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Tuna for Tomorrow: Information on an Important Indian Ocean Fishery Resource

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Prepared by

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TABLE DES MATIÈRES

ABBREVIATIONS

ADB	Asian Development Bank
ALB	Albacore (*Thunnusalalunga*)
BET	Bigeye tuna (*Thunnusobesus*)
cm	Centimetre
CPUE	Catch per unit of effort
€	EURO
EU	European Union
EEZ	Exclusive Economic Zone
FAD	Fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FMSY	Fishing mortality at MSY
IOC	Indian Ocean Commission
IOTC	Indian Ocean Tuna Commission
Kg	Kilogramme
LL	Longline
LOA	Overall length
m	Metre
Mt	Metric tonne
MFCL	Multifan-CL
MPA	Marine Protected Area
MSY	Maximum sustainable yield
NGO	Non-governmental organization
PS	Purseseine
RFMO	Regional Fisheries Management Organization
SC	Scientific Committee of the IOTC
SKJ	Skipjack tuna (*Katsuwonuspelamis*)
SSB	Spawning stock biomass
SWO	Swordfish (*Xiphiasgladius*)
UNCLOS	United Nations Convention on the Law of the Sea
WCPFC	Western and Central Pacific Fisheries Commission
WP	Working Party of the IOTC
YFT	Yellowfin tuna (*Thunnusalbacares*)

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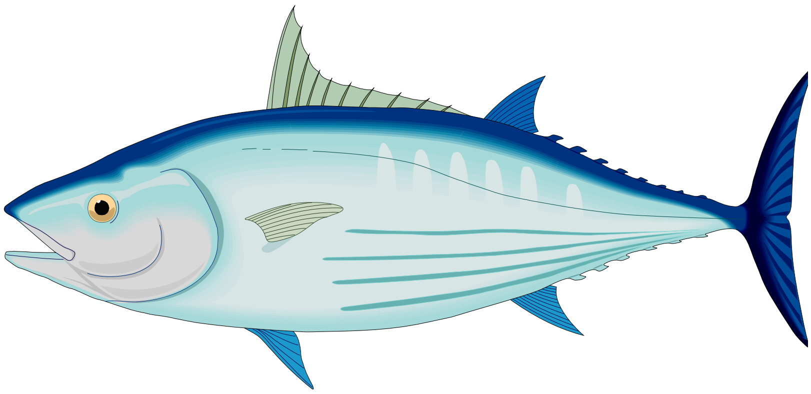
1. INTRODUCTION

The Indian Ocean is one of several important tuna fishing areas of the world. Compared to the Atlantic and eastern/western Pacific, a high proportion of catches in the Indian Ocean comes from areas beyond national jurisdiction. In addition, tuna catches in this region are split about equally between industrial and non-industrial fisheries. The various types of Indian Ocean tuna fishing is set in a diversity of cultures and economic situations.

Indian Ocean tuna is an important component of food security, as well as a basis for significant industrial activity. These activities are set in a complex situation in which the different stakeholders have vastly different aspirations for the future.

Although the amount of tuna in the Indian Ocean is large, like all fish resources in the world, it is not infinite. We often hear of collapses of fish stocks in other parts of the world – and to prevent over-exploitation of Indian Ocean tuna, some form of control is required.

The process of gathering fisheries information and then using it to formulate and apply such control is never simple, but for Indian Ocean tuna fishing the situation is very complex – perhaps among the most complicated in the world, considering the mixture of fishing activity, speed of development, geographic area, countries and stakeholders involved. Recent publicity related to tuna fisheries worldwide adds additional complexity to the management environment.



It is important that the various stakeholders involved with Indian Ocean tuna are aware of the major issues. The purpose of this booklet, therefore, is to summarize in non-technical terms what we know about tuna in the Indian Ocean, the health of this resource, the institutions/processes involved with safeguarding tuna and the major concerns for the future.

2. THE IMPORTANCE OF TUNA AND TUNA-LIKE SPECIES IN THE INDIAN OCEAN

Indian Ocean tuna supports a wide range of economic activities. The artisanal fishing is a significant contributor to employment and nutrition, while large-scale fishing is associated with government revenue for foreign fishing, onshore processing and payments for supplies and port fees.

The total value of the tuna catch in the Indian Ocean is not well understood. Several estimates of the landed value of the catch are in the range of € 1.5 to 2 billion, with the relatively high prices paid for artisanal caught tuna being a major factor in the overall value.

Artisanal fishing in the Indian Ocean has produced nearly 140,000 tonnes (Mt) of tuna annually in recent years. Nine Indian Ocean countries catch more than 5,000 Mt of tuna by artisanal fishing: Comoros, India, Indonesia (Indian Ocean portion), Iran, Madagascar, Maldives, Oman, Sri Lanka, and Yemen. By contrast, few counties in the other tuna fishing regions of the world have artisanal tuna fisheries this large.

The economic importance of tuna in the region is the greatest in the small island countries. As examples:

- Maldives: Fishing, of which more than 90% is for tuna, is responsible for over 9% of the country’s GDP and provides employment for over 15,000 people. Tuna is largely responsible for the Maldives having one of the highest per capita fish consumption rates in the world.
- Comoros: Fishing by residents is mainly for tuna and tuna-like species and is exclusively artisanal. This activity produces a significant amount of local food and is responsible for about 55% of all employment in the agriculture/fishing sector, involving 8,000 fishers.

Industrial-scale tuna fishing activity is also economically important. Six coastal states receive government revenue for granting fishing privileges to foreign vessels. There are large scale tuna canneries in at least five countries of the region. Large purse seiners and longliners (over one thousand operate in the Indian Ocean) are associated with a significant expenditure in regional ports. Tuna caught in the Indian Ocean supplies about 40% of the EU tuna market.

It has been estimated[1] that the processing of tuna directly employs almost 10,000 people in countries of the central and western Indian Ocean.

[1] Evert Liewes (2010). Status of the Tuna Sector in the Indian Ocean.

Jobs in Tuna Processing[2]

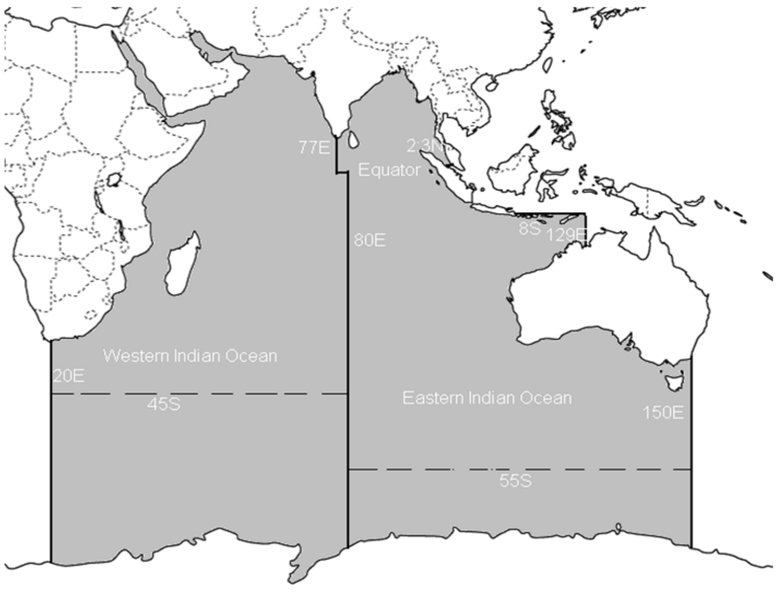
Country	**Number of people directly employed**
Kenya	300
Maldives	800
Madagascar	1,500
Seychelles	2,600
Mauritius	4,500
Total	**9,700**

Overall, it is likely that tuna is the most economically important fishery resource of the Indian Ocean.

3. THE INDIAN OCEAN

In the study of fisheries for statistical, scientific and practical purposes, it is important to be precise about the area concerned. In this booklet (and for tuna fishing in general), the "Indian Ocean" is taken to be the geographic area covered by the Indian Ocean Tuna Commission (IOTC), (map below).

The Area Covered by the Indian Ocean Tuna Commission



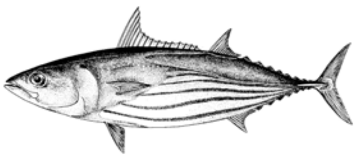
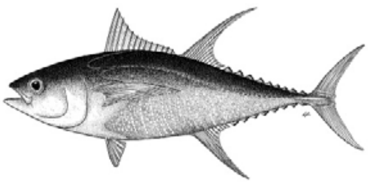
[2]Evert Liewes (2010). Status of the Tuna Sector in the Indian Ocean.

4. WHAT IS TUNA?

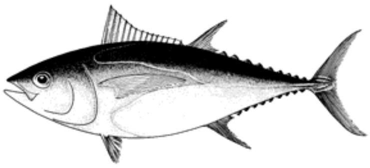
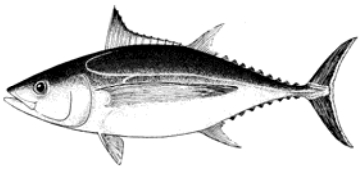
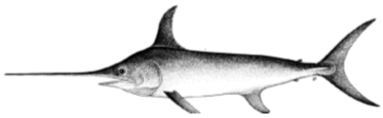
Tuna is not a single species of fish, but rather several species. Scientists often use the term “tuna and tuna-like fish” to refer to a total of 61 species, 14 of which are considered “true tuna.” Four species are of major commercial importance in the Indian Ocean: skipjack, yellowfin, bigeye, and albacore. The most important tuna-like species in the Indian Ocean is swordfish.

These five species[3] are quite distinct with respect to many properties, such as how they are captured, the amount presently captured, the size of the populations and the end use of the product.

The Main Tuna and Tuna-Like Species in the Indian Ocean

Species		Approximate Annual Catch (Mt)	Important Aspects
Skipjack		400,000 to 600,000	Skipjack tuna is a cosmopolitan species found in tropical and subtropical waters. It generally forms large schools, often in association with other tunas of similar size, such as the juveniles of yellowfin and bigeye tuna. This species has a high reproductive potential (fecundity) and spawns opportunistically throughout the year in the entire inter-equatorial Indian Ocean (north of 20°S). The size at first maturity is about 42 cm fork length. Skipjacks are caught mainly on the surface by purse seine and pole/line gear and used mainly for producing canned tuna.
Yellowfin		270,000 to 525,000	Small yellowfin are caught on the surface by purse seine, gillnet, pole/line gear and trolling while larger/older fish are caught in deeper water using longline gear. The sizes exploited in the Indian Ocean range from 30 to 180 cm fork length. Spawning occurs mainly from December to March in the equatorial area (0–10°S), with the main spawning grounds west of 75°E. Secondary spawning grounds exist off Sri Lanka and the Mozambique Channel and in

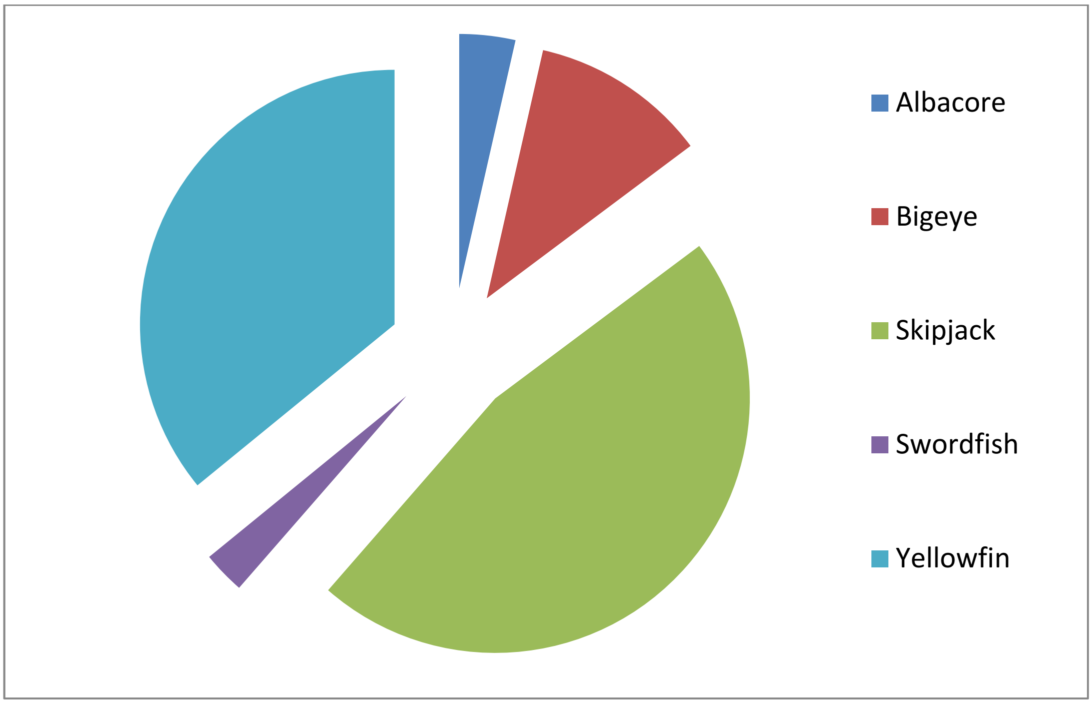
[3]For simplicity, in this booklet the four tunas and one tuna-like species are referred to as the “main tuna species”.

Species		Approximate Annual Catch (Mt)	Important Aspects
			the eastern Indian Ocean off Australia. Yellowfin tuna size at first maturity has been estimated at around 100 cm. The fish is used for both canning and the fresh/frozen trade.
Bigeye		70,000 to 140,000	Small bigeye are caught on the surface by purse seine, gillnet, pole/line gear, while larger/older fish are caught in deeper water using longline gear. Bigeye tuna account for a relatively small proportion of the total tuna catch in the region, but these tuna are extremely valuable, especially in the Japanese market.
Albacore		30,000 to 50,000	Small albacore are caught by trolling at the surface in cool water outside the tropics, while larger fish are caught in deeper water and mainly at lower latitudes using longline gear. Most of the catch is used for producing what is widely referred to as "white meat" canned tuna.
Swordfish		20,000 to 25,000	Swordfish are caught in the Indian Ocean mainly using drifting longlines (95%) and gillnets (5%). Between 1950 and 1980, catches of swordfish in the Indian Ocean slowly increased. Since 2004, annual catches have declined steadily, largely due to the continued decline in the number of active Taiwanese / Chinese longliners in the Indian Ocean.

Mt = metric tons, Source: IOTC

The proportion of the catches by weight for these five species is shown in the figure below. It can be seen that the catch of skipjack approaches the combined catches of the albacore, yellowfin, bigeye, and swordfish.

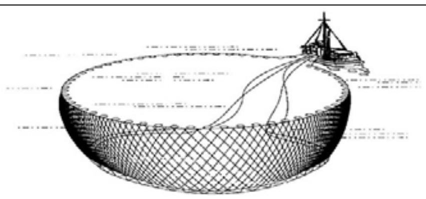
Tuna Catch by Species in the Indian Ocean

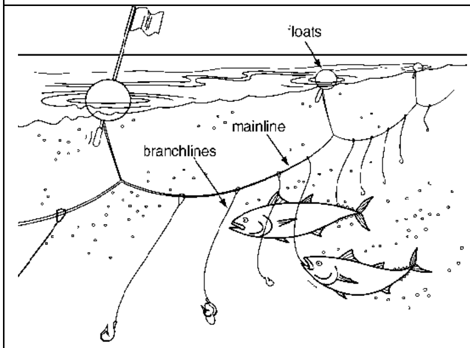
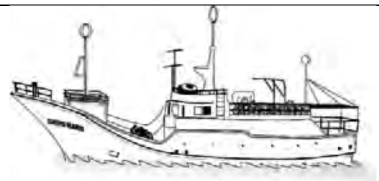
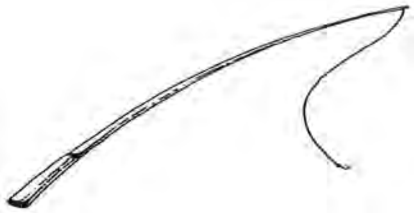
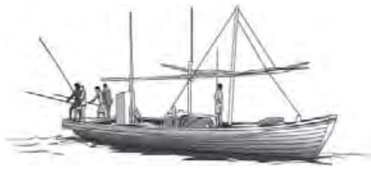
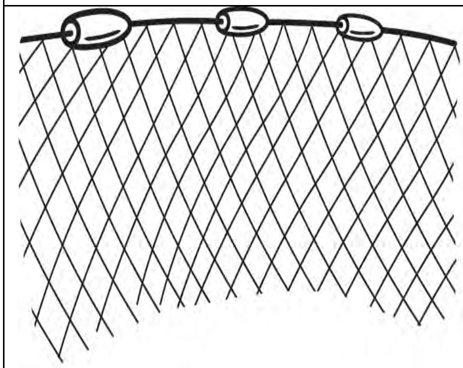


5. HOW ARE TUNA CAUGHT?

Tuna have been caught for centuries in the Indian Ocean. There are accounts of skipjack capture and trading in the Maldives that dates from almost a thousand ago. Japanese longliners began fishing for tuna in the Indian in the early 1950s. By the early 1980s most tuna catches were made by Japanese, Taiwanese and Korean longline vessels and smaller-scale fishing activity based in Indian Ocean countries using pole/line, gillnet, and troll gear. The first tuna purse seining in the region was undertaken by vessels from Spain and France in the mid-1980s.

The Major Tuna Fishing Gear

Gear Type	Catch	Typical Vessel	Notes
Purse seine			
	Mainly skipjack and small yellowfin are caught by purse seine gear. Most catch is for canning.		About a third of the Indian Ocean tuna catch is made by purse seine gear – about 330,000tonnes in recent years. Most of the catch is taken

			in the west of the Indian Ocean.
Longline			
	Most tuna caught are large size yellowfin, bigeyeand albacore. The prime yellowfin and bigeye often are exported fresh to various world markets. Most of the albacore is for canning.		About 17% of the Indian Ocean tuna catch is made by gear – about 150,000 Mt in recent years. Most of the catch is taken in the west of the Indian Ocean.
Pole-and-line			
	Mainly skipjack and small yellowfin are caught by pole-and-line gear. Most catch is for canning or producing a dried product.		About 10% of the Indian Ocean tuna catch is made by pole-and-line gear – about 90,000Mt in recent years. This gear is currently used only only the Maldives and the Lakshadweep islands of India
Gillnet			
	In many Indian Ocean countries only a part of the gillnet catch is tuna. Large amounts of bycatchare likely to be taken but there are little verified catch data.		About a quarter of the Indian Ocean tuna catch is made by gillnet gear – about 225,000 Mt in recent years. Significant amounts of tuna are caught by gillnetting by vessels from Iran (reports of 5,920 gillnetters currently operating), Pakistan, India, Oman, and Sri Lanka.

A group of similar fishing boats is called a "fleet". The box below gives the major tuna fleets in the Indian Ocean and estimations of the numbers of boats in each fleet.

The Size of the Various Indian Ocean Tuna Fleets

Purse seiners: The number of purse seine vessels operating in the Indian Ocean expanded rapidly between the early 1980s and the mid-1990s. It reached a maximum in the mid/late 2000s when there were between 75 and 80 large-scale purse seiners (i.e. having length overall of 24 metres or greater) operating in the region. The number of seiners has since declined due to several reasons, including piracy, capacity controls and economic conditions. Currently there are about 38 large-scale purse seiners fishing in the Indian Ocean, with most registered in Spain, France, and the Seychelles.

Longliners: Industrial longline vessels have been operating in the Indian Ocean since 1952. The number of large scale industrial longliners in the Indian Ocean has ranged between 1,200 and 1,400 in recent years, while the number of small scale longliners (having an overall length smaller than 24 m) have been around 1,200 vessels. At present, longliners from Taiwan, Indonesia and Japan account for more than 80% of the total number of longline vessels in the Indian Ocean. India, China, Malaysia and the EC also have important longline fleets in the region.

Other types of vessels: Significant numbers of other types of tuna vessels operate in the Indian Ocean, including pole-and-line vessels from Maldives and India, gillnet vessels from Iran and Pakistan and vessels from Sri Lanka that use a combination of gillnets and longlines. At present many countries have not supplied to IOTC complete information about vessel sizes and operating areas, making it difficult to derive the actual numbers of vessels from these countries that are active in the Indian Ocean. In recent years as many as 9,000 gillnet vessels, 2,800 gillnet/longline vessels and 900 pole-and-line vessels have been operating in the region.

Artisanal tuna fishing craft: Compared to other tuna fishing areas of the world, an important characteristic of the Indian Ocean is the large proportion of the tuna catch that comes from very small-scale fishing. Important examples are in Comoros where trolling from about 1,500 fiberglass skiffs (length: 6 to 7 m) produces over 9,000 tonnes of tuna annually and in Yemen where hand-lining from several thousand fiberglass boats (length: 7 to 9 m) produces over 15,000 tonnes of tuna.

A Spanish Purse Seiner

6. FLOATING OBJECTS AND FISH AGGREGATION DEVICES

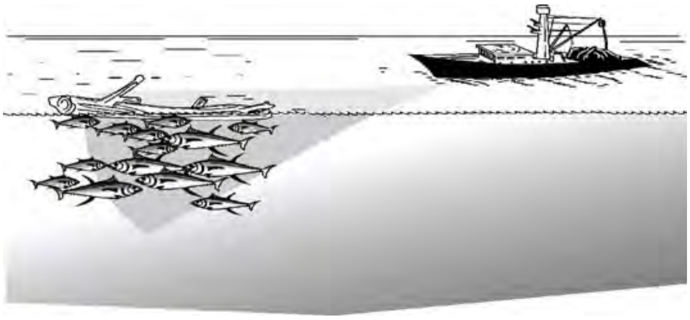
Objects that floatin the ocean are often important in tuna fishing. For reasons still unknown to science, almost anything floating in the ocean tends to attract tuna and several other types of fish -sometimes in very large quantities. Tuna fishers know that tuna catches can be very good around objects floating offshore-especially ones that have been in the water for several weeks. Purse seine fishers seek floating objects, as they can set their nets and capture the attracted tuna: sometimes over 100 Mt from a single set (e.g. 25,000 fish weighing 4 kgeach).

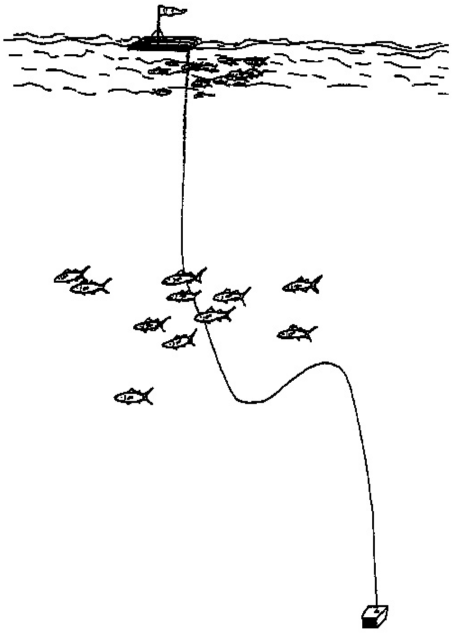
Several types of floating objects are significant in tuna fishing. The most common is simply a log. Another form of floating object is a “fish aggregation device” or FAD. This is simply a manmade object placed in the ocean to specifically draw fish to an area. In some cases, the FAD is anchored (lots of anchor line is required in the open ocean) or it can be drifting.

Purse seining uses mainly drifting FADs, while anchored FADs are common for smaller scale fishing, especially in the Comoros, Maldives, and Indonesia.

Logs are commonly used for purse seining in the Mozambique Channel, while the use of FADs for purse seining occurs in most areas of the Indian Ocean where seiners operate. In the last decade about 50% of all purse seine fish were caught around FADs. Non-FAD fishing (i.e. fishing on free-swimming tuna schools) tends to occur April to July in the areas to the east and west of the Seychelles as well as off Tanzania.

An important point about FADs and logs is that, in addition to attracting tuna, they also attract other fish. The non-tuna catch by purse seiners is larger around these objects than when setting nets on free-swimming tuna schools. The catch of small tuna is also much greater around FADs and logs, which is important at present when efforts are being made to reduce fishing on small bigeye and yellowfin.





There are actually a lot of FADs deployed for tuna fishing in the Indian Ocean. There are reports that some purse seiners use several hundred per vessel. Currently, there are no controls on the use of FADs. A logical approach would be to collect more information on the number of FADs being deployed and the tuna and other species caught in association with FADs as a basis for determining if the regulation of FADs is required.

7. TUNA MOVEMENT

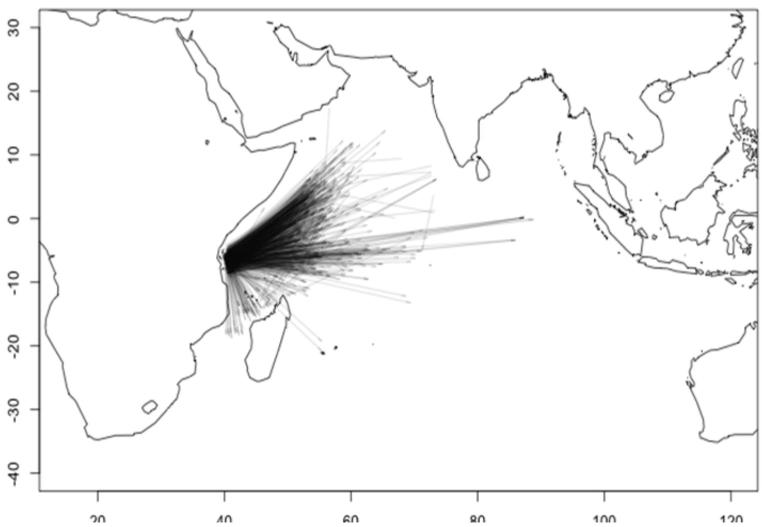
A very large region (often a whole ocean) is used for tuna catch statistics because tuna have the capability to move considerable distances. Catches in one country could potentially have some impact in an area thousands of miles away. An important technique for studying the movement of tunasis tagging.

The IOTC in cooperation with the Indian Ocean Commission (IOC) recently carried out an extensive tuna tagging program. Over a period of five years about 200,000 yellowfin, skipjack and bigeye were captured, measured, tagged and released.

Inserting a PlasticTag into a Skipjack

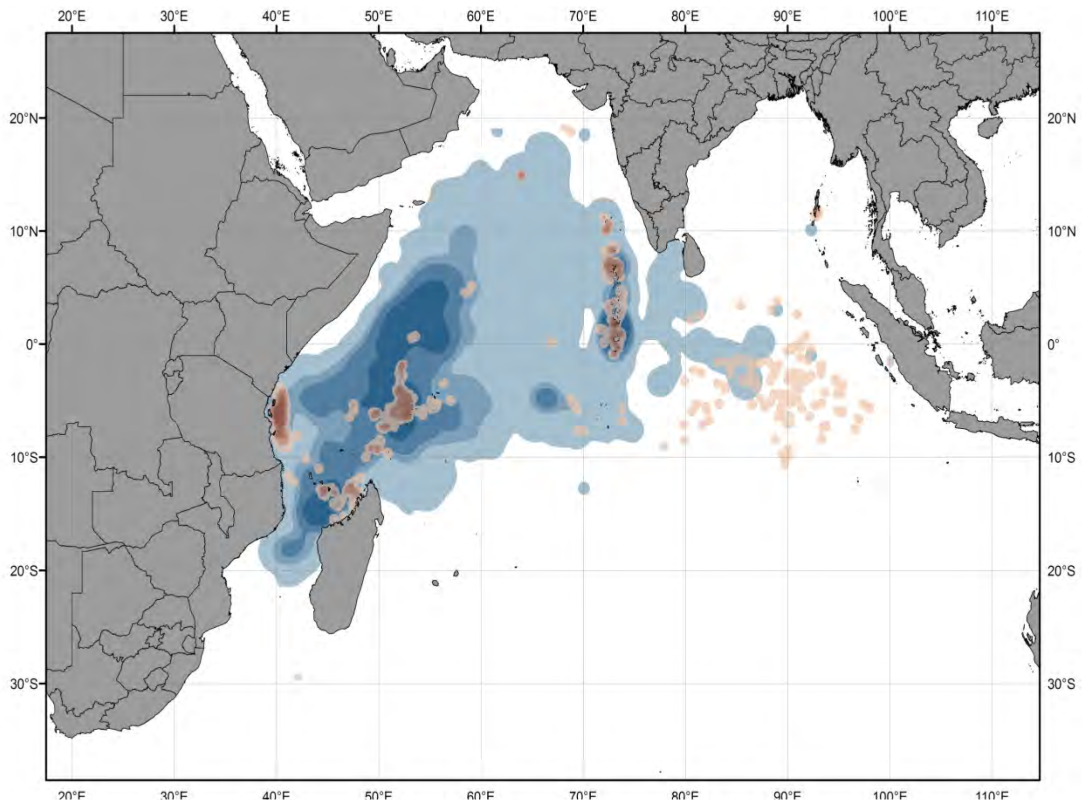
By late 2011,10,560 tagged yellowfinhad been recaptured and reported to IOTC representing 16.7% of the numberreleased.In addition, 15,270 skipjack (15.2%), and 5,563bigeye (15.7%) were tagged/recovered. The information from those recovered fish (date, position captured and length of fish) can be analyzed in a variety of ways. One way is to simply draw a line between the point of release and the point of recapture. This is shown below for 1000 tagged and recaptured yellowfin.

Yellowfin Tagging and Recapture



Another more analytical way of looking at the tagging&recapture information is to take into consideration the concentration oftagged/released tuna and of the recovered tuna. The map below shows the densities of released (red) and recovered (blue) of skipjack tagged during the recent program.

Skipjack Release and Recovery Densities



The tagging data was used for both the assessment of yellowfin tuna and bigeye tuna in 2010, but a substantial amount of analysis remains to be done. From the preliminary results the following is apparent:

- The tagged yellowfin, bigeye, and skipjack are capable of moving great distances, hence the term "highly migratory". All three species showed at least some movement from the western Indian Ocean (where most of the tagging was done) to the eastern Indian Ocean.
- It is important to note that, despite some tuna showing considerable movement, most of the tagged tuna were actually recaptured close to the locations where they were tagged. The straight-line arrows on the map above shows mainly the long-distance movements for yellowfin, but there were actually many more short-distance movements.
- Tagging data show that there is considerable movement of tuna between the waters of adjacent countries. Using information from tagging and other studies, scientists can now estimate how much tuna in one area have come from a neighboring area.
- Although tag recapture information is interesting and can show some important characteristics of tuna, the most powerful use of tagging data occurs when it is combined with other data, such as those concerning

tuna growth, mortality and catches, to give an overall picture of the condition of the resource. This is covered in a later section.

Some Terms Often Used in Studying Fisheries

An understanding of some of the science associated with studying fisheries is made easier with a knowledge of the following terms:

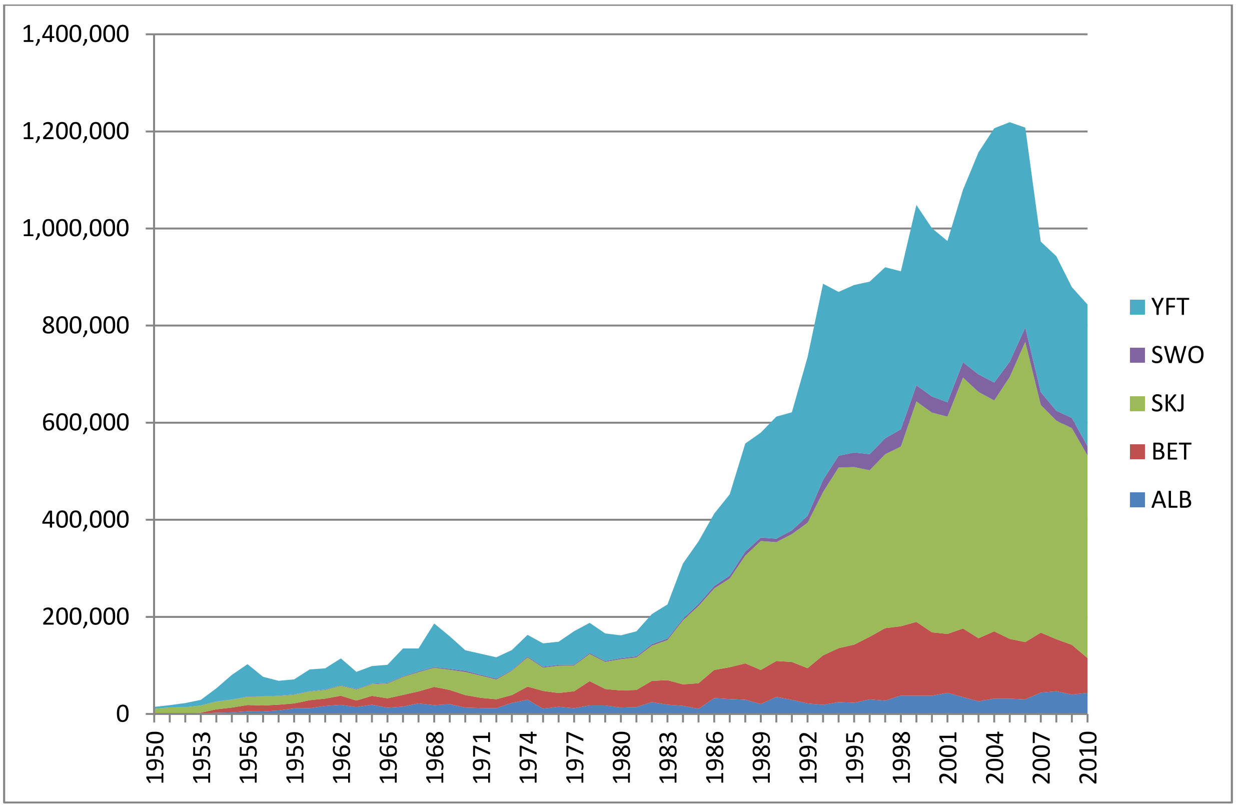
- **Biomass -** The total physical weight of a group of fish.
- **Fish population** or **fish stock-** A unit of a single species of fish that is at least partially isolated from other fish of the same species in other areas.
- **Fishery-** Fishing for a kind of fish, such as the albacore fishery. This is often further broken down by classifications such as gear type and area as in, for example, the Maldives skipjack pole-and-line fishery.
- **Ecosystem -** The biological and physical environment in which a particular species or group of species lives. The pelagic ecosystem inhabited by tuna comprises the water masses of the various current systems, as well as the diverse biological components of these areas -from phytoplankton, zooplankton, and small baitfish, to the large upper predators such as tuna, billfishesand sharks.
- **Fishery management-** Doing something to achieve objectives that have been set for a fishery, such as limiting fishing when conservation has been established as an objective.Charging license fees to increase government revenue is another example.
- **Fleet -** A group of similar fishing vessels, such as the Japanese purse seine fleet.
- **Fishing effort -**A measurement of the amount of fishing, e.g. one purse seiner fishing for 1 day.
- **Model -** A mathematical description of something. Most fishery models enable predictions (such as fish catch) when inputs (such as fishing effort) are specified.
- **Mortality-** The rate at which fish are dying from either natural causes (natural mortality) or from fishing (fishing mortality).
- **Pelagic-** Strictly speaking “occurring in the open sea” as opposed to demersal. However, the term is often used for the open ocean environment, as distinct from coastal. The five main species covered in this booklet are considered pelagic as they are found far from shore.
- **Recruitment-** The entry of small fish into a size category that can be captured by fishing gear.
- **Stock assessment-** The analysis of information collected to assess the condition of a fish population.

8. TUNA CATCHES

The major source of information on the amount of tuna captured in the Indian Ocean is that reported to the IOTC by its member countries. If these data are not reported, the IOTC statistical staff estimates catches from a range of sources, including the databases of the Food and Agriculture Organization (FAO - the UN agency responsible for fisheries), data collected through port sampling and data reports publicly available but not submitted to the IOTC.

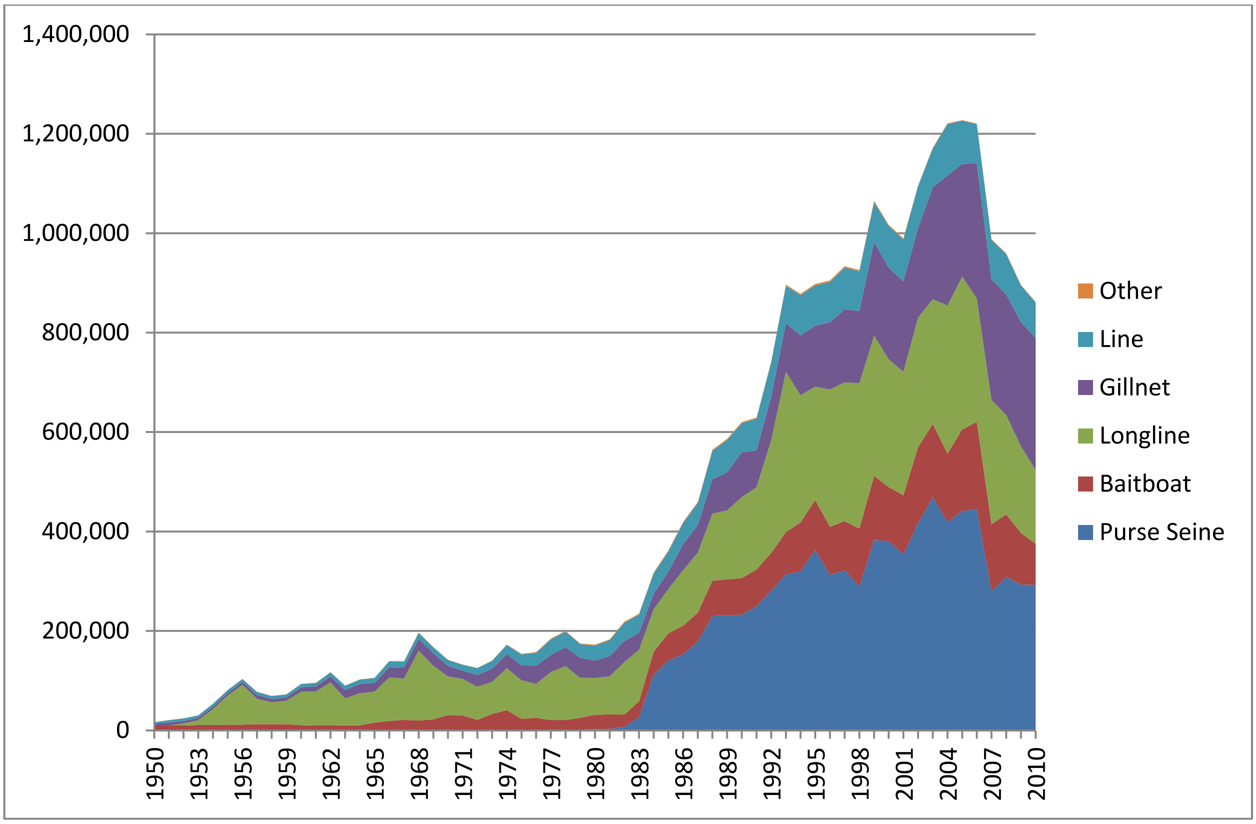
Indian Ocean tuna catches can be shown many different ways. The graphs below show annual totals by the four species covered in this report and by gear. Other forms of representing catches are possible, such as catches by individual fleets or during particular seasons or in the zones of particular countries.

Indian Ocean Annual Catches by Species



Units: Mt YFT= Yellowfin; SWO=Swordfish; SKJ=Skipjack; BET=Bigeye; ALB=Albacore

Indian Ocean Annual Catches by Gear



Units: Mt

From the above graphs a number of features can be seen:

- Since the mid-1980s, a major expansion of catches by purse seining.
- Since the mid-1980s, a large increase in the capture of skipjack and yellowfin, a moderate increase in the capture of bigeye and no major increase in albacore catches.
- The small catch of swordfish relative to the other four species
- Total catches of the five species combined peaking in the mid-2000s, with a reduction in recent years.

An important feature of tuna fishing in the Indian Ocean compared to other major tuna fishing regions of the world is the large proportion of catches taken by gillnetting. In recent years about 225,000 Mt of yellowfin, bigeye, skipjack, and swordfish have been taken by gillnets in the Indian Ocean, or about 25% of the catch of those species. The photograph below shows an Iranian gillnet vessel retrieving its net with tuna.

Iranian Gillnet Vessel Hauling Gear

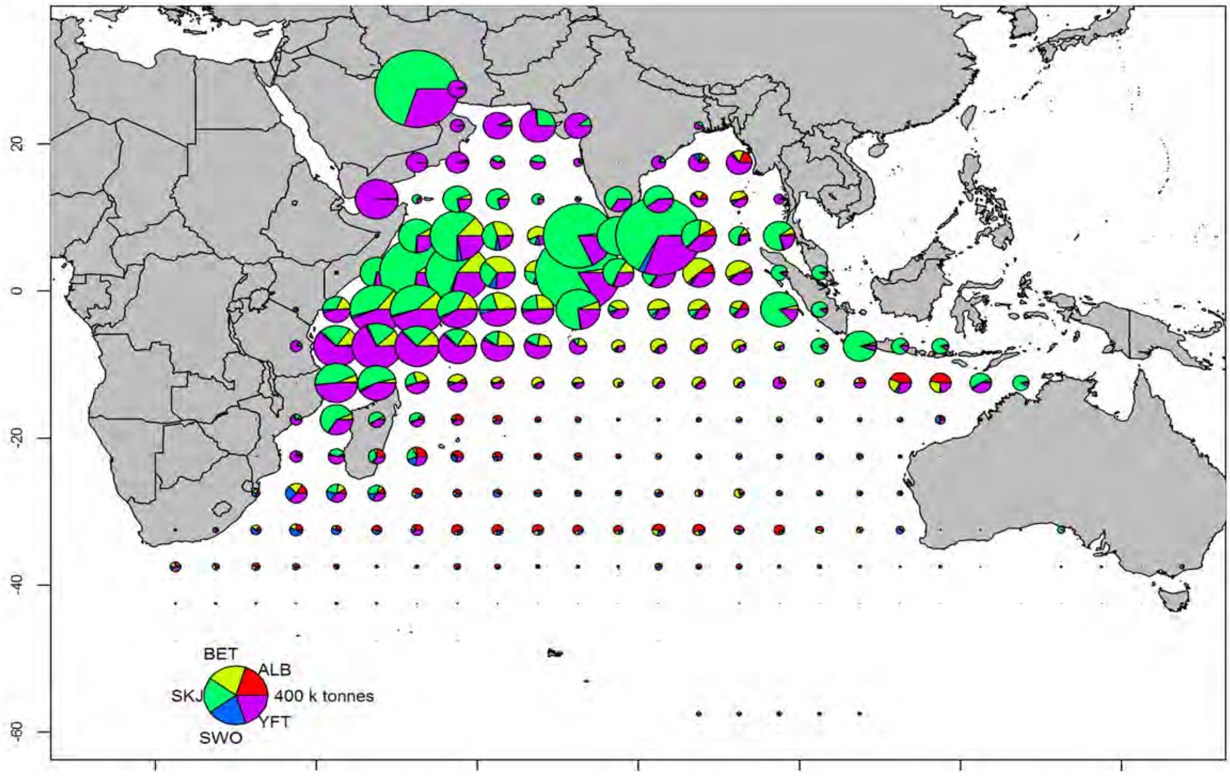
Photo courtesy of IOTC

A major issue in tuna fisheries concerns the sustainability of the catches. Can the very large tuna catches in the Indian Ocean continue into the long-term future? There are obviously limits - tuna catches cannot continue to expand as they have done for the past 25 years - but where are those limits? At what point should we be concerned about overfishing? These and related questions occupy much of the attention of the scientists who study tuna resources.

9. WHERE IS TUNA CAUGHT?

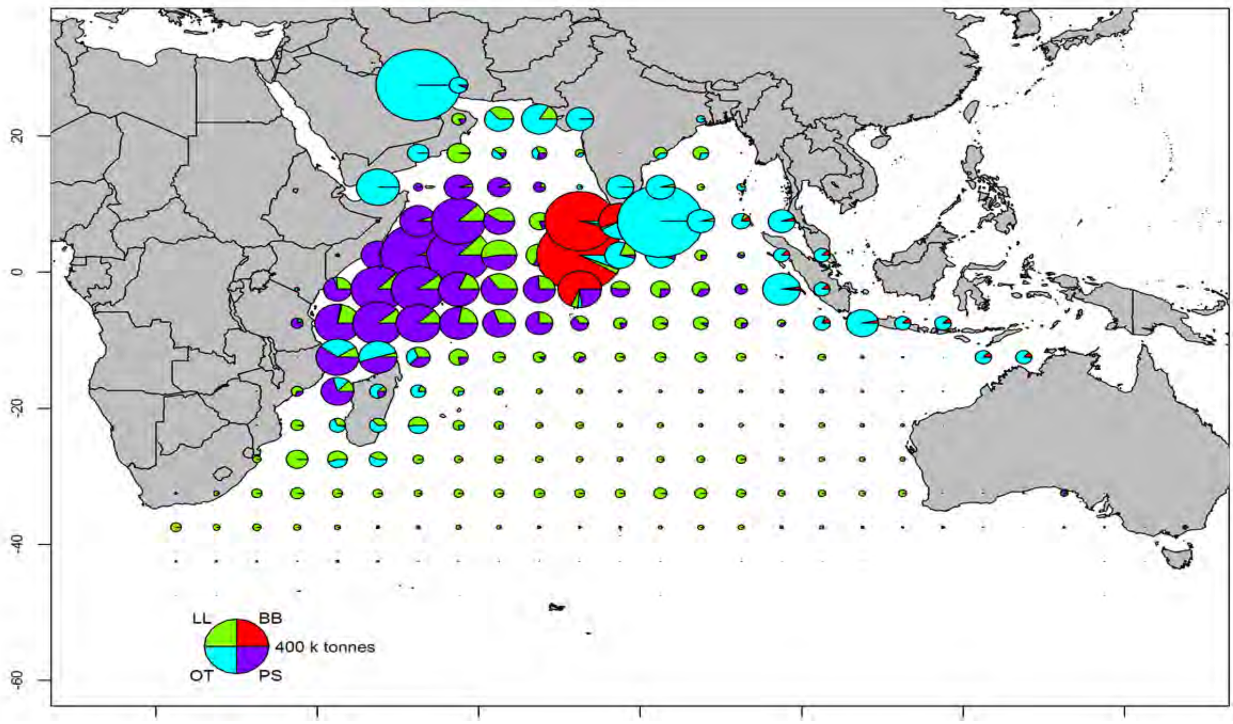
The geographic distribution of tuna catches is shown on the maps below by species and by gear type.

Distribution of Indian Ocean Catches by Species



Time-area catches of tropical tunas, albacore and swordfish estimated by species during 2000-2009: Albacore (ALB, red); yellowfin tuna (YFT, purple); swordfish (SWO, dark blue); skipjack tuna (SKJ, bright green); bigeye tuna (BET, yellow).

Distribution of Indian Ocean Catches by Gear



Time-area catches of tropical tunas, albacore and swordfish) estimated by gear during period 2000-2009: Longline (LL, bright green): freezing longliners from Japan, Taiwan,China, EU, Seychelles, South Korea, and other fleets; Purse seine (PS, purple) from EU, Iran, I.R., Japan, Seychelles, Thailand and other fleets; Pole-and-line (BB, red): baitboat fisheries from Maldives, India, and other countries; Other fleets (OTHR, blue): other fleets, especially small-scale fisheries operating in coastal waters.

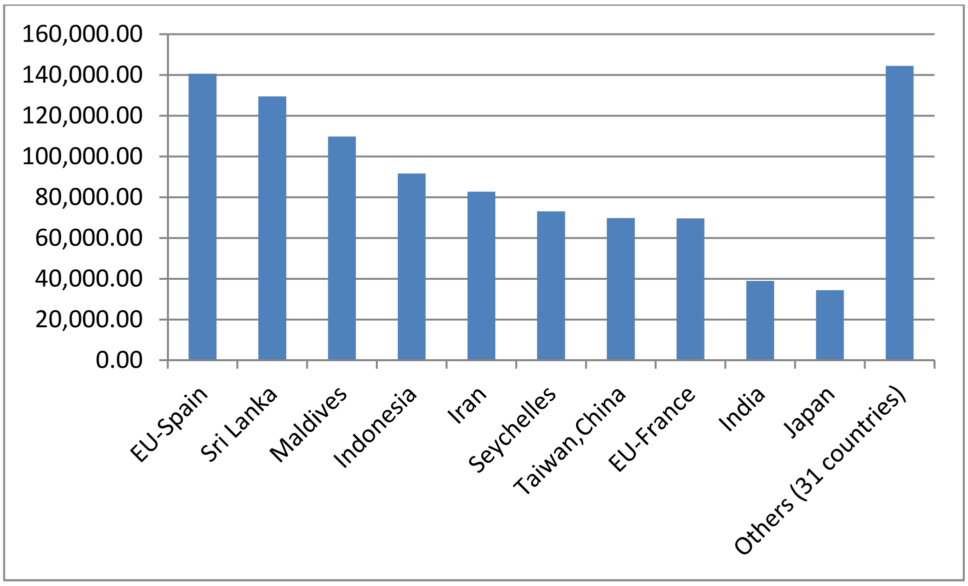
Some of the major features of tuna catches in the Indian Ocean apparent from the above maps are:

- A concentration of total catches and purse seine activity in the western Indian Ocean.
- Relatively low catches in the eastern Indian Ocean.
- An absence of bigeye catches in the northwest.
- The concentration of swordfish catches in the southwest.
- The concentration of pole-and-line catches in the central Indian Ocean.
- The concentration of catches from "other gear" (mainly gillnetting) in the north and central Indian Ocean.

10.WHO CATCHES THE TUNA?

The IOTC estimates that in the five-year period 2006 to 2010 vessels from over 40 countries made substantial catches of yellowfin, bigeye, skipjack, albacore and swordfish. The figure below shows that Spain, Sri Lanka, and the Maldives were the leading fishing nations in the Indian Ocean in terms of tonnage of tuna harvested. The "Others" category consists of 31 countries that individually caught less than 35,000 tonnes.

Tuna Catches by Country 2006 to 2010



11.BIOLOGY OF THE BEASTS

Before we look at the sustainability of tuna catch in the region, it may be helpful to examine some biological characteristics of tuna - features that may affect the amount of fishing that can be supported. Key characteristics common to yellowfin, bigeye, skipjack and albacore are:

- **Elevation of body temperature**. Unlike most fish, tuna have body temperatures that are higher than that of the seawater where they live. This has important implications for the vertical and horizontal movements of tuna, their food requirements, and in conjunction with oceanographic features, the manner in which fish are best caught.
- **Abundant spawning**. A spawning female tuna can release about 100,000 eggs per kilogram of body weight. Because there is so much spawning by a single fish, no strong relationship usually exists between the number of spawners and subsequent numbers of new fish entering the fishery.
- **Variable recruitment**. The survival of the eggs, larvae, and juvenile tuna to a size that can be captured by fishing is highly dependent on environmental features in the post-spawning period. This can result in large variations in the total numbers of adult fish.

The four tunas, skipjack, yellowfin, bigeye, and albacore - plus the tuna-like swordfish, each have individual characteristics that have an important effect on the fishing pressure they can sustain. These are shown in the following box.

Description of the Species

Skipjack	This species is found year-round, concentrated in the tropical waters of the Indian Ocean. Its distribution expands seasonally into subtropical waters to the north and south. It is a species characterized by large stock size, fast growth, earlymaturation, prolific year-round spawning over a wide area, a relatively short life span and highly variable recruitment into a fishable size. For stock assessment and management purposes, it is assumed that there is one population in the Indian Ocean.
Yellowfin	These tuna are fast growing, mature at about 2 years of age and spawn prolifically. Yellowfin can grow to over 100 kg at 6 years or older. The majority of the catch is taken from the equatorial region where they are harvested with a range of gear types, predominantly purse seine and longline. For stock assessment purposes, yellowfin tuna are believed to constitute a single stock in the Indian Ocean.
Bigeye	This species has a moderate growth rate and matures at approximately 3 - 4 years of age. Bigeye are known to grow up to about 200 cm and 180 Kg when 8 years or older. They have a wide distribution between 40°S and 20^{o}N – but bigeye are rare in the northwest of

	the Indian Ocean. These fish are fished vertically between the surface and 500 mdeep (occasionally up to 1000 m) because of their tolerance of low oxygen levels and low temperatures. These and other characteristics make them less resilient to exploitation than skipjack and yellowfin. The geographical distribution of bigeye is continuous east/west across the Indian Ocean. Large fishes are caught mainly by longline and this longline-caught bigeyeis the most valuable of the tropical tuna. Juvenile fish tend to form mixed schools with skipjack and yellowfin, which results in surface fishery catches, particularly in association with floating objects. Natural mortality is estimated to be relatively low compared with other tropical species.
Albacore	Mature albacore (age at first maturity is about 4 - 5 years) spawn in tropical and subtropical waters between 10^0 S and 25^0S of the equator, with individual fish becoming available to surface fishing about 40^0 from the equator approximately 1 - 2 years later, at a size of 45 - 50 cm. From this area, albacore appears to gradually disperse toward lower latitudes, but may make seasonal migrations between tropical and subtropical waters. Albacore are relatively slow growing and have a maximum length of about 120 cm. Natural mortality is low compared to tropical tuna, with significant numbers of fish reaching an age of 10 years or more.
Swordfish	Swordfish life history characteristics, including a relatively late maturity, long life and sexual dimorphism, make the species vulnerable to over exploitation. Juvenile swordfish are commonly found in tropical and subtropical waters and migrate to higher latitudes as they mature. Large, solitary adult swordfish are most abundant at 15 - 35˚S. Males are more common in tropical and subtropical waters. By contrast with tunas, swordfish is not a gregarious species, although densities increase in areas of oceanic fronts and seamounts. Extensive daily vertical migrations from surface waters during the night to depths of 1000 m during the day occur.For the purposes of stock assessments, one pan-Indian Ocean stock has been assumed.

Bigeye (left) and Yellowfin (right):not easy to distinguish the two species at small sizes

12.THE PELAGIC ECOSYSTEM, PRODUCTIVITY, AND OCEANOGRAPHY

Several aspects of the climate and oceanography of the Indian Ocean affect the tuna fishing of the region. One of the most important features is that the western Indian Ocean produces much more tuna than the east. This is thought to be because the west has greater primary productivity – meaning more nutrients in the water that enable microscopic plants and animals to flourish and support a food chain, including tuna at the top.

The greater primary productivity in the west is likely to be associated with the north-flowing currents and eddies that are created where those currents brush against other currents. These current boundaries tend to persist at certain times of the year, forcing nutrients into surface waters. This phenomenon occurs off Somalia, but also to a lesser degree south of Sri Lanka, near the Maldives and around the Seychelles.

Another important aspect of Indian Ocean oceanography is the reduced amount of dissolved oxygen in the northwest. In the area north of 10^{o}N to 15^{o}N the low concentrations of O_2 at depths of around 500 m are insufficient for bigeye to survive, resulting in few of these fish in the Arabian Sea. The reduced amount of oxygen also tends to concentrate the yellowfin towards the more oxygenated surface waters, which at times produces spectacular catches – like those obtained by Taiwanese longliners in 1993.

Another phenomenon is known as the “Indian Ocean dipole”. This is an oscillation of sea-surface temperatures in which the western Indian Ocean becomes warmer then cooler than the eastern Indian Ocean. This affects the strength of monsoons over the region and, importantly for tuna fishing, the depth of the ocean’s thermocline (the depth at which the warm surface layer gives way to much colder water). In a strong positive dipole there is a deeper thermocline in the west and consequently purse seining for tuna is less successful as those fish are no longer concentrated close to the surface.

13.ASSESSING THE CONDITION OF INDIAN OCEAN TUNA POPULATIONS

13.1. MAXIMUM SUSTAINABLE YIELD

An overview discussion of tuna stock assessment would be incomplete without some mention of the concept of maximum sustainable yield (MSY). In simple terms, the concept indicates that, as fishing effort increases on an unexploited stock, the amount of fish harvested can be increased to a certain point, after which the yield declines as fishing effort increases. At that point, referred to as MSY, the amount of fish yielded over the long term is at a maximum.

Another way of thinking of MSY is that, with very little fishing on a virgin fish population, the harvest would obviously be very small. A huge amount of fishing could wipe out that same fish population and the subsequent harvest would also be small. Somewhere between these two extremes in fishing pressure is a point (MSY) at which the long-term harvest is greatest.

The MSY concept can be quite useful in that it can convey important ideas. There are, however, several major drawbacks:

- MSY tends to oversimplify a complex situation. Applied to tuna, it assumes that other factors known to affect the yield from tuna fisheries (for example, oceanographic conditions) remain constant (or at least can be represented by an average situation), something that definitely does not occur in nature.
- Another aspect to beware of is that in fishery management, MSY often becomes a target to strive toward, when the reality is that at MSY, profits for the fishing activity may be small or nonexistent ("good sustainable catch levels, but all fishers going broke").
- Results from MSY modeling are often 1 or 2 years behind the actual catches and as technological advances in fishing methods can be fast, when the point of measured MSY is reached the total fishing effort may be beyond the MSY level with declining catch per unit efforts as a result.

Despite these obvious shortcomings of MSY, the concept is likely to be around for a long time. MSY is embedded in the Law of the Sea Convention and it is incorporated in the fisheries legislation of many countries. MSY is also calculated by most stock assessment methods.

What can be concluded about MSY? It can be a useful tool in fishery work and is understandable by the general public. However,it is important that theshortcomings of MSY mentioned above are recognized and the concept is not pushed beyond its limitations.

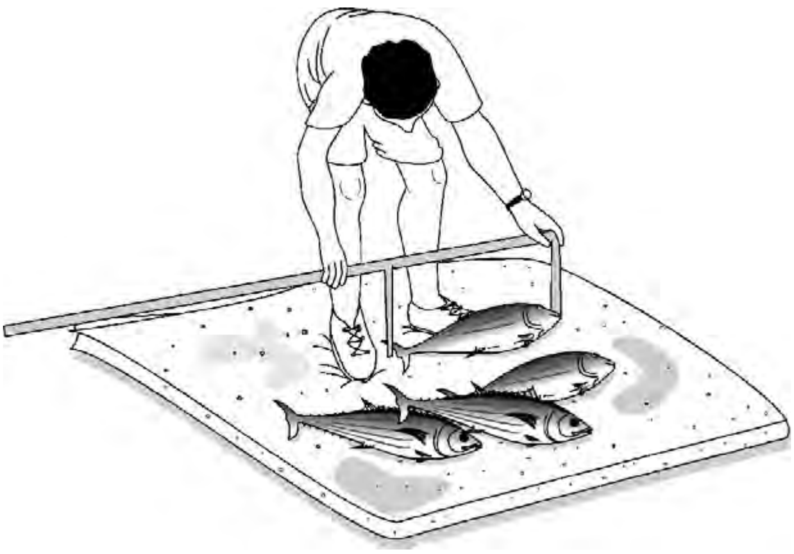
A Small Pole-and-Line Boat in the Maldives

13.2. STOCK ASSESSMENT

The status of a fish population is difficult to assess because it is rarely possible to count them directly. In this respect, tuna are especially difficult because they occur far from land and often very deep in the ocean and over vast regions. Indirect methods must therefore be used to determine how much tuna is present and more importantly, the change in the amount of tuna and why the change is occurring.

The most basic analysis to conduct is a simple inspection of various fishery status indicators. Examples of such indicators include:

- Trend in the catches: Have catches been increasing since the beginning of the fishery? Have they been stable for a number of years?
- Catch rates in the various fisheries: typically on the basis of the catch taken for a given amount of fishing effort (e.g.: a fishing day, or a thousand hooks), so they are called catch-per-unit-effort (CPUE) indices. The basic concept is that as a fish population declines, fishermen need more effort to catch the fish.
- Distribution of fish sizes in the catch: How many fish of different ages are in the population; Are too many juvenile fish caught?



Each of the above simple methods (and several others) has been used to obtain indications about the condition of tuna populations. For example, if total skipjack catch in the Indian Ocean has been increasing for many years, this could suggest that the underlying population is likely to be healthy.

It is important to note that none of the above simple assessment methods, taken by itself, is conclusive-when a change is noticed in one indicator, there are often several possible explanations of why that change is occurring. For example, an increase in the average tuna catch from a day of fishing could be explained by an increase in the tuna population. It also could be because of fishermen becoming more skilled at catching fish (gear innovation or greater experience in an area), or because favourable environmental conditions made the fish easier to catch in one particular year. In another example, a decrease in the proportion of large fish in the catch could be good news (more young fish being born) or bad news (too much fishing pressure on older fish). Declines in catch rates also need to be interpreted carefully - according to biological theory, a population is most productive at a size smaller than that before exploitation, so the extent of the decline is crucial to appreciate the status of the population.

These examples illustrate why simple indicators should be treated with caution. If information on the situation can be added from other study methods, we can be more certain about the underlying reasons for a change. Combining many observations from all the relevant methods would be best, if that were somehow possible.

Some of the methods preferred by fishery scientists do not depend completely on the fishery operations, but they can be quite expensive. Unfortunately, conducting surveys with research vessels over the range of the distribution of the species,which is a popular method for many coastal species, is impractical for tuna populations, as they are distributed over vast regions. An alternative method and a favourite amongst tuna scientists, is to conduct tagging experiments. In these programmes, tuna are caught and carefully brought on board a dedicated vessel, where scientists attach a plastic tag on the side of the fish before returning it into the water (see earlier section on tuna tagging).

Combining several different sources of information and coming up with an explanation that is consistent with all the observations becomes a difficult task as the number of sources increases, but this is where computers have come to the rescue of fishery scientists. Modern stock assessment is based on increasingly complex models. These models are simplified descriptions of a system using mathematical expressions that can be programmed on a computer. Relying on the idea that most of what is observed in nature can be quantified, several different types of observations relevant to assessing tuna can be expressed mathematically and incorporated into a single description. Then, it is up to the computer to try many different combinations of values of key quantities in the model, searching for a combination that better predicts the data actually observed.

Fishery scientists studying Indian Ocean tuna have applied several different models to the various tuna species - and these models can be grouped into three broad categories according to their data requirements (table below).

Models Used for Tuna Stock Assessment in the Indian Ocean

Categories	Computer Programmes/Model	Inputs	Outputs	Comment
Production models, biomass dynamic models	**ASPIC PROCEAN PRODFIT**	Catch, fishing effort, CPUE indices	Estimates of potential yield of the population	Simple data requirements (no size data needed), but the model gives little detail on the situation of the population. Models based on many implicit simplifying assumptions about the population.
Production models with age-structure	**ASPM, and many other simple versions**	Catch, fishing effort, size distribution in the catch, CPUE indices and other external values assumed	Estimates of potential yield, past history of the population and its exploitation pattern	An intermediate level of detail. External analyses (e.g. pattern of exploitation by size) have to be conducted to supply some key input parameters.
Integrated catch-at-size, or catch-at-age models	**SS3 MULTIFAN-CL CASAL**	Many different types of data affecting the population, such as catch, fishing effort, size composition and tagging data	Estimates of potential yield, past history of the population and exploitation pattern; movement between areas	Typically including spatial structure, these are very complex models with large data demands. Often several possible explanations explain data equally well, contributing to the uncertainty.

Information from these models, together with simpler fishery indicators (e.g. trends in catch per unit effort), have been used to determine the condition of the various Indian Ocean tuna species - which is summarized in following sections.

13.3. THE ‘KOBE’ PLOT

The status of the stock can be summarized in a practical way through two main indicators that are normally provided by the stock assessment analyses: a measure of the fishing intensity or fishing mortality, (in simple terms, the catch relative to the population size) and a measure of the population size, in most cases, expressed as the size of the mature portion of the population, or spawning biomass.

Fishing mortality and spawning biomass are often expressed as ratios, relative to the maximum sustainable yield levels, so as to make clear where we are relative to those desirable levels. For example a fishing mortality ratio above 1 would cause concern, as it indicates that the proportion of the population taken by the fishery is too high to sustain MSY. On the other hand, a biomass ratio below 1 would cause concern, as it means that the population has been reduced too much and it will not produce the maximum catch until it is allowed to recover.

The stock assessment methods can usually estimate these ratios for each of the years included in the analysis, and therefore, the history of the status of the stock and its response to fishing can be simply shown in a figure based on two axes: one for the fishing intensity and one for the population level. Because this type of figure became popular at a meeting of tuna management organizations in Kobe in 2007, it has been called the Kobe plot and is one of the main tools to convey the situation of the stock and its exploitation.

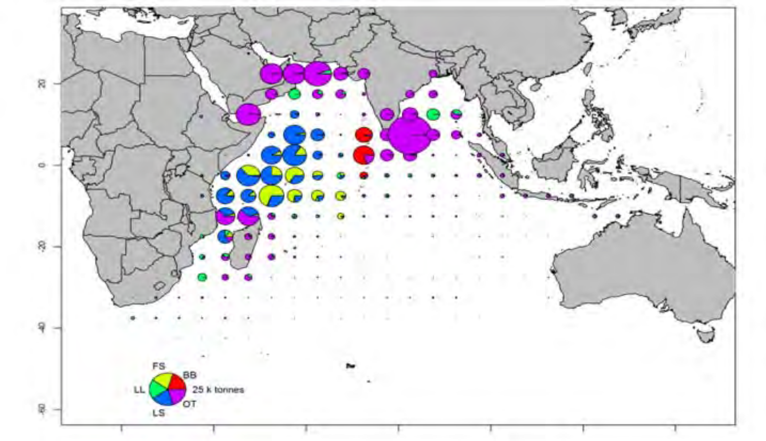
The following sections on stock status use these Kobe plots. The plot is usually divided into four regions, one for each of the different combinations of fishing and biomass status relative to the MSY level. The point where the four sectors intersect corresponds to the MSY level. The red region is reserved for the worst case, in which the population is overly depleted and, at the same time, the fishing intensity is too high. The ideal situation is when the stock is in the green quadrant of the figure. The orange quadrant means that the stock is being overfished, although it has not yet been depleted to overfished status, so a reduction in fishing intensity would bring it back to a green level. The yellow sector indicates that the stock has been overfished, but that it will recover in due time, if the fishing intensity is maintained at the current level.In the example below, the “X” indicates that the stock is not overfished, but is being subjected to overfishing.

Example of Kobe Plot

	Stock overfished (current biomass less than biomass at MSY)	**Stock not overfished** (current biomass greater than biomass at MSY)
Stock subject to overfishing (current fishing mortality greater than that at MSY)		X
Stock not subject to overfishing (current fishing mortality less than that at MSY)		

13.4. YELLOWFIN STOCK STATUS AND OUTLOOK

Catches of Yellowfin in 2010 by Type of Gear

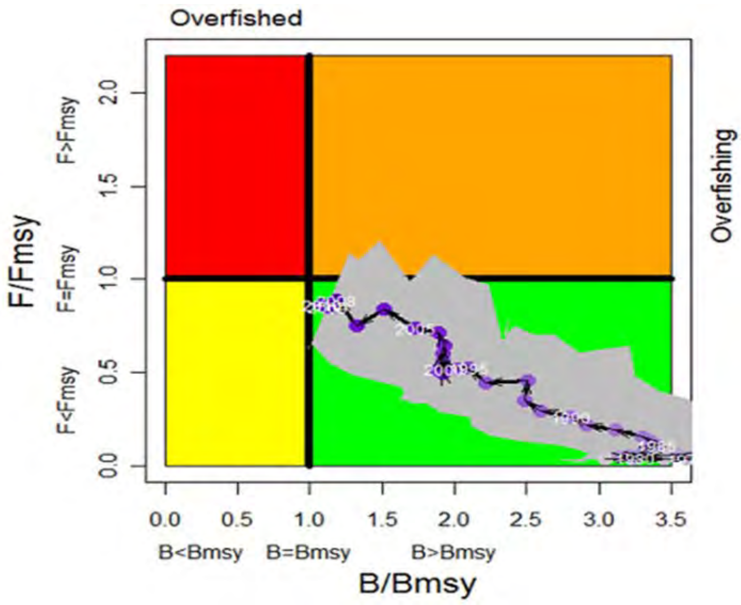


Catches of yellowfin estimated for 2010 by type of gear: Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including drifting gillnets, and various coastal fisheries.

The 2011 meeting of IOTC's Scientific Committee (SC) discussed the stock status of yellowfin - as well as that of the four other species covered by this booklet. The report of the SC represents the consensus of opinion on the conditions of the stocks - and therefore considerable credibility is attached to the views put forward in the agreed report of the SC.

The stock assessment model used for Indian Ocean yellowfin in 2011 suggests that the stock is currently not overfished and overfishing is not occurring. Spawning stock biomass in 2009 was estimated to be 35% (31 - 38%) of the unfished levels. However, estimates of total and spawning stock biomass show a marked decrease over the last decade, accelerated in recent years by the high catches of 2003 - 2006. It was noted that the current assessment does not explain the high catches of yellowfin tuna from 2003 - 2006, as it does not show peaks in fishing mortality or biomass for this period. Recent reductions in effort and hence catches, has halted the decline. It is likely that the main reason behind the very high catches in the period 2003 - 2006, was the oceanographic conditions,which generated high concentrations of prey items for yellowfin.

The decrease in longline and purse seiner effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality has not exceeded the MSY-related levels in recent years. If the piracy situation in the western Indian Ocean were to improve, a rapid reversal in fleet activity in this region may lead to an increase in effort, which the stock might not be able to sustain, as catches would then be likely to exceed MSY levels. Catches in 2010 (299,074 Mt) are within the lower range of MSY values The current assessment indicates that catches of about the 2010 level are sustainable, at least in the short term. However, the stock is unlikely to support higher yields based on the estimated levels of recruitment from over the last 15 years.

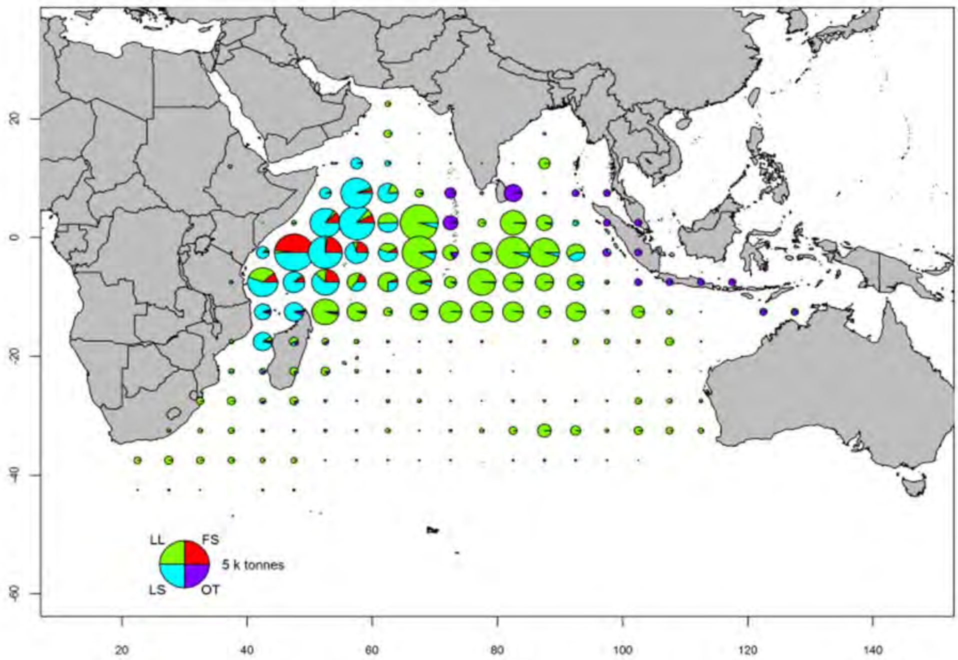


Indian Ocean Yellowfin Kobe Plot

As presented in report of 2011 IOTC Scientific Committee.

13.5. BIGEYE STOCK STATUS AND OUTLOOK

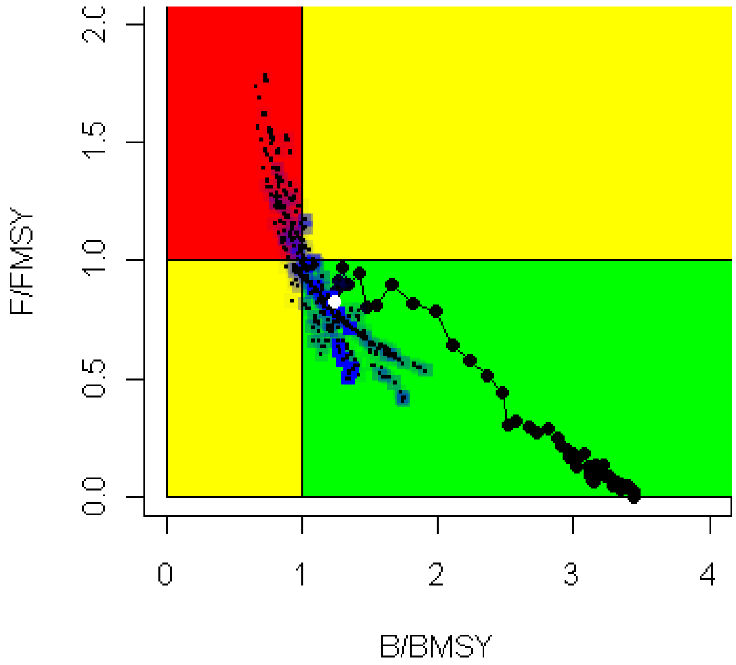
Catches of Bigeye in 2010 by Type of Gear



Catches of bigeye estimated for 2010 by type of gear:Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), and other fleets (OT), including pole-and-line, drifting gillnets, and various coastal fisheries.

Assessments from two types of models suggest that the Indian Ocean bigeyestock is above a biomass level that would produce MSY in the long term and that current fishing mortality is below the MSY-based reference level. Current spawning stock biomass was estimated to be 34 - 40 % of the unfished levels.

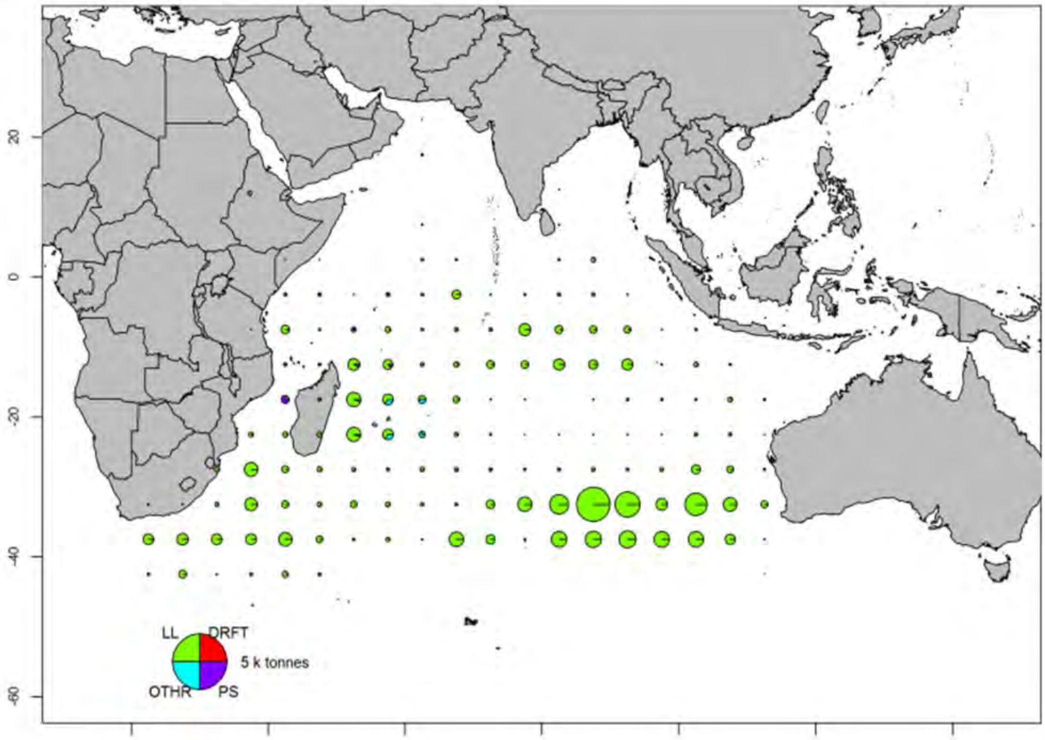
The recent declines in longline effort, particularly from the Japanese, Taiwan,China and Republic of Korea longline fleets, as well as purse seiner effort have lowered the pressure on the Indian Ocean bigeye tuna stock, indicating that current fishing mortality would not reduce the population to an overfished state. Catches in 2010 (71,489 t) were lower than MSY values and catches in 2009 (102,664 Mt) were at the lower range of MSY estimates. The mean catch over the 2008 - 2010 period, was 93,761 Mt, which is lower than estimated at MSY.



Aggregated Indian Ocean Assessment Kobe Plot for Bigeye

13.6. ALBACORE STOCK STATUS AND OUTLOOK

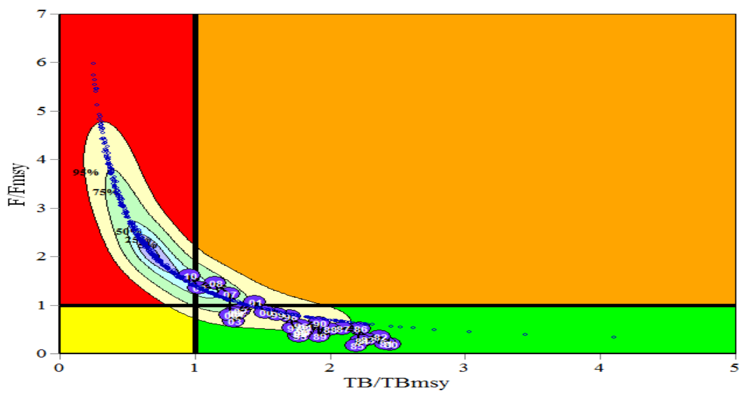
Catches of Albacore in 2010 by Type of Gear



Catches of albacore estimated for 2010 by type of gear: Longline (LL, green), Driftnet (DFRT, red), Purse seine (PS, purple), Other fleets (OTHR, blue).

Trends in the Taiwanese CPUE series suggest that the longline vulnerable albacore biomass has declined to about 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980 and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that the biomass was less than that at MSY, so the risk will have increased further. It is considered likely that recent catches have been above MSY, so recent fishing mortality exceeds that at MSY. There is a moderate risk that total biomass in 2010 was below that at MSY.

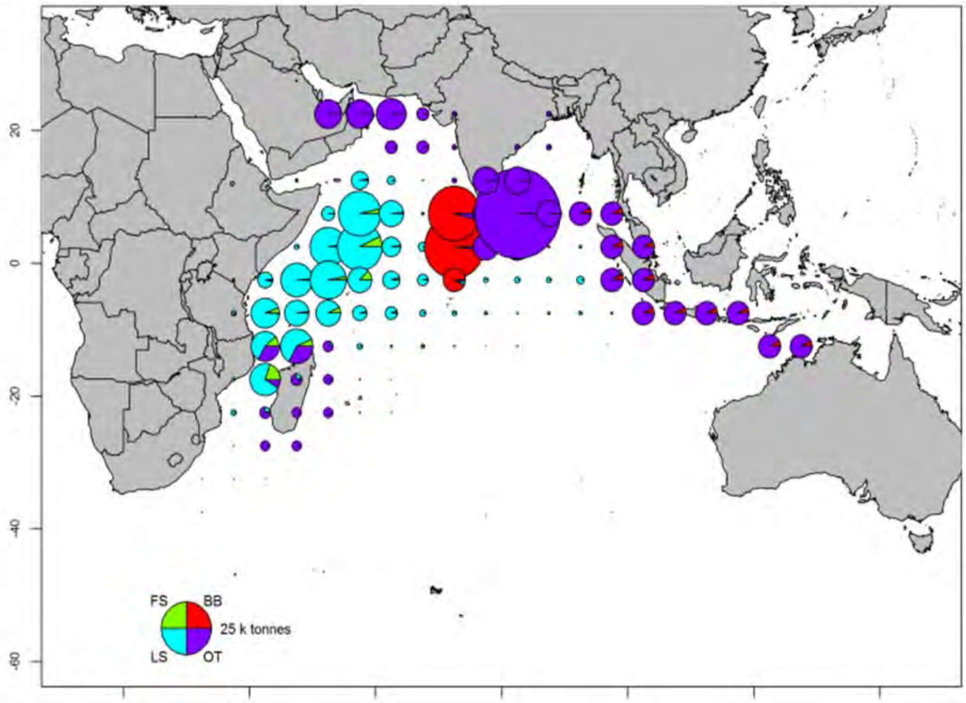
Maintaining or increasing fishing effort, will probably result in further declines in albacore biomassproductivity and CPUE. The impacts of piracy in the western Indian Ocean have resulted in the displacement of a substantial portion of longline fishing activity into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that effort on albacore will decline in the near future.



Aggregated Indian Ocean Assessment Kobe Plot for Albacore

13.7. SKIPJACK STOCK STATUS AND OUTLOOK

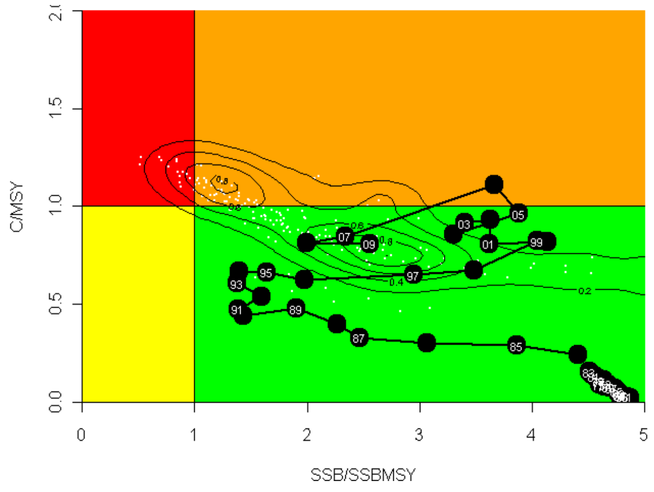
Catches of Skipjack in 2010 by Type of Gear



Catches of skipjack estimated for 2010 by type of gear: Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including longline, drifting gillnets, and various coastal fisheries

Recent assessments suggest that the stock is not overfished and that overfishing is not occurring. Spawning stock biomass was estimated to have declined by approximately 47% in 2009 from unfished level.

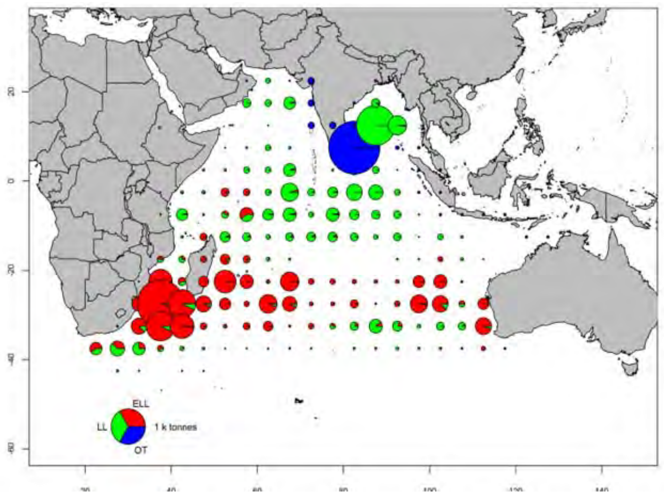
The recent declines in catches are thought to be caused by a recent decrease in purse seine effort as well as due to a decline in CPUE of large skipjack tuna in the surface fisheries. However, the recent declines of pole and line catch and CPUE are puzzling – and may be due to the combined effects of the fisheries and environmental factors affecting recruitment or catchability. Total Indian Ocean skipjack catches in 2009 (455,999 Mt) and 2010 (428,719 Mt), as well as the average level of catches of 2006 - 2010 (489,385 Mt), were lower than the median value of MSY.



Aggregated Indian Ocean Assessment Kobe Plot for Skipjack

13.8. SWORDFISH STOCK STATUS AND OUTLOOK

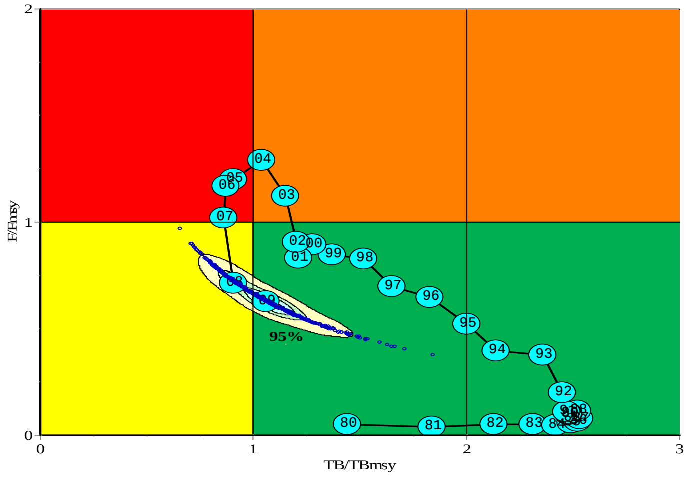
Catches of Swordfish in 2010 by Type of Gear



Catches of swordfish estimated for 2010 by type of gear: Swordfish longliners (**ELL**), Otherlongliners (**LL**), Other fleets (**OT**). Time-area catches are not available for non-longline fleets (OT, blue); catches for those were fully assigned to the one or more 5x5 squares lying within the EEZs of the countries concerned.

Recent analysis suggests that the Indian Ocean swordfish stock is above, but close to, a biomass level that would produce MSY and current catches are below the MSY level. Spawning stock biomass in 2009 was estimated to be 30 - 53% of the unfished levels.

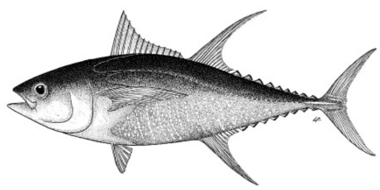
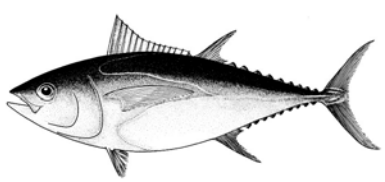
The decrease in longline catch and effort in recent years has lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality would not reduce the population to an overfished state. There is a low riskof exceeding MSY-based reference points by 2019 if catches drop further or are maintained at current levels until 2019.

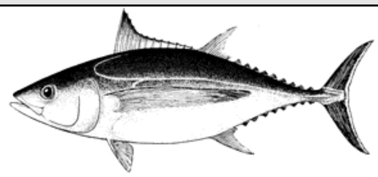
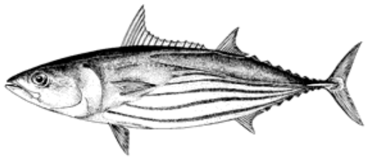
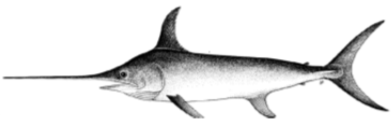


Aggregated Indian Ocean Assessment Kobe Plot for Swordfish

13.9. SUMMARY

Summary of Stock Status for the Five Species

Species		**2011 Stock Status Determination** **(**most recent years' data used for the assessment)	**Indicators**
Yellowfin		**(2009)**	Catch 2010: 299,074 Mt Averagecatch 2006-2010:326,556 Mt MSY: 357,000 Mt (290,000-435,000Mt)
Bigeye		**(2009)**	Catch 2010: 102,000 Mt Average catch 2006-2010: 104,700 Mt MSY: 114,000 Mt (95,000 - 183,000 Mt) (from the SS3 analysis)

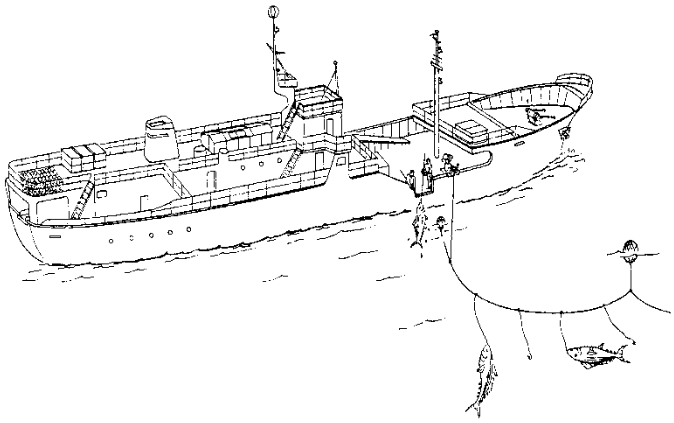
Species		2011 Stock Status Determination (most recent years' data used for the assessment)	Indicators
Albacore		**(2010)**	Catch 2010: 43,711 Mt Average catch 2006-2010: 41,074 Mt MSY: 29,900 Mt (21,500 - 33,100 Mt)
Skipjack		**(2009)**	Catch 2010: 428,719 Mt Average catch 2006 - 2010: 489,385 Mt MSY: 564,000 Mt (395,000 - 843,000 Mt)
Swordfish		**(2009)**	Catch 2010: 18,956 Mt Average catch 2006-2010: 23,799 Mt MSY (4 models): 29,900 - 34,200 Mt

Key

	• current fishing mortality greater than that at MSY • current biomass is greater than that at MSY
	• current fishing mortality less than that at MSY • current biomass is greater than that at MSY

(See earlier section on Kobe plots)

How do we know the tuna stock assessments are correct?In stock assessment there is always a degree of uncertainty. In the various models used, the more complete the data and the higher quality the data, the more confidence we can have as to the accuracy of the stock assessments. Although using multiple types of models could improve the assessments, this may not be the case if the various models are subject to similar data gaps requiring similar assumptions. We can be most certain that the tuna stock assessments are the best possibleby using models that incorporate all available information, including catch, effort, fish sizes and tagging data. The current stock assessments have considerable credibility because they include all available information and because the data and results of analysis have been scrutinized by diverse groups of scientists in various IOTC forums, including the Scientific Committee.



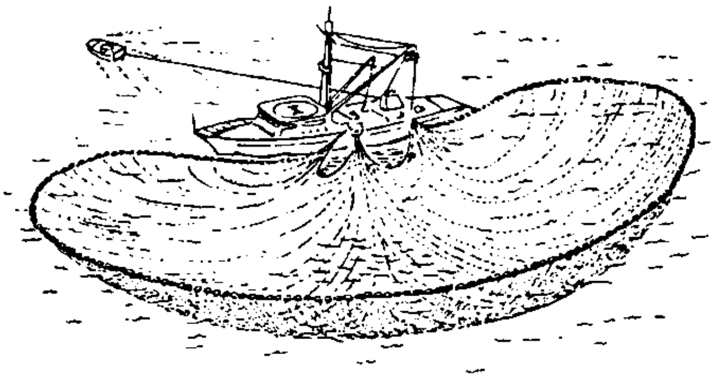
14. CONSIDERING THE LATEST STOCK ASSESSMENT INFORMATION, WHAT ACTION SHOULD BE TAKEN?

The 2011 meeting of IOTC’s Scientific Committee (SC) discussed and debated the status of the five species covered by this booklet. In addition to giving the above information on the stock status of those species, the agreed report of the SC 2011 provided recommendations on what action should be taken.

- **Yellowfin:**The maximum sustainable yield estimate for the whole Indian Ocean is 357,000 Mt with a range between 290,000 - 435,000 Mt. The annual catches of yellowfin tuna should not exceed the lower range of MSY (300,000 Mt) in order to ensure that stock biomass levels could sustain catches at the MSY level in the long term. Recent recruitment is estimated to be considerably lower than the whole time series average. If recruitment continues to be lower than average, catches below MSY would be needed to maintain stock levels.
- **Bigeye:**The MSY estimate for the Indian Ocean ranges between 102,900 and 114,000 Mt. Annual catches of bigeye tuna should not exceed the lower range of this estimate, which corresponds to the 2009 catches and the management advice of the 2010 Scientific Committee. If the recent declines in effort continue and catch remains substantially below the estimated MSY of 102,900 - 114,000 Mt, then immediate management measures are not required. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments.
- **Albacore:**The available evidence indicates considerable risk to the stock status at current effort levels. The two primary sources of data that drive the assessment, total catches and CPUE, are highly uncertain and should be investigated further as a priority.Current catches (average ~41,000 Mt over the last five years, ~44,000 Mt in 2010) likely exceed MSY (29,900 Mt, range: 21,500–33,100 Mt). Maintaining or increasing effort will probably result in further declines in biomass, productivity and CPUE.

- **Skipjack:**The median estimates of the MSY for the skipjack tuna Indian Ocean stock is 564,000 Mt and considering that the average catch level from 2005 - 2009 was 512,305 Mt, catches of skipjack tuna should not exceed the average of 2005 - 2009. If the recent declines in effort continue and catch remains substantially below the estimated MSY, then urgent management measures are not required. However, recent trends in some fisheries, such as the Maldivian pole-and-line fishery, suggest that the situation of the stock should be closely monitored.
- **Swordfish:** The MSY estimate for the whole Indian Ocean is 29,900 - 34,200 Mt and annual catches of swordfish should not exceed this estimate. If the recent declines in effort continue and catch remains substantially below the estimated MSY of 30,000 - 34,000 Mt, then management measures are not required. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments.

In terms of preventing an increase of fishing pressure on Indian Ocean tuna, the urgency depends on the species. The IOTC feels that currently the top priority is to establish catch limits.



15.TUNA MANAGEMENT IN THE INDIAN OCEAN

15.1. WHY INTERNATIONAL COOPERATION IS NECESSARY

In earlier sections of this booklet it was shown that the various tuna species are capable of long distance movements and that tuna catches in one country can affect catches in other countries. In a situation where steps should be taken to reduce catches, some form of agreement between all the fishing countries on what should be done to safeguard tuna resources is required - because action to reduce by just a few countries is likely to be ineffective due to the large movements that can be made by these tunas. In addition, because about 60% of the industrial-scale tuna fishing in the Indian Ocean is on the high seas (beyond the control of a single country), even strong fishing controls applied in all national waters may not be effective.

As it is the case in other oceans, some form of international agreement is required to discuss, agree andimplement actions dealing with safeguarding the tuna of the Indian Ocean. The mechanism that has been established to fulfill this role is the Indian Ocean Tuna Commission (IOTC).

15.2. THE INDIAN OCEAN TUNA COMMISSION

The box below gives information on the Indian Ocean Tuna Commission. It is important to note that the IOTC is not the office in Victoria, Seychelles (that is the IOTC secretariat), but rather the IOTC is the meeting of the representatives of member governments.

The Indian Ocean Tuna Commission (IOTC)

The IOTC is an intergovernmental organization mandated to manage tuna and tuna-like species in the Indian Ocean and adjacent seas. The objective of the IOTC is to promote cooperation among its members with a view to ensuring, through appropriate management, the conservation and optimal utilization of tuna stocks and encouraging sustainable development of fisheries based on such stocks.

The IOTC was established under the framework of the Food and Agriculture Organization of the United Nations (FAO) Constitution, as a management organization that is, the Members countries can adopt conservation and management measures that are binding on all the Members and the cooperating countries. It was approved by the FAO Council in November 1993 and came into force upon accession of the tenth member in March 1996. Although under the umbrella of the FAO, the IOTC is fully autonomous both financially and functionally.

Membership in the IOTC is open to members of FAO that are a) coastal States or (ii) States whose vessels engage in fishing in the IOTC Area; or regional economic integration organizations. IOTC is currently composed of 30 member States: Australia, Belize, China, Comoros, Eritrea, European Union, France, Guinea, India, Indonesia, Iran, Japan, Kenya, Madagascar, Malaysia, Maldives, Mauritius, Mozambique, Oman, Pakistan, Philippines, Republic of Korea, Seychelles, Sierra Leone, Sri Lanka, Sudan, Thailand, United Kingdom, United Rep. of Tanzania and Vanuatu. Cooperating Non-Contracting States are Senegal and South Africa.

The structure of IOTC basically consists of:

- **Plenary: The main governing body of the IOTC is the Commission itself. It is composed of all members and cooperating states and is empowered to adopt conservation and management measures. Normally, it meets once a year.**
- **Scientific Committee: The Scientific Committee (SC) advises the Commission on the status of stocks and their ecosystem and it advises the Commission on the possible effectiveness and consequences of conservation and management actions.**
- **Compliance Committee: The Compliance Committee reviews annually the status of the implementation of the measures agreed by the Members in each of the States, advising also on technical matters related to the implementation of future measures;**
- **Working Parties: The primary function of the Working Parties is to analyze in detail technical issues related to the management goals of the Commission. One of the primary functions is to analyze the condition of the stocks on the basis of the data supplied by the members. Ten Working Parties have been established to date, including groups dedicated to the status of Tropical Tunas, Billfish, Neritic Tunas, Ecosystem and Bycatch, and Methods.**

15.3. HOW THE IOTC WORKS

In a nutshell, the IOTC process is based on actions agreed by the member States in response to the scientific advice on the condition of the stocks and their environment by scientists and experts. The latter, after analyzing the data supplied by the member States, issues recommendations as to what is necessary to do to ensure a sustainable utilization of the resources. A correct implementation of these actions is essential to the success of this process, thus the importance of the Compliance Committee, who monitors progress and identifies technical problems affecting the implementation of the actions.

In more detail, the process goes through three steps:

Step I: Advice is generated based on best available science

A wide range of data, collected by the member countries from their own fisheries, is reported to, and centralized by the IOTC Secretariat, which processes the data in a way to facilitate further analyses by the Working Parties. National scientists (as individuals, not delegations) meetin Working Parties to conduct the actual stock assessment and review and discuss the results of the analyses of the data, issuing a report to the Scientific Committee that includes recommendations for the management. The Scientific Committee(composed of national delegations, and thus more formal) reviews the reports from every Working Party, and issues advice to the Commission,sometimes proposing management actions if necessary.

The Scientific Committee also coordinates research efforts by national scientists or the Secretariat. The Indian Ocean Tuna Tagging Programme(IOTTP) was a large-scale effort to improve the data available for the status of the stocks. The IOTTP tagged more than 200,000 tuna, the vast majority (almost 170,000 fish) under the successful Regional Tuna Tagging Programme (RTTP-IO), a large-scale tagging project funded by the EU under the Indian Ocean Commission and supervised by the IOTC Secretariat.

Step II: The actual decision making

As soon as it is published, the Secretariat circulates the report of the Scientific Committee to all members, who initiate a period of internal consultation with their scientists. The recommendations of the Scientific Committee are considered and translated, when necessary, to proposals for conservation and management measures.

Not all matters to be discussed by the Commission are directly related to the scientific advice. For those other issues, briefings are prepared by national administrations, following internal consultation with various stakeholders, to define the position to be taken on matters related, for example, to compliance, or actions required to combat IUU fishing.

At the Annual Session of the Commission, these proposals (and other matters) are discussed, seeking, when possible, to achieve consensus in the actions to be taken, and eventually, translating those agreements into binding resolutions adopted at the Session. Binding resolutions are normally adopted by consensus, but that it is not necessary. The Members can vote on a particular measure if there is no consensus, requiring two-thirds majority to adopt a binding resolution. There is also an objection procedure which has never been fully invoked to date for those who profoundly disagree with a measure adopted.

Step III: Implementation and Compliance

Following the Annual Session, each delegation briefs higher authorities on the outcomes of the meeting.The need for changes in the domestic legislation arising from any agreed measure is evaluated and action is taken to modify legislation as necessary to ensure an effective implementation.Contacts are established with national agencies and institutions that could be responsible for implementation of some of the actions (e.g. Port Authority, provincial authorities).Meetings with stakeholders are scheduled to brief them on the outcomes of the Commission Session and their consequences at the domestic level. Finally, throughout the year, there is a monitoring and reporting of activities to the Secretariat according to the agreed schedule of reporting.

This is an ideal sequence of events. In reality, there are still gaps in the implementation of these processes at a national level for some members, although, as a collective body, the Commission has made big progress in recent years.The basic regulatory body required to reduce illegal fishing has been adopted by the members and, more importantly, most of the major stocks seem to be in good shape.

In analyzing the effectiveness of the IOTC, it is important to note that the Commission operates in a very complex environment and its decisions require inevitable compromises between stakeholders with vastly different interests and goals.

The difficultiescoming from the design and in the implementation by the Members of the IOTC model of Regional Fisheries Management Organisations (RFMOs)have been well documented by a performance review conducted in 2009, by a Panel that included representatives from members and independent experts. The Panel identified in its report a number of shortcomings and produced recommendations that the IOTC members have adopted as a guidance for reform in the past three years, although the biggest reform of all, the revision of the Agreement that established the IOTC itself,to modernize it and bring it in line with more recent international instruments, has not yet started.

Skipjack on the Deck of a Purse Seiner

15.3.1. THE MAIN CONSERVATION AND MANAGEMENT MEASURES FOR INDIAN OCEAN TUNA AND TUNA-LIKE SPECIES

The IOTC member countries have taken an approach to management that todate has produced two main types ofmeasures; both intended to prevent too much effort being exerted on the stocks:

- **Controls of fishing capacity**: IOTC Resolution 09/02 is the latest of a series of resolutions that implement a limitation on fishing capacity, measured in fleet size tonnage. The resolution establishes a limit based on what the actual fishing capacity targeting tropical tunas was during the year 2006 and for swordfish and albacore during 2007.
- **Time-area closure:** IOTC Resolution 10/01 closes an area east of Somalia (0 ° to 10° north; 40° to 60° east) in February to longline fishing and in November to purse seine fishing, as a preventive measure. At the same time, a Technical Committee has been formed to look at the problem of allocation in the case of future quotas

These two main management measures of the IOTC were adopted by the Commission after a large amount of debate and compromise between the member countries and their very different national interests. In many respects their adoption represents a major accomplishment, but there is still along way to go. A full implementation of the Fleet Development Plans (established in order to provide for the legitimate development aspirations of coastal states)would take fishing capacity beyond sustainable levels. Also, the Scientific Committee has advised that time-area closures would have to be substantially larger to have a significant effect on overall fishing mortality.

16.SOME OF THE CHALLENGES FOR THE FUTURE

How to avoid fleets that are too large for the size of the stocks?

One of the common problems in all fisheries of the world is their overcapitalization (too many fishing vessels for the number of fish to be caught). In the period of expansion, the perception that there are inexhaustible fishing opportunities leads to societies and individuals investing in building fishing capacity that is excessive to achieve sustainable exploitation. The results are often painful for all involved, and they could lead to irreparable damage to the resource.

The IOTC members have worked in the direction of agreeing to a limitation in the fishing capacity (e.g. a limit to the size of the fleet catching tuna) but there is the challenge to accommodate the legitimate aspirations of coastal States to develop their own fleets.As the fleets continue to grow, it might be inevitable to adopt measures that could include catch limits or quotas. That is, countries will have to agree to stop fishing when the total catch is reached, even if it is well before the end of the year.

This brings us to the next challenge, because unless there is an agreement to allocate those quotas amongst the Members using some set of criteria, there will be an incentive for fishermen to race to get as much as possible each year before the annual limit is reached.

16.1. WHAT IS THE FAIREST WAY TO ALLOCATE FISHING OPPORTUNITIES AS THE ROOM FOR EXPANSION DWINDLES?

In many fisheries around the world, as an alternative to an open race amongst all fleets to catch the quota each year, a scheme of allocation amongst users assigns a share of the catch to specific fishers, fleets, or countries, depending on the case. The process of distributing the total allowable catch amongst the various participants in a fishery is known as *allocation* – and is one of the hottest issues in fisheries management in the world today.

The controversial aspect of allocation is how to decide on the rules for who is entitled to what (i.e. how to divide the “pie”). Participants with a long involvement in a fishery usually feel that historical fleet catches should be an important part of the allocation criteria. Coastal states in the region (some of them with little historical catch by their national fleets) often have strong sentiments that catches in their exclusive economic zones (EEZs) should be a major factor in deciding allocations. Coastal states commonly feel that their aspirations to development their own tuna fishing industries should be taken into consideration in formulating allocation criteria. The IOTC Members are currently engaged in such a debate as to what is the best way to proceed, including looking at alternative management measures that could circumvent the problem of having to decide on an allocation mechanisms.

It is generally recognized that for the tuna fisheries of the Indian Ocean (as is the case with other regions as well) the process of establishing allocation criteria willbe complex, likely to require several years and considerable compromise will be required by the various stakeholders before consensus can be achieved. As it is the case in other fisheries organizations, this will be the most difficult debate in the history of IOTC.

Offloading Yellowfin from a Longliner

16.2. HOW CAN THE MEMBERS BEST COOPERATE TO IMPROVE COMPLIANCE?

Undoubtedly, one of the main challenges for the sustainability of Indian Ocean tuna fisheries is a poor level of compliance with IOTC conservation and management measures. Unless all countries comply with sufficient rigor with the actions that they agreed to pursue, there will be areas of weak compliance that illegal operators can take advantage of.

The IOTC Compliance Committee has been recently strengthened and mandated to conduct a thorough analysis of the level of compliance at the country level, in order to assist the IOTC Members to identify the main challenges that they face, to the extent possible, identifying the reasons for non-compliance in each case and possible remedial actions. The Compliance Committee also analyses compliance at the resolution level, seeking for patterns that would suggest possible improvements in the design of the measures that could facilitate compliance in the long term.

There are no easy solutions to the problem of non-compliance. There are several reasons for non-compliance by the Member countries; from a lack of understanding of the requirements of the measures, to a lack of needed resources, both financial and human. To correct these shortcomings will require a firm commitment from the Members to assign the necessary resources to compliance and to cooperation amongst Members in capacity building in the region. The IOTC Secretariat is conducting workshops in the region to improve understanding of the requirements of the various measures in place, often in cooperation with other initiatives.

For some measures, like port State measures, it is also essential that effective implementation is established at the same time in all the member countries. Failure to do so would create ‘safe havens’ for illegal operators who would naturally be attracted to the less strictly controlled areas.

16.3. ARE THE DATA AVAILABLE SUFFICIENT TO ASSESS THE STOCKS?

In general, all types of fishery catch statistics are obtained through sampling schemes and are therefore by definition ‘estimates’. Such catch estimates will always have some level of uncertainty associated with them however, the uncertainty is dependent on the sampling design, the type of fishery and the amount of catch and effort that are sampled. The same applies to the catches that the IOTC Scientific Committee adopts each year as the best estimates, as they are the product of data reviews and further estimation by the IOTC Secretariat, including estimation of catches when they are not reported by the flag countries concerned.

Therefore, the time-series of catches used for stock assessment at the IOTC cover all known fishing activities in the Indian Ocean and for this reason represent the best estimates of catches for the species managed by the IOTC, in particular tropical tunas, albacore, and swordfish. Although some of the issues identified are likely to compromise the quality of the estimates to some degree, the final estimates of catch for those species are not thought to be substantially affected by these issues.

In the Indian Ocean, the IOTC Scientific Committee has expressed concern about three particular issues, considered to account for most of the uncertainty in the assessments IOTC species:

- Insufficient monitoring of small-scale fisheries: In the Indian Ocean small-scale fisheries catch substantial amounts of IOTC species, in particular yellowfin tuna, skipjack tuna, neritic tunas and some species of billfish and sharks. Small-scale fisheries are by far the major contributor to the uncertainty in the estimates of catch for these species.
- Limited amount of catch-and-effort data that can be used to derive indices of abundance to be used in the assessments: Catch-and-effort is often assumed to be proportional to stock size. To date, the majority of IOTC assessments have relied on indices of abundance derived from a limited number of time-area catch-and-effort data series (fishing logbooks), mostly Asian longline fleets and the bait-boat fleet in the Maldives.
- Poor knowledge concerning the range of sizes taken by some important fisheries: other than data on the catches and effort from the fisheries, in most cases the quality of stock assessments improve when data on the sizes taken from the stock concerned are available for each fishery. This is because the component of the stock vulnerable to fishing tends to vary depending on the type of gear, gear configuration, time and area fished, and other factors, with different lengths taken by each gear. Knowing the total amount of fish sizes (or ages derived from them) taken by the fisheries through time makes for more precise stock assessments. In the Indian Ocean the amount of size data available is low for most small-scale and some longline fisheries, which affects in particular assessments of yellowfin tuna and skipjack tuna.

16.4. HOW SERIOUS IS THE BYCATCH? WHAT SPECIES ARE THE MOST AFFECTED?

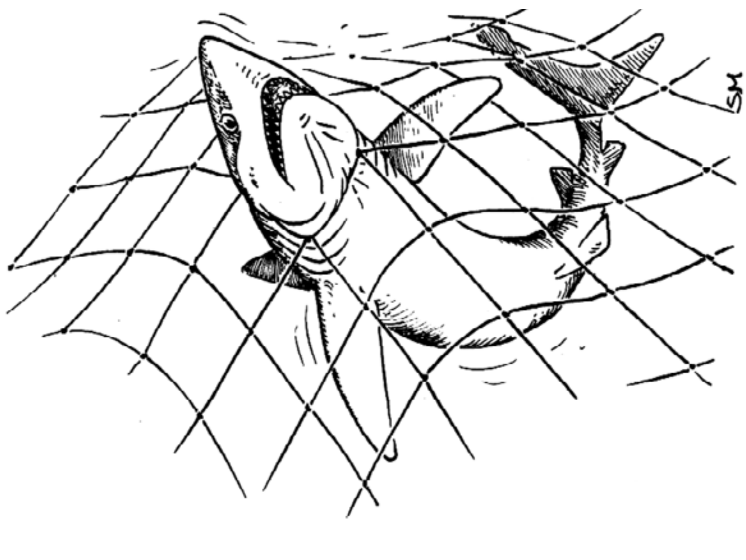
The effects of any fishing activity does not end with the fish that is intended to be taken. Often the fishing gear catches unintended species (also known as bycatch) that sometimes are discarded, together with fish that is too small for the fish operators (also termed ‘discards’). The regrettable part is that many of the fish discarded is perfectly fit for human consumption and would have contributed to the food security of coastal communities if made available. For this reason, the IOTC Members adopted a recommendation in 2010 encouraging member States to retain, on board, fish that would be suitable for human consumption.

In any case, one of the main problems is to assess correctly the level of bycatch currently taking place. In spite of the requests having been forwarded for many years, most of the Member States encounter difficulties in supplying data on the bycatch of their fleets, as it has been documented by the Scientific and Compliance Committees. In response to the recommendations, the IOTC Members have adopted a scientific observer programme, based on national implementation that has as a main objective to provide better estimates of all species and quantities being caught by all fleets. Observer programmes will be essential to improve data availability, especially for discards and bycatch.

Of particular concern in this area are species such as sharks, for which there is little information that the scientists could use to assess their status, although there is enough knowledge about their biology to believe that some species are fragile to exploitation and are a common bycatch (or target) for some gears.

Currently, no organization has a clear mandate to manage shark fisheries, and it is not difficult to imagine a future in which some direct action would be required to ensure that they do not disappear completely. The IOTC Members have responded to some of these concerns, but adopting measures to ban the retaining of some fragile species (e.g. thresher sharks), and action that could be extended to other species as well.

17. OTHER IMPORTANT ASPECTS OF THE TUNA FISHING OF THE REGION



Data were collected by a French and Spanish observer programme on 1,958 seiner sets in the Indian Ocean between 2003 and 2007. That work showed that the percentage of bycatch in sets near FADs and seamounts was 5.31%, while those sets on free-schools (i.e. not close to FADS/seamounts) were 1.17%.Data available from observers placed on longline fleets operating in the Indian Ocean suggests a high percentage of catch is sharks.

Some of the Purse Seine Bycatch Species

17.1. THE PRECAUTIONARY APPROACH

In the management of natural renewable resources, the conceptof the *precautionary approach* is often invoked as a guiding principle for managers who have to make decisions in the face of uncertainty, either in the basic data or in the consequences to be expected of the decisions, or in both.

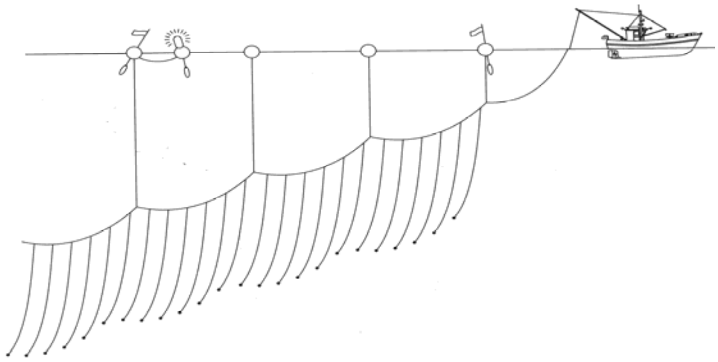
This makes the precautionary approach an especially useful guiding principle in fisheries management, where uncertainties abound. Strictly speaking, the precautionary approach applies to the decision-making, and not to the nature of the advice. That is, it is the managers who should make decisions acknowledgingan uncertainty, and it is up to the scientists, to supply, together with their advice, an indication of the degree of uncertainty that surrounds their advice.

Considering the status of the five species covered in this booklet, (close to be fully utilized) a greater emphasis on the precautionary approach in the decisions of the Commission seems to be warranted.

In response to this, the IOTC Members are working to formally implement the precautionary approach, and the Scientific Committee has initiated a process to evaluate what critical values and associated management measures (also known as harvest control rules) are the most adequate to bring the risk of a serious damage to the stocks, to an absolute minimum. Until the scientific work is completed, the Scientific Committee has recommended provisional values that would be replaced at the end of the evaluation work.

If adopted by the Members (and indications are that they will) this will represent an important step forward in embracing best practices and implementing the recommendations of the IOTC Performance Review.

Presently, the precautionary approach is especially applicable to the Indian Ocean albacore resource. The best scientific information available shows that current levels of albacorefishing mortality carry high risks of overfishing- indicating that management action to reduce catches should be taken now rather than waiting for the results of more definitive stock assessments.



17.2. ECO-CERTIFICATION

"Eco-certification" of fishery products can be defined as assurance to consumers that the concerned products are from fisheries that are well-managed. There are a number of fishery eco-certification schemes in the world, but the two that are most involved with tuna fisheries are the Marine Stewardship Council (MSC) and Friend of the Sea. In both schemes an independent assessment of a fishery is carried out in which three main subject areas are scrutinized: stock under consideration, management systems and ecosystem approaches. Those fisheries that pass an established standard become eligible to have a label on their products. The process is essentially one of independent audit, and is repeated at 3-4 year intervals.

Currently in developed country marketsthere is growing demand by retailers for fishery products that have been certified as being from well-managed fisheries. This is especially evident in the tuna trade of northern Europe.

There are several tuna fisheries in the world that have received eco-certification, including the tuna hand-line fisheries of the Maldives and Sri Lanka (by Friends of the Sea). Considering that a very large tuna purse seine fishery in the western Pacific has just received certification (by MSC), we can expect to see additional interest in certifying various Indian Ocean tuna fisheries. An interesting feature of the quest for certification is that it creates a real commercial incentive for the fishing industry to pressure the concerned fisheries management agency to improve management so as to be eligible for certification.

17.3. PIRACY

Piracy in the western Indian Ocean has had major impacts on tuna fishing activity in recent years.

Pirate attacks in the waters off Somali (one of the most productive areas tuna fishing areas of the IndianOcean) have progressively increased since the early 1990s. Originally, the target was coastal shipping but it has grown to include all ships, including tuna longliners, purse seiners, and gillnetters.

The geographic area has expanded as well; tuna vessels have been attacked over 1,000 nautical miles from the Somalia coast and now the area of threat covers almost all of the western Indian Ocean. Past incidents have involved hijacking of Spanish, French, Seychelles and Thai purse seiners and Chinese, Taiwanese andKenyan longliners. In response, there has been much movement of tuna fishing activity vessels away from the Somalia zone to avoid piracy. The purseseine fleet of larger vessels usually carries security personnel on board and has been less affected on the areas of distribution, although there is a considerable impact in terms of additional costs and stress for the fishing crew on board.

The situation is more delicate for the longline and gillnet vessels that are smaller and slower and therefore, more vulnerable to the attacks.

The major impacts of this piracy on tuna resources and tuna fishing are:

- There has been a displacement of a substantial portion of longline fishing effort from the piracy area, possibly into the other fishing areas in the southern and eastern Indian Ocean. This might have contributed to the additional fishing pressure to the Indian Ocean albacore stockthat is likely to be currently under excessive fishing pressure.
- It is also likely that other gillnet fleets that would normally target tuna in the high seas are restricting their activities more in the coastal areas and so affecting other bycatch species.
- The displacement of longline effort means also a loss of revenue for states with EEZs within the range of pirate activities that used to license these vessels.

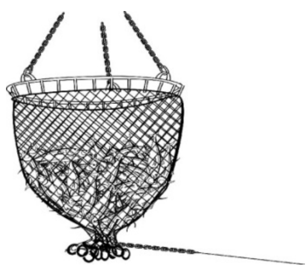
17.4. MARINE PROTECTED AREAS

Marine protected areas (MPAs) are zones in which fishing activity is significantly restricted or banned (sometimes called fish reserves, fish sanctuaries or no-take areas). In recent years the use of MPAs as fishing management tools has increased, especially in coastal areas. Often the concept is to create a refuge for fish so that the fish are protected from fishing pressure when they are particularly vulnerable to the fishing, such as during spawning and nursery aggregations.

There is some interest in creating large pelagic marine protected areas.The Chagos Marine Protected Area in the middle of the Indian Ocean is about a half a million square kilometres in size. The country of Kiribati in the Pacific is creating an MPA of over 400,000 square kilometres.

The case for fish stock protection by MPA is most compelling for fish and other marine species with low mobility and discrete areas where activities such as that related to spawning and growth of juveniles is concentrated. One of the difficulties is applying the MPA concept to the conservation of major tuna species in the Indian Ocean is that such concentrations do not appear to exist. Alternatively, it has been stated that “resident populations” of tuna in the MPA could re-populate depleted stocks. While this is a possibility, the existence of such populations and any regeneration ability they may have, are uncertain.

The effectiveness of a fisheries management intervention is obviously related to the objectives - and there could be a range of objectives for a large pelagic MPA, including contributing to the protection of endangered species (e.g. sea turtles) or ecosystem preservation. Due to the characteristics of the main tuna species in the Indian Ocean, it does not appear that the objective of tuna stock conservation (arguably the most pressing concern) can be readily achieved through a large pelagic MPA.In summary, despite considerable enthusiasm from some stakeholders, MPAs should not be considered a proven tuna fishery management tool.



18. A PARTING MESSAGE

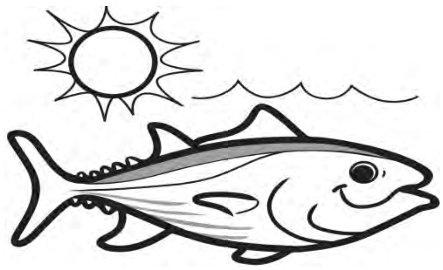
Most of the tuna stocks in the Indian Ocean are being exploited at a sustainable level currently. Only albacore seems to be subject to a pressure that will require some action before the stock is reduced too much.

However, as most of the stocks status seems to show that stocks are close to the full utilization level, it seems also that there is little room for further expansion of the fisheries. This will mean that accommodating the legitimate aspirations for development of the coastal states will require creative solutions or catch limits to ensure that the pressure on the stocks does not exceed the optimal levels.

As the stock conditions are close to optimum levels, there will be an increasing importance for good data that would allow more precise management actions, and for effective compliance that would ensure that the protective measures adopted by the members have the intended beneficial consequences.

The consequences of fishing activities cannot be ignored under management goals that reflect concern for the condition of the ecosystem, now and in the long term. Considerable effort in data collection and mitigation of adverse impacts needs to be spent so as to improve the current situation

Above all, there is a need for a clear understanding that only through the concerted effort of all nations and other stakeholders, will there be a chance to secure the benefits of the profitable tuna fisheries of the Indian Ocean for generations to come.



La bonne gouvernance et la bonne gestion des pêches et de l'aquaculture permettent d'améliorer la contribution du secteur à la sécurité alimentaire, au développement social, à la croissance économique et au commerce régional ; ceci en assurant par ailleurs une protection renforcée des ressources halieutiques et de leurs écosystèmes.

La Commission de l'Océan Indien (COI) ainsi que la COMESA (Common Market for Eastern and SouthernAfrica), l'EAC (East AfricanCommunity) et l'IGAD (Inter-GovernmentalAuthority on Development) ont développé des stratégies à cette fin et se sont engagés à promouvoir la pêche et l'aquaculture responsable.

SmartFish supporte la mise en œuvre de ces stratégies régionales en mettant l'accent sur le renforcement des capacités et des interventions connexes visant à :

- la mise en œuvre d'un développement et d'une gestion durables des pêcheries ;
- le lancement d'un cadre de gouvernance pour les pêcheries durables dans la région;
- le développement d'un suivi-contrôle-surveillance efficace pour les ressources halieutiques transfrontalières ;
- le développement de stratégies commerciales régionales et la mise en œuvre d'initiatives commerciales;
- l'amélioration de la sécurité alimentaire à travers la réduction des pertes post-capture et la diversification.

SmartFish est financé par l'Union Européenne dans le cadre du 10ème Fond Européen de Développement.

SmartFish est mis en œuvre par la COI en partenariat avec la COMESA, l'EAC et l'IGAD et en collaboration avec la SADC. Une collaboration étroite a également été développée avec les organisations régionales de pêche de la région. L'assistance technique est fournie par la FAO et le consortium AgrotecSpA.

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By improving the governance and management of our fisheries and aquaculture development, we can also improve food security, social benefits, regional trade and increase economic growth, while also ensuring that we protect our fisheries resources and their ecosystems.

The Indian Ocean Commission (IOC), the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Inter-Governmental Authority on Development (IGAD) have developed strategies to that effect and committed to regional approaches to the promotion of responsible fisheries and aquaculture.

SmartFish is supporting the implementation of these regional fisheries strategies, through capacity building and related interventions aimed specifically at:

- implementing sustainable regional fisheries management and development;
- initiating a governance framework for sustainable regional fisheries;
- developing effective monitoring, control and surveillance for trans boundary fisheries resources;
- developing regional trade strategies and implementing regional trade initiatives;
- contributing to food security through the reduction of post-harvest losses and diversification.

SmartFish is financed by the European Union under the 10th European Development Fund.

SmartFish is implemented by the IOC in partnership with the COMESA, EAC, and IGAD and in collaboration with SADC. An effective collaboration with all relevant regional fisheries organisations has also been established. Technical support is provided by Food and Agriculture Organization (FAO) and the AgrotecSpA consortium.