



HOW TO PROFIT BY PRACTICING SUSTAINABLE FISHING:

LOBSTER FISHING PRACTICES GUIDELINES FOR THE MESOAMERICAN REEF



CONTENTS



Prologue

I. Introduction

Panulirus argus

II. Status and Challenges of the Lobster Fisheries in the Mesoamerican Reef Illegal catch of under-sized lobster (baby-lobster)

Catch of egg-laying females

Lobster fisheries in the MAR

Honduras

Mexico

Belize

Guatemala

III. Best fishing practices as an instrument to deal with fishing problems

Fishing Practices Guidance

a. Artisanal fishermen

Shades with lasso

Shades with nets

Shades with hook

Traps

Snorkeling

Nets

Diving with compressor

SCUBA diving

b. Industrial fishing

Traps

SACUBA diving

III. How to increase profits: Business organization and commercialization

Benefits of working in association

How the cooperative works

ANNEX A. Trade chains in the Mesoamerican Reef.

ANNEX B. Fishing organizations: cooperatives and private firms

ANNEX C. Landings in the Caribbean and Mesoamerican Reef.

ANNEX D. Fishing regulations

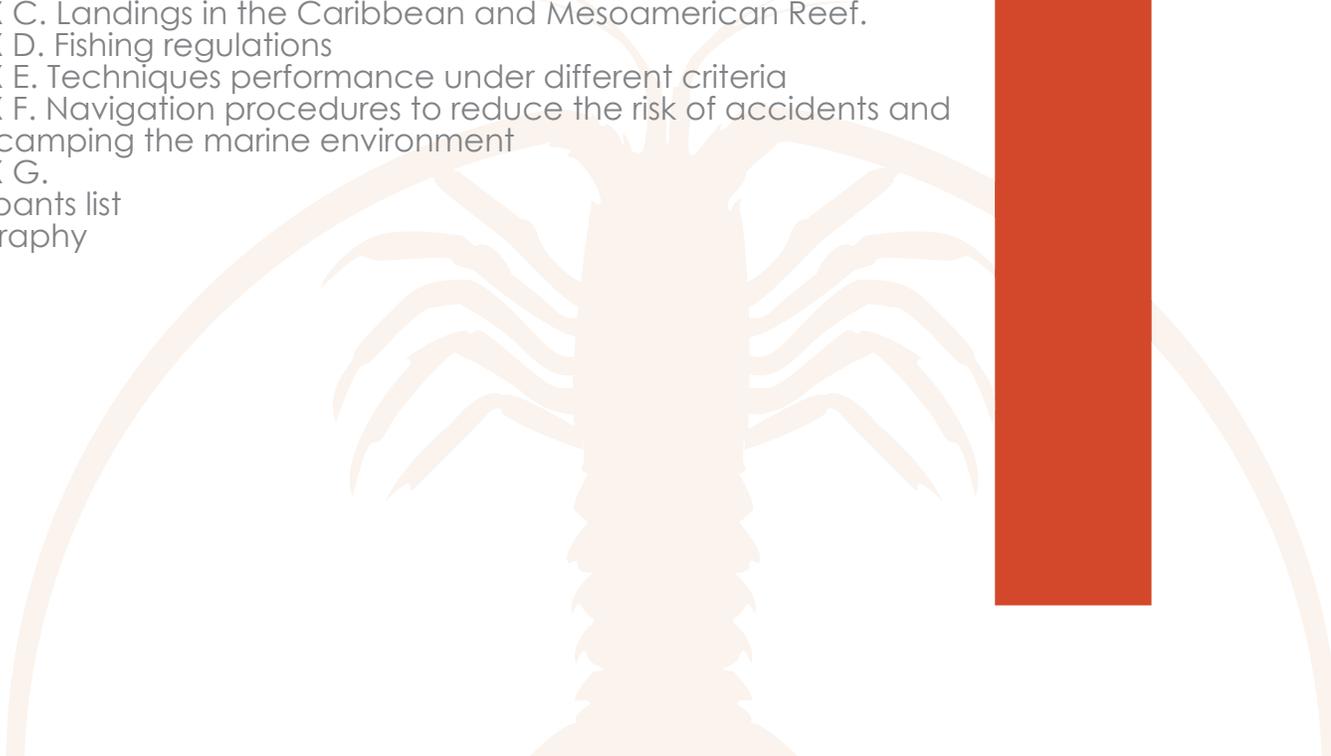
ANNEX E. Techniques performance under different criteria

ANNEX F. Navigation procedures to reduce the risk of accidents and avoid camping the marine environment

ANNEX G.

Participants list

Bibliography





Over 50 years ago, when Mr. Cruz was about 7 years old, there were so many lobsters in the area around his small Caribbean seaside village, that all his mother had to do to get dinner was to walk along the beach.

The days of commercial lobster fishing began when some foreign businessmen arrived in large boats and offered the townspeople a few paltry cents for each kilo of lobster tail. This scenario repeated itself in many communities throughout the Mesoamerican Reef System and in other sites in the Caribbean.

The commercial lobster fisheries resulted in an economic bonanza for most lobster fishers as production was high, costs were low, and one only had to travel in his cayuco (small dugout canoe) to the shallows near the coast to find their catch. Gradually the businessmen increased the price offered to the area's fishermen so that they would increase their output. Production grew in the whole of the Caribbean and prices continued to rise as foreign demand did increase, which encouraged more and more fishermen to enter the fishery in search of better incomes.

As time passed, the amount of lobsters caught decreased particularly in areas where fishermen traditionally found their lobsters. It soon became necessary for them to improve their fishing techniques, acquire stronger boats- made of fiberglass and equipped with outboard motors and search in places further out to sea and at much greater depths in order to find lobsters. The costs of catching lobster increased, as well as their sale price. Notwithstanding these costs, fishers were able to maintain high yields.

Many fishermen devised diverse and ingenious techniques to increase their catches, some with positive results, but others with grave consequences for the reef. In some areas, investors brought in industrial vessels to catch the crustaceans, which in turn brought higher operational and maintenance costs. To be competitive in the business and to receive an adequate return on their investments, fishers were forced to bring in even higher yields.

The reef's total output began to decline year after year despite new infrastructure investments. The scarcity and the appreciation for the product in foreign markets kept both the product's demand and the prices increasing. New government regulations, organizations, and institutions were formed to help Caribbean nations support their fisheries.

What could they do?

Should they stop fishing? No, because even though costs were high, sale prices were even higher, and it was a profitable business.

Should they keep fishing under the same conditions? And, for how long and at what costs?

Should they fish less? Perhaps, but how and who would decrease the size of their catches?

These are some of the questions dealt with in this manual. Here, fishermen of the Mesoamerican Reef and researchers from various institutions share their experience, knowledge, and expectations with you in an attempt to find practical answers to the questions asked.

Chapter 1

INTRODUCTION



Lobsters are one of the most important natural resources within the Mesoamerican Barrier Reef System. This reef system extends from the Yucatan peninsula, in Mexico, to the islands in the “Bahia Honduras” running along the Caribbean coasts of Honduras, Guatemala, Belize, and Mexico. Among all commercial fishing resources of the region, this species is the one that has attained the highest market value, which, in turn with its abundance and wide distribution, has transformed it into the primary revenue source for a great number of coastal communities in this ecoregion. Annual whole lobster production in the Caribbean is 40,000 metric tons with an approximate “beach” value of \$350 million US. This value can increase as much as 300% by the time the lobster reaches the consumer. For example, a fisherman at Punta Allen, Mexico receives \$22 US per kilo from a buyer at the beach, while at a restaurant just North in Cancun, a 300 gram portion of lobster tail will sell for between \$18 US and \$27 US. In other words, one kilo of lobster tail in the restaurant is sold for between \$60 US and \$90 US.



The Caribbean areas reporting the highest lobster production are Cuba (28%), Brazil (22%), the Bahamas (14%), Honduras (13%), Florida (10%), Nicaragua (8%), Mexico (3%), and Belize (2%). The four countries comprising the Mesoamerican Reef contribute 6000 metric tons per year or approximately 17% of the Caribbean’s total production. Despite its importance, this resource shows signs of grave deterioration, and the yield statistics, as presented in Figure 1 below, show a significant decline within the last 18 years.

One of the principal strategies Caribbean countries have developed to face this critical situation is the creation of international forums and groups to adopt regional management measures that will reverse this trend of decreasing yields. They have also adopted different national domestic programs and policies to confront the problem. However, in the short run, we have not seen a reversal of the deterioration of resources, as important regional lobster stocks (e.g. Cuba and Mexico) are showing signs of decline in spite of good management and population control measures (Lobster Resource Workshop Merida, Mexico, 28- 29 September, 2006).

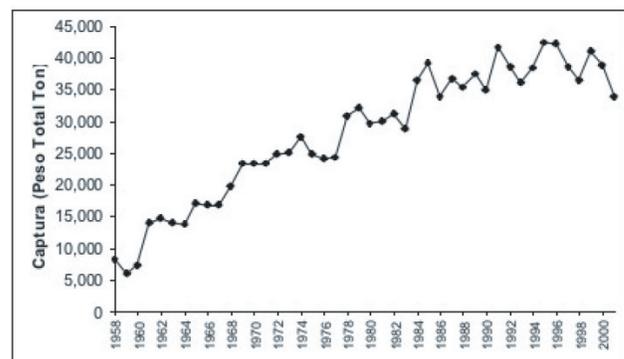


Figure1: Record of spiny lobster yields in the Caribbean from 1958 to 2001, converted to total weight (FAO, 2003).

Panulirus argus

The Caribbean lobster, whose scientific name is *Panulirus argus* (Figure 2), is widely found in the Atlantic Ocean, along the coast of the American Continent from Brazil to North Carolina (Figure 3). Most scientists agree that the lobster population of the Caribbean forms a metapopulation, which is to say that they are a network of local populations connected by a great number of individual lobsters that migrate during different phases of their life cycles. This connectivity imposes certain management problems due to the fact that not all countries use the same resource management protocols.

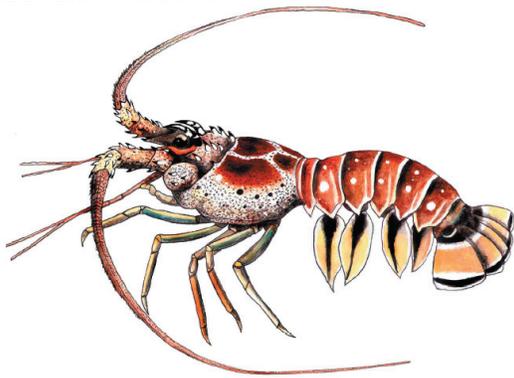


Figure 2: Spiny lobster, whose scientific name is *Panulirus argus*. Adults may reach up to 40 cm in total length and live in coral reefs from 2 to more than 30 fathoms in depth. Generally males are larger than females. (Illustration by Roberto Arreola).

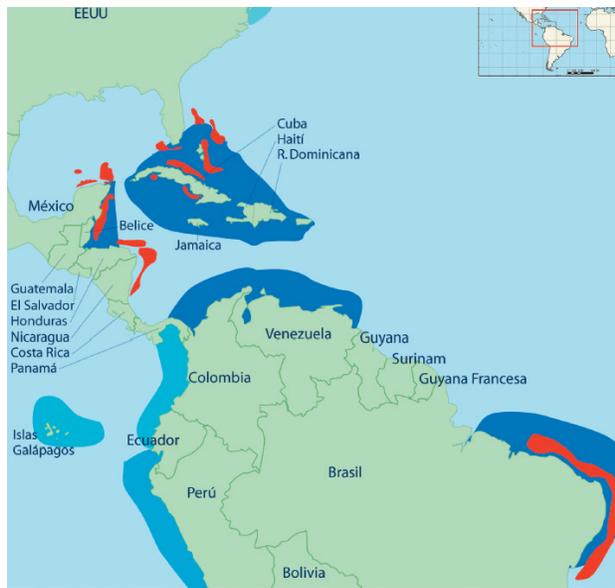


Figure 3: Distribution of spiny lobsters (*P. argus*) on the Atlantic coasts.

During its life cycle, lobster larvae can remain for over 10 months as part of zooplankton (Figure 4), a phase where they remain at the mercy of the currents. For this reason it is possible for some larvae produced off the Brazilian coast, at the easternmost part of the continent, to travel great distances and even settle on the Caribbean coasts of Jamaica, Belize, Cuba, or Florida. Until now scientists have not precisely determined which sites have the highest larval production. They also have not been able to estimate the direction and migration rates of the species' larval population, from its point of origin until its final settlement as a puerulus, with an adult-like shape, but with a length of 1 cm. Fishermen have noticed the presence of hundreds of larvae or pueruli in the branches of seaweed and algae found drifting at different times of the year.

After the larval phase, the pueruli settle in algal habitats where there is an abundance of mangroves, sea grasses and shallow corals in bays and atolls. There they seek refuge and food to continue their growth to the juvenile phase. After the juvenile phases, individual pre-adults migrate to deeper waters to mature and reproduce, reaching their first reproductive age at three years, with an abdominal length of approximately 13.5 cm.

For many years, the Caribbean lobster has undergone heavy exploitation, but its wide distribution and high reproductive rates have avoided an even more accelerated population decline. Notwithstanding, severe exploitation combined with phenomena such as hurricanes, depletion of other species, along with the elimination of sea grasses and mangroves has provoked a marked decrease in their populations.

Considering the need to improve the economic conditions of those whose primary economic activity is closely tied to this resource and, the need to promote the recuperation of the Mesoamerican Reef Lobster, this manual has as its primary objective the identification and promotion of better lobster fishing practices among fishers and, to present a strategy to change damaging practices for better ones. This would be done with the cooperation of fishermen groups, fish and game authorities, industrial groups, and environmental authorities.

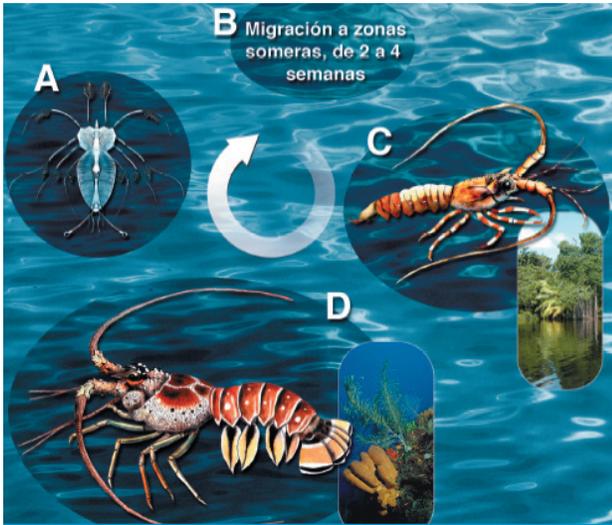


Figure 4: Life cycle of the lobster. (A) Fertilized females expels eggs in a column of water, where larvae. At 8 to 10 months they undergo a series of metamorphoses, forming part of the zooplankton. (B) When they reach the puerulus stage, with an adult-like shape but barely 1 cm long, they settle on the sea floor. At 2 to 4 weeks they migrate to the coasts, seeking refuge in coral reefs, sea grasses, and mangroves. (C) Once ensconced in their shelters, they continue to grow feeding off detritus, other small crustaceans and fragments of seaweed, algae, and other marine organisms. After reaching the post-puerulus phase (3 cm in length), they continue to grow until their juvenile stage, reaching an approximate length of between 8 and 10 cm. (D) At the pre-adult stage (17 cm total length), they begin their migration to deep waters, where they will continue their life cycle.

Chapter II

STATUS AND CHALLENGES OF THE LOBSTER FISHERIES IN THE MESOAMERICAN REEF

Illegal catch of under-sized lobster (baby-lobster)

One of the most widespread problems in the whole region is the illegal capture of undersized lobster. It is a fact that the decrease in the lobster population is in great part due to the fishing of smaller sized specimens. In the three lobster-producing countries of the Mesoamerican Reef (Honduras, Belize and Mexico), there is a significant amount of small-sized lobster caught which is neither registered nor monitored. Since these lobsters do not comply with international trade standards, they are usually sold locally (Figure 5) or processed in plants or restaurants as meat to avoid sanctions. To increase the size of the species' population, it is necessary to significantly decrease the practice of catching and consuming small lobsters. Otherwise, we would be drastically depleting the amount of future reproducers that guarantee the survival of this resource.



Figure 5: A lobster dinner served in a Mesoamerican Reef restaurant. Compare the reduced size of the lobster (marked with an arrow) with that of the knife or the lime. It is common to find baby lobster on the menu in restaurants in all of the region's countries, which is why consumers, chefs, restaurateurs and fishermen need to be made aware of the problem of the illegal consumption of such small lobsters (see Annex D).

The job of reducing this practice belongs to all those involved: fishermen, consumers, traders, and restaurants. It is, in this case, important to educate consumers, most of all tourists, as undersized lobster is served in restaurants in all of the countries of the region. Once enlightened tourists start sending back orders prepared with smaller lobsters (baby lobsters) and demand legal sizes, they will be participating in the sustainable use of the resource. Certain prestigious restaurants have already begun to implement size-regulation guidelines for their patrons. By the same token, traders who abide by sustainable fishing management initiatives should avoid buying undersized lobster. Minimum size standards vary from country to country. For details, please consult Chart 3 of Annex D in this manual. Fishing techniques which would foster legal-sized catches should also be employed. With this idea in mind, this manual recommends the fishing techniques shown in Chapter IV, part iii.

Capture of egg-laying females

In the majority of Caribbean nations, laws exist which forbid the capture of egg-laying female lobsters (mature females that have been fertilized and are producing eggs). Despite the condition that meat from a fertile female is of no value to consumers, some fishing techniques hurt these creatures due to the methods employed. One example is the use of hooks, which, upon catching the female, causes severe damage and, even though the lobster is unfit for consumption, its return to the marine environment does not allow it to survive. Recommended techniques which would minimize this possibility are outlined in Chapter IV, part iii of this manual.

Lobster fisheries in the MAR

This section describes the differences that exist between lobster fisheries in the four countries which make up the Mesoamerican Reef. As mentioned earlier, three of the four Mesoamerican Reef coun-

tries practice lobster fishing. However, the number of fishermen, type of organization and the technical and financial resources governments allocate to the management of the fishery can be very different from one nation to another.

Honduras

Honduras is the country with the largest production of lobster in the Mesoamerican Reef Region. In 2003 it produced a total of 1360 tons of lobster tail, which generated approximate revenue, in exports and local consumption, of \$30 million US. As with other countries of the region, lobster yields in Honduras have exhibited a downward tendency. For example, in 1991 Honduras produced approximately 3,000 tons of lobster tails, while in 1998 the production was 1,300 tons of tails; a reduction of more than 50% in just seven years (see Annex C).

In Honduras there are two types of lobster fishermen, those who work on industrial vessels using the methods of SCUBA diving and capturing with nasas (traps), and the traditional fishermen using nets, traps or free diving. Industrial fishing nets the largest portion of national production and the fleet has its base of operations in Islas de la Bahia and at La Ceiba. Divers are recruited from the various communities of the Miskito peoples found on the eastern coast of Honduras in the parishes of Islas de la Bahia (Roatán and Guanaja), Utila (Cayo Cochinos), and Atlantida (La Ceiba) (Figure 7). In this area an extensive continental shelf is found, with oceanographic characteristics that promote high primary productivity.



Figure 6: Principal lobster-fishing camps and communities in Honduras. 1) Tela, 2) Utila, 3) La Ceiba, 4) Roatán, 5) Cayo Cochinos, 6) Trujillo, and 7) Guanaja.

There are 172 industrial vessels devoted to lobster fishing 82 of which use traps while 90 use SCUBA divers.

Industrial fishing using divers is a highly effective practice in terms of cost and production. However, this practice has provoked grave social and health costs. For example, a high percentage of divers in the industrial fleet suffer from decompression illnesses. Other problems associated with this practice include alcoholism and drug addiction. The industry also promotes competition between the best divers, whose physical conditioning allows them to make a greater number of dives and for longer periods (beyond established norms for safe diving). However, this has, on occasions, encouraged the young people to use drugs to increase their performance, which exposes them to greater health risks. In fact, a great number of lobster divers do not have the appropriate dive certification at all.

Investing in diver certification and limiting their productivity by establishing safety guidelines, would result in a short-term decrease in the profitability of fishing, but in the long term it would allow for higher yields and protect the lives and health of divers.

The practice of SCUBA diving has not decreased, although the Honduran government is trying to eradicate it completely.

In another area, the rapid depletion of lobster banks in recent years has forced boats to increase the number of traps they carry on board.

As for traditional fishing of lobster and other shellfish, there are a reported 9,132 fishermen in the northern coast of Honduras. Traditional method usually means free diving and targets lobsters for self-consumption and sale to the domestic market. Despite this, in some areas of the northern coast, notably La Ceiba and La Mosquitia there are 700 traditional fishermen using SCUBA equipment which they used to increase their yields.

The fleet of traditional fishermen is composed of 5,383 vessels (70% are pangas or canoes, 25% are boats, and 5% other small craft). Recently, the Honduran government has replaced cayucos with small fiberglass boats equipped with outboard motors, which has given fishermen greater autonomy. By and large, traditional fishermen capture lobster by diving with a snorkel and a hook, although sometimes they also use traps. Official data does not give a true picture of the depth of traditional fishing, but it must be substantial, as domestic market is supplied with lobster largely produced by the traditional fishermen of the Caribbean.

Mexico

Mexico is the second-largest lobster producer in the Mesoamerican reef region. During the 2004-2005 season, it produced 1074 metric tons of whole lobster (this in the state of Quintana Roo, part of the Mexican Caribbean), with an approximate beach value of \$50 million US. Just as in the other countries, the yields have registered, over the last years, a constant decrease. For example, from 1990 to 2001, the production in Quintana Roo fell by 11% (Annex C). Such a situation leads us to believe that it is not possible to hope for a substantial increase in the short to medium term, until reserves have recuperated.

Unlike Honduras, lobster fishing in the Mexican Caribbean is totally traditional. Traditional fishermen in Mexico have developed a system of cooperatives, which in most cases, has permitted others limited access to lobsters, favoring a more-ordered harvest.

There are cases where these cooperatives successfully handle resources through their community assemblies. However, tourism development in the northern region of the Mexican Caribbean has resulted in a high population migration to the region. The results is that easy access to resources has been gained by non-cooperative fishermen using illegal fishing methods (fishing without proper licensing, the harvesting of lobster smaller than minimum size or fishing out of season). This problem is exacerbated by minimal government resources allocated to monitoring and by ignorance of species conservation programs by the inhabitants in general. The greater part of this illegal harvest is marketed directly to restaurants and local markets using some intermediaries or “middle-men”.

Fishing methods and techniques used to capture lobster are varied and depend on tradition, the ecological characteristics of the area and the type of product intended to market. The fishing methods are: free-diving and snorkeling in shallow waters, SCUBA diving in deep water, hooks, and traps or gillnets.

In Mexico there are 19 cooperatives licensed to catch lobster. Some, 570 persons are associated members of these cooperatives though their numbers have decreased due to entrance restrictions for new members.

Lobsters fishing records in the state of Quintana Roo show that approximately 800 small crafts are used in the capture of lobster and others species. The records also show that the number of lobstermen in the Mexican Caribbean is 2,400, scattered in towns like Holbox, Isla Mujeres, Cancún, Puerto Morelos, Co-

zumel, Tulum, Punta Allen, Mahahual, Xcalak and Banco Chinchorro (Figure 6).

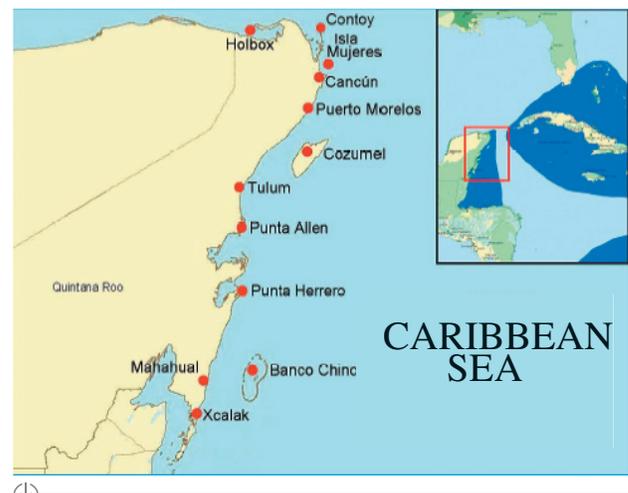


Figure 7: Main fishermen villages and fishing camps where lobster is caught in Mexico.

Belize

Belize is the third-largest producer of lobster in the Mesoamerican Reef with annual yields of 800 metric tons and annual revenue of approximately \$6.5 million US. Unlike the others countries, in Belize the harvests of this species shows no signs of decline; production has stabilized at between 700 and 800 metric tons of whole lobster annually, with some spikes occurring in the last decade (see Annex C).

The majority of the lobster harvesting is done in coralline habitats all along the coastline, using wooden traps, shades or “casitas” or diving using hooks. In the northern part of the country, the preferred gear is the wooden trap whereas the “hook-stick” is widely used in the south.

In Belize, fishermen are organized into cooperatives, but unlike Mexico, there are only five cooperatives, two of which count most of the 3000 plus lobster fishermen as members or affiliates. Belizean cooperatives retain all of their production and export it themselves thereby benefiting directly from the commercial value of the product. In contrast, Mexican cooperatives take charge of production, while the selling of product is left to external agents.

Belize is a privileged country for having a great number and variety of coral reefs ecosystems, where hundred of species co-exist for feeding, nursing and reproduction. That is why lobster fishing is closely associated with most of the cays in the country (Figure 8).

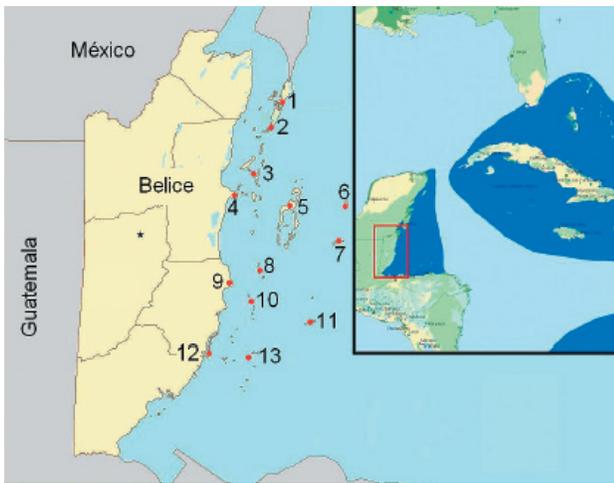


Figure 8: Principal lobster-fishing camps and communities in Belize. 1) Ambergris Caye, 2) San Pedro, 3) Caye Caulker and St. George's Caye, 4) Belize City, 5) Turneffe Islands, 6) Lighthouse Reef, 7) Half-Moon Caye, 8) Caye Largo, 9) Dangriga, 10) Columbus Caye, 11) Glovers Reef, 12) Placencia, and 13) Gladden Spit.

In recent years, the main problems in lobster fishing in the country have revolved around accounting irregularities within the cooperatives, the illegal sale of product and unlicensed or unregistered sales. Additionally, there is little enforcement of minimum-size regulations, and lobster not fit for export to the United States is sold to local restaurants.

Guatemala

For its part, Guatemala lacks precise reporting of lobster fishing, although there are some fishermen who undertake this activity in the Gulf of Honduras (Punta de Manabique) and sell their product directly to Honduras or the local market. Methods used mostly include the use of mesh nets while a few catch lobsters using free diving with the help of hooks.

Chapter III

DEVELOPMENT OF THE BEST FISHING PRACTICES AS AN INSTRUMENT TO REVERT FISHERY PROBLEMS



A “best” fishing practice is the set of specific procedures fishermen should follow to properly manage and sell their product, to decrease their health risks and to maintain acceptable levels of the resource in the ecosystem. These procedures would describe everything that should happen starting from the moment when the fisherman prepares to head out to sea, what he does during the trip, and the routine he should follow until the time when he returns to port to turn in his catch. The Best Fishing Practices (BFP’s) should be backed up by the proper organization of activities so as to guarantee that fishermen are committed to do all in their power to abide by stipulated practices.

The fishermen of the Mesoamerican Reef have developed fishing techniques which use different methods and equipment. Ten different techniques for the capture of lobster have been identified the use of which has been defined by the oceanographic conditions peculiar to the ecosystems in which they are used, by the skills of the fishermen themselves, their traditions, and by the type of product to be marketed (for example, live lobster or lobster tails). The following describes these fishing techniques and the oceanographic characteristics of the areas in which they are utilized (Fig. 9):

Fishing techniques and oceanographic conditions where they take place
<p>1. Cuban shelter traps, free diving with bowknots in traditional boats.</p> <p>Fishing normally occurs in shallow bay areas with depths of 1.5 to 5 meters. The type of sea floor includes clay pits, areas with sea grasses, corals, and mangroves.</p>
<p>2. Cuban shelter traps, free diving with landing nets in traditional boats</p> <p>This occurs within inner bays, with shallow, clear and sandy waters. Generally, these bays are protected in the front by barrier reefs which allow for a low hydrodynamic intensity compared to the open sea. These contain numerous areas of sea grasses and mangroves, mainly near the coastline.</p>

Fishing techniques and oceanographic conditions where they take place
<p>3. Cuban shelter traps, free diving with hooks in traditional boats</p> <p>Performed within coastal lagoons in areas characterized by shallow, muddy and brackish waters with low hydrodynamic intensity compared to the open seas or bays, and like the latter they have sea grasses and mangroves, which are favorable conditions for the growth and reproduction of lobsters and other species (small sharks or dogfish, mutton snapper, etc..) which are of commercial importance as well.</p>
<p>4. Artisanal Traps</p> <p>Traps are placed in areas of shallow to medium depths (1.5 to 10 meters) in the open sea. This method is mainly used in coralline areas with light to medium ocean currents.</p>
<p>5. Free-diving with hooks on artisanal boats</p> <p>This is normally conducted in deep waters of the open sea at depths of at least 36 meters. The type of sea floor varies between clay pits, area of sponges, coralline areas with “grottoes”, etc., with moderate to strong currents.</p>
<p>6. Nets on artisanal boats</p> <p>Nets are deployed in areas of open sea with medium depths of 15 to 20 meters, principally in areas with rocky, non-coralline formations and moderate currents.</p>
<p>7. Compressor-based diving with artisanal boats</p> <p>Divers operate in deep waters of the open sea up to 50 meters (140 feet) deep. There can be different types of sea floor ranging from clay pits, to sponge areas to coralline zones, etc., and moderate to strong sea currents.</p>
<p>8. SCUBA diving on artisanal boats</p> <p>SCUBA equipment is used in deep areas of open seas between 20 and 40 meters in depth (60 to 120 feet). The type of sea floor varies between areas covered with sponges, cornices, etc., and with moderate to strong currents.</p>

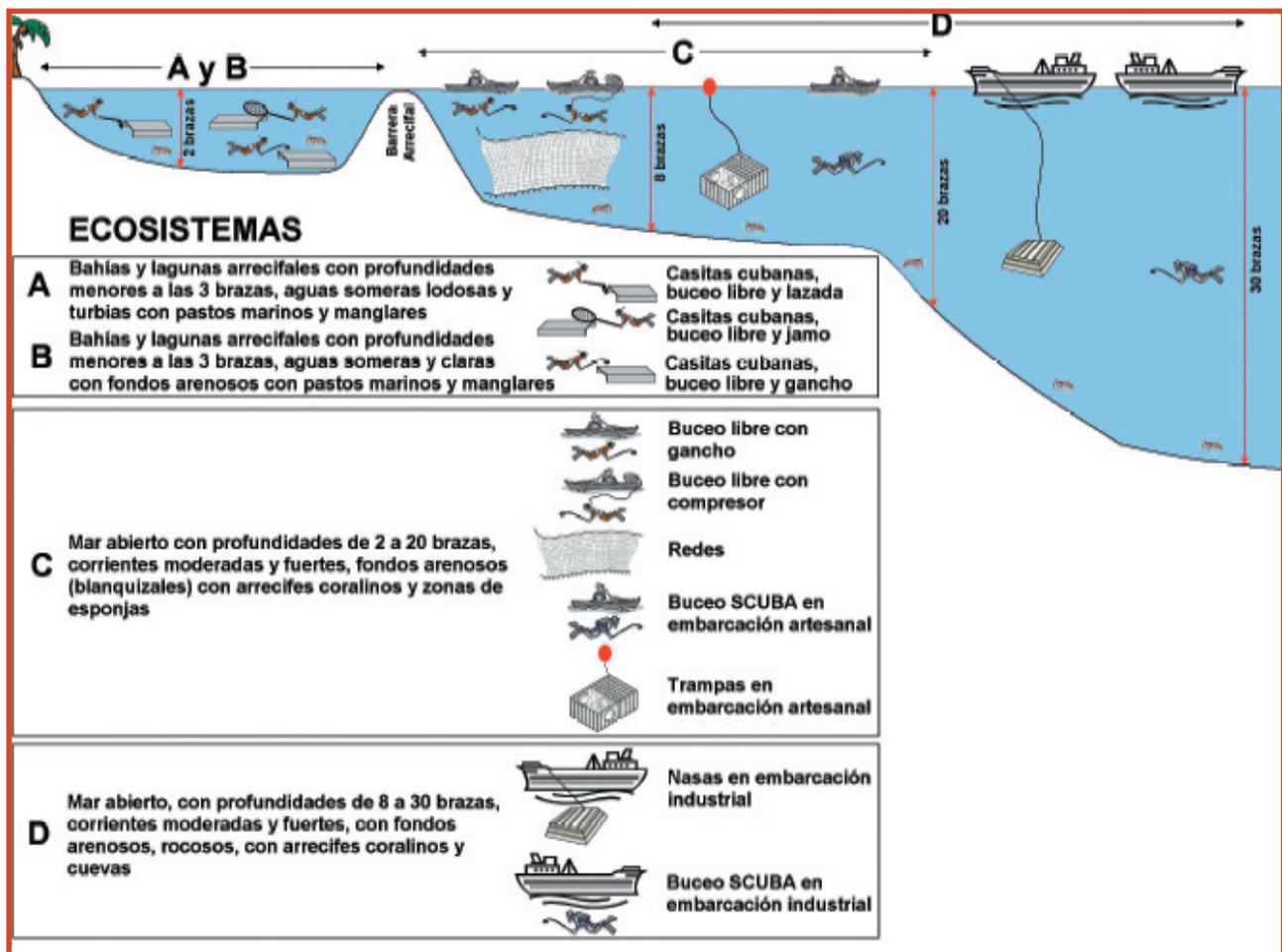


Figure 9: The relationship between oceanographic and bathymetric characteristics (depth and type) of the sea floor and the different techniques used for the capture of lobster.

I. Guidelines for Better Fishing Practices

a. Artisanal fishing

To guarantee the safety of traditional fishermen, the use of the following type of boats and navigational gear are recommended (The safety procedures the crew of any fishing vessel should adopt are mentioned in Annex F):

Fiberglass boats from 23 to 26 feet in length and from 5 to 7 feet in width, with a 25 to 85 horsepower outboard motor, equipped with a GPS locator or a loran and VHF radio, flares, lifejackets and first-aid kit (At some sites the harbormaster inspects this equipment).

We all know that some techniques facilitate the following of regulations, and others provide more safety for the fishermen, and yet others afford the least environmental impact. Considering that the objective of this manual is not to compare the effectiveness of all the fishing methods but to give the fisherman a guide to describe the methods that will allow him to make better use of his resources while at the same time respecting the environment, we here, therefore, describe the best fishing practices for each one of the techniques or methods identified.

Cuban shelter traps with bowknot snares

Required gear:

Fins, snorkel, mask, metal measuring gauge, cement shelter traps (made from cement, rebar, gravel, and sand. Measurements-2.0 m x 1.60 m x 0.14m each).

Method:

Bowknot



Procedure for capture:

Total trip duration: from 4 to 5 hours

- Onboard the boat there can be two to three fishermen, who will be transported to the fishing site.
- Once at the site, the fishermen practice free (breath-holding) diving to catch live lobster.
- Using the bowknot the diver snares the lobster by the cephalothorax to remove it from the shelter. This method requires great manual dexterity in comparison to the use of hooks or landing nets.
- Once onboard, fishermen place live lobsters in crates alongside the boat in the water.
- With their gauges, all lobsters are measured onboard at capture sites, and not upon arrival at the pier or at the delivery point.
- Should a lobster fail to make the required length or is found to be an egg-bearing female, the creature is returned to the sea alive, and in the best possible biological condition.
- Gloves are suggested to prevent damage to the hand from the lobster's spines.
- The duration of each dive can vary, and will depend on the number of sites and traps visited, along with the number of lobsters found and the fisherman's skill level.
- Upon arrival at the collection point, lobsters are weighed on a scale to record the fisherman's catch. After this, they can be deposited in a tank where they would remain until enough lobster accumulates for onward transport, by refrigerated truck, to the area where they will be sold as live lobster.



- On certain occasions, when yields are especially abundant, live lobster can be transported directly from the boat's crates to refrigerated trucks.

Cuban shelter traps with Landing Nets

Required gear:

Fins, snorkel, mask, measuring gauge, shelter traps (constructed from cement, rebar, gravel and sand. Measurements: 2.0 m x 1.6 m x 0.14 m each).

Method:

Landing net



Procedure for capture:

Total trip duration: 4 to 5 hours

- At the moment traps are placed, each fisherman would be responsible for recording its location using a GPS, thus making it easier to find later.
- 
- It is highly recommended that lobster fishing cooperatives have their members maintain an inventory of shelters placed in the sea. For example, it is

estimated that there are over 5,000 such shelters in Bahía de la Ascensión alone.

- Two to three fishermen will go out on each trip, where they would be transported to the site where traps are located.
- It is recommended that shelters be placed in a line formation.
- Once shelters are located using the GPS, to capture the lobster it is recommended that inspection begin at one end of the line and then to advance one shelter at a time.
- With free-diving equipment, the fisherman would jump into the water which has a depth of between 1 and 3 meters.
- Once in the water, the fisherman would lift one end of the shelter; if a lobster is found, he would insert a wedge underneath to keep the shelter raised while he surfaces to get a landing net from the boat's pilot.
- With the net, the fisherman enters the water again and by fanning his fin at the shelter he would drive the lobster out of it to catch it alive with the net.
- The net, with the lobster caught inside, would then be handed over to the pilot for weighing.
- With the measuring gauge, each lobster should be measured at the capture site. It is not recommended that fishers wait until they get to the port or delivery site to measure caught lobsters.
- In case a lobster is not of the required legal size or, is an egg-bearing female, the creature should be released back into the sea, alive and in the best possible biological condition. The lobster should be released in the same place it was caught.
- If needed, the pilot would give the fisherman the net for another dive.
- Once a shelter is emptied, the fisherman would re-board to visit the next shelter in the line.
- If shelters are empty, the inspection process takes about five minutes. If lobsters are present and the landing net is used, it takes about 10 or 15 minutes to clear each shelter.
- Up to 200 shelters can be checked during a day's trip.

- Once onboard, live lobsters will be placed in baskets or holding tanks to be unloaded at beachside where they will be weighed, recorded, and placed in a truck's refrigerated compartment.



Cuban shelter traps with hooks

Required gear

Mask, snorkel and fins, a curved knife, measuring gauge, shelter traps (some made in cement, rebar, gravel and sand; others in hardwood measuring 2.0 m x 1.6 m x 0.14 m each).

Fishing Method

Silk seine net and hook.



Procedures for capture

Trip duration: 4 to 5 hours.

- Two to three fishermen can travel aboard boats which take them to the capture site.
- Once shelters are installed, they will be left in place for their full operational life (3 to 5 years) and will be cleaned in situ or removed to avoid being buried in the sea floor.
- The harvest would only take place during the stipulated season.
- Because the hook method is used which hurt the lobsters caught, it is recommended that fishers be especially careful not to hook undersized lobsters.
- At the beginning of each season, fishermen using hooks, will check and harvest their shelters by free-diving.
- Due to the water's brackishness in some parts of the Mesoamerican Reef, fishermen could use seine nets to surround the shelter and remove the lobster with their hook.

- Once on board, lobsters may be de-tailed and dev-ined, using the curved knife which allows the fisherman to cut the tail off at the joint uniting the head with the body. This allows the fisher to present a good looking product which attracts a high value.
- Tails are then immersed in a cooler containing purified fresh water and ice. The use of saltwater to preserve lobster tails is not recommended.
- In cases where 10 to 15 day lobster camps are organized, the water in these holding tanks should be changed every three days to counter oxidation and degradation of the product. This will not be necessary if the product is delivered to port in less than 7 days.



- Special attention should be paid to the use of sodium bisulfate at product/ reception sites.
- The remains of the lobster (cephalothorax) should be placed in a plastic basket and not thrown back out to sea. This is to prevent contamination of the marine environment. It has also been seen that lobsters avoid these contaminated areas and, lobster remains attract predators to the area.
- Once on land, the flesh at the base of the antennae of the lobsters can be removed and sold, but in case there is no manpower to do it, they should be disposed of properly to avoid contamination of the beaches.
- It has been observed that, beginning in the month of December, there is an abundance of small lobsters (8 to 12 cm tails) in certain parts of the northern Mesoamerican Reef. The lobsters are mainly taking refuge in shelter traps. For this reason it is recommended that lobsters are not taken from the shelter traps after this month starts. This will allow the creatures to grow inside the shelters so that in February legal-sized specimens can be caught there.

- It is recommended that fishers immediately initiate an organizational plan for the installation, registry, and operation of shelter-type traps in areas where they could be used.

Traps

Required gear

Fins, snorkel, mask, gloves, hook, curved knife, compass, lifejackets, buoys, clamps and measuring gauge.

Method

Rectangular traps are metallic structures covered in plastic mesh (to reduce their costs). Dimensions are 1.5 m x 1.2 m x .40 cm, with a 20 cm opening ending in a funnel-shaped wedge at one end. During their placement on the sea floor these traps are tied to a submerged buoy and positioned by GPS to prevent them from being found, moved or stolen by other fishermen, thus earning them the nickname in Spanish of “drowned” traps. For better effectiveness, fishermen bait these traps with cowhide to attract lobsters. Each boat can carry 10 traps and can handle up to 40 a day within its area.



Procedure for capture

Total trip duration: 6 to 8 hours

- 3 to 4 fishermen can travel on a boat. Once a trap is found, one fisherman would descend to hook the trap and have it raised up to the surface on a winch.
- Once a trap is installed, it is important to check it regularly as strong currents could kill the lobsters inside and lobsters could cannibalize each other. In general it is recommended not to leave traps unattended for more than 15 days.
- Onboard the boat the catch is removed from the trap and the trap is then cleaned, making sure it is still in proper working condition. If repairs are not needed, it is again baited and placed in the same or another site, depending on the success of its' previous location.

- Using the lobster measuring gauge, each lobster would be measured onboard the boat in the area it was caught. Fishers should not wait until they get to the delivery pier or until delivery time before they measure their lobster.
- In case lobsters fail to meet minimum size standards or, are found to be egg-bearing females, then they should be released back into the environment where they were caught and in the best possible biological condition.
- Aboard the boat, lobsters will be placed in baskets or holding tanks to be unloaded alive at beachside, where they will be weighed, recorded, and placed in a refrigerated truck.



- For the sale of live lobster, these should be kept in their boatside cages to take them to port where they will be sold in bulk to a seafood buyer. If they do not fetch a high enough price, the lobsters may be held in pens until their sale.
- In case they are to be sold as lobster tails, the creatures should be de-tailed and deveined, using the curved knife which allows the tail to be cut off cleanly at the joint which unites the tail to the cephalothorax thus giving the product a better presentation and higher value.
- Tails will be immersed in a cooler with purified fresh water and ice. The use of saltwater to preserve lobster tails is not recommended.
- In the event of a prolonged lobster camp or expedition (10 to 15 days) this water should be changed at least every third day to prevent the product from oxidizing and losing its attractiveness. This is not necessary if the product is sold within less than 72 hours after being caught.

- Special precautions should be taken when using sodium bisulfate, as a food preservative, at product collection sites.
- The remains of the lobster should be disposed of properly by placing them in a plastic container and not throwing them back into the sea as this would contaminate the area, scare off other lobsters, and attract predators to the area.
- Once on land, the pulpy flesh at the base of the lobster's antennae could be extracted and sold as well. In the case where there is no manpower for this task, these remains should then be properly disposed of to avoid contaminating the beach.

Free (breath-holding) diving

Required gear:

Fins, snorkel, mask, gloves, mesh bags, curved knife and measuring gauge.

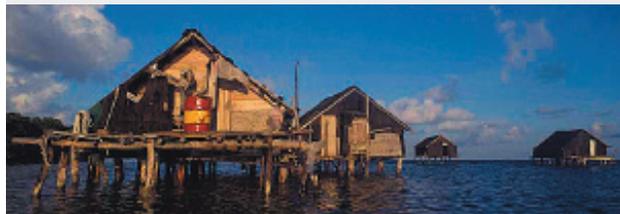
Fishing Method:

Hook, spear and harpoon



Procedure for Capture:

Total trip duration: 5 to 7 hours. In periods of abundance, the outing could be as short as 2 hours with enough time to make a second trip. Some sites require "camps" of 10 to 15 days.



- There can be between 3 and 5 fishermen on each boat.
- At the site, fishermen would work in turn to dive for lobster, follow the divers from the surface and look out for them from the boat.

- The pilot or motorist may also participate in the catch.
- Each diver can make several dives during the outing.
- Gloves are recommended to avoid injuries to the hand from the crustacean's spines.
- The duration of each dive is variable, depending on the fisherman's skill level.
- Once onboard, the creature should be de-tailed and deveined, using the curved knife which allows the tail to be cut off cleanly at the joint which unites the tail to the cephalothorax thus giving the product a better presentation and higher value.
- Tails will be immersed in a cooler with purified fresh water and ice. The use of saltwater to preserve lobster tails is not recommended.
- In the event of a prolonged lobster camp or expedition (10 to 15 days) this water should be changed at least every third day to prevent the product from oxidizing and losing its attractiveness. This is not necessary if the product is sold within less than 72 hours after being caught.
- Special precautions should be taken when using sodium bisulfate, as a food preservative, at product collection sites.
- The remains of the lobster should be disposed of properly by placing them in a plastic container and not throwing them back into the sea as this would contaminate the area, scare off other lobsters, and attract predators to the area.
- Once on land, the pulpy flesh at the base of the lobster's antennae could be extracted and sold as well. In the case where there is no manpower for this task, these remains should be properly disposed of to avoid contaminating the beach.

Mesh nets

Fishing gear

Fins, snorkel, mask, gloves, hook, curved knife, compass, lifejacket, buoys, clamps and measuring gauge.

Fishing Method

Mesh lobster net. The nets used can be of varying sizes and are made of silk. The apertures in the net and the thread gauges vary from zone to zone: in deeper waters the nets used have 6" apertures and use No. 9 gauge thread. In shallower areas 4 ½ "aperture nets with No. 6 gauge thread are used. Each drape of netting has a total length of between 50 and 60 fathoms. Several of these drapes, varying in length between 5 and 15 fathoms can also be joined together. The nets, which have weights and buoys, form bags at their joints, lowering total height to 60 or 70 cm during operation. The placement depth of each net varies between 10 and 12 fathoms in deep water and 2 fathoms in shallower areas.



Procedure for Capture

The total trip duration: 4 to 5 hours to either set the nets or check them the next day.

- Once the cast zone for the nets is identified fishermen can install the nets conveniently between 3 and 4 o'clock in the afternoon so that they will be in operation all night.
- Nets are in operation for 15 to 16 hours at a time (during afternoon and evening hours).
- Under no circumstance should the nets be left longer than the previously mentioned time limit as this method can catch other unintended species of crustaceans, fish and sea birds which may be of low economic value but of great importance to the marine ecosystem.



- The next morning, the nets would be checked, harvested and recovered so that they may be used again later that afternoon. The three fishermen onboard could do this to clear the net.



- With the measuring gauge the catch should be measured and weighed; not at the delivery or collection site at port.
- In case a lobster does not meet minimum size or is an egg-bearing female, it should be released back to its environment alive and in the best biological condition possible and in the same area where it was caught.
- Caught lobsters would then be selected for sale as live lobster or lobster tails.
- For the sale of live lobsters, these should be kept in their boatside cages to take them to port where they will be sold in bulk to a seafood buyer. If lobsters do not fetch high enough prices they may be held in pens until sold.
- In case they are to be sold as lobster tails, tails will be immersed in purified fresh water and ice in a cooler. The use of saltwater to preserve lobster tails is not recommended.

- In the event of a prolonged lobster camp or expedition (10 to 15 days) this water should be changed at least every third day to prevent the product from oxidizing and losing its attractiveness. This is not necessary if the product is sold within less than 72 hours of being caught.
- Special precautions should be taken when using sodium bisulfate, as a food preservative, at product collection sites.
- The remains of the lobster should be disposed of properly by placing them in a plastic container and not throwing them back into the sea as this would contaminate the area, scare off other lobsters, and attract predators to the area.
- Once on land, the pulpy flesh at the base of the lobster's antennae could be extracted and sold as well. In the case where there is no manpower for this task, these remains should be properly disposed of to avoid contaminating the beach.
- Despite the fact that lobster is the targeted species, a number of species of low commercial value, such as crabs, are caught as by catch, especially during their reproductive season. For this reason it is recommended that this method be used only in approved areas and during the properly authorized seasons.
- Fishermen could take advantage and market the other species caught as long as they follow correct fish and game protocols.
- The average weekly catch with nets is about 90 kg. It is worth mentioning that this method is restricted and used only during lobster migratory season, when adults travel to reproduce.

Compressor-based diving

Required gear

Fins, snorkel, mask, gloves, curved knife, plastic baskets, mesh bag, handmade "balloon" (balloon of canvas or waterproof cloth, to which the mesh bag is tied and sent to the surface after being filled with air), and measuring gauge. Also needed is an apparatus to provide air to the diver. This apparatus is composed of three elements: the motor, the tank and the compressor. The compressor has a 4 to 5 horsepower gasoline engine; minimum capacity of 5.5 liters and tank capacity of 200 to 300 pounds per square inch. When

lower capacity tanks are used there is a risk of poor air supply which could affect the health and performance of the diver. Some equipment is homemade or adapted, but it is recommended that compressors specifically made for diving be used. The compressor is connected to the “hookah” by a ¼” diameter hose measuring 100 to 200 meters long. This hose delivers air to the diver’s mouthpiece.

It is important to remember to use vegetable oil in the compressor motor to prevent the introduction of toxic fumes to the diver’s air supply via the hose and hookah. A log of hours of compressor use should be kept. This would help in developing a proper maintenance plan so lowering the risk of accidental malfunction of the motor. Proper maintenance also minimizes the use of the vegetable oil which is more costly than synthetic oils.



Method:

Hook and harpoon.

Procedure for capture:

Total trip duration: 7 to 10 hours.

- Three to four fishermen travel per boat. One would work exclusively to monitor and follow the diver below by swimming at the surface with a mask and snorkel. He would also help with onboard duties.
- Each diver would dive no more than two times per trip, with each dive lasting no more than one hour. Notwithstanding, the duration of each dive is variable and depends, among other things, on the number of shelter visited, the number of lobsters found and the ability of the fisherman. It is recommended that when diving at depths under 60 feet (18 meters) that the dive does not exceed one hour. If the depth is over 60 feet, the dive time should be less than 45 minutes (subtracting 5 minutes for every 10 feet of depth).
- As a safety measure, divers should maintain an ascension rate no faster than 1 foot per second. The air bubbles escaping the mouthpiece is used as an indicator of speed of ascent; divers rate of ascent should

not be faster than the smallest observable bubble. A proper rate of ascent reduces the risks of decompression. It is also recommended that a 1-minute safety stop in climb occur at 15 feet.

- There should be a 1 ½ hour rest and recuperation period between each dive. This allows another fisherman the opportunity to work during this time.
- On days when two dives are made, the second dive should be for a shorter duration and at a shallower depth than the first.
- Each day’s dive trip should have a plan known to all members onboard should include information like: specifics on the dive site, average depth, and distance from shore. Also, this plan should be shared with cooperative members. This is to allow for better control of the expedition and to cut down on response time in case of an emergency at sea.
- As a safety measure, it is recommended that the boat captain (pilot) be the timekeeper for the divers. Even though the divers wear watches, on occasion they get so focused on their activities that they lose track of time.
- Considering the differences between lobster and recreational diving, we recommend that divers adhere to security measures to decrease the risk of decompression. These include a full medical checkup, performed by a physician especially trained to treat divers, at least once yearly. Continuous training in the use of dive tables and first aid is essential to staying safe under water.
- For the capture, the fishermen could take a hook, which is used to remove the lobster from its shelter.
- The use of gloves is recommended to prevent injuries to the hands from the lobster’s spines. It is also recommended that divers take a mesh bag with them to hold lobsters caught.
- Once onboard, the creature should be de-tailed and deveined, using the curved knife which allows the tail to be cut off cleanly at the joint which unites the tail to the cephalothorax thus giving the product a better presentation and higher value.
- Tails will be immersed in a cooler containing purified fresh water and ice. The use of saltwater to preserve lobster tails is not recommended.
- In the event of a prolonged lobster camp or expedition (10 to 15 days) this water should be changed at

least every third day to prevent the product from oxidizing and losing attractiveness. This is not necessary if the product is sold within less than 72 hours of being caught.

- Special precautions should be taken when using sodium bisulfate, as a food preservative, at product collection sites.
- The remains of the lobster should be disposed of properly by placing them in a plastic container and not throwing them back into the sea as this would contaminate the area, scare off other lobsters, and attract predators to the area.
- Once on land, the pulpy flesh at the base of the lobster's antennae could be extracted and sold as well. In the case where there is no manpower for this task, these remains should then be properly disposed of to avoid contaminating the beach.
- Special attention should be paid to carefully select the lobsters you catch as those that are hooked are usually killed, regardless of their usefulness.
- It has been observed that a high percentage of young, or juvenile, lobsters are caught using this method; they measure less than 15 cm in tail length. Fishermen are asked to take special notice of their sizes because on occasion when antennae jut out from their sanctuaries they can fool divers as to their size, as they may not belong to a legal-sized creature.
- Sometimes lobsters known as milk lobsters (due to their color and texture) are caught. Lobsters with these characteristics are displaying symptoms of a viral disease, and it is recommended they are not put back into the water but kept in plastic bags to avoid contact with healthy specimens. The unhealthy lobsters can be disposed of properly back on land.

SCUBA diving

Required gear

Fins, snorkel, mask, SCUBA gear (consisting of regulator, BC, wristwatch, depth gauge, pressure gauge, weight belt and lead weights), compressed air tanks (from 6 to 12 per boat, each with a 3000 pound capacity), mesh lobster bags, artisanal balloon, measuring gauge and curved knife.

Method

Hook and harpoon or spear.



Procedure for capture

Total trip duration: 6 to 7 hours.

- A maximum of three fishermen can travel on the boat. One of them, wearing a snorkel, mask, fins and harpoon, will remain at the surface monitoring the divers below, and can serve to warn against the presence of sharks, inclement weather and other dangers at sea.
- A sign of the possible presence of sharks is when schools of fish suddenly disperse from the dive area. They can usually be scared off by pounding against the side of an air tank with a metal rod or spear or also by the sound of the boat's motor as the boat turns tight circles above.
- No diver may make more than two dives in one day of lobster fishing. When diving at depths greater

than 60 feet, the total dive time should be less than 45 minutes. 5 minutes should be subtracted from the total dive time for every 10 feet thereafter.

- Once a diver notices that he has 500 pounds of air left in his tank he should begin his ascent. He should ascend at a rate of one foot per second (as a reference point he could use the air bubbles escaping from his mouthpiece, and not rise any faster than the smallest bubble he sees). This will allow him to have sufficient air to make a 3-minute safety stop 15 feet from the surface. Recovery time between first and second dives can be no less than 1 ½ hours.
- It is recommended that divers take an underwater dive light with them to look for lobsters hidden in small caves and holes.
- As a security and prevention measure divers should use and keep maintenance log book for all of gear and equipment. The regulator should be inspected annually and tanks should undergo a hydrostatic evaluation every five years. A toolkit and extra gaskets for air tanks should also be part of equipment accompanying the dive.



- Considering the differences between lobster and recreational diving, we recommend that divers stick to safety measures to decrease the risk of decompression. These include a full medical checkup at least once yearly performed by a physician specially trained to treat divers.

- Continuous training in the use of dive tables and first aid is essential to staying safe under water.
- Each diver and each boat should have dive depth and duration tables and should apply them and adjust them to lobster fishing or to formulate the dive plan for each day's outing. This plan should be submitted to the cooperative to allow them to properly assist the divers in case an accident occurs.
- It is well known that when a site has an abundance of lobster, the fishermen will, after the first dive, want to return to that site as quickly as possible. For proper recuperation, it is crucial for divers to make the appropriate stops during their ascent and also to stay on the boat at least 1 ½ hours before diving again. Also, the second dive should be at a shallower depth and, in case of a third dive, even shallower.
- To catch lobsters, the diver could take a hook, which he could use to pull them out of their hiding places. He could also use gloves to guard against injuries to his hands by the lobster's spines. Divers should take mesh bag with them which would be used to hold all lobsters caught.
- Special attention should be paid to carefully select lobsters you catch as those that are hooked are usually killed, regardless of their usefulness.
- It has been observed that a high percentage of young or juvenile lobsters (less than 15 cm in tail length) are caught using this method. Fishermen are asked to take special notice of their sizes because when a lobster's antennae sticks out its sanctuary they can fool divers as to their size, and they may not belong to a legal-size lobster.
- To increase efficiency, the use of an artisanal balloon is recommended. The balloon is inflated with air from the mouthpiece and is used to send full lobster mesh bags back to the surface to be picked up by the diver's colleagues onboard the boat.
- Once onboard, the creature should be de-tailed and deveined, using the curved knife which allows the tail to be cut off cleanly at the joint which unites the tail to the cephalothorax thus giving the product a better presentation and higher value.
- Tails will be immersed in purified fresh water and ice in a cooler. The use of saltwater to preserve lobster tails is not recommended.
- In the event of a prolonged lobster camp or expedition (10 to 15 days) this water should be

changed at least every third day to prevent the product from oxidizing and losing attractiveness. This is not necessary if the product is sold within less than 72 hours of being caught.

- Special precautions should be taken when using sodium bisulfate, as a food preservative, at product collection sites.
- The remains of the lobster should be disposed of properly by placing them in a plastic container and not throw them back into the sea as this would contaminate the area, scare off other lobsters, and attract predators to the area.
- Once on land, the pulpy flesh at the base of the lobster's antennae could be extracted and sold as well. Where there is no manpower for this task, these remains should then be properly disposed of to avoid contaminating the beach.
- Sometimes lobsters known as milk lobsters (due to their color and texture) are caught. Lobsters with these characteristics are displaying symptoms of a viral disease, and it is recommended they are not put back into the water but kept in plastic bags to avoid contact with healthy specimens. The unhealthy lobsters can be disposed of properly back on land.

b. Industrial fishing

We make the following recommendations to guarantee the safety of fishermen working aboard industrial vessels:

Boats with fiberglass or metal hulls, with 65-85 feet total length, 10-ton weight capacity, a 130 to 400 horsepower diesel engine, and a rudder and 15-day autonomy are used in the fishery. These vessels should be equipped to handle a 100-man crew. They should also have basic navigational equipment, such as loran, navigational charts, radio, GPS, lifejackets, emergency flares, batteries, and first aid supplies.

The following is a description of the best fishing practices for the methods used on board industrial lobster fishing vessels.

Wooden traps on Industrial boats

Required Fishing Gear

Gloves, buoys, a winch, curved knife, lobster measuring gauge.

Method

Wooden traps, tied to a block or a line forming a "lingada" or trap line, which has a buoy on every 20 traps. No boat may transport more than 5,000 such traps.

Procedures for capture

35 to 45 crew members may travel onboard the vessel.

- Lobster fishing may only be carried out during the stipulated season.
- Traps may be baited with (salted and frozen) cowhide.
- Once the fishing site is located, the trap lines may be set.
- The trap lines can hold from 100 to 150 traps, with one buoy every 20 traps.
- The trap lines are set at a depth of 90 to 250 feet. No more than 1,000 traps should be set per day, approximately 6 lines worth. The GPS location of each trap line should be recorded after setting it in the sea.
- After placing the first trap line, the vessel should move on to another area to identify another potential site.
- Traps may be submerged for no longer than five days, after which they should be raised with a winch or hydraulic lift.
- At the moment traps are checked, and before lobsters are bagged, they must be measured with the lobster gauge on board the ship to make sure they meet minimum size requirements.
- When a lobster fails to meet size requirements or is found to be an egg-bearing female, it should be released back into the sea in the best possible biological condition.
- After inspection, lobsters should be de-tailed using the curved knife to include the skin that joins the abdomen to the thorax. Tails will be placed in plastic freezer bags and treated with sodium bisulfate (the bisulfate should be dissolved in a container with water for five minutes before it is used). Each bag can hold up to 75 pounds of lobster tails and should be placed in cold storage.



- The heads of the lobsters are also refrigerated, and the “clipper” (fisherman in charge of unhooking the traps when they are raised on the winch) is in charge of removing the meat from these.
- The remains of the head should be placed in a container to be disposed of properly on land. Remains should not be thrown overboard as they scare off other lobsters, affecting yields significantly.
- Used traps can then be stacked in the rear of the craft. If any are damaged, they can be repaired there for their future use. Traps showing severe signs of damage will be destroyed and disposed of on land. If unusable, traps are thrown overboard into the sea they contaminate the environment and threaten sea life.
- Once a large quantity of lobster is stored in the freezer, a call can go out via radio to the collection boat to pick up the product for processing at the export fishery back on land.
- The vessel can stay out in the open sea for several months or even for the whole season. If the latter is the case, collection boats can pick up the product out on the open sea and bring supplies of water, food and fuel for the vessel and crew.
- Those vessels that do not have walk-in coolers but do have freezers and use ice and salt to preserve their catch can stay out for just over 15 days on the open seas before they must return to port to deliver their catch and re-supply themselves.
- It is absolutely imperative that, after the season is over, all vessels recover the traps they set out on the sea floor. If they fail to do so the abandoned traps will continue to trap and kill different aquatic species indiscriminately.

SCUBA diving on industrial boats

Required Gear

Fins, snorkel, mask, SCUBA equipment (regulator, dive watch, BC, depth gauge, pressure gauge, weight belt and lead weights), compressed air tanks (from 200 to 300 per boat with a 3,000 pound capacity per tank), gloves, mesh lobster bag, lobster measuring gauge and curved knife.

Method

Hook and harpoon or spear.

Procedure for capture

Up to 100 crewmembers can travel on board each boat, 80 of which will be divers.

The total duration of the trip will be from 15 to 22 days.

- Lobster may only be caught during the authorized season.
- Each vessel can carry 40 kayaks (or rowboats or canoes), which will have a diver and his helper (the helper will stay in the canoe or kayak to help during the catch).
- Once at the fishing site, each diver and his helper will leave the large boat in their rowboat and with their dive equipment. Each small boat can carry up to 6 air tanks for both crewmembers. The canoes usually set out at 7 a.m., and can return at 2 p.m. Under no circumstance should they make more than two fishing trips.
- If the helper on board the small boat is also a trained diver, he may also participate.
- Dives will be from between 120 and 140 feet.
- No diver may make more than two dives in one day of fishing, taking into consideration that if he dives at a depth of more than 60 ft below the surface the dive should last less than 45 minutes, and 5 minutes of dive time should be subtracted for every 10 feet thereafter.
- Given that average dives are at depths of between 120 and 140 feet, divers should remain no more than 20 minutes on the sea floor.
- It should also be noted that when there are 500 pounds of air left in the tank, the diver should begin his ascent, always respecting an ascending rate no faster than one foot per second (as a reference the diver may use his air bubbles, and the rule dictates that he should not ascend faster than the smallest bubble leaving his mouthpiece). This should leave the diver enough air to make a 3-minute stop 15 feet before reaching the surface. The recovery time between dives should be at least 1 ½ hours.
- As a safety precaution an equipment use and maintenance record should be kept. It is recommended that the regulator be checked annually. Also, each tank should undergo a hydrostatic check every 5 years. During the fishing trip a tool kit and extra gaskets for the tanks should be safely stored on board.

- Safety measures should be strictly followed to reduce the risks of decompression sickness affecting divers. These measures include an annual physical examination of divers performed by a doctor especially experienced in treating divers.
- Continuous training in the use of dive tables and first aid measures is fundamental to maintaining on-board security.
- Each diver and boat should have dive and depth tables which should be used to formulate the dive plan for each lobster fishing outing. The plan must be shared with the crew so that the correct actions can be taken in the event of an emergency.
- Once lobsters are located, the diver may use a hook (or “hook stick” as known locally), to catch the lobsters by the head, although sometimes when lobsters hide in caves they would have to be hooked by the trunk.
- After being hooked, the lobster is held by a gloved hand and is placed in a mesh lobster bag. The diver will then continue to work as long as his air reserves permit.
- Once onboard the smaller boat, the lobsters will be measured using the gauge. In case a lobster fails to meet minimum size guidelines or is found to be an egg-bearing female, it should be released into the water in the best biological state possible.
- Lobsters caught that do comply with minimum size guidelines shall be placed in plastic bags. Bags have a 15-lobster capacity.
- Afterward, the diver and his helper should return to their boat, where they can de-tail their catch, and

with their curved knives they can cut off the tail so that it includes the joint that unites the abdomen with the thorax. The diver’s catch would be recorded immediately after de-tailing.

- Tails should be placed in a container of fresh water for 15 to 20 minutes, after which they would be packed in bags to which water and ice, and sodium bisulfate would be added as a preservative. The bagged lobsters would then be placed in the boat’s walk-in cooler.
- The cephalothorax should be put in the freezer, shell and all. Once frozen, the meat inside will be easier to remove because as it is frozen it will come off in one piece and not in small bits. This meat will undergo the same treatment in freshwater, ice, and sodium bisulfate and will be bagged as well. The remaining carapace will then be soaked so that it can freeze better and its meat can be sold as pulp.
- All lobster remains should be placed in plastic bags to be properly disposed of once on land. These remains should never be thrown overboard and into the sea as they repel lobsters in the area and contaminate the environment.
- Under no circumstances should boats dispose of the sodium bisulfate by throwing it overboard and into the sea. This material should be properly disposed of back on land.
- Damaged dive fins or masks should also not be thrown overboard and into the sea. They should be properly disposed of on land.

II. How to increase profits: Business organization and commercialization

When fishermen are freely allowed to catch fish, after several years a “race for fish” or in this case a “race for lobster” emerges. The “race for fish” is one of the most common causes of over-exploitation in fisheries. When we catch too many lobsters, obviously those that remain in the sea are fewer, which make it harder to find and catch them. In such a situation, it will be necessary to make more trips or travel further than usual in order to earn the same income as in the past. Therefore we must answer a question: Is it better for the fisherman to fish in a group or by himself? There are advantages and disadvantages of fishing alone or in group. Some of these advantages and disadvantages are explained in the next paragraph.

If the abundance is high and a fisherman has great experience, fishing by himself will let him to get a higher catch. Then, each fisherman will develop a preference to catch fish in certain areas, which he will not reveal to others to prevent them from fishing in “his field”. When abundance decreases, this advantage turns into disadvantage because even more experienced fishermen will catch less lobster, therefore benefits will decrease. Under such a situation, working in group turns into an advantage, for instance fishermen may pool their catch together so they could offer a higher volume to the buyer, which would result in a better position for price negotiation. To put it simply, the race for fish may be eliminated by cooperation instead of competition.

Some benefits of working in group

Economics efficiency means striving for the highest quantity and quality production possible, reducing costs as much as possible, which will result in increase profits. When fishermen organize, production is more efficient and this reflects itself in an increased yield at lower costs, if and when the resource does not show signs of over-exploitation. Some of the benefits gained in working in a system of cooperatives or associations include:

- Access to credit for the purchase of equipment and gear.
- Access to facilities such as walk-in coolers.
- Development of better commercial strategies.
- Higher production which is an advantage when negotiate the price.

- Better support from the authorities to carry out the activity.
- Receiving awards of permits or concessions to explore certain sites.
- A larger commitment from fishermen to respect statutes and guidelines.
- More input from the fishermen in the drafting of different regulations, avoiding a race for lobsters and maintaining acceptable biomass levels for the reef.

How the cooperative should work

In order to have the highest economic efficiency, it is necessary to establish management rules for the investment (boats, engines, navigation equipment, facilities, etc.) and the optimum use of inputs, such as fuel, gears, etc. It is also necessary for the cooperative to have a code of conduct for fishermen to ensure that assigned duties and responsibilities are fully executed. Historical catch data may be used to estimate the ecosystems’ capacity to produce biomass (for instance kilos of lobster tail per bay per season). This information could be useful in helping to reduce the risk of an excessive investment in boats, avoid over catching lobsters, which may compromise the next season’s production.

As with any other type of firm, the cooperative requires labor and capital. Technology is acquired by the capital, which may come from different sources such as members’ quotas, grants, credits, governmental funds, non-governmental projects, etc. Labor is provided by members of the cooperative, who use their own fishing gears and boats. The more complex the organization become, the higher investment should be. For instance, if the cooperative has facilities such as freezers, processing plants, docks, vehicles, offices and community halls, the costs will be higher than that of a simple organization that does not have those facilities. Considering that lobster prices are constantly increasing in the domestic and international markets, the more complex the organization is, the more benefits it will get.

When fishermen come together and form cooperatives, they acquire rights and obligations. One of the principal obligations is to keep the cooperative functioning, whether it is via contributions of money and/or service (for example by being part of the board of directors or a committee member).

To keep the cooperative functioning, it is necessary for fishermen to contribute 100% of its working capital, thus avoiding the negative consequences of subsidies. Some of the costs a well-organized cooperative could have are: employee salaries (accountant, secretary, support staff etc.), maintenance of property, purchase of office equipment, payment for services, vehicle maintenance, etc.

Fishing gear and equipment should not be figured into operational costs as fishermen use these individually and personally. Since each fisherman's catch is variable and dependent on

many factors, including such fluctuating situations such as climate change, it is not possible for the cooperative to demand a certain production or quota from a fisherman. And, as independent producers who collectively share the costs of marketing their products once on the beach, the cooperative should establish a fair system of contributions.

Let us suppose that the annual costs for a particular cooperative to commercialize a product are as shown in Table 1 below. The amount that the members must contribute during the season would be \$48,000 US.

ITEM	ANUAL COST
1 Accountant (part time)	US\$ 14,200
1 Secretary (full time)	US\$ 16,000
1 Staff (full time)	US\$ 72,000
Services (electric power, etc)	US\$ 3,500
Facilities maintenance	US\$ 1,000
Vehicles maintenance	US\$ 1,500
Office equipment	US\$ 1,000
Bank services	US\$ 1,900
Others	US\$ 1,900
TOTAL	US\$ 48,100



Table 1: The Cooperative's Annual Operating Costs. These costs are only for businesses that produce and sell lobster at the docks.

To figure out the necessary contribution to be had from each member, the logical thing to do would be to look at his production figure. Clearly the benefits he receives will be proportional to his production (a higher production would require higher administrative efforts) and consequently, the contribution must be proportional to and reflective of the members' production and benefits. Generally, members determine a constant contribution for each kilogram of lobster brought in. Due to the difficulty involved in predicting the total yield a cooperative will have in a season, initial estimates would be made based on past years' yields for the whole cooperative.

Calculating contributions per kilo of lobster tail for the season which is starting requires some basic data such as average annual landings, number of fishermen, number of boats, trips per boat during the season, etc. (Table 2)

Variable		Value
A	Total annual landings	134 tones (134,000 Kg.)
B	Price of lobster tail kilo paid on docks	US\$12
C	Cost of fishing trip	US\$ 17
D	Fleet	54 boats
E	Total trips during the season	2,862
F	Average of trips per boat	53
G	Fishermen participating	90
H	Number of fishermen per boat	3
I	Total annual costs for the cooperative	US\$ 48,100 (Chart 4)



Table 2: Basic information needed to calculate individual contributions from members of the cooperative.

Using simple calculations, it is possible to calculate the percentage of contributions per kilo of tail given to the cooperative

$$J = \frac{A}{E} = \frac{134,000 \text{ Kg}}{2,862 \text{ trips}} = 46,82 \text{ Kg / trip}$$

$$K = \frac{A}{E} = \frac{46,82 \text{ Kg / trip}}{3 \text{ fisherman}} = 15,6 \text{ Kg / (trip / fisherman)}$$

$$L = F \times K = 53 \text{ trips} \times 15,61 \text{ Kg / (trip / fisherman)} = 827,16 \text{ Kg / fisherman}$$

$$M = B \times L = 12 \text{ USD} \times 827,16 \text{ Kg / fisherman} = 9,926 \text{ (USD x Kg) / fisherman}$$

$$N = \frac{I}{G} = \frac{48,100 \text{ USD}}{90 \text{ fisherman}} = 534,44 \text{ USD / fisherman}$$

$$O = \frac{M}{N} = \frac{9,926 \text{ (USD x Kg)/fisherman}}{534,44 \text{ USD/fisherman}} = 0,054 \text{ Kg} = 5,4 \%$$

The final result may be obtained using the next expression:

$$O = \frac{E \times H \times I}{A \times B \times F \times G} = 46,82 \text{ Kg / trip}$$

Therefore, to keep the cooperative operating well, it is estimated that fishermen will contribute 5.4% of their catch, or 65 cents from each kilo of tail they deliver, to the cooperative. The basic assumption of this exercise however, is based on the premise that all fishermen must deliver their entire catch to the cooperative for their commercialization ¹.

This percentage would change if annual production is higher or lower than the estimated 134 metric tons. If, for example, production were 10% higher, there would be a surplus in the contributions (fishermen would have paid US\$52,910 instead of US\$48,100), then fishermen would have to contribute 65 cents per kilo of whole lobster caught, or 7% of their revenue. On the other hand, if landings were lower than the forecast, there would be a deficit equal to the percentage of the difference between the observed and expected catch. For both cases, the cooperative should establish a fund for bad years. The costs mentioned are the minimum required to keep the cooperative working; however it is possible to create a fund for equipment substitution, equipment maintenance, vehicles maintenance, facilities maintenance, etc. In this regard, it would be necessary to divide total costs between the years to account for depreciation of the items.

It is important to underline the point that the cooperative itself will not produce a profit, as all profits are

kept by fishermen as they bring in their catch during the season. For this reason it is not possible to compare profit percentages from percentages that would correspond to the payment of salaries.

Conclusion

A good practice for lobster fishing includes a strong organization of fishermen, total commercialization of product caught by the cooperative, along with transparent administrative and accounting systems. Sanctions for intentional faults or violations of the cooperative rules may be as severe as the loss of all rights and privileges as members. In some cooperatives, this drastic practice has produced good results, because it dissuades violations ².

The organization could proceed to a higher level, even transform itself into one that could also process the lobster internally, which would require the development of human and technical abilities and whose costs are higher than those of a cooperative which only commercializes its product. In the case of a processing cooperative, it would be necessary to conduct an analysis similar to the one done for the commercializing cooperative to determine the generation of profits, which occurs in the next stage of the market chain. After this, guidelines would be established for equal sharing of profits among members, as is the case in Belize.

¹ In the same way, if a fisherman would decide to market his product outside the cooperative and not honestly report their catch, avoiding proper contributions ("free rider"), then the percentage of contributions as a function of those lobsters marketed through the cooperative would also increase. When this happens, cooperatives generally fail to cover their operational costs, and at season's end they would have to declare a deficit. If this situation takes root, then fishermen would no longer receive benefits from the cooperative and would degrade into a situation of disorganization and almost free access to the resource. Fishermen would get short-term benefits for sales outside of the cooperative, but would lose out, in the long run, from the benefits of the cooperative which would in turn damage the same cooperative.

² In economics, profits are income generated by the investment during a given period of time. For instance, the lower profits investments are those obtained from banks. If instead of investing in a bank, a person decides to invest in his/her own small business, it would be necessary to discount all the costs, even salaries, no matter if the only employee is the owner. At the end of the period the investment should produce a percentage of gains or profits, which may be re-invested or simply retired for other purposes.

Generally, there are two ways to get agreements in a group: voluntary or by enforcement. When voluntary, it may be conscious, knowing the rationale of the agreement or simply by imitation or acceptance. Misbehaviors may be due to unfamiliarity with the rules or to an intentioned action knowing the damage it may produce. These situations vary from culture to culture and many developed societies follow agreements by voluntarily applying severe sanctions to violators, with a previous knowledge that none or only few will break the rules.

ANNEXES



ANNEX A

Trade chains in the Mesoamerican Reef

Honduras

In Honduras, industrial vessels sell their lobster catch directly to processing and commercialization plants, some which are owned by local and American investors.

The processing plants export all of their lobster mainly to the United States, through third parties who sell to larger wholesalers or distributors like Darden. These same wholesalers offer the product to retail sales companies, such as supermarket chains, and also distribute to restaurant chains like Red Lobster™

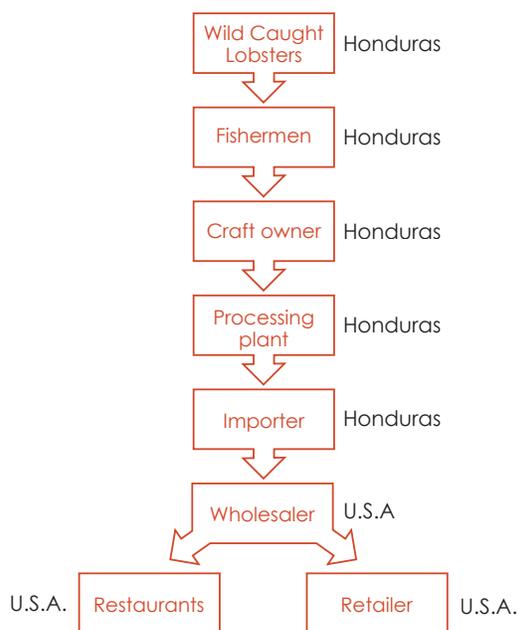


Figure 10: The commercial chain of lobster caught in Honduras. The country where each stage of the process occurs is shown in parentheses.

Mexico

Cooperatives in Mexico are micro and small businesses, with sales that fluctuate between \$100,000 US and \$400,000 US annually. The majority sell to wholesale distributors, while some sell directly to restaurants.

Fishermen face different obstacles in trying to sell directly to final consumers (hotels and restaurants). These difficulties include: ability to produce quantity, product quality, product presentation, transportation, storage and logistical conditions required by restaurants. Since producers lack the capacity to deliver lobsters directly to the distributor or end consumer, sales are generally conducted beachside, where transportation costs are covered by the distributor.

The main product sold to distributors is lobster tail, which accounts for 75% of the total sale volume during the 2004 season. Live lobster represented 22% of the total volume of sales, with fresh frozen lobster accounting for the remaining 3%.

Cooperatives do not handle sales of frozen lobster, lobster meat or processed lobster as they do not have processing plants. Only one cooperative sold processed lobster for a short time in the 2004 season. Lobster sold in this instance was in very low quantity and was part of a custom order for a particular client.

Prices vary during the season as a function of, (i) the presentation of the product, (ii) proximity to the end of the season, and (iii) the season's particular demand. Prices start rising closer to the end of the season, which means that one can get lobster at a lower price during the months of July to September, while the price increases during the months of Decem-

ber to February. This phenomenon is related to the supply of the resource which declines as the season progresses. It is also true that prices have risen from year to year.

Very few cooperatives sell on credit. In fact, on many occasions distributors must pay for their product in advance hoping that fishermen will have the resources to provide the catch later (Table 3)

The lobster distributors are principally mercantile associations and independent contractors. The size of these companies is also variable, but small businesses dominate the field. A large number of dis-

tributors are also wholesalers, although others operate as intermediaries and fish markets. They have the infrastructure and installations adequate for transporting, processing and storing lobster, which permits direct access to consumers, and the opportunity to present a product of the best quality and, to get a higher price.

Final consumers of the product are mainly hotels and restaurants, although fish markets and other distributors can be clients. Frozen lobster occupies first place in sales, followed by lobster tail, then live lobster. The Mexican lobster market chain is shown in Figure 11 below.

Product Presentation	Ex-vessel price per Kilo	Buyers Prices per Kilo	Sellers price per Kilo
Alive	US\$13.70	US\$19.33	US\$22.32
Frozen whole lobster	ND	US\$30.13	US\$35.71
Fresh whole lobster	US\$19.60	US\$12.43	ND
Fresh lobster tail	US\$27.20	US\$28.92	US\$33.59



Table 3: Relevant data on lobster sales in the Mexican Caribbean Region.
1: As reported by fishermen. 2: As reported by seafood buyers. ND – not declared.

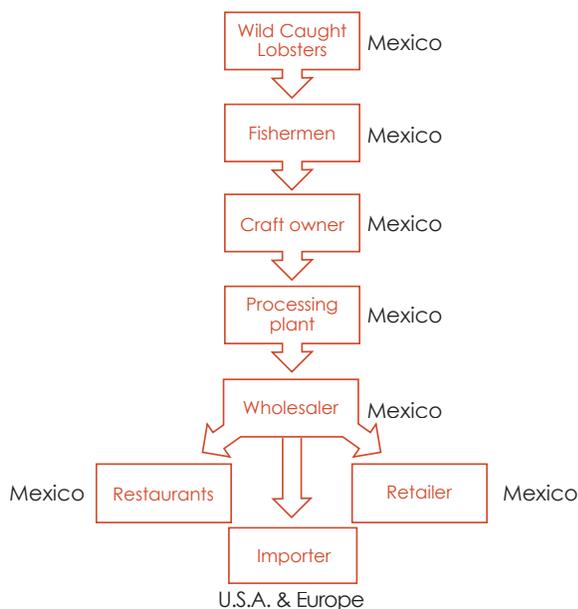


Figure 11: Market chain for lobster caught in Mexico. The country where each stage of commercialization takes places is shown in parentheses.

Belize

In Belize, fishermen sell their product to the fishing cooperatives. The cooperatives pay fishermen for their catch according to prices set by the cooperative’s management committees. At the end of a season, fishermen can receive a bonus as part of a profit-sharing program, depending on the success of total sales.

Cooperative	Est. First Payment (received by fishers)	Est. Second Payment (received by fishers)	Est. Selling Price (received by coop from buyers)
Northern Fishermen Cooperative	BZ \$15.00	BZ \$8.50	BZ \$31.00
National Fishermen Cooperative	BZ \$15.00	BZ \$8.00	BZ \$29.50



Table 4: Market chain for lobster caught in Mexico. The country where each stage of commercialization takes places is shown in parentheses.

Source: Northern Fishermen Cooperative -Annual Report 2006; National Fishermen Cooperative -Annual Report 2006.

The cooperative is in charge of processing the product and selling it directly to foreign markets via import /export companies. The cooperatives are the only national organizations that are allowed to export lobsters from Belize. The principal client for Belizean cooperatives is Darden, an American company that purchases each season's product before the season begins. Darden distributes the product to its restaurants, mainly the well-known Red Lobster™. In Figure 12 we present the Belizean market chain.

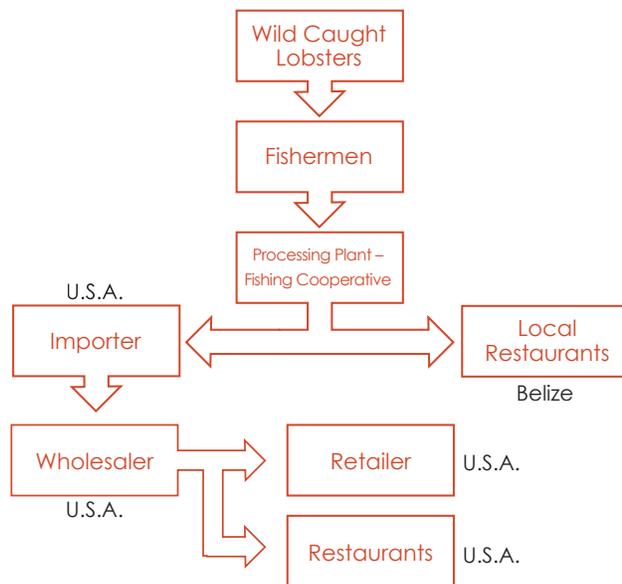


Figure 12: Market chain for wild caught marine lobsters (*Panulirus argus*) in Belize.

The country where each stage of the process occurs is shown in parentheses.

Supply and Markets

In examining the supply side of the market, a recent study by La Salle University in Quintana Roo, Mexico (Vanegas and Ferreyra, 2005), identifies the main problems facing commercial wholesalers as follows:

1. Scarcity of product (given the irregular nature of capture, poaching, fishing out of season, piracy and illegal sale).
2. Lack of seriousness on the part of fishermen (few are organized with adequate boats and fishing gear).
3. Price instability (the price increases as the end of

the season approaches).

4. Wholesalers must buy with cash and oftentimes in advance, while they often sell on credit (wholesalers would need enough working capital to survive until they are paid).
5. Low product quality (difficult to introduce to higher-level markets that can pay a better price for the lobster).

These problems can be resolved if and when fishermen create their own internal controls and wholesalers support these actions as they are key players in this industry. Fishermen, wholesalers and consumers must be told that the best fishing practices bring short, mid and long-term benefits and that by adopting these practices they will ensure that this resource would continue to flourish for generations.

Vanegas and Ferreyra (2005) noted that the Mexican commercial wholesalers are, by and large, not aware of most of the certifications developed for fishery products. Wholesalers are however, willing to pay a high price for lobster that is well-treated and of a high quality as it will open up their market to include higher-end hotel and restaurants.

In this respect, and according to the study, up until the year 2001 lobster held fourth place in seafood purchased by the hotel industry with a 13.4% share of the market. Lobsters were surpassed by shrimp, sea bass and Mahi Mahi. Lobster is consumed mainly in 5-star and Grand Tourism hotels. 4-star category hotels consume smaller amounts. The hotel market is dominated by wholesale distributors and hotels prefer to buy from them as wholesalers can offer frozen product (which represents a storage cost savings to the hotels). Additionally, wholesale distributors have better product availability and can offer credit which individual fishermen cannot do.

Hotels in Chetumal and the Riviera Maya in Mexico are able to use a more direct distribution pipeline than do the hotels in Cancún. These final consumers are also able to access lobster from other areas: domestic (from the states of Yucatán, Veracruz, Campeche, Baja California Sur and Sinaloa) or international (Cuba and Central America), because of the quality, availability and payment options available for the product. Demand for lobster in this area is expected to increase as the number of hotels increase in the coming years. The adoption of an “all-inclusive” structure by hotels should also increase demand.

In the year 2001, more lobsters were consumed in

restaurants than within the hotel industry. Lobsters accounted for a 25.9% share of all seafood sales, this volume of sales was surpassed only by that of shrimp.

Restaurants can take advantage of more direct channels of distribution than the hotels, though they do also prefer to deal with the wholesalers when looking to purchase large volumes of a high quality, highly presentable products. Predictions are that there is a brighter future for the industry as demands for the product will increase. The adoption of an all-inclusive system by more and more hotels may, however, temper that increase although it won't eliminate it entirely.

The consumption of lobster by the local population is low compared to that of hotels and restaurants. According to a supply and demand study of the seafood products for the state of Quintana Roo, annual per capita consumption is only 1.78 kg. This is less than half the average of all seafood products consumed. Among the local inhabitants, lobster consumption occupies 21st place with only a 1.13% share of total seafood consumption. It is important to note, however, that as migration to the state continues to increase (the year 2004 witnessed a 10.3% population increase in resort areas in Quintana Roo) demand for and consumption of lobster is expected to increase.



ANNEX B

Fishing organizations: cooperatives and private firms

Honduras

In Honduras, industrial fishermen are private entrepreneurs (ship owners) with boats and licenses that allow them to harvest lobster.

These independent contractors have no formal association among themselves, and each one responds independently to the authorities. Generally, there is an established strong bond between these businessmen and divers through senior divers who are older expert divers in the community of fishermen. These senior divers, also known as sacabuzos, recruit young, salaried divers, whose income depends on the quantity of lobsters they catch.

Divers and sacabuzos are members of the Caribbean community of Honduras and for the most part are ethnically Miskitos or Garífunas. Historically, these ethnic

groups have developed important cultural and social systems, but they have failed to establish a solid system of cooperatives. For this reason, fishermen harvest their catch and sell them independently or in small groups, creating free competition conditions with no restrictions in their practices (for example, lax enforcement and vigilance on safe-diving practice measures).

For this reason, the lobster fishing organization behaves as a private industry subject to international market conditions, operational costs, local labor costs, and national government fishing and health codes. As shown in Table 5 below, the number of industrial fishing vessel owners is 101. 97 individuals own 115 boats (68% of the fleet), two other have 15 boats (15% of the fleet) and two more own the remaining 38 vessels (23%).

No. of Owners	No. of vessels per owner	Total vessels
82	1	82
13	2	26
1	3	3
1	4	4
1	7	7
1	8	8
1	13	13
1	25	25
101	63	168



Table 5: Number of vessels per licensed owner for use in lobster fishing in.

Mexico

As mentioned earlier, lobster fishing in the Mexican Caribbean region is of the traditional variety. Traditional fishermen here are organized into 19 cooperatives, each with an average of 37 members. This indicates that a little over 50% of all the fishermen in the state of Quintana Roo are members of a cooperative.

The cooperatives are joined together under the aegis of the Federation of Cooperatives of Quintana Roo, an organization which has the authority to call them

to assemble as one body and whose functions include maintaining a constant dialogue with environmental and fishing authorities and submitting proposals for support to governmental organizations. Proposals would typically include, among things, request for support of the cooperatives in the construction of port infrastructure, equipment, and boat procurement.

Cooperatives behave as small businesses whose proprietors are the fishermen themselves who have their

own independent administrative body through which they competitively place their product in a free market economic scheme.

Before the 1980's, cooperatives enjoyed a policy of support, under which they received credits and subsidies. This policy promoted the acquisitions of boats, motors, walk-in coolers, and other property and equipment. However, as time passed, many of these credits went unpaid. The main reason for this lapse was that members behaved as individuals at the moment of harvest and sales, and their profits were not used to fund the cooperative's debts.

At the end of the 1980's the government changed this policy to one of unsubsidized free markets. Many cooperatives faced grave financial problems, but others were able to overcome the situation by centralizing commercialization and ensuring that each member made contributions to the central fund. This type of organization required strict disciplining to discourage marketing of the catch outside the cooperative. A transparent and efficient system of administration based on complete trust and with zero tolerance for corruption was instituted. Only those cooperatives that lived up to those principles were able to succeed.

Belize

In Belize fishermen have organized themselves into cooperatives. One of the major functions of the cooperative is to market the fishermen's product. Prior to the 1960's, fishermen operated independently from one another and sold their product to two large companies, who then processed it for export. The fishermen realized that the price they received was too low compared to the prices the companies were receiving. The fishermen of Cay Caulker were the first to organize and to personally process and sell their lobster directly to foreign buyers. In September of 1960 they formed the Northern Fishermen Cooperative Society Ltd. In 1962 groups of fishermen from Placencia registered the Placencia Producers Cooperative and in 1966 the National Fishermen Producers Cooperative Society was registered. The fishing cooperatives of Belize enjoyed great success during the decade of the 60's, and continued to function mainly as marketing organizations. Indeed, by 1983 at least 10 fishermen cooperatives were in existence. The result of the establishment of these cooperatives was a substantial increase in the price fishermen received for their lobster. Today, there are five fishermen cooperative operating in the country.

- National Fishermen Producers Cooperative Society Ltd.
- Northern Fishermen Cooperative Society Ltd.
- Caribeña Producers Cooperative Society Ltd.
- Placencia Producers Cooperative Society Ltd.
- Rio Grande Fishermen Cooperative Society Ltd.

An estimated 60% of the 652 fishing boats licensed in 2005 belong to individual fishermen cooperative members. These cooperatives are owned by Belizeans and have Belizean employees who are responsible for processing, packaging and administering the daily business activities of the cooperatives. The two major fishing cooperatives, Northern and National Fishermen Cooperative, however, are the only cooperatives that have a processing plant that process fishery products for export. Caribena, Placencia and Rio Grande Cooperatives deliver their products to either one of these two major fishing cooperative.

These cooperatives function as private corporations, whose owners and administrators are the fishermen themselves. The fishermen elect an administrative committee composed of seven members who hold the authority to run the business. The committee hires an executive secretary or administrator, who then hires a plant supervisor and a group of accountants. The responsibility for product handling, from receiving, to packing and refrigeration, falls on the plant supervisor. The Belizean Department of Cooperatives and Credit Unions has given support to the fishermen to establish their own organizations.

In 1970, fishers felt a need to take things one step further and form a parent organization which could represent their views in one voice and therefore become a strong lobby. As a result, in October, 1970 the Belize Fishermen Co-operative Association (B.F.C.A.) was registered. The BFCA's current members include National, Placencia, Caribbena and the Rio Grande Cooperatives. This excludes the Northern Fishermen Cooperative Society Ltd., a foundation member of the BFCA. The principal objective of the Association is to provide legal and technical assistance, along with training, to its members.

The lobster industry has generated positive revenues and has created a great number of jobs in some parts of the country, yet in the South it has not been able to diminish poverty. Some communities, especially in this southern region, lack the social structure to organize new cooperatives and thus replicate the successful model of industrial organizations in Belize.

Guatemala

As was previously mentioned, lobster fishing activity in Guatemala is minimal. Some traditional fishermen who catch shellfish with nets and other methods also catch a small amount of lobsters. These fishermen, who live mainly in San Francisco del Mar or in the other small towns of Punta de Manabique work in an independent manner, but most of them are affiliated with the Guatemalan and Lago de Izabal Caribbean Fishermen's Network. This network was, until recently, an association of different

groups of fishermen and has over 3,000 members. In the following sections no further information is included on lobster fishing in Guatemala because the industry has not been properly developed largely due to oceanographic conditions in the region combined with the fact that Guatemalan territorial waters (extending 12 miles out from the coast) and its exclusive economic zone (extending 200 miles out from the coast) cover a relatively small area in this coastal region.

ANNEX C

Landings in the Caribbean and Mesoamerican Reef

Average annual lobster production in the Caribbean is some 40,000 metric tons. In the following chart (Figure 13) we see each country's average annual contribution to this total.

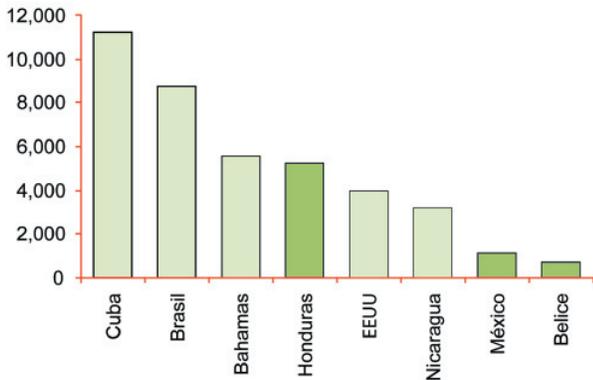


Figure 13: Historical series of lobster tail production in Honduras (Modified from Ehrhardt/OSPESCA, 2004). The official figures may be skewed as there are high percentages of unreported landings.

Honduras is the largest producer of lobster in the Mesoamerican Reef region. Figure 14 represents the historical tendency of lobster landings for this country.

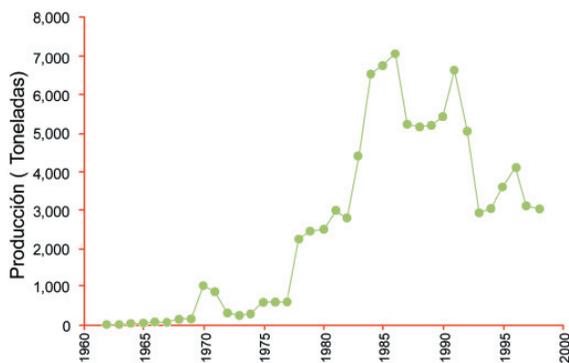


Figure 14: Average annual lobster production for the last ten years for the countries of the Caribbean. The three countries of the Mesoamerican Reef are shaded in blue. They contributed approximately 17% of total production (FAO, 2003).

Mexico is the second-highest producer of lobster in the Mesoamerican Reef region. Figure 15 shows the trend of landings for this country.

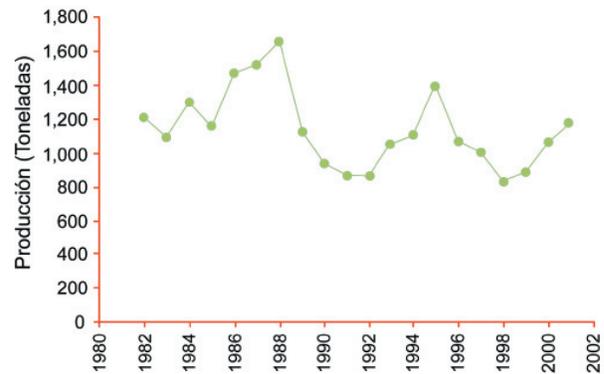


Figure 15: Record of landings in the Mexican Caribbean (only for the state of Quintana Roo). Weight is reported as live catch, equivalent to total weight (FAO, 2003).

In Belize, unlike other countries, the trend in the capture of lobsters shows no sign of weakening. In the last few years landing have stabilized (See Figure 16) at between 700 and 800 tons (whole weight).

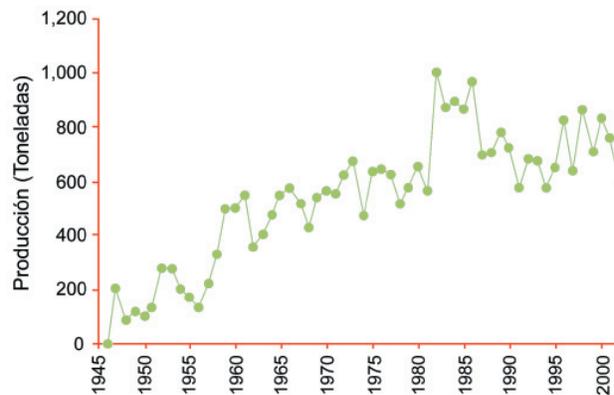


Figure 16: Record of spiny lobster landings in Belize from 1946 to 2002, converted to total weight (FAO, 2003).

ANNEX D

Fishing Regulations

Honduras

Authorities Responsible

- The Government issue licenses for fishing operations, which are permits/quotas to capture lobster

Fishing Operations

- The size of the commercial fishing fleet for lobster is limited to a maximum of 170 fishing vessels.
- The licenses (permit issued per fishing vessel) are issued permanently and are not transferrable and thus, cannot be traded.
- In case of any sale, confiscation or transfer of the vessel within the country, the owner shall not include the fishing license, which shall become null and void and is not replaceable.
- In the case of selling the fishing vessel outside of the country, the owner of the vessel will have the right to keep the license and can only utilize it whenever another vessel is purchased for the fishing activities authorized under the licence.
- It will only be allowed to change the fishing method from diving to the use of lobster traps.
- The lobster trap operations can utilize a maximum of 2,500 lobster traps, maintaining the number of divers at 35. In practice, lobster fishing vessels have an average of between 5,000 and 6,000 traps.

Safety onboard

- There are current agreements that regulate the safety and health aspects of the fishing operations and diving equipments to minimize risks which the fishermen are exposed to. Under these agreements, established standards and obligations are to be observed both by the owners of the fishing operations and the fishermen.

Closed Season

- From 1st April to 30th June

Size Limit

- The minimum size limit for capture is 5.5 inches or 145 mm tail length.

Biological Stage

- The capture of gravid or berried females is prohibited.

Prohibition of fishing methods

- The use of traps constructed of any wire, plastic or any other material which is not made out of lumber is prohibited .
- The use of SCUBA, long-lines and gill nets in the southern zone of the Cayos Cochinos Marine Reserve is prohibited (see management plan). Scuba diving is not allowed within the coastal areas and the marine protected area since the enactment of legislation in 2002 (Satutory Instrument No.005-02, Management Plan, 2004). Scuba diving is also not allowed within the Marine Protected Area. Only free-diving is allowed with the south-east zone.

México

Authorities Responsible

- The Authority issues fishing permits and concessions to Cooperatives that have traditionally been involved in lobster fishery activities. In recent years, no more permits have been issued and only provisional permits have been renewed. In general, since the permits only allow fishing fleets, and not individual fishermen to operate, it is possible that fishermen who are not members of an organized group may utilize fishing boats which are the property of the fishing cooperatives.

Closed Season

- From 1st March to 30th June

Size Limit

- The minimum size limit for capture is 135 mm abdominal length, 746 mm cephalothórax and 233 mm of total length.

Biological Stage

- The capture of gravid or berried females is prohibited.

No Fishing Zones

- The Management Plans of the Marine Protected Areas can include “no fishing zones” within the MPA zoning plan.

Belize

Authorities Responsible

- The Government is responsible for issuing licenses/quotas to the fishermen.

Closed Season

- From 15th February to 14th June.

Size Limit

- Minimum carapace length of 7.6 cm (3 inches)
- Minimum tail weight of 112 grams (4 ounces).

Biological Stage

- The capture of gravid or berried females is prohibited.
- The capture of soft shelled or molting lobsters is prohibited to.

No Fishing Zones

- Establishment of no fishing zones for lobster in Marine Protected Areas is permitted.

Prohibition of fishing methods

- The use of SCUBA is strictly prohibited for any commercial fishing operation.
- The use of traps or nets within coral reefs is prohibited.

In Table 6 below, a) Closed Seasons and b) other regulations in the three countries are described

Country	From	To	Duration
Belize	15 th February	14 th June	(19 weeks & 2 days)
Mexico	1 st March	30 th June	(17 weeks & 2 days)
Honduras	1 st April	30 th June	(10 weeks & 2 days)



Table 6: a) Comparison of Closed Seasons in the three countries

ANNEX E

Techniques performance under different criteria

In Table 7, the result of a rapid evaluation of the fishing techniques using four different criterias are presented. Since the number of fishermen within the MBRS eco-region remains unknown, it is estimated

that there are approximately between 14 to 15 thousand fishermen in the region. These fishermen are estimated to be distributed as follows: Honduras 61%, Belize 21% and Mexico 17%.

Fishing Methods	Techniques used under different criterias				Percent of fishermen using this method:			
	Safety for fishermen	Complies with the regulations	Environmentally friendly	Captures live lobsters	Mesoamerican barrier reef	Honduras	Belize	Mexico
Free diving with hookstick in artesanal fleets					55%	41%	93%	23%
Scuba diving in industrial fleets					24%	32%	0%	0%
Lobster traps in industrial fleets					9%	13%	0%	0%
Scuba diving in artesanal fleets					9%	8%	0%	28%
Diving with compressors in artesanal fleets					9%	6%	0%	37%
Use of gill nets in artesanal fleets					4%	0%	0%	36%
Cuban Casitas, Free diving with hookstick in artesanal fleets					3%	0%	3%	30%
Lobster traps in artesanal fleets	✓	✓	✓	✓	2%	2%	3%	11%
Cuban Casitas, Free diving with Jamo in artesanal fleets	✓	✓	✓	✓	1%	0%	0%	16%
Cuban Casitas, Free diving with loop type method in artesanal fleets	✓	✓	✓	✓	< 1%	0%	0%	5%

Scale:



Satisfactory



Moderate



Low

ANNEX F

Safety and proper navigation procedures to avoid damage to environment

- Identifying dark water areas as possible important shallow ecosystems, such as shallow reefs.
- If anchoring, always drop anchors in sand or rubble channels, well away from living reefs and allow sufficient scope to avoid dragging along the bottom.
- Have a mechanic perform regular servicing of engines, fuel tanks and associated components, to maximize operating capacity and minimize fuel consumption. Use clean-burning four-stroke engines whenever possible.
- Report your departure to authorities or the cooperative leaders before you leave the port. Keep open communication with land-based stations.
- Carrying a supply of basic tools for engine repairs out at sea.
- Always carrying both a primary and secondary anchor line so that vessel can be securely moored in emergency situation.
- Keep toxic-absorbent sponges in bilges. These sponges can significantly reduce and/or eliminate discharge of oils and fuels.
- Using nontoxic oils wherever possible. Wait until you get to a marina to dispose of any waste oil.
- Refuel only at a dock or in the marina. If you fill up at sea you could spill fuel into the water.
- When applicable, use nontoxic antifouling paints on boat hulls. International laws are beginning to ban commonly used antifouling paints. These paints are known to contain biocides and heavy metals that can negatively affect both human health and the marine environment. Less harmful antifouling paints are now commercially available, including paints that are made from biodegradable substances and are significantly less toxic than past products.
- Use biodegradable cleaning agents. Several commercial nontoxic bio degradable cleaning agents are now available that reduce the amount of toxic pollutants and chemicals that boats release into the environment.
- Avoid pumping oily bilge water or other hazardous substances into the sea. Unless the boat is in danger, wait to pump out oily bilge water, particularly when you are near a coral reef.
- Keep garbage contained and minimize use of plastics and Styrofoam. Enclose garbage bins on tour boats, or keep them inside, to minimize the chance of debris blowing overboard. Pick up damaged fishing nets or lines cut away from propellers. Leaving fishing nets or lines in the sea could harm marine wildlife.



ANNEX G

Depth and Marine Distance Tables

Conversion: from feet to meters

Feet	Meters	Feet	Meters
1	0.3	25	7.6
2	0.6	26	7.9
3	0.9	27	8.2
4	1.2	28	8.5
5	1.5	29	8.8
6	1.8	30	9.1
7	2.1	31	9.4
8	2.4	32	9.8
9	2.7	33	10.1
10	3.0	34	10.4
11	3.4	35	10.7
12	3.7	36	11.0
13	4.0	37	11.3
14	4.3	38	11.6
15	4.6	39	11.9
16	4.9	40	12.2
17	5.2	45	13.7
18	5.5	50	15.2
19	5.8	55	16.8
20	6.1	60	18.3
21	6.4	65	19.8
22	6.7	70	21.3
23	7.0	75	22.9
24	7.3	80	24.4

Conversion: from fathoms to meters

Fathoms	Meters	Fathoms	Meters
1	1.9	21	38.9
2	3.7	22	40.8
3	5.6	23	42.6
4	7.4	24	44.5
5	9.3	25	46.3
6	11.1	26	48.2
7	13.0	27	50.0
8	14.8	28	51.9
9	16.7	29	53.7
10	18.5	30	55.6
11	20.4	31	57.4
12	22.2	32	59.3
13	24.1	33	61.1
14	25.9	34	63.0
15	27.8	35	64.9
16	29.6	36	66.7
17	31.5	37	68.6
18	33.4	38	70.4
19	35.2	39	72.3
20	37.1	40	74.1

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