Promote improved lobster fisheries management, environmental compliance and conserve marine biodiversity in the MAR Ecoregion in Support of ECA under CAFTA – DR




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COVER:

Ecosytem based monitoring and assessment in Cayos Miskitos, Nicaragua, and Half Moon Keys, Honduras. Clockwise, from left: inventory of invertebrates in *Montastraea* coral; Spiny lobster (*Panulirus argus);* dead coral; and coral species *Millepora complanata* and *Acropora palmate.*

WWF is pleased to present its first annual report for the project **Promote improved lobster fisheries management, environmental compliance and conserve marine biodiversity in the MAR Eco-region in Support of ECA under CAFTA – DR,** covering the period of July 1, 2008 – October 31, 2009.

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CONTENTS

LIST OF ACRONYMS

ANEPMAR	Asociación de Empresas Procesadoras de Maricos
APESCA	Asociación de Pescadores del Caribe
APESCO	Areas of ecological interest on fiheries
BFPs	Better Fishing Practices
BMPs	Best Management Practices
CAF	Central American Fisheries Sea food
CAFTA-DR	Central American and Dominican Republic Free Trade Agreement
CAPENIC	Camara de la Pesca de Nicaragua
CCAW	USAID Conservation of Central American Watersheds Program
DIGEPESCA	Direccion General de Pesca y Acuicultura, Honduras
EBFM	Ecosystem Based Fisheries Management
INPESCA	Instituto Nacional de Pesca, Nicaragua
MARENA	Ministerio de Recursos Naturales de Nicaragua
NGO	Non-governmental Organization
OSPESCA	Organización Centroamericana del Sector Pesquero y Acuicola
PASENIC	Pacific Seafood
SERNA	Secretaria de Recursos Naturales de Honduras
USAID	United States Agency for International Development
WWF	World Wildlife Fund

INTRODUCTION

Lobster fisheries are one of the most important natural resources within the Mesoamerican Reef ecoregion (MAR), which extends along the Caribbean coasts of Mexico, Belize, Guatemala, and Honduras, as they form the basis for the primary export fishery in the MAR. The vast majority of lobster exports from the region are destined for the United States, which accounts for almost 90% of the market. The fishery, however, is seriously overexploited and catches have been decreasing in recent years (by up to 25%). Coupled with a decrease in lobster purchase prices (from $19/lb. in 2008 to $12/lb. in January 2009), this reduced catch has been devastating to the local people that depend on fishing as a primary source of income. The fishery is also detrimental to the health of the local fishermen. Within this context, the declining lobster stocks, reduced catches, health issues and the global economic crisis are of concern to the fishing industry, the U.S. importers, conservationists and fishermen alike.

The Central American Free Trade Agreement (CAFTA), and in particular, its Environmental Cooperative Agreement, includes obligations to provide for environmental protection and promote effective enforcement of environmental laws and biodiversity conservation. This USAID-funded WWF initiative is aligned with the CAFTA process in that it seeks to improve the sustainability of commercial fisheries through more comprehensive management approaches and better implementation of fisheries laws and regulations.

The long-term goal of this initiative is to transition the lobster fishery in Honduras and Nicaragua away from the unsustainable practices and overcapacity of the fleet that have led to the decimation of the lobster stocks over the past 20 years, and toward a set of practices and level of fishing effort that will allow the lobster stocks to recover over time while allowing fishermen to continue to earn their livelihoods from the fishery. It will, in effect, promote environmental compliance, improve fisheries management, and conserve marine biodiversity and ecosystem services, through an ecosystem-based approach.

OVERVIEW OF PROGRESS

WWF has made substantial progress over the period of July 1st 2008– October 31, 2009, transitioning from initial activities related to staffing and planning to full implementation of project activities in the field. .The project kicked off with a strategy meeting in July 2008 in Roatan, Honduras. Sylvia Marin and Carlos Morales from WWF-CARO joined project members Alicia Medina, Alvaro Hernandez, and Pablo Rico as well as Gina DeFerrari from WWF-US and George Williams, WWF Fellow, to develop a work plan for the project. They also met with a Board member of APESCA, Steven Guillen, and secured a commitment from the organization to collaborate on this project.

The team also worked to establish solid relationships with the main stakeholders. It is important to mention that the foundation of this project is the work that WWF has been doing with lobster fisheries in Belize and Honduras over the past three years. Bringing experienced staff onboard for this project has allowed WWF to build on these efforts, expanding opportunities for collaboration with other organizations. The involvement of priority stakeholders such as INPESCA, APESCA, DIGEPESCA and CAPENIC in implementation has been critical in achieving the project’s objectives.

Significant advances have been made in identifying critical lobster habitat in the Moskitia coast in Honduras and Nicaragua. A scientific expedition to assess important ecological areas for spiny-lobster and fishery management, carried out by Guadalajara University and experts from the Fisheries Departments of Honduras and Nicaragua, is a milestone for the region. Additionally, the launch of on onboard observers' program in both Honduras and Nicaragua is a key first step in completing a stock assessment and measuring the level of fishing effort happening in these two fisheries. This information will undoubtedly be useful in further efforts to reduce the overexploitation of lobster in the region.

WWF has also dedicated significant effort to promoting the EBFM approach with government authorities and OSPESCA. Along with these more localized efforts, marketing studies to inform a strategy for approaching the private sector were completed, and a business model describing the APESCA case was pulled together to promote similar public private alliances in other regions. A more detailed description of these topics and other achievements are included in this document.

Key accomplishments achieved over the past year include:

- Staffing up of the project, including a Regional Coordinator (Bessy Aspra) for the project as well as a National Coordinator for Nicaragua, Bayardo Canales;
- Briefing key stakeholders about the project;
- Completion of desk studies to help in identifying the key habitats that need to be protected, resulting in two preliminary maps indicating critical lobster habitat areas;
- Formulation of a list of Best Fishing Practices (BFP's) for circulation among lobster buyers; BFPs were printed on posters and flyers and distributed among lobster producers, boat owners, fishers and restaurants in Honduras and Nicaragua;
- Promoting the socialization and discussion of the final version of the proposed Honduran Fishing Law;
- Influencing OSPESCA's approval of a Regional Regulation for Lobster Fisheries, which resulted in a decision to call off for the lobster trap experiment with a private owned research vessel;
- Active participation in the work group for the Whole System in the Room meeting for the Spiny Lobster Initiative within the G-FISH Alliance;
- Securing catch data from processing plants, which is crucial for carrying out stock assessments and establishing catch quotas in Honduras and Nicaragua;
- Launch of a Scientific Observers Program in Honduras with the support of the fishing industry, and training observers in Nicaragua with government and industry support;
- Carrying out a joint monitoring and educational trip on Ecosystem Based Fisheries Management to the Miskito Keys in Nicaragua and Cayos Media Luna (Half Moon Keys) in Honduras with Renaldi Barnutti, of INAPESCA;
- Completion of an integrated desktop study for Lobster fishery in the MAR eco-region;
- Conducting a survey of alternative livelihoods in coastal Honduras.

DETAILED NARRATIVE REVIEW OF PROGRESS

This section provides a detailed description of the progress achieved by WWF over this past year of the project´s implementation. The overall objective of this project is to promote environmental compliance, improve fisheries management, and conserve marine biodiversity and ecosystem services in Honduras and Nicaragua. We will accomplish this goal by employing the following strategies:

1. Promote ecosystem – based fisheries management;
2. Promote voluntary adoption of lobster "better fisheries practices"
3. Strengthen enforcement of current regulations;
4. Support the establishment of effective fisheries quotas by governments of Honduras and Nicaragua;
5. Build demand for responsibly and sustainably-caught lobster in local and international markets.

The description of work to date is broken down by sub-objective in relation to proposed activities in the project's FY09-10 Work Plan

Key Objective 1: Ecosystem-based Fisheries Management

An ecosystem-based approach to lobster fisheries management, involving zoning to protect nursery areas and brood stock and a complementary zoning scheme to ensure that fishing methods and gear types (e.g. free diving, traps) are compatible with the habitat in which they are conducted, is critical for the long-term health of the stock. The initial step in implementing EBFM at any site is to identify the key areas that need protecting. At the same time, it is critical to secure buy-in to the EBFM approach from key policymakers in order to ensure that these areas, once identified, will be protected. In working towards these goals, WWF has completed work along the following lines:

Sub-Objective #1: Identify critical habitats for lobster that need to be protected if the stocks are to recover.

We have made significant progress over the course of the year towards meeting this sub-objective, gathering data through desk studies and ground-truthing in the field in order to identify and map the most important lobster habitat areas in Honduras and Nicaragua.

Map of critical habitats for adult lobster (lobster fishing grounds): We have made a first cut at identifying critical adult lobster habitat in the Moskitia zone of northwestern Nicaragua and southwestern Honduras (Fig. 1). Though this initial map is only preliminary, it includes important information gathered through direct interviews with fishermen. The map will be refined further pending an experts' workshop during which we will validate the data and rectify potential errors. Project maps will be printed at a scale of 1:1,000,000, though the actual resolution will be higher (perhaps 1:250,000), which will allow us to print derived maps in a higher resolution of different areas of the Moskitia coast. This first cut of critical habitats for lobster conservation is important not only because it helps us to more accurately prioritize our efforts to protect important habitat areas, but also because it can be used as a communications tool with political leaders in both Honduras and Nicaragua to illustrate the importance of managing lobster stocks with a coordinated, bi-national approach.

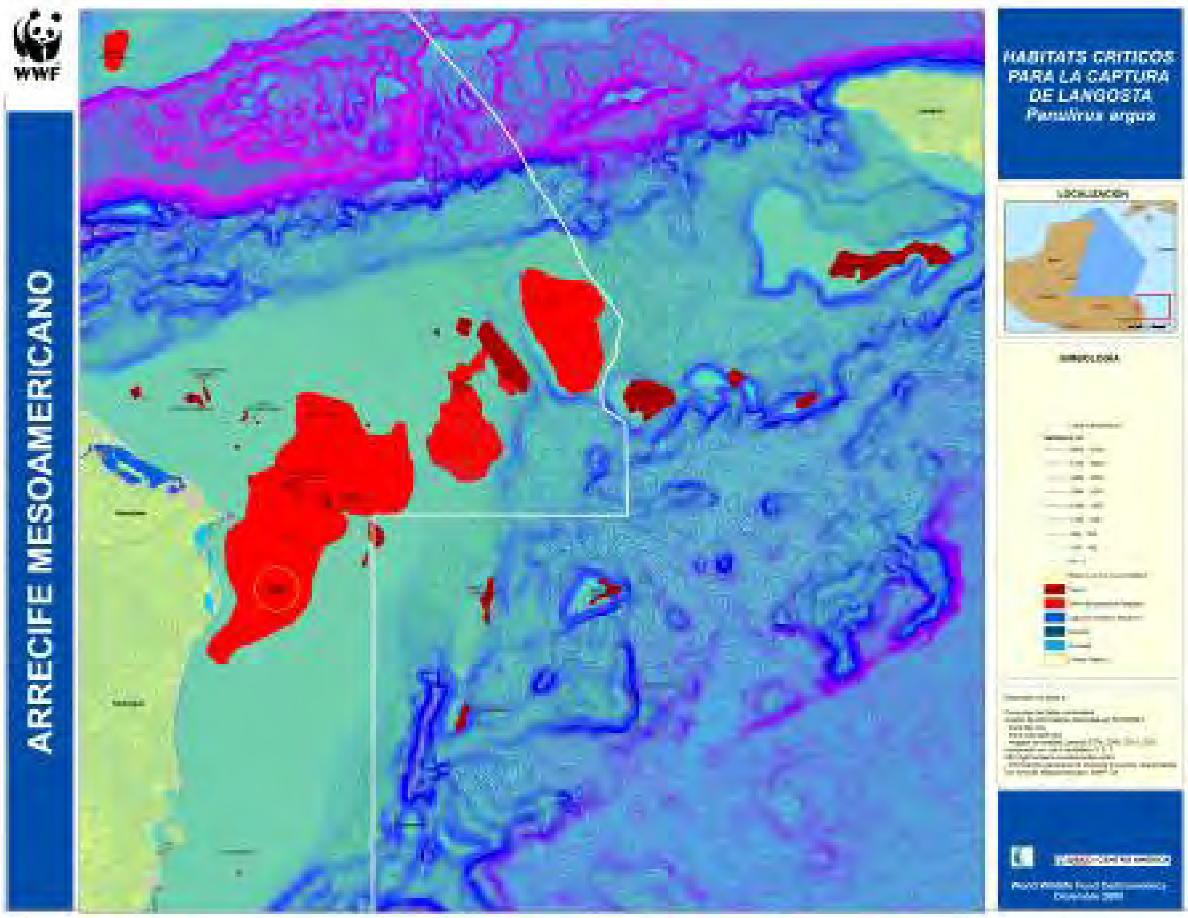


Figure 1. Adult lobster critical habitats and lobster fishing grounds in the Moskitia Zone (Honduras and Nicaragua). (See Annex 3.1 for a high-resolution version).

Map of critical habitats for post-larval and juvenile lobster: This second map was produced at a regional scale, and encompasses a broader area than the first. The map identifies seven zones with critical habitats for post-larval and juvenile lobster, presumably sea-grass beds, mangroves and coral reefs. Each of these zones are presented in frames that show land and coastal/marine characteristics of the ecosystem, including cays and islands, estuaries and coastal lagoons, mangrove forests, wetlands, sea-grass beds, coral reefs.

In September 2009, WWF organized a trip to the field in order to ground-truth the results of our initial analyses. We are now in the process of using this data to update these maps, and more information about this field exercise can be found under "Sub-objective 3" below. EBFM monitoring and training trip for Nicaragua government officials and scientist Fabian Rodriguez from the University of Guadalajara and Pablo Rico from WWF gathered during the last week of September and first week of October.

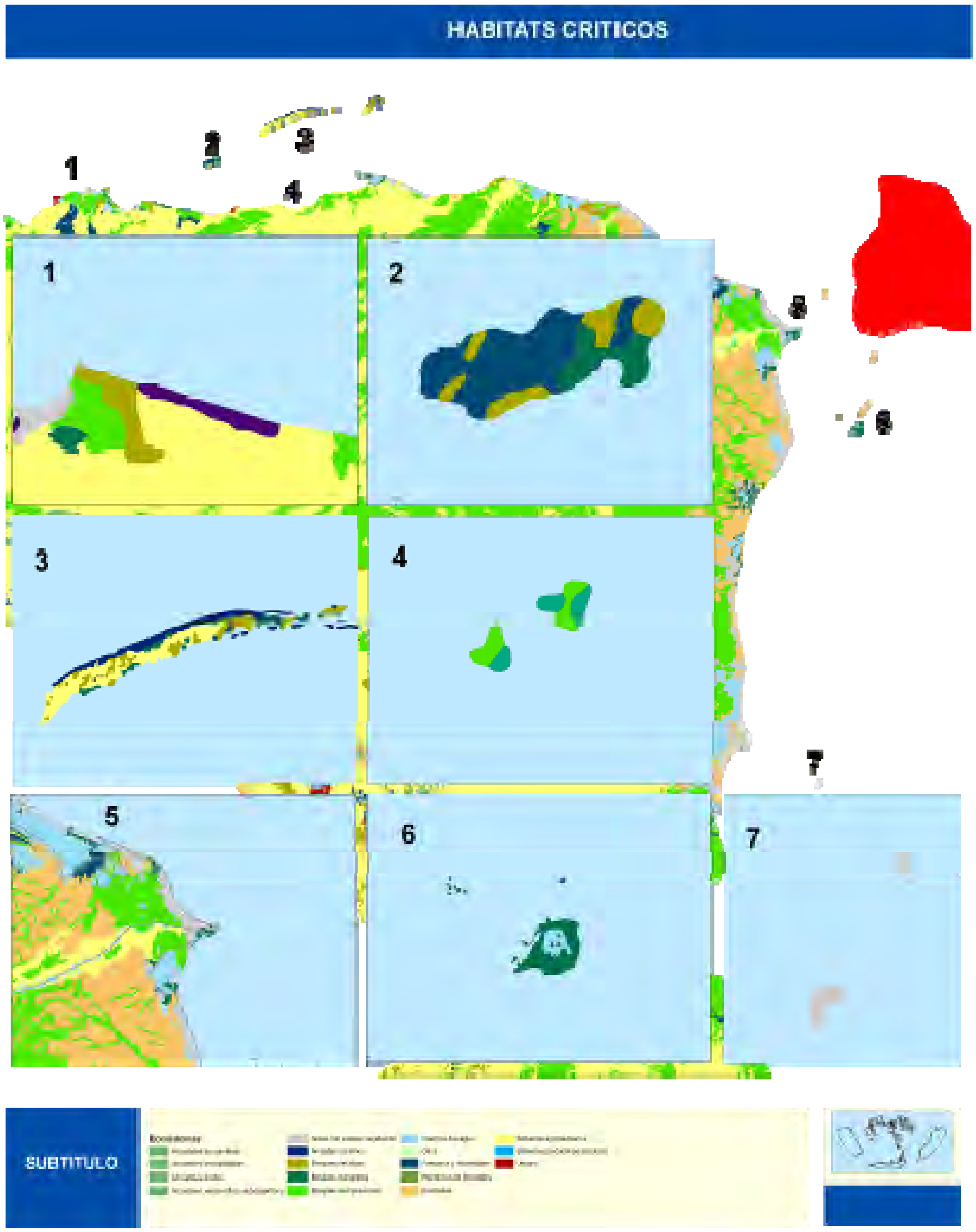


Figure 2. Post-larval and juvenile lobster critical habitats. (See Annex 3.2 for a high resolution version).

WWF is currently working with a GIS specialist to refine this map, principally focusing on improving the data on sea-grass habitats in areas up to 10 meters deep. Additional information such as reef geomorphology, cays and banks visible on images of the continental shelf and the historical dynamics of tropical ecosystems such as mangroves have also been collected and analyzed.

With this spatial information in hand, the project´s coordinator held a meeting in Managua, Nicaragua with MARENA officials to discuss the possibilities for increasing the number of hectares on the Atlantic Coast under protection within the National System of Protected Areas (NSPA). The government of Nicaragua is currently working on an update of the protected areas map and the opportunity to include nursery and brood stock areas for lobster conservation is high.

Similarly, the Honduran government is in the process of conducting a gap analysis with support from The Nature Conservancy, aimed at identifying conservation gaps in marine ecosystems. As part of the results, lobster fishery grounds and nursery areas identified as part of this analysis with great potential of entering in the legal process to be included in the National System of Protected Areas (SINAPH).

To take advantage of these opportunities to influence the coverage of protected areas in both countries, WWF will hold a workshop for regional and international experts in order to validate the data and rectify potential errors in the lobster fishing grounds in the Moskitia zone. With the final information refined the proposal to protect additional critical areas will be presented to the Nicaragua and Honduras governments, using the mechanisms described above.

Photo1and 2: Critical Lobster Habitat meeting with MARENA officials on May 18, 2009 in Managua Liliana Diaz from SINAP and Ricardo Montoya -Biodiversity and WWF Team: Bessy Aspra and Bayardo Canales. EBFM cruise to Miskito Keys in Nicaragua in Sept 2009.

As agreed during the initial stages of development of this initiative, this project's field team has worked in close coordination with the "Conservation of Central America Critical Watersheds Project (CCCAW)", funded by USAID and operated by Chemonics International and WWF. As a result, critical habitats for lobster conservation in Belize have also been identified using a similar methodology to that of this project, and results were subsequently discussed and validated in an experts' workshop (see map in Fig. 3/Appendix XX, etc). This effort has the full support of the Belizean Fisheries Department. This case illustrates the advantages and strategic importance of working with a regional partner such as WWF that has the ability to coordinate efforts across a large scale, ultimately resulting in better-informed lobster management and conservation efforts in all three countries.

Figure 3. Belize critical habitats for lobster conservation, identification of areas for reproduction and nursery. Complementary maps in Annex 1.

Ecological Monitoring and Assessment
An Ecological Monitoring and Assessment was carried out during the last week of September and first of October, the expedition to areas of ecological interest to ground-trotting the information on Critical Habitats for spiny-lobster fishery. It seeks to identify the most vulnerable areas or sites recognized as critical habitats used to harvest lobsters, in order to classify them as key areas for protection and develop a zoning scheme.

Two sites were prioritized, according to their importance. In the case of Nicaragua, the most appropriate site was considered to be Cayos Miskitos, as previously agreed on with fishing authorities (INPESCA), and its coordinates were ascertained in situ. In Honduras, the Arrecife Media Luna was chosen, due to fishermen's reports that it contains nursery grounds for this species.

Undertaking this expedition required a series of actions to ensure the research permits required by each of the countries and to secure the transportation, equipment and materials needed for this research. This was accomplished in coordination with each country's authorities, DIGEPESCA (Honduras) and INPESCA (Nicaragua). Concurrently, a cooperation agreement was executed with the Guadalajara University in Mexico, with the aim of performing joint monitoring. Subsequently, Dr. Fabián Rodríguez performed a technical-scientific analysis. He has a PhD degree in Marine Science and ample experience in the field of ecosystem monitoring, and he is the head of the Ecology Department at the Guadalajara University. His scientific staff assisted him with this analysis and WWF personnel provided their support. This research was performed from September 28 to October 10 in the Honduran-flag ship Bobby Junior II, owned by Bob McNab, a fishing entrepreneur.

Methodology

In order to obtain more ecological information on the areas where the spiny lobster lives, minimum sampling had to be performed in two sites or critical habitats (CH) that were previously identified as APESCO (Spanish acronym for Fishing Areas of Interest for Conservation). They were distributed as follows: APESCO 1: Nicaragua's Cayos Miskitos fishing area, and APESCO 2: Arrecifes Media Luna. The sampling unit is a transect 50-meters long. Total sampling included 66 transects (30 in APESCO 1 and 36 in APESCO 2).

Figure 4: General representation of APESCOS IN Honduras and Nicaragua. (Digitalized by PRico)

The scientific staff consisted of four participants from Mexico: Dr. Fabian Rodriguez, Dr. Amilcar Cupul Magaña, Rosario and Daniel Goard; adeep-sea diving instructor, Italo Bonilla, from Honduras; one representative from WWF-CARO, Pablo Rico; andtwo representatives from INPESCA who acted as observers for sampling in Nicaragua (including Renaldi Barnuti).

The team traveled to the sampling sites in the Bobby Jr. II, a 73-foot long recreational aluminum yacht, with two engines and an average speed of 12 knots. Once the technical-scientific team and the INPESCA personnel reached the APESCOS, they discussed the exact coordinates for each sampling site and provided them to the Captain, in order to define the proper navigation routes. When they arrived at each site, all diving equipment was prepared: tanks, materials, video cameras, etc.

1. The first diver laid a 50-meter transect and simultaneously took a census of adult fish, to determine both their abundances and their sizes in a transect measuring 50 meters long and 2 meters wide.
2. The second diver video-recorded the 50-meter transect at 40 centimeters from the bottom of the sea and picked up the tape.

3. The third diver recorded topographic complexity by placing a 10-meter long chain that followed the shape of the sea-bottom, later measuring the linear distance from the beginning to the end. Then he recorded key invertebrates in a band transect measuring 20 meters long and 5 meters wide.

After concluding each dive, GPS points and parameters were recorded with a YSI probe, aiming to measure dissolved O2, temperature, salinity, etc.

This operation was performed after each dive, three times a day: nine per APESCO. At the end of the day, the information gathered was entered into the Excel database, the videos were reviewed (MTS HD format and MiniDV tapes), and the GPS coordinates for the next sampling point were reviewed.

All this information was stored in previously-established electronic sheets that will later be analyzed statistically to determine abundance, biomass, density-biomass relation, specific wealth and diversity of fish, trophic structure, fish assemblages and determination of critical habitats.

Preliminary Results
Following are the results obtained from both APESCOs:

APESCO: Cayos Miskitos, Nicaragua

Name of Site	Date	Coordinates		Depth (m)	Transects
London Reef	1/10/09	14°22.600´N	82°42.308´W	3	5
Lamarka	4/10/09	14°17.285´N	82°51.507´W	3	5
Porgee Reef	4/10/09	14°26.237´N	82°39.458´W	3	5
Nee Reef	4/10/09	14°32.602´N	82°34.384´W	3	5
Martínez Reef	5/10/09	14°38.129´N	82°38.986´W	3	5
Muerto Cay	5/10/09	14°32.351´N	82°46.195´W	3	5

In this APESCO it was possible to observe that these are very shallow sites that are no more than 3 meters in depth, with a topography that is very similar to all sampling sites and thus, in all the APESCO.

Figure 5: APESCO 1 (Nicaragua) localization of the six trails sampled (Digitalized by Pablo Rico)

London Reef

The species of adult fish included in the census at this site were:

1. *Ocyurus chrysurus*
2. *Sparisoma viride*
3. *Abudefduf saxatilis*
4. *Anisotremus virginicus*
5. *Lachnolaimus maximus*
6. *Microspathodon chrysurus*
7. *Acanthurus bahianus*
8. *Lutjanus jocu*
9. *Caranx latus*
10. *Sparisoma aurofrenatum*
11. *Halichoeres bivittatus*
12. *Thalassoma bifasciatum*
13. *Ginglymostoma cirratum*
14. *Stegastes diencaeus*
15. *Sparisoma chrysopterum*
16. *Sparisoma viride*
17. *Sparisoma rubripinne*
18. *Hypoplectrus unicolor*
19. *Acanthurus chirurgus*
20. *Haemulon sciurus*
21. *Haemulon plumierii*
22. *Lutjanus apodus*
23. *Pomacanthus arcuatus*
24. *Scarus taeniopterus*
25. *Sphyraena barracuda*

The most abundant were the *Ocyurus chrysurus* (Yellow Tail), *Sparisoma rubripinne* (Yello Tail Parrot Fish), *Sparisoma viride* (Stoplight Parrot Fish).
The average topographic complexity was P= 0.2586
Key invertebrates identified were: Lobster (*Panulirus argus*), sea urchin (*Tripneustes esculentus*), long-spined sea urchin (*Diadema antillarum*) and *Echinometra sp;* the two latter species were the most abundant.
Comments: Site with abundant dead corals, especially *Acroporas,* and few fishes.

Name of APESCO: Arrecife Media Luna, Honduras

Name of Site	Date	Coordinates		Depth (m)	Transects
Arrecife Media Luna 1	7/10/09	15°13.183´N	82°42.577´W	4	6
Arrecife Media Luna 2	7/10/09	15°13.793´N	82°42.378´W	4	6
Arrecife Media Luna 3	7/10/09	15°15.455´N	82°39.974´W	4	6
Arrecife Media Luna 4	8/10/09	15°15.677´N	82°38.324´W	5	6
Arrecife Media Luna 5	8/10/09	15°14.157´N	82°36.481´W	6	6
Arrecife Media Luna 6	8/10/09	15°12.413´N	82°34.427´W	5	6

APESCO 2 was sub-divided into 6 sites due to its large size. Sites at the exterior fringe of the reef were chosen, seeking to find increased representativeness. As is the case with APESCO 1, this is a rather shallow area with an average depth of 4 meters.

Figure 6: APESCO 1 (Nicaragua) with its 6 sampling sites (Digitalized by Pablo Rico)

Arrecife Media Luna 1

1. *Stegastes planifrons*
2. *Haemulon plumierii*
3. *Ocyurus chrysurus*
4. *Scarus iserti*
5. *Hypoplectrus puella*

6. *Chaetodon capistratus*
7. *Thalassoma bifasciatum*
8. *Halichoeres bivittatus*
9. *Hypoplectrus guttavarius*
10. *Pomacanthus arcuatus*
11. *Stegastes leucostictus*
12. *Hypoplectrus unicolor*
13. *Stegastes partitus*
14. *Sparisoma aurofrenatum*
15. *Lutjanus jocu*
16. *Kiphosus sectator*
17. *Diodon holocanthus*
18. *Sparisoma atromarium*
19. *Abudefduf saxatilis*
20. *Sparisoma viride*
21. *Synodus intermedius*
22. *Stegastes diencaeus*
23. *Stegastes adustus*
24. *Scarus vetula*
25. *Halichoeres garnoti*
26. *Hypoplectrus aberrans*
27. *Anisotremus virginicus*
28. *Scarus coelestinus*
29. *Haemulon flavolineatum*
30. *Sparisoma rubripinne*
31. *Halichoeres radiatus*
32. *Carangoides ruber*
33. *Lactophrys triqueter*
34. *Scarus guacamaia*
35. *Haemulon sciurus*
36. *Synodus foetens*

The most abundant fish species were: *Stegastes planifrons, Ocyurus chrysurus, Scarus iserti*.
The average topographic complexity was P= 0.232
Key invertebrates identified were: Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp*; the latter was the most abundant. The detailed preliminary report of the expedition is included in Annex 2.

Preliminary Conclusions

- This report shows the overall results from the study of the two APESCOs. They include data on the abundance and on species identification, the corresponding statistical analyses on abundance, biomass, density-biomass relation, specific resources, diversity of species, trophic structure, fish assemblages, and lastly, the determination that they are critical habitats, a fact that will be established after analyzing the video transects and the application of the various statistical packages in the laboratory.

- It was observed that both APESCOS have some similar characteristics, such as depth, but that there are differences in their structures and shapes. Thus, we can assert that these are sites that have been severely impacted by fishing and by some environmental phenomena, especially in APESCO 1 in Nicaragua, where there is less abundance of fish if compared with APESCO 2 in Honduras.

- Similarly, it was possible to observe that both APESCOs are appropriate sites for juvenile or sub-adult lobster aggregations, given the characteristics of these reef patches surrounded by lagoons, sand and sea grasses, which create an adequate habitat for lobsters at some point of their developmental stages.

- It is important to consider these two APESCOs as sites that should be protected, given their ecological importance and their high degradation indices, especially in APESCO 1 in Nicaragua, which is severely impacted. Even before concluding the statistical analyses, it can be asserted that both APESCOs are critical habitats for lobster conservation. Additionally, the Vivorillos area in Honduras –which was not monitored but has characteristics that are similar to those of the APESCOs that were studied– should also be considered as a critical habitat.

Sub objective 2. Develop a zoning scheme, including "better fishing practices" (BFP´s) a small number of specific areas with threats identified and appropriate fishing gear for specified zones

We already have the field information of two important sites for nursery and juvenile areas in the Miskito Cays in Nicaragua and Media Luna Keys in Honduras to develop a zoning scheme proposal jointly with both countries authorities, industrial and artisanal fishermen. Small areas such as London Reef, Lamarka, Porgee Reef, Nee Reef, Martínez Reef, Muerto Cay in Nicaragua and six sites in Media Luna Keys in Honduras will be analyzed by Scientist Fabian Rodriguez from the University of Guadalajara and WWF Staff Pablo Rico with the information collected from the video transects during the Ecological Monitoring and Assessment and from the information collected from the officials in Nicaragua during the trip.

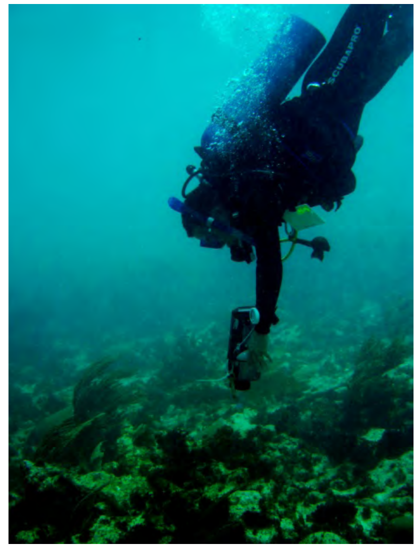


***Photo3**: Renaldi Barnutty from INPESCA, Fabian Rodriguez, Amilcar Cupul, Rosario Prego fron U of Guadalajara and Pablo Rico from WWF prioritizing the monitoring sites during the expedition to the Miskito Keys in Nicaragua and Media Luna keys in Honduras. **Photo 4**: Pablo Rico during a video transect filming.*

Sub-objective #3: Promote adoption of elements of an ecosystem-based approach 9EBFM) to lobster management (specifically zoning) by the Honduran and Nicaraguan Governments.

A workshop was held in Managua with INPESCA and MARENA authorities with support from Dr. Fabian Rodriguez of University of Guadalajara, on September 29 2009. A total of 20 people participated in this event. The objective of the activity was oriented to train the Nicaraguan officials on Ecosystem Based Fisheries Management for Lobster Fisheries.

***Photos 5 and 6**: INPESCA and MARENA Authorities and Staff during the EBFM Workshop in Managua.*

EBFM Workshop with OSPESCA

Framed in the OSPESCA and WWF Memorandum of Understanding and within the Project for Interdisciplinary Research for Responsible Fisheries in the Central American Countries (FIINPESCA) project a Regional Workshop on an Ecosystem Based Approach on Fisheries was held in San Salvador during the second week of September; governmental authorities, fisheries administration´s technicians, regional experts from FAO and University Students and Scientists from Central America participated in this event. In a follow-up of the lines proposed by the Code of Conduct for Responsible Fisheries and Integration Policy, Fisheries and Aquaculture, in order to strengthen national offices technically fisheries management to identify solutions that
The purpose of this workshop was oriented to use and promote the ecosystem based fisheries management (EBFM) amongst the central american managers scientists, and decision makers to take into account the biological, economic and social factors that must be explicitly considered under this concept in order to move towards a more holistic concept in fisheries management than the traditional one single species approach.

Gabriela Bianchi, Oficial Superior de Recursos Pesqueros de FAO (Roma); Doris Soto, Oficial Superior de Acuicultura FAO (Roma); Claudia Beltrán and Renato Guevara, International Experts, illustrated the participants with the principles and practices of the theory of Ecosystem Approach to Fisheries (EAF) as is understood under the FAO code.

Eloy Sosa, ECOSUR scientist and WWF consultant and Bessy Aspra, fisheries manager of WWF CARO, shared with the participants the experience we have gathered during the past years in implementing the EBFM on lobster and the Ecological Monitoring.

During the workshop the need to standardize the methodology for collecting and analyzing the necessary information for implementing the ecosystem approach, through a prioritized list of actions and recommendations to national and regional level was raised amongst participants. Also the status of national and regional implementation of EAF, the potential obstacles and solutions, and the use of specific software to work the ecosystem approach to fisheries (Ecopath and ECOSIM) was used as part of the workshop methodology.

***Photo6**: Regional Authorities and International Experts during the EBFM in San Salvador*

***Photo 7**:Participants in the EBFM workshop*

Key Objective 2: Promote Voluntary adoption of lobster "better fisheries practices" (BFPs) in at least 50% of the industrial fleet in Honduras and Nicaragua and 25-30% of the artisanal fleet using wooden traps.

WWF Program Director, Carlos Morales and Bessy Aspra met in San Salvador with OSPESCA officials Mario Gonzalez, Sergio Martinez and Manuel Perez on July 20, 2009 and agreed upon continue working under the MOU signed between the two organizations and coordinate the actions around lobster issues through the Ecosystem –based fisheries management.

Photo8: Carlos Morales and Fisheries Manager Bessy Aspra met in San Salvador with OSPESCA officials Mario Gonzalez, Sergio Martinez and Manuel Perez on July 20, 2009.
http://www.sica.int/busqueda/Noticias.aspx?IDItem=38554&IDCat=3&IdEnt=47

Sub-objective #1: Demonstrate effectiveness of modified traps

Considering WWF had been working with the Industrial Fishermen's Association of Honduras (APESCA) to promote the use of "environmentally-friendly traps" with an expanded opening of $2^{1/8}$, similar to the one used in Nicaragua which allows juvenile lobsters to escape, and taking into account that further research was required by the Honduran government to refine the trap design and prove scientifically its use and better performance than the $2^{1/4}$ and afterwards DIGEPESCA were going to changing it in the Honduran Fishing Law.

However, the legal regional context for lobster fisheries management has changed from a Memorandum of Understanding to a Regional Lobster Regulation within the Central American Fisheries and Aquaculture Regional Organization –OSPESCA- which is totally binding with the SICA Secretariat; therefore, since the minister for Agriculture has signed on may the lobster regulation then modification of the actual used trap in Honduras is already done trough this regulation.

Therefore, considering this scenario, Bessy Aspra from WWF-CARO in coordination with USAID officer Dr. Barbara Best decided to propose to the Honduras government to discontinue the ¨friendly trap experiment¨. Under these circumstances, the project´s director had a meeting on june 9 2009 with DIGEPESCA director Gabriela Pineda and the OSPESCA representative Sergio Martínez to clarify the situation with the new regulation and it was agreed not to continue with that activity and it is expected that for the 2009-2010 fishing season all the traps will be required by law as modified traps.

Due to the above mentioned, this experiment has been disregarded under the present regulatory legal frame in OSPESCA where Honduras and Nicaragua are binding to the Lobster Regulation.

This Regulatory Frame is indeed a huge step to walk towards more sustainable practices in the Lobster Fishery in Central America and WWF have worked closely with OSPESCA to accomplish part of this agreement.

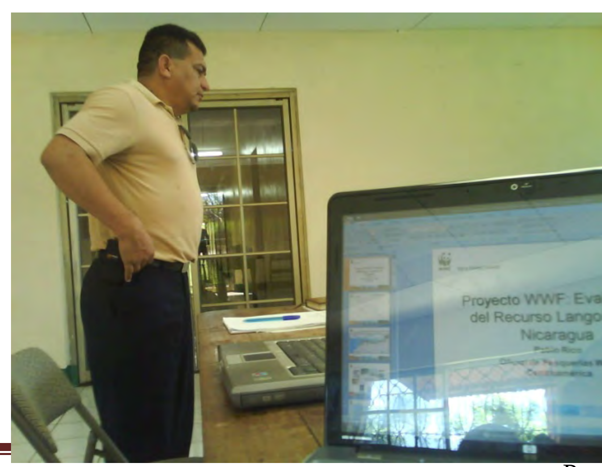
Observers on Board Program

The Program begun in Honduras and Nicaragua with the support of the fishing industry, 2 observers have joined the crew of Lady Alexander and Miss Genesaret

Photo 9: *Boarding of one observer in a lobster Fishing boat in Roatan, Honduras*

Photo 10*: An observer taking Biometric data. in Honduran fishing grounds.*

In Nicaragua more than 15 observers have been trained to carry on the activities in lobster fishing vessels. People from Corn Island showed interest in participating in the program and they were trained. On the other hand, the government throughout INPESCA has a MOU with the University of Bluefields and they have suggested we work with biology students from BICU. The industry CAPENIC, is supporting the program and they will give us the program of the fleet to embark.



***Photos 11/12**: Training potential observers and Biologist Renaladi Barnutty*
In Corn Island training future observers in Corn Island

The Program has successfully send out 4 observers on board the lobster fishing vessels for 2.5 month period from july 11 to September 27 to gather information on this fishing season (2009-2010) in the lobster fihing grounds of Bancos Rosalinda, Hobbies, Serrania, K Gorda, Este del Canal.. Members of the fishing industry (pots) where contacted in order to obtain access to vessels and promote voluntary participation in the program.

In this opportunity Seafood Caribbean Company at Roatan and owner Oscar Valladares let two boats, Lady Miss Alexandra Galilee join the program where two observers were on board for a period of 2.5 months, from 11 July to 27 September.
Some preliminary results are shown:
Name of vessel. Miss Genesaret
Capitain: Geovany Reyes
Observador: Santos Mariano Solorzano

3,939 lobsters were measured, the biometric information was filed in the form; catches per that period were 4,236 pounds of tails. In Table 1 catch/month are detailed, catch depth and number of lobsters measured.

Table 1: Miss Genesaret

Miss Genesaret			
Month	**Tails (lbs)**	**Depth ft**	**Lobsters measured**
July	**486**	**86**	**3,939**
August	**2,425**	**94**	
September	**1,325**	**97**	

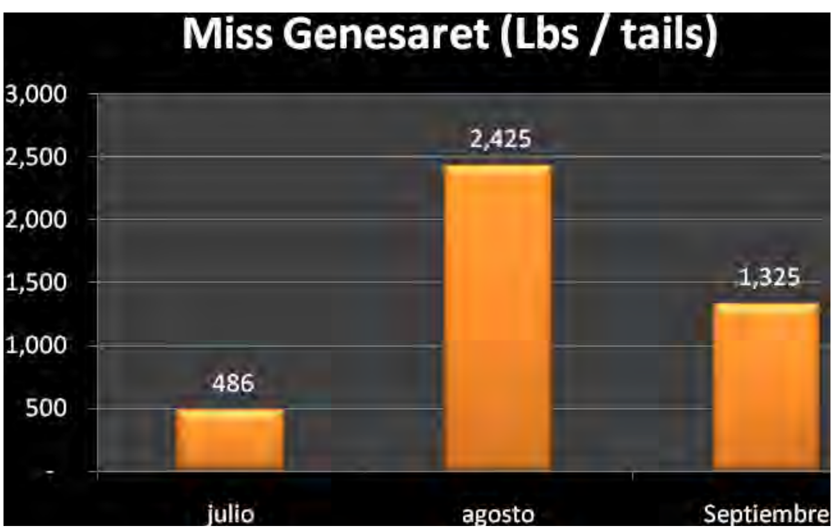


Figura 8:Total catches during 2.5 months

Vessel: Lady Alexandra
Capitain: Angel Balico
Observador: Santos Leopoldo Canales

2,785 lobsters measured, catches for the period were 5,725 pounds of tails, in table 2 catches per month, catch depth and the number of lobsters measured is shown in the table below.

Table 2: Lady Alexandra

Lady Alexandra			
Month	**Tails (lbs)**	**Depth prom ft**	**Lobsters measured**
July	**890**	**94**	**2,785**
August	**2,370**	**79**	
September	**2,465**	**85**	

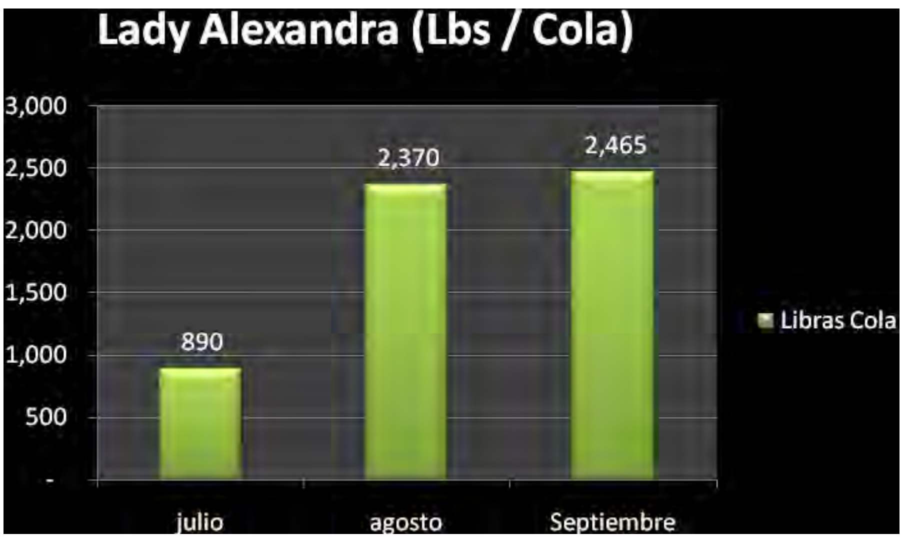


Figure 9: Lady Alexandra totals catches in 2,5 months

The information gathered by the observers in a four month period in Honduras and Nicaraguan vessels is being transferred to a data base in order to carry out the statistical analyses.

WWF USAID FORMATO PARA MUESTREO BIOLOGICO DE LANGOSTA ESPINOSA *Panulirus argus*

A BORDO DE BARCOS NASEROS INDUSTRIALES

NOMBRE DEL BARCO: ladi alexandra

FECHA: 25/9/9

EMPRESA: /

NOMBRE DEL CAPITAN: angel Balico

NOMBRE DEL OBSERVADOR: Santos canales

NUMERO DE LANCE O ESTACION: 1025

Posición Geográfica

Latitud (N): 1538

Longitud (W): 8107

AREA DE PESCA: Este del canal

PROFUNDIDAD: 80

Nº DE INDIVIDUOS	Talla (Long. Cef. mm)	Sexo	Estado reproductivo hembras (Marcar estado): HO	HP	HO-HP	NR
1	78 mm	M				
2	97	M				
3	84	M				
4	60	M				
5	72	M				
6	83	M				
7	91	M				
8	74	H			/	
9	86	M				
10	60	M				
11	67	M				
12	91	M				
13	84	H			/	
14	60	H	/			
15	71	M				
16	89	M				
17	74	H		/		
18	87	H		/		
19	76	M				
20	68	M				
21	94	M				
22	69	M				
23	81	M				
24	60	M				
25	71	M				
26	81	M				
27	76	M				
28	97	M				
29	69	M				
30	86	M				
31	93 mm	M				
32	74	M				
33	87	H				
34	70	H		/		
35	79	H		/		
36	84	M				
37	70	M				
38	68	M				
39	74	M				
40	97	M				
41	61	H	/			
42	73	M				
43	91	M				
44	84	H			/	
45	96	M				
46	76	M				
47	97	M				
48	84	M				
49	79	M				
50	87	H	/			
51	84	M				
52	84	H	/			
53	71	M				
54	74	M				
55	93	H		/		
56	60	M				
57	63	M				
58	74	M	/			
59	97	M				
60	60	M				

HO = Hembra Ovígera
HP = Hembras con parche
NR = En no reproducción
HO-HP = Hembra con huevos y parche
Sexo: H = Hembra, M = Macho

Figure 10: Example of the formats filled out by the on-board observers

Key Objective 3: Strengthening enforcement of current regulations

In order to promote compliance with existing lobster fishing laws and regulations WWF sponsored the socialization and discussion of the last version of the proposed Honduran Fishing Law. Eighty participants such as government officials, fish product exporters, the fishing industry, fishermen and NGO´s, attended the meeting held in Tegucigalpa on February 25th, 2009 to comment on the new regulation before it is sent to Congress. This work comes at an important time, as the Honduran government is in the process of revising its Fisheries Law of 1959 (the oldest in Central America).

During the event Alicia Medina, Marine Conservation manager made a presentation on how WWF is working towards promoting a more innovative approach on fisheries management: the Ecosystem Based Fisheries Management (EBFM), also enforcement of current regulations under CAFTA, also promote voluntary adoption of BFP´s, the establishment of a quota system and fisheries concessions.

Sub-objective #1: Educate stakeholders in government and industry about the CAFTA requirement that governments enforce their own laws, including fisheries laws relating to lobster fisheries – in order to promote better adherence to the laws

During the review WWF checked if the new proposed fishing law was in harmony with the CAFTA requirements.
A poster, in Spanish and English, to publicized amongst fishermen, boat owners, restaurant owner, government officials and NGO´s the new Lobster Fishing regulation from OSPESCA sign on may 2009 and FAO guidelines for responsible fishing as well as national regulations, and distributed to the fishing industry for posting on boats, restaurants, hotels.

Key Objective 4: Support the establishment of effective fisheries quotas by governments of Honduras and Nicaragua

The establishment and implementation of a scientifically-based quota is the best means of reducing the catch to levels that will allow the stocks to recover. While stock assessments should be undertaken by the governments and an argument could be made that they should be funded by the industry, neither are happening currently, so this year we are undertaking the research needed to assess the stock and establish a quota for Honduras and review the Nicaraguan system.

Nicaragua has had a very good statistic system for several years. The information collected from the processing plants and the fishing boats is fairly accurate. INPESCA has developed a Quota system that has worked for at least 5 years. The opinion of Nicaraguan scientists, Rodolfo Sanchez and Renaldi Barnutti about reviewing the quota system is positive and also is important to engage Honduras in this endeavor, considering both countries share the same stock.

Sub-objective #1: Build a case for a lobster catch quota

Honduras: Since the stock assessment is based on historic catch data it was crucial to obtain this information from the packing plants in Roatan and Guanaja; thanks to support of Mr Charles Haylock, president of ANPEMAR and Shawn Hyde, manager of Mariscos Hybur the project team was able to start a database. It is important to mention that DIGEPESCA´s statistic department has been a key factor to obtain the required information. This past three years the information collected from the processing plants is by far more accurate than previous years; therefore, significant progress has been made on building an historic data base.

Catch data of landings and commercial size category of 3 fishing seasons is already under construction (from hard copy data to digital sheets). Lobster evaluation expert Eloy Sosa from ECOSUR, Mexico is working with us in the evaluation of the lobster stock and setting a proposed quota for the Honduran lobster fishery.

Nicaragua: In Nicaragua, a mechanism is in place for collecting information from processing plants (developed by Renaldy Barnutti with INPESCA, Nicaragua's Fisheries Agency). This system collects information on both the quantity and size of lobster that the plants are processing – information that can be used to project annual production rates, which in turn can be used to determine a stock assessment.

Nicaragua´s statistic system has been on track for several years. The information collected from the processing plants and the fishing boats is totally accurate. INPESCA has developed a Quota system that has worked for at least 5 years. The opinion of Nicaraguan scientists, Rodolfo Sanchez and Renaldi Barnutti about reviewing the quota system is positive and also is important to engage Honduras in this endeavor, considering both countries share the same stock. Although the broad experience from Nicaraguan fisheries expert is excellent, the project team considers that a ¨neutral¨ scientist like Eloy Sosa would minimize any given tension among the countries.

Belize: As we have explained previously in this document, there are specific activities that expand its approach thanks to the tight coordination between this initiative and the "Critical Conservation of Central America Watershed (CCAW)", founded entirely by USAID. This is one of the topics were the cooperation has been more evidently. Therefore with CCAW a stock assessment was conducted on the lobster fishery of Belize upon a request from the Government of Belize. The GoB requested this technical advice as they are interested in exploring the allocation of fishing quotas or catch shares on this fishery. This document deals with the stock assessment of the spiny lobster resource in Belize, based upon data available for the 2007-2008 fishing season.

The analysis consisted of three sections, each one based on a different dataset and using a different modeling framework. Data for this work was collected from the purchase slips of the "National Fishermen Producers' Cooperative" and the "Northern Fishermen Cooperative Society" for one fishing season, June 2007 to February 2008. The size composition of the catch was also obtained by monthly sampling of the catch during the product delivering at both fishing cooperatives (Castañeda, 2009). For short-term analysis a depletion model was fitted to daily data of total catch of lobster for the entire fleet during the period June 15th to July 15th. We fitted a depletion model, after Battaile and Quinn (2006), to daily catch data in weight. Then, for catch in numbers and effort in fishing trips, we applied a depletion model after Medley and Ninnes (1997). A seasonal analysis was also conducted. To monthly catch-effort data of the season 2007-2008, we fitted a depletion model without recruitment term. Fishing effort was measured as number of fishing trips, and monthly total catch of lobster in pounds was converted to numbers. Analysis followed the integrated approach (Maunder 2001) to model the resource dynamics and simultaneously standardize the CPUE, catch per fishing trips, for four factors: fishing area, fleet type (skiffs vs sailboats), trip's duration in fishing days, and month. Finally, based upon the size composition of the catch, and parameters of the growth curve for Cuba (de León et al. 1995), we obtained the age composition of the catch for the 2007-2008 fishing season. Then, we applied a corrected pseudo-cohort analysis of the catch by age (Lorance et al., 2001; Chessot et al., 2008), avoiding the classical assumption of equilibrium which implies that fishing mortality and recruitment have remained constant. In this case, we were able to perform a correction for non-constant fishing mortality using the nominal fishing effort available for the period 2000-2007 as the number of annual fishing licenses granted by the Government of Belize.

The major outcomes of the stock assessment were as follows:

Short-term analysis: Although two different depletion models were fitted, the initial population estimates resulted quite similar. According to the depletion model after Battaile and Quinn (2006), the biomass before the 15th June was =203,867 pounds of lobster tails; and using the depletion model after Medley and Ninnes (1997) we obtain an estimation of R_0 = 468,400 lobsters, equivalent to an initial biomass of B_0=203,700 pounds. A second feature detected in this section was the relatively high fishing pressure exerted during the first month of the lobster fishing season.

Seasonal analysis: Three relevant results were achieved in this section. One, the CPUE standardization showed us that catchability coefficient q is affected by several factors, for instance q for sailboats is 3.2 times higher than q for skiffs (fishing trip duration of sailboats is also greater), and the catchability coefficient in fishing area # 5 (and 6) is 15% greater than the q-value for fishing area # 1. Also, q decays with time in months during the fishing season. Second, the estimate of initial population size was 2,037,000 lobsters and to the end of the season the population size was ~ 720,000. The total catch at the end of the fishing season was 437,122 pounds of tails, with a remaining population of 720,000 lobsters, equivalent to 271,000 pounds of tails, indicating that around 64% of the lobster were fished. Third, the monthly fishing mortality follows a decaying trend with time, with the highest value in June (0.15) and the lowest in February (0.05). According to the final depletion model, the F-value for the entire fishing season equals to 0.77. This value is in the range of values previously estimated by Medley et al. (2004) using a similar model, but with catch and catch per unit effort data based on biomass instead of numbers.

Corrected pseudo-cohort analysis: Major results achieved with this technique are three. First, lobsters 2 years old are partially recruited, and the greater fishing pressure is exerted upon age-groups 3 and 4. Second, the relatively low numbers of lobsters age group 5 onwards had two explanations, the high fishing pressure acting upon ages 3 an 4, and the concentration of fishing activities on shallow waters causing a poor representation of older lobsters in the catch. Third, the estimates of values of fishing mortality through the weighted mean of F-values by age, amounting 0.60 with the Pope´s method and 0.53 with the corrected pseudo-cohort analysis are considered more reliable than the F-estimates coming from the final depletion model. In particular, the value F= 0.60 is viewed as the most reliable for further discussion.
Overall, regarding the state of the resource it must be noted that the value of F= 0.60 is 1.7 times the natural mortality M= 0.36 commonly assumed in regional analysis by FAO experts. This is indicative of a relatively high fishing pressure, which corroborates that the Belize stock of spiny lobster is fully exploited (Cochrane and Chakalall, 2001). However, it must be highlighted that the size of the stock dwelling in the deep waters off-Belize is not included in the calculations. Taking into account the number of lobsters living in deeper waters will have a lowering effect on the current F-value.

Based upon this stock assessment we do **recommend**: a) any increase of fishing mortality or fishing effort in the spiny lobster fishery of Belize must be avoided; b) It will be worthy to define the desirable state of the lobster resource for the welfare of Belize as a country, under the leadership of the Belize Fisheries Department, with participation of the stakeholders –fishing cooperatives and other relevant actors; c) Reference points in terms of lobster population size, catch-effort limits or fishing mortality level must be clearly defined to be used as benchmarks to contrast the performance of the Belize’s lobster fishery under the new directions in management; d) Closely related to the management objectives and reference points, it is also needed to set up a program of fishery monitoring; e) Issues deserving further research are the population size of lobsters in the deep waters off-Belize, morphometric relationships, growth parameters, and reproductive activity during the season.

The data collection system in place, including catch-effort censuses from fishing cooperatives slips, as well as size sampling must be maintained. There is a room for small additions to improve the data collection, such as recording date and month, and to increase the sample size of length and weight composition of the catch. It is recommended to quantify the abundance of lobsters living in deeper waters. In addition to validate the common assumption concerning the presence of a healthy deeper population, it will improve the current F-estimates which could be over-estimations since a part of the population is not being included in the stock assessment

Finally, this analysis is a bench mark to develop the analysis for Honduras and Nicaragua and preferably standardize the methodology to calculate the main indicators. Besides, this is a unique opportunity to merge the efforts of Mesoamerica, including the expertise developed in Mexico in the last decade.

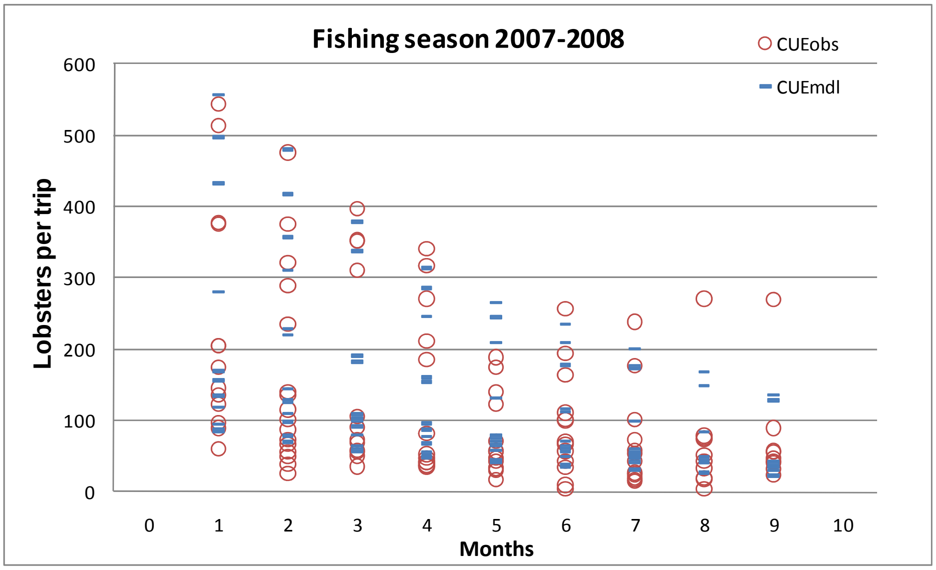


Figure 11. Example of the catch per unit effort calculate; observed (circles) and predicted (line) values of monthly catch per unit effort, in number of lobsters per fishing trip according the final depletion model.

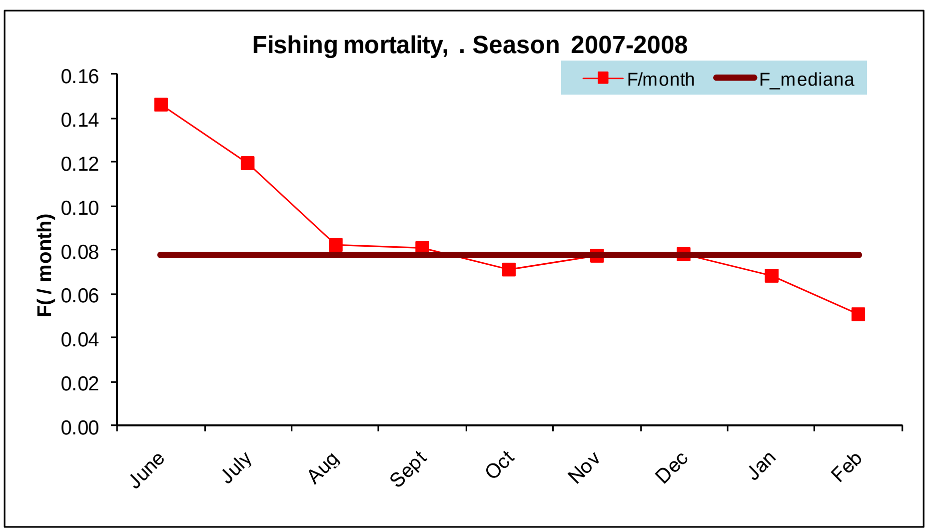


Figure 12. Time variation of lobster population size, in numbers (upper panel) and monthly fishing mortality rate F (lower panel) during the fishing season 2007-2008 in Belize. In the latter it is also indicates the median value for F (thick horizontal line).

Key Objective 5: Build demand for responsibly and sustainably-caught lobsters in local and international markets

Under this objective, our goal is to make the market a force for conservation by enlisting purchasers -- both in the U.S. and in Central America – to use their purchasing power to do two things: to pressure the industry to adopt sustainable practices, and to pressure the governments to bolster those efforts with effective law enforcement.

We think that the most effective way to do this is to enlist purchasers in the U.S. and Central America to use their purchasing power to do two things: to pressure the industry to adopt sustainable practices, and to pressure the governments to bolster those efforts with effective law enforcement. Our goal is to promote responsible and sustainable fisheries that can plug into a growing demand for sustainably-caught lobster.

In this period we continue building the trustworthy relationship with the industry and mainly we updated and develop the "lobster value chain" and the "lobster business case", considering the market changes coming from the global financial crisis and the effects in the sea food sector. This effort was again closely coordinated with the CCAW project and the "Environment and Labor Excellence for CAFTA-DR Program (ELE)", funded by USAID and operated by Chemonics International, was WWF is implementing directly the component "C", related with private alliances. Further in this report we have included some of the main conclusions.

Sub-objective 1: Build demand for lobster from fisheries that have adopted sustainable fishing practices

Building on our work started earlier this year to identify the top Best Practices that we would like seafood buyers to commit to asking of their suppliers, WWF Senior Fellow George Williams presented our priorities to the Senior Seafood Buyer at Darden Restaurants in early April. The meeting was highly successful; the reaction from Darden was very positive and they seem amenable to supporting these practices and making them known to their suppliers moving forward. The Best Practices proposed to Darden are the following:

1) Compliance with all laws & regulations pertaining to the fishing of lobster in Honduras & Nicaragua with an emphasis upon:

- *Fishing Season*
- *Licensing Requirements*
- *Worker Safety*
- *Size & Berried Female Restrictions*

2) Eliminate "Ghost Fishing" of traps by removing all traps at the end of the fishing season & during the season dispose of all damaged traps on land

3) Work cooperatively, including the sharing of catch & processing data as requested, with government & spiny lobster fishery management experts to develop scientifically grounded stock assessments

4) Engage with stakeholders to address issues pertaining to overcapacity & safety of the industrial dive fleet through a transition to alternative fishing methods, being respectful of the needs of coastal communities

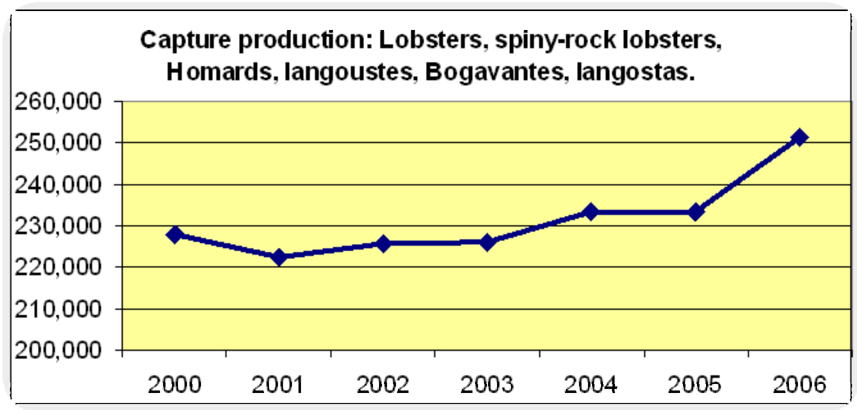
WWF feels that securing Darden's buy-in to the Best Practices is an important first step in enlisting the purchasing power of large companies to drive a shift in industry practices, and we will continue to push for this commitment as it will set an example for other buyers. We also hope that they will be supportive in the broader importing and purchasing community by providing contacts and influence, and are happy to report that this has already started to happen. Coincidentally, the same day that George Williams was presenting to Darden, he also had the opportunity to present to the Mazetta Seafood Company, a large U.S. importer of Caribbean Spiny lobster, as they were in the Darden offices for a sales meeting. The concept of "sustainable" lobster was newer to Mazetta than it was to Darden, who has been considering these issues for a number of years, and they were interested but cautious in their response to the presentation. WWF will follow up with Mazetta on these issues, as our experience in the past indicates that continued outreach and education to companies on these issues is needed in order to create a level of comfort that will potentially lead to agreements like the one we've achieved with Darden down the road.

Finally, WWF-US has recently signed an MOU with Sysco, and we are exploring the potential of using this new partnership to open the door towards engaging with them about their purchasing policy. This work will continue over the next year.

<u>The Central American Spiny Lobster value chain</u>. In this section we are including a summary of the main facts we accomplish during the marketing study. Lobster fisheries are still one of the most important natural resources within the Mesoamerican Reef, which is located along the Caribbean coasts of Honduras, Nicaragua, Belize, and Mexico. Among all fishery resources, this is the species with the highest market value. This fact, in addition to its abundance and ample distribution, has turned it into the main source of income for a large number of coastal communities located along this eco-region. The average annual production of whole lobster in the Caribbean reaches 40,000 metric tons, with an approximate US$350 million landed value. This value can increase up to 300% or more when lobsters reach consumers. For example, as it will become evident in the course of this document, a fisherman in the Miskitos Allen Keys receives less than US$8 per pound of lobster tails at a gathering center, while a seafood restaurant can sell a 300-g lobster tail portion for US$28 or more.

Global lobster catches have increased up to almost 10% in the last 6 years; the global lobster production increased steadily in the past years, from 228,000 metric tons (MT) in the year 2000 to over 251,000 MT in 2006. American Lobster (Homarus americanus) and Spiny Lobster (Panulirus spp.) catches constituted 67 percent of world lobster production in 20041.

[1] http://www.fas.usda.gov/ffpd/Fishery_Products_Presentations/Lobster_2006/lobster_2006.pdf



ftp://ftp.fao.org/fi/stat/summary/a1d.pdf

Figure 13. Global lobster catches according FAO-STAT. 2000-2006

World lobster exports increase conservatively, mostly due to the increase in frozen- and fresh/refrigerated-product sales2. In America, the United States, Cuba, The Bahamas, Brazil, Mexico and Honduras are the main actors in the lobster-export activity.

The average annual production of whole lobster in the Caribbean reaches 40,000 metric tons, with an approximate US$350 million landed value. The places reporting the highest lobster production in the Caribbean are Cuba (28%), Brazil (22%), The Bahamas (14%), Honduras (13%), Florida (10%), Nicaragua (8%), Mexico (3%), and Belize (2%). The four countries located along the Mesoamerican Reef contribute approximately 6,000 tons of whole-lobster per year; that is, 17% of the total Caribbean production.

United States is a considerable lobster producer/exporter/ importer/consumer. This country exports almost 17% of world exports (tons) and imports 29% of them.

Lobsters and their by-products are commercialized in various forms, ranging from frozen to fresh. The most common presentation is frozen lobsters, followed by live and fresh/refrigerated lobsters.

Lobsters are considered superior goods (those goods whose consumption or demand increases as real income increases)3. Thus, the better the economic conditions, the greater the lobster consumption. Lobsters are commercialized in large volumes in restaurants, cruise lines, hotels, and various supermarket chains.

[2] Lobster Markets, Holmyard and Franz, 2006

[3] http://www.eco-finanzas.com/diccionario/B/BIEN_SUPERIOR_O_NORMAL.htm

When examining Table 1, it can be noted that many countries substantially decreased their lobster exports to the United States in 2008, when compared to 2007. On the other hand, Canada –the main lobster exporter to the USA– showed a growth of 7.6% during that same period.

Since lobsters are a luxury item, their price is not a barrier for end consumers, especially in specialty restaurants. However, price is an important variable in all the other links of the chain. It is important to consider that catches have decreased in Nicaragua and Honduras during the past years (up to a 25% reduction) and that purchase prices have not varied. On the other hand, lobster-harvesting costs have continuously increased, so agents' benefits have gradually diminished, and main importers or wholesalers compare prices before buying. The origin of the products also affects prices; for example, lobsters originating in certain countries are perceived as better products due to the nature of its stocks, but also because of the methods used to catch them and their quality standards and international regulations.

Most traditional agents believe that as long as end consumers do not raise environmental issues, there is no need for them to change their practices. Some firms have been in the lobster-import business for more than 25 years, and these products have always been sold to their regular customers. Unless they demand otherwise, exporters will keep to their practices, seeking to comply only with their customers' specifications.

On the other hand, individual fishermen and/or fisheries see best practices as a way to optimize their operation costs, either by applying better technologies that reduce their costs in catching and storage, or above all, that promote stock recovery, so that fishing efforts diminish (better catch volume per the same number or a fewer number of fishing trips). In addition, there is considerable pressure for this segment to comply with legal requirements, which include eliminating fishing gear that is damaging lobster stocks and that is dangerous for fishermen, such as deep-sea scuba diving[4].

CAFTA-DR lobster exporters have seen a decrease in lobster prices in the past six months. US importers' sales prices shifted from US$19 per pound in 2008 to US$12 in January 2009[5]. Usually, when there is an economic contraction in the United States, the restaurant industry (Food Service) is rapidly affected during adjustment periods (the last one occurred in September 2001), and products whose turnover is reduced are packed in institutional presentations (over 5 Kg), since the period until they are consumed is longer. On the other hand, freezing plants and agents have limited storage space, and their storage costs are nearly US$0.03 per month, which raises production and distribution costs.

[4] OSPESCA, Memorándum de Nicaragua para la Mejores Prácticas de Pesca de Langosta de La Región Centroamericana (Nicaragua Memorandum on Best Lobster Fishing Practices in the Central American Region), 2007.

[5] Direct interviews with exporters and buyers

IMPORTS TO THE UNITED STATES

February 11, 2009

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREIGN AGRICULTURAL SERVICE

BICO IMPORT COMMODITY AGGREGATIONS

AREA/COUNTRIES OF ORIGIN AND COMMODITIES IMPORTED		JANUARY - DECEMBER VALUES IN 1000 DOLLARS					JANUARY - DECEMBER COMPARISONS		
CONSUMPTION IMPORTS		2003	2004	2005	2006	2007	2007	2008	% CHNG
TOTAL		995,669	991,120	1,058,403	1,083,143	1,054,589	1,054,589	1,057,022	0.23
CANADA	LOBSTER	609,290	594,432	673,503	707,085	660,711	660,711	710,944	7.6
BRAZIL	LOBSTER	70,680	79,762	75,406	77,319	78,469	78,469	68,352	-12.89
AUSTRALIA(*)	LOBSTER	63,839	69,070	76,098	70,708	82,038	82,038	61,736	-24.75
BAHAMAS, THE	LOBSTER	62,650	53,797	44,748	45,422	45,288	45,288	50,116	10.66
HONDURAS	LOBSTER	42,447	47,663	48,694	41,774	47,942	47,942	49,218	2.66
NICARAGUA	LOBSTER	36,700	41,043	33,244	43,070	47,099	47,099	43,482	-7.68
SOUTH AFRICA, REPUBL	LOBSTER	13,417	16,905	18,346	18,741	19,604	19,604	17,428	-11.1
CHINA, PEOPLES REPUB	LOBSTER	6,343	5,138	4,789	5,456	8,405	8,405	11,572	37.68
BELIZE	LOBSTER	7,727	7,648	6,998	7,207	7,959	7,959	6,116	-23.16
COLOMBIA	LOBSTER	9,091	8,650	7,219	9,368	7,929	7,929	4,854	-38.78
UNITED ARAB EMIRATES	LOBSTER	12,435	14,512	13,572	13,058	11,704	11,704	4,803	-58.96
ST. HELENA (BR W AFR	LOBSTER	4,660	2,859	1,466	972	1,974	1,974	4,741	140.17
NEW ZEALAND(*)	LOBSTER	3,581	3,223	3,777	4,368	3,021	3,021	3,276	8.44
THAILAND	LOBSTER	4,435	4,056	4,665	5,571	4,707	4,707	3,037	-35.48
JAMAICA	LOBSTER	5,337	3,786	3,783	1,629	2,033	2,033	2,479	21.94
PANAMA	LOBSTER	2,537	2,156	3,203	2,166	2,547	2,547	2,388	-6.24
TAIWAN	LOBSTER	3,681	5,378	2,746	3,066	911	911	2,109	131.5
DOMINICAN REPUBLIC	LOBSTER	202	551	2,671	4,447	3,069	3,069	1,968	-35.87
TURKS AND CAICOS ISL	LOBSTER	1,547	3,343	3,441	3,625	3,364	3,364	1,631	-51.52
MEXICO	LOBSTER	13,392	7,440	5,586	5,761	3,522	3,522	1,556	-55.82
CHILE	LOBSTER	408	769	2,520	2,081	2,610	2,610	1,415	-45.79
ECUADOR	LOBSTER	529	1,121	776	1,328	1,071	1,071	822	-23.25
SPAIN	LOBSTER	203	958	705	449	723	723	698	-3.46
JAPAN	LOBSTER	178	359	449	757	869	869	430	-50.52
VIETNAM	LOBSTER	139	140	0	603	612	612	351	-42.65
PAPUA NEW GUINEA	LOBSTER	1,324	1,053	1,055	493	269	269	304	13.01
NAMIBIA	LOBSTER	303	147	347	234	217	217	217	0
INDONESIA	LOBSTER	81	72	208	60	1,184	1,184	148	-87.5
INDIA	LOBSTER	625	75	331	26	218	218	129	-40.83
FRANCE(*)	LOBSTER	150	0	50	145	70	70	74	5.71
COSTA RICA	LOBSTER	352	423	363	276	478	478	60	-87.45
EL SALVADOR	LOBSTER	341	3,067	6,780	3,652	367	367	50	-86.38
BRITISH PACIFIC ISLA(*)	LOBSTER	43	47	29	120	31	31	37	19.35
SINGAPORE	LOBSTER	20	10	24	37	59	59	37	-37.29
SRI LANKA	LOBSTER	443	697	257	71	31	31	35	12.9
UNITED KINGDOM	LOBSTER	30	135	120	70	81	81	31	-61.73
LEEWARD-WINDWARD ISL(*)	LOBSTER	77	508	489	11	5	5	8	60
GUATEMALA	LOBSTER	327	177	246	234	88	88	7	-92.05
VENEZUELA	LOBSTER	144	88	0	0	95	95	6	-93.68
ARMENIA, REPUBLIC OF	LOBSTER	0	0	0	0	2	2	4	100
ITALY(*)	LOBSTER	0	0	0	0	8	8	4	-50
MALAYSIA	LOBSTER	15	4	37	0	12	12	4	-66.67
KOREA, REPUBLIC OF	LOBSTER	15	25	0	0	3	3	3	0
PORTUGAL	LOBSTER	0	0	0	0	7	7	3	-57.14

Data Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

Because of the global economic crisis, the region's fishing industry, packing plants, and exporters, mainly in Honduras and Nicaragua, are expecting a very difficult season. Some of them estimate that their incomes will only be 30% of those obtained during the 2007-2008 period.

Another issue that will affect the lobster market during the current year will be the lack of financial resources and cash flow. This will impact overnight-loan portfolios (there is great leverage in this sector), and also the availability of fresh financial resources to reactivate the activities of this sector.

It is important to underscore that, as previously described; prices in most stages of the value chain leading to the end consumer have undergone slight variations. They are not in accordance with accumulated inflation, increased input costs, and higher overhead expenses (electricity, fuels, etc.).

In the current context, low prices, product-accumulation in cold storage rooms, market contraction projected for at least one year, the lack of funding, and high leveraging seem to be the greatest constraints faced by this industry.

To them, we must add short-term threats, such as reduced lobster stocks due to overfishing6, which increase the cost of activities due to greater fishing efforts. Another threat that increases uncertainty in the sector is the ruling by The Hague's International Court in Geneva (The International Court of Justice in The Hague?)7, reducing the access to fishing sites by Honduran fishing fleets.

In the long term, factors such as access to remote fishing areas; the lack of governance; the lack of compliance with territorial-water regulations, and the weakness of Fishing Institutes to enforce laws will hinder proper compliance with the "best fishing practices" included in national laws as well as compliance with the ban on catching egg-bearing females and smaller-size juveniles (a tail of at least 5½"). This also applies to protected areas where there are important foraging and spawning areas that are not adequately safeguarded, due to lack of rangers or maritime authorities needed to enforce the laws in these areas. These insufficiencies, along with illicit product- or human-smuggling activities, further complicate control of these areas.

Even in the current scenario, there are other products in the region going through difficult circumstances, and they have sought differentiation strategies, both in their growing practices and in their guaranteed innocuousness (coffee and berries are a good example). Therefore, it is very probable that the reaction to these grim circumstances will be, **precisely, to seek differentiation alternatives** in order to recover their competitiveness and obtain additional commercial advantages. This is the precise avenue seeking for this initiative.
Conversely, the proven success of Mexican cooperatives' certified products –and the possibility of sharing this experience– opens up new alternatives on how to approach this problem from the production perspective. As Asian countries enter the consumer market, and as new restaurants are established to cater to the emergent middle and high classes in these regions, new opportunities will be available for exports, provided prices covering the cost of transportation to the Pacific coast can be integrated. In this sense, Central American customs integration among El Salvador, Guatemala, Nicaragua and Honduras; reduced transit tariffs and projects to establish "dry" channels to transport products between the Pacific and Atlantic Oceans increase the possibility of accessing those markets.

[6] FAO, Reporte de Pesquerías de Langosta del Caribe (Report on Caribbean Lobster Fisheries, Merida, Yucatan, 2007.

[7] Published in the Official Newspaper, Tegucigalpa, Honduras, November, 2008.

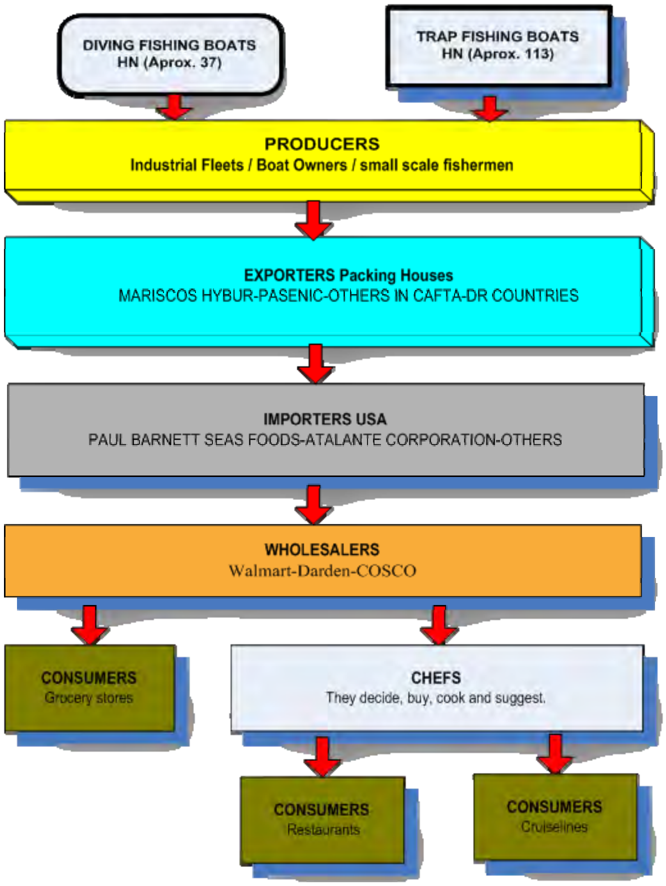


Figure 14. Description of the lobster frozen tale commercialization chain; there are deformations regarding the illegal size lobster trade not included in the picture

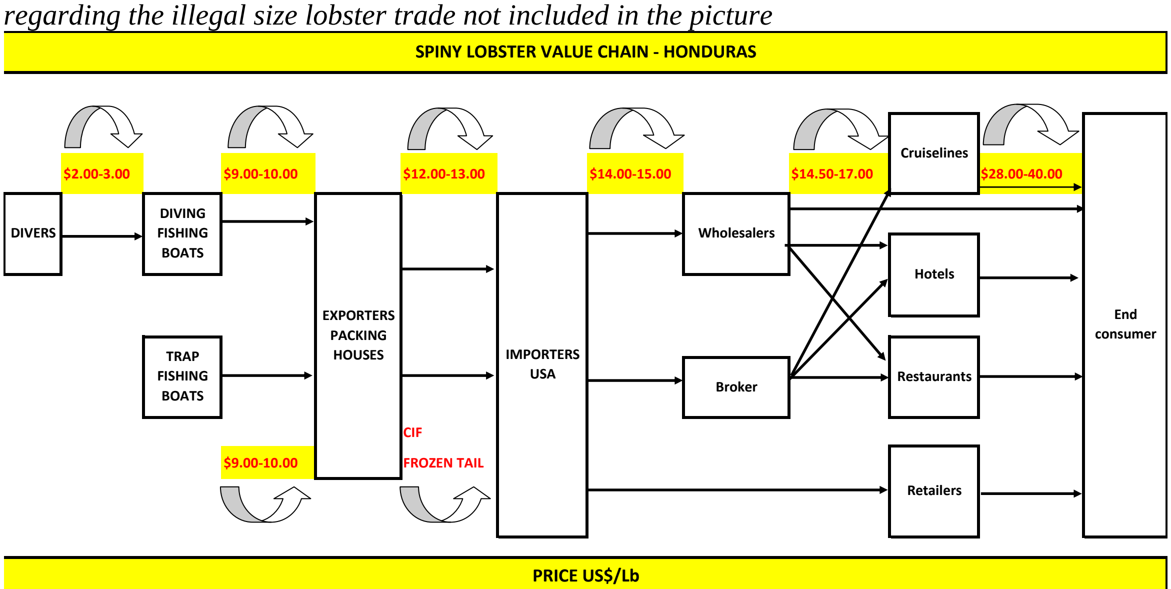


Figure 15. Update of the spiny lobster frozen value chain

Sub-objective 2: Educate public in Central America about environmental impacts of eating undersized lobsters

<u>*APESCA Business Model.*</u> This business model was developed using a standardized methodology to compare private sector alliances promoting environmental practices to improve its competitiveness. This is an important effort to spread the efforts built with the fishing sector during the last decade. In the following lines there is a summary of the results.

APESCA is a private association funded in 1967 and its core business is the wild capture and commercialization of sea food products in the Atlantic Coast of Central America. The organization includes around 127 associated boats located in Bay Islands Honduras and other sites close to La Ceiba city. The main products are lobster, shrimps conk, porgy, etc. and its volumes and capture fishing gears depend on the site and the seasons.

The international market of sea foods there has been a vast increase in food trade in the ‘‘globalization period’’ starting in the mid 1980s. The volume of food trade increased 2.1 times from 1980 to 2003. The rate was 3% per year trade growth in the 1980s, 2.3% in the 1990s, and then 8% per year in 2000– 2005[8]. The trade increase was driven by trade liberalization policies (such as GATT, NAFTA, MERCO SUR), demand side factors as growth of consumer incomes and supply side factors as improvements in packaging, storage, transport technology, and communications. The meat, fish and dairy have been the clear winners: there were vast increases (300–500%) in trade in non-traditional products; meat and seafood trade grew 300–400%; in addition, in that period the frozen food and other process presentations trade grew very rapidly. In this case, the lobster frozen tail has been one of this “specialties” coming from operations as the ASPESCA represent. Industrialized countries are still the main food importers in the world, accounting for 75% of food imports worldwide[9]; so even though food markets are growing extremely fast in the emerging market of Asia, Latin America, and Central and Eastern Europe to around 1 billion middle class consumers, US is still the main importer of the lobster coming from the Honduras operation.

During the recent years Central America’s share in world fresh and frozen sea food produce trade dropped from 3% to 2.2%, mostly because the competitors come from behind and race ahead and for the global financial crisis that affect specially the “high end” products as lobster.

Therefore, in this context the rules for competiveness have change too and some of the most significant characteristics that the sea food sector recognizes are:

Flexibility, cost-competitiveness and innovation. Reducing cost of production and cost of transaction it is the more traditional approach but still applicable in the region. This is the most straightforward incentive for the producer to include better practices in their operations.

Alliances. There is in fact a major changing in the value and distribution chain in the food industry; the tendency is still to integrate main sector of the vertical chain but in a more focused

[8] FAOSTAT, 2007
[9] FAOSTAT, 2008

fashion (not just for cost-effective reasons). Nevertheless it hasn't be the case in the lobster industry in Honduras and most of the companies are still doing "business as usual" with a small number of brokers with a limited differentiation in their products

Market consolidation. The supermarkets since 1980's are very quickly displacing traditional retail and supermarket chains are extending the coverage of their procurement catchment areas. In this case the producers are far to sell directly to big retailers in US and by now, there are few cases were the fishermen are selling "fresh product" directly to local supermarkets.

Volume and local transportation . Competing on volume has been a key challenge for Central America besides competing with cost, quality and market organization. However, the volume and the proximity of the final markets has play an important role in the competitiveness of this industry.

Market intelligence. It is critical to build ‘‘Market intelligence capital’’ to understand the rapidly changing opportunities and requirements of the market; this is one of the most critical factor for the sea food industry in Central America.

Technological and financial capital. This is one of the major factors/barriers to develop competitiveness, the most of the significant changes in cost, quality and differentiation involves a considerable investment and financial resources availability. More than 90% of the micro and meso enterprises don't have access to the private financial resources by lack of assets to guaranty short or long terms loans.

Private standards compliance (including labor and environmental standards). Suppliers are screened for their ability to meet the rapid emergence of quality, safety, environmental and labor private standards of the retail or processor clients, and whether they can meet the volume and consistency requirements. It is obvious that this trend is both risk-reducing and market-developing and thus an opportunity, but also a challenge to suppliers. This is the venue follow in this particular case, where the producers (fishermen) and the buyers establish an early alliance to promote "sustainable and responsible fishing techniques" to assure the lobster provision in the near future.

Opportunities for the business. As previously mentioned, diminished catches of legal-size adults and the increase in production costs have opened up a window of opportunity to promote best fishing practices seeking to improve competitiveness and to optimize costs, thus reducing the risk that this stock will cease to exist in commercial volumes. Many feasibility studies have identified that the most important factor to maintain and reduce production cost is the "size of the lobster captured" and the abundance of the population that reduce the capture effort.

Furthermore, in view of the contraction of the United States market, it is possible that its portfolio can be diversified to other countries, with other presentations and other characteristics. Access to more and better market information is, thus, an attraction to processors/exporters that need these elements to react better and quicker to the changes in context. The newly introduced guarantee and green-investment (or P+L) funds are a form of advantageous funding that will provide capital flow to the sector, provided it complies with certain requirements that, in turn, will lead to increasingly-responsible production.

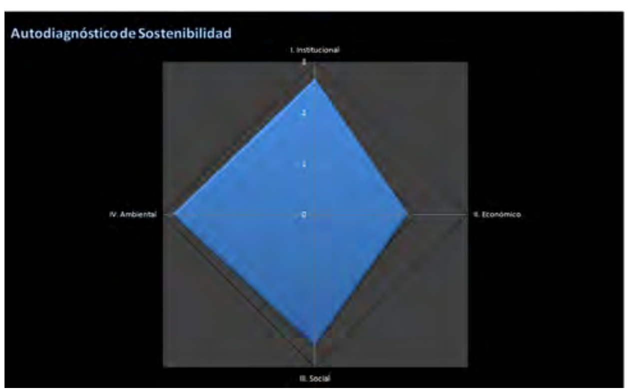
Conversely, the proven success of Mexican cooperatives' certified products –and the possibility of sharing this experience– opens up new alternatives on how to approach this problem from the production perspective. As Asian countries enter the consumer market, and as new restaurants are established to cater to the emergent middle and high classes in these regions, new opportunities will be available for exports, provided prices covering the cost of transportation to the Pacific coast can be integrated. In this sense, Central American customs integration among El Salvador, Guatemala, Nicaragua and Honduras; reduced transit tariffs and projects to establish "dry" channels to transport products between the Pacific and Atlantic Oceans increase the possibility of accessing those markets.

Lastly, improved, lower-price technologies open up new opportunities that range from better control –by using GPSs to track fishing-boat activities–, to immunoassays –in order to detect egg-bearing females whose egg pouches have been extracted–, to new transport alternatives –such as the "Fresh-tainers", which can be used to transport live individuals in a "physiological lethargy" state.

There had never before been such a concentration of projects and efforts aimed at the same objectives pertaining to this fishery. Thus, all actors of the value chain expect that this immediate crisis will eventually cause a reaction in the sector, which is so important to local and national economies and to conserving reef areas.

Benefits for conservation

1. Reduce the spiny lobster overexploited and through the good management practices allowed some stock recovery.
2. Co-management practices have been undertaken for many years in other parts of the world and positive results are evident in enforcement activities.
3. The stocks beyond free diving depths are legally protected.
4. In addition, sustainability of the fishery will be ensured, allowing higher stock biomass and less uncertainty to cope with years when recruitment is low.



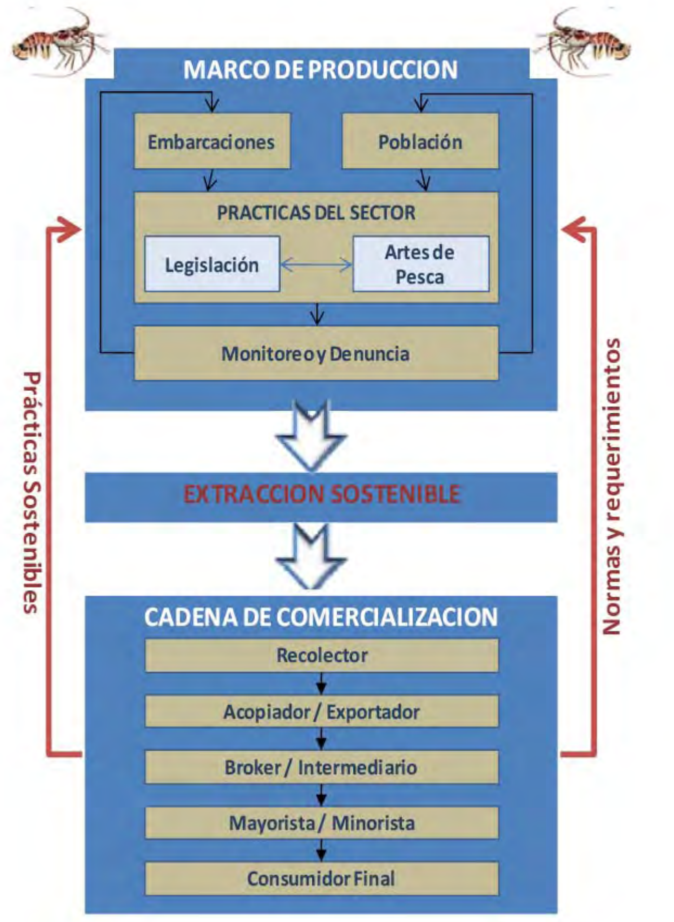
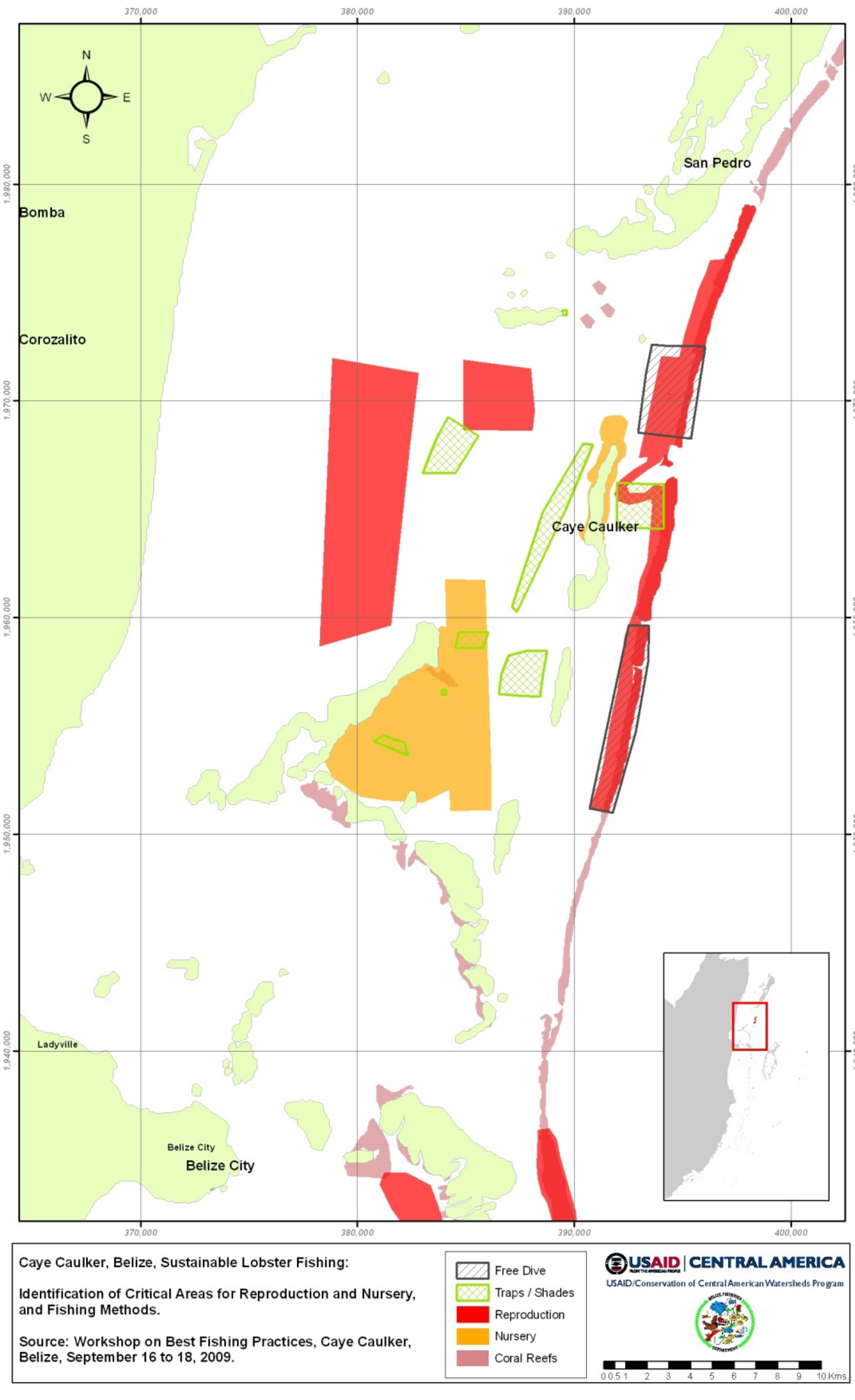


Figure 16 APESCA business model and sustainability analysis graph

Over the past year and in collaboration with the Roatan Marine Park, a local conservationist NGO, we have formed a new partnership with restaurants in Roatan as a way to promote public demand for legally caught lobster. Participating restaurants have agreed to display posters. We will soon be expanding the program to Corn Island and Managua.

Annex 1.

Belize critical habitats for lobster conservation. In specific zones, Key Caulker in this case, identification of areas for reproduction and nursery



Annex 2. Ecological Monitoring in Miskito Keys Nicaragua and Half Moon Keys Honduras

The expedition to areas of ecological interest to observe spiny-lobster fishery management is part of the objectives contained in the work plan developed by WWF with the support of USAID CAFTA-DR. It seeks to identify the most vulnerable areas or sites recognized as critical habitats used to harvest lobsters, in order to classify them as key areas for protection.

Taking into account the distance to the fishing grounds, two sites were prioritized, according to their importance. In the case of Nicaragua, the most appropriate site was considered to be Cayos Miskitos, as previously agreed on with fishing authorities (INPESCA), and its coordinates were ascertained in situ. In Honduras, the Arrecife Media Luna was chosen, due to fishermen's reports that it contains nursery grounds for this species.

Undertaking this expedition required a series of actions to ensure the research permits required by each of the countries and to secure the transportation, equipment and materials needed for this research. This was accomplished in coordination with each country's authorities, DIGEPESCA (Honduras) and INPESCA (Nicaragua). Concurrently, a cooperation agreement was executed with the Guadalajara University in Mexico, with the aim of performing joint monitoring. Subsequently, Dr. Fabián Rodríguez performed a technical-scientific analysis. He has a PhD degree in Marine Science and ample experience in the field of ecosystem monitoring, and he is the head of the Ecology Department at the Guadalajara University. His scientific staff assisted him with this analysis and WWF personnel provided their support. This research was performed from September 28 to October 10 in the Honduran-flag ship Bobby Junior II, owned by Bob McNab, a fishing entrepreneur.

Methodology

In order to obtain more ecological information on the areas where the spiny lobster lives, minimum sampling had to be performed in two sites or critical habitats (CH) that were previously identified as APESCO (Spanish acronym for Fishing Areas of Interest for Conservation). They were distributed as follows: APESCO 1: Nicaragua's Cayos Miskitos fishing area, and APESCO 2: Arrecifes Media Luna. The sampling unit is a transect 50-meters long. Total sampling included 66 transects (30 in APESCO 1 and 36 in APESCO 2).

Figure 1: General representation of APESCOS IN Honduras and Nicaragua. (Digitalized by PRico)

The scientific staff consisted of four participants from Mexico: Dr. Fabian Rodriguez, Dr. Amilcar Cupul Magaña, Rosario and Daniel Goard; adeep-sea diving instructor, Italo Bonilla, from Honduras; one representative from WWF-CARO, Pablo Rico; andtwo representatives from INPESCA who acted as observers for sampling in Nicaragua (including Renaldi Barnuti).

The team traveled to the sampling sites in the Bobby Jr. II, a 73-foot long recreational aluminum yacht, with two engines and an average speed of 12 knots. Once the technical-scientific team and the INPESCA personnel reached the APESCOS, they discussed the exact coordinates for each sampling site and provided them to the Captain, in order to define the proper navigation routes. When they arrived at each site, all diving equipment was prepared: tanks, materials, video cameras, etc.

1. The first diver laid a 50-meter transect and simultaneously took a census of adult fish, to determine both their abundances and their sizes in transect measuring 50 meters long and 2 meters wide.
2. The second diver video-recorded the 50-meter transects at 40 centimeters from the bottom of the sea and picked up the tape.
3. The third diver recorded topographic complexity by placing a 10-meter long chain that followed the shape of the sea-bottom, later measuring the linear distance from the beginning to the end. Then he recorded key invertebrates in a band transect measuring 20 meters long and 5 meters wide.

After concluding each dive, GPS points and parameters were recorded with a YSI probe, aiming to measure dissolved O2, temperature, salinity, etc.

This operation was performed after each dive, three times a day: nine per APESCO. At the end of the day, the information gathered was entered into the Excel database, the videos were reviewed

(MTS HD format and MiniDV tapes), and the GPS coordinates for the next sampling point were reviewed.

All this information was stored in previously-established electronic sheets that will later be analyzed statistically to determine abundance, biomass, density-biomass relation, specific wealth and diversity of fish, trophic structure, fish assemblages and determination of critical habitats.

Preliminary Results

Following are the results obtained from both APESCOs:

Name of the APESCO: Cayos Miskitos
Country: Nicaragua

Name of Site	Date	Coordinates		Depth (m)	Transects
London Reef	1/10/09	14°22.600´N	82°42.308´W	3	5
Lamarka	4/10/09	14°17.285´N	82°51.507´W	3	5
Porgee Reef	4/10/09	14°26.237´N	82°39.458´W	3	5
Nee Reef	4/10/09	14°32.602´N	82°34.384´W	3	5
Martínez Reef	5/10/09	14°38.129´N	82°38.986´W	3	5
Muerto Cay	5/10/09	14°32.351´N	82°46.195´W	3	5

In this APESCO it was possible to observe that these are very shallow sites that are no more than 3 meters in depth, with a topography that is very similar to all sampling sites and thus, in all the APESCO.

Figura 2: APESCO 1 (Nicaragua) localization of the six trails sampled (Digitalized by Pablo Rico)

London Reef

The species of adult fish included in the census at this site were:

1. *Ocyurus chrysurus*
2. *Sparisoma viride*
3. *Abudefduf saxatilis*
4. *Anisotremus virginicus*
5. *Lachnolaimus maximus*
6. *Microspathodon chrysurus*
7. *Acanthurus bahianus*
8. *Lutjanus jocu*
9. *Caranx latus*
10. *Sparisoma aurofrenatum*
11. *Halichoeres bivittatus*
12. *Thalassoma bifasciatum*
13. *Ginglymostoma cirratum*
14. *Stegastes diencaeus*
15. *Sparisoma chrysopterum*
16. *Sparisoma viride*
17. *Sparisoma rubripinne*
18. *Hypoplectrus unicolor*
19. *Acanthurus chirurgus*
20. *Haemulon sciurus*
21. *Haemulon plumierii*
22. *Lutjanus apodus*
23. *Pomacanthus arcuatus*
24. *Scarus taeniopterus*
25. *Sphyraena barracuda*

The most abundant were the *Ocyurus chrysurus* (Yellow Tail), *Sparisoma rubripinne* (Yello Tail Parrot Fish), *Sparisoma viride* (Stoplight Parrot Fish).

The average topographic complexity was P= 0.2586

Key invertebrates identified were: Lobster (*Panulirus argus*), sea urchin (*Tripneustes esculentus*), long-spined sea urchin (*Diadema antillarum*) and *Echinometra sp;* the two latter species were the most abundant.

Comments: Site with abundant dead corals, especially *Acroporas*, and few fishes.

Figure 3: a) Topographic complexity   b) Sea Urchin (Echinometra sp) © I Bonilla

Lamarka Reef

The species of adult fish included in the census at this site were:

1. *Anisotremus virginicus*
2. *Lutjanus apodus*
3. *Haemulon plumierii*
4. *Lutjanus jocu*
5. *Scarus coelestinus*
6. *Halichoeres bivittatus*
7. *Ocyurus chrysurus*
8. *Haemulon macrostomum*
9. *Kiphosus sectator*
10. *Chaetodon capistratus*
11. *Sphyraena barracuda*
12. *Anisotremus surinamensis*
13. *Scarus guacamaia*
14. *Abudefduf saxatilis*
15. *Stegastes planifrons*
16. *Pomacanthus arcuatus*
17. *Haemulon flavolineatum*
18. *Sparisoma viride*
19. *Scarus iserti*
20. *Haemulon sciurus*
21. *Thalassoma bifasciatum*
22. *Scarus taeniopterus*
23. *Sparisoma aurofrenatum*
24. *Sparisoma rubripinne*
25. *Pomacanthus paru*
26. *Scarus vetula*
27. *Stegastes diencaeus*

28. *Lutjanus mahogoni*
29. *Stegastes adustus*
30. *Lachnolaimus maximus*
31. *Lutjanus analis*
32. *Lutjanus griseus*
33. *Lutjanus synagris*

The most abundant were: *Haemulon flavolineatum, Abudefduf saxatilis, Lutjanus apodus*
The average topographic complexity was P= 0.3976
Key invertebrates identified were: *Echinometra sp*—the most abundant species; 415 individuals were counted– and a *Tripneustes esculentus* sea urchin.

Figure 4: a) Fire corals (Millepora complanata) and elkhorn corals (Acropora palmata), b) School of Snappers (Lutjanus apodus) © I Bonilla

Porgee Reef

The species of adult fish included in the census at this site were:

1. *Stegastes planifrons*
2. *Ocyurus chrysurus*
3. *Abudefduf saxatilis*
4. *Sparisoma viride*
5. *Pomacanthus arcuatus*
6. *Thalassoma bifasciatum*
7. *Sparisoma aurofrenatum*
8. *Acanthurus bahianus*
9. *Anisotremus virginicus*
10. *Haemulon carbonarium*
11. *Haemulon plumierii*
12. *Halichoeres bivittatus*
13. *Hypoplectrus guttavarius*

14. *Carangoides ruber*
15. *Stegastes diencaeus*
16. *Stegastes adustus*
17. *Lutjanus apodus*
18. *Kiphosus sectator*
19. *Lutjanus jocu*
20. *Sparisoma chrysopterum*
21. *Scarus taeniopterus*
22. *Scarus vetula*
23. *Sphyraena barracuda*
24. *Sparisoma rubripinne*
25. *Acanthurus chirurgus*
26. *Microspathodon chrysurus*
27. *Haemulon flavolineatum*
28. *Haemulon macrostomum*
29. *Haemulon sciurus*
30. *Ginglymostoma cirratum*
31. *Hypoplectrus puella*
32. *Scarus iserti*

The most abundant fish species at this site were *Abudefduf saxatilis, Sparisoma viride, Stegastes planifrons*.
The average topographic complexity was P= 0.2158
Key invertebrates identified were: Lobster (*Panulirus argus*), Queen Conch (*Strombus gigas*), Long-spined sea urchin (*Diadema antillarum*) and *Echinometra sp;* the latter two are the most abundant
Comments: Reef patch with abundant dead corals and few fishes.

Figura 5: a) Dead corals (ideal lobster-refuge site), b) Spiny Lobster (Panulirus argus) © I Bonilla

Nee Reef
The species of adult fish included in the census at this site were:

1. *Abudefduf saxatilis*
2. *Kiphosus sectator*
3. *Stegastes planifrons*
4. *Sparisoma viride*
5. *Haemulon macrostomum*
6. *Microspathodon chrysurus*
7. *Pomacanthus arcuatus*
8. *Lutjanus apodus*
9. *Haemulon plumierii*
10. *Ginglymostoma cirratum*
11. *Acanthurus chirurgus*
12. *Scarus taeniopterus*
13. *Anisotremus virginicus*
14. *Thalassoma bifasciatum*
15. *Lutjanus jocu*
16. *Haemulon sciurus*
17. *Sparisoma rubripinne*
18. *Haemulon flavolineatum*
19. *Scarus iserti*
20. *Sparisoma aurofrenatum*
21. *Scarus vetula*
22. *Acanthurus coeruleus*
23. *Scarus coelestinus*
24. *Sparisoma chrysopterum*
25. *Acanthurus bahianus*
26. *Ocyurus chrysurus*
27. *Scarus guacamaia*
28. *Stegastes diencaeus*
29. *Carangoides ruber*
30. *Stegastes adustus*
31. *Sphyraena barracuda*
32. *Cacharhinus perezii*

The most abundant fish species were: *Haemulon sciurus, Sparisoma viride, Sparisoma rubripinne.*
The average topographic complexity was P= 0.25525
Key invertebrates identified were: Lobsters (*Panulirus argus*) and *Echinometra sp;* the latter was the most abundant.
Comments: Shallow reef patch with few fishes.

Martínez Reef

The species of adult fish included in the census at this site were:

1. *Stegastes planifrons*
2. *Halichoeres bivittatus*
3. *Haemulon macrostomum*
4. *Haemulon plumierii*
5. *Microspathodon chrysurus*
6. *Stegastes leucostictus*
7. *Pomacanthus arcuatus*
8. *Anisotremus virginicus*
9. *Lutjanus apodus*
10. *Hypoplectrus puella*
11. *Scarus coelestinus*
12. *Acanthurus coeruleus*
13. *Scarus guacamaia*
14. *Kiphosus sectator*
15. *Sparisoma viride*
16. *Thalassoma bifasciatum*
17. *Lutjanus jocu*
18. *Stegastes diencaeus*
19. *Stegastes adustus*
20. *Sparisoma rubripinne*
21. *Haemulon sciurus*
22. *Scarus iserti*
23. *Sparisoma aurofrenatum*
24. *Sparisoma chrysopterum*
25. *Scarus taeniopterus*
26. *Scarus vetula*
27. *Lachnolaimus maximus*
28. *Ocyurus chrysurus*
29. *Haemulon flavolineatum*
30. *Holacanthus tricolor*

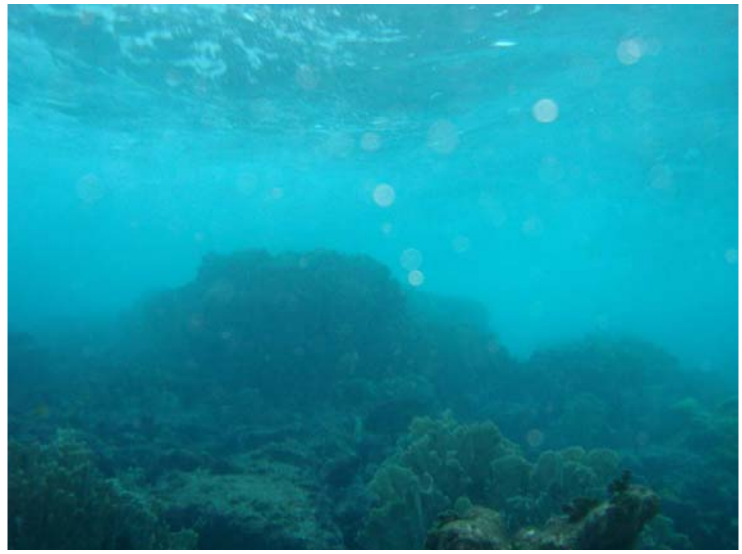


Figure 6: Shallow reef patch no more than 2.5-m deep © I

Figure 11: Reef patch with abundant Acropora palmata corals and Midnight Parrotfish (Scarus coelestinus) © I Bonilla

Muerto Cay

The species of adult fish included in the census at this site were:

1. *Abudefduf saxatilis*
2. *Kiphosus sectator*
3. *Stegastes planifrons*
4. *Scarus coelestinus*
5. *Microspathodon chrysurus*
6. *Sparisoma viride*
7. *Haemulon macrostomum*
8. *Sparisoma aurofrenatum*
9. *Lutjanus apodus*
10. *Scarus guacamaia*
11. *Lutjanus jocu*
12. *Haemulon carbonarium*
13. *Sparisoma atromarium*
14. *Sphyraena barracuda*
15. *Pomacanthus arcuatus*
16. *Ocyurus chrysurus*
17. *Stegastes leucostictus*
18. *Stegastes diencaeus*
19. *Stegastes adustus*
20. *Scarus iserti*
21. *Sparisoma rubripinne*
22. *Haemulon sciurus*
23. *Hypoplectrus aberrans*
24. *Ginglymostoma cirratum*
25. *Hypoplectrus indigo*
26. *Hypoplectrus puella*
27. *Nicholsina usta*
28. *Haemulon flavolineatum*
29. *Carangoides ruber*
30. *Diodon hystrix*
31. *Halichoeres bivittatus*
32. *Acanthurus chirurgus*
33. *Haemulon parra*
34. *Haemulon plumierii*
35. *Lutjanus analis*
36. *Scarus vetula*

The most abundant fish species were *Abudefduf saxatilis, Stegastes planifrons, Kiphosus sectator.*
The average topographic complexity was P= 0.3822

Key invertebrates identified were: Lobsters (*Panulirus argus*), Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp;* the latter was the most abundant.

Name of APESCO: Arrecife Media Luna
Country: Honduras

Name of Site	Date	Coordinates		Depth (m)	Transects
Arrecife Media Luna 1	7/10/09	15°13.183´N	82°42.577´W	4	6
Arrecife Media Luna 2	7/10/09	15°13.793´N	82°42.378´W	4	6
Arrecife Media Luna 3	7/10/09	15°15.455´N	82°39.974´W	4	6
Arrecife Media Luna 4	8/10/09	15°15.677´N	82°38.324´W	5	6
Arrecife Media Luna 5	8/10/09	15°14.157´N	82°36.481´W	6	6
Arrecife Media Luna 6	8/10/09	15°12.413´N	82°34.427´W	5	6

APESCO 2 was sub-divided into 6 sites due to its large size. Sites at the exterior fringe of the reef were chosen, seeking to find increased representativeness. As is the case with APESCO 1, this is a rather shallow area with an average depth of 4 meters.

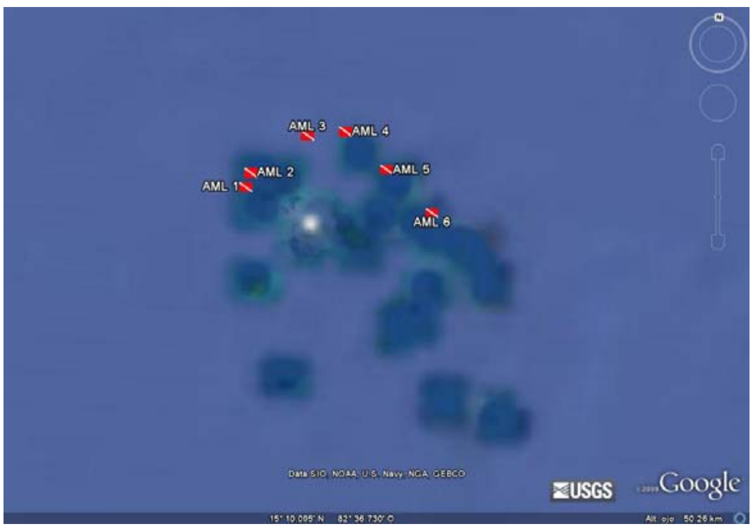


Figure 7: APESCO 1 (Nicaragua) with its 6 sampling sites (Digitalized by Pablo Rico)

Arrecife Media Luna 1

1. *Stegastes planifrons*
2. *Haemulon plumierii*
3. *Ocyurus chrysurus*
4. *Scarus iserti*
5. *Hypoplectrus puella*
6. *Chaetodon capistratus*
7. *Thalassoma bifasciatum*
8. *Halichoeres bivittatus*
9. *Hypoplectrus guttavarius*
10. *Pomacanthus arcuatus*
11. *Stegastes leucostictus*
12. *Hypoplectrus unicolor*
13. *Stegastes partitus*
14. *Sparisoma aurofrenatum*
15. *Lutjanus jocu*

16. *Kiphosus sectator*
17. *Diodon holocanthus*
18. *Sparisoma atromarium*
19. *Abudefduf saxatilis*
20. *Sparisoma viride*
21. *Synodus intermedius*
22. *Stegastes diencaeus*
23. *Stegastes adustus*
24. *Scarus vetula*
25. *Halichoeres garnoti*
26. *Hypoplectrus aberrans*
27. *Anisotremus virginicus*
28. *Scarus coelestinus*
29. *Haemulon flavolineatum*
30. *Sparisoma rubripinne*
31. *Halichoeres radiatus*
32. *Carangoides ruber*
33. *Lactophrys triqueter*
34. *Scarus guacamaia*
35. *Haemulon sciurus*
36. *Synodus foetens*

The most abundant fish species were: *Stegastes planifrons*, *Ocyurus chrysurus, Scarus iserti*.
The average topographic complexity was P= 0.232
Key invertebrates identified were: Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp*; the latter was the most abundant.

Arrecife Media Luna 2

1. *Stegaste*
2. *Scarus i*
3. *Haemulon plumierii*
4. *Halichoeres bivittatus*
5. *Ocyurus chrysurus*
6. *Thalassoma bifasciatum*
7. *Microspathodon chrysurus*
8. *Halichoeres garnoti*
9. *Sparisoma aurofrenatum*
10. *Sparisoma atromarium*
11. *Hypoplectrus guttavarius*
12. *Hypoplectrus puella*
13. *Chaetodon capistratus*
14. *Sparisoma viride*
15. *Haemulon bonaeriensi*
16. *Pomacanthus arcuatus*
17. *Hypoplectrus unicolor*
18. *Stegastes diencaeus*
19. *Haemulon flavolineatum*
20. *Stegastes adustus*
21. *Anisotremus virginicus*
22. *Scarus vetula*

23. *Hypoplectrus aberrans*
24. *Synodus foetens*
25. *Gramma loreto*
26. *Canthidermis sufflamen*
27. *Lachnolaimus maximus*

The most abundant fish species were: *Scarus iserti. Stegastes planifrons, Halichoeres garnoti.*
The average topographic complexity was P= 0.3314
Key invertebrates identified were: Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp*; the latter was the most abundant.


Figure 8: a) Hypoplectrus aberrans, *b) Herbibores (Scarus iserti) © I Bonilla*

Arrecife Media Luna 3

1. *Stegastes planifrons*
2. *Halichoeres bivittatus*
3. *Haemulon plumierii*
4. *Sparisoma aurofrenatum*
5. *Scarus iserti*
6. *Stegastes partitus*
7. *Ocyurus chrysurus*
8. *Microspathodon chrysurus*
9. *Haemulon aurolineatum*
10. *Haemulon macrostomum*
11. *Sparisoma atromarium*
12. *Chaetodon capistratus*
13. *Pomacanthus arcuatus*
14. *Carangoides bartholomaei*
15. *Kiphosus sectator*
16. *Sphyraena barracuda*
17. *Hypoplectrus guttavarius*
18. *Stegastes diencaeus*
19. *Stegastes adustus*
20. *Haemulon flavolineatum*
21. *Halichoeres garnoti*
22. *Sparisoma viride*

23. *Hypoplectrus puella*
24. *Sparisoma chrysopterum*
25. *Sparisoma rubripinne*
26. *Thalassoma bifasciatum*
27. *Haemulon chrysargyreum*
28. *Hypoplectrus aberrans*
29. *Scarus taeniopterus*
30. *Calamus calamus*
31. *Hypoplectrus unicolor*
32. *Hypoplectrus nigricans*

The most abundant fish species were: *Stegastes planifrons*, *Haemulon aurolineatum*, *Halichoeres bivittatus*.
The average topographic complexity was P= 0.2376
Key invertebrates identified were: Lobsters (*Panulirus argus),* Slate Pencil Urchins (*Eucidaris tribuloides*), Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp*; the latter two were the most abundant.

Figure 9: Acropora cervicornis coral colony © I Bonilla

Arrecife Media Luna 4

1. *Haemulon aurolineatum*
2. *Haemulon plumierii*
3. *Abudefduf saxatilis*
4. *Sparisoma atromarium*
5. *Sparisoma rubripinne*
6. *Stegastes planifrons*
7. *Microspathodon chrysurus*
8. *Halichoeres bivittatus*
9. *Thalassoma bifasciatum*
10. *Ocyurus chrysurus*
11. *Scarus iserti*
12. *Kiphosus sectator*
13. *Sparisoma viride*
14. *Anisotremus virginicus*
15. *Sparisoma aurofrenatum*

16. *Pomacanthus arcuatus*
17. *Acanthurus coeruleus*
18. *Haemulon macrostomum*
19. *Pempheris schomburgkii*
20. *Stegastes leucostictus*
21. *Stegastes adustus*
22. *Halichoeres garnoti*
23. *Scarus taeniopterus*
24. *Lutjanus jocu*
25. *Hypoplectrus puella*

The most abundant fish species were: *Kiphosus sectator, Pomacanthus arcuatus, Sparisoma rubripinne*.
The average topographic complexity was P= 0.2486
Key invertebrates identified were: Sea Urchins (Tripneustes esculentus), Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp*; the latter was the most abundant.


Figure 10: Combination of hard and soft corals   © I Bonilla

Arrecife Media Luna 5

1. *Scarus coelestinus*
2. *Stegastes planifrons*
3. *Halichoeres bivittatus*
4. *Sparisoma atromarium*
5. *Ocyurus chrysurus*
6. *Haemulon plumierii*
7. *Sparisoma aurofrenatum*
8. *Abudefduf saxatilis*
9. *Sparisoma viride*
10. *Thalassoma bifasciatum*
11. *Scarus iserti*
12. *Gramma loreto*
13. *Anisotremus virginicus*
14. *Haemulon macrostomum*

15. *Pomacanthus arcuatus*
16. *Lachnolaimus maximus*
17. *Carangoides ruber*
18. *Canthigaster rostrata*
19. *Carangoides bartholomaei*
20. *Haemulon aurolineatum*
21. *Holacanthus ciliaris*
22. *Lutjanus synagris*
23. *Stegastes adustus*
24. *Microspathodon chrysurus*
25. *Scarus guacamaia*
26. *Sparisoma rubripinne*
27. *Stegastes leucostictus*
28. *Halichoeres garnoti*
29. *Cephalopholis cruentatus*
30. *Kiphosus sectator*
31. *Scarus vetula*
32. *Hypoplectrus guttavarius*
33. *Hypoplectrus nigricans*
34. *Haemulon chrysargyreum*
35. *Hypoplectrus puella*
36. *Chaetodon capistratus*
37. *Haemulon sciurus*
38. *Echeneis naucrates*
39. *Synodus foetens*

The most abundant fish species were: *Ocyurus chrysurus*, *Scarus coelestinus*, *Stegastes planifrons*.
The average topographic complexity was P= 0.2
Key invertebrates identified were: Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp* ; the latter was the most abundant.

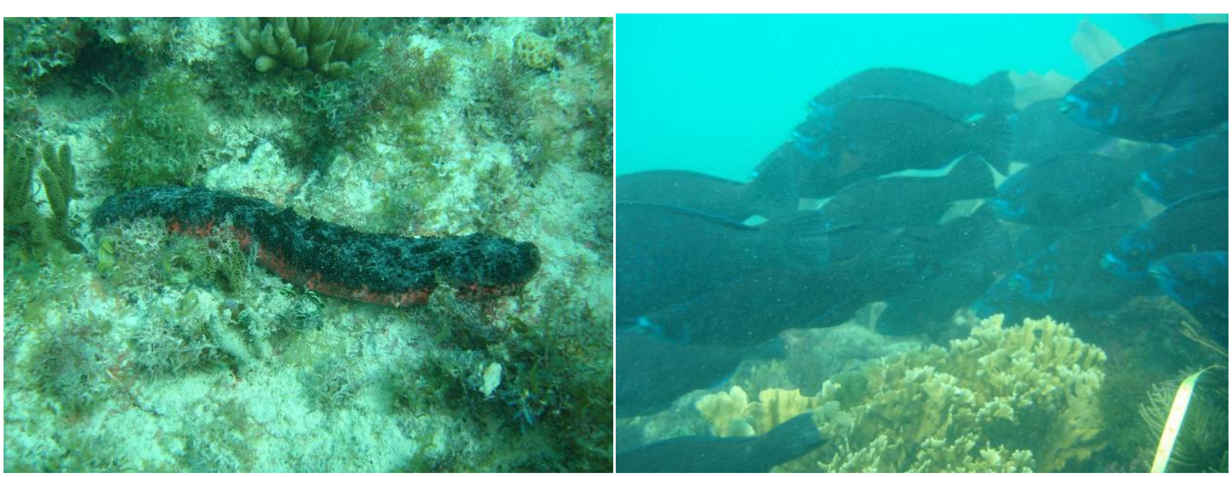


Figure 11: a) Sea Cucumbers *b) Midnight Parrotfish (Scarus coelestinus)*

Arrecife Media Luna 6

1. *Lutjanus jocu*
2. *Abudefduf saxatilis*
3. *Stegastes planifrons*
4. *Caranx latus*
5. *Microspathodon chrysurus*
6. *Sparisoma viride*
7. *Kiphosus sectator*
8. *Scarus iserti*
9. *Pomacanthus arcuatus*
10. *Haemulon macrostomum*
11. *Lachnolaimus maximus*
12. *Lutjanus apodus*
13. *Scarus coelestinus*
14. *Thalassoma bifasciatum*
15. *Sparisoma atromarium*
16. *Ocyurus chrysurus*
17. *Sparisoma aurofrenatum*
18. *Haemulon plumierii*
19. *Halichoeres radiatus*
20. *Gramma loreto*
21. *Sparisoma rubripinne*
22. *Stegastes adustus*
23. *Sparisoma chrysopterum*
24. *Halichoeres bivittatus*
25. *Anisotremus virginicus*
26. *Stegastes leucostictus*
27. *Halichoeres garnoti*
28. *Hypoplectrus puella*
29. *Sphyraena barracuda*
30. *Scarus vetula*
31. *Scarus guacamaia*
32. *Hypoplectrus guttavarius*
33. *Carangoides ruber*
34. *Chaetodon capistratus*
35. *Stegastes diencaeus*
36. *Diodon holocanthus*
37. *Hypoplectrus nigricans*

The most abundant fish species were: Scarus *coelestinus*, *Lutjanus jocu*, *Sparisoma rubripinne.*
The average topographic complexity was P= 0.3344
Key invertebrates identified were: Lobsters (*Panulirus argus),* sea urchins *(Tripneustes esculentus)*, Long-spined sea urchins (*Diadema antillarum*) and *Echinometra sp* ; the latter was the most abundant.

Figure 12: Large Diploria Brain Coral © I Bonilla

Figure 13: a) Dead corals *b) Lobster (Panulirus argus) © I Bonilla*