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AN INVENTORY OF SOURCES OF DATA IN CENTRAL AMERICA ON SHARK FISHERIES OPERATING IN THE EASTERN PACIFIC OCEAN

METADATA REPORT

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EXECUTIVE SUMMARY

There is great concern about the exploitation of sharks throughout the world's oceans, and the eastern Pacific Ocean (EPO) is no exception. In the EPO, sharks are targeted or caught incidentally (as bycatch) by multi-species and multi-gear artisanal fisheries of the coastal nations and also by industrial high-seas longline vessels from distant-water nations. They are also taken as bycatch in the purse-seine fishery for tunas. There is a critical need for stock assessments of sharks to better inform their management and conservation; unfortunately, stock assessments of sharks in the EPO have to date not been possible due to the lack of reliable fishery statistics from all important fisheries

The IATTC has received funding from the United Nations Food and Agriculture Organization (FAO) and the Global Environmental Facility (GEF), in the framework of the *Common Oceans* program, to address this situation. The goal of the project is to improve data collection for shark fisheries in the EPO, particularly in Central America, where much of the shark catch[1] is landed and where the need for better data collection is greatest. Field trips were made to the six Central American nations with shark fisheries in the EPO in search of various types of data sources. The information obtained is presented in this report, which also provides background on shark fisheries in the region and describes the sources of data identified.

In summary, the main source of shark fishery data available in Central America are the landings inspection programs, conducted mainly for compliance purposes. Such programs have been operating in all Central American countries involved in the fishery since the early- or mid-2000s. The quality of the data varies among programs. Some programs collect data on shark landings by species and fleet, while others pool all sharks into a single category which may or may not be classified by fleet. The coverage by these programs of both ports and fleets varies, and is difficult to quantify. Shark trade records are also available for most countries since the mid-2000s, but not at the species level. Fishery and/or biological sampling programs for sharks, conducted mainly for resource monitoring and/or research purposes, are very scarce in Central America, with only a few sporadic pilot programs implemented in the region for very short periods of time. A second report prepared under this project (Aires-da-Silva and Siu 2016; Document SAC-07-06b(iii)) describes the factors limiting data collection from shark fisheries in Central America and the EPO in general, and presents recommendations for improvements.

The data collected during the project will be incorporated into a database suitable for stock assessments. Future research will attempt to use the data obtained to mitigate the data-limited situation currently faced by stock assessments of sharks in the EPO.

1. INTRODUCTION

1.1. Shark fisheries[2] in Central America

Elasmobranchs, a group of fishes that includes sharks and rays, are highly vulnerable to fishery exploitation, due to their life history characteristics of slow growth, long life cycle, late age of maturity, and low fecundity (Bonfil 1994). There is great concern about the exploitation of shark stocks throughout the world's oceans, and the EPO is no exception (Watts and Wu 2005).

In the EPO, sharks are targeted or caught incidentally (as bycatch) by multi-species and multi-gear artisanal fisheries of the coastal nations and also by large longline vessels from distant-water nations. Sharks are also taken as bycatch in the tuna purse-seine fishery (Roman-Verdesoto 2014; Watson *et al.*

[1] NOTE ON TERMINOLOGY: No information on shark discards is available, therefore in this report the term 'catch' refers to retained catch, and thus observed landings/unloadings. Also, 'size' is usually, but not necessarily, synonymous with 'length'.

[2] Unless otherwise specified, "shark fisheries" means all fisheries in which sharks are caught, whether as target or bycatch.

2014).

Marine resources are of great commercial and economic importance for Central America, and also provide an important source of protein for local populations. Fisheries, including the artisanal fishing communities, generate over USD 2 billion in economic activity annually, and employ more than 250 000 people in catching, processing, and marketing fisheries products (FAO 2014; Avendaño 2004). In 2010, the Central American Fisheries and Aquaculture Sector Organization (*Organización del Sector Pesquero y Acuícola de Centroamérica*; OSPESCA), a directorate of the Central American Integration System (*Sistema de Integración Centroamericana*; SICA), estimated that there were 118 400 fishermen in Central America, 60% of whom operated in the EPO (OSPESCA 2010).

Since 1995, OSPESCA, has developed various strategies for regional fisheries management, in conjunction with the fisheries authorities of the various Central American countries. This regional work has resulted in several projects for the management of shark fisheries, such as the Regional Plan of Action for Sharks (2011), regional pilot sampling programs for sharks (2009-2010), the regulation of tourism and fisheries activities around the migration routes of whale shark (*Rhincodon typus*) stock (2011), and a regional ban on shark 'finning'[3] (2011).

Historically, economic development within the Central American region has been variable, which has led to unequal growth in each fisheries and aquaculture sector (Araya 2013). For example, El Salvador has the largest number of fishermen (around 19 000) in the region, but has the least-developed fisheries and aquaculture sectors, with no active large longline vessels; other countries, like Guatemala and Nicaragua, are regional leaders in aquaculture, but also have sizeable fleets of longliners and trawlers. Costa Rica and Panama have the leading industrial (trawl, purse seine, and longline) and recreational fisheries sectors (OSPESCA 2010).

For Central American countries, small-scale artisanal fisheries, which were developed between about 1940 and the mid-1970s (Meneses 2010; JICA 2002; Melenderas 2008), are not only a source of employment, but are also directly linked to food independence, with nearly 70% of their production destined for direct local human consumption (Avendaño 2004). However, despite the number and importance of these fisheries, the socio-economic level and quality of life of fishing communities is among the lowest, and, in addition to overexploitation of fisheries and degradation of marine ecosystems caused by unsustainable development, population growth, and pollution, they are vulnerable due to several factors, including lack of access to education and relevant training, competition with industrial fishing, and lack of public policies for modernizing small-scale fisheries. Coastal areas have enormous advantages for tourism development and other projects, but in some countries the high volume of tourism and construction, port infrastructure projects, and lack of security have generated conflict and exposed fishing communities to forced displacement.

Central American artisanal fisheries have several common characteristics, the most common being: 1) use of different types of fishing gear during a single trip; 2) catches of various species in their juvenile stage; 3) seasonal fishing activity; and 4) numerous, often isolated, landing places and different marketing channels.

The statistics available for Central American shark fisheries consist mainly of landings records published by FAO. The most recent FAO statistics (2013) show Costa Rica as the dominant Central American nation in terms of volume of shark landings (3 590 tonnes), followed by Panama (1 798 t), Guatemala (143 t), Nicaragua (51 t), and El Salvador (44 t).

[3] Defined as removing the fins from sharks and discarding the rest of the animal.

1.2. The shark-fishing fleets in Central America

Before identifying and understanding available shark data sources in Central America, it is important to define the different shark fisheries operating in the region. In Central America, vessels that catch sharks, as target species or incidentally, can be broadly divided by size into two categories: 'artisanal' vessels,

TABLE 1. Number and classification of vessels that fish for sharks in the EPO, by flag, category, and gear. T/B: Target/bycatch; LOA: length overall; NRT: net registered tonnage; GN: gillnet; HX: handline; LL: longline; PS: purse seine; TX; trawl net.

Category	Definition	Number	Gear	Date	T/B
BELIZE					
Industrial	Belize vessels that fish in the EPO	11	LL	2014	T/B
COSTA RICA					
Small-scale/ artisanal	<3 nautical miles from coast	6 100	GN/LL	2010	B
Medium-scale	Autonomy <25 days, <40 nautical miles from coast	350	LL	2015	T/B
Advanced	Autonomy >25 days, >40 nautical miles from coast	93	LL	2015	B
Semi-industrial	Trawl net fishery	36	TX	2015	B
Foreign	See section 2.2				
EL SALVADOR					
Industrial	>10 m LOA	3*	LL	2010	T
Artisanal	<10 m LOA	8 300	GN/LL	2010	T/B
GUATEMALA					
Large-scale commercial	30.1-150 NRT	3	PS	2015	B
Medium-scale commercial	2-30 NRT	17		2015	T
Small-scale commercial	1-1.99 NRT	5	LL	2015	T/B
Small-scale artisanal	0.46-0.99 NRT; <10 m LOA, fiberglass hull, outboard motor, autonomy <4 days	4 860	GN/LL	2010	T/B
NICARAGUA					
Industrial	>15 m LOA, mechanically-operated fishing gear, electronic fish-finding and location equipment	50†	LL/TX	2015	T
Artisanal	<15 m LOA, fiberglass hull, outboard motor	4 300	GN/LL	2010	T/B
PANAMA					
High-seas 1	≥100 NRT	344	83 LL; 261 PS/TX	2015	T/B
High-seas 2	10-99 NRT				
Coastal 1	<10 NRT; limited autonomy	3 554	GN/LL/LX	2010	T/B
Coastal 2	Rowed vessels				
International	Panamanian and foreign vessels that fish outside the 200-mile EEZ	82	26 PS/ 56 LL	2015	T

* Inactive since 2011; † 8 of the 50 industrial vessels are <15 m LOA.

generally called *pangas*, which are typically less than 15 meters length overall, with outboard motors and fiberglass hulls, and larger vessels, which in this report are grouped into a single 'industrial' category, although the number of categories, their names and cutoff points, vary among countries, as do the criteria for allocating vessels to categories (Table 1).

In some countries the larger vessels are further broken down into two or more subcategories, usually based not only on the vessel's length overall but also on where, when, and how it fishes, and with what gear (Table 1). There is no common standard for classifying vessels or fleets, which makes any assessment of fishing effort problematic. Fleets with similar physical characteristics and modes of operation are classified quite differently: for example, a *panga* is defined as less than 10 m long in one country and 15 m in another, and vessels classified as 'semi-industrial' in one country may fall into two categories with different names in another.

This problem of lack of comparability of fleet data needs to be resolved. A standardized classification system should be developed, based if possible on criteria that are objective, quantifiable and verifiable, and comparable among fleets and countries.

1.3. Sharks and the IATTC

The Antigua Convention, which entered into force in 2010, requires that the Inter-American Tropical Tuna Commission (IATTC) "adopt, as necessary, conservation and management measures and recommendations for species … that are affected by fishing for, or dependent on or associated with" the tuna stocks. Sharks are among these species, and there is a critical need for stock assessments to improve shark management and conservation. Unfortunately, data on shark fisheries in the eastern Pacific Ocean (EPO) are limited. Although the data on shark bycatches available from observer programs for tuna purse-seine vessels are of very good quality, the data for other bycatch and target fisheries (*e.g.* longline) are deficient. Without reliable fishery statistics from all important fisheries, stock assessments of sharks in the EPO have to date not been possible.

The IATTC has received funding from the United Nations Food and Agriculture Organization (FAO) and the Global Environmental Facility (GEF) in the framework of the *Common Oceans* program, as part of the Sustainable Management of Tuna Fisheries and Biodiversity Conservation in Areas Beyond National Jurisdiction (ABNJs) project, one component of which is reducing the impacts of tuna fisheries on the ecosystem, and

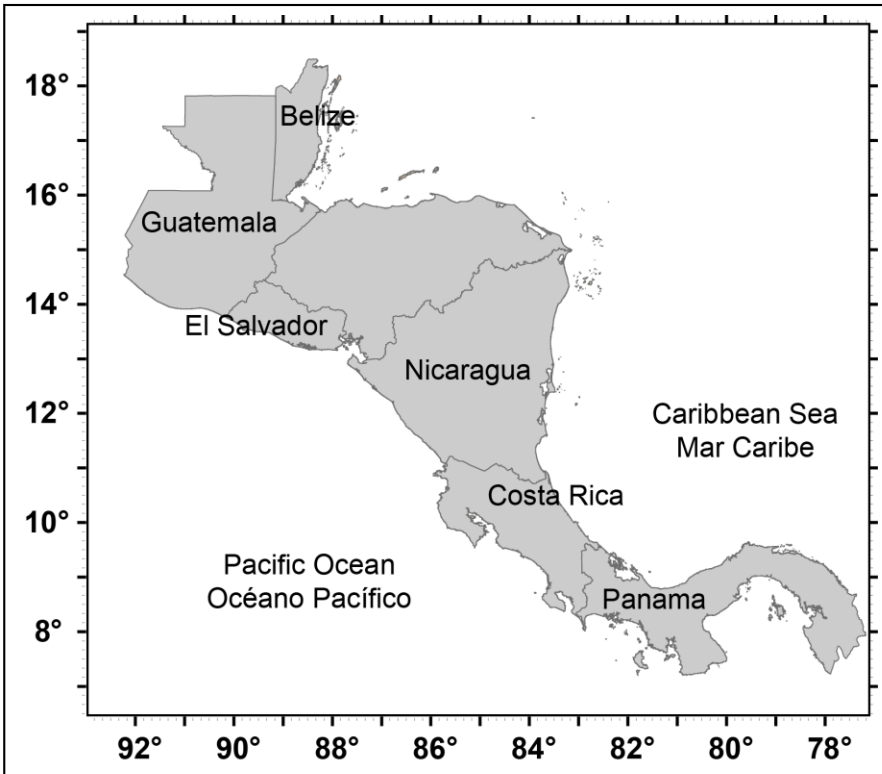

FIGURE 1. Central America, showing the six countries involved in shark fisheries in the eastern Pacific Ocean

specifically on sharks.

1.4. Objectives of study

The broad goal of the IATTC project is to improve data collection for shark fisheries in the EPO, with a main focus on Central America, where much of the shark catch is landed and where the need for better data collection is greatest. One of the main tasks of the project is to identify sources of data on shark fisheries in the EPO available in Central America.

This report provides historical background on shark fisheries in the Central American region and describes the sources of fishery data for shark species available in that region that were identified during this project. They include existing fishery inspection and trade records, data-sampling programs (fishery and/or biological), research conducted at fisheries institutes and universities, and anecdotal information, as well as biological studies and existing management commitments. The information is summarized for each country in Section 2 of the report, and presented in detail in metadata format in Section 3. A second report prepared under this project (Aires-da-Silva and Siu 2016; Document SAC-07-06b(iii)) describes the factors limiting data collection from shark fisheries in Central America and the EPO in general, and presents recommendations for improvements.

2. IDENTIFICATION AND DESCRIPTION OF DATA SOURCES - METADATA

In order to identify available shark fishery data sources for the EPO and obtain the data, between October 2014 and December 2015 the senior author of this report traveled to the six Central American nations with shark fisheries in the EPO (Figure 1). He visited government fisheries agencies, research institutes, universities, and commercial companies in search of various types of data sources: 1) fishery inspection programs, conducted mainly for compliance purposes; 2) fishery and/or biological data-sampling programs, conducted for resource monitoring and research purposes; 3) trade records; 4) research conducted at fishery institutes and universities; and 5) anecdotal information. The information obtained is presented in Section 3 of this report, and also illustrated chronologically in Figures 8 and 9. The activities and outcomes of the field visits are summarized in the Appendix.

2.1. BELIZE

2.1.1. Background

For Belize, the only country covered in this report without coastal access to the EPO, fisheries make a significant contribution to the economy, primarily from exports of lobster, conch shellfish, and shrimp. Belize has a high-seas industrial fleet comprised primarily of longline vessels, but also including a few trawlers, purse seiners and reefer vessels, operating in both the Caribbean and the Pacific Ocean. The longline fleet, which concentrates its effort in the Pacific, is the Belizean fleet of interest for the management and conservation of sharks in the EPO.

There are two institutions in Belize responsible for the management of aquatic and fisheries resources: the Belize Fisheries Department, under the Ministry of Agriculture and Fisheries, responsible for management within the national Exclusive Economic Zone (EEZ), and the International Merchant Marine Registry of Belize (IMMARBE), under the Ministry of Finance, which manages the activities of the high-seas longline fleet through the Belize High Seas Fisheries Unit (BHSFU).

The management regime for the Belizean high-seas fishing fleet was created by the High Seas Fishing Act of 2003, amended in 2013, when the regulatory framework for managing the fleet was extended and strengthened. The main objectives of the Act are, among others, to ensure the conservation and optimal utilization of marine resources, the management and maintenance of fishing operations, and the sanctioning of violations of conservation and management measures.

The high-seas industrial longline fleet consists of vessels from nations outside the EPO (mainly Chinese Taipei) operating under Belizean flag through license agreements. Until 2013 they were licensed to target tuna and tuna-like species (which also allows them to target sharks) on the high seas in the EPO and the Western and Central Pacific Ocean (WCPO) (WCPFC 2013), but this status was not renewed in 2014; however, they can also operate in the EEZs of other Central American states in the EPO under license agreements (Gianni 2005).

Data on the number of Belizean high-seas longline vessels licensed to fish for tuna and tuna-like species in the Pacific Ocean were obtained from the IMMARBE database for 2001-2015. This fleet, which began operating in 2001, has shown a steady decrease since 2005, from 44 vessels in 2005 to 11 in 2014. The average size of the vessels has fluctuated during 2006-2014 from a low of 25 GRT to a high of 915 GRT.

The number of Belizean vessels in the EPO has also decreased, from 33 in 2009 to 11 in 2014. The decline began in 2013, when the amended High Seas Fishing Act was adopted, and many new requirements, regulations, and a revised fee schedule were implemented; also, vessels which were laid up inactive for more than 3 months would be deleted from the Belizean vessel registry. Moreover, national plans of action (NPOAs) on sharks and illegal, unreported, and unregulated (IUU) fishing were implemented, as were on-board observer and unloading inspection programs. Many vessel owners were unwilling to meet these new requirements and transferred to other registries. In 2013, Belize withdrew from the Indian Ocean Tuna Commission (IOTC) and the Western and Central Pacific Fisheries Commission (WCPFC), and all Belize-flag vessels operating in those areas had to either move to another area or change flag. Belize is currently a member of the IATTC and the International Commission for the Conservation of Atlantic Tuna (ICCAT), whose areas of responsibility are closer to Belize and allow better management of the fleet.

2.1.2. Data collection

The BHSFU does not conduct any fishery and/or biological sampling programs for monitoring and/or research purposes, but it receives landings data for the Belizean high-seas longline fleet through agreements with the EPO coastal nations where the catches are landed. Inspections of landings in EPO ports by Belizean longline vessels are carried out jointly by inspectors from BHSFU and from the country where the landing takes place. Depending on the terms of the agreement, the BHSFU inspector has to travel to the point of landing (in El Salvador, for example) or if, as in Costa Rica, the regulations of the country that receives the landing are in line with Belizean regulations, the country has only to submit an official report of the landing to the Belizean authorities. The coverage of Belizean vessels by the national inspection programs varies by country, but is 100% in the case of Costa Rica and El Salvador. Belize provides its longline landings data to the IATTC periodically.

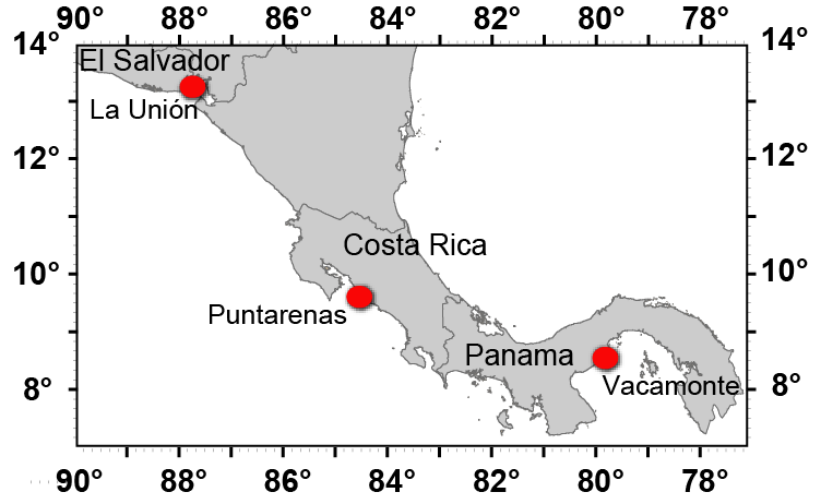

FIGURE 2. Principal ports where shark catches are landed by the Belizean high-seas longline fleet.

The main ports used by the Belizean longline fleet in Central America are, in order of importance, Puntarenas (Costa Rica), Vacamonte (Panama), and

La Unión (El Salvador) (Figure 2).

Additionally, in 2013 BHSFU initiated the process of implementing an observer program for the foreign longline fleet. However, the program, which shares information with the IATTC, did not commence until 2015. In accordance with IATTC Resolution C-11-08, coverage is 5%; the data collected, which will be used to verify compliance with IATTC resolutions on bycatch, are similar to those collected by the IATTC observer program.

2.1.3. Research

No research studies were found related to the Belizean high-seas longline fleet that fishes for sharks.

2.1.4. Management

Management of high-seas fishing by Belizean vessels is carried out under the 2013 High Seas Fishing Act and the regulations, rules, notices, and directions promulgated in accordance with that Act. In addition, vessels targeting sharks are also subject to the following: 1) NPOA for sharks; 2) IUU fishing law; 3) observer and inspection programs; 4) prohibition of 'finning'; 5) ban on exports of hammerhead sharks; and 6) hourly VMS reports. Belize also complies with measures adopted by international or regional organizations and instruments such as IATTC, ICCAT, OSPESCA, and CITES (Table 3.4.9).

2.2. COSTA RICA

2.2.1. Background

Costa Rica manages fisheries through the Costa Rican Fisheries and Aquaculture Institute (*Instituto Costarricense de Pesca y Acuicultura*; INCOPESCA), created in 1994, which regulates fishing activities in Costa Rica in conjunction with other institutions and organizations involved in the protection, conservation, and utilization of marine and coastal resources.

Costa Rican vessels operate principally out of ports on the Pacific coast of the country, mainly due to their better infrastructure. The main ports of landing are Puntarenas, Quepos, Cuajiniquil, and Golfito (Figure 3). In 2015 there were a total of 6 579 Costa Rican fishing vessels, almost all operating in the commercial fishery, and classified in the following categories: small-scale or artisanal (6 100 vessels), medium scale (350 vessels), advanced (93 vessels), and semi-industrial (36 vessels), plus foreign vessels.

According to INCOPESCA, the 443 domestic medium-scale and advanced[4] longliners target large pelagic fishes in the EPO. Their catches consist mainly of sharks (70%), dorado (18%), and billfishes (swordfish, marlin, and sailfish) (12%) (Cubero-Pardo *et al.* 2013).

The fishery targeting sharks started in Costa Rica and spread to other countries in Central America. The productivity of Costa Rican waters in terms of high catches of large pelagic fishes – mainly tuna, billfish, and sharks – has been well known since the 1960s, when foreign (mainly Japanese) purse-seine vessels and high-seas longliners expanded into Central American waters (Suzuki *et al.* 1978). However, it was not until the 1980s that, due to overexploitation and lower availability of coastal fish stocks (shrimp, snapper, corvina, *etc*.), Costa Rican fishermen became interested in large pelagic species (Porras 1993). During the early 1980s, cooperative programs (the so-called "international missions") between Costa Rica and Asian nations (mainly Chinese Taipei) transferred technology and expertise to Costa Rican fishermen. Some of the expert fishery technicians from those countries settled in Costa Rica and initiated family-owned fishing operations targeting large pelagics (mainly sharks), some of which are still active.

The Costa Rican domestic longline fleet began its operations in 1986. The development of the fishery for

[4] Defined as having autonomies of fewer and more than 25 days, respectively.

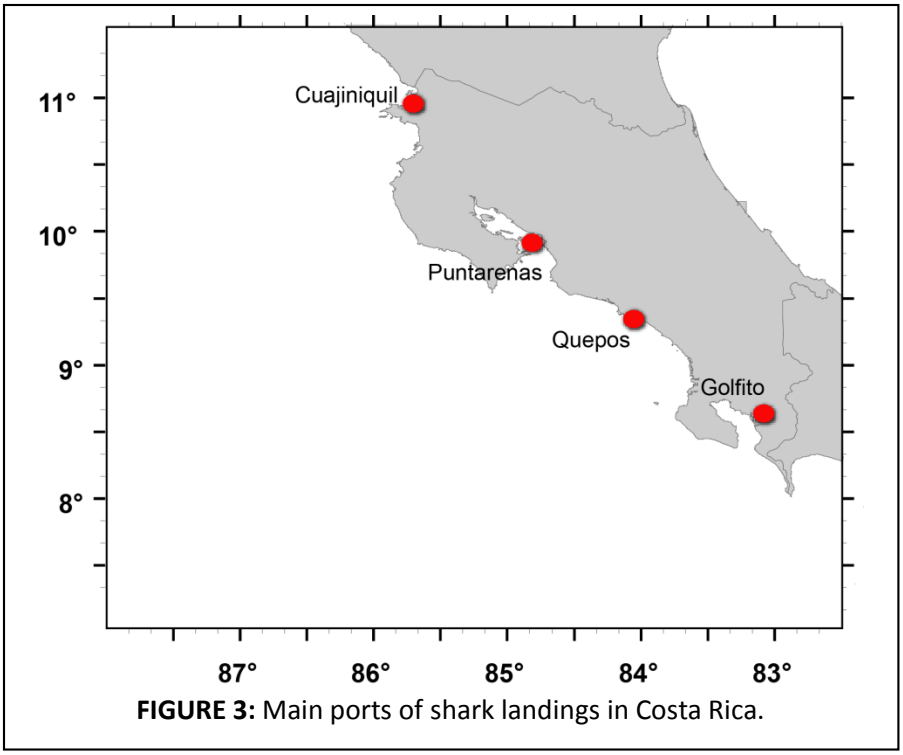

FIGURE 3: Main ports of shark landings in Costa Rica.

large pelagics was greatly assisted by the high demand for, and high commercial value of, these species in the Japanese, US, and European markets, and by 1993 there were 600 artisanal longline vessels in the domestic fishery, ranging from 11 to 23 meters in length and with a maximum autonomy of 14 days (Porras 1993). By 2002, INCOPESCA reported 588 longline vessels involved in the fishery, which landed about 17 000 tonnes of large pelagic fishes (tuna, billfish, sharks, and dorado).

According to INCOPESCA fishery inspections data, during 2004-2010 an average of 36 foreign longliners unloaded in Costa Rica (mainly Puntarenas) each year, mainly from Belize (81%), Chinese Taipei (9%), Cambodia (5%), and Indonesia (3%), plus Panama, Georgia, El Salvador, and the United States (< 1% each). This high level of activity by foreign longliners was possible under agreements with countries, such as Chinese Taipei, which supported economic development in Costa Rica, in particular its fisheries, through the construction of infrastructure (*e.g*. docks, piers, and warehouses).

During 2010-2014, the number of foreign vessels landing their catches in Costa Rica decreased, due to a drop in the price of shark fins in Asian markets, the increased cost of fuel, and stronger domestic regulations for monitoring and controlling the activities of these vessels. One important management measure implemented by Costa Rica in 2003 (Regulation 415) to regulate shark finning was the requirement that shark fins be unloaded partially attached to the animal[5], which resulted in closer monitoring of shark unloadings, and some foreign vessels that targeted these species moved to other ports in Central America, mainly in El Salvador and Panama, where regulations were not so strict. By 2015, no foreign longliners were unloading in Costa Rica.

2.2.2. Data collection

Since 2004, Costa Rica has an inspection system covering the landings of the medium-scale, advanced, and foreign components of the longline fleet (Table 1) in the four main ports where sharks are landed (Figure 3).

Puntarenas is the major port of landing for longline vessels, domestic and foreign, and has two public ports (Calderas and INCOPESCA) where foreign vessels can unload. The former is used by large vessels, mainly purse seiners, and the second is dominated by domestic and foreign longline vessels.

[5] The fin may be cut, but must still be naturally attached to the animal at some point; this reduces the space required to store the animals aboard the vessel, but ensures that the body is not discarded.

INCOPESCA employs 16 fisheries inspectors, who inspect landings of large pelagic fishes, including sharks, caught by longline vessels. Foreign vessels are required to unload at public docks; domestic vessels may unload at public or private docks, but must allow access to inspectors. Foreign vessels are subject to strict monitoring: on entering port they are required to seal their freezing wells, which can only be opened once the vessel is docked at its assigned dock and in the presence of a fishery inspector. The inspection program must be given at least 24 hours' notice of a planned unloading, and catches may not be unloaded or marketed until they have been inspected. The inspection program covers 100% of landings by both domestic and foreign longliners in Costa Rican ports.

Prior to 2004, sharks landed in Costa Rica were recorded simply as "sharks"; since 2004 they have been classified by species, but with some misidentifications. In 2012 fisheries inspectors began using OSPESCA forms, which facilitate recording landings by species and by vessel flag. These data were recorded in Microsoft Excel until 2014, when a Microsoft Access database designed by INCOPESCA was adopted. More recently, the historical data were transferred to an Access database developed by the IATTC and OSPESCA, which is also used for new data.

A form called FIAD[6] has been used for recording and tracking landings by vessels targeting sharks since 2003 (Regulation 415 2003), and for all longline vessels since 2009. If the landings comply with the regulations on finning sharks, INCOPESCA authorizes the transport, marketing, and/or export of the product recorded on the FIAD, which then becomes the tracking document. Both sellers and purchasers of the product must follow the procedures established by the regulations, which give INCOPESCA access to the tracking information (when sold, by whom, what was sold (fins, meat, *etc*.)), which is then recorded in the INCOPESCA database.

Additionally, starting in 2015, two technicians collect biometric data (length and sex composition) on sharks unloaded in Puntarenas, which are then recorded in the Access database. Also, in 2016 an observer program for the longline fleet will be implemented, in accordance with IATTC resolution C-11-08.

2.2.3. Research

Some research on shark fisheries has been conducted at Costa Rican universities. One student thesis and two research papers were found, describing the shark fishery and the distribution and abundance of coastal sharks (Villalobos 1983; Clarke 2012; Villalobos *et al.* 2014).

Shark research has also been conducted by Costa Rican non-governmental organizations (NGOs). Eight research papers by NGOs were found, covering topics such as descriptions of the shark fishery, an analysis of catches of sharks and rays in the artisanal fishery, and population structure (Arauz *et al.* 2014; Arauz 2014; Cubero-Pardo *et al*. 2013; López n.d.; López *et al.* 2009; López *et al.* 2012; Zanella *et al.* 2009; Zanella *et al.* 2010; Zanella *et al.* 2012).

2.2.4. Management

Management of the Costa Rican shark fishery started in 2003, when the ban on finning sharks was introduced. There are other management measures in force, such as a size limit for the main shark species based on size at first maturity (N° 38027-MAG/2013). Costa Rica also complies with measures adopted by international or regional organizations and instruments such as IATTC, ICCAT, OSPESCA, and CITES (Table 3.4.9).

[6] FIAD: Inspection Form and Unloading Authorization.

2.3. EL SALVADOR

2.3.1. Background

The Directorate-General of Fisheries and Aquaculture Development (*Dirección General de Desarrollo de la Pesca y Acuicultura*; CENDEPESCA), under the Ministry of Agriculture and Livestock (*Ministerio de Agricultura y Ganadería*; MAG), is the authority in charge of managing fisheries in El Salvador.

Most of the catch of the Salvadorian fleet is for domestic consumption, with a few products exported (tuna, dorado, and sharks). According to fishing effort census data from OSPESCA (2010), the industrial component of the fleet consisted of 53 vessels over 10 meters long: 46 trawlers, primarily for shrimp and fish for local markets, four tuna purse seiners, and 3 longliners targeting sharks, billfish, and dorado; since 2011, however, the longliners have been inactive. The artisanal fisheries employed approximately 18 000 fishermen, operating about 8 300 *pangas* of less than 10 meters length overall, using various types of gear: gillnets (47%), *atarrayas* (hand cast nets) (20%), handlines (12%), trawl nets (9%), longlines (7%), and others (3%). Some vessels use more than one gear, sometimes during a single trip. Target species vary according to the season; during the rainy season (May to September), neonate scalloped hammerhead sharks (*Sphyrna lewini*) are particularly targeted, using gillnets.

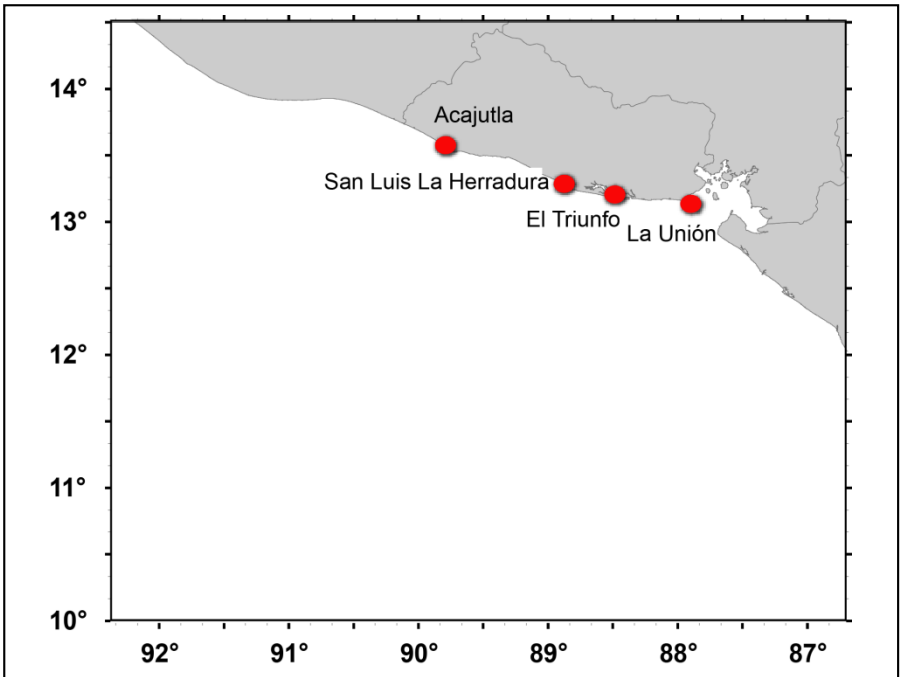

FIGURE 4. Main landing ports of the Salvadorean fleet.

Prior to 2011 there were three Salvadorian industrial longliners targeting sharks, making 4 to 10 trips per year lasting 20 to 90 days, depending on whether the catch was chilled or frozen, with crews of 5 to 12, and operating between 55 and 1 000 nm from the coast (Siu and Pacheco 2007). Sharks made up 45% of the total catch, followed by billfish (31%), and dorado (20%). The main species of sharks caught in this fishery were silky (*Carcharhinus falciformis*), blacktip (*C. limbatus*), scalloped hammerhead, and blue (*Prionace glauca*) sharks (Siu 2006). These vessels ceased operating in 2011 for economic reasons.

The main ports where sharks are landed in El Salvador are Acajutla and San Luis La Herradura for the artisanal fleet, and El Triunfo and La Unión for the industrial fleet (Figure 4). There are 28 identified *caletas*, where vessels are launched directly from the beach and catches are unloaded manually, as well as hundreds of small artisanal fishing communities with their own landing areas.

During 2003-2005, eight longliners that mainly targeted sharks, registered in Georgia but with owners in Chinese Taipei, unloaded at various ports in Central America. In 2004, during an unloading in La Unión, CENDEPESCA discovered that the vessels did not have licenses to fish in the EPO, and refused to authorize the unloading. Further actions led to these vessels being included in the IATTC IUU list. The vessels applied

for Salvadorian flag in 2005, but this was refused because of insufficient evidence to prove that the vessels were under new ownership. Subsequently, the vessels changed flag to another member country of the IATTC and changed their names.

In 2015, eight Belizean longliners made 14 unloadings of shark catches at La Unión. As mentioned above (Section 2.1.2), these landings are inspected by both CENDEPESCA and the Belizean fishing authorities (BHSFU). A Letter of Understanding between El Salvador and Belize on inspecting landings of sharks by Belizean vessels is under review by the Minister of Agriculture and Livestock of El Salvador.

2.3.2. Data collection

Fisheries in El Salvador are less well developed than in any other country in Central America. CENDEPESCA employs only seven fisheries inspectors to cover the four main unloading ports (Figure 4). Therefore, the level of coverage by the inspection program varies among CENDEPESCA's regional offices, but since 2007 has declined to less than 25%. Before 2014, the inspectors recorded general fishery information such as catch, but not species composition and effort data; currently they use the OSPESCA form and record shark catch data by species, but only for foreign longline vessels. Data on shark landings during 2001-2007 are available in a Microsoft Access database.

Currently, CENDEPESCA does not conduct any fishery and/or biological sampling programs. Data are available from a pilot fishery data collection program conducted by OSPESCA throughout Central America in 2009-2010. There were also some joint studies by the National University of El Salvador and CENDEPESCA during 2003-2005 and 2011-2012 (Table 3.4.2).

2.3.3. Research

There have been some research studies on shark fisheries in El Salvador, mainly student theses at local universities. The first was Villatoro (1994), which described the development of shark fisheries in El Salvador and generated interest for subsequent studies (Table 3.4.2).

Five university theses were found (Galdámez 2014; Siu *et al.* 2007; Siu 2012, Villatoro *et al.* 1994; Zambrano 2014) (Table 3.4.2). The topics covered included descriptions of the shark fishery, distribution and abundance of coastal sharks, stock assessment of coastal sharks, and an analysis of growth parameters.

CENDEPESCA has also conducted shark research in El Salvador. Four reports were found (CENDEPESCA 2008; Siu *et al.* 2005a; Siu 2006; Zambrano 2010) (Table 3.4.2). The topics covered included descriptions of the shark fishery, analysis of catches of sharks and rays in the artisanal fishery, and population structure. The only study by an NGO found was an economic study of the shark fisheries (Siu 2005).

2.3.4. Management

El Salvador manages its fisheries through the General Law for the Management and Promotion of Fisheries and Aquaculture of 2001, which is implemented by means of CENDEPESCA resolutions, which take into consideration technical advice provided by CENDEPESCA's Fisheries Research Department.

Management of shark fisheries in El Salvador is based on the 2008 National Plan of Action for the Conservation and Management of Sharks for El Salvador (NPOA-El Salvador), which was developed in 2008 with support from FAO and OSPESCA. The first management measure for the shark fishery was a 2006 resolution prohibiting finning, followed by a 2013 resolution on the fishery on neonate hammerhead sharks which restricts certain types of fishing gear and fishing in nursery grounds. El Salvador also complies with measures adopted by international and regional organizations such as IATTC, WCPFC, ICCAT, OSPESCA, and CITES (Table 3.4.9).

2.4. GUATEMALA

2.4.1. Background

The Directorate of Regulation of Fisheries and Aquaculture (*Dirección de Normatividad de la Pesca y Acuicultura*; DIPESCA) is the competent authority in Guatemala that administers national aquatic resources, promotes their sustainable harvesting, and monitors the administration of regulations and laws.

Guatemala's General Fisheries and Aquaculture Law (*Ley General de Pesca y Acuicultura*; Decree No. 80-2002) classifies fishing vessels by their net registered tonnage (NRT), as follows: large-scale commercial (30.1-150 NRT); medium-scale commercial (2-30 NRT); small-scale commercial (1-1.99 NRT); artisanal[7] (0.46-0.99 NRT) (Table 1). Guatemala currently has 31 large- and medium-scale shrimp vessels, three large-scale tuna purse-seiners, 18 medium-scale longliners, 5 small-scale gillnet/longline vessels, and 4 860 small-scale artisanal vessels operating in the EPO. According to OSPESCA (2010), Guatemalan fisheries employ a total of 18 600 fishermen, almost half of whom operate in the Pacific.

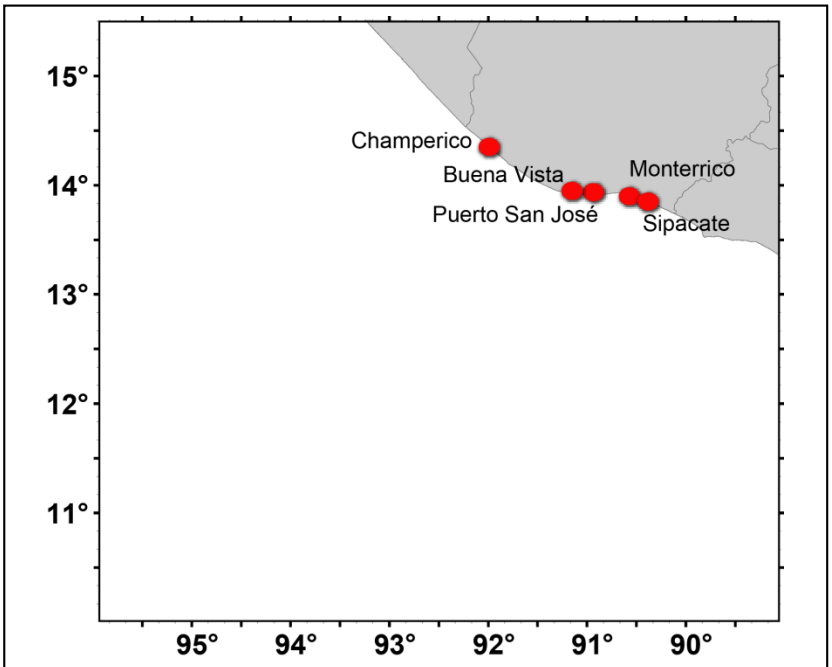

FIGURE 5. Main ports of shark landings in Guatemala.

In the Guatemalan EEZ, sharks are taken mostly by *pangas* in artisanal longline fisheries and small-scale vessels targeting sharks, but also as bycatch in artisanal gillnet fisheries (Ruano *et al.* 2007). About thirty species of sharks are caught in these fisheries, mainly species belonging to the orders Carcharhiniformes, Lamniformes and Rajiformes (Calderón-Solís 2014). Additionally, about 200 artisanal longliners target sharks in the Guatemalan EEZ (PROBIOMA 2005).

Sharks are also targeted by medium-scale industrial longliners (Ruiz *et al.* 2000). This fishery is fairly recent, having started in 2005, in contrast to the small-scale commercial fishery, which started in the early 1980s. The main ports for shark landings in Guatemala are, in order of importance, Puerto San José, Buena Vista, Champerico, Monterrico, and Sipacate (Figure 5). Landings by small-scale and artisanal vessels are concentrated in San José, and those of medium-scale vessels in Buena Vista.

2.4.2. Data collection

Data on shark landings in Guatemala originate mainly from port inspection records. Specifically, since 2001 DIPESCA inspectors collect data on landings, by species, and effort for the medium- and small-scale longline fleets at the five main fishing ports (Figure 5). Prior to 2015, effort was recorded in fishing days,

[7] Defined as commercial activity by *pangas* (vessels less than 10 meters long, with outboard engines, fiberglass hulls, and autonomy of less than 4 days).

but currently it is recorded in number of hooks.

Coverage by the inspection program of landings by medium-scale longliners is 100%. This is possible because fishery inspectors live in the communities near the ports where these vessels unload, and can thus collect information at any time. Vessels arriving at night are not monitored until the next day, because the product must be certified.

Each fishing port has one inspector. In the case of Buena Vista, where the medium-scale fleet is concentrated, the inspector has collected complete landings data, using OSPESCA forms, since 2014, classifying the catch by species, and, if appropriate, issuing a "no finning" certificate, thus allowing the product to be marketed. At the other ports the inspectors record landings data for small-scale and artisanal vessels, which contribute a large portion of the landings of sharks in Guatemala, and sometimes carry out fishery and/or biological sampling of landings of sharks and related species. However, both landings data and samples are collected opportunistically, so no consistent long-term data series are available.

The port inspection data were stored in a Microsoft Access database until 2001. Subsequently they were stored in Microsoft Excel until 2014, when DIPESCA started to use the standard OSPESCA data collection form. The information stored in Excel was then transferred to an Access database developed by the IATTC and OSPESCA.

Other than the landing inspections, DIPESCA does not have any fishery and/or biological sampling programs. However, a few data collection studies supported by external funding sources were conducted in Guatemala (*e.g.* FAO 2005-2006; OSPESCA 2009-2010; AECID 2006; (Table 3.4.2). Also, DIPESCA holds datasets collected by students during thesis research projects (see next section).

2.4.3. Research

In addition to DIPESCA's port inspection records, research studies provide valuable information on shark fisheries in Guatemala. One of the leading contributors to marine resource research in Guatemala is the University of San Carlos (USAC), particularly its Center for Marine and Aquaculture Studies (*Centro de Estudios del Mar y Acuicultura*; CEMA), which has provided the scientific basis for management and conservation of Guatemalan aquatic resources. As mentioned above, DIPESCA does not conduct any sampling programs; however, the data collected by CEMA students during their thesis work are provided to DIPESCA.

Guatemala has produced more research than any other country in Central America. A total of 15 Guatemalan research studies dating from 1982 to 2014 were identified and obtained (Table 3.4.2). These studies, conducted mainly by USAC and DIPESCA, address the following topics: reproduction (maturity), growth (length and weight), ecology (breeding areas), and others (chemical and pharmaceutical analyses, local trade analysis, and descriptions of fisheries).

In addition, ten university theses were found, covering the following topics: description of the shark fisheries, distribution and abundance of coastal sharks, chemical analysis, and ecological studies (Section 3). Three of these were published in scientific journals, while the others were published in local journals or remain unpublished.

Shark research in Guatemala has also been conducted by NGOs. A total of five reports produced by NGOs were found (Table 3.4.2), addressing the following topics: description of the shark fisheries, catch analysis of sharks and rays in the artisanal fishery, ecological and taxonomic studies, and population structure.

2.4.4. Management

The General Fisheries and Aquaculture Law (*Ley General de Pesca y Acuicultura*; Decree 28-2002)

establishes the bases for managing shark fisheries in Guatemala; for instance, it prohibits fishing for sharks within 20 nautical miles of the coast and specifies the fishing gears that can be used. However, specific regulations, such as prohibitions of finning or closed seasons, are put into effect by implementing measures adopted by international or regional organizations and instruments such as IATTC, ICCAT, OSPESCA, and CITES; for example, finning of sharks is regulated through, among others, OSPESCA Resolution OSP-05-11 (Table 3.4.9).

2.5. NICARAGUA

2.5.1. Background

The Nicaraguan Fisheries and Aquaculture Institute (*Instituto Nicaragüense de Pesca y Acuicultura*; INPESCA), established in 2007, is the competent authority for managing fisheries in Nicaragua.

According to OSPESCA (2010), there are about 32 000 fishermen in Nicaragua, about half of whom operate in the EPO. In 2015 the industrial fleet comprised 50 vessels[8], and the artisanal fleet about 4 330 *pangas*[9], which use mainly gillnets (36%), followed by handlines (20%), cast nets (15%), and longlines (7%).

Data published by INPESCA in 2014 indicate a 32% increase in the landings of marine species on the Nicaraguan Pacific coast from 2013 to 2014, from 9 379 t to 13 861 t, of which 85% were fish, 14% shrimp, and 1% lobster.

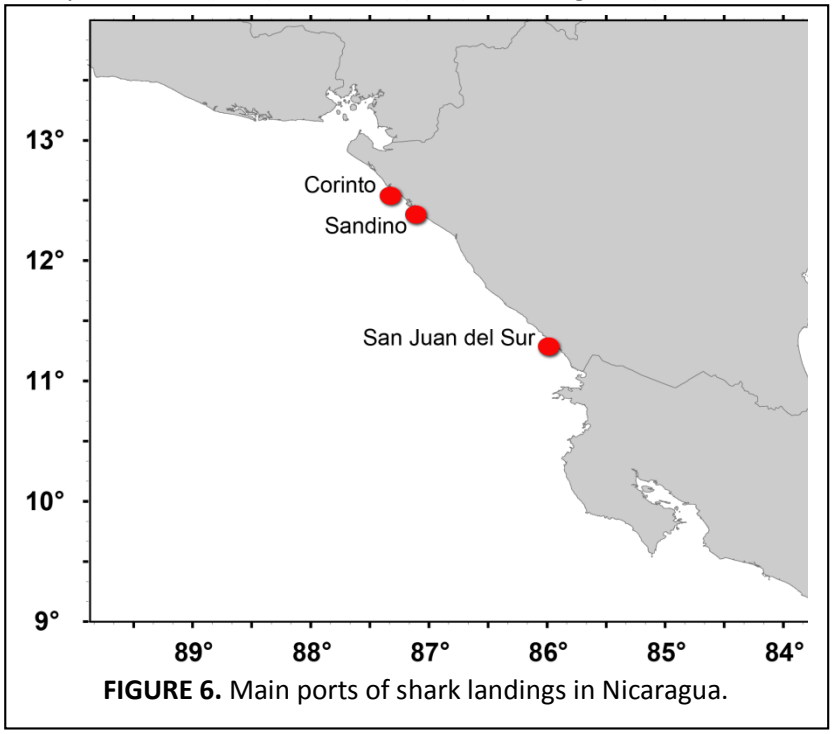

FIGURE 6. Main ports of shark landings in Nicaragua.

Sharks are the main target species of the artisanal and industrial longline fleets. However, the volume of these catches by species are poorly known, since the landings inspection program for the industrial fleet does not record catches by species, and there are no sampling programs or studies of the shark fishery in Nicaragua. The shark fishery is of relatively minor economic importance compared to other fisheries (*e.g.* shrimp and lobster), so it has been given little attention or resources by the fisheries administrations.

In 2011, Belizean vessels landed shark catches in Nicaragua, but shark conservation campaigns by NGOs in Nicaragua and Costa Rica have prevented any further landings.

2.5.2. Data collection

The main shark landing ports in Nicaragua are Corinto, Sandino, and San Juan del Sur (Figure 6). The industrial fleet operates from San Juan del Sur. INPESCA fishery inspectors regularly collect landings data from these and about 33 other fishing ports; however, INPESCA's human and financial resources are

[8] Defined as having mechanically-operated fishing gear and electronic fish-finding and location equipment, and over 15 meters length overall. However, 8 of the 50 industrial vessels are under this size limit.

[9] Defined as artisanal vessels of less than 15 meters length overall, with fiberglass hulls and outboard motors.

insufficient to address the needs of the entire country, so some of INPESCA's institutional functions are delegated to local governments, which provide inspectors additional to the 11 INPESCA inspectors who work in EPO ports. Coverage by the inspection program varies among ports, but is generally above 50%, and can reach 75%. It also varies between the regional offices of INPESCA and local governments; the latter focus mainly on artisanal vessels, whereas INPESCA focuses on the industrial fleet.

Since 2005, the INPESCA database classifies shark landings by species, but only for the artisanal fleet; landings by industrial vessels have never been classified by species. Currently, INPESCA does not have any fishery and/or biological sampling programs for sharks additional to the landings inspection program. During 2009-2010, OSPESCA implemented a pilot program for collecting shark landings data in all Central American countries, and in 2012 the IATTC and the Overseas Fisheries Cooperation Foundation (OFCF) of Japan implemented a pilot program for collecting data on landings by artisanal vessels (Table 3.4.2).

2.5.3. Research

Nicaragua has improved its recording of landings through INPESCA inspections and partnerships with local governments, but little research on the shark fishery (two undergraduate theses) has been done by the National University of León. There are some size and weight composition samples for species caught in artisanal fisheries in the Pacific from surveys conducted during the 1980s and the 2009-2010 pilot program funded by OSPESCA. No reports or studies by NGOs were found. INPESCA has developed two shark fishery reports (INPESCA 2005, INPESCA 2008), focused mainly on describing the shark fishery in Nicaragua.

2.5.4. Management

Nicaragua implements the management of all fisheries through its Fisheries and Aquaculture Law (No. 489, published as No. 251, 2004), whose articles 75 and 95 regulate fishing activities.

Management of the shark fishery began in 2004, when finning was prohibited. Nicaragua also complies with measures adopted by international or regional organizations and instruments such as IATTC, ICCAT, OSPESCA, and CITES (Table 3.4.9); for example, under CITES it has banned the export of hammerhead shark fins since 2013.

2.6. PANAMA

2.6.1. Background

The Aquatic Resources Authority of Panama (*Autoridad de los Recursos Acuáticos de Panamá*; ARAP) is the competent authority for managing fisheries in Panama. It is an autonomous institution created in 2006, when two government agencies, the Ministry of Agricultural Development and the Panama Maritime Authority, were merged. It aims to coordinate its activities with other existing or future institutions and/or authorities involved in fishing, aquaculture, and coastal marine management.

About 90% of the industrial and artisanal fishing activity in Panama occurs on the Pacific coast, where there are about 108 landing points, of which Vacamonte and Coquira are the most important (Figure 7).

Currently, Panama has an active fishing fleet of 3 980 vessels, comprising 344 high-seas (industrial) vessels, 3 554 coastal (artisanal) vessels, and 82 international vessels[10] (56 longliners and 26 purse seiners). The number of international longliners is significantly lower than in previous years. Vessels with international fishing licenses are required to carry VMS equipment.

2.6.2. Data collection

ARAP fisheries inspectors, who work in conjunction with the Maritime Port Authority (*Autoridad Marítima*

[10] Panamanian-flag vessels that fish outside the 200-mile EEZ

Portuaria; AMP), collect information on landings by artisanal and industrial vessels, national and foreign. The level of coverage varies among the ARAP/AMP regional offices and between fleets: all unloadings by international vessels are monitored, whereas coverage of artisanal vessels is generally less than 25%. Since 2015 unloadings are recorded by species, currently on ARAP forms similar to the OSPESCA form, but the new regional data forms developed by IATTC and OSPESCA are being introduced.

Both existing databases (landings and exports) include data since 2001. The export database is more reliable, since foreign trade is subject to stricter requirements

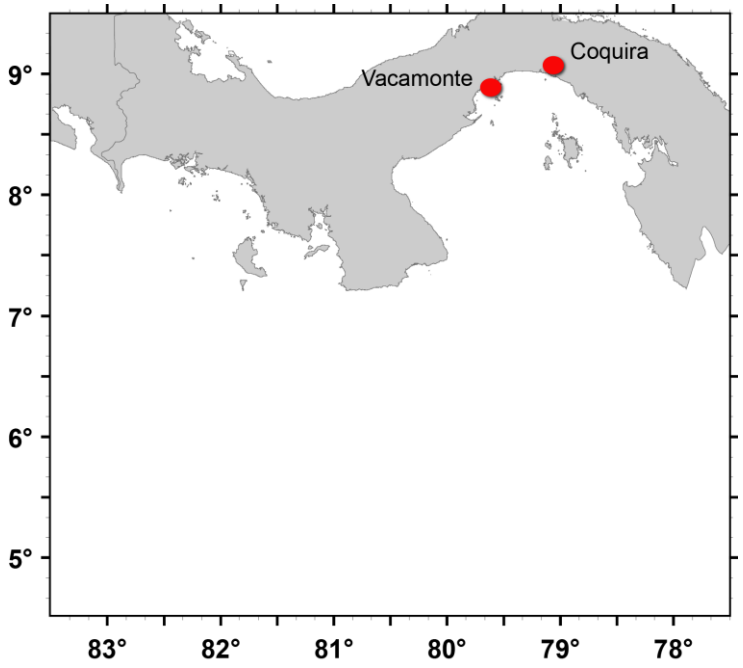

FIGURE 7. Main ports of shark landings in Panama.

ARAP is aware of the need to improve the collection and processing of landings data, and is building a nationwide online database, called SIERAC[11], which will include these data. It is also training its inspectors in the identification of fish species and in the use of the new data forms and the database.

At the present time ARAP does not have any fishery/biological sampling programs for sharks.

2.6.3. Research

Few biological studies have been carried out in Panama, but a very wide range of information is available, including descriptions of the fishery (mainly from the central and northern parts of the country), surveys of fishing gear, catch composition in artisanal fisheries, identification of nursery areas, proposals for constructing processing plants, pharmaceutical analyses, and others.

During this study, a total of six university theses (Arenas and Vargas 1983; Batista and Bernal 2008; Bruno and Escartin 1992; Del Cid 2011; Laffo and Mills 1986; Robles 2015) were found in Panama (Section 3), including descriptions of the shark fishery, trade analyses, and pharmaceutical and chemical analyses.

Shark research in Panama has also been conducted by NGOs. As part of this study, five reports by NGOs were found (Table 3.4.2), including descriptions of the shark fishery and an anthropological study of the fisheries (Maté 2005; Meneses 2010; Rodríguez 2013; Rodríguez 2014; Vega 2009).

Also, ARAP has developed four shark fishery reports (ARAP 2010; Rodríguez 2011a; Rodríguez 2011b; Rodríguez 2008), focused mainly on describing the main artisanal ports of Panama, with detailed information on the sizes of the main species caught by the artisanal fleet.

2.6.4. Management

Management of the Panamanian shark fishery started in 2006, with a prohibition on finning. Panama has had a NPOA for sharks since 2010, but it has not yet been implemented. There are also regulations for

[11] *Sistema nacional de información para la evaluación de la pesca, la acuicultura y la calidad de las aguas*

managing shark catches (Law No. 9 of 2006, and conditions on fishing licenses for sharks), and for industrial longlining in the Panamanian EEZ (Law No. 486) (Table 3.4.9). Panama has received international and regional assistance in developing management strategies and managing this resource, and guidance for strengthening institutional arrangements for collecting and recording fisheries and biological information (Table 3.4.9).

Panama also complies with measures adopted by international or regional organizations and instruments such as IATTC, WCPFC, ICCAT, OSPESCA, and CITES (Table 3.4.9).

3. SUMMARY OF DATA SOURCES FOR SHARKS (IATTC and Central American databases)

3.1. IATTC data

IATTC member governments submit information on the catches and effort in the tuna fishery annually, in accordance with Resolutions C-03-05 (Provision of data) and C-04-05 REV (Bycatch), in the Task I and Task II[12] format used by other regional fisheries management organizations (RFMOs). The requirements on how to submit this information are established by the IATTC scientific staff. All six countries of Central America provide Task I data, but only Belize provides Task II data.

The IATTC database contains records of bycatches by large (IATTC Class 6)[13] purse-seine vessels of 28 species of sharks and 9 species of rays reported by on-board observers since 1993. Catches are reported in number of individuals, although prior to 2005 they were also reported in weight. Data are also collected on set type (on tunas associated with dolphins, with floating objects, and unassociated schools), as well as on quantities retained and discarded. See Morua *et al.* (2010) for a review of the shark data available at the tuna RFMOs, including the IATTC.

Data on bycatches by the tuna longline fleet are provided to the IATTC by the vessels' flag governments. Some data on bycatches of sharks and rays have been provided by seven countries (Belize, China, Korea, Mexico, French Polynesia, Chinese Taipei, and the United States), some dating back to 1979, but they are sporadic and incomplete. The IATTC database contains records of 9 species of sharks and 1 species of ray, classified by 5° x 5° area, fishing effort (number of hooks), and species.

In summary, all countries In Central America involved in the shark fishery have had landings inspection programs, mainly for compliance purposes (Section 2), since the early- or mid-2000s. The quality of the data varies among programs: some collect shark landings data by species and fleet, while others pool all sharks into a single category, which may or may not be classified by fleet. The level of coverage of both ports and fleets varies, and is difficult to quantify. Shark trade records are also available for most countries since the mid-2000s, but not at the species level. The IATTC has received some form of summary catch and effort data at the Task I level from all Central American countries; more detailed (Task II) records (*e.g.*, catch and effort data by trip, spatial data) have been submitted only by Belize.

3.2. Research data

Research on sharks in Central America consists mainly of descriptions of the fisheries, both artisanal and industrial. There is some research dedicated exclusively to particular species (Pacas 1999; Porras 2005;

[12] **Task I statistics.** CATCH: gross annual harvest (whole weight of all the fish caught or killed during fishing operations) and disposition (retained or discarded) of the tunas, tuna-like species, and other species caught in the fisheries covered by the Antigua Convention. EFFORT: annual number of fishing vessels, by gear, operating in the Antigua Convention Area.

Task II statistics. CATCH AND EFFORT: catch and effort by area, gear, and species. Gross harvest and disposition (retained or discarded) for each species, and the associated fishing effort, at the finest resolution possible.

[13] Greater than 363 t carrying capacity.

Ixquiac 2009; Diego 2012; Siu 2012; Zambrano 2010; Zambrano 2014; Galdámez 2014; Arenas and Vargas 1983, Zanella *et al.* 2010, Zanella *et al.* 2012, Zanella *et al.* 2013), and to particular fisheries that catch several species of sharks (Ruiz 1998; Ruiz *et al.* 2000; Jolón *et al.* 2005; Ixquiac 2009; Calderón 2014; Villatoro-Vaquiz and Rivera González 1994; PRADEPESCA/INRECOSMAR 1999; Siu 2005; Maté 2006; Rodriguez 2008; Vega 2009; Rodriguez 2011; Del Cid 2013; Robles *et al.* 2015; Clarke 2012; Villalobos-Rojas *et al.* 2104, Zanella *et al.* 2009). Only two investigations (Siu 2012; Galdámez 2014) addressed stock assessment methods or growth parameters, for three primarily coastal species (scalloped hammerhead shark and two rays, *Dasyatis longus* and *D. brevis*). Also, there has been greater emphasis on researching reproductive parameters (fishing seasons, sexual maturity, gonadosomatic indices, spawning areas, *etc.*); and feeding habits and/or sex ratios (Galdámez 2014; Ixquiac 2009; Ixquiac 2010; Ixquiac *et al.* 2009; Pacas 1998; Porras 2005; Robles 2015; Rodríguez 2011a; Rodríguez 2014; Ruano *et al.* 2007; Ruiz-Alvarado *et al.* 2000; Sinay 2013; Siu *et al.* 2005b; Siu 2012; Villalobos 1983; Villatoro 1994; Zambrano 2014; Zanella *et al.* 2009; Zanella *et al.* 2012).

Universities have been important for scientific research into the shark fishery. Biological and fishery data collected for student theses have led to investigations of sizes at maturity, growth parameters, trophic analysis, distribution and abundance, and breeding areas, also pharmaceutical studies, descriptions of shark fisheries, and business analyses of the fishing sector dedicated to sharks, among others (Table 3.4.2). University researchers contacted during this project could in the future form a network that could collaborate in studies of sharks.

3.3. Databases on landings of sharks

There are good quality historical databases available in Central America for fisheries for some marine species, mainly coastal species such as shrimp, lobster, snapper, and sardines, but not for sharks and other pelagic species. Also, the type of detailed species-specific data necessary for stock assessments are scarce.

The situation is improving: standardized forms for recording biological, effort, and landings data on sharks in different fisheries are now being used, and artisanal shark fisheries are now more closely monitored. A methodology for obtaining biological and fishery information has been adopted for use throughout the region, and has resulted in an analysis of the status of the population of scalloped hammerhead sharks in Central America, the definition of nursery areas for neonate hammerhead sharks, and estimates of the growth parameters of two types of ray (Table 3.4.2).

A major problem encountered in the preparation of this report is that landings data are obtained mainly from multi-species fisheries and bycatch and are not classified by species or fishery. Belize, Costa Rica, Guatemala, and Nicaragua have landings data broken down by species (for the industrial fleet in the case of Belize and Costa Rica, and for the artisanal fleet in the case of Guatemala and Nicaragua), classified by weight, and with effort information, in either days fishing or number of hooks.

3.4. Data tables

3.4.1. Codes and acronyms used in the tables

Countries:

Country	Code
Belize	BLZ
Costa Rica	CRI
El Salvador	SLV
Guatemala	GTM
Nicaragua	NIC

Panama	PAN

National fisheries institutes:

Country	Acronym	Name
BLZ	BHSFU	Belize High Seas Fisheries Unit
CRI	INCOPESCA	Instituto Costarricense de Pesca y Acuicultura
SLV	CENDEPESCA	Dirección General de Desarrollo de la Pesca y Acuicultura
GTM	DIPESCA	Dirección de Normatividad de la Pesca y Acuicultura
NIC	INPESCA	Instituto Nicaragüense de Pesca y Acuicultura
PAN	ARAP	Autoridad de los Recursos Acuáticos de Panamá

Species:

Code	Scientific name	Common name	
		FAO/ASFIS[14]	Central America
ALS	*Carcharhinus albimarginatus*	Silvertip shark	-
BLR	*Carcharhinus melanopterus*	Blacktip reef shark	-
CCE	*Carcharhinus leucas*	Bull shark	Gambuzo, toro, ñato, barroso
CCG	*Carcharhinus galapagensis*	Galapagos shark	Blanco
CCL	*Carcharhinus limbatus*	Blacktip shark	Cazón, punta zapato, puntinegro, puntas negras
CCR	*Carcharhinus porosus*	Smalltail shark	Cueriduro
CNX	*Nasolamia velox*	Whitenose shark	Picuda, picudo fucsia, punta zapato, pico blanco
CTD	*Mustelus dorsalis*	Sharptooth smooth-hound	Mamón
CTK	*Mustelus henlei*	Brown smooth-hound	Mamón, mamón enano
DUS	*Carcharhinus obscurus*	Dusky shark	Prieto
FAL	*Carcharhinus falciformis*	Silky shark	Azul, blanco, gris, mexicano
GNC	*Ginglymostoma cirratum*	Nurse shark	Gata tonta, gata, lija
JAG	*Raja velezi*	Velez ray	-
JFQ	*Raja equatorialis*	Equatorial ray	Raya ecuatorial
JUA	*Urotrygon aspidura*	Spiny-tail round ray	Raya redonda picuda
JUC	*Urotrygon chilensis*	Chilean round ray	Raya pintada
JUN	*Urotrygon nana*	Dwarf round ray	Raya redonda enana
JUO	*Urotrygon rogersi*	Rogers' round ray	Raya redonda
MAE	*Aetobatus narinari*	Spotted eagle ray	Gavilán, raya, chucho pintado
MRS	*Rhinoptera steindachneri*	Pacific cownose ray	Gavilán dorado
MUU	*Mustelus lunulatus*	Sicklefin smooth-hound	Mamón
PTH	*Alopias pelagicus*	Pelagic thresher shark	Zorro
RBU	*Rhinobatos leucorhynchus*	Whitesnout guitarfish	Guitarra
RDL	*Dasyatis longus*	Longtail stingray	Raya, raya látigo
RDV	*Dasyatis brevis*	Whiptail stingray	Raya
RHU	*Rhizoprionodon longurio*	Pacific sharpnose shark	-
RMJ	*Mobula japanica*	Spinetail mobula	Manta

[14] Aquatic Sciences and Fisheries Information System

RMO	*Mobula thurstoni*	Smoothtail mobula	Diablo
RSK	*Carcharhinidae* spp.	Requiem sharks	Gris
SDV	*Mustelus* spp.	Smooth-hounds	Mamón
SPE	*Sphyrna media*	Scoophead shark	-
SPJ	*Sphyrna tiburo*	Bonnethead shark	Martillo
SPL	*Sphyrna lewini*	Scalloped hammerhead shark	Charruda, cornuda, cornuda blanca, cornuda rosada, martillo
SPN	*Sphyrna* spp.	Hammerhead sharks	Martillo
SSN	*Sphyrna corona*	Scalloped bonnethead shark	Martillo
THR	*Alopias* spp.	Thresher sharks	Zorro
TIG	*Galeocerdo cuvier*	Tiger shark	Tintorera, tigre
TNE	*Narcine entemedor*	Giant electric ray	Raya eléctrica común
TNV	*Narcine vermiculatus*	Vermiculate electric ray	Raya eléctrica rayada
TRB	*Triaenodon obesus*	Whitetip reef shark	-
TTD	*Torpedo peruana*	Peruvian torpedo ray	-
ZXY[15]	*Zapteryx xyster*	Witch guitarfish	Guitarra rayada

[15] Not an ASFIS code

3.4.2. Summary of shark data sources

DATABASES	BLZ	CRI	SLV	GTM	NIC	PAN
Databases						
Landings	2001-2004; 2005-2014[1]	2004-2014[2]	2001-2007[3]	2001-2014[1]	2000-2014[4]	2003-2013[5]
Export records	-	2004-2014[3]	2002-2011[5]	2008-2014[5]	2006-2014[5]	2003-2013[5]
Observer programs	Starting in 2015	Starting in 2016				
Sampling programs						
Fishery and biological data[6]	2009-2010	2009-2010; 2015[+]	2009-2010	1998; 2000; 2007; 2009-2010; 2012*	2009-2010; 2012*	2009-2010

LITERATURE[1]	BLZ	CRI	SLV	GTM	NIC	PAN
Fisheries institutes						
Technical reports		30	13, 76, 79, 91	20, 71	32, 33	2, 64, 65, 68
Universities						
Technical reports		60		72		
Theses			26, 78, 80, 87, 92	11, 16, 18, 21, 28, 39, 46, 58, 59, 72, 75		6, 8, 10, 17, 40
NGOs						
Technical reports		3, 15	77	38, 62, 70		44, 47, 66, 67, 83
Peer-reviewed literature						
		4, 5, 14, 41, 42, 43, 85, 86, 93, 94, 95		34, 35, 36, 37		63
OSPESCA						

Fishery regulation	Fishery management	Technical reports
53, 56	54	51, 52, 55, 57, 61

[1] Classified by species and fleet
[2] Classified by species only
[3] Classified by fleet only
[4] Classified by species (artisanal fleet only)
[5] Not classified by species
[6] All OSPESCA, except [+] INCOPESCA; *IATTC/OFCF
[1] See list of references

3.4.3. Descriptions of the fisheries

Country	Subject	Coverage	Ref.
CRI	Purse-seine and longline fisheries in Costa Rican EEZ	2002-2011	15
CRI	Shark fishery by fleet		41
CRI	Fishery sector in Costa Rica	1977-1982	84
SLV	Fishing grounds, number and type of vessels, fishing gear, main ports	2005	76
GTM	Description of ports (San José, Buena Vista, Iztapa, Monterrico, Las Lisas) and 29 shark and ray species reported in artisanal and industrial fisheries	2013-2014	11
GTM	Artisanal fleet targeting sharks and rays	2006	35
GTM	Artisanal fisheries in Guatemala (coastal species; shark, dorado, tuna group)	2005	38
GTM	Description of Puerto de San José	1997	71
GTM	Description of shark fisheries	1997	72
NIC	Shark fisheries in Nicaragua: legal, trade, and management status		32
PAN	Artisanal fisheries in Gulf of Chiriquí and Montijo	2005	44
PAN	Background information about shark fisheries	2000-2007	68
PAN	Artisanal shark fishery in Panama	2009-2010	64
PAN	Shark fishery on the Pacific coast of Panama	2009-2013	66
FAO	Analysis of fishing vessels operating under open registries and their impact on IUU fishing; case study Panama	1960-2004	22
FAO	Metadata of artisanal and industrial fisheries in Central America	2000-2010	23

3.4.4. Catch and fishing effort

Country	Institution	Data available	Coverage
LANDINGS			
BLZ	BHSFU	By fleet By species, number of hooks, fishing days, fleet, spatial data	2001-2004 2005-2014
CRI	INCOPESCA	By species, fishing days, fleet; no spatial data	2004-2014
SLV	CENDEPESCA	By fleet; species and spatial data not recorded	2001 -2007
GTM	DIPESCA	By species, fishing days, fleet; no spatial data	2001-2014
NIC	INPESCA	Industrial and artisanal fleets; by species (artisanal fleet only); no spatial data	2000-2014
PAN	ARAP	By fleet; species and spatial data not recorded	2003-2014
EXPORTS			
BLZ	BHSFU	No data	
CRI	INCOPESCA	By market category[1], fleet; species not recorded	2004-2014
SLV	CENDEPESCA	By market category; species not recorded.	2002-2011
GTM	DIPESCA	Species not recorded, no market categories available	2008-2014
NIC	INPESCA	By market category; species not recorded	2006-2014
PAN	ARAP	By market category; species not recorded	2003-2013

[1] Fins or meat; in El Salvador, other parts of sharks are also marketed

3.4.5. Size and sex composition

Inspection and sampling programs					
Country	**Institution**	**Data available**	**Inspection/ Sampling**	**Coverage**	
BLZ	BHSFU	Size composition of catch, spatial data; no sex composition data	I	2008	
CRI	INCOPESCA	Length and sex composition of artisanal catch, spatial data	S	2009-2010	
SLV	CENDEPESCA	Length and sex composition of artisanal catch; spatial data	S	2003-2004; 2008-2012	
GTM	DIPESCA	Length and sex composition of artisanal catch; spatial data	S	2006; 2009-2010	
NIC	INPESCA	Length and sex composition of artisanal catch; spatial data	S	2009-2010	
PAN	ARAP	Length and sex composition of artisanal catch; spatial data	S	2009-2011	
Literature					
Country	**Species**	**Data available**	**Inspection/ Sampling**	**Coverage**	
CRI	CTK, JAG, TTD, ZXY	Length	S	2010-2011	14
CRI	BLR	Length	S	2012	43
CRI	SPL	Length, fishing area, and fishing gear used	S	2006-2007	93
SLV	RDL, RDV	Length and sex	I/S	2012	26
SLV	RSK, SPN	Length composition	I	2003-2004	77
SLV	FAL, CCL, CNX, SPL	Length and sex data	S	2009-2010	90
GTM	SPL	Morphometrics	S	2012	18
GTM	SPL	Length and sex	S	2001-2013	37
GTM	FAL	Size at birth; maximum length; average length	S	1998	58
GTM	CNX	Length composition, by month	S	1996-1997	59
GTM	FAL, CNX, SPL	Size composition of 3 species; 12 others reported as bycatch	S	1999-2000	73
PAN	SPL, CCR, CCL, CCE, SPJ, SSN,CNX, GNC	13 species reported, 8 species with length data	S	2008	8
PAN	CCE, CCL, CCR, RHU, SPE, SPJ, SPL, SSN	Length composition	S	2010-2011	63
PAN	CCL, SNX, CTK, RDL, RHU, SDV, SPL, SSN	Size composition of 8 species; 16 others reported as bycatch	S	2009-2010	64
PAN	SPL	Length structure of neonates	S	2013-2014	67
PAN	SPL	Size, weight, and reproductive status of sharks in artisanal landings	S	2009	84

3.4.6. Species composition

Country	Species	Inspection/ Sampling	Coverage	Ref.
CRI	CNX, CTK, MUU, RHU, RDL, SPL	S	2006-2007	42
SLV	CCL, CNX, FAL	S	2005-2006	78
SLV	ALS, CCG, CCL, FAL, SPL, THR (longline catches)	S	2005-2006	79
SLV	CCL, CCR, FAL, SPL (artisanal longline)	I	1991-1992	87
SLV	SPL, CNX, FAL, CCL (artisanal longline and gillnet)	S	2009-2010	91
GTM	28 shark species identified in landings of small- and medium-scale fleets	S	2013-2014	11
GTM	JUC, JFQ, JUA, JUN, JUO, MAE, MRS, RBU, RDL, RDV, RMJ, RMO, TNE, TNV, ZXY	S	2006	35
GTM	FAL, SPN	I	2005	38
PAN	CCR, SPL	S	2008	8
PAN	CCL, CCR, CNX, CTD, GNC, MUU, PTH, RHU, SPE, SPJ, SPL, SSN, TIG, TRB	S	2009-2010	17
PAN	CCE, CCL, CCR, RHU, SPE, SPJ, SPL, SSN,	S	2010-2011	63
PAN	CCL, CNX, CTK, RDL, RHU, SDV, SPL, SSN (16 other species reported)	S	2009-2010	64
PAN	CCE, CCL, CCR, CNX, CTK, RDL, RHU, SPL, SSN, TIG (10 other species reported)	S	2009-2013	66
PAN	CCL, CCR, CTK, DUS, PTH, RHU, SPL, SSN	S	2013-2014	67

3.4.7. Distribution and abundance (CPUE)

Country	Species	Data available	Coverage	Ref.
CRI	TRB	Tagging data	2010-2011	95
SLV	ALS, CCG, CCL, FAL, SPL, THR	CPUE (catch/# hooks) of longline fleet (industrial and artisanal)	2005-2006	78
SLV	SPL	CPUE (catch/hour) of artisanal gillnets	2009-2010	92
GTM	MNT, SKA, MAE, THR	Spatial distribution of rays (Mobulidae, Rajidae) and Alopidae	2008- 2009	16
GTM	JFQ, JUA, JUC, JUN, JUO, MRS, RBU, RDL, RDV, RMJ, RMO, TNE, TNV, ZXY	CPUE (kg/nm^2)	2006	36
GTM	SPL	Fishing grounds	2001-2013	37
PAN	SPL	Tagging data; CPUE analysis of 3 fishing gears	2013-2014; 2012-2014	67
PAN	SPL	Fishing grounds and bycatch (sharks and turtles)	2009	83

3.4.8. Biology and life history

Country	Species	Data available	Coverage	Ref.
Age and growth				
SLV	RDV, RDL	Age and growth by sex	2012	26
SLV	SPL	Growth parameters	2009	80
Length-weight relationship				
SLV	SPL	Length-weight relationship parameters	2009	80
Mortality				
SLV	SPL	Mortality analysis (*Z, M, F*)	2009	80
Biomass				
SLV	SPL	Biomass ($F_{35\%}$, $F_{40\%}$, ABC, F_{ABC} analyses)	2009	80
Reproduction				
CRI		Catch season	2012	85
CRI	TRB	Sexual maturity (male)	2010-2011	95
SLV	RDV, RDL	Gonadosomatic index	2012	26
SLV	RSK, SPN	Landings, products (skin, fin, meat, cartilage, jaws)	2003-2004	77
SLV	CCL, CCR, FAL, SPL	Catch seasons	1991-1992	87
GTM	SPL	Breeding areas, seasons	2006	34
GTM	FAL	Sexual maturity; gestation period; size at birth; maximum length; average length; sex ratios	1998	58
GTM	CNX	Mating period, maturity stages	1996-1997	59
GTM	CCE, CNX, FAL, SPL	Catch seasons, neonates/juveniles	2006	70
GTM		15 shark species reported; sexual maturity of 3 species: CNX, FAL, SPL	1999-2000	73
PAN	SPL	Estimation of breeding areas	2013-2014	67
Feeding habits				
CRI	SPL	Analysis of stomach contents of 52 juveniles (25 females, 27 males).	2006-2007	93
GTM	SPL	Analysis of stomach contents of 100 juveniles	2009	75
Sex ratios				
SLV	RDV, RDL		2012	26
SLV	SPL		2009	80
SLV	SPL		2010-2012	92
GTM	JFQ, JUA, JUC, JUN, JUO, MAE, MRS, RBU, RDL, RDV, RMJ, RMO, TNE, TNV, ZXY		2006	35
GTM	SPL		2001-2013	37
GTM	CNX		1996-1997	59
GTM	FAL, CNX, SPL; 12 other species reported		1999-2000	73
PAN	CCR, SPL		2010-2011	63
PAN	CCL, CNX, CTK, RDL, RHU, SDV, SPL, SSN		2009-2010	64
PAN	SPL		2013-2014	67
Miscellaneous				
CRI	History of fisheries for highly-migratory species in Costa Rica		1950-1993	60
GTM	Elemental mercury in shark meat in Guatemala		2007	21

GTM	Contamination of shark meat with *Salmonella sp., Shigella sp., E. coli,* and others	2012	28
GTM	Manual for identification of batoid species in the Guatemalan Pacific	2006	36
GTM	Comprehensive utilization of shark products (liver and meat)	1982	39
GTM	History of fisheries in Guatemala: anthropogenic analysis by province		46
PAN	Pharmaceutical study of tiger shark and bull shark liver oil	1983	6
PAN	Pharmaceutical study of shark cartilage; chemical analysis of shark cartilage pills	1992	10
PAN	Chemical analysis of shark products (meat, liver, fins)	1982	39
PAN	Economic feasibility analysis for shark processing	1986	40
PAN	History of fishing in Panama	1950-2010	47

3.4.9. Management of shark fisheries

NATIONAL MANAGEMENT				
Country	**Subject**		**Year**	**Ref.**
Artisanal				
PAN	Rodríguez, Y. 2011	Resource management by shark fishermen as a strategy for a sustainable fishery	2009-2010	65
GTM	PROBIOMA, 2009	Recommendations for management of artisanal fisheries in Guatemala		62
Purse seine / Longline				
CRI	Arauz, R. *et al.* 2014	Zoning and planning for commercial fisheries for tuna and related species in the Pacific EEZ		4
Longline				
CRI	Arauz, 2015	Recommendations for the management of silky sharks in the dorado fishery in the Eastern Tropical Pacific		3
Trawl				
CRI	Clarke, 2012	Recommendations for the management of sharks and rays in trawl fisheries in Costa Rica		14
National Plans of Action (NPOAs) for the conservation and management of sharks				
BLZ	IMMARBE		2009	-
CRI	INCOPESCA		2008	30
SLV	CENDEPESCA		2012	12
GTM	DIPESCA		2008	20
NIC	INPESCA		2008	33
PAN	ARAP		2010	2
Shark finning prohibition				
BLZ	IMMARBE	Regulation OSP-05-11 (OSPESCA)	2011	53
CRI	INCOPESCA	Fins partially attached	2006	-
SLV	CENDEPESCA	Fins partially attached	2006	-
GTM	DIPESCA	Regulation OSP-05-11 (OSPESCA)	2011	53
NIC	INPESCA	Fins partially attached/Fins less than 5% of total weight of shark catch	2005	-
PAN	ARAP	Fins partially attached (industrial vessels)/Fins less than 5% of total weight of shark catch (artisanal vessels)	2006	-

REGIONAL MANAGEMENT		
Subject	**Year**	**Ref.**
OSPESCA		
Manual: Data collection and biological sampling of landings by artisanal and industrial shark and ray fisheries in Central America	2009	52
Regional Plan of Action for the conservation and management of sharks	2011	54
Analysis of pilot fishery/biological sampling program in Central America	2011	55
Shark finning ban: Regulation OSP-05-11	2011	53
Whale shark Regulation OSP-07-14	2012	56
Manual: Data collection and biological sampling of landings by artisanal and industrial shark and ray fisheries in Central America (update)	2013	51
PROAMBIENTE/PRADEPESCA/INRECOSMAR		
Main shark species captured by artisanal and industrial longline fisheries: BSH, BTH, CCR, CCL, CNX, FAL, GNC, OCS, SPK, SPL, TIG	1998	61

INTERNATIONAL MANAGEMENT[2]		
Subject	**Measure**	**Year**
IATTC		
Conservation of sharks caught in association with fisheries in the eastern Pacific Ocean	C-05-03	2005
Establishment of a list of longline fishing vessels over 24 meters (LSTLFVS) authorized to operate in the eastern Pacific Ocean	C-11-05	2011
Scientific observers for longline vessels	C-11-08	2011
Conservation of oceanic whitetip sharks caught in association with fisheries in the Antigua Convention Area	C-11-10	2011
Establishing a program for transshipments by large-scale fishing vessels	C-12-07	2012
Resolution (amended) on a Regional Vessel Register	C-14-01	2014
Conservation of Mobulide rays caught in association with fisheries in the IATTC Convention Area	C-15-04	2015
ICCAT		
Conservation of sharks caught in association with fisheries managed by ICCAT	2004-10	2004
Conservation of thresher sharks caught in association with fisheries in the ICCAT Convention Area	2009-07	2009
Atlantic shortfin mako sharks caught in association with ICCAT fisheries	2010-06	2010
Conservation of oceanic whitetip shark caught in association with fisheries in the ICCAT Convention Area	2010-07	2010
Hammerhead sharks (family Sphyrnidae) caught in association with fisheries managed by ICCAT	2010-08	2010
WCPFC		
Provision of data; prohibition of finning	2010-07	2010
Prohibition of retention of oceanic whitetip sharks	2011-04	2011
Protection of whale sharks from purse-seine fishing	2012-04	2012
Prohibition of retention of silky sharks	2013-08	2013
Banning of sharklines or wire traces; provision of management plans	2014-05	2014

[2] Belize, Costa Rica, El Salvador, Guatemala, Nicaragua, and Panama are Members of IATTC and CITES, and Contracting Parties to ICCAT. El Salvador and Panama are Cooperating Non-Members of WCPFC, a status that Belize held until 2013.

CITES, Appendix II[3]		
Basking shark; whale shark	COP12	2002
Great white shark	COP13	2004
Sawfishes (Pristidae, a family of rays)	COP14	2007
Oceanic whitetip shark; scalloped, smooth, and great hammerhead sharks; porbeagle shark; Manta rays (Manta spp.)	COP16	2013

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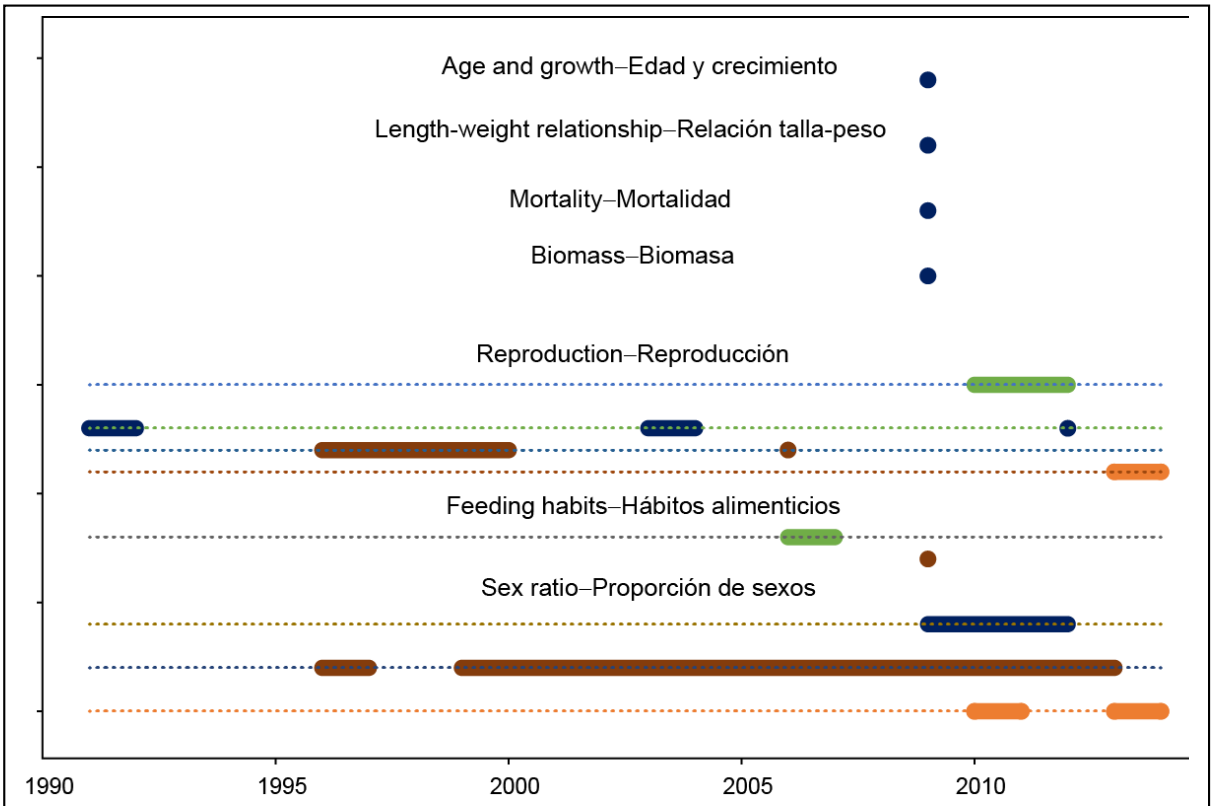

FIGURE 8. Chronology of life-history studies available for sharks in Central America.

[3] Appendix I of CITES prohibits trade under all but exceptional circumstances (*e.g.* specimens for scientific or educational purposes); Appendix II recognizes that although a species may not now necessarily be threatened with extinction, it may become so unless its trade is subject to strict regulation; Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation

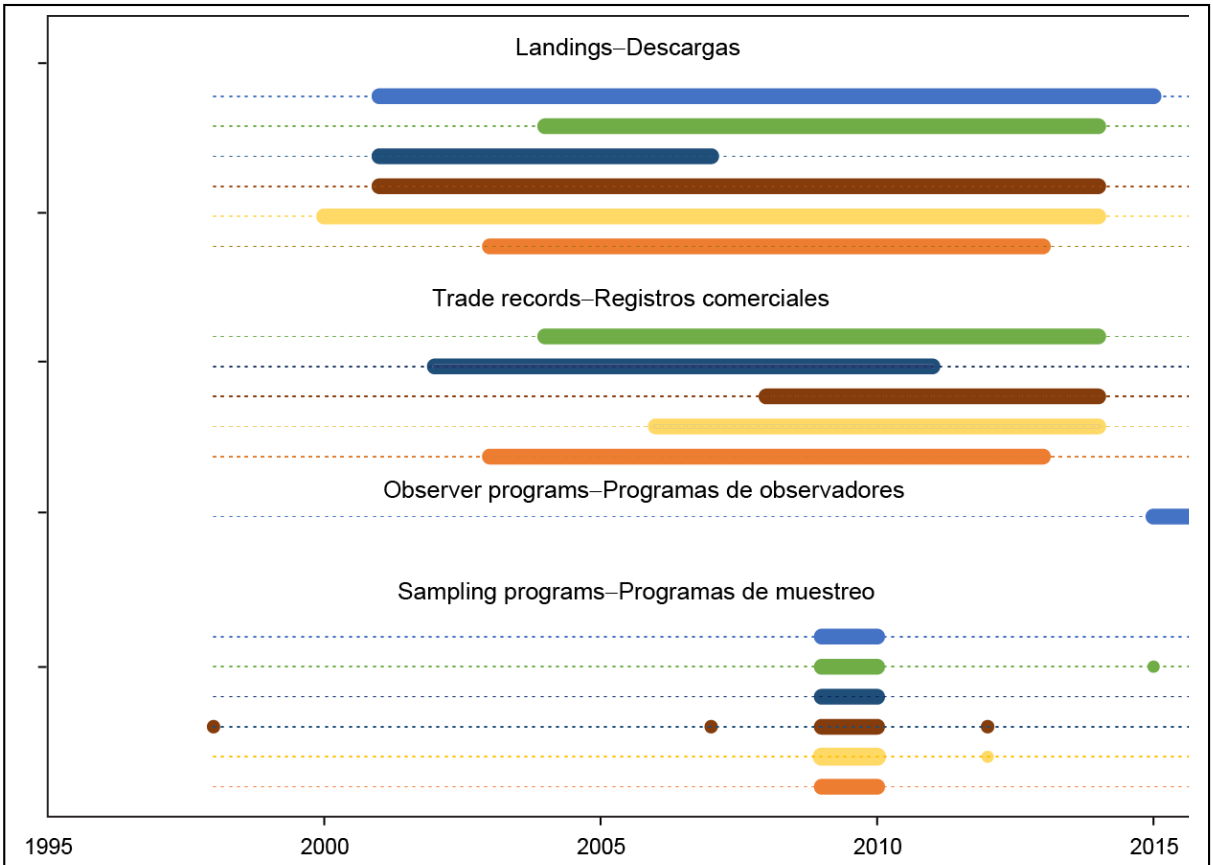

FIGURE 9. Chronology of shark fishery data sources available in Central America.

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APPENDIX.

SUMMARY REPORT OF FIELD TRIPS TO CENTRAL AMERICAN COUNTRIES TO IDENTIFY DATA SOURCES FOR SHARK FISHERIES IN THE EASTERN PACIFIC OCEAN

4.1.1. BELIZE

20-22 April 2015

Fisheries authorities:

1. Belize High Seas Fisheries Unit (BHSFU) of the International Merchant Marine Registry of Belize (IMMARBE) (Ministry of Finance)
2. Fisheries Department (Ministry of Agriculture and Fisheries)

Meetings:

- Delice Pinkard, Senior High Seas Fishing Officer, IMMARBE
- Robert Robinson, Deputy Director, BHSFU

  Ms. Pinkard and Mr. Robinson are in charge of monitoring the activities of fishing vessels in the Pacific Ocean and represent Belize at RFMO meetings.
- Technical staff of the IMMARBE Vessel Monitoring System (VMS) office and registration of fishing vessels unit
- Mauro Góngora and other members of Fisheries Department staff

Outcomes:

1. Obtained full database of landings by Belize-flag vessels and registration data for these vessels (2001-2015);
2. Training of Fisheries Department technical and research staff in the use of the OSPESCA-IATTC shark data collection database.

Contacts:

Name	Institution	Position
Delice Pinkard	IMMARBE	Senior High Seas Fishing Officer
Robert Robinson	IMMARBE	Deputy Director, BHSFU
Mauro Góngora	Fisheries Department	Fisheries officer

4.1.2. COSTA RICA

10-14 August 2015

Fisheries authority: Instituto Costarricense de Pesca y Acuicultura (INCOPESCA)

Series of meetings planned with Mr. José Carvajal, regional representative of Costa Rica on issues of sharks and other highly migratory species.

Meetings:

- Gustavo Meneses Castro, Executive President of INCOPESCA
- INCOPESCA technical staff
- Mauricio González Gutiérrez, Executive Director of the National Chamber of the Longline Industry (Cámara Nacional de la Industria de Palangre, CNIP)
- Helena Molina Ureña, Associate Professor, School of Biology and Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), National University of Costa Rica.

Outcomes:

1. Mr. Meneses promised his institution's full support of the project, which will be given access to:
   a. CNIP shark landings database;
   b. INCOPESCA database on shark trade (exports and imports) by the national and international fleets;
   c. INCOPESCA database of landings for 2004-2014;
   d. Database of articles and undergraduate/graduate theses on shark species by the University of Costa Rica's Centro de Investigación en Ciencias del Mar y Limnología (CIMAR).
2. INCOPESCA's technical personnel in research and statistics were trained in the use of the MS Access database for shark data developed by OSPESCA and IATTC.

Contacts:

Name	Institution	Position
Gustavo Meneses	INCOPESCA	Executive President
Marcolino Ocampo Quesada	INCOPESCA	Head of Export Department
José Miguel Carvajal	INCOPESCA	GTEAM[1] Member
Miguel Durán	INCOPESCA	Head of Fisheries Statistics Department
Mauricio González Gutiérrez	CNIP	Executive Director
Helena Molina Ureña	Univ. of Costa Rica	Associate Professor, School of Biology and CIMAR

4.1.3. EL SALVADOR

9-11 March 2015

Fisheries authority: Dirección General del Centro de Desarrollo de la Pesca y Acuicultura (CENDEPESCA), under the Ministerio de Agricultura y Ganadería (MAG)

Meetings:

- Gustavo Portillo, Director General of CENDEPESCA
- Georgina Mariona, Ministerio de Medio Ambiente y Recursos Naturales (MARN)
- Alberto González, National University of El Salvador, School of Biology
- Rafael Baires**,** Pesca Pelágicos Aurora S.A. de C.V.

Outcomes:

1. Research projects funded by MARN, with shark resources as the main objective;
2. 37 undergraduate research theses provided by the University of El Salvador, most describing shark bycatch, four specific to sharks and rays;
3. Access to the shark fin trade accounting records of Pesca Pelágicos Aurora, the largest exporter of shark fins in El Salvador.

Contacts:

Name	Institution	Position
Gustavo Portillo	CENDEPESCA	Director
Celina De Paz	CENDEPESCA	GTEAM Member
Georgina Mariona	MARN	Researcher of coastal marine species

[1] GTEAM: *Grupo de trabajo sobre Tiburones y Especies Altamente Migratorias* (Working group on Sharks and Highly Migratory Species)

Alberto González	National University of El Salvador	Researcher of marine species
Rafael Baires	Pesca Pelágicos Aurora	President

4.1.4. GUATEMALA

2-6 March 2015

Fisheries authority: Dirección General de Pesca y Acuicultura (DIPESCA)

Meetings:

- Carlos Marín, Director General, DIPESCA
- Freddy Góngora, Department of Statistics, DIPESCA
- Manuel Ixquiac, Fisheries researcher, National University of San Carlos (USAC); FUNDAECO (NGO)

Outcomes:

1. DIPESCA provided its longline fishery database;
2. USAC provided 15 undergraduate theses on shark fisheries;
3. FUNDAECO shared its research and database on artisanal longline fisheries.

Contacts:

Name	Institution	Position
Carlos Marín	DIPESCA	Director
Freddy Góngora	DIPESCA	Department of Statistics
Eduardo Juárez	DIPESCA	GTEAM coordinator
Manuel Ixquiac	USAC/FUNDAECO	Fisheries researcher

4.1.5. NICARAGUA

6-10 April 2015

Fisheries authority: Instituto Nicaragüense de Pesca y Acuicultura (INPESCA)

Scheduled meetings were cancelled, but followed up by e-mail.

Meetings:

- Luis Emilio Velázquez, shark researcher

Outcomes:

1. Obtained statistical information on shark catches for both artisanal and industrial fisheries.

Contacts:

Name	Institution	Position
Danilo Rosales	INPESCA	Director
Renaldi Barnutti	INPESCA	Head of Research
Luis Emilio Velázquez	INPESCA	GTEAM member

4.1.6. PANAMA

23-27 February 2015

Fisheries authority: Autoridad de los Recursos Acuáticos de Panamá (ARAP)

Meetings:

- Ivan Flores, Deputy Administrator, ARAP
- Raul Delgado, Director of Monitoring, Control and Surveillance, ARAP
- Alexis Peña, Research Coordinator, Directorate for Research and Development, ARAP
- Jasmine Villareas, Head of Research and Development, ARAP
- Marino Abrego, Head of Marine Management Action Plan, Ministry of the Environment

Outcomes:

1. Full support of the project by ARAP;
2. Access to:
    a. ARAP database on shark trade (exports and imports) of longline fleet;
    b. Database of landings for 2003-2014;
    c. University of Panama database of articles and undergraduate/graduate theses on sharks;
3. Training of ARAP technical personnel (research and statistics staff) on the use of the shark data collection database developed by OSPESCA and IATTC;
4. Creation of an ARAP internal team for shark issues.

Contacts:

Name	Institution	Position
Iván Flores	ARAP	Deputy Administrator
Raúl Delgado	ARAP	Monitoring, Control and Surveillance Directorate
Marcos Mendizabal	ARAP	Research and Development Directorate
Carlos La Casa	ARAP	Head of Monitoring, Control and Surveillance
Marino Abrego	MIAMBIENTE	Head of marine management Action Plans, Ministry of the Environment