FAO's Input to the UN Secretary-General's Comprehensive Report for the 2016 Resumed Review Conference on the UN Fish Stocks Agreement

1. General Considerations

The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea (UNCLOS)[1] of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (herein referred to as the Fish Stocks Agreement or FSA)[2] was adopted on 4 August 1995 by the United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks and it entered into force on 11 December 2001.

As provided in Article 36 of the FSA, a Review Conference on the Agreement was held in New York, 22 to 26 May 2006, four years after it entered into force, with a view to assess the effectiveness of the Agreement in securing the conservation and management of straddling fish stocks and highly migratory fish stocks.

In preparation to the 2006 Review Conference, the General Assembly requested the Secretary-General to submit to the conference a report prepared in cooperation with FAO providing a comprehensive report on the state of exploitation of stocks and fisheries in the high seas. To this end FAO prepared a background document reviewing the state of exploitation of highly migratory species and straddling stocks, as well as, the state of discrete high seas stocks and non-target and associated dependent species, using the best available information until 2005. FAO's inputs were integrated into UN Secretary-General Report of the 2006 Review Conference[3]. Following a request made by the eighth round of Informal Consultations of States Parties to the FSA, held in New York, 16-19 March 2009 to the Secretary-General, FAO prepared an updated comprehensive report and submitted it to the resumed Review Conference in 2010.

At the eleventh round of Informal Consultations of States Parties to the FSA, held in New York, 16-17 March 2015, a request was made to the Secretary-General, to prepare in cooperation with FAO, an updated comprehensive report to be submitted to the resumed Review Conference in 2016.

In response to this request, this paper provides the required background information for the forthcoming review of the FSA, with updates on the landings and estimates of the state of exploitation of stocks of highly migratory species, straddling stocks, discrete high seas stocks and non-target and associated dependent species. The paper follows the outline of the previous reports prepared as FAO's inputs to the UN Secretary-General's Comprehensive Report for the Review Conference in 2006 and 2010 and updates any relevant information based on the best available scientific data.

[1] UNCLOS is available at: http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf
[2] The Fish Stocks Agreement is available at: http://daccessdds.un.org/doc/UNDOC/GEN/N95/274/67/PDF/N9527467.pdf?OpenElement

3 UN Secretary-General Report of the Review Conference on the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, held in New York, 22 to 26 May 2006 (UNGA Document A/CONF.210/2006/1

1.1 Species and Stock Terminology

FAO (1994)[4] provides a general elaboration on species and stock[5] terminology. For the purpose of this review, **highly migratory species** are the species listed in Annex 1 of UNCLOS.[6] This is a legal definition rather than a scientific definition based on the actual migratory behaviour of the species. Nevertheless, the species listed in Annex 1 are in general capable of migrating relatively long distances, and stocks of these species are likely to occur both within EEZs and on the high seas. Where available, information on individual stocks will be provided.

UNCLOS does not use the term "**straddling stocks**", but article 63, clause 2 says: "[...] *the same stock or stocks of associated species [which] occur both within the exclusive economic zone and in an area beyond and adjacent to the zone*" which can be taken as a working definition of the concept of straddling stock. The Fish Stock Agreement, while using the term extensively, does not define it. The concept of straddling fish stock can cover a continuum from most of the fish being inside EEZ's to most of the fish being outside EEZ's. No minimum portion outside or inside has been defined, but usage seems to indicate that as long as there is some directed fishing effort at catching the stock on either side of the EEZ line, it is considered to be straddling.

Neither the term **discrete high seas fish stocks** nor the concept behind it are used in UNCLOS: Part VII of the Convention addresses the living resources of the high seas in general. The term or concept does not appear either in the Fish Stock Agreement, because of the nature and scope of the Agreement as originally conceived and negotiated. FAO (1994) used the term "purely high seas stocks" for stocks that are not found within EEZs. This review uses the term "**other high seas stocks**" to refer to stocks that are not highly migratory or straddling. It is preferred to "discrete high seas stocks" because the discreteness of such stocks is generally unknown (e.g. fish caught on distinct seamounts hundreds or thousands of kilometres apart do not necessarily belong to discrete separate biological units). The list of other high seas stocks used in this review is considered provisional as new resources continue to come under exploitation.

Associated and dependent species are caught and/or impacted in fisheries for straddling fish stocks, highly migratory fish stocks, and other high seas fish stocks. Since any landed catch that is not from a straddling fish stock or highly migratory fish stock, may be regarded as from other high seas fish stocks, this review considers associated species as impacted species that are not part of the landed catch.

This document does not consider EEZ stocks (those found either entirely within one country's EEZ or stocks occurring within the exclusive economic zones of two or more coastal States, but not on the high seas) or the sedentary species of the continental shelf in the sense described in Article 77 of the United Nations Law of the Sea.[7]

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[4] FAO 1994. World review of highly migratory species and straddling stocks. FAO Fisheries Technical Paper 337, 70pp.

[5] While the definition of a species is straightforward (members of the same species can reproduce with one another), the definition of a stock can vary according to the knowledge available. For example, early in the development of a fishery, two species (e.g. of redfish) with similar characteristics could be considered as a stock for management purposes.

[6] Note that whales (i.e. Cetaceans) are included in Annex 1 of UNCLOS as highly migratory species. The International Whaling Commission (IWC) has management authority for the harvest of whales. At present there is a moratorium on commercial whaling, although there is some aboriginal subsistence whaling, whaling under scientific permits, and whaling in coastal state waters by countries lodging an "objection" within IWC. Whaling is not addressed in the FSA and Cetaceans are not considered in this review.

[7] Article 77 of UNCLOS refers to "…living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical

1.2 Approach Including Data Issues

The paper is based on information from Regional Fishery Organizations [8] in particular, the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Indian Ocean Tuna Commission (IOTC), the Inter- American Tropical Tuna Commission (IATTC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Northeast Atlantic Fisheries Commission (NEAFC), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), the Secretariat of the Pacific Community (SPC), the International Council for the Exploration of the Sea (ICES), and national fishery management authorities. Information from the latest FAO's publication on the State of World Fisheries and Aquaculture[9] is also used, particularly on the state of selected straddling stocks. Catch information is from the FAO Global Capture Production Database[10]. The most recent complete year of data is 2013.

Species /stocks were classified according to a three-level classification scheme used previously by FAO[11] as follows:

Overexploited: include stocks that are being exploited above the optimal yield/effort level which is believed to be sustainable in the long term, stocks that are depleted or are recovering from a depletion or collapse.

Fully exploited: stocks exploited at or close to an optimal yield/effort level, with no expected room for further expansion.

Non-fully exploited: include stocks exploited by undeveloped or new fishery, with a significant potential for expansion in total production, or stocks exploited with a low fishing effort, with some limited potential for expansion.

This scheme simplifies the six-level classification scheme used by FAO in the past. This simplification was undertaken to reflect the underlying uncertainty in many of the assessments and to ensure greater standardization in the assessment methods among regions. It should be noted the categories used are not new but are simply the result of aggregating the previous six categories into three categories (stocks overexploited, recovering and depleted were aggregated into the one category *overexploited*, and the categories of moderately exploited and underexploited into the single group *non-fully exploited*). Thus the reduction in the number of categories should not affect the comparison of the state of resources reported in previous assessments, at least in terms of the broad categories of overexploited, fully and non-fully exploited.

While these species (or species group)-statistical area combinations reviewed in this paper are referred to as stocks, in many cases they are a collection of several stocks according to either a management or biological perspective. For example, cod in the Northwest Atlantic (FAO statistical area 21) is reported on as a single entry although there are 10 separate management units for cod fisheries in the area, and often more than one reproductively isolated breeding populations (i.e. stocks from a biological perspective) probably exists in some of these management units. In spite of

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contact with the seabed or the subsoil" with respect to continental shelf resources. These species are generally known as "creatures of the shelf" and they are subject to the jurisdiction of coastal nations.

[8] For information on Regional Fisheries Organizations, including their web addresses, visit the following FAO web address: http://www.fao.org/fi/body/rfb/index.htm

[9] FAO. 2014. The State of World Fisheries and Aquaculture 2014. FAO, Rome.

[10] Downloadable at: http://www.fao.org/fishery/statistics/software/fishstatj/en

[11] FAO 2011. Review of the state of world marine fishery resources. FAO Fisheries and Aquaculture Technical Paper No. 569. Rome, FAO. 2011. 334 pp.

these limitations, the state of stocks compiled here and in previous FAO reviews derives from the best available global sources of information on state of stocks, including from Regional Fisheries Bodies, national fisheries authorities and fishery specific knowledge of FAO Fisheries and Aquaculture Department staff and its consultants.

Information on the species associated with fisheries for highly migratory species, straddling fish stocks and other high seas fish stocks is very limited. Rarely are catches of these species reported. Most are discarded at sea. Some countries collect data on discards, but the information is incomplete and it is not routinely reported to FAO. Thus, this review highlights known and potential issues concerning associated species, but at present a comprehensive assessment is not possible.

Information on the biological characteristics and geographic distribution of the species is kept at a minimum level in this paper, as it is extensively covered in previous reports prepared by FAO (including FAO, 1994 and Maguire et al., 2006). Information is also available in various FAO information sources including the FAO species catalogues and other information products provided by the FAO Species Identification and Data Programme (FishFinder)[12], Search Species Fact Sheets[13], and FishBase[14].

2. Highly Migratory Species

As indicated above, highly migratory species are legally defined as those listed in Annex 1 of UNCLOS. They include tuna and tuna-like species, oceanic sharks, pomfrets, sauries, and dolfinfish. Some of these species may only occur and /or be caught within EEZs but the available global database does not allow distinguishing between catches made on the high seas and those made within EEZs. Highly migratory species are therefore discussed without regard to stocks or occurrence within EEZs or on the high seas.

2.1 Tuna and tuna-like species

2.1.1 The resources

All tuna and tuna-like highly migratory species (billfishes, bonitos, mackerels and tunas) belong the sub-order Scombroidei. The tunas (*Thunnini*) include the most economically important species referred to as principal market tunas because of their global economic importance and their intensive international trade for canning and sashimi. Tunas are sub-classified into four genera (*Thunnus*, *Katsuwonus*, *Euthynnus* and *Auxis*) with fourteen species all together.

The **tunas** included in Annex 1 of UNCLOS, in the order they are listed in Annex 1, are: albacore tuna (*Thunnus alalunga*) which occurs in tropical and temperate waters; bluefin[15] tuna (*Thunnus thynnus*), mostly found in temperate waters of the Atlantic, including the Mediterranean, and Pacific Oceans; bigeye tuna (*Thunnus obesus*), found in the Atlantic (but absent from the Mediterranean), Indian and Pacific Oceans; skipjack tuna (*Katsuwonus pelamis*) with a worldwide distribution in tropical and temperate waters; yellowfin tuna (*Thunnus albacares*), also with a worldwide

[12] The web address for FishFinder is: http://www.fao.org/fishery/fishfinder/en
[13] The web address for Search Species Fact Sheets is: http://www.fao.org/fishery/species/search/en
[14] The web address for Fishbase is: http://www.fishbase.org
[15] Since the drafting of UNCLOS, bluefin tuna in the northern Pacific has been identified as a different species, Pacific bluefin tuna (*Thunnus orientalis*) while bluefin in the Atlantic has been re-named Atlantic bluefin tuna.

distribution in tropical and sub-tropical more temperate seas, but absent from the Mediterranean; blackfin tuna (*Thunnus atlanticus*) found in the western Atlantic in tropical and warm seas; little tuna [16](*Euthynnus alleteratus*), found in tropical and subtropical waters of the Atlantic, including the Mediterranean, the Black Sea, the Caribbean Sea and the Gulf of Mexico, and *E. affinis*, in the Indian and Pacific Oceans; southern bluefin tuna (*Thunnus maccoyii*), in temperate waters of the southern hemisphere in the Atlantic, Indian and Pacific Oceans; and, frigate mackerel[17](*Auxis thazard* and *A. rochei*) found in the Atlantic (including the Mediterranean Sea where only *A. rochei* is found), Indian and Pacific Oceans.

The tunas species listed as highly migratory species in the 1982 UN Convention have extensive distribution on the high seas. Although their total catches amount to less than 5% of the total world marine fish catches, their landed value has been estimated to account for nearly 20% of the global total.
Tuna species can be loosely categorised into tropical and temperate tunas. They exhibit a wide range of life histories, ranging from the skipjack tuna, which has a short lifespan, high fecundity and wide distribution in tropical and temperate waters, to the bluefin tuna which is long lived, breeds late and has well defined breeding and migration patterns. Differing life histories result in contrasts in vulnerability to overfishing. Skipjack are generally considered to be more resilient to exploitation, while bluefin are considered more vulnerable, all the more because of their extremely high market value. The other species have life history characteristic that are intermediate between those two extremes.

The **tuna – like** species included in Annex 1 of UNCLOS also have an extensive distribution. These are: marlins[18] of which there are nine species (*Tetrapturus angustirostris, T. belone, T. pfluegeri, T. albidus, T. audax, T. georgei, Makaira nigricans M. indica, M. nigricans*) with one or more species found in every Ocean; sailfishes, with two species, *Istiophorus platypterus* formerly restricted to the Indian and Pacific Oceans, but is now found in the Mediterranean Sea where it entered via the Suez Canal, and *I. albicans* found in the Atlantic and migrating in the Mediterranean Sea; and swordfish (*Xiphias gladius*) found in the Atlantic, Indian and Pacific Oceans, the Mediterranean Sea, the Sea of Marmara, the Black Sea and the Sea of Azov.

Little tunny (*E. alleteratus*) and kawakawa (*E. affinis*), and to some extent, blackfin tuna (*T. atlanticus*), black skipjack (*E. lineatus*), bullet tuna (*A. rochei*) and frigate tuna (*A. thazard*) are less oceanic and more associated with the continental shelves than the other tunas and tuna-like species in Annex 1 of UNCLOS.

The longtail tuna (*T. tonggol*) is also an important tuna, not included in UNCLOS Annex 1, which also has a wide but less oceanic distribution associated with the continental shelves. Other important tuna-like species not in Annex 1 of UNCLOS include slender tuna (*Allothunnus fallai*), butterfly kingfish (*Gasterochisma melampus*), wahoo (*Acanthocybium solandri*), bonitos (*Cybiosarda, Orcynopsis* and *Sarda*), and species of the genus *Scomberomorus* (Spanish mackerel, king mackerels, seerfish and sierra). Slender tuna and butterfly kingfish (with a circumpolar distribution in the Southern Ocean) are now caught mostly as bycatch of the longline fishery targeting southern bluefin tuna.

[16] Presently, *Euthynnus alleteratus* is called little tunny and *E. affinis* is called kawakawa.
[17] Presently, *Auxis thazard* is referred to as frigate tuna and *A. rochei* as bullet tuna.
[18] Presently, *Tetrapturus* are referred to as spearfishes.

2.1.2 The fisheries

Tuna fisheries[19] are among the oldest fisheries in the world with Phoenician trap fisheries[20] for bluefin tuna occurring around 2000 BC. They are mentioned by Aristotle, Oppian and Pliny the Elder, and they are also recorded in excavations at prehistoric sites. Until the second part of the 20th century, fishing occurred mostly in coastal areas. As a result of increasing demand for tuna for canning, industrial fisheries began during the 1940s and 1950s. During the 1950s, the major industrial fisheries were the Japanese longline fishery and the pole-and-line fisheries of the United States and Japan, which operated in the Pacific Ocean. The longline fishery reached the Atlantic Ocean during the late 1950s. Also, some European pole-and-line vessels, based in local ports, began fishing off the west coast of Africa at that time.

During the 1960s, European pole-and-line and purse-seine vessels began fishing for tunas off tropical West Africa. Japanese pole-and-line vessels increased and expanded their area of operation in the western and central Pacific. Japanese longliners also expanded their fishing operations all over the world, targeting mostly albacore and yellowfin for canning. During the mid-1960s, vessels of the Republic of Korea and Taiwan Province of China became involved in large-scale longline fishing for tunas. At the end of the decade, improvements in freezing technology and cold storage systems developed for Japanese longliners, made it possible to produce fish that was acceptable for the sashimi market, which, in turn, led the vessels to shift their target species from yellowfin and albacore for canning to bluefin and bigeye for sashimi. In the eastern Pacific Ocean, the pole-and-line vessels of the United States were almost completely replaced by purse-seine vessels. Quotas for yellowfin in that region were first established in 1966.

During the 1970s the European purse-seine fishery in the tropical eastern Atlantic developed quickly while the United States purse-seine fishery of the tropical eastern Pacific expanded offshore. In the tropical eastern Pacific a number of vessels of the United States either changed flags to Central and South American countries to avoid the national regulations aimed at reducing the incidental mortality of dolphins or shifted their fishing effort to the western and central Pacific Ocean, where the association of yellowfin with dolphins was not observed.

A purse-seine fishery for tunas began in the western Indian Ocean during the 1980s, when European vessels, which had fished in the Atlantic Ocean until then, moved to that area. In the Pacific Ocean the purse-seine fishery further expanded its fishing area, particularly in the western and central Pacific Ocean. In the Atlantic, countries such as Brazil and Venezuela entered the purse-seine fisheries. During the same period, the numbers of Japanese and Korean large-scale longliners began to decrease, whereas the fleet of Taiwan Province of China, and the numbers of vessels reflagged to countries of open registry increased rapidly.

Purse seiners began fishing with artificial fish-aggregating devices (FADs) in the Atlantic Ocean early in the 1990s, and the method quickly spread to the Indian and Pacific Oceans. Management intensified during the 1990s and continues to do so in response to stock concerns and increasing focus on illegal, unreported and unregulated (IUU) fishing. The catch by small-scale coastal longline fisheries increased greatly during the 1990s. Another important aspect is the development

[19] This description of the fisheries is based on FAO (2005c) which reports on the FAO Project on "Management of tuna fishing capacity: conservation and socio-economics".
[20] Ravier and Fromentin (2001. ICES Journal of Marine Science 58:1299-1317) analyzed tuna catches from ancestral trap fisheries in the Mediterranean and Atlantic.

of bluefin tuna farming which can increase fishing pressure, particularly on juvenile life history stages.
Tuna are fished, traded, processed and consumed globally. The industrial fleets often transfer their operations from one ocean to another in response to changing conditions either in fish availability, markets, and/or fishing regulations, which makes it difficult to manage fishing capacity on a regional scale. In addition, the fish caught are frequently transported to other parts of the world for processing. Also, substantial illegal, unreported and unregulated (IUU) fishing, which occurs in all oceans in spite of recent efforts to control it, significantly complicates the management of the fisheries for tunas.

In 2013, tuna and tuna-like species classified as highly migratory in Annex 1 of UNCLOS accounted for about 6 million tonnes, nearly 80% of the total reported catches of all tunas and tuna-like species. Two species, skipjack tuna and yellowfin tuna accounted for more than 60% of the catch (4.3 million tonnes) in that year. Not all the catches are from the high seas however, and a substantial portion is caught within EEZ's.

2.1.3 State of the stocks

Most highly migratory **tropical** tunas have very high fecundity, wide geographic distribution, opportunistic behaviour and other characteristics that make them highly productive and resilient to exploitation. With proper management, they are capable of sustaining high yields, but possibilities of overexploitation and stock depletion nevertheless exist if fishery management is not adequate. Highly migratory **temperate** tunas have life history characteristics that make them much more sensitive to exploitation. As a result, expected yields are lower and the risks of overexploitation are higher making it all the more important to exercise prudent management.

Bluefin tuna was depleted in the past in both western and eastern Atlantic. Both stocks have shown signs of recovery in the last decade, following the adoption of rebuilding plans. The stock in the east Atlantic is still probably overexploited while the one in the west could be considered either fully or overexploited. Both southern bluefin tuna and Pacific Bluefin tuna stocks are overexploited, with current biomasses at very low levels.

Albacore stocks are fully exploited in the North and South Pacific, overexploited in the North Atlantic and possibly also overexploited in the South Atlantic. Albacore is probably fully exploited in the Indian Ocean while the state of exploitation in the Mediterranean Sea is unknown.
Although bigeye tuna is tropical and has a life span shorter than bluefin, there is increasing concern that its exploitation may be too high. In addition to being overexploited, there is concern that increasing purse seine catches of small bigeye associated with FADs may negatively affect the longline catches of large bigeye, which have a much higher price. Bigeye tuna is fully exploited in the eastern Pacific, with fishing mortality rates and levels of spawning biomass slightly below the level corresponding to MSY. In the western Pacific the stock is overexploited. Bigeye tuna is probably fully exploited in the Atlantic and Indian oceans. The stock of yellowfin tuna in the Indian Ocean became overexploited following extraordinarily high catches in early 2000s. The decrease in catches in the following years probably brought the stock to a state of fully exploited. However catches in recent years were in excess of the MSY estimates and could bring again the stock to state of overexploitation. Yellowfin is overexploited in the Atlantic and fully exploited in the Pacific Ocean.

Skipjack tuna is considered not fully exploited in the Pacific and probably also in the Indian Ocean. The reported 2013 catches of skipjack in the Pacific (2 386 thousand tonnes) were the highest on record. However, with the present fishing technique, catches of skipjack cannot be increased

without undesired increases of catches of other species. Although the state of skipjack in the Atlantic is less certain, the stocks are likely to be close to fully exploited.

The state of exploitation of many other tuna and tuna-like species is highly uncertain or unknown. Given the absence of reliable information on the state of exploitation, caution should be exercised in managing these fisheries, and it would not be prudent to allow fisheries to expand. Significant uncertainties in the state of exploitation of many billfishes represent a serious conservation problem. In the Atlantic, blue and white marlins and sailfish seem to be overexploited even though they are not generally targeted. Blue marlin is fully exploited in the eastern Pacific. Striped marlin is overexploited in the northern Pacific, likely to be fully exploited in the eastern Pacific and is likely to be overexploited in the southwestern Pacific. The state of the stock of billfishes in the Indian Ocean is less certain. Blue marlin is likely to be fully exploited while striped marlin is considered overexploited. Preliminary assessments of black marlin and sailfish indicate that the stocks are close to fully exploited. . Because of commercial exploitation, there is more known on the state of swordfish exploitation than for other billfishes. The stock of swordfish in the North Atlantic is considered rebuilt and currently fully exploited. Although the situation in the South Atlantic is less certain, the available indicators suggest a lower exploitation rate than in the North Atlantic. Swordfish is overexploited in the Mediterranean. Stocks are fully exploited in the South Pacific.The assessment of the state of exploitation of swordfish in the western and central north Pacific indicates that the stock is probably no fully exploited. The Indian Ocean stock is considered fully exploited. However, there is a high risk of overexploitation if current level of catches is maintained. Of the other tuna-like species included in Annex I of UNCLOS, the only species that has been assessed in recent years is the kawakawa (*E. affinis*), which is considered fully exploited in the Indian Ocean.

In summary, the scientific information available primarily from regional tuna fishery management organizations and other intergovernmental organizations indicates that for those stocks where the state of exploitation is known, 13 percent are not-fully exploited, 51 percent are fully exploited and 36 percent are overexploited. Compared to the last global assessment prepared by FAO in 2010, there has been a slight deterioration in the overall state of stocks, with a reduction in the percentage of fully exploited stocks from 54% to 51% and an increase in the number of overexploited stocks from 28% to 36%. In terms of trends in the state of individual stocks, for the majority of stocks (71%) there has been no change in the state of exploitation. Improvements in the state of exploitation were noted in 9 percent of the stocks, while for 20 percent of the stocks the state of exploitation deteriorated since the last assessment. As noted in the previous assessment, there are probably few opportunities to increase exploitation of tunas and tuna-like species, except in some areas of the Pacific and Indian oceans, where increases in catches of skipjack tuna might be sustainable. However, if current fishing techniques are used, this can only be done at the expense of undesired increases of catches of other species.

2.2 Oceanic sharks

2.2.1 The resources

Sharks covered under this heading are those listed in Annex 1 of UNCLOS: Bluntnose sixgill shark (*Hexanchus griseus*), basking shark (*Cetorhinus maximus*), thresher sharks (family Alopiidae), whale shark (*Rhincodon typus*), requiem sharks (family Carcharhinidae), hammerhead, bonnethead, or scoophead sharks (family Sphyrnidae), and the mackerel sharks (family Lamnidae[21]).

[21] The family Lamnidae is listed as Isurida, using an old family name, in UNCLOS

Unfortunately, the state of many shark populations is unknown, or poorly known. However, the life history of sharks (e.g. slow growth, long life span, low fecundity) make them particularly vulnerable to overexploitation and depletion such that fishing sharks and managing the fisheries exploiting them requires great caution. The total reported catches of species and families of sharks, listed in the Annex 1 of UNCLOS, has gradually increased during the last decade, from 104 700 tonnes in 2003 to 214 400 tonnes in 2013. The requiem sharks (Carcharinidae) account for 83% of these catches in 2013. The increasing trend in reported catches observed in recent years may be due to a combination of factors related to species exploitation, changes in market demand, fisheries management, monitoring, and enhanced species breakdown in the catch statistics reported. One the one hand, the wider application of restrictions on shark finning may be leading to increased landings of whole sharks that were traditionally targeted for their fins. It is also possible that the market demand for shark meat has increased in response to changes in consumer preferences and marketing strategies, as traditional fisheries reach levels of full or overexploitation. The observed increase in landings of these species also reflect improved species identification and reporting by shark fishing nations that used to report shark catches in highly aggregated taxonomic categories[22,23,24]. For instance, in the same period of increasing catches of highly migratory sharks there has been a decreasing trend in unidentified catches lumped together under "Elasmobranchii" (Sharks, rays, skates, etc. nei), from 383 283 tonnes in 2003 to 252 363 tonnes in 2013.

2.2.2 The fisheries

Shark fisheries pre-date recorded history and every part of these animals has been used for some purpose. Shark meat is important food consumed fresh, dried, salted or smoked. In many communities fins of sharks are among the world's most expensive fishery products. Shark cartilage and other products are increasingly sought for medicinal purposes. Few fisheries use the whole animal however: some use only the meat, others only use the fins, or livers or skin. Whereas in the past, in the majority of cases, only parts of the sharks (mainly the fins) were utilized and the rest discarded at sea, in recent years there has been an increasing trend to fully utilize shark catches.

Fisheries for sharks are common throughout the world and use a variety of fishing gears and vessels. Sharks are taken mainly by gillnet and hook or trawl in industrial and artisanal fisheries. Small amounts are taken in traditional and recreational fisheries (including game fishers and divers) and in beach gillnet and drumline fishing as bather protection programmes. There are several fisheries directed at one or a small number of species of shark, but most sharks are taken in multispecies fisheries where the fishers tend to target more highly valued traditional bony fish species.

The following categories of shark fisheries can be identified: coastal hook and gillnet fisheries, demersal trawl bycatch fisheries, deepwater bycatch fisheries, pelagic bycatch fisheries (primarily bycatch in tuna longline and purse seine fisheries) and freshwater shark fisheries. Since most shark catch is taken as bycatch, most of the catch is reported as unidentified shark, mixed fish or is not reported at all. This lack of species identification of the catches and lack of information on fishing effort means basic data for fishery assessment are usually not available for most species.

[22] FAO. 2009. Shark statistics in the FAO capture database. In: Report of the Technical Workshop on the Status, Limitations and Opportunities for Improving the Monitoring of Shark Fisheries and Trade. Rome, 3–6 November 2008. FAO Fisheries and Aquaculture Report. No. 897. Rome, FAO. 2009. 152 p.
[23] FAO. 2009. The State of World Fisheries and Aquaculture 2008 (SOFIA). FAO. Rome. 176 p.
[24] Fischer, J., Erikstein, K., D'Offay, B., Guggisberg, S. & Barone, M. 2012. Review of the Implementation of the International Plan of Action for the Conservation and Management of Sharks. FAO Fisheries and Aquaculture Circular No. 1076. Rome, FAO. 120 pp.

An important concern about fisheries that catch sharks is that harvest strategies designed to maximize economic and social benefits from multi-species fisheries have a high probability of depleting the least productive species (such as sharks), unless methods for making fishing more selective (thus able to avoid overfishing vulnerable species like sharks) are developed and implemented.

2.2.9 State of the stocks

There are no assessments of the state of the stock(s) or exploitation of the bluntnose sixgill shark (*Hexanchus griseus*). Catches in the Atlantic Ocean and Mediterranean Sea show an overall increasing trend since 1998, with 64 tonnes recorded in 2013. Because of its life history characteristics (e.g. reported age of maturity of females range between 18 and 35 years) the species is susceptible to overexploitation even at low levels of fishing. Unless demonstrated otherwise, it is therefore prudent to consider these species as being fully exploited or overexploited globally.

The basking shark (*Cetorhinus maximus*) are likely to be extremely vulnerable to overexploitation, perhaps more so than most sharks, and this can be ascribed to its slow growth rate, advanced age of maturity, long gestation period, low fecundity (like all sharks), and probable small size of existing populations. Reported catches in excess of 8 000 tonnes were common during 1960 to 1980, but they have been much less since the end of the 1990s, with less than 100 tonnes reported in 2007 and no catches reported in 2013. There are few data on regional abundance, no estimates for abundance worldwide and no good data on population trends. The species is probably overexploited globally with some areas being depleted. Basking shark is listed on the Protocol 'Endangered or Threatened Species' of the Barcelona Convention for the Protection of the Mediterranean Sea, on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and on the Convention on the Conservation of Migratory Species of Wild Animals (CMS). It is also legally protected by several countries, including EU countries, USA, New Zealand, Mexico and Canada.

There are three species of thresher sharks (family Alopiidae): *Alopias pelagicus, Alopias superciliosus* and *Alopias vulpinus*. All three species are believed to occur in temperate and tropical waters of all oceans. The total reported catches of thresher sharks was stable at about 1 000 tonnes for most of the 1990s and early 2000s, but since 2004 there has been a remarkable increase in catches reaching about 20 000 tonnes in 2013. This recent increase in catches is mostly due to the improved reporting of shark statistics by Indonesia, the world's top shark fishing nation. Likewise, catches of *A. pelagicus* have been recorded by countries fishing in the Southeastern Pacific Ocean only since 2006. Given their life-history characteristics, these species are not expected to have a high resilience to exploitation. Stock state of exploitation remains uncertain in most areas of occurrence. Unless demonstrated otherwise, it is prudent to consider these species as being fully exploited or overexploited globally. The three species of thresher sharks are listed on Appendix II of CMS.

Whale sharks (*Rhincodon typus*) have been fished sporadically by some countries around the Indian and Western Pacific Oceans[25] but no catches have been reported to, or are recorded in the FAO Global Capture Production database. There exists a paucity of reliable assessments of *R. typus* population densities and size that can allow the effective monitoring of their status and abundance. Given its life-history characteristics, the whale shark is expected to have low resilience to exploitation, but the state of stocks remains uncertain in most areas. Unless demonstrated otherwise, it is prudent to consider the species as being fully exploited globally. The species is listed on the Appendix II of both CMS and CITES.

[25] http://www.fao.org/figis/servlet/FiRefServlet?ds=species&fid=2801

Requiem sharks (family Carcharhinidae), have a worldwide distribution in tropical and temperate waters. There are 50 species in the family (30 in genus *Carcharinus*) which is, by far, the most important shark family for fisheries in the tropics. The main species from a fisheries point of view are: *Carcharhinus falciformis, Carcharhinus signatus, Carcharinus longimanus, Carcharinus sorrah* and *Prionace glauca. Carcharinus sorrah*, however is not an oceanic species and will not be considered further. Catches of requiem sharks reported to FAO were less than 10 000 tonnes in the 1950s, increasing to 40-50 000 tonnes in the 1960s and 1970s. After a brief decline in the early 1980s, reported catches have increased more or less steadily to 172 000 tonnes in 2013. Catches are reported from the Atlantic, Indian and Pacific Oceans with blue shark, spot-tail shark (*Carcharinus sorrah*, a coastal non-oceanic species) and silky shark being the most important species.

The silky shark, *Carcharhinus falciformis*, is one of the three most common oceanic sharks, along with the blue shark (*Prionace glauca*) and oceanic whitetip shark (*Carcharinus longimanus*), and one of the more abundant large marine organisms. It is very commonly taken by pelagic longline fisheries, and occasionally by fixed bottom nets. The stock in the western central Pacific is considered overexploited. The state of exploitation in other regions is unknown. Its wide distribution and high abundance in most tropical shelves of the world suggests that presently there are no major concerns over the conservation of this species globally. However, as for other sharks, considering the low resilience of the species to overexploitation, it is not disregarded the possibility of stocks being fully exploited. The silky shark is at present relatively free of threats in the form of habitat destruction because it does not live inshore nor does it utilise coastal lagoons as pupping or nursery areas like other shark species. Recorded catches peaked at 27 000 tonnes in 1999 and have steadily declined since then. Catches have been oscillating between 3 000 and 7 700 tonnes a year since 2004. The silky shark is included on Appendix II of CMS.

The night shark, *Carcharhinus signatus* is an oceanic species generally occurring in outer continental shelf waters in the western Atlantic Ocean from Delaware (USA) to Argentina and in the eastern Atlantic from Senegal to northern Namibia. Although a decline in catches of night sharks occurred in some fisheries in the western Atlantic, it is unclear whether this decline is due to a real population declines. Abundance data from the northeastern Atlantic were inconclusive but indicated that species have not suffered large magnitudes in decline[26]. The stock in the northeastern Atlantic is considered at least fully exploited. The state of the species in other parts of its range is unknown.

Whitetip shark, *Carcharinus longimanus*, is an oceanic shark found in tropical and warm-temperate waters of the Atlantic, possibly in the Mediterranean Sea, in the Western Indian Ocean and in the Pacific. It is one of the most common oceanic species of shark. The highest catches (1 430 t) were recorded in 2000. Catches declined to 75 tonnes in 2007, increased to close to 1 000 tonnes in 2010 and declined again to reach about 270 tonnes in 2013. The stock is considered overexploited in the western central Pacific. The state of exploitation in other areas is unknown. However, considering the marked decline in the abundance observed in many parts of its range[27], it is likely that the species is globally either fully or overexploited. The species was listed on the Appendix II of CITES in 2013.

[26] Carlson, J. K., Cortes, E, Neer, J. A., Mccandles, C. T. And L. R. Beerkircher. 2008. The Status of the United States Population of Night Shark, Carcharhinus signatus. Marine Fisheries Review 70:1-13

[27] FAO. 2013. Report of the fourth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species, Rome, 3–8 December 2012. FAO Fisheries and Aquaculture Report No. R1032. Rome, FAO. 161 pp.

Blue shark, *Prionace glauca*, has a worldwide distribution in temperate and tropical oceanic waters. It is one of the most abundant and the most heavily fished shark in the world, often as bycatch in pelagic longlines fisheries, but also on hook-and-lines, in pelagic trawls, and even bottom trawls near the coasts. The total recorded catches of blue sharks practically doubled in the last five years, increasing from 61 000 tonens in 2007 to about 120 000 tonnes in 2012/2013. Blue sharks in the Atlantic and westernPacific are considered not fully exploited and under moderate levels of exploitation. However because of the considerable uncertainties of the assessments, resulting from data limitations, it is prudent to consider also the possibility that these stocks are fully exploited. The state of the species is unknown in other parts of its range. The family Sphyrnidae comprises nine species: the winghead shark (*Eusphyra blochii*), the scalloped bonnethead (*Sphyrna corona*), the whitefin hammerhead (*Sphyrna couardi*), the scalloped hammerhead (*Sphyrna lewini*), the scoophead (*Sphyrna media*), the great hammerhead (*Sphyrna mokarran*), the bonnethead (*Sphyrna tiburo*), the smalleye hammerhead (*Sphyrna tudes*), and the smooth hammerhead (*Sphyrna zygaena*). The members of the family are considered coastal; occasionally occurring in brackish water with a global distribution mostly in warm waters. The total reported catch of Sphyrnidae in 2013 was 3 428 tonnes, down from about 5 500 tonnes in 2007. Although all species are caught, in general only the scalloped hammerhead and the smooth hammerhead are reported as individual species in the FAO statistics. The scalloped hammerhead (*S. lewini*) is probably the most abundant hammerhead. This species is apparently highly mobile and in part migratory, forming huge schools of small migrating individuals. Owing to its abundance, the species is common in inshore artisanal and small commercial fisheries, as well as offshore operations. Given its life-history characteristics, the scalloped hammerhead shark is expected to have very low resilience to exploitation. Unless demonstrated otherwise, fishing the species should only be allowed under strict controls. The status of the species is unknown. However, considering the marked decline in abundance observed in different parts of the species range[28], it is likely that stocks of *S. lewini* are either fully or overexploited. Concerns about the conservation status of *S. lewini* led to its inclusion in Appendix II of CITES in 2013. The great hammerhead (*S. mokarran*) and the smooth hammerhead (*S. zygaena*) were also included in Appendix II for look-alike reasons.

Mackerel sharks (currently family Lamnidae, although UNCLOS Annex 1 refers to them as Isurida) include the great white shark (*Carcharodon carcharias*), the shortfin mako (*Isurus oxyrinchus*), the longfin mako (*Isurus paucus*), the salmon shark (*Lamna ditropis*), and the porbeagle (*Lamna nasus*). Reported catches of Lamnidae have increased steadily from about 1 000 tonnes in the early 1980s to 11 500 tonnes in 2013, with the shortfin mako accounting for the bulk of catches. .

The great white shark (*Carcharodon carcharias*), is of little interest to commercial fisheries. Information on population status and trends are scarce. The sensitivity of the species to harvest has led to its listing in Appendix II of CITES as well as on CMS and in the Protocol 'Endangered or Threatened Species' of the Barcelona Convention for the Protection of the Mediterranean Sea. The species is also protected in several range states including South Africa, Australia, USA, and Malta.

The shortfin mako (*Isurus oxyrinchus*) is an important species for longline fisheries where it occurs, because of its high quality meat. Given its life-history characteristics, the shortfin mako is expected to have medium resilience to exploitation (relative to other sharks). Its worldwide distribution and relatively high abundance in some areas probably means it is not currently at risk, but like all elasmobranch it can be easily overfished and localize depletion is always a risk. The assessment of the state of exploitation of the North and South Atlantic stocks indicated that stocks are healthy and

[28] FAO. 2013. Report of the fourth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species, Rome, 3–8 December 2012. FAO Fisheries and Aquaculture Report No. R1032. Rome, FAO. 161 pp.

the probability of overfishing is low. In the Eastern Pacific Ocean the stock is not considered overexploited. The stock state in other areas is unknown. The shortfin mako is listed on Appendix II of CMS.

Little is known about the distribution and state of longfin mako (*I. paucus*) populations. Catches have been only recorded in the Atlantic, with the highest catch (20 t) recorded in 2013. The species is probably often mistaken for the apparently far more common shortfin mako shark (*Isurus oxyrinchus*) or included with records for it. Without such information, management should be cautious with fisheries that catch this species. The longfin mako is listed on Appendix II of CMS.

The salmon shark (*Lamna ditropis*) is a common coastal-littoral, offshore and epipelagic shark, found in cool waters of the north Pacific. Salmon shark is the second most important species, after the blue shark, caught by Japanese pelagic fisheries (longline and driftnet), with annual landings in the period from 1992-2006 ranging from 1 400 to 4 400 tonnes. They are also caught in salmon seines, by salmon trollers towing hooks, and possibly by bottom trawlers off Alaska. They are occasionally trammel-netted by halibut fishermen off California and as bycatch in gillnets set for swordfish and threshers sharks off California. The species is considered heavily fished even though most of the catch is discarded bycatch. Knowledge of its biology is limited despite its abundance, but its fecundity is very low and the species probably cannot sustain current fishing pressure for extended periods.

The porbeagle (*Lamna nasus*) is a coastal and oceanic, amphitemperate species, with its centres of distribution in the North Atlantic, and in a circumglobal band of temperate water of the southern Atlantic, southern Indian, southern Pacific and Antarctic Oceans. The species has been heavily fished commercially and utilized for human consumption in the temperate North Atlantic and the Mediterranean, but is also caught as bycatch in the Southern Hemisphere (e.g., it is the second most common shark taken as bycatch of the New Zealand longline fishery). Stocks in the North Atlantic have shown signs of serious overexploitation as indicated by a large decline in catch. The western Atlantic stock is considered depleted. A management plan to rebuild the stock is being implemented in the United States and Canada and catch quotas have been reduced to support the population recovery. The northeast Atlantic stock is also considered depleted. Recent regulations adopted by the European Commission have prohibited the capture and landing of porbeagle shark in EU waters and also by fishing vessels flagged to the EU. Porbeagle are an important bycatch of Japanese longliners and probably of the pelagic fishing fleets of other countries fishing in the southern Indian Ocean and elsewhere in the Southern Hemisphere. The catch is poorly known and may be little-utilized except for fins. The state of the stock(s) in the Southern Oceans is unknown, although available assessments indicate substantial declines in abundance in parts of the species range in the southern hemisphere. Porbeagle is listed on Appendix II of CMS and was also recently listed on Appendix II of CITES.

The general paucity of data about the shark species listed in Annex I of UNCLOS precludes a comprehensive assessment of the status and trends in exploitation of these species. According to the available information reviewed above, the state of exploitation is currently known for some stocks of only seven species (*C. falciformis*, *C. signatus*, *C. longimanus*, *P. glauca*, *S. lewini*, *I. oxyrinchus* and *L. nasus*). About 60 percent of the stocks with available information are considered potentially overexploited or depleted. Effective conservation measures are required to protect these species against further declines and to recover their productive capacity. In general, sharks are vulnerable to overexploitation and depletion, especially locally. In the absence of stock specific information on the state of fisheries and fishery resources, it is prudent to consider the state of shark populations as being at least fully exploited, and to apply a precautionary approach to management.

2.3 Other highly migratory species

The species in this section, unlike tunas and to some extent sharks, have not attracted large or high profile fisheries. Therefore, there is little information about the biology of these species and the state of exploitation, other than reported catches[29]. The main "other highly migratory species" are pomfrets, sauries and dolphinfish.

The pomfrets (family Bramidae) include eight genera and 21 species. Annex I refers to the family Bramidae without listing individual species. Thus all 21 species are considered Highly Migratory with respect to UNCLOS. It is a family of pelagic, benthopelagic and bathypelagic fishes found in temperate and tropical waters of the Atlantic, Indian and Pacific Oceans. The main characteristic of most of the species is that they are oceanodromous, that is, they are migrating within oceans typically between spawning and different feeding areas, with migrations being cyclical, predictable and covering more than 100 km. The worldwide landings of pomfrets are poorly documented. The FAO database lists Atlantic pomfret (*Brama brama*), Southern rays bream (*Brama australis*), Sickle pomfret (*Taractichthys steindachneri*) and Pomfrets, and ocean breams not elsewhere included (nei). Catches oscillated around an average of about 7 000 tonnes per year until the early 2000s. There was a marked increase in reported catches in recent years, from 11 682 tonnes in 2007 to a historical high of close to 47 000 tonnes in 2011. Total catches of 28 700 tonnes were reported in 2013, half of it originated from Atlantic and half from the Pacific Ocean. Although fifteen countries report landings of pomfrets, three countries (Chile, South Africa and Spani) accounted for about 90 percent of the reported catches in recent years. Because pomfrets are mostly caught as a bycatch in other fisheries, there is very limited biological information on the species. Pomfrets are included in some national management plans but are not assessed by international fisheries bodies. Although their state of exploitation is not known, they are unlikely to be overexploited.

Sauries belong to the Scomberesocidae family. The species included in Annex 1 of UNCLOS are the Atlantic saury (*Scomberesox saurus*), the Pacific saury (*Cololabis saira*), the saury (C. *adocetus*), and the king gar (*Scomberesox saurus scombroides*)[30]. These species are pelagic, schooling and oceanodromous. Landings have fluctuated between 200 000 tonnes and 600 000 tonnes since 1950 without a clear long term trend. A total of 411 000 tonnes were reported in 2013, with the Pacific saury (*C. saira*) responsible for more than 95% of the total landings. Historically, Japan, Taiwan Province of China, Republic of Korea and the Russian Federation accounted for the bulk of the reported catches.. Similar to pomfrets, sauries are included in national management plans but they are not a species of direct interest in international fisheries bodies. Although their state of exploitation is not known, sauries are unlikely to be overexploited.

The two dolphinfishes of the Coryphaenidae family, the common dolphinfish (*Coryphaena hippurus*) and the Pompano dolphinfish (*Coryphaena equiselis*), are included in Annex 1 of UNCLOS. Both species follow boats and associate with floating objects which may be used as attracting devices in fisheries. More than sixty countries reported dolphinfish landings to FAO (*C. hippurus* only). Reported landings show a sustained increasing trend from 7 000 tonnes in 1950 to almost 103 000 tonnes in 2013 after a maximum reached in 2012 at 114 000 tonnes. The Pacific Ocean accounts for more than 80 percent of catches in recent years, being Peru, Taiwan Province of

[29] The FAO Species Identification and Data Programme (SIDP) web site, Fishbase and other FAO information resources were used as sources of information on the biological characteristics and geographical distribution of the species of other highly migratory species.

[30] The list contains three species and one subspecies belonging to one of the species cited. The species *Scomberesox saurus* has two subspecies: *S. saurus saurus* and *S. saurus scombroides*. It is assumed that *Scomberesox saurus* in Annex 1 is *Scomberesox saurus saurus.*

China, Ecuador and Indonesia the largest contributors. Dolphinfish are considered in some national fishery management plans but similarly to pomfrets and sauries they do not appear to be assessed by international fishery bodies. Although the state of exploitation is not known, considering that the species is widely distributed and highly productive, it is unlikely that dolphinfish are overexploited.

3. Selected Straddling Fish Stocks

The following sections summarize the state of the main straddling stocks in each FAO Statistical Area, based on the list of species identified by FAO for the 2005 Review Conference. The state of stocks is based mostly on the State of World Fisheries and Aquaculture 2014 (SOFIA)[31]. The main species that constitute straddling stocks are generally well studied (e.g. cod, pollock, flounders) compared to several highly migratory species, particularly the non-tunas. Therefore, this document does not review the biology, and life history and migratory behaviour of these species. Such information is readily available from various published sources of information or regional fishery bodies.

3.1 Pacific Ocean

3.1.1 Northwest Pacific

Straddling stocks in the Northwest Pacific include Alaska (Walleye) pollock (*Theragra chalcogramma*), flying squid (*Ommastrephes bartrami*), Boreal clubhook squid (*Onychoteuthys borealjaponica*), Boreopacific armhook squid (*Gonatopsis borealis*), Pacific Ocean Perch (*Sebastes alutus*), pelagic armourhead (*Pentaceros richardsoni*) and the alfonsino (*Beryx splendens*). The pollock stocks that produced record catches in the late 1980s, declined in the early 1990s mainly due to unregulated fishing in the international waters of the Northwest Pacific. In 1995, pollock fishing in the high seas areas of the Central Bering Sea (including in the "Donut Hole") became regulated by the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea. The stock in the western Bering Sea showed a substantial decline in biomass in the early 1990s and remains at a low level since then[32]. The stock is likely to be overexploited. The stocks of squids display large variability in catches, abundance and distribution in response to changing environmental conditions in the North Pacific. There is scanty information about the state of the stocks. However, considering that oceanic squids are widely distributed and highly productive, it is unlikely that they are currently overexploited. Based on reported landings, the Pacific Ocean Perch was considered overexploited in the 2010 review. A slight increase in catches was reported since then, but the 2013 catches of 2 500 tonnes is still a small fraction of the historical peak of 41 000 tonnes (1979). In lack of new information, the state of the stock is likely to remain unchanged. The state of pelagic armourhead and alfonsino is not known. Major decline in catch per unit effort of alfonsino in the North Pacific indicates that stocks are probably overexploited or depleted[33].

3.1.2 Northeast Pacific

Straddling stocks in the northeast Pacific include Jack mackerel (*Trachurus picturatus symmetricus*) and Alaska (Walleye) pollock (*Theragra chalcogramma*). The Jack mackerel is widespread in the

[31] FAO. 2014. The State of World Fisheries and Aquaculture 2014 (SOFIA). FAO. Rome. 243 p.
[32] 18th meeting of the Scientific and Technical Committee of the Parties to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea, 16 – 30 September 2013.
[33] Bensch, A.; Gianni, M.; Gréboval, D.; Sanders, J.S.; Hjort, A. 2009. Worldwide review of bottom fisheries in the high seas. FAO Fisheries and Aquaculture Technical Paper. No. 522, Rev.1. Rome, FAO. 2009. 145p.

northeastern Pacific and there is no indication that the stocks is either fully exploited or overexploited. The stocks of Alaska pollock in the Eastern Bering Sea and Aleutian Islands region are fully exploited.

3.1.3 Western Central Pacific

There is no information on straddling stocks in the Western Central Pacific.

3.1.4 Eastern Central Pacific

The straddling stocks of giant squid (*Dosidicus gigas*) and Spanish mackerel (*Scomber japonicus*) in the Eastern Central Pacific are not overexploited.. The stock of jack mackerel (*Trachurus symmetricus*) also remains lightly exploited since the early 2000s. Catches of jack mackerel have shown a clear downward trend from the late 1970s until 2012, when only 337 tonnes were landed. A slight recovery in catches was observed in 2013 (2 255 t), but still well below the historical peak of 66 000 tonnes recorded in 1952. As discussed by FAO, the severe decline and low catches of jack mackerel in the last decades seems to be due mostly to lack of commercial interest in the species.

3.1.5 Southwest Pacific

There exist two types of straddling fish stocks in the southwest Pacific. The more common types associated with large continental shelves and another type associated with small islands with limited continental shelves whose fishery depend on oceanic resources found both within and outside their EEZ's. Species with straddling stocks include orange roughy (*Hoplostethus atlanticus*), oreo dories (*Allocyttus verrucosus, A. Niger, Neocyttus rhomboidalis, Pseudocyttus maculatus*) and hoki (*Macruronus novaezealandiae*). Straddling oceanic resources include the narrow-barred Spanish mackerel (*Scomberomorus commerson*), flying squids, and flying fish. Orange roughy is overexploited, oreo dories are fully to overexploited and hoki is fully exploited. The state of exploitation on Spanish mackerel, flying squid and flying fish is unknown but given their wide distribution and productivity they are unlikely to be overexploited.

3.1.6 Southeast Pacific

Straddling stocks in the southeast Pacific include jumbo squid (*Dosidicus gigas*) and Chilean jack mackerel (*Trachurus picturatus murphyi*). Spanish mackerel (*Scomber japonicus*) is also found beyond the EEZ but the catches are small. The stock is fully exploited.. The Chilean jack mackerel is considered overexploited while the stock jumbo squid is not overexploited.

3.2 Atlantic Ocean

3.2.1 Northwest Atlantic

Straddling stocks in the northwest Atlantic include cod (*Gadus morhua*), American plaice (*Hypoglossoides platessoides*), redfish (*Sebastes marinus*), witch flounder (*Glyptocephalus cynoglossus*), Atlantic halibut (*Hippoglossus hippoglossus*), black halibut (*Reinhardtius hippoglossoides*), yellowtail flounder (*Pleuronectes ferruginaeus*), grenadiers (Macrouridae), capelin (*Mallotus villosus*) and shrimp (*Pandalus borealis*). It should be noted that stocks of some of the species on the Flemish Cap (NAFO Division 3M), such as cod, redfish, American place and

shrimp, may be separate from EEZ stocks, and as such, may be other high seas fish stocks, rather than straddling stocks. Therefore their status is discussed separately in this section.

Based on the most recent assessments by the Northwest Atlantic Fisheries Organization (NAFO)[34], the stocks of cod and redfish in the Flemish Cap have shown an increasing trend in biomass in the last decade and can be considered fully exploited. The stock of American place has also shown some slight increase in biomass in recent years but remains overexploited. The stock of shrimp in Flemish Cap is currently overexploited.

As for the main straddling stocks, cod is under a rebuilding plan and a moratorium implemented in 1994 but remains overexploited, with very low levels of biomass. The stocks of American place, Atlantic halibut, capelin and shrimp are overexploited. Witch flounder stocks are either fully or overexploited. The stocks of redfish and yellowtail flounder are considered fully exploited. The stock of black halibut was considered overexploited in the last review prepared by FAO. No new information could be found on the status of this stock. Its status was assumed to remain unchanged. The state of grenadiers is unknown.

3.2.2 Northeast Atlantic

The main "traditional" straddling stocks in the northeast Atlantic are: blue whiting (*Micromesistius poutassou*), oceanic redfish (*Sebastes mentella*), cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), black (Greenland) halibut (*Reinhardtius hippoglossoides*), Norwegian spring-spawning herring (*Clupea harengus*), mackerel (*Scomber scombrus*) and horse mackerel (*Trachurus trachurus*).

The stocks of blue whiting, mackerel, horse mackerel, herring and Greenland halibut are fully exploited. The stocks of haddock and cod vary from fully exploited to overexploited. Oceanic redfish was considered overexploited in the last review prepared by FAO. No new information could be found on the status of this stock, which was assumed to remain unchanged.

In addition to these, most deep water species for which fisheries have developed in recent decades are also considered as being straddling. These species are: Baird's smoothhead (*Alepocehalus bairdii*), Risso's smoothhead (*Alepocephalus rostratus*), Blue antimora (Blue hake, *Antimora rostrata*), Black scabbardfish (*Aphanopus carbo*), Iceland catshark (*Apristuris* spp), Greater silver smelt (*Argentina silus*), Alfonsinos (*Beryx* spp.), Tusk (*Brosme brosme*), Gulper shark (*Centrophorus granulosus*), Leafscale gulper shark (*Centrophorus squamosus*), Black dogfish (*Centroscyllium fabricii*), Portuguese dogfish (*Centroscymnus coelolepis*), Longnose velvet dogfish (*Centroscymnus crepidater*), Deep-water red crab (*Chacon* (*Geyron*) *affinis*), Rabbit fish (Rattail) (*Chimaera monstrosa*), Frilled shark (*Chlamydoselachus anguineus*), Conger eel (*Conger conger*), Roundnose grenadier (*Coryphaenoides rupestris*), Kitefin shark (*Dalatias licha*), Birdbeak dogfish (*Deania calceus*), Black (Deep-water) cardinal fish (*Epigonus telescopus*), Greater lanternshark (*Etmopterus princes*), Velvet belly (*Etmopterus spinax*), Blackmouth dogfish (*Galeus melastomus*), Mouse catshark (*Galeus murinus*), Bluemouth (Blue mouth redfish) (*Helicolenus dactylopterus*), Blondnose six-gilled shark (*Hexanchus griseus*), Orange roughy (*Hoplostethus atlanticus*), Silver roughy (Pink) (*Hoplostethus mediterraneus*), Large- eyed rabbit fish (Ratfish) (*Hydrolagus mirabilis*), Silver scabbard fish (Cutless fish) (*Lepidopus caudatus*), Eelpout (*Lycodes esmarkii*), Roughhead grenadier (Rough rattail) (*Marcrourus berglax*), Blue ling (*Molva dypterigia*), Ling (*Molva molva*), Common mora (*Mora moro*), Sailfin roughshark (Sharpback shark) (*Oxynotus paradoxus*), Red (blackspot) seabream (*Pagellus bogaraveo*), Forkbeards (*Phycis* spp.), Wreckfish

[34] http://www.nafo.ca/science/advice/nafo-stocks.html

(*Polyprion americanus*), Round skate (*Raja fyllae*), Arctic skate (*Raja hyperborea*), Norwegian skate (*Raja nidarosiensus*), Straightnose rabbitfish (*Rhinochimaera atlantica*), Knifetooth dogfish (*Scymnodon ringens*), Small redfish (Norway haddock) (*Sebastes viviparous*), Greenland shark (*Somniosus microcephalus*), Spiny (Deep-sea) scorpionfish (*Trachyscorpia cristulata*).

Fisheries for deep water species have developed rapidly since 1990 in the Northeast Atlantic as a result of management limitations and reduced resource availability of traditional species. Several of these species are caught as bycatch in multispecies fisheries and, with very few exceptions; the state of stocks is not assessed using traditional stock assessment methodologies because of the limited data available. For data-limited stocks, ICES[35] adopts a precautionary approach that provides advice on precautionary catch levels based on ancillary information, including abundance trends. Recommendations to increase or maintain constant the allowable catches are made for stocks that show consistent increasing or stable trends in abundance indicators. This is the case, for instance, for the stocks of alfonsino, black scabbardfish, greater forkbeard, ling, some stocks of roundnose grenadier, greater silver smelt and tusk. These stocks are probably fully exploited. For stocks with declining trends in abundance indicators or a past history of depletion, the recommendation is to decrease catches or to not allow any catch from direct and bycatch fisheries. Among the stocks in this situation are the orange roughy, red (blackspot) seabream and some stocks of blue ling, great silver smelt, roundnose grenadier and tusk. These stocks are probably overexploited. No information is available on the state of the other species.

3.2.3 Eastern Central Atlantic

The analysis of catches by non-coastal States in the Eastern Central Atlantic indicated that the target stocks are composed of a mixture of coastal and oceanic species such as common cuttlefish (*Sepia officinalis*), octopuses (Octopodidae), red porgy (*Pagrus pagrus*), West African goatfish (*Pseudupeneus prayensis*), common sole (*Solea solea*), cuttlefish (Sepiidae), bobtail squids (Sepiolidae), European hake (*Merluccius merluccius*), Natantian decapods, Croakers and drums (Sciaenidae), tonguefish (Cynoglossidae), chub mackerel (*Scomber japonicus*), European pilchard (*Sardina pilchardus*), jack and horse mackerel (*Trachurus* spp), alfonsinos (*Beryx* spp), flatfishes (Pleuronectiformes), Senegalese hake (*Merluccius senegalensis*) and other marine fishes. Considering that most of these species are likely to be distributed inside EEZs, and are being caught under fishing agreements with coastal States, it was concluded, as in the previous review elaborated by FAO, that there are no significant fisheries for straddling stocks outside of EEZs at present in the Eastern Central Atlantic.

3.2.4 Western Central Atlantic

The analysis of catches by non-coastal States was also performed for the Western Central Atlantic. It identified catches of a mixture of coastal and oceanic species in general categories such as: sharks, rays and skates (Elasmobranchii), croakers and drums (Scianidae), Natantian decapods and other marine fishes (Marine fishes nei), which suggest that these catches were probably made within EEZs under fishing agreements with coastal States. As for the Eastern Central Atlantic, it was concluded that there are no significant fisheries for straddling stocks outside EEZs at present in the Western Central Atlantic.

[35] http://www.ices.dk/community/advisory-process/Pages/Latest-Advice.aspx

3.2.5 Southwest Atlantic

Straddling stocks in the in the southwest Atlantic include short-fin squid (*Illex argentinus*), common (Patagonian) squid (*Loligo* spp.), a flying squid (*Martialia hyadesi* of the Ommastrephidae family), the hakes (*Merluccius hubbsi* and *M. australis*), the southern blue whiting (*Micromesistius australis*), the pink cusk eel (*Genypterus blacodes*), the Patagonian toothfish (*Dissostichus eleginoides*), the tadpole mora (*Salilota australis*), the Patagonian grenadier (*Macruronus magellanicus*), the grenadier (*Macrourus whitsoni*), the Antarctic cod (*Notothenia rossii*), rockcods (*Notothenia* spp.) and sharks and rays.

The state of stocks of flying squid, tadpole mora, grenadier, Antarctic cod, rockcods and the shark and rays are not known. The Patagonian grenadier and the Patagonian squid are fully exploited. The Patagonian toothfish, the shortfin squid and the southern hake (*M. australis*) are fully exploited to overexploited. The stocks of pink cusk eel, the southern blue whiting and the Argentinean hake (*M. hubbsi*) are overexploited.

3.2.6 Southeast Atlantic

The Southeast Atlantic Fisheries Organization (SEAFO) identified the following species as straddling: Alfonsinos (Family Bercycidae), orange roughy, horse mackerel (*Trachurus* spp.), lanternfish (Family Myctophidae), mackerel (*Scomber* spp), skates (Family Rajidae), sharks (Order Selachomorpha), armourhead (*Pseudopentaceros* spp), cardinal fish (*Epigonus* spp), deep sea red crab (*Chaceon maritae*), octopus (Family Octopodidae), squids (Family Loliginidae), and wreckfish (*Polyprion americanus*). There is a general lack of data on the state of fisheries and stocks of most of these species. As a precautionary measure against overfishing, catch limits based on harvest control rules and closed areas have been established by SEAFO for some deep water species considered highly vulnerable to fishing, including orange roughy, oreo dories, alfonsino, armourhead, cardinal fish, wreckfish and deep-sea red crab. However, the state of exploitation is unknown for all of the species except for stocks of horse mackerel which vary from fully exploited to overexploited.

3.3 Indian Ocean

No fisheries on straddling stocks have been identified in the Indian Ocean. There are straddling resources (e.g. deep water snapper), but they are not fished to any significant extent. As noted by Maguire et al. (2006), there are also areas in the Indian Ocean that are suitable for straddling stocks in terms of topography with relatively shallow water extending from an EEZ into the high seas, such as shelf areas off Mauritius and the Seychelles in the Western Indian Ocean and the South Tasmanian Rise in the Eastern Indian Ocean. However, as noted also in the previous review prepared by FAO, fishing on straddling stocks does not seem significant at present in those areas.

3.4 Southern Ocean

The Southern Ocean is considered to be delimited by the Antarctic Convergence where cold Antarctic waters meet warmer waters of the Atlantic, Pacific and Indian Oceans to the north. There is a unique legal situation for the Southern Ocean (FAO statistical areas 48, 58, and 88) which is within the jurisdiction of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)[36]. Claims of sovereignty over the Antarctic Continent or its continental shelf

[36] http://www.ccamlr.org/default.htm

have been put aside under provisions of the Antarctic Treaty (which entered into force in 1961)[37]. However, several countries have established EEZs within the Southern Ocean area of CCAMLR off the coasts of their island territories in that area, in addition to the EEZs extending from the tip of South America. Given the unique situation of the Southern Ocean with respect to territorial and jurisdictional claims, this review reports on all of the species fished in the CCAMLR convention area as if they were straddling fish stocks or other high seas fish stocks.

Prior to the mid-1960s, only whale catches were reported to FAO from the Southern Ocean. Since then, the fisheries have targeted various species including marbled rockcod, mackerel icefish, humped rockcod, south Georgian icefish, Patagonian and Antarctic toothfish and Antarctic krill. Reported catches exceeded 600 000 tonnes in the early 1980s, but dropped to almost 74 000 in 1993 and followed a gradual increasing trend since then, with 237 000 tonnes reported in 2013.. Catches in the last decade have been dominated by Antarctic krill (*Euphausia superba*) (88%), Patagonian toothfish (*Dissostichus eleginoides*) (7%), Antartic toothfish (*Dissostichus mawsoni*) (2%) and mackerel icefish (*Champsocephalus gunnari*) at less than 2%. About sixty species are reported in the remaining 2% of the total catches. IUU (Illegal, Unreported and Unregulated) fishing is a concern within the convention area of CCAMLR and creates uncertainties on the actual volume of catches, especially of the Antarctic toothfish.

Antarctic krill is not fully exploited as catches are well below the precautionary catch limit established by CCAMLR. Lanternfishes (Myctophidae) are also probably not fully exploited in all FAO Areas. The Patagonian toothfish and the Antarctic toothfish are considered fully exploited and the mackerel icefish is considered overexploited. Antarctic rockcods and blackfin icefish were considered overexploited in the last review prepared by FAO. No new information was available on the status of these stocks and they were assumed to remain unchanged.

3.5 Mediterranean Sea

Most of the Mediterranean states have not exercised their right to establish, implement or give effect to the claims on exclusive economic zones (EEZs) beyond the 12 nautical miles of territorial sea, so many of the exploited stocks correspond to the definition of a straddling stock. The General Fisheries Commission for the Mediterranean (GFCM) uses the concept of shared stocks, exploited by two or more countries on the high seas and only by the riparian countries in territorial waters. Such stocks in the Mediterranean include hake (*Merluccius merluccius*) in the Gulf of Lions, deep sea shrimps, the blue and red shrimp (*Aristeus antennatus*) and the giant red shrimp (*Aristaeomorpha foliacea*), sardines (*Sardina pilchardus*) in the Sea of Alboran and Adriatic sea and anchovy (*Engraulis encrasicolus*) in the gulf of Lions and the Adriatic sea. The blue and red shrimp and the giant red shrimp are overexploited in the western Mediterranean. The state of these stocks in the eastern Mediterranean is unknown. The stocks of rose shrimp and hake are under unsustainable levels of exploitation and are considered overexploited in some zones. . The state of sardines and anchovies ranges from fully to overexploited, depending on the zone. It should be noted that fishing with towed gears beyond 1 000 m depth is forbidden by GFCM.

3.6 State of the selected straddling stocks

Overall, taking those species for which stock status information is available, it is found that 16 percent of the straddling stocks are not fully exploited, 44 percent are fully exploited, and 40 percent are overexploited. There was very little change in the overall status of these stocks since the

[37] http://www-old.aad.gov.au/information/treaty/treaty.asp

last review prepared by FAO in 2010. Trends in the exploitation of selected straddling fish stocks since the last assessment show that the status of 59 per cent of the stocks remained unchanged, 16 per cent of stocks showed improvement and 25 per cent of stocks showed some deterioration. In addition, the status of approximately half of the stocks described in this report is unknown due to lack of sufficient information.

4. Other High Seas Fish Stocks

This section considers the fish stocks that are not comprised of highly migratory species and occur exclusively in the high seas, i.e. in waters beyond the areas of national jurisdiction, as referred to in section 1.1. Most of the currently known high seas stocks are comprised of deep water species, but several others may exist for pelagic species[38]. Most fisheries[39] for these deep water species are relatively recent (major fisheries first developed off New Zealand and Australia in the late 1970s and 1980s) and the development of a majority of them has outpaced the ability to provide scientific information and to implement effective management. Relatively little is known about many of the species and most of the fisheries.

In general, deep water species are believed to be particularly vulnerable to over-exploitation and depletion (at least localized) because of their slow growth and late maturity. Some species form dense aggregations which are accessible to fisheries which have developed the capability to fish in deep water (to 2 000 m or more) over the last few decades. Deep water fisheries often exploit aggregations associated with topographic features like seamounts, ocean ridges and canyons. However, fisheries associated with particular topographic features usually do not persist, presumably because of localized depletion of the fishery resource.

Important species that form deep water aggregations include orange roughy (*Hoplostethus atlanticus*) and the oreos (*Allocyttus* spp., *Neocyttus* spp. *Pseudocyttus* spp., etc), which are often fished together, alfonsinos (*Beryx* spp.) in lower latitude fisheries, Patagonian toothfish (*Dissostichus eleginoides*) in Southern Ocean fisheries, pelagic armourhead (*Pseudopentaceros wheeleri*) and various species of Scorpaenidae found on both coasts of North America. A number of deep water species, treated under straddling stocks in the North East Atlantic, also potentially make up other high seas fish stocks.

The Orange Roughy (*Hoplostethus atlanticus*), a member of the Trachichthyidae family, is found in the North and South Atlantic, in the Southern Indian Ocean, the Tasman Sea, around New Zealand, and in the South Pacific. They are found within EEZs, some are straddling stocks, while others are entirely on the high seas. The species is mainly caught at depths over 800 m by fisheries on fish aggregations associated with seamounts. The proportion of the resource outside of the fished area is not known. Fisheries appear to have serially depleted fish aggregations that may or not correspond to distinct stock units. The biological characteristics of this species (slow growth and exceptional longevity) and its aggregating behaviour make it vulnerable to overfishing. As such, many smaller fisheries for this species have been closed down as the stocks have been overexploited and the fishery has become commercially unviable.

[38] The information from this section is drawn / adapted from the chapter on Deepwater fisheries in the last Review of the State of World Marine Resources (*FAO Fisheries Technical Paper* No. 569), Deep Sea 2003, an international Conference on Governance and Management of Deep-Sea Fisheries (*FAO Fisheries Report* No. 772), advice and information from the Advisory Committee on Fisheries Management of the International Council for the Exploration of the Sea, and other Regional Fisheries Organisations.

[39] There is no rigorous definition of a deep water fishery, but in general, they occur in depths of at least 500 m, and they are commonly though of as occuring at depths of 1000 m or more. Current technology allows fishing to depths of about 2500 m.

The Oreo dories (*Allocyttus* spp., *Neocyttus* spp. and *Pseudocyttus* spp.), members of the Oreostomadidae) occur close to the sea bed in deepwaters. They form large aggregations over rough grounds near seamounts and canyons in the Antarctic, Atlantic, Indian, and Pacific (reported primarily off South Africa, New Zealand and southern Australia). As for orange roughy, the proportion of the resource outside of the fished area is not known and fisheries appear to have serially depleted fish aggregations that may or may not correspond to distinct stock units.

The Alfonsino (*Beryx splendens*), belong to the Bericidae family and are found in the Atlantic, Indian, western and central Pacific Oceans though they are generally not present in the northeast Pacific. They inhabit the outer shelf (180 m) and slope to at least 1 300 m depth, and they may make vertical migrations at night. Genetic studies suggest that Alfonsinos may have an ocean-wide population structure, but the relationship between the various fish aggregations is not known. Unlike many deepwater species, Alfonsinos growth and mortality rates are relatively high, which means that the species should be better able to sustain a fishery than other less productive deepwater species?

Toothfishes (*Dissostichus* spp.), belong to the Notothenidae family and have a circumpolar distribution within Antarctic and Southern Ocean waters. Patagonian toothfish (*D. eleginoides*) are found asymmetrically around southern South America and Antarctic toothfish (*D. mawsoni*) occurs in high latitudes, in the Pacific region. The two species overlap between 60°S and 65°S and both occur to depths of 3 000 m. The northern limit for most populations of Patagonian toothfish is 45°S, except along the Chilean and Argentinean coasts where they may extend north in deeper cold water. Significant populations of Patagonian toothfish exist in the waters of, and adjacent to, the various sub-Antarctic islands and of Chile, Argentina, Uruguay and Peru. The problem of illegal, unregulated and unreported fishing (IUU) has been considerably reduced in recent years. However, it still remains a major concern in many regions.

Pelagic armourhead (*Pseudopentaceros wheeleri* and *P. richardsoni*), belong to the Pentacerotidae family. The species is associated with seamounts, especially in the North Pacific, but the family is distributed throughout the Indian and Pacific Oceans and in the southwestern Atlantic. Trawling by Japanese and Russian vessels between 1969 and 1982 depleted the stocks of pelagic armourhead in the Emperor Seamount chain and the Northern Hawaiian Ridge. The species was later replaced in the area by alfonsino (*Beryx splendens*), although the alfonsino has never been as abundant as the pelagic armourhead was. There is no evidence that either of the fish stocks will recover enough to allow commercially viable fisheries in the near future.

Hoki (*Macruronus novaezelandiae*) is a benthopelagic Merlucciidae, that usually lives near the bottom of the southwest Pacific Ocean, but the species also form mid-water aggregations for spawning. Large adult fish generally occur deeper than 400 m, while juveniles may be found in shallower water. Midwater trawl fisheries target aggregations near canyons that are often close to coasts in areas of narrow continental shelves. While fisheries for hoki are generally considered deep water fisheries, most of the catch is from EEZs. The significance of hoki as an “other high seas fish stock” is probably minor. Management experience in at least some jurisdictions indicates that fisheries exploiting hoki can be sustainably managed.

A further suite of deepwater, or at least slope species, have been the target of fisheries in many tropical regions. These can be targeted by small-scale deepwater fisheries usually along the shelf break and shelf slope wherever the continental shelf is relatively narrow and the fishing grounds are accessible to fishermen using small fishing boats. The principle species consist of members of the Lutjanidae (snappers), Serranidae (Sea basses: groupers and fairy basslets), and Carangidae (Jacks

and pompanos) families and mostly importantly include the Eteline snappers (e.g. *Etelis coruscans* and *E. carbunculus*) and the jobfishes (e.g. *Pristomopoides filamemtosus*, *P. typus* and *P. multidens*). These fisheries are particularly important to small island states that often have few other demersal fish resources though they are also widely found along the continental margins in tropical and sub-tropical areas. However, their significance as "other high seas fish stocks" is probably minor.

5. Associated Species

As mentioned earlier in this review, associated species are considered to be impacted species that are not part of the landed catch. Fisheries for straddling fish stocks, highly migratory fish stocks, and other high seas fish stocks, impact other species as a result of (1) discards, (2) physical contact of fishing gear with organisms (and habitat) that are not caught, and (3) indirect processes. Since the preparation of the FAO report to the 2006 Review Conference there was no new comprehensive review of these impacts on a global scale. Considering that the information presented in 2006 remain relevant, the sections below summarize the main consideration made about these mechanisms.

5.1 Discards

Information on global fisheries discards was reviewed by Kelleher (2005). The highest discard rates[40] are associated with shrimp trawling fisheries. The aggregate discard rate for cold/deepwater shrimp fisheries, such as the fishery for *Pandalus* shrimp in the Northwest Atlantic, is 39%, but where use of bycatch reduction devices (BRDs) is mandated (e.g. as in the Labrador and Flemish Cap fishery), the discard rate is relatively low, in the order of 5%. There are a variety of finfish and invertebrate species caught, including juveniles of target species of many fisheries.

Following shrimp trawling, longline fishing for highly migratory species (primarily tuna and tuna like species) has the highest discard rate (averaging 28% with a range of 0 to 40%). Other fisheries for highly migratory species have much lower discard rates: 5% for tuna purse seines, 0.4% for tuna pole and line fishing. The total discards by these highly migratory species fisheries is estimated at about 700 000 tonnes annually. The most common discard species from longlines are sharks (especially the blue shark), frigate tuna, Kawakawa, Indo-Pacific king mackerel, and narrow-barred Spanish mackerel. Albatross, petrels and other seabirds are also caught by longlines. For tuna purse seines, some of the discarded species are bonito, dogtooth tuna, rainbow runner, dolphinfish, jacks, sharks, billfish, mantas and undersize target species (i.e. skipjack and yellowfin tuna). Dolphins are also encircled by purse seines in some areas (see discussion below).

Fisheries for straddling fish stocks and other high seas fish stocks are primarily conducted with bottom trawlers. The estimated discard rate for trawlers targeting demersal finfish is 9.6% (for all fisheries). There is no basis to judge if the rate is likely to be higher or lower for straddling fish stocks and other high seas fish stocks than for stocks entirely within EEZs. Many species are discarded depending on the target species (typically the species composition differs between flatfish and roundfish fisheries), geographic area, and depth. Discards of juveniles of the target species are common, as well as species with low commercial value, such as horse mackerel, long jawed mackerel (*Rastrelliger* spp), elasmobranchs (e.g. dogfish and skates), arrowtooth flounders and flathead sole. Many benthic invertebrates are discarded, such as molluscs, echinoderms (e.g. urchins and starfish), crabs, rajids, and whelks. Deepwater trawling (often at 1 000 m or more) results in

[40] Percentage of total catch discarded.

discards of additional species, such as grenadiers, whiptails, rabbitfish, oreos, chondrichthyans (e.g. birdbeak dogfish), batoids and chimaeroids, and cold water corals (*Lophelia sp.*).

In addition to bottom trawlers, demersal longlining is an important form of fishing in the Southern Ocean in the CCAMLR area (Statistical Areas 48, 58, 88). The discard rate for this type of fishing is estimated as 7.5% (ranging from 0.5 to 57%). The overall discard rate in the CCAMLR area is estimated as 12.7% resulting in about 2 000 tonnes annually.

Charismatic species[41] and species at risk of extinction are known bycatch of fisheries for highly migratory fish stocks, straddling fish stocks and other high seas fish stocks. Sea turtles and sea birds are a well-documented bycatch in longline fisheries for tuna and tuna like species and for demersal species, such as the Southern Ocean demersal longline fishery for toothfish. Concern about sea bird mortality from longline fisheries leads the FAO Committee on Fisheries to adopt an International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries[42]. FAO also hold both an Expert Consultation[43] and a Technical Consultation[44] to consider ways of reducing mortality of sea turtles in fishing operations, including in longline fisheries. Measures introduced in several fisheries and RFBs (such as changes in hook shape, bait type and the use of torilines) have reduced significantly the bycatch of sea birds and sea turtles in longline fisheries.

Bycatch of marine mammals is known to occur in some trawl fisheries (particularly large high speed pelagic trawls) and to a lesser extent on longlines. It is unclear to what degree marine mammal bycatch by trawlers and longliners occurs in high seas fisheries, but there is probably some. In the case of purse seine fishing for tuna in the Eastern Tropical Pacific, dolphins are intentionally encircled in the nets since they are an indicator of the location of schools of tuna. This practice has resulted in a cumulative mortality of several million dolphins since the 1960, jeopardizing some dolphin species. This led to the negotiation of the Agreement on the International Dolphin Conservation Program (AICDP), which entered into force in 1999, and whose Secretariat is provided by the Inter-American Tropical Tuna Commission (IATTC). The Program reduced drastically the mortality from 132 000 dolphins in 1986 to about 800 in 2013. In spite of this success, dolphin populations appear to have been slow to recover[45].

The recent expansion of trawl fisheries to deepwater (often much more than a 1 000 m) into areas previously unfished has resulted in the bycatch of cold water corals (*Lophelia sp.*), sometimes as boulder size pieces. For instance, it was estimated that in the first year of the deepwater trawl fishery for orange roughy on the South Tasman Rise straddling the Australian EEZ 10 000 tonnes of coral were caught associated with a catch of about 4 000 tonnes of orange roughy[46].

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[41] Species which significant segments of society want protected regardless of their abundance.

[42] http://www.fao.org/figis/servlet/static?dom=org&xml=ipoa_seabirds.xml

[43] FAO. 2004. Expert Consultation on the Interactions between Sea Turtles and the Fisheries within an Ecosystem Context. Rome, Italy, 9-12 March 2004. *FAO Fisheries Report* No. 738. Rome, 37p. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/007/y5477e/y5477e00.htm

[44].FAO. 2004. Technical Consultation on Sea Turtles Conservation and Fisheries. Bangkok, Thailand, 29 November-2 December 2004. *FAO Fisheries Report* No. 765. Rome, FAO. 31p. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/007/y5887e/y5887e00.htm

[45] http://www.iattc.org/DolphinSafeENG.htm for the IATTC conservation program and http://swfsc.nmfs.noaa.gov/PRD/ for the Southwest Fisheries Science Center (US National Marine Fisheries Service) research program on dolphin conservation.

[46] Anderson, O.F. and M.R. Clark. 2003. Analysis of the bycatch in the fishery for orange roughy, *Hoplostethus atlanticus*, on the South Tasman Rise. Marine and Freshwater Research. **54**: 643-652. Also see a review by Matthew Gianni (2004. High seas bottom trawl fisheries and their impacts on the biodiversity of vulnerable deep-sea ecosystems: options for international action. IUCN. 83 pp. http://www.iucn.org/themes/marine/pdf/Gianni_HS-BottomTrawling_FullVersion.pdf)

5.2. Physical contact by fishing gear with organisms that are not caught, and indirect processes

Trawling is the primary type of fishing that causes physical contact between fishing gear and associated species and their habitat. The bycatch of cold water corals is probably a symptom of a larger impact of trawling as reefs are damaged without traces of corals being hauled up in nets. Trawls also come in physical contact with the bottom in areas were reefs are not present and here the effects are less obvious, but ecosystems are altered and species of benthic organisms will be differently affected.

Indirect processes affect the growth, survival and reproduction of species that are the target of fisheries, as well as associated species. When fisheries remove fish from populations, food webs are altered. Some species may suffer from the loss of prey; others may benefit from removal of their predators. Species that compete will be affected differently with cascading impacts on other dependent species. Impacts through indirect processes are hard to detect, and even harder to predict. However, they must occur[47].

Alteration of the sea bottom resulting from physical contact by fishing gear probably changes habitat suitability thus indirectly effecting associated species. For example, some species depend on complex "three dimensional" biogenic structures, such as reefs, for shelter from predators. When such structures are destroyed, the species may disappear.

6. Straddling fish stocks, highly migratory fish stocks and other high seas fish stocks for which no measures have been adopted by regional fisheries management organisations or arrangements

Fisheries on highly migratory tuna and tuna-like species as defined by UNCLOS Annex I, are all under some form of management. However, the global nature of some highly migratory species fishing fleets and of markets, make it more difficult for regional organizations to manage fisheries on these species than it is to manage fisheries that are less global.

Unlike fisheries for tuna and tuna like species, management of fisheries for oceanic sharks and other highly migratory species listed in Annex 1 is spotty and incomplete. The International Plan of Action for the Conservation and Management of Sharks is a non-binding instrument that should guide management of oceanic sharks, but it does not implement conservation measures. Regional Fisheries Organizations that have jurisdiction over fisheries that interact with oceanic sharks and other highly migratory species (particularly longline fisheries) are aware of bycatch issues, but for the most part, it is unregulated. In recent years several RFMOs have adopted measures to combat the finning of sharks and to prevent the capture and landing of sharks species of conservation concern, including those listed in the Appendices of CITES.

With the exception of a few species producing large catches (e.g. tunas and swordfish), knowledge of the biology and state of exploitation of highly migratory species (such as billfishes and sailfishes)

[47] The International Council for Exploration of the Sea is a good source of information on the ecosystem effects of fishing (for example http://www.ices.dk/pubs/crr/crr272/CRR272.pdf). Also, the US National Research Council published a report on the effects of trawling on the seafloor: http://www.nap.edu/catalog/10323.html

remains scarce. Knowledge is even more limited for most shark species included in UNCLOS Annex I.
Fisheries on pomfrets, sauries and dolphinfish are sometimes included in national fishery management plans, either as a component of the plans for other species or on their own, but generally speaking, a more systematic treatment of these species is necessary before it could be said that the fisheries exploiting them are properly managed.

Most fisheries on straddling fish stocks are either covered, or in the process of being covered, by existing regional fisheries management organizations, or organizations and arrangements that are in the process of being formed. The situation is more variable for fisheries for other high seas fish stocks. The management of deep-sea fisheries in the high seas are presently addressed by the General Fisheries Commission for the Mediterranean (GFCM), North East Atlantic Fisheries Commission (NEAFC), Northwest Atlantic Fisheries Organization (NAFO), South East Atlantic Fisheries Organisation (SEAFO), South Pacific Regional Fisheries Management Organisation (SPRFMO), the South Indian Ocean Fisheries Agreement (SIOFA) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). In the North Pacific, States are negotiating an agreement for a new RFMO (the North Pacific Fisheries Commission).

7. Conclusions

One of the main impediments to assess the state of exploitation of highly migratory species, straddling stocks and other high seas fish stocks is the considerable limitation in fisheries and biological data on these species. Problems noted in the previous FAO contribution to the Review Conference still pose considerable challenges to evaluate the performance of the FSA in maintaining stocks within sustainable levels of exploitation.

The lack of a global data set that allows the catch and state of straddling and other high seas fish stocks to be separated from EEZ fisheries is a particular limiting factor. Likewise, evaluating the protection afforded to associated species under the FSA is difficult with the available data on bycatch and state of exploitation, or lack thereof. Furthermore, the link between high-seas fishing and the state of associated species is difficult to determine since many of the associated species are impacted by EEZ fisheries (often more so than high seas fisheries), coastal development and other human activities.

Some progress has been made in improving the reporting of catches of highly migratory shark species in recent years, but with rare exceptions, the information available does not allow a comprehensive evaluation of the state of exploitation of this group of species.

Some progress has also been made in the incorporation of ecosystem considerations in the management regimes of deep-sea fisheries in the high seas, including in the inventory of areas particularly vulnerable to the impact of bottom fisheries. A global database on Vulnerable Marine Ecosystems (VME database)[48] was launched by FAO in response to the request from the UN General Assembly (61/105, paragraph 90). It builds on the FAO International Guidelines for the Management of Deep-sea Fisheries in the High Seas (FAO DSF Guidelines), which provides details on the VME concept for fisheries management. The database was developed in collaboration with the regional bodies with mandates to manage deep-sea fisheries in the high seas and provides interactive maps and factual information on management measures taken to reduce current or potential impacts on areas where VMEs are known or likely to occur.

[48] http://www.fao.org/in-action/vulnerable-marine-ecosystems/en/

Despite the current data limitations, this report attempted to provide an updated summary of the situation of stocks and fisheries in the high seas using the best available information. There were no major changes in the overall state of stocks and fisheries catches since the first review prepared by FAO in in 2005. The majority of the species for which information is available are considered either fully exploited or overexploited. This situation reinforces the need for countries fishing on the high seas to cooperate either directly or through RFBs to employ effective measures to sustainably manage fisheries and to conserve stocks already overfished. Cooperation among countries will be also key to improve the monitoring of fisheries in the high seas. The quality of future evaluations of the performance of the FSA hinges on substantial improvements in the availability of data on the high seas stocks and fisheries.