



Characterization of the Use of Resources in the Cayman Crown Reef, Based on Information from User Communities of the Gulf of Honduras

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Summary

The Cayman Crown reef, located in Guatemala and Belize, is considered a jewel in the Mesoamerican Reef System (MAR), due to its geographic position in the middle of the Gulf of Honduras, partially isolated from the continent and in excellent health (Giró, 2019). Based on information collected in the community, the use of the reef's resources was characterized in the three countries that share the gulf: Belize, Guatemala, and Honduras. Constant pressure from fisheries was reported (daily and monthly) and evidence of fish spawning aggregations (FSA), especially for snapper and grouper. It is of vital importance for all of the MAR to efficiently protect and manage this reef together with the communities, in order to maintain the health of the region.

1. Introduction

The Cayman Crown reef is located in the middle of the Gulf of Honduras, between Guatemala and Belize. It stands out as a gem in the Mesoamerican Reef System (MAR) due to its location and excellent health. The reef is vital for the connectivity, resilience, and biodiversity of the marine resources and the communities that inhabit the region (Giró, 2019).

This reef was reported to science in 2013 for the first time by Ana Giró, Guatemala coordinator of Healthy Reef Initiative for Healthy People (HRI), along with the support of the artisanal fishermen of El Quetzalito. Since then, its physical and biological characteristics have been identified, discovering a complete system of reefs with abundant biodiversity. It is one of the two sites with major live coral cover in the MAR and the most productive reef of Guatemala. Data suggests that the reef is an essential area of fish spawning aggregations (FSA), a moment when fish massively gather to reproduce (Giró, 2019).

Although it is far from the coast, it is assumed that there is pressure on the reef from fisheries, mainly from Honduras (Giró, 2019), but the commercial use of the reef had not been characterized until now. Knowing how communities of the three countries (Belize, Guatemala, and Honduras) use the resources of the reef, provides the opportunity to

propose adequate and effective plans for the sustainable use of the resources of one of the most important reefs for the Gulf of Honduras and the MAR.

This study seeks to understand the use of the Cayman Crown reef to be able to propose management and protection measures that are adequate for this jewel in the region. Community-based research was conducted surveying the artisanal fishermen and sport fishing guides in seven locations of the three countries of the Gulf of Honduras.

The fishermen shared their vast knowledge of the marine resources and of the Cayman Crown reef. Information collected regarding the general aspects of fisheries in the region and the commercial use of the fishery resources of the reef were characterized by answering who, how, when, and why.

Cayman Crown is a highly productive area for fisheries and is also a critical reef for health and economy of the region. Snapper, grouper, lobster, conch, and pelagic species are the main species fished in the reef. The fishermen consider it as “the breeding ground for all the Gulf of Honduras, a nursery, and an aggregation and reproduction zone. The fishing pressure from the three countries on the Gulf of Honduras, the different fishing policies, and the alarming environmental unbalance are enormous challenges for the protection and management of the reef.

2. Methodology

A survey was designed, jointly with conservation agents in the Gulf of Honduras, regarding the use of the reef (annex 1), and also included the participation of organizations such as the Mesoamerican Reef Fund (MAR Fund), Healthy Reefs for Healthy People (HRI), Fundación Mundo Azul (FUNMZ), Toledo Institute for Development & Environment (TIDE) and Southern Environmental Association (SEA).

A total of 56 artisanal fishermen and sport fishing guides in seven locations of the Gulf of Honduras were surveyed. The local conservancy organizations of each of the gulf countries provided guidance as to whom to interview, either to work only with people that know the Cayman Crown reef or use it as a fishing area.

In Belize, TIDE, SEA, and the Environmental Defense Fund (EDF) supported the effort. Twenty-two surveys were conducted in three locations: Punta Gorda, Monkey River, and Sapodilla Cayes.

In Guatemala, the FUNMZ team and the new Fishermen Committee of El Quetzalito were the collaborators. Seven of the main boat captains of the community were surveyed.

In Honduras, support came from Omoa Conservation Corps (CCO), and surveys were conducted in three locations of the Omoa Bay, mainly in the communities of Paraiso, Omoa, and Puerto Cortez. Twenty-seven fishermen of the organized fishing committees of each community and other fishermen that use the area were surveyed.

The species identified by the fishermen were compared to the document of the Belize Department of Fishing: “Common Marine Finfish Species of Belize.” The remaining species were identified using the common name from the Red List of the International Union for Conservation of Nature (IUCN, 2019).

3. Outcomes

3.1. General Aspects of the Interviewed Fishermen

Fifty-six fishermen were interviewed in the region of the Gulf of Honduras: 22 in Belize, 7 in Guatemala, and 27 in Honduras.

3.1.1. Age Range

Regarding the age range, 55% of the interviewed fishermen (n=31) were 41-60 years old, 34% (n=19) were 26-40 years old, and the remaining 11% (n=6) were more than 60 years old. There were no fishermen interviewed between the ages of 15 to 25 (Figure 1).

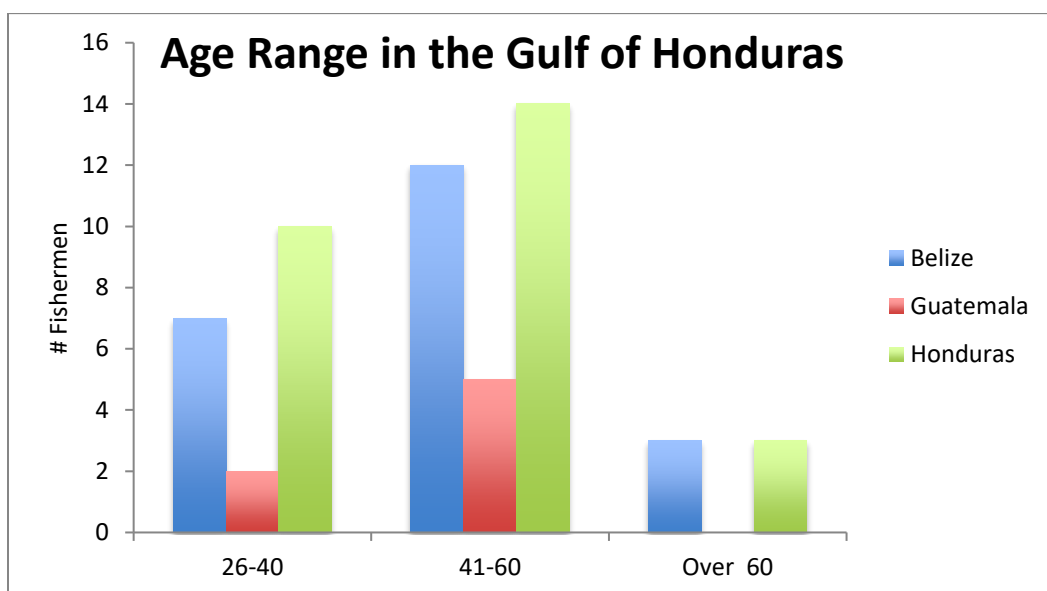


Figure 1. The age range of the interviewed fishermen in the three countries of the Gulf of Honduras.

3.1.2. Fishing Activity

The interviewees were asked if they currently are fishermen, if they are not but used to be, or if they have never been. The results were:

- 46 fishermen (82%) are currently artisanal fishermen.
- 4 fishermen (7%) (two in Belize and two in Honduras) no longer fish.
- In Belize, 6 fishermen (11%) of the total, are sport fishing guides or operators.

3.1.3. Years Dedicated to Fishing

The fishermen responded for how long or since when they had been fishermen, the results were:

- 73% (n=41) responded “since childhood” or “all my life.”
- 14% (n=8) responded between 25 and 40 years.
- 13% (n=7) between 10 and 24 years.

3.1.4. Changes in Fishing Dynamics

The fishermen were asked if fishing had changed over time. Without hesitation, the 56 fishermen (100%) responded positively to this question.

They were asked how fisheries had changed, and 95% of the fishermen (n=54) responded that it had “Decreased.” In Belize, three fishermen (5%) responded “Increase and Decrease,” referring to seasons with high yields and others when there it is almost nil.

The reason for this decrease or changes in the fishing dynamics was due to a wide range of causes and changes in the region and ecosystems, primarily as a consequence of human-induced processes (Figure 2). The main causes mentioned were the following:

- “Greater fishing pressure and demand” mentioned by 66% of the fishermen (n=37), also understood as human overpopulation.
- “Destructive fishing practices,” primarily referring to the use of gillnets and the different types of longline fishing gear (44%, n=25).
- “Contamination” (32%, n=18).
- “Loss of habitat” (30%, n=17).

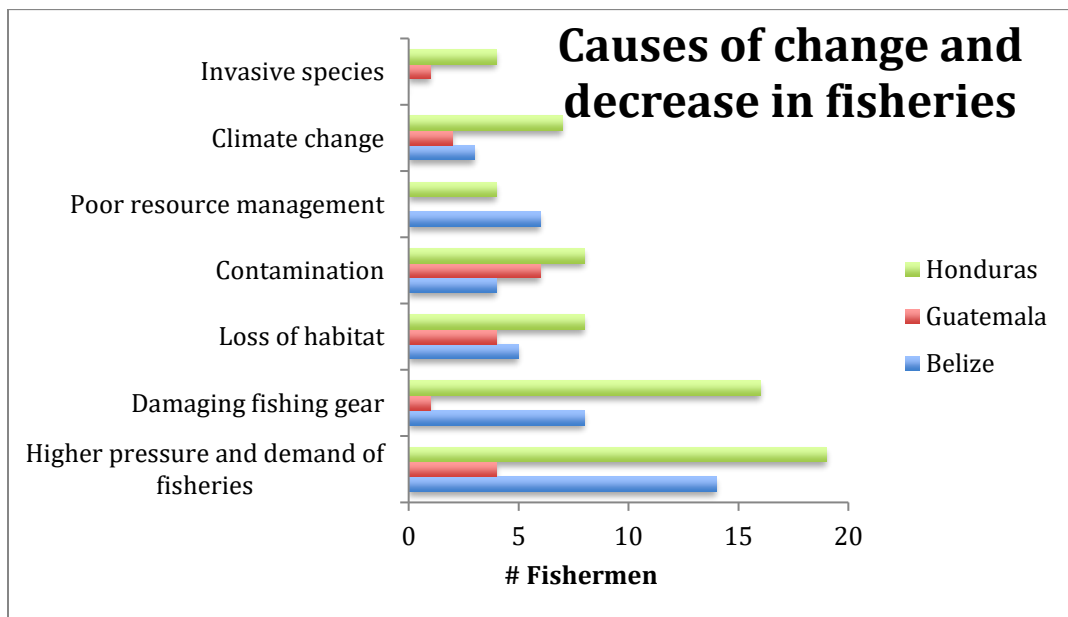


Figure 2. Causes of change or decrease in fishery resources, according to the interviewed fishermen of the Gulf of Honduras.

3.1.4.1. Key Causes of Change - Belize

In Belize, 14 of the 22 interviewees (64%) responded “more pressure and demand on the resources” as the primary cause. The second threat on the fishery resources was “destructive fishing gear,” mentioned by 36% of the fishermen (n=8). The fishermen consider gillnets, traps, and longlines destructive for the resources and that they are not sustainable with the environment because they are not selective, interrupting the ecological equilibrium. In this country, these types of destructive fishing gear are largely regulated, and the regulations strongly support transitioning to more selective fishing gear, such as lines with hooks, trolling, and diving without harpoons.

The third most common cause in Belize, mentioned by 27% of the interviewees (n=6), was the “poor management of the resources,” referring State management of the resources, including aspects like scarce patrolling, corruption and licenses provided to neighboring

countries; in addition to illegal fishing. These causes were followed by “loss of habitat,” mentioned by 27% of the interviewees (n=6), particularly linked to tourism and urban development. Lastly, the fishermen indicated “contamination” (n=4) and “climate change” (n=3).

One fisherman responded, “I don’t know, it must be something else,” referring that in his region, sustainable fishing gear has already been implemented, and there are no positive signs of change.

Another fisherman emphasized that the real threat is not the artisanal fishermen but the fishing and tourist industries. The fisherman said: “They want to eliminate the gillnets, but that is ridiculous. What about the large industrial ships, the tourist industry dredging reefs, seagrass and mangroves to build resorts, multimillionaire homes, and new white beaches? Our common objective is the pelagic species, they come and go.” The fisherman mentioned that artisanal fishing has minimal impact, for they have established closed seasons and give the resources time to replenish. On the other hand, when the tourism industry develops their projects, the resources are lost forever. He finalized his concern by proposing that tourism in the region should be sustainable and restricted to a type of “eco-cabin.”

3.1.4.2. Key Causes of Change - Guatemala

In Guatemala, six of the seven fishermen (85%) recognized “contamination” to be the main threat to fisheries resources. It can be explained because the interviewed community inhabits the side of one of the most contaminated rivers in the country and region, the Motagua River. For this category, the fishermen referred to the pesticides, plastics, and other contaminants that flow downriver.

One fisherman responded: “The fish come with plastic. There is a season when large quantities of dead fish come down, when the industry open their wastewater gates. The fish move away from the shore.” Another responded: “The reefs are dead due to the river; the fish reproduce in the river.”

The second threat recognized by the fishermen was “more fishing pressure and demand,” recognized by 57% of the country’s fishermen (n=4). On the other hand, one fisherman pointed out that fishermen and the younger generation have retired from fishing.

The third cause was “loss of habitat,” attributed to the fact that there are no more mangroves, the river is contaminated, and there is more exploitation and tourism. The

fourth cause was “climate change,” mentioned by 29% of the fishermen (n=2). One of the fishermen replied, “When a hurricane hits, it brings fishery product. The climate hasn’t been bad; the currents are weak due to climate change.” Finally, a fisherman mentioned an invasive species, specifically the “toad fish,” “knot eater,” or “rope cutter.” A fish they recognize as an invader, “It has big teeth and its belly bloats, it eats either the gill nets or the hooks,” to which they lose their product and fishing gear. Its scientific identification was not possible.

Only one fisherman mentioned “destructive fishing gear” as a threat. In Guatemala, campaigns to transition to sustainable fishing gear and regulations for non-selective fishing gear are almost non-existent. Gillnets are the fishing gear most commonly used on the country’s coasts, along with different types of longline.

3.1.4.3. Key Causes of Change - Honduras

In Honduras, the key causes of decrease in fisheries resources were “more fishing pressure and demand,” mentioned by 70% of the interviewees (n=19). One fisherman answered, “There is no work. Any boy goes out fishing to make some income.” On the other hand, another fisherman commented, “The young generations don’t want to fish, the work is hard for very little income, and they can’t take it.”

The second cause was “damaging fishing gear,” clearly referring to gillnets and longlines. According to the fishermen, even though the efforts to eliminate the use of and regulate gillnets are not the most efficient in Honduras, the country has laws and campaigns to regulate this type of fishing gear, controlling the size of the mesh, which must be greater than three inches. Currently, 74% of the interviewed fishermen (n=20) use handlines with hooks and trolling. Some still use gillnets, but say that they use a mesh of three inches or more. Several fishermen mentioned that fishery destruction takes place close to shore by fishermen that use gill nets with two-inch or even one-inch mesh. Two fishermen answered that they even use mosquito nets, primarily those that fish for little-eye hearing, *Jenkinsia majua* (LC).

Another cause, attributed by 30% of the fishermen (n=8), was the “loss of habitat,” mainly in mangroves, lagoons, and rivers where fish reproduce. The fishermen also mentioned “contamination” (30%, n=8), followed by “climate change” (26%, n=7), and “invading species” (15%, n=4).

The last cause mentioned by 15% of the fishermen (n=4) was the “poor management of the resources,” referring to the management of closed seasons by the government, with

inaccurate information. The fishermen know their resources like the back of their hand and the Directorate for Fisheries in the city “sets up closed seasons from the desk.” The fishermen criticized the closed season Guatemala has on snapper, which is enforced during the winter (September and October), and it is during the summer (April and May) that the fish reproduce. They also mentioned that there are no regulations on gillnets, nobody provides control or awareness. Gillnets with mesh less than three inches are still used and are destroying the resources, “even larvae are taken.”

3.1.4.4. Changes in Fishing Practices

In Belize, the fishermen generally mentioned they are not using gillnets, fish traps, and long lines anymore. Only three of the 22 fishermen mentioned that their fishing gear has not changed and they continue to use hooks, gillnets and diving.

In Guatemala, the fishermen stressed that their fishing gear has changed because they needed to improve them in order to increase their catch, reflected in the increased use of hooks, longer gillnets, floating longlines and not at depth, use of fresh bait and fishing further out. Guatemalans use gillnets up to two kilometers in length and longlines with up to 300 hooks (FUNMZ, 2019).

In Honduras, the fishermen generally mentioned not using gillnets and longlines. The commonly used fishing gear in the region are handlines with hooks and trolling. Of the 27 fishermen, five mentioned that they continue to use gillnets, and it is common to see this type of fishing gear on land and at sea.

3.2. Do You Know the Reef in the Gulf of Honduras?

Of the 56 fishermen interviewed, 89% (n=50) responded that they did know the Cayman Crown reef.

In Belize, a better question for the fishermen and sport fishing guides was formulated: Do you know the deep banks or the reef south of Sapodilla Cayes, towards Manabique, after the “Rise and Fall”? Of the 22 fishermen interviewed in Belize, 77% (n=17) replied “Yes,” they knew it, 14% (n=3) said they had heard of them, and the remaining 9% (n=2) responded “No.”

The seven fishermen interviewed in Guatemala (100%) answered that “Yes,” they knew the reef. In the region, they know it as the outer reef, in front of Motaguilla and before entering the gulf to fish for shark.

In Honduras, 94% of the fishermen (n=26) answered that “Yes,” they knew the reef. Only one fisherman (6%) answered “No.” In this country, a better question was if they knew the “banks of twenty-one,” towards Manabique, in front of the “Malezona” (the Motaguilla reef). Some recognized the reef by a large cargo shipping channel or as “Post of Changel,” because of a fisherman that died when he was run over by a ship while he slept waiting for his catch.

3.3. Do You Visit Cayman Crown Reef?

59% of the fishermen interviewed (n=33) visit the reef, and 20% (n=11) have visited it in the past. The remaining 21% never visit the reef.

Using this point of view, the information to characterize the specific commercial use of the Cayman Crown reef only considered responses from the 44 fishermen that know the location, visit, or have visited the reef.

In Belize, 45% (n=10) visit the reef, and 14% (n=3) had visited the reef in the past. The remaining 41% (n=9) do not visit the reef. Four of the 13 fishermen interviewed that visit or have visited the reef are sport fishing guides.

All of the interviewed fishermen in Guatemala (n=7) answered that they do not fish in that reef, their fishing area is in the Motaguilla reef, in the open sea on the gulf to go out to fish for shark and at the mouth of the Motagua river. Six of the fishermen (86%) said they had only visited the reef for scientific and conservation reasons, as guides for foundations and organizations that operate in the country and perform biological monitoring, mapping, diving, and hunt for lionfish.

According to the two fishermen who were interviewed in El Quetzalito, all the fishermen (n=7) use the open sea of the gulf to fish shark, about 40 minutes from the “outer reef” (Cayman Crown). Many of the shark species that are captured in this area could be associated with the reef for reproduction and life cycles, but inhabit the continental shelf in deeper water and the open sea.

Seventeen fishermen interviewed in Honduras (63%) visit the reef, and seven (26%) visited it in the past. Only three fishermen (11%) answered that they do not visit the reef, one of them responded, “No, because of the Guatemalan patrol,” and another responded, “No, because of the Belizeans, they may think I am camping out to enter at night.” A total of 24 fishermen know the reef.

3.4. How Often?

Not all the fishermen that visit or have visited the reef (n=44) responded to a specific frequency, indicating instead only one season.

Each country and community have their own routine to visit the reef, depending on their fishing target, season, and distance to the reef. The most common responses were “2 to 3 times per year” by 27% of the fishermen (n=12), and “once a year” by 23% of the fishermen (n=10), in Honduras and Belize. The highest frequency of fishing reported in Belize and Honduras by nine fishermen (20%) that visit the site “2 to 4 times a month.”

In Guatemala, they go shark fishing on the gulf every 15 to 20 days, not directly on the reef. They also visit it when there are scientific or conservation projects. In Belize and Honduras, four fishermen (9%) responded “very little” meaning that they have not gone more than three times in their life (Figure 3).

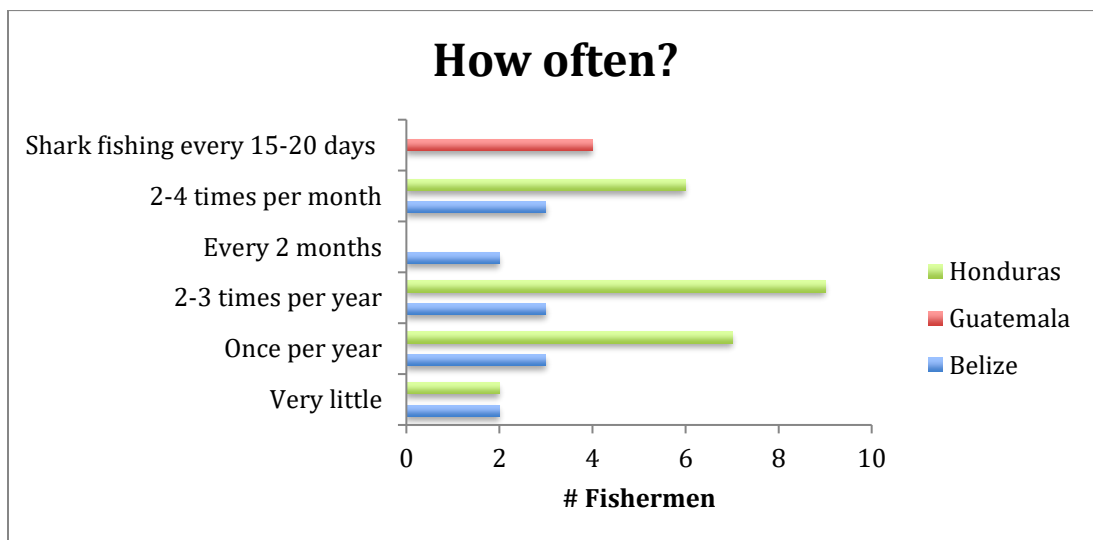


Figure 3. Frequency of visits to the Cayman Crown reef by fishermen on the Gulf of Honduras.

Several fishermen responded to the question by indicating they only visit the area during certain seasons, not regularly. Of the 44 fishermen that visit the reef, 23 (52%) visit the area during the winter, between October and November, taking into consideration the changes in climate, expecting bad weather, rain, or north winds. The summer, between April and May, was mentioned by 17 fishermen (39%). Two other fishermen mentioned the importance of the new and full moon to go out, referring to aggregations and good fishing almost every month during these lunar phases.

In Belize, 13 interviewees visit or have visited the reef, with 38% of the fishermen (n=5) visiting it regularly: three fishermen “2 to 3 times per month” and two “every two months,” fishing in one area one month and in another area the next. Two fishermen from Monkey River responded that they visit it “very little,” having been there only once or twice during their lifetime, accompanying or as guides for scientific mapping.

The four sport fishing guides (31%) visit the area more frequently, one visiting it “2 to 3 times per month” and the other “2 to 3 times per year.” The remaining tourist guide does not visit the reef, but mentioned that he has observed movement during the night, “four to five boats a day.”

In Belize, three commercial fishermen (23%) said they visit the area mainly during the summer, March, April, and May. Only one fisherman mentioned he also visited it during the winter in November, December, and January.

In Guatemala, they do not fish directly on this reef; however, four of the seven fishermen visit the area for scientific and conservation purposes, “only during projects.” The fishermen from El Quetzalito mentioned that other communities from Manabique fish commercially on the Cayman Crown reef. The fishermen said, “The fishermen from San Francisco fish daily.”

The El Quetzalito community go shark fishing about “every 15 to 20 days”, respecting the close season months. Although it is known that pressure for this resource has diminished, particularly in this community, the fishing pressure with longlines and gillnets is high in the gulf area and the Motaguilla reef, adjacent to the Cayman Crown reef (FUNMZ, 2019).

In Honduras, nine of the 24 fishermen (38%) answered that they visit it “twice a year,” referring to the winter (October and November) and in the summer (April and May). Considering only the seasons, 16 of the 24 fishermen (67%) said they visit the area during the winter, and eight fishermen (33%) during the summer.

The 16 fishermen that said they visit the reef during the winter explained that during this season, they expect bad weather or north winds. The rain and strong north winds come from the open sea, and the fish from the reef move closer to the continent seeking shelter in the gulf, where the winds aren’t so strong. When this happens, the fishermen go out for snappers, fishing large quantities for no more than one week after the first bad weather from the north.

25% of the fishermen (n=6) commented that they visit Cayman Crown reef regularly. Of these, three fishermen said that they visit it “2 to 3 times per month” and the other three up to “4 times per month.” This response was limited to the communities of Paraiso and Omoa.

It is important to point out that nobody from Puerto Cortez responded visiting the area regularly. Six of the nine interviewed fishermen in this location (67%) indicate only going seasonally, especially for the “winter snappers.” Two of them also go during the summer. On the other hand, members of the artisanal fishermen association of Puerto Cortez and the Puerto Cortez fishermen cooperative mentioned that a couple of well know fishermen visit the reef regularly, yet they were fishing on the days the interviews were conducted.

3.5. Which Activities Are Carried Out?

Of the fishermen that visit or have visited the reef, 73% (n=32) are commercial artisanal fishermen, 11% (n=5) practice sport fishing in the area, and the remaining 14% (n=6) have participated in scientific and conservation efforts, collaborating with monitoring, mapping, diving, and hunting lionfish. Beyond the reef, in deeper waters of the Gulf of Honduras, Guatemalan fishermen fish for shark (Figure 4).

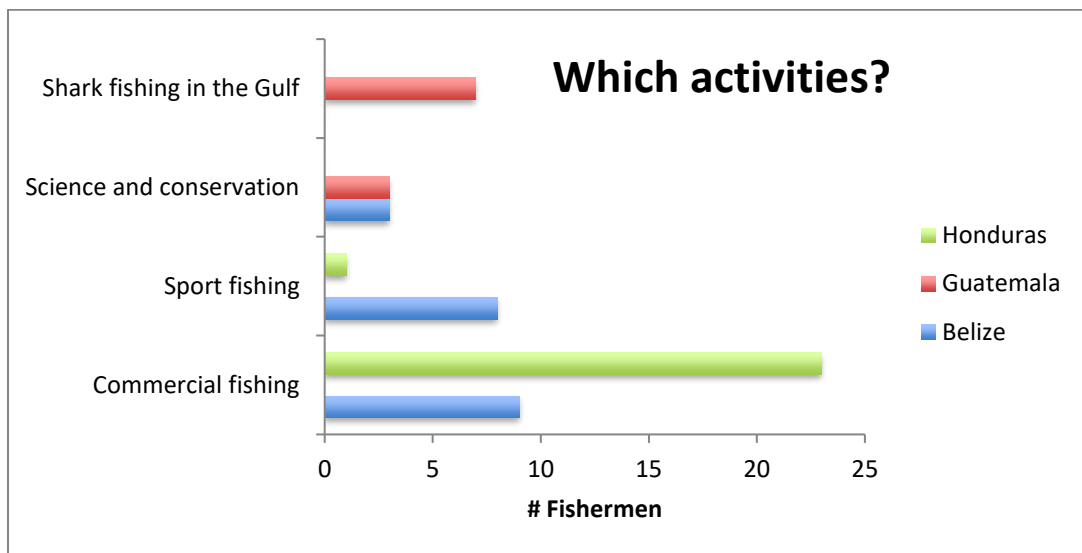


Figure 4. Activities carried out on the Cayman Crown reef.

In Belize, six fishermen currently fish commercially on the reef, four of them practice sport fishing, and three have participated in scientific investigation efforts. On the latter, the participants mentioned having participated in scientific monitoring and mapping dives.

In Guatemala, particularly those from the El Quetzalito village, do not put direct pressure on Cayman Crown Reef. The fishermen did mention that there is commercial fishing pressure by other villages from Manabique, such as San Francisco del Mar, Cabo Tres Puntas and from Livingston, and Puerto Barrios.

In Honduras, 23 fishermen (96%) mentioned they do commercial fishing seeking snapper, mainly during the winter after the first northern cold front. One fisherman said he also “goes sport fishing sometimes with his boss and friends.”

3.6. Target Species and Fishing Gear

All 24 fishermen shared the species they consider as target species for the Cayman Crown reef area, where snapper and grouper have the highest demand. The pelagic and chondrichthyan species are also target species of the area. Each country differs in the fishing gear they use, but in Belize and Honduras the use of handline with hooks and trolling prevails. They continue using gillnets in Honduras, and in Guatemala, they predominantly use gillnets and longlines (Table 1).

Snappers are the target species with the highest demand, as it brings a significant income to 95% of the fishermen interviewed (n=42). The fishermen mentioned at least nine species of snapper, such as gray snapper, *Lutjanus griseus* (LC); cubera, *Lutjanus cyanopterus* (VU); mutton snapper, *Lutjanus analis* (NT); yellowtail snapper, *Ocyurus chrysurus* (DD), and deepwater snappers such as red snapper, *Lutjanus campechanus* (VU); silk snapper, *Lutjanus vivanus* (LC), and black snapper, *Apsilus dentatus* (LC)¹.

¹ IUCN categories under high risk of extinction, 2019

LC = Least concern NT = Near threatened CR = Critically endangered

VU = Vulnerable DD = Data deficient

Table 1. Target species and fishing gear used in the Cayman Crown reef.

Belize				
Fishing gear	Depth (m)	Target species	Fishing Duration (Hours)	Anchors
Hand line	5-20	Snapper and grouper	~ 12	1
	25-60			
	70-100	Deepwater snapper and grouper		
Trolling (with rod or hand line)	Pelagic	Pelagic species and shark	~ 3-4	0
Skin diving	15	Lobster and conch	~ 8	0
Guatemala				
Fishing gear	Depth (m)	Target species	Fishing duration (hours)	Anchors
Lobster nets	10-50	Lobster, conch, snapper and grouper	~ 12 – 72 *	2
	50-90	Deepwater snapper and grouper, and shark		
Bottom longline: (50, 100, 200, 300 hooks)	30-50	Snapper, grouper, rays and jacks	~ 12-72 *	2
	55-80	Deep water snapper and grouper, sharks and stingrays	~ 24	
	85-200			
Floating longline	10-70	Snapper and grouper, pelagic species	~ 12-72 * Shark ~ 24	2
		Deep water snapper and grouper, sharks and stingrays.		
Honduras				
Fishing gear	Depth (m)	Target species	Fishing duration (hours)	Anchors
Hand line	5-20	Snappers and grouper	~ 24-48	1
	25-60			
	70-100	Deep water snappers and grouper, Pelagic species and shark		
Trolling (using fishing pole or hand line)	Pelagic	Pelagic species and shark	~ 12-24	0

* The fishermen leave the fishing gear 12 to 72 hours before collecting it.

Source: Own preparation

Groupers are the second target species for 89% of the fishermen that use this reef (n=39). The fishermen mentioned at least six species, including deepwater grouper, such as the Atlantic goliath grouper, *Epinephelus itajara* (VU); black grouper, *Mycteroperca bonaci* (NT); red grouper, *Epinephelus morio* (VU); and red hind, *Epinephelus guttatus* (LC). A common denominator of all fishermen was commenting that “groupers are pure luck” “you may catch 1 or 2 per trip,” and they also commented that every season “there are fewer groupers.”.

The pelagic species are the third target species for 64% of the fishermen (n=28), including at least eight jack species, such as jack, *Caranx spp.* (LC); big eye scag, *Selar crumenophthalmus* (LC); king fish or king mackerel, *Scomberomorus cavalla* (LC); wahoo, *Acanthocybium solandri* (LC); bonito, *Thunnus alalunga* (NT); and barracuda, *Sphyraena barracuda* (LC).

Chondrichthyans were the fourth most common group for 30% of the fishermen, and they mentioned species such as sharp nose shark, *Rhizopriondon spp.* (LC); nurse shark, *Ginglymostoma cirratum* (DD); tiger shark, *Galeocerdo cuvier* (NT); hammerhead shark, *Sphyrna spp.* (CR); blue shark, *Prionace glauca* (NT), and stingrays, *Hypanus spp.* (DD). Data from Fundación Mundo Azul indicates that on the Gulf of Honduras they have registered at least 33 species of Chondrichthyans (annex 2) fished by El Quetzalito community.

3.7. Fish Spawning Aggregations (FSA)

Fishermen were asked on which season do the most common target species (snappers and groupers) come naturally with a large quantity of roe, indicating an active state of reproduction.

3.7.1. Snapper FSA Season

Fishermen provided information regarding the spawning season for snapper. 59% of the fishermen (n=26) mentioned it occurred in April, 52% (n=23) said snappers spawn in May, and 30% (n=13) of the fishermen mentioned March (Figure 5).

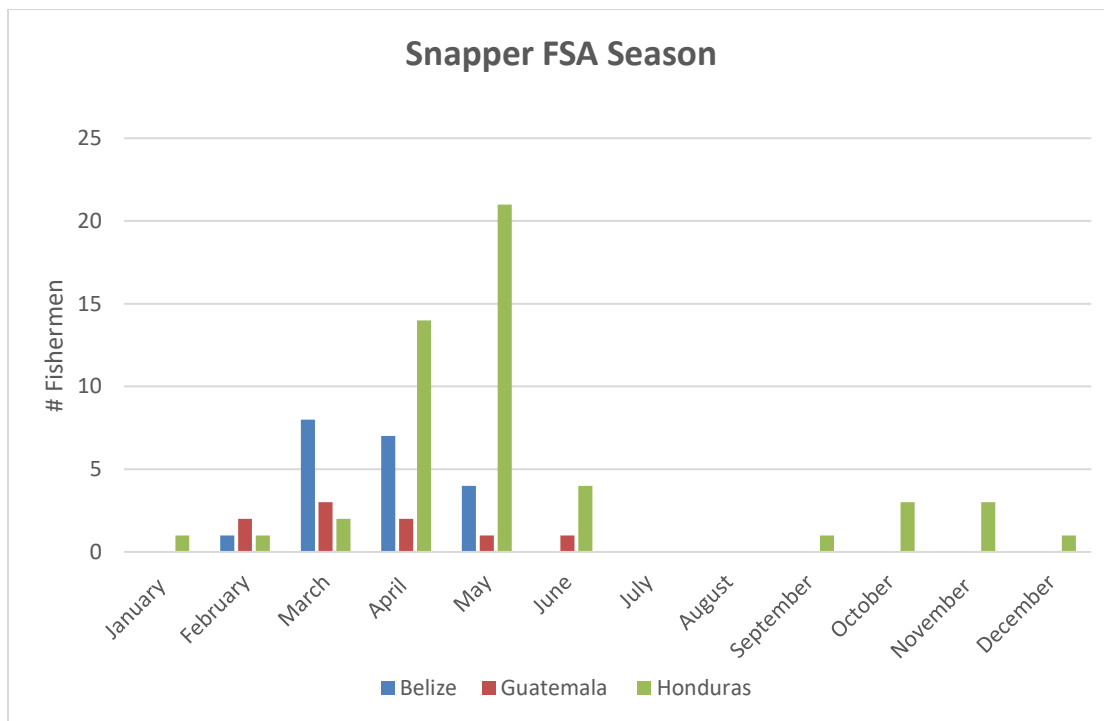


Figure 5. Spawning aggregation season for snapper in Cayman Crown reef, according to the community.

Fishermen were very specific in saying that during the winter (October to December), when they fish large volumes of snapper, they have few eggs, and questioned the close season imposed by Guatemala, usually during September and October. One fisherman answered that during the winter “no more than five out of fifty will have eggs.” The fishermen from the three countries on the Gulf of Honduras said that snappers actually reproduce during the summer, March through May.

3.7.2. Grouper FSA Season

Grouper spawning season is not as clear, but 50% of the fishermen (n=22) mentioned January and December as the main spawning month; 27% of the fishermen (n=12) mentioned February (Figure 6).

Of the 20 remaining fishermen, many said that the spawning season is not well defined, and they almost always have eggs. One fisherman even responded, “It is random, and it has always been that way.”

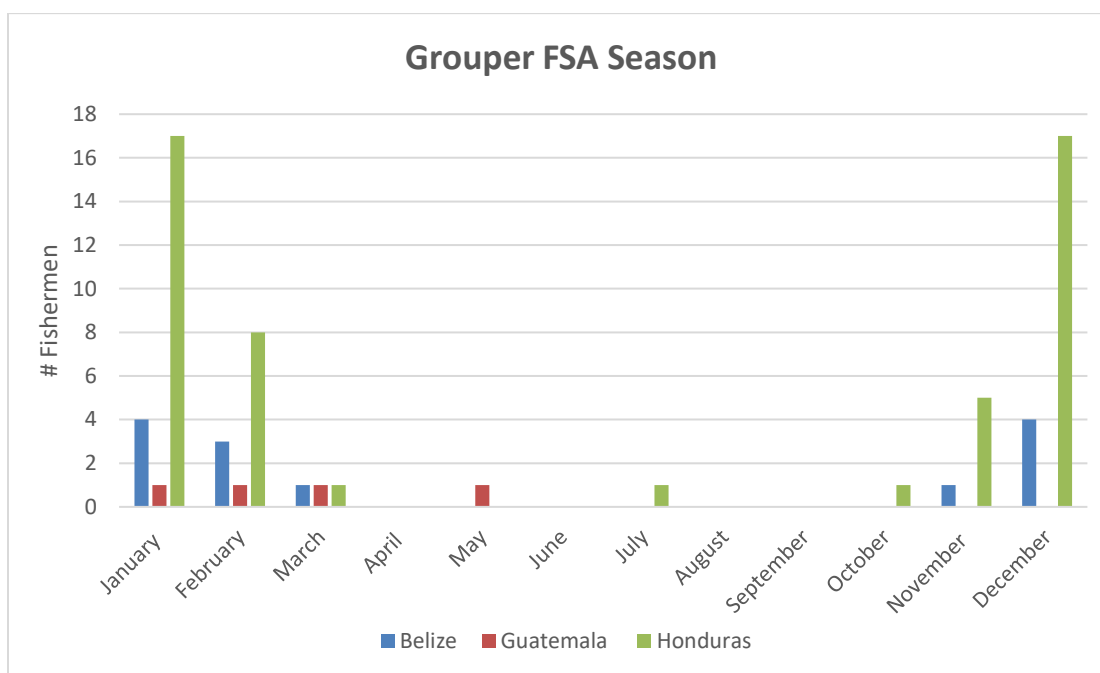


Figure 6. Spawning aggregation season for grouper in Cayman Crown reef, according to the community.

3.8. Type of vessel and crew

The reef is visited by fishermen and sport fishing guides with 18 to 28-foot boats, with 40 to 60 horsepower motors. Commercial fishermen of all three countries usually have crews of three people.

The 13 fishermen that visit the area from Belize said they use 20 to 28-foot boats. One fisherman said that when he goes out, he uses a smaller boat to get to Sapodilla Cayes and then changes to a larger one to get to the reef. They mentioned using 40 to 60 horsepower motors, and a sport fishing guide said to use a 225-horsepower motor. The commercial fishermen use a crew of three, for sport fishing a crew of four, and one fisherman that has gone for science and investigation purposes has taken five to six people.

All of the fishermen from El Quetzalito in Guatemala said to have 25-foot boats with 40 horsepower motors. Their crew size is two to three to go out to sea. When going with science and conservation purposes, they take larger groups of five to six people.

Fishermen from Honduras use 18 to 28-foot boats, commonly using 23-foot boats they call “tiburonerías” with 40 horsepower motors. Others use 50 to 115 horsepower motors. Usually, they carry a crew of three, but in some cases two or four.

3.9. Equipment

The fishermen that visit the Cayman Crown reef take water, food, fuel and fishing gear, 84% (n=37) they also take a GPS, 86% (n=38) take a cooler and ice to keep their catch fresh, and 66%(n=29) take a fish finder that indicates depth and amount of fish under the boat. Thirteen of the fishermen (69%) from Belize and 20 of the 24 fishermen (83%) from Honduras use a fish finder as well. None of the Guatemalan fishermen from El Quetzalito are equipped with this technology.

In Honduras, 63% of the fishermen (n=15) said to have lights under the boats. They explain that they use these lights to attract fish at night. They line the outside of the lights with tape to waterproof them and lower them about three meters below the boat, for which they need to take a battery with them. The fishermen from El Quetzalito use flashlights when they go shark fishing in the gulf because they spend the night at sea.

3.10. Tourism in the Area

Of the interviewees, only four sport fishing guides from Belize use the area to take tourist fishing. The fishermen from Guatemala and Honduras provided information on tourism that they have seen, but don't personally partake in that activity. In Honduras, only one interviewee mentioned he occasionally goes out with his boss and friends for sport fishing in the area.

Of the fishermen, 75% (n=33) have seen tourism in the reef, the other 25% (n=11) have not. Also, 73% of the fishermen (n=32) said that the type of tourism on the reef was sport fishing, and 23% (n=10) mentioned recreational diving (Figure 7).

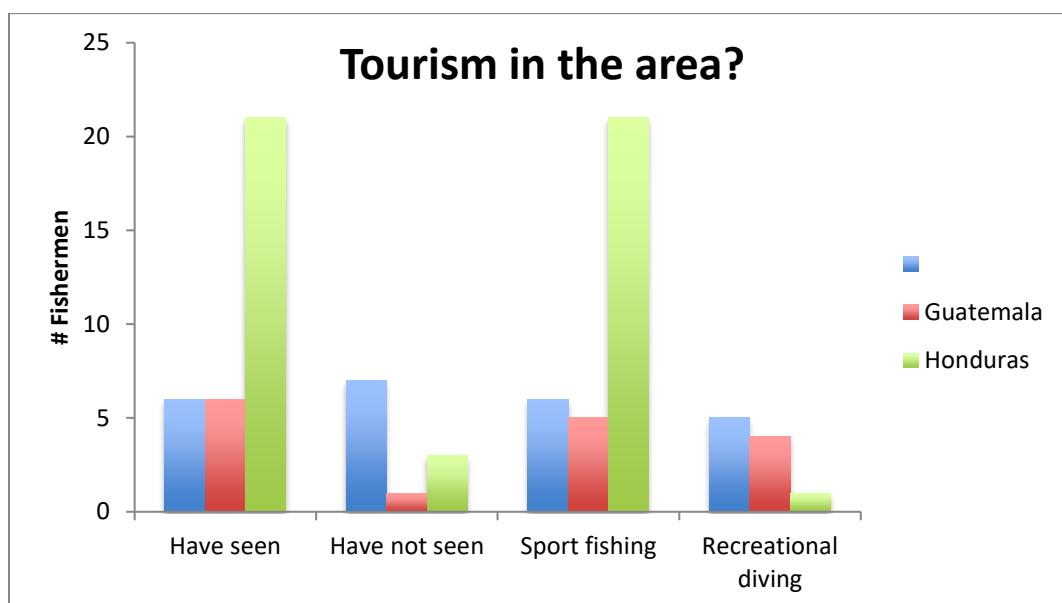


Figure 7. Tourism activities on the Cayman Crown reef.

3.11. Have you seen other people?

Fishermen from all three countries, 95% (n=42), said to have seen mostly Guatemalans on the Cayman Crown reef. The fishermen interviewed from El Quetzalito pointed out that two Manabique communities put enormous fishing pressure on the reef, and they are also fishing with air compressors and hoses, which is the reason that the lobster and conch production is extremely low. They also mentioned that fishermen come from Puerto Barrios, and even from Livingston, fishing with longlines with 1,000 or more hooks and gillnets that are several kilometers long.

Honduras was the second most mentioned country, with 91% of the interviewees (n=40) saying they had seen fishermen from that country on the reef. The Honduran fishermen pointed out that the fishermen from Omoa and Paraíso visit the area most frequently. Some mentioned that fishermen from Puerto Cortez also go.

Belize was the country with the least number of mentions, with only 23% of the interviewed fishermen (n=10) mentioning seeing fishermen from that country. The Belizeans have mostly been seen by the Honduran fishermen who mentioned to have seen sport fishing boats and the presence of a Belizean patrol. Two Guatemalan fisherman said that it is rare to see Belizean fishermen (Figure 8).

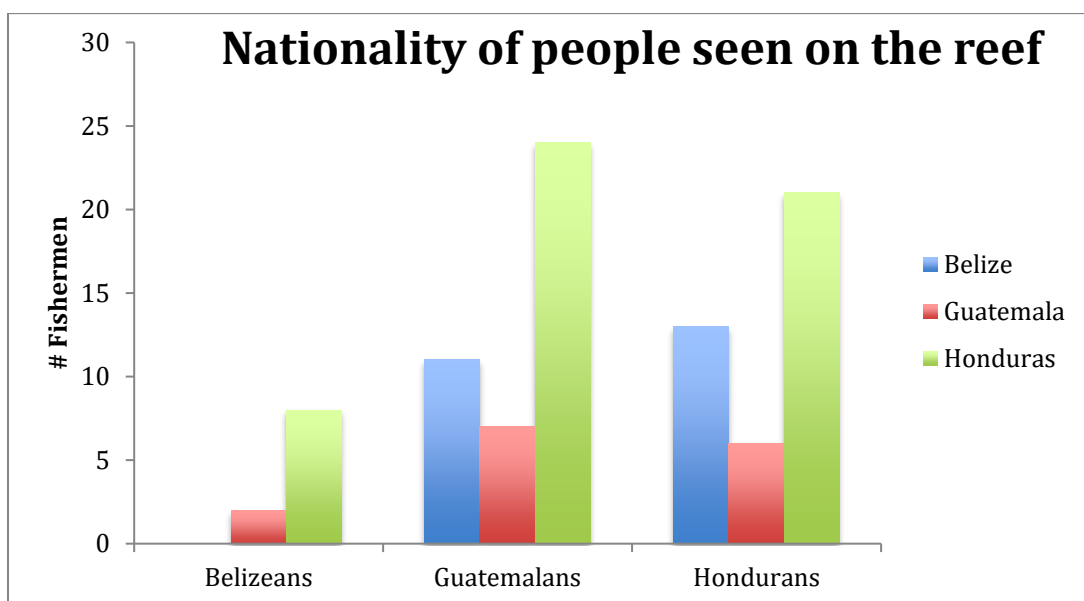


Figure 8. Nationality of the people seen on the Cayman Crown reef, according to the fishermen interviewed in the different countries.

3.12. What do the people observed on the reef do?

All of the fishermen (n=44) said that the observed people are fishing commercially, and 70% (n=31) said that they are also sport fishing.

3.13. Should we protect the Cayman Crown reef? Why?

Responses of all the participants were taken into consideration, even of those that do not specifically know the Cayman Crown reef. It is important to know the opinion of fishermen regarding the conservation of marine resources and their reasoning.

Of the interviewees, 93% (n=52) did not hesitate to responding “yes” to this question. Their main reasons and concerns can be seen in Figure 9. The primary reason was to replenish the fisheries production with 41% of the fishermen (n=23), stating that by protecting the reef, the fishery production can be replenished in the region. Also related to this reasoning, 36% of the fishermen (n=20) stated that the Cayman Crown reef is an area where there are aggregation and reproduction zones of marine life, which is why it should be conserved.

The four remaining fishermen, two from Belize and two from Honduras, responded, “I don’t know.” One of the fishermen from Belize said: “they close, they provide work for 10, but they take away the bread from 100.” The other fisherman said he did not know if that area was Belizean. One of the fishermen from Honduras responded, “No, there is not much there, there used to be, but now there are only rocks and a navigation channel.”

The other one said, “I don’t know, ships navigate there, and it belongs to Guatemala. In areas where the “chapines” (Guatemalans) fish, there are no more fish because they use longlines and gillnets, they say so themselves. One takes care of it, and the other disturbs it. It can’t work that way.”

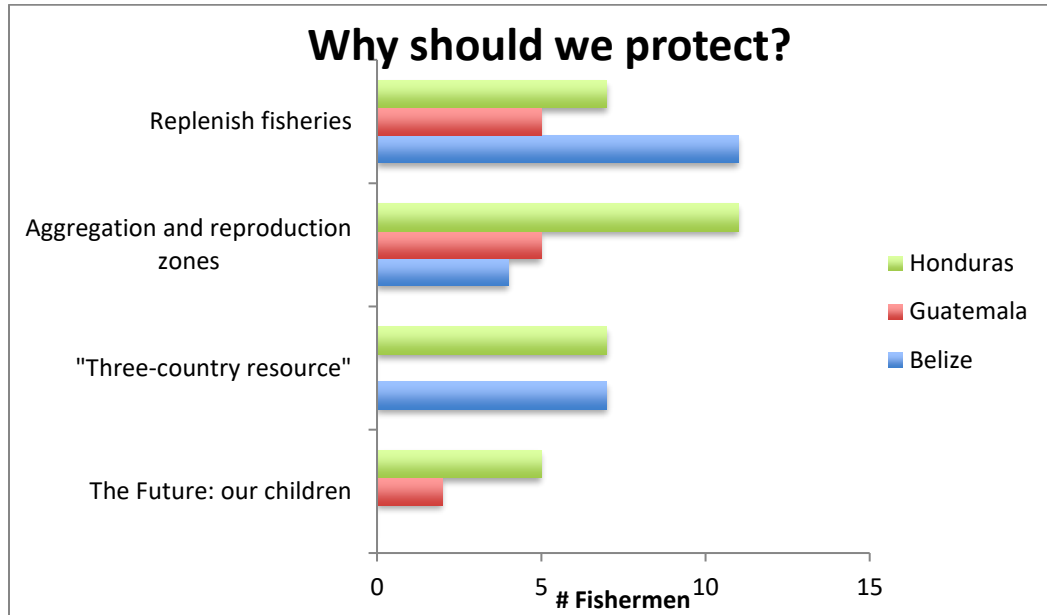


Figure 9. Reasons to agree to protect the Cayman Crown reef, according to the Gulf of Honduras fishermen.

The main reason for Belize to conserve the area is to replenish fisheries, with 50% of the fishermen of that country (n=11) expressing that, “with an adequate management of the fishery areas, productivity can be replenished, for the wellbeing of all the communities.”

Seven fishermen from Belize responded that we should protect it because “it is a resource for the three countries,” considering the international challenge that the region faces for an adequate management of the reef. These challenges include “they are international waters,” “benefits for Belize and neighboring countries,” “high probability of increased pressure from fisheries” and “increased risk of piracy.” Other fishermen in Belize answered, “Because the Hondurans and Guatemalans are destroying it.”

Four fishermen from Belize said that the protection and management of the Cayman Crown reef are a priority because there are “fishery aggregation and reproduction zones.” One fisherman responded, “because it is an aggregation zone for snapper and grouper.” Fishermen of this country also mentioned that aggregation zones need to be protected, and one of the tourist guides said, “Of course it should be protected! That’s where most of the large fish are.”

Of the Guatemalan fishermen, 71% (n=5) mentioned that there are fishery aggregation and reproduction zones in the Cayman Crown reef. They said that the reef should be protected using the arguments such as the “Benefit the nursery,” “Protect all reefs and reproduction,” “It would be good, that is where fish are born,” “Of course, a time will come where there is no more lobster, no more conch, no more snapper. It is a nursery. We will join and take care of it.” All five fishermen said that protecting it would be a way to replenish the fishery productivity, which is getting increasingly worse.

Other Guatemalan fishermen said that protecting the reef would secure the future of livelihood of their families and community, as they believe that for their children to be healthy, the reef needs to be healthy and with high fishery productivity. Two fishermen from Honduras also mentioned their children’s future, one of them said, “I do want the reserve, I have children.” Another fisherman said that “having a nice reef” is necessary for adequate tourism in the region.

The main reason to protect the reef for 41% of the fishermen (n=11) interviewed in Honduras, is because there are fishery aggregation and reproduction zones. One fisherman answered, “Definitely, it’s the breeding ground for the gulf,” another said: “Breeding ground, nest, reproduction,” others said, “Yes, so they reproduce” and “Protect it all, especially the reproduction.” Another fisherman mentioned, “There is production, we need a way to help one thousand families.” Additionally, seven fishermen of this country said that it is necessary to protect the reef to replenish the fishery productivity of the region.

According to the Honduran fishermen, another reason to protect the reef is that it is a “resource for three countries.” They point out that the policies regarding fishing, fishing gear, and close seasons are different for each country, but all are fishing on the same reef and region.

Regarding the differences in policies, fishing gear, and close seasons, the fishermen responded:

- “Close seasons are poorly planned; they are based on information from people that don’t really know.”
- “Closed seasons are not the same.”
- “Each country’s policies are very different.”
- “One takes care of it and the others destroy it. It can’t work that way.”
- “Fishing gear that Guatemalans use take all indiscriminately.”

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- “We rarely fish there, it belongs to Guatemala and Belize, we all should protect it.”
 - “It’s good and bad because that’s where we rest; it’s a good fishing area for all three countries.”

4. Discussion

The Cayman Crown reef and its resources are used by several communities of the three countries that share the Gulf of Honduras region. The reef is visited regularly for different reasons, mainly for commercial fishery and sport fishing. Of the interviewed fishermen, 21%, mainly from communities of Belize and Honduras, said to visit the area every month, every two months, and there were even some that go four times a month. A sport fishing guide from Belize told us, “I see four to five boats every day.”

The Honduran fishermen interviewed were the ones that most used and knew the Cayman Crown reef, even though politically, they are not allowed to use these waters. The fishermen go to the reef mainly to find the “winter snappers.” It seems that in October, November, and December, after the first bad weather or north wind, the fish “escape from the bad weather” and take shelter closer to the continent, in the reefs of the Gulf of Honduras.

Communities of Paraiso and Omoa are the ones that make the most use of the resources in the reef, because they are closer to the area. Fishermen from Puerto Cortez know the reef and visit it mainly during winter. Distance and fuel costs are keeping them from going regularly. Other Honduran fishermen say that the waters belong to Guatemala and prefer not to risk losing their fishing gear or boats and end up in jail. The interviewees from Puerto Cortez know of a couple of fishermen that go to the reef regularly but, unfortunately, they could not be interviewed.

The most important commercial resource of the Gulf of Honduras and the visitors to Cayman Crown is the snapper, which 95% of the fishermen that know the reef indicate that this is the target species. It seems that this diverse group of species inhabit the gulf in large quantities, especially during the winter (October and November), looking for shelter from bad weather closer to the continent, and during the summer (April and May) for their spawning aggregations. This was reported previously by Heyman, W. D. and Granados-Dieseldorff, P. in 2012. The grouper is also a target species for fishermen of this area, although they say that they are becoming more uncommon to catch. According to the fishermen, the deep-water snapper and grouper species are also important and abundant in the reef.

Fishing policies and especially close seasons need to be standardized for the three countries that share the reef. Fish reproduction season, especially for snapper and grouper, does not vary much in the Cayman Crown reef region or in the other nearby reefs. It is clear for the Gulf of Honduras fishermen that snappers reproduce mainly in April and May and groupers in December and January, which is key information to set the correct time and location for an efficient close season. The information provided by the fishermen of the three countries is highly valuable because they are the ones that truly know the marine resources and their reproductive cycles, as they live from these resources. The artisanal fishermen have shown over time that they are willing to participate in the national and regional management of the fisheries (Heyman and Granados-Dieseldorff, 2012).

The health of the Cayman Crown reef is at high risk due to the constant fishery pressure, the use of destructive fishing gear, especially by Guatemala, and to the different fisheries policies of each country that uses the reef.

Although fishermen from Honduras and Belize continue to use gillnets, these countries, mainly Belize, are way ahead of Guatemala in regulating them and transitioning to more sustainable fishing gear. The use of gillnets and longlines are predominantly used in Guatemala without regulation, using very long gillnets and longlines with up to 300 hooks. These types of fishing gear use two anchors, which could represent a threat to the reef. The fishermen use three or more gears per day, dropping six anchors per boat at random per fishing trip. The fishing gear is left for 72 hours or more, frequently losing part of their catch or the fishing gear itself. The loss of gear increases the possibility of “ghost fishing,” meaning that lost plastic gear drifts for ages underwater, killing fish pointlessly.

Only one Honduran fisherman that visits the reef for sport fishing was interviewed, but 23 of 24 fishermen (95%) have seen or know of others that practice sport fishing, mainly for fishing tournaments and with people from the mainland that sport fish on weekends. The Honduran fishermen said Guatemalans go for sport fishing and recreational diving.

It is striking to see the adversity towards neighboring countries over fishing territories. This is strange because the region is called the Gulf of Honduras, and all those who live there should have the same right to fish. It is even more striking to hear stories of fishermen that end up in prison for going out to provide for their families, how they are treated, and the huge social impact it has on their household. During that time, who will provide for their children? What will the children think of their father or mother? What is the cost of their time in prison, the boat, the engine, and the fishing gear they lost? What

will the fisherman do to recover that money? He will have to go back and increase his fishing frequency.

The fishermen risk their lives every time they go out to sea to bring food to the table. They are the base of the food chain and the ones that get the least benefit from it. They face dire economic challenges due to the fuel costs and the alarming ecological unbalance of fisheries. They comment that many times they are not able to make enough to pay the boat owner, or they lose part of their investment because their catch is insufficient to cover costs.

In this order of ideas, pressure on fisheries increases, fishermen will catch whatever in whatever quantities they can to cover fuel costs, seek a profit, pay the boat owner and the crew, without taking depreciation into account. This creates an economic imbalance reflected in a high level of overfishing, which seriously affects the Cayman Crown reef, the fishermen, and the whole Mesoamerican region.

The value chain of the fishery products must be reassessed, starting from the price paid by the intermediaries and restaurants, who can earn up to ten times the price paid to the fishermen. The importance of community fishery organizations, with the inclusion of various social sectors, is that they can establish fixed and fair prices for their products, without generating social and environmental controversies.

5. Recommendations and Conclusions

Considering the importance of the reef for the Gulf of Honduras region and the MAR, and the risk it faces due to the lack of management and fishery protection, the following conservation measures are proposed:

1. Redefine the three countries fishery policies for the region, including:

- Evaluating and standardizing the close seasons for the main commercial species of the region's reefs, taking into consideration the fishermen's knowledge of the resources, and including scientific studies of the area. The fishermen that participated in the study indicated that the close season for snapper should be in April and May, and for grouper, in December and January.
- Conducting studies, investigations and protection of the spawning aggregation zones of the Cayman Crown reef.

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- Transition and regulation of destructive fishing gear. The length and mesh of gillnets and the number of hooks on longlines must be regulated by government entities. Stronger campaigns to transition towards the use of more sustainable fishing gear, like hooks and handlines, must be conducted by governments, especially in Guatemala and even in Honduras. The destruction caused by the fishing gear currently used, especially by Guatemala, pose a significant risk for the Cayman Crown reef.
 - The transitioning campaigns should be immediate, educational and should include the fishermen involved, as well as the communities. Mapping the sand banks and seagrass areas would be a great aid for the reef so fishermen can anchor without impacting the coral, and would avoid losing decades of evolution every fishing day.
 - Regulate as soon as possible the shark trade in Guatemala for the sake of the health of the area and humans, considering the health risk to humans due to the high levels of mercury and arsenic in shark meat.
 - Management and awareness campaigns regarding fishing, trading, and consumption of shark meat need to be established, taking into consideration the serious threat of global extinction of dozens of species and environmental repercussions for all of the MAR, as key species of marine ecosystems.
 - Establish rigorous policies for the control and environmental licenses for industrial companies in the region, especially in Guatemala, where the Motagua River constitutes a severe threat to human and ocean health. This river is in a precarious condition, contaminated with poorly managed industrial waste, like pesticides and wastewater, plastic and pollution from the watersheds. Due to this scenario, its inhabitants are being deprived of the right to safe drinking water that many are surely not valuing as they should. It also has deprived them of the right to food and economic security, as the fish from the river cannot be consumed and the repercussions it has on the reefs close to the river's mouth, like Motaguilla and Cayman Crown.
2. Launch educational campaigns in the region on the importance of preserving the Cayman Crown reef. Of the fishermen, 89 % know the area, and 93% said to agree to its protection. This is a good indicator to start the campaigns.
 3. Reassess the social and economic value of the artisanal fishermen, who live a complicated lifestyle and seem to be invisible to society and the government. Develop economic alternatives for the fishermen.
 4. In Guatemala, recover the villages and the Punta de Manabique Wildlife Refuge (RVSPM, for its initials in Spanish), which is covered with monocultures and extensive

livestock farming, apparently combined with illicit businesses. This will help continue with the inclusion and conservation of the communities that seem to be the constant users of the Cayman Crown reef.

There is constant fishery pressure on the Cayman Crown reef, daily and monthly, but mainly during the two special seasons: Winter (October, November, and December) and summer (April and May). Reef protection and management must be done including the fishing communities, seeking food security and taking care of the reef that is of vital importance to the MAR, the “breeding ground of the gulf.”

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Annex 1. Reef Use Questionnaire

REEF USE QUESTIONNAIRE

Country _____

Date _____

Community/location _____

Name of interviewee _____

Sex F ____ M ____

Age 15-25 ____ 26-40 ____ 41-60 ____ more than 60 ____

1. Are you currently a fisherman?

Yes

No, but used to be

No, I have never been

2. How long have you been fishing or for how long did you fish?

3. Do you think the fishery has changed over the years?

- No

- Yes

- o How has it changed? Has it increased or decreased?

- o How has the way you fish changed?

- o Why do you think the fishery has changed or decreased?

4. Do you know the Gulf of Honduras reef? (the question may change for each country)

Belize: Do you know the Gulf of Honduras reef, the deep banks south of Sapodilla Cayes, beyond the Rise and Fall, towards Manabique?

Guatemala: Do you know the Gulf of Honduras reef, the "Outside Reef," the one in front of Motaguilla, before you go out on the gulf to fish for shark?

Honduras: Do you know the reef in the Gulf of Honduras, the 21 banks in front of Malezona, close to Manabique?

5. Do you visit the area?
 6. How often do you go? Which season?
 7. What do you do when you go to the area?
Do you fish?
 - No
 - YesIf so:
 - What do you fish in or close to the area? Target species or incidentals.
 - What fishing gear do you use? (The response to this question will vary depending on the target species. It is important to obtain information of fishing gear used for grouper and snapper).
 - For how long do you fish?
 - Type of boat, equipment, and crew
- 7.1 Tourism?
- Tour description
8. Have you seen other people visiting the reef? Where do they come from and what were they doing?
 9. Should we protect this reef? Why?

Annex 2. Chondrichthyan diversity registered in the Guatemala Caribbean (Source: FUMNZ, 2019. Data under revision).

Class: Chondrichthyes			
Order	Family	Scientific name	Common name
Carcharhiniformes	Carcharhinidae	<i>Carcharhinus cf. signatus</i>	Night shark
		<i>Carcharhinus falciformis</i>	Silky shark
		<i>Carcharhinus leucas</i>	Bull shark
		<i>Carcharhinus limbatus</i>	Blacktip shark
		<i>Carcharhinus perezii</i>	Caribbean reef shark
		<i>Carcharhinus plumbeus</i>	Sandbar shark
		<i>Carcharhinus brevipinna</i>	Spinner shark
		<i>Galeocerdo cuvier</i>	Tiger shark
		<i>Prionace glauca</i>	Blue shark
		<i>Rhizoprionodon lalandii</i>	Brazilian sharp nose shark
		<i>Rhizoprionodon porosus</i>	Caribbean sharp nose shark
		<i>Rhizoprionodon terraenovae</i>	Atlantic sharp nose shark
	Scyliorhinidae	<i>Scyliorhinus hesperius</i>	White saddled catshark
	Sphyrnidae		Scalloped hammerhead shark
		<i>Sphyrna lewini</i>	Great hammerhead shark
	Trikidae		Dusky smooth-hound shark
		<i>Mustelus canis</i>	Narrow fin smooth-hound shark
		<i>Mustelus norrisi</i>	
Squaliformes	Centrophoridae	<i>Centrophorus cf. granulosus</i>	Gulper shark
Orectolobiformes	Ginglymostomatidae	<i>Ginglymostoma cirratum</i>	Nurse shark
Hexanchiformes	Hexanchidae	<i>Hexanchus cf. nakamurai</i>	Big-eyed six gill shark
		<i>Heptranchias perlo</i>	Sharp nose seven gill shark
Lamniformes	Alopiidae	<i>Alopias superciliosus</i>	Bigeye thresher shark
	Lamnidae	<i>Isurus oxyrinchus</i>	Shortfin mako shark
		<i>Isurus paucus</i>	Longfin mako shark
Squaliformes	Squalidae	<i>Cirrhigaleus asper</i>	Roughsking spurdog shark
		<i>Squalus cubensis</i>	Cuban dogfish shark

Myliobatiformes	Dasyatidae	<i>Hypanus guttatus</i>	Longnose stingray
		<i>Hypanus americanus</i>	Southern stingray
		<i>Styracura schmardae</i>	Chupare stingray
	Aetobatidae	<i>Aetobatus narinari</i>	White-spotted eagle ray
Rhinopristiformes	Rhinobatidae	<i>Rhinobatos percellens</i>	Guitarfish
Rajiformes	Rhinopteridae	<i>Rhinoptera bonasus</i>	Cownose ray
Chimaeriformes	Rhinochimaeridae	<i>Neoharriotta carri</i>	Dwarf Sicklefin Chimaera
