DÉVELOPPEMENT DURABLE & RELATIONS INTERNATIONALES

# Indian Ocean tuna fisheries: between development opportunities and sustainability issues

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**June 2017**

## Context of the report

This report was produced as part of the "Diagnosis of the Tuna Industry in the Indian Ocean" project, co-funded by IDDRI and the French government in the framework of the programme "*Investissements d'avenir*", managed by ANR (the French National Research Agency) under the reference ANR-10-LABX-01.

The work was carried out on the basis of a review of the scientific and grey literature, as well as through numerous interviews with international, regional and national experts and staekehoders.

The authors would like to thank the experts who took part in the project's steering committee and who, through their advice and recommendations, have made it possible to carry out this work: Selim Azzi (WWF France), Pascal Bach (IRD), Norbert Billet (IRD), Thomas Binet (Vertigo Lab), Jacques Bruhlet (Eurothon), Christian Chaboud (IRD), François Chartier (Greenpeace France), Pierre Commere (Association des entreprises de produits alimentaires élaborés), Sylvain Cuperlier (Thai Union Europe), Elisabeth Druel (Client Earth), Margaux Favet (MSC), Marc Ghiglia (Union des armateurs à la pêche), Michel Goujon (Orthongel), Patrice Guillotreau (Université de Nantes), François Henry (AFD), Edina Ifticene (WWF France), Joséphine Labat (WWF France), Edouard Le Bart (MSC), Francisco Leotte (MW Brands), Frederic Le Manach (Bloom Association), Yvon Riva (Union des armateurs à la pêche), Thomas Roche (Ministry of Ecology), Cécile Schneider (Conservation International), Pauline Soudier (WWF France), Yvan Yvergniaux (Smart Fish).

Section 4.5 is based on a study authored by Sibylle Dueri, "Impacts of climate change and ocean acidification on Indian Ocean tuna", carried out within the framework of the project.

Finally, it should be noted that some of the data presented in this study have been estimated from scientific and economic evaluations, which are subject to numerous uncertainties.

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## Abbreviations list

| | |
|---|---|
| ACP | African, Caribbean and Pacific Group of States |
| ANABAC | National Association of Tuna Freezer Vessels Shipowners (Asociación Nacional de Armadores de Buques Atuneros) |
| AP2HI | Indonesia Pole Line and Handline Association |
| ASEAN | Association of Southeast Asian Nations |
| ASTUIN | Indonesia Tuna Association |
| ATLI | Indonesia Tuna Longline Association |
| CBI | Centre for the Promotion of Imports from developing countries |
| CFC | Ceylon Fisheries Corporation |
| CFTO | French company of oceanic tuna (Compagnie Française du Thon Océanique) |
| CIF | Cost Insurance and Freight |
| CNOI | Indian Ocean Shipyard (Chantier Naval de l'Océan Indien) |
| COI | Indian Ocean Commission |
| CPUE | Catch per unit effort |
| CRPMEM | Committees of Maritime Fisheries and Marine Fish Farms |
| CTOI/IOTC | Commission des Thons de l'Océan Indien/Indian Ocean Tuna Commission |
| DF | Day fished |
| EBA | Everything But Arms |
| EEZ | Exclusive Economic Zone |
| EPA | Economic Partnership Agreement |
| EU | European Union |
| FAO | Food and Agriculture Organization |
| FIP | Fisheries Improvement Project |

| | |
|---|---|
| FMA | Fisheries Management Area |
| FOB | Free On Board |
| FPA | Fisheries Partnership Agreement |
| G | Grams |
| GSP | Generalised Scheme of Preferences |
| GT | Gross tonnage |
| IBL | Ireland Blyth Limited |
| IEO | Spanish Institute of Oceanography (Instituto Español de Oceanografía) |
| IFAD | International Fund for Agricultural Development |
| IFO | Iran Fisheries Organization |
| IOT | Indian Ocean Tuna |
| IPNLF | International Pole And Line Foundation |
| IRD | Research Institute for Development (Institut de recherche pour le développement) |
| ITQ | Individual Transferable Quota |
| IUCN | International Union for the Conservation of Nature |
| IUU | Illegal, Unreported and Unregulated |
| JICA | Japan International Cooperation Agency |
| M | Million |
| MCS | Monitoring Control and Surveillance |
| MFARD | Ministry of Fisheries and Aquatic Resources Development (Sri Lanka) |
| MFCF | Mauritius Fishermen Cooperative Federation |
| MIFCO | Maldives Industrial Fishing Company |
| MMAF | Ministry of Marine Affairs and Fisheries (Indonesia) |

| | |
|---|---|
| NARA | National Aquatic Resources Research and Development Agency (Sri Lanka) |
| OEC | Observatory of Economic Complexity |
| OPAGAC | Organización de Productores Asociados de Grandes Atuneros Congeladores |
| ORTHONGEL | Organisation of producers of frozen and deep-frozen tropical tuna (Organisation des producteurs de thon congelé) |
| OVPOI | Observatory of Port and Cities of the Indian Ocean (Observatoire des Villes et des Ports de l'Océan Indien) |
| SCF | Semi-Commercial Fishing |
| Rec | Recommendation |
| RSW | Refrigerated Sea Water |
| SAPMER | Société Anonyme de Pêche Malgache et Réunionnaise |
| SECREN | Société d'Etudes, de Construction et de Réparation Navales |
| SFA | Seychelles Fisheries Authority |
| SFP | Sustainable Fisheries Partnership |
| SPA | Seychelles Port Authority |
| SPC | Secretariat of the Pacific Community |
| SST | Sea Surface Temperature |
| SWIO | South West Indian Ocean |
| SWIOFP | South West Indian Ocean Fisheries Project |
| T | Tonnes |
| TAC | Total allowable catch |
| USITC | United States International Trade Commission |
| VMS | Vessel Monitoring System |
| WG | Working Group |
| WTO | World Trade Organization |

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# Executive summary

- ✓ The Indian Ocean is the world's second largest tuna production area. It accounts for nearly **20% of the world commercial tuna catch (i.e., 1 million tons)** and **16% of the world tuna industry's revenue (i.e., USD 6.5 billion based on total wholesale price of canned tuna)**.

- ✓ Two types of fleet operate in the Indian Ocean: **industrial-type distant water fishing fleets** and **coastal state fleets, mostly of the artisanal type**. Unlike other ocean basins, these artisanal coastal fleets contribute significantly to the overall fishing effort, accounting for more than half of the catches. The vast majority of tuna fishers in the Indian Ocean are artisanal fishers, and most of the tuna fleet consists of small fishing units, operating mainly on the scale of exclusive economic zones.

- ✓ The Indian Ocean is also characterized by the **importance of neritic tuna catches**. This type of tuna, which is a coastal species, represents **36% of the total tuna catch** in the Indian Ocean and is almost exclusively caught by coastal fleets.

- ✓ Indian Ocean tuna catches supply local and export markets, **providing a diverse range of end products**: canned tuna, sashimi, steak tuna, dried tuna and Maldives Fish. Six sectors account for nearly 77% of the total catch in the Indian Ocean and their trade turnover amounts to an estimated value of **$2.9 billion**:
    - Tuna canneries in the Western Indian Ocean (Seychelles, Mauritius, Madagascar) supplied by the European purse seine fleet;
    - Catches of artisanal fleets that supply local markets;
    - Gillnetters from the Middle East that supply Iranian canneries;
    - Freezer longliners supplying the Japanese sashimi market;
    - Processing units specializing in fresh tuna for the sashimi and fresh markets;
    - Catches from MSC-certified Maldivian pole and liner vessels.

- ✓ . The Indian Ocean industries are among the main suppliers of the world's tuna can, steak and sashimi markets.

- ✓ Nearly half **(44%)** of the catch comes from stocks that are overexploited and overfished. The two species mainly concerned, yellowfin tuna and longtail tuna, supports industries with major economic stakes. At present, however, only yellowfin tuna is the subject of IOTC management measures.

- ✓ Some fisheries in the Indian Ocean have a significant bycatch (cetaceans, rays, sharks, etc.). Gillnet fisheries thus account for nearly **29,500 tonnes** of bycatch per year, and industrial longline fisheries for almost **22,130 tonnes** (including bait).

- ✓ Part of the fleet operating in the Indian Ocean remains uncontrolled and poorly documented: almost **half of the catch data is incomplete or unavailable** and the capacity of some fleets remains unknown.

- ✓ The implementation of development plans outlined by coastal States would increase fishing capacity by **250% above 2006-2007 levels**, an increase that is incompatible with the sustainable exploitation of tuna resources. The balance between the access of new entrants and the maintenance of the historical fleets is a major challenge for the coming years.

- ✓ Indian Ocean tuna fisheries are characterized by a **low level of governance**: the Indian Ocean Tuna Commission (IOTC) is struggling to establish management measures, particularly due to the polarization of the debate between the positions of the industrial-type distant water fishing fleets and those of the artisanal coastal fleets. The management policies of coastal States remain limited and the lack of resources dedicated to the sector does not facilitate the effective monitoring, control and surveillance of these fisheries. Market governance appears to be more effective, but for now remains limited to certain export markets.

# 1. Introduction

The term "tuna" refers to several species of oceanic fish belonging to the Thunnini tribe. Within this tribe, 14 species can be distinguished, 7 of which are commercially exploited: skipjack tuna, yellowfin tuna, albacore tuna, bigeye tuna and three species of bluefin tuna (Pacific bluefin, Atlantic bluefin and Southern bluefin) (Table 1).

**Table 1: Commercial tuna species (Source: (GOUJON and MAJKOWSKI 2000))**

| English name | French name | Scientific name |
|---|---|---|
| Skipjack tuna | Listao | *Katsuwonus pelamis* |
| Yellowfin tuna | Albacore | *Thunnus albacares* |
| Bigeye tuna | Thon obèse or patudo | *Thunnus obesus* |
| Albacore tuna | Germon | *Thunnus alalunga* |
| Atlantic Bluefin | Thon rouge de l'Atlantique | *Thunnus thynnus* |
| Pacific Bluefin | Thon rouge du Pacifique | *Thunnus orientalis* |
| Southern Bluefin | Thon rouge du Sud | *Thunnus maccoyii* |

Tuna is a major species group in terms of global catches. In 2015, catches of these seven species reached 4.8 million tonnes, i.e. 5% of the world marine fish catch. Thus, every second, nearly 152 kilos of tuna are caught, while the skipjack alone is the third most fished species in the world. Tuna are present in all the world's oceans, with the Western Pacific representing the largest fishing area (Figure 1).

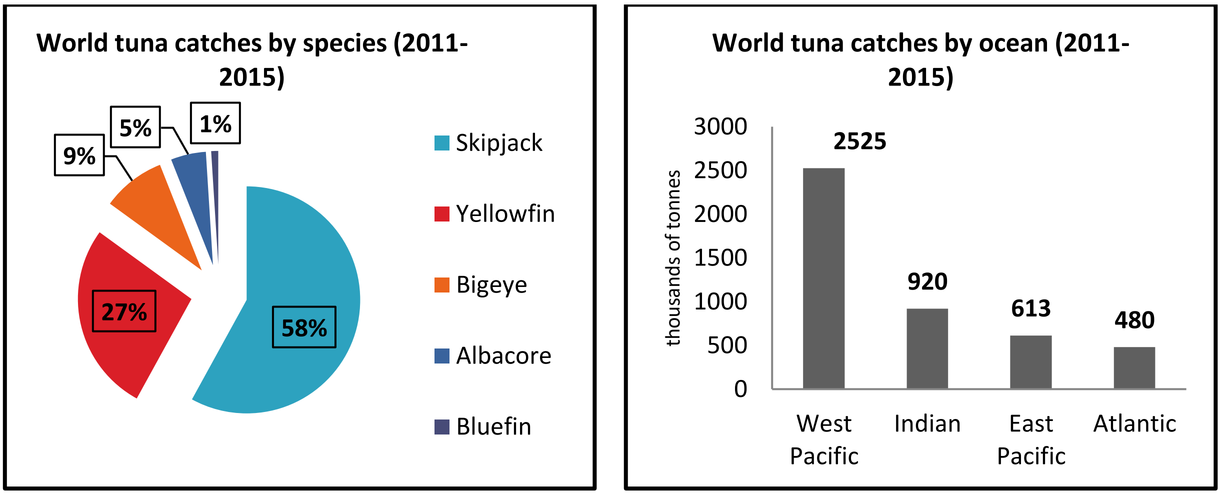



**Figure 1: Breakdown of world tuna catch (left figure) and distribution of world tuna catch by ocean (right figure) for the period 2011-2015 (Source: (ISSF 2017))**

Industrial fleets account for most of the tuna catch. The main fishing gears are purse seine (64% of catches), longline (12%) and pole and line (9%) (Figure 2).

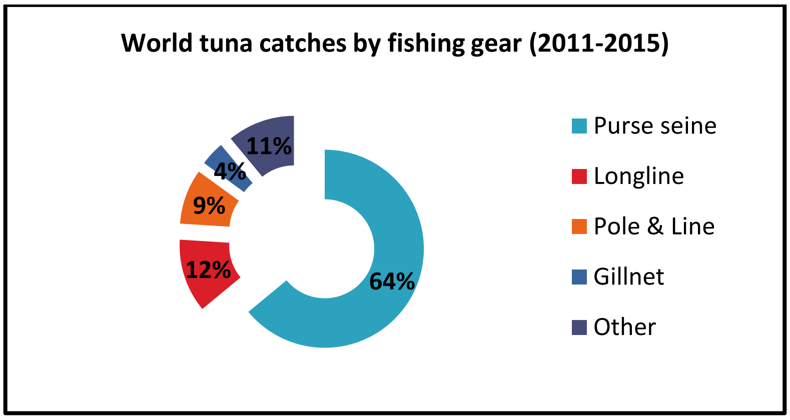



**Figure 2: World tuna catches by fishing gear over the period 2011-2015 (Source: (ISSF 2017))**

**Tuna fishing gear**

**A purse seine** is a long trapezoidal net that can encircle a school of tuna and then close shut underneath it to prevent escape. The size of these nets can be up to 2km long and about 300m high, depending on the characteristics and power of the vessel and the target species. Purse seiners have two fishing strategies: the targeting of free schools, or of schools gathering under floating objects known as Fish Aggregating Devices (FADs), that can be associated with artificial electronic buoys for tracking by fishers.

**A longline** consists of a main line that is set to hang near the surface, on which several branch lines are attached, each equipped with several thousand baited hooks.

**Pole and line** involves a rigid pole (often fibreglass) of between 2 to 3 metres in length, equipped with a short line, at the end of which hangs a feathered lure mounted on a barbless hook. The pole is held by a standing fisher.

**Lines** consist of simple lines with natural or artificial hooks, baited or not.

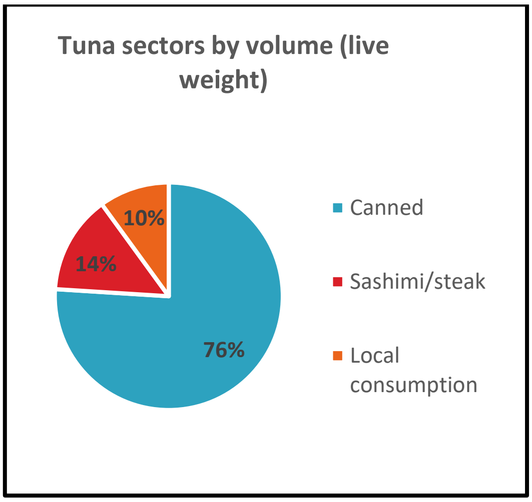
**Gillnets** are made up of a large net with a line of floats at the top, keeping it close to the surface, and a steel chain to hold the bottom of the net in the mid-water. The length of the nets can reach several kilometres, with a height between 20 and 30 metres.

Tuna species are traded within international value chains. In 2013, nearly half (46%) of tuna catches were traded on the world market (FAO 2015). In the international seafood trade, tuna is the fourth most traded product and represents 9% of the total value of seafood exports, behind salmon (14%), shrimp (15%) and white fish (10%) (POTTS *et al.*, 2016).

Tuna is thus one of the world's most popular seafood products, with a consumption level of 0.45 kg/year/person, which is equivalent to that of Nutella. Tuna species are associated with several forms of consumption, which constitute several sectors of the tuna industry (MACFADYEN and DEFAUX 2016) (Figure 3):

- Canned tuna is the main form of tuna consumption: nearly 75% of the world's tuna catch is destined for canneries. The main species consumed are skipjack and yellowfin tuna, which are mainly caught by purse seiners;
- Sashimi tuna is characteristic of the Japanese market. The species consumed are yellowfin tuna, bigeye tuna and the three bluefin species, the latter being almost exclusively destined for this market. This market, which has very strict quality criteria, is served by longliners;
- Tuna in the form of steak consumed in European and American markets consists mainly of yellowfin and albacore, caught by longliners and artisanal fishing units from Indonesia, the Maldives and Sri Lanka;
- Tuna consumed locally in certain countries with large artisanal tuna fleets (notably Indonesia, Maldives and Sri Lanka) also represent a significant market.

In terms of markets, the main consumer centres are concentrated in Japan, the world's largest tuna market (all forms of consumption taken together), the United States and the European Union (KAWAMOTO 2016). These so-called "traditional" markets are now seeing a stabilization of their consumption levels, while many emerging countries are now developing a certain appetite for tuna, especially canned tuna.



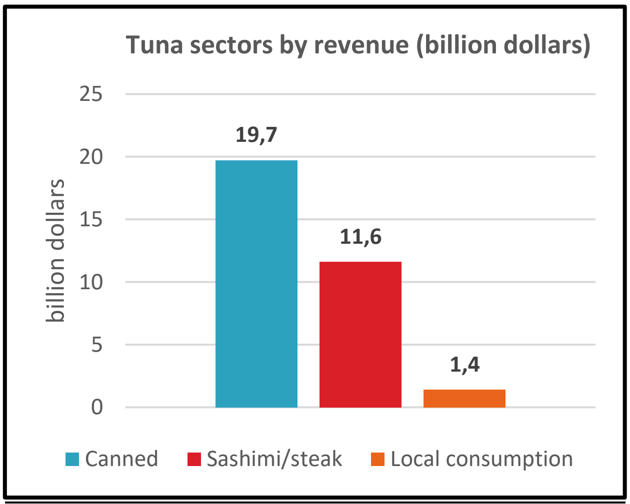




**Figure 3: The main forms of consumption by volume (left figure) and by revenue (right figure) (Source: (MACFADYEN 2016))**

The tuna industry is a major economic sector. In 2014, it was worth around $33 billion, or 24% of the value of the global seafood industry, reflecting the high value of tuna compared to other seafood products (MACFADYEN 2016). Within this sector, the main segment of the tuna industry is canned tuna, both in terms of volume and value (Figure 3). Canned tuna is the cheapest animal protein, representing an annual market of 1.7 million tonnes (8.5 billion tins). Tuna processing in canneries is a major industrial sector for some countries (Thailand, Spain, Ecuador) and represents a considerable source of employment. The sashimi market is a very high-end market, where tuna reaches one of the highest prices of any seafood. In 2016, a Japanese restaurateur bought a 200kg tuna at a record price of 600,000 euros.

The tuna industry is particularly important for some island and coastal States. For some Pacific States, for example, tuna is a vital sector and represents a significant part of the GDP. For example, public revenues from the issuing of fishing licences represent 36% of Tuvalu's GDP and 32% of Kiribati's GDP (VIRDIN 2016).

Tuna fisheries are a major source of export income: tuna accounts for 90% of exports from Kiribati, 84% of Maldivian exports and 60% of Seychellois exports (ITC Trade Map 2017). In some island countries, tuna is also the main source of protein and plays a major role in terms of food security. There are few fish species that are so vital to the economy of a country.

This report focuses on the Indian Ocean, the second largest tuna production area with nearly 20% of the world's commercial tuna catch. It aims to present the challenges facing the sector today, in particular in terms of the sustainable management of resources. To do this, Section 2 presents the main characteristics of the sector, and Section 3 discusses the different regional industries. Section 4 highlights the sustainability issues facing the sector today, while Section 5 provides avenues for the better governance of tuna resources.

## 2. The Indian Ocean, the world's second largest tuna production basin

Diversity in terms of development, political systems, religions and cultures make the Indian Ocean a unique region. The relative importance of the fisheries sector and the levels of fish and seafood consumption vary considerably from one country to another. The East African coast, for example, is characterized by low levels of development and fisheries that focus on freshwater species.[1] In the countries bordering the Arabian Sea (Iran, Pakistan), the fisheries sector makes only a marginal contribution to the national economy (less than 1% of national GDP) and fish product consumption levels are among the lowest in the world (9.8kg for Iran and 1.9kg for Pakistan) (FAO STAT 2013, FAO 2015, World Bank 2013). In the Western Indian Ocean, rapid population growth and overall economic expansion have dramatically increased the pressure on coastal resources in coastal countries (GROENEVELD 2015). Thus, many countries are now seeking to diversify their fishing effort and to restructure their fishing industry towards the development of tuna fisheries to reduce the pressure on lagoon resources (IOC 2016). The Maldives and Seychelles are two island states with economies that are not very diversified and for which fishing is a key sector. Their levels of fish consumption (particularly tuna) are among the highest in the world (94 kg of tuna per capita for the Maldives(HEMMINGS, HARPER, and ZELLER 2011)) and fishing plays a vital role in their national economies.

Fishing also plays a central role in Indonesia, which is the world's second largest fishing country and second largest aquaculture producer. Indonesia's tuna catch is also the largest in the world. Fish provides more than 50% of animal protein to Indonesian consumers (FAO 2016). Sri Lanka's fishery sector is also of major economic importance and represents a food security issue. Nearly 30% of the population is involved in fisheries and seafood product processing, and fish is the main source of animal protein (FAO STAT 2013, MINISTRY OF FISHERIES RESOURCES AND AQUATIC RESOURCES DEVELOPMENT 2017).

[1] These freshwater fisheries account for 80% of Kenya's fish production and 86% of Tanzanian fish production (Ministry Of Agriculture, Livestock And Fisheries And State Department Of Fisheries 2013; Ministry Of Livestock And Fisheries Development And Fisheries Development Division 2014).

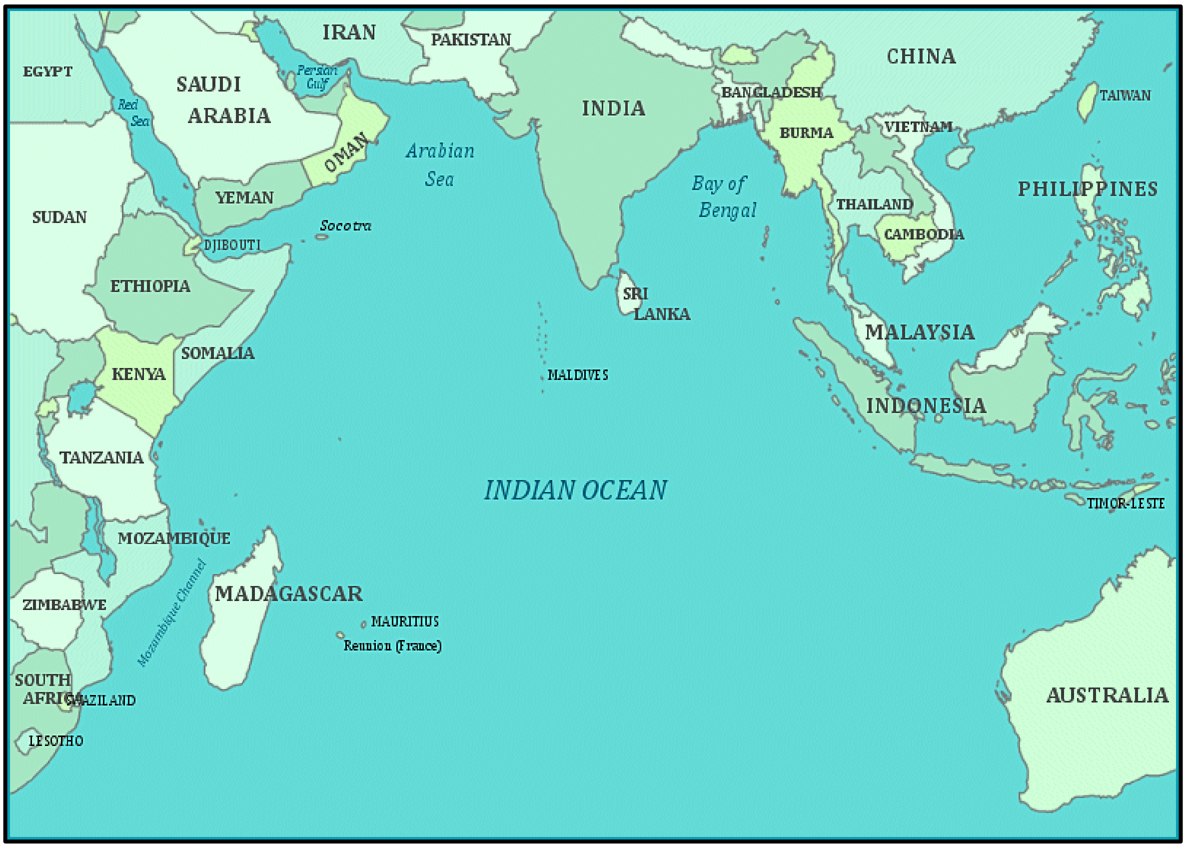



**Figure 4: Countries of the Indian Ocean**

In the Indian Ocean, tuna is one of the most important fisheries: main tuna species represent 10.4% of total catches (FIGIS 2016). Tuna fisheries represent the largest fisheries in some coastal countries, for example in Sri Lanka, the Maldives and Indonesia.

At the global level, the Indian Ocean is the second largest tuna production area, accounting for nearly 20% of world commercial tuna catches (skipjack, yellowfin, albacore, bigeye). The tuna industry in the Indian Ocean has an estimated turnover of $6.5 billion,[2] i.e. 16% of the value of the world tuna industry (MACFADYEN 2016).

## 2.1 A rapidly developing story

Tuna fisheries have been present in the Indian Ocean for several centuries. The first fisheries to develop were the artisanal fisheries of the coastal countries (STEQUERT and MARSAC 1986). The Maldivian tuna fishery is one of the oldest documented: the great Arab traveller, Ibn Battuta, told of the importance of this fishery during his voyages between 1343-1344 and 1346 (GRAY 1889).

Industrial tuna fisheries appeared in the 1950s (STEQUERT and MARSAC 1986). The longliner fleet was the first to develop (STEQUERT and MARSAC 1986). The first fleet was Japanese (1952), soon to be followed by the Taiwanese (1954) and the Koreans (1960). Together with the Maldivian pole and line fleet, this Asian longliner fishery accounted for most catches from the 1950s to the 1980s.

[2] Taking into account the total wholesale price of canned tuna, and not just the value of the drained weight of canned tuna (MACFADYEN *et al.* 2016).

During the 1970s, the first industrial surface fisheries developed (purse seine and pole and line) (STEQUERT and MARSAC 1986). Pole and line experimentation was not successful due to difficulties with bait supply (STEQUERT and MARSAC 1986). In the 1980s, the first purse seiners from Japan and the USSR carried out a number of trials, but only the arrival of European (French and Spanish) purse seiners really enabled the significant development of this fishery during the 1990s (POSEIDON *et al.*, 2014). During this period, the first canneries were established in the Western Indian Ocean: Princes Tuna (Mauritius) in 1971, Indian Ocean Tuna (Seychelles) in 1985, and Pêche et Froid Océan Indien (Madagascar) in 1991 (POSEIDON *et al.*, 2014).

A fleet of small longliners (about 25 metres long) also developed during the 1990s, targeting the European tuna steak market (POSEIDON *et al.*, 2014). At the time the main fleets came from Indonesia and the Western Indian Ocean countries (Seychelles, Réunion, Mauritius) (POSEIDON *et al.*, 2014, IOC 2016). Meanwhile the first fresh tuna processing industries were established in the Maldives and Sri Lanka (Sri Lankan company 2016, ADAM, JAUHAREE, and MILLER 2015). During the same decade, the Iranian and Pakistani gillnet fisheries underwent significant development (IOTC-2016-DATASETS-NCDB 2016).

A peak in catches was observed in 2004 and 2005. This was linked to a change in the catchability of yellowfin tuna (IRD 2016, CAMPLING 2012b): the presence of surface pelagic crustaceans in the Western Indian Ocean attracted yellowfin tuna to the surface, which facilitated their capture by purse seine (IRD 2016). Catches of yellowfin tuna thus increased substantially during this period.

Between 2009 and 2011, the development of piracy in the Somali area led to a reduction in tuna catches (Figure 5). Fleets operating in the northwest zone moved their activities or reduced their catches (GEEHAN and PIERRE 2015). The Asian longliner fleet was the most affected by this reduction in catches (GEEHAN and PIERRE 2015). Although purse seiners have also been affected by piracy, their catches did not decline so dramatically because these fleets were able to hire on-board security forces and could therefore continue to operate in areas affected by piracy (GEEHAN and PIERRE 2015). Piracy activities decreased from 2011, almost disappearing in 2012-2015 (NISHIDA and GEEHAN 2015). Catches of tropical tuna then showed signs of recovery, particularly those from distant water longliner fleets (GEEHAN and PIERRE 2015).

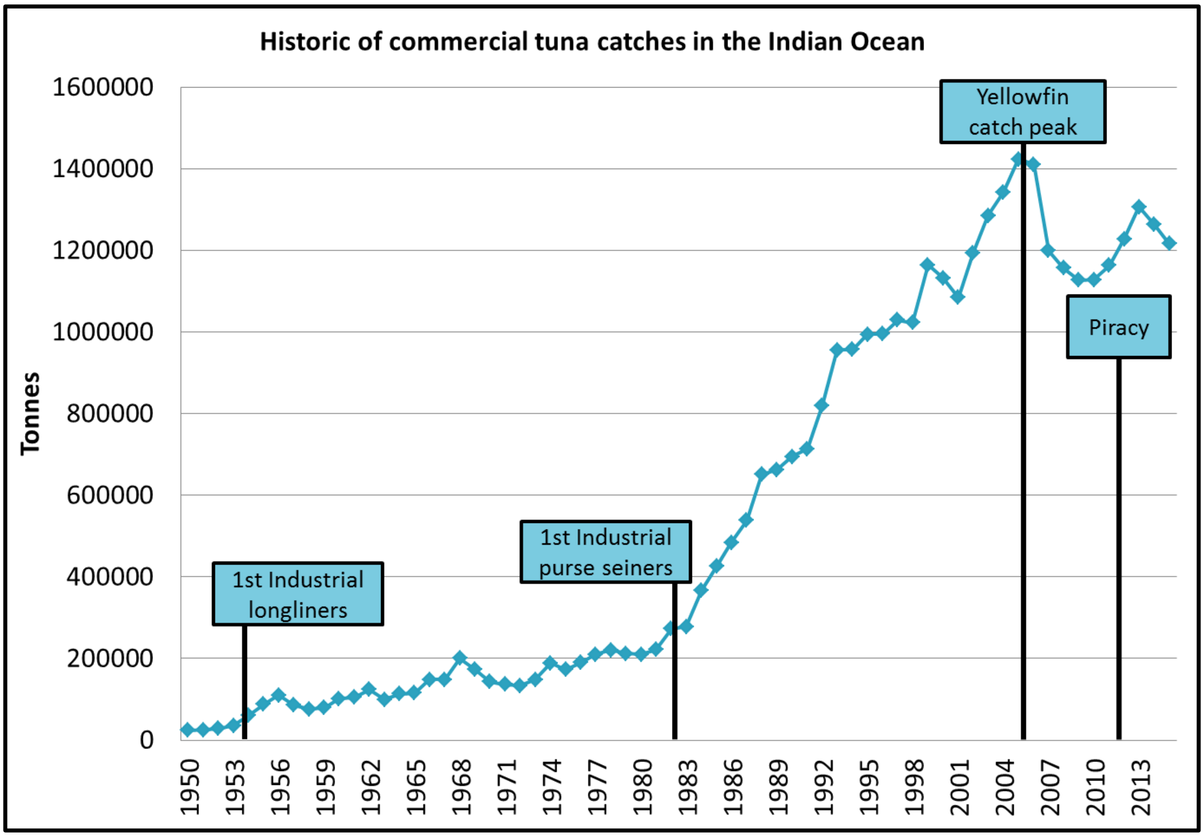



**Figure 5: Development of tuna catches in the Indian Ocean between 1950 and 2015 (Source: (IOTC-2016-DATASETS-NCDB 2016))**

## 2.2 The importance of neritic species

The tuna fisheries of the Indian Ocean exploit several species of tuna (CTOI 2015):

- Tropical tuna (bigeye, skipjack, yellowfin) and albacore (temperate tuna) are caught both by industrial and artisanal fisheries on the high seas, and in the exclusive economic zones (EEZs) of coastal countries. These species mainly supply the export industries and some local markets in the case of skipjack tuna;
- Neritic tuna (longtail, bullet, frigate, kawakawa) are species that live closer to the continental shelf, and around the islands and archipelagos, which do not undertake transoceanic migrations (FAO 1995). These species are exclusively caught by the artisanal fleets of coastal countries in the EEZs. In the Indian Ocean, catches of neritic species have become increasingly important in recent years. These tuna mainly supply local markets (IOTC 2015).

Unlike other tuna fishing basins, catches of neritic tunas represent a significant proportion of total tuna catches in the Indian Ocean. Thus, the third most caught species, after skipjack and yellowfin, is longtail tuna (13% of catches). Kawakawa is the fourth most caught species with 12% of catches, while bigeye accounts for only 7% of catches and albacore 3% of catches (Figure 6).

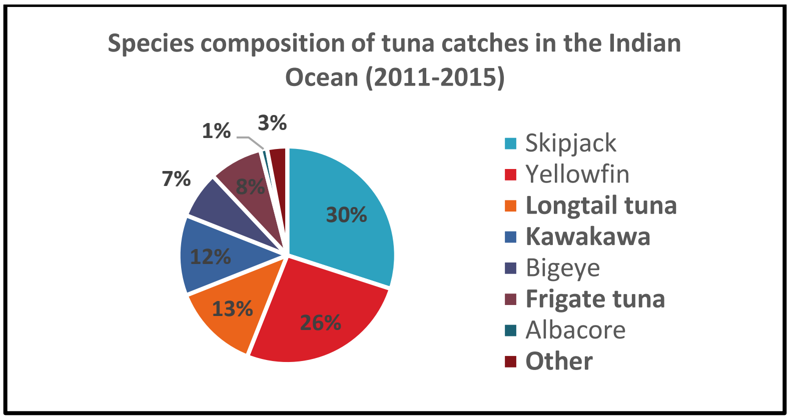



**Figure 6: Species composition of tuna catches in the Indian Ocean over the period 2011-2015 (neritic tunas are indicated in bold) (Source: (IOTC-2016-DATASETS-NCDB 2016))**

These neritic tunas are mainly caught by the artisanal fisheries of coastal states. Unlike tropical and temperate tuna species that are highly migratory, neritic tuna have a more limited migratory range and a more limited distribution. They are coastal species, with a distribution that is limited to national EEZs in some Eastern Indian Ocean countries (India, Indonesia, Iran, Pakistan, Sri Lanka, and Thailand) (Annex 2).

These species are of considerable importance to coastal countries. Unlike tropical tunas, neritic tunas do not enter global value chains and are rarely consumed on international markets (except for some Thai canning plants that process longtail tuna). These species are therefore exclusively consumed in local markets around the Indian Ocean and play an important role in food security.[3]

Given the significance of longtail tuna and kawakawa in terms of the total catch, we include them as commercial tuna species. **Also, in the rest of this report the term "tuna catches" refers to the following species: skipjack, yellowfin, kawakawa, longtail, bigeye and albacore.**

[3] This is the case in Indonesia for example.

## 2.3 Coastal fishing fleets are the main type of fishing fleet in the Indian Ocean: *"we have small boats but we catch big tunas"*[4]

Two types of fleets operate in the Indian Ocean:

- Industrial foreign fleets, typically with a specialization in one type of fishing gear: purse seine for Spanish, French and Korean fleets, longline for Asian fleets (Taiwan, Japan, China, Korea);
- Coastal fleets (i.e fleets from the Indian Ocean neighboring countries), that are mainly artisanal, using a wide variety of fishing gear, including gillnets, lines and small purse seines, often in combination. There are also some industrial coastal fleets: Seychellois and Mauritian purse seiners (European-owned), some Iranian gillnetters and many Indonesian longliners, all of which fall under the category of industrial vessels.

These coastal fleets are responsible for a significant volume of catches and constitute the main fleets operating in the Indian Ocean (Figure 7). They thus account for 76% of the total catches of the Indian Ocean over the period 2011-2015 (IOTC-2016-DATASETS-NCDB 2016).

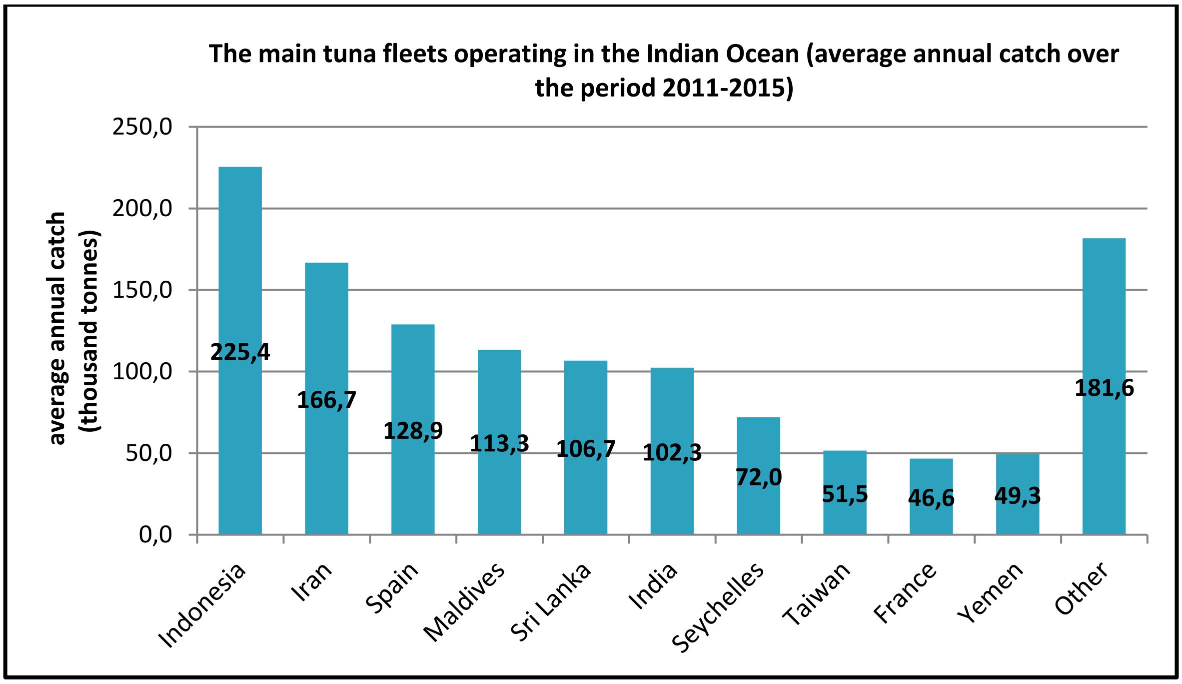



**Figure 7: Main tuna fleets operating in the Indian Ocean over the period 2011-2015 (Source : (IOTC-2016-DATASETS-NCDB 2016))**

Indonesia is the main fishing country accounting for 19% of catches (Figure 7). Iran comes in second with 13% of catches, and Spain is in third position, representing the predominant industrial fishing fleet, with 11% of catches.

[4] Comment by a coastal State representative at the IOTC plenary session in 2017.

These coastal tuna fleets are essentially artisanal: 81% of their catches come from artisanal fishing units. These artisanal fishing units[5] are defined by the IOTC as vessels of less than 24 metres operating only in coastal State EEZs (MORENO and HERRERA 2013). Unlike other ocean basins, these artisanal fleets are responsible for a significant volume of tuna catches. If we only consider tropical tuna catches[6], then artisanal fisheries account for around half (52%) of the catches over the period 2011-2015 (IOTC-2016-DATASETS-NCDB 2016).

### *2.3.1 Variety of artisanal fishing gear in use*

Artisanal fishing units operating in the Indian Ocean are characterized by the wide variety of fishing gear used. In terms of catch volumes, gillnets represent the main fishing gear used by these artisanal fisheries (Figure 8). Line fishing is in second place, followed by purse seine, and pole and line.

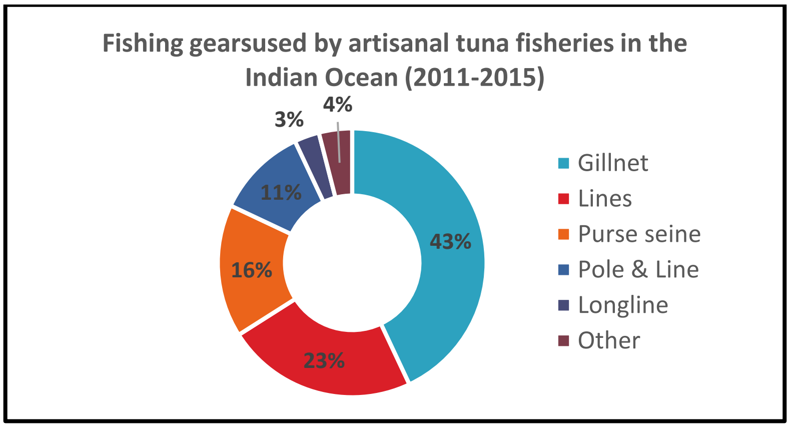



**Figure 8: The fishing gear used by the artisanal tuna fisheries of the Indian Ocean over the period 2011-2015 (Source: (IOTC-2016-DATASETS-NCDB 2016))**

#### *Gillnets, a feature of the Indian Ocean*

The Indian Ocean gillnetter fleet is unique in the world in terms of its catch level (FONTENEAU 2011). The main gillnetter fleets are from Iran (40% of catches) and Sri Lanka (17%) (IOTC-2016-DATASETS-NCDB 2016), followed by Pakistan (11%) and Indonesia (9%). Although considered as artisanal by the IOTC, some of these fleets operate on the high seas: nearly half of the catches of the Iranian fleet are thus made outside of the Iranian EEZ (Iran Fisheries Organization 2016, IFO 2017).
These gillnetters do not have on-board freezers and catches are kept fresh under ice. Catches are dominated by neritic tunas: longtail and kawakawa make up 54% of total catches (IOTC-2016-DATASETS-NCDB 2016).

#### *Lines, the second most predominant fishing gear of artisanal fishers*

The main line fishing fleets are from Indonesia (36% of catches), Maldives (18%) and Yemen (16%) (IOTC-2016-DATASETS-NCDB 2016). These line fisheries mainly target large yellowfin tuna. Catches are dominated by yellowfin and skipjack tuna and are chilled on-board.

[5] It should be noted that there is no universal definition of the term “artisanal” within the international community, as the term encompasses different realities in each country (CACAUD 2016).
[6] Yellowfin, skipjack, bigeye tuna.

### *Pole and line, a Maldivian specialty*

The main pole and line fleet is the Maldivian fleet (80% of catches), although the west coast of India, Sri Lanka and Indonesia[7] have similar fleets. These are the only commercial pole and line fleets in the Indian Ocean due to the shortage of appropriate small fish/bait throughout the region (POSEIDON *et al.*, 2014). The catch is kept on-board under ice and is mainly composed of skipjack tuna. In the Maldives, pole and line boats operate around anchored FADs.

**Anchored and drifting FADs**

Fish aggregating devices (FADs) are floating objects placed in the water around which tuna and pelagic species gather (sea bream, mahi-mahi, mackerels, marlins). The two types of FAD are distinguished by the way they move and their ownership: anchored FADs and drifting FADs (ANON 2012):

- **Anchored FADs** are fixed buoys located along the coastline. These FADs are mainly used by artisanal fisheries that employ various fishing gears: lines, artisanal purse seine, handlines, etc. These FADs are generally deployed by the public authorities responsible for fisheries management. In the Indian Ocean, anchored FADs are present in Mauritius, Reunion, Indonesia and the Maldives.

- **Drifting FADs** are freely drifting buoys equipped with echo sounders and GPS beacons that provide information on location and the level of biomass present under a buoy. These buoys are deployed by fishing companies far from the coast. Globally, it is estimated that 40% of total tuna catches are made using these drifting FADs.

[7] Indonesia is the world's second largest pole and line tuna fishery, but most catches of Indonesian pole and line boats come from the Pacific coast (AP2HI 2016).

### *2.3.2 Fisheries contribute significantly to coastal economies*

Most of tuna fishers in the Indian Ocean are artisanal fishers. Far from being homogeneous, these artisanal tuna fisheries differ from one another in terms of fishing gears, operational zones (coastal or remote), catch destinations (local or export market) and the impacts on tuna resources and ecosystems. With exception mentioned above of Iranian and Sri Lankan fleets, these artisanal fleets operate most exclusively in EEZs and are solely owned by national interests. These fisheries are of considerable socio-economic importance, especially for coastal populations. Artisanal fisheries are thus a major employment source, with an employment/landed tonnes ratio that is much greater than that of industrial fisheries (Table 2). Artisanal fishing vessels also represent the main fishing fleet of the Indian Ocean, far outnumbering industrial vessels.

**Table 2: The crew/landed tonnes ratio of selected fleets operating in the Indian Ocean (Source: LECOMTE.M)**

| Type of vessel | Ratio of crew / landed tonne per year per vessel | Ex-vessel value/crew (dollars) |
|---|---|---|
| French industrial purse seiner | 0.006 crew / tonne | 272 500 $/crew |
| Japanese industrial longliner | 0.09 crew / tonne | 75 349 $/crew |
| Maldivian Baitboat | 0.18crew / tonne | 27 271 $/crew |
| Sri Lankan longliner | 0.53 crew / tonne | 11 003 $/crew |
| Iranian gillnetter | 0,96 crew / tonne | 2 592 $/crew |

This strong contribution to employment is also reflected in the rest of the value chain, since artisanal fisheries are associated with a large number of middlemen and artisanal processors. Income and profits generated from the sale and processing of these catches generally remain in the national territory. These fisheries generate little waste and a significant part of the catch is consumed by the national populations and contributes significantly to the food security of the populations of the coastal areas.

## 2.4 Foreign industrial fleets operating under a fishing agreement

### *2.4.1 Industrial fishing gear: purse seine and longline*

Industrial fleets in the Indian Ocean are vessels over 24 metres in length and/or are vessels that operate on the high seas. Unlike artisanal fleets, industrial fleets use a single type of gear and cannot easily change fishing gear. The main fishing gears used by industrial fleets in the Indian Ocean are purse seine (60% of catches) and longline (31% of catches) (Figure 9).

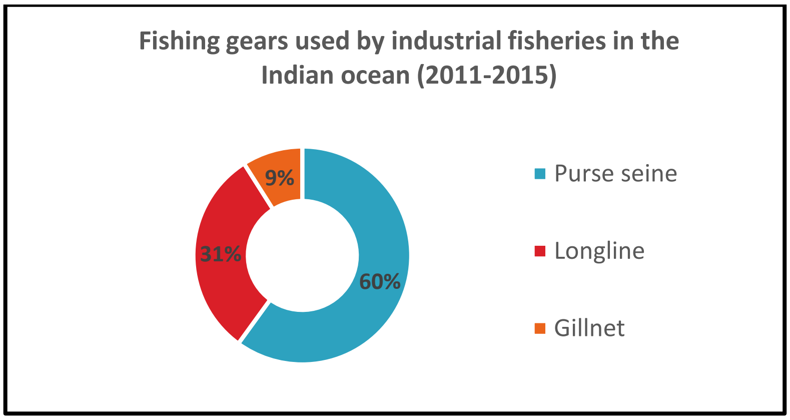



**Figure 9: Fishing gear used by industrial tuna fleets over the period 2011-2015 (Source: (IOTC-2016-DATASETS-NCDB 2016))**

***Purse seine: two distinct fishing strategies depending on the usage intensity of drifting FADs***

The main fleets of industrial purse seiners are from Spain, the Seychelles (fleet funded by Spanish capital), France, Korea and Mauritius (funded by French capital). This industrial fleet includes vessels between 80 and 100 metres with a capacity ranging from 1,000 to 2,500 gross tonnage (GT). These industrial tuna purse seiners target skipjack and yellowfin tuna and operate mainly using drifting FADs: in 2015, 72% of their catches in the Indian Ocean involved the use of FADs (SFA 2016). There is a distinction between an intensive FAD fishing strategy and a mixed strategy that combines FADs and free school fishing (COFREPECHE *et al.*, 2015). This latter strategy is characteristic of the French fleet and some Spanish vessels, while the Seychellois fleet (Spanish-owned) and the majority of the Spanish fleet mainly use the FAD intensive method (CAMPLING 2012a).

The FAD intensive strategy is a volume strategy: the objective of the fleets is to deploy a large number of FADs to maximize the volume of tuna caught. Tunas caught under FAD's are mostly skipjack and juveniles of yellowfin and bigeye of low commercial value (because of their small size). Fleets using this strategy are typically high capacity vessels (between 2,500 and 3,000 GT). These fleets have also invested in supply vessels (also called auxiliary ships). These vessels are not equipped with fishing gear but assist one or more fishing vessels in the deployment and collection of FADs and in the identification of the most successful FADs (ASSAN *et al.*, 2015). The use of these supply vessels allows fleets to increase the number of FADs deployed[8] and frees up time to assess and manage these FADs. It has been estimated that a boat with a supply vessel can increase its daily catch yield by 10 tonnes compared to a purse seine vessel without such support (ORTHONGEL 2017). In 2015, the Spanish fleet had 17 supply vessels and the Seychellois fleet had 13 (SFA 2016). In addition, purse seine fleets that

[8] It is estimated that a skipper of a tuna purse seiner can manage between 300 and 350 FADs (ORTHONGEL 2017).

operate an intensive FAD strategy use highly sophisticated buoys, including echo sounders and GPS. The size of the purse seiner and the high level of investment required for the deployment of such FADs means that these fishing fleets are locked into maximizing catch volumes so that the invested capital can be recouped.

The free school fishing strategy targets large yellowfin tuna,[9] which have a higher market value on the final markets. This strategy aims to maximize the catch value through the targeting of higher market value species. Shipowners that opt for this strategy typically comprise small vessels and a limited number of supply vessels: in 2015, the French fleet had only one supply vessel (SFA 2016). Until recently, this fleet also deployed a low number of FADs because all French vessels voluntarily limited usage to 250 FADs per ship. Beyond historical reasons and market preference that underlie this mixed strategy (the French market being a major yellowfin consumer), some consider that it is also a result of the reluctance of the main French shipowner (CFTO) to make the necessary investment to launch a FAD intensive strategy.

***Longline: the development of fresh-longliners that store catches on ice***

The longliner fleet operating in the Indian Ocean can be divided into several groups depending on the species targeted and how the catch is preserved (POSEIDON *et al.* 2014; MORENO and HERRERA 2013; COI 2016):

- Asian freezer longliners targeting bigeye tuna (Taiwan, Seychelles (Taiwanese funded), Japan) and yellowfin tuna (Japan);
- Longliners from Indonesia and Sri Lanka that target mainly yellowfin tuna, which preserve their catches with ice;
- Longliners from Reunion Island, Seychelles and Mauritius that target swordfish and tuna, which preserve their catches with ice.

The longline fleet landing fresh tuna has grown significantly in recent years (MORENO and HERRERA 2013). Longline fishing is a small-scale, low-tech fishing sector. This type of fishing is thus accessible and lends itself to the rapid development of industrial fishing chains (ADAMS 2012). Many countries in the Western Indian Ocean are seeking to develop longliner fleets to target the European market for fresh tuna (COI 2016).

[9] The yellowfin tuna in free schools are larger than those that gather around FADs.

### *2.4.2 Fishing rights and port expenditure as a contribution to the economies of coastal States*

Distant water industrial fishing fleets operate on the high seas and in the EEZs of coastal states in the Indian Ocean. To operate in national EEZs, these fleets must pay coastal States for the right to exploit the fishery resources contained within a particular EEZ. Not all coastal states in the Indian Ocean allow access to their EEZs. For example, the Maldives, Indonesia and Sri Lanka have banned foreign fleets from their EEZs.

In countries that permit the exploitation of fishery resources by foreign fleets, access to a country's fishing areas to catch tuna and related species may be granted through several mechanisms that are exclusive and non-cumulative (European Commission 2016; POSEIDON *et al.* 2014; CHABOUD 2013):

- Public agreements between two countries in the region, or between a coastal country and a distant fishing nation;
- Fisheries Partnership Agreements (FPAs) negotiated and agreed between the European Union (EU) and coastal States;
- Private trade agreements, reached by mutual agreement between countries and fishing companies, with or without the formation of a joint venture. These agreements are essential for access to EEZs in countries that have not established public agreements;
- Foreign fleets may change the flag under which they sail to use that of a coastal State[10] (which is the case for the Seychellois purse seiner fleet funded by Spanish capital, along with the Seychellois longline fleet funded by Taiwanese capital or the Mauritian purse seine fleet with French capital, although Mauritius is not a tuna-rich EEZ) or there can be "joint ventures" between companies in coastal States and foreign investors.

These public trade agreements and the EU's FPAs are a source of significant revenue for the coastal States of the Indian Ocean, particularly those in the west, which host the European purse seine fleet (Comoros, Kenya, Tanzania, Madagascar, Mauritius, Seychelles). Regarding the European FPAs, coastal States also benefit from a specific financial contribution dedicated to sectoral support, which consists of a fund used independently by countries to strengthen the capacities of the fisheries sector (POSEIDON *et al.* 2014).

Beyond this payment to access resources, foreign industrial fleets also contribute significantly to the economies of coastal States through the port expenditure of fleets (Mauritius, Seychelles). When industrial fleet catches are processed in the processing units of coastal States (Madagascar, Mauritius, Seychelles) they also contribute to the creation of local value added and, where the products are exported, to the trade balance between States.

[10] The practice of using flags of convenience.

## 2.5 Two fishing areas for two distinct development strategies

The Indian Ocean is divided into two fishing zones: the western zone, which corresponds to FAO Area 51 and the eastern zone, which corresponds to FAO Area 57.

Most of the catch is obtained from the western zone (Figure 10). The Iranian fleets (20% of catches) and the European one (22% of catches) dominate the area (IOTC-2016-DATASETS-NCDB 2016). The main fishing gear used is purse seine (35% of catches), followed by gillnets (31% of catches) (IOTC-2016-DATASETS-NCDB 2016). Catches are almost equally distributed between industrial and artisanal fleets (IOTC-2016-DATASETS-NCDB 2016). Yellowfin tuna is the main species caught (36%) followed by skipjack tuna (30%) (IOTC-2016-DATASETS-NCDB 2016). In this area, States typically seek to exploit their tuna resources by allowing foreign fleets to access their EEZs. Fisheries in these countries target mainly demersal (Seychelles, Madagascar, Mauritius, Mozambique) or freshwater species (Kenya, Tanzania). The tuna fisheries of these States are not at present particularly developed and are mainly of the artisanal or semi-industrial type (except for the Seychellois industrial longline and purse seine fleet).

The eastern zone is dominated by artisanal coastal fleets. Indonesia and Sri Lanka are the two dominant fishing countries, accounting for 81% of catches in this area (IOTC-2016-DATASETS-NCDB 2016). Gillnets are the main gear used (26% of catches), followed by purse seine (24%) and longline (22%) (IOTC-2016-DATASETS-NCDB 2016). Skipjack is the main catch (36%) followed by yellowfin tuna (22%) (IOTC-2016-DATASETS-NCDB 2016). In this area, States typically seek to develop their tuna fisheries by only allowing their own nationals to exploit their fishery resources (Indonesia, Maldives, Sri Lanka). The tuna fisheries of these countries are among the most important in the Indian Ocean and are almost exclusively artisanal.

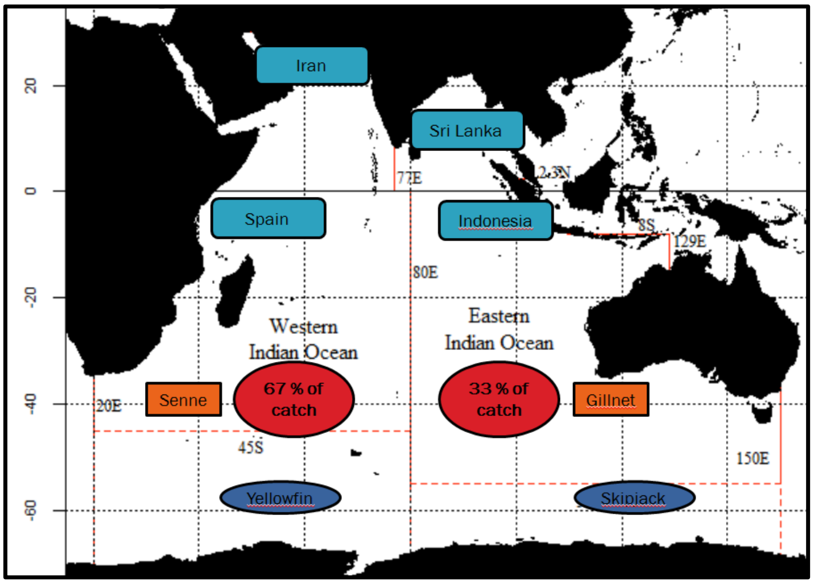



**Figure 10: Characteristics of catches in the two Indian Ocean fishing areas (Source: (CTOI 2016b))**

# 3. Indian Ocean tuna industries

This report focuses on the following value chains (Figure 11):

- Canneries in the Western Indian Ocean;
- Gillnetters supplying Iranian canneries;[11]
- Processing industries for fresh yellowfin tuna;
- Frozen tuna market for sashimi supplied by freezer longliners;
- MSC-certified Maldivian Pole and line tuna [for canned and market?];
- Local markets for tuna

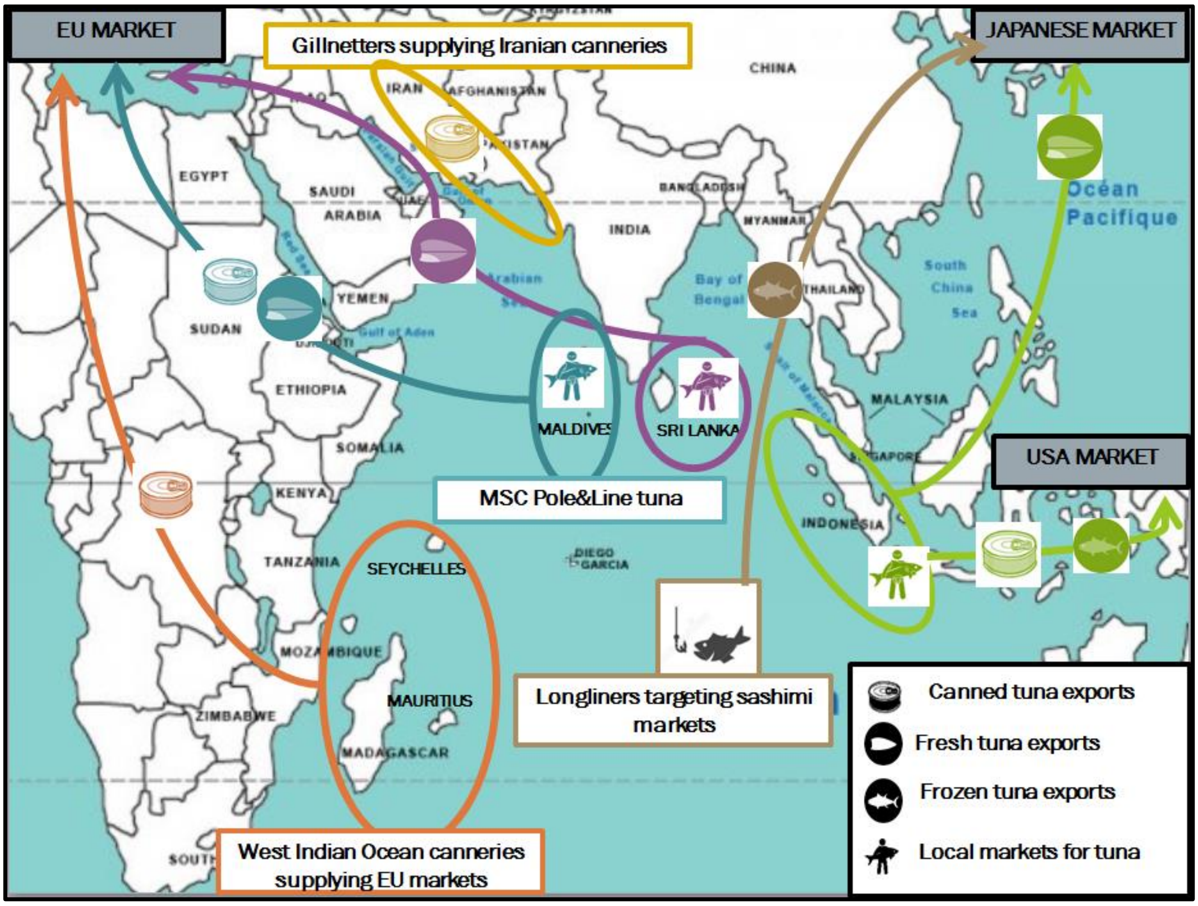
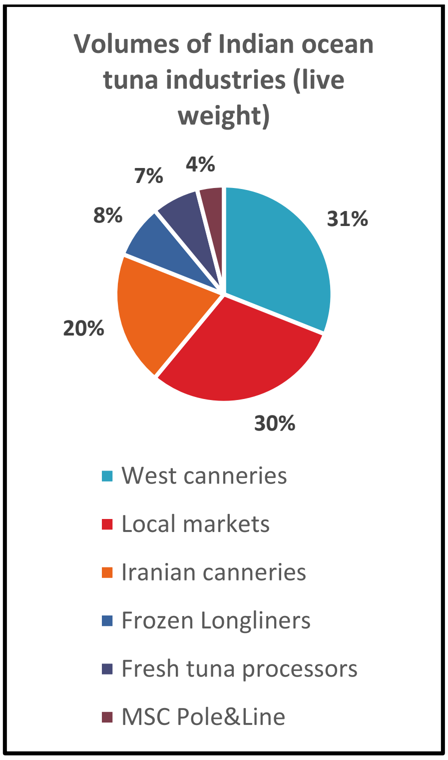



**Figure 11: Indian Ocean tuna value chains (Source: LECOMTE.M)**

[11] There is also a significant canning industry in Indonesia, which is not analysed in this report due to the complexity involved in separating the canning production derived from the Indian Ocean and that of the Pacific Ocean.



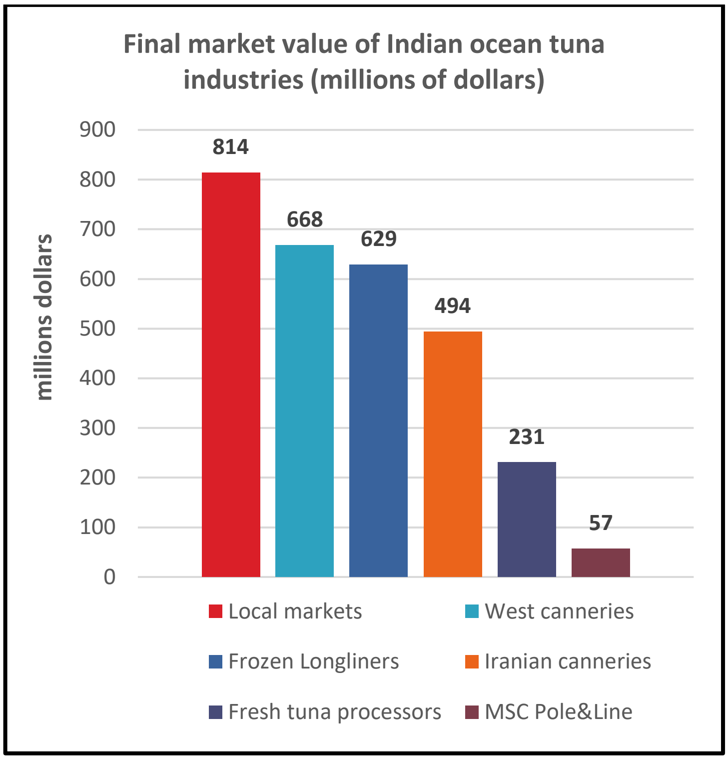




**Figure 12: Indian Ocean tuna industries in terms of volume (live weight) (left figure) and final market value revenue (right figure) (Source: (IOTC-2016-DATASETS-NCDB 2016; ITC Trade Map 2017))**

These different sectors account for nearly 77% of total Indian Ocean catches, with an estimated final sales value of 2.9 billion dollars (i.e. 44% of the total revenue of the Indian Ocean industries[12]). In terms of volume, the main industries are those of the local markets and the canneries of the Western Indian Ocean (Figure 12). In terms of final sales value, the main value chain is that of the local markets, followed by that of the Western Indian Ocean canneries. The importance of these local markets must however be put into perspective because the revenue of this industry is calculated by considering the live weight of catches, unlike other sectors where the final sales or export weights are used. Depending on the conversion coefficient adopted, the final sales value of these local markets may thus decrease.

Thus, unlike the traditional image associated with artisanal fisheries, Indian Ocean tuna artisanal fisheries make up a significant proportion of the tuna catch and are able to export their catches to international markets (sometimes with very stringent quality criteria, such as for Japanese sashimi or European fresh tuna markets).

[12] Assuming the revenue of the Indian Ocean tuna sector is 6.5 billion dollars, as established by MACFADYEN(MACFADYEN 2016)

## 3.1 Western Indian Ocean Canneries: complementarity of fishing agreements/trade agreements

Some countries in the Western Indian Ocean (Mauritius, Madagascar, Seychelles) have large canneries that process tuna landed by industrial purse seiners operating in the region. This processing activity represents the main contribution of the tuna sector to the economies of these three countries (YVERGNIAUX, GREBOVAL, and BREUIL 2016). Indeed, tuna is not traditionally targeted by the Malagasy, Mauritian and Seychellois. Their tuna fleets are of the artisanal or semi-industrial type and their landings are very low (Table 3) and make a limited contribution to the national economy. Their catches supply local markets (artisanal fleets) or export markets (semi-industrial fleets)..

**Table 3: The Malagasy, Mauritian and Seychellois tuna fisheries (Source: (COI 2016))**

| Country | Artisanal fishing | | Semi-industrial fishing | |
|---|---|---|---|---|
| | Annual tonnage (2015) | Crew number | Annual tonnage (2015) | Crew number |
| **Madagascar** | 100 t | 700 | 400 t | 84 |
| **Mauritius** | 300 t | 300 | 100 t | 60 |
| **Seychelles**[13] | / | / | 200 t | 132 |
| **TOTAL** | 400 t | 1 000 | 700 t | 276 |

The canneries of Madagascar, Mauritius and the Seychelles are thus supplied by catches from the industrial purse seine fleet operating in the Western Indian Ocean. These industrial purse seiners come from European (French and Spanish), Seychellois (funded by Spanish capital), Mauritian (funded by French capital) and Korean fleets. Although the Korean fleet lands its catches in the region's ports, these catches are not processed in the Indian Ocean canneries. Therefore, we only address here the European and Seychellois and Mauritian fleets.

These purse seine fleets follow the migratory routes of tuna. Access to the coastal states' EEZs is crucial, as nearly half of the tuna catches of the purse seine fleets are made in the EEZs of SWIO countries, particularly in the Seychellois EEZ (POSEIDON *et al.*, 2014).

To access these EEZs, industrial purse seine fleets establish fishing agreements with the coastal states' governments. The European fleet operates under fishing agreements negotiated and concluded by the European Commission. These agreements, known as Fisheries Partnership Agreements (FPAs), enable European vessels to fish tuna resources in the EEZ of third countries involved, in exchange for payment for fishing rights (European Commission 2016). These agreements are characterized by the fact that they are accompanied by a sectoral contribution consisting of a fund dedicated to the development of the fishery sectors of coastal States. In 2016 the European Union had implemented FPAs with the Seychelles, Mauritius, Madagascar and Comoros.

[13] Seychellois artisanal fisheries target only demersal species.

French and Spanish fishing vessels have also established private agreements for access to the EEZs of Kenya and Tanzania (European Commission 2016). These fishing rights represent a significant income for the countries in the area, and make up a significant proportion of the budgets of some fishery ministries in the region (Table 4).

**Table 4: Payments from European vessels for fishing access rights to the region's countries (Source: (POSEIDON *et al.* 2014; YVERGNIAUX, GREBOVAL, and BREUIL 2016))**

| Country | Annual amount (in million euros) | Contribution to national tax revenues | % catches in the EEZ | | Reference tonnage per seiner | Cost of reference tonnage |
|---|---|---|---|---|---|---|
| | | | French ships | Spanish ships | | |
| **Comoros** | 0.76 | 1.8% | 1% | 1% | 77 tonne/ purse seiner/year | 55 €/tonne |
| **Mauritius** | 0.89 | 0.1% | 4% | 1% | 106 tonne/ purse seiner/year | 35 €/tonne |
| **Madagascar** | 1.95 | 0.4% | 1% | 3-5% | 190 t/purse seiner/year | 60 €/tonne |
| **Seychelles** | 6.45 | 3.2% | 35% | 30% | 700 t tonne/ purse seiner/year | 120 €/tonne |
| **TOTAL** | 10.05 | | 41% | 36% | | |

Catches by industrial purse seiners are in the order of 290,000 tonnes per year (IOTC-2016-DATASETS-NCDB 2016). All catches by this fleet are landed in the following three ports: Victoria (Seychelles), Port Louis (Mauritius) and Diego Suarez (Madagascar) (OVPOI 2015a). The main landing port is Victoria, which accounts for 95% of the fleet's landings, while Port Louis and Diego Suarez each host 2% of landings (SFA 2016).

Within the fleet of European industrial purse seiners, there are two strategies for adding value to catches.

- "Traditional" purse seiners freeze their catches in brine tanks at -18°C and allocate most of their catch to the region's canneries.[14] These purse seiners constitute most the European fleet at present;
- Other European purse seiners freeze their catches at -40°C (SAPMER vessels) or -60°C (Echebastar vessels) for the European tuna steak markets and Asian sashimi markets. These catches are valued at higher prices than tuna for canning. The SAPMER catches are mainly processed in Mauritian processing units, while the Echebastar has its own processing plant in Spain (SAPMER 2017; Echebastar 2017).

[14] According to European Regulation (EC) No 853/2004, catches which have been frozen at -18°C in a brine bath can only be used for canning. Their consumption as fresh fish is not authorized.

The Korean fleet lands its catches in the region but does not process them within the region's canneries, as they are owned by vertically integrated groups (Silla, Donwgon, Sajo). These catches are largely sent to their Korean canneries.

Once landed in Victoria, a small proportion of the purse seine catch (24%) is processed in the Indian Ocean Tuna cannery. The majority (76%) of the landed catch is trans-shipped by refrigerated cargo ships (74% of trans-shipped catches) or by container (26% of trans-shipped catches) (SFA 2016). Cargo vessels enable large volumes of tuna to be trans-shipped in bulk, while containers allow small quantities (26 tonnes per container) to be transported. Recently, investment in a Fish Loader in Victoria has boosted the containerization of tuna for export: this allow enhancement of the catches' value and to target the demand from final markets (SPA 2016b). The shipment of tuna with container allows the export of homogeneous batches (tunas sorted by quality, species, size) that responds to specific market request. The average price of tuna exported by container is much higher than the price of bulk tuna exported by reefers. A regular bulk cargo line has been established between Victoria and Mauritius and between Victoria and Madagascar to supply canneries in both countries. These canneries receive very little direct landings and are thus dependent on these cargo ships for their supplies.

Mauritius has two canneries and two units specializing in processing tuna at -40°C and -60°C. It is currently the largest processing capacity in the Western Indian Ocean ( 105 000 tonnes annually). Madagascar's cannery is of smaller capacity and the volumes produced by this cannery are currently very limited.

Figure 13 shows the organization of this sector.

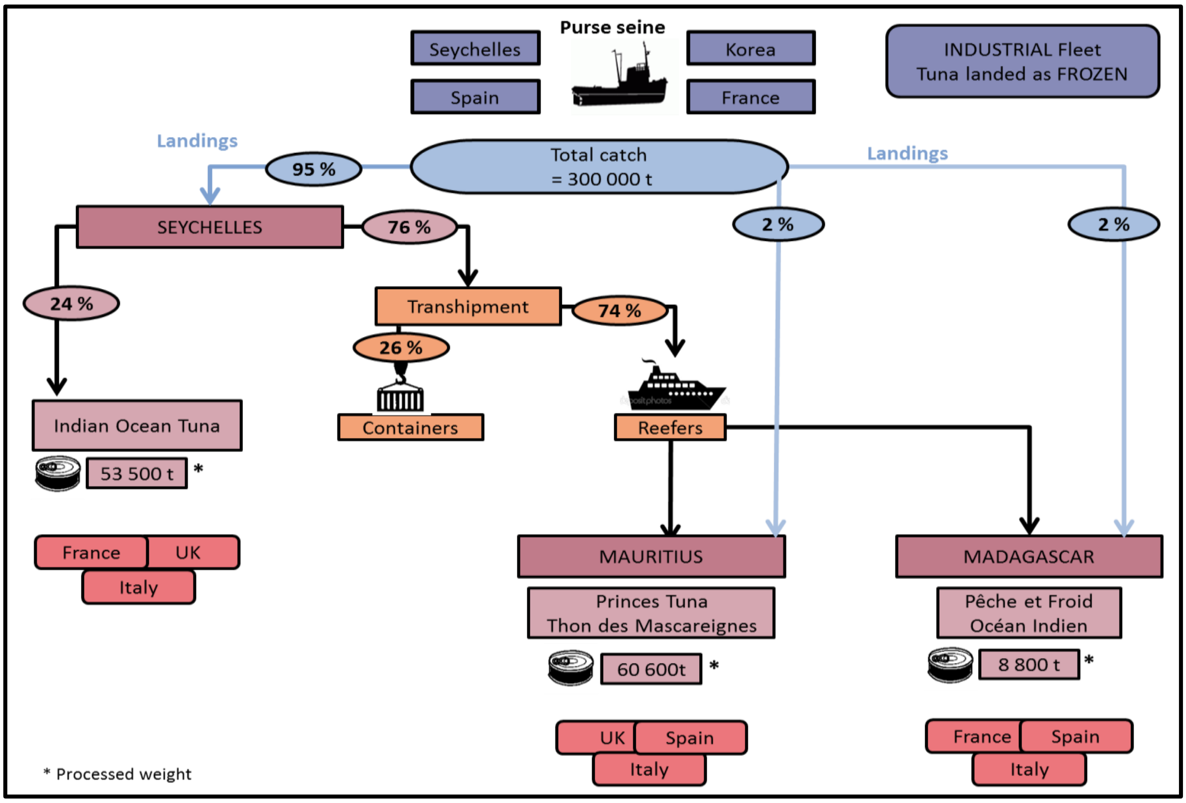


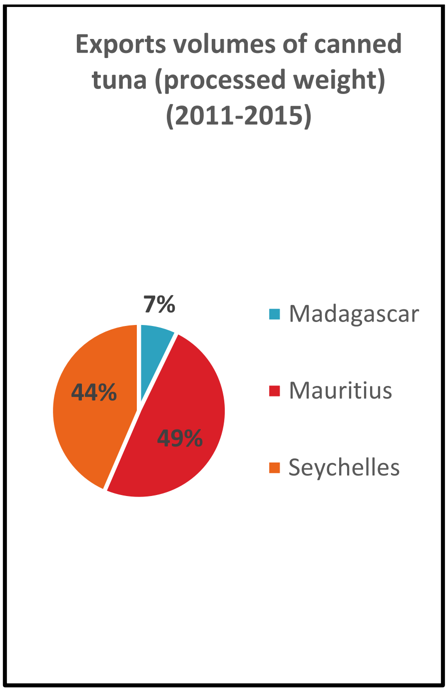

**Figure 13: The Western Indian Ocean cannery value chain (Source: LECOMTE.M from (SFA 2016; ITC Trade Map 2017))**

The majority of catches from the industrial purse seine fleet are destined for canneries in the area. These canning plants thus process nearly 70% of the European and Seychellois fleets' catches. Table 5 summarizes the main characteristics of these canneries.

**Table 5: Characteristics of the Southwest Indian Ocean canneries (Source: (POSEIDON *et al.* 2014))**

| Country | Owner | Annual raw material production capacity | Average exports 2011-2015 (processed weight) | Average unit value of exports | Markets served by volume (2011-2015) |
|---|---|---|---|---|---|
| Madagascar | Thunnus Overseas Group | 36,000 tonnes | 8,837 tonnes | $4,692/tonne | France (52%)<br>Spain (11%)<br>Italy (10%) |
| Mauritius | Princes Tuna | 50,000 tonnes | 60,581 tonnes | $4,912/tonne | United Kingdom (32 %)<br>Spain (19 %)<br>Italy (12 %) |
| | Thon des Mascareignes | 55,000 tonnes | | | |
| Seychelles | Thai Union Group-MW Brands | 100,000 tonnes | 53,502 tonnes | $6,106/tonne | France (47%)<br>United Kingdom (32%)<br>Italy (14%) |
| **TOTAL** | | 241,000 tonnes | 122,920 tonnes | $5,237/tonne | United Kingdom (30 %)<br>France (27 %)<br>Italy (13 %)<br>Spain (10 %) |

These canneries account for 6% of the global tuna canning capacity (HSU 2012). Mauritius and Seychelles rank 6th and 8th among the world's largest canned tuna exporters and the combined exports of these canneries represent 7% of the world's canning market (ITC Trade Map 2017). The cumulative value of canned exports from these three countries is $650 million (Figure 14).



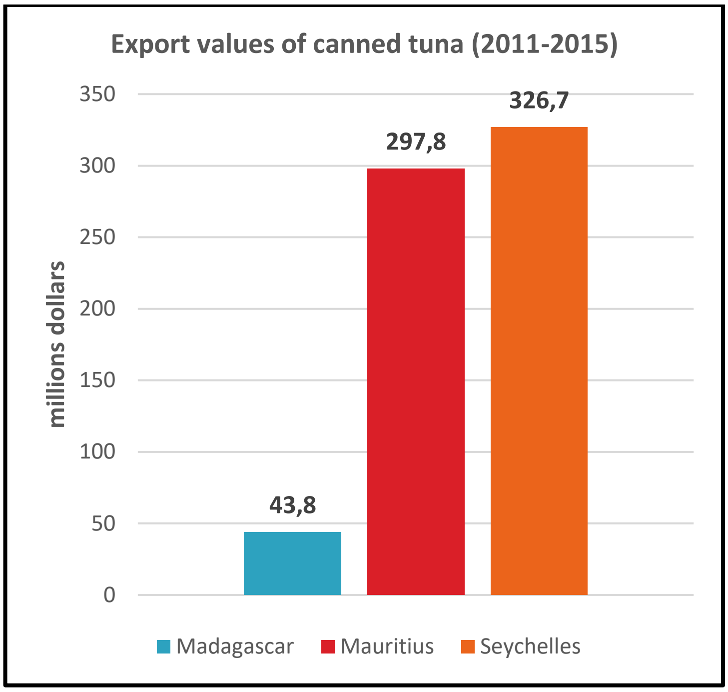




**Figure 14: Exports from canneries in the Western Indian Ocean by volume (left figure) and by value (right figure) (Source: (ITC Trade Map 2017))**

This canning industry is also associated with a by-product processing industry. The area's canneries valorize the residues from processing by the production of fishmeal, tuna oil and animal feed. These by-products account for 3.7% of the revenue of the canned industry in the Western Indian Ocean (Table 6).

**Table 6: Canning by-product industry in the Western Indian Ocean (Source: (ITC Trade Map 2017))**

| Country | Annual exports (2011-2015) | Average value of annual exports (2011-2015) (million dollars) |
|---|---|---|
| **Madagascar** | 1,600 t[15] | 1 |
| **Mauritius** | 10,513 t | 12.6 |
| **Seychelles** | 10,158 t | 11.1 |
| **TOTAL** | 22,271 t | 24.7 |

The main markets served by these canneries are: France (27% of exports' volume), the United Kingdom (27%), Spain (11%) and Italy (10%). These four markets account for 75% of exported volumes and 84% of the value exported. Canneries in this region are thus highly dependent on European markets and are likely to be affected by an external shock in these markets.

This polarization towards European markets is directly linked to the way in which the canneries are capitalized. These canneries belong to large vertically integrated groups that own the main can brands on the European markets. The export destination corresponds to the markets served by the brand of the group owning the cannery. The Seychellois cannery is owned by Thaï Union/MW Brands, the world

[15] Since export data are unavailable for by-products from the Malagasy cannery, we have estimated the volumes from the conversion coefficients.

leader in canned tuna: one in every five tins of tuna in the world derives from this group. It owns the leading brands o the French, British and Italian market namely, *Petit Navire John West* and *Mareblu*. Mauritian canneries produce the *Princes Tuna* brand, one of the most recognized brands on the British market. Finally, the PFOI cannery in Madagascar produces its own *Pompon rouge* brand, which is distributed on the French market, mainly to the catering sector.

These canneries are thus extremely dependent on preferential access to European markets. Exports from these canning plants have duty-free access to European markets under the Economic Partnership Agreements with the European Union. Under this preferential tariff arrangement, exports of canned tuna from the SWIO countries are exempt from the 24% tariff rate. However, to benefit from these tariff exemptions, canned exports from SWIO countries are subject to a preferential agreement (commonly known as the "rule of origin"). The rules are as follows (European Commission 2014):

- Tuna must be caught in territorial waters (12 nautical miles from the coastline) of the beneficiary countries;
- If tuna is caught outside territorial waters (i.e. in the EEZs or on the high seas), it may be considered as originating from the beneficiary country in question (or from the EU) if: the vessel is registered or listed in the beneficiary country and flies its flag (or that of an EU Member State) and meets one of the following conditions: (a) at least 50% of the vessel belongs to a national of the beneficiary country or a Member State, or (b) it belongs to a company - whose head office and principal place of business is situated in the beneficiary country or in a Member State - which is at least 50% owned by the beneficiary country, by a Member State, or by public authorities or the nationals of the beneficiary country or of a Member State;
- This tuna must then be processed in canneries located in the territory of the beneficiary country.

This rule of origin restricts the Western Indian Ocean canneries in terms of their supply. Thus, their main source of originating tuna remains tuna caught by European purse seiners and purse seiners from their national fleets (i.e. Seychellois and Mauritian purse seiners). European shipowners thus benefit from a captive market for their catches, because the SWIO countries do not have enough domestic fleets to supply their canneries (CAMPLING 2015). Mauritian, Malagasy and Seychellois canneries are only allowed to process small quantities of non-originating tuna through an allowance in the rule of origin. This allowance amounts to 8,000 tonnes per year for tuna cans and 2,000 tonnes per year on tuna loins. These tonnage allowances are relatively low in comparison to the capacity of the canneries and considerably limit their supplies of non-originating tuna. In addition, since these tonnages are not allocated per country, the SWIO Canneries have to compete for their supplies of non-originating tuna (COFREPECHE *et al.*, 2016). This rule of origin is particularly limiting for canneries seeking to obtain MSC-labelled tuna to produce MSC-labelled tins. Indeed, catches by European, Seychellois and Mauritian purse seiners are not MSC certified. Therefore, to offer MSC-labelled products, canneries must rely on imports of certified tuna from other fisheries, the main source being fisheries from countries in the Western Pacific that are members of the Nauru Agreement[16] (Princes Tuna 2016). The

[16] The member countries of the Nauru Agreement are: Kiribati, Marshall Islands, Micronesia, Palau, Papua New Guinea, Solomon Islands and Tuvalu.

rule of origin thus constrains the supply of these canneries in terms of MSC-certified tins, which is increasingly problematic given the importance of this ecolabel on European markets.

For these SWIO canneries, changes in the European preferential arrangements are key, particularly for tariff regimes affecting the Philippines and Thailand, two major can producers. Without this preferential tariff, canneries of SWIO countries would struggle to compete with South-East Asian exporters. Indeed, these countries benefit from labour,[17] water and electricity costs that are lower than those of SWIO canneries (CAMPLING and DOHERTY 2007, African Bank of Development 2014). Sea freight costs are also higher for the Seychelles and Mauritius than for Thai exporters, with an estimated difference of nearly 20% (CAMPLING and DOHERTY 2007). Finally, with the exception of the Mauritian model, the region's canneries suffer from diseconomies of scale: due to the absence of other canneries on the national territory, most of their production materials (aluminium sheets, packaging) must be imported in relatively small quantities, resulting in higher procurement costs (CAMPLING and DOHERTY 2007; African Bank of Development 2014). As a result, SWIO canneries are dependent on maintaining this preferential regime to maintain their competitiveness on the European market.

This canning industry contributes to the Malagasy, Mauritian and Seychellois economies in three ways:

- Payment of fishing access rights;
- Financial flows from industrial purse seine fleets into their port infrastructure;
- Distribution of the catches from this purse seine fleet into canneries and processing units that involve labour intensive activities (however, in Seychelles and Mauritian canneries a large proportion of the labor force employed is foreign workers).)

In the Seychelles, in particular, activities related to the landing and processing of catches from the industrial purse seine fleet are vital to the Seychellois economy. The purse seiner fleet and the associated supply vessels account for the bulk of the Port of Victoria's traffic: in 2014, this fleet accounted for half of the moorings (SPA 2016a). Expenditures for this fleet (purse seiners and supply vessels) amounted to $163 million in 2014 (SFA 2016). Nearly 1,000 port workers[18] are directly involved in the landing and handling of catches. Almost all the activities of the Seychelles Petroleum Company are linked to these fleets: 96% of the fuel expenses of the fishing fleet is related to purse seiners (SFA 2016). The Seychellois economy is largely dependent on the activities of the canneries (African Bank of Development 2014), which represents the island's largest private employer and is responsible for nearly 37% of goods export's value from the Seychelles (Table 7). These exports generate a large amount of container traffic and ensure that the Port of Victoria is on the route of container ships. This dynamism in the Port of Victoria also indirectly benefits the tourist industry, which imports a large quantity of goods to satisfy tourist demand. Canned tuna exports enable container companies to rationalize their transport operations by refilling their containers with canned tuna to bring back, thus adding to the attraction of the Port of Victoria.

The contribution of this industrial purse seiners sector is less significant for the national economies of Mauritius and Madagascar. Purse seine fleet expenditure in port infrastructure in these two countries

[17] A 2007 study estimated that hourly wages for workers were $1.90 in the Seychelles, $0.90 in Mauritius, compared to $0.65 in Thailand (CAMPLING and DOHERTY 2007).
[18] Or 2.3% of the total labour force.

is lower than in the Seychelles, but the activities of the canneries constitute almost all the income generated by the fisheries sector.

In Mauritius, purse seiners only land a small proportion of their catches; most of the tuna catch being delivered to canneries via cargo ships. However, tuna processing is the main activity of the so-called *Seafood Hub*, a centre being developed by the Mauritian government to promote seafood processing activities, particularly for tuna products. Presented as the fourth pillar of the Mauritian economy, the Seafood Hub contributes nearly 1.3% of Mauritian GDP through these tuna activities (YVERGNIAUX, GREBOVAL, and BREUIL 2016). The direct value added created by Mauritian canneries is thus the highest of the region's canning plants (Figure 15).

In Madagascar, the impact of this canning industry is noticeable on the scale of the economy of the city of Diego Suarez. The PFOI cannery and the SECREN shipyard are the main employers in the Northern region of Madagascar. The Diego Suarez salt plant, which supplies almost all the salt for the purse seine fleet's brine tanks, is also a major employer in the region. A 2016 study thus estimated that the tuna fishery accounted for 35% of the economy of the city of Diego Suarez (RAKOTOMOLALA 2017).

**Table 7: Presentation of the economic impact of the purse seine sector in the region's countries (Source: (YVERGNIAUX, GREBOVAL, and BREUIL 2016; OEC 2016; CNOI 2016; SECREN 2016))**

| Country | Number of port jobs | Number of ship repair jobs | Number of jobs in canneries | % active employment | Contribution of canned tuna exports to total exports in 2015 | Share of fishing in GDP |
|---|---|---|---|---|---|---|
| **Mauritius** | 10,000 | 400 | 6,000 | 2.6% | 8.7% | 1.3% |
| **Madagascar** | 1,000 | 700 | 1,500 | 0.01% | 1.6% | 5.9% |
| **Seychelles** | 1,000 | / | 2,500 | 7% | 37% | 19.7% |

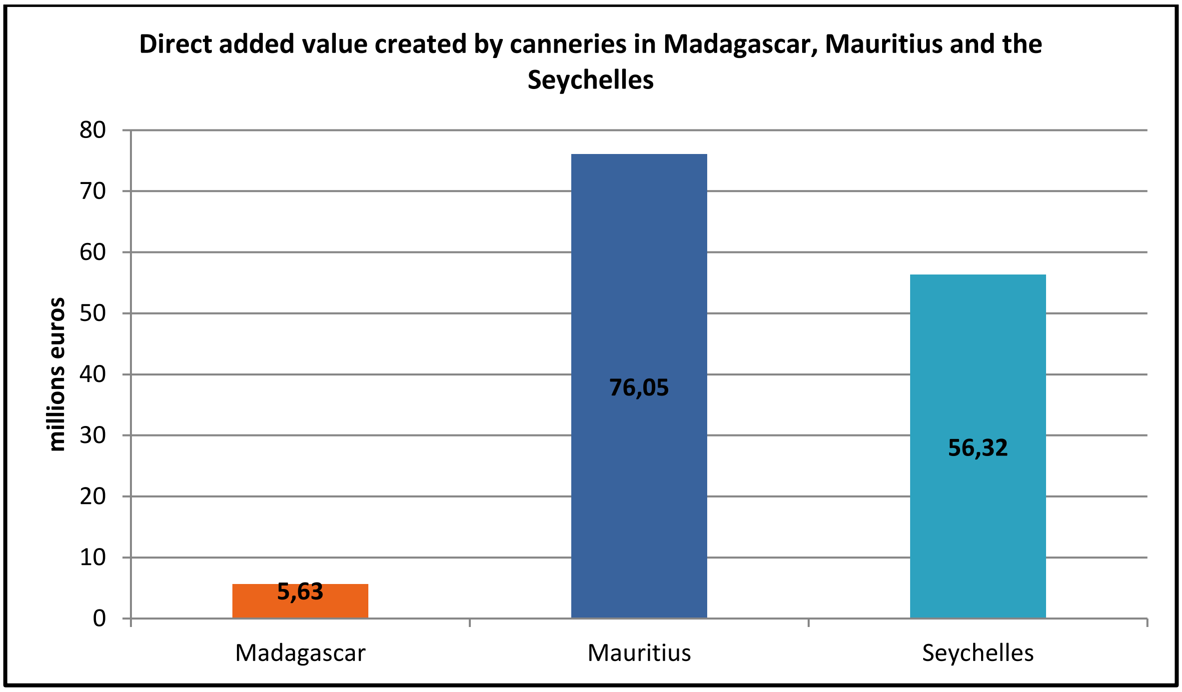



**Figure 15: Direct value added created by tuna canneries in Madagascar, Mauritius and the Seychelles (Source: (YVERGNIAUX, GREBOVAL, and BREUIL 2016))**

## 3.2 Local markets: tuna as a food security issue

The Indian Ocean is also characterized by the importance of tuna consumption within coastal states. The main markets are Indonesia, Comoros, Maldives and Sri Lanka. The tuna consumed in these markets is landed by artisanal fishing units, using nets (Sri Lanka), artisanal purse seine (Indonesia), pole and line (Maldives) or various types of lines (Comoros) (Figure 16). In Indonesia, the fleet of artisanal purse seiners using anchored FADs mainly supply the local market, while in Sri Lanka all catches of the tuna gillnet fleets are either processed into dried tuna or consumed fresh. In the Maldives, almost half of the catch of the pole and line vessels (or bait-boats) are consumed by the atoll populations, while the catches of the Comorian artisanal fleet are only consumed locally.

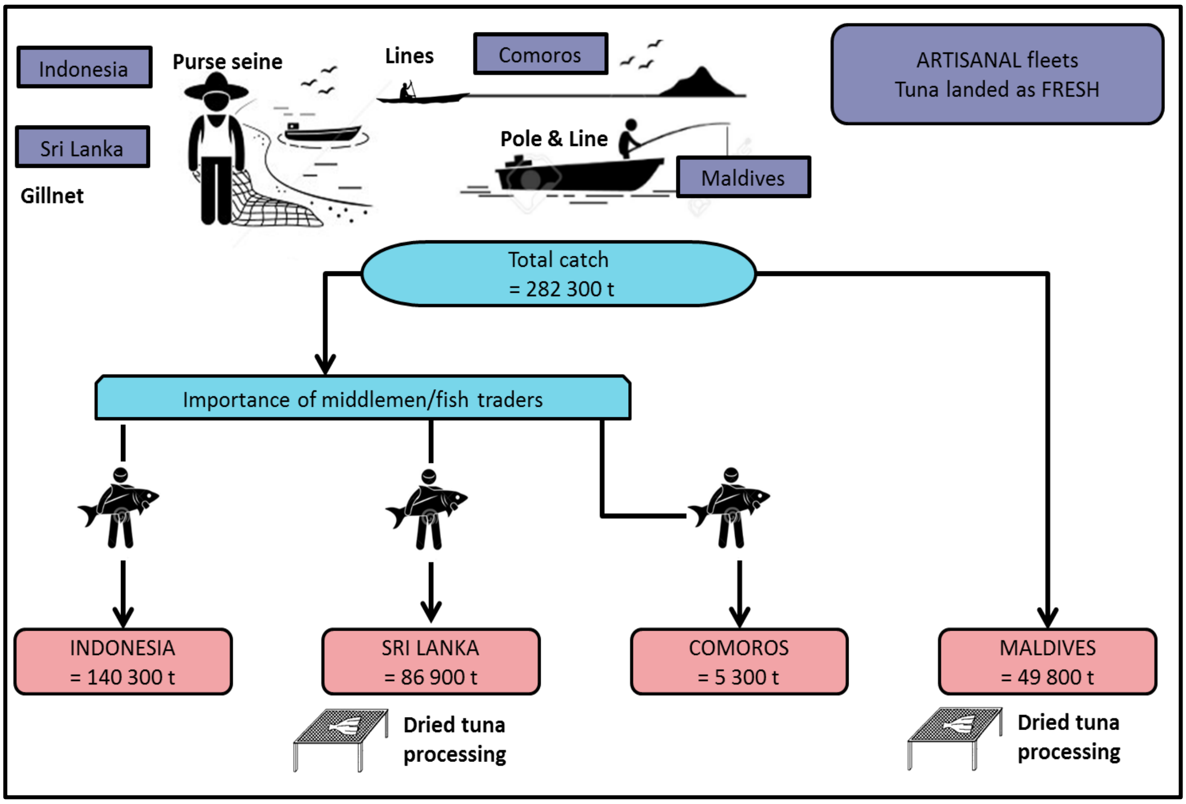



**Figure 16: The value chain of local markets for Indian Ocean tuna (Source: LECOMTE.M from (MFARD 2016; MAHAMOUD 2013; POSEIDON *et al.* 2014))**

The volumes destined for these markets are substantial: it is estimated that about 282,250 tonnes of tuna[19] are consumed annually within these countries, i.e. 56% of world tuna volumes for local consumption (i.e 500 000 tonnes). These local markets in the Indian Ocean are also valuable markets. The final value of these markets is estimated at almost $814 million, with Indonesia representing the largest market (Figure 17). The value of tuna on these local markets is thus almost three times higher than that of tuna exports from processing units in these countries.

[19] In live weight

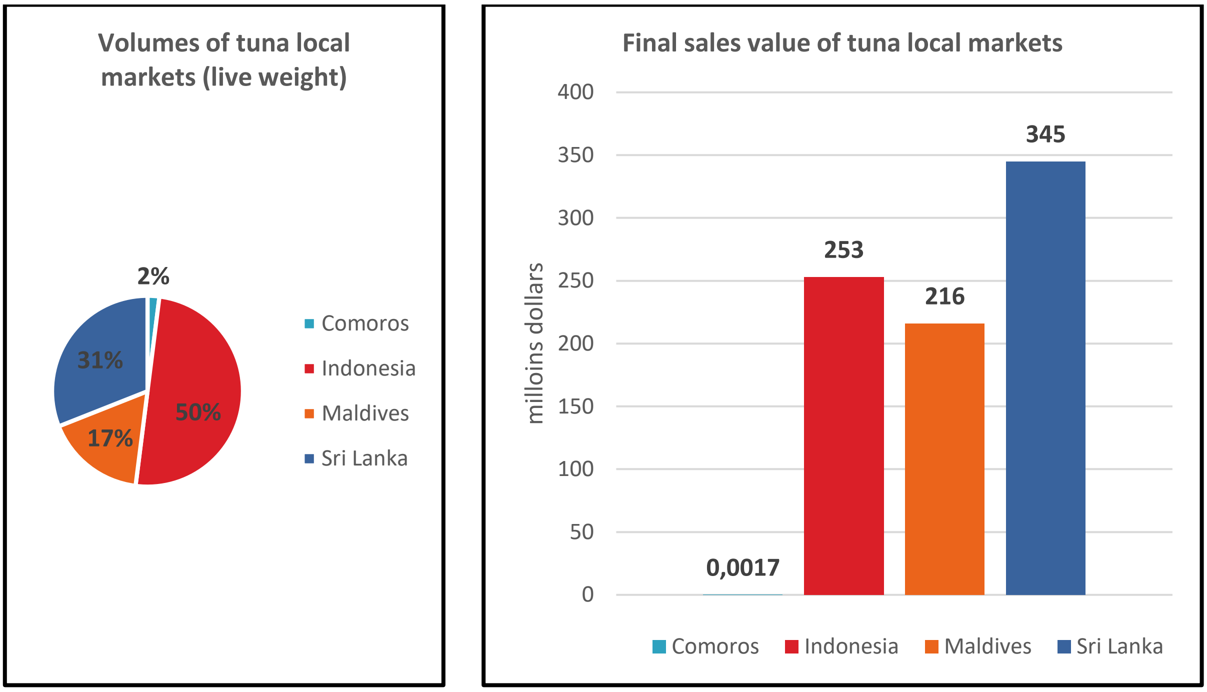



**Figure 17: Local markets for Indian Ocean tuna by volume (left figure) and final sales value (right figure) (Source: (MFARD 2016; National Bureau of Statistics 2016; MACFADYEN 2016))**

Within these local markets, neritic species have a major role. Indeed, these species are exclusively consumed on the local markets of the Indian Ocean and are paramount in terms of national food security. In these countries, pelagic fish (including tuna) are the main seafood species consumed (Figure 18). In Sri Lanka, Indonesia and the Maldives, tuna is considered to be the favourite fish of a large proportion of the population. The small size of neritic species and skipjack tuna is appealing to consumers. Within these countries, tuna species also account for a significant proportion of the protein intakes of the populations. Pelagic fish thus account for more than half of the animal protein consumed in Comoros, Sri Lanka and the Maldives (Figure 18). Maldivians are the world's largest tuna consumers with an annual per capita tuna consumption of around 140kg (SINAN 2017a). Tuna is eaten at breakfast, lunch and dinner. In Sri Lanka, fishing is considered a food security issue in a country where the majority of the population is Buddhist or Hindu and does not consume meat (MFARD 2016, National Ocean Committee 2016). On Sri Lankan market, most of the tuna is consumed in dried form (Sri Lankan company 2016).

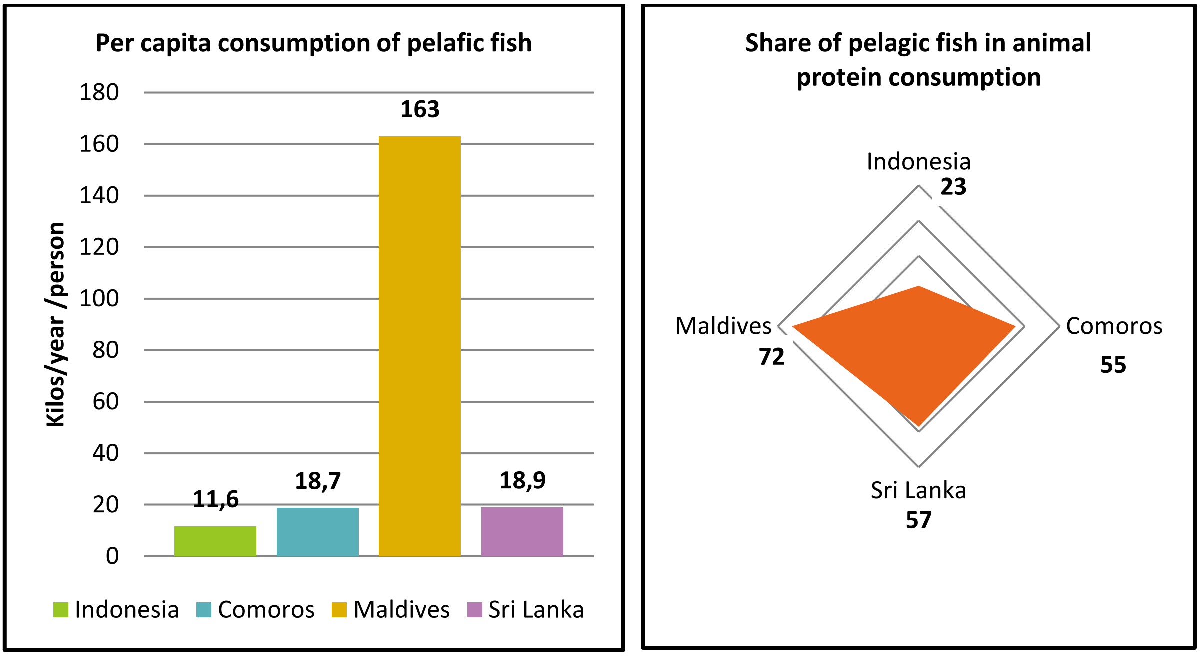



**Figure 18: Per capita consumption of pelagic fish and the share of pelagic fish in animal protein consumption in Comoros, Indonesia, the Maldives and Sri Lanka (Source: (FAO STAT 2013))**

## 3.3 Middle East gillnetters focusing on the Iranian market

Iran and Pakistan are two large fleets in the Indian Ocean. These two fleets together accounts for 16% of the catches of the main commercial types of tunas in the Indian Ocean (IOTC-2016-DATASETS-NCDB 2016).

However, these two countries are characterized by the small contribution of fisheries to the national economy. The contribution of the fisheries sector to GDP is minimal: around 0.23% for the Iranian fisheries and 1% for the Pakistani fisheries (FAO 2015, World Bank 2013). Exports of seafood products are very low and mainly consist of lightly processed products (PAKFEA 2011). Marine fishers represent less than 1% of the working population in these two countries. Iran and Pakistan are also among the countries with the lowest levels of seafood consumption worldwide: 9.8kg per capita per year for Iran and 1.9kg for Pakistan (FAO STAT 2013, WWF Pakistan 2017, Innovasjon Norge 2016).

The catches of these two fleets almost exclusively supply the Iranian canneries (Figure 19). Tuna is not consumed much in these two markets and only bycatch (except marine mammals and turtles) is sold on the local market. The Pakistani fleet thus supplies only the Iranian can market. About thirty Iranian canneries thus annually process around 200,000 tonnes (live weight), to which must be added nearly 30,000 tonnes of imported tuna. The Iranian market for canned tuna, estimated at almost 92,000 tonnes, constitutes an important market, the size of which is equivalent to that of the French market. Canned tuna is very popular on the Iranian market and is mainly sold in local bazaars at prices between $1 and $1.5 a can (IFO 2017; Innovasjon Norge 2016).

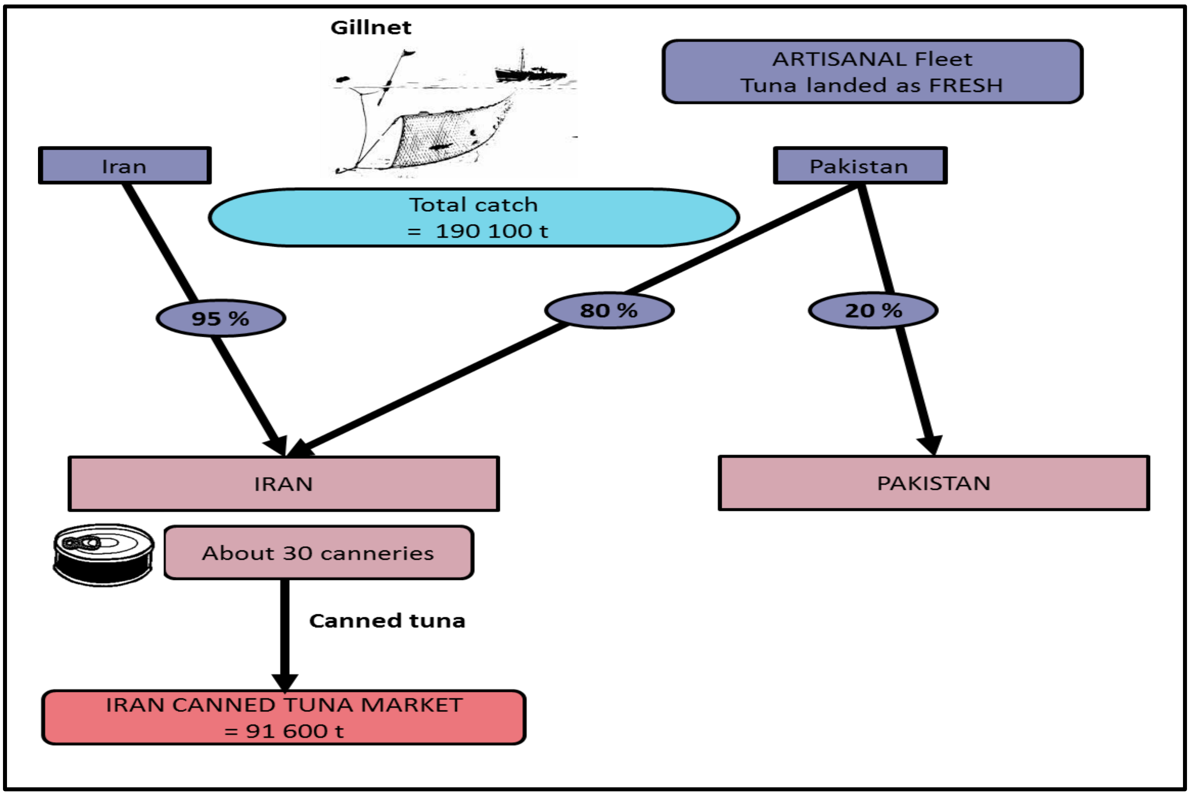



**Figure 19: The Middle East gillnet value chain (Source: LECOMTE.M d'après (IFO 2017; WWF Pakistan 2017))**

Canned products derived from the catches of gillnetters taken on their own represent a production of close to 76,000 tonnes, equating to $494 million.

Despite the significant size of landed volume, this gillnetter fleet remains poorly monitored and controlled (ARDILL, ITANO, and GILLETT 2013; WWF Pakistan 2017; IOTC-2016-DATASETS-NCDB 2016):

- Some of the Iranian and Pakistani gillnetters sail under the flags of both countries and may land their catches (either entirely or a portion) in either country;
- The gillnetter fleets are extremely heterogeneous, with some vessels smaller than 10 metres and others exceeding 40 metres in length;
- While the precise lengths of the nets remain unknown, the average length is often greater than the size limit under international regulations (2,5 km)[20], and some fleets operate with nets of up to 4km to 7km long.

These tuna fisheries are very important for the coastal populations of Iran and Pakistan. They represent the main livelihoods of coastal populations, particularly in Pakistan, where the majority of tuna fishers are migrants displaced from conflict zones in the north of the country (WWF Pakistan 2017).

Thus the progression towards the greater sustainability of these fisheries should not only be envisaged from an environmental perspective, but also from the social and economic points of view. The main way to achieve a reduction of the fishing effort is through the creation of alternative livelihoods: the creation of jobs in coastal regions would encourage fishers to engage in other sectors (WWF Pakistan 2017).

## 3.4 Industrial longliners supplying the sashimi market: a sector that depends on trans-shipping

These longliners are more than 24m long and have deep freezing capacities for ultra-low temperatures (-55°C to -60°C) (MORENO and HERRERA 2013). The main freezer longliner fleets in the Indian Ocean are from Taiwan, Japan, Seychelles (funded by Taiwanese capital) and China (Figure 20) (Appendix 2).

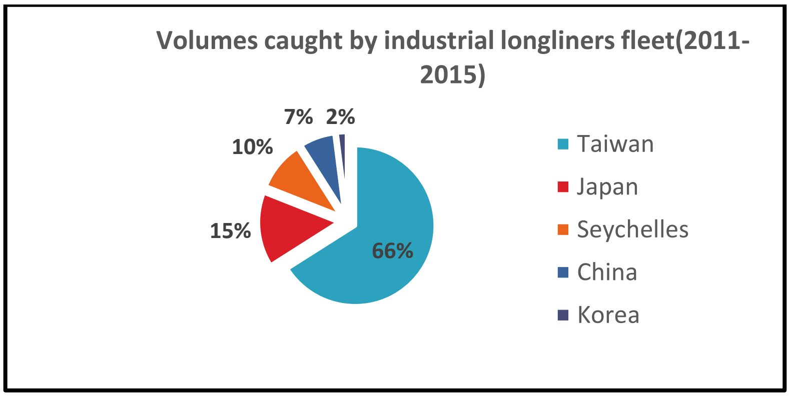



**Figure 20: Volumes caught by industrial longliner fleets over the period 2011-2015 (Source: (IOTC-2016-DATASETS-NCDB 2016))**

[20] The Convention for the prohibition of large-scale gillnetting in the South Pacific, concluded at Wellington on 24 November 1989, sets up the 2.5 km limit.(SAVINI 1990).

Fishing expeditions last from 18 months to 2 years and this fleet is characterized by the predominance of trans-shipping[21]: nearly 30% to 40% of catches are thus trans-shipped in the high seas. The remainder of the catch is landed in the ports of the region and exported to Japan in containers (MORENO and HERRERA 2013). This use of trans-shipping is justified by the high fuel costs for this fleet. The fuel-per-tonne of catch ratio is very high for longline vessels, which use nearly 1,070 litres of fuel per tonne of landed tuna (compared to 368 litres per tonne for purse seine vessels) (TYEDMERS and PARKER 2012). Thus the profitability of these fleets depends on the use of trans-shipping (MIYAKE *et al.* 2010).

Most of the catches of industrial longliners are bigeye and yellowfin tuna. Although their marketing chain is very difficult to assess, it is thought that the majority of bigeye tuna catches are destined for the Japanese sashimi market. These longline fleets are the main suppliers to the Japanese market for frozen bigeye tuna (ITC Trade Map 2017). Yellowfin tuna are destined for Thailand and Japan. Exports from Asian fleets totalled $630 million (Figure 21).

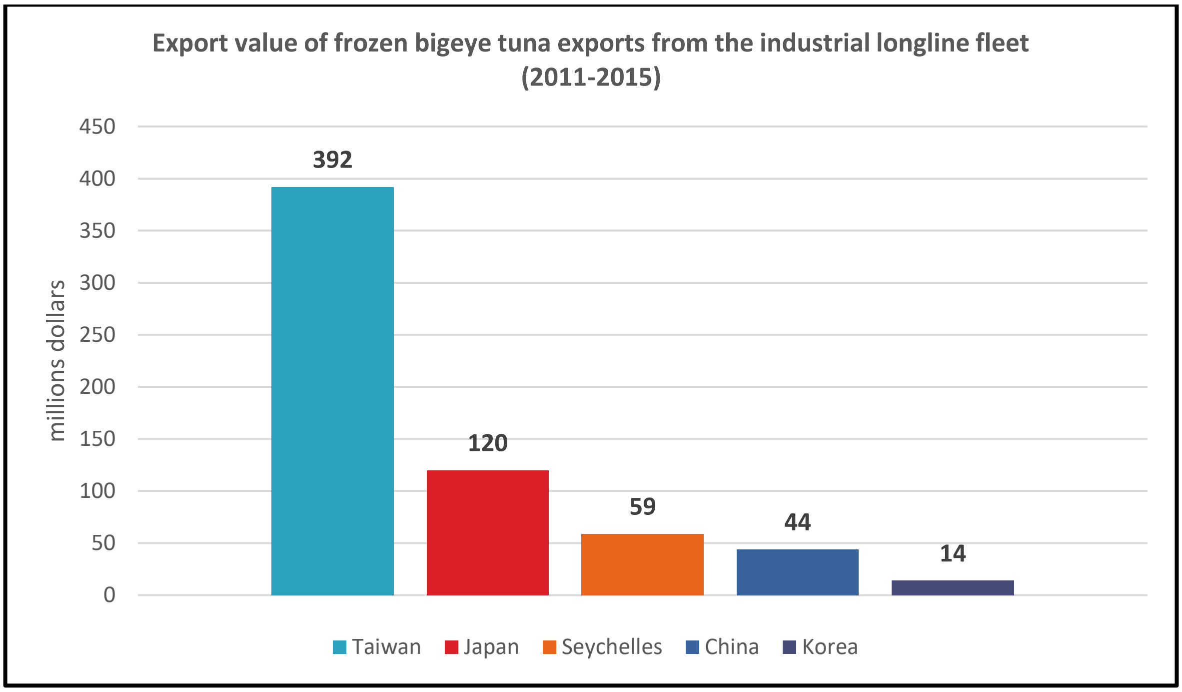



**Figure 21: Value of frozen bigeye tuna exports (FOB) from the freezer longliner fleet (Source: (IOTC-2016-DATASETS-NCDB 2016; ITC Trade Map 2017))**

The contribution of these longline fleets to the economies of the coastal states is less than that of the purse seine fleet due to the importance of trans-shipping which deprives Indian Ocean countries of the incomes related to fleet expenditure in the port infrastructure. Coastal States, however, receive payments for fishing rights. The majority of Asian longliners operate under private agreements to gain access to the EEZs of Indian Ocean countries. Japan operates in the Mauritian EEZ under private agreements with the Japan Tuna Fisheries Cooperative Association (COFREPECHE *et al.*, 2016). Taiwanese longliners operate in the Seychellois EEZ under the agreement with the Taiwan Deep-Sea Tuna Longline Boat Owner and Exporter Association (SFA 2016). Unlike the European agreements that

[21] Trans-shipping means the transfer of catches at sea from a fishing vessel to another ship.

are public, it is very difficult to access data on the price of licences in the framework of these private agreements.

The main landing ports for these longline fleets are Port Louis (Mauritius) and Port Victoria (Seychelles). Port Louis is the main landing port for freezer longliners, particularly the Taiwanese fleet. Nearly half of the catches of freezer longliner fleets are landed at Port Louis, making it a major landing centre (ACP Fish II 2013; MOOTOOSAMY *et al.* 2016).

This high landing volume is partly related to the conditions of the Mauritian fishing licences. They stipulate that all catches in the Mauritian EEZ must be landed at Port Louis (MINISTRY OF FISHERIES AND AQUATIC RESOURCES DEVELOPMENT 2013). The competitiveness of the port services and the presence of a range of cold storage rooms allowing handling and processing of catches at -40°C for loins, chunks and steaks are also a factor in the competitiveness of the Mauritian port (OVPOI 2015a).

In 2015, 52,586 tonnes of tuna were landed by longliners in Port Louis (i.e. 70% of the total catches of the freezer longliner fleet) (MOOTOOSAMY *et al.*, 2016). In that year, the majority of tuna landed was albacore (40% of tonnage) (MOOTOOSAMY *et al.*, 2016). These landings represent a significant part of Port Louis's port traffic. Between 2006 and 2013, berthing of industrial longliners accounted for 20% of the average annual moorings (for comparison, purse seiners accounted for only 1% of moorings) (OVPOI 2015b).

Mauritius' industry is also the only one in the Western Indian Ocean that processes longliner catches, particularly albacore. Thus, almost 15,000 tonnes of albacore are processed annually in Mauritian canneries (IBL 2016). The canneries work for the US can tuna brand *Bumble Bee* for loining part of the catches, which are then exported to the US for canning (IBL 2016, GHERKE and GUTH 2007). The US market is the main consumer of canned albacore, which accounts for 60% of the tins consumed, i.e. nearly 240,000 tonnes a year (processed weight)(MELBOURNE 2016).

Port Victoria receives the landings of the Seychellois, Taiwanese and Chinese fleets. They generate a relatively low maritime traffic: longliners' moorings accounted for 11% of tuna vessel moorings in 2014 (SFA 2016). Their expenditures contribute little to total spending. In 2014, these fleets expenditure only accounted for 0.2% of tuna fishing vessel expenditure (SFA 2016). Their catches are not processed locally and are exported by container or cargo ships to final markets.

Thus, with the exception of a proportion of the albacore catches of the Taiwanese fleet, freezer longliners' catches are not processed in the region, but are sent by directly to the Japanese market. Countries in the region do not benefit from the processing of catches.

Figure 22 summarizes the organization of this sector.

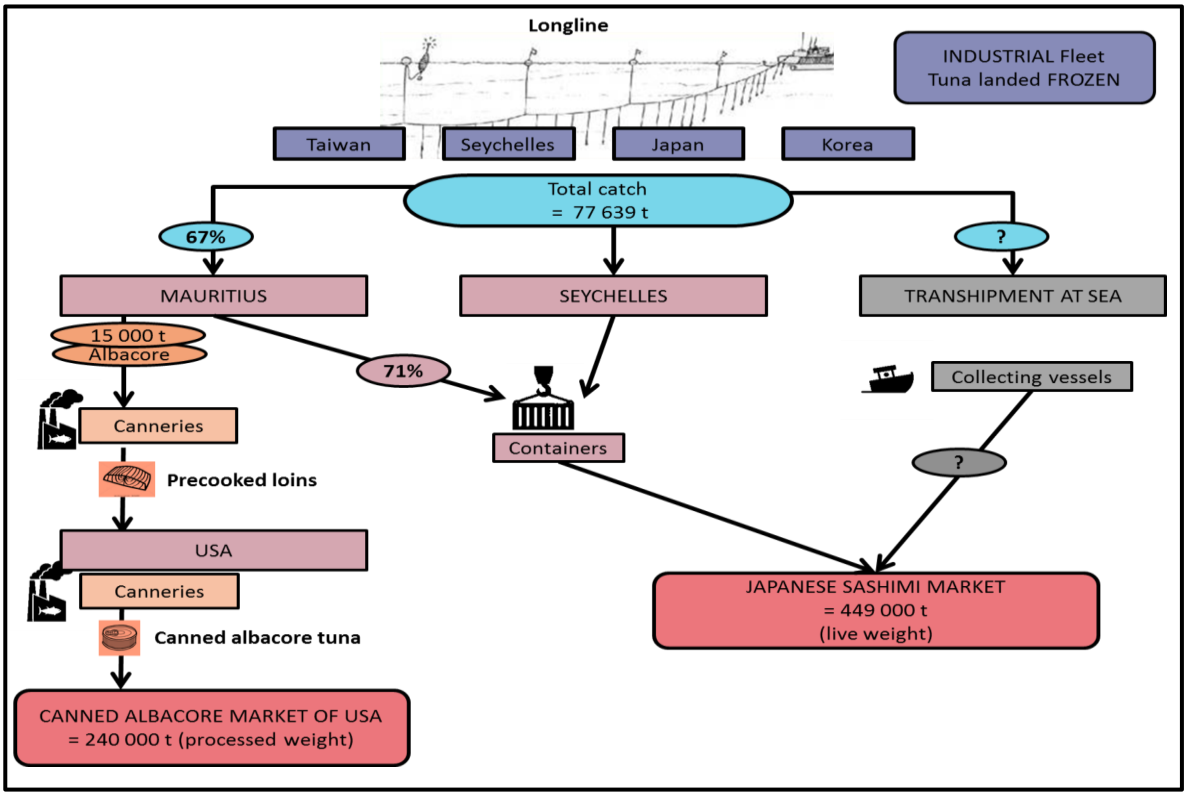



**Figure 22: The industrial longline value chain (Source: LECOMTE.M from (ITC Trade Map 2017; IBL 2016; MOOTOOSAMY *et al.* 2016))**

## 3.5 Fresh tuna processing units targeting sashimi and steak tuna markets

Some coastal Indian Ocean countries with a large national fleet have become specialized in processing and exporting fresh yellowfin tuna (and to a lesser extent bigeye). This processing industry is relatively new, becoming established in the 1990s in the Maldives and Sri Lanka (Sri Lankan Enterprise 2016, ADAM, JAUHAREE, and MILLER 2015). The main tuna processors in the Indian Ocean are Indonesia, Sri Lanka and the Maldives.

These processing industries are supplied by artisanal fishing units (with the exception of some Indonesian longliners which are considered as industrial by the IOTC). These fleets mainly use line or longline. Line fishing vessels do not have freezer units, fishing trips are limited to 10-14 days so that catches retain their quality. Similarly, Sri Lankan longliners keep their catches fresh in ice. In Indonesia, however, a proportion of the longliner fleet freezes their catches on board. With the exception of the Indonesian longline sector, where some processing units are vertically integrated and have their own vessels, the majority of vessels are owned by the fishers themselves (Maldives) or by private individuals (Sri Lanka, Indonesia).

Middlemen play a key role in this value chain, except in the Maldives where fishers sell their catches directly to the plants. They are responsible for collecting and distributing tuna to the processing units. Some middlemen also own fishing vessels and finance fishing trips (fishing gear, fuel, bait, food for crew) (BAILEY *et al.*, 2016, DE SILVA 2016). They are also responsible for price transmission between processing units and fishers and for informing on the catch quality requirements of the processing units.

These processing units supply two market types: the sashimi markets (Japanese and American) and the tuna steak markets (European and American). The type of market served is related to the quality of the catches: the higher quality catches are destined for the Japanese and American sashimi markets, while the lower quality catches are for tuna steak consumption on the European and American markets. Tuna that do not meet export market requirements are redistributed to local markets. The processing units are responsible for grading catches according to the tuna sashimi grading scheme. Figure 23 summarizes the organization of this industry.

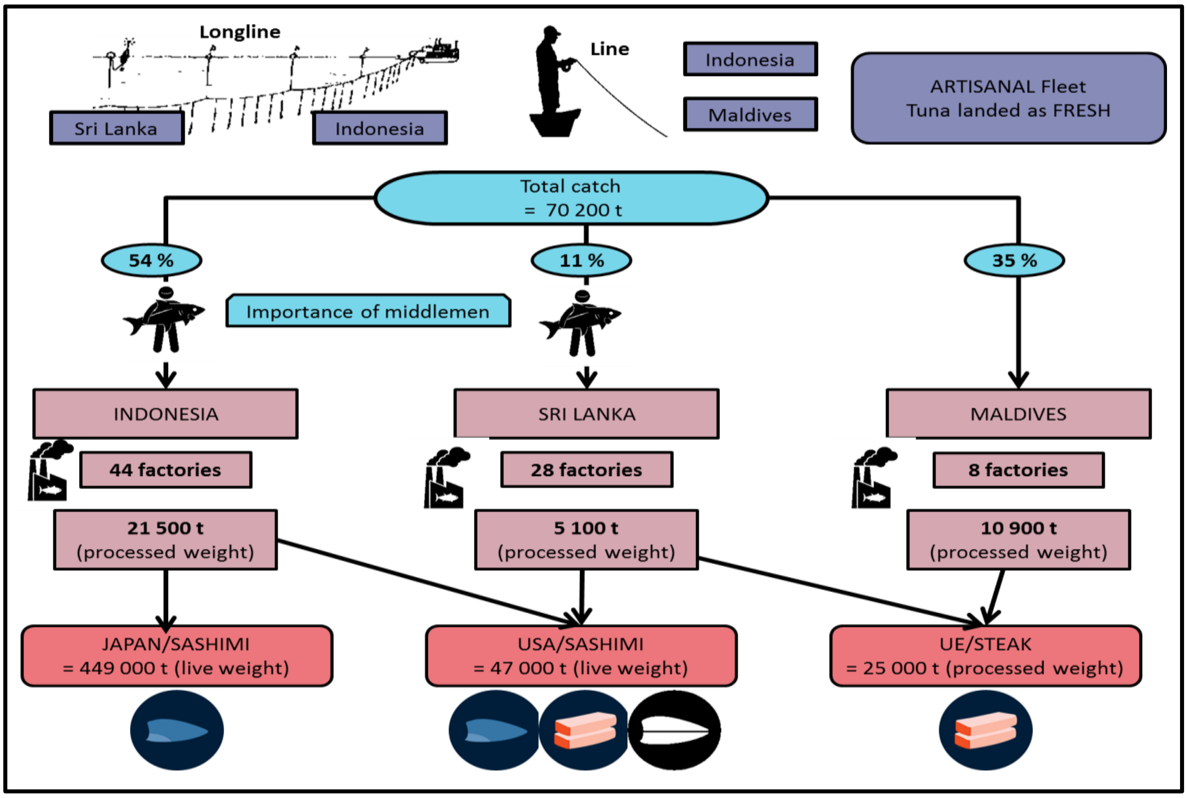



**Figure 23: The value chain of fresh tuna processing units (Source: LECOMTE.M from (ITC Trade Map 2017; MACFADYEN *et al.* 2016; BAILLY 2017))**

Table 8 shows the tuna sashimi grading scheme and the presentation of the catches according to their quality and their export market.

**Table 8: The different quality grades and their international market destination**

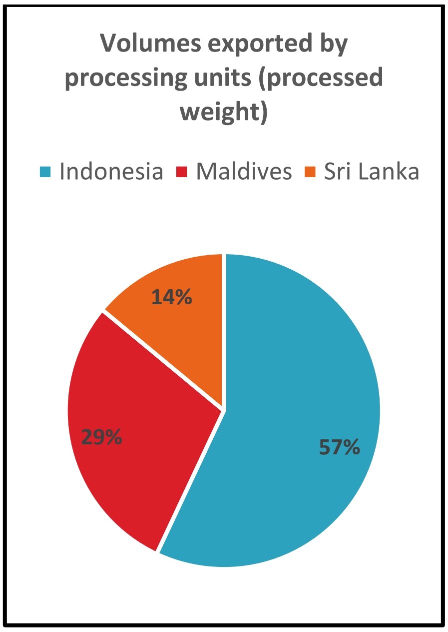
| Grade | Destination | Form of presentation | Export type |
|---|---|---|---|
| A | Japanese and US Sashimi Markets | Chilledheaded and gutted (H&G) | Air freight |
| B | European and US tuna steak markets | Chilled or frozen loins, sakus, chunks | Air freight (fresh tuna)<br>Containers (frozen tuna) |
| | US market for carbon monoxide-treated tuna | Frozen loins | Containers |
| Rejected | Local market | Fresh whole fish | / |

These processing industries are thus closely linked to the presence of a tourist industry of sufficient size to allow regular flight connections to the main export markets. In the European and US markets, tuna is sold via import companies that are responsible for the redistribution of tuna to end customers.

The volumes exported by the processing units are close to 40,000 tonnes. Indonesia is the main exporter, followed by the Maldives and Sri Lanka (Figure 24). The total value of exports is in the region of $231 million (Figure 24).

This value chain is characterized by a high level of post-harvest losses. The majority of processing units encounter difficulties in their supplies: quality is generally not sufficient for the highest value markets. This quality issue directly penalizes the profitability of companies, which make most of their profits from higher quality (Grade A) catches. This lack of quality is due in particular to the lack of on-board preserving equipment (Sri Lanka) and a lack of knowledge on good fish handling practices (Indonesia, Sri Lanka, Maldives).

In addition, these processing units are responsible for a significant volume of by-products and processing residues. Nearly 26,000 tonnes are valorized as co-products. The level of valorization of these products differs widely between countries and processing units. Some companies give or sell unprocessed co-products on local markets, while other processed them as diverse products: canned tuna, fish paste (*rihaakuru*), etc. Valorization of co-products remains very low, despite they represent substantial volumes of good quality products that could be more highly valued.



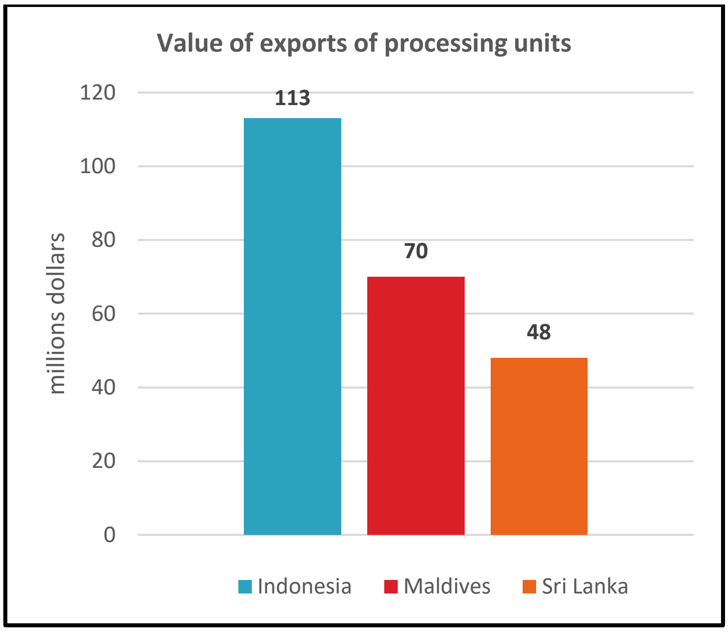




**Figure 24: Exports of fresh tuna and frozen tuna from processing units in volume (left figure) and value (right figure) (Source: (ITC Trade Map 2017; MACFADYEN 2016; National Bureau of Statistics 2016; MFARD 2016))**

The main markets served by the Indian Ocean processing units are the Japanese (sashimi), US (sashimi and steak) and European (steak) markets.

The Japanese market is the world's largest sashimi market (449 000 tonnes/year (live weight)) and constitutes a market with extremely strict quality standards. Bigeye tuna is the main species consumed in this sashimi market (38% of consumption), followed by yellowfin tuna (20% of consumption) (KAWAMOTO 2016). The Japanese market is a complex market, where tuna is sold through an auction system, with high price fluctuations. Processing units are sometimes reluctant to export to this market due to price uncertainty and the importance of quality criteria. Indonesia is the world's largest supplier to the Japanese market for fresh yellowfin tuna, representing 36% of Japan's fresh yellowfin tuna imports for the period 2011-2015 (ITC Trade Map 2017, HIDAYATI *et al.*, 2015).

The US market is the world's second largest sashimi tuna market (47,000 tonnes annually) and is expanding. Consumption follows the development of sushi chains and Japanese restaurants that consume mainly yellowfin tuna (called *ahi*) (BENETTI, PARTRIDGE, and BUENTELLO 2015). Quality is also important in the US market, but it has a less complex price system than the Japanese market.

The US market is also characterized by its strong demand for carbon monoxide-treated tuna (sometimes known as "injected tuna"). This treatment involves the injection of carbon monoxide into the fresh tuna, with the aim of improving its colouration. Indeed, the main quality criterion on the US market is colour, which must be as red as possible. In the Indian Ocean, only Indonesian and some Sri Lankan units produce carbon monoxide-treated tuna. Indonesian exports of frozen yellowfin tuna accounted for 45% of US imports over the period 2011-2015 (ITC Trade Map 2017). The main supplier to the US market for fresh yellowfin tuna is Sri Lanka (82% of US imports) (ITC Trade Map 2017).

The European market is a tuna steak market rather than a sashimi market. The market is estimated at 25,000 tonnes annually, the main markets being France, Germany, Italy and the United Kingdom (BAILLY 2017). Yellowfin tuna is the main species consumed in this market (CBI 2017). Intra-European trade dominates the supply of fresh tuna in Europe (81%), imports from developing countries account for only 18% of European imports (IWC 2017). Imports from third countries come from Indian Ocean countries. The Maldives and Sri Lanka are thus the main suppliers of the European market. This regional supply leads to relatively stable and homogeneous prices. The Maldives represents 12% of European fresh tuna imports, while Sri Lanka was once the second largest supplier, but the 2015 export ban drastically reduced its market share (CBI 2017).

Recently these processing industries have suffered from competition from thawed processed tuna. This tuna comes from purse seine fleets: it is cut into loins before being thawed and processed with plant extracts to improve its colour (BAILLY 2017). This tuna directly competes with fresh tuna because it is sold fresh at very low prices, and it has a very attractive red colour. Its marketing is however prohibited by the European Union. Moreover, in the European market, the recent increase in demand for super-frozen tuna (-60°C) is competing with fresh products. This tuna can be stored for long periods and can be sold fresh after thawing, and has a very similar quality. However, this market remains a niche market in Europe, due to the lack of storage infrastructure at this temperature (CBI 2017).

Thus, processing units specializing in fresh yellowfin tuna in the Indian Ocean (Indonesia, Maldives, Sri Lanka) are among the world's major yellowfin tuna exporters. The Maldives is the world's second largest exporter of fresh yellowfin tuna, and Sri Lanka is the fourth largest exporter (ITC Trade Map 2017). In addition, these processing units occupy key positions in the world's fresh tuna markets: Indonesia is the largest supplier to the Japanese market, while Sri Lanka is the largest supplier to the US market, and the Maldives to the European market.

At the national level, these processing industries play a major role for the Sri Lankan, Maldivian and Indonesian economies (Table 9).

**Table 9: Economic importance of yellowfin tuna processing sectors (Source: (World Bank 2015; ITC Trade Map 2017; SINAN 2017b; MINISTRY OF FISHERIES RESOURCES AND AQUATIC RESOURCES DEVELOPMENT 2016, 2017))**

| Country | Contribution to labour force | | | Share of fishing in GDP | Share of fresh tuna in total exports | Share of fresh tuna in seafood exports |
|---|---|---|---|---|---|---|
| | Fresh tuna fishers | Processors | Total | | | |
| Indonesia | / | / | / | 3% | 0.06% | 4% |
| Maldives | 10,000 | 250 | 4.9% | 1.3% | 47% | 53% |
| Sri Lanka | 15,000 | 900 | 0.19 % | 2% | 0.5% | 22% |

Fresh tuna is thus the main export product of the Maldives (together with frozen skipjack tuna) and represents half (50%) of national exports (OEC 2016). These exports are the main seafood products exported by Sri Lanka (22% of Sri Lanka's seafood exports), which play a major role in the food policy of the Sri Lankan government. Indeed, Sri Lanka has a negative trade balance for seafood, with massive imports that far exceed the production of national fisheries. This large import volume is due to the importance of fish consumption in Sri Lanka. The government's objective is to import fish at low prices for local consumption, while exporting products of high commercial value to improve the seafood trade balance (MINISTRY OF FISHERIES RESOURCES AND AQUATIC RESOURCES DEVELOPMENT 2017). Exports of fresh tuna play a major role in this national food security policy.

## 3.6 The Maldivian pole and line MSC certified tuna

Fishing is of paramount importance in the Maldives and represents the country's second largest industry after tourism. The tuna fishery is the oldest and largest fishery in the Maldives and it is strongly rooted into the island's culture (National Bureau of Statistics 2016). It is one of the most important sectors of the national economy: exports of tuna products account for 75% of Maldivian exports and the tuna fishery is the main source of employment in remote atolls (National Bureau of Statistics 2016).

In the Maldives, the main fishing gear used to catch tuna is pole and line: pole and line catches represent 70% of the tuna caught in the Maldives and 6% of the total catches of tuna in the Indian Ocean (IOTC-2016-DATASETS -NCDB 2016). This fishery is thus one of the largest pole and line tuna fisheries, accounting for 21% of the world's pole and line catches, behind Indonesia and Japan (AP2HI 2016).

This Maldivian fishery is also the only fishery in the Indian Ocean certified by the Marine Stewardship Council (MSC) ecolabel.[22] This fishery is the main MSC-certified pole and line tuna fishery, accounting for 74% of the catches of certified tuna pole and liners (MSC 2016).

This pole and line fishery is closely associated with the live bait fishery. This bait is mainly composed of reef fish that are caught during fishing trips and kept alive on-board. The Maldivian pole and liners operate mainly around anchored FADs located around the atolls. The majority (80%) of pole and line catches consists of skipjack tuna, the remainder being juvenile yellowfin and bigeye tuna (IOTC-2016-DATASETS-NCDB 2016).

Pole and linevessels sell their catches directly to processing units or to local markets without going through middlemen. These catches are destined for several distribution channels (Figure 25):

- Tuna for local markets;
- Tuna for the processing units on the atolls to make dried tuna;
- Frozen tuna exported to Thailand (raw tuna);
- Tuna canned and exported to European markets.

[22] When this report was prepared in May 2017, the Maldives was the only certified fishery in the Indian Ocean and the Echebastar fleet was still under evaluation.

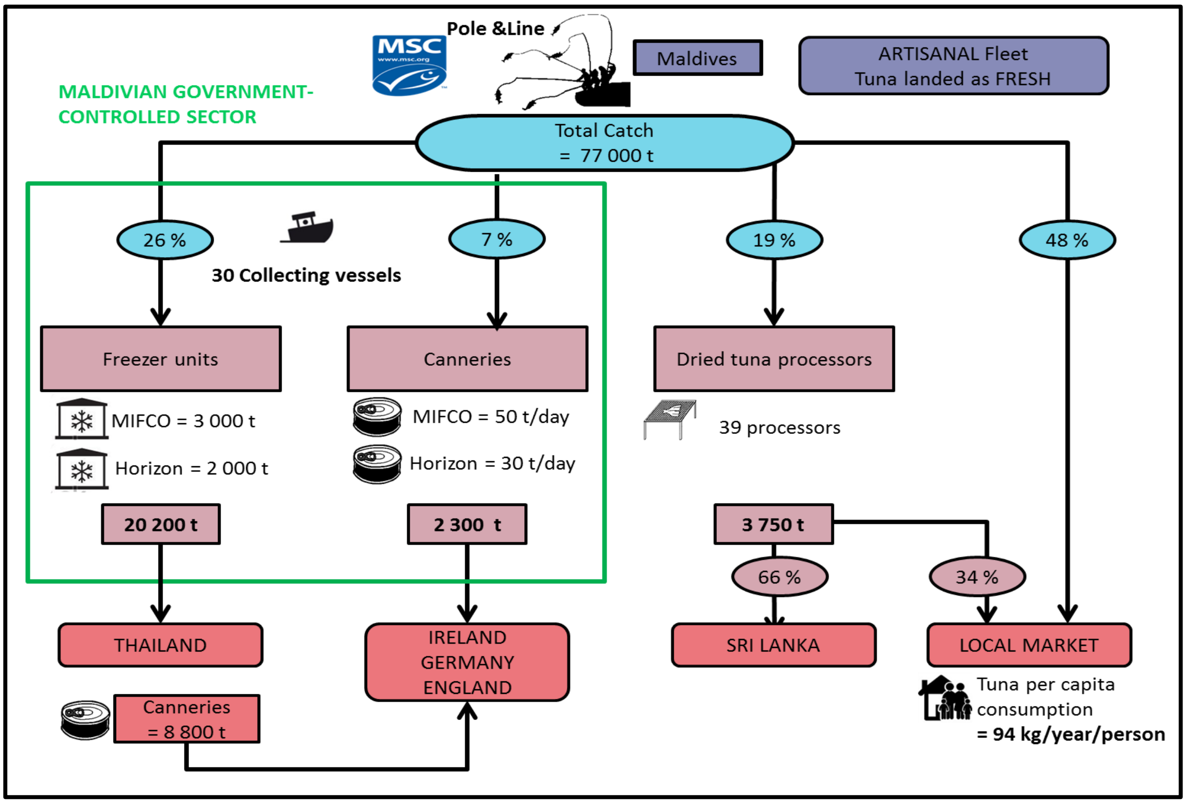



**Figure 25: The Maldivian pole and line tuna value chain (Source: LECOMTE.M from (IOTC-2016-DATASETS-NCDB 2016; ITC Trade Map 2017; POSEIDON *et al.* 2014))**

The majority (48%) of pole and line catches is destined for the local market. Indeed, Maldivians are among the biggest consumers of fish in the world, especially tuna. Maldivians consider tuna, their favourite type of fish, to be a "noble" fish (STEQUERT and MARSAC 1986; SATTAR *et al.* 2014).

A significant proportion (19%) of these catches are destined for processors that produce Maldives Fish, a speciality made by boiling tuna in salt water after which it is dried.[23] This dried tuna processing sector plays an important role in the remote islands and atolls where employment opportunities are limited. For example, the income level of fish processors is between $238 and $1,736 per month depending on the catch level and season (HOHNE-SPARBORTH, ADAM, and ZIYAD 2013). More than half (66 %) of this dried tuna is exported to Sri Lanka.

Two companies dominate the export of the pole and line catch: MIFCO, a public company, and Horizon Fisheries, a private company. They purchase nearly 33% of pole and line tuna catches and are involved in all export activities: they have collection vessels, freezing units and canneries (Table 10).

[23] During processing, it takes 3kg to 5kg of tuna to produce 1kg of Maldives Fish.

**Table 10: Companies involved in the Maldivian pole and line tuna sector (Source: (Horizon Fisheries 2016; MIFCO 2016b))**

| Company | Number of collection vessels | Freezer unit capacity | Cold room capacity | Daily capacity of cannery | Markets served |
|---|---|---|---|---|---|
| **MIFCO** | 20 vessels | 350 tonnes | 3,000 tonnes | 50 tonnes/day | Waitrose, Sainsbury's (United Kingdom) |
| **Horizon Fisheries** | 10 vessels | 450 tonnes | 2,000 tonnes | 30 tonnes/day | Sainsbury's, Marks & Spencer, Waitrose (United Kingdom) Billa (Germany) |
| **TOTAL** | 30 vessels | 800 tonnes | 5,000 tonnes | 80 tonnes/day | / |

The skipjack purchased by MIFCO and Horizon Fisheries is mainly exported frozen to Thailand without prior processing (particularly to the Thai Union company) (MIFCO 2016a). Although the Maldives is the eighth largest supplier to the Thai market (3.7% of Thai imports of frozen skipjack tuna), Maldivian round frozen tuna exports are of critical importance to Thai canneries, as they represent one of their main sources of MSC-certified tuna. This raw frozen tuna thus represents the main export of the Horizon Fisheries and MIFCO processing units. However, in recent years, the quantities of frozen tuna exports have been declining. This decrease is related to the strategy of these companies, which wish to process as much tuna as possible in their own canneries.[24] Indeed, since this frozen tuna is mainly bought by Thailand, the production of Thai canneries competes directly with canned tuna from the Maldives, because both sell the same product: MSC-certified canned tuna from the pole and line fishery of the Maldives. Thailand is thus the world's largest producer of MSC-certified canned tuna. The aim of MIFCO and Horizon Fisheries is to limit their exports of unprocessed frozen tuna to be able to sell it at the highest possible price. The increase in prices for frozen tuna allows Maldivian canners to maintain price competitiveness with Thai canned products by influencing their supply (the purchase price of raw tuna accounts for nearly 50% of the cost of production of thai canneries) (Maldivian company 2016 MIFCO 2016b). Indeed, at an equivalent purchase price for raw tuna, one of the Maldivian canners estimated that Thai cans were 30% cheaper than Maldivian ones (MIFCO 2016b).

Only a small proportion of the catch (7%) is destined for the two canneries (Figure 26). Indeed, these two canneries are small, with an effective daily capacity of 80 tonnes. Annual exports of these canneries are in the order of 2,300 tonnes and account for 0.2% of world exports of canned tuna (ITC Trade Map 2017). This low volume of processed catches is related to the lack of maintenance of the cannery infrastructure, which is currently outdated and unable to operate at full capacity. Thus, even considering the world market for the canneries of pole and line caught tuna,[25] the export of Maldivian canned products accounts for less than 2% of this market. The main markets are the Irish, German and

[24] The aim of MIFCO for next year is to process 70% of its skipjack tuna purchases (between 20,000 and 25,000 tonnes) and to export 30% of skipjack tuna as raw tuna (without processing) (MIFCO 2016a).

[25] If we consider that all pole and line tuna catches are canned, we estimate the global market to be 190,000 tonnes (a Maldivian company 2016).

British markets. These canneries mainly produce goods for the own brands of the British distributors Marks & Spencer, Sainsbury's and for the German distributor Billa.

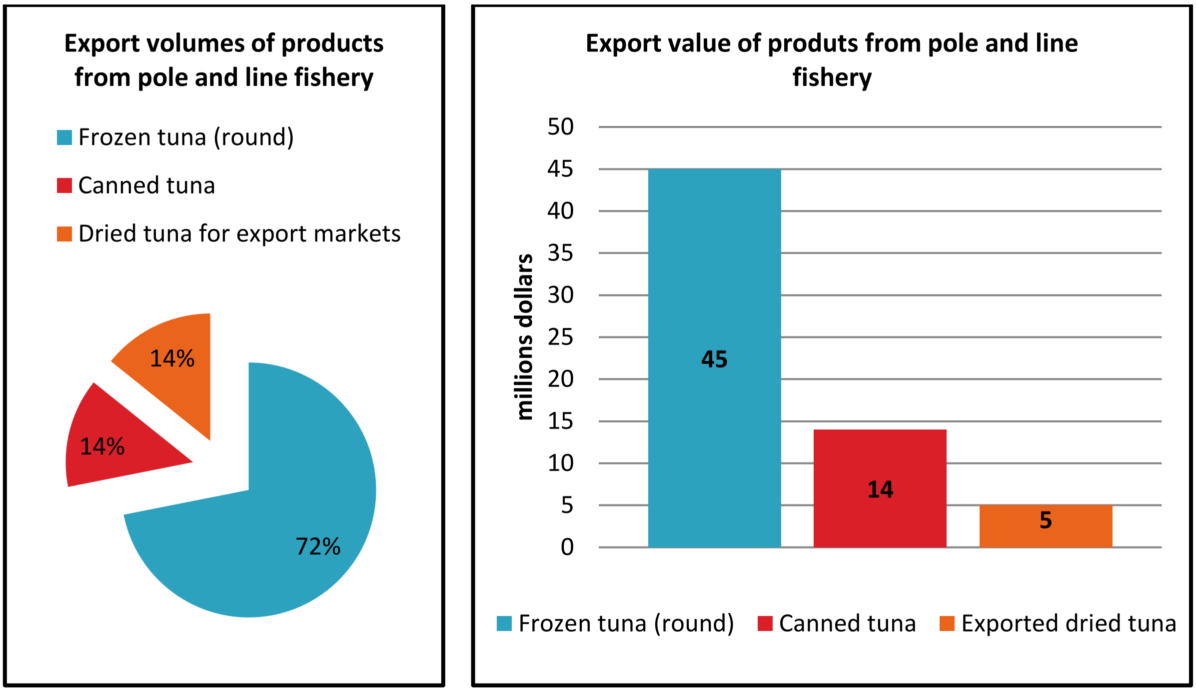



**Figure 26: Exports of the Maldivian pole and line sector (Source:(POSEIDON *et al.* 2014; National Bureau of Statistics 2016; ITC Trade Map 2017))**

The Maldivian state exerts strong control over this export industry, through its involvement in the sector via the state-owned company, MIFCO. Through this company, the government intervenes directly in the purchasing and processing of pole and line caught skipjack tuna. The infrastructure network established by MIFCO (collection vessels, cold rooms on remote atolls, canneries) has helped Maldivian fishers to access export markets. The Maldivian government is also responsible for setting the price for the tuna landed by the pole and liners (Maldives Fishermen Association 2016; Marine Research Center 2016). This price is based on the international price of skipjack tuna in Bangkok, but includes a price premium and is fixed all year. There is strong political pressure to maintain this price parity between Maldivian skipjack and the skipjack landed in Bangkok (HOHNE-SPARBORTH, ADAM, and ZIYAD 2013). This price premium is not linked to the MSC certification, but is related to the pole and line fishing gear. This State price thus guarantees a stable income level for Maldivian pole and linevessels that supply the export markets (this price does not apply to pole and liners that supply local markets).

At the moment, the State organization of this pole and line industry has enabled the development of an efficient export sector, beneficial to all pole and liners, including those from remote atolls.

This Maldivian industry is promoted by many NGOs (Greenpeace, WWF, IPLNF) as an exemplary model of sustainability and is of interest to a number of coastal countries.

In terms of the environment, the Maldivian pole and line fishery has a minimal impact on the ecosystem: catches and interactions with threatened or protected species or other ecologically important species are virtually non-existent (AHUSAN *et al.*, 2016 ). This fishery produces virtually no waste, since most of the bycatch is utilized and the rest is mostly released alive. Tuna that are too small or damaged end up in local markets or are eaten by the fishers (Marine Research Center 2016).

Regarding the livebait fishery , the species used are small pelagics and recifal fish with short growth cycles and high spawning rates (JAUHAREE, NEAL, and MILLER 2015).

From a social point of view, pole and line fishing is the main source of employment, particularly in remote atolls where job prospects are rare. Due to the modernity and comfort of the vessels, the working conditions are relatively good. Wages for tuna fishers are relatively high: between $2,000 and $3,000 per month during the high fishing season and $400 to $500 per month during the low season (Maldives Fishermen Association 2016). The average monthly income of tuna fishers is $1,500, twice the per capita GDP of the Maldives. The income levels generated allow fishers to save enough to invest in fishing vessels and send their children to study abroad.

However, this model is difficult to transpose to other fisheries. Among the main factors that have enabled the development of these fisheries, the presence of a surface thermocline[26] near the coast and the availability of live bait are essential conditions for the development of these fisheries. The traditional role played by fishing in Maldivian culture and a supportive institutional framework have also been decisive factors (HOHNE-SPARBORTH, ADAM, and ZIYAD 2013). Development assistance programmes have also played a major role in the modernization of the fishing fleet and infrastructure, but also in capacity building and the transfer of technology (LINTON and SHAREEF 2011). Finally, the dynamism of the tourism sector has also contributed to the development of the tuna sector, as some tourism investors have developed their activities in the tuna processing sector.

## 3.7 Conclusion

The tuna catches from the Indian Ocean supply several types of channels. Industrial purse seine fleets operating in the Western Indian Ocean are responsible for the largest catch volumes and mainly supply the canning plants of Madagascar, Mauritius and the Seychelles. The contribution of this fleet is of major importance to the economies of these states, whether in terms of expenditure in the port infrastructure, revenues from fishing licensing or processing in canneries. Within these countries, the main contribution of the fisheries sector to the national economy is related to the processing of the purse seine catches in national canneries.

Due to the importance of the artisanal tuna fleets operating in the Indian Ocean, a significant proportion of tuna catches are destined for local consumption, particularly in Indonesia, the Maldives, Sri Lanka and Comoros. Tuna has a major role in the food security of these countries, where it is the main fish consumed and the main source of animal protein at the national level.

The Pakistani and Iranian gillnetters contribute significantly to overall catches and supply only Iranian canneries. Although the fisheries sector is of marginal importance in these two countries, these tuna fisheries play a major role within the coastal communities, particularly in terms of employment. Despite the significance of their contribution to tuna catches and their impact on bycatch, these fisheries are little regulated and are not subject to strict national level management measures.

[26] The thermocline is a gradient of temperature in a body of water, where there is a sudden change in temperature at the boundary between a body of cold, deep water and a warmer mass of surface waters.

Unlike industrial purse seiners, industrial longliners generate less economic spin-offs in the countries of the region, since most of their catches are trans-shipped and sent directly to the Japanese market without prior processing.

Fresh tuna processing plants in Indonesia, the Maldives and Sri Lanka are mainly supplied by artisanal fisheries. These processing plants are a low-value-added activity, the profitability of which is sometimes compromised by the lack of quality of catches. However, the contribution of this sector to the coastal communities is very significant, especially in terms of employment. Although tuna from these plants accounts for the majority of seafood products exported by these countries, their contribution to total exports is marginal because, with the exception of the Maldives, seafood products only represent a small proportion of the total exports (around 2% in Indonesia and Sri Lanka) (OEC 2016). These Indian Ocean processing units are a major industry in the international fresh tuna market and represent the main suppliers to the world's major markets for tuna sashimi and steak.

Maldivian pole and line vessels are the only MSC-certified fishery in the Indian Ocean and represent one of the world's largest pole and line tuna fisheries. This fishery is of major economic importance, and constitutes one of the main pillars of the Maldivian economy. The pole and line tuna fishery is the main source of employment in remote atolls, and the income levels generated by this activity are among the highest in the Maldives. Tuna caught by this fishery mainly supply the local market and the processors of Maldives Fish, and is crucial for the protein intake of the Maldivian population. The political weight of Maldivian fishers and their ability to influence the management policies of the sector reflects the importance of these fisheries at the national level (HOHNE-SPARBORTH, ADAM, and ZIYAD 2013).

# 4. Sustainability challenges of tuna fisheries in the Indian Ocean

## 4.1 Overcapacity of tuna fleets

Fishing capacity is a concept with a definition that varies according to biologists, economists and managers (FAO 1999; MARTIN 2012). However, the commonly used definition is the amount of fish that can be caught by a vessel (FAO 1999).

Within the tuna fleets, the problem of overcapacity has been recognized for two decades (MIYAKE *et al.*, 2010). This fleet overcapacity is common to all oceans and is even more problematic in the Indian Ocean, because the prevalence of coastal fleets makes this overcapacity difficult to estimate (MORENO and HERRERA 2013). The majority of fishing vessels operating in the Indian Ocean are artisanal and not registered with the IOTC. Their numbers are difficult to estimate and the majority of fisheries authorities are unable to accurately report the number of ships involved in tuna fishing activities. In most cases, the exact fishing capacity of these vessels and their impact on tuna catches and bycatches remains unknown (MORENO and HERRERA 2013).

The fleet capacity also cannot be accurately estimated for the industrial fleets operating in the Indian Ocean. Indeed, the concept of fleet overcapacity is not only defined in terms of numbers of vessels, but must also take into account other factors such as vessel storage capacity, vessel size, fishing efficiency (particularly the technological advances that improve vessel performance) (ISCF 2009, MIYAKE *et al.*, 2010). These aspects are particularly important in the purse seine fleet, where technological developments over the last decade have played a major role in improving fishing efficiency.

The development of equipped drifting FADs has been a major technological advance and has resulted in a significant increase in catches. Subsequently, the technological evolution of these buoys, through the establishment of GPS beacons and echo sounders, has also led to an increase in fishing yields. Supply vessels have also increased fishing capacity and efficiency, while also making it more complicated to assess the effective fishing effort of purse seiners that use drifting FADs. These FADs and supply vessels must also be considered in the evaluation of the capacity of purse seiner fleets. However, their impact is difficult to characterize because they are not included in the assessment of the purse seine fishing effort. Indeed, before these devices were used, the evaluation of the purse seine fishing effort was based on the time spent searching for schools. This search time no longer exists and the technological variation between the types of buoys and the differing use of supply vessels from one fleet to another complicate any estimate of a typical effort for this fishing fleet.

This overcapacity is all the more problematic in view of the ambitions of certain countries in the region to develop their own tuna fleets, along with a lack of IOTC guidance on capacity. The IOTC has not established a closed registry of vessels authorized to operate in its mandated area.

The only new entrants allowed access to the Indian Ocean tuna fishery are the coastal States. Many countries[27] have thus established National Fleet Development Plans. If these plans are implemented and if the countries operating in the Indian Ocean maintain their current capacities, by 2020 the

[27] Particularly India, Indonesia, Iran, Maldives, Mauritius, Mozambique, Oman, Pakistan, Seychelles, Sri Lanka and Tanzania (MORENO and HERRERA 2013).

capacity of these fleets will be 250% higher than the 2006-2007 levels, which is an unsustainable level for Indian Ocean tuna stocks (IOTC-SC19 2016 2016). It should be noted, however, that these fleet development plans are not generally implemented, and many countries struggle to make the necessary investment for the development of their national fleets.

For the majority of coastal states, the establishment of industrial tuna fleets meets their "development aspirations". At present, foreign industrial tuna fleets are reluctant to transfer capacity from their fleets to the coastal fleets. Hence, reconciling legitimate wishes for development and participation in the exploitation of regional tuna resources, given the current overcapacity and the overexploitation of stocks, seems very difficult at present.

## 4.2 Incomplete catch data that impacts on stock assessments and management efforts

The catch data for tuna fisheries operating in the Indian Ocean are generally incomplete or unavailable, despite the mandatory nature of national declarations (IOTC-SC19 2016 2016). In 2015, almost half of the catch data for major tropical tunas were not available (Figure 27). In 2016, 16 IOTC Contracting Parties did not provide a national report within the timeframe required according to Resolution 15/02 on Mandatory Reporting of Catch Data.

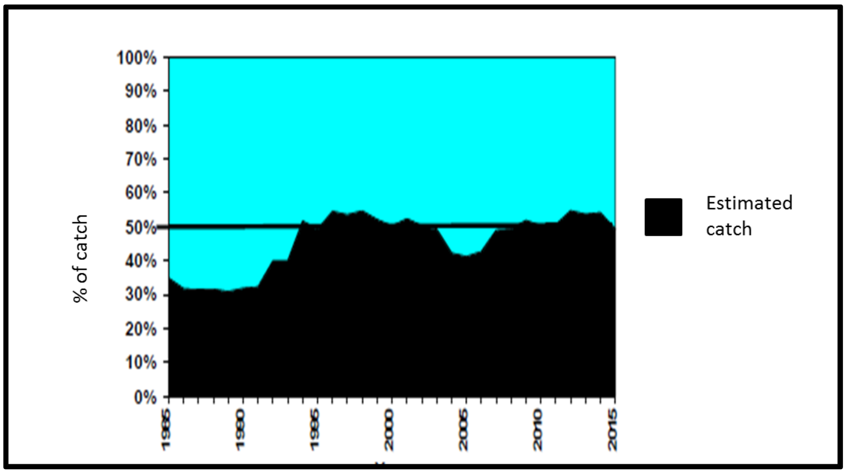



**Figure 27: Annual percentages of catches of tropical tunas based on accurate statistical data (turquoise zone) and without statistical data (black zone) (Source: (FONTENEAU 2017))**

This lack of statistical data is mainly related to the importance of coastal and artisanal fleets. The latter only report a small proportion of their catch and fishing effort (IOTC-SC19 2016 2016). Many coastal states face capacity or infrastructure constraints that limit their ability to fulfil the IOTC obligations, particularly in terms of data collection and processing (CEO *et al.*, 2012). Some of the largest fisheries in the Indian Ocean are thus unable to provide their catch data. This lack of catch data is particularly evident for neritic tunas (IOTC-SC19 2016 2016). For coastal countries, the IOTC budget is not sufficient to address these shortcomings in terms of data collection and processing.

Moreover, the definition of "artisanal" as adopted by the IOTC considerably limits data collection because it excludes certain fisheries from reporting catches, ones that have a major impact on total catch (MORENO and HERRERA 2013). There remains considerable uncertainty as to the capacity of the artisanal fleets and their impact on the resource.

This lack of catch data also includes industrial fishing fleets, particularly the freezer longline fleet. The importance of trans-shipping for this fleet complicates the catch estimation. Observer coverage is also very low for this fleet: compulsory coverage only concerns 5% of vessels and at present all fleets do not respect this rate.

Although the IOTC has adopted a resolution on the establishment of a regional observer scheme[28], there have been difficulties in the implementation of this scheme. This programme is generally poorly implemented in member countries and the observer schemes differ considerably from one country to another. Data from these observers are often not reported (or not in a format that meets IOTC standards). The fleets operating in the Indian Ocean are thus poorly monitored by observers (IOTC-SC19 2016 2016). With the exception of the industrial purse seine sector, coverage of industrial fisheries is lower than the compulsory 5% level (IOTC 2017). The embarkation of observers in artisanal fishing units is a logistical, security and financial challenge. However, observer data are needed to provide information on fishing practices at sea, including on the levels of discards and bycatch (IOTC-SC19 2016 2016).

This lack of catch data (especially for neritic tunas) undermines the validity of stock assessments. For several stocks under the IOTC mandate, the secretariat is obliged to estimate catch levels, which increases uncertainty over the actual state of stocks (IOTC-SC19 2016 2016). It is currently very difficult to estimate their actual condition (IOTC-SC19 2016 2016). This poor quality of catch data also hinders attempts to establish management measures. The argument of a lack of scientific data is widely used in IOTC negotiations to counter any proposed resolutions regarding any species with a stock status that is subject to uncertainty.

[28] Resolution 11/04 stipulates that the presence of on-board observers is mandatory for vessels over 24 metres long and vessels operating partially or totally outside their exclusive economic zone (IOTC 2011). The level of coverage must be 5% for these fleets (IOTC 2011).

## 4.3 A critical stock situation for nearly half of the tuna catch

In the Indian Ocean, each tuna species has an associated stock status. Table 11 shows the state of stocks of the main commercial tuna species. It should be noted that stocks of neritic tuna are evaluated using inventory assessment methods that are based on low quality data.

**Table 11: Status of main Indian Ocean tuna stocks (Source: (IOTC–SC19 2016 2016))**

| Species | Catch levels and MSY | Stock status 2016 |
|---|---|---|
| **Yellowfin tuna** | Catches 2015 = 407,575 tonnes<br>Average catches 2011-2015 = 390,185 tonnes<br>MSY = 422,000 tonnes | |
| **Albacore tuna** | Catches 2015 = 35,068 tonnes<br>Average catches 2011-2015 = 34,092 tonnes<br>MSY = 38,800 tonnes | |
| **Skipjack tuna** | Catches 2015 = 393,954 tonnes<br>Average catches 2011-2015 = 394,320 tonnes<br>MSY = 684,000 tonnes | |
| **Bigeye tuna** | Catches 2015 = 92,736 tonnes<br>Average catches 2011-2015 = 101,515 tonnes<br>MSY = 104,000 tonnes | |
| **Longtail tuna** | Catches 2015 = 135,920 tonnes<br>Average catches 2011-2015 = 157,313 tonnes<br>MSY = 143,000 tonnes | |
| **Kawakawa** | Catches 2015 = 152,772 tonnes<br>Average catches 2011-2015 = 158,817 tonnes<br>MSY = 152,000 tonnes | |

| **Legend** | |
|---|---|
| Healthy stock | |
| Overexploited and overfished stock | |

Currently, it is estimated that at least two stocks are overexploited and overfished in the Indian Ocean: the yellowfin stock and longtail stock (Table 11). Catches of yellowfin tuna are equally distributed between industrial and artisanal fisheries. The catches of the latter have increased in recent years: the proportion of yellowfin tuna catches by artisanal fishing units was 30% in the 2000s, compared to 50% in recent years (IOTC 2016a). The main fishing gears responsible for yellowfin tuna catches are industrial purse seine using FADs (20% of yellowfin catches), longliners (19% of yellowfin tuna catches) and gillnets (16% of catches) (IOTC-SC19 2016 2016).

Concerning longtail tuna, there is considerable uncertainty regarding the stock structure. Longtail tuna have a strong affinity to certain regions, which is cause for concern because localized overfishing could lead to stock depletion (IOTC 2016c). Almost all catches of longtail tuna (75%) come from artisanal fishing units that use gillnets: the Iranian, Indonesian and Pakistani fleets are the main contributors to total catches.

It should also be noted that, despite the apparently healthy status of the skipjack stock, some scientists remain concerned that many fishing indicators are showing that FADs are exerting an excessive pressure (FONTENEAU 2017). Free schools consisting of skipjack and small yellowfin tuna have considerably declined in the Western Indian Ocean, suggesting that skipjack tuna are closely linked with FADs (FONTENEAU 2014). This association thus increases the catchability of skipjack tuna by purse seine fishing units. Some scientists therefore consider that the Indian Ocean stock of skipjack tuna is in a rather critical state (FONTENEAU 2014, 2017). The next assessment of skipjack stock will take place in 2017.

In terms of catch volumes, nearly half of the tuna catches in the Indian Ocean come from stocks that are overexploited and overfished. Yellowfin tuna and longtail tuna accounted for 44% of the catches of commercial tuna during the period 2011-2015, and these two species support essential activities in the Indian Ocean.

Catches of yellowfin tuna supply two main industries: processing units specializing in fresh tuna from Indonesia, Maldives and Sri Lanka, and the canneries from Mauritius, Madagascar and the Seychelles. In the latter case, the markets they serve are among the world's largest consumers of canned yellowfin tuna. The majority of canned tuna consumed on the French market is raw packed yellowfin tuna, while the Italian and Spanish markets are also major consumers of canned yellowfin (Oceanic Development, Poseidon Aquatic Resource Management Ltd., and MegaPesca Lda 2005; BUTRAGUEÑO 2013). These canneries are limited in their supply by the rule of origin and can only import catches of tuna if they are from the European fleet. Thus, a decrease in the landings of purse seine vessels or the establishment of a quota has severe impacts on the activity of these canneries. For fresh tuna processing units, yellowfin tuna accounts for almost all the activity of these companies. Any catch reduction would lead to the discontinuation of the activities of these companies, which are the main suppliers to the tuna steak markets (European Union, US) and the Japanese sashimi market (for fresh yellowfin tuna).

Longtail tuna supplies two sector types: Iranian canneries and local Sri Lankan and Indonesian markets. The longtail tuna thus represents the main species caught by the Iranian gillnetters and the main species processed in the Iranian canneries. In the Sri Lankan and Indonesian markets, longtail tuna is one of the main species consumed. The management of this stock therefore addresses a food security issue for certain countries of the region.

The critical situation of these stocks therefore threatens the survival of the main tuna industries in the region, but also the food security of some coastal populations. Although management measures were immediately established when the yellowfin tuna stock went into the red,[29] this was not the case for the longtail tuna, which received red classification in 2015 and has still not been subject to management measures.

[29] Resolution 16/08, which resulted in the introduction of a catch reduction in the form of a quota for the European purse seine fleet.

## 4.4 Impact of tuna fisheries on ecosystems: the importance of bycatch

All tuna fishing techniques have an impact on the exploited ecosystem. Unlike some fisheries, tuna fishing gear operates relatively close to the surface and has no direct impact on the benthic ecosystem. The main impact of tuna fisheries on the marine ecosystem is bycatch and pollution related to losses from fishing gear (FAD loss, ghost fishing with lost gillnets).

Bycatch is a difficult term to define, especially for artisanal fisheries (ARDILL, ITANO, and GILLETT 2013). In the case of industrial fisheries, it is relatively easy to identify by-catch as these fisheries focus on particular species (ARDILL, ITANO, and GILLETT 2013). On the other hand, in the case of artisanal or small-scale fisheries, almost all catches have an economic or subsistence value and are thus likely to constitute target catch (ARDILL, ITANO, and GILLETT 2013). In addition, for some Indian Ocean fisheries, the target species is a specific species and tuna represents by-catch (ARDILL, ITANO, and GILLETT 2013).

In the context of this report we use the following definition: "*non-target marine organisms (non-target fish, cetaceans, sea turtles, sharks, etc.), whether retained and sold or discarded (bycatch or incidental catch)*" (ARDILL, ITANO, and GILLETT 2013). Bycatch can be divided into two components: (i) co-products, which are bycatch retained on-board for sale or consumption by the crew, and (ii) discards, which are bycatch (dead or alive) that is rejected at sea because of low commercial value or the legislation in force (CHAPMAN 2001).

Bycatches of Indian Ocean tuna fisheries include sharks, rays sea turtles,seabirds and different species of pelagic fish (marlins, swordfish, mahi-mahi) . As with tuna, bycatch and discard data are often lacking or absent, making it difficult to assess the impact of tuna fisheries on these species (IOTC-SC19 2016 2016). This lack of data is particularly pronounced for catches of shark, which are species with low reproductive potential. The status of shark stocks in the Indian Ocean is also highly uncertain (IOTC-SC19 2016 2016). Regarding seabirds, only six IOTC members have reported their levels of interaction with these species (IOTC-SC19 2016 2016).

Where data are available, the majority of these bycatch species are shown to be in critical condition. For example, stocks of black marlin and striped marlin are overexploited and overfished (IOTC-SC19 2016 2016). The IUCN considered most of these bycatches to be threatened, vulnerable, or endangered (Annex 3).

In the Indian Ocean, the main fishing gears responsible for large volumes of bycatch are gillnets and longliners (Table 12). Bycatch tonnages were calculated using the bycatch rates and the average catch amounts of the fleets during the period 2011-2015.

**Table 12: Amount of bycatch per fishing gear (Source: (ARDILL, ITANO, and GILLETT 2013; SHAHIFAR 2016; CLARKE *et al.* 2014))**

| Fishing gear | Main bycatch | Bycatch rate | Amount of bycatch in the Indian Ocean |
|---|---|---|---|
| Purse seine – free schools | | 1.17% | |
| Purse seine - FADs | | 5.3% | |
| Purse seine - combined | Various tunas (54%)<br>Various fish (34%)<br>Sharks (10%)<br>Sailfish/marlins (1.5%)<br>Rays (0.7%) | 3.5% | 10,500 tonnes (Korea, Mauritius, Seychelles, France, Spain) |
| Pole and line | Neritic tunas<br>Various fish<br>Bait (8.3%) | 11.6% (including bait) | 8,900 tonnes (Maldives) |
| Industrial Longline | | 28.5% (including bait) | 22,127 tonnes (Japan, Taiwan, Korea) |
| Gillnet (Middle East) | Various fish (11.4%)<br>Sailfish/marlins (2.8%)<br>Sharks (1.3%) | 15.5% | 29,500 tonnes (Iran, Pakistan) |

The bycatch rate does not really reveal the impact of the fishing gear on the ecosystem because the rate must be compared with the total catch volume. It is necessary to take into account the biology of the species affected and the status of their stocks to estimate the impact of fishing gears (JUSTEL-RUBIO and RESTREPO 2015). For example, rays and sharks are particularly sensitive species classified by the IUCN as endangered or vulnerable.

The fishing gear with the greatest ecosystem impact is the gillnet, that are responsible for the largest volumes of bycatch. In addition, gillnets have a significant impact on ecologically important species such as cetaceans (dolphins and whales), sharks and turtles (Figure 28). These species generally die of suffocation before the net is raised, it is not possible to release them alive. Gillnets are also responsible for the majority of catches of black marlin and blue marlin, the stocks of which are overfished and overexploited (IOTC-SC19 2016 2016). Beyond their impact on bycatch species, gillnets are also responsible for ghost fishing: lost or abandoned gillnets that continue to catch fish and other species and contribute significantly to coastal pollution. The impact of these gillnet fisheries on the ecosystem is all the more problematic because these fisheries are uncontrolled and provide very little data on their levels of catch and bycatch interaction.

After gillnet fisheries, longline fisheries have the next largest impact on bycatch, particularly on seabird and shark populations (Figure 28). Baits are also a source of bycatch (ARDILL, ITANO, and GILLETT 2013). The main species used are Pacific saury and sardines (BEVERLY, CHAPMAN, and SOKIMI 2009). It has been estimated that nearly 45,000 tonnes of bait are required each year, i.e. almost half of the longline catches from this ocean (ARDILL, ITANO, and GILLETT 2013).

The bycatch of purse seine fisheries using FADs is composed of resilient species (rainbow runner, kawakawa, triggerfish), while shark catches represent less than 0.5% of catches (JUSTEL-RUBIO and

RESTREPO 2015, ARDILL, ITANO, and GILLETT 2013). Nevertheless, the use of FADs increases the bycatch compared to purse seine vessels operating on free schools. The use of FADs also results in large catches of juvenile bigeye tuna and yellowfin tuna. These two species are caught at sizes that are well below the first spawning size, which reduces the biological productivity of these stocks (FONTENEAU and CHASSOT 2014). In addition, FADs are a significant source of pollution, with an estimated 10% lost every year (MAUFROY *et al.*, 2015). At the scale of the Indian Ocean this represents nearly 1,000 to 1,400 beachings annually (if we only consider the European and Seychellois fleets) (BALDERSON and MARTIN 2015). These FADs consist mainly of non-biodegradable plastics and contribute significantly to marine pollution[30] (BALDERSON and MARTIN 2015). Where FADs are stranded in coastal areas, they can have a significant impact on coral reefs (BALDERSON and MARTIN 2015).


**Figure 28: Impact of fishing gear on certain bycatch species at the global level[31] (Source: (JUSTEL-RUBIO and RESTREPO 2015))**

[30] A study conducted in the Seychelles on the impact of FAD stranding estimated that 39% of FADs recovered had had an impact on the coral reef (BALDERSON and MARTIN 2015).

[31] Note that there is no purse seine dolphin associated set in the Indian Ocean, this fishing technique is specific to the Eastern Pacific Ocean.

## 4.5 The impact of climate change on Indian Ocean tuna fisheries[32]

Climate change is modifying the physical and biogeochemical conditions of the oceans. The Indian Ocean, and more particularly the western side of the ocean basin, appears to be particularly affected by global warming. A recent study shows that the Western Indian Ocean has for more than a century warmed at a faster rate than other regions of the tropical oceans, and is thus the largest contributor to the global increase in sea surface temperature (SST) (ROXY *et al.*, 2014).

Tuna species are highly sensitive to changes in environmental conditions. Each species is characteristic of a particular habitat, which is mainly determined by temperature and oxygen concentration. If the water temperature exceeds the thermal tolerance or if the oxygen concentration is insufficient to maintain physiological requirements, the tuna will move to different latitudes, longitudes and depths. Coastal upwellings and oceanic eddies are also important parameters for the spatial distribution of tuna as they increase prey availability and influence tuna feeding habitat.

Changes in oceanographic conditions induced by climate change therefore have important implications for the distribution and abundance of tuna species. Ocean acidification could also affect tuna; although its effects on the ecosystem are difficult to predict and have not been integrated into forecasting models. However, some laboratory studies show a negative impact of acidification on the survival of tuna larvae (BROMHEAD *et al.* 2015; FROMMEL *et al.* 2016).

### *4.5.1 Climate change impact on the abundance and distribution of Indian Ocean tuna*

Projections on the impacts of climate change on Indian Ocean tuna are only available for skipjack and yellowfin tuna under a business as usual scenario (RRCP8.5). Projections are not available for bigeye, albacore and longtail tuna.

According to these projections, skipjack tuna, currently present in equatorial and tropical surface waters, will move to higher latitudes. The simulations predict an increase in biomass in the first half of the century, followed by a sharp decrease after the middle of the 21st century. These projections also predict a long-term reduction in yellowfin biomass in the second half of the 21st century, with an average reduction of around 50% (SENINA *et al.*, 2015).

Compared to skipjack and yellowfin tuna, bigeye tuna has a higher tolerance to low oxygen levels and high temperatures. In lower latitudes, the water temperature could be higher than the thermal tolerance and bigeye tuna could move to deeper waters and higher latitudes.

The spatial distribution of albacore is strongly influenced by environmental conditions such as surface water temperature, dissolved oxygen levels, currents and prey concentration. In latitudes and depths where albacore is currently caught, projections indicate an increase in oxygen concentration, which may limit the future distribution of albacore.

Due to the lack of knowledge available on the biology of neritic tunas and their tolerance to environmental conditions, the consequences of climate change on these species cannot be accurately assessed.

[32] This section on climate change is based on the report by Sibylle Dueri: "Impacts of climate change and ocean acidification on Indian Ocean tunas (in press)"

Table 13 summarizes the main impacts of climate change on Indian Ocean tuna species.

**Table 13: Summary of habitat and biomass changes for skipjack, yellowfin, bigeye, albacore and longtail tuna (Source (DUERI 2017))**

| Species | Habitat change | Biomass change | Source |
|---|---|---|---|
| **Skipjack tuna** | **2010-2050**<br>- Degradation of habitat conditions in equatorial waters<br>- Improvement of habitat conditions along the Somali coast and in latitudes above 10°N and 10°S<br><br>**2050-2095**<br>- Strong decrease in equatorial waters<br>- Decrease along the Somali coast and in the North Indian Ocean | **2010-2050**<br>- Increase in biomass<br>-Displacement to higher latitudes<br><br>**2050-2095**<br>- Strong decrease in biomass | Projections according to RCP 8.5 scenario (DUERI, BOPP, and MAURY 2014) |
| **Yellowfin tuna** | - Temperature range favourable to spawning is exceeded<br>- Decreased availability of prey<br>- Degradation of habitat quality | - Long-term decline in biomass after 21st century | Projections using RCP 8.5 scenario (SENINA *et al.* 2015) |
| **Bigeye tuna** | - Habitat could move towards deeper waters and/or higher latitudes<br>- Decreased availability of prey | Unknown | Evaluations by S. DUERI (DUERI 2017) |
| **Albacore tuna** | - Decreased dissolved oxygen concentration in areas and depths where catches of albacore are currently reported<br>- Possible habitat limitation due to oxygen availability | Unknown | Estimations by S. DUERI (DUERI 2017) |
| **Longtail tuna** | Unknown | Unknown | / |

### *4.5.2 Impact of climate change on Indian Ocean fisheries and economies*

The expected changes in the current distribution and abundance of tuna will have major implications for tuna fisheries in the Indian Ocean. The catch volumes and their specific compositions will be redistributed between the EEZs and will have consequences for the national economies of the coastal states (SUMAILA *et al.*, 2011). The price and value of catches are likely to vary, affecting the incomes of fishermen and fishing companies (SUMAILA *et al.*, 2011). To assess the vulnerability of Indian Ocean economies to climate change, we need to consider: 1) the level of exposure to climate change impacts; 2) the sensitivity or importance of tuna fisheries in the national economy and in food security, and 3) the capacity to adapt to these changes (ALLISON *et al.*, 2009).

Least developed coastal states are the most vulnerable to the effects of climate change due to the limited resources available to invest in climate change adaptation (BARANGE *et al.*, 2014). Small island States, whose economies are dependent on fishing, such as the Seychelles and the Maldives, will be directly affected by the displacement of skipjack biomass to more equatorial waters and higher latitudes. However, other countries (Madagascar, Mauritius) could benefit from this latitudinal change in the distribution of skipjack tuna. Indonesia may also be negatively affected by the decline in skipjack biomass after 2050. Projections of yellowfin tuna biomass change (2005-2050) in the Western Indian Ocean are more pessimistic and suggest a decline of between 20% and 40% in the EEZs of tropical coastal countries (from Oman to Mozambique, as well as Madagascar).

These consequences will be even more pronounced in coastal communities that rely heavily on fisheries for their food and economic security (BARANGE *et al.*, 2014). This is particularly the case in the Maldives, Indonesia and Sri Lanka, which are highly dependent on tuna catches (especially skipjack tuna) to ensure their animal protein intake. Any change in tuna distribution or abundance thus directly threatens the food security of coastal populations.

Changes in the distribution and catchability of tuna species also threaten the profitability of fishing operations and could lead to the shifting of fishing zones. Artisanal fleets, which make up the bulk of the catches in the Indian Ocean, are particularly threatened by these changes because of the coastal nature of their operations and their limited capacity to operate in more remote fishing areas. Artisanal fishers and coastal communities and value-chain operators dependent (middlemen, fish wholesalers, processors) on fishing activities could see their incomes drastically reduced and their livelihoods threatened.

For coastal states that have canneries, changes in the distribution and abundance of tuna are likely to greatly limit the supply to these canning plants and thus threaten the profitability of these processing units. This redistribution of tuna species would also affect the fresh tuna industry. This industry is mainly supplied by artisanal units targeting the fresh tuna market, which are considerably limited within their operational range by the storage time of their chilled catches. Without the use of trans-shipping, artisanal fishing units are not able to move away from the coastal strip to access tuna resources and supply processing units with fresh tuna.

In the case of States that derive income through the granting of fishing rights, changes in the distribution and abundance of tuna directly threaten government revenues and in some cases the budget allocated to the fisheries ministries.

Maldives tuna fisheries are particularly sensitive to climate change related variation. Indeed, climate change also affects coral reefs and reef species and thus directly threatens live bait fisheries, which target these reef species. Any change in the distribution or abundance of these reef species directly threatens Maldivian line, and pole and line, tuna fisheries, which are highly dependent on these live baits for their operations (Marine Research Center 2016; SINAN 2017b).

However, the future of tuna fisheries is not only determined by climate change. A study using a model linking economic and ecosystem data has shown that an increase in demand for tuna products could lead to a collapse of tuna fisheries in the coming decades, long before climate change has affected these tuna stocks (MULLON *et al.* 2016).

## 4.6 Conclusion

As in other ocean basins, the tuna fleets operating in the Indian Ocean are in a situation of overcapacity. The important role of artisanal fishing units is a characteristic of this basin, making it extremely difficult to assess the existing capacity of the fleets. The "development aspirations" of coastal States have been taken into account and these fleets have been able to submit national fleet development plans to the IOTC. The implementation of the majority of these plans is impossible, but if this was not the case the increased capacity resulting from these plans would be likely to lead to a collapse of Indian Ocean tuna fisheries. The reconciliation of the development aspirations of coastal States with the maintenance of a fishery that enables the sustainable exploitation of resources currently seems unlikely.

The importance of coastal fisheries also limits the available data for stock assessment. The assessments produced do not provide a clear picture of the state of stocks, particularly for neritic tunas and bycatch species, whose stocks are estimated using data-poor assessment methods. Despite this lack of certainty regarding the actual state of stocks, nearly 44% of tuna catches in the Indian Ocean come from stocks in critical situations: stocks of yellowfin tuna and longtail tuna are both in an overexploited and overfished situation (IOTC-SC19 2016 2016). Coastal artisanal fleets are the main contributors to the catches of these two species. Thus, in contrast to the idyllic image attached to artisanal fisheries, in the case of the Indian Ocean their impact on the most threatened species is greater than that of the industrial fleets.

Some of these coastal artisanal fleets also have a major impact on the ecosystem. Artisanal gillnetters from Iran and Pakistan are responsible for major volumes of bycatch and have a major impact on cetaceans, turtles and sharks. The industrial longliner fleet is also one of the fleets with the greatest impact on bycatch, including sailfish and marlins, some of which are considered vulnerable or endangered by IUCN. Purse seiners' FADs have a lesser impact in terms of bycatch but lead to higher levels of juvenile catches of bigeye and yellowfin tuna, which considerably affect the biological productivity of these stocks.

Finally, according to the forecasts from the main scientific models, climate change could have major consequences for Indian Ocean tuna. Tuna fisheries and coastal States are directly affected by changes in the distribution and abundance of tuna species. In particular, artisanal fisheries are highly affected by these changes in tuna distribution, due to their limited capacity to operate in distant waters. However, these fisheries have a considerable impact in terms of employment and food security for coastal communities. Any change in fishing operations thus directly threatens the incomes of fishers, middlemenand processors, which is an important part of employment in coastal communities. Any decline in the catches of these artisanal fisheries also jeopardizes the food security of some countries, since the catches of these fisheries are the main source of protein at the national level.

# 5. What governance for tuna fisheries in the Indian Ocean?

Different actors are involved in improving the sustainability of tuna fisheries in the Indian Ocean. Depending on the nature of these actors (public or private) and their scale of action, there are several types of governance that apply to Indian Ocean tuna fisheries:

- Regional governance at the level of the IOTC area of competence;
- National governance at the level of the EEZ of each coastal State;
- Market-based governance, at the level of supply chains, emanating from certain market players committed to integrating more sustainability into seafood products.

These types of governance consider tuna resources in different ways. Within the framework of the IOTC and coastal States, tuna is regarded as a natural resource which management must be framed (GUTIERREZ and MORGAN 2016). Market actors consider tuna as a commodity that reaches end markets according to a supply chain that they can influence through their market power (GUTIERREZ and MORGAN 2016).

## 5.1 Tuna as a regional resource: the weaknesses of the Indian Ocean Tuna Commission

The Indian Ocean Tuna Commission (IOTC) is the regional organization responsible for the management of tuna fisheries in the Indian Ocean. It currently has 32 members, including Indian Ocean Coastal States and remote fishing nations (IOTC 2016d). The IOTC mandate includes 16 tuna and large pelagic species. Beyond these species, the Commission Secretariat collects data on bycatch, non-target and dependent species that are affected by tuna fishing activity (CTOI 2016a).

### *5.1.1 Confrontation between two blocs that limits the establishment of management measures*

Within the IOTC plenaries, two major blocs with opposing views can be observed: the bloc of distant fishing nations, which includes the European Union, Japan, Korea and China, and the bloc of coastal States, mainly led by the Maldives, Mauritius, South Africa and more recently the Seychelles.

The arrival of South Africa in 2016 has considerably changed the way debates are organized (although tuna catches in South Africa are marginal).[33] This country has positioned itself as the leader of coastal States, particularly African States, and strongly supports the right of coastal States to develop. The Maldives has also positioned itself as a regional champion of sustainability and often provides motions for resolution. Mauritius has also become a strong actor in proposing management measures. Formerly aligned with the Spanish perspective, the position of the Seychelles has recently changed to follow the Maldivian and Mauritian positions. These three countries and South Africa constitute the main coastal States bloc that provides the main proposals for management measures. Within this

[33] Around 350 tonnes over the period 2011-2015 (IOTC-2016-DATASETS-NCDB 2016)

coastal States bloc, many African States (Kenya, Mozambique, and Tanzania) are also increasingly involved in the establishment of management proposals.

Opposing this bloc, the European Union, Japan, China and Korea represent the interests of distant industrial fisheries.

The debates are thus polarized between distant and industrial fishing fleets on one side, and mainly artisanal coastal fleets on the other, with two distinct rationales. In the eyes of coastal States, distant fishing fleets are the main ones responsible for the reduction of resources, and operate only for profit. By contrast, artisanal fleets are more ecologically virtuous and guarantee national food security and livelihoods.

Thus, for tropical tunas, distant industrial fleets are often regarded as the main culprit for the decline in stocks: *"Distant water fishing nations are seen as a villain getting in the way of sustainability",* is the general opinion often heard in the corridors of the IOTC. Artisanal fisheries in coastal developing countries emphasize their contribution to the economy and local food security. The management measures for the recovery of the yellowfin tuna stock have thus mainly focused on the European industrial purse seiner fleet (IOTC 2016).

The majority of the fleets of these coastal States are indeed exempt from management measures because of their artisanal status, even though their contribution to total catches and the overexploitation of stocks is notable. This "double standard" reduces the effectiveness of management measures, which should ideally apply to all fleets that have an impact on stocks.

Within some coastal countries, there is also a demonization of the industrial purse seiners and the associated FADs, which are perceived as the main drivers of stock overexploitation: "*FADs are harmful to our economies*", is the view of certain countries in the region.

Thus, the main proposals for management measures from coastal countries have in recent years almost exclusively focused on the regulation of FADs and supply vessels in the purse seine fleet. It is debatable whether focusing on this fleet is appropriate, since it contributes only 22% of the total catch. In addition, this focus on purse seiners obscures the important impacts of artisanal fleets on catches of tropical tunas or bycatch species for example. For some, this focusing of the debates onto the purse seine fleet reflects a growing lack of understanding between the European Union and certain Indian Ocean coastal countries.

In the case of neritic tunas where stock degradation is solely linked to the catches of artisanal fisheries,another bloc of coastal States exploiting those neritic ressources invoke their national sovereignty to oppose any management measures. Stocks of neritic tuna are considered to be national stocks, and there is tension among coastal States regarding the shared nature of the resource. This argument is not in line with the provisions of the United Nations Convention on the Law of the Sea, since stocks of neritic tuna, although coastal, are straddling stocks and fall within the mandate of the IOTC (MARSAC 2017). In the case where artisanal fisheries are likely to be affected by management measures, the question of the applicability of these management measures on fishing units that are scattered, multi-specific and multi-geared is systematically raised.

The black-and-white view of the two blocs can be summarized as: a distant industrial fleet motivated solely by profit versus a mainly artisanal coastal fleet that guarantees food security and livelihoods in coastal areas. However, these two blocs are far from homogeneous. Thus, within the European fleet, there is a growing dissension between the French position and those of certain Spanish shipowners. The French position is sometimes considered more balanced in terms of the use of FADs and supply vessels, and is close to the position of the Seychelles and Mauritius. Conversely, some Spanish shipowners advocate the extensive use of FADs and supply ships. This difference is explained by the fishing models implemented by the shipowners (see 2.4.2: Industrial fishing gear).

### *5.1.2 Difficulty in establishing a quota system*

This bloc situation is reflected in the ongoing discussions on the allocation of fishing quotas. At present, the IOTC does not impose quotas (or "fishing opportunities") and for nearly 6 years the contracting parties have debated the definition of the allocation criteria for these quotas. Foreign fleets advocate allocation criteria based on catch history, while coastal fleets argue for allocation criteria based on catch geography (based on the catch level within each EEZ). Within these discussions, the coastal fleets regularly present themselves as the most legitimate exploiters of the region's tuna resources. Coastal States also invoke their development aspirations to justify the use of geographical allocation criteria. At the IOTC plenary session in 2017, the proposal for management measures on the allocation of fishing opportunities based on catches in EEZs has met with strong opposition from distant fishing nations.

In the event of the establishment of a quota system, its implementation would be complicated by the insufficient means of coastal States for monitoring and control (MORENO 2013). Thus, the majority of countries with a large artisanal fishing fleet are unable to produce real-time reports to accurately estimate on an annual basis the date at which the quota has been exceeded (MORENO 2013).

Moreover, the lack of compliance of some coastal States suggests that these States would not respect these quotas. The lack of confidence in the management capacities of some coastal States would thus negatively impact on the actual implementation of this quota.

### *5.1.3 Weakness of the management measures in place*

The management measures implemented within the IOTC are relatively weak and there are currently no quota systems or measures that constrain fleet capacity. With the exception of skipjack tuna, the IOTC has no harvest control rules in place.

These catch control rules define the level of fishing on a given tuna stock depending on the status of that stock. They consist of a previously accepted emergency measure that is only taken when the stock decreases to a defined level. These control rules are thus management measures taken in response to changes in the status of stocks (Atuna 2017). IOTC does not have a "safety net" for exploited stocks. It should be noted that these catch control rules are also mandatory for fisheries wishing to obtain MSC certification.

Although some fleets are subject to the Vessel Monitoring System (VMS), vessel position data are not centralized at the IOTC level. The data are only kept by flag States and are not analysed at the level of the IOTC Compliance Committee.

Finally, for existing management measures, there is a low level of compliance by Member States (CEO *et al.*, 2012). This lack of compliance considerably reduces the effectiveness and scope of management actions taken by the IOTC.

### *5.1.4 Lack of consideration of socio-economic criteria in the definition of management measures*

Despite the importance of the contribution of artisanal fleets to total catches and the national importance of fishing for some coastal States, the IOTC does not currently collect socio-economic data.[34] It was not until 2017 that this collection of socio-economic data was the subject of a management measure proposal.

This lack of consideration of socio-economic aspects is also reflected in the definition of management measures. Thus, the implementation of Resolution 16/01 on yellowfin tuna[35] had important consequences for the fleet of industrial purse seiners and especially for the Indian Ocean canning countries. This resolution was amended 6 months after its implementation because of these socio-economic impacts to allow fleets of purse seiners and canneries to operate for a few more months.

Consideration of these socio-economic criteria, although necessary, further complicates the implementation of management measures. Within some coastal states of the Indian Ocean, the economic importance at the national level of tuna fisheries and tuna catch processing makes management measures very sensitive. Any reduction in catches would directly impact on the national economy of these countries, with considerable effects on employment, trade balance and food security. This is particularly the case in the Seychelles and Maldives, where the economic contribution of the tuna industry is important and represents the main pillar of the economy of these countries, together with tourism.

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[34] Ex-vessel prices, prices of species under IOTC mandate on local markets, export prices, etc.

[35] The CPCs will reduce their catch of Yellowfin as follows: 3. Purse seine: a) CPCs whose Purse seine catches of Yellowfin reported for 2014 were above 5000 MT to reduce their Purse seine catches of Yellowfin by 15 % from the 2014 levels. b) The number of Fish Aggregating Devices (FADs) as defined in Resolution 15/08, paragraph 7, will be no more than 425 active instrumented buoys and 850 acquired annually instrumented buoys per purse seine vessel. c) Supply vessels: The total number of supply vessels by CPC on the IOTC active list shall not exceed half of the number of Purse seine vessels reported per CPC on the IOTC active list for the same year. Complementary to Resolution 15/08 on “Procedures on FADs Management Plan including a limitation on the number of FADs, more detailed specifications of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species” and to Resolution 15/02 “Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs)”, CPC shall report annually which Purse seiners are served by each Supply vessel. In the light of assessments made available by the Working Group (WG) on FADs and the Scientific Committee, the Commission shall update, if necessary the above limits in point b) and c). 4. Gillnet: CPCs whose Gillnet catches of Yellowfin reported for 2014 were above 2000 MT to reduce their Gillnet catches of Yellowfin by 10 % from the 2014 levels. 5. Longline: CPCs whose Longline catches of Yellowfin reported for 2014 were above 5000 MT to reduce their Longline catches of Yellowfin by 10 % from the 2014 levels. 21 // RESOLUTION 16/01 // 6. CPCs’ other gears: CPCs whose catches of Yellowfin from other gears reported for 2014 were above 5000 MT to reduce their other gear catches of Yellowfin by 5 % from the 2014 levels.

## 5.2 National governance: coastal States with limited fishery management policies

Fishing States (distant and coastal) play a major role in the management of tuna fisheries. Coastal fleets contribute nearly 80% of total tuna catches in the Indian Ocean and coastal States thus play a leading role in the management of tuna fisheries.

The primary role of coastal States is to establish an effective monitoring and control system for their tuna fisheries, enabling them to report their catches to the IOTC. These States may also introduce management measures specific to their tuna fleets, limiting the use of certain fishing gear or limiting fishing capacity.

Within coastal countries, fishery management policies vary considerably and appear to be poorly developed in some States. Among the coastal countries, the Maldives, Sri Lanka and Indonesia have recently adopted fishery management policies that reserve the exclusive use of resources for national fleets. The common feature of these States is that they have closed their EEZs to foreign fleets, either to combat illegal fishing (Indonesia, Sri Lanka) or to allow their national fleets to exclusively exploit their fishery resources (Indonesia, Maldives). This closure of EEZs allows States to concentrate their monitoring and control efforts on their national fisheries and to facilitate the establishment of management measures. In the case of Indonesia, this policy of EEZ closure is also justified through food security arguments: "*security of protein is very important for our country*" (PUDJASTUTI 2017). Measures taken by the Government of Indonesia to combat illegal fishing have facilitated the monitoring of the catches of longline vessels through the prohibition of trans-shipping at sea and the change in the licensing arrangements.

Some countries are also attempting to reorient the fishing practices of their fleets towards gears considered to be more sustainable. The Maldives and Indonesia have thus prohibited the use of the purse seinein their national waters, while Sri Lanka is reorienting its fleet of gillnetters towards other fishing gear. Iran has frozen the licensing of gillnetters and is trying to convert these vessels back to purse seine or longline (IFO 2017). Coastal fishing nations may also impose certain measures on fleets operating in their EEZ. This is the case for Mauritius, which has introduced a landing requirement for longline fleets operating in their economic zone, enabling them to have a better estimate of the volumes caught by these fleets and their destination. This landing obligation also generates economic spill-over effects : port revenues, processing activity for Mauritian canneries, export taxes, etc.

However, most coastal States have not defined an actual fishing policy and even fewer States have a specific management policy for tuna fisheries (IOC 2016). No country has set quotas or restrictions on tuna catches.

The majority of coastal States in the area are reluctant to invest in the management of their fishery resources. Thus, most of these States do not have adequate control and monitoring facilities and often struggle to manage scattered, multi-specific and multi-gear artisanal fisheries. As mentioned above, some States cannot accurately estimate the amounts caught by their national fleets.

Finally, among the Indian Ocean coastal States, some do not comply with the measures implemented by the IOTC, in particular regarding the submission of information (IOTC 2017). Thus, the three least respected resolutions are 15/02 on mandatory statistics, 05/05 on shark data and 11/04 on the regional observer mechanism (IOTC 2017). In 2016, several States did not submit their national reports. Some States do not participate in IOTC meetings and working groups (IOTC 2017). In 2016, only 60% of IOTC members participated in the scientific committees (IOTC 2017). This low participation is explained by the limited budgets of certain States, but also by the lack of scientific personnel authorized to attend such meetings.

## 5.3 Market-based governance: an application limited to export markets

In recent years, demand for sustainable seafood has led to the development of non-state market-oriented governance tools to improve fisheries governance (GUTIERREZ and MORGAN 2016). These tools are mainly: certification programmes (ecolabels and labels), fishery improvement projects (FIPs), and traceability programmes (GUTIERREZ and MORGAN 2016).

### *5.3.1 MSC and Fair Trade labels*

The MSC ecolabel is the main ecolabel in the seafood and tuna industry. In 2015, eleven tuna fisheries were certified, which accounted for nearly 17% of the world's catches (GUTTERIDGE 2016). Of these, only one was from the Indian Ocean: the Maldivian pole and line vessels targeting skipjack tuna (MSC 2016).

Many distributors use the MSC label, considered as the "gold standard" of ecolabels, to show their commitment in terms of sustainability. It allows them to facilitate their supplies while avoiding the need to develop expertise to understand the problems related to stock status, the impact of fishing practices on habitats, bycatch and stock management (GUTIERREZ and MORGAN 2015).

The MSC ecolabel certifies wild fisheries in freshwater and at sea and has two standards:

- A Fisheries Standard, used to assess the sustainability of fishery catches;
- A Chain of Custody Standard, which ensures product traceability.

The Fisheries Standard is composed of three main principles, which are presented in Table 14.

**Table 14: Principles of the Fisheries Standard (Source: (MSC 2015a))**

| | |
|---|---|
| **Principle 1: Sustainability of targeted stocks** | Fishing activity must be at a level that ensures the sustainability of fish populations. Each certified fishery must ensure that its fishing activity can be exercised indefinitely without leading to resource overexploitation. |
| **Principle 2: Preservation of ecosystems/minimizing environmental impacts** | Fishing operations must be managed in such a way as to preserve the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends. |
| **Principle 3: Effectiveness of the Fisheries Management System** | The fishery must comply with all local, national and international laws and standards and must incorporate institutional and operational frameworks that require responsible and sustainable use of the resource. |

However, the MSC is today subject to certain criticisms as to the credibility of its fishery standard:

- Certification is open to any fishing gear type, regardless of its impact on the ecosystem;
- Cumbersome nature and complexity of the procedure for objecting to certification (POTTS *et al.*, 2016);
- Not much improvement in fisheries once certified (FROESE and PROELSS 2012,MRAG 2011; POTTS *et al.* 2016) ;
- Unproven positive environmental impact (some stocks of certified fisheries are in situations of overexploitation or overfishing) (FROESE and PROELSS 2012);
- Simplification of the definition of catch control rules which enable certain fisheries to access certification even though they are poorly regulated (WWF 2016);
- Costly and inaccessible certification for artisanal fisheries (POTTS *et al.* 2016).

Due to its market power, the MSC ecolabel is economically necessary for certain processing units in the Indian Ocean to gain access to European markets. Most companies processing fresh tuna declare that their European customers demand MSC certification on their products. Canned tuna markets, and more particularly the European markets, are also very demandingfor MSC-canned tuna products. . Beyond certifying the sustainability of catches, the MSC ecolabel also gives a company a good image, one that assures final market buyers of the quality of the certified company.

Obtaining MSC certification requires the establishment of control rules on the entire stock exploited by the fishery wishing to obtain the label. Also, to obtain their MSC certification, the Indian Ocean tuna processing industries are dependent on the implementation of management measures at the IOTC level. Some processing units have therefore put pressure on their national governments to encourage them to propose the implementation of management measures within the IOTC. This is the case for the Maldives, which during the 20$^{th}$ IOTC plenary advocated for the establishment of catch control rules for skipjack tuna. Indeed, in the absence of the adoption of such measures by the IOTC, the Maldives would have lost their MSC certification for their skipjack pole and line fishery. The MSC thus exerts a certain market pressure on processors, who then lobby coastal States to push for management measures or the definition of catch control rules, and these States in turn transfer this request to the IOTC negotiating arena.

The MSC ecolabel has also helped raise awareness in some of the Indian Ocean coastal countries about fisheries management. Indonesia has thus assessed its tuna fisheries according to the MSC criteria and used the results of this assessment to formulate new management measures for these fisheries.

However, the MSC ecolabel remains hard to access for artisanal fisheries, which account for almost half of the Indian Ocean catches. The absence of social and economic criteria also penalizes these artisanal tuna fisheries, since their major role in coastal communities is not given sufficient recognition. To overcome these difficulties in obtaining this MSC label, some artisanal tuna fisheries in the Indian Ocean are turning to the Fair Trade label, in particular the artisanal tuna fisheries of Indonesia and the Maldives. This label is adapted to artisanal fisheries, it includes a price premium and highlights the social and economic benefits of artisanal fisheries. It also includes environmental criteria for the status of the stock and bycatch species affected by the fishery. This label also includes criteria on catch data collection and fishing management system (Fair Trade 2016). Although the launch of this label is still underway, it is possible to imagine that it could compete with the MSC in the Indian Ocean due to its better adaptation and accessibility to the characteristics of artisanal fisheries, and its recognition of the social and economic criteria, which is increasingly demanded by consumers. Indeed, the seafood industry and particularly the tuna industry, have recently found themselves in the limelight following numerous reports denouncing working conditions on fishing vessels and processing units. The social and economic component will certainly be an additional criterion in the consumer demand for sustainable products, and the Fair Trade label can help to address these concerns, unlike the MSC that does not include any socio-economic aspects.

### *5.3.2 Are Fisheries Improvement Projects (FIPs) a bluewashing instrument?*

Fisheries Improvement Projects (FIPs) bring together supply chain actors, NGOs, fishers, distributors and processors to identify the changes needed to improve the sustainability of fisheries (GUTIERREZ and MORGAN 2016 ). These FIPs are generally linked to the supply policies of seafood distributors.

The shift of fisheries towards greater sustainability depends directly on the type of FIP implemented (TOLENTINO-ZONDERVAN *et al.*, 2016). California Environmental Associates has defined 4 FIP archetypes (California Environnemental Associates 2015):

- Top-down FIPs are generally issued from supply chains and are primarily aimed at facilitating market access. Fisheries are encouraged to introduce more sustainable fishing practices in exchange for facilitated market access. These FIPs require a high level of individual ability and run the risk of selecting only those fishers who are most economically comfortable and capable of meeting the sustainability criteria, in exchange for a price premium (TOLENTINO-ZONDERVAN and Paragraph 2016). These FIPs could thus considerably reduce the scope for improvement of fisheries, by leaving behind the fishers who do not have such capacities to be included (TOLENTINO-ZONDERVAN *et al.*, 2016). However, the economic impact on fishers is clearly marked, whether in terms of price clarity or in terms of premium (TOLENTINO-ZONDERVAN *et al.*, 2016). In addition, this type of FIP can also allow fishers to be trained in fish handling to improve the quality of fish sold and to reduce post-harvest losses;

- Bottom-up FIPs are primarily aimed at improving fisheries and are generally carried out by NGOs. These FIPs are more inclusive and allow wider fisher participation but appear less effective for the development of improvements at the scale of the entire fishery (TOLENTINO-ZONDERVAN *et al.*, 2016). Moreover, the price benefits are not directly available to fishers because these FIPs result in a weak relationship between the supply chain and the fishers involved (TOLENTINO-ZONDERVAN *et al.*, 2016). However, this type of FIP is the most likely to receive sustained support from governments that can be directly involved in the process of improving fisheries management (TOLENTINO-ZONDERVAN *et al.* 2016);
- Basic FIPs are characterized by a simple, low cost model that offers small incremental improvements to advance fisheries towards greater sustainability. These FIPs are usually initiated by NGOs or fishing associations and generally concern artisanal fisheries that are not eligible for MSC certification. In the Indian Ocean, Indonesian fishery FIPs are basic FIPs (Table 15);
- Comprehensive FIPs are mainly aimed at obtaining MSC certification and are associated with more structured fisheries, with the necessary means to obtain certification. These FIPs usually come from well-structured distributors or fisheries that wish to improve their market access. The FIP established by the South West Indian Ocean canneries and purse seiners is an example of a comprehensive FIP, that ultimately aims to obtain MSC certification.

**Table 15: The main Indian Ocean FIPs (Source : (CEA 2016; WWF Indonesia 2016))**

| Country | FIP name | FIP type | Remarks |
|---|---|---|---|
| **Indonesia** | Indian Ocean Longline Tuna FIP | Bottom up | The FIP was initiated by the NGO Sustainable Fisheries Partnership and then taken over by the company PT Intimas Surya (CEA 2016). |
| | WWF Seafood Savers Programme | Bottom up | The Seafood Savers programme began in 2009 and consists of a B2B platform to facilitate producers, distributors, restaurants, hotels and financial institutions to develop sustainable fishing models. |
| | Indonesian Pole & Line and Handline Tuna FIP (AP2HI) | Bottom up | The FIP was established in 2013 by the association AP2HI (Indonesia Pole, Line and Handline Association). The development of the action plan for this FIP was supported by the IPNLF in collaboration with other NGOs. |
| **Mauritius, Madagascar, Seychelles** | Indian Ocean Tuna Fishery Improvement Project | Top down | This FIP was initiated by the Government of the Seychelles and the IOT cannery. The governments of Mauritius, Madagascar and the shipowners of the region then joined this FIP. WWF is also involved in this FIP.<br><br>Participants include: TUNSA Inc.; Beach Fishing Limited; Compagnie Française du Thon Océanique (CFTO); Hartswater Limited; Inspesca Fishing Ltd; Indian Ocean Ship Management Services (IOSMS); Interatun Ltd.; Industria Armatoriale Tonniera; Isabella Fishing, Ltd; OPAGAC; Orthongel; OPTUC (ANABAC); Princes Limited; SAPMER SA; Thai Union Europe; Thunnus Overseas Group; and Tuna Fishing Company (TFC). |
| **Sri Lanka** | National FIP | Bottom up | This FIP was initiated by the Sri Lankan Exporters Association and the Ministry of Fisheries. |

The development of these FIPs is directly linked to the commitments of distributors. Under pressure from environmental NGOs, these distributors must demonstrate that their seafood supply is sustainable.

One of the main approaches of these commitments is to source only from fisheries with the least ecological impact, such as line and pole and line fisheries. However, the volumes caught by these fisheries are small (10% of world catches) and most of these catches do not reach the final markets (as the Maldives example shows). Another approach considered by distributors is to deal only with MSC-certified fisheries. Again, certified catch volumes are low: nearly 17% of the world tuna catches are certified (MSC 2016). In the Indian Ocean, pole and line catches represent 7% of the total catches in the Indian Ocean, 6% of this total catch derives from the certified pole and line fishery in the Maldives.

Faced with this shortage of sustainable seafood products, FIPs are an attractive alternative for distributors, since they enable them to “create”, at lower cost, large volumes of seafood “that are in the process of becoming sustainably produced”. These FIPs also provide protection against NGO criticism.

This is demonstrated by Thai Union, the global tuna giant, which has committed to ensuring that by 2020, 75% of its canned tuna will be sourced from MSC-certified fisheries or engaged in a FIP aiming for MSC certification. Thai Union has thus invested nearly 90 million dollars in this initiative, particularly an investment to create eleven FIPs (Thai Union 2016). These FIPs enable the company to fulfil its sustainability commitments without being constrained by the available volumes.

In some cases, however, the credibility of these FIPs is debatable. At present, any fishery may claim to be engaged in a FIP. So far the MSC has had no control over the development of these FIPs. In some cases it is difficult to distinguish the basic FIPs from the comprehensive ones because many fisheries claim that they are aiming for MSC certification, but are unable to obtain it. There is currently no clear distinction between fisheries engaged in a FIP to access MSC certification and fisheries engaged in a FIP just to improve their fishing practices or improve their market access (bluewashing) and MSC.

The lack of clarity on the definition of a credible FIP allows distributors to proclaim themselves to be “sustainable” without making major changes. FIPs thus make it possible to “pre-sell sustainability” (when they ultimately aim to achieve MSC certification) or simply constitute “bluewash” that acts as a shield against the attacks of certain NGOs.

### *5.3.3 The demand for traceability: a new data collection tool?*

Beyond consumer demand for sustainable tuna products, there is currently a strong pressure on companies to guarantee the traceability of their products. Regulatory requirements for export markets require seafood suppliers to publish information on fishing methods, catch area and fishing gear. Some seafood buyers go further, by asking their suppliers for traceability of their products, sometimes even down to the fishing boat. In the case of the sector supplied by artisanal fishers, this demand can sometimes be difficult to satisfy since these sectors are supplied by a large number of small fishing vessels, generally dispersed along the coast. This recent requirement for traceability plays a major role in the supply policy of processing units and also affects fisheries management policies.

In recent years, different actors have been involved in several segments of the value chain to improve the availability of data on fisheries (BUSH and BAILEY 2014). Some NGOs aim to improve the data requested by RFMOs while others are positioning themselves on the market to improve the information requested by consumers (BUSH and BAILEY 2014). Technological developments (tablets, smartphones) play a major role in this data collection, making it easier to report catches and to rapidly transfer them to a high number of recipients.

This progress in data collection makes it possible to improve the information available on artisanal fisheries. The data collected, if communicated to the government, will enable the improvement of knowledge available on fisheries and will thus improve fishery management (BUSH and BAILEY 2014). This demand for traceability could also provide incentives for artisanal fisheries to move towards a better knowledge of their fisheries and an improved sustainability through improved data collection (BUSH and BAILEY 2014).

Moreover, the establishment of traceability throughout the whole supply chain also represents a particular form of valorization of artisanal catches. At present, it is increasingly important to be able to sell seafood "with a story" (KRAFT 2017). Tuna sold with the fisher's image and a description contributes to the promotion of artisanal fisheries and improves their access to final markets.

### *5.3.4 EU policy on the fight against illegal, unreported and unregulated fishing*

Although this falls under the public standards of a community of States, we will consider here the EU policy to fight illegal fishing as a matter of market governance because it relies on the market power of the EU (the largest seafood importer) to bring about changes in the fisheries management regimes of third countries.

Since 1 January 2010, the EU has set up a community system to prevent, deter and eradicate illegal, unreported and unregulated (IUU) fishing, with the adoption of Regulation (EC) No 1005/2008 (European Commission 2009). This Regulation extends the EU's regulatory capacity, particularly of DG MARE, to fisheries beyond its jurisdiction. Indeed, this regulation applies to all seafood products caught by vessels operating under the jurisdiction of EU Member States, as well as vessels operating on the high seas or in waters under national jurisdiction of third states (non-EU members) (European Commission 2009). Coastal, flag and port states thus have to satisfy three conditions (MILLER, BUSH, and MOL 2014):

- Fish imported into the EU must have a catch certificate. Third countries must have a competent domestic authority to attest to the veracity of the information contained in this catch certificate;
- EU-supplying ships cannot be on the list of vessels recognized by the EU as having carried out illegal fishing activities;
- Fish must not come from a third country recognized by the EU as non-cooperating. Fish from such a country are prohibited from export to the European market and their catch certificate will not be accepted.
- The EU has put in place a progressive system to establish a list of non-cooperating third countries. Countries considered as non-cooperating are prohibited from exporting their seafood products to the European market ("red card") (Appendix 4).

This policy uses the market power of the European Union as a lever for action to fight against illegal fishing practices. In the Indian Ocean tuna fisheries, only Sri Lanka and Comoros[36] have received a red card and therefore a total ban on exports to the European market. The European Union issued this red card to the Government of Sri Lanka on 15 December 2014 and the export ban took effect on 15 January 2015 (SUBASINGHE 2016). This export ban had a major impact on the Sri Lankan tuna industry and the Sri Lankan fisheries management system. Following the inclusion of Sri Lanka in the non-cooperating country registry, the Sri Lankan Government was very responsive and put in place a package of measures (MFARD 2015) including:

- A letter of credit has been opened for the purchase of 1,500 VMS beacons;
- The opening of the Fishing Monitoring Center and the training of staff working at the centre;
- Establishment of fishing log books;
- Establishment of an awareness and training programme about fishing on the high seas for 2,800 fishers;
- Withdrawal of eight purse seine vessels from the Sri Lankan and IOTC vessel registry;
- Strengthening of the legal framework governing fisheries on the high seas through the amendment of the Fisheries and Aquatic Resources Act No. 2 to include sanctions as suggested by the EU.

The Sri Lankan government responded quickly by implementing a more robust and structured fisheries management policy. *"As a personal opinion this (EU policy) has been a very good way to improve management. It was really appreciated. Now we have a good management system"* (MINISTRY OF FISHERIES RESOURCES AND AQUATIC RESOURCES DEVELOPMENT 2017).

All longliners operating on the high seas are thus monitored via a VMS and are registered with the IOTC (IOTC-SC19 2016 2016).

The credibility of the Ministry of Fisheries and its influence on the fishers and processing industries have been reinforced, with industries and fishers now showing more respect and responsiveness to the recommendations of the Sri Lankan government (MINISTRY OF FISHERIES RESOURCES AND AQUATIC RESOURCES DEVELOPMENT 2017). This form of market governance has thus made it possible to significantly improve the national fisheries management system of a third State.

### 5.3.5 Limits of market-based governance: an effectiveness restricted to export markets

Market governance, through labels and the demand for fishery improvement and traceability, comes mainly from European and North American markets, for which the sustainability of seafood is increasingly important. Only catches intended for this market are likely to be affected by this type of governance.

However, in the Indian Ocean, more than half of the tuna catches are destined for local markets. These local markets are important markets in volume but also in value. The bulk of the catch of neritic tuna (and especially longtail tuna) is consumed locally and, in countries with fresh tuna processing units,

[36] It should be noted, however, that in contrast to Sri Lanka, Comorian seafood exports to the European Union were very low.

the tuna rejected by these units is resold on local markets. Iran is also an important market, especially for neritic tunas, . The Iranian market operates in isolation, and is only supplied by the catches of the Pakistani and Iranian tuna fleets.

Within these local markets, consumers are generally insensitive to the sustainability of fisheries, particularly in terms of the size of tuna consumed and the impact of fishing gears on the ecosystem or bycatch. There is thus no market pressure on consumers to guide fishing practices towards sustainable fishing practices. Environmental NGOs (Greenpeace, WWF) do not intervene in these markets and do not develop consumer awareness campaigns. Labels (MSC, Fair Trade) are not present in these markets and have a limited presence in export markets. The Japanese market also seems to have little awareness of seafood sustainability issues at present, and ecolabels have a very limited presence in this market (SWARTZ *et al.*, 2017). A major proportion of tuna catches from the Indian Ocean therefore avoid market-based governance.

In the can market, the stagnation of tuna demand in traditional markets (European Union, United States) has led to a redirection of canned tuna exports to emerging markets, particularly in the Middle East (GLOBEFISH 2017). Thus in 2015, Saudi Arabia represented the main recipient of canned tuna exports from Indonesia. These emerging markets constitute growing markets and, in some cases, are high value markets for Indonesian canneries. The Saudi Arabian market is thus estimated at nearly 30,000 tonnes, the Egyptian market at 45,000 tonnes and the Libyan market at nearly 35,000 tonnes (SENGUPTA 2014, 2014, ITC Trade Map 2017). Consumers in these markets are, however, not currently aware of the sustainability issues of tuna fisheries. Although these emerging markets are unlikely to outweigh the market volumes of "traditional" markets (EU 700,000 tonnes, US 400,000 tonnes), there is a risk that constraints related to traditional market demand for sustainable tuna products may lead some canneries to redirect towards these emerging markets. The stagnation of demand in these traditional markets, the ones that are most aware of sustainability issues, could thus impact on the shift of the canning industry towards greater sustainability, insofar as these emerging markets constitute growing markets.

## 5.4 Conclusion

The Indian Ocean tuna fisheries appear to be subject to a low level of governance at all levels considered: regional, national and market levels.

The IOTC struggles to both define management measures and ensure their application. The lack of catch data undermines the credibility of scientific advice and is a widely cited argument to avoid the introduction of a precautionary approach. The level of compliance of IOTC Member States is still very low and no sanctioning measures have been defined to penalize non-compliance with the resolutions. The organization of members into blocs of either coastal states or distant fishing fleets makes it difficult to negotiate and implement management measures. These two blocs are conflicting: artisanal fisheries consider themselves as guarantors of food security and local jobs, while industrial fleets are regarded as the main culprits for the degradation of stocks by focusing only on profit. This caricature does not, however, stand up to an analysis of the realities of artisanal fisheries, which contribute significantly to the main commercial tuna catches and are able to export them to international markets. Recent debates on the criteria for allocating fishing opportunities now seem to have stalled, which prevents the IOTC from moving towards the adoption of a quota system.

National governance at the scale of the EEZs, or in the case of distant fishing nations at the scale of the fleet operating in the Indian Ocean, seems to be weak. Among coastal States, the majority do not have a fisheries policy specific to the tuna sector, and the limited human and financial resources allocated to the management of the fisheries sector hamper any progress in the implementation of management measures. The distant longliner fleet remains difficult to control, particularly because of the significance of trans-shipping at sea. The purse seine fleet is subject to numerous management measures (especially regarding target species discards and social standards), but none focus on the restriction of fishing gears or catch volumes.

Market-based governance seems to have a significant impact in certain countries with a tuna industry that exports to European markets. The market power of the MSC ecolabel has played an important role for some coastal countries by encouraging them to propose management measures to establish catch control rules at the IOTC level, which are necessary to obtain MSC certification. However, this ecolabel remains difficult to obtain for artisanal fisheries in the Indian Ocean. The Fair Trade label, although more adapted to these fisheries, does not yet have the necessary market power to take on this lobbying role. However, this market-based governance remains limited to export markets and more specifically to European markets. The Asian markets for sashimi and local Indian Ocean markets do not presently seem particularly sensitive to sustainability issues.

Figure 29 summarizes the different types of governance that apply to Indian Ocean tuna fisheries.

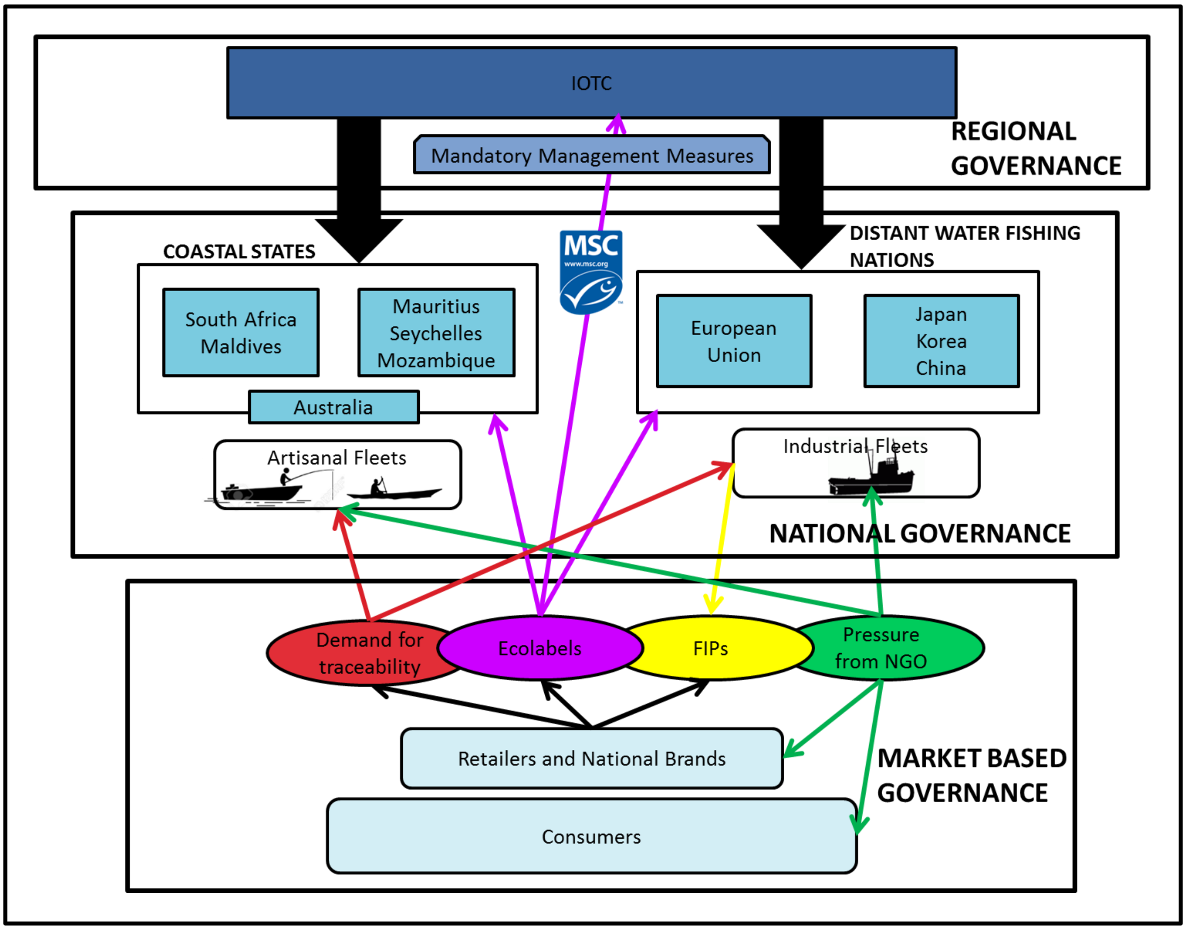
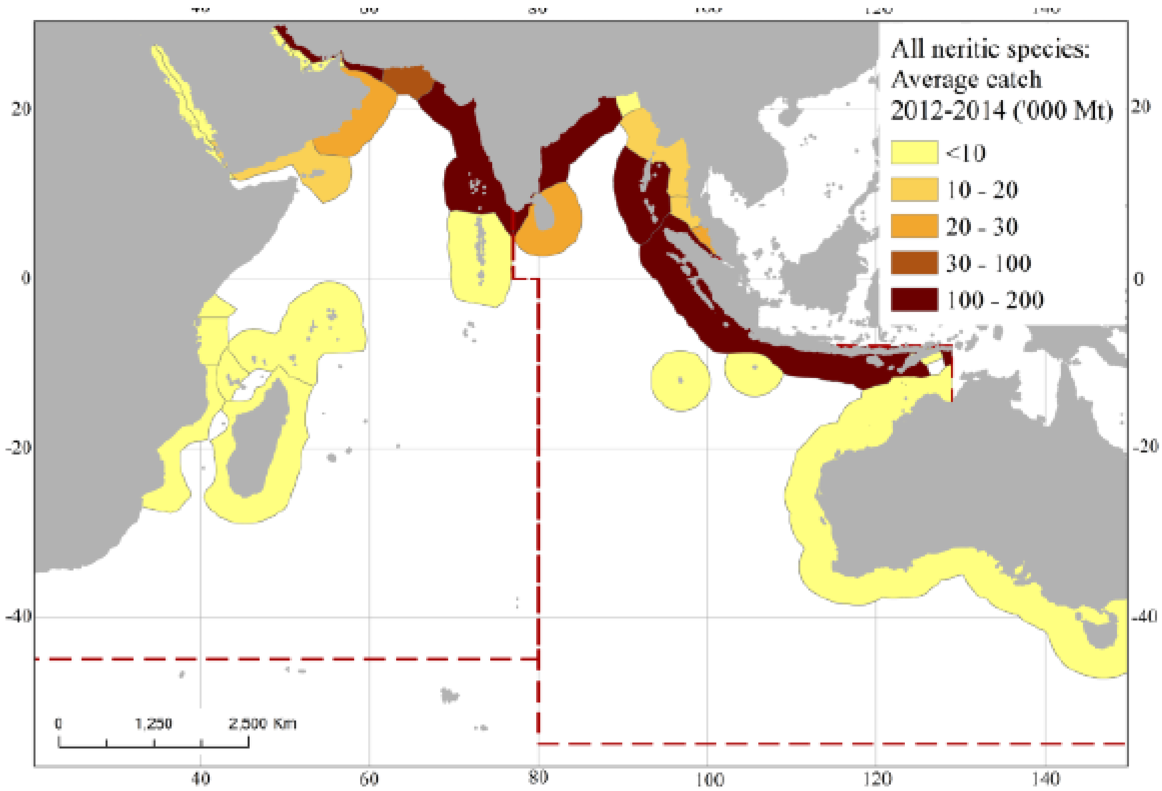



**Figure 29: Main governance types that apply to Indian Ocean tuna fisheries (Source: LECOMTE.M)**

# Appendices

### Appendix 1: Distribution of neritic tuna catches by country over the period 2012-2014 (Source: (IOTC–SC19 2016 2016))




### Appendix 2: Table of industrial longliner freezer fleets operating in the Indian Ocean in 2015 (Source: (IOTC 2017a))

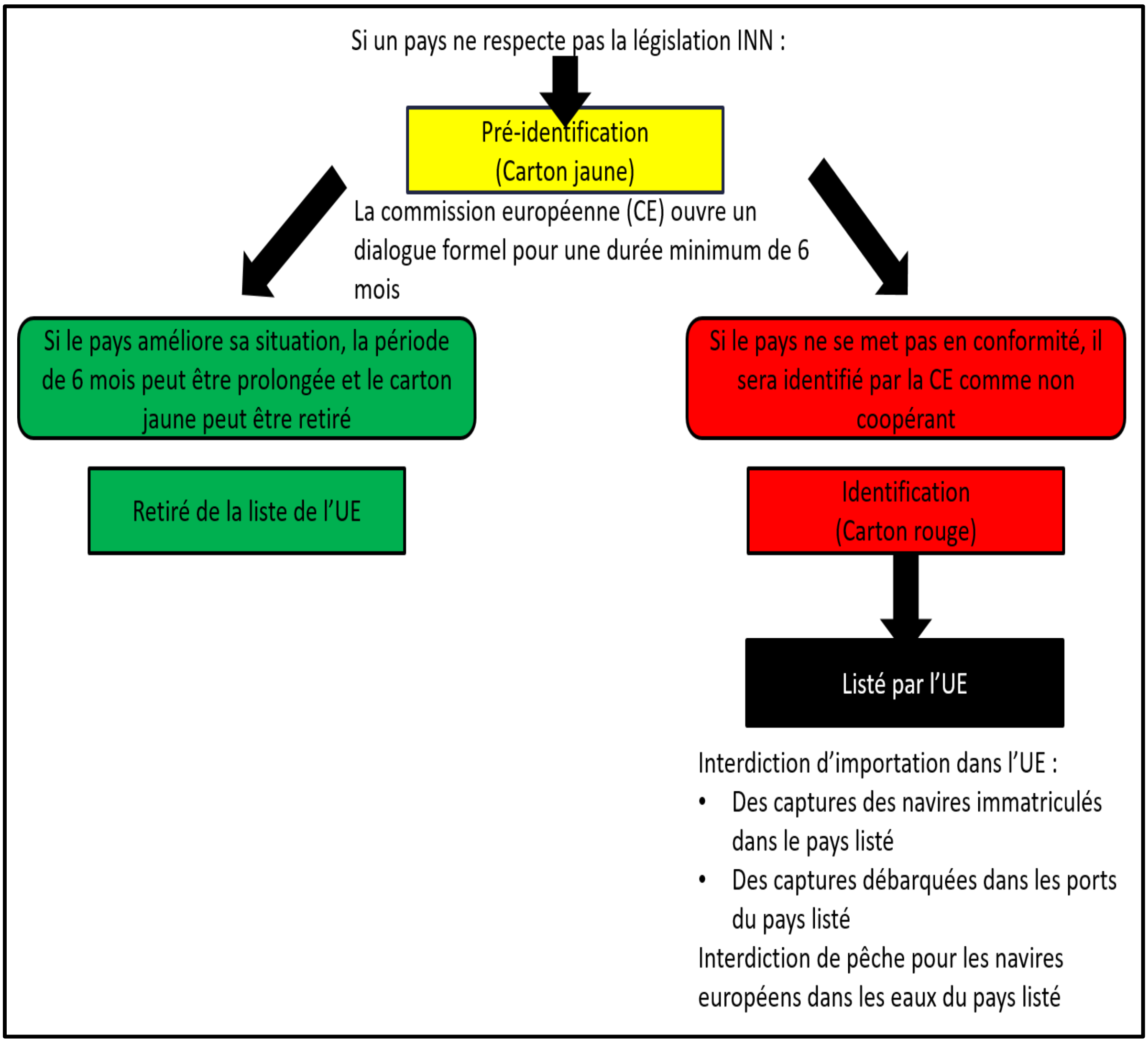
| Fleet | Number of vessels active in 2015 | | Average vessel capacity | Amount of tuna catches in 2015 |
|---|---|---|---|---|
| | 24-40 metres | 40-60 metres | | |
| China | 18 | 28 | 485 GT | 8,365 t |
| Korea | 3 | 11 | 535 GT | 2,230 t |
| Japan | 0 | 53 | 619 GT | 8,904 t |
| Seychelles | 5 | 32 | 515 GT | 6,812 t |
| Taiwan | 28 | 91 | / | 48,365 t |
| TOTAL | 56 | 216 | / | 74,677 t |

## Appendix 3: The main bycatches in the Indian Ocean and their IUCN status (Source: (IUCN 2017))

| Species | Scientific name | IUCN status |
|---|---|---|
| Swordfish | *Xiphias gladius* | Least Concern |
| Blue marlin | *Makaira nigricans* | Vulnerable |
| Black marlin | *Makaira indica* | Data deficient |
| Striped marlin | *Tetrapturus audax* | Near Threatened |
| Indo-Pacific sailfish | *Istiophorus platypterus* | Least Concern |
| Indo-Pacific king mackerel | *Scomberomorus guttatus* | Data deficient |
| Narrow-barred Spanish mackerel | *Scomberomorus commerson* | Near Threatened |
| Blue shark | *Prionace glauca* | Near Threatened |
| Oceanic white tip shark | *Carcharhinus Longimanus* | Vulnerable |
| Scalloped hammerhead shark | *Sphyrna lewini* | Endangered |
| Shortfin mako shark | *Isurus oxyrinchus* | Vulnerable |
| Silky shark | *Carcharhinus falciformis* | Near Threatened |
| Bigeye thresher | *Alopias superciliosus* | Vulnerable |
| Flatback sea turtle | *Natator depressus* | Data deficient |
| Green sea turtle | *Chelonia mydas* | Endangered |
| Hawksbill turtle | *Eretmochelys imbricata* | Critically Endangered |
| Leatherback sea turtle | *Dermochelys coriacea* | Vulnerable |
| Loggerhead sea turtle | *Caretta caretta* | Vulnerable |
| Olive ridley | *Lepidochelys olivacea* | Vulnerable |
| Yellow-nosed albatross | *Thalassarche chlororhynchos* | Endangered |
| Black-browed albatross | *Thalassarche melanophrys* | Near Threatened |
| Indian yellow-nosed albatross | *Thalassarche carteri* | Endangered |
| Shy albatross | *Thalassarche cauta* | Near Threatened |
| Sooty albatross | *Phoebetria fusca* | Endangered |
| Light-mantled albatross | *Phoebetria palpebrata* | Near Threatened |
| Amsterdam albatross | *Diomedea amsterdamensis* | Critically Endangered |
| Tristan albatross | *Diomedea dabbenena* | Critically Endangered |
| Wandering albatross | *Diomedea exulans* | Vulnerable |
| White-capped albatross | *Thalassarche steadi* | Near Threatened |
| Grey-headed albatross | *Thalassarche chrysostoma* | Endangered |
| Cape petrel | *Daption capense* | Least Concern |

| | | |
|---|---|---|
| Great-winged petrel | *Pterodroma macroptera* | Least Concern |
| Grey petrel | *Procellaria cinerea* | Near Threatened |
| Southern giant petrel | *Macronectes giganteus* | Least Concern |
| Northern giant petrel | *Macronectes halli* | Least Concern |
| White-chinned petrel | *Procellaria aequinoctialis* | Vulnerable |
| Cape gannet | *Morus capensis* | Vulnerable |
| Flesh-footed shearwater | *Puffinus carneipes* | Least Concern |

**Appendix 4: European system to tackle IUU fishing (Source: (European Commission 2015b))**




Key :
If a country does not comply with IUU legislation
Pre-identification (Yellow Card)
The European Commission (EC) opens a formal dialogue for a minimum period of 6 months
If the country improves the situation, the 6 month period can be extended and the yellow card can be withdrawn
Delisted from the EU list

If the country does not address the problems, it will be identified by the EC as non-cooperating / Identification (Red Card) / Listed by EU

EU import ban of:

- Catches by fishing vessels registered in the countries listed
- Catches landed in the ports of listed countries

Fishing ban for European vessels in the waters of the listed country

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