

# The Long and Short Term Economic Drivers of Overexploitation in Honduran Coral Reef Fisheries Due to Their Dependence on Export Markets

STEPHEN J. BOX\* and STEVEN W. J. CANTY

*Centro de Ecología Marina, Edificio Florencia, Oficina 401-403, Blvd Suyapa, Tegucigalpa, Honduras.*

*\*[steve@utilaecology.org](mailto:steve@utilaecology.org)*

## ABSTRACT

Improvements in international trade routes have connected rural fishing communities to international markets; this has significantly altered the supply and demand dynamics of small-scale fisheries for many Caribbean coastal and island communities.

The current study examines the economics of a small fishing community in the Bay Islands of Honduras, to assess how connecting the community to international markets in 1992 has affected fish price structure, fishing effort, and profit shares. The study brought together data from the purchasing records of the main fish buyer in the community, fisheries landing records, export records for the main fish exporter in Honduras and import records for the United States.

The fishery records show the "classic" reductions in landed catches and export of grouper species over the past twenty years. Importantly, the study found that the price per pound paid to fishermen for groupers, snappers and other coral reef fish has not changed in local currency (Lempira) since 1992. This is significant as the Lempira has more than halved in value against the dollar over the same time period, whilst the costs of fishing, especially fuel, has risen on average by 6% per annum, as has the cost of living. In consequence the profit margins of local fishermen have continued to fall, pushing continual increased effort to maintain the same level of income.

The inability of fishermen to set their sale price in relation to their fishing costs and the continual shift in profit share from fishermen to exporters over the time period are important causes of escalating effort and the overexploitation of coral reef fisheries in Honduras.

KEY WORDS: Serranidae, Lutjanidae, overfishing

## Factores Económicos a Largo y Corto Plazo que Impulsan la sobre Explotación de las Pesquerías en los Arrecifes Coralinos de Honduras, Debido a su Dependencia de los Mercados de Exportación

La mejora en las rutas del comercio internacional, que han conectado a las comunidades pesqueras rurales con los mercados internacionales; han modificado significativamente la dinámica en la demanda del pescado capturado por las comunidades costeras alrededor del Caribe.

En este estudio, examino la economía de una pequeña comunidad de pescadores en las islas de la Bahía de Honduras, para evaluar cómo las conexiones entre la comunidad y los mercados internacionales en 1992; han afectado la estructura de precios del pescado, esfuerzo pesquero y acciones de beneficio.

El estudio compila los registros de compras de pescado del comprador principal en la comunidad, datos directos de desembarques de pescado y registros continuos desde el exportador principal. Mientras que los resultados muestran las "clásicas" reducciones en las capturas descargadas de mero y pargo, lo que más ha sorprendido, es que el estudio encontró que el precio por libra a los pescadores no ha cambiado en moneda local (Lempira) desde 1992.

Esto es importante porque el valor del lempira frente al dólar se depreció por la mitad en el mismo período de tiempo, mientras que los costos de la pesca, especialmente de combustible, han aumentado notablemente, al igual que el costo de vida. En consecuencia el margen de ganancia de los pescadores locales ha continuado bajando, empujándolos a aumentar continuamente el esfuerzo para mantener los niveles de ingresos. Las inhabilidades de los pescadores para establecer su precio de venta en relación con los costos de la pesca y el continuo cambio en la proporción de la ganancia total desde los pescadores a los exportadores durante el período de tiempo, son causas importantes de escalada de esfuerzo y la sobreexplotación de la pesca de arrecife de coral en Honduras.

PALABRAS CLAVE: Serranidae, Lutjanidae, sobreexplotación de la pesca de arrecife de coral

## Facteurs Économiques à Court et Long Terme Favorisant, dans les Récifs Coralliens du Honduras, la Surexploitation de la Pêche du Fait de sa Dépendance aux Marchés D'exportation

L'amélioration des routes commerciales internationales, connectant les communautés rurales de pêcheurs aux marchés internationaux, a sensiblement modifié la dynamique de la demande de poissons capturés par les communautés côtières des Caraïbes.

Dans cette étude, j'examine l'économie d'une petite communauté de pêcheurs dans les îles de la baie du Honduras, afin d'évaluer comment les liens entre la communauté et les marchés internationaux en 1992 ont affecté la structure des prix du poisson, l'effort de pêche et ont eu des conséquences sur les bénéfices.

L'étude compile les registres des achats de poisson de l'acheteur principal dans la communauté, les données directes de déchargement à quai du poisson et les registres suivis de l'exportateur principal. Les résultats de l'étude montrent les «classiques» réductions de capture du mérou et du vivaneau mais le plus surprenant reste la révélation que le prix par livre pour les pêcheurs n'a pas changé en monnaie locale (Lempira) depuis 1992.

Ceci est important car la valeur du Lempira par rapport au dollar américain s'est dépréciée de moitié durant la même période de temps, tandis que les coûts de pêche, notamment de carburant, ont fortement augmenté, de même que le coût de la vie. Par conséquent, la marge bénéficiaire des pêcheurs locaux a continué de baisser, les poussant à augmenter sans cesse l'effort de pêche pour maintenir leur niveau de revenu. L'impossibilité des pêcheurs de fixer leurs prix de vente par rapport aux coûts de la pêche et le changement continu de la proportion du revenu total de la chaîne, depuis les pêcheurs jusqu'aux exportateurs pour ce laps de temps, sont les principales causes de l'augmentation de l'effort de pêche et la surexploitation des récifs coralliens au Honduras.

MOTS CLÉS: Serranidae, Lutjanidae, surexploitation des récifs coralliens

## INTRODUCTION

The fisheries of the Honduran Caribbean are indispensable natural resources, fundamental to the food security, income and employment of rural coastal communities, with an estimated 10,000 artisanal fishers on the north shore of Honduras (Castellon and Sarmiento, DIGEPESCA Personal Communication). As mixed fisheries which are seasonally and spatially variable, these near shore fisheries present an ecologically complex management challenge. In addition, whilst commercial fisheries such as lobster and conch have been a focus of management attention in Honduras, the near shore fisheries exploited by artisanal and small-scale fishermen have slipped between these management frameworks. As fishing technologies (such as GPS and depth finders) have become increasingly affordable and new markets and trade routes have developed that link once remote fishing communities to profitable international markets, previously marginal artisanal fishermen have rapidly increased their fishing effort, resulting in dramatic changes in fish community composition.

The traditional focus of Honduras' main commercial fisheries on conch, lobster, and shrimp for export, may explain why fin fisheries have, to date, not been the focus of national management strategies, despite the emergence of important export markets for some species, e.g. Nassau Grouper (*Epinephelus striatus*) and Silk Snapper (*Lutjanus vivanus*). The management strategies designed and applied to standard, single species, commercial enterprises have not been adjusted for the more complex, multi-stakeholder, multi-species fisheries scenario presented by these fin fisheries. In addition, the emergence of an "artisanal fleet" which can tie into strong market demand, creates new management requirements. The current lack of studies of small-scale fisheries in the area and the resultant poor understanding of the nature of the fisheries themselves, and the influences which shape the exploitation behavior of the fishing communities, provides little basis upon which to design effective management strategies. Despite the realization that fin fish play an essential role in the ecology of coral reefs and other near shore environments and underpin the socioeconomic fabric of many coastal communities, prior to 2011 there had been no specific regulation under Honduran fisheries laws related to the direct management of a teleost fish species (DIGEPESCA 2005).

This management vacuum has left commercial fin fishing enterprises, as well as small-scale and artisanal

fishers, to exploit the fish resources unchecked. Similarly, market chains have developed unaffected by scrutiny or regulation. To begin to understand the multiple factors affecting these fisheries and build information on which to develop management priorities and strategies, it is important to identify the drivers behind the exploitation and map out the market chains of the fishery. To address the existing data deficiency, a fisheries programme was initiated by a Honduran non-governmental organization the Centro de Ecología Marina de Utila, to collect high resolution landing information on the small-scale fisheries of the north shore and Bay Islands of Honduras in addition to collecting socioeconomic and market data relating to the landed catch.

This initial study focused on a mixed fin fish fishery targeted by a small island community on the Caribbean coast of Honduras which has been the focus of little previous research (Gobert, Berthou et al. 2005, Korda, Hills et al. 2008). The fishing community, which is established on two small cays, south west of the island of Utila, was identified by Gobert, Berthou et al. (2005) as the most active small-scale fishing force, in terms of comparative fishing effort, in the Bay Islands. The current study examines the different components of the fishery and connections of the small-scale fishery to different market chains, including the export market to the United States, to identify the economic drivers behind the exploitation behavior of the fishermen. The cays community provides an ideal location for this study as it is a self contained "microcosm" of fishing activity that has clear and easily identifiable connections into the fisheries market chains based on the north shore of Honduras and the neighboring island of Roatán.

## METHODS

This study collected detailed landing information from 53 fishermen captains of the cays community throughout 2009 and 2010. Data included fishing duration, location, total catch per species, mean lengths, dock side price, resale price, and market destination of catch components. Here examples of the fishery structure are given based on a portion of the data corresponding to 1,053 separate landings between August and November 2010 and landing data from the mutton snapper migration of 2009. Surveys of households were conducted in the cays fishing community to assess the level of fishing dependence and structured interviews were conducted with all the active fishermen to estimate direct and indirect fishing costs over

different time scales. Due to the lack of precision in Honduran national fisheries statistics, export records were collated from the main fish exporter who is responsible for an estimated 70% of fish exports from Honduras and import statistics to the United States from Honduras were collated from the National Marine Fisheries Service, Fisheries Statistics Division. Economic data for the consumer price index and the depreciation of the Lempira were sourced from the Honduran Central Bank.

## RESULTS

### The Community

The Utila cays, in the Bay Islands archipelago of Honduras, have a current population of around 300 people in 92 households. Established in the 19<sup>th</sup> Century and colonized by white settlers, the cays had, until recently, a distinct demographic which was separate from the rest of Honduras. Migration to the cays over the past 20 years by Latinos and Garifuna, mainly attracted by employment in the fishery, has increasingly integrated this community into the north shore of Honduras, but white Cayans remain in the majority with 65% of the population, Latinos 25%, and Garifuna<sup>1</sup> 8% (the remainder are expatriates).

With no land available on the cays beyond housing, there are few local employment opportunities with no possibility for farming or other land use activities. Some households rely on remittances from family members in the United States or off shore (7.6%); however this is relatively low by rural Honduran standards. A further (14.1%) of households have retired or live from profits of land sales on the neighbouring island of Utila. Of the remaining 72 households containing a working population, two thirds (43 households), are directly reliant on fishing, defined as having at least one active fisher or being involved in the buying or selling of fish or fishing supplies. Many of these fishing households have multiple sources of income, which includes occasional work in construction, tourism, catering or odd jobs at different times of year, depending on the seasonality of the fisheries and weather conditions.

### The Fishery

Cayan fishermen use small open top boats called "Dories", traditionally made from wood. However fiberglass versions are becoming more popular. These boats normally have inboard diesel engines ranging from 15 to 150 Horse power. Some of the migrant fishers use fiberglass skiffs with outboards that are the common craft of the north shore. The fishermen range up to 40 km from the island, selecting their locations depending on weather conditions, time of year and target catch. Whilst handlines are the dominant gear, traps are used for groupers in deeper

water (> 40 m) at known spawning sites and several fishers use large mesh nets (3" to 5" mesh size) for pelagic species. Fishermen diving for lobster and conch also carry spears to shoot large fish they encounter during their search for crustaceans, although data from this fishery is not presented here.

The bathymetry of the area means that Utila sits towards the edge of the continental shelf, providing deep water oceanic conditions to the north and east and shallower reef banks across a wide area to the south and west. This means that the cays fishermen have three distinct fisheries they can target: the pelagic species including small species of tuna (*Thunnus atlanticus*, *Katsuwonus pelamis* and *Euthynnus allerreratus*), wahoo (*Acanthocybium solandri*), kingfish (*Scomberomorus cavalla*) and jacks (including *Seriola dumerili*, *Caranx hippos* and *C. latus*); the shallow water coral reef associated grouper-snapper complex including yellowtail snapper (*Ocyurus chrysurus*) and red hind (*Epinephelus guttatus*); and the deep water snapper species (including *Rhomboplites aurorubens*, *Etelis oculatus* and *Lutjanus campechanus*) which are spread across a large area of continental shelf (Table 1).

Shallow reef fish are the most important catch accounting for nearly half of the total landed weight by all the fishermen combined (Table 2). Shallow and deep reef species combined account for 87% of the total landed catch with pelagic species making up the remaining 13%. On average fishermen land 43.5 ( $\pm 1.2$ ) lbs of fish per excursion. When deep species are landed they are caught in higher amounts per trip (68.5  $\pm 4.1$  lbs). Non tuna pelagics are caught in the lowest amounts per trip (36.8  $\pm 3.8$  lbs). Interestingly the majority of the tunas which are caught (accounting for 8% of total landed weight of all species) are not sold for food. Tuna is rarely chosen for local consumption as it is not part of the local culinary heritage, and whilst some is sold to tourist restaurants in neighbouring Utila, the majority is either used as bait by local fishers inside fish traps, or on hooks, or frozen for sale to the commercial fishing fleets that also use them as bait in the commercial groupers and snapper fishery. This is an unusual occurrence of a fishery using a higher trophic level fish, (Tuna - Mean Trophic Index 4.3) to catch lower trophic level ones, (Grouper M.T.I. 4.2 and Snappers M.T.I 3.9) (Froese and Pauly 2010).

There is clear segregation between fishermen in the community in terms of their target catch (Table 3). Shallow water reef fishermen account for 36 of the fishers and on average 77% of their catch weight of target species is from the shallow reefs, with 16% being the incidental species that are caught at the same time. A further 4% are deep water snapper species that may have been caught incidentally on the shallow species banks with only 3% of

<sup>1</sup>Garifuna are an ethnic group of African descent with their own culture and language, who have settled across the north shore of Honduras and Nicaragua.

their catch coming from pelagic species. These pelagic are normally caught trolling, on the way to or from the shallow reef fishing grounds. Deep reef fishermen likewise are highly specific in their targeting of deep water fish with 71% of their catches, on average, comprised of these species and a further 14% on average coming from target and non target shallow reef species. Again trolling to and from the fishing banks for pelagic comprises 6% of their catch as pelagics. There are only two specialized pelagic fishers with an average of 77% of their catch coming from non tuna pelagics and 19% from tunas, with no target reef species being caught. Non-specific fishers (10) have no clear preference in what they catch and are most likely the migrant fishers who do not have enough acquired local knowledge to successfully select target species and tend to catch a wider variety of fish species or switch between fisheries more frequently.

Generally the peak fishing season is from October to April and the low season is May to September, when the easterly trade winds make sea conditions too rough for the small open top boats and thus limit fishing effort. The activity in a specific fishery however changes and fishers may switch between fisheries for different months (Table 1). For example there are seasonal peaks for specific fish species including the mutton snapper (*Lutjanus analis*) which migrates past the island around the full moon in

October or November, following the continental shelf, and a selection of groupers (including *Mycteroperca venenosa*) which are targeted at specific spawning sites using baited traps for 4 days either side of the full and new moons, between December and March. The yellowtail snapper (*Ocyurus chrysurus*) is the single most important fish accounting for 36% by weight of all fish landed with all groupers combined accounting for 11 % of the catch but are only present in specific seasons.

**Table 2.** Mean weight ( $\pm 1$  S.E) of landed catch by fishery category and its proportion of total landed catch between August and November 2010

Fishery Category	Mean total weight per landing (lb)	N	Proportion of total landed catch weight
Mean total landing	43.5 ( $\pm 1.2$ )	1053	-
Shallow Reef (Target)	51.4 ( $\pm 2.0$ )	425	48%
Shallow Reef (Incidental)	25.8 ( $\pm 1.6$ )	327	18%
Deep Reef (Target)	68.5 ( $\pm 4.1$ )	138	21%
Pelagic (non tuna)	36.8 ( $\pm 3.8$ )	99	8%
Pelagic (tuna)	38.3 ( $\pm 4.4$ )	64	5%

**Table 1.** Different fisheries targeted by the cays fishermen and the drivers and limitations that control their exploitation. Note that the term "insatiable demand" means that the fishermen cannot catch enough fish to fill the market and so the buyers will always buy what they catch without price depreciation.

	Target Species	Incidental Species	Season	Driver	Limitations	
Domestic	Pelagic non tuna (net)	<i>Acanthocybium solandri</i> , <i>Scomberomorus cavalla</i> , <i>Seriola dumerili</i> , <i>Caranx hippos</i> , <i>C. latus</i>	Small snappers e.g. <i>L. apodus</i> (if net too near reef)	October to March	Lent; salt fish insatiable demand,	Higher cost of salting if caught too early: low demand beyond Lent
	Pelagic non tuna (line)	<i>Thunnus atlanticus</i> , <i>Katsuwonus pelamis</i> , <i>Euthynnus allereratus</i>	<i>Balistes vetula</i> ,	October to March	Lent, salt fish insatiable demand	Seasonal variability in abundance and demand by commercial fleet
	Pelagic tuna (line)	None	None	All Year	Bait for commercial and local use	
Export	Grouper Aggregations (trap)	<i>Epinephelus striatus</i> (Dec / Jan) <i>Mycteroperca venenosa</i> and <i>M. bonaci</i> (Feb / Mar)	Not landed, but small reef fish including Parrotfish and Butterfly fish used as bait for traps	December to March	High yield from spawning aggregations, high price and export demand for some species	Aggregations 5 days either side of full moon between December and March
	Yellowtail snapper (line)	<i>Ocyurus chrysurus</i>	Some reef fish especially <i>Balistes vetula</i> <i>Canthidermis sufflamen</i>	All Year, but with peaks Sept-Mar	High yield, high price and insatiable export demand	Seasonal variability in abundance, medium high skill levels limiting entry
	Deepwater snapper (line)	<i>Rhomboplites auro-rubens</i> , <i>Etelis ocellatus</i> , <i>Lutjanus campechanus</i>	Shark, Groupers and Jacks	All Year	High yield, moderate price, and insatiable export demand	Seasonal variability in abundance, high skill level limiting entry
	Mutton snapper (line)	<i>Lutjanus apodus</i>	Occasional reef fish especially <i>Balistes vetula</i> and <i>Canthidermis sufflamen</i>	October / November	Very high yield, moderate price with export ability to absorb large volume, though price depreciates	Migration past island in large numbers, low abundance rest of year,

**Table 3.** Segregation of fishermen by target catch. Fishermen were segregated into a particular fishery if over 60% of their total landed catch weight was from one fishery category. Non-specific fishers did not have a majority of catch from any one fishery group (N is the number of fishermen).

	N	Mean proportion of total landed catch weight for each fishermen in group				
		Shallow Reef Target	Shallow Reef Incidental	Deep reef Target	Pelagic non tuna	Pelagic tuna
Shallow reef fishermen	36	77%	16%	4%	2%	1%
Deep reef fishermen	4	14%	10%	71%	6%	0%
Pelagic Fishers	2	0%	4%	0%	77%	19%
Non-specific fishers	10	29%	38%	6%	14%	13%

### Fish Market Chain

Fish are landed directly on to the cays and the product flows through several distinct market chains, destined for domestic or international markets as determined by species, size and time of year (Table 1). The majority of all landed fish are bought by two fish buyers located on the cays with only a small proportion sold directly to consumers by fishermen, or eaten locally. These two buyers normally maintain the same prices between each other and sell onto the same set of buyers located in the coastal provincial capital, La Ceiba or Roatán, a neighbouring Bay Island. Both fish buyers have the same key position in the chain, linking local fishers to the market. Not only do these buyers provide the economy of scale required to move the fish off the island, they also offer essential fishing supplies such as ice, fuel and credit to fishers. Both fish buyers also own multiple boats.

The cay's fish buyers will purchase from any fishermen and will take all the catch of the main species, but will not buy mixed, low trophic level reef fish like angelfish or parrotfish that are a common component of the fish markets in other Caribbean locations. As a consequence these do not form part of the catch of the fishermen of the cays. Fishermen using one of the boats owned by the fish buyers are obliged to sell to that buyer.

The sale price is fixed and does not change between fishermen, but varies by species and in some cases by size and in the specific case of mutton snapper (*Lutjanus analis*) by volume (Table 4). Buying prices range from 5-7 Lps (\$0.25) per pound for grunts (Haemulidae; mainly *Haemulon sciurus* and *Haemulon plumieri*) and triggerfish (Balistidae; mainly *Balistes vetula* and *Canthidermis sufflamen*) which are caught incidentally, up to 21 Lps (\$1.10) per pound (whole cleaned weight) for specific grouper (*Mycteroperca venenosa*) and yellowtail snapper (*Ocyurus chrysurus*) (Table 4). Large reef snappers like Dog snapper (*Lutjanus jocu*) and Cubera snapper (*Lutjanus cuanopterus*) command a lower price (17 Lps, \$0.89) as do the deep water snappers such as queen snapper (*Etelis oculatus*). Large reef snappers over 5 lbs tend to decrease in value, because of their relatively heavy head weight. In addition these large individuals are not desired for export and there are potential concerns over ciguatera poisoning in the domestic market which means they are normally filleted and sold as "snapper fillet" (perhaps to conceal which fish they originally were). Jacks (Caranidae),

barracudas (Sphyraenidae) and all types of shark, are classed as white fish and have a low sale price of 10 Lps (\$0.53) when fresh.

Independent fishermen and the fish buyers tend to store these low value "white" fish salted from October to April to supply the high national demand for salt fish during lent (Table 1). Salting fish increases the price of these fish to 35 Lps (\$1.84) per pound (approximately doubling its value when accounting for the cost of salt and weight loss of drying). Salt fish is also produced from any other species that are caught during the run up to the lent holy season which cannot be sold fresh for export or local consumption. The salting of fish provides an opportunity to convert fish not favored by the fresh fish market, with a low price into a higher value fish product for which there is strong seasonal demand. In addition, it may be used to disguise species that are specifically protected and prohibited from sale, such as sharks (all species of which have been under a fishing moratorium in Honduran territorial waters since 2010), and enable them to be sold into the domestic market chain. It can be extremely difficult to identify the species of origin in a salted fish fillet.

In general, there are three distinct market forces controlling the small-scale fisheries on the cays. The exploitation of small tunas is controlled by the demand for bait by local and commercial fleets. When the commercial fleet is less active there is less demand for tuna and fishers switch to other targets. The high quality, larger size reef fish (groupers and snappers) and the deep water snappers are controlled by the export market, which provides a constant demand for all that is caught, with the under size individuals going to the local domestic market. The pelagics (non-tuna) are controlled by national domestic demand for salt fish in the build up to lent (Table 1).

The fish buyers transport the collected catch, which is maintained fresh on ice, by boat to La Ceiba on average every three days. La Ceiba is the capital of Atlántida department where the main fish buyers are located. There are also occasional sales made to other buyers including the fish export factories on Roatán. Despite slightly higher purchase prices for fish on Roatán, due to prevailing easterly wind conditions, the rising costs of fuel means that it is often less profitable to move the fish the 55 km against the wind to Roatán compared to the 37 km trip to La Ceiba, which is perpendicular to the winds.

**Table 4.** Landing price of fish per pound paid to fishermen by the main fish buyers on the cays (whole clean weight).

	Fish group	Species or example of group	Price in local currency (Lempiras)	Equivalent price in US\$
Snappers	Deep water Snappers	<i>Etelis oculatus</i>	17	\$ 0.89
	Yellowtail Snapper <0.75lb	<i>Ocyurus chrysurus</i>	17	\$ 0.89
	Yellowtail Snapper >0.75lb		21	\$ 1.10
	Mutton Snapper <0.75lb or >5lb	<i>Lutjanus apodus</i>	15	\$ 0.79
	Mutton Snapper >0.75lb & <5lb		17	\$ 0.89
	All other Snappers	<i>e.g. Lutjanus synagris</i>	15	\$ 0.79
Groupers	Yellowfin Grouper	<i>Mycteroperca venenosa</i>	21	\$ 1.10
	Red Hind	<i>Epinephelus guttatus</i>	18	\$ 0.95
	All other large Groupers	<i>e.g. Epinephelus striatus</i>	17	\$ 0.89
	Small Groupers	<i>Epinephelus cruentus</i>	15	\$ 0.79
Pelagic	Wahoo	<i>e.g. Acanthocybium solandri</i>	21	\$ 1.10
	Kingfish	<i>Scomberomorus cavalla</i>	21	\$ 1.10
	Tuna*	<i>e.g. Katsuwonus pelamis</i>	8	\$ 0.42
	Barracuda	<i>Sphyræna barracuda</i>	10	\$ 0.53
	Jacks	<i>e.g. Caranx hippos</i>	8	\$ 0.42
Other	Grunts & Triggerfish	<i>e.g. Haemulon plumier, Balistes vetula</i>	7	\$ 0.37
	Salted fish	Any	35	\$ 1.84

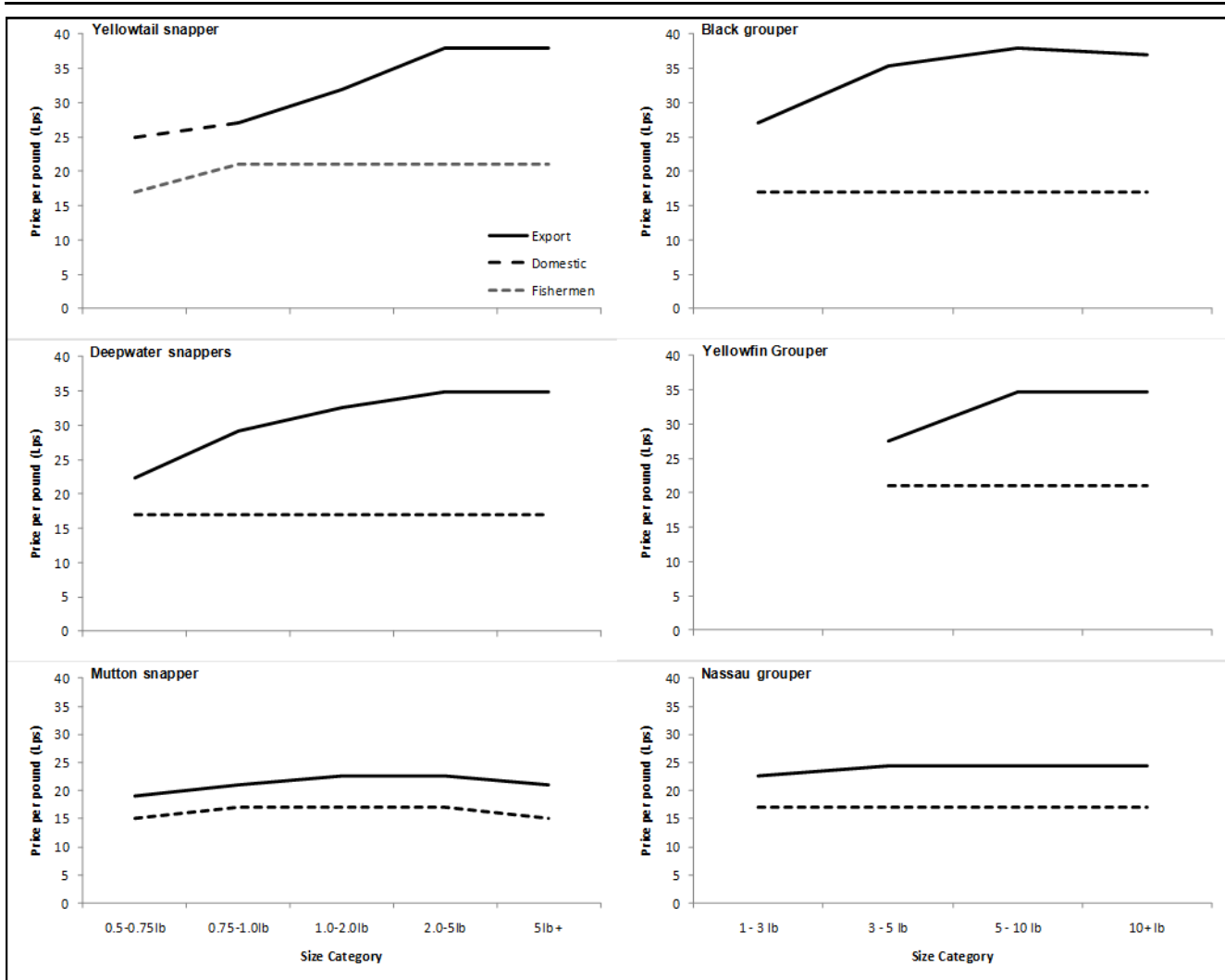
\* tuna are the only species sold whole but not cleaned, because it is used as bait rather than for consumption

The re-sale price of the fish to the buyers in La Ceiba varies between species. Fish destined for domestic consumption has between a 10% and 50% premium on the resale price compared to dockside. This is highest for the lowest value fish such as grunts and jacks which resale at 10 Lps and 12 Lps, respectively. Despite the premium over landing prices, the domestic market does not make the fishery profitable considering the costs of storage and transport, the low total weight of these species and the comparatively low value of these species. It is the export species therefore that generate the real revenues.

The reason for the profitability in these species is that whilst the price received by fishermen is set per pound irrespective of fish size (apart from a price premium on yellowtail snapper individuals above 0.75 lb and a price penalty on mutton snappers above 5 lbs) the resale prices increase a great deal with increasing fish size when resold in La Ceiba or Roatán (Figure 1). The margin between buying price and resale price on yellowtail snapper for example increases from 47% for individuals less than three quarters of a pound to 81% on individuals greater than 2 lbs. Deepwater snappers have a greater margin, from a margin of 32% when less than three quarters of a pound to 100% when an individual is greater than two pounds. A similar pattern occurs for black grouper which is the most profitable fish, rising from a margin of 59% on individuals between one and three pounds up to 124% on individuals between five and ten pounds (Figure 1).

For both the Mutton snapper and the Nassau grouper the margins are very low compared with other species at around 30% to 40%. This may be because Nassau grouper is not allowed to be imported in the United States so may be going to other export markets or shipped as filleted fish, which reduces its value. Mutton snapper generally comes to market in volume, as it is exploited heavily during its migrations. The saturation of the market keeps the price low, but strangely the price does not increase at other times of the year when the fish is scarcer.

Interestingly, with the sole exception of mutton snapper, for the last ten years, based on interviews with fishermen, fish purchasers and reviews of purchase and landing records, the dockside prices paid to fishermen in Lempiras have not changed since 2000 and likely since the fish buyer started in 1995. This stasis in price may actually go further back as a report on a grouper fishing event in Guanaja in 1992, gives the price per pound in dollars for grouper that corresponds to 21 - 23 Lempira at the exchange rate of the day (Fine 1992).



**Figure 1.** Comparison between dockside prices paid to fishermen and resale prices for commercially important fish species of different size categories for export. Prices in local currency, Lempira, with exchange rate of Lps19.02 = US\$1.00.

**Costs of Fishing**

This price freeze over time is an important issue for the fishery. Assuming fishing effort in terms of distance travelled has stayed the same over the last decade, (which is unlikely), the costs of fishing, especially in terms of boat maintenance costs and fuel, have increased consistently over this time period. The inflation rate has been on average 6.8% (± 0.5%) per annum since 2000, based on the consumer price index data from the Honduran Central Bank (Central Bank of Honduras, Personal communication). The maintenance of a standard fishing “Dory” over a five year period was estimated by this study to cost \$8,050, in 2010, which is the equivalent of \$4.41 a day. The average fuel consumption per trip was 4 gallons of diesel costing \$14.72. A boat in 2010 must therefore catch on average at least 20 lbs of grouper or snapper, or 40 lbs of tuna a day to cover its daily costs. The average landed catch of tunas during the period of August to November 2010 was 38.3 lbs, helping to explain why fishers do not

specialise exclusively in this fishery as it does not cover the costs of fishing. The average landing of target reef fish was between 51.4 lbs and 68.5 lbs providing limited profit opportunities (Table 2). The fishermen therefore must rely on the high yield events of spawning aggregations or migrations to elevate income. In 2009 the fishermen of the cays landed 17,884 lb of Mutton snapper between 25<sup>th</sup> October and 5<sup>th</sup> November. One fishing boat landed 954lbs following one night of fishing (Table 5). The economic reliance on these events, which are critical to the sustainability of the fishery, is an important issue to reconcile for the management of the fishery.

The issue of the fixed Lempira price is compounded because over the same time period (2000 – 2010) the Lempira has decreased in value against the U.S. Dollar from \$1 = 15.1 Lps in 2000 to \$1 = 19.02 Lps in 2010 (devaluation of 26%). So the equivalent dollar value to fishermen of the premium grade fish has decreased from

around \$1.39 per pound to \$1.10 over this time period. By comparison, the recorded import value for grouper from Honduras to the United States, calculated as dollars per pound, has nearly doubled during this time period (National Marine Fisheries Service, Fisheries Statistics Division, Pers. comm.).

### DISCUSSION

A well managed small-scale fishery can have greater sustainability, lower environmental impacts and greater wealth distribution than industrial fishing enterprises (Pauly 2006). Where a small-scale fishery is connected to strong market demand and in the absence of management however, similar drivers that push industrial fisheries to overexploit resources in international waters exist. With no effective management or enforcement to restrict activities the short term rewards outweigh long term sustainability because of open access (Garcia and Rosenberg 2010). Market forces alone, operating on small-scale fisheries without regulation are unlikely to be equitable, nor promote sustainability, since an axiom of standard profit maximization is to drive down the buying price whilst increasing the sale price.

In the small-scale fishery studied here, the fishermen had no ability to set their sale price. Few fishermen have access to alternative buyers away from the cays, due to the relative isolation of the cays community and the economies of scale required to move fish to the main market on the north shore. A fisherman landing an average of 40 lbs of fresh fish on the cays would need to sell to one of the two fish buyers, as they are the only ones who can guarantee purchase. Fishermen cannot store the fresh fish indefinitely in the hopes of catching enough to make it worth shipping to La Ceiba personally, and freezing the fish decreases its subsequent market value. As a consequence, despite the continuing increase of fishing costs and living costs, the fishermen must rely on increasing fishing effort, such as travelling to new sites, switching to nets, or targeting fish spawning aggregations to maintain incomes. Without market regulation and the ability to set their sale price to reflect their costs, these fishermen have no tangible incentive, nor economic ability, to follow sustainable practices, which are increasingly being proposed to manage the important coral reefs and the fisheries of the area. Thus the fishermen remain entrapped in a negative fishing cycle, which ultimately damages their future livelihoods as well as impacting the integrity of coastal ecosystems and harming the wider economy, including tourism potential.

Salt fish provides a real alternative market for some fishermen during the months leading up to lent. Individual fishermen can salt their own catch and buyers from the Honduran capital city Tegucigalpa, visit the community to purchase directly from individuals. Fishermen who do not own their own boats and are tied to other boat owners, including the boats owned by the fish buyers, do not have

this option, however. Their catch must be sold to the owner of the boat at the fixed prices of the fish buyers. In general the white Cayans own at least one boat, whilst the migrants to the island do not. This divide in sale options is reflected clearly in the income and obvious gap in living standards between the Cayans and the migrant Latinos and Garifuna.

Tourism on the main island of Utila has been expected to provide a new market for the fishermen. Unfortunately, due to the majority of tourism being low-budget “back packers”, the demand for relatively expensive fish such as snappers remains low. A couple of fishermen regularly supply the tourist restaurants with low grade tuna and the cheaper pelagic species such as barracuda. These cheaper fish enables the restaurant to keep the final cost of the plate low. Other restaurants including some of the all inclusive resorts now source farmed tilapia instead of local fish. Tilapia as a farmed fish provides no benefit to the local fishing community and so the links between the benefits of tourism and the fishermen remain slight.

The sustainable management of the cays fisheries faces some clear challenges. Fisheries regulations which are being proposed by the national fisheries department to prevent the fishing of spawning aggregations or the capture of certain species of grouper, will only be accepted and adopted by the fishermen if they can compensate this loss through increased revenues from other fish species. This study estimated that up to 25% of the yearly income of fishermen comes from targeting aggregations including spawning aggregations and migrations. If fishermen cannot set their sale price, then they will not be able to compensate for this loss of earnings and will be inclined, in the face of limited enforcement, to ignore the regulations. Since the spawning aggregations and the migrations of mutton snapper occur in the build up to lent, the easiest way for the fishermen to circumvent any sales restriction on these fish, will be to salt them. A similar management problem faces the implementation of shark conservation strategies.

**Table 5.** Landings of the Mutton snapper *Lutjanus analis* caught on its seasonal migration past Utila during the full moon of October November 2009.

Date	Total Landing weight (Lbs)				
	Total (lbs)	Mean landing (lbs)	N	Max. (lbs)	Min. (lbs)
25-Oct-09	602	60.2 (±14.5)	10	140	11
26-Oct-09	930	84.5 (±10.1)	11	132	26
27-Oct-09	927	71.3 (±12.5)	13	170	8
28-Oct-09	288	48.0 (±16.5)	6	116	6
01-Nov-09	2,046	85.3 (±15.7)	24	255	13
02-Nov-09	8,620	159.6 (±17.9)	54	757	10
03-Nov-09	4,471	165. (±33.3)	27	945	59
Total	17,884				



Effective management strategies for the area therefore need to focus on integrating new regulations with mechanisms to enable the adjustment in the dockside price of the remaining fish species, considering that fish prices for groupers and snappers in Honduras are the lowest in the Caribbean (S.J.B., Unpubl. data). If not, even if the regulations are effectively enforced, the result will be to drive increased exploitation levels on other fisheries such as the pelagic species or shift to exploit ecologically important reef species, e.g. parrotfish, that are in demand in emerging international markets.

Whilst there are increasing signs of decline and collapse in important fisheries including Nassau grouper (*Epinephelus striatus*) (Box and Bonilla 2008) the Honduran grouper snapper fishery has not declined so far that the fishermen are yet targeting low trophic group species. There is therefore time to implement effective management to conserve remaining high trophic level species in a sustainable management plan, before these fisheries decline further beyond their ability to recuperate and Honduras follows the same decline and collapse of near shore fisheries as witnessed in much of the rest of the Caribbean.

Fisheries management in Honduras is severely limited in technical and enforcement capacity and was ranked globally amongst the poorest for fisheries policy transparency and in the bottom quarter for implementation capability, and scientific robustness in its management (Mora and Myers et al. 2009). Independent scientific capacity in the non-governmental sector is however developing to build fisheries information to guide and support the creation of effective and pragmatic management plans at local and national levels that effectively integrate long-term and short-term economic, environmental, social and equity considerations. To continue this, there is an urgent need for further in-depth and interdisciplinary knowledge about the interactions between socio-economic drivers, industrial interests, governance efficacy, and environmental concerns of the fisheries of Honduras.

#### ACKNOWLEDGEMENTS

The research leading to these results has received funding from the European Union Seventh Framework Programme (P7/2007-2013) under grant agreement no 244161.

#### LITERATURE CITED

- Box, S. and I. Bonilla. 2008. El estado de la conservación y explotación del mero Nassau en la costa Atlántica de Honduras. *The Nature Conservancy Reports*.
- Castellon, M. and M.T. Sarmiento. 2005. Report: Situación de la pesca artesanal en Honduras. *Secretaría de Agricultura y Ganadería, Dirección General de Pesca y Acuicultura (DIGEPESCA)*.
- DIGEPESCA. 2005. Report: Bases y componentes del plan nacional de ordenación de la capacidad de pesca en Honduras. *Secretaría de Agricultura y Ganadería, Dirección General de Pesca y Acuicultura (DIGEPESCA)*.
- Fine, J.C. 1992. Greedy for groupers. *Sea Frontiers* **November - December**: 68-71. University of Miami, Miami, Florida USA.
- Froese, R. and D. Pauly (eds.). 2010. FishBase. World Wide Web electronic publication. [www.fishbase.org](http://www.fishbase.org), version (11/2010).
- Garcia, S.M. and A.A. Rosenberg. 2010. Food security and marine capture fisheries: characteristics, trends, drivers and future perspectives. *Philosophical Transactions of the Royal Society* **365**: (2869-2880).
- Gober, B., P. Berthou, E. Lopez, P. Lespagnol, M.D. Oqueli-Turcios, C. macabiau, and P. Portillo. 2005. Early stages of snapper-grouper exploitation in the Caribbean (Bay Islands, Honduras). *Fisheries Research* **73**:159-169.
- Korda, R.C., J.M. Hills, and T.S. Gray. 2008. Fishery decline in Utila: Disentangling the web of governance. *Marine Policy* **15**:191-199.
- Mora, C., R.A. Myers, M. Coll, S. Libralato, T.J. Pitcher, R.U. Sumaila, D. Zeller, R. Watson, K.J. Gatsos, and B. Worm. 2009. Management Effectiveness of the World's Marine Fisheries. *PLoS Biol* **7** (6):e1000131.
- Pauly, D. 2006. Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences. *Maritime Studies (MSAT)* **4**(2):7-22.