CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Sixteenth meeting of the Conference of the Parties
Bangkok (Thailand), 3-14 March 2013

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Inclusion of *Sphyrna lewini* (scalloped hammerhead shark) in Appendix II in accordance with Article II paragraph 2(a) of the Convention and satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP14).[1] Inclusion of *Sphyrna mokarran* (great hammerhead shark) and *Sphyrna zygaena* (smooth hammerhead shark) in Appendix II in accordance with Article II paragraph 2(b) of the Convention and satisfying Criterion A in Annex 2b of Resolution Conf. 9.24 (Rev. CoP14).

Inclusion in Appendix II with the following annotation:

The entry into effect of the inclusion of these species in Appendix II of CITES will be delayed by 18 months to enable Parties to resolve the related technical and administrative issues.

Annex 2a, Criterion A. *It is known, or can be inferred or projected, that the regulation of trade of the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future.*

Sphyrna lewini qualifies for inclusion in Appendix II under this criterion because it is over-exploited for its fins, which are large, have a high fin ray count, and are highly valued in trade. This low-productivity species is also taken as bycatch in global fisheries. The greatest threats to this species worldwide are due to the international fin trade and bycatch, which have caused historic declines of at least 15-20% from the baseline for long-term time series in multiple ocean basins. Furthermore, the newborn and juveniles are captured by small-scale fisheries in the nursery zones (Dudley & Simpfendorfer 2006; Hayes *et al*. 2009; Jong 2009; Harry *et al*. 2011). Declines from the mid-1970s, 1980s, and early 1990s to recent years range from 98%, 89% and 76%-89%, respectively, in the northwest Atlantic Ocean. A meta-analysis of multiple times series from various gear types in the Mediterranean Sea suggested declines of a hammerhead shark complex that includes *S. lewini* of up to 99.9% since the early 19th century. Based upon rates of exploitation, this species is likely to become threatened by extinction unless international trade regulation provides an incentive to introduce or improve monitoring and management measures to provide a basis for non-detriment and legal acquisition findings.

Annex 2b, Criterion A. *The specimens of the species in the form in which they are traded resemble specimens of a species included in Appendix II under the provisions of Article II, paragraph 2(a), or in Appendix I, such that enforcement officers who encounter specimens of CITES-listed species, are unlikely to be able to distinguish between them.*

[1] *The CITES listing criteria and definitions must be applied with flexibility and in context. This is consistent with the "Note" at the beginning of Annex 5 in Resolution Conf. 9.24 (Rev. CoP15): "Where numerical guidelines are cited in this Annex, they are presented only as examples, since it is impossible to give numerical values that are applicable to all taxa because of differences in their biology." The definition of "decline" in Annex 5 is relevant to the determination of whether a species meets either criterion in Annex 2a of the resolution. Nonetheless, it is possible for a species to meet the criteria and qualify for listing in Appendix II, even if it does not meet the specific parameters provided in the definition of "decline", which is indeed more relevant to inclusion of species in Appendix I. Where quantitative data are available, they should be used to evaluate a species' status. However, where data on population abundance are not available but there are indications that over-exploitation is or may be occurring (i.e., "it is known, or can be inferred or projected") and the regulation of trade could benefit the conservation of the species, listing should be supported.*

B. Proponent

Brazil, Costa Rica and Honduras[2]

C. Supporting statement (Co-sponsors)

Colombia, Ecuador, European Union and Mexico

1. Taxonomy

1.1 Class: (Subclass:	Chondrichthyes Elasmobranchii)
1.2 Order:	Carcharhiniformes
1.3 Family:	Sphyrnidae
1.4 Genus, species:	*Sphyrna lewini* (Griffith and Smith, 1834)
1.5 Scientific synonyms:	Cestracion leeuwenii (Day 1865), Zygaena erythraea (Klunzinger 1871), Cestracion oceanica (Garman 1913), Sphyrna diplana (Springer 1941).
1.6 Common names:	English: scalloped hammerhead, bronze hammerhead shark, hammerhead, hammerhead shark, kidney-headed shark, scalloped hammerhead shark, and southern hammerhead shark French: requin marteau halicorne Spanish: tiburón-martillo, cachona, cornuda común Portuguese tubarão martelo, tubarão-martelo-entalhado, cambeva, cambeva-branca, cambevota, vaca, vacota, panã
1.7 Code numbers:	Not applicable

2. Overview

Sphyrna lewini is a circumglobal shark species residing in coastal warm temperate and tropical coastal seas. *S. lewini* have among the lowest recovery potential when compared to other species of sharks. Population growth rates determined for populations in the Pacific and Atlantic Ocean are low (r=0.08-0.10 yr^{-1}) and fall under the low productivity category (r<0.14) as defined by Food and Agriculture Organization of the United Nations (FAO) (Section 3.3). Abundance trend analyses of catch-rate data specific to *S. lewini* and to a hammerhead complex of *S. lewini*, including *Sphyrna mokarran* and *Sphyrna zygaena*, have reported large declines in abundance ranging from 60-99% over recent years. A stock assessment using information on catch, abundance trends and biology specific to *S. lewini* from the northwest Atlantic Ocean indicate a decline of 83% from 1981-2005. In the southwest Atlantic Ocean off Brazil, catch per unit effort (CPUE) of inshore fisheries indicate adult female *S. lewini* decreased between 60 and 90% from 1993 to 2001. A meta-analysis of multiple times series from various gear types in the Mediterranean Sea suggested declines of the hammerhead shark complex that includes *S. lewini* of up to 99.9% since the early 19th century. A comparison of standardized catch rates of pelagic sharks (species-specific information was not available) in the Exclusive Economic Zone of Costa Rica from 1991-2000 showed a decrease of 60% in catch rates. Another study found a 71% decline in *S. lewini* populations in the Cocos Island National Park, despite this area being designated a “no take zone” from 1992 to 2004. An independent assessment of shark catch in the Australian-Queensland Shark Control Program found that catch rates of hammerheads have decreased by more than 85% over 44 years. Catch rate information from shark nets deployed off the beaches of South Africa in the southwestern Indian Ocean from 1978-2003 indicated a decline of approximately 64% for *S. lewini.* In the Indian Ocean catch information is available for shark nets deployed off the beaches of Kwa-Zulu Natal, South Africa, in the southwestern Indian Ocean, from 1978-2003. CPUE of *S. lewini* declined approximately 64% over a 25-year period. A 50-75% decline in hammerhead CPUE

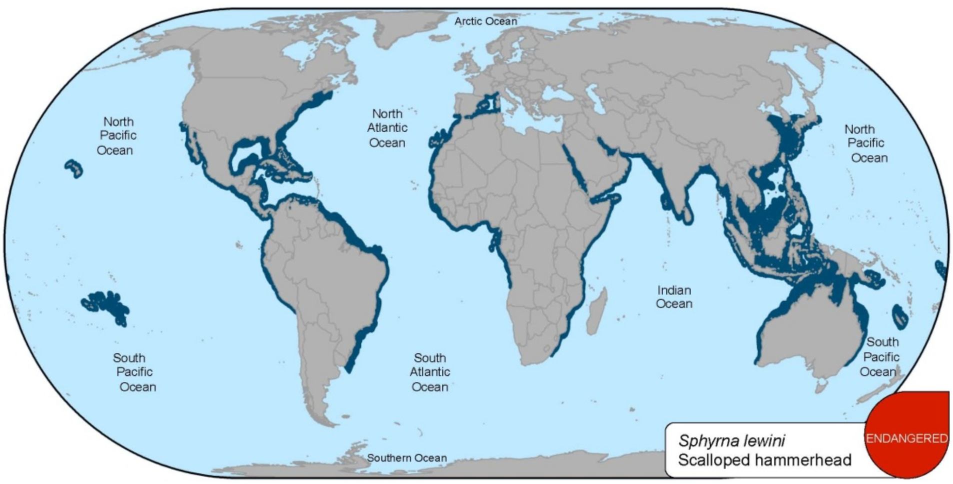
[2] *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat or the United Nations Environment Programme concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

was observed in the Western Australia North Coast Shark Fishery between 1997-1998 and 2004- 2005. This relatively low productive species is listed on the IUCN Red List of Threatened Species as Endangered globally (Section 4).

S. lewini is taken as direct catch or incidental catch in domestic fisheries as well as in multinational fisheries on the high seas. Catches of *S. lewini* are often amalgamated as *Sphyrna spp.* or reported specifically as *S. lewini* or as *S. zygaena.* The United Nations FAO database reports hammerheads in one of three categories: “hammerhead sharks”, “smooth hammerhead”, or “scalloped hammerhead”. Many catches go unreported, and analysis of fin trade data indicates that 49,000–90,000t (or 1.3 to 2.7 million individuals) of *S. lewini* and *S. zygaena* are taken for the fin trade each year (Section 5). An Appendix II listing would have beneficial effects upon the wild populations of these animals by helping regulate the international trade of fins (Section 6). Hammerheads are listed in Annex I of the United Nations Convention on the Law of the Sea (UNCLOS) and therefore should be subject to its provisions concerning fisheries management in international waters. A number of countries have prohibited shark fishing within their Exclusive Economic Zones (Section 7). Palau, French Polynesia the Maldives, Honduras, the Bahamas, and the Marshall Islands have recently prohibited all shark exploitation within oceanic habitats that lie inside their Exclusive Economic Zones. Elsewhere, some countries and Regional Fishery Management Organizations (RFMOs) have implemented finning or retention bans. The International Commission for the Conservation of Atlantic Tunas (ICCAT) has prohibited retention of the family Sphyrnidae that are caught in association with ICCAT fisheries within their fisheries (with the exception of *Sphyrna tiburo*) (Section 8). An Appendix II listing and associated legal acquisition requirements will thus help the aforementioned States, others with domestic prohibitions, and contracting Parties to relevant Regional Fisheries Management Organizations (RFMOs), to ensure compliance with these measures.

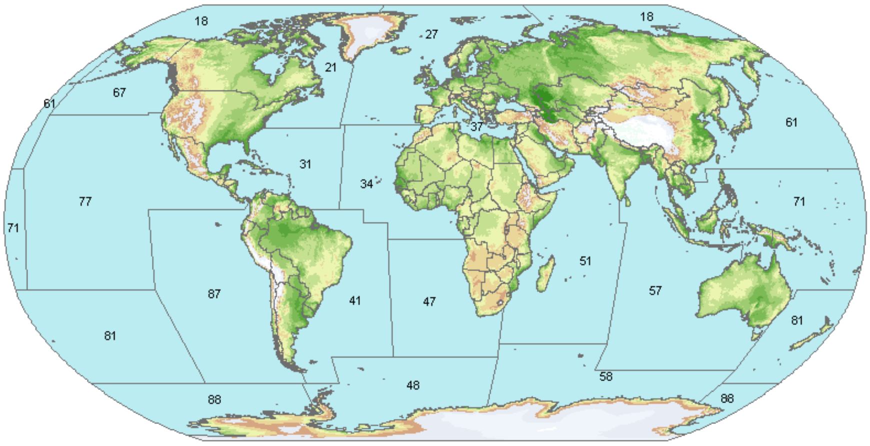
3. Species characteristics

3.1 Distribution



World distribution map for *S. lewini* courtesy of IUCN

S. lewini is a circumglobal shark species residing in coastal warm temperate and tropical seas in the Atlantic, Pacific, and Indian Oceans between 46°N and 36°S to depths of 1000 meters.. In the western Atlantic Ocean, this shark is found from south of New Jersey (United States) to Brazil, including the Gulf of Mexico and Caribbean Sea; in the eastern Atlantic it is distributed from the Mediterranean Sea to Namibia. Sperone et al. (2012) documented the range extension of the species to the central Mediterranean off southern Italy. Distribution in the Indo-Pacific Ocean includes South Africa and the Red Sea, throughout the Indian Ocean, and from Japan to New Caledonia, Hawaii (U.S.), and Tahiti; it is found on both east and west coasts of India, with higher abundance along the east coast. *S. lewini* is found in the eastern Pacific Ocean from the coast of southern California (U.S.) to Ecuador and perhaps as far south as Peru. In Australia, *S. lewini* may be found off the northwestern, northern, and eastern Australia coast. It is found in the following FAO Fishing Areas: 21, 31, 34, 41, 47, 51, 57, 61, 71, 77, and 87.



FAO Fishing Areas courtesy of VLIMAR

In the Colombian Caribbean, the species is registered in the San Andrés Archipielago, Providencia and Santa Catalina (Caldas, 2002), and along the coastline of the continental Caribbean in Isla Fuerte (Caldas, 2002; Orozco, 2005; Vishnoff, 2008; Almanza, 2009; Rey y Acero, 2002; Arriaga *et al*., 1999; Gómez-Canchong *et al*., 2004). Recently the species was registered in the oceanic Caribbean waters. In the Colombian Pacific, juveniles prefer coastal waters, are found in protected areas and river mouths (Gómez y Díaz, 1979), while adults are found in oceanic waters (Tapiero, 1997; Navia *et al*., 2008; Bessudo *et al*., 2011). The species has been registered in all of its development stages in most of the Colombian Pacific (Tapiero, 1997; Navia *et al*., 2008). *Sphyrna lewini* is characterized for doing great migrations in the tropical Eastern Pacific of Colombia with individulas travleing from the Malpelo Sanctuary to Cocos Island and Galapagos Islands (Bessudo *et al*., 2011).

3.2 Habitat

As a coastal pelagic semi-oceanic species, *S. lewini* occurs over continental and insular shelves and adjacent deeper water. It has been observed close inshore, even entering estuarine habitats, as well as offshore to depths of 1000m. Adult aggregations are common at seamounts, especially near the Galapagos, Malpelo, Cocos, and Revillagigedo Islands, and in past times within the Gulf of California. Kotas (personal communication) observed in 1995 to 2009 south of Brazil horizontal migrations of *S. lewini* and its concomitant body growth from the shallower coastal zones (<20m) where the birth zones are located, going through the continental shelves (<200m), where only adults seem to be encountered.

3.3 Biological characteristics

Hammerhead sharks are viviparous. Reproductive cycle analysis from all studies indicates an 8-12 month gestation period followed by a one year resting period.Various studies have examined life history parameters for *S. lewini* (see summary in Annex 1). In the northwestern Atlantic Ocean *S. lewini* appear to grow more slowly and have smaller asymptotic sizes than conspecifics in the eastern and western Pacific Ocean. Growth rates, expressed as the von Bertalanffy growth parameter (k), are 0.05-0.13 year^{-1} in the Atlantic Ocean (Hazin et al. 2001,Piercy et al. 2007), 0.10-0.156 year^{-1} in the eastern Pacific Ocean (Anislado-Tolentino and Robinson-Mendoza 2001, Anislado-Tolentino et al. 2008) and 0.22-0.24 year^{-1} in the western Pacific Ocean (Chen et al. 1990). Kotas et al. (2011) found lower values on at the Brazilian south coast , that is 0.05 year^{-1} for both males and females. Within-basin differences in growth rates are also reported for *S. lewini* sampled off the Central Pacific coast of Mexico (Kmale = 0.131/year, Kfemale = 0.156/year) and those sampled a short distance to the south (Kmale = 0.123/year, Kfemale = 0.100/year; Anislado-Tolentino and Robinson-Mendoza 2001, Anislado-Tolentino et al. 2008). While geographic differences are likely to occur, the much higher growth rate found in the western Pacific Ocean may be due to the growth band interpretation (aging methodology, i.e. in this case the formation of two metal rings/year in place of only one) than true biological differences. A recent life history study of *S. lewini* on the east coast of Australia (Harry et al. 2011) found significant differences in von Bertalanffy growth parameters and age of 50% maturity between sharks caught in tropical waters (L_{∞} = 2119 mm, k = 0·163, LST50 = 1471 mm, A50 = 5·7 years) and those caught in temperate waters (L_{∞} = 320 cm, k = 0·093, L ST50 = 204 cm, A50 = 8·9 years) and the results differed significantly from Chen et al. (1990). The oldest known animal among all populations was 31.5 years for both males and females in the northwest Atlantic Ocean (Kotas et al. 2011) with estimates of 13 to 14 years in the Pacific (Chen et al. 1990, Anislado-Tolentino and Robinson-Mendoza 2001). A recent study by Harry et al. (2011a) estimated 21 yrs for the oldest male and 15 years for the oldest female off the east coast of Australia.

Pregnant females ready to whelp migrate to the birth zones in shallow waters (10 to 20m of depth), where they whelp (Chen et al. 1988; Branstetter 1990; Vooren *et al* 2005; Motta 2006). Jorgenson et al. (2009) and Bessudo et al. (2011b) found that when away from islands, scalloped hammerhead sharks made infrequent nocturnal short dives down to 1000 m where temperatures were as low as 4 °C. Studies indicate high rates of adult site fidelity near seamounts and coastal areas as well as annual homing in nursery areas.

Samples taken from the coasts of Paraná state, south of Brazil, indicated that between 65.1 to 70.5% of the samples were newborn, from 27.1 to 29.2% were juveniles and sexually mature animals were only 2.5 to 5.6%. Thus, 97.6% of the males and 87.2% of the females were immature (M. Almeida, MPEG/Pará, personal communication). In the northern coastal zone of São Paulo State, data are similar, predominating the juveniles (Motta 2006), but the small scale fisheries using small fishing nets not always convert into an adequate sample and estimate of the big specimens which are unable to be seized by their fishing nets.

In comparison with other hammerhead species, *S. lewini* in Mexico has low to intermediate fertility levels (Córtes 2002). The presence of pregnant females and newborn during summer in the central and southeast region of the Gulf of California suggests that these are important nurseries for the common horned in the Gulf of California.

Male and female *S. lewini* in the northwest Atlantic Ocean attain sizes at maturity of 131 cm FL (Fork-Length) male and 180-200 cm FL female (A. Piercy, University of Florida, personal communication) similar to those reported in the Mexican Pacific (Anislado-Tolentino and Robinson-Mendoza 2001), for the northeastern Brazil of 180 to 200 cm total length (TL) male and 240 m TL female (Hazin et al. 2001), and in Indonesian waters (White et al. 2008). Off the coasts of Taiwan Province of China, *S. lewini* males mature at similar sizes as males in the northwest Atlantic (Chen et al. 1988). However, *S. lewini* females in the waters of Taiwan Province of China attain maturity at apparently smaller sizes (152 cm FL) than females in the Northwest Atlantic (161 cm FL). In north Australian waters, *S. lewini* males and females mature at notably shorter lengths than what is reported for many other *S. lewini* populations (Stevens and Lyle 1989). In the Eastern Pacific of Colombia the size of first maturity was estimated at 150 cm LT for males and 200 cm LT for females (Tapiero, 1997).Biologic observations from 1993 to 2006 of *S. lewini* captured with gill nets, profound nets and seines along the south coast of Brazil indicated that males of this species matured with 140 cm, being 100% matured above those with 250 cm total length (TL) (Kotas, CEPSUL/MMA, personal communication). Galina & Vooren (2005) found first reproduction longitudes with 192 cm (males) and 204 cm (females). Noriega et al. (2011) found a positive correlation between female length and litter size in northeastern Australia.

The average litter size of *S. lewini* in northwest Atlantic waters (23; A. Piercy, University of Florida, personal communication) is greater than the mean reported in northeast Brazilian waters (14; Hazin *et al*. 2001) but slightly less than the average litter size found in the waters of Taiwan Province of China and Indonesian waters (25-26; Chen et al. 1988; White et al. 2008). In turn, Vooren et al. (2005) found an uterine fecundity between 15 and 22 embryos south of Brazil. Considering previous information from distinct zones of the globe, the mean number of embryos in the uterus varies between 12 up to 41 per female/year, and the size of the newborn found vary between 31 and 57 cm total length (Castro 1983; Branstetter 1987; Compagno 1984; Chen et al. 1988; Stevens & Lyle 1989; Chen *et al* 1990; Oliveira *et al* 1991; Amorim *et al* 1998; White *et al* 2008; Kotas *et al* 2005). Hazin et al. (2001) did not find a direct relation between the maternal size and the average litter size in *S. lewini.* In the Eastern Pacific of Colombia fecundity is 14 embryos per female, with a range of 2 -25 embryos, the size at birth was determined at 47,42 cm LT (Tapiero, 1997).

The reproductive cycle analysis from all studies indicates an 8-12 months gestation period followed by a resting period of one year. The births occur in spring and summer in shallow waters close to the coast, where the newborn stay during the first months of life (Castro 1983; Branstetter 1987; Chen et al. 1988; Stevens & Lyle 1989; Chen et al. 1990; Oliveira et al. 1991, 1997; Amorim et al. 1998; White et al. 2008; Kotas et al. 2005; Vooren et al. 2005; Motta 2006). According to Vooren et al. (2005) and Motta (2006), the platform south of Brazil is an important birth zone for *S. lewini.* In Costa Rica the reproductive peak is in March and May, particularly in the Central Pacific (Tárcoles) (Zanela *et al*, 2009) and in South Pacific in the wetland of Térraba Sierpe (Clarke et al, 2011).

Demographic analyses using a variety of techniques have found that *S. lewini* have low intrinsic rates of population growth and productivity when compared to other sharks. Using a demographic method that incorporates density dependence, Smith et al. (1998) determined that *S. lewini* figured among the lowest productivity when compared to 26 other species of sharks. Cortés (2002), using a density independent demographic approach, calculated population growth rates (λ) of 1.086 yr^{-1} (r=0.082 yr^{-1}) and 1.60 yr^{-1} for the northwest Atlantic and western Pacific populations, respectively. Generation times (T) are 16.7 and 5.7 years for the Atlantic and Pacific Oceans, respectively. The much higher population growth rate found for the western Pacific population may be the result of the growth information used in the demographic model rather than real differences. Recent ecological risk assessments using updated life history information from the northwest Atlantic Ocean found that the productivity of *S. lewini* sharks was 1.11 yr^{-1} (λ) (Cortés et al. 2009).

In 2008, ICCAT's Standing Committee on Research and Statistics (SRCS) conducted an Ecological Risk Assessment (ERA) for Atlantic sharks, also known as a productivity and susceptibility analysis. The 2008 ERA ranked the scalloped hammerhead 7th and the smooth hammerhead 8th out of 11 in terms of their vulnerability to ICCAT longline fisheries. Cortés et al. (2010) updated that ERA and found that scalloped hammerhead ranked 9th and smooth hammerhead ranked 8th; the estimated productivity of scalloped hammerhead sharks was 1.11 yr^{-1} (λ) (Cortés et al. 2010). In June 2012, the SCRS began updating the ERA for 16 species of sharks, five more species (including *S. mokarran*) than in the 2008 ERA. Preliminary results of the 2012 productivity analysis are similar to those published in 2010 ICCAT (2012) reported productivity rates for scalloped hammerhead in the south Atlantic Ocean were 0.121 yr-1 while those in the north Atlantic were 0.096 yr-1. The 2012 ICCAT ERA, which used updated information, has been partially completed with productivity assessed for 20 stocks (16 species), including *S. lewini, S. mokarran,* and *S. zygaena.* Scalloped hammerheads were 6th (South) and 9th (North) most productive of the 20 stocks considered (some of the 16 species were analyzed separately for north and south areas), while *S. zygaena* was ranked 4th and *S. mokarran* was ranked 11th. The full ERA analysis will be completed and presented as an SCRS document at the September 2012 species group meeting of ICCAT.

Overall estimates of the intrinsic rate of increase for this species (r~0.08-0.105 yr^{-1}) indicate that populations are vulnerable to depletion and will be slow to recover from over-exploitation based on FAO's low productivity category (<0.14 yr^{-1}) (FAO 2001; Musick et al. 2000).

3.4 Morphological characteristics

The three big sized species (*S. lewini, S. mokarran* and *S. zygaena*) are larger than other in the family and grow up to at least 3 m total length in the ocean coast areas around the world.

S. lewini has a front margin of the head scalloped with a central notch; lateral margins of the head very pronounced; ventral apices of the pectoral and caudal fins are dark or black; teeth have a large base and oblique cusp, smooth borders or finely sawn in the larger animals; the first dorsal fin begins on the insertion point or slightly behind the pectoral fins, and the rear tip is in front of the origin of the pelvic fin. The pelvic fin has a straight posterior margin while the anal fin is deeply notched on the posterior margin. The second dorsal fin has a posterior margin that is approximately twice the height of the fin, with the free rear tip nearly reaching the origin of the upper caudal lobe (Compagno 1984).

3.5 Role of the species in its ecosystem

Sphyrna lewini is a high trophic level predator in coastal and open ocean ecosystems. It has a diverse diet, feeding on crustaceans, teleosts, cephalopods and rays (Compagno 1984). An analysis of its stomach contents revealed that the male feed on 42% of *Ancistrocheirus lesueurii* (Orbigny 1842), a species of mesopelagic cephalopod (Klimley 1987). On the other hand, females consumed 63% mesopelagic squid species, *Mastigoteuthis* sp and *Moroteuthis robusta* (VERRIL 1876). Cortés (1999) determined the trophic level to be 4.1 (maximum=5.0) for *S. lewini,* based on diet information. Navia *et al*. (2010) propose that this is the second most topologically important species for the maintainance of the structure of the community in the central fishing zone in the Colombina Pacific.

4. Status and trends

4.1 Habitat trends

S. lewini utilise coastal bays and estuaries as possible nursery areas (Duncan et al. 2006a; McCandless et al. 2007 López *et al.*, 2009, Zanela *et al.*, 2009, Clarke *et al*. 2011). Habitat degradation and pollution affect coastal ecosystems that juvenile *S. lewini* sharks occupy during early life stages. However, the effects of these changes and their ultimate impact on populations of *S. lewini* are currently unknown. In the Eastern Tropical Pacific, there was found to be connectivity between Malpelo, Cocos, and the Galapagos Islands and that hammerheads left the islands based on seasonal cues (Bessudo et al. 2011). Tagging data indicate that scalloped hammerhead sharks use offshore oceanic habitat, but do not regularly roam across large distances. Studies indicate high rates of adult site fidelity near seamounts and coastal areas, especially for females, as well as annual homing in nursery areas (Klimley 1999, Ketchum 2011, Daly-Engel, et al. 2012). Diemer et al. (2011) report on a tagging study from 1984-2009 involving *S. lewini and S. zygaena* along the east coast of South Africa. Maximum and average distance moved was 629 km and 147.8 km for *S. lewini*. Directional movements observed may have been migrations in response to seasonal sea temperature changes. The authors identify coastal locations in Transkei that are of importance to juvenile and subadult hammerhead populations year-round. Tagging data indicate that *S. lewini* use offshore oceanic habitat, but do not regularly roam across large distances. The median distance between mark and recapture of adults along the eastern U.S. from a total of 3,278 tagged individuals taken from 0 to 9.6 years (mean = 2.3 years) was less than 100 km (Kohler and Turner 2001). These sharks are most often encountered over continental or island shelves; it is unusual to capture a hammerhead in the open ocean.

4.2 Population size

Few population assessments are available for *S. lewini*. In the northwest Atlantic Ocean, Hayes *et al.* (2009) conducted an assessment using two surplus production models. Population size in 1981 was estimated to be between 142,000 and 169,000 sharks, but decreased to about 24,000 sharks in 2005 (an 83-85% reduction).

An annual biomass of 2,466.3 tons was estimated for *S. lewini* in the Mexican Pacific (INAPESCA-CONAPESCA 2012). The species present a variation in its intrinsic growth rate (r), depending on the site monitored, being from 0.23 to 0.39 in Michoacán (Anisaldo 2000), and 0.08 in the Gulf of Tehuantepec (INAPESCA-CONAPESCA 2012); similarly, the net reproductive rate (Ro) presents variations, from 11.8 in Michoacán (Anisaldo 2000) to 19.39 in the Gulf of Tehuantepec (INAPESCA-CONAPESCA 2012).

In the Pacific of Colombia an almost total decrease in juveniles of *Sphyrna lewini* was noted in the total captures of the shrimp trawling fishery between 1995 and 2004 (Mejia-Falla y Navia, 2010).

4.3 Population structure

S. lewini has strong genetic traits that distinguish regional populations of this species and mtDNA lineages that appear to have been isolated within ocean basins for hundreds of thousands of years (Duncan et al. 2006b). Recent studies indicate that the Northwest Atlantic, Caribbean Sea, and Southwest Atlantic populations of this species are genetically distinct from each other, as are the Eastern Central Atlantic and Indo-Pacific populations (Chapman et al. 2009). The boundaries between each population are not yet completely defined due to sampling constraints. However, the "Caribbean Sea" population includes Belize and Panama, and the "U.S. Gulf Of Mexico" population covers Texas (U.S.) through south-western Florida (U.S.), and the boundary or transition zone is considered between Texas and Northern Belize (Chapman et al. 2009). The thesis of Nance (2010) characterized the population genetic structure, inferred the evolutionary processes shaping it, and estimated effective population size throughout the Eastern Pacific range of *S. lewini*. She found significant genetic differentiation among seven coastal sites between Mexico and Ecuador using 15 microsatellite nuclear DNA loci, and significant isolation by distance among samples of mtDNA control region haplotypes. In a publication from that thesis, Nance et al. (2011) document that all populations have experienced a bottleneck and that all current values of genetic diversity are at least an order of magnitude smaller than ancestral values, indicating large decreases in effective population size. Ovenden et al. (2011) used eight microsatellite loci and an mtDNA marker and found negligible population genetic structure between northern and eastern Australia. Naylor et al. (2012) analyzed genetic variation in mtDNA from 45 specimens initially identified as the scalloped hammerhead *S. lewini* from the western North Atlantic

(11 specimens), the Gulf of Mexico (6), Senegal (4), Madagascar (3), India (5), Borneo (10), Gulf of California (2), and Taiwan Province of China (4). Their analysis found two strongly divergent clusters; the first cluster included the western Atlantic, Gulf of Mexico, Senegal, Madagascar, India, and Malaysian Borneo, while the second included the Gulf of California, Borneo, and Taiwan Province of China. Naylor found finer substructuring in the Indo Pacific than Chapman et al. (2009).

Ovenden *et al*. (2011) did not find genetic subdivisions between the populations of Indonesia, east and west Australia, this result being apparently associated to the high dispersion capacity of the species.

Duncan *et al*. (2006b) concluded that nursery populations of *S. lewini* linked by continuous coastline have high connectivity, but that oceanic dispersal by adult females is rare. Monitoring of *S. lewini* landings from the industrial fleets in the harbours of Itajaí and Navegantes, Santa Catarina State, Brazil, for the period of 1995 to 2009, indicated a pattern of horizontal distribution for this species in the south coasts of Brazil, that is, newborn in shallow waters ($\leq$ 20m), juveniles on the continental shelf (> 20m and $\leq$ 200m) and adults on the shelf border and slopes (> 200m) (Kotas *et al*. in preparation.

Despite the ability to disperse long distances, recent studies suggest that *S. lewini* are endemic to certain regions. Bessudo et al. (2011a) however estimated that a tagged scalloped hammerhead shark covered a total distance of 1941km, travelling from Malpelo Island through the Cocos Islands to around the Galapagos Islands. Especifically there has been great arrivals in Malepelo Island from February and March, mostly of females, besides there being a resident group of 80-100 animals. (Bessudo *et al.*, 2011).

Males are found to disperse long distances, but female *S. lewini* show no evidence of trans-oceanic movement, instead displaying site fidelity to certain coastlines or nursery areas (Daly-Engel *et al*. 2012). As a result, males help to facilitate gene flow but females define the mitochondrial lineage for *S.lewini*, which has been found to be discrete with a traceable point of origin (Chapman et al. 2009). Thus, females are critical to sustaining or rebuilding the *S. lewini* populations. Consequently, recovery is dependent on the reduction of fishing pressure on these female sharks.

In the southwest Atlantic there possibly exist various population units of the species, determined once the nursery zones of *S. lewini* were detected in the northeast and south of Brazil (Vooren *et al*. 2005; Yokota & Lessa 2006). However, the disembarked volumes in the different regions of Brazil indicate that the mayor abundance of the species occurs in the southeast and south regions of Brazil.

Main sizes captured: In the Mexican Pacific, juveniles <95cm (Bizarro *et al* 2007). In the Gulf of Mexico, capture intervals including from juveniles (40cm) to reproducing adults (310cm) for Yucatán, Tamanlipas and Veracruz; and juveniles and newborn for Tabasco and Tamanlipas (Alejo-Plata 2008; Cruz-Jiménez *et al* 2990, 2010 and 2011; INAPESCA-CONAPESCA 2012; Wakida-Kusunoki *et al* 2010).

4.4 Population trends

Estimates of trends in abundance of *S. lewini* are available for this species (Summary in Annex 2). Given the difficulties in differentiating the species, *S. lewini, S. mokarran*, and *S. zygaena,* and the amalgamation of catch records, estimates of trends in abundance are also listed for hammerheads as a complex.

In Mexico, the indexes of abundance (CPUE) indicate fluctuations along a period of 13 years with a diminishing tendency; it is not known if the cause is overfishing, changed fishery dynamics or influence of natural fenomena (INAPESCA-CONAPESCA 2012).

Atlantic Ocean

Multiple data sources from the Atlantic Ocean have demonstrated substantial declines in populations of *S. lewini*. A standardized catch rate index of a hammerhead complex (i.e., *S. lewini, S. mokarran, and S. zygaena*) from commercial fishing logbook data in the U.S. pelagic longline fishery between 1986-2000 and from observer data between 1992-2005 estimated a decline of 89% (Baum *et al*. 2003), while pelagic longline observer data indicated that *Sphyrna spp.* declined by 76% between 1992-2005 (Camhi et al. 2009).

Standardized catch per unit effort from a shark-targeted, fishery-independent survey off North Carolina (U.S.A.) from 1972-2003 indicated a decline of *S. lewini* by 98% over this 32 year time period (Myers *et al*. 2007).

Off South Carolina (U.S.A.), Ulrich (1996) reported a 66% decrease in population size between population estimates for 1983-1984 and for 1991-1995. However, time series analysis conducted since 1995 suggested the northwest Atlantic population may be stabilized but at a very low level (Carlson *et al*. 2005). An assessment for the hammerhead complex in the northwest Atlantic Ocean, utilising catch and population trend data from multiple studies, found a 72% decline in abundance from 1981-2005 (Jiao et al. 2008).

Also in the northwest Atlantic Ocean, Hayes *et al*. (2009) conducted the most recent assessment using two surplus production models. From this study, population size in 1981 was estimated to be between 142,000 and 169,000 sharks, but decreased to about 24,000 animals in 2005 (an 83-85% reduction).

The recent observation in the western North and South Atlantic Oceans of a rare hammerhead shark closely related to but evolutionary distinct from *S. lewini* suggests that this new lineage had been previously combined in catch data and assessments with *S. lewini* (Pinhal *et al* 2011, Quattro *et al*. (2006), Naylor et al. (2012). As a result, populations may be lower than previously reported.

A meta-analysis of multiple times series from various gear types in the Mediterranean Sea suggest declines of the hammerhead shark complex of up to 99.9% in different time periods, in one case since the early 19th century (Ferretti *et al*. 2008). Elsewhere in the eastern Atlantic Ocean, data indicating trends in abundance are generally not available. However, Zeeberg et al. (2006) suggested that similar population trends for hammerheads (grouped) documented in the northwest Atlantic could be expected in the northeast and eastern central Atlantic. This is because longline fleets in these areas exert comparable fishing effort, and effort is seen to shift from western to eastern Atlantic waters (Buencuerpo *et al.* 1998; Zeeberg et al. 2006).

In the southwest Atlantic Ocean off Brazil, data from fisheries targeting hammerhead sharks indicates bottom gillnet CPUE declined by 80% from 2000-2008 (FAO 2010). The targeted hammerhead fishery was abandoned after 2008 because the species had become rare (Kotas pers. comm. to FAO 2010). Also off Brazil, catch-per-unit effort analyses of inshore fisheries indicate adult female *S. lewini* decreased between 60-90% from 1993-2001 (Vooren and Klippel, 2005). However, nominal catch-per-unit effort from commercial fishing logbook data of the hammerhead shark complex caught by the Brazilian tuna longline fleet from 1978-2007 indicated a relatively stable trend (Felipe Carvalho, University of Florida, personal communication). This indicates that declines may be more severe in inshore areas where *S. lewini* are more common.

Industrial landings of the hammerhead shark complex (mainly *S. lewini* and *S. zygaena*) in the State of Santa Catarina, south of Brazil, were of 6.7 t in 1989, coming to a peak of 570 t in 1994, due to the fast development of net fishing. Later a decrease occurred to 202 t in 1998, 353 t in 2002 and 381 t in 2005. Lastly, in 2008, production reached only 44 t without ever recovering any more to the levels of 1994. However Vooren et al. (2005) comment that fishing statistics are only related to the landed carcases and thus the true extension of catches is unknown.

In the southeast of Brazil the catch statistics include *S. lewini* and *S. zygaena* into the category of "hammerhead sharks", of which about 80% are *S. lewini* (Kotas, personal communication). CPUE reductions (kg/trip) of 96% and 93% were observed for this "category" from bottom gillnet and longline vessels , respectively, in the State of Santa Catarina, south of Brazil (Kotas, 2004; Kotas, personal communication; http://www.univali.br/gep).

Utilizing analysis of covariance models and generalized linear models applied to gill net fishing along the south coasts of Brazil, Kotas et al. (2008) found a catch and CPUE decline of over 80% of the hammerhead sharks complex during the period of 1995 to 2005 (Kotas et al. 2008).

Samples of hammerhead sharks taken between 1995 and 2008 from the operating longline and gill net vessels in the ports of Itajaí and Ubatuba (south and southeast of Brazil) indicated that *S. lewini* are suffering high mortality levels from fishing during its entire life cycle, in other words, from the birth zones (hammerheads' total lengths (LT) between 50 and 60cm) through the continental shelf where the juveniles and adults live, and sub-adults (60 to 180 cm LT), as well as in the open sea on the slopes and borders of the continental shelf where the adults occur (180 to 370 LT). Until 2008, vessels with drift nets normally caught hammerheads between 70 and 370 cm LT (mode 180 cm) (Kotas, personal communication). This unsustainable model of fishing exploitation on the different sizes of *S. lewini* (newborn-juveniles-adults) caused by economic pressure of hammerhead fins for the international market is the main cause of the population reduction of the hammerhead sharks in south and southeast of Brazil.

The industrial deep fishing with gill nets in the south of Brazil is a great threat to recruiting coastal hammerheads. Samples from disembarkations of this fleet in the port of Itajaí, Santa Catarina State, between 2008 and 2009 indicated catches of *S. lewini* newborn and juveniles sized (LT) between 43.7 and 137.5 cm. The mean size caught was 70.2 cm (LT) (n = 1019). Biologic observations between 1993 and 2006 of *S. lewini* caught with gillnets, longline and seines along the south coast of Brazil indicated that males of this species matured at 140 cm, with 100% mature above 250 cm LT (Kotas, personal communication). Galina and Vooren (2005) found sizes of the first reproduction of *S. lewini* at 192 cm (males) and 204 cm (females).

The fishing effort concentrated in spring and summer (reproduction period of this species), as well as in the birth zones in shallow waters and mating areas on the slope banks, provoked a fast decline on the catches of *S. lewini* in the southeast and south of Brazil to the end of 1990 (Kotas 2004; Vooren *et al.* 2005b; SBEEL 2005; Kotas et al. 2006). This phenomenon made the fishing of this species economically unviable (Kotas et al. 1995; Kotas *et al*. 1997; SBEEL 2005).

Vooren *et al*. (2005b) observed the off loading of the industrial fisheries in the port of Rio Grande (Rio Grande do Sul State) between June 2002 and July 2003, where *S. zygaena* occurred in 25% of the off load of the gillnet fleet and 9% of the seines. However, these authors affirm that the CPUE of the hammerhead sharks caught in gillnets diminished drastically, declining from 0.37 t per trip in 2000 to 0.13 t per trip in 2002.

Bizerril and Costa (2001) concluded *Sphyrna tiburo* is an extinct species on the coast of Rio de Janeiro. Comparing studies made on the coasts of São Paulo State in different periods also shows a situation of local extinction of the species (Gadig 2002). Sadowsky (1967), in the region of Cananeia, south of the State, registered 114 samples in four sampled years, and informed that the species was common in the lagoon. More recent monitoring from 1996 to 2003 (Gadig *et al* 2002; Motta *et al* 2005; Motta 2006), in the central-south coasts of São Paulo State did not record any specimens of this species.

<u>Pacific Ocean</u>

In Mexico, populations, catches and offloadings of various shark populations have diminished (Soriano *et al* 2011). Shark catches indicate a sustained decline in the last ten years (D.O.F. 2012). The general trend of production of sharks in the states of Sinaloa and Sonora oscillates, with a clear negative trend (INP 2000). In Sonora, a maximum of 7,000 t were caught in 1980, declining to 3,000 t in 2000, while in Sinaloa a maximum of 5,000 t were caught in 1980, declining to 1,500 t in 2000 (INP 2000).

In the Mexican Pacific Ocean, the CPUE of the longline fishing fleet (100 fish hooks) for *S. lewini* showed a declining trend of 0.19 in 1987 to 0.03 in 1999 (INP 2000). In the Gulf of Tehuantepec the captures of *S. lewini* declined from the maximum of 300 t in 1997 to a few tons in 2006 (Carta Nacional Pesquera 2010). From 2008 to 2010, the annual catch of *S. lewini* in the south zone of the Mexican Pacific showed a declining trend (Soriano *et al* 2011).

Off Central America, large hammerheads were formerly abundant in coastal waters but were reported to be depleted in the 1970s (Cook 1990). In the Eastern Pacific, *S. lewini* were found in a series of separate and potentially small populations (Nance *et al*. 2011). With the small-scale fisheries mainly catching juveniles, the inshore schools of juvenile hammerheads are particularly vulnerable to even the simplest fishing methods. Consequently, *S. lewini* are far less abundant than in the past (Nance et al. 2011). Myers *et al*. (2007) determined a 71% decline in *S. lewini* populations in the Cocos Island National Park (Costa Rica) from 1992-2004, despite this area being designated a “zero catch zone.”

In general, the catch of sharks in Costa Rica shows a decrease of 60% in the relative abundance since 1991 up to 2001 (Arauz et al, 2004). The CPUE (per 1000 hooks) of *S. lewini* in the longline fishery of the Pacific of Costa Rica between 1999 and 2008 resulted in 0.041 ± 0.279 (Whoriskey *et al*, 2011).

In Colombia, although there is capture data of the species in industrial and artisinal fisheries there is no information of CPUE, which makes it difficult to infer population trends; nevertheless, it is evident that the majority of captured individuals (73,7%) are captured below the maturity size (200 cm LT) calculated for the species in the Colombian Pacific (Tapiero, 1997; Mejía-Falla y Navia, 2011; datos Fundación Malpelo), also, Mejía-Falla and Navia (2010) noted the decrease of juveniles in the shrimp trawling fishery between 1995 and 2004, and having no reports of the species in 2007

In Ecuador, catch records for combined *S. lewini*, *S. mokarran*, and *S. zygaena* indicated a peak in landings of approximately 1000 t in 1996, followed by a decline through 2001 (Herrera et al. 2003). Landings of *S. lewini* caught by artisanal longline and driftnet fleets in the Port of Manta (which accounts for 80% of shark landings in Ecuador) were about 160 t in 2004, 96 t in 2005, and 82 t in 2006, a decline of 51% (Martínez-Ortíz et al. 2007).

The incidental catches of hammerhead sharks (*S. lewini*) by tuna vessels which use purse seine nets in the East Pacific show a declining trend from a peak of 1,009 specimens in 2002 to 247 specimens in 2011 (CIAT 2012). In addition, the specimens of *S. mokarran* peaked at 189 in 2003 and declined to 21 in 2011, while *S. zygaena* peaked at 1,205 in 2004 and declined to 436 in 2011 (CIAT 2012).

An independent assessment of shark catch in the Queensland Shark Control Program which was designed to examine long-term trends (44 year dataset) in shark stocks found that catch rates of hammerheads have decreased by more than 85% since the onset of the program (44 year dataset). The preliminary results of this study suggest an overall long-term decline of hammerheads in the Cairns and Townsville regions, where the study was focused (de Jong and Simpfendorfer 2009). Noriega et al. (2011) analyzed data from 1996-2006 from mesh net and drumline fisheries in northeastern Australia from the Queensland Shark Control Program and found a significant decline in *S. lewini* female total length but an increase in catch per unit effort (CPUE).

<u>Indian Ocean</u>

During 1978 to 2003, catch-per-unit effort of *S. lewini* in shark nets deployed off the beaches of Kwa-Zulu Natal, South Africa, declined significantly from approximately 5.5 sharks/km net/year to approximately 2 sharks/km net/year (Dudley and Simpfendorfer 2006). This trend data indicate a decline of ~ 64% over a 25-year period. Dudley and Simpfendorfer (2006) also reported large catches of newborn *S. lewini* by prawn trawlers on the Tugela Bank, South Africa, ranging from an estimated 3,288 sharks in 1989 to 1,742 sharks in 1992.

Although there have been few formal assessments of hammerhead populations in western Australia, a 50-75% decline in hammerhead CPUE was observed in the WA North Coast Shark Fishery for 2004-2005 compared to 1997-1998 (Heupel and McAuley 2007).

For the Indian Ocean, there is a lack of available data, no quantitative stock assessment, and no fishery indicators for *S.lewini.* As a result, the stock status is highly uncertain. Often taken in a range of fisheries in the Indian Ocean, *S. lewini* are vulnerable to these fisheries, particularly the gillnet fishery. Inshore fisheries often exploit the pups found in the shallow coastal nursery grounds. If current fishing effort is maintained or increased, further declines in biomass and productivity will occur. (IOTC 2011)

<u>Global</u>

As explained above, studies on multiple areas indicate that this relatively low productive species has declined to at least 15-20% of the baseline for long-term series. Based upon shorter-term abundance series, recent rates of decline are projected to drive this species down from the current population level to the historical extent of decline within roughly a 10-year period. *S. lewini* is listed on the IUCN Red List of Threatened Species as Endangered globally.

4.5 Geographic trends

None available.

5. <u>Threats</u>

S. lewini is taken as catch and bycatch in domestic fisheries within Exclusive Economic Zones and in multinational fisheries on the high seas. This species is highly desired for the shark fin trade because of the fin size and high fin ray count (i.e. ceratotrichia) (Rose 1996). Fins from the Hong Kong SAR market can be genetically assessed and have been shown to originate in the Indo-Pacific, eastern and western Atlantic Ocean basins. For example, ~21% of the sample was sourced from the western Atlantic (Chapman et al. 2009). Some harvest for meat, usually for local consumption, and other products occurs. They are caught in a variety of fisheries including artisanal and small-scale commercial fisheries, bottom longlines as well as offshore pelagic longlines, gillnets, etc. Hammerheads are generally not a target species but suffer high bycatch and at vessel mortality (Morgan and Burgess 2007, Morgan et al. 2009). Catches of sphyrnids have been reported in the FAO statistics, but only the scalloped hammerhead and the smooth hammerhead are reported as individual species, and most of the catch is reported at the family level, and many countries have only recently begun reporting data. Catches of *S. lewini* are often amalgamated as *Sphyrna spp.* with *S. zygaena.* Despite their distinctive head morphology, hammerheads are largely underreported; discrepancies are evident when compared to trade statistics. The FAO database reports hammerheads in three categories: “hammerhead sharks,” “smooth hammerhead,” and “scalloped hammerhead.” Reported worldwide landings for 2000-2010 increased between 2000 and 2002, decreased about 20% in 2003 and 2004, and then doubled from 2004 to 2005 to over 3750 tonnes. An upward trend continued to a peak of 5486 tonnes in 2007 and then decreased slightly through 2009 to 4900 tonnes. 2010 was a record year (Table 1 and Figure 2). Bromhead et al. (2012) provide information on factors influencing catch and mortality rates of a number of sharks in the Marshall Islands, including scalloped and great hammerhead sharks. Recent increases in overall longline effort along with the large increase in the purse‐seine fishery (Williams and Terawasi 2011) in the equatorial region of the western and central Pacific could imply large increases in fishing mortality over the last two decades.

Table 1. FAO catch statistics for 2000-2009

Species	**Worldwide Landings (tonnes)**										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
(*Sphyrnidae spp.*)	2053	2282	2101	1773	1038	3131	3574	4963	4541	4306	5786
Sphyrna lewini	262	515	798	425	492	328	224	202	158	109	336
Sphyrna zygaena	37	27	40	119	207	298	183	321	380	134	65

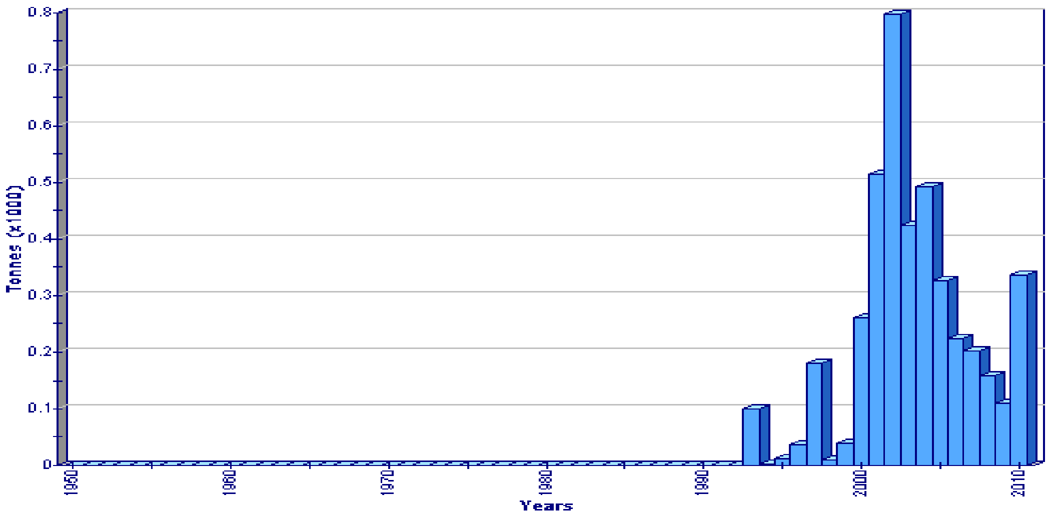


Figure 2. Global capture production for Sphyrna lewini from 1950-2010 (FAO species fact sheet 2012).

<u>Atlantic Ocean</u>

In the northwest Atlantic Ocean, *S. lewini* are targeted and caught as bycatch in bottom and pelagic longlines and coastal gillnet fisheries. In the U.S. fisheries of highly migratory species in the Atlantic, directed shark permit holders using bottom longline gear catch the majority of hammerhead sharks (U.S. Department of Commerce 2011). U.S. catch reports on commercial and recreational landings data (including discards) peaked in 1982 at about 49,000 sharks. Currently landings are only about 2,500-6,000 animals, but this is largely due to increased regulation and reduction in quotas in U.S. shark fisheries (Hayes et al. 2009). Landings in 2010 were 1548 sharks.

Off Belize coast, hammerheads were fished heavily by longlines in the 1980s and early 1990s (R.T. Graham, personal communication to IUCN, 2006). Interviews with fishers indicated that the abundance and size of *Sphyrnids* have declined dramatically in the past ten years as a result of overexploitation, leading to a halt in the Belize-based shark fishery (R.T. Graham, personal observation 2006). However, the pressure is still sustained by fishers driving into Belizean waters from Guatemala (R.T. Graham, personal communication to IUCN, 2006). *Sphyrna lewini* is also taken in various fisheries along the Caribbean coast of South America, in artisanal gillnet fisheries targeting mackerel off Guyana, Trinidad and Tobago, and in pelagic tuna fisheries of the eastern Caribbean Sea (Shing 1999).

In Colombia *S. lewini* is identified as a species of importance in the fishing activities in the Colombian Caribbean (Caldas *et al*., 2009), associated in the capture of several fishing gears like: bottom longlines (Caldas, 2002), artisanal longlines and gill nets (Arriaga, 1999; Vishnoff, 2008; Almanza, 2009), shrimp trawling nets (Duarte *et al*., 2009) and oceanic longlines (Caldas y Correa, 2010). It has been documented the predominance of juveniles in artisinal fisheries (Orozco, 2005; Vishnoff, 2008; Almanza, 2009), preadults in industrial fisheries (Caldas, 2002) and gravid females in artisinal fisheriesl (Gaitán-Espitia y Galofre, 2008).

The two main sources of fishing mortality for *S. lewini* south of Brazil are: fishing of juveniles and neonates on the continental shelf by gillnets and trawl nets (Vooren and Lamónaca 2003; Vooren *et al*. 2005; Kotas and Petrere 2002; Kotas et al. 2005; Doño 2008) and fishing of adults with gillnets and longlines on the continental shelf borders and adjacent oceanic waters (Kotas *et al*. 2000; Kotas and Petrere 2002; Kotas and Petrere 2003; Kotas et al. 2008; Zerbini & Kotas 1998). Thus, the species faces fishing pressure over all its distribution and in all its life phases.

The aggregating habit of *S. lewini* makes it very vulnerable to capture. In the nursery zones (<10 m) south and southeast of Brazil the newborn are intensively fished through coast gillnets, prawn trawls and pair trawls, as well as recreational capture (Haimovici & Mendonça 1996; Kotas 2004; Kotas et al. 2005; Vooren *et al*. 2005).

Combined annual landings of hammerhead sharks in the ports of Rio Grande and Itajaí (Brazil) increased rapidly from approximately 30 t in 1992 to 700 t in 1994, after which catches decreased, fluctuating between 100-300 t from 1995-2002, with the majority of the catch on the outer shelf by surface gillnets (Vooren et al. 2005). In inshore areas (depths down to 10 m), neonates are fished intensively by coastal gillnets and are also caught as bycatch by shrimp trawl, pair trawl, and intensive recreational fisheries. As a result, their abundance in coastal waters has decreased markedly (Haimovici and Mendonça 1996; Kotas *et al*. 1998, 2000; Kotas and Petrere 2002). Since finning of hammerhead sharks is often practiced (Kotas 2000; Vooren and Klippel 2005), the true extent of catches is unknown. The Brazilian pelagic fishery based in Santos catches significant numbers of sharks, including *S. lewini* (Amorim *et al*. 1998). Given the high level of largely unregulated fishing pressure on both juveniles and adults in this region, similar declines to those documented in the northwest and western central Atlantic are suspected here.

S. lewini is caught by both inshore artisanal fisheries and offshore European fisheries operating along the coast of western Africa. A study of bycatch rates in European industrial freeze trawlers targeting small pelagic fish off Mauritania from 2001 to 2005 showed that *Sphyrna* species combined represented 42% of total bycatch during this period (Zeeberg et al. 2006). The Subregional Workshop for Sustainable Management of Sharks and Rays in West Africa (26-28 April 2000 in St Louis, Senegal, Anon 2002) noted the high threat to sharks in the West African region and a noticeable decline in the CPUE of total sharks and rays.Walker et al. (2005) also noted that there was concern for *S. lewini* off Mauritania, with catches exclusively of juveniles. Increased targeting of sharks began in the 1970s, when a Ghanaian fishing community settled in Gambia and established a commercial network throughout the region, encouraging local fishermen to target sharks for exportation to Ghana. By the 1980s, many fishermen were specializing in catching sharks, resulting in a decline in overall shark populations (Walker et al. 2005).

S. lewini is frequently caught along the western African coast and is heavily targeted by driftnets and fixed gillnets from Mauritania to Sierra Leone (M. Ducrocq, personal communication to IUCN 2006). There is concrete evidence for some declines in catches off Senegal and Gambia (M. Ducrocq, personal communication to IUCN, 2006). *S. lewini* were taken as bycatch in the milk shark fishery and in the Banc d'Aguin national park, Mauritania, until the fishery was stopped in 2003, and they are still caught in large quantities in the sciaenid fishery. A specialized artisanal fishery for carcharhinid and sphyrnid species was introduced in Sierra Leone in 1975, and since then fishing pressure has been continuous (M. Seisay, personal observation to IUCN, 2006). Mauritania just began reporting catches to FAO and their 2010 catch is the highest reported by any country since 2003.

Pacific Ocean

Throughout the Eastern Pacific Ocean, juvenile *S. lewini* are heavily exploited in directed fisheries, and are also taken as bycatch by shrimp trawlers and coastal fisheries targeting teleost fish. Fishing pressure directed at juveniles also appears to have increased in parts of the Gulf of California and off western Costa Rica. Increased fishing pressure from international longline fleets in the eastern central Pacific and southeast Pacific, driven by increasing demand for fins, is of concern. Furthermore, as traditional and coastal fisheries in Central America are depleted, domestic fleets have increased pressure at adult aggregating sites such as Cocos Island and the Galapagos Islands, or along the slopes of the continental shelf where high catch rates of juveniles can be obtained (Vargas and Arauz 2001). *Sphyrna lewini* is the second most commonly caught sharks in artisanal fisheries on the Pacific coast, representing 37% of the catch (Rustrian 2010). The Instituto Nacional de Pesca of Ecuador (INP 2010) provides landings data for the hammerhead complex for Ecuadorian ports from 2004-2010 that show little temporal pattern in landings.

In Mexico *S. lewini* is captured by directed fishing, artisanal and surface longliner fleet of medium and deep height. The reported capture rate in the Mexican Pacific is of 24,885 individuals from 1995 – 2008 (Bizzarro *et al*. 2007; Perez-Jiménez et al. 2005; Tovar-Ávila *et al*. 2012; Soriano Velásquez et al. 2000, 2006a, 2006b; INAPESCA-CONAPESCA 2012). The CPUE values varies according to site and season (2.5 to 0.28 ind./trip in Low California, 13.61 ind./trip in Sonora). On the Gulf of Mexico the reported capture rate is 6,216 individuals from 1985 – 2011 (Rodriguez de la Criz et al. 1996; Cruz-Jiménez et al. 2009, 2010 and 2011; Bonfil et al. 1988, 1990, 1993; De Anda 2002; INAPESCA-CONAPESCA 2012).

Bottom set gillnets and longlines produce the majority of the catch Landings data for 1996-1998 from the Gulf of Tehauntepec, Mexico, indicated that *S. lewini* is the second most important shark caught in the artisanal shark fishery, representing 36% of the total catch (Soriano et al. 2002). Bizzarro et al. (2009) provide information on catch in Mexican artisanal fishery camps in one region in 1998-1999 where *S. lewini* were the dominant catch in winter and spring.

In Mexico, *S. lewini* is one of the main shark species caught in artisanal fisheries. *S. lewini* is the second most commonly caught shark species in artisanal fisheries in the Pacific coast representing 37% of the catch (Rustrian 2010). The size of sharks caught and the presence of newborns and pregnant females depended on the season and also suggests that the Gulf of Tehuantepec is a breeding area for this species (Rustrian 2010). *S. lewini* is considered the most important commercial species and has dominated the catch of sharks in Oaxaca (Bejarano-Alvarez 2007) and represents 64% of the artisanal catch (2004-2005) south of Oaxaca. In Chiapas, *C. falciformis* and *S. lewini* represent the majority of catch, a combined 89.3%. While *S. lewini* can be found throughout the year, they are more abundant in the summer, especially pregnant females and newborns. As adults become less abundant moving towards deeper waters, the newborns and juveniles remain along the coast dominating the catch (Bejarano-Alvarez 2007). In Michoacán, hammerhead sharks represent 70% of the catch, and effort is directed at juveniles and pregnant females in the breeding zones. Since hammerhead populations are sensitive to changes in structure and size, Anislado-Tolentino (2001) suggested that *S. lewini* had reduced the size of maturity as a consequence of fishing pressure. Anislado-Tolentino (2001) also found the exploitation rate to be 0.66, indicating that the capture of hammerheads is of more than half the population, leading to overexploitation in the region.

In the Gulfs of California and Tehuantepec represents over 80% of the total of hammerhead captures (Alejo-Plata et al. 2008); while in the Gulf of Mexico represents only 5%. The high proportion of newborn and juveniles of hammerhead sharks captured with gill nets in shallow coastal waters suggests that the main nurseries are submitted to high fishing pressure (Castillo-Géniz 1998).

Off Pacific Guatemala, the importance of this species in the fishery landings appears to vary across areas, from 6% to 74% of the total catch from 1996-1999 (Ruiz and Ixquiac 2000). Data from El Salvador collected in 1991-1992, indicated this species represented 11.9% of the landed catch in a sample of 412 specimens (Villatoro-Vaquiz and Rivera-Gonzalez 1994).

Based on information provided from each country, *S. lewini* represented 51% of the total catch of sharks, mostly neonates, in 2009 in Central America, with gillnets as the main gear. *S. lewini* are caught in inshore artisanal and small-scale commercial and offshore fisheries. Pelagic and fixed bottom longlines, fixed bottom nets, bottom and pelagic trawls, and gillnets are all used to catch *S. lewini*. During this study, El Salvador was found to catch the most *S. lewini,* particularly juveniles. In 2009, the biomass for *S. lewini* in the Central American region was estimated at 54,230 mt This estimate is based on the catch of 5,438 mt from the artisanal fleet using gillnets and longlines near the coast (Siu Navarro 2012). *S. lewini* ranged between 31-275 cm in total length. Fishing in the nursery areas has a negative effect on the biomass, especially when *S. lewini* are caught prior to first maturity. An acceptable biological catch was noted at

4,782 mt, but the current catch was 5,438 mt suggesting that fishing, particularly in the nursery areas, should be reduced (Siu Navarro 2012).

In Panama, from 2009-2011, artisanal fishermen, mainly using gillnets, primarily caught *S. lewini,* with 96% of the catch comprising neonates and juveniles. While considered as a bycatch fishery, the meat of the younger sharks is profitable, suggesting that fishermen target the smaller *S. lewini* (Arriatti 2011).

In Colombia this species is captured regularly in drift net fisheries, although it is also captured in hand lines and longlines, shrimp trawling fishery in all of its life stages; Due to high concentrations, especially gravid females this species is vulnerable to be capture which represent a great threat (Mejia-Falla y Navia, 2011). Although capture reports have decreased, fishing efforts continue in their distribution areas which indicate a major threat for the species.

Gribble et al. (2004) determined that *S. lewini* constituted a large proportion (18%) of the Queensland East Coast (Australia) shark catch and had a high-risk sustainability due to a combination of low productivity and relatively high mortality. Harry et al. (2009) found that great and scalloped hammerheads, which combined make up about 30% by weight of the total shark catch in the East Coast Inshore Finfish Fishery on the East coast of Queensland, can withstand a moderate amount of fishing pressure because the species is still quite common. The study also found that these species are extremely susceptible to all types of fishing, as all size classes may be caught in nets regardless of the mesh size. Harry et al. (2011b) found male biased harvest within the Great Barrier Reef. Reid et al. (2011) document a decrease in average size since 1950 in the catch from the New South Wales, Australia, Shark Meshing Program.

Data on Ecuador's Fisheries see Annex 6.

Indian Ocean

Sphyrna lewini is captured in various fisheries throughout the western Indian Ocean. Countries with major fisheries for sharks include the Maldives, Kenya, Mauritius, Seychelles and United Republic of Tanzania (Young 2006). Sharks are considered fully to over-exploited in these waters (Young 2006).

S. lewini are often targeted by semi-industrial, artisanal, and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish and purse seine fisheries) in the Indian Ocean. There is little information on the fisheries prior to the early 1970s, and some countries continue not to collect shark data. Other countries collect data, but do not report it to the Indian Ocean Tuna Commission. It appears that significant catches of sharks have gone unrecorded in several countries and many catch records likely under-represent the actual catches of sharks. *S. lewini* is captured in various fisheries throughout the western Indian Ocean. Countries with major fisheries for sharks include Kenya, Mauritius, Seychelles, and United Republic of Tanzania (Young 2006). Sharks are considered to be fully overexploited in these waters (Young 2006).

S. lewini is one of five dominant species in the catches of Oman. Henderson et al. (2007) surveyed landings sites in Oman between 2002 and 2003 and reported a notable decline in catches of *S. lewini* in 2003, although the trend varied between areas, and large pelagic sharks, such as *S. lewini,* were displaced during 2003 by smaller shark species. Informal interviews with fishermen also revealed a general trend of declining shark catches over the last number of years, particularly large pelagic species (Henderson et al. 2007). A study of directed shark fisheries at two sites in southwest Madagascar (2001-2002) showed that hammerhead sharks represented 29% of sharks caught and 24% of the total wet weight, but species-specific data are not available (McVean et al. 2006). *S. lewini* is one of the main shark species caught by foreign longliners licensed to fish in Mozambican waters in 2010 and by the longliner fleet based in the Island Reunión (IOTC 2011).

Off Indonesia, *S. lewini* is a target and bycatch species of shark longline, tuna gillnet, and trawl fisheries in several areas of this region (White et al. 2006, SEAFDEC 2006). White et al. (2008) noted that substantial catches of *S. lewini* were taken by gillnet and longline fisheries. Inshore fishing pressure is intense throughout Southeast Asia and juveniles and neonates are heavily exploited, with large numbers of immature sharks caught in other areas (SEAFDEC 2006). Foreign vessels are also reported to target sharks in eastern Indonesian waters (Clarke and Rose 2005). Given the marked declines in this species' abundance in areas for which data are available, there is reason to suspect that declines have also occurred in other areas of the Indian Ocean and Western Pacific, where fishing pressure is high.

India responded to the U.S. range state consultation request and provided the following information. *Sphyrna lewini* is caught in floating and bottom gillnets, floating longlines and hook and lines in India. It is utilized fresh and dried-salted for human consumption, the liver is processed for oil, and fins have high export value. During 2000-2002, *S. lewini* contributed 8.1% of total shark landings at Cochin Fisheries Harbor, with a size range of 1.2 to 1.5 m. From 2007-2011 *S. lewini* contributed 8.1 to 16.1% of total shark landings at Cochin with size generally declining over time (see Table 2). Present landings shows an increasing trend, but with large quantities of small sharks being landed, a sign of overexploitation.

Table 2. Details of *Sphyrna lewini* landed at Cochin Fisheries Harbour, India by Mechanised drift Gillnet-Hook and Line units (2007-2011) (Source : Demersal Fisheries Division, CMFRI).

Year	*S. lewini* Catch (t)	% in total shark landings	Size range (m)
2007	71.25	8.1	1.1-2.79
2008	204.1	14.8	0.9-2.89
2009	298.94	16.1	0.7-3.19
2010	229.27	15.8	0.7-2.99
2011	227.07	12.2	0.7-3.19

6. Utilization and trade

6.1 National utilization

Hammerhead meat is considered unpalatable because of high urea concentrations, but it is consumed domestically (Rose 1996). According to Vannuccini (1999), countries documented to consume hammerhead meat (usually salted or smoked) include Mexico, Mozambique, Philippines, Seychelles, Spain, Sri Lanka, China (Taiwan), Tanzania, and Uruguay. *S. lewini* is a preferred species for production of leather and liver oil (Rose 1996). There is utilisation of jaws and teeth as marine curiosities. In some countries, shark fins are retained for local consumption.

There exist catches for recreational purposes fishing with gears in some coastal zones, mainly on the entire southeast coasts of the United States. In the south of Brazil, during November (springtime) to March (summer) there are records of hammerhead catches on the amateur fishing grounds for *Sphyrna lewini* and *Sphyrna zygaena*, from 20 to 72 samples per fisher/day, mainly being first year juveniles, with total lengths (LT) between 45-60 cm (Peres and Klippel 2005). In Brazil, the least size allowed is LT = 60 cm. In this case, the annual CPUE for hammerhead sharks, from 1999 to 2004, oscillated between 5 to 9 samples per fisher/day. In the State of Rio Grande do Sul, south of Brazil, the amateur fishery is an important recreational activity and in expansion.

CEAGESP, located in São Paulo city, is considered one of the largest Brazilian wholesale fish markets, which commercialised shark meat in two categories: “cação caçonete” and “cação congelado” (freezed cação), at mean values quoted on 04/07/2012 at R$ 4.8 and R$ 5.3 per kg, respectively (http://www.ceagesp.gov.br/cotacoes/?grupo=6&data=04%2F07%2F2012&consultar=Consultar&grupo_nome=Pescado). These two categories include various species of carcharhinids and sphyrnids.

The artisanal fisheries of hammerheads have been an important source of food and employment in Mexico for many years. This fishery is multi-specific and based on seasonal abundance of several species (Castillo-Géniz 1998), including the hammerhead shark *Sphyrna lewini*.

In the Colombian Pacific *lewini* es considered of high commercial values, whose meat is consumed locally and nationally, fins are exported and oil is extracted from its liver. The meat has high commercial value in the port of Buenaventura (in relation with other shark species) and has high sale value in the interior of the country. Its mandibles and teeth are commercialized as art crafts and its vertebrae uses for shark cartilage for medical uses against cancer. (Navia *et al*., 2008). In the Colombian Caribbean meat, fins and liver oil are commercially used (Vishnoff, 2008; Almanza, 2009; Anguila y Hernández, 2011, Caldas *et al*., 2009).

6.2 Legal trade

Presently over 11,000 annual tons of sharks and rays are caught in Brazil corresponding to 3% of the total sea extracting fish caught (IBAMA 2005).

International shark trade information is not documented at species' level for sharks in the Harmonized Commodity Description and Coding System (Harmonized System); therefore, specific information about overall quantities or value of imports or exports is not available. International trade of *S. lewini* products is unregulated. The problem of species-specific trade data is also hampered by the fact that most parties do not report catches at species level to FAO or RFMOs. However, information on the trade of shark fins can be obtained by examination of the Hong Kong SAR fin market, whose trade in fins represented 65-80% from 1980-1990 (Clarke 2008) and 44-59% of the market from 1996-2000 (Fong and Anderson 2000; Clarke 2004). Prior to 1998, imports of fins to Hong Kong SAR were reported as either dried or frozen ("salted") without distinguishing between processed and unprocessed fins. In order to avoid double counting of fins returning to Hong Kong SAR after having been processing in mainland China, only unprocessed dried and frozen fins were included into total imports to Hong Kong SAR. Hong Kong SAR shark fin traders use 30–45 market categories of fins (Yeung *et al*. 2000), but the Chinese names of these categories do not correspond to the Chinese taxonomic names of shark species (Huang 1994). Instead, Chinese market categories for shark fins appear to be organized primarily by the quality of fin rays produced and secondarily by distinguishing features of dried fins. Using commercial data on traded weights and sizes of fins, the Chinese category for hammerhead shark, coupled with DNA and a Bayesian statistical model to account for missing records, Clarke *et al*. (2006a,b) estimated the percentage and volume of *Sphyrnidae spp* traded by means of the fins, globally (see section 6.3.2).

For information on shark exports and imports from Mexico see Annex 5.

6.3 Parts and derivatives in trade

Fins are one of the primary products from *S. lewini* in international trade (see section 6.2). There is some international trade in meat. Other types of *S. lewini* products, including skin, liver oil, cartilage, and teeth, are not traded in large quantities or are not separately recorded in trade statistics (Clarke 2004). Demand for these products appears to fluctuate over time with changes in fashion, medical knowledge, and the availability of substitutes. While the current volume of traded meat and other products specific to hammerheads is unknown, it is likely that this amount is insignificant when compared to the volume of fins in trade. There are numerous difficulties in using the existing trade databases to quantify trends in the shark trade by species. For example, none of the 14 commodity categories used by FAO for chondrichthyan fishes can be taxonomically segregated, with the exception of four categories for various forms of dogfish sharks (Squalidae family). Furthermore, because of non-specific reporting of both trade and capture production figures by many countries, sharks are commonly aggregated into generic fish categories. Therefore, at present, quantitative analysis of shark product trade based on FAO data can only be conducted for generic shark products. The use of commodity codes also varies considerably among countries, further complicating the traceability of products by species and provenience. Information on trade of *S. lewini* products, other than fins, is mostly from observation of personnel in the field.

6.3.1 Meat

Shark flesh is used for meat in some regions, most particularly in Europe, with northern Italy and France as the major consuming countries and Spain as the world's largest exporter of shark meat (Vannuccini 1999). While hammerhead sharks have the highest urea concentration, which gives the meat a particular smell and a somewhat bitter and acid taste, some reports indicate imports and exports of hammerhead meat. According to Lovatelli (1996), Kenyan dried and salted shark meat is sold in units of 16 kg and by grades (1-6). Quality, as well as species, determines grades. Grade 1 is the highest quality and includes hammerhead shark, which is preferred for exports inside Africa. Imports of hammerhead meat from the Seychelles to Germany were noted by Fleming and Papageogio (1996). Although trade information is not documented to species, Vannuccini (1999) indicated hammerhead shark meat was a favored imported species for meat in countries like Spain and Japan. Uruguay indicated exports of hammerhead meat to Brazil, Spain, Germany, Netherlands, and Israel (Vannuccini 1999).

6.3.2 Fins

Hammerhead shark fins are highly desired in the international trade because of the fin size and high needle (ceratotrichia) count (Rose 1996). According to Japanese fin guides (Nakano 1999), *S. zygaena* fins, which are morphologically similar to *S. lewini*, are thin and falcate with the dorsal fin height longer than its base. Because of the higher value associated with the larger triangular fins of hammerheads, traders sort them separately from carcharhinid fins, which are often lumped together. An assessment of the Hong Kong SAR shark fin market has revealed that various Chinese market categories contain fins from hammerhead species: “Bai Chun” (*S. lewini*),“Gui Chun” (*S. zygaena*), “Gu Pian” (*S. mokarran*), and the general category “Chun Chi” containing both *S. lewini* and *S. zygaena* in an approximately 2:1 ratio, respectively. Abercrombie et al. (2005) reported that traders stated that hammerhead fins were one of the most valuable fin types on the market. Compilation of market prices from auction records indicated an average, wholesale, unprocessed fin market value of US $135/kg for “Gu Pian,” $103/kg for “Bai Chun,” and $88/kg for “Gui Chun,” indicating preferences for these species in trade (Clarke 2003). Fowler and Séret (2010) report more recently that hammerhead fins from the European Union (EU) sold to Asian ports for 27.50€/kg (~ $100/lb). Together, *S. lewini, S. mokarran,* and *S. zygaena* account for nearly 6% of the identified fins entering the Hong Kong SAR shark fin market (Clarke et al. 2006b). *S. lewini* and *S. zygaena* account for 4.4% of the fin trade. News reports from May 2012 report that DNA tests of shark fins in Taiwan Province of China by the Taiwan Fisheries Agency identified scalloped hammerhead fins in fish markets in Taiwan Province of China. Chapman *et al*. (2010) used mitochondrial control region (mtCR) sequences to trace the broad geographical origin of 62 Hong Kong SAR market-derived *Sphyrna lewini* fins. Of these fins, 21% were derived from the western Atlantic, where this species is listed as ‘Endangered’ by the International Union for the Conservation of Nature (IUCN). An August 2012 study found one *S. lewini* and one *S. zygaena* in samples from shark fin soup in U.S. restaurants. Using commercial data on traded weights and sizes of fins, the Chinese category for hammerhead shark fins, coupled with DNA and Bayesian statistical analysis to account for missing records, Clarke *et al.* (2006a,b) estimated that between 1.3 and 2.7 million sharks of these species, equivalent to a biomass of 49,000–90,000t, are taken for the fin trade each year.

6.4 Illegal trade

There is little regulation of trade in these species, and the extent of illegal trade activities is unknown. Most RFMO regulations and some national laws prohibit finning sharks at sea (discarding the carcass and transhipping the fins at sea). With the exception of finning sharks at sea, which is prohibited under most Regional Fisheries Management Organizations’ regulations and some national laws, there is little control of trade in this species (however, see 2010 ICCAT provision below). Other countries have an outright ban on the trade of sharks. For example, The Bahamas banned the sale, import, and export of sharks, shark parts, and shark products within its waters. The Maldives and Marshall Islands also prohibit the trade of sharks. In addition, Guam and the Commonwealth of the Northern Mariana Islands (U.S. territories) both prohibit the sale or trade of shark fins within their waters. ICCAT members are prohibited from retaining, transhipping, landing, storing, selling, or offering for sale any part or whole carcass of hammerhead sharks from the family Sphyrnidae (except Sphyrna tiburo). While Developing coastal States are exempt from this prohibition, they are to ensure that Sphyrnidae do not enter international trade. Thus, there should be no trade occurring from ICCAT fisheries. To date, the ICCAT Compliance Committee has not reviewed the contracting Parties’ implementation of this measure. All ICCAT Parties have not reported on their domestic implementation, so their level of international trade that may be out of compliance is unknown. It is likely possible that neither potential exporting nor importing countries of these products have not implemented domestic regulations to monitor or prevent such trade. Furthermore, not all potential importing countries are parties to ICCAT and may not be aware of or required to comply with this measure

Hammerhead sharks have been documented in illegal, unreported, and unregulated (IUU) fishing activities. For example, about 120 longline vessels were reportedly operating illegally in coastal waters of the western Indian Ocean prior to 2005, and this number was expected to increase (IOTC 2005). These vessels were primarily targeting *Sphyrna* spp and *Rhynchobatus djiddensis* for their fins (Dudley and Simpfendorfer 2006). Illegal fishing by industrial vessels and shark finning are reported in other areas of the Indian Ocean (Young 2006).

There has also been a large increase in the illegal, unregulated, and unreported (IUU) fishing in northern Australia in the last few years (J. Stevens, pers. obs.). Illegal fishing around the Galapagos is conducted by local fishermen and artisanal and industrial fleets from continental Ecuador and abroad, often targeting sharks for their fins (Coello 2005). While species' specific data is unavailable, *S. lewini* is one of the most common species around the Galapagos (J. Martinez personal observation), and given the high value of its fins, it is very likely that *S. lewini* is targeted in illegal finning activities. The Ecuadorian Government issued a decree in 2004 prohibiting fin export from Ecuador. Unfortunately, the decree only resulted in establishing new illegal trade routes, with fins exported mainly via Peru and Colombia. Interviews with fishers and traders in Ecuador and Peru suggest there are illegal trade routes for fins transported both from Ecuador and from Galapagos to Peru (Saenz 2005; WildAid 2005). Reports in October of 2011 document the illegal killing of up to 2000 hammerhead sharks near the Malpelo Island wildlife sanctuary in the Pacific waters of Colombia (http://www.guardian.co.uk/environment/2011/oct/19/shark-massacre-colombia). Palau fined a ship from Taiwan Province of China US$65,000 for illegal shark finning it its waters (http://www.fijitimes.com/story.aspx?id=193824). A Japanese tuna transhipment vessel was fined US$125,000 for violating a ban on shark fishing in waters of the Marshall Islands (http://www.fijitimes.com/story.aspx?id=194235).

Lack and Sant (2008) compiled an assessment on illegal hammerhead shark fishing (non-declared nor regulated) extracted from the available literature. These authors found *Sphyrna spp.* and silky shark (*Carcharhinus falciformis)* to be the most frequently cited species taken in illegal fishing. More recent acts of illegal fishing in 2011 include 2,000 finless hammerhead, Galapagos, and whale shark carcasses found in the Malpelo Wildlife Sanctuary (Colombia), and 357 dead sharks, including hammerheads, caught within the Galapagos.

In Belém, north of Brazil, in May 2012, a surveillance operation of IBAMA apprehended a non-declared load of over 7 tons of hammerhead fins of several species, without their respective carcasses, characterizing the violation as *finning*. Through the photos of the apprehension it is possible to distinguish "tall" fins, that is, from hammerhead sharks.

In Brazil, the trade of hammerhead sharks is not regulated and frequently one observes fin purchasers from foreign (Asian) countries. Many of such purchasers also sell equipments for fishing operations and frequently are seen trading fins in different communities along the coasts. During the development of gillnet fishing south and southeast of Brazil, at the, en of the 1980s and beginning of 1990, many shark fishers paid for the acquisition of nets, equipments an fuel for the rations by means of selling shark fins (Kotas, personal communication).

6.5 Actual or potential trade impacts

Though *S. lewini* is landed and sold in domestic markets and contributes to subsistence needs in some coastal communities, the predominant demand for this species is the international fin trade. Current landing levels may be unsustainable (see section 6.3). The management of this trade, for example, through the introduction of management measures that will enable non-detriment findings to be made, should reduce fisheries mortality and promote population recovery.

7. Legal instruments

7.1 National

In 1998, the Environmental Agency of the Brazilian Government (IBAMA – Brazilian Institute for the Environment and the Natural Renewable Resources) made a first effort to control finning (taking the fins and discharging the carcasses of hammerhead sharks) (Portaria IBAMA 121 dated 24/08/1998), prohibiting that practice in all operating vessels in Brazilian waters (Kotas *et al.* 2005; Kotas *et al.* 2000). As the execution of this law proved to be difficult, it was recommended to unload the carcasses with the fins attached to the hammerhead bodies (as well as for other shark species). In 2004 the Normative Instruction MMA nº 05 was published establishing the list of fauna endangered by extinction and the over-exploited species in Brazil. *Sphyrna. lewini* and *S. zygaena* are listed among the over-exploited species. The Normative Instruction MMA 53/2005 establishes the minimum size of marine and estuarine species for capture on the south and southeast coasts of Brazil. Among the marine species are *S. lewini* and *S. zygaena*, with minimum length of 60 cm for capture. In Brazil laws exist that limit the extension of the pelagic gillnets as well as prohibit trawl fishing at a distance less than 1.5 to 3 nautical miles from the coast (depths equivalent to less than approximately 10 m). However, compliance with these laws has proven to be very difficult. Thus, trawl and gillnet activities in nursery areas continue.

Presently, for the Brazilian coasts the establishment of marine areas with fishing exclusion is recommended, so as to protect the nurseries of various species of elasmobranches including the hammerhead sharks. Migratory corridors that protect the migratory path of various species, that is, from the shallow environments up to the area of the banks are recommended (Anónimo 2002; Vooren and Klippel 2005).

In Colombia this species is protected from finning by Resolution 1633 of 2007, which prohibits this practice in Colombian waters, and Resolution 003333 of 2008 which forbids direct fishery of sharks in the Archipelago de San Andrés, Providencia and Santa Catalina (Colombian Caribbean). In the National Plan of Action for the Conservation and Management of Sharks, Mantas and Rays (Caldas *et al*., 2010), it was classified as as a species of High Priority and Very High Priority in the Caribbean and Pacific respectively for its conservation, base on four criteria (fishery relation, commercialization, distribution, and IUCN criteria). Some registers and captures are associated to the protected areas system of the Colombian National Natural Parks.

Honduras decreed its national waters as a “Shark Sanctuary” in July 18, 2011, prohibiting capture of all species of sharks and the practice of finning.

S. lewini should benefit from legislation enacted by French Polynesia (2006), Palau (2003, 2009), Maldives (2010), Honduras (2011), The Bahamas (2011), Tokelau (2011), and the Marshall Islands (2011) to prohibit shark fisheries throughout their Exclusive Economic Zones. Other countries have protected areas where no shark fishing is allowed, such as Cocos Island (Costa Rica), Malpelo Sanctuary (Colombia), and the marine reserve of Galapagos Islands (Ecuador). Countries including the United States and Chile require sharks to be landed with their fins naturally attached. Shark finning bans implemented by 21 countries, the European Union, and nine RFMOs could also help reduce some shark mortality (Camhi *et al.* 2009). Cases of illegal fishing and shark finning that still occur in these places, such as Malpelo, indicate the need for measures to prevent countries from importing fins that were obtained illegally (Section 6.4).

In the United States, scalloped hammerheads (*Sphyrna lewini*) are managed as part of the Atlantic Large Coastal Shark Complex with a separate stock assessment. It is overfished and undergoing overfishing (NMFS 4th Quarter 2011 stock status). A new stock assessment for the northwestern Atlantic was released April 2011 Under the Magnuson Stevens Act there is a two year deadline to implement a rebuilding plan to end overfishing. The stock assessment estimated that a total allowable catch (TAC) of 2,853 scalloped hammerhead sharks per year (or 69 percent of the 2005 catch) would allow a 70 percent probability of rebuilding to MSY in 10 years. Great hammerhead (*S. mokarran*) and smooth hammerhead (*S. zygaena*) are also part of the Atlantic Large Coastal Shark Complex, but are assessed at the complex level. The overfished and overfishing status of this complex is unknown as of the 4th quarter of 2011 (NMFS 4th Quarter 2011 stock status). For all three species there are quotas, limited entry, time-area closures, recreational bag limits, and the requirement that all sharks be offloaded from vessels with their fins naturally attached. Finning in U.S. waters was banned in December 2001 with passage of the Shark Finning Prohibition Act. The requirement to land sharks with their fins naturally attached was adopted in January 2011 with passage of the Shark Conservation Act. In August 2011, the United States published a final rule to prohibit the retention of great, smooth and scalloped hammerhead sharks caught in associations with ICCAT fisheries. On August 14, 2011 the U.S. government received a petition to list scalloped hammerhead sharks under the Endangered Species Act (ESA). A decision on whether to propose ESA listing of the species is due in October.

Camhi *et al*. (2008) reported that finning bans had been implemented by 19 countries and the European Union (EU) that do not allow the total weight of shark fins landed or found on board to exceed 5 percent of the total weight of shark carcasses landed or found on board. The countries include: Australia, Brazil, Canada, Cape Verde, Colombia, Costa Rica, Ecuador, Egypt, El Salvador, French Polynesia, Israel, Japan, Mexico, Namibia, Nicaragua, Oman, Palau, Panama, Seychelles, South Africa, Spain, and the United States. Since 2008 additional or more restrictive bans have been implemented in Honduras, United States, Chile, Mexico, Taiwan Province of China and the Bolivarian Republic of Venezuela. In November 2011, the European Commission proposed a more complete shark finning ban in EU waters and by EU fishermen worldwide.

Shark fishing is prohibited within the large areas of tropical open Pacific Ocean habitat that lie within the extensive Exclusive Economic Zone of Palau, French Polynesia, the Maldives, Honduras, Bahamas, and the Marshall Islands. In an effort to help stop the illegal finning occurring in the Galapagos, the Ecuadorian Government issued a decree in 2004 prohibiting fin export from Ecuador. Unfortunately, the Decree resulted in establishing illegal trade routes, with fins now being exported mainly via Peru and Colombia where there is no finning ban in place. Moroccan management measures include 5% maximum total harvest, logbook requirements, prohibition on manipulation of sharks on board, and prohibition on finning and oil extraction. The Spanish Ministry of Environment and Rural and Marine Affairs prohibited the capture of scalloped hammerhead sharks by means of a Ministerial Order that entered into force on 1 January 2010. According to the order, Spanish fishing ships will not be able to catch, transfer, land or commercialise these sharks in any of the fishing-grounds they target. In 1998 the Brazilian Government Environmental Agency (IBAMA - Brazilian Institute of Environment and Renewable Natural Resources) made a first attempt to control "finning" (IBAMA Portaria 121 of 24 August 1998), prohibiting the practice in all vessels operating in Brazilian waters (Kotas et al., 2005; Kotas et al., 2000). Implementation of this law was difficult, and subsequent laws required landing of the carcasses with fins attached for hammerhead sharks and other shark species. This new law was published in 2004, the MMA Normative Instruction n. 05. Brazil also implemented minimum size restrictions for *S. lewini and S. zygaena*.

In Mexico, the utilization of this species is regulated by the General Law for Sustainable Fisheries and Aquaculture (DOF 2007a) and the National Fisheries Chart (DOF 2006).

In Ecuador through the Executive Decree No. 486 issued in July 2007 and reformed in February 2008, Ecuador issued the regulations for the incidental catch of sharks, their trade and export in continental Ecuador in which it was prohibited: the direct fishery of sharks, the use of fishing gear and systems which are employed specifically to catch sharks and the practice of “finning”. Also, Ecuador established the policy of conservation and management of shark resources through the implementation of the National Plan of Action for the Conservation and Management of Sharks in Ecuador.

7.2 International

Hammerheads are listed in Annex I of UNCLOS and should be subject to its provisions concerning fisheries management in international waters. Hammerhead sharks are not listed under the Convention on Migratory Species of Wild Animals (CMS). Also of relevance is the FAO International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) which recommends that RFMOs carry out regular shark population assessments and that member States cooperate on joint and regional shark management plans. Countries which are implementing IPOA-Sharks are Argentina, Brazil, France, Japan, Malaysia, Mexico, New Zealand, Portugal, Spain, Thailand, U.K., and USA. Like other sharks, however, international regulations for hammerheads are limited and few countries regulate hammerhead shark fishing. It is prohibited to retain onboard, tranship, land, store, sell, or offer for sale any part of whole carcass of any hammerhead shark of the family *Sphyrnidae* within the fisheries covered by the Convention area of ICCAT (2010) (except for the *Sphyrna tiburo*). Although Developing coastal States are exempt from this prohibition, they are to ensure that hammerhead sharks do not enter into international trade. RFMOs have adopted finning bans, which require full utilization of captured sharks and encourage the live release of incidentally caught sharks. If effectively enforced, this measure could help to reduce the number of hammerheads killed exclusively for their fins. Regulations by RFMOs only pertain to the entities that are contracting Parties and to the fisheries that are within the scope of the Convention; thus the catch and trade of hammerhead sharks is largely unmanaged and unregulated.

In 2008, the European Community proposed a prohibition on retention of all hammerhead species under ICCAT, but the measure met with opposition and was defeated. Most Regional Fisheries Management Organizations have implemented finning bans which, if effectively enforced, could reduce the number of hammerheads killed exclusively for their fins. RFMOs with finning bans are: ICCAT, GFCM, IOTC, IATTC, NAFO, SEAFO, WCPFC, CCAMLR, and NEAFC. In November 2011, the eight member countries of the Central American Integration System (SICA: Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama) adopted a common binding regulation outlawing shark finning. Unlike finning bans in many countries, the Regulation OSP-05-11 (effective 1 January 2012) applies not only to domestic and foreign vessels that catch and land sharks in SICA countries, but also to vessels fishing in international waters that fly the flag of a SICA member country. Member governments can only permit landing sharks when the fins are still naturally attached to the whole body or to a portion of the shark body. In 2011, ICCAT adopted a recommendation that requires any party that does not report specifies-specific shark data to submit a data collection improvement plan to the SCRS by July 2012 (Recommendation 11-08). To date, the ICCAT Compliance Committee has not reviewed the contracting Parties’ implementation of this measure. All ICCAT Parties have not reported on their domestic implementation, so their level of international trade that may be out of compliance is unknown. It is possible that importing and exporting countries of these products have not implemented domestic regulations to monitor or prevent such trade.

Furthermore, not all potential importing countries are parties to ICCAT and may not be aware of or required to comply with this measure IOTC resolution 08/04 requires logbook records of catch from longline vessels and Recommendation 11/06 expands that requirement to all purse seine, gillnet and pole and line fishing vessels. The IOTC rejected a hammerhead retention ban.

Sphyrna lewini has been included in Appendix III of CITES by Costa Rica, entering into force in September 25 of 2012 (Notification 2012/044).

8. Species management

8.1 Management measures

Catch of hammerhead sharks is prohibited in the U.S. Atlantic pelagic longline fishery, and there is a quota for other U.S. Atlantic fisheries catching hammerhead sharks. The European Union prohibits the catch of hammerhead sharks throughout the ICCAT convention area. Other countries are implementing the ICCAT management measures or have domestic measures prohibiting the catch and trade of all sharks in their waters. Otherwise, no focused species-specific management measures are in place for *S. lewini*.

8.2 Population monitoring

Population monitoring requires collection of catch data as initial inputs for stock assessment. Species' specific landings data are lacking; hammerhead catches are often amalgamated as *Sphyrna spp*., while *S. zygaena* and *S. lewini* are often confused and misidentified, even at the genus level. Maguire *et al.* (2006) reported that, of all hammerheads caught in world fisheries, only *S. lewini* and *S. zygaena* are reported as individual species in FAO statistics. Based on review of 2010 FAO data, *S. lewini* and *S. zygaena* continue to be the only two hammerheads with data submitted on a species specific level. In addition, landings have only been reported from the Atlantic and Pacific Ocean at the species level. In 2004, ICCAT required all members to annually report shark catches and effort data. Other RFMOs have followed suit and request data on shark catches, particularly those most commonly caught, including hammerheads.

8.3 Control measures

8.3.1 International

Several RFMOs require full utilization of sharks caught and recommend the live release of incidentally caught sharks. Shark finning bans implemented by 21 countries and the European Union (EU), as well as by nine RFMOs could help reduce mortality driven by international trade demand (Camhi *et al.* 2009). The ICCAT measure described above applies to members of that RFMO and applies in the Convention Area. Otherwise, no species-specific international or domestic control measures are in place for hammerhead sharks.

8.3.2 Domestic

Mexico

The Official Mexican Norm: NOM-029-PESC-2006. Responsible Fishing of Hammerheads and Rays, Specifications for your utilization. It recently prohibited gillnets from vessels of medium and high height (August 15, 2007) for fishing of hammerheads in Mexican waters (DOF 2007b).

Agreement modifying the Communication for establishing periods and zones prohibited for fishing of several species of the aquatic fauna in waters under the federal jurisdiction of the Mexican United States, published on March 16, 1994, to establish the periods of prohibition for octopus in the Reefs' System of Veracruz, for crabs in Sonora and Sinaloa, for hammerheads and rays in the Pacific Ocean and for hammerheads in the Gulf of Mexico (DOF 2012).

The periods of prohibition for all shark species in waters under federal jurisdiction from June 12, 2012 onwards are:

a) Pacific Ocean, from May 1st to July 31st each year.

b) Gulf of Mexico and Caribbean Seas, from May 1st to June 30th each year.

c) In addition to the established under item b), from August 1st to 31st each year in the Campeche Banks.

The Agreement through which the allowed volume of incidental capture in the fishing operations of hammerheads and rays in waters under the federal jurisdiction of the Mexican United States situated in the Pacific Ocean (DOF 2008) is established.

8.4 Captive breeding and artificial propagation

n/a

8.5 Habitat conservation

n/a

8.6 Safeguards

n/a

9. Information on similar species

Within the hammerhead shark family (Sphyrnidae) two genera are known and 8 to 9 species among them are distinguished by variations of the head shape. The genus *Eusphyra* and its single species *E. blochii* from the Indo-Pacific has a much broader head (its broadness is nearly half of its total length). In the geographically more distributed genus *Sphyrna* e minor species can be clearly verified of 1,5 m length, present only in the coastal areas of the tropical and subtropical Americas (*S. corona, S. media, S. tudes* and *S. tiburo*). The great hammerhead shark (*S. mokarran*) is distinguished by a T-shaped head with a nearly straight front border, a notch in the centre, teeth strongly sawn and the posterior margin of the second dorsal fin and the anal fin profoundly concave. Another distinguishing characteristic of the great hammerhead is the curved rear margin of the pelvic fins whereas the scalloped hammerhead has straight posterior edges

While identification of hammerhead sharks by species may be difficult, the distinction between hammerheads and other shark species, including the fins can be done. Fin traders in the Hong Kong SAR market are able to identify hammerhead fins from other shark fins sorting *S. lewini* and *S. zygaena* fins together and *S. mokarran* fins separately from other shark fins. Clarke et al. (2006) demonstrated that fins from “chun chi” were 96% accurately identified as *S. lewini* or *S. zygaena* shark fins, and fins from “gu pian” were 86% accurately identified as *S. mokarran* fins. The majority of the hammerhead fins that were misidentified were found to be of another species of hammerhead, demonstrating that fin traders are able to differentiate between hammerhead fins and other shark species, but not always to the species level. According to a fin identification guide by Abercrombie and Chapman (2012), hammerhead fins can be distinguished from other shark fins as they have a uniform light brown colour and the fin is considered “tall”(see Annex 4). To further confirm identity, a PCR-based assay has been published for hammerhead sharks (Abercrombie et al. 2005) and DNA tests are also available.

Because of the difficulty in identification of some hammerhead species, catches of *S. lewini* are often amalgamated with *S. mokarran* and *S. zygaena.* Quattro et al. (2006), Naylor et al. (2012) and Pinhal et al. (2012) provide morphological and genetic information on a cryptic lineage of scalloped hammerhead sharks. This cryptic lineage is likely to have entered trade as well since it is sympatric with *S. lewini* in the western Atlantic. As fins in trade, *S. mokarran* and *S. zygaena* fins are morphologically similar to *S. lewini*. Fins from all three species are thin and falcate with the dorsal fin height longer than its base. Because of the higher value associated with the larger triangular fins of hammerheads, traders sort them separately from other carcharhinid fins, which are often lumped together. Identification guides of whole animals and fins are available. Further information relative to the biology and status of other similar species can be found in table 1 and Annex 3.

Table 3. ‘Look-alike’ species for *S. lewini* fins

Family	Species	Scientific synonym	Common name	FAO Fishing areas	IUCN Red List
Sphyrnidae	*Sphyrna mokarran* (Rüppell 1837)	*Sphyrna tudes Zygaena dissimilis Sphyrna ligo*	Great hammerhead shark	21, 27, 31, 34, 37,41,47, 51, 57, 71, 77, 81, 87	Endangered
Sphyrnidae	*Sphyrna zygaena* (Linnaeus 1758)	*Zygaena malleus, Zygaena vulgaris, Zygaena subarcuata*	Smooth hammerhead shark	21, 31, 27, 34, 37, 41, 47, 51, 57, 61, 71, 77, 81, 87.	Vulnerable (VU)

10. Consultations

A letter of consultation was sent to 105 range states of *S. lewini*. Responses were received from Mexico, USA, Germany, Colombia, Ecuador, Honduras, Costa Rica and European Union. The comments and data received from several Parties were added to the proposal. Colombia, Costa Rica, Ecuador, Honduras, Mexico and European Union accepted to be coproponents of the proposal.

11. Additional remarks

An Information Document will be submitted to identify and propose solutions to potential implementation issues that need to be addressed during the 18-month delayed implementation period.

11.1 Implementation issues

11.1.1 Scientific Authority

It would be most appropriate for the Scientific Authority for this species to possess an understanding of assessments. The Scientific Authority would need to be capable of making a non-detriment finding based upon stock assessments and a fishery management plan that defines sustainable harvest levels.

11.1.2 Identification of products in trade

While the current volume of traded meat and other products specific to hammerheads is unknown, it is likely this amount as insignificant when compared to the volume of fins in trade. Thus, it will be important to develop guides for the meat/carcass and fins of this species. According to Japanese fin guides (Nanakano 1999), *S. zygaena* fins, which are morphologically similar to *S. lewini*, are thin and falcate with the dorsal fin height longer than its base (see Annex 4). An assessment of the Hong Kong SAR shark fin market has revealed that various Chinese market categories contain fins from hammerhead species: “Bai Chun” (scalloped hammerhead, *S. lewini*), “Gui Chun” (smooth hammerhead, *S. zygaena*), for “Gu Pian” (great hammerhead, *S. mokarran*), and the general category “Chun Chi” containing both *S. lewini* and *S. zygaena* in an approximately 2:1 ratio, respectively.

The first dorsal fins of hammerhead sharks as a group can be separated from all other large sharks using two simple measurements that describe their characteristic shape (much taller than they are broad) and color (dull brown or light grey). The three hammerhead species, scalloped hammerhead (*Sphyrna lewini*), great hammerhead (*Sphyrna mokarran*), and smooth hammerhead (*Sphyrna zygaena*), are common in the international trade of shark fins (Abercrombie and Chapman 2012)(see Annex 4 for more information).

A PCR-based assay has been published in the primary scientific literature for hammerhead sharks (Abercrombie et al. 2005) that addresses shark identification. In addition, DNA tests are also available to confirm species identification (Rodrigues-Filho *et al*. 2012). A recent study by

Caballero et al. (2012) documents successful application of multiples PCR genetic methods to identify scalloped hammerhead shark parts from a large sample of unidentified sharks landed in Pacific ports in Colombia.

11.1.3 Non-detriment findings

Non-detriment findings can be declared for species that are the subject of a management plan, as long as the proposed export is consistent with the sustainable management provisions of that plan (CITES AC22 Doc. 17.2). Management for scalloped hammerhead shark would ideally be based upon stock assessments but in the absence of an assessment on sustainable fisheries, harvest levels (e.g. quotas) or technical measures could be sufficient. Extensive guidance exists for making non-detriment findings that could serve to assist in implementation (CITES 2000, 2009, Spain 2009).

11.1.4 RFMO measures

These CITES requirements would complement the measures that were adopted for sharks by ICCAT, by helping to ensure that any international trade of these species would be monitored.

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Life history parameters for scalloped hammerhead shark

Growth rate (von Bertalanffy k)	0.13 yr^{-1} (M, NW Atlantic) 0.09 yr^{-1} (F, NW Atlantic) 0.13 yr^{-1} (M, eastern Pacific) 0.15 yr^{-1} (F, eastern Pacific) 0.22 yr^{-1} (M, western Pacific) 0.25 yr^{-1} (F, western Pacific)	Piercy *et al*. (2007) Tolentino and Mendoza (2001) Chen *et al*. (1990)
Size at Maturity	131 cm FL (M, NW Atlantic) 180-200 cm FL (F, NW Atlantic) 152 cm FL (M, western Pacific) 161 cm FL (F, western Pacific) 108-123 cm FL (M, northern Australia) 154 cm FL (F, northern Australia) 138-154 cm FL (M, SW Atlantic) 184 cm FL (F, SW Atlantic) 135 cm FL (M, Indo-Pacific) 175-179 cm FL (F, Indo-Pacific)	Piercy (personal communication) Tolentino and Mendoza (2001) Chen *et al*. (1988) Stevens and Lyle (1989) Hazin *et al*. (2001) White *et al*. (2008)
Age at Maturity	6 years (M, NW Atlantic) 15-17 years (F, NW Atlantic)	Piercy (personal communication)
Observed longevity	30.5 years (NW Atlantic) 12.5 years (eastern Pacific) 14 years (western Pacific)	Piercy *et al*. (2007) Tolentino and Mendoza (2001) Chen et al. (1990)
Gestation period	8-12 months (Global)	Piercy (personal communication) Chen *et al*. (1988) Hazin *et al.* (2001) White *et al*. (2008)
Reproductive Periodicity	2 years	Piercy (personal communication) Chen *et al*. (1988) Hazin *et al*. (2001) White *et al*. (2008)
Litter size (mean)	Global range=12-41 23 (NW Atlantic) 14 (SW Atlantic) 25-26 (Indo-Pacific) 14 Eastern Pacific	Piercy (personal communication) Chen *et al*. (1988) Hazin *et al.* (2001) White *et al.* (2008) Tapiero (1997)
Generation time (T)	20 years	Cortés *et al*. (2008)
Population growth rates (r)	0.09 $year^{-1}$	Cortés *et al*. (2009)

Summary of population and abundance trend data for scalloped hammerhead and *Sphyrna* spp. complex

Year	Location	Data	Trend	Reference
1972-2003	NW Atlantic Ocean	Fishery independent survey (CPUE)	98% decline*	Myers et al. (2007)
1992-2003	NW Atlantic Ocean	Commercial pelagic fishery logbook (CPUE)	89% decline*	Baum et al. (2003)
1992-2005	NW Atlantic Ocean	Commercial pelagic longline observer program (CPUE)	76% decline*	Baum et al. (2003)
1983-1984 and 1991-1995	NW Atlantic Ocean	Fishery independent survey (CPUE)	66% decline	Ulrich (1996)
1994-2005	NW Atlantic Ocean	Commercial gillnet observer program (CPUE)	25% decline*	Carlson et al. (2005)
1994-2005	NW Atlantic Ocean	Commercial shark longline observer program (CPUE)	56% increase*	Hayes et al. (2009)
1995-2005	NW Atlantic Ocean	Fishery independent survey (CPUE)	44% decline*	Ingram et al. (2005)
1981-2005	NW Atlantic Ocean	Stock assessment (catch, life history, CPUE)	72% decline*	Jiao et al. (2008)
1981-2005	NW Atlantic Ocean	Stock assessment (catch, life history, CPUE)	83% decline*	Hayes et al. (2009)
1898-1922 1950-2006 1978-1999 1827-2000	Mediterranean Sea	Sightings, trap, longline (CPUE)	99% decline*	Ferretti et al. (2008)
1993-2001	SW Atlantic Ocean	Landings	60-90% decline	Vooren et al. (2005)
1978-2007	SW Atlantic Ocean	Commercial pelagic longline observer program (CPUE)	None	Carvalho (personal communication)
1992-2004	Eastern Pacific Ocean	Sightings	71% decline*	Myers et al. (2007)
2004-2006	Eastern Pacific Ocean	Landings	51% decline	Martinez-Ortiz et al. (2007)
1963-2007	Western Pacific Ocean	Beach mesh (CPUE)	85% decline	de Jong and Simpfendorfer (2009)
1978-2003	Western Indian Ocean	Beach mesh (CPUE)	64% decline*	Dudley and Simpfendorfer (2006)
1997-1998 and 2004-2005	Eastern Indian Ocean	Catch (CPUE)	50-75% decline	Heupel and McAuley (2007)

* Indicates the data has undergone a statistical standardization to correct for factors unrelated to abundance

Supplemental information concerning species proposed for listing under Conf. 9.24 (Rev. CoP13) Annex 2b. Information was summarized from AC24 Doc. 14.1 [Conservation and management of sharks and stingrays-Activities Concerning Shark Species of Concern (Decision 14.107)]

Hammerheads, *Sphyrna* sp.

Hammerhead sharks, primarily great, *Sphyrna mokarran*, scalloped, *S. lewini*, and smooth, *Sphyrna zygaena*, are caught in a variety of fisheries including artisanal and small-scale commercial fisheries, bottom longlines as well as offshore pelagic longlines. Hammerheads are generally not a target species but suffer high bycatch mortality. Catches of *Sphyrnidae* have been reported in the FAO statistics but only the scalloped hammerhead and the smooth hammerhead are reported as individual species (Maguire *et al* 2006). Hammerheads are highly valued among Hong Kong SAR fin traders and are one of the most valuable fin types in the market (Abercrombie et al. 2005). According to Clarke et al. (2004, 2006a, 2006b), hammerheads are the second most abundant species in the international trade in fins.

Hammerheads have relatively moderate productivity depending on the species (Cortés 2002). Species-specific stock assessments for hammerheads are generally lacking but some studies have reported large declines in relative abundance. A recent assessment for a hammerhead complex (i.e. *S. lewini*, *S. mokarran* and *S. zygaena*) in the northwest Atlantic Ocean found about a 70% decline in abundance from 1981 (Jiao *et al* 2008). According to Maguire et al. (2006), the state of exploitation for species is unknown except scalloped hammerheads, which are reported as fully- to overexploited. The most recent IUCN red list assessments list the *Sphyrnidae* as Endangered globally (IUCN 2008).

There is limited species-specific conservation or management measures in place for the *Sphyrnidae*. They are listed on Annex I, Highly Migratory Species, of the UN Convention on the Law of the Sea, and some shark finning bans by fishing states, the European Union (EU), as well as by nine RFMOs, including the tuna commissions in the Atlantic (International Committee for the Conservation of Atlantic Tunas, ICCAT), Eastern Pacific (Inter-American Tropical Tuna Commission, IATTC), and Indian (Indian Ocean Tuna Commission, IOTC) Ocean (Camhi et al. 2009) may help reduce the mortality of hammerhead sharks for their fins alone. It is prohibited to retain onboard, tranship, land, store, sell, or offer for sale any part of whole carcass of any hammerhead shark of the family *Sphyrnidae* within the fisheries covered by the Convention area of ICCAT (2010) (except for the *Sphyrna tiburo*). While developing coastal States are exempt from this prohibition, they are to ensure that hammerhead sharks do no enter into international trade. In the U.S., this species is managed as a Large Coastal Shark on U.S. Highly Migratory Species Fishery Management Plan (National Marine Fisheries Service: Federal Fisheries Management Plan for Atlantic Tuna, Swordfish and Sharks). The U.S. prohibits hammerheads from being caught in the Atlantic pelagic longline fishery. The European Union prohibits hammerheads from being caught. Other countries are implementing the ICCAT management measures or have domestic measures prohibiting the catch and trade of all sharks in their waters. Otherwise, no focused species-specific international management measures are in place for scalloped hammerhead sharks.

These two species are often caught and accounted for as part of a complex of multiple hammerhead species. This section describes information and studies relevant to each species individually. Information on the complex as a whole is included in the body of the proposal.

A B

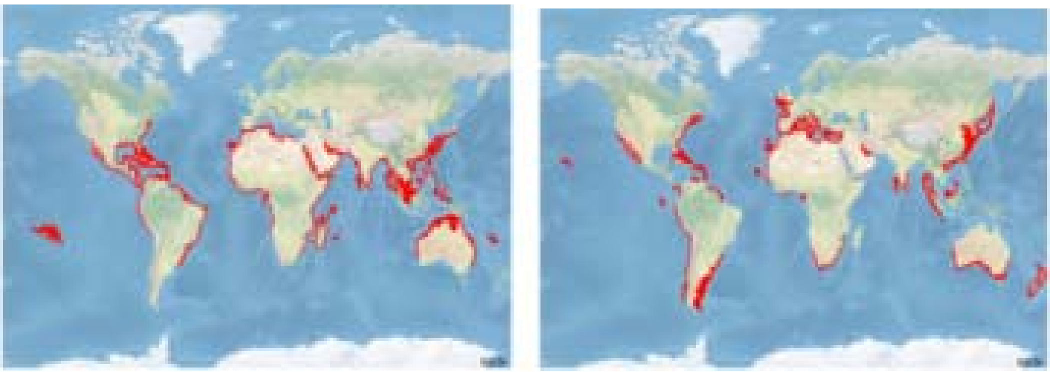


Figure 1. Distribution map for *S. mokarran* (A) and *S. zygaena* (B) (IUCN, Dec. 2011).

Great Hammerhead: *Sphyrna mokarran*

Sphyrna mokarran occurs circumglobally between 45°N - 37°S at depths to 300 m (Figure 1). In India they are found on both the southeast and southwest coasts. They are coastal-pelagic and can be found close inshore as well as far offshore. They can be bottom-oriented in depths of 1-80 m. Some populations move polewards in the summer (off Florida and in the South China Sea).

Sphyrna mokarran feed on stingrays and other batoids, groupers and sea catfishes, but also prey on other small bony fishes, crabs, squid, other sharks, and lobsters. Maximum weight is about 450 kg. The species is generally solitary in behavior. Pups are born in late spring to summer in the Northern Hemisphere and between December and January off Australia. Litter sizes are 13 to 42 with size at birth of about 56 to 70 cm, but reproduction is only every other year, so that it's potential population growth rate is more limited and it is vulnerable to overexploitation. Piercy et al. (2010) recently documented age and growth parameters in the northwest Atlantic and Gulf of Mexico of k = 0.16/yr for males and 0.11 for females. A bomb radiocarbon age validation study verified annual periodicity in growth bands and ages of at least 42 years (Passerrotti *et al*. 2010). Harry et al. (2011a) studied animals off the east coast of Australia and found that *S mokarran* grew at a similar rate to *S. lewini* with the best-fit estimates for a two-parameter von Bertalanffy equation fit to length-at-age data for sexes combined with an assumed mean length-at-birth of 700 mm were L_∞ = 4027 mm and k = 0·079. Females attained a maximum age of 39.1 years and grew to at least 439 cm LST. The oldest male *S. mokarran* was 31.7 years old and 369 cm LST. males mature at about 235 to 270 cm, and reach at least 340 cm, and females mature at about 250 to 300 cm and reach 480 to 550 cm. However, a recent life history study of *S. lewini* and *S. mokarran* on the east coast of Australia (Harry et al. 2011a) found no significant difference in length and age at maturity of male and female *S. mokarran*, which reached 50% maturity at 228 cm LST and 8.3 years. *Sphyrna mokarran* grew at a similar rate to *S. lewini*.

Naylor *et al.* (2012) have recently published the first data on population structure. They analyzed mtDNA of 22 specimens from the Gulf of Mexico (9 specimens), the western North Atlantic coast from Massachusetts to Florida (7), Malaysian Borneo (1), and northern Australia (5). They found two distinct clusters: one comprised of the specimens collected from the Atlantic and a second consisting of specimens from Australia and Borneo. There was no haplotype overlap between the two clusters, supporting recognition of these as distinct allopatric species.

Sphyrna mokarran has a regular directed fishery off Porto Novo, Tamil Nadu, on the southeast coast of India. Meat is used for human consumption fresh, frozen, dried, salted or smoked. The liver is used for oil, the fins for soup, the hide for leather, and the carcass for fish meal. Fins have very high market demand. From 2000-2002 it comprised 0.75% of total shark landings at Cochin Fisheries Harbor, India, with size ranging from 2.4 - 3.5m. However, from 2007-11, only stray numbers were landed, clearly indicating a declining status of the stock along the west coast of India. Harry et al. (2011b) found highly female-biased harvest in the Great Barrier Reef of Australia. Female-biased harvest likely exacerbates the status of the species there. There is a suspected decline of at least 80% in the past 25 years for populations of *S. mokarran* off West Africa (IUCN 2008). The species suffers high at vessel mortality (Morgan and Burgess 2007; Morgan et al. 2009).

Smooth Hammerhead: *Sphyrna zygaena*

Sphyrna zygaena is circumglobal coastal-pelagic and semioceanic species that occurs in temperate and tropical seas between 59°N - 55°S (Figure 1). In India this species is found on the east and southwest coasts, with greater abundance in the southwest. Sperone et al. (2012) have documented it in the central Mediterranean off southern Italy. It occurs in the north of New Zealand. It has been observed in freshwater in Florida and Uruguay. They occur from the surface to 200 m, but are most common to depths to 20 m. They can be found both inshore and well offshore. Diemer et al. (2011) report on a tagging study from 1984-2009 involving *S. lewini* and *S. zygaena* along the east coast of South Africa. Maximum and average distance moved was 384 km and 141.8 km for *S. zygaena.* Directional movements observed may have been migrations in response to seasonal sea temperature changes. The authors identify coastal locations in Transkei that are of importance to juvenile and subadult hammerhead populations year-round. Individuals tend to migrate poleward in summer.

Sphyrna zygaena reaches 500 cm TL and 400 kg weight. Young are often found in large aggregations of hundreds of individuals. They feed on small sharks, skates and stingrays, but also bony fishes, shrimps, crabs, barnacles and cephalopods (Rogers et al. 2012). Litter size is from 30-40. Length at maturity is about 250-265 cm TL for males and 265 cm for females. Gestation period appears to be 10-11 months. Possible pupping grounds and nursery areas for this species include the northern Gulf of California; the eastern Bay of Plenty, Firth of Thames and inner Hauraki Gulf, all in New Zealand, and shallow coastal waters off southern Brazil and Uruguay. *Sphyrna zygaena* from the northeastern Pacific Ocean off Baja California have been aged up to 18 years (Garza 2004). In a 2008 ERA, ICCAT's Standing Committee on Research and Statistics (SCRS) ranked the smooth hammerhead 8th out of 10 in terms of their vulnerability to ICCAT longline fisheries. Cortes et al. (2010) updated that ERA and found that smooth hammerhead ranked 8th. The recent ICCAT (2012) ERA meeting was able to assess 16 species, five more species than in their 2008 ERA . At this point, only the productivity analysis portion of the ERA has been completed. Smooth hammerheads were ranked 4th most productive of the 20 stocks (16 species) considered (some of the 16 species were analyzed separately for north and south areas). The full ERA is due to be completed this fall.

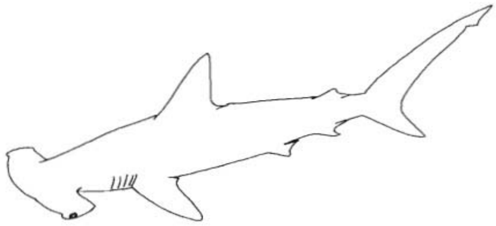
Naylor *et al*. (2012) have recently published the first data on population structure. They analyzed mtDNA of 16 specimens from the Gulf of California (4 specimens), western North Atlantic (6), Senegal (1), Viet Nam (1), Taiwan Province of China (3), and Japan (1) and found little evidence of population structuring.

Sphyrna zygaena is caught with pelagic longlines and gillnets. It is the only member of the hammerhead complex found regularly in New Zealand where it is only legally taken as bycatch. It is utilized fresh and dried/salted/smoked for consumption; the liver oil is used for vitamin extraction, the fins for the oriental fin trade, offal for fishmeal, and the hide for leather. Hide, fins and cartilage are exported. During 2000-2002, *S. zygaena* formed 0.36% of the total shark landings at Cochin Fisheires Harbor, India, with size ranging from 2.3 - 3.5m. But during 2007-11, only stray numbers were landed, clearly indicating a declining status of the stock. In New Zealand, there is some anecdotal evidence from game fishers that large adults may be less abundant than they used to be, but juveniles and sub-adults are still abundant around the northern North Island (Clinton Duffy, NZ, personal observation). While very steep declines in *S. zygaena* have been recorded in most areas, the species is afforded some refuge in other areas of its range, such as southern Australia, where it is abundant and fishing pressure is low.

Guide to identification of smooth hammerhead shark fins
(with permission from Dr. Hideki Nakano, Characterization of Shark Fin Products, A Guide of Shark fin caught by Tuna Longline Fishery, Fisheries Agency of Japan).

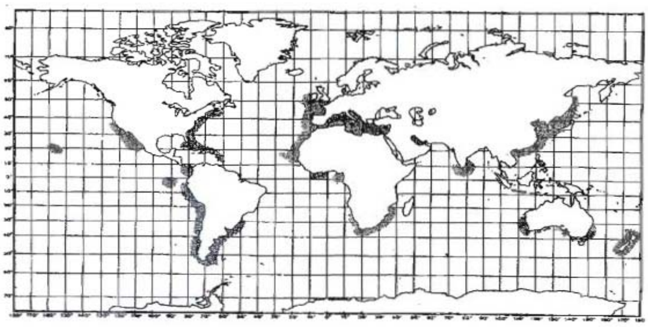
Smooth hammerhead

(*Sphyrna zygaena*)



§ Distribution §

Widespread in temperate seas in both hemispheres (also in tropical seas in some regions).



From Compagno, 1984

§ Fin Characteristics §

First Dorsal Fin

Shape: ・Thin, relatively falcate.
・Fin height longer than its base length.
・Slightly concave on posterior margin.
・Length of free rear tip more than one-third of the fin base length.

Color: ・Grayish brown.

Others: ・Posterior margin without denticulation.

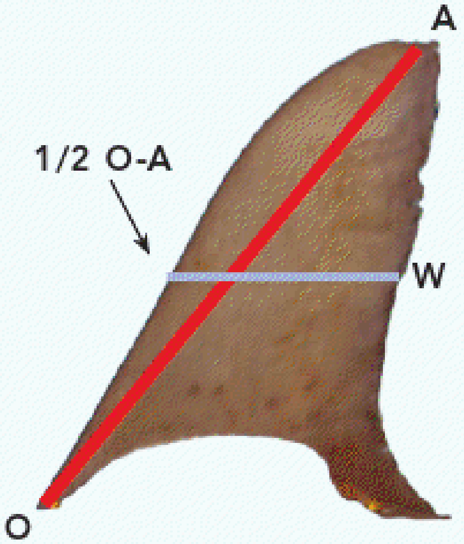
22

Identification of Hammerhead Sharks (family *Sphyrnidae*)
(from: Abercrombie, D. and Chapman, D. 2012.
Identifying shark fins: Oceanic whitetip, porbeagle and hammerheads)

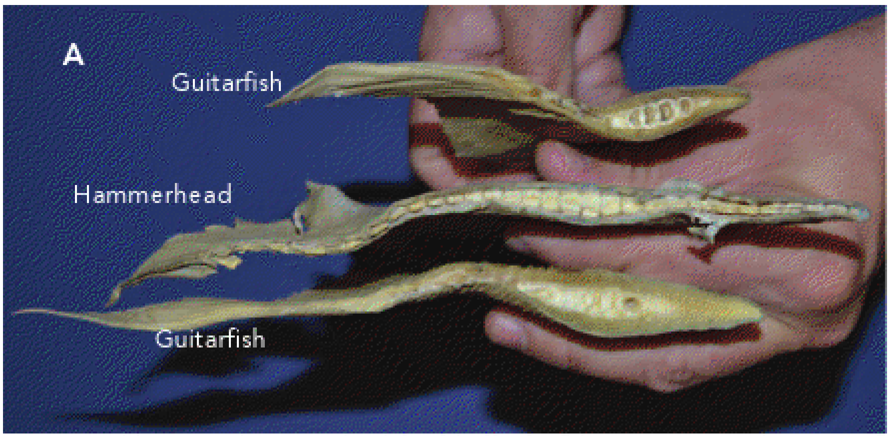
Take fin measurements

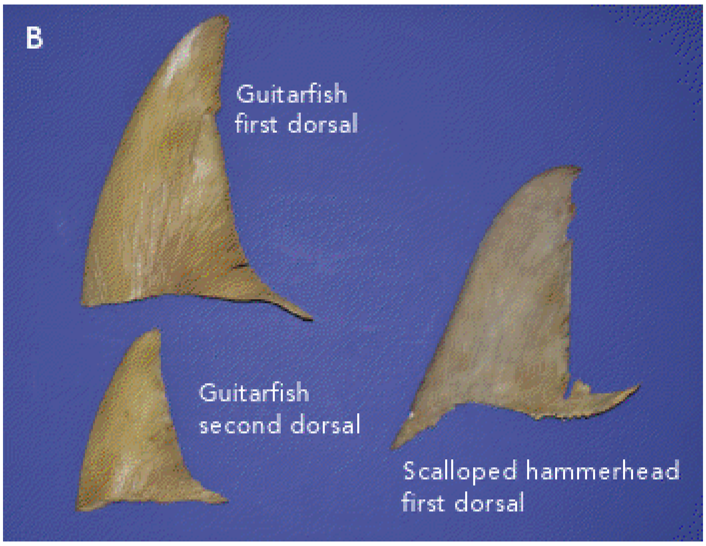
1) Measure fin origin to apex (O-A).
2) Measure the fin width (W) at the halfway point of O-A (i.e., if O-A is 10 cm, measure W at 5 cm along O-A).
3) Divide O-A by W (O-A/W).

Origin, apex and fin width (measured from leading edge to trailing edge) are landmarks found to be the most useful for species identification purposes, as measurements based on fin height, fin base and free rear tip were often too variable and dependent on cut and condition of the fin.

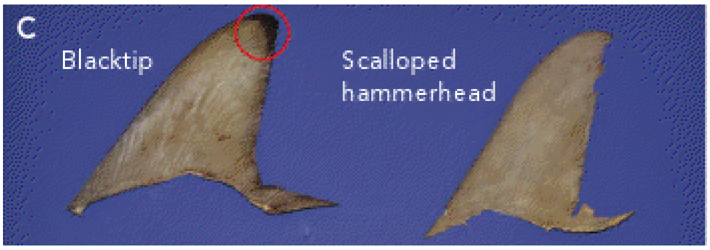


Dorsal fins that are tall and slender and dull brown or light grey are probably one of three species of hammerhead sharks: great hammerhead (*Sphyrna mokarran*), scalloped hammerhad (*Sphyrna lewini*) or smooth hammerhead (*Sphyrna zygaena*). Tall dorsal fins can also come from several species of guitarfish or blacktip sharks. In guitarfish first dorsal fins, cartilaginous blocks do not extend across the entire fin base (Image A). In hammerheads, these cartilaginous blocks are present along almost the entire fin base (Image A). Guitarfish dorsal fins also exhibit a glossy sheen (Image B), and some species also have white spots, unlike the dull brown, uniform coloration of hammerhead dorsal fins.

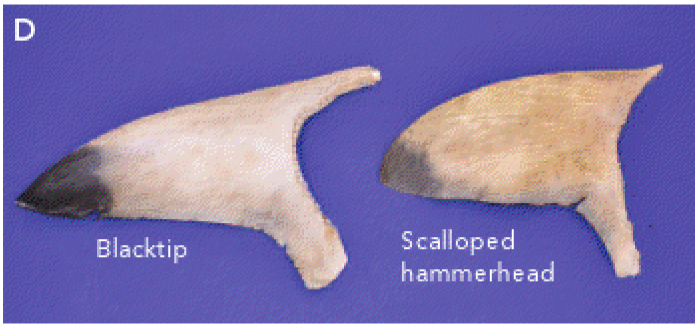




To distinguish hammerheads from other species, it is important to mention that some blacktip shark (*Carcharhinus limbatus*) first dorsal fins exhibit O-A/W that is close to or slightly greater than 2.5. However, they often (but not always) have a black spot on the dorsal fin apex, and the fin has a glossy appearance that is unlike the dull of the hammerheads (Image C).



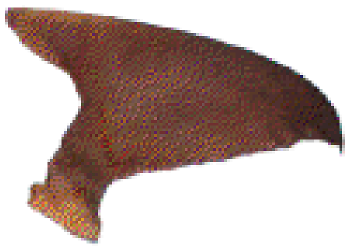
In addition, Blacktip shark pectoral fins are also longer and more slender than the short, broad fins of the hammerheads (Image D).



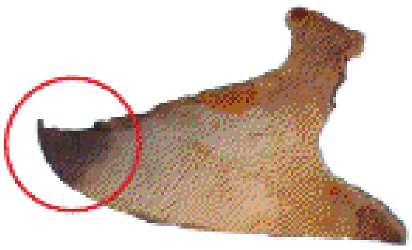
Three hammerhead species are common in international trade of shark fins. The main criteria of identification for **Scalloped hammerhead (*Sphyrna lewini*)** are illustrated below:

1st dorsal fin: tall, flattening out toward apex; straight to moderately curved trailing edge (similar to smooth hammerhead, less slender than great hammerhead 1st dorsal fin)

Pectoral fins: short and broad with black tips visible at the apex on ventral side



Dorsal view
(top)



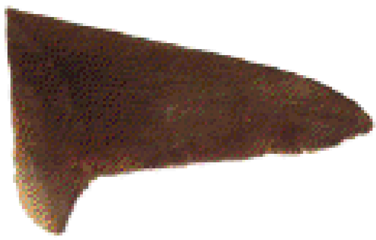
Ventral view
(underneath)

The following are the main criteria for identification of **Smooth Hammerhead (*Sphyrna zygaena*)**:

1st dorsal fin: tall, sloping more at apex; moderately curved trailing edge (similar to scalloped hammerhead, less slender than great hammerhead 1st dorsal fin)

Note: Scalloped and smooth hammerhead 1st dorsal fins are so similar they are often extremely hard to differentiate. However, it is not uncommon for valuable fins from an individual to be traded as a set (first dorsal, paired pectoral fins and lower caudal lobe). f this is the case, the two species can be distinguished using the pectoral fins.

Pectoral fins: short and broad with faint to no markings on ventral side



Dorsal view
(top)

Ventral view
(underneath)

The main criteria for identification of **Great Hammerhead (*Sphyrna mokarran*)** are illustrated below:

1st dorsal fin: tall, slender from leading edge to trailing edge; elongated and pointed at apex

Note: Small to moderate-sized great hammerhead first dorsal fins may be difficult to distinguish from those of the winghead shark (*Eusphyra blochii*). However, wingheads are only found in India, Thailand, Indonesia and Northern Australia and are extremely rare in trade. On a global basis, 1st dorsal fins with this shape are much more likely to be from great hammerheads than wingheads.

Pectoral fins: Pointed apex, moderately curved along trailing edge with dusky color at apex on ventral side and often along trailing edge

Dorsal view (top) | Ventral view (underneath)

Anexo 5: Información adicional recibida por las Partes

México

Importaciones de tiburón (valores en dólares americanos y volúmenes en kg, de acuerdo a lo estipulado en la Tarifa de los Impuestos Generales de Importación y Exportación)

OPERACIONES DE IMPORTACIÓN DE TIBURÓN (A1. Importación definitiva)											
FRACCIÓN	TEXTO	PRODUCTO ESPECÍFICO	PAÍS ORIGEN	2009		2010		2011		2012	
				VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN
0302.65.01	Escualos	Tiburon fresco / entero /cazón.	EUA	229962	145234	446898	283288	220974	140155	290164	170624
0302.65.01	Escualos	Tiburon fresco / entero /cazón.	Guatemala	0	0	23300	40000	0	0	0	0
0303.75.01	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	EUA	34292	22236	30713	17414	854	1070	16435	11380
0303.75.02	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Taiwan	1074962	819066	842190	469455	1098820	813970	542055	398030
0303.75.03	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	China	52500	175000	53326	22000	79200	22000	0	0
0303.75.04	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Costa Rica	4833852	2272085	6021862	2845322	3940156	1908561	1279616	647200
0303.75.05	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Suriname	29602	26911	0	0	0	0	0	0
0303.75.06	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Nueva Zelanda	0	0	0	0	9273	23184	0	0
0303.75.07	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Panama	7284	18210	0	0	53250	61500	50400	63000
0303.75.08	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	España	0	0	1218	221	0	0	0	0
0303.75.09	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Nicaragua	0	0	852	363	182093	113310	0	0
0303.75.10	Escualos.	Tiburón congelado/ tiburón sin cabeza y sin aletas / cazón	Guatemala	8400	4000	25000	25000	0	0	0	0
		TOTAL		6270854	3482742	7445359	3703063	5584620	3083750	2178670	1290234

OPERACIONES DE IMPORTACIÓN DE TIBURÓN (IN, Importacion temporal de bienes que seran sujetos a transformación, elaboración o reparación IMMEX)											
FRACCIÓN	TEXTO	PRODUCTO ESPECÍFICO	PAÍS ORIGEN	2009		2010		2011		2012	
				VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN
0303.75.01	Escualos.	Tiburón congelado /tiburón para uso didáctico	Canadá	0	0	0	0	53885	33878	54571	34291
0303.75.01	Escualos.	Tiburón congelado /tiburón para uso didáctico	EUA	62236	51439	20616	17038	13240	10943	0	0
		TOTAL		62236	51439	20616	17038	67125	44821	54571	34291

OPERACIONES DE IMPORTACIÓN DE TIBURÓN (C1, Importacion definitiva a la franja fronteriza norte y region fronteriza al amparo del decreto de la franja o region fronteriza)											
FRACCIÓN	TEXTO	PRODUCTO ESPECÍFICO	PAÍS ORIGEN	2009		2010		2011		2012	
				VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN
0303.75.01	Escualos	Tiburon chico (sin cabeza y sin cola) y congelado en cajas	Panamá	23062	12000	0	0	0	0	0	0
0303.75.01	Escualos	Tiburon entero y congelado	Nicaragua	0	0	1705	839	0	0	0	0
		TOTAL		23062	12000	1705	839	0	0	0	0

Exportaciones de tiburón (valores en dólares americanos y volúmenes en kg, de acuerdo a lo estipulado en la Tarifa de los Impuestos Generales de Importación y Exportación)

OPERACIONES DE EXPORTACIÓN DE TIBURÓN (A1, Exportación definitiva)											
FRACCIÓN	TEXTO	PRODUCTO ESPECÍFICO	PAÍS DESTINO	2009		2010		2011		2012	
				VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN	VALOR	VOLUMEN
0302.65.01	Escualos.	Tiburón Fresco, tiburón entero, tiburón en troncho o cazón.	EUA	62547	70291	36677	27747	18141	11577	1131	1000
0303.75.01	Escualos.	Aleta de tiburon fresca congelada	Hong Kong	0	0	0	0	174244	8827	0	0
0303.75.01	Escualos.	Piel de tiburon congelado	Taiwan	110400	184000	55200	92000	0	0	0	0
			TOTAL	**172947**	**254291**	**91877**	**119747**	**192385**	**20404**	**1131**	**1000**

Ecuador's technical considerations to the inclusion of sharks on the CITES Appendices

Ministerio de Agricultura, Ganadería, Acuacultura y Pesca

INSTITUTO NACIONAL DE PESCA ECUADOR

INSTITUTO NACIONAL DE PESCA
INVESTIGACIÓN RECURSOS PESQUEROS Y SU AMBIENTE
Consideraciones técnicas sobre tiburones para la Inclusión en Apéndices de CITES

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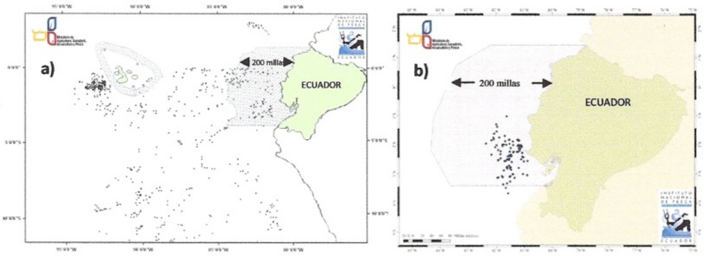
En Ecuador los elasmobranquios o peces cartilaginosos constituyen parte importante de la fauna asociada de las pesquerías de dorado, espada, miramelindo, picudos y atunes (peces pelágicos grandes, PPG): capturados principalmente con red de enmalle de superficie, palangre de superficie y media agua, así como también por línea de mano de media agua.

Los tiburones en el mar ecuatoriano se encuentran distribuidos en aguas costeras y oceánicas, siendo capturados tanto por la flota artesanal como industrial y por lo general sus zonas de pesca coinciden con las de PPG. A nivel artesanal para el 2010, las zonas de captura de la flota de barcos de Esmeraldas, Manta, y Anconcito, estuvieron registradas principalmente fuera de las 40 millas de protección de la reserva marina de Galápagos (Figura 1a); mientras que para los botes de fibra de vidrio de la caleta de Santa Rosa se concentraron frente a la Península de Santa Elena dentro de las 200 millas marinas del territorio ecuatoriano (Figura 1b).



Fuente: Herrera y Cajas (2011) — Fuente: Coello et al (2011)

Fig. 1. Áreas de captura de tiburones por flota de pesca: a) Barcos de madera y b) Botes de fibra de vidrio.

El desembarque total estimado a nivel artesanal para el 2010 fue de 11 072,79 t aproximadamente, constituido por 19 especies de tiburones; siendo la especie de mayor aporte tiburón rabón (*Alopias pelagicus*), que registró más del 66 % del desembarque total, seguido de tiburón mico (*Carcharhinus falciformis*) y tiburón aguado (*Prionace glauca*); juntas estas tres especies representan más del 92 % del desembarque total.

Por otro lado, considerando la información biológica colectada a través del programa de seguimiento de PPG durante el 2010 (Tabla 1) y lo referente a 2004, 2006, 2007, 2008, 2010 y 2011 en los desembarques artesanales (Mora 2005, Herrera et al 2007, Ruiz y Díaz 2008, Peralta 2009, Herrera y Cajas 2011, y Coello et al 2011), indican un mayor registro de especies con tallas correspondientes a estadios inmaduros de las especies tiburón martillo (*Sphyrna zygaena*), tinto (*Isurus oxyrinchus*) y mico (Figura 2).

Tabla 1. Porcentaje de madurez por sexo de tiburones durante 2010.

ESPECIE	TALLA MEDIA DE MADUREZ (cm) *		MADUREZ (%)			
			Macho		Hembras	
	Macho	Hembras	Inmaduros	Maduros	Inmaduros	Maduros
Alopias pelagicus	259	265	29	**71**	27	**73**
Alopias superciliosus	250	267	27	**73**	43	**57**
Carcharhinus falciformis	188	194	**77**	23	**74**	26
Isurus oxyrinchus	190	209	**76**	24	**88**	12
Prionace glauca	207	188	**53**	47	30	**70**
Sphyrna zygaena	214	235	**98**	2	**91**	9

Fuente: Herrera y Cajas (2011).

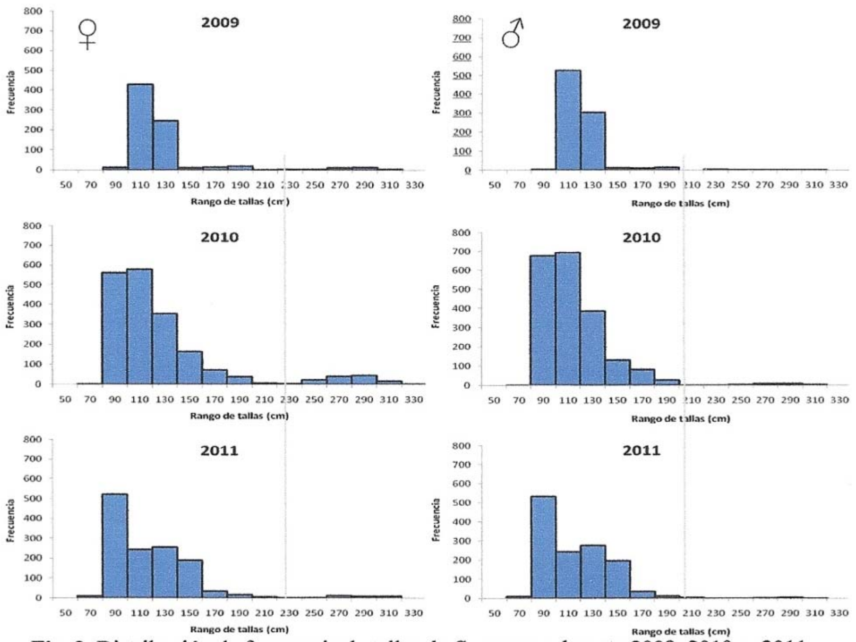
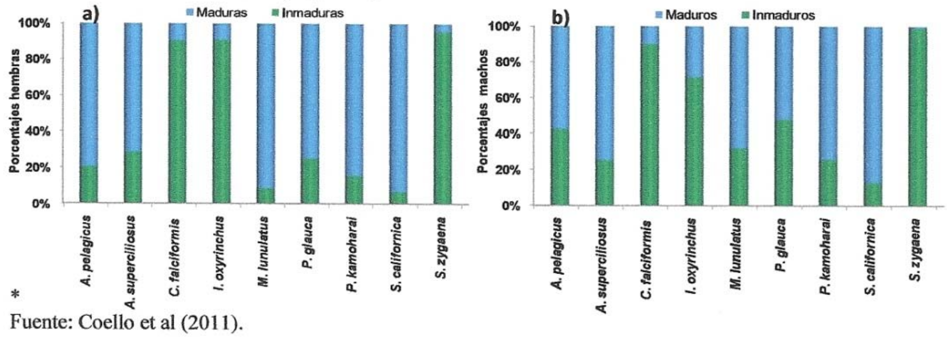


Fig. 2. Distribución de frecuencia de tallas de *S. zygaena* durante 2009, 2010, y 2011.

Coello et al (2011), establecieron que *S. zygaena* presentó un 96,0 y 99,0 % de individuos inmaduros para hembras y machos respectivamente, mientras que en el caso de *Isurus oxyrrinchus* se registraron un 91,0 % de hembras inmaduras y 71,0 % para machos inmaduros y *C. falciformis* con 90,0 % de inmaduros para ambos sexos (Figura 3); comportamiento opuesto registraron otras especies con porcentajes de madurez superiores al 50,0 % en ambos sexos (Figura 3).



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Fuente: Coello et al (2011).

Fig. 3. Tallas medias de primera madurez y frecuencia relativa de madurez de tiburones en Santa Rosa (junio 2009-diciembre 2010).

Durante 2010 la tendencia del desembarque de individuos inmaduros de *S. zygaena* fue casi total (Tabla 1 y Figura 3), debido a que representaron el 96,0 y 99,0 % de hembras y machos respectivamente. Esta tendencia se ha incrementado (Figura 2) paulatinamente desde el 2006 cuando el porcentaje de inmaduros representaba 86,7 % para sexos combinados (Herrera y Coello 2010); Según Coello et al (2011), indican que en la zona marino costera de la península de Santa Elena existen áreas de nacimiento y crianza (Fotos 1 y 2)

Fuente: Coello et al. (2011)

Fotos.- 1) *Sphyrna zygaena*, hembra con neonatos a punto de expulsarlo; 2) Juveniles *Sphyrna zygaena* (junio 2009-diciembre 2010).

En base a lo analizado y registrado por el programa de seguimiento de la pesquería de PPG y su fauna asociada del INP se pone de manifiesto un **97,5 % de los tiburones martillos (*S. zygaena*) corresponden a individuos inmaduros** con tallas inferiores a 150 cm de longitud total.

Por otro lado para el caso de los tiburones mico y tinto, se debería considerar un manejo de estas especies con un enfoque de ordenamiento regional considerando que estas son especies de hábitos oceánicos y registran una amplia distribución.

RECOMENDACIONES

De una forma concisa y basada en información biológica y pesquera, a nivel técnico se recomienda como una medida que promueva la salud de las poblaciones de *Sphyrna zygaena*, así como también de *Isurus oxyrinchus* y *Carcharhinus falciformis* sea considerada su inclusión en Apéndices de CITES.

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