European Elasmobranch Association

European shark fisheries:

a preliminary investigation into fisheries, conversion factors, trade products, markets and management measures

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Introduction

European fleets are among the world's leaders in fishing for sharks, reporting over 13% of global landings to the FAO in 2004. The most valuable parts of most sharks are their fins, which are a delicacy in Chinese cuisine. Shark meat is less profitable, which results in a strong economic incentive to cut off the fins and discard the carcass back into the sea, a practice called shark "finning". In June 2003, the Council of the European Union adopted a Regulation on the removal of shark fins on-board vessels, which was intended to prevent the practice of shark finning within the European fleet (one of the world's largest shark fishing entities). The European Commission reviewed the finning regulation in December 2005, stimulating significant debate in the European Parliament on its efficacy and whether the measures in force were fit for the purpose.

An expert workshop, funded by the Lenfest Ocean Program, was convened in Brussels in October 2006 by the Shark Alliance to contribute towards shark fisheries management discussions in Europe. The purpose of the workshop was to describe and compare available data about shark fisheries, markets, trade and biology, and to develop science-based recommendations regarding precautionary and science-based conversion rates for shark products, particularly fin to carcass ratios or other methods that might be used to prevent the practice of shark finning. This document is the report of that workshop.

Europe's shark fisheries

European fisheries have traditionally exploited many small bottom-living coastal sharks and skates, and have recently increased their exploitation of deep-water sharks. These species and fisheries are relatively well-understood. In contrast, the largest European shark fisheries, undertaken on the high seas by pelagic fleets from Spain, France and Portugal in the Atlantic, Pacific and Indian Oceans, are very poorly documented. Though these fisheries historically targeted primarily tunas and swordfish, longline catches of oceanic sharks are as large as or larger than the catch of target species, and most longliners now also target sharks. Additionally, the Atlantic shark stocks exploited by European fleets are also heavily fished by Japanese and Taiwanese tuna vessels that operate in the Atlantic as well as in the Indo-Pacific Ocean.

A lack of data on shark catches, use and discard has hampered stock assessments and the introduction of fisheries management. There is evidence, however, that many large oceanic sharks are being fished unsustainably and that the populations of the most biologically-vulnerable of these species are below healthy levels. Improved information on shark catches is essential for effective shark fisheries management but should not be used as an excuse for inaction. Precautionary limits are warranted immediately, based on the low reproductive capacity of sharks and the history of frequent collapse in shark fisheries.

International trade in shark products

Shark fisheries have often been undervalued and ignored, but have boomed in recent decades as international demand has risen for shark products. Shark fins, now among the most expensive seafood products in the world (up to 500 €/kg), are exported to East and Southeast Asia for processing and preparation of shark fin soup. The European Union is the world's largest exporter of shark fins to China, the biggest consumer market. Shark meat is usually low value, but is becoming increasingly popular; reported world landings have tripled since 1985. EU countries (particularly Spain and Italy) were responsible for 56% of global shark meat imports in 2005. Other shark products on the international market include liver oil, skins, cartilage, jaws and teeth.

Since most shark product trade is under-recorded, it is difficult to estimate the relationship between trade and shark catches, and the total volume of shark fisheries globally. Those data that are available demonstrate that the volume of traded shark products has increased considerably over the past 15 years. Official data on the quantity of shark fins landed, in particular, are clearly huge underestimates. The number of sharks that must be caught globally to produce the fins observed in international trade (some 26 to 73 million sharks *per annum*) is more than four times higher than the United Nation's (UN) Food and Agriculture Organization's (FAO) mid-range estimate of landings, and three times higher than the FAO's high-end estimate. These calculations demonstrate the benefit of using trade data to generate comparative estimates of fish landings, but require accurate conversion factors from products to whole weight of fish.

Accurate fisheries and trade data are needed for effective management

While the precautionary approach to fisheries dictates that fisheries management should not wait until we have all the answers, fisheries scientists need good estimates of how many sharks have been taken out of the sea in order to make sound recommendations for fishing limits. This requires improved records both of shark catches and the products traded. When sharks are processed before they are brought to the dock, scientists and managers must use the volumes of processed products landed (such as meat, liver oil or fins) to determine how many animals were taken. They do this using a 'conversion factor' for how much shark product is equivalent to the original live sharks. Without such conversion factors, it is difficult to estimate the relationship between the volume of shark products traded and the quantities of sharks originally taken by fisheries. We do not, therefore, know the global impact that these fisheries are having on shark populations unless we can develop ways to measure how quantities of shark products relate to the number of sharks caught. Conversion factors are also important for the regulation of fisheries. They are used to calculate and enforce fishing quotas, and are widely used to implement bans on shark finning, such as the EU Shark Finning Regulation.

What is the shark fin conversion factor?

Most finning regulations mandate a simple conversion factor between the weight of shark fins and the weight of the remainder of the body brought to the dock, verifying that all fins have a body to match, in an attempt to ensure that finning does not take place. Difficulties arise when conversion factors vary between fisheries, often because of different processing techniques, and the highest ratios drive the regulations. Discrepancies arise from keeping different numbers of fins from each carcass and/or cutting sharks differently when removing the fins so that more or less shark meat is left attached. For example, the fin:carcass ratio for blue sharks taken in US and Canadian Atlantic fisheries is about 2% of fin to whole weight or 5% of fin to dressed (headed and gutted) carcass weight. Portuguese and Spanish fleets fish the same blue shark population, but report ratios that are three times larger (over 6% and 15% respectively). There is no reason to believe that the morphology of blue sharks differs between the Northwest and the Northeast Atlantic. Instead, the differences indicate that fleets are not using the same fins, the same parts of the fins, and/or the same dressing criteria.

The main reason for the discrepancy between the fin:carcass ratios obtained by Spanish and Portuguese longline fleets and those observed in other shark fisheries is because the former retain the entire tail of each shark, instead of just the high value lower caudal lobe that is used in shark fin soup, as well as small fins not kept in other fisheries. They also leave some meat attached to the fins, which is later removed and discarded before processing. This meat may make up as much as one third of the reported 'fin weight'. Keeping the whole tail also significantly increases the weight of the 'fins' because it includes part of the vertebral column and other tissues (likely another one third of the total fin weight). Some fin traders air-freight high value shark fin (including lower caudal lobes) to East Asia, but send the rest of the tail by low cost sea-freight because they will be processed into lower value products.

The EU Shark Finning Regulation specifies a maximum conversion factor for fins from whole sharks as 5%, in those cases where Special Permits are issued to permit removal of fins on board vessels. This is much higher than the fin:carcass ratio obtained for deepwater sharks (1.6%), and slightly lower than the ratios obtained by the Spanish and Portuguese pelagic longline pelagic shark fisheries, partly because significant quantities of meat are left attached to the fins. These fisheries may not be representative of all EU fisheries or fisheries in European waters.

What is the best way to enforce a finning ban?

There are three main ways to enforce a finning ban. The first and most simple is to require that shark carcasses (whether gutted and beheaded on board or not) are landed with their fins still attached and further processing is undertaken on land. This approach is already common practice in many fleets, including Japan's and Taiwan's nearshore Pacific longline fleets. The second option is to require that the fins landed detached be counted and do not exceed a maximum number per carcass (but this would vary by species and fishery, be very time-consuming to monitor, and has never been applied). The third option is to require that there be a maximum fin to body weight ratio, and that fins and carcasses be landed together. This is the most widely used option around the world, including in Europe, although fins and carcasses can be landed separately under permit by 186 Spanish vessels and a small number of vessels registered in Portugal, UK, Germany and Lithuania.

The problem with the last approach stems from the fact that weight ratios can vary between species and fisheries. It is too complicated to set different ratios for different shark species or fisheries, so a single ratio is set nationally or regionally. Often these are set on the high end of calculated ratios and may fail to protect species with the smallest fins. In mixed shark fisheries, generous ratios can allow room to fin some sharks with high value fins and low value meat. At the same time, fishermen often argue for a ratio high enough to ensure they can keep all the desired fins of their target species. This approach can result in challenges, as currently the case in the EU and in regional fisheries bodies (e.g. ICCAT). These ratios may, therefore, need to be revised regularly in response to complaints, as dressing criteria change (for example as a result of changing market demand) or as fishers discover new ways to get around the management measures in force and hence to increase the profitability of the fishery. It would be difficult to ensure that these revisions reflect true practices while still ensuring that finning does not occur.

Conclusions

After thorough deliberation, the expert workshop reached the following conclusions:

- There are insufficient data to determine whether the current EU Shark Finning Regulation is effectively prohibiting shark finning.
- Implementation of the EU Shark Finning Regulation is seriously hampered by the derogation that allows the transhipment and separate landings of fins and carcasses.
- A fin:carcass ratio is a complicated and usually inadequate tool for preventing finning because of differences in fin cutting techniques and variability among shark species' fin sizes and values; these create loopholes to fin.
- Setting ratios at the upper end of (or above) scientifically derived ratios, as is often the case, exacerbates this problem and leaves species with small fins and/or low value meat at particular risk of finning.
- Lack of information and inconsistency in fin removal practices prevent scientific determination of a single optimal fin to carcass ratio.
- Given the uncertainty and complexity of the situation, the current EU Shark Finning Regulation cannot be characterized as effective.

- Consequently, to ensure finning cannot take place, sharks should be landed with their fins attached. This would not be too burdensome for the industry, because many onshore processing facilities already deal with whole sharks, and any port that can handle shark carcasses can also handle shark fins.
- Additional benefits of a "fins attached" policy include:
  - Calculation, decisions and alterations regarding ratios for different species or fisheries are unnecessary.
  - Enforcement burden is reduced because fins and carcasses do not need to be weighed separately.
  - Quality of the information on species and quantities of sharks landed (information important for fisheries management) is vastly improved.
  - "High-grading" (mixing carcasses and fins from different animals) is impossible.
  - Land-based processing of carcasses can include careful and precise fin cutting, increasing the value of the finished product.
- Shark fisheries and trade are not constrained by national borders. Their management is therefore a global issue, requiring action and coordination by managers at several jurisdictional levels.
- High fishing pressure coupled with the inherent vulnerability of most shark species makes the need for effective shark conservation measures urgent.
- Species-specific statistics from EU shark fisheries, landings, markets and trade are severely lacking; such information is vital for assessing shark populations and understanding and managing fisheries effectively.

Recommendations[1]

The expert group made the following recommendations based on their findings:

The European Commission and Council of Ministers should:

- Amend the EU Shark Finning Regulation to require that sharks be landed with their fins still attached (sharks could still be beheaded and gutted); and
- Promote more effective Shark Finning Regulations within the Regional Fisheries Bodies (governing international waters) to which the EU is Party.

Individual EU Member States should take the following stop-gap actions to prevent shark finning in the meantime:

- Justify to the EU the need to process sharks at sea (as required) or discontinue issuing the special fishing permits that allow fishermen to remove shark fins at sea;
- Immediately stipulate that vessels removing shark fins under existing special fishing permits must land shark fins and carcasses at the same time, in the same port; and
- Encourage prompt amendment of the EU Shark Finning Regulation, as detailed above.

The EU Commission, Member States and Regional Fisheries Bodies should:

- Mandate full coverage on shark fishing vessels by independent, on-board observers;

1 Recommendations and opinions expressed herein are of the authors only and do not imply endorsement by any agency associated with the authors.

- Increase investment in shark data collection at landing sites and by processing and marketing industries;
- Establish effective monitoring and management measures for target and bycatch shark fisheries within their remit, including precautionary catch limits when data are lacking;
- Cooperate in the exchange of information and the harmonisation of management measures across borders; and
- Ensure that all landings and trade of shark fins, meat, and oil are recorded separately by commodity (and to the species level where possible).

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We apologise to anyone whose names are omitted from this list and note that errors in this report are not the responsibility of the above. We also stress that opinions expressed and conclusions drawn herein are of the authors only and do not imply endorsement by any agency associated with the authors or other experts named above.

1 Introduction

European fisheries have traditionally exploited many small bottom-living coastal sharks and skates, and have recently increased their exploitation of deep-water sharks, both as target and utilised bycatch in multi-species fisheries. These species and fisheries are relatively well-understood.

In contrast, the largest European shark fisheries, undertaken on the high seas by pelagic fleets from Spain, France and Portugal in the Atlantic, Pacific and Indian Oceans, are very poorly documented. Though these fisheries historically targeted primarily tunas and swordfish, longline catches of oceanic sharks are as large as or larger than the catch of target species, and most longliners now also target sharks. Additionally, the Atlantic shark stocks exploited by European fleets are also heavily fished by Japanese and Taiwanese tuna vessels that operate in the Atlantic as well as in the Indo-Pacific Ocean. Even basic information, such as landings statistics and the number of vessels engaged in these fisheries, is very poor. Understanding their impact on shark stocks is seriously impeded by the lack of data on shark catches, use, landings and discards.

These factors have led to a situation in which, although shark stocks are under increasing exploitation pressure, there have been very little data or information available for assessing stocks and managing them. This situation is especially serious for shark species that are regarded as vulnerable to exploitation. There is evidence, however, that many large oceanic sharks are being fished unsustainably and that the populations of the most biologically-vulnerable of these species are below healthy levels.

In 2004, the International Committee for the Conservation of Atlantic Tunas (ICCAT) Sub-Committee on bycatches conducted a stock assessment of two pelagic species: blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrhinchus*) (Anon. 2005). Preliminary results for the blue shark, which is a relatively fecund species, indicated that current biomass in the North Atlantic Ocean appears to be above the level that can support maximum sustainable yield (MSY). Current shortfin mako biomass may be below that producing maximum sustainable yield in the North Atlantic. However, results for these species "were highly conditional on the assumptions made and the data available" and the assessors noted that "if historical blue shark catch had exceeded the level estimated by the Group, results could indicate the current stock level well below biomass at MSY" (Anon. 2005). Unfortunately, the lack of Spanish shark fisheries data meant that possibly the largest source of shark mortality could not be quantified. An estimate of blue shark catches based on international trade data for blue shark fins exceeded the highest catch scenario modelled.

The uncertainties described by the ICCAT assessors underscore the importance of obtaining accurate catch, discard, landings, market and trade data if stock assessments are to be improved and appropriate management measures adopted. Traditionally, however, not only have catches, discards and landings been under-recorded, but trade in shark products has been poorly understood and trade statistics are poor.

Records of the volumes of fisheries products landed and marketed (such as fins, meat and liver oil) provide an important source of data for assessing the impact of these fisheries on fish stocks, provided that an accurate conversion factor exists between the weight of product landed and the original weight of live fish caught. Without such conversion factors, it is difficult to estimate the relationship between the volume of shark products traded and the quantities of sharks originally taken by fisheries. Conversion factors are also important for the regulation of fisheries. They are used to calculate and enforce fishing quotas, and are widely used to implement bans on shark finning.

Finning is widely defined as the removal and retention of a shark's fins before discarding the remainder of the body at sea. It takes place because shark fins have become one of the most valuable of all fisheries products, whereas demand for shark meat is smaller and the markets less lucrative. The practice of finning is considered to lead to a particularly high and unsustainable exploitation rate of sharks, because vessels that fin have fewer constraints upon hold space for storage of their catch than do vessels that retain the carcass. It also makes it more difficult to assess how many sharks are killed by a fishery.

Recognition of these problems has led to the adoption of shark finning prohibitions in a number of fishing States, in the EU, and in several Regional Fisheries Management Organisations. Two measures have been applied to enforce prohibitions on shark finning: a "whole landings" policy, under which fins must remain attached to the shark carcass until landed, or a mandatory maximum fin to carcass weight ratio. The EU uses both of these: whole landings are required unless a special permit is issued to enable shark fins to be removed on board a vessel, in which case a fin to carcass weight ratio is specified. The weight ratio most widely used internationally, originally based on commercial practice in shark fisheries in the Northwest Atlantic, is 5% of wet fin weight to 'dressed' (gutted and beheaded) carcass weight (this is equivalent to 2% of wet fin weight to whole ('round' or 'live') shark weight. The ratio specified in the European Shark Finning Regulation[2], however, is 5% of wet fin weight to live weight (the ratio for fin weight to dressed weight is not specified). The adoption of different weight ratios has caused some controversy and in 2006 the European Parliament questioned whether the Shark Finning Regulation is effective at preventing the practice of finning.

The report presents the results of an expert workshop, funded by the Lenfest Ocean Program, which was convened in Brussels in October 2006 by the Shark Alliance to order to contribute towards shark fisheries management discussions in Europe. The purpose of the workshop was to describe and compare available data about shark fisheries, markets, trade and biology, and to develop science-based recommendations regarding precautionary and science-based conversion rates for shark products, particularly fin to carcass ratios or other methods that might be used to prevent the practice of shark finning.

Section 2 describes briefly what is known about European shark fisheries. Section 3 describes the markets for and international trade in shark products. Section 4 presents the information compiled by experts on conversion factors that can be used to calculate the actual catch in 'round' weight from landings of shark products, including fin to carcass ratios, and evaluates how suitable these factors are for European fisheries. Section 5 explains why finning poses a fisheries management problem and the potential range of measures that are being and may be applied to implement finning bans effectively. The conclusions from each of these sections are presented at the end of that section, and are then compiled to produce the overall conclusions presented in Section 6. References are listed at the each of each section, not at the end of the report.

References

Anonymous. 2005. Report of the 2004 inter-sessional meeting of the ICCAT subcommittee on by-catches: shark stock assessment. *Col. Vol. Sci. Pap. ICCAT*, **58**, 799–890.

[2] Regulation EC 1185/2003

2 Fisheries involved in the removal of shark fins on board vessels

Member States (MS) of the European Community are involved in fisheries in European Union (EU) waters, the waters of MS territories elsewhere in the world, the national waters of other States under various agreements, and in international waters. The stocks exploited by MS in the North Atlantic and Mediterranean Sea are also exploited by non-EU countries. The present report covers both EU and international fisheries in the North Atlantic and Mediterranean Sea, and EU fisheries elsewhere in the world. Descriptions of these fisheries have relied heavily on reports of the ICES Working Group on Elasmobranch Fishes (WGEF) (ICES, 2006) and the Scientific, Technical and Economic Committee for Fisheries (STECF) (STECF 2002, 2003). Outside the ICES area, FAO landings data have been used to indicate the importance of the various fisheries and the species taken.

Permits to remove shark fins on board vessels have been issued to pelagic and deepsea fishing vessels under the EU Shark Finning Regulation. The former include over 200 longline freezer vessels operating in the Atlantic, Pacific and Indian Oceans. These vessels remain at sea for long periods and partly process shark carcasses on board prior to freezing them. The latter (about 20 vessels) operate deepwater gillnets and longlines in the Northeast Atlantic and partly process deepsea shark carcasses on board before landing them in Spain.

According to FAO fishery data (Table 2.1), reported landings of chondrichthyan fishes were more than 810 000 tonnes (t) in 2004, representing 1.12% of the world production of marine fishes. In the same year, European landings of chondrichthyan fishes was 109 121 t (13.5% of world landings). The major European countries involved in chondrichthyan fisheries are Spain, France, the UK and Portugal. These countries are also among the world's top 20 shark fishing nations (Lack and Sant 2006). The combined landings of all EU States is very close to those of the world's largest fishing nation, Indonesia (Table 2.2).

Table 2.1. Total landings (tonnes) of elasmobranch fishes and other marine fishes in 2004. (FAO FISHSTAT)

2004	Elasmobranch fishes (t)	Marine fishes (t)	Elasmobranchs %
World	810 322	72 663 480	1.12
Spain	51 071	768 797	6.64
France	21 306	503 144	4.23
UK	16 024	522 503	3.07
Portugal	7 161	202 498	3.54
Ireland	5 043	243 521	2.07
Belgium	2 505	23 488	10.67
Norway	1 822	2 460 846	0.07
Italy	1 060	181 710	0.58
Greece	925	141 070	0.66
Germany	859	218 381	0.39
Netherlands	631	500 830	0.13
Denmark	402	965 948	0.04
Sweden	285	261 520	0.11
Malta	26	1971	1.32
Poland	1	157 013	0.00
Europe (tonnes)	109 121	7 153 240	1.53
Europe in %	13.47	0.98	

Table 2.2. Top twenty shark catching countries in 2003. (Lack and Sant 2006)

Country	% of world shark catch	Country	% of world shark catch
1. Indonesia	14.09	11. Thailand	2.89
2. Taiwan, Prov. of China	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

The FAO data do not include undeclared catches or discards, so the total catch is unknown. It is also not possible to identify the volume of landings made by EU vessels that operate under joint ventures or fisheries agreements with other States and are flagged outside the EU. These catches are reported by other States (e.g. Namibia and Brazil). However, FAO's data for EU States are still useful to follow the evolution of fisheries over time and to make comparisons between countries.

There is generally a parallel evolution in national chondrichthyan landings from European seas (Northeast Atlantic and Mediterranean) and total national landings (i.e. from elsewhere in the world) (see Table 2.3). Most EU nations report chondrichthyan fishes only from European seas, although some nations (e.g. Spain and Portugal) include large quantities of landings from outside European waters. Though some nations do not report chondricthyan fishes outside European seas they are known to have important fisheries in other areas, suggesting that chondrichthyan fishes are not routinely reported for these fisheries. Figures 2.1 and 2.2 are examples of the evolution of the production of chondrichthyan fishes in selected European countries.

Table 2.3. Landings of chondrichthyan fish production (tonnes) in 2004, by EU State. (FAO FISHSTAT)

Country	'Marine waters' (world)	Northeast Atlantic and Mediterranean (Europe)	European landings as % of world landings
Spain	51 071	13 560	27
France	21 613	21 306	99
UK	16 066	16 024	100
Portugal	12 765	7 161	56
Ireland	5 043	5 043	100
Belgium	2 505	2 505	100
Norway	1 827	1 822	100
Island	1 400	1 400	100
Italy	1 061	1 060	100
Greece	925	911	98
Germany	859	859	100
Netherlands	631	631	100
Denmark	402	402	100
Sweden	285	285	100
Malta	26	26	100
Slovenia	13	5	38
Poland	1	1	100

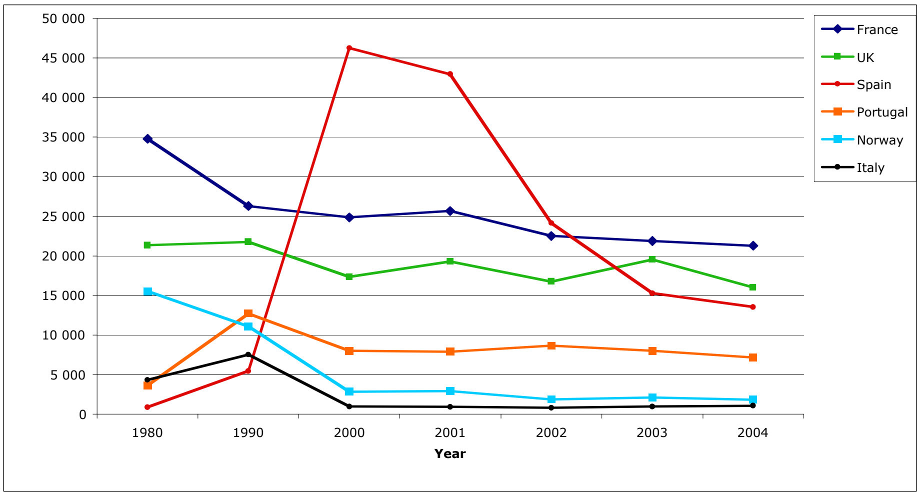

Figure 2.1. Landings of elasmobranch fishes in European and Mediterranean waters, 1980–2004, in tonnes for selected European countries. (FAO FISHSTAT)

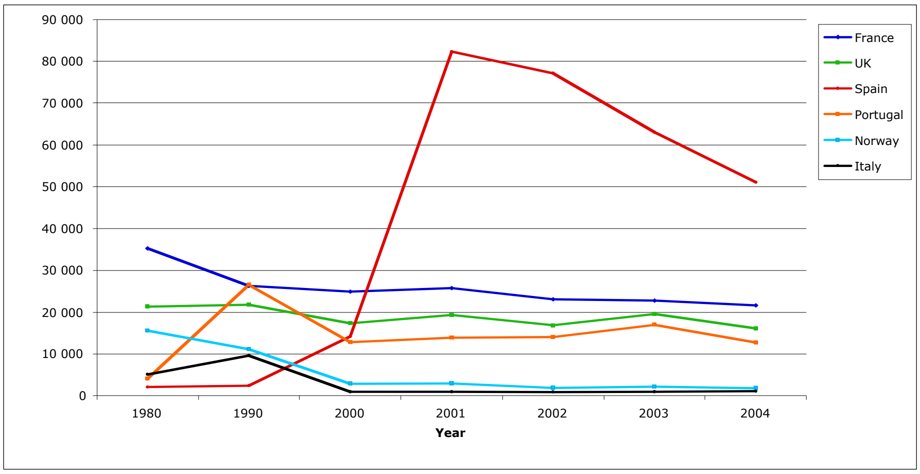

Figure 2.2. Total Landings of elasmobranch fishes (worldwide) 1980–2004 for selected European countries. (FAO FISHSTAT)

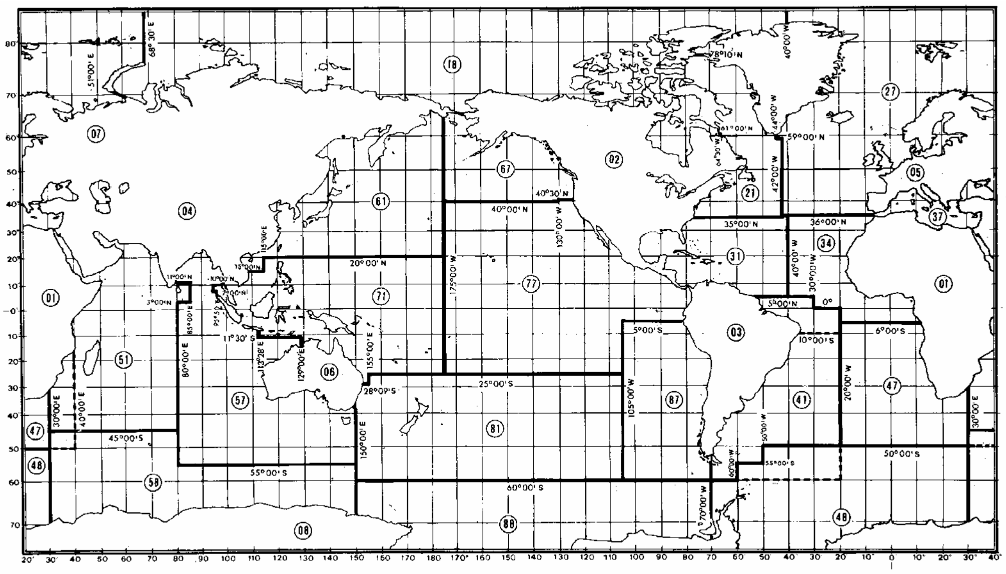

Figure 2.3. FAO fishery statistical areas.

2.1 Fisheries in the Northeast Atlantic (FAO area 27) and Mediterranean Sea (FAO area 37)

2.1.1 Demersal fisheries

Many EU fisheries occur in various coastal inshore and offshore fisheries operating on the continental shelf of the Northeast Atlantic and Mediterranean; most of these are reasonably well-described (e.g. STECF 2003; ICES 2006). Demersal fisheries target a variety of fish (e.g. gadoids and flatfishes) with various skates, rays and demersal sharks also taken. Various small-bodied dogfishes, houndsharks and catsharks may be captured and these may be landed or discarded, but all larger fish are landed. Most of these species have relatively small fins and there is no evidence that smoothhounds (*Mustelus spp.*) and catsharks (e.g. *Galeus* and *Scyliorhinus*) are subject to finning. These species tend to be landed whole for either human consumption or as bait for pot fisheries although a variety of presentations (fresh or frozen) may be reported, including:

- whole (heads on ungutted)
- heads on gutted
- heads off gutted
- skinned and gutted heads off
- single fillets skins on
- single fillets skins off

Tope (*Galeorhinus galeus*) is often taken in these fisheries and has been suggested as a potential species to harvest for its fins. Larger tope are also taken in pelagic fisheries, including longline.

Mediterranean

As in the Northeast Atlantic, Mediterranean elasmobranch fisheries have a modest production in comparison to teleosts and shellfish. In Italy, for example, elasmobranchs represent less than the 2% of total catches (Shotton 1999) and smoothhounds and skates (*Rajidae*) represent about 50% (4 463 t/yr) and 38% (3 340 t/yr) respectively of elasmobranch landings. Most landings of smoothhounds are from the Adriatic Sea and southern Mediterranean basins. Catches have increased since 1978, with a peak in 1985.

Few elasmobranchs are subject to directed fisheries in the Mediterranean, with local fisheries mostly landing elasmobranchs as bycatch. In the northern Adriatic Sea, gillnet fisheries take smoothhounds (*M. mustelus* and *M. punctulatus*), spurdog (*Squalus acanthias*), greater-spotted catshark (*S. stellaris)*, eagle ray (*Myliobatis aquila)* and tope shark (*G. galeus)* during spring and winter (Costantini *et al*. 2000).

Starry ray (*Raja asterias*) is commonly caught in trawl fisheries, especially along the Tyrrhenian coasts. The capture of this species occurs mainly in the 'rapido' (modified beam-trawl) fisheries that target flatfish (*Solea* spp. and *Psetta maxima*). Bottom trawl fisheries operating on the continental shelf and slope capture various elasmobranchs such as blackmouth catshark (*Galeus melastomus*), lesser-spotted catshark *(S. canicula*), velvet belly *(Etmopterus spinax)* and skates (*Raja* spp.) along the northern coasts of the Mediterranean, including Spain, France, Italy, Greece, Croatia, Slovenia and Albania (Relini *et al*. 1999) with carcharhinids, lamnids, guitarfishes (*Rhinobatos* spp.) and angel shark (*Squatina squatina*) also caught by gillnets and longlines along the Libyan coasts (Lamboeuf 2000).

Trammel nets positioned near the bottom may also catch individuals of larger species of shark (Serena and Vacchi 1997) and even white shark (*Carcharodon carcharias*) have been reported from these gears off Malta and Sicily (Fergusson 1996). In the Adriatic Sea, the bycatch of trammel nets includes several demersal species including spiny dogfish (*S. acanthias),* smoothhounds *(Mustelus* spp.), skates (*Raja* spp.), electric rays (*Torpedo* spp.), catsharks (*Scyliorhinus* spp.), tope *(G. galeus)* as well as occasional specimens of thresher shark (*Alopias vulpinus*) and juvenile sandbar shark (*Carcharhinus plumbeus*).

Muñoz-Chàpuli (1985) described the Alboran Sea shelf's bottom trawl fisheries where two species, angel shark (*Squatina aculeata)* and smoothhound (*M. asterias*) were frequently caught. Torres *et al.* (2001) also studied the catch composition on different grounds in the Alboran Sea, especially in some lightly or not-exploited grounds, and reported that chondrichthyan catches were higher than those in exploited grounds in the area where vessels from Almeria operated.

2.1.2 Deep-water fisheries

Deep-water fisheries operate widely off the edge of the continental shelf of EU waters, including the Azores, Portuguese mainland, parts of the Bay of Biscay, at Rockall Bank, Hatton Bank and waters along the western seaboard of the British Isles. Deep-water sharks, particularly the larger species of the Order Squaliformes, can be an important component of mixed deep-water trawl fisheries and may be either a target species or bycatch in deep-water longline and gillnet fisheries. The various deep-water fisheries have been well described in reports (STECF 2003; ICES 2006; Hareide *et al.* 2004).

Historically, several of these shark fisheries landed the squalene-rich livers only, though markets for the flesh were subsequently developed. Though some fisheries land deep-water sharks as 'livers' and 'heads-on gutted', some vessels undertake more on-board processing with the caudal fins and more recently the pectoral fins removed and stored separately. Many species of squaliform sharks have a spine in front of the dorsal fins and these fins are typically discarded during processing. Some UK, Anglo-Spanish and German-registered vessels have special permits to land fins and trunks separately.

About ten EU-registered vessels and approximately 56 vessels under flags of convenience have been gillnetting for deep-water sharks in recent years. Most of the EU vessels involved in this fishery are registered in the UK and Germany and receive a share of the TACs for these States, but almost all these boats belong to Spanish companies and operate out of Galician ports (Oceana 2005).

Table 2.4. Deepwater gillnet vessel distribution by segment and flag. (Franquesca 2006)

Flag state	Shark net	Monk net	Total
Germany	1	5	6
UK	9	7	16
Spain	0	0	0
France	0	1	1
Total	10	13	23

Shark net – deep water

The usual working area is the continental slope to the west of the British Isles, Rockall Bank, and the North East Atlantic Fisheries Commission (NEAFC) area. Vessels target deep-water species including Portuguese dogfish (*Centroscymnus coelolepis*), leafscale gulper shark (*Centrophorus squamosus*) and gulper shark (*Centrophorus granulosus*). Originally landed fresh (when the fishery began in the 1990s), processing of shark fillets is now undertaken on board. The meat is frozen while shark livers are used to produce oil, a product with commercial interest to the cosmetics industry. The fishery has also expanded to West Africa and into international waters in the North Atlantic.

Recent data available for 2005 landings show that the production of deep-water sharks dropped by 30% between 2004 (1 584 t) and 2005 (1 099 t) in the North Atlantic.

Mediterranean – deep water

Many shark species are taken as the bycatch of Mediterranean deep-water fisheries. Most frequently caught species are blackmouth catshark (*Galeus melastomus*), smallspotted catshark (*Scyliorhinus* *canicula*), gulper shark (*Centrophorus granulosus*), Portuguese dogfish (*Centroscymnus coelolepis),* kitefin shark (*Dalatias licha*), velvet belly *(Etmopterus spinax*) and longnose spurdog (*Squalus blainvillei).* Blackmouth catshark and smallspotted catshark are more abundant and have a greater commercial value; other species may be discarded.

Along the slope of the continental shelf of Greece (EC FAIR Project 95/655), velvet belly is one of the most important elasmobranchs in the bycatch of shrimp fisheries and is also common in the North Aegean and the Thracian Sea. Elsewhere in the eastern Mediterranean, gulper sharks *(Centrophorus* spp.), blackmouth catshark, little sleeper shark (*Somniosus rostratus)*, velvet belly and sixgill shark (*Hexanchus griseus*) are bycatch species in deep-water fisheries (Hornung *et al*. 1993).

Around Majorca (Spain), deep-water crustacean fisheries take a bycatch of small sharks. Spurdogs *(Squalus* spp.), catsharks (*S. canicula*, *G. melastomus*) and gulper shark are usually landed (EC FAIR 1996).

Italian deep-water trawl fisheries, targeting red shrimps (*Aristeus antennatus* and *Aristaeomorpha foliacea*), scampi *Nephrops* and hake (*Merluccius merluccius*), also land blackmouth catshark. The long-nose skate (*Dipturus oxyrhinchus*) was formerly a relatively common species in the central Ligurian Sea and in other Italian areas, but is now seen more rarely. There is a relatively high abundance of thornback ray (*Raja clavata*) in some deep-water grounds (Serena and Abella 1999). Bottom-set longlines targeting hake also take a bycatch of six-gill shark, especially in the Ligurian Sea (Aldebert 1997) and along the southern Italian coasts, as well as blackmouth catshark and gulper shark.

2.1.3 Pelagic fisheries in the Northeast Atlantic

Many EU States have fisheries targeting large pelagic fishes, though for some nations these are seasonal and localised, when certain pelagic sharks are abundant (e.g. porbeagle (*Lamna nasus*) fisheries in Denmark, France and the UK). Some of the more important pelagic fisheries are described below.

In general, the vessels involved in offshore pelagic longlining may target a variety or combination of species, including tunas, swordfish (*Xiphias gladius*) and sharks, depending on what is most abundant on the fishing grounds, with other species (various billfish, sharks, opah, oilfish, *etc*.) often landed as bycatch. Tuna and swordfish are the principal species targeted, though some fisheries equally target shortfin mako (*Isurus oxyrhinchus*) or blue shark (*Prionace glauca*) in various seasons and/or areas. These fisheries may land fish whole (e.g. porbeagle) or gutted (e.g. shortfin mako), but some fisheries undertake further on-board processing, including the removal of fins.

Japanese and Taiwanese tuna longline fisheries in the North Atlantic

The ICCAT Subcommittee on Bycatches stock assessment of blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*) evaluated approximately 150 active Japanese pelagic longline vessels operating over the entire Atlantic Ocean (Anon. 2005). Targeted species are bluefin tuna (*Thunnus thynnus*) in the North Atlantic and yellowfin tuna (*Thunnus albacares*) and bigeye tuna (*Thunnus obesus*) in the remaining regions. Pelagic sharks, including blue shark and shortfin mako, are caught as bycatch.

Fishing effort reached a peak in the mid-1990s and then decreased because of a reduction in the number of fishing vessels. Shark catches by species (blue, shortfin mako, porbeagle and other sharks) were estimated using species-specific logbook data from 1994 to 2003, with total shark catches of 2 200–7 700 t. Over ten years, annual catches of blue shark by Japanese tuna longline fisheries ranged from 1 700–6 200 t (84% of the total shark catch). Catches of shortfin mako ranged from 120–1 030 t (10.8% of total shark catch). There were 2–380 t of porbeagle (*Lamna nasus*) caught in the North Atlantic (Matsunaga *et al.* 2005).

The observer programme for Japanese tuna longline fisheries in the North Atlantic Ocean carried out from August 2004 to January 2005 estimated the catch of blue sharks among others. Eight vessels (a total of 358 operations) operated in the North Atlantic during this period and the total catch of blue shark was 1 831 individuals (52% of total catch), 31 shortfin mako and seven porbeagles; the total number of sharks caught was 3 521 (Matsumoto 2006).

Albacore (*Thunnus alalunga*) has been one of the important targets of Taiwanese longline fisheries in the Atlantic since the early 1960s. The FAO fisheries database reported an 18 t bycatch of sharks, rays and skates for Taiwanese longline fisheries in 2003. Furthermore, fishing trends appear to have declined since 1992, with some high fluctuations between the mid-1980s and the early 1990s (Chiu *et al.* 1999). Taiwanese fisheries now mainly operate in the South Atlantic, where 67 fishing vessels operated in 1995 and 112 in 1996. This change in fishing patterns resulted in a historically low catch rate of albacore in the early 1990s (Wu *et al*. 1999).

A fleet of Japanese longliners (which are about 50 m long), operating out of Las Palmas, is known to unload blue shark and other shark species. According to Spanish foreign trade statistics, Japanese imports of frozen sharks (excluding dogfish) to the Spanish province of Las Palmas in 2005 came to 1 650 t product weight, compared to imports of 373 t of frozen swordfish (ICEX 2006). It is not known whether the shark products were fins or carcasses.

Spanish longline fisheries in the North Atlantic

The Spanish surface longline fishery in the North Atlantic primarily targets swordfish, sharks and tunas over a variety of years, areas and seasons (Mejuto and de la Serna 2000). It can be considered a multi-species fishery because the gear can be modified (e.g. by switching configurations such as the depth of set or hook type) to target swordfish, tunas or sharks. Overall, the percentage of sharks to swordfish taken by this fleet is approximately 50:50, but can reach 70:30.

The fishery comprises large freezer vessels operating in the North Atlantic from 45º to 15º N and as far as 55º W (Mejuto *et al.* 2002). The gear used is the standard Spanish surface longline for swordfish (using a mean number of 1 100–1 500 hooks per set), although some technological improvements have been documented over time (e.g. the introduction of light sticks and changing from a multifilament to a monofilament line) (Mejuto and de la Serna 1997; Mejuto *et al*. 2002). As a result of this change, blue shark (*Prionace glauca*) has become a target species in recent years for some sets, trips and areas; this change in fishing strategy is also related to the recent increase in price of this species on the international market (Mejuto and García-Cortés 2004) and the ability of modern vessels to freeze their catch and therefore to retain sharks caught without any deterioration of the meat and cross-contamination of teleosts in the hold.

During the 1990s, a reduction in the fleet size was observed in the North Atlantic as a result of the introduction of the total allowable catch (TAC) quota system for swordfish in 1995. At the same time the fishing strategy changed.

Elasmobranch bycatch (more accurately termed ‘secondary catch’) consists mainly of pelagic sharks, particularly blue shark and shortfin mako (*Isurus oxyrinchus*). Other species such as the common thresher (*Alopias vulpinus*), bigeye thresher (*A. superciliosus*), smooth hammerhead (*Sphyrna zygaena*), tope (*Galeorhinus galeus*), porbeagle (*Lamna nasus*), Galapagos shark (*Carcharhinus galapagensis*) and other requiem sharks (*Carcharhinus* spp.*)* are also regularly taken (see Mejuto *et al*. 2005 for details).

Once caught, the sharks are immediately processed on-board and frozen. Special Permits to remove shark fins on board were issued to 99 surface longliners operating in Spanish waters in 2004. Some of the fish from the last sets may be landed fresh. Most are landed at the ports of Vigo and La Coruña.

Swordfish landings from the Spanish fishery have been reported to ICCAT since the 1950s. However shark data in general only began to be reported in 1996, when sharks represented about 70% of the total landings. Blue shark is the predominant species (representing about 80% of the total 'bycatch') and landings averaged 28 600 t/year for the period 2000–2004 (Mejuto *et al*., 2005). Shortfin mako was the second most important species, representing about 9.5% of the total 'bycatch', with other shark species representing about 1.7%.

Since 1998, a small number of Basque artisanal long liners have spent part of the year targeting blue sharks and other pelagic sharks in the Northeast Atlantic, landing an average of 275 t of blue sharks (gutted, with fins still attached) in Basque ports (Diez *et al*. 2004). This small fleet operates with a special licence from the Spanish Dirección General de la Secretaría General de Pesca Marítima. The license covers a limited period (usually June to November) and is renewable annually. The number of vessels involved in this fishery ranges from three to seven vessels *per annum*, depending upon the number of licences requested and issued. The licence bans the retention and landing of billfishes and any other species that fall under a TAC and quota regime (Diez, personal communication).

Portuguese longline fisheries in the North Atlantic

Pelagic shark catches from Portugal in the North Atlantic are predominantly associated with the swordfish fishery that began around 1987. Two components of the fleet can be defined. The Azorean component operates mostly around the Azores (Pereira 1988; Simões and Silva 1994; Simões 1995; Simões 1998; Silva and Pereira, 1999; Pinho 2005). The mainland Portugal component operates more around the Azores Exclusive Economic Zone (EEZ) (Silva and Pereira 1998; Santos *et al*. 2001, 2004).

The Azorean component of the fleet predominantly consists of open-deck wooden boats (less than 9 m, which use hand lines) and small-size cabin-deck vessels (less than 14 m, which use hand lines or bottom longlines); both lack freezing capacity. They operate mainly in coastal waters but sometimes further out on major banks and seamounts. It is a typical small-scale fishery and often follows a seasonal scheme, shifting from swordfish in summer to demersal fish in winter. Open-deck boats make daily trips of one set a day whereas the cabin-decks may stay up to one week at sea but also with one set a day. Landings from these regional fishing boats are in Azorean ports. The Azorean fleet also includes a few larger-sized cabin-deck vessels (over 14 m, using longlines) with large on-board freezing capacity that are capable of undertaking longer voyages of up to a month at sea with daily sets. These vessels operate mainly on offshore fishing areas (banks and seamounts), sometimes even outside the Azorean EEZ.

The mainland Portugal fleet operating in Azorean waters is composed solely of large-sized longliners landing their catch mostly in Portuguese mainland and Spanish harbours, sometimes in Cape Verde.

The swordfish fishery is carried out during night hours due to the negative phototropism exhibited by the target species (swordfish *Xiphias gladius*). The surface longline gear is set until dusk and hauled-in at dawn (Simões 1995). The area covered by each set depends mostly on vessel size and holding capacity. Mackerel, squid and pieces of shark belly are commonly used as bait. A clear seasonal pattern is observed in the fishery, with blue shark taken in winter/spring and swordfish in summer/autumn.

Elasmobranch bycatch of the Portuguese swordfish fishery consists mainly of pelagic sharks, particularly blue shark (*Prionace glauca)* and shortfin mako (*Isurus oxyrinchus).* Other species, such as thresher sharks (*Alopias vulpinus* and *A. superciliosus*), smooth hammerhead (*Sphyrna zygaena)*, tope (*Galeorhinus galeus)* and Galapagos shark (*Carcharhinus galapagensis*), are also regularly taken. Once caught, the sharks are immediately processed on-board and frozen. Thirty-four Portuguese longliners have Special Permits to remove shark fins on board. Most of the trunks are directly transported to mainland Portugal in large freezer containers, then immediately shipped to Spanish exporting intermediaries and markets.

Blue shark landings reported to ICCAT from Portuguese surface longline fisheries in the North Atlantic averaged 5 000 t for the period 1993–1996 and about 2 200 t for the period 1997–2002. For the shortfin mako the figures are about 698 t and 340 t respectively for the same periods. However, according to the ICCAT website, Portuguese Atlantic longline fleets reported catching 14 806 t of fish, of which 11 767 t (almost 80% of all catches) was shark, in 2005. It appears that the shark longline catch is now more important than the swordfish catch and should not really be categorised as a 'bycatch' of the swordfish fishery.

In 2005, imports of frozen sharks (excluding dogfish) to the Spanish port of Pontevedra from Portugal were 1 988 t product weight compared to 674 t of frozen swordfish imports.

Utilisation of fins was reported for the mainland-based swordfish fishery fleet (Santos and Garcia 2004). The fins were collected and exported to Asian markets. A mean percentage of fin weight of 6.6% relative to round weight for a complete set of fins was reported for the blue shark.

French longline fisheries in the North Atlantic

Since 1978, a directed French longline fishery for porbeagle (*Lamna nasus*) has operated from the Isle d'Yeu (landing into La Rochelle) (Lallemand-Lemoine 1991) in the Celtic Sea and Bay of Biscay. Annual landings (as reported to the FAO) are generally in the region of 200–600 t/year, but exceeded 1 000 t in the late 1970s. In terms of the Isle d'Yeu fishery, most of the landings are taken during the summer (ICES 2006) with 8–11 vessels landing the majority of the catch. The ICES Working Group on Elasmobranch Fisheries (WGEF) will undertake further examination of French data in 2007.

Other species commonly taken include blue shark, thresher shark (*Alopias vulpinus*) and tope (*Galeorhinus galeus*), though it is not possible to disaggregate pelagic and demersal captures of the latter species from FAO data. Reported landings of blue shark ranged from 10–90 t/year during the 1970s and 1980s, increasing to 200–400 t/year during the 1990s. Landings have declined since 2000, although this period may include some preliminary landings data. Reported landings of thresher shark are generally less than 15 t/year though just over 100 t were reported in both 2000 and 2001. Although other sharks are taken occasionally in French fisheries, including hammerhead and requiem sharks, these captures are generally sporadic.

In terms of other pelagic fisheries: France has important tuna fisheries (landing 3 000–7 000 t/year of albacore and 300–1000 t/year of bluefin tuna in recent years), but catches of billfish are generally low (usually less than 150 t/year of swordfish).

Mediterranean fisheries for large pelagic fishes

There are no Mediterranean pelagic fisheries targeting migratory oceanic sharks, but these species constitute a large component of the bycatch in tuna and swordfish fisheries operating in coastal and offshore waters using longlines, driftnets and purse seines.

The fixed tuna traps represent the fishing activities that historically had a major impact on cartilaginous fishes, catching large pelagic sharks and other demersal elasmobranchs. These structures were distributed all along the Mediterranean coasts, but mainly along the Italian coasts that are the most important tuna migration routes to the rich areas of the Ligurian-Provencal basin. About twenty tuna traps were active in the Mediterranean up to 30 to 40 years ago; today their number is greatly reduced because of low yields and confined to the major Italian islands and North Africa (Cushing 1988). The main species of elasmobranch fishes traditionally caught as bycatch in these traps were large individuals of common thresher (*Alopias vulpinus*), basking shark (*Cetorhinus maximus*), blue shark (*Prionace glauca*), devil ray (*Mobula mobular*) and sometimes the great white shark (*Carcharodon carcharias*) (Boero and Carli 1979; Vacchi *et al*. 2002).

Surface longline fisheries that target tuna and swordfish also catch blue shark, pelagic or violet stingray (*Pteryplatotrygon violacea*), common thresher, shortfin mako (*Isurus oxyrinchus*), porbeagle (*Lamna nasus*), smooth hammerhead (*Sphyrna zygaena*), sixgill (*Hexanchus griseus),* requiem sharks *(Carcharhinus spp.),* devil ray *etc*. (Fleming and Papageorgiou 1997; Muñoz-Chàpuli 1994; Kabasakal 1998; Hemida 1998; De Metrio *et al*. 1999; Garibaldi and Orsi-Relini 1999). Fishing activities targeting swordfish are more common in the southern parts of the Mediterranean, such as Italy, Malta, Morocco, Tunisia and Crete, and small driftnets may be used in some areas – with a bycatch of common thresher and blue shark.

Large elasmobranchs are often caught incidentally as bycatch in artisanal fisheries, especially in longline fisheries (Serena and Vacchi 1997). A local artisanal fishery targeting blue shark utilises the so-called 'stese' (short lines with hooks placed near the surface); this fishery operates mainly in the spring along the Calabria and Apulia southern regions of Italy.

Modest catches of blue shark have been landed as bycatch of the surface longline fisheries for swordfish and albacore. Depending on hook selectivity and seasonal cycles, swordfish fisheries land larger blue sharks (mean weight 25 kg) than do albacore fisheries (3 kg) (De Metrio *et al*. 1984).

A large number of elasmobranch fishes may be taken in large driftnet fisheries, which were once used widely in the Mediterranean basins. This type of fishery is prohibited by the EU although non-EU nations may still use the gear. This ban may be extended to the whole Mediterranean in the future. The elasmobranch species frequently taken with driftnets are blue shark, common thresher, shortfin mako, porbeagle, requiem sharks (*Carcharinus* spp.), basking shark, hammerheads (*Sphyrna* spp.), devil ray and pelagic stingray (De Metrio *et al*. 1999; Muñoz-Chàpuli 1994). With the moratorium on driftnets in the Mediterranean (as of January 2002), it is expected that the undesired fishing mortality of elasmobranchs caught with this gear will be reduced.

In the northern Adriatic Sea, gillnets (often set for demersal species) also have a bycatch of pelagic species, with blue shark and common thresher taken during the summer (Costantini *et al*. 2000).

Basking sharks are incidentally caught with trammel and gillnets, with young individuals caught mainly in shallow waters during spring, though adolescents and adults are also present in the area. Basking sharks also occur off the coasts of Tuscany and Liguria in spring (Serena *et al*. 1999).

Blue sharks are also caught by offshore pelagic fisheries along the Algerian coasts. Important catches of requiem sharks (*Carcharhinus brachyurus, C. brevipinna, C. falciformis, C. obscurus, C. plumbeus* and *C. altimus*) are obtained by pelagic longline fisheries operating from ports east of Algeria (Hemida and Labidi 2001).

Until now, there have been no statistical data on shark bycatch in Mediterranean pelagic fisheries. In spite of this, in some cases, we have significant examples of elasmobranchs such as pregnant devil ray caught during purse seine activities targeting anchovy (Notarbartolo and Serena 1998). Pelagic stingrays are caught as bycatch in the swordfish fishery in the Ligurian Sea (Orsi Relini *et al*. 2002) and in the south-western Mediterranean Sea (Aguilar *et al*. 1992), with all specimens discarded at sea because of their low commercial value.

Finning is not known to be practiced in the Mediterranean basin, but recently the Italian Coast Guard stopped a Spanish fishing boat finning in international waters just off the Calabrian coast (13 nautical miles out of Italy) (Serena pers. comm.).

2.2 Pelagic fisheries in the Eastern and Western Central Atlantic (FAO areas 34 and 31)

In 2004, Spain and Portugal both reported shark catches to the FAO in West African waters (FAO area 34). Spain reported 9 955 t of blue shark (*Prionace glauca*) and 468 t of shortfin mako (*Isurus oxyrinchus*). Portugal reported 661 t of blue shark and 42 t of shortfin mako (FAO website).

ICCAT's recent Report of the Standing Committee on Research and Statistics (SCRS) described several fisheries in West African waters (FAO area 34) where EU vessels are involved and sharks are taken as bycatch (ICCAT 2006).

In Cape Verde waters, billfish and swordfish are caught mostly by EU vessels and through sport fishing. In the industrial fishery, sharks are taken as bycatch. The foreign fleet operating in the Cape Verde EEZ is comprised essentially of tuna vessels (bait boats and purse seiners) and surface longliners, the majority of which are from EU States. The catches mainly comprise sharks, followed by tunas and swordfish.

Although Côte d'Ivoire does not have any industrial tuna fishing fleets, fleets that visit the fishing port of Abidjan have been monitored since 1985. In 2005, the following was reported: 26 tuna vessels (15 Spanish and associated vessels, nine French, two Ghanaian, two Guinean); 102 459 t of tuna was processed (landings and trans-shipments to canneries); and 21 500 t of 'false tuna' or 'false fish' (tunas rejected by the canneries because they are damaged or too small e.g. frigate tuna, and mackerel and all other species landed by the purse seiners) was landed.

Tuna fishing in the Republic of Guinea is carried out exclusively by industrial and foreign fleets. This fishing is dominated by EC fleets, in particular the Spanish and French fleets that land their catches at Dakar, Abidjan or Las Palmas. In 2005, about 30 tuna-fishing licenses were issued while only six Spanish-flag tuna vessels fished in Guinean waters. The reported catches of these purse seiners amounted to 108 t and were composed mainly of yellowfin tuna (*Thunnus albacares*) (ICCAT 2006).

There are important Spanish fisheries in the eastern Central Atlantic with reported annual landings including 25–50 000 t/year of skipjack tuna (*Katsuwonus pelamis*), 20–40, 000 t/year of yellowfin tuna, 10–15 000 t/year of bigeye tuna and other tuna and billfish. The major shark species taken in this area include blue shark (7–12 000 t/year) with occasional reports of hammerheads, silky sharks and thresher sharks. Shortfin mako is a high-value species that should occur in this region; the apparent lack of species-specific landings data for this shark is a cause of concern.

France also has important fisheries for tuna and billfish in this area, reporting catches of 4 000–10 000 t/year of bigeye tuna, 16 000–30 000 t/year of skipjack tuna and about 30 000 t/year of yellowfin tuna, as well as various other tunas and billfish. Fisheries for tuna and billfish generally have a bycatch of sharks, so it is very strange that there are no reports of shark landings by France from this FAO area. France should be requested to provide catch, discard and landings data of sharks taken in these fisheries, if such data are available. If shark carcasses are not being landed, finning may be occurring in these fisheries; closer monitoring is required to determine the species composition of shark bycatch, levels of discards, and the potential extent of finning.

Portuguese fisheries in this region take about 1000 t/year of bigeye tuna as well as albacore, skipjack tuna, swordfish, and other tunas and billfish. Sharks taken as bycatch include blue shark, porbeagle, shortfin mako, hammerheads, threshers and tope.

Spanish fisheries also extend into the western Central Atlantic, with reported landings comprised mostly of swordfish (900–2700 t/year), with other billfish and various pelagic sharks (e.g. blue, shortfin mako and silky sharks) also reported.

2.3 Pelagic fisheries in the Southeast and Southwest Atlantic (FAO areas 41 and 47)

Some EU Member States have important fisheries for pelagic fishes off Southwestern African coasts. These fisheries also have a bycatch of elasmobranch, including blue shark (*Prionace glauca*), shortfin mako (*Isurus oxyrinchus*), hammerheads (e.g. *Sphyrna lewini* and *S. zygaena*), requiem sharks (*Carcharhinus* spp.) and common thresher (*Alopias vulpinus*) (STECF 2003).

Spain and Portugal both have tuna and billfish fisheries in the south Atlantic, with albacore, bigeye tuna, swordfish, shortfin mako and blue shark the major species landed. The Spanish fisheries report taking about 5–10 000 t/year of swordfish, 500–1 000 t/year of shortfin mako, and 1 500–4 500 t/year of blue shark.

In 2004, a total of 5 708 t of blue shark caught in the Southeast Atlantic (FAO area 47) were reported to ICCAT. The main fishing nations were Spain (3 084 t), Namibia (1 906 t), Portugal (590 t) and South African waters (128 t). The reported catches by Namibia in 2006 were more than three times higher than in 2005 at 6 616 t.

Spanish and Portuguese vessels fish off the Namibian coast. Blue shark and shortfin mako are targeted in longline fisheries, with other species taken as bycatch (SEAFO 2005); these fisheries are not covered by Namibia's National Shark Plan. Spanish companies have fishing agreements with the government of Namibia (Abuin 2006). In 2005 Galician companies caught 140 000 t of fish (mainly hake) in Namibian waters (Martin 2006).

A purse seine tuna fishery has operated for decades in the eastern tropical Atlantic in the Gulf of Guinea and off the West African coasts, mostly by French and Spanish fleets. From 1997 to 1999, a European observer programme was carried out on-board French and Spanish purse seiners. This indicated that elasmobranch fishes represented 51% of bycatch and 1.15% of the total catch. If the ratio is applied to recent catches (60 000 t for France and 104 000 t for Spain in 2004), the bycatch of sharks can be estimated at 690 t and 1 200 t respectively.

The main shark species taken in these bycatches were hammerheads (e.g. *Sphyrna lewini*), silky shark (*Carcharhinus falciformis*) and oceanic white-tip shark (*Carcharhinus longimanus*). The observer programme showed that 90% of the silky sharks and 67% of the other shark species were kept for their fins, which were marketed by the African crews. Of the sharks released, the mortality rate was estimated at 33% for those caught in non-associated sets and 66% for those in log sets.

The French fleet respects the finning ban established by the EC in 2003 and no vessel asked for a special permit for shark finning (as allowed under the Shark Finning Regulation). As a result, the sharks caught are released and are not recorded in the fishing logbooks, hence the absence of records in the ICCAT database. The instructions given by the fishing companies to their captains are generally followed, however some finning practices may still continue as fins represent a substantial income bonus for the African crews on-board French purse seiners. In 2007, new observer programmes should allow the collection of data on this bycatch and information on fishing practices.

In 2004, Brazil, Spain, Portugal and Uruguay reported to ICCAT a total of 7 759 t of blue shark catches in the Southwest Atlantic (FAO area 41). Spain was the main fishing nation taking blue shark with reported catches of 4 283 t, followed by Brazilian vessels (1 670 t) and Portuguese vessels (1 273 t). Montevideo (Uruguay) is an important harbour for unloading Spanish vessels (*El Pais* 2006). Shark carcasses enter south American markets, but shark fins are generally shipped back to Las Palmas (Andres Domingo, personal communication).

2.4 Pelagic fisheries in the Indian Ocean (FAO areas 51 and 57)

According to the Indian Ocean Tuna Commission (IOTC), there are a total of 498 EU vessels from Spain, France, Portugal, Italy and the UK authorised to fish in the Indian Ocean; 300 of these are registered as longliners or purse seiners. Some of the fleets are described below.

There has been important development of the purse seine tuna fishery in the western Indian Ocean in the last decade. It is mainly operated by French and Spanish fleets. In 2000, the total purse seine tuna catch was 330 000 t, achieved by about 50 vessels licensed in the Seychelles. The average catch rate was about 25 t/day, which is the highest CPUE (catch per unit of effort) recorded. In 2000, the longline tuna catch was 3 237 t obtained with a fishing effort of about 9 million hooks, giving a catch rate of about 0.4 t/1 000 hooks.

The tuna fisheries mainly catch the oceanic whitetip (*Carcharhinus longimanus*), blue (*Prionace glauca*), silky (*Carcharhinus falciformis*), shortfin mako (*Isurus oxyrinchus*), hammerhead (*Sphyrna* spp.) and thresher (*Alopias* spp.) sharks, as well as some mobulid rays (*Manta birostris* and *Mobula* spp.) and the pelagic stingray (*Pteroplatytrygon violacea*).

The proportions of these species vary according to the mode of fishing (longline or purse seine); the diversity of sharks is usually greater in the longline fishery. In the purse seine fishery, the proportions of sharks also vary with the type of sets: school sets, log sets, marine mammals associated sets. As an example, the following data are provided by the IRD (Institut de Recherche pour le Développement) research programme, including an observer programme conducted between 1993 and 2001 in the Réunion-Seychelles area (see Table 2.5).

The IOTC working party on bycatch (2006) noted that coverage by observer programmes in the Indian Ocean is currently very low, which means that it is unable to provide reliable estimates of the overall total catch of non-target species. Furthermore, the IOTC Secretariat currently holds no data from any of the observer programmes operating in the Indian Ocean (IOTC 2006).

Table 2.5 - Shark and ray bycatch per 1 000 t in the purse seine tuna fishery in the Réunion-Seychelles area.

Species	All sets	Log sets	School sets	Dolphin sets
Silky shark	248	152	76	20
Oceanic white-tip	18	15	2	1
Hammerhead sharks	12	5	6	1
Other sharks	68	46	16	6
Manta rays	26	1	21	4
Pelagic stingrays	9	1	6	2
Total	379	220	127	34

The shark bycatch per set varied from 0.01 to 6.0, allowing an estimated yearly bycatch of about 55,000 sharks, i.e. about 1 650 t/year (assuming a mean shark weight of 30 kg).

Another study (Romanov 1998) provides data on bycatch in purse seine tuna fisheries in the western Indian Ocean, giving 27.2 t of bycatch species per 1 000 t of target species (tunas), with 3.4 t per 1 000 t in free school sets, 11 t per 10 000 t in whale-associated sets, and 41.3 t per 1 000 t in log sets. In these fisheries, sharks represent 38% of the weight of bycatch in free school sets, 94% in whale-associated sets and 22% in log sets.

If these ratios are applied to the total catch of the purse seine tuna fishery, i.e. 330 340 t in 2000, an estimated catch of sharks of about 3 600 t/year is obtained.

In the longline tuna fishery, the bycatch species (sharks and billfishes) represent about 17% of the total catch, i.e. about 548 t out of the 3 227 t of the total catch in Seychelles waters in 2000. However, this represents only a part of the real catch, as only 54% of the logbooks of the 137 licensed longliners had been returned to SFA (Seychelles Fishing Authority) (Séret 2002).

A tuna purse seine fishery operates in the western Indian Ocean, and EU States (Spain and France) are active in this fishery. In 2000, the total purse seine tuna catch was 330 340 t, achieved by about 50 vessels licensed in the Seychelles (STECF 2003). The main species of shark taken in these fisheries include oceanic white-tip shark (*Carcharhinus longimanus*), blue shark (*Prionace glauca*), silky shark (*Carcharhinus falciformis*), shortfin mako (*Isurus oxyrinchus*), hammerheads (*Sphyrna* spp.) and thresher sharks (*Alopias* spp.), with catch composition affected by type of set.

Two Spanish fleets operate in the Indian Ocean, a purse seine fleet targeting tropical tuna (yellowfin, skipjack and bigeye) and a longline fleet targeting swordfish and sharks. In 2004, there were 20 purse seiners and 24 longliners (27–42 m in length) actively operating in the area (IOTC 2005), although 125 longliners are registered by Spain in the Indian Ocean. Observer programmes have been used to estimate the bycatch associated with the purse seine fishery, and some sharks have been tagged and released opportunistically.

FAO landings data indicate that Spanish fisheries land approximately 100–175 000 t/year of tuna (mostly yellowfin, skipjack and bigeye tuna), and just over 2 000 t/year of swordfish and other billfish. Sharks have been reported since 1995, though the majority (about 5–12 000 t/year in recent years) have been as unspecified sharks. Improved species-specific landings data for these fisheries are required. Portuguese fisheries take mostly billfish and sharks, including blue shark and shortfin mako.

Two French fleets fish for tuna in the Indian Ocean: purse seiners operating from the Seychelles, and longliners operating from La Réunion, with about 30 longliners targeting swordfish (IOTC 2005). There is also a small artisanal fleet operating from La Réunion. Once again, French landings data do not include any sharks, even though annual landings of 50–108 000 t of tuna have been reported in recent years. Once again, France should be requested to submit any available landings data for elasmobranchs in these fisheries, and closer monitoring of these fisheries is required to determine the species composition of shark bycatch and the potential extent of finning.

Both the French and Spanish fisheries extend into the eastern Indian Ocean, though landings of pelagic species are much lower than in the western Indian Ocean, and Spain has only reported landings of sharks since 2002.

2.5 Pelagic fisheries in the Pacific Ocean (FAO areas 61, 67, 71, 77, 81 and 87)

The Spanish purse seine fleet has operated in the Pacific Ocean since 1978, and the target species are yellowfin, skipjack and bigeye tuna. Since 1998, the fleet has comprised five large tuna purse seine vessels in the Pacific Ocean, whose fishing activity has been primarily carried out in the eastern Pacific Ocean, with some catches in the western Pacific Ocean (WCPFC 2005).

Spain has reported landing about 3–7 000 t/year of yellowfin tuna, 12–23 000 t/year of skipjack tuna and 3–8 000 t/year of bigeye tuna in the eastern central Pacific, though no shark landings are reported. Spanish fisheries operating in the southeast Pacific have reported annual landings of about 1–8 000 t/year for yellowfin tuna, 2–17 000 t/year for skipjack, 1–13 000 t/year for bigeye tuna and 1–6 000 t/year for swordfish. Blue shark, mako and porbeagle are the major species reported in landings, with occasional reports of hammerhead and thresher sharks, though shark landings have only been reported in recent years. Although often referred to as ‘bycatch’, sharks are targeted in the swordfish longline fishery and comprise about half of the utilised catch (Figure 2.4).

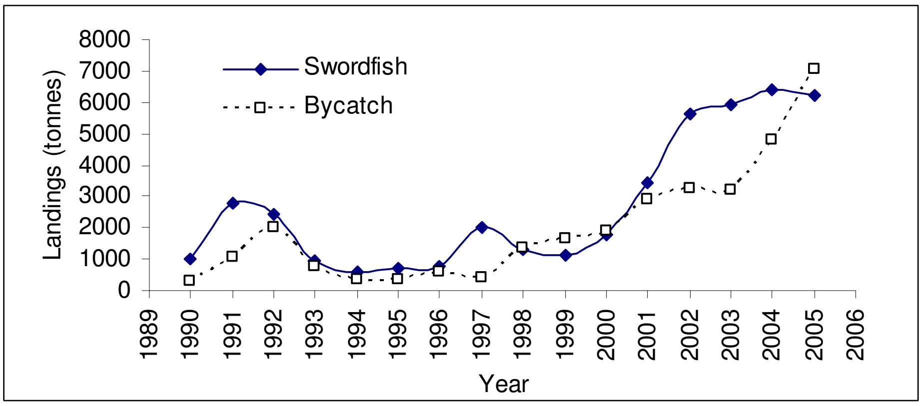

Figure 2.4. Landings of swordfish and bycatch from the Spanish longline fishery in the Pacific, 1990-2005. (Mejuto *et al.* 2007)

Though little information was available on bycatch in these fisheries, some of these vessels will have observers on board in order to monitor marine mammal and turtle bycatch.

2.6 Conclusions

European shark fisheries operate in all of the world's oceans and are very much larger than is generally understood. Taking into account significant under-reporting of shark catches by several of its pelagic fleets, and the catches made by EU vessels flagged in other States, the EU is possibly the world's largest shark fishing entity.

European fisheries have traditionally exploited many small bottom-living coastal sharks and skates, and have recently increased their exploitation of deep-water sharks. These species and fisheries are relatively well-understood, but generally lack effective fisheries management measures. In contrast, the largest European shark fisheries, undertaken on the high seas by pelagic fleets from Spain, France and Portugal in the Atlantic, Pacific and Indian Oceans, are very poorly documented and unmanaged (other than through shark finning prohibitions). Though these fisheries historically targeted primarily tunas and swordfish, longline catches of oceanic sharks are as large as or larger than the catch of target species, and most longliners now also target sharks. Additionally, the Atlantic shark stocks exploited by European fleets are also heavily fished by Japanese and Taiwanese tuna vessels that operate in the Atlantic as well as in the Indo-Pacific Ocean. There is evidence that many large oceanic sharks are being fished unsustainably (Maguire *et al*. 2006, Figure 2.5 and Table 2.6) and that populations of the most biologically-vulnerable of these species are below healthy levels. The majority of stocks utilised by the EU will likely soon be overexploited, if they are not already, unless management is introduced.

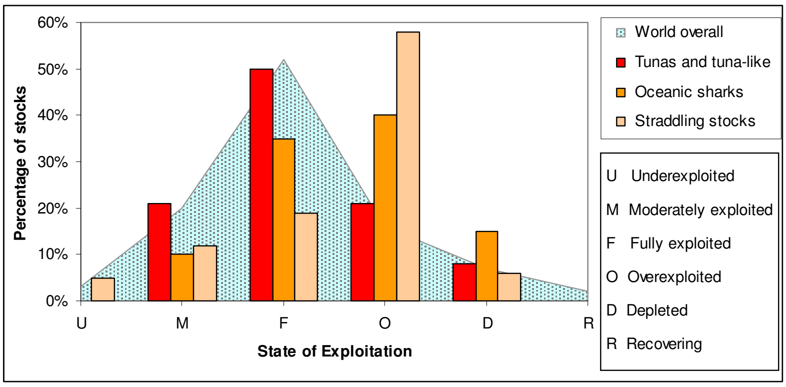

Figure 2.5. Summary of the state of exploitation of highly migratory tuna and tuna-like species, highly migratory oceanic sharks, and straddling stocks. (Maguire *et al*. 2006)

Table 2.6. FAO classification of fish stock status. (Maguire *et al*. 2006)

Classification	Definition	Highly migratory shark stocks	All straddling fish stocks
Depleted	Catches are well below historical optimal yields, irrespective of the amount of fishing effort exerted	15%	6%
Overexploited	The fishery is being exploited above the optimal yield/effort which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse	40%	58%
Fully exploited	The fishery is operating at or close to optimal yield/effort, with no expected room for further expansion	35%	19%
Moderately exploited	Exploited with a low fishing effort. Believed to have some limited potential for expansion in total production	10%	12%
Not known	Not much information is available to make a judgment, but stocks are at least fully exploited.	39%	0%
Underexploited	Undeveloped or new fishery. Believed to have a significant potential for expansion in total production	0%	4%
Recovering	Catches are again increasing after having been depleted or a collapse from a previous high	0%	1%

A lack of data on shark catches, use and discard, particularly species-specific statistics, has hampered stock assessments and the introduction of fisheries management. It is extremely important to obtain better data from EU shark fisheries, markets and trade, as a matter of urgency. To continue a fishery of this importance and vulnerability on such a scale without proper data on landings, effort, fishing grounds *etc*. is not responsible. Greater investment in data collection and management is required.

Shark fisheries, particularly pelagic shark fisheries, are a global issue (fisheries and trade are not constrained by national borders). Greatly improved international cooperation, exchange of data and harmonisation of management are needed if stocks are to rebuild and the fisheries become sustainable.

While improved information on shark catches is essential for effective shark fisheries management, this should not be used as an excuse for inaction. Precautionary limits are warranted immediately, based on the low reproductive capacity of sharks, current high fishing pressures, and the history of frequent collapse in shark fisheries.

The EU Commission, Member States and Regional Fisheries Bodies should:

- Mandate full coverage on shark fishing vessels by independent, on-board observers;
- Increase investment in shark data collection at landing sites and by processing and marketing industries;
- Establish effective monitoring and management measures for target and bycatch shark fisheries within their remit, including precautionary catch limits when data are lacking;
- Cooperate in the exchange of information and the harmonisation of management measures across borders; and
- Ensure that all landings and trade of shark fins, meat, and oil are recorded separately by commodity (and to the species level where possible).

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3 Markets and international trade in shark products

3.1 Introduction

Elasmobranchs (a class of fish comprising sharks, skates and rays) are versatile fisheries resources providing meat and shark fins for human consumption; skins for leather; shark liver oil for use in lubricants, cosmetics and vitamin A; shark cartilage for medicinal use; and jaws and teeth as marine curios. This diversity of products is remarkable among fisheries commodities and is matched by an exceptionally large variability in the value of the products. With the exception of speciality markets, many of which are in Europe, shark meat has historically been considered a low-value product. In contrast shark fins, particularly those from desirable species, are some of the most expensive seafood products in the world (up to 500 €/kg). Markets for other shark products, including skin, liver oil and cartilage, appear to fluctuate over time with changes in fashion, medical knowledge and the availability of substitutes. Shark fisheries have historically been undervalued and ignored except during boom-and-bust cycles for export products such as liver oil and fins. However the versatility of elasmobranch products and the ease with which fishing effort can be targeted towards elasmobranchs when other species are depleted, restricted or seasonally unavailable have led to increasing exploitation over the past few decades (Fowler *et al*. 2004).

Global statistics on the production of particular shark products, such as meat, fins and liver oil are available from the FAO Fishstat database (see Tables 3.1 and 3.2) but suffer from sparse and incomplete data and the potential for double-counting. Produced quantities of less valuable elasmobranch products, such as skins and leather, cartilage, fish meal and fertiliser, are rarely tabulated by trade authorities and are thus even more difficult to assess.

Most countries worldwide have agreed to use a harmonised system of six-digit codes to record imports and exports that pass through the control of their custom authorities. These six-digit codes have progressively been complemented by eight-digit codes that allow for more detailed recording of the trade and, in the case of sharks, allow separation of meat and fins. For example, dried shark fins would be recorded under 030559 ('Fish dried whether or not salted not smoked') under the six-digit system but under 0305-5930 ('Shark fins dried') under the eight-digit system. However the recording and reporting of trade by custom authorities at this level of detail has not been agreed upon internationally and is therefore not required. Expanding the requirement from six- to eight-digit codes is recommended to allow separation of the growing trade in shark meat from shark fins and to facilitate accurate tracking of shark products.

Another key issue is that in recent years the international trade in frozen fins has significantly increased replacing the trade in dried fins between some important trading partners such as Spain and Hong Kong. On the basis that Hong Kong's commodity codes separate dried from frozen fins, FAO has decided to add a distinct category of 'Frozen fins' to the list of products recorded in its Fishstat database. A similar adjustment should be made to the list of Harmonised System Codes for custom commodities, since most countries do not distinguish between shark fins in various forms even though they may differ substantially in weight. Both the separation of shark meat from shark fins and the separation of frozen from dried fins are necessary to increase the potential use of international trade statistics in estimating the total quantity of global trade and the relationship between trade and shark catches.

The following sections describe trade in these products using the FAO data (FAO 2006) as a foundation, but using other databases to cross-check quantities where possible.

Table 3.1. Global production, import and export quantities for elasmobranch commodities (metric tonnes), 1985–2004 (FAO 2006)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Shark meat (fresh, chilled or frozen																				
Production	31 068	30 476	33 110	39 150	27 637	34 486	40 824	50 153	51 105	48 053	53 194	42 918	47 484	72 094	65 286	63 904	62 092	73 985	73 528	71 795
Import	34 448	32 085	38 530	40 308	39 027	44 614	46 638	45 431	44 448	46 212	52 596	53 759	54 752	59 169	57 120	70 846	82 228	79 154	76 519	81 447
Export	25 089	26 945	31 531	33 835	29 542	37 396	45 637	46 010	53 227	49 644	56 892	52 049	56 532	63 973	59 354	70 645	74 271	70 961	78 481	83 981
Shark meat (dried or salted)																				
Production	8 240	9 759	11 317	10 227	11 896	11 108	7 239	10 355	13 085	11 577	13 373	15 889	20 306	23 252	24 694	26 765	21 968	25 376	25 425	27 900
Import	0	0	0	0	0	0	40	0	0	1	7	0	0	0	0	0	0	0	0	0
Export	67	1	8	30	1	1	17	1	0	0	0	0	5	201	114	170	0	114	109	104
Shark meat (total)																				
Production	39 308	40 235	44 427	49 377	39 533	45 594	48 063	60 508	64 190	59 630	66 567	58 807	67 790	95 346	89 980	90 669	84 060	99 361	98 953	99 695
Import	34 448	32 085	38 530	40 308	39 027	44 614	46 678	45 431	44 448	46 213	52 603	53 759	54 752	59 169	57 120	70 846	82 228	79 154	76 519	81 447
Export	25 156	26 946	31 539	33 865	29 543	37 397	45 654	46 011	53 227	49 644	56 892	52 049	56 537	64 174	59 468	70 815	74 271	71 075	78 590	84 085
Shark fins (dried)																				
Production	3 710	2 671	1 971	4 929	5 860	4 973	3 662	3 300	5 095	2 851	3 227	1 869	3 747	1 301	1 919	3 657	2 478	2 996	3 679	3 909
Import	3 795	3 922	4 907	5 781	5 083	5 061	5 623	9 961	9 682	10 534	7 685	12 071	11 297	10 594	10 964	12 375	9 892	10 480	11 390	12 446
Export	2 674	2 738	3 349	3 179	3 971	4 059	2 723	4 077	4 204	4 385	3 211	5 482	4 467	4 257	4 655	5 488	4 510	5 324	5 962	6 026
Shark fins (salted, in brine or frozen)																				
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	134	153	213	170	865	557	471	1 217	1 877	2 225	2 482	2 755	4 667	4 495	4 774	5 747	4 671
Export	98	116	268	308	357	603	300	260	307	166	378	291	363	245	430	1 029	665	670	901	776
Total (adjusted) shark fins																				
Production	3 710	2 671	1 971	4 929	5 860	4 973	3 662	3 300	5 095	2 851	3 227	1 869	3 747	1 301	1 919	3 657	2 478	2 996	3 679	3 909
Import	3 795	3 922	4 907	5 815	5 121	5 114	5 666	10 177	9 821	10 652	7 989	12 540	11 853	11 215	11 653	13 542	11 016	11 674	12 827	13 614
Export	2 699	2 767	3 416	3 256	4 060	4 210	2 798	4 142	4 281	4 427	3 306	5 555	4 558	4 318	4 763	5 745	4 676	5 492	6 187	6 220
Shark liver oil																				
Production	113	82	45	42	31	35	53	41	31	39	1	11	4	-	-	-	1 700	2 881	2 550	-
Import	2	3	45	181	303	544	821	402	397	749	448	286	192	36	100	110	140	125	146	132
Export	992	31	36	429	18	29	214	234	113	66	129	100	137	69	55	56	47	147	93	81

Notes:

Shark meat (fresh, chilled): 'Dogfish (*Squalus* spp.) and catshark fillets, fresh or chilled', 'Dogfish (*Squalus* spp.) and catshark fillets, frozen', 'Dogfish (*Squalus* spp.), fresh or chilled', 'Dogfish (*Squalus* spp.), frozen', 'Shark fillets, fresh or chilled', 'Shark Fillets, frozen', 'Sharks, rays, chimaeras nei fillets, fresh or chilled', 'Sharks, rays, chimaeras nei fillets, frozen', 'Sharks, fresh or chilled', 'Sharks, frozen', 'Sharks, rays, chimaeras nei, frozen', 'Sharks, rays, skates, fresh or chilled, nei'.

Shark meat (dried or salted): 'Sharks, dried, salted or in brine', 'Sharks, rays, etc. dried, salted or in brine'.

Shark meat: Shark meat (fresh, chilled or frozen), Shark meat (dried or salted).

Shark fins: 'Shark fins dried, unsalted', 'Shark fins dried, salted, etc.'.

Shark fins (salted, in brine or frozen): 'Shark fins salted or in brine, but not dried or smoked', 'Shark fins, frozen'.

Shark-liver oil: 'Shark-liver oil', 'Shark oil'.

Table 3.2 European production, import and export quantities for elasmobranch commodities (metric tonnes), 1985–2004 ((ref?))

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Shark meat (fresh, chilled or frozen																				
Production	3 224	2 435	3 607	3 341	3 725	3 162	4 856	5 512	6 142	5 881	6 171	7 546	12 820	17 552	17 690	16 268	11 987	10 720	10 226	9 918
Import	32 664	30 113	36 622	36 183	33 333	38 015	39 164	38 020	37 338	36 543	40 157	41 952	40 290	41 817	40 422	43 807	45 951	43 876	39 533	40 908
Export	19 447	19 517	22 811	19 737	16 364	18 538	19 885	16 699	20 805	16 183	16 120	17 931	23 682	28 607	30 515	32 320	25 691	24 382	23 280	26 765
Shark meat (dried or salted)																				
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Export	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shark meat (total)																				
Production	3 224	2 435	3 607	3 341	3 725	3 162	4 856	5 512	6 142	5 881	6 171	7 546	12 820	17 552	17 690	16 268	11 987	10 720	10 226	9 918
Import	32 664	30 113	36 622	36 183	33 333	38 015	39 164	38 020	37 338	36 543	40 157	41 952	40 290	41 817	40 422	43 807	45 951	43 876	39 533	40 908
Export	19 447	19 517	22 811	19 737	16 364	18 538	19 885	16 699	20 805	16 183	16 120	17 931	23 682	28 607	30 515	32 320	25 691	24 382	23 280	26 765
Shark fins (dried)																				
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Export	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shark fins (salted, in brine or frozen)																				
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Export	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (adjusted) shark fins																				
Production	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Export	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shark-liver oil																				
Production																				
Import	.	.	.	30	104	187	122	59	26	358	312	152	154	22	58	26	46	17	44	31
Export	.	.	.	7	-	7	-	4	-	11	111	89	132	69	55	56	47	57	42	48

Notes:

Shark meat (fresh, chilled or frozen): 'Dogfish (Squalus spp.) and catshark fillets, fresh or chilled', 'Dogfish (Squalus spp.) and catshark fillets, frozen', 'Dogfish (Squalus spp.), fresh or chilled', 'Dogfish (Squalus spp.), frozen', 'Shark Fillets, fresh or chilled', 'Shark Fillets, frozen', 'Sharks, rays, chimaeras nei fillets, fresh or chilled', 'Sharks, rays, chimaeras nei fillets, frozen, 'Sharks, fresh or chilled', 'Sharks, frozen', 'Sharks, rays, chimaeras nei, frozen', 'Sharks, rays, skates, fresh or chilled, nei'.

Shark meat (dried or salted): 'Sharks, dried, salted or in brine', 'Sharks, rays, etc. dried, salted or in brine'.

Shark meat (total): Shark meat (fresh, chilled or frozen), Shark meat (dried or salted).

Shark fins (dried): 'Shark fins dried, unsalted', 'Shark fins dried, salted, etc.'.

Shark fins (salted, in brine or frozen): 'Shark fins salted or in brine, but not dried or smoked', 'Shark fins, frozen'.

Shark-liver oil: 'Shark-liver oil', 'Shark oil'.

3.2 Shark meat

Reported production of fresh, frozen and dried chondrichthyan meat and fillets nearly tripled from approximately 38 000 t in 1985 to just under 100 000 t in 2004. Major producers of frozen shark meat in recent years were Spain, Taiwan and Japan. In 2003 Taiwan exported 17 161 t of frozen shark meat, becoming the world's leading exporter of frozen shark meat, and exceeded exports by Spain (which had led world exports since 1997) by several thousand metric tonnes in 2003 and 2004. With regards imports, Italy and France dominated shark meat imports from 1985 until 1998 when Spain surpassed France and then Italy (in 2000) to become the world's largest importer (17 500 t in 2004). Other major importers (consistently over 2 000 t/yr) in 2000–2004 were China, Brazil, Mexico and the UK (FAO 2006).

FAO statistics indicate that the EU is a major region of trade in shark products, but this may be due to better recording of this trade compared to other nations (Vannuccini 1999). The 25 Member States (MS) of the EU constitute a 'unique economic market' where the movement of goods takes place freely. This means, for example, that no taxation is applicable to commercial commodities transported from one MS to another and that such shipments are therefore not submitted to systematic customs controls. The European trade statistics system Eurostat does, however, record internal EU trade via a system of reporting by the relevant agencies of each MS. The way this internal EU trade is reported to the FAO and then recorded in the Fishstat database is unclear. If under the current EU reporting system this trade is not being captured in FAO Fishstat, then a potentially large volume of trade is unrecorded in FAO-based estimates of global trade.

EU countries play a major role in the international trade of sharks and shark meat. Even if they produced about 12% of shark meat worldwide in 2005, they are responsible for 56% of global shark imports and 32% of worldwide exports. In 2005 out of all EU countries Spain was the biggest importer of sharks and shark meat, responsible for 42% of EU total imports. The second biggest importer was Italy, responsible for another 25% of EU total imports.

3.3 Shark fins

According to FAO data on shark fins, as of 2004 Indonesia is the world's largest producer of shark fins (1 660 t) followed by Singapore (1 000 t) and India (455 t) (FAO 2006). A more useful measure of the scope of the shark fin trade is provided by a compilation of national customs statistics from the major shark fin markets of Hong Kong, mainland China, Taiwan, Japan and Singapore. Data were adjusted for water content, under-reporting (Clarke 2004a) and double-counting (e.g. imported and exported by one of the five jurisdictions to another of the five), where possible. Figures suggest that during the period 1996–2000 trade dipped in 1998 (probably due to the Asian financial crisis (Clarke 2003)) and reached a peak of just over 11 600 t in 2000 (see Table 3.3).

Table 3.3. Global estimate of traded quantity of shark fins, 1996–2000. (Clarke *et al.* 2006b)

	1996	1997	1998	1999	2000
Mainland China Singapore Taiwan and Japan	6 171	6 054	5 788	5 672	6 101
Hong Kong	4 061	4 414	4 086	4 489	5 501
Total	10 232	10 468	9 874	10 161	11 602

These figures only extend through to 2000, because after this time customs statistics from mainland China no longer reflect the true volume of trade in that country. Specifically, in May 2000, the China Customs Authority issued guidance stating that from that time forward all fresh, chilled and frozen (i.e. not dried) shark fins should be recorded under commodity codes designated for fresh and chilled or frozen shark meat (Clarke 2004b). Reported imports of frozen shark meat to mainland China have expanded four-fold since 1999, reflecting either an increasing trend of declaring shark fins as shark meat and/or an expanding market for frozen shark meat (see Table 3.4).

Table 3.4. Imports of fresh and frozen shark meat to mainland China (metric tonnes) 1998–2005 (Hong Kong customs statistics are shown for reference).

	Mainland China fresh or chilled	Mainland China frozen	Hong Kong fresh or chilled	Hong Kong frozen
1998	70	243	0	0
1999	211	1 004	0	25
2000	350	3 603	0	11
2001	419	2 382	0	85
2002	595	4 603	0	3
2003	1 099	3 614	0	45
2004	504	4 631	0	5
2005	na	na	0	0

In November 2001 China became a member of the World Trade Organisation (WTO). As a result a vast number of regulations governing international trade were revised, greatly improving Chinese traders' ability to import fins directly into China without first travelling across Hong Kong. Given the change in China's customs commodity coding in 2000 it is not possible to observe this change statistically, but Hong Kong-based traders cited WTO entry as a reason for the decline of their businesses in 2001 (Clarke 2004a). Recent import statistics for Hong Kong show that after maintaining a stable annual quantity of imports in the range of 6 435 to 6 960t over the period 2000–2003, Hong Kong imports dropped to 6 142t in 2004 and 5 887t in 2005 (see Figure 3.1) (Anon. 2006b).

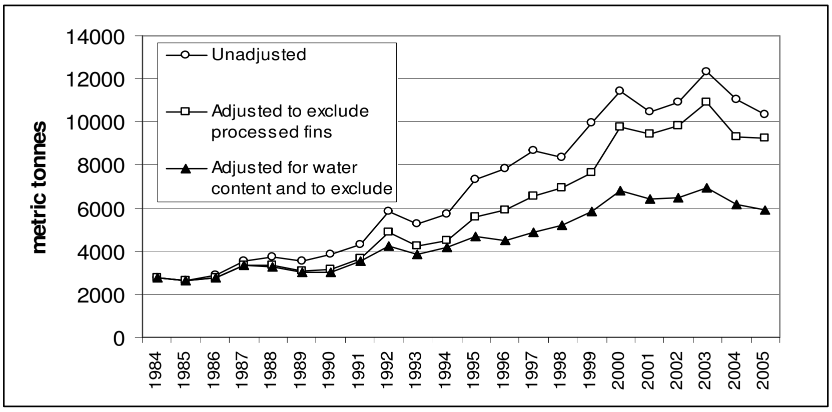


Figure 3.1. Adjusted[3] Hong Kong imports of shark fin (in tonnes), 1984–2005.

In November 2004 China abolished its duty-free import classification for shark fins imported for the purpose of processing and re-export (Anon. 2004a). This action *per se* should have no effect on China's reported import quantities, since China maintains that it records all goods for processing in its trade statistics in compliance with UN recommendations (Anon. 2006a). However, anecdotal information suggests this may not always be the case. The large discrepancy in Hong Kong and mainland China's shark fin trade statistics on the northbound route (i.e. export from Hong Kong import to mainland China) and close agreement on the southbound route (i.e. export from mainland China and import to Hong Kong) as noted by Clarke (2004a) suggests under-reporting of raw shark fins entering China (whether or not for inward processing).

Observations in fresh fish markets in Galicia, Spain, provides information on differences in cutting techniques for shark fins. In these fresh markets all sharks were brought in with all fins still attached. Species observed included blue (*Prionace glauca*), shortfin mako (*Isurus oxyrinchus*), hammerhead

[3] The two adjustments applied to the total declared import figures are: 1. all figures for dried and salted fins prior to 1998 have been adjusted for double-counting of re-imported (i.e. processed) fins and 2. salted or in-brine imports (i.e. frozen) in all years have been adjusted for water content.

(*Sphyrna* spp.) and porbeagle (*Lamna nasus*) sharks, smoothhounds (*Mustelus* spp.) birdbeak dogfish/ shovelnose (*Deania calceus),* spiny dogfish (*Squalus acanthias*) and catsharks (*Scyliorhinus canicula).* The thresher sharks (*Alopias* spp.) were the exception, as they were all brought in without their very long upper caudal fin. Some sharks, including blue shark and shortfin mako, had all their fins cut and used (except in some cases when the anal fins of the blue shark were not cut). The smoothounds had only the caudal fins cut for further use together with the shark meat. The rest of the fins were removed and discarded along with the head and internal organs. Catsharks were skinned with their fins and tails included and then discarded; only the meat was used. Birdbeak dogfish were observed being skinned; fins were discarded with the skin and only the liver and the meat were used for further processing.

Determination of the correct weight ratio between the useable fin set from a given shark and that shark's whole weight depends to a great extent on whether the upper caudal fin is included in the fin set. Informal interviews with shark fin traders in Asia indicate that while the upper caudal fin is not particularly valuable it does contain some useful material and so it is traded and processed. Traders in Hong Kong and Japan explained that upper caudal fins are processed to remove small sections of meat to produce a product called 'fish lips'. These are either served separately, e.g. in restaurants as an appetiser, or mixed with low-value shark fins and ray products as a bulking agent.

Another trader in Singapore claimed that upper caudal fins are a valuable source of chondroitin for the cosmetics industry and that he routinely buys upper caudal fins for this purpose. He also explained that traders may use upper caudal fins to camouflage traded weights for other high-value fins under the former 'inward processing trade' duty system used in China until 1 November 2004 (Anon. 2004a). Under this system certain goods imported for the sole purpose of processing were exempt from customs duties as long as the imported and (processed) exported weight conformed to the expected ratio of raw product to processed product yield. For shark fins this is approximately 30–50% (Parry-Jones 1996) or 35% (Clarke 2003). This system has been subject to considerable abuse since the major market for processed fins was within mainland China and there were many traders who wished to both import duty-free raw materials and sell the finished product on the domestic market. Since the upper caudal fins are the heaviest shark fin per unit weight (because of their cartilage content) traders would import raw upper caudal fins and re-export minimally processed upper caudal fins in order to increase the export weight, thereby allowing some processed fins to be sold on the domestic market. It is not clear to what use, if any, the exported processed upper caudal fins were put.

From this information it seems clear that upper caudal fins should be considered part of the shark fin trade, regardless of whether they are used to produce fin ray 'needles'. The possibility that fishermen or traders will retain upper caudal fins for their value as marketable products or for other reasons should thus be taken into account when formulating and enforcing shark fin regulations.

3.4 Liver oil and cartilage

In the 1930s and 1940s the use of shark liver oil as a lubricant and source of vitamin A prompted a boom in fisheries for Greenland shark (*Somniosus microcephalus*) basking shark (*Cetorhinus maximus*) tope (*Galeorhinus galeus*) spiny dogfish (*Squalus acanthias*) and the deep-water sharks *Centrophorus squamosus* and *Centroscyllium coelolepis*. In later years the development of synthetic substitutes soon caused the shark liver-oil market to collapse. Although the oil is still used in the manufacture of cosmetic and pharmaceutical products, reported production has decreased markedly since the mid-1970s (Fowler *et al*. 2004). Since 1997 only the Maldives has reported any production of shark liver oil (annually 2 000–3 000 t) and only Norway, Korea and the Philippines report any trade in this product (FAO 2006).

Shark cartilage is increasingly marketed as a health supplement and alternative cure for certain diseases. Many claims have been made about its beneficial effects, but these mostly remain unproven.

There is currently no information on the volume of production or trade of shark cartilage products. Major producing and trading countries are believed to be the USA, Japan, Australia and India. Products are also sold in Europe, Hong Kong, Taiwan, Singapore and many other countries (Vannuccini 1999).

3.5 Shark finning and its influence on trade statistics

Rapid expansion of the trade in shark fins has placed a disproportionate value on this small portion of the shark carcass and led to the practice of shark finning (in which all but the fins are discarded). Since better records are kept for more valuable products, it can be argued that shark fins are the most useful product to study in order to fill gaps in our knowledge about shark fisheries. In addition, due to the potential for discarding shark carcasses, landing statistics and therefore production and trade statistics for shark meat (even when converted to whole shark equivalents) may not reflect the true quantity of sharks caught. An example is presented in Figure 3.2 (FAO 2006).

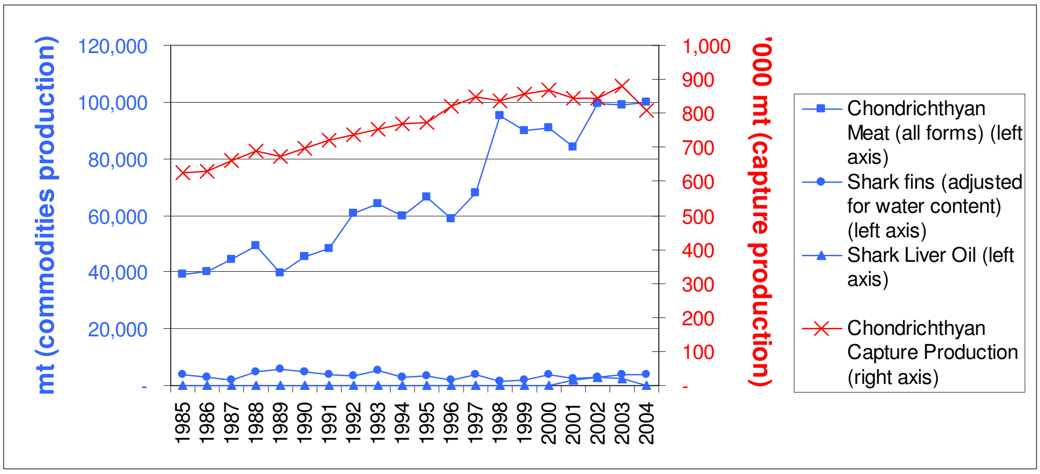


Figure 3.2. Chondrichthyan capture production contrasted with reported production quantities of chondrichthyan meat, shark fins and shark liver oil (in tonnes), 1985–2004.

Over time the ratio of reported shark meat production to reported capture production (catches) has grown from 6% in 1985 to more than 12% in 2004. Despite this growth in reported meat production, and assuming both sets of figures are accurately reported, these figures still represent much less than full utilisation of reported capture production. Applying the conservative assumptions that all capture production is reported in whole weight, that dressed weight (i.e. headed and gutted) is 50% of whole weight and that ultimate yield for meat is 35% of whole weight, we would expect commodities production figures to be near 35% than 12% of capture production quantities. This suggests that a large proportion of biomass is used domestically and not traded (for example for subsistence or local market use), used for undifferentiated products such as fishmeal, or discarded. Given this, for the purpose of understanding the impact of markets and trade on shark populations the remainder of this section will primarily focus on shark fin products.

3.6 Shark product consumers

Consumption of shark meat has been recorded in literature as early as the fourth century and represents a traditional part of the diet in coastal areas of Asia, Africa, Latin America and the Pacific islands (Vannuccini 1999). Fresh, chilled or frozen shark meat is more marketable than dried shark meat, but requires timely processing to control high levels of urea and bacteria and many artisanal (small-scale traditional) fisheries lack the necessary on-board handling space and freezing facilities (Kreuzer 1993). In Europe, commercial production of shark meat began after the First World War in the form of *schillerlocken* and fish and chips, but it was only with the advent of commercial refrigeration in the 1950s that the consumption of shark meat gained widespread acceptance (Vannuccini 1999). There appears to be a growing demand for shark meat in mainland China, since reported imports of frozen shark meat have expanded four-fold since 1999 (see Table 3.4). However, this may reflect an increasing trend of declaring shark fins as frozen shark meat, or an expanding market for shark meat, or both.

Notwithstanding that shark fins have been a traditional element of Chinese haute cuisine for centuries (Rose 1996), during the Mao Zedong and early Deng Xiaoping eras consumption was either discouraged by policies of cultural reform or priced beyond the reach of all but the wealthiest consumers (Cook 1990). Due to a resurgent Chinese economy, more relaxed social norms and current population growth of approximately 10 million/year (FAO 2005), a large number of consumers are sampling shark fin for the first time. In addition to its popularity as a requisite component of wedding banquets and other celebratory events, the connection between shark fins and beliefs about health and vitality play a role in market demand, particularly among the older generation. At the same time the discovery of contaminants in shark fin, including hydrogen peroxide and the carcinogen formaldehyde (which are believed to be used as bleaching or finishing agents: Anon. 2004b; Clarke 2004a) and high levels of mercury (US Government 2004; Dickman *et al*. 1998), received wide coverage by local media and may have some effect on reducing demand. Since there is no branding of shark fin goods, consumers judge both the prestige and tonic properties of the product by the length, thickness and texture of the ceratotrichia or fin needles, believing that the better quality ceratotrichia derive from the larger and more powerful sharks. In Japan mixing of artificial shark fin with real loose shark fin needles is allowed as long as at least 10% of any product labelled as shark fin is real shark fin. However the use of artificial shark fins in traditional Chinese society is usually objectionable and thus covert. To ensure value for money, knowledgeable Chinese consumers choose products in which the fin needles are still in their original configuration, i.e. a chevron, and avoid canned or loose fin needle items (Clarke unpublished data).

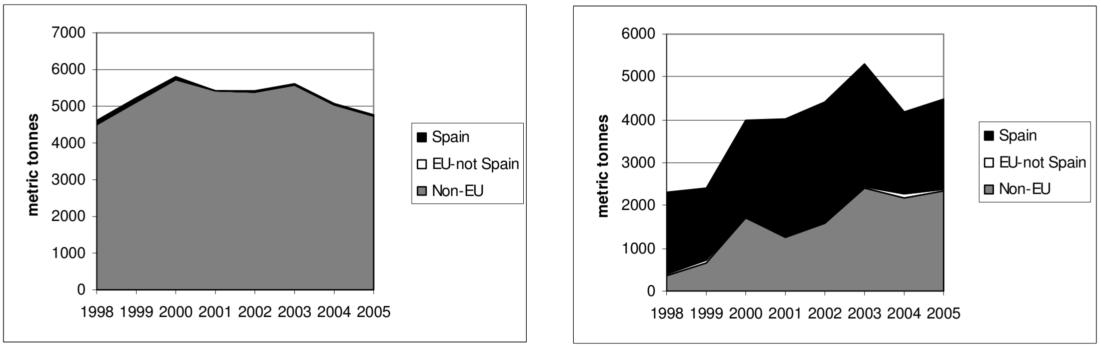
3.7 Shark fin producers and exporters

Throughout 2000, Hong Kong handled one-half to two-thirds of global trade in shark fins (Clarke 2004a). In recent years imports to Hong Kong have declined, although the shark fin trade in mainland China is expected to increase continuously (Clarke 2004b). Hong Kong may no longer control the majority share of world trade but its continuing entrepôt (a port where merchandise can be imported and re-exported without paying import duties) status in combination with its straightforward and duty-free customs system still represents the most useful point of global shark fin trade monitoring (Clarke 2004a; 2004b).

From 1998 to 2000, Spain, Indonesia, the United Arab Emirates (UAE), Taiwan and Japan comprised the top five countries importing shark fins to Hong Kong. (UAE's large imports include fins originally imported from several east African and Arabian States.) However, in recent years (2001–2005), imports from mainland China (reflecting cross-boundary trading with Hong Kong, not catches) and Taiwan have overtaken all other countries, while imports from Spain (which dropped from the top importer to the third largest), Indonesia and Japan have declined. Brazilian and Costa Rican imports are now among the top ten sources of supply to Hong Kong (Anon. 2006b).

Import growth of 5% *per annum* to Hong Kong through 2000 has recently levelled off, but this more likely reflects an increasing direct trade with mainland China than a decline in demand for shark fins. The previous trend of growing demand for shark fins appeared to be tracking the increase of disposable income in mainland China as well as recent cycles in the regional and global economy (Clarke 2003).

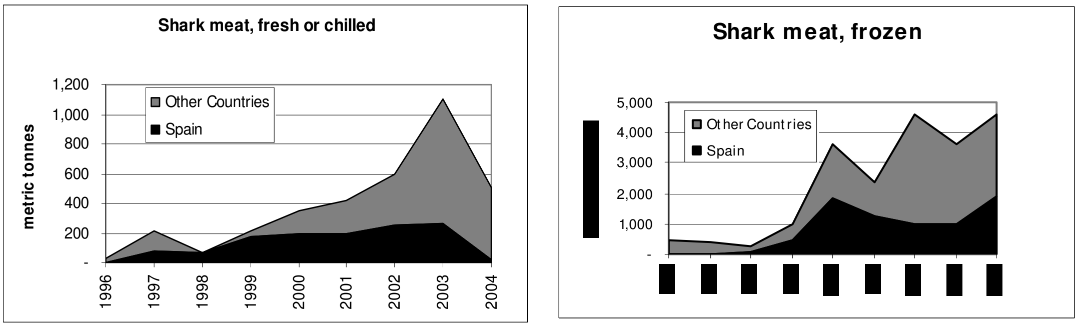
Clarke and Mosqueira (2002) reported that as of 1999 Hong Kong recorded imports of shark fin from at least 85 countries. As of 2005, this figure stands at 83 countries (Anon. 2006b). Most of the EU's contribution to both dried and frozen shark fin imports to Hong Kong derives from Spain (see Figures 3.3a and 3.3b). In the case of dried fins, however, the overall EU contribution is very small, ranging between 0.3 and 2.2% of total imports from 1998–2005 (Anon. 2006b). In contrast, China's imports of frozen shark fins from the EU range from 83% in 1996 to 47% in 2005 (95–100% of this derives from Spain (see Figure 3.3b) (Anon. 2005).



a) Dried unprocessed shark fins **b) Frozen unprocessed shark fins**

Figure 3.3. Shark fin imports to Hong Kong 1996–2005, showing the proportion of imports deriving from non-EU countries, EU countries other than Spain, and Spain, for a) dried unprocessed shark fins and b) frozen unprocessed shark fins. (Anon. 2006b)

It is difficult to assess Spain's role as a contributor to the mainland China market for shark products due to the commodity coding issues identified above. However Spain's share of frozen shark meat imports has grown in the past few years until it is now more than 40% of the total (see Figure 3.4). At the same time Spain's role in supplying dried shark fins (the only shark fin commodity recorded by mainland China) has decreased since 2000 and is now negligible (see Figure 3.5) (Anon. 2005). Given the dominant share of Spain in the Hong Kong frozen-fin market and the mainland China regulation in 2000 reclassifying frozen shark fins as frozen shark meat, it is likely that a sizeable portion of the Spanish frozen shark imports to mainland China is fins.



a) fresh or chilled shark meat imports **b) frozen shark meat imports**

Figure 3.4. Mainland China imports of shark meat from Spain and other countries (tonnes) 1996–2004 in a) fresh or chilled and b) frozen form. (Anon. 2005)

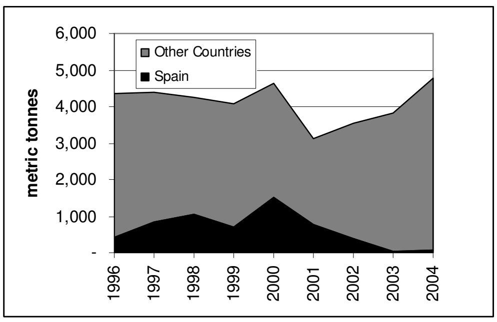


Figure 3.5. Mainland China imports of dried shark fins from Spain and other countries (tonnes) 1996–2004 (Anon. 2005)

3.8 Species composition

Information on species composition in the shark fin trade is limited to one quantitative study of the Hong Kong auction trade (Clarke *et al.* 2006a) and qualitative information based on interviews with traders (Rose 1996; Fong and Anderson 2000). Although there are more than 400 species of sharks, traders in Hong Kong use only 50 categories to describe shark fins (Yeung *et al.* 2000). However the relationship between Chinese market category and shark species is unclear, preventing identification of all species that are included in the trade.

Many of these categories have not yet been mapped to specific taxonomic groups due to access and methodological difficulties (Clarke *et al.* 2006a). However existing information suggests that between 34 and 45% (a 95% probability interval [PI]) and possibly more (because of presence in unstudied categories) of the Hong Kong shark fin auction trade is composed of only 14 species e.g. blue, shortfin, mako, silky (*Carcharhinus falciformis*), dusky (*C. obscurus*), sandbar (*C. plumbeus*), tiger (*Galeocerdo cuvier*), bull (*C. leucas*), oceanic whitetip (*C. longimanus*), great hammerhead (*S. mokarran*), scalloped hammerhead (*S. lewini*) and smooth hammerhead (*S. zygaena*) sharks, and the three species of thresher shark. This finding may reflect the relative abundance of these species in global fisheries, preferential demand for their fins in this market, or a combination of these and other factors (Clarke *et al.* 2006a). The largest component of the trade is believed to be blue shark. This species has been estimated based on Hong Kong auction data to comprise at least 17% of the shark fin market. This finding is consistent with and potentially attributable to the fact that blue sharks form a large proportion of shark bycatch in pelagic longline fisheries. Other taxa, including the shortfin mako, silky, sandbar, bull, hammerhead and thresher sharks, comprised at least 2–6% of the trade.

Prices of shark fins depend on several factors, including fin position, size and quality as well as species origin (Fong and Anderson 2000). Price data from INFOFISH suggests that full sets of oceanic whitetip sharks are more highly valued than blue shark and blue shark are more highly valued than shortfin mako. Observations in Hong Kong auctions indicate that, in general, lower caudal fins are the most valuable fins followed by pectoral and dorsal fins and then all other fins (Clarke 2003).

3.9 Number and biomass of sharks represented in the shark fin trade

Estimates of the total number of sharks annually traded worldwide range from 26–73 million/year (95% PI) with an overall median of 38 million/year. The shark biomass represented by the global fin trade is estimated to lie between 1.21 and 2.29 million t/year (95% PI) with a median of 1.70 million t/year. The median biomass estimate for the global shark fin trade (1.70 million t/year) is more than four times higher than a mid-range estimate of shark landings based on FAO-based figures (0.39 million t) and nearly three times higher than a high-end FAO estimate (0.60 million t/year). Differences between these estimates and the FAO figures may be attributable to factors suppressing FAO landings data, such as unrecorded shark landings, shark biomass recorded in non-chondrichthyan specific categories, and/or a high frequency of shark finning and carcass disposal at sea. In addition, due to the lack of data on domestic production and consumption of shark fins by major Asian fishing entities such as Taiwan and Japan, unless exported for processing and then re-imported these fins are not accounted for within the methodology. Furthermore shark mortality which does not produce shark fins for market, e.g. fishing mortality where the entire carcass is discarded, is also not included. These discrepancies suggest that world shark catches are considerably higher than reported and thus shark stocks are facing much heavier fishing pressures than was previously indicated (Clarke *et al*. 2006b).

Estimates of numbers and biomass in the fin trade were also prepared by species and estimates for one species, the blue shark, were compared to stock assessment reference points (Clarke *et al.* 2006b). Estimates of the number of blue sharks represented in the global shark fin trade suggest that 10.7 million

(95% PI = 4.6–12.6 million) individuals or 360 000 t (95% PI = 200 000–620 000 t) of biomass are utilised annually. These estimates were then compared to extrapolated maximum sustainable yield reference points derived from stock assessments in the Atlantic and North Pacific. Acknowledging the margins of error and the likely downward bias of the trade-based estimates, the comparison to the Pacific reference point suggests that globally blue sharks are being harvested at levels close to or possibly exceeding maximum sustainable yield (MSY). In contrast, the Atlantic reference point suggests catch levels may be less problematic. Given that the MSY reference point is the highest possible catch that could theoretically be sustainable, any catch that approaches or exceeds this level is of concern. Conclusions regarding the sustainable or unsustainable use of other species and thus the shark fin trade as a whole should not be inferred from this blue shark example. Other species common in the fin trade are generally of lower productivity and it is quite likely that sustainable catch levels have already been exceeded in some cases (Clarke *et al*. 2006b).

3.10 Conclusions

Although there is significant under-reporting of trade in shark products, available evidence indicates that the European Union dominates world shark trade activity. Although, according to FAO, reported chondrichthyan landings by the EU represented only 13.5% of world landings in 2004, in 2005 the EU was responsible for 56% of global shark imports and 32% of worldwide exports (although this may be due to better trade records in Europe). The EU (primarily Spain) was also the world's largest single exporter of raw shark fins to Hong Kong from 1998 to 2000. This is likely still the case, although a change in customs codes means that it is now no longer possible to distinguish between imports of frozen shark meat and imports of frozen fins in customs records. The largest component of this trade is believed to be blue shark fins, which comprise at least 17% of the Hong Kong shark fin auction market. Other shark products include liver oil, skins and cartilage.

The demand for and the value and volume of shark products in trade have increased considerably over the past 15 years and continue to rise. Estimates of the total number of sharks traded annually worldwide range from 26–73 million/year (95% PI) with an overall median of 38 million/year. The shark biomass represented by the global fin trade is estimated to lie between 1.21 and 2.29 million t/year (95% PI) with a median of 1.70 million t/year. This is some three to four times higher than indicated by FAO's landings data, and does not include sharks that are discarded at sea or that are wholly processed and utilised domestically (for example those taken by the Japanese and Taiwanese fleets). The conclusions are that shark stocks are facing much heavier fishing pressures than was previously indicated, that it is unsustainable for many shark species, and that EU fleets contribute significantly to this.

Trade studies are very important as a cross-check on production figures for sharks and hence for assessing shark fisheries. Most other businesses around the world provide reliable export statistics, so this would also be expected for the shark trade; greater investment in data collection is required by processing and marketing industries. The following recommendations are therefore made:

- States be encouraged to separate their trade statistics on shark fins and shark meat and frozen and dried fins.
- States be encouraged to implement eight-digit Harmonised System (HS) customs codes for shark products (and to fully utilise existing six-digit codes), with the goal of compiling better more specific trade-flow information.
- Given the importance of the accuracy of China's trade data to understanding the global trade in shark products (especially fins), China be encouraged to rectify its agglomeration of frozen shark meat and frozen shark fins.

- EUROSTAT and FAO trade data for shark products in Europe be compared, with the caveat that the EUROSTAT database often contains data based on six-digit HS customs codes (rather than eight-digit) from the reporting countries and thus comparisons must be done with care. (It is important to be aware of double-counting.)
- A longer-term series of shark fin price data be obtained through INFOFISH and examined. Prices themselves are not of primary concern but trends may provide insight into the overall vibrancy of trade, particularly with regard to supply issues.
- Implement the recommendations of the Convention on International Trade in Endangered Species (CITES) on extending the current six digit codes used by the World Customs Organisation so as to improve the recording of shark fins and other products in trade. This can be done by adopting a simple standardised set of commodity codes for the shark products from both CITES-listed and non-listed species that most commonly enter trade in order to differentiate between fresh/frozen and dried, processed and unprocessed meat and fin products.
- Investigate whether there are any trade data on fins from France, given that the fisheries section of this report has highlighted a possibility of finning activity by French vessels.

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4 Conversion factors and fin to carcass ratios

4.1 Introduction

The goal of fishery statistics is to keep an account of all fish that are taken out of the sea. According to established international standards, official landings statistics are given in 'live' (whole) weight. Total allowable catches (TACs) are also given in live weight. In many fisheries the fish are processed before being landed, so it is not possible to weigh the whole fish ashore. In order to calculate live weight from the landed products, conversion factors have been developed. These factors vary by species and product. Conversion factors should describe the proportion between the live weight of a fish and the weight of the processed product.

Most fish species have isometric growth. This growth can be expressed by the formula:

$$W = C \times L^3 \text{ (L = length, W = round weight, C = constant).}$$

For those fish having isometric growth, the weight ratio between different organs in the fish is constant over all length groups. However, the yield from processing of fish varies by season, fishing grounds, condition, fishing gear, processing equipment and processing techniques. The official agreed conversion factors are often established as the mean of the variations described above.

Conversion factors = RW/PW (RW = round weight; PW = product weight). This factor is a raising factor for landed weight to round weight. In most fisheries and countries the conversion factors are given as raising factors.

However, within the shark finning debate and legislation (see section 5), conversion factors are given as a percentage. In the rest of this section the conversion factors are only given as a percentage.

$$\text{Conversion factors \%} = (PW/RW) * 100$$

For example, if the product weighs 2 kg and the total weight of the fish is 10 kg:

$$\text{Conversion factor (raising factor)} = 5$$

$$\text{Conversion factor \%} = 20\%$$

For many species insufficient data are collected to establish a reliable conversion factor. Often conversion factors are based on small amounts of data and also on data from single areas and seasons. For some species there are no factors at all.

Each national fleet may have different criteria for gutting and dressing the fish. It is therefore necessary to develop conversion factors by species and fleet.

For less important species, factors derived from fish in the same taxonomic group are often used as a surrogate. For some species several products, such as carcass, liver, fins, roe, *etc*., are landed from the same fish. In such fisheries only one of the products should be raised to total live weight. It can very often be difficult to get an overview, since products are landed in different markets and sold to different buyers, such as oil, fins and meat. This problem is especially acute for sharks (see section 2). In order to be able to calculate total landings, it is necessary to use the product that is always landed from the species. For many sharks this product would be the fins.

Since TACs are expressed as live weight, the industry is interested in establishing conversion factors that give the highest yield from their quota. Discussions about conversion factors, therefore, take place in many different fisheries. Since fins are the most important shark product, there has been a debate on the fin ratio in these fisheries. In addition, the managers have started to use the fin to body ratio in the management of shark fisheries.

Council Regulation (EC) N° 1185/2003 on the removal of fins of sharks on-board vessels establishes a general prohibition on the practice known as 'shark finning'. This involves cutting off a shark's fins after it has been brought on-board a vessel and then discarding the rest of the carcass at sea.

The Regulation states:

- "Special fishing permits can be issued to fishing vessels where a capacity to use all parts of the sharks has been demonstrated." Article 4.2(EC) No 1185/2003).
- "The weight of the fins kept from the catch shall never exceed the theoretical weight of the fins that would correspond to the remaining parts of sharks retained on board transshipped or landed." Article 4.4(EC) No. 1185/2003)
- "For the purpose of controlling the application of paragraph 4, the theoretical correspondence between weights of fins and bodies shall be established by Member States, taking into account the type of fishery, the species composition and the type of processing and storage. *In no case shall the theoretical weight of the fins exceed 5% of* ***the live weight*** *of shark catch*." Article 4.5(EC) No. 1185/2003)

In order to evaluate this regulation it is necessary to know the ratio between the weight of the wet fins and the live weight for the different species; it is also important to mention that the finning regulations in other parts of the world use the ratio between wet fins and the processed carcass.

In general it can be stated that relatively little effort has been put into collecting the necessary data for establishing reliable conversion factors for elasmobranch fishes and hence recording good landing statistics for elasmobranch fishes in general.

In order to get a worldwide overview of conversion factors for sharks, information has been compiled. This work can hopefully establish a foundation for establishing better conversion factors and thereby landing statistics for elasmobranch fishes.

The amount of work that has to be done before there are good factors for all exploited elasmobranch species is huge and this report can only be a starting point.

There are several important European fisheries where sharks comprise an important part of the catches. In general, the most important species are blue shark (*Prionace glauca*), porbeagle (*Lamna nasus*), shortfin mako (*Isurus oxyrinchus*), thresher sharks (*Alopias* spp.) and various members of the genus *Carcharhinus*. When discussing the fin to carcass ratio for European shark fisheries it is necessary to look at the factors for these species. Since the factors differ between species, in theory the species composition in the different fisheries will determine the correct fin ratio to apply. However, cutting practices vary so much that the discrepancies in fin ratios for a single species between different vessels in the same fleet can be as large as the variation between different fleets. In practice, it would be very difficult to implement and enforce different fin ratios for different fisheries.

Figure 4.1 illustrates various stages in processing blue sharks in order to produce fin and meat products. Figure 4.2 illustrates some different fin cutting practices.

Figure 4.1. Stages in the onshore processing of blue shark (*Prionace glauca*). (All photos: J. Martinez, Ecuador.)

a) Shark landed gutted with head and fins on.
b) Gutted and beheaded sharks, fins on.
c) Dressed carcass, fins, head and gut removed.
d) Skinned carcasses.

Figure 4.2. Illustrations of different shark fin cutting practices. (All photos © Oceana)

a) Removal of lower caudal fin lobe only (Peru).
b) Entire caudal fins removed (Spain).
c) Removal of excess flesh from crudely cut fins before exporting fins from Spain to East Asia.

4.2 Porbeagle (*Lamna nasus*)

There are established conversion factors for different products from different countries for porbeagle (see Table 4.1). However, the results are not consistent.

Table 4.1. Porbeagle (*Lamna nasus*) conversion factors used in different countries for different products.

Product	Country	FAO area	Fin type	FW/ RW %	DW/ RW %	FW/ DW %	Source	Sample size
Fresh/chilled	France	-	-		96.15		FAO	-
Fresh/chilled	Portugal	-	-		100.00		FAO	-
Mean					**98.08**			-
Fresh/chilled, gutted	Denmark	-	-		75.19		FAO	-
Fresh/chilled, gutted	Faeroe Is.	-	-		90.09		FAO	-
Fresh/chilled, gutted	France	-	-		75.19		FAO	-
Fresh/chilled, gutted	Germany	-	-		75.19		FAO	-
Fresh/chilled, gutted	Norway	-	-		90.91		FAO	-
Fresh/chilled, gutted	Portugal	-	-		89.29		FAO	-
Frozen, gutted	Germany	-	-		79.37		FAO	-
Frozen, gutted	Portugal	-	-		79.37		FAO	-
Mean					**81.82**			
Fresh/chilled, gutted, head off	Norway	-	-		76.92		FAO	-
Fresh/chilled, gutted, head off	Portugal	-	-		75.19		FAO	-
Fresh/chilled, gutted, head off	Sweden	-	-		80.00		FAO	-
Frozen, gutted, head off	Germany	-	-		69.44		FAO	-
Frozen, gutted, head off	Norway	-	-		76.92		FAO	-
Mean					**75.70**			
Frozen fillets	Germany	-	-		38.61		FAO	
Wet fin round weight	-	-	-	2.19			US-FMP 1993	-
Wet fin round weight	-	-	-	2.22			Clarke 2006	-
Wet fin round weight	US	21	Primary	2.19			Casey, NMFS/NEFSC	1
Wet fin round weight*	Canada	21	Primary	2.16			Campana 2004	619
Wet fin round weight	NZ	81		2.22			NZ MFish Regulation	
Mean				**2.20**				
Wet fin dressed weight	Canada	21				3.60	Cortes & Neer 2005	

*Ranges from mean 1.8% in a 100 cm shark to mean 2.8% in a 260 cm shark. Individual values range from 0.7–4.0%.

DW/RW (Dressed Weight – gutted (head on)/Round Weight)

For gutted fish there is a cluster at 75–79% and 90–91%. Most probably the former are developed from gutted and headed fish.

DW/RW (Gutted (head off)/Round weight)

The conversion factors vary between 70 and 80% (mean: 75.7%).

FW/RW (Wet fins/Round weight)

Three conversion factors from US fisheries are available and they vary between 2.19 and 2.20% (mean: 2.20%). Campana (pers comm.. 2004) provided the following relationship between fin weight (FW) and shark total weight (TW): TW = 10.8 + 35.4*FW $r2=0.90$ $n=619$. "However, the ratio of fin weight to total weight is not constant, ranging from a mean of about 1.8% in a 100-cm porbeagle to a mean of 2.8% in a 260-cm porbeagle. Individual values range from 0.7 - 4.0%. The overall mean ratio is

2.16%. …Significant variation [was] associated with the fishing vessel: some crews trimmed considerably more off of their fins than did others."

FW/DW (Fin/Dressed weight)

Cortes and Neer (2005) give information on a FW/DW ratio of 3.6%, based on Campana *et al.* (1999) and Campana (unpublished). In addition, FW/DW ratios are calculated (Table 4.2) from the FW/RW conversion factors in Table 4.1 by this formula: **FW/DW =($^{FW/RW}/_{DW/RW - FW.RW}$)*100**

Table 4.2. Porbeagle (*Lamna nasus*): FW/DW ratio for different dressing methods calculated from US conversion factors given in Table 4.1.

Dressed product	FW/RW %	DW/RW %	FW/DW %
Fresh chilled	2.20	98.08	2.29
Fresh/chilled or frozen, gutted	2.20	81.82	2.76
Fresh/chilled, gutted, head off	2.20	75.70	2.99
Frozen fillets	2.20	38.61	6.04

For porbeagle, the FW/RW is 2.2%, which is less than half the upper limit of 5%. For this species, it is possible to discard 50% of the carcasses and still be able to comply with the regulation. All calculated FW/DW ratios for this species are well below 5%, apart from when the meat is landed as fillets.

4.3 Blue shark (*Prionace glauca*)

This species is the most dominant in the European pelagic fisheries. Conversion factors for DW/RW, FW/RW and FW/DW are available (see Table 4.3).

DW/RW (Dressed weight/Round weight)

For gutted fish from French fisheries the DW/RW is 75.19%. There is also a factor for landed round weight to live weight (96.15%). This factor most probably means that there is a 4% reduction in weight because of lost moisture.

FW/RW (Wet fin/Round weight)

The ratios vary between 2.08 and 6.6%. The results can be divided into two clusters. Five references calculated the ratio to be in the range 2.08 to 2.16 %; three authors give ratios in the range 6.0 to 6.6%.

FW/DW (Wet fin/Dressed weight)

We have only one source of information on FW/DW from Europe (Mejuto and Garcia 2004) and their factor is much higher than that from other sources (14.72%). The high FW/RW factor found by Santos and Garcia (2004) in Portuguese fisheries supports the high FW/DW factor in European fisheries.

The highest group of fin ratios is derived from European fisheries, and the lowest are from American fisheries. ICCAT (2005) explains these differences: "The fins landed from the US fleet generally consist of the primary fin set [in order of value–see end of section 3.8: lower caudal fin lobe, two pectoral, and first dorsal], whereas in the case of the European fleets it includes all the fins, including the entire tail". The smallest ratios are thereby calculated from only primary fins. As noted below, however, it seems highly likely that the difference is also influenced significantly by different cutting practices; the European fleet leaves more meat attached to fins than do US fishers.

Table 4.3. Blue shark (*Prionace glauca*) conversion factors used in different countries for different products.

Product	Country	FAO Area	Fin types	FW/ RW %	DW/ RW %	FW/ DW %	Source	Sample size
Fresh/chilled	France	-	-	-	96.15	-	FAO	-
Fresh/chilled, gutted	France	-	-	-	75.19	-	FAO	-
Wet fin, round weight	US	21, 31	Primary	2.16	-	-	Baremore *et al*., in prep.	65
Wet fin, round weight	US	21	Primary	2.06	-	-	Casey, NMFS/NEFSC 1992	52
Wet fin, round weight	-	-	-	2.06	-	-	US-FMP 1993	-
Wet fin, round weight	-	-	-	2.16	-	-	Baremore et al 2005	-
Wet fin, round weight	-	-	-	2.08	-	-	Clarke 2006	-
Wet fin, round weight	NZ	81	-	2.08	-	-	NZ MFish Regulations	-
Wet fin, round weight	Spain	-	All fins	6.53	-	-	Mejuto & Garcia 2004	-
Wet fin, round weight	NW Pacific	-	All fins	6.00	-	-	Gordievskaya 1973	-
Wet fin, round weight	Portugal		All fins	6.66	-	-	dos Santos & Neves 2004	-
Wet fin, dressed weight	-	-	-	-	-	3.74	US-FMP, 1993	-
Wet fin, dressed weight	-	-	-	-	-	4.46	Baremore *et al*. 2005	-
Wet fin, dressed weight	US	21	Primary	-	-	3.74	Casey, NMFS/NEFSC 1992	8
Wet fin, dressed weight	Spain	-	All fins	-	-	14.72	Mejuto & Garcia 2004	-
Wet fin, dressed weight	Portugal	34	All fins	6.56			dos Santos & Garcia 2004	99
Dry fin, dressed weight	US	21	Primary	-	-	1.07	Casey, NMFS/NEFSC 1992	8
Dry fin, round weight	US	21	Primary	0.60	-	-	Casey, NMFS/NEFSC 1992	28

The FW/RW ratio for blue shark is found to be between 6.0 and 6.66% in European fisheries, slightly more than the maximum allowed limit of 5%. This corresponds to a FW/DW of 14–15%; considerably higher than in US fisheries, where a fin to carcass ratio of below 5% is found to be appropriate.

Table 4.4 compares fin weight to whole weight ratios for the blue shark primary fin set only (pectoral fins, first dorsal fin and lower caudal fin, see Figure 4.3), using the values for different fin types provided in dos Santos and Garcia (2004), compared with the values for the primary fin set from US vessels (Table 4.3). In order to do so, it is estimated that the lower caudal fin lobe, which is one of the primary fins retained in the US fishery, comprises approximately 1/3rd of the whole caudal fin weight, and that the first dorsal comprises approximately 2/3^{rds} of the weight of both dorsal fins as reported by dos Santos and Garcia (2004). These estimates require confirmation.

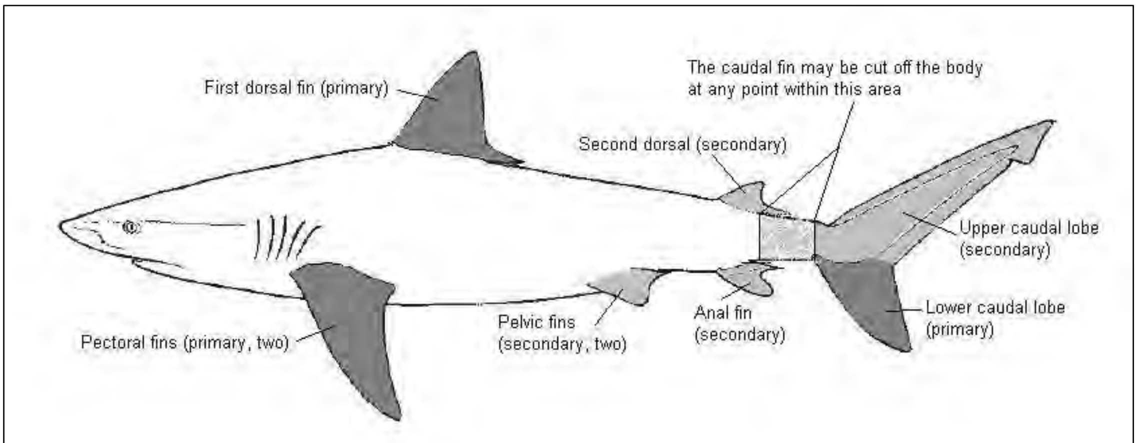

Figure 4.3. Primary and secondary shark fin sets. (Graphic: S. Fowler)

It appears from this analysis that the higher ratios obtained in the European fleets do not arise solely from the inclusion of the smaller fins (pelvic, anal and second dorsal, which together represent only about 0.679% of total weight) and the entire caudal fin, but are also influenced by different cutting practices.

Thus, the estimated mean weight ratio for the primary fins retained by the Portuguese fleet, at 3.802%, is almost twice the weight ratio of 2.06% for the same set of fins retained by the USA fleet. Indeed, the two pectoral fins alone exceed the weight of all four primary fins retained in the USA Atlantic shark fishery. This is most likely due to the observed practice of Portuguese and Spanish fishers leaving more meat attached to the fins than is common in USA fleets. Indeed, it appears from Table 4.4 that the excess meat left attached to the primary fin set alone may represent as much as 1.7% of whole weight (close to the weight of the fins themselves). This meat is of no value and is trimmed off by fin buyers before the fins are shipped out of Europe (Figure 4.2). If this meat was removed from both the primary and secondary fins before weighing, the total weight of fins would fall well below the EU mandatory 5% ratio. An additional 2% of whole weight is likely represented by the upper caudal lobe and caudal peduncle.

Furthermore, the fin:dressed carcass (FW/DW) ratio will also be increased significantly if less of the carcass is retained, for example if part of the precaudal tail (between the pelvic and caudal fins) or the epaxial muscles (above the gill arches) is also discarded. The FW/DW ratio is the most important for the implementation of finning bans, since it is needed in order to assess compliance with the regulation.

Table 4.4. Blue shark (*Prionace glauca*) conversion factors for different fin sets in different countries (adapted from dos Santos and Garcia 2004 and NMFS 1993).

Relationship	Sample size	Country	Source	Mean % of fin weight	Mean % primary fins	Mean % secondary fins
Primary fins						
RW : all primary fins	52	USA Atlantic	Casey, NMFS/ NEFSC 1992	2.06	2.06	n/a
RW : First dorsal fin (est. 2/3rd of both dorsals)	66	Portugal	dos Santos & Garcia 2004	0.442	3.802	
RW : Pectoral fin	66	Portugal	«	2.319		
RW : Lower caudal lobe (est. 1/3rd whole caudal fin)	66	Portugal	«	1.041		
Secondary fins						
RW : Pelvic fin	66	Portugal	«	0.354		2.761
RW : Anal fin	66	Portugal	«	0.104		
RW : Second dorsal (est. 1/3rd of both dorsals)	66	Portugal	«	0.221		
RW : Upper caudal lobe (est. 1/3rd whole caudal fin)	66	Portugal	«	2.082		
RW : All fins	99	Portugal	«	6.564		

4.4 Shortfin mako (*Isurus oxyrinchus*)

This species is one of the three most important shark species in European shark fisheries.

DW/RW (Dressed weight/Round weight)

Factors for fresh, gutted and gutted, headed sharks are available from the FAO, based on Norwegian data. The results are 87% and 77%, respectively (Table 4.5).

FW/DW (Wet fin/Dressed weight)

Mejuto and Garcia (2004) give a ratio of 5.81% from European fisheries based on retaining all fins.

FW/RW (Wet fin/Round weight)

Conversion factors are available from different areas and are relatively consistent. There are, however, no data available from European fisheries. The factors vary between 1.68 and 1.77%. All data are based on primary fins and so are probably not representative for European fisheries for the reasons explained above for blue sharks.

The wet fin/round weight ratio for European fisheries for this species can be calculated by using the DW/RW ratio and the WF/DW ratio.

Table 4.5. Shortfin mako (*Isurus oxyrinchus*) conversion factors used in different countries for different products

Product	Country	FAO area	Fin types	FW/ RW %	DW/ RW %	FW/ DW %	Source	Sample size
Fresh/chilled, gutted, head off	Norway	-	-	-	76.92	-	FAO	-
Fresh/chilled, gutted	Norway	-	-	-	86.96	-	FAO	-
Wet fin, round weight	US	21, 31	Primary	1.77	-	-	Baremore *et al.*, in prep.	46
Wet fin, round weight	US	21	Primary	1.68	-	-	Casey, NMFS/NEFSC	28
Wet fin, round weight	-	-	-	1.76	-	-	Baremore *et al.* 2005	-
Wet fin, round weight	-	-	-	1.68	-	-	US-FMP 1993	-
Wet fin, round weight	-	-	-	1.69	-	-	Clarke 2006	-
Wet fin, round weight	NZ	81		1.7			NZ MFish Regulations	
Wet fin, dressed weight	US	21	Primary	-	-	4.22	Casey, NMFS/NEFSC	5
Wet fin, dressed weight	-	-	-	-	-	4.22	US-FMP 1993	-
Wet fin, dressed weight	-	-	-	-	-	2.99	Baremore *et al.* 2005	-
Wet fin, dressed weight	Spain	-	All	-	-	5.81	Mejuto & Garcia 2004	
Dry fin, dressed weight	US	21	Primary	-	-	1.01	Casey, NMFS/NEFSC	4
Dry fin, round weight	US	21	Primary	-	-	0.70	Casey, NMFS/NEFSC	17

For shortfin mako the fin/round weight ratio in US fisheries is well below 5%. In European fisheries the ratio is also below 5%.

4.5 Smooth hammerhead (*Sphyrna zygaena)*

This is one of the species that is regularly caught in European shark fisheries, but in small quantities.

We have only found conversion factors from fin weight to round weight and no factors for fin weight: carcass weight. Since there is no information available on conversion factors for carcass weight to round weight, it is not possible to calculate this ratio.

Table 4.6. Smooth hammerhead (*Sphyrna zygaena)* conversion factors used in different countries for different products.

Type	Country	FAO area	Fin types	FW/ RW %	DW/ RW %	FW/ DW %	Source	Sample size
Wet fin, round weight	-	-	-	1.49	-	-	US-FMP 1993	-
Wet fin, round weight	-	-	All fins	8.38	-	-	Mejuto & Garcia 2004	381
Wet fin, round weight	US	21	Primary	1.49	-	-	Casey, NMFS/NEFSC	1
Dry fin, round weight	US	21	Primary	0.74	-	-	Casey, NMFS/NEFSC	1
Wet fin, dressed weight	US	21	Primary	-	-	-	Casey, NMFS/NEFSC	-
Dry fin, dressed weight	US	21	Primary	-	-	-	Casey, NMFS/NEFSC	-

4.6 Deep-water sharks

The deep-water shark fisheries are targeting the leafscale gulper shark (*Centrophorus squamosus*) and Portuguese dogfish (*Centroscymnus coelolepis*). In the deep-water gillnet and longline fisheries (except in

Portugal) the fish are landed as frozen products with mainly skinless backs (Figure 4.4). In the French, Scottish and Irish deep-water trawl fisheries the sharks are landed gutted with all fins still on. In the Spanish deep-water trawl fishery in the Hatton Bank area the sharks are landed as frozen skinless backs.

The deep-water gillnet and longline vessels land the backs of leafscale gulper shark and Portuguese dogfish. They also land some of the biggest longnose velvet dogfish (*Centroscymnus crepidater*) and some birdbeak dogfish (*Deania calcea*). However most of them are discarded, although no information is available on the discards from these fisheries. Most probably all the black dogfish (*Centroscyllium fabricii*) are discarded.

As far as we know, only in recent times have the fins of deep-water sharks been landed. Anecdotal evidence from one gillnet vessel stopped in Scotland earlier this year suggests that only caudal fins are landed. However the caudal fins are taken from all the deep-water sharks, not only the target species.

The caudal fin/RW ratio is very similar for all species. For the two target species (leafscale gulper shark and Portuguese dogfish) the ratio is 1.7 and 1.5%, respectively. This is well below the 5% ratio. If all fins are landed, the FW/RW ratio for the two target species is 3.8 and 2.0%, also well below 5%. When the sharks are processed at sea, the FW/DW ratio for skinless back will be 6.5 and 6.6% for the two target species, based on the ratios for caudal fin/RW and skinless backs/RW in Table 4.7.

Table 3.7. Conversion factors (%) for deep-water sharks (Kjerstad *et al.* 2003).

	Caudal fin/RW	Other fins/RW	All fins/RW	Skinless back/RW	Caudal fin/DW
Leafscale gulper shark	1.7	3.8	5.5	26.1	6.5
Portuguese dogfish	1.5	2.0	3.5	22.9	6.6
Black dogfish	1.5	3.4	4.9	23.5	6.4
Longnose velvet dogfish	1.8	4.0	5.8	23.1	7.8
Birdbeak dogfish	1.6	5.4	7.0	31.5	5.1
Mean	1.6	3.7	5.3	25.4	6.4

Figure 4.4. Some deepwater sharks are processed on board and the fillets frozen. (Photo: Nils Hareide)

4.7 Fin ratios in European fisheries

Fin ratios (FW/RW) are available from only a small part of the European fisheries, namely the Portuguese and Spanish fisheries in the Northeast Atlantic and deepwater fisheries. The ratios are summarised in Table 4.8, below. For all species except blue shark and smooth hammerhead, the FW/RW ratio is below 5%. These will be the highest FW/RW ratios allowed for these species (Article 4.4(EC) No 1185/2003). As noted in section 3.3 above, the FW/RW ratio for blue sharks would fall to well below 5% if the primary fins were cut to remove excess meat, as is the practice in the US fleet, even with the whole caudal fin and the secondary fins retained. The same may be true for the smooth hammerhead.

Table 4.8. Conversion factors (FW/RW) from European fisheries.

Species	FW/RW
Porbeagle (US)	2.20
Blue shark	6.67
Shortfin mako	3.90
Smooth hammerhead	8.38
Deep-water sharks	1.60

For mixed landings of sharks the theoretical weight of the fins combined shall not exceed 5% of the live weight of shark catch (Article 4.5(EC) No. 1185/2003). In order to validate this ratio it is necessary to know the species composition in the different fisheries. The data on species composition is very poor for all European fisheries (see section 2) and it is therefore not possible to do a realistic assessment on the data available. Some information is available on the fins most commonly entering international trade; this is described in section 3. The two dominant species in pelagic fisheries are the blue shark (83%) and the shortfin mako (10% (see Table 4.9). The mean FW/RW ratio for this species composition is calculated as 6.4%, based on cutting practices described for the Spanish and Portuguese fleets.

For deep-water sharks, however, a reliable FW/RW factor of 1.6% can be used.

Table 4.9. Catch composition (%) of sharks in some European fisheries.

	Catch composition %		
Species	**Spanish longlines**	**Japanese longlines**	**Portuguese longline**
Porbeagle (US)			
Blue shark	81	84	80–85
Shortfin mako	9	10.8	Approx. 10
Smooth hammerhead			

The European ratios are significantly different to the ratios found in the Northwest Atlantic for the same species. There is no reason to believe that the morphology of sharks differs between these two areas (indeed they share the same blue shark and shortfin mako stocks). The differences indicate that fleets are not using the same fins, or the same parts of the fins, or the same dressing criteria, or all of these factors.

The main difference seems to stem from the fact that the Spanish and Portuguese fleets are using all the fins and are cutting ‘deeper’ (leaving more meat on the fins). In addition, the European fleets utilise the whole caudal fin rather than the lower lobe only.

The results show that it is necessary to carry out more studies of this type to confirm these interim conclusions. However, it will take a long time to establish reliable factors for even the most important species. The factors also have to be revised every time the fleets change their dressing criteria, which they do in order to adjust to market changes or to get around management measures. The monitoring and enforcement of different ratios for different fleets and different species would also be impractical, particularly where shared stocks are fished by different fleets and a common approach to management and monitoring is essential.

To avoid these problems it is recommended that fisheries land all sharks with the fins attached.

4.8 Conclusions

Most finning regulations mandate a simple conversion factor between the weight of shark fins and the weight of the remainder of the body brought to the dock, verifying that all fins have a body to match, in an attempt to ensure that finning does not take place. Difficulties arise when conversion factors vary between fisheries, often because of different processing techniques, and the highest ratios drive the regulations. Discrepancies arise from keeping different numbers of fins from each carcass and/or cutting sharks differently when removing the fins so that more or less shark meat is left attached. For example, the fin:carcass ratio for blue sharks taken in US and Canadian Atlantic fisheries is about 2% of fin to whole weight or 5% of fin to dressed (headed and gutted) carcass weight. Portuguese and Spanish fleets fish the same blue shark population, but report ratios that are three times larger (over 6% and 15% respectively). This fishery may not be representative of all EU fisheries and fisheries in European waters (for example, the FW/RW factor for deep-water sharks is 1.6%).

Overall, the fin weight to round weight (FW/RW) factor for the European mixed pelagic shark fishery seems to average around 6%, based on the available information and influenced by the high proportion of blue sharks in the fishery. This conversion factor is based on the cutting of fins in Spanish and Portuguese pelagic longline fisheries and is higher than that obtained by other fleets and that specified in the EU Shark Finning Regulation for two main reasons. Firstly, Spanish and Portuguese longline fleets retain small low value secondary fins that are discarded in other fisheries, including the entire tail of each shark, instead of just the high value lower caudal lobe that is used in shark fin soup. Secondly, the fins are cut so as to leave significant weights of meat still attached, which is later removed and discarded before processing. This meat may make up as much as one third of the reported 'fin weight'. Keeping the whole tail also significantly increases the weight of the 'fins' because it includes part of the vertebral column and other tissues (likely another one third of the total fin weight). Some fin traders air-freight high value shark fin (including lower caudal lobes) to East Asia, but send the rest of the tail by low cost sea-freight because they will be processed into lower value products.

Given the above, there is scope for European pelagic shark fisheries to improve their fin cutting practices and reduce the FW/RW ratio to one that is very close to those obtained in the West Atlantic without making processing on board more difficult or reducing the economic return from the fishery by discarding secondary shark fins.

There are many problems connected to the EU Shark Finning Regulation, but the basic problem is associated with the use of conversion factors. Further complications arise because although the Regulation specifies the FW/RW, it is only applied when processed fish are landed and this ratio can no longer be observed. It is therefore necessary to back-calculate the round weight from dressed weight. The fin weight to dressed weight factor is not specified in the Regulations, although it is the most important ratio for assessing compliance. These calculations add insecurity to the results.

To estimate a more appropriate conversion factor it is necessary to have:

1. better information on the processing/cutting of fins in different fleets;
2. more measurements of conversion factors;
3. better information on fisheries and catch compositions.

In practice, however, cutting practices vary considerably and dressing criteria can change very rapidly (for example as a result of changing market demand, or as fishers discover new ways to get around the management measures in force and hence to increase the profitability of their fishery). This means that conversion factors may need to be revised regularly in response to complaints that they are inappropriate, but it would be difficult to ensure that any such revisions reflect true practices while still ensuring that finning does not occur. It would also be very difficult to implement and enforce different fin ratios for different fisheries.

Until better information is available that addresses these concerns, the only two ways to enforce the EU Finning Regulation are either to land all sharks with their fins on or to have observers on all vessels.

The workshop therefore recommended that all sharks from all fisheries be landed with their fins still attached. This would not be too burdensome for the industry, because many onshore processing facilities already deal with whole sharks, and any port that can handle shark carcasses can also handle shark fins. It is also possible to use a partial cut to fold fins next to the carcass for freezing, as has been demonstrated in States where a whole landings policy has been adopted.

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5 Finning: a fisheries management problem

5.1 Introduction

Finning is widely defined as the removal and retention of shark fins and the discard of the remainder of the carcass at sea. It takes place because during the past two decades shark fins have become one of the most valuable of all fisheries product (section 3), while other shark products (meat, liver oil and cartilage) are of low value. Shark fins are also low-volume products and very easy to store dried or frozen for long periods, whereas it is difficult to store shark meat in good condition unless it has been frozen because the flesh contains high levels of nitrogen compounds that can cause rapid spoilage. The removal of fins from a landed shark during processing is not shark finning.

Finning is known to take place in large-scale fisheries (e.g. by a fleet of 120 Taiwanese and Indonesian vessels in the Indo-Pacific Ocean (Anon. 2005)) that target sharks solely for the utilisation of their fins. Finning also occurs on a large scale in fisheries primarily targeting other species, but which also take large numbers of sharks as bycatch. Indeed, in many cases the level of shark bycatch may exceed the catch of the target species (Ayres *et al*. 2004) and the distinction between target and bycatch species is disappearing (Stevens *et al*. 2005). Pelagic longline and purse seine fisheries for swordfish and tuna may, for example, practice finning when vessels spend long periods at sea and hold-storage limitations or low market demand for meat mean that it is not economically viable or practical for bycaught sharks to be retained. Fins, however, can easily be retained and may represent a significant part of the income for crew or vessel owners (McCoy and Ishihara 1999). Major discrepancies between reported shark catches and the volume of shark fins in trade (Clarke *et al*. 2006) suggest that the finning and discard of carcasses at sea is widespread. The quantity of blue shark fins exported from the International Council for the Conservation of Atlantic Tunas (ICCAT) area to Hong Kong greatly exceeds shark catches estimated from observer data on ratios of shark to tuna, while the latter in turn also exceeds shark catches reported to ICCAT (Anon. 2004a). The EU is one of the world's largest single producers of shark fins.

Despite being associated with considerable waste, finning *per se* would not pose a risk to shark populations were it not being undertaken at levels that cause stock depletion. Unfortunately, however, even fully-utilised shark fisheries have generally been unsustainable unless carefully managed, very few shark populations are managed, and many are seriously overfished. Even relatively small-scale, closely managed target fisheries, such as the Canadian porbeagle (*Lamna nasus*) fishery, struggle to achieve sustainability (Campana *et al*. 2002; DFO 2005). Finning, whether in target or bycatch fisheries, is particularly damaging to shark stocks because there are very few technical or vessel-capacity constraints to limit this very significant source of mortality. Market demand for shark fins is also rising steeply at 5% *per annum* (Clarke 2004) and, because shark fin soup is an important traditional and cultural luxury commodity in Asian cuisine, demand is unlikely to be affected by rising prices as supplies decline.

In addition to its inherently unsustainable nature, shark finning also raises ethical and socio-economic concerns because the discard of the shark carcasses represents significant waste. An important source of protein is lost, together with the associated benefits that could arise from processing shark carcasses on-shore. As stated by the European Commissioner for Fisheries and Maritime Affairs (J. Borg 2007): *"Discarding is wrong because it represents a waste of precious marine resources. Therefore, it makes no ecological, economic or ethical sense."* The potential ecological impact of removing shark populations is uncertain, but may be dramatic and undesirable (potentially threatening yields of other commercially important fisheries [Stevens *et al.* 2005]). Finally, finning impedes the collection of the species-specific scientific data that are essential for monitoring catches and landings and implementing sustainable shark fisheries management (as required under international agreements and statutes).

5.2 Regulation of finning

In recognition of these problems, several countries and regional fisheries management organizations (RFMOs) have adopted finning bans. In addition to the EU, these include most Australian states and Australian federal waters, Brazil, Canada, Cap Verde, Costa Rica, Ecuador, El Salvador, Egypt, Mexico, Namibia, Nicaragua, Oman, Palau, Panama, Seychelles, South Africa, the USA (Stone *et al.* 1998), ICCAT, GFCM, IATTC, IOTC, NAFO, NEAFC, SEAFO, and WCPFC.

The UN FAO International Plan of Action for the Conservation and Management of Sharks (IPOA–Sharks) was adopted by the November 1999 FAO Conference (FAO 1999). The IPOA builds upon the FAO Code of Conduct for Responsible Fisheries. It provides a valuable framework for data collecting and information sharing, as well as making recommendations for developing national Shark Plans. Paragraph 22 of the IPOA sets out recommendations for the aims of such Plans, including two indirect references to the need to prevent finning:

- “Minimize 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.”

5.3 Implementing a shark finning ban

Three potential methods of achieving a shark finning ban have been discussed, if not implemented, internationally. These are to keep the fins attached to carcasses until they have been landed, or if fins may be detached on-board, to set either the maximum number of fins per carcass or the maximum weight ratio of fins to carcass weight that may be landed.

5.3.1 Fins must be attached to the shark carcass until landed

Requiring fins to be landed still attached to each carcass is the basis for the finning bans in some Australian states, Costa Rica, El Salvador, Oman, South Africa (for sharks taken in South African waters), Panama (for industrial fisheries), and the EU. This form of regulation has several advantages: it is extremely easy to enforce and monitor (any detached fin is illegal); it makes species-specific monitoring of landings much easier; and it has been found to increase the overall value of fins and carcasses processed on-shore (whole shark landings are required by Australian shark processors and by European porbeagle shark buyers). One disadvantage is that it makes freezing and the subsequent handling of frozen sharks difficult and may prevent the filleting of shark carcasses on-board. Costa Rican fisheries use a partial cut to lay the fins flat along the shark carcass to overcome these issues, and El Salvador’s Regulation requires that fins must remain attached to the carcass by at least 25% of their base. This would not be feasible if processing into skinned fillets is undertaken on-board the vessel. The EU Finning Regulation enables fishing vessels to apply for a derogation (special fishing permit) when processing on-board is being undertaken and there is justification for removing fins on board.

5.3.2 Maximum permitted number of detached fins to be landed with each carcass

This option was discussed during the consultation prior to the enactment of the US Finning Act (Anon. 1993). The suggestion that a maximum of five detached fins should be landed with each shark carcass was rejected for several reasons, including the potential for large fins from large sharks to be retained alongside small shark carcasses (high grading), that fisheries might wish to land other small (secondary) fins rather than just the largest primary fin set, and that it would be hard to enforce at landing sites (because it would be necessary for every fin and every carcass to be counted). This method has not been used to implement any known finning ban.

5.3.3 Maximum permitted fin/body weight ratio

This is the most widely used means to enforce finning bans through national legislation and is also mentioned in all regional fisheries organisations' resolutions or recommendations. The ratio most widely applied is 5% of wet fin weight to 'dressed' (gutted and beheaded) carcass weight, or 2% of wet fin weight to whole shark ('round' or 'live') weight. These ratios were probably originally based on commercial shark practices in the US Atlantic (Anon. 1993a) and have also been found to apply to shark fisheries in New Zealand (Anon. 2004b), Australia (Rose and McLoughlin 2001), and Canada (Anon. 2001). The EU Finning Regulation, (Anon. 2003), however, specifies a maximum landing size of 5% cent of live weight, which is equivalent to 12–15% of dressed weight when finning permits are issued, although no fin:dressed carcass weight (which would be more useful for monitoring compliance with the regulation and enforcement of the ratio at landings sites) is specified in the Regulation.

The finning recommendations or resolutions adopted by RFMOS (see above) all include a fin/body weight ratio. The common wording is that Contracting Parties, Cooperating non-Contracting Parties and other bodies (CPCs): "Shall require their vessels to have on board fins that total no more than 5% of the weight of sharks on board, up to the first point of landing". Using the terminology 'sharks retained on board' avoids addressing the discrepancies between finning regulations in the EU and other CPCs, that enable EU vessels to retain more than twice the weight of fins than vessels flagged in States with other finning regulations in force.

The other major difference between the EU Finning Regulation and other national or regional regulations is that EU vessels are permitted to land or trans-ship fins and carcasses separately. All other regulations require fins and carcasses to be landed together so as to facilitate monitoring and enforcement; logbook trails tend not to be as effective as direct observations at landing sites.

5.3.4 Fin/carcass ratios

Variations in fin/carcass ratios between fisheries (summarised in section 4) arise for several reasons. The most important includes the difference in the number of shark fins that are retained from each shark. Many fisheries only retain the most valuable primary fin set (the two pectoral fins, first dorsal fin and lower caudal fin lobe – see Figure 4.3). For species with a large second dorsal fin, this may also be retained. In contrast, most European fisheries appear to retain every fin, including the secondary (small and lower value) pelvic, second dorsal and anal fins. While retention of these small fins will have minimal impact upon the overall fin:carcass ratio, the EU practice of retaining the entire caudal fin (see Figure 4.2) does significantly increase the total weight of fins retained. As noted in section 3, only the lower lobe of the caudal fin is of high value in the international fin trade, but the remainder of the caudal fin is still utilised. It yields some low-value food products, but has also been the means by which some fin traders and processors were formerly able to avoid excise duties in China.

The additional weight of these fins, however, is not sufficient to explain the high ratios obtained by EU fleets; fin cutting practice, which leaves significant quantities of meat attached to the fins, also increases the total weight above that in other fleets (see section 4.3).

The drawbacks of this practice for the fishermen are that fin quality, and hence product value, may be significantly reduced. McCoy and Ishihara (1999) describe this practice by Pacific shark fisheries: "*Most crew have either been instructed by buyers on the proper cutting of fins and handling to minimise spoilage or know such techniques and methods from fishing in the US east or Gulf coast fisheries. They know, for example, that the usual practice is to retain for sale the dorsal, two pectorals, and lower caudal fins, strung together as a set. While some newer crew might think that they will get paid more by weight if they leave some meat on the fin, they quickly learn that discriminating buyers deduct for such practices*". Furthermore, the quality and value of the meat that can be obtained from a carcass from which the fins have been removed at sea rather than by onshore processors is also diminished; this has led to the promotion of a whole-shark landing policy by buyers and fishermen in some Australian fisheries.

Figure 5.1, reproduced from Subasinge (1992) a shark fin processors' guide, illustrates the various forms of shark fin cuts encountered by processors. Crude cuts, which leave large quantities of meat attached to fins (as common practice in EU pelagic shark fisheries), are not recommended. The recommended form of cut is the half moon cut, which removes all meat and also most of the basal cartilages at the base of the fins.

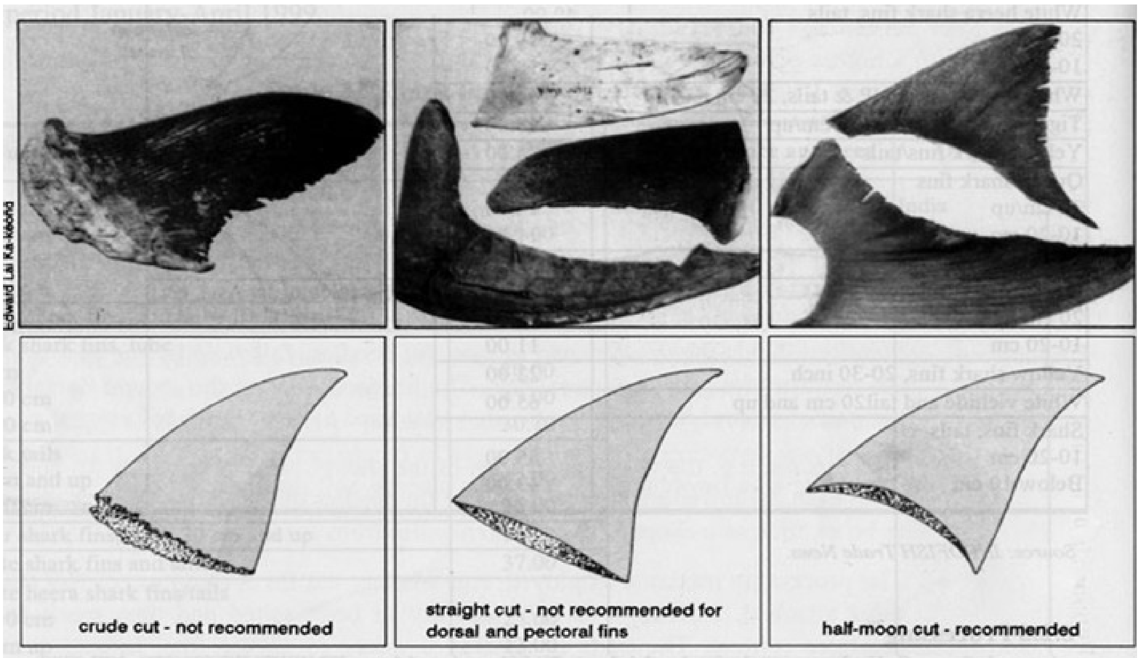

Figure 5.1. Different methods of cutting fins (Subasinge 1992).

5.4 Monitoring compliance

Monitoring compliance with any finning prohibition becomes increasingly difficult as regulations become more complex. As already noted, no State has adopted a regulation requiring that fins and carcasses be counted individually (5.3.2); this would be far too time-consuming to monitor. The simplest form of regulation is to require sharks to be landed with fins still attached (5.3.1), which is the basis for the EU Shark Finning Regulation. The other option that has been adopted by several shark fishing States and Regional Fisheries Management Organisations is to specify a maximum weight ratio of fins to carcasses (5.3.3). Compliance monitoring is made possible by requiring that fins and carcasses be landed together so that their weights can, if necessary, be compared on landing.

The EU Regulation enables EU Member States to issue special permits to vessels that can justify the need for fins to be removed on board, and specifies the fin ratio that should be applied under these circumstances. It is, however, different from all other finning regulations that are implemented through the application of a ratio. Firstly, it does not require fins and carcasses to be landed together (they may be landed or transhipped separately). This makes compliance monitoring unachievable, other than through the scrutiny of logbook records – verification of these records is not possible. It is unclear under what circumstances transhipment or separate landings would be necessary (any port that can handle shark carcasses can also handle fins) and this provision appears not to have been used by any EU vessel (or if it has, this does not appear in Member State reports to the Commission seen by the authors). The second major difference is that the ratio specified in the EU Regulation is a theoretical ratio only; it does not exist and cannot be measured once processing has occurred on board. This is because it is a fin to live weight ratio, rather than the fin to carcass ratio that is used in all other State finning bans. The development of the applicable fin to dressed carcass ratio is left to the discretion of each Member State that issues permits to remove fins on board, it is not mandated in the Regulation. This makes compliance monitoring even more difficult, particularly if vessels are landing at ports outside the Member State that has issued their permit.

5.5 Reasons to land sharks with fins attached

- Fins can be cut carefully and precisely, increasing the value of the finished product.
- Fins can be cut on shore from fresh carcasses, from frozen carcasses, or upon the thawing of the carcass (in fleets landing frozen carcasses) and then dried. Fin traders prefer purchasing dry fins because the quality can be more easily assessed, and the transport and storage of light, dry fins is easier and cheaper.
- Based on the practices of the Japanese and Taiwanese fleets, storage of sharks on-board with their fins attached is not problematic. It is neither a stacking problem (for frozen carcasses) nor a urea contamination issue (for fresh/chilled carcasses).
- Trans-shipment will continue to occur and when these trans-shipped products are landed they are not recorded as shark landings, thus we have severe under-reporting of shark catches and serious implications for fisheries management.
- In some European countries (e.g. Spain and Portugal), a whole fish must be landed in a controlled auction environment, which facilitates data collection. Processed fish are landed as products rather than fish, and data collection suffers. For example, although Spain is the largest importer of shark fins into Hong Kong it records no exports, and in some years fails to report shark catches to ICCAT.
- Landing sharks with fins on facilitates species identification.
- Finning regulations based on a percentage derives from the US where there is almost no market for shark meat. In Europe, the market for shark meat is very large and thus already there many facilities and processes set up to deal with whole sharks (i.e. fishermen/traders need to handle the whole shark at some point anyway).
- Landing sharks with fins on avoids problems with fin ratios; these problems include:
  - different species may in reality have different fin weight/whole weight ratios
  - different fisheries take different fin positions and different numbers of fins
  - problems with determining what is considered dressed weight, i.e. it could be a variably-sized carcass
  - as fisheries are ever-evolving, there will always be arguments over changing the fin ratios
  - with a fin-ratio approach there is always the possibility of high-grading i.e. discarding low-value, heavy carcasses (or trimming them to a tiny carcass size) and keeping their high-value fins (the US has already experienced such problems)
  - proper enforcement of finning ratios is much more labour intensive (because it involves weighing fins and weighing carcasses) than a simple fins-on regulation which can be assessed by eye.

5.6 Conclusions

- There are insufficient data to determine whether the current EU Shark Finning Regulation is effectively prohibiting shark finning.
- Implementation of the EU Shark Finning Regulation is seriously hampered by the derogation that allows the transhipment and separate landings of fins and carcasses.
- A fin:carcass ratio is a complicated and usually inadequate tool for preventing finning because of differences in fin cutting techniques and variability among shark species' fin sizes and values; these create loopholes to fin.
- Setting ratios at the upper end of (or above) scientifically derived ratios, as is often the case, exacerbates this problem and leaves species with small fins and/or low value meat at particular risk of finning.
- Lack of information and inconsistency in fin removal practices prevent scientific determination of a single optimal fin to carcass ratio.
- Given the uncertainty and complexity of the situation, the current EU Shark Finning Regulation cannot be characterized as effective.
- Consequently, to ensure finning cannot take place, sharks should be landed with their fins attached. This would not be too burdensome for the industry, because many onshore processing facilities already deal with whole sharks, and any port that can handle shark carcasses can also handle shark fins.
- Additional benefits of a "fins attached" policy include:
    - Calculation, decisions and alterations regarding ratios for different species or fisheries are unnecessary.
    - Enforcement burden is reduced because fins and carcasses do not need to be weighed separately.
    - Quality of the information on species and quantities of sharks landed (information important for fisheries management) is vastly improved.
    - "High-grading" (mixing carcasses and fins from different animals) is impossible.
    - Land-based processing of carcasses can include careful and precise fin cutting, increasing the value of the finished product.

The expert group made the following recommendations based on their findings:

The European Commission and Council of Ministers should:

- Amend the EU Shark Finning Regulation to require that sharks be landed with their fins still attached (sharks could still be beheaded and gutted); and
- Promote more effective Shark Finning Regulations within the Regional Fisheries Bodies (governing international waters) to which the EU is Party.

Individual EU Member States should take the following stop-gap actions to prevent shark finning in the meantime:

- Justify to the EU the need to process sharks at sea (as required) or discontinue issuing the special fishing permits that allow fishermen to remove shark fins at sea;
- Immediately stipulate that vessels removing shark fins under existing special fishing permits must land shark fins and carcasses at the same time, in the same port; and
- Encourage prompt amendment of the EU Shark Finning Regulation, as detailed above.

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6 Conclusions and recommendations[4]

The following conclusions are collated from the conclusions at the end of each of sections 2–5.

6.1 Fisheries

European shark fisheries operate in all of the world's oceans and are very much larger than is generally understood. Taking into account significant under-reporting of shark catches by several of its pelagic fleets, and the catches made by EU vessels flagged in other States, the EU is possibly the world's largest shark fishing entity.

European fisheries have traditionally exploited many small bottom-living coastal sharks and skates, and have recently increased their exploitation of deep-water sharks. These species and fisheries are relatively well-understood, but generally lack effective fisheries management measures. In contrast, the largest European shark fisheries, undertaken on the high seas by pelagic fleets from Spain, France and Portugal in the Atlantic, Pacific and Indian Oceans, are very poorly documented and unmanaged (other than through shark finning prohibitions). Though these fisheries historically targeted primarily tunas and swordfish, longline catches of oceanic sharks are as large as or larger than the catch of target species, and most longliners now also target sharks. Additionally, the Atlantic shark stocks exploited by European fleets are also heavily fished by Japanese and Taiwanese tuna vessels that operate in the Atlantic as well as in the Indo-Pacific Ocean. There is evidence that many large oceanic sharks are being fished unsustainably and that populations of the most biologically-vulnerable of these species are below healthy levels. The majority of stocks utilised by the EU will likely soon be overexploited, if they are not already, unless management is introduced.

A lack of data on shark catches, use and discard, particularly species-specific statistics, has hampered stock assessments and the introduction of fisheries management. It is extremely important to obtain better data from EU shark fisheries, markets and trade, as a matter of urgency. To continue a fishery of this importance and vulnerability on such a scale without proper data on landings, effort, fishing grounds *etc.* is not responsible. Greater investment in data collection and management is required.

Shark fisheries, particularly pelagic shark fisheries, are a global issue (fisheries and trade are not constrained by national borders). Greatly improved international cooperation, exchange of data and harmonisation of management are needed if stocks are to rebuild and the fisheries become sustainable.

While improved information on shark catches is essential for effective shark fisheries management, but should not be used as an excuse for inaction. Precautionary limits are warranted immediately, based on the low reproductive capacity of sharks, current high fishing pressures, and the history of frequent collapse in shark fisheries.

The EU Commission, Member States and Regional Fisheries Bodies should:

- Mandate full coverage on shark fishing vessels by independent, on-board observers;
- Increase investment in shark data collection at landing sites and by processing and marketing industries;

[4] Recommendations and opinions expressed herein are of the authors only and do not imply endorsement by any agency associated with the authors.

- Establish effective monitoring and management measures for target and bycatch shark fisheries within their remit, including precautionary catch limits when data are lacking;
- Cooperate in the exchange of information and the harmonisation of management measures across borders; and
- Ensure that all landings and trade of shark fins, meat, and oil are recorded separately by commodity (and to the species level where possible).

6.2 Markets

Although there is significant under-reporting of trade in shark products, available evidence indicates that the European Union dominates world shark trade activity. Although, according to FAO, reported chondrichthyan landings by the EU represented only 13.5% of world landings in 2004, in 2005 the EU was responsible for 56% of global shark imports and 32% of worldwide exports (although this may be due to better trade records in Europe). The EU (primarily Spain) was also the world's largest single exporter of raw shark fins to Hong Kong from 1998 to 2000. This is likely still the case, although a change in customs codes means that it is now no longer possible to distinguish between imports of frozen shark meat and imports of frozen fins in customs records. The largest component of this trade is believed to be blue shark fins, which comprise at least 17% of the Hong Kong shark fin auction market. Other shark products include liver oil, skins and cartilage.

The demand for and the value and volume of shark products in trade have increased considerably over the past 15 years and continue to rise. Estimates of the total number of sharks traded annually worldwide range from 26–73 million/year (95% PI) with an overall median of 38 million/year. The shark biomass represented by the global fin trade is estimated to lie between 1.21 and 2.29 million t/year (95% PI) with a median of 1.70 million t/year. This is some three to four times higher than indicated by FAO's landings data, and does not include sharks that are discarded at sea or that are wholly processed and utilised domestically (for example those taken by the Japanese and Taiwanese fleets). The conclusions are that shark stocks are facing much heavier fishing pressures than was previously indicated, that it is unsustainable for many shark species, and that EU fleets contribute significantly to this.

The expert workshop recognised that trade studies are very important as a cross-check on production figures for sharks and hence for assessing shark fisheries. Most other businesses around the world provide reliable export statistics, so this would also be expected for the shark trade; greater investment in data collection is required by processing and marketing industries. Participants therefore recommended that:

- States be encouraged to separate their trade statistics on shark fins and shark meat and frozen and dried fins.
- States be encouraged to implement eight-digit Harmonised System (HS) customs codes for shark products (and to fully utilise existing six-digit codes), with the goal of compiling better more specific trade-flow information.
- Given the importance of the accuracy of China's trade data to understanding the global trade in shark products (especially fins), China be encouraged to rectify its agglomeration of frozen shark meat and frozen shark fins.
- EUROSTAT and FAO trade data for shark products in Europe be compared, with the caveat that the EUROSTAT database often contains data based on six-digit HS customs codes (rather than eight-digit) from the reporting countries and thus comparisons must be done with care. (It is important to be aware of double-counting.)
- A longer-term series of shark fin price data be obtained through INFOFISH and examined. Prices themselves are not of primary concern but trends may provide insight into the overall vibrancy of trade, particularly with regard to supply issues.

- The recommendations be implemented of the Convention on International Trade in Endangered Species (CITES) on extending the current six digit codes used by the World Customs Organisation so as to improve the recording of shark fins and other products in trade. This can be done by adopting a simple standardised set of commodity codes for the shark products from both CITES-listed and non-listed species that most commonly enter trade in order to differentiate between fresh/frozen and dried, processed and unprocessed meat and fin products.
- Investigate whether there are any trade data on fins from France, given that the fisheries section of this report has highlighted a possibility of finning activity by French vessels.

6.3 Conversion factors and the EU finning regulation

Conversion factors describe the proportion of the live weight of a fish that is converted into weight of processed product. They provide important information for scientists and fishery managers because they enable the weight of products landed to be converted back to the weight of sharks that was originally taken from the sea (this is essential information for stock assessment and the implementation of management measures such as a Total Allowable Catch). Conversion factors were compiled during the workshop for a number of shark species and their products from a variety of sources and fleets, providing a good basis for more work in this area.

The workshop paid greatest attention to conversion factors between shark fin weight and round (whole) weight (FW/RW), since this provides important information for ongoing reviews of Council Regulation (EC) N° 1185/2003 of 26 June 2003 on the removal of fins of sharks on-board vessels.

Most finning regulations mandate a simple conversion factor between the weight of shark fins and the weight of the remainder of the body brought to the dock, verifying that all fins have a body to match, in an attempt to ensure that finning does not take place. Difficulties arise when conversion factors vary between fisheries, often because of different processing techniques, and the highest ratios drive the regulations. Discrepancies arise from keeping different numbers of fins from each carcass and/or cutting sharks differently when removing the fins, so that more or less shark meat is left attached. For example, the fin:carcass ratio for blue sharks taken in US and Canadian Atlantic fisheries is about 2% of fin to whole weight or 5% of fin to dressed (headed and gutted) carcass weight. Portuguese and Spanish fleets fish the same blue shark population, but report ratios that are three times larger (over 6% and 15% respectively). This fishery may not be representative of all EU fisheries and fisheries in European waters (for example, the FW/RW factor for deep-water sharks is 1.6%).

Overall, the fin weight to round weight (FW/RW) factor for the European mixed pelagic shark fishery seems to average around 6%, based on the available information and influenced by the high proportion of blue sharks in the fishery. This conversion factor is based on the cutting of fins in Spanish and Portuguese pelagic longline fisheries and is higher than that obtained by other fleets and that specified in the EU Shark Finning Regulation for two main reasons. Firstly, Spanish and Portuguese longline fleets retain small low value secondary fins that are discarded in other fisheries, including the entire tail of each shark, instead of just the high value lower caudal lobe that is used in shark fin soup. Secondly, the fins are cut so as to leave significant weights of meat still attached, which is later removed and discarded before processing. This meat may make up as much as one third of the reported ‘fin weight’. Keeping the whole tail also significantly increases the weight of the ‘fins’ because it includes part of the vertebral column and other tissues (likely another one third of the total fin weight). Some fin traders air-freight high value shark fin (including lower caudal lobes) to East Asia, but send the rest of the tail by low cost sea-freight because they will be processed into lower value products.

Given the above, there is scope for European pelagic shark fisheries to improve their fin cutting practices and reduce the FW/RW ratio to one that is very close to those obtained in the West Atlantic without making processing on board more difficult or reducing the economic return from the fishery by discarding secondary shark fins.

There are many problems connected to the EU Shark Finning Regulation, but the basic problem is associated with the use of conversion factors. Further complications arise because although the Regulation specifies the FW/RW, it is only applied when processed fish are landed and this ratio can no longer be observed. It is therefore necessary to back-calculate the round weight from dressed weight. The fin weight to dressed weight factor is not specified in the Regulations, although it is the most important ratio for assessing compliance. These calculations add insecurity to the results.

These results demonstrate the desirability of carrying out more studies of this type. To establish a more appropriate conversion factor necessitates better information on fin cutting/ processing practices in different fleets, more measurements of conversion factors, and better information on fisheries and catch composition. It would, however, take a long time to establish reliable factors for even the most important species. In addition, these factors would have to be revised every time fleets change their dressing criteria, which they may do rapidly do in order to adjust to market changes or to get around management measures and hence increase the profitability of their fishery.

In practice, it would be very difficult to implement and enforce different fin ratios for different fisheries, unless observers are placed on all vessels. The workshop participants concluded unanimously that the EU finning regulation is not useful for managing the European shark fisheries. Sharks must be landed with their fins attached. This would not be too burdensome for the industry, because many onshore processing facilities already deal with whole sharks, and any port that can handle shark carcasses can also handle shark fins. It is also possible to use a partial cut to fold fins next to the carcass for freezing, as has been demonstrated in States where a whole landings policy has been adopted.

The following points summarise the conclusions and recommendations of the expert workshop regarding the provisions of the EU Shark Finning Regulation that allow the fins of sharks to be removed on board and sets a theoretical ratio for fins to carcasses.

- There are insufficient data to determine whether the current EU Shark Finning Regulation is effectively prohibiting shark finning.
- Implementation of the EU Shark Finning Regulation is seriously hampered by the derogation that allows the transhipment and separate landings of fins and carcasses.
- A fin:carcass ratio is a complicated and usually inadequate tool for preventing finning because of differences in fin cutting techniques and variability among shark species’ fin sizes and values; these create loopholes to fin.
- Setting ratios at the upper end of (or above) scientifically derived ratios, as is often the case, exacerbates this problem and leaves species with small fins and/or low value meat at particular risk of finning.
- Lack of information and inconsistency in fin removal practices prevent scientific determination of a single optimal fin to carcass ratio.
- Given the uncertainty and complexity of the situation, the current EU Shark Finning Regulation cannot be characterized as effective.
- Consequently, to ensure finning cannot take place, sharks should be landed with their fins attached. This would not be too burdensome for the industry, because many onshore processing facilities already deal with whole sharks, and any port that can handle shark carcasses can also handle shark fins.

- Additional benefits of a "fins attached" policy include:
  - Calculation, decisions and alterations regarding ratios for different species or fisheries are unnecessary.
  - Enforcement burden is reduced because fins and carcasses do not need to be weighed separately.
  - Quality of the information on species and quantities of sharks landed (information important for fisheries management) is vastly improved.
  - "High-grading" (mixing carcasses and fins from different animals) is impossible.
  - Land-based processing of carcasses can include careful and precise fin cutting, increasing the value of the finished product.

The expert group made the following recommendations based on their findings:

The European Commission and Council of Ministers should:

- Amend the EU Shark Finning Regulation to require that sharks be landed with their fins still attached (sharks could still be beheaded and gutted); and
- Promote more effective Shark Finning Regulations within the Regional Fisheries Bodies (governing international waters) to which the EU is Party.

Individual EU Member States should take the following stop-gap actions to prevent shark finning in the meantime:

- Justify to the EU the need to process sharks at sea (as required) or discontinue issuing the special fishing permits that allow fishermen to remove shark fins at sea;
- Immediately stipulate that vessels removing shark fins under existing special fishing permits must land shark fins and carcasses at the same time, in the same port; and
- Encourage prompt amendment of the EU Shark Finning Regulation, as detailed above.

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For information on the EEA's member organisations and annual scientific meeting, please visit www.eulasmo.org.

This document is the report of an expert workshop on shark fisheries in Europe, held in Brussels in October 2006. It was attended by a group of international experts in shark research, trade, conservation and management drawn from ten countries.

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