Indian Ocean Tuna Commission
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Pilot project to improve data collection for tuna, sharks and billfish from artisanal fisheries in the Indian Ocean

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Executive Summary

The Indian Ocean Tuna Commission (IOTC), acknowledging the need for improved artisanal fisheries reporting by the countries in the region, proposed a study to investigate the issues affecting these countries and possible solutions to the problems. This study concentrated on the capacity that countries in the Indian Ocean have to report artisanal fishery catches on near-real time but recommendations were also made in some specific cases about semi-industrial and industrial fisheries if deficiencies were observed. Nine countries were visited and initial assessments made on their capacities to report catches from artisanal fleets in near real-time. Speed of reporting and quality of data were investigated and recommendations made where appropriate. The countries visited capture over 87% of the total catch through coastal fisheries of the three species of interest (bigeye, yellowfin and skipjack tuna) to the IOTC. Other countries were not visited for a variety of reasons. Pakistan and Yemen have important catches (6.7%) but could not be visited due to security concerns; Comoros has an IOTC-OFCF project in progress, and Oman has a good reporting system in place.

The limitations of this study must be appreciated. Understanding the plethora of issues in such a short amount of time, sometimes as little as five days in a country, presents particular challenges that cannot be ignored. The amount of time spent and size of each country, complexities of the fisheries, people met, institutional linkages, politics, and other factors influenced the understanding of the issues by the consultant as well as the actions proposed. Much of the information collected may not be considered factual but anecdotal as on many occasions people from the same or different organizations contradicted each other and it was not always possible to verify the accuracy of their claims. In addition, the lack of consistency on how data are gathered in the same country shows that the region is a long way from having consistent methodologies in place. Although many artisanal fisheries do not target tuna due to limitations in the vessels the changes proposed here apply not only to tunas, sharks and billfishes but also to the rest of species as the issues encountered with experimental design, sampling and reporting are pervasive and common to all fisheries.

The objectives of the mission were 1. to meet with relevant officials including the Chief of Statistics, personnel responsible for aggregation and handling of fisheries data, and representatives at the provincial and district levels; 2. to visit various ports to determine the flow of information and possible areas for improvement; 3. to describe the issues affecting the timely report of artisanal fishery data and investigation of possible solutions, implementation and costs; and 4. to recommend on data collection and management activities that would make possible close to real-time reporting of data from artisanal fisheries including implementation of pilot sampling activities and strengthening of existing data collection and management systems. These activities aimed to answer the question posed by the Commission on whether countries in the region, as a whole, have the capacity to report accurate catches in near-real time

The short answer to the question made by the Commission is an unequivocal no. There are many issues affecting the capacity of these countries to produce not only reliable but timely statistics and in this document these concerns are addressed individually in the country reports. This does not mean, however, that there are no countries that with small changes and a dose of political will could report significantly improved statistics in the time frame proposed. Some of the countries visited could have reduced timelines and improved statistics if collection of fisheries data were given the priority it deserves. At this time, however, the great majority of countries cannot, or do not report, their catches discriminated by species, gear and month in the proposed timeframe of one to two weeks after the end of each month.

It is necessary for IOTC to define artisanal vessels as the temporary definition used in this study includes boats from semi industrial and industrial fleets. Because of the diversity and complexity of fishing fleets found throughout the region, neither size nor any other single characteristic will be sufficient to describe an artisanal vessel. The definition will have to be based on a series of criteria (*e.g.* fulfilling three out of five characteristics that may include gear used, size of boat, size of motor, autonomy, type of storage, etc). The fleets encountered in many countries show a range of interchangeable fishing techniques, capacity to fish close or far to shore, capabilities to stay from a few to many days away from port and other characteristics that are usually associated with more developed fleets. Even if a definition by IOTC exists, countries need to define their fisheries management units to clearly separate artisanal, semi industrial and industrial components to avoid aggregation of vessels that may use similar gear but have different capacities (*e.g.* sizes, autonomy, etc) and therefore different catches.

Contracting and Cooperating Non-contracting Parties (CPCs) in the region have the obligation to fulfil the requirements set by the Commission. At this time near-real time reporting is not one of them but countries should evaluate their needs and consider the suggestions given here to improve their reporting systems. To successfully implement any activities to improve reporting systems, it will be necessary for the countries to critically assess the possibilities that they have to continue the work once support, financial and logistical, is suspended regardless if the support is external or in-country. It is not very useful to realize improvements if the

proposed activities are discontinued soon after support stops because the responsible departments do not assign the priority, funds or capacity to maintain them. Ideally, these changes should be incorporated into existing structures and given the importance needed to ensure procedural continuity and high quality of data.

A common problem through the region is the aggregation of species under a common label (*e.g.* sharks). Substantial amounts of money and time have been spent on the design, compilation and production of identification guides (*e.g.* FAO in Tanzania and Kenya) but they have serious shortcomings as they present one or two species from groups such as tuna, a resolution that leaves much to be desired. For fisheries management purposes, data must be collected with species resolution and these guides fall short of their intended objective. A possible replacement to printed guides is the use of electronic tablets that can be used for identification purposes as well as for data collection. The use of this technology would resolve the most common problem encountered in this mission, that of considerable delays in report production due to hold ups in entry of data. The costs of said tablets and the development of the software in most cases would be less or comparable to the cost of purchasing laptops and other computers, photocopying forms, and mailing these to the various centres. Furthermore, the use of tablets would allow for remote supervision, thus reducing the need for on-site monitoring, as many of these tablets have GPS or other methods to determine position that allow for immediate localization and monitoring of personnel in the field. This technology, however, may not be appropriate to all countries visited, as it would need reliable Internet connection and technical support. It would be possible for countries like India and Sri Lanka to start using this technology as they have already expressed interest in its use and would address the issues presented above which are relevant to these countries.

The countries visited exhibited a wide range of fisheries, gears, species, and of course issues thus they are presented individually in the country reports although general comments follow to highlight the most important findings and recommendations.

India possesses one of the most complex fisheries in the region because of its size, large number of boats and people. In addition, the large numbers of landing sites make this country a challenge to sample. Nonetheless, there is infrastructure and institutional capacity to address these concerns. The Central Marine Fisheries Research Institute gathers data in far more detail than the State Unions and at this time harmonization of techniques and sampling by the two groups is taking place. There is no direct weighing of the catch but estimates are made visually. It is proposed that validation of this technique is done frequently to ensure the reliability of the estimates. Although there is stratified random sampling in place, it is suspected that there is substantial underestimation of the catches. There is an urgent need to revise the stratification to allocate more sampling time to major ports. Manpower, however, is the most important issue as there are only 80 enumerators to cover 8,118 km of coastline where 1,896 ports and landing sites and 3,937 fishing villages are found. Increased sampling coverage and effort are proposed as the critical issue in India.

Indonesia is one of the countries of high interest due to its geographically extensive fishery and to the large volume of fish caught. It is here proposed that with minor modifications to its port sampling and reporting procedures, Indonesia can report its artisanal catches on time and reliably. Some of these changes include improved identification and classification of species, harmonization of datasheets throughout the various districts in the country, and reduced aggregation of data as they are passed along the chain of reporting. Although there are issues with the Indonesian fishery reporting system, there are no indications to suggest that large underreporting is taking place. There are problems with identification of species and underreporting, not so much from omission of data as for mishandling of information. In some cases tuna weights are reported from processed (gilled and gutted) animals and these weights are not converted to live weight. Although it is likely that there is some underreporting due to the size of the country and the complexity of the fishery, it appears that most of the catch is reported, albeit partly identified incorrectly. One of the main issues of concern in Indonesia is the catch of large numbers of small bigeye and yellowfin tuna associated to *"rumpons"*, *i.e.* anchored Fish Aggregating Devices (FADs). Their monitoring is proposed as a priority.

Iran is home to one of the largest fleets of gillnet vessels in the Indian Ocean and currently has the best reporting system for total retained catch sampled in port of the countries visited. Large numbers of these vessels have the capacity to fish offshore and there is an urgent need to separate the coastal or EEZ fleet from that one that fishes on the high seas. The system in Iran covers effectively the effort (trips) for fishing vessels in its EEZ as this is mandatory and strictly enforced, but there is the need to improve the logbook system for vessels fishing on the high seas. Enumerators interview about 10% of the fleet but the same vessels are always sampled and this could be a source of bias that needs to be addressed. In addition, information on gear configuration is needed to be able to standardise the effort per fishing event, something missing at this time. An important issue for the fleet fishing in this country may be bycatch of turtles, marine mammals and birds, and this will only be address accurately with observers on board the vessels.

Kenya has a small fishery for tuna, sharks and billfish. Although there is basic infrastructure and personnel in place, there is a need to improve the reporting system substantially, something already in development by the

Fisheries Department in the country, with the creation of a new sampling protocol, datasheets and database. It is necessary to have dedicated enumerators (at this time personnel work on many tasks and sampling is sporadic) and basic equipment including hardware and software. The recreational fishery is effectively covered and there is a working database in use that houses a large dataset although it presents problems in specimen weights as these are estimated.

Madagascar's sampling and statistics infrastructure needs a complete overhaul. This will require massive amounts of money, time and expertise, assets that would be, in this consultant's opinion, misplaced if we consider IOTC's interests. Furthermore, the total catches of the species of interest, except sharks, are thought to be very low. It is very likely that the foreign fleet present in the Malagasy Exclusive Economic Zone (EEZ) catches most of the tuna and sharks in the country. A small longline fleet targets bigeye and yellowfin but the catches are relatively small and the operators appear to record their catches in detail although it is unknown what the relevant authorities do with the information. The reporting of this component needs to improve to take advantage of the detailed information collected by operators. The main concern for Madagascar's fishery is the large number of sharks caught which in many cases may go unreported. Investigation of the unreported shark catch and how to measure it is here proposed as a priority for this country.

The tuna fishery in Maldives is simpler than in other countries in the region. The main gear is pole and line although handlines and trolling are also used and there are plans to introduce longline. The main species caught are skipjack and yellowfin, the latter mainly for export. There are very good records of number of individuals caught and their weights for exported fish but the same cannot be said for fish that stay for local consumption. The large number of islands and their relative isolation make it challenging to sample and monitor the fleet. An increase in effort in the various ports and landing sites and a revision of the sampling strategy are priorities for Maldives. In addition, there is mislabelling of bigeye (called yellowfin) although the numbers are low compared to the other species.

Mozambique possesses one of the best data collection systems encountered. Although the artisanal fleet catches small quantities of tuna, the system and the personnel in place gather data with sufficient detail about gears, species and effort to allow for detailed analysis. There are reporting problems, however, as the institutional obligations are not clear and Mozambique does not report its artisanal catches to the IOTC. The semi industrial fleet, also included here because of the IOTC definition, does not have a comparable system as catch data are collected from logbooks without verification. Furthermore, concerns exist on underreporting from this and the foreign industrial fleet fishing in its EEZ.

Sri Lanka's fishery, even if similar to India's because both are multi-gear, multi-species, is not as complex because the country does not land as much fish in as many landing places with as many gears. The harbours visited are relatively well organized and seem fairly easy to sample. As in India, the main problem is shortage of enumerators and the fact that two institutions sample for landings with different methodologies. This leads to duplication of work and it is proposed here that one institution conducts the sampling. Although there is stratified random sampling, sampling effort is not sufficient and there is a need to cover the landing sites more intensively and extensively. Collaboration between the two institutions responsible for fisheries data collection and reporting will improve the data gathering efforts in Sri Lanka.

Tanzania (mainland and Zanzibar), like Kenya, has experienced marked changes in its tuna fishery. Most vessels fishing for tuna were from foreign fleets but they have moved away from the area due to piracy threats in this part of the Indian Ocean. Extremely small catches of tuna, billfish and sharks are reported from the artisanal fleet because the boats are basic and this forces them to remain very close to shore where tuna species are not found in abundance. In most cases, data from artisanal fisheries (within 12 nm from shore) are collected by Beach Management Units (BMUs) who then pass the information to their respective fisheries department for collation and production of statistics. Further training of the BMUS was identified as a priority for Tanzania.

The countries that need the most urgent intervention on their current sampling and reporting methodologies are India (tunas and sharks), Indonesia (tunas and sharks), Madagascar (sharks), Maldives (tunas) and Sri Lanka (tunas and sharks). These are the countries with the highest catches of tunas and sharks that currently present issues with their data collection and reporting structure.

In addition to the fisheries covered in this report, there are others that are industrial and which are not monitored or reported adequately. This includes the longline fishery of India and Indonesia, gillnet in Iran, and both fishing arts by the fleet from Sri Lanka. Although logbook systems are sometimes in place, the reporting from these fleets is sporadic at best and needs substantial improvement. At present, most of these fleets would not be able to report data in near-real time as proposed by the IOTC.

Even though port sampling should register most of the species caught, there are species that are discarded for a variety of reasons. Furthermore, some fleets are semi-industrial or industrial because the boats are larger than 24

m or they fish outside their EEZ, but the required coverage of 5 % of fishing events is not being met and they should be monitored more closely, thus the need to implement an observer programme as required by the IOTC. This is not feasible in many of the countries due to the small size of the vessels but monitoring at sea may be possible from patrol vessels where the observer does not need to spend more than a short amount of time on a boat to document the complete catch. Fishers in the countries visited may keep all of the catch (*e.g.* India) or in some cases may get rid of certain bycatch species because it is illegal to possess them (*e.g.* sharks in Maldives) or because they have no commercial value (*e.g.* birds) but this is difficult to verify. Thus it is important to ensure that observer programmes are implemented where possible to guarantee that all species caught, and their fates, are recorded and included in regional statistics.

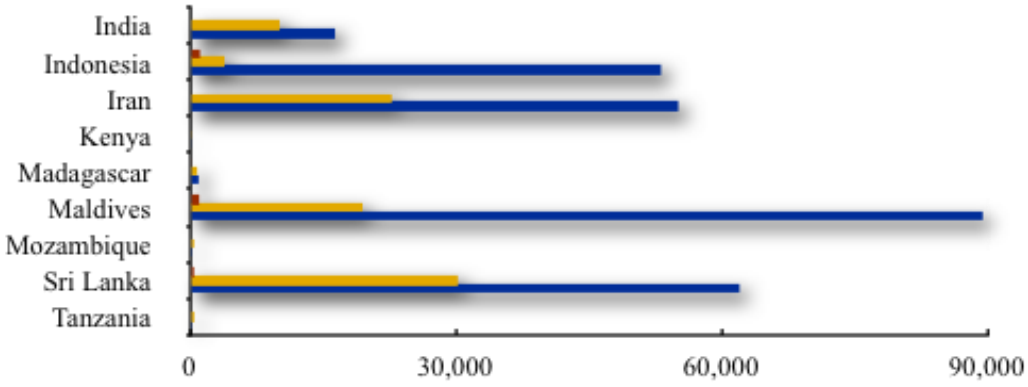
Many programmes have been carried out in countries in the region to support the development of fisheries management but few, if any, have taken root and become an integral part of the way countries collect, process and utilize information. When support is given it must be clearly defined and the commitment to sustain and develop their monitoring and sampling must be secured from the receiving countries as part of this effort. It is common practice that after the period of support ends, initiatives and projects grind to a halt because of lack of funds, shifting priorities within ministries or departments, or lack of political will to continue. This model clearly does not work and the result is the loss of massive amounts of money, time and effort from aid agencies and RFMOs, therefore an alternative is needed. Collaboration with the fishing community in data gathering activities may be a possibility for some of the countries in the region such as Tanzania, but for countries with large and complex fisheries this model is not workable. In this case, governmental support in funds, personnel and infrastructure is the only way in which countries will have an independent, reliable and workable fisheries framework.

The changes proposed in the country reports are applicable not only to tuna, billfish and shark fisheries, but they are measures to improve reporting systems as a whole, changes that are sorely needed for the management of all species. The key to the success of any initiative will be political commitment from the concerned countries and the need to realize the importance of fisheries management to the stability of the fishing industry and food security, and preservation of the resources.

Background Information

Artisanal fisheries play a significant role in fish production in the Indian Ocean (Figure 1) contributing over 50 % of the total catch of species of interest (excluding sharks) to the Indian Ocean Tuna Commission (IOTC). A recent analysis by the review panel to measure the performance of IOTC concluded that "the high level of artisanal catch and high frequency of Contracting and Cooperating Non-contracting Parties (CPCs) with inadequate data collection and reporting mechanisms make the development of an accurate and comprehensive database of catch, effort and size statistics very difficult"[1]. These difficulties became particularly relevant when IOTC Members considered, at the IOTC 14, the adoption of a global quota system for some of the major species. One of the concerns at the time was the difficulty of producing the near-real-time reporting necessary to accurately estimate each year the date when the catch limit would be reached by the combined fisheries acting on the stock in question (*i.e.* the date of closure). Although the ability to report timely and questions about quality of data reported affect both industrial and artisanal fisheries, the Commission noted the particular challenges faced by reporting systems that have to deal with small-scale fisheries spread over long coastlines, and decided that a special effort was necessary to improve the catch reporting systems for these fisheries.

Figure 1: Estimated metric tonnes of bigeye (*Thunnus obesus* λ), skipjack (*Katsuwonus pelamis* λ) and yellowfin (*T. albacares* λ) tuna caught per year by the artisanal fleet (as per IOTC definition) in each of the countries visited. Low values or absence of bigeye may be partly attributed to misidentification of this species as it is commonly labelled yellowfin tuna.



Estimated Average Catch (MT) per Year by Artisanal Fisheries (2006-2010)

Accordingly, the IOTC Members decided through Resolution 10/01:

> *"In order to have a more extensive knowledge of the exploitation rate of these species and also the assessment of the feasibility of near real time reporting, the IOTC CPCs agree to implement as soon as possible a pilot project within the framework of the port sampling programme under Resolution 10/04, with a view to enhancing the gathering of catch data related to the activities of the artisanal fishery sector and to establishing a catch reporting system."*

This paragraph recognizes that port sampling activities already due to be implemented under Resolution 11/04 would not only improve the overall level of catch reporting, but they would also provide the information required to assess whether the timeliness of the reporting could also be improved to allow an accurate estimate of the date of closure.

BOX 1: Definition of artisanal fisheries on this study

Provisions in IOTC Resolution 11/04 call for IOTC CPCs to deploy observers onboard fishing vessels under their flag authorized to fish for IOTC species within the IOTC Area. This includes all vessels with length overall 24m or greater and all other vessels when they operate, fully or partially, outside the EEZ of their flag states. In addition, IOTC CPCs are called to monitor their artisanal fisheries in port, through field samplers.

By exclusion and for the purpose of this study, **artisanal fisheries are defined as those undertaken by vessels (or any other types of fishing crafts) with LOA less than 24m and operated full time within the EEZ of their flag states**.

[1] Anonymous (2009). Report of the IOTC Performance Review Panel: January 2009. *Indian Ocean Tuna Commission*. 56 pp.

The following paragraphs assign the Secretariat the role of coordinator for the implementation of the activities and place the responsibilities of evaluating and advising on the Scientific Committee:

> *"The pilot project shall be implemented for a 12 months period by the IOTC Secretariat in collaboration with the CPCs concerned.*
>
> *The pilot project will contribute relevant information to the work of the Scientific Committee in future revision of stock estimates and in the assessment of the reporting requirements in respect of catch quota reporting, particularly in the artisanal fisheries.*
>
> *The Scientific Committee will examine the results of the pilot project at its 2011 meeting and provide management advice to the Commission."*

General Terms of Reference

To assess the status of data collection and reporting of artisanal fisheries in coastal countries of the IOTC area and prepare a report to respond to the Commission's request on how close said countries are to real-time reporting of the catches of the species of interest to the Commission.

Terms of Reference for the Missions to the Countries

1. Meet with relevant officials including the Chief of Statistics, personnel responsible for aggregation and handling of fisheries data, and representatives at the provincial and district levels.
2. Visit various ports to determine the flow of information and possible areas for improvement.
3. Describe issues affecting the timely report of artisanal fishery data and investigation of possible solutions, implementation and costs (following "Improving Reporting Systems" questionnaire).
4. Recommend data collection and management activities that would make possible close to real-time reporting of data from artisanal fisheries, including implementation of pilot sampling activities and strengthening of existing data collection and management systems.

Methodology

Information about the fisheries in each country was extracted from the Internet and various documents held at IOTC, including past missions from staff of the IOTC Secretariat, the majority under the framework of the IOTC-OFCF Project, to countries in the region. In addition, visits were made to the countries to find out the data gathering structure and details on data handling. Most countries in the region were visited and the main criterion was their importance in total catches of tunas in the Indian Ocean. Where possible, countries with smaller catches were also visited. Nine countries were visited and assessed: India, Indonesia, Iran, Kenya, Madagascar, Maldives, Mozambique, Sri Lanka and Tanzania. Two countries with important catches, Pakistan and Yemen, were not visited due to security concerns. A further two were not visited because there are other missions by IOTC-OFCF covering its reporting system (Comoros) or good reporting exists (Oman).

Relevant authorities in each country were contacted to authorize and help coordinate the visit. The trip was usually initiated with the collection of detailed information about the data gathering, processing and reporting systems in place with subsequent corroboration through visits to as many ports and landing sites as possible, as well as interviews with personnel working at various levels of data collection and management.

The report has a General Findings and Conclusions section (see below) that covers issues common to the countries in the region. Detailed information about the countries is found in the individual country reports where general observations and detailed suggestions are made as well as a general description of the ports visited is provided. A map with the sites visited, a summary table, a budget for the proposed activities per country, and an itinerary of the trip as well as a list of people met follow this section. Recommendations and budgets were sent to the appropriate people in the relevant departments for their comments and their input was used to write the final draft. Summary tables for each country were filled with the use of existing documentation at IOTC but due to the obsolescence of much of the data, they were sent to the respective departments for updating. Unfortunately, some of the departments concerned did not update the information thus there are lacunae on the information.

General Findings and Conclusions

Not surprisingly, the capabilities, issues, and proposed activities for each country are quite diverse. It is not possible to make an overall statement about all these issues in a sweeping generalization, thus the general results are presented by country highlighting the findings and recommendations proposed, and broad characteristics of the ports and landing sites visited. These profiles also include a budget for the proposed activities, details about the fishery, and itinerary and people visited. Although many of the countries have similar needs, their current status will determine whether these wants can be fulfilled at this time. It is necessary to be realistic about the capacity of the responsible departments, political and economic situation of the country, and resources available internally to follow up any proposed changes before activities are started. Short-term solutions are not feasible and continuity is one of the main issues that will determine the success on any initiatives proposed.

Interviews at the data gathering level were critical and informative about the true structure, difficulties and issues encountered in each country. Although detailed information was usually found at the central level, the reality found at the ports often differed from the overall image provided at higher levels. The most enlightening part of the trips was usually the visit to ports and landing sites where direct observation of the conditions, together with conversations held with enumerators, allowed for an understanding of the issues and possible solutions.

Even thought it is obvious that there is an urgent need for all countries in the region to implement better gathering, analysis and reporting of data along with monitoring, management, and enforcement measures, for IOTC purposes it is necessary to concentrate efforts on those countries that present the highest catches of the species of interest (tunas, sharks and billfishes) and where relatively minor changes will produce significant and substantial changes in reporting. There are countries where massive overhaul to data gathering and reporting systems is needed but due to limitations on capacity, funds, political stability and institutional willingness, fast improvements are not feasible and long-term projects should be implemented. This is not to say that there are no recommendations that could take place in the short term, but rather that the capacity for these countries to present accurate statistics should be viewed as a long-term objective and that critical analyses of the issues must take place to ensure funds and effort are utilized in those places where they will be more effective.

There are various tools that are necessary for fisheries data gathering, management and analysis and which are independently designed and produced throughout the region with mixed success. Datasheets, databases and identification tools are standard materials needed to gather and input data yet there is a serious lack of cohesion and comprehensiveness on their design. Acknowledging that there are substantial differences in the fisheries in each country, this should not limit the development of a guiding framework onto which relevant information unique to a country may be appended. An attempt was made by IOTC to address this difficulty with the database FINSS. This was an effort to standardize data input and output for tuna fisheries but one of its main problems, in this consultant's opinion, was the separation of commercial tuna fisheries data from that of other fisheries although an integration between FINNS and ARFISH from FAO was tried unsuccessfully. This division increased the complexity encountered by data entry personnel as well as the need to enter data twice, once in FINSS and again in existing databases.

Various organizations (FAO, SPC and others) have developed generic fisheries databases that could in theory be adapted to the various species, gears and fisheries encountered in the Indian Ocean region. For the purposes of IOTC, it is worth investigating what databases are available, whether they are suitable and how one may become the standard database if not for the whole region, at least for those countries that are still developing their own. Although it is likely that different countries will have specific requirements in addition to the basic fisheries data (economics, demographics, etc) it would be tremendously beneficial to have a standard framework from which to work together. This proposal becomes more difficult as reporting systems in each country become more sophisticated and their time and monetary investments increase while developing their own statistical structures.

Databases should not focus on one fishery (*e.g.* tuna) but should address the suite of species, issues, and data encountered (vessel registration, observer data, biological data, effort, gears, etc), with the aim of presenting a tool that includes, or allows the development and addition of rare and individual characteristics from specific fisheries. Possible "generic" databases include Allegro (http://www.ifremer.fr/allegro/index.html), part of the Fisheries Information System developed by Sodifrance, and TUFMAN (Tuna Fisheries Database Management System; http://www.spc.int/OceanFish/en/ofpsection/data-management/spc-members/dd/140-tufman) developed by the Secretariat of the Pacific Community (SPC), although the latter is specific to tuna fisheries.

A frequent issue encountered through the Indian Ocean region is the loss of information as data progress up the administrative chain with the consequent difficulty in interpretation of the data. It is astonishing to see the amount of information that is collected and either lost through aggregation or never entered into a

comprehensive database. It is common for enumerators to collect data on gears, catches, areas, effort but most of this detail is lost as most departments are interested in production totals. Hand calculations and aggregation are big contributors to this problem as data are collected but not entered into databases and the information remains non-transcribed on paper.

Some of the problems encountered during collection and entry of data may be alleviated by the use of portable electronic devices. Their use would allow the immediate entry of data at the port or landing site permitting real time reporting to the main offices. The hardware is coming down in price and is more accessible than desktop or portable computers and direct entry would resolve many of the issues identified in this study (delays in data entry, errors in handwriting interpretation, etc). Added benefits include the capability to track where, when and whether the enumerators visited the sites (many of the new tablets have positioning technology incorporated), thus allowing for remote supervision. In addition, features like photos of the species of interest would increase the possibility of correct identification *in situ*. Current efforts by various organizations rely on identification guides that are incomplete (*e.g.* one species of tuna) or if complete become too expensive and awkward to carry in the field. Another problem commonly encountered during data collection is that a large amount of repeated information is collected and entered and this makes the systems cumbersome. Upon entry of license number in the electronic device, for example, all other relevant fields (*e.g.* vessel name, size, type, etc) may be appended automatically to avoid repetitious labour that has no added benefit. Finally, changes, additions and corrections on sampling schedules, methodologies, ID guides and other issues can be addressed expediently through this technology thus making the technology more feasible logistically and economically. Obviously, this does not mean that portable electronic tablets are a panacea and that data should go straight into a database unchecked, as there would be a need for supervision to ensure the reliability of the numbers. This revision could be done in near-real time thus allowing for corrections to be made close to the time of collection of the data.

Economic limitation is the issue most often cited by these countries for their inability to realise successful sampling, reporting, monitoring, control and surveillance of their fisheries. There is a need to change their existing models and for the fishing industry to start contributing financially to the management of their fisheries as the revenues created from fishing are considerable and, when compared to the funds needed to manage the fisheries, substantially higher. Their contribution to the management of their fisheries must be seen as an investment and an obligation to the sustainability of their businesses and livelihoods. The costs of the proposed activities are a fraction of the money gained from fishing in the various countries (less than 0.02% of the gross value of fisheries output except Kenya where it is 0.6%) thus an investment of this magnitude is more than justifiable to ensure the health and sustainability of the industry. Furthermore, the costs presented here are not yearly as they would be reduced considerably once they have been implemented (*e.g.* new hardware and software).

The countries that most urgently need an improvement on their artisanal fisheries reporting are India (tunas and sharks), Indonesia (tunas and sharks), Madagascar (sharks), Maldives (tunas) and Sri Lanka (tunas and sharks). These countries were selected because they have significant catches of the species of interest and they currently lack optimal reporting structures and mechanisms. They are neither the best nor the worst countries reporting catches in the region but could show considerable improvement in their reporting systems with relatively minor changes. In most cases, countries have an experimental design (Table 1; total score = 22/45) that addresses some of the issues but the implementation of said designs (score = 15/45), processing of data (score = 16/45) and reporting of statistics (score = 15/45) show flaws that result in data of less than optimal accuracy or precision. The region as a whole is a long way from having a comprehensive data collection, processing and reporting system, but if the main fishing countries improve their methodologies, the quality of the data will improve substantially and will have direct impact on management of fisheries in the Indian Ocean.

Table 1: Scores given to the countries visited during this mission according to their capacity to address four stages of data production.

Country	Experimental Design	Sampling	Data Processing	Statistics Production	Score per Country
India	3	2	2	2	**9/20**
Indonesia	3	2	2	2	**9/20**
Iran	3	3	3	2	**11/20**
Kenya	2	1	1	1	**5/20**
Madagascar	1	1	1	1	**4/20**
Maldives	2	1	2	2	**7/20**
Mozambique	3	2	2	2	**9/20**
Sri Lanka	3	2	2	2	**9/20**
Tanzania	2	1	1	1	**5/20**
Score per Issue	**22/45**	**15/45**	**16/45**	**15/45**	

Experimental Design: measures the presence, implementation and updates done on the experimental design (*e.g.* stratification).
Sampling: shows the reliability and frequency of the port sampling.
Data Processing: measures the dependability of the methods, people, software used to calculate the catch statistics.
Statistics Production: indicates the delay of the monthly statistic production.
A higher score value indicates a better system. Scores go from 0 to 5 the former indicating no system while the latter is a perfect score.
The values given are subjective but they are based on observations in the field and the known mechanisms structure in each country.

Increase in revenue from fishing is the main reason cited by countries for increasing effort. Many of them would achieve this not by increasing catches but by improving quality. The mishandling and lack of basic on-board processing of large valuable yellowfin and bigeye tuna dramatically decreased their quality and value. Although most vessels in the region are basic and do not have optimal storage facilities, basic processing would allow for increased revenue from the fish caught and would encourage fishers to concentrate on larger, more valuable specimens of said species, thus reducing fishing of smaller specimens.

Finally, but vital to the success of any initiative aiming to improve fisheries governance and reporting is institutional and political commitment. This commitment is necessary to successfully implement and, very importantly, continue with the proposed activities. There are no short cuts to the issues and continuity is a must if activities proposed are to have a lasting impact on the reporting systems of the countries in the Indian Ocean region. Many of the countries visited have cumbersome administrative and political structures associated to their fisheries data gathering and processing institutions. If the departments responsible for fisheries management are to become sustainable and self sufficient, it will be necessary for these governments to streamline these structures to address the issues at hand. This will only occur once the relevant people in government understand the need and importance of fisheries data and the significant role the data will have on the management of the resources of interest. This reorganization falls outside the scope of this study but nonetheless it is highlighted here as ***the*** key issue for fisheries governance and management for countries in the region.

Country Recommendations and Profiles

India

Main findings and proposed actions

In 2009 it is estimated that India caught 32,401 MT of kawakawa, 12,295 MT of skipjack and 16,681 MT of yellowfin tuna as well as large quantities of narrow-barred Spanish seerfish (32,155 MT) and Indo Pacific seerfish (23,764 MT). These species were mainly caught with the use of gillnets, purse seines and handlines by the vast and diverse fleet found in the country.

India possesses the most complex fisheries observed of all the countries visited. The massive size of the country, countless ports and landing sites, numerous boats (most of which are considered artisanal by the IOTC definition) and multispecies, multi-gear fisheries make India a daunting challenge. There is institutional mandate to gather information and the current stratified random sampling should in theory allow for the gathering of data in sufficient detail and quantity to accurately describe the fisheries. Concerns exist, however, on the estimates made at landing sites. It is believed that underreporting occurs and suggestions on how to improve the system are presented. Because of the complexity of the fishing industry, it is necessary to work within the existing framework as there are many players in the industry (fishers, traders, stevedores, government officials) who will need to accept the necessary modifications and this will take time.

The biggest shortcoming found in the Indian model was the lack of manpower to cover the large number of ports and landing sites. In many cases, due to the size of the coast, number of ports, and complexities of the fisheries because of gears and species, important landing areas are not covered as intensively as they should be. There is the need to cover the ports proportionally to their importance in catches.

One of the most important numbers that an enumerator gathers while sampling is the quantity of vessels out fishing. In India this number is acquired through informal questioning of locals but the reliability of this estimate is questioned here. Not only may this number be flawed for local boats, but because fleets move around the country during monsoon season, visiting boats that are not familiar to the local population might be overlooked and the estimates may be under-representing the total number of vessels fishing at any time. Also,

sampling takes place from 6 am to 6 pm thus overlooking the offloading that occurs in the evening, something that could bias the sampling specifically on ports of significance that work around the clock. Although personnel at CMFRI questioned this finding, the information gathered at the various landing sites supports it.

Finally, the stratification currently in place will need to be modified to reflect the changes encountered during the census done last year. Other changes may have to take place including higher sampling effort in ports with significant landings, validation of basket weights, validation of catches because they may be sorted on board before offloading thus biasing any sampling, and others.

Findings and Recommendations

1. ENUMERATORS
   India has a large coastline and many landing sites. The current number of enumerators (80) is not sufficient to effectively cover the main ports and smaller landing sites (1,896) thus a significant increase in their number is strongly suggested.

2. VALIDATION
   There are various measurements and methodologies that need to be verified due to uncertainties:
   a. Catch is estimated from counts of baskets multiplied by an average weight.
   b. Number of vessels that go fishing on a given day
   c. Sampling bias due to sorting of catch by species and sizes before offloading
   d. Multi-day offloading

3. DATA ENTRY
   Enumerators do not enter the data that they collect and this should be remedied. There are many issues when people away from the site of data collection enter data including interpretation of handwriting, mistakes, delay in production of statistics and others that could be avoided if the enumerators are trained in data entry and verification.

4. TRAINING
   Although various training workshops already take place, personnel in a country of the size and complexity of India would benefit from additional preparation. Subjects that should be covered include sampling techniques, identification of species (particularly relevant for sharks), biological sampling, and others. Training should be done in the ports and landing sites where enumerators usually work to address site-specific issues.

5. DATASHEETS
   Enumerators transcribe data onto standard datasheets after the fieldwork is completed. Transcription increases the chances of mistakes and omissions and should be avoided by recording data directly into the relevant datasheets in the field for later digital transcription.

6. STRATIFICATION
   Although there is a stratified random sampling scheme in place, there are concerns about the stratification and it is suggested that the scheme is revised and updated. New data from the census carried out in 2010 should be available soon and this would help on the design of a more up-to-date sampling programme.

   Issues to consider while revising the stratification programme, include the need to consider ports where there is night offloading, and effort should be higher for ports with larger landings.

7. MULTIDAY OFFLOADING
   Boats may offload the catch in a single day but commonly hold it for two or more days waiting for favourable market conditions. This makes sampling difficult and information is usually gathered through interviews of the skippers but validation of this information is needed. A multiday offloading strategy needs to be developed to cope with this issue.

8. DSA
   Enumerators get a DSA when sampling sites but the allowance is not according to the site but rather to their level of pay. This presents problems as some of the sites are much more expensive (lodging, food, transportation) that the allowance given and this may create incentives for some enumerators to invent data to avoid having to pay out of their own pocket for work-related expenses. It is suggested that enumerators get paid in accordance to the areas visited to allow them to get adequate accommodation, transportation and food.

9. DEPREDATION
   India is the only country visited where depredation rates from tuna longlines are available. A vessel from FSI deploys experimental longlines 20 days per month every month and there are detailed records per area and month to show the depredation by sharks. These estimates must be included in the total catch reported by the longline commercial fleet, as they could be significant (up to 13% of the total catch for longline in some areas).

10. MONITORING OF PROCESSING PLANTS
    There are significant discrepancies between the estimates of yellowfin tuna landed and the product exported, the later being higher. This difference becomes larger if we consider the number of fish that stay for internal consumption. It is suggested that a possible source of unrecorded fish may be processing plants that offload into their facilities directly from their or hired boats through private piers. It is proposed that these plants are visited and monitored to measure the catches offloaded there.

11. ELECTRONIC DATA GATHERING
    The longest delay in catch estimates occurs in Kochi where all data are entered. This delay has resulted in plans to modernize the data collection system through the use of portable electronic tablets at ports and landing sites. This proposal is still under investigation, but it would be very beneficial for the team in charge of developing this initiative to communicate with countries already using this technology. Oman has this system in place, and it is proposed that interested people in India contact Oman or IOTC to investigate the issues, possibilities and experiences.

12. OBSERVERS
    At this time observers are not deployed in any of the fisheries in India waters. India does not have the infrastructure or experience to train its observers and it is here proposed that contacts be made on its behalf with organizations already doing this type of work in the area (*e.g.* SWIOFP) to investigate the possibility of collaboration to train India's observers.

13. OVERCAPACITY
    Even though there is a ban currently in place in some of the states (*e.g.* Gujarat) for the construction of new vessels, it is obvious that this ban is not working. In Gujarat alone the estimated number of new boats entering the fishery is of 400-500 per annum. It is here proposed that expertise on a mechanism to realize this ban is provided.

14. LENGTH MEASUREMENTS
    Various ports and landing sites gather length measurements with varying tools (measuring tape, measuring board). This should not be a problem as long as there is an indication of the type of measurement taken to ensure appropriate conversion. This information must be included in all measurement recordings to avoid mixing data collected differently. In addition, the various measurements must be collected to calculate conversion factors, as these do not exist in the country at this time.

15. GENETIC SAMPLING
    IOTC has identified genetic information as necessary to determine the unity of stocks of various species. Personnel at the Fishery Survey of India (FSI) propose that this organization is more than capable to participate in this effort with the expertise available in the institution. Integration of these efforts should take place to allow for collaboration between the different entities thus reducing replication of efforts and costs while increasing communications amongst the interested parties. The person in charge is Dr. K. K. Vijayan Principal Scientist and Head of the Marine Biotechnology Division (vijayankk@gmail.com)

Fishing Ports and Landing Sites

CHENNAI FISHING HARBOUR (TAMIL NADU): This port is home to a fleet of trawlers that catch a variety of fish species although tunas are not targeted. There is an area where catch is landed but because there are various boats offloading at the same time, it is not known how the enumerators keep track of the provenance of the fish. Fish are not weighed but estimates are made on the number of baskets offloaded per boat and this is raised to the total number of boats. Sharks and rays are landed but do not seem to be recorded in the sampling.

A fleet of longliners also operates here and it targets tuna and seerfish. The boats are made of wood and metal and there are 20 boats below 20 m in length and an unknown number of larger ones.

LAWSON'S BAY (ANDRA PRADESH): This landing site is a beach where fish are offloaded. Fish are auctioned *in situ* and in the case of tuna, packaged on ice and sent by road to the state of Kerala for further processing and in some cases export. Yellowfin tuna is caught with longline and gillnet and sharks are uncommon.

PUDIAMADAKA (ANDRA PRADESH): This small site shows important catches of tuna from October through February with a daily catch of 10-20 MT of yellowfin tuna. From March to July the catch drops to 20 MT per month and August through September is the low season with 1-2 MT per month. Skipjack and kawakawa are also landed with an approximate catch of 5-6 MT and 1 MT per month respectively. All tunas are sent to Chennai or Kochi.

Swordfish, sailfish and marlin are also landed here and the total catch is approximately 40-50 MT per year Sharks have not been landed at this site for the last three years but recently their catches have increased where, according to Indian officers, *Carcharinus carcharias* and *C. limbatus* are the main two species.

TUTICORIN FISHING HARBOUR (TAMIL NADU): The main fleet found here is made of trawlers and this results in a multispecies fishery. Tuna are caught with gillnets and the main species are kawakawa, skipjack, bullet tuna and bonito. Billfish and sharks are rarely found here and species identification of the later is suspect due to lack of training. Catch at this site is sorted upon offloading and there is a need to validate the values reported by enumerators as weights are estimated by eye.

THARUVAIKULAN (TAMIL NADU): Gillnets are the main gear here with approximately 100-150 boats using them. Their target species are tunas and also catch seerfish and billfish but sharks are rarely found. Curve length is taken and it is unknown if this is converted into fork length. As in other sites visited, catch is sorted by species and sizes before offloading thus the need to verify the length frequencies sampled. Part of the fleet targets barracuda and seerfish among other species, but also catches tunas as bycatch. It is believed that these animals are not counted. Sharks and rays are also caught and there is no estimation of weight or numbers.

VIZHINJAM (KERALA): There is a large fleet of boats using drift gill nets as well as hook and line in this port. Various tunas are targeted with the former pursuing larger tunas and billfish while the latter targets bullet tuna (*Auxis rochei*, *A. thazard*). Fish baskets are counted as they are offloaded from the selected vessel and estimates of weight made. If a basket has more than one species, an eye approximation on the percentage composition of each species is made and verification of estimate takes place through sampling of a basket.

POONTHURA (KERALA): This landing site is heavily affected by the monsoon and is used only from September until March. Landings from boats from this beach are made at Vizhinjam during the monsoon season. Gillnets are the main gear and tunas, seerfish, billfish, and smaller pelagic species are targeted.

COLACHEL (TAMIL NADU): This port has 250-300 boats that use gillnet for small pelagic fishes and longline for tunas, sharks and billfish. As in other ports data are collected by enumerators by asking locals for the numbers of fishing vessels out to sea and individual boats are sampled as they arrive. Weight of fish offloaded is guessed from the weight of a basket and extrapolated to the total number of baskets offloaded. Sharks are fished from December through January.

KANYAKUMARI (TAMIL NADU): This port has a large number of trawlers that target shrimp and demersal fish.

CHINNAMUTTOM (TAMIL NADU): This landing site has a number of motorized and non-motorized boats that use gillnets and hook and line (handline) that target tuna, sharks and billfish among other species. This site is very affected by the monsoon and the time of the visit was not being used due to poor weather.

KOCHI FISHING PORT (KERALA): This is the second largest port visited. There is a large area for fish sorting, weighing, icing, and auctioning. A variety of vessels and gears including trawl, purse seine, gillnet and longline are found here. Tunas (yellowfin, skipjack, kawakawa, bullet tuna), sharks, seerfish are landed in large quantities. Sharks, manta rays and billfish are also landed but in smaller numbers. One of the issues of interest at this port is the fact that all the catch is weighed after auction and this might allow for a comparison between data gathered by CMFRI and data collected from traders to compare and determine the accuracy of the former.

MATSYAFED PROCESSING PLANT (KERALA): This plant processes approximately 1,000 MT of skipjack and yellowfin tuna for export each year, most of which come from the state of Tamil Nadu where tuna are not consumed. Large fish are headed/gutted or gilled/gutted while smaller ones are exported whole. Information from this plant suggests that a considerable quantity (60% by weight) of smaller yellowfin tuna (1-4 kg) stays for local consumption while the larger animals are exported to Europe and Asia.

SASOON DOCK (MAHARASHTRA): This is one of five landing sites on the metropolitan Mumbai area. It has a mix of longline, gillnet, and trawl vessels that target a large variety of fishes including seerfish, small tuna (longtail tuna and kawakawa), sharks, sailfish and marlin.

VERAVAL FISHING PORT (GUJARAT): This port holds a total of 65 processing plants and many of the tuna brought here are sent to Thai Union, the large cannery in Thailand. It is the largest port by landings in India (650,000 MT per year) and tunas (skipjack, yellowfin, kawakawa, and neritic species) and billfish are landed here. Sharks are particularly important during the summer months but appear to be for local consumption. Fishers from Tuticorin in the south east coast of India go all the way to the Veraval area to fish sharks during those months.

JALESHWAR (GUJARAT): This is a smaller landing site where gillnet boats land seerfish, tuna, and sharks.

CASTLEROCK FISHERIES LTD: This processing plant exports yellowfin tuna and skipjack to Europe, China and the Middle East. It also exports swordfish fillets to China, Malaysia, Taiwan and Thailand. During the high tuna-fishing season, it exports up to 25 MT per day per plant (this company has two plants) but other companies also have plants in the Veraval area (total of 45 plants).

VANAKBARA (DIU): This is a large port with a fleet of around 400 trawlers and 250 gillnet boats. Due to poor catches, gillnet boats have recently converted to longline targeting tunas and seerfish although catches are low due to inexperience with this new gear.

GHOGHLA (DIU): This is a beach landing site with more than 115 gillnet boats. This fleet targets seerfish and pomfret on fishing trips that last 3-5 days.

Map of India with ports and landing sites visited during this mission

Summary Table: India

General Information

Vessels and gears: By far, the most important gear is gillnet followed by purse seine and handline. As of 2003, there were 280,491 vessels (181,284 traditional craft, 44,578 motorized traditional, 53,684 mechanized, 810 catamarans and 135 beach landing crafts) although it is not specified which gear they use or what species they fish for.

Catches by species: In 2009 India caught 32,401 MT of kawakawa, 12,295 MT of skipjack, and 16,681 MT of yellowfin tuna although narrow-barred Spanish seerfish (32,155 MT), and Indo Pacific seerfish (23,764 MT) were also important.

Legislation:

- Marine Fishing Regulation Act (Fishing regulations in Indian Territorial Waters for each State).
- The Maritime Zones of India (Regulation of Fishing by Foreign Fishing Vessels) Act of 1981 allowed the establishment of Rules in 1982.
- The Deep Sea Fishing Policy and Rules
- Government Order for the Deep-Sea Fishing Policy.

Institutions responsible for data collection and processing and linkages among them, if any: The Central Marine Fisheries Research Institute (CMFRI) is in charge of 1. Monitoring and assessment of exploited and under-exploited marine fishery resources of coastal fisheries, including assistance to State/UT departments on monitoring; 2. Monitoring and assessing the exploited marine fishery resources and rendering policy support to the Union and State Governments; 3. Acting as a repository of information on marine fishery resources with a systematic database; and 4. Collecting species data of the tuna, mackerel and seerfish fisheries. Fishery Survey of India, (FSI) in mandated to 1. Conduct exploratory surveys and stock assessments for deep-sea and oceanic resources in the EEZ and coastal fish stocks; 2. Monitor fishery resources for fisheries regulation, management and conservation; and 3. Maintain data on deep-sea fishery resources and dissemination of information to different user groups. The Marine Products Export Development Authority (MPEDA) in Kochi 1. Monitors the exports and imports (secondarily) of all marine fish products, and assists exporters in fish product development and management and 2. Conducts product research and development and provides reliable information on the species, volumes and values that are exported. Finally, the Fisheries Departments of each State or Union Territory (UT) manage and regulate the operations of fishing vessels within the State/UT 12nm.
FSI: FSI is the nodal institution for the IOTC, and it has many other institutional linkages (14 institutions) associated with ocean studies and fisheries development.
CMFRI: CMFRI is the nodal marine fisheries research agency in India.
MPEDA: MPEDA works with the Customs to obtain documents and invoices for fish export data.

State/UT: State/UT Administration works with CMFRI with regards to potential of fisheries resources in the Indian EEZ, Fish production and average annual growth rate etc. Collaboration with FSI/CMFRI is important for improving statistical systems, which will be required in all levels, including the tunas caught within the 12 nm territorial waters.

Sampling

Existing data collection system: In general, data collection on tuna fishery sub-sectors is conducted by more than one institution – at Ministry, State and institutional levels – usually by trained enumerators that travel to many landing centres and fishing villages. FSI also conducts exploratory tuna surveys and holds detailed information on all catches. For the private tuna fisheries sector:

1) FSI is also responsible for collection and processing private sector deep-ocean tuna catch data through 'voyage reports'.
2) CMFRI participates in tuna data collection from the coastal fisheries in all States using its own enumerators.
3) States also have enumerators that can identify and record tunas.
Enumerators do not catch and logbooks are validated. Size frequency for tunas is for research and the size-frequency strata are consistent with catch/effort estimation. Fish are measured randomly and all tuna species are monitored. Boats are sampled for each net type based on the order of arrival. If there are up to 5 boats, all boats are sampled; 6-10 boats and every other boats is sampled; 11-20 boats and one from every four (25%) boats is sampled and if there are more than 20 boats one in every five boats (20%) is sampled.
FSI
Sampling technique: Time, space and multi-stage stratified random sampling.
Coverage: 5-10% of total landings.
Periodicity: 10 landing centre days (24 hrs.), or 20 calendar days for each enumerator.
MPEDA
Invoices from the Customs Authority for all exported marine products.
State/UT
Oceanic fishery catch is gilled and gutted, thus the nominal catch is converted by applying a raising factor of 1.15.

Recent projects aimed at strengthening statistical systems, if not when was last:

Sampling Design

Date of creation, last revision and frequency of revision: The sampling strategy was designed in 1970 and except for some minor changes it is basically the same.

Documentation (present/absent): Yes

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc): There is a need for more enumerators and for further training for the same.

Type of effort data collected

Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed): A frame survey

and a census are done although their frequencies should be higher. All fishing vessels are licensed.

Frame survey date last conducted and frequency:

Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.):

Coverage (total enumeration or % sampled): 5-10% of total landings.

Type of catch data collected

Reports from fishermen or other non-governmental sources: Logbooks

Enumerators sample catches at the landing place: Yes

Both sources:

By gear or aggregated: Partially aggregated.

By species or aggregated: Up to 30% of the tuna species are aggregated.

Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): Fish weight is estimated by eye

Coverage (total enumeration or % sampled):

Data Processing

Personnel involved, qualifications (database admin) and main functions: Personnel who enter and analyze data need further training.

Data flow, including time frames for each step: The statistical system is not standardized although there is a centralized statistical unit.

Amount of data handling before data are input in a computer and time frames for each step:

Hardware and software in place:

Type of system: Centralized system or other: Centralized statistical unit.

Type of data input and flow of electronic data, including time frames:

Data validation and verification procedures: by hand, electronic, etc: Data validation procedures are implemented at data entry and in some cases are built into the database. Information in some cases is crosschecked independently. There is a feedback mechanism to the data collection team if errors are found.

Catch estimation procedures

Date of creation last revision and frequency of revision:

Documented or not documented:

Estimator (formula used to estimate catch): Catch estimation is centralized. The formula used for calculation of the 'Final production estimate' is:

Processing – Manually on monthly basis by each State

Final production estimate –

$$C = \frac{D \cdot N}{n} \sum_{i}^{n} \frac{B_i}{b_i} \sum_{j=1}^{bi} C_{ij}$$

Where

- C_{ij} = *Catch of fishing unit observed at the centre*
- B_i = *No. of fishing units landed during the sample day*
- b_i = *No. of fishing units selected for observation*
- N = *Total centres in the zone;*
- D = *No. of days in the month*
- n = *No. of sample days*
- C = *Estimated monthly catch of the zone*

Reporting - Every 3 months to Ministry of Agriculture

CMFRI - Similar methodology

Platform (integrated in database, external):

Procedures: minimum coverage, substitution scheme, etc.: There is a substitution scheme in place if for some reason data are not collected in a specific area.

Type of output: catch plus estimates of precision, etc.: Catch estimate includes variation

Estimation time frames: It takes two months for estimates for a specific month to be produced. This delay is due to the entry of data for the whole country in Kochi.

Review of estimates (never, as more data becomes available, or other):

Reports

Timeliness of production of type of catch estimates: There is a delay of about two months

Preliminary estimates: Yes

Final estimates: Yes

Proposed Budget for Improving the Reporting System in India

Item	Number	Months	Cost Unit	Total Cost USD
Enumerators	180^	12	$200	$432,000
Validation	4	1	$5,000	$20,000
Genetics	1,020*	1	$60	$61,200
Observer trainer	1	6	$7,000	$42,000
Revision stratification	1	5	$8,000	$40,000
Training	8	1	$8,000**	$64,000
Validation Kochi	1	2	$10,000	$20,000
PDA	200	1	$150	$30,000
PDA software development	1	5	$7,000	$35,000
Monitoring processing plants	4	4	$3,000	$48,000
Subtotal USD				**$792,200**
Misc (10%) of subtotal				**$79,220**
Total Cost USD				**$871,420**

* 60 samples for 17 sites
** This figure includes salary, transportation and lodging
^ This number reflects new enumerators

Mission schedule

Date	Activity
14/8/2011	Travel Seychelles-Dubai-Chennai
15/8/2011	Meeting with government officials
16/8/2011	Visit to Chennai Fisheries Harbour; meeting with officials
17/8/2011	Travel to Vishakpatnam; visit to Lawson's Bay, Fishing Harbour and meeting with officials at FSI and CMFRI
18/8/2011	Visit to Pudiamadaka landing site, meeting with officials
19/8/2011	Travel Vishakpatnam-Chennai-Madurai-Tuticorin. Visit to fishing harbour and meeting with CMFRI officials
20/8/2011	Visit to Tharuvaikulam landing site
21/8/2011	Travel Tuticorin-Trivandrum
22/8/2011	Visit to Vizhinjam and Poonthura landing sites
23/8/2011	Visit to Kanyakumari and Chinnamuttam landing sites
24/8/2011	Travel to Kochi; writing of findings; meeting with officials
25/8/2011	Visit to Kochi Fishing Harbour; meeting with officials CMFRI
26/8/2011	Meetings with officials CMFRI
27/8/2011	Travel to Mumbai; meeting with officials FSI
28/8/2011	Visit to Sasoon Dock Mumbai; travel to Rajkot; travel to Veraval
29/8/2011	Visit to Veraval Fishing Port, Jaleshwar landing site and Castlerock Fisheries Ltd
30/8/2011	Visit to Vanakvara and Ghoghale
31/8/2011	Travel to Rajkot; travel to Mumbai
1/9/2011	Writing of findings
2/9/2011	Travel Mumbai-Dubai
3/9/2011	Writing of findings

People met during the visit

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Indonesia

Main findings and proposed actions

Indonesia's large fleet uses longline, purse seine, gillnet, troll and hand line to catch skipjack (48,028 MT) kawakawa (38,536 MT), longtail tuna (32,804 MT) and narrow-barred Spanish seerfish (24,379 MT) along with large unknown quantities of small bigeye and yellowfin tuna.

This year the Indonesian government promised to increase the country's marine production to become the largest in the world. Even though a large proportion of this suggested increase would come from aquaculture, some of it would come from capture fisheries. Furthermore, considerable effort is being put into the aquaculture of carnivorous species and this will create a demand for trash fish, the cheapest, most accessible form of food available to growers in the various islands in Indonesia. The country has serious issues of overfishing on many of its stocks and there should be a concerted effort to increase revenues not by increasing production but rather by improving quality. There are miscellaneous issues in the way the fish are handled (*e.g.* lack of basic processing at sea) and the government and managing bodies should encourage the fishing industry to develop its handling, processing, shipping capabilities while they tackle management issues in the country's fisheries, measures which at this point are mostly lacking.

Indonesia has the administrative structure and mandate to gather information on fisheries although there is a need to revise sites and include those that have become larger and where considerable numbers of tuna are now offloaded. Also, the current federative structure of the country results in increased delays of data reporting by some provinces in the country. Nonetheless, Indonesia has the potential to report data on time and in enough detail to meet IOTC requirements with relatively small changes in reporting structure and data collection. Enumerators send information on the first week of every month for the previous month but data are aggregated and information lost at the Regency, Provincial and Central levels and this is where delay and loss of data resolution take place.

Although a number of fishing ports were visited, not all ports of importance were covered due to time constraints. An effort was made to get a cross section of the various types of ports to identify the issues and difficulties encountered there. While not all ports were covered, it is here suggested that the findings and

recommendations may be applied to all ports as a way of standardizing and harmonizing procedures, data collection, paperwork and data handling.

Most ports do complete enumeration of the catch offloaded, and this information is usually collected from auction organizations but the detail needed is lacking in most cases. Misidentification is probably the biggest issue, not due to lack of knowledge of species but instead due to the lack of understanding of the need for discrete separation of catches at species level. This can be easily remedied with the introduction of standard datasheets and database that have fields for all this information, as well as intensive training *in situ* to explain the differences in taxonomy, particularly for small specimens of bigeye and yellowfin, and how to enter these new data. In addition, more details on the boats, gears and effort used would improve the quality of the data tremendously.

Findings and Recommendations

1. SAMPLING DESIGN
   Frame surveys (FS) are conducted at least once every five years although Districts are encouraged to conduct them more often. The FS (also called Village Potential Survey) aims to count the number of gears, fishing households, and vessels. Sampling at the village level takes places according to the number of Sub districts in the District (i.e. two Sub districts, two samples) without taking into account how many actual fishing villages exist or their relative importance in terms of catch. This methodology needs to be revised to reflect the number of fishing villages and their respective importance in fisheries production. Also, FS should take place more often, at least once every two years but preferably every year. This is particularly relevant to ports where there is no 100% enumeration, notably Benoa in Bali.

   Although there is a record of the movement of the vessels, there is neither a measurement of the time spent fishing, number of hooks/lines/panels/etc nor of the Boat Activity Coefficient (BAC). The BAC may not be relevant to all ports because vessels offload in various ports including that where they are registered or in some cases there is complete enumeration of all boat movements and catch.

2. SPECIES IDENTIFICATION
   The main issues with sampling are species identification (although it seems that most enumerators know the species well), lack of collection of size/weight data, and estimation of effort. Most enumerators did not know the document prepared by G. Merta, et al. [2] that was written in Indonesian and has a large number of photographs and explanations on internal and external differences for small specimens of bigeye and yellowfin tuna. The file was distributed again (previously done by the authors) in electronic form to all offices to encourage correct identification of small specimens of these two species of tuna. New ID sheets for all tuna, sharks, and billfishes are urgently needed to address the lack of knowledge on species identification.

   It is common to weigh various species of tuna (bigeye, skipjack, and yellowfin) together in baskets. It is necessary to modify the methodology to sample these baskets and determine the proportion of each species and their sizes and weights. At this time they are represented as tongkol, a category that in theory should include one species but includes what is called baby tuna (mentioned above) as well as *Auxis thazard* and *Euthynnus affinis*. The two latter species are usually identified and weighed separately but reported together.

3. VALIDATION
   All production estimates are gathered either from the TPI or from processors. The accuracy of these data is unknown thus the need to crosscheck these values with independent estimates. There might be issues with under or over reporting because of taxation, tariffs, quotas and others. It is also necessary to estimate the amount of fish that goes unrecorded as in some sites fish are sent directly to processing facilities bypassing the TPI, and traders may not always provide this information (*e.g.* Kedonganan).

   In 2009, validation sampling was conducted in the field, independently from the work done by the Districts and the results compared to determine if production estimates were accurate. Overall, the validation exercise showed good agreement between the two estimates. This sort of validation sampling should be done throughout the whole year, alternating areas to determine accuracy of estimates. It is unknown how many times or where these verifications were done.

[2] Merta G, Andamari, Itano D, and Proctor C (2005). Training guides for the identification of yellowfin and bigeye tunas to assist Indonesian port sampling and observer programs. WCPFC-SC1 FT IP-2

In some landing sites, fish are weighed and sent to larger sites for processing and export. This presents the possibility of double reporting and it is important to see if this occurs. Fish from Kedonganan (Bali) are sent to Benoa and it is not known if these fish are counted twice or even counted at all.

4. FACILITIES

Most ports visited, with the exception of Benoa, had suitable facilities for enumerators that included offices with A/C, computers and Internet connection. Possible improvements might include filing cabinets or shelves for storing data sheets and scanners to digitize them. There is also the need to implement a system for automatic backups. Benoa did not have A/C, archiving facilities, computers or Internet. The current office is a room rented on the site of one of the processing plants and it is far from being a suitable office for such an important port unless upgraded with adequate equipment.

Various offices need new computers, Internet connection and other facilities to accomplish their work. This includes measuring equipment, ID guides, etc.

5. ENUMERATORS

Enumerators were interested and showed considerable knowledge about the species and fisheries. Most ports had enough enumerators although the glaring exception is the most important port visited, Benoa in Bali. Here there is a need to at least double the number of enumerators (from 5 to 10) not only because they are overstretched but also because they are going to start sampling gillnet and purse seine vessels, something not done until now. The size of the port, number of vessels and complexity of offloading into 14 different processing plants make this port the most challenging of all sites visited. In addition, there is the need for an enumerator supervisor who can modify the sampling according to the changes that take place on the fishery and fleet. Finally, it is necessary to sample all fishing arts as there are some that target very different species (jiggers for squid) but which also catch tuna opportunistically although their catch is unknown.

High turnover was suggested as a reason for the discontinuity on data collection. Most enumerators met, however, have been at their stations for a few years and seem happy with their work. It was suggested that enumerators in DINAS offices are moved frequently and this needs to be addressed. Continuous changes in personnel do not allow for continuity on data gathering and this results in the need for training new personnel every few months.

6. TRAINERS

It is suggested that four local fishery workers (current enumerators are suggested) be trained to go to the sites and show *in situ* the necessary adjustments to current sampling. Due to the complexities in language and culture, local trainers should be engaged who can communicate not just in Indonesian but also on the island languages (Javanese, Balinese etc). The need to do this work *in situ* derives from the need to address specific issues and queries that may not be resolved in theoretical meetings in Jakarta.

These persons need to be trained on port sampling topics including catch and effort sampling, biological sampling, taxonomy and species identification, random sampling, weight conversion, fishing gears, otolith collection, data entry, form filling, sampling etiquette etc.

Current enumerators who seem capable of becoming trainers due to their experience, interest and knowledge include Mr Karma in Palabuhanratu, Mr. Joko Rianto in Cilacap, Mr. Muhtadianto in Bungus, and Mr. Galih Rakasiwi in Tanjung Luar.

7. FLEET SURVEY

The artisanal fleet, for IOTC purposes, is made of vessels under 24 m and this excludes most longliners but includes a large range of vessels. There is a need to update and redefine the classification scheme as there are large numbers of vessels that are semi-industrial and this will change the status of various ports and landing sites.

8. LOGBOOKS

Catch landing data are collected at auction places although there is no form or consistent way of gathering the information. If TPIs around Indonesia were provided with standard logbooks or log sheets and were trained on how to use them, basic data collection on catch landings would improve considerably (Proctor C, personal communication).

Logbooks are currently in use for the longline fishery but there are plans to introduce them to all vessels regardless of size or gear although most fishers are reluctant to participate and avoid meeting the enumerators when approached about this subject. Support to encourage its use is recommended.

Socialization must happen after the new logbook version, already agreed upon with the input from various RFMOs, is in use. At this time, and due to previous printing of incomplete forms, the old version is still used.

9. DATASHEETS
There is a diversity of datasheets available in Indonesia. Although most ports use the SL3 datasheet, there also are many other forms that collect slightly different data. There is a need to develop new datasheets that capture the information required by IOTC on tunas, sharks and billfishes as well as information for all existing fisheries. In addition, there is no form to sample the vessels catch and said form must be developed. This form should capture information on vessel, gear, effort, fishing area, species caught, size frequency, weight of individuals and total weight caught by species. New changes should take place within the existing datasheets, if possible, to reduce confusion and disruption to sampling.

In addition to all the locale-specific datasheets, there is a plethora of official forms to record countless aspects of the fisheries. A revision of all these forms is appropriate, as this will streamline the data entry/revision process to which enumerators and supervisors are subjected.

10. BIAS
In most cases, only rejected fish are measured and this could pose a problem if there are differences in weight, size and species compared to fish for export. This is a tricky issue, as owners want to pack and ship the fish as soon as possible to avoid deterioration of the animals and sampling might create friction between the enumerators and the buyers. Although buyers record the individual weights (of processed fish) they are under no obligation to provide this information to enumerators.

Sampling needs to address the sorting of fish that takes place in most ports before they arrive to the TPI. Sorting may occur by species, weight, quality and this presents challenges to enumerators on how to sample to obtain a representative section of the catch.

11. FISH AGGREGATING DEVICES (FADS)
There is a need to register and monitor the catches on FADs as they are becoming more popular in western Indonesia. They have been in use for a long time in many areas of Indonesia and their use usually results in the capture of small individuals of various tuna species. A programme similar to the longline sticker could be introduced to register the FADs and monitor the catches to get an accurate record of the number of these structures and their possible impact on undersized individuals of yellowfin and bigeye tunas. FADs are particularly relevant to the fisheries in Palabuhanratu and Sadeng in Java and Bungus, Muara, Sibolga, Carucok and Banda Aceh in Sumatra, Benoa and Kedonganan in Bali, and Tanjung Luar and Labuhan Lombok in Lombok.

Although it is unlikely that FAD use will be stopped, there are certain measures that would help to reduce their misuse. Restrictions on the types of gear and the size of fish caught are two of the measures that would ensure the sustainable use of FADs.

Indonesia's Research Centre for Fisheries Management and Conservation and CSIRO, in collaboration with DGCF, is currently developing a proposal for a study on Indonesia's FAD fisheries and thus it would be important to talk about this issues with the relevant people (*e.g.* Craig Proctor, CSIRO) to avoid duplication of effort and to determine how the two groups can collaborate.

12. SURVEY OF LANDING SITES
Although established ports have the capacity to report catch data, there are minor sites that have become more important (*e.g.* Muara Padang in west Sumatra) and need to be monitored. There is the need to conduct a survey to determine what new sites need to be included and to implement monitoring. Due to the proliferation of FADs and to the catch of small yellowfin and bigeye, some of these minor sites may be disproportionately important.

13. ELECTRONIC DATA GATHERING
Delays in data entry and reporting may be avoided or reduced through the use of portable electronic tablets at the ports and landing sites. Oman has this system in place, and it is proposed that interested people in Indonesia contact Oman or IOTC to investigate the issues, possibilities and experiences.

14. DATABASES IN USE
FINSS is actively used in the four major ports. In addition, there is another database (Aplikasi Pengolahan Data Statistik Perikanan Tangkap Pelabuhan) that is used on all ports under the jurisdiction of DGCF. Data are entered by the enumerators and are sent monthly to Jakarta via the

Regency, District, and Province depending on the port in question. The data are sent within a week after the end of the month and are aggregated and processed with a similar program (SISKA) in Jakarta to prepare production statistics. A final application is used (Pusat Informasi Pulabuhan Perikanan) in other ports although it is not know what the differences are and whether they could all be merged with FINSS to avoid repetition of data entry, double reporting, and other issues associated with multiple entries of data. It is suggested that if possible, ONE software package that addresses all the needs of various government departments and RFMOs is built.

It was not possible to get copies of the various databases due to restrictions on their distribution. It is suggested that upper level contacts are made to see if copies can be made available to study the possibilities of merging, modifications, etc.

15. TRAINING ON DATA MANAGEMENT AND ENTRY
Most enumerators (with the exception of the enumerator in Carucok) use FINSS and other software with enough proficiency. It is not known why data are exported into Excel before they are sent to Jakarta. If a new database is to be built (or a modification of current ones done), all enumerators must become proficient on data entry and understand the validation systems in place. They also must know how to produce reports, back up and re-install programs in case of system failure. Again, *in situ* training should take place to address the idiosyncrasies of each site and provide real answers to issues identified at each port or landing site.

16. TRAINING MATERIALS
Indonesia has produced a number of publications to help enumerators identify gears and species in the field. In addition, a relevant publication is available to help identify small bigeye and yellowfin tuna and it was distributed in electronic form to all offices visited. There is a need to make plasticized one-sheet identification guides for all tuna and billfish species highlighting the differences. This already exists for shark species although it necessary to have it revised by a shark expert to confirm that the main species are there. Dr. William White from CSIRO, an expert on Indonesian sharks, showed interest on helping on this issue. He already identified various mistakes on the current ID sheet and proposed using drawings from existing publications to update and correct it.

17. ACCESS TO DATA BEFORE HANDLING AND AGGREGATION
The delay for data reporting takes place at Province and Central levels where summaries of the statistics are produced. Because most of the detail of the data is lost at these two steps, it is suggested that data are sent from collection sites to Jakarta where a person collates all the information and then sends it to IOTC thus bypassing the delays and aggregation encountered at lower levels. This option may not be acceptable to DGCF as the data need to be published before they are given to the public. A compromise must be reached, as current practices do not allow for rapid delivery of information.

18. COMMUNICATIONS WITH PARTNER ORGANIZATIONS
There are other groups, most notably CSIRO from Australia, in collaboration with Indonesia's Research Centre for Fisheries Management and Conservation (RCFMC), working on tuna and shark issues in the same areas as IOTC. It is important to keep close communications with this and other groups to ensure synchronization of goals and avoid duplication of effort.

19. SHARKS AND BILLFISH
Shark data are already collected regularly at Cilacap and Tanjung Luar and include species and weight information. The dataset dates back to 2001 and is a valuable source of information for catch composition, total catches, relative species abundance and other parameters. Other ports have scant information on sharks and billfish and in most cases these data are not reported. Training on species identification, biological measurements and other parameters should take place as soon as possible. All shark and billfish data must be captured in the proposed datasheets and database.

Fishing Ports and Landing Sites

PPN PALABUHANRATU (WEST JAVA): Most of the fleet is made of longline vessels that are registered under the IOTC sticker programme. There are six enumerators who do complete enumeration of all vessels and tuna. Although not all the catch is unloaded at the auction place (Tempat Pelelangan Ikan, TPI), the processors are all within the harbour and are visited to register the catch. Tuna arrive already gilled and gutted by tender boats that collect them from the fishing boats to ensure freshness. Fish are no older than 15 days old and are destined for export. Whole weights are calculated on the computer from the length. There are other types of vessels including smaller longliners, gillnetters and boats for hand lining and trolling. Sharks are identified although there is no information on weight because they arrive already dressed.

Data for larger longliners are entered into FINSS while all data for this plus all other fleets are entered into the standard software developed to gather fisheries statistics (Aplikasi Pengolahan Data Statistik Perikanan Tangkap Pelabuhan). Data entered into this database are gathered from the SL3 form and are entered daily by all enumerators who then forward the monthly report within the first week of the following month. There are no calculations performed, only to determine whole weights of fish that arrive already dressed. Data written into this software may be exported with all details about vessel, gear, catch and species.

There are 25 FADs registered with DINAS in waters of around 2,000 m depth. Although some FADs are registered, there is the possibility that others are not. Information about which FAD was fished and catches will give fine detail on effort.

Facilities for enumerators include a room with A/C, computers and Internet connection. There is a need to replace some of the computers because they are obsolete. Personnel on site deem the number of enumerators sufficient.

Personnel at this site were asked to collect DNA samples (n=50) for skipjack according to specifications. The samples are to be stored in 70% ETOH and frozen until further instructions of where they are to be sent. Data to be collected include size, weight, sex (if possible), location and date of capture.

PPP SADENG (CENTRAL JAVA): This is a District office where three enumerators monitor the catches of handline, gillnet, trolling, purse seine, longline and kite fishing vessels. The main species caught are skipjack, yellowfin, bigeye, marlin and sharks. Tuna are weighed in lots and are separated into skipjack and bigeye/yellowfin. Smaller tunas are all aggregated as tongkol and are registered as such even though they may be a mix of species.

Data for all vessels are entered into the standard software developed to gather fisheries statistics (Aplikasi Pengolahan Data Statistik Perikanan Tangkap Pelabuhan). Data entered into this database are gathered from the SL3 form and are entered daily by all enumerators who then forward the monthly report to the Provincial office within the first week of the following month. At the Provincial office, all district data are aggregated and forwarded to Jakarta for production of statistics.

Shark species offloaded at this port include *Sphyrna lewini*, *Alopias pelagicus*, *A. supercilosus*, *Carcharhinus limbatus*, and *Hemipristis elongatus*. Sharks are weighed whole and all species are aggregated. There is no count of specimens for sharks or tunas. Although shark data are collected, they are not sent to the Province.

Large tunas may arrive gilled and gutted and the weight is not recalculated to account for this loss thus their weight is underestimated.

The largest fleet here uses gillnet and it fishes around FADs (five FADs at this time with plans for a further five) with the use of large halogen lamps. A typical catch is around 1 MT up to 2-2.5 MT per seven-day trip. The FADs are far out to sea (40 nm) and are only accessible to larger boats. Up to six boats may fish the same FAD at the same time. Smaller outrigger boats fish within 5 miles of the coast with monofilament nets and target mainly smaller tunas (longtail) and mackerel.

PPS CILACAP (CENTRAL JAVA): The fleet is made of longliners targeting southern bluefin tuna (December through March) and albacore (rest of the year), drift gillnets for skipjack and handlines for yellowfin, bigeye and albacore tuna although the former two are considered bycatch. Fish are weighed whole as there is no processing at sea. All albacore goes to local processors for canning where weighing takes place and where enumerators get information on catches.

There are three enumerators who cover 100% of the catch by weight and species but not numbers of fish caught. They also record some effort data like time spent fishing, fishing ground and numbers of hooks but there are no fields where to enter this information in either of the databases. The number of enumerators is deemed sufficient. Some length data are collected for albacore, yellowfin and bigeye tuna as well for swordfish. Since January 2011, enumerators collect information on the number of fish caught by longliners (tuna and swordfish). Sharks are not measured and all species are weighed together.

Species of shark offloaded in the port include *Prionace glauca*, *Carcharhinus longimanus*, *C. falciformis*, *Alopias pelagicus*, and *A. supercilosus*. Billfishes landed include *Makaira indica*, *M. mazara*, *Xiphias gladius* and *Istiophorus orientalis*.

Facilities for enumerators include an office with computers and Internet although there is no A/C and some of the computers need replacing (need at least two new computers). The data in this port are entered into an EXCEL spreadsheet because the data are sent to DGCF broken by GRT of vessels. All longline information is

entered into FINSS. IOTC forms are still used. In addition, the Pusat Informasi Pulabuhan Perikanan software is used.

There is a large fleet of trammel net vessels (*ca.* 200) fishing for shrimp and outrigger canoes catching the crab *Portunus pelagicus*.

There are no FADs in the area due to conflicts with gillnet vessels.

PPN PRIGI (EAST JAVA): Surprisingly, this port had the largest number of vessels found in any port visited in Java. The main art is handline (542 boats) that targets *Trichiurus* spp., followed by purse seine (157 boats) that targets *Decapterus macrosoma*, troll (86 boats) targets *Trichiurus* spp., and an unknown number of Danish seiners that target small pelagic fish like *Auxis thazard* and *Euthynnus affinis*. Boats fish in association to 20 FADs and target these small pelagic fish. The most fished tuna species is skipjack for which 180 kg are landed per day.

Although this port used to have a higher catch of larger tunas (skipjack, yellowfin and bigeye) the numbers in the past 5 years have declined dramatically and these species are only caught as bycatch and are not actively targeted. Sharks (Carcharhinidae) are rarely caught and, like tuna, are not weighed, counted or sampled.

There are three enumerators in the port who record the arrival of all vessels on the port although not all boats report their catches. No effort or size information is collected although production numbers are made for each species of tuna for most boats although it is not known how they account for those boats that do not report.

As in other ports, data are collected on the SL3 form and entered into the standard software and sent to Jakarta every first week of the month. As in most other ports surveyed, there is no estimation of effort. The office includes five computers, Internet connection, two scanners and A/C.

PPS BUNGUS (WEST SUMATRA): There are 60 longliners that target bigeye and yellowfin tuna, all registered under the IOTC sticker programme. If a longline vessel arrives into the port without a sticker, a request is made to Jakarta to assign a number and the sticker is given the vessel. In addition, there are 10-20 large purse seiners from Sibolga that go to Bungus to offload. They target skipjack but catch a considerable number of small bigeye and yellowfin as well as *Auxis thazard* and *Euthynnus affinis*. Finally, there are 20-30 lift-net boats that target the same species as purse seiners. The purse seine and gillnet boats fish associated to FADs thus the large catch of small tunas.

There are four enumerators in the port and they have a supervisor. The amount and quality of the data are probably the highest seen in all the ports visited and shows that it is possible to collect the required information from enumerators in Indonesia. All longline tuna are measured for length, weight and girth, although there are no measurements for tuna landed by gillnet or purse seine boats. Tuna from longliners may arrive gilled and gutted and the weight is later converted to whole weight from the fork length. Production data from vessels are crosschecked independently to ensure quality of reports from vessels. All tuna from purse seine and gillnet vessels are weighed in baskets and the species are mixed. Other data gathered but not entered into the longline logbook from Pusat include days at sea and numbers of hooks used, important information to determine effort. There is 100% enumeration of the catch weight through the TPIs although there are details of weight for individual species.

Different software is used at this port (Pusat Informasi Pelabuhan Perikanan) in addition to the common application. All information from the SL3 form is entered into the standard software as well. It is not understood why two different applications are used. FINSS is not used at this port.

Facilities for enumerators are adequate and consist of enough office space and desks. There are four working computers, printers, A/C and Internet connection. There is a scanner but it is broken. The filing system is adequate.

MUARA PADANG (WEST SUMATRA): This site is monitored by DINAS although it requires a higher frequency of visits due to the large numbers of small tuna (yellowfin and bigeye) offloaded every day. DINAS reported that it monitors the landing area 1-2 times per week but the fishers report a single monthly visit to gather weight measurements from traders.

There are around 200 boats based here that fish with handline and troll in the Mentawai Islands area. These boats fish close to approximately 500 FADs deployed in the area and catch a guessed 200 kg per boat per day. The majority of the catch (90%) is medium size skipjack with an estimated 1% yellowfin and bigeye tuna and the rest shared by dolphinfish, billfish and sharks. Large tunas are sent to a factory for processing while all small tunas are sent to the market for local consumption.

Sharks are commonly found in the market and include *Alopias pelagicus, A. supercilosus, Carcharhinus limbatus, C. fitzroyensis, C. falciformis, Hemispristis elongatus, Sphyrna lewini, Loxodon macrorhinus, Pseudocarcharies* spp., *Stegostoma fasciatum, Isurus oxyrinchus, Centroscymnus crepidater*, and *Atelomysterus marmoratus*. No information is gathered on these species or on billfish.

PPP CARUCOK TERUSAN (WEST SUMATRA): This port has 64 lift net, 15 Danish purse seine and 28 gillnet boats. Only boats registered in this port offload there. All lift net boats fish associated to FADs of which there are 100 in the area. There is no length information gathered in this port although there is weight by species for large specimens and mixed weight for smaller tuna. All fish are consumed locally and approximately 4.6 MT are offloaded at this site per day. Tuna comprises 15% of the catch and the two species caught are bigeye (60%) and yellowfin tuna (40%) with a substantial amount made of small specimens of both species (90%). There are no records (numbers or weights) for sharks or billfish although *Alopias pelagicus, Sphyrna lewini, Loxodon macrorhinus* are caught with hooks and *Istiophorus platypterus, Makaira mazara, Tetrapterus audax* and *Xiphias gladius* are caught with gillnets. Sharks are processed for fins but the trunk is also kept.

Data are gathered on the SL3 form and entered into the common application by a person different from the enumerator at the site. There is no information gathered on fishing zone or effort.

PPP LAMPULO (NORTH SUMATRA): The information presented for Lampulo was gathered through a phone interview with Mr. Ullil the enumerator at this port. There are 15-20 vessels (10-20 GRT) that use longline and target sharks including *Isurus* spp. and *Carcharhinus melanopterus*. The sharks are kept whole and anywhere between 15-28 sharks are caught per one-week trip. There are 10-15 (5 GRT) boats that use handline and target large yellowfin tuna (35-50 kg). These boats catch 1-3 tuna and 1-3 *C. melanopterus* per one-day trip. Finally, there are 150 purse seiners (20-30 GRT) that fish for skipjack, *Auxis thazard*, and *Euthynnus affinis* although they also catch small yellowfin and bigeye tuna because they fish around FADs. These boats catch 1-2 MT per trip of which approximately 30% are small tuna of the two latter species. There is complete enumeration of the catch.

PELABUHAN BENOA (BALI): Benoa is considered a "general" (Umum) and not a fishing port, and does not fall under the jurisdiction of DGCF. This presents difficulties for enumerators, as they cannot get all the information needed from the processing plants. Benoa is by far the largest and busiest port visited and also, unfortunately, the most understaffed. The size of this harbour and importance beg for much higher sampling effort and better facilities for the enumerators. There are five enumerators working in an unsuitable office with no A/C, no Internet connection, and, more importantly, no computers except a small laptop for all data entry.

Due to the volume of catch, large number of vessels and processing plants where the fish are offloaded (14), this is the only port visited where there was not 100% enumeration of all the catch. Sampling covers 30-40% as per IOTC sampling protocol and this is raised to 100%. The issues mentioned before present a logistical challenge to properly estimate the number of vessels offloading and to conduct sampling fulfilling the criteria for all strata. There is a large fleet of large and small longliners the latter of which are not registered under the IOTC sticker programme. In addition, there is a large fleet of jiggers targeting squid but also opportunistically catching tuna. Unfortunately, these vessels are not monitored and the catch goes unrecorded. In addition there are some gillnet and purse seine vessels that have officially been included in the sampling programme but have yet to be sampled due to bureaucratic delays.

Enumerators are measuring over 30% of all landings. There appears to be a need to further stratify the sampling scheme as there are large and small longliners and this information is not taken into account when creating a raising factor. Furthermore, enumerators will soon start to sample purse seine and gillnet boats so these fishing arts need to be included in the sampling strata. Enumerators report that the large fleet of jiggers that target squid also catches tuna but these data are not captured under the current sampling scheme. The original sampling scheme by designed IOTC/RCCF/CSIRO in 2002 focused on industrial longline vessel landings only. It was not designed for artisanal/small scale vessels so modifications to this need to accommodate these changes.

Enumerators enter data in FINSS but export the data as an Excel file to send to Jakarta. FINSS does not run under Windows 7 and this presents a limitation about which computer they use for data entry. The SL3 form is not used here because it assumes 100% enumeration. It is not known how DGCF in Jakarta raises the proportion of vessels sampled to 100%. This is particularly important because there is no stratification between large and small longliners and soon between longliners and purse seiners-gillnetters. Data collected includes individual weight for rejected tuna (i.e. for internal consumption not export), species, and total weight per species for all tuna sampled within the vessels/offloading/processing plants strata.

Personnel at this site were asked to collect DNA samples (n=50) for skipjack according to specifications. The samples are to be stored in 70% ETOH and frozen until further instructions of where they are to be sent. Data to be collected include size, weight, sex (if possible), location and date of capture.

PPP JIMBARAN/KEDONGANAN (BALI): Approximately 80% of the catch is from handline boats (6 MT GRT) although four vessels use purse seine (30 MT GRT) and an unknown number uses trolling. Purse seiners catch 15-20 MT and apparently boats of all categories fish associated to FADs.

Information is gathered from the TPI although not all fishers offload there but ship directly to their clients so it is unknown how accurate the production estimates are. Species and weight are recorded for fish of 30 kg or more. Although smaller fish also have species and weight recorded, their weight is presented as a global estimate in the "tuna" category. Because the large fish go to Benoa for export, it is necessary to ensure that there is no double reporting by the enumerators in that port. Also, the weight gathered is for fish gilled and gutted and there is no recalculation of whole weight so the catch is under reported. There are identification issues with small specimens of bigeye and yellowfin and of smaller tuna species (*e.g. Auxis* spp.).

This site has a new office and two enumerators who gather production information from the TPI and fishers. There are no computers, no Internet connection and no A/C. Data are entered in Excel and sent to the Regency on the first week of every month.

PPI TANJUNG BENOA (BALI): The most important fleet is made of 30 purse seine vessels (30 GRT) that fish associated to 10 FADs in the area around south Sumbawa. They catch around 12 MT of fish per five-day trip of which 2 MT are tunas mainly bigeye and skipjack tuna and 50 kg are sharks of various species. In previous months the catch was 60 MT for tuna. There also are handline, trolling and kite fishing boats although their numbers are unknown.

Data collected include vessels, gear, total weight of catch and species of fish although difficulties exist to identify smaller specimens of bigeye and yellowfin tuna. Tuna heavier than 15 kg are weighed individually and all smaller specimens weighed together. There is 100% enumeration and this information is gathered from the TPI.

The office has two computers, Internet connection but no A/C. There is one enumerator and this number seems sufficient for the site.

PPI TANJUNG LUAR (LOMBOK): The fleet is made of gillnet, mini purse seine and handline boats that fish in association with FADs in Sumbawa, the neighbouring island to Lombok. Small fish are weighed on baskets of mixed species although a great majority is made of *Euthynnus affinis* and *Auxis thazard* with some small yellowfin tuna found. This is a port managed by DINAS and there is no requirement to report species individually so the tunas are all clumped together. Sometimes the weight of baskets is estimated by eye so this adds to the uncertainty of the capture in this port. The catch information is gathered from the TPI.

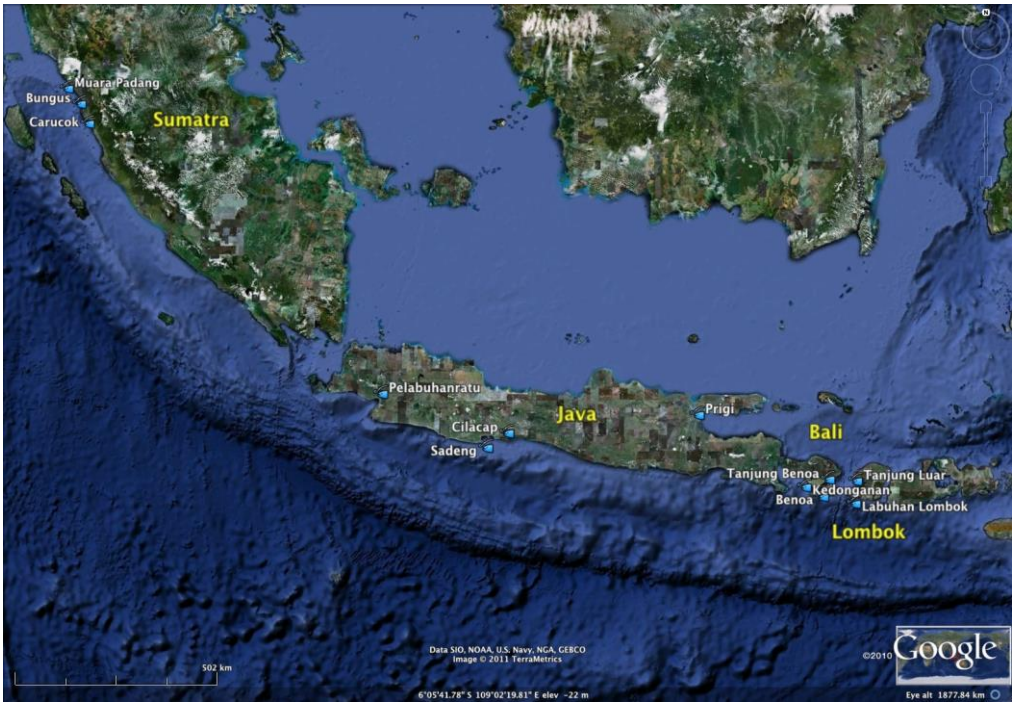
Many species of fish are offloaded in this port although tunas of interest (bigeye and yellowfin tuna) are not very important in terms of catch. Sharks, rays and billfishes are far more important, the former in particular, with up to 9 MT offloaded there in April 2011. There are no records on species of this group although there are a large variety of sharks as observed in this visit. Genera observed include *Alopias*, *Isurus*, *Sphyrna* and *Carcharhinus* among others.

There are 2 enumerators that work this port and the data they report are of higher quality than that required by DINAS. The office is of suitable size although there are no working computers or Internet. The enumerators use a personal computer to enter and send the data. Data are entered into Excel and sent to the Provincial office on the first week of each month. If work is to be expanded at this port, there is the need to provide at least another enumerator as well as Internet and computers.

PPP LABUHAN LOMBOK (LOMBOK): The main fleet here is handline with about 100 vessels. They catch a mix of bigeye, skipjack and yellowfin tuna fishing in close proximity to around 20 FADs. Large fish are sent to processing plants and smaller ones are sold for local consumption. As seen on other ports, the latter are called tongkol but are made of the three species mentioned above. Although there is a high proportion of larger bigeye, there is no such category in the reporting and they are all labelled as yellowfin tuna. For example, in May 2011, 399 MT of the two species were landed but were reported as yellowfin tuna. Approximately 75% of the total catch is made of these three species with 50% bigeye, 30% skipjack and 20% yellowfin tuna. There are no sharks landed here. There is total enumeration of the catch by the TPI.

The office is large and has two working computers with Internet connection. The data are entered on the PIPP software and onto the general SL3 database.

Map of Indonesia with ports and landing sites visited during this mission



Summary Table: Indonesia
General Information
Vessels and gears: The artisanal fleet in Indonesia is characterized by a large number of non-motorized or outboard-powered vessels of less than 10 GT although there are large numbers of inboard powered vessels up to 25 GRT. The primary fishing gears used for pelagic species are troll line, hand line, purse seine and drift gillnets. Not all vessels have permits. Handlines are used mainly to catch large yellowfin tuna and skipjack while troll lines catch the latter, small tuna species, and juveniles of yellowfin and bigeye tuna. Gillnet is the main gear used to catch longtail tuna, and kawakawa is caught with purse seines. Vessels unload in various ports according to their classification and tonnage. There are four types of ports: Oceanic Fishing Port (n = 5), Archipelagic Fishing Port (n = 11), Coastal Fishing Port (n = 17), and Fish Landing Centre (n = 477). Most of the catch comes from gillnet (45% of the catch), purse seine (37%) and various types of line fishing (12%).
Catches by species: Skipjack (48,028 MT), kawakawa (38,536 MT) and longtail tuna (32,804 MT) and narrow-barred Spanish seerfish (24,379 MT) make a large portion of the pelagic species landed by the artisanal sector in the Indian Ocean. Considerable quantities of juvenile yellowfin and bigeye tuna are also landed but they are under-reported as they are labelled as tongkol, a category that includes smaller tuna species, very importantly kawakawa.
Legislation: The Statistics Law No. 16 Year 1997 regulates activities of national statistics to realize a system of national statistics that is reliable, effective and efficient.
Institutions responsible for data collection and processing and linkages among them, if any: Directorate General of Capture Fisheries (DGCF); Central Bureau of Statistics (BPS), DINAS
Sampling
Existing data collection system: Government production estimates are plagued with inconsistencies and high level of inter-annual variability. The national fisheries statistical system includes a multitude of forms – "survey forms" (the "SL" series) and "estimation forms" (the "EL" series) that together provide data for a series of "reporting forms" (the "LL" series) that are completed quarterly by District Fisheries Offices (DFO) and sent to Provincial Fisheries Offices (PFO). The PFO in turn collate data from all the LL-forms from DFO within the province, which then forward the data to the DGCF quarterly. The PFO also use the LL-form data to produce annual reports with production statistics and fishing effort (vessels, households, establishments, units) tables similar to that presented in the DGCF annual reports. The reporting system was designed to have two primary outcomes: 1) nationwide statistics on annual production for all species groups fished, both at industrial and artisanal levels, and 2) nationwide annual inventories of the number of fishing units (households, companies, operators) and number, size, and gear-type of fishing vessels involved in the fishing activities at both levels in all provinces. The current methodology for the estimation of size of the artisanal fleet is household surveys. BPS is primarily responsible for the annual census of fisheries households at the fishing village level, whereas DGCF is responsible for doing the more routine weekly and monthly sampling of catch at all levels of landing places. Catch records are compiled from the tally sheets from processing companies and from records from the auction officer either daily after each auction session or monthly. Auction records vary from informal notes to more formal logbooks. Estimation of weight may be done with balances or, in those places with no weighing facilities, by eye. Separation of tuna species is still an issue of concern particularly for small yellowfin and bigeye tuna. This also seems to be a problem for smaller tuna species that in the early literature were called "tongkol" and meant the oceanic bonitos, which were the dominant species in the 1980's. Currently, most small tunas found are bullet and frigate tunas but these unfortunately are still classified as *E. affinis/E. yaito*[3]. Also, size frequency data are collected for research, not monitoring. Finally, size frequencies for strata are not consistent with catch/effort estimation, sample size is not sufficient and fish are not randomly measured. There is considerable variability among districts in the ways data are collected and reported, particularly at the first point of collection. This includes variability in: 1) the agencies involved, 2) the actual procedures of data acquisition and estimation, and 3) the level of validation and crosschecking[4]. A Fisheries Production Survey was implemented in 1976. The DGCF-PFO– DFO conduct this survey every year. The survey for marine capture fisheries covers: 1. Companies (L-I survey) 2. Major fish landing places (L-II survey) 3. Fishing villages sample (L-III survey) Data are collected by DFO officers with the use of data forms (SL forms). The number of households and fishing boats is tallied annually. The number of fishing units (gears) for non-powered boats is collected quarterly. The number of trips and production are collected weekly, monthly and quarterly depend on the type of survey. Collection of data in major landing places, auction places, and in sample villages are conducted every week, every month and every quarter, respectively.
Recent projects aimed at strengthening statistical systems, if not when was last: There was a catch monitoring programme for

[3] Ingles J, Flores J, Musthofa I and Mous P (2008). Getting off the hook: reforming the tuna fisheries in Indonesia. WWF-Coral Triangle Initiative
[4] IOTC-OPCF (2004). Report of the regional workshop and summary of the country report

industrial vessels, longline specifically, funded and implemented by the Indian Ocean Tuna Commission (IOTC), Commonwealth Scientific and Industrial Research Organization (CSIRO, Australia), the Ministry of Marine Affairs and Fisheries (Indonesia) through the Research Centre for Capture Fisheries (RCCF)/Research Institute for Marine Fisheries (RIMF) and the Directorate General of Capture Fisheries (DGCF), Japan's Overseas Fisheries Cooperation Foundation (OFCF), the Australian Department of Agriculture Fisheries and Forestry (DAFF) and Australian Centre for International Agricultural Research (ACIAR). This programme included training of enumerators, sampling design, data entry and software usage. In addition, Indonesia, in collaboration with WCPFC/SPC/CSIRO/ACIAR, has made good progress towards setting up enumeration of artisanal/small scale fisheries in eastern Indonesia, at Bitung and Kendari (both in Sulawesi) with plans to expand to other ports.

Sampling Design

Date of creation, last revision and frequency of revision: The national system has remained relatively unchanged since it was developed and implemented between 1974-1976 by FAO fisheries statistician, Dr Yamamoto, although DGCF has commenced a program of modifications. There was an overhaul done to the system in 2003-2007 but it has reverted to the original plan since 2010.

Documentation (present/absent): The system designed by Dr. Yamamoto is fully documented as is the overhaul implemented in 2003-2007.

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc):
Capture fisheries statistics (includes marine capture fisheries & inland open water capture fisheries) are handled by the Capture Fisheries Statistics Division under the Directorate General of Capture Fisheries (DGCF). Capture fisheries statistics are produced by the DGCF in cooperation with the PFO and the DFO.
The DGCF has the tasks of:

1. Providing survey methodology.
2. Guidance for implementation of survey.
3. Processing, analyzing and publication of national capture fisheries statistics.

The PFOs have the tasks of:

1. Deciding design of sample survey in districts.
2. Processing, analyzing and publishing of provincial capture fisheries statistics.

The DFOs have the task of:

1. Collecting data.
2. Estimation/processing data.
3. Reporting statistics

Type of effort data collected

Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed): Catch is reported by processors and auction officers every day and compiled in a monthly report. Assumption of sample randomness not tested. Enumerators typically gather production information from TPIs and compile it by species or in some cases groups of species (sharks, billfishes and small tunas). Sampling of the catch is done in the main longline ports and in some of the smaller ports (*e.g.* Bungus) although there are no forms or databases into which to enter the data.

Frame survey date last conducted and frequency: This varies from port to port as they are done independently by the Division or Provincial office

Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.): Few ports or landing sites actually measure effort

Coverage (total enumeration or % sampled):

Type of catch data collected

Reports from fishermen or other non-governmental sources: Catches reported by processors and auction officers

Enumerators sample catches at the landing place: No

Both sources: No

By gear or aggregated: Gears aggregated

By species or aggregated: Species identification not satisfactory. Percentage tuna species aggregated 30%

Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): Fish may or may not be weighed depending on the availability of scales. If no equipment available the estimation is done by eye. Weight is not estimated independently but processors and auction officers give values. Logbooks or values given by processors or auction officers are not validated (*e.g.* by landings). There is taxation linked to catch and this might encourage under reporting. Not all tunas are monitored and the size-frequency strata are not consistent with catch-effort estimation.

Coverage (total enumeration or % sampled): For most ports and landing sites, 100% of the catch is weighed by the TPI. Benoa measures 0ver 30% of the vessels arriving according to IOTC specifications.

Data Processing

Personnel involved, qualifications (database admin) and main functions: No permanent database manager

Data flow, including time frames for each step

Amount of data handling before data are input in a computer and time frames for each step

Hardware and software in place

Type of system: Centralized system or other

Type of data input and flow of electronic data, including time frames

Data validation and verification procedures: by hand, electronic, etc: No validation procedures in place during data entry but validation integrated into database design. The information is crosschecked from independent sources and feedback given to collection team if errors are found.

Catch estimation procedures
Date of creation last revision and frequency of revision
Documented or not documented: Documented
Estimator (formula used to estimate catch): Unknown. Most ports in theory report 100% of the catch as it is offloaded and measured by the TPIs. The most notable exception is Benoa in Bali where 30-40% of the longline catch is measured according to IOTC standards although it is unknown how this percentage is raised to 100%. In addition, other gears are used to catch tuna although they are not sampled at this time.
Platform: integrated in database, external: External
Procedures: minimum coverage, substitution scheme, etc. Unknown
Type of output: catch plus estimates of precision, etc. There is no variance included in the estimation
Estimation time frames: Two to three months from date of collection of data.
Review of estimates (never, as more data becomes available, or other): Estimates are not revised.
Reports
Timeliness of production of type of catch estimates: Reports take 2-3 months to produce at the Central level although data are reported on time from each sampling office.
Preliminary estimates: There are no preliminary estimates.
Final estimates: Three months after data collection although in some cases provinces may delay reporting and final reports can be up to two years late.

Proposed Budget for Improving the Reporting System in Indonesia

Item	Number	Months	Cost Unit	Total Cost Rps
Enumerators	50	12	$1,000,000	$600,000,000
Computers	50	1	$5,000,000	$250,000,000
Filing Equipment (cabinets, binders)	50	1	$3,000,000	$150,000,000
Travel (trainers)	12*	6	$3,000,000	$216,000,000
Accommodation (trainers)	80**	6	$300,000	$144,000,000
Salary (trainers)	4	6&	$3,000,000	$72,000,000
Materials sampling (calipers etc)	30	1	$5,000,000	$150,000,000
Backup System	20	1	$5,000,000	$100,000,000
Office improvement	20	1	$5,000,000	$100,000,000
Survey ports, landing sites and fleet	1	4	$50,000,000	$200,000,000
Logbook socialization	15	6	$1,000,000	$90,000,000
FAD survey and sticker programme	10	1	$200,000,000	$2,000,000,000
Database consolidation	1	6	$50,000,000	$300,000,000
Trainer for trainers (salary, transport, etc)	1	2	$100,000,000^	$200,000,000
PDA	100	1	$1,700,000	$170,000,000
PDA software development	1	5	$60,000,000	$300,000,000
Validation (to be done by the trainers)	10	4	$3,000,000	$120,000,000
Datasheet and logbook revision	1	4	$40,000,000	$160,000,000
Subtotal				**$5,322,000,000**
Misc (10%) of subtotal				**$532,200,000**
Total Cost IND Rp				**$5,854,200,000**
Total Cost US $				**$681,117**

* Four trainers times three weeks per month
** Four trainers times 20 days per month
& One month training four months travelling
^ This value includes salary, transportation, and accommodation

Mission schedule

Date	Activity
11/6/2011	Travel Nairobi-Dubai
12/6/2011	Travel Dubai-Jakarta
13/6/2011	Arrival Jakarta, rest
14/6/2011	Meeting with officials at DGCF
15/6/2011	Meeting with officials at DGCF
16/6/2011	Writing of findings
17/6/2011	Travel to Pelabuhan Ratu. Visit to port and meetings with DGCF officials
18/6/2011	Writing of findings/Travel to Jogyakarta
19/6/2011	Visit to Sadeng and meeting with officials
20/6/2011	Visit to Cilacap and meetings with officials
21/6/2011	Writing of findings/Travel to Surabaya
22/6/2011	Visit to Prigi and meetings with officials
23/6/2011	Writing of findings/Travel to Jakarta-Padang
24/6/2011	Visit to Bungus, Padang and Carucok and meetings with officials
25/6/2011	Writing of findings and travel to Jakarta
26/6/2011	Rest
27/6/2011	Meeting with meeting with official from DGCF, Travel to Denpasar
28/6/2011	Visit to Benoa and meetings with officials
29/6/2011	Public holiday for all public officials. Writing of findings
30/6/2011	Visit to Jimbaran/Kedonganan
1/7/2011	Visit to Kedonganan/Benoa. Travel to Lombok
2/7/2011	Visit to Tanjung Luar and Labuhan Lombok. Travel to Bali
3/7/2011	Writing of findings
4/7/2011	Writing of findings. Meeting with Mr. Craig Proctor, CSIRO
5/7/2011	Meeting with Dr. Besweni. Writing of findings. Travel to Jakarta
6/7/2011	Travel to Dubai and Seychelles

People met during the visit

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Iran (Islamic Republic of)

Main findings and proposed actions

Iran's catches for 2009 were estimated at 48,304 MT of longtail tuna, 45,978 MT of skipjack and 22,596 MT of yellowfin with an insignificant component of bigeye tuna. Iran has a large but relatively simple tuna fishery concentrated mainly on the use of gillnets. Nonetheless, the country meets substantial challenges due to the large size of the fleet and numerous ports where fish are offloaded. Due to strict management and security measures, all boats going out must report their trips thus resulting in a very good measure of effort. Similar findings were encountered by the Secretariat in the Sistan-Baluchestan region during a previous mission this year. This area is where most of the high-seas drift-net fishing fleet is based.

Logbooks have been introduced for vessels over 24 m although the coverage is still low. There are plans to have the same system in smaller vessels and this should happen by the end of the year. Problems exist with the sampling but overall Iran has the best system in the region. Issues to be addressed include the lack of resolution on effort data (number of panels, hooks, etc) per fishing set, non-random sampling of vessels, deficiency on length frequency sampling, and lack of observers. At this time, there are 17 designated places where length frequencies are taken but it is necessary to expand this to include more landing sites to avoid bias from the current methodology.

Data entry is not delayed in Iran because enumerators enter their own data at the port of collection. The data are then checked randomly by the supervisor and are again checked in Tehran. Port facilities are the best observed in the region and the orderliness and cleanliness of the sites make sampling much easier. Adequate offices with AC, Internet, computers and other facilities are the norm.

Unlike other countries, there is a limit on the number of vessels allowed to fish and the introduction of a new vessel will result on the destruction of the vessel it replaces.

Because Iran has the largest fleet of drift gillnetters in the Indian Ocean and because there are serious concerns on the impacts of said gear due to non-selectivity on turtles, marine mammals and birds, it is urgent to implement an observer programme in Iranian waters. Modifications to the gear or outright exchange for more

selective techniques should be viewed as a necessity under the ecosystem-based management sought by the IOTC and other RFMOs.

Findings and Recommendations

1. EFFORT
   Data are gathered by trips that may be daily or longer. Also, boats may use one gear or more and the reporting does not reflect either of these issues. It is proposed that catches and effort be recorded by set (line, net, etc) not by day to increase the resolution of the data collected. The specification of the number of gillnet panels and their lengths is necessary as Iran has a large fleet with many gillnetters and the number of nets in the water at anyone time is substantial. These proposed changes must be reflected in the existing datasheets.

2. SAMPLING
   Although boats were initially selected randomly to cover the boat/gear strata, due to issues in collaboration while interviewing fishers, the number of boats sampled is reduced and the boats sampled are always the same. It is necessary to determine if there is a bias in this methodology and if so modifications will be needed to remedy this potential issue. Preferably, vessels should be sampled randomly although this may not be an option if fishermen are uncooperative.

3. STRATIFICATION
   It is necessary to review the sampling stratification currently in place. Not all fishing ports and landing sites are sampled and it is necessary to determine if the current scheme represents the fleet, effort and catch objectively. Stratification is revised within a port to determine its representation of the fleet in the port but it is not revised to determine the suitability of the overall sampling scheme in representing the whole country.

4. LENGTH FREQUENCIES
   Length frequencies are taken at 17 specific sites in the whole of Iran but the coverage should be increased. It is possible that the current sampling plan is biased as there are significant gear/fish size differences from port to port and it is unknown how the current plan was designed.

5. ENUMERATORS
   The number of enumerators was recently reduced and this should be addressed. As a result length frequency sampling has been considerably lowered. It may be necessary to hire new personnel due to the variety of activities that the samplers do in each port.

6. OBSERVERS
   As seen in many other countries in the region, there is a need to implement an observer programme to cover issues like bycatch. Iran has a fleet that can support observers, unlike other countries where vessels size and facilities are restrictive. In the case of smaller vessels that cannot support observers, the possibility of having observers deployed from coastguard vessels or other types of boats to visit the fishing vessels for a few hours to gather data without staying onboard should be investigated.

Fishing Ports and Landing Sites

SISTAN-BALUCHESTAN: This province was visited during a previous mission this year. It is home to the largest fleet of high-seas driftnet vessels (*ca.* 1,000) in the country.

BANDAR KONG (HORMUZGAN): This port is home to 137 small boats and 116 dhows that target kawakawa, Spanish and king mackerel, longtail tuna, frigate tuna and some sharks. The main gears used here are handline, gillnet and traps. Approximately 20 MT of all fish species are landed here every day with approximately 60% being tuna totalling about 10,000 MT per annum. Two enumerators sample this port but collection of length frequencies was suspended a month ago.

HASINE (HORMUZGAN): This is one of the most important ports in the province and the main gear used is surface gillnet. There are 24 dhows and 60 smaller boats that target longtail tuna and Spanish mackerel and approximately 7,500 MT are landed per year. One enumerator takes approximately 50% of the required samples 7 days per week and the other half is done by the Fishermen's Cooperative. The port manager revises all datasheets.

BOSTANEH (HORMUZGAN): A fleet of 166 boats and 115 dhows that mainly use gillnets reside here. As already observed in other ports, no biometrics are taken and the same boats are sampled every time. Dhows fish

anywhere from one week to 10 days while boats make single-day trips. Approximately 40 MT of all species are offloaded here every day.

BANDAR ABBAS F.P. CO. (HORMUZGAN): This processing plant cans tuna for internal consumption and also exports to the Middle East. It packs mainly skipjack and longtail tuna but low supply of fish is a difficulty discussed. This plant is considering importing items not consumed in Iran (those that are not halal like squid and octopus) to process and re-export to diversify its portfolio and reduce problems with undersupply of fish for canning.

BANDAR ABBAS (HORMUZGAN): This site is home to the small (four boats) commercial Iranian fleet of purse seiners. Logbooks were revised and the coverage is very good although they could be improved by the inclusion of gear specifications (size of net, mesh size, depth of net, etc). It is also necessary to break certain categories into species (*e.g.* sharks, rays).

BASAEEDU (QESHM ISLAND): Like most ports in the region, this one is home to a fleet of gillnetters. The nets used here are drift gillnets that may vary in length but were suggested to be as big as 50 pieces of 200 yards/piece and the main species targeted is longtail tuna. A fleet of 60 dhows and 85 boats resides here.

SALKH (QESHM ISLAND): This port holds a fleet of 55 small boats (7 m fibreglass) and 48 dhows that use gillnets, troll, traps and two-boat purse seines. The main species targeted are Spanish mackerel, cobia and longtail tuna.

Map of Iran with ports and landing sites visited during this mission

Summary Table: Iran

General Information

Vessels and gears: Artisanal vessels, ranging from small boats with outboard engines to large traditionally built wooden dhows, dominate the fisheries in terms of catches. In the case of tunas, these artisanal vessels account for about 94 % of total catch, most of which is taken with gillnets. The importance of the industrial tuna vessels has been variable over the last ten years. Currently, fishing operations take place both in the Iranian EEZ as well as in distant waters of the Indian Ocean. The importance of this fleet is expected to decrease.
The fleet in the southern provinces consists of more than 10,000 boats, dhows and trawlers. Small boats are usually powered by outboard engines. The size of the dhow fleet, comprised of wooden vessels of traditional design and And more modern vessels are made of fiberglass, is controlled by a licensing scheme. These vessels fish in coastal waters also and occasionally offshore. A large number of the dhows may engage in trawling during the shrimp fishing season. In Sistan-Baluchistan province, where larger dhows operate, landings are dominated by tuna species such as yellowfin, skipjack and longtail tuna.
Vessels are classified by GRT and they are divided in four categories for sampling purposes:
1. vessels less than 3 tonnes (Boats)
2. vessels from 3 to 20 tonnes
3. vessels from 21 to 50 tonnes
4. vessels >50 tonnes

Catches by species: Iran reported 48,304 MT of longtail tuna, 45,978 MT of skipjack and 22,596 MT of yellowfin tuna in 2009.

Legislation: Not specified

Institutions responsible for data collection and processing and linkages among them, if any: The Iranian Fisheries Company, usually referred to as Shilat, is responsible for fisheries administration in IRN, Which is affiliated to the Ministry of Jihad-e-Agriculture. The Statistical Unit under the Department of Fisheries Management, Shilat, is responsible for the collection, processing, validation and dissemination of fisheries statistics. Sampling for biological data is also undertaken, on a regular or intensive basis. Representative fisheries offices have been established in all of the southern coastal provinces of the country.
Research: Responsibility of the Iranian Fisheries Research Organization (IFRO). It has seven affiliated centres situated in the Caspian Sea (Gilan and Mazandaran, Golestan province) and the Persian Gulf and Oman Sea (Khozestan province for fresh water; Bushehr province for Persian Gulf area; Hormozgan province for Oman Sea; and Sistan-bluchestan province (Chabahar city) for Off-shore fisheries).

Sampling

Existing data collection system: Complete census of the artisanal fleet was undertaken in 1997, including the various fishing crafts categories from small boats with outboard engines to the large fishing dhows (> 50 tonnes GRT). Information concerning the industrial fleet, including purse seiners, a longliner (not active yet) and trawlers, is based on a complete enumeration system through the compulsory submission of catch and efforts logbooks. Fish landing data on artisanal fisheries are obtained by landings surveys at selected landing sites throughout the southern coastline of the country. A major revision of the collection system was undertaken over the period from 1995 to 1997, including a change of responsibility from the IFRO to Shilat in Iranian northern waters in Caspian sea we carry out total enumeration. The fishing method is beach seine for bony fishes also for anchovy we use some small size fishing vessels for sturgeon fishes we implement complete census.
The landings surveys cover 42 out of a total of 63 landing sites, distributed among the four southern provinces; Khozestan, Bushehr, Hormozgan and Sistan-Baluchestan provices. The methodology involves sampling of about 10% of the fleet taking into account boat category, fishing area and fishing gear. These vessels are chosen as a representative sample of various categories and consistently sampled after each fishing trip. A fishing permit/licence is issued for every fishing trip, which involves supplying information on fishing area, method, gear, and fishing effort. Nine species of tuna and tuna-like species are collected/identified in the pelagic category. The catches of industrial purse seine tuna vessels are reported by species, although some other species are aggregated. The method used for estimating landings of the artisanal fisheries appears to be adequate and preliminary estimates indicate that CPUE can be estimated with a low coefficient of variation (1-3%) based on stratification techniques. Validation of catch estimates is thorough and effort data comes from complete enumeration, which is the best solution available.
Biological data, such as size frequency data and average weight, are collected on for 10 important species by landing site samplers (Field observers). This includes inter alia: *Scomberomorus commerson, Thunnus tonggol* and *Euthynnus affinis, Thunnus albacares* etc. The size data are collected on a routine and regular basis.
The Fisheries Research Centre (FRC) in Chabahar (Sistan-Baluchistan) gives considerable attention to tuna species as they are biologically important species in the region. Of special interest are data on gillnet selectivity and geographical information on catch and effort of the artisanal fisheries as well as biological data on yellowfin and skipjack tuna primarily, including their length, weight, sex, gonad weight, maturity stage, and stomach content. The research centres in the Bushehr and Hormuzgan provinces concentrate more on the valuable shrimp resources, but biological data are available on some species of interest such as seerfish and longtail tuna. However, these data are not sampled regularly and the sampling intensity is rather low. Instead Shilat will cover the size data sampling for those species under its size data collection system.

Recent projects aimed at strengthening statistical systems, if not when was last:

Sampling Design

Date of creation, last revision and frequency of revision:

Documentation (present/absent):

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc):
A total of 60 people work on licensing, control and monitoring, sampling of landings and prices, size frequency sampling and data input. Of these, 42 are full-time samplers allocated along the southern coast. Data input is undertaken in 42 major landing sites in the

south under the responsibility of the samplers. Separate staff deal with the compilation of economic data for bio-economic analysis.
Type of effort data collected
Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed): Effort data are obtained from fishing licenses, based on a complete enumeration system.
Frame survey date last conducted and frequency:
Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.): Landings surveys are undertaken to obtain catch estimates from the artisanal fisheries, while effort data is obtained from fishing license, based on a complete enumeration system. The conventional approach for raising catches is used, involving the estimation of mean catch per unit of effort by strata (month, landing site, vessel type and gear) and then extrapolating these estimates to the whole population (fleet) using the known effort. Generally, the precision of estimates is considered to be reasonable and statistical collection system appears to function efficiently. In the case of the industrial fisheries, information on catch and effort are obtained from fishing logbooks, observer programmes and landing inspections.
Coverage (total enumeration or % sampled): 10% of the catch and 100% of the effort are sampled.
Type of catch data collected
Reports from fishermen or other non-governmental sources: Yes, logbooks from fishermen
Enumerators sample catches at the landing place: Yes. Questionnaire is filled at landing site by 42 enumerators who are also involved in activities related to licensing, control and monitoring (including size frequency). The questions in this form include: vessel code and capacity, landing centre code, fishing ground code (out of 26), dates of departure and arrival, fish permit number, fishing method and gear (number and duration of gear set in the water), and name of species caught (choice of 52 species) and amount of catch per species. 10 % of the vessels are chosen as a representative sample of various categories and consistently sampled after each fishing trip.
Both sources: Yes
By gear or aggregated: By gear
By species or aggregated: By species
Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): Weight. Weighed with scales.
Coverage (total enumeration or % sampled): 10%
Data Processing
Personnel involved, qualifications (database admin) and main functions: Database administrator is a permanent staff
Data are not transcribed before entry. Short time between data acquisition and entry but data entry is done far from place of collection. Monthly reports are submitted to the provincial offices and these are aggregated on a quarterly basis and sent to the data collection unit in Tehran. A statistical scientific Committee, including representatives from Shilat, IFRO and Fishermen Associations, meet on a quarterly basis to validate the aggregated data. The software AMAR, based on FoxPro 2.6, was created for the compiling, processing and presentation of statistics in 1997 in connection with the major revision of the collection system.
Amount of data handling before data are input in a computer and time frames for each step
Hardware and software in place: Software AMAR based on FoxPro 2.6 was built in 1997. The program was designed for compilation, processing and reporting of statistics. Now The AMAR software works on SQL 2000 and in near future it will be upgraded to SQL 2008 and web.
Type of system: Centralized system or other: Multiple server
Type of data input and flow of electronic data, including time frames: It takes 1 month from the time the data are gathered to the time they are entered into a database.
Data validation and verification procedures: by hand, electronic, etc.: Validation procedures implemented at entry and integrated into database design. Information crosschecked with independent sources and feedback provided to collection team. Basic data are transmitted electronically and the catch estimation procedure is centralized and includes variance. Size frequency data are raised to total catch and the reports are prepared electronically. Data are checked for errors during and after entry. This is done automatically through triggers and manually as well. Key punching errors are handled through a filter in FoxPro. Verification of total enumeration done at provincial level by the Head of the Statistical Unit and the process is repeated in Tehran. There is crosschecking by total census in one or two landing sites in each province from time to time.
Catch estimation procedures
Date of creation last revision and frequency of revision
Documented or not documented
Estimator (formula used to estimate catch)
Platform: integrated in database, external
Procedures: minimum coverage, substitution scheme, etc.: Catch is estimated by two scientific committees, one in the province and one in Tehran.
Type of output: catch plus estimates of precision, etc.
Estimation time frames
Review of estimates (never, as more data becomes available, or other)
Reports
Timeliness of production of type of catch estimates: Three, six, nine months and yearly reports are ready within two months of receipt of data.
Preliminary estimates: Yes

Final estimates: Yes

Proposed Budget for Improving the Reporting System in Iran

Item	Number	Months	Cost Unit	Total Cost USD
Observers	40	12	$800	$384,000
Observer training	4	1	$5,000	$20,000
Improvement datasheets	1	2	$5,000	$10,000
Enumerators	40	12	$500	$240,000
Stratification revision	1	3	$7,000	$21,000
Boat sampling revision	3	3	$5,000	$45,000
Subtotal USD				**$720,000**
Misc (10%) of subtotal				**$72,000**
Total Cost USD				**$792,000**

Mission schedule

Date	Activity
30/10/2011	Travel Dubai-Iran
31/10/2011	Meeting with officials; briefing at UNLSA Office; travel to Bandar Abbas
1/11/2011	Visit to Bandar Kong, Hasine, and Bostaneh
2/11/2011	Visit to Basaeedu, Salakh, Bandar Abbas F.P. Co. and Shahid Bahonar
3/11/2011	Visit to Bandar Abbas FP CO, return to Tehran
4/11/2011	Public holiday, rest
5/11/2011	Meetings with officials
6/11/2011	Writing of findings
7/11/2011	Travel Iran-Dubai-Seychelles

People met during the visit

Name	Institution/Post	Contact
Mr. Khorshidi Sabah	Head of Fishing Data Collection, SHILAT	skh981@yahoo.com
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Kenya

Main findings and proposed actions

The fishery for tuna, billfishes and sharks in Kenya is relatively small although an important sport fishery for sailfish and other billfish exists. The large fleet of longliners that used to fish in its EEZ has moved due to piracy concerns and the current fishery is done with small and medium artisanal boats. Weather dictates the location of the fleet, thus what species it targets for good part of the year.

One of the main problems encountered is the lack of definition of roles for enumerators who may also work on many other tasks assigned to them thus reducing their work time to data gathering. Clear specification of their roles will allow for continuous collection of data, activity that at this time is discontinued often. The current team of enumerators and supervisors is close to retirement age and this is a perfect opportunity to recruit, train and motivate the next wave of fisheries employees to develop their skills and educate themselves on the importance of data gathering, and fisheries management.

The fisheries department in Kenya has been proactive, acknowledging deficiencies in their data gathering efforts and has developed new datasheets and a new database to address these shortcomings. It is important to support these efforts with input on the design of these materials to ensure that they conform to IOTC standards and gather the information needed for management goals.

Findings and Recommendations

1. SAMPLING DESIGN
   A frame survey is conducted every two years and consists of total enumeration of vessels, gears, etc. Although the survey is usually conducted regularly (last time was in 2008. The survey was cancelled in 2010 due to budget cuts), the high seasonality of the fishery results in the need for frame surveys to take place during each season to determine the fleet characteristics (boats, gear, etc) per area. Current geopolitical situation, namely migration of large numbers of people from Somalia, is likely to affect the fishing effort as this is one of the first activities undertaken by displaced populations so this needs to be taken into account.

Current sampling methodology for effort, catch, etc needs to be re-assessed to more effectively cover the main landing sites without overlooking smaller landing sites. The new proposed sampling might resolve some of these issues but revision of the new datasheets and database should improve the effort component to ensure proper data collection. There is the need to suspend the use of Beach Management Units for data collection if sufficient coverage of the landing sites exists. This should increase data quality and consistency.

2. SPACE FOR STORAGE OF DATA SHEETS AND OTHER INFORMATION
The state of data holding facilities in the Divisions visited is dire. There is a need to implement a filing system to ensure that all data sheets are properly labelled and stored.

3. ENUMERATORS
Enumerators are not dedicated exclusively to data collection but also work on any issues proposed including aquaculture, lake fisheries and others thus reducing their effort on data collection and collation. It is suggested that clarification and definition of their roles takes place. The current enumerators are in their majority at the point of retirement but this is not an obstacle but an opportunity. The new generation of enumerators should be trained on various topics (experimental design, computers, species identification, etc) and encouraged to develop their skills and education to ensure continuity and quality of the data.

There is the need to hire new enumerators to cover the coast effectively and further training is needed on data collection, experimental design, data entry and identification of species. In addition, the purchase of computers with necessary software and motorbikes for enumerators to visit selected sites is suggested.

4. NEW SAMPLING PROTOCOL
The new sampling protocol still showed clumping of species during the pilot study although there is the possibility to register individual species. It is important to build capacity in the department on species identification to take full advantage of this new methodology. Special attention needs to be paid to tuna, seerfish, billfish and shark species identification.

Personnel in the Fisheries Department are very eager, as demonstrated by the development of a new sampling scheme, datasheets and database. It is believed that with little effort the sampling in Kenya can improve substantially provided there are follow-ups and training for the personnel concerned as well as a clear understanding from the managers of the need to collect data and the need to have dedicated enumerators.

5. DATA MANAGEMENT AND ENTRY
A new database is being built on Access to accommodate the new proposed data collection system. It was not possible to see the see or test the new database but would be beneficial to comment on its development and help on its design and training (as well as that of the datasheets).

6. ACCESS TO DATA BEFORE HANDLING AND AGGREGATION
The Fisheries Department is interested in summarizing the data for production estimates and this results in the aggregation and consequent loss of details. A possibility is to propose to the department that the data be sent to a dedicated person in Nairobi who would prepare them according to IOTC specifications, before any manipulation (aggregation, averaging) takes place to ensure that all the particulars are present in the data set, thus allowing more detailed analysis of the information.

7. BILLFISH DATA
An important sport fishery exists in Kenya. Data collected by the African Billfish Foundation (ABF) are important because of the detail and numbers of billfish recorded by this group. At this time it collects species and weight information although the latter is estimated by eye because most animals are released after tagging. It was proposed to have a ruler marked on the side of fishing boats to help measure the billfish and the ABF is supportive of the idea. This proposal will be presented to the relevant committee for approval and it is hoped this will be implemented rapidly to improve the quality of the data collected

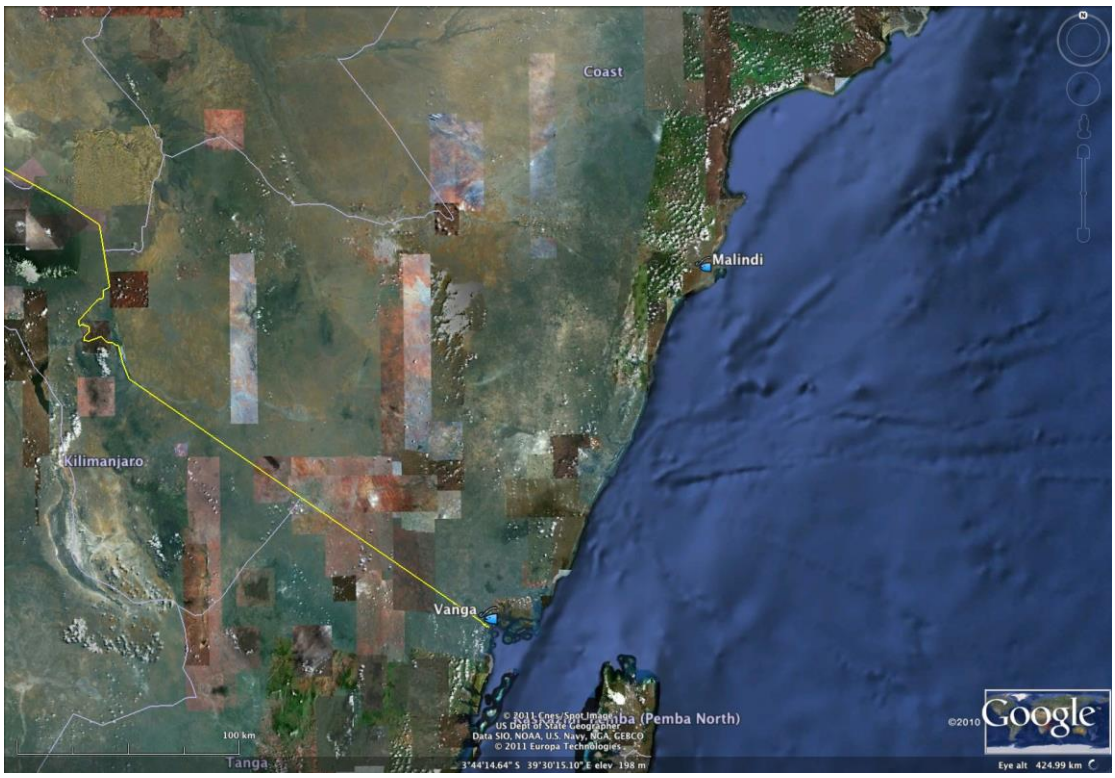
At this time, IOTC has pop-up tags (20 tags) left from the Regional Tuna Tagging Programme that are not being used. It is suggested that these tags are loaned to the ABF to improve our knowledge of one or two billfish species. IOTC could suggest the species to tag.

Fishing Ports and Landing Sites

VANGA: This small landing site is typical in Kenya. A variety of fish are landed here and catches are heavily influenced by the monsoon, as it determines where the fishers can go. Tuna and shark catches are small and the main gears are gillnets and handlines.

MALINDI: This site is important due to the presence of a large sport fishing fleet. Its participation on billfish tagging activities has high profile and the data gathered by the various boats are of interest but need improvement particularly on size/weight estimations.

Map of Kenya with ports and landing sites visited during this mission



Summary Table: Kenya
General Information
Vessels and gears: Fishing in Kenya is small scale, mainly done by artisanal fishermen using small un-motorized fishing craft propelled by sail and paddles. In 2008, artisanal fishing was undertaken by 12,077 fishers, from 2,687 fishing vessels that unload their catch at 141 landing sites. The most common fishing methods used for tuna are handline (4,132), longline, trolling, monofilament nets and gillnets (3,956)[5]. A new type of fishing method is ring net for which there are 15 registered vessels. These boats have the capacity to catch up to seven tonnes per day, mainly consisting of skipjack and mackerels. This fleet has shown a 500% increase from 2004-2008 and is likely to continue its expansion due to higher earnings and to the decline of traditional fisheries.
Catches by species: The main tuna species caught by artisanal fishers is skipjack although smaller species (longtail, kawakawa, and frigate tuna) as well as small juveniles of yellowfin and bigeye tuna are also caught.
Legislation: Licensing is mandatory for all boats but only an estimated 15-20% are actually registered.
Institutions responsible for data collection and processing and linkages among them, if any: Fisheries Department, Kenya Marine Fisheries Research Institute, BMUs, CORDIO, WCS, WWF, Universities, Sports Fishing Clubs.
Sampling
Existing data collection system: Total enumeration has been implemented at each major landing site. However, due to difficulties in accomplishing this, 10-15% of the total of each fish group is added to adjust for missing coverage. In addition, less important sites are visited on a rotational basis. The enumerator compiles the monthly totals from his records for his respective landing beaches and sends them to the Division office where the data are aggregated and passed on to the District office, which in turn sums and passes data to the Provincial office. Enumerators record weight (by eye), usually aggregated by species, and value at each landing site. The ultimate aim is to gather 30 samples per gear/boat/landing site combination per month. In cases where enumerators are not present, the Beach Management Units (BMU) composed of fishers from the locality, collect data to be submitted. Fishers collect these data voluntarily because there is a tax of 2 shillings per kg of fish offloaded which goes to the BMU as profit. In addition, if fishers from other areas offload in landing zones not designated for them, they must pay 5 shillings per kg, providing an additional source of income to the BMU. The reasons for fishers from other areas offloading fish in other landing zones include distance from home site, prices at offloading site and issues related to preservation of fish. Data collection system has been established in each district. All data are submitted to the Mombasa office on a monthly basis. Shortage of personnel in the statistics section in Mombasa office causes some delay on data entry.
Recent projects aimed at strengthening statistical systems, if not when was last: In September 2009, FAO trained all district fisheries officers and produced a pocket guide for species identification. In June 2010, funds were provided by the Regional Coastal Management Programme of the Indian Ocean Countries (RECOMAP) to develop a new database (Access) to gather capture data including sizes and arts per landing site. This database is still on the developmental stage and should be finished by the end of July. In addition, enumerators were trained at this time and a trial run was done on the use of datasheets but due to a change in priorities by upper management, effort was deviated from data collection and the pilot study stopped.
Sampling Design
Date of creation, last revision and frequency of revision: The old system is still in place but a new design aims at sampling 10% of all effort. This will result in new datasheets that capture considerably more detail than previous efforts. In addition, a new database is under construction to accommodate this new design.
Documentation (present/absent): The process and reasoning are not documented.
Personnel involved in main functions (enumerators, supervisors, head of statistics, etc): There is a considerable number of personnel who collect data but unfortunately, this is not their only task and depending on the priorities assigned by their superiors, their efforts in data collection may be considerably reduced. Supervisors at the division level do not seem to have the necessary education and training to manage the personnel involved and the need for careful data management and gathering. Supervisory role seems to be limited to summarizing the catch data into large species groups that are then delivered to the district level for further aggregation and summation.
Type of effort data collected
Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed): Frame survey and a new sampling design of vessel activities and catch.
Frame survey date last conducted and frequency: The last frame survey was conducted on 2008. It was due to be conducted on 2010 but due to budgetary cuts it was not done. Because of the seasonality of the fisheries, it is suggested that two frame surveys are conducted, one in each season, to determine the fleet, areas, gears and other factors affecting catches and effort.
Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.): Boat activity coefficient, number of vessels fishing, and as part of the new design, gear is included.
Coverage (total enumeration or % sampled): Proposed 10% of all vessel/gear/major landing site combinations
Type of catch data collected
Reports from fishermen or other non-governmental sources: Fishermen report data, as part of the BMU, although there are doubts about the motivation. It is possible that they might over or under report due to taxation or incentives for higher catches so these possibilities need to be explored
Enumerators sample catches at the landing place: Yes

[5] Ndegwa S, Sigana D (2010). National report of Kenya (2010). IOTC-2010-SC-Inf06

Both sources: Yes
By gear or aggregated: Current systems aggregates gears and species although the new system proposes to resolve some of these issues
By species or aggregated: Aggregated. There is a need to train enumerators to identify small bigeye and yellowfin tuna as well as the smaller species of tunas (kawakawa, longtail and frigate) and sharks.
Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): The weight of the fish caught is determined by eye and species aggregated into groups (*e.g.* tunas). The new proposed sampling methodology will determine individual catches of each group of species (issues with identification of some species) and will measure sizes and weights of chosen species. Tunas will be weighed and measured by species.
Coverage (total enumeration or % sampled): The aim under the new plan is to cover up to 10% although it is not clear what the criteria are to accomplish this percentage. It is necessary to determine what the most important landing sites are and assign a higher percentage of the effort to these with the minor sites being sampled on a rotational basis.
Data Processing
Personnel involved, qualifications (database admin) and main functions: There is minimal understanding and knowledge of basic statistics and data handling issues. Although the new database should remedy some of these issues because the data will be transferred in raw format to the Provincial office, there is a need to train personnel. There is the need for a database administrator who understands about fisheries and its issues to be able to screen and validate data.
Data flow, including time frames for each step: Data are sent from Division to District (every two weeks) to Province (two weeks) and the estimates are produced monthly for the whole country.
Amount of data handling before data are input in a computer and time frames for each step: Data are compiled manually at each step as groups of species.
Hardware and software in place: Not all division offices have access to computers. Data are not entered into a spreadsheet but manually aggregated. The new system will require complementary hardware and software to allow for entry of data.
Type of system: Centralized system or other: Other. Data are compiled manually and sent to the next level for further aggregation. All detail is lost but the new system proposes to address these issues.
Type of data input and flow of electronic data, including time frames: Data are compiled manually and sent to the next level for further aggregation. All detail is lost but the new system proposes to address these issues.
Data validation and verification procedures: by hand, electronic, etc: None.
Catch estimation procedures
Date of creation last revision and frequency of revision: Present methodology relies on complete enumeration (by weight measured by eye) of all catches in the artisanal fleet. The current proposal aims to measure 10% of all effort and catch by increasing the detail of information gathered
Documented or not documented: Not documented
Estimator (formula used to estimate catch): Total enumeration of catch plus 10-15% for each type of fish is added to account for missed landings but the rationale behind these percentages is not known.
Platform (integrated in database, external): External.
Procedures: minimum coverage, substitution scheme, etc.: There is no estimation to allow the use of substitution schemes.
Type of output: catch plus estimates of precision, etc.: Theoretically there is total enumeration of catch but in reality there is 85-90% enumeration and 10-15% is added to account for missed landings.
Estimation time frames: Two months
Review of estimates (never, as more data becomes available, or other): Never
Reports
Timeliness of production of type of catch estimates: It takes about six months to complete the Fisheries Annual Statistical Bulletin. The frame survey report is produced 6 weeks after the completion of the exercise.
Preliminary estimates: Estimates for a given month are produced one month later.
Final estimates: Final estimates are produced per month in Nairobi for the whole country. There is no revision of estimates as it is assumed that total enumeration plus the correction factor are enough to account for the whole catch.

Proposed Budget for Improving the Reporting System in Kenya

Item	Number	Months	Cost Unit USD	Total Cost USD
Enumerators	30	12	$400	$144,000
Computers	30	1	$500	$15,000
Filing Equipment (cabinets, etc)	20	1	$500	$10,000
Travel Trainer	1	3	$1,000	$3,000
Accommodation Trainer	1	3	$1,800	$5,400
Salary trainer	1	3	$1,000	$3,000
Materials sampling (calipers etc)	30	1	$500	$15,000
Backup System	20	1	$500	$10,000
Office improvement	30	1	$1,000	$30,000
Survey ports and landing sites	1	1	$5,000	$5,000
Motorbikes	20	1	$5,000	$100,000
Fuel (liters)	1400	1	$3	$4,200
Database	1	1	$20,000	$20,000
Train supervisors	30	1	$1,000	$30,000
Data entry training	30	1	$1,000	$30,000
Frame Survey	1	1	$95,000	$95,000
Personnel data entry	3	12	$600	$21,600
Subtotal				**$541,200**
Misc (10%) of subtotal				**$54,120**
Total Cost USD				**$595,320**

Mission schedule

Date	Activity
5/6/2011	Travelling Seychelles-Kenya
6/6/2011	Meetings at Fisheries Department and the Ministry Headquarters
7/6/2011	Travelling Nairobi-Mombasa. Discussion Billfish database. Meetings at District Office Mombasa
8/6/2011	Travelling Mombasa-Vanga. Inspection landing sites and issues for collection of data
9/6/2011	Mombasa: Discussion Billfish database and initial training for volunteer student
10/6/2011	Travelling Mombasa-Malindi. Visit to Malindi office and meeting with African Billfish Foundation
11/6/2011	Discussion EEZ database. Travelling Mombasa-Nairobi-Dubai-Jakarta

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Madagascar

Main findings and proposed actions

In 2009 the large fleet of artisanal vessels and the few commercial boats in Madagascar captured an estimated 740 MT of yellowfin tuna and 915 MT of skipjack mainly with the use of gillnets and handlines.

Most of Madagascar's artisanal boats do not target tuna or sharks due to the limitations of the fleet. A large fleet, however, catches tuna and tuna-like species from September to December in the Mozambique Channel although the volumes and species are unknown. Most of this catch apparently is bought for consumption in other parts of the country. Because buyers are required to record their purchases for transport to other regions, it might be possible to gauge the catches from this fleet through these receipts. There are issues with this reporting system, however, including that the weight may refer to processed fish and that there is no record of the catch that stays for local consumption.

All motorized boats are registered regardless of size and there are plans to do the same for non-motorized boats soon. In addition, all fishers are inscribed and their identification cards indicate their names, date of birth, fishing area, gear, boat, engine size, and a few other details. Although in theory this should facilitate the collection of fisheries data, the reality is that the size of the country and difficulties reaching many of the fishing landing sites still make the estimation of catch by the artisanal fleet challenging.

The foreign commercial fleet that fishes in the Malagasy EEZ catches the great majority of tuna as well as sharks. Because of the existing system it is suggested, although unverified, that the EU and Asian commercial fleets working there underreport their catches. A motive for the EU purse seine fleet to underreport is the presence of a quota of around 13,000 MT and the lack of monitoring in the area. Although the fleet is permitted to fish above the quota mentioned, it must pay much higher prices for every additional tonne caught, an incentive to underreport its total catch. The Asian fleet does not have a quota, as the only limitation is the number of vessels licensed to fish in the area. Although part of the purse seine fleet from the EU offloads in Madagascar, the actual catch of tuna and sharks in its waters is unknown due to lack of an inspection scheme to ensure compliance with the established quota and the use of authorized gear. Both EU and Asian longline fleets

appear to have large captures of sharks as observed in their arrival and departure reports. The issue of underreporting for tuna and sharks needs to be addressed promptly to ensure the sustainability of Malagasy fisheries.

Even though a frame survey is a common method for determining fishing characteristics of a population and thus to calculate its fishing output from stratified sampling, Madagascar presents particular challenges. Not only is the country large and many communities live in isolation, but the fishing community experiences large and sometimes rapid fluctuations that would be difficult to measure and incorporate into a sensible framework. Current economic, political and social issues in the country preclude stability on which a frame survey would be useful thus it is necessary to wait for more stable conditions. Nonetheless it would be worth monitoring the important known landing sites for tuna and sharks until conditions improve for a more comprehensive framework.

Findings and Recommendations

1. BUYERS' REPORTS
   Buyers document their purchases for transport within the country. Although these reports are not detailed and have some flaws, with some improvements they could provide a clearer picture of the landings of fish in Madagascar. At this time fish are aggregated in groups (*e.g.* tuna, sharks) so there is no species resolution but it would be worthwhile investigating the possibility of changing this reporting to reflect species. In addition, codes would have to be introduced to indicate the processing of the product as in many cases the fish are filleted or headed. Finally, validation checks are needed to determine the volume retained locally for consumption, as this information is not captured in the current forms.

2. SURVEY IN MAHAJANGA
   Mahajanga, on the northwest coast of Madagascar, has a large fleet of non-motorized vessels that fish for tuna and tuna-like species in the Mozambique Channel from September to December. A survey on this site to measure the fleet, catches and species composition is of importance due to the large volumes of fish landed during the fishing months. It is the only site visited that warranted an extensive survey although it must be kept in mind that there may be other sites in the country that require similar visits and surveys.

3. ESTIMATION OF SHARK CAPTURES
   Shark catches in the country are very high and even though most of the fins are exported to the Far East (a small component stays locally for Chinese restaurant consumption) and should in theory be registered for export, there is an unknown component of this catch that is exported illegally and for which there are no records. This makes the estimation of shark captures in the country a real challenge due to the large number of landing sites and low coverage of the same. An investigation on where this illegal trade takes place and ways to stop it would result in better estimates of shark captures and would improve the reporting system. It was suggested that some of the shark fin exported illegally left via ships on various ports as a way of avoiding taxation on this expensive item.

   Reporting of shark captures is made more difficult by the allowance to have sharks finned. Identification and catch estimation are far easier to do when the fins are naturally attached to the sharks, something that could be implemented by the IOTC following suit of other RFMOs and countries where unattached fins are illegal. One of the major fishing fleets in the Indian Ocean, the Taiwanese, has agreed to implement such a measure at the beginning of 2012 and the EU will vote on a similar measure some time this fall.

4. SPORT FISHING CLUBS
   As already seen in Kenya and Mozambique, sport fishing clubs can be an important source of data. It could be possible, with the permission of the authorities in Kenya, to give these clubs a copy of the existing sport database and have them use it. The relevant people have been put in touch with the authorities in Kenya and with the African Billfish Foundation to get a copy of the database, share experiences and avoid replication of mistakes.

5. DATA FROM FOREIGN VESSELS
   There are shortcomings on the reporting of data from foreign fleets to the relevant Malagasy authorities. The Malagasy government must enforce the requirements present in the agreements and demand reporting by the foreign fleet. Furthermore, CPCs are required to report the data to the IOTC from their as well as foreign fleets licensed to fish in their EEZ.

The most important players on shark and tuna fisheries in Madagascar fisheries are commercial foreign fleets (EU and Asian countries). Unfortunately, their reporting system leaves much to be desired and it has been suggested that there is substantial underreporting. Vessels are not undergoing an inspection at entry or exit of the EZZ of Madagascar, making it very easy to misreport catches of these species. At this time EU vessels apparently refuse to have port inspections before or after fishing even though this is mandatory through Resolution 10/11 on Port State Measures from IOTC. Apparently most Asian fleets (excepting the Japanese) accept to have port inspections and observers but because the EU and Japanese do not comply, they also bypass these requirements.

Although observer presence onboard the foreign fishing fleet is explicitly outlined on the various agreements, it is common practice not to have them and this should be remedied as part of the new agreements that will be negotiated in the next few months for the Japanese and EU fleets.

Finally, the status of many of the vessels fishing in Malagasy waters needs to be revised. It has been suggested that a large number of IUU vessels (mainly longliners) that previously targeted Patagonian toothfish in the Southern Ocean are fishing illegally for deep-water sharks with gillnets [6].

Fishing Ports and Landing Sites

RAMENA: This small landing site near Diego Suarez has a very small catch of tuna or sharks during specific times of the year although these species are not targeted. In reality, most of the vessels found at this type of site do not have the capacity to go very far offshore and their catches are usually limited to demersal fish and occasionally pelagic fish including tunas. Ramena is a typical Malagasy landing site and one of thousands in the country, making it quite difficult and expensive to realistically cover the artisanal fleet due to institutional and logistical limitations.

DIEGO SUAREZ: This port is a major landing site for tuna caught by EU purse seiners. At this port the vessels' logbooks are analyzed to stratify sampling accordingly. The main season for tuna is January-June, time when most purse seiners offload to the Pêche et Froide Ocean Indien, a major cannery in the Indian Ocean region. There is an office with adequate facilities to accomplish the work. During the busy season it is necessary to employ extra enumerators to be able to cover the port effectively. Species landed include bigeye, yellowfin, albacore, swordfish, wahoo, sailfish and various shark species.

After transcription by the enumerators a database operator enters the data, as there is no database manager. The data are validated by hand and by the software. Validations are done by comparing logbook and port reports. The software used is Acquisition et Validation des Donnes Thonieres (AVDTH). There is an interest to develop a sport-fishery application and it was suggested that they use the software already developed by the Department of Fisheries in Kenya.

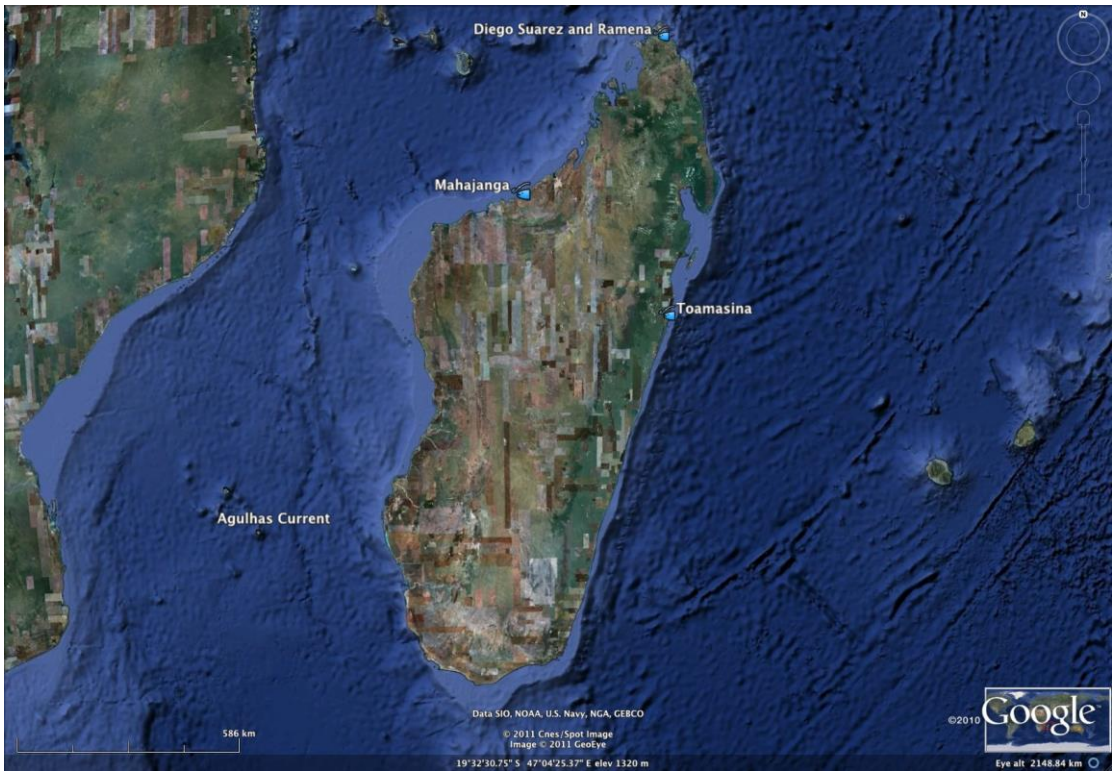
This group is also working on the development of a longline and artisanal fleets database and the aim is to have it online for easy data access and entry.

MAHAJANGA: There is a large fleet of non-motorized vessels that fish for tuna and tuna-like species on the Mozambique Channel. Most of the fish is purchased and transported to other areas of the country and these records, mandatory for transport, can serve to calculate catches although there is a need to improve their species resolution. In addition, there is a need to determine the amount of fish that stays for local consumption, as this portion is not recorded in the purchase records. Finally, some of the species are processed yet there is no record of the type of processing or the conversion factor needed to calculate live weight so the later is underestimated.

TOAMASINA: There are at least six Malagasy-flagged longliners (13-20 m) at this port and the reports submitted by the fishing companies look detailed enough to allow for 100% coverage. Their main catch is bigeye and yellowfin (30%), albacore (30%), swordfish and marlin (25%) and sharks (10%) caught as bycatch. All of the fish caught by Réfrigépêche, the larger of the two companies, is exported to France. It is worth noting that the weights reported by the two companies are for processed fish (gilled and gutted) so there is a need to provide a conversion factor. It does not seem necessary to get a sampling programme at this site as the production is small and the operators are careful and interested in providing all the information needed.

[6] SADC (2008). Study and analysis of the status of IUU fishing in the SADC region and an estimate of the economic, social and biological impacts. Volume 2 Main report.

Map of Madagascar with ports and landing sites visited during this mission



Summary Table: Madagascar

General Information

Vessels and gears: Artisanal boats fish for tuna using gillnets and handlines and there are approximately 70,000 fishers using 62,000 canoes were estimated in 2004 although it is unlikely most of these catch tuna or sharks. The foreign commercial fleet that uses purse seine and longline catch most of the tunas although the latter also contributes to the high catch of sharks. Fishing by the EU fleet is limited to 43 purse seiners and 50 surface longliners and this agreement is up for revision on 2012. Japan has an agreement that is in revision at this time for 20 longliners to fish in Malagasy waters.

Non-motorized boats are not registered but motorized boats are all registered and have a plaque on the bow with an identification number.

Catches by species: According to the IOTC estimates, Madagascar caught 3,804 MT of yellowfin tuna, and 4,573 MT of skipjack in 2009.

Legislation:
Ordinance No. 93-022 from 4 May 1993 regulates fishing and aquaculture
Decree No. 94-112 from 18 February 1994 on the general organization of marine fishing
Decree No. 2007-957 from 31 October 2007 defines the conditions for fishing activities of coastal shrimp.

Institutions responsible for data collection and processing and linkages among them, if any: The Ministry of Agriculture and Fisheries (MAEP) is responsible for the management of fishing through the Directorate of Fishing and Fish Resources. The Regional Directorate for Rural Development, the Regional Services for Fishing and Fish Production are responsible for implementation of projects and providing services at a regional level. They work in collaboration with the councils for fishing and agriculture. The various agencies co-ordinate the application of fisheries legislation.

Sampling

Existing data collection system: There is no strategy *per se* and there is as much coverage as possible with the limited resources available. Approximately 2-3% of the landing sites are covered and the catches logged here are extrapolated to the total number of sites. All tuna and shark species are aggregated. The procedure is for fishers to report to a collector or to a fishing association their catches once a week and a report is sent every month to a District office where extrapolation takes place. From here it takes a further three months for a final estimate to be produced. There are three sites sampled per District but not all Districts are sampled. Tuna and sharks are only reported if caught within District waters but not incorporated into official statistics if caught in waters that do not belong to a District.

Catch data are recorded on companies' logbooks and sent to the regional directorates and the Directorate General. Data processing is done at the Directorate-General by the Department of Statistics. Catch estimates are based on previous data from surveys and censuses.

Diego Suarez, the main port where tuna is landed, stratifies its sampling to reflect the characteristics of the wells on the purse seiners that discharge there.

Recent projects aimed at strengthening statistical systems, if not when was last:

1. FAO / MAG 85014: Establishment of a National Computerized System Standard Statistics (SSSNI) in 1985.
2. TCP / MAG 88022: Support for the establishment of SSSNI.

Sampling Design

Date of creation, last revision and frequency of revision: 2003 and has not been revised since.

Documentation (present/absent): Present

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc): There are no enumerators as the personnel do not sample or measure the catch. The people in charge of data collection gather information from fishers or from fishing associations as to the fishing activities and volumes caught. These numbers are then sent to the District and extrapolated to account for landing sites not covered. For the frame surveys there are samplers, supervisors, person responsible for statistics, etc. Samplers are recruited during the period of the survey. Production statistics are the responsibility of the regional statistics team.

Type of effort data collected

Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed): Census information includes socio-economic statistics and traditional fishing characteristics. Production survey includes a survey of the catch/effort at sites previously defined (based on criteria depending on the size of the site, representativeness of the gear used, the number of species caught, the number of fishermen). A new frame survey will take place in September 2011 and will measure the number of fishers, engines, boats, and gear types.

Frame survey date last conducted and frequency: Creation date, last audit and audit frequency of the National Framework Survey: 1988-1989. Partial frame survey conducted in 1999-2001 in four out of six provinces: Toamasina, Toliara, Mahajanga, Antsiranana.
2nd National Survey part: planned for this year (September 2011).
Due to the economic vulnerability of the population, these results may change rapidly as people will migrate to fish if there is a loss or reduction of income.

Type of effort units (*e.g.* no. trips, no. vessels, no. of net panels (gillnet), etc.): During the frame survey, information on number canoes, number and characteristics of vessels per unit, number of fishermen per boat is collected.

For production sampling, information on numbers of fishermen, types and numbers of gear used by canoe per fishing trip, catch composition (species, size, frequency) is collected. For industrial fishing completed logbooks are collected and the gear allowed are

defined in the license.
Coverage (total enumeration or % sampled): In 2003, 2-3% of all landing sites in the country and 25% of all Marine Districts were sampled (10 out of 40). At present there is no sampling as there are serious budgetary issues.
Type of catch data collected
Reports from fishermen or other non-governmental sources: Fishers report directly to a data collector or to a fishing association. Reports are of guesses of catches done in the last week and possibly month. In addition, buyers who wish to transport fish outside a district, must report their purchases by group of species and number of kilograms although the latter may represent processed fish.
Enumerators sample catches at the landing place: No
Both sources: No
By gear or aggregated: Aggregated
By species or aggregated: Aggregated by group (*e.g.* sharks, tuna, etc)
Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): The catch is reported by weight and it is estimated by eye.
Coverage (total enumeration or % sampled): 2-3% although at this time there is no proper enumeration but rather collection of production estimates from fishing organizations or fishermen. There is no sampling.
Data Processing
Personnel involved, qualifications (database admin) and main functions: The persons in charge of data collection and subsequent data entry have high-school equivalent diploma. There is no database administrator.
Data flow, including time frames for each step: Data are collected at landing sites and sent to the person in charge of collation at the end of each month. It takes a month for revision and data entry and then three more months for the production of final statistics.
Amount of data handling before data are input in a computer and time frames for each step:
Hardware and software in place: Data entry at the District level is done in Excel and these data are then forwarded and entered in ARTFISH 2009 (FAO).
Type of system: Centralized system or other: Centralized
Type of data input and flow of electronic data, including time frames:
Data validation and verification procedures: by hand, electronic, etc: Validation procedures include manual checks for mistakes as well as verification procedures incorporated into the software.
Catch estimation procedures
Date of creation last revision and frequency of revision: The procedure in use is that of Stamatopoulos 2004[7].
Documented or not documented: Documented.
Estimator (formula used to estimate catch): Extrapolation of sites visited against total number of sites.
Platform (integrated in database, external): External
Procedures: minimum coverage, substitution scheme, etc.: None.
Type of output: catch plus estimates of precision, etc.: Estimate with no precision.
Estimation time frames: It takes about five months to get an estimate of catch for the whole country.
Review of estimates (never, as more data becomes available, or other): Estimates may be reviewed as data become available.
Reports
Timeliness of production of type of catch estimates: An annual report is produced four months after the end of the year. Monthly reports are produced approximately five months after the end of the month.
Preliminary estimates: Yes
Final estimates: Yes

[7] Stamatopoulos C (2004). Safety in Sampling. FAO Fisheries Technical Paper 454.

Proposed Budget for Improving the Reporting System in Madagascar

Item	Number	Months	Cost Unit	Total Cost USD
Port Inspection Trainer	2	6	$8,000	$96,000
Port Inspectors	10	12	$1,000	$120,000
Buyer report modification and training	1	8	$5,000	$40,000
Revision IUU Listing	1	6	$5,000	$30,000
Survey Mahajanga	1	4	$6,000	$24,000
Investigation unreported shark catch	1	6	$6,000	$36,000
Subtotal USD				**$346,000**
Misc (10%) of subtotal				**$34,600**
Total Cost USD				**$380,600**

Mission schedule

Date	Activity
12/7/2011	Travel Seychelles-Mauritius
13/7/2011	Travel Mauritius-Madagascar. Meeting with Blue Ventures
14/7/2011	Meetings at Ministère de la Pêche et des Ressources
15/7/2011	Meetings at Ministère de la Pêche et des Ressources and Autorité Sanitaire Halieutique
16/7/2011	Writing of findings
17/7/2011	Rest
18/7/2011	Travel to Diego Suarez, meetings with officials at Unite Statistique Thoniere D'Antsiranana (USTA)
19/7/2011	Travel to Ramena, meetings with officials at USTA, travel to Antananarivo
20/7/2011	Meeting with WWF, travel to Mahajanga
21/7/2011	Meetings with government officials and industry, travel to Antananarivo
22/7/2011	Travel to Toamasina; meetings with government officials and industry
23/7/2011	Writing of findings
24/7/2011	Writing of findings, travel to Antananarivo
25/7/2011	Writing of findings, travel to Mauritius
26/7/2011	Travel to Seychelles

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Maldives

Main findings and proposed actions

The tuna fishery in Maldives caught 66,189 MT of skipjack and 19,611 MT of yellowfin in 2009. The Maldivian fishery is simple compared to that of other countries in the region. The main gear is pole and line although some fishing is also done with handlines. In addition, longlines are being introduced but this is at an early stage. There seems to be a good record of the catches for export as they are offloaded from fishing vessels to collector vessels, collection centres and processing plants. Some problems found at the plants visited, and possibly others, include the reporting of processed weight as live weight (this value needs to be recalculated using the appropriate conversion factor) and the mixing of small specimens of bigeye and yellowfin tuna.

The weak link appears to be the reporting of fish that stay for internal consumption and there is a need to improve it to get an accurate description of the fishery for tuna in Maldives. Some of these fish may come from fish rejected by the various processors but the great majority comes from vessels that fish without a license and cannot sell their fish to processors who export but may sell it to local consumers and processors (*valhomas*, dried fish) for internal consumption. Fishing vessels only need a license if they are going to sell their catch to processors for export thus there is the need to ensure that all vessels that fish are licensed regardless of the final destination of their catch.

Sampling at landing sites is cursory at best and has a number of problems. The most important ones are the lack of verification of catch information provided by skippers and, more worrying, the paucity of information on the number of boats arriving at a port and their catches. Finally, misidentification of bigeye for yellowfin tuna may be an issue in processing plants where large numbers of juvenile specimens are bought.

Findings and Recommendations

1. SAMPLING STRATEGY
   Fishing in Maldives has changed considerably in the last few years. Past efforts measured catch through complete enumeration but this does not seem to be the case anymore. It is imperative that the

current strategy is specified and if necessary a sampling programme developed to deal with recent changes. Even though the fishery in Maldives is simple compared to that of neighbouring countries, if complete enumeration is not an option anymore there will be the need to stratify sampling by gear, boat size and port importance to allocate the right amount of effort and resolve issues concerned with length frequencies, effort and others.

2. CONVERSION FACTORS
   Processing plants may report fish as live weight but in reality this is processed weight (gilled and gutted). It is necessary to recalculate the numbers after verifying with the various processors the type of weight reported. Reporting forms need to be standardized to have all companies report data in the same format to avoid misunderstandings on the weights and the type of processing.

3. FISHING LICENSES
   At this time, only about 60% of the fishing fleet is licensed. Boats that sell their catch to processors for later export are required by law to have a license but boats that catch fish for internal consumption do not. This needs to be remedied with the introduction of a mandatory license for all fishing vessels regardless of their size, gear or destination of catch.

4. SPECIES SEGREGATION
   Small bigeye and yellowfin tuna are aggregated in the catch reports as the latter. In addition, there might be aggregation of skipjack, frigate and other smaller species under skipjack. It is necessary to separate all species to determine the catches accurately.

5. OFFLOADING
   Logbooks are not enough as it is necessary to verify the reporting as well as collect information on length frequencies. Sampling during offloading is a must and is needed to validate the data reported by fishermen. Because it is common for vessels that sell fish to processing factories to keep some of the catch for later marketing, either because the animals are not the correct species, quality or size, it is necessary to develop a sampling scheme that takes into account this separate offloading. Even though licensed boats are supposed to report the whole catch, not just that sold to processing factories for export, there is a need to verify this and to ensure there is no double sampling of fish already reported.

6. FISH AGGREGATING DEVICES
   Most of the fishery for tuna in Maldives is done in association with FADs. Although the FADs are named after the closest and most popular fishing island there is a need to ensure the reporting reflects their usage. Furthermore, the large number of small yellowfin tuna caught in association to FADs is of concern and because most of the fishing is done with selective gears like pole and line and handline, it might be possible to introduce size limits.

7. LOGBOOKS
   The sizes of tuna vary depending on the type of school and gear used and this needs to be reflected in the logbook. As the logbook stands, there is no way to separate different types of associations and fishing methods within the same day and this needs to be segregated. All fishers and boats received logbooks but only a small fraction (will vary depending on the region) fill and return them to the relevant authorities. The use of logbooks must become mandatory. Corroboration of the reports must occur to ensure the validity of the data.

8. DATA COLLECTION AT LANDING FACILITIES
   There is a lack of strategy on the type of survey done in the various landing sites. Although there is supposed to be complete enumeration, observations in the field do not support this. If there is no complete enumeration, a sampling protocol must be implemented. At this time a protocol to choose vessels is not in place and there is no verification of the information given. Captains from boats that arrive and offload when the fisheries inspector is at the port are briefly interviewed and their statements about catches and species taken at face value with no corroboration. The data include number or kilograms of a species and may be further divided into small or large, complicating interpretation of results even more. Furthermore, the sampling schedule covers three to four hours per day but boats arrive and offload continuously through the day, and in some cases at night, and there is no way to measure their total number, a value that is necessary to calculate the total catch.

9. TRAINING
   The few fisheries inspectors met have no training on species identification, scientific names, sampling methodologies, etc. There is a need to conduct *in situ* training to address the characteristics of each landing site, port and species, particularly the identification of small bigeye and yellowfin tuna and random sampling.

10. LENGTH FREQUENCIES
    The current sampling for length frequencies must be revised. Current sampling overlooks fish in processing factories, places where a substantial number of fish are offloaded. Processing plants usually keep a very detailed record of individual weights for large fish (gilled and gutted for yellowfin and few bigeye tuna) by date and vessel, but these data that are not incorporated into the current sampling. In addition, at least one of the large processing factories, Horizon Fisheries, buys large numbers of small yellowfin tuna that are not measured thus biasing the average size of this species.

11. ELECTRONIC DATA GATHERING
    Delays in data entry and reporting may be avoided or reduced through the use of portable electronic tablets at the ports and landing sites. Oman has this system in place, and it is proposed that Maldives contacts Oman or IOTC to investigate the issues, possibilities and experiences.

12. OBSERVERS
    At this time observers are not deployed on any of the fisheries in Maldivian waters. It is here proposed that contacts be made on its behalf with organizations already doing this type of work in the area (*e.g.* SWIOFP) to investigate the possibility of collaboration to train Maldivian observers. Boats over 24 m are obligated to carry observers and this becomes more relevant as the fishery becomes multi gear and multi day.

13. DATABASE
    A new database was developed although it was not possible to see it in operation as it was being debugged at the time of the visit. A revision of the database is essential, particularly if the current methodology of complete enumeration is dropped and a new sampling protocol developed.

Fishing Ports and Landing Sites

ENSIS FISHERIES FACTORY (HULHUMALE): This factory processes mainly yellowfin tuna for export caught by their own, hired and independent vessels. All their catch, along with that of all other processing plants, comes from licensed vessels and there are rigorous procedures to ensure chain of custody. Data are collected on individual weights although the weights reported to government are of fish already partially processed (gilled and gutted). The fish rejected here (less than 5%) go into the local market through the fishing vessel operators. Most of the product is for export (47%), some cuts are for local consumption (12%) and approximately 40% is waste from heads, bones, etc. This company exports around 800 MT per year in a mix of fish gilled and gutted, headed and gutted and loins. Only yellowfin above 18 kg are processed here. This company has an MSC Chain of Custody Certificate for the production of skipjack tuna in various forms.

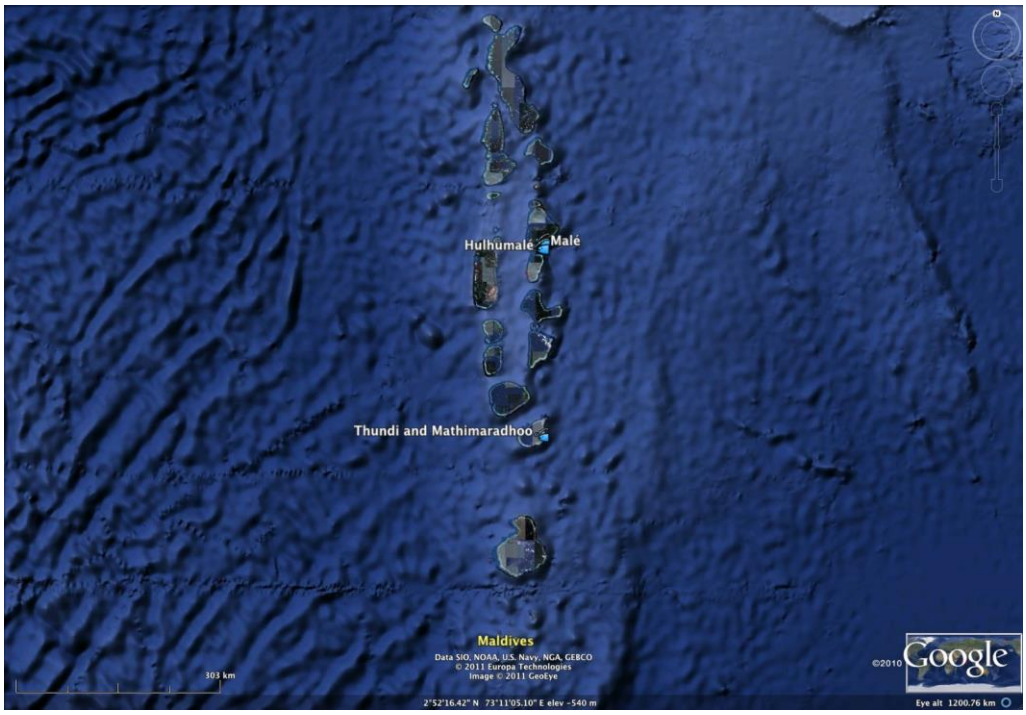
HORIZON FISHERIES (KADHDHOO): A large processing plant on the island purchases and packs tuna into cans and pouches. It owns 5 large collector vessels, 5 freezer vessels and in addition it manages some pole and line fishing boats. All fish bought is traced through the system by fishing boat and date and this company holds an MSC Chain of Custody Certificate. The majority of fish bought is skipjack for packing but a large number of small yellowfin and bigeye tuna are also bought as an incentive for the fishermen to sell the commercially sized fish to the company. Although these small fish are not suitable for processing due to the low amount of flesh, the fish are consumed internally in the mess halls of the factory. These two species are at the moment classified as yellowfin although there is a small proportion of bigeye tuna as well. This factory has the capacity to process up to 4,500 MT of tuna per year for all species combined and exports its product to EU countries like Germany and the United Kingdom. A small quantity of large yellowfin tuna is purchased per month (ca. 1 MT) for processing and the fish are reported as live weight even though they have initial processing (gut and gills removed) done at sea.

THUNDI HARBOUR (KADHDHOO): Small harbour where pole and line vessels arrive and offload part of the catch. Typically they sell 50% of the catch to the Horizon Fisheries Processing Plant, 40% to dry fish processors and 10% to the public. The fish sold to the last two buyers is not weighed but estimated.

MATHIMARADHOO (KADHDHOO): A small harbour for pole and line boats of different sizes.

MALÉ HARBOUR (MALÉ): This is the largest port in Maldives with a mixed fleet of medium and large pole and line vessels and artisanal boats. Most boats here fish for various days with a mix of gears. Many tuna, demersal fish and billfish are offloaded and processed manually here. The sampling is patchy at best and more effort is needed to adequately sample this port. No direct measurement of the catches is done and all information comes from interview of the skippers without verification of their claims. Only a portion of the port is sampled and the rationale behind not sampling the other part of the port is unknown.

Map of Maldives with ports and landing sites visited during this mission



Summary Table: Maldives

General Information

Vessels and gears: The pole and line fishing fleet in 2008 consisted of approximately 1,307 fishing vessels. These vessels may use other fishing arts but pole and line accounted for 69-76% of the total fishing effort. These vessels fish for skipjack although may catch small yellowfin and bigeye tuna. The hand line fishery had fishing effort records for only 70 vessels in 2008 but it is believed the real size of the fleet is between 200-250 vessels. Some vessels also fish by trolling. The hand line fishery targets large yellowfin tuna for fresh fish export. There were 32 foreign fishing vessels fishing in the offshore fishery zone, and area beyond 75 nm of the local EEZ. These vessels operated under a fixed license issued by the Ministry of Economic Development but their licenses were not renewed as of April 2010. Vessel monitoring system was implemented as a pilot study but was soon after discontinued. The main gear in terms of total catch is pole-and-line (73% of the total catch), with trolling (13%), hand line (12%) and others (2%) being less important.

Catches by species: In 2009 Maldives caught 66,189 MT skipjack, 19,611 yellowfin tuna, the main two species fished in the country.

Legislation: All seagoing vessels are registered with the Ministry of Transport. Fishing vessels are also registered with the Ministry of Fisheries and Agriculture (MOFA) under Law No. 19/83 and a national registry of all fishing vessels is maintained by the Fisheries Management Agency of MOFA.
To comply with the European Union Regulation dealing with Illegal, Unreported and Unregulated (IUU) fishing (Council Regulation (EC) No. 1005/2008 of 29 September 2008), a directive was introduced under the general Fisheries Law (Law No. 5/87) implementing the following management measures:

1. Mandatory licensing of all commercial fishing vessels
2. Mandatory licensing of all commercial fish processing establishments
3. Mandatory licensing of all commercial fish aquaculture/mariculture and live fish holding operations
4. Mandatory reporting of catch and effort by all commercial fishing vessels (by-monthly in logbook format)
5. Mandatory reporting of fish purchase records by all fish processing establishments

Mandatory reporting of fish production or fish purchase by all fish aquaculture or live fish holding establishments

Institutions responsible for data collection and processing and linkages among them, if any:
Fisheries Statistics: Within the Ministry of Fisheries, Agriculture and Marine Resources (MoFAMR), Statistics and Database Management Services (SDMS) is responsible for the collection, processing and reporting of fisheries statistics.
Survey and research:
FiDEx (Fisheries Development and Extension Services) maintains a fishing vessel registry and oversees licensing (for fisheries other than the EEZ fishery).
The Marine Research Centre (MRC), is responsible for conducting the research on living marine resources
Fisheries Management:
The Fisheries Advisory Board (FAB) advises the Minister on issues relating to fisheries policy and management.
The Ministry of Trade and Industries has responsibility for licensing of the EEZ fishery.
The Ministry of Atolls Administration is responsible for issues relating to administration and development of the atolls. Government offices in the islands and atolls have responsibility for overseeing and facilitating all government activities in the atolls. This includes collection of fisheries statistics.

Contacts for each fishery:

Sampling

Existing data collection system:
Tuna pole and line fishery
The tuna pole and line fishery is the largest fishery in the country, and the one that receives most attention from both statistical and research perspectives. Catches are reported in the Daily and Monthly Report forms. The monthly forms are forwarded from each island to SDMS. There is some problem with misreporting. Malé catches are recorded by the SDMS market inspector and also reported by boat owners on a fortnightly basis. Note that bigeye tuna are not separated from yellowfin tuna in Maldivian tuna fishery statistics. A large proportion of the catch is sold to MIFCO and other commercial buyers MRC conducts extensive length frequency sampling of pole and line tuna landings.
Tuna troll fishery
Catches from tuna troll fishery are reported in the standard Daily and Monthly Report forms. These are completed on each island and returned on a monthly basis to SDMS. There is believed to some underreporting, but this has never been properly investigated. There has been hardly any length frequency sampling from the troll fishery.
Large yellowfin fishery
Any vessel catching large yellowfin tuna for export should complete a 'Large Yellowfin Fishery Information Form'. This form has been in use since 2000. Data are to be recorded by day or by trip and should include: vessel details, date and fishing position (GPS coordinates), type of school, type and quantity of gear catch by species (yellowfin, bigeye, longtail tuna, shark, others).
Industrial tuna longline fishery
Licensed vessels (both foreign and Maldivian) must submit detailed catch reports. The terms of the license specify that catch must be reported by individual set. The catches (in both numbers and kg) should be reported in 11 species categories; yellowfin tuna, bigeye tuna, skipjack tuna, kawakawa, seerfish, swordfish, marlin, sailfish, dolphinfish, sharks, Others. Other information provided includes set position and times, bait and weather. New reporting forms were introduced in 2002. Prior to this there was no standard catch reporting form, so different parties submitted data in different formats. Catch records are currently submitted directly to MoFAMR, but prior to 2001 they were submitted via MTI. As a result of SDMS following up non-submissions, reported rates are currently of

the order of 90%. However, there is no check on the accuracy of the data submitted.

The statistical system in the Maldives is based in the collection of data at the landing place, including total enumeration of all fish unloaded from the fisheries. However, catch-and-effort and size data are reported by landing place which is thought to be insufficient, especially for large-scale vessels or vessels trans-shipping catches to collector vessels. Maldives has implemented a logbook system for its fisheries since 2010 in order to address the concerns referred to above. In addition, a web interface was developed for ease of data entry by fishery officials working on the various atolls. The information collected includes time spent fishing, bait used, area for bait fishing, area of fishing, details of catch by species, discards, details of catch sold to processors, etc. The nominal catch data from Maldives for 2009 was fully available, while catch and effort was partially available and size frequency not available [8] but this was remedied on 2010 when a complete set of catch and effort and size frequency statistics was presented. Timely delivery, however was poor. It has been noted that the Maldives time series requires revision and application of more comprehensive conversion factors derived from the size sampling programme for the estimation of total weights caught.

Initial collection of fisheries catch and effort data is done through the MOFA/SDMS Daily Report Form. One sheet is completed each day on every inhabited island, recording the catch from every boat that goes fishing. This form is usually completed by a clerk on the island office. Data may be provided verbally to that person by the boat owner of skipper, in a written note, or as a copy of a receipt for fish sold. Items recorded include: date, vessel name and registration number, name and address of vessel owner, type of and number of pieces of fishing gear used and number of days fished[9].

Numbers of fish caught in the following species groups (only groups of interest are shown): *Godhaa* (large skipjack) *Kandumas* (small skipjack) *Kanneli* (small yellowfin) *Bodu kanneli* (large yellowfin). Details of daily catches are forwarded daily from each island to its atoll office, normally by radio. There the details of catches from the three best islands in the atoll are compiled and forwarded to MOFA (by fax). These form the basis of a daily report to the Minister.

Daily Report Forms are not forwarded to SDMS, but are summarized onto a Monthly Fishing Report, with catch and effort for each vessel kept separate. This summary is carried out by the same person who completes the Daily Report Forms (i.e. usually an island office clerk). The completed form is signed by the Island Chief. The Monthly Fishing Report is often more complete than the Daily Report Forms since data omitted from the latter due to late returns can be included. In addition the Monthly Report Forms include information detailing why any particular boat did not go fishing. This system of fishing report forms has a number of problems:

1. The transcription of data onto the Daily Report Form and then onto the Monthly Fishing Report is subject to clerical errors. Data from the monthly reports are then computerized in Malé, where further errors can occur. These errors may significant in some cases[10].
2. The system relies on accurate reporting of catch by the fishermen or boat owners. This is not thought to be a major problem since the boat owners have an interest in reporting (completion of 120 days fishing is a requirement for registration of fishing boats and exemption from charges levied on other types of boat). Nevertheless, there is undoubtedly some misreporting, most frequently under-reporting.
3. Fish catch is reported in numbers. This requires the use of conversion factors to estimate weight of catch. The estimation and use of conversion factors is subject to many difficulties.

A second sheet (Monthly Fisheries Report 2) is completed each month from each island. This report requires summaries of:
Exports of fisheries products (in kg) from each island, in the following categories:
Smoke dried tuna (*hiki kandumas*) Salt dried tuna (*kandumahuge lonumas*)

Recent projects aimed at strengthening statistical systems, if not when was last: Responding to an urgent request made by MOFA in October 2008, IOTC sent an expert to provide advice to develop the new data collection logbook. Also, MOFA in collaboration with the World Bank started a pilot program in 2009 to initiate a Vessel Monitoring System (VMS) in the Maldives. Based on the results of the programme, the government plans to implement a full scale VMS for all fishing vessels in the Maldives.

Sampling Design

Date of creation, last revision and frequency of revision:

Documentation (present/absent):

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc):

Type of effort data collected

Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed):

Frame survey date last conducted and frequency:

Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.):

Coverage (total enumeration or % sampled):

Type of catch data collected

[8] Herrera M. et al. (2010). IOTC-2010-WPDCS-03
[9] Anderson RC, Adam S, Rasheed H (2003). Country report on fisheries and statistics in the Maldives.
[10] Parry G, Rasheed H (1995) Fisheries statistics system. EPCS Economic Paper No.4, Economic Planning and Coordination Section, Ministry of Fisheries and Agriculture, Malé. 49pp.

Reports from fishermen or other non-governmental sources:

Enumerators sample catches at the landing place:

Both sources:

By gear or aggregated:

By species or aggregated:

Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other)

Coverage (total enumeration or % sampled):

Data Processing

Personnel involved, qualifications (database admin) and main functions

Data flow, including time frames for each step:

SDMS survey

SDMS processes the bulk of its tuna fisheries data using a computer system called FIREPLUS (Fisheries Recording System Plus). As a result of the growing limitations of FIREPLUS, SDMS has contracted a private company in Malé to design and produce a replacement fisheries database system for MoFAMR. Once the new database system is installed, it is planned to abandon the system of reporting island catches using Monthly Fishing Reports. Instead, revised Daily Report Forms will become the main means of reporting catch and effort data to SDMS.

Tuna pole and line fishery

Catch and effort data reported from islands on the Monthly Fisheries Reports are compiled in FIREPLUS. Records from Malé collected by the SDMS inspector are initially compiled in a separate FoxPro database; data submitted by boat skippers or owners are cross checked against these records before all Malé data are imported to FIREPLUS. Customs data of tuna exports are compiled by SDMS in Excel.

Tuna troll fishery

Catch and effort data reported from islands on the Monthly Fisheries Reports are compiled in FIREPLUS.

Large yellowfin tuna fishery

The large yellowfin fishery catch data do not fit readily into the established FIREPLUS database structure. As a result they are compiled separately in EXCEL spreadsheets. Some large yellowfin are reported under the traditional pole and line tuna fishery (via island offices and Monthly Fishing Reports); these data are processed in FIREPLUS.

Industrial tuna longline fishery

The EEZ fishery catch data do not fit readily into the established FIREPLUS database structure. Summary data were previously compiled in Excel. On two occasions in the past the data were lost following computer crashes. Since 2002 data are compiled (with more detail) in dbf files (Visual Basic). This system is not compatible with FIREPLUS.

MRC survey

Tuna pole and line fishery

Length frequency and biological data are compiled in Excel spreadsheets (Tuna pole and line fishery, large yellowfin tuna fishery).

Amount of data handling before data are input in a computer and time frames for each step

Hardware and software in place

Type of system: Centralized system or other

Type of data input and flow of electronic data, including time frames

Data validation and verification procedures: by hand, electronic, etc.

Catch estimation procedures

Date of creation last revision and frequency of revision

Documented or not documented

Estimator (formula used to estimate catch)

Platform: integrated in database, external

Procedures: minimum coverage, substitution scheme, etc.

Type of output: catch plus estimates of precision, etc.

Estimation time frames

Review of estimates (never, as more data becomes available, or other)

Reports

Timeliness of production of type of catch estimates:

Unknown. Likely to be within one month after the end of the month concerned.

Two types of reports are sent from each atoll to the Ministry of Fisheries, Agriculture and Marine Resources in Male:

Reports of catches by day, gear, species and atoll, sent within 12 hours after the end of each day

Reports of catches by month, gear, species and atoll, sent at a non-specified time

The latter reports are considered to be more accurate

SDMS survey

The major responsibility for fisheries data reporting lies with SDMS.

Tuna troll fishery

A summary of catch and effort from this fishery is reported annually in Basic Fishery Statistics.

Tuna pole and line fishery

A summary of catch and effort from this fishery is reported annually in Basic Fishery Statistics. A summary of tuna exports (weight and value by commodity category) is also provided. SDMS has started work on a major recompilation of all available tuna catch and effort data to the level of island, month and species; this is expected to be published within the next two years.

Large yellowfin fishery Catches are not reported separately from other yellowfin (i.e. mostly pole and line caught) in Basic Fishery Statistics. This fishery has not been properly surveyed or reported upon. *Industrial tuna longline fishery* Summaries of annual catch by species and number of vessels licensed are reported in Basic Fishery Statistics. This fishery has not been properly monitored or reported upon.
Preliminary estimates
Final estimates

Proposed Budget for Improving the Reporting System in Maldives

Item	Number	Months	Cost Unit	Total Cost USD
Training	1	4	$6,000	$24,000
Enumerators	10	12	$400	$48,000
PDA	30	1	$150	$4,500
PDA software development	1	5	$7,000	$35,000
Database revision	1	3	$7,000	$21,000
Revision Sampling	1	4	$5,000	$20,000
Revision Stratification	1	3	$4,000	$12,000
Revision Datasheets/logbooks	1	2	$6,000	$12,000
Subtotal USD				**$176,500**
Misc (10%) of subtotal				**$17,650**
Total Cost USD				**$194,150**

Mission schedule

Date	Activity
17/9/11	Travel Sri Lanka-Maldives
18/9/11	Meeting with officials
19/9/11	Visit to Ensis Fisheries; meeting with officials
20/9/11	Travel to Khadhdhoo; visit to Horizon Fisheries, Thundi, Mathimaradhoo
21/9/11	Writing of findings; attendance to new fisheries reporting software training session
22/9/11	Writing of findings, meeting with officials; visit to Male harbour and fish market
23/9/11	Rest
24/9/11	Writing of findings
25/9/11	Meeting with officials, review fisheries database, writing of findings
26/9/11	Travel to Dubai and Seychelles

People met during the visit

Name	Institution/Post	Contact e-mail, phone
Dr. Hussain Rasheed Hassan	Minister of State for Fisheries and Agriculture	hussain.hassan@fishagri.gov.mv
Mr. Sinan Hussain		hussain.sinan@fishagri.gov.mv
Ms. Shafana Rasheed		
Mr. Hussain Afeef	Manager, Ensis Fisheries Pvt, Ltd	hussain@ensisgroup.com
Mr. Savan Mohamed	Manager Production, Ensis Fisheries Pvt, Ltd	ensis@dhivehinet.net.mv
Mr. Mohamed Waseem	Managing Director, Ensis Fisheries Pvt, Ltd	waseem@ensisgroup.com
Mr. Joby K. Jose	Quality Manager, Ensis Fisheries Pvt, Ltd	joby@ensisgroup.com
Dr. Shiham Adam	Director, Marine Research Centre	msadam@mrc.gov.mv
Mr. Abdul Razzaq Yoosuf	General Manager, Horizon Fisheries	razzaq@maandhoofisheries.com.mv
Mr. Ashraf Ali	Assistant Manager, Horizon Fisheries	ashraf.ali@maandhoofisheries.com.mv
Mr. Hassan Zameer	Fisheries Inspector, MoFAMR	zameer@avid.edu.mv

Mozambique

Main findings and proposed actions

Mozambique exhibits one of the best data collection systems in the region for the artisanal fishery although it does not report these catches to the IOTC as required. The semi industrial fleet, also included in the IOTC definition for artisanal, is another matter. Reporting by this and the industrial fleet (domestic) is based on logbooks returned by licensed fishers but there is no verification of the catches. Although the artisanal catch of tuna is very small, foreign fleets fish for tuna in Mozambique waters with longline and purse seine. Significant catches of seerfish do occur and it is also suspected that a considerable number of sharks may be caught although not targeted. The system shows delays in final data production due to the existing system of quarterly reporting from district to central office but this procedure could be easily changed.

The data collected include gear, effort, and species although it is common for the country to report its catches by groups of species (*e.g.* pelagic fishes) but this issue is easy to resolve as all the data are present in full detail in the database. The Access database (PescArt 3.5) was written in 1997 but has been updated frequently and seems to capture all the necessary information and it is one of the few databases in the region that really meets the needs of the fishery and reporting.

Findings and Recommendations

1. VERIFICATION OF NON-SAMPLED LANDING SITES
   Many sites are not sampled due to logistical limitations although catches are estimated using the fleet and gear counted through the census. It is necessary to determine the accuracy of said estimations by comparing them to occasional on-the-ground measurements.

2. VERIFICATION OF SEMI-INDUSTRIAL AND INDUSTRIAL DOMESTIC FLEET CATCHES
   Catches from the domestic fleets are not measured but assumed to be what they report in their logbooks. There is a need to verify the catches and species composition as there is an incentive for

these fleets to underreport their catches because they work under a quota system which if reached means further expense for the fishing companies.

3. ENUMERATORS
The number of enumerators has been slashed due to budgetary cuts and this number needs to be increased to cover the large number of landing sites in the country.

4. DATABASE
Although the database is sufficient to meet the needs of the artisanal fishery, semi-industrial and industrial fisheries data are registered somewhere else and in many cases not in a database but in Excel spreadsheets. There is a need to integrate all data to avoid issues of misreporting by one or another agency. There are plans to develop a semi-industrial and industrial database but this is on its early stages still.

5. ELECTRONIC DATA GATHERING
As already found on other countries, the possibility of entering the data electronically *in situ* would speed up reporting thus it would be very beneficial to present this technology to the concerned teams and to put them in contact with countries already using this technology. Oman has this system in place, and it is proposed Mozambique contacts it or IOTC to investigate the issues, possibilities and experiences.

6. SPORT FISHING CLUBS
As already seen in Kenya and Madagascar, these clubs can be an important source of data. It could be possible for the authorities people in Kenya to give the relevant departments a copy of the existing sport database and have them use it. The people in charge of contacting these clubs have been put in touch with the authorities in Kenya and with the African Billfish Foundation to get a copy of the database, share experiences and avoid replication of mistakes in the collection of data.

Fishing Ports and Landing Sites

MAPUTO FISHING PORT (MAPUTO): This is one of the few ports in the country. It is home to a small fleet of boats mainly small trawlers.

TOFO (INHAMBANE): This beach-landing site has approximately 38 small boats that use handline to catch various pelagic species including seerfish, sharks, billfish and occasionally tuna. The Fishing Community Council (CCP) in this site has lobbied effectively to implement bans on targeted shark and turtle catches due to its negative effect on tourism. Nonetheless, there is considerable conflict between the artisanal community and the tourism industry.

PRAIA DA BARRA (INHAMBANE): This beach-landing site is home to approximately 25 small boats that target *Scomberomorus* species with the use of handlines. Tunas and sharks are rarely caught.

NHADUGA (INHAMBANE): This is a landing site in a bay and the fleet targets shrimp and some fish with the use of hand-pulled trawl nets.

GUINJATA (INHAMBANE): Another landing site where seerfish are the main target but these are caught with rod and reel from small wooden boats and even from kayaks. This is one of the sites where information is not collected but where calculations on its catch composition and volume are done from catches in a nearby landing site with similar fleet and gear.

Map of Mozambique with ports and landing sites visited during this mission

Summary Table: Mozambique
General Information
Vessels and gears: For management purposes fishing fleets are divided into three categories: industrial, semi-industrial and artisanal Industrial: Vessels with total length greater than 20 m, autonomy of at least 30 days at sea, engine power cannot exceed 1500 hp or 1100 kw Semi-industrial: Vessels with total length between 10-20 m, autonomy for 10 days or less if they carry ice, or 15 to 20 days for onboard freezing capacity; engine power can not exceed 350 hp or 250 kw Artisanal: activity taken locally in fishing communities by families or companies, using traditional fishing gears, involving boats or not, boats should have a total length less than 10 m, engine power up to 100 hp or 75 kw.
Catches by species:
Legislation: Fishery Policy, Fishery Law, General Maritime Fishery Regulation, Sport and Recreational Fishing Regulation, Basic tools for Fisheries Communities Council, Co-management Committees Regulation
Institutions responsible for data collection and processing and linkages among them, if any: The General Directorate for Fisheries Administration (ADNAP) has the responsibility for the areas of fisheries administration, management and monitoring and control with a department created for each of these three areas. *Department of Fisheries Administration*: responsible for licensing of industrial, semi-industrial and artisanal gears/vessels, which are given on a yearly basis. It also has the responsibility for control and surveillance of the fisheries with the support of SAFMAR. Fisheries inspectors undertake this in landing sites and at sea. Fishing vessels are obliged to take two inspectors or observers from the Fisheries Research Institute, if requested by the ADNAP. *Department of Fisheries Management*: has the responsibility for collecting, compiling and processing statistics the fisheries industry The Institute for Small-Scale Fisheries Development (IDPPE) was created with the specific objective of promoting development in the artisanal fisher communities, including aspects relating to socio-economic conditions, fishing technology and related activities. The Fisheries Research Institute (IIP) has the responsibility for undertaking research in fisheries related issues as well as the aquatic environment and aquaculture aiming to propose management measures of fisheries. The Directorate of Fisheries Economics has the responsibility for the promotion of the fisheries Policies/ Laws and for the dissemination of *Fishing Statistics in Mozambique*. National Institute for Aquaculture Development was created with the specific objective of promoting development of small-scale aquaculture and has the responsibility for collecting, compiling and processing of aquaculture statistics.
Sampling
Existing data collection system: Catch and effort, species composition, biological information. Logbooks from industry are collected every 10 days.
Recent projects aimed at strengthening statistical systems, if not when was last: Norway IMR.
Sampling Design
Date of creation, last revision and frequency of revision: 1996. Revised in 2004 (Consultancy for review of the IIP artisanal fisheries monitoring program)
Documentation (present/absent): present
Personnel involved in main functions (enumerators, supervisors, head of statistics, etc): Industrial and semi-industrial: Inspectors and samplers under ADNAP and IIP supervision; Artisanal: Inspector and samplers under IDPPE and IIP supervision
Type of effort data collected
Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed):
Frame survey date last conducted and frequency: A national census on artisanal fisheries was carried out by the IDPPE, which is an essential source of information for statistical purposes. The last one was in 2007 and they are done every five years.
Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.): Catch and effort data (fishing days) obtained through fishing logbooks from the semi-industrial and industrial fisheries, and are supplied for broad species group such as marine fish, shrimp, etc. In the case of tuna and large pelagic fishes, the artisanal fishery collection system has many deficiencies and limited coverage, however, a new statistical collection system is being prepared and will be based on estimating mean catch by gear and extrapolating to total catch by landing sites effort information. Biological information: obtained through sampling programs in ports and onboard of fishing vessels through IIP observers in the Industrial and Semi-industrial and recreational fishery. For Artisanal Fisheries some biological information (length data) is taken during the sampling No biological sampling for tuna takes place.
Coverage (total enumeration or % sampled): Industrial (around 6%) and semi-industrial (4%) fisheries: all vessels are required to supply logbooks although the record is incomplete, and inspectors collect information onboard of some vessels. Industrial and semi-industrial fisheries: all vessels are required to supply logbooks although the record is incomplete, and inspectors collect information onboard some vessels. Artisanal fishery: Only 4 Provinces out of 10 are well covered by sampling program, and assuming that these Provinces have been sampled completely, the estimated coverage would be around 63 % in terms of boat and gears.
Type of catch data collected
Reports from fishermen or other non-governmental sources: Yes
Enumerators sample catches at the landing place: Yes
Both sources: Yes
By gear or aggregated: Aggregated but it is possible to separate by gear.
By species or aggregated: Aggregated into groups (*e.g.* tuna) but it is possible to split into species.
Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other):

Weight measured with scales.
Coverage (total enumeration or % sampled): There are 94 enumerators for marine waters. The coverage must be improved (landing sites and number of gears). In average, the estimated coverage would be around 40 % in terms of landing sites or gears.
Data Processing
Personnel involved, qualifications (database admin) and main functions: There are two people in each province. There is adedicated team to deal with statistics. Two staff members are involved but they would have the stock assessment as the main task/higher priority. The database on industrial and semi-industrial fisheries was developed in-house by a technician with several modifications over time by outside consultants. This has resulted in a hybrid database that uses software such as Clipper and Microsoft Access, which has serious limitations and is in urgent need of updating.[11]
Data flow, including time frames for each step: Data for artisanal fisheries catch and effort are compiled quarterly at the provincial level then sent to headquarters. After the verification the information is sent to the Fisheries Managers and sent back to the provincial level
Amount of data handling before data are input in a computer and time frames for each step:
Hardware and software in place: A database for industrial and semi-industrial fisheries was developed in-house but it has serious limitations to the point that statistics from the tuna fisheries are being registered separately in Excel files. There is a Database called PESCART for the artisanal fisheries from which the statistics on catch and effort are produced and store some other information related to this fisheries
Type of system: Centralized system or other: Other
Type of data input and flow of electronic data, including time frames: electronic data: Quarterly
Data validation and verification procedures: by hand, electronic, etc: by hand and electronically in the database PESCART
Catch estimation procedures
Date of creation last revision and frequency of revision: 2004
Documented or not documented: Documented
Estimator (formula used to estimate catch): In the documentation of PESCART
Platform: integrated in database, external No
Procedures: minimum coverage, substitution scheme, etc: Minimum coverage
Type of output: catch plus estimates of precision, etc. Yes
Estimation time frames: Quarterly
Review of estimates (never, as more data becomes available, or other): Never
Reports
Timeliness of production of type of catch estimates: Quarterly
Preliminary estimates: Quarterly
Final estimates: Yearly

[11] Stobberup KA, Lichucha I, Luís AM (2004). Profile of the Fisheries Sector in Mozambique: with particular emphasis on tuna fisheries. Country Report prepared for the Indian Ocean Tuna Commission

Proposed Budget for Improving the Reporting System in Mozambique

Item	Number	Months	Cost Unit	Total Cost USD
Revision Database	1	4	$6,000	$24,000
Enumerators	40	12	$300	$144,000
Verification of non sampled sites	10	4	$3,000	$120,000
Verification of semi industrial and industrial fleets	1	4	$3,000	$12,000
PDA	50	1	$150	$7,500
PDA software development	1	4	$6,000	$24,000
Subtotal USD				**$331,500**
Misc (10%) of subtotal				**$33,150**
Total Cost USD				**$364,650**

Mission schedule

Date	Activity
20/10/2011	Travel Tanzania-South Africa-Mozambique
21/10/2011	Meeting with officials; visit to Maputo Fishing Port
22/10/2011	Writing of findings
23/10/2011	Travel to Inhambane
24/10/2011	Visit to Tofo, Praia da Barra and Nhaduga; meetings with officials
25/10/2011	Visit to Ginjata and inspection of database and data forms
26/10/2011	Travel to Maputo; writing of findings
27/10/2011	Meeting with officials
28/10/2011	Writing of findings
29/10/2011	Travel Mozambique-Johannesburg-Dubai
30/10/2011	Travel Dubai-Iran

People met during the visit

Name	Institution/Post	Contact e-mail, phone
Mr. Osvaldo Chacate	Investigador Assistente, IIP	chacatemz@gmail.com
Ms. Isabel Chauca	Chefa Departamento de Pesca de Pequena Escala, IIP	rchauca@yahoo.com.br
Dr. Paula Santana Afonso	Director, IIP	psantanaafonso@gmail.com
Mr. Rui Mutombene	Coordenador do Programa de Pesca Semi Industrial de Linha, IIP	ruimutombene@gmail.com
Mr. Osvaldo Felipe	Chefe do Dep. Dos Recursos Pesqueiros e Aquicolas, IIP	
Ms. Anastacia Simango	Pesca Desportiva e Recreativa, IIP	anastacis.simango@gmail.com
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Mr. Avene Eduardo Netimane	Delegado Provincial Inhambane, IIP	aveneeduardo@yahoo.com.br
Mr. Augusto Songane	Secretario do CCP, Tofo	
Mr. Francisco Bambo	Presidente do CCP, Tofo	
Mr. Florian Giroux	Monitoring, Control and Surveillance Advisor, ADNAP	fgiroux@nfds.info

Sri Lanka

Main findings and proposed actions

Sri Lanka caught significant numbers of yellowfin tuna (38,704 MT) and skipjack (82,127 MT) in 2009. It has a large fleet of artisanal boats although many could be considered semi-industrial. The main gears used are gillnets and longlines, the former by far the most important art throughout the country. There are single-day and multi-day boats and their capacities and ranges change considerably accordingly. Multi-day boats mainly catch large tunas while single-day vessels catch coastal tunas, and smaller pelagic and demersal fishes.

The Department of Fisheries and Aquatic Resources (DFAR) and National Aquatic Resources Research and Development Agency (NARA) share the responsibility of collecting fisheries catch data but their roles overlap and this needs to be resolved to effectively cover the necessary landing sites. These two bodies use different methodologies, and for a country with dire need to cover more landing sites, the overlap in effort in some areas is redundant. It is here suggested that one institution gets the support to revise its sampling methodology, hire more enumerators and cover all ports and landing sites, not just those with large pelagic species. The Icelandic International Development Agency (ICEIDA) previously undertook this initiative but it was suspended when it was near to completion. This initiative should be revived and completed to streamline data gathering in Sri Lanka.

Data entry is done in Colombo and datasheets are sent there once a month. It is proposed that data entry be done at the site of collection by the enumerators to avoid interpretation errors and delays. This proposal could be taken a step further by investigating the possibility of using electronic tablets to enter all data in the field thus avoiding much of the paperwork and accompanying delays that make the system cumbersome. Currently, a project by IOTC-OFCF aims to develop a centralized database to improve data input and speed up reporting, as well as incorporate electronic tablet usage.

Findings and Recommendations

1. ENUMERATORS

Sri Lanka has a deficiency on the number of enumerators covering the coastline and large number of landing sites. The current number of enumerators is not sufficient to effectively cover all main ports and smaller landing sites effectively thus an increase in their number is strongly suggested.

2. CLARIFICATION OF DATA GATHERING RESPONSIBILITIES

At this time the DFAR and NARA collect data at the same ports with different methodologies and duplication of effort. It is suggested one of the organizations is in charge of this activity and utilizes a stratified random sampling method to accomplish this. There are various pros and cons to either of the organizations taking full control of the sampling. It is imperative, however, that their roles are clearly defined and that the initiative by ICEIDA mentioned above is revived and completed.

3. VALIDATION

Most catch landings are estimated by eye and in some cases compared to weights taken by traders and middlemen. Because it is common for boats to unload their catches already sorted by species and in some cases sizes, it is necessary to determine if the current methodology is biased. Thus, it is proposed that in a pre-determined frequency, catches are estimated with the current methodology and verified by actual weighing of the total catch of a selected number of boats to determine the difference.

Another number that needs validation at the port level if number of boats that go fishing. Although these estimates are taken from various organizations or individuals responsible in the different districts, it is crucial that they are accurate as this will be one of the main numbers used to creating a raising factor for each landing site or port sampled.

4. CATCH ESTIMATES

At this time, catch estimates are made by DFAR personnel in the field and this should be avoided for a variety of reasons. The first is the loss or information during the calculation of a mean and its multiplication to a total landing value where the variability of the boat catches is lost. The second is the lack of training and increased possibility of errors when fisheries inspectors make said calculations. The raw data should be entered and forwarded to the relevant authority to make the calculations thus avoiding loss of information and mistakes from calculations done by hand.

5. GEAR AGGREGATION

Catches from different gears are not separated and this needs to be remedied. In addition, the same boat may use two or more types of gear but the effort and catch are usually reported as from one fishing art. Separation of effort and species by gear type should take place in the logbooks.

6. SAMPLING EFFORT

NARA samples the main ports for 10 days (although it was observed that in some cases the number of days was eight) and major landing sites for another 10 days. These 10 days, however, are further divided into sampling for small and large pelagic fish, division for which there is no logical explanation and which results in reduced time for each species group. The time allocation is arbitrary and should be revised based on the importance of the port, gears and species landed, and other factors. A port with a multi-gear, multi-species fishery will need more intensive sampling than a port where one or two gears are used and few species landed. Furthermore, data sheets show that in many cases not enough samples are taken for each boat class. It was observed that in important ports like Beruwala, one boat was sampled per day for each boat category and this is not sufficient. In many cases, boat categories were not sampled and their catches are unknown. A relatively small number of boats (10-20) offload each day in the major ports; therefore it should be possible to increase the number of boats sampled to improve the precision of the estimates. In many cases only one or two vessels are sampled and this is not enough.

DFAR, on the other hand, samples only one day per week and most of the information is collected via interviews. The data are not discriminated by gear and many of the species are clumped into general groups. For example, yellowfin tuna are labelled as such for small specimens but larger ones go under the "Tuna" category. Furthermore, all sites may be visited in one day per week but there is no sampling, just interviews to gather information.

7. DATA ENTRY

Enumerators do not enter the data they collect and this should be remedied. There are many issues when people away from the site of data collection enter data including interpretation of handwriting,

mistakes, delay in production of statistics and others that could be avoided if the enumerators are trained in data entry and verification.

8. DATA COLLECTION

A considerable amount of repetitious data is collected every time a boat is logged or sampled. This methodology must be changed to reduce the amount of data collected, entered and processed. For example, if boat registration number is logged, other information like boat type code, length, boat name, and other parameters can be appended electronically without having to manually enter this information, thus reducing the amount of time recording, transcribing and entering data.

9. DATABASE

At this time DFAR has no database and uses Excel spreadsheets to calculate fishery production. NARA uses two different databases one for large and another for small pelagic fishes, although the rationale behind this separation is unknown. Mr. P. Premawardana, from DFAR, developed a database in Access as part of his degree and it is almost complete. This database has not been tested but its use is a possibility that should be investigated, as it was custom made for the circumstances in Sri Lanka. There is also the current effort through the IOTC-OFCF project that will look into this possibility as well as developing a new database.

10. SUPERVISION

It is important that field staff be supervised and corrections made where necessary. Supervisors and personnel from the statistical unit should make surprise visits to sites to determine the validity of the data collected and the reliability of the enumerators involved. Funds are necessary for these trips.

11. TRAINING

Although various training workshops already take place, personnel at NARA and DFAR would benefit from additional instruction. Subjects that should be covered include random sampling, identification of species (particularly relevant for sharks), biological sampling, and others. Training should be done in the ports and landing sites where enumerators usually work to address site-specific issues.

12. DATASHEETS

There are standard datasheets but data are transcribed to them after the fieldwork is completed. Transcription increases the chances of mistakes and omissions and should be avoided by recording data directly into the relevant datasheets in the field for later digital transcription.

13. STRATIFICATION

Although there is a stratified random sampling scheme in place, there are concerns about the stratification and it is suggested that the scheme is revised and updated. More time should be spent on ports that contribute significant catches to the overall production of each district. Sampling effort should be proportional to the importance of the ports.

14. ELECTRONIC DATA GATHERING

The longest delay in catch estimates occurs in Colombo where all data are entered. This delay has resulted in plans to modernize the data collection system through the use of portable electronic tables at the ports and landing sites. This proposal is still under investigation, but it would be very beneficial for the team in charge of developing this initiative to visit and communicate with countries already using this technology. Oman has this system in place and Sri Lanka authorities should contacts it or IOTC to investigate the issues, possibilities and experiences.

15. OBSERVERS

At this time observers are not deployed in any of the fisheries in Sri Lankan waters. It is here proposed that contacts be made on its behalf with organizations already doing this type of work in the area (*e.g.* SWIOFP) to investigate the possibility of collaboration to train Sri Lankan observers. Although it is likely that observers cannot be deployed in the boats due to limitations in space and facilities, the use of logbooks should resolve some of the issues. Also, partial deployment where the observer records part of the days' activities, and catch and bycatch from a patrol or other type of vessel is also a possibility. Another possibility includes video surveillance of the fishing activities to determine bycatch species and possibly quantities.

16. MULTIDAY OFFLOADING

Boats may offload the catch in a single day but commonly hold it for two or more days depending on market conditions. This makes sampling difficult and may result in biased data, as information is

usually gathered through interviewing the skippers but validation of these data is needed. A multiday offloading strategy needs to be developed to cope with this issue.

17. BOAT CLASSIFICATION
Currently, the two responsible institutions (DFAR and NARA) have two different boat classification schemes and these need to be unified into a unique categorization to allow comparisons of data. Furthermore, the current NARA scheme must be re evaluated as the differences in boat categories is minimal and the results from the database are difficult to interpret.

18. TRANSPORT
Samplers usually go to landing sites on motorbikes provided by the FAO/UNDP project but the equipment is in bad condition and needs replacement. The use of motorbikes is more reliable than that of buses or other transport and it gives samplers the autonomy to go to isolated places.

19. LENGTH MEASUREMENTS
Various ports and landing sites gather length measurements with varying tools (measuring tape, measuring board). This should not be a problem as long as there is an indication of the type of measurement taken to ensure appropriate conversion. This information must be included in all measurement recordings to avoid mixing data collected with different tools and methodologies.

Fishing Ports and Landing Sites

BERUWALA: This is one of the most important ports in Sri Lanka. There are variety of boats using various gears including gillnet, longline, handline, ring nets although trawlers are notoriously absent as this type of fishing is prohibited in Sri Lankan waters. Yellowfin tuna caught for export are sent directly to processing plants and there the enumerators gather information on catches and length frequencies. Species of interest found offloaded here include yellowfin tuna, skipjack, frigate and bullet tunas, marlin, swordfish, and seerfish.

Although large fish come already gutted and gilled, weight measurements are labelled as such and converted to full weight. Information is collected from skippers and it includes days out fishing, gear used, catch, estimated weight and number of gears used. Boats may change gear at sea depending on the fishing conditions and this is in theory tracked by the skippers and registered in port by the enumerators.

Sharks are landed whole and billfish headed and tailed making their weight estimation challenging. This site is covered by NARA and DFAR.

MARDANE: This landing site will be developed into an anchorage through the development of a breakwater. An auction/community centre facility has been finished and will be inaugurated shortly. It is home to 70-75 single-day boats that fish with longline, handline, and troll and target yellowfin tuna, marlin and sailfish. This site is covered by DFAR twice a week.

MIRISSA: There are 332 multi-day and 34 single-day boats in this port. The multi-day boats use longline and gillnet and target yellowfin, skipjack, marlin, and small quantities of bigeye tuna, and various shark species that are incidental. The port is sampled four days per month by two enumerators but the frequency of sampling must be increased to cover it effectively. As in other ports, information for large specimens includes individual weight but weight for smaller specimens and species is estimated. This site is covered by NARA and DFAR. NARA samples 4 days per month, keeping in mind that the time is divided into two days each for large and small pelagic fishes.

DODANDUWA: This anchorage site has 200 outrigger boats that fish from 3-4 hrs and target small tunas with gillnets. They catch mainly skipjack, frigate and bullet tuna and some billfish. Sharks are not caught here. All fish are weighed during auction and there are good records. This site is highly seasonal due to the influence of the monsoon. During six months of the year, fishing is conducted every day but during the remaining six months fishers go out only 3-4 days per week due to weather limitations. The fishers' association records the number of boats that go fishing. This site is covered by DFAR.

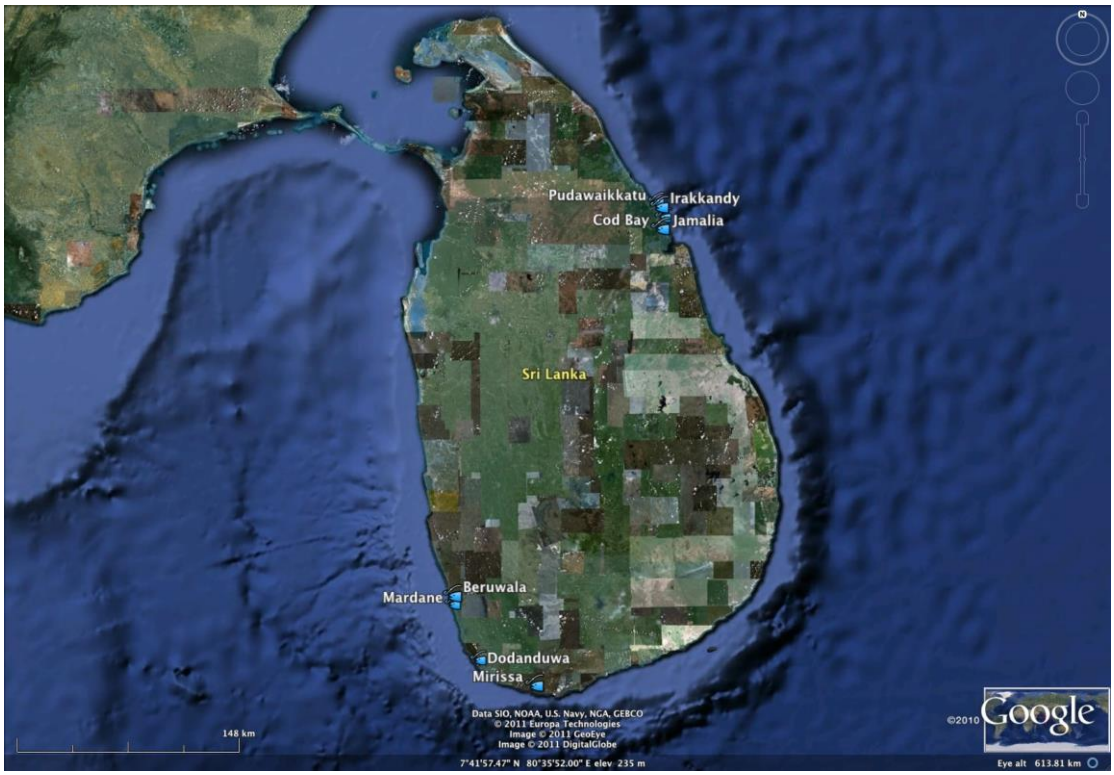
COD BAY: This port is home to a large fleet of multiday boats (200) that use longline and gillnets and single day boats (164) that use the same gears. Both gears are used seasonally and are used in the same boats. Each boat offloads approximately 2 MT for a two-week to a month campaign and they target yellowfin tuna, marlin, swordfish and some skipjack. Sharks are caught incidentally. Bullet tuna are caught with gillnets. Billfish arrive already headed, gutted, tailed and cut in pieces. Large yellowfin are weighed individually but smaller species like skipjack are estimated in baskets. This site is covered by NARA and DFAR.

PUDAWAIKKATU: This site is labelled an anchorage and 50-60 single-day and 20-30 multi-day boats reside there. The former use gillnets while the latter use this gear in addition to longlines. Gillnets are used to catch small pelagic fishes like mackerel and sprats and larger pelagic fishes like skipjack, yellowfin tuna and swordfish. Longlines are used to catch yellowfin tuna, swordfish, marlin, swordfish and a small quantity of bigeye tuna. A very small quantity of small scalloped hammerhead sharks is also landed. Boats offload an average 1-2 MT per every 2-3 week trip. This site is covered by NARA and DFAR.

IRAKKANDY: A fleet of 120 one-day vessels fish from here with the use of longline and target yellowfin tuna from January to May. Each boat brings approximately 50 kg per day and there are 35-80 boats fishing in any specific day.

JAMALIA: This ports houses 65 single-day boats that use longline to catch skipjack, bullet tuna and demersal fishes. There is little catch of billfish or sharks here. There are 20 boats fishing per day and five are sampled and the estimates compared to trader figures.

Map of Sri Lanka with ports and landing sites visited during this mission



Summary Table: Sri Lanka

General Information

Vessels and gears: Gillnets contribute significantly to the catch of tunas, sharks and billfishes. Longlines are used increasingly and are replacing gillnets as the gear of choice. There are two vessel classifications, one from NARA and one from DFAR. These systems should be simplified and reduced to one. NARA classifies vessels as follows:

1. UN1: 5.5 – 7.2 m (17' – 21') FRP dinghy, outboard engine – 8-40 HP (usually 15 – 25 HP), single day boats – assumed to be fishing in coastal waters
2. UN2A: 8.8 – 9.8 m (28' – 34') displacement hull. FRP or wooden, Inboard engine (single) – 40 HP, No ice box or insulated fish hold, no gear hauler, navigational, or acoustic equipments. Single day boats – assumed to be fishing in coastal waters
3. UN2B: 8.8 – 9.8 m (28' – 34') displacement hull. FRP wooden, Inboard engine (single) – 40 HP, Insulated fish hold – no gear hauler, may have GSP/sounder/fish finder
4. UN3A: 9.8 – 12.2 m (34' – 40') displacement hull. FRP wooden, Inboard engine (single) – 60 HP – (includes Abu Dhabi vessels), Insulated fish hold any may have gear, Hauler/GPS/sounder/fish finder. Multi-day boats-assumed to be fishing in offshore waters
5. UN3B: 12.2 m – (40' – 50') displacement hull. FRP or wooden, Inboard engine (single) – 60 + HP, Insulated fish hold and may have freezer facilities. Gear Hauler/GPS/sounder/fish finder. Multi-day boats-assumed to be fishing in offshore waters
6. UN4: Reserved for vessel category *e.g.* 15.2 – 18.3 m (50' – 60')

DFAR classifies vessels in the following manner:

1. NTRB: traditional non-motorized craft.
2. MTRB: traditional motorized craft.
3. OFRP: Fibreglass craft
4. IDAY: single-day boats (inboard engines)
5. IMUL multiday boats (deep sea and offshore)

Catches by species: In 2009 Sri Lanka caught 309,831 MT of skipjack, 150,845 MT of yellowfin, by far the most important species.

Legislation: Fisheries and Aquatic Resources Act No 2 of 1996 covers the aspects of Fisheries. SU has been given the provision to collect information by the Statistics and Census Ordinance 1956 (Amended in 2000).

Institutions responsible for data collection and processing and linkages among them, if any: The principal entity involved in fisheries statistics collection is the Statistical unit (SU) of the Ministry of Fisheries and Ocean Resources. The Department of Fisheries and Aquatic Resources (DFAR) and National Aquatic Resources Research and Development agency (NARA) are the actual data collectors. SU act as the central collation agency of fisheries statistics. Ceylon Fishery Harbours Cooperation, Ceylon Fisheries Cooperation and Sri Lanka Customs are also involved in data collections relevant to their interests. Fishing boat Owners Association, Fish Trader Organizations, Fishing boat and gear manufacturers, boat builders, some ice and fuel suppliers may maintain fisheries related data for their own interests. NARA collects fisheries data for stock assessments purposes.

Sampling

Existing data collection system:

Coastal fisheries

Fish landing data on coastal fisheries by DFAR.

Coastal tuna landing data, including lengths biology by NARA

There are 15 Fisheries Administrative Districts along the coastal zone of the country to administrate the fisheries activities. Each District has number of Fisheries Inspectors (FI). There is a total of 153 FIs.

The FIs are assigned to various duties including data collection. Generally they visit the landing sites one day per week particularly to collect fish statistics. They select representative landing sites within their division to collect statistics to estimate the monthly production. They interview fishermen and fisher organizations to verify the figures.

Offshore fisheries

Offshore fisheries landing data, lengths, biology by NARA

Offshore landing data by SU

The landing survey by NARA covers selected harbours and anchorages from each fishing zone. The landings of offshore boats take place in western, southern and eastern coasts only. The landing area is divided into seven fishing zones. At least 30% of the landed boats are sampled. Sampling is carried out 10 days per month per zone by two samplers.

The SU also estimates the offshore fish production. The FIs attached to SU visit five selected harbours on four days a month. They record the catch of 5 landed boats of the sampling day. A standard formula is used to estimate the production.

There are issues with species identification and the catch by gear type is not disaggregated. Logbooks are not validated through landings or other methods.

Recent projects aimed at strengthening statistical systems, if not when was last:

The ADB funded Coastal Resources Management Project of the MFOR conducted a comprehensive review of the fisheries data collection systems in Sri Lanka in 2001/2002 and proposed a new system to improve the situation. Initial steps were taken to implement the system.

Suggested main improvements in the system:

1. Allocation of FI for data collection- 30 FI to be appointed for fulltime data collection to cover entire coast
2. Introduction of systematic sampling system; this included sampling procedure and schedule
3. Standard data forms were prepared to obtain fish catch data separately for coastal fisheries, offshore fisheries and lagoons. Fish

catch (weight and species) is linked to fishing gear in revised data sheets
4. Monitoring and Supervision/ Data validation - proper monitoring to be done by officers
5. Enhanced travel allowance/Facilities for SU and other relevant staff as incentives
6. Offshore data collection to be carried out jointly with NARA programme

ICEIDA, FAO (vessel record) and the IOTC-OFCF (sampling of offshore fishery by NARA plus database development) have also assisted.

Sampling Design

Date of creation, last revision and frequency of revision:

Documentation (present/absent):

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc):

Coastal fisheries

In total 153 Fisheries Inspectors are involved in data collection. They spend only one day per week for this duty. 15 Additional Directors are involved in preparation of monthly data summaries. Staff of the SU: one statistician, two statistical officers, three fisheries inspectors, and one data entry operator.

Offshore fisheries

NARA sampling programme: nine full time samplers, two data entry operators, research assistants and research officers. A proposed new system will employ 30 full-time samplers for both coastal and offshore data collections.

Type of effort data collected

Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed):

Frame survey date last conducted and frequency: All fishing vessels are required to have a permit and the total number of fishing units is estimated through a census. The last fisheries census was conducted in 1972. In 1995-97 another 'census' was conducted based on samples but it was not full enumeration. The last national population census was conducted in 2001. That also produced data on the number of inland and marine fishermen, the number of fishing households and the number of other fisheries workers. In 2001 a survey was conducted on the motorized fishing vessels.

Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.): Landings per boat type per day.

Coverage (total enumeration or % sampled):

Type of catch data collected

Reports from fishermen or other non-governmental sources: No.

Enumerators sample catches at the landing place: Yes

Both sources: No

By gear or aggregated: Aggregated

By species or aggregated: 10-30% of tuna species are aggregated.

Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): Data recorded include weight, weight type and measuring tool.

Coverage (total enumeration or % sampled):

Data Processing

Personnel involved, qualifications (database admin) and main functions: There is a research officer to supervise activities and two data entry operators, one each for large and small pelagic species

Data flow, including time frames for each step: Data are collected every day, transcribed onto datasheets and sent to Colombo for input once a month.

Amount of data handling before data are input in a computer and time frames for each step: Data are transcribed from field notebooks into datasheets and these are sent to Colombo at the end of the month. It takes about two months for data to be entered into the database.

Hardware and software in place: NARA estimates offshore fish production using software called PELAGOS written in Access. This program calculates production by type of crafts and by fishing zone.

Type of system: Centralized system or other: Centralized

Type of data input and flow of electronic data, including time frames: Two month delay on data entry and production of estimate

Data validation and verification procedures: by hand, electronic, etc.:

Catch estimation procedures

Date of creation last revision and frequency of revision: Unknown

Documented or not documented

Estimator (formula used to estimate catch)

Coastal fishery

Step 1: Daily landing estimate at one landing site for a given boat category (Cd):

$Cd = (\Sigma_{b=1-n} Cb) * N/n$

Cb : Landing of species on sampling day per boat type

n : Number of vessels sampled on sampling day

N: Number of vessels operated on sampling day

Step 2: Monthly landing estimate by boat category at a landing site (Cm):

$Cm = (\Sigma_{b=1-Nds} Cd) * N/Nds$

Cd: daily landing on sample day

Nl: Number of landing days in that month

Nds: Number of days sampled Step 3: Monthly catches are summed to obtain the annual landings by boat category at a landing site.
Platform: integrated in database, external:
Procedures: minimum coverage, substitution scheme, etc.: Unknown
Type of output: catch plus estimates of precision, etc.: Catch without estimate of precision
Estimation time frames
Review of estimates (never, as more data becomes available, or other): Never
Reports
Timeliness of production of type of catch estimates: Monthly summaries of the costal fishery statistics are prepared at District Fisheries Offices. SU collects the data summaries by district and prepares a report for the whole country. The statistical unit (SU) of MFOR is the key entity responsible for authoritative collection and reporting of fisheries statistics information in Sri Lanka The unit is functioning under the planning and monitoring Division of the ministry. Director General of Fisheries is responsible for field fishery data collection through District Fisheries Offices Offshore fisheries NARA provides tuna statistics to MFARD and the latter issues official statistics to IOTC. Catch estimates take approximately two months to produce due to delays in data entry in Colombo.
Preliminary estimates
Final estimates

Proposed Budget for Improving the Reporting System in Sri Lanka

Item	Number	Months	Cost Unit	Total Cost USD
Enumerators	60	12	$200	$144,000
Training	1	4	$8,000*	$32,000
Revision stratification	1	3	$8,000	$24,000
Database	1	5	$4,000	$20,000
Motorbikes for sampling trips	20	1	$5,000	$100,000
Supervisory trips	4	12	$100	$4,800
PDA	100	1	$150	$15,000
PDA software development	1	5	$7,000	$35,000
Subtotal USD				**$374,800**
Misc (10%) of subtotal				**$37,480**
Total Cost USD				**$412,280**

* includes salary, transport and living expenses for trainer

Mission schedule

Date	Activity
4/9/2011	Travel Dubai-Colombo
5/9/2011	Writing of findings
6/9/2011	Meeting with officials
7/9/2011	Meeting with officials
8/9/2011	Meeting with officials
9/9/2011	Travel to Beruwala, Mardane, Mirissa, and Dodanduwa
10/9/2011	Writing of findings
11/9/2011	Rest
12/9/2011	Travel to Triconmalee; meeting with officials, visit Codbay Fishing Harbour
13/9/2011	Visit to Pudawaikka, Irakkandy, and Jamalia; travel to Colombo
14/9/2011	Writing of findings
15/9/2011	Meeting with officials
16/9/2011	Writing of findings
17/9/2011	Writing of findings. Travel to Maldives

People met during the visit

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Mr. K. Nayal Priyanga	Fisheries Inspector, DFAR	0718175956
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Tanzania (United Republic of)
Zanzibar (Revolutionary Government of)

Main findings and proposed actions

Tanzania catches very low volumes of yellowfin (123 MT) and swordfish (469 MT) mainly through handlines and to a minor extent longlines. The reporting system in Tanzania is divided between the mainland (the United Republic of Tanzania) and the Revolutionary Government of Zanzibar, a semi-autonomous part of the former. This complicates reporting because fisheries are controlled and managed by different administrative units and sampled independently and differently. All deep-sea fisheries, those outside the 12 nm limit and inside the EEZ, are managed and monitored by the Deep Sea Fishing Authority based in Zanzibar. Fishing within the 12 nm limit is monitored by the respective Fishery Department of Tanzania and Zanzibar.

Tuna fishing has changed substantially in the last few years due to the piracy threat and the foreign licensed fleet has diminished dramatically as a result. The large fleet of foreign longliners are not licensed to fish in Tanzanian waters and there is only a reduced fleet of EU purse seiners. There is no local fleet that targets tuna outside the 12 nm limit and it is unlikely that most of the artisanal boats found in the area go beyond 10 nm from shore. All local boats make single day trips and return to port for offloading, as there are no on-board storage facilities. The gears used to catch tuna include gillnets and handlines but the catches are small due to the limitations exhibited by the fleet that force it to fish in proximity to shore.

Data are mainly gathered not by enumerators, but by Beach Management Units (BMUs) composed of members of the fishing communities. Due to budgetary constraints and to landing sites accessibility, this seems to be a workable solution for Tanzania but the BMUs need further training and incentives to ensure the continuation of their cooperation.

Findings and Recommendations

1. SAMPLING DESIGN
   A frame survey is conducted every two years and consists of total enumeration of vessels, gears, etc. Although the survey is usually conducted regularly (last time was in 2008. The survey was cancelled

in 2010 due to budget cuts), the high seasonality of the fishery results in the need for frame surveys to take place during each season to determine the fleet characteristics (boats, gear, etc) per area.

Current sampling methodology for effort, catch, etc needs to be re-assessed to more effectively cover the main landing sites without overlooking smaller landing sites. Because of the paucity in frame surveys, an alternate sampling methodology will need to be investigated. At this time the same landing sites are sampled and it is necessary to sample sites randomly and according to the importance of catches offloaded.

2. SPECIES AGGREGATION
Tunas, sharks and billfish are aggregated into broad categories, as there is no species identification. It is necessary to report the species individually. For example, at this time all tunas are collectively called yellowfin tuna and there is no estimation of the true proportion of the various species.

3. FISH AGGREGATING DEVICES
Four new FADs have been deployed in Zanzibar's waters and they are being monitored by the DSFA. It is proposed that to avoid the common problem of substantial catches of small bigeye and yellowfin tuna observed in other countries, the DSFA implements size and gear restrictions on the fishers who make use of the FADs.

4. CATCH ESTIMATION
Catch estimation calculations are made by hand on calculators. All data should be entered and estimates made by the database in use or other procedures created to do the work.

5. REPORTING OF CATCHES
The Departments of Fisheries from Zanzibar and Tanzania do not report the catches by the artisanal fleet to IOTC and this need to change. At this time, all catches are reported by the DSFA that manages the foreign fleet and it is proposed that both Departments of Fisheries send their data to the DSFA for inclusion in the country report. IOTC can communicate with the relevant departments to request the data but contact details are needed.

6. FISH FOR PERSONAL CONSUMPTION
Fishers' catches information is gathered through auction organizations or individuals but the part that they keep for their consumption is not included in the production estimates. This number can be considerable, if we take into account the large number of fishers in Zanzibar and Tanzania, and must be included in the final production statistics. This estimate may be calculated through random surveys of fishers' households.

7. TRAINING
BMUs collect most of the production data in Tanzania at this time but have little training. Their training is essential to the success of the data gathering efforts in the country. Subjects that should be covered include catch sampling, identification of species (particularly relevant for sharks), biological sampling, and others. Training should be done in the landing sites where enumerators or BMUs operate to address site-specific issues.

8. ELECTRONIC DATA GATHERING
The longest delay in catch estimates occurs in Dar es Salaam and Stone Town where all data are entered. This delay, and other issues, begs for the use of portable electronic tables at landing sites. Oman has this system in place, and it is proposed that Tanzania contacts it or IOTC to investigate the issues, possibilities and experiences.

Fishing Ports and Landing Sites

MKOKOTONI (ZANZIBAR): This landing site is home to a fleet of mechanized outboard and inboard boats as well as many sailboats. Gears used include various nets (gillnets, ring nets), handlines, and longlines to catch a variety of tunas, sharks, skates and billfish. There is complete enumeration of the boats that land their catches here although it relies on the data collected by the auction staff. Information on effort and gears is collected along with fished areas. Large yellowfin tuna are caught during the NE monsoon with longline. Anywhere between 200-500 boats may offload their catches here in a day.

NUNGWI (ZANZIBAR): This beach is considered a large landing site in Zanzibar. Most boats fish for one day and return to the site although if weather is a factor they may go to other landing sites or continue fishing until conditions improve. Tunas of various species are caught along with sharks and billfishes. Approximately 800-1,000 kg of tuna are landed per day and are sold for local and hotel consumption. Approximately 65 boats

offload in the site per day and one enumerator is in charge of collecting information. Data on the capture of all boats are collected.

MALINDI (ZANZIBAR): This is Zanzibar's largest landing site with various types of boats with gears that include longline, handline and various nets (gillnet, ring net). There are a variety of tunas landed here including yellowfin, skipjack and kawakawa as well as billfish, rays and skates.

DAR ES SALAAM FISH MARKET (TANZANIA): This is the site with the largest number of enumerators (8). The market is divided into zones where fishes caught with different gears are brought and sold. The boats offloading here use a mix of ring nets, handlines, traps and beach seines. Species found here include skipjack, kawakawa and yellowfin along with sharks and billfishes although the catches of all these species are low.

MSASANI (TANZANIA): This beach-landing site is home to approximately 65 boats that catch an average 50 kg of fish per boat day. The gears used include gillnet, handline and longline. Information is collected from the BMUs and according to its members they would be able to separate by species if required. Issues mentioned by the BMUs include lack of training and equipment like balances.

KUNDUCHI (TANZANIA): This beach-landing site has about 50 boats that use ring nets for small pelagic fishes like sardines and anchovies. There is no BMU and fisheries officers collect the information. Interestingly, members of the community mentioned that tuna (small neritic species) are caught with the use of dynamite in this area.

Map of Tanzania with ports and landing sites visited during this mission

Summary Table: Tanzania

General Information

Vessels and gears: The artisanal fleet is large but made up of small vessels like dugout canoes and other type of non-motorized boats. The main gears used include gillnets, handlines, longlines and trolls.

Catches by species: Catches of tuna are low although it is likely there is underreporting. In 2009 Tanzania reported 469 MT of swordfish, 123 MT of yellowfin and 358 MT of marlin.

Legislation: Fisheries Act No. 6 of 1970 and its regulations are the major policy instruments under the current fisheries management system. The Fisheries Act was enacted as regulatory framework, within which the fish resource would be managed, conserved, protected by protecting breeding/nesting sites as well as prohibiting the use of destructive gears.
The Fisheries Act No. 6 of 1970 has been reviewed and replaced by the new one, Fisheries Act No. 22 of 2003 which is now operational and which applies national and FAO standards and the New International Act establishes in 1996.
The principal fisheries regulations have also been reviewed to accommodate new developments in the industry and to cater for new Act and the National Fisheries Sector Policy and Strategy Statement 1997. Fishery regulations of 2005 were endorsed by the government and came into force starting October 2005. Other related Acts include The Territorial Sea and EEZ Acts 1989 and the "Marine Parks and Reserves Act 1994".

Institutions responsible for data collection and processing and linkages among them, if any:
Mainland
Fisheries Division has the mandate to collect, compile, process and report fisheries statistics to all stakeholders within the country. For the users who are outside the country, data can be provided through a request to Director of Fisheries.
Zanzibar
The Department of Fisheries deals mainly with the supervision of the implementation of the Fisheries Act passed by the House of Representatives in 1988, concerning laws governing fishing activities in Zanzibar. Main role of the Department of Fisheries is to supervise all fishing activities, training and dissemination of information to fishers on better fishing methodology. The Department also carries out the following activities, which are covered in the Fisheries Act:
1. Supervision of the fisheries Act.
2. Collection of data and keeping records of fishing boats, amount of catch, fish prices, fishing gears etc. Data collection is conducted for 16 days per month.
3. Issuing of fishing licenses.
4. Registration of fishing boats.
5. Auctioning of fish caught by fishers.
6. Collection of royalty of 5% (based on purchasing price) from fishery products to be exported.

Fisheries activities are undertaken in accordance with the Fisheries Act of 1988 and the Fisheries Principle Regulations of 1993. The two legislations have given wide powers to the Minister responsible for Fisheries and to the Director of Fisheries to regulate any fisheries or fisheries related activity that needs to be undertaken in Zanzibar.
Coverage of the legislation includes registration and licensing of fishers and fishing vessels, collection of fisheries data, conservation and protection of marine resources and environment, and regulation of fishing gears and methods. It also covers the control of destructive fishing gears and methods, migration of fishers, closed fishing seasons and areas, and exportation of fish and fish products.

Sampling

Existing data collection system: Data on fishing effort is obtained through biannual frame surveys, while catch data are obtained by sampling in time and space. Sample data collected are then raised to provide estimated total production. Objectives of the Frame Surveys are:
* To collect data on the current fishing effort, i.e. numbers of fish landing sites, number of fishermen, fishing vessels, number of fishing gears by type and size and some social economic information on facilities at the landing sites.
* To provide accurate raising factors for estimating the total catch
* To provide sampling frames for various surveys being conducted and others to be undertaken in the future.

Objectives of the Catch Assessment Survey (CAS)
- To obtain data on fish production and values, species composition and the effort used.

Regular Fisheries Statistics
28 fish groups aggregated are used for data as weight and value at landing sites for Marine Fisheries.
Type of fishing boats, fishing gear, number of crew members, arrival time, production volume according to fish species, price, number of fish and other data are collected in Regular Fisheries Statistics.
Data are collected through two-stage sampling. At stage one, a few landing sites are selected randomly from the list of landing sites obtained from the frame survey. The selected sites are known as the Primary Sampling Unit (PSUs). At stage two, 10 days are selected randomly each month in which catch data are collected at the selected landing sites. The "Day" is therefore the Secondary Sampling Unit (SSU). In Fisheries data analysis a minimum of 30 records per gear type strata of any given landing site, per unit sample is needed for 90% confidence level in the lowest level analysis. These records are allocated to the BMUs in proportion to the extent of the use of the gear type of that particular landing site. A sampling of fishery statistics are collected from 28 major fish landing sites out of 257 landing sites throughout the nation to obtain the annual fishery statistics.
The data are collected for 10 days per month on the type of fishing boats, fishing gear, number of crew members, arrival time, production volume according to fish species, price, number of fish and other data. Regarding Marine Fisheries Statistics, the District Fisheries Officer in partnership with BMUs, is responsible for supervising, collecting and recording the statistics. Due to a shortage of personnel, the stipulated daily data has not been recorded faithfully at all of the sampling landing sites. Therefore, the conditions

are not clearly known at present.
Zanzibar
1. The objectives of collecting statistical data include:
* To know current fishing effort (i.e. number of fishers, fishing vessels by categories and fishing gears by type and size).
* To know amount of fish landed (species, size, weight and value).
* To know the number of people involve in the fishing industry (fishers and fisher folk).
* To understand fishing zones/area and seasons.
19 fish groups are used for weight and value data at landing sites for Marine Fisheries.
31 out of 116 landing sites are officially used to collect fisheries data for 16 days a month. Selection of the sites has been considered based on volume of catch, variety of fish species, accessibility to the site, number of boats and all year round operation etc.
Data are obtained through weighing and physical verification. On sampling days all the catch that is landed at the selected beach is weighed and recorded. Usually there are no practical problems with weighing of the catch. The exercise has been going on since the early 1970s and the fishers are familiar with the work of the enumerators. At the end of each month data sheet are sent to the Regional office for entering into the database.
On every recording day the recorder at the selected landing sites will record in his workbook (Form Z – CASF 1) all the catch that is landed that day. Items of information to be collected from every fishing unit will be as follows.
1. Type of fishing unit category / boat type and registration number (for units using boats)
2. Type and number of fishing gears used.
3. Number of fishers in the unit.
4. Weight and value of fish caught by species / species group.
5. Number of fish caught (for the large sized fish only)
6. Time of Departure to the fishing ground
7. Time of Arrival from the fishing ground
8. Time spent for actual fishing
9. Any additional information will be entered in the remarks.
At the end of the day the recorder will transfer the data in to Form Z – CASG 2 (The Daily Recorder of Fish Landed Form). A separate sheets will be used for every fishing unit category i.e. Boats, Canoe, Dugout canoes, Outrigger canoes, Dhow and Foot fishermen.
At the end of the month the forms will be sent to the District office for further processing.

Recent projects aimed at strengthening statistical systems, if not when was last: The system is updated from time to time depending on necessity and availability of funds. The system currently in use was established in 1992 by UNDP/FAO financed project, Strengthening Fisheries Statistics. However, data processing system was updated by SADC in 2001 under Artisanal Fisheries Information Management System project. It was then modified by United Nations University – Fisheries Training Program (Iceland) database expert in 2006. Currently, the database is not working properly due to lack of database expertise at the Fisheries Division.

Sampling Design

Date of creation, last revision and frequency of revision:

Documentation (present/absent):

Personnel involved in main functions (enumerators, supervisors, head of statistics, etc): 4 - 5 staff are concerned with fisheries statistics in the District Offices. The number depends on the sampling sites selected to be sampled in each particular district.
The data are entered at the district level for those districts that have computers. The Central Fisheries Division Statistics Section enters and analyzes the data and information submitted by those District Offices.
The Central Fisheries Division Statistics Section:
Number of staff members: Administrator (data editing, analyst) 2 persons
Data input members: 3 persons, sometimes about 3 helpers are employed on temporary basis to help in data input
Zanzibar
40 staff members are involved in the work in ten district offices and statistic stations.

Type of effort data collected

Source: Frame survey, sampling of vessel activities by enumerators or other (*e.g.* number of gears licensed): Frame surveys.
All licensed vessels are required to report to the licensing authority (Fisheries Division) the catches (Fishing Log form) of prawns and fish on a monthly basis. The data are entered and analyzed at the Statistics Section based on the total enumeration to provide total catches.
1. Deep sea catch data:
Since 2000 The Government started licensing foreign vessels (from EU, Japan, China and Korea) to fish in the EEZ of Tanzania. Currently there are about 70 foreign vessels operating in the EEZ. The vessels send reports on the catches made in Tanzanian waters although there is no way of verifying the data because they do not land nor transship on any Tanzanian ports.
Data: Landing sites, Frame Survey, Prawn Trawl Fishing, Catch reports on foreign vessels operating in EEZ
Database TANFIS collapsed in 2000. The data from the Fisheries Frame Survey 2005 has been entered into Excel spread sheet. Now new program by utilizing MS Access is being developed but not working properly due to lack of database expert at the Statistics Section.
Zanzibar
Each month the District Fisheries Officer receives all the Daily Recorder Forms (Z – CASF2) from the landing sites. The forms should be arranged according to the landing sites and fishing unit category.
Forms should be checked for consistency and accuracy. It is important to cross check the horizontal and vertical totals.

Data are transferred into Form Z – CASF3 (Work Sheet – 1) for each landing site and fishing unit category. A separate sheet is used for each fishing unit category.
The raising factor "R1" will be calculated by dividing the total number of days in the month by the number of sampling days. i.e.
R1 = No. of Days in the Month / No. of sampling days
The estimated total fish catch for the landing sites and fishing unit category for that month will be calculated by multiplying the total recorded sample by " R1".
The estimated total catch for the landing site and fishing unit category (last column of Form Z – CASF3) will be transferred in to Work Sheet – 2 (Z – CASF4).
The raising factor "R2" will be calculated by dividing the total number of fishing units in the District by number of fishing units in the sampled landed sites. i.e.
R2 = No. of fishing unit in the District / No. of fishing unit in the sampled landing sites
The total weight and value from all the sampled landing sites will be multiplied by the raising factor "R2" to obtain the estimated total landings for the Districts by fishing unit category.
The total estimated catch for the District is obtained by adding up all the estimates from all the fishing unit categories. These are entered into Form Z – CASF5.
Form Z – CASF6 will be used to calculate the average catch per boat, average crew per boat and average catch per fishers by fishing unit category. It must be noted that the data used is the sampled data only.
On completing the estimations, the District Fisheries Officer should send copies of Form Z – CASF4 to Z – CASF6 to the Statistics Section in the Department of Fisheries every month for final compilation and report writing.
At the Statistics Section all data forms must be checked for consistency and accuracy. Total estimated fish catch for the Island and finally the whole country will be obtained by adding up all the District estimations.
Deep-sea fisheries data:
The Zanzibar government started licensing foreign vessels (from EU, Japan, China, Taiwan and Korea) to fish in the EEZ of Zanzibar from 2000. The vessels send the catch reports, which forms are provided by the government, to the Department of Fisheries of Zanzibar to where the licenses were granted. VMS (vessel monitoring system) was implemented in 2006 in cooperation with the mainland.

Frame survey date last conducted and frequency: The latest Marine Fisheries Frame Survey for Tanzania was implemented in June-July 2005 and for Zanzibar in 2003.

Type of effort units (*e.g.* no trips, no vessels, number of net panels (gillnet), etc.): Number of all vessels and of net panels(gillnets) etc.

Coverage (total enumeration or % sampled): Total enumeration, a fisheries census-based approach in which data are collected on all fishing vessels and gears by type and size at all landing sites.

Type of catch data collected

Reports from fishermen or other non-governmental sources: Physical verification, interview is conducted by data enumerator to fishers or beach leader at their respective landing sites.

Enumerators sample catches at the landing place: Beach management unit's (statistics and information sub committee) are trained on the importance of collecting fisheries data and how to collect at their respective landing sites.

Both sources: Yes

By gear or aggregated: By gear

By species or aggregated: Aggregated into 24 and 19 fish groups for the mainland and Zanzibar respectively

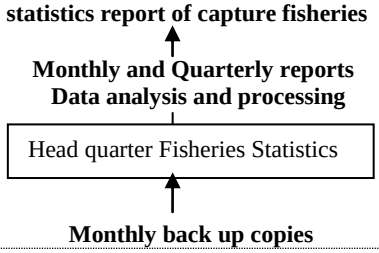
Unit of catch: number of fish, weight (round or processed, including type of processing). Measuring tools (eyeball or other): Both. Measuring balances are used (200 kg).

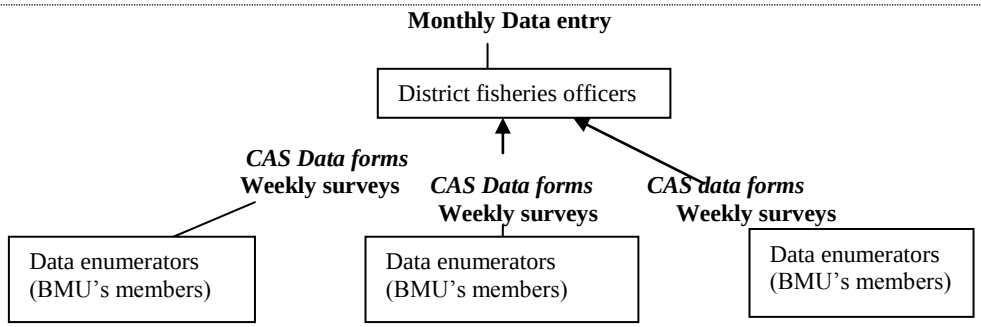
Coverage (total enumeration or % sampled): Data are collected on sampling basis in selected landing sites

Data Processing

Personnel involved, qualifications (database admin) and main functions:
There are 4 personnel in headquarter fisheries statistics section.
i). Head of statistics section: BSc in Marine biology; MSc in Environmental Management: International training course in fisheries statistics and data collection.
ii). Principal Assistant fisheries Officer: Diploma in statistics and computer: Diploma in Fisheries Science.
iii). Assistant fisheries officer: Diploma in processing and fish marketing.
iv). Assistant fisheries officer: Diploma in processing and fish marketing.
Others are
v). Two district fisheries officer and BMUs members in their respective landing site.

Data flow, including time frames for each step:





Amount of data handling before data are input in a computer and time frames for each step:

Hardware and software in place: A customized data processing program (TANFIS) developed by FAO for data entry and processing was used up to 2000 when it crashed. A new program in Microsoft Access is being developed for use in all water bodies other than Lake Victoria.

Type of system: Centralized system or other: Fisheries data are collected in collaboration between beach management units (BMU's) and fisheries headquarters.

Type of data input and flow of electronic data, including time frames:

i). Weight of fish
ii). Price (value) of fish
iii). Type of species
iv). Time spent on fishing
v). Type of fishing vessels and its registration number
vi). Type of fishing gears and its amount
vii). Name of recorder
viii). Name of Landing site and village
ix). Name of fishing ground
x). Date
xi). Evaluation of fishing trips for consecutive three days to get information on boat activity coefficient.

Data validation and verification procedures: by hand, electronic, etc: It is done electronically, data are exported into Excel datasheet and analysed accordingly.

Catch estimation procedures

Date of creation last revision and frequency of revision: The frequency of data revision is monthly

Documented or not documented:

Estimator (formula used to estimate catch): Yield calculation is based on catch per gear (CAS data), number of gears per village/district (Frame survey data), 10 Standard operation days and boat activity coefficient (BAC)

Platform: integrated in database, external: Integrated in database, external; CAS data are integrated in stand-alone database

Procedures: minimum coverage, substitution scheme, etc.: One or two selected landing sites per districts, selection of landing sites are based on its accessibility.

Type of output: catch plus estimates of precision, etc.: Total catches and their values per district/region/whole country can be reported monthly or annually.

Estimation time frames: Monthly

Review of estimates (never, as more data becomes available, or other): Reviewed as more data becomes available

Reports

Timeliness of production of type of catch estimates:

Mainland

Since 1997 Annual Statistics Reports have not been published due to several issues and constraints. These include, retrenchment of data enumerators at the district level, y2K problem of the computer which hinder TANFIS to work due to different computer working environment and lack of data entry personnel at he regional offices. The data from the Fisheries Frame Survey 2005 had been entered into Excel spread sheet and the report was published in early 2006.

Zanzibar

Every month the Statistics Section in the Department of Fisheries will prepare a monthly fisheries statistical report to present a summary of the Catch assessment results. The data will be presented in a form of tables to be decided depending on user's requirement. The followings are examples of statistic report which could be prepared:

1. An overall summary of fish catch, value and fishing efforts broken down to Unguja and Pemba Islands.
2. Total fish catch and value broken down to different species/ species groups.
3. Species percentage composition.
4. Total catches and values by species and by District.
5. Species percentage composition by District etc.

Preliminary estimates

Final estimates

Proposed Budget for Improving the Reporting System in Tanzania

Item	Number	Months	Cost Unit	Total Cost USD
Revision Stratification	1	3	$5,000	$15,000
Training Enumerators and BMUs	2	4	$5,000	$40,000
PDA	60	1	$150	$9,000
PDA software development	1	5	$7,000	$35,000
Frame Surveys	2	2	$20,000	$80,000
Subtotal USD				**$179,000**
Misc (10%) of subtotal				**$17,900**
Total Cost USD				**$196,900**

Mission schedule

Date	Activity
13/10/2011	Travel Seychelles-Kenya-Tanzania
14/10/2011	Travel to Zanzibar; public holiday
15/10/2011	Meeting with officials
16/10/2011	Writing of findings
17/10/2011	Meeting with officials; visit to Mkokotoni, Nungwi and Malindi; writing of findings
18/10/2011	Travel to Dar es Salaam; meeting with officials; writing of findings
19/10/2011	Visit to Dar es Salaam Fish Market, Msasani and Kunduchi
20/10/2011	Travel Tanzania-South Africa-Mozambique

People met during the visit

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Mr. Sigali Juma	Fisheries Officer, Fisheries Development Division	

Acronyms and Abbreviations

ABF	African Billfish Foundation (Kenya)
ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ADNAP	Administraçao Nacional das Pescas (Mozambique)
ARTFISH	Approaches, Rules and Techniques for Fisheries Statistical Monitoring
AVDTH	Acquisition et Validation des Donnes Thonieres
BAC	Boat Activity Coefficient
BMU	Beach Management Unit (Kenya)
BPS	Central Bureau of Statistics (Indonesia)
CMFRI	Central Marine Fisheries Research Institute (India)
CCP	Conselho Comunitario de Pescado (Mozambique)
CORDIO	Coral Reef Degradation in the Indian Ocean (Kenya)
CPC	Cooperating Non-Contracting Party (Indian Ocean Tuna Commission)
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
DFAR	Department of Fishery and Aquaculture Resources (Sri Lanka)
DFO	District Fisheries Office (Indonesia)
DGCF	Directorate General of Capture Fisheries (Indonesia)
DINAS	Department of Oceans and Fisheries (Indonesia)
DSA	Daily Service Allowance
EEZ	Exclusive Economic Zone
EU	European Union
FAB	Fisheries Advisory Board (Maldives)
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization
FI	Fishery Inspector (Sri Lanka)
FiDEx	Fisheries Development and Extension Services (Maldives)
FINSS	Fisheries Integrated Statistical System
FIREPLUS	Fisheries Recording System Plus (Maldives)
FS	Frame Survey
FSI	Fishery Survey of India
ICEIDA	The Icelandic International Development Agency
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
IIP	Instituto Nacional de Investigaçao Pesqueira (Mozambique)
IOTC	Indian Ocean Tuna Commission
IUU	Illegal, unreported and unregulated fishing
LOA	Length overall
MFOR	Ministry of Fisheries and Ocean Resources (Sri Lanka)
MOFA	Ministry of Fisheries and Agriculture (Maldives)
MoFAMR	Ministry of Fisheries, Agriculture and Marine Resources (Maldives)
MPEDA	Marine Products Export Development Authority (India)
MRC	Marine Research Centre (Maldives)
MSY	Maximum Sustainable Yield
MT	Metric Tonnes
NARA	National Aquatic Resources Research and Development Agency (Sri Lanka)
NE	Northeast
NGO	Non governmental organization
OFCF	Overseas Fisheries Cooperation Foundation (Japan)
ORSTOM	Institut Francais de Recherche Scientifique pour le développement en Coopération
PFO	Provincial Fisheries Office (Indonesia)
PFO	Provincial Fisheries Officer (Indonesia)
PIPP	(Indonesia)

RCCF	Research Centre for Capture Fisheries (Indonesia)
RCFMC	Research Centre for Fisheries Management and Conservation (Indonesia)
RECOMAP	Regional Coastal Management Programme of the Indian Ocean Countries
RFMO	Regional Fisheries Management Organization
RIMF	Research Institute for Marine Fisheries (Indonesia)
SDMS	Statistics and Database Management Services (Maldives)
SE	Southeast
SL3	Sampling Form (Indonesia)
SPC	Secretariat of the Pacific Community
SU	Statistical Unit (Sri Lanka)
SWIOFP	South West Indian Ocean Fisheries Project
TPI	Tempat Pelelangan Ikan (Fish Auction Place, Indonesia)
TUFMAN	Tuna Fisheries Database Management System (Secretariat of the Pacific Community)
USTA	Unite Statistique Thoniere D'Antsiranana (Madagascar)
UT	Union Territory (India)
VMS	Vessel Monitoring System
WCS	Wildlife Conservation Society (Kenya)
WWF	Worldwide Fund for Nature

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