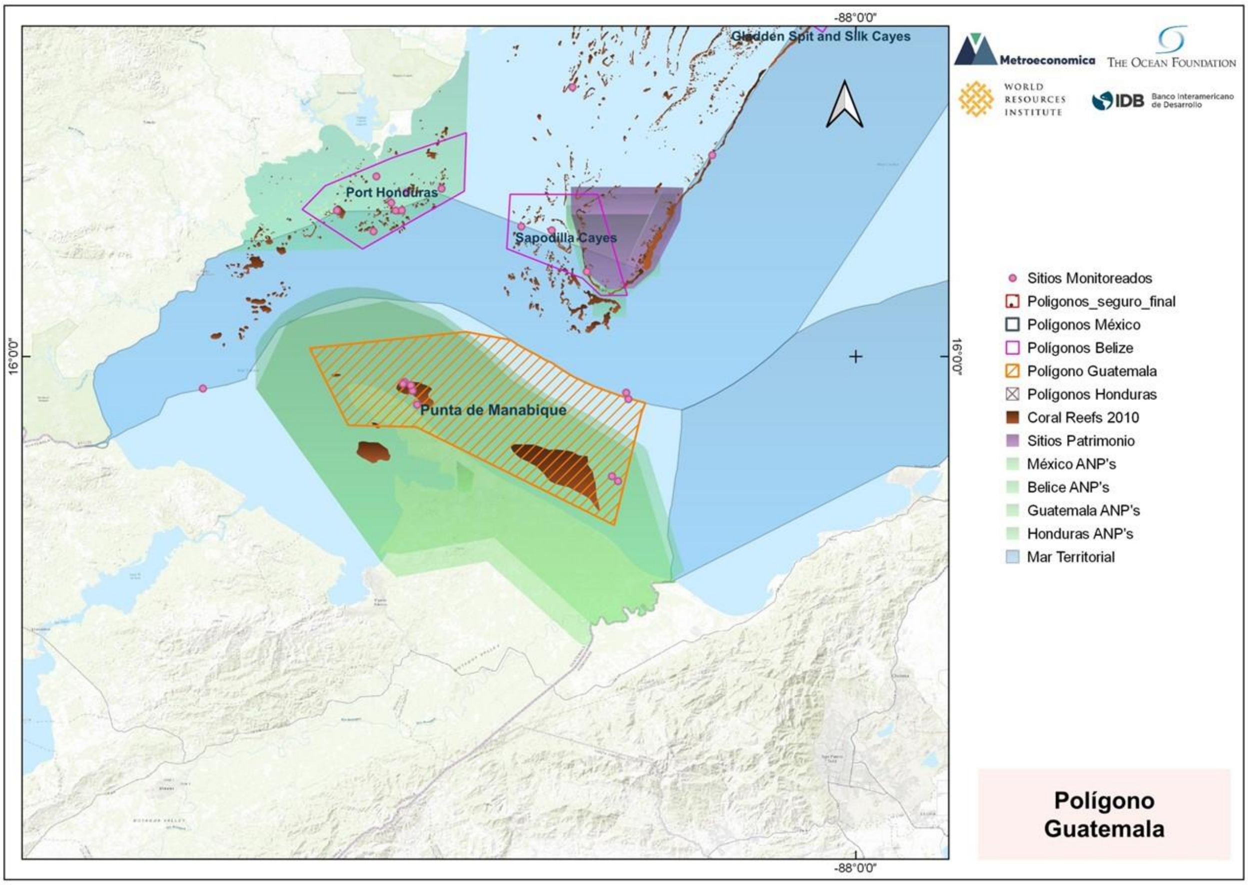
3.3.2 Guatemala

We built only 1 polygon in Guatemala. It belongs to the protected area named Punta de Manabique with a surface of 84,063.95 Ha (Table 16). Map is represented in Figure 11.

Table 16. Polygon in Guatemala

Name	Surface (Ha)
Punta de Manabique	84063.95 Ha

Figure 11. Polygon in Guatemala



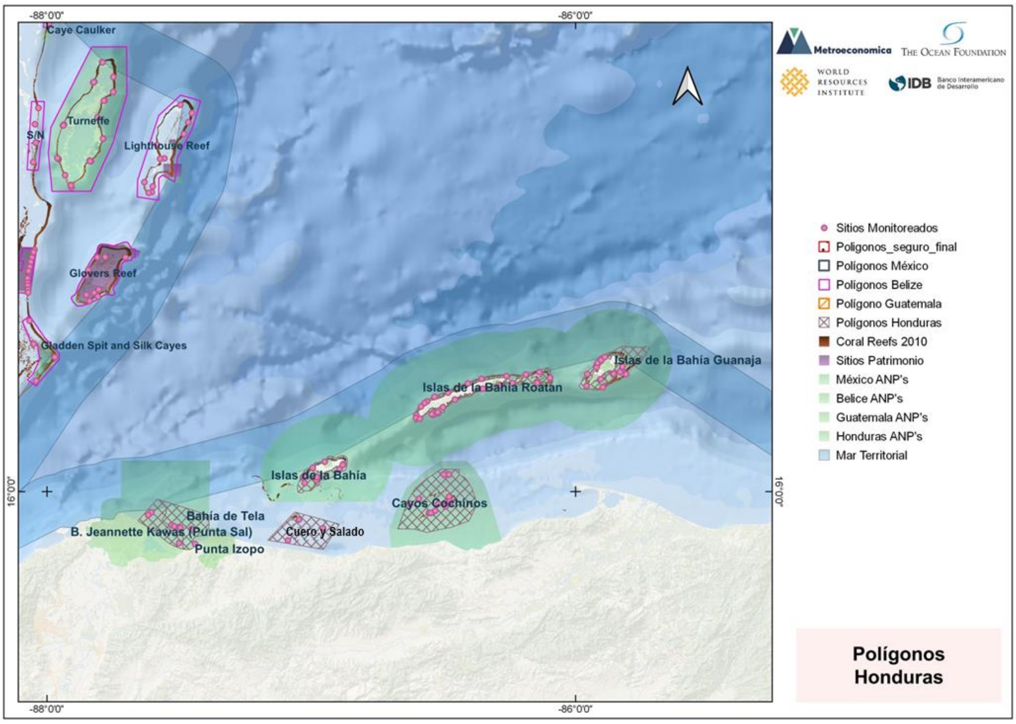
3.3.3 Honduras

We built eight polygons in Honduras, three of these polygons belonging to the Marine Protected Area Islas de la Bahía with a total surface of 647,152.00 Ha (Table 17). Map is represented in Figure 12.

Table 17. Polygons in Honduras

Name	Surface (Ha)
Bahía de Tela	20697.68
Jeannette Kawas	15350.16
Cayos Cochinos	57712.21
Barras de Cuero y Salado	13027.00
Islas de la Bahía	47,152.49
Punta Izopo	108.42

Figure 12. Polygons in Honduras



3.3.4 Belize

We built 12 polygons in Belize, 11 of them belonging to protected areas while only one of them do not correspond to a protected area – this polygon is labeled s/n and it is close to the Turneff Atoll protected area. We list the polygons and their surfaces in Table 18, while the map representing the polygons built are in Figure 13 and Figure 14.

Table 18. Polygons in Belize

Name	Surface (Ha)
S/N	14273.32
Port Honduras	17323.16
Turneffe Atoll	131758.04
Lighthouse Reef	53799.52
South Water Caye	15018.01
Glover's Reef	35089.56
Caye Caulker	2213.77
Bacalar Chico	3115.43
Gladden Spit and Silk Cayes	16978.98
Laughing Bird Caye	14553.63
Sapodilla Cayes	14296.08
Hol Chan	3866.71

Figure 13. Unnamed polygon not belonging to a protected area

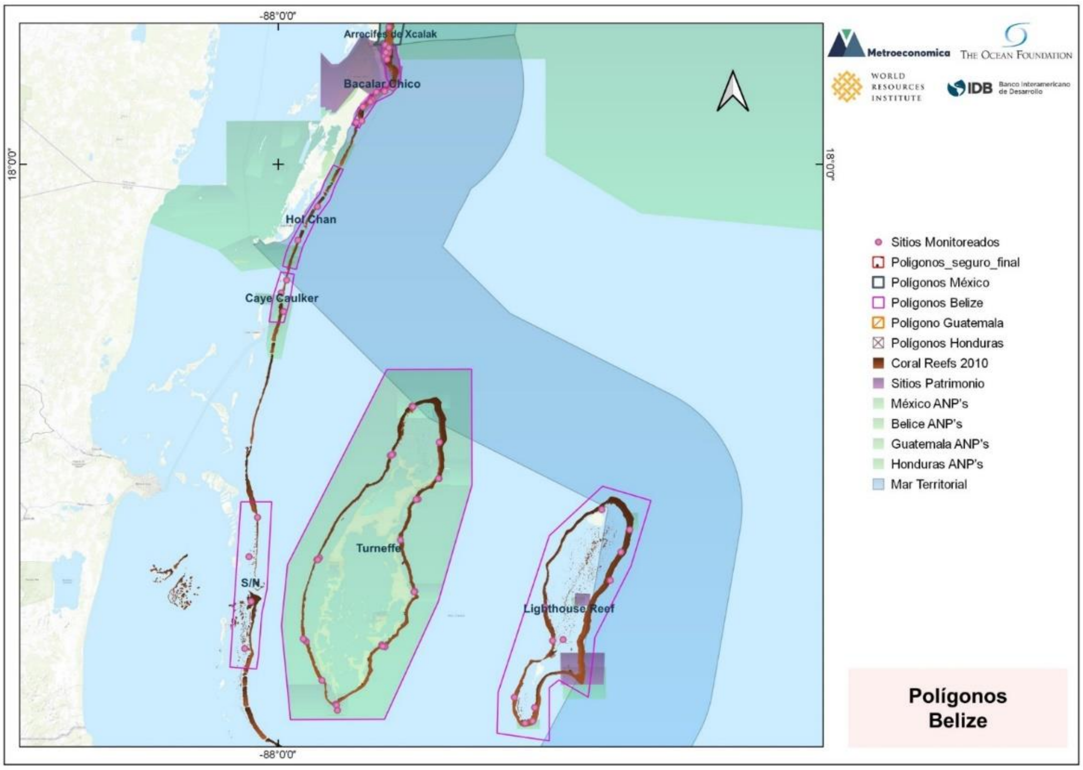
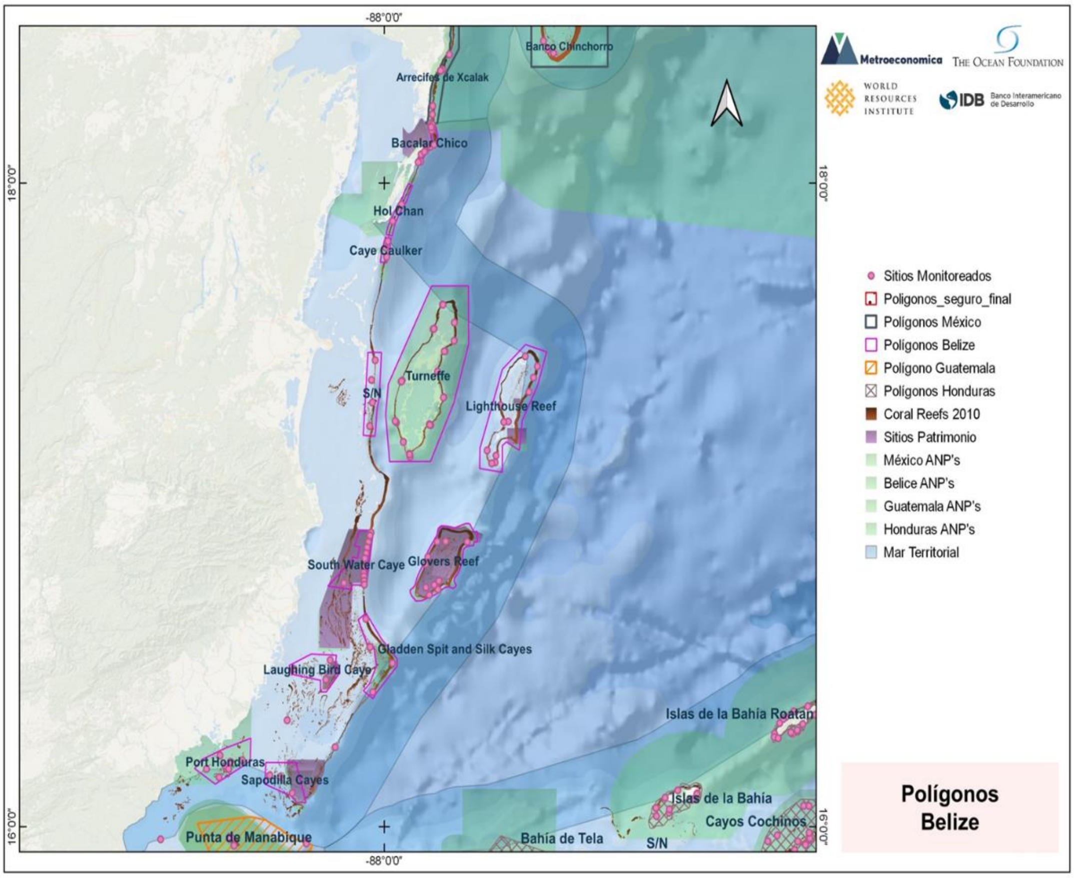


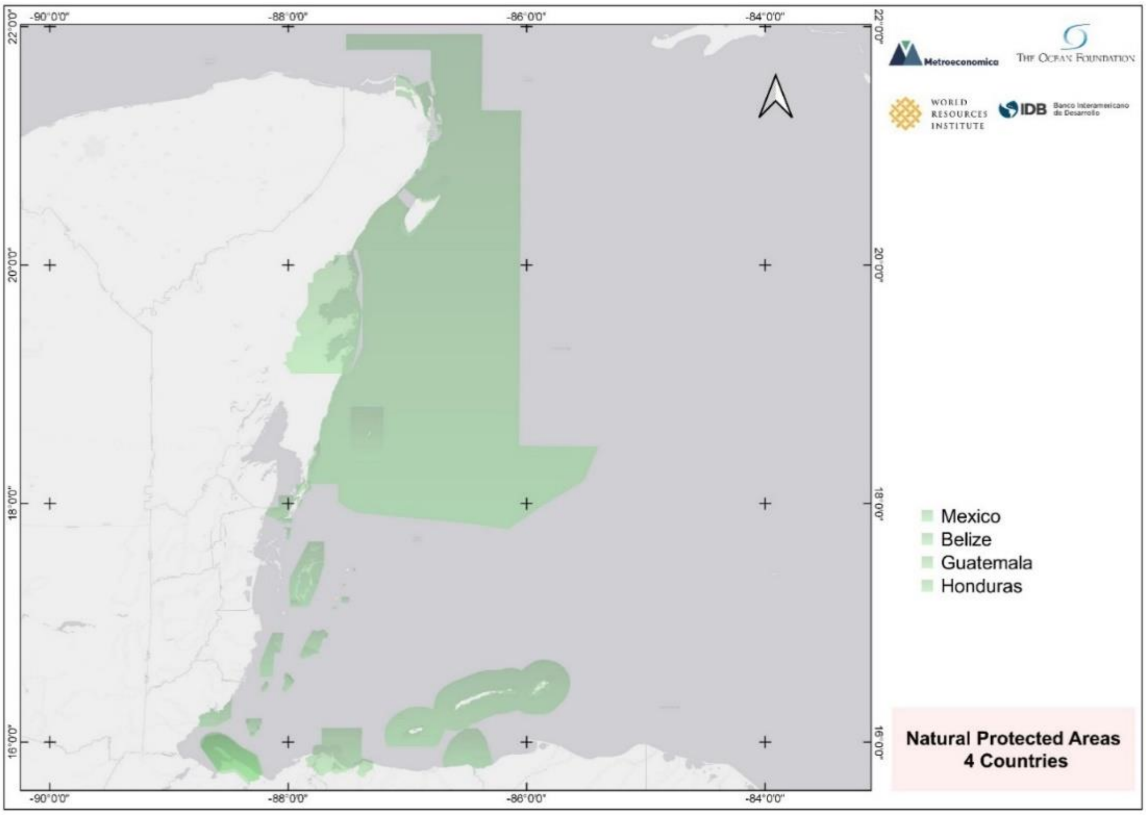
Figure 14. Polygons in Belize



3.3.5 Final selection of sites

After a careful observation and analysis of the information available for the economic valuation of the sites, and considering that almost all the polygons are part of a protected area, we decided that the sample unit should be the protected areas to provide a more accurate estimation of such value, so the final site selection is the following (Figure 15).

Figure 15. Final sites selection based on protected areas



3.4 DESCRIPTION OF SITES AND CHANGES IN ECOSYSTEM SERVICES

3.4.1 General introduction

Coral reefs are among the most vulnerable ecosystems on Earth and many are already degraded. As previously explained, climate change is the biggest and most urgent environmental problem, but, unfortunately, it is not the only phenomenon coral reefs are facing. Other threats include marine heatwaves, overfishing, ocean acidification, scuba diving activities, pollution, coastal engineering and land filling, sedimentation and erosion and a weak legislation to protect them, among others. In any case, it should be noted that not all coral species are equally vulnerable to impacts such as heat stress.

In summary, despite growing awareness of the importance of coral ecosystems to human well-being, their degradation continues and will continue on a large scale.

The Healthy Reefs for Healthy People initiative recently published the 2020 Healthy Reefs Report Card (this is the latest version of the regular Mesoamerican reef report cards). These reports assess the health of coral reefs in the MAR region using four indicators[65]: 1) coral cover; 2) freshy macroalgae cover; 3) herbivorous fish biomass; and 4) commercial fish biomass. On this basis, the Reef Health Index (RHI) is estimated and five quality categories established: very good, good, fair, poor and critical (Figure 16).

Figure 16. Threshold values for the four indicators

Threshold Values for Indicators | Valores de los Indicadores
(ASSIGNED THE HIGHEST RANK MEETING THESE MINIMUM VALUES)
(SE ASIGNA EL RANGO MÁS ALTO QUE CORRESPONDE A ESTOS VALORES MÍNIMOS)

Grade *Rango*	**Coral Cover** *Cobertura de Coral*	**Fleshy Macroalgae Cover** *Cobertura de Macroalgas Carnosas*	**Herbivorous Fish Biomass** *Biomasa de Peces Herbívoros*	**Commercial Fish Biomass** *Biomasa de Peces Comerciales*
Very Good | *Muy Bien*	40%	1%	3,290	1,620
Good | *Bien*	20%	5%	2,740	1,210
Fair | *Regular*	10%	12%	1,860	800
Poor | *Mal*	5%	25%	990	390
Critical | *Crítico*	<5%	>25%	<990	<390

Biomass in g/100m² ▪ Cover in percent benthic cover ▪ Fish biomass modifications based on new a and b values; and adjustments for total vs fork length as described in the online supplement (healthyreefs.org) ▪ Grades assigned to the class meeting these minimum values (maximums for macroalgae) | *Biomasa en g/100m² ▪ Cobertura en % de cobertura bentónica ▪ Modificaciones de biomasa de peces basadas en nuevos valores a y b; y ajustes para la longitud total vs a la horquilla tal como se describe en el suplemento en línea (healthyreefs.org) ▪ Rangos asignados al valor mínimo (máximo para macroalgas)*

Source: Mesoamerican Reef Report Card (2020)

The **main result** is that **16 percent** of the reefs in the MAR region are in a **critical** state, **46 percent** in a **poor** state, **29 percent** in a **fair** state, **8 percent** in a **good** state and only **1 percent** in a **very good** state (specifically in Belize and the Cozumel area). In addition, 7 of the 17 sub-regions into which the study was divided[66] had worsened since the last report in 2018 and only 4 had improved. Two fewer subregions are good, and none are critical.

Out of a possible total of 5 points that the RHI can reach, Mexico has 2.8, Belize has 3, Guatemala has 2 and Honduras has 2.5, as shown in Figure 17.

[65] These are the same indicators that have been used for site selection.
[66] Mexico (North Quintana Roo, Cozumel, Central Quintana Roo, South Quintana Roo, Banco Chinchorro); Belize (North Barrier Complex, Ctr. Barrier Complex, South Barrier Complex, Turneffe, Lighthouse Reef, Glover's Reef); Guatemala; Honduras (West Coast Honduras, Cayos Cochinos, Utila, Roatán, Guanaja).

Figure 17. Reef Health Index for the four countries

Source: Mesoamerican Reef Report Card (2020)

- **Mexico** and **Guatemala** are stuck with the same index since 2018.
  - In Mexico, commercial fish biomass has steadily declined and there is a high value of fleshy macroalgae. The biomassof herbivorous fish has now increased thanks to the high values in Cozumel.
  - As for Guatemala, its RHI remains "Poor" and the lowest in the region. There is a critical decline in commercial fish biomass. In addition, although herbivorous fish doubled (after protection in 2015), it remains "Critical". Coral cover also declined, but is in good condition at 22 percent.
- The RHI in **Honduras** went from "Fair" to "Poor" due to the decrease in herbivores and commercial fish biomass and the increase in macroalgae (note that commercial fish are in a critical situation). Efforts must therefore focus on managing fisheries in a more sustainable manner. On the positive side, coral cover increased (22 percent to 27 percent).

Of all the sites they have monitored in the country, none is in very good health: 15 percent are critical, 54 percent poor, 27 percent fair and only 4 percent good. Roatan is where reefs are in slightly better health.

- **Belize** obtained the highest RHI score in the region, especially thanks to an increase in herbivorous fish biomass and a decrease in macroalgae. However, fleshy macroalgae remained "Poor" (19 percent) and commercial fish declined slightly, reflecting the need for better fisheries management. Fully protected since 2009, parrotfish have increased, now reaching the only "Good" indicator.

At the **regional level**, the health index has also **declined** over time, being 2.3 in 2006 and 2009, 2.5 in 2011, 2.8 in 2014 and 2016 and **2.5** in 2018.

Overall, the main problem is the amount of freshy macroalgae cover, so efforts should focus on reducing it. This means investing in more wastewater treatment plants, reducing pollution of the seas and reducing the emissions that are affecting our seas. Unsustainable fishing practices are also a major challenge in the region and reef-building corals are at risk: as indicated by the report *2020 Healthy Reefs Report Card*, only 7 percent of colonies in 2018 were star corals (*Orbicella spp.*) and 1 percent elkhorn/staghorn corals (*Acropora spp.*).

It should also be noted that **Stony Coral Tissue Loss Disease Outbreak (SCTLD)** is a rapidly spreading disease affecting more than 20 species of hard corals in the Caribbean. It severely affected the Mexican portion in July 2018 (the disease spread rapidly along its 450km coastline and more than 90 percent of the rare pillar coral have died) and reached northern part of Belize in July 2019. The disease eliminated more than 30 percent of the coverage of 22 affected species in Mexico in approximately one year. The data reveal that there are 15 countries/territories where SCTLD is present, 9 countries/territories where treatments against SCTLD is being established, 18 countries/territories are monitoring against SCTLD and 18 countries/territories with education outreach.

3.4.2 Description of sites and changes in ecosystem services

A speed of change (improvement or decrease) was calculated for site quality (RHI) from 2016 to 2018 using the following estimator:

$$\text{SIRHIm}=\frac{d(e^{RHI})}{dt}+\log(VHa)+SP+AP \qquad [1]$$

being

$$RHI=\frac{FM+CF+HF+CC}{4} \qquad [2]$$

where *SIRHIm* is the value index of the modified reef, *FM* corresponds to the coverage of fleshy macroalgae (%), *CF* to the biomass of commercial fishing species ($g/Hm^{2)}$,), *HF* to the biomass of herbivorous fish (g/Hm^2) and *CC* to coral cover (%). *Vha* is the tourist economic value per hectare (USD/Ha) and *SP* corresponds to the proximity to world heritage sites and Protected Areas proximity or belonging to protected areas.

1717 sites were evaluated, obtaining the following results:

a) Mexico. There are only useful data for the evaluation of changes only for 44 sites: 27 (61.36 percent) of these sites worsened their overall condition, 8 (18.18 percent) remained with the same valuation and 9 (20.45 percent) improved their condition (Table 19).

Table 19. Change assessment of sites in Mexico

Site Name	Name of Protected Area	Site Latitude	Site Longitude	Change	Condition final
ZRP Cabezo	Sian Ka'an	19.39949	-87.45519	-2	Critical
Ixcayal	Arrecifes de Xcalak	18.40018	-87.76702	-2	Poor
ZRP Punta Loria	Sian Ka'an	19.51921	-87.42758	-2	Critical
ZRP Punta Loria (Control)	Sian Ka'an	19.5288	-87.42542	-2	Critical
80ssessme Tortugas	Caribe Mexicano	20.58415	-87.10606	-2	Critical
Tulum / Casa Cenote	Caribe Mexicano	20.25863	-87.38535	-2	Poor
Tulum / Sin nombre	Caribe Mexicano	20.21802	-87.41906	-2	Poor
Limones	Arrecife de Puerto Morelos	20.98729	-86.79642	-2	Fair
Banco Chinchorro	RBBC	18.68282	-87.38642	-2	Fair
ZRP El Gallinero (Control)	Sian Ka'an	19.40712	-87.45648	-1	Critical
Cabezo (Control)	Sian Ka'an	19.39314	-87.45577	-1	Poor
Cresta Punta Gavilán	Arrecifes de Xcalak	18.34974	-87.79838	-1	Poor
Mahahual Sin Nombre	Caribe Mexicano	18.66265	-87.71636	-1	Poor
Sian Ka'an Bajo	Sian Ka'an	20.11526	-87.45794	-1	Critical
Maria Helena Sian Ka'an	Sian Ka'an	19.48939	-87.42848	-1	Critical
Between Punta Venado and Paamul	Caribe Mexicano	20.53629	-87.16451	-1	Poor
Bonanza Profundo	Arrecife de Puerto Morelos	20.9575	-86.80848889	-1	Poor
Chunchakab Bajo	Arrecifes de Cozumel	20.27226	-86.99994	-1	Poor
Coral Garden	Arrecifes de Xcalak	18.24015	-87.82623	-1	Fair
Hanan II	La porción norte y la franja costera oriental, terrestres y marinas	20.499	-86.761	-1	Poor
Akumal Profundo	Caribe Mexicano	20.39135833	-87.30757778	-1	Poor
La Bonita	Arrecife de Puerto Morelos	20.91632	-86.8288	-1	Fair
Sian Ka'an Profundo	Sian Ka'an	20.05696	-87.46059	-1	Fair
Tanchacte	Arrecife de Puerto Morelos	20.90759	-86.8326	-1	Fair
Tankah-Cuevitas	Close to Caribe Mexicano	20.26706	-87.39255	-1	Fair
40 Cañones Sur Control	Banco Chinchorro	18.68017	-87.3865	-1	Poor
Banco Chinchorro	RBBC	18.77204	-87.31446	-1	Critical
ZRP El Gallinero	Sian Ka'an	19.41254	-87.46046	0	Poor
80ssessme Punta Gavilán	Arrecifes de Xcalak	18.35314	-87.7907	0	Fair
San Francisco	Caribe Mexicano	18.64969	-87.71769	0	Fair

Site Name	Name of Protected Area	Site Latitude	Site Longitude	Change	Condition final
Hanan	La porción norte y la franja costera oriental, terrestres y marinas	20.51116	-86.75259	0	Fair
Las Cuevitas	Arrecifes de Xcalak	18.2137	-87.82744	0	Good
Akumal Somero	Caribe Mexicano	20.39225	-87.30866111	0	Fair
40 Cañones Norte Control	Banco Chinchorro	18.73953	-87.35179	0	Good
Banco Chinchorro	RBBC	18.76841	-87.32899	0	Critical
Los Gonzalez	Banco Chinchorro	18.58342	-87.4175	1	Fair
Punta Cancun Nizuc	Occ. De I. Mujeres, Pta. Cancún y Pta. Nizuc	21.13336	-86.74054	1	Poor
Villa Blanca	Close to Arrecifes de Cozumel	20.48621	-86.97072	1	Poor
Francesa	Arrecifes de Cozumel	20.35842	-87.02822	1	Good
Yucab	Arrecifes de Cozumel	20.420611	-87.017472	1	Good
Bandera	Occ. De I. Mujeres, Pta. Cancún y Pta. Nizuc	21.17059	-86.72976	1	Good
Banco Chinchorro	RBBC	18.74242	-87.35142	1	Fair
Entre Playa y Punta Venado	Caribe Mexicano	20.55096	-87.1424	2	Fair
Coco Beach	Caribe Mexicano	20.64057	-87.05353	2	Good
Subtotal Mexico				**44**	

When running the analysis by polygon, out of the 8 areas, only 2 (25 percent) improved in the overall condition, while 6 (75 percent) worsened (results are shown in Table 20):

Table 20. Change of overall condition by polygon in Mexico

Name of the polygon	Change rate
Promedio Arrecife de Puerto Morelos	-1.25
Promedio Sian Ka'an	-1.2222
Promedio Arrecifes de Xcalak	-0.8
Promedio La porción norte y la franja costera oriental, terrestres y marinas de la Isla de Cozumel	-0.5
Promedio Caribe Mexicano	-0.5455
Promedio Banco Chinchorro	-0.2857
Promedio Arrecifes de Cozumel	0.5
Promedio Costa Occidental de Isla Mujeres, Punta Cancún y Punta Nizuc	1

b) Guatemala. 10 sites in Guatemala had data that can be used for evaluation of changes: 4 found that 4 (40 percent) of these sites worsened their overall condition, 1 (10 percent) remained with the same valuation and 5 (50 percent) improved their condition (Table 21).

Table 21. Change assessment of sites in Guatemala

Site Name	Name of the Protected Area	Site Latitude	Site Longitude	Change	Condition final
Cabo Tres Puntas	Punta de Manabique	15.96867	-88.55356	-3	Critical
Bajon	Punta de Manabique	15.94762	-88.2788	-2	Fair
Cabo Tres Puntas Sur	Punta de Manabique	15.94085	-88.53802	-1	Poor
King Fish/Foudara	Punta de Manabique	15.9606	-88.80076	-1	Critical
Cabo Tres Puntas 12	Punta de Manabique	15.96642	-88.55547	0	Critical
Los Trozos	Punta de Manabique	15.96464	-88.54567	1	Fair
Motaguilla 136	Punta de Manabique	15.84682	-88.29156	2	Good
Placas	Punta de Manabique	15.95781	-88.54364	2	Good
Motaguilla	Punta de Manabique	15.85288	-88.29902	3	Good
Little Italy (East Bank)	Punta de Manabique	15.85825	-87.45343	3	Very Good
Subtotal Guatemala				**10**	

The overall change in Punta de Manabique was of 0.1, meaning that the condition improved with time (Table 22).

Table 22. Change of overall condition of the polygon of Guatemala

Name of the polygon	Change rate
Glovers Reef	-1.4

c) <u>Honduras</u>. 69 sites were evaluated in Honduras for changes: 51 (73.91 percent) of these sites worsened their overall condition, 13 (18.84 percent) remained with the same valuation, and only 6 (8.69 percent) improved their condition (Table 22).

Table 23. Change assessment of sites in Honduras

Site Name	Name of the Protected Area	Site Latitude	Site Longitude	Change	Condition final
Banco Salmedina	Islas de la Bahia	15.89436	-87.0462	-3	Critical
Front Porch	Islas de la Bahia	16.33441	-86.57124	-3	Critical
Judy’s Place	Bahí¡a de Tela	15.86862	-87.51843	-3	Poor
Baalmorales	Islas de la Bahia	16.42489	-85.90453	-2	Poor
Tariagagu	Cayos Cochinos	15.91957	-86.55431	-2	Critical
Well Roy	Islas de la Bahia	16.45228	-85.83158	-2	Poor
Tom Howell’s Shoal	Islas de la Bahia	16.03252	-87.02547	-2	Poor
Cliff	Islas de la Bahia	16.41113	-86.23973	-2	Poor
Lion’s Paw / Pelican 4	Cayos Cochinos	15.98111	-86.47856	-2	Poor
Salmedina’s Cay Corrected	Islas de la Bahia	16.04326	-86.98087	-2	Poor
Shark Alley	Islas de la Bahia	16.44352	-85.80896	-2	Poor
Linda’s Wall	Islas de la Bahia	16.10348	-86.87947	-2	Poor
Little Cay	Islas de la Bahia	16.05409	-86.97887	-2	Poor
Shallow Sea Quest	Islas de la Bahia	16.28918	-86.6027	-2	Poor

Site Name	Name of the Protected Area	Site Latitude	Site Longitude	Change	Condition final
The Maze	Islas de la Bahia	16.11266	-86.94912	-2	Poor
Wrasse Hole	Islas de la Bahia	16.34072	-86.56174	-2	Poor
Cordelia	Islas de la Bahia	16.29285	-86.54411	-2	Fair
Las Palmas	Islas de la Bahia	16.3188	-86.5016	-2	Fair
Shark / Cara a Cara	Islas de la Bahia	16.28987	-86.54247	-2	Fair
Boomerang Point	Islas de la Bahia	16.41108	-86.14527	-2	Poor
Cayo Cordero	Cayos Cochinos	15.95947	-86.47297	-2	Critical
Capiro Alegria	Bahía de Tela	15.86554	-87.5006	-2	Fair
Jeannette's Reef	Bahía de Tela	15.87305	-87.52869	-2	Poor
Calaway	Islas de la Bahia	16.50801	-85.88915	-1	Critical
Caballeros 2	Cayos Cochinos	15.95457	-86.62655	-1	Critical
Captain Crack	Islas de la Bahia	16.39414	-85.89658	-1	Poor
Perez Corner	Barras de Cuero y Salado	15.86143	-86.9556	-1	Critical
Rock Caves	Islas de la Bahia	16.44394	-85.95537	-1	Poor
Shark Shoal	Islas de la Bahia	16.42967	-86.09623	-1	Poor
Voitague	Cayos Cochinos	15.91946	-86.54763	-1	Critical
West Peak	Islas de la Bahia	16.48613	-85.91708	-1	Poor
Shark Stop	Islas de la Bahia	16.44486	-85.85587	-1	Fair
Trunk Turtle	Islas de la Bahia	16.45107	-86.13706	-1	Poor
Atkins Bight	Cayos Cochinos	15.96647	-86.47972	-1	Poor
Cayo Culebra	Cayos Cochinos	15.95399	-86.51929	-1	Poor
Jose Ramon Shoal	Islas de la Bahia	16.05797	-87.02756	-1	Poor
Port Royal	Islas de la Bahia	16.4003	-86.2836	-1	Poor
Man of War	Islas de la Bahia	16.35788	-86.53368	-1	Poor
Mangrove Bight	Islas de la Bahia	16.10096	-86.88094	-1	Poor
Moon Hole	Islas de la Bahia	16.08498	-86.89317	-1	Poor
Palmetto Bay	Islas de la Bahia	16.37378	-86.48286	-1	Poor
Paraiso	Islas de la Bahia	16.08995	-86.99433	-1	Poor
Politilly Bight	Islas de la Bahia	16.40841	-86.40711	-1	Poor
Rita's Scary Wal	Islas de la Bahia	16.44242	-86.1879	-1	Fair
El Bucanero	Islas de la Bahia	16.3475	-86.4566	-1	Fair
Key Hole Bay	Islas de la Bahia	16.27498	-86.58928	-1	Fair
Smith Bank	Islas de la Bahia	16.29008	-86.5369	-1	Fair
Cordelia Bank	Islas de la Bahia	16.29843	-86.51913	-1	Good
Caballeros 1	Cayos Cochinos	15.9727	-86.59276	-1	Poor
Cocalito	Blanca Jeannette Kawas (Punta Sal)	15.91183	-87.61714	-1	Fair
Jellyfish Garden	Punta Izopo	15.80171	-87.43948	-1	Critical
Allerson Wall	Islas de la Bahia	16.49697	-85.90324	0	Poor
Eel Garden	Islas de la Bahia	16.47025	-85.92023	0	Fair
George Cay	Islas de la Bahia	16.47248	-85.82225	0	Fair
Graham Cay	Islas de la Bahia	16.46074	-85.82514	0	Fair
West End Reef Patches	Islas de la Bahia	16.39906	-85.9585	0	Fair
Camp Bay East	Islas de la Bahia	16.4368	-86.26131	0	Fair

Site Name	Name of the Protected Area	Site Latitude	Site Longitude	Change	Condition final
Cayo Mayor	Cayos Cochinos	15.96377	-86.4761	0	Fair
Cordelia	Islas de la Bahia	16.30007	-86.52129	0	Fair
Oak Ridge	Islas de la Bahia	16.38838	-86.35029	0	Fair
Punta Gorda Bay	Islas de la Bahia	16.42614	-86.35575	0	Fair
Overheat Reef	Islas de la Bahia	16.32145	-86.58442	0	Good
Tree House	Islas de la Bahia	16.27845	-86.60387	0	Good
Piedra de San Juan	Blanca Jeannette Kawas (Punta Sal)	15.80472	-87.50055	0	Poor
Roatan Banks 1	Cayos Cochinos	16.06445	-86.49831	1	Good
Roatan Banks 2	Cayos Cochinos	16.06433	-86.47906	1	Good
Piedra de Pablo	Barras de Cuero y Salado	15.8155	-87.0884	2	Good
Punta Sal (Corumo)	Blanca Jeannette Kawas (Punta Sal)	15.92113	-87.60552	2	Good
Morning Delight/Butterfinger	Islas de la Bahia	15.86358	-87.49528	4	VeryGood
Subtotal Honduras				**70**	

The overall assessment of Honduras is as follows: 57.14 percent of the areas worsened their overall condition (4 polygons) and 42.85 percent improved it (3 polygons). Results are shown in Table 24.

Table 24. Change assessment in the Honduras' polygons

Name of the polygon	Change rate
Promedio Islas de la Bahia	-1.166666667
Promedio Punta Izopo	**-1**
Promedio general	-0.897058824
Promedio Cayos Cochinos	**-0.818181818**
Promedio Barras de Cuero y Salado	0.5
Promedio Blanca Jeannette Kawas (Punta Sal)	**0.5**
Promedio Bahia de Tela	0.75

d) Belize. There are useful data for 48 sites: 25 (52.08 percent) of these sites worsened their overall condition, 19 (39.58 percent) remained with the same valuation and only 4 (8.33 percent) improved their condition (Table 25).

Table 25. Change assessment of sites in Belize

Site Name	Name of Protected Area	Site Latitude	Site Longitude	Change	Condition final
1071_SFR	Turneffe Atoll	17.47736	-87.78485	-2	Poor
Glover's North inner patch	Glovers Reef	16.88644	-87.78005	-2	Critical
SP_SFR	Turneffe Atoll	17.33352	-87.78812	-2	Poor
1206_SFR	Turneffe Atoll	17.2486	-87.83705	-2	Poor

Site Name	Name of Protected Area	Site Latitude	Site Longitude	Change	Condition final
Glover's Southwest	Glovers Reef	16.72	-87.8387	-2	Poor
South of Curlew (sunken caye)	South Water Caye	16.76494	-88.0761	-2	Poor
SWCCZFR2	South Water Caye	16.86805	-88.06128	-2	Poor
SWCGUZFR1	South Water Caye	16.91365	-88.04752	-2	Poor
SWCGUZFR2	South Water Caye	16.90474	-88.05085	-2	Poor
Control	Bacalar Chico	18.06742	-87.86975	-2	Critical
Glovers	Glovers	16.81538	-87.85217	-2	Fair
Carrie Caye	Laughing Bird Caye	16.51746	-88.19352	-1	Critical
Paranga Grounding Site	Turneffe Atoll	17.31848	-88.0425	-1	Poor
Rendezvous Caye Patch	Turneffe Atoll	17.24508	-88.05223	-1	Fair
SP_DFR	Turneffe Atoll	17.33406	-87.78709	-1	Poor
WP4_DFR	Turneffe Atoll	17.38347	-87.93974	-1	Poor
Glover's NW	Sapodilla Cayes	16.8856	-87.8102	-1	Poor
Southwes Glovers patch	Glovers Reef	16.74339	-87.85077	-1	Poor
West of Hat Caye	South Point Lighthouse	17.1692	-87.6317	-1	Fair
West of Laughing Bird Caye	Laughing Bird Caye	16.45676	-88.2093	-1	Poor
CB_BR	Turneffe Atoll	17.15853	-87.91023	-1	Fair
CB_DFR	Turneffe Atoll	17.14891	-87.90773	-1	Fair
North of Caye Caulker Marine Reserve	Caye Caulker	17.79961	-87.99541	-1	Fair
Glover's Northeast	Northern Glovers Reef	16.88532	-87.70304	-1	Poor
South of Carrie Bow Caye	South Water Cay	16.64572	-88.0662	-1	Fair
Big White-Gladden Channel	Gladden Spit and Silk Cayes	16.5079	-87.9707	0	Critical
1062_DFR	Turneffe Atoll	17.25871	-87.95925	0	Poor
1062_SFR	Turneffe Atoll	17.2603	-87.96102	0	Poor
Round Caye	Gladden Spit and Silk Cayes	16.4185	-88.0413	0	Poor
Bugle's Caye	Laughing Bird Caye	16.4903	-88.3236	0	Fair
Mackerel Hole	Caye Caulker	17.77042	-87.99141	0	Poor
North of Middle Caye	Glovers Reef	16.75118	-87.8214	0	Poor
Sandbore SPAG site	Sandbore	17.4303	-87.45177	0	Fair
South Point Wreck Site	South Point Lighthouse	17.15318	-87.59994	0	Fair
Transfer Wrecksite	Sandbore	17.3956	-87.46557	0	Fair
West HalfmoonCaye park edge	Half Moon Caye	17.2591	-87.5558	0	Fair
West of Sandbore Caye	Sandbore	17.46172	-87.49525	0	Fair
WP4_SFR	Turneffe Atoll	17.38359	-87.93821	0	Fair
1206_DFR	Turneffe Atoll	17.24799	-87.83337	0	Fair
Near Wee Wee Caye	South Water Caye	16.75744	-88.14417	0	Good
North of Hol Chan MR	Hol Chan	17.8817	-87.96947	0	Poor
Sianora Dive Site	Turneffe Atoll	17.19558	-87.9318	0	Fair
SWCGUZFR6	South Water Caye	16.75225	-88.07146	0	Fair

Site Name	Name of Protected Area	Site Latitude	Site Longitude	Change	Condition final
West of Jack Barrow Camp	Turneffe Atoll	17.54819	-87.821	0	Good
East of Turneffe Flats	Turneffe Atoll	17.41428	-87.8094	1	Fair
Daly Bank	Port Honduras	16.33054	-88.34744	1	Fair
Southwest of Maugre Caye	Turneffe Atoll	17.56664	-87.7489	1	Poor
North of Mexico Rocks	Bacalar Chico	18.186	-87.83305	2	Fair
Subtotal Belize				**48**	

When running the analysis by polygons, we found that, out of the 12 areas, only 1 (8.33 percent) showed improvement in the overall condition, 8 (66.67 percent) worsened their overall condition, and 3 areas kept the same score (25 percent). Results are shown in Table 26.

Table 26. Change of overall condition by polygon in Belize

Name of the polygon	Change rate
Glovers Reef	-1.4
South Water Caye	-1.28571429
Glover’s Reef	-1
Sapodilla Cayes	-1
Laughing Bird Caye	-0.66666667
Turneffe Atoll	-0.58823529
Caye Caulker	-0.5
South Point Lighthouse	-0.5
Bacalar Chico	0
Gladden Spit and Silk Cayes	0
Hol Chan	0
Port Honduras	1

4. SELECTED METHODOLOGY AND ALIGNMENT WITH THE SEEA

In this section, a clear justification for the economic method being selected and its alignment with those being discussed in the context of the SEEA Ecosystem service accounts is provided. An analytical framework for conducting this mapping is shown in Table 27 below.

Table 27. Preliminary analytical framework for mapping available methods

Ecosystem service	Appropriate methods	Aligned with the SEEA
Food	Market price	✓
	Production function	✓
Raw materials	Market price	✓
	Production function	✓
Medicinal resources	Damage cost avoided	✓
	Replacement cost	✓
	Production function	✓
Tourism and recreation	Market price	✓
	Travel cost	✓
	Choice modelling	✗
	Contingent valuation	✗
	Hedonic pricing	✓
Erosion regulation	Replacement cost	✓
	Damage cost avoided	✓
Biodiversity protection	Choice modelling	✗
	Contingent valuation	✗
	Travel cost	✓
	Hedonic pricing	✓
Nutrient cycling	Damage cost avoided	✓
	Contingent valuation	✗
Historical and cultural issues	Choice modelling	✗
	Contingent valuation	✗
Genetic resources	Market price	✓
	Damage cost avoided	✓
Climate regulation	Choice modelling	✗
	Contingent valuation	✗
Science, knowledge, education	Choice modelling	✗
	Contingent valuation	✗

Source: own elaboration based on Waite, R., Burke, L., Gray, E. (2014)

4.1 METHODOLOGIES: SELECTION AND JUSTIFICATION

Both use (tourism, fisheries and shoreline protection) and non-use values are estimated. Building on the framework set out in section 1.2.3, we identified the approaches to be used in the analysis:

- **Tourism & recreation**: market prices.
- **Fisheries**: market prices.
- **Shoreline protection**: benefit transfer.
- **Non-use values**: contingent valuation.

In this way, the key components of **total economic value** for coral reefs in the Mesoamerican Reef region can be obtained.

In the next part of this final document – Economic Valuation Results – we detail more precisely the methodology used for the monetary estimation of each good and service. However, we consider it appropriate to give a brief explanation of the method chosen and the justification for having been selected.

4.1.1 Use values

Coral reefs provide direct economic benefits that should be considered when taking decisions on investing in their conservation and protection. Building on the framework set out in section 2.1.2 and 2.2.2, the approach to assess their "use values" adapts to the fact that the commodities associated are often sold in existing markets (MA, 2005; TEEB 2009, 2010; OECD, 2002; Christie et al. 2012; OECD, 2018).

Reefs participate in the provision of private or quasi-private goods for which market prices usually exist. In well-functioning markets, preferences and marginal costs of production are reflected in a market price, which implies that these can be taken as accurate information on the value of goods and services (EU et al., 2013). Market prices are expected to reflect the minimum values of the current transaction prices or market prices for the associated goods, services, or assets that are exchanged. (UN, 2014)[67]. The main advantage of using the market price approach is that we can use data from actual transactions, thus reflecting actual preferences or costs to individuals (Hanley et al., 2007; Stavins, 2008; Field & Field, 2017). However, the accuracy of the valuation analysis is ultimately limited by the quality and availability of data for the sites that will be study (WRI, 2009).

As presented in the section 2.2.2, 2.2.3 and 2.2.4, the market price method has been used in several studies worldwide, in particular in the Caribbean region, to highlight the economic value of coral reefs (UN Environment, ISU, ICRI & Trucost, 2018). For this project, we used the literature review and followed the guide and tools[68] presented in the *Coastal Capital Project*: Economic Valuation of Coastal Ecosystems in the Caribbean developed by World Resources Institute (WRI) which was used for case studies in Belize, Jamaica, Tobago St. Lucia and Dominican Republic (Burke & Maidens 2004; Cooper et

[67] Strictly, market prices are defined as amounts of money that willing purchasers pay to acquire goods, services, or assets from willing sellers. The exchanges should be made between independent parties on the basis of commercial consideration. (UN, 2014).
[68] https://www.wri.org/our-work/project/coastal-capital-economic-valuation-coastal-ecosystems-caribbean/coastal-capital#project-tabs

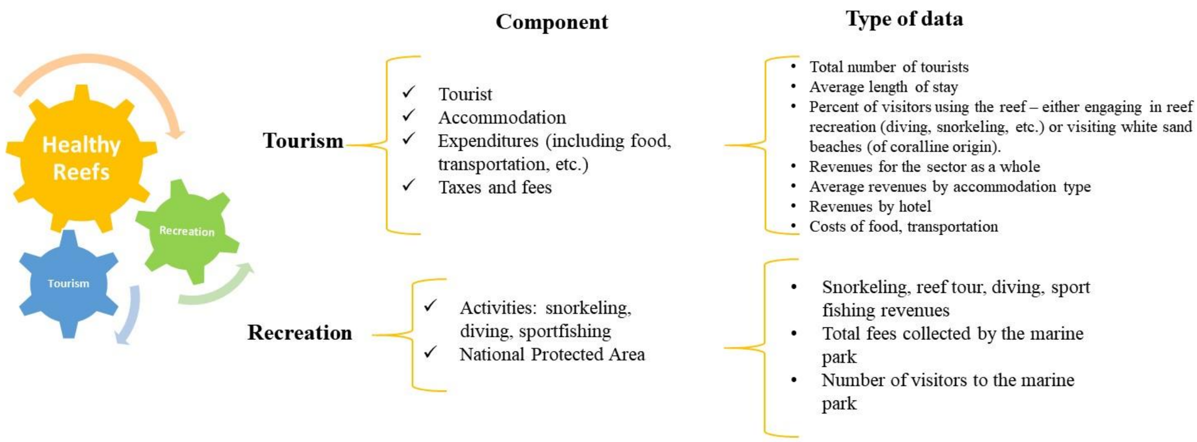
al., 2009; Waite et al., 2011; Kushner et al., 2011). The project focuses on three key coral reef-associated goods and services for which it is feasible to obtain market values: tourism & recreation, fisheries, and shoreline protection.

Tourism and recreation

The first step to assess the economic value of reef-related tourism is to estimate the percentage of tourists in a touristic location that visit the coral reefs. Tourist profiles and trip characteristics (e.g. main purpose of the trip, average length of stay, nationality, gender, type of travel package used, average income, travel expenditures, type of aquatic activities undertaken (snorkeling, scuba diving, kayaking, photographing, etc.), are key variables for the estimations (WRI, 2009). These characteristics influence how much the local economy benefits from a tourist's visit and reflect how important coral reefs and coastal environmental quality are for the choice of destination. This information allows researchers to identify the number of visits to sites motivated at least partially by their coral reefs (Spalding et al, 2017).

The percentage of visitors related to coral reefs visits are used to prorate revenues from the major tourism categories: accommodation, cash flow (revenue, wages, taxes, etc.), recreation activities, miscellaneous expenses, etc. This is especially important when specific data are not available. These values can also be used to approximate the number of visitors to the sites if direct data are not collected at the site (Stynes, 1999; WRI, 2009; EuroStats, 2012; Mayer, 2016). However, this only represents a portion of the value, or welfare, that society derives from this natural resource. In particular, the portion that is captured by the economy. Figure 18 presents the components and information needed to calculate the use value (tourism & recreation) of reefs in the MAR Region.

Figure 18. Components and information needed to calculate de market price value for tourism and recreation



Source: Adapted from WRI (2009)

In terms of accommodation data, it is important to define the nights spent in the locality where there are coral reef-related activities, as mentioned above. Depending on the quality of data available on room rates, occupancy rates, type of accommodation, annual revenues from accommodation, foreign versus domestic ownership and/or type of visitors attracted, the estimate will be more accurate. However, if such information is not available, more aggregated information should be used. The two approaches to estimating gross or total income from accommodation are (Stynes, 1999; WRI, 2009; EuroStats, 2012; Mayer & Vogt, 2016; WTO, 2019):

1. Estimating revenue based on the number of tourists, the nights they spend and the time they stay.
2. Estimating revenue based on the number of rooms, the average price of rooms and the occupancy rate.

If accommodation costs are not available, the alternative is to use labor and non-labor operating and maintenance costs for each category of establishment. Aggregated data are used to estimate these costs, as microdata are often not available at this level (WTO, 2019).

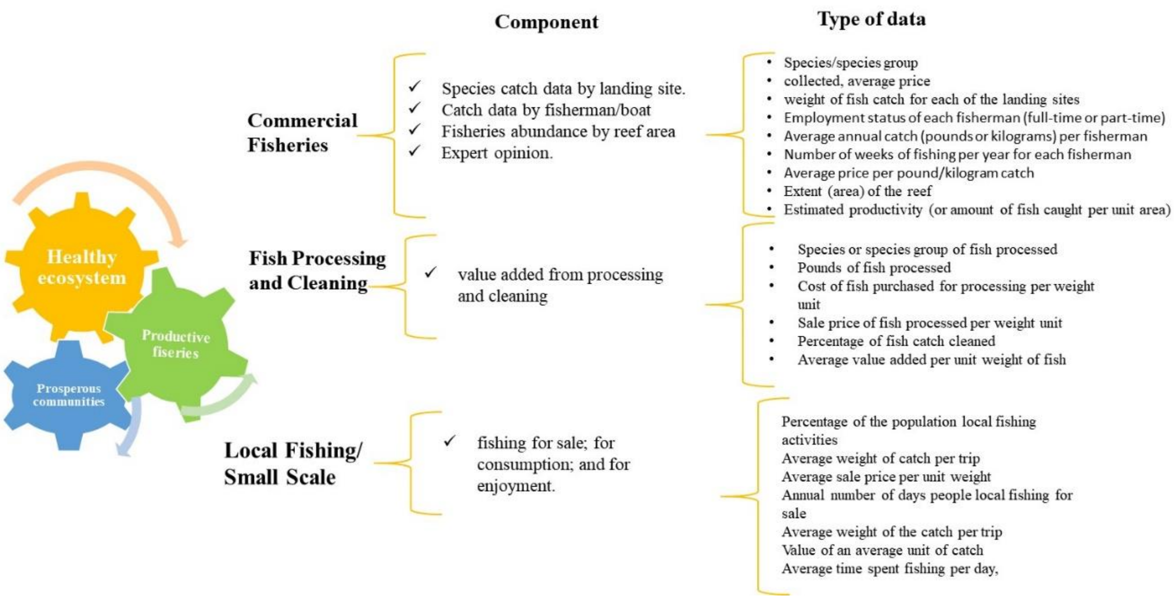
Reef recreation includes visiting reefs for diving, snorkeling, kayaking, reef hiking, sport fishing on reefs within or outside a protected area (Arin & Kramer, 2002; Green & Donnelly, 2003; Spalding, 2017). Estimating revenues per activity requires information such as the number of tourists per activity, the number of trips or the price of the activity. Therefore, it is important to gather information on the percentage of trips that are purchased as part of all-inclusive packages and on-site tourism packages (WRI, 2009).

The following secondary sources are used to collect the information needed: the most up-to-date and relevant market data related to tourism research on activity prices, literature review, exit surveys on visitor activities, revenue from recreation activities generated by Marine Park and local statistics (RPA, 2013; OECD, 2017). Some of the sources to be used include the World Tourism Organization Statistics compendium, the Belize Tourism Board's Visitor Expenditure and Motivation Survey (VEMS), the Statistics of the Instituto Hondureño de Turismo, Statistics of the Instituto Guatemalteco de Turismo, Tourism Statistics from National Institute of Statistics and Geography for Mexico (INEGI), Statistics of Natural Protected Areas visitors, price of activities, revenues from fees collected for countries in the MAR Region, databases of tourism operations and tourism market studies.

Fisheries

To assess the economic value of reef-related fisheries, it is useful to define the profile of the fishing industry and small-scale fisheries for each study site, including the type of fishery, the main species, the level of production and the main markets where the fish is sold (Crutchfield, 1962; Burke et al., 2008; WRI, 2008; Cooper et al., 2009; UN Environment, ISU, ICRI & Trucost, 2018), as shown in Figure 19.

Figure 19. Components and information needed to calculate de market price value for fisheries



Source: Adapted from WRI (2009)

The value of commercial fishing is calculated by using the revenue from catching reef associated fish and subtracting the estimated operating costs. Revenue is based on the catch of fish and the price of fish (annual average) for each reef-associated species. Fishing costs are based on estimates of labor and operating costs for the fishing vessel owner (WRI, 2008; Burke et al., 2008). Depending on data availability, WRI (2008) suggests three ways to calculate the value of commercial fishing by landing site:

- Catch data by fishermen/vessel. If official statistics are not collected, a representative sample of fishermen or vessels can be used to calculate the total value of the commercial fishing sector.
- Abundance of fishing by reef area. Estimates of reef and productivity require knowledge of the number of fish caught per unit area, as well as statistics on the extent of the reef and regional estimates of fishery abundance for fish catch statistics.
- Expert opinion: This method is used when reliable data are not available to estimate fish catches. Experts can provide estimates of the number of fishermen or vessels at each landing location, as well as the number of fishing trips and average catch by species.

For the next component (fish processing facilities), the value is calculated as the difference between the price paid to the fishermen for their catch and the final selling price of the processed fish. This is the added value of processing (WRI, 2008; Burke et al., 2008).

Finally, the last component – the economic value of cleaning – can be calculated with the local price of the total fish versus the cleaned fish, and also as the percentage of the catch that is sold after cleaning at landing sites. If this information is not available, it is also possible to estimate revenue with information on the number of independent fish cleaners at the study site: average hours worked per week/year (seasonally weighted if necessary); and. average hourly earnings (WRI, 2008; Burke et al., 2008).

The small-scale fishing sector has problems with data collection and analysis. One option is to use replacement cost methods to estimate the economic value of subsistence fisheries. This method is based on the premise that, if subsistence users were deprived of their source of livelihood (e.g. fish), they would have to purchase products of similar quality, which would incur a cost.

Localized surveys or expert opinion can be used to estimate the number of fish that fishermen keep for their livelihoods over the course of an average year. In many places, fish kept for consumption is of slightly lower quality than market fish. Therefore, a price slightly below market value can be used to estimate the equivalent market value of subsistence fish (Schumann & Macinko, 2007). Another option is to conduct a survey to directly measure the proportion of the population that fishes for their own consumption, including both commercial fishermen and the general population, and how much fish they catch for subsistence in a given year.

Data limitations have proven to be an additional challenge in the fisheries sector, and there are considerable differences in the data richness in different parts of the Caribbean. While reliable estimates of fish catch exist in some areas, in many parts of the Caribbean there are no reliable records of fish catch. In those cases, rough estimates of catch can be made through fishing effort or reef productivity. Very little information exists on local and subsistence fishing in much of the Caribbean.

Shoreline protection.

A benefit transfer has been conducted to estimate the economic value of the shoreline protection service. In this way, economic values for the MAR region can be calculated by transferring available information from previous studies calculating the same values in another location or context. This requires making a series of adjustments to get as close as possible to the value we want to obtain. As mentioned above, there are several studies/reports valuing this service worldwide (Cesar et al., 2003; de Groot et al., 2012; Beck et al. 2018), in the Caribbean (Burke & Maidens, 2004; Burke et al., 2008; Cooper et al., 2009; Wielgus et al., 2010; van Zanten & van Beukering, 2012; UN Environment, ISU, ICRI & Trucost, 2018; Reguero et al., 2019) and in other regions (see Table 5). These studies were used as a basis for the analysis.

4.1.2 Non-use values

As mentioned in section 2.2.3, stated preference techniques have received growing attention over the last decades due to their flexibility and ability to estimate non-use values (Atkinson & Mourato, 2008; Hoyos et al., 2012). In our case, a contingent valuation study has been conducted in order to elicit the WTP pay for the coral reef's protection[69]. It is also a very useful tool for taking efficient decisions and improving the efficient allocation of ecosystem services. Thus, we have chosen this method because of its many advantages:

- It has great flexibility, as it can be utilized to estimate the economic value of almost anything. In other words, it allows for the valuation of a wider variety of non-market ecosystem services than is possible with any of the other above-mentioned techniques. However, it is desirable to apply it for goods and services that are easily identified and understood by users, even if there is no observable behavior available to deduce values through other means.
- Without a doubt, it is the most widely accepted method for estimating total economic value, including all types of non-uses values (existence, bequest, and altruistic values). Since the first published contingent valuation study on valuing outdoor recreation in 1963, around 1400 studies related to the method have been published. Likewise, it has been used successfully in a variety of situations.
- Results are easy to analyze and describe. Dollar values are presented (in terms of a mean or median value) per capita, per household or as an aggregate value for the population concerned.
- Randomly selected samples or stratified samples selected from the general population are given information about a particular problem. Nevertheless, the resulting data are then analyzed statistically and extrapolated to the population.
- As mentioned in section 1.2.3, it is based on the random utility approach (economic utility theory) developed by McFadden in 1974 and can produce reliable estimates. Moreover, a great deal of research is constantly carrying out to improve the methodology and make the results even more reliable. Most biases can be eliminated by careful survey design and important progress has been made with the validity of stated preference techniques.

As explained above, the way people value and perceive coral reefs goes beyond consideration of its natural ecosystem, so the value given varies according to individuals' circumstances and experiences. Applying these methods thus involve considering behavioral patterns and the heterogeneity of preferences within or between individuals (Farizo et al., 2014a, 2016). Traditionally, heterogeneity has been included through variables reflecting individual characteristics (education, gender, age, or income), so the

[69] Considering that surveys will be conducted online, it is more appropriate to use contingent valuation instead of choice modelling, whose design is better suited to face-to-face interviews.

effect of these variables on individuals' utility and WTP can be explored. Attitudinal and behavioral factors, as well as the influence of the socio-cultural and regional context, have often been disregarded. However, their inclusion has been increasing over the last years (Boxall & Adamowicz, 2002; Johnston, 2007; Soliño et al., 2009; Farizo et al., 2014a, b, 2016; Hoyos et al., 2015).

The key elements of the study are the design of the instrument (Boyle, 2003) and the analysis of the data obtained. The steps for a correct implementation of the study are:

1. Identify the change or changes in the quantity or quality of the ecosystem service, as well as the effects that occur with that change.
2. Agree on the way to collect the information or, what is the same, to carry out the surveys (personal, by mail, online ...).
3. Define the sample size: it must be a large size.
4. Design the survey:
    a. Describe the service to be assessed by a general introduction in which information is provided to the respondent, exposing the current status of the service, and asking questions about previous experiences.
    b. Explain the method of provision of the good or service.
    c. Select the payment vehicle to be used (tax, donation, entry, etc.), as well as the timeframe for payment (single, temporary, permanent payment ...).
    d. Select the decision rule that will explain that if, for example, 50 percent of respondents respond affirmatively to a dichotomous question, a specific policy to conserve biodiversity will be implemented.
5. Design the contingent valuation question:
    a. Select the question format (open or closed).
    b. Prepare questions to detect potential null values, as well as protest and strategic answers.
6. Develop a series of auxiliary questions:
    a. Include questions that provide covariances for statistical analysis.
    b. Include questions that help assess the validity of valuation responses.
7. Perform a pre-test: it is desirable to conduct a pre-test with individual interviews or focus groups. This seeks to ensure that the survey questions are understandable to the respondents. They also help to know a range of amounts to determine the willingness to pay / accept.

In our case, 3,910 online surveys were conducted (details on the distribution of the number of interviews by country are given in the next section). Online surveys were conducted in Mexico, Honduras, and Guatemala. In Belize, face-to-face interviews were conducted.

The survey was designed by the study group and double-checked by external experts before survey implementation. The surveys used in Deloitte (2017) and Ruiz-Gauna (2017) have become a fundamental source of information for the design.

Survey implementation was outsourced to Ipsos Public Affairs, the 3rd largest company in the world in market and public opinion research specialized in conducting surveys. They was conducted using the Ipsos own panel, which has representative samples of the

Internet population in all countries under study except in Belize. Note that it does not exist a panel in Belize, whether from Ipsos nor from any other company.

The approach aims to cover two broad areas: resident population and potential tourists.

Bearing in mind the objective of this study, online interviews are recommended because the Internet user population in these countries probably corresponds to the best positioned socio-economic groups in the country, which are also those whose opinion is most taken into account.

4.2 ALIGNMENT OF THE METHODS WITH THE SYSTEM OF ENVIRONMENTAL ECONOMIC ACCOUNTING: A DEEP REVIEW

Ecosystems provide many services that are relevant to society, such as climate change regulation or biodiversity conservation. Thus, environmental (and ecosystem) accounts[70] are relevant in that they permit analyzing the interactions between the economy and the natural environment, as well as knowing the state of natural stocks in terms of sustainability (Nordhaus & Kokkelenberg, 1999).

While the System of National Accounts (SNA) is the international accounting standard, developed and developing countries, as well as supranational institutions, have made important advances with the view to helping this system become a more effective tool in policy making (OECD, 2004; Bos, 2013). There has, therefore, been an increasing interest in scientific and political arenas for extending national accounts to ecosystem services that are not recorded by the SNA but are essential for human well-being (Stiglitz et al., 2009). The System of Environmental and Economic Accounts (SEEA) and the SEEA Experimental Ecosystem Accounting (SEEA-EEA) frameworks were developed to that end. SEEA-EEA relates ecosystems to economic activities in both physical and economic terms and covers some of the associated services classified by the report published by the Millennium Ecosystem Assessment (MA) in 2005. Even though this system has its roots in conventional and 'satellite'[71] systems of accounts, it aims to shed light on the non-market activity related to ecosystems and to integrate this information with market related data (UN et al., 2013: 19). It also attempts to make visible some market environmental services that are not recorded by current measurements of conventional national accounts and to differentiate ecosystem services and assets in terms of the actors involved, namely public and private sectors (UN et al., 2013: 113).

The World Bank also launched the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) program to start pilot applications in developing countries (including Costa Rica and Guatemala), and previous efforts can be found in the Millennium

[70] Environmental accounting aims at assessing the influence of natural resources into the national accounts, which are a set of macroeconomic accounts oriented towards providing a detailed picture of the economic activities in an economy and the interactions between stakeholders. Thus, it obtains information (stocks and flows) on a wide range of natural resources and their use. Ecosystem accounting (or natural capital accounting) is a subfield within environmental accounting. Consequently, it provides information on ecosystem stocks and flows.
[71] Satellite accounting was created to allow for conceptual variation of the standard SNA (Edens & Hein, 2013).

Ecosystems Assessment or The Economics of Ecosystems and Biodiversity (TEEB) project. In Europe, the European Commission set the implementation of Environmental and Economics Accounts as a goal for the EU member states by 2020.

4.2.1 Background

Based on the double-entry bookkeeping method, national accounting systems emerged around the efforts to measure aggregated economic activity. Although the first formal national accounts were published in the United States, soon there were also important advances in Europe. That is why the United Nations began preparing the groundwork for the future development of the SNA. The first SNA was presented in 1968 and remained valid until 1993, when the new version was endorsed. It was *"a comprehensive and detailed framework for the systematic and integrated recording of the flows and stocks of an economy"* (Bartelmus, 1989, 81).

National accounts consist of two sets of accounts:

- Current accounts: they provide information on monetary transactions linked to the production and use of goods and services, as well as on the distribution and redistribution of income from productive activities (ISWGNA, 2009: 3). Gross Domestic Product (GDP) is the main aggregate measure in these accounts.
- Assets accounts (capital balance): they describe the changes in the stock of an asset and the monetary information on stocks of productive assets (ISWGNA, 2009: 331).

Both accounts contain two common concepts: consumption of fixed capital (depreciation) and gross capital formation (gross investment). Thus, subtracting them from GDP yield conventional Net Domestic Product (NDP).

Nevertheless, the SNA has some ‘gaps’ when it comes to the role played by the environment in economic activity:

- It only incorporates final consumption.
- Newly discovered reserves and changes in the values of reserves because of price changes are not considered either (Harrison, 1989).
- Non-market *amenities* are not included.
- Differences experienced during the period by man-made capital and natural capital are left out (Caparrós et al., 2003). It therefore fails to adjust accounting indicators by the use of productions in progress (as part of costs) and natural growth of the year (as part of final production) (Campos, 2015).

In this way, the SNA only estimates an incomplete and inconsistent concept of national income, known as Net Valued Added (NVA), rather than tending towards the measurement of Hicksian income: *“the maximum value which a person can consume during a week, and still expect to be as well off at the end of the week as he was in the* *beginning*" (Hicks, 1946: 172). The correct measurement of total income thus involves measuring Hicksian income. Economists have been expressing the need for official statistics to advance on a better measurement of it. Steps have been taken toward achievement of this goal over the last two decades, but there is still some way to go[72] (Ruiz-Gauna, 2017).

The strong dependence of certain developing countries on natural and energy resources, as well as the negative effects of environmental degradation, made it necessary to develop an international framework for the environment. Led by the UN Statistical Commission and involving statistical offices worldwide, international organizations (European Commission and the World Bank), scientists and nongovernmental organization representatives, the SEEA became the world's leading natural capital accounting approach (Hein et al., 2020). The SEEA includes two parts:

- Central Framework (CF) adopted as a statistical standard by the UN Statistical Commission in 2012 (UN et al. 2014a). It is used to report on water, energy, mineral, and emissions to air. However, neither the SNA nor the SEEA CF were designed for accounting for ecosystem services or ecological capital (Edens & Hein, 2013).
- Experimental Ecosystem Accounting (EEA) framework (not yet a standard) first published in 2014 (UN et al., 2014b). EEA accounts have now been published in 24 countries, including Costa Rica, Mexico, and Guatemala within the MAR region.

The SEEA was published, for the first time, in 2003 as a system of 'satellite accounts' of the SNA. Following the guidelines laid down by the SNA though, the SEEA is considered to be more comprehensive. Nevertheless, the discovery of new resources, production in progress and natural growth of the year remained unacknowledged (Nordhaus & Kokkelenberg, 1999) because commercial NVA was again the only concept measured. Likewise, much of the debate about extending market limits to incorporate other non-market inputs and outputs was not wound up. Note that the SNA and the SEEA only include direct use values for market goods and services. Concerning environmental degradation, SEEA did not make any clear recommendation. Indeed, it proposed various methods such as the cost-based valuation methods and damage-based valuation methods (UN et al., 2003, 394-395).

A multi-year process of revision to the SEEA was initiated by the United Nations Statistical Commission. The revised SEEA builds upon the SEEA 2003. The SEEA Central Framework was subsequently adopted by the United Nations Statistical Commission at its 43rd Session in 2012, as the first international standard for environmental-economic accounting. The final, official version of the SEEA Central Framework was published in February 2014.

[72] A new version of the SNA was published in 2008. It was an update of the 1993 SNA rather than a revision. Some methodological and conceptual improvements were, however, undertaken to reflect the changes occurring since the 1990s (UN. et al., 2008, 581-601; Eurostat, 2014, 27-28). Still, it did not prevent the new version from being immune to the required changes needed to calculate Hicksian income.

It should be pointed out that *"in the SEEA Central Framework environmental assets are measured from the perspective of 'individual' environmental assets, such as timber resources, land, mineral and energy resources, and water resources". "In contrast, the SEEA-EEA measures environmental assets from the perspective of the ecosystems…Ecosystem assets are thus environmental assets seen from a systems perspective"* (European Commission et al., 2013, para. 1.19 and 1.20). That is, the SEEA-EEA provides a framework for measuring ecosystems and their uses, recognizing that ecosystems provide different types of services such as those compiled by MA (2005). However, in order to avoid a potential problem regarding double counting, a better distinction between intermediate and final ecosystem services would be desirable. Progress is being made in the SEEA-EEA with a view to redefine this differentiation (Obst, 2015: 44-55).

As mentioned above, the SNA does not provide an explicit accounting for environmental stocks. It is defined by a set of boundaries, the most important one being the production boundary that defines when an activity is considered productive[73] (Edens & Hein, 2013). By contrast, the SEEA-CF extends the asset boundary of the SNA (in physical, not monetary terms)[74], while the SEEA-EEA also extends the production and consumption boundary (Hein et al., 2020). However, principles of valuation are aligned between the two systems.

4.2.2 Monetary valuation

Policy makers and international institutions require more data to draw up strategies, programs and policies oriented toward protecting the environment and mitigating the environmental degradation process. In this way, for accounts compiled in accordance with the SNA and the SEEA, the question of economic valuation is key.

In order to maintain consistency with the SNA, monetary valuation in the SEEA-CF is based on exchange prices. In other words, the SEEA-CF recommends that exchange values (prices times quantity) be used whenever market prices are observable (UN et al., 2014a). In cases where this does not occur (for example, for goods that are recollected free and without paying a price), the use of market price equivalents (i.e. the use of prices for similar markets) is proposed because it is considered that they provide an approximation to market prices (UN, 2008, 51; UN et al., 2014a, 33). However, some goods and services have neither market prices nor similar markets. What is then the solution?

The first option that comes to mind is to use the consumer surplus calculated with non-market valuation techniques (section 1.2.3). However, the SEEA excludes welfare measures for both market and non-market goods and services[75]: "*One problem with the*

[73] Several cultural services may not enter any production function, so they are typically lie outside the SNA production boundary (Edens & Hein, 2013).
[74]The CF measures emissions, stocks and uses of individual natural resources, and transactions related to environmental management.
[75] However, there is no consensus about how exchange values should be obtained for them (Ruiz-Gauna, 2017).

use of contingent valuation to value environmental damage is that it gives an average willingness to pay figure which includes an element of consumer surplus of indeterminate amount. This poses a problem when using contingent valuation in the accounting context, since the national accounts exclude consumer surplus" (UN et al., 2003, 407)

Note that national accounts are not about measuring welfare, but economic activity as defined by SNA system boundaries. This means that integrating ecosystem service values into national accounts is only feasible if market exchange values exist, that is, if methods that yield values which are consistent with SNA principles are applied (Edens & Hein, 2013). Nevertheless, most studies on the valuation of ecosystem services aim to assess the value of ecosystems in terms of generating social welfare (works in section 1.2.4 are an example), as such valuation exercises are important in informing policy. Thus, the SEEA-EEA's shortcomings should be considered when using it in policymaking, as monetary values in the SEEA-EEA cannot be interpreted as the total value of nature (Hein et al., 2020).

Despite the important steps that have been taken so far, several conceptual and practical issues remain to be addressed (see UN et al., 2013). For this reason, there are ongoing efforts to face these challenges: the UN Statistical Commission is working with scientists and statisticians toward establishing a statistical standard for the EEA by 2021. Among the issues to be addressed, the valuation of non-market ecosystem services is on the table. One interesting proposal that will be analyzed is the possibility of estimating these services on the basis of simulated exchange values. An interesting approach with relevance for ecosystem accounting is the Simulated Exchange Value (SEV) method. It was initially proposed in Caparrós (2000) and later empirically applied in Caparrós et al. (2003), Campos & Caparrós (2006), Oviedo et al. (2016), Caparrós et al. (2017) and Ruiz-Gauna (2017). This methodology is intended to obtain the (*simulated*) economic value of ecosystem services for which there are neither observable market prices nor similar markets. To that end, it simulates, in a partial equilibrium model, the whole market (demand, supply, and competitive environment) in order to estimate the (*simulated*) market price that would set for the service if it were internalized. This estimation helps ensure consistency with market-based figures considered in the national accounts[76]. Another approach it to anchor non-use values to payments made by NGOs and other organizations through which individuals can express their WTP for a non-use service.

[76] The only way of internalizing consumer surplus in a market is to assume that each individual would pay their maximum WTP, namely a differentiated price to each individual. As his assumption is far-fetched, the premise of the SEV method is that there would be a single price for the provision of the service with the goal of maximizing profits. To get this price, this method uses a demand function (a WTP function) estimated with one of the non-market valuation techniques previously explained in section 1.2.3, and a supply function based on the commercial costs associated with the provision of the service. Once having the price, the number of units consumed at that price must be estimated. The common procedure followed by studies estimating ecosystem values based on prices for similar markets involves multiplying the price by all the units consumed outside the market. This is the proposal of the SNA. According to this approach, setting a price would not result in a drop in the number of units consumed. However, from the demand functions we know that when a price is set, only part of the population would pay that price in the case that the non-market services were internalized.

Finally, when it comes to the valuation of the **stock** of ecosystems – ecosystem assets –, the use of market price observations, or, alternatively, the use of information from similar assets would also be, ideally, the best options. But considering that many of them are not traded in the marketplace, difficulties when applying the market price principle appear (Ruiz-Gauna, 2017). That is why accounting frameworks propose two approaches:

- Written-down replacement costs: it entails that the value of the asset will decline over time because the acquisition price is reduced by the consumption of fixed capital over the asset's life (UN. et al., 2014b, 151).
- Net Present Value (NPV): it calculates the discounted present value of expected future returns (UN, 1993; UN et al., 2013, 2014b). As the SEEA defines returns using the concept of economic rent, it may also be understood as the net present value of the economic rent to be generated for each of the future years. One needs first to estimate the current level of the resource rent, and then to make projections into the future. Future rents must finally be discounted to a current value (UN et al., 2003, 317).

This last method is, without a doubt, the most applied so far. In fact, as shown in section 1.2.4, many studies on the economic valuation of coral reefs estimate NPV. In calculating such values, however, the issue of exchange values arises again, so it is important for the NPVs to be derived from flow values based on this concept. This essentially excludes, for the present the use of non-use values, other than those where a payment can be identified.

In short, the main ecosystem services that are already captured, directly or implicitly, in the SNA and the SEEA are provisioning and regulating services:

- **Provisioning services**: monetary estimates can often be obtained by looking at the market price of the service, both if is traded in the marketplace or by analyzing the contribution of the service to a good that is traded. In the case of commercial fisheries, net unit price could be estimated as the value of the landed fish minus harvesting costs (unit resource rent).
- **Regulating services**: the replacement cost method could be applied. Over the last decade, there has seen an increase in the number of markets for certain services such as carbon sequestration (see, for example, the EU Emissions Trading Systems). For these services, the price levels provide an indication of the exchange value of the service (Edens & Hein, 2013).

In the framework of the current project, only use values from tourism & recreation, fisheries and shoreline protection would be in line with the economic valuation guidelines of the SEEA-EEA, as exchange values (or market price equivalents when market prices are not observable) are estimated. Non-market values would then be excluded.

5. ECONOMIC VALUATION RESULTS

The general objective of this section is to set out the **methodologies** chosen for economic valuation in the selected locations, to carry out the **primary data collection** and to present the **provisional results** of the valuation.

5.1 CONTEXT

We are witnessing unprecedented degradation of natural resources in general and of coral reefs in particular, so there is an urgent need to preserve, conserve and protect them. Economic valuation aims to stop this process of degradation and loss of biodiversity by making visible the economic importance of nature and the long-term economic benefits of conservation. It provides a means of measuring and comparing these benefits and is a powerful tool for improving the management of natural resources. Knowing the value of coral reefs allows policymakers to determine what the economic losses would be if they were to disappear, perhaps irreversibly, or become degraded.

The economic logic underlying the understanding of the role of the economy in protecting nature implies the assumption that markets are normally a good mechanism for organizing economic activity and that price, which balances supply and demand, leads to an efficient allocation of resources and, therefore, maximizes social welfare. The central point in addressing the economic valuation of natural resources and ecosystems is that some of the goods and services provided by these ecosystems are not traded on the market and, thus, lack observable prices (e.g., water supply by watersheds, crop pollination by bees, biodiversity conservation, shoreline protection by wetlands and coastal vegetation, and aesthetic and cultural values). This implies that they are automatically excluded from economic dynamics and that the costs, benefits, and effects of economic activity on them are not correctly calculated and thus not optimally managed. This may lead policymakers and society at large to underestimate the importance of environmental conservation and sustainable development for socio-economic development. It cannot be overlooked that there are limited resources to meet several objectives that may even conflict with each other. Nevertheless, finding ways to reconcile these objectives is essential to allocate resources in the most efficient manner. Otherwise, social or economic objectives, which generally tend to be considered more valuable to society, will continue to take precedence over underestimated environmental objectives.

However, this should not be the case, but rather the opposite, as it is undeniable that ecosystems and "natural capital" provide a range of services to promote economic performance, quality of life, and therefore the well-being of society. Thus, although some of them do not have a market price, they have a value to society. In this context, economic valuation becomes an even more necessary tool to capture that value.

That the environment is of significant value to people refers to the fact that ecosystems, such as coral reefs, affect the utility (or well-being) of individuals in some way. This means that value could ultimately be described as a measure of the benefit that ecosystems (and their services) provide to an economic agent. This value is expressed through individual preferences, which reflect the needs and perceptions of individuals through their willingness to pay. In other words, preferences are measured by what users or society are willing to pay for a particular good or service (for example, a fish or a snorkeling day) or to conserve natural resources (for example, biodiversity). It is this willingness to pay that makes it possible to determine the value of that good or service in monetary terms (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field, 2017). For some goods and services, price and value coincide, but this does not necessarily have to be the case.

In short, economists calculate the value of ecosystem services (or of the environment in general) by assigning a monetary value based on the "goods" (or "bads") perceived by individuals as a result of changes in the quality of those ecosystems. This means that individuals are able to find a satisfactory balance between the amount of money and the ecosystem "goods" they want (or the "bads" that they do not want to be affected). Economic valuation therefore aims to measure the wide range of effects of changes in ecosystems on the same monetary scale.

5.1.1 Total Economic Value

The economic value of any ecosystem good or service is generally measured in terms of what people are willing to pay for it or to conserve it. Conventional economic approaches tended to view value only in terms of the willingness to pay for raw materials and physical products generated for human production and consumption (e.g., fish, mining materials, pharmaceutical products, etc.) and focused particularly on market activities and commercial profits, i.e., goods and services that have market prices. However, as recognition of the potential negative impacts of human activity on the environment and species extinction became more widespread, traditional concepts of value focused the debate. Economists began to understand that people might also be willing to pay for other reasons beyond the own current use of the service, including, for example, to protect coral reefs from degradation or to know that coral reefs will remain intact in the future.

This persistent undervaluation of environmental and ecosystem goods and services has in many cases led to decisions which have resulted in economically suboptimal outcomes and, in the worst case, have incurred substantial costs and losses to the economy. That is why in the eighties, and after two decades of debate, the concept **Total Economic Value** became the most widely used and commonly accepted framework for classifying economic benefits of ecosystems and for trying to integrate them into decision-making.

5.1.2 Valuing coral reefs

As explained above, the most direct way, and the method conventionally used by cost-benefit analysis, is to look at the market prices for goods and services. However, coral reefs goods and services are very often priceless or have characteristics of public goods so that they are not adequately allocated or priced by the free market. For this reason, the total value of coral reefs cannot be accurately calculated using market prices. While it is possible, assigning a value to goods and services that do not have a market price (called non-market goods and services) is more technically complex.

Parallel to the advances in the definition and conceptualization of Total Economic Value, the techniques for quantifying environmental values and expressing them in monetary terms have also evolved in recent decades. Today, a wide range of methods are available and used to value the benefits of coral reef that go beyond the use of direct market prices. These methods are known as non-market valuation techniques and are divided into revealed preference methods and stated preference methods. In this study,

Revealed preference methods observe consumer preferences through their (real) purchasing behaviour. In this way, the expenses incurred in the markets associated with ecosystem services are examined. The main methods within this group are:

- *Travel cost method*: It has been used mainly to obtain the social value of natural areas for recreation. There is no market that can give us the value of the natural park through explicit market prices, but there are other travel costs for individuals (e.g., gasoline, entry or travel time). Thus, knowing the amount of time and money that a person uses to visit the area and the number of visits made, a demand function is estimated from which the willingness to pay by visitors is determined.
- *Hedonic pricing method*: It is based on the idea that individuals value the characteristics of a good, rather than the good itself. Thus, the market price reflects the value of all the characteristics of this good, including environmental ones, which influences other goods for which there is a market, such as housing.

These methods can only be used to capture use values.

Stated preference methods: both use and non-use values are captured by asking individuals directly, through questionnaires, how much they are willing to pay (or receive as compensation) to change the condition of the good or service or to preserve it. Hypothetical markets that elicit individual preferences are built (Atkinson, 2010). The main methods within this group are:

- *Contingent valuation*: since its creation in the mid-1970s, it has become the most widely applied method (Hanley et al., 2007, 332; Atkinson & Mourato, 2008) due to its flexibility. It uses ad hoc surveys that ask respondents the maximum amount of money they would be willing to pay (or, alternatively, the minimum price they would be willing to accept in compensation for being deprived of the good or service). The value obtained reflects the difference in the wellbeing of the population due to a hypothetical change in the provision of the good or service. It has been applied to a wide variety of ecosystem services.
- *Choice modelling*: respondents are presented with several options with different alternatives, each one described by a set of attributes (different types of trees, existence or not of infrastructure, etc.) and costs (entrance fee, contribution to a fund, a tax increase, etc.) that they would have to pay. As the implicit prices of the attributes are calculated, the average willingness to pay for an additional unit is reflected.

The economic valuation section has been divided the economic valuation section into two different sections: data collection and analysis and results of the economic valuation for tourism, fisheries, shoreline protection and non-use values.

5.2 DATA COLLECTION AND ANALYSIS

In this section, the procedure for (i) obtaining the information needed to estimate the monetary values and (ii) analyzing the information obtained through the previous methodology is presented. A differentiation between use values (tourism, fisheries and shoreline protection) and non-use values is made.

5.2.1 Use values

For tourism and fisheries, tools for collecting specific data for the economic sectors to be evaluated for coral reefs were developed. The data collection was guided by WRI's Coastal Capital Valuation Methodology[77]. WRI's Valuation Tool serves as a guidebook and calculator: a way for policymakers, civil society or other interested parties to assess the value to their economies of goods and services provided by coral reefs and to aid in setting coastal management policies.

TOURISM

Coral reefs are the main natural asset attracting tourism in the Caribbean, as well as the region's most important economic sector. They are the biological source of the beautiful sandy beaches and, as living organisms, they continuously attract divers and snorkelers from all around the world. Despite their environmental and economic importance, there are still gaps in terms of information of their importance. To cover them, there are several methodologies, one of which will be used as follows.

The tourism analysis components are divided in 8 categories:

a) Tourism site profiles.
b) Direct travel expenses.
c) Marine Protected Area (MPA) revenues.
d) Recreational activities outside of MPA: snorkeling, diving, sport fishing.
e) Local tourism: direct expenses and visits.
f) Cruise tourists' expenses.
g) Indirect economic impacts, through the use of economic multipliers.
h) Consumer surplus estimation.

a) Tourism site profiles: This first component presents a site description that includes economic, social and environmental variables to set up the context. The variables collected are:

[77] https://www.wri.org/our-work/project/coastal-capital-economic-valuation-coastal-ecosystems-caribbean/coastal-capital

- Gross Domestic Product (GDP):
  - Average annual GDP growth rate.
  - GDP *per capita*.
- Population site:
  - Population within 10km of coast.
  - Average annual population growth.
- Total land area:
  - Land area under permanent crops.
  - Land in urban areas.
  - Forested land.
- Coral Reef and mangroves area:
  - Coastal shelf area (to 30-meter depth).
  - Marine Protected Areas (number and extinction).

Annex 1 presents the information publicly available per country. After setting the context, a description of a tourist profile is needed to define the market interested in coral reefs and their economic contribution. This profile should include the following information:

- Total number of tourists.
- Demographic information, including nationality.
- Type of trip (in package or other).
- Average price of the trip.
- Type of accommodation and average price per day.
- Average length of stay.
- Purpose of the visit.
- Percentage of visitors engaging in reef recreation (diving, snorkeling, sports fishing etc.) or visiting white-sand beaches, among others.

The proportion of all-inclusive visitors is also important to be considered, as it helps avoid double-counting in later stages of the analysis. The percentage of reef-related visitors is used to pro-rate some of the revenues in the sections below, including accommodation and other tourist spending.

Annex 2 presents the available information by site per country. The most difficult issue to address is the number of visitors, tourist nights and expenses that can be attributed to the days spent using the reefs. This needs to be addressed differently in each country because of differences in how (or if) data on tourism activities are collected.

Burke (2008) used estimates showing that about 25 percent of visitors to Tobago and St. Lucia are reef-related. This estimate was based on a systematic collection of expert opinions on the number of visitors to St. Lucia who dive or snorkel and was combined with an informal on-site survey. Cooper et al. (2009) assume that 100 percent of the Glover’s Reef MPA tourists in Belize were reef-related. In the case of Bonaire, 50 percent of all tour expenditures are attributed to direct or indirect experience of natural beauty brought by the reefs, while 100 percent of expenditures on diving and snorkeling activities are attributed to this ecosystem (van Zanten, 2012)

All of these studies are based on assumptions or expert opinions. In order to find a way of checking the actual accuracy of the expense site, Spalding et al., (2017) developed a methodology aimed at offering a first approach. Their study defines "on-reef" value to describe direct use and association with direct non-extractive uses, such as diving, snorkelling and glass-bottom boat tours; and "reef-adjacent values" or ex situ values to describe the indirect use not linked to in-water activities, but indirectly linked to the presence of reefs, such as white beach sand, exceptional views, fresh seafood, etc. The on-reef value was calculated with two indicators: a) abundance of dive stores in relation to hotel rooms and, b) abundance of underwater photographs in relation to all photographs shared on social networks. The reef-adjacent values were then set as a fixed proportion of 10 percent of this expenditure.

b) Direct travel expenses

The analysis of the economic impact of the tourism sector tracks the flows of expenditures associated with this activity in a region to identify changes in sales, tax revenues, income, and jobs. The main sources of information are visitor expenditure surveys, analysis of secondary data from government economic statistics, economic base models, input-output models and multipliers (Frechtling, 1994).

Net revenue from tourism and recreation is calculated by taking gross revenue and subtracting operating costs. Accommodation is one of the largest expenditures. To calculate revenues, the methodology offers three different approaches, each adapted to different levels of data: (i) revenues from the sector as a whole; (ii) average revenues by type of accommodation; and (iii) revenues from hotel. Annex 2 presents the available information by country.

- Revenues for the sector as a whole: to calculate the reef-related accommodation value using only national-level data, the data required is:
    - Average room rate excluding taxes and service charges.
    - Average occupancy rate in the accommodation sector.
    - Average number of rooms per hotel.
    - Number of accommodations in study area.
- Average Revenues by accommodation type: This method is used to provide a more specific picture of the types of accommodation in the study area: number of hotels, guesthouses and apartments, among others.
    - Average room rate excluding taxes and service charges per category.
    - Average occupancy rate in the accommodation sector per category.
    - Average number of rooms per category.
    - Total number of accommodations and per category in the study area.

These data provide a more accurate estimation of the revenues from the accommodation sector than the average information described above.

- Revenues by hotel: This approach is optional and enables a more accurate valuation of revenues to be calculated and thus to determine what part of that revenue can be attributed to coral reefs. The data required by this method is information about individual hotels, including:
  - Number of rooms.
  - Occupancy rates in different seasons.
  - Percent of visitors using the reef and average room cost.
  - All hotels in the study area.
- Operating costs: The costs, taxes, and service charges are estimated with the same method, regardless of the method selected for estimating accommodation revenues. The required data are:
  - Average hourly wage.
  - Average hours worked per week.
  - Average number of persons employed by room.
  - Non-labor operating costs as a percentage of base revenue.
  - Tax rate.
  - Service charge rate.

If no data is available, the WRI tool provides default values for costs, taxes and service charges. Burke (2008) studied Tobago and St. Lucia using the more disaggregated method due to the availability of information provided by the hotel association; Cooper et al. (2009), however, used general information of hotels in Belize.

c) Marine Protected Area (MPA) revenues

Marine Protected Areas have an important economic contribution to the tourism sector. Benefits include (Font, 2004):

- Revenue generation for the conservation of natural resources.
- Contributions to economic and social development, supplementary ways for communities to receive revenue from biological diversity.
- Tourist satisfaction and experience gained at tourist destination.

The user pays approach offers a mechanism for raising funds through tourism. The equation used to calculate the Gross Revenues in MPA is [3]:

$$Marine\ Revenue = \sum Visitor_{ik} + Marine\ Vessel_{ik} + Other_{ik} + Taxes_{ik} \qquad [3]$$

where

$Visitor_{ik}$ refers to fees charged to visitors to marine park “k” in study site “i”; $Marine\ Vessel_{ik}$ to fees charged to operators of marine vessels in marine park “k” in study site “i”; $Other_{ik}$ to other fees charge at marine park “k” in study site “i”; and $Taxes_{ik}$ to the taxes collected from users of marine park “k” in study site “i”.

Net gross revenue is estimated by [4]:

$$Net\ Marine\ Park\ Revenue = \sum(Marine\ Revenue_{ik} - Collection_{ik}) \qquad [4]$$

where:

$Marine\ Revenue_{ik}$ is the gross revenue from marine park “k” in study site “i”; and $Collection_{ik}$ the collection costs for marine park “k” in study site “i”.

The cost of Marine Parks should only include the costs of collecting and administering fees, not the costs of administering the park. The information available by MPA and by country is disaggregated in Annex 3.

d) Recreational activities outside of MPA (snorkeling, diving and sport fishing)

Direct recreational use of the reef includes activities such as diving, snorkeling, reef tours and sportfishing. The best practice is to use company level information for each activity. Revenue is calculated as follows:

- Revenue from snorkel and reef tours comes from the number of people taking snorkel trips and the average price of snorkel trip.
- Dive revenue derives from the number of dive trips and the average price of dive trip, or the number of divers, the number of dives per diver and the price of the average dive package.
- Sport fishing revenue comes from the number of fishing charters and the average price of fishing charters.

Other sources of revenues are dive certificates and equipment rentals. To avoid double counting the revenues due to all-inclusive packages containing recreation activities, we have to subtracted them from the total. If room prices do not include package rates, double counting will not be a problem, and all reef recreation can be counted only at the company level. The detailed information needed to calculate the net revenues from each of the recreation activities is described in the next section. Annex 4 presents the information available for each component by country.

- Diving valuation: there are four sections for this component (WRI, 2009):
  - Tax rates and service charges.
  - Annual number of divers. The number of dives can be calculated in one of three ways, depending on the information available:
    - Using the total visitors to the site: the proportion of that dive.
    - Using total divers: the average number of dives at the site.
    - Using the data from the individual dive store and the all-inclusive resort.
  - Price of the dive. These prices can be entered in three ways:

    - Average price of the dive (single tank and certification).
    - Price per type of dive, with distribution (one, two tanks, package of ten dives, etc. and the proportion of each type).
    - Dive store prices (average price of the dive price and price of the dive certification per store).
  - Price of the equipment
    - The average price of the equipment and rental rates, or
    - Specific information about the store's equipment.

The economic valuation of coral reefs from diving is calculated as the sum of gross revenues from diving minus costs plus transfers within the economy (total wages, service charges and taxes).

$$Gross\ Dive\ Revenue\ =\ Total\ Annual\ Dives\ x\ \left[Avg.Price\ per\ Dive\ + \left(\begin{matrix} Equipment\ Rental\ Price\ per\ Dive \\ x\ Proportion\ of\ Divers\ Renting\ Equipment\end{matrix}\right)\right] + (Total\ Annual\ Certifications\ x\ Average\ Price\ per\ Certification) \qquad [5]$$

Revenues from all-inclusive resorts is not included here; this revenue from diving is captured in the accommodation revenues from all-inclusive properties.

Diving costs are equal to the sum of total wages plus non-labor operating costs. Net revenue is calculated by subtracting dive costs from the gross dive revenue.

$$Net\ Dive\ Revenue\ =\ Dive\ Revenue - Total\ Labor\ Costs - Other\ Costs \qquad [6]$$

Transfers in the economy are separated into: (i) Transfers to employees (total wages and service charges), and (ii) Transfers to the government (taxes). These transfers are supposed to bring back the economy and create additional spending. Net revenues are added to the transfers to the economy to give a total diving valuation.

- Snorkeling and boating valuation: The snorkel and boating component has four sections for calculating revenues (WRI, 2009):
  - Tax rates and service charges.
  - Annual number of snorkel trips. This number can be calculated in one of three ways:
    - Using the total number of visitors to the study area: proportion who snorkel or take boat trips.
    - Using the total number of snorkelers: average number of trips per snorkeler.
    - Using data from individual snorkel tour operators and all-inclusive resorts.

- Average price of snorkeling trips. Three methods available to calculate trip prices depending on the type of data available for the study site:
  - Average price of a snorkel trip.
  - Price by trip type, with distribution. (short, long and various trips).
  - Prices from individual operators.
- Price of the equipment. To estimate the price of the equipment there are two methods available:
  - Average price of the equipment.
  - Average prices of individual operators.

Costs incurred due to snorkeling and boating operations are estimated as a percentage of total revenue and are separated into labor and non-labor costs. Annex 4 presents the information available for each component by country of location.

Gross revenues are calculated according to the following equation [7]:

$$Snorkel\ Revenue\ =\ (Snorkels_{si}\ x\ Price_{i})$$
$$+\ (Rentals\_i\ \ x\ Rental\ price\_i\ ) \qquad [7]$$

where $Snorkels\_si$ refers to the number of snorkel trips occurring in study site "i", $Price\_i$ to the price of snorkel trips in study site "i", $Rentals\_i$ to the number of snorkel equipment rentals occurring in study site "i", and $Rental\ price\_i$ to the price of snorkel equipment rental, all of them calculated through multiple available methods.

Snorkeling and boating costs are calculated using equations [8] and [9]:

$$Total\ Labor\ Costs\ =\ Percent\_\ Labor\ X\ Snorkel\_Revenue \qquad [8]$$

where:
$Percent\_\ Labor$ refers to the percent of gross revenue that is labor operating costs, and $Snorkel\ Revenue$ to gross revenue from the sector.

$$Other\ Costs\ =\ Percent\_Non\_Labor\ x\ Snorkel\_Revenue \qquad [9]$$

where:

$Percent\_Non\_Labor$ is the percent of gross snorkel revenue that is non-labor operating costs, and $Snorkel\_Revenue$ is gross revenue from the sector.

Total wages and non-labor operating costs are subtracted from the estimated gross revenue to obtain net revenue from the snorkeling sector.

$$Net\ Snorkel\ Revenue\ =$$
$$Snorkel\_Revenue - Total\ Labor\ Costs - Other\ Costs \qquad [10]$$

Net revenues are added to the transfers to the economy to give a total snorkel component valuation.

In a literature review, Burke (2008) used price information from 12 of the 17 dive stores in the Tobago study and two dive prices were used for the two-dive and six-dive package. In the case of Belize, Cooper et al. (2009) collected prices from tour operators throughout the country and selected the most popular packages; with the opinion of experts, the distribution of the variety of prices of the packages was set and it was concluded that the two-dive package was the most popular.

e) Local use of the resources

Local people often play an important role through their own coral reefs and reef-based amenities. To estimate local use, surveys are the primary source of information (Burke, 2008; WRI, 2009). This component estimates the benefits to local use of visits to coral reefs and coralline beaches.

The following data is required (WRI, 2009):

- Population of study area.
- Average hourly wage (the value of the opportunity cost of recreation).

For coralline beach, the following data on benefits are required:

- Percentage of local population visiting coralline beaches for pleasure.
- Average number of visits per person per year to coralline beaches.
- Average duration of visit to coralline beaches.

The benefits of coralline beaches are calculated by multiplying the population of the study area by the percentage of the local population that visit the coralline beaches for pleasure, the number of visits per year per person, the average duration of the visit and the prevailing average hourly wage. This is because the value of the time people spend on a local visit to a free access site is a partial measure of what they are willing to pay to visit it.

In terms of the benefits of reef recreation to local people, the following information is useful:

- Percentage of local people engaged in reef recreation outside of organized tours.
- Average number of visits per year per person.
- Average length of visit.

The benefits of reef recreation are similarly calculated by multiplying the population of the study area by the percentage of the local population engaged in reef recreation outside of organized tours, the number of visits per year per person, the average length of visit, and the prevailing average hourly wage. Annex 4 presents available information by site and country.

f) Cruise tourist expenses

Cruises are important for the Caribbean's tourism sector. For this analysis, the main purpose of the cruise trip is not considered a purely reef-related activity. Determining the number of cruise passengers participating in reef-related activities, and the revenues and costs associated with the cruise industry is difficult to calculate in many countries, so the approach changes.

Port surveys are now the main source of information. Records of visits to MPAs can be another source if they are differentiated by type of tourists. The analysis should include both revenues from reef recreation revenues and any port taxes or fees applied to cruise ship passengers visiting the reef area. Other expenditures are not considered, as a simplification of the expenditure patterns of cruise related tourism.

g) Indirect economic impacts (multipliers use)

Multipliers capture the secondary or indirect effects of tourism activity and represent the economic interdependencies between economic sectors of a given region. They vary considerably from region to region and from sector to sector. There are many types of multipliers that reflect which secondary effects are included and depend on the measure of economic activity used (sales, income, or employment). For example, Stynes (1999) uses:

- The Type I sales multiplier = direct sales + indirect sales direct sales.
- The Type II or III sales multiplier1 = direct sales + indirect sales + induced sales direct sales.

Multipliers are expressed as ratios of sales, income or employment, or as ratios of changes in total income or employment relative to direct sales. Multipliers should only be used if they are developed for an economy similar to the region of interest so that estimates of indirect impacts are reliable. Regardless of whether applicable multipliers are available, it may be preferable not to include multipliers in the valuation exercise (WRI, 2009).

h) Consumer surplus estimation

Consumer surplus is defined as the difference between the price consumers pay and the price they are willing to pay. It is the area between the equilibrium price and the demand curve (Hanley, 2007). This component is typically assessed for diving and snorkeling by administering surveys. If resources are available to conduct the surveys, this is the preferred approach. In the absence of local surveys, the tool provides lower-level estimates typical of the region. Before using these defaults, it is recommended to look for any consumer surplus studies that may already exist for the study site.

FISHERIES

The commercial fisheries component is divided in 5 categories:

a) Fishing profile;
b) Commercial fishing information including processing and cleaning value;
c) Local non-commercial fishing;
d) Indirect economic impacts (multiplier use);
e) Consumer surplus estimation.

a) Fishing profile

The country profile includes a description of commercial fisheries, processing industries and information on the division of commercial fishing industries into large scale and small scale (or artisanal) fisheries. The variables needed are the fish and shellfish species of commercial interest related to the reef and the type of fishermen. It is also valuable if the fish catch is sold or used for self-consumption. The role of artisanal fisheries in contributing to the economy and social welfare can be captured with the former. Annex 5, 6 and 7 present the information available by country.

b) Commercial fishing

The value of commercial fisheries is calculated by adding the revenue produced by the capture of fish associated with the reefs and subtracting the estimated operating costs. Revenue is based on fish catch and fish price (averaged over the year) for each reef-associated species. Fishing costs are based on estimates of labor and operating costs for the fishing vessel owner. There are three approaches to choose from, depending on data availability (WRI, 2009):

- Fish Processing Revenues estimates: This component calculates the economic contributions of fish processing industries that add value to the fish catch from harvest to the retail sector. The data needed for this calculation are as follows (WRI, 2009):
  - Year data collected.
  - Species or species group of fish processed.
  - Pounds of fish processed.
  - Cost of fish purchased for processing per weight unit.
  - Sale price of fish processed per weight unit.

  The equation used to calculate the processing revenue is:

  $$Processing\ Revenue_y = \sum_{sj}\left[\left(processed\ fish\ price_{sjy}\right)x\left(output_{sjy}\right)\right] \qquad [11]$$

  where $processed\ fish\ price_{sjy}$ is the average price received for processed fish for each species "s" for company "j" in year "y" (USD/kg) and $output_{sjy}$ is the quantity of processed fish for each species s sold by company "j" in year "y".

Costs are calculated using equation [12]:

$$Processing\ Costs = \sum_{sj}\left[fish\ price_{sjy} + labor\ costs_{y} + operating\ costs_{y}\right] \quad [12]$$

where $fish\ price_{sjy}$ refers to the price of reef fish purchased by processor for species "s" in year "y", $labor\ costs_{y}$ to the cost of labor for processing fish, and $operating\ costs_{y}$ to other costs of processing fish.

- Cleaning value added: Instead of buying processed fish, buyers from hotels, restaurants or for personal consumption often pay for the cleaning of the fish at the place of landing. The added value of cleaning can be calculated in a similar way to processing on the local price of whole fish versus cleaned fish (by species), and also on the percentage of the catch sold after cleaning at landing sites, it is straightforward to calculate the cleaning values. If this information is collected through interviews or experts, it is also possible to estimate the earnings of independent cleaners by collecting information on weight or landing site (WRI,2009).
  - Option 1. Weight.

    The data needed by the weight option is the percentage of fish catch cleaned and the average value added per unit weight of fish. The equation used to calculate de value added is the following:

    $$Value\ Added = \sum\left[\left(amount\ fish_{y}\right)x(p\_fish\_cleaned)x(value)\right] \quad [13]$$

    Where $amount\ fish_{y}$ is the number of fish sold in year "y", $p\_fish\_cleaned$ is the percent of fish cleaned, and $value$ is the average value of fish cleaned (by weight).

  - Option 2. Landing site. It requires the following data:
    - Number of cleaners at the landing site.
    - Average number of days per year that cleaners operate.
    - Average number of hours per day that cleaners operate.
    - Average earnings per hour of fish cleaning.

    Equations used to calculate the Cleaning Fish Revenue is [14]:

    $$Cleaning\ Fish\ Revenue_{y} = \sum\left[N_{iy}\ x\ D_{iy}\ x\ H_{iy}\ x\ Cleaning\_earnings_{y}\right] [14]$$

    where N_{iy} refers to the number of cleaners at each landing site "i" in year "y", D_{iy} to the number of days cleaners work at each landing site "i" in year "y", H_{iy} to the number of hours per day cleaners work at each landing site "i" in year "y", and $Cleaning\_earnings_{y}$ to the average hourly earnings from cleaning fish in year "y"

    Annex 8 and 9 present the available information per country.

c) Small-scale fisheries and local non-commercial fishing

In coastal countries, small-scale fisheries play an important role in human well-being. Catching involves fishermen's households (as opposed to commercial companies), using a relatively small amount of capital and energy, relatively small fishing vessels, making short fishing trips, close to the coast, and mainly for local consumption (FAO, 1999).

The local fishing section is used to value any fish that is not caught by official government statistics. Its value has three components that must be estimated separately: the fish for sale, for consumption and for enjoyment.

- Local fisheries for sale or consumption: The equation for calculating revenue from sale and consumption is:

  $$Subsistence\ Revenue_y = \sum_s [(fish\ price_{sy}) x (sub\ catch_i) x (trips_y) x (fishers_y)] \quad [15]$$

  where $fish\ price_{sy}$ is the average retail market price for fish "s" in year y (USD/kg), $sub\ catch_i$ is the average weight of fish caught on trip "i" per fisher (counting only fish caught for consumption), $trips_y$ is the average number of trips or annual days in activity in year "y" per fisher, and $fishers_y$ is the number of subsistence or local (own consumption) fishers in year "y".

- Local fishing for enjoyment: The equation for calculating revenue from recreational fishing is [16]:

  $$\sum[(fishers_y)\ x\ (days_y)\ x\ (wage_y)] \quad [16]$$

  where $fishers_y$ refers to the number of residents fishing for enjoyment in year "y", $days_y$ to the average days spent fishing in year "y", and $wage_y$ to the average wage of selected population in year "y".

  Annex 10 presents the available information per country.

d) Indirect economic impacts (multiplier use)

Multipliers capture the respective impacts resulting from the demands for goods or services associated with a given commercial fisheries. Different impact multipliers could be used for direct, indirect, induced and total impacts, i.e. for the whole fishing industry or the commercial fishing/harvesting and processing/cleaning sectors.

$$Indirect\ Economic\ Impacts = [(Gross\ Commercial\ Fisheries\ Value) + (Value\ Added\ Fish\ Processing) + (Gross\ Local\ Fishing\ Value)]\ x\ Overall\ Fisheries\ Multiplier \quad [17]$$

Calculations using separate multipliers for the commercial harvesting and processing/cleaning sectors are:

$$Indirect\ harvesting\ economic\ impacts = (Gross\ commercial\ fisheries\ value) x (Overall\ fisheries\ multiplier) \quad [18]$$

$$Indirect\ processing\ cleaning\ economic\ impacts = (Gross\ commercial\ fisheries\ value + value\ added\ fish\ processing) x (processing\ cleaning\ multiplier) \quad [19]$$

The value added in fish processing in these equations excludes the cost of the fish purchased to avoid double counting the indirect impacts of the harvested fish.

Annex 10 presents the information available in the literature.

SHORELINE PROTECTION

Estimates of shoreline protection were made applying the benefit transfer approach, which has been often used for economic valuation of ecosystems and their services. This method allows estimating the economic value for ecosystem services (or of an ecosystem) by transferring an existing valuation estimate from a similar ecosystem to the site for which there is a lack of information (Galarraga et al., 2004; TEEB, 2010; Smith, 2018). It thus takes available value estimates from one or more studies and transfers them to a new context after making some adjustments (Hanley et al., 2007: 358). This is why a process of homogenization in terms of comparable units is necessary[78].

It is common to refer to the environmental policy being evaluated as the **"policy site"** (PS) and the source of the values being used as the **"study site"** (SS). In principle, the values at the policy site can be different from those of the study site for two sets of reasons: differences in the characteristics of the two environmental features being valued and differences between the populations valuing the resource change (e.g. differences in income, tastes, and preferences, and other relevant socioeconomic characteristics). In the transfer process, **values must be adjusted** to reflect these two types of differences.

There are three general approaches or ways in which a benefit transfer can developed:

- *Unit value transfer* (or simply benefit transfer): it consists on assuming that the value (usually values per unit) of an ecosystem service in the study site is approximately equal to that in the policy site (Sainz de Murieta, 2016), either without adjustment (simple-unadjusted unit value transfer) or with adjustment for differences in income levels and/or in the costs of living (unit value transfer with income adjustments) and/or in the time of data collection (unit value transfer with temporal adjustment). When differences in income levels and in the costs of living between the two sites exist, values can be adjusted using the Purchasing Power Parities (PPPs) which reflects the true purchasing power of currencies and accounts for differences in the costs of living. To adjust the value estimate from the time of data collection to current currency, the Consumer Price Index (CPI) for the policy

[78] Several reasons make these methods widely used in providing information to policy makers. They are consistent in estimating values across policy sites and are less expensive in terms of time and money (European Environment Agency, 2010).

context country must be used. Even though CPI is based on the preferences of consumers, they could value environmental goods higher or lower over time than the basket of goods which provide the basis for calculating CPI. In this way, unit values from the study-site are multiplied by the number of units at the policy-site (Brander, 2015). That is, the value of the study site (for example, USD of year 2000) is first converted into a value of the policy site using the following formula:

$$V_{PS\,2000} = V_{USD\,2000} * \frac{PPP_{PS\,2000}}{PPP_{USA\,2000}} \qquad (Spatial\ transfer) \qquad [20]$$

Once the value is in policy site value of year 2000, it needs to be updated in time (for example, to 2020), using the national (policy context) CPI. This can be done with the following formula:

$$V_{PS\,2020} = V_{PS\,2000} * \frac{CPI_{PS\,2020}}{CPI_{PS\,2000}} \qquad (Temporal\ transfer) \qquad [21]$$

- The unit value transfer procedure permits to include adjustments for differences in income and cost of living. However, it does not allow for more systematic adjustments of study site values to account for differences in site characteristics (e.g. environmental quality or cultural conditions) and populations.

- *Value function transfer*: it uses a value function (usually a demand function estimated by different techniques such as revealed preference or stated preference) and combines these values with information on parameters values for the policy site. In other words, the valuation function used for the study-site is applied at the policy site by introducing specific information and parameters from the area under study. For example, a WTP function might have been estimated in which WTP depends on the quantity or quality of the ecosystem service provided and socioeconomic characteristics of the population originally surveyed. This can be written as:

$$WTP_{per\ household} = b_0 + b_1 Q_{es} + b_2 Income + b_3 Age + e \qquad [22]$$

Where WTP is the willingness-to-pay of a household for an environmental good or service, Q_{es} is the quality or quantity of the environmental good or service being valued and b_0, b_1, b_2, and b_3 represent the regression coefficients, and *e* is the random error. This equation would allow the analyst to tailor the WTP per household to the specific quality or quantity of the environmental good or service (e.g., acres of habitat, number of endangered fish protected) and key socioeconomic characteristics of users at the policy site by inserting the quality or quantity and mean income and age at the policy site into the WTP function.

The main problem with the benefit function approach is the need for information on relevant parameters (b_0, b_1, b_2 and b_3) and variables (Q), which most of the times are not available in a single study. The lack of such information prohibits inclusion of these variables and parameters in the benefit function (Navrud & Lindhjem, 2011).

- *Meta-analysis*: The difference with the previous two approaches lies in the fact that this function is built on multiple values from different studies. That is, it makes a review of the quantitative estimations obtained by similar studies about a certain effect so that the value for the study-site is not obtained from one single study but from a compilation of values obtained from a meta-analysis. As this method evaluates separately studies, it is a good tool for summing up a set of indicators and values of these empirical studies (van den Bergh, et al., 1997), and for giving an overall result of all the studies incorporated in the analysis.

The application of the benefit transfer method involves the following steps (Plummer, 2009):

1. Identify similar existing studies or values through a comprehensive literature review;
2. Analyze the similarities to determine whether they can be transferable to the study in question. Note that values found cannot be automatically transferred. This means evaluation of:
    a. Whether the good or service is comparable to that valued in the existing study (site characteristics, quality or availability of substitutes); and
    b. Parameters about the relevant population (if the characteristics of the relevant population are comparable).
3. Assess the quality and relevance of the studies to be transferred. This should be done with care and requires professional judgement to validate the results.
4. Adjust available values to better reflect the values of the site (or ecosystem) in question (differences in income, time, population and site characteristics).
5. Estimate the total value by multiplying the transferred values by the number of people affected ("popularity").

Within the context of this project, a unit value transfer with income adjustments using formula [20] above has been used, as neither existing studies offer a value function nor are meta-analysis for the valuation of coral reefs in the Mesoamerican region. Moreover, unit value transfer with income adjustment (where necessary) is recommended as the simplest and most transparent way of transfer between countries. This transfer method has in general also been found to be just as reliable as the more complex procedures of value function transfers and meta-analysis. This is mainly due to the low explanatory power of willingness-to-pay (WTP) functions of Stated Preference studies, and the fact that methodological choices, rather than the characteristics of the context and the affected populations, has a large explanatory power in meta-analyses (Navrud & Lindhjem, 2011).

5.2.2 Non-use values

For **non-use values**, a contingent valuation (CV) exercise has been carried out. The questionnaire survey can be conducted using questions asked in open-ended or closed-ended formats. The first one implies that respondents do not have to choose a predetermined amount of money; whereas the second question to respondents is whether they are willing to pay a certain amount of money, and "yes" or "no" are the only possible answers. In the early versions, the open-ended format was the most common option, but subsequently the closed-ended format has been gaining popularity among researchers. In this case, the questionnaire begins by asking whether one is willing to pay a certain amount of money. If so, the question can be repeated by increasing the amount. If not, a smaller amount is offered (this is known as dichotomous choice approaches). Finally, respondents are often asked what the maximum price they would be willing to pay is (open-end bid), taking into account the above answers.

It is also important to note that the survey applies to a sample of respondents, not to the entire population or to specific groups, and that the nature of the sample will depend on the target population that it is intended to be represented in these surveys.

In the context of this project, this valuation exercise was implemented in the four countries of the Mesoamerican region (Belize, Guatemala, Honduras and Mexico) and in Canada, the United States, Argentina and the United Kingdom, as these are the main tourism source markets in the region.

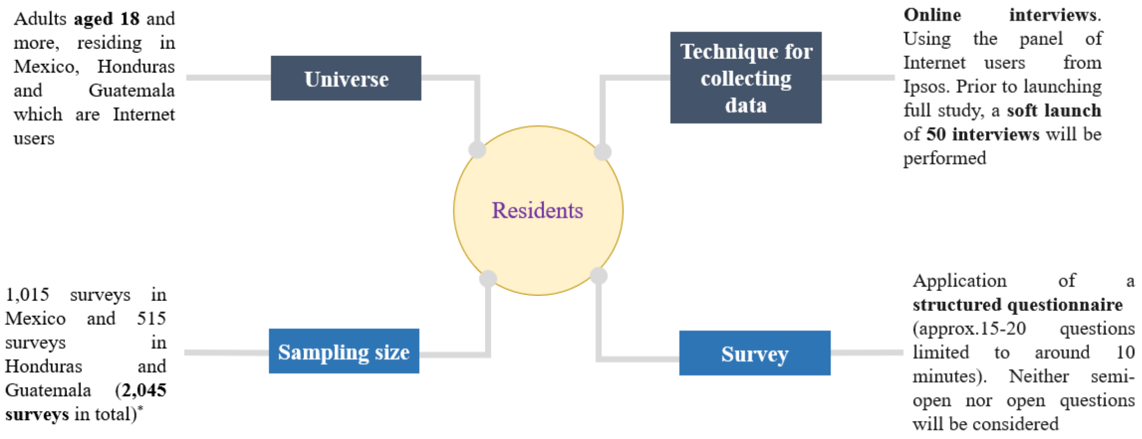
Online surveys have been conducted using representative samples of the Internet population in all countries under study except **Belize**, as there are no representative panels for this country. In this case, the surveys have been conducted **face-to-face**.

Ipsos Public Affairs was the company in charge of carrying out the surveys. The focus is on the **resident population** and **potential tourists**.

- **Residents** in countries where coral reefs are located are an important agent in working for their maintenance and good conservation. Knowing the views of this segment of the population is critical to working for the sustainability of reefs in the area.

  The sampling size consisted of 1015 surveys in Mexico (sample error: Emax = ±3.16 percent), 515 in Honduras and Guatemala (sample error: Emax = ±4.47 percent) and 105 in Belize. Individuals were selected by sex and age quotas. A pre-test of 50 surveys was done.

  In Honduras, Guatemala, and Mexico the penetration is below 70 percent (32 percent, 19 percent and 66 percent respectively), so it is important to record that the sample is representative of the Internet population of each country, not of the total resident population. The sample in Mexico is bigger than in Guatemala and Honduras because of the large size population of this country. Individuals were selected by sex and age quotas. The sample error is: 1000 surveys (Emax = ±3.16 percent) and 500 surveys (Emax = ±4.47 percent).

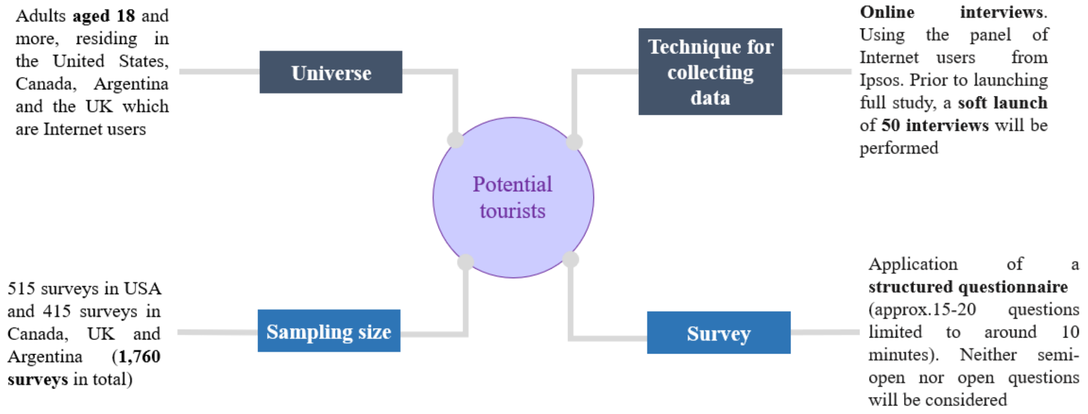


* 105 face-to-face surveys in Belize (2,150 surveys in total)

- **Tourists** who visit the areas where coral reefs are located are another important agent involved in their sustainability. For this reason, the study also contemplates knowing the opinion of these potential tourists about the reefs, and their possible predisposition to get financially involved in their care.

  The sampling size consisted of 515 surveys in the United States and 415 surveys in Canada, United Kingdom and Argentina; that is, a total of 1760 surveys. A pre-test of 50 surveys was also done.

  In United States, Canada, United Kingdom and Argentina, which have been the countries chosen for being the main tourism issuing markets to the region, Internet penetration is higher than 88 percent in all cases, so using an online approach does not present a bias in the opinion collected (compared to the total of the population). Again, individuals were selected by sex and age quotas. The sample error is: 500 surveys (Emax = ±4.47 percent).



The surveys used can be found in Annex 11.

In terms of how the data collected through the studies was treated, two types of analysis were carried out: descriptive analysis and econometric analysis.

Descriptive analysis

The first step in any quantitative analysis is to describe the data in numerical terms. In this sense, understanding the measurement scale is key, as it determines how the questions have been measured, how the data are presented in a descriptive way and the statistical analysis to be carried out.

In the table below, the four measurement scales are shown and described:

Nominal scale is used for identification and categorisation purposes (i.e. labels). It lacks numeric order, magnitude, or size. It is only possible to track the number of respondents that choose each option or the option that was selected the most or least (frequency distribution). Example: "Select the main reason for your visit"	**Ordinal scale** incorporates order or ranking, so that respondents are asked to rank some items or choose from an ordered set of values. It lacks magnitude and size, so it is unable to make direct comparisons between ranks. It us helpful to collect data about respondents' opinions and perceptions. Example: "How much do you agree with the following statements? Strongly disagree, disagree, agree…"
Interval scale is a continuous scale that incorporates order and magnitude. It is a quantitative measurement scale in which there is no true zero point. Example: "How likely are you to recommend a visit to coral reefs to a friend or colleague? 1 (very unlikely), 2, 3,4 and 5 (very likely)"	**Ratio scale:** unlike interval scale, it allows having true zero point. Example: "What is your age? Less than 18, between 19 and 65, more than 65"

Nominal and ordinal data are reported taking the form of frequencies or percentages of response for each response alternative. As explained in the table, they do not have magnitude, so descriptive statistics such as the mean or standard deviation are meaningless and therefore are not calculated for that cases.

However, for **interval and ratio data**, several descriptive statistics can (and have been) be used:

- Measures for *Central tendency* to show how the scores are distributed around a central point. It includes the mean (add up all the scores and then divide by the total number of scores), the median (middle score of the set of data) and the mode (most frequent observed score within a variable's data).

- Measures for the *variability* of the data to show how the data vary between each score and also from de mean. It includes the range of data (difference between the lowest and highest scores) and the variance (measure of how spread out a score is around the mean, i.e., how close the scores in the distribution are to the middle of the distribution) or standard deviation (square root of variance: it describes the score's variability from the mean based on a normal – or approximately normal – distribution).

Software SPSS was used to estimate all these descriptive statistics, when possible depending on the questions in the survey. One of the advantages of SPSS is that data from other sources (e.g., Excel) can be easily imported.

Econometric analysis

Information obtained was tabulated and processed. An in-depth **econometric analysis** was then undertaken to obtain the aggregated value that society gives to coral reefs. Results are shown both per country and in aggregated form.

The methodology follows a two-step strategy. We first present the econometric specification of the binary discrete-choice format to be used in the contingent valuation exercise and the formulas needed for estimating aggregated economic values for the conservation program. We then test an original *ad hoc* model that includes the open-end bids.

1. *Econometric analysis of the Binary Discrete-Choice Format*

The contingent valuation method asks individuals whether they are willing to pay a certain amount of money for an improvement in the environmental quality of a resource (in this case, coral reefs). The valuation question was posed in a double-bounded format in which the first question asked respondents whether they would be willing to pay a certain amount of money to implement a program to protect coral reefs (see Question 6). If the answer was 'yes', they were offered the possibility of paying a larger amount (Question 7). If the answer was 'no', they were offered the possibility of *paying* a lower amount (Question 8). Following-up, an open-ended question was included that asked respondents to indicate the maximum amount of money they would be willing to pay (Question 9). Since WTP is the monetary measure of utility (in our case, utility derived from the conservation of the reef), the open bid question aimed at checking the number of individuals who were willing to pay different amounts than the one proposed from the bounded exercise (in the next section, the open-ended question was included to analyze what would happen if it would be considered).

Following the procedure adopted in Ruiz-Gauna (2017), the econometric specification of the binary discrete-choice format used and the formulas for estimating aggregated economic values are presented.

A linear-in-parameters utility function for individual *i* and alternative *j* (the conservation of coral reefs) in a set of *J* alternatives *(j=1,2)*[79] with a systematic (V_{ij}) and a random component (ε_{ij}) is assumed:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta' X_{ij} + \varepsilon_{ij} \qquad [23]$$

where β is the vector of parameters to be estimated, X_{ij} is a vector of observed variables for individual *i* and alternative *j*; and ε_{ij} are random errors normally distributed with mean zero and constant variance. We include as explanatory variable the variable *Visitor* plus an *Intercept*. We only considered one monetary attribute (*Bid*).

The probability that the respondent *i* chooses alternative *j* over any alternative *y* ($\forall\, y \in J$) is:

$$Pr_{ij} = Pr\left[V_{ij} + \varepsilon_{ij} > V_{iy} + \varepsilon_{iy}\right] = Pr\left[V_{ij} - V_{iy} > \varepsilon_{iy} - \varepsilon_{ij}\right] \forall j, y \in J \qquad [24]$$

Using the proposal by Hanemann (1984, 1991) and assuming that $\varepsilon_i = \varepsilon_{iy} - \varepsilon_{ij}$ is logistically distributed, the probability that individual *I* will give a 'yes' answer is:

$$Pr_{ij} = \frac{1}{1+e^{-\mu\left(V_{ij}-V_{iy}\right)}} \qquad [25]$$

The goodness-of-fit of the model is estimated using the maximum log-likelihood ratio. The log-likelihood function of any binary choice model is:

$$lnL(\beta) = \sum_{i=1}^{n} \left\{ d_{ij}^{yes}\, lnPr_{ij}^{yes}(Bid_l) + d_{ij}^{no}\, lnPr_{ij}^{no}(Bid_l) \right\} \qquad [26]$$

where d_{ij}^{yes} is 1 if the response is 'yes' to the payment and 0 otherwise; while d_{ij}^{no} is 1 if the response is 'no' to any payment and 0 otherwise.

Unlike in the single-bounded modelling, in the double-bounded model respondent is presented with two bids. The level of the second bid depends on the response to the first bid. Thus, there are four possible results: both responses were 'yes', both responses are 'no', a 'yes' followed by a 'no' and a 'no' followed by a 'yes'. Under the assumption of a utility-maximizing respondent (Hanemann, 1991), the log-likelihood function is:

$$lnL(\beta) = \sum_{i=1}^{n} \left\{ \begin{array}{l} d_{ij}^{yes,yes}\, lnPr_{ij}^{yes,yes}(Bid_l, Bid_l^u) + d_{ij}^{no,no}\, lnPr_{ij}^{no,no}\left(Bid_l, Bid_l^d\right) \\ +d_{ij}^{yes,no}\, lnPr_{ij}^{yes,no}(Bid_l, Bid_l^u) + d_{ij}^{no,yes}\, lnPr_{ij}^{no,yes}\left(Bid_l, Bid_l^d\right) \end{array} \right\} \qquad [27]$$

where $d_{ij}^{yes,yes}$, $d_{ij}^{no,no}$, $d_{ij}^{yes,no}$ and $d_{ij}^{no,yes}$ are binary-valued indicator variables, Bid_l^u is the upper *bid* and Bid_l^d is the lower *bid*.

[79] We only include two values for alternative *j* (paying a certain amount of money to implement the program to conserve coral reefs or not paying).

We used NLOGIT version 4.0 for estimating the parameters through maximum likelihood for the double-bounded logit function.

From this model empirical distributions for the parameters of each type of respondent (visitor and non-visitor) were also calculated (Krinsky and Robb, 1986). This estimation was then utilized to estimate mean marginal WTP for each type of individual by using the following formula:

$$WTP_{Visitor} = \frac{\beta_{Intercept}}{\beta_{Bid}} + \frac{\beta_{visitor}}{\beta_{Bid}} X_{visitor} \quad [28]$$

When it comes to the estimation of aggregated values, the compensating variation (CV) is a welfare measure commonly used in Cost-Benefit Analysis. The CV for each type of individual (Small and Rosen, 1981) is:

$$CV_j = \frac{1}{\beta_{Bid}} \left[(\beta' x_0) - \left(\beta' x_j\right) \right] \quad [29]$$

where $(\beta' x_0)$ and $\left(\beta' x_j\right)$ are the part of utility corresponding to the alternative 0 (the status quo) and j (the conservation of coral reefs)[80]. This allows us to obtain the value of this alternative. β_{Bid} is the parameter of the payment vehicle.

In this way, we obtain the WTP for visitors and non-visitors: considering that we want to get an aggregated WTP per country, we can estimate the weighted average depending on the percentage of respondents who visited the reefs and of those who did not visit it.

2. *Econometric analysis Including Reported Open Bids*

We added a piece of analysis, as part of the sample has declared a WTP different than the proposed options. We first constructed the variable, including the stated values that were different from the bounded amount.

We then tested an empirical model (built *ad hoc*) in order to assess the factors affecting the respondents' utility U_{ij} (whose monetary measure was expressed by the WTP) for the coral reef conservation. In particular,

$$U_{ij} = \left[U\left(Z_{ij}\left(x_{ij}\right), K_{ij}, \beta\right) \right] \quad [30]$$

This equation says that the utility derived from the reef conservation depends on (i) the vector x_{ij} of exogenous characteristics/variables (in our setting, the respondents' socio-economic characteristics); (ii) one endogenous regressor Z_{ij} simultaneously determined with the dependent variable (in our case, having visited the reef, as it expresses a consumption choice that not only states utility, through WTP declaration, but also reveals utility through consumption experience) and (iii) a vector of explanatory variables,

[80] $\left(\beta' x_j\right)$ represents the utility that the alternative j (conservation of reefs) provides to the different types of individuals.

K_{ij} including mostly opinions and beliefs of the respondent regarding environmental issues. Some variables were endogenous and other exogenous because they were pre-determined and existing with respect to the declaration of WTP (utility), but also important to contribute to its determination A constant and error term completed the empirical model.

The model was estimated with a two -stage least squared (2SLS) estimation routine.

3. *Scaling up*

The scaling up has to take account of how the WTP is interpreted and what group in society it applies to. Since the survey was conducted through the internet, the reference group can only be persons with a household connection.

5.3 RESULTS

5.3.1 Use values

TOURISM & RECREATION

MEXICO

Caribbean tourism profile

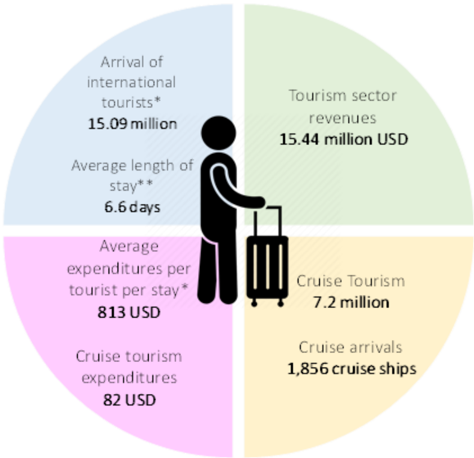
The Mesoamerican Reef begins in north of the Yucatan Peninsula. Quintana Roo is located in the Peninsula and is a state privileged by nature, surrounded by the beautiful Caribbean Sea that has 1,176 km of coastline (Instituto Nacional de Estadística y Geografía, 2017) and a land area of 44,705.5 km^2 which represents about 2.26 percent of the country's total (Instituto Nacional de Estadística y Geografía, 2015). It houses some of the most impressive beaches in the world with 17 percent of the mangroves at the national level (CONABIO, 2015), and with a reef area of 491.58 km^2 which represents 28 percent [81] of the total reef area of the country[82].

The Mexican Caribbean attracts millions of visitors every year. In 2019, the number of visitors to Quintana Roo was 22.8 million people, including national and international tourists, cruise ship passengers and travellers crossing the border between Mexico and Belize (World Atlas of Coral Reefs; Spalding, Ravilious, & Green, 2001).

It is estimated that, in 2019, visitors in Quintana Roo was USD 15.9 million (SEDETUR, 2010 – 2019) and the cruise industry brought a high volume of tourists each year (e.g. in 2019 more than 7.2 million cruise passengers visited the Mexican Caribbean). In terms of tourism revenues, USD 15.44 million were captured by tourism and the average expenditure per tourism was USD 813 (Figure 20).

[81] Calculated with data from Healthy Reefs.
[82] World Atlas of Coral Reefs, (Spalding, Ravilious, & Green, 2001)

Figure 20. Quintana Roo's tourism sector in numbers



*Cancún, Cozumel, Chetumal, Riviera Maya, Isla Mujeres; **Consejo de Promoción Turística de Quintana Roo, 2019. Source: SEDETUR (2019)

The most popular destinations are Cancun and the Riviera Maya, which represent more than 80 percent of the state's total visitors. The United States is the main source of tourists for almost all the destinations in Table 28, except for Cancun and Holbox, where the highest percentage of tourists comes from Mexico and the European Union, respectively.

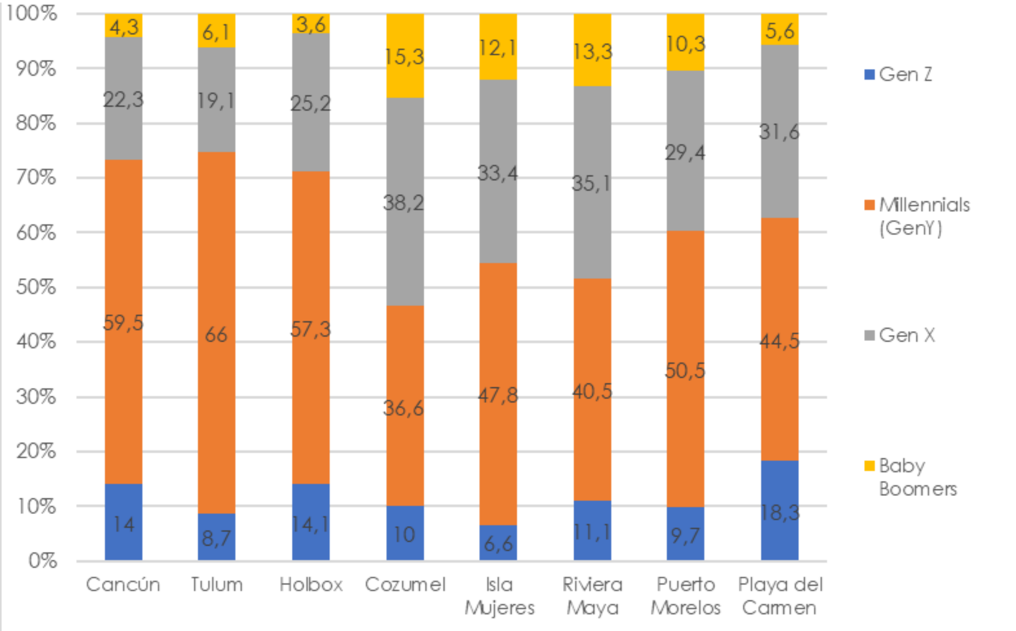
Table 28. Tourist arrivals by country and region in 2019 (percentages)

Destination	Canada	USA	Mexico	Latin America	Europe	Rest of the world
Cancún	3.5	30.7	41.8	18.7	4	1.3
Tulum	12.2	36.3	20	8.1	21	2.4
Holbox	2.1	13.5	45.7	5.5	29.4	3.8
Cozumel	9.2	49.1	39.1	0.1	1.1	0.1
Isla Mujeres	9.7	47.8	16.7	4.7	15.4	5.7
Riviera Maya	19.9	43.6	13.9	7.9	13.9	0.6
Puerto Morelos	9.9	58.5	20.2	5.1	5.9	0.4
Playa del Carmen	6.5	33.8	32.9	15.2	11.2	0.3

Source: The information was collected from each destination report from Consejo de Promoción Turística de Quintana Roo (2019). https://cptq.mx/inteligencia/perfil-de-turista/

Tourist by age group showed that, in 2019, the millennials or Generation Y were the main percentage of tourists (see Figure 21).

Figure 21. Quintana Roo's tourist by group of age



Source: The information was collected from each destination report from Consejo de Promoción Turística de Quintana Roo (2019). https://cptq.mx/inteligencia/perfil-de-turista/

The main purpose of reported trip is rest and relaxation (60 percent), followed by adventure tourism (9.5 percent), honeymoon (6 percent) and the rest is for wedding, visiting family/friends, cultural tourism, business and conventions, among others (Consejo de Promoción Turística de Quintana Roo, 2019). The first three activities reported by tourists are (i) enjoying the travel package with buffet, pool, beach (55.41 percent), (ii) nature tourism including snorkeling as a reef-related activity (17 percent) and (iii) cultural visits to archaeological sites (10.3 percent), as shown in Table 29.

*Table 29. Tourists activities in the Mexican Caribbean**

Activities	2019 (%)
Be in the pool and beach, enjoy the buffet and the animation and some parks visiting	55.41
Nature tourism, snorkeling, canopy, cenotes and ecotourism	17
Visit archaeological zones, museums and Mayan communities	10.3
Beach clubs, bars, discotheques and night parties	3.1
Romantic dinner, beach, shopping and activities for couples	5.6
Attend a wedding, get married and honeymoon	1.7
Attend conferences, expos, team building, integration and corporate benefits	1.6
Yoga, fitness, meditation temazcal and paddle	1.8
Enjoy renowned restaurants, local and regional gastronomy	1.4
Sports activities, golf, diving, sport fishing and running	1.1
Attend events such as cultural, musical, gastronomic and/or sports festivals	0.9
Yacht tour, gourmet restaurants, golf and shopping luxury items	0.6

*Cancún, Riviera Maya, Puerto Morelos, Costa Mujeres, Tulum, Chetumal, Mahaual, Bacalar, Cozumel e Isla Mujeres.
Source: Consejo de Promoción Turística de Quintana Roo (2019). Perfil y comportamiento del turista. Caribe Mexicano. https://qroo.gob.mx/sedetur/indicadores-turisticos

One of Quintana Roo's main attractions are the Marine Protected Areas (MPAs) that protect the ecosystem services of the Mesoamerican Reef Barrier (see Table 30).

Table 30. Visitors to Marine Protected Areas in Quintana Roo, Mexico

MPA	Visitors (millions)
Parque nacional Costa Occidental de Isla Mujeres, Punta Cancún y Punta Nizuc	0.343
Arrecifes de Cozumel	0.197
Banco Chinchorro	0.002
Arrecifes de Puerto Morelos	0.167
Arrecifes de Sian Ka'an	0.116
Caribe Mexicano	0.189
Arrecifes de Xcalak	0.001
TOTAL	**1.015**

Source: CONANP (2019)

In 2019, 38.4 percent of the visitors were of national origin, showing the main states of origin of these tourists in Table 31.

Table 31. National visitors to Marine Protected Areas in Quintana Roo, Mexico

	Mexico 38.4 percent	
Top	**Mexican States**	
1	Mexico City	23.2
2	Nuevo León	11.5
3	Jalisco	10.6
4	Estado de México	9.6
5	Chihuahua	5.8
6	Guanajuato	4.3
7	Baja California	4.1
8	Querétaro	3.8
9	Puebla	2.5
10	Coahuila	2.3

Source: Consejo de Promoción Turística de Quintana Roo (2019).
https://cptq.mx/inteligencia/perfil-de-turista/

Tourism economic valuation

The WRI methodology assesses the economic contribution of reef-related recreation and tourism. This includes four elements: (1) accommodation revenues, (2) revenues from marine parks, (3) reef recreation (diving and snorkeling), and (4) local resource use.

The first value to define is the percent of visitors who use the reef either for recreation activities on the reef (diving, snorkeling, etc.) or to visit white sand beaches (coral origin). Estimating the percentage of visitors who use the reef is a critical step in the valuation.

This information allows the valuation estimate to focus on only visitors who came to the study site at least partially because of its coral reefs. Revenue from the main categories of tourism, accommodation and miscellaneous expenditures from tourists are prorated using the percentage of visitors using the reef. When more specific data are not available, these values can also be used to approximate the number of users.

For Quintana Roo, the percentage of visitors who use the reef is 55.41 percent (Consejo de Promoción Turística, 2019)[83]. It represents tourists who spend time on the beach. This value is used to calculate reef-related accommodation. Other values to be defined in this section are the annual number of visitors and the average length of stay.

Table 32. Default values defined for Quintana Roo, Mexico

Number of "Stay Over" Visitors (millions)	15.09
Average length of stay (nights)	6.35
Percent of visitors using the reef[84]	55.41

Source: SEDETUR, 2019; Consejo de Promoción Turística de Quintana Roo (2019)

Accommodation revenues

The value of the accommodation sector is calculated using gross revenues and costs for the sector as a whole with state-level data.

Gross Revenues

To calculate gross revenues from accommodation, revenues of the sector as a whole is estimated. The variables used are: the average rate of the rooms, excluding taxes and service charges, the average occupancy rate, the average number of rooms per hotel and the number of accommodations in study area (see Table 33).

Table 33. Gross revenues for accommodation in Quintana Roo, Mexico

Variable	Value
Occupancy Rate (%)	79
Average room rate (USD)[85]	153.64
Average number of rooms per accommodation	95
Total number of accommodations in study area	1,129
Percent of visitors using the beach	55.41
Gross revenues (millions USD)	**2,641**

Source: SEDETUR, 2019; Consejo de Promoción Turística (2019)

[83] The results of the survey have 94 percent of confidence level.
[84] Percent of visitors who use the reef is estimated as the same the percentage of tourists using the beach.
[85] Trivago Hotel Price Index was used to calculate the 2019 average room rate in Cancun, Cozumel, Tulum, Playa del Carmen, Puerto Morelos, Isla Mujeres and Bacalar.

Costs, Taxes and service charges

The data required are: the average hourly wage, the average hours worked per week, the average number of people employed by room, non-labor operating costs as a percentage of basic revenue, the tax rate, and the service charge rate. If data are not available, the WRI tool provides default values for costs, taxes and service charges from Cooper et al. (2009). The defined data are presented in Table 34.

Table 34. Operating costs for accommodation in Quintana Roo, Mexico

Variable	Value
Average room rate (US dollars)[86]	153.64
Average hour hotel wage (US dollars)[87]	0.8 per hour
Number of persons employed per room[88]	1.5 persons
Non labor operating costs (US dollars)[88]	25
VAT[89] (%)	16
Accommodation tax[90] (%)	3

For the average room rate, the value used is the Trivago Hotel Price Index for Cancun, Cozumel, Tulum, Playa del Carmen, Puerto Morelos, Isla Mujeres and Bacalar.

The average hotel hourly wage used is USD 0.8 per hour[91] (World Bank, 2020). As a reference, the minimum daily wage in Quintana Roo area is approximately USD 5.4 per day or USD 0.68 per hour (CONSAMI, 2019). The number of 1.5 people employed to do service per room is taken from the WRI tool and the value of non-labor operating costs value is of 25 percent of revenue, also from WRI tool.

VAT in Mexico is 16 percent (Ley del Impuesto al Valor Agregado, 2019) and there is also a 3 percent accommodation tax (Impuesto al Hospedaje Quintana Roo, 2019). Recently, Quintana Roo approved an environmental sanitation tax of approximately USD 1 per room per night (H. Congreso del Estado de Quintana Roo, 2018). This tax has been included in the valuation.

No information is available on the percentage of revenue leakage, which means that all revenue remains in the local economy.

All in all, the **total value of accommodation** is **USD 2,483 million** (see Table 35).

[86] Trivago Hotel Price Index was used to calculate the 2019 average room rate in Cancun, Cozumel, Tulum, Playa del Carmen, Puerto Morelos, Isla Mujeres and Bacalar.
[87] Calculated considering a USD 140.6 monthly minimum wage for a cashier, age 19, with one year of work experience from World Bank Study Doing Business in Mexico, assuming 22 working days in a month and 8 hours daily.
[88] WRI tool, default value.
[89] Ley del Impuesto al Valor Agregado. http://www.diputados.gob.mx/LeyesBiblio/pdf/77_091219.pdf.
[90] Impuesto al Hospedaje Quintana Roo http://documentos.congresoqroo.gob.mx/leyes/L187-XV-27122017-611.pdf
[91] It was calculated considering the monthly minimum wage for a person age 19, with one year of work experience, taken from World Bank's Study Doing Business in Mexico, assuming 22 working days in a month and 8 hours daily or 40 hours per week.

Table 35. Value of accommodation for reef-related tourism in Quintana Roo, Mexico

Concept	USD Mn.
Gross Revenue	2,641
Costs	808
Net Revenue	**1,833**
Transfers to the economy (taxes, wages and service charges)	650
Total Value	**2,483**

Revenues from Marine Parks

In order to calculate the revenue from the Marine Parks, information is needed on the fee paid by users and the costs of collecting this fee. The Natural Protected Area Commission collect the information annually, as shown in Table 36.

Table 36. Gross Marine Park Revenues

MPA Revenues	Revenues 2019 USD Mn.	Visitors in 2019 (Million)
Parque nacional Costa Occidental de Isla Mujeres, Punta Cancún y Punta Nizuc	0.642	0.343
Arrecifes de Cozumel	0.717	0.197
Banco Chinchorro	0.007	0.002
Arrecifes de Puerto Morelos	0.312	0.167
Arrecifes de Sian Ka'an	0.422	0.116
Caribe Mexicano	0.354	0.189
Arrecifes de Xcalak	0.003	0.001
TOTAL	**2.458**	**1.015**

Source: Estimated with CONANP (2019) information. Exchange rate used 19.2605

The cost of parks should include only the costs of collecting and administering fees, not the costs of administering the park. However, this information is not available.

Table 37. Value of Marine Parks for reef-related tourism in Quintana Roo, Mexico

Concept	USD Mn.
Gross revenues	2.458
Costs (collection costs of the park)	Nd
Net Revenue	**2.458**

The estimated **net revenue** of all Marine Protected Areas is estimated at **USD 2.4 million**.

Diving revenues

To calculate the gross revenue, this component needs the following information: annual number of divers, average number of dives, average price per dive (distribution, single or two tank dives, package of ten dives, etc. and the proportion of each type) and average price of equipment and rental rates.

The annual number of divers is calculated with the percentage of visitors who dive (1.4 percent) (Consejo de Promoción Turística de Quintana Roo, 2019) and the total number of tourists arriving annually.

For the average number of dives per diver, the information was taken from expert opinion consulted in workshops. For the prices of the diving tours, the average price per dive estimated is USD 56 and the average price of the equipment is USD 18, which is obtained from several dive stores and tour operators. There is a 50 percent of all dives with equipment rentals (Cooper, Burke & Bood, 2009).

There is no information available that includes the revenue from dive certifications and revenues from all-inclusive packages (see Table 38).

Table 38. Gross revenues for diving in Quintana Roo, Mexico

Variable	Value
Number of divers (million)	1.7
Percentage of visitors who dive	1.14
Number of averages dive per dive	2
Average price of diving (USD)	56
Average equipment price (USD)	18
Proportion of all dives with equipment rentals (%)	50

Sources: Estimation with Cooper, Burke, & Bood, 2009; Consejo de Promoción Turística de Quintana Roo (2019) information: Tour operator's information in their web pages. Expert opinion from workshops.

Costs

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges (Table 39).

Table 39. Diving costs assumptions

Costs	
Percentage from the revenues are the labor costs	40
Percentage from the revenues are the non-labor costs	35

Source: WRI tool, default value

All in all, the **diving value** is **USD 18.12 million** (Table 40).

Table 40. Diving economic value in Quintana Roo, Mexico

Concept	USD Mn.
Gross Revenue	22.37
Costs	16.78
Net Revenue	5.59
Transfers to the economy [16% from taxes (USD 3.58 million), USD 8.95 million from wages, and service charges non available]	12.53
Total value	**18.12**

Snorkeling revenues

The following information is used to calculate snorkeling revenues: the annual number of snorkel trips estimated by the total visitors to the study area and the proportion of snorkelers or boat trips; the average price of snorkel trips, and the average price of the equipment.

For the estimation of the annual number of snorkelers, the annual number of visitors and the percentage of visitors who declared to snorkel (17 percent) is used (Consejo de Promoción Turística de Quintana Roo, 2019). For the number of trips, a conservative estimate of 1.5 trips is used (Cooper, Burke, & Bood, 2009).

In terms of pricing, the same approach is applied as for the diving component. Average prices are obtained from tour operators. The average price of a trip is USD 105, with an average equipment rental price of USD 15. It is assumed that 15 percent of trips charge for equipment rental (see Table 41).

Table 41. Gross revenues of snorkeling in Quintana Roo, Mexico

Variables	Value
Number of snorkelers (millions)	2.58
Percentage of visitors who snorkelers	17.09
Number of averages snorkel trips	1.5
Average price of snorkeling (USD)	105
Average equipment price (USD)	15
Proportion of all dives with equipment rentals (%)	15

Sources: Estimation with Cooper, Burke, & Bood, 2009; Consejo de Promoción Turística de Quintana Roo (2019) information; Tour operation information in their web pages.

<u>Costs</u>

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges.

All in all, the **snorkeling value** is **USD 329 million** (Table 42).

Table 42. Snorkeling economic value in Quintana Roo, Mexico

Concept	USD Mn.
Gross Revenue	406.24
Costs	304.68
Net Revenue	101.56
Transfers to the economy (16 % from taxes (USD 65 million), USD 162.5 million from wages and service charges non available)	227.49
Total value	**329**

Indirect economic impacts

A multiplier from the tourism sector in Quintana Roo is used to calculate the indirect economic impacts of reef-related tourism and recreation. The value is 1.21531 (Scandizzo, 2020) which captures the secondary or indirect economic effects of tourism activity and represents the economic interdependencies between sectors in Quintana Roo.

The multiplier is applied to gross revenue from lodging, diving, snorkeling and marine parks. This means that for every dollar spent on tourism and recreation, an additional twenty-one cents impacts the economy. The gross revenues from the items listed are USD 3,073 million [92]. **Indirect impacts** are estimated at **USD 661.63 million** (Table 43).

Table 43. Indirect economic impacts of tourism in Quintana Roo, Mexico

Concept	USD Mn.
Total direct economic impacts	2,832.99
Total Indirect economic impacts	661.63
Total direct and indirect economic value	3,494.62

Uncaptured value

No information is available on local tourism, cruise ship tourism and the net revenue remaining in the country, so experts have been consulted.

Total value

The **total use value** of the reef-related tourist sector is approximately the **22.6 percent of tourism expenditure** – USD 15,440.41 million – (Table 44).

[92] Sum of gross revenues from tables 35,37,40,42.

Table 44. Use Value of reef-related tourism in Quintana Roo, Mexico

Concept	Value (USD Mn.)
1. Accommodation	2,483
2. Marine Parks	2.458
3. Diving	18.12
4. Snorkeling	329
5. Local Use	Nd
6. Cruise ships	Nd
Total Direct expenses	2,832.99
7. Indirect impacts	661.63
8. Total use value	**3,494.20**

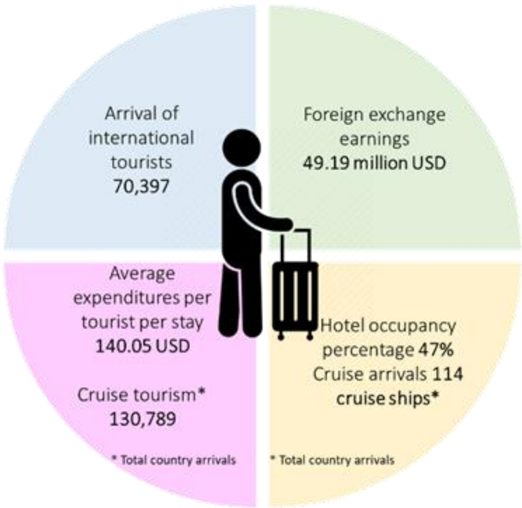
GUATEMALA

Caribbean tourism profile

The Department of Izabal is located in the northeast region of Guatemala. It is bordered on the north by the department of Petén, Belize and the Caribbean Sea; on the South by the department of Zacapa; on the east with the Republic of Honduras; and on the west by the department of Alta Verapaz. In Izabal are the ports of Santo Tomás and Puerto Barrios, which have the capacity to dock deep-draft vessels at their docks, becoming essential points of international exchange in the Atlantic Ocean.

It is estimated that, between 2018 and 2019, the average annual number of visitors was 70,397 non-resident visitors and the cruise industry brought in more than 130,789 cruise passengers in 2018. In terms of the tourism economy, 49.19 million dollars in foreign exchange earnings were captured by tourism and the average expenditure on tourism was USD 140, as shown in Figure 22.

Figure 22. Izabal's tourism sector in numbers



Source: INGUAT (2018); SITCA (2018)

One out of every two visitors (58 percent) come from Central America, especially El Salvador, with a 44 percent share. Next in order is the United States with the 18 percent. When it comes to foreign visitors, 33 percent come mainly from the United States and 21 percent from Europe, as shown in Table 45.

Table 45. Tourist arrivals by country and region in 2018 (%)

Destination	Canada	USA	Mexico	El Salvador	Rest of Central America	Europe	Rest of the world
Guatemala	1	18	4	44	14	6	13
Izabal	4	33	2	19	7	21	14

Source: INGUAT (2018)

The main purpose of visitors' trips to Izabal is leisure and vacation (79 percent), followed by visiting friends and family (14 percent), business (4 percent) and others (3 percent), as shown in Table 46 (INGUAT, 2018).

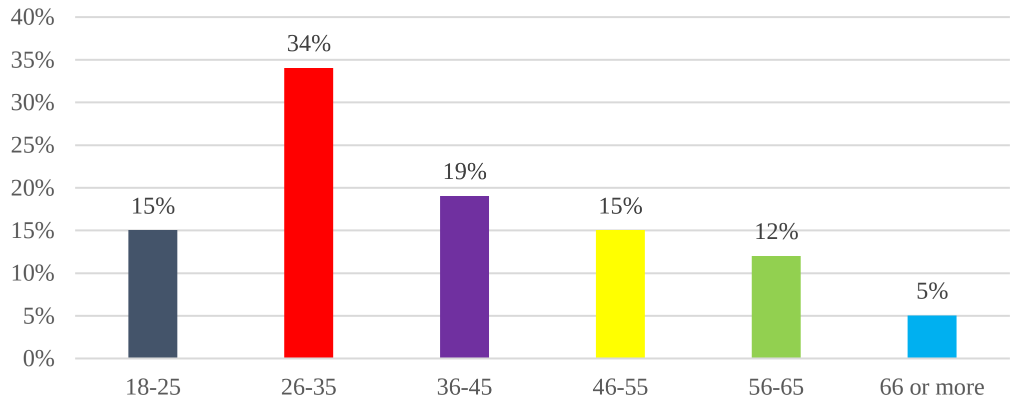
Table 46. Tourists activities in Izabal, Guatemala

Activities	2019 (%)
Visit the beach	41
Visit lakes and lagoons	41
Visit Archaeological Sites	39
Travel	26
Landscaping	26
Visit Natural Protected Areas	21
Visit Towns	21
Visit museums	16
Visit family and friends	16
Gastronomy	15

Source: INGUAT (2018)

The main age group of visitors to Izabal is between 26 and 35 years old (Figure 23).

Figure 23. Age group of non-resident visitors in Izabal, Guatemala



Source: INGUAT (2018)

From 2006 to 2017 there has been a steady increase in the number of visits to Punta de Manabique, one of Guatemala's Marine Protected Areas, estimated to represent an annual growth of 10 percent.

Table 47. Visitors to Marine Protected Area in Guatemala

Punta de Manabique	**Visitors (Million)**
2006	2,506
2007	3,007
2008	3,910
2009	5,865
2010	5,865
2011*	6,452
2012*	7,097
2013*	7,806
2014*	8,587
2015*	9,446
2016*	10,390
2017*	11,429

Source: PROARCA/APM (2004)
* Estimation with 10 percent annual growth.

Tourism economic valuation

The WRI methodology assesses the economic contribution of reef-related recreation and tourism. This includes four elements: (1) accommodation revenues, (2) revenues from marine parks, (3) reef recreation (diving and snorkeling), and (4) local resource use.

As explained for the Mexican case, the first value to define is the percent of visitors who use the reef either for recreation activities on the reef (diving, snorkeling, etc.) or to visit white sand beaches (coral origin).

For Izabal, the percentage of visitors who use the reef is 41 percent (INGUAT, 2018). It represents tourists who spend time on the beach. This value is used to calculate reef-related accommodation. Other values to be defined in this section are the annual number of visitors and the average length of stay (Table 48).

Table 48. Default values defined for Izabal, Guatemala

Number of "Stay Over" Visitors (millions)	0.070
Average length of stay (nights)	4.99
Percent of visitors using the reef[93]	41

Source: INGUAT (2018)

Accommodation revenues

The value of the accommodation sector is calculated using gross revenues and costs for the sector as a whole with state-level data.

Gross Revenues

To calculate gross revenues from accommodation, revenues of the sector as a whole is estimated. The variables used are: the average rate of the rooms, excluding taxes and service charges, the average occupancy rate, the average number of rooms per hotel and the number of accommodations in study area (see Table 49).

Table 49. Gross revenues for accommodation in Izabal, Guatemala

Variable	Value
Occupancy Rate (%)	45
Average room rate (USD)[94]	66
Average number of rooms per accommodation	24
Total number of accommodations in study area	48
Percent of visitors using the beach	41
Gross revenues (millions USD)	**5.1**

Sources: INGUAT (2015, 2017, 2018)

Costs, Taxes and service charges

The data required are: the average hourly wage, the average hours worked per week, the average number of people employed by room, non-labor operating costs as a percentage of basic revenue, the tax rate, and the service charge rate. If data are not available, the WRI tool provides default values for costs, taxes and service charges from Cooper et al. (2009). The defined data are presented in Table 50.

[93] Percent of visitors who use the reef is estimated as the same the percentage of tourists using the beach.
[94] Estimated using the Trivago Hotel Price Index for the cities of Antigua Guatemala and Guatemala and booking.com for hotels nearby Punta de Manabique in Izabal and Livingston.

Table 50. Operating costs for accommodation in Izabal, Guatemala

Variable	Value
Average room rate (US dollars)	66
Average hour hotel wage (US dollars)[95]	2.5 per hour
Number of persons employed per room[96]	1.5 persons
Non labor operating costs (US dollars)[97]	25
Taxes (%)	12
Accommodation tax[98] (%)	10

For the average room rate, we use the value calculated by taking the averages of the cities of Antigua Guatemala, Guatemala and hotels near Punta de Manabique in Izabal and Livingston. Prices are taken from the Trivago Hotel Price Index and booking.com.

The average hourly wage of the hotel used is USD 2.5 per hour[99]. It is calculated considering the minimum monthly salary of a 19-year-old cashier with one year of work experience, taken from the World Bank's Doing Business 2018 Study, assuming 22 days of work in a month and 8 hours per day or 40 hours per week (World Bank, 2018). The minimum daily wage is approximately USD 1.5 per day. The number of 1.5 people employed to do service per room is taken from the WRI tool and the value of non-labor operating costs value is of 25 percent of revenue. VAT in Guatemala is 12 percent and there is also a 10 percent accommodation tax. No information is available on the percentage of revenue leakage. It means that all revenue remains in the local economy.

All in all, the **total value of accommodation** is **USD 4.9 million** (see Table 51).

Table 51. Value of accommodation for reef-related tourism in Izabal, Guatemala

Concept	USD Mn.
Gross Revenue	5.1
Costs	4.96
Net Revenue	0.156
Transfers to the economy [12% VAT (USD 0.61 million), USD 3.68 million via wages and 10% accommodation tax (USD 0.51 million)]	4.81
Total Value	**4.966**

[95] Calculated considering a USD 411.2 monthly minimum wage for a cashier, age 19, with one year of work experience from World Bank Study Doing Business 2018, assuming 22 working days in a month and 8 hours daily.
[96] WRI tool, default value.
[97] WRI tool, default value.
[98] Superintendencia de Administración Tributaria. https://sites.google.com/site/elabcdelosimpuestossat/el-abc-de-los-impuestos-1/c-impuesto-a-la-ocupacion-hotelera
[99] It was calculated considering the monthly minimum wage for a person age 19, with one year of work experience, taken from World Bank's Study Doing Business in Mexico, assuming 22 working days in a month and 8 hours daily or 40 hours per week.

Revenues from Marine Parks

In order to calculate the revenue from the Marine Parks, we use data available on the only marine protected area in Guatemala: Punta de Manabique. There are few data available for Punta de Manabique. The number of visitors to the marine park is estimated with a 10 percent annual growth over the 2010 estimates made by PROARCA/APM (2004). Local visitors pay an entrance fee of 5.00 Quetzals and the fee for foreign visitors is USD 1. We assume all visitors are foreign and pay their respective fee. This yields a valuation of USD 12,572 in 2018.

Table 52. Gross Marine Park Revenues

MPA Revenues	Revenues 2018 USD Mn.	Visitors in 2018 (Million)
Punta de Manabique	**0.012**	**0.012**

Source: PROARCA/APM (2004). Estimated with a 10 percent annual growth rate

The cost of parks should include only the costs of collecting and administering fees, not the costs of administering the park. However, this information is not available.

Table 53. Value of Marine Parks for reef-related tourism in Izabal, Guatemala

Concept	USD Mn.
Gross revenues	0.012
Costs (collection costs of the park)	Nd
Net Revenue	**0.012**

The estimated **net revenue** of all Marine Protected Areas is estimated at **USD 0.012 million**.

Diving revenues

To calculate the gross revenue, this component needs the following information: annual number of divers, average number of dives, average price per dive (distribution, single or two tank dives, package of ten dives, etc. and the proportion of each type) and average price of equipment and rental rates.

For the average number of dives per diver two estimates are applied[100] (Table 54). 1) A high estimate: it calculates the number of visitors in Punta de Manabique by multiplying the number of non-resident visitors in Izabal by the percentage of visitors in Protected Areas (21 percent) taken from INGUAT's visitor profile studies. This value would be the maximum number of visitors to the MPA assuming that it is the only Protected Area where visitors come. Then the percentage of visitors who go to the visits (PROARCA/APM, 2004) is applied to the number of visitors to the MPA to obtain the number of divers and snorkelers. 2) A lower estimate: we take the estimated number of visitors used in the

[100] Estimated using 10 percent annual growth with data from PROARCA/APM (2004).

Marine Park section and multiply it by the same percentage of visitors who go on excursions (8 percent) in Punta de Manabique used in the upper estimate.

Table 54. Estimation of the number of divers

High estimate	
Izabal visitors	70,397
% visiting Protected Areas	21
MPA visitors (high estimate)	14,738
Percent of visitors touring	8
Divers & Snorkelers in MPA (high estimate)	1,183
Low estimate	
MPA visitors	12,572
Percent of visitors touring	8
Divers & Snorkelers in MPA (low estimate)	1,006

Source: PROARCA/APM (2004); INGUAT (2018)

For the average number of dives per diver, the information of previous studies in the region is taken (Cooper, Burke & Bood, 2009). For the prices of the diving tours, the average price per dive estimated is USD 60 and the average price of the equipment is USD 15, which is obtained from several dive stores and tour operators. There is a 25 percent of all dives with equipment rentals.

There is no information available that includes the revenue from dive certifications and revenues from all-inclusive packages (see Table 55).

Table 55. Gross revenues for diving in Guatemala

Variable	Value
Number of divers (million)	0.0010 - 0.0011
Percentage of visitors who dive	8
Number of averages dive per dive	4
Average price of diving (USD)	60
Average equipment price (USD)	15
Proportion of all dives with equipment rentals (%)	25

Source: Estimation with PROARCA/APM (2004); Cooper, Burke, & Bood (2009); INGUAT (2018); Tour operator's information in their web pages.

Costs

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges.

All in all, the **diving value** is **USD 0.19 – 0.23 million** (Table 56).

Table 56. Diving economic value in Guatemala

Concept	USD Mn.
Gross Revenue	0.25 – 0.3
Costs	0.19 – 0.22
Net Revenue	0.064 – 0.075
Transfers to the economy (12% from taxes, USD 0.10 - 0.12 million from wages and service charges non available)	0.13 – 0.15
Total value	**0.19 – 0.23**

Snorkeling revenues

The following information is used to calculate snorkeling revenues: the annual number of snorkel trips and the proportion of snorkelers or boat trips; the average price of snorkel trips, and the average price of the equipment.

The total snorkelers approach is applied. For the estimation of the annual number of snorkelers, the same value is used as the number of divers calculated in the diving section. For the number of trips, a conservative estimation of 1.5 trips is used (Cooper, Burke & Bood, 2009).

In terms of pricing, the same approach is applied as for the diving component. Average prices are obtained from tour operators. The average price of a trip is USD 48, with an average equipment rental price of USD 15. It is assumed that 80% of snorkelers require equipment and that all trips charge for equipment rental (see Table 57).

Table 57. Gross revenues of snorkelling in Guatemala

Variables	Value
Number of snorkelers (millions)	0.0010 - 0.0011
Percentage of visitors who snorkelers	8
Number of averages snorkel trips	1.5
Average price of snorkeling (USD)	48
Average equipment price (USD)	15
Proportion of all dives with equipment rentals (%)	100

Source: Estimation with PROARCA/APM (2004); Cooper, Burke, & Bood (2009); INGUAT (2018); Tour operator's information in their web pages.

Costs

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges.

All in all, the **snorkeling value** is **USD 0.046 – 0.054 million** (Table 58).

Table 58. Snorkeling economic value in Guatemala

Concept	USD Mn.
Gross Revenue	0.060 – 0.070
Costs	0.045 - 0.053
Net Revenue	0.015 – 0.017
Transfers to the economy [12 % from taxes (USD 0.007-0.008 million), USD 0.024-0.028 million from wages and service charges not available]	0.024 – 0.028
Total value	**0.046 - 0.054**

Indirect economic impacts

A multiplier of 1.2 is used to calculate the indirect economic impacts of reef-related tourism and recreation (Cooper, Burke, & Bood, 2009). The multiplier is applied to gross revenue from lodging, diving, snorkeling and marine parks. This means that for every dollar spent on tourism and recreation, an additional twenty cents impacts the economy. The gross revenues from the items listed are USD 5.45 – 5.50 million[101]. **Indirect impacts** are estimated at **USD 1.089 - 1.101 million** (Table 59).

Table 59. Indirect economic impacts of tourism in Guatemala

Concept	USD Mn.
Total direct economic impacts	5.22 – 5.26
Total Indirect economic impacts	1.089 – 1.101
Total direct and indirect economic value	6.31– 6.36

Uncaptured values

No information is available on local tourism, cruise ship tourism and the net revenue remaining in the country, so experts have been consulted.

Total value

[101] Sum of gross revenues from tables 51,53,56,58.

The **total use value** of the reef-related tourist sector in Honduras is between **USD 6.31 and 6.34 million** (Table 60).

Table 60. Use Value of reef-related tourism in Guatemala

Concept	Value (USD Mn.)
1. Accommodation	4.97
2. Marine Parks	0.012
3. Diving	0.19 – 0.23
4. Snorkeling	0.046 – 0,054
5. Local Use	Nd
6. Cruise ships	Nd
Total Direct expenses	3.1. – 5.26
7. Indirect impacts	1.089 – 1.102
8. Total use value	**6.31 – 6.36**

HONDURAS

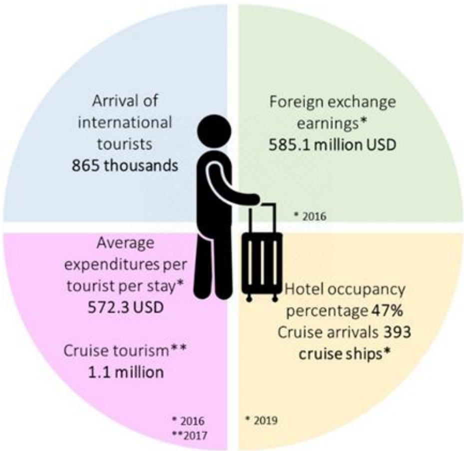
Honduras is located in Central America, bordering Guatemala, Nicaragua and El Salvador and has coasts on the Caribbean Sea and the Pacific Ocean. Its total land area is 111,890km^2, of which 29 percent is agricultural and 39.9 percent is forest. The area of urban land is 3,702 km^2. The area of reefs and mangroves in Honduras is estimated at 810 km^2 and 1,458 km2 respectively (Spalding, Ravilious, & Green, 2001).

In 2019, Honduras's GDP was estimated at USD 25,113 million, in per capita term this means USD 2,742. The average annual GDP growth rate between 2010-2019 was 8.4 percent (Banco Central de Honduras, 2019).

Honduras is divided into 18 departments, five of which have coastlines on the Caribbean Sea: Atlántida, Colón, Cortes, Gracias a Dios and Islas de la Bahía. The population of these five departments is estimated at 2.7 million people.

In 2018, 865,000 tourists and 1,289,000 cruise ship passengers visited Honduras (Instituto Nacional de Estadística, 2016). Between 2010 and 2018 the number of tourists and cruise ship passengers has grown at an average annual rate of 7 percent.

Figure 24. Honduras tourism sector in numbers 2019



Source: World Tourism Organization (2019)

Tourism in Roatan focuses on the richness of its marine biodiversity. For this reason, the protection and preservation of the area through education and law enforcement is key. In addition to Roatan's biodiversity, conservation efforts must expand the physical attributes to include the cultural and historical riches captured in Roatan's local communities.

There are efforts to diversify the main tourist attractions in Roatan and the surrounding region. The tourist expansion will almost certainly take advantage of the talent and history of the local cultures. There is also potential for tourism at the historical and archaeological sites found in Roatan, Guanaja, and Utila. The reef around Roatan is considered the second largest barrier reef in the world.

Tourism is the most important economic income for Roatan and the Bay Islands of Honduras. The tourist activity has had a great boom in the last years, especially since the construction of the international airport and since the cruise ship established the ports. It is estimated that there was an arrival of 1.6 million tourists visiting Roatan each year, that figure only increases from year to year.

The most visited MPA in Honduras is Islas de la Bahía Marine National Park, with over 1,095,000 visitors in 2017, followed by the Cayos Cochinos with 22,123 visitors and Jeannette Kawas National Park with 6,212 visitors (Instituto Nacional de Estadística, Honduras, 2019).

Table 61. MPAs in Honduras with coral reefs

MPA	Category	Area (ha)
Parque Nacional Jeannette Kawas	Parque Nacional	79,382
Bahía de Tela	Refugio de vida silvestre	86,259
Cayos Cochinos	Monumento natural marino	122,088
Islas de la Bahía	Parque Nacional Marino	646,810
Punta Izopo	Parque nacional	18,585

Source: Instituto de Conservación Forestal, n.d.

Tourism economic valuation in Honduras

The WRI methodology assesses the economic contribution of reef-related recreation and tourism. This includes four elements: (1) accommodation revenues, (2) revenues from marine parks, (3) reef recreation (diving and snorkeling), and (4) local resource use.

For Honduras, the percentage of visitors who use the reef is 26.4 percent. The number of visitors is estimated with data from UNWTO statistics and the percentage of visitors related to the reef uses the information available from Secretaría de Integración Turística Centroamericana (SITCA) from 2010 to 2015 and Instituto Hondureño del Turismo which has surveys available from 2011 to 2016 that report on the tourist's recreational activities.

Table 62. Percentage of reef users in Honduras

Activity	Avg. 2011-2016
Beach	14.4
Diving	5.6
Snorkeling	6.4
Total Reef Users	26.4

Source: SITCA (2010-2016)

The valued defined for Honduras in presented in Table 63.

Table 63. Default values defined for Honduras

Number of "Stay Over" Visitors (millions)	865,000
Average length of stay (nights)	10.1
Percent of visitors using the reef[102]	26.4

Source: SITCA (2010- 2015), average and forecast; Instituto Hondureño del Turismo (2011-2016), average and forecast; World Tourism Organization (2019)

Accommodation revenues

The value of the accommodation sector is calculated using gross revenues and costs for the sector as a whole with state-level data.

<u>Gross Revenues</u>

The variables used to calculate gross revenues from accommodation are: the average rate of the rooms, excluding taxes and service charges, the average occupancy rate, the average number of rooms per hotel and the number of accommodations in study area (see Table 64).

[102] Percent of visitors who use the reef is estimated as the same the percentage of tourists using the beach.

Table 64. Gross revenues for accommodation in Roatan, Honduras

Variable	Value
Occupancy Rate (%)	47
Average room rate (USD)	136
Average number of rooms per accommodation	21.36
Total number of accommodations in study area	1,081
Percent of visitors using the beach	26.4
Gross revenues (millions USD)	**142.22**

Sources: Last data 2010, estimation; Trivago Hotel Price Index Roatan disponible; SITCA (2016); Instituto Hondureño Turismo (2016)

Costs, Taxes and service charges

For the average room rate, the value used is the Trivago Hotel Price Index for Roatan. The average hotel hourly wage used is USD 3 per hour. As a reference, it is double the minimum wage in 2018 (USD 1.54), considering that the minimum wage for workers assumed in the case study for the World Bank's Doing Business program in 2018 was USD 460.4 per month or USD 2.6 per hour. One of the assumptions is that hotel employees work 40 hours per week.

The number of 1.5 people employed to do service per room is taken from the WRI tool and the value of non-labor operating costs value is of 25 percent of revenue, also from WRI tool.

VAT in Honduras is 15 percent (SEFIN, 2016). No information is available on the percentage of revenue leakage.

All in all, the **total value of accommodation** is **USD 127.9 million** (see Table 65).

Table 65, Value of accommodation for reef-related tourism related in Honduras

Concept	USD Mn.
Gross Revenue	142.2
Costs	92.6
Net Revenue	49.6
Transfers to the economy [taxes (USD 21.3 million), wages (USD 57 million) and service charges non available]	78.3
Total Value	**127.9**

Revenues from Marine Parks

To calculate the revenue from Marine Parks information of the user pays fee is needed and the costs of collecting this fee. The National Institute of Statistics collects the information regarding visitors to the MPAs (Instituto Nacional de Estadística, Honduras, 2019).

Revenues are calculated with an entrance fee for foreign visitors of USD 5. It is assumed that all visitors to MPAs are foreigners.

Table 66. Gross Marine Park Revenues

MPA Revenues	Revenues 2018 USD Mn.	Visitors in 2018 (Million)
Monumento Natural Marino Cayos Cochinos	0.112	0.022
Parque Nacional Blanca Jeannette Kawas (Punta Sal)	0.022	0.004
Parque Nacional Punta Izopo	0.001	0.000
Parque Nacional Marino Islas de la Bahía	5.567	1.113
TOTAL	**5.703**	**1.141**

Source: Estimated with latest data from 2017 (Instituto Nacional de Estadística, Honduras, 2019) using overnight tourists growth rate; Instituto Nacional de Estadística, Honduras, 2019; Estimated with latest data from 2016 (Instituto Nacional de Estadística, Honduras, 2019) using overnight tourists growth rate.

The cost of parks should include only the costs of collecting and administering fees, not the costs of administering the park. However, this information is not available.

Table 67. Value of Marine Parks for reef-related tourism in Honduras

Concept	USD Mn.
Gross revenues	5.703
Costs (collection costs of the park)	Nd
Net Revenue	**5.703**

The estimated **net revenue** of all Marine Protected Areas is estimated at **USD 5.7 million**.

Diving revenues

To calculate the gross revenue, this component needs the following information: annual number of divers, average number of dives, average price per dive (distribution, single or two tank dives, package of ten dives, etc. and the proportion of each type) and average price of equipment and rental rates.

The annual number of divers is calculated with the percentage of visitors who dive (5.6 percent) (Instituto Nacional de Estadística, Honduras, 2019) and the total number of tourists arriving annually.

For the average number of dives per diver, the information of previous studies in the region is taken (Cooper, Burke & Bood, 2009). For the prices of the diving tours, the average price per dive estimated is USD 79 and the average price of the equipment is USD 14.9, which is obtained from several dive stores and tour operators. There is a 25 percent of all dives with equipment rentals (Cooper, Burke & Bood, 2009).

There is no information available that includes the revenue from dive certifications and revenues from all-inclusive packages (see Table 68).

Table 68. Gross revenues for diving in Honduras

Variable	Value
Number of divers (million)	0.04
Percentage of visitors who dive	5.6
Number of averages dive per dive	4
Average price of diving (USD)	79
Average equipment price (USD)	14.9
Proportion of all dives with equipment rentals (%)	25

Sources: Estimation with Cooper, Burke, & Bood (2009); World Tourism Organization (2019); Instituto Nacional de Estadística, Honduras (2019); Tour operator's information in their web pages.

Costs

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges (Table 69).

Table 69. Diving economic value in Honduras

Concept	USD Mn.
Gross Revenue	16.02
Costs	12.02
Net Revenue	4
Transfers to the economy [15% from taxes (USD 2.4 million), USD 6.4 million from wages and service charges non available]	8.81
Total value	**12.82**

All in all, the **diving value** is **USD 12.82 million**.

Snorkeling revenues

The following information is used to calculate snorkeling revenues: the annual number of snorkel trips estimated by the total visitors to the study area and the proportion of snorkelers or boat trips; the average price of snorkel trips, the average price of the equipment.

For the estimation of the annual number of snorkelers, the annual number of visitors and the percentage of visitors who declared to snorkel (6.4 percent) are used (Instituto Nacional de Estadística, Honduras, 2019). For the number of trips, a conservative estimate of 1.5 trips is used (Cooper, Burke, & Bood, 2009).

In terms of pricing, the same approach is applied as for the diving component. Average prices are obtained from tour operators. The average price of a trip is USD 28, with an average equipment rental price of USD 15. It is assumed that 100 percent of trips charge for equipment rental and 80 percent of snorkelers require equipment (see Table 70).

Table 70. Gross revenues of snorkeling in Honduras

Variables	Value
Number of snorkelers (millions)	0.055
Percentage of visitors who snorkelers	6.4
Number of averages snorkel trips	1.5
Average price of snorkeling (USD)	28
Average equipment price (USD)	15
Proportion of all dives with equipment rentals (%)	100

Sources: Estimation with Cooper, Burke, & Bood (2009); World Tourism Organization (2019); Instituto Nacional de Estadística, Honduras (2019); Tour operator's information in their web pages.

<u>Costs</u>

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges.

All in all, the **snorkeling value** is **USD 2.65 million** (Table 71).

Table 71. Snorkeling economic value in Honduras

Concept	USD Mn.
Gross Revenue	3.32
Costs	2.49
Net Revenue	0.83
Transfers to the economy [15% from taxes (USD 0.5 million), USD 1.32 million from wages and service charges non available]	1.82
Total value	**2.65**

Indirect economic impacts

A multiplier of 1.2 is used to calculate the indirect economic impacts of reef-related tourism and recreation (Cooper, Burke, & Bood, 2009).

The multiplier is applied to gross revenue from lodging, diving, snorkeling and marine parks. This means that for every dollar spent on tourism and recreation, an additional twenty cents impacts the economy. The gross revenues from the items listed are USD 167.2 million[103]. **Indirect impacts** are estimated at **USD 33.4 million**[104] (Table 72).

Table 72. Indirect economic impacts of tourism in Honduras

Concept	USD Mn.
Total direct economic impacts	149.18
Total Indirect economic impacts	33.45
Total direct and indirect economic value	182.63

[103] Sum of gross revenues from tables 65,67,69,71.
[104] This is the 20 percent of gross revenues.

Uncaptured values

No information is available on local tourism, cruise ship tourism and the net revenue remaining in the country, so experts have been consulted.

Total value

The **total use value** of the reef-related tourist sector in Honduras is **USD 182.63 million** (Table 73).

Table 73. Use Value of reef-related tourism in Honduras

Concept	Value (USD Mn.)
1. Accommodation	127.9
2. Marine Parks	5.7
3. Diving	12.8
4. Snorkeling	2.6
5. Local Use	Nd
6. Cruise ships	Nd
Total Direct expenses	149.18
7. Indirect impacts	33.45
8. Total use value	**182.63**

BELIZE

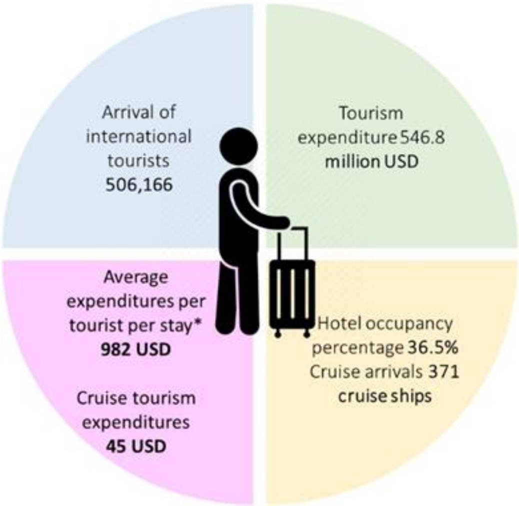
Tourism profile

Belize is located on the east coast of Central America, bordered by Mexico to the north, Guatemala to the south and west, and the Caribbean Sea to the east. The total area of Belize is 22,810 km2, of which 7 percent is agricultural and 59.6 percent is forest land. The area of urban land represents 2.2 percent of the total land area and covers 508 km2.

The country is considered to be relatively unique: "a very small country with a rich endowment of natural resources of global importance". This is based on its richness in biodiversity to the current dependence on a healthy natural resource-based tourism industry, primary productivity sectors (fisheries, agriculture and forestry) and ecosystem services that provide the nation with water security, protection from tropical storms and floods. The area of reefs and mangroves is estimated at 1330 km2 and 719 km2, respectively.

In 2019, Belize received 506,166 overnight tourists, on average more than 95 percent of the tourists who traveled for leisure purposes. Between 2010 and 2019 the number of tourists who spend the night in Belize has increased by more than 100 percent (Belize Tourism Board, 2019). Belize's tourism expenditure in 2019 is USD 546.8 million, representing 28 percent of the country's GDP (Belize Tourism Board, 2019). The total use value of tourism and recreation is 21 percent of the tourism sector expenditure.

Figure 25. Belize's tourism sector in numbers 2019



Source Belize Tourism Board (2019)

More than 60 percent of tourist arrivals are from the United States, followed by Europe and Latin America (see Table 74).

Table 74. Tourists arrivals by country and region in 2019 (percentages)

Destination	Canada	USA	Latin America	Europe	Rest of the world
Belize	7.1	64.8	10.3	11.8	6

Source: Belize Tourism Board (2019)

According to visitor exit surveys conducted by the Belize Tourism Board, on average in 2019, 17 and 63.40 percent of tourists participated in diving and snorkeling activities during their trip, respectively. The Barrier Reef is the most popular with 59 percent of tourists visiting it. In 2019 there were 987 hotels and 8,853 rooms in Belize, since 2010 the number of hotels and rooms has grown by 49 and 29 percent, respectively (Table 75).

Table 75. Tourists activities per country of origin in 2019 (%)

ACTIVITIES	USA	CANADA	EUROPE	CARIBBEAN	CENTRAL AMERICA	SOUTH AMERICA	OCEANIA	Other	Average
Snorkeling	61.30	66.3.	75.90	12.50	30.20	62.30	83.00	55.50	63.40
Diving	16.90	17.30	17.70	6.30	8.20	17.90	18.90	15.90	16.90
Cave exploration/tubing	25.40	32.80	25.00	7.50	6.90	9.40	34.90	15.40	25.30
Canoe/Kayaking	15.30	19.10	13.30	2.50	3.80	9.40	8	5.70	14.60
Sailing	10.40	11.30	11.10	6.30	1.90	7.50	18.90	7.50	10.50
Fishing	21.70	13.90	8.10	7.50	7.50	1.90	10.80	4.80	18.10
Island Tour	14.90	14.40	16.70	11.30	10.10	20.80	18.90	15.90	15.20
Horseback -riding	2.80	2.90	2.00	1.30	0.00	0.90	0.90	1.30	2.60
Jungle Trekking	13.60	16.90	15.40	3.80	6.30	5.70	9.90	4.80	13.60
Ziplining/Aerial Trekking	9.70	7.00	2.50	2.50	0.00	0.00	0.50	1.80	7.80
Birding	6.30	7.70	7.80	3.80	3.80	4.70	1.90	4.40	6.40
Camping	1.10	3.00	4.00	1.30	1.90	6.60	3.80	1.80	1.80
Other	7.90	7.30	3.30	15.00	3.80	1.90	1.90	3.50	6.90
None	13.30	13.40	8.80	58.80	42.80	22.60	4.70	26.40	13.60
DKNS	0.70	0.90	1.40	2.50	5.70	2.80	0.90	3.50	1.00

Source: Belize Tourism Board (2019)

There are 9 marine protected areas in Belize covering 723,761 acres. Table 76 shows the areas and date of establishment of each MPA.

Table 76. MPAs in Belize

MPA	Establishment	Area (acres)
Bacalar Chico	1996	15,766
Hol Chan	1987	3,813
Caye Caulker	1998	9,670
Turneffe Atoll	2012	325,412
Glover's Reef	1996	86,653
South Water Caye	1996	117,875
Gladden Spit and Silk Cayes	2003	25,978
Sapodilla Cayes	1996	38,594
Port Honduras	2000	100,000

Source: National Protected Areas Secretariat (2014)

Tourism economic valuation

The WRI methodology assesses the economic contribution of reef-related recreation and tourism. This includes four elements: (1) accommodation revenues, (2) revenues from marine parks, (3) reef recreation (diving and snorkeling), and (4) local resource use.

The percentage of visitors using the reef for Belize is 64 percent (calculated with the WRI estimate based on expert opinion found in (Cooper, Burke & Bood, 2009)), which represents visitor nights attributed to coral beaches. This value is used to calculate reef-related accommodation. Other values to be defined in this section are the annual number of visitors and the average length of stay (Table 77).

Table 77. Default values defined for Belize

Number of "Stay Over" Visitors (millions)	0.5
Average length of stay (nights)	6.1
Percent of visitors using the reef[105]	64

Source: Belize Tourism Board (2019)

Accommodation revenues

The value of the accommodation sector is calculated using gross revenues and costs for the sector as a whole with state-level data.

<u>Gross Revenues</u>

The value of the accommodation sector is calculated from the revenues of the sector as a whole using national-level data. The Belize Tourism Board (BTB) collects accommodation statistics (including number of hotel rooms and occupancy rates) by district.

Table 78. Reef-related visitation by district in Belize 2019

District	Total # of rooms (a)	Occupancy rate (%) (b)	Avg. # of occupied rooms/night (c) a x b	% of visitor days spent using reefs, mangroves, beaches (d)	Avg. # rooms occupied by "reef users"/night (e) c x d
Belize District	1,021	41.7	426	30	128
Caye Caulker	939	38.0	357	100	357
Cayo	1,382	39.6	547	1	5
Corozal	382	35.5	136	1	1
Orange Walk	274	20.9	57	1	1
Placencia	1,046	31.1	325	90	293
Ambergris Caye	2,378	33.6	799	100	799
Stann Creek	694	34.5	239	90	215
Toledo	321	19.9	64	50	32
Other Islands	416	38.7	161	100	161
Total	8,853	33.4	3,111	NA	1992
Estimated % of visitor nights attributed to the reef					**64.03**

Source: WRI estimate, based on expert opinion (Cooper, Burke, & Bood, 2009); Belize Tourism Board (2019);

To determine the percentage of total tourist nights related to reef activities, the WRI estimate based on expert opinion from previous studies is used (Cooper, Burke and Bood, 2009). Using 2019 BTB data on total rooms and occupancy rates, the result is that 64 percent of visitor nights in Belize can be attributed to days spent using coral beaches, reefs, and mangroves (Table 78).

The variables used to calculate gross revenues from accommodation are: the average rate of the rooms, excluding taxes and service charges, the average occupancy rate, the average

[105] Calculated with data from WRI estimates, based on expert opinion and (Cooper, Burke, & Bood, 2009).

number of rooms per hotel and the number of accommodations in study area (see Table 79).

Table 79. Gross revenues for accommodation in Belize

Variable	Value
Occupancy Rate	36.5
Average room rate (USD)[106]	153.22
Average number of rooms per accommodation	8.97
Total number of accommodations in study area	987
Percent of visitors using the beach	64
Gross revenues (millions USD)	**122.57**

Source: Estimated in Table 21 with data from WRI based on expert opinion (Cooper, Burke, & Bood, 2009); Belize Tourism Board (2019)

Costs, Taxes and service charges

Table 80. Operating costs for accommodation in Belize

Variable	Value
Average room rate (US dollars)	153.22
Average hour hotel wage (US dollars)	2 per hour
Number of persons employed per room	1.17 persons
Non labor operating costs (US dollars)	25
VAT (%)	12.5
Accommodation tax (%)	9

Sources: Belize Tourism Board (2019); 2019 Belize Chamber of Commerce and Industry Web and Doing Business 2020, World Bank; WRI tool, default value; http://gst.gov.bz/gst-faqs/; Belize Tourism Board

For the average room rate, the value used is the one obtained from de Belize Tourism Board (2019). The average hotel hourly wage used is USD 2 per hour. This is a conservative estimate, considering that the minimum wage in Belize is USD 1.64 per hour and that the minimum wage for workers assumed in the case study for the World Bank's "Doing Business in Belize 2020" program is USD 345 per month (World Bank, 2020) or USD 1.96 per hour[107]. One of the assumptions is that hotel employees work 40 hours per week.

The number of 1.17 people employed to do service per room is estimated with information from BTB’s 2019 Travel & Tourism Statistics Digest and the non-labor operating costs value used is of 25 percent of revenue from the WRI tool.

[106] Trivago Hotel Price Index was used to calculate the 2019 average room rate in Cancun, Cozumel, Tulum, Playa del Carmen, Puerto Morelos, Isla Mujeres and Bacalar.
[107] Assuming 22 working days in a month.

VAT in Belize is 12.5 percent (GST, 2019) and there is also a 9 percent accommodation tax (Belize Tourism Board, 2019). No information is available on the percentage of revenue leakage, which means that all revenue remains in the local economy.

All in all, the **total value of accommodation** is **USD 118.28 million** (see Table 81).

Table 81. Value of accommodation for reef-related tourism in Belize

Concept	USD Mn.
Gross Revenue	122.57
Costs	61.9
Net Revenue	60.6
Transfers to the economy [VAT (15.3 million), wages (31.3) and accommodation tax (11 million)]	57.66
Total Value	**118.28**

Revenues from Marine Parks

To calculate the revenue from Marine Parks, available data is used for four MPA (Table 53): Port Honduras, Laughing Bird Caye, Glovers Reef and Hol Chan. Data for Port Honduras is for 2019, while data for Glovers Reef and Laughing Bird Caye is estimated for 2019 using data from 2015 (WWF Belize). Data for Hol Chan is collected from BTB statistics (Belize Tourism Board, 2019).

Table 82. Gross Marine Park Revenues

MPA Revenues	Revenues 2019 USD Mn.	Visitors in 2019
Port Honduras	0.008	3,750
Laughing Bird Caye	1.79	6,425
Glovers Reef	0.64	5,362
Hol Chan	0.86	172,037
TOTAL	**3.30**	**187,574**

Source: TIDE (2019); WWF Belize; Belize Tourism Board (2019)

The cost of parks should include only the costs of collecting and administering fees, not the costs of administering the park. However, this information is not available.

Table 83. Value of Marine Parks for reef-related tourism in Belize

Concept	USD Mn.
Gross revenues	3.30
Costs (collection costs of the park)	Nd
Net Revenue	**3.30**

The estimated **net revenue** of all Marine Protected Areas is estimated at **USD 3.30 million**.

Diving revenues

The annual number of divers is calculated from the percentage of diving visitors reported in visitor exit surveys (17 percent) (Belize Tourism Board, 2019). For the average number of dives per diver, the information of previous studies in the region is taken (Cooper, Burke & Bood, 2009).

For the prices of the diving tours, the average price per dive estimated is USD 67 and the average price of the equipment is USD 27, which are obtained from several dive stores and tour operators. For the proportion of all dives with equipment rentals, 25 percent is used.

There is no information available that includes the revenue from dive certifications and revenues from all-inclusive packages (see Table 55).

Table 84. Gross revenues for diving in Belize

Variable	Value
Number of divers (million)	0.085
Percentage of visitors who dive	17
Number of averages dive per dive	4
Average price of diving (USD)	67
Average equipment price (USD)	27
Proportion of all dives with equipment rentals (%)	25

Sources: Estimation with information from Cooper, Burke, & Bood (2009); Belize Tourism Board (2019); Tour operation information in web pages.

Costs

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges.

Table 85. Diving economic value in Belize

Concept	USD Mn.
Gross Revenue	25
Costs	18.8
Net Revenue	6.27
Transfers to the economy [12.5% from taxes (USD 3.1 million), USD 10 million from wages and service charges not available]	13.17
Total value	**19.44**

All in all, the **diving value** is **USD 19.44 million** (Table 56).

Snorkeling revenues

For the estimation of the annual number of snorkelers, the annual number of visitors and the percentage of visitors who declared to snorkel (63 percent) are used (Belize Tourism

Board, 2019). For the number of trips, a conservative estimate of 1.5 trips is taken from previous studies in the region (Cooper, Burke, & Bood, 2009).

In terms of pricing, the same approach is applied as for the diving component. Average prices ar obtained from tour operators. The average price of a trip is USD 153, with an average equipment rental price of USD 7. It is assumed that 13 percent of trips charge for equipment rental (see Table 57).

Table 86. Gross revenues of snorkeling in Belize

Variables	Value
Number of snorkelers (millions)	0.319
Percentage of visitors who snorkelers	63.4
Number of averages snorkel trips	1.5
Average price of snorkeling	153
Average equipment price	7
Proportion of all dives with equipment rentals (%)	13

Sources: Cooper, Burke, & Bood, 2009; Belize Tourism Board (2019); Tour operation information in web pages.

Costs

For cost calculations, the WRI tool defaults to 40 percent of revenues as labor costs, 35 percent as other costs, and costs such as tax rates and service charges.

All in all, the **snorkeling value** is **USD 37 million** (Table 87).

Table 87. Snorkeling economic value in Belize

Concept	USD Mn.
Gross Revenue	48.8
Costs	36.6
Net Revenue	12.2
Transfers to the economy [12.5% from taxes (USD 6.1 million), USD 19.5 mill from wages and service charges not available]	25.6
Total value	**37.83**

Indirect economic impacts

A multiplier of 1.2 is used to calculate the indirect economic impacts of reef-related tourism and recreation (Cooper, Burke, & Bood, 2009).

The multiplier is applied to gross revenue from accommodation, diving, snorkeling and marine parks. This means that for every dollar spent on tourism and recreation, an additional twenty cents impacts the economy. The gross revenues from the items listed are USD 199.76 million[108]. **Indirect impacts** are estimated at **USD 39.95 million** (Table 88).

[108] Sum of gross revenues from tables 81,83,85,87.

Table 88. Indirect economic impacts of tourism in Belize

Concept	USD Mn.
Total direct economic impacts	178.84
Total Indirect economic impacts	39.95
Total direct and indirect economic value	218.8

Uncaptured values

No information is available on local tourism, cruise ship tourism and the net revenue remaining in the country, so experts have been consulted.

Total value

The **total use value** of the reef-related tourist sector in Belize is approximately **40 percent of revenues of the Belizean tourism sector** – USD 546.8 million – (Table 60).

Table 89. Use Value of reef-related tourism in Belize

Concept	Value (USD Mn.)
1. Accommodation	118.29
2. Marine Parks	3.30
3. Diving	19.44
4. Snorkeling	37.83
5. Local Use	Nd
6. Cruise ships	Nd
Total Direct expenses	178.84
7. Indirect impacts	39.95
8. Total use value	**218.80**

TOURISM & RECREATION (USD million)

MEXICO	GUATEMALA	HONDURAS	BELIZE
3,494	6.31 – 6.36	182.63	218.8

Mesoamerican Region
USD 3,902 million

FISHERIES

MEXICO

Sector profile

The fishing sector in Mexico represented 0.08 percent of the total current GDP in 2018, contributing USD 6,217 million to the economy (INEGI, 2018). The data used for this valuation exercise corresponds to the year 2018 at the state level of Quintana Roo. The population of fishermen registered in commercial fishing and aquaculture activities in Quintana Roo Mexico is 2,877 people (CONAPESCA, 2018). During 2018 in Quintana Roo, the weight of capture and aquaculture production represented 52 and 48 percent of total production, respectively (CONAPESCA, 2018). The number of small boats in 2018 was 889, this corresponding to boats with an overall length of less than 30 feet. The number of large vessels (deep-sea fishing) officially registered in Quintana Roo is 29 (CONAPESCA, 2018). In 2017 there were 3,373 sport fishing permits with revenues of USD 27,162 (CONAPESCA, 2018).

Commercial fisheries value

The value of the commercial fishing sector is calculated from the gross revenues and costs of the sector as a whole, using state-level data.

Gross Revenues

Revenues are based on the catch of fish and the price of fish (averaged over the year) for each reef-associated species. CONAPESCA is the main source of information to calculate the value of commercial fishing. The list of captured species, weight and prices are from CONAPESCA (2018). Other prices are from the Ministry of Economy (Secretaría de Economía, 2020). Data from FishBase (Froese, 2019), a study of fisheries in the Puerto Morelos reef area (Salas Márquez, 2013), and the management programs of Quintana Roo's marine protected areas are used to identify reef-related species.

Table 90 presents a first approach to the gross income of the commercial fishing sector.

Table 90. Revenues from commercial fisheries in Quintana Roo, Mexico 2018

Species	Weight (kg)	Price (USD)**	Gross revenues (thousands of USD)
Sea bream*	2,900	1.29	3.74
Comber*	7,037	1.53	10.77
School shark	40,366	3.6	145.32
Red Snapper	15,502	3.64	56.43
Atlantic horse mackerel	42,388	1.87	79.27
Spiny lobsters	374,755	35.34	13,243.83
Liza	24,389	1.82	44.39
Grouper	475,259	5.36	2,547.39
Mojarra	49,089	3.01	147.76
Pompano	1,982	4.16	8.25
Snapper	200,065	3.76	752.24
Wahoo	79,426	4.68	371.71
Robalo	50,898	5.85	297.75
Rubia and Villajaiba	48,472	3.22	156.08
Shark	226,282	1.97	445.78
TOTAL	**1,638,809**		**18,310**

Source: *CONAPESCA (2018). Prices calculated from landing site value
** Exchange rate USD 19.2432

Costs

Fishing costs are based on estimates of the labor and operating costs for the fishing vessel owner. To calculate costs for the commercial fishing sector, labor costs and non-labor operating costs are calculated using the ratios of 25 and 10 percent of gross revenue, respectively (WRI Tool, 2009).

The total value of **commercial fishing** is estimated at **USD 16.47 million** (Table 91).

Table 91. Value of commercial fisheries in Quintana Roo, Mexico (USD, million)

Concept	USD Mn.
Gross Revenue	**18.31**
Average annual wages	4.58
Annual operating costs	1.83
Net Revenue	**11.90**
Transfers to the economy (wages)	4.58
Total commercial value	**16.47**

*WRI fisheries valuation tool currently does not capture the transfers to the economy via taxes as in the tourism valuation tool, we are currently analyzing including these values.

Fish processing value

For the value of fish processing (Table 92), production data from CONAPESCA (2018) and prices from the Ministry of the Economy (Ministry of the Economy, 2020) are used.

The production data includes the production of the freezing facilities. Purchase prices are calculated considering weight and catch values reported by CONAPESCA. Sale prices of frozen fish are the averages of the largest fish markets in Mexico City.

Quintana Roo's production statistics are divided into the number of fish processed and the production obtained from it. Considering this, the revenue is calculated with the sales prices and the production of processed fish and the costs are calculated with the purchase prices and the number of fish processed. Labor costs and non-labor operating costs are calculated with the averages of other sites provided by the WRI. The values used are 25 percent of revenues as labor costs and 10 percent of revenues as non-labor operating costs.

Table 92. Revenues from fish processing in Quintana Roo, Mexico 2018

Revenues			
Species[a]	**Production (Kg)[a]**	**Sale price (Kg per USD)[b]**	**Revenues (USD Mn.)**
Escama	143,000	4.74	0.68
Tiburón y Cazón	472,000	3.47	1.64
Gross Revenue USD			**2.32**
Costs			
Fish costs (USD Mn.) [c]	**Labor costs (USD Mn.) [d]**	**Operating Costs (USD Mn.) [e]**	**Total Costs (USD Mn.)**
0.470	0.579	0.232	1.281
Net Revenue (USD Mn.)			**1.036**
Total Valuation (USD Mn.)			**1.62**

a. CONAPESCA (2018). Anuario Estadístico de Acuacultura y Pesca 2018; b. Average whole sale Price in La Viga. CONAPESCA. (2018). Anuario Estadístico de Acuacultura y Pesca 2018; c. Purchase Price * Weight of purchased fish. CONAPESCA (2018). Anuario Estadístico de Acuacultura y Pesca 2018; d. Default WRI value of 25 percent of revenues; e. Default WRI value of 10 percent of revenues. * Exchange rate USD19.2432

Fish cleaning value

The valuation of fish cleanliness uses the catch production from the commercial fishing. The percentage of fish cleaned, and the value added per kilogram of fish cleaned, are taken from St. Lucia's valuation in Burke, Prager, Greenhalgh, & Cooper (2008).

To calculate the value added of the cleaning, the percentage of fish cleaned from commercial fisheries must first be determined. Then that amount is multiplied by the amount paid per kilogram of fish cleaned to the workers to obtain the value added in the cleaning process (Table 93).

Table 93. Value of fish cleaning in Quintana Roo, Mexico 2018

Concept	Value
Weight of commercial catch (thousands of kg) [a]	1,639
Percentage of fish cleaned [b]	60%
Total fish cleaned (thousands of kg)	**983.3**
Value added (USD per kg of fish cleaned) [b]	0.83
Value added of cleaning (USD Mn.)	**0.82**

Sources: Burke, Prager, Greenhalgh, & Cooper (2008); CONAPESCA (2018) ; * Exchange rate USD 19.2432 **Fish cleaned ***Value added

Local fishing value

The local fishing section estimates the value of fish production that is not captured by official government statistics. Its value has three components that must be estimated separately: fishing for sale, for consumption, and for enjoyment.

Due to the lack of available data on local fisheries, the preliminary results of the valuation used data from a marine protected area of Arrecifes de Puerto Morelos (Salas Márquez, 2013). The value is taken to the current 2018 value using the annual price index reported by INEGI (INEGI, 2020). In 2013, there were 44 fishermen fishing for consumption and more than 2,000 fishermen practicing sport fishing (Table 94).

Table 94. Value of local fishing in Quintana Roo, Mexico (Puerto Morelos)

Species	Amount (thousand kg)	Value USD Mn.*	Price USD*
Grouper	9.11	0.442	48.53
Spiny lobsters	5.61	0.135	24.14
Snapper	8.07	0.030	3.73
Hog fish	6.97	0.030	4.29
Xcochin	6.02	0.012	1.93
Red snapper	4.25	0.022	5.10
Lionfish	3.20	0.013	3.95
Atlantic pomfret	2.79	0.005	1.69
Two-banded sea bream	2.73	0.006	2.36
European pollock	2.26	0.014	6.09
Greater amberjack	1.45	0.003	1.97
White trevally	1.00	0.002	1.62

Robalo	0.80	0.003	3.72
Clownfish	0.59	0.002	2.78
Comber	0.65	0.002	3.81
Croakers	0.73	0.002	2.96
White grunt	0.69	0.001	1.95
School shark	0.50	0.001	2.07
Rabbitfishes	0.16	0.001	4.68
Grouper	0.12	0.000	3.52
Tuna	0.06	0.000	2.68
Sciaenidae	0.05	0.000	1.86
Wahoo	0.02	0.000	2.57
Peto	0.01	0.000	3.08
Total	**57.83**	**0.726**	**5.88****

Source: Salas Márquez (2013); * 2018 present value; ** Average price.

Multiplier

Multipliers are a useful method for estimating indirect economic impacts. A single multiplier can be used for the entire fishing industry or separate multipliers can be used for the commercial fishing/harvesting and processing/cleaning sectors. In this case, an income multiplier of 1.19 (Table 95) for commercial marine capture is used for the net income from commercial fishing (Jacobsen, 2014).

Table 95. Indirect impacts in Mexico

Concept	USD Mn.
Commercial net revenue	11.90
Income multiplier	1.19
Indirect economic impact	**2.26**

Total fisheries value

The **total use value** of the reef-related fishing sector in Quintana Roo (Mexico) is estimated at **USD 21.90 million** (Table 96).

Table 96. Use Value of reef-related fisheries in Quintana Roo, México

Concept	Value (USD Mn.)
1. Commercial fishing	16.47
2. Fish processing	1.62
3. Fish cleaning	0.82
4. Local Fishing	0.73
5. Total direct impacts	19.64
6. Indirect impacts (commercial sector)	2.26
Total reef-related fisheries valuation	**21.90**

GUATEMALA

Fisheries profile

The number of artisanal fishermen in the marine areas of Guatemala is estimated at 12,400 people. (OSPESCA, 2009-2011). Other sources estimate the number of artisanal fishers at 12,500, of which 9,700 are on the Pacific coast and 2,800 on the Caribbean coast (FAO, 1998).

The industrial fishing industry is very small in Guatemala and employs about 350 fishermen (FAO, 1998).

In 2016, Guatemala had 50 boats with an overall length of less than 12 meters, 35 boats with an overall length of between 12 and 24 meters, and only two boats with an overall length of more than 24 meters (FAO, 2018).

The main landing sites in the Guatemalan Caribbean are Livingston, Puerto Barrios, San Francisco del Mar and El Quetzalito (Pacay Barahona, 2015)

Commercial fisheries valuation

FAO 2018 catch production data (FAO, 2020) are used to calculate the valuation of commercial fisheries (Table 97). Prices are calculated using data from the World Fisheries production estimated value by group of species (FAO, 2020). FishBase data are used to identify reef-related fish species (Froese, 2019).

Table 97. Revenues from commercial fisheries in Guatemala 2018

Species	Weight (kg)[a]	Price (USD)[b]	Revenues (thousands of USD)
Marine fishes	78,000	1.50	117
TOTAL	**78,000**		**117**

a. Fishery Statistical Collections. Global Capture Production (FAO, 2020); b. FAO yearbook. Fishery and Aquaculture Statistics 2018 (FAO, 2020)

Costs

For labor costs and non-labor operating costs in the commercial fishing sector, values of 45 percent and 10 percent, respectively, are used. The costs are calibrated to capture 55 percent of the revenue allocated to costs in artisanal fisheries (FAO 1998).

The total value of **commercial fisheries** is estimated at **USD 0.11 million** (Table 98).

Table 98. Value of commercial fisheries in Guatemala

Concept	USD Mn.
Gross Revenue	0.12
Average annual wages (45% of revenue)	0.05
Annual operating costs (10% of revenue)	0.01
Net Revenue	0.05
Transfers to the economy (wages)*	0.05
Total commercial value	**0.11**

*WRI fisheries valuation tool currently does not capture the transfers to the economy via taxes as in the tourism valuation tool, we are currently analyzing including these values.

Fish processing valuation

The weight of fish purchased (Table 99) is obtained from the FAO's 2018 processed production statistics (FAO, 2020. Price information is obtained from FAO (FAO, 2020) and (MAGA, 2020).

Table 99. Revenues from fish processing in Guatemala

Processed products 2018[a]	Weight (thousands of kg)[a]	Sale price USD/ Kg[b]	Gross Revenues (thousands of USD)
Fish, dried and salted	105	2.7	**283.50**

a. Fishery Statistical Collections. Fishery Commodities and Trade. Processed Production (FAO, 2020); b. Serie Histórica de Precios de Hidrobiológicos. Octubre 2020. (MAGA, 2020).

Costs

For labor and non-labor costs in the fish processing sector, the default values of 25 percent of labor costs and 10 percent of non-labor operating costs taken from the WRI-estimated averages of other sites are used (Table 100).

Table 100. Fish processing costs in Guatemala

Processed products 2018[a]	Weight (thousands of kg)[a]	Purchase price USD/Kg[b]	Processing costs (thousands of USD)
Fish, dried and salted	105	1.5	**157.50**

a. Fishery Statistical Collections. Fishery Commodities and Trade. Processed Production (FAO, 2020); b. FAO yearbook. Fishery and Aquaculture Statistics 2018 (FAO, 2020).

The total value of the coral reef-related processing sector is estimated at USD 0.10 million (Table 101).

Table 101. Value of fish processing in Guatemala

Concept	USD Mn.
Gross Revenues	**0.28**
Processing costs	0.16
Labor costs (25% of revenue)	0.07
Operating costs (10% of revenue)	0.03
Net revenue	**0.027**
Transfers to the economy (wages)*	0.07
Total Processing Valuation	**0.098**

*WRI fisheries valuation tool currently does not capture the transfers to the economy via taxes as in the tourism valuation tool, we are currently analyzing including these values.

Fish cleaning value

The valuation of fish cleanliness uses the catch production from the commercial fishing. The percentage of fish cleaned, and the value added per kilogram of fish cleaned are taken from St. Lucia's valuation in Burke, Prager, Greenhalgh, & Cooper (2008).

To calculate the added value of the cleaning, the percentage of fish cleaned from commercial fishing must first be determined. Then that amount is multiplied by the amount paid per kilogram of fish cleaned to the workers to obtain the value added in the cleaning process (Table 102).

Table 102. Value of fish cleaning in Guatemala

Concept	Value
Weight of commercial catch (thousands of kg) [a]	78
Percentage of fish cleaned [b]	60
Total fish cleaned (thousands of kg)	**46.8**
Value added (USD per kg of fish cleaned) [b]	0.83
Value added of cleaning (million USD)	**0.04**

a. Fishery Statistical Collections. Global Capture Production (FAO, 2020);
b. Burke, Prager, Greenhalgh, & Cooper (2008)

Local fishing valuation

Artisanal fishing is one of the most important productive activities in Punta de Manabique. Fish processing only takes place in San Francisco del Mar, a small community where people make cured fish products (Consejo Nacional de Áreas Protegidas (CONAP), 2006).

Fishing activities in Punta de Manabique are often the only economic activity and source of income for the small communities living nearby. These fishing communities are Santa Isabel, La Graciosa, Punta Gorda, Estero Lagarto, Punta de Manabique, Cabo Tres Puntas, Jaloa, San Francisco del Mar and El Quetzalito.

Artisanal fishing is one of the main activities. According to the WRI methodology of local fishing, the value of local fishing is divided into three parts: fishing for sale, for consumption and for enjoyment. Due to the lack of available data, it is not possible to separate the valuation into these three parts, the valuation presented calculates the value of the local fishing sector as a whole (Table 104).

The number of artisanal fishermen is obtained by the FAO (FAO, 1998). The average catch per trip (Table 103) is estimated considering the length of the fishing trip by type of fishery; the average sales price is obtained from the prices of eleven species caught in the community of El Quetzalito (Pacay Barahona, 2015).

Table 103. Average catch per trip in the artisanal fishery in El Quetzalito, Guatemala

Species	Weight captured per working trip (kg)	Number of days per working trip	Catch per day (kg)
Bagre	80	1	80
Cubera	55	1	55
Curbina	20	1	20
Jurel	7	1	7
Langosta	203	2	101.5
Mirasol	3	1	3
Raya	61	1	61
Róbalo	260	1	260
Sábalo	595	1	595
Tiburón	738	4	184.5
Vaca ariidae	80	1	80
Average	**191**		**131.55**

Source: Pacay Barahona (2015)

Table 104. Value of local fishing in Guatemala

Concept	Value
Number of artisanal fishers [a]	2,800
Average Catch per Trip Kg [b]	131.55
Average Annual Days in Activity [a]	175
Total Annual catch (Million Kg)	64.45
Average Sale Price per unit USD/Kg [b]	0.56
Total Value of Local Fishing USD Mn. (2018 present value)	**41.91**

a Source: FAO (1998); b Source: Pacay Barahona (2015)

Multiplier

Multipliers are a useful method for estimating indirect economic impacts. A single multiplier can be used for the entire fishing industry or separate multipliers can be used for the commercial fishing/harvesting and processing/cleaning sectors. In this case, an income multiplier of 1.28 (Table 105) for commercial marine capture is used for the net income from commercial fishing (Jacobsen, 2014).

Table 105. Indirect impacts in Guatemala

Concept	USD Mn.
Commercial net revenue	0.05
Income multiplier	1.28
Indirect economic impact	**0.014**

Total fisheries valuation

The **total use value** of the reef-related fishing sector in Guatemala is estimated at **USD 42.17 million** (Table 106).

Table 106. Use Value of reef-related fisheries in Guatemala

Concept	Value (USD Mn.)
1. Commercial fishing	0.11
2. Fish processing	0.10
3. Fish cleaning	0.04
4. Local Fishing	41.91
5. Total direct impacts	42.16
6. Indirect impacts (commercial sector)	0.01
Total Reef related Fisheries valuation	**42.17**

HONDURAS

Fisheries profile

In 2018, the fishing industry in Honduras contributed with USD 75 million (1,789 million Lempiras) to GDP at current prices, approximately 0.29 percent of GDP (Banco Central de Honduras, 2019).

In 2018 there were 181 artisanal boats (SICA, 2020). Other estimates are that between 2011 and 2013 there were 17,000 artisanal fishermen in Honduras and 10,625 artisanal boats.

The estimated artisanal catch in the Caribbean Ocean is 8,287 tons. In addition, there are 2 processing facilities in Honduras (OSPESCA, 2009-2011).

Industrial fishing takes place mainly in the Caribbean region, focusing on the Bay Islands, La Ceiba and Cuaquira. The most important landing sites on the Caribbean side of Honduras are Port Oak Ridge, Jonsville and French Harbor (FAO, 2015).

Commercial fisheries valuation

FAO 2018 catch production data (FAO, 2020) are used to calculate the valuation of commercial fisheries (Table 107). Prices are calculated using data from SIAMPH's weekly price reports (SIMPAH, 2018). FishBase data are used to identify reef-related fish species (Froese, 2019).

Table 107. Revenues from commercial fisheries in Honduras 2018

Species	Weight (thousands kg)[a]	Price (USD)[b]	Revenues (thousands of USD)
Caribbean spiny lobster	6,100	12.5	76,250
Marine fishes	1,900	5.7	10,830
Stromboid conchs	800	12.17	9,736
Tropical spiny lobsters	1	12.5	12.5
TOTAL	**8,801**		**96,829**

a. Fishery Statistical Collections. Global Capture Production (FAO, 2020); b. Lobster prices from (FAO, 2020), resto of species prices taken from Reportes semanales de precios de venta al por mayor de pecuarios y otros (SIMPAH, 2018); ** Exchange rate USD 23.9024 lempiras

Costs

To calculate costs for the commercial fishing sector, labor costs and non-labor operating costs are calculated using the ratios of 25 and 10 percent of gross revenue, respectively (WRI Tool, 2009).

The total value of **commercial fishing** is estimated at **USD 77.32 million** (Table 108).

Table 108. Value of commercial fisheries in Honduras

Concept	USD Mn.
Gross Revenue	85.91
Average annual wages (25 percent of revenue)	21.48
Annual operating costs (10 percent of revenue)	8.59
Net Revenue	**55.84**
Transfers to the economy (wages)*	21.48
Total commercial value	**77.32**

*WRI fisheries valuation tool currently does not capture the transfers to the economy via taxes as in the tourism valuation tool, we are currently analyzing including these values.

Fish processing valuation

The weight of fish purchased (Table 109) is obtained from the FAO's 2018 processed production statistics (FAO, 2020). Price information is obtained from FAO (FAO, 2020) and SIMAPH (SIMPAH, 2018).

Table 109. Revenues from fish processing in Honduras

Processed products 2018[a]	Weight (thousands of kg)[a]	Sale price USD per Kg[b]	Gross Revenues (thousands of USD)
Spiny lobsters (Panulirus spp.), whole, fresh or chilled	2,125	16.97	36.06

a. Fishery Statistical Collections. Fishery Commodities and Trade. Processed Production (FAO, 2020); b. Reportes semanales de precios de venta al por mayor de pecuarios y otros en San Pedro Sula (SIMPAH, 2018); ** Exchange rate USD 23.9024 lempiras

Costs

To calculate the costs of fish processing (Table 110), the available information is found in Global Fishery Production by Species Group (FAO, 2020).

Table 110. Fish processing costs in Honduras

Processed products 2018[a]	Weight (thousands of kg)[a]	Purchase price USD/Kg[b]	Processing costs (thousands of USD)
Spiny lobsters (Panulirus spp.), whole, fresh or chilled	2,125	12.5	26.56

a. Fishery Statistical Collections. Fishery Commodities and Trade. Processed Production (FAO, 2020); b. FAO yearbook. Fishery and Aquaculture Statistics 2018 (FAO, 2020)

The total value of the **coral reef-related processing sector** is estimated at **USD 5.89 million** (Table 111).

Table 111. Value of fish processing in Honduras

Concept	USD Mn.
Gross Revenues	**36.06**
Processing costs	26.56
Labor costs (18% of revenue)	5.41
Operating costs (10% of revenue)	3.61
Net revenue	**0.48**
Transfers to the economy (wages)*	5.41
Total Processing Valuation	**5.89**

*WRI fisheries valuation tool currently does not capture the transfers to the economy via taxes as in the tourism valuation tool, we are currently analyzing including these values.

Fish cleaning value

The valuation of fish cleanliness (Table 112) uses the catch production from the commercial fishing. The percentage of fish cleaned, and the value added per kilogram of fish cleaned are taken from St. Lucia's valuation in Burke, Prager, Greenhalgh, & Cooper (2008).

Table 112. Value of fish cleaning in Honduras

Concept	Value
Weight of commercial catch (thousands of kg) [a]	6,900
Percentage of fish cleaned [b]	60
Total fish cleaned (thousands of kg)	**4,140**
Value added (USD per kg of fish cleaned) [b]	0.83
Value added of cleaning (million USD)	**3.44**

a. Fishery Statistical Collections. Global Capture Production (FAO, 2020); b. Burke, Prager, Greenhalgh, & Cooper (2008)

Local fishing valuation

Information on local fisheries is not available and experts are consulted.

Multiplier

Multipliers are a useful method for estimating indirect economic impacts. A single multiplier can be used for the entire fishing industry or separate multipliers can be used for the commercial fishing/harvesting and processing/cleaning sectors. In this case, an income multiplier of 1.23 (Table 113) for commercial marine capture is used for the net income from commercial fishing (Jacobsen, 2014).

Table 113. Indirect impacts in Honduras

Concept	USD Mn.
Commercial net revenue	55.84
Income multiplier	1.23
Indirect economic impact	**12.84**

Total fisheries value

The **total use value** of the reef-related fishing sector in Honduras is estimated at **USD 99.5 million** (Table 114).

Table 114. Use Value of reef-related fisheries in Honduras

Concept	Value (USD Mn.)
1. Commercial fishing	77.32
2. Fish processing	5.89
3. Fish cleaning	3.44
4. Local Fishing	Nd
5. Total direct impacts	86.65
6. Indirect impacts (commercial sector)	12.84
Total Reef related Fisheries valuation	**99.55**

BELIZE

Fisheries profile

In 2018, fishing industry contributed USD 18.60 million (37.2 million BZD) to GDP at current prices, approximately 1.2 percent of GDP (Statistical Institute of Belize, 2020).

According to the FAO, in 2018 there were 2,116 fishermen and 561 fishing vessels (FAO, 2020). These figures are FAO estimates with data from 2016. More recent sources estimate the number of fishermen in 2018 at 2,550 people and the number of boats at 623. (UNCTAD, 2020). The boats are mainly made of wood or fiberglass and equipped with outboard motors or sails, with lengths ranging from 3.6 to 9.14 meters. (Caribbean Regional Fisheries Mechanism (CRFM), 2018)

More than 50 percent of fishers are members of fishing cooperatives in Belize, as a result these cooperatives are the main landing sites. The five established and functional fishermen cooperatives are: Caribbean Fishermen Coop, Northern Fishermen Coop, National Fishermen Coop, Placencia Fishermen Coop and Rio Grande Fishermen Coop. For the independent fishermen, the main landing site are markets in urban areas where they directly sell the fish, these markets are Vernon Street Market, Corozal Market, Dangriga Market and Punta Gorda Market. (FAO, 2005).

Commercial fisheries value

To calculate the value of commercial fisheries, FAO catch data are collected, 2018 catch production (FAO, 2020), prices used FAO global fisheries production data by species group (FAO, 2020). FishBase data are used to identify reef-related fish species (Froese, 2019). Income from the commercial fishing sector is presented in Table 115:

Table 115. Revenues from commercial fisheries in Belize

Species[a]	**Weight (kg) [a]**	**Price (USD) [b]**	**Gross revenues (thousands of USD)**
Caribbean spiny lobster	774	13.78	10,67
Porgies, seabreams	821	1.65	1,35
Stromboid conchs	2,380	1.59	3,78
Wahoo	29	1.65	0.048
TOTAL	**4,004**		**15.85**

a. Fishery Statistical Collections. Global Capture Production (FAO, 2020); b. Calculated with the estimated value by group of species FAO yearbook. Fishery and Aquaculture Statistics 2018 (FAO, 2020)

Costs

Fishing costs are based on estimates of the labor and operating costs for the fishing vessel owner. To calculate costs for the commercial fishing sector, labor costs and non-labor operating costs are calculated using the ratios of 25 and 10 percent of gross revenue, respectively (WRI Tool, 2009).

The total value of **commercial fishing** is estimated at **USD 14.27 million** (Table 116).

Table 116. Value of commercial fisheries in Belize

Concept	**USD Mn.**
Gross Revenue	**15.85**
Average annual wages	3.96
Annual operating costs	1.59
Net Revenue	**10.3**
Transfers to the economy	3.96
Total commercial value	**14.27**

*WRI fisheries valuation tool currently does not capture the transfers to the economy via taxes as in the tourism valuation tool, we are currently analyzing including these values.

Fish processing value

The weight of fish purchased (Table 117) is obtained from the FAO's 2018 processed production statistics (FAO, 2020). Price information is obtained from FAO (FAO, 2020) and from a study by UNCTAD (UNCTAD, 2020).

Table 117. Revenues from fish processing in Belize

Processed products 2018[a]	Weight (thousands of kg)[a]	Sale price USD per Kg[b]	Gross Revenues (thousands of USD)
Fish fillets, frozen	3	2.79	0.01
Fish, frozen	10	2.79	0.03
Sharks, dried, whether or not salted, but not smoked	11	1.452	0.02
Spiny lobsters (Panulirus spp.), meat or tails, frozen	255	15.5	3.95
Spiny lobsters (Panulirus spp.), whole, frozen	240	15.5	3.72
Stromboid conchs (Strombus spp), frozen	575	2.49	1.43
Total	**1,094**		**9.16**

a. Fishery Statistical Collections. Fishery Commodities and Trade. Processed Production (FAO, 2020); b. UNCTAD (2020)

Costs

To calculate the costs of the fish processing sector, the labor costs and non-labor operating costs used are 10 and 5 percent of gross revenue, respectively[109]. This assumption is currently being confirmed by experts opinion (Table 118).

Table 118. Fish processing costs in Belize 2018

Processed products 2018[a]	Weight (thousands of kg)[a]	Purchase price USD/Kg[b]	Processing costs (thousands of USD)
Fish fillets, frozen	3	0.6	0.002
Fish, frozen	10	0.6	0.006
Sharks, dried, whether or not salted, but not smoked	11	1.21	0.013
Spiny lobsters (Panulirus spp.), meat or tails, frozen	255	13.78	3.514
Spiny lobsters (Panulirus spp.), whole, frozen	240	13.78	3.307
Stromboid conchs (Strombus spp), frozen	575	1.59	0.914
Total	**1,094**		**7.756**

a. Fishery Statistical Collections. Fishery Commodities and Trade. Processed Production (FAO, 2020); b. Calculated with the estimated value by group of species. FAO yearbook. Fishery and Aquaculture Statistics 2018 (FAO, 2020)

[109] The WRI tool values gives an inconsistent result presenting net loss not benefits.

The total value of the coral reef-related processing sector is estimated at USD 0.94 million (Table 119).

Table 119. Value of fish processing in Belize

Concept	USD Mn.
Gross Revenues	**9.156**
Processing costs	7.756
Labor costs (10% of revenue)	0.916
Operating costs (5% of revenue)	0.458
Net revenue	**0.027**
Wages	0.916
Total Valuation	**0.942**

Fish cleaning value

The valuation of fish cleanliness uses the catch production from the commercial fishing. The percentage of fish cleaned, and the value added per kilogram of fish cleaned are taken from St. Lucia's valuation in Burke, Prager, Greenhalgh, & Cooper (2008).

To calculate the value added of the cleaning, the percentage of fish cleaned from commercial fisheries must first be determined. Then that amount is multiplied by the amount paid per kilogram of fish cleaned to the workers to obtain the value added in the cleaning process (Table 120).

Table 120. Value of fish cleaning in Belize

Concept	Value
Weight of commercial catch (thousands of kg) [a]	4.004
Percentage of fish cleaned [b]	60
Total fish cleaned (thousands of kg)	**2.4**
Value added (USD per kg of fish cleaned) [b]	0.83
Value added of cleaning (million USD)	**1.99**

a. Fishery Statistical Collections. Global Capture Production (FAO, 2020);
b. Burke, Prager, Greenhalgh, & Cooper (2008)

Local fishing value

Information on local fisheries is not available and experts are consulted.

Multiplier

Multipliers are a useful method for estimating indirect economic impacts. A single multiplier can be used for the entire fishing industry or separate multipliers can be used for the commercial fishing/harvesting and processing/cleaning sectors. In this case, an income multiplier of 1.23 (Table 121) for commercial marine capture is used for the net income from commercial fishing (Jacobsen, 2014).

Table 121. Indirect impacts in Belize

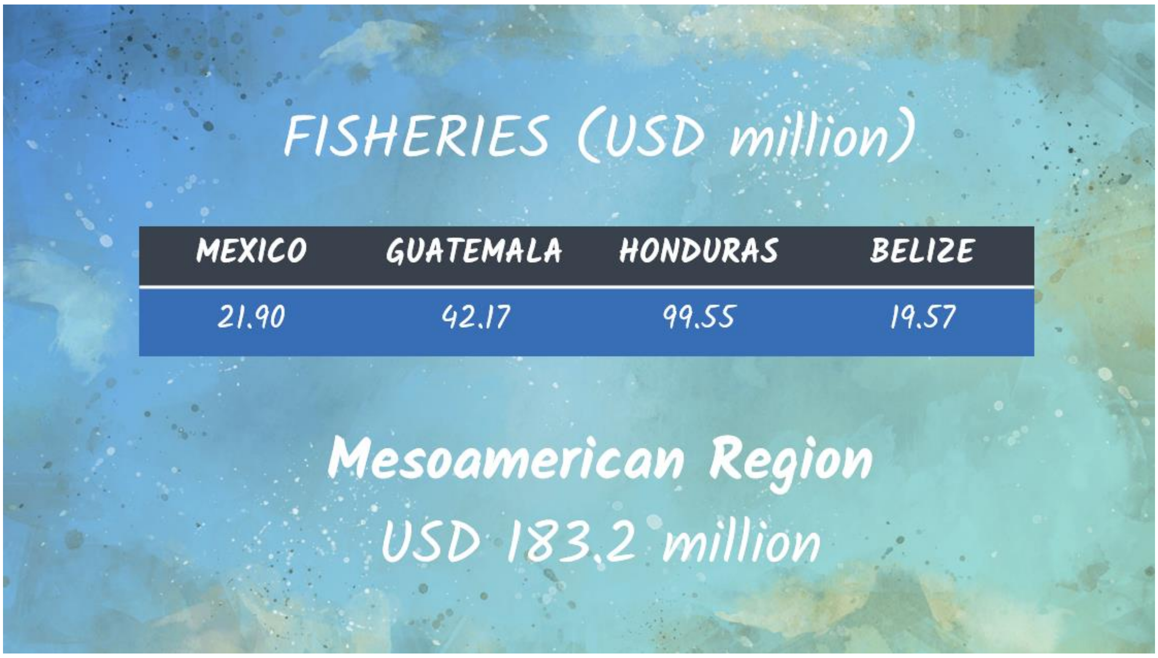
Concept	USD Mn.
Commercial net revenue	102.66
Income multiplier	1.23
Indirect economic impact	**23.61**

Total fisheries value

The **total use value** of the reef-related fishing sector in Belize is estimated at **USD 19.57** million (Table 122).

Table 122. Use Value of reef-related fisheries in Belize

Concept	Value (USD Mn.)
1. Commercial fishing	14.27
2. Fish processing	0.94
3. Fish cleaning	1.99
4. Local Fishing	Nd
5. Total direct impacts	17.20
6. Indirect impacts (commercial sector)	2.37
Total reef-related fisheries valuation	**19.57**



After having estimated the values for tourism & recreation and fisheries, and following the example used for the Great Barrier Reef [110], Table 123 presents the information according to the SEEA - Experimental Ecosystem Accounting framework. In this case, marine ecosystem specifically refers to coral reef.

[110] https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/4680.0.55.001Main%20Features12015?opendocument&tabname=Summary&prodno=4680.0.55.001&issue=2015&num=&view=

Table 123. Ecosystem service flows, according to the SEEA – Experimental Ecosystem Accounting framework

ECOSYSTEM SERVICE FLOWS (PHYSICAL AND MONETARY MEASURES) AND VALUE OF PRODUCTION, MESOAMERICAN REEF, 2010-2019														
Domain					**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Marine - Coral reefs														
	Tourism													
		Reef related Overnight visitors*		Numbers										
			Belize (a)		154828	160168	177366	188273	205581	218343	246773	273329	313127	322026
			Guatemala (b)		18134	18799	19447	19836	22218	23871	25686	26902	28863	28399
			Honduras (c)		227832	229944	236280	227832	229152	232320	221232	224664	228360	
			Mexico (d)		4165978	4349774	4787955	5214781	5617194	5892677	6198520	7503142	7914065	8362899
			Total		4566772	4758685	5221048	5650722	6074145	6367211	6692212	8028036	8484415	8713325
	Fishing Production													
		Catch Production		Tonnes										
			Belize**		397300	276946	171135	34246	75433	97524	91431	121299	216107	
			Guatemala**		8284	6543	7663	9909	11240	13111	11913	15722	13456	
			Honduras**		7939	9081	10098	9704	6457	8609	8500	8500	8500	
			Mexico**		199991	197039	221141	190549	211661	261259	265361	289454	297055	
			Total		613514	489609	410037	244408	304791	380503	377205	434975	535118	

*Reef related percentages are not available for all years. The estimations were made with the latest data available.
The reef related percentage from Belize corresponds to the year 2019
The reef related percentage from Guatemala corresponds to the year 2018
The reef related percentage from Honduras corresponds to the years 2011-2016
The reef related percentage from Mexico correspond to the year 2019
(a) Reef related overnight tourists in Belize. Source: Belize Tourism Board
(b) Reef related overnight tourists in Guatemala in Izabal (Estimated). Source: UNWTO. Total international arrivals. Overnights visitors (tourists).
(c) Reef related overnight tourists in Honduras (Includes tourists in all regions in Honduras). Source: UNWTO. Total international arrivals. Overnights visitors (tourists).
(d) Reef related overnight tourists in Quintana Roo, Mexico. Source: SEDETUR. Indicadores Turisticos
** Capture production in Atlantic Ocean and adjacent seas. Source:FAO. Fishery Statistical Collections. Global Capture Production

SHORELINE PROTECTION

Several studies have been examined to determine whether they are appropriate for transferring the values obtained. They are listed below:

- *Reguero, B. et al. (2019). The Risk Reduction Benefits of the Mesoamerican Reef in Mexico. Frontiers in Earth Sciences*. It spatially quantifies the risk reduction benefits of the Mesoamerican Reef in Quintana Roo for people, buildings, and hotel infrastructure. The study also compares the risk reduction of coral reefs with the protection offered by dunes and the increase in coastal risk from sealevel rise.
- *Storlazzi, C. et al. (2019). Rigorously Valuing the Role of U.S. Coral Reefs in Coastal Hazard Risk Reduction. U.S. Geological Survey Open-File Report 2019–1027*. It (i) develops and applies a process-based, high resolution, nonlinear model of shoreline protection benefits from corals reefs, (ii) maps these natural defence benefits at a resolution relevant to management scales, and (iii) provides a framework to rigorously value the people and property protected by coral reefs for a range of storm scenarios. Data are generated for all populated U.S. coral-reef-lined coasts (Hawai'i, Florida, Guam, American Samoa, Puerto Rico, Virgin Islands, and the Commonwealth of the Northern Mariana Islands).
- *Beck, M. et al. (2018). The global flood protection savings provided by coral* reefs. *Nature* 9: 2186. The authors estimate the annual expected benefit of coral reefs for protecting people and property globally by comparing flooding for scenarios with and without reefs for four storm return periods.
- UN *Environment, ISU, ICRI & Trucost (2018). The Coral Reef Economy: The business case for investment in the protection, preservation, and enhancement of coral reef health.* A quantitative model of selected interactions between live coral cover and the economic returns generated by three sectors that benefit directly from coral reefs – tourism, coastal development and commercial fisheries – was applied to two case study regions: The Coral Triangle in South East Asia and the Mesoamerican Reef in the Caribbean.
- *O'Garra, T. (2012). Economic Valuation of a traditional fishing ground on the coral coast in Fiji. Ocean & Coastal Management*. It estimates shoreline protection afforded by coral reefs and mangroves from storms and flooding in Fiji by using values from various secondary sources. A benefit transfer is conducted to that end. Net annual and net present values are also obtained.
- *Sarkis et al. (2010, 2013*). *Total Economic Value of Bermuda's Coral Reefs. Valuation of Ecosystem Services*. Physical shoreline protection in Bermuda has been estimated through avoided damages approach.
- *Pascal, N.* et al. (2010, 2011). *Valeur économique des services rendus par les récifs coralliens et écosystèmes associés des Outre-mer français & Cost-Benefit Analysis of community-based marine protected areas: 5 case studies in Vanuatu*. Economic valuation of impacts on shoreline protection in South Pacific and Vanuatu has been assessed through damage costs avoided.
- *Burke et al. (2011). Reefs at Risk. Revisited in the Coral Triangle. Washington D.C. World Resources Institute.* Shoreline protection from storm damage and erosion is estimated in the Coral Triangle Region (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, Timor-Leste and Brunei Darussalam and Singapore).
- *Cooper, E., Burke, L., Bood, N. (2009). Coastal Capital: Belize. The Economic Contribution of Belize's Coral Reefs and Mangroves. WRI Working Paper. Washington D.C. World Resource Institute*. It evaluates the average annual contribution of reef- and mangrove-associated tourism, fisheries, and shoreline protection services to the economy of Belize.
- *Cesar, H.S.J. & van Beukering, P. (2004). Economic Valuation of the Coral Reefs of Hawai'i.* The contribution of coral reefs to the welfare of Hawai'I and net benefits of the protection of this ecosystem is calculated. The benefits for coastal infrastructure is also examined.

- *van Beukering, P. et al. (2006a,b). The Economic Value of the Coral Reefs of Saipan, Commonwealth of the Northern Mariana Islands & The economic value of Guam's coral reefs.* Total Economic Value is estimated, and this included the service of shoreline protection. Using GIS, the potential flooding zones caused by storms (and subsequent number of damaged buildings) were determined for two scenarios: 'with reefs' and 'without reefs'. The average damage each year is also calculated.
- *Wilkinson, C. et al. (1999). Ecological and Socioeconomic Impacts of 1998 Coral Mortality in the Indian Ocean: An ENSO Impact and a Warning of Future Change?* Estimates of the economic damage due to bleaching process is estimated under two scenarios: optimistic and pessimistic.
- *Costanza, R. et al. (1997). The value of the world's ecosystem services and natural capital. Nature 387: 253-260*. The current economic value of 17 ecosystem services for 16 biomes, based on published studies and a few original calculations, are calculated.
- *Cesar, H.S.J. (1996). Economic Analysis of Indonesian Coral reefs. Environmental Department – World Bank. Towards Environmentally and Socially Sustainable Development*. It evaluates benefits of shoreline protection in Indonesia. In particular, for tourism and shoreline protection losses, it gives both 'high' and a 'low' scenario estimates, depending on the types of coastal construction and tourism potential.

However, as explained above, the unit value transfer method requires that the case studies considered share some common features: they are coastal zones where the Mesoamerican reef system is present to protect them. That is why we chosen to focus on those study sites that are closest to our policy site. Particularly useful is the work of **Beck et al. (2018)** for three reasons: (i) it uses a very consistent method, which follows and advances methods recently used to assess the risk reduction benefits of ecosystems; (ii) it is a recent research; and (iii) it offers values for countries belonging to the Mesoamerican region (México and Belize).

This study spatially and economically quantifies the coastal flood risk reduction benefits for people and properties (or built capital)[111] of coral reefs. To assess this risk reduction benefits, the expected damage cost avoided approach is used to estimate the benefits by their avoided flood damages. This method is commonly used in insurance sectors and recommended for the assessment of shoreline protection services from habitats.

The first step of our valuation exercise consisted of identifying the km of coastline of the area to be estimated. Stretching for around 600 – 625 miles (around **1,000 kilometres**) along the coast of Honduras, Guatemala, Belize and Mexico, the **MAR region** is the largest barrier reef in the Western Hemisphere – from the Yucatan Peninsula in Mexico to the islands off Honduras –. Pending more precise figures on the kilometres of coastline of each country, we make estimates based on the literature review and our estimations from the information used in the mapping exercise (Table 124).

[111] Beck et al. (2018) also estimated the ratio between built capital per capita and GDP per capita for each country by using the average from countries with similar income levels: they obtained an overall global mean ratio of 2.67 (in 2011 USD).

Table 124. Coastline kilometers per country

	Kilometers – km –
Mexico	300
Guatemala	70
Honduras	285
Belize	300
TOTAL	**955 km**

In Mexico, coral reefs extend for around 450 km (Álvarez-Filip et al., 2019), especially in the region of Quintana Roo, with 300 km (Ardisson et al., 2011) [112] – around 270 km in the continental area and 30 additional km for Cozumel and Islas Mujeres –.

According to the study by Beck et al. (2018), at national scale, reefs provide annual expected benefits of hundreds of millions of dollars in avoided flood damages. **Mexico** is one of the countries that receive the most flood protection benefits from reefs (the annual averted damages amounts to **USD 452 million**). For extreme events (e.g., 100-year events), reefs avert billions to tens of billions of dollars in damages for more than 10 countries (USD 18.87 billion in Mexico). The **Ocean Wealth Explorer** also provides an interesting database for estimates of the benefits provided by coral reefs in flood protection annually and from catastrophic storms. In this case, for Mexico, the annual expected benefit accounts to **USD 616 million**, this value representing predicted losses avoided by keeping coral intact. However, it includes coral reefs throughout the country (Gulf of Mexico and Pacific also). Thus, if we are to focus exclusively on the **Mesoamerican reef system**, the value would be slightly lower, as it covers 300 km of the 450 km in total (USD 301– 411 million).

Mexico is one of the countries that receive most flood protection benefits from reefs in terms of avoided flooding of land: the difference in land area that would be flooded with and without reefs is 38.02 km2, while in Honduras is 4.83 km2 and in Belize 4.27 km2 (Beck, et al., 2018). This may reflect why, in **Belize**, the annual averted damages amounts to **USD 9 million annually)**.

For income adjustment (Table 125), purchasing power parity (PPP) is used:

Table 125. GDP per cápita, PPP (2019) for the four countries (World Bank database)

	GDP per capita, PPP (current international $, 2019)
Mexico	20,410.7
Guatemala	8,995.5
Honduras	5,965.4
Belize	7,295.2

[112] Between Sian Ka'an and Arrecifes de Xcalak the reef is interrupted (around 80.46 km).

The relation between Honduras' GDP and Belize's GDP is:

$$\frac{GDP_{Honduras}}{GDP_{Belize}} \qquad [31]$$

If we take into account income differences and the annual expected area flooded per km2, which is the case in this study, the value of coastal services would be estimates as follows:

$$\frac{GDP_{Honduras}}{GDP_{Belize}} \times \frac{9 \times kmHonduras}{km\ Belize} \times \frac{4.83km2}{4.27} \qquad [32]$$

where 9 refers to the avoided flood damages in Belize, according to the study of Beck et al. (2018). The same procedure would be followed for the remaining countries.

Considering all the above and that Honduras and Guatemala are countries with income levels, annual expected area flooded per km2 and characteristics more similar to Belize than to Mexico, the approximate values of shoreline protection are shown in Table 126:

Table 126. Annual net benefits of shoreline protection in the Mesoamerican region

	Annual benefits (USD Mn.)
Mexico	301 - 411
Guatemala	1.94 – 3.99
Honduras	7.90 – 10.76
Belize	9 – 12.25[113]
TOTAL	**319.84 – 438**

To convert this annual benefit streams from an annual figure to a **Net Present Value (NPV)** figure of this service over a 30-year time horizon (2050) with two social discount rates (12 percent and 3 percent)[114], we use formula [33]:

$$NPV = \sum_{t=1}^{n} \frac{R_t}{(1+r)^t} \qquad [33]$$

where R_t refers to the cash flow, r to discount rate and t to the number of time periods.

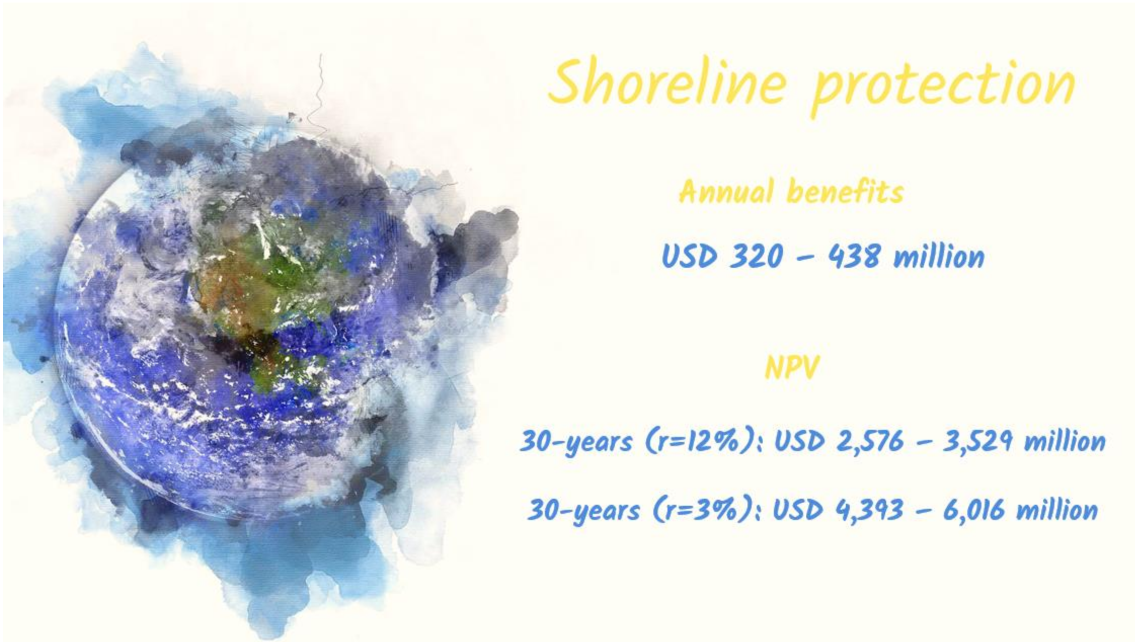
Note that NPV is a method for determining the current value of all future cash flows. A measure is acceptable if the NPV is positive. Results are shown in Table 127.

[113] These results are lower than if we were simply to extrapolate the results by Cooper et al. (2009), who obtained a value of [120-180] million USD in 2008 for Belize. This may depend on the fact that a different methodology has been used and on the measured effect. For example, Cooper et al. calculated economic losses (in property value – land and built structures –) to a coastal area from a given storm event, or what is the same, the potential avoided damages afforded by coral reef-related storm protection (from erosion and wave-induced damage) by following a methodology developed jointly by the Institute of Marine Affairs in Trinidad and Tobago and WRI. In our case, flood hazard for built structures is considered by applying a probabilistic analysis of damages.

[114] The choice of the discount rate is a critical decision: the higher the discount rate, the lower the present value of future costs and benefits. According to Campos et al. (2016), developed countries tend to apply lower rates (in the range of 3 percent to 7 percent) than developing countries (between 8 percent and 15 percent). In Latin American countries, the IDB uses a rate of 12 percent. Therefore, inn this project we have considered a social discount rate of 12 percent, and a useful life of the measures of 25 years (European Commission, 2014). However, we also compare these results with those obtained by applying a rate of 3 percent.

Table 127. Net present value of shoreline protection in the Mesoamerican region (USD Mn.)[115]

	Net Present Value (r =12 percent)	Net Present Value (r =3 percent)
Mexico	[2,425 – 3,311]	[4,134 – 5.645]
Guatemala	[15.6 – 32.1]	[26.6 – 54.8]
Honduras	[63.6 – 86.7]	[108.5 – 147.8]
Belize	[72 – 99]	[124 – 168]
TOTAL (PPP)	**[2,576 – 3,529]**	**[4,393 – 6,016]**



5.3.2 Non-use values

The results of the pre-test are shown in Annex 13.

5.3.2.1 General descriptive results

When it comes to determining the percentage of respondents who have ever visited the reef, it is important to note that Belizeans have visited the reef the most (1 out of 2 have ever visited the Reef), followed by Hondurans, Guatemalans and Mexicans. In terms of international tourists, the Americans and Argentines are in the lead, while the Canadians and the British are in third and fourth position, respectively (only 5 percent of British have ever visited it). However, of the foreign respondents who have enjoyed the corals over the past five years, the British and Canadians have visited the region the most, especially for

[115] In Annex 12, different scenarios are presented.

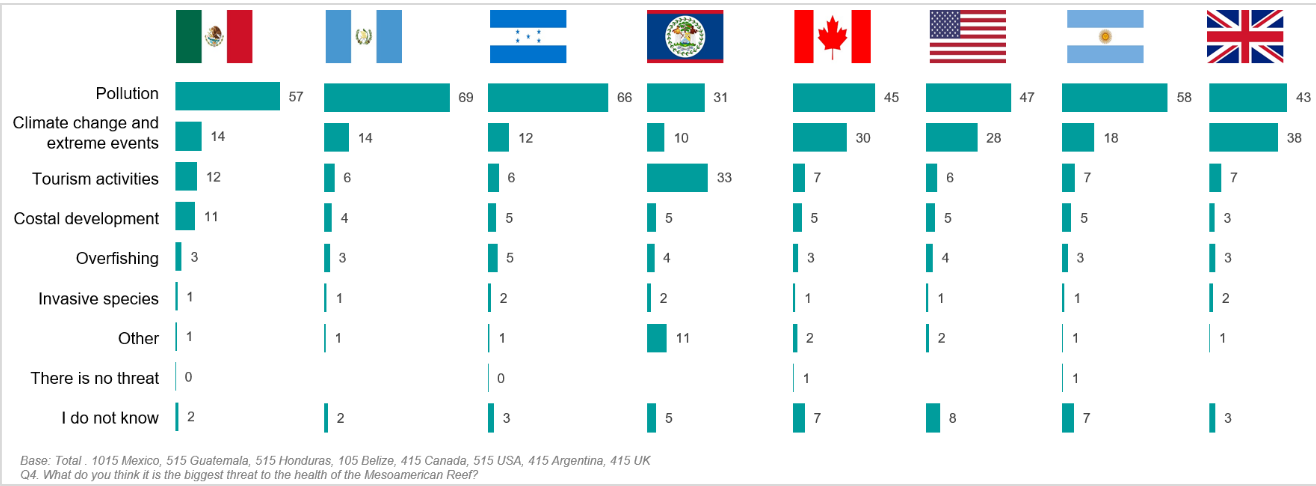
holidays. 24 percent of Americans visited the reefs for business, while this percentage is much lower for the rest of the cases, including residents of countries in the MAR region.

Ever visited the Mesoamerican Reef	**21%**	**24%**	**36%**	**54%**	**9%**	**11%**	**11%**	**5%**
Base: Have ever visited	(209)	(123)	(184)	(57)	(39)	(58)	(47)	(22*)
Visited Past 5 Years	64%	65%	65%	77%	44%	64%	55%	64%
Number of visits (Past 5 Years) (Average)	3,0	2,7	2,6	19,1	7,6	4,2**	2,0	7,8
Main reason for visited								
Holiday (as a tourist)	**82%**	**75%**	**75%**	**16%**	**92%**	**62%**	**83%**	**77%**
Visiting family and friends	10%	12%	11%	12%	3%	14%	9%	14%
Business	3%	11%	8%	5%	5%	24%	9%	9%
Recreational use	5%	2%	7%	67%	--	--	--	--

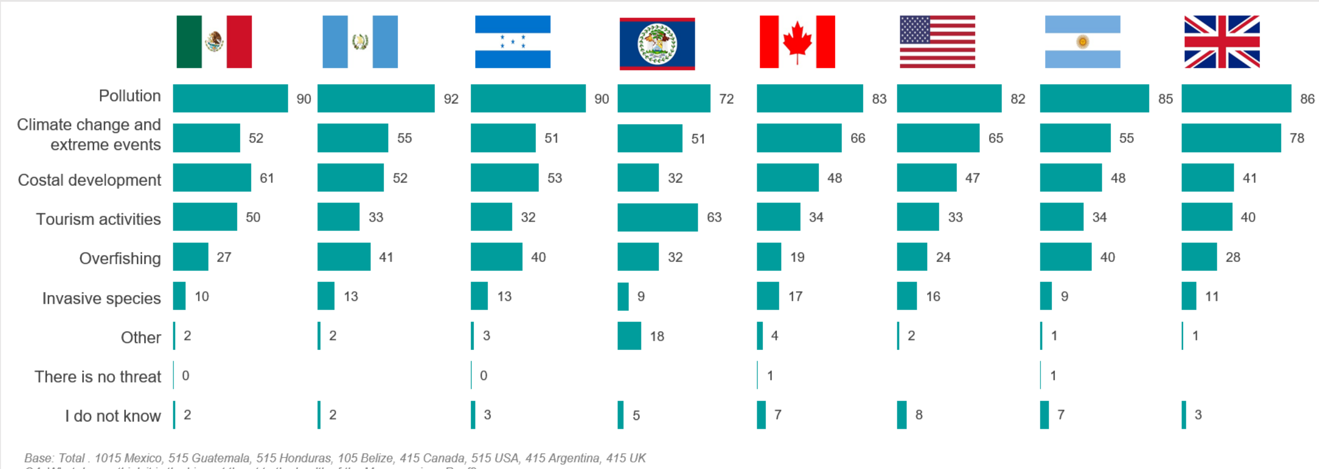
* Small base
**Values 200+ excluded

Base: Total . 1015 Mexico, 515 Guatemala, 515 Honduras, 105 Belize, 415 Canada, 515 USA, 415 Argentina, 415 UK
Q1. Have you ever visited the Mesoamerican Reef?
Q2. Have you visited the Mesoamerican Reef in the past five years? /How many times?
Q3. What was the main reason for your visit?

Respondents believe that pollution is the greatest threat to the health of the Mesoamerican Reef. This option was especially chosen by respondents in Mexico, Guatemala, Honduras and the United States. For British people, climate change and extreme events is almost as important as pollution and, for Belizeans, tourism activities surpass pollution as the greatest threat.

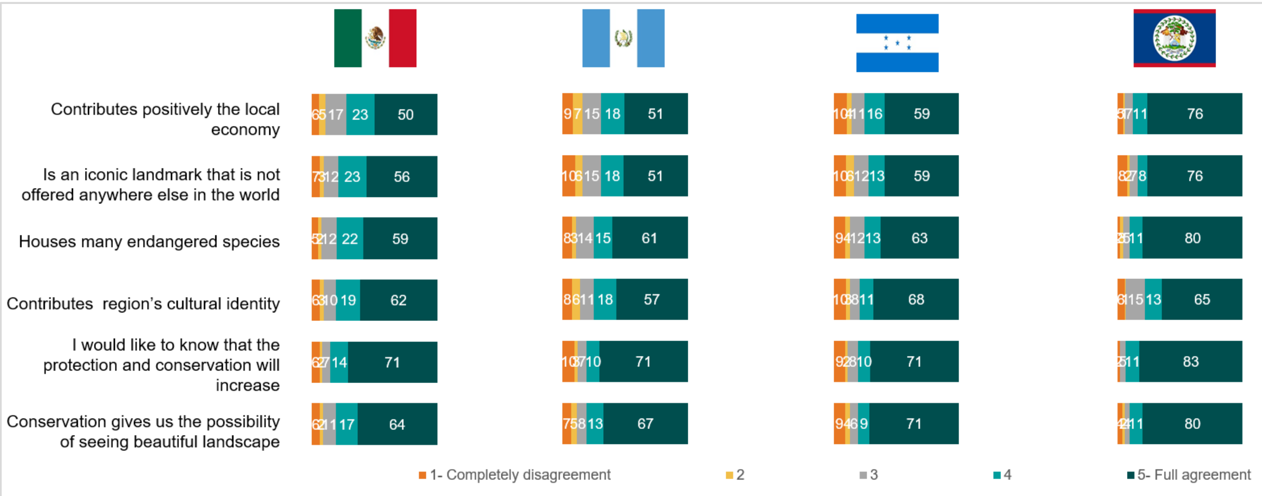


The three top threats to the health of the Mesoamerican reef are pollution followed by climate change and extreme events and costal development. However, tourism activities is considered to be the second threat by Belizeans.



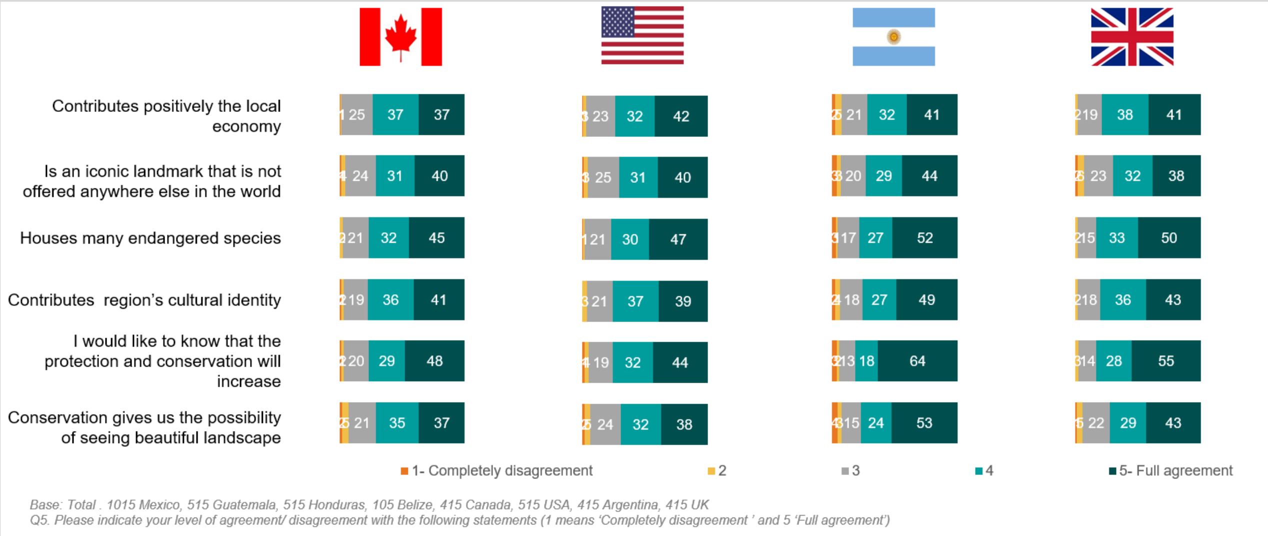
Base: Total . 1015 Mexico, 515 Guatemala, 515 Honduras, 105 Belize, 415 Canada, 515 USA, 415 Argentina, 415 UK
Q4. What do you think it is the biggest threat to the health of the Mesoamerican Reef?

Regarding respondents' agreement (or disagreement) with different issues related to the Mesoamerican reef, almost 4 out of 5 respondents in resident countries want to know that protection and conservation will increase. Around 65 percent of respondents fully agree that conservation gives the possibility of seeing beautiful landscape, and 60 percent are in full agreement that coral reefs are houses for many endangered species.

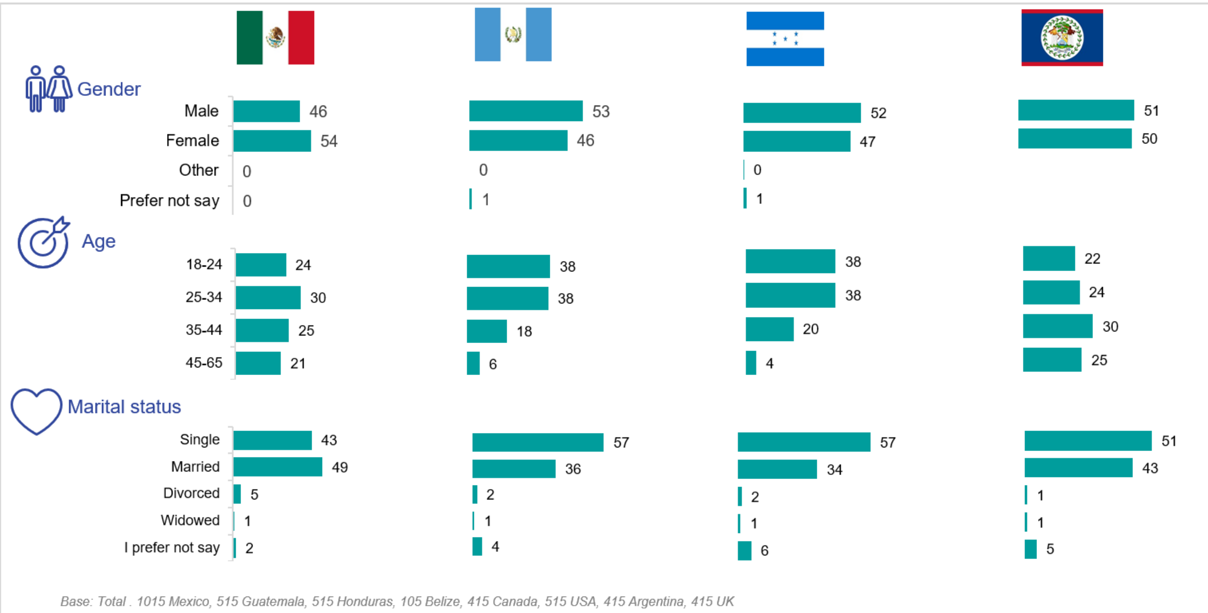


Base: Total . 1015 Mexico, 515 Guatemala, 515 Honduras, 105 Belize, 415 Canada, 515 USA, 415 Argentina, 415 UK
Q5. Please indicate your level of agreement/ disagreement with the following statements (1 means 'Completely disagreement ' and 5 'Full agreement')

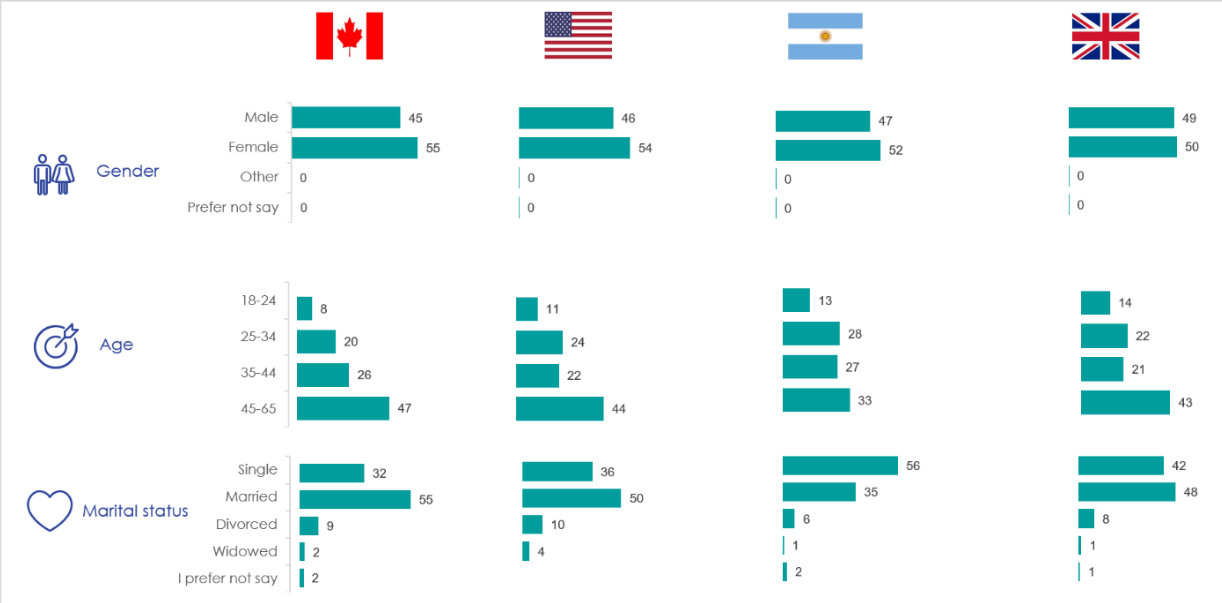
When it comes to foreign respondents, in Canada, the US, Argentina and the UK more respondents selected the option "agree" than in Mexico, Guatemala and Honduras. However, a large number of respondents agree or fully agree with the six statements.



Regarding sociodemographic variables, it can be said that most of respondents in Mexico, Guatemala, Honduras and Belize are single or married and between 18 and 45 years (except in Mexico and Belize where age distribution is more spread out). In terms of gender, about half of the respondents are women and half are men, reflecting the existing composition of society.

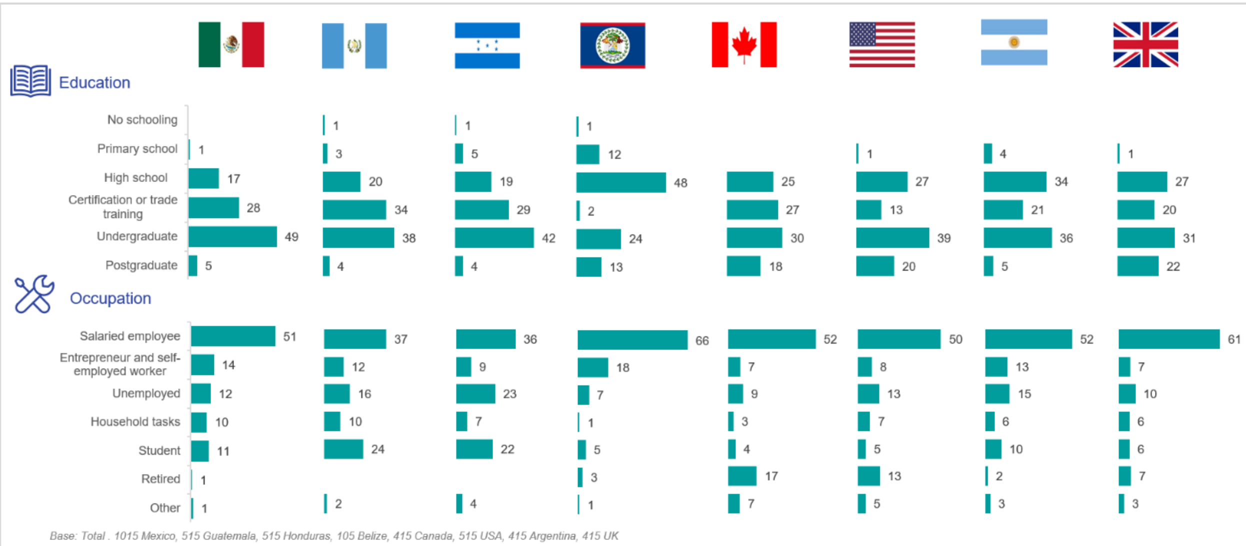


Similar results are obtained for Canada, the US, Argentina and the UK: most of them are single or married. However, there are more respondents of more than 45 years old than in the resident population, especially in Canada, the US and the UK.

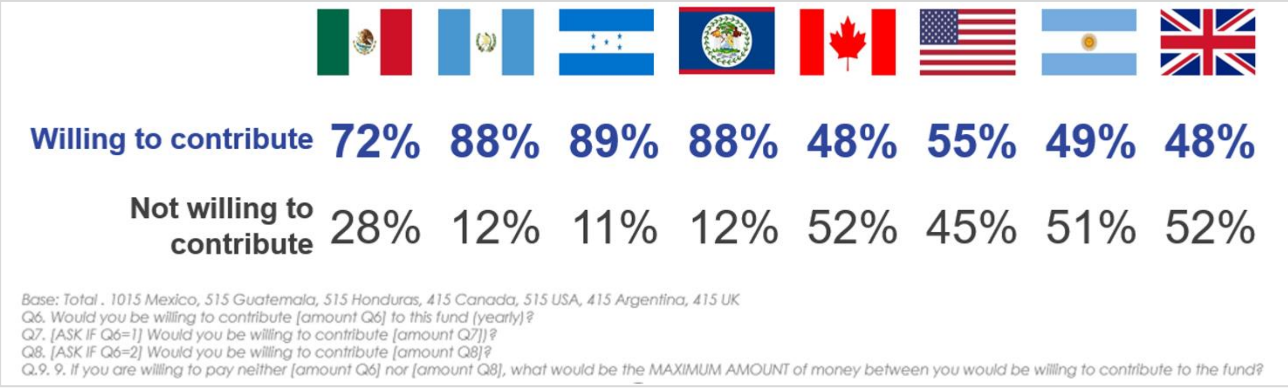


In Mexico, 82 percent of respondents are educated beyond secondary education. This percentage is of 86 in Guatemala, 75 in Honduras and 39 in Belize, respectively. These percentages are larger than in Canada, the US, Argentina and the UK. This may be due to the fact that in these four countries, Internet penetration is higher than 88 percent, so using an online approach does not present a bias in the opinion collected (compared to the total of the population). In Honduras, Guatemala and Mexico the penetration is much lower (32 percent, 19 percent and 66 percent, respectively), so the sample is representative of the Internet population of each country. People with the greatest access to and use of the Internet is that with the most resources and studies, so the results reflect this fact.

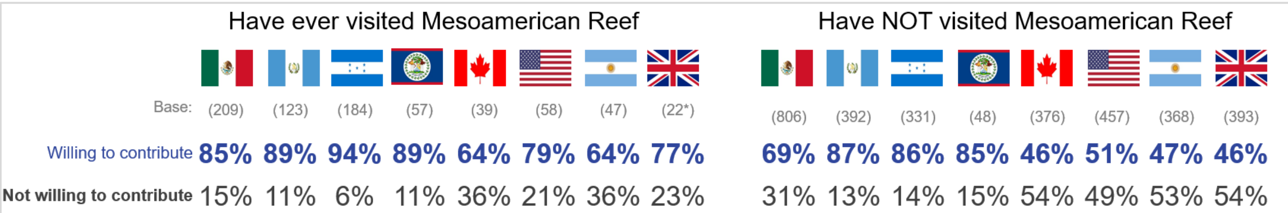
When occupation is asked, around 50 percent of respondents in Mexico are salaried employees, around 37 percent in Guatemala and Honduras, and more than 65 percent in Belize. In Canada and the US, the second position is occupied by retired people, whereas by students in Guatemala. A range between 9 and 15 percent of foreign respondents are unemployed, this range being between 12 and 23 percent for resident population.



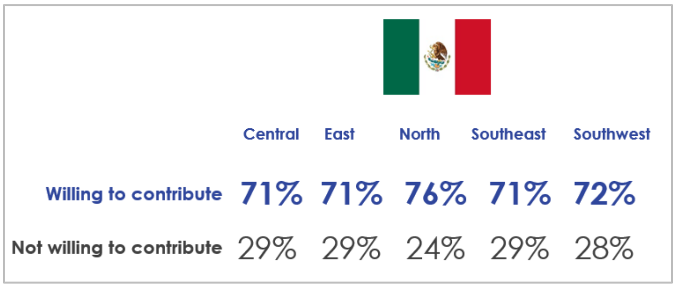
When looking at the willingness to contribute to the conservation of the Mesoamerican reef, Mexico is the residential country less willing to contribute, and Canada and the UK the countries of origin of potential tourists where only 48 percent of respondents would contribute. Likewise, different ideological motivations across countries spur the respondents to contribute.



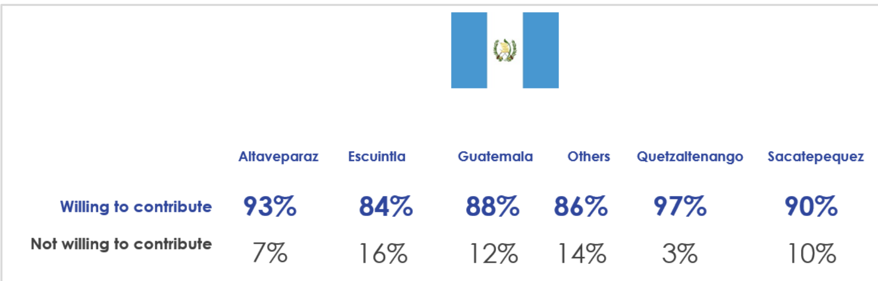
As would be expected, visitors are more willing to contribute than non-visitors. The difference between both groups is higher for potential tourist countries.



When looking at the results by regions, there is hardly any difference in Mexico.



The range is somewhat wider in Honduras and Guatemala.



	Atlantida	Choluteca	Comayagua	Cortes	Francisco Morazan	Others
Willing to contribute	90%	78%	94%	89%	98%	88%
Not willing to contribute	10%	22%	6%	11%	2%	12%

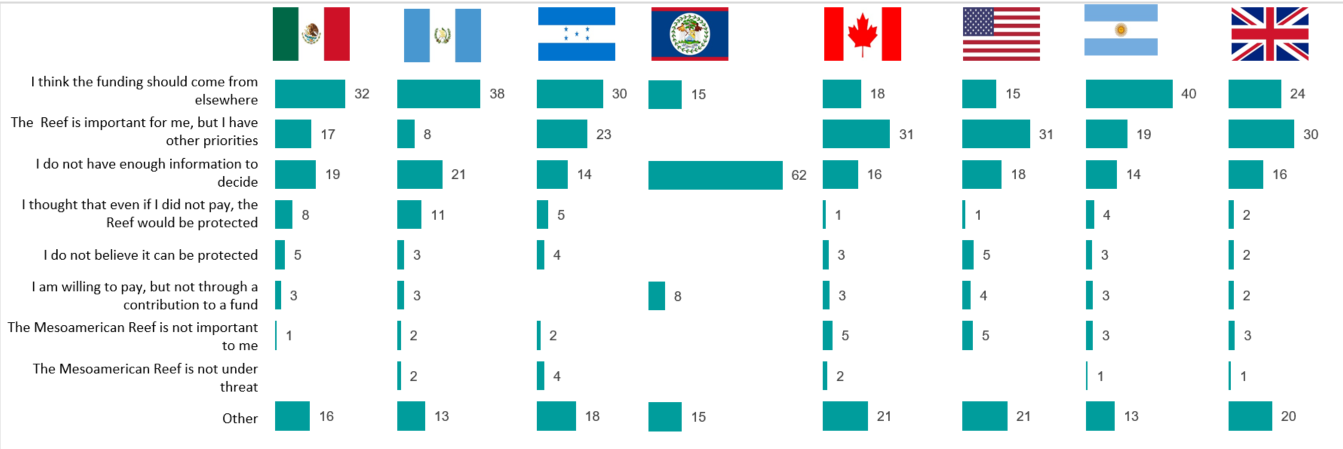
If we now differentiate by gender, age, education and occupation, there is a similar pattern for the three resident population (see Table 128). Women are more willing to pay than men, the younger the population, the more they are willing to pay. Likewise, as the level of education increases, so does the willingness to pay. People working at home and unemployed are the ones who are willing to pay the least.

Table 128. Sociodemographic results (%)

	MEXICO	GUATEMALA	HONDURAS	BELIZE
GENDER				
Male	70	86	88	83
Female	74	90	91	92
AGE				
18-24	79	91	88	83
25-34	73	89	91	88
35-44	68	82	89	94
45-65	69	77	82	88
EDUCATION				
No schooling	0	67	60	100[116]
Primary school	45	79	65	69
Secondary school	66	85	90	90
Certification	71	90	91	0[117]
Undergraduate	75	89	90	96
Postgraduate	78	89	91	93
OCCUPATION				
Salaried employee	74	92	91	88
Self-employee	74	87	89	79
Unemployed	69	85	88	86
Household tasks	62	88	79	100
Student	75	85	89	100
Retired	57	100	100	100
Other	85	70	89	100

[116] Note that only 1 respondent answered not having schooling.
[117] Note that only 2 respondents answered having a certificate.

However, there are some people who are not willing to pay under no circumstances. The reasons they give for not paying are varied, as shown below, but among them three stand out: “Think that the funding should come from elsewhere”, “Have other priorities” and “Not have enough information”.



Base: Not willing to contribute with any amount or don't know. 282 Mexico, 63 Guatemala, 56 Honduras, 13 Belize, 216 Canada, 234 USA, 212 Argentina, 217 UK
Q11. Could you tell us the reason why you did not accept paying any amount of money to contribute to the conservation fund for the Mesoamerican Reef? (select just one option)

In short:

- Although respondents are convinced that threats to the reef exist, the population that is willing to contribute varies by country.
- Among resident countries, Mexico (72 percent) is the least willing to contribute the amounts indicated in the questionnaire. In contrast, in Guatemala and Honduras, more than 4 out of 5 would be willing to contribute.
- As for the countries of potential tourists, the United Kingdom (48 percent) and Canada (48 percent) are the least willing to contribute the amounts shown in the questionnaire, while Argentina (49 percent) and the USA (55 percent) would contribute a little more. However, when they have visited the Mesoamerican reef, there is an increase in their willingness to contribute to the Fund.
- Age and region are other factors that increase willingness to contribute. The contribution would be higher for those 34 years old or younger and in some regions of the resident countries.
- Mainly people who are not willing to contribute the requested amounts do not know the maximum amount they would be willing to contribute. Thinking that the funding should come from somewhere else, having other priorities or not having enough information are the main reasons for not contributing or not knowing if they are willing to do so.

5.3.2.2 Econometric analysis: WTP estimation[118]

The results of the econometric model (calculation of the WTP) are presented by country. The specification of the model and other statistics are shown in Annex 14.

DOMESTIC VALUES

MEXICO

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (177 pesos – USD 8) for the single-bounded question (Q6), a higher amount (310 pesos – USD 14) for the upper bound (Q7) of the double-bounded question, and a lower amount (89 pesos - USD 4) for the lower bound (Q8) of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 129). Non-visitors are willing to pay the lowest value.

Table 129. Mean willingness to pay (WTP) values (Mexico, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	280.82 pesos [280.45 – 281.19]	165.15 pesos [164.78 – 165.52]	**189.44 pesos** [189.07 – 189.81]
	USD 12.69 [12.32 - 13.05]	USD 7.46 [7.09 - 7.83]	**USD 8.56** [8.19 - 8.93]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 130):

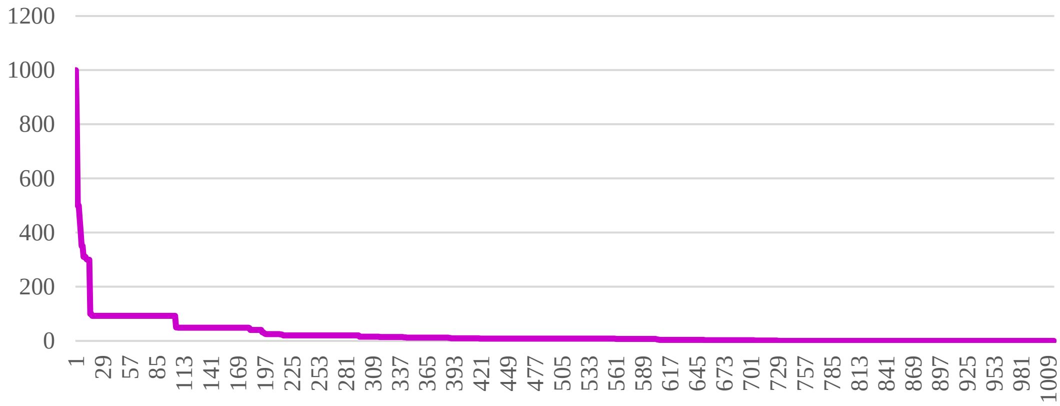
Table 130. Willingness to pay (WTP) values (Mexico, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	533.43 pesos	**177 pesos**
	USD 24.11	**USD 8**

Such a "skewed" distribution is graphically shown in Figure 26.

[118] Econometric analysis is only presented for three countries of the Mesoamerican Region: Mexico, Guatemala and Honduras. When having the results for Belize and the countries where tourists come from most, results will be included.

Figure 26. WTP distribution (Mexico, pesos)



As the figure shows, the open ended distribution is heavily skewed, with a large number having a much lower WTP. The actual numbers in the population with the very high WTP may not be accurately represented by the number in the sample. Thus, the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In this regard, it is interesting to note that the median WTP with the open bids (USD 8) is quite close to the withed average with the double bounded method (USD 8.56).

In short, by combining both models, the range of values shown in Table 131 is obtained:

Table 131. Willingness to pay (WTP) values (Mexico, year 2020) – range from the two models

Willingness to pay (WTP) values	[177.05 – 189.44] pesos per year USD [8 - 8.56] per year

Scaling up

The survey was conducted through the internet, so the reference group can only be people with a household connection. In Mexico that is estimated at 70 percent for a population of 127.5 million[119]. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 3.7[120] Thus, the group to which the scaling up should be applied is 127.5*0.7/3.7= 24.1 million.

In Table 132, results for compensating variation are shown.

[119] Data are taken from https://data.worldbank.org/country/MX
[120] https://population.un.org/Household/index.html#/countries/484

Table 132. Aggregated values of compensating variation of a conservation program for coral reefs (Mexico, year 2020) – Non-use values

	Pesos per person	Population	Aggregated
Compensating Variation	177.05	24.1 million	4266.90 million
	189.44	24.1 million	4565.50 million
	USD per person	**Population**	**Aggregated**
	8	24.1 million	192.8 million
	8.56	24.1 million	206.3 million

GUATEMALA

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (31quetzals – USD 4) for the single-bounded question, a higher amount (54 quetzals – USD 7) for the upper bound of the double-bounded question, and a lower amount (15 quetzals – USD 2) for the lower bound of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 133). Non-visitors are willing to pay the lowest value.

Table 133. Mean willingness to pay (WTP) values (Guatemala, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	61.73 quetzals [61.21 – 62.25]	51.87 quetzals [51.35 – 52.39]	**54.23 quetzals** [53.71 – 54.75]
	USD 7.96 [7.44 – 8.48]	USD 6.69 [6.17 – 7.21]	**USD 7.03** [6.51 – 7.55]

Econometric analysis Including Reported Open Bids

We first compute statistical description to compare the mean and the median values of all stated WTP (Table 134):

Table 134. Willingness to pay (WTP) values (Guatemala, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	186.74 quetzals	**54 quetzals**
	USD 24.08	**USD 7**

Again, distribution is graphically sketched, so the mean is too much affected by the long tail. Thus, it is more reasonable to use the median as the central figure.

In this regard, it is interesting to note that the median WTP with the open bids (USD 7) is quite close to the withed average with the double bounded method (USD 7.03).

In short, by combining both models, the range of values shown in Table 135 is obtained:

Table 135. Willingness to pay (WTP) values (Guatemala, year 2020) – range from the two models

Willingness to pay (WTP) values	[54 – 54.23] quetzals per year USD [7 – 7.03] per year

Scaling up

In Guatemala, people with a household connection is estimated at 40.7 percent for a population of 16,604,026 million. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 2.4. Thus, the group to which the scaling up should be applied is 16,604,026*0.4/2.4 = 2, 767,337.

In Table 136, results for compensating variation are shown.

Table 136. Aggregated values of compensating variation of a conservation program for coral reefs (Guatemala, year 2020) – Non-use values

	Quetzals per person	Population	Aggregated
Compensating Variation	54	2, 767,337	149,436,198
	54.23	2, 767,337	150,072,685.51
	USD per person	**Population**	**Aggregated**
	7	2, 767,337	19,371,359
	7.03	2, 767,337	19,454,379.11

HONDURAS

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (50 lempiras – USD 2) for the single-bounded question, a higher amount (100 lempiras – USD 4) for the upper bound of the double-bounded question, and a lower amount (25 lempiras – USD 1) for the lower bound of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 137). Non-visitors are willing to pay the lowest value.

Table 137. Mean willingness to pay (WTP) values (Honduras, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	119.61 lempiras [119.14 – 120.08]	86.99 lempiras [86.53 – 87.46]	**98.65 lempiras** [98.18 – 99.12]
	USD 4.78 [4.31 – 5.25]	USD 3.48 [3.01 – 3.95]	**USD 3.95** [3.48 – 4.42]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 138):

Table 138. Willingness to pay (WTP) values (Honduras, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	613.53 lempiras	**175.16 lempiras**
	USD 24.52	**USD 7**

As in the previous case, distribution is graphically sketched, so the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In short, by combining both models, the range of values shown in Table 139 is obtained:

Table 139. Willingness to pay (WTP) values (Honduras, year 2020) – range from the two models

Willingness to pay (WTP) values	[98.65 – 175.16] lempiras per year
	USD [3.95 - 7] per year

Scaling up

In Honduras, people with a household connection is estimated at 32.13 percent for a population of 9,746,117. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 4.5. Thus, the group to which the scaling up should be applied is 9,746,117*0.32/4.4 = 708, 808 million.

In Table 140, results for compensating variation are shown.

Table 140. Aggregated values of compensating variation of a conservation program for coral reefs (Honduras, year 2020) – Non-use values

	Lempiras per person	Population	Aggregated
Compensating Variation	98.65	708,808	69,923,909
	175.16	708,808	124,154,809
	USD per person	**Population**	**Aggregated**
	3.95	708,808	2,799,792
	7	708,808	4,961,656

BELIZE

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (8 Belize dollars – USD 4) for the single-bounded question, a higher amount (14 Belize dollars – USD 7) for the upper bound of the double-bounded question, and a lower amount (4 Belize dollars – USD 2) for the lower bound of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 141). Non-visitors are willing to pay the lowest value.

Table 141. Mean willingness to pay (WTP) values (Belize, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	21.98 Belize dollars [20.91 – 23.04]	17.3 Belize dollars [16.24 – 18.37]	**19.78 Belize dollars** [18.71 – 20.85]
	USD 11 [9.93 – 12.07]	USD 8.65 [7.58 – 9.72]	**USD 9.89** [8.82 – 10.96]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 142):

Table 142. Willingness to pay (WTP) values (Belize, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	22.94 Belize dollars	**13 Belize dollars**
	USD 11.48	**USD 6.51**

As in the previous case, distribution is graphically sketched, so the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In short, by combining both models, the range of values shown in Table 143 is obtained:

Table 143. Willingness to pay (WTP) values (Belize, year 2020) – range from the two models

Willingness to pay (WTP) values	[13 – 19.78] Belize dollars per year USD [6.51 – 9.89] per year

Scaling up

In Belize, people with a household connection is estimated at 47 percent for a population of 390,353[121]. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 3.8[122]. Thus, the group to which the scaling up should be applied is 390,393*0.47/3.8 = 42,285.

In Table 144, results for compensating variation are shown.

Table 144. Aggregated values of compensating variation of a conservation program for coral reefs (Belize, year 2020) – Non-use values

	Belize dollars per person	**Population**	**Aggregated**
Compensating Variation	13	42,285	549,705
	19.78	42,285	836,397.3
	USD per person	**Population**	**Aggregated**
	6.51	42,285	275,275.35
	9.89	42,285	418,198.65

A summary of previous results is shown in Table 145.

Table 145. Annual WTP, domestic values (2020 values, USD)

	WTP per person (USD)	**Population**	**Aggregated**
Mexico	[8 – 8.56]	24,100,000	[192,800,000 – 206,300,000]
Guatemala	[7– 7.03]	2, 767,337	[19,371,359 – 19,454,379]
Honduras	[3.95 – 7]	708,808	[2,799,792 – 4,961,656]
Belize	[6.51 – 9.89]	42,285	[275,275 – 418,199]

[121] Data are taken from https://data.worldbank.org/country/belize
[122] https://population.un.org/Household/index.html#/countries/484 https://www.prb.org/international/indicator/hh-size-av/map/country/

This non-use value can be described as social, cultural and iconic. It represents the place of the Mesoamerican Barrier Reef System in Mexican, Hondurans, Guatemalans, Belizeans culture in a way that no existing market price reflects.

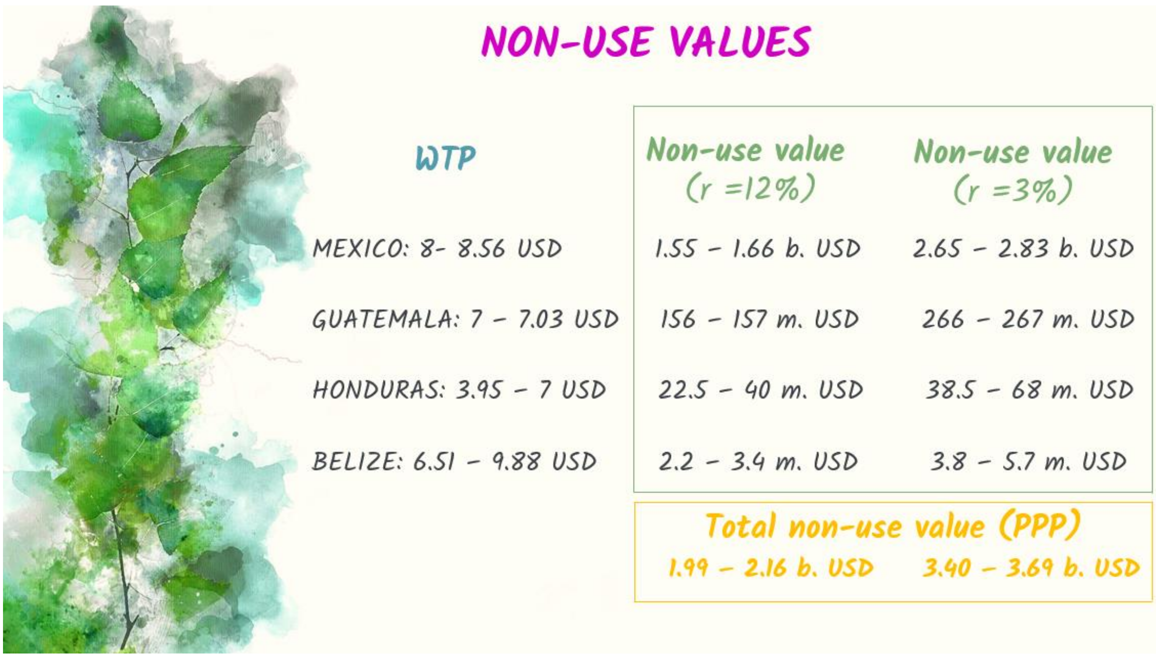
Following the procedure used for shoreline protection, we convert this annual willingness to pay figures from an annual figure to a **total value asset** figure by taking a 30 year net present value and apply two social discount rates (12 percent and 3 percent per year).

Thus, the total **non-use value** to domestic people over this period is as shown in Table 146. The asset value is sensitive to the discount rate and time period applied. If a discount rate of 3 percent were used, non-use value to domestic people over this period would be higher.

Table 146. Total non-use value

	Net Present Value (r =12 percent)	**Net Present Value (r =3 percent)**
Mexico	[1,553,039,469 – 1,661,784,453]	[2,648,179,352 – 2,833,606,848]
Guatemala	[156,039,860 – 156,708,602]	[266,072,785 – 267,213,095]
Honduras	[22,552,840 – 39,967,052]	[38,456,179 – 68,150,181]
Belize	[2,217,391– 3,368,670]	[3,781,004 – 5,744,118]
TOTAL (PPP)	**[1,990,461,092 – 2,163,527,495]**	**[3,394,052,802 – 3,689,158,547]**

In order to obtain the total non-use value at regional level, values for each country have been adjusted by using purchasing power parity (PPP) (see Table 124). We use the Mexican GDP per cápita, PPP, as basis.



INTERNATIONAL VALUES

CANADA

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (48 Canadian dollars –USD 36) for the single-bounded question, a higher amount (92 Canadian dollars – USD 68) for the upper bound of the double-bounded question, and a lower amount (24 Canadian dollars – USD 19) for the lower bound of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 147). Non-visitors are willing to pay the lowest value.

Table 147. Mean willingness to pay (WTP) values (Canada, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	40.08 Canad. dollars [39.28 – 40.87] USD 30.06 [29.26 – 30.85]	5.84 Canad. dollars [5.04 – 6.63] USD 4.38 [3.58 – 5.17]	**9.06 Canad. dollars** [8.26 – 9.85] **USD 6.79** [5.99– 7.58]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 148):

Table 148. Willingness to pay (WTP) values (Canada, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	19.06 Canad. dollars USD 14.29	0 Canad. dollars USD 0

As in the previous case, distribution is graphically sketched, so the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In short, by combining both models, the range of values shown in Table 149 is obtained:

Table 149. Willingness to pay (WTP) values (Canada, year 2020) – range from the two models

Willingness to pay (WTP) values	[0 – 9.06] Canadian dollars per year USD [0 – 6.79] per year

Scaling up

In Belize, people with a household connection is estimated at 92.7 percent for a population of 37,589,262[123]. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 2.4[124]. Thus, the group to which the scaling up should be applied is 37,589,262*0.927/2.4 = 14,518,852.

In Table 150, results for compensating variation are shown.

Table 150. Aggregated values of compensating variation of a conservation program for coral reefs (Canada, year 2020) – Non-use values

	Canadian dollars per person	Population	Aggregated
Compensating Variation	9.06	14,518,852	131,540,799
	USD per person	**Population**	**Aggregated**
	6.79	14,518,852	98,583,006

THE UNITED STATES

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (USD 49) for the single-bounded question, a higher amount (USD 92) for the upper bound of the double-bounded question, and a lower amount (USD 25) for the lower bound of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 151). Non-visitors are willing to pay the lowest value.

Table 151. Mean willingness to pay (WTP) values (The United States, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	USD 99.22 [98.57 – 99.87]	USD 8.26 [7.62 – 8.91]	**USD 18.50** [17.82 – 19.15]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 152):

[123] Data are taken from https://data.worldbank.org/country/canada
[124] https://population.un.org/Household/index.html#/countries/484

Table 152. Willingness to pay (WTP) values (The United States, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	USD 529.8	**USD 10**

As in the previous case, distribution is graphically sketched, so the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In short, by combining both models, the range of values shown in Table 153 is obtained:

Table 153. Willingness to pay (WTP) values (The United States, year 2020) – range from the two models

Willingness to pay (WTP) values	USD [10 – 18.5] per year

Scaling up

In the United States, people with a household connection is estimated at 88 percent for a population of 328,239,523[125]. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 2.4[126]. So the group to which the scaling up should be applied is 328,239,523*0.88/2.4 = 120,354,492.

In Table 154, results for compensating variation are shown.

Table 154. Aggregated values of compensating variation of a conservation program for coral reefs (The United States, year 2020) – Non-use values

	USD per person	Population	Aggregated
Compensating Variation	10	120,354,492	1,203,544,920
	18.5	120,354,492	2,226,558,102

ARGENTINA

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (623 pesos – USD 9) for the single-bounded question, a higher amount (1177 pesos – USD 17) for the upper bound of the double-bounded question, and a lower amount (346 pesos – USD 5) for the lower bound of the double-bounded question.

[125] Data are taken from https://data.worldbank.org/country/guatemala
[126] https://population.un.org/Household/index.html#/countries/484

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 155). Non-visitors are willing to pay the lowest value.

Table 155. Mean willingness to pay (WTP) values (Argentina, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	733 pesos [732.29 – 733.71] USD 10.59 [9.88 – 11.30]	4.84 pesos [4.13 – 5.55] USD 0.07 [0 – 0.78]	**87.22 pesos** [86.51 – 87.93] **USD 1.26** [0.55 – 1.97]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 156):

Table 156. Willingness to pay (WTP) values (Argentina, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	5,406.95 pesos USD 78.11	**0 pesos** **USD 0**

As in the previous case, distribution is graphically sketched, so the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In short, by combining both models, the range of values shown in Table 157 is obtained:

Table 157. Willingness to pay (WTP) values (Argentina, year 2020) – range from the two models

Willingness to pay (WTP) values	[0 - 87.22] pesos per year USD [0 – 1.26] per year

Scaling up

In Belize, people with a household connection is estimated at 74.3 percent for a population of 44,938,712[127]. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 3.3[128]. So the group to which the scaling up should be applied is 44,938,712*0.743/3.3 = 10,118,019.

[127] Data are taken from https://data.worldbank.org/country/argentina
[128] https://population.un.org/Household/index.html#/countries/

In Table 158, results for compensating variation are shown.

Table 158. Aggregated values of compensating variation of a conservation program for coral reefs (Argentina, year 2020) – Non-use values

	Pesos per person	Population	Aggregated
Compensating Variation	87.22	10,118,019	882,493,617.18
	USD per person	**Population**	**Aggregated**
	1.26	10,118,019	12,748,703.94

THE UNITED KINGDOM

Econometric analysis of the Binary Discrete-Choice Format

We used a bid amount (26 pounds – USD 35) for the single-bounded question, a higher amount (47 pounds – USD 63) for the upper bound of the double-bounded question, and a lower amount (13 pounds – USD 17.5) for the lower bound of the double-bounded question.

As regards the WTP values, there are significant differences between types of individuals – visitors and non-visitors – (Table 159). Non-visitors are willing to pay the lowest value.

Table 159. Mean willingness to pay (WTP) values (The United Kingdom, year 2020) from the double-bounded model

	Visitors	Non-visitors	Weighted average
Mean willingness to pay (WTP) values	45.03 pounds [43.99 – 46-06]	3 pounds [1.96 – 4.02]	**5.22 pounds** [4.19 – 6.25]
	USD 60.62 [59.59 – 61.65]	USD 4.04 [3.01 – 5.07]	**USD 7.03** [6.00 – 8.06]

Econometric analysis Including Reported Open Bids

We first compute statistical description, to compare the mean and the median values of all stated WTP (Table 160):

Table 160. Willingness to pay (WTP) values (The United Kingdom, year 2020) from the model including reported open bids

Variable	Mean	Median
WTP	19.41 pounds	**0 pounds**
	USD 26.13	**USD 0**

As in the previous case, distribution is graphically sketched, so the mean is too much affected by the long tail, so it is more reasonable to use the median as the central figure.

In short, by combining both models, the range of values shown in Table 161 is obtained:

Table 161. Willingness to pay (WTP) values (The United Kingdom, year 2020) – range from the two models

Willingness to pay (WTP) values	[0– 5.22] pounds per year USD [0– 7.03] per year

Scaling up

In Belize, people with a household connection is estimated at 92.5 percent for a population of 66,834,405[129]. The number with internet connection would include all members of the household. It is unlikely, however, that they would all have the stated WTP. This stated WTP can more reasonably be taken as the WTP of the household. Average household size is estimated at 2.3[130]. Thus,1 the group to which the scaling up should be applied is 66,834,405*0.925/2.3 = 26,879,054.

In Table 162, results for compensating variation are shown.

Table 162. Aggregated values of compensating variation of a conservation program for coral reefs (The United Kingdom, year 2020) – Non-use values

Compensating Variation	**Pounds per person**	**Population**	**Aggregated**
	5.22	26,879,054	140,308,661.88
	USD per person	**Population**	**Aggregated**
	7.03	26,879,054	188,959,749.62

A summary of previous results is shown in Table 163.

Table 163. Aggregated results for non-use values, international values (2020 values-USD-)

	USD per person	Population	Aggregated
Canada	[0 – 6.79]	14,518,852	[0 – 98,583,006]
The United States	[10 – 18.5]	120,354,492	[1,203,544,920 – 2,226.558.102]
Argentina	[0 – 1.26]	10,118,019	[0 – 12,748,703.94]
The United Kingdom	[0 – 7.03]	26,879,054	[0 – 188,959,749.62]

To convert this from an annual figure to a **total value asset** figure (Table 164), we take a 30 year NPV and apply a social discount rate of 3 percent per year, except for Argentina (12 percent).

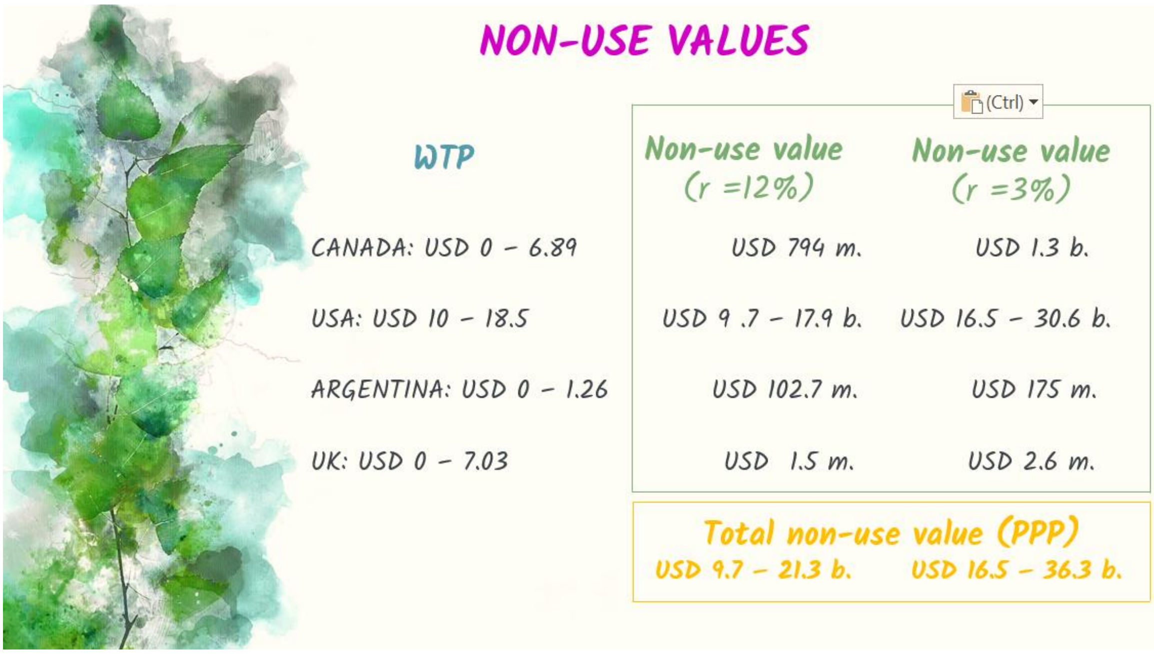
Values for each country have been adjusted by using purchasing power parity (PPP). We use the GDP per cápita, PPP, of the United States as basis.

[129] Data are taken from https://data.worldbank.org/country/unitedkingdom
[130] https://population.un.org/Household/index.html#/countries/484

Table 164. Net Present Value (2020 values, USD)[131]

	Net Present Value (r =12 percent)	Net Present Value (r =3 percent)
Canada	[0 – 794,104,249]	[0 – 1,354,074,071]
The United States	[9,694,775,744 – 17,935,335,126]	[16,531,134,885 – 30,582,599,538]
Argentina	[0 – 102,693,156]	[0 – 175,108,167]
The United Kingdom	[0 – 1,522,105,549]	[0 – 2,595,432,097]
TOTAL (PPP)	**[9,694,775,744 –21,268,793,603]**	**[16,531,134,885 – 36,266,676,527]**

However, this figure cannot be reported as 'international' non-use value, because (i) there are changing cultural and contextual factors, (ii) considerable differences in purchasing power, and (iii) surveys do not represent the world, among other reasons. Despite the 'world' non-use value not being presented in equivalent terms to the 'domestic' non-use value, the conclusions of the study are not less valuable.



[131] In Annex 15, different scenarios are presented.

Inter-American Development Bank

Metroeconomica · The Ocean Foundation · WRI México

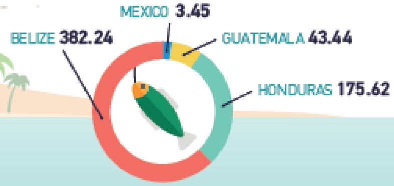
Economic Valuation of Reef Ecosystems in the MAR Region and the Goods and Services they Provide

The Mesoamerican Reef contains the largest barrier reef in the northern hemisphere (about 625 miles from the northern Yucatan peninsula to the coasts of Guatemala, Belizeand Honduras). Different types of attractive corals form this underwater desert that provides home and food to hundreds of species of fish, mollusks, sea turtles, sharks, algae and sea grasses. However, coral reefs are among the most vulnerable ecosystems on the planet and many of them are already degraded.

Tourism & Recreation (million USD)

Mesoamerican Region
USD 4,092 million

Fisheries (million USD)



Mesoamerican Region
USD 615 million

Arrival of international tourists

ANNUAL 2019

MEXICO	HONDURAS	BELIZE	GUATEMALA
15.06 million	865,000	506,166	70,397

Non-use values

WILLINGNESS TO PAY (WTP)

USD

- MEXICO 8 – 8.56
- BELIZE 6.51 – 9.88
- HONDURAS 3.95 – 7
- GUATEMALA 7 – 7.03

Shoreline protection

ANNUAL BENEFITS

322.83 - 440.71 million USD

5.4 COMPARISON WITH OTHER STUDIES

This sector compares the results of this study with those obtained by other reports. In particular, we focus on the following studies, for being the closest to the approach of the present project.

- UN Environment, ISU, ICRI & Trucost (2018). "The Coral Reef Economy: The business case for investment in the protection, preservation, and enhancement of coral reef health".
- Deloitte (2017) "The economic, social and icon value of the Great Barrier Reef" in Australia.
- Sarkis et al. (2013) "Total Economic Value of Bermuda's coral reefs. Valuation of Ecosystem Services".

It should be noted that the results are not strictly comparable because of the diversity of contexts in which they have been obtained, as well as because the estimation of values have been approached from different perspectives, so that ecosystem services have been valued slightly differently. All in all, this comparison can be used to provide an overview of what coral reefs in the MAR are worth relative to other similar reef ecosystems.

The Coral Reef Economy: The business case for investment in the protection, preservation, and enhancement of coral reef health

This report selects two case study regions (Coral Triangle and Mesoamerican Reef) and considers the following four sectors:

- Tourism: it includes (i) on-reef tourism, such as snorkelling, scuba diving and boat trips; and (ii) reef-adjacent tourism, including coastal tourism activities that benefit indirectly from coral reefs through the provision of calm waters, sandy beaches and attractive views.

- Commercial fisheries: it includes the total value of reef-associated capture fisheries (direct returns to the commercial fisheries sector and the indirect economic multipliers generated across other sectors). It does not include the value of reef-associated small-scale or artisanal fishing.

- Coastal development: it includes the value of protection afforded to coastal infrastructure by coral reefs, and changes in coastal infrastructure investment and construction in response to changes in on-reef and reef-adjacent tourism.

- Agriculture and Forestry

Results for each service are shown in Table 165. To make these results comparable with those obtained in our study, the figures have been converted into 2020 USD, adjusted by PPP.

Table 165. Results for Coral Triangle and Mesoamerican Reef (2017, USD Mn.). Direct and indirect economic returns

	Tourism	Commercial Fisheries	Coastal development
Coral Triangle	6,225	5,850	2,417
Mesoamerican Reef	4,356	480	1,813

Source: UN Environment, ISU, ICRI & Trucost (2018).

Again, we first take into account the Inflation rate [132] (Table 166):

Table 166. Results for Coral Triangle and Mesoamerican Reef (2020, USD Mn.). Direct and indirect economic returns

	Tourism	Commercial Fisheries	Coastal development
Coral Triangle	6,664	6,263	2,588
Mesoamerican Reef	4,886	538	2,033

To later adjust by the GDP (PPP), taking Mexican GDP[133] as a basis (Table 167):

Table 167. Results for Coral Triangle and Mesoamerican Reef (2020, USD Mn., adjusted by PPP). Direct and indirect economic returns

	Tourism	Commercial Fisheries	Coastal development
Coral Triangle	1,364	1,282	530
Mesoamerican Reef	4,886	538	2,033
Our study	4,097	183.2	320 – 438

Values for tourism are similar to those obtained in the current study. However, there are differences between the two studies when it comes to fisheries and coastal development. This difference for the latter service may be due to the fact that the study by UN Environment, ISU, ICRI & Trucost (2018) incorporates not only the value of protection afforded to coastal infrastructure, but also changes in coastal infrastructure investment and construction in response to changes in on-reef and reef-adjacent tourism.

[132] An inflation rate of 2.3 percent is applied for the Coral Triangle (it is calculated as the average of inflation rates from Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste) and 3.9 percent for the Mesoamerican reef (it is calculated as the average of inflation rates from Mexico, Guatemala and Honduras).
[133] The average GDP (PPP) per cápita of the six countries is estimated (USD 4,212) – The Mexican is 20,582 –..

The economic, social and icon value of the Great Barrier Reef – Australia –

This study assesses the economic, social, icon and brand value of the Great Barrier Reef (GBR). In particular, it estimates:

- The contribution to the Australian economy in 2015–16 through industry value added ($6.4 billion) and employment (64,000 full-time jobs): The economic activities considered are:
    - Tourism: $5.7 billion
    - Commercial fishing and aquaculture production: $162 million
    - Recreational activity: $346 million
    - Scientific research and management $182 million
- The economic, social and icon value of the reef: $56 billion
    - Total non-use value to Australians: $24 billion
    - Total direct use benefit to domestic tourists: $29 billion
    - Total direct use benefit to recreational visitors: $3 billion

  Note that the annual GDP contribution of the Great Barrier Reef shown above ($6.4 billion) does not entirely reflect the total contribution of the reef to the welfare of society, as people may be willing to pay more than the price they actually pay to, for example, enjoy the reef. This underestimated value comes from (i) direct use through tourism and recreation, and (ii) non-use values.

- The significance to Aboriginal and Torres Strait Islander Traditional Owners, and brand value to Australia and the international community.

All in all, the interesting results for the comparison are as follows (Table 168):

Table 168. Primary results for the Great Barrier Reef (2016, Australian dollars)

	Tourism & recreation		Commercial Fishing	Scientific research	Non-use values
	Annual benefits	**Total direct use benefit**	**Annual benefits**	**Annual benefits**	**NPV[134]**
Great Barrier Reef	6.05 billion	32 billion	162 million	182 million	24 billion

As explained above, results are not directly comparable, but some extrapolations can be made. To make these results comparable with those obtained in our study, the figures have been converted into 2020 USD, adjusted by PPP. The steps taken to adjust these values are:

[134] It was estimated considering a 33-years horizon and a discount rate of 3.7 percent.

1. Take into account the Australia Inflation rate[135] (Table 169):

Table 169. Results for the Great Barrier Reef (2020, Australian dollars)

	Tourism & recreation		Commercial Fishing	Scientific research	Non-use values
	Annual benefits	Total direct use benefit	Annual benefits	Annual benefits	NPV
Great Barrier Reef	6.47 billion	34.2 billion	173.3 million	195 million	25.7 billion

2. Convert the values from Australian dollars to US dollars (Table 170):

Table 170. Results for the Great Barrier Reef (2020, USD)

	Tourism & recreation		Commercial Fishing	Scientific research	Non-use values
	Annual benefits	Total direct use benefit	Annual benefits	Annual benefits	NPV
Great Barrier Reef	5.01 billion	26.5 billion	134.14 million	151 million	19.9 billion

3. Adjust by the GDP (PPP), taking Mexican GDP[136] as a basis (Table 171):

Table 171. Results for the Great Barrier Reef (2020, USD, adjusted by PPP)

	Tourism & recreation		Commercial Fishing	Scientific research	Non-use values
	Annual benefits	Total direct use benefit	Annual benefits	Annual benefits	NPV
Great Barrier Reef	1.78 billion	9.43 billion	47.7 million	53.7 million	7.08 billion

4. Adjust by the km of coastline (Table 172). Note that the GBR stretches for over 2.300 km of coastline in comparison with the Mesoamerican reef – 955 km –:

Table 172. Results for the Great Barrier Reef (2020, USD, adjusted by PPP and km) and comparison with the values obtained in the current study for the MAR region

	Tourism & recreation		Commercial Fishing	Scientific research	Non-use values
	Annual benefits	Total direct use benefit	Annual benefits	Annual benefits	NPV
Great Barrier Reef	739 million	3.91 billion	19.8 million	2.23 million	2.94 billion
MAR region	3.9 billion		183.2 million		3.4 – 3.69 billion

[135] An inflation rate of 1.7 percent is applied: it is an average of the rates of the rates of quarters of last years.
[136] Australian GDP (PPP) is USD 57,374, while the Mexican GPD (PPP) is 20,410.

Values for tourism & recreation are similar. However, differences are higher when it comes to the fishery sector. Non-use values are also similar in the two studies: one of the reasons why values for non-use values are a slightly higher in the present study than in the Australian's one may be the fact that the scaling up process has involved a higher population in the MAR region.

Total Economic Value of Bermuda's coral reefs. Valuation of Ecosystem Services

This study focuses on valuing Bermuda's reef. The following values are estimated:

- Tourism value
- Fishery value
- Amenity value
- Recreational and cultural values
- Coastal protection value

with an **average annual value** of the coral reef ecosystem amounting to **USD 722 million**. Considering the uncertainty surrounding the economic analysis, a lower and upper range is offered: TEV ranges from USD 488 million per year to USD 1.1 billion per year. Results for each service are shown in Table 170. To make these results comparable with those obtained in our study, the figures have been converted into 2020 USD, adjusted by PPP.

Table 173. Results for Bermuda's reef (2007, USD Mn.). Annual benefits

	Tourism	Commercial Fishing	Research & education	Coastal protection	Amenity	Recreation & cultural
Bermudas	405.9	4.9	2.3	287.6	6.8	36.5

We first take into account the Bermuda Inflation rate[137] (Table 171):

Table 174. Results for Bermuda's reef (2020, USD Mn.). Annual benefits

	Tourism	Commercial Fishing	Research & education	Coastal protection	Amenity	Recreation & cultural
Bermudas	559.5	6.8	3.2	396.5	9.4	50.3

To later adjust by the GDP (PPP), taking Mexican GDP[138] as a basis (Table 172):

Table 175. Results for Bermuda's reef (2020, USD Mn., adjusted by PPP)

	Tourism	Commercial Fishing	Research & education	Coastal protection	Amenity	Recreation & cultural
Bermudas	133.7	1.6	0.8	94.7	2.2	12

[137] An inflation rate of 2.5 percent is applied: it is an average of the rates of the rates of quarters of last years.
[138] Bermuda's GDP (PPP) is USD 85,418, while the Mexican GPD (PPP) is 20,410.

Considering that the coastline is around 90-100 km (compared to the 955 km of the MAR region), adjusted results are in Table 173.

Table 176. Results for Bermuda's reef (2020, USD, adjusted by PPP and km)

	Tourism	Commercial Fishing	Research & education	Coastal protection	Amenity	Recreation & cultural
Bermudas	1.42billion	17 million	8 million	1.05 billion	24 million	128 million

6. ENGAGING BENEFICIARIES AND STAKEHOLDERS

Once the value of coral reefs in the MAR region is known, the next step is to (i) identify and characterize the beneficiaries and other stakeholders of the ecosystem services provided by coral reefs and (ii) allocate and distribute the value among stakeholders (public sector, private sector, etc.) and willingness to pay for coral reef insurance.

6.1 STAKEHOLDER IDENTIFICATION AND ENGAGEMENT

One of the most important steps of the process of economic valuation is the identification and engagement of beneficiaries and stakeholders of the ecosystem goods and services in order to understand the distribution of benefits and costs of actions that protect or damage them.

6.1.1 Identifying beneficiaries and stakeholders of coral reefs

The selection of these stakeholders should assist in identifying the activities that receive or cause significant benefits or losses to them, or have an effect on, or relationship to, reef ecosystems in the MAR region. It must also consider the interest and the level of influence in policy decisions. The following steps will help elaborate a stakeholder analysis (Mayers, 2005; Reed, 2008):

- Step 1. Identify key stakeholders.
- Step 2. Investigate stakeholders’ interests, characteristics, and circumstances.
- Step 3. Identify patterns and contexts of interaction between stakeholders.
- Step 4. Assess stakeholder power and potential.

In an economic valuation exercise, ecosystems can be viewed as being on the supply side of the goods and services. On the demand side, one would find human communities benefitting as users and consumers, even just experiencing them (Culhane et al., 2020).

While we need biological and ecological sciences to understand the supply side, to incorporate the demand side effectively, it is important to identify who is benefitting and in what way (DeWitt et al., 2020). The demand side is usually defined within the classical microeconomic framework, where the direct and indirect beneficiaries of ecosystem services become the stakeholders. In this type of analysis, stakeholders are defined as all those who affect, and/or are affected[139] by, the policies, decisions, and actions of the system. They can be individuals, communities, social groups or institutions of any size, aggregation or level in society. The term thus includes policymakers, planners and administrators in government and other organizations, as well as commercial and subsistence user groups’ (Grimble et al., 1995).

[139] The words ‘affect’ and ‘affected’ denotes whose individuals or groups have influence over the decision making or feel impact of a set of decisions. The stakeholder word includes winners and losers, and those involve or excluded of the decision-making process.

There are direct and indirect benefits, for example, the owners of property protected by coastal habitats, the communities that eat and sell the products of the fisheries or the people that rely on the supply of water and timber for their economic activities. Identifying the beneficiaries connects the specific Final Ecosystem Goods and Services (FEGS)[140] approach to human wellbeing by guiding policy decisions based on what is of greatest value to specific users (Landers & Nahlik, 2013). Identifying the beneficiaries[141] inside the diverse stakeholder groups helps policymakers to identify and articulate how the community interacts and benefits from the environment.

Figure 27 illustrates the connections between different stakeholder groups and the coral ecosystem services that are of most immediate concern to them. Here, provisioning services are of interest to all groups, most directly to primary stakeholders, but also indirectly to governments as the source of tax revenues and income generated by tourist-based enterprises. In contrast, cultural services are mostly important to those people living close to the coastal ecosystems as their social norms, traditions, and spiritual beliefs may have co-evolved with these resources.

Another group, which we could call secondary stakeholders, refers to the people who might be visiting from further away, for example, to use costal ecosystems for recreation and relaxation. They will benefit from the aesthetic features and the chance to reconnect with traditional customs and activities. Although there are obvious links between the regulating and supporting services provided by coastal ecosystems and individual well-being, one could argue the supporting services are perhaps of greatest interest to communities (SOAS, 2014).

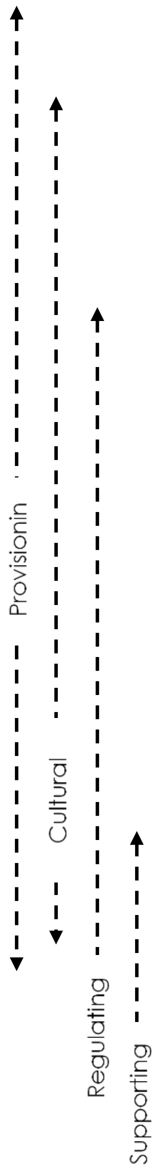
Coastal communities not only benefit, but also influence the level of conservation of natural resources. By being increasingly able to receive payments for the regulating and supporting services their blue forests, corals and seagrasses provide, they can invest in and set aside areas for conservation, and more easily modify the actions that would otherwise have a negative impact.

[140] USEPA develop the has developed the Final Ecosystem Goods and Services Classification System (FEGS-CS) as a step towards providing a framework and common language for evaluating ecosystem goods and services. This framework is very useful to identify individual users and not only as a group with specific characteristics such a stakeholder group. In terms of economic valuation, it is important to include de preferences of an individual direct user to make an accurate link between ecosystems services and human wellbeing.

[141] Their roles as stakeholders, however, do not necessarily explicitly connect to how they are engaging with and benefiting from the environment. Using both concepts, decision makers can connect how community members identify themselves within the community to how they benefit from the environment.

Figure 27. Coral reefs resources and environmental services important to beneficiary's well-being and livelihood

Stakeholder groups	Immediate interest Coral Reefs	Environmental services of immediate interest
Industrial enterprises and large businesses	• Tourism is one of the world's largest cultural industries, a driver of growth for all the diverse Caribbean countries where it supports directly and indirectly the livelihoods of entire communities through consumption of local produce and services.	
Small and medium-sized enterprises	• Coral reefs provide fish and shellfish for consumption and sale. • Harvesting of ornamental corals and pharmaceutical inputs. • Coral reef areas also have extraction of raw materials such as limestone and other building.	
Households	• Employment mainly due the Tourism sector. • Employment for fish production. • Market introduction. • Use of resources.	
Individuals	• Its more salient expression are the recreational and outdoor activities like snorkelling, scuba diving birdwatching and sightseeing tours, whose focus is on experience and aesthetic values. • The opportunity for science and education to study and learn from them; and the market benefits of recreation and tourism.	
Communities	• Coral reefs provide physical protection to other coastal ecosystems and human habitats in the shoreline. • Their location and structure help to dissipate wave energy through breaking, reducing the impact of storm surge floods. • Improve water quality through the processing of nutrients and other biochemical cycling. This is linked to the supporting services of habitat protection, fundamental for different stages of the species linked directly or indirectly to commercial fisheries in the Caribbean region.	
National governments	• Tax revenues from extractive/productive activities and export National income from tourism and other coastal living sources enterprises. • Welfare and health costs averted. • Maintaining national well-being and environmental resilience.	



Source: Adapted from SOAS (2014a)

Waite et al. (2014) classify stakeholders as either primary, secondary, or external, in terms of the type of impact received and the power to influence the project decisions. Different ecosystems could have a different mix of these stakeholders, and it is important to note that influence is endogenous, given previous actions, and several routes and strategies can empower otherwise marginalized groups.

Table 177 presents an example of this classification, and one can notice the tension of the short-term vs long-term nature of certain stakeholders. Perhaps one of the clearest contrasts is the short-term benefit for current fishers that, if unsustainably harvest is allowed, could result in losses for future generation of fishers, some of them part of the same families today. The connection over time is also relevant for indirect beneficiaries, as, for example, research institutions would benefit immediately from learning from a healthy ecosystem and act as stakeholders for present conservation, but all fisher communities in the future would benefit from the ecosystem connections they find.

Table 177. Stakeholders Categories by type of interests

Type of stakeholder	Characteristics	Groups
Primary stakeholder	• Experience the impacts of decisions involving natural resources and development on their livelihoods or well-being. • Have little power to influence the outcome of a decision-making process. • Are highly dependent on coastal resources.	• Fishermen • Reef tour operators and local tourism businesses (e.g., dive shops, hotels). • Coastal communities. • Local community and civil society groups • Local recreational users. • Families of these groups. • Future generations.
Secondary stakeholder	• Not directly impacted by these decisions. • People with the power to make decisions.	• National government departments and ministries. • Local government officials. • Coastal and marine resource managers
External stakeholder	• Not significantly impacted findings and recommendations of the economic valuation. • Their interests are affected. • Have the power to influence decisions.	• Environmental, conservation, or sustainable development NGOs not based locally at the valuation site • Land developers. • Multinationals investing in the area (e.g., cruise tourism operators) • Domestic and international tourists. • Trade groups • Lobbying organizations • Universities and other researchers • Media

Source: Adapted from Mayers (2005); Waite et al. (2014)

Such stakeholders would include Governments; international, regional, and sectoral bodies; intergovernmental organizations and civil society; scientists and research organization; and the public. Stakeholders could also include indigenous and local communities, as well as tourism providers where relevant. We intend to involve relevant stakeholders in the project development through the work sessions.

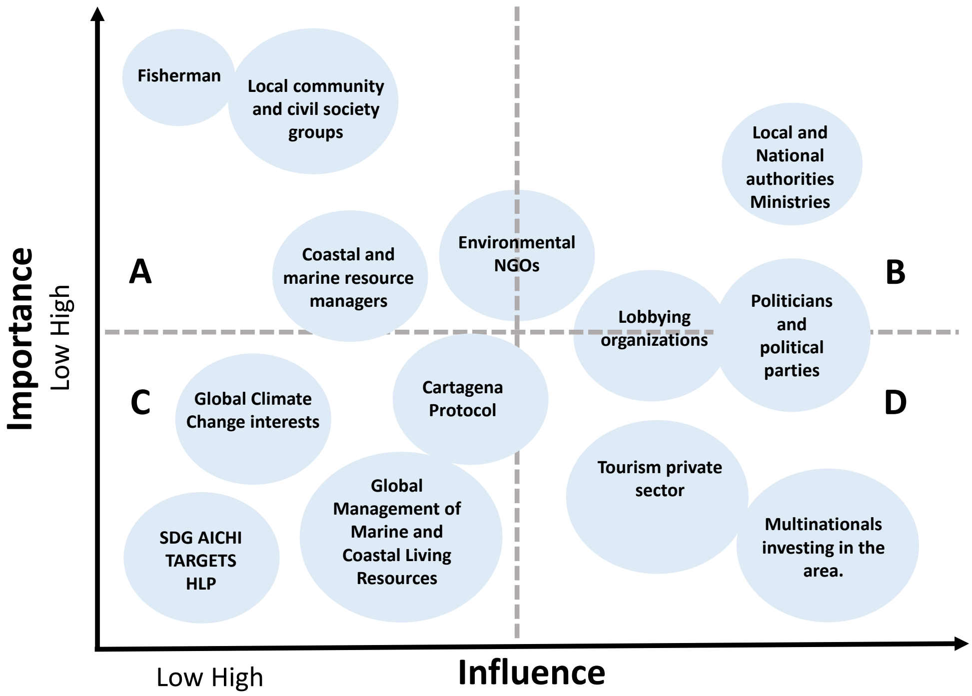
Stakeholders and their different degrees of importance and influence can be represented by Figure 28. Primary and direct stakeholders might have a low influence (area A) on larger process, while the private sector tourism industry and politicians might have a much greater ability to influence long-term management decisions (area D).

The four different groupings enable appropriate engagement strategies to be built by resource managers. For example, engagement with group A would be about involvement, capacity building, and empowerment, whereas with group D it would be about monitoring, defending, and mitigating potential impacts of the stakeholder actions. Group

C may not be worth involving beyond monitoring, and group B actions might involve closer collaboration and alliance building as well as negotiating interests and outcomes.

There is relevant analysis of the effectiveness of stakeholder engagement activities – monitoring, empowerment, alliance building, etc. – in the literature (Schwerner, 2020; Tompkins, 2002; Partridge 2006) and it is important to keep track of what strategies work best in different circumstances and balances of current use, threats and opportunities for the conservation of coastal and marine ecosystems.

Figure 28. Coastal ecosystem stakeholders and their different degrees of importance and influence



Source: Adapted from SOAS 2014b

Area A: High importance, low influence

Area B: High importance, high influence

Area C: Low importance, low influence

Area D: Low importance, high influence

The project team identified relevant stakeholders in all activities that receive or cause significant benefits or losses to, or have an effect on, or relationship to, reef ecosystems in the MAR region. Stakeholders included Governments; international, regional, and sectoral bodies, including IDB country offices; intergovernmental organizations and civil society, including NGOs; scientists and research organization; and the public. Stakeholders also included indigenous and local communities, as well as tourism providers where relevant.

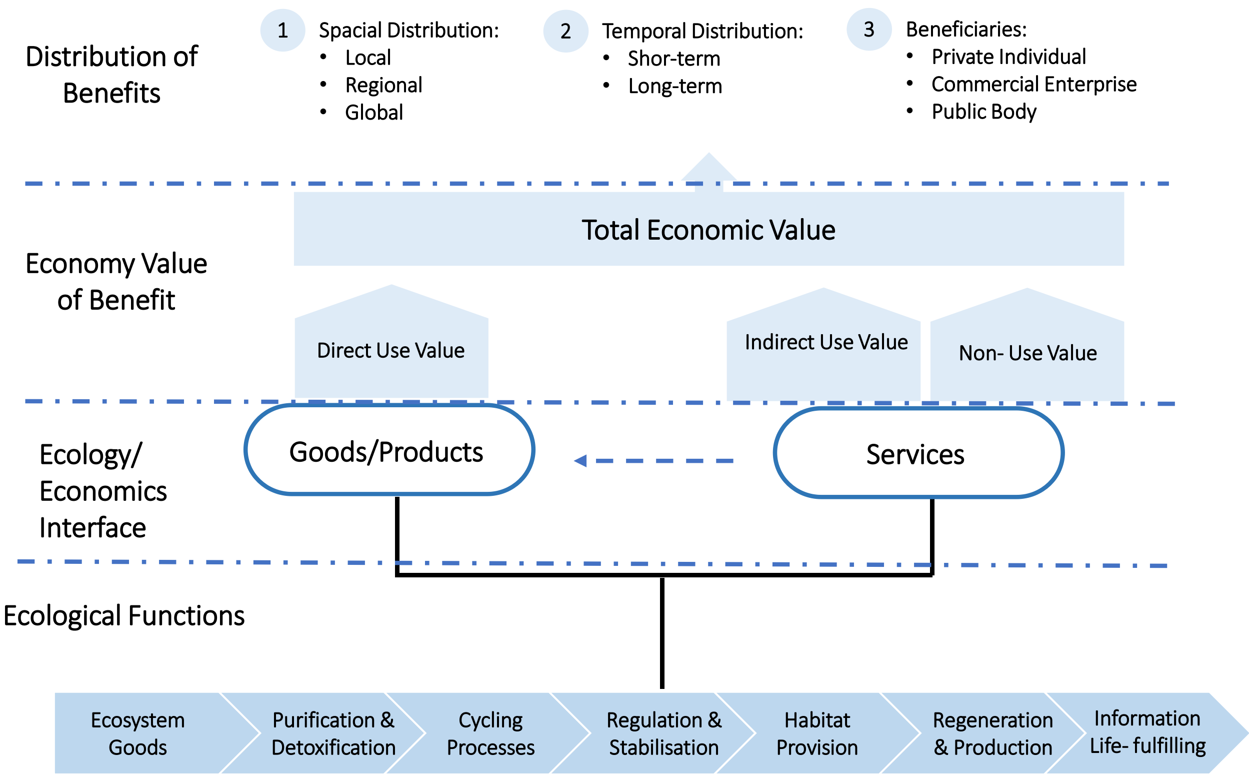
6.1.2 Stakeholder engagement

Stakeholder engagement in an early stage in the process is the key to success of any economic valuation project. This engagement will support (WRI, 2014):

- Local capacity building and collaboration.
- Study design appropriate to the local context and relevant to local issue.
- Data collection, including the integration of local and traditional knowledge.
- Local ownership of the analysis.
- Legitimacy and credibility of results.
- Identification of opportunities for outreach and influence, tracking of influence, and ways to lessen conflicts and overcome obstacles.

Stakeholder engagement must be done considering different time horizons and several scales, because of the long-term and regional dimension of ecosystem connections, as shown in Figure 29.

Figure 29. Integrated ecosystem valuation framework



Source: Adapted from Eftec (2005)

Within our project, stakeholders were engaged in the process through online working sessions. Four online work sessions were organized in order to involve relevant stakeholders in the project development, particularly in the selection of sites, but also in the identification of ecosystem services changes. The workshops were participatory and brought together a group of relevant stakeholders to obtain their views. The workshops were held in Spanish (Mexico, Guatemala and Honduras) and English (Belize).

6.2 ALLOCATION AND DISTRIBUTION OF THE VALUE

6.2.1 Description of Beneficiaries and Source of Benefits

The benefits from the coral ecosystem to different groups is summarized in Table 178. Each category and benefit they derive is explained further below.

Table 178. Benefits by Group from Ecosystem Services Provided by the Coral Ecosystem

Category/Beneficiaries	Owners/Providers	Employees	Customers	Government
Tourism & Recreation				
Hotel Sector	Producer S	Rent	Consumer S	Tax Revenue
Marine Parks	–	Rent	Consumer S	Tax Revenue
Diving Revenues	Producer S	Rent	Consumer S	Tax Revenue
Snorkeling revenues	Producer S	Rent	Consumer S	Tax Revenue
Fisheries				
Commercial fisheries	Producer S	Rent	–	Tax Revenue
Fish processing	Producer S	Rent	–	Tax Revenue
Fish cleaning	Producer S	Rent	–	Tax Revenue
Local fisheries	Net Income	–	–	–
Shoreline protection				
Areas Protected	Gain in Property Value	–	–	Reduction in Extreme Event Outlays
Non-use values				
Benefits gained	–	–	Consumer S	Possible Revenues for Conservation

Producer S = Producer surplus
Consumer S = Consumer surplus

TOURISM & RECREATION

For tourism and recreation, excluding marine parks, the values calculated in Chapter 4 gave the value added to the hotel sector and to providers of tourism services.

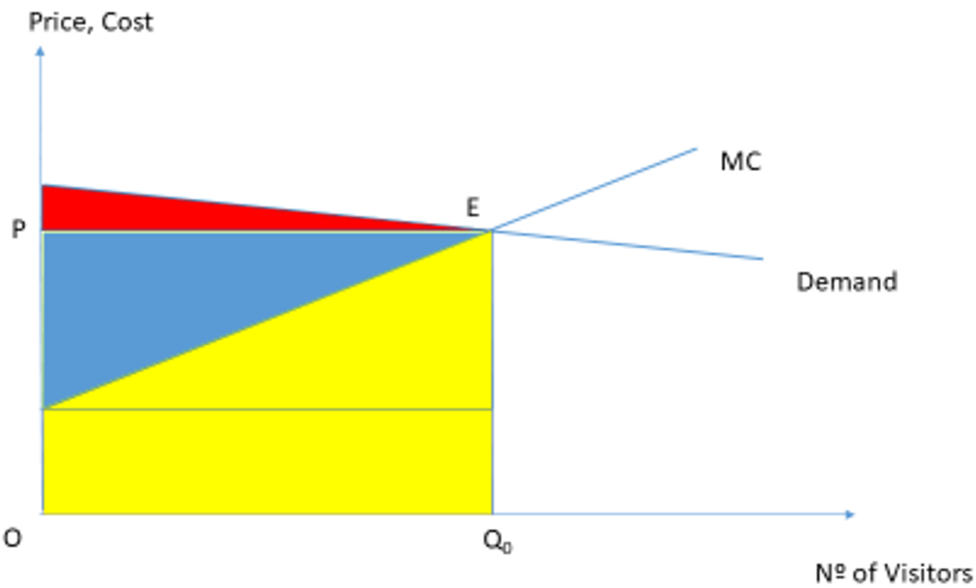
The value added to providers of services can also be thought of as a producer surplus, as shown in Figure 30, where the marginal cost of providing services is represented by MC. If the amount of the service (number of visitors) is Q_0, then the total cost of provision is the area shaded in yellow, while the total revenue is the area $OPEQ_0$. This leaves the area shaded in blue as the value added from the provision, and is also called the producer surplus. The estimates of the value to the hotel sector and the provision of diving and snorkeling services in Chapter 4 are an estimate of that blue triangle

In addition, there are three other beneficiaries from these activities. The first are the visitors. While they make a payment equal to the area $OPEQ_0$, their willingness to pay for the visits is greater than that. The amount by which it exceeds the payment made is referred to as the consumer surplus and is represented by the areas shaded in red in Figure 30. Estimates of this benefit were not made in Chapter 4.

Workers in the service providing sectors will be beneficiaries to the extent that the amount they are paid exceeds the opportunity cost of their labor. The opportunity cost is the amount they could earn if they were employed in the next best alternative employment. The difference between the amount paid and the opportunity cost is referred to the rent from the employment. If there is full employment in the economy this opportunity cost is close to the actual amount paid and there is no rent, or very little. In economies with unemployment the rent can be significant. One way in which it is calculated is by estimating the shadow wage for the sector, which in effect measures the opportunity cost of labor in the sector. We return to estimates of this cost and the benefits, which are not covered in Chapter 4, in the next section.

The last group to benefit from the activity is the public sector. Tax revenues are a transfer of benefits from customers and providers of the service to the government as a representative of the public sector. Estimates of this transfer were made in Chapter 4.

Figure 30. Beneficiaries of tourism services related to coral ecosystems



<u>Beneficiaries of marine parks</u>

The estimation in Chapter 4 has calculated the net revenues to the public sector for entry to the parks, which is akin to the producer surplus for the private providers of hotel and recreational facilities. In addition, there will be some consumer surplus and there may be a rent to employees as well as additional tax revenues to the central or provisional governments.

FISHERIES

For commercial fisheries, fish processing and fish cleaning, the producer surpluses, which go to owners of the enterprises providing these services, have been estimated. Also tax revenues have been estimated. Not covered are possible rents to employees and consumer surplus. The latter, however, can be considered as negligible, as the supply from these sources to the commercial markets is small and if they were removed from the market they would be replaced by other suppliers at close to the current price. Intermediary service providers such as fish cleaning and processing can be assumed to operate in a competitive market where the recipients of the services will have no surplus benefits.

For local fisheries there is no tax income and the distinction between owners and employees is blurred. So the estimated gains in Chapter 4 go to the fishers.

SHORELINE PROTECTION

The protection offered by the coral benefits the owners of property and land that would be further inundated if the coral were to be damaged. In addition, the public sector that bears the cost of disaster alleviation benefit to the extent that the amounts they have to spend our reduced by the presence of the coral reefs. Chapter 4 provides an estimate that includes both kinds of benefits, but it does not separate them.

NON-USE BENEFITS

The beneficiaries here are the people willing to make the payment. To the extent that they do not make it, they retain the full benefit as measured by their WTP. If they pay an amount less than their full WTP to, say, a fund dedicated to the conservation of the reef, they still retain the difference as a surplus, but the amount paid is a benefit to the wider community that depends on a health coral in the region. In Table 178 it is represented under the Government cell, but it could an NGO or other provider of conservation services.

6.2.2 Quantitative Estimation of the Benefits

In this subsection the distribution of the benefits is quantified further, building on what was done in Chapter 4. The addition categories explored here are: (a) consumer surplus benefits to users, (b) rents to employees (c) beneficiaries of shoreline protection and (d) sharing of non-use benefits.

Consumer Surplus

Consumer surplus estimates depend on the price elasticity of demand for the service concerned. For tourism services related to coral in Central America one has to take account of the availability of similar services elsewhere, as well as the possibility of substituting coral-related vacations with other vacations. For these reasons, the price elasticity of demand will tend to be high and the consumer surplus low.

On the other hand, studies of actual demand functions tend to find relatively low elasticities. Pascoe et al. (2014) estimate the price elasticity for visits to marine parks in SE Asia at -0.3. Carr & Mendelson (2003) estimate the consumer surplus for visits to the Great Barrier Reef and found a very significant amount of surplus. The price elasticity is not reported but in the log-log form estimated for the equation it has to be numerically above one if the consumer surplus is not to be infinite in that format. More widely, the price elasticity for tourism in Europe is estimated at -1.2 (Konovalova & Vidishcheva, 2013).

In extending the analysis to account for consumer surplus we have taken a linear demand curve, with a price elasticity of -1.0 at the current level of consumption of the service. With a linear demand curve this implies an increasing numerical value of elasticity as the number of visits declines and price rises.

<u>Employee Rents</u>

The calculation of the shadow wage (SW) can be a complex procedure, involving considerations of labor mobility, unemployment and taxes on the labor force. Details of how the SW is calculated can be found in EC (2008). In those guidelines the simplest formulation gives SW as follows [34]:

$$SW = W(1-u)(1-t) \qquad [34]$$

where W is the market wage, u is the regional unemployment rate, t is the rate of social security payments and taxes on employment. The unemployment rate should also be the one that applies to the particular category of workers engaged in the relevant sector.

As a first approximation SW ratio has been estimated based on the latest overall unemployment data for each country, assuming social security tax on employment of 5 percent[142]. The resulting ratios are: Belize: 0.89, Guatemala: 0.93, Honduras: 0.90, Mexico: 0.92. Estimates based on these rations are presented below.

<u>Beneficiaries of Shoreline Protection</u>

As noted the beneficiaries are land and property owners and public authorities. The public authorities undertake additional protection by building protective barriers etc. as well as supporting communities after an extreme event. At present it is not possible to make an estimate of the relative gains of the two groups. The estimates in Chapter 4 only give total damages avoided by reefs.

[142] This is the approximate rate in Mexico; data for other countries are being sought. More accurate unemployment rates are also being sought.

Non-use Benefits

The total non-use benefits are reported in Chapter 4. They apply to the groups from which estimates are made (households with access to the internet) by country for the four countries in the region as well as Argentina, Canada, the UK and the USA.

If a fund were set up to realize the mobilization of payments from non-users, previous studies indicate that actual payments would be much lower that stated amounts. Loomis et al. (1996) review studies that say it is found to be between a third and half the stated amounts. Studies such as Onwujekwe et al. (2005) in a health context find actual payments to be around half. In the context of payments for payments to farmers for agri-environmental programs Sauer & Fisher (2005) found actual payments were made by only a small percent of those who said they would pay. Finally, in the context of passive or non-use values, Veisten & Navrud (2006) find a discrepancy between actual and stated WTP of over a half. In the subsequent discussion we take a proportion of 20 percent as the amount of the stated WTP that can be transferred as actual payments in a well-designed conservation program, leaving the people stating their WTP with 80 percent of the total.

Dividing the Benefits from the Coral Reefs to the Different Groups

Table 179-182 give a break-down of the benefits from the different activities for each activity, including the benefits to non-users. These exclude benefits to non-users who are resident outside the countries, which are considered separately. Also not included are the indirect effects calculated in Chapter 4, as it is not possible to pin down which groups benefits from them.

The total amounts of benefits that could in principle be drawn on annually to fund the protection of the reefs in the region are USD 4.5 billion in Mexico, USD 69 million in Guatemala, USD 252 million in Honduras and USD 346 in Belize. In terms of who benefits, the largest share goes to owners of businesses and properties (between 50 percent and 66 percent across the four countries), followed by customers in the tourism sector in Mexico, Honduras and Belize. In Guatemala, the 2nd largest share goes to non-users at 28 percent. The government´s benefits in the form of tax revenues amount to between 9-12 percent, except in Guatemala where they are only 2 percent.

Table 179. Distribution of Benefits from Coral Ecosystems in Mexico (USD Mn.)

MEXICO	Owners	Employees	Customers	Government	Non-users
Tourism & Recreation					
Reef-related VA in hotel sector	1,833.00	24.14	1,320.50	348.27	
Marine Park	–	n.a	1.25	2.50	
Diving revenues	5.59	0,72	11.185	3.58	
Snorkeling revenues	101.56	13.00	203.12	65.00	
Fisheries					
Commercial fisheries	11.9	0.37	–	–	
Fish processing	1.04	0.05	–	–	
Fish cleaning	0.82	n.a	–		
Local fisheries	0.73	–	–	–	
Shoreline protection	356.00				
Non-use benefits					200.00
TOTAL	**2310.63**	**38.27**	**1536.06**	**419.35**	**200.00**
As percentage of Total	**51.30%**	**0.85%**	**34.10%**	**9.31%**	**4.44%**

Notes

1. The shadow wage is 0.92 times the actual wage, so the rent is 8 percent.
2. The taxes are 19 percent on accommodation and 16 percent elsewhere.

Table 180. Distribution of Benefits from Coral Ecosystems in Guatemala (USD Mn.)

GUATEMALA	Owners	Employees	Customers	Government	Non-users
Tourism & Recreation					
Reef-related VA in hotel sector	0.156	0.252	2.550	1.122	
Marine Park	–	n.a	0.006	0.012	
Diving revenues	0.070	0.008	0.138	0.033	
Snorkeling revenues	0.016	0.002	0.033	0.008	
Fisheries					
Commercial fisheries	0.050	0.004	–	–	
Fish processing	0.027	0.005	–	–	
Fish cleaning	0.040	n.a	–		
Local fisheries	41.910	–	–	–	
Shoreline protection	2.97				
Non-use benefits					19.40
TOTAL	**45.23**	**0.27**	**2.73**	**1,17**	**19.40**
As percentage of Total	**65.74%**	**0.39%**	**3.97%**	**1.70%**	**28.20%**

Notes

1. The shadow wage is 0.93 times the actual wage, so the rent is 7 percent.
2. The taxes are 22 percent on accommodation and 12 percent elsewhere.

Table 181. Distribution of Benefits from Coral Ecosystems in Honduras (USD Mn.)

HONDURAS	Owners	Employees	Customers	Government	Non-users
Tourism & Recreation					
Reef-related VA in hotel sector	49.60	5.71	71.10	21.33	
Marine Park	–	n.a	2.85	5.70	
Diving revenues	4.00	0.64	8.01	2.40	
Snorkeling revenues	0.83	0.13	1.66	0.50	
Fisheries					
Commercial fisheries	56.99	2.19	–	–	
Fish processing	0.48	0.54	–	–	
Fish cleaning	3.64	n.a	–		
Local fisheries	n.a	–	–	–	
Shoreline protection	9.33				
Non-use benefits					3.88
TOTAL	**124.87**	**9.21**	**83.62**	**29.93**	**3.88**
As percentage of Total	**49.65%**	**3.66%**	**33.25%**	**11.90%**	**1.54%**

Notes

3. The shadow wage is 0.90 times the actual wage, so the rent is 10 percent.
4. The taxes are 15 percent.

Table 182. Distribution of Benefits from Coral Ecosystems in Belize (USD Mn.)

BELIZE	Owners	Employees	Customers	Government	Non-users
Tourism & Recreation					
Reef-related VA in hotel sector	60.60	3.44	61.29	26.35	
Marine Park	–	n.a	1.65	3.30	
Diving revenues	6.27	1.10	12.5	3.13	
Snorkeling revenues	12.20	2.15	24.4	6.10	
Fisheries					
Commercial fisheries	102.66	4.34	–	–	
Fish processing	0.03	0.10	–	–	
Fish cleaning	0.04	–	–		
Local fisheries	n.a	–	–	–	
Shoreline protection	10.63				
Non-use benefits					3.88
TOTAL	**192.42**	**11.13**	**99.84**	**38.88**	**3.88**
As percentage of Total	**55.59%**	**3.22%**	**28.84%**	**11.23%**	**1.12%**

Notes

5. The shadow wage is 0.90 times the actual wage, so the rent is 10 percent.
6. The taxes are 15 percent.

In addition to these benefits the study has estimated a WTP from non-users outside the region of about USD 2 billion, made up of USD 99 million a year from Canadian citizens, USD 1.7 billion from US citizens, USD 13 million from Argentinian citizens and USD 189 million from UK citizens. This compares to a total of benefits inside the countries of about USD 5 billion (Tables 179-182), making a total of USD 7 billion a year in benefits.

7. RECOMMENDATION FOR REEF PROTECTION IN THE MAR REGION

This section focusses on make recommendations for reef protection and restoration to overcome hurricanes impacts, in recognition of the value of the reefs and the services they provide, both for the public and private sectors in the four of MAR countries.

6.1 CALLS TO ACTION: MAINTAINING CORAL REEFS IN THE MAR REGION

It is clear that a broad and varied set of measures to conserve and restore coral reefs in the MAR region needs to be put on the table. We have grouped them into eight blocks, as shown in Figure 31.

Figure 31. Actions to protect coral reefs

Source: own elaboration

The **ecosystem** should be **restored** in the long-term (growing populations of herbivorous fish or reef-building corals) and needs to be massively scaled up. Restoration is underway in some areas, but should go one step further. It requires the establishment of specific criteria for the selection of corals to be restored, adaptive scientific monitoring and close collaboration with the local community to ensure the sustainability of coral reefs.

This is related to the **recovery of species** such as the long-spined sea urchins (*Diadema antillarum*) or the Parrotfish, among others. The ecological importance of *Diadema antillarum* lies in its ability to make space for corals by reducing algae. In areas where overfishing caused the disappearance of many grazing fishes, the role played by urchins was even more relevant (Burke et al., 2011a). This species suffered massive mortality in 1982 (Jackson et al., 2014), resulting in a loss of 97 percent of urchins throughout the

Caribbean, Florida and Bermuda (Lessios et al., 1984, 1988). Since then, there has been a moderate recovery (Lessios, 2016), especially in Mexico where increases in abundance and high localized densities have been reported. As for parrotfish, they are very effective in grazing macroalgae and keeping reefs clean. Note that parrotfish spend 90 percent of their day cleaning the reef of algae. Parrotfish also contribute to the sand on beaches. Large parrotfish, although not abundant, are present in 89 percent of sites in the MAR region. Since 2006, the biomass of herbivorous fish has increased in all countries except Honduras, as explained below. Therefore, there is a need to protect herbivorous fish at the regional level to help corals grow and thrive.

Improving **sewage and sanitation treatments** is key, as it threatens reefs and human health. In a context of rising sea temperatures and ocean acidification that pose global threats to coral reefs, turbidity remain a major stress factor (Reopanichkul et al. 2009; Anthony et al. 2011; Wear et al. 2020). Wastewater disposal significantly increased inorganic nutrients and turbidity levels. This degradation causes substantial ecological changes, especially a reduction in hard coral cover, a decrease in fish biomass and an increased in macroalgal density. There is a need to invest in more wastewater treatment plants and to implement stricter regulations to control and prevent spills. Solid waste management plans would also help improve water quality and coral recovery. Plastic trash is also making coral reefs sick, and reef-building corals are very vulnerable.

> In a survey of 159 coral reefs in the Asia-Pacific region, researchers found and reported in the journal *Science* that the likelihood of disease in a plastic-waste-free coral was only 4 percent, but increased to 89 percent in a plastic-damaged coral.

Recommendations should be made to promote sustainable management measures: 1) strengthening partnerships and national planning to eliminate marine litter and plastic pollution and address land-based sources of plastic litter; 2) developing and implementing regional regulations and guidelines; 3) financial investment by governments and other entities; and 4) academic, research and education efforts to raise awareness of the problem (United Nations Environment Program, 2019).

Expanding the number of **protected areas** and **fully-protected fish replenishment zone areas** is also essential to protect and maintain fisheries. In Belize, these areas have increased up to 20 percent. Mexico has also increased fish replenishment zones up to 20 percent, with adequate enforcement. Something similar occurred in Guatemala, in the healthiest reef area. Honduras also declared and implemented more protected fish replenishment zones. The adoption of size limits closed seasons during spawning season for key species and increased enforcement of fishing regulations would also be necessary to reverse the decline in fish populations and create sustainable fisheries based on better management and improvements in market supply chains to expand the benefits to fishermen. Monitoring the situation in these areas and implementing these measures can produce more promising results if there is regional coordination and surveillance. There would also be great benefit in conducting consultation processes, working at the community level and promoting responsible consumption, as this would allow local and regional communities to be involved in the process of protecting and conserving coral reefs.

The most significant threats to the reef from tourism are coastal habitat destruction associated with hotel and resort development and the associated infrastructure, water pollution from coastal development and cruise ships, coastal and marine habitat degradation associated with heavy, concentrated cruise visitor impacts, and increased fishing pressure (Fernando Garcia-Flores et al. 2008). Participatory process can help implement **sustainable tourism practices**. Tourism is one of the fastest growing industries in the MAR region in recent decades. However, reef management in relation to tourism must adjust to the new world in which we live. Sustainable and eco-tourism may help ensure that coral reefs are not damaged, benefit the economy and maintain cultural diversity and pluralism. Best practices are not always known by tourists, even if they are eco-minded. Therefore, it is necessary to include some guidelines, such as not touching or stepping on coral, not buying souvenirs made from coral or taking home a shell, or minimizing the use of sunscreens that contain chemicals proven to damage coral reefs, among others.

All these recommendations should be made in the context of **best practice initiatives and guidelines**. Otherwise, the results will not be as optimal as possible and stakeholders will not have the appropriate framework to implement measures, to put into practice management plans and to enforce conservation instruments.

6.2 BUILDING A CASE FOR REEF PROTECTION AND RESTORATION

As explained in Section 2.1.5, there are also financial tools for coral reef conservation and restoration, including reef insurances and funds such as the Mesoamerican Reef Rescue Initiative. This instruments are relatively new but has a great potential, especially in the Caribbean countries, for supporting a more sustainable management and efficient protection of coral reefs in the future.

In this line, and on the basis of the results in Section 4 and the distributional exercise in Section 6, a case for reef protection and restoration is proposed.

It has to be taken into consideration that only a small percentage of the benefits can be captured through mechanisms such as taxes or voluntary contributions. Factors limiting what can be collected are possible shares from each source and possible collection rates, which are as follows:

<u>Owners</u>

The net value added or producer surplus for providers of services includes a component or normal profit, which, if taxed, would result in a closure of the business. In the case of owners of properties who receive shoreline protection such a consideration does not apply but it may be possible to demand a higher payment for the protection provided by well-managed reefs. Some property owners have insurance against damages from extreme events. The expected damages are reduced by the presence of effective coral reefs. Thus. a payment into a fund that protects reefs from damages as well as restoring them when they are damages by extreme events should reduce the insurance payable for shoreline properties. Although there is ongoing work on reef insurance schemes (see section 2.1.5) no estimate has been made of the value of the protection offered to properties from the reefs. This report has provided an initial figure. Based on this a **marginal benefit** has to be calculated of the amount by which different sizes of the reef protection fund would prevent future increases in costs. That marginal benefit can then be recovered from owners of properties who are willing to undertake insurance. We do not have this marginal benefit from the present study. As an illustrative figure we believe that 10% of losses prevented from the program is plausible[143].

Further investigation of the profitability of reef related tourism is required, but on the judgmental basis given above we would suggest that a 5% levy on the net revenues for service providers and 10% on the rental values of coastal properties maybe considered and investigated further before **putting it to consultation**[144].

Employees

As the persons involved have modest incomes in the first place, it is not feasible to collect a part of these rents and retain a tax system that is equitable. This includes local fishers.

Customers

There is a significant consumer surplus according to the estimates made here and it may be feasible to tap into that for the protection of the reefs. A modest levy of 5 percent, for example, on the fee paid may be considered. It would have to be imposed uniformly across the region to avoid a loss of customers from one country to another.

Government

The governments gain around USD 490 million in revenues that can be attributed to tourism, which is significant. They might consider earmarking a percentage of that (perhaps about 20 percent) for refer protection.

Non-user benefits

These are very large but the potential amount that can actually be raised will be much lower. We consider it would be a success if a fund would be able to mobilize 20 percent of the stated amounts.

[143] For property owners who do not have insurance because they cannot afford it, the government might contribute on their behalf.
[144] This would not apply to local fishers, who are more like employees.

Taken together these would create a bundle of financial resources for protection that are significant and could make a difference. The following figures (Table 183) are indicative of feasible amounts and can form the basis for further discussion.

Table 183. Bundle of financial resources for protection (USD, Mn.)

Owner Contributions (5% for service providers and 10% for property owners)	150
Customers (5% levy)	86
Government earmarked funds	122
Non-user benefit fund	447
TOTAL	**805**

This would raise a **possible total of USD 805 million**, of which half would come from domestic and foreign non-users. The instruments for allocating these funds have been touched on above. Payments from hotel owners and clients of hotels would go to government revenues from which they would be allocated for specific reef protection and management tasks. These could be supplement by addition earmarked public sector funds justified on the grounds given. In addition to this public fund, two additional channels could be set up. One would be a reef insurance fund drawing on property owner contributions and the other a non-user fund.

8. WORK SESSIONS

Virtual Expert Workshop. Economic Valuation of Coral Reef Ecosystem Services in the Mesoamerican Reef System

Mexico. October 6, 2020

9:30 a.m. – 11:30 p.m. (CDT)

Moderator: Alejandra Navarrete, The Ocean Foundation

Background

Environmental Economics relies on valuation to provide society with information about the relative level of resource scarcity (Markandya & Richardson, 19933). Economic valuation can make explicit to society and policy makers that environmental and natural resources are scarce and that their conservation has associated benefits. If these benefits are not accounted for policy will be misguided and society will be worse off due to misallocation of resources. Therefore, valuing natural resources and the environment (i.e., measuring 'economic values' of environmental and natural resources) can support decision making affecting environmental and natural resources.

Given the ecosystem services provided by coral reefs and the serious nature of threats to their ecological integrity, there is demand for information on the value of welfare losses associated with a decline in the provision of ecosystem services (Millennium Ecosystem Assessment, 2005).
The value of environmental and natural resources reflects what we, as a society, are willing to pay to conserve these natural resources (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field, 2014).
Putting a monetary value on natural resources and the environment involves two steps:

Step 1 consists in identifying the ecosystem services (ES) provided.

Step 2 is to estimate them in monetary units.

Value information and decision making

The Inter-American Development Bank (IADB) is financing a study to assess the economic value of reef ecosystems services in the *Mesoamerican Reef Region* (MAR Region). The objective of the study is to understand the value of the coral reef ecosystems in the MAR region, and the importance of their conservation to better inform decision makers. The institutions responsible for this economic analysis are Metroeconomica, World Resources Institute (WRI) and The Ocean Foundation (TOF).

This information can be used in different policy-making contexts, including the determination of investment in reef health, compensation payments for damage and cost-benefit analysis of conservation measures. The economic valuation will also identify and generate economic arguments to support policies that help ensure healthy coastal ecosystems and sustainable economies

In this context, the results of this study will provide information to encourage the governments of Belize, Guatemala, Honduras and Mexico to increase budgetary resources for reef conservation and management. It will also raise local to global awareness on the economic importance of coral reefs as natural infrastructure, and will open the door to discussions with the private sector (e.g. tourism, fisheries) on how they can protect their business interests by investing in the health of the reefs on which their industries depend.

This virtual workshop was participatory and will bring together a group of relevant stakeholders to obtain their views. The sessions was held in Spanish.

Main objectives of the workshop

The main goals of this work session are:

a) Present the project and the valuation methods;
b) Explain the importance of the reef system in environmental, social and economic terms;
c) Present the ecosystem services provided by the system and the importance of monitoring on reef quality;
d) Expose the importance of assessment for decision-making;
e) Present the specific methodology to estimate use and non-use values;
f) Select the most appropriate sites based on a long list of potential sites prepared; and
g) Collect information and feedback to be able to identify the changes that will affect coral reefs.

Number of participants

34 attendees participated in the workshop, 24 of whom were experts from outside the project. The complete list, with detailed information, can be found at the end of this summary.

Institutions

Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), Comisión Nacional de Áreas Naturales Protegidas (CONANP), Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), Instituto Nacional de Estadística y Geografía (INEGI), Instituto Nacional del Pesca (INAPESCA), Gobierno del Estado de Quintana Roo, Costa Salvaje, Coral Reef Alliance, Envrionmental Law Alliance WorldWIDE (ELAW) and Comunidad y Biodiversidad (COBI).

Opening remarks

In this first session we had the presence of the following four participants:

- Santiago Bucaram, as representative of the Inter-American Development Bank. He highlighted the IADB's role in financing innovative projects within the Natural Capital Lab and explained how this project was hatched and the importance of conserving coral reefs in the Mesoamerican region. He also mentioned the need to collect information and inputs from experts so that the assessment is as close to reality as possible and allows decision makers to be informed.
- Francisco (Patxi) Greño, as representative of Metroeconomica. He introduced the firm (consulting firm specialized in the economic analysis of environmental impacts and the evaluation of public policies, also focusing on energy and sustainable development issues) and the team.
- Adriana Lobo, as representative of WRI and The Ocean Foundation. She highlighted that the ocean contributes to the global economy, supporting thousands of jobs and generating income, including tourism and fisheries. However, climate change impacts in ocean economy. The High Level Panel for a Sustainable Ocean Economy examines the impacts of climate change across three of the largest ocean-based industries, including wild capture fisheries, marine aquaculture and coral reefs tourism. She also pointed out the importance of the restoration of these ecosystems to fulfill the SDGs, especially SDG 14.
- Maria José González, as representative of MAR Fund. She explained the objective of MAR Fund and its activities in the region.

Importance of the Mesoamerican reef system and monitoring experience

The presentation was made by Melina Soto, Representative of Healthy Reefs Initiative in Mexico.

She presented the latest report (the sixth report after 12 years of monitoring) on the health of the Mesoamerican reef system, which was published in February 2020, entitled "Mesoamerican Reef Report Card. Evaluation of ecosystem health" (https://www.healthyreefs.org/cms/wp-content/uploads/2020/02/2020_Report_Card_MAR.pdf). In particular, she:

- Explained that Healthy Reef Initiative began in 2004. They conduct regular reporting (Scientific Foundations Guidebook, 2007) and report cards on reef health, collaborate for catalyzing conservation solutions and carry out eco-audits of management implementation (3 eco-audits online).

- There are actually more than 74 organizations in the 4 countries working in the same direction to manage this shared ecosystem.
- To date, they have trained over 250 local monitors (biologists, engineers, etc.) who help them take the data. They have 16 trainers, and 19 weeklong training courses in reef monitoring. They also use 256 database users.
- They use 4 indicators to know if the reef is healthy or not: 1) coral cover; 2) freshy macroalgae cover; 3) herbivorous fish biomass; and 4) commercial fish biomass. The first two compete for space on the seabed and the aim is for much more coral cover rather than freshy macroalgae cover. On this basis, they establish five quality categories: very good, good, fair, poor and critical.
- They have monitored 286 sites with the help of 82 people and 26 organizations. The result is that 16 percent of the reefs are in a critical state, 46 percent in a poor state, 29 percent in a fair state, 8 percent in a good state and only 1 percent in a very good state (specifically in Belize and the Cozumel area). In addition, 7 of the 17 sub-regions into which the study was divided had worsened since the last report in 2018 and only 4 had improved. Two fewer subregions are good, and none are critical.
- Of a possible total of 5 points, which would be the maximum reef health index score, Mexico has 2.8, Belize has 3, Guatemala has 2 and Honduras has 2.5. Belize scored the highest thanks to an increase in herbivorous fish biomass and a decrease in macroalgae. The index in Honduras fell due to a decrease in herbivores fish

biomass and an increase in macroalgae. Mexico and Guatemala are stuck with the same index since 2018.

- At the regional level, the health index has declined over time, being 2.8 in 2014 and 2016 compared to 2.5 in 2018, and is classified as poor.
- The main problem is the amount of freshy macroalgae cover, so we must focus the efforts on reducing this cover. This means investing in more wastewater treatment plants, reducing pollution of the seas and reducing the emissions that are affecting our seas.
- As for the results In Guatemala, Belize and Mexico there is a critical decrease in biomass of commercial fish.
- She also mentioned the importance of UN's Sustainable Development Goals to 2030, with special emphasis on SDG 6 (clean water and sanitation), 12 (responsible consumption and production), 13 (climate action) and 14 (life below water) for the four countries.
- There is new Stony Coral Tissue Loss Disease Outbreak (SCTLD) now affecting the MAR: 15 countries/territories with SCTLD present, 9 countries/territories with SCTLD treatments, 18 countries/territories monitoring with SCTLD and 18 countries/territories with education outreach.
- She pointed out that there is platform called Mapping Ocean Wealth (www.oceanwealth.org).

Presentation of the project

The presentation was made by Francisco (Patxi) Greño, from Metroeconomica. He presented the project (background and objectives, methodology and work Plan).

He highlighted the main objectives of the project which are as follows:

- Understand the value of the MAR region's coral reef ecosystems;
- Learn about the importance of conserving the MAR region's coral reef ecosystem;
- Inform policy makers (and other stakeholders) of the importance of implementing policies to protect the MAR region's coral reef ecosystem; and
- Determine how value is distributed among stakeholders (public, private, etc.) and willingness to pay for insurance to protect reefs.

He also explained the methodology followed, starting with the first deliverable on the existing literature in this field, to continue with the determination of the assessment methodologies, the realization of the workshops and the obtaining of the results. It was mentioned that a final workshop will be held in which the results will be presented and to which those attending these workshops will be invited.

Finally, it was shown the chronogram of the project and the dates that we are managing for the completion of the project and the different phases.

Importance of valuation for decision making

The presentation was made by Marisol Rivera, from The Ocean Foundation. She focused on the importance of valuing ecosystems to improve their management.

Economic valuation is key because it allows for:

- Determining costs and benefits of a given policy (its economic viability) so that it can help decide whether or not it is worth intervening;
- Designing policy interventions;
- Assessing the distribution of costs and benefits of environmental degradation/environmental improvements;
- Determining the compensation needed in case of damage; and
- Identifying the contribution of ecosystems and the environment to well-being.

Marisol also presented the main scheme of Total Economic Value and explained the differentiation between use and non-use values.

Finally, she used five applications in order to show why and how economic valuation can be useful for policy-makers.

1) Entrance fee;
2) Payment for ecosystem services;
3) Project evaluation and budget justification;
4) Evaluation and policy design; and
5) Compensation and penalty fees.

There have been some initiatives of economic services valuation in Mexico. She also pointed out that it would be needed to relate pressure indicators, but that it would require having much more information for the baseline.

Marisol also mentioned two iconic cases of economic valuation: the first one was the Exxon Valdez Oil Spill in Alaska, and the second one was the first economic valuation for penalties carried out by Mexico in Alacran Archipelago.

Methodologies for economic valuation and progress of the study

The presentation was made by Itziar Ruiz de Gauna, from Metroeconomica, and Marisol Rivera, from the Ocean Foundation. Both explained the methodologies adopted for the valuation of use and non-use values.

<u>Itziar Ruiz de Gauna</u>: she focused the first part of her intervention on why economic valuation is important, how values are obtained (through the preferences of individuals

and, therefore, through their willingness to pay for a good or service or for keep it intact for the future) and their relationship with prices. She later explained that conventional economic approaches conventional economic approaches tended to underestimate the value, as only the willingness to pay for raw materials and physical products generated for human production and consumption (such as fish, mining materials, pharmaceutical products, etc.) was considered. Nevertheless, as it became more evident the consequences of environmental modifications, traditional concepts of value became a topic of debate and economists began understanding that people might also be willing to pay for other reasons beyond the own current use of the service. In this context, the concept Total Economic Value emerged and became the most widely used framework. Itziar explained what this concept means and that there are different values (use values, option values and non-use values). She dedicated the last part of her intervention to explain the different existing methodologies to value ecosystem goods and services that do not have market prices, differentiating between stated and revealed preference techniques, as well as explaining that in this study we have focused on contingent valuation and why. Finally she gave some data about our study (number of surveys, format of the surveys, etc.) and mentioned that a benefit transfer would be carried out in order to estimate the values for shoreline protection.

Marisol Rivera: she focused on explaining the methodologies for the estimation of use values, and more specifically of fisheries and tourism (market prices). She explained that it would be ideal to use data from the last 10 years (2010-2020) or any other information from this time on.

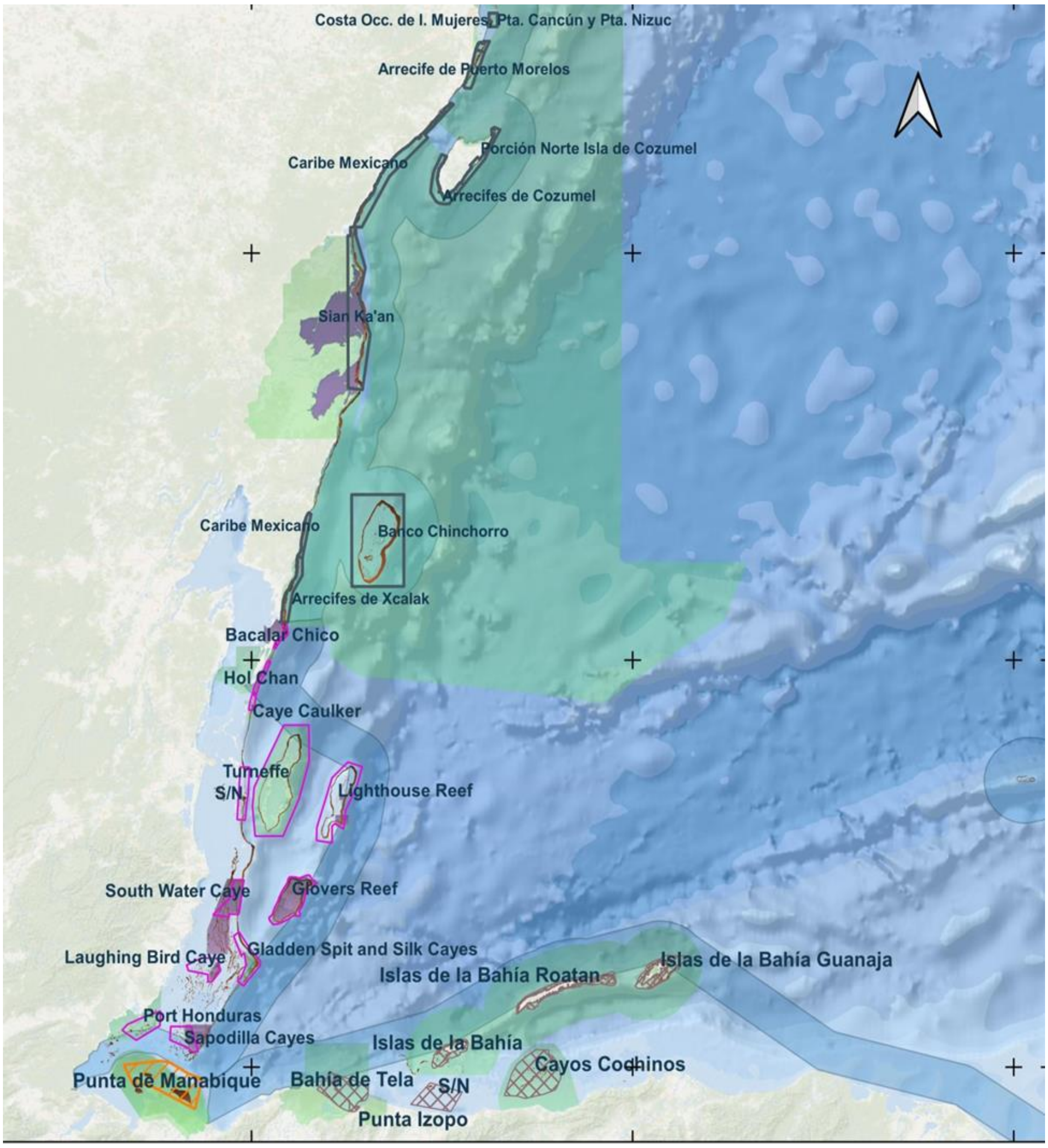
- Tourism sector: this project seeks information directly related to corals regarding: number of international and national tourism, direct income-expenses, visitors in protected natural areas, fees, recreational activities outside the NPAs, local tourism, expenses of cruise tourists, indirect impacts.
- Fisheries: for this sector, it is required (preferably georeferenced information) of capture, commercial fishing, fish processing and cleaning, local and artisanal or community fishing, etc.

Finally, Rebeca Kobelkowsky was in charge of making a presentation on the mapping of coral reef areas, with the goal of determining which areas should be selected to calculate their use values (fisheries and tourism). To that end, the following 9 criterion were selected:

1) Sites closed or in marine protected areas;
2) Sites near tourism areas;
3) Contributions to costal protection;
4) Productivity;
5) Important habitat;

6) Historical or cultural remains;
7) Ecological features;
8) Regulatory mechanism; and
9) Level of governance.

On this basis, polygons for Mexico can be seen in the Figure below.



Final comments

- Question - Miguel Ángel Cisneros (INAPESCA): is there an option to take into account pollution sources from residual waters and information on residual plants? Marisol replied that it would not be included in this project. He also offered his help to contact INAPESCA in Quintana Roo.
- Question - Alfredo Arellano Quintana Roo): does the project anticipate the cost of ecosystem restoration? Marisol answered no, as the project only use and non-

use values. He also pointed out that the state lives off its tourism, the hotel infrastructure dependent on the health of the reefs. He offered his support to contact with the Ministry of Tourism and other sectors to provide information.

- Question - Manuel Cervera (WRI): How were the amounts defined in the contingent valuation exercise? Itziar Ruiz de Gauna replied that values were defined through the analysis of in situ studies in the region, in other regions, such as Australia, and by analyzing purchasing power parity.
- Statement - Geogina Alcantar (SEMARNAT): the ecosystem valuation exercise in Mexico has not yet studied pressure indicators (sectors that directly affect ecosystems).
- Statement - Javier Pizaña Alonso (Coral Reef Alliance): it is important to know how the idea is sold to the private sector.
- Marisol also mentioned that evaluations will be done at the macro level using national data.
- The project team (Metroeconomica, WRI, TOF) will keep all participants informed through personal emails, so that they can see the progress and help us in the search for specific information.

List of participants

	Name	Institution	Position
	EXTERNAL EXPERTS		
1	Alfredo Arellano Guillermo	Gobierno del Edo. de Quintana Roo, México	Advisor for Environment and Coastal Policy
2	Melina Soto	Healthy Reefs for Healthy People	Country Coordinator
3	Claudia Ruiz A.	MAR Fund	Reef Rescue Coordinator
4	Alfredo Arellano Guillermo		
5	Manuel Cervera	WRI México	Forest Landscape Coordinator
6	Hansel Caballero Aragón	CONABIO	Marine Monitoring Specialist
7	Rebeca Meléndez	COSTASALVAJE, A.C.	Coral Conservation Manager
8	René A. Ibarra	WRI México	Forest Communities Coordinator
9	Javier Pizaña Alonso	Coral Reef Alliance	Project Manager in Mexico
10	Georgina Alcantar López	Semarnat-DGEIA México	Director of Environmental Statistics
11	Katie Thompson	The Ocean Foundation	Manager of the CariMar Initiative
12	Jesarela López Aguilar	INEGI	Director Technical Coordination (Environment)
13	Alejandra Serrano Pavón	ELAW	Lawyer
14	Anayeli Cabrera Murrieta	CONANP	Wetlands Care Coordinator
15	Christian Alva Basurto	PNUD/CONANP	Field Officer
16	Miguel A Cisneros Mata	INAPESCA- Guaymas	Researcher
17	Magdalena Précoma de la Mora	COBI	Curator
18	Javier Warman	WRI	Forestry Director
19	Magdalena Precoma de la Mora	UABCS	Technical staff
20	Richard Castillo	The Ocean Foundation	Lawyer
21	Javier Warman	WRI	Forest Director
22	Teresa Tattersfield	WRI	Project Manager
23	Alejandro Lópex	WRI	
24	Valeria López Portillo	WRI	
	TEAM		
25	Santiago Bucaram	IADB	
26	Maria José González	MAR FUND	
27	Marisol Hernández	The Ocean Foundation	
28	Alejandra Navarrete	The Ocean Foundation	
29	Norma P. Arce	WRI	
30	Marisol Rivera Planter	The Ocean Foundation	
31	Rebeca Kobelkowsky	Universidad Autonoma de Baja California Sur/ AICMMARH	
32	Mayela Vargas		
33	Patxi Greño	Metroeconomica	
34	Itziar Ruiz de Gauna	Metroeconomica	

Virtual Expert Workshop. Economic Valuation of Coral Reef Ecosystem Services in the Mesoamerican Reef System

Guatemala. October 7, 2020

9:30 a.m. – 12:30 p.m. (CST)

Moderator: Norma Arce, WRI Mexico

Background

Environmental Economics relies on valuation to provide society with information about the relative level of resource scarcity (Markandya & Richardson, 19933). Economic valuation can make explicit to society and policy makers that environmental and natural resources are scarce and that their conservation has associated benefits. If these benefits are not accounted for policy will be misguided and society will be worse off due to misallocation of resources. Therefore, valuing natural resources and the environment (i.e. measuring 'economic values' of environmental and natural resources) can support decision making affecting environmental and natural resources.

Given the ecosystem services provided by coral reefs and the serious nature of threats to their ecological integrity, there is demand for information on the value of welfare losses associated with a decline in the provision of ecosystem services (Millennium Ecosystem Assessment, 2005).

The value of environmental and natural resources reflects what we, as a society, are willing to pay to conserve these natural resources (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field, 2014).

Putting a monetary value on natural resources and the environment involves two steps:

Step 1 consists in identifying the ecosystem services (ES) provided.

Step 2 is to estimate them in monetary units.

Value information and decision making

The Interamerican Development Bank (IDB) is financing a study to assess the economic value of reef ecosystems services in the *Mesoamerican Reef Region* (MAR Region). The objective of the study is to understand the value of the coral reef ecosystems in the MAR region, and the importance of their conservation to better inform decision makers. The institutions responsible for this economic analysis are Metroeconomica, World Resources Institute (WRI) and The Ocean Foundation (TOF).

This information can be used in different policy-making contexts, including the determination of investment in reef health, compensation payments for damage and cost-benefit analysis of conservation measures. The economic valuation will also identify and generate economic arguments to support policies that help ensure healthy coastal ecosystems and sustainable economies

In this context, the results of this study will provide information to encourage the governments of Belize, Guatemala, Honduras and Mexico to increase budgetary resources for reef conservation and management. It will also raise local to global awareness on the economic importance of coral reefs as natural infrastructure, and will open the door to discussions with the private sector (e.g. tourism, fisheries) on how they can protect their business interests by investing in the health of the reefs on which their industries depend.

This virtual workshop was participatory and will bring together a group of relevant stakeholders to obtain their views. The session was held Spanish.

Main objectives of the workshop

The main goals of this work session were:

a) Present the project and the valuation methods;
b) Explain the importance of the reef system in environmental, social and economic terms;
c) Present the ecosystem services provided by the system and the importance of monitoring on reef quality;
d) Expose the importance of assessment for decision-making;
e) Present the specific methodology to estimate use and non-use values;
f) Select the most appropriate sites based on a long list of potential sites prepared; and
g) Collect information and feedback to be able to identify the changes that will affect coral reefs.

Number of participants

36 attendees participated in the workshop, 24 of whom were experts from outside the project. The complete list, with detailed information, can be found at the end of this summary.

Institutions

Healthy Reefs Initiative, Wetlands International, Worls Resources Institute, Comando Naval del Caribe, Instituto Nacional de Estadística, Metroeconómica, MAR Fund, ICIAAD/Ser-Océano, DIPESCA, Ministerio de Ambiente y Recursos Naturales (MARN), FUNDAECO, OTUS, The Ocean Foundation, APROSARSTUN, World Wildlife Fund, UICN, IPNUSAC and Pixanja.

Opening remarks

In this first session we had the presence of the following four participants:

- Santiago Bucaram, as representative of the Inter-American Development Bank. He highlighted the IADB's role in financing innovative projects within the Natural Capital Lab and explained how this project was hatched and the importance of conserving coral reefs in the Mesoamerican region. He also mentioned the need to collect information and inputs from experts so that the assessment is as close to reality as possible and allows decision makers to be informed.
- Francisco (Patxi) Greño, as representative of Metroeconomica. He introduced the firm (consulting firm specialized in the economic analysis of environmental impacts and the evaluation of public policies, also focusing on energy and sustainable development issues) and the team.
- Javier Warman, as representative of WRI Mexico. He explained the scope and the role of the institution he represents in the present project. They are partnering with The Ocean Foundation for many projects, including activities within the High-Level Panel for Sustainable Ocean Economy initiative, blue carbon and natural based solutions projects, among others.
- Claudia Ruíz, as representative of MAR Fund. She explained the objective of MAR Fund and its activities in the region.

Importance of the Mesoamerican reef system

The presentation was made by Claudia Ruíz, from the MAR Fund.

She presented the economic importance of the Mesoamerican Reef Region, including economic, environmental and social importance. She highlighted the main threaths to the MAR Region, including overfishing, climate change, storms and pollution. She mentioned that previous studies have cuantified the value of coral reef ecosystems.

Presentation of the project

The presentation was made by Francisco (Patxi) Greño, from Metroeconomica. He presented the project (background and objectives, methodology and work Plan).

He highlighted the that the main objectives of the project are as follows:

- Understand the value of the MAR region's coral reef ecosystems;

- Learn about the importance of conserving the MAR region's coral reef ecosystem;
- Inform policy makers (and other stakeholders) of the importance of implementing policies to protect the MAR region's coral reef ecosystem; and
- Determine how value is distributed among stakeholders (public, private, etc.) and willingness to pay for insurance to protect reefs.

He also explained the methodology followed, starting with the first deliverable on the existing literature in this field, to continue with the determination of the assessment methodologies, the realization of the workshops and the obtaining of the results. It was mentioned that a final workshop will be held in which the results will be presented and to which those attending these workshops will be invited.

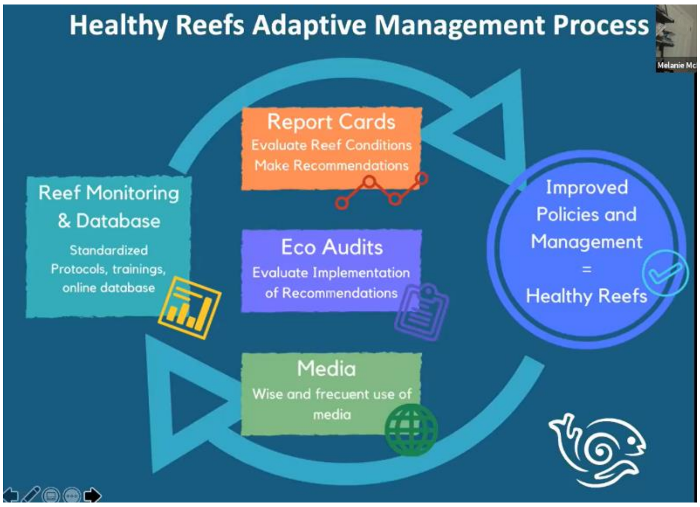
Finally, the chronogram of the project was presented, outlining the dates for the completion of the project and the different phases.

Ecosystem services and monitoring experience on the quality of the reefs in the MAR

The presentation was made by Ana Giró Petersen, from Healthy Reefs Initiative.

She presented the latest report (the sixth report after 12 years of monitoring) on the health of the Mesoamerican reef system, which was published in February 2020, entitled "Mesoamerican Reef Report Card. Evaluation of ecosystem health" (https://www.healthyreefs.org/cms/wp-content/uploads/2020/02/2020_Report_Card_MAR.pdf). In particular, she:

- Explained that Healthy Reef Initiative began in 2004. They conduct regular reporting (Scientific Foundations Guidebook, 2007) and report cards on reef health, collaborate for catalyzing conservation solutions and carry out eco-audits of management implementation (3 eco-audits online).



- There are actually more than 74 organizations in the 4 countries working in the same direction to manage this shared ecosystem.

- To date, they have trained over 250 local monitors (biologists, engineers, etc.) who help them take the data. They have 16 trainers, and 19 weeklong training courses in reef monitoring. They also use 256 database users.
- They use 4 indicators to indicate the health of the reef: 1) coral cover; 2) freshy macroalgae cover; 3) herbivorous fish biomass; and 4) commercial fish biomass. The first two compete for space on the seabed and the aim is for much more coral cover rather than freshy macroalgae cover. On this basis, they establish five quality categories: very good, good, fair, poor and critical.
- They have monitored 286 sites with the help of 82 people and 26 organizations. The result is that 16 percent of the reefs are in a critical state, 46% in a poor state, 29 percent in a fair state, 8 percent in a good state and only 1 percent in a very good state (specifically in Belize and the Cozumel area). In addition, 7 of the 17 sub-regions into which the study was divided had worsened since the last report in 2018 and only 4 had improved. Two fewer subregions are good, and none are critical.
- Of a possible total of 5 points, which would be the maximum reef health index score, Mexico has 2.8, Belize has 3, Guatemala has 2 and Honduras has 2.5. Belize scored the highest thanks to an increase in herbivorous fish biomass and a decrease in macroalgae. The index in Honduras fell due to a decrease in herbivores fish biomass and an increase in macroalgae. Mexico and Guatemala are stuck with the same index since 2018.
- At the regional level, the health index has declined over time, being 2.8 in 2014 and 2016 compared to 2.5 in 2018, and is classified as poor.
- The main problem is the amount of freshy macroalgae cover, so we must focus the efforts on reducing this cover. This means investing in more wastewater treatment plants, reducing pollution of the seas and reducing the emissions that are affecting our seas.
- She also mentioned the importance of UN’s Sustainable Development Goals to 2030, with special emphasis on SDG 6 (clean water and sanitation), 12 (responsible consumption and production), 13 (climate action) and 14 (life below water) for the four countries.
- There is new Stony Coral Tissue Loss Disease Outbreak (SCTLD) now affecting the MAR: 15 countries/territories with SCTLD present, 9 countries/territories with SCTLD treatments, 18 countries/territories monitoring with SCTLD and 18 countries/territories with education outreach.
- She pointed out that there is platform called Mapping Ocean Wealth (www.oceanwealth.org)

Importance of valuation for decision making

The presentation was made by Marisol Rivera, from The Ocean Foundation. She focused her talk on highlighting the importance of valuing ecosystems to improve their management.

Economic valuation is vital because it allows for:

- Determining costs and benefits of a given policy (its economic viability) so that it can help decide whether or not it is worth intervening;
- Designing policy interventions;
- Assessing the distribution of costs and benefits of environmental degradation/environmental improvements;
- Determining the compensation needed in case of damage; and
- Identifying the contribution of ecosystems and the environment to well-being.

Marisol also presented the main scheme of Total Economic Value and explained the differentiation between use and non-use values.

Finally, she used five applications in order to show why and how economic valuation can be useful for policy-makers.

6) Entrance fee;
7) Payment for ecosystem services;
8) Project evaluation and budget justification;
9) Evaluation and policy design; and
10) Compensation and penalty fees.

Marisol also mentioned two iconic cases of economic valuation: the first one was the Exxon Valdez Oil Spill in Alaska, and the second one was the first economic valuation for penalties carried out by Mexico in Alacran Archipelago.

Methodologies for economic valuation and progress of the study

The presentation was made by Itziar Ruiz de Gauna, from Metroeconomica, and Marisol Rivera, from the Ocean Foundation. Both explained the methodologies adopted for the valuation of use and non-use values.

Itziar Ruiz de Gauna: she focused the first part of her intervention on why economic valuation is important, how values are obtained (through the preferences of individuals and, therefore, through their willingness to pay for a good or service or to keep it intact for the future) and their relationship with prices. She later explained that conventional economic approaches conventional economic approaches tended to underestimate the value, as only the willingness to pay for raw materials and physical products generated for human production and consumption (such as fish, mining materials, pharmaceutical products, etc.) was considered. Nevertheless, as it became more evident the consequences of environmental modifications, traditional concepts of value became a topic of debate and economists began understanding that people might also be willing to pay for other reasons beyond the own current use of the service. In this context, the concept Total Economic Value emerged and became the most widely used framework. Itziar explained what this concept means and that there are different values (use values, option values and non-use values). She dedicated the last part of her intervention to explain the different existing methodologies to value ecosystem goods and services that do not have market prices, differentiating between stated and revealed preference techniques, as well as explaining that in this study we have focused on contingent valuation and why. Finally, she gave some data about our study (number of surveys, format of the surveys, etc.) and mentioned that a benefit transfer would be carried out in order to estimate the values for shoreline protection.

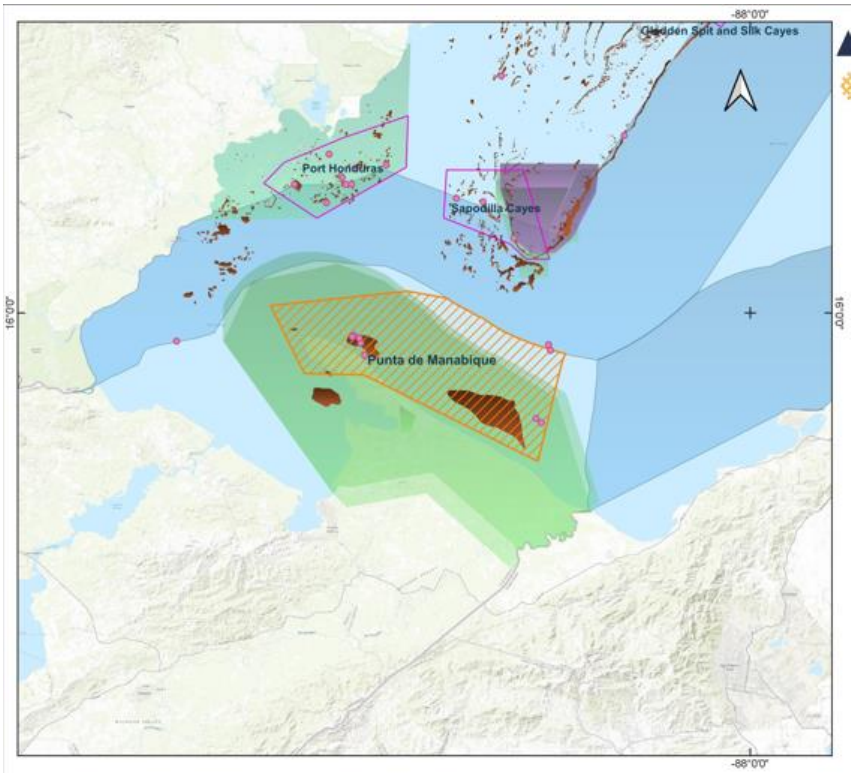
Marisol Rivera: she focused on explaining the methodologies for the estimation of use values, and more specifically of fisheries and tourism (market prices). She explained that it would be ideal to use data from the last 10 years (2010-2020) or any other information from this time on.

- Tourism sector: this project seeks information directly related to corals regarding: number of international and national tourism, direct income-expenses, visitors in protected natural areas, fees, recreational activities outside the NPAs, local tourism, expenses of cruise tourists, indirect impacts.
- Fisheries: for this sector, it is required (preferably georeferenced information) of capture, commercial fishing, fish processing and cleaning, local and artisanal or community fishing, etc.

Finally, Rebeca Kobelkowsky was in charge of making a presentation on the mapping of coral reef areas, with the goal of determining which areas should be selected to calculate their use values (fisheries and tourism). To that end, the following 9 criteria were selected:

10) Sites closed or in marine protected areas;
11) Sites near tourism areas;
12) Contributions to costal protection;
13) Productivity;
14) Important habitat;
15) Historical or cultural remains;
16) Ecological features;
17) Regulatory mechanism; and
18) Level of governance.

On this basis, polygons for Guatemala can be seen in the Figure below.



Final comments

- Statement: little is mentioned about the high importance of the MAR Region. There is an urgent need for selling the importance of the reef. How could this be achieved at a wider scale?
- Statement: it is important to include information on the threats and sources of damage to the corals, in order to identify main options for conservation and management.
- Question: are the main sources of pollution being considered in the coral valuation studies? Patxi answered that the project focuses on valuing the main benefits of the coral reefs in order to prevent any future damage.
- Question: how were the surveyed people elected? Itziar replied that the surveys were conducted through a specialized firm (Ipsos) and that a representative sample was selected.
- Statement: marine protected areas are very important to include in the study. Yet, other important areas that should be taken into account are the no-take zones, or fishery recovery areas. They have as much as 10 time more fish biomass than other areas, and they play a key part of ecosystem functioning. HRI will share the information to see if it can be included in the study.

- Question: were rent fees of houses and other hosting services included in the study? Marisol replied that we would include only the existing information on each country.
- Question: is there an option to take into account pollution sources from residual waters and information on residual plants? Marisol answered that it will not be included in this project.
- Question: will mobile applications be included in the project in order to conduct valuation exercises? Marisol said that it was a great idea and that there were some initiatives in other countries. Yet, this would not be included in the project.
- The project team (Metroeconomica, WRI, TOF) will keep all participants informed through personal emails, so that they can see the progress and help us in the search for specific information.

List of participants

	Name	Institution	Position
EXTERNAL EXPERTS			
1	Jorge Alberto Ruiz Ordoñez	Wetlands International	Country Officer
2	Kareen Lucia Urrutia Estevez	WRI	Junior Climate Finance Officer
3	Williams Estuardo Casasola Cordon	Comando Naval del Caribe	Third Commander
4	Claudia Carolina Cuentas	WRI - Finance Center	Consultant - Climate Finance Associate
5	Karin Lenisse Barrios Carrascosa	Instituto Nacional de Estadística	Head of Environmental Statistics Section
6	Claudio González	MAR Fund	Technical Director
7	Edgar Selvin Pérez	OTUS, S.A/Proyecto Biodiversidad USAID.	Consultant
8	Ana Giró	Inicitiva Arrecifes Saludables	Coordinator for Guatemala
9	Bryslie Cifuentes Velasco	ICIAAD/Ser- Océano	Consultant
10	Carol Sosa	DIPESCA	Research Technician
11	David Penados	FUNDAECO	Field Technician
12	Iliana Pocasangre	Ministerio de Ambiente y Recursos Natuales (MARN)	Advisor in the International Cooperation Unit
13	Juan Carlos Diaz	Ministerio de Ambiente y Recursos Natuales (MARN)	International Cooperation Coordinator
14	José Domingo Caal Caal	APROSARSTUN	General Coordinator
15	Ana Victoria Rodriguez	WWF Guatemala/Mesoamerica	Climate Change Officer
16	Blanca Rosa Garcia	UICN-Proyecto Biodiversidad Costera	Site Coordinator Guatemala - Honduras
17	Magaly Arrecis	IPNUSAC	Socio-environmental analyst
18	Angela Mojica	PixanJa	Co-founder and director
19	Anabella Barrios	Centro de Acción Legal-Ambiental y Social (CALAS)	
20	Jeanette Noack	Alianza de Derecho Ambiental y Agua	Director
21	Regina Sánchez	PROBIOMA	
22	Reinhold Gelera	Universidad del Valle	
23	Samuel Coc yat	Ecologic	
24	Pilar Velázquez	WWF	Fisheries and Marine Conservation Officer
TEAM			
25	Claudia Ruiz	MAR Fund	
26	Rebeca Kobelkowsky	Metroeconomica	
27	Mayela Vargas	Metroeconomica	
28	Ana Beatriz Rivas	MAR Fund	
29	Alejandra Navarrete	THe Ocean Foundation	
30	Katie Thompson	The Ocean Foundation	
31	Norma Arce	WRI México	
32	Itziar Ruiz de Gauna	Metroeconomica	
33	Javier Warman	WRI México	

Virtual Expert Workshop. Economic Valuation of Coral Reef Ecosystem Services in the Mesoamerican Reef System

Honduras. October 13, 2020

9:30 a.m. – 12:30 p.m. (CDT)

Moderator: Norma Arce Peña, WRI México

Background

Environmental Economics relies on valuation to provide society with information about the relative level of resource scarcity (Markandya & Richardson, 19933). Economic valuation can make explicit to society and policy makers that environmental and natural resources are scarce and that their conservation has associated benefits. If these benefits are not accounted for policy will be misguided and society will be worse off due to misallocation of resources. Therefore, valuing natural resources and the environment (i.e. measuring 'economic values' of environmental and natural resources) can support decision making affecting environmental and natural resources.

Given the ecosystem services provided by coral reefs and the serious nature of threats to their ecological integrity, there is demand for information on the value of welfare losses associated with a decline in the provision of ecosystem services (Millennium Ecosystem Assessment, 2005).

The value of environmental and natural resources reflects what we, as a society, are willing to pay to conserve these natural resources (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field, 2014).

Putting a monetary value on natural resources and the environment involves two steps:

Step 1 consists in identifying the ecosystem services (ES) provided.

Step 2 is to estimate them in monetary units.

Value information and decision making

The Interamerican Development Bank (IDB) is financing a study to assess the economic value of reef ecosystems services in the *Mesoamerican Reef Region* (MAR Region). The objective of the study is to understand the value of the coral reef ecosystems in the MAR region, and the importance of their conservation to better inform decision makers. The institutions responsible for this economic analysis are Metroeconomica, World Resources Institute (WRI) and The Ocean Foundation (TOF).

This information can be used in different policy-making contexts, including the determination of investment in reef health, compensation payments for damage and cost-benefit analysis of conservation measures. The economic valuation will also identify and generate economic arguments to support policies that help ensure healthy coastal ecosystems and sustainable economies

In this context, the results of this study will provide information to encourage the governments of Belize, Guatemala, Honduras and Mexico to increase budgetary resources for reef conservation and management. It will also raise local to global awareness on the economic importance of coral reefs as natural infrastructure, and will open the door to discussions with the private sector (e.g. tourism, fisheries) on how they can protect their business interests by investing in the health of the reefs on which their industries depend.

This virtual workshop was participatory and will bring together a group of relevant stakeholders to obtain their views. The sessions was held in Spanish.

Main objectives of the workshop

The main goals of this work session are:

h) Present the project and the valuation methods;

i) Explain the importance of the reef system in environmental, social and economic terms;

j) Present the ecosystem services provided by the system and the importance of monitoring on reef quality;

k) Expose the importance of assessment for decision-making;

l) Present the specific methodology to estimate use and non-use values;

m) Select the most appropriate sites based on a long list of potential sites prepared; and

n) Collect information and feedback to be able to identify the changes that will affect coral reefs.

Number of participants

29 attendees participated in the workshop, 19 of whom were experts from outside the project. The complete list, with detailed information, can be found at the end of this summary.

Institutions

Centro Universitario Regional del Litoral Atlántico – Universidad Nacional Autónoma de Honduras (UNAH-CURLA), Instituto Nacional de Conservación y Desarrollo Forestal/ICF, Dirección General de la Marina Mercante, The Ocean Foundation, Roatan Marine Park, Cuerpos de Conservación Omoa, Coral Reef Alliance, Secretaría de Recursos Naturales y Ambiente (MiAmbiente), Zona Libre Turística Islas de la Bahía, FAO, Dirección General de biodiversidad (MiAmbiente), Ministerio de Turismo, Parque Nacional Bahía de Loreto, Healthy Reefs Initiative y Fundación Cayos Cochinos.

Opening remarks

In this first session we had the presence of the following four participants:

- Santiago Bucaram, as representative of the Inter-American Development Bank. He highlighted the IADB's role in financing innovative projects within the Natural Capital Lab and explained how this project was hatched and the importance of conserving coral reefs in the Mesoamerican region. He also mentioned the need to collect information and inputs from experts so that the assessment is as close to reality as possible and allows decision makers to be informed.
- Francisco (Patxi) Greño, as representative of Metroeconomica. He introduced the firm (consulting firm specialized in the economic analysis of environmental impacts and the evaluation of public policies, also focusing on energy and sustainable development issues) and the team.
- Alejandra Navarrete, as representative of The Ocean Foundation. She explained the scope and the role of the institution she represents in the present project and made a comprehensive presentation on the importance of this project and the conservation of coral reefs in the region. For instance, she mentioned that tourism contributes around USD 35,8 billion and that the ocean supports some USD 2.5 trillion dollars of the global economy, so we should look more after the sea.
- Maria José González, as representative of MAR Fund. She explained the objective of MAR Fund and its activities in the region.

Importance of the Mesoamerican reef system and monitoring experience

The presentation was made by Ian Drysdale, from Healthy Reefs Initiative. He is the coordinator for Honduras of this Initiative and is in charge of partner relations and other outreach efforts, such as the media in Honduras.

He presented the latest report (the sixth report after 12 years of monitoring) on the health of the Mesoamerican reef system which was published in February 2020. In particular, he:

- Explained what the Mesoamerican reef system is: it is the largest reef system on the planet, covering 4 countries and over 1000 kilometres of coastline, with a very high and rich biodiversity. It sustains more than 2.5 million people in the region and generates billions of dollars each year.

- There are actually more than 74 organizations in the 4 countries working in the same direction to manage this shared ecosystem.
- To date, they have trained over 250 local monitors (biologists, engineers, etc.) who help them take the data. They have 16 trainers and use the AGRRA (Atlantic and Gulf Rapid Reef Assessment) system.
- They use 4 indicators to know if the reef is healthy or not: 1) coral cover; 2) freshy macroalgae cover; 3) herbivorous fish biomass; and 4) commercial fish biomass. The first two compete for space on the seabed and the aim is for much more coral cover rather than freshy macroalgae cover. On this basis, they establish five quality categories: very good, good, fair, poor and critical.
- They have monitored 286 sites with the help of 82 people and 26 organizations. The result is that 16 percent of the reefs are in a critical state, 46 percent in a poor state, 29 percent in a fair state, 8 percent in a good state and only 1 percent in a very good state (specifically in Belize and the Cozumel area). In addition, 7 of the 17 sub-regions into which the study was divided had worsened since the last report in 2018.
- Of a possible total of 5 points, which would be the maximum reef health index score, Mexico has 2.8, Belize has 3, Guatemala has 2 and Honduras has 2.5. Belize scored the highest thanks to an increase in herbivorous fish biomass and a decrease in macroalgae. The index in Honduras fell due to a decrease in herbivores fish biomass and an increase in macroalgae. Mexico and Guatemala are stuck with the same index since 2018.
- At the regional level, the health index has declined over time, being 2.8 in 2014 and 2016 compared to 2.5 in 2018, and is classified as poor.
- The main problem is the amount of freshy macroalgae cover, so we must focus the efforts on reducing this cover. This means investing in more wastewater treatment plants, reducing pollution of the seas and reducing the emissions that are affecting our seas.
- As for the results for Honduras:
  - 2018 results: health index of 3.0. Likewise, there was 22 percent coral cover 8 (good), 27 percent freshy macroalgae cover (critical), very good status of herbivorous fish biomass and poor status of commercial fish biomass.
  - 2020 results: health index of 2.5. Nowadays, there is 27 percent of coral cover 8 (good), 24 percent freshy macroalgae cover (poor), fair status of herbivorous fish biomass and critical status of commercial fish biomass.

  - Decrease in both types of fish, so efforts must be focused on managing fisheries in a more sustainable way.
  - Of all the sites they have monitored, none is in very good health: 15 percent are critical, 54 percent poor, 27 percent fair and only 4 percent good.
  - Roatan is where reefs are found in slightly better health.
- It is worrisome that we are moving from a coral reef to an algal or eroded ecosystem, which would threaten the economy of USD 6.2 billion annually (only from the tourism sector).
- Tourism directly employs 2 million people and accounts for more than USD 30 billion annually, mangroves contribute USD 1 billion a year in Florida, and a shark has much more value over its lifetime (1.9 million) than when it is fished and is only worth USD 108.
- It is also called coral reef barrier because it is a barrier that stops the force of waves caused by storms and hurricanes, thus protecting our coastal investments.
- Belize is in the lead, as in 2017 they released a report on the economic valuation of their reefs and with this information they have managed to stop the degradation. We need this same information in all countries to do the same.
- The value of culture is key, it is priceless, but it has a fundamental value for these cultures (Garifuna, etc.) and for us.
- Something similar happens with biodiversity: there are more than 30 species on the IUCN red list. Therefore, it is essential to put a number on it to be able to appreciate its value even more.

Presentation of the project

The presentation was made by Francisco (Patxi) Greño, from Metroeconomica. He presented the project (background and objectives, methodology and work Plan).

He highlighted the that the main objectives of the project are as follows:

- Understand the value of the MAR region's coral reef ecosystems;
- Learn about the importance of conserving the MAR region's coral reef ecosystem;
- Inform policy makers (and other stakeholders) of the importance of implementing policies to protect the MAR region's coral reef ecosystem; and
- Determine how value is distributed among stakeholders (public, private, etc.) and willingness to pay for insurance to protect reefs.

He also explained the methodology followed, starting with the first deliverable on the existing literature in this field, to continue with the determination of the assessment methodologies, the realization of the workshops and the obtaining of the results. It was mentioned that a final workshop will be held in which the results will be presented and to which those attending these workshops will be invited.

Finally, it was shown the chronogram of the project and the dates that we are managing for the completion of the project and the different phases.

Importance of valuation for decision making

The presentation was made by Marisol Rivera, from The Ocean Foundation. She focused her talk on highlighting the importance of valuing ecosystems to improve their management.

Economic valuation is key because it allows for:

- Determining costs and benefits of a given policy (its economic viability) so that it can help decide whether or not it is worth intervening;
- Designing policy interventions;
- Assessing the distribution of costs and benefits of environmental degradation/environmental improvements;
- Determining the compensation needed in case of damage; and
- Identifying the contribution of ecosystems and the environment to well-being.

Marisol also presented the main scheme of Total Economic Value and explained the differentiation between use and non-use values.

Finally, she used five applications in order to show why and how economic valuation can be useful for policy-makers.

11) Entrance fee;
12) Payment for ecosystem services;
13) Project evaluation and budget justification;
14) Evaluation and policy design; and
15) Compensation and penalty fees.

There are some initiatives in the Mesoamerican region. She also pointed out that it would be needed to relate pressure indicators, but that it would require having much more information for the baseline.

After her presentation, there were some comments from the experts:

- Sara Zelaya talked about the fact that there was a boat embedded in Puerto Cortéz in which it was not possible to determine with certainty the damages (and therefore fines), so this type of valuation is very important.
- Michelle Fernández asked if we were going to do valuation of ecosystems that have been devastated by a phenomenon or accident. Marisol replied that we were going to focus on tourism because indicators already exist, and that it would be very helpful for us if she could tell us what other sites would be needed, such as shoreline protection services.

- It was also asked whether the assessment would be done by site or by country. Sometimes in the MAR region, policy-makers receive data from other countries, although it would be interested to also have specific data. Marisol replied that data will be produced for each country but also for the main sites, i.e., grand tourism sites.
- Marcio Aronne: in Honduras, tourism is returning to a certain normality after COVID. He proposed to take advantage of COVID's opportunities as an example of impact reduction. It helps to determine more precisely what the tourist is capable of paying. He also asked if we were going to consider blue carbon capture services?

Methodologies for economic valuation and progress of the study

The presentation was made by Itziar Ruiz de Gauna, from Metroeconomica, and Marisol Rivera, from the Ocean Foundation. Both explained the methodologies adopted for the valuation of use and non-use values.

Itziar Ruiz de Gauna: she focused the first part of her intervention on why economic valuation is important, how values are obtained (through the preferences of individuals and, therefore, through their willingness to pay for a good or service or for keep it intact for the future) and their relationship with prices. She later explained that conventional economic approaches conventional economic approaches tended to underestimate the value, as only the willingness to pay for raw materials and physical products generated for human production and consumption (such as fish, mining materials, pharmaceutical products, etc.) was considered. Nevertheless, as it became more evident the consequences of environmental modifications, traditional concepts of value became a topic of debate and economists began understanding that people might also be willing to pay for other reasons beyond the own current use of the service. In this context, the concept Total Economic Value emerged and became the most widely used framework. Itziar explained what this concept means and that there are different values (use values, option values and non-use values). She dedicated the last part of her intervention to explain the different existing methodologies to value ecosystem goods and services that do not have market prices, differentiating between stated and revealed preference techniques, as well as explaining that in this study we have focused on contingent valuation and why. Finally she gave some data about our study (number of surveys, format of the surveys, etc.) and mentioned that a benefit transfer would be carried out in order to estimate the values for shoreline protection.

Marisol Rivera: she focused on explaining the methodologies for the estimation of use values, and more specifically of fisheries and tourism (market prices). She explained that it would be ideal to use data from the last 10 years (2010-2020) or any other information from this time on.

- Tourism sector: this project seeks information directly related to corals regarding: number of international and national tourism, direct income-expenses, visitors in protected natural areas, fees, recreational activities outside the NPAs, local tourism, expenses of cruise tourists, indirect impacts.

- Fisheries: for this sector, it is required (preferably georeferenced information) of capture, commercial fishing, fish processing and cleaning, local and artisanal or community fishing, etc.

Finally, Rebeca Kobelkowsky was in charge of making a presentation on the mapping of coral reef areas, with the goal of determining which areas should be selected to calculate their use values (fisheries and tourism). To that end, the following 9 criteria were selected:

19) Sites closed or in marine protected areas;

20) Sites near tourism areas;

21) Contributions to costal protection;

22) Productivity;

23) Important habitat;

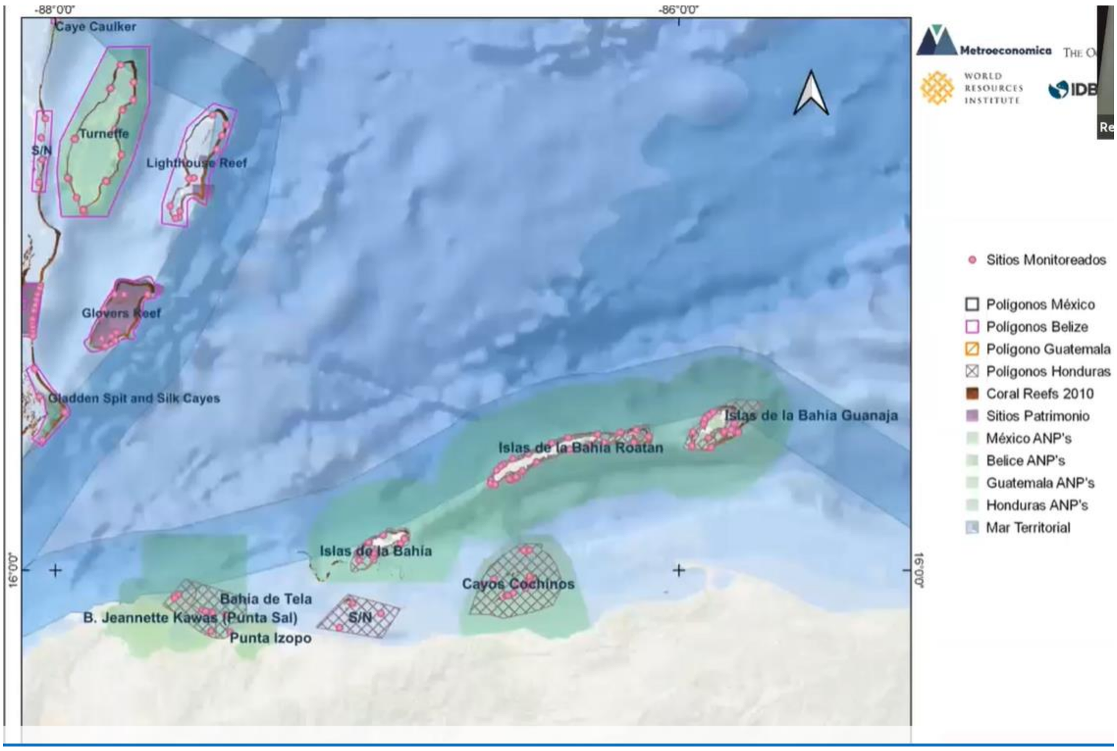
24) Historical or cultural remains;

25) Ecological features;

26) Regulatory mechanism; and

27) Level of governance.

On this basis, polygons for Honduras can be seen in the Figure below.



We did not know the name of one of the polygons, so Rebeca asked the experts to help us find out the name of this area.

Final comments

- Ian Drysdale kindly provided contact names for people who can provide data in the MAR islands of Honduras.
- Concern about the extraction of carbides because in the event of a spill, which to date has not occurred in Honduras, due to prevailing currents it would be deposited on the country's reefs. It is necessary to be in force and to identify in a balance the resources that must be prioritized.
- In Bahía de Tela there are data since 2016. It is important to take the methodology and data to the communities and to involve the diverse actors.
- The project team (Metroeconomica, WRI, TOF) will keep all participants informed through personal emails, so that they can see the progress and help us in the search for specific information.

List of participants

	Name	Institution	Position
EXTERNAL EXPERTS			
1	Arlene Rodríguez	UNAH-CURLA	Professor
2	Cindy Carola Flores	Instituto Nacional de Conservación y Desarrollo Forestal/ICF	Technical Coordinator, Protected Areas and Wildlife ICF/IB
3	Doland McLaughlin	Dirección General de la Marina Mercante	Environmental Technical Officer
4	Fernando Bretos	The Ocean Foundation	Program Officer, CariMar
5	Francis Lean	Roatan Marine Park	Executive Director
6	Giselle Brady	Roatán	Program Coordinator
7	Gustavo Cabrera	Cuerpos de Conservación Omoa, CCO	General Manager
8	Julio San Martin	Coral Reef Alliance	Senior Program Coordinator for the North Coast
9	Marnie Portillo	Secretaría de Recursos Naturales y Ambiente (MiAmbiente)	Technical Assistant in Biodiversity and Environment
10	Michelle Fernandez	Zona Libre Turística Islas de la Bahía (ZOLITUR)	Marine Environmental Management
11	Mirella Gonzalez	Dirección General de la Marina Mercante	Technical Assistant/Biologist
12	Pablo Rico	FAO	National Fisheries and Aquaculture Consultant
13	Sara Isabel Zelaya	Dirección General de la Marina Mercante	Head of Marine Environment Protection Department
14	Skarlet Pineda Lim	Dirección General de biodiversidad (MiAmbiente)	Environmental Analyst
15	Tatiana Siercke	Ministerio de Turismo	Manager of Institutional Management and International Relations
16	Nikee Fabre	Parque Nacional Bahía de Loreto	Technical assistant
17	Ian Drysdale	Healthy Reefs Initiative	Coordinator for Honduras
18	Aristides Martínez	Dirección General de la Marina Mercante	Environmental Technical Officer
19	Marcio Aronne	Fundación Cayos Cochinos	Director of Conservation and Sustainable Development
TEAM			
20	Santiago Bucaram	IADB	
21	Maria José González	MAR FUND	
22	Marisol Hernández	MAR FUND	
23	Alejandra Navarrete	The Ocean Foundation	
24	Norma P. Arce	WRI	
25	Marisol Rivera	The Ocean Foundation	
26	Rebeca Kobelkowsky	Universidad Autonoma de Baja California Sur/ AICMMARH	
27	Mayela Vargas		
28	Patxi Greño	Metroeconomica	
29	Itziar Ruiz de Gauna	Metroeconomica	

Virtual Expert Workshop. Economic Valuation of Coral Reef Ecosystem Services in the Mesoamerican Reef System

Belize. October 15, 2020

8:30 a.m. – 11:30 p.m. (CDT)

Moderator: Alejandra Navarrete, The Ocean Foundation

Background

Environmental Economics relies on valuation to provide society with information about the relative level of resource scarcity (Markandya & Richardson, 19933). Economic valuation can make explicit to society and policy makers that environmental and natural resources are scarce and that their conservation has associated benefits. If these benefits are not accounted for policy will be misguided and society will be worse off due to misallocation of resources. Therefore, valuing natural resources and the environment (i.e., measuring 'economic values' of environmental and natural resources) can support decision making affecting environmental and natural resources.
Given the ecosystem services provided by coral reefs and the serious nature of threats to their ecological integrity, there is demand for information on the value of welfare losses associated with a decline in the provision of ecosystem services (Millennium Ecosystem Assessment, 2005).
The value of environmental and natural resources reflects what we, as a society, are willing to pay to conserve these natural resources (Pearce & Turner, 1990; Turner et al. 1994; Pearce, 2002; Hanley et al. 2007; Stavins, 2008; Atkinson, 2010; Field, 2014).
Putting a monetary value on natural resources and the environment involves two steps:

Step 1 consists in identifying the ecosystem services (ES) provided.

Step 2 is to estimate them in monetary units.

Value information and decision making

The Interamerican Development Bank (IDB) is financing a study to assess the economic value of reef ecosystems services in the *Mesoamerican Reef Region* (MAR Region). The objective of the study is to understand the value of the coral reef ecosystems in the MAR region, and the importance of their conservation to better inform decision makers. The institutions responsible for this economic analysis are Metroeconomica, World Resources Institute (WRI) and The Ocean Foundation (TOF).

This information can be used in different policy-making contexts, including the determination of investment in reef health, compensation payments for damage and cost-benefit analysis of conservation measures. The economic valuation will also identify and generate economic arguments to support policies that help ensure healthy coastal ecosystems and sustainable economies

In this context, the results of this study will provide information to encourage the governments of Belize, Guatemala, Honduras and Mexico to increase budgetary resources for reef conservation and management. It will also raise local to global awareness on the economic importance of coral reefs as natural infrastructure, and will open the door to discussions with the private sector (e.g. tourism, fisheries) on how they can protect their business interests by investing in the health of the reefs on which their industries depend.

This virtual workshop was participatory and will bring together a group of relevant stakeholders to obtain their views. The sessions was held in English.

Main objectives of the workshop

The main goals of this work session are:

o) Present the project and the valuation methods;

p) Explain the importance of the reef system in environmental, social and economic terms;

q) Present the ecosystem services provided by the system and the importance of monitoring on reef quality;

r) Expose the importance of assessment for decision-making;

s) Present the specific methodology to estimate use and non-use values;

t) Select the most appropriate sites based on a long list of potential sites prepared; and

u) Collect information and feedback to be able to identify the changes that will affect coral reefs.

Number of participants

39 attendees participated in the workshop, 29 of whom were experts from outside the project. The complete list, with detailed information, can be found at the end of this summary.

Institutions

The Summit Foundation, Healthy Reefs, Hol Chan Marine Reserve, Protected Areas Conservation Trust, Wildlife Conservation Society, World Wildlife Fund, Fragments of hope, The Ocean Foundation, Toledo Institute for Development and Environment, Caribbean Community Climate Change Center (CCCCC), University of Belize – Environmental Research Institute, WRI, Belize Tourism Board, National Biodiversity Office – MFFESD, Turneffe Atoll Sustainability Association, Belize Fisheries Department, Wildlife Conservation Society, International Coral Reef Initiative, Smithsonian Institution and Goldman Environmental Foundation.

Opening remarks

In this first session we had the presence of the following four participants:

- Santiago Bucaram, as representative of the Inter-American Development Bank. He highlighted the IADB's role in financing innovative projects within the Natural Capital Lab and explained how this project was hatched and the importance of conserving coral reefs in the Mesoamerican region. He also mentioned the need to collect information and inputs from experts so that the assessment is as close to reality as possible and allows decision makers to be informed.
- Francisco (Patxi) Greño, as representative of Metroeconomica. He introduced the firm (consulting firm specialized in the economic analysis of environmental impacts and the evaluation of public policies, also focusing on energy and sustainable development issues) and the team.
- Mark Spalding, as representative of The Ocean Foundation. He explained the scope and the role of the institution he represents in the present project. They are partnering with WRI México for many projects, including this. These projects include some on the blue economy (the high-level panel for sustainable ocean economics, and blue carbon and nationally based solutions, among others). He also mentioned that economic valuation is extremely important because when you do not value, you do not take care of. One of the things he also wanted to highlight was the expected effects of climate change on the ocean economy. The ocean contributes to the global economy, supporting hundred of thousands of jobs and generating income (approximately USD 2.5 trillion each year). It would the the seventh global economy when compared nations' GDP. In addition, non-market services are significant and may exceed the value added by market based goods and services. However, climate change is affecting ocean economy, so it is needed to reduce greenhouse gases emissions. According to the IPCC, climate change induces declines of four hundred twenty eight billion dollars per year to the economy by 2050 and 1.97 trillion per year by 2100. The High Level Panel for a Sustainable Ocean Economy examines the impacts of climate change across three of the largest ocean-based industries, including wild capture fisheries, marine aquaculture and coral reefs tourism.

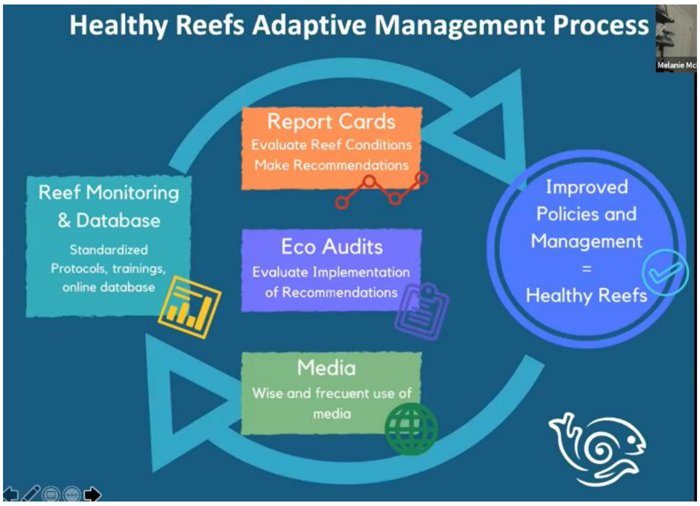
- Maria José González, as representative of MAR Fund. She explained the objective of MAR Fund and its activities in the region.

Importance of the Mesoamerican reef system and monitoring experience

The presentation was made by Melanie McField, Director of Healthy Reefs Initiative.

He presented the latest report (the sixth report after 12 years of monitoring) on the health of the Mesoamerican reef system, which was published in February 2020, entitled "Mesoamerican Reef Report Card. Evaluation of ecosystem health" (https://www.healthyreefs.org/cms/wp-content/uploads/2020/02/2020_Report_Card_MAR.pdf). In particular, she:

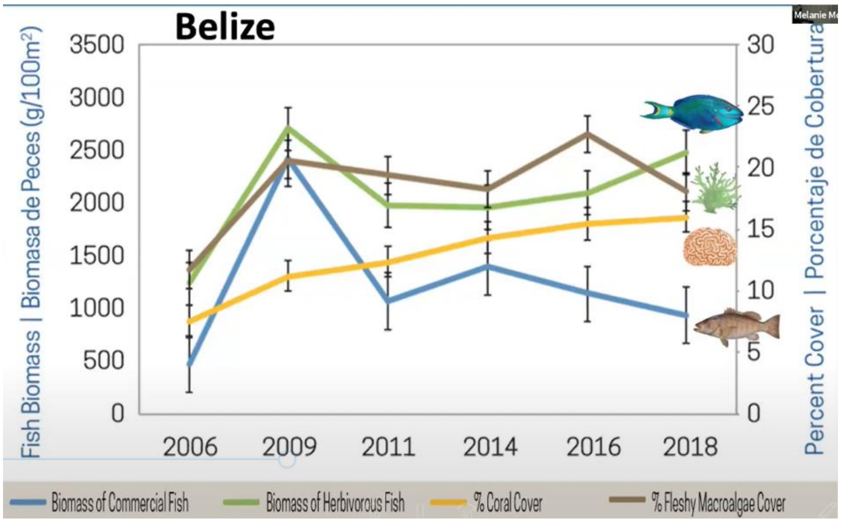
- Explained that Healthy Reef Initiative began in 2004. They conduct regular reporting (Scientific Foundations Guidebook, 2007) and report cards on reef health, collaborate for catalyzing conservation solutions and carry out eco-audits of management implementation (3 eco-audits online).



- There are actually more than 74 organizations in the 4 countries working in the same direction to manage this shared ecosystem.
- To date, they have trained over 250 local monitors (biologists, engineers, etc.) who help them take the data. They have 16 trainers, and 19 weeklong training courses in reef monitoring. They also use 256 database users.
- They use 4 indicators to know if the reef is healthy or not: 1) coral cover; 2) freshy macroalgae cover; 3) herbivorous fish biomass; and 4) commercial fish biomass. The first two compete for space on the seabed and the aim is for much more coral cover rather than freshy macroalgae cover. On this basis, they establish five quality categories: very good, good, fair, poor and critical.
- They have monitored 286 sites with the help of 82 people and 26 organizations. The result is that 16 percent of the reefs are in a critical state, 46 percent in a poor state, 29 percent in a fair state, 8 percent in a good state and only 1 percent in a very good state (specifically in Belize and the Cozumel area). In addition, 7 of the

17 sub-regions into which the study was divided had worsened since the last report in 2018 and only 4 had improved. Two fewer subregions are good, and none are critical.

- Of a possible total of 5 points, which would be the maximum reef health index score, Mexico has 2.8, Belize has 3, Guatemala has 2 and Honduras has 2.5. Belize scored the highest thanks to an increase in herbivorous fish biomass and a decrease in macroalgae. The index in Honduras fell due to a decrease in herbivores fish biomass and an increase in macroalgae. Mexico and Guatemala are stuck with the same index since 2018.
- At the regional level, the health index has declined over time, being 2.8 in 2014 and 2016 compared to 2.5 in 2018, and is classified as poor.
- The main problem is the amount of freshy macroalgae cover, so we must focus the efforts on reducing this cover. This means investing in more wastewater treatment plants, reducing pollution of the seas and reducing the emissions that are affecting our seas.
- As for the results for Belize, she used the following figure to explain the situation:



  - Belize's Reef and Mangroves are worth between USD 395 and 559 million per year – every year – if we maintain it (in 2007 values).
  - USD 500 million (2017) is about 627 million now.
  - However, the full value is "priceless".

- She also mentioned the importance of UN's Sustainable Development Goals to 2030, with special emphasis on SDG 6 (clean water and sanitation), 12 (responsible consumption and production), 13 (climate action) and 14 (life below water) for the four countries.
- There is new Stony Coral Tissue Loss Disease Outbreak (SCTLD) now affecting the MAR: 15 countries/territories with SCTLD present, 9 countries/territories

with SCTLD treatments, 18 countries/territories monitoring with SCTLD and 18 countries/territories with education outreach.
- She pointed out that there is platform called Mapping Ocean Wealth (www.oceanwealth.org)

Presentation of the project

The presentation was made by Francisco (Patxi) Greño, from Metroeconomica. He presented the project (background and objectives, methodology and work Plan).

He highlighted the that the main objectives of the project are as follows:

- Understand the value of the MAR region's coral reef ecosystems;
- Learn about the importance of conserving the MAR region's coral reef ecosystem;
- Inform policy makers (and other stakeholders) of the importance of implementing policies to protect the MAR region's coral reef ecosystem; and
- Determine how value is distributed among stakeholders (public, private, etc.) and willingness to pay for insurance to protect reefs.

He also explained the methodology followed, starting with the first deliverable on the existing literature in this field, to continue with the determination of the assessment methodologies, the realization of the workshops and the obtaining of the results. It was mentioned that a final workshop will be held in which the results will be presented and to which those attending these workshops will be invited.

Finally, it was shown the chronogram of the project and the dates that we are managing for the completion of the project and the different phases.

Importance of valuation for decision making

The presentation was made by Marisol Rivera, from The Ocean Foundation. She focused her talk on highlighting the importance of valuing ecosystems to improve their management.

Economic valuation is key because it allows for:

- Determining costs and benefits of a given policy (its economic viability) so that it can help decide whether or not it is worth intervening;
- Designing policy interventions;
- Assessing the distribution of costs and benefits of environmental degradation/environmental improvements;
- Determining the compensation needed in case of damage; and
- Identifying the contribution of ecosystems and the environment to well-being.

Marisol also presented the main scheme of Total Economic Value and explained the differentiation between use and non-use values.

Finally, she used five applications in order to show why and how economic valuation can be useful for policy-makers.

16) Entrance fee;
17) Payment for ecosystem services;
18) Project evaluation and budget justification;
19) Evaluation and policy design; and
20) Compensation and penalty fees.

There are some initiatives in the Mesoamerican region. She also pointed out that it would be needed to relate pressure indicators, but that it would require having much more information for the baseline.

Marisol also mentioned two iconic cases of economic valuation: the first one was the Exxon Valdez Oil Spill in Alaska, and the second one was the first economic valuation for penalties carried out by Mexico in Alacran Archipelago.

Methodologies for economic valuation and progress of the study

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Finally, Rebeca Kobelkowsky was in charge of making a presentation on the mapping of coral reef areas, with the goal of determining which areas should be selected to calculate their use values (fisheries and tourism). To that end, the following 9 criterion were selected:

28) Sites closed or in marine protected areas;
29) Sites near tourism areas;
30) Contributions to costal protection;
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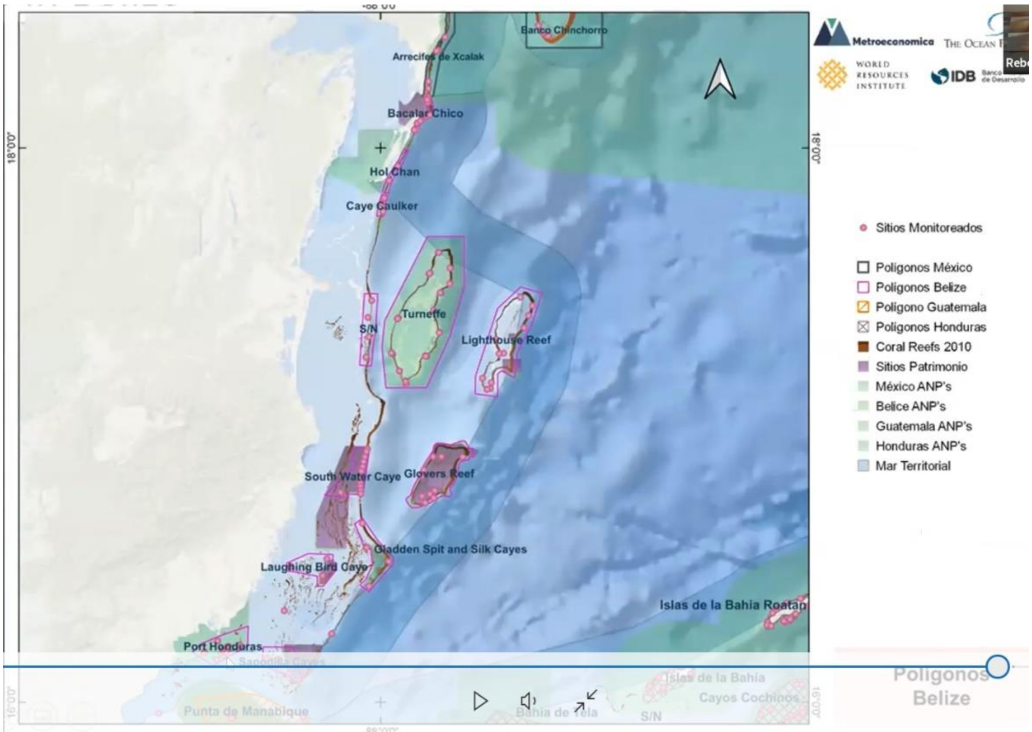

Final comments

- Question/statement: many times, economic valuation does not consider management costs and these costs may be high. Itziar replied that it is true that these costs are key but that their estimation is out of the scope of this project.
- Question: what's the role of the reefs as carbon sinks? Melanie said that it depended on the time scales: in a large time scale (10.000 years), it may work as a sink, but the benefit of corals as sinks themselves is minimal. Corals are home for fish and species that work as sinks and this makes a better case. We need to think of seagrass, for example, as sinks.
- Question: leakage in terms of transborder, fish sold to restaurants or others may be difficult to capture. What is the way to calculate the leakages? Marisol replied that we were not considering leakages and that it is a weakness of the model. We know about this, but we do not consider it in the evaluation.
- Marisol also mentioned that evaluations will be done at the macro level using national data.
- The project team (Metroeconomica, WRI, TOF) will keep all participants informed through personal emails, so that they can see the progress and help us in the search for specific information.

List of participants

	Name	Institution	Position
		EXTERNAL EXPERTS	
1	Alanna Waldman	The Summit Foundation	Program Associate
2	Nicole Craig	Healthy Reefs for Healthy People	Country Coordinator
3	Angeline Valentine	MAR Fund	Project Officer
4	Kirah Forman-Castillo	Hol Chan Marine Reserve	Technical Manager
5	Ismael Teul	Protected Areas Conservation Trust	Monitoring Officer
6	Nicole Auil Gomez	Wildlife Conservation Society	Country Director
7	Nadia Bood	World Wildlife Fund	Senior Program Officer, Marine and Climate
8	Lisa Carne	Fragments of hope	Executive director/founder
9	Caroline Oliver	Toledo Institute for Development and Environment	Project Coordinator
10	Vincent Peter	Caribbean Community Climate Change Center	Project Development Specialist
11	Leandra Cho-Ricketts	University of Belize - Environmental Research Institute	Science Director (Marine)
12	Lauretta Burke	WRI	Senior Associate - Ocean Initiative
13	Rasine Gillett	Belize Tourism Board	Tourism Data Specialist
14	Saul Cruz	National Biodiversity Office, MFFESD	Biodiversity Officer
15	Amanda Acosta	Belize Audubon Society	Executive director
16	Valdemar Andrade	Turneffe Atoll Sustainability Association	Executive Director
17	Alicia Eck-Nunez	Belize Fisheries Department	Marine Reserves Operations Manager
18	Christian Barrientos	Wildlife Conservation Society	Mesoamerican Marine Coordinator
19	Melanie McField	Healthy Reefs Initiative / Smithsonian Institution	Director
20	Ben Scheelk	The Ocean Foundation	Program officer
21	Darrel Audinette	Protected Areas Conservation Trust	Conservation Investment Manager
22	Edson Méndez	University of Belize · Department of Science	Undergraduate
23	Eduardo Borbolla		
24	Fidel Cal		
25	Janet Gibson	Wildlife Conservation Society	Biologist and Zoologist
26	Joyce Tun	Protected Areas Conservation Trust	Grant Officer
27	Richard Castillo		
28	Mark J. Spalding	The Ocean Foundation	President
29	Vivian Ramnarace	International Coral Reef Initiative	Fisheries Officer
		TEAM	
30	Santiago Bucaram	IADB	
31	Maria José González	MAR FUND	
32	Marisol Hernández	MAR FUND	
33	Alejandra Navarrete	The Ocean Foundation	
34	Norma P. Arce	WRI	
35	Marisol Rivera	The Ocean Foundation	
36	Rebeca Kobelkowsky	Universidad Autonoma de Baja California Sur/ AICMMARH	
37	Mayela Vargas		
38	Patxi Greño	Metroeconomica	
39	Itziar Ruiz de Gauna	Metroeconomica	

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10. ANNEXES

ANNEX 1. COUNTRY AND TOURISM PROFILES

Table 184. Mexico´s country and tourism profile

MEXICO			
Variable	**Period**	**Unit**	**Source**
			ECONOMY
Gross Domestic Product (GDP)	2009-2020	Millions of MX pesos (prices 2013)	INEGI https://www.inegi.org.mx/temas/pib/default.html#Tabulados
Average annual GDP growth rate	2015-2020	Percent	INEGI https://www.inegi.org.mx/temas/pib/default.html#Tabulados
GDP per cápita	2009-2020	MX pesos	Sistema Nacional de Información Estadística y Geográfica. INEGI. Sistema de Cuentas Nacionales de México. Producto Interno Bruto Trimestral. CONAPO. Proyecciones de la Población de México y de las Entidades Federativas, 2016-2050 y Conciliación Demográfica de México, 1950 -2015. https://www.snieg.mx/cni/escenario.aspx?idOrden=1.1&ind=6207090302&gen=13080&d=n
			DEMOGRAPHY
Population of site	2009-2020	millions of persons	CONAPO. http://www.conapo.gob.mx/work/models/CONAPO/Mapa_Ind_Dem18/index_2.html
Population within 10km of coast	2009-2020	millions of persons	
Average annual population growth	2015-2020	Percent	CONAPO. http://www.conapo.gob.mx/work/models/CONAPO/Mapa_Ind_Dem18/index_2.html
			ENVIRONMENTAL AND COASTAL INFORMATION
Total Land area			
Land area under permanent Crops	2009-2020	Hectares (Has)	SEMARNAT. http://dgeiawf.semarnat.gob.mx:8080/ibi_apps/WFServlet?IBIF_ex=D2_AGRIGAN03_01&IBIC_user=dgeia_mce&IBIC_pass=dgeia_mce&NOMBREANIO=*

Mexico (continue)

Land in urban Areas	2009-2020	Km^2	SEMARNAT. http://dgeiawf.semarnat.gob.mx:8080/ibi_apps/WFServlet?IBIF_ex=D1_SISCDS01_02&IBIC_user=dgeia_mce&IBIC_pass=dgeia_mce&NOMBREANIO=*
Forested Land	2010 y 2015	Hectares (Has)	SEMARNAT. http://dgeiawf.semarnat.gob.mx:8080/ibi_apps/WFServlet?IBIF_ex=D3_RFORESTA01_04&IBIC_user=dgeia_mce&IBIC_pass=dgeia_mce&NOMBREANIO=*
Coral Reef area	ND 2020	Km2.	Total Reef Area in México. CONABIO https://www.biodiversidad.gob.mx/ecosistemas/arrecifes.html Reef area in Quintana Roo. (estimaciones propias con información de XXX)
Area of Mangroves	2015	Hectares (Has)	CONABIO https://www.biodiversidad.gob.mx/monitoreo/smmm/extensionDist Superficie de Maglares en Quintana Roo. (estimaciones propias con información de XXX)
Coastal Shelf Area (to 30-meter depth)			
Marine Protected Areas	2018	Number and Hectares	CONANP. Región Península de Yucatán y Caribe Mexicano https://www.gob.mx/conanp/documentos/region-peninsula-de-yucatan-y-caribe-mexicano?state=published

Table 185. Guatemala's country and tourism profile

GUATEMALA			
Variable	**Period**	**Unit**	**Source**
ECONOMY			
Gross Domestic Product (GDP)	2013-2020	Million GTQ	Banco de Guatemala. https://www.banguat.gob.gt/es/page/cuadros-estadisticos-resumidos File: https://www.banguat.gob.gt/sites/default/files/banguat/cuentasnac/PIB2013/resumidos/1.1_PIB_Tasa_de_Variacion_AR2013.xlsx
Average annual GDP growth rate	2014-2020	Percent	Banco de Guatemala. https://www.banguat.gob.gt/es/page/cuadros-estadisticos-resumidos File: https://www.banguat.gob.gt/sites/default/files/banguat/cuentasnac/PIB2013/resumidos/1.1_PIB_Tasa_de_Variacion_AR2013.xlsx
GDP per cápita	2009-2020	USD	World Bank. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=GT
DEMOGRAPHY			
Population of site	2008-2020		Instituto Nacional de Estadística. http://www.oj.gob.gt/estadisticaj/reportes/poblacion-total-por-municipio(1).pdf
Population within 10km of coast	2009-2020		Instituto Nacional de Estadística. http://www.oj.gob.gt/estadisticaj/reportes/poblacion-total-por-municipio(1).pdf
Average annual population growth	2010-2050		Instituto Nacional de Estadística. https://www.ine.gob.gt/ine/proyecciones/
ENVIRONMENTAL AND COASTAL INFORMATION			
Total Land area		Km2	Land Area. World Bank https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=GT File: http://api.worldbank.org/v2/en/indicator/AG.LND.TOTL.K2?downloadformat=excel

Guatemala (continue)

Land area under permanent Crops	2009-2020	% of Land Area	Agricultural Land. World Bank https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?locations=GT File: http://api.worldbank.org/v2/en/indicator/AG.LND.AGRI.ZS?downloadformat=excel
Land in urban Areas	2009-2020	Km2	Urban land area. World Bank. https://data.worldbank.org/indicator/AG.LND.TOTL.UR.K2?locations=GT File: http://api.worldbank.org/v2/en/indicator/AG.LND.TOTL.K2?downloadformat=excel
Forested Land	2010 and 2015	% of Land Area	Forest Area. World Bank. https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=GT File: http://api.worldbank.org/v2/en/indicator/AG.LND.FRST.ZS?downloadformat=excel
	2001	n.a.	Reef area. World Atlas of Coral Reefs. https://archive.org/details/worldatlasofcora01spal/page/114/mode/2up
Coral Reef area	2020	Has	Reef area estimaciones propias con información de XXX)
	2007	M2	Reef area in Punta de Manabique. Plan maestro de Punta de Manabique. Fuente: CONANP. https://conap.gob.gt/wp-content/uploads/2019/10/PM-. RVS-Punta-de-Manabique.pdf
Area of Mangroves			
Coastal Shelf Area (to 30-meter depth)			
	2006	Has	CONAP. https://conap.gob.gt/wp-content/uploads/2019/10/PM-. RVS-Punta-de-Manabique.pdf
Marine Protected Areas			CONAP. https://turismo-sigap.conap.gob.gt/?s=manabique
	2020	Number	

Table 186. Honduras' country and tourism profile

HONDURAS			
Variable	**Period**	**Unit**	**Source**
ECONOMY			
Gross Domestic Product (GDP)	2010-2019	Million Lempiras	Banco Central de Honduras https://www.bch.hn/pib_base2000.php File: https://www.bch.hn/esteco/sector_real/pib/pibenfoque_produccion.xls
Average annual GDP growth rate	2010-2019	Percent (based on USD)	Banco Central de Honduras https://www.bch.hn/pib_base2000.php File: https://www.bch.hn/esteco/sector_real/pib/pibenfoque_produccion.xls
GDP per cápita	2010-2019	USD	Banco Central de Honduras https://www.bch.hn/pib_base2000.php File: https://www.bch.hn/esteco/sector_real/pib/pibinpc_dolares.xls
DEMOGRAPHY			
Population of site	2013-2020	People	Instituto Nacional de Estadística. http://170.238.108.227/binhnd/RpWebEngine.exe/Portal?BASE=PROYPOB&lang=ESP
Population within 10km of coast	2013-2020	People	Instituto Nacional de Estadística http://170.238.108.227/binhnd/RpWebEngine.exe/Portal?BASE=PROYPOB&lang=ESP
Average annual population growth	2013-2020	Percent	Instituto Nacional de Estadística. http://170.238.108.227/binhnd/RpWebEngine.exe/Portal?BASE=PROYPOB&lang=ESP
ENVIRONMENTAL AND COASTAL INFORMATION			
Total Land area		Km2	Land Area. World Bank https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=HN File: http://api.worldbank.org/v2/en/indicator/AG.LND.TOTL.K2?downloadformat=excel

Honduras (continue)

Land area under permanent Crops	2009-2020	% of Land Area	Agricultural Land. World Bank https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?locations=HN File: http://api.worldbank.org/v2/en/indicator/AG.LND.AGRI.ZS?downloadformat=excel
Land in urban Areas	2009-2020	Km2	Urban land area. World Bank. https://data.worldbank.org/indicator/AG.LND.TOTL.UR.K2?locations=HN File: http://api.worldbank.org/v2/en/indicator/AG.LND.TOTL.K2?downloadformat=excel
Forested Land	2010 y 2015	% of Land Area	Forest Area. World Bank. https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=HN File: http://api.worldbank.org/v2/en/indicator/AG.LND.FRST.ZS?downloadformat=excel
Coral Reef area	2001	Km2	Reef area. World Atlas of Coral Reefs. https://archive.org/details/worldatlasofcora01spal/page/114/mode/2up
	2020	Has	Reef area estimaciones propias con información de XXX)
Area of Mangroves	2001	Km2	Mangrove area. World Atlas of Coral Reefs. https://archive.org/details/worldatlasofcora01spal/page/114/mode/2up
	2019	Has	Anuario estadístico forestal de Honduras. ICF. http://sigmof.icf.gob.hn/downloads/Anuario-Forestal-2019.pdf
Coastal Shelf Area (to 30-meter depth)			
Marine Protected Areas	2020	Number and Hectares	Instituto de Conservación Forestal. http://sigmof.icf.gob.hn/?page_id=6583

Table 187. Belize s country and tourism profile

BELIZE			
Variable	**Period**	**Unit**	**Source**
ECONOMY			
Gross Domestic Product (GDP)	2009-2020	BZ$ million	Statistical Institute of Belize http://sib.org.bz/statistics/gross-domestic-product/ File:http://sib.org.bz/wp-content/uploads/GDP_Activity_1992-2018.xlsx
Average annual GDP growth rate	2015-2020	Percent	Statistical Institute of Belize http://sib.org.bz/statistics/gross-domestic-product/ File:http://sib.org.bz/wp-content/uploads/GDP_Activity_Percent_Change_1981-2018.xlsx
GDP per cápita	2009-2020	BZ$	Statistical Institute of Belize http://sib.org.bz/statistics/gross-domestic-product/ File:http://sib.org.bz/wp-content/uploads/GDP_Activity_1992-2018.xlsx
DEMOGRAPHY			
Population of site.	2009-2020	People	Statistical Institute of Belize http://sib.org.bz/statistics/population/
Population within 10km of coast.	2009-2020	People	Statistical Institute of Belize http://sib.org.bz/statistics/population/
Average annual population growth,	2015-2020	Percent	Statistical Institute of Belize http://sib.org.bz/statistics/population/
ENVIRONMENTAL AND COASTAL INFORMATION			
Total Land area.	2010-2018	Km2	Land Area. World Bank https://data.worldbank.org/indicator/AG.LND.TOTL.K2?locations=BZ File: http://api.worldbank.org/v2/en/indicator/AG.LND.TOTL.K2?downloadformat=excel
Land area under permanent Crops.	2010-2016	% of Land Area	Agricultural Land. World Bank https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?locations=BZ File: http://api.worldbank.org/v2/en/indicator/AG.LND.AGRI.ZS?downloadformat=excel

Belize (continue)

Land in urban Areas.	1990, 2000, 2010	Km2	Urban land area. World Bank. https://data.worldbank.org/indicator/AG.LND.TOTL.UR.K2?locations=BZ File: http://api.worldbank.org/v2/en/indicator/AG.LND.TOTL.K2?downloadformat=excel
Forested Land	2010-2016	% of Land Area	Forest Area. World Bank. https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=BZ File: http://api.worldbank.org/v2/en/indicator/AG.LND.FRST.ZS?downloadformat=excel
Coral Reef area	2001	Km2	World Atlas of Coral Reefs. https://archive.org/details/worldatlasofcora01spal/page/114/mode/2up
	2020	Has	Reef area in Belize (estimaciones propias con información de XXX)
Area of Mangroves.	2001	Km2	World Atlas of Coral Reefs. https://archive.org/details/worldatlasofcora01spal/page/114/mode/2up
Coastal Shelf Area (to 30-meter depth).			
Marine Protected Areas	2014	Number and Acres	National Protected Areas System (NPAS). http://protectedareas.gov.bz/marine-reserves/

ANNEX 2. DIRECT EXPENSES AND ACCOMODATION INFORMATION PER COUNTRY

Table 188. Mexico. Direct expenses and accommodation

MEXICO			
Variable	**Period**	**Unit**	**Source**
Annual number of “Stay Over” Visitors	2018	Number	SECTUR https://www.datatur.sectur.gob.mx/ITxEF/ITxEF_QROO.aspx SEDETUR Quintana Roo. Indicadores Turísticos Enero-Diciembre 2009-2019 https://qroo.gob.mx/sedetur/indicadores-turisticos
Llegada de Turistas totales a la Entidad	2009-2019	Tourists	2009: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTuristicos2009.pdf 2010: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTuristicos2010.pdf 2011: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTuristicos2011.pdf 2012: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTuristicos2012.pdf 2013: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTuristicos2013.pdf 2014: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/indicadoresturisticos2014.pdf
Tourist flow in Quintana Roo Visitors flow in Quintana Roo	2009-2019	Visitors	2015: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTur-Diciembre2016.pdf 2016: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTur-Diciembre2016.pdf 2017: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/IndicadoresTur-Diciembre2017.pdf 2018: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/Indicador-Tur-Dic-2018.pdf 2019: https://sedeturqroo.gob.mx/ARCHIVOS/indicadores/Indicador-Tur-Dic-2019.pdf
Percent of visitors Using Reef % of Tourists doing water activities	2017-2018	Percent	Estudios de Perfil del comportamiento del turista 2017 y 2018 SEDETUR Quintana Roo https://qroo.gob.mx/sedetur/estudios-del-perfil-del-turista-en-quintana-roo-2018 https://qroo.gob.mx/sedetur/estudios-del-perfil-del-turista-en-quintana-roo-0
%of Tourists going to recreational parks	2017-2018	Percent	
%of Tourists traveling for sun and beach	2017-2018	Percent	

Mexico (continue)

Average hour hotel wage			Collecting through interviews or experts
Hour worked per week			Collecting through interviews or experts
Persons employed per room			Collecting through interviews or experts
Non-Labor Operating Costs			Collecting through interviews or experts
Tax rate			Ley del Impuesto al Valor Agregado. http://www.diputados.gob.mx/LeyesBiblio/pdf/77_091219.pdf
VAT	2010-2020	Percent	Ley del impuesto al Hospedaje. 2016: http://documentos.congresoqroo.gob.mx/leyes/fiscal/ley010/L1520161215028.pdf 2018: http://documentos.congresoqroo.gob.mx/leyes/L187-XV-27122017-611.pdf
Local tax rate	2016-2018	Percent	L.C. http://documentos.congresoqroo.gob.mx/transparencia/proceso_legislativo/iniciativas/I1520171106004.pdf Solidaridad: http://documentos.congresoqroo.gob.mx/historial/15_legislatura/decretos/1anio/1PO/dec034/E1520161215034.pdf Cozumel: https://cozumel.gob.mx/wp-content/themes/isla-cozumel-v2/SaneamientoAmbiental/LeyHacienda.pdf
Derecho de saneamiento ambiental in Lázaro Cárdenas, Solidaridad and Cozumel.	2018, 2016, 2019-2020	$MXN per room	
Service Charge rate			Collecting through interviews or experts
Rooms foreign owned			Collecting through interviews or experts
Average room rate			Collecting through interviews or experts
Average occupancy rate			
Porcentaje de ocupación de la Entidad	2018	Percent	SECTUR https://www.datatur.sectur.gob.mx/ITxEF/ITxEF_QROO.aspx
Occupancy rate in Quintana Roo	2009-2019	Percent	SEDETUR Quintana Roo. Indicadores Turísticos Enero-Diciembre 2009-2019 https://qroo.gob.mx/sedetur/indicadores-turisticos

Mexico (continue)

Number of rooms. Cuartos y unidades de hospedaje registrados por municipio según tipo de alojamiento / Al 31 de diciembre de 2018	2017-2018	Number of rooms	INEGI. https://www.inegi.org.mx/app/areasgeograficas/?ag=23 File: 2017: https://www.inegi.org.mx/contenidos/temas/areasgeograficas/infxentidad/QRoo/2018/21/21.2.xls 2018: https://www.inegi.org.mx/contenidos/temas/areasgeograficas/infxentidad/QRoo/2019/21/21.2.xls
Hotels in Quintana Roo	2009-2019	Number of rooms	SEDETUR Quintana Roo. Indicadores Turísticos Enero-Diciembre 2009-2019 https://qroo.gob.mx/sedetur/indicadores-turisticos
Number of accomodations. Accomodations registered in Quintana Roo by type.	2017-2018	Number	INEGI. https://www.inegi.org.mx/app/areasgeograficas/?ag=23 Files 2017: https://www.inegi.org.mx/contenidos/temas/areasgeograficas/infxentidad/QRoo/2018/21/21.1.xls 2018:https://www.inegi.org.mx/contenidos/temas/areasgeograficas/infxentidad/QRoo/2019/21/21.1.xls
Hotels in Quintana Roo	2009-2019	Number	SEDETUR Quintana Roo. Indicadores Turísticos Enero-Diciembre 2009-2019 https://qroo.gob.mx/sedetur/indicadores-turisticos

Table 189. Guatemala. Direct expenses and accommodation

GUATEMALA			
Variable	**Period**	**Unit**	**Source**
Annual number of "Stay Over" Visitors.			INGUAT. http://www.inguat.gob.gt/index.php/informacion-estadistica/estadisticas/category/79-boletines-estadisticos
Tourists in Guatemala	2018-2020 (sept)	Tourists	UNWTO. https://www.unwto.org/statistic/basic-tourism-statistics
Overnight tourists' arrivals Tourists, Cruise passengers)	2010-2019	Thousands	File: https://webunwto.s3.eu-west-1.amazonaws.com/s3fs-public/2020-10/Arrivals-1995-2019.xlsx
Percent of visitors Using Reef.			INGUAT. http://www.inguat.gob.gt/index.php/informacion-estadistica/estadisticas/category/78-2018
% of Tourists in Izabal visiting beaches and Protected Areas	2018	Percent	File: http://www.inguat.gob.gt/index.php/informacion-estadistica/estadisticas/category/78-2018?download=395:perfil-del-visitante-del-departamento-de-izabal
Average hour hotel wage.			Collecting through interviews or experts
Hour worked per week.			Collecting through interviews or experts
Persons employed per room.			Collecting through interviews or experts
Non-Labor Operating Costs			Collecting through interviews or experts
Tax rate.			Collecting through interviews or experts
Service Charge rate.			Collecting through interviews or experts
Rooms foreign owned			Collecting through interviews or experts

Guatemala (continue)

Average room rate			
Average prices in Antigua Guatemala	2016	USD	El mercado del turismo en Guatemala. Oficina Económica y Comercial de la Embajada de España en Guatemala.
Prices by type of room in Guatemala City			
Average occupancy rate	2010-2017	Percent	INGUAT. Boletin De Ocupación Hotelera Y Movimiento Hotelero De Turistas Residentes Y No Residentes.
Number of rooms			INGUAT. http://www.inguat.gob.gt/index.php/servicios/al-turista/directorio-de-servicios-registrados
Rooms in Honduras and Izabal	2020	Number of rooms	File: http://www.inguat.gob.gt/index.php/servicios/al-turista/directorio-de-servicios-registrados?download=141:directorio-de-servicios-registrados-y-recomendables
Number of accommodations			INGUAT. http://www.inguat.gob.gt/index.php/servicios/al-turista/directorio-de-servicios-registrados
Accommodations in Izabal	2020	Number of hotels	File: http://www.inguat.gob.gt/index.php/servicios/al-turista/directorio-de-servicios-registrados?download=141:directorio-de-servicios-registrados-y-recomendables

Table 190. Honduras. Direct expenses and accommodation

HONDURAS			
Variable	**Period**	**Unit**	**Source**
Annual number of "Stay Over" Visitors.			UNWTO. https://www.unwto.org/statistic/basic-tourism-statistics File: https://webunwto.s3.eu-west-1.amazonaws.com/s3fs-public/2020-10/Arrivals-1995-2019.xlsx
Overnight tourists' arrivals (Tourists, Cruise passengers)	2010-2018	Thousands	Instituto Nacional de Estadística de Honduras. https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/3SectoresEconomicos.html Fie:
Arrival of tourists (Tourists, Cruise passengers). Note: is the same series as the UNWTO.	2011-2016	Tourists	https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/Cuadros/3/3.8.3.xls
Percent of visitors Using Reef.			Instituto Nacional de Estadística de Honduras. https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/3SectoresEconomicos.html Fie:
Percentage of tourists using beaches	2016-2017	Percent	
Percentage of tourists diving	2016-2017	Percent	https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/Cuadros/3/3.8.1.xls
Average hour hotel wage.			Collecting through interviews or experts
Hour worked per week.			Collecting through interviews or experts
Persons employed per room.			Collecting through interviews or experts
Non-Labor Operating Costs			Collecting through interviews or experts
Tax rate.			Collecting through interviews or experts
Service Charge rate.			Collecting through interviews or experts
Rooms foreign owned			Collecting through interviews or experts
Average room rate			Collecting through interviews or experts
Average occupancy rate	2010	Percent	Instituto Hondureño del Turismo. https://sitca.info/wp-content/uploads/2020/01/Boletin-de-Estadisticas-2010_compressed.pdf
Number of rooms			Collecting through interviews or experts
Number of accommodations	2014-2016	Number	Instituto Nacional de Estadística de Honduras. https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/3SectoresEconomicos.html File: https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/Cuadros/3/3.8.10.xls

Table 191. Belize. Direct expenses and accommodation

BELIZE			
Variable	**Period**	**Unit**	**Source**
Annual number of "Stay Over" Visitors. Overnight tourists' arrivals	2010-2020	Tourist	Belize Tourism Board, Statistical Institute of Belize File: 2002-2018: http://sib.org.bz/wp-content/uploads/TourismStatistics.xlsx Belize Tourism Board. Tourism Statistics Digest 2019: https://infogram.com/overnight-tourist-arrivals-1hdw2j7kjq1x2l0
Percent of visitors Using Reef.			
% of Tourists diving, snorkeling and fishing.	2014-2019	Percent	Belize Tourism Board. Tourism Statistics Digest 2014-2018.
% of Tourists visiting Barrier Reef, Blue Hole and MPA's	2014-2019	Percent	
Average hour hotel wage.			Collecting through interviews or experts
Hour worked per week.			Collecting through interviews or experts
Persons employed per room.	2010-2018	Number	Calculated with data from Belize Tourism Board, Statistical Institute of Belize File: 2002-2018: http://sib.org.bz/wp-content/uploads/TourismStatistics.xlsx
Non-Labor Operating Costs			Collecting through interviews or experts
Tax rate.	2010-2020	Percent	Department of General Sales Tax. http://gst.gov.bz/gst-faqs/
Service Charge rate.	2010-2020	Percent	Tourism accommodation Tax. Belize Tourism Board. https://www.belizetourismboard.org/industry-sectors/hotel-and-tourist-accommodation-taxes/
Rooms foreign owned			Collecting through interviews or experts
Average room rate	2010-2019	$BZ	Belize Tourism Board, Statistical Institute of Belize File: 2002-2018: http://sib.org.bz/wp-content/uploads/TourismStatistics.xlsx 2019. Accomodation Sector Perfomance. Belize Tourism Board. https://infogram.com/accommodation-sector-performance-1h7g6kvool5g4oy

Belize (continue)

Average occupancy rate	2010-2019	Percent	Belize Tourism Board, Statistical Institute of Belize File: 2002-2018: http://sib.org.bz/wp-content/uploads/TourismStatistics.xlsx 2019. Accomodation Sector Perfomance. Belize Tourism Board. https://infogram.com/accommodation-sector-performance-1h7g6kvool5g4oy
Number of rooms	2010-2019	Rooms	Belize Tourism Board, Statistical Institute of Belize File: 2002-2018: http://sib.org.bz/wp-content/uploads/TourismStatistics.xlsx 2019. Accomodation Sector Perfomance. Belize Tourism Board. https://infogram.com/accommodation-sector-performance-1h7g6kvool5g4oy
Number of accommodations	2010-2019	Hotels	Belize Tourism Board, Statistical Institute of Belize File: 2002-2018: http://sib.org.bz/wp-content/uploads/TourismStatistics.xlsx 2019. Accomodation Sector Perfomance. Belize Tourism Board. https://infogram.com/accommodation-sector-performance-1h7g6kvool5g4oy

ANNEX 3. MARINE PROTECTED AREAS

Table 192. Mexico. Marine Protected Areas

MEXICO			
Variable	**Period**	**Unit**	**Source**
Number of marine parks	2018	Number	CONANP. https://www.gob.mx/conanp/documentos/region-peninsula-de-yucatan-y-caribe-mexicano?state=published
Visitors	2010-2019	Visitors	Estimated with data from CONANP and Ley Federal de Derechos. https://www.conanp.gob.mx/acciones/recursos_gen.php http://www.diputados.gob.mx/LeyesBiblio/ref/lfd.htm
Number of divers (Percentage of tourists doing water recreation activities)	2017-2018		Estudios de Perfil del comportamiento del turista 2017 y 2018 SEDETUR Quintana Roo https://qroo.gob.mx/sedetur/estudios-del-perfil-del-turista-en-quintana-roo-2018 https://qroo.gob.mx/sedetur/estudios-del-perfil-del-turista-en-quintana-roo-0
Fees collected	2010-2019	$mxn	Ley Federal de Derechos 2010-2019 México: Diario Oficial de la Federación.

Table 193. Guatemala. Marine Protected Areas

GUATEMALA			
Variable	**Period**	**Unit**	**Source**
Area of Punta de Manabique		Has	Plan maestro de Punta de Manabique. Fuente: CONANP. https://conap.gob.gt/wp-content/uploads/2019/10/PM-. RVS-Punta-de-Manabique.pdf
Fees collected			Collecting through interviews or experts.
Number of visitors			Collecting through interviews or experts.
Number of MPA in Guatemala	2019	Number	https://www.sciencedirect.com/science/article/abs/pii/S0308597X16307163

Table 194. Honduras. Marine Protected Areas

HONDURAS			
Variable	**Period**	**Unit**	**Source**
Visitors to MPA's: Cayos Cochinos, B.Jeannette Kawas, Punta Izopo, Islas de Bahía.	2010-2018	Visitors.	Departamento de Áreas Protegidas del ICF, Co manejadores, Instituto Hondureño de Turismo (IHT). https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/Cuadros/1/1.4/1.4.3.xls
Area and number of marine areas	2020	Has	Estadísticas de Áreas Protegidas en Honduras. Instituto de Conservación Forestal http://sigmof.icf.gob.hn/?page_id=6583
Fees collected			Collecting through interviews or experts.

Table 195. Belize. Marine Protected Areas

BELIZE			
Variable	**Period**	**Unit**	**Source**
Visitors to Hol Chan	2010-2019	Visitors	Belize Tourism Board. Tourism Statistics Digest 2014-2019 Files: 2014: http://belizetourismboard.org/wp-content/uploads/2016/03/2014_Tourism_DigestWEB.pdf 2015: http://belizetourismboard.org/wp-content/uploads/2016/09/BTB-TRAVEL-DIGEST-2015-FINAL.pdf 2016: http://belizetourismboard.org/wp-content/uploads/2018/07/TravelTourismDigest2017v2.pdf 2017: http://belizetourismboard.org/wp-content/uploads/2018/07/TravelTourismDigest2017v2.pdf 2018: http://belizetourismboard.org/wp-content/uploads/2019/07/2018-TT-Statistics-Digest_Final.pdf 2019: https://infogram.com/visits-to-protected-areas-in-belize-1hzj4omnn1w76pw
Visitors to Half Moon Caye	2010-2019	Visitors	Belize Tourism Board. Tourism Statistics Digest 2014-2019 Files: 2014: http://belizetourismboard.org/wp-content/uploads/2016/03/2014_Tourism_DigestWEB.pdf 2015: http://belizetourismboard.org/wp-content/uploads/2016/09/BTB-TRAVEL-DIGEST-2015-FINAL.pdf 2016: http://belizetourismboard.org/wp-content/uploads/2018/07/TravelTourismDigest2017v2.pdf 2017: http://belizetourismboard.org/wp-content/uploads/2018/07/TravelTourismDigest2017v2.pdf 2018: http://belizetourismboard.org/wp-content/uploads/2019/07/2018-TT-Statistics-Digest_Final.pdf 2019: https://infogram.com/visits-to-protected-areas-in-belize-1hzj4omnn1w76pw

Visitors to Blue Hole	2010-2018	Visitors	Belize Tourism Board. Tourism Statistics Digest 2014-2018 Files: 2014: http://belizetourismboard.org/wp-content/uploads/2016/03/2014_Tourism_DigestWEB.pdf 2015: http://belizetourismboard.org/wp-content/uploads/2016/09/BTB-TRAVEL-DIGEST-2015-FINAL.pdf 2016: http://belizetourismboard.org/wp-content/uploads/2018/07/TravelTourismDigest2017v2.pdf 2017: http://belizetourismboard.org/wp-content/uploads/2018/07/TravelTourismDigest2017v2.pdf 2018: http://belizetourismboard.org/wp-content/uploads/2019/07/2018-TT-Statistics-Digest_Final.pdf
Visitors to MPA Port Honduras.	2019	Visitors	Toledo Institute for Development and Environment http://tidebelize.org/wp-content/uploads/2020/05/2019-PHMR-Annual-Report.pdf
Fees collected. Glover´s Reef Atoll.	2015	USD	Glover's Reef Atoll. https://www.glovers.com.bz/#:~:text=In%201996%20the%20reef%20was,US%20per%20day%20per%20person.
Half Moon Caye and Blue Hole Caye	2015	USD	Data from WWF Belize.

ANNEX 4. RECREATIONAL ACTIVITIES

Table 196. Mexico. Recreational activities outside of NPA (snorkeling and diving)

Variable	Period	Unit	Source
Diving			
Total visitors			Collecting through interviews or experts
% of visitors diving			Collecting through interviews or experts
Number of dives			Collecting through interviews or experts
Price of dive	2020	USD	Data from individual operators.
Number of dive certifications			Collecting through interviews or experts
Price of equipment	2020	USD	Data from individual operators.
Tax rate			Collecting through interviews or experts
Service Charge			Collecting through interviews or experts
Labor costs			Collecting through interviews or experts
Snorkeling			
Total visitors			Collecting through interviews or experts
% of visitors snorkeling			Collecting through interviews or experts
Number of trips per snorkeler			Collecting through interviews or experts
Average trip price	2020	USD	Data from individual operators.
Proportion of all snorkel trips with equipment rental			Collecting through interviews or experts
Average price per snorkel trip of equipment rental	2020	USD	Data from individual operators.
Tax rate			Collecting through interviews or experts
Service Charge			Collecting through interviews or experts
Labor costs			Collecting through interviews or experts

Table 197. Guatemala. Recreational activities outside of NPA (snorkeling and diving)

Diving			
Variable	**Variable**	**Variable**	**Variable**
Total visitors			Collecting through interviews or experts
% of visitors diving			Collecting through interviews or experts
Number of dives			Collecting through interviews or experts
Price of dive			Collecting through interviews or experts
Number of dive certifications			Collecting through interviews or experts
Price of equipment			Collecting through interviews or experts
Tax rate			Collecting through interviews or experts
Service Charge			Collecting through interviews or experts
Labor costs			Collecting through interviews or experts
Snorkeling			
Total visitors			Collecting through interviews or experts
% of visitors snorkeling			Collecting through interviews or experts
Number of trips per snorkeler			Collecting through interviews or experts
Average trip price			Collecting through interviews or experts
Proportion of all snorkel trips with equipment rental			Collecting through interviews or experts
Average price per snorkel trip of equipment rental			Collecting through interviews or experts
Tax rate			Collecting through interviews or experts
Service Charge			Collecting through interviews or experts
Labor costs			Collecting through interviews or experts

Table 198. Honduras. Recreational activities outside of NPA (snorkeling and diving)

Variable	Period	Unit	Source
Diving			
Total visitors			Collecting through interviews or experts
% of visitors diving	2015-2016	Percent	Instituto Hondureño de Turismo. File: https://www.ine.gob.hn/publicaciones/anuarios%20sen/Anuariosen2014-2018/Cuadros/3/3.8.1.xls
Number of dives			Collecting through interviews or experts
Price of dive	2020	USD	Data from individual operators.
Number of dive certifications			Collecting through interviews or experts
Price of equipment	2020	USD	Data from individual operators.
Tax rate Sales Tax (15%)	2020	Percent	Data from individual operators.
Service Charge Average service tax (10%)	2020	Percent	Data from individual operators.
Labor costs			Collecting through interviews or experts
Snorkeling			
Total visitors			Collecting through interviews or experts
% of visitors snorkeling			Collecting through interviews or experts
Number of trips per snorkeler			Collecting through interviews or experts
Average trip price	2020	USD	Data from individual operators.
Proportion of all snorkel trips with equipment rental			Collecting through interviews or experts
Average price per snorkel trip of equipment rental			Collecting through interviews or experts
Tax rate	2020	Percent	Data from individual operators.
Service Charge	2020	Percent	Data from individual operators.
Labor costs			Collecting through interviews or experts

Table 199. Belize. Recreational activities outside of NPA (snorkeling and diving)

Diving			
Variable	**Period**	**Unit**	**Source**
Total visitors			Collecting through interviews or experts
Number of divers in Hol Chan	2010-2019	Number	Belize Tourism Board. Belize Travel and Tourism Digest. https://www.belizetourismboard.org/belize-tourism/statistics/
Divers in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015		Data from WWF Belize.
% of visitors diving	2014-2019	Percent	Belize Tourism Board. Belize Travel and Tourism Digest. https://www.belizetourismboard.org/belize-tourism/statistics/
Number of dives			
Price of dive	2020	USD	Data from individual operators.
Prices in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015	USD	Data from WWF Belize.
Number of dive certifications			Collecting through interviews or experts
Price of equipment			
Prices in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015	USD	Data from WWF Belize.
Tax rate. Goverment sales tax (12.5%)	2010-2020	Percent	Department of General Sales Tax. http://gst.gov.bz/gst-faqs/
Service Charge Average service charge (10%)		Percent	Collecting through interviews or experts
Labor costs			Collecting through interviews or experts

Snorkeling			
Total visitors	2010-2019		Belize Tourism Board. Belize Travel and Tourism Digest.
Number of snorkelers in Hol Chan MPA 2010-2019.		Number	https://www.belizetourismboard.org/belize-tourism/statistics/
Snorkelers in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015		Data from WWF Belize
% of visitors snorkeling	2014-2019	Percent	Belize Tourism Board. Belize Travel and Tourism Digest. https://www.belizetourismboard.org/belize-tourism/statistics/
Number of trips per snorkeler			Collecting through interviews or experts
Average trip Price	2020	USD	Data from individual operators.
Prices in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015	USD	Data from WWF Belize.
Proportion of all snorkel trips with equipment rental.			
Proportion in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015	Percent	Data from WWF Belize.
Average price per snorkel trip of equipment rental.	2020	USD	Data from individual operators.
Prices in Half Moon Caye, Blue Hole Monument, Glover´s Reef Atoll and Laughing Bird Caye.	2015	USD	Data from WWF Belize.
Tax rate. General.	2010-2020	Percent	Department of General Sales Tax. http://gst.gov.bz/gst-faqs/
Service Charge			Collecting through interviews or experts
Labor costs			Collecting through interviews or experts

ANNEX 5. COMMERCIAL FISHERIES REEF RELATED

Table 200. Commercial fisheries reef-related in Mexico

Order	Family	Species	Name	Occurrence	Use	Use elsewhere
Albuliformes	Albulidae	Albula vulpes	Bonefish	native	minor commercial	minor commercial
Perciformes	Carangidae	Alectis ciliaris	African pompano	native	minor commercial	minor commercial
Perciformes	Sparidae	Archosargus probatocephalus	Sheepshead	native	commercial	commercial
Tetraodontiformes	Balistidae	Balistes polylepis	Finescale triggerfish	native	minor commercial	commercial
Perciformes	Carangidae	Caranx crysos	Blue runner	native	minor commercial	minor commercial
Perciformes	Carangidae	Caranx hippos	Crevalle jack	native	commercial	commercial
Perciformes	Carangidae	Caranx sexfasciatus	Bigeye trevally	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus acronotus	Blacknose shark	native	highly commercial	minor commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus altimus	Bignose shark	native	minor commercial	minor commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus brevipinna	Spinner shark	native	minor commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus falciformis	Silky shark	native	commercial	highly commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus leucas	Bull shark	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus limbatus	Blacktip shark	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus obscurus	Dusky shark	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus perezi	Caribbean reef shark	native	minor commercial	commercial
Perciformes	Centropomidae	Centropomus undecimalis	Common snook	native	commercial	commercial
Perciformes	Cirrhitidae	Cirrhitus rivulatus	Giant hawkfish	native	commercial	commercial
Perciformes	Carangidae	Decapterus macrosoma	Shortfin scad	native	commercial	commercial
Perciformes	Carangidae	Elagatis bipinnulata	Rainbow runner	native	commercial	highly commercial
Perciformes	Serranidae	Epinephelus itajara	Atlantic goliath grouper	native	minor commercial	minor commercial
Perciformes	Serranidae	Epinephelus morio	Red grouper	native	commercial	commercial
Syngnathiformes	Fistulariidae	Fistularia commersonii	Bluespotted cornetfish	native	minor commercial	minor commercial
Orectolobiformes	Ginglymostomatidae	Ginglymostoma cirratum	Nurse shark	native	highly commercial	minor commercial
Perciformes	Carangidae	Gnathanodon speciosus	Golden trevally	native	commercial	minor commercial
Myliobatiformes	Dasyatidae	Hypanus longus	Longtail stingray	native	minor commercial	minor commercial
Perciformes	Lutjanidae	Lutjanus argentiventris	Yellow snapper	native	commercial	commercial
Perciformes	Lutjanidae	Lutjanus campechanus	Northern red snapper	native	commercial	commercial
Perciformes	Lutjanidae	Lutjanus peru	Pacific red snapper	native	minor commercial	subsistence fisheries
Perciformes	Lutjanidae	Lutjanus synagris	Lane snapper	native	commercial	commercial
Mugiliformes	Mugilidae	Mugil curema	White mullet	native	minor commercial	commercial

Perciformes	Serranidae	Mycteroperca bonaci	Black grouper	native	minor commercial	highly commercial
Perciformes	Serranidae	Mycteroperca prionura	Sawtail grouper	native	subsistence fisheries	subsistence fisheries
Carcharhiniformes	Carcharhinidae	Negaprion brevirostris	Lemon shark	native	minor commercial	commercial
Perciformes	Lutjanidae	Ocyurus chrysurus	Yellowtail snapper	native	commercial	commercial
Perciformes	Serranidae	Paralabrax maculatofasciatus	Spotted sand bass	native	minor commercial	of no interest
Perciformes	Scombridae	Scomberomorus cavalla	King mackerel	native	commercial	commercial
Perciformes	Carangidae	Selar crumenophthalmus	Bigeye scad	native	commercial	highly commercial
Perciformes	Carangidae	Seriola rivoliana	Longfin yellowtail	native	commercial	commercial
Carcharhiniformes	Sphyrnidae	Sphyrna tiburo	Bonnethead	native	commercial	commercial
Perciformes	Carangidae	Trachinotus rhodopus	Gafftopsail pompano	native	commercial	minor commercial
Rhinopristiformes	Trygonorrhinidae	Zapteryx exasperata	Banded guitarfish	native	commercial	minor commercial

Source: Froese, R. and D. Pauly. Editors. 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2019)

Table 201. Commercial fisheries reef-related in Guatemala

Order	Family	Species	Name	Occurrence	Use	Use elsewhere
Albuliformes	Albulidae	Albula vulpes	Bonefish	native	minor commercial	minor commercial

Source: Froese, R. and D. Pauly. Editors. 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2019)

Table 202. Commercial fisheries reef-related in Honduras

Order	Family	Species	Name	Occurrence	Use	Use elsewhere
Albuliformes	Albulidae	Albula vulpes	Bonefish	native	minor commercial	minor commercial
Perciformes	Carangidae	Elagatis bipinnulata	Rainbow runner	native	commercial	highly commercial
Perciformes	Carangidae	Gnathanodon speciosus	Golden trevally	native	commercial	minor commercial
Perciformes	Lutjanidae	Lutjanus colorado	Colorado snapper	native	commercial	commercial
Perciformes	Lutjanidae	Lutjanus novemfasciatus	Pacific dog snapper	native	commercial	commercial
Perciformes	Carangidae	Seriola rivoliana	Longfin yellowtail	native	commercial	commercial
Perciformes	Carangidae	Trachinotus rhodopus	Gafftopsail pompano	native	commercial	minor commercial

Source: Froese, R. and D. Pauly. Editors. 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2019).

Table 203. Commercial fisheries reef-related in Belize

Order	Family	Species	Name	Occurrence	Use	Use elsewhere
Albuliformes	Albulidae	Albula vulpes	Bonefish	native	subsistence fisheries	minor commercial
Tetraodontiformes	Balistidae	Balistes capriscus	Grey triggerfish	native	commercial	commercial
Perciformes	Carangidae	Carangoides bartholomaei	Yellow jack	native	commercial	commercial
Perciformes	Carangidae	Caranx hippos	Crevalle jack	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus leucas	Bull shark	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus limbatus	Blacktip shark	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Carcharhinus perezi	Caribbean reef shark	native	commercial	commercial
Perciformes	Centropomidae	Centropomus undecimalis	Common snook	native	commercial	commercial
Perciformes	Serranidae	Epinephelus itajara	Atlantic goliath grouper	native	commercial	minor commercial
Perciformes	Serranidae	Epinephelus striatus	Nassau grouper	native	commercial	commercial
Orectolobiformes	Ginglymostomatidae	Ginglymostoma cirratum	Nurse shark	native	commercial	minor commercial
Perciformes	Haemulidae	Haemulon aurolineatum	Tomtate grunt	native	commercial	minor commercial
Perciformes	Labridae	Halichoeres caudalis	Painted wrasse	native	minor commercial	minor commercial
Perciformes	Labridae	Lachnolaimus maximus	Hogfish	native	commercial	minor commercial
Perciformes	Lutjanidae	Lutjanus analis	Mutton snapper	native	commercial	highly commercial
Perciformes	Lutjanidae	Lutjanus griseus	Grey snapper	native	commercial	commercial
Perciformes	Lutjanidae	Lutjanus jocu	Dog snapper	native	commercial	commercial
Perciformes	Lutjanidae	Lutjanus synagris	Lane snapper	native	commercial	commercial
Elopiformes	Megalopidae	Megalops atlanticus	Tarpon	native	commercial	commercial
Perciformes	Serranidae	Mycteroperca tigris	Tiger grouper	native	commercial	commercial
Carcharhiniformes	Carcharhinidae	Negaprion brevirostris	Lemon shark	native	commercial	commercial
Perciformes	Lutjanidae	Ocyurus chrysurus	Yellowtail snapper	native	commercial	commercial
Perciformes	Pomacanthidae	Pomacanthus arcuatus	Gray angelfish	native	commercial	minor commercial
Perciformes	Rachycentridae	Rachycentron canadum	Cobia	native	minor commercial	minor commercial
Carcharhiniformes	Carcharhinidae	Rhizoprionodon porosus	Caribbean sharpnose shark	native	commercial	commercial
Perciformes	Scombridae	Scomberomorus brasiliensis	Serra Spanish mackerel	native	commercial	commercial
Perciformes	Scombridae	Scomberomorus regalis	Cero	native	commercial	minor commercial
Perciformes	Sphyraenidae	Sphyraena barracuda	Great barracuda	native	commercial	minor commercial
Perciformes	Carangidae	Trachinotus falcatus	Permit	native	commercial	commercial

Source: Froese, R. and D. Pauly. Editors. 2019. FishBase. World Wide Web electronic publication. www.fishbase.org, version (12/2019).

ANNEX 6. COMMERCIAL FISHERIES PROFILE

Table 204. Mexico Fisheries Profile

Variable	Period	Unit	Source
Number of full time and part time fishermen.			
Number of reef fishers.	2010	Number	Teh, L.S.L., Teh, L.C.L., Sumaila, U.R. (2013). A Global Estimate of the Number of Coral Reef Fishers. PLoS ONE, 8 (6): e65397 CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Población pesquera en Quintana Roo.	2010-2018	Number	
Number of small (<15ft) and large (>15ft) boats.			CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Embarcaciones escameras por principales características (tamaño de eslora >15ft)	2010-2018	Number.	
Embarcaciones de pesca de altura y pesca ribereña	2010-2018	Number.	

Number of landing sites. Number of fish processing facilities. Número de plantas en Quintana Roo (total, congelado, enlatado, reducción y otros)	2010-2018	Number	Collecting through interviews or experts CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Annual GDP from fisheries sector.	2010-2019	$mxn	Calculated with data from INEGI. File: https://www.inegi.org.mx/contenidos/temas/economia/pib/pibt/tabulados/ori/PIBT_5.xlsx
Average price of Reef Fish per pound			Collecting through interviews or experts
Average price of Shellfish per pound.			Collecting through interviews or experts

Table 205. Guatemala Fisheries Profile

Variable	Period	Unit	Source
Number of full time and part time fishermen.			
Number of fishermen in Punta Manabique.	2005	Number	CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Number of small (<15ft) and large (>15ft) boats.			
Number of small boats in Punta Manabique.	2005	Number	CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Number of landing sites.			Collecting through interviews or experts
Number of fish processing facilities.			Collecting through interviews or experts
Annual GDP from fisheries sector.			Collecting through interviews or experts
Average price of Reef Fish per pound			Collecting through interviews or experts
Average price of Shellfish per pound.			Collecting through interviews or experts

Table 206. Honduras Fisheries Profile

Variable	Period	Unit	Source
Number of full time and part time fishermen			Teh, L.S.L., Teh, L.C.L., Sumaila, U.R. (2013). A Global Estimate of the Number of Coral Reef Fishers. PLoS ONE, 8 (6): e65397
Number of reef fishers	2010	Number	FAO. http://www.fao.org/fishery/facp/HND/es
Number of fishermen employed	2013	Number	
Number of small (<15ft) and large (>15ft) boats.			DIGEPESCA. https://s3.amazonaws.com/appforest_uf/f1555037174728x393538874020303900/TEMPORADAS-PESQUERAS-POR-EMPRESAS-2008-2012.pdf
Number of ships (all sizes)	2010-2013	Number	
Number of landing sites.			FAO. http://www.fao.org/fishery/facp/HND/es
Main landing sites	2013	List	
Number of fish processing facilities.			Collecting through interviews or experts
Annual GDP from fisheries sector.	2013	Percent of GDP	FAO. http://www.fao.org/fishery/facp/HND/es
Average price of Reef Fish per pound			Collecting through interviews or experts
Average price of Shellfish per pound.			Collecting through interviews or experts

Table 207. Belize Fisheries Profile

Variable	Period	Unit	Source
Number of full time and part time fishermen			
Number of reef fishers	2010	Number	Teh, L.S.L., Teh, L.C.L., Sumaila, U.R. (2013). A Global Estimate of the Number of Coral Reef Fishers. PLoS ONE, 8 (6): e65397
Number of Fishers	2010-2018	Number	FAO - Fisheries and Aquaculture Information and Statistics Branch http://www.fao.org/fishery/static/Yearbook/YB2018_USBcard/navigation/index_intro_s.htm
Number of small (<15ft) and large (>15ft) boats.			Collecting through interviews or experts
Number of landing sites.			Collecting through interviews or experts
Number of fish processing facilities.			Collecting through interviews or experts
Annual GDP from fisheries sector.	2010-2018	$Bz	Statistical Institute of Belize http://sib.org.bz/statistics/gross-domestic-product/
Average price of Reef Fish per pound			Collecting through interviews or experts
Average price of Shellfish per pound.			Collecting through interviews or experts

ANNEX 7. COMMERCIAL FISHERIES DATA

Table 208. Mexico Commercial Fisheries Valuation

Variable	Period	Unit	Source
Fish landing approach			
Species/species group	-	List	Fishbase. https://www.fishbase.se/search.php?c_code=484#country
Commercial Reef related species.			
Sales price for each species/species group per unit weight at each landing site (kg/pound/metric ton).			CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Precio promedio al mayoreo y menudeo de productos pesqueros comercializados en el Distrito Federal según presentación (some species only).			
Precios de producción pesquera.	2010-2018		Calculated using weight and value from CONAPESCA. Anuario Estadístico de Acuacultura y Pesca.
Weight (kg/pound/metric ton) of each species of fish caught at each landing site.			CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Producción pesquera Quintana Roo.	2010-2018	Kg.	FAO - Fisheries and Aquaculture Information and Statistics Branch
Catch Production in Mexico	2010-2018	Ton	
Individual Fishermen			
Number of full-time and part-time fishermen			Collecting through interviews or experts

Employment status of surveyed fishermen (full or part time)			Collecting through interviews or experts
Species caught			Collecting through interviews or experts
Average weight (kg/pound) catch/week by species			Collecting through interviews or experts
Number of weeks of year fishermen fish			Collecting through interviews or experts
Sales price of each species/species group per unit weight (kg/pound/metric ton)			Collecting through interviews or experts
Reef Extent			
Area of reef			Calculated with data from XXX.
Reef area in Quintana Roo.	2020	Has	
Average annual reef productivity (fish catch per unit area of reef)			default values available in tool
Average price of fish caught on reef			Collecting through interviews or experts

Table 209. Guatemala Commercial Fisheries Valuation

Variable	Period	Unit	Source
Fish landing approach			
Species/species group	-	List	Fishbase. https://www.fishbase.se/search.php?c_code=484#country
Commercial reef related species			
Species in Punta de Manabique	2016	List	FUNDAECO. https://fundaeco.org.gt/fundaeco.org.gt/areas-trabajo/fichas-tecnicas/punta-de-manabique.html
Fish products in punta de Manabique (species)	2005	List	CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Sales price for each species/species group per unit weight at each landing site (kg/pound/metric ton).			CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Prices of six species from Punta de Manabique (Fishermen, Retail, Wholesale)	2007	$GTQ	
Weight (kg/pound/metric ton) of each species of fish caught at each landing site.			
Catch production in Guatemala	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Individual Fishermen			
Number of full-time and part-time fishermen			Collecting through interviews or experts

Employment status of surveyed fishermen (full or part time)			Collecting through interviews or experts
Species caught			Collecting through interviews or experts
Average weight (kg/pound) catch/week by species			Collecting through interviews or experts
Number of weeks of year fishermen fish			Collecting through interviews or experts
Sales price of each species/species group per unit weight (kg/pound/metric ton)			Collecting through interviews or experts
Reef Extent			
Area of reef			Calculated with data from XXX.
Patch Reef area in Punta de Manabique	2020 2007	Has M2	CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Average annual reef productivity (fish catch per unit area of reef)			Default values available in tool
Average price of fish caught on reef			

Table 210. Honduras Commercial Fisheries Valuation

Variable	Period	Unit	Source
Fish landing approach			
Species/species group	-	List	Fishbase. https://www.fishbase.se/search.php?c_code=484#country
Commercial reef related species			
Sales price for each species/species group per unit weight at each landing site (kg/pound/metric ton).			Collecting through interviews or experts
Weight (kg/pound/metric ton) of each species of fish caught at each landing site.			
Catch production in Honduras.	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Individual Fishermen			
Number of full-time and part-time fishermen			Collecting through interviews or experts
Employment status of surveyed fishermen (full or part time)			Collecting through interviews or experts
Species caught			Collecting through interviews or experts
Average weight (kg/pound) catch/week by species			Collecting through interviews or experts
Number of weeks of year fishermen fish			Collecting through interviews or experts
Sales price of each species/species group per unit weight (kg/pound/metric ton)			Collecting through interviews or experts
Reef Extent			
Area of reef	2020	Has	Calculated with data from XXX.

Average annual reef productivity (fish catch per unit area of reef)	default values available in tool
Average price of fish caught on reef	Collecting through interviews or experts

Table 211. Belize Commercial Fisheries Valuation

.Fish landing approach			
Variable	**Period**	**Unit**	**Source**
Species/species group Commercial reef related species	-	List	Fishbase. https://www.fishbase.se/search.php?c_code=484#country
Sales price for each species/species group per unit weight at each landing site (kg/pound/metric ton).			Calculated with weight and landed value from Sea around us. Reconstructed Data.
Catch production in Belize	2010-2016	USD	
Weight (kg/pound/metric ton) of each species of fish caught at each landing site. Catch production in Belize	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Catch production in Belize	2010-2016	Ton	Sea around us. Reconstructed Data
Individual Fishermen			
Number of full-time and part-time fishermen	2017	Number	FAO. http://www.fao.org/fishery/facp/blz/en#CountrySector-Statistics
Employment status of surveyed fishermen (full or part time)			Collecting through interviews or experts.
Species caught			Collecting through interviews or experts.
Average weight (kg/pound) catch/week by species			Collecting through interviews or experts.

Number of weeks of year fishermen fish			Collecting through interviews or experts.
Sales price of each species/species group per unit weight (kg/pound/metric ton)			Collecting through interviews or experts.
Reef Extent			
Area of reef	2020	Has	Calculated with data from XXX.
Average annual reef productivity (fish catch per unit area of reef)			default values available in tool
Average price of fish caught on reef			Collecting through interviews or experts.

ANNEX 8. FISHERIES PROCESSING VALUATION

Table 212. Mexico Fish Processing Valuation

Variable	Period	Unit	Source
Purchaser			Collecting through interviews or experts
Species/species group processed. Volumen De La Materia Prima Procesada Y Producción Obtenida En Las Plantas Congeladoras, Enlatadoras, Reductoras y otros procesos Por Principales Especies según Litoral Y Entidad Federativa.	2010-2018	List of species	CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Weight of purchased fish. Volumen De La Materia Prima Procesada Y Producción Obtenida En Las Plantas Congeladoras, Enlatadoras, Reductoras y otros procesos Por Principales Especies según Litoral Y Entidad Federativa.	2010-2018	Ton	CONAPESCA. Anuario Estadístico de Acuacultura y Pesca. https://www.gob.mx/conapesca/documentos/anuario-estadistico-de-acuacultura-y-pesca
Processed production	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Purchase price for each species by unit weight.			Collecting through interviews or experts
Sale price for each species by unit weight			

Table 213. Guatemala Fish Processing Valuation

Variable	Period	Unit	Source
Purchaser			Collecting through interviews or experts
Species/species group processed.			Collecting through interviews or experts
Weight of purchased fish			
Processed production	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Purchase price for each species by unit weight.			Collecting through interviews or experts
Sale price for each species by unit weight			Collecting through interviews or experts

Table 214. Honduras Fish Processing Valuation

Variable	Period	Unit	Source
Purchaser			Collecting through interviews or experts
Species/species group processed.			Collecting through interviews or experts
Weight of purchased fish			
Processed production	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Purchase price for each species by unit weight.			Collecting through interviews or experts
Sale price for each species by unit weight			Collecting through interviews or experts

Table 215. Belize Fish Processing Valuation

Variable	Period	Unit	Source
Purchaser			Collecting through interviews or experts.
Species/species group processed.			Collecting through interviews or experts.
Weight of purchased fish			
Processed production	2010-2018	Ton	FAO - Fisheries and Aquaculture Information and Statistics Branch
Purchase price for each species by unit weight.			Collecting through interviews or experts.
Sale price for each species by unit weight			UNCTAD. Table 7 p.47) https://unctad.org/system/files/official-document/ditc-ted-04122019-belize-Legal-draft.pdf
List of fish products in Belizean supermarkets	2019	$BZ/lb.	

ANNEX 9. FISH CLEANING

Table 216. Mexico Fish Cleaning Valuation

Variable	Period	Unit	Source
Using Weight Calculations Approach			
Percent of fish catch (kg/pound/metric ton) cleaned			Collecting through interviews or experts
Average value added per weight unit (kg/pound/metric ton) of fish cleaned			Collecting through interviews or experts
Using Cleaners by Landing Site Approach			
Number of cleaners at each landing site selected			Collecting through interviews or experts
Average number of days worked by cleaners at each landing site per year			
Average number of hours per day worked by cleaners at each landing site			Collecting through interviews or experts
Average revenue per hour received from fish cleaning at each landing site			Collecting through interviews or experts

Table 217. Guatemala Fish Cleaning Valuation

Variable	Period	Unit	Source
Using Weight Calculations Approach			
Percent of fish catch (kg/pound/metric ton) cleaned			Collecting through interviews or experts
Average value added per weight unit (kg/pound/metric ton) of fish cleaned			Collecting through interviews or experts
Using Cleaners by Landing Site Approach			
Number of cleaners at each landing site selected			Collecting through interviews or experts
Average number of days worked by cleaners at each landing site per year			
Average number of hours per day worked by cleaners at each landing site			Collecting through interviews or experts
Average revenue per hour received from fish cleaning at each landing site			Collecting through interviews or experts

Table 218. Honduras Fish Cleaning Valuation

Using Weight Calculations Approach			
Variable	**Period**	**Unit**	**Source**
Percent of fish catch (kg/pound/metric ton) cleaned			Collecting through interviews or experts
Average value added per weight unit (kg/pound/metric ton) of fish cleaned			Collecting through interviews or experts
Using Cleaners by Landing Site Approach			
Number of cleaners at each landing site selected			Collecting through interviews or experts
Average number of days worked by cleaners at each landing site per year			
Average number of hours per day worked by cleaners at each landing site			Collecting through interviews or experts
Average revenue per hour received from fish cleaning at each landing site			Collecting through interviews or experts

Table 219. Belize Fish Cleaning Valuation

Using Weight Calculations Approach			
Variable	**Period**	**Unit**	**Source**
Percent of fish catch (kg/pound/metric ton) cleaned			Collecting through interviews or experts.
Average value added per weight unit (kg/pound/metric ton) of fish cleaned			Collecting through interviews or experts.
Using Cleaners by Landing Site Approach.			
Number of cleaners at each landing site selected			Collecting through interviews or experts.
Average number of days worked by cleaners at each landing site per year			
Average number of hours per day worked by cleaners at each landing site			Collecting through interviews or experts.
Average revenue per hour received from fish cleaning at each landing site			Collecting through interviews or experts.

ANNEX 10. LOCAL FISHING

Table 220. Mexico Fish Local Fishing

Variable	Period	Unit	Source
Population of defined site.			Collecting through interviews or experts
Percent of population fishing for sale, consumption and enjoyment.			Collecting through interviews or experts
Average weight catch per trip for those engaging in local fishing for sale and consumption.			Collecting through interviews or experts
Sale price/value of average unit weight of catch for those engaging in local fishing for sale/consumption.			Collecting through interviews or experts
Average hourly wage for the population.			Collecting through interviews or experts
Average time spent fishing per day for those in the population engaging in local fishing for enjoyment.			Collecting through interviews or experts
Average annual days people at the site engage in local fishing for sale, consumption, or enjoyment.			Collecting through interviews or experts

Table 221. Guatemala Fish Local Fishing

Variable	Period	Unit	Source
Population of defined site.			
Percent of population fishing for sale, consumption and enjoyment.			
Average weight catch per trip for those engaging in local fishing for sale and consumption.	2007	Metric tonne per year	CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Sale price/value of average unit weight of catch for those engaging in local fishing for sale/consumption.	2007	$GTQ	CONANP. Plan Maestro del RVS Punta de Manabique. https://conap.gob.gt/wp-content/uploads/2019/10/PM-.RVS-Punta-de-Manabique.pdf
Average hourly wage for the population.			Collecting through interviews or experts
Average time spent fishing per day for those in the population engaging in local fishing for enjoyment.			Collecting through interviews or experts
Average annual days people at the site engage in local fishing for sale, consumption, or enjoyment.			Collecting through interviews or experts

Table 222. Honduras Fish Local Fishing

Variable	Period	Unit	Source
Population of defined site.			Collecting through interviews or experts
Percent of population fishing for sale, consumption and enjoyment.			Collecting through interviews or experts
Average weight catch per trip for those engaging in local fishing for sale and consumption.			Collecting through interviews or experts
Sale price/value of average unit weight of catch for those engaging in local fishing for sale/consumption.			Collecting through interviews or experts
Prices of six species from Punta de Manabique (Fishermen, Retail, Wholesale)			
Average hourly wage for the population.			Collecting through interviews or experts
Average time spent fishing per day for those in the population engaging in local fishing for enjoyment.			Collecting through interviews or experts
Average annual days people at the site engage in local fishing for sale, consumption, or enjoyment.			Collecting through interviews or experts

Table 223. Belize Fish Local Fishing

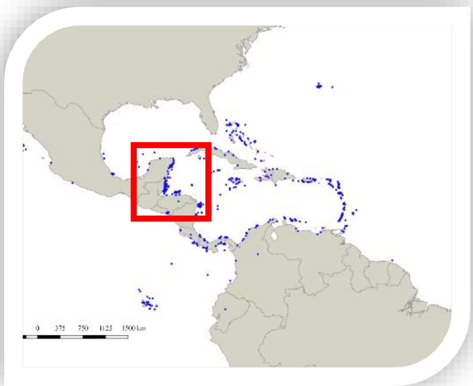
Variable	Period	Unit	Source
Population of defined site.			Collecting through interviews or experts.
Percent of population fishing for sale, consumption and enjoyment.			Collecting through interviews or experts.
Average weight catch per trip for those engaging in local fishing for sale and consumption.			Collecting through interviews or experts.
Sale price/value of average unit weight of catch for those engaging in local fishing for sale/consumption.			Collecting through interviews or experts.
Average hourly wage for the population.			Collecting through interviews or experts.
Average time spent fishing per day for those in the population engaging in local fishing for enjoyment.			Collecting through interviews or experts.
Average annual days people at the site engage in local fishing for sale, consumption, or enjoyment.			Collecting through interviews or experts.

ANNEX 11. SURVEYS

Example of a survey - Mexico

CORAL REEFS IN THE MESOAMERICAN REGION

Coral reefs are one of the most diverse and valuable ecosystems on Earth. They are highly economically and biologically productive ecosystems providing a wide range of benefits to society. Thus, corals and their associated marine life are considered as one of the main global assets because of their richness and uniqueness.



The Mesoamerican Reef contains the largest barrier reef in the Western Hemisphere (625 miles from the northern Yucatan Peninsula down through the coasts of Guatemala, Belize, and Honduras). Different types of attractive corals form this underwater wilderness and provide homes and food to hundreds of fish species, molluscs, marine turtles, sharks, algaes and seagrasses.

However, coral reefs are among the most vulnerable ecosystems of the planet and many of them are already degraded. In 2018, 46 percent of coral reefs at the Mesoamerican Reef were in poor condition (compared to 37 percent in 2016), while only 8 percent were in good condition (compared to 12 percent in 2016).

If adequate measures are not put into place, degradation of coral reefs will continue to rise, and most of the Caribbean coral reefs could disappear in the next 20 years.

THIS SURVEY IS CONDUCTED WITHIN THE FRAMEWORK OF A RESEARCH PROJECT BY THE INTERAMERICAN DEVELOPMENT BANK AND THE MESOAMERICAN REEF FUND.
THIS SURVEY IS COMPLETELY ANONYMOUS.

WE ARE VERY GRATEFUL FOR YOUR COOPERATION.

Please read the booklet and answer the following questions about the Mesoamerican Reef.

COUNTRY

Mexico	

Q1. Have you ever visited the Mesoamerican Reef? (**ASK Q2 if Q1=YES**)

☐ Yes
☐ No → **GO TO Q4A**

Q2. Have you visited the Mesoamerican Reef in the past five years?

☐ Yes
☐ No → **GO TO Q3**

If yes (Q2 = YES): How many times? __________

ASK Q3 IF Q1 = YES

Q3. What was the main reason for your visit?

☐ Business
☐ Holiday (as a tourist)
☐ Visiting family and friends
☐ Recreational use (live near, so you are current visitor)

ASK ALL

Q4A. What do you think it is the biggest threat to the health of the Mesoamerican Reef? (select just one option)
Q4B. And the second biggest threat to the health of the Mesoamerican Reef? (select just one option)
Q4C. And the third biggest threat to the health of the Mesoamerican Reef? (select just one option)

	Q4A	Q4B	Q4C
Climate change and extreme events			
Overfishing			
Tourism activities (scuba diving, cruises)			
Costal development (construction)			
Pollution (landfill of waste, discharges from agriculture, etc.)			
Invasive species			
There is no threat to the Mesoamerican Reef			
Other (specify)			
I do not know			
If Q4A=Other. Specify 1st threat			
If Q4B=Other. Specify 2nd threat			
If Q4C=Other. Specify 3rd threat			

Q5. Please indicate your level of agreement/ disagreement with the following statements (1 means 'Completely disagreement ' and 5 'Full agreement')

	1 Completely disagreement	2	3	4	5 Full agreement
The Mesoamerican Reef positively contributes to the local economy					
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world					
The Mesoamerican Reef houses many endangered species					
The Mesoamerican Reef contributes to the region's cultural identity					
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them					
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape					

Suppose that a "Coral Protection Fund" to ensure that the Mesoamerican Reef is protected and conserved is established. This fund would be managed by an independent agency which would be subject to government auditing. The money would only be allocated for the described purpose.

Q6. Would you be willing to contribute 177 pesos (USD 8) to this fund (yearly)?

☐ Yes (go to question Q7)
☐ No (go to question Q8)

[If Q6= YES] Q7. Would you be willing to contribute 310 pesos (USD 14)?

☐ Yes
☐ No

[IF Q6=NO] Q8. (If you answered NO to question 6) Would you be willing to contribute 89 pesos (USD 4)?

☐ Yes
☐ No

Q9. I*nterviewer: read question text depending on previous answers.*

[if Q6=YES AND Q7=YES] You specified that you would be willing to contribute 310 pesos (USD 14). What would be the MAXIMUM AMOUNT of money you would be willing to contribute to the fund?

[**if Q6=YES AND Q7=NO]** You specified that you would be willing to contribute 177 pesos (USD 8) but not 310 pesos (USD 14). What would be the MAXIMUM AMOUNT of money between 177 pesos (USD 8) but to 310 pesos (USD 14) you would be willing to contribute to the fund?

[If Q6=NO AND Q8=YES] You specified that you would be willing to contribute 89 pesos (USD 4) but not 177 pesos (USD 8). What would be the MAXIMUM AMOUNT of money between 89 pesos dollars (USD 4) to 177 pesos (USD 8) you would be willing to contribute to the fund?

[if Q6=YES AND Q8=NO] You specified that you would not be willing to contribute 89 pesos (USD 4). What would be the MAXIMUM AMOUNT of money you would be willing to contribute to the fund?

☐ pesos (USD) ☐ Don't Know

IF Q9=0 GO TO Q11
IF Q9= don't know and Q6=NO and Q8=NO GO TO Q11

ASK Q10 if Q9>0 or (Q9=dk and (Q6=YES or Q8=YES))

Q10. Why do you think paying to protect the Mesoamerica Reef is worth it? **RM** (select all that apply)

It is important for tourism	
It is important for fish industry	
It will make sure that coastlines will be less exposed to damaging effects of wave action and tropical storms	
Reef animals are a food resource-base for many people living in the Mesoamerican region	
It is important to the planet	
I enjoy diving and swimming in pristine waters and seeing colourful corals	
Future generations should be given the opportunity to visit them	
It is morally and ethically right to protect it	
The Mesoamerican region would not be the same without it	
Other (specify) ____	
I do not know	

GO TO Q12

ASK Q11 if Q9=0 or (Q9= don't know and Q6=NO and Q8=NO)

Q11 Could you tell us the reason why you did not accept paying any amount of money to contribute to the conservation fund for the Mesoamerican Reef? (select just one option)

The Mesoamerican Reef is important for me, but I have other priorities and willing to first pay for them	
I do not believe it can be protected	
I am willing to pay, but not through a contribution to a fund	
I thought that even if I did not pay, the Mesoamerican Reef would be protected, since the rest of people (contributors) would pay	
The Mesoamerican Reef is not important to me	
I do not have enough information to decide	
The Mesoamerican Reef is not under threat	
I think the funding should come from elsewhere	

To conclude, we would like to ask you some personal questions. We remind you that this questionnaire is anonymous

Q12. Age__________

Q13. Gender

- ☐ Male
- ☐ Female
- ☐ Other
- ☐ Prefer not to say

Q14. Municipality of the habitual residence________________________________

Q15. Marital status

- ☐ Single
- ☐ arried
- ☐ Divorced
- ☐ dowed
- ☐ Prefer not to say

Q16. Level of education

- ☐ No schooling
- ☐ Primary school
- ☐ High school
- ☐ Certification or trade training
- ☐ Undergraduate
- ☐ Postgraduate

Q17. Occupation

- ☐ Salaried employee
- ☐ Entrepreneur and self-employed worker
- ☐ Unemployed
- ☐ Household tasks
- ☐ Student
- ☐ Retired
- ☐ Other (specify)____

Name

____

phone number

____

Interviewer

____

ANNEX 12. NPV FOR SHORELINE PROTECTION

Table 224. Net present value of shoreline protection in the Mesoamerican region (million USD)

	20-years			25-years		
	NPV (r =1%)	**NPV (r =3%)**	**NPV (r =12%)**	**NPV (r =1%)**	**NPV (r =3%)**	**NPV (r =12%)**
Mexico	[3,632 – 4,959]	[3,265 – 4,458]	[2,248 – 3,070]	[4,412 – 6,024]	[3,808 – 5,199]	[2,361 – 3,224]
Guatemala	[23.4 – 48.14]	[21.04– 43.27]	[14.5 – 29.8]	[28.4 – 58.5]	[24.54 – 50.48]	[15.2 – 31.3]
Honduras	[95.31 –129.83]	[85.68 –116.70]	[59 – 80.37]	[115.79 –157.7]	[99.94 –136.12]	[62 – 84.39]
Belize	[109 – 148]	[98 – 133]	[67 – 92]	[132 – 180]	[114 – 155]	[71 – 96]
TOTAL	**[3,859 – 5,285]**	**[3,470 – 4,751]**	**[2,388 – 3,272]**	**[4,688 – 6,420]**	**[4,046 – 5,541]**	**[2,509 – 3,436]**

	30-years			50-years		
	NPV (r =1%)	**NPV (r =3%)**	**NPV (r =12%)**	**NPV (r =1%)**	**NPV (r =3%)**	**NPV (r =12%)**
Mexico	[5,084 – 6,942]	[4,134 – 5.645]	[2,425 – 3,311]	[6,675 – 9,114]	[4,409 – 6,020]	[2,500 – 3,413]
Guatemala	[32.8– 67.4]	[26.6 – 54.8]	[15.6 – 32.1]	[41.02 – 88.48]	[28.41 – 58.44]	[16.11 – 33.13]
Honduras	[133.43 – 181.7]	[108.5 – 147.8]	[63.6 – 86.7]	[175.18 – 238.6]	[115.71 – 157.60]	[65.6 – 89.36]
Belize	[152 – 207]	[124 – 168]	[72 – 99]	[200 – 272]	[132 – 179]	[75 – 102]
TOTAL	**[5,402 – 7,298]**	**[4,393 – 6,016]**	**[2,576 – 3,529]**	**[7,091 – 9,713]**	**[4,685 – 6,415]**	**[2,657 – 3,637]**

ANNEX 13. RESULTS OF THE PRE-TEST

A pre-test was conducted in each country to determine whether the survey was understandable to respondents and the range of amounts offered appropriate (50 surveys per country, with the exception of the UK where 93 surveys were conducted).

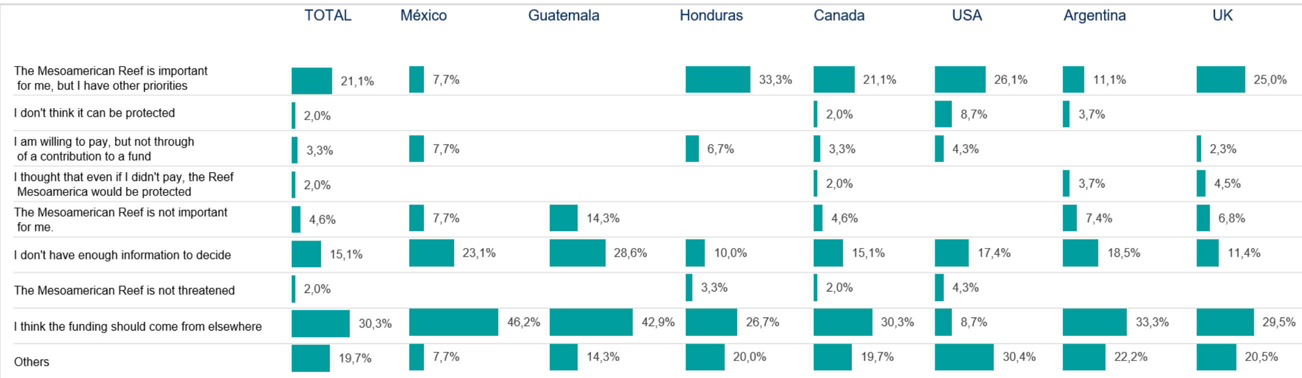
Those who have not visited the reef are less likely to contribute to the fund.

	TOTAL	México	Guatemala	Honduras	Canada	USA	Argentina	UK
TOTAL	393	50	50	50	50	50	50	93
Q6=Yes y Q7=Yes	97	19	20	27	4	12	7	8
Q6=Yes y Q7=No	70	10	11	11	5	5	11	17
Q6=Yes y Q8=No	35	4	6	3	5	4	3	10
Q6=No y Q8=No	191	17	13	9	36	29	29	58
Have visited the reef	65	14	11	22	3	4	6	5
Q6=Yes y Q7=Yes	33	6	4	16	0	2	3	2
Q6=Yes y Q7=No	14	4	4	3	1	0	0	2
Q6=Yes y Q8=No	5	2	1	1	0	0	1	0
Q6=No y Q8=No	13	2	2	2	2	2	2	1
Do not have visited the reef	328	36	39	28	47	46	44	88
Q6=Yes y Q7=Yes	64	13	16	11	4	10	4	6
Q6=Yes y Q7=No	56	6	7	8	4	5	11	15
Q6=Yes y Q8=No	30	2	5	2	5	4	2	10
Q6=No y Q8=No	178	15	11	7	34	27	27	57

Most of those who are not willing to pay do not know what they would be willing to pay.

	TOTAL	México	Guatemala	Honduras	Canada	USA	Argentina	UK
TOTAL	191	17	13	9	36	29	29	58
Nothing (0)	28	0	0	0	7	5	7	9
Some amount*	39	4	6	1	6	6	2	14
Do not know	124	13	7	8	23	18	20	35
Average amount*	--	59,5 Pesos	8,5 Quetzales	15,0 Lempiras	10 Canadian Dollars	7,7 USD	126,5 pesos	6,3£

Having other priorities or thinking that funds should come from elsewhere are the main reasons.



ANNEX 14. ECONOMETRIC SPECIFICATION

The survey

The survey contained 4 types of questions: (1) those aiming at eliciting the socio-economic profile of the respondent; (2) those at eliciting the opinions and beliefs of the respondent with respect to environmental and conservation issues; (3) those at knowing the respondents travel habits and motivations and (4) those at eliciting the respondents' willingness to pay (WTP) for the conservation of the reef.

In particular, with respect of the last category, the valuation question was posed in a double-bounded format in which the first question asked respondents whether they would be willing to pay a certain amount of money to implement a program to protect coral reefs (see Question 6). If the answer was 'yes', they were offered the possibility of paying a larger amount (Question 7). If the answer was 'no', they were offered the possibility of paying a lower amount (Question 8). Following-up, an open-ended question was included that asked respondents to indicate the maximum amount of money they would be willing to pay (Question 9). Since WTP is the monetary measure of utility (in our case, utility derived from the conservation of the reef), the open bid question aimed at checking the number of individuals who are willing to pay different amounts than the one proposed from the bounded exercise.

MEXICO

a) Descriptive statistics

Table below reports descriptive statistics for the Mexico sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 1,115 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents					
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	-	**34.37**	**10.85**	**18**	**39**
Gender	Male (46.20) Female (56.80)	-	-	-	--
Provenience	Center (22.07) East (21.08) North (22.27) South-East (15.37) South-West (19.11) Patagonia (0.10)	-	-	-	-
Civil Status	Single (43.35) Married (49.16) Divorced (4.73) Widowed (2.76)	-	-	--	--
Education Level	No Schooling (0.10) Primary School (1.08) High School (16.75)	-	-	-	-

	Certification/ Trade Training (28.08) Undergraduate (48.97) Graduate (5.02)				
Job	Salaried employee (51.43) Entrepreneur/ Self-employed (13.99) Unemployed (12.02) Household tasks (9.75) Student (10.84) Retired (0.69) Other (1.28)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	**Standard Deviation**	**Min**	**Max**
WTP	-	24.11	61.67	0	1000
Ratio (between WTP and 2019 per capita GDP, from WB)		0.002	0.006	0	0.10

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (20.59) No (79.41)
Visited the Reef in the Last 5 years	Yes (63.64) No (36.36)
Number of Times Visited the Reef in the Last 5 years	1 (33.83) 2 (37.59) 3 (14.29) 4 (6.02) 5 (2.26) 6 (0.75) 7 (1.50) 8 (0.75) 10 (0.75) 20 (1.50) 70 (0.75)
Travel Motivation	Business (0.59) Holiday (as a tourist) (16.85) Visiting family/friends (3.15) Did not visit (79.41)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (13.39) Overfishing (3.35) Tourism Activities (11.72) Construction (10.54) Pollution (56.85) Invasive Species (0.79) No Threat (0.69) Other (0.59)

	Do not know (1.48)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (6.01) Disagree (4.83) 3 (16.45) 4 (22.56) Fully Agree (50.15)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (6.50) Disagree (2.96) 3 (11.63) 4 (22.66) Fully Agree (56.26)
The Mesoamerican Reef houses many endangered species	Completely Disagree (5.22) Disagree (2.27) 3 (12.22) 4 (21.48) Fully Agree (58.82)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (6.31) Disagree (2.96) 3 (10.05) 4 (19.11) Fully Agree (61.58)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (6.11) Disagree (1.97) 3 (6.90) 4 (13.89) Fully Agree (71.13)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (6.31) Disagree (8.57) 3 (10.74) 4 (16.95) Fully Agree (63.74)
Protecting the reef is important for tourism	0 = 72.03 1 = 27.97
Protecting the reef is important for the fish industry	0 = 90.04 1 = 9.96
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 64.94 1 = 35.06
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 56.21 1 = 43.79
Protecting the reef is important for the planet	0 = 29.47 1 = 70.53
Protecting the reef is important for diving, swimming in pristine waters	0 = 83.08 1 = 16.92
Protecting the reef is important for future generations	0 = 55.93 1 = 44.07
Protecting the reef is important because it is moral and ethical	0 = 53.97 1 = 46.93
The Mesoamerican region would not be the same without it	0 = 68.89 1 = 31.11
Other	0 = 98.77 1 = 1.23
Do not know	0 = 99.18 1 = 0.82

Reason for not contributing /zero WTP	Other priorities (16.67) Do not believe can be protected (4.61) Willing to pay through a fund (2.84) The rest of people would pay (8.16) Not important to me (0.71) Not enough information to decide (18.79) The reef is not under threat (18.79) Funding from elsewhere (32.27) Other (15.96)

Before proceeding with the empirical analysis, we performed a non-parametric analysis to find correlations among variables. The main results show that a strong opinion for the conservation of the environment and the reef (even if aware of the threats) is not necessarily correlated with the willingness to pay for the protection and conservation.

Investigating the distributions between declared WTP and ideological views, it is found that a large majority of the sample (around 20-25 percent in all five cases) agrees with the ideological statement but declares 0 WTP (see Onofri et al (2018)). Report only results with statistically significant Chi[2].

WTP and Contribution of coral reef to local economy (Q5_1_scale). USD (year 2020)

WTP	1	2	3	4	5	Total
0	23	18	62	61	118	282
.4	0	0	0	0	1	1
.5	1	0	0	0	1	2
1	0	3	2	7	12	24
2	2	0	8	15	18	43
3	0	1	1	2	5	9
4	0	3	7	19	18	47
5	0	0	2	0	0	2
6	0	0	0	1	0	1
7	1	1	4	7	29	42
8	5	0	19	33	82	139
9	0	0	1	0	1	2
10	2	2	3	8	15	30
11	0	0	1	0	1	2
12	2	3	8	4	27	44
13	0	0	0	0	3	3
14	0	0	3	8	14	25
16	1	0	0	3	17	21
20	4	6	12	16	41	79
23	0	0	0	0	1	1
24	0	0	0	0	2	2
25	2	0	2	5	6	15
26	0	0	1	0	0	1
29	0	0	0	0	1	1

32	0	0	0	0	2	2
40	2	0	1	2	7	12
48	0	0	1	0	0	1
49	4	6	15	16	33	74
50	1	0	0	0	1	2
92	10	5	14	19	39	87
100	0	0	0	0	2	2
300	0	0	0	0	3	3
302	0	0	0	0	1	1
310	0	0	0	0	3	3
350	0	1	0	1	0	2
403	0	0	0	0	1	1
450	0	0	0	0	1	1
500	0	0	0	0	2	2
800	1	0	0	0	0	1
1000	0	0	0	1	0	1
Total	61	49	167	228	508	1,013

Pearson chi2(156) = 185.2627 Pr = 0.055

WTP and Coral reef as iconic landmark (Q5_2_scale). USD (year 2020)

WTP	1	2	3	4	5	Total
0	23	12	50	56	141	282
.4	1	0	0	0	0	1
.5	1	0	0	0	1	2
1	2	1	3	6	12	24
2	2	1	6	8	26	43
3	0	0	2	2	5	9
4	2	3	5	17	20	47
5	0	1	0	0	1	2
6	0	0	0	1	0	1
7	1	0	2	10	29	42
8	4	1	10	40	84	139
9	0	0	0	1	1	2
10	2	1	4	6	17	30
11	0	0	0	1	1	2
12	0	2	2	8	32	44
13	0	0	1	0	2	3
14	1	0	3	9	12	25
16	1	0	2	2	16	21
20	7	1	8	17	46	79
23	0	0	0	0	1	1
24	0	1	0	0	1	2

25	0	2	1	3	9	15
26	0	0	0	0	1	1
29	0	0	0	0	1	1
32	0	0	0	1	1	2
40	2	0	2	4	4	12
48	0	0	0	0	1	1
49	4	3	9	15	43	74
50	1	0	0	1	0	2
92	9	1	8	18	51	87
100	0	0	0	1	1	2
300	1	0	0	0	2	3
302	1	0	0	0	0	1
310	0	0	0	0	3	3
350	0	0	0	1	1	2
403	0	0	0	0	1	1
450	0	0	0	1	0	1
500	0	0	0	0	2	2
800	1	0	0	0	0	1
1000	0	0	0	0	1	1
Total	66	30	118	229	570	1,013

Pearson chi2(156) = 189.6955 Pr = 0.034

WTP and Contribution of coral reefs to local culture identity (Q5_4_scale). USD (year 2020)

WTP	1	2	3	4	5	Total
0	25	12	40	63	142	282
.4	0	0	0	0	1	1
.5	1	0	0	0	1	2
1	0	1	2	5	16	24
2	1	3	6	11	22	43
3	0	0	0	2	7	9
4	2	1	6	9	29	47
5	0	0	0	2	0	2
6	0	0	1	0	0	1
7	1	1	4	4	32	42
8	3	1	7	35	93	139
9	0	0	0	0	2	2
10	4	0	2	5	19	30
11	0	0	1	0	1	2
12	0	3	5	4	32	44
13	0	0	0	0	3	3
14	0	1	1	7	16	25
16	1	0	0	3	17	21

20	6	1	7	14	51	79
23	0	0	0	0	1	1
24	0	0	0	1	1	2
25	2	0	0	3	10	15
26	0	0	0	0	1	1
29	0	0	0	0	1	1
32	0	0	0	0	2	2
40	3	0	0	1	8	12
48	0	1	0	0	0	1
49	5	2	12	12	43	74
50	1	0	0	0	1	2
92	8	3	8	12	56	87
100	0	0	0	0	2	2
300	0	0	0	0	3	3
302	0	0	0	0	1	1
310	0	0	0	0	3	3
350	0	0	0	1	1	2
403	0	0	0	0	1	1
450	0	0	0	0	1	1
500	0	0	0	0	2	2
800	1	0	0	0	0	1
1000	0	0	0	0	1	1
Total	64	30	102	194	623	1,013

Pearson chi2(156) = 184.6378   Pr = 0.058

WTP and Conservation for consumption of beautiful places (Q5_6_scale). USD (year 2020)

WTP	1	2	3	4	5	Total
0	28	10	49	45	150	282
.4	0	0	0	0	1	1
.5	1	0	0	0	1	2
1	0	3	1	1	19	24
2	1	2	3	12	25	43
3	1	0	1	2	5	9
4	1	1	3	11	31	47
5	0	0	0	1	1	2
6	0	0	1	0	0	1
7	1	0	2	7	32	42
8	4	1	8	29	97	139
9	0	0	0	1	1	2
10	4	1	6	3	16	30
11	0	0	1	0	1	2

12	1	0	3	8	32	44
13	0	0	0	0	3	3
14	1	0	2	3	19	25
16	1	0	1	2	17	21
20	5	2	5	15	52	79
23	0	0	0	1	0	1
24	0	0	0	0	2	2
25	2	0	1	1	11	15
26	0	0	0	0	1	1
29	0	0	0	0	1	1
32	0	1	0	0	1	2
40	1	0	2	3	6	12
48	0	0	0	0	1	1
49	4	1	11	8	50	74
50	1	0	0	0	1	2
92	7	1	8	13	58	87
100	0	0	0	0	2	2
300	0	0	0	1	2	3
302	0	0	0	1	0	1
310	0	0	0	0	3	3
350	0	0	0	2	0	2
403	0	0	0	0	1	1
450	0	0	0	0	1	1
500	0	0	0	0	2	2
800	0	0	1	0	0	1
1000	0	0	0	1	0	1
Total	64	23	109	171	646	1,013

Pearson chi2(156) = 184.0456 Pr = 0.062

WTP and Visits. USD (year 2020)

WTP

Q1	**0**	**.4**	**.5**	**1**	**2**	**3**	**4**	**5**	**Total**
1	32	0	1	4	11	1	9	0	209
2	250	1	1	20	32	8	38	2	804
Total	282	1	2	24	43	9	47	2	1,013

Q1	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**Total**
1	0	6	28	0	7	0	11	0	209
2	1	36	111	2	23	2	33	3	804
Total	1	42	139	2	30	2	44	3	1,013

Q1	14	16	20	23	24	25	26	29	Total
1	13	6	29	0	1	5	0	0	209
2	12	15	50	1	1	10	1	1	804
Total	25	21	79	1	2	15	1	1	1,013

Q1	32	40	48	49	50	92	100	300	Total
1	1	5	0	13	0	19	0	2	209
2	1	7	1	61	2	68	2	1	804
Total	2	12	1	74	2	87	2	3	1,013

Q1	302	310	350	403	450	500	800	1000	Total
1	0	1	1	1	0	2	0	0	209
2	1	2	1	0	1	0	1	1	804
Total	1	3	2	1	1	2	1	1	1,013

Pearson chi2(39) = 77.4128 Pr = 0.000

WTP and Threats. USD (year 2020)

	WTP								
Q4	0	.4	.5	1	2	3	4	5	Total
1	32	1	0	5	5	1	5	1	142
2	12	0	0	2	3	0	2	0	34
3	41	0	0	2	1	2	5	0	119
4	24	0	0	4	4	1	2	0	107
5	157	0	2	10	29	5	30	1	576
6	3	0	0	0	0	0	1	0	8
7	2	0	0	1	0	0	0	0	6
8	3	0	0	0	0	0	0	0	6
9	8	0	0	0	1	0	2	0	15
Total	282	1	2	24	43	9	47	2	1,013

Q4	6	7	8	9	10	11	12	13	Total
1	1	5	23	0	6	0	9	0	142
2	0	1	2	0	0	0	0	0	34
3	0	5	21	1	2	0	3	0	119
4	0	6	12	1	4	0	7	2	107
5	0	23	81	0	18	2	24	1	576
6	0	0	0	0	0	0	1	0	8
7	0	2	0	0	0	0	0	0	6
8	0	0	0	0	0	0	0	0	6
9	0	0	0	0	0	0	0	0	15
Total	1	42	139	2	30	2	44	3	1,013

Q4	14	16	20	23	24	25	26	29	Total
1	3	2	18	0	1	3	0	0	142
2	1	1	2	0	0	0	1	0	34
3	2	1	10	0	0	3	0	0	119
4	6	2	11	0	0	2	0	0	107
5	12	15	37	1	1	6	0	1	576
6	0	0	0	0	0	0	0	0	8
7	0	0	1	0	0	0	0	0	6
8	1	0	0	0	0	1	0	0	6
9	0	0	0	0	0	0	0	0	15
Total	25	21	79	1	2	15	1	1	1,013

Q4	32	40	48	49	50	92	100	300	Total
1	0	1	0	8	0	9	0	0	142
2	0	1	0	0	0	5	1	0	34
3	0	1	0	13	1	4	1	0	119
4	0	1	0	9	0	7	0	1	107
5	2	7	0	43	1	59	0	2	576
6	0	0	0	1	0	0	0	0	8
7	0	0	0	0	0	0	0	0	6
8	0	0	1	0	0	0	0	0	6
9	0	1	0	0	0	3	0	0	15
Total	2	12	1	74	2	87	2	3	1,013

Q4	302	310	350	403	450	500	800	1000	Total
1	1	1	0	0	0	0	1	0	142
2	0	0	0	0	0	0	0	0	34
3	0	0	0	0	0	0	0	0	119
4	0	0	1	0	0	0	0	0	107
5	0	2	1	1	1	0	0	1	576
6	0	0	0	0	0	2	0	0	8
7	0	0	0	0	0	0	0	0	6
8	0	0	0	0	0	0	0	0	6
9	0	0	0	0	0	0	0	0	15
Total	1	3	2	1	1	2	1	1	1,013

Pearson chi2(312) = 662.1426 Pr = 0.000

b) Testing the WTP

Econometric analysis of the Binary Discrete-Choice Format

Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	1.08815***	0.0821
Visitor	0.76214***	0.1434
Bid	-0.00659***	0.0032
n	1015	
Log-likelihood	-1298.548	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Econometric analysis Including Reported Open Bids

Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	**Est. Coefficient**
Having visited the reef	1.15***
Feeling that the reef is under threat	0.004
Considering the reef important for the local economy	0.07**
Considering the reef a unique iconic landmark	0.02*
Considering the reef a house for endangered species	0.08**
Constant	0.50
Wald chi2(4) = 8.51	
Prob > chi2 = 0.013	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the instrumental variable is "Having visited the reef" and the instruments are "being a male, age, provenience, job, marital status and education level".

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 1.15 percent higher for respondents that have visited the reef.

GUATEMALA

a) Descriptive statistics

Table below reports descriptive statistics for the Guatemala sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 515 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents					
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	-	**28.87**	**8.56**	**18**	**55**
Gender	Male (53) Female (46)	-	-	-	--
Provenience	Alta Verapaz (2.72) Escuintla (6.21) Guatemala (40.19) Quetzaltenango (7.38) Sacatepéquez (3.88) Other Regions (39.61)	-	-	-	-
Civil Status	Single (56.70) Married (35.92) Divorced (6.41) Widowed (0.97)	-	-	--	--
Education Level	No Schooling (1.17) Primary School (2.72) High School (20.39) Certification/ Trade Training (33.98) Undergraduate (38.06) Graduate (3.69)	-	-	-	-
Job	Salaried employee (37.28) Entrepreneur/ Self-employed (11.65) Unemployed (15.53) Household tasks (9.90) Student (23.50) Retired (0.19) Other (1.94)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	Standard Deviation	Min	Max
WTP	-	24.08	45.79	0	642
Ratio (between WTP and 2019 per capita GP, from WB)		0.005	0.0099	0	0.13

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (23.88) No (76.12)
Visited the Reef in the Last 5 years	Yes (65.04) No (34.96)
Number of Times Visited the Reef in the Last 5 years	1 (28.75) 2 (46.52) 3 (11.25) 4 (5.00) 5 (2.50) 7 (1.27) 10 (2.50) 20 (1.25)
Travel Motivation	Business (2.52) Holiday (as a tourist) (17.86) Visiting family/friends (3.49) Did not visit (76.12)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (13.59) Overfishing (3.11) Tourism Activities (5.83) Construction (4.27) Pollution (68.54) Invasive Species (1.36) No Threat (0.39) Other (0.78) Do not know (2.14)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (8.54) Disagree (7.38) 3 (14.76) 4 (18.45) Fully Agree (50.87)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (10.10) Disagree (5.63) 3 (14.76) 4 (18.25) Fully Agree (51.26)
The Mesoamerican Reef houses many endangered species	Completely Disagree (7.77) Disagree (3.11)

	3 (13.98) 4 (14.56) Fully Agree (60.58)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (7.77) Disagree (6.41) 3 (11.07) 4 (17.48) Fully Agree (57.28)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (6.11) Disagree (1.97) 3 (6.90) 4 (13.89) Fully Agree (71.13) . tab q5_5_scale Q5_5_scale | Freq. Percent Cum. ------------+------------------------ 1 | 49 9.51 9.51 2 | 15 2.91 12.43 3 | 36 6.99 19.42 4 | 52 10.10 29.51 5 | 363 70.49 100.00 ------------+---------------------------- Total | 515 100.00
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (6.80) Disagree (4.66) 3 (7.96) 4 (13.20) Fully Agree (67.38)
Protecting the reef is important for tourism	0 = 59.96 1 = 40.04
Protecting the reef is important for the fish industry	0 = 88.27 1 = 11.73
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 65.27 1 = 34.73
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 56.21 1 = 43.79 tab q10_4 Q10_4 | Freq. Percent Cum. ------------+---------------------------- 0 | 254 56.19 56.19 1 | 198 43.81 100.00 ------------+---------------------------- Total | 452 100.00
Protecting the reef is important for the planet	0 = 29.47 1 = 70.53
Protecting the reef is important for diving, swimming in pristine waters	0 = 31.42 1 = 68.58
Protecting the reef is important for future generations	0 = 79.42 1 = 20.58
Protecting the reef is important because it is moral and ethical	0 = 46.68 1 = 53.32
The Mesoamerican region would not be the same without it	0 = 52.43 1 = 45.57

Other	0 = 59.29 1 = 40.71
Do not know	0 = 98.89
Reason for not contributing /zero WTP	Other priorities (7.49) Do not believe can be protected (3.17) Willing to pay through a fund (3.17) The rest of people would pay (11.11) Not important to me (1.59) Not enough information to decide (20.63) The reef is not under threat (1.59) Funding from elsewhere (38.10) Other (12.70)

The Chi2 for cross tabulations signalled lack of statistical significance even at correlation level (WTP and selected variables). Thus, we do not present the non-parametric analysis.

b) *Testing the WTP*

Econometric analysis of the Binary Discrete-Choice Format

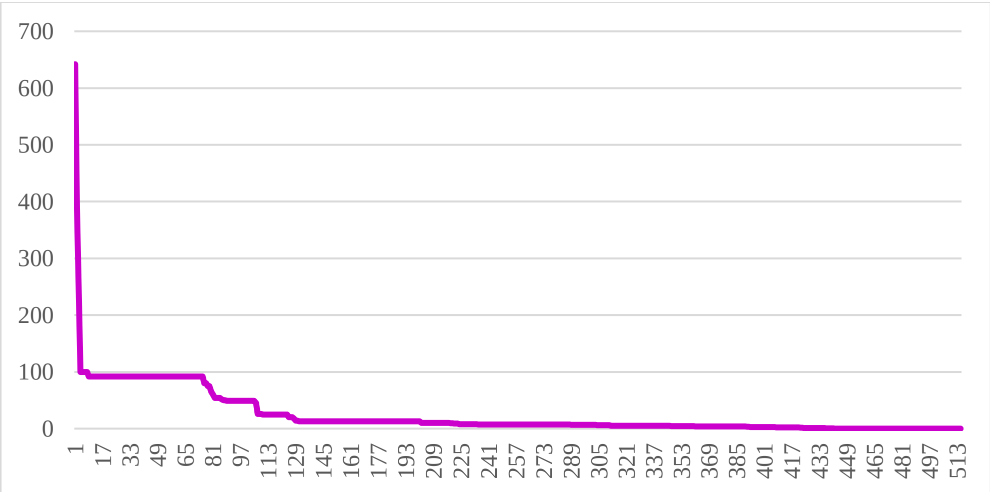
Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	2.11787***	0.1459
Visitor	0.40223**	0.2018
Bid	-0.04083***	0.0027
n	515	
Log-likelihood	-620.67	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Econometric analysis Including Reported Open Bids

The WTP distribution (quetzals) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	Est. Coefficient
Having visited the reef	1.07*
Feeling that the reef is under threat	0.10***
Considering the reef important for the local economy	0.37***
Considering the reef a unique iconic landmark	0.26***
Considering the reef a house for endangered species	0.81
Constant	0.003
Wald chi2(4) = 13.21 Prob > chi2 = 0.021	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is "Having visited the reef" and the instruments are "being a male, age, provenience, job, marital status and education level".

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 1.07 percent higher for respondents that have visited the reef.

HONDURAS

a) Descriptive statistics

Table below reports descriptive statistics for the Honduras sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 515 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents						
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	**-**	**28.78**	**7.19**	**18**	**50**
Gender	Male (51.46) Female (48.53)	-	-	-	--
Provenience	Atlantida (7.77) Choluteca (3.50) Comayagua (6.80) Cortes (25.24) Francisco Morazan (23.30) Other Regions (33.40)	-	-	-	-
Civil Status	Single (57.09) Married (34.17) Divorced (5.83) Widowed (2.92)	-	-	--	--
Education Level	No Schooling (0.97) Primary School (4.47) High School (19.42) Certification/	-	-	-	-

	Trade Training (28.74) Undergraduate (42.14) Graduate (4.27)				
Job	Salaried employee (35.53) Entrepreneur/ Self-employed (8.93) Unemployed (23.30) Household tasks (6.60) Student (21.94) Retired (0.19) Other (3.50)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	**Standard Deviation**	**Min**	**Max**
WTP	-	24.52	52.37	0	650
Ratio (between WTP and 2019 per capita GDP, from WB)		-	-	-	-

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (35.73) No (64.27)
Visited the Reef in the Last 5 years	Yes (65.22) No (34.78)
Number of Times Visited the Reef in the Last 5 years	1 (33.33) 2 (35.83) 3 (10.83) 4 (6.67) 5 (7.50) 6 (1.67) 10 (3.33) 20 (0.83)
Travel Motivation	Business (2.72) Holiday (as a tourist) (26.80) Visiting family/friends (6.21) Did not visit (64.27)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (11.46) Overfishing (4.85) Tourism Activities (6.02) Construction (4.66) Pollution (66.02) Invasive Species (1.55) No Threat (1.17) Other (0.97) Do not know (3.30)

The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (10.29) Disagree (3.69) 3 (10.68) 4 (15.92) Fully Agree (59.42)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (10.10) Disagree (6.21) 3 (11.65) 4 (12.82) Fully Agree (59.22)
The Mesoamerican Reef houses many endangered species	Completely Disagree (8.93) Disagree (4.08) 3 (11.65) 4 (12.82) Fully Agree (62.52)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (10.10) Disagree (3.11) 3 (7.57) 4 (11.07) Fully Agree (68.16)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (9.32) Disagree (1.94) 3 (9.96) 4 (9.90) Fully Agree (70.87)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (9.13) Disagree (4.08) 3 (6.21) 4 (9.32) Fully Agree (71.26)
Protecting the reef is important for tourism	0 = 51.85 1 = 48.15
Protecting the reef is important for the fish industry	0 = 89.32 1 = 10.68
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 68.19 1 = 31.81
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 52.77 1 = 44.23
Protecting the reef is important for the planet	0 = 31.15 1 = 68.85
Protecting the reef is important for diving, swimming in pristine waters	0 = 78.43 1 = 21.57
Protecting the reef is important for future generations	0 = 40.09 1 = 59.91
Protecting the reef is important because it is moral and ethical	0 = 50.33 1 = 49.67
The Mesoamerican region would not be the same without it	0 = 66.83 1 = 33.17
Other	0 = 98.26 1 = 1.74

Do not know	0 = 98.04 1 = 1.96
Reason for not contributing /zero WTP	Other priorities (23.21) Do not believe can be protected (3.57) Willing to pay through a fund (0) The rest of people would pay (5.36) Not important to me (1.79) Not enough information to decide (14.29) The reef is not under threat (3.57) Funding from elsewhere (30.36) Other (17.86)

In this case, Chi2 for cross tabulations signalled lack of statistical significance even at correlation level (WTP and selected variables). Thus, we do not present the non-parametric analysis to find the crossed tabulations.

b) Testing the WTP

<u>Econometric analysis of the Binary Discrete-Choice Format</u>

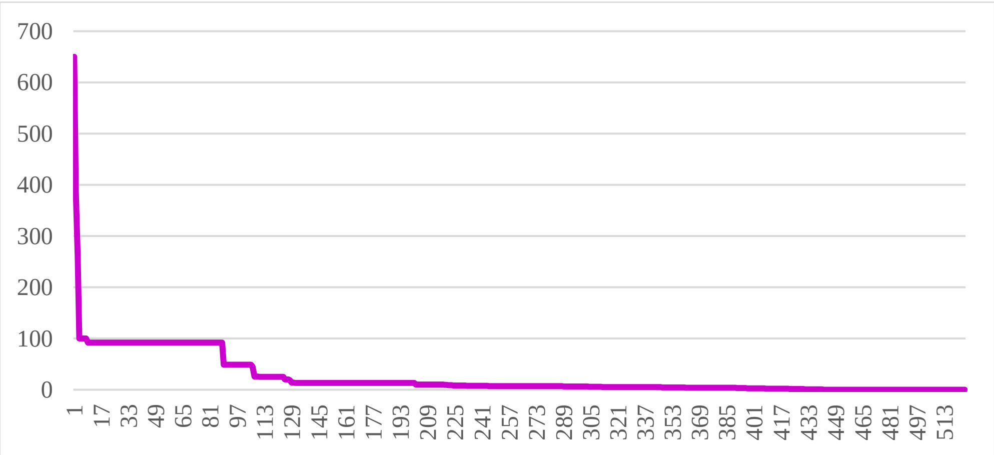
Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	2.00497***	0.1489
Visitor	0.75179***	0.1812
Bid	-0.02305***	0.0015
n	515	
Log-likelihood	-605.9948	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

<u>Econometric analysis Including Reported Open Bids</u>

The WTP distribution (lempiras) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	Est. Coefficient
Having visited the reef	1.15
Considering the reef important for the local economy	0.07
Considering the reef animals food resource base for many people living in the Mesoamerican region	0.16
Enjoying diving and swimming in pristine Waters and seeing colourful corals.	0.46***
Considering morally and ethical right to protect the reef.	0.23*
Constant	0.02
Wald chi2(4) = 10.56	
Prob > chi2 = 0.10	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is “Having visited the reef” and the instruments are “being a male, age, provenience, job, marital status and education level”.

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 1.15 percent higher for respondents that have visited the reef.

BELIZE

a) *Descriptive statistics*

Table below reports descriptive statistics for the Belize sample. Surveys were administered face-to-face, in the period 02/11/2020 – 16/11/2020. We have gathered 105 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents						
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	**-**	**36.01**	**12.32**	**18**	**71**
Gender	Male (50.48) Female (49.52)	-	-	-	--
Provenience	No info	-	-	-	-
Civil Status	Single (50.48) Married (42.86) Divorced (1.90) Widowed (4.76)	-	-	--	--
Education Level	No Schooling (0.95) Primary School (12.38) High School (47.62)	-	-	-	-

	Certification/ Trade Training (1.90) Undergraduate (23.81) Graduate (13.33)				
Job	Salaried employee (65.71) Entrepreneur/ Self-employed (18.10) Unemployed (6.67) Household tasks (0.95) Student (4.76) Retired (2.86) Other (0.95)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	**Standard Deviation**	**Min**	**Max**
WTP	-	22.94	27.20	0	100
Ratio (between WTP and 2019 per capita GDP, from WB)		0.004	0.0055-	0	0.020

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (54.29) No (45.71)
Visited the Reef in the Last 5 years	Yes (77.19) No (22.81)
Number of Times Visited the Reef in the Last 5 years	1 (15.91) 2 (18.18) 3 (6.82) 4 (9.09) 5 (13.64) 6 (2.27) 8 (2.27) 10 (4.55) 20 (4.55) 30 (4.55) 50 (6.82) 90 (4.55) 100 (6.82)
Travel Motivation	Business (2.86) Holiday (as a tourist) (15.24) Visiting family/friends (36.19) Did not visit (45.71)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (9.52) Overfishing (3.81) Tourism Activities (33.33)

	Construction (4.76) Pollution (31.43) Invasive Species (1.90) No Threat (0) Other (10.48) Do not know (4.76)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (4.76) Disagree (0.95) 3 (6.67) 4 (11.43) Fully Agree (76.19)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (7.62) Disagree (1.90) 3 (6.67) 4 (7.62) Fully Agree (76.19)
The Mesoamerican Reef houses many endangered species	Completely Disagree (1.90) Disagree (2.86) 3 (4.76) 4 (10.48) Fully Agree (80.00)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (5.71) Disagree (0.95) 3 (15.24) 4 (13.33) Fully Agree (64.76)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (1.90) Disagree (0) 3 (4.76) 4 (10.48) Fully Agree (82.86)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (3.81) Disagree (1.90) 3 (3.81) 4 (10.48) Fully Agree (80.00)
Protecting the reef is important for tourism	0 = 60.87 1 = 39.13
Protecting the reef is important for the fish industry	0 = 79.35 1 = 20.65
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 78.26 1 = 21.74
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 70.65 1 = 29.35
Protecting the reef is important for the planet	0 = 76.09 1 = 23.91
Protecting the reef is important for diving, swimming in pristine waters	0 = 90.22 1 = 9.78
Protecting the reef is important for future generations	0 = 51.09 1 = 48.91

Protecting the reef is important because it is moral and ethical	0 = 83.70 1 = 16.30
The Mesoamerican region would not be the same without it	0 = 92.39 1 = 7.61
Other	0 = 93.48 1 = 6.52
Do not know	0 = 96.74 1 = 3.26
Reason for not contributing /zero WTP	Willing to pay through a fund (7.69) Not enough information to decide (61.54) Funding from elsewhere (15.38) Other (15.38)

Before proceeding with the empirical analysis, we performed non-parametric analysis to find correlations among variables. The main results show that a strong opinion for the conservation of the environment and the reef (even if aware of the threats) is not necessarily correlated with the willingness to pay for the protection and conservation.

WTP and Having visited the reef

	WTP								
Q1	**0**	**2**	**4**	**5**	**6**	**7**	**10**	**12**	**Total**
1	8	1	0	1	0	3	5	0	57
2	8	0	1	8	1	7	3	1	48
Total	16	1	1	9	1	10	8	1	105

	Q9B								
Q1	**13**	**15**	**20**	**25**	**38**	**49**	**50**	**88**	**Total**
1	7	7	2	14	0	2	4	1	57
2	3	1	0	4	1	2	0	0	48
Total	10	8	2	18	1	4	4	1	105

	WTP		
Q1	**92**	**100**	**Total**
1	1	1	57
2	8	0	48
Total	9	1	105

Pearson chi2(17) = 37.1459 Pr = 0.003

Reef hosts of endangered species WTP

WTP

Q5_3_scale	0	2	4	5	6	7	10	12	Total
1	0	0	0	1	1	0	0	0	2
2	0	0	0	1	0	1	0	0	3
3	1	0	0	0	0	1	0	0	5
4	3	0	0	1	0	2	2	0	11
5	12	1	1	6	0	6	6	1	84
Total	16	1	1	9	1	10	8	1	105

Q5_3_scale	13	15	20	25	38	49	50	88	Total
1	0	0	0	0	0	0	0	0	2
2	0	0	0	0	0	0	0	1	3
3	0	0	0	2	0	0	0	0	5
4	0	0	0	1	0	0	1	0	11
5	10	8	2	15	1	4	3	0	84
Total	10	8	2	18	1	4	4	1	105

Q5_3_scale	92	100	Total
1	0	0	2
2	0	0	3
3	1	0	5
4	0	1	11
5	8	0	84
Total	9	1	105

Pearson chi2(68) = 122.3191   Pr = 0.000

WTP and Level of education

WTP

Q16	0	2	4	5	6	7	10	12	Total
1	0	0	0	0	0	0	0	0	1
2	6	0	0	0	0	1	0	0	13
3	6	0	1	5	1	5	4	1	50
4	2	0	0	0	0	0	0	0	2
5	1	1	0	3	0	3	3	0	25
6	1	0	0	1	0	1	1	0	14

Q16									Total
Total	16	1	1	9	1	10	8	1	105

Q16	13	15	20	25	38	49	50	88	Total
1	0	0	0	0	0	0	0	0	1
2	1	0	1	2	0	2	0	0	13
3	3	2	1	12	1	2	0	1	50
4	0	0	0	0	0	0	0	0	2
5	5	2	0	2	0	0	1	0	25
6	1	4	0	2	0	0	3	0	14
Total	10	8	2	18	1	4	4	1	105

Q16	92	100	Total
1	0	1	1
2	0	0	13
3	5	0	50
4	0	0	2
5	4	0	25
6	0	0	14
Total	9	1	105

Pearson chi2(85) = 182.5541 Pr = 0.000

b) Testing the WTP

Econometric analysis of the Binary Discrete-Choice Format

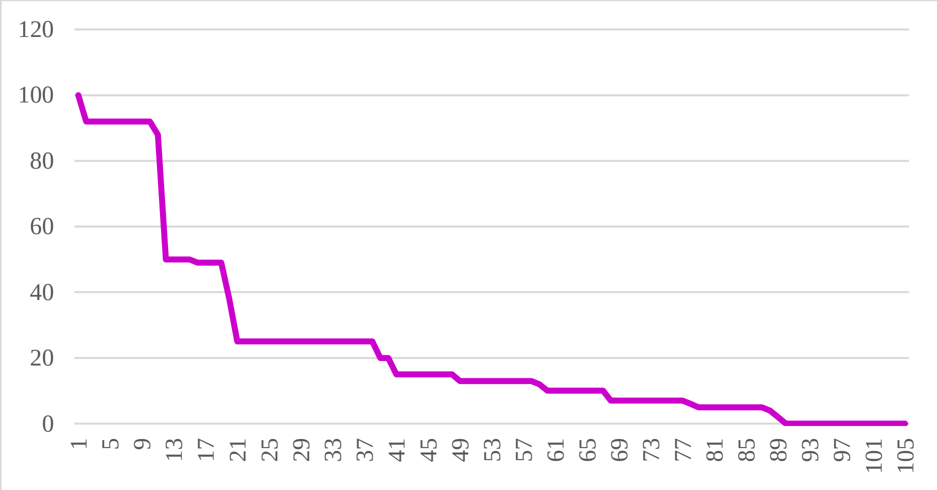
Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	2.04859***	0.4251
Visitor	0.55312	0.4140
Bid	-0.11838***	0.0224
n	105	
Log-likelihood	-102.9280	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Econometric analysis Including Reported Open Bids

The WTP distribution (Belizean dollar) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	Est. Coefficient
Having visited the reef	0.92
The reef houses many endangered species	0.15
I would like to know that the protection and conservation of the reef will increase even if I knew that my family and I would never visit them	-0.53***
It is important for the planet.	0.50***
The Mesoamerican region would not be the same without reef.	0.66*
Constant	5.97***
Wald chi2(4) = 11.15 Prob > chi2 = 0.048	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is “Having visited the reef” and the instruments are “being a male, age, provenience, job, marital status and education level”.

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 0.92 percent higher for respondents that have visited the reef.

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CANADA

a) *Descriptive statistics*

Table below reports descriptive statistics for the Canada sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 415 questionnaires.

Socio Economic Profile of the Respondents					
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	-	**44.84**	**13.70**	**18**	**65**
Gender	Male (44.58) Female (55.42)	-	-	-	--
Provenience	Atlantic (9.16) British Columbia (15.18) Ontario (40.96) Prairies (21.93) Quebec (12.77)	-	-	-	-
Civil Status	Single (31.81) Married (54.70) Divorced (9.16) Widowed (5.34)	-	-	--	--
Education Level	No Schooling (0) Primary School (0.24) High School (24.82) Certification/ Trade Training (27.23) Undergraduate (29.64) Graduate (18.07)	-	-	-	-
Job	Salaried employee (52.29) Entrepreneur/ Self-employed (7.23) Unemployed (8.92) Household tasks (3.13) Student (4.34) Retired (17.11) Other (6.99)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	**Standard Deviation**	**Min**	**Max**
WTP	-	19.06	48.81	0	800
Ratio (between WTP and 2019 per capita GDP, from WB)		0.00041	0.0010	0	0.017

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (9.40) No (91.60)
Visited the Reef in the Last 5 years	Yes (43.59) No (56.41)
Number of Times Visited the Reef in the Last 5 years	1 (47.06) 2 (29.41) 3 (11.76) 5 (5.88) 100 (5.88)
Travel Motivation	Business (0.48) Holiday (as a tourist) (8.67) Visiting family/friends (0.24) Did not visit (90.60)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (29.40) Overfishing (2.89) Tourism Activities (6.51) Construction (4.82) Pollution (45.30) Invasive Species (1.45) No Threat (0.96) Other (2.17) I do not know (6.17)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (0.48) Disagree (2.52) 3 (22.91) 4 (31.65) Fully Agree (42.33)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (1.20) Disagree (3.61) 3 (24.10) 4 (31.33) Fully Agree (39.76)
The Mesoamerican Reef houses many endangered species	Completely Disagree (0.24) Disagree (2.41) 3 (20.72) 4 (32.05) Fully Agree (44.58)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (1.20) Disagree (2.41) 3 (19.28) 4 (36.14) Fully Agree (40.96)

I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (1.45) Disagree (1.93) 3 (20.24) 4 (28.67) Fully Agree (47.71)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (2.41) Disagree (5.06) 3 (21.45) 4 (34.46) Fully Agree (36.63)
Protecting the reef is important for tourism	0 = 76.38 1 = 23.62
Protecting the reef is important for the fish industry	0 = 76.88 1 = 23.22
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 54.27 1 = 45.73
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 58.29 1 = 41.71
Protecting the reef is important for the planet	0 = 23.72 1 = 76.28
Protecting the reef is important for diving, swimming in pristine waters	0 = 84.92 1 = 15.08
Protecting the reef is important for future generations	0 = 42.21 1 = 57.79
Protecting the reef is important because it is moral and ethical	0 = 34.67 1 = 65.33
The Mesoamerican region would not be the same without it	0 = 61.81 1 = 38.19
Other	0 = 98.49 1 = 1.51
Do not know	0 = 99.50 1 = 0.50
Reason for not contributing /zero WTP	Other priorities (31.02) Do not believe can be protected (2.78) Willing to pay through a fund (3.24) The rest of people would pay (1.39) Not important to me (4.63) Not enough information to decide (16.20) The reef is not under threat (2.31) Funding from elsewhere (17.59) Other (20.83)

Before proceeding with the empirical analysis, we performed non-parametric analysis to find correlations among variables. The main results show that a strong opinion for the conservation of the environment and the reef (even if aware of the threats) is not necessarily correlated with the willingness to pay for the protection and conservation.

WTP and Having visited the reef

WTP (national)	Q1 1	2	Total
0	15	205	220
4	0	11	11
8	1	27	28
9	0	1	1
12	0	4	4
16	0	13	13
18.5	1	0	1
19	0	4	4
19.5	1	7	8
20	0	3	3
23.5	0	9	9
25	3	14	17
37.5	0	1	1
38	0	2	2
39	8	32	40
40	0	1	1
47	1	8	9
49	1	7	8
50	0	1	1
59	0	5	5
74	0	2	2
80	1	8	9
91	1	0	1
92	4	7	11
94	0	1	1
137	0	1	1
160	1	1	2
235	0	1	1
800	1	0	1
Total	39	376	415

Pearson chi2(28) = 58.1313 Pr = 0.001

WTP and Reasons for visiting

WTP (national)	Q3 1	2	3	5	Total
0	0	15	0	205	220
4	0	0	0	11	11
8	0	1	0	27	28

9	0	0	0	1	1
12	0	0	0	4	4
16	0	0	0	13	13
18.5	0	1	0	0	1
19	0	0	0	4	4
19.5	0	1	0	7	8
20	0	0	0	3	3
23.5	0	0	0	9	9
25	0	3	0	14	17
37.5	0	0	0	1	1
38	0	0	0	2	2
39	0	8	0	32	40
40	0	0	0	1	1
47	1	0	0	8	9
49	0	1	0	7	8
50	0	0	0	1	1
59	0	0	0	5	5
74	0	0	0	2	2
80	0	1	0	8	9
91	0	1	0	0	1
92	1	3	0	7	11
94	0	0	0	1	1
137	0	0	0	1	1
160	0	1	0	1	2
235	0	0	0	1	1
800	0	0	1	0	1
Total	2	36	1	376	415

Pearson chi2(84) = 502.5451 Pr = 0.000

WTP and Region cultural identity

WTP (national)	Q5_4_scale 1	2	3	4	5	Total
0	5	6	55	83	71	220
4	0	0	3	6	2	11
8	0	1	6	14	7	28
9	0	1	0	0	0	1
12	0	0	1	1	2	4
16	0	0	0	7	6	13
18.5	0	0	1	0	0	1
19	0	0	0	1	3	4
19.5	0	0	0	1	7	8
20	0	0	0	1	2	3
23.5	0	0	1	4	4	9

25	0	0	2	4	11	17
37.5	0	0	0	0	1	1
38	0	0	0	0	2	2
39	0	1	6	12	21	40
40	0	0	1	0	0	1
47	0	0	1	1	7	9
49	0	0	0	2	6	8
50	0	0	1	0	0	1
59	0	0	0	2	3	5
74	0	0	0	2	0	2
80	0	0	0	6	3	9
91	0	0	0	0	1	1
92	0	1	0	2	8	11
94	0	0	1	0	0	1
137	0	0	0	0	1	1
160	0	0	1	1	0	2
235	0	0	0	0	1	1
800	0	0	0	0	1	1
Total	5	10	80	150	170	415

Pearson chi2(112) = 136.4803 Pr = 0.058

WTP and Occupation

Wtp (national)	Q17 1	2	3	4	5	6	7	Total
0	108	9	20	9	8	50	16	220
4	6	2	2	0	0	1	0	11
8	22	0	0	1	1	3	1	28
9	1	0	0	0	0	0	0	1
12	3	1	0	0	0	0	0	4
16	12	0	0	0	1	0	0	13
18.5	0	0	0	0	0	1	0	1
19	2	0	1	0	1	0	0	4
19.5	2	0	2	0	0	3	1	8
20	1	0	0	0	0	2	0	3
23.5	3	0	1	0	0	2	3	9
25	9	4	1	0	0	2	1	17
37.5	0	0	1	0	0	0	0	1
38	1	0	0	0	1	0	0	2
39	22	6	2	0	4	3	3	40
40	0	0	0	0	0	0	1	1
47	3	4	1	0	1	0	0	9
49	4	1	1	0	0	1	1	8

50	0	0	1	0	0	0	0	1
59	3	1	0	0	0	1	0	5
74	2	0	0	0	0	0	0	2
80	0	0	4	1	1	1	2	9
91	0	0	0	0	0	1	0	1
92	8	1	0	2	0	0	0	11
94	1	0	0	0	0	0	0	1
137	1	0	0	0	0	0	0	1
160	2	0	0	0	0	0	0	2
235	0	1	0	0	0	0	0	1
800	1	0	0	0	0	0	0	1
Total	217	30	37	13	18	71	29	415

Pearson chi2(168) = 221.0963 Pr = 0.004

b) *Testing WTP*

<u>Econometric analysis of the Binary Discrete-Choice Format</u>

Model shows that the parameters from the double-bounded model are all significant.

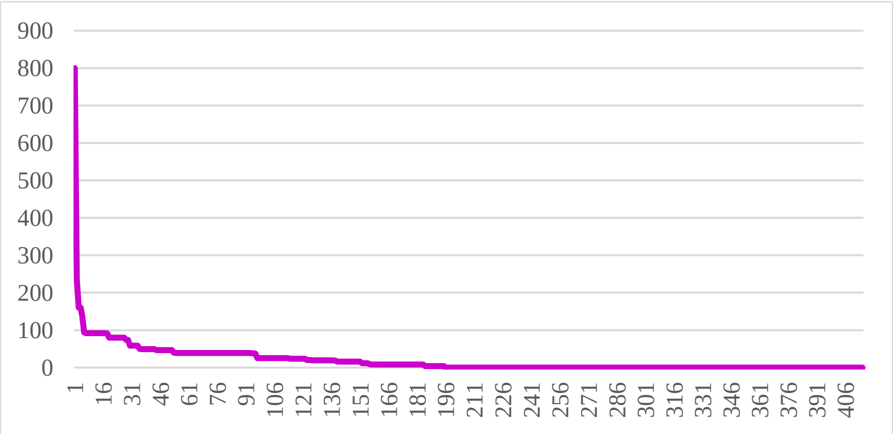
Double-bounded model

	Parameter	Standard errors
Intercept	-0.15777	0.1341
Visitor	1.2401***	0.3086
Bid	-0.02700***	0.0026
n	415	
Log-likelihood	-402.4068	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

<u>Econometric analysis Including Reported Open Bids</u>

The WTP distribution (USD) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	Est. Coefficient
Having visited the reef	1.99*
The reef contributes to the local economy	0.26***
The reef houses many endangered species	0.30***
Protecting the reef is important for the fishing industry	0.40*
The Mesoamerican reef would not be the same without it	1.47*
Constant	-3.06
Wald chi2(4) = 14.38 Prob > chi2 = 0.013	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is "Having visited the reef" and the instruments are "being a male, age, provenience, job, marital status and education level".

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 1.58 percent higher for respondents that have visited the reef.

THE UNITED STATES

a) Descriptive statistics

Table below reports descriptive statistics for the United States sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 515 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents						
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	**-**	**43.51**	**14.04**	**18**	**65**
Gender	Male (45.63) Female (54.37)	-	-	-	--
Provenience	East North Central (15.92) East South Central (7.96) Middle Atlantic (13.20) Mountain (8.93) New England (2.91) Pacific (14.56) South Atlantic (20.78) West North Central (5.63) West South Central (10.10)	-	-	-	-
Civil Status	Single (35.53) Married (50.10) Divorced (10.29)	-	-	--	--

	Widowed (4.08)				
Education Level	No Schooling (0.19) Primary School (0.97) High School (26.99) Certification/ Trade Training (13.20) Undergraduate (38.64) Graduate (20.00)	-	-	-	-
Job	Salaried employee (49.71) Entrepreneur/ Self-employed (8.35) Unemployed (12.62) Household tasks (7.18) Student (4.66) Retired (13.01) Other (4.47)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	**Standard Deviation**	**Min**	**Max**
WTP	-	529.79	8884.42	0	21,260
Ratio (between WTP and 2019 per capita GDP, from WB)		0.008	0.13	0	3.06

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (11.26) No (88.74)
Visited the Reef in the Last 5 years	Yes (63.79) No (34.21)
Number of Times Visited the Reef in the Last 5 years	1 (16.22) 2 (27.03) 3 (16.22) 4 (8.11) 5 (8.11) 6 (2.70) 10 (5.41) 20 (2.70) 22 (2.70) 200 (2.70) 500 (8.11)
Travel Motivation	Business (2.72) Holiday (as a tourist) (6.99) Visiting family/friends (1.55) Did not visit (88.74)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (28.16)

	Overfishing (3.69) Tourism Activities (6.21) Construction (4.66) Pollution (46.21) Invasive Species (0.97) No Threat (0.97) Other (1.55) Do not know (7.57)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (0.58) Disagree (2.52) 3 (22.91) 4 (31.65) Fully Agree (42.33)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (0.97) Disagree (3.30) 3 (24.66) 4 (31.26) Fully Agree (39.81)
The Mesoamerican Reef houses many endangered species	Completely Disagree (0.58) Disagree (1.17) 3 (21.17) 4 (30.29) Fully Agree (46.80)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (0.19) Disagree (3.30) 3 (20.78) 4 (36.50) Fully Agree (39.22)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (1.36) Disagree (3.50) 3 (19.42) 4 (31.84) Fully Agree (43.88)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (1.94) Disagree (4.47) 3 (23.88) 4 (32.23) Fully Agree (37.48)
Protecting the reef is important for tourism	0 = 74.02 1 = 25.98
Protecting the reef is important for the fish industry	0 = 68.68 1 = 31.32
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 63.70 1 = 36.30
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 58.36 1 = 41.64
Protecting the reef is important for the planet	0 = 20.28 1 = 79.72

Protecting the reef is important for diving, swimming in pristine waters	0 = 76.87 1 = 23.13
Protecting the reef is important for future generations	0 = 79.42 1 = 20.58
Protecting the reef is important because it is moral and ethical	0 = 47.33 1 = 52.67
The Mesoamerican region would not be the same without it	0 = 35.52 1 = 65.48
Other	0 = 64.41 1 = 35.59
Do not know	0 = 98.58 1 = 1.42
Reason for not contributing /zero WTP	Other priorities (30.77) Do not believe can be protected (5.13) Willing to pay through a fund (3.85) The rest of people would pay (1.28) Not important to me (4.70) Not enough information to decide (17.95) The reef is not under threat (0.43) Funding from elsewhere (15.38) Other (20.51)

Before proceeding with the empirical analysis, we performed non-parametric analysis to find correlations among variables. The main results show that a strong opinion for the conservation of the environment and the reef (even if aware of the threats) is not necessarily correlated with the willingness to pay for the protection and conservation.

WTP and Having visited the reef

	Q1		
Q9A dollar	1	2	Total
0	12	229	241
1	0	2	2
2	0	1	1
5	0	12	12
10	1	21	22
12	0	1	1
15	0	4	4
20	1	2	3
22	1	0	1
23	0	1	1
24	0	1	1
25	2	35	37
30	0	8	8
35	0	1	1
49	0	18	18
50	6	41	47

55	0	3	3
60	0	16	16
66	0	1	1
70	0	2	2
75	1	5	6
80	0	1	1
92	5	21	26
93	1	0	1
95	1	2	3
100	11	19	30
120	0	3	3
140	0	1	1
150	1	4	5
200	3	1	4
250	0	1	1
299	1	0	1
300	1	0	1
400	1	0	1
500	1	0	1
2000	2	0	2
2500	1	0	1
10000	3	0	3
19999	1	0	1
200000	1	0	1
Total	58	457	515

Pearson chi2(39) = 172.7394 Pr = 0.000

WTP and Biggest threat

	Q4								
Q9A dollar	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
0	55	10	10	15	113	1	0	6	241
1	0	0	0	0	2	0	0	0	2
2	0	0	0	0	1	0	0	0	1
5	5	0	2	1	4	0	0	0	12
10	7	1	1	0	10	0	0	2	22
12	0	0	0	0	1	0	0	0	1
15	0	0	0	1	3	0	0	0	4
20	1	0	0	0	2	0	0	0	3
22	0	0	0	0	0	0	1	0	1
23	1	0	0	0	0	0	0	0	1
24	0	0	0	0	1	0	0	0	1
25	11	0	1	3	16	3	0	0	37
30	3	0	2	0	3	0	0	0	8

35	0	0	0	0	1	0	0	0	1
49	8	1	1	1	5	0	0	0	18
50	15	1	3	1	27	0	0	0	47
55	0	0	1	0	2	0	0	0	3
60	5	2	0	1	8	0	0	0	16
66	1	0	0	0	0	0	0	0	1
70	1	0	0	0	1	0	0	0	2
75	1	0	0	0	4	0	0	0	6
80	1	0	0	0	0	0	0	0	1
92	5	1	3	0	14	1	2	0	26
93	0	1	0	0	0	0	0	0	1
95	0	0	1	0	2	0	0	0	3
100	16	0	5	0	7	0	1	0	30
120	2	1	0	0	0	0	0	0	3
140	0	0	0	0	1	0	0	0	1
150	1	0	0	0	4	0	0	0	5
200	2	0	0	0	1	0	1	0	4
250	0	0	0	0	1	0	0	0	1
299	0	0	0	0	1	0	0	0	1
300	0	0	0	0	1	0	0	0	1
400	0	1	0	0	0	0	0	0	1
500	1	0	0	0	0	0	0	0	1
2000	0	0	1	1	0	0	0	0	2
2500	0	0	0	0	1	0	0	0	1
10000	2	0	0	0	1	0	0	0	3
19999	1	0	0	0	0	0	0	0	1
200000	0	0	1	0	0	0	0	0	1
Total	145	19	32	24	238	5	5	8	515

Pearson chi2(312) = 398.3332 Pr = 0.001

WTP and Importance to safeguard for the planet

Q9A dollar	Q10_5 0	1	Total
0	2	5	7
1	2	0	2
2	1	0	1
5	2	10	12
10	7	15	22
12	0	1	1
15	0	4	4
20	1	2	3
22	1	0	1

23	1	0	1
24	0	1	1
25	7	30	37
30	1	7	8
35	0	1	1
49	3	15	18
50	4	43	47
55	1	2	3
60	1	15	16
66	0	1	1
70	0	2	2
75	0	6	6
80	0	1	1
92	7	19	26
93	0	1	1
95	2	1	3
100	5	25	30
120	0	3	3
140	1	0	1
150	3	2	5
200	3	1	4
250	0	1	1
299	0	1	1
300	0	1	1
400	1	0	1
500	0	1	1
2000	1	1	2
2500	0	1	1
10000	0	3	3
19999	0	1	1
200000	0	1	1
Total	57	224	281

Pearson chi2(39) = 63.0176 Pr = 0.009

WTP and Moral and ethical foundations to safeguarding

	Q10_8		
Q9A dollar	0	1	Total
0	5	2	7
1	2	0	2
2	1	0	1
5	4	8	12
10	10	12	22

12	0	1	1
15	0	4	4
20	1	2	3
22	0	1	1
23	1	0	1
24	0	1	1
25	12	25	37
30	0	8	8
35	1	0	1
49	7	11	18
50	7	40	47
55	0	3	3
60	3	13	16
66	1	0	1
70	0	2	2
75	1	5	6
80	0	1	1
92	12	14	26
93	0	1	1
95	2	1	3
100	12	18	30
120	0	3	3
140	0	1	1
150	2	3	5
200	3	1	4
250	1	0	1
299	1	0	1
300	1	0	1
400	1	0	1
500	0	1	1
2000	2	0	2
2500	1	0	1
10000	2	1	3
19999	1	0	1
200000	0	1	1
Total	97	184	281

Pearson chi2(39) = 65.2133 Pr = 0.005

WTP and Reef contribution to local economy

	Q5_1_scale					
Q9A dollar	1	2	3	4	5	Total
0	1	7	74	73	86	241
1	0	1	0	0	1	2

2	0	0	0	1	0	1
5	0	0	3	2	7	12
10	1	0	4	6	11	22
12	0	0	1	0	0	1
15	0	0	2	2	0	4
20	0	0	1	2	0	3
22	0	0	1	0	0	1
23	0	0	1	0	0	1
24	0	0	0	1	0	1
25	0	1	9	14	13	37
30	0	0	1	3	4	8
35	0	1	0	0	0	1
49	0	1	4	4	9	18
50	0	0	2	15	30	47
55	0	0	2	1	0	3
60	0	0	3	5	8	16
66	0	0	0	0	1	1
70	0	0	0	1	1	2
75	0	0	0	3	3	6
80	0	0	0	0	1	1
92	0	0	3	11	12	26
93	0	0	0	0	1	1
95	0	0	1	1	1	3
100	0	2	2	8	1 8	30
120	0	0	0	1	2	3
140	0	0	0	1	0	1
150	0	0	1	2	2	5
200	0	0	0	2	2	4
250	0	0	0	0	1	1
299	0	0	0	1	0	1
300	0	0	1	0	0	1
400	0	0	0	1	0	1
500	0	0	1	0	0	1
2000	1	0	1	0	0	2
2500	0	0	0	1	0	1
10000	0	0	0	0	3	3
19999	0	0	0	0	1	1
200000	0	0	0	1	0	1
Total	3	13	118	163	218	515

Pearson chi2(156) = 250.7744 Pr = 0.000

WTP and Contribution of the reef to the region cultural identity

Q9A dollar	Q5_4_scale 1	2	3	4	5	Total
0	0	7	74	76	84	241
1	0	1	0	1	0	2
2	0	0	0	1	0	1
5	0	1	2	5	4	12
10	0	0	2	10	10	22
12	0	0	0	1	0	1
15	0	0	1	2	1	4
20	0	0	1	2	0	3
22	0	0	1	0	0	1
23	0	0	0	1	0	1
24	0	0	0	1	0	1
25	0	3	8	15	11	37
30	0	0	2	3	3	8
35	0	0	0	1	0	1
49	0	1	2	6	9	18
50	0	0	2	13	32	47
55	0	0	0	3	0	3
60	0	0	1	6	9	16
66	0	0	0	1	0	1
70	0	0	0	1	1	2
75	0	0	1	2	3	6
80	0	0	0	0	1	1
92	0	0	5	15	6	26
93	0	0	0	0	1	1
95	1	0	1	0	1	3
100	0	2	2	8	18	30
120	0	0	0	2	1	3
140	0	0	0	0	1	1
150	0	0	1	4	0	5
200	0	0	0	0	4	4
250	0	0	0	1	0	1
299	0	0	0	1	0	1
300	0	0	0	0	1	1
400	0	1	0	0	0	1
500	0	0	0	1	0	1
2000	0	1	1	0	0	2
2500	0	0	0	1	0	1
10000	0	0	0	3	0	3
19999	0	0	0	0	1	1
200000	0	0	0	1	0	1
Total	1	17	107	188	202	515

Pearson chi2(156) = 348.8008 Pr = 0.000

b) Testing WTP

Econometric analysis of the Binary Discrete-Choice Format

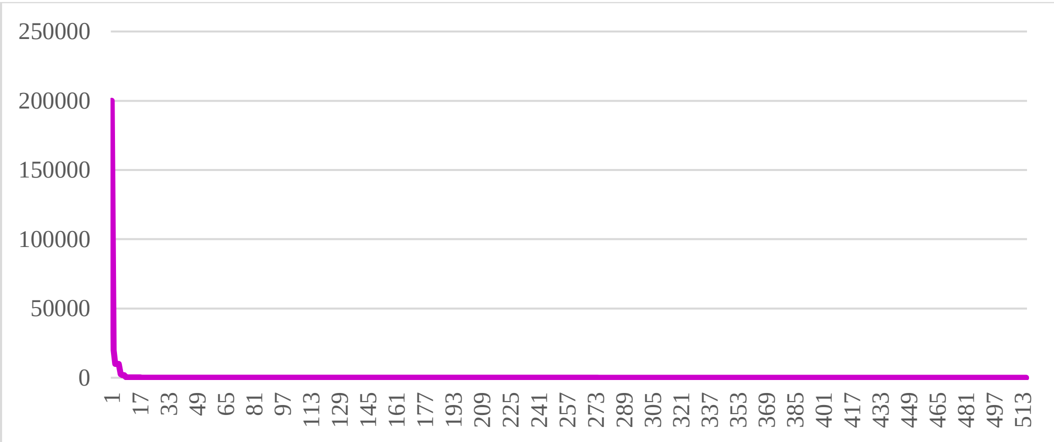
Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	0.17908	0.1102
Visitor	1.97214***	0.2517
Bid	-0.02168***	0.0017
n	515	
Log-likelihood	-575.9563	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Econometric analysis Including Reported Open Bids

The WTP distribution (USD) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	**Est. Coefficient**
Having visited the reef	3.31***
The Mesoamerican reef is an iconic landmark not offered elsewhere in the world	0.14*
The Mesoamerican reef houses many endangered species	0.46***
I would like to know that protection and conservation increase, even if I know that my family and I Will never visit the Mesoamerican reef.	0.43***
Reef animals are a food resource-base for many people living in the region	0.20*
It is important to the planet	0.59***
Constant	8.91***
Wald chi2(4) = 62.92 Prob > chi2 = 0.001	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is "Having visited the reef" and the instruments are "being a male, age, provenience, job, marital status and education level".

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 3.31 percent higher for respondents that have visited the reef.

ARGENTINA

a) Descriptive statistics

Table below reports descriptive statistics for Argentina sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 415 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents					
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	**-**	**41.27**	**13.35**	**18**	**65**
Gender	Male (47.23) Female (42.77)	-	-	-	--
Provenience	Buenos Aires (50.12) Centro (20.24) Cuyo (9.64) Nordeste (6.51) Noroeste (6.51) Patagonia (6.99)	-	-	-	-
Civil Status	Single (55.66) Married (35.42) Divorced (6.72) Widowed (2.17)	-	-	--	--
Education Level	No Schooling (0) Primary School (4.34) High School (33.49) Certification/ Trade Training (20.96) Undergraduate (36.14) Graduate (5.06)	-	-	-	-
Job	Salaried employee (52.05) Entrepreneur/ Self-employed (13.25) Unemployed (14.70) Household tasks (5.54) Student (9.64) Retired (1.69) Other (3.13)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	Standard Deviation	Min	Max
WTP	-	24,174	490,877	0	10million
Ratio (between WTP and 2019 per capita GDP, from WB)		2.4	49.05	0	999.4

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (11.33) No (88.67)
Visited the Reef in the Last 5 years	Yes (55.32) No (44.68)
Number of Times Visited the Reef in the Last 5 years	1 (53.85) 2 (15.38) 3 (26.92) 10 (3.85)
Travel Motivation	Business (0.96) Holiday (as a tourist) (9.40) Visiting family/friends (0.96) Did not visit (88.67)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (17.83) Overfishing (3.13) Tourism Activities (6.99) Construction (4.82) Pollution (58.07) Invasive Species (1.45) No Threat (0.72) Other (6.99)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (2.17) Disagree (5.06) 3 (20.72) 4 (31.57) Fully Agree (40.48)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (3.37) Disagree (3.37) 3 (20.00) 4 (28.92) Fully Agree (44.34)
The Mesoamerican Reef houses many endangered species	Completely Disagree (2.89) Disagree (1.45) 3 (17.11) 4 (26.51) Fully Agree (52.05)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (2.17) Disagree (4.10) 3 (18.07)

	4 (26.75) Fully Agree (48.92)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (3.37) Disagree (1.93) 3 (12.77) 4 (18.31) Fully Agree (63.61)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (4.10) Disagree (3.37) 3 (15.42) 4 (24.34) Fully Agree (52.77)
Protecting the reef is important for tourism	0 = 70.44 1 = 29.56
Protecting the reef is important for the fish industry	0 = 89.66 1 = 10.34
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 65.50 1 = 34.50
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 56.65 1 = 43.35
Protecting the reef is important for the planet	0 = 26.65 1 = 73.35
Protecting the reef is important for diving, swimming in pristine waters	0 = 80.79 1 = 19.21
Protecting the reef is important for future generations	0 = 45.32 1 = 44.68
Protecting the reef is important because it is moral and ethical	0 = 53.20 1 = 46.80
The Mesoamerican region would not be the same without it	0 = 59.11 1 = 40.89
Other	0 = 96.55 1 = 3.45
Do not know	0 = 98.03 1 = 1.97
Reason for not contributing /zero WTP	Other priorities (18.87) Do not believe can be protected (2.83) Willing to pay through a fund (3.30) The rest of people would pay (3.77) Not important to me (3.30) Not enough information to decide (14.15) The reef is not under threat (0.94) Funding from elsewhere (39.62) Other (13.21)

Before proceeding with the empirical analysis, we performed non-parametric analysis to find correlations among variables. The main results show that a strong opinion for the conservation of the environment and the reef (even if aware of the threats) is not necessarily correlated with the willingness to pay for the protection and conservation.

WTP and visited the reef

WTP (national)	Q1: 1	Q1: 2	Total
0	18	204	222
1	1	15	16
2	0	2	2
2.5	0	1	1
3	0	2	2
3.5	1	2	3
4	0	5	5
4.5	0	1	1
5	1	4	5
6	0	2	2
8	0	13	13
8.5	1	9	10
9	0	3	3
10	1	11	12
11	0	1	1
12	1	8	9
15	2	7	9
17	1	0	1
18	3	6	9
20	0	4	4
24	1	9	10
25	4	4	8
26	1	0	1
30	0	1	1
37	1	1	2
49	2	22	24
50	0	1	1
92	4	24	28
120	0	1	1
240	0	1	1
340	0	1	1
1118	1	0	1
2000	2	0	2
3000	0	1	1
6000	0	1	1
12200	0	1	1
1.00e+07	1	0	1
Total	47	368	415

Pearson chi2(36) = 77.7620 Pr = 0.000

WTP and reef unique landmark

WTP (national)	Q5_2_scale 1	2	3	4	5	Total
0	8	10	50	56	98	222
1	2	0	2	8	4	16
2	0	0	0	1	1	2
2.5	0	0	0	0	1	1
3	0	0	0	1	1	2
3.5	1	0	1	1	0	3
4	0	3	1	0	1	5
4.5	0	0	0	1	0	1
5	0	0	0	3	2	5
6	0	0	1	0	1	2
8	0	0	2	4	7	13
8.5	1	0	1	3	5	10
9	0	0	0	0	3	3
10	0	0	4	3	5	12
11	0	0	0	1	0	1
12	0	0	1	1	7	9
15	0	0	2	2	5	9
17	0	0	0	0	1	1
18	0	0	4	3	2	9
20	0	0	1	2	1	4
24	0	0	2	4	4	10
25	0	0	2	6	0	8
26	0	0	0	1	0	1
30	0	0	0	1	0	1
37	0	0	0	1	1	2
49	1	0	2	6	15	24
50	0	0	0	0	1	1
92	0	0	5	8	15	28
120	0	0	0	0	1	1
240	0	0	1	0	0	1
340	0	1	0	0	0	1
1118	0	0	0	1	0	1
2000	1	0	0	1	0	2
3000	0	0	0	1	0	1
6000	0	0	0	0	1	1
12200	0	0	1	0	0	1
1.00e+07	0	0	0	0	1	1
Total	14	14	83	120	184	415

Pearson chi2(144) = 189.7932 Pr = 0.006

WTP and important for fish industry

WTP (national)	**Q10_2** 0	1	Total
0	10	0	10
1	13	3	16
2	2	0	2
2.5	1	0	1
3	2	0	2
3.5	3	0	3
4	5	0	5
4.5	0	1	1
5	4	1	5
6	1	1	2
8	11	2	13
8.5	9	1	10
9	3	0	3
10	10	2	12
11	1	0	1
12	9	0	9
15	7	2	9
17	1	0	1
18	9	0	9
20	3	1	4
24	10	0	10
25	7	1	8
26	1	0	1
30	0	1	1
37	2	0	2
49	23	1	24
50	1	0	1
92	26	2	28
120	1	0	1
240	0	1	1
340	1	0	1
1118	1	0	1
2000	2	0	2
3000	1	0	1
6000	0	1	1
12200	1	0	1
1.00e+07	1	0	1
Total	182	21	203

Pearson chi2(36) = 52.1321 Pr = 0.040

b) Testing WTP

Econometric analysis of the Binary Discrete-Choice Format

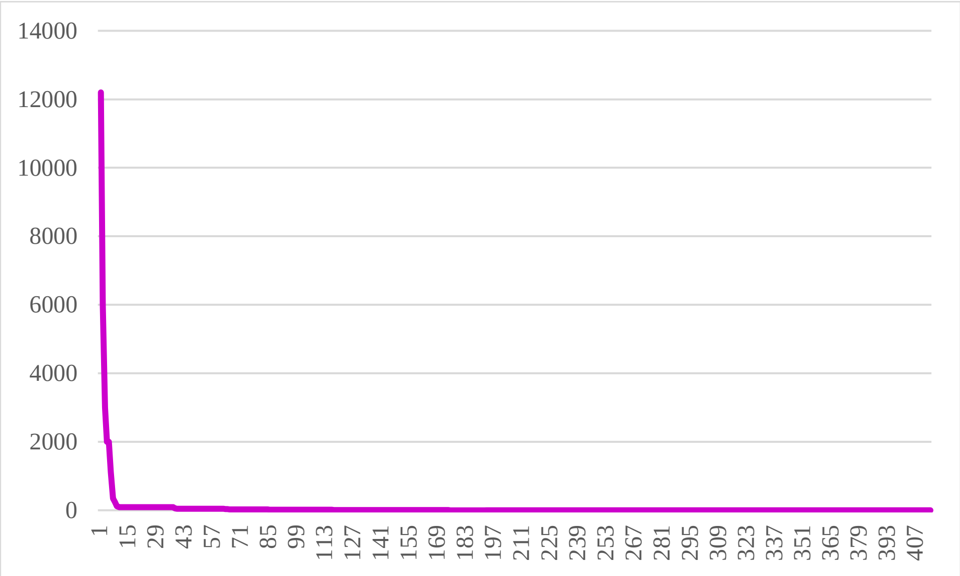
Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	-0.00604*	0.1213
Visitor	0.93023***	0.2765
Bid	-0,08727***	0.0089
n	415	
Log-likelihood	-444.8094	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Econometric analysis Including Reported Open Bids

The WTP distribution (pesos) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	Est. Coefficient
Having visited the reef	1.58
Protecting the reef is important for tourism	-0.77***
Protecting the reef is important for the planet	0.58*
The Mesoamerican reef would not be the same without it	0.53***
Constant	5.46
Wald chi2(4) = 9.64	
Prob > chi2 = 0.046	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is "Having visited the reef" and the instruments are "being a male, age, provenience, job, marital status and education level".

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 1.58 percent higher for respondents that have visited the reef.

THE UNITED KINGDOM

a) Descriptive statistics

Table below reports descriptive statistics for the United Kingdom sample. Surveys were administered on-line, in the period 21/09/2020 – 30/09/2020. We have gathered 415 questionnaires.

Descriptive Statistics

Socio Economic Profile of the Respondents					
Variables	**Frequency %**	**Mean**	**Standard Deviation**	**Min**	**Max**
Age	**-**	**41.27**	**13.35**	**18**	**65**
Gender	Male (51) Female (49)	-	-	-	--
Provenience	Greater London (14.46) Midlands (15.90) Northwest (0.24) North&Yorkshire (12.29) NorthWest (10.60) Northern Ireland (2.65) Scotland (8.43) South East&Anglia (22.65) SouthWest&Wales (12.77)	-	-	-	-
Civil Status	Single (42.17) Married (47.95) Divorced (7.71) Widowed (2.17)	-	-	--	--
Education Level	No Schooling (0) Primary School (1.20) High School (26.51) Certification/ Trade Training (19.76) Undergraduate (30.60) Graduate (21.93)	-	-	-	-
Job	Salaried employee (60.48) Entrepreneur/ Self-employed (6.75) Unemployed (9.88) Household tasks (6.27) Student (6.27) Retired (7.23) Other (3.13)	-	-	-	-

Willingness to Pay (in 2020 US dollar)					
		Mean	Standard Deviation	Min	Max
WTP	-	19.41	68.73	0	1300
Ratio (between WTP and 2019 per capita GDP, from WB)		0.0005	0.0016	0	0.30

Travel Habits and Motivation	
	Frequency %
Ever Visited the Reef	Yes (5.30) No (94.70)
Visited the Reef in the Last 5 years	Yes (81.82) No (18.18)
Number of Times Visited the Reef in the Last 5 years	1 (44.44) 2 (27.78) 3 (5.56) 4 (5.56) 5 (5.56) 10 (5.56) 100 (5.56)
Travel Motivation	Business (0.48) Holiday (as a tourist) (4.10) Visiting family/friends (0.72) Did not visit (94.70)

Personal Opinions and Positioning WTP Coral Reef Conservation and Threats	
	Frequency %
Threat to the Coral Reef	Climate Change/ Extreme Events (37.59) Overfishing (3.37) Tourism Activities (6.75) Construction (3.13) Pollution (42.65) Invasive Species (1.69) No Threat (0.96) Other (0.48)
The Mesoamerican Reef positively contributes to the local economy	Completely Disagree (0) Disagree (5.54) 3 (22.89) 4 (31.57) Fully Agree (38.31)
The Mesoamerican Reef is an iconic landmark that is not offered anywhere else in the world	Completely Disagree (0) Disagree (2.17) 3 (14.70) 4 (33.25) Fully Agree (49.88)
The Mesoamerican Reef houses many endangered species	Completely Disagree (0) Disagree (2.17) 3 (14.70) 4 (33.25)

	Fully Agree (49.88)
The Mesoamerican Reef contributes to the region's cultural identity	Completely Disagree (0.24) Disagree (2.17) 3 (17.83) 4 (36.39) Fully Agree (43.37)
I would like to know that the protection and conservation of the Mesoamerican Reef will increase, even if I knew that my family and I would never visit them	Completely Disagree (0) Disagree (2.89) 3 (13.98) 4 (28.43) Fully Agree (54.70)
The conservation of the Mesoamerican Reef is important for me because it gives us the possibility of seeing beautiful landscape	Completely Disagree (1.45) Disagree (4.58) 3 (21.93) 4 (28.92) Fully Agree (43.13)
Protecting the reef is important for tourism	0 = 76.26 1 = 23.74
Protecting the reef is important for the fish industry	0 = 82.32 1 = 17.68
Protecting the reef is important because of protection to damaging effects of wave action and tropical storms	0 = 65.66 1 = 34.34
Protecting the reef is important for Reef animals are a food resource-base for many people living in the Mesoamerican region	0 = 73.74 1 = 26.26
Protecting the reef is important for the planet	0 = 23.23 1 = 76.77
Protecting the reef is important for diving, swimming in pristine waters	0 = 88.38 1 = 11.62
Protecting the reef is important for future generations	0 = 51.52 1 = 48.8
Protecting the reef is important because it is moral and ethical	0 = 31.82 1 = 68.18
The Mesoamerican region would not be the same without it	0 = 67.17 1 = 32.83
Other	0 = 97.98 1 = 2.02
Do not know	0 = 98.04 1 = 1.96 . tab q10_11 Q10_11 | Freq. Percent Cum. ------------+----------------------------------- 0 | 196 98.99 98.99 1 | 2 1.01 100.00 ------------+----------------------------------- Total | 198 100.00
Reason for not contributing /zero WTP	Other priorities (29.95) Do not believe can be protected (2.30) Willing to pay through a fund (2.30) The rest of people would pay (2.30) Not important to me (2.76) Not enough information to decide (15.67) The reef is not under threat (0.92) Funding from elsewhere (23.96) Other (19.82)

Before proceeding with the empirical analysis, we performed non-parametric analysis to find correlations among variables. The main results show that a strong opinion for the conservation of the environment and the reef (even if aware of the threats) is not necessarily correlated with the willingness to pay for the protection and conservation.

WTP	**Q1** 1	2	Total
0	5	219	224
3	0	4	4
5	0	1	1
7	0	40	40
8	0	2	2
13	0	9	9
17	0	3	3
20	0	18	18
25	1	7	8
26	0	1	1
27	0	6	6
34	0	6	6
35	0	2	2
40	1	36	37
42	1	0	1
45	0	1	1
46	0	1	1
47	0	5	5
48	0	5	5
49	3	6	9
65	1	1	2
67	5	9	14
80	0	1	1
92	3	6	9
100	1	0	1
130	0	3	3
260	0	1	1
1300	1	0	1
Total	22	393	415

Pearson chi2(27) = 127.1486 Pr = 0.000

WTP and reef animals as food resource-base for many people living in the region

WTP	Q10_4 0	1	Total
0	6	1	7
3	4	0	4
5	0	1	1
7	29	11	40
8	1	1	2
13	6	3	9
17	3	0	3
20	15	3	18
25	6	2	8
26	0	1	1
27	5	1	6
34	2	4	6
35	2	0	2
40	27	10	37
42	1	0	1
45	0	1	1
46	0	1	1
47	5	0	5
48	4	1	5
49	9	0	9
65	1	1	2
67	11	3	14
80	0	1	1
92	6	3	9
100	1	0	1
130	1	2	3
260	0	1	1
1300	1	0	1
Total	146	52	198

Pearson chi2(27) = 37.3012 Pr = 0.090

WTP and important to the planet

WTP	Q10_5 0	1	Total
0	5	2	7
3	1	3	4
5	0	1	1
7	10	30	40

8	0	2	2
13	0	9	9
17	0	3	3
20	3	15	18
25	3	5	8
26	0	1	1
27	1	5	6
34	0	6	6
35	0	2	2
40	3	34	37
42	1	0	1
45	1	0	1
46	0	1	1
47	2	3	5
48	1	4	5
49	3	6	9
65	1	1	2
67	5	9	14
80	1	0	1
92	4	5	9
100	1	0	1
130	0	3	3
260	0	1	1
1300	0	1	1
Total	46	152	198

Pearson chi2(27) = 43.3586 Pr = 0.024

WTP and enjoy diving and swimming in pristine waters and seeing colorful corals

WTP	**Q10_6**		
	0	1	Total
0	6	1	7
3	3	1	4
5	1	0	1
7	38	2	40
8	2	0	2
13	8	1	9
17	3	0	3
20	15	3	18
25	7	1	8
26	1	0	1
27	4	2	6
34	6	0	6
35	2	0	2

```
        40 |      34          3 |        37
        42 |       1          0 |         1
        45 |       1          0 |         1
        46 |       0          1 |         1
        47 |       5          0 |         5
        48 |       2          3 |         5
        49 |       9          0 |         9
        65 |       1          1 |         2
        67 |      13          1 |        14
        80 |       1          0 |         1
        92 |       7          2 |         9
       100 |       1          0 |         1
       130 |       3          0 |         3
       260 |       0          1 |         1
      1300 |       1          0 |         1
-----------+----------------------+----------
     Total |     175         23 |       198

   Pearson chi2(27) =  41.7173   Pr = 0.035
```

b) Testing WTP

<u>Econometric analysis of the Binary Discrete-Choice Format</u>

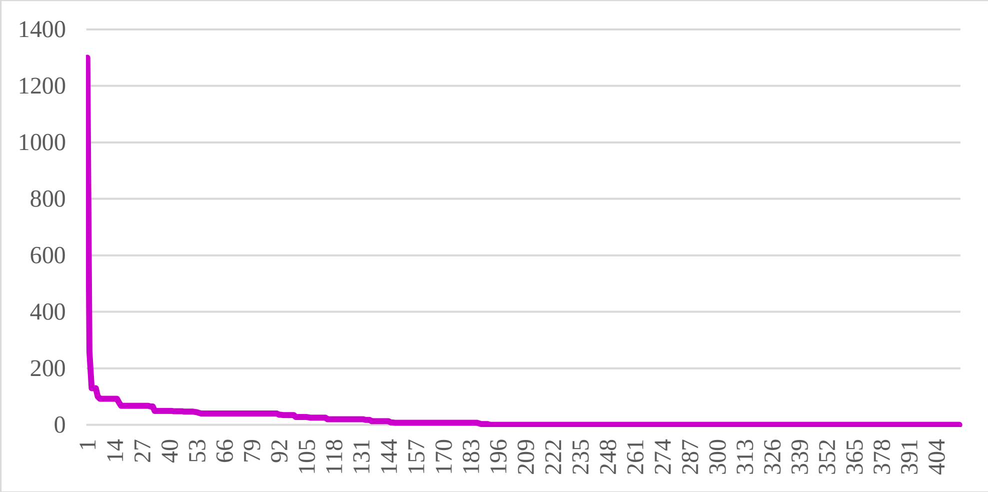
Model shows that the parameters from the double-bounded model are all significant.

	Parameter	Standard errors
Intercept	-0.15483	0.1360
Visitor	2.4856***	0.4016
Bid	-0,05176***	0.0054
n	415	
Log-likelihood	-391.1129	

Note: standard errors are shown in brackets; n: number of observations; asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

<u>Econometric analysis Including Reported Open Bids</u>

The WTP distribution (pounds) is as follows:



Model estimated through the two -stage least squared (2SLS) estimation routine is:

Dependent Variable Log(WTP)

Variable	Est. Coefficient
Having visited the reef	1.61***
Considering the reef important for the local economy	0.23***
Considering the conservation important for the possibility of seeing beautiful landscape	0.15**
The Mesoamerican reef would not be the same without it	0.24***
Constant	4.59***
Wald chi2(4) = 21.12 Prob > chi2 = 0.0003	

*** = 1% statistically significant; ** = 5% statistically significant; * = 10% statistically significant

where the Instrumental variable is “Having visited the reef” and the instruments are “being a male, age, provenience, job, marital status and education level”.

All estimated coefficients positively impact the WTP. However, we can highlight that the WTP is approximately 1.61 percent higher for respondents that have visited the reef.

ANNEX 15. NPV FOR NON-USE VALUES

Table 225. Net present value of non-use values in the Mesoamerican region (2020 USD) – Domestic values –

	20-years			25-years		
	NPV (r =1%)	NPV (r =3%)	NPV (r =12%)	NPV (r =1%)	NPV (r =3%)	NPV (r =12%)
Mexico	[2,326,310,701 – 2,489,200,714]	[2,091,071,414 – 2,237,489,797]	[1,440,108,731– 1,540,946,220]	[2,825,841,986 – 3,023,709,553]	[2,439,044,920 – 2,609,828,667]	[1,512,157,221 – 1,618,039,599]
Guatemala	[233,733,401 – 234,735,114]	[210,098,003 – 210,998,422]	[144,693,274 – 145,313,387]	[283,923,234 – 285,140,047]	[245,060,243 – 246,110,499]	[151,932,263 – 152,583,401]
Honduras	[33,782,086 – 59,866,978]	[30,366,001 – 53,813,159]	[20,912,889 – 37,060,810]	[41,036,150 – 72,722,281]	[35,419,183 – 62,768,163]	[21,959,158 – 38,914,958]
Belize	[3,321,448 – 5,058,024]	[2,985,579 – 4,546,551]	[2,056,151 – 3,131,183]	[4,034,666 – 6,144,140]	[3,482,407 – 5,303,139]	[2,159,020 – 3,287,836]
TOTAL (PPP)	**[3,303,396,829 – 3,585,205,664]**	**[3,237,140,460 – 3,509,203,107]**	**[3,053,793,448 – 3,298,886,065]**	**[3,444,092,403 – 3,746,597,319]**	**[3,335,149,007 – 3,621,628,534]**	**[3,074,086,275 – 3,322,163,936]**
	30-years			**50-years**		
	NPV (r =1%)	**NPV (r =3%)**	**NPV (r =12%)**	**NPV (r =1%)**	**NPV (r =3%)**	**NPV (r =12%)**
Mexico	[3,256,456,386 – 3,484,475,894]	[2,648,179,352 – 2,833,606,848]	[1,553,039,469 – 1,661,784,453]	[4,275,296,915 – 4,574,656,398]	[2,823,957,680 – 3,021,693,306]	[1,601,107,309 – 1,713,218,038]
Guatemala	[327,188,723 – 328,590,958]	[266,072,785 – 267,213,095]	[156,039,860 – 156,708,602]	[429,555,557 – 431,396,507]	[283,733,911 – 284,949,912]	[160,869,422 – 161,558,861]
Honduras	[47,289,422 – 83,804,027]	[38,456,179 – 68,150,181]	[22,552,840 – 39,967,052]	[62,084,762 – 110,023,613]	[41,008,787 – 72,673,789]	[23,250,868 – 41,204,065]
Belize	[4,649,487 – 7,080,411]	[3,781,004 – 5,744,118]	[2,217,391– 3,368,670]	[6,104,162 – 9,295,644]	[4,031,976 – 6,140,043]	[2,286,021 – 3,481,237]
TOTAL (PPP)	**[3,565,377,187 – 3,885,722,877]**	**[3,394,052,802 – 3,689,158,547]**	**[1,990,461,092 – 2,163,527,495]**	**[3,852,338,906 – 4,214,896,164]**	**[3,303,249,554 – 3,745,988,526]**	**[3,099,139,531 – 3,350,902,479]**

Table 226. Net present value of non-use values in the Mesoamerican region (2020 USD) – International values –

	20-years			25-years		
	NPV (r =1%)	NPV (r =3%)	NPV (r =12%)	NPV (r =1%)	NPV (r =3%)	NPV (r =12%)
Canada	[1,189,495,341]	[1,069,212,167]	[736,360,206]	[1,444,917,000]	[1,247,138,901]	[773,200,230]
The United States	[14,521,884,993 – 26,865,487,238]	[13,053,414,825 – 24,148,817,426]	[8,989,810,929 – 16,631,150,219]	[17,640,185,516 – 32,634,343,205]	[15.225.623.048 – 28,167,402,639]	[9,439,570,235 – 17,463,204,935]
Argentina	[153,824,930]	[138,269,972]	[95,225,726]	[186,855,929]	[161,279,366]	[99,989,859]
The United Kingdom	[2,279,974,525]	[2,049,420,808]	[1,411,424,200]	[2,769,555,992]	[2,390,463,270]	[1,482,037,606]
TOTAL (PPP)	**[14,521,884,993 – 31,858,702,337]**	**[13,053,414,825 – 28,637,112,718]**	**[8,989,810,929 – 19,722,213,102]**	**[17,640,185,516 – 38,699,756,941]**	**[15.225.623.048 – 33,402,591,526]**	**[9,439,570,235 – 20,708,913,372]**

	30-years			50-years		
	NPV (r =1%)	NPV (r =3%)	NPV (r =12%)	NPV (r =1%)	NPV (r =3%)	NPV (r =12%)
Canada	[1,665,099,893]	[1,354,074,071]	[794,104,249]	[2,186,056,128]	[1,443,953,511]	[818,682,424]
The United States	[20,328,275,622 – 37,607,309,901]	[16,531,134,885 – 30,582,599,538]	[9,694,775,744 – 17,935,335,126]	[26,688,339,644 – 49,373,428,342]	[17,628,422,820 – 32,612,582,218]	[9,994,836,969 – 18,490,448,392]
Argentina	[215,329,868]	[175,108,167]	[102,693,156]	[282,699,662]	[186,731,331]	[105,871,593]
The United Kingdom	[1,522,105,549]	[2,595,432,097]	[3,191,593,281]	[4,190,140,229]	[2,767,709,218]	[1,569,215,958]
TOTAL (PPP)	**[20,328,275,622 – 42,365,116,478]**	**[16,531,134,885 – 36,266,676,527]**	**[9,694,775,744 – 23,500,675,545]**	**[26,688,339,644 – 58,549,965,725]**	**[17,628,422,820 – 38,673,951,461]**	**[9,994,836,969 – 21,927,080,130]**