

SHARK FISHERIES IN CENTRAL AMERICA: A REVIEW AND UPDATE

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ABSTRACT

The demand for shark products, especially fins and cartilage, has led to an expansion in fisheries and trade throughout the region. Increased fishing efforts, scarce biological data, and lack of management are key factors that negatively impact this fishery. A project under way aims to gather basic information on population status, nursery and fishery grounds, socioeconomics of the fishery, and necessary conservation measures. Twenty four commercially valuable species have been identified. The most important are *Carcharhinus falciformis* and *Nasolamia velox* (Guatemala), *C. falciformis* (Nicaragua), *C. falciformis* and *M. dorsalis* (Costa Rica), *C. obscurus* (El Salvador), and *C. limbatus* (Panama). Commercial products include the meat, fin, oil, cartilage, and skin. Shark fins are the most valuable product (i. e. dried caudal fins sell from \$US 150 to 400 per kg in Costa Rica) and are exported to Hong Kong, Taiwan, Japan, and the United States.

RESUMEN

La demanda por derivados de tiburón, especialmente aletas y cartílago, ha llevado a una expansión de las pesquerías y del comercio a través de la región. El incremento en el esfuerzo pesquero, las escasas referencias biológicas y la falta de manejo, son factores claves que impactan negativamente esta pesquería. Con el fin de contar con información sobre el estado de las poblaciones,

zonas de pesca y crianza, aspectos socioeconómicos y medidas necesarias para la conservación, se llevó a cabo esta investigación. Se identificaron 24 especies de importancia comercial, siendo las más importantes: *Carcharhinus falciformis* y *Nasolamia velox* (Guatemala), *C. falciformis* (Nicaragua), *C. falciformis* y *Mustelus dorsalis* (Costa Rica), *C. obscurus* (El Salvador), *C. limbatus* (Panamá). Los productos comerciales incluyen carne, aleta, aceite, cartílago y piel. Las aletas son el producto de mayor valor (i.e. aletas caudales secas se venden desde \$150 a \$400/kg en Costa Rica) y son exportadas a Hong Kong, Taiwán, Japón y Estados Unidos

REGIONAL VISION

The Central American coastline totals 6,526 km, 57.4% on the Pacific coast and 42.6% on the Caribbean. The Exclusive Economic Zone of all countries in this region extends to 1.640,000 km². This marine surface includes vast fishery resources that have been under exploitation over several decades. Among them, sharks are a group of fish that constitute both an important economic asset and an important source of protein for local consumption. As in many other regions of the world, sharks have experienced strong fishing pressure in Central America, due to the growing demand of fins in Asian countries and an increased consumption of its meat and other products in markets of the United States, Canada and Europe (PROAMBIENTE 1999).

Despite the importance of the economic development of shark fisheries in Central America, few systematic efforts have been reported towards scientific research or management of shark species. Guatemala is the only Central American country with baseline biological studies aimed at managing their shark resources (PORRAS *et al.* 1993, PORRAS 1996, VILLATORO 1997, HERNÁNDEZ and MARADIAGA 1998 and RAMÍREZ and MEDINA 1999).

In fact, in the region, there is a lack of basic information to address questions such as: What is the effect of the foreign fishing fleets on Central American shark populations?, what type of regional control exists on these foreign fleets, and who is doing it?, are sharks a main fishing target or is it an incidental capture?, what is the socioeconomic importance of this fishery?. The list of queries could be extensive but we should focus on the necessary elements to address management issues. Continuous exploitation of the shark resource does exist as well as growing pressure for extended regional and international fishing that could lead to the collapse of these resources. We must keep in mind that sharks grow slow, mature late, produce few offspring and live long (K strategist). These features, which have served them well since the Cretaceous era, make them extremely vulnerable to overfishing and are indicative of the need for immediate action (development of knowledge and its application for management) for the adequate protection of sharks population (WEBER and FORDHAM 1997).

HISTORICAL FACTS

Nicaragua was the first country in the region where commercial exploitation of sharks took place. The origins of this activity go back to the forties, when the Borden Company began the exploitation of bull sharks (*Carcharhinus leucas*) in the Lake of Nicaragua. The activity continued until the mid sixties, time at which three new local companies joined this fishery. Commercialization included exports of fins, cartilage, liver oil and dry meat, which was sold as cod, French cod, Norwegian cod or boneless fish. In the early eighties, the strong fishing pressure on this lacustrine resource caused its collapse (THORSON 1982).

Costa Rica was the second country to start the commercial use of shark. In the fifties shark meat was introduced to the market as "dorado", the common name for mahi mahi (*Coryphaena hippurus*). Yet in the decade of the 70s, the opening of national and international markets, good prices for subproducts of shark (oil, fins, cartilage, skins and meat) investment securities, in addition to a reduction in the fish catch in the Gulf of Nicoya, together with an increase in the operational costs of the shrimp fleets contributed to shift the interest of the fishing sector towards sharks. Consequently, what was a coastal activity is now a high sea fishery where the capture of sharks takes place hundreds of miles offshore (CAMPOS 1989, CAMPOS *et al.* 1993).

In other Central American countries, commercial use of shark began approximately 15 years ago. This happened as a response to a process of diversification of the fishery. This, in part, was forced by the reduction of traditional fishing resources such as a snappers (Lutjanidae), croakers, drums (Sciaenidae), sea-bass (Serranidae), shrimps and lobsters and because of recognition of this group of fish as a new source of revenue and protein (PORRAS 1996, VILLATORO 1997, HERNÁNDEZ and MARADIAGA 1998 and RAMÍREZ and MEDINA 1999).

SPECIES OF COMMERCIAL IMPORTANCE

According to BUSSING and LÓPEZ (1993) and ALLEN and ROBERTSON (1994) Central American waters are highly diverse in shark species; nevertheless, not all are of commercial value. For example, in Guatemala, *Carcharhinus falciformis*, *Nasolamia velox* and *Sphyrna lewini* represent the largest catch (RUIZ 1997). In Honduras and Panama commonly captured species are *C. falciformis* and *S. lewini* (RAMÍREZ and MEDINA 1999). In Costa Rica and Nicaragua the pelagic sharks species more frequently captured are *Prionace glauca*, *C. falciformis*, *S. lewini* and *Alopias superciliosus* (PORRAS 1996, HERNÁNDEZ and MARADIAGA 1999). Table 1 presents the species that are commercially used in the region.

Table 1
Commercial shark species in Central America

Scientific name	Countries					
	Guatemala	Honduras	El Salvador	Nicaragua	Costa Rica	Panamá
<i>Alopias superciliosus</i>			*	*	*	*
<i>Alopias pelagicus</i>			*		*	
<i>Carcharhinus altimus</i>					*	
<i>C. falciformis</i>	***	***	***	*	**	
<i>C. leucas</i>	*	*		*		*
<i>C. limbatus</i>	*	*	**		*	**
<i>C. longimanus</i>	*		*	*	*	**
<i>C. porosus</i>		*	*			
<i>Galeocerdo cuvier</i>	*	*	*	*	*	*
<i>Ginglymostoma cirratum</i>	*	*	*			
<i>Isurus oxyrinchus</i>				*	*	
<i>Mustelus dorsalis</i>	*			*	***	
<i>M. lunulatus</i>	*				**	
<i>Nasotamia velox</i>	**		**	*	*	*
<i>Negaprion brevirostris</i>					*	
<i>Prionace glauca</i>	*	*	*	*	*	*
<i>Rhizoprionodon longurio</i>		*		*		
<i>Sphyrna lewini</i>	*	*	**	*	**	**
<i>S. media</i>					*	
<i>S. mokarran</i>	*		*		*	*
<i>S. tiburo</i>		*			*	
<i>S. zygaena</i>	*				*	*

*** = more than 30% of the shark captures, ** = 15%, * = 1%

FISHING AREAS

Except for Costa Rica, most sharks in the region are captured near the coast. In Guatemala, sharks are fished all along the Pacific Coast. However, it is in Puerto San José, Buena Vista, Champerico, Escuintla, Iztapa and Aldea Sicapate, where shark fishing and commercialization concentrates (RUIZ 1997, MARQUEZ and RUIZ 1997). Reports of experimental commercial fishing campaigns in pelagic sharks suggest that the best fishing areas are between 14°-14°30'N and 92°-93° W (PORRAS 1996, MARQUEZ and RUIZ 1997).

In Honduras, shark fishing is limited to the Caribbean coast. Although specific fishing areas are unknown, Puerto Cortés and La Ceiba are among the landing sites with high commercialization volumes (SALINAS 1998).

In El Salvador sharks represent the largest landings of the artisanal fleet and are captured in the Pacific coast around Port of Acajutla, Barra de Santiago, La Libertad and El Tamarindo (VILLATORO 1997). Some geographical positions where pelagic sharks are frequently captured are between 12°-12°30'N and 88°-89°30' W and 13°-13°30'N and 89°30'-99°00' W (PORRAS 1996).

In Nicaragua shark fishing is documented only in the Pacific coast at San Juan del Sur, Puerto Corinto, and Puerto Jiquilillo. A research project on the evaluation of high seas fishery was developed between 1995-1997. Twenty-six cruises and approximately 131 fishing trials were conducted within the EEZ. BRENES (1999) correlated temperature and salinity with the presence of sharks and showed that *Sphyrna lewini* was the most abundant species between 26.8 °C and 27.8 °C, with a

thermocline between the 30 m and 40 m. In addition, *C. falciformis* presents a distribution associated with the border of the continental shelf, at depths between 300 m and 500 m and temperatures between 20 °C and 25 °C.

In Costa Rica only 2% of the total national catch comes from Barra del Colorado, in the Caribbean. Playas del Coco, Puntarenas, Quepos and Golfito, in the Pacific coast, are the main landing ports for shark and where national and international companies that market this group of fish concentrate. Sharks that live in pelagic environments (EEZ, Thermal Dome and International waters) are captured along the submarine mounts of Guardian Banks (08°-09°N, 87°-90°W), Medina Banks (03°N-84-87°W) and Paramount Banks (03°N-90°W) (PORRAS 1996).

Ninety percent of the shark marketed in Panama is captured between 1 and 10 miles off the coast. The main fishing areas are found in Coquira (Province of Panamá), Búcaro (Los Santos), the Gulf of Panamá (costa de Darién), costa de Veraguas, Coiba, Playa Honda, Chiriquí (mainly in Balsa and Puerto Limones) and in the Province of Herrera (Boca, Agarita, and Puerto Gallito). The pelagic shark fishery is a recent activity. Sharks catches have been reported (*Alopias* sp., *C. longimanus* and *Galeocerdo cuvier*) in front of the Gulf of Montijo, just in the northwest limit of the Gulf of Panama among 6°30'-7°30'N and 81°00' - 82°00' W (RAMIREZ and MEDINA 1999).

CHARACTERISTICS OF ARTISANAL AND INDUSTRIAL FLEETS

Tables 2 and 3 show the general characteristics of artisanal and industrial fleets and fishing gear used in shark fisheries in Central America.

USE OF RESOURCE

Although Central America is a small earth fringe, marked differences exist in natural resource use and marketing. The above-mentioned is reflected in the use of marine resources and shark doesn't escape this reality. What is discarded in a country because it is good for nothing (for example skin and jaws), it is kept in other countries where mar-

kets for such products exist. Guatemala is the country that takes better advantage of sharks, since except for viscera, the whole animal is used (RUIZ 1997). Honduras, Nicaragua and Costa Rica are the extreme cases where markets exist only for meat and fins (SALINAS 1998, HERNÁNDEZ and MARADIAGA, 1998 and PROAMBIENTE 1999) (Table 4).

SHARKS: TARGET FISHERY OR INCIDENTAL CATCH?

Shark landings in Central America come from two activities. One is coastal fishing, where sharks are incidental or complementary catches of the shrimp (Penaeidae), lobster (Paniluridae), snapper (Lutjanidae), drum (Sciaenidae) and grouper (Serranidae) fisheries. The other one is pelagic fisheries, where sharks are incidental catch of mahi mahi (*Coriphaena hippurus*), marlin (*Tretrapterus audax*, *Makaira indica*), sailfish (*Istiophorus platypterus*), swordfish (*Xiphias gladius*) and tuna (*Thunnus albacares* and *T. obesus*) (PROAMBIENTE 1999).

Occasionally, the fishery targets on sharks under the following situations: a) During some lunar phases, b) when fishermen know the reproduction areas and nursery grounds, or c) when it is the only resource available. This is the case in Guatemala and Costa Rica. In Guatemala, fishermen of Ports San José, Buena Vista, Champerico and Aldea Sicapate direct their effort to the capture of *C. falciformis* and *N. velox* (RUIZ 1997). In Costa Rica, the better documented instances of shark capture are during the spawns of hammerheads (*Sphyrna lewini*) and the cazón (*Mustelus lunulatus* and *M. dorsalis*) at the beginning of the rainy season in Isla Chirra's surroundings and Isla Yuca (Gulf of Nicoya), and the reproduction of *C. limbatus*, *S. lewini* and *R. longurio* in the Río Coto estuary (Golfo Dulce) (CAMPOS 1989). Also, during May, June and July in the Caribbean coast (Barra del Colorado), different shark species (i. e. *C. limbatus*, *C. leucas*, *Galeocerdo cuvier*) are substitute catches in the absence of traditional species of commercial importance, such as the fat snook (*Centropomus paralellus*), green turtle (*Chelonia mydas*) and lobster (*Panilurus argus*) (PROAMBIENTE 1999).

Table 2.

Artisanal fishing fleets and fishing gear

Features	Guatemala 1)	Honduras 2)	El Salvador 3)	Nicaragua 4)	Costa Rica 5)	Panamá 6)
Length of boats (m)	7.6-9.7	ND	9.1	ND	6.1	6.1-15
Material	Fiber glass, wood	Fiber glass	Fiber glass, wood	Fiber glass, wood, and alluminium	Fiber glass, wood	Fiber glass, wood
Outboard motors (HP)	20-75	50	40-75	20-80	10-70	8-9
Crew	2-3	2	2	2	2-3	2-3
Communication systems	No	No	No	No	No	No
Navigation systems	No	No	No	No	No	No
Trip (days)	1-2	1	1	1-2	1-2	1-2
Coolers	No	No	No	No	No	No
Fishing gear	Longline	Longline	Longline	Longline	Longline	Longline
Length of longline (m)	1000	ND	500	ND	1000	1000-2000
Number of hooks	200-600	ND	200	300	400-1200	400-1000
Gillnets (inches)	ND	ND	ND	ND	3-3.5	2.5-8

1 (RUIZ 1997), 2 (SALINAS 1998), 3 (VILLATORO 1997), 4 (HERNÁNDEZ and MARADIAGA 1998), 5 (PROAMBIENTE 1999) and 6 (RAMÍREZ and MEDINA 1999).

Table 3.

Industrial fishing fleets and fishing gear

Features	Guatemala 1)	Honduras 2)	El Salvador 3)	Nicaragua 4)	Costa Rica 5)	Panamá 6)
Length of boats (m)	10	ND	20.7	9.7-14.6	12.2-24.4	9.1-15.2
Material	Fiberglass	Steel	Fiberglass, wood	Wood	Fiberglass	Fiberglass, wood
Outboard motors (HP)	150-200	ND	350	180-200	90-350	ND
Crew	5-8	5-7	7	5-7	5-6	ND
Communication systems	UHF	ND	UHF	UHF	Side band UHF	UHF
Navigation systems	GPS and compass	ND	GPS and compass	GPS and compass	GPS and compass	GPS and compass
Trip (days)	7-15	ND	12	5-7	20	ND
Fishing gear	Longline	Longline	Longline	Longline	Longline	Longline
Length of longline (m)	3000	ND	3000	ND	20000-60000	ND
Number of hooks	600-700	500	400-600	400-600	800-2000	ND
Bait	Bonito { <i>Sarda sp.</i> }	Squid	Skip jack { <i>Katsunomus pelamis</i> }	Sardine, sharks, tuna squid	Tunna { <i>Scomber japonicus</i> }, Squid (<i>Loligo sp.</i>)	ND

1 (RUIZ 1997), 2 (SALINAS 1998), 3 (VILLATORO 1997), 4 (HERNÁNDEZ and MARADIAGA 1998), 5 (PROAMBIENTE 1999) and 6 (RAMÍREZ and MEDINA 1999).

Table 4

Use of shark subproducts in Central America

Resources	Countries					
	Guatemala	Honduras	El Salvador	Nicaragua	Costa Rica	Panamá
Fresh meat	X	X	X	X	X	X
Dry meat	X	X	X	X	—	—
Salted meat	X	—	—	—	—	—
Fresh fin	X	—	X	X	X	X
Dry fin	X	X	X	—	X	X
Cartilage	X	—	—	—	—	X
Liver oil	X	—	—	—	—	X
Jaws	X	—	—	—	—	—
Skin	X	—	—	—	—	—

OVERVIEW OF THE REGIONAL ECONOMIC IMPORTANCE OF SHARK TRADE

Between 1992 and 1998 the total annual capture of the Guatemala artisanal fleet added to 1,439,424 kg. Shark represented 36.5% of this catch and reached a market value of \$555,727. For the same period, the industrial sector reported landings in the order of 19,143,709 kg from which 0.37% (72,605 kg) was shark, marketed for a value of \$46,926 (RUIZ 1999). Shark captures by the industrial fleet have increased from 990 kg (1992) up to 32,915 kg (1998), an increment of 3,521% in six years. On the other hand, the artisanal fleet showed a decrease of 65% in its shark catch. Most of the catch is sold locally. However, in recent years there is a increased tendency of increased exports to Mexico and El Salvador, two major trading markets (RUIZ 1997, 1999). According to the Bank of Guatemala, exports of shark to Mexico from 1993 to 1994 reached 268,797 kg with a value of \$141,075. Exports to El Salvador were 45,296 kg, worth \$239,920. The portion of the national catch consumed in local markets from 1992 to 1998 (estimated as the difference between the total national shark catch minus exported sharks) was 79% (1992) and 94.8 % (1993) of the national catch, except for 1995 when local markets consumed 35% of the total production (RUIZ 1999).

In Honduras the fishing activity is third in national export revenues, however the importance

of sharks in the fishery economy is unknown. Reports from SALINAS (1998) show that a portion of the shark catch is sold in local markets, mainly in Choluteca and Tegucigalpa and some is exported to Guatemala and El Salvador. Sharks landed in Golfo de Fonseca are sent to the capital to be sold. Shark fins landed on the Caribbean are exported to Mexico, while those landed at Golfo de Fonseca are traded in Departamento de la Unión and then exported to Mexico and United States.

In El Salvador, sharks represent an important source of income for fishermen. In fact, between 1993 and 1997 4,178,780 kg were landed, 12.3% of it was exported at a value of \$8,987,368 (CENDEPESCA 1998). There is no doubt that sharks are important for the local market, but its is not clear how complex is the trade web and what are the prices at every link of it. Largest local market for shark is Acajutla while the main export market are the United States, Mexico and Asian countries (VILLATORO 1997).

In Nicaragua there is no historic data on prices or marketed shark products. SERGIO MARTÍNEZ (Biologist Director of CENDEPESCA-Nicaragua) (pers. comm.) believes that Costa Rica and the United States have become Nicaragua's main export markets for shark fins and meat respectively. Principal local markets are San Juan del Sur, Puerto Corinto and Puerto Jiquilillo (HERNÁNDEZ and MARADIAGA 1998).

In Costa Rica, fishermen are the main beneficiaries of the revenues produced by shark trade. Around 10,000 people are directly involved in the activity. Shark meat and fins contribute up to 25% of the income generated by the fishery. According to INCOPECA (1998) (Costa Rican Fishery Authority) marketing department, between 1987 and 1997, 21,847,504 kg have been landed with an average price of \$1.00/kg. The commercial category called *cazón* (sharks smaller than 5 kg) (i.e. *R. longurio*, *N. velox*, *C. limbatus*, *M. dorsalis* and *M. lunulatus*) contributed with 11 981,954 kg. Shark fins are special case. Despite the fact that its contribution the total catch is low, it has experienced a sustained increase in production. Between 1987 and 1997, the volume of shark fin trade was around 140,000 kg (INCOPECA 1998), which represents an increment of 236% from 1987 to 1997. Depending of its presentation, dry or fresh, price varies between \$40 and \$70 per kilogram. Main export markets are Taiwan, Hong Kong, Japan and United States.

In Panama, shark fillet exports have increased from 30,252 kg (1993) to 215,133 (1997). By 1997 estimated revenues were \$1,356,168. Shark fins trade is a very dynamic activity. It increased 53% between 1996 and 1997. Last year, shark fin exports reached 67,582 kg with a value of \$ 4,511,042. Principal markets are Hong Kong (67% of shark fins) and the United States (25.7% of shark fins trade and more than 50% of shark meat) (RAMÍREZ and MEDINA 1999).

SHARK FISHERY MANAGEMENT

In this brief review we have showed that in a short time period sharks became a resource of increasing commercial value and are subject to growing fishing pressure. Guatemala (RUIZ 1999), through a collaborative agreement with Mexico has begun to evaluate the importance of the artisanal shark fishery in the Pacific Coast. Other Central America countries stand behind data on the current status of shark populations available, management measures are lacking and studies that lead to the sustainability of the resource are absent. Practices to reduce post-capture handling losses are needed. The problem worsens because of the use of inadequate fishing gear, constant growth of the fishing fleets, and absence of adequate data on

landings.

According to the background information analyzed and our experiences, the following management measures can be suggested:

- 1) Identification the most important fishing banks and seasonality of shark populations present at those fishing grounds.
- 2) Establishment of a research program to assess basic fishery data such as of growth, mortality, abundance, distribution, reproduction, recruitment sizes, weight, sex size and age at sexual maturity and age structure of the populations, in particularly for species that have economic importance in Central America.
- 3) Estimation of capture per unit of effort (CPUE) for shark species landed by national and international fleets that fish the Central American waters.
- 4) Identification of breeding and nursery areas and definition of means to protect those areas from fishing or other environmental pressures.
- 5) Establishment of a monitoring program to estimate the mortality of sharks due to incidental fishing, as well as the fraction of sharks species that are subject of incidental capture.
- 6) Design of management measures to continuously advice Central American fishing authorities and companies, on the sustainable use of this resource.
- 7) Integration of the FAO Code of Conduct for Responsible Fisheries and the United Nations Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks to a regional fishery management scheme.
- 8) Design and implement a communication campaign to educate the public and interested groups at the national, regional and international levels.

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