# India's Shark Trade:
## An Analysis of Indian Shark Landings Based on Shark Fin Exports

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*Abstract* The growth of the international market for shark fins has coincided with an expansion of shark fishing in India, raising concerns that some shark stocks are over-exploited. India exports almost all shark fins it produces in what is largely an informal and unregulated sector, and most observers believe that official export data greatly understate actual shark fin exports. Two estimates of Indian shark fin exports, one based on projected shark fin production from the Food and Agriculture Organisation (FAO) recorded landings data and the other based on recorded Hong Kong imports from India, show that actual exports are likely many times greater than officially recorded amounts. A comparative analysis of Hong Kong and FAO data indicates that FAO landings data may be much lower than actual shark landings. Recent events -- the short-lived 2001 blanket ban on shark fishing and trade by the Government of India in particular -- are analysed in terms of their effect on shark fin trade and production. The implications of a trade-based estimate of total shark landings on current shark fishing practices in India are examined, and suggestions are given regarding effective and equitable methods to protect shark stocks and fishers livelihoods.

### Introduction[1]

Until recently, Indian shark landings occurred largely in the form of incidental catch from artisanal and trawler mixed-species fisheries.[2] Shark fisheries both in India and worldwide have grown, due in part to the expanded market for shark fins over the last few decades, raising concerns about the sustainability of shark stocks in what is largely an unregulated sector. While it is difficult to measure the volume of Indian shark fin exports, considerable evidence suggests that it has expanded rapidly. This paper analyses production, import, and export data and attempts to paint a more accurate picture of the volume of Indian shark fin exports over the past decade. The first part of the paper examines the state of current shark fisheries in India and the species targeted. The second part provides an overview of the global market for shark fins and examines India's export contributions. The third part provides an in-depth analysis of the volume of Indian shark fin exports and attempts to craft a reasonable estimate of actual shark fin exports. The fourth part examines the role of recent political events on Indian shark fisheries and shark fin exports, and examines the biological and stock size limitations on the sustainable expansion of shark fisheries. Finally, the conclusion suggests possible steps to ensure the sustainable management of shark stocks in light of the data and analysis in previous sections. This paper argues that a better understanding of the volume of Indian shark fin exports is important in framing any future decisions relating to resource conservation and management of shark stocks.

## Dynamics of Indian Shark Fisheries

Sharks have always been part of the catch by artisanal fishers in mixed-species fisheries in shallow waters off the Indian coast. Shark meat was traditionally considered low-quality meat in most of India owing largely to the high concentration of uric acid in the body tissue (Hanfee 1999). In the past fishers often finned and discarded shark carcasses to feed the fledgling fin export market. Since the 1960s, however, a fairly substantial demand for fresh, salted, and dried shark meat has emerged in the South Indian states of Kerala and Tamil Nadu (Frej and Gustafsson 1990). Still, the most valuable shark commodity by far is the fin, which is generally exported to East Asia. Shark catches in India have risen from around 17,000 metric tonnes (mt) in 1950 to close to 70,000mt in 2002, driven largely by the expanding international shark fin market (Fishstat+ 2004; Hanfee 1999). Since the late 1980s, a targeted shark fishery of around 600 to 800 mechanized vessels has developed out of Thoothoor in Tamil Nadu (Vivekanandan 2001).

A number of different groups in India exploit shark stocks. Traditional fishers using *katumaram* and hand lines, as well as motorized canoes using bottom set gill nets and hook-and-line, engage in seasonal shark fishing off the east coast of India. Traditional longline fishers of Malabar in north Kerala are also known to go shark fishing in certain locations like Elathoor (Vivekanandan 2001). One of the most significant sources of shark catches is trawlers. Since the introduction of mechanized trawlers in the 1960s, trawlers operating in all Indian coastal waters were estimated to account for around thirty-two percent of shark catches in 1985, while gillnets set largely by artisanal fishers[3] accounted for forty-eight percent of the catches, and hook and line made up around twelve percent (Hanfee 1999).[4] The Thoothoor shark-fishing fleet has also grown in recent years, using bottom longlines in both continental shelf (100m-300m) and ocean pelagic (300m-1000m or more) waters to land sharks (Vivekanandan 2001), though Hanfee (1999) suggests that longlines constitute no more than eight percent of total shark landings. A large shark fishery exists in the state of Gujarat, whose catch has historically made up more then half of India's total shark landings. Sharks are caught seasonally off the coast of Gujarat using a variety of gear including gill nets, hook-and-line, and trawls (Vivekanandan 2001).[5] Foreign vessels are known to poach in Indian waters, though the extent to which they target or incidentally catch sharks is unknown (Vivekanandan 2001). Shark finning is practiced in the Andaman and Nicobar Islands, where no local market for shark meat exists and where ships will not accept dried shark meat for transport to the mainland. Shark poaching in the Andamans by Sri Lankan and other foreign fleets is also a concern (Srivastava 2002; Vivekanandan 2001).

As many as seventy species of sharks are found in Indian waters, though only eighteen species are occasionally or frequently caught. On the northwest coast, spadenose sharks (*Scoliodon laticaudus*) constitute approximately eighty-three percent of shark landings, with requiem shark (*Carcharhinus* spp.) catches making up much of the remainder at thirteen percent. On the southwest coast, requiem sharks provide around fifty-six percent of catches, with scalloped and great hammerhead sharks (*Sphyrna lewini* and *Sphyrna mokarran*) comprising twenty-seven percent. On the east coast, major requiem sharks form around sixty percent of catches, followed by scalloped hammerheads and winghead sharks (*Eusphyra blochii*) at twenty-three percent and milk sharks (*Rhizoprionodon acutus*) at around fifteen percent (Hanfee 1999). Virtually no fishing vessels maintain logs of their fishing operations, and catch data is generally collected by

the Central Marine Fisheries Research Institute (CMFRI) using a multi-stratum random sampling method. Data is collected from 2251 fish landing centres, with a frequency of observation of up to eighteen days per month. Major landing centres are given more staff, and roughly ten percent of the landings are recorded at random with the data adjusted to approximate a hundred percent of landings for that day. Daily data is used to estimate total monthly landings at each port, and the CMFRI reports that the margin of error on their estimates is only five percent (Hanfee 1999). By not counting finned sharks, for example those finned in the Andaman and Nicobar islands, and poaching by foreign fleets, the CMFRI data may slightly understate actual catches.[6] The United Nations Food and Agriculture Organization provides a database of Indian shark landings based on data reported by India. There is, however, considerable dissatisfaction among FAO officials over the 'quality of elasmobranch catch data, both in identifying species that are caught, and the amount of catch and landings' worldwide (Handwerk 2003). They admit that FAO trade data for shark fins is highly uncertain and may over or underestimate actual traded volumes (Shotton 1999).[7]

## The International Market for Shark Fins

The international market for shark fins has grown dramatically over the last few decades, largely driven by increasing consumer demand in mainland China. Shark fin soup is an important part of Chinese cuisine, and the consumption of shark fins is seen as a symbol of wealth and social status. As a result, shark fin soup is served to celebrate important events like weddings, birthdays, and business functions. Not serving shark fins is, in some circles, tantamount to admitting poverty (Watts 2001:9). While shark fin soup is very expensive (usually between US$10 and US$100 per bowl depending on the quality and amount of shark fin), the dramatic growth of Chinese GDP in recent years has greatly expanded the purchasing power of consumers and increased the demand for shark fin products (Clarke 2002:11). Shark fins are currently widely consumed. A recent survey of Hong Kong residents found that eighty-five percent of respondents were served shark fin soup more then once a year, with forty-six percent consuming it more then five times a year (Clarke 2002:16). Shark fins are often used in traditional Chinese medicine, and some people believe that shark fin serves as an aphrodisiac (Trivedi 2002).

The port of Hong Kong largely dominates the international trade in shark fins. Handling anywhere between fifty percent and eighty-five percent of the global shark fin imports, Hong Kong is able to act as an *entrepôt* with some fins consumed domestically but the majority re-exported to other Chinese-speaking parts of the world (Clarke 2002:17; Watts 2001:32). While Singapore handles much of the remaining international trade, it is Hong Kong's ability to serve as a conduit of goods to Mainland China that allows it to dominate the seafood trade (Clarke 2002:13). The international nature of the trade in shark fins is underscored by the fact that eighty-six different countries export shark fins to Hong Kong (Clarke 2004). Hong Kong's dry raw shark fin imports have increased from 2,420mt in 1972 to 6,788mt in 2000, according to official import data (Clarke 2002:46; Rose 1996). Between 1984 and 2000, Hong Kong's dry raw shark fin imports increased at an average annual rate of 6.1 percent (Clarke 2004). Major trading partners with exports of 250 tonnes or more are, in order of import volume in 2000:

Spain, Taiwan, Indonesia, United Arab Emirates (UAE), Yemen, India, Singapore, Mexico, and Japan. UAE and Singapore are known to serve as transhipment points for shark fins from Africa, India, and Sri Lanka (Clarke 2002:27-28).

Market prices of shark fins vary considerably by species and preparation. Fin prices range from US$45 to US$88 per kilogram in the Singapore market (Catarci 2004). Prices have risen dramatically in the past few decades, with average price per kilogram in Hong Kong rising from US$11.20 to US$44 between 1980 and 1992 alone (Rose 1996). Shark fin exports are divided into 'white' fins and 'black' fins based on species, with white fins generally worth more than black fins in the international market (Vannuccini 2001: 6.2.3). Some highly desired fins can sell for as much as US$744 per kg, and fins from trophy species like basking sharks (*Cetorhinus maximus*) are known to sell for US$10,000 or more per large fin (Clarke 2002:61; CITES 2002). FAO data indicates that the global shark fin trade has approximately doubled over the last twenty years and prices have more then tripled, though actual trade volume may have as much as quadrupled (Clarke 2002:46; Watts 2001:18). Some types of shark meat, whale shark meat in particular, are also fairly high-value commodities. Whale shark meat, known as 'tofu-meat' for its white flesh and soft texture, retails for around US$11 per kilogram in Taiwan markets (Chen and Phipps 2002:13).

The overwhelming majority of shark fins produced in India are exported to Hong Kong or Singapore, though there is a small domestic market catering to major hotels with ethnic Chinese guests (Chen 1999).[8] The Marine Product Export Development Agency (MPEDA) identifies major Indian white shark fin exports as coming from, in no particular order, whale sharks (*Rhincodon typus*),[9] whitetip sharks (*Carcharhinus longimanus*), tiger sharks (*Galeocerdo cuvier*), lemon sharks (*Negaprion acutidens*), milk sharks, spadenose sharks, smooth hammerhead sharks (*Sphyrna zygaena)*,[10] scalloped hammerhead sharks, and major Indian black shark fin exports from blacktip sharks (*Carcharhinus limbatus*) and finally blacktip reef sharks (*Carcharhinus melanopterus*) (Chen 1999). Fins from sharks caught in Indian waters are usually dried in preparation for export. Chennai and, to a lesser extent, Mumbai serve as the major centres for shark fin export with fins coming from all over the Indian coast. [11] Wholesale prices for shark fins are Rs.280-340 per kg ($7-$8.50) domestically,[12] while end-market retail prices are often five times greater in the Hong Kong or Singapore markets, with the middlemen pocketing most of the profits (Varma 1999). Shark fin exports are an informal business, largely devoid of paperwork like recording sales that are followed by exporters with other seafood products (Vivekanandan 2001). Couriers carry shark fins by air, often clandestinely exported in personal baggage to avoid import tariffs at ports like Singapore (Hanfee 1999). These factors make it difficult to quantify the actual traded volume of shark fins, as official data where it exists is likely to considerably underestimate trade.

## Estimating the Volume and Value of Indian Shark Fin Exports

*Landings-Based Export Estimates*

Given the difficulty in tracking shark fin exports, a more accurate picture of trade volume may be found from estimating total shark fin production based on recorded shark landings. Table 1.1 provides an estimate of total fin production (TFP) for the

years 1989 to 2002, and contrasts it with recorded MPEDA export data. To create the total fin production estimate in Table 1.1, a number of assumptions must be made. Since there is almost no domestic consumption of shark fins, and since fins are widely known as the most valuable part of the shark, TFP estimates assume that virtually all shark fins produced in India are subsequently exported. TFP estimates also assume that virtually all exported fins are dried. Shark fins in the international market are exported in either a 'wet' (frozen or salted in brine) or 'dry' (dried 'raw' fin with cartilage intact) form.[13] While India is known as a major dry fin exporter, the extent of wet fin exports, if any, is unclear. Frej and Gustafsson (1990:23-24) identify all exported shark fins as dried, the MPEDA reports only dried fin exports (MPEDA 2004b), and import data from Hong Kong (Hong Kong CSD 2004) indicates that less then one percent of shark fins imported from India are wet. The weight ratio of dry to wet fins is assumed to be approximately one to four (twenty-five percent).[14]

The TFP estimates also assume that FAO landings data is based on weights of intact landed sharks. The CMFRI, the government body in India that reports landings data, calculates only intact shark landings (Kizhakudan 2004). As most shark fishing in India is artisanal or short voyage, most sharks are landed intact and not headed and gutted at sea. The TFP estimates are calculated using a two percent proportion of fin to body weight for intact landed sharks, a number which is thought to be a fairly conservative approximation of average fin to body weight for most shark species (IUCN SSG 2003).[15] The formula used to calculate TFP estimates is:

*TFP = L*0.02*0.25*

*L* is the FAO landings data, 0.02 is the fin to body weight ratio, and 0.25 is the dry to wet fin ratio.

Table 1.1. *Indian Shark Fin Production Estimates (in metric tonnes), 1989-2002*

| Year | FAO Shark Landings | MPEDA Fin Exports | Total Fin Production (TFP) |
|---|---|---|---|
| **1989** | 66,281 | N/A | 331 |
| **1990** | 51,230 | N/A | 256 |
| **1991** | 55,925 | N/A | 280 |
| **1992** | 59,730 | N/A | 299 |
| **1993** | 76,604 | 139 | 383 |
| **1994** | 83,689 | 185 | 418 |
| **1995** | 77,078 | 303 | 385 |
| **1996** | 132,160 | 241 | 661 |
| **1997** | 71,991 | 219 | 360 |
| **1998** | 74,704 | 156 | 374 |
| **1999** | 76,802 | 123 | 384 |
| **2000** | 76,057 | 248 | 380 |
| **2001** | 67,971 | 146 | 340 |
| **2002** | 67,358 | 146 | 337 |

Indian FAO landings data is from Fishstat+ (2004). 1993-1997 MPEDA Indian export data is from Hanfee (1999) and 1998-2002 is from MPEDA (2004a).[16]

The informal nature of the shark fin trade means that official MPEDA export data are likely to substantially understate actual trade. We see from Table 1.1 that TFP estimates are between 1.27 and 3.12 times greater than MPEDA export data, with TFP estimates averaging 2.24 times greater than MPEDA exports over the ten years that the datasets overlap. Changes in MPEDA data between years do not correspond particularly well to changes in TFP data. For example, MPEDA exports increased greatly between 1999 and 2000 while TFP remained approximately the same. Likewise, MPEDA exports decreased sharply between 1997 and 1998 while TFP increased slightly.

Since existing official MPEDA figures are widely regarded as underestimations (Vivekanandan 2001), total shark fin production estimates based on FAO reported shark landings may provide a more accurate indicator of actual traded volume. While it should be noted that this analysis would be considerably weakened by relaxing the assumption that the fins of all sharks landed in India are subsequently exported, TFP estimates can be seen as an upper bound for possible export quantities, making the heroic assumption that FAO landings data is accurate—an assumption that will later come into question.

*Estimating Export Shares by Destination*

Table 1.2 shows the percentage of MPEDA reported exports by export location. This data shows Hong Kong as the major export destination, followed by Singapore and China. The large yearly variations in China's share of the exports are puzzling and might be a result of confusion between Hong Kong (province of China) and mainland China as an export destination, as the data shows the Chinese share existing only after 1997, the year Hong Kong became a province of China. The increasing Chinese share seems to directly correspond with a decreasing Hong Kong share, and if China and Hong Kong's shares are summed, the Hong Kong shares seem more consistent. The sudden decrease in China's share between 2001 and 2002-2003, and the corresponding increase in Hong Kong's share, seems to indicate that China's share is now attributed to Hong Kong.

Table 1.2: *MPEDA shark fin export percentages by destination, 1996-2003*

| Year | Hong Kong | Singapore | China | Other | China + Hong Kong |
|---|---|---|---|---|---|
| **1996** | 52.05 | 47.54 | 0 | 0.41 | 52.05 |
| **1997** | 51.02 | 46.94 | 0 | 2 | 51.02 |
| **1998** | 53.84 | 27.56 | 1.92 | 15.38 | 55.76 |
| **1999** | 35.77 | 22.76 | 35.77 | 6.5 | 71.54 |
| **2000** | 41.53 | 37.1 | 19.76 | 2.02 | 61.29 |
| **2001** | 38.36 | 29.45 | 24.66 | 7.53 | 63.02 |
| **2002** | 73.97 | 25.34 | 0 | 0.68 | 73.97 |
| **2003** | 61.02 | 35.03 | 0.56 | 3.4 | 61.58 |
| **Avg.** | **50.95** | **33.97** | **10.33** | **4.74** | **61.28** |

Data calculated from destination-specific export statistics from MPEDA (2004a).

There is reason to believe that MPEDA export data overestimates the role of Hong Kong as a destination for Indian shark fin exports. MPEDA data is based largely on voluntary reporting by shark fin exporters. Because Hong Kong is a duty-free port, traders exporting to Hong Kong would have little incentive to underreport exports.[17] Singapore and China, on the other hand, charge a duty on shark fin imports that provides an incentive for traders to underreport Indian exports to these locations.

*Estimates of Indian Shark Exports and Landings based on Hong Kong Imports*

Table 1.3 presents a new set of data based on recorded Hong Kong imports of dry fins from India (column three), and uses this data along with the export percentages by destination from Table 1.2 to estimate Indian shark fin exports (column five). This shark fin export estimate is then used to calculate Indian shark landings (column six), and the shark landings estimates are compared to FAO landings data (column seven).

In calculating exports, we make two assumptions: First, Hong Kong import data are assumed to be an accurate representation of Indian exports to Hong Kong. Because Hong Kong is a duty free port there is little rational incentive for import statistics to be inflated (Clarke 2002:39), actual shark fin exports from India imported to Hong Kong are likely to be either accurate or slightly underreported. Second, we assume that the MPEDA reported share of exports sent to Hong Kong + China—from Table 1.2—is probably greater than or equal to the actual share. Summing Hong Kong and Chinese shares provides the most conservative estimate of exports, and MPEDA data is likely to inflate the share of exports going to Hong Kong as exports destined for other ports may be underreported to avoid duties.[18] In calculating landings, we take estimated exports and use all the assumptions about fin/body and dry/wet weight proportions used in calculating TFP in Table 1.1. The formulas used in calculating export and landings estimates for each year are:

$$Export = \frac{I}{C+HK} \qquad Landing = \frac{Export}{0.02 * 0.25}$$

where *I* is Hong Kong imports from India and *C* and *HK* are the Chinese and Hong Kong percentage share of exports for the respective year.

Comparing recorded Hong Kong to MPEDA exports reveals rather dramatic differences. In the year 2000, for example, Hong Kong recorded imports of 665mt of dry raw (and weight-adjusted processed) fins from India, while the MPEDA reported total dry fin exports of only 248mt to all destinations. Overall, recorded Hong Kong imports range from 2.21 to 4.22 times greater than MPEDA exports, and are on average 3.4 times greater over the five years. This discrepancy certainly reflects poorly on reported MPEDA export data, indicating a ubiquitous gross underreporting of actual shark fin exports.[18] Hong Kong imports are also on average 1.49 times greater than total fin production (TFP) estimates, indicating that the major assumption underlying TFP estimates -- that FAO landing data is accurate -- may not be true. Estimated Indian exports (column five) are likewise much larger than both MPEDA and TFP figures. Estimated exports are between 4.37 and 6.47 times greater than

Table 1.3: *Indian shark fin exports and landing estimates for 1998-2002 (in metric tonnes)*

| Year | MPEDA Dry Fin Exports | Hong Kong Dry Fin Imports from India | Total Fin Production | Estimated Indian Imports | Estimated Indian Landings | FAO Landings for India |
|---|---|---|---|---|---|---|
| **1998** | 156 | 344 | 374 | 618 | 123,550 | 74,704 |
| **1999** | 123 | 519 | 384 | 725 | 144,967 | 76,802 |
| **2000** | 248 | 665 | 380 | 1084 | 216,855 | 76,057 |
| **2001** | 146 | 596 | 340 | 945 | 189,060 | 67,971 |
| **2002** | 146 | 564 | 337 | 762 | 152,446 | 67,358 |

MPEDA export, TFP, and FAO Landings data is taken from Table 1.1. Hong Kong imports data is from the Hong Kong Special Administrative Region Government Census and Statistics Department (Hong Kong CSD 2004)[19]

MPEDA exports for all five years, and are on average 5.18 times greater. In comparing estimated exports to TFP data, we find that estimated exports are on average 2.29 times greater.

The substantial discrepancy between estimated exports and TFP data indicates that the volume of sharks actually landed in India is much greater than that recorded by the FAO. In 2000, for example, we find that FAO landings data may understate actual Indian shark landings by at least 140,000mt. If the Indian shark fin exports estimated above are accurate, then actual shark landings over the five years covered by the dataset are on average 2.29 times greater than reported FAO landings. Given the number of assumptions involved in producing these estimates, however, and the uncertainties surrounding the trade-based estimations of Indian shark fin production, few firm conclusions can be drawn regarding the accuracy of reported landings data, other then a general note that reported landings seem to understate actual landings as derived from traded fin volume.

## Recent Developments in Indian Shark Fisheries

In July 2001, the Indian Ministry of Environment and Forests (MOEF) placed sixty items caught and removed from the sea, including all shark species, under Schedule One of the Wildlife Protection Act, ruling that they could not be caught, harvested, traded, or made into any product for sale. The ban was imposed with no consultation whatsoever with fisheries organizations, and came as a surprise. The ban came to light only when the Coast Guard informed fishers from the Thoothoor shark-fishing fleet in September that their activities were illegal, and when customs authorities held up shark fin exports to Singapore in early October (Vivekanandan 2001). The ban was a result of lobbying by environmental groups concerned with the depletion of stocks of some shark species,[20] and was justified by the perceived difficulty of selectively catching only non-threatened shark species (India Today 2002). It contributed to considerable social unrest among the estimated 15,000 to 20,000 fishers almost entirely dependent on shark fishing for their livelihood, and the additional 100,000

or so fishers for who sharks provide seasonal or occasional income (Vivekanandan 2001).[21] After a spirited protest campaign by fishers, the MOEF lifted the blanket ban on December 5th, 2001, and reduced the number of protected shark species to nine, none of these particularly important commercially (Gobar Times 2002; India Today 2002).[22,23] The whale shark also received protection in May 2001, though this move elicited considerably less opposition than did the blanket ban (Sharma 2001).

Between July and December 2001, Indian shark landings likely declined due to the ban on shark fishing. The FAO shark landings data (Table 1.1) shows Indian shark landings between 2000 and 2001 decreasing from 76,057mt to 67,971mt. During the same period, recorded MPEDA shark fin exports decreased forty-one percent from 248mt to 146mt, as the shark-fishing ban also banned the trade in shark products. This was the largest annual decrease, in both percent and absolute volume, in the decade covered by the dataset. The Hong Kong import data also shows a marked decline in volume between 2000 and 2001, and a month-by-month analysis of import quantities shows declines in October, November, and December 2001 compared to the quantities imported in the same months in 2000 (Hong Kong CSD 2004). Interestingly, the all datasets show the 2002 production and trade figures still stagnating or slightly decreasing compared to 2001 despite a high market price per tonne for shark fins (MPEDA 2004a).[24]

Despite continued high shark fin prices, recorded Indian shark landings have increased at an average rate of only roughly three percent per year (Table 1.1— FAO Landings). Some observers have expressed concern that some Indian shark fisheries may be overfished, especially in coastal waters of less then fifty meters depth, as reports of decreasing length of sharks caught seem to attest (Hanfee 1999; Watts 2001:10).[25] As much of the artisanal fishing and trawling takes place in relatively shallow waters, a decline in coastal shark populations may explain why, despite the development of a deepwater shark-fishing fleet and an expanding market, reported shark landings have not increased substantially. Until 2001, the CMFRI estimated the maximum sustainable yield of sharks in the Indian exclusive economic zone (EEZ) at 168,000 tonnes—65,000 tonnes in coastal waters of less then fifty meters and 103,000 tonnes in deeper water (Vivekanandan 2001). As of late 2001, the CMFRI revised the maximum sustainable yield estimate downward from 168,000 tonnes to 96,000 tonnes (Vivekanandan 2001). While combined maximum sustainable yield estimates for all shark species are not particularly useful, as growth and fecundity characteristics vary significantly between species (Smith *et al.* 1998), sustainable yield estimates for specific species are not available. Shark stocks, due to their unique biology and lifecycle characterized by low population growth rates and low natural mortality, tend to be highly vulnerable to overexploitation; intensive shark fisheries have historically been characterized by a boom and bust cycle (Camhi *et al.* 1998:3-4, 7-8). The fact that the maximum sustainable yield for Indian shark fisheries is considerably less than the annual shark landings estimated in this paper -- assuming the estimations are somewhat accurate -- is cause for concern.

The analysis of Indian shark fin exports presented in this paper suggests that officially reported shark landings data understate actual shark landings. If this is the case, then it is possible that some Indian shark fisheries may be overexploited. It is essential to ensure that powerful economic incentives, led by the increasing value of the international shark fin trade, do not drive the unsustainable overexploitation of

shark stocks. The economic extirpation of shark stocks for short-term gain would hurt fishers more than anyone else. It may be much easier for traders, who take a substantial share of the profits from the shark fin trade, to move on to other goods than it would be for the fishers whose livelihoods partially or completely depend on shark fishing.[26]

## Conclusions and Recommendations

The growing international market for shark fins is an important factor driving the expansion of shark fisheries worldwide. In India, a growing but largely informal shark fin export market has led to substantially increased pressure on shark stocks over the last few decades. Since official MPEDA export data is patchy at best, there are two different methods we can use to estimate actual Indian shark fin exports. First, we can calculate total fin production based on FAO landings data. This data can be used as an estimate of shark fin exports if we assume that domestic consumption is insignificant and produced shark fins are almost universally exported. These estimates, for all years that data exists, are on average 2.24 times greater then MPEDA reported exports. Second, total Indian shark fin exports can be estimated based on reported Hong Kong imports of Indian shark fins adjusted by the share of reported shark fin exports destined for Hong Kong and China in the MPEDA database. As Hong Kong is a duty-free port, it should provide a fairly accurate picture of actual traded volumes. The official export data is likely, if anything, to overestimate the percentage of exports exported to Hong Kong since exports to other ports are more likely to be informal to avoid tariffs. The total estimated Indian shark fin exports calculated using this method are on average 5.18 times greater then reported MPEDA exports. If the second method of estimating total Indian shark fin exports is reasonably accurate, we can use this data to calculate an approximation of total Indian shark landings. Total Indian shark landings are calculated to range from 123,000mt to 216,000mt in the five years for which we have data, and are on average 2.29 times greater than reported FAO landings data.

Given the high vulnerability of most shark species to overexploitation and the role of the shark fin trade in driving the expansion of shark fishing, understanding both the scope of Indian shark fin exports and the relationship between the export market and shark production is important in assessing the need for sustainable management of shark stocks to avoid stock collapse. The recent decision to revise downward the maximum sustainable yield of shark fisheries in India coupled with the reported decline in the size of landed sharks and the concentration of fishing pressure in shallow coastal waters -- where many of the species most vulnerable to overfishing live (Smith *et al.* 1998) -- may necessitate a reassessment of the sustainability of current shark fishing practices in India. If official landings data understates actual shark landings, there is even more cause for concern. As the fishery is currently largely unregulated, it may be necessary to set some restrictions to prevent the economic extirpation of shark stocks. However, the 2001 blanket ban on all shark fishing may have been an overreaction on the part of authorities, and a compromise that attempts to protect shark stocks while ensuring the livelihood of shark fishers would be a better solution. One important step that can be taken, which is supported

by Vivekanandan among others, would be to ban the practice of finning sharks off the Andaman and Nicobar islands. This step could more easily gain political support, and would help protect a unique and highly diverse ecosystem. Additional regulations on shark fishing may be necessary in the future, but they should be undertaken only with a strong awareness of the impacts of such regulations on fishing populations. Regulations should be accompanied by financial assistance and programs to enable fishers and communities dependent on shark stocks to shift their means of livelihood to other products. In addition, better data concerning stocks of particular species of sharks, skates, and rays would help craft sustainable management regimes that would minimize the impact on fishers and assist the most vulnerable species.

To ensure the sustainable management of shark stocks, it is important to discover the extent to which official landings data is underestimating actual shark landings, and additional research could be done on this topic in the future. More accurate trade-based landings estimates could be produced if a wider time range was analysed, and if better data could be found on destination-specific Indian shark fin exports and imports from India by Singapore, Hong Kong, and China. While inherently uncertain and based on a number of assumptions, the trade-based estimations of Indian shark landings calculated in this paper should be taken into account by the CMFRI, and the Indian government should make sure that the methods they are currently using to estimate shark landings are producing accurate results. The MPEDA trade data on shark fins is clearly an underestimation of actual traded volumes, and the organization could improve the methods it uses to collect information on trade and work with the Indian government to try and ensure that the shark fin trade uses more formal channels.

## Notes

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[2] The term shark is often used to refer to all *elasmobranchii*, a group that contains both sharks and batoids (skates and rays). This shorthand will be used in all cases unless otherwise specified.

[3] While the majority of gillnet and hook and line fishing in India is artisanal, there are some larger mechanized boats that use these gears to catch sharks in mixed-species fisheries.

[4] These figures are subject to debate. Varma (1999), for example, estimates the trawl nets accounting for sixty percent and gillnets for thirty-eight percent of shark landings.

[5] A substantial whale shark fishery using hooks and harpoons existed off the coast of Gujarat for much of the 1990s, but has collapsed in recent years with the whale shark coming under protection (Pravin 2000; Sharma 2001).

[6] Sharks poached by foreign fleets would not make their way into India's export trade, and are reflected neither in CMFRI data nor in later calculations in this paper.

[7] Clarke (2002: 46), for example, argues that actual global trade in shark products may be considerably greater then FAO estimates.

[8] The main consumers of shark fin are ethnic Chinese people worldwide, though the globalisation of cuisine may have helped create limited demand among other groups.

[9] The export of whale shark fins has likely decreased substantially since the 2001 ban on fishing of that species.

[10] There seems to be some confusion as to which hammerhead sharks are commonly caught in Indian waters. While the MPEDA (Chen 1999) identifies *S. zygaena* as one of India's most important shark exports, Hanfee (1999) puts *S. zygaena* in the rare/limited catch category.

[11] Frej and Gustafsson (1990) identify Chennai as the main export port for shark fins in 1987, controlling approximately ninety-two percent of the market, and Vivekanandan (2001) confirms that Chennai is still the major export centre. Hanfee (1999) identifies both Mumbai and Chennai as major export centres.
[12] See Frej and Gustafsson for a more complete -- though dated -- breakdown of prices per fin type and size (1990:26).
[13] Fins are also exported in a dry processed form, but for the purposes of calculations in this paper all dry processed fins have been converted into dry raw fin weights. See the later discussion of Hong Kong imports for more on this point.
[14] The twenty-five percent dry/wet fin weight is taken from Clarke (2002). Other estimates range from twenty percent (Fong and Anderson 2000) to thirty percent (Kuang 1999
[15] For headed and gutted sharks, this proportion would be five percent (IUCN SSG 2003).
[16] Note that the 1998 to 2002 MPEDA data is for the fiscal year of April 1st to March 31st rather then for the calendar year, and actual export figures for the calendar year may be slightly different (MPEDA 2004a).
[17] Clarke argues that if shark fins were being imported by Hong Kong for immediate re-export to China, then there might be an incentive to underreport imports. China charges an import tariff on shark fins, and smuggling of shark fins into the country to avoid the tariff is thought to be fairly common (Clarke 2002:23-24).
[18] See the explanation of Table 1.2 for reasons for summing Hong Kong and Chinese export shares. Additionally, fins are often imported by China for processing before being re-exported to Hong Kong. Unfortunately, the MPEDA reported exports is the only dataset available that records the share of Indian exports destined for different ports, so some uncertainty is unavoidable.
[19] Hong Kong import data include both dried processed fins (customs code 0305-5960) and dried raw fins (code 0305-5950), and here the weights of all dry processed fin imports are adjusted to reflect the weight difference between dried processed and dried raw fins. Dried raw fins weigh roughly three times as much as dried processed fins (Parry-Jones 1996), so the volume of dried processed fin imports is adjusted by 3x to standardize all units in dried raw fins.
[20] Note that MPEDA data does not differentiate between dried raw and dried processed weight. If the composition of MPEDA recorded exports were known, and if the data were adjusted for the weight difference between processed and raw fins, they would probably compare more favourably with (though still substantially understate) Hong Kong import data.
[21] At the time of the ban, there were four shark species found in Indian waters listed in the IUCN red list as 'vulnerable' and one -- the freshwater Ganges shark -- listed as critically endangered (Samudra 2001).
[22] Vivekanandan estimates the total number of fishers and their dependents affected by the ban as up to 1,200,000 people.
[23] The sharks protected under the revised 2001 Schedule 1 listing are the knifetooth sawfish (*Anoxypristis cuspidate*), the Pondicherry shark (*Carcharhinus hemiodon*), the Ganges shark (*Glyphis gangeticus*), the speartoothed shark (*Glyphius glyphius*), the Ganges stingray (*Himantura fluviatilis*), the freshwater sawfish (*Pristis microdon*), the green sawfish (*Pristis zijsron*), the giant guitarfish (*Rhynchobatus djiddensis*), and the porcupine ray (*Urogymnus asperrimus*) (MOEF 2001).
[24] In 2002, after the blanket ban on shark fishing was rescinded, Vivekanandan, on the behalf of the South Indian Federation of Fisherman Societies, made an offer to CMFRI to take scientists on board shark-fishing vessels in the Thoothoor fleet to collect species-specific data on shark landings. This initiative should help improve existing data on the species composition of catches and help evaluate the status of shark populations in Indian waters (Srivastava 2002).
[25] The global economic downturn during 2001 could also have had an effect on Indian shark fin exports and Hong Kong imports, and it is difficult to interpret the exact impact of the ban on the Indian and international shark fin markets.
[26] Hanfee and Watts see declining shark length as a possible indication of overfishing, though there could be other explanations for the phenomenon.
[27] See Appendix C of Clarke's (2002) report for some interesting anecdotal evidence of traders' reaction to fears of overfishing.

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