3. 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 dolphinfish. 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, except for tunas and some tuna-like species for which more detailed data are available.

3.1 HIGHLY MIGRATORY TUNA AND TUNA-LIKE SPECIES

The information presented in this section is based primarily on the recent summary in FAO (2005a) and on the report of the FAO project on "Management of tuna fishing capacity: conservation and socio-economics" (FAO, 2005b). Information has also been obtained from Regional Fisheries Organizations, either directly or from their published reports and Web sites. In particular, updated information has been obtained from the Web pages of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT, http://www.ccsbt.org/), the Inter-American Tropical Tuna Commission (IATTC, http://www.iattc.org/), the International Commission for the Conservation of Atlantic Tunas (ICCAT, http://www.iccat.es/), the Indian Ocean Tuna Commission (IOTC, http://www.iotc.org/) and the Secretariat of the Pacific Community (SPC, http://www.spc.org.nc/), their publications, or through submissions they have made to FAO specifically for the review Conference on the Fish Stock Agreement.

3.1.1 The resources

All highly migratory tuna and tuna-like species (billfishes, bonitos, mackerels and tunas) belong to 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 are in the order they are listed:

- Albacore tuna (*Thunnus alalunga*), which occurs in tropical and temperate waters worldwide.
- Bluefin tuna (*Thunnus thynnus*), mostly found in temperate waters of the Atlantic, including the Mediterranean, and Pacific Oceans. It is noted that since the adoption 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.
- 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 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 (*Euthynnus alleteratus* and *E. affinis*), with *E. 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. It is noted that presently, *E. alleteratus* is called little tunny and *E. affinis* is called kawakawa.
- Southern bluefin tuna (*Thunnus maccoyii*), in temperate waters of the southern hemisphere in the Atlantic, Indian and Pacific Oceans.
- Frigate mackerel (*Auxis thazard* and *A. rochei*) found in the Atlantic (including the Mediterranean Sea where only *A. rochei* is found), Indian and Pacific Oceans. It is noted that presently, *A. thazard* is referred to as frigate tuna and *A. rochei* as bullet tuna.

The above tuna species listed as highly migratory species in Annex 1 of UNCLOS have extensive distribution on the high seas. Although their total catches amount to less than 5 percent of the total world marine fish catches, their landed value has been estimated to account for nearly 20 percent of the global marine total.

Tuna species can be loosely categorized 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 characteristics that are intermediate between those two extremes.

The **tuna–like** species included in Annex 1 of UNCLOS also have an extensive geographical distribution. These are:

- Marlins, of which there are eight species (*Tetrapturus angustirostris, T. belone, T. pfluegeri, T. albidus, T. audax, T. georgei, Makaira indica, M. nigricans*), with one or more species found in every Ocean. It is noted that presently, species of the genus *Tetrapturus* are referred to as spearfishes. It is also noted that the blue marlin species (*Makaira nigricans* and *M. mazara*) have been recently consolidated in one single species named *Makaira nigricans* (Buonaccorsi *et al.*, 1999; Graves and McDowell, 1995). Changes have been already implemented in the FAO capture database and species list – Aquatic Sciences and Fisheries Information System (ASFIS) and accepted by all members of the Coordinating Working Party on Fishery Statistics (CWP) (L. Garibaldi, personal communication, 2006).
- Sailfishes, with two species (*Istiophorus platypterus* and *I. albicans*). *I. platypterus* was formerly restricted to the Indian and Pacific Oceans, but is now found in the Mediterranean Sea where it entered via the Suez Canal. *I. albicans* is found in the Atlantic Ocean and migrates into the Mediterranean Sea.
- 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 general distribution and the location of the main fishing grounds of all the highly migratory tuna and of the main tuna-like species mentioned above are shown in Figures 3 and 4.

FIGURE 3

General geographic distribution (in red = known distribution; pink = uncertain distribution) and main fishing grounds (in green, based on 2000–2005 catches, when available) of highly migratory tuna species.
Maps modified from Collette and Nauen (1983) with 2000–2005 catch data extracted from Carocci and Majkowski (2003) integrated with unpublished data

Albacore tuna *(Thunnus alalunga)*

Atlantic bluefin tuna *(Thunnus thynnus)*

Pacific bluefin tuna *(Thunnus orientalis)*

Bigeye tuna *(Thunnus obesus)*

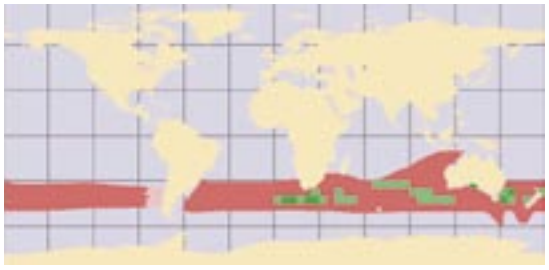
Skipjack *(Katsuwonus pelamis)*

Yellowfin tuna *(Thunnus albacares)*

Blackfin tuna *(Thunnus atlanticus)*

Little tunny *(Euthynnus alleteratus)*

Kawakawa *(Euthynnus affinis)*



Southern bluefin tuna *(Thunnus maccoyii)*

Frigate and bullet tunas *(Auxis thazard, A. rochei)*

The longtail tuna (*T. tonggol*) is also an important tuna, not included in UNCLOS Annex 1, which 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. In line with the definitions in UNCLOS and FSA, these species are therefore to be considered as straddling stocks or as high seas stocks if/when occurring only in the high seas.

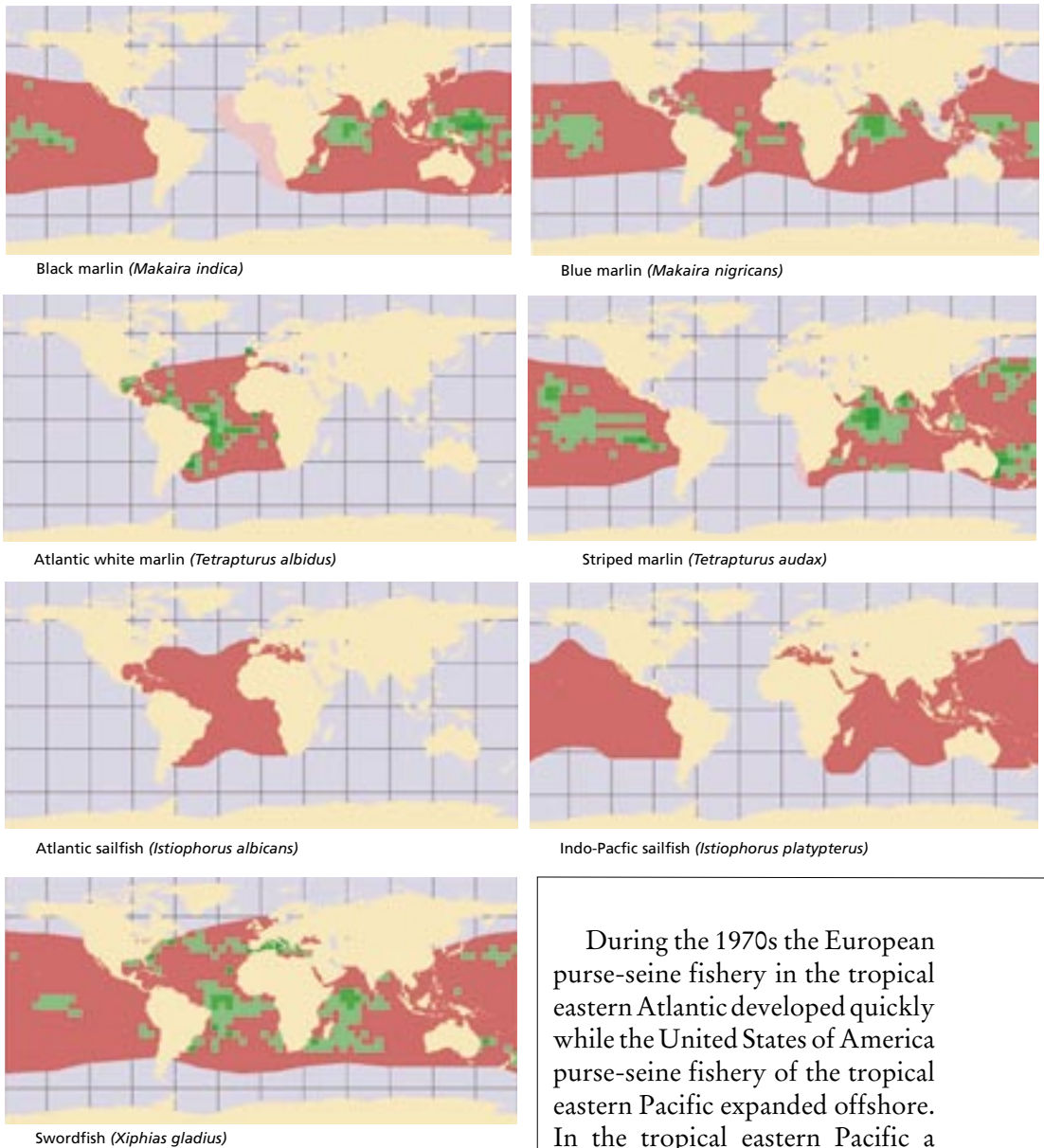
3.1.2 The fisheries

Tuna fisheries are among the oldest fisheries in the world (FAO, 2005b) with Phoenician trap fisheries (Ravier and Fromentin, 2001) 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 twentieth 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 of America 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 in tropical areas off 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, making 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 of America were almost completely replaced by purse-seine vessels. Quotas for yellowfin in that region were first established in 1966.

FIGURE 4

General geographic distribution (in red = known distribution; pink = uncertain distribution) and main fishing grounds (in green, based on 2000–2005 catches, when available) of selected highly migratory billfish species. Maps modified from Nakamura (1985) with 2000–2005 catch data extracted from Carocci and Majkowski (2003), integrated with unpublished data



Black marlin *(Makaira indica)*

Blue marlin *(Makaira nigricans)*

Atlantic white marlin *(Tetrapturus albidus)*

Striped marlin *(Tetrapturus audax)*

Atlantic sailfish *(Istiophorus albicans)*

Indo-Pacfic sailfish *(Istiophorus platypterus)*

Swordfish *(Xiphias gladius)*

During the 1970s the European purse-seine fishery in the tropical eastern Atlantic developed quickly while the United States of America purse-seine fishery of the tropical eastern Pacific expanded offshore. In the tropical eastern Pacific a number of vessels of the United States of America 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 important.

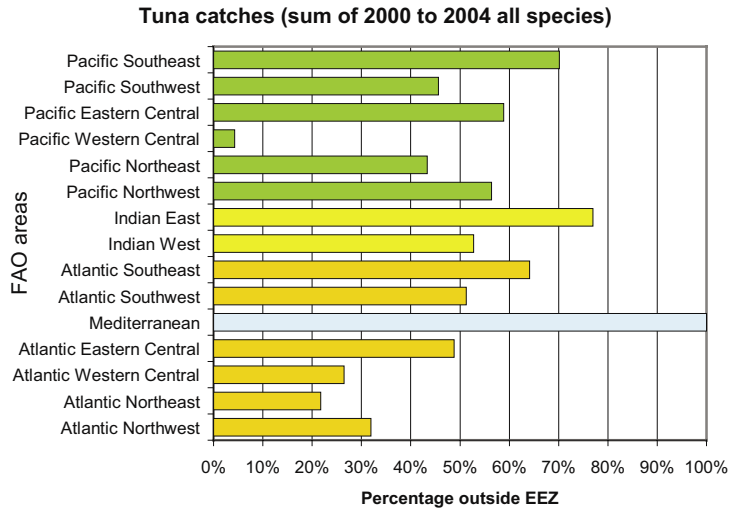
A purse-seine fishery for tunas began in the western Indian Ocean during the 1980s, when European vessels, which had fished in the Atlantic Ocean until then, moved to that area. In the Pacific Ocean the purse-seine fishery further expanded its fishing area, particularly in the western and central Pacific 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. Fisheries management became more active and intensified during the 1990s and continues to be more active 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 event was the development of bluefin tuna farming which can have a significant effect in increasing fishing pressure on the wild stocks, particularly by targetting on young individuals.

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 solely on a regional scale. In addition, the fish caught are frequently transported to other parts of the world for processing. Also, substantial 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 2004, tuna and tuna-like species classified as highly migratory in Annex 1 of UNCLOS accounted for 4.8 million tonnes, nearly 80 percent of the total reported catches of all tunas and tuna-like species. Two species, skipjack tuna and yellowfin tuna accounted for nearly 60 percent of the catch (3.5 million tonnes) in that year. Not all the catches are from the high seas however, and the estimated portion caught outside EEZs varies from about 4 percent in the western central Pacific to almost 80 percent in the eastern Indian Ocean (Figures 5 and 6). In the Mediterranean, because countries have generally not declared EEZs, 100 percent of the catches are considered to be taken outside EEZs.

FIGURE 5
Proportion of highly migratory tuna and tuna-like catches made outside EEZs by major FAO statistical areas during 2000–2004, for all highly migratory tuna and tuna-like species and all fishing gears



3.1.3 State of highly migratory tuna and tuna-like stocks

This section classifies the state of exploitation of stocks of tuna and tuna-like species according to the FAO classification scheme described in section 2.2 and their state of exploitation of this species group, based on the most recent information available, is summarized in Table 1. The main sources of information are the recent FAO summaries (FAO, 2005a; 2005b). Additional information was obtained from the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), the Inter-American Tropical Tuna Commission (IATTC, 2005), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Indian Ocean Tuna Commission (IOTC) and the Secretariat of the Pacific Community (SPC).

FIGURE 6
Catches of all highly migratory tuna and tuna-like species for all fishing gears, 2000–2004

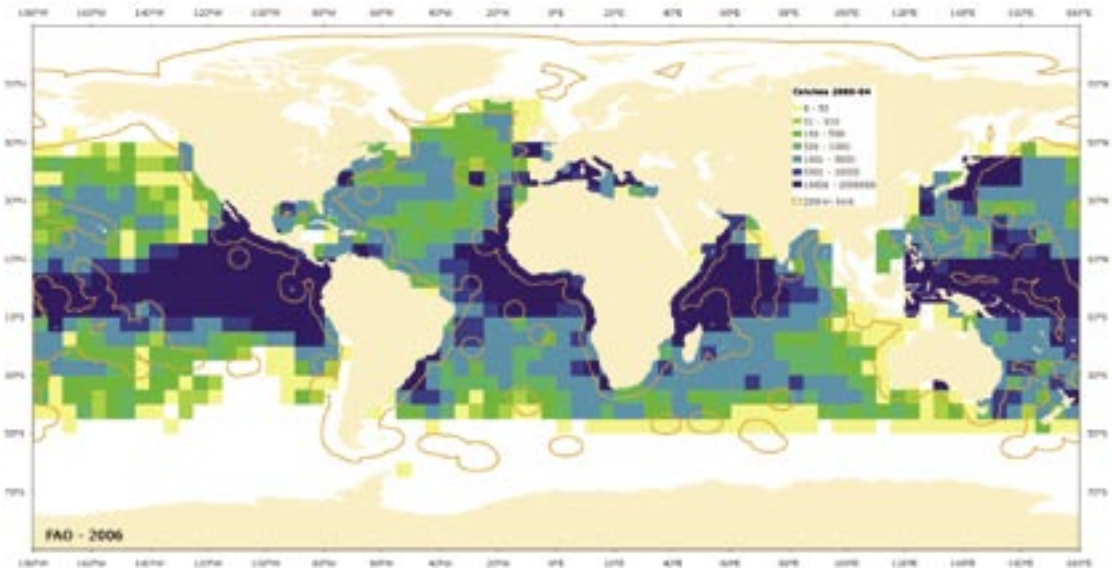


TABLE 1
Summary of the state of exploitation of highly migratory tuna and tuna-like species by major ocean area

Species/stocks	Major Ocean area	Catch (thousands of tonnes)[1]					State of exploitation[5]
		2000	2001	2002	2003	2004[2]	
Albacore (*T. alalunga*)	Northern Pacific Ocean	81	87	89	15	n.a.	F
	Southern Pacifc Ocean	47	47	51	50	n.a.	F
	Mediterranean Sea	6	5	6	8	n.a.	N
	Northern Atlantic Ocean	34	25	23	26	n.a.	O
	South Atlantic Ocean	29	34	32	28	n.a.	F
	Indian Ocean	38	41	33	24	n.a.	M
	Total	**235**	**240**	**233**	**150**	**216**	
Bigeye tuna (*T. obesus*)	Eastern Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	O
	Western and Central Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	F
	Atlantic Ocean	102	96	76	85	n.a.	F
	Indian Ocean	129	114	130	139	n.a.	F
	Total	**231**	**210**	**206**	**224**	**113**	
Pacific bluefin tuna (*T. orientalis*)	Pacific Ocean	27	16	16	10	12	F
Atlantic bluefin tuna (*T. thynnus*)	East Atlantic and Mediterranean Sea	34	35	33	28	n.a.	O
	West Atlantic Ocean	3	3	3	2	n.a.	D
	Total	**36**	**37**	**36**	**31**	**32**	
Southern bluefin tuna (*T. maccoyii*)	Southern Oceans	15	16	15	14	15	D
Sailfish and spearfish[2,3]	East Atlantic Ocean	1	1	1	1	2	N
	West Atlantic Ocean	1	1	2	1	1	N
	Total	**2**	**2**	**3**	**3**	**3**	
Skipjack tuna (*K. pelamis*)	Eastern Pacific Ocean	211	145	161	260	n.a.	M
	Western Pacific Ocean	1 251	1 135	1 295	1 271	n.a.	M
	East Atlantic Ocean	109	118	93	123	n.a.	N
	West Atlantic Ocean	29	31	21	24	n.a.	N
	Indian Ocean	422	426	489	475	n.a.	M-F
	Total	**2 022**	**1 855**	**2 059**	**2 153**	**2 092**	

Species/stocks	Major Ocean area	Catch (thousands of tonnes)[1]					State of exploitation[5]
		2000	2001	2002	2003	2004[2]	
Small tuna[2, 4]	Atlantic and Mediterranean Sea	29	26	29	26	26	N
Yellowfin tuna (*T. albacares*)	Eastern Pacific Ocean	297	424	442	420	n.a.	F
	Western Pacific Ocean	435	427	414	465	n.a.	N
	Atlantic Ocean	133	159	139	124	n.a.	F
	Indian Ocean	307	285	305	400		M-F
	Total	**1 172**	**1 295**	**1 300**	**1 408**	**1 384**	
Black marlin (*M. indica*)[2]	Pacific Ocean	1	2	2	3	3	N
Blue marlin (*M. nigricans*)[2]	Pacific Ocean	27	26	27	29	25	F
	Atlantic Ocean	3	3	3	3	2	O
	Total	**30**	**29**	**30**	**32**	**27**	
Striped marlin (*T. audax*)	Eastern Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	M
	Western Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	N
	Total[2]	**6**	**6**	**6**	**6**	**5**	
Atlantic white marlin (*T. albidus*)[2]	Atlantic Ocean	1	<1	1	1	n.a.	O
Sailfish (*I. platypterus*)	Eastern Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	N
	Western Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	N
	Total[2]	**4**	**2**	**3**	**6**	**6**	
Spearfish shortbill (*T. angustirostris*)	Eastern Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	N
	Western Pacific Ocean	n.a.	n.a.	n.a.	n.a.	n.a.	N
	Total[2]	**<1**	**<1**	**<1**	**<1**	**<1**	
Swordfish (*X. gladius*)[2]	Northeastern Pacific Ocean	<1	<1	<1	<1	<1	M
	Northwestern Pacific Ocean	10	7	7	3	10	N
	Southeastern Pacific Ocean	5	6	12	11	10	F
	Southwestern Pacific Ocean	3	2	3	3	3	N
	Western Central Pacific Ocean	4	5	8	11	8	N
	Mediterranean Sea	16	15	13	16	14	N
	North Atlantic Ocean	5	5	5	5	6	F
	South Atlantic Ocean	16	14	13	11	12	F
	Total	**59**	**55**	**60**	**59**	**63**	

[1] Catch data by stock area from Carocci and Majkowski (2005), unless otherwise stated
[2] Catch data from FAO FISHSTAT Plus
[3] Include Atlantic sailfish (*I. albicans*) and longbill spearfish (*T. pluefgeri*)
[4] Include Frigate tuna (*A. thazard*), bullet tuna (*A. rochei*), kawakawa (*E.affinins*), little tunny (*E. alleteratus*) black skipjack (*E. lineatus*) and blackfin tuna (*T. atlanticus*)
[5] Symbols: N = Not known; U = Underexploited; M = Moderately exploited; F = Fully exploited; O = Overexploited; D = Depleted; R = Recovering

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, their expected yields are lower and the risks of overexploitation are higher making it all the more important to exercise prudent management.

Bluefin tuna, a temperate species most desired for sashimi, is depleted in the western Atlantic, as is southern bluefin tuna, and it is overexploited in the eastern Atlantic. The Pacific bluefin is fully exploited.

Albacore, another temperate species, is used mostly for canning. The stocks are fully exploited in the South Atlantic as well as in the North and South Pacific and overexploited in the North Atlantic. Albacore is probably moderately exploited in the Indian Ocean while the state of exploitation in the Mediterranean Sea is not known.

Although bigeye tuna, another species highly desired for sashimi, 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 overexploited in the eastern Pacific and is probably fully exploited elsewhere.

The yellowfin tuna stocks are close to or are being fully exploited in all oceans while skipjack tuna is only moderately exploited in the Pacific and probably also in the Indian Ocean. However, with the present fishing technique, catches of skipjack cannot be increased without undesired increases of catches of other species. In the Atlantic, the state of skipjack is uncertain.

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 in the absence of further studies. Significant uncertainties in the state of exploitation of many billfishes represent a serious concern. In the Atlantic, blue and white marlins seem to be overexploited even though they are not generally targeted. Blue marlin is fully exploited in the eastern Pacific, but striped marlin is only moderately exploited. Because of commercial exploitation, there is more known on the state of swordfish exploitation than for other billfishes. In the Atlantic and the southeastern Pacific, swordfish are fully exploited, and there is concern about the effect of recent increases in fishing effort in the South Pacific. In the northeastern Pacific, swordfish is only moderately exploited. There is also concern about the intensification of fisheries targeting swordfish in the Indian Ocean.

In summary, the scientific information available primarily from regional tuna fishery management organizations and other intergovernmental organizations indicates that none of the tuna and tuna-like species are considered underexploited. For those stocks/species area combinations in Table 1 where the state of exploitation is known (24 out of 41, or 59 percent), 21 percent are moderately exploited, 50 percent are fully exploited, 21 percent are overexploited and 8 percent (southern bluefin and bluefin in the western Atlantic) are depleted. There are probably few opportunities to increase exploitation of these species, except in some areas of the Pacific, and possibly in the Indian Ocean, where significant 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 in bycatch of other species, some of which may already be fully exploited or overexploited, and in need of tighter conservation measures.

The summary assessment provided above is essentially based on the reports of the scientific working groups of the relevant tuna fisheries management commissions and on publications by tuna experts. These assessments imply that 50 percent of the stocks are at or around 50 percent of their unfished biomass and 29 percent are well below that level. According to some other publications based on a crude analysis of a small part of the available catch and effort data, the state of tuna and tuna–like fishery resources would be much bleaker. For example, Myers and Worm (2003), examining data mostly from pelagic longline fisheries for highly migratory species, concluded that there had been a 90 percent decline in abundance of these species groups since the onset of the fishery. However, methodological flaws of the studies have been documented by Walters (2003), Hampton *et al.* (2005) and others (see http://imina.soest.hawaii.edu/PFRP/large_pelagics/large_pelagic_predators.html for more detailed information). Aside from methodological flaws, it is worth noting that most of the apparent declines occurred 50 years ago, when those fisheries started,

21% of highly migratory tuna and tuna-like species are moderately exploited, 50% fully exploited, 21% overexploited and 8% depleted

and before management was instituted. The study also fails to mention that substantial declines (around 50 percent or more) from the unfished abundance are to be expected even for stocks exploited around their maximum biological productivity.

The high value of tuna, and the global nature of fleets and markets aggravate the concerns about excess fleet capacity and increased risk of overexploitation and stock depletion. In recent years, the World Tuna Purse-Seine Organization (WTPSO, an industry organization) temporarily limited fishing effort by their vessels in order to decrease the overall supply of fish to increase the price. Also, the number of longline vessels has been reduced in some countries. However, these actions are not regarded as sufficient in the long term to control fishing capacity and exploitation. Most of the regional tuna fishery management organizations are attempting to address the issue of tuna-fishing capacity in their areas of responsibility, in addition to the management of stocks through catch and fishing effort controls. However, the problem of managing tuna-fishing capacity is complex, involving biological, socio-economic and technological issues, whereas the conventions of most, if not all, of the tuna fishery management organizations do not address the social and economic aspects of fishery management.

Industrial tuna fleets are highly mobile and the principal market tunas are intensively traded on the global scale. In addition, many tuna research, conservation and management problems are similar in all oceans. Therefore, there is a need for exchange of information and for collaboration on the global scale regarding fisheries, fisheries research and fisheries management for tunas and other species with wide global distribution.

3.2 HIGHLY MIGRATORY OCEANIC SHARKS

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) (it is noted that in UNCLOS the family Lamnidae is listed as Isurida, using an old family name).

The total reported catches of species and families of sharks, listed in Annex 1 of UNCLOS, was close to 100 000 tonnes in 2004. The requiem sharks (Carcharinidae) account for 90 percent of these catches. However, the total catch and mortality of sharks (such as discarded bycatch) is likely to be much larger than the reported catch. Unfortunately, the state of many shark populations is unknown, or poorly known. However, the life history characteristics of sharks (e.g. slow growth, long life span, low fecundity) make them particularly vulnerable to overexploitation and depletion and therefore fisheries for such sharks should be managed with caution.

Due to the nature of the available information, this section dealing with oceanic sharks provides descriptions of resources, fisheries and their state of exploitation on a species by species, as well covering fisheries and state of exploitation separately. An FAO report (Castro, Woodley and Brudek, 1999) prepared in support of the International Plans of Action for Conservation and Management of Sharks, FAO catalogues (Compagno, 1984a; 1984b; 2001), other FAO sources, and Fishbase, provided information on the biological characteristics and geographical distribution of oceanic sharks. When available, drawings from the FAO databases and Species Identification Programme have been included in the text. This report intentionally gives greater emphasis in reviewing the biology of oceanic sharks than for tuna and tuna-like species, because the biology of the latter is more readily available in other reviews.

3.2.1 Bluntnose sixgill shark

Bluntnose sixgill shark (*Hexanchus griseus*) (Figures 7 and 8) has an almost circumglobal distribution in tropical and temperate seas on the continental and insular shelves and upper slopes at depths from surface to at least 1 875 m, but it is mostly a deep-water shark. It is locally common and taken by line gear, gillnets, traps and pelagic and bottom trawls, for use fresh, frozen, dried salted for human consumption, and for fishmeal and oil. It is also the subject of dive tourism on the Canadian Pacific coast. There are no assessment of the state of the stock(s) or exploitation. Catches have been reported only from the Atlantic Ocean since 2001 (one tonne) with up to 30 tonnes in 2004.

FIGURE 7
Bluntnose sixgill shark *(Hexanchus griseus)*

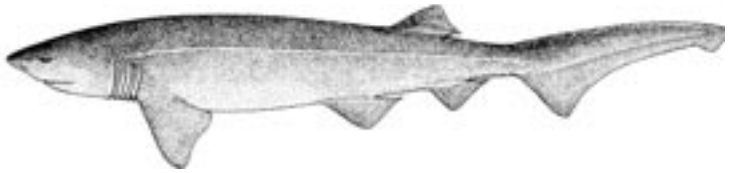
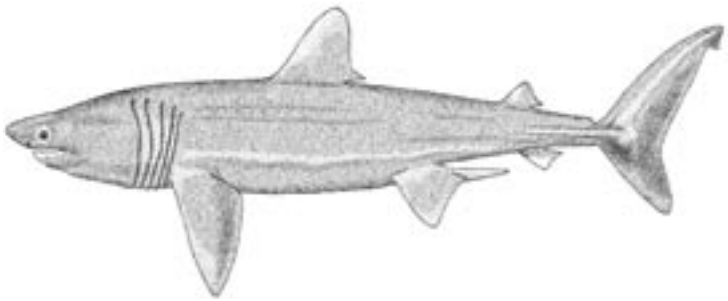


FIGURE 8
Geographic distribution of the bluntnose sixgill shark *(Hexanchus griseus)* **(from Compagno, 1984a)**

3.2.2 Basking shark

The basking shark (*Cetorhinus maximus*) (Figures 9 and 10), is a coastal-pelagic shark found in boreal to warm temperate waters of the continental and insular shelves, occurring from far offshore to near shore just beyond the surf zone. It occurs around all the continents except Antarctica and the Arctic. Surface basking in this shark is thought to be related to feeding on surface concentrations of food plankton, and courtship and mating, although the species is also known to feed on plankton aggregations in deep waters on the edge of continental shelves. Basking sharks undertake long-distance migrations.

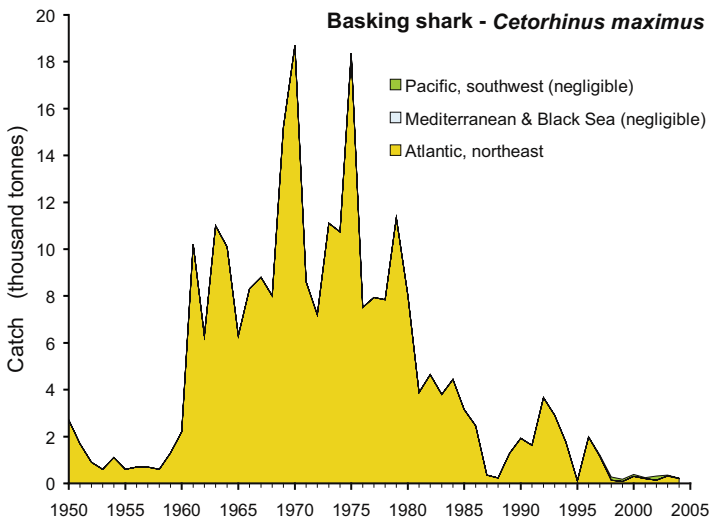
FIGURE 9
Basking shark *(Cetorhinus maximus)*



The basking shark has been the target of harpoon fisheries from small boats, but it has also been taken in nets, including bottom gillnets and occasionally bottom and pelagic trawls. The species also interacts with other gears, causing gear damage and harming themselves in the process.

FIGURE 10
Geographic distribution of the basking shark *(Cetorhinus maximus)* **(from Compagno, 2001)**

FIGURE 11
Catches of basking shark *(Cetorhinus maximus)* **reported to FAO**



The basking shark has been exploited commercially for centuries in several parts of the world mainly for its liver oil, which was used as lighting fuel for lamps in the past, and during this century as a source of chemical compounds. Several localized basking shark fisheries have shown sharp declines recently and in the past, but it is difficult to separate natural fluctuations in local abundance from the effects of exploitation globally.

The basking shark 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 (Figure 11) were common during 1960 to 1980, but they have been much less since the end of the 1990s. In 2004, 239 tonnes were reported. The species is probably overexploited globally with some areas being depleted.

The basking shark is listed on Annex II to the Protocol "Endangered or Threatened Species" of the Barcelona Convention for the Protection of the Mediterranean Sea and in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It is legally protected by several countries (such as UK, Malta, US Federal waters) and targeting basking sharks is prohibited in New Zealand.

3.2.3 Thresher sharks (family Alopiidae)

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. Given their life-history characteristics, these species are not expected to have a high resilience to exploitation, but stock status remains uncertain. Unless demonstrated otherwise, it is prudent to consider these species as being fully exploited or overexploited globally.

Alopias pelagicus (Figures 12 and 13) was formerly exploited by longline fisheries in the northwestern Indian Ocean, but it is also fished in the Central Pacific. It is utilized for its meat (for human consumption), liver oil for vitamin-A extraction, hides for

leather, and fins for shark-fin soup.

Alopias superciliosus (Figures 14 and 15), commonly known as the bigeye thresher shark, has been caught in the oceanic longline fisheries operating in the northwestern Indian Ocean, western and Central Pacific, eastern North Pacific and North Atlantic. This species is also taken as incidental bycatch in fixed bottom and pelagic gillnets and in trawls.

Alopias vulpinus (Figures 16 and 17) is frequently caught by offshore longline and pelagic gillnet fisheries. It is also fished with anchored bottom and surface gillnets, and it is a bycatch of other gear including bottom trawls and fish traps. The species became the object of an important targeted pelagic gillnet fishery off the west coast of the United States of America (particularly California, and also Washington and Oregon) in the late-1970s, with a peak reported catch of 1 000 tonnes in 1982 (not reported in FAO statistics), declining due to overfishing to less than 300 tonnes by the late-1980s. The targeted fishery was ended by 1990, but the species is still caught as bycatch of the swordfish gillnet fishery and may be sold for higher prices in the market than swordfish.

Catches of Alopiidae that have been reported to FAO since the early-1980s have generally been less than 1 600 tonnes (Figure 18) and around 1 000 tonnes since 1998 (972 tonnes in 2004). Apparently, not all catches

FIGURE 12
Thresher shark *(Alopias pelagicus)*

FIGURE 13
Geographic distribution of the pelagic thresher shark *(Alopias pelagicus)* **(from Compagno, 2001)**

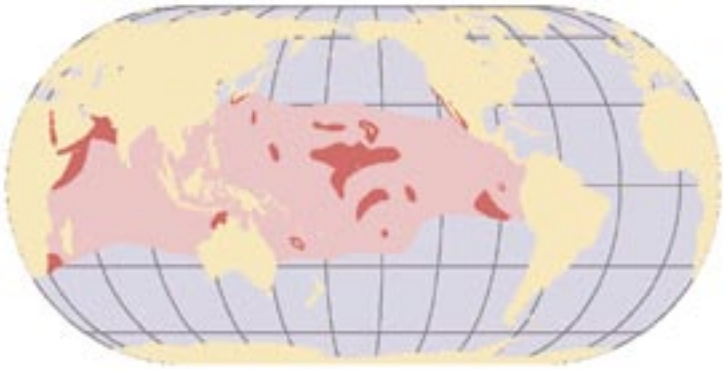


FIGURE 14
Bigeye thresher shark *(Alopias superciliosus)*

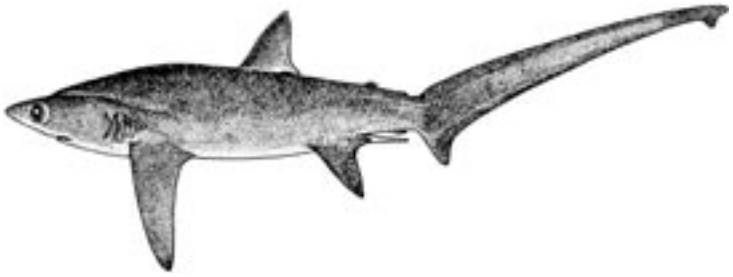


FIGURE 15
Geographic distribution of the bigeye thresher shark *(Alopias superciliosus)* **(from Compagno, 2001)**

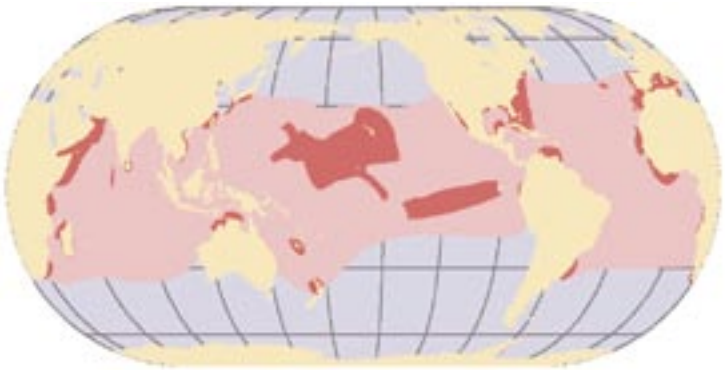


FIGURE 16
Thresher shark *(Alopias vulpinus)*

FIGURE 17
Geographic distribution of the thresher shark *(Alopias vulpinus)* **(from Compagno, 2001)**

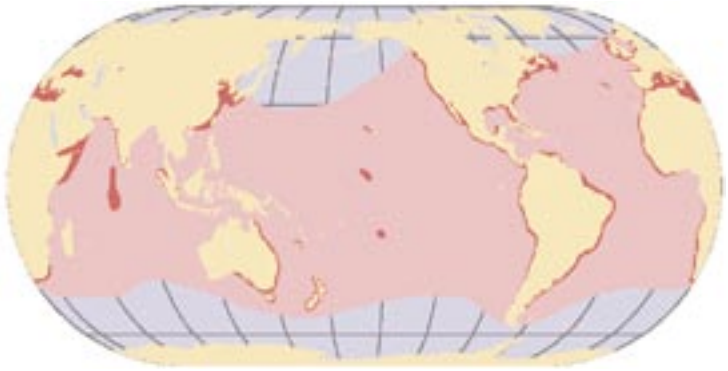
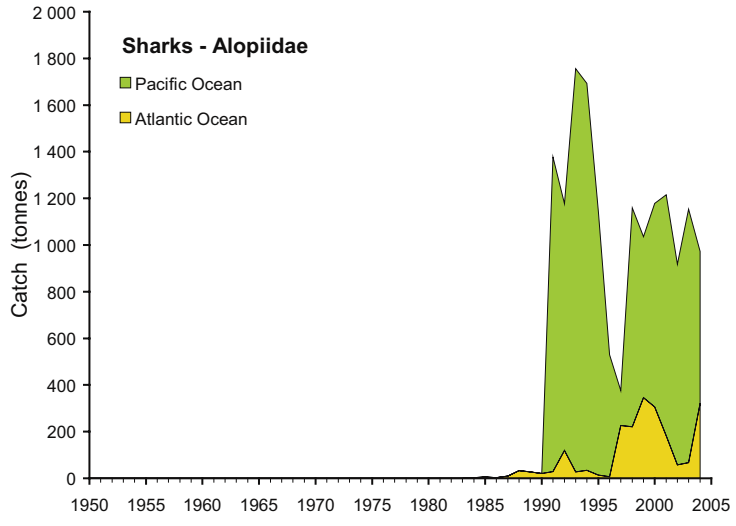


FIGURE 18
Catches of thresher sharks (family Alopiidae) as reported to FAO



are reported to FAO, given the 1 000 tonnes referred to in the paragraph above.

3.2.4 Whale shark *(Rhincodon typus)*

Whale shark (*Rhincodon typus*) (Figures 19 and 20) has a circumglobal distribution in tropical and warm temperate seas. It is an epipelagic oceanic and coastal pelagic species ranging from far offshore to close inshore, sometimes entering lagoons of coral atolls. It is generally encountered close to or at the surface, as solitary individuals or in aggregations of up to hundreds of sharks. Whale sharks migrate long distances, with their movements probably timed with plankton blooms and changes in water temperatures. They are often associated with schools of pelagic fish, especially scombrids. Whale sharks have been fished sporadically by some countries around the Indian and western Pacific Oceans, but no catches are recorded in the FAO fisheries statistics database.

Given its life-history characteristics, the whale shark is expected to have low resilience to exploitation, with most recent fisheries having collapsed or ceased due to legal protection, 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. Whale sharks are currently protected in several parts of the world: Western Australia, India, the Maldives, the Philippines, and in parts of the United States of America

(Florida state waters and all federal waters of the Gulf of Mexico and Atlantic coast). The whale shark is listed on Appendix II of both the Convention on Migratory Species and CITES.

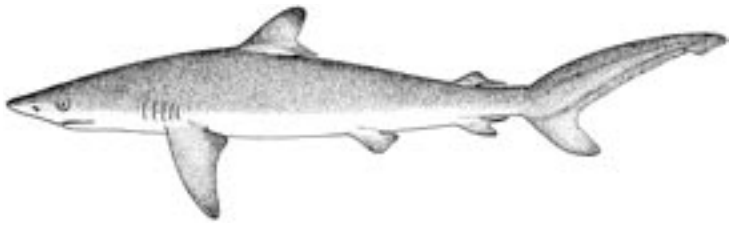
FIGURE 19
Whale shark *(Rhincodon typus)*

FIGURE 20
Geographic distribution of the whale shark *(Rhincodon typus)* **(from Compagno, 2001)**

3.2.5 Requiem sharks (family Carcharhinidae)

Requiem sharks (family Carcharhinidae), have a worldwide distribution in tropical and temperate waters. There are 50 species in the family (30 in genus *Carcharhinus*) 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, Carcharhinus longimanus, Carcharhinus sorrah* and *Prionace glauca.* However, *Carcharhinus sorrah* is not an oceanic species and it is not considered further.

FIGURE 21
Silky shark *(Carcharhinus falciformis)*



The silky shark (*Carcharhinus falciformis)* (Figure 21), has an oceanic and coastal, circumtropical distribution and most common offshore. It is an oceanic, epipelagic and littoral, tropical shark, found near the edge of continental and insular shelves, as well as far from land in the open sea, to depths of 500 m. It occasionally occurs inshore where the water is as shallow as 18 m. It is an active, quick-moving, aggressive shark. Its population dynamics and stock structure are poorly known. This is one of the three most common oceanic sharks, along with the blue shark (*Prionace glauca*) and oceanic whitetip shark (*Carcharhinus 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 state of exploitation 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. 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 utilize coastal lagoons as pupping or nursery areas like other shark species. In 2004 slightly more than 4 000 tonnes were reported, but past catches have been considerably higher.