Sharks: Conservation, Fishing and International Trade

Norma Eréndira García Núñez

GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

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MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO

2008

Ministerio de Medio Ambiente y Medio Rural y Marino.
Catalogación de la Biblioteca Central

GARCÍA NÚÑEZ, NORMA ERÉNDIRA
Tiburones: conservación, pesca y comercio internacional = Sharks: conservation, fishing and international trade / Norma Eréndira García Núñez. — Madrid: Ministerio de Medio Ambiente y Medio Rural y Marino, 2008. — 236 p. : il. ; 30 cm
ISBN 978-84-8320-474-0
1. TIBURON 2. ESPECIES EN PELIGRO DE EXTINCION 3. COMERCIO INTERNACIONAL 4. ECOLOGIA MARINA I. España. Ministerio de Medio Ambiente y Medio Rural y Marino II. Título
639.231
597.3

Cita: García Núñez, N.E. 2008, ***Tiburones: conservación, pesca y comercio internacional.*** Edición bilingüe. Ministerio de Medio Ambiente, y Medio Rural y Marino, Madrid. 117 pp.

Citation: García Núñez, N.E. 2008. ***Sharks: Conservation, Fishing and International Trade***. Bilingual edition. Dirección General para la Biodiversidad. Ministerio de Medio Ambiente, y Medio Rural y Marino, Madrid. 111 pp.

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Foto de portada: Pescadores artesanales cargando un tiburón toro *Carcharhinus leucas* capturado frente a las costas de Salina Cruz, Oaxaca, en México (Maribel Carrera y Felipe Galván).

Cover photo: Artisanal fishermen carry a bull shark *Carcharhinus leucas* caught off Salina Cruz, Oaxaca, in México (Maribel Carrera & Felipe Galván).

MINISTERIO DE MEDIO AMBIENTE Y MEDIO RURAL Y MARINO

Secretaria General Técnica: Alicia Camacho García. **Subdirector General de Información al ciudadano, Documentación y Publicaciones:** José Abellán Gómez. **Director del Centro de Publicaciones:** Juan Carlos Palacios López. **Jefa del Servicio de Producción y Edición: Mª** Dolores López Hernández. **Dirección Técnica del Proyecto:** Manuel María Calderón Moreno **(MARM)**, Emetro Ruiz Richi **(ATECMA. S.L.) Autores fotos de Portada:** Maribel Carrera y Felipe Galván

Edita:

Secretaría General Técnica
Centro de Publicaciones

Distribución y venta:
Paseo de la Infanta Isabel, 1
Teléfono: 91 347 55 51 - 91 347 55 41
Fax: 91 347 57 22

Maquetación, Impresión y Encuadernación:
EGRAF, S.A. Comunicación Grafica

Plaza San Juan de la Cruz, s/n
Teléfono: 91 597 60 81
Fax: 91 597 66 01
Tienda virtual: www.marm.es
e-mail: centropublicaciones@marm.es

NIPO: 770-08-114-4
ISBN: 978-84-8320-474-0
Depósito Legal: M. 53124-2008
Catálogo General de publicaciones oficiales:
http://www.060.es (servicios en línea / oficina virtual/Publicaciones)

Impreso en papel reciclado al 100 % totalmente libre de cloro.

Datos técnicos: Formato: 21 x 29,7 cm. Caja de texto: 16 x 24,5 cm. Composición: una columna. Tipografía: Arial a cuerpos 11 y 8. Encuadernación: Rústica cosida. Papel: Interior en cyclus print de 115 g. Cubierta en cyclus print de 350 g. Tintas: Cubierta a 4/0 colores. Interiores a 4/4 colores. Plastificado mate de la cubierta.

Pious harpooneers never make good voyagers—it takes the shark out of 'em; no harpooneer is worth a straw who ain't pretty sharkish.

HERMAN MELVILLE

Moby Dick; or The Whale, 1851.

Cuando izaron el copo y la cubierta se llenó de pesca, Simón Orozco decidió quedar al garete durante una hora, hasta que se hiciese la selección del pescado y se devolviese al mar su basura. Ya era de noche (...). Paleaban la basura Artola y Ugalde. Fosforecía la mar. Las cailas y su clan subieron de las profundidades, pegándose a los costados del barco. Las cailas se dejaban mecer por las aguas, casi en la superficie, esperando que las paletadas de pesca les llegasen hasta la puntiaguda cabeza; entonces abrían la boca y la cerraban automáticamente. La paletada desaparecía entre sus mandíbulas.

IGNACIO ALDECOA

Gran Sol, 1957.

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Foreword

When I was asked by the managers of the Project that was the seed of this book to prepare a foreword for it, it was an honour and a great pleasure for me. What I could not imagine at the time was that it would also signify various difficulties. Although I had at first conceived several ideas to include in these paragraphs, one by one they fell into pieces as I realised they were all faithfully captured in the following text, in a style that was hard to overcome – a circumstance, on the other hand, easy to understand, given the hours of work that hide behind each piece of text. But somehow I must begin.

Back in the beginning of this century, the foremost debate in the review of criteria for including species in the appendices of the Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES) was focused on those that would govern “aquatic species subject to commercial exploitation”: in one word, fishing. In some way, every piece that is now being assembled upon the best management and trade practices for shark species was already on the floor for international debate. It appeared both necessary and unavoidable, conditions persuasive enough to get our hands to work.

The Ninth Conference of the Parties to CITES, held in Fort Lauderdale, USA, in 1994, was the starting point for shark issues in CITES. A document presented by the USA in that forum originated a Resolution directed to the Animals Committee of the Convention, by means of which a Working Group was established. Eversince, this Group has not ceased to deliver information and results considered positive indeed by the Conference of the Parties. At that time FAO participated already in the debates and considerations about sharks that were held in the framework of CITES. This machinery, involving Parties to the Convention, the Animals Committee and the *ad hoc* Working Group together with other stakeholders, has recently produced 17 Decisions on sharks during the 14th Meeting of the Conference of the Parties, held in June 2007. The Conference had seldom adopted such an amount of Decisions at once regarding one single subject.

Sharks are present in CITES, therefore, regardless the number of species included in the appendices, scarcely ten. But this remarkable animal group bursting in the Convention has a qualitative rather than quantitative importance. On one hand, they have peculiar biological and ecological characteristics, they are marine, they are subject to big scale commercial exploitation (despite of which there are many more questions than certainties about them), basic information on catches and landings is lacking… and it is in this scenario that non-detriment findings must be prepared. Oddly enough, and due to the unavoidable globalisation, the acronym “NDF” has crossed the borders of language and is now used for referring to such findings even in Spanish.

Non-detriment findings (NDF) are the tool through which CITES authorities must guarantee that international trade will not pose a threat for the survival of a particular species. This book attempts to lay the foundations for making NDF for sharks. In 2002 IUCN developed a proposal for making NDF, based on 26 criteria which consider biology, management, protection measures, consequences of trade and, among other factors, the quality and certainty of the available information for a species. But those guidelines are general; it is advisable to adapt them and fix them for different animal and plant groups.

This work, and hence the difficulty of writing a foreword for it, tackles in a thorough and well structured way all the crucial elements to make NDF, although for obvious reasons it should be further developed. The author has built a weft based on information, sources, fisheries organisations and managers and the need for sustainability compulsory for CITES, which create the ideal framework for making NDF. But this task cannot be accomplished by CITES authorities themselves. CITES needs fisheries science and fisheries scientists in order to guarantee that NDF are made correctly. They either have the information or know which bits we are lacking. The need of the findings, the way

CITES sees it, is an optimum opportunity for putting all that information to the service of the sustainable use of shark resources, as well as to tackle the challenge of unravelling what we do not know and need for achieving reasonable and sustainable fishing.

The inclusion of sharks in CITES suffers constant attacks from the fisheries sector exactly due to the lack of information around most fisheries, to illegal, unreported and unregulated catches and trade, to the limitations that CITES may pose for the fishing industry. But it is precisely on information, on the legalisation and control of practices where CITES works, implementing only those limitations which are necessary to maintain trade in the long term. In this framework, CITES wants to share (and ask for) everything that is available for making the best NDF. CITES understands that it is an interesting, attractive, but above all necessary challenge, from the scientific, legal and enforcement points of view for those regulations adopted by, remember, 173 countries which are currently Parties to the Convention.

Having said that, apart from discussing the issue of sharks and CITES, this book also introduces us to the biology and ecology of these species, explaining why they are so sensitive to overfishing, and it guides us through other international fora which deal with conservation and sustainable use of sharks around the world, be it from the point of view of the conservation of cartilaginous fish populations and their role in the marine ecosystem (such as IUCN, Bonn Convention, Barcelona Convention, OSPAR or HELCOM), or from the view provided by the exploitation of this biological resource (such as regional fisheries organisations). Having both approaches, we end up with a broad and up-to-date view, complementary to that of other publications more focused on assessing the conservation status or on analysing fisheries management of elasmobranch populations.

Carlos Ibero Solana

Acknowledgements

We would like to deeply thank Ramón Bonfil (Fisheries Consultant and Shark Ecologist), Marcello Vasconcellos (FAO), Rod Hay (CITES Animals Committee), David Morgan (CITES Secretariat), Henk Eggink (CITES Team of the European Commission), Luis Gil de Sola (Malaga Oceanographic Centre-Instituto Español de Oceanografía), and Sarah Fowler (IUCN SSC Shark Specialist Group), who kindly reviewed the drafts of this paper and provided useful and helpful assistance, as well as valuable insights and proposals for improving this work.

Thanks to Carlos Ibero, too, for carefully reviewing the Spanish version of the manuscript.

And last but not least, thanks are also due to Mauricio Hoyos, Felipe Galván, Maribel Carrera, Carlos Polo-Silva (all from Centro Interdisciplinario de Ciencias Marinas, CICIMAR-IPN), Deni Ramírez (Centro de Investigaciones Biológicas del Noroeste, CIBNOR) and Roberto Chavez-Arce (Buceo Vallartech), for providing many (and the best) of the images illustrating this work.

Note on Terminology

In this work, the term ***shark*** is used to refer not only to the different species of sharks but also to other closely related taxa, such as rays, skates, and chimaeras (rat, rabbit and elephant fish), that is, to all cartilaginous fish, Class Chondrichthyes. Such use of the term is generally used in international fisheries policy documents, including the United Nations Food and Agriculture Organization International Plan of Action for the Conservation and Management of Sharks, CITES documents and other papers referenced here. On the same line, **shark catch** is taken to include directed, bycatch, commercial, recreational and other forms of taking sharks from the wild.

Abbreviations and Acronyms used

AC	CITES Animals Committee
APEC	Asia-Pacific Economic Cooperation
CCAMLR	Commission on the Conservation of Antarctic Marine Living Resources
CFP	Common Fisheries Policy of the European Union
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on Migratory Species (Bonn Convention)
COFI	FAO's Committee on Fisheries
CoP	Conference of the Parties to the Convention
CPC	Contracting and Non-Contracting Cooperating Parties
EEZ	Economic Exclusive Zone (usually 200 nautical miles from the coast)
FAO	Food and Agriculture Organization of the United Nations
GFCM	General Fisheries Commission for the Mediterranean
IATTC	Inter-American Tropical Tuna Convention
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
IGO	Intergovernmental Organisations
IOTC	Indian Ocean Tuna Commission
IPOA-Sharks	FAO’s International Plan of Action for the Conservation and Management of Sharks
IUCN	International Union for the Conservation of Nature and Natural Resources - The World Conservation Union
IUU fishing	Illegal, Unregulated and Unreported fishing
NAFO	Northwest Atlantic Fisheries Organisation
NDF	Non-Detriment Findings
NEAFC	North East Atlantic Fisheries Commission
NGO	Non-Governmental Organisations
NPOA	National Plan of Action, within the framework of FAO’s IPOA-Sharks
OLDEPESCA	Latin American Organization for Fishery Development
PoC	Province of China, when referring to Taiwan
RFMO	Regional Fisheries Management Organisation
SAR	Special Administrative Region, when referring to Hong Kong, China
SCRS	ICCAT’s Standing Committee on Research and Statistics
SEAFO	South East Atlantic Fisheries Organisation
SSC-IUCN	Species Survival Commission of The World Conservation Union
SPC	South Pacific Commission
SSG	IUCN’s Shark Specialist Group
TED	Turtle Excluder Devices, sometimes used in trawl fisheries.
UNCLOS	United Nations’ Convention on the Law of the Sea
UNEP-WCMC	World Conservation Monitoring Centre of the United Nations Environment Programme
UNFSA	United Nations Fish Stocks Agreement

Executive Summary

Sharks are an evolutionary successful group of almost 1 200 living species, superbly adapted to a variety of habitats. But their biology is not well known; information on life history, reproductive biology and population dynamics is available only for some commercially exploited species. Those shark species for which age and growth have been estimated and verified generally exhibit strongly K-selected life history strategies, which has serious implications for the sustainability of fisheries, by limiting their capacity to sustain and recover from declines. Furthermore, many species have geographical distributions which cross international boundaries, resulting in individual populations being harvested by multinational fisheries. The contribution of bycatch and discards to overall shark mortality is also calculated to be very important. According to the IUCN Red List of Threatened species, 126 shark species (over 21% of those assessed by 2007) are currently considered as threatened.

Since World War II there has been a steady growth in shark fisheries, resulting from an overall intensification of marine fisheries and increasing human populations worldwide. Many shark species are affected by fishing around the world; still, there is a general lack of adequate data required for making proper shark fisheries management decisions. Reporting should include catch, bycatch, discard and landings data by species and by weight. Illegal, unreported and unregulated fishing is another major problem.

Fishing pressure on sharks has increased because of their rising economic value, due in turn to the growing demand for their products. These include meat, skins, liver oil, fins, cartilage, jaws and teeth. Live sharks are also captured for the ornamental fish trade and public aquaria. Other shark uses are non-consumptive, such as various ecotourism operations. Between 1950 and 2000 there has been more than a three fold increase (220%) in reported catch of sharks. Exports totalled 86 500 tonnes in 2003, with a value of US$249 million. The trade of the product with highest market value, fins, grew by 5% per year from 1995 until 2000.

As a consequence of the variety of threats faced by shark populations worldwide, several institutions and organisations have recognised the requirement for shark conservation through multilateral agreements and initiatives, such as the FAO IPOA-Sharks, fishing regulations implemented by regional fisheries management organisations and actions by international conventions.

As part of its permit system regulating international trade in specimens of wild species, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) requires that a Scientific Authority of the exporting country prepares Non-Detriment Findings (NDF). Scientific Authorities are, therefore, continually challenged to define whether exports will be detrimental to the survival of a species. Currently, ten shark species are listed: six sawfishes *Anoxypristis cuspidata, Pristis clavata, P. pectinata, P. perotteti, P. pristis* and *P. zijsron* are listed in Appendix I, while the whale shark *Rhincodon typus*, the great white shark *Carcharodon carcharias*, the basking shark *Cetorhinus maximus* and the freshwater sawfish *P. microdon* are included in Appendix II.

Since CITES does not provide specific guidance on the making of NDF by Scientific Authorities, efforts have been made to develop some practical assistance for this process. This lack of clear guidance has been stated by some Parties as a reason for not listing shark species in the CITES Appendices. To date, NDF have seldom been made for sharks.

An NDF should focus on whether the status of a shark population is good, fair or bad, and based on this, assess if trade is likely to be promoting an undesirable level of exploitation. However, conservation and management of shark populations has always been a complicated issue, even more than in other commercial fisheries. Some of the main components to consider when assessing the possible detrimental effect of fishing on shark populations are:

1. their particular life-history strategies,
2. the existence of migratory and straddling stocks,
3. their position in marine ecosystems as top predators, and
4. the tendency of many shark species to have coastal nursery areas, where gravid females, newborns and early juveniles are easily targeted by fisheries.

Management for shark species should ideally be based upon expert stock assessments and scientific advice on sustainable fisheries harvest levels. The ideal process should also allow Scientific Authorities to compare their findings with those made in other countries for similar species or similar commodities in trade.

The main problem is that, although good fisheries management tools have been developed, population characteristics of CITES listed shark species, along with many other aspects of their biology and ecology, are not well understood. Furthermore, data are often incomplete and biased. Nevertheless, some fundamental considerations when making NDF for shark species are suggested and general guiding principles on how to make NDF for sharks are proposed:

a. Ideally, each shark population should be considered separately when making NDF, in order to better assess the impact that harvest would have on that population, and how it could interact with other populations in response to fishing pressure.

b. The level of depletion of the stock should be known: the levels of mortality (intentional, unintentional and natural) and the proportion mortality/production. Once the status of the population is known, the extent to which trade demand may increase or diminish fishing mortality should be assessed.

c. The implementation of effective management plans at the regional, national and local levels, using modelling tools and other available methodologies, will fulfil many of the requirements of an NDF.

d. Where appropriate management schemes are in place, and they include population and habitat monitoring, a long term positive determination can be adopted when making NDF. If not, a case-by-case analysis must be developed.

e. Relevant domestic factors that potentially affect shark take should be considered, particularly if a long-term determination is to be made.

f. Peer review and sharing of NDF methodologies for sharks and other marine species is encouraged.

g. Export quotas are not recommended as a method for keeping international trade on levels that are safe for shark populations.

Other proposals for improving conservation and management of sharks, and therefore facilitating the process of making NDF include: adaptive management based on adequate monitoring and appropriate feedback; compilation of accurate, relevant and timely data in a standard form that makes it comparable; coordination among fleets and through FAO, other IGO, RFMO and international conventions (including CITES and CMS); improvements in reporting and data quality; improvements in trade monitoring, identifying shipments of shark products at the species level; careful follow-up on the implementation of the IPOA-Sharks; and improving communication, both at the international level (among States, IGO, RFMO and international conventions) and within States (among Fisheries Departments and CITES Authorities), in order to enhance the positive effects that isolated actions could have on the conservation and management of sharks.

The Animals Committee of CITES has identified several sharks as species of concern that may require consideration for inclusion in the Appendices if their management and conservation status does not improve. Beyond the additional paperwork and increased reporting burden that the potential inclusion of some such species in the Appendices would represent, it is worth highlighting that CITES permits and reporting requirements would be a regulation equally applicable to all Parties to this Convention (currently 173 States). This would benefit those fleets with the best fishing practices, as well as significantly undermine both IUU shark fishing and disloyal competitor fleets which are not subject to strict fishing regulations. Eventually, it would lead towards the adoption of formal rules that governed access and use to this valuable marine resource worldwide, resulting in obvious advantages for the conservation and sustainable use of wild shark populations.

Introduction

Sharks, skates, rays, guitarfishes, sawfishes and chimaeras are all grouped into the Chondrichthyans, a Class encompassing all cartilaginous fishes, also called elasmobranchs (the sharks and batoids) and holocephalans (chimaeras). There are between 954 and 1 168 living species in at least nine orders, 57 families and 182 genera (Compagno *et al.* 2005). Sharks' general body plans and life history strategies have been so successful that they have remained almost unchanged for over 400 million years. Populations of these species are generally less abundant relative to those of most teleosts (bony fishes).

Most large sharks are apex predators occupying the tops of marine trophic chains. Sharks have a wide variety of prey: other fish species (even smaller sharks), marine mammals, benthic animals (including polychaetes, amphipods, bivalve molluscs) and reptiles (sea turtles), although some are scavengers and some others, such as the whale shark *Rhincodon typus* or the basking shark *Cetorhinus maximus,* are plankton feeders. Still, and despite the extensive existing literature on the food habits of sharks, comparatively little is known of the dynamic function they serve in their ecosystems (Cailliet *et al*. 2005). Also, information on the life history and reproductive biology of sharks is only available for few species, mainly those that are subject to important fisheries.

Most shark species live at sea, but some live in estuaries or even freshwater lakes and rivers. They are superbly adapted to a variety of habitats; different shark species can be found in shallow, bathyal and abyssal waters; benthic, pelagic, inshore or offshore environments (Compagno *et al.* 2005).

Sharks are generally long-lived animals (mostly 10-30 years, although species such as the spiny dogfish *Squalus acanthias* can live up to 70 years (Lack 2006)) and take a long time to reach maturity. Small species such as the Australian sharpnose shark *Rhizoprionodon 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, specimens of most species cannot be aged reliably without extensive research, even when using relatively simple methods such as the count of growth rings in calcified structures.

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. Shark reproductive strategies are appropriate and successful in an environment where the main natural predators are large sharks. They are usually slow-growing creatures who reach maturity at rather late age, producing small numbers of large and well-developed young. This K-strategy is characteristic of species with low natural mortality and few natural predators, which can be highly successful under natural conditions. However, this also imposes limits on reproductive productivity, which together with a tendency exhibited by many species of sharks to aggregate by age and sex, renders some species vulnerable to over exploitation in the absence of careful management.

Thus, sharks are prone to overfishing, local extirpation and population collapse if mortality rates overcome productivity, and are normally slow to recover even when conservation and fisheries management measures are introduced. As a result, many shark stocks are now depleted and some species are considered to have a heightened risk of extinction, mostly as a consequence of the rapid and largely unregulated growth of target and bycatch fisheries.

Other threats to shark stocks include depletion of their prey species and habitat loss, mainly through coastal development and pollution. Coastal species have been impacted by habitat degradation due to human activities, such as coastal urbanisation and bad fishing practices. Estuarine species are affected by the destruction of marsh and mangrove habitats, which are often nurseries for many commercially exploited species. Freshwater species have been affected by the construction of dams, deforestation, eutrophication and chemical pollution. Offshore species are often buffered from most human-induced habitat degradation. Yet, as other shark species do, they must still face the major threat of overfishing. Finally, there is a risk of pollutants bioaccumulating in their bodies, due to their position in food chains.

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. However, the increased international demand for shark products in recent years has resulted in higher levels of exploitation of some shark species. Between 1990 and 2003, reported shark catch increased by 20% and exports of shark products doubled (Lack & Sant 2006b). These estimates are, however, likely to underestimate shark catches significantly, as they are based on incomplete catch data, take no account of mortality arising from discards and, in relation to trade, do not necessarily reflect all shark products traded. Expanding global fisheries, whether directed or incidental, is a major factor influencing shark populations.

Keeping a record of the effects of fishing activities on shark populations is not an easy matter. Although fisheries statistics have been recorded for decades in several countries, landing records on shark catches are usually imprecise due to a variety of reasons. In most catch records, shark species often appear grouped, which makes it difficult to determine the fishing pressure on a single species. Customs codes for recording international trade on sharks, products and derivatives may also differ among countries, making it difficult to trace trade volumes and hence their effect in the status of wild populations. On a different focus, existing biological and environmental data are often insufficient to develop proper research and management. An additional difficulty comes regarding transboundary, straddling, highly migratory and high seas stocks, since coordination between countries is essential for the adequate collection of relevant information. Finally, many of the fisheries catching sharks are not species-specific, extracting species with a range of life-history characteristics, each of which would benefit from a particular management approach. All these factors cause significant problems in the adequate conservation and management of sharks, often (and not surprisingly) resulting in unsustainable shark fisheries.

From a total of 591 chondrichthyan species evaluated for the Red List of Threatened Species, over 21% have been assessed as Threatened (Critically Endangered, Endangered or Vulnerable, see Annex I), 44% as Least Concern and nearly 35% as Data Deficient (IUCN 2007). There are well-documented cases of collapsed shark fisheries, such as the porbeagle *Lamna nasus* fishery in the North Atlantic, the tope or soupfin shark *Galeorhinus galeus* fishery off California and Australia, various basking shark *Cetorhinus maximus* fisheries, the spiny dogfish *Squalus acanthias* fisheries both in the North Sea and off British Columbia, and the large coastal shark fishery off the east coast of the United States of America (Anderson 1990, Campana *et al.* 2001, Ripley 1946, Olsen 1959, Parker & Scott 1965, Holden 1968, Ketchen 1986, Hoff & Musick 1990, Musick *et al.* 1993, NMFS 1999; all in Musick & Bonfil 2005).

Even in the view of such fisheries management failures, and despite increasing concern over the vulnerability of sharks to overexploitation, effective international shark conservation and management remains unsatisfactory. Even where legislation is already in place, enforcement can still pose a significant challenge. At the global level, significant progress has been made through the adoption of the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), created by the United Nations

Food and Agriculture Organisation. Yet, the voluntary nature of its implementation has made this process extremely slow, despite encouragement from CITES Parties.

Also in the United Nations frame, the Convention on the Law of the Sea (UNCLOS) provides for shark populations, promoting the adoption of proper conservation and management measures towards the optimum utilisation of living marine resources, and especially in the case of highly migratory species such as oceanic sharks (UNCLOS 1982).

A few Regional Fisheries Management Organisations (RFMO) have implemented initiatives for better reporting data on shark catches, both directed or as bycatch. In some cases, stock assessments are being developed based on data collected within the normal reporting requirements of certain RFMO.

IUCN-The World Conservation Union is another international body involved in shark conservation, alongside that of many other plant and animal species. It supports and develops conservation science, implements this research in field projects around the world, and then links both research and results to local, national, regional and global policy by convening dialogues among stakeholders, including governments, civil society and the private sector.

IUCN has also developed the Red List of Threatened Species, based on assessments of the conservation status of individual species. Currently, the List recognises 126 shark species as threatened (IUCN 2007, species listed in Annex I). As a complementary approach, IUCN has created, through its Species Survival Commission (SSC, a science-based network of volunteer experts), the Shark Specialist Group (SSG).

Three threatened shark species are currently included in the Appendices of the Convention on Migratory Species (CMS), in recognition of their unfavourable conservation status and need for concerted international protection. In this frame, Parties to the Convention should make their best effort to protect them and preserve their habitats, including the establishment of international cooperation initiatives. Whale shark *Rhincodon typus* was listed on Appendix II in 1999, great white shark *Carcharodon carcharias* on Appendices I and II in 2002, and basking shark *Cetorhinus maximus* on Appendices I and II in 2005 (CMS, 2006). Several other highly migratory shark species exhibit similar characteristics to these species. Those that require concerted international protection may in the future be nominated for inclusion in the CMS Appendices.

Ten of the shark species that enter international trade are listed in the CITES Appendices (Convention of International Trade in Endangered Species of Wild Fauna and Flora). This means that 6 of the 7 sawfish species (family Pristidae) cannot be commercially traded between countries, and that international trade of specimens, parts or derivatives from *Rhincodon typus*, *Cetorhinus maximus, Carcharodon carcharias* and *Pristis microdon* is regulated through the internationally recognised CITES permit system. International trade of specimens of these species shall only be allowed when, among other requisites, a Scientific Authority of the exporting country makes the correspondent Non-Detriment Findings (NDF), a compulsory report stating that trade will not be detrimental to the survival of the species concerned. NDF are made in a case-by-case basis, either for individual shipments or for annual quotas.

The significance of making appropriate NDF is unquestionable. Determining whether the export of a particular shipment is likely to be detrimental to the survival of the species involved is essential to keep international trade at sustainable levels. The key considerations to bear in mind should be: the different factors affecting total mortality (be it intentional, unintentional or natural), the life-history strategy of the species concerned (and, therefore, its productivity), the status of the population being harvested and the extent to which trade may influence commercial demand and, therefore, fishing pressure. According to CITES' principles, if NDF fail to achieve their goal and trade regulation becomes inadequate, species would have to be transferred to Appendix I, prohibiting international commercial trade.

Already a complex issue for terrestrial species, making an NDF for marine species becomes even more complicated. First, knowledge of the marine environment is far from thorough. The exact distribution and population dynamics of many marine species are also unknown. The existence of migratory species adds another important parameter to be considered. Further guidance on NDF for shark species requires additional work. It would also be desirable that the general approach for making NDF be essentially equivalent for all Parties, so that NDF made by different countries could be comparable and hence useful for keeping global international trade of sharks parts and derivatives on sustainable levels.

Action has already been taken to improve the situation and to assist Scientific Authorities in fulfilling their obligations. IUCN-SSC, assisted by the CITES Secretariat, Parties to the Convention and other organisations, convened two workshops in order to develop some practical assistance for Scientific Authorities, which resulted in a checklist system that aims to give orientation to Parties on the technical and biological aspects of making NDF. Other workshops and processes have been developed for particular species or groups of species, such as medicinal plants, agar wood *Aquilaria* sp., and more recently humphead wrasse *Cheilinus undulatus* (Sadovy *et al.* 2007) and bigleaf mahogany *Swietenia macrophylla* (CITES CoP14 Doc.64 Rev.1). However, it is still necessary to continue working based on relevant results and lessons learned with such efforts, in order to facilitate the development of appropriate NDF for shark species by Scientific Authorities.

This paper aims to review the global conservation and management situation of shark species, with an emphasis on CITES, and propose general guidelines for better assessing the effect that harvest due to commercial international trade may have on shark populations. It is not intended to be an exhaustive review, but rather a compilation of existing information on conservation, management, methodologies, tools, data, expertise and other available resources which can be useful for enhancing Parties' capacities to undertake improved NDF for sharks. Shark listings in CITES Appendices are still relatively new, and incorporating new experiences on their implementation, as well as lessons learned on that process, will certainly improve this proposal. Much work remains to be done on this issue, but the results may potentially apply over a broader range of CITES listed marine species.

Biology, Ecology and Conservation of Sharks

Biology

The biology of sharks is among the least known and understood of any major marine animal group. Information on life history, reproductive biology and population dynamics is available only for some of the species that are of commercial importance for fisheries. The main reason for this is the difficulty to collect ecological data for most shark populations, particularly those that are restricted to deepwater habitats or that are sampled only at certain times of the year or stages in the lifecycle, most of the research being therefore fisheries-dependent. Furthermore, fisheries research on sharks is usually of relatively low priority compared with other commercial species.

Feeding. Sharks are predominantly predatory; however, some are also opportunistic scavengers, and some of the largest, such as the whale shark *Rhincodon typus*, basking shark *Cetorhinus maximus* and megamouth *Megachasma pelagios*, as well as manta rays, filter-feed on plankton and small fishes. Predatory sharks are found at or near the top of marine food chains. As a group, sharks have a long evolutionary history as highly successful predatory fishes. Wherever they occur, therefore, their numbers are naturally limited by the carrying capacity of the ecosystem and are relatively low compared to those of most teleost fishes (Camhi *et al.* 1998).

Figure 1. Manta *Manta birrostris*, a typical planktivorous elasmobranch (Photo: Mauricio Hoyos).

In recent years the numbers of studies on their diet, feeding behaviour, feeding mechanisms and mechanics have increased. However, many areas still require additional investigation. Probably due to the relative simplicity of field techniques for making dietary studies, these are generally more abundant than those on feeding activity patterns, and most of the studies are confined to relatively few species, many being requiem sharks (order Carcharhiniformes).

Sharks are generally asynchronous opportunistic feeders on the most abundant prey item, which are primarily other fishes. Studies of natural feeding behaviour are few and many observations of feeding behaviour are based on anecdotal reports. To capture their prey they either ram, suction, bite, filter, or use a combination of these behaviours. Foraging may be solitary or aggregate. Much is known about their morphology, but functional studies are primarily theoretical and await experimental analysis (Mottaa & Wilgab 2001).

Age and Growth. Good age estimates provide valuable information on recruitment, age at maturity, age-specific reproduction and mortality rates, longevity and growth rates of fished populations. Although many age and growth studies have been developed (mainly based on the analysis of growth zones in calcified structures, such as vertebral centra), most shark species have not yet been reliably aged (Cailliet *et al.* 2005). Information on age and growth, however, is basic for achieving proper fishery management. The risks of generalising from limited information are highlighted by the spadenose shark *Scoliodon laticaudus*, which reaches sexual maturity at 1-2 years, while the females of the Pacific population of the spiny dogfish *Squalus acanthias* reach maturity at 23 years old (Fowler *et al.* 2005).

Reproduction. Different shark species show a wide array of reproduction modes, all of which involve considerable maternal investment to produce small numbers of large, fully-developed young. Fertilisation is always internal, and the subsequent embryonic development can be described by one of the following patterns, according to the species (Castro 1983):

Oviparity. The young develop and hatch outside the body of the female. Large, leathery egg cases are usually laid in relatively protected sites.

Ovoviviparity. Also called *aplacental viviparity*. The eggs are retained in the maternal uterus. Embryos grow and develop consuming the egg yolk, and birth occurs after hatching. In some species one of the following forms of matrophagy occurs (Cailliet *et al.* 2005): ingestion of infertile eggs (*oophagy*), ingestion of eggs and smaller embryos (*adelphophagy*) or ingestion of fluids secreted by the uterus (sometimes called uterine milk).

Viviparity. Embryos (either one or more per uterus) are attached to a placenta, and development is nourished by the maternal blood supply.

Depending on the species, female sharks may bear from one to, exceptionally, as many as 300 pups per litter (Camhi *et al.* 1998). 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*. There is no known post-birth parental care; however, sharks have relatively low natural mortality coefficients.

Although some small sharks reproduce annually, many species do not, because mature females have a rest period of one to two years between pregnancies, and/or because gestation periods exceed 12 months, e.g. dusky shark, *Carcharhinus obscurus* (Fowler *et al.* 2005). 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.

Ecology

Habitat. Sharks dwell in a wide range of habitats, including freshwater river and lake systems, inshore estuaries and lagoons, coastal waters, the open sea and the deep ocean. Habitat requirements often vary for different species during different stages of their lifecycles. Most species have a relatively restricted distribution, occurring mainly along continental shelves and slopes and around islands, with some endemic to small areas or confined to narrow depth ranges. Others have disjunct distributions, with many populations occurring in widely separated areas around the world. Many of the latter exhibit little or no genetic exchange between populations, even if migrating stocks appear to overlap. A relatively small number of species are known to be genuinely wide ranging. Among the best studied are the large pelagic sharks, which make extensive migrations. Still, at least some of the deepwater species, such as the Portuguese dogfish *Centroscymnus coelolepis*, may exhibit similar wide-ranging movements, although very few of these have been studied (Cailliet *et al.* 2005). Finally, as a result of their life history strategies, sharks are usually unable to adapt to rapidly changing environmental conditions.

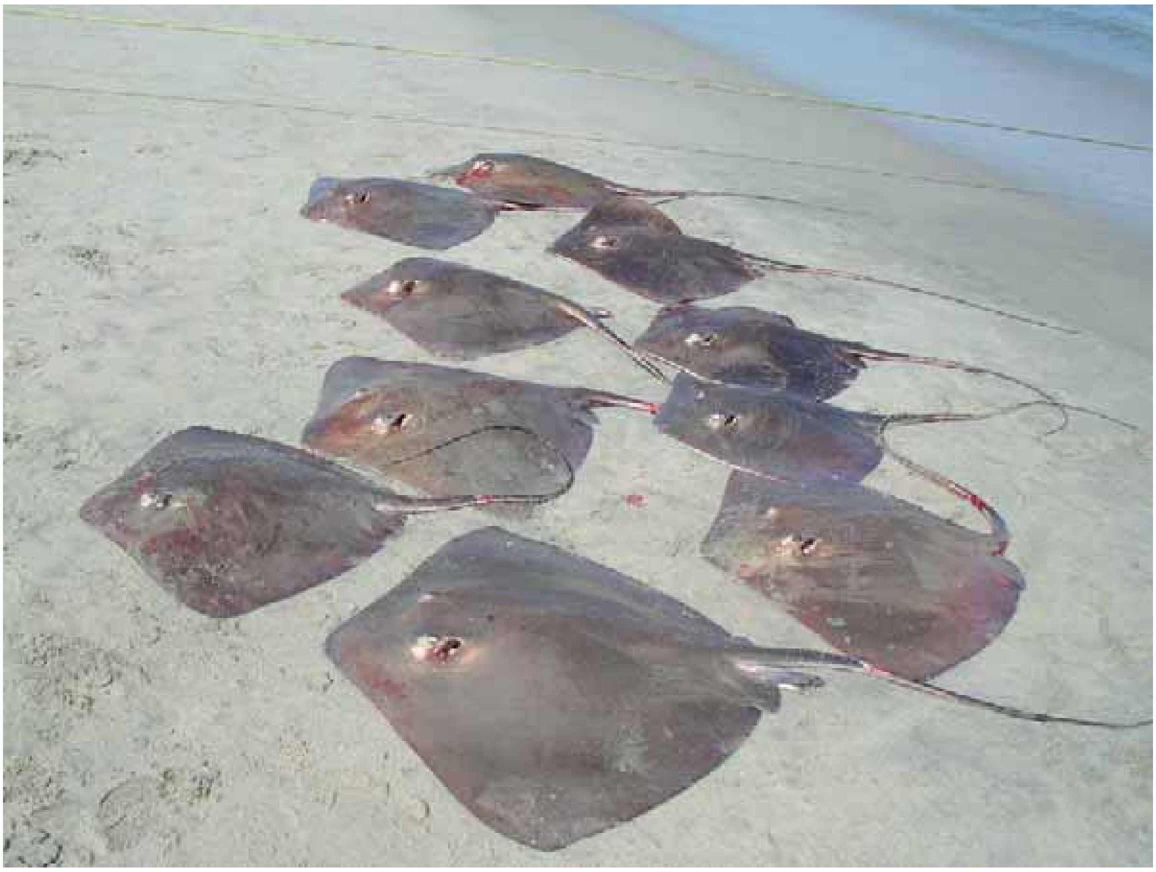

Figure 2. A stingray aggregation caught in the Eastern Pacific Coast. The tendency to aggregate is a characteristic of many shark species that can render them particularly vulnerable to fisheries (Photo: Maribel Carrera & Felipe Galván).

Many shark species tend to aggregate by age, sex and reproductive stage, a characteristic that can render them particularly vulnerable to fisheries. As an example, newborns and juveniles may remain all year around in shallow areas, which provide both abundant food and shelter from predators (Camhi *et al.* 1998). Besides, it is not unusual that sharks give birth in sheltered coastal or estuarine areas known as nursery grounds, where predation risks to the pups (primarily from other sharks) are reduced (Branstetter 1990, in Cailliet *et al.* 2005), or deposit eggs in locations where they are most likely to survive undamaged until hatching.

However, the use of nursery grounds or dependence throughout the lifecycle on coastal, estuarine or freshwater habitats has become a particular danger for sharks. Human activities threaten coastal and estuarine habitats through urban development, fishing activities, chemical and nutrient pollution, freshwater diversion from incoming rivers, garbage dumping and sewage sludge. Destructive fishing activities, such as bottom sea trawling, use of explosives and 'ghost fishing' from lost or abandoned fishing gear also have a direct impact on fish populations and the marine environment.

Life History Characteristics. The life history of an organism is determined by the biological features of its lifecycle and the strategies that influence its survival and reproduction. Studies of parameters such as age and growth, along with basic information on distribution, abundance, migrations, feeding, reproduction and genetics, are essential to understand and predict how populations will grow and how they will respond to fishing pressure. Among existing shark species there is considerable variation in life history parameters.

Those shark species for which age and growth have been estimated and verified generally exhibit strongly K-selected life history strategies (Camhi *et al.* 1998). With few exceptions, sharks exhibit, to a greater or lesser degree:

- slow growth;
- late age at maturity;
- low fecundity and productivity (small, infrequent litters);
- birth of fully-developed young, with a relatively high natural survival rate;
- long gestation periods;
- high natural survivorship for all age classes, and
- long life span.

These reproductive strategies are appropriate and successful in an environment where the main natural predators are other large sharks. K-strategy is characteristic of species with low natural mortality and few natural predators, and can be highly successful under natural conditions. However, these same characteristics, combined with the above mentioned tendency of many shark species to aggregate, render sharks very sensitive to depletion by fishing. Their limited reproductive productivity and, for many species, restricted geographical distribution, severely limit the capacity of populations to sustain fisheries and recover from declines resulting from human activities (Stevens *et al.* 2005).

But not all shark species are slow-growing with low productivity. A few species of sharks, mainly the smaller species, are not as extreme in their life histories as the larger, K-selected species. Species that have shorter lifespans (such as the gummy shark *Mustelus antarcticus* in Southern Australia, with a maximum age of 16 years) are likely to have higher productivity and are better able to sustain commercial fisheries, although they still require careful and conservative management (Cailliet *et al.* 2005).

Unlike many teleost fishes, recruitment of sharks to the adult population is very closely linked to the number of breeding females. This suggests that as mature individuals are fished out, the recruitment of younger fish that will support future generations will also decline, which in turn limits future productivity of the fishery and the capacity of shark populations to recover from overfishing. In this respect, the reproductive potential and strategies of sharks, particularly the larger species, are more closely related to those of the cetaceans, sea turtles and large land mammals and birds than to the teleost fishes

(Musick 1997, Musick 1999, Musick *et al.* 2000; in Cailliet *et al.* 2005). As a result, a very different approach to management than that currently employed for teleosts is required for chondrichthyan fisheries to be sustainable (Stevens *et al.* 2005).

Ecological Role. The ecological role of sharks and their influence on the structure of complex fish communities has only recently been studied as summarised by Cailliet *et al.* (2005), since growing fisheries pressure has disturbed marine ecosystems. In some cases shark abundance increases when bony fishes are removed through fishing, probably due to the decrease in their teleost competitors and predators on young (e.g. Rajidae species *vs.* cod *Gadus morhua* and haddock *Melanogrammus aeglefinus*). In other cases, fishing pressure directed to a single shark species results in seriously diminished stocks (e.g. spiny dogfish *Squalus acanthias* and tope shark *Galeorhinus galeus*). Fishing pressure may also cause declines in the larger species, while smaller species (reaching maturity at an earlier stage) increase in abundance, either due to an increase in food availability or through selective fishing, favouring species with the lowest age at maturity (e.g. skates *Dasyatis laevis, D. batis, D. oxyrhyncus* and *Raja alba*). Conversely, removal of large predatory sharks from tropical ecosystems may result in a decline in numbers of some important commercial fish species, instead of an increase in abundance as might have been expected. This has happened even though the latter were not important prey for the sharks, e.g., removal of tiger sharks *Galeocerdo cuvier* coincided with decreases in tuna. In this particular case, the tuna decline occurred because the sharks kept populations of other predators of these fishes in check.

In general, indirect ecosystem effects induced by predator removal from oceanic food webs remain unpredictable. However, it is widely considered that, as apex predators, the larger species are likely to significantly affect the population size of their prey species, and the structure and species composition of the lower trophic levels of the marine ecosystem. For example, in coastal northwest Atlantic ecosystems populations of small elasmobranch species have increased over the past 35 years, as abundances of great sharks that consume them fell. Effects of this community restructuring have cascaded downward, resulting in the cownose ray *Rhinoptera bonasus* enhancing predation on its bay scallop prey in a scale enough to collapse a century-long scallop *Argopecten (Aequipecten) irradians* fishery (Myers *et al.*, 2007).

Additionally, as top marine predators, long-lived sharks are in significant danger of bioaccumulating pollutants, probably more than most other groups of marine organisms (Walker 1988 and Forrester *et al.* 1972, both in Camhi *et al.* 1998). Adult sharks accumulate such high levels of mercury that some Australian shark fisheries have maximum size limits on sharks landed by commercial fisheries, in order to avoid danger for human consumption (Camhi *et al.* 1998).

Conservation Status

Many shark species are affected by fishing around the world. Some skates, sawfish, and deep-water dogfish have been virtually extirpated from large regions. Other sharks are more resilient to fishing, thanks to their life-history and population parameters. At the species level, fishing may alter size structure and population parameters. Fishing can also affect trophic interactions, causing species replacement and shifts in community composition. It has even been suggested that some shark species could learn to associate trawlers with food, and that feeding on discards may increase their populations (Stevens *et al.* 2000). In either case, further biological knowledge is needed to design adequate management strategies.

Some important international shark conservation and management initiatives have been implemented in recent years. Causes of this are increased awareness of sharks' vulnerability to overexploitation and increasing fishing pressure as other fish stocks have been depleted and shark products have experienced an expansion in demand and rising economic value. A range of organisations have recognised the requirement for shark conservation through multilateral agreements and initiatives, drawing attention to the need to improve the protection afforded to threatened shark species, as well as managing fisheries.

One of them is IUCN, an umbrella organisation of the world's conservation agencies and institutions including both governmental and non-governmental members. It aims to preserve the integrity and diversity of nature, and to ensure that any use of natural resources is equitable and ecologically sustainable. IUCN is known worldwide for developing the above mentioned annually updated Red List of Threatened Species (IUCN 2007), the most comprehensive global approach for evaluating the conservation status of plant and animal species. It can also be used as a tool for measuring and monitoring changes in the status of biodiversity and existing knowledge of the taxa. Although it has no statutory remit, the Red List is useful for focusing attention on species of conservation concern, for determining management priorities to be targeted, and for monitoring the long-term success of management and conservation initiatives. The assessments evaluate the conservation status of individual species, identify threatening processes affecting them and, if necessary, propose recovery objectives for their populations.

Figure 3. Pelagic thresher *Alopias pelagicus*, a species recently added to the IUCN Red List (Photo: Carlos Polo-Silva & Felipe Galván).

The most recent additions of shark species to the Red List show that several species of pelagic sharks, considered to be the fastest and widest ranging, are threatened by overfishing: all three species of thresher sharks *Alopias vulpinus, A. pelagicus* and *A. superciliousus;* longfin mako *Isurus paucus*, porbeagle *Lamna nasus* and great hammerhead *Sphyrna mokarran* are listed under categories considered as threatened. The blue shark *Prionace glauca*, the world's most abundant and heavily fished pelagic shark, stayed as Near Threatened. Scientists noted declines of 50-70% in the North Atlantic and stated their concern over the lack of conservation measures, but could not reach consensus that the species is threatened with extinction on a global scale (SSG 2007, Dulvy *et al*. in press).

IUCN has specifically addressed shark issues through the Species Survival Commission (SSC) and the Shark Specialist Group (SSG). Established in 1991, the SSG aims to promote the long-term conservation of the world's sharks and related species, effective management of their fisheries and habitats, and, where necessary, the recovery of their populations. Its members are experts on elasmobranch research and fisheries management, marine conservation and policy formulation worldwide. The Group is in charge of assessing all shark species (about 1 200) for the Red List. To date, 591 have already been evaluated, although for 205 of them there is not adequate information yet to assess their risk of extinction; hence they are catalogued as Data Deficient (IUCN 2007). Over 21% of all species assessed by 2007 were evaluated as threatened. All shark species will have been assessed by the time the Red List is updated in 2008 (Fowler, pers. comm.). SSG also provides expert advice to other international organisations working on shark issues, such as FAO, CMS and CITES, as well as sound scientific information through its publications and website.

The SSG keeps a close watch on developments in international, regional and national conservation and management initiatives for sharks, and uses this information to summarise existing initiatives to improve the conservation status of sharks. As part of its Action Plan series, the status survey *Sharks, rays and chimaeras: the status of the chondrichthyan fishes* (Fowler *et al.*) was published in 2005, and a series of Red List reports is in preparation (e.g. Cavanagh & Gibson 2007, Dulvy *et al.* in press).

It should be noted that even though research on shark biology, ecology and population dynamics has increased in the last decades, the status of many species remains unknown. New species are constantly being described, even in waters where commercial fisheries operate frequently (e.g. Pérez-Jiménez *et al.* 2005). What is more worrying: shark species that have not even been described face the same threats as other shark species. Thus, the IUCN Red List contains two new species of the genus *Rhynchobatus* which, although not yet described, are already classified as Vulnerable (IUCN 2007).

Legal and Management Status of Sharks

International Fisheries Management Organisations

Many shark stocks and species have geographical distributions which cross international boundaries, resulting in individual populations being harvested by multinational fisheries. International efforts to better manage fish stocks beyond borders have been made through the provisions of several intergovernmental organisations (IGO).

UNCLOS. The United Nations Convention on the Law of the Sea (UNCLOS) provides a framework for the conservation and management of fisheries and other uses of the seas by giving coastal States rights and responsibilities for the management and use of fishery resources within their national jurisdictions. It was adopted in 1982 and entered into force in 1994. One of its provisions is that Member States shall adopt proper conservation and management measures to ensure that the maintenance of the living resources in their exclusive economic zone is not endangered by over-exploitation, aiming to achieve their optimum utilisation (UNCLOS 1982). The Convention promotes international cooperation on high seas for these purposes, and especially in the case of highly migratory species. Such species, listed on Annex I of the Convention, include *inter alia* oceanic sharks, namely the bluntnose sixgill shark *Hexanchus griseus,* basking shark *Cetorhinus maximus,* Family Alopiidae (thresher sharks), whale shark *Rhincodon typus,* Family Carcharhinidae (requiem sharks), Family Sphyrnidae (hammerhead sharks), and Family Isurida (now considered as Family Lamnidae, mackerel sharks and the great white shark). These total some 43 species.

Complementarily, the Agreement for the Implementation of the Provisions of UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks contains important provisions on the conservation and management of migratory sharks. This UN Fish Stocks Agreement (UNFSA) amplifies and facilitates the implementation of UNCLOS provisions by setting out detailed cooperation mechanisms between States. Adopted in 1995, it came into force in 2001. Although no formal definition of ‘straddling fish stocks’ exists in either UNCLOS or UNFSA texts, Article 63.2 of UNCLOS refers to: ‘the same stock or stocks of associated species occur both within the exclusive economic zone’ (EEZ, usually extending 200 nautical miles from the coast) ‘and in an area beyond and adjacent to the zone’, while the UNFSA refers to ‘stocks occurring both within and beyond the exclusive economic zone’.

Specifically, UNFSA calls for Parties to protect marine biodiversity, minimise pollution, monitor fishing levels and stocks, provide accurate reporting of and minimise bycatch and discards, and gather reliable, comprehensive scientific data as the basis for management decisions. It mandates a precautionary, risk-averse approach to the management of straddling and highly migratory stocks and species in cases where scientific uncertainty exists. States are directed to pursue cooperation for such species through subregional fishery management organisations or arrangements. The Agreement specifically requires coastal States and fishing States to co-operate to ensure the conservation and optimum utilisation of the species listed on Annex I of UNFSA. Other species and populations may qualify as ‘straddling stocks’ under Article 63.2 of the Convention, particularly in areas where jurisdiction has not been extended to the 200 mile limit. Coastal and fishing States are also required to agree measures to ensure the conservation of qualifying shark species or stocks that straddle coastal waters and high seas. Finally, for sharks occurring only on the high seas, fishing States must take measures to ensure their conservation.

UNGA. On 18th December 2007, the General Assembly of the United Nations (UNGA) adopted resolution 62/177 on "Sustainable fisheries, including through the 1995

Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, and related instruments" (UNGA 2008). Part of this Resolution calls on fishing nations and RFMO to urgently adopt science-based measures (such as limits on shark catch and fishing effort) and to take immediate and concerted action to improve implementation of existing shark measures. The Resolution makes specific mention of shark finning and encourages requirements that sharks be landed with their fins still attached to their bodies.

FAO. Also within the United Nations framework, the Food and Agriculture Organisation (FAO) is a source of knowledge and information at a global level, aimed at leading international efforts to defeat hunger. Its activities comprise four main areas: putting information within reach; sharing policy expertise; providing a meeting place for nations; and bringing knowledge to the field (better, to the sea).

One of the main pillars in FAO's structure is the Fisheries and Aquaculture Department, created to facilitate and secure the long-term sustainable development and utilisation of the world's fisheries and aquaculture. This requires, *inter alia,* preventing overfishing, as well as the coordination and delivery of effective research. The Fisheries and Aquaculture Department therefore provides, on the request of Members, technical assistance in all aspects of fisheries management and development (FAO 2007).

At its 28th Session in October 1995, FAO Conference adopted the Code of Conduct for Responsible Fisheries (FAO 1995). It contains principles and international standards of behaviour for responsible fishing practices. Four years later a Declaration on the implementation of the Code of Conduct was released by a Ministerial Meeting held in Rome, but as requested to FAO during its Conference in 1995, appropriate technical guidelines in support of the implementation of the Code had to be elaborated, in collaboration with Members and interested organisations.

IPOA-Sharks. In 1994, CITES 9th Conference of the Parties (CoP) adopted Resolution Conf. 9.17, on the Biological and Trade Status of Sharks, requesting *inter alia* that FAO and other international fisheries management organisations establish programmes to collect biological and trade data on shark species. The request resulted in the issue being discussed at the 22nd session of FAO's Committee on Fisheries (COFI) in 1997. Since conservation and effective management of shark populations merited further examination, an expert consultation tasked with developing guidelines for a plan of action to be submitted to the next session was organised by FAO, Japan and the United States of America. The outcome was an International Plan of Action for Conservation and Management of Sharks (IPOA-Sharks, FAO 1999). Presented and adopted on the 23rd session of COFI (1999), it was noted that the implementation of the Plan should be pursued as high priority and shark fishing States were urged to develop National Shark Plans by 2001.

The objective of the IPOA-Sharks is to ensure the conservation and management of sharks and their long-term sustainable use. It consists of the nature and scope, principles, objectives and procedures for implementation, and encompasses both target and non-target catches. It has been elaborated within the framework of the Code of Conduct for Responsible Fisheries (FAO 1995, Article 2d). The implementation of the IPOA-Sharks is voluntary, since a mandatory approach is not feasible; however, all concerned States are encouraged to implement it.

The guiding principles of the IPOA–Sharks are that States contributing to fishing mortality of a species or stock should participate in its conservation and management, and that shark resources should be used sustainably. Each State should develop, implement and monitor a national plan of action (NPOA) for the conservation and management of shark stocks if its vessels conduct directed fisheries for sharks or get them as bycatch.

Experience of sub-regional and regional fisheries management organisations should be taken into account, as appropriate. NPOA should aim to:

- ensure that shark catches from directed and non-directed fisheries are sustainable;
- assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use;
- identify and provide special attention, in particular to vulnerable or threatened shark stocks;
- improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States;
- minimise unutilised incidental catches of sharks;
- contribute to the protection of biodiversity and ecosystem structure and function;
- minimise waste and discards from shark catches in accordance with article 7.2.2.(g) of the Code of Conduct for Responsible Fisheries (for example, requiring the retention of sharks from which fins are removed);
- encourage full use of dead sharks;
- facilitate improved species-specific catch and landings data and monitoring of shark catches; and
- facilitate the identification and reporting of species-specific biological and trade data.

States report on the progress of the assessment, development and implementation of their Shark-plans as part of their biennial reporting to FAO on the Code of Conduct for Responsible Fisheries. Presently, about 113 States report shark landings to FAO, with 20 major shark fishing nations reporting landings that represent around 80% of the annual reported shark catch (Lack & Sant 2006b, based on FAO data).

FAO has taken several actions in support of the development and implementation of the IPOA-Sharks, including the publication of detailed guidelines for the development of Shark Plans (FAO 2000) and a manual of Techniques for the management of Elasmobranch fisheries (Musick & Bonfil 2005). An Expert Consultation on the Plan was also held on December 2005. The experts considered that the comprehensive guidelines for shark fisheries management provided by the IPOA-Sharks were excellent, although there was uncertainty whether a NPOA was expected to be a thorough programme to be implemented, or simply a document specifying the needs on shark fisheries in each State. In either case, their opinion was the IPOA should be reviewed to evaluate its effectiveness, and improved actions over the next ten years should be considered (CITES AC22 Inf.3). As in other fisheries around the world, the most critical issues complicating the Plan's implementation appear to be the lack of long-term funds for management and the lack of human resources. States that manage other fisheries well are also likely to manage their shark fisheries effectively, the opposite situation being also true. Equally, solving the issues constraining shark fisheries management (such as poor data collection and monitoring) will probably benefit all other related fisheries problems. Thus, the IPOA-Sharks has not achieved the level of success envisaged at the time of its introduction; moreover, that the problems of unsustainable shark fisheries remain and many have even intensified. In general, however, the view of the Consultation was that the IPOA-Sharks was a beneficial endeavour and that efforts to improve its effectiveness should be strengthened (FAO 2006).

Finally, FAO will be convening in November 2008 a Workshop on ‘Status, limitations and opportunities for improving the monitoring of shark fisheries’. It will be aimed at countries with extensive shark fishing activities, especially those that have not yet developed NPOA (CITES AC23 WG6 Doc.1).

RFMO. Formal cooperation among States for the conservation and management of fish stocks beyond borders has also been established through Regional Fisheries Management Organisations (RFMO), which are usually established under the mandate of FAO. Currently, there are 19 management bodies that directly establish management measures for marine fisheries resources, plus 21 advisory bodies that provide Members with scientific and management advice, and 6 scientific bodies dealing with specific marine resources in particular areas (FAO 2007b, see Figure 4). While some gaps remain, most of the marine fisheries resources of the world’s oceans are under the control of at least one RFMO. Although there is considerable geographical overlap between different organisations, overlap in species responsibilities does not generally occur (Willock & Lack 2006).

Figure 4. Regional Fisheries Management Organisations of the world (Source: FAO 2007b)

In general, RFMO have a mandate to establish binding management measures for fisheries resources. However, their Terms of Reference are generally not as precautionary in their approach as is required by UNFSA, partly due to the relatively recent introduction of the precautionary approach concept to fisheries management fora. Sharks are usually not included in the species-specific marine resources on which RFMO focus. To date, none of the existing RFMO have developed a Regional Plan of Action, as proposed by the IPOA-Sharks (Lack & Sant 2006a).

As with other efforts at international legislation, there is a lack of enforcement and poorly fulfilled flag-State responsibilities. Hence, some RFMO have implemented trade measures to ensure compliance with their conservation and management regimes, aimed mainly at combating illegal, unreported and unregulated (IUU) fishing (Tarasofsky, 2003).

Several intergovernmental fisheries bodies have initiated efforts to encourage member countries to collect information on sharks. This is the case for the Inter-American Tropical

Tuna Convention (IATTC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Indian Ocean Tuna Commission (IOTC), the Latin American Organization for Fishery Development (OLDEPESCA), the Northwest Atlantic Fisheries Organization (NAFO), the South Pacific Commission (SPC) and, although not being an RFMO, the International Council for the Exploration of the Sea (ICES). Among these efforts, it is worth highlighting that ICES and ICCAT have developed regional databases for the purpose of stock assessment. Moreover, some RFMO have actually implemented specific measures for sharks beyond basic catch reporting requirements (CITES AC18 Doc. 19.2, Lack & Sant 2006a). Some of these data registers and management measures directed to shark species are listed below.

- Commission on the Conservation of Antarctic Marine Living Resources, CCAMLR:
    - Prohibition of targeting vulnerable sharks in CCAMLR waters until the effects on fishing them are assessed.
    - Release of incidentally caught sharks is encouraged.

- General Fisheries Commission for the Mediterranean, GFCM
    - Data for all catches of shark are required to be reported.
    - All parts of the shark, except head, guts and skin, must be retained to the first point of landing.
    - Vessels may not have onboard fins that total more than 5% of the weight of the sharks onboard at the first point of landing.
    - Contracting and non-contracting cooperating Parties (CPC) to ensure compliance with the measure through certification, monitoring by an observer or other appropriate measures.
    - Retention, transhipment or landing of fins harvested in contravention of the measure is prohibited.
    - CPC to encourage the release of live shark, especially juveniles, taken as bycatch.
    - CPC encouraged to research selective gears and identify nursery areas.

- Inter-American Tropical Tuna Convention, IATTC:
    - Various resolutions adopted relating to the need to investigate measures to assess and reduce bycatch.
    - Estimate of catches and incidental fishing mortality of sharks and assessing the impacts on these species.
    - Requirement for fishers on purse-seiners to promptly release unharmed, to the extent practicable, all sharks, billfishes, rays.

- International Commission for the Conservation of Atlantic Tunas, ICCAT:
    - Requires submission of shark catch data by quarter and 5x5 area, gear, species and year, for stock assessment purposes.
    - A workshop on sharks was held in September 2001 to ‘review in detail the available statistics for Atlantic and Mediterranean pelagic sharks, with emphasis on Atlantic blue *Prionace glauca*, porbeagle *Lamna nasus* and shortfin mako *Isurus oxyrinchus*, with a view towards planning an assessment in the future’. The workshop recommended that members develop and conduct observer programmes aimed to collect accurate data on shark catches by species, including discards.
    - Stock assessments will be undertaken in 2008 on blue shark *Prionace glauca* and shortfin mako *Isurus oxyrhinchus*, and no later than 2009 for porbeagle *Lamna nasus.*

- Indian Ocean Tuna Commission, IOTC:
    - In 1999, agreed to a five-year research plan on predation by marine mammals and sharks in the context of an ecosystem-based approach.
    - From 2005 data for catches of sharks are reported annually.

- Additionally:
    - all parts of the shark, except head, guts and skin, must be retained to the first point of landing;
    - vessels may not have onboard fins that total more than 5% of the weight of the sharks onboard at the first point of landing;
    - CPC to ensure compliance with the measure through certification, monitoring by an observer or other appropriate measures;
    - retention, transhipment or landing of fins harvested in contravention of the measure is prohibited;
    - CPC to encourage the release of live shark, especially juveniles, taken as bycatch;
    - CPC encouraged to research selective gears and identify nursery areas; and
    - consider appropriate assistance to developing CPC for data collection on shark catches.

- North West Atlantic Fisheries Organisation, NAFO:
  - Catch quota established for skates (family Rajidae). To date, NAFO is the only RFMO to set a catch limit for elasmobranchs.
  - Members to provide reports on progress on developing NPOA for sharks to NAFO for circulation among members.
  - Reporting of catch of shark species required.
  - All parts of the shark, except head, guts and skin, must be retained to the first point of landing.
  - Vessels may not have onboard fins that total more than 5% of the weight of the sharks onboard at the first point of landing.
  - CPC to ensure compliance with the measure through certification, monitoring by an observer or other appropriate measures.
  - retention, transhipment or landing of fins harvested in contravention of the measure is prohibited.
  - CPC to encourage the release of live shark, especially juveniles, taken as bycatch.
  - CPC encouraged to research selective gears and identify nursery areas.
  - Improve training in identification and recording of shark catches.

- North-East Atlantic Fisheries Commission, NEAFC:
  - Prohibition on shark finning.
  - Limits on deep-fishing effort, aiming to reduce the bycatch of deep-sea shark species.
  - Prohibition of directed fishing for basking shark in 2006 and 2007.

- South East Atlantic Fisheries Organisation, SEAFO:
  - Banned shark finning in fisheries for species covered by SEAFO.
  - All parts of the shark, except head, guts and skin, must be retained to the first point of landing.
  - Vessels may not have onboard fins that total more than 5% of the weight of the sharks onboard at the first point of landing.
  - Contracting Parties to ensure compliance with the measure through certification, monitoring by an observer or other appropriate measures.
  - Contracting Parties to encourage the release of live shark, especially juveniles, taken as bycatch.
  - Contracting Parties to report annually data for shark catch.
  - Contracting Parties encouraged to research selective gears and identify nursery areas.
  - Consider appropriate assistance to Parties which are developing States for data collection on shark catches.

- International Council for the Exploration of the Sea, ICES (2007):
  - Uses shark fisheries and/or bycatch data to develop stock assessments.

Deciding that its sphere of activity for 'tuna and tuna-like species' did encompass sharks, ICCAT's Standing Committee on Research and Statistics (SCRS) established in 1994 an *ad hoc* Working Group, which later became a formal Sub-Committee on Bycatches, covering all bycatch species encountered by tuna fisheries. The Sub-Committee established its own Shark Working Group, which implemented a data collection system on its first meeting in 1996. In 2001 the Shark Working Group held a data preparation meeting for an Atlantic shark stock assessment, to focus on *P. glauca* and *I. oxyrinchus*, in collaboration with ICES (Nakano 2002 in Fowler & Cavanagh 2005). In 2004, ICCAT adopted a Resolution on Conservation and management of sharks, with the following main elements (Lack & Sant 2006a):

1. The collection of data on shark catch from CPC.
2. Providing assistance to developing CPC for the collection of data.
3. The introduction of controls on finning and prohibitions on the retention, transhipment and landing of fins harvested in contravention of existing bans.
4. Encouraging the release of live sharks, especially juveniles, that are taken as bycatch.
5. Encouraging research into selective gears and nursery areas.

Still, RFMO involvement in shark conservation and management does not mean that shark populations will be sustainably exploited. Despite their proliferation and the development and evolution of instruments aimed at empowering them, RFMO have generally failed to prevent over-exploitation of straddling and highly migratory fish stocks, to rebuild overexploited stocks and to prevent degradation of the marine ecosystems in which fishing occurs (Willock & Lack 2006). Only NAFO has so far adopted any catch limit for elasmobranchs, in this case for a skate species.

APEC. On a different approach, the Asia-Pacific Economic Cooperation (APEC) began working in 2001 on a Project for the Conservation and Management of Sharks. On one hand, the aim was to identify the need for areas of collaboration and technical cooperation in the implementation of the IPOA-Sharks to collect data for an assessment of sharks' populations, allowing for sustainable use of the species. The target audience included fisheries policymakers, industry planners and environmental NGO. On the other hand, the study was also directed to shark product development, particularly targeted to industry segments that wasted or discarded a high percentage of their shark catch. The project was expected to provide APEC economies the tools to implement national assessment of shark stocks, as well as viable and sustainable commercial means to minimise waste and discards from shark catches. Results were published jointly with FAO (Musick & Bonfil 2005).

European Union. A particular intergovernmental fisheries management body was established after the creation of the European Union (EU). Adopted in 2002, the Common Fisheries Policy (CFP) is the EU's instrument for the management of fisheries and aquaculture, stating common rules adopted at EU level and implemented in all Member States. It is aimed to ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions, *via* the appliance of precautionary and ecosystem approaches to fisheries management. The quantities that can be taken and landed from each stock called total allowable catches (TAC) are set annually by the Council of Ministers, based on scientific studies of the main stocks (European Community 2002).

Since 2007 European Community's law prohibits Community vessels to fish for, to retain on board, to tranship and to land basking shark *Cetorhinus maximus* and great white shark *Carcharodon carcharias* in all Community and non-Community waters (European Community 2007a, 2008), in response to the listing of these species on CMS.

Also in that year, TAC were allocated for leafscale gulper shark *Centrophorus squamosus*, Portuguese dogfish *Centroscymnus coelolepis*, kitefin shark *Dalatias licha*, birdbeak dogfish *Daenia calcea*, great lantern shark *Etmopterus princeps*, smooth lantern shark *E. pusillus*, velvet belly shark *E. spinax*, gulper shark *Galeorhinus galeus,* porbeagle *Lamna nasus*, spiny dogfish *Squalus acanthias* and for skates and rays of the family Rajidae. Further precautionary bycatch quotas were also adopted for the last two: these could not comprise more than 25% by live weight of the catch retained on board (European Community 2006). In 2008, TAC were allocated for the same shark species and a further reduced quota has been established for skates of the family Rajidae (European Community 2008).

Specific mesh sizes are also established for direct fishing of skates of the family Rajidae (European Community 2006). Moreover, European Law specifically addresses finning, one of the main threats to shark stocks globally (European Community 2003).

Although not specifically directed to sharks, the CFP also addresses the problem of bycatch aiming to the introduction of more selective fishing gear, such as nets with larger meshes or fitted with square-meshed panels, restrictions on fishing to protect juvenile fish, definition of sensitive non-target species and habitats, minimum landing sizes in line with the selectivity of the gear concerned, ‘discard ban trials’ in which representative samples of fishing vessels would be encouraged through economic incentives to retain their entire catch and the development of economic incentives for the use of more selective fishing practices (European Community 2002).

In a complementary approach, the EU has funded a study (identified as CFP 99/055) on the Development of Elasmobranch Assessments (DELASS), aimed to improve the scientific basis for the management of fisheries taking shark species. Developed between 2000 and 2002, it involved collating existing data and starting the collection of new data on sharks, and to develop assessment methods for nine case study species: thornback ray *Raja clavata*, cuckoo ray *R. naevus*, Portuguese dogfish *Centroscymnus coelolepis*, leaf-scale gulper shark *Centrophorus squamosus*, kitefin shark *Dalatias licha*, blackmouth catshark *Galeus melastomus*, spiny dogfish *Squalus acanthias*, lesser spotted dogfish *Scyliorhinus canicula* and the blue shark *Prionace glauca* (Heesen 2002). One of the outcomes of this study was a dedicated database and preliminary assessments for the analysed stocks. At the same time, ICES (which was closely involved in the development of the project) was expected to be furnished with an understanding of the data requirements and assessment methods needed to provide management advice for both directed and by-catch shark fisheries (Pawson 2001). It was several years after the completion of this study, however, before management advice was requested from the ICES Working Group on Elasmobranch Fishes, but this scientific advice has generally not been adopted (or at least not fully).

Finally, the EU is currently preparing its Community Action Plan on the conservation and management of sharks (within the framework of the IPOA-Sharks), inside and outside Community waters. It will outline the measures already in place, and will describe the additional measures needed to manage sharks in a comprehensive and coherent way. Stakeholders were invited to submit comments on the draft by 15 February 2008 (European Community 2007b) and the final version is planned to be adopted by the end of 2008.

International Conventions

CMS. The Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention, aims to conserve terrestrial, marine and avian migratory species throughout their range. Appendix I of the Convention includes migratory species threatened with extinction. CMS Parties should take measures towards the strict protection of these animals, conserve or restore their habitats, mitigate obstacles to migration and control other factors that might endanger them, as well as cooperating with other Range States of many of these species. Migratory species that need or would significantly benefit from international co-operation are listed in Appendix II of the Convention. For these species, the Convention encourages the Range States to develop and apply global or regional Agreements or Memoranda of Understanding. In such cases, CMS acts as a framework Convention. This allows the application of models adapted to the conservation needs throughout the migratory range of each species.

The whale shark *Rhincodon typus* is listed on CMS Appendix I, whereas the great white shark *Carcharodon carcharias* and the basking shark *Cetorhinus maximus* are listed on both Appendices I and II. CoP6 of the CMS (1999) called for co-operative actions to be undertaken for the whale shark. At CoP8 (2005) Australia, New Zealand and the Seychelles successfully co-sponsored a Recommendation calling for the development of a global conservation instrument for migratory sharks. Recommendation 8.16 'Migratory Sharks' was adopted by the CoP, and strongly supported by India, Philippines, Mauritania and the United Kingdom, among other Parties. Work began on this instrument with an international workshop in December 2007, in preparation for CoP9 to be held at the end of December 2008.

CBD. The Convention on Biological Diversity (CBD) aims to promote the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources. Implementation of the Convention's provisions is responsibility of each Party, and may be taken forward in varying ways in different States. CBD can influence and drive national conservation and management policies for commercially fished species, sharks included, if considered appropriate by Parties. However, not many Parties have yet implemented specific management and conservation measures for sharks in the CBD frame.

CITES. Another intergovernmental treaty involved in shark conservation and management is the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It aims to ensure that international trade of wild animals and plants does not threaten their survival, through a permit system that regulates international trade in specimens of species included in their Appendices. The history of shark species under this Convention, their status and the consequences of measures adopted are described with more detail under the section 'The role of CITES'.

Barcelona Convention. Some international agreements with a regional coverage also consider measures for the conservation and management of sharks and their habitats, at different scales and through different legal instruments. The Convention for the Protection of the Mediterranean Sea against Pollution, also known as the Barcelona Convention, was adopted in 1976, and entered into force in 1978. However, it was significantly modified in 1995, changing its name to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean. Article 4 of the Convention text states that Parties shall cooperate in the formulation and adoption of Protocols, legally binding instruments prescribing agreed measures, procedures and standards for the implementation of the Convention.

In this frame, the 'Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean', in force since 1999, lists three shark species (*Carcharodon carcharias*, *Cetorhinus maximus* and the giant devil-ray *Mobula mobular*) on Annex II (endangered or threatened species), and five more species (shortfin mako *Isurus oxyrinchus*, porbeagle *Lamna nasus*, blue shark *Prionace glauca*, white skate *Raja alba* and angel shark *Squatina squatina*) on Annex III (species whose exploitation is regulated). Parties should still provide legal protection to Annex II species under their national legislation.

In a complementary approach, an Action Plan for the conservation of cartilaginous fish in the Mediterranean Sea (UNEP MAP 2003) was developed under the Mediterranean Action Plan of the Barcelona Convention. This document recommends providing legal protection status for the endangered species identified, namely sawfishes *Pristis* spp., sand tiger sharks *Carcharias taurus* and *Odontaspix ferox* and the grey skate *Dipturus batis*, as has already been done with the three species listed on Annex II of the Protocol. It also recommends assessing the status of hammerheads *Sphyrna* spp., guitarfishes *Rhinobatos* spp. and the speckled skate *Raja polystigma*.

Other recommendations include the development of management programmes for sustainable fisheries, reducing bycatch and identifying critical habitats for sharks. All proposed actions should be undertaken in cooperation with, and with the support of, RFMO, establishing Memoranda of Understanding where necessary. Participation of NGO and national environmental bodies is advisable. Implementation of the Action Plan is the responsibility of the national authorities of Parties to the Convention, to be regionally coordinated by the Mediterranean Action Plan's Secretariat, through the Regional Activity Centre for Specially Protected Areas.

OSPAR. The Convention for the Protection of the Marine Environment of the North-East Atlantic (also known as OSPAR Convention) considers shark issues in different way. A List of Threatened and/or Declining Species and Habitats was adopted in 2004, including three shark species: basking shark *Cetorhinus maximus*, common skate *Dipturus batis* and spotted ray *Raja montagui*.

The list contains species and habitats in need of protection, in order to guide the setting of priorities by the OSPAR Commission for its activities in implementing Annex V to the Convention ('On the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area'). Several more shark species are currently being considered for listing,: angel shark *Squatina squatina*, stingray *Dasyatis pastinaca*, thornback ray *Raja clavata*, lesser-spotted dogfish *Scyliorhinus canicula*, spurdog *Squalus acanthias*, white skate *Rostroraja alba*, tope *Galeorhinus galeus*, porbeagle *Lamna nasus* and blue shark *Prionace glauca*.

Nevertheless, the OSPAR Convention preamble specifically recognises that 'questions relating to the management of fisheries are appropriately regulated under international and regional agreements dealing specifically with such questions'. Hence, it can only draw these matters to the attention of the authority or international body competent for that question, but has no competence to adopt programmes or measures on questions relating to fisheries management.

Helsinki Convention. Aimed to protect the marine environment of the Baltic Sea from pollution through intergovernmental co-operation, the Helsinki Commission, or HELCOM, is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area - more usually known as the Helsinki Convention.

The Commission has developed a Red List of Threatened and Declining Species of Fishes (HELCOM 2007), where several shark species are included as priority species, as shown in Table 1. Nevertheless, no specific action is proposed for the recovery of listed species.

Table 1. Priority shark species listed in HELCOM's Red List of Threatened and Declining Species of Fishes

Family	Species	English name	Status HELCOM
Squalidae	*Squalus acanthias*	Piked dogfish	High Priority
Squatinidae	*Squatina squatina*	Angelshark	High Priority
Alopiidae	*Alopias vulpinus*	Thintail thresher	High Priority
Cetorhinidae	*Cetorhinus maximus*	Basking shark	High Priority
Lamnidae	*Lamna nasus*	Porbeagle	High Priority
Scyliorhinidae	*Galeus melanostomus*	Blackmouth catshark	High Priority
Scyliorhinidae	*Scyliorhinus canicula*	Small-spotted catshark	High Priority
Triakidae	*Galeorhinus galeus*	Tope shark	High Priority
Somniosidae	*Somniosus microcephalus*	Greenland shark	Medium priority
Etmopteridae	*Etmopterus spinax*	Velvet belly lantern shark	Medium priority
Carcharhinidae	*Prionace glauca*	Blue shark	Medium priority
Torpedinidae	*Torpedo marmorata*	Spotted torpedo	Medium priority
Rajidae	*Dipturus batis*	Blue skate	High Priority
Rajidae	*Amblyraja radiata*	Thorny skate	High Priority
Rajidae	*Raja clavata*	Thornback ray	High Priority
Rajidae	*Raja montagui*	Spotted ray	High Priority
Rajidae	*Leucoraja fullonica*	Shagreen ray	Medium priority
Dasyatidae	*Dasyatis pastinaca*	Common stingray	Medium priority
Chimaeridae	*Chimaera monstrosa*	Rabbit fish	Medium priority

Other treaties. The remit of some other regional international treaties is also on biodiversity and habitat conservation. However, either their approaches are focused on terrestrial species (such as the Convention for the Conservation of European Wildlife and Habitats – the Bern Convention), or they are based on marine pollution and habitat conservation instead of adopting a species approach, as is the case of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

Some regional seas conventions could address the specific issue of shark conservation and management, as is the case for the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean, and the ASEAN Agreement on the Conservation of Nature and Natural Resources. However, to date no shark species are listed in any of these legal instruments.

UNEP-related regional seas programmes could also include specific measures for shark protection. To date, the following have been adopted (UNEP 2007):

- Mediterranean Action Plan (1975, later consolidated in the Barcelona Convention),
- Red Sea and Gulf of Aden Action Plan (adopted in 1976, revised in 1982),
- Kuwait Action Plan (1978),
- West and Central African Action Plan (1981),
- Caribbean Action Plan (1981),
- East Asian Seas Action Plan (1981),
- South-East Pacific Action Plan (1981),
- South Pacific Action Plan (1982),

- Eastern Africa Action Plan (1985),
- Black Sea Action Plan (1993),
- North-West Pacific Action Plan (1994), and
- South Asian Seas Action Plan (1995).

Two further plans are still in preparation: the South-West Atlantic Action Plan since 1980 and the North-East Pacific Action Plan since 1997.

Finning bans

Shark fins are a high value and low volume product, being also easier to handle and store than meat. The disparity between the exceptionally valuable shark fins and the less valuable meat creates an economic incentive to take sharks solely for their fins. The practice known as **finning** (removing shark fins and casting off the remainder at sea) results in discarding most of the edible portion of a carcass. It doubtless contributes to an extraordinary waste of fishery resources, unsustainable shark mortality and dangerous declines in shark populations.

Over the last 15 years, widespread public concern against finning has led to ban this practice in many countries and most of the world's international waters (Fordham 2006). To date, finning bans have been adopted at least in the United States of America (NOAA 2002), the European Union (European Community 2003), Costa Rica and Ecuador (CITES CoP14 Doc. 59.1), Brazil, Australia, South Africa and Oman (Clarke *et al.* 2005) and Mexico (SAGARPA 2007). Regional initiatives have also been undertaken to tackle this practice, including the abovementioned regulations implemented by GFCM, IOTC, NAFO, NEAFC and SEAFO. Still, adequate enforcement of such measures remains a complicated issue. Shark finning occurs, often by foreign flagged fleets, in the Indo-Pacific Ocean (with fleets recently moved from offshore Central America, following declines in shark resources), Australia, Costa Rica, Ecuador, to mention a few examples (CITES CoP14 Doc. 59.1).

Current European regulation (European Community 2003) prohibits the removal of shark fins on board vessels and their retention on board, transhipment or landing forbidding also the purchase or sale of shark fins which have foregone this process in contravention of the regulation. It also prohibits discarding at sea the remaining parts of sharks after removal of the fins, except those resulting from basic processing operations (such as beheading, gutting and skinning). A special permit authorising the removal on board of fins from dead sharks can be obtained, on condition that the remainder of the carcass is also retained on board. A system of recording and monitoring the quantities of shark fins and other parts of sharks retained on board, transhipped, landed and sold makes possible the monitoring of compliance with these provisions.

Although there is general consensus on the convenience of prohibiting shark finning, the way the fin/body weight ratio is applied by different regulations has raised concern. In the EU, the weight of the fins retained on board must never exceed 5% of the total weight of the shark catch (live weight). The USA and other countries use that same 5% proportion, but related to the dressed weight (i.e., the weight once the carcasses have been gutted and beheaded) (Anonymous, 2007). This significantly diminishes the amount of shark fins that can be legally brought into port.

Debate is ongoing about which fin:body weight ratio should be used for establishing finning bans. Discrepancies arise from keeping different numbers of fins from each carcass and/or different ways of cutting when removing the fins, so that more or less shark meat is left attached (Hareide *et al*. 2007). Ratios also differ according to species and probably the geographical zone where individuals come from.

Mejuto & García-Cortés (2004) estimated this relationship to be around 14% in blue shark *Prionace glauca* when dressed, and roughly 6.5% if live weight was used. For the mako shark *Isurus oxyrhinchus* the mean percentage was estimated to be 5.8-6.8% of the dressed weight.

Conversely, a study referred by Kelleher (2005) considers fins to constitute approximately 2.5% of the live weight of the blue shark *Prionace glauca* (5% of dressed carcass weight). Cortés & Neer (2006) found ratios (fin weight to dressed weight) ranging from 2.5% for the silky shark *Carcharhinus falciformis* to 5.3% for the sandbar shark *C. plumbeus*.

Ariz *et al.* (2006) compared the weight of all fins to the dressed weight of four pelagic shark species caught in the south-western Indian Ocean. Values obtained were 6.26% for mako shark *Isurus oxyrinchus*, 11.16% for silky shark *Carcharhinus falciformis*, 14.90% for blue shark *Prionace glauca* and 16.05% for oceanic whitetip shark *C. longimanus*.

These results highlight the need to establish ratios for each species and fleet. However, species-specific management would be difficult to enforce. Still, some adaptations could be implemented in order enhance the benefits derived from legal limits on fin:body weight ratios. As an example, due to their different life styles, pelagic sharks usually have bigger fins related to their body weight than those of reef or deep-sea sharks. Such groups of species are also generally caught by specific fishing gears. Hence, ratios could be adapted for specific groups of species according to fishing gear used and even fishing zone, being both reasonably enforceable and useful for effectively protecting sharks from finning.

Regardless of which ratio is selected, it is strongly advisable that it be periodically revised, ideally on a species and fleet specific basis, as any other conversion factor should be in order to keep its accuracy. In all, the only guaranteed method to avoid shark finning is to land sharks with all fins attached.

Shark Fisheries

Almost all traditional fisheries management is based on the typical teleost life history strategies, since these species support most fisheries worldwide (Hilborn & Walters 1992). Teleosts produce millions of miniature eggs annually and, although just a few young survive to maturity, recruitment to the adult population is broadly independent of the size of the spawning stock (unless this declines to extremely low levels). This is partly due to the operation of density-dependent factors that compensate for adult population decline.

But reproductive strategies of most teleosts contrast distinctly with those of sharks, which, as mentioned earlier in this paper, are among the latest-maturing and slowest-reproducing of vertebrates. Recruitment of sharks to the adult population is closely linked to the number of mature, breeding females, although some density-dependent factors may also operate for their stocks. The result is that, as mature animals are caught, the production of offspring that will support future generations also declines, which in turn limits future productivity of the fishery and the ability of shark populations to recover from overfishing. Hence, a very different management regime to that employed for teleosts is required if fisheries are to be sustained over a long period. Management must be implemented at the beginning of shark fisheries. However, this has not been the case for the vast majority of shark fisheries that have developed around the world (Bonfil 1994). Rather, the vastly dominating pattern has been one of no management, growing fishing pressure until populations collapse, followed by decades of recovery, if it occurs at all (Musick & Bonfil 2005).

Proper fisheries monitoring programs are costly and difficult to implement for long periods, with episodic funding preventing the implementation of long-term monitoring programmes in both developed and developing States. Although general fisheries statistics have been recorded for decades in several countries, landing records of shark catches are usually imprecise due to a variety of reasons. Imprecise reporting of fishery statistics, where several species are lumped together as one category (i.e. ‘sharks’ or ‘rays’), can mask basic changes in community structure and profound reductions in populations of the larger, slower growing species (Musick & Bonfil 2005). And, despite growing efforts for recording catch data to a lower taxonomic level, species identification can turn problematic. Although much progress has been made on developing species identification guides, sometimes these are not widely available. There can also be difficulties when trying to identify look-alike species. This happens even if the carcasses are kept and landed whole or in still recognisable parts, which is not always the case, given the need for optimising freezers’ capacity onboard fishing vessels or simply to speed up the unloading and processing of the catch. It is also common that data available on catches, fishing effort and landings are incomplete and/or inadequate. Furthermore, even when identification of whole specimens should pose no problem when proper guides are available, there is a relative lack of tools available to identify the products that are traded in significant quantities (such as fins, meat and cartilage). Comprehensive and easy to use identification techniques for these products would be desirable (CITES AC22 Doc. 17.2).

Consequently, there is a general lack of adequate data, on matters such as catch, bycatch, discard and landings data by species, weight and length, required for making proper management decisions. This happens even if and when enough personnel and funds are designated to such activities. But many developing countries had either a weak or non-existent capacity to undertake any form of fisheries management, particularly for elasmobranchs (CITES AC22 Inf.3). An additional difficulty comes regarding transboundary, straddling, highly migratory and high seas stocks, which are often exploited by different fishing fleets. In such situations, coordination is essential for the collection of relevant and consistent information for adequate management and enforcement.

Customs codes for recording international trade on sharks, products and derivatives may also differ among countries, making it difficult to trace trade volumes and hence their effect in the status of wild populations.

Finally, although directed fisheries have been the cause of stock collapse for many shark species, a more important threat to long-lived sharks is mortality in multispecies fisheries and bycatch in fisheries targeted at other species (Bonfil 1994). Many of the fisheries catching sharks are not species-specific, extracting species with different life-history characteristics, which would benefit from a particular management approach.

All these factors cause significant problems in the adequate conservation and management of sharks, often (and not surprisingly) resulting in unsustainable shark fisheries.

Main Shark Uses

Sharks have been sought for centuries for their meat, skins, liver oil, fins and teeth, and more recently for emerging uses such as cartilage skeletons for medical products and ecotourism. Many coastal shark fisheries utilise the whole carcass and yield a wide range of products. Although their rich liver oil has been and continues to be a reason to fish for sharks and some recreational shark fishing occurs, most of today's shark fisheries are driven by commercial demand for their meat and fins. Smaller sharks are more easily marketed for human consumption owing to lower concentrations of urea and mercury, ease of processing and size comparability with other fisheries species. In contrast, when they are taken to supply the demand for fins or skin, larger sharks are preferred (Clarke *et al.* 2005).

Meat. Several countries are consumer and traders of shark meat. Shark meat is sold fresh, frozen, salted and dried. It is difficult to identify shark species preferred for their meat on a worldwide basis. There is a great variety of favourite species according to regional differences in species availability, processing and preparation techniques, as well as consumption patterns. Yet, there are a few species whose meat is widely considered of higher quality than others, such as shortfin mako *Isurus oxyrinchus*, thresher shark *Alopias* spp. and porbeagle *Lamna nasus*. Shortfin mako shark is to a wide extent recognised as the world's best quality shark. It is particularly appreciated fresh in the USA and Europe where it is sold at prices in line with those of swordfish. It is used to prepare a high quality sashimi in Asia, especially in Japan. The quality of the meat of thresher and porbeagle is also considered similar to that of swordfish and both these species are often marketed in the same form as swordfish meat, as steaks and blocks. Smaller species like spiny dogfish *Squalus acanthias* and smooth-hounds (Family Triakidae) are particularly appreciated, as they contain smaller concentrations of urea and mercury than other species and are also easier to process. They do not usually require soaking, and the fish are finned, gutted and landed as whole carcasses with the skin intact. The backs are used in Europe and Australia while fresh whole carcasses are sold in South America where they are marketed as *cazón*. This product is exported for sale as fillets, steaks or portions, and is also used in the fish-and-chips trade. Dogfish are particularly appreciated in Europe, especially in France, U.K., Germany (Vanuccini 1999) and Spain. There is strong market demand for the meat of deepwater sharks (called *siki*) in France (Fowler, pers. comm. 2008).

The value of shark meat varies considerably between species and markets. According to FAO data, the value of frozen shark meat in 2005 was roughly USD$1 per kilogram, whereas for fresh meat it rose to around USD$5.50 (Josupeit, 2008). But there are several specific examples that is worth mentioning. A market study found that spiny dogfish *Squalus acanthias* frozen meat from the UK sold to Italy was the most expensive shark meat, at US$9.91 per kilogram (Vanuccini 1999). In Germany, this meat is sold as *See-Aal* (sea eel) and belly flaps are smoked to make *Schillerlocken*. The latter is a delicacy retailing at between 45€ and 57€/kg in Germany (wholesale import price of around 15€/kg). The relatively high price in Germany reflects an increasing shortage in supply, and some consumer resistance to the high price is also reported (CITES CoP14 Prop. 16). A shark meat product popular in Italy is *palombo* and, formerly, British fish and chips used to be made from shark meat, before prizes rose enough to make it non-profitable (Josupeit, 2008). The meat from the shortfin mako, the common thresher and the porbeagle shark is also of notable value (Rose 1996).

Figure 5. *Schillerlocken* sold at the Fish market in Hamburg, Germany (Photo: Eréndira García).

Consumption of shark meat has recently been the subject of public health warnings, because of the bioaccumulation of high levels of mercury in the flesh that may harm unborn infants and children (USFDA 2001, Food Standards Agency 2002, both in Clarke *et al*. 2005).

Fins. Even though shark meat can reach very high market prices, the most valuable part of a shark is usually its fins. These are the main ingredient of shark fin soup, a traditional Chinese delicacy which is becoming increasingly popular. Sets of shark fins can sell for more than US$700 per kilogram, and the global shark fin trade is estimated to be increasing by 5% per year (Clarke *et al.* 2005).

In the early days of the trade, fins were sold as matched sets, but as the market has matured a broader range of species and fin positions is being utilised in a more complex system of quality grading (Clarke *et al.* 2005). Fins of different shark species are graded based on the density of their *ceratotrichia*, soft collagen and elastin fibres commonly referred to as 'fin rays' or 'fin needles'. Essentially tasteless but gelatinous, processed shark fin needles resemble rice noodles in wet, dried or cooked forms (Rose 1996).

In general, 'white' fins have high fin needle counts, and are thus the best quality and most valuable in trade. It must be noted that this is only a vernacular name and it does not imply that fins are taken from the great white shark *Carcharodon carcharias*. Fins with lesser needle counts are of secondary quality and are called 'black fin'. Fins of similar quality and appearance are grouped together into categories, regardless of their taxonomic affinity (Clarke 2003 in McDavitt 2006). Actually, shark fin traders distinguish between 30–45 fin types that are known to produce useable fin rays, but these fin types may contain multiple species and there is no clear nomenclatural system to match fin types with species (Vannuccini 1999).

Market surveys over the last three decades have revealed differing results in terms of the preferred shark species for fins, due primarily to regional differences. Giant guitarfish *Rhynchobatus djiddensis* yield the highest value fins in the world, with some US$90 per kilogram paid to fishermen in Indonesia (Rose 1996). Most studies, however, include hammerheads *Sphyrna* spp. among the most valuable species for fins, and count fins from blue shark *Prionace glauca* and mako *Isurus* spp. as important in trade, if not always top quality. Other Northeast Atlantic shark species prized for their fins include tope shark *Galeorhinus galeus* and basking shark *Cetorhinus maximus*, with a single fin from the latter species once selling for nearly US$10,000 (CITES CoP12 Proposal 36). The fins of dogfish *Squalus* spp. are generally considered as low quality, but they have been part of the international fin trade for decades and make up a substantial proportion of the volume of shark fin trade (Clarke *et al.* 2005).

Fins are a by-product of several target fisheries, directed to obtain shark meat for human consumption, particularly, and those for deep sea sharks (oil and meat fisheries). On the other hand, meat is a by-product of some shark fisheries that are primarily driven by the high value of fins in international trade (CITES CoP14 Doc. 59.1). As the yield of other fisheries (mainly teleosts and invertebrates) decrease, the demand for shark meat continues to increase and meat products become more important drivers for shark fisheries.

Artisanal shark fisheries worldwide usually produce and export dry fins obtained from shark catches. However, these fisheries utilise the whole carcass and yield a wide range of products, which are generally sold at domestic markets (CITES CoP14 Doc. 59.1).

Skin. Shark skin is used to produce a variety of leather products, including handbags, watchstraps, cowboy boots and belts in a number of countries, as well as for sanding a variety of ceramic and wood products. The increasing use of shark meat discourages the production of shark skins, because the skins are often left intact to protect the meat. Skinning is also time consuming and not worth the effort in some fisheries. However, the processing of shark skin in small-scale fisheries is more feasible and therefore production of shark leather remains significant in some countries (Rose 1996). One such country is Mexico, where a number of shark skin tanneries operate provided by local small-scale fishermen. A pair of cowboy boots made of ray skin was sold for US$700 in 2007.

Oil. The liver and body oils of sharks, such as the spiny dogfish *Squalus acanthias* and various deepwater species, are used in the USA and Europe in the tanning and curing of leather. Shark liver oil is also used in Japan in sanitary wipes for cleaning toilets, in French perfumery, and sometimes as an ingredient in an haemorrhoid liniment manufactured in the USA and distributed internationally. In artisanal fishing fleets in Africa and the Indian Ocean, shark liver oil is used for use in maintenance of traditional fishing vessels. Liver oil also yields squalene, an acyclic hydrocarbon used in the manufacture of lubricants for precision instruments, bactericides, pharmaceuticals and cosmetic products such as skin creams (Rose 1996).

Medicines. In traditional Chinese medicine, shark meat is utilised as a general tonic, shark skin for blood and heart problems, and shark bile to heal sore throats. In modern times, three sawfish products are considered *materia medica* in traditional Chinese medicine: sawfish liver, ova, and bile (McDavitt 2006). Sawfish rostra are also utilised in the traditional medicine of Mexico, although their use is not extended (Cifuentes-Lemus *et al.* 1993). Shark liver oil is also widely used as a tonic in Mexico.

More recently, several medicinal and food products are produced from the cartilage of sharks. Chondrichthyan natrium, a chemical compound found in the cartilage, is used in Japan as a treatment for eye fatigue and rheumatism, with blue shark *Prionace glauca* considered a good source. A chemical extracted from shark cartilage has also been used in the development of a synthetic skin for burn victims. In recent years, shark cartilage powder and capsules have been marketed extensively as a product purporting to assist in the treatment of cancer (Rose 1996).

Figure 6. Sawfish rostrum in an Aztec offering (*ca.* XVI century). National Anthropology Museum, Mexico City. (Photo: Eréndira García).

Curios and trophies. Rostra of species in the family Pristidae have historically been used by many cultures in ceremonies and offerings. They also have long been a favourite marine curio, with large rostra commanding impressive prices (McDavitt 2006). Rostra are sometimes fashioned into elaborate sheaths for knives. They are also utilized as ceremonial weapons in the folk religion of Chinese Taipei (CITES CoP14 Prop. 17). Medium sized sawfish rostra (usually *Pristis perotteti*) are sometimes decorated by local Brazilian artisans for sale to tourists. Artisans affix elaborate floral designs or grotesque faces created out of resin, often incorporating animal fangs, horns, hair, precious stones, seeds, and large fish scales (McDavitt 2006).

Rostral teeth of sawfishes have been the preferred material used to manufacture artificial spurs on Peruvian fighting cocks. The rostral teeth are mostly obtained from Brazil, Ecuador, Panama and various Caribbean countries. McDavitt & Charvet-Almeida (2004) determined that rostra find their way into the international cockfighting market from Brazil. Rostral teeth have been favoured over other natural spur materials (such as deer antler, sea turtle shell, sea-lion teeth, mammal bones, and stingray spines), because systematic testing revealed that teeth of species in the family Pristidae were more durable and have a sufficiently porous surface to cause greater body damage to the opponent (McDavitt & Charvet-Almeida, 2004).

In the case of the great white shark *Carcharodon carcharias*, the most prized products are its teeth and jaws, particularly for sale to tourists and increasingly through the internet (CITES CoP13 Prop.32).

Figure 7. Shark teeth have always attracted people’s attention (Photo: Eréndira García).

It is important to note, however, that it is impossible to utilise every shark for all uses, as the preservation and preparation methods are often mutually exclusive and not all shark species are suitable for all applications (Vanuccini 1999).

Aquaria. Live sharks are also captured for the ornamental fish trade and public aquaria (García-Núñez 2004). Sawfishes have long been prized as exhibit animals in public aquaria, since they can survive long in captivity (McDavitt 2006). Other species, such as the tiger shark *Galeocerdo cuvier* have also been kept in captivity for almost eight years (Marín-Osorno, pers. comm. 2006), and some large sharks (particularly sandbar shark *C. plumbeus*) now breed regularly in captivity. Even whale sharks have been kept in public aquaria, although their maintenance is much more difficult than it is with other shark species. Freshwater stingray species have been regularly captured for ornamental purposes for decades, being also eventually used as a subsistence food source (CITES AC20 Inf. 8). The biomass of sharks traded for the aquarium trade is rather small compared to other consumptive uses, and the volume of fish taken for this purpose is much smaller than in any other fishery. The biomass of sharks fished for the ornamental trade is also smaller relative to teleosts. Moreover, both the educational value of captive animals and awareness and public support can be very useful to species conservation initiatives.

Non-consumptive uses. Ecotourism operations to observe sharks in their natural environment by cage diving (especially for great white shark *Carcharodon carcharias*), from the deck of vessels, diving or even snorkelling (usually with whale sharks *Rhincodon typus*) can be found in several parts of the world. Many recreational anglers have switched to catch and release, sometimes including involvement in tagging programmes. However, the long-term effects that these activities might have on shark populations are currently unknown.

Figure 8. Snorkelling with whale shark *Rhincodon typus* is an increasingly popular tourist activity. (Photo: Deni Ramírez).

Targeted Shark Fisheries

The FAO Fisheries and Aquaculture Department has built up statistical databases since its inception, being the only organisation with a worldwide remit to engage in the systematic data collection and compilation of fisheries and aquaculture information. Recognising the importance of internationally agreed methods and tools for data compilation, it has cooperated in international efforts directed towards the development of standard concepts, definitions, classifications and methodologies for the collection and collation of fishery statistics, most notably through the Coordinating Working Party on Fisheries Statistics (FAO 2007a). Data are provided by FAO Members and verified from other sources wherever possible (Shotton 1999). However, datasets are still far from accurate, homogeneous and complete. It must be kept in mind, therefore, that the reliability of the analysis based on FAO data and the quality of the advice to which it gives rise, depends on the reliability and quality of data themselves. On an alternative approach, it has proven to be indeed useful to examine trade data in order to estimate catches (Clarke *et al*. 2005)

A comprehensive overview of world shark fisheries has been published by FAO (Bonfil 1994), including regional trends in landings and bycatch, patterns of exploitation, and an assessment of their problems and management needs. According to this report, growth in shark fisheries in the past was limited because of their low economic value and relatively low abundance. Still, since World War II there has been steady growth in shark fisheries, resulting from an overall intensification of marine fisheries and increasing human populations worldwide. Most recently, the growing demand for shark fins (and, to a lesser extent, meat) has further stimulated shark fisheries in some parts of the world (Rose 1996, Clarke 2004b). Even so, current commercial shark catches comprise only about 1% of the reported world fisheries catch.

Nonetheless, actual shark catches are likely to be significantly higher than indicated by FAO data because of widespread lack of reporting, inaccurate record keeping and, in some cases, wilful underestimation (Clarke *et al.* 2005). Offshore fleets with a large shark bycatch may land partially processed sharks in foreign ports or tranship cargo at sea, thus biasing information. In addition, thousands of metric tonnes of sharks are believed to be discarded at sea, often unaccounted for in logbooks. Finally, sharks caught by artisanal fisheries are often consumed locally and bypass official record keeping, or there may be no system of monitoring at all. Indeed, actual catches may be up to double those recorded in the official FAO statistics (Bonfil 1994). But despite these shortcomings, FAO data are a significant source of fisheries information and statistics, and often the only available source of information on fisheries in many countries.

Between 1950 and 2000 there has been more than a threefold increase (220%) in reported catch of sharks. The period of greatest increase during those 50 years was between 1960 and 1970 (60%). The rate of increase showed a declining trend in the 1970s and 1980s (20% and 15% respectively) but returned to around 25% in the 1990s. Catches trended upwards in the 1990s but the rate of increase slowed in the latter half of the decade (see Figure 9).

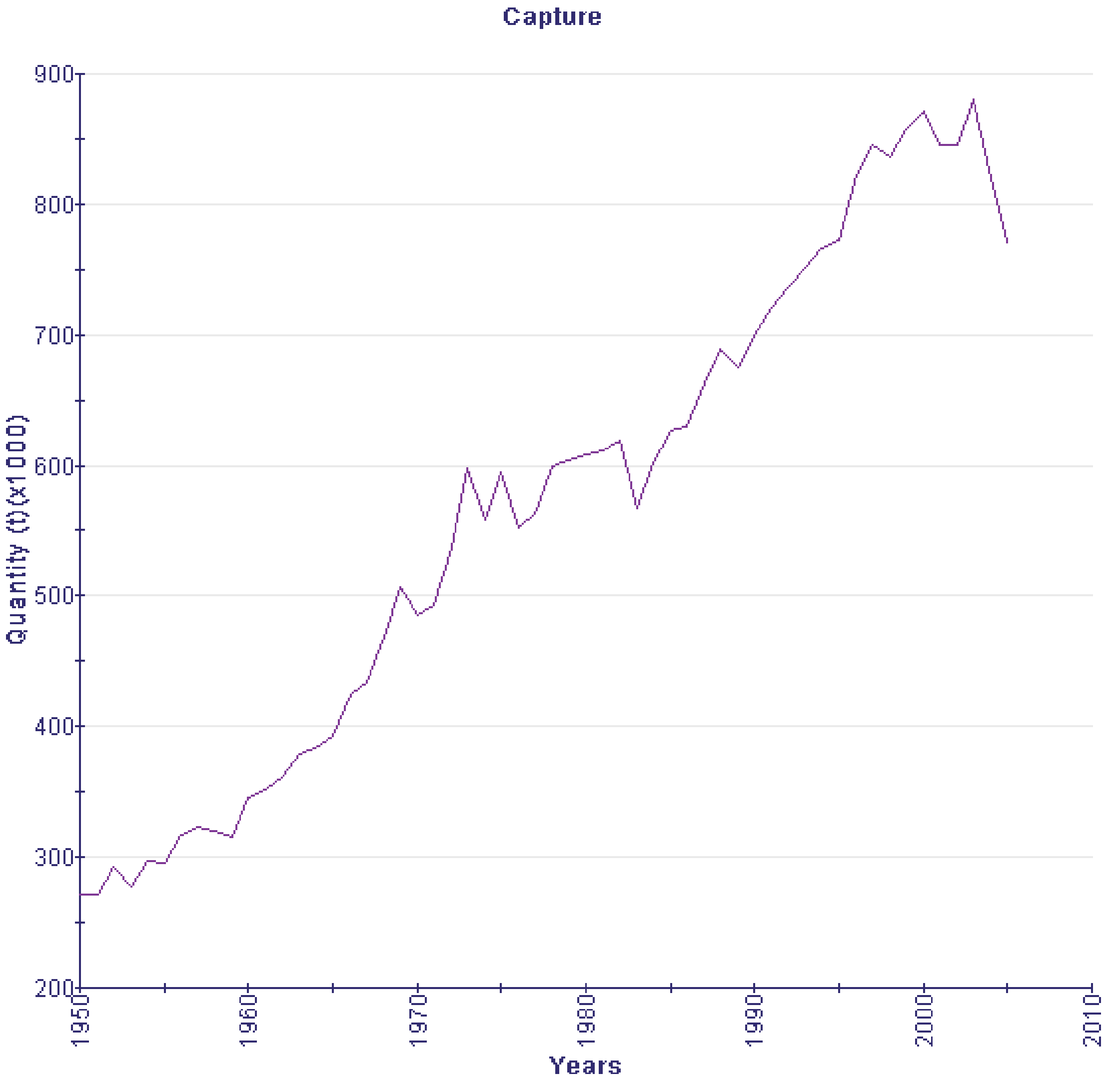

Figure 9. Elasmobranch world catches 1950-2005. *t* refers to metric tonnes.
(© FAO - Fisheries and Aquaculture Information and Statistics Service, 30.08.2007)

As for the main shark fishing areas, in 2003 the Pacific Ocean was the major source of the global shark catch, accounting for 38% of catches. The Western and Central Pacific Ocean account for over 20% of the total world catch. The Atlantic Ocean's contribution to global catch represented 32% of the total, with most of that catch taken from the Northeast Atlantic (Lack & Sant 2006b).

Another serious problem when using FAO datasets is species identification. In 2003, 106 categories of shark were identified. However, only 15% of the catch reported was recorded by species. Approximately 45% of the total shark catch was categorised as Sharks, rays, skates not elsewhere included; 24% as Rays, stingrays, mantas not elsewhere included; 6% as *Raja* rays not elsewhere included; 4% as Requiem Sharks not elsewhere included, 4% as Blue Shark and 3% as Piked Dogfish (Lack & Sant 2006b). This makes it virtually impossible to identify catch trends of species which are inherently more vulnerable to overfishing.

Table 2. Shark captures by top 20 catching countries 1950-2003 (tonnes).
(Source: Capture production 1950-2003. FAO Fisheries Department 2000, in Lack & Sant 2006b)

Country	1950	1960	1970	1980	1990	2000	2001	2002	2003	TOTAL 1950-2003
Top 20 1950-2003										
1. Japan	100 700	83 900	61 544	54 298	32 103	31 873	27 696	32 879	24 906	3 035 820
2. India	30 000	35 600	44 100	49 656	51 230	76 057	67 971	66 923	63 266	2 677 213
3. Indonesia	1000	6100	10 100	42 855	73 272	113 626	110 311	106 398	120 670	2 267 523
4. Taiwan Province of China	9000	17 100	36 300	52 260	75 731	45 923	42 355	44 412	67 432	2 030 447
5. Pakistan	4800	6600	34 300	64 975	40 043	51 170	49 269	49 904	33 248	1 866 822
6. France	17 600	26 300	28 017	35 267	26 310	24 952	25 799	23 136	22 547	1 480 088
7. UK	29 400	29 340	22 400	21 355	21 776	17 389	19 346	16 832	19 581	1 332 363
8. Mexico	.	4700	9100	26 551	44 880	35 260	32 718	30 888	30 872	1 089 646
9. Norway	12 000	30 000	43546	15 572	11 117	2857	2921	1901	2020	1 033 527
10. Spain	10 800	14 100	7500	2052	14 163	82 349	77 103	62 996	61 613	1 023 565
11. Korea, Republic of	11 500	10 900	16 300	18 029	15 721	15 394	11 131	11 961	12 567	830 862
12. Sri Lanka	500	8100	12 500	14 170	15 263	23 890	24 110	25 340	21 290	787 766
13. USA	2613	2795	1700	11 221	34 576	30 935	22 072	24 076	35 372	750 990
14. Peru	1300	7200	19 000	13 277	12 266	15 405	11 870	16 633	8613	643 689
15. Malaysia	2500	3000	6600	10 855	17 360	24 521	25 209	24 167	27 948	619 672
16. USSR	.	100	26 376	12 649	-	-	-	-	-	588 017
17. Thailand	2000	4300	11 400	9456	10 950	24 689	24 278	30 208	24 724	580 727
18. Nigeria	1300	2000	8300	21 476	8402	13 238	14 626	13 449	15 179	457 656
19. New Zealand	1000	2000	2600	6590	10 108	17 718	19 796	21 238	18 459	383 979
20. Portugal	3100	2200	1900	4095	26 563	12 783	13 854	14 016	16 999	380 556
TOTAL	241 113	296 335	403 583	486 659	541 834	660 029	622 435	617 357	627 306	

It is also interesting to note that most of the shark catch is harvested by relatively few countries. Catches of the major shark catching countries between 1950 and 2003 are summarised in Table 2. In the latter, twenty States or Provinces harvested 80% of the reported global shark catch, with five of them contributing 40% of the reported total catch (Lack & Sant 2006b). The proportion of global catches provided by each country is shown in Table 3.

Table 3. Proportion of total shark captures by top 20 catching countries in 2003.
(Source: FAO Fisheries Department 2000, in Lack & Sant 2006b)

Country	%Total shark catch 2003	Country	%Total shark catch 2003
1. Indonesia	14.09	11. Thailand	2.89
2. Taiwan PoC	7.87	12. France	2.63
3. India	7.38	13. Sri Lanka	2.49
4. Spain	7.19	14. United Kingdom	2.29
5. USA	4.13	15. New Zealand	2.15
6. Pakistan	3.88	16. Portugal	1.98
7. Argentina	3.7	17. Iran	1.86
8. Mexico	3.6	18. Nigeria	1.77
9. Malaysia	3.26	19. Brazil	1.47
10. Japan	2.91	20. Korea	1.47

Bycatch and Discards

According to FAO (2007c), **bycatch** is 'the part of a catch of a fishing unit taken incidentally in addition to the target species towards which fishing effort is directed. Some or all of it may be returned to the sea as discards, usually dead or dying'. In turn, **discard** is defined as 'to release or return fish to the sea, dead or alive, whether or not such fish are brought fully on board a fishing vessel'. Discards represent a significant proportion of global marine catches and are generally thought to constitute waste or suboptimal use of fishery resources (Kelleher 2005). This problem is not restricted to shark species.

Sharks are caught as bycatch in many commercial fisheries and by most fishing methods (Bonfil 1994, Rose 1996). For fishermen who are not targeting sharks, lost revenue from shark predation on hooked targeted species can amount to several thousand U.S. dollars in a single set in some fisheries (Gilman *et al.* 2007). But the growing value of shark parts and products, combined with declining stocks of traditional target species has turned them into an increasingly important component of the economic and food value of fisheries, thus shifting from a largely unwanted, discarded bycatch, to a by-product or joint catch, or even the main fishing target. However, the contribution of bycatch and discards to overall shark mortality is still very important. And several species of sharks taken as bycatch and subject to trade are of particular concern owing to their rarity or dependence on threatened or degraded habitats (Fowler *et al.* 2005).

Figure 10. Sharks caught as bycatch A bigeye thresher *Alopias superciliosus* caught when targeting billfish in Manta, Ecuador (Photo: Carlos Polo-Silva & Felipe Galván).

Being inshore animals, sawfishes are in close proximity to human activity and fisheries, and their unique tooth-studded rostrum (sometimes also called saw) leaves them disproportionately vulnerable to entanglement in nets and other fishing gear. Bycatch is even more problematic for the freshwater sawfish *Pristis microdon*, as individuals are unable to move away from threats in their landlocked habitat (McDavitt 2006).

In some pelagic longline fisheries, shark interactions pose substantial economic, ecological and social problems. Information on existing fisher knowledge and new strategies for shark avoidance may benefit sharks and fishers wanting to reduce shark interactions. Improving the understanding of current and projected future longline industry attitudes and practices towards shark interactions will provide industry and management authorities with better information to manage these problems (Gilman *et al.* 2007).

Beyond bycatch and discards, it is important to note that no allowance has been made for the numbers of sharks and other fish killed through interactions with fishing gear that do not result in their capture. These unobserved mortalities may be caused by the impact of trawl gear on the bottom, escapement or drop-out from nets, ghost fishing by lost or drift nets and similar gear inefficiencies (Kelleher 2005). In either case, these can become relevant mortality causes that can have a detrimental effect on wild populations of sharks and other fish species.

It is difficult to determine the numbers of sharks being captured as bycatch and/or discarded from fishing operations worldwide. Most countries do not require reporting of shark bycatch in logbooks, so few bycatch data are incorporated into FAO statistics. And although observer programmes provide the best available information, coverage on the high seas is minimal.

Even in those cases where data are available, Bonfil (1994) cautioned against extrapolating the catch rates from one fishery to another, because of the wide variation in the distribution of sharks. Although the extent of bycatch and discards is poorly documented, Kelleher (2005) reports shark discards occurring in the following fisheries:

- **Deepwater shrimp fisheries.** Located mainly on the slopes of the continental shelves (100–600 m depth) in both tropical and temperate regions. Most of the discard database records are from the Mediterranean and North Atlantic and indicate a high level of discards (20%-94%). The deepwater shrimp fisheries contribute over 70 000 tonnes to the global discard estimate. The main discards include small sharks (dogfish), rays, hake and blue whiting.

- **Shrimp/prawn trawling.** Sawfishes are taken as bycatch by a number of fishing gear types, including shrimp/prawn trawls and gillnets (CITES CoP14 Prop.17). In Australia, prawn fishermen often retain the valuable fins and saws of incidentally captured pristids (Pender *et al*. 1992, Rose & McLoughlin 2001, both in McDavitt 2006). Conservation efforts which benefit other species may be of marginal value to sawfishes. For example, initial tests of Turtle Excluder Devices (TED) in Australia's Northern Prawn Fishery revealed a benefit to shark species: though designed for sea turtle escape, the TED also excluded nearly all shark (Rose & McLoughlin 2001 in McDavitt 2006). The same effect has been found in the Gulf of California shrimp fishery, although enforcement of the current regulation that makes mandatory the use of TED in shrimp trawlers is still an issue: trawlers have installed the mandatory devices, but they trawl without closing the TED doors (Márquez-Farías pers. comm. 2001). However, TED have had little impact on sawfish mortality, since a sawfishes' toothy rostrum can become easily entangled in the trawl netting or even in the TED itself (McDavitt 2006).

- **Deepsea (deepwater) finfish fisheries.** These are located on continental slopes and high seas plateaus or on seamounts outside coastal state jurisdiction. Several types of gear, including trawls, longlines and gillnets are used, causing growing concern over the status of these fisheries. With the exception of small-scale dropline fisheries, discards are considered high in many deep sea fisheries. The discard database records from fisheries in the Northeast Atlantic and Chile give a weighted discard rate of 39.6 percent (range 31%-90%) and total discards of 37 000 tonnes. These fisheries target grenadier *Coryphaenoides* sp, ling, 'siki sharks' and orange roughy. Discards have been particularly high in the French fishery for roundnose grenadier. Teleosts and sharks such as birdbeak dogfish *Deania*, batoids and chimaeras are discarded. There is evidence that survival of discards from these fisheries is low, because of the great depth from which catches are raised and the length and volume of trawl hauls.

Figure 11. Sharks are often caught by gillnets (Photo: Mauricio Hoyos).

- **Longline.** Smaller longliners tend to have shorter trips and retain more sharks and other non-target species. The long-range (mostly Asian) vessels are likely to discard greater quantities of bycatch. Discard rates for the long-range vessels vary from 30% to 40%. The discard rate of 40% is applied in the absence of other information and a rate of 15% is applied to the smaller, locally based longline vessels. Principal discards include blue shark *Prionace glauca* (probably the most commonly discarded species), requiem sharks *Carcharhinus* spp. and others (some fleets routinely fin these discards), damaged fish, albatross, petrels and other seabirds. Prior to 2005 landings of sharks were not recorded in the IOTC database and it is assumed that industrial longliners discarded the catch of these and other species. Sharks, particularly deep-sea species, are the most important component of the bycatch on the hake semipelagic near-bottom 'pedra-e-bola' longline fishery in the Algarve (South Portugal) and most of these fish are discarded (Coehlo *et al.* 2003).

- **Purse seine.** Discard rates vary from 1.5% in small Mexican seiners to 6.9% in the IATTC area. Other discard rates are Atlantic, 4.1%; Indian Ocean, 5%; and SPC area, 5.9%. Total recorded discards are approximately 145 000 tonnes. Discards include undersized target species, non-commercial tunas, shark, dolphinfish *Coryphaena hippurus*, billfish and mantas. Bycatch and discards are much greater for sets made on fish aggregation devices (FAD) which are now very commonly employed (Fowler, pers. comm. 2008).

- **Bottom longline.** Discards of non-quota species occurs, such as arrowtooth flounder, starry ray, hake, shark, macrourids and rajids.

- **Shark fisheries.** It is likely that weights of discarded sharks and other species can be derived from available longline observer data and a more accurate estimation of discards can be made at the RFMO level. But in the absence of recent comprehensive data, Kelleher (2005) inferred a longline discard rate has been estimated in the Indian Ocean of 21.7% of the total catch. Besides, and assuming that carcasses of all finned sharks globally are discarded[1], over 200 000 tonnes of shark are discarded annually as a result of finning (discard rate of 96%). Independently, discards of sharks in high seas fisheries alone are estimated to account for 204 000 tonnes annually (Bonfil 1994).

Although they are limited, shark avoidance practices exist, including avoiding certain areas, moving when shark interaction rates are high, using fish instead of squid for bait and deeper setting of fishing gear. Some conventionally employed fishing gear and methods used to target non-shark species contribute to shark avoidance (Gilman *et al.* 2007). In longlines, for example, these include hook selectivity, hook position (Coehlo *et al.* 2007), restrictions on wire traces and minimum lengths of longline gudgeons to reduce unwanted shark bycatch or to increase survival rates. Other methods include night setting; disposal of offal; use of weights and line shooters for underwater setting; examination of the relationship between propeller rotation and line sinking (Kelleher 2005); and gillnet selectivity (Márquez-Farías 2005). Chemical, magnetic, electrical and electropositive rare earth metal shark repellents and deterrents also seem to be a promising line, although more research and development is needed (Gilman *et al.* 2007). Development of specifically designed equipment to discard sharks could improve shark post-release survival prospects, reduce gear loss and improve crew safety.

In the particular case of sawfishes, bycatch mortality can be significantly reduced where the financial incentive to land sawfishes is removed, and fishermen are trained on how to remove sawfishes safely and efficiently from their gear (McDavitt 2006).

Illegal, Unreported and Unregulated Fishing

Illegal, unreported and unregulated (IUU) fishing is a problem faced to varying degrees by all fishing countries. This activity has two main impacts. Firstly, it compromises the accuracy of the data used by scientists to undertake stock assessments and formulate management advice and generally leads to an underestimate of fishing mortality. The fact that scientific advice may be unduly optimistic as a result of IUU fishing increases the

[1] Estimation made by Kelleher (2005) using the following information: International trade in shark fins totals approximately 5 000 tonnes (recorded quantities as per FAO Fishstat commodity statistics). Real quantities are considered to be closer to 9 000 tonnes, re-exports excluded. Fins are here considered to constitute approximately 2.5% of the live weight of the shark (5% of dressed carcass weight). Trade information and fin yield information from IUCN SSC Shark Specialist Group. Fin yield is derived from United States studies on *Prionace glauca*.

likelihood that management measures will not reflect the true status of the stock. Even where IUU fishing is known to occur, it is extremely difficult to estimate the level of the total catch and to consider this parameter into stock assessments. Secondly, where conservation and management measures are in place, IUU fishing undermines the effectiveness of those measures (Lack 2007).

Importantly, IUU fishing not only affects target stocks. It ignores other conservation and mitigation measures such as those designed to mitigate bycatch. Failure to comply with such measures can make fishing operations cheaper relative to that of legal operations and allows IUU-caught product to be offered at a lower market price. This undercuts legitimate operators and places increased economic pressure on them, providing an incentive to fish illegally and/or to place more pressure on managers to resist tightening of management restrictions.

Currently, Australia is preparing a report which brings together all the different aspects of IUU fishing and its relevance to shark catch (CITES AC23 WG6 Doc.1). This information will certainly be relevant for improving shark fisheries management.

Shark Product Identification Techniques

A number of States have their own identification guides for shark species, often focusing in local species. FAO has produced global and many regional fish identification guides, now also available on CD. Some of them are even being periodically updated and improved. However, these are of limited application and sometimes not available to all users. Most importantly, these guides are usually good for identifying whole or nearly whole specimens, but are of little use for identifying parts and products in trade (CITES AC22 Inf.3).

In accordance with the provisions of Resolution Conf. 11.19, Australia, India, the Philippines and the United Kingdom prepared identification sheets for great white shark *Carcharodon carcharias*, whale shark *Rhincodon typus* and basking shark *Cetorhinus maximus*. On November 2007, the identification sheets in English, French and Spanish, as well as in Cantonese, Indonesian and Mandarin were expected to be available soon through the CITES Identification Manual on the CITES website (CITES Notification to the Parties No. 2007/042).

Some molecular tests exist for identifying shark products and derivatives. DNA fingerprinting techniques have already been developed for great white shark *Carcharodon carcharias.* Shivji *et al.* (2002, in CITES CoP14 Inf.12) have developed a species-specific primer and highly efficient multiplex PCR (Polymerase Chain Reaction) screening assay for the products of several sharks, including porbeagle *Lamna nasus*, makos *Isurus* sp., silky shark *Carcharhinus falciformis*, blue shark *Prionace glauca*, sandbar shark *C. plumbeus* and dusky shark *C. obscurus*. Cost per sample processed varies from USD$20-60, depending upon condition of sample, being less for large numbers. Turn-around time is between 2 and 7 days from receipt of sample, depending upon urgency. These tests can already distinguish between northern and southern stocks, and should soon be capable of simultaneously identifying the species and population of origin. Thus, these techniques are too expensive for routine identification use, although they are indeed useful to detect infringements and enforce regulations.

In some cases, the most commonly traded product is often identified by species name, especially when prizes for that particular species reach market good value, as is the case for the meat of porbeagle *Lamna nasus* (CITES CoP14 Prop.15). However, relying solely on the producers' and traders' information does not appear to conform to proper trade regulation. For example, records of 'spurdog' imports from Argentina recorded on the EU customs database include the meat of at least two other small shark species (Fowler, pers. comm. 2008).

Figure 12. Silky shark *Carcharhinus falciformis*, one of the species for which molecular identification tests have been developed (Photo: Mauricio Hoyos).

Easy-to-use and affordable identification techniques are needed for shark parts and derivatives entering international trade, if trade records are to be accurately recorded. Still, a further problem to be considered is that species-specific information is not available for custom codes, which are a mandate of the World Customs Organisation.

In the case of fins, the characteristic shapes of most fins make morphological identification possible and practical, if adequate guides are used. An identification guide for shark fins is in preparation by Pascal P. Deynat, Museum National d'Histoire Naturelle, Paris, in cooperation with WWF. It was expected to be finished in the course of 2007 (CITES CoP14 Inf.12).

International Trade: Data and Trends.

Estimating the scale of international trade in shark products is complicated by discrepancies between data sources. Data on imports, exports and production figures seldom match, for a variety of reasons. Unlike production figures, import and export figures are subject to biases introduced where the same goods are counted each time they are consigned or transhipped en route to their final destination. However, analysis of existing data still allows to have a general idea of the existing trends of trade in shark products.

Where sharks are taken in order to supply international trade demand, the main products are fins and meat, probably in order of significance and economic importance. Most fisheries yield these products, but while fins are nearly always retained, meat is not. Both the international and domestic trade of shark products are complicated to track. Trade usually involves fresh, frozen, dried, semiprocessed and processed products. Their origin may be in local, national or foreign fisheries. Shark products may be delivered to traders in shipments which have been mixed, sorted and graded according to specific market requirements, and not necessarily according to their origin. The use of commodity codes also varies considerably among countries, further complicating the traceability of products by species and provenience.

Based on import and export data reported to FAO, exports of shark products doubled between 1990 and 2003. Exports totalled 86 500 tonnes in 2003, with a value of US$249 million. The ten countries exporting most shark products in 2003 were (in decreasing order) Taiwan PoC, Spain, Costa Rica, Chile, United Kingdom, Japan, Panama, New Zealand and the USA (Lack & Sant 2006b).

With regard to the most important States importing shark products in 2003, these include in decreasing order Spain, Republic of Korea, Hong Kong SAR, Mexico, Italy, China, Brazil, France, United Kingdom and Singapore (Lack & Sant, 2006b). In 2005 this group included Spain, Hong Kong, China, Brazil and Mexico (Josupeit, 2008). States that are not recording trade using Customs codes for sharks were not included in these analysis.

Meat. According to FAO statistics (summarised by Clarke *et al.* 2005), reported production of fresh, frozen and cured shark meat and fillets more than doubled from approximately 31 500 tonnes in 1985 to over 73 000 tonnes in 2000. Throughout this period more than half of all production was in the form of frozen whole sharks, with a large portion of the remainder, particularly in recent years, being sharks in dried or salted whole form. Major producers of frozen shark meat (>10 000 tonnes annually) in 1998–2000 were Spain and Japan, whereas Pakistan dominated dried and salted shark production (>20 000 tonnes annually).

According to the same source, reported exports of fresh, frozen and cured shark meat and fillets have grown in parallel with production and, in 2000, were roughly equivalent in quantity: approximately 73 350 tonnes and valued at over US$152 million. The UK and Ireland led exports in the mid-1980s; as Ireland’s exports began to decline in 1989, the UK was joined by Norway in dominating the export market until 1993. The USA was the world’s largest exporter from the mid-1990s until 1997, when Spain’s exports soared to capture 20%-30% of the world market. Other major exporters (consistently >2 000 tonnes annually) in the late 1990s included Japan, New Zealand, and Taiwan PoC.

Finally, recorded imports of shark meat have increased from approximately 34 500 tonnes in 1985 to 70 900 tonnes, valued at over US$145 million in 2000. Italy and France dominated imports of shark meat (7 000–15 000 tonnes annually) from 1985 until 1998. In this year Spain surpassed France and in 2000 Italy to become the world’s largest importer (13 913 tonnes in 2000). The only other major importer (consistently >2 000 tonnes per annum) in 1998–2000 was the UK. These statistics indicate that the European Union (EU) is the main importing region, although this could be due to better recording of this trade compared with other nations (Vannuccini 1999).

Figure 13. Dried or salted whole carcasses are one of the most common shark products in trade.
Shark carcasses drying in Piura, Peru (Photo: Ernesto Ruiz).

Fins. Because of their high market value, fins represent a particular case of internationally traded shark product. According to Lack & Sant (2006b, based on FAO data), exports of dried, salted shark fins peaked in 1996 at 4 251 tonnes. After falling for several years afterwards, exports of dried, unsalted shark fins increased since 2000 and peaked in 2003 at 2 079 tonnes.

At least 125 countries are involved in the shark fin trade, with Hong Kong Special Administrative Region (SAR), China and Singapore at its centre. In terms of producers, Taiwan (Province of China, PoC) reported annual production averaging nearly 1 000 tonnes from 1980 to 1996, although most is consumed domestically (Rose 1996). The most important suppliers appear to have been China, Singapore, Japan, Indonesia and the USA. According to Hong Kong SAR Customs data, total reported imports of shark fin rose from 2.7 million kilograms in 1980 to 6.1 million in 1995: an increase of more than 120%. It must be noted, though, that much of the increase appears to be fins counted at least twice in trade, which were exported from Hong Kong to China for processing and then re-exported back to Hong Kong for domestic consumption or export. This repeat counting of the fins in trade may also appear in trade statistics for China, Singapore and regional trade centres, such as the USA and Yemen (Rose 1996).

Imports in Hong Kong SAR until 2000 suggest that the trade grew by 5% per year. However, at that time China joined the World Trade Organisation and changed the commodity coding system in use: frozen shark fins are now classified grouped with frozen shark meat. Therefore, although it appears to have acquired an increasingly larger proportion of the world trade, it is impossible to quantify trade levels accurately (Clarke 2004b). Still, according to FAO data, quantities of shark fins traded globally are rising, while their value is falling (Josupeit, 2008).

The Hong Kong SAR auction market consists of at least 17% blue shark and only 14 species made up approximately 40% of the market. Based on extrapolated auction data, the number of sharks represented in the global shark fin trade per year is estimated at approximately 40 million (Clarke 2004b). The value of the global trade in shark fins is estimated at USD$400-550 million. Comparison to FAO databases indicates underreporting for shark fins such that an alternative minimum estimate of world trade is at least twice the FAO estimates in 1998-2000 (Clarke 2004a).

The main exporters of shark fins in 2005 were, in order of importance, Taiwan, Spain, Panama, Costa Rica, Japan and Canada. In all, these countries exported around 2 000 tonnes of shark fins, with a value of USD$150 million (Josupeit, 2008).

Due to clear anatomical reasons, the total volume of shark meat entering international trade is far greater than the volume of fins. However, the average economic value of shark fins vastly exceeds that of shark meat and, taking into account domestic consumption and finned carcasses discarded at sea, the number of sharks entering the fin trade is likely to significantly exceed the number of those whose meat is traded.

Liver Oil. Japan has historically been one of the most important squalene producers. While export data are not available for Japan after 1980, South Korea reported importing an average of 52 tonnes annually from Japan during 1987 to 1994. It is estimated that one tonne of squalene could require the livers of some 2 500 to 3 000 sharks, many of which are derived from unsustainable deepwater fisheries.

The decline in the last few decades of shark liver and liver oil processing and marketing by many former suppliers may be due to the difficulty of collecting the livers and the strong odour of the products. Much of the current production has shifted to developing countries. In terms of consumption, South Korea appears to be among the world's largest consumers, with 364 tonnes of shark liver oil imported in 1994 alone. European markets for shark liver oil or squalene products appear to be growing: these products were found on the market in Belgium, France, Germany, Greece, Iceland, Netherlands, Spain and the U.K. Growing European markets are also indicated by the development of new fisheries for liver oil in Spain (Rose 1996).

Cartilage. Since it is a relatively new product on the market, neither national fisheries agencies nor Customs agencies report production or trade volumes. Nevertheless, research made (Rose 1996) shows that major producing nations include Australia, Japan and the USA, where it is likely a by-product of meat utilisation. Shark cartilage is also supplied by and/or manufactured in a number of other countries, such as Argentina, Mexico, New Zealand and possibly Kenya. In the USA, pre-packaged cartilage products are marketed and exported under dozens of brand names to about 35 countries. In Europe, shark cartilage products are commonly marketed in Belgium, France, Germany, Greece, Italy, the Netherlands, Spain and the U.K. Retail prices can be high, in some cases reaching up to US$100 for a single bottle of capsules.

Aquaria. Sawfishes have historically commanded high prices in the aquarium trade. Currently, an Australian exporter regularly sells sawfishes to public aquaria worldwide. Under 2005 pricing, *Pristis zijsron* and *P. microdon* sell for US$1 650 each, and *P. clavata* sells for US$1 750 each (McDavitt 2006).

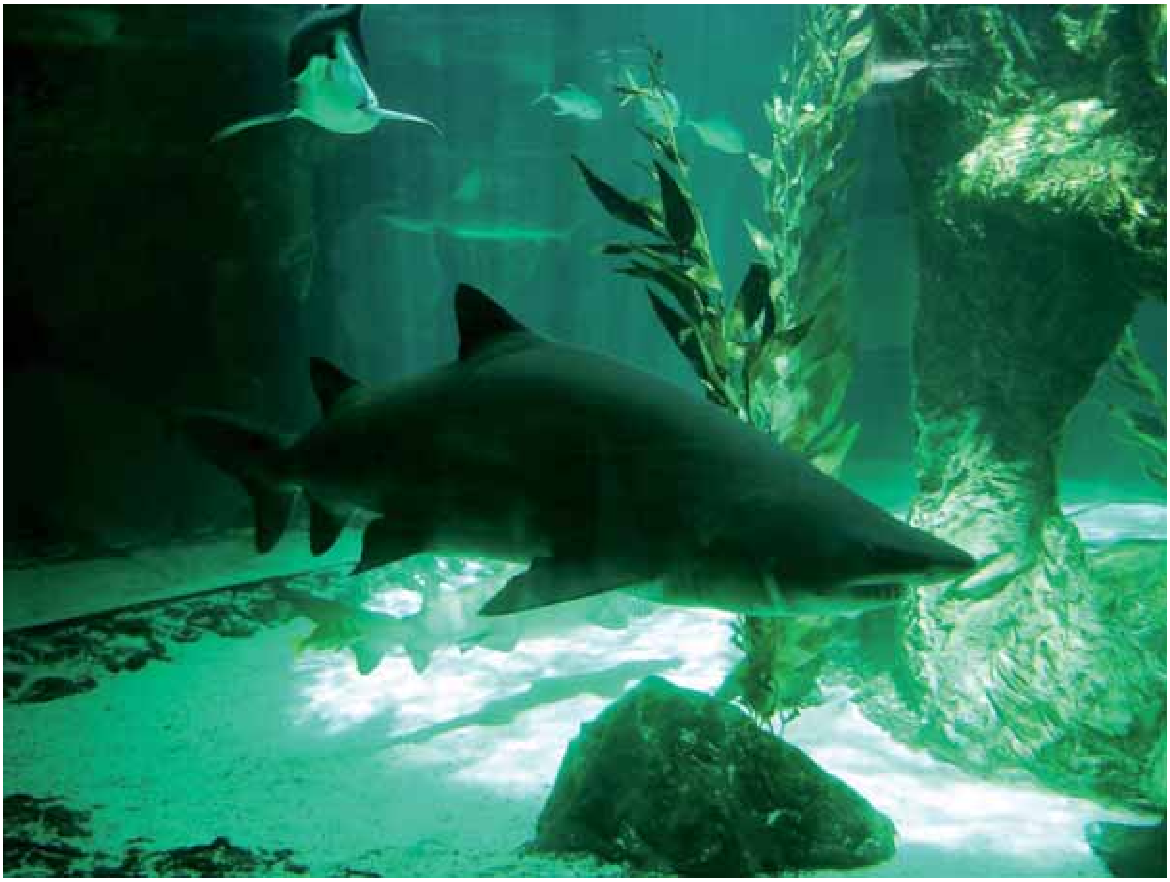

Figure 14. Sand tiger shark *Carcharias taurus*, a species commonly displayed at public aquaria. Here, in Zoo Aquarium de Madrid, Spain (Photo: Eréndira García).

Juvenile specimens of freshwater sawfish *P. microdon* continue to be supplied to the international market by exporters in the Jambi province of Sumatra, Indonesia. Even though this is a targeted fishery, the volume is apparently low since the animals themselves are scarce, with reported annual estimates under 20 animals per year. There is demand for these animals from private aquarium enthusiasts in Germany, Taiwan PoC and Japan, as well as from public aquaria worldwide (McDavitt 2006). As for freshwater stingrays (family Potamotrygonidae), official records of exports for aquarium trade are currently being kept in Brazil, although they only represent a fraction of freshwater stingrays entering international ornamental fish trade (CITES AC20 Inf. 8).

Curios. Before online auctions became prevalent, sawfish rostra were usually sold locally as curios, through biological supply companies, antique stores, or in shell shops (McDavitt 2006). Ongoing daily trade in sawfish rostra occurs on eBay and other online auction houses. A six month study of sawfish rostra sales on eBay reported that the maximum price realised in an auction for a rostrum was US$1 242 (McDavitt & Charvet-Almeida 2004).

In the case of the great white shark *Carcharodon carcharias*, teeth and jaws have a particularly high economic value. A jaw of a white shark from Gansbaai, South Africa, recently recovered after being stolen, was valued at US$50 000. Small jaw sets may be sold for US$12 500 to US$15000, and individual teeth for US$425 to US$600. There is also reportedly a commercial market for neonates. Increased scarcity of white sharks is considered inevitably to result in significantly increased economic value of their jaws and teeth, possibly leading to increased targeting and over-exploitation, as well as growth of a black market for these highly profitable products (CITES CoP13 Prop.32).

The Role of CITES: Non-Detriment Findings

CITES and Non-Detriment Findings

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival, through subjecting international trade in specimens of species included in their Appendices to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. For the purposes of the Convention, each Party must designate one or more Management Authorities competent to grant permits or certificates on behalf of that Party, and one or more Scientific Authorities.

CITES has three species lists known as Appendices. Appendix I includes species threatened with extinction which are or may be affected by trade. Appendix II includes species which, although not necessarily now threatened with extinction, may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilisation incompatible with their survival. Appendix III includes species which any Party has identified as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the co-operation of other Parties in the control of trade.

As Articles III and IV of the Convention state, export permits for specimens of species included in Appendices I and II shall only be granted when, among other requisites, a Scientific Authority of the exporting country has advised that such export will not be detrimental to the survival of the species concerned. Such reports are called Non-Detriment Findings (NDF). Equally, the compulsory certificate for introducing from the sea any such specimen also requires NDF from a Scientific Authority of the State of introduction. This shall be done in consultation with other national scientific authorities or, when appropriate, international scientific authorities. Conversely, import permits for Appendix I species require among other conditions that a Scientific Authority of the State of import has prepared the corresponding NDF. Some important markets, such as the EU, also develop assessments equivalent to NDF before allowing imports of Appendix II specimens.

In addition, in Resolution Conf. 10.3 – Designation and role of the Scientific Authorities, the Conference of the Parties (CoP) to CITES recommends that Management Authorities not issue any export or import permit, or certificate of introduction from the sea, for species listed in the Appendices without first obtaining the appropriate Scientific Authority findings or advice (NDF). It also recommends that the findings and advice of the Scientific Authority of the country of export be based on the scientific review of available information on the population status, distribution, population trend, harvest and other biological and ecological factors, as appropriate, and trade information relating to the species concerned.

Consequently, Scientific Authorities of exporting countries, and sometimes also from importing countries, are continually challenged to define whether a particular export will be detrimental to the survival of a species. Therefore, it is important to have documented guidelines and methodologies to make more complete and scientifically sound findings that facilitate the implementation of the Convention, hence improving the benefits for wildlife populations.

Sharks in the CITES Appendices

Concern for the conservation of some shark species has resulted in ten species being listed in the CITES Appendices. In 2002, whale shark *Rhincodon typus* and basking shark *Cetorhinus maximus* were included in Appendix II of the Convention, followed in 2004 by the great white shark *Carcharodon carcharias*. Basking shark had previously been included in Appendix III for the United Kingdom, being this also the case for the great white shark and Australia. Subsequently, since the 13th September 2007, six of the seven living species of sawfishes (family Pristidae: *Anoxypristis cuspidata, Pristis clavata, P. pectinata, P. perotteti, P. pristis* and *P. zijsron*) are included in Appendix I, while *Pristis microdon* is included in Appendix II for the exclusive purpose of allowing international trade in live animals to appropriate and acceptable aquaria for primarily conservation purposes (ENB 2007). This exception, however, appears to be unnecessary. Although specimens of Appendix I listed species are not to enter international commercial trade, Article VII of the Convention provides that such provisions do not apply to the non-commercial loan, donation or exchange between scientists or scientific institutions registered by a Management Authority of their State.

It is worth mentioning that the taxonomy of family Pristidae is currently under scientific review, and the published distribution of individual species may also change to align with taxonomic modifications (CoP14 Amendment Proposal 17). It could therefore be expected that, should a new species be described, it would automatically be included in the corresponding Appendix. However, this would not be necessarily the case. According to a recent report by the World Conservation Monitoring Centre of the United Nations Environment Programme (UNEP-WCMC 2007), 36 mammal species, 8 bird species, 20 reptile species, 4 amphibian species and 3 fish species were newly described in 2002 (2 species), 2003 (6 species), 2004 (6 species), 2005 (11 species), 2006 (37 species) and 2007 (9 species), and are covered by CITES higher taxon listings. However, since they have not been yet considered by the Convention's Animals Committee they will, therefore, not be approved by the CoP until at least 2010, when the next CoP(15) is scheduled. The status of such species is clearly poorly known at present and it would be desirable that they should not be subject to trade until their situation is better known. The convenience of having newly described species immediately included in the Appendices, if a higher taxon is already listed, is obvious, since the situation regarding environmental and trade-related threats to the species' survival are likely to be similar, or even worse.

History. CITES concern on sharks began long before including shark species in its Appendices. Since 1994, the conservation and management of sharks has been included in the agenda for the CoP and the Animals Committee (AC) meetings, originating the creation of an *ad hoc* Working Group of the AC and being the subject of productive intersessional work. When it became originally an agenda item, proposed by the USA, the aim was twofold: 1) to encourage discussion of how best to collect data on international trade in shark parts and products, particularly how to document catches by species; and 2) to collect data that would provide the best information about the impact of international trade (including introduction from the sea) in shark parts and products, both on shark populations and on their ecosystems (CITES CoP9 Doc 9.58). The result was Resolution Conf. 9.17, which *inter alia* directed the AC to review information provided by Parties on the trade and biological status of sharks, including historical catch and trade data on shark fisheries. It also requested FAO and other international fisheries management organisations to establish programmes to further collect and assemble the necessary biological and trade data on shark species. As mentioned before, this Resolution was a seed for the existing IPOA-Sharks developed by FAO (see 'International Fisheries Management Organisations' above).

After discussions at CoP10 (1997, CITES CoP10 Doc. 10.51), Decision 10.48 was adopted, aiming to assist the effective implementation of Resolution Conf. 9.17 through the improvement of those methods and systems used to identify, record, and report landings of sharks from directed fisheries and those taken as bycatch. Furthermore, Parties with shark fisheries were to initiate efforts to collect a range of species-specific data, and to reduce the mortality of sharks caught through incidental catch in other fishing activities. Through Decision 10.48, Parties were encouraged to initiate management of shark fisheries at the national level, and to establish international and regional bodies to coordinate management of shark fisheries, to ensure that international trade would not be detrimental to the long-term survival of shark populations.

Figure 15. The great white shark *Carcharodon carcharias* is included in Appendix II of CITES since 2004 (Photo: Roberto Chavez).

Resolution Conf. 9.17 was later repealed in 2000, at CoP11, following the adoption of the FAO IPOA–Sharks, but actions regarding monitoring its implementation and improving international records of trade in shark products were included in Decisions 11.94 and 11.151. Decision 11.94 addressed the maintenance of the existing liaison between the Secretary of the Committee on Fisheries of FAO and the Chairman of the CITES Animals Committee, in order to monitor the implementation of the IPOA-Sharks. The results of this liaison were reported regularly at meetings of the Animals Committee and the CoP. Decision 11.151 instructed the CITES Secretariat to maintain liaison with the World Customs Organization, to promote the establishment and use of specific headings within the Harmonized System of Standard Tariff Classifications, to discriminate between shark meat, fins, leather, cartilage and other shark products entering international trade.

The subject was further discussed in CoP12 (2002, CITES CoP12 Doc. 41.1 and Doc. 41.2), resulting in Resolution Conf. 12.6, which, *inter alia*, instructed the CITES Secretariat to urge FAO to take steps to actively encourage relevant States to develop

NPOA-Sharks. It also directed the AC to continue activities specified under Decision 11.94, critically review progress towards IPOA and NPOA-Sharks implementation by major fishing and trading nations, examine information provided by range States on shark assessment and make species-specific recommendations to the CoP. On the same CoP meeting, three Decisions were made: Decision 12.47, on the liaison with FAO and reporting on progress with implementation of the IPOA-Sharks; Decision 12.48, on the transmission to FAO of concerns regarding progress with the IPOA-Sharks and encouraging States and regional fisheries management agencies in its implementation; and Decision 12.49, encouraging Parties to report progress on national implementation of the IPOA-Sharks at future meetings of the Animals Committee. CoP12 also approved the inclusion of the basking shark *Cetorhinus maximus* and the whale shark *Rhincodon typus* in Appendix II.

As instructed, the AC continued working in regular meetings and intersessionally, reporting progress made at CoP13 (2004, CITES CoP13 Doc. 35). The CoP made two Decisions in response to the AC recommendations. Decision 13.42, *inter alia*, invited Parties to request FAO to convene a workshop for considering and reviewing progress with the implementation of the IPOA-Sharks (held in 2005) and assessing the effectiveness and efficiency of current conservation and management measures for shark populations. It also encouraged them to improve their data collection and reporting to FAO catches and landings of and trade in sharks, as well as to take note of the species-specific recommendations made by the AC. On the other hand, Decision 13.43 directed the AC to review implementation issues related to sharks listed in the CITES Appendices, identify specific cases where trade had an adverse impact on sharks, and prepare a report on trade-related measures adopted and implemented by Parties that were aimed at improving the conservation status of sharks. However, experiences and solutions were likely to be limited, since the inclusion in Appendix II for whale and basking sharks were only two years old and the great white shark had been listed at that CoP.

To address the abovementioned tasks, the *ad hoc* Working Group of the AC participated in a Workshop on April 2006, assisted by shark conservation and shark fisheries experts, including the Shark Specialist Group of IUCN (CITES AC22 Doc. 17.1 and Inf.3). The Working Group reviewed implementation issues through information provided by Parties (responses to Notification to the Parties No.2005/044), trade-related threats to sharks, and the list of species made (CITES AC20 Inf.28 and CoP13 Doc. 35) in order to identify key species facing trade-related threats. Intersessional work continued afterwards in order to meet the objectives traced. The results of these three reviews and the related recommendations were reported on July 2006 to the AC (CITES AC22 Doc. 17.2, Doc. 17.3 and Doc. 17.4, respectively). At the same meeting, the Working Group reconvened to, under the mandate from the AC: 1. draft a report for CoP14 concerning the implementation of Decision 13.43, including clear conclusions and recommendations; 2. draft a report identifying key shark species for consideration and possible listing under CITES, and 3. formulate species-specific recommendations on improving the conservation status of sharks and the regulations of international trade in these species. Another task was to review the shark listing proposals and associated annotations and decisions prepared by Germany on the spiny dogfish *Squalus acanthias* and the porbeagle *Lamna nasus*, and give technical and scientific input thereon.

CoP 14. The AC presented to CoP14 (2007, CITES CoP14 Doc. 59.1) the report and proposals resulting from the work of the Working Group during AC22. Since Australia introduced further recommendations (CITES CoP14 Doc. 59.2), a Working Group established by the CoP worked on consolidating and simplifying the two proposals. The outcomes took the form of 17 Decisions (CITES Decisions 14.101 to 14.117) on: implementation and effectiveness of shark listings; commodity codes for international trade, species-specific reviews and recommendations, South American freshwater stingrays (family Potamotrygonidae), capacity building, the IPOA-Sharks, and illegal, unregulated and unreported (IUU) fishing. Through these Decisions the CoP, *inter alia*, encourages Parties, when considering proposals to include shark species in the CITES appendices, to consider factors affecting implementation and effectiveness such as NDF for commercially-traded marine species, monitoring and enforcement practicalities, and the likely effectiveness of listing. It also encourages shark fishing and trading entities to improve, in cooperation with FAO and relevant fisheries management bodies, the monitoring and reporting of catch, bycatch, discards, market and international trade data, and to establish systems to provide verification of catch information. Finally, it directs the AC, in consultation with FAO, to report on linkages between the trade in shark fins and meat and IUU shark fishing activities, including the main shark species taken by IUU fishing and the relative importance of fins compared to meat in trade arising from IUU fishing.

Figure 16. Spiny dogfish *Squalus acanthias* was proposed for inclusion in Appendix II of CITES in 2007. (Photo: Mauricio Hoyos).

Also at CoP14, the European Union presented two proposals to include sharks in Appendix II: porbeagle shark *Lamna nasus* (CITES CoP14 Prop.15) and spiny dogfish *Squalus acanthias* (CITES CoP14 Prop.16). However, the proposals failed to achieve a two-thirds majority vote, being therefore rejected. There was also a proposal for adopting trade measures regarding both species (CITES CoP14 Doc.59.3), but it was again rejected by the CoP. Most opponents to these proposals criticised the little proof of domestic conservation efforts inside the EU, despite several years of quota management for spiny dogfish and the recent closure of the target fishery for this species. This highlights the necessity of adopting prior conservation measures in order to build a successful listing proposal. Later on the same meeting, the CoP approved the inclusion of sawfishes (family Pristidae) in the Appendices, proposed jointly by Kenya and the USA (CITES CoP14 Prop.17).

Provisions of Decisions 14.104, 14.106, 14.108 and 14.115 are addressed by the Notification to the Parties 2007/033, which requests: 1. all Parties to report progress in identifying endangered shark species that require consideration for inclusion in the Appendices, if their management and conservation status does not improve; 2. Parties landing and exporting products from shark species of concern identified by the AC (Annex 3 to document CoP14 Doc. 59.1) to report on the fisheries, environmental and international trade management measures adopted, levels of landings and exports, and the status of these stocks and fisheries; 3. shark fishing and trading entities to identify opportunities to: improve, in cooperation with FAO and relevant fishery management bodies, the monitoring and reporting of catch, bycatch, discards, market and international trade data, at the species level where possible and to establish systems to provide verification of catch information; and 4. all Parties to provide details of their commodity codes for fish products.

At its 23rd Meeting (April 2008) the AC, through the *ad hoc* Working Group, analysed the information obtained from responses to this Notification provided by Argentina, Australia, China, Costa Rica, Cuba, Ecuador, the EU, Granada, Japan, Malaysia, Mexico and the USA (CITES AC23 Doc.15.1, AC23 Doc.15.1 Addendum, AC23 Inf.3, AC23 Inf.4 & AC23 Inf.7). Information provided by the World Customs Organisation on the classification in the Harmonized System of sharks (CITES AC23 Doc.15.1) was also considered. The AC highlighted the importance of more detailed international trade data on shark products. This would provide a stronger basis for CITES deliberations on shark trade and would also augment sources of information that can assist with shark fisheries monitoring, management and stock assessments. The benefits of a more universal tracking system, or at least the development of uniform customs codes among all CITES Parties, were also acknowledged. However, given the nature of the actions needed for achieving such objectives, the AC proposed the Standing Committee of the Convention to continue working on this line (CITES AC23 WG6 Doc.1).

Figure 17. Leopard shark *Triakis semifasciata* has been identified by the CITES Animals Committee as a species of concern. (Photo: Maribel Carrera & Felipe Galván).

At the same meeting, the AC examined a list including several shark species of concern that may require consideration for inclusion in the Appendices if their management and conservation status does not improve. These include spiny dogfish *Squalus acanthias*, porbeagle *Lamna nasus*, freshwater stingrays of the family Potamotrygonidae, gulper sharks *Centrophorus* spp., tope shark *Galeorhinus galeus*, requiem sharks (including hammerheads *Sphyrna* spp., shortfin mako *Isurus oxyrinchus*, tiger shark *Galeocerdo cuvier*, threshers *Alopias* spp., oceanic whitetip shark *Carcharhinus longimanus*, silky shark *C. falciformis*, dusky shark *C. obscurus*, sandbar shark *C. plumbeus* and bull shark *C. leucas*), guitarfishes and shovelnose rays (order Rhinobatiformes), devil rays (family

Mobulidae) and leopard shark *Triakis semifasciata* (CITES AC23 Doc. 15.02). According to the provisions of Decision 14.107, the AC will refine this list,through an intersessional Working Group, which will report its results for consideration by the 24th Meeting of the AC (2009). It is therefore possible that such work leads to proposing the inclusion of some such species in the Appendices.

Non-Detriment Findings for Exports of CITES Listed Species

IUCN Checklist. The above-mentioned Resolution Conf. 10.3 also encouraged the Parties, the Secretariat and interested non-governmental organisations (NGO) to develop and support workshops or seminars specifically designed to improve the implementation of CITES by Scientific Authorities. IUCN, through its Species Survival Commission (SSC), assisted by the CITES Secretariat, Parties to the Convention and other organisations, convened two workshops in order to develop some practical assistance for Scientific Authorities when making Non-Detriment Findings (NDF). The first workshop (Hong Kong, October 1998) brought together wildlife managers, biologists, and government officers in an attempt to look at the practical challenges and requirements for making NDF. A checklist system proposed at the initial workshop was refined and then tested extensively at a second workshop, held in Cambridge.

Results of the two workshops were later compiled by Rosser & Haywood (2002), resulting in a helpful tool that aims to give orientation to Parties on the technical and biological aspects of how to make NDF. A checklist of information to be monitored was designed to help build the capacity of Scientific Authorities in advising whether exports of Appendix II-listed taxa are detrimental or not to the species' survival. The checklist comprises two tables and text for plants and animals, which were developed together in an effort to ensure that the format and contents resulted as standardised as possible for both major kingdoms.

Table 1 of the checklist compiles information on the types of harvest, the degree of control over the harvest, the segment of the population harvested, the level of total harvest (for domestic and international use), the reason for the harvest, and the end users of the harvest. Scientific Authorities need to distinguish between regulated and illegal or unmanaged harvesting. Consideration of these data will further assist the process of consultation between Scientific and Management Authorities. In the case of some types of harvest (where products are removed without killing the species, or where ranching occurs), it even allows the Scientific Authority to advise quickly that harvest is not detrimental to survival.

Table 2 of the checklist encourages Scientific Authorities to review in more depth more general biological and management information for those species where Table 1 has raised concerns. Information is also sought on management history and planning, harvest management, status of the species in the country on which harvesting takes place, capacity for monitoring the harvest, benefits and risks of harvest, levels of strict protection, and the relationship between ranched and captive-bred specimens to those that are wild caught. Only the most precautionary answer to each question (i.e. worst scenario) will count when scoring information. A simple scoring system based on where ticks are placed for answers to each question will help Scientific Authorities advise whether or not that component of international trade carried out for commercial purposes is detrimental to the survival of the species. A high degree of uncertainty should lead a Scientific Authority to conclude that insufficient information exists on which to base a NDF. In such a case, it is suggested that Parties do not allow commercial trade until information quality is improved.

Annex III of this paper proposes an adapted version of the IUCN checklist, which intends to take into account the particular requirements of making non-detriment findings for shark exports. Considerations and recommendations made in this work are also included.

The compilation of the checklist does not necessarily constitute a NDF. Rather, the use of the checklist should inform the NDF, and can guide the Scientific Authority in obtaining the necessary information. When a preponderance of factors point to potential detriment, the Scientific Authority should inform the Management Authority that the proposed export should not proceed.

Other guidelines. Following this effort, and as recommended in the guidelines document itself, other workshops and progress have been developed. A regional workshop of Scientific Authorities on the making of NDF was held in Nicaragua in 2002. Successive efforts have focused on specific taxa, such as medicinal plants, agar wood *Aquilaria* sp. (ENB 2007) and humphead wrasse *Cheilinus undulatus* (Sadovy *et al.* 2007). More recently, a workshop was held on April 2007 in Cancun, Mexico (CITES CoP14 Doc. 64 (Rev. 1)), with the aim of defining a feasible methodological approach that could be used to formulate NDF for bigleaf mahogany *Swietenia macrophylla*, so as to improve the implementation of the provisions of CITES Appendix II listing and ensure international sustainable harvesting and trade in the species. All these actions have been successful in compiling relevant information and methodologies needed to prepare NDF for some plant and animal species, thus providing single-species guidance. However, there is still a definite need to build on relevant results and lessons learned in the light of existing experiences. An international expert workshop on non-detriment findings is expected to be held in November 2008 in Cancún, Mexico, given the need to continue developing Parties' capacities for the proper implementation of the Convention, particularly in relation to the methodologies, tools, information, expertise, and other resources needed by Scientific Authorities, through case studies that build on the guidelines developed by IUCN.

Making Non-Detriment Findings for Sharks

Non-Detriment Findings Made for Sharks

As is the case for other CITES listed species, there are no specific guidelines for making these findings in the case of sharks, beyond the above mentioned progress made by IUCN and Parties. In August 2005 the CITES Secretariat circulated a Notification to the Parties (CITES Notification 2005-044) including a questionnaire on the conservation and management of sharks. It requested information on international trade of the listed shark species, asking details of each transaction. It also asked for existing identification guides and other techniques which could be useful for legislation enforcement. This Notification was emitted due to a demand from the Animals Committee (AC) after its 21st meeting (May 2005), in an effort to comply with the mandate of the CoP established in Decision 13.43. The aim was to assess the implementation of shark listings in the Appendix II of CITES and, more importantly, to evaluate the parameters being used by Parties when making NDF.

Answers were reviewed in December 2005 by the AC *ad hoc* Working Group, by which time 14 Parties had responded: four reported imports, five reported exports and one reported re-exports of the three shark species listed at that time. Traded parts were mostly jaws and teeth of great white shark *Carcharodon carcharias*, and health products derived from cartilage and fins of basking shark *Cetorhinus maximus*. There were no trade records for whale shark *Rhincodon typus*. Based on these responses, few specimens of the listed species appear to have been targeted. However, there was a lack of responses from major target fishing States (some of whom had stated Reservations on these listings) (CITES AC22 Inf.3). Still, the three shark listings valid at the time had only recently been implemented, which had certainly limited the volume of international trade that could be recorded and evaluated. Furthermore, there are usually several Notifications to which the Parties must pay attention, and responses often take considerable time before being answered.

Decision 14.103, adopted during CoP14 in June 2007, states that the CITES Secretariat should distribute a new Notification to the Parties on implementation of listings for shark species. This Notification is expected to focus specifically on obtaining from Parties' Scientific and Fishery Authorities case studies on the development of NDF for shark species. The information collected is to be collated and summarised for provision to the international expert workshop on NDF to be held in Mexico in November 2008.

It is important to note that the lack of specific guidelines for making NDF for marine species in general and specifically for sharks has been stated by some Parties as a reason for not listing shark species in the CITES Appendices (CITES CoP14 Prop. 17). Concern has been expressed that the listing of such species might constitute a *de facto* trade ban until the technical aspects on the making of NDF have been resolved (CITES CoP14 Inf.45).

General Considerations

As shark species are some of the first marine fishes to be listed on CITES Appendices and may be taken in either managed or unmanaged fisheries, special considerations apply when making NDF. Specimens may be obtained from unintentional catch. However, these conditions are not necessarily relevant for an NDF. Since CITES provisions require that the export must not be detrimental to the survival of the species, the key considerations for an NDF must be the total mortality (intentional, unintentional and natural) and the extent to which trade demand may increase or diminish that mortality. But the absolute level of mortality *per se* tells little about the level of depletion of a stock. It is also crucial to consider the proportion of mortality and production, and most importantly, the status of the population. For example, a level of mortality that is not offset by growth (in numbers and biomass) may not pose a threat for a virgin population, but it becomes a major problem when the stock is below the optimal biomass. Therefore, an NDF should focus on whether the status of a shark population is good, fair or bad, and based on this, assess if trade is likely to be promoting an undesirable level of exploitation.

Conservation and management of shark populations has always been a complicated issue, even more than in other commercial fisheries. Some of the main components to consider when assessing the possible detrimental effect of fishing on shark populations are:

1. their peculiar life-history strategies, including limited reproductive potential and their tendency to aggregate by sex or age groups, both of which make this group very prone to overfishing;
2. the existence of migratory and straddling stocks, making a single population prone to be harvested by a variety of fleets and States,
3. their position in marine ecosystems as top predators, which turns the depletion and/or reduction of shark stocks into a potential ecological disaster with no simple solution, and
4. the tendency of many shark species to give birth in shallow-water, coastal lagoons and estuaries, where gravid females, newborns and early juveniles are easily targeted by the most basic fishing methods, with obvious devastating consequences for recruitment and the future stocks.

Management for shark species should ideally be based upon stock assessments and scientific advice on sustainable fisheries harvest levels (e.g. annually established quotas per region, fleet and/or fishing techniques). It would probably be most appropriate if Parties designated a fisheries expert as Scientific Authority for shark species. Good fisheries management tools have been developed (e.g. Musick & Bonfil 2005), although their implementation and enforcement are a complex issue. Besides, while some countries have made remarkable progress in adequately managing their shark fisheries, others have not.

The process of issuing an NDF for any of the CITES listed shark species is a challenge, given that population characteristics of none of them are well understood to date. The ideal process should allow Scientific Authorities to compare their findings with those of other countries for similar species or commodities in trade. In any case, when making NDF for sharks it is important to consider a variety of factors, which are intended to be summarised below.

Population Dynamics. When basic life history information, such as age, mortality (age-specific death rates) and natality (age specific birth rates), is available, demography can be applied to better understand the population dynamics of sharks. Using life tables constructed of survivorship and reproductive schedules, the following reproductive demographic parameters can be calculated (Cailliet *et al.* 2005):

- Net Reproductive Rate (R_0 or multiplication rate per generation);
- Generation Length (G = the average time between the birth of an individual and the birth of her first offspring; also defined as the mean age of living, reproductive females in the population by IUCN);

- Intrinsic (instantaneous) Rate of Increase or growth coefficient of the population (*r*);
- Finite (usually annual) Rate of Population Increase (e^r), and
- Doubling Time (time, in years, taken for a population to double).

The large majority of shark species is slow-growing with low reproductive potential, although a few species are not as extreme in their life histories. In general, smaller-sized elasmobranch species have a tendency to mature earlier, be shorter-lived, and have higher rates of population increase, although there are also notable exceptions (e.g. the spiny dogfish *Squalus acanthias*). In contrast, larger, longer-lived species generally have less capacity to sustain exploitation or recover from depletion (Camhi *et al.* 1998). CITES listed species appear to follow this rule: although much life history information is missing, the annual rate of population increase has been calculated as 8% for *Rhincodon typus*, 1.3-2.8% for *Cetorhinus maximus*, 4-5.6% for *Carcharodon carcharias*, 8-12% for *Pristis pectinata*, and 5-12% for *P. perotteti* (Fowler *et al.* 2005).

As a result of few and incomplete age and growth estimates, the use of stock replacement and yield per recruitment models and demographic analyses has not been widely applied to shark species. Because of these gaps in biological knowledge, populations have continued to suffer from overexploitation without the benefit of reasonable management strategies.

It is important to highlight that even if information is available for calculating demographic parameters and making proper stock assessments, close monitoring of the effects of fishing on the harvested populations is crucial for detecting any detrimental effect on time for correcting the management model and achieving sustainability.

Habitat and Other Ecological Factors. Although fisheries mortality has the single greatest effect upon world shark populations, it should be considered that some species can be affected by other factors, including pollution and debris, and the degradation and loss of habitats (e.g. through land claim in coastal nursery grounds, dam construction on rivers, and damage by fishing gears). Such circumstances should certainly be considered when assessing the possible effect of fishing on those populations. This is especially important when making NDF for sawfishes, since their preference for coastal habitats makes them more vulnerable to environmental degradation due to human activities.

Fishing Regulations. The implementation and appropriate enforcement of existing fisheries regulations would certainly be a major contribution to the conservation of shark populations. In general, NDF could be declared for species that are the subject of a management plan, as long as the proposed export is consistent with the sustainable management provisions adopted and these are properly enforced. This could also be applied for other commercially-harvested marine species. It would, in principle, minimise the extra burden that commercial marine fish listings place on CITES Scientific Authorities. Where Fisheries Authorities are employing sustainable management regimes, the NDF requirements are already being fulfilled. It must be noted, however, that poor fishery management, inappropriate or non-existant monitoring, and IUU fishing occur almost worldwide. This results in poor data available on fishery mortality (catches, landings and discards), abundance indices, domestic market consumption and international trade data (both exports and imports).

Catch, Effort and Trade Data. Available information on catch, landings, fishing effort and trade is significantly incomplete and the species involved are rarely specified. Without accurate, relevant, timely and standardised catch data recorded by species and the associated fishing effort used to obtain such catches, it will be impossible to perform proper stock assessments for sharks and therefore determine the state of fisheries resources and the development of the sector, as well as to recognise emerging and established trends. This task requires improving fisheries data recording efforts at the national level, complemented by intensive international cooperation. FAO has already made a remarkable progress by developing a vast database on shark fisheries and trade data worldwide. FAO data, as well as other useful tools for analysing and better presenting them, are readily available on the Internet, cost free (see Annex II for details). It should be stressed, though, that the accuracy and comprehensiveness of FAO data are determined by the reports it receives. States need to collect complete data on shark catches by species, and report them on a timely basis. Several RFMO and other IGO have also initiated efforts for compiling data on shark catches and have similar data bases, but face the same problems and constraints.

Trade in Shark Products. As a very general guidance for Scientific Authorities, the following trends for shark fin trade were anticipated by the *ad hoc* Working Group of the Animals Committee of CITES on April 2006 (CITES AC22 Inf.3):

1. Consumers: Demand will continue to rise alongside China's economic development, unless the popularity of shark fin soup falls.
2. Producers: It is likely that more targeted shark fisheries will develop.
3. Species: The abundant and fecund blue shark *Prionace glauca* populations might be able to sustain current fishing pressure, but the resilience of most other shark species is unknown.
4. Utilisation: Existing finning regulations may drive a change in production patterns towards better and thorough utilisation of both shark meat and fins. However, they will not stop the overall increasing trend on shark catches worldwide.

Figure 18. Thorough utilisation of both shark meat and fins is critical for achieving sustainable use of the resource (Photo: Mauricio Hoyos).

Migratory and Straddling Stocks. *Carcharodon carcharias, Rhincodon typus* and *Cetorhinus. maximus* are highly migratory species. Therefore, sharks found in any Party's waters might belong to widely shared stocks. To ensure non-detriment, individuals of these species should be taken from sustainably exploited high seas fisheries, a situation that cannot be achieved without coordinated management action among countries via the relevant RFMO.

Cooperation among Parties for better managing these species could also be facilitated through CMS, since all three species are also listed in the Annexes of this Convention. Migration, however, is not a problem to consider when making NDF for the majority of sawfish stocks. It should be considered, though, that many populations straddle boundaries between adjacent Exclusive Economic Zones (EEZ); hence, international initiatives are essential for effective management.

Introduction From the Sea. Discussions are ongoing in the frame of CITES for defining the meaning of this phrase. For the species already listed, repercussions of the results of such negotiations on fishing for *Carcharodon carcharias, Rhincodon typus* and *Cetorhinus maximus* in international waters are expected to be crucial. Again, introduction from outside the Exclusive Economic Zone of a Party is not an issue for the Pristidae family, since their distribution is relatively close to shore.

A Proposal for Guidelines

In view of the abovementioned general considerations and the information previously reviewed in this paper, the following general guiding principles on how to make NDF for sharks are proposed.

1. **Population status:** Ideally, each shark population should be considered separately when making NDF, in order better to assess the impact that harvest would have on a specific population, and how it could interact with other populations to respond to fishing pressure. However, this can turn into an almost impossible task, given the limited information available on shark ecology and the relative uncertainty about the specific provenance of almost all shark catches. Fortunately, some quality information is already available, hence facilitating the process of making NDF. IUCN Red List assessments synthesise information on all known shark populations (IUCN 2007). Regional assessments have also been undertaken to provide guidance for conservation and management on a regional basis. Information on specific populations is also available in cases where this is more threatened than the overall global assessment for the species. The SSG has also published a comprehensive compilation of existing information on the different aspects of shark biology, ecology, fisheries, conservation and trade (Fowler *et al.* 2005). It includes a summary of life-history traits of some shark species, as well as species accounts for more than 100 species, which are now updated on the IUCN Red List. Useful and reliable information on the biology and population status of shark species can also be found on the FishBase and a variety of other sources. See Annex II for details.
2. **Management plans.** As stated above, management for shark species should ideally be based upon stock assessments and expert scientific advice on sustainable fisheries harvest levels. The importance of their adequate implementation and enforcement is strongly emphasized. FAO has published useful and comprehensive methods for shark fisheries assessment and management, including technical guidelines (FAO 2000), modelling tools and quantitative methodologies (Musick & Bonfil 2006).

Management plans which include CITES listed shark species should exist at the regional, national and local levels. According to the reported origin of the specimens, a careful analysis must be developed. If one or more than one management plan are in place, the requirements and conditions to be met by each specific regulation should be checked. Complementarily, the actual implementation level achieved by each regulation must be assessed, before considering such management plans a positive or negative element when making an NDF.

a. **IPOA Sharks.** The first step should be to identify whether the relevant RFMO, State or territory has already developed a National Plan of Action under the IPOA-Sharks framework or not. If an NPOA is in place, the adequacy of the management and conservation measures implemented must be assessed for each country. Although the main objective of the IPOA-Sharks is to ensure that shark catches from directed and non-directed fisheries are sustainable, the mere existence of a NPOA does not imply that this objective is met. As reviewed above, NPOA can either be a thorough programme to be implemented, or simply a document specifying the needs of shark fisheries in each State. It is also recognised that some States have already implemented a management plan that includes sharks, although they have not yet developed an NPOA.

b. **Regional Fisheries Management Organisations.** Relevant information is available on shark products originating from fishing operations developed according to the principles of several RFMO. In cases where databases are kept by an RFMO on shark catches and bycatch, or where stock assessments have already been developed, the relevant organisation could provide more information to Scientific Authorities in order better to assess the shark's population status. Although these conditions may vary, and other RFMO can implement regulations directed to the conservation and management of sharks, at least the following have been officially implemented.

    i. **CCAMLR.** No vulnerable sharks can be targeted by fishing operations in CCAMLR waters, until the effects of fishing them are assessed. Incidentally caught sharks are to be released. Before using information from this RFMO, it is recommended to check progress made in such assessments and any specifications on 'vulnerable sharks' .

    ii. **GFCM.** Since shark catches are required to be reported, a database of shark catches exists. A finning ban is in place; fins cannot represent more than 5% of the weight of the sharks onboard at the first point of landing. Compliance with the measure is to be ensured through certification, monitoring by an observer or other appropriate measures. The retention, transhipment or landing of fins in contravention with the organisation's provisions is prohibited. Incidentally caught sharks, especially juveniles, should be released. Research on selective gear is encouraged, as is the identification of shark nursery areas.

    iii. **IATTC.** Catches and incidental fishing mortality of sharks and rays are estimated, and the impacts on these species are assessed. Fishers on purse-seiners are required to promptly release unharmed all sharks, to the extent practicable. An *ad hoc* Working Group deals with shark-related issues.

iv. **ICCAT.** Shark catch data are reported by quarter and 5x5 area, gear, species and year, for stock assessment purposes. A recommendation has been made to members to develop and conduct observer programmes. These should be aimed to collect accurate data on shark catches by species, including discards. Some stock assessments have been attempted, but not for CITES listed species.

v. **IOTC.** From 2005, data for catches of sharks are reported annually. A finning ban is in place: fins cannot represent more than 5% of the weight of the sharks onboard at the first point of landing. Compliance with the measure is to be ensured through certification, monitoring by an observer or other appropriate measures. The retention, transhipment or landing of fins in contravention with the organisation's provisions is prohibited. Incidentally caught sharks, especially juveniles, should be released. Research on selective gears is encouraged, as is the identification of shark nursery areas.

vi. **NAFO.** Reporting of catch of shark species is required. A finning ban is in place: fins cannot represent more than 5% of the weight of the sharks onboard at the first point of landing. Compliance with the measure is to be ensured through certification, monitoring by an observer or other appropriate measures. The retention, transhipment or landing of fins in contravention with the organisation's provisions is prohibited. Incidentally caught sharks, especially juveniles, should be released. Research on selective gears is encouraged, as is the identification of shark nursery areas. To date, is the only RFMO that has adopted a skate catch quota.

vii. **NEAFC.** A finning ban is in place, as is a prohibition of directed fishing for basking shark in 2006 and 2007.

viii. **SEAFO.** Parties report annually data for shark catch. A finning ban is in place in fisheries for species covered by the SEAFO Convention. This list should be checked for CITES listed shark species. Fins cannot represent more than 5% of the weight of the sharks onboard at the first point of landing. Compliance with the measure is to be ensured through certification, monitoring by an observer or other appropriate measures. Incidentally caught sharks, especially juveniles, should be released. Research on selective gears is encouraged, as is the identification of shark nursery areas.

ix. **ICES.** Uses shark fisheries and/or bycatch data to develop stock assessments and, when requested, management advice.

c. **National and/or local regulations regarding shark fishing.** Some CITES listed shark species are considered as endangered or subject to some degree of protection under national laws. This situation generally indicates that commercial harvest is subject to special conditions. For example, management plans may have been developed and/or population assessments could be mandatory before specimens can be legally obtained from wild populations, or target fisheries may be prohibited but the utilisation of bycatch is permitted. Conversely, if specimens come from a marine protected area or a location where special shark fishing regulations are in force, it is likely that information will exist on the status of natural populations and their habitats.

d. **Finning bans.** Shipments containing shark fins could be better assessed if they are coming from a country that adequately implements existing finning bans. It is important to note that of all CITES-listed species, basking shark fins are most commonly consumed, but none of these species are preferred for taste. Whale and white shark fins are perceived as rather poor quality and are more popular for display (Clarke 2004b).

3. **Bycatch and Discards.** Fishing activities usually involve either retaining the fins while discarding the trunk (if permitted), retaining the fins with the trunk landed (if required), or discarding a certain proportion of sharks, dead or alive. Apart from discarding (when a proportion of live discards can survive), the other fishing practices necessarily result in shark mortality. The level of mortality arising from discards varies according to species, the method of fishing and the way in which the catch is handled prior to release. Although assessing the mortality due to unwanted bycatch and discarding is difficult (some research is underway into discard survival), both situations must be considered when calculating total mortality in shark populations. Although extrapolations in this regard are discouraged (Bonfil 1994), data for bycatch and discards for some specific fisheries have been compiled (Gilman *et al.* 2007, Kelleher 2005) and can be a useful guidance for this step.

4. **Trade data and trends.** As previously reviewed in this paper, there is insufficient knowledge of the impact of international trade on shark populations and the contribution of international trade, rather than domestic consumption or bycatch, to overall shark mortality. This makes unadvisable the option of assigning export quotas as a safe approach for keeping international trade at levels that are safe for shark populations: focus should be on fishing pressure and not only on trade data.

   The use of trade data and trend identification is an additional tool for long-term assessment and monitoring. Although trade has no significance as a proxy of population status, it is certainly an important indicator of commercial demand for shark products and of mortality when landings are under-reported. It is also useful to draw the relevant authorities' attention to possible cases of overexploitation. International trade of shark products and derivatives should, therefore, be carefully monitored and, whenever possible, be monitored through the use of species-specific commodity codes and identification guides.

   Weight ratios applicable to fins. Different regulations specify different conversion factors, but debate is ongoing about which fin:body weight ratio should be used. A ratio of 1.5% can be applied in order to calculate the equivalent on shark catches to a given dry fin shipment (Rose 1996). Regarding fresh fins, the proportion has been reported to range from 2.5% for the silky shark *Carcharhinus falciformis* (Cortés & Neer 2006) to 16.05% for oceanic whitetip shark *C. longimanus* (Ariz *et al.* 2006), both comparing fin weight to dressed weight. On the other hand, there is considerable variation among results from different research groups, even for the same species. The ratio for blue shark *Prionace glauca*, for example, has been reported to be 6.5% by Mejuto & García-Cortés (2004), but only about 2.5% in a study referred by Kelleher (2005), both considering live weight. For NDF purposes, ratios should ideally be used only when established for each species and fleet, and they should be periodically revised. Data from related species can be useful, however, if no ratios have been determined for a given species.

5. **Long-term vs. short-term approaches for decision making.** In view of the information available in each case, Scientific Authorities must decide which approach is better. When appropriate management schemes are in place, including population and habitat monitoring, and these are properly enforced, a long term positive opinion can be adopted when making NDF. However, where this situation is not applicable, it is advisable to develop a case-by-case analysis.
6. **Relevant domestic aspects that potentially affect shark take.** In general, artisanal shark fisheries utilise the whole carcass and yield a wide range of products, although most (if not all) of them are generally sold at domestic markets, being the base of livelihoods in many developing regions. Economic incentives exist for shark finning, although this practice cannot usually be associated with sustainable shark fisheries (it is strongly discouraged by FAO and prohibited by most RFMO and by several States). Stricter domestic measures may also be in place. These and a variety of other factors at the domestic or local level, as well as their effects in shark populations, must certainly be assessed by Scientific Authorities when making NDF.
7. **Peer reviewed NDF.** As commented above, a first review of the approaches adopted by Parties when making NDF for sharks was developed in December 2005 by the *ad hoc* Working Group of the CITES Animals Committee. Results, however, were not successful due to the relatively short period since shark listings had been implemented. A second attempt for obtaining from Parties' Scientific and Fishery Authorities case studies on the development of NDF for shark species is contained in CITES Decision 14.103. The importance of reviewing this information, once it has been collected and collated, is crucial if consistent and comparable NDF for sharks are to be developed worldwide. Moreover, information on NDF making for other marine fish species, such as sturgeons and paddlefish, the humphead wrasse *Cheilinus undulatus* or the eel *Anguilla anguilla* can also be used for improving the process for making NDF for sharks, provided that biological, ecological and other relevant differences are properly accounted for.

Finally, it is important to note that several databases on biological and trade data on shark species have been developed by a variety of institutions and organisations. Useful bibliographic and Internet resources available are summarised in Annex II.

Other Proposals for Conservation and Management

Adaptive management based on adequate monitoring and appropriate feedback is vital to ensure the sustainability of shark fisheries and, in turn, international trade of shark products. Current problems with making NDF result mainly from lack of capacity and resources to implement monitoring schemes across the wide range of species in international commercial trade. More attention should be given to developing and promoting cost-effective and pragmatic methods of resource monitoring, and in providing Scientific Authorities, who should in some cases be appointed from fisheries management bodies, with the skills and means to make these determinations. Monitoring of fishing pressure levels and trade patterns, as well as of population data, will allow establishment of the feedback loop necessary for adaptive management.

As reviewed in this paper, actions are and should still be taken worldwide to significantly improve data obtained on shark catches, as well as on the implementation of effective regulation measures and their enforcement. Measures for improving reporting and monitoring of shark catches and bycatch have been implemented by a series of RFMO and FAO itself. However, coordination among fleets and homogenisation of procedures adopted are essential for achieving the desired quality of data on shark catches.

Adequate reporting and follow-up of catches, landings, bycatch, discards and trade of these species is mandatory for improving the amount and quality of data obtained.

For a number of reasons discussed in this paper, it is desirable that internationally traded shipments of shark products are properly identified at the species level. Several States have their own identification guides for shark species, often focusing in local species. Nevertheless, most of them are to be used only with whole (or at least nearly whole) specimens. FAO has also edited useful and comprehensive catalogues and identification guides for shark species (see Annex II for details). Some of the tools required to regulate the trade in shark fins in compliance with the requirements of CITES also appear to be already available: representatives of the Chinese Management Authority have claimed that *Cetorhinus maximus, Rhincodon. typus* and *Carcharodon carcharias* fins would be easy to distinguish based on their size and saw little or no need for genetic techniques for forensic identification (Clarke 2004b). Identifications of fins for other species would also be possible if enforcement officers receive adequate training (Clarke 2004b). In the case of meat and/or other products it is possible (although most probably not affordable in all cases) to carry out molecular tests, such as DNA fingerprinting techniques.

Improved trade monitoring is clearly needed. The compilation of accurate, relevant and timely data in a standard form that makes it comparable is essential to underpin the development of the world's shark product trade and, to a certain extent, their effect on fishing pressure on shark populations. Given the CITES sphere of activity on trade regulation, this Convention might contribute to encouraging or implementing elements of the sustainable management measures for shark fisheries supplying international trade that are the responsibility of national fishery departments, FAO and RFMO. It could also enhance the homogenisation of shark product codes used for international trade, through cooperation with the World Customs Organisation.

A variety of activities can also be developed in the frame of the recently adopted Memorandum of Understanding between FAO and CITES (CITES SC54 Doc.10). The IPOA-Sharks is one of the most important management measures adopted at the global level. However, and as has been discussed above, the level and approach of its implementation varies considerable among countries and at the regional, national and local levels. Ideally, proper implementation of comprehensive NPOA could, in specific cases, be considered as a ‘fast-track’ for obtaining a positive NDF, as required by CITES.

It is also essential to improve communication between Fisheries Authorities and CITES Authorities within States, especially if they are designated as the relevant Scientific Authority for making NDF for sharks and/or other aquatic species.

Communication between CITES and other International Conventions aimed in one way or another to the conservation of shark populations, such as the already mentioned CMS or the Barcelona Convention, is also desirable. These international bodies may in turn be able to liaise at the regional and international levels to promote collaboration with FAO and relevant RFMO, therefore enhancing the positive effects that isolated action could have on the conservation and management of sharks.

Conclusions and Recommendations

Sharks are a numerous and evolutionary successful group, superbly adapted to a variety of habitats. However, they exhibit ecological characteristics that render them particularly vulnerable to fishing. Their biology is among the least known and understood among the major marine species; information on life history, reproductive biology and population dynamics is available only for some of the species that are of commercial importance for fisheries.

Those shark species for which age and growth have been estimated and verified generally exhibit strongly K-selected life history strategies, appropriate and successful in an environment where the main natural predators are other large sharks. However, this has serious implications for the sustainability of fisheries.

Their limited reproductive productivity and, for many species, restricted geographical distribution, severely limit the capacity of populations to sustain and recover from declines resulting from human activities. Besides, many shark species have geographical distributions which cross international boundaries, resulting in individual populations being harvested by multinational fisheries. Moreover, being apex predators, their depletion is likely to significantly affect the population size of their prey species and the structure and species composition of the lower trophic levels of marine ecosystems.

Directed fisheries have been the cause of stock collapse for many shark species. Still, there is a general lack of adequate data required for making proper shark fisheries management decisions. The contribution of bycatch and discards to overall shark mortality is unknown, still it is estimated to be very important. Reporting should include catch, bycatch, discard and landings data by species and by weight.

Illegal, unreported and unregulated fishing is another problem faced to varying degrees by all fishing countries. This compromises the accuracy of the data used by scientists to undertake stock assessments and formulate management advice. It also results in underestimates of fishing mortality.

The amount of shark fished in the past was limited because of their low economic value and relatively low abundance. Still, since World War II there has been steady growth in shark fisheries, resulting from an overall intensification of marine fisheries and increasing human populations worldwide. Between 1950 and 2000 there has been more than a three times increase (220%) in reported catch of sharks. Most of the shark fishing and trade is performed by relatively few countries. In 2003, twenty States or Provinces harvested 80% of the reported global shark catch, with five of them contributing 40% of the reported total catch. Exports totalled 86 500 tonnes in 2003, with a value of US$249 million.

Fishing pressure on sharks has increased, partly due to the growing demand for, and rising economic value of, their products. These include meat, skins, liver oil, fins, cartilage, jaws and teeth. Live sharks are also captured for the ornamental fish trade and public aquaria. Other shark uses are non-consumptive, such as various ecotourism operations. Because of their high market value, fins represent a particular case of internationally traded shark product.

According to the IUCN Red List of Threatened species, 126 shark species (over 21% of those assessed by 2007) are currently considered as threatened. Even though research on shark biology, ecology and population dynamics has increased in the last decades, the current situation of many species remains unknown. Several institutions and organisations have recognised the requirement for shark conservation through multilateral agreements and initiatives, drawing attention to the need to improve the protection afforded to threatened shark species. The United Nations Convention on the

Law of the Sea, the UN Fish Stocks Agreement, the FAO Code of Conduct for Responsible Fisheries and the FAO International Plan of Action for Sharks, are some of the international instruments that have implemented regulations which, in one way or another, are aimed to conserve and properly manage shark populations. It is important to note, regrettably, that lack of enforcement and poorly fulfilled flag-State responsibilities under international legislation efforts is not uncommon.

Formal cooperation among States for the conservation and management of fish stocks beyond borders has also been established through Regional Fisheries Management Organisations. Several of them have initiated efforts to collect information on sharks. Some of them have also adopted finning bans. Parallel national regulations on this matter have been adopted in several States, including Australia, Brazil, Colombia, Costa Rica, Ecuador, El Salvador, the European Union, Mexico, Panama, South Africa, Oman and the USA, to tackle this practice.

Intergovernmental efforts for the conservation and management of sharks have also arisen within the framework of international conventions. The Convention on the Conservation of Migratory Species of Wild Animals and the Convention for the Protection of the Mediterranean Sea against Pollution have adopted provisions specifically directed to shark species. Other Conventions aim to promote the conservation of biodiversity and/or habitats, but few have implemented measures specifically directed to shark species.

Within its remit of ensuring that international trade in specimens of wild animals and plants does not threaten their survival, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has implemented a permit system for regulating international trade. Issuing export permits for specimens of species included in Appendices I and II, as well as certificates for introducing such species from the sea, requires that a Scientific Authority of the exporting country prepares the Non-Detriment Findings (NDF). Scientific Authorities are, therefore, continually challenged to define whether a particular export will be detrimental to the survival of a species. This makes necessary to have documented guidelines and methodologies to develop more complete and scientifically sound findings, improving the benefits for wildlife populations.

Concern for shark conservation and management within CITES began in 1994. To date, ten shark species are currently listed in the Appendices: six sawfishes (*Anoxypristis cuspidata, Pristis clavata, P. pectinata, P. perotteti, P. pristis* and *P. zijsron*) are listed in Appendix I, while the whale shark *R. typus*, the great white shark *C. carcharias*, the basking shark *C. maximus* and the freshwater sawfish *P. microdon* are included in Appendix II.

Since CITES does not provide specific guidance on the making of NDF by Scientific Authorities, efforts have been made to develop some practical assistance for this process, but no general methodology has been officially adopted. Moreover, the lack of specific guidelines for making NDF for marine species in general and specifically for sharks has been stated by some Parties as a reason for not listing shark species in the CITES Appendices. In the particular case of sharks, NDF have seldom been made.

The key consideration for an NDF must be whether the status of a shark population is good, fair or bad, and based on this, assess if trade is likely to be promoting an undesirable level of exploitation. Some of the main components to consider when assessing the possible detrimental effect of fishing on shark populations are:

1. their peculiar life-history strategies, including limited reproductive potential and their tendency to aggregate by sex or age groups, both of which make this group very prone to overfishing;
2. the existence of migratory and straddling stocks, making a single population prone to be harvested by a variety of fleets and States,

3. their position in marine ecosystems as top predators, which turns the depletion and/or reduction of shark stocks into a potential ecological disaster with no simple solution, and
4. the tendency of many shark species to give birth in shallow-water coastal lagoons and estuaries, where newborns and early juveniles are easily targeted by the most basic fishing methods, with obvious devastating consequences for recruitment and the future stocks.

Management for shark species should ideally be based upon expert stock assessments and scientific advice on sustainable fisheries harvest levels. The main problem is that, although good fisheries management tools have been developed, the population characteristics and many aspects of the biology and ecology of CITES listed shark species are not well understood to date. Nevertheless, some considerations are fundamental when making NDF for shark species:

- CITES listed shark species are slow-growing and have low reproductive potential, having limited capacity to sustain exploitation or recover from depletion. Although life history information is still lacking, the annual rate of population increase has been calculated as 8% for *R. typus*, 1.3-2.8% for *C. maximus*, 4-5.6% for *C. carcharias*, 8-12% for *Pristis pectinata*, and 5-12% for *P. perotteti*.
- The implementation and appropriate enforcement of existing fisheries regulations would be a major contribution to the conservation of shark populations - albeit currently many of them are not widely applied. In general, NDF could be declared for species that are the subject of a management plan, as long as the proposed export is consistent with the sustainable management provisions adopted.
- Even with appropriate management measures in place, close monitoring of the effects of fishing on harvested shark populations is crucial for detecting any detrimental effect on time for correcting the management model and achieving sustainability.
- Available information on catch, landings, fishing effort and trade is significantly incomplete and the species involved are rarely specified. Accurate, relevant, timely and standardised data are necessary to monitor the state of fisheries resources and the development of the sector, as well as to recognise emerging and established trends. This task, however, requires intensive international cooperation. FAO, various RFMO and other IGO have already developed databases which can prove very useful when making NDF for sharks.
- *C. carcharias, R. typus* and *C. maximus* are highly migratory species. Therefore, sharks found in any Party's waters belong to widely shared stocks. Specimens of these species would have to be taken from sustainably exploited high seas fisheries, which cannot be achieved without coordinated management action among countries through relevant RFMO.
- It is important to follow ongoing discussions regarding introduction from the sea within CITES. There will certainly be implications for fishing for *C. carcharias, R. typus* and *C. maximus* in international waters. However, introduction from outside the Exclusive Economic Zone of a Party is not an issue for the Pristidae family, since their distribution is relatively close to shore.
- Although fisheries mortality has the single greatest effect upon world shark populations, it should be considered that some species can be affected by other factors, including pollution and debris, and the degradation and loss of habitats.

With this in mind, and considering the information reviewed in this paper, the following general guiding principles on how to make NDF for sharks are proposed:

i. Ideally, each shark population should be considered separately when making NDF, in order to better assess the impact that harvest would have on a specific population, and how it could interact with other populations to respond to fishing pressure. Although information on shark ecology is limited and there is a relative uncertainty about the specific provenience of many shark catches, quality information is already available, facilitating the process for making NDF.

ii. FAO has published useful and comprehensive guides for shark fisheries management, including modelling tools and methodologies. Management plans exist for CITES listed shark species at the regional, national and local levels: IPOA Sharks, provisions made by RFMO, national/local regulations regarding shark fishing and finning bans. In cases where databases are kept by RFMO on shark catches and bycatch, or where stock assessments have been developed, the relevant organisation could provide more information to Scientific Authorities in order to better assess population status.

iii. The level of mortality arising from bycatch and discards varies according to species, the method of fishing and the way in which the catch is handled prior to release. But although assessing the mortality due to unwanted bycatch and discarding is practically impossible, both situations must be considered when calculating total mortality in shark populations. Recent and useful information on shark bycatch and discards has been compiled and edited.

iv. There is insufficient knowledge of the impact of international trade on shark populations and the contribution of international trade, rather than domestic consumption or bycatch, to sharks' fishing mortality. Therefore, assigning export quotas for keeping international trade on levels that are safe for shark populations is discouraged. However, trade is certainly an important indicator of commercial demand on shark products and of landings (where these are under-reported), and useful to drive the relevant authorities' attention to possible cases of overexploitation. Improvement and analysis on international trade data can be utilised as an additional tool for long-tem assessment and monitoring, including by providing important information on mortality rates for stock assessments.

v. Where appropriate management schemes are in place, including population and habitat monitoring, a long term positive opinion can be adopted when making NDF. However, where this is not true, a case-by-case analysis must be developed.

vi. Relevant domestic aspects that potentially affect shark take must certainly be assessed by Scientific Authorities when making NDF.

vii. Peer reviewed NDF on sharks, as well as information on NDF making for other marine species, should also be used for improving the process, provided that biological, ecological and other relevant differences are properly accounted for.

Other proposals for improving conservation and management of sharks, and therefore facilitating the process of NDF making include the following:

- Adaptive management based on adequate monitoring and appropriate feedback is vital to ensure the sustainability of shark fisheries and, in turn, international trade of shark products. Monitoring of fishing pressure levels and trade patterns, as well as of population data, will allow establishment of the feedback loop necessary for this.
- The compilation of accurate, relevant and timely data in a standard form that makes it comparable is essential to monitor the state of shark populations, as well as to recognise emerging and established trends. This task, however, requires intensive international collaboration and cooperation. Coordination among fleets

and homogenisation of procedures adopted are essential for achieving the desired quality of data on shark catches. In addition, FAO, other IGO, RFMO and international conventions (mainly CITES and CMS) can optimise efforts made on achieving standardisation on this kind of data, as well as improving reporting quality. International coordination is also essential for properly managing migratory and straddling shark stocks.

- Improved trade monitoring is clearly needed. Shipments of shark products should be properly identified at the species level. Tools required to regulate the trade in shark products in compliance with the requirements of CITES are already available.
- A careful follow-up on the implementation of the IPOA-Sharks is needed in order to determine whether measures implemented in a given country should be considered as positive for obtaining a NDF as required by CITES.
- Communication is essential, both at the international level (among States, IGO, RFMO and international conventions) and within States (among Fisheries Departments and CITES authorities), in order to enhance the positive effects that isolated action could have on the conservation and management of sharks.

These proposals are, and other initiatives for making appropriate NDF for shark species should ideally be, aimed at adopting standard procedures that allow the resulting NDF to be equivalent and comparable, regardless of their provenance. Given the transboundary nature of most stocks of CITES listed shark species, reaching this level of coordination among Parties is crucial for best implementing the Convention's provisions and effectively protecting these species from the negative effects of international trade of their products. Moreover, this scenario would allow the simplification and standardisation of the process, since NDF could be made in non-centralised management institutions, such as Provinces or States, through adequate participation and coordination channels.

The Animals Committee of CITES has identified several sharks as species of concern that may require consideration for inclusion in the Appendices if their management and conservation status does not improve. It is true that the potential inclusion of some such species in the Appendices would represent additional paperwork and an increase in reporting burden. But such requirements (especially making NDF) would also represent a regulation equally applicable to all Parties to this Convention (currently 173 States). This would benefit those fleets with the best fishing practices, as well as significantly undermine both IUU shark fishing and disloyal competitor fleets which are not subject to strict fishing regulations. Eventually, it would lead towards the adoption of formal rules that governed access and use to this valuable marine resource worldwide, resulting in obvious advantages for the conservation and sustainable use of wild shark populations.

Finally, further guidance on NDF for shark species certainly requires additional studies, which may potentially apply over a broader range of marine fish species listed in the CITES Appendices.

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Annex I: Threatened shark species in the IUCN 2007 Red List[1]

Threat Level[2]	Scientific Name	Common Name(s)	Red List Category	Trend
38	*Aetobatus flagellum*	Longheaded Eagle Ray (Eng)	EN A2d+3d+4d ver 3.1 (2001)	Decreasing
39	*Aetomylaeus maculatus*	Mottled Eagle Ray (Eng)	EN A2d+3d+4d ver 3.1 (2001)	Decreasing
100	*Aetomylaeus nichofii*	Banded Eagle Ray (Eng)	VU A2d+3d+4d ver 3.1 (2001)	Decreasing
34	*Aetomylaeus vespertilio*	Ornate Eagle Ray (Eng), Reticulate Eagle Ray (Eng)	EN A2bd+3d+4d ver 3.1 (2001)	Decreasing
101	*Aetoplatea zonura*	Zonetail Butterfly Ray (Eng)	VU A2d+3d+4d ver 3.1 (2001)	Decreasing
9	*Anoxypristis cuspidata*	Knifetooth Sawfish (Eng), Narrow Sawfish (Eng) Pointed Sawfish (Eng), Poisson-Scie (Fre), Pejepeine (Spa), Pez Sierra (Spa)	CR A2bcd+3cd+4bcd ver 3.1 (2001)	Decreasing
121	*Aptychotrema timorensis*	Spotted Shovelnose Ray (Eng)	VU B1ab(v) ver 3.1 (2001)	Unknown
32	*Atlantoraja castelnaui*	Spotback Skate (Eng), Raia-Chita (Spa), Raia-Jereba (Spa), Raya A Lunares (Spa), Raya Chita (Spa), Raya Pintada (Spa)	EN A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
104	*Atlantoraja cyclophora*	Eyespot Skate (Eng), Raya Ojona (Spa), Raya (Spa)	VU A3bd+4bd ver 3.1 (2001)	Decreasing
109	*Atlantoraja platana*	La Plata Skate (Eng), Empalastro (Spa), Oscura (Spa), Platana (Spa), Raya Oscura (Spa), Raya (Spa)	VU A4bd ver 3.1 (2001)	Decreasing
117	*Aulohalaelurus kanakorum*	New Caledonia Catshark (Eng)	VU B1ab(iii) ver 3.1 (2001)	Unknown
108	*Bathyraja albomaculata*	Whitedotted Skate (Eng), Raya De Manchas Blancas (Spa), Rayas De Lunares (Spa)	VU A4bcd ver 3.1 (2001)	Unknown
35	*Bathyraja griseocauda*	Graytail Skate (Eng), Raya Gris (Spa), Raya Lija (Spa)	EN A2bd+4bd ver 3.1 (2001)	Decreasing
122	*Benthobatis kreffti*	Brazilian Blind Electric Ray (Eng), Arraia Cega (Spa)	VU B1ab(v) ver 3.1 (2001)	Unknown
51	*Carcharhinus borneensis*	Borneo Shark (Eng)	EN C2b ver 2.3 (1994)	Unknown
6	*Carcharhinus hemiodon*	Pondicherry Shark (Eng)	CR A2acd; C2a(i) ver 3.1 (2001)	Unknown
114	*Carcharhinus leiodon*	Smoothtooth Blacktip (Eng)	VU B1+2c, C2b ver 2.3 (1994)	Unknown
65	*Carcharhinus longimanus*	Oceanic Whitetip Shark (Eng), White-Tipped Shark (Eng), Whitetip Oceanic Shark (Eng), Whitetip Shark (Eng), Requin Océanique (Fre), Tiburón Oceanico (Spa)	VU A2ad+3d+4ad ver 3.1 (2001)	Decreasing
62	*Carcharhinus signatus*	Night Shark (Eng)	VU A2abd+3bd+4abd ver 3.1 (2001)	Decreasing
52	*Carcharias taurus*	Grey Nurse Shark (Eng), Sand Tiger Shark (Eng), Spotted Ragged-Tooth Shark (Eng), Requin Taureau (Fre), Toro Bacota (Spa)	VU A1ab+2d ver 2.3 (1994)	Unknown
57	*Carcharodon carcharias*	Great White Shark (Eng)	VU A1cd+2cd ver 2.3 (1994)	Unknown
64	*Centrophorus granulosus*	Gulper Shark (Eng), Squale-Chagrin Commun (Fre), Quelvacho (Spa)	VU A2abd+3d+4d ver 3.1 (2001)	Decreasing
18	*Centrophorus harrissoni*	Dumb Gulper Shark (Eng), Dumb Shark (Eng), Harrison's Deepsea Dogfish (Eng), Harrison's Dogfish (Eng)	CR A2bd+3d+4bd ver 3.1 (2001)	Decreasing

Threat Level[2]	Scientific Name	Common Name(s)	Red List Category	Trend
78	*Centrophorus squamosus*	Deepwater Spiny Dogfish (Eng), Leafscale Gulper Shark (Eng), Nilson's Deepsea Dogfish (Eng), Squale-Chagrin De L'atlantique (Fre), Quelvacho Negro (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
53	*Cetorhinus maximus*	Basking Shark (Eng), Pelerin (Fre), Peregrino (Spa)	VU A1ad+2d ver 2.3 (1994)	Unknown
106	*Dasyatis colarensis*	Colares Stingray (Eng)	VU A3d ver 3.1 (2001)	Unknown
70	*Dasyatis fluviorum*	Brown Stingray (Eng), Estuary Stingaree (Eng), Estuary Stingray (Eng)	VU A2bcd+3cd+4bcd ver 3.1 (2001)	Decreasing
116	*Dasyatis garouaensis*	Niger Stingray (Eng), Smooth Freshwater Stingray (Eng)	VU B1+2cde, C2b ver 2.3 (1994)	Decreasing
25	*Dasyatis laosensis*	Mekong Freshwater Stingray (Eng)	EN A1cde+2cde, B1+2ce ver 2.3 (1994)	Unknown
79	*Diplobatis colombiensis*	Colombian Electric Ray (Eng), Torpedo (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Unknown
80	*Diplobatis guamachensis*	Brownband Numbfish (Eng), Temblador (Spa), Torpedo Redondo (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Unknown
81	*Diplobatus ommata*	Bullseye Electric Ray (Eng), Ocellated Electric Ray (Eng), Raie Électrique Ocellée (Fre), Raya Eléctrica De Ocelo (Spa), Raya Eléctrica Diana (Spa), Raya Eléctrica Ocelada (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Unknown
82	*Diplobatus pictus*	Variegated Electric Ray (Eng), Raya Electrica Variegada (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Unknown
16	*Dipturus batis*	Blue Skate (Eng), Flapper Skate (Eng), Grey Skate (Eng), Flotte (Fre), Pocheteau Gris (Fre), Pochette (Fre), Noriega (Spa), Raya Noruega (Spa)	CR A2bcd+4bcd ver 3.1 (2001)	Decreasing
110	*Dipturus chilensis*	Kite Ray (Eng), Large-Nose Ray (Eng), Yellownose Skate (Eng), Raya De Ramales (Spa), Raya Picuda (Spa), Raya Roja (Spa), Raya Trompa De Cristal (Spa), Raya (Spa), Volantín (Spa)	VU A4bd ver 3.1 (2001)	Decreasing
107	*Dipturus crosnieri*	Madagascar Skate (Eng)	VU A3d ver 3.1 (2001)	Unknown
23	*Dipturus laevis*	Barndoor Skate (Eng)	EN A1bcd ver 3.1 (2001)	No changes
112	*Dipturus mennii*	South Brazilian Skate (Eng)	VU A4d ver 3.1 (2001)	Unknown
44	*Dipturus sp. nov. L*	Maugean Skate (Eng)	EN B1+2c ver 2.3 (1994)	Unknown
111	*Dipturus trachydermus*	Roughskin Skate (Eng), Raya Espinuda (Spa)	VU A4bd ver 3.1 (2001)	Decreasing
90	*Galeorhinus galeus*	Liver-Oil Shark (Eng), Miller's Dog (Eng), Oil Shark (Eng), Penny Dog (Eng), Rig (Eng), School Shark (Eng), Snapper Shark (Eng), Soupfin (Eng), Soupie (Eng), Southern Tope (Eng), Sweet William (Eng), Tope Shark (Eng), Toper (Eng), Tope (Eng), Vitamin Shark (Eng), Whithound (Eng), Cagnot (Fre), Canicule (Fre), Chien De Mer (Fre), Haut (Fre), Milandré (Fre), Palloun (Fre), Requin-Hâ (Fre), Tchi (Fre), Touille (Fre), Bosti (Spa), Bostrich (Spa), Ca Marí (Spa), Cacao (Spa), Cassó (Spa), Cazón (Spa), Gat (Spa), Musola Carallo (Spa), Musola (Spa), Pez Calzón (Spa), Pez Peine (Spa), Tiburón Trompa De Cristal (Spa), Tiburón Vitamínico (Spa)	VU A2bd+3d+4bd ver 3.1 (2001)	Decreasing
123	*Galeus mincaronei*	Southern Sawtail Catshark (Eng)	VU B1ab(v) ver 3.1 (2001)	Decreasing

Threat Level[2]	Scientific Name	Common Name(s)	Red List Category	Trend
19	*Glyphis gangeticus*	Ganges Shark (Eng)	CR A2cde; C2b ver 3.1 (2001)	Decreasing
50	*Glyphis glyphis*	Speartooth Shark (Eng)	EN C2a ver 2.3 (1994)	Unknown
21	*Glyphis sp. nov. A*	Bizant River Shark (Eng)	CR C2a(i) ver 3.1 (2001)	Decreasing
22	*Glyphis sp. nov. C*	New Guinea River Shark (Eng), Northern River Shark (Eng)	CR C2a(i) ver 3.1 (2001)	Decreasing
124	*Gurgesiella dorsalifera*	Onefin Skate (Eng)	VU B1ab(v) ver 3.1 (2001)	Decreasing
95	*Gymnura altavela*		VU A2bd+4bd ver 3.1 (2001)	Decreasing
83	*Hemipristis elongatus*	Fossil Shark (Eng), Snaggletooth Shark (Eng), Milandre Chicor (Fre), Comadreja Sobrediente (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
118	*Hemiscyllium hallstromi*	Papuan Epaulette Shark (Eng)	VU B1ab(iii) ver 3.1 (2001)	Unknown
119	*Hemiscyllium strahani*	Hooded Carpet Shark (Eng)	VU B1ab(iii) ver 3.1 (2001)	Unknown
47	*Hemitriakis leucoperiptera*	Whitefin Topeshark (Eng)	EN B1+2ce, C2b ver 2.3 (1994)	Unknown
125	*Heteroscyllium colcloughi*	Bluegray Carpetshark (Eng)	VU C2b ver 2.3 (1994)	Unknown
54	*Himantura chaophraya*	Giant Freshwater Stingray (Eng)	VU A1bcde+2ce ver 2.3 (1994)	Unknown
24	*Himantura fluviatilis*	Ganges Stingray (Eng)	EN A1cde+2cde, B1+2c ver 2.3 (1994)	Unknown
45	*Himantura oxyrhyncha*	Marbled Freshwater Stingray (Eng)	EN B1+2c ver 2.3 (1994)	Unknown
46	*Himantura signifer*	White-Edge Freshwater Whipray (Eng)	EN B1+2c ver 2.3 (1994)	Unknown
7	*Isogomphodon oxyrhynchus*	Daggernose Shark (Eng)	CR A2ad+3d+4ad ver 3.1 (2001)	Decreasing
91	*Isurus paucus*	Longfin Mako (Eng), Petit Taupe (Fre), Taupe Longue Aile (Fre), Dientuso Prieto (Spa), Marrajo Carite (Spa)	VU A2bd+3d+4bd ver 3.1 (2001)	Decreasing
92	*Lamna nasus*	Porbeagle (Eng), Requin-Taupe Commun (Fre), Marrajo Sardinero (Spa), Tiburón Sardinero (Spa), Tintorera (Spa)	VU A2bd+3d+4bd ver 3.1 (2001)	Decreasing
8	*Leucoraja melitensis*	Maltese Skate Or Ray (Eng), Raie De Malte (Fre)	CR A2bcd+3bcd+4bcd ver 3.1 (2001)	Decreasing
42	*Mobula mobular*	Giant Devilray (Eng), Mante (Fre), Manta (Spa),	EN A4d ver 3.1 (2001)	Decreasing
4	*Mustelus fasciatus*	Striped Dogfish (Eng), Striped Smooth-Hound (Eng), Gatuso (Spa), Gatuzo (Spa)	CR A2abd+3bd+4abd ver 3.1 (2001)	Decreasing
33	*Mustelus schmitti*	Narrownose Smoothhound (Eng), Cazón (Spa), Gatuzo (Spa)	EN A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
98	*Mustelus whitneyi*	Humpback Smoothhound (Eng), Musola Prieta (Spa), Tollo Común (Spa)	VU A2d ver 3.1 (2001)	Decreasing
49	*Myliobatis hamlyni*	Purple Eagle Ray (Eng)	EN B1ab(v); C2a(i) ver 3.1 (2001)	Decreasing
5	*Narcine bancroftii*	Caribbean Electric Ray (Eng)	CR A2abd+3bd+4bd ver 3.1 (2001)	Unknown
84	*Narcine brevilabiata*	Shortlip Electric Ray (Eng)	VU A2bd+3bd+4bd ver 3.1 (2001)	Unknown

Threat Level[2]	Scientific Name	Common Name(s)	Red List Category	Trend
60	*Nebrius ferrugineus*	Tawny Nurse Shark (Eng)	VU A2abcd+3cd+4abcd ver 3.1 (2001)	Decreasing
59	*Negaprion acutidens*	Sharptooth Lemon Shark (Eng)	VU A2abcd+3bcd+4abcd ver 3.1 (2001)	Decreasing
71	*Oxynotus centrina*	Angular Rough Shark (Eng), Centrine Commune (Fre), Cerdo Marino (Spa)	VU A2bcd+4bd ver 3.1 (2001)	Unknown
10	*Pristis clavata*	Dwarf Sawfish (Eng), Queensland Sawfish (Eng), Poisson-Scie (Fre), Pejepeine (Spa), Pez-Sierra (Spa)	CR A2bcd+3cd+4bcd ver 3.1 (2001)	Decreasing
3	*Pristis microdon*	Freshwater Sawfish (Eng), Largetooth Sawfish (Eng), Leichhardt's Sawfish (Eng), Smalltooth Sawfish (Eng), Poisson-Scie (Fre), Pejepeine (Spa), Pez Sierra (Spa)	CR A2abcd+3cd+4bcd ver 3.1 (2001)	Decreasing
11	*Pristis pectinata*	Smalltooth (Eng), Wide Sawfish (Eng), Poisson-Scie (Fre), Pejepeine (Spa), Pez Sierra (Spa), Sayyafah (Spa), Sayyaf (Spa)	CR A2bcd+3cd+4bcd ver 3.1 (2001)	Decreasing
2	*Pristis perotteti*	Largetooth Sawfish (Eng)	CR A2abcd ver 3.1 (2001)	Decreasing
1	*Pristis pristis*	Common Sawfish (Eng)	CR A1abc+2cd ver 2.3 (1994)	Decreasing
12	*Pristis zijsron*	Narrowsnout Sawfish (Eng), Poisson-Scie (Fre), Pejepeine (Spa), Pez Sierra (Spa)	CR A2bcd+3cd+4bcd ver 3.1 (2001)	Decreasing
105	*Pseudoginglymostoma brevicaudatum*	Shorttail Nurse Shark (Eng), Requin-Nourrice À Queue Courte (Fre), Gata Nodriza Rabicorta (Spa),	VU A3cd+4cd ver 3.1 (2001)	Unknown
85	*Rhina ancylostoma*	Bowmouth Guitarfish (Eng), Mud Skate (Eng), Shark Ray (Eng)	VU A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
55	*Rhincodon typus*	Whale Shark (Eng), Requin Baleine (Fre), Tiburón Ballena (Spa)	VU A1bd+2d ver 2.3 (1994)	Decreasing
40	*Rhinobatos cemiculus*	Blackchin Guitarfish (Eng), Guitarre De Mer Fouisseuse (Fre), Guitarra Barbanegra (Spa), Guitarrón (Spa)	EN A4bd ver 3.1 (2001)	Decreasing
102	*Rhinobatos formosensis*	Taiwan Guitarfish (Eng)	VU A2d+3d+4d ver 3.1 (2001)	Unknown
93	*Rhinobatos granulatus*	Sharpnose Guitarfish (Eng)	VU A2bd+3d+4d ver 3.1 (2001)	Decreasing
17	*Rhinobatos horkelii*	Brazilian Guitarfish (Eng)	CR A2bd ver 3.1 (2001)	Decreasing
97	*Rhinobatos jimbaranensis*		VU A2cd+3cd+4cd; B1ab(iii,v) ver 3.1 (2001)	Decreasing
94	*Rhinobatos obtusus*	Widenose Guitarfish (Eng)	VU A2bd+3d+4d ver 3.1 (2001)	Decreasing
96	*Rhinobatos penggali*		VU A2cd+3cd+4cd ver 3.1 (2001)	Decreasing
41	*Rhinobatos rhinobatos*	Common Guitarfish (Eng), Violinfish (Eng), Guitare De Mer Commune (Fre), Guitarra Comùn (Spa), Guitarra (Spa), Guitarró (Spa)	EN A4cd ver 3.1 (2001)	Decreasing
63	*Rhinobatos thouin*	Clubnose Guitarfish (Eng)	VU A2abd+3bd+4abd ver 3.1 (2001)	Unknown
86	*Rhinobatos typus*	Common Shovelnose Ray (Eng), Giant Shovelnose Ray (Eng)	VU A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
26	*Rhinoptera brasiliensis*	Brazilian Cownose Ray (Eng)	EN A2abcd+3bcd+4abcd; B1ab(i,iii,v) ver 3.1 (2001)	Decreasing

Threat Level[2]	Scientific Name	Common Name(s)	Red List Category	Trend
99	*Rhinoptera javanica*	Flapnose Ray (Eng), Javanese Cownose Ray (Eng), Mourine Javanaise (Fre)	VU A2d+3cd+4cd ver 3.1 (2001)	Unknown
87	*Rhynchobatus australiae*	White-Spotted Guitarfish (Eng), White-Spotted Wedgefish (Eng)	VU A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
103	*Rhynchobatus djiddensis*	Giant Guitarfish (Eng), Whitespotted Wedgefish (Eng)	VU A2d+3d+4d ver 3.1 (2001)	Decreasing
88	*Rhynchobatus laevis*	Smoothnose Wedgefish (Eng)	VU A2bd+3bd+4bd ver 3.1 (2001)	Unknown
27	*Rhynchobatus luebberti*	African Wedgefish (Eng), Guitarra (Eng), Lubbert's Guitarfish (Eng), Spikenose Wedgefish (Eng), Guitare A Tachés (Fre)	EN A2ad+3d+4ad ver 3.1 (2001)	Decreasing
66	*Rhynchobatus sp. nov. A*	Roughnose Wedgefish (Eng)	VU A2ad+3d+4ad ver 3.1 (2001)	Decreasing
67	*Rhynchobatus sp. nov. B*	Broadnose Wedgefish (Eng)	VU A2ad+3d+4ad ver 3.1 (2001)	Decreasing
113	*Rioraja agassizi*	Rio Skate (Eng), Raya Lisa (Spa)	VU A4d ver 3.1 (2001)	Unknown
37	*Rostroraja alba*	Bottlenose Skate (Eng), Spearnose Skate (Eng), White Skate (Eng), Raie Blanche (Fre), Raya Bramante (Spa)	EN A2cd+4cd ver 3.1 (2001)	Decreasing
120	*Schroederichthys saurisqualus*	Lizard Catshark (Eng)	VU B1ab(iii,v) ver 3.1 (2001)	Unknown
115	*Scylliogaleus quecketti*	Flapnose Houndshark (Eng)	VU B1+2c, C2b ver 2.3 (1994)	Unknown
36	*Sphyrna mokarran*	Great Hammerhead (Eng), Hammerhead Shark (Eng), Squat-Headed Hammerhead Shark (Eng), Grand Requin-Marteau (Fre), Marieau Millet (Fre), Poisson Pantouflier (Fre), Sorosena (Fre), Cornuda (Spa), Guardia Civil (Spa), Pez Martillo (Spa),	EN A2bd+4bd ver 3.1 (2001)	Decreasing
68	*Sphyrna tudes*	Curry Shark (Eng), Golden Hammerhead (Eng), Smalleye Hammerhead Shark (Eng), Requin-Marteau À Petits Yeux (Fre), Cornuda Ojichica (Spa)	VU A2ad+3d+4ad ver 3.1 (2001)	Decreasing
89	*Squalus acanthias*	Cape Shark (Eng), Piked Dogfish (Eng), Spurdog (Eng), Aiguillat Commun (Fre), Cazón Espinoso (Spa), Espinillo (Spa), Galludo (Spa), Mielga (Spa), Tiburón Espinoso (Spa), Tollo (Spa), Tolo De Cachos (Spa)	VU A2bd+3bd+4bd ver 3.1 (2001)	Decreasing
14	*Squatina aculeata*	Monkfish (Eng), Sawback Angelshark (Eng), Spiny Angelshark (Eng), Ange De Mer Épineux (Fre), Angelote Espinudo (Spa)	CR A2bcd+3cd+4cd ver 3.1 (2001)	Decreasing
28	*Squatina argentina*	Argentine Angel Shark (Eng), Longfin Angel Shark (Eng), Angelote (Spa), Pez Ángel (Spa)	EN A2b ver 3.1 (2001)	Decreasing
29	*Squatina guggenheim*	Hidden Angelshark (Eng), Spiny Angel Shark (Eng)	EN A2bd ver 3.1 (2001)	Decreasing
30	*Squatina occulta*	Smoothback Angel Shark (Eng)	EN A2bd ver 3.1 (2001)	Decreasing
13	*Squatina oculata*	Monkfish (Eng), Smoothback Angel Shark (Eng), Ange De Mer De Bonaparte (Fre), Ange De Mer Jaune (Fre), Ange De Mer Ocellé (Fre), Angelote (Spa), Pez Angel (Spa)	CR A2bcd+3cd+4bcd ver 3.1 (2001)	Decreasing
31	*Squatina punctata*	Angular Angelshark (Eng)	EN A2bd ver 3.1 (2001)	Decreasing
72	*Squatina sp. nov. A*	Eastern Angel Shark (Eng)	VU A2bd ver 3.1 (2001)	Decreasing

Threat Level[2]	Scientific Name	Common Name(s)	Red List Category	Trend
15	*Squatina squatina*	Angel Shark (Eng), Ange De Mer (Fre), Angel (Fre), Ange (Fre), Antjou (Fre), Bourgeois (Fre), Bourget (Fre), L'anelot (Fre), L'ange (Fre), Martrame (Fre), Mordacle (Fre), Squatine Occelee (Fre), Angelote (Spa), Mermejuela (Spa), Pardon (Spa), Pez Angel (Spa)	CR A2bcd+3d+4bcd ver 3.1 (2001)	Decreasing
61	*Stegostoma fasciatum*	Leopard Shark (Eng), Zebra Shark (Eng)	VU A2abcd+3cd+4abcd ver 3.1 (2001)	Decreasing
73	*Sympterygia acuta*	Bignose Fanskate (Eng), Raya Marrón Oscuro (Spa), Raya (Spa)	VU A2bd ver 3.1 (2001)	Decreasing
69	*Taeniura meyeni*	Black-Blotched Stingray (Eng), Black-Spotted Stingray (Eng), Blotched Fantail Ray (Eng), Fantail Stingray (Eng), Giant Reef Ray (Eng), Round Ribbontail Ray (Eng), Speckled Stingray (Eng), Pastenague Eventail (Fre)	VU A2ad+3d+4ad ver 3.1 (2001)	Unknown
126	*Triakis acutipinna*	Sharpfin Houndshark (Eng)	VU C2b ver 2.3 (1994)	Unknown
74	*Triakis maculata*	Spotted Houndshark (Eng), Virli Tacheté (Fre), Tollo Manchado (Spa)	VU A2bd ver 3.1 (2001)	Decreasing
56	*Urogymnus asperrimus*	Porcupine Ray (Eng)	VU A1bd, B1+2bcd ver 2.3 (1994)	Unknown
43	*Urogymnus ukpam*	Pincushion Ray (Eng)	EN B1+2abcd ver 2.3 (1994)	Unknown
75	*Urolophus bucculentus*	Great Stingaree (Eng), Sandyback Stingaree (Eng)	VU A2bd ver 3.1 (2001)	Decreasing
20	*Urolophus javanicus*	Java Stingaree (Eng)	CR B1ab(iii,v) ver 3.1 (2001)	Decreasing
48	*Urolophus orarius*	Coastal Stingaree (Eng)	EN B1ab(v) ver 3.1 (2001)	Unknown
76	*Urolophus sufflavus*	Yellowback Stingaree (Eng)	VU A2bd ver 3.1 (2001)	Decreasing
77	*Urolophus viridis*	Greenback Stingaree (Eng)	VU A2bd ver 3.1 (2001)	Decreasing
58	*Zapteryx brevirostris*	Shortnose Guitarfish (Eng)	VU A2ab+3b+4ab ver 3.1 (2001)	Decreasing

[1] Species appear listed in alphabetical order.

[2] Threat level faced by each species. Number 1 (*Pristis pristis*) is the most endangered shark species to date, and number 126 (*Triakis acutipinna*) the least endangered of all species considered as threatened.

Source: IUCN 2007. **2007 IUCN Red List of Threatened Species.** www.iucnredlist.org Downloaded on 15.09.2007.

Annex II: Useful Bibliographic and Internet Resources Available

There are numerous sources of information on shark biology, ecology, fisheries and management, either at international, regional or local level. This list aims to show a very few of these sources, with the purpose of inviting the reader to explore the possibilities of each of them, and to discover the many other possibilities not included here.

- CITES: www.cites.org

  Webpage of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. The website makes available the Convention Text and general information on how CITES works. It also contains official documents from the Animals and Plants Committees, the Conference of the Parties and the Standing Committee. Information on meetings, Resolutions, Decisions, Reservations and Export Quotas is available too. There are useful links to databases on wildlife international trade, in collaboration with the World Conservation Monitoring Centre, WCMC.

- Convention on the Conservation of Migratory Species of Wild Animals (CMS): www.cms.int

  Besides general information on the Convention and on its bodies and meetings, this website also offers the Convention Text, official documents and information on news and events. Data on species and the CMS Appendices are also available.

- European Commission. Fisheries: www.ec.europa.eu/fisheries

  General information on the European Union's Common Fisheries Policy and how it is applied. Links to relevant legislation, including Regulations, species protected, Total Allowable Catches, fishing techniques and other relevant information.

- FAO www.fao.org
  - The Fisheries and Aquaculture Information and Statistics Service Website (http://www.fao.org/fi/website/FIRetrieveAction.do?dom=topic&fid=16000) offers information on Fisheries, Fish Utilisation, Trade & Fisheries, Fisheries Development, Fisheries Governance, Fishery Resources, Fisheries Technology, Ecosystems and Fisheries Research, among other key issues. It is possible to make a personalised query on specific fisheries resources, geographical zone and time period. Links are available to the electronic pages of the Committee on Fisheries (COFI) and its Sub-Committees on Aquaculture and Trade, including official documents and information on meetings. Information on the existing Regional Fisheries Bodies (cited in the corresponding section of this paper) can also be accessed through this website.
  - Statistical collections. Global time series are available over 50 year time spans. Data from each statistical collection are available through various formats, tools and information products, such as summary tables of fishery statistics, yearbooks and online query panels. Other data collections, also fully-documented, are organised by records, Fact Sheets and maps, thus complementing the overall statistical collections.
    http://www.fao.org/fi/website/FIRetrieveAction.do?dom=topic&fid=16003
  - A compilation of fishery software is available for diverse user needs, ranging from fishery statistical applications through biologic, socio-economic, or ecosystem modelling for fisheries assessment, such as ARTFISH, BEAM1 to BEAM4, CLIMPROD, CLIMPRODPLUS, FAST, FISAT II, FishStat Plus, MTBASE 1.1, NANSIS, SPATIAL, THOMPSON and VONBIT.
    http://www.fao.org/fi/website/FIRetrieveAction.do?dom=topic&fid=16066
  - Publications. http://www.fao.org/icatalog/inter-e.htm

Useful and illustrative publications such as the State of World Fisheries and Aquaculture (SOFIA), the Code of Conduct for Responsible Fisheries, Technical Guidelines for Responsible Fisheries, Fisheries Reports, International Plans of Action, Yearbooks of Fishery Statistics and Fisheries Technical Papers (FTP) can be downloaded on PDF version or ordered for delivery by mail. Among the many publications by FAO that contain information useful for making NDF on sharks, the following should be highlighted:

- MUSICK, J.A. & R. BONFIL. (eds). 2005. **Management techniques for elasmobranch fisheries.** FAO FTP No. 474. Rome, FAO. 251pp.

  The objectives of the manual are to provide the necessary information for fisheries managers to effectively address the IPOA Sharks, thus leading to sustainable shark fisheries. A step by step approach is provided to collect the information needed for proper stock assessment and sustainable shark management. Each chapter progresses from simple to more complex techniques.

- KELLEHER, K. 2005. **Discards in the world's marine fisheries. An update.** FAO Fisheries Technical Paper. No. 470. Rome, FAO. 131pp.

  This study provides an update of the quantity of discards in the world's marine fisheries based on a fishery-by-fishery approach.

- GARCIA, S.M., A. ZERBI, C. ALIAUME, T. DO CHI & G. LASSERRE. 2003. **The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook.** FAO Fisheries Technical Paper. No. 443. Rome, FAO. 71 p.

  An interesting study concluding that the future of the ecosystem approach to fisheries and fisheries depends on the way in which the two fundamental concepts of fisheries management and ecosystem management, and their respective stakeholders, will join efforts or collide.

- FAO Marine Resources Service. **Fisheries management. 1. Conservation and management of sharks.** FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 1. Rome, FAO. 2000. 37pp.

  The guidelines are intended to provide general advice and a framework for development and implementation of Shark Plans and Shark Assessment Reports prepared at national, subregional and regional levels.

- SHOTTON, R. (ed.) 1999. **Case studies of the management of elasmobranch fisheries.** FAO Fisheries Technical Paper. No. 378, parts 1 & 2. Rome, FAO. 1999. pp.1–479

  This report, consisting of 29 studies, describes the relevant population biology, resource analyses and fishery management of elasmobranchs at regional, national and sub-regional levels. The authors further provide a descriptive and critical review of the policy setting process in relation to the elasmobranch fisheries, its successes, ongoing and unresolved problems and the nature of their weaknesses.

- Fishbase: www.fishbase.org

  FROESE, R. & D. PAULY. Editors. 2007. **FishBase.** World Wide Web electronic publication. www.fishbase.org, version (08/2007).

  A user-friendly database containing basic information on 30,000 fish species (including sharks) and 259,300 common names, based on 40,200 scientific references, being continuously updated by 1,480 collaborators. Information sheets for each species comprise synonyms, common names, distribution (including maps), images, taxonomy, maximum size, environment, climate, importance, morphology, biology, red list status and, more important still, information on resilience and reproduction, when available. It also offers useful resources such as an e-book, field guides and identification keys, as well as useful on-line tools for biogeographic modelling, length-frequency relationships, life-history and point data distribution maps.

- IUCN Red List of Threatened Species: www.iucnredlist.org

  IUCN Red List assessments attempt to address the global status of a species, synthesising information on all known populations. Currently, the List recognises 126 shark species as threatened. As a complementary approach, IUCN has created, through its Species Survival Commission (SSC, a science-based network of volunteer experts), the Shark Specialist Group (SSG).

- IUCN/SSC Shark Specialist Group
  http://www.flmnh.ufl.edu/fish/organizations/ssg/ssg.htm

  Among other valuable information on the SSG activities and research, the website makes available the following publication:

  FOWLER, S.L., CAVANAGH, R.D., CAMHI, M., BURGESS, G.H., CAILLIET, G.M., FORDHAM, S.V., SIMPFENDORFER, C.A., MUSICK, J.A.(comp.&ed.).2005. **Sharks, rays and chimaeras: the status of the chondrichthyan fishes. Status survey.** IUCN/SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge. U.K. 461pp.

  This Status Survey is a comprehensive resource documenting the biology, threats, and opportunities for global action for the conservation of chondrichthyan fishes. The Survey arose out of widespread concern that many populations are in serious decline worldwide, resulting from expanding exploitation largely in the absence of fisheries management, conservation measures, or reliable data to guide sustainable fisheries. Its eight chapters include information on taxonomy, biology, and life history; the products, trade, and economics of exploitation; regional reports summarising shark fisheries from nine geopolitical SSG regions and their fishing nations; and status assessments for more than one hundred shark species.

- Western Pacific Regional Fishery Management Council
  - GILMAN, E., S. CLARKE, N. BROTHERS, J. ALFARO-SHIGUETO, J. MANDELMAN, J. MANGEL, S. PETERSEN, S. PIOVANO, N. THOMSON, P. DALZELL, M. DONOSO, M. GOREN & T. WERNER. 2007. **Shark Depredation and Unwanted Bycatch in Pelagic Longline Fisheries: Industry Practices and Attitudes, and Shark Avoidance Strategies.** Western Pacific Regional Fishery Management Council, Honolulu, USA. 203pp.

    In some pelagic longline fisheries, shark interactions pose substantial economic, ecological and social problems. Information on existing fisher knowledge and new strategies for shark avoidance is presented. This project collected information from a diverse range of pelagic longline fisheries in eight countries (Australia, Chile, Fiji, Italy, Japan, Peru, South Africa, USA). The main purpose is to benefit sharks and fishers wanting to reduce shark interactions, by providing the industry and management authorities with better information to manage these problems.

- **Shark identification guides.** There are numerous identification guides specialised in sharks, some developed by scientists, others by State Governments and others by fisheries research bodies. Among the many available, FAO has developed a catalogue on sharks of the World and three regional shark identification guides. They include sections on technical terms and measurements for sharks and batoids, and fully illustrated keys to those orders and families that occur in the region, besides species accounts.

- COMPAGNO, L.J.V. 1984. **Sharks of the world. An annotated and illustrated catalogue of shark species known to date.** FAO Fish Synop. 125, part I: pp.1–249, part II: pp.251-655.
- FAO. 2005. **Field identification guide to the sharks and rays of the Mediterranean and Black Sea**. FAO Species Identification Guides for Fishery Purposes. FAO, Rome.136pp.
- FAO. 2004. **Field identification guide to the sharks and rays of the Red Sea and Gulf of Aden**. FAO Species Identification Guides for Fishery Purposes. FAO, Rome. 106pp.
- FAO. 1999. **The living marine resources of the Western Central Pacific. Volume 2. Cephalopods, crustaceans, holothurians and sharks** (716 pp.). **Volume 3. Batoid fishes, chimaeras and bony fishes part 1 (Elopidae to Linophrynidae)** (678 pp.). FAO Species Identification Field Guides. FAO, Rome.

Annex III: Checklist to assist in making non-detriment findings for shark exports (modified from Rosser & Haywood 2002)

The World Conservation Union (IUCN) and the CITES Secretariat developed a checklist to guide Scientific Authorities in evaluating the necessary information in order to make non-detriment findings (Rosser & Haywood 2002). The original list contains two tables and 26 parameters relating to the species' life history, populations, evolution, management, and possible economic and social implications of its use. IUCN proposes different answers for each parameter, which can also be expressed graphically. The procedure generates confidence in decision making using available information, in an easy-to-use format.

A modification to the abovementioned checklist is proposed here, considering the peculiarities of sharks' life history and a number of recommendations contained in relevant documents developed by FAO, such as the Technical Guidelines for Conservation and Management of Sharks[1], the FAO Code of Conduct for Responsible Fisheries and the Ecosystem Approach to Fisheries[2] . As in the original developed by IUCN, the modified checklist does not intend to be a NDF in itself, but rather an orientating first step for assessing the status of shark fisheries management in data poor situations.

Part I is aimed at gathering the information needed to understand the scope of the fishery undergoing an NDF.

Part 2 consists of a series of questions aimed to indicate the sensitivity of the species to the impacts of fishing and commercial use. Original numbering is kept, although some questions have been significantly modified or removed and new questions have been added, in order to keep an easy to use reference to the original questionnaire.

For each question there is one of four definite answers, or a fifth answer for "uncertain". Definite answers that indicate greatest confidence in sustainability of fishing appear at the top of each numbered question. Only one answer should be checked. A simple addition of the number preceding each answer selected will guide Scientific Authorities on whether or not that component of international trade carried out for commercial purposes is detrimental to the survival of the species.

Some of the information requested by this questionnaire is available on the IUCN Red List database. Since this database is continuously updated, it is advisable to check for the latest additions and modifications displayed in the Red List website.

According to Rosser & Haywood (2002), when a preponderance of factors point to potential detriment, the Scientific Authority should inform the Management Authority that the proposed export should not proceed.

Finally, and as stated earlier in the present document, the key consideration for making an NDF must be whether the status of a shark population is good, fair or bad, and based on this, assess if trade is likely to be promoting an undesirable level of exploitation.

[1] FAO. 2000. Fisheries Management. 1. Conservation and management of sharks. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 1. Rome, FAO. 37pp.

[2] FAO. 2003. The ecosystem approach to fisheries. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 2 Rome, FAO. 122pp.

Part 1. Summary of fishing regime for shark stocks or species

Species: ____

Site (coastal State or Province and, if available, fishing zone or area coordinates):
____

Has this area been identified as important or critical habitat for the species (e.g. nurseries, parturition and mating areas, migration lanes)? ____________________

Date (of making non-detriment finding): ____

Period to be covered by finding: ____

Name/ Position of officer in Scientific Authority making NDF: ______________________
____

Is the species (stock, population) endemic, found in a few countries only, or widespread?
____

Conservation status of the species (stock, population), if known: ____________________

IUCN Global status: ________ National status: ______Other: ________________________

Is the species (stock, population) protected by any national or international legislation? _
If so, how does this affect fishing of wild populations? ______________________
____

In case the source stock/population has been identified, is it migrating or straddling? ____
If so, Is it listed under the Bonn Convention (CMS)? ________________________
are management measures coordinated among range countries? _____________
Is the stock/population fished by more than one fleet? ______________________

Is there a National Plan of Action for Sharks, based on FAO's IPOA-Sharks? __________
If so, which management measures are already in force for the species (stock, population)? ____
Have databases on catches, stock assessments and/or other analysis been developed for the species (stock, population), as part of this Plan or other national programmes? ____
Were these consulted for making this NDF? _______________________________

Is the species commercially fished? ____
Is there a fishery stock assessment? ______________________________________
Is there scientific management advice for this species?______________________
If so, is this advice being adopted? _______________________________________
If catch records are kept, do they account for bycatch and/or discards? _________
Were these consulted for making this NDF? _______________________________

Specify the type of fishery where the shipment comes from (select one option from each classification for each fleet catching the species):

A. Subsistence
   Artisanal
   Industrial
B. Directed
   Bycatch in multispecies fishery
C. Coastal hook and gillnet fisheries
   Deepwater bycatch fisheries
   Pelagic shark bycatch fisheries
   Freshwater fisheries

In general, does the fishery utilise the whole carcass of the shark or only a fraction of it?
____

Relevant Fisheries Management Organisation(s) in the area where the catch was obtained:

- Commission on the Conservation of Antarctic Marine Living Resources, CCAMLR
- General Fisheries Commission for the Mediterranean, GFCM
- Indian Ocean Tuna Commission, IOTC
- Inter-American Tropical Tuna Convention, IATTC
- International Commission for the Conservation of Atlantic Tunas, ICCAT
- North-East Atlantic Fisheries Commission, NEAFC
- Northwest Atlantic Fisheries Organisation, NAFO
- South East Atlantic Fisheries Organisation, SEAFO
- Western Central Pacific Tuna Commission (WCPO)
- Other (specify) ____

Regulations implemented and other measures taken by the abovementioned RFMO affecting the species, stock or population:

- Data collection programmes
- Stock assessment based on regional databases
- Actions against finning or other forms of partial use of sharks
- Certification, observer programmes, inspection schemes, vessel monitoring systems and/or other similar measures
- Research on stock identification & structure, nursery areas, selective gears, etc.
- Limits on fishing effort to reduce the bycatch of shark species
- Scientific advice available/being applied
- Other measures (specify) ______________________________________
- Were the databases and/or other analysis developed by the abovementioned RFMO consulted for making this NDF? ____________________________

Have fishery independent surveys and/or other analysis been developed for the species?

- If so, were the results consulted for making this NDF? ___________________

Type of fishing	Main product*	Degree of control	Demographic segment removed from wild population					Relative level of fishing (number or quantity if known)				Commercial destination(s) (numbers and % if known)		
			Eggs	Juvs	Adult males	Adult females	Nonselective	Low	Medium	High	Unknown	Local	National	International
Directed fishery or bycatch		a) Regulated: i) Directed fishery - high seas (industrial) fleet ii) Bycatch - high seas (industrial) fleet iii) Directed fishery - coastal (artisanal) fleet iv) Bycatch - coastal (artisanal) fleet												
		v) Recreational fishery												
		b) Illegal or unmanaged												
Live capture for aquarium trade		a) Regulated												
		b) Illegal or unmanaged												
Persecution or problem animal control		a) Regulated												
		b) Illegal or unmanaged												

* The following classification for shark products is proposed by the FAO Technical Guidelines for Responsible Fisheries (2000[4]):
- whole,
- headed and gutted carcass with skin on and fins on,
- headed and gutted carcass with skin on and fins off,
- headed and gutted carcass with skin off and fins off,
- filleted meat only,
- heads only,
- head cartilage,
- vertebral cartilage,
- powdered cartilage,
- skin only,
- fins only,
- whole livers only, or
- liver-oil.

[4] FAO. 2005**. Fisheries Management. Supplement 1: Conservation and management of sharks.** FAO Technical Guidelines for Responsible Fisheries. FAO, Rome. 48pp.

Part 2:

Biological characteristics:

2.2 Ecological adaptability: To what extent is the species adaptable (habitat, diet, environmental tolerance etc.)?

1. Extreme generalist
2. Generalist
3. Specialist
4. Extreme specialist
5. Uncertain

2.3 Geographical range: The stock is:

1. A straddling stock with global distribution
2. A straddling stock with regional distribution
3. A global highly migratory stock
4. A local endemic species
5. Uncertain

2.4 Interaction with humans: Is the species tolerant to human activity other than fishing?

1. No interaction
2. Highly tolerant
3. Tolerant
4. Sensitive
5. Uncertain

National status:

2.5 National distribution: How is the species distributed nationally?

1. Widespread, contiguous in Exclusive Economic Zone (EEZ) waters
2. Widespread, fragmented in EEZ waters
3. Restricted and fragmented
4. Localized
5. Uncertain

2.6 National abundance: What is the abundance nationally?

1. Very abundant
2. Common
3. Uncommon
4. Rare
5. Uncertain

2.7 National population trend: What is the recent national population trend?

1. Increasing
2. Stable
3. Reduced, but stable
4. Reduced and still decreasing
5. Uncertain

2.8 Type of information: What type of information is available to describe abundance and trend in the national population?

1. Fishery independent surveys
2. Fishery stock assessments
3. Catch per unit effort
4. Landings
5. None

2.8a Quality of information: What type of information is available to describe abundance and trend in the national population?

1. Quantitative data, recent
2. Good local knowledge
3. Quantitative data, outdated
4. Anecdotal information
5. None

2.9 Major threats: What major threat(s) is the species facing (underline following: overuse by direct fisheries, overuse as bycatch, habitat loss and/or alteration, other-specify____) and how severe is it? Respond separately if more than one threat is selected.

1. None
2. Limited/Reversible
3. Substantial
4. Severe/Irreversible
5. Uncertain

Fisheries management:

2.10 Illegal fishing or trade: How significant is the national problem of illegal or unmanaged fishing or trade?

1. None
2. Small
3. Medium
4. Large
5. Uncertain

2.11 Management history: What is the history of the fishery?

1. Managed fishing: ongoing with adaptive framework
2. Managed fishing: ongoing but informal
3. Managed fishing: new
4. Unmanaged fishing: ongoing or new
5. Uncertain

2.12 Management plan or equivalent: Is there a management plan or scientific advice related to the fishing of the species? Consider National Plans under IPOA-Sharks, management regulations implemented by RFMO, international/regional/national/local management regulations or any other existing management regimes, as well as management advice from scientific bodies.

1. Approved and co-ordinated local and national management plans
2. Approved national/state/provincial management plan(s)
3. Approved local management plan
4. No approved plan: informal unplanned management
5. Uncertain

Control of fishing:

2.14 Quotas: Is the fishery based on a system of quotas?

1. Ongoing national quota: based on scientific advise
2. Ongoing quotas: “cautious” national or local
3. Untried quota: recent and based on scientific advise
4. Market-driven quota(s), arbitrary quota(s), or no quotas
5. Uncertain

2.14a Fishing effort: Is fishing effort (e.g. number of vessels, nets or hooks) controlled and to which extent?

1. Ongoing effort limit: based on biologically derived assessments, national scale
2. Ongoing effort limit: “cautious” national or local
3. Untried effort limit: recent and based on biologically derived assessments
4. Arbitrary effort limit(s), or no limits
5. Uncertain

2.14b Fishing seasons. Are seasonal restrictions in place for this fishery?

1. National fishing seasons established: based on biological assessments
2. Fishing seasons established: “cautious” national or local
3. Untried fishing season: recent and based on biologically derived assessments
4. Arbitrary fishing seasons or no fishing seasons
5. Uncertain

2.14c Size limits. Are size limits in place for the species?

1. Ongoing minimum size limit: based on biologically derived assessments, national scale
2. Ongoing minimum size limit: “cautious” national or local
3. Untried size limit: recent and based on biologically derived assessments
4. Arbitrary size limit(s), maximum size limits (e.g. due to possible danger to human health), or no limits
5. Uncertain

2.14d Bycatch control and report. Have any techniques for shark avoidance, other techniques for limiting bycatch or actions to promptly release sharks incidentally, been implemented for this fishery?

1. Ongoing: techniques for shark avoidance and/or other techniques for limiting bycatch; bycatch data recorded
2. Ongoing: fishermen encouraged to promptly release sharks incidentally; bycatch data recorded
3. Bycatch data recorded
4. No effort made to control or report bycatch
5. Uncertain

2.14e Finning. Is there any finning ban in place for this fishery?

1. Ongoing finning ban: fins landed correspond to carcasses landed
2. Ongoing finning ban: recently implemented
3. No finning ban in place, but finning is not a common practice
4. Finning is a common practice in the fishery
5. Uncertain

2.15 Fishing in Protected Areas: What percentage of the legal national fishing occurs in Protected Areas?

1. High
2. Medium
3. Low
4. None
5. Uncertain

2.16 Limited fishing access: Is access to fishery limited and to which extent?

1. Ongoing national limiting access: based on biologically derived assessments
2. Ongoing limiting access: “cautious” national or local
3. Untried limiting access: recent and based on biologically derived assessments

4. Arbitrary limit(s), or no limits to access
5. Uncertain

2.17 Fishing in areas with open access: What percentage of the legal national fishing occurs in areas where there is no strong local control, giving *de facto* or actual open access?
1. None
2. Low
3. Medium
4. High
5. Uncertain

2.18 Confidence in fishing management: Do budgetary and other factors allow effective implementation of management plan(s) and fishing controls?
1. High confidence
2. Medium confidence
3. Low confidence
4. No confidence
5. Uncertain

Monitoring of fishing:

2.19 Methods used to monitor the fishing: What is the principal method used to monitor the effects of the fishing?
1. Direct population estimates
2. Quantitative indices (e.g. fishery catch per unit of effort (CPUE))
3. Qualitative indices
4. National monitoring of exports
5. No monitoring or uncertain

2.20 Confidence in fishing monitoring: Do budgetary and other factors allow effective fishing monitoring?
1. High confidence
2. Medium confidence
3. Low confidence
4. No confidence
5. Uncertain

2.20a Species identification: Are catches identified to species level?
1. Identification to species level: proper identification guides are widely used
2. Identification to lowest taxon possible: need to develop/make available proper identification guides
3. Recently implemented measures for species identification: training on species identification ongoing
4. No identification made / No identification guides developed / Data recorded as broad groups (e.g. “sharks”, “rays”, “fish meat”)
5. Uncertain

2.20b Species identification: Are parts and products in trade identified to species level?
1. Identification to species level: proper identification guides are widely used
2. Identification to lowest taxon possible: identification to species or al least genus level; need to develop/make available proper identification guides
3. Recently implemented measures for species identification: training on species identification ongoing
4. No identification made / No identification guides developed / Data recorded as broad groups (e.g. “fins”, “fish fillets”)
5. Uncertain

Protection from fishing:

2.24 Proportion strictly protected: What percentage of the species' natural range or population is legally excluded from fishing?

1. >15%
2. 5-15%
3. <5%
4. None
5. Uncertain

2.25 Effectiveness of strict protection measures: Do budgetary and other factors give confidence in the effectiveness of measures taken to afford strict protection?

1. High confidence
2. Medium confidence
3. Low confidence
4. No confidence
5. Uncertain

The visual representation of results obtained in Part 2 can be developed with a radar plot or the electronic template available from the CITES Secretariat, in the same way that the original checklist developed by IUCN.

In this case, it is also possible to add the numbers which correspond to each question marked. Twenty-eight questions are proposed. Therefore, 28 (28 x 1) would be the score of an ideal situation, indicating that complete confidence exist for making NDF; and 140 (28 x 5) would be the worst case scenario, where the stock is completely unmanaged and there is no information that could guide the Scientific Authorities for making the NDF.