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# USAID REGIONAL PROGRAM FOR THE MANAGEMENT OF AQUATIC RESOURCES AND ECONOMIC ALTERNATIVES

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# THE CURRENT STATUS OF EXPLOITATION AND CONSERVATION OF THE QUEEN CONCH *STROMBUS GIGAS* IN THE GULF OF HONDURAS AND THE BAY ISLANDS

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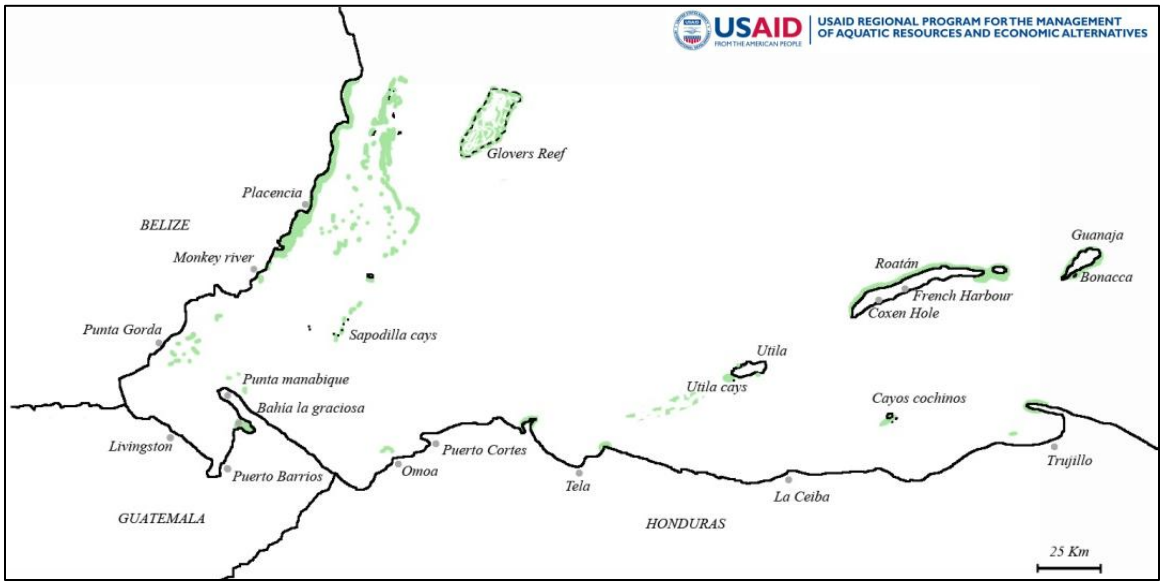
## Acronyms

| | |
|---|---|
| AGRRA | Atlantic and Gulf Rapid Reef Assessment |
| BICA | Bay Islands Conservation Association |
| CEMU | Centro de Ecología Marina de Utila |
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| DIGEPESCA | Dirección General de Pesca y Acuicultura |
| DIPESCA | Departamento de Manejo de la Pesca y Acuicultura |
| EEZ | Exclusive Economic Zone |
| GOH | Gulf of Honduras |
| ICF | Instituto Nacional de Conservación y Desarrollo Forestal, Areas Protegidas y Vida Silvestre |
| NGO | Non Governmental Organization |
| OIRSA | Organismo Internacional Regional de Sanidad Agropecuaria |
| PMAIB | Proyecto de Manejo Ambiental de la Islas de la Bahía |
| SAG | Secretaria de Agricultura y Ganadería |
| TAC | Total allowable catch |
| TIDE | Toledo Institute for Development and Environment |
| TRIGOH | La Alianza Trinacional para la Conservación del Golfo de Honduras |
| WCS | Wildlife Conservation Society |

# INTRODUCTION

The Gulf of Honduras (GOH), in the Caribbean Sea, is bordered by Guatemala, Honduras and Belize. The Gulf is commonly considered to encompass the coastal waters in southern Belize from the town of Dangriga, across to La Ceiba on the north shore of Honduras. It also extends up to incorporate the Bay Islands of Honduras (Map 1). The Gulf's geographic position means it is influenced by complex dynamics from both coastal and Open Ocean waters. Their seasonal current patterns help structure the marine environment of the area and have helped develop a highly diverse set of systems within this eco-region, including estuaries, lagoons, intertidal salt marshes, mangrove forests, seagrass beds, cays, fringing reefs and barrier reefs. This array of habitats supports a wealth of marine fauna and flora, both resident and migratory, making the Gulf of Honduras a marine biodiversity hotspot and an important focus for management attention and conservation action.




**Map 1 – Locations of the main fishing communities and areas of suitable habitat for queen conch (shaded green) within the Gulf of Honduras and the Bay Islands.**

The Gulf is influenced by the changing conditions brought about by two seasonal weather patterns. The rainy season, during July to October, when the fluvial input from the watersheds of 16 important rivers (including the Rio Dulce and Sarstún in Guatemala) strongly influence the area. This creates estuarine conditions of lowered salinity, increased turbidity and elevated water temperature. These fluvial influences extend out from the coastal areas of the Gulf towards the Sapodilla Cayes and around Punta Manabique.

The dry season in contrast, when fresh water input drops, brings with it conditions controlled by the Caribbean sea with oceanic water moving into the

gulf from the deep oceanic currents of the Cayman trench, combined with the effects of the trade winds pushing surface waters to the west. These changing seasons and resultant fluctuations in marine conditions strongly influence the fisheries of the area. The change from coastal estuarine conditions to oceanic ones, affects the productivity of distinct food webs that ultimately influences the abundance and distribution of many of the important fish species of the area and their migrations in and out of the Gulf. The Gulf is therefore integrally connected both with the coastal zone and with the wider Caribbean Sea.

The Gulf of Honduras is as geopolitically complex as it is biophysically. Incorporating the territorial waters of three countries the area has historically been of strategic importance for its safe harbors and trade routes that link Central America to the wider Caribbean. In addition the rich marine resources including the area's diverse fisheries as well as the potential for unexploited mineral wealth, and increasing coastal tourism, mean that the boarders demarcating the Gulf have been the focus of long running international debate, dating back to colonial times.

As the human population in the Gulf continues to grow, and pressure on the area's natural resources increases, anthropogenic impacts are threatening the integrity of the areas marine diversity. In addition to coastal develop and point and non-point source pollution that decreases the extent and quality of coastal ecosystems and their adjacent waters, the unsustainable exploitation of the areas fisheries and negative feedback loops between fisheries health and that of their supporting ecosystems, is of acute concern. Amongst the various fisheries of the area that include shrimp, fin fish and lobster, it is the queen conch that provides one of the greatest fisheries management challenges for the region.

The queen conch, *Strombus gigas*, is the largest of the marine gastropods in the Caribbean. Long lived and slow growing, its life history traits make their populations vulnerable to unsustainable exploitation. The preference of conch for shallow waters, easily accessible to divers from the surface and its large obvious shell, means it is a simple fishery for coastal communities to target (See Appendix I for more on the biology and ecology of conch). Its edible foot muscle provides a source of high quality protein and has made conch part of the culinary heritage of the Caribbean. Today strong market demand ensures that conch remains a high value product, especially in the insatiable market of the United States. Conch fisheries remain the second most valuable coastal fishery in the Caribbean basin, eclipsed only by the spiny lobster (*Panulirus argus*).

These qualities have meant that conch has been heavily exploited across its entire range. As a result of concerns of regional population declines conch was listed on Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) in 1992. As an Appendix II listed species conch is not necessarily threatened with extinction, however trade must

be monitored and controlled to ensure that international trade does not threaten their survival.

Since 1992 there has been sustained interest and effort of individual nations in adopting national management and technical measures aimed at keeping national queen conch stocks at sustainable levels. A species review by CITES in 2003 however found that the implementation of the CITES regime and subsequent national management plans had been experiencing some difficulties in many countries, especially those that lack the necessary technical capacity. Thirteen countries (including Belize) were provided with recommendations to improve management whilst three countries (including Honduras), were deemed to not be controlling exploitation. Imports of conch from those countries was banned by CITES.

To date there are continuing concerns that a large element of illegal fishing and trade still persists despite the CITES listing and conch stocks at a regional level are struggling to recover. USAID continue to work within Latin America and the Caribbean to promote environmental compliance, including specific attention to increasing the capacity within countries to provide effective oversight and enforcement of the CITES regulations.

As a species with a pelagic larval phase, conch populations may be connected at larger scales with stocks reliant on seeding from individuals whose reproductive output crosses national boundaries which are biologically arbitrary. Similarly, especially in small bodies of water with multiple territorial jurisdictions there is a need for increased coordination and harmonization in management strategies to provide consistent regulation and oversight to the areas resources, irrespective of the waters they are in. In the Gulf of Honduras there is a clear requirement to shift the management paradigm towards cross border cooperation in marine management.

The unequal spatial distribution in the fisheries resources of the Gulf compared to human population density and resultant fishing pressure provides a complex management challenge, with the only viable solution being tripartite cooperation. Belize has the lowest human population yet the highest density of conch in the Gulf of Honduras. Honduras by contrast has regionally important stocks of conch, but they are located in its eastern territorial sea, about 500 km from the Gulf's waters. Yet Honduras has a significant coastal population in the west including its second largest city, San Pedro Sula, of a million people which lies just 25 km from the Gulf of Honduras coast. Guatemala has the largest population and likely the largest number of active fishers in the Gulf of Honduras, but does not have a commercially viable national conch fishery. There is market demand for conch in each of the three countries and currently fishers from each are actively targeting the available resources.

## Methodology

Against this background, the objective of the current program is to develop a framework to build a tripartite management plan for queen conch in the Gulf of Honduras. In this review, we look at the current status of exploitation and conservation of conch in each of the three countries in the Gulf region. Through a comprehensive literature review, interviews with stakeholders across the zone, and fisheries data compiled from fisheries departments, independent data sources, CITES databases and international import/export records, we provide an in-depth analysis of the existing conch fisheries situation. This document will form the basis to identify key issues facing sustainable management of conch, and through a participatory process with stakeholders and a series of workshops we aim to prioritize these issues and define pragmatic ways of resolving or mitigating them through a realistic, implementable, management framework.

# BELIZE

## Executive Summary – Belize

Belize has the largest extent of coral reefs and connected coastal habitats, as well as the largest conch stocks in the Gulf of Honduras. Belize also has the fewest number of fishermen whilst possessing the most developed fisheries management framework of the three countries.

With both industrial fishing and tank diving for fishing banned within Belizean waters the conch fishery is structured around highly commercialized small scale fishers, who skin dive from small boats to collect conch. Fishing cooperatives, largely formed in the 1960´s, control much of the harvesting of conch and are the only organizations that can process and pack conch for export.

The conch fishery has a strong management framework with an annual closed season (1st July to 30th September), a minimum size (178mm) and a total allowable catch (TAC) for the fishery as a whole. There are not individual catch limits or a limit on the number of fishermen, although all fishermen need to be licensed. The TAC is set by the fisheries department using yield data supplied by the cooperatives from export volume combined with biannual population estimates from underwater visual surveys of fishing banks and protected areas across the country. A simple, surplus production model is used to calculate maximum sustainable yield and this is the basis upon which the total allowable catch is set. Conch populations are provided with additional protection from fishing through a network of marine protected areas that currently cover 2% of the territorial waters of Belize.

The current conch management paradigm in Belize relies on effective population and fishing estimates to be used in the yield model to set quotas. In addition the sustainability of the fishery relies on the as yet unproven ability of protected areas to repopulate fished areas, and the as yet unquantified, deep water conch populations to replenish shallow water stocks. As more fisheries data becomes available it may be possible to change the current reliance on simple yield models to a more accurate estimator based on catch and effort time series data. In addition there is an urgent need to quantify connectivity of areas inside and outside of reserves and between demographically and bathymetrically segregated populations both within and beyond national boundaries.

Whilst the majority of conch is for the export market, there is an expanding domestic market driven by tourism growth. This alternative market demand has the potential to reduce the efficacy of the cooperative data for the fisheries regulatory mechanism, since domestic supply can occur directly without being channeled through the cooperative system and thus is not included in fisheries statistics. The current data collection process may therefore need to evolve to reliably quantify and regulate conch landings destined for the national market to ensure they are accounted for within the annual quotas of the fishery and subsequent catch quotas.

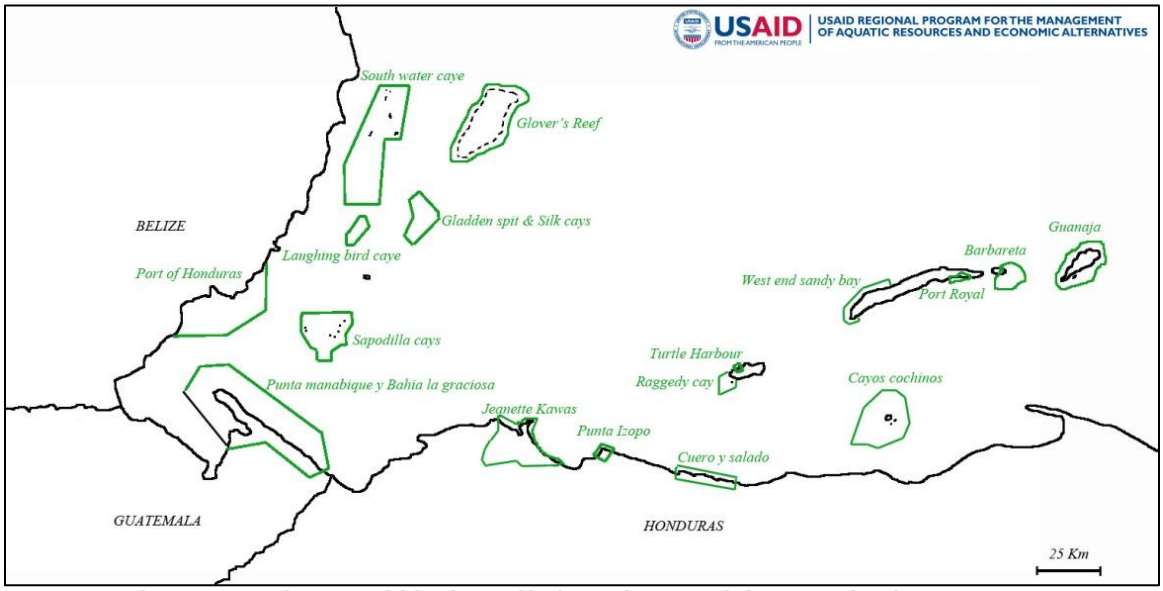
The illegal fishing by Guatemalan and Honduran fishers within Belizean territorial waters is a main concern for the sustainable management of the conch fishery in southern Belize. Illegal capture by Guatemala and Honduras could form an additional 20 % of the weight of registered Belizean exports. In addition to strengthening enforcement,

developing mechanisms to facilitate the legal export of conch from Belize to its neighbors is an important priority to help decrease the illegal fishing activities.

Belize has made significant progress in developing management capacity for its marine resources, especially for conch and lobster which dominate the fisheries economy. It is crucial that management of conch remains an active and adaptive process with the aim of continually recuperating the conch population, following the population crash of 1970's brought about by overfishing.

## The fishing communities and actual practices

The waters of Belize are divided into six fishing zones demarcated by the Fisheries Department based on the separation of distinct habitat types and resultant fish assemblages in each area. Southern Belize incorporates area 6, south of Gladden Spit, and Area 5 around Glover's Reef. The area includes six designated marine protected areas of Glover's reef, South Water Caye, Gladden spit and Silk Cayes, Laughing Bird Cayes, Port of Honduras and the Sapodilla Cayes (Map 2). Each marine protected area is under a separate management plan.




**Map 2 – Marine protected areas within the Gulf of Honduras and the Bay Islands.**

There are currently (2009) 2,759 licensed fishermen across the Belize Barrier Reef marine ecosystem. More than 76% of them belong to a fishing cooperative (Carcamo 2008). The majority of these fishers are located in northern Belize and belong to the two main fishing cooperatives, the National cooperative and the Northern cooperative (Carcamo 2008). Southern Belize, encompassing the waters south from Glover's Reef, and forming part of the Gulf of Honduras, includes an extensive Belizean coastline. This area has a lower density of fishermen and fishing communities than the north, partly because infrastructure development was only relatively recently built to effectively connect this area to the larger towns in the north.

The main fishing communities of southern Belize include Placencia, Mango Creek, Monkey River, Punta Negra, and Punta Gorda as well as the Sapodilla Cayes and Snake Cayes (Map 1). Glover's reef is fished by the communities of Sarteneja, Dangriga and Hopkins.

Diving on SCUBA is prohibited for fishing in Belize so all conch collection occurs through skin diving. Conch fishing grounds are situated in the shallow (3-5 m) back reef waters that normally contain sea grass, sand and algae. This is the depth range that can be efficiently skin dived, although people can reach down to deeper depths. Visibility is also a limiting factor and clearer off shore waters tend to attract more intensive fishing effort as it is easier to locate conch. The main fishing grounds in the south are around the Sapodilla Cayes and other outer reef banks and seagrass areas (Map 1) as well as north

around Glover's reef and areas closer in shore in the Port of Honduras. Once again the fishers are focusing on fishing for lobster and collecting conch they encounter at the same time. In areas where the fishers use lobster huts, there is an increasing tendency to place the lobster huts in areas where conch are found in larger aggregations, to minimize effort within the two fisheries. The lower price of conch means that fishermen do not believe it can be a standalone fishery, but as with other areas, this may be a historical position for which the actual economic rational may not be certain.

The fishing cooperatives

The conch fishery has a long history in Belize. Conch was historically abundant in near shore waters with records of its local consumption as far back as the 1800s (Morris 1883). Conch collection has always been intertwined and somewhat overshadowed by lobster fishing. The lobster fishery was the first to grow commercially in the 1950s to supply export demand through foreign owned businesses. A major change to the organizational structure of Belizean fisheries occurred in the 1960s with the development of fisheries cooperatives, started by groups of fishermen. In 1965 a law that granted export quotas only to cooperatives effectively shut down foreign fish exporters, leaving the fisheries and the export markets to Belizean fishers.

The *Northern Fishermen Cooperative* Society Ltd was the first fishing cooperative to be founded, on Caye Caulker, in 1960. The *Placencia Producers Cooperative Society* Ltd followed in 1962 and the fishermen of San Pedro, Ambergris Caye, formed the *Caribeña Producers Cooperative Society* Ltd, in 1963. The *National Fishermen Producers Cooperative Society* Ltd. was the last of the four main cooperatives to form and was registered in 1966.

From about 1965 the cooperatives diversified from lobster into conch, due to its abundance, ease of collection and high export price. Conch was plentiful, the demand was high and the fishery boomed. The Belizean fisheries became "highly commercialized artisanal fisheries" using simple fishing techniques but harvesting in significant quantity. However, by 1970 the conch population was already in decline with fishers needing to skin dive to deeper areas to collect them. Production peaked at 1200 t in 1972 (Acosta 2006).

In 1975 the conch population crashed, just a decade after the law that granted the fisheries to the cooperatives. The conch population and its dependent fishery has never recovered to pre 1975 levels (Huitric 2005) and current production has averaged between 227 t – 272 t since the 1980s (Carcamo 2008), just 25% of peak production levels. This well documented fisheries crash illustrates that whilst the formation of fisheries cooperatives and granting local ownership helps to redistribute the economic gains of a fishery, it does not automatically lead to sustainable fisheries if other management measures are not also in place. The Fisheries Department of Belize instigated management measures for the conch fishery in 1977.

Each of the four main cooperatives in northern Belize established the infrastructure to supply the export market for lobster, conch and fish through their own processing and packing plants. Since the early 1990s, when the cooperatives in Placencia and San Pedro discontinued processing their catch for export, due to rising costs and lower production, the National and Northern cooperatives absorbed the supply and have dominated the export industry.

More recently in Punta Gorda, the *Rio Grande cooperative* was established with around 60 members in 2001. A branch of the Northern Fishermen's Cooperative Society based in Mango Creek also opened following damage to fisheries further north in the wake of 2 hurricanes in 2000 and 2001. Whilst these and other smaller cooperatives have been established in central and southern Belize, they essentially lack the critical mass or economic investment to establish the logistical requirements to become completely independent. Instead they tend to simply provide products to the larger cooperatives in the north.

There are concerns from some local fishers in the south that developing a chain of cooperatives is slightly at odds with the initial principle to cut out intermediaries and connect fishers directly to markets. In the Rio Grande cooperative particularly, where as the southernmost cooperative, the transport costs to the north significantly limit profit margins, there is a desire to seek market independence. This includes diversifying into additional fisheries products such as deep water snappers or live seafood products and working to develop stronger demand in national markets.

## Commercialization and final markets

The conch fishery continues to be driven by export demand. Over 99% of conch exports from Belize are to the Unites States with CITES data showing Belize exported 301 t of clean conch meat in 2009, the last year when full records are currently available (Figure 1). Conch exports have shown steady growth in Belize since 1995, when CITES records start. Despite some inter-annual fluctuations exports have increased by an average of 16% per annum across the fourteen year period to 2009 (Figure 2). There is currently no CITES imposed limit on exports of conch from Belize, but the government sets a total allowable catch limit. This is set every two years based on the results of conch surveys and production data from the cooperatives. The total allowable catch is divided between the cooperatives but is also then transferable between them. Under production in the first year can also be transferred into the second year of the quota[1].

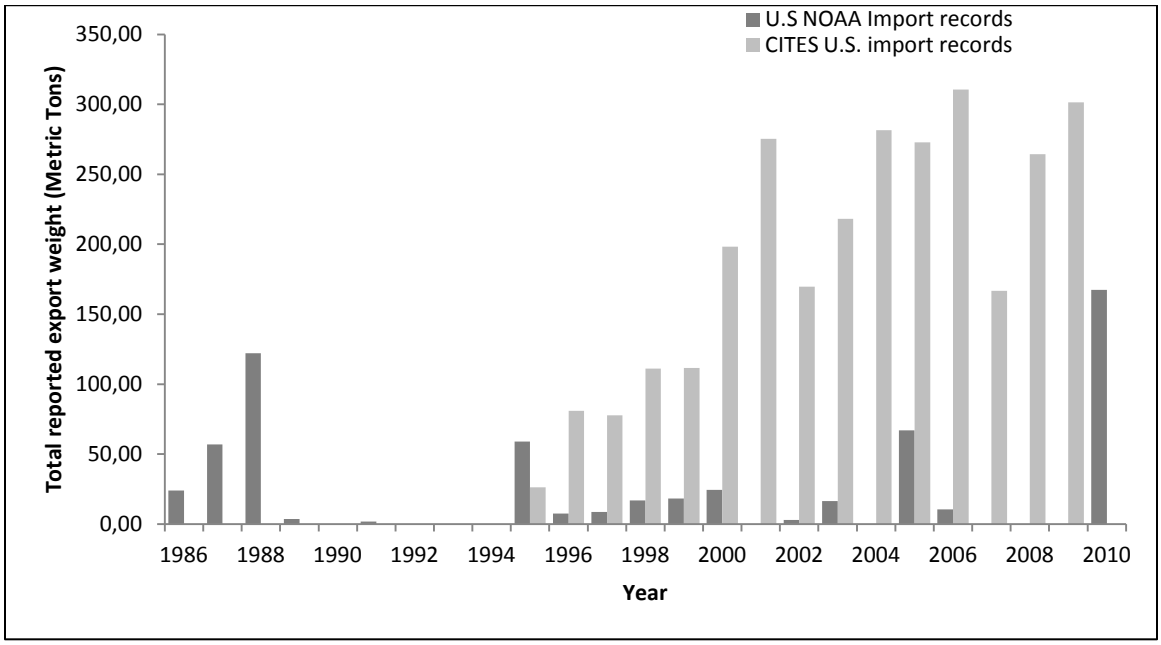



**Figure 1 - Total import weight of conch in to the United States from Belize in metric tons. Data from NOAA fisheries imports data base (dark grey bars) and from the CITES trade database (light grey bars).**

To supply the export market conch is bought by the cooperatives from the cooperative member fishermen at a fixed price. The cooperative then process and pack it for export. Once the costs of the operations and overheads are deducted, the cooperative members receive a second payment at the end of the season in proportion to the amount of conch they bought in. This payment mechanism is one reason why landing data from the cooperatives is so complete, because the records are essential to ensure the second payment system for their members. This data is also an essential part of the conch management framework in Belize, with the government fisheries department relying on these records for data on landed catch.

[1] Based unpublished data from the Fisheries Department of Belize biannual quota allocation and production data from 2009-2010 presented at the national workshop in Belize May 2011

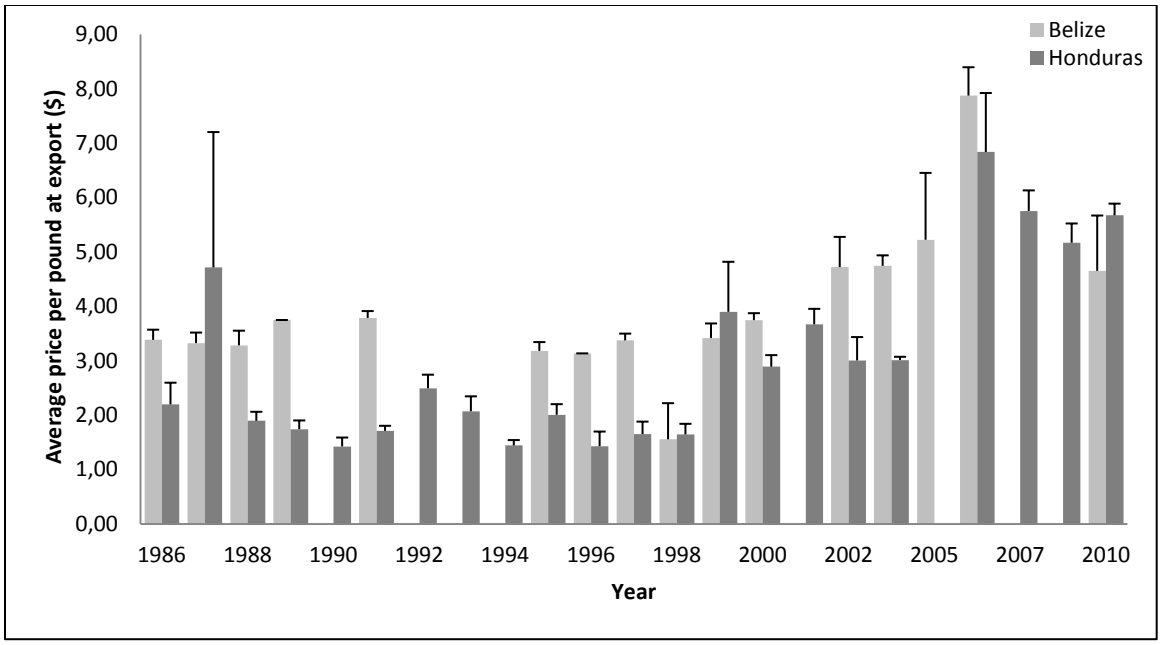



**Figure 2 – Average price at export for Belize and Honduras to the United States (data from NOAA). There is not data for Guatemala as it does not export conch.**

The price at export for conch remained very stable in Belize between 1986 and 2001 averaging $3.27 per pound. The variability in price was very small during this period, with 95% of the prices ranging from $2.91 to $3.63 (Figure 2). In 2002 there was a large increase in the price per pound, with the average price $5.44 per pound between 2002 and 2010. With the increase in price there has also been a significant increase in price fluctuations indicating a more volatile market (Figure 2 & Figure 3). Whilst it is difficult to pin point the exact cause in this sudden price increase, it is likely linked to the 2000 hurricane Keith and the 2001 hurricane Iris which both severely impacted Belize and significantly affected the national fisheries capacity in the north of the country, limiting supply. At a regional level the Jamaican fishery was closed from 2000 to 2002. Jamaica was one of the biggest conch exporters to the U.S and with their fishery closed there would be increased demand for conch from the remaining suppliers, likely elevating prices.

Interestingly, the conch from Belize has historically always had a higher price at export than Honduran conch according to import figures from NOAA (Figure 2). Since 1986 the average import price of conch per pound to the United States from Belize has been one and a half times higher than conch imported from Honduras. This difference is statistically highly significant (One way ANOVA; $P < 0.005$, $F = 34.64$, 1df).

This difference may be because the Belizean cooperatives are able to control price in Belize to favor their members. In contrast the market chain in Honduras is controlled by independent packers and exporting businesses that are separate from the fishers. It is these businesses that set the dockside purchase price of conch and thus the resultant value recorded at export. The fishers cannot effectively influence this pricing system. The exporters from Honduras therefore look to depreciate the local price to maximize profits at the resale end in the Unites States. This is the same in other Honduran fisheries where prices to fishers have not changed for more than a decade despite rising fishing costs (Box and Canty (In Press)). This difference in price between Belize and

Honduras shows the potential benefits that fisheries cooperatives in control of markets and value chains can have for their members, resulting in a better distribution to national fishers of the economic returns from the fisheries resources.

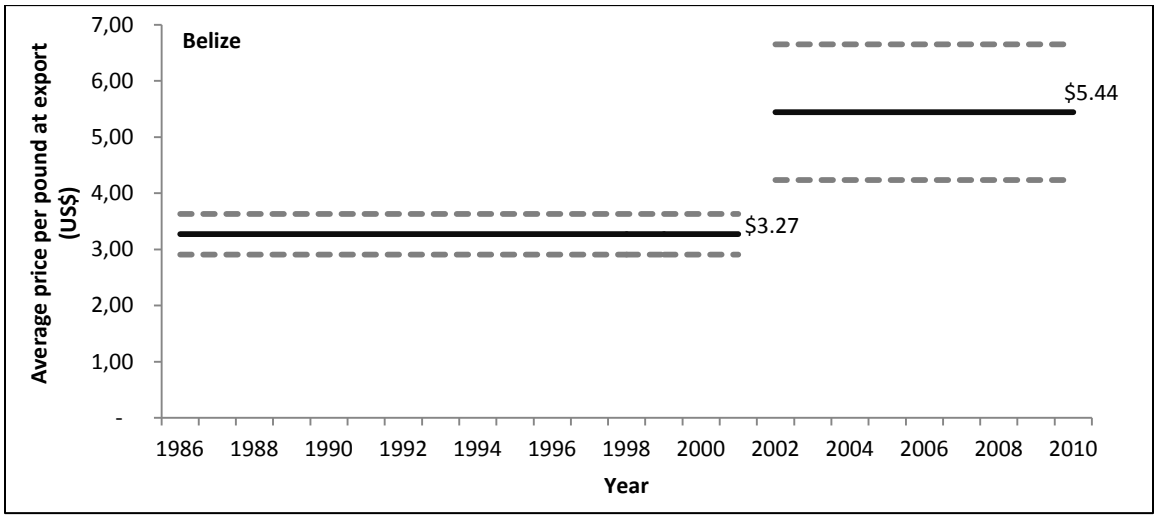



**Figure 3 – Mean price per pound for conch imported from Belize to the United States (solid line). The dashed lines are the 95% limits around the mean, showing the degree of variability in the price. From 1986 to 2001 there was little variability, since 2002 when the price jumped the variability in price has also increased. Data collated from NOAA fisheries import records.**

In recent years however conch prices have been rising in Honduras and the limited data from 2010 suggests that prices for Honduran conch may now be slightly higher than that of Belize (Figure 2, see also Figure 3 and Figure 6). This is most likely a direct result of the trade limitations and consequent quota restrictions placed on conch from Honduras by CITES.

In addition to the export trade there is a highly evident local market for conch in Belize supplying both domestic and tourist markets. Conch is part of the culinary heritage of the country, available in nearly every restaurant in a variety of traditional dishes. Conch is legally sold from the cooperatives at 60% of the export price but as national demand for the product increases through tourism many consumers may be sourcing their conch directly and not through cooperatives. Domestic consumption rates remain poorly quantified and there are few reliable estimates of the consumption of legal conch or illegal conch across the country (Acosta 2006). Quantifying this consumption rate should be an urgent priority to improve quota determination as the proportion of total landed catch consumed nationally is likely to be increasing.

## Critical habitats, conditions and threats

Belize has extensive areas of suitable habitat for conch, including seagrass meadows, sand-algal flats, and near shallow coral reefs (Map 1). In southern Belize important areas include the reefs and seagrass around the Sapodilla Cayes and Glover's Reef, as well as the Port of Honduras and nearer shore waters around Placencia.

The condition of the coral reefs in southern Belize however is declining through a range of local and global threats including amongst others, climate change, coastal development, coral diseases and ocean acidification. Reefs in southern Belize are thought to be in a poorer condition than reefs to the north. Of 33 sites in southern Belize assessed using 4 reef health indicators, 12 were in a critical condition (the lowest category) and 14 were in a poor condition. By contrast only 3 sites were fair, 3 were good and just 1 was very good (McField, Kramer et al. 2010). Whilst Belize has the highest amount of area under marine protection of the countries within the GOH, it accounts for just 2% of their 12 mile territorial waters. Current scientific advice is that 20% of marine areas should be protected from fishing to provide resilience to fish populations and coral reefs. There are initiatives underway for the marine area under protection in Belize to be increased to 15% and then 30% in the coming years (TNC, Pers comms).

In addition to large scale assessment of coral reefs in Belize there has also been a monitoring program on seagrasses as part of "SeagrassNet"[2], which encompasses 14 sites in Belize including Punta Gorda, Placencia and Glovers Reef in the gulf of Honduras. Whilst there is limited data, in Placencia cover has remained stable at around 80%, in Glover's data suggests that seagrass cover has declined slightly between 2008 and 2009 from 45% to 35%. In Punta Gorda, cover has remained stable in East Snake cay at around 40%, but declined at Joe Taylor beach from 65% to 15% between 2008 and 2010. It is important that this seagrass monitoring continues in Belize to ensure that long term data sets can be built up about these important habitats.

There is no specific legislation protecting seagrass areas in Belize, and there are several potential threats facing these near shore habitats as perturbations that influence salinity, water temperature, or turbidity, will affect the productivity of these systems. These areas are particularly sensitive to degradation due to agricultural, industrial, and domestic pollution as well as effluent from coastal shrimp farms. The outflow from shrimp farms contains high levels of organic pollutants, herbicides, pesticides and other chemicals. Whilst little is known about the impacts of these and other coastal pollutants on seagrass, generally as water quality decreases it will have a correlating negative impact on the overall condition of the affected ecosystem.

Pollution, habitat destruction related to coastal development, especially tourism, is a key concern. The construction of marinas and docks and the dredging of channels for access, the removal and deposition of sand and the resultant increases in turbidity and changes to coastal water dynamics can all affect seagrass spatial extent. It is important that future studies assess changes to the marine landscape especially to quantify the loss and fragmentation of coastal and shallow water habitats beyond coral reefs. This is essential because of the links between coral reefs and other coastal habitats and the reliance of conch and other species on more than one of these areas during their life cycle (Appendix I). In addition, fragmentation of habitats presents a key ecological challenge as the increasing separation of suitable habitat reduces their carrying capacity for species across the area as a whole.

[2] www.SeagrassNet.org

## Legislation and regulations

In contrast to Honduras and Guatemala, where marine related tourism and commercial fisheries currently provide a small proportion of the overall national employment and gross domestic product, Belize's economy is underpinned by these sectors. Conch, lobster, fish and wild caught sea-shrimp collectively earned $BZ 24 million dollars from exports in 2006 (Fisheries Department, 2007) accounting for 3% of Gross Domestic Product (GDP) and a significant source of foreign currency. Tourism connected to reefs was estimated to contribute approximately $395 - $559 million US dollars in goods and services each year (approximately 65% of GDP) (McField, Kramer et al. 2010).

As a small country with rich natural resources, there is a political incentive to ensure their sustainability, with the pragmatic realization that there are few obvious alternatives for continued economic growth within the country. Of the three countries bordering the Gulf of Honduras, Belize has made the clearest advances in terms of fisheries management. It actively collects and uses fisheries records; it has the clearest regulations and management strategy for marine resources and the most involved fisheries department and visible enforcement capacity.

The current regulations on conch include a closed season from 1$^{st}$ July to 30$^{th}$ September, a minimum shell length for landed conch of 178 mm and the minimum market 90% clean weight of 3 ounces (85g) and 100% clean weight of 2.75 oz. In addition it is illegal to sell chopped conch and restaurants are only allowed to hold 5 lbs of chopped conch at a time. The closed season was designated to encompass the reported peak period of reproductive activity during summer months and the minimum size aims to ensure only mature adults are harvested. The use of SCUBA and hookah are illegal for all fishing activity (Table 1).

Belize management actions include a systematic data collection and analysis program for conch, incorporating both fisheries dependent (landing records from the fisheries cooperatives) and fisheries independent data (biannual underwater visual surveys). In addition there is a network of marine protected areas that are connected to the goals of fisheries management, by aiming to protect ecologically important areas with increased fishing restrictions in these sites. Enforcement capacity is present through patrols by the fisheries department, the coast guard, the Belize Defense Force and the non-governmental organizations in charge of the co-managed marine protected areas (Map 2).

Following the listing of *Strombus gigas* by CITES in 1992 and the significant trade reviews of 1995 and 2003, the Belize conch fishery was identified as a possible concern based on visual population assessments in shallow waters from 1996, finding few adult size conch. A stock assessment made in 1999 based on available catch and effort data from 1996 to 1998 estimated the total maximum sustainable yield at 284 t per year. The figure however was considered to be an unreliable estimate and it was concluded that the queen conch stocks were overexploited in Belize (CITES 2003).

| | Belize | Guatemala | Honduras |
|---|---|---|---|
| Fisheries law | Regulation No. 6 of chapter 210s of the Belize laws Revised 2000 | ACUERDO MINISTERIAL SG-0059-2010 Articulo 2 | Ley general de pesca vigente 1959 and, Acuerdo 002-2011, 6th January 2011 |
| Minimum Shell length | 178 mm | X | X |
| Minimum clean meat weight (90%) | 3 oz | X | X |
| Minimum clean meat weight (100%) | 2.75 oz | X | X |
| Minimum Lip thickness | X | X | X |
| Gear Restrictions | Cannot use SCUBA | X | X |
| Closed Season | 1st July to 30th September | July 1st to July 31st | Fishery closed, but industrial fishing occurs under the research program which fished from March to August during 2010 |
| CITES export limit | X | X | 210 t per year (2006-2010) |
| Government TAC limit | 347 t per year (2011-2012) | X | X |
| Additional Regulations | Prohibition of diced conch | X | X |

**Table 1 - Current legislation for queen conch in each of the countries of the Gulf of Honduras.**

CITES submitted recommendations to Belize that is should establish cautious catch quotas, initiate the collection of catch and effort data and implement a long term monitoring program. These recommendations would need to be complied with in order to continue to export conch. The Belize Fisheries Department implemented biannual national conch surveys from 2004. The program conducts underwater visual surveys to estimate the conch population and size distribution, with survey transects of 500m by 4m being conducted on the main fishing banks and in marine protected areas across the country.

This survey data is used to estimate density and is then multiplied by the total suitable habitat for conch in the survey area to give an overall abundance. The abundance is then used in conjunction with production figures from the cooperatives using simple production model equations to calculate potential yield of the resource and the maximum sustainable yield. This is used to cautiously set the total catch quota which is divided between the fishing cooperatives. The Belize Fisheries Department set an export quota of 228 t, plus a "local consumption" quota of 12 t per year based on maximum sustainable yield estimates in 2004 (Acosta 2006). In the 2008 Belizean fisheries conch stock population report, the MSY estimates had increased to between 418 t to 492 t (Carcamo 2008) and the yearly quota for 2009-2010 was set at 313 t. Based on the 2010 assessment the quota for 2011-2012 was raised to 347 t.

The Belize conch fishery is considered stable by the Belize fisheries department, based on the data they are collecting. Fishing effort however continues to increase with new entry into the fishery and catch per unit effort does show some indication of decline. For example, from 2004 to 2009 catch per unit of fishers around Glovers reef dropped from an average of 11 conch per hour per fisher (c/h/f) in 2007 to 3 c/h/f in 2009 (WCS 2009). Similarly since 2004 based on the fisheries statistics of the Belize fisheries department whilst total production has increased, the total number of licensed fishers has increased

at a greater rate, meaning production per fisher is actually decreased over the past 5 years, from 163.50 kg per fisher in 2004 to 121.26 kg per fisher in 2009.

## Conservation accomplishments

Conch as the second most important fishery in Belize has received significant attention in the country. It has consistently been incorporated in to management plans and national fisheries laws. It is clear that Belize has made obvious efforts to provide management oversight to the conch fishery and its latest published population assessment found an average density of 88.3 conchs per hectare across the country (Carcamo 2008). Unpublished data from 2010 found an average of 284 conch per hectare, which is a remarkable increase and this density is well above the threshold of 56 conch per hectare thought to be the minimum required to trigger reproductive events and above the 200 required for a stable population.

The recent introduction of full time marine protection in Sapodilla Cayes is a crucial development for the conservation of resources in the region. The area of the Sapodilla Cayes was demarcated in 2009 and resident management station with patrol boats established in 2010. This is important for the area as the Sapodilla Cayes are a contentious area within the Gulf of Honduras and a site of much illegal conch fishing particularly by fishers from Guatemala and Honduras (Perez 2009). It is hoped that increased enforcement presence will help to curb illegal fishing activity including the collection of conch by tourists and visiting tour guides.

Another important development for conch management in Belize is the testing of an individual catch quota system. Whilst there is currently an export limit on conch for the cooperatives set by the government quota system, and all fishermen are required to have fishing licenses, there is currently no limit on the number of national fishing licenses and no individual catch limit. In 2011 two pilot schemes are being initiated to test the efficacy of management through individual conch licenses and a specific individual catch quota for fishermen. This is being tested on a small scale, using fishers associated with two marine reserves, Port of Honduras administered by Toledo Institute for Development and the Environment (TIDE) and Glover's Reef managed by Wildlife Conservation Society (WCS). The project is being coordinated by the Environmental Defense Fund and it is hoped to roll out over the next 12 months.

There are positive indications that protection afforded by the marine protected areas has helped local populations. Glover's Reef has had statistically significant increases in its adult conch populations since enforcement was established in 1998 with this increase primarily in the no take zone of the marine park (Acosta 2006). Data from the Glover's reef surveys conducted by WCS between July 2004 and August 2009 found an average of 25.0 conch per ha (s.d. = 13.1) in the no fishing zone and 20.3 conch per ha (s.d. = 10.4) in the General Use Zone. Importantly there were just 7.3 adult conch (>178mm) per hectare (s.d. = 3.6) in this fishing zone, compared to 17.2 (s.d. = 9.7) in the protected zone (WCS 2009). So whilst the protection is increasing abundance of conch, the numbers even in the reserve are still low. These figures collected by WCS however contrast strongly with the results of the government fisheries survey for 2008. That government report gave an average of 178 adult conch per hectare around Glover's reef

(Carcamo 2008). The reason for the factor of ten discrepancies in the density found by the two data sets is not clear.

There is less data available for the Port of Honduras protected area. The NGO in charge of management (TIDE) have conducted surveys since 2006. In 2009 they found 60 conch per hectare with no significant difference in the density or mean size of conch between the general use and the no take zones (Foster and Williams 2009), but the proportion of adult conch that were part of this population is not determined in the data presented. The fisheries department found 25 adult conch per hectare in the same area (Carcamo 2008). Data collected by TIDE for the 2010 conch surveys for the fisheries department was not included in the national report. The reason for this exclusion of the data is unclear.

The inconsistency between the survey data collected by the fisheries department and the data of the nongovernmental organizations conducting surveys is concerning. Wide variation in conch density is normal because the species aggregate and so density is not homogenous over an area. The concern therefore lies in multiplying an average density produced from a few discrete surveys by a large total area of available habitat (Carcamo 2008) to estimate total abundance. The gregarious nature of conch mean there is not a correlation between density in one area and total abundance over the reef scape as a whole (Ehrhardt and Valle-Esquivel 2008) and studies by Stoner & Ray Culp (2000) found that conch may only use about 25% of the available suitable habitat. Multiplying density estimates by total available habitat may therefore over estimate total population by a factor of four. It is urgent that this fundamental concern in estimating current standing stock of conch is addressed.

# GUATEMALA

## Executive Summary - Guatemala

Guatemala has no commercially viable queen conch populations exploitable within its territorial waters. Conch however is a locally available seafood commodity, widely sold at wholesalers and local markets in the Caribbean towns of Livingston and Puerto Barrios. Conch is not a major sector of the Guatemalan fishery and its collection and sale is closely linked to the more valuable lobster fishery. In contrast to some of the national near shore fisheries such as the anchovy which underpins the supply of protein to both coastal and inland communities, conch is considered a relatively luxury product not linked to rural food security.

Conch to supply the Guatemalan demand is collected from the territorial waters of Belize and taken for sale in Guatemala. This fishing activity occurs legally by dual nationality fishermen and illegally by Guatemalan fishers, poaching in Belize. The export of the conch occurs without the required permission of the Belize fisheries department, or the required CITES permits for export and import. As such the scale of the trade is undocumented. Guatemalan landings of conch suggest they are equivalent in weight to about 15% of the total recorded exports of conch by the Belize fisheries cooperatives. The current situation complicates efforts to manage the Belizean fisheries resources that rely on reported figures for the yearly landed catch as part of the subsequent quota calculations. Guatemalan landings are not included in these calculations.

Guatemala is limited in its management capacity for its coastal fisheries. It currently has poor data on which to evaluate the status or changes in the fisheries and therefore struggles to develop proactive management strategies. Data sets for the number of fishers, fishing effort and landed catch are poor and there is an urgent need to improve data collection, analysis and administrative efforts for all fisheries sectors. The fishermen in the Caribbean are organized in to at least 31 fisheries associations, cooperatives or groups. Whilst these ostensibly come under the umbrella of the “network of fishermen”, declines in marine resources increase tensions between different fisheries sectors, fomenting disagreements between the groups.

The management of conch in Guatemala needs to focus on regulating the import of conch from Belize and identifying mechanisms to legalize this trade route as a method to control illegal fishing activities. It must also look to integrate lobster in to this scheme as the two fisheries are strongly connected and neither is abundant in Guatemalan territorial waters.

It is important that the management of the conch fishery be viewed in the context of the wider issues of Guatemalan coastal resources and socioeconomic conditions. Growth in the conch fishery may be a symptom of a general decline in other resources, and the economic situation of coastal communities. Successfully controlling conch exploitation as part of a tri-national plan needs to be strongly linked to the strengthening of fisheries management capacity for Guatemala across the fisheries sectors. This should focus on important fisheries found in its territorial waters and the development of sustainable fisheries plans for its national marine resources. This ultimately can help to reduce the reliance by Guatemalan fishers on the resources in the territorial waters of its neighbors.

## The fishing communities and actual practices

The main fishing communities in the Guatemalan Gulf of Honduras are Livingston and Puerto Barrios with smaller communities found around Punta Manabique and the Sarstún area (Map 1). Whilst official statistics derived from fisheries licenses do not exist for the number of active fishermen, there are estimated to be between 1500 (Heyman and Graham 2000) and 2,615 fishermen (Cabrera 2006), in the Guatemalan Caribbean. This is nearly equal to the total number of licensed fishermen in the whole of Belize.

The majority, around 700 fishermen, are centered in Livingston, with another 500 in Puerto Barrios (DIPESCA pers comm.) and the remainder dispersed throughout the outlying communities. There are several distinct types of fishery within the Guatemalan waters, including shrimp, the manjua (*Anchovia* sp.) and pelagic fin fish such as jacks (Caranidae) and mackerel (Scombridae). Each fishery is generally targeted by a specific set of fishermen, using a different fishing technique. These include trawl nets dragged behind boats to target shrimp, fine mesh nets for manjua, beach seines for fry fish and larger mesh gill nets and long lines for fin fish.

The social and cultural delineation of the fisheries is well defined. This is exemplified in the existence of 31 fishing associations for the Guatemalan Caribbean area. These include the association of net fishermen, the association of manjua fishermen and the association of shrimp fishermen. Together these associations integrate to form the "*Fishermen's Network"*. There is no association of diver fishermen who target conch and lobster. Often these fishermen do however belong to other groups as they may use different fishing techniques at different times of year.

The lobster and conch divers form only a small proportion of the total number of local fishers. There are an estimated 80 to 100 lobster and conch divers between all the fishing communities (Cabrera 2006). These fishers skin dive, using fiber glass speed boats to reach the fishing grounds. There are thought to be 20 boats operating for conch and lobster, with an average of 4 fishers per boat. The boats are around 23 feet in length and will normally have 75hp or twin 40 hp motors or similar engine sizes (Box, pers obs). Whilst there is a local lobster fishery with divers coming from the communities of San Francisco, el Cabo, Manabique y Quetzalito to target the reefs on the north side of Punta Manabique (Map 1), it is suggested by local groups that the lobsters found now in Guatemala are only those migrating past to and from other areas, at specific times of the year and resident lobster populations no longer exist.

In contrast to the other fisheries which exploit national stocks, there is no evidence of exploitable populations of queen conch of edible size, within territorial waters of Guatemala (Ruano Solares, Salaverria et al. 2010). Local fishermen report that they occasionally find a conch whilst skin diving or have them trapped in their nets, but the conch in these areas is reported to have been fished out by Guatemalan tank divers in the 1980s and populations have never recovered. This tank fishery closed during the 1990s as it was no longer viable to fish for conch and lobster with the additional costs of compressed air and dive equipment.

Fishermen in the different communities are vocally aware of the issues of overexploitation and resource decline facing local fisheries. Common recommendations for management action include geographic limitations and seasonal closures on the use

of gill nets, trawls and beach seines and to make certain fishing gears such as fine mesh nets illegal (Heyman and Graham 2000). Despite the fishermen being well organized into groups and associations, that provide strong representation for the fisheries sector, the weak institutional capacity of the fisheries department and the complex legal framework for fisheries management creates significant impediments in actually regulating the fishery. The improved management of other fisheries may strongly influence the fishing pressure on conch. If restrictive measures are put in place that push people out of national fisheries they may move into conch as an alternative. In contrast if successful fisheries rehabilitation programs can be put in place that boost national fish stocks, then this may attract people out of conch fishing. As a consequence the management of conch fishing in Guatemala must be framed in the context of the management of its national fisheries, with the overarching aim of improving the management capacity of the local fisheries department. If the resources in the territorial waters of Guatemala continue to decline, the failure to find viable, sustainable solutions will put further pressure on fishers to expand their range and extend into the water's of their neighbors.

Livingston

Guatemala's socioeconomic situation in the departments that boarder the Atlantic is an important causal factor for the pressure that the country's fishermen are putting on the marine resources of the region. Guatemala has the largest population of the three counties in the Gulf of Honduras with 71% of the economically active population of the Atlantic coast of Guatemala dedicated to subsistence agriculture activities.

Currently the illiteracy rate in these Atlantic departments is 50% and only 25% of the population has access to basic services like potable water, solid waste disposal and sewage systems. These services are concentrated in the two main towns on the coast, Livingston and Puerto Barrios.

The municipality of Livingston is made up of a town, 24 villages and 124 small villages, located 17 nautical miles from the municipality, Puerto Barrios (Map 1). Its main point of access is by sea through the Bay of Amatique or the Rio Dulce.

Livingston has a population of approximately 48,600 inhabitants who are concentrated mainly in rural areas of the municipality (80%). Its population is composed of different ethnic groups. The Q'eqchí is the main ethnic group (48%) followed of the Mestizo, Garífuna and Culi (of Hindu descent).

Livingston remains one of the poorest municipalities of Guatemala, with a poverty index of 81%. Most of the population does not have access to education, suitable housing, essential health, and basic services. For example only 15% of the rural population has access to potable water. The average rate of illiteracy for the municipality is 39% mainly made up of women.

The economy of Livingston is focused on several basic activities like agriculture, commerce, ranching, fishing, tourism and the services sector. Subsistence agriculture of maize, beans and rice is the main occupation. Land ownership is one of the main issues generating conflict in the area. It is estimated that in Livingston 95% of land is owned by just a few people with the remaining 5% owned by the remaining population. This poor

distribution of land ownership drives the population to search for other options of income generation, including pushing more people in to extractive uses of resources such as fishing (Anon 2011).

Puerto Barrios

Located on the Bay of Amatique, Puerto Barrios is a small city of 81,000 inhabitants and is the departmental capital of Izabal. The ports of Santo Tomás de Castilla and Puerto Barrios are the only ports for Guatemala in the Caribbean and together they create strong economic activity related to the movement of cargo. The area is responsible for more than 65% of the imports and exports of Guatemala, and are also essential to the banana industry of the country. The economy of the town therefore centers on the port, with some additional inputs from tourism, subsistence agriculture and fishing. Puerto Barrios has limited urban infrastructure with some important limitations including no drainage system or sewage treatment.

The socioeconomic context of the area provides prescient concerns over low food security and a high vulnerability to malnutrition (Pittaluga 2000). Fish and shell fish provide a high quality source of essential protein, both for the coast and inland communities (Heyman and Graham 2000). This means that much of the fisheries sector is driven by basic consumption requirements. Sustainable resource management is complex in situations where consumption demands outstrip a sustainable limit in the supply and this is complicated further in situations where the socioeconomic context provides few viable alternatives to this source of nutrition. This situation will likely complicate the development of management plans and their implementation in fisheries such as the “manjua” (anchovy) or the use of small nets for the Guatemalan fry fish collection, as the dried fish produced from these fisheries is easily transported far in land as a cheap and important source of protein to rural mountain communities.

This bleak management scenario is less likely however for conch. Conch is an expensive food in comparison to other fish or meats and would be considered a “luxury” product. Ruano Solares, Salaverria (2010) found that 45% of households in Puerto Barrios and 70% in Livingston ate conch in their home. This survey however was based on a highly biased sampling of the consumer population. Of the 120 people interviewed, 50 worked in the seafood industry as fishermen, fish sellers or fish restaurateurs and would likely have far higher consumption rates of seafood than the average person. The remaining interviewees were customers who were asked about their consumption choices when already in a fish market. Asking people located in a fish market biases the sampling because their location suggests a predisposition to purchase seafood.

It is highly unlikely that the high percentage of conch consumers found in Ruano Solares study reflects the true proportion of households that consume conch in the area. Certainly in the poorer rural areas its price would be prohibitive. It is therefore believed that conch fishing is driven by a niche market demand. (Ruano Solares, Salaverria et al. 2010) estimated that 95% of the product was being shipped to urban centers like Guatemala City and we agree with this assessment. It is also likely that conch is being moved into El Salvador from Guatemala as there are reports of conch for sale in San Salvador labeled as “Belizean White Conch”, but there is not trade reported between Belize and El Salvador.

Fishers from Guatemala are therefore fishing conch because of its high market price, however because the product is not intrinsically linked to essential nutrition and there are few fishers actively involved, it presents an easier case for effective management than some of the other national fisheries that are currently targeted by Guatemalan fishers.

## Commercialization and final markets

It is commonly accepted that all conch on the market in Guatemala originate in Belizean waters. Whilst reliable statistics do not exist, estimates from the local fishers, buyers and local organizations suggest that conch forms about 10% of the total fisheries value in the Guatemalan Caribbean. Livingston and Puerto Barrios, are the main commercial centers for conch, as with all other fisheries products.

Of the estimated eighty conch and lobster divers in the Guatemalan Caribbean, twenty to twenty five are found in Livingston all of whom are thought to fish in Belizean waters. Whilst Guatemalan published reports state that conch in Guatemala is caught by Guatemalans who have dual nationality (Cabrera 2006) locals claim that less than half of the fishers have Belizean nationality and that perhaps as much as 70 % of all the fishing activity by Guatemalans occurs in the territorial waters of Belize. These opinions however cannot be corroborated.

It is clear however that since the Belizean fisheries cooperatives are the only organizations that can legally export conch under the 1965 fisheries law, the conch currently being taken to Guatemala is illegally exported. Neither the Belizean export permissions nor the CITES regulations under Appendix II are not being complied with. Therefore, whether the conch is caught legally by dual nationality fishermen, or illegally by sole nationality Guatemalans, at the present time all conch for sale in Guatemala must have arrived there illegally. There are no records of CITES conch trades between Belize and Guatemala and the fisheries department of Belize confirm that there has been no official exports to Guatemala of conch (Belize Fisheries Department, pers comm.). Similarly there are no records of exports from Honduras to Guatemala.

Conch is readily available in the markets and at fish wholesalers in Puerto Barrios and Livingston. The price for clean conch to the fishermen is around Quetzales.25 – Q.30 ($3.50) a pound and is resold by the fish whole sellers at between Q.50 to Q.60 ($6.66 to $8) a pound. Conch is also sold without being cleaned by the fishermen (known as dirty conch) at Q15 ($2.00) per pound and resold by the wholesalers for Q27 ($3.60).

It is estimated that fishers catch between 30 to 35 pounds of clean conch per fishing trip to Belize, averaging around 100 lbs per week per boat (Ruano Solares, Salaverria et al. 2010). A third of these conchs are thought to be under the Belize legal size limit of 178mm (Cabrera 2006). Fishers and fish buyers reported that during the lobster closed season it is less economically viable to make the round trip from Guatemala to Belize just to collect conch or capture fin fish. They estimated the costs of fishing in Belize from Guatemala to be Q.4000 to Q.5000 ($600) per fishing trip in fuel costs. In addition the extra surveillance during the lobster closed season in Belize decreases fishing activity. (Ruano Solares, Salaverria et al. 2010) estimated that 53 t of conch were landed by Guatemalan fishers during open season contracting to just 8.1 t during closed season.

The fishermen and the fish buyers have the perception that conch by itself is not sufficiently valuable to be a standalone fishery and as with conch fishing across the region its collection and market supply is closely linked to lobster fishing. Whilst conch may make up a quarter of the landings by weight for the fishermen, they comprise only about 10% of the total value (Cabrera 2006). Lobster is considered to be more abundant and is therefore considered the target fishery, with conch being collected opportunistically if encountered. A complete market analysis of the two fisheries may well determine however that conch is equally valuable to lobster.

The total number of fishermen that the Guatemalan fisheries department believes are involved in conch fishing represents less than 5% of the total number of estimated fishermen in the Guatemalan Caribbean. Their activities are however sufficient to supply large volumes of conch to national Guatemalan markets. Cabrera (2006) estimated that the Guatemalan fishers were taking 93,000 lbs (42.2 t) of cleaned conch meat annually from Belize. (Ruano Solares, Salaverria et al. 2010) (2010) estimated 60.4 t. Our own estimates during this study put the figure around 52 t, based on estimates of landed catch from fishers multiplied by the length of the lobster season and the estimated number of active fishermen. These figures are likely to be underestimates of the true volume, but even so this illegal export is equivalent to between 15 – 20 % of the total volume legally exported by Belize, based on 2009 figures (Figure 6). It is believed that there are only two conch and lobster merchants in Guatemala, which run the lobster and conch fishery based in Puerto Barrios. These are the key figures that need to be the focus of management influence as they ultimately control the actions of the fishers. Working with these two commercial operators, who own the fishing boats, buy the conch and lobster, store it in cold rooms and then ship it for resale, is such simpler than trying to affect the actions of one hundred fishermen at sea. This should be the foundation for management action in Guatemala.

The conch being taken to Guatemala is not currently being included in fisheries statistics for Belize. There is an urgent need to accurately quantify the volume of conch being taken by Guatemala as this fishing activity affects the ability to set appropriate quotas for management. Quotas are one of the main tools used by the Belizean fisheries department for the conch fishery. Efforts then need to be made to facilitate the legal export of conch from Belize to Guatemala to fill the market demand, but in a transparent process that conforms to the obligations of CITES of both countries and the management requirements for this species.

## Critical habitats, conditions and threats

In comparison to its two neighbors, in the Gulf of Honduras, Guatemala possesses only a small proportion of the regions marine resources and diversity. The majority of the area is a typical estuarine environment due to the Rio Dulce and other rivers that discharge into the gulf. The sea bottom is characterized by soft sediments and there is little hard substrate. The near shore water is laden with sediment, limiting light penetration. As a consequence, there is little hard substrate and the incorrect environmental conditions for corals or seagrass beds, suitable for conch, to develop within the sheltered waters enclosed by Punta Manabique and the southern border between Guatemala and Belize.

On the north east shore of Punta Manabique however, where waters are less influenced by fluvial discharge, there are small areas of coral reefs (totaling less than 1 $km^2$) and seagrass areas (4 $km^2$), (Map 1) but the area remains dominated by soft sediments (304 $km^2$) and sand (31 $km^2$) (Ruano Solares, Salaverria et al. 2010). Despite the presence of some suitable habitat, no adult conchs have been found in this area, although there is an average of nine juvenile conch per hectare with a mean size of 4.5 – 7.0 cm (Ruano Solares, Salaverria et al. 2010). Other small areas of reefs also exist closer to the border with Honduras, but they have not been officially documented.

The area on the north shore of Punta Manabique may be a nursery area for juvenile conch. Its relative importance for the region however has not been established as the patterns of connectivity between juvenile and adult areas have not been investigated to date. Considering that the pelagic larvae of conch remain in the water column for up to 28 days (Appendix I), the waters within the Guatemalan section of the Gulf may be transitory points for larvae entrained in the currents of the area, providing the connection between different areas of viable habitat. So whilst for conch there is little suitable habitat within the Guatemalan portion of the Gulf, the quality of the water originating from Guatemala may have important ramifications for the population of the wider area.

Land based sources of pollution, especially from agricultural runoff and the port activities in Guatemala and the other two countries in the Gulf, are therefore of concern to regional conch populations. Conch spawning potential may be adversely affected by nutrification (elevated nutrient levels), and reduced dissolved oxygen (Glazer and Quintero 1998). Similarly, larval development has been shown under laboratory conditions to be impeded by poor water quality, with high nutrient levels and lower dissolved oxygen both reducing larval fitness (Glazer and Quintero 1998). Pesticides have also proved fatal to conch during embryonic development (McIntyre, Glazer et al. 2006). Although there have been no direct studies on the effects of pollutants on conch development in the Gulf of Honduras, if coastal water quality continues to deteriorate through increased coastal development and industrialization, this may have detrimental effects on the future viability of conch populations across the region. There is an urgent need to quantify the potential impacts of water quality on conch viability in the Gulf especially in areas which are important nursery and reproductive grounds. This requires connecting water quality testing with subsequent laboratory experiments on different life stages of conch for the recorded ambient concentrations of chemicals.

## Legislation and regulations

There are two Guatemalan government fisheries inspectors of DIPESCA for the Gulf of Honduras, one based in Livingston and the other in Puerto Barrios. They are responsible for the governmental oversight of the Guatemalan fisheries in the area.

Despite local presence of the fisheries department, the small size of the national fishing fleet, the concentration of the majority of the fishers in two small towns, and the majority of the fish products controlled by a few key merchants, the actual fisheries records are poor for Guatemala.

The DIPESCA office does not keep records of the number of fishermen that are active in the area and to date, a proposed fisherman licensing scheme has not been

implemented. DIPESCA say the fishermen have not submitted the information to the fisheries department. Equally, the fisheries inspectors do not ask to see the licenses of the fishermen, nor enforce the current requirement to be licensed.

Boats do undergo licensing. This is done annually, with the cost of boat registration, depending on the type of craft, ranging between Q300 to Q400 ($40 – $53). Guatemalan fishing boats however do not have to have their licenses painted on them and do not have to be presented for inspection to renew the licenses each year. As such, some boats are registered in Belize, which requires them to be painted with a license number in large lettering and are then also registered in Guatemala simply by submitting the boat's papers.

Current Guatemalan fisheries regulations for the area revolve around a series of closed seasons. These include a closed season for all strombid species, which includes conch from July 1st to July 31st (Table 1) It is unclear how the management system of closed seasons is actually enforced, and fishers report that the fisheries department is not active in controlling fishing activity in the area.

Guatemala currently has no legislation regulating the minimum size of conch. There is proposed legislation currently under discussion for a minimum lip thickness of 8.3mm. The potential problem for regulators if this becomes law is that most conch are landed without the shells, making measurements at the dockside of the shell lip impossible. This is why, for example Belize, has a clean meat weight minimum as well as a shell length minimum (Table 1).

Overall there is weak oversight on any of the activities that occur in the Guatemalan fisheries and under the very limited regulations that do exist, the fisheries remain largely unmanaged. It is also uncertain from a biological standpoint, why a short closure in July was established nor how it can be an effective management tool. It is recommended that the closed season in Guatemala is extended to reflect that of its neighbors.

In contrast to Guatemalan fisheries enforcement, the Belizean regulations and patrols place important structuring forces on the Guatemalan fishing activities. During the closed season for lobster and subsequently for conch, the fish buyers report that the Guatemalan fishers do not frequently bring conch to Guatemala from Belize and the market contracts. Buyers reported stockpiling conch during the month running up to the lobster closed season (February). Guatemalan fishers believe they can face fines of between BLZ$, 8,000 and BLZ$ 50,000 for illegal fishing outside of the open season, along with the confiscation of their fishing gears. The Belizean law prohibiting SCUBA diving for lobster and conch also ensures there are no reports of Guatemalans using SCUBA in Belize to fish.

It is suggested that during the lobster closed season some of the Guatemalan fishers remain in Belize and sell their fish in local markets, rather than returning to Guatemala. Living either in the towns or in fishermen's camps on the remoter cays, the Guatemalan fishers are seen in the markets of Punta Gorda and have licensed stalls to sell fish there.

## Existing scientific information, current monitoring, research efforts and gaps

The 2010 (Ruano Solares, Salaverria et al. 2010) report is the most recent information available specifically related to conch in Guatemala. Whilst identifying Punta Manabique as a possible site of importance for juvenile conch, they found very few individuals per hectare. A government study in 2006 found some conch of small size in Bahía La Graciosa, Cabo Tres Puntas y Motaguilla (Y3K and CONAP 2006) but did not estimate density. It is important that new surveys be carried out in these areas to provide accurate assessments of density of both juvenile and adult conchs across these habitats. Connectivity studies can also be used to help determine what role the nursery areas of Guatemala could play for conch spawned in other areas of the Gulf and wider region.

## Conservation accomplishments

A national plan for the exploitation of *Strombus gigas* in the Guatemalan Caribbean was produced in 2010 (Ruano Solares, Salaverria et al. 2010). Following the initial population surveys under this program and the discovery that Guatemala did not possess exploitable populations of adult conch, the plan became oriented towards a series of suggested steps aimed to increase cooperation in the protection of conch regionally and to help avoid that conch sold in Guatemala have been obtained illegally. The measures aim to engage the neighboring countries of Honduras and Belize in a dialog and inter-institutional agreements for conch exploitation. The report recommended that since Guatemala is a member of CITES it should be recording and reporting imports of conch. It also recommended that the closed season of the 1$^{st}$ July to 30$^{th}$ September of each year should be harmonized across the region to include Guatemala. It also suggested that Guatemala should establish a registry of hotels and restaurants serving conch in an attempt to control consumption of conch during the closed season. At the time of writing these recommendations have not been implemented although they have been discussed as part of the tri-national working group for the Gulf of Honduras TRIGOH meetings. At the moment however there are no direct conservation initiatives for conch in Guatemala.

# HONDURAS

## Executive Summary - Honduras

Honduras is the only country bordering the Gulf of Honduras that has two fisheries sectors for conch. Firstly there is the small scale and subsistence fishers located in fishing communities on the Caribbean coast and Bay Islands that dive from small boats on banks close to shore in search of lobster and conch. They sell their catch to local buyers who then either resell it locally or sell it into the commercial market chain. Secondly there is the industrial conch fishery, centered in the ports of La Ceiba and Roatán, whose boats exploit the banks in the eastern exclusive economic zone of Honduras, in an area known as the "Grand Banks". These two fisheries, whilst connected by the exploitation of a common resource, operate independently from each other. That being said, the activities of the industrial fishery have important repercussions on the markets and actions of the small scale fishery.

Following the development of the industrial fisheries in the 1980s, conch collected by tank divers, became the second most important fishery in the country, after lobster. By the new millennium Honduras was exporting over 1000 metric tons (t) of clean meat annually, with 95% exported to the United States. The management of the conch fishery however, did not keep pace with the growth in this sector and there was little oversight or direct management action.

The fisheries department (DIGEPESCA) granted annual licenses to industrial boats and to fish processing plants and the capacity of the fishery grew rapidly. This growth however was unsustainable. In 2003 the Convention in International Trade in Endangered Species of Wild Fauna and Flora (CITES) imposed a ban on conch imports from Honduras and in 2004 the Honduran government closed the conch fishery. Following this closure, the government then started to take action to fulfill the requirements of CITES to facilitate the re-opening of the export markets. DIGEPESCA initiated the "Queen Conch Scientific Research Program" in 2006 to determine the stock status, show non-detrimental findings to sustainability under a limited fishing effort and to develop the data on which to base future fishing quotas. Under this program the fishery was allowed to export 210 t of 100% clean conch annually. The subsistence and small scale fisheries on the north shore of Honduras and Bay Islands, by contrast, have remained without a management framework and there is confusion within the sector as to whether the industrial ban on conch collections also extends to their fishing activities.

Within the geographic area of the Gulf of Honduras, conch has been heavily overexploited across its range on the north shore and islands of Honduras. To date there has been little attempt to quantify remaining populations. Conch has become a fishery of little importance in these areas because of the crash in their populations. In the few places where some conch fishing remains, such the divers based out of the Utila cays, there is no regulation and conch of all sizes are collected. Larger conchs are sold into the commercial chain through processing plants in La Ceiba and small conchs are consumed locally. The partial reopening of the industrial fishery through the Scientific research Program has created windows in the national market with legal (industrial) and illegal (small scale) conch both available in local markets to supply the national demand. Conch is widely available across the country, including on the Pacific coast.

Scientifically, the marine ecosystems of the Grand banks, which support all of the major industrial fisheries of the country, remain virtually un-documented by researchers. On the north shore and across the Bay islands, whilst there is general information about the condition of reefs and coastal habitats, the existing conch populations are poorly documented, including within the managed protected areas. More information is urgently needed on the status of conch populations across Honduras and the conditions of the habitats on which they rely. In addition understanding how these areas connect together ecologically is essential in the design of effective, long term, management strategies.

The focus of current management of the industrial fishery in Honduras is to ensure that the CITES trade restrictions are lifted and the industrial conch fishery can reopen under a total allowable catch system. It is important that this narrow focus by managers, which is solely interested on the industrial sector, be expanded to consider the conch fishery across Honduras in to the Gulf of Honduras. Management strategies need to address the connections between the industrial and small scale sectors, both ecologically and socioeconomically. This is imperative considering both the industrial and the small scale fishers often employ the same fishermen, access the same markets and use the same gears (SCUBA divers). Consequently management of one will ultimately have repercussions on the management of the other.

There is also an important relationship between conch fishing and lobster fishing and opportunities must be identified to co-manage these fisheries sectors together, including harmonization of tank dive fishing regulations to apply to both fisheries equally. In general there is an urgent need to strengthen regulation and oversight of the industrial fishing operations and national markets to limit the undocumented amount of illegal capture, landing and processing of conch. In addition the technical capacity and data management systems of the fisheries department and the CITES office in Honduras needs strengthening to ensure that international trade is effectively monitored, reported and controlled.

## The fishing communities and actual practices

It must be noted that since 2004 conch fishing has been under an indefinite moratorium in the territorial waters of Honduras. As such there is no specific legislation regarding conch fishing outlined in the current fisheries regulations, because the fishery is closed. The opening up of the industrial fishery under the conch scientific research program in 2006 did not occur in conjunction with regulatory limits for the minimum size or season of the conch fishery. As the law currently stands, all conch collected outside of the industrial fishery included in the remit of the scientific program are illegal, including those collected by the small scale fishers on the north shore and islands. Yet within the industrial fishery included in the scientific program there are no fishing restrictions in terms of minimum size, closed season of gear use. There is a total allowable catch, which at 210 t per year, is significant by regional standards (Table 1).

### The small scale fishery – North shore

Along the north shore of Honduras, between the town of Omoa in the west and the Garifuna villages up to Rio Esteban, east of La Ceiba, conch is not considered an important local fishery. There is limited suitable habitat in the vicinity of most of these communities (Map 1) and local fishers instead target fin fish using lines, nets and traps.

In the small communities east of La Ceiba, towards Rio Esteban, including Corozal, Sambo Creek, Nueva Armenia and Balfate conch is not commonly fished. Conch is not allowed to be collected within the boundaries of the Cayos Cochinos Natural Marine Monument which essentially covers all areas of suitable conch habitat in the vicinity of these communities (Map 1 and Map 2). Any locally caught conch would therefore be illegally poached from this area. Most fishers and fish buyers did not report having local conch available to buy. Conch supplying local consumption comes from La Ceiba and the industrial fishery. Conch is widely used in restaurants and local cuisine especially in the traditional seafood soups and ceviche.

Of the tank divers in Omoa and Puerto Cortes, none reported conch from Honduran waters being an important resource. There are reports however that they collect conch and lobster from the territorial waters of Belize around the Sapodilla Cayes. This illegally caught conch is sold locally in Honduras. It is however difficult to trace the origin of conch in a market, or quantify the extent of illegal captures. This is because the conch can easily be combined with the legally caught product, which comes from La Ceiba and has been processed by the industrial fishery. The industrially caught conch is widely available in local markets in western Honduras.

The only exception on the north shore where there are active small scale conch fishers are the few communities west of La Ceiba from Porvenir to Tela. The tank divers from these areas can reach banks that are located between 10 and 15 miles off shore and contain conch and lobster. As elsewhere, divers are looking for lobster but will collect conch if encountered. In Porvenir for example there are an estimated 8 tank divers using a communal compressor. However there is no information on the total number of divers operating out of the north shore communities or data on the landings by these fishing communities. It is assumed that they will take any size conch they encounter as there is

no regulation or control. Fishers in these areas did report that conch is increasingly scarce.

Fishers in communities around Tela can access Punta Sal and Punta Izopo, but again conch is not reported to be an important fishery in these areas. The abundance throughout the north shore of Honduras is thought to be low. Many of the fishers in these areas were under the impression that they were not legally allowed to collect conch due to the fishery closure.

**The small scale fishery – Bay Islands**

Around the three main Bay Islands of Utila, Roatán, and Guanaja, the near shore reefs and seagrass beds have likely been long overfished of conch. Whilst there is no historical record of this, anecdotal information from local communities suggest that conch was plentiful up to around the 1970s but as the islands' resident human population grew, the cheap and readily available protein source that conch provided, meant the near shore stocks continued to decline. As the commercial fisheries opened up in 1980s, the Bay Islands conch populations were probably the first to be targeted. The area of reef shelf around these islands is relatively small thus the conch populations would have declined dramatically. Conch remains scarce today.

Roatán

On Roatán the local small scale subsistence fishers around the island do collect conch from the near shore waters. Subsistence fishing is important to the east of Roatán such as Punta Gorda and St. Helena where tourism has not greatly benefited the local economy. Fishers mainly use hook and line with a few skin divers who occasionally look for lobster and conch whilst also spearing fish.

Conch cannot be collected within West End Sandy Bay (WESB) marine reserve[3]. Poaching within the marine reserve occurs by subsistence fishers from Sandy Bay as well as fishers attracted to the park from other areas because of its higher densities of marine life due to the marine protection. Tourists have also been caught removing conch from the sea in this area. The area is patrolled by the local nongovernmental organization (NGO) Roatán Marine Park in cooperation with the local police. Between December 2006 and May 2010 the WESB patrol recovered 371 conchs illegally caught during 51 separate incidents, with an average of 4.2 conch per seizure. Data on the size of the conch captured is not available, but from photos of the seizures taken by the marine patrols, the majority seems to be well under the size of maturity. Conch collected on Roatán is most likely consumed locally by the community or sold to local restaurants. Without local enforcement in these markets, conchs of any size are likely to be collected if encountered because of the ease of sale.

Local awareness campaigns, lead by the Roatán Marine Park, are aiming to persuade restaurants in tourism areas to only serve conch sourced from supplies registered with the *Honduran Queen Conch Research Study* – which include all of the commercial operators.

[3] The West End Sandy Bay area is actually no longer a specific marine reserve, but is part of a larger protected area system for the Bay Islands. Patrols of the original area are however still being conducted.

Since there are no official fishing license figures from DIGEPESCA for small scale fishers it is not possible to know how many small scale and subsistence fishers there are currently active on Roatán, or anywhere else in Honduras. Estimates made in 1999/2000 as part of the Environmental Management Project of the Bay Islands (PMAIB) reported there were 293 fishing boats around Roatán (Gobert, Berthou et al. 2005). These estimates were made before the islands underwent extensive tourism development and rapid population growth, significantly changing the economy and demographics of the islands. These changes make the estimates of fishing numbers of little use today and there is an urgent need for new fisheries statistics. It is likely that the total number of fishers has declined on the island as alternative sources of income have become available.

Utila

Of the three main islands, Utila is the only one to have both a local subsistence and a small scale conch fishery. Divers based on the Utila cays use tanks to target the banks to the south west of the island. Conch is not fished exclusively and is collected by divers, in addition to lobster, in a ratio of about 3 lobsters: 1conch (Pers obs). The main fishing areas are to the south west in areas known as “Green Grass” towards Tela (Map 1). During the open season for lobster, conch is sold to a commercial buyer on the cays who runs the diving operation (filling tanks and providing regulators). During the closed lobster season, this buyer switches his operation to target fin fish such as yellowtail snapper and does not fill tanks nor send his boats diving. This switching of fishery by these divers, to yellowtail snapper, provides an opportunity to link management strategies of the lobster/conch fishery with the management of the yellowtail snapper fishery. The development of an effective management strategy for yellowtail snapper to make it a sustainable and highly profitable fishery could provide the economic incentive to increase compliance with closed seasons. The Utila Centre for Marine Ecology is currently working on developing a local management strategy for yellowtail snapper for this community.

Unfortunately, because there is no enforcement, diving continues, with local fishers getting their tanks filled at a local dive shop on Utila. Both conch and lobster therefore continue to be collected during the closed season and the product is sold to local shops and restaurants.

Local awareness campaigns have persuaded some restaurants not to serve conch on their menus, but the local market, especially in the closed fishing season, remains strong. Undersize conch is sold to local restaurants, food stalls and small shops that do not regularly serve the tourist market. In addition small conch and lobster from out of season are bought by intermediaries and shipped to La Ceiba to supply national demand. Once again awareness campaigns that effectively target resident consumption rather than just aimed at the tourist segment are require, in addition to better enforcement of closed season regulations.

There are no records for the volume of conch caught by the Utila based fishermen, nor exact numbers of divers. Gobert et al (2005) estimated there were 114 active fishing boats on Utila, but did not estimate how many divers were in the community. These statistics are out of date and are no longer valid. The conch buyer operates 6 of his own boats which normally have two divers and there are some independent divers from the community as well. It is estimated that there are around 20 divers operating out of the

Utila cays during the lobster season, with perhaps a third continuing during closed season. Many of the divers come from Garifuna communities on the north shore to work in the Utila based fishery. This may be a consequence of the management restrictions of Cayos Cochinos that displaces fishers to Utila because they cannot fish for conch within the waters close to their communities.

The growing population on the cays, especially of migrant Garifuna and main land Hondurans who are attracted to work in the fishery, means there is a strong local demand for a cheap source of protein. The seagrass areas around the cays are reportedly an important area for juvenile and immature conch. These are exploited by non-cayan fishermen, working from Cayucos (a dugout canoe) with a snorkel and mask. These fishers collect tiny conch, with up to 50 conchs needed to make a pound of cleaned conch meat. This is the equivalent of a 1/3 oz per conch. These conchs are either eaten directly by the collectors or are sold to a local shop for resale. Local cayans and Utilians whilst not necessarily directly collecting the conch still shoulder some responsibility since they run the shops which purchase these juvenile conchs.

Guanaja

There is no information available for Guanaja on the status of its current or historic conch populations or the number of active fishers that are there. It is assumed that conch populations are in a similar depauperate state similar to the other Bay Islands and that local subsistence fishing in general is in decline. There is no active organization working on Guanaja for the local fisheries and the main commercial fish factory is not involved in the conch scientific fishing initiative, dealing only in lobster and fish. The lack of involvement or information on Guanaja is a serious concern for regional management.

There is a conch festival held on Guanaja over 6 days in July to coincide with Columbus Day on July 30$^{th}$. Whilst this celebration suggests that conch is of local cultural importance and part of the culinary heritage of the area, visitors at the event suggested that there was virtually no conch available during the festivities, with food stalls offering chicken and fish.

Cayos cochinos

Cayos Cochinos (Hog Islands) are a protected area within which some fishing activities are allowed. There is one main fishing community within the Cayos Cochinos archipelago called Chachahuate that is part of a migratory population of Garifuna connected to the north shore community of Nueva Armenia. In addition other north shore Garifuna communities also have fishing settlements in Cayos Cochinos with the community of Rio Esteban connected to “East End” and fishers from Sambo Creek using an area known as “Bolanos”. There are an estimated 80 people living in Cayos Cochinos who fish with hook and line or skin dive for lobster that are caught in traps. Additional fishers travel from the north shore to fish in the Cayos Cochinos area, but there is a limit on the total number of fishers that are allowed to fish within the reserve area.

Since 1993 the fishing of conch has been prohibited within the Protected Area of Cayos Cochinos that extends to the north shore of Honduras between the coastal communities of Corozal and Rio Esteban (TNC 2008). The regulations also prohibit fishing with SCUBA in the south zone of the biological reserve. Despite conch being protected within

the reserve, population monitoring has not been conducted as part of the management of the reserve and accurate data are only available for 1996.

**The industrial fishery**

Whilst the subsistence and small scale operations to supply conch for local demand have been going on for generations, the industrial conch fishery in Honduras started in 1986. This year coincided with the moratorium on conch fishing imposed by the United States over its territorial waters. The closure of the U.S domestic fishery generated a large market demand in the Unites States for conch from the rest of the Caribbean. The Honduran conch fishery grew rapidly to start filling this demand, with foreign investors providing the capital to quickly expand the commercial fishery sector. Although the areas targeted by the commercial fishery are to the East of Honduras and beyond the geographic scope of this program, the product is landed in the city of La Ceiba and in the Bay islands and thus is widely available across the zone of this project. As such understanding the industrial fishery and its operations, history and management is essential to understand the wider management of conch in the region of interest.

United States import records for conch from Honduras, collated by NOAA, are the only historic data available for Honduras as landing records were not collected. These data show that Honduras was exporting to the Unites States an average of 128.5 metric tons (±12.3t) of conch a year between 1987 and 1999. This quantity increased substantially between 2000 and 2003 to an average of 323.8t (±45.7t) over these 4 years (Figure 4).

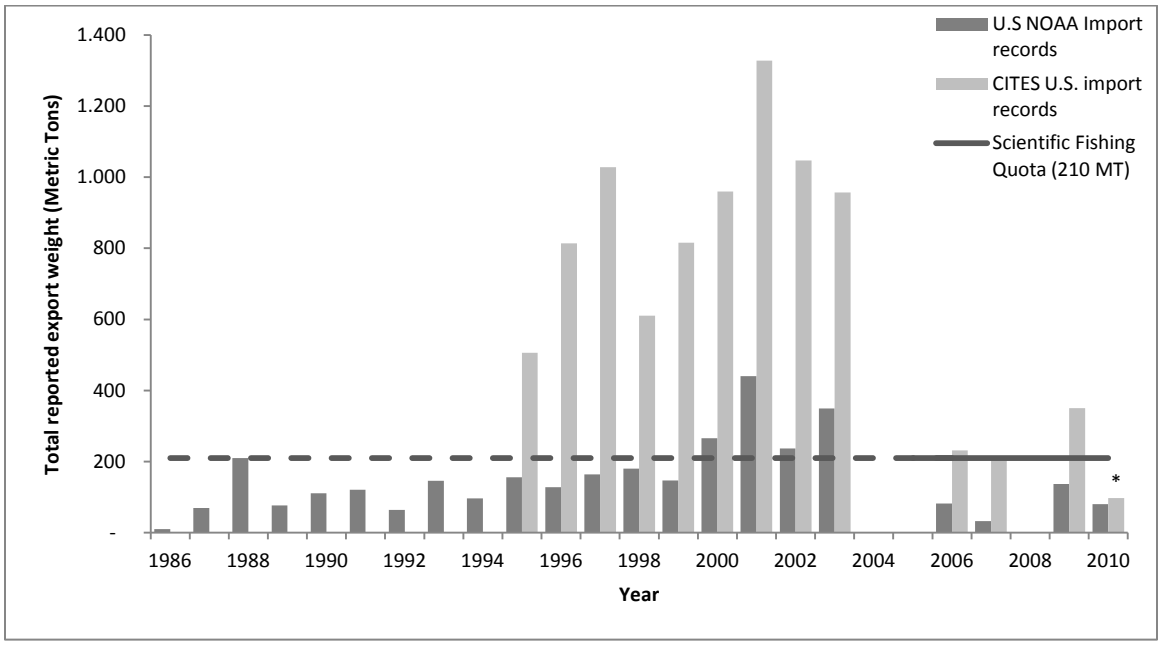



**Figure 4 – Total import weight of conch in to the United States from Honduras in metric tons. Data from NOAA fisheries imports data base (dark grey bars) and from the CITES trade database (light grey bars). The current catch quota under the conch scientific research program set in 2006 of 210 metric tons annually is shown as a line. Both data sets for 2010 are not confirmed to be complete. The asterisks denotes that the 2010 CITES export total includes 37.4 MT where the destination country was unknown, but it assumed to be U.S..**

These NOAA figures however seem to be a large underestimate of actual conch imports as they are dwarfed by the CITES trade records that started in 1995. CITES trade

records show that the United States imported an average of 896.1t (±81.8t) of conch between 1995 and 2003. This dropped to virtually zero during 2004 and 2005 and then started again in 2006 with 232t imported and a further 208t in 2007. The fishery dropped off again to virtually zero in 2008 when the government re-closed the fishery, but then spiked in 2009 with 350t. This 2009 export amount is 167% of the CITES export quota limit. Data from 2010 are still incomplete but it currently shows 60t of imports with an additional 37t currently unspecified (Figure 4)[4].

| Year | Licensed industrial conch boats |
|---|---|
| 1996 | 14 |
| 1997 | 12 |
| 1998 | 10 |
| 1999 | 11 |
| 2000 | 15 |
| 2001 | 15 |
| 2002 | 15 |
| 2003 | 14 |

**Table 2 - Number of registered conch fishing boats in Honduras prior to the closure (Morales 2005).**

The available export figures chart the rise and fall of the Honduran commercial conch fishery. The sharp rise in Honduran exports in 2001 (Figure 4) prompted international concern about Honduras's management of the conch fishery mainly lead from Jamaica. Honduras was highlighted as a "country of concern" in the 2003 CITES significant trade review with the belief that either Honduras was severely overexploiting its national stocks or that the Honduran commercial fleet was poaching conch from the territorial waters of Jamaica, on the Pedro Bank, whilst Jamaica's fishery was temporarily closed during 2001 and 2002 (Aiken et al 2006).

The CITES review upheld these concerns placing a ban on member countries from importing conch from Honduras in 2003 (Acosta, 2006). The Honduran government responded by implementing a voluntary moratorium on conch exports on 29th September 2003 (Agreement 820-03), followed by defining a closed season for conch between 1st April and 30th September 2004 (Agreement 187-04) and then on the 25th of February 2005 indefinitely closed the conch fishery (Agreement 103-05).

In 2006 the CITES, under an agreement with the Government of Honduras, authorized the reopening of conch export fished under a 4 year scientific fishing program. This program called the "*Research and evaluation program for the biological monitoring of Queen conch populations (Strombus gigas) in Honduras*", under Ministerial Decree Nº 391-06, 10th May 2006, had the stated aims to:

- Evaluate the abundance of *Strombus gigas* in the main banks of fishing defined by Honduras during the 2003 CITES review of the state of the species (all of these 13 banks are in the East of Honduras's Exclusive economic zone including

[4] Whilst eleven countries have reported receiving conch imports from Honduras since 1995, 97% of total trade volume has been with the United States. For clarity only the U.S. figures are given here.

the banks of Rosalinda, Gorda, Thunder Knoll, Media Luna and Arrecife Lagarto)[5]
- Evaluate the exploitation state of the species in these defined fishing banks
- Develop the scientific bases on which an annual fishing quota could be defined
- Establish the scientific protocols (mathematical and statistical) that could provide annual quotas to sustain the resource over the long term.

Under the scientific fishing program, overseen by Prof Ehrhardt from University of Miami, an annual catch quota was set at 210 metric tons of 100% clean conch was set for four consecutive years. Only four of the original fleet of fourteen registered industrial boats from 2003 (Table 2) were authorized to fish for conch. The total quota of 210 t was divided between the boats equally as 52.5 t per boat.

Each commercial fishing boat holds around forty five divers. Divers use SCUBA, diving from unpowered canoes launched from the main vessel. Each diver uses around 3 or 4 tanks per dive session and may complete multiple dive sessions per day. Similar to the operation of the original fishery before the closure, there is no specific dive training for these divers and they are diving well beyond safe diving limits, exposing themselves to the risk of decompression sickness, which can be fatal.

Following the initial work in 2006 and a preliminary report which detailed the methodology and identified the fishing banks and initial findings (Ehrhardt and Galo 2007), the program then stopped for unspecified reasons in 2007. The program was then suspended by the government in 2008, who cited a lack of industry cooperation in implementing the project (Ehrhardt and Romero 2010). The fishing industry in contrast refute this reason for the suspension in 2008 and say there was distrust from the industry in DIGEPESCA's transparency in managing fisheries data and producing fisheries policies (Pers comms, Anon). Poor engagement with the fisheries sector by DIGEPESCA exacerbated this problem. This lack of communication and mutual understanding may in part be due to the majority of the government fisheries department personnel (60%) being in offices in areas where no fishing occurs (Tegucigalpa and San Pedro). These issues with the project are reflected in the export records, with conch exports to the U.S. dropping in 2007 and falling to zero in 2008 (Figure 2).

In 2009 the program officially restarted under agreement 124-2009 (19th March 2009) (Ehrhardt and Romero 2010). It is unclear why such a large export volume occurred in excess of the CITES limits during this year if the program was functioning correctly (Figure 2). It is very likely that the political turmoil caused by the coup d'état in the summer of 2009 limited the actual implementation of the program and export oversight.

In 2010, the last year of the program, there were inspectors on each of the 4 boats during 4 trips between March and August and on two boats that made an additional trip at the end of August. Each trip had a maximum of 6 active fishing days on the banks. The fisheries officers, employed by DIGEPESCA, collected catch and effort data from the divers and weights of clean meat samples, whole animal measurements, sex,

[5] Following the redefining of the maritime boarder between Honduras and Nicaragua in 2008 many of the locations of the conch study are now in the territorial waters of Nicaragua. It is unclear why the study continued to collect and use data from these areas, since their conch are no longer legally part of the Honduran stock. It is also unclear how Honduras is able to use conch collected from areas within this boarder "buffer zone" and from Nicaragua as part of their national export quota.

maturity and size (Ehrhardt and Galo 2007), (Ehrhardt 2006), (Ehrhardt and Valle-Esquivel 2008). They are also on board to provide government oversight so that the divers are not catching lobster at the same time.

As an additional data source and method of regulation DIGEPESCA established in 2010 a protocol for the industry to record data of conch landings and to start monitoring the market chain. Satellite trackers were also fitted to the fishing fleet to record movements. The protocol includes the industry supplying landing data and a list of buyers to DIGEPESCA, and example is shown in Figure 5. The landing records of the processing plants are cross checked with the figures of the fisheries inspectors. In return DIGEPESCA provides a licensing number and lot identification for internal markets stating that the product is from a registered source and legally caught as part of the conch research program. DIGEPESCA also provides the paperwork for the export permissions with CITES.

Data from Ehrhardt and Romero (2010) show that 214.7 t of conch were landed from the 4 boats over the 5 trips and processed (Table 3 & Table 4). This 214.7 t slightly exceeds the CITES quota (210 t), by 2.23% or 10,384.68 pounds (4.7 t). There are currently no comparative figures for 2010 from other available data sources, as the CITES figures for 2010 are not confirmed to be complete until 12 months after the current year.

**Table 3 – Conch landings reported by the Honduran commercial fishing fleet for 2010 in metric tons (Data from Ehrhardt and Romero 2010)**

| | Landings in Metric tons | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | TOTAL |
| Miss Lillian | 15.32 | 13.15 | 11.60 | 14.18 | - | 54.25 |
| Douggy | 13.72 | 13.91 | 12.67 | 13.16 | - | 53.45 |
| Captain Dago | 16.38 | 12.69 | 11.87 | 5.96 | 6.71 | 53.61 |
| Miss Shanelly | 16.79 | 11.75 | 10.73 | 14.13 | - | 53.40 |
| | | | | | | 214.72 |

**Table 4 – Total weight of reported conch processing by packing plants in 2010 (Data from Ehrhardt and Romero 2010)**

| Processing plant | Total (t) |
|---|---|
| Pesca del Atlántico | 14.13 |
| Perla Mar | 25.79 |
| INVERCA | 16.26 |
| Sea Pearl | 29.45 |
| Hybur | 37.32 |
| Diva Seafood | 25.21 |
| Marinos Pescadería | 66.56 |
| | 214.72 |

The ultimate objective of the conch research program to set sustainable catch limits on the commercial fishery may be difficult under the current fisheries framework and the limited enforcement capacity. There is widespread belief that the actual capture of conch and lobster from all boats operating divers in the fishing banks exceeds the official landing figures generated by the conch and lobster management programs respectively.

Product from these fisheries, landed illegally, floods national markets and thus provides direct competition to products caught by the small scale fishermen, depreciating their dockside values.

Legally the conch boats are not allowed to fish for lobster or other species and the conch monitors are on board to provide oversight. Conversely, the lobster boats that use divers are not allowed to fish for conch, but there is currently limited oversight of this much larger capacity fishery. There is wide belief in the fisheries sector that boats with divers fish for all species, with the common opinion that fishing for conch occurs at the same time as lobster. Divers may also spear fish such as grouper whilst underwater, filleting and freezing them before landing (Box and Bonilla 2008). There is also a strong belief that commercial boats dock outside the main ports and unload illegal catch (such as conch caught by lobster boats or vice versa) so when they arrive at the official dock they only contain their allotted catch. The illicitly landed catch is then packed for national consumption as well as undocumented export to neighboring countries in Central America. These assertions by members of the fishery however cannot be independently verified and as such the extent of this activity cannot be evaluated. Conch, undersized lobster and filleted “grouper” are however available across the nation and it is unlikely that it is coming from the official landings since legal landings are supplying the export market.

Whilst officially each fishery is distinct and licensed separately, they are likely to be highly interconnected. Actual and effective oversight and enforcement is required, combined with direct incentives and awareness programs with the divers, boat captains and processing plant owners to regulate collection behavior and subsequent landings.

The region wide plans to prohibit tank diving for lobster which was agreed to by Honduras in 2009, has the potential to limit unregulated and illegal fishing on conch. However, it remains uncertain whether Honduras will finally implement this diving ban as it has not been included in the 2011 fisheries amendments despite the original agreement for it to enter in to force from the 2011 season, which opens in August. It is widely believed that the Honduran fisheries department is likely to continue to permit diving for lobster and delay the ratification and implementation of this ban. Despite the obvious humanitarian cost of diving related injuries and deaths to these fishers, and the over-efficiency of collecting lobster on SCUBA, making the fishery unsustainable, the lobster diving sector is highly lucrative and a wide employer for coastal communities in the impoverished areas in the east of Honduras. Politically the employment and financial factors make implementing the ban on lobster diving less appealing.

The situation may be complicated further if the commercial conch fishery reopens fully and the divers are allowed to continue to use SCUBA. In the absence of sufficient oversight, conch divers would be able to collect lobsters and it is likely that capacity in this fishery would grow quickly. Closing tank diving in one fishery without closing it in the other would therefore be illogical and counterproductive. It would be more advisable to prohibit the use of tanks for diving for conch as well as the diving for lobster, effectively banning the use of SCUBA in all Honduran fisheries, similar to the policy of Belize, whilst permitting free diving.

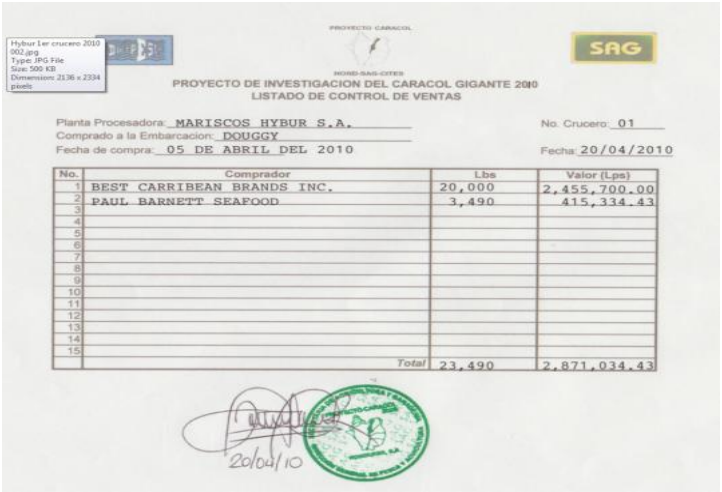
The Scientific Conch Program has managed to partially re-open the industrial conch fishery, but the limited outreach and publicity about the program has left many people in the market chain including consumers, confused about the current regulations. It must

be noted that the current conch scientific research program does not have a regulation on minimum sizes that can be collected by its divers, nor does it have a closed season as conch collection is occurring throughout the summer. This is because the program is being conducted officially to provide the information to set these limits for the future. As it currently stands there are no restrictions in law on what size queen conch can be collected as part of the 210t scientific quota limit. The partial opening of the commercial conch fishery, freed from any other regulatory control, whilst maintaining a closure on the small scale and artisanal fishers across the north shore and islands, could be seen to be biased towards the commercial interests of the fisheries sector. Whilst management remains focused on the industrial fisheries it has continued to ignore the small scale sector.

## Commercialization and final markets

Conch collected by small scale and subsistence fishermen are normally sold to intermediaries, such as the fishery on the Utila cays. The price per pound for clean conch paid to fishermen is around 50 Lempiras (Lps) which is the equivalent of US$ 2.63. This is mainly resold to local market suppliers in La Ceiba if the conchs are small. Larger conch may be sold to other national market suppliers in La Ceiba or to some of the fish processing plants, where they are processed and sold on. The resale price of conch by intermediaries is around 80Lps per pound with retail price to consumers between 100Lps to120 Lps.

All ten of the fish processing plants in La Ceiba and Roatán are licensed under the scientific research program to purchase conch from the four licensed boats and process it for export. One of the four boats is owned by a pair of fish processing plants and so lands its catch directly with them. The other three boats are independent and sell to the other plants. These plants compete on price with the price in 2010 around $4 per pound for 95% clean conch. The export price of conch from these packing plants is around $6.50 (Figure 2). This makes the total export value of the conch in 2010 worth $3.1 million. The national market price of conch is around $5.25 but national demand and export volume to other Central American or Caribbean countries has not been quantified.



PROYECTO DE INVESTIGACION DEL CARACOL GIGANTE 2010
LISTADO DE CONTROL DE VENTAS

Planta Procesadora: MARISCOS HYBUR S.A.
Comprado a la Embarcacion: DOUGGY
Fecha de compra: 05 DE ABRIL DEL 2010
No. Crucero: 01
Fecha: 20/04/2010

| No. | Comprador | Lbs | Valor (Lps) |
|---|---|---|---|
| 1 | BEST CARRIBEAN BRANDS INC. | 20,000 | 2,455,700.00 |
| 2 | PAUL BARNETT SEAFOOD | 3,490 | 415,334.43 |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| | Total | 23,490 | 2,871,034.43 |

20/04/10

**Figure 5 – Example of the sales records supplied to DIGEPESCA by the packing plants as part of the conch research program.**

Conch from the commercial sector, in whole-sale bags of 100lbs, is available across the north coast of Honduras, being found in markets in Puerto Cortes, San Pedro and Tegucigalpa. It may be exported into Guatemala, despite competition from product that the Guatemalans catch in Belize (Pers comm. Anon.). Some conch is apparently sold to El Salvador but, as with exports to Guatemala, there are not CITES records of these transactions. It is believed that the conch being exported to these countries from Honduras comes from the illegal landings made outside of the main docks and is not reported by the commercial boats or official programs.

The majority of legally landed conch is destined for the export market of the United States. The mean export price of conch in Honduras has had three distinct levels, jumping suddenly rather than gradually increasing over time. From 1986 to 1998 the price remained very stable, averaging just over $2 a pound. This stability in price occurred despite high inflation and a devaluing local currency. Following hurricane Mitch in 1998, the price rose to stabilize around $3.30 until the closure of the fishery in 2004. When the fishery reopened in 2006 the price had jumped to average $5.86, with slightly larger variation around this mean (Figure 6). It is not clear why the price jumped after the 1998 hurricane but it may have been due to limitations in the fishing capacity, that pushed prices up, similar to price shifts seen in the Belizean fishery following hurricane Keith and Iris in 2000 and 2001.

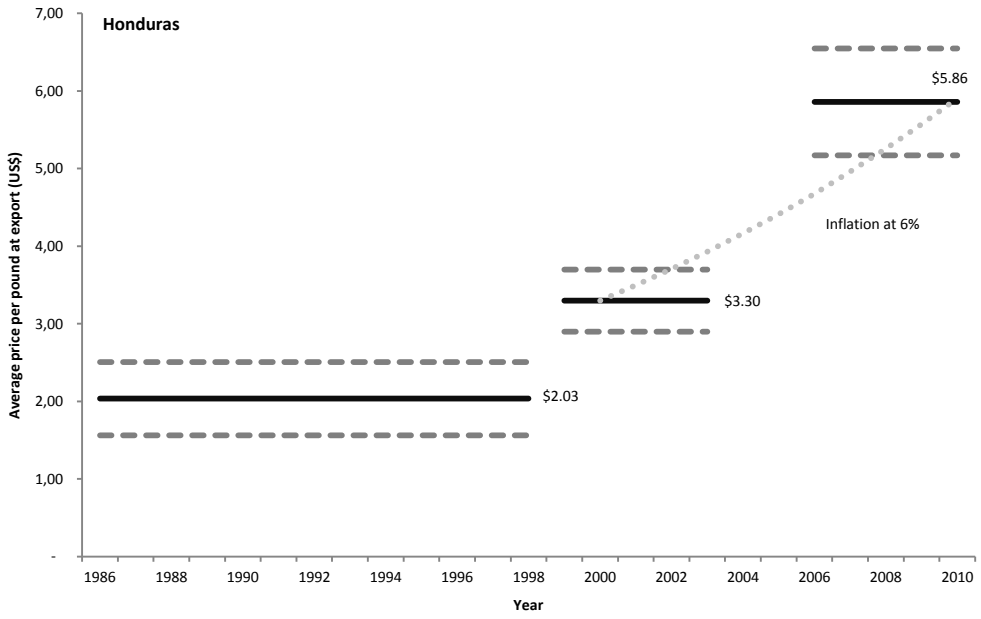



**Figure 6 - Mean price per pound for conch imported from Honduras to the United States (solid line) showing three distinct pricing levels over time. The dashed lines are the 95% limits around the mean, showing the degree of variability in the price. Dotted lined shows expect price increase from the year 2000 price based on mean inflation rate of 6% per annum. Data collated from NOAA fisheries import records and inflation rate from the Honduran Central Bank.**

The rise in price in 2006 is easier to interpret. When the fishery reopened after the government closure it was highly restricted under the control of the scientific research

program that limits total catch. This will have pushed prices up as the different packing plants compete for limited product from independent boats. In addition, there is a $0.56 levy per pound on Honduran conch for the research program that must be absorbed in to the pricing system. Interestingly the price of conch now matches the expected price per pound as calculated from its increase due to inflation from the year 2000 that has averaged 6% per annum (Figure 6). This matching of the export price and the expected price due to inflation suggests that the market price of conch for export is now much more closely linked to true fishing costs rather than dockside price being artificially undervalued by the exporters.

To fund the scientific program there is a tax on the conch meat of $0.56 per pound of clean conch paid by the boats and collected by DIGEPESCA. Based on the landing records for 2010 the research program made US$264,535. Under government regulations, half of this revenue is for the general treasury of the republic, for use in the national budget and the other half is for use by DIGEPESCA.

## Current Information, Protection and Management

Besides the data described by the scientific research program for the commercial fishing banks, overall the data on the current status of conch populations in Honduras is scant. There is little data for the north shore outside of the Bay Islands and the majority of the existing data is derived from coral reef surveys rather than from specific conch surveys conducted in seagrass area and other shallow water areas of suitable conch habitat.

The only existing data set that encompasses reef areas across the north shore is the Atlantic and Gulf Rapid Reef Assessment (AGRRA) data collected by Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre (ICF). The majority of this data is from 2006, where 9 sites were visited and 322, 10 m x 1m transects were completed (Table 5).

**Table 5 – Total number of conch found by surveyors using the Atlantic and Rapid Reef Assessment method of 10 $m^2$ belt transects (10 m x 1 m) across reefs on the north shore of Honduras. Data courtesy of Andrés Alegría, Investigación y Monitoreo Biológico, Departamento de Áreas Protegidas (Pers comm).**

| | 2006 | | 2009 | | 2010 | |
|---|---|---|---|---|---|---|
| **Location** | **Total conch** | **N** | **Total conch** | **N** | **Total conch** | **N** |
| Puerto Cortes | 0 | 16 | - | - | - | - |
| Tela | 0 | 15 | - | - | - | - |
| Trujillo | 0 | 22 | - | - | - | - |
| Cayos Cochinos | 1 | 58 | - | - | 0 | 21 |
| Utila | 1 | 57 | - | - | - | - |
| Roatán | 4 | 77 | 0 | 48 | - | - |
| Morat (East Roatán) | 0 | 5 | 0 | 6 | - | - |
| Barbareta (East Roatán) | 0 | 24 | - | - | - | - |
| Guanaja | 1 | 48 | - | - | - | - |
| TOTAL | 7 | 322 | 0 | 54 | 0 | 21 |

In 2006 only 4 of the locations had conch, all of which were in the Bay Islands. The equivalent density of conchs based on these surveys was 20 conch per hectare in Cayos Cochinos, Utila and Guanaja, and 50 conch per hectare in Roatán. Further AGRRA surveys were conducted in 2009, but only in Roatán and Morat (an island to the east of Roatán), however in the 54 surveys no conch were found. In 2010 only Cayos Cochinos was surveyed and no conchs were found during 21 surveys (Table 5).

It is important to note that the survey methodology used by AGRRA is to assess coral reef condition and resident fish populations and is not an effective method for evaluating conch populations. This is because the method uses a short 10 m transect of 1m width for the benthic surveys and 30m by 4m belt transects for fish. Standard conch transects are 50 m x 3 m which covers an area 15 times greater during each replicate than the AGRRA benthic survey methods. In addition these AGRRA surveys were located on reef substrate and did not aim to assess seagrass beds or other habitat types where conchs are commonly found.

In addition to the AGRAA data the following information exists for the Bay Islands.

Utila

The Bay Islands Conservation Association (BICA) – Utila, along with the municipality and the ICF are the co-managers of Turtle Harbour / Rock Harbour and Raggedy cay / South west cay which have all been designated under the Bay Islands management plans to be “Special Protected Areas”. The exact meaning of this term however has not been defined and there are currently no statutes governing fishing in these areas. Whilst under the management plan process different areas and zones have been delimited the rules which govern what can occur in each area have not been drafted leaving a vacuum of fisheries legislation for the area.

The only area that remains protected is Turtle Harbour which is a no fishing zone by municipal decree. BICA mount patrols during daylight that circumnavigate the island with the aim of enforcing fishing restrictions including the prohibition of nets, spears or traps, and the collection of conch. In early 2011 patrolling by BICA had stopped the supply and marketing of most juvenile conch in local shops on the Utila cays. The marine patrol of BICA had confiscated 688 conchs, from fishers during 17 different incidents from March 2010 to February 2011. BICA recovered an average of 40 conchs per incident. No data have been collected on the size of conch, but it is assumed they are well below maturity, given the numbers being collected at each incident and the known adult density of the area.

Recent anecdotal information (April 2011) from members of the community on Utila cays suggest that the current efforts of the BICA patrol are now being curbed by the local mayor’s office, following complaints from a handful of fishermen. Juvenile conch has now reappeared in the local shops.

Surveys conducted by Centro de Ecología Marina de Utila in the white water areas of seagrass to the south west of Utila found an average of 6 adult conch per hectare during 103 transects (50m x 4m) between 2008 and 2009. The white waters to the southwest of

Utila were protected by municipal decree between 2000 and 2001. Anecdotes from the cays fishermen suggest that protection of this area benefited conch because the area is an important aggregation site. This closure was lifted by the mayor Alton Cooper during 2001, citing concerns that he was preventing locals from being able to feed their families (Anon, Pers comms). There is now popular local support to put the closure back in place.

There is no data from inside the marine protected area of Turtle Harbor and the co-managers of the area have not been able to conduct recent assessments of its biological condition.

Cayos Cochinos

The conch closure in Cayos Cochinos followed concerns that local conch populations were low (Guzman and Jácome 1998) and in 1996 surveys of conch across about one third of the reserve found 14.6 conch.ha$^{-1}$. This density was used to approximate a total abundance of 223,818 conchs within the reserve. The majority (58.8%) of conch found in transects of depths of less than 10 m (Tewfik, Guzman et al. 1998). It was this sole data set that was included in the CITES review of the conch fishery in Honduras in 2003.

More recent population surveys have only been conducted by a scientific tourism organization, Operation Wallacea, using volunteer tourists to conduct conch transects in 19 sites around the archipelago. Unfortunately their reports, available on line, do not provide clear results nor density estimates in standard units such as conch per hectare. The reports do not specify the actual area of the transects used, simply giving a transect length of 50m (Saunders, Connerlly et al. 2009). However if we assume the transects were 50m x 3m (i.e.150 m$^2$), and use the average number of conch per transect as 1.6 conch, taken from their figures, then the estimated density from the data they present is 106.7 conch.ha$^{-1}$.

Clearly there is a need for surveys to be conducted and reported properly in Cayos Cochinos to provide a current estimate of conch density and confirm whether after nearly 20 years of no take protection the local conch populations has indeed shown signs of recuperation.

Roatán

The 10 year management project for the Bay Islands “Proyecto de Manejo Ambiental de la Islas de la Bahia” (PMAIB), which mainly focused its efforts on Roatán, did not collect data on conch, conch fisheries or on seagrass beds. The fisheries reports did recognize the importance of this fishery to the islands and the need for management, but provided no further details nor suggested a management framework. To date there has been no management action concerning conch populations on Roatán, beyond the activities of the Roatán marine park.

The USAID-MIRA (2005) project included a rapid conch survey for Roatan (Dunbar and Perumal 2006). The work completed 40 transects in total at 4 locations on the south side of Roatán. They found a total of only 4 conch across all their surveys, which they extrapolated to calculate an approximate density of 6 conch per hectare. This estimate is based on a very low sample size and poor sampling strategy which focused on the south

side of the island despite the fact that the main areas of sea grass and suitable habitat for conch are on the north side of Roatán. The extrapolation from the few surveys conducted to produce a density estimate is therefore considered unsound.
In the east of Roatán around the island of Barbareta Fonseca et al (Fonseca, Breedy et al. 2004) found 13.9, 12.0, and 79.6 individuals per hectare for 3 selected sampling sites.

There have been no surveys of the seagrass areas inside the reef crest, on the north side of Roatán, importantly, this lack of data includes the areas inside the main protected area in West End Sandy Bay, which prohibits conch fishing, but as with the other marine protected areas cannot determine if this restriction is assisting in population recovery.

Overall there are no current population estimates for the island including within the protected areas. Existing estimates come from limited sampling and poor location choices. The absence of information does not make it easy to evaluate if conservation action in the protected areas is making a difference, nor is it possible to assess populations for management purposes

Guanaja and the north shore

There is no information for Guanaja besides the 48 surveys conducted by the AGRRA team in 2006, where they reported 1 conch. Similarly for the sites of suitable habitat identified in Map 1 such as Punta Sal, Punta Izopo and the main banks between Tela and Utila, the limited number of surveys conducted by AGRRA is the only available data set (Table 5). There is an urgent need to conduct conch specific surveys in these areas to assess current population densities.

CITES Honduras

The listing of *Strombus gigas* on Appendix II meant that CITES as an international agreement between governments became one of the main management mechanisms for conch in the region. All import, export and re-export of conch have to be authorized through a licensing system. Each Party to the Convention must designate one or more *Management Authorities* in charge of administering that licensing system and one or more *Scientific Authorities* to advise them on the effects of trade on the status of the species. Conch may be imported into or exported (or re-exported) only if the appropriate document has been obtained and presented for clearance at the port of entry or exit.

In Honduras the *National Office of CITES*, is the designated Management Authority responsible for storing and processing information relating to exports, imports and re-export permits for trade in CITES listed species. The CITES office in Honduras has a single staff member in charge of all the office's duties.

The CITES office stores records for Honduras as paper files. The only digitized years are for 2009 and 2010, corresponding to the current administration. The digitized information is stored in MS Excel spreadsheets and in its current form is not routinely analyzed. Due to the current data management system it is not possible for the administrator to know, at the time of processing applications for CITES permits, what quantity of a species have already been certified by the office in a given period. Therefore it is not possible for them to know, in the case of conch, if the CITES export quota limits, have already been reached.

There is no backup to digital information within the system, leaving the already limited available information vulnerable to intentional or accidental modifications, system failures and losses. This may explain why there are no historical digitized records from past administrations and there are no digital copies of reports that have been developed by the local CITES office in previous years available at the CITES office prior to 2009.

The local office of CITES works hand in hand with quarantine control authorities located in customs, which certify that CITES products leaving and entering the country comply with the documentation requirements and verify quantities. There is however, no internal communication system between the two organizations to enable the real time exchange of information. Instead, once a month customs are obliged to send paper records to be filed at the CITES office.

DIGEPESCA is the relevant Scientific Authority for CITES for conch in Honduras working through the scientific program to advise on the status of the species. This program has made significant progress towards developing the data upon which to build a management framework for 4 banks of the commercial fishery. The limitations in the current capacity of the CITES office may explain why the export data for conch is not currently being collected by the office and instead it is collected by the Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA), which is not the legally recognized CITES authority for Honduras. There is an urgent need to improve the collection, storage, use, sharing and security of data at the CITES office as well as enhance communication capabilities and data sharing in real time between relevant agencies involved in conch management as well as all other natural resources under the CITES control system.

## Critical habitats, threats and opportunities

Without data on the population distribution of conch in the Honduran portion of the Gulf of Honduras, it is difficult to evaluate the threats to this population or potential effects from impacts on their critical habitat. Suitable habitat areas outlined in Map 1 show that most suitable habitat is around the Bay Islands as well as smaller areas on the north shore towards Punta Izopo and Punta Sal. Seagrass however has been widely ignored from specific management plans and are still not incorporated in to the management plans of the Bay Islands developed by PMAIB. Whilst reefs in some areas are under management, it is not known how reef condition actually effects conch populations.

Threats to seagrass and reefs would originate locally from direct destruction caused by coastal development as well as associated impacts from pollution. This is compounded by global stressors such as rising sea level and ocean acidification. The rapid development on Roatán and the increasing development of Tela Bay would be a cause for general concern for the condition of coastal resources and direct habitat destruction. In addition the port in Puerto Cortes is an obvious site for point source pollution concerns.

At this stage without better information and data on where the important areas for conch are located within Honduras, such as the location of reproductive aggregations and whether populations are segregated into deep and shallow water populations, and most importantly how these areas and populations connect together, it is not possible to effectively assess the relative importance or respective threats to different areas. Much

work is needed to be able to prioritize and target management actions, beyond blanket precautionary management of a moratorium on conch fishing.

To begin with, it is crucial to determine whether the management of areas such as Cayos Cochinos, West End Sandy Bay, Turtle Harbour and other protected areas (Map 2) are having a noticeable effect on conch populations. This can be accomplished by assessing conch density and then regularly monitoring their population. In addition where local knowledge has defined areas as potentially important, these need to be prioritized for research and subsequent community management. These areas include the white waters west of Utila, the banks between Utila and Tela and the reefs around Punta Izopo and Punta Sal.

It is clear that the greatest threat to conch populations, has been and continues to be, fishing pressure. Whilst destruction of seagrass areas by dredging, and near shore development obviously decreases total available habitat, the effects of this are likely to be masked by sustained fishing. Suitable habitat is unlikely to be a limiting factor at current population levels, nor is water quality likely to be of primary concern.

The best conservation strategy would be to confirm that in areas where protection has occurred for some time, it has had some measurable success at recuperating conch populations. The next step would be to identify which additional areas need to be protected in order to conserve critical areas to recuperate conch across the area. At the current time it is highly unlikely that many areas on the north shore of Honduras have the 56 to 200 conch per hectare needed to trigger successful reproductive events. Once again it is essential to know where the aggregation sites are as sources of reproductive output. Similarly it is important to know where the sink areas are, whose populations are sustained by other areas. This information can help define if the current placement and network of marine protected areas will facilitate conch population recovery. This can underpin the process of prioritizing conservation action. This connectivity work can only feasibly be achieved through a genetic study across the area. Using such an approach would be relatively quick, simple, and economically viable. The technical capacity exists in Honduras between the Centre for Marine Ecology and the Zamorano Pan-American School for Agriculture, who are already working on genetic connectivity projects for commercially important marine species.

# CONCLUSIONS

This review of the current status of exploitation and conservation of conch in the Gulf of Honduras found that the remaining conch stocks for the zone are concentrated in the southern Belize portion of the Gulf of Honduras. Conch has been effectively fished out of the small reef areas of Guatemala. Similarly across the north shore of Honduras conch has largely disappeared from the coastal fisheries and there is only one fishing area, on the off shore banks between Utila and Tela, that supports a small scale fishery targeted by tank divers from Utila cays, the north shore community of Porvenir and fishers from La Ceiba. Conch around the Bay Islands is collected incidentally if encountered by local fishers on snorkel but are considered to be very scarce.

Existing management of conch in the Gulf of Honduras reflects the difference in the relative national importance of this fishery between the three countries in this area. In Belize where conch is the second most valuable fishery and the fisheries sector is well organized and politically important, there is a long history of government management. Belize has a well structured management framework and an active fisheries department. There are a suite of management tools including size, season and gear restrictions used to control their conch fishery. In contrast, neither Guatemala nor Honduras, have significant conch resources within the Gulf of Honduras and as such conch management for this particular area is not a high priority for these two governments. As a consequence, management capacity, regulation and enforcement are virtually nonexistent in the area for Guatemala or Honduras. Conch is effectively unmanaged by these two countries in this zone.

Guatemala focuses its limited fisheries management capacity, which comprises of two fisheries officers in the Caribbean, on shrimp and anchovy fisheries. These are the most important national fisheries along their Caribbean coast. There is virtually no oversight of the conch fishery nor a concerted effort to collect landings information, fishing effort, or other fisheries dependent data for conch. It is well known that all conch in Guatemala are being caught in Belize. The poor management in the area is compounded further by the complex web of jurisdictional control to regulate different stages of the fisheries market chain from capture through to the consumer in Guatemala. The lack of coordination between these departments means in essence there is no effective control or regulation of the fisheries in the area. In its current form the current governance framework is considered to be overly complex and opaque to provide effective management to conch or any other fishery in the area.

In Honduras the fisheries department has focused on regulating the industrial fisheries which target banks in the eastern EEZ of Honduras. Management capacity is therefore focused in the industrial port areas of La Ceiba, Roatan and Guanaja, and largely concentrates on licensing the industrial fleet. The entire zone encompassed by the Gulf of Honduras and the near shore waters of the Bay Islands has been largely ignored by existing fisheries management. Industrial fishing has been prohibited in this area and small scale fisheries have not been on the management agenda. Little effort has been made to quantify or control the small scale fisheries based from the coastal and island

communities across the area, nor assess current conch stocks that are not on the industrial fishing banks. There is no tangible government presence for Honduran fisheries management in the Gulf of Honduras. Overall there is little Honduran government interest in the management of conch for the Gulf of Honduras area by and large because the decline in the conch population means that the area now contains few conch nor supports many conch fishermen. Fishermen from Omoa and Puerto Cortes are known to fish in Belize for a variety of fish including conch. To date, similar to Guatemala there has been no government intervention to address this.

Beyond direct management oversight of the fishery, the conservation of conch in the area is centered around protected areas. In Honduras however the main protected areas that have large areas of suitable conch habitat including Cayos Cochinos, Roatán and Utila have not had fisheries assessments to be able to determine if protection is making any difference to the conch population. No information is available for the remainder of the north shore. In Guatemala recent surveys inside the protected areas of Punta Manabique and Bahía de la Graciosa found no adult conch and so these protected areas may be of little use to conch conservation. In Belize the biannual conch surveys conducted by the fisheries department, assisted by nongovernmental organizations do provide relevant population data, but the assertion by the fisheries department that there is a deep water population that replenishes shallow water fished stocks has not actually been investigated.

Across the region the role of protected areas in supplying conch to the fishery has not been demonstrated or its efficacy quantified. Similarly how the protected areas connect together at larger spatial scales, whether the correct areas are protected to enhance conch recovery and whether protected areas are the correct tool for conch management has not been investigated.

The lack of data across local, national and regional scales, specifically in terms of the connectivity of the conch population and the effectiveness of marine managed areas is the major weakness in the ecological knowledge hindering the future management of conch at the regional level. The disparity in the abundance of conch between the three countries and the associated national importance attributed to the fishery politically in each of the three countries is the main governance obstacle for developing a tripartite framework for a sustainable fishery.

The recommendations presented here aim to address the factors that underpin these two main conclusions; the ecological weaknesses and the governance weaknesses. The recommendations provide the basis for the pragmatic actions that will be detailed in the management plan for conch in the Gulf of Honduras that will provide the framework to resolve these issues across the multiple scales necessary.

# RECOMMENDATIONS

## Ecological Recommendations

### 1. Sustained data collection in marine managed areas

The absence of reliable data beyond Belize, especially in potentially important habitat for conch in Honduras including the Bay Islands, makes it difficult to evaluate if conservation action in the protected area network is making a difference. In addition it is not possible to assess existing populations to form a baseline to measure future management efficacy.

***Recommendation*:** Conduct an initial survey across the north shore of Honduras and Bay islands and then initiate permanent monitoring programs of conch as part of all protected area management plans across the Gulf of Honduras. In addition marine park managers should strive to quantify seizures from illegal fishing and compile landing records that include fishing effort. Data should be collated at a regional level to facilitate interpretation of results at appropriate scales.

### 2. Develop an understanding of the connectivity of the area

Conch populations are fragmented spatially in different areas of habitat across the Gulf of Honduras and the importance of different areas as sources or sinks of conch are unknown.

***Recommendation*:** Conduct genetic studies to assess the connectivity of conch temporally and spatially across their range especially inside and outside protected areas and between and within the different countries and their fishing banks.

### 3. Determine the existence and role of the deep water conch population

In Belize where fishing is limited in depth because of the prohibition of tank diving there is an assumption that a deep water population of conch regenerates the fished shallow water population. This deep water population has never been surveyed nor has its connection to shallow water populations been demonstrated

***Recommendation*:** Conduct surveys in deep water to quantify conch aggregations beyond the reach of fishers. Determine degree of mixing and migration between the shallow and deep populations through a combination of genetic and tagging experiments.

### 4. Treat with caution the estimates of total conch population

Recent studies are demonstrating that there is no correlation between survey density estimates and total population abundance for conch across large spatial scales. This is because conch form aggregations and use only a small proportion of the total suitable habitat available. Connecting mean density to total population through a simple multiplication of density by suitable habitat area can lead to large over estimates of conch populations.

***Recommendation:*** Refine the models connecting discrete abundance calculated from surveys with total population, building on models created conducted by Prof Ehrhardt in Honduras. Identify additional mechanisms for monitoring the fishery including paying greater attention to changes in catch per unit effort and the total amount of effort that a fishing bank can support.

### 5. Segregate the management of the fishery in to banks

Whilst the lack of population connectivity data means it remains unclear at what scales conch populations should be managed, it is likely that the management units need to be small, i.e. quotas for specific fishing banks, rather than large i.e. country wide quotas.

***Recommendation*:** in conjunction with connectivity studies develop quotas at appropriate scales potentially for individual fishing banks that can then be connected to specific fishing communities as part of rights based fishery management schemes.

### 6. Local conch rehabilitation

The reproductive success of conch is density dependent. Early life stage survival is low. These factors can hinder population recovery

***Recommendation:*** Work with local fishing groups to trial the effectiveness of corrals in known conch reproductive areas to bring conch together for mating (such as established by Corallina in Providencia, Colombia). Also trial community conch hatcheries that can produce small conch from egg casings to repopulate protected white waters (as piloted by Centro de Ecología Marina, in Utila).

## Governance Recommendations

### 1. Harmonization of fishing rules

For regional management to be effective all countries need to be following similar fishing regulations so there is consistency in management efforts across the area.

***Recommendation***: Seek to harmonize all fishing regulations related to conch across the three countries, especially closed season and minimum size. This should be applied to commerce as much as to the actions of the fishers.

### 2. Specific ban on tank diving for conch

As part of the harmonization process and because of the connection to lobster fishing, tank diving should also be prohibited for conch fishing. In addition fishers put themselves at risk of serious injury from diving accidents.

***Recommendation:*** Prohibit tank diving for conch following on from the legislation prohibiting tank diving for lobsters through OSPESCA. Fishers should be encouraged that this can be replaced by skin diving.

### 3. Integrate management of Honduran commercial fishery into Gulf management

The imminent reopening of the Honduran industrial fishery is likely to have a significant effect on the conch fishery across into the Gulf of Honduras. This is due to the strong connection of fishers and markets, where fishers migrate to work in the industrial fishery

or in the small scale fishery and the market chains intertwine across the north shore of Honduras and into other Central American countries. It is essential that this reopening occurs with consideration for the regional management of this resource.

***Recommendation*:** The industrial fishery in Honduras should be managed as a separate unit to the Gulf of Honduras but with lateral consideration for harmonization of regulations, seasons, sizes and gears and the understanding that the change in the management of one area's fishery will affect the other.

### 4. Continue the efforts on strengthening CITES implementation

CITES is the regional management mechanism for regulating conch. This review however has uncovered fundamental weaknesses in the ability of CITES to record trade and provide oversight to this fishery especially in Honduras

***Recommendation*:** Strengthen the capacity of CITES in each country to compile, analyze and disseminate data related to conch trade and to coordinate in real time with other agencies such as customs and fisheries departments. Update technology especially in the acquisition, storage and use of data and provide a secure and independent data store for this information

### 5. Control Illegal trade of conch between Central American countries

There is significant movement of conch between the countries of Central America that is likely to be illegally landed catch and is certainly undocumented trade. This confounds management efforts as it is essential to be able to quantify exploitation levels to be able to manage a resource.

***Recommendation:*** Conduct a trade review of conch movements between Belize and Guatemala, Honduras and Guatemala and Honduras and El Salvador with an aim to estimate the amount of movement and market volume that can be used to improve exploitation estimates of regional conch stocks. Then seek to restrict the illegal movement of conch across borders and provide a simpler way to legally move this product so that it can be registered under CITES and accounted for in national statistics.

### 6. Incentivize fishermen to maximize efficiency of fishery

There is a strong connection between conch fishing and lobster fishing. By maximizing the efficiency of both fisheries the fishers can increase their profit margins without having to increase exploitation levels.

***Recommendation*:** Work with local fishers to set up lobster casitas in conch areas so that they can be fished together to cut costs. Work with local restaurants and other markets to encourage that their business prefer products from local responsible fishing.

### 7. Fishing licenses and landing statistics

It is not possible to accurately evaluate fishing pressure if it is unknown how many fishermen there are active in an area. Similarly without landing statistics it is difficult to assess catch per unit effort.

***Recommendation*:** Implement a national license scheme for small scale fishers in Guatemala and Honduras that is connected to a boat registration system. This should be connected between countries to assist in the cross boarder identification and regulation of illegal fishing. Connect fishers into a network so that their catch can be effectively

recorded and incorporated in to local, regional and national fishing statistics as is being piloted by the Centre for Marine Ecology, Honduras.

### 8. Identify viable alternative fisheries

There is a need to find alternative fishing activities that can reduce the reliance of fishers on conch. In addition when a closed season is long, it is essential to find alternative fisheries that coincide with this period to increase the likelihood of compliance.

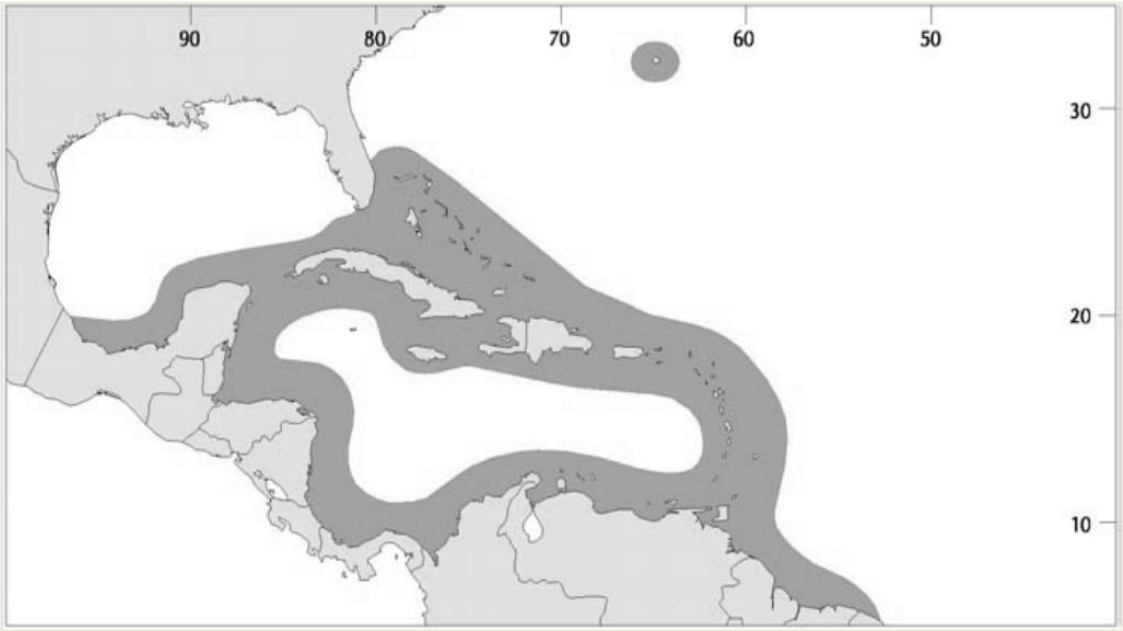
***Recommendation*:** Conduct a review of potential alternative fisheries, such as yellowtail snapper (Honduras and Belize) and snook ranching (Guatemala) that have the potential because of their life history traits, to be easier to develop sustainable management schemes for than conch. Species should specifically be suitable for exploitation during the closed conch season.

# Appendix I – Queen Conch Biology

The Queen Conch (*Strombus gigas*) is the largest extant species of marine gastropod within the Caribbean Sea, with a maximum shell length of approximately 30 cm. It is also one of the longest living gastropods with estimates that this species can live in excess of 30 years (Glazer and Berg 1992)

## Habitat and distribution

The geographical range of *Strombus gigas* is limited to the Western Atlantic (Map 3), specifically from Florida, down through Central America to the North coast of South America, up through the windward and leeward Caribbean islands and Bermuda (McCarthy 2008).




**Map 3 – Distribution of queen conch (*Strombus gigas*) across the western Atlantic[6].**

The preferred habitats of conch are in shallow clear waters, where salinities are similar to oceanic levels, including sand flats, coral rubble, algal plains and seagrass beds. Conch occur in discreet aggregations of a few individuals to many thousands (Stoner and Ray-Culp 2000) and can be found at depth of 75m, but are normally found above 30m and in the range of 2-15m. The limiting factor of their distribution is likely to be light which determines the range of some of their preferred habitats and food (Stoner and Sandt 1992), as seagrass and algae require high light levels for photosynthesis.

[6] Adapted from Leal, J. H. (1990). "Chapter: Gastropods." Publication of the Baileys-Matthews Shell Museum: 100-147.

## Anatomy

The shell has spines on each whirl of the spire and combined with a flared aperture that is glossy and deep pink in color makes this species easily distinguishable from other species. Shell morphology has high plasticity, differences is shell form are attributed to habitat type, food availability and predator densities during development (Appeldoorn 1990) (Stoner, Glazer et al. 1996). The shell of the conch develops in tandem with soft body parts, secreted via an orange-yellow mantle that surrounds the soft body (Davis 2005).

Locomotion is via the contraction of a singular large muscular black-speckled foot, although when threatened by a predator a hopping motion, the *Stromboid leap*, is utilized. Conch use the hardened tip (the operculum) located at the end of the foot to perform this *leap.* The leap is thought to provide a more rapid means of escape in addition to breaking up the scent trail (Davis 2005).

Conch sight is highly developed. A pair of eyes are situated at the tip of two protruding stalks which can be retracted within the shell for protection (Picture 1).
At the base of the eye stalks is a long proboscis, or feeding tube, which is used for grazing on diatoms and detritus upon seagrass blades and sand grains, the preferred food of Queen Conch (Davis 2005).

## Reproduction

Conch are gonochoristic and so individuals are either male or female and do not change sex during their life. In unexploited populations sex ratios are 1:1. Sexual maturity has normally occurred by the time the lip of the shell is full flared, at 4 around years or 20 cm length (Appeldoorn 1988) but due to the high level of morphological variation, size and flaring are not good determinates of maturity, instead lip thickness is a better indicator, as conch only thicken their shell lip once they have reached maturity. Conch have a specific reproductive season, which depending on the region and environmental conditions ranges in duration from six to eight months beginning in March and ending in October. The day length (photoperiod) and water temperature are considered important cues in the onset of conch reproduction (Stoner, Sandt et al. 1992). Peaks in reproductive activity are observed in large expanses of sand at depths of 10-20m when water temperature is 28-30$^{o}$C (Stoner and Sandt 1992).

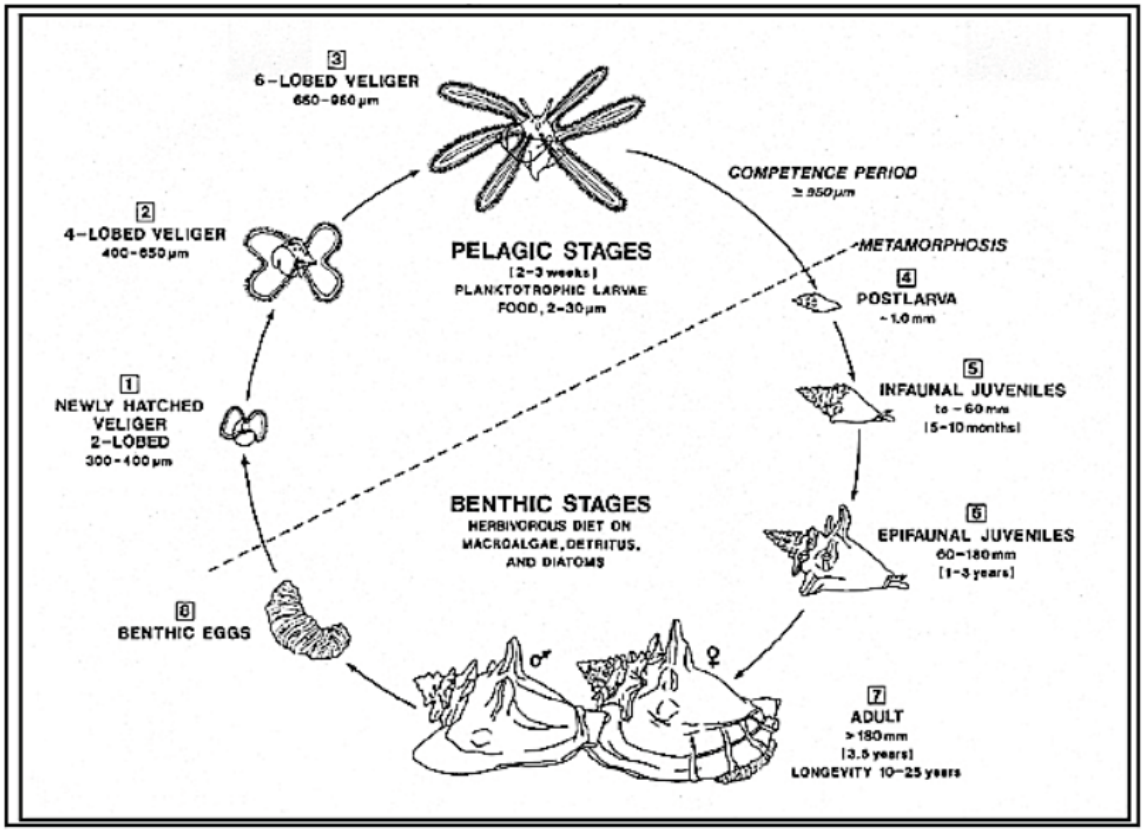
Appeldoorn (Appeldoorn 1988) hypothesized that reproduction within conch populations is reliant upon a positive feedback loop of copulation and spawning which stimulates reproduction in other individuals, thus increasing a populations reproductive output. (Stoner and Ray-Culp 2000) (2000) observed critical density dependence in conch reproduction. No spawning was observed when conch densities were less than 48 indv.ha$^{-1}$ and minimal mating behavior was observed at densities of 56 indv.ha$^{-1}$ interestingly when densities reached 200 indv.ha$^{-1}$ an asymptote in reproductive output is reached, suggesting this is the minimum density required for a population to be classified as stable.

Conch copulation is classified into four stages by (1) copulating; (2) pairing—when the shells of 2 individuals were touching and in the mating position but copulation was not

occurring; (3) spawning—when eggs were being extruded by the female; and (4) non-reproductive (Stoner and Sandt 1992). Fertilization of eggs is internal, with both males and females copulating with multiple individuals throughout the spawning period (McCarthy 2008). Females are able to store eggs for several weeks (D'Asaro 1965), this suggests a single egg mass could be fertilized by a number of different males. Females can lay up to nine egg masses per reproductive season, a single egg mass can contain between 400,000 to 750,000 eggs (Appeldoorn 1993) however the number of egg masses and eggs within eggs masses produced by an individual are highly variable between years. Conch egg mass are demersal comprised of a single thin sticky strand 10-12 inches long which usually takes on a crescent shape (Davis 2005). The egg masses are laid in sandy substrates and occasionally seagrass beds, and are covered by a thin layer of sand to camouflage eggs during their 3 to 4 day incubation period.

## Larval and Juvenile Development

Embryonic development of conch is temperature dependent, but generally proceeds rapidly, the larval shell develops within 24 hours and free swimming veliger larvae emerge from the eggs within 72 hours (Davis 1994) (Figure 7). The duration of the larval planktonic phase is dependent upon prey concentrations, temperature and proximity of suitable settlement substrate, thus varies greatly at between two and eight weeks. Veliger larvae must settle on the benthos to metamorphose to the benthic animal. Optimal nursery areas are *Thalassia testudinum* seagrass beds at approximately 6m depth with a shoot density of 600-900 $m^2$. Settlement and metamorphosis are dependent upon the stage of morphological and physiological development, but may also be influenced by chemical cues identifying suitable habitat, including from algae such as *Laurencia spp.* Conch recruitment is temporally and spatially variable due to variations in conch reproductive effort throughout the reproductive season and over years (Appeldoorn 1992), Once recruited to a nursery area secondary dispersal is limited. Thus juvenile populations are dependent upon the extent of suitable nursery habitat and their ability to find these areas.




Drawing by Bonnie Bower-Dennis

**Figure 7 – Life cycle of the Queen conch (*Strombus gigas*)**

For the first two years of life juveniles remain in nursery areas, generally seagrass beds. The first year they remain buried, feeding on a variety of algae such as the green seaweed *Batophora oerstedi* or on detritus or diatoms commonly associated with the seagrass *Thalassia testudinum*. Juveniles show seasonality in growth, associated with changes in temperature, (Appeldoorn 1990).

The mobility of benthic juveniles increases greatly with size, with juveniles as small as 35mm being able to make relatively large movements (Sandt and Stoner 1993). With the onset of sexual maturity and the flaring of the shell lip sub-adult conch migrate to deeper waters joining adult populations (Stoner, Glazer et al. 1996).

## Adult development

Queen conch grow in shell length until the onset of sexual maturation, at the onset of sexual maturation the shell-lip flares, shells continue to grow however it is shell thickness not length that changes (Appeldoorn 1988) (Aldana-Aranda and Frenkiel 2005).

Adult conch inhabit expanses of seagrass meadows and sand patches at depths of 10-40m, although can be found at both shallower and deeper depths, with seasonal changes observed from sandy substrates to hard benthos (Stoner and Sandt 1992). Home ranges average approximately 8 hectares or less, although there are reports of ranges of 60 hectares (Glazer and Kidney 2004). Movements of conch are limited,

between 2-15m per day with an estimated maximum of 100m per day (Stoner and Ray-Culp 2000). Seasonal migrations occur within populations, moving to shallower grounds (5-20m) in the summer to spawn, at this time little feeding occurs, and returning to deeper waters (20-75m) after the spawning season where they remain for the rest of the year (Stoner and Sandt 1992). There may be distinct populations segregated by depth which important for management as deeper water populations by replenish shallower water exploited stocks. However, until a greater understanding of population connectivity is achieved through genetic analysis this remains hypothetical.

# APPENDIX II - List of people interviewed

| Organisation | Position | Representative |
|---|---|---|
| DIGEPESCA | Departamento de Investigación Científica / Asistente de Investigación | Jose Antonio Romero |
| Oficina Regional Roatán de la Direccion General de Pesca y Acuicultura DIGEPESCA | Jefe Regional Roatan | Rene Betancourt |
| Unidad de Manejo Ambiental Municipalidad de Omoa | Jefe de la Unidad Ambiental | Gustavo Cabrera |
| Unidad de Manejo Ambiental Municipalidad de Utila | Responsable de UMA | Michelle Fernández |
| Roatan Marine Park | Directora Ejecutiva | Grazzia Matamoros |
| Utila Dive Safety and Environment Council | Asesor Científico | Andrzej Narozanski |
| Bay Islands Conservation Association (BICA) | Asistente Técnico | Pamela Ortega |
| Fundacion Cayos Cochinos | Director Ejecutivo | Adrian Oviedo |
| Cuerpos de Conservación de Omoa (CCO) | Director | Roger Flores |
| Proyecto Golfo de Honduras | Especialista Ambiental | Roberto Rivas |
| Asociación de Pescadores Artesanales (APESCA) | Presidente | Edgar Hyde |
| Asociación de Pescadores de Utila | Presidenta | Relina Yolany Asiego |
| Centro de acopio Utila Cays (Caracol y Langosta | Dueño | Newton Diamond |
| Asociación de Pescadores de Chachaguate | Presidente | Juan Diego Calix |
| Federación Nacional de Pescadores Artesanales de Omoa | Presidente | Noe Chavarria |
| Asociación de Pescadores Artesanales (APESCA) | Presidente | Kenny MacNab |
| Asociación de Pesca Industrial de Honduras (APICAH) | Presidente | Richard Bonilla |
| Representante de Empacadoras de Ceiba | Presidente | Francisco Terry |
| Representante de Empacadoras de Roatan | Presidente | Shawn Hyde |
| Flying Fish | Gerente | Russ Summerell |
| Mariscos Agua Azul | Gerente | Edwin Castillo |
| DIPESCA | Asistente técnico de pesca | Misael James |
| FUNDAECO-COSTAS | Sub Coordinadora Programa Marino costero | Cleopatra Méndez |
| FUNDAECO-COSTAS | Técnico de la organización | Justo Rodríguez |
| DIPESCA | Oficial de pesca | Elías Valdés |
| CISP | Especialista en Pesca | Juan Ramón Pocón |
| Fishermen | Diver | Mario Saldívar Hernández, |

| | | |
|---|---|---|
| Fishermen | Diver | Erick Marín Ramirez, |
| Fishermen | Diver | Alberto Fúnez |
| Conch market chain | Main Conch merchants | Anonymous x 2 |
| Fisheries Department of Belize | Fishers Administrator | Beverly Wade |
| Fisheries Department of Belize | Fisheries Officer Belize City | Mauro Gongora |
| Fisheries Department of Belize | Fisheries Officer Punta Gorda | Lyndon Rodney |
| Rio Grande Fisheries Cooperative | Representative | Armando Ramirez |
| Rio Grande Fisheries Cooperative | President | George Ramirez |
| University of Belize | Researcher | Arlenie perez |
| Wildlife Conservation Society (WCS) | Head | Janet Gibson |
| Toledo Institute for Development and Environment (TIDE) | Executive Director | Celia Mahun |
| Toledo Institute for Development and Environment (TIDE) | Director of Science | James Foley |
| Southern Environmental Association (SEA) | Station manager Sapodilla Cayes | James Garbutt |
| Anonymous | Guatemalan market stall holders | Fish sellers x 4 |

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