INTER-AMERICAN TROPICAL TUNA COMMISSION

WORKSHOP TO DEVELOP A PILOT STUDY FOR A SHARK FISHERY SAMPLING PROGRAM IN CENTRAL AMERICA[1]

La Jolla, California (USA)
25-27 September 2017

REPORT OF THE WORKSHOP

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1. EXECUTIVE SUMMARY

The IATTC received funds from the FAO-GEF Common Oceans program for a project aimed at improving data collection for shark fisheries in the eastern Pacific Ocean (EPO). One of the goals of the project is to report on challenges to collecting shark fishery data in the EPO and recommendations for improvement. Recommendation 5.1, to "develop and implement a pilot fishery/biological data sampling program for sharks in Central America", was endorsed by the IATTC Scientific Advisory Committee (SAC) in May 2016.

Following up on Recommendation 5.1, the funding for the IATTC project has been extended for an additional year to develop an experimental design for a long-term shark fishery sampling program in Central America. In collaboration with the Working Group on Sharks and Highly Migratory Species (GTEAM) of the Organización del Sector Pesquero y Acuícola del Istmo Centroamericano (OSPESCA), the IATTC staff will implement a year-long pilot study to obtain the data necessary for evaluating alternative sampling designs.

This report describes the work, discussions, and work plan defined during the Workshop to Develop a Shark Fishery Sampling Program in Central America, which took place in La Jolla, California, USA, on 25-27 September 2017. An important conclusion of the workshop was that more information is needed on the various shark fisheries in order to design the sampling program. Specifically, additional information is needed on all landing sites and the potential magnitude of the shark catches at each site. Obtaining this information is a prerequisite for designing the stratification of a sampling program with a primary focus on estimation of total catch. This is particularly important for countries in which the fishery is dominated by artisanal fleets, which have received little research focus by the IATTC staff. Another important conclusion of the workshop is that there is great diversity in unloading strategies for shark catches among

[1] Organized under the FAO-GEF ABNJ project

companies, landing sites, and fleet components: for example, whether sharks are unloaded one-by-one or in groups, or unsorted or sorted by size, species, quality, or other criteria. This has implications for the design of the size- and sex-composition sampling.

The IATTC staff has identified two tasks for the pilot study: The first is a "fact-finding mission" on the artisanal component of the shark fishery. This will consist of identifying all landing sites along each nation's Pacific coastline (using online mapping tools and local sources), visiting as many of these sites as possible, and collecting information. The data will be used to map all landing sites, estimate the magnitude of the shark catches landed at each site, and develop other information useful for designing the program. The second task consists of testing different sampling designs for composition data. Sampling technicians will conduct a survey of landing sites to identify the different unloading strategies. Following analysis of the resulting data, different sampling designs, customized to the various unloading schemes, will be developed, and then tested by the sampling technicians, working in pairs. Task 2 will take place mostly in Costa Rica and Panama, where the industrial fleet predominates in the shark fishery, but the results of these experiments could be applied to all countries as part of the long-term sampling program.

2. INTRODUCTION

The Antigua Convention requires that the Inter-American Tropical Tuna Commission (IATTC) adopt management measures for shark species associated with the tuna fisheries in the eastern Pacific Ocean (EPO). There is a critical need for stock assessments of sharks so that soundly-based conservation recommendations and effective measures can be developed.

Unfortunately, developing stock assessments for sharks faces several major challenges, including the limited availability of reliable fishery statistics. Although data on incidental catches (bycatches) of sharks collected by IATTC and national observer programs from purse-seine tuna fisheries are of good quality, there is a great need for reliable fishery statistics from the longline multi-species fisheries of EPO coastal States. These fisheries, which target large pelagic species (mainly tunas, billfishes, sharks, and dorado), are believed to take the majority of the shark catches in the EPO.

In the framework of the United Nations Food and Agriculture Organization (FAO) *Common Oceans* program, and specifically the *Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the Areas Beyond National Jurisdiction* (ABNJ) project, the IATTC received funding to improve data collection for shark fisheries in the EPO, particularly in Central America, where much of the shark catch is landed and where the need for better data collection is greatest.

Among the results of the IATTC ABNJ project to date are a Metadata Report, which identifies the available sources of data on shark fisheries in Central America, and a report on challenges to collecting shark fishery data in the EPO and recommendations for improvement. Recommendation 5.1, to "develop and implement a pilot fishery/biological data sampling program for sharks in Central America", was endorsed by the IATTC Scientific Advisory Committee (SAC) in May 2016. Another important development was the adoption by the IATTC of Resolution C-16-06 on conservation measures for sharks, with an emphasis on silky sharks. However, without a good shark data collection program in place in Central America, it will be extremely difficult to establish the scientific basis necessary to determine the conservation status of shark stocks, and thus evaluate the impact of this resolution.

Following up on Recommendation 5.1., the funding for the IATTC project has been extended for an additional year to develop an experimental design for a long-term shark fishery sampling program in Central America. In collaboration with the Working Group on Sharks and Highly Migratory Species (GTEAM) of the Organización del Sector Pesquero y Acuícola del Istmo Centroamericano (OSPESCA), the IATTC staff will implement a year-long pilot study to obtain the data necessary for evaluating alternative sampling designs.

The first task conducted under this extension was a workshop aimed at designing a pilot study to sample shark fisheries in Central America, held in La Jolla, California, USA, on 25-27 September 2017 (see agenda, Appendix 1). The workshop was chaired by Alexandre Aires-da-Silva, of the IATTC staff, coordinator of the IATTC ABNJ project. A panel of scientific and technical experts from OSPESCA's GTEAM was invited to provide advice on the feasibility and applicability of alternative sampling designs for the pilot study, and provide input on logistical aspects relevant to the development of the pilot study (see list of participants, Appendix 2). An external panel, consisting of four experts in fisheries sampling (see Appendix 3), was also invited to participate in the discussions and help the IATTC staff and regional experts with the development of the best sampling design for the pilot study.

This report summarizes the main points and conclusions noted by the IATTC staff during discussions, along with the recommendations by the external panel of experts and the work plan adopted by the IATTC staff for the pilot study.

3. OBJECTIVES AND WORK PLAN

Summary

Since the entry into force of the Antigua Convention in 2010, the IATTC has been moving from only tunas to an ecosystem approach, which includes bycatch species such as sharks, dorado, etc. Conventional stock assessments of sharks are currently handicapped by a lack of basic fishery data such as total landings, so although the long-term goal is to develop such assessments, in the meantime stock status indicators, productivity-susceptibility analyses, and other methods suitable for data-poor species must be used. The goal of the workshop was to develop a pilot data collection program for fisheries that catch sharks in Central America, where there is a need for improving data collection, human-resource training, etc. The current project includes funds for the sampling technicians needed to cover five countries (Costa Rica, El Salvador, Guatemala, Nicaragua, Panama). Deliverables include a final report prepared by the IATTC staff. The working plan for the workshop included presentations and discussions on background information, logistical aspects of fisheries operations, the resource allocation plan proposed by the staff, and discussions with the external experts' panel and national representatives.

4. BACKGROUND DOCUMENTS

In preparation for the workshop, the IATTC staff, in consultation with regional experts, prepared two background documents. They contained information that was considered confidential by the countries, and were thus circulated only to meeting participants. A summary of these documents and of the ensuing discussions are provided below.

Shark fisheries and sampling opportunities in Central America (Alexandre Aires-da-Silva)

Summary

In the Pacific Ocean, sharks are targeted or caught incidentally (as bycatch) by multi-species and multi-gear artisanal fisheries of six Central American nations, as well as by large longline vessels from distant-water nations.

In Central America, vessels that catch sharks, as target species or incidentally, can be broadly divided by size into two categories: 'artisanal' vessels, generally called *pangas*, which are typically less than 10 meters length overall (LOA), with outboard motors and fiberglass hulls, and larger vessels, which are generally included in an '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 Metadata Report). Developing a standardized vessel classification system across countries is an important objective, but was not considered at this workshop.

There are several data sources available for shark fisheries data from Central American countries that can be considered in the design of the pilot study (see Metadata Report for detailed description). The main source of data are the landings inspection programs that collect data for compliance monitoring 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.

Although catch[2] data are available for six countries in Central America, the level of fleet coverage by the various national fisheries institutions varies. In brief, the following aspects of the available Central American shark fishery data are pertinent to the long-term goals of designing sampling programs and conducting stock assessments of sharks in the EPO:

a. Costa Rica and Belize have complete landings data (global and, since 2004 and 2007, respectively, by species);
b. Landings data for the other Central American countries are incomplete (time period and/or fleets covered; species composition);
c. The main shark species in the available landings data are the silky (60-90%) and blue (20-60%) sharks;
d. Some effort data are available, but fleet coverage is not complete.

Discussion

- While the main focus of the pilot study is pelagic sharks, it also offers a unique opportunity for sampling other species of interest to the IATTC, not only tunas, but also billfishes and dorado, which share the pelagic ecosystem with tunas. The fisheries for large pelagic species in Central America catch many species, so the pilot study will opportunistically gather data on all species in the landings. Demersal sharks are not included in the scope of the project.
- The variability in the characteristics of the fleet - distribution (coastal vs. high-seas), vessel dimensions, fish-processing methods (*e.g.*, fresh, frozen), and others - makes a pilot study difficult to design. Additionally, in some areas, a narrow continental shelf can allow *pangas* to reach oceanic waters and target pelagic sharks.
- The staff had originally planned to focus the pilot study on sampling the larger, typically more technologically-advanced vessels (categorized as, *inter alia*, 'medium' 'advanced', and 'industrial' in different countries), numbering in hundreds, that operate out of ports, not on the thousands of small-scale artisanal *pangas* that unload at a multitude of sites along the coast. The distribution of the former is mainly oceanic, and their shark catches are clearly dominated by pelagic species, so focusing the pilot study on those vessels seemed like a good strategy. However, although the small artisanal fleet is more coastal, in some areas *pangas* can reach oceanic waters and interact with pelagic sharks. The artisanal gillnet fishery also catches large numbers of hammerhead sharks, whose nursery grounds are around mangrove swamps and are thus found in coastal areas during their early life stages. Therefore, excluding the smaller fleet entirely from the pilot study may not be desirable, particularly since there is little information available about this fleet.
- It is important that all fleets catching pelagic sharks be covered, but it may be better to design the pilot study on sampling for species composition rather than on sampling fleet components.
- All countries included in the project have some form of landings inspection program in operation,

[2] Unless otherwise specified, "catch" means retained catch that is landed. No information is available on catches discarded.

mainly for compliance purposes. The pilot study should take advantage of the information already collected by these programs, and avoid duplication whenever possible. Compliance inspections and sampling for research purposes should be clearly separated: samplers working for the pilot study should not take on compliance duties.

- Belize reports landings data for its fleet, but this information is also available from the countries where Belizean vessels land their catches from the EPO (Costa Rica prior to 2015, currently only El Salvador). However, there is no duplication of these sources in the data provided to IATTC.

Exploratory sampling analyses with existing Central American shark fishery data

An exploratory analysis was conducted with available data from Costa Rica, but was not presented at the workshop due to confidentiality concerns. This confidential document was circulated among OSPESCA participants and may be useful in the future when exploring sampling design options.

5. LOGISTICAL ASPECTS RELEVANT TO THE DEVELOPMENT OF THE PILOT STUDY – SUMMARY PRESENTATIONS BY REGIONAL EXPERTS

An important step before designing the pilot study is to understand the operational practices associated with shark landings at different points of landing, and of the existing data collection programs in the various Central American countries. The following summaries of fisheries that interact with sharks and related data-collection programs were provided by regional participants for their respective countries.

BELIZE

Description of the shark landings operation in Belize (Delice Pinkard, Belize High Seas Fisheries Unit)

Summary:

- The fleet is composed of 7 longline vessels; there are no transshipment vessels.
- Three types of data collection: a) fishing logbooks and electronic catch reporting, b) unloading reports, and c) reports from fisheries observers.
- Electronic catch reporting is currently being implemented.
- Vessels unload at one port, could land in more but currently do not.
- Catches are sorted by species before unloading, and by size during unloading. Fins are separated from bodies during unloading; bodies are transferred via cranes to containers for export.
- 100% coverage of landings by inspectors from both Belize and El Salvador. If unloadings are done mainly at night, to preserve the cold chain, may take 3 to 5 nights; otherwise 2 to 3 days.

Discussion:

- Information by trip or unloading, rather than the summaries provided to IATTC, is available, and could be provided if requested.
- Current coverage of longline vessels by on-board observers is 5% of fishing days.
- Need to be careful that data are not duplicated, given that there are inspectors from both Belize and El Salvador

COSTA RICA

Description of shark landing operations in Costa Rica (José Carvajal, INCOPESCA)

Summary

- Costa Rica's longline vessel register includes 30 medium- and 83 advanced-scale vessels that target large pelagic species.
- Nearly 80% of the total landings by the longline fleet take place in Puntarenas, which has one public

and fifteen private landing piers. The public pier is administered by INCOPESCA, which has nine inspectors to cover unloadings at all piers, seven days a week.

- Unloadings of large pelagic species vary from buyer to buyer, and do not necessarily begin with sharks. Usually prime-quality product (for export) is unloaded first, regardless of species.
- Buyer preferences are also important for determining how shark species are unloaded. Some important factors are species preference, quality of the meat (related to the preservation method; iced for the medium fleet, lasting up to 25 days), and size of the pieces (trunks). Catches by the advanced fleet are unloaded frozen, and may be different species and size of the trunks.
- In addition to the unloadings data collected by the inspectors, INCOPESCA also collects some biological information in Costa Rica (OSPESCA forms). Inspections and biological sampling are performed by different people.

Discussion:

- The unloading sequence may be biased towards sharks of a particular size, so is not random for sampling.
- The type of unloading is set mainly by the buyer, not by vessel, port, or species.
- Buyer size categories (small, medium and large) may vary by fish, buyer, and port.
- The quality of the fish preferred by the buyer will affect the sequence of storage in vessels using icing.
- Buyer records by size category may exist, but may not be available.
- How shark bodies are cut depends on species and buyer preference. Some sharks are unloaded with no head or caudal fins, so that sometimes the only measurement that can be taken is the interdorsal length.
- Days fished is not a good proxy for effective fishing time; it may include travel and/or search time.
- Landings inspections seem reasonable in Costa Rica, but biological sampling is more challenging due to great diversity in unloading methods.
- The pilot study may need to subsample, given the multiple landing sites. Unloading methods and species composition vary among sites, and different sites may have preferences by size, species, etc. It will be difficult to raise the samples to the total catch without representatively covering landing sites with different preferences.
- Obtaining CPUE information by trip could be complicated by the fact that vessels may unload catches from a single trip at more than one site, and also transship catches. However, it is possible to trace and link unloadings at different sites and transshipments via the inspection forms.
- In general, it is not feasible for samplers to move between two fishing communities and sample sites in both during the same day.
- A multistage sampling program may be possible if vessels notify fishing authorities in advance of where they will be unloading.
- Vessels unloading transshipped catches are not “child” vessels associated with a specific “mother” vessel; they are regular fishing vessels that return to port early, usually to reduce costs.
- It may be difficult to stratify strata for size-composition sampling with so much variability across landing sites. One option is a practical hierarchical system: sample docks within sites, and at each dock sample for a particular unloading system. Two difficulties: moving quickly between landing sites (blocks of places/time may need to be defined in the design), and samplers may end up at landing sites with no landings taking place.
- The goal of the pilot study is to collect data to design a final sampling program. So, it may be desirable to sample as much as possible across sites, to maximize the quantity of data available to design the program.
- Currently 91 Costa Rican longliners carry vessel monitoring system (VMS); it will be mandatory within

12 months, and some financial support is available from the government (brief summary talk by Lorna Marchena, INCOPESCA).

EL SALVADOR

Description of shark landing operations in El Salvador (Celina de Paz, CENDEPESCA)

Summary

- The fishing fleet of El Salvador includes about 8,300 *pangas* (<10 m) of which 219 have been identified as catching sharks (mainly adult silky sharks) and other large pelagic species (tunas, billfishes and dorado) throughout the year, using longlines; the others target neonate hammerhead sharks, mainly with gillnets, during May-October, and small coastal species (snapper, grouper, mackerel) during the rest of the year.
- There are only 3 industrial longline vessels operating in El Salvador, which catch mainly sharks, billfishes, and dorado.
- A typical unloading by a *panga* takes 40 minutes to 1 hour. *Pangas* are not required to notify the port authority upon arrival in port before unloading catches. Unloadings are by groups of species, with the largest unloaded first.
- Foreign industrial longline vessels (>10 m and <19 m) have to notify the port authority two days in advance of arrival. A typical unloading by these vessels takes up to two days, depending on the buyer.
- Landing sites are close to each other, about two hours' drive apart.
- Biological sampling of sharks is conducted at three fishing communities (Acajutla, La Libertad, and La Herradura).
- Size measurement varies by fleet component: a) artisanal fleet: before the shark is headed and gutted, up to 2 minutes per specimen (iced); b) industrial fleet: before fins are separated from the body, about 1 min per specimen (frozen); c) international fleet, size measurements not taken.

Discussion:

- Worker safety needs to be considered when planning the pilot study in El Salvador. There are safety issues in some of the ports.
- The *panga* fleet should be included when designing the pilot study, to estimate the magnitude of its catches, especially of hammerhead neonates. The data available suggest that they may be very substantial.
- It would be useful to have some rough estimates of potential catches by fleet to help in designing the sampling and decide what components should be given priority in the pilot study.
- Considering the low frequency of landings by the industrial fleet, alternating sampling between large vessels and *pangas* may be an option if the pilot study is to cover the *pangas*.

NICARAGUA

Methodology for data collection of landings in Nicaragua (Luis Emilio Velázquez & Tania Norori, INPESCA)

Summary

- Vessels <15 m LOA are considered artisanal, in contrast to 10 m in other Central American countries.
- There are 1,913 registered *pangas*, but that may represent only a fraction of the total number.
- Vessels are registered with two national (INPESCA, MTI) and one regional (OSPESCA) institutions. There are 19 fishing communities registered along the coast, but landings are recorded and sampled at only 3 sites: a) Puerto Corinto (2 inspectors; unloadings of artisanal gillnetters and longliners, also trawlers; 6 vessels reported as targeting sharks); b) Puerto Sandino (1 inspector; mainly shrimp trawlers; no records of shark unloadings); c) Puerto San Juan del Sur (1 inspector, mainly longliners

and trawlers; 9 unload sharks). Most catches are landed on open beaches, with no reports or sampling.
- Vessels unload in one specific location only, no records of unloadings in multiple ports.
- Artisanal fisheries catch both neonates and adults. The fishery that targets neonates catches 70-90% neonates of different species in April, May, and June.
- Transshipments do take place.
- 26% of recorded landings of sharks are reported by species, others are recorded by taxonomic group (*e.g*. Alopias spp).
- Unloadings are with no heads, size measurements are interdorsal distances.
- Landings by the industrial fleet have to be reported 12 to 24 hours prior and take 2-3 hours, for the artisanal fleet about 30 minutes.

Discussion

- Although landing sites are easily accessible by road, no more than a single unloading site could be visited by one person per day. Sites are relatively safe, with less security concerns than in other countries.
- Main species of elasmobranchs caught are silky and thresher sharks and rays. The continental shelf break is only 30-40 miles from shore, so the artisanal fleet has access to oceanic sharks.
- There is no separate database for sharks and highly-migratory species. There is a 2-month delay between collecting data and recording it in electronic format.

PANAMA

Shark unloading operations in the main ports of Panama (Robert Duarte & Lucas Pacheco, ARAP)

Summary

- Shark unloadings are conducted in all Pacific ports.
- The artisanal fleet can unload without advance notice, therefore sampling has been done opportunistically. International vessels have to report arrival 24 hours ahead of time, so that an inspector can be assigned.
- Principal artisanal unloading point is in Panama City.
- Principal industrial unloading port is Vacamonte, which is exclusively for the industrial fleet (national and international).
- International longline vessels have an autonomy of 30-90 days at sea. Typically, one to two vessels arrive in port each week; catches are unloaded in one to two 8-hour working days, and go directly to processing plants. Some vessels transship to motherships at sea. Motherships transship the product of up to 14 vessels and unload every 3 months. Unloadings of motherships take around 10 days.
- Principal species caught are tunas, billfishes, sharks, and dorado. 27 shark species have been recorded, the main 9 are *Alopias superciliosus*, *A. pelagicus*, *Carcharhinus falciformis*, *C. porosus*, *C. limbatus*, *Galeocerdo cuvier*, *Nasolamia velox*, *Prionace glauca* and *Sphyrna lewini*.
- 90% of industrial and artisanal fisheries take place in the Pacific.
- There are 6,387 *pangas* in the ARAP database; about 10% of these do not have updated licenses. Since 2015, no licenses are issued to *pangas* not currently included in the database.
- There are 83 inspectors, but most work on activities other than landings and fish information.
- There are 17 landing ports, and 28 fishing communities. However, there are also about 132 fishing associations and cooperatives, but data are received from only 50. There could be as many as 300-400 unloading sites.
- At least some of the *pangas* are transient, they move along the coast seasonally following the fish.

Discussion

- Vacamonte is the only landing site in Panama for large international fishing vessels. Data by species are sporadic; most records include blue sharks, but these identifications may not be reliable.
- Classification of vessels is different from other places in Central America: vessels are classified as artisanal/coastal if catch is for domestic consumption, industrial if catch is for export. There is overlap between the two categories, with a great deal of overlap around 10 m LOA.
- There are security issues in the transshipment sector of the fleet.
- It would be difficult to identify sharks by species using cameras, particularly when only part of the fish is landed with no head, tail, etc.
- Sometimes vessels unload their catches at more than one site; it is not known whether if the unloadings are representative of the catch or are sorted based on some preference.
- It is estimated that about 40% of landings are not recorded.

6. RECOMMENDATIONS BY EXPERT PANEL

Recommendations

General comments:

1. It is not possible to propose an adequate sampling design at this moment, before more information becomes available on the fleet, the landing sites and the specific process of landing of sharks.
2. It is assumed the shark species of interest are captured by 3 fleets. It would be good to be sure no other fleets are fishing important amounts of these species.

Detailed comments:

1. Handle separately the industrial and artisanal fleets
2. Make sure there are adequate length-weight relationships for each species (for each country, if possible)
3. Make sure there are adequate morphometric relationships between the different linear measures: between-fin, TL, FL SL, other.
4. Make sure there are conversion factors between round weight and different dressings of the sharks (gutted, gutted and headed, tail in and off, etc.) for each species
5. Make sure the sampling forms include a field for the type of dressing of the fish, and that this is also clearly explained in the field manual.
6. Make sure the sampling forms include fields for recording the total landing for each vessel (or other unit) on which a sample is taken.

For the industrial fishery

- Start by making more videos of different landings to show all the different types of unloading the fish. - Confirm exactly what kind of landing is used in each company/landing site/fleet segment
- Develop a guide for the species identification of frozen dressed sharks – improve the one developed in Mexico.
- Describe, for the different types of landing, the sequence of landing of different groups of sharks.

For the pilot study:

- Organize recording of the stream of unloaded sharks/bunches, and record a description, as detailed as possible, of each shark/bunch of sharks in the sequence. Also record the time of exit and the processing time of each shark/bunch of sharks. Make sure there is video documentation of the whole process, from start to end.

- Describe also the sequence of processing of each shark/bunch on the pier.
- This must be done at ALL Landing sites and ALL vessels.
- NB: Make sure you get ALL information that is already available (by making enquiries to inspectors etc.) before going out to the field.
- NB2: Make sure this research is done for the typical landing periods (e.g. Belize normally lands during cooler parts of the day) – Time of day and weekday
- Make sure the sampling/study is distributed across the different landing sites and seasons of the year (capture variability along the year).
- Prepare a detailed work plan for the fact-finding mission on the small-scale segment of the fishery.
- The template of the report and data sheets to be done for each country and for each access point should be prepared and discussed beforehand.
- The sites to be visited should be selected after the list of potential landing sites and their description is known.
- Provide a summary of any additional information that might be of use for designing an adequate sampling strategy.

7. STAFF WORK PLAN

Considering the variability in current knowledge about the existing national shark fleets, port infrastructure, and fishery landings inspection programs in Central America, two main tasks (sub-projects) were identified as necessary under the pilot study.

Task 1: "Fact-finding mission" on the artisanal component of the shark fishery

An important conclusion of the workshop was that more information is needed on the various shark fisheries in order to design the sampling program. Specifically, additional information is needed on all landing sites and the potential magnitude of the shark catches at each site. Obtaining this information is a prerequisite for designing the stratification of a sampling program, with a primary focus on estimation of total catch. This is particularly important for countries in which the fishery is dominated by artisanal fleets, which have received little research focus by the IATTC staff. Sampling these fleets may be critical for monitoring population trends for species of high conservation concern (*e.g*. listed by CITES), such as hammerhead sharks, which are caught mostly with gillnets by coastal artisanal vessels. Information (including videos) on the specific process of unloading sharks is also needed to design the sampling of sex and size compositions.

Five sampling technicians, coordinated by the project's expert on shark data collection, will carry out this task, which will consist of identifying all landing sites along each nation's Pacific coastline, using online mapping tools and local sources, visiting as many of these sites as possible, and collecting the information. The data will be used to map all landing sites, estimate the order of magnitude of the shark catches landed at each site, and develop other information useful for designing the program.

Task 2: Testing of different sampling designs for composition data

Another important conclusion of the workshop is that there is great diversity in unloading strategies for shark catches among companies, landing sites, and fleet components: for example, whether sharks are unloaded one-by-one or in groups, or unsorted or sorted by size, species, quality, or some other criterion. This has implications for the design of the size- and sex-composition sampling.

Two sampling technicians will survey landing sites to identify the different unloading strategies. Following analysis of the resulting data, different sampling designs, customized for the various unloading schemes, will be developed, and then tested by the two sampling technicians, working as a team. Task 2 will take place mostly in Costa Rica and Panama, where the industrial fleet predominates in the shark fishery, but

the results of these experiments could be applied to all countries as part of the long-term sampling program.

Resource allocation

The fundamental resource defined by the IATTC staff, with input from the external and regional experts at the workshop, are the technicians required to survey the fisheries (Task 1) and collect the data required to develop the sampling design (Task 2). For Task 1, hiring a technician in each country[3] will simplify logistics and also meet the capacity-building requirement of the project. For the composition sampling to be carried out under Task 2, the two Task-1 technicians from Costa Rica and Panama will work as a team to obtain the samples in those two countries.

Travel funds are needed for the technicians within their respective countries (Task 1), and for the project's data-collection expert to periodically visit each country to work with the sampling technicians (Task 2). One capacity-building workshop is planned for shortly after the start of the pilot study, to give sampling technicians the opportunity to meet as a group in one country, discuss difficulties encountered so far with the project's coordinator and each other, and strengthen their training on shark data collection.

Sampling technicians	Task 1	Task 2
Costa Rica	1	1
El Salvador/Belize	1	
Guatemala	1	
Nicaragua	1	
Panama	1	1
Total	**5**	**2**
Other resources		
Travel funds		
Workshop funds		
General operating expenses		

Deliverables and schedule

The field activities conducted by the sampling technicians in each country will be evaluated in four quarterly summary reports by the project's data-collection expert, who will also be responsible for coordinating those activities.

Data collected under Tasks 1 and 2 will be analyzed by the IATTC scientific staff, who will also prepare a final report with recommendations for the design of a shark fishery sampling program in Central America.

The table below shows the proposed schedule of activities:

Activity	**Description**	**Month**											
		1	2	3	4	5	6	7	8	9	10	11	12
Field work	Task 1: Fact-finding mission and survey	■	■	■	■	■	■	■	■	■	■	■	■
	Task 2: Development and testing sampling designs for composition data	■	■	■	■	■	■	■	■	■	■	■	■
Workshop	Capacity-building workshop	■											
Reports	Quarterly activity summaries			■			■			■			■
	Analysis and final report										■	■	■

[3] Belize and El Salvador are combined, because Belize has no ports in the Pacific, and Belizean vessels unload in El Salvador.

Appendix 1. Agenda

1. **Opening**
   1.1. Welcome remarks. *Guillermo Compeán, Director IATTC*
2. **Background documents (presentations by IATTC staff)**
   2.1. Summary of shark fisheries and sampling opportunities in Central America
   2.2. Exploratory sampling design analyses with existing Central American shark fishery data
3. **Logistical aspects relevant to the development of the pilot study (discussion with regional experts)**
   3.1. Summary presentations by regional experts
   3.2. Videos of unloading operations
4. **Development of the sampling design for the pilot study (discussion with external experts)**
5. **Recommendations from external experts**
6. **Others**
7. **Adjournment**

Appendix 2. List of participants

ASISTENTES - ATTENDEES	
BELICE-BELIZE	
DELICE PINKARD Belize High Seas Fisheries Unit sr.fishofficer@bhsfu.gov.bz	**ERNIE HOWE** Belize High Seas Fisheries Unit fisheriesofficer@bhsfu.gov.bz
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SECRETARÍA – SECRETARIAT	
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Appendix 3. External expert panel

Pedro de Barros

Pedro de Barros works on fisheries monitoring, assessment and management since 1987, when he joined the University of Algarve and started working on his first project on the monitoring of the crustacean fisheries in the South of Portugal.

He has since developed intensive work on these fields, and continues working on these areas.

Pedro de Barros is a Professor at the University of Algarve, Portugal, currently working at the Fisheries and Aquaculture Department of the Food and Agriculture Organization of the United Nations (FAO) as Senior Fishery Resources Officer at the Inland and Marine Fisheries Branch. He has also worked as Scientific Adviser to the Angolan Fisheries Research Institute, and as a consultant on a number of projects on fisheries monitoring, assessment and management.

He has taught several University-level and professional courses on scientific monitoring and assessment of fisheries, and supervised several Master's thesis dealing with sampling and monitoring of fisheries.

He has co-authored an FAO Fisheries Technical Paper on sampling methods applied to fisheries science (FTP 434), and written a number of reports on the design and evaluation of scientific fisheries monitoring systems.

He has developed, or supervised the supervision, of several software tools for the management and analysis of data from the scientific monitoring of fisheries (namely for Angola and Mozambique, plus tailor-made tools for research projects).

He has also provided professional technical advice to the assessment, evaluation and improvement of scientific fisheries monitoring systems in Europe, Mediterranean countries and African countries.

Marti McCracken

Dr. Marti McCracken has worked for the Pacific Islands Fisheries Science Center, NOAA for over 17 years as a statistician. One of her primary responsibilities is to provide statistical advice to the Pacific Islands Regional Observer Program concerning sampling designs for observer placement in three different longline fisheries. Each of these fisheries presents its own challenges in developing a practical sampling design. Dr. McCracken created a novel sampling design for Hawaii's deep-set longline fishery that takes into account the practical constraints of the fishery and observer program. This sampling design has been used since year 2003. For the American Samoa longline fishery, it has not been practical to have a rigorous sampling design in place, so she continues to work with the observer program to establish measures to reduce the likelihood of selection bias and to collect additional information to assist in bycatch estimation. She is currently working on recommendations on a sampling design for Hawaii's shallow-set longline fishery. This fishery currently has 100% observer coverage and is managed under hard caps for leatherback sea turtles and loggerhead sea turtle interactions (the fishery closes for the remainder of the year if either of these hard caps is reached). There is interest in managing this fishery under these same hard caps but with reduced observer coverage. As Dr. McCracken is responsible for producing annual bycatch estimates for all species caught by these fisheries, she has been exposed to a wide variety of catch (bycatch) distributions and the challenges of handling these distributions when estimating or modeling bycatch or catch. In addition to this experience, Dr. McCracken has served as a member of the National Observer Program Advisory Team where she has been exposed to a wide variety of sampling designs used to sample a wide variety of fishing fleets in the United States. Prior to working for NOAA, she consulted on various fisheries and ecological projects under her different positions in United Kingdom, New Zealand, and Chile.

Jean Opsomer

Jean Opsomer is Professor in the Department of Statistics at Colorado State University. He obtained a PhD from Cornell University and an MBA from University of Chicago. He is a Fellow of the American Statistical Association and the Institute of Mathematical Statistics., and an Elected Member of the International Statistical Institute. His main research area is survey statistics, and he collaborates with several federal statistical agencies on survey-related topics. In the natural resource area in particular, he has worked on survey design and estimation for the National Resources Inventory conducted by the U.S. Natural Resources Conversation Service and on the redesign of the Marine Recreational Information Program, the recreational marine fisheries surveys program managed by the U.S. National Oceanic and Atmospheric Administration.

Jon Helge Vølstad

Dr. Vølstad is chief scientist and leader of the Fishery Dynamics research group at Institute of Marine Research, Norway. His education includes a Ph.D. in quantitative fisheries biology (biometrics) from University of Bergen, Norway, and graduate studies in mathematical statistics (Oxford University, UK). Dr. Vølstad has more than 25 years of international research experience in statistical survey methods, quantitative fisheries biology, and statistical ecology from academia, national institutes, and private industry. He has directed the development and implementation of multiple large-scale research surveys and field experiments for ecological studies and the monitoring and assessment of fish stocks and the environment in marine, estuary and river systems. His research interests primarily focus on the development and optimization of statistical survey techniques for assessment of fisheries resources and the environment, and the quantification of uncertainty in stock assessments.