Doc. 10.51

Interpretation and Implementation of the Convention

BIOLOGICAL AND TRADE STATUS OF SHARKS

1. This document is submitted by the Secretariat on behalf of the Animals Committee.

Background

2. The ninth meeting of the Conference of the Parties (Fort Lauderdale, 1994) adopted Resolution Conf. 9.17 on the Status of International Trade in Shark Species (Annex 1) in response to growing concern that some shark species are being over-exploited to meet an international demand for sharks and shark products. Resolution Conf. 9.17, *inter alia*, directs the Animals Committee to review information on the biological and trade status of sharks and to prepare a discussion paper for consideration at the 10th meeting of the Conference of the Parties.

3. This report has been compiled from information contained in the following working documents submitted to the Animals Committee, and from other sources:

4. – An Overview of Impacts on the Biological Status of Sharks – United States of America (Doc. AC.13.6 & Annex)

5. – CPUE Trend and Species Composition of Pelagic Sharks Caught by Japanese Research and Training Vessels in the Pacific Ocean – Japan (Doc. AC.13.6.1 & Annex)

6. – The Implications of Biology for the Conservation and Management of Sharks – IUCN (Doc. AC.13.6.2)

7. – The Utilisation and Trade of Sharks and Related Species – TRAFFIC Network [Doc. AC.13.6.3, document which is a summary of detailed information contained in a report by Rose (1996)]

8. – Implementation of Resolution Conf. 9.17 on Sharks: Activities Undertaken by FAO (Doc. AC.13.6.4)

9. Additional information has been drawn from two reports prepared for the CITES Secretariat by the Scientific Adviser to the Delegation of Panama (Palacio, 1995 a,b). The report also summarises information provided by Parties in response to Secretariat Notification to Parties No. 884 of 6 November 1995. Copies of these documents, which contain more detailed information, are available on request from the CITES Secretariat.

Biological Characteristics of Sharks

10. Sharks, which comprise approximately 400 currently recognized species, are included among the nearly 1100 species of chondrichthyan, or cartilaginous fishes. The term 'shark' is often used generically to refer to all chondrichthyan or cartilaginous fishes (sharks, rays, skates and chimaeras). In this report, 'sharks' will be used in this sense unless otherwise stated.

11. Sharks occupy a wide range of aquatic habitats, including freshwater riverine and lake systems, inshore estuaries and lagoons, coastal waters, open sea and the deep ocean. Many species are characterized by restricted distributions (e.g. 54 per cent of the Australian chondrichthyan fauna is endemic (Last & Stevens, 1994). However, some of the larger and more important fisheries species are widely distributed and exhibit extensive movements – occurring principally in coastal inshore waters, along the continental shelf and slopes and pelagic waters. Sharks are predominantly predatory, however, some species are also scavengers, while some of the largest species (whale, basking and megamouth sharks) are filter-feeders of plankton and small fish.

12. The large predatory sharks are apex predators occupying the tops of marine food chains. Populations of these species are generally less abundant relative to those of most teleost (bony) fishes. Information on the life history and reproductive biology of sharks is only available for the few species that are subject to important fisheries.

13. Collection of these data for species that are restricted to deep-water habitats or those that are only sampled at certain times of year or during certain stages in the life cycle is logistically difficult and expensive.

14. In general sharks can be characterized by the following life-history features:

- slow growth
- late maturity
- low fecundity and productivity
- high natural survivorship for all age classes
- long life.

15. Sharks are generally long-lived (mostly 10-30 years and up to 70 years in the case of the spiny dogfish *Squalus acanthias*) animals and take a long time to reach maturity. Small species such as the Australian sharpnose shark *Rhizoprionondon taylori* attain maturity in one year (Simpfendorfer, 1993), while others like the dusky shark *Carcharhinus obscurus* require a period of 20-25 years (Natanson *et al*., 1995). However animals of most species cannot be aged reliably without the need for extensive research. As apex predators with few natural enemies, sharks need to produce only a few young capable of reaching maturity in order to maintain stable populations in undisturbed systems. Moreover, they are vulnerable to severe ecological disruption such as excessive predation.

16. Annexes 2a and 2b summarize the life-history and ecological characteristics respectively for about 40 species of elasmobranchs that are taken in large-scale fisheries or are believed to be important in international trade. In this regard, the absence of species-specific data, particularly for sharks taken as a by-catch of other fisheries and shark products that enter trade, makes it difficult to determine the full range of species involved.

Reproduction and Management Constraints

17. The reproductive strategies of most sharks contrast markedly with those employed by all but a few of the teleost fishes that support most of the world's fisheries. Many millions of small eggs are produced annually by large teleost fishes. Under natural conditions, although only very few young survive to maturity, recruitment to the adult population is broadly independent of the size of the spawning stock (IUCN, 1996).

18. There are several modes of reproduction in chondrichthyans, all of which involve considerable maternal investment to produce small numbers of large, fully-developed young. Internal fertilization of relatively few eggs is followed by:

19. Oviparity – in which large, leathery eggcases are laid and the young continue to develop and hatch outside the female;

20. *Ovoviviparity* – or aplacental viviparity, in which the eggs are retained within the maternal female and embryonic development occurs in the uterus, before a live birth; or

21. *Viviparity* – in which an embryo is attached to a placenta and embryonic development is nourished by the maternal blood supply.

22. Depending on the species, female sharks may bear 1-12 offspring per litter. Atypically, the largest species, the whale shark, *Rhincodon typus*, has been recorded with 300 embryos. Gestation periods are unknown for most species but range from less than three months to more than 22 months for the ovoviviparous spiny dogfish, *Squalus acanthias*. Although some small sharks reproduce annually (see Annex 2a), many species do not, because mature females have a rest period of one to two years between pregnancies (Branstetter, 1990), and/or because gestation periods exceed 12 months, e.g. sandbar shark, *Carcharhinus obscurus* (Musick, 1995).

23. In general, species that exhibit a shorter longevity and early age at sexual maturity are likely to have higher productivity and thus to be better able to sustain a commercial fishery, e.g. gummy shark *Mustelus antarcticus* (Stevens *et al*., in press).

24. Shark reproductive strategies, developed over some 400 million years, are appropriate and successful in an environment where the principle natural predators are large sharks. However, a 'k-selected' life-history strategy imposes limits on reproductive productivity. This characteristic, together with a tendency exhibited by many species of sharks to aggregate by age and sex, renders some species vulnerable to inappropriate management. The potential for shark populations to become depleted through inappropriate management, particularly those species with restricted distributions, is greater than for most teleost fishes.

Factors Influencing the Status of Shark Stocks

25. Factors influencing the status of shark stocks include commercial and recreational fisheries capture in by-catch, beach netting, and habitat degradation and loss. The extent to which any one (or combination) of these factors impacts on the wild resource is largely unknown but considered to be highly variable according to species and location. Furthermore, as apex predators, many shark species serve a vital role in marine ecosystems. Over-exploitation of prey species by fisheries may have an adverse impact on sharks along with natural factors including altering predator-prey relationships and environmental changes. The specialized life-history strategies of many species of sharks render them potentially vulnerable to unmanaged fisheries.

Fisheries

26. Expanding global fisheries, whether directed or incidental, is a principal factor influencing shark populations. From the fisheries data reported to FAO over the last 15 years, sharks comprised 60 per cent of the world elasmobranch catch (Bonfil, 1994). Reported commercial landings of elasmobranchs (Table 1) grew globally from 201,000 tonnes in 1947 (Bonfil, 1994) to a record 730,784 tonnes in 1994 (FAO, 1996). Whereas statistics indicate that landings are increasing in most FAO major fishing areas, the areas where fisheries were developed first are showing declining trends in landings. However, it should be noted that these statistics do not represent the total catch of sharks worldwide, owing to the lack of reporting on sharks taken as by-catch or discarded at sea, as well as on those taken in recreational, artisanal and subsistence fisheries.

27. It is not possible, from FAO statistics, to derive the proportion of the total elasmobranch landings represented by different species of shark. FAO compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data reported by most countries. Increased overall landings for all elasmobranch species over the last fifty years contrasts against a general pattern of decline in landings for individually exploited shark populations. However, these increased landings may be explained as a combination of:

28. – increased fishing effort and technology;

29. – targeting of by-catch species, such as sharks, as other fishery resources decline;

30. – increased use of by-catch, thus increased reporting;

31. – increased and/or improved reporting of shark landings by individual countries;

32. – expansion of fishing areas by long-range fleets; and

33. – development of markets and directed shark fisheries in developed countries.

34. Some shark species may also be declining fisheries resources, as many are vulnerable to over-exploitation (Compagno, 1990; Bonfil, 1994). Long life cycles, delayed sexual maturation and low fecundity rates severely limit the level of sustainable harvest for many of these fishes. Furthermore, for most species, little is known of stock structure, abundance or reproductive behaviour. In addition, many species are highly migratory, further complicating management.

35. There are historical examples of targeted shark fisheries that could not be sustained in different parts of the world, such as *Galeorhinus galeus* (tope, soupfin or school shark) and *Alopias vulpinus* (common thresher shark) fisheries off California, *Cetorhinus maximus* (basking shark) off Ireland and Scotland, the *Lamna nasus* (porbeagle) fishery in the Atlantic Ocean, and the Irish and Scottish-Norwegian *Squalus acanthias* (spiny dogfish) fishery.

36. The ability to sustain fishing effort depends in part on the fecundity and life-history characteristics of the particular species involved. Shark fisheries have not originated from a search for a suitable target species or population. They have developed in response to market demand for a species. Strongly 'k-selected' species that are currently harvested by commercial fisheries include *C. maximus*, *G. galeus, L. nasus, Carcharhinus plumbeus* (sandbar shark), *C. obscurus* and *Squalus acanthias.*

By-catch and Discards

37. By-catch is the incidental capture of species in fisheries targeting other species. Incidental take is a major factor in human-caused mortality of sharks (Bonfil, 1994; Rose, 1996). Sharks are caught as by-catch in many commercial fisheries and by most fishing methods (Bonfil, 1994; Rose, 1996). However, the extent of by-catch and discards is poorly documented. Mortality of incidentally caught sharks is thought to have increased as higher prices for fins suggest that a larger proportion of shark by-catch is now utilized (Manire & Gruber, 1990)

38. Few commercial fisheries target migratory oceanic sharks but a number of species form a large by-catch of coastal and high-seas longline and purse seine fisheries directed at tuna and billfish. Preliminary estimates (Stevens, 1997) suggest that approximately 140,000 tonnes of blue shark (*Prionace glauca*), 50,000-239,000 tonnes of oceanic whitetip sharks (*Carcharhinus longimanus*) and 84,000 tonnes of silky shark (*C. falciformes*), together with smaller quantities of shortfin mako (*Isurus oxyrinchus*) and thresher sharks (*Alopias* spp.) were caught by high seas fishing fleets operating in the Pacific Ocean during 1994. In the late 1980s, high seas fisheries are estimated to have taken 12 million elasmobranchs equalling about 300,000 tonnes as by-catch. Discards from high seas fisheries are thought to account for an additional 230,000-240,000 tonnes of sharks removed annually from populations (Bonfil, 1994). The estimates of total elasmobranch by-catch in high seas driftnet fisheries between 1989 and 1991 was between 3,280,000 and 4,310,000 sharks and rays. However, high seas driftnet fisheries ended in 1992. Bonfil (1994) also estimates that a total of 8.3 million sharks, the equivalent of 232,425 tonnes, were caught as by-catch in longline fisheries during 1994, distributed more or less evenly throughout the globe.

39. Japanese tuna longline research vessels collected data on the stock status of pelagic shark species caught by the longline fishery in 1967-1970 and 1992-1995 in the central North Pacific. The researchers concluded that the catch rates of major pelagic sharks captured by tuna longline does not indicate any clear change in overall abundance during the period 1968-1995. However there was a change in CPUE for individual species, which was thought to be due to changes in depth of gear used (Matsunaga & Nakano, 1996). Nakano (1996), using standardized data from 1971-1993, found no significant trend with time in blue shark catch rates in the Atlantic or Indian Oceans, but noted a 20 per cent decrease in the North Pacific over a period of two decades.

40. By-catch of sharks in both the eastern and western tropical Pacific purse seine fisheries for tuna varies by set method. By-catch of sharks per set is highest in nets set around logs and man-made Fish Aggregating Devices compared to sets around dolphins or schooling fish (Garcia pers. comm., 1996; Anon., 1996a). Most countries do not require reporting of shark by-catch in logbooks, so few by-catch data are incorporated into FAO statistics. Although observer programmes provide the best available information, coverage on the high seas is minimal. Several species of chondrichthyan taken as by-catch and subject to trade are of particular concern owing to their rarity or dependence on threatened or degraded habitats.

41. Some species of sawfish (Pristiformes spp.), for example, are considered to be rare in parts of their range and are further threatened because of their dependence on habitats that are threatened in rivers, estuaries and shallow coastal waters (Adams & Wilson, in press). Sawfishes are taken as by-catch by a number of fishing gear types including shrimp/prawn trawls and gillnets (Adams & Wilson, in press).

Recreational Sportfishing

42. Recreational sport fisheries based on sharks have existed for many years and occur in many parts of the world. However, the documented catch by recreational fisheries depends on self-reporting systems. The survivorship of released sharks should be monitored and quantified. Many warm weather tourist destinations promote gamefishing for visitors and manage commercial fisheries to enhance populations of recreational species. Dive tourism that features “shark dives” is becoming increasingly popular and, in one study in the Maldives, it has been estimated that a grey reef shark may be worth 100 times more alive at a dive site than if it were taken and used in a shark fishery (Anderson and Ahmed, 1993). The extent to which sharks are caught as a by-catch of other recreational fisheries is poorly known. There is a need to collect data in order to assess the impact of these fisheries on sharks.

Habitat

43. Another important factor that may influence the conservation of some sharks is degradation and/or loss of suitable areas that serve as nursery habitat for sharks and their prey. Adults of many species are known to utilize inshore pupping and nursery grounds on a seasonal basis, usually in the spring and summer. These habitats are often found in shallow fresh or brackish water and coastal areas with abundant food species, where juveniles are less exposed to predation. Less is known about the location and characteristics of offshore overwintering areas inhabited by many species of coastal sharks, both adults and juveniles, and the offshore pupping grounds of pelagic sharks.

Beach-netting

44. Australia and South Africa maintain extensive public safety beach-netting programmes to remove sharks from areas near public beaches. In 1991, it was estimated that Australian nets captured 1,000 to 1,500 sharks each year. Beach nets in South Africa take an average of 1,470 sharks annually in 44 km of permanently maintained nets (Cliff & Dudley, 1992).

<u>World Trade in Shark Products</u>

45. Sharks are valuable and versatile fisheries resources. Not only the meat and fins but even the skin and internal organs are used for human consumption. Sharks and rays have become an important attraction to recreational anglers. Shark fin, appreciated in Chinese cuisine, is a valuable product derived from shark fisheries. While considered of low value or entirely unpalatable in some areas, shark meat is becoming popular in many parts of the world. Recently developed markets for shark cartilage offer the opportunity to utilize a fisheries by-product that would otherwise be discarded or used in low-value fishmeal production. It is not clear whether new directed shark fisheries have developed in response to new market demands. The social and economic importance of sharks is increased by the fact that fisheries based on these species are often not

regulated, and therefore have proven an accessible alternative when other fish species are depleted, restricted or seasonally unavailable. A significant percentage of all sharks fished are taken as by-catch in other fisheries. Data on such fisheries and related trade data for sharks and shark products are poor if not non-existent. Data on directed shark fisheries often lack detail, reflecting the lower economic importance of these species relative to more lucrative fisheries such as tuna. As a result, it is difficult to form a comprehensive picture of the species or volumes of sharks fished or in trade.

Reporting on Shark Fisheries and Trade

46. Shark fisheries have historically represented only a minor and relatively low-value contribution to the overall fisheries production of most countries, and are often a small and/or seasonal component of multi-species fisheries. Therefore, there has often not been any priority on gathering data on sharks or related fisheries. Consequently, information on both the volume and species composition of shark catches and landings and on the species themselves is sparse or non-existent. The fisheries and production data compiled by FAO are based on data supplied by individual countries. Countries often summarize fisheries information when reporting to FAO, with a consequent loss of detail, especially for less important fishery species. In cases where countries do not report on their fisheries, FAO estimates fisheries and production rates using information from other sources. As a result, FAO statistics are often even less detailed than national statistics. Annex 3 provides a composite presentation of primary species landings data. These data have been obtained from the information provided by Parties in response to Secretariat Notification No. 884 of 6 November 1995, FAO and numerous fisheries managers and scientists consulted by the United States in the course of compiling document Doc. AC.13.6 Annex.

47. Trade data for sharks are similarly incomplete. Standard 6-digit Customs tariff headings adopted under the 'Harmonised System' tariff classification system are not specific for shark products other than 'dogfish and other sharks'. A few countries use sub-codes to separate 'dogfish' from 'other sharks' and/or to identify shark fin in trade, but Customs records of trade in shark leather, cartilage and oil are rarely reported. This is reflected in the trade data compiled by FAO. Furthermore, national Customs classification of imports and exports often do not correspond to FAO trade categories.

48. Even when reported, international trade figures may not accurately reflect actual trade. In some cases, trade figures may significantly overestimate the actual volume of world trade in a given item, e.g. shark fins, because the same items are counted several times as they pass through a series of countries for repeated processing and transhipment. And for other trade, even if the product form is known (e.g. meat), standard conversion factors needed to convert weights into live or carcass weight vary widely by species, processing technique, country and region. The limitations of existing published fisheries and trade data reduce their utility for fisheries assessment and management.

Meat

49. Shark meat in dried, salted and smoked form has traditionally been consumed in coastal communities worldwide. In most regions, large-scale commercial exploitation of sharks began only after World War I. In many countries, industry and/or government marketing campaigns and market development efforts succeeded in overcoming an initial consumer reluctance to accept shark meat for human consumption. However, owing to the relatively low value of or demand for the meat of most shark species, historical domestic markets and trade in shark meat have not been identified as having led to the over-exploitation of stocks. The former porbeagle fishery in the North-west Atlantic and spiny dogfish fishery of the North Sea represent exceptions.

50. The production of shark meat reported by FAO (recorded as sharks/skates fresh/frozen and shark fillets fresh/frozen) appears to represent only a small fraction of the total world production. This reflects the fact that many countries do not report domestic production of shark meat in their national catch and landing statistics. Many countries do not report their fisheries imports and exports to FAO. Furthermore, because most of the national shark trade data reported are very general (e.g. reported as sharks, rays and skates) or may not be reported as shark at all, published FAO data do not accurately reflect world production of shark meat. Unfortunately, Customs data are often even less specific than FAO production data with regard to products. Items reported under the Customs classification for frozen shark may include whole carcasses, headed and gutted carcasses with the fins removed, blocks or clippers and/or fillets.

51. Sharks, rays, skates and chimaeras have become increasingly important in recent years in both domestic and international markets. The principal importers are Italy, France, United Kingdom, Germany and Denmark, while the main exporters are: the United Kingdom; Ireland; Denmark; and Germany (Figure 1). The importance of these countries in shark trade, as reflected in FAO data, is likely to be due in part to their historical role in shark (specifically dogfish) trade and to more complete reporting of trade.

52. According to FAO data (FAO, *in litt.*) reported world exports of fresh, chilled, and frozen shark meat rose from 27,700 tonnes in 1986 to 52,132 tonnes in 1994, while reported world imports increased from 32,085 tonnes in 1986 to 56,031 tonnes in 1994 (Figure 2). Reported trade in shark fillets remains much lower in volume. World trade in fresh, chilled and frozen skates appears to remain significantly under-reported. An average of 1,780 tonnes of unidentified sharks, rays, skates, and chimaeras were reported as exported annually.

Fin

53. Many species of shark have commercially valuable fins. Value is determined by their colour, size, thickness and fin needle content (Kreuzer and Ahmed, 1978; Subasinghe, 1992). Average unit value of fins imported into Hong Kong increased from USD 11.20/kg in 1980 to USD 40.60/kg in 1992, peaking in 1995 at USD 41.00/kg (Parry-Jones 1996, cited in Rose, 1996).

54. Available data demonstrate a steady increase in the volume of shark fins traded internationally, until 1988 when the level of trade in this commodity became more stabilised. There are insufficient data to determine whether the development of new shark fisheries or increased shark landings have resulted from declining catches of other fisheries or represent a stimulated response to an increase in the price of shark fin and expanding trade networks to and through key Asian consumer centres such as Hong Kong and China.

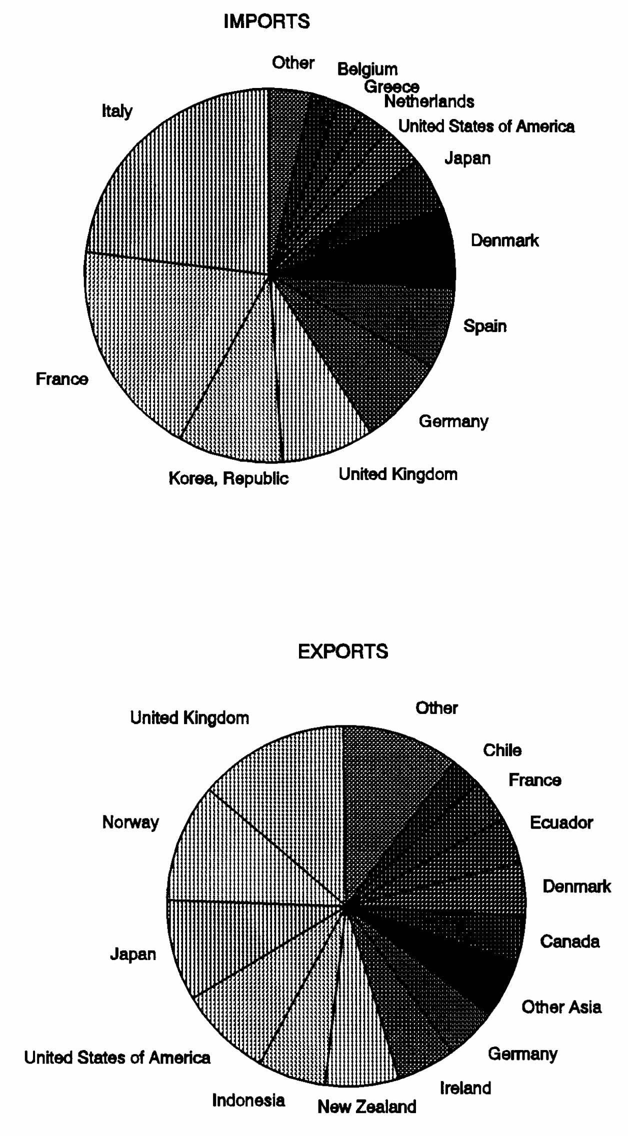

Figure 1: Reported trade in shark meat (fresh, chilled, frozen) by major trading countries in metric tonnes (average for years 1986 to 1994), after Rose (1996) and updated with most recent data from FAO

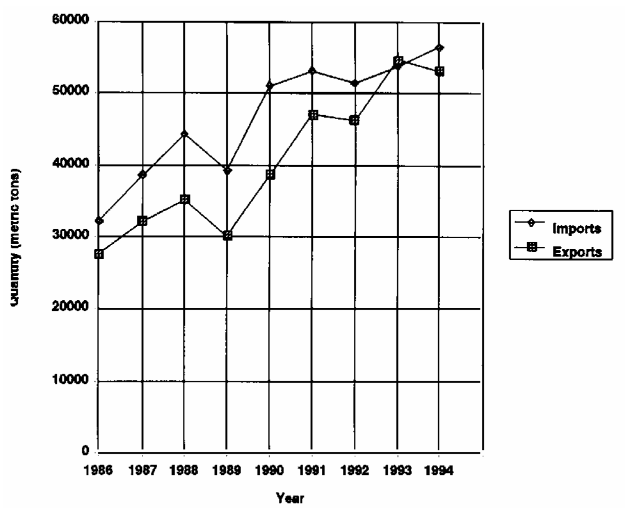

Figure 2: World trade in shark, ray, skate and chimaera meat, including fillets (fresh, chilled & frozen) as reported by FAO [after Rose (1996) with updated data from FAO]

55. Fisheries and trade data currently available are insufficient to provide a basis from which to adequately assess the impact of world demand for shark fins. Far greater emphasis must be placed on documenting shark fisheries in order to assess whether or not they are sustainable. Published FAO trade data for shark fins are substantially incomplete. Only about 20 countries report domestic production of shark fins and these data are likely to significantly underestimate actual production as shark fins are often retained by fishermen and sold to dealers or processors as a supplement to their wages (Kiyono, 1996; Parry-Jones and Anonymous, 1996). Fins may also be sold at sea to vessels of other countries (Parry-Jones and Anonymous, 1996). The FAO database for 1993 contains import data for only nine countries and export data for only 15 although 125 countries are known to trade in shark fins directly with Hong Kong. The total reported world imports of dried and salted shark fins averaged 5,330 tonnes annually during the period 1986-1994, peaking in 1988 at 5,915 tonnes (Figure 3). Total reported world exports averaged 4,500 tonnes annually during this period, peaking in 1989 at 5,481 tonnes (FAO, *in litt.*).

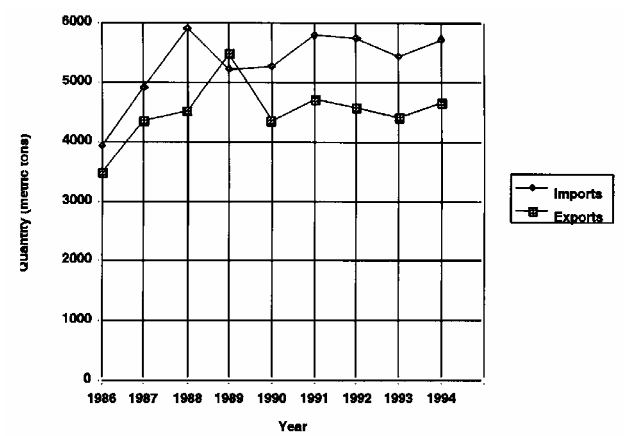

Figure 3: World trade in shark fin (dried & salted) as reported by FAO, after Rose (1996) with updated data from FAO

56. Several factors limit the utility of national Customs data on shark fins and other products for the purposes of developing a cumulative total for the production or international trade in shark fins, or for comparing reported exports with imports. Several countries that are important producers of shark fin also consume large amounts of fin domestically. These export data would therefore not account for fin that was landed or processed within their borders. In many cases, fins are accumulated from domestic fisheries and/or foreign sources for a considerable period of time before being exported or re-exported. During this time they are likely to be sorted and repackaged – thus obscuring the country of origin. Shark fins may also be imported for processing then re-exported in one of several forms of processed fins, thereby appearing in trade as a different commodity. Trading countries may or may not report separately each of the product forms in which fins are traded, further confusing comparison. Furthermore, the volume by weight of fins often changes following processing. Finally, a significant proportion of the world trade in shark fins appears to involve several phases (e.g. import and production of unprocessed fins; export/re-export of these fins for processing; and re-importation of the same fins in a different stage of processing). As a

result, the same fins may appear in the national Customs statistics of several countries more than once. These factors also make it extremely difficult to compare reported trade between two countries, and to relate reported world trade to global or national production of shark fins. The general absence of species identification further reduces the usefulness of FAO and Customs data for assessing conservation impact or for developing management plans. Current trade data provide no species-specific information; shark fins in trade are not identified and in some cases (e.g. processed fins) are not identifiable. Experienced shark fin dealers readily recognize most wet and dried shark fins by species but this ability does not generally extend to Customs agents or fisheries management personnel.

57. Much of the world trade in shark fins passes through Hong Kong for processing, consumption or re-export. Relatively detailed Customs statistics on trade with 125 countries are maintained and are available for the period 1985-1995. These data provide the most comprehensive view of the world trade in shark fins in terms of long-term trends and trading countries. However, these data are likely to overstate total trade volumes owing to the fact that fins, in various phases of processing, may be included more than once in the data.

Skin and Leather

58. Shark skins were originally used as a rough abrasive for rasping and polishing. Shark leather is extremely durable and has an attractive grain that sometimes resembles crocodile skin (Kreuzer and Ahmed, 1978). A significant market for shark leather developed initially in the United States of America, but was followed by markets in Japan and Europe (Kreuzer and Ahmed, 1978). More recently, tanneries in Australia, Europe, Japan and Thailand have begun to process shark leather (Bostock, 1991; Rigney, 1991).

59. Fisheries historically based primarily on the production of hides have proven to be economically unsuccessful. The increasing popularity of fresh and frozen shark meat also discourages the use of shark skins for leather production. Shark skins are damaged by exposure to fresh water or ice. Onboard processing for meat typically includes gutting and immediate refrigeration or freezing of the carcass. Retaining shark skins is much more feasible during production of dried and/or salted meat from large sharks, especially in small-scale fisheries with short trip durations (Kreuzer and Ahmed, 1978). Production of shark leather remains significant in some countries, e.g. Mexico (Rose, 1992; 1996).

60. Insufficient information is available from the majority of producer nations to determine the implications of trade in shark skins and leather for fisheries management and conservation. Available trade data are inadequate to determine the sources and species most important to the production of and trade in shark leather. Market information from Mexico suggests that the use of and trade in shark skins is extremely limited and is dependent on the close proximity and accessibility of specialized tanneries. Shark skins are a relatively low value product in the Mexican fishery. When taken as a byproduct of existing fisheries, they contribute marginally to the overall value of the fishery (Rose, 1996). Unfortunately, neither domestic production data nor trade data for shark skins are available from the majority of producing countries, e.g. Australia, Bangladesh, China, Japan and Thailand.

Liver Oil

61. Shark oil has been widely used historically as a lubricant, in the preservation of small wooden vessels and in the tanning of leather. Vitamin A is derived commercially from shallow water species and squalene from deep water species. In the 1930s, global markets developed for shark liver oil for use in the production of Vitamin A supplements. By the 1950s, these markets had collapsed following the development of synthetic Vitamin A. Currently, a limited market remains for shark liver oil, sold in capsule form as a health supplement. Shark liver oil also yields squalene, a hydrocarbon that is used in the manufacture of lubricants, bactericides, pharmaceuticals and cosmetic products (e.g. skin creams). Shark liver oil also has a chemical compound, an ether, which has been reported as effective in the healing of wounds having bacteriostatic action and protecting against radiation (Kreuzer & Ahmed, 1978; Summers & Wong, 1992). The compound squalamine was recently isolated from dogfish and studies suggest it is effective against bacterial infection and also acts against viruses, including HIV. Other studies suggest that synthetic squalamine might slow the process of vascularization in solid brain tumours (Altman, 1996).

62. Although shark liver oil is still used in the manufacture of cosmetic and pharmaceutical products, little production or trade information is available. One trend observed by TRAFFIC during regional market studies is the apparent decline of the processing and marketing of shark livers and liver oil by many former suppliers, at least in part because of the difficulty of collecting the liver and the strong odour of the products. Much of the current production of shark liver oil therefore appears to have shifted to developing countries.

63. Past fisheries based on shark liver oil have resulted in declined stocks. The decline of liver oil fisheries on the United States Pacific Coast during World War II is an example of a shark fishery that was over-exploited. Shark liver oil production continues at present *albeit* at much reduced levels. Several fisheries specifically target deep water shark species, however there is little information available on these fisheries to determine the extent to which stocks of these species may be vulnerable to local overfishing.

Cartilage

64. Several pharmaceutical and food products are produced from the soft and hard cartilage of sharks. In recent years, shark cartilage powder and capsules have been marketed extensively as a treatment for cancer. However, conclusive tests involving human subjects are not yet available, and there is no evidence that shark cartilage administered orally contains sufficient amounts of active ingredients to be effective (Dold, 1996).

65. The use of shark cartilage for human consumption is relatively recent and neither national fisheries nor Customs agencies report the volume of production or trade. Production volumes are also difficult to assess because of the nature of the manufacture and trade. A limited number of companies manufacture powder from cartilage that they purchase direct from i) vessels, ii) processors or retail outlets and/or iii) shark fin dealers who handle a

variety of dried products. Manufacturers often import cartilage as well as obtaining it from domestic suppliers, then market it under their own brand names or supply ground cartilage to other domestic and/or foreign companies.

66. Medical research also provides a significant market for cartilage in several countries. Major cartilage producing nations are known to include Australia, Japan and the United States of America. It is likely that shark cartilage is supplied by and/or manufactured in other countries but tracing trade routes is difficult owing to the nature of the trade.

67. There is growing concern that new markets for shark cartilage are an additional source of pressure on shark stocks worldwide. These concerns are based on the high retail prices of pharmaceutical products, thereby further stimulating fishing pressure. However, there is little evidence to indicate that the use of cartilage stimulates harvesting of sharks. Rather, it appears that cartilage is a by-product from shark fisheries based on other products. Retail prices for processed shark cartilage are high but processors pay almost nothing (circa USD 1/kg in North America) for the raw material. Since shark 'bones' account for an average of four per cent of total shark body weight, the value of the cartilage relative to meat and fins is extremely low (Kreuzer and Ahmed, 1978). Processed cartilage is often imported from several countries as well as being purchased locally. Casual observation of processing operations does not therefore provide a valid basis for any critical assessment of the volume of supply from local or even national/regional fisheries.

Other Products

68. 'Waste' products of sharks may be used in the production of fishmeal for use in animal feeds, fertilizers, or oils for industrial uses. Shark teeth and jaws have traditionally been used in many cultures in making both functional and ceremonial objects. Shark teeth and jaws are widely used in local curio trades and may enter international trade as tourist souvenirs. A number of shark species are frequently kept as live specimens in public and private aquaria. In some countries, juveniles of small species and egg cases are also collected and exported for sale to private aquarists (Rose, 1996). Glue made from sharks was used in traditional Japanese lacquerware (Kiyono, 1996). Carcasses of some small sharks are used for dissection in biology courses. Shark skin is also consumed as a food product in some Asian and Pacific cultures as are some organs, such as stomachs, livers and intestines, and other body parts (e.g. gills and ova).

69. Shark products have long been used in traditional Chinese medicine, with many edible products considered to be beneficial to health. Other parts and derivatives used for medicinal purposes include the foetus, ovaries, brain, bile, skin, meat and liver oil. In some Asian cultures, shark fin is also believed to be helpful to diabetics, and shark cartilage is considered a health tonic and used as an ingredient in soups (Kiyono, 1996).

Limitations of Available Data

70. There is a paucity of reliable information on the biology and population ecology of sharks – owing principally to the low priority traditionally afforded to shark research. The fragmentary nature of available information increases the difficulty of evaluating the impacts of trade on the resource. The lack of structured management programmes for many shark fisheries is both a cause and a result of not having adequate species-specific data and of the following inadequacies:

71. – lack of basic life history information (growth rate, longevity, age at maturity, fecundity, recruitment);

72. – lack of population data (temporal and spatial distribution in general and by sex and age);

73. – lack of data on stock size and on exchange between stocks;

74. – lack of or unreliable nature of species-specific catch and effort data with data on size at capture;

75. – misleading or significantly incomplete published catch statistics for shared fisheries; and

76. – lack of ecological studies (habitat requirements, predator-prey relationships, etc.).

Current Management of Sharks

77. According to published data of FAO, world reported catches of sharks and related species have been rising steadily since the 1940s (Compagno, 1984: Bonfil, 1994). Total reported world catches averaged 678,249 tonnes in the decade 1985-1994, with an upward trend from 625,974 tonnes in 1985 to 730,784 tonnes in 1994 (see Table 1 and Figure 4, FAO 1995; 1996).

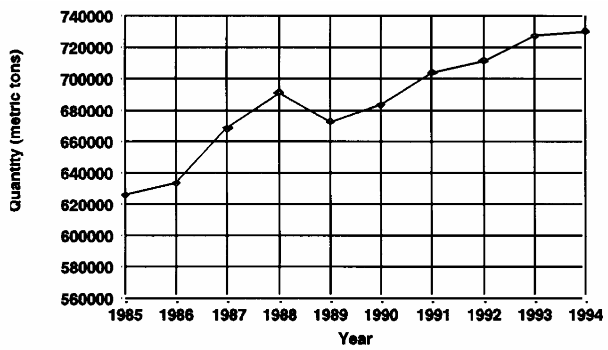

Figure 4: World elasmobranch catches (catch and landings represent specimens kept and reported) as reported by FAO, after Rose (1996) with updated data from FAO

78. The Western Indian Ocean (FAO Area 51), Eastern Indian Ocean (FAO Area 57), North-west Pacific (FAO Area 61), and Western Central Pacific (FAO Area 71) reported the highest catches of chondrichthyans, together accounting for nearly 57 per cent (Table 1) of world reported catches (FAO, 1995, 1996). These data underestimate the actual annual catch because FAO statistics do not include discards and subsistence fisheries, and usually exclude recreational and artisanal catches (Bonfil, 1994).

79. Data on the utilization of sharks are scarce because countries do not regularly report statistics on shark products or local consumption. Fresh shark meat is consumed locally in many parts of the world, but because shark meat is difficult to process, it has been of low export value. In contrast, dried shark fins and dried shark meat are easy to process and supply. In the mid-1980s, the demand for shark fins in Asia increased markedly. This caused an increase in fin prices. Although data on the fin trade are substantially incomplete because many countries do not report fin exports, trade in fins increased dramatically in the 1980s and has remained stable since 1988 (Figure 3).

80. In 1994, about 105 countries reported chondrichthyan landings to FAO. Of these, 26 are considered to be major shark-fishing nations, landing more than 10,000

tonnes of chondrichthyans a year. Only three countries (Australia, New Zealand and the United States of America) have integrated research and management plans for their shark fisheries. Recently, Canada became the fourth nation to implement a shark management plan. Annex 4 presents a summary of the domestic management tools currently in use by countries that operate a shark fishery.

81. Although directed shark fisheries have been documented throughout the world, few are managed. Management of most sharks is complicated by the lack of adequate baseline data on species-specific abundances, life-history information, size of catches and fishing effort, and discards at sea. Effective management is complicated further by the migratory nature of some species. The long life span and slow maturation of some species means that the effects of fishing and management strategies introduced will not be apparent until 15-20 years later in some cases.

<u>Intergovernmental Fishery Management and Scientific Organizations</u>

82. Many shark species have wide-ranging distributions which frequently traverse national boundaries and are harvested by multinational fisheries. In recent years several intergovernmental fisheries bodies, e.g. FAO, the International Council for the Exploration of the Sea (ICES), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Latin American Organization for Fishery Development (OLDEPESCA), the Inter-American Tropical Tuna Convention (IATTC), the South Pacific Commission (SPC) and the Indian Ocean Tuna Commission (IOTC), have initiated efforts to encourage member countries to collect information on sharks. Improved recording and reporting of landings of certain sharks in European Community waters (e.g. basking shark, spiny dogfish, porbeagle, dogfish sharks [Squalidae spp.], smoothhounds [*Mustelus* spp.] and mako shark) will result from EC Council Regulation (COM(95) 322 final).

83. The UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks negotiated an Agreement to facilitate implementation of the UN Convention on the Law of the Sea's (UNCLOS) provisions relating to the conservation and management of high seas fish stocks. The Agreement was opened for signature and ratification on 4 December 1995. It will enter into force for each State or entity that ratifies or accedes to it 30 days after receipt of the 30th instrument of ratification. The Agreement will establish rules and conservation measures for high seas fishery resources. The Agreement calls for Parties to protect marine biodiversity, minimize pollution, monitor fishing levels and stocks, provide accurate reporting of and minimize by-catch and discards, and gather reliable, comprehensive scientific data as the basis for management decisions. It also calls for a precautionary, risk-averse approach to management of these species when scientific uncertainty exists. The UN Agreement on Straddling Fish Stocks and Migratory Fish Stocks also directs States to seek to co-operate in relation to these species through appropriate subregional fishery management organizations or arrangements. Under UNCLOS, oceanic sharks, defined as highly migratory species are: *Hexanchus griseus, Cetorhinus maximus*, *Rhincodon typus*, Alopiidae spp., Carcharinidae spp., Sphyrnidae spp. and Lamidae spp.

84. Other species and populations may qualify as a "straddling stock" under Article 63(2) of the Convention, particularly in areas where jurisdiction has not been extended to the 200 mile limit (e.g. the Mediterranean Sea). For these sharks, co-ordinated management and assessment of shared migratory populations would promote an understanding of the cumulative impacts of fishing effort on the status of shared populations.

85. Existing intergovernmental fishery management regimes manage other migratory species such as tunas and billfishes. Various intergovernmental fishery organizations have jurisdiction within specific regions or oceans. These include ICCAT, the South Pacific Forum Fisheries Agency, the Commission for the Conservation of Southern Bluefin Tuna, IATTC and IOTC. Although only a few of the legal instruments that establish these intergovernmental organizations provide the competence to recommend regulatory measures for species other than tunas and tuna-like species (e.g. the South Pacific Forum Fisheries Agency, IOTC and OLDEPESCA), none is currently managing sharks or their fisheries. However, some measures can be taken to establish mechanisms by which these organizations are able to manage shark fisheries in the future. Scientific organizations, such as ICES and the SPC, study and provide scientific recommendations on species within the scope of their competence.

86. Some co-ordinated scientific programmes for sharks currently exist. Co-operative tagging programmes have existed for more than two decades in some parts of the world and have advanced knowledge of migratory patterns, age and growth, natural mortality, behaviour and habitat areas (Casey and Taniuchi, 1990). Data gathered through these efforts confirm that many shark species have wide-ranging distributions, which frequently traverse national boundaries and are thus subject to exploitation by more than one national fishery.

87. Current international regimes for managing fisheries that catch sharks directly or incidentally are inadequate to ensure sustainable fisheries. Besides large geographic gaps in which there is no management of fisheries affecting sharks, existing management regimes suffer from significant functional gaps, including data collection on shark catches and application of the precautionary principle (Weber and Fordham, 1997). Where existing international regimes are competent to recommend regulatory measures, enforcement of these recommendations rests with signatory States. However, non-compliance with recommendations impacts the effectiveness of recommended management measures.

Food and Agriculture Organization of the United Nations (FAO)

88. FAO, with respect to fisheries, has a role in the collection, analysis and dissemination of information as well as providing policy guidelines for the rational management and development of world fisheries. The data currently available to FAO are highly variable in quality and are thought to concern only a portion of catches and trade. The catch data held by FAO have not been collated with the intention of stock assessment or management. As a consequence the level of aggregation is by country, year, species and FAO statistical area

89. The concept of responsible fisheries emerged during the 19th session of the FAO Committee on Fisheries (COFI) in 1991 (Palacio, 1995a). In May 1992 the Government of Mexico, in co-operation with FAO, organized an International Conference on Responsible Fishing, from which the Declaration of Cancún was derived. This in turn led FAO to develop the Code of Conduct for Responsible Fisheries. The Code complements the provisions of the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks and sets out principles

and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with respect for the ecosystem and biodiversity. The Code addresses fisheries management, fishing operations, aquaculture development, integration of fisheries into coastal zone management, post-harvest practices and trade, and fisheries research.

90. Although no specific reference to CITES is contained in the Code, two articles in particular incorporate provisions that are similar in intent to relevant sections of CITES. The general principles of the Code (Article 6) call on non-participants of regional fisheries management activities, whose vessels engage in practices that undermine the effectiveness of measures contained in the Code, to co-operate in implementing the Code (Palacio, 1995a). In cases where such activities are not rectified, countries implementing the Code, are able, within the framework of the Code and consistent with international law, to "restrict the introduction into their domestic markets of fish and fish products originated by vessels of such non-participants in waters where the conservation and management measures are applied". With respect to Post-harvest Practices and Trade, Article 10 of the Code states that international trade should not compromise the sustainable development of fisheries and responsible utilization of resources (Palacio, 1995a). The FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas is an integral part of the Code. This section is applicable to high seas fisheries in the event that international conservation and management measures are adopted for sharks.

91. FAO is currently developing a programme to improve shark catch and trade statistics in response to Resolution Conf. 9.17. The three proposed components of the programme include:

92. – a consultancy to design and undertake an inquiry on the availability of biological and trade data on sharks;

93. – production of a species catalogue for batoid fishes and of an update of the Shark World Species Catalogue produced in the early 1980s; and

94. – production of an update of the Shark Utilization and Marketing Monograph issued in 1978.

95. The total cost of these activities is estimated at USD 330,000, which the Government of Japan will fund.

96. In July 1996, FAO engaged a consultant to design a questionnaire for the collection of species-specific catch and trade data on elasmobranchs for the period 1990-1995, including available information on the status of elasmobranch stocks. Additional information on shark catches and trade in shark products will be obtained by liaising with identified national experts on elasmobranchs and major business enterprises that exploit elasmobranchs. These data will be assembled, analyzed and published in a summary report providing preliminary indications of those species of sharks at risk and of what follow-up action or monitoring is necessary.

International Council for the Exploration of the Sea (ICES)

97. ICES is an intergovernmental organization established in 1902 for the purpose of promoting and co-ordinating research on living marine resources in the North Atlantic Ocean and adjacent seas. For the last few decades, it has been responsible for providing advice at the international level on scientific and policy matters relating to fisheries, pollution and other marine environmental issues. Member nations include all North Atlantic coastal States, including all but one of the Baltic countries.

98. Following an initiative to establish a Study Group on Elasmobranch Fisheries in 1989 (ICES, 1989), ICES established a Study Group on Elasmobranch Fishes in 1994, which met in August 1995. Bonfil (1996) summarizes the Study Group's terms of reference as follows:

99. – to review the status of elasmobranch stocks within the North-east and North-west Atlantic and, where possible, identify trends in biomass and recruitment;

100. – to identify the extent of the commercial and sport fisheries in which elasmobranchs are targeted or caught as by-catch and estimate the amount (biomass/numbers per size class) of elasmobranchs taken as catch and lost as discards;

101. – to describe/review the ecological role of elasmobranch species, their reproductive dynamics and predation of elasmobranchs by species or species group;

102. – to co-ordinate techniques of age determination and age verification of elasmobranchs;

103. – to co-ordinate methods of modelling and assessment of elasmobranch stocks;

104. – to identify the development of compensatory mechanisms as a response to exploitation; and

105. – to outline an action plan for attaining the goals set above.

106. The meeting produced a report that contains much of the available information on elasmobranch fishes and fisheries in North American and European waters and initiated some joint work on some of the key issues related to achieving sustainable exploitation of elasmobranchs. The report from this Study Group was presented at the 1995 ICES Annual Science Conference (ICES, 1995) and includes a number of recommendations on fisheries in the North Atlantic:

107. – all survey cruises should identify skates and sharks to the species level;

108. – records should improve the level of species classification for commercial catches of sharks and skates;

109. – member countries should check conversion factors used to raise species to live weight;

110. – the pattern of elasmobranch discards should be examined from other fisheries, discards should be quantified and survival rates studied;

111. – elasmobranchs should be included in the remit of the ICES Study Group on Stock Identification;

112. – workshops on predation and ageing should be convened;

113. – a case population for which there is a good data set should be used to test the validity of assessment methods on elasmobranch populations;

114. – management advice on elasmobranch exploitation should be provided, including consideration of precautionary measures where strong evidence exists of decreasing abundance in an elasmobranch fishery; and

115. – maintain contact between ICES and ICCAT.

International Convention for the Conservation of Atlantic Tunas (ICCAT)

116. In recognition of the migratory nature of the species, the objective of ICCAT is to conserve and manage tunas and tuna-like species occurring in the Atlantic Ocean and adjacent seas in a manner which achieves maximum sustainable catch. The Commission was established to provide an effective programme of international co-operation in research and conservation of these species. ICCAT is responsible for providing internationally co-ordinated research on the condition of the species, their environment and development of regulatory harvest proposals for consideration by Parties. ICCAT is competent to study populations of tuna and tuna-like fishes and other species exploited in tuna fishing in the Convention area if not under investigation by another international fishery organization (ICCAT, 1985).

ICCAT initiated a new data-collection effort for member countries to provide species-specific information on sharks caught as by-catch in tuna fisheries in the Atlantic Ocean. In 1994 the ICCAT Standing Committee on Research and Statistics (SCRS) created a new Sub-Committee on By-catch and a Working Group on Sharks. The Working Group met in February 1996 to continue efforts to identify shark species caught as by-catch in the Atlantic and Mediterranean tuna fisheries. The analysis was based on responses to a Questionnaire on By-catches circulated to members in 1995 by the ICCAT Secretariat. The February meeting of the Working Group also finalized a work plan for collecting statistics on shark species. The Group has designed a new species-specific shark by-catch reporting form and expects to review the new data during the 1996 SCRS Species Group meeting in October 1996. The Working Group also intends to compile conversion factors for species likely to be taken as by-catch in the Atlantic tuna fisheries and evaluate species-specific catch rate patterns for pelagic sharks taken as by-catch in ICCAT managed fisheries. The Group plans to meet again in the first quarter of 1997. Recommendations of the Group will be subject to the approval of the Commission (ICCAT, 1996).

Commission for the Conservation of Southern Bluefin Tuna (CCSBT)

117. The CCSBT is a regional fisheries management organization established under the Convention for the Conservation of Southern Bluefin Tuna (SBT). The Convention was established to enhance the conservation and optimal use of SBT. Parties to the CCSBT are Australia, Japan and New Zealand. Article 8 of the Convention provides for the Commission to collect scientific information, statistical data and other information relating to southern bluefin tuna and ecologically related species. Sharks could be considered to fall within the competence of the CCSBT as "ecologically related species" (Palacio, 1995b).

118. Although an "Ecologically Related Species Working Group" has been established to provide advice to the Commission, there has been little discussion or focus by the CCSBT on the interaction of SBT fisheries with sharks. To date the activities of this Working Group have been directed to the problem of interactions between seabirds and the SBT fishery with some attention to predator and prey species. Edwards (1996, pers comm.) has advised that the Parties to the CCSBT have a responsibility to consider the impacts of SBT fishing on the marine ecosystem and a responsibility to mitigate those effects. However, to date, the attention of the three Parties has been focused on the assessment and management of southern bluefin tuna.

Latin American Organization for Fishery Development (OLDEPESCA)

119. The Agreement that established OLDEPESCA does not define a specific area of competence, but refers to the need to encourage the correct use and protection of fishery resources within the Maritime Jurisdiction zones of each State. The species covered include all living marine resources. Membership is limited to States belonging to the Latin American Economic System (i.e. Belize, Bolivia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Peru, Uruguay and Venezuela). The United States of America participates as an observer.

120. OLDEPESCA has solicited information about shark fisheries in the region (Mazal, pers. comm. 1996). Member States have been requested to improve monitoring and the recording of biological and trade statistics on sharks. The inclusion of sharks in the appendices to CITES and CITES Resolution Conf. 9.17 were considered at the XIIth Conference of Ministers of OLDEPESCA which met in Havana, Cuba, in November 1996. The OLDEPESCA Ministers adopted Resolution No. 136-CM-96 on Shark Fisheries, which *inter alia* recognized the regional objective to promote sustainable use of resources; noting also that countries are making considerable efforts to implement research and management programmes for various species of shark, within the framework of international agreements and instruments such as the Code of Conduct for Responsible Fishing. The XIIth Conference of OLDEPESCA Ministers concluded that no inclusion of any species of shark in the appendices to CITES was warranted at the present time.

Indian Ocean Tuna Commission (IOTC)

121. The Agreement creating the IOTC entered into force in April 1996, when the Republic of Korea became the 10th country to accede to it. The other members are: Australia, Eritrea, the European Union, France, India, Japan, Madagascar, Mauritius, Pakistan, the Seychelles, Sri Lanka, the Sudan and the United Kingdom. The first official meeting to create the Commission was held in Rome in December 1996. The Commission has been established and will be located in the Seychelles. This body is succeeding partly from the Indo-Pacific Tuna Development and Management Programme (IPTP) which was more of a statistics-gathering body. Unlike its predecessor, the IOTC will have management powers. The issue of shark catches in tuna fisheries was discussed at the last two IPTP Expert Consultations on Indian Ocean Tunas. The issue was agreed to be an important one and it was recommended that all countries fishing for tuna and tuna-like species in the Indian Ocean should provide data on by-catch and dis-

cards of sharks and non-tuna species in a timely manner (IPTP, 1995).

Inter-American Tropical Tuna Commission (IATTC)

122. IATTC was established to study the biology of the tunas and other kinds of fish taken by tuna purse seiners of the Eastern Pacific Ocean with a view to determining the effects that fishing and natural factors have on their abundance. The Commission is authorized to recommend appropriate conservation measures to ensure that the stocks are maintained at levels that allow maximum sustainable catches. The terms of reference for the Commission were broadened in 1976 to include work on problems arising from the tuna-dolphin relationship in the Eastern Pacific Ocean. Member countries include Costa Rica, France, Japan, Nicaragua, Panama, the United States of America and Venezuela.

123. Since 1992, IATTC has been administering an observer programme to gather information on all catches and by-catches of all species taken by tuna purse seiners within the Commission's area of competence. The programme achieves 100 per cent coverage of all trips by vessels of all flags. The Commission does not have access to part of the observer data collected under Mexico's national programme, but the database includes approximately 70 per cent of all sets made in the Eastern Pacific Ocean. Information collected under this programme will assist the Commission and member countries to manage for a reduction of by-catches of all species (Hall, *in litt*., 1996). Furthermore, IATTC and OLDEPESCA propose to organize a workshop during 1997 to discuss shark fisheries and their management in the eastern tropical Pacific Ocean (Mazal, pers comm. 1996).

South Pacific Commission

124. Established by an Agreement signed in 1947, the South Pacific Commission's activities are not restricted to fisheries but include a diverse range of responsibilities such as agriculture, education and health information. Membership of the SPC includes most Pacific Island countries, Australia, New Zealand, Papua New Guinea, the United Kingdom and the United States of America. The SPC serves as the scientific and data-collection organization for the Forum Fisheries Agency (FFA).

125. The Commission operates several coastal fisheries projects covering all living marine resources and an oceanic programme (OFP) which deals exclusively with research and statistics on tunas and billfishes. The data held by the OFP include catch and effort logbook and observer data on species composition of catches, by-catch and discards, and other biological information (Anon, 1996b).

126. The OFP holds observer data collected under an observer programme of the United States of America as part of a multilateral tuna treaty. This observer programme is managed by the FFA. The OFP also holds observer data collected by several national observer programmes including those of the Federated States of Micronesia, Marshall Islands, New Caledonia, Palau, Papua New Guinea and the Solomon Islands. Since February 1995, the OFP has operated a limited observer programme to collect data on all catches, including those of sharks, by vessels operating in the SPC area. This programme is operated under a five-year EC-funded South Pacific Regional Tuna Resource Assessment and Monitoring Project. The observer data indicate that significant numbers of sharks are taken throughout the western Pacific Ocean longline fisheries as well as purse seine sets on floating objects (Anon, 1996b). The observers have covered many fleets active in the region, but the distant-water longline fleets of Japan, the Republic of Korea and Taiwan, Province of China, considered particularly important in relation to the purpose of monitoring by-catch and discards, have proven logistically difficult to cover (Anon, 1996b).

Conclusions

127. In general sharks are long-lived animals that exhibit slow growth, late maturity, low fecundity and productivity, and high natural survivorship for all age classes.

128. The k-selected life-history strategy exhibited by many species of shark limits reproductive productivity and renders some species too vulnerable to inappropriate management.

129. Shark meat and fins are currently traded in the largest quantities and together these two commodities support many commercial directed shark fisheries economically.

130. Historically, the total value of directed commercial shark fisheries ranks low in relation to other commercial fisheries. As a result, sharks have been a low priority resource for research and management.

131. The increased international demand for shark products in recent years has resulted in higher levels of exploitation of some species of sharks. Some of this exploitation has been in regions not traditionally associated with the trade in shark products.

132. Historical and current reported data on catches and landings are inadequate to determine with any certainty whether or not the high value of shark fins and the increasing trade networks are stimulating increased landings of sharks and the development or expansion of targeted shark fisheries in some parts of the world.

133. Given the purpose of the statistical data and hence the manner in which they are collected by FAO, it is not possible to determine, with any degree of reliability, the proportion of the total elasmobranch landings represented by different species of sharks.

134. Although it is known that fins from a large number species are traded internationally, there are no data to document the volume of this trade on a species basis. Even the geographic source of fins in trade is often impossible to determine from trade data, owing to the complex nature of the fin trade.

135. Given the value of and demand for some shark products, the present volume of shark landings and the potential for expansion of national or global fisheries based on generally unknown fish stocks, it is imperative that better fisheries and trade data are collected in order to identify those species most at risk, as a first step toward developing sustainable management regimes.

136. Various intergovernmental tuna conventions have competence to gather statistical data on sharks that are captured along with tunas, although few have the competence to manage sharks. Whether or not motivated by Resolution Conf. 9.17, in recent years these bodies have given greater attention to the need for more accurate information on the incidence of shark by-catch and the species involved.

137. Parties with shark fisheries, and/or trade and international fishery management organizations, should implement research and management efforts to develop a more complete understanding of the biologi-

cal characteristics of sharks that are subject to harvesting and the extent to which trade is impacting species and ensure that all existing shark fisheries are sustainable.

Recommendations

138. It is recommended that the Conference of the Parties endorse the following recommendations to achieve full implementation of Resolution Conf. 9.17.

139. – Parties should, in collaboration with FAO and other regional fisheries organizations, improve methods to accurately identify, by species, record and report landings of sharks from directed fisheries and sharks taken as a by-catch in another fishery.

140. – Parties that have a shark fishery and/or trade in sharks and shark parts and derivatives should establish appropriate species-specific recording and reporting systems for all sharks that are landed as a directed catch or a by-catch.

141. – In an effort to improve statistics on trade in sharks and shark parts and derivatives the Secretariat, in collaboration with FAO, should consult the World Customs Organization to establish more specific headings within the standard six-digit Customs tariff headings, adopted under the Harmonised System tariff classification, to discriminate between shark meat, fins, leather, cartilage and other products.

142. – It is suggested that FAO should, as a matter of urgency, initiate a work programme involving:

143. – changing the manner in which it requests members to record and report data on shark landings;

144. – giving a consultancy to design and undertake an inquiry on the availability of biological and trade data on sharks (commenced in 1996);

145. – updating the Shark World Species Catalogue and the 1978 Shark Utilization and Marketing Monograph; and

146. – finalizing and publishing the World Catalogue of Rajiformes.

147. – It is also suggested that FAO should transmit the results of the consultancy to the CITES Secretariat for circulation to and comment by the Parties to the Convention.

148. – Parties that have a shark fishery should initiate efforts to:

149. – collect species-specific data on landings, discards and fishing effort;

150. – compile information on life-history and biological parameters such as growth rate, life span, sexual maturity, fecundity and stock-recruitment relationships of sharks taken in their fisheries;

151. – document the distribution of sharks by age and sex, as well as their seasonal movements and interactions between populations; and

152. – reduce mortality of sharks captured incidentally in the course of other fishing activities.

153. – Parties are encouraged to initiate management of shark fisheries at the national level and develop international/regional bodies to co-ordinate management of shark fisheries throughout the geographic range of species that are subject to exploitation in order to ensure that international trade is not detrimental to the long-term survival of shark populations.

154. – The Conference of the Parties to the Convention should urge FAO to encourage its member States that have a shark fishery, or a fishery that takes sharks as a by-catch, to implement the principles and practices elaborated in: i) the FAO Code of Conduct for Responsible Fisheries; ii) the FAO Precautionary Approach to Fisheries, Part 1: Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions; and iii) the FAO Code of Practice for the Full Utilization of Sharks.

155. – FAO, in collaboration with the CITES Secretariat and the CITES Animals Committee, should convene a consultative meeting involving FAO representatives, fisheries biologists/managers, intergovernmental fisheries organizations and non-governmental organizations with expertise on shark management to develop a programme to further the implementation of Resolution Conf. 9.17.

156. – The Secretariat should communicate the relevant recommendations to FAO and other intergovernmental fisheries management and/or research organizations and establish liaison with these bodies to monitor implementation.

References

157. Altman, L.K. (1996) – Shark Substance Found to Limit Tumour Growth. New York Times (1 May 96): 15.

158. Adams, W.F. & Wilson, C. (in press) – The Status of the Sawfish, *Pristis pectinata* Latham, 1794 (Pristiformes: Pristidae) in the United States. Chondros 6(4).

159. Anderson, R.C. & Ahmed, H. (1993) – Shark Fisheries in the Maldives. Ministry of Fisheries and Agriculture, Maldives & FAO. 76pp.

160. Anon (1996a) – Case Study: An Update of By-catch Issues in the Western and Central Pacific Ocean Tuna Fisheries. Ocean Fisheries Programme, Sth Pacific Comm. Sept. 12pp.

161. Anon (1996b) – Report of the Technical Consultation on the Collection and Exchange of Fisheries Data, Tuna Research and Stock Assessment. Oceanic Fisheries Programme/South Pacific Commission & Forum fisheries Agency. South Pacific Commission Headquarters, Noumea, New Caledonia, 15-19 July 1996, 40pp.

162. Bonfil, R. (1994) – Overview of World Elasmobranch Fisheries. FAO Fisheries Technical Paper, No. 341. FAO, Rome.

163. Bonfil, R. (1996) – ICES Study Group on Elasmobranch Fisheries. Sharks News 6. March p5.

164. Bostock, T.W. (1991) – Shark Leather. INFOFISH International 2: 30-32.

165. Branstetter, S. (1990) – Early Life History Implications of Selected Carcharhinoid and Lamnoid Sharks of the Northwest Atlantic. pp17-28, In: Elasmobranchs as Living Resources: Advances in Biology, Ecology, Systematics and the Status of the Fisheries (Pratt, H.L., Jr., Gruber, S.H. and Taniuchi, T. Eds.) NOAA Tech. Rep. 90.

166. Casey, J.G. & Taniuchi, T. (1990) – Recommendations for future shark tagging programmes. in Pratt Jnr, H.L., S.H. Gruber & T. Taniuchi (Eds) Elasmobranchs as living resources: advances in the biology, ecology, systematics, and the status of fisheries.

167. Cliff, G. & Dudley, S.F.J. (1996) – Sharks caught in the protective gill nets off Natal, South Africa. 6. The copper shark *Carcharhinus brachyurus* (Gunther). South African Journal of Marine Science 12: 663-674.

168. Compagno, L.J.V. (1984) – Sharks of the World: An Annotated and Illustrated Catalogue of Shark Species Known to Date. FAO Fish Synopsis 125 2 Vols 655pp.

169. Compagno, L.J.V. (1990) – Shark Exploitation and Conservation. In H.L. Pratt, Jr., S.H. Gruber and T. Taniuchi, eds., Elasmobranchs as Living Resources: Advances in the Biology, Ecology, Systematics, and the Status of the Fisheries. NOAA Technical Report NMFS 590. US Department of Commerce, Washington, D.C.

170. Dold, C. (1996) – Shark Therapy. Discover (April): 51-57.

171. FAO (1991). Draft Code of Practice for the Full Utilization of Sharks. FAO Fisheries Circular No.844. FAO, Rome.

172. FAO (1995) – Yearbook of Fisheries Statistics: Production, 1993. FAO, Rome.

173. FAO (1996) – Fishtat PC. Fishery Information, Data and Statistics Unit, FAO Fisheries Department, Food and Agriculture Organization of the United Nations, Rome.

174. ICCAT (1985) – Basic Texts. 2nd Revision. Madrid, Spain.

175. Hall, M. (*in litt.*) – letter from IATTC to USNMFS, Nov. 1996.

176. ICCAT (1996) – Report of the first meeting of the Shark Working Group of the ICCAT Sub-committee on Bycatch (Miami, Florida, USA, February 26 to 28, 1996).

177. ICES (1989) – Report of the Study Group on Elasmobranch Fishes. Demersal Fish Committee. ICES CM 1989/G: 54.

178. ICES (1995) – Report of the Study Group on Elasmobranch Fishes. ICES CM 1995/G: 3.

179. IPTP (1995) – Report of the Expert Consultation on Indian Ocean Tunas, 6th Session. Colombo, Sri Lanka, September 1995. IPTP/95/GEN/23.

180. Kiyono, H. (1996) – TRAFFIC Report on Shark Fisheries and Trade in Japan. In M.J. Phipps, comp., TRAFFIC East Asia Report on Shark Fisheries and Trade in the East Asian Region. TRAFFIC East Asia-Taipei, Taipei.

181. Kreuzer, R. & Ahmed, R. (1978) – Shark Utilization and Marketing. FAO, Rome.

182. Last, P.R. & Stevens, J.D. (1994) – Sharks and Rays of Australia. CSIRO, Division of Fisheries & Oceanography, Melb. Aust. 513pp.

183. Manire, C.A. & Gruber, S.H. (1990) – Many Sharks may be Headed Towards Extinction. Cons. Biol., Vol.4 pp10-11.

184. Matsunaga, H & Nakano, H. (1996) – CPUE Trend and Species Composition of Pelagic Shark Caught by Japanese Research and Training Vessels in the Pacific Ocean. Doc.AC.13.6.1 Annex.

185. Musick, J. (1995) – Critically Endangered Large coastal Sharks: the Sandbar Shark, *Carcharhinus plumbeus* (Nardo, 1827). Shark News 5, oct 1995, pp6-7.

186. Nakano, H. (1996) – Historical CPUE of Pelagic Shark Caught by Japanese Longline Fishery in the World. Information paper for 13th meeting of the CITES Animals Committee. 4pp.

187. Natanson, L.J., Casey, J.G., & Kohler, N.E. (1995) – Age and Growth Estimates for the Dusky Shark *Carcharhinus obscurus*, in the western North Atlantic Ocean. Fish. Bull. 93:116-126.

188. Palacio, F.J. (1995a) – A Report to the CITES Secretariat on Participation in the 21st Session of the FAO Committee on Fisheries to Present CITES Resolution Conf. 9.17 on the Status of International Trade in Shark Species and Overview of Pertinent Activities. Unpublished report to the CITES Secretariat by the Delegation of Panamá. June 55pp.

189. Palacio, F.J. (1995b). – Report to the CITES Secretariat on the 1995 Meeting of the Standing Committee on Research and Statistics (SCRS) of the International Commission for the Conservation of Atlantic Tunas (ICCAT), with Related Remarks Concerning the Implementation of CITES Resolution Conf. 9.17 on the Status of International Trade in Shark Species. Unpublished report to the CITES Secretariat by the Delegation of Panamá. October 38pp.

190. Parry-Jones, R. & Anonymous (1996) – TRAFFIC Report on Shark Fisheries and Trade in China. In: Phipps, M.J. (comp). TRAFFIC East Asia Report on Shark Fisheries and Trade in the East Asia Region. TRAFFIC East Asia – Taipei.

191. Rigney, H. (1991) – Shark Skins. Australian Fisheries (February): 38-41.

192. Rose, D.A. (1992) – The Sharks of Mexico: A Resource for All Seasons. TRAFFIC USA 11(4):4-6.

193. Rose, D.A. (1996) – An Overview of World Trade in Sharks and other Cartilaginous Fishes. TRAFFIC International, Cambridge, UK.

194. Rose, D.A. (1996) – North American Shark Fisheries and Trade. TRAFFIC USA, Washington, DC.

195. Simpfendorfer, C.A. (1993) – Age and Growth of the Australian Sharpnose Shark, *Rhizoprionodon taylori*, from North Queensland, Australia. Environmental biology of Fishes. 36:233-241.

196. Stevens, J.D., Walker, T.I. & Simpfendorfer, C.A. (in press) – Are Southern Australian Shark Fisheries Sustainable? Proc. 2nd World Fish. Congr. Bris., Australia, Jul-Aug 1996.

197. Stevens, J.D. (1997) – The Population Status of Highly Migratory Oceanic Sharks in the Pacific Ocean in Getting Ahead of the Curve : Proc. of Symp. on Conserving Highly Migratory Fish in the Pacific Ocean. 4-6 Nov. 1996, Monterey, Calif. publ. Coalition for Marine Conservation, Washington DC.

198. Subasinghe, S. (1992) – Shark Fin, Sea Cucumber and Jelly Fish: A Processor's Guide. INFOFISH Technical Handbook 6. INFOFISH, Kuala Lumpur.

199. Summers, G. & Wong, R. (1992) – Cosmetic Products from Semi-Refined Shark Liver Oil. INFOFISH International 2: 55-58.

200. USNMFS (1996) – Animals Committee Discussion Paper Pursuant to CITES Resolution Conf. 9.17. An overview of the Impacts of Trade on the Biological Status of Sharks. Doc.AC.13.6. Annex.

201. Weber, M. & Fordham, S. (1997) – Managing Shark Fisheries: Opportunities for International Conservation, Centre for Marine Conservation, Washington DC.

RESOLUTION OF THE CONFERENCE OF THE PARTIES (CONF. 9.17)

Status of International Trade in Shark Species

NOTING the increase in the international trade in parts and derivatives of sharks, and the document on this issue (Doc. 9.58) submitted by the United States of America;

CONCERNED that some shark species are heavily utilized around the world for their fins, skins and meat;

NOTING that levels of exploitation in some cases are unsustainable and may be detrimental to the long-term survival of certain shark species;

NOTING that, at present, sharks are not specifically managed or conserved by any multilateral or regional agreement for the management of marine fisheries;

NOTING further the ongoing initiatives to foster international co-operation in the management of fisheries resources;

CONCERNED that the international trade in parts and products of sharks lacks adequate monitoring and control;

RECOGNIZING that the members of the IUCN/SSC Shark Specialist Group are currently reviewing the status of sharks and the global trade in their parts and derivatives in the course of developing an action plan on shark conservation;

CONSIDERING that the Conference of the Parties has competence to consider any species subject to international trade;

RECOGNIZING that other intergovernmental organizations and bodies, including the Food and Agriculture Organization (FAO) of the United Nations, and the International Commission for Conservation of Atlantic Tunas (ICCAT), have undertaken efforts to collect elaborate statistical data on catches and landings of diverse marine species, including sharks;

RECOGNIZING further that the collection of species-specific data is a complex task, considering that there are some 100 species of sharks being exploited both commercially and for recreation, and that numerous countries utilize this marine resource;

THE CONFERENCE OF THE PARTIES TO THE CONVENTION

URGES the Parties to submit to the Secretariat all available information concerning the trade and biological status of sharks, including historical catch and trade data on shark fisheries;

DIRECTS the Animals Committee, with the assistance of experts as may be needed, to:

a) review such information, and information made available through consultation with FAO and other international fisheries management organizations and, where appropriate, to include information made available by non-governmental organizations;

b) summarize the biological and trade status of sharks subject to international trade; and

c) prepare a discussion paper on the biological and trade status of sharks, at least six months prior to the tenth meeting of the Conference of the Parties; and

REQUESTS:

a) FAO and other international fisheries management organizations to establish programmes to further collect and assemble the necessary biological and trade data on shark species, and that such additional information be provided no later than six months prior to the 11th meeting of the Conference of the Parties;

b) all nations utilizing and trading specimens of shark species to co-operate with FAO and other international fisheries management organizations, and to assist developing States in the collection of species-specific data; and

c) FAO and other international fisheries management organizations to fully inform the CITES Secretariat of progress on collection, elaboration and analyzes of data.

Life-history Traits of Some Chondrichthyan Species Subject to International Trade or of Special Conservation Concern[1]

Scientific and common names	Age to maturity (years)	Size (cm TL)	Life span (years)	Litter size	Annual rate of population increase	Reproductive periodicity (years)	Gestation time (months)
Notorynchus cepedianus Broadnose sevengill shark	?	M: 150 (mat) F: 200 (mat) 300 (max)	20 82 (max)	?	?	?	?
Squalus acanthias Spiny or piked dogfish or spurdog (NW Atlantic population)	M: 6-9[2,3,4,5] 100 (max) F: 9-29	M: 60 (mat) F: 40 F: 70 (mat) 124 (max)	M: 35 70 (in NW Pacific)	2-15	2.3%	2 (but no resting stage)	22-24
Dalatias licha Kitefin shark	?	M: 120(max) F: 160 (max)	?	10-16	?	?	?
Squatina californica Pacific angelshark	≥ 20	M: 75-80(mat) 114 (max) F: 86-108 (mat) 152 (max)	?	10	?	?	?
Alopias superciliosus Bigeye thresher	?	M: 270(mat) F: 300-355 (mat)	?	2-4	?	?	?
Alopias vulpinus Thresher shark	7	491 (max) M: 319 (mat) F: 376 (mat)	?	2-6	?	?	9
Cetorhinus maximus Basking shark	4-5[6] M: 12-16[7] F: 20?[7,8]	M: 500-700 (mat) F: 810-980 (mat) 1000-1300 (max)	12[6]	5	?	2?	12-36?
Carcharodon carcharias Great white shark	M: 9-10 F: 12-14	M: 350-410 (mat) F: 400-430 (mat) 640 (max)	15[9] 23[10]	7-11	?	?	>12?
Isurus oxyrinchus Shortfin mako	M: 2.5[11] M: 9[12] F: 6[11] F: 15[12]	M: 195 F: 280 394 (max)	11-17[11,13] 45[12]	4-16	?	?	?
Lamna nasus Porbeagle shark	4-8 F: 7.5 (max TL)	F: 225 300-365	20[14] 2-30[7] 26[15]	1-5	?	Females may breed annually	8-9
Galeorhinus galeus Tope, school, or soupfin shark	F: 10-15[16] M: 8-10[16]	200 (max TL)	60[16] 40[17]	8-50 mean= 30	?	annually F: every 3 years in Brazil	12
Mustelus antarcticus Gummy shark	4-5	M: 80 (mat) F: 85 (mat) 175 (max)	16[18]	1-38 mean= 14	?	annually in W. Australia 2 years in Bass Strait	11-12
Mustelus mustelus Smoothhound	?	M: 70-74 (mat) F: 80 (mat) 164 (max)	?	4-15	?	?	10-11
Carcharhinus falciformis Silky shark	M: 6-10[19,20] F: 9-12[19,20]	M: 187-217 (mat) 270-300 (max) F: 213-230 (mat) >305 (max)	14-22[19,20]	2-14	?	?	?
Carcharhinus leucas Bull shark	6-8	200 (mat) 320 (max)	M: 16 F: 12	1-13	?	?	10-11
Carcharhinus limbatus Blacktip shark	M: 4-5 F: 6-7	M: 130 (mat) 175 (max) F: >155 (mat) 193 (max)	≥10	2-4	2.2-13.6%	2	11-12
Carcharhinus longimanus Oceanic whitetip shark	F: 4-5[21]	M: 175-195 (mat) F: 80-200	11[21]	1-15	?	?	12

Scientific and common names	Age to maturity (years)	Size (cm TL)	Life span (years)	Litter size	Annual rate of population increase	Reproductive periodicity (years)	Gestation time (months)
Carcharhinus melanopterus Blacktip reef shark	?	95-110 (mat) 140 (max)	?	3-4	?	annually or 2 years	8-9
Carcharhinus obscurus Dusky shark	M: 19[22,23] F: 21[22,23]	F: 280 (mat) 365 (max)	40-45[22] 39[23]	3-14[7]	2.8%	2 or 3	16[7] 22-23[25]
Carcharhinus plumbeus Sandbar shark	13-16[26,27] 29[28]	M: 170 (mat) F: >180 (mat) ~235 max (in US)	21-24[26,27] >35[29] 28[30]	8-13	2.2-11.9% [5.2% if maturity is 29 years]	2	9-12
Galeocerdo cuvier Tiger shark	8-10	M: 310 (mat) F: >310 (mat) 600 (max)	16[31] 50[32]	10-80	?	probably 2 years	12-16
Negaprion brevirostris Lemon shark	11-13	M: 224 (mat) >279 (max) F: 239 (mat) >285 (max)	21[33]	4-17	1.2%	?	?
Prionace glauca Blue shark	M: 4-6[34] F: 5-7[34]	383 (max TL)	20[34] 9-12[13,35]	40	?	females? males mate annually?	9-12
Rhizoprionodon terraenovae Atlantic sharpnose shark	3-4	110 (max)	10	4-6	4.4%	annual	11
Scoliodon laticaudus Spadenose shark	1-2?	M: 24-36 (mat) 58 (max) F: 33-35 (mat) 69 (max)	10-15?	1-14	?	?	?
Sphyrna corona Mallethead shark	?	M: 67 (mat) 92 (max)	?	2?	?	?	?
Sphyrna lewini Scalloped hammerhead	15	M: 150 (mat) F: 212 (mat) 309-420 (max)	?	15-40	?	?	9-12
Sphyrna mokarran Great hammerhead	?	M: 234-269 (mat) >341 (max) F: 250-300 (mat) 482-549 (max)	?	6-42	?	?	11?
Sphyrna tiburo Bonnethead shark	3	M: 52-75 (mat) 124 (max) F: 84 (mat) >130 (max)	12	4-16	0.01-0.27%	annual?	?
Pristis microdon Greattooth or freshwater sawfish	?	700 (max)	?	?	?	?	?
Pristis pectinata Smalltooth or wide sawfish	?	760 (max)	?	15-20	?	?	?
Rhynchobatus djiddensis Whitespotted wedgefish or giant guitarfish	?	M: 110 (mat) >300 (max)	?	?	?	?	?
Raja (*Raja*) *clavata* Thornback skate or ray	5[36]	M: 69 (mat) F: 72 (mat)	23[36]	[52 eggs/ year]	0 or less in North Sea	annual	n/a
Raja (*Dipturus*) *binoculata* Big skate	M: 10-11 F: 12	M: 100-110 (mat) 139 (max) F: >130 (mat) 168 (max)	?	?	?	?	n/a
Raja batis Common skate	11	254 (max) M: 125 (mat)	50	40 eggs	?	annual?	n/a

Key: TL = total length, mat = matured, max = maximum

1 This is a preliminary and abridged version of a similar table that will appear in the IUCN/SSC Action Plan for the Conservation of Sharks. Many of the data presented here are derived from Compagno (1984) with updates for a small number of species.

2 Aasen, O. (1961) Piggsaundersokelsene. *Fiskets Gang, Fisken og Havet*, nr. 1: 36-44.

3 Holden, M.J. & P.S. Meadows (1962) The structure of the spine of the spur dogfish (*Squalus acanthias* L.) and its use for age determination. *J. Mar. Biol. Ass. UK*. 42: 179-197.

4 Ketchen, K.S. (1972) Size at maturity, fecundity and embryonic growth of the spiny dogfish (*Squalus acanthias*) in British Columbia Waters. *J. Fish. Res. Bd. Canada.* 29: 1717-1723.

5 Jones, B.C. & G.H. Green (1977) Reproduction and embryonic development of spiny dogfish (*Squalus acanthias*) in the Strait of Georgia, British Columbia. *J. Fish. Res. Bd. Canada*. 34: 1286-1292.

6 Paker, H.W. & F.C. Scott (1965) Age, size and vertebral calcification in the basking shark, *Ceterhinus maximus* (Gunnerus*). Zool. Med. Deel*. 40(34): 305-319.

7 Compagno, L.J.V. (1984) *Sharks of the World: an annotated and illustrated Catalogue of Shark Species Known to Date.* FAO Fish Synopsis 125. 2 Vols, 655pp.

8 Fowler, S.L. (In prep) Basking Shark Species Account. In Fowler (Ed) *IUCN Chondrichthyan Fishes Action Plan*.

9 Cailliet, G.M., L.J. Natanson, B.A. Welden & D.A. Ebert (1985) Preliminary studies on the age and growth of the white shark, *Carcharodon carcharias*, using vertebral bands. Biology of the White shark. *Mmoirs*, Vol. 9: 49-60.

10 Fergusson, I.K., L.V.J. Compagno, & M.A. Marks (in prep) White shark species account. In Fowler (Ed) *IUCN Chondrichthyan Action Plan*.

11 Pratt Jr, H.L. & J.G. Casey (1983) Age and growth of the Shortfin mako, *Isurus oxyrinchus*, using four methods. *Can. J. Fish. Aquat. Sci*. 40: 1944-1957.

12 Cailliet, G.M., L.K. Martin, J.T. Harvey, D. Kusher & B.A. Welden (1983) Preliminary studies on the age and growth of blue, *Prionace glauca*, common thresher, *Alopias vulpinus*, and shortfin mako, *Isurus oxyrinchus*, sharks from Californian waters. In Prince, E.D. & I.M. Pulos (Eds) *Proceedings of the international workshop on age determination of oceanic pelagic fishes: Tunas, billfishes and sharks*, NOAA Technical Report, NMFS 8: 179-188.

13 Cailliet, G.M. & D.W. Bedford (1983) The biology of three pelagic sharks from California waters and their emerging fisheries: a review. *Cal. COFI Rep*. Vol. XXIV: 57-69.

14 Aasen, O. (1963) Length and growth of the Porbeagle (*Lamna masus*, Bonnaterre) in the North West Atlantic. *Fiskdir. Skr. Ser. Havunder*. 13(6): 20-37.

15 Gould, J.A. (1989) Records of porbeagles landed in Scotland, with observations on biology, distribution and exploitation of the species. *Scottish Fisheries Research Report No. 45*.

16 Steven, J. (in prep) Tope account. In Fowler (Ed) *IUCN Chondrichthyan Fishes Action Plan*.

17 Ferreira, B.P. & C.M. Vooren (1991) Age, growth and structure of vertebra in the school shark *Galeorhinus galeus* (Linnaeus, 1758) from southern Brazil. *Fish. Bull*. 89: 19-31.

18 Moulton, P.L., T.I. Walker & S.R. Saddlier (1992) Age and growth studies of gummy shark, *Mustelus antarcticus* Gunther, and school shark, *Galeorhinus galeus* (Linnaeus) from southern Australian waters. *Aust. J. Mar. Freshwater Res*. 43: 1241-1267.

19 Branstetter, S. (1987) Age, growth, and reproductive biology of the silky shark, *Carcharhinus falciformis*, and the scalloped hammerhead, *Sphyrna lewini* from the northwestern Gulf of Mexico. *Environ. Biol. Fish*. 19(3): 161-173.

20 Bonfil, R., R. Mena & D. Anda (1993) Biological parameters of commercially exploited silky sharks, *Carcharhinus falciformis*, from the Campeche Bank, Mexico. *NOAA Tech. Rep*. NMFS 115: 78-85.

21 Seki, T., T. Tariuchi, M. Shimizu, and H. Nakano (in prep) *Age growth and reproduction of the oceanic whitetip shark from the North Pacific*.

22 Sminky, T.R. (1996) Demographic analysis of natural and exploited populations of three large coastal sharks. Document SB-III-8 in *1996 report of the Shark Evaluation Workshop, June 1996*. Southeast Fisheries Science Centre, Miami, Fl, 5pp.

23 Natanson, L.J., J.G. Casey, and N.E. Kohler (1995) Age and growth studies for the dusky shark, (*Carcharhinus obscurus*) in the western North Atlantic Ocean. *Fish. Bull.*93(1): 117-126.

24 Cortes, E. (In press) Demographic analysis as an aid in shark stock assessment and management. *Fisheries Research.*

25 Gulf and South Atlantic Fisheries Development Foundation (1966) Commercial shark fishery observer programme, *MARFIN final Report.* Tampa, Fl, 33pp+figs & tables.

26 Casey, J.G., H.L. Pratt Jr., C.E. Stillwell (1985) Age and growth of the sandbar shark (*Carcharhinus plumbeus*) from the western North Atlantic. *Can. J. Fish. Aqua. Sci.* 42: 963-975.

27 Sminkey, T.R. & J.A. Musick (1995) Age and growth of the sandbar shark, *Carcharhinus plumbeus*, before and after population depletion. *Copeia*, 1995(4): 871-883.

28 Casey, J.G. & L.J Natanson (1992) Revised estimates of age and growth of the sandbar shark (*Carcharinus plumbeus*) from the western North Atlantic. *Can. J. Fish Aquatic Sci*. 49: 1474-1477.

29 Sminkey, T.R. & J.A. Musick (1996) Demographic analysis of sandbar sharks in the western North Atlantic. *Fishery Bulletin* 94: 431-470.

30 NOAA (1994) *The Shark Tagger 1993 Summary. Newsletter of the Cooperative Shark Tagging Programme*. NOAA National Marine Fisheries Service, Narranganset, USA.

31 Branstetter, S., J.A. Musick & J.A. Colvocoresses (1987) A comparison of the age and growth of the tiger shark, *Galeocerdo cuvieri*, from off Virginia and from the northwestern Gulf of Mexico. *Fish. Bull.* 85(2): 269-279.

32 Simpendorfer, C. (in prep) Tiger shark account. In Fowler (Ed) *IUCN Chondrichthyan Fishes Action Plan*.

33 Brown, C.A. & S.H. Gruber (1988) Age assessment of the lemon shark *Negaprion brevirostris* using tetracycline validated vertebral centra. *Copeia* 1988: 743-753.

34 Steven, J. (in prep) Blue shark account. In Fowler (Ed) *IUCN Chondrichthyan Fishes Action Plan*.

[35] Tanaka, S., G.M. cailliet & K.G. Yudin (1990) Difference in growth of the blue shark, *Prionace glauca*: Technique or population? NOAA Tech. Rep. 90: 177-187.

[36] Ryland, J.S. & T.O. Ajayi (1984) Growth and population dynamics of three *Raja* species (Batoidei) in Carmarthen Bay, British Isles. *J. Cons. Inst. Explor. Mer.,* 41: 111-120.

Doc. 10.51 Annex 2(b)

Ecology of Some Chondrichthyan Species Subject to International Trade or of Special Conservation Concern

(Note: This is a preliminary and abridged version of a similar table that will appear in the IUCN/SSC Action Plan for the Conservation of Sharks. Much of the information presented here is derived from Compagno (1984) with updates for a small number of species)

Scientific and Common Names	Distribution	Habitat Information	
	cosmopolitan, wide-ranging, regional, country endemic, localized, restricted	pelagic, demersal	insular, oceanic, bathyal (>200m), coastal (shore-200m), reef, mangrove, estuarine, freshwater
Notorynchus cepedianus Broadnose sevengill shark	wide-ranging in temperate waters	demersal	coastal
Squalus acanthias Spiny or piked dogfish or spurdog (NW Atlantic population)	cosmopolitan in temperate to subarctic waters	demersal	coastal
Dalatias licha Kitefin shark	wide-ranging in warm temperate to tropical waters	demersal	bathyal
Squatina californica Pacific angelshark	localized in cold to warm temperate waters	demersal	coastal
Alopias superciliosus Bigeye thresher	wide-ranging in temperate to tropical waters	demersal-pelagic	coastal to oceanic
Alopias vulpinus Thresher shark	cosmopolitan in warm waters	pelagic	coastal to oceanic
Cetorhinus maximus Basking shark	wide-ranging in temperate to boreal waters	pelagic	coastal
Carcharodon carcharias Great white shark	wide-ranging in temperate to boreal waters	pelagic	coastal-oceanic
Isurus oxyrinchus Shortfin mako	cosmopolitan	pelagic	oceanic, sometimes coastal
Lamna nasus Porbeagle shark	wide-ranging	pelagic and demersal	coastal and oceanic
Galeorhinus galeus Tope, school, or soupfin shark	wide-ranging	demersal, sometimes pelagic	coastal (but down to 800m)
Mustelus antarcticus Gummy shark	endemic (temperate Australia)	demersal	coastal
Mustelus mustelus Smoothhound	localized	demersal	coastal
Carcharhinus falciformis Silky shark	wide-ranging in temperate and tropical waters	pelagic	coastal-oceanic
Carcharhinus leucas Bull shark	wide-ranging in sub-tropical to tropical waters	pelagic	coastal into estuaries and freshwater
Carcharhinus limbatus Blacktip shark	cosmopolitan in warm-temperate to tropical waters	pelagic	coastal
Carcharhinus longimanus Oceanic whitetip shark	cosmopolitan	pelagic	oceanic, insular
Carcharhinus melanopterus Blacktip reef shark	widespread (Eastern hemisphere)	demersal	insular (reefs)
Carcharhinus obscurus Dusky shark	wide-ranging in sub-tropical and temperate oceans	coastal-pelagic	coastal
Carcharhinus plumbeus Sandbar shark	wide-ranging in tropical and temperate oceans	pelagic	coastal, oceanic

Scientific and Common Names	Distribution	Habitat Information	
	cosmopolitan, wide-ranging, regional, country endemic, localized, restricted	pelagic, demersal	insular, oceanic, bathyal (>200m), coastal (shore-200m), reef, mangrove, estuarine, freshwater
Galeocerdo cuvier Tiger shark	cosmopolitan in tropical and subtropical waters	coastal-pelagic	coastal
Negaprion brevirostris Lemon shark	regional	demersal	coastal, insular and reefs
Prionace glauca Blue shark	cosmopolitan	pelagic	oceanic, sometimes coastal
Rhizoprionodon terraenovae Atlantic sharpnose shark	wide-ranging in warm temperate to tropical Atlantic	demersal	coastal
Scoliodon laticaudus Spadenose shark	regional (Asian waters)	demersal?	coastal
Sphyrna corona Mallethead shark	regional (eastern Pacific)	demersal-pelagic?	coastal
Sphyrna lewini Scalloped hammerhead	wide-ranging in warm temperate to tropical waters	pelagic	coastal-oceanic
Sphyrna mokarran Great hammerhead	wide-ranging in tropical waters	demersal-pelagic	coastal-oceanic
Sphyrna tiburo Bonnethead shark	regional	demersal	coastal and reefs
Pristis microdon Greattooth or freshwater sawfish	localized	demersal	freshwater
Pristis pectinata Smalltooth or wide sawfish	wide-ranging (disjunct)	demersal	coastal and freshwater
Rhynchobatus djiddensis Whitespotted wedgefish or giant guitarfish	wide-ranging in tropical waters	demersal	coastal
Raja (*Raja*) *clavata* Thornback skate or ray	wide-ranging in temperate waters	demersal	coastal
Raja (*Dipturus*) *binoculata* Big skate	regional (Pacific)	demersal	coastal
Raja batis Common skate	regional, cool temperate to boreal waters	demersal	coastal