UN environment CMS

MEMORANDUM OF UNDERSTANDING ON THE CONSERVATION OF MIGRATORY SHARKS

CMS/Sharks/MOS3/Doc.9.1.2
18 July 2018
Original: English

3rd Meeting of the Signatories (Sharks MOS3)
Monaco, 10 – 14 December 2018
Agenda Item 9.1.2

PROPOSAL FOR THE INCLUSION OF THE ENTIRE POPULATION OF SMOOTH HAMMERHEAD (*Sphyrna zygaena)* IN ANNEXE 1 OF THE CMS MEMORANDUM OF UNDERSTANDING ON THE CONSERVATION OF MIGRATORY SHARKS

(Presented by the European Union and its Member States)

Summary:

The present proposal for the inclusion of the entire population of the smooth Hammerhead (*Sphyrna zygaena)* in Annex 1 to the Sharks MOU has been submitted by the European Union and its Member States.

At its 2nd meeting (Sharks AC2) which took place in Bonaire in November 2017, the Advisory Committee of the Sharks MOU recommended the inclusion of the species in Annex 1. Please refer to document CMS/Sharks/AC2/Rec.2.1 for further details

PROPOSAL FOR THE INCLUSION OF THE ENTIRE POPULATION OF SMOOTH HAMMERHEAD (*Sphyrna zygaena)* IN ANNEXE 1 OF THE CMS MEMORANDUM OF UNDERSTANDING ON THE CONSERVATION OF MIGRATORY SHARKS

A. Proposal

Common name: Smooth Hammerhead (Figure 1)

Taxonomic name: *Sphyrna zygaena*

Inclusion of the entire species or only one or more populations? **Entire**

B. Proponent

European Union and its Member States

C. Supporting Statement

1. Taxon: Chondrichthyes, subclass: Elasmobranchii

1.1. Order: Carcharhiniformes
1.2. Family: Sphyrnidae
1.3. Genus/Species/Subspecies, including author and year: *Sphyrna zygaena*, (Linnaeus, 1758)
1.4. Population (s)
1.5 Common name(s), when applicable: English: Smooth hammerhead shark
French: Requin marteau commun
Spanish: Tiburón martillo liso
German: Glatter Hammerhai
Italian: Squalo martello comune
Portuguese: Tubarão-martelo-liso

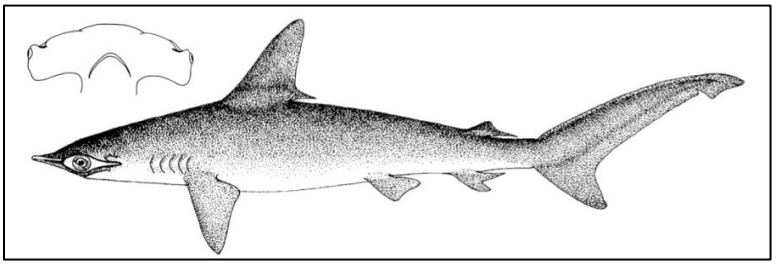

Figure 1. Smooth hammerhead shark (*Sphyrna zygaena*). Source: FAO

2. Ecological data

2.1. Distribution and range extension– see also Section 5

Sphyrna zygaena has a circumglobal distribution in tropical to warm temperate waters, generally between the 59°N and 55°S latitude (FAO, 2010; Figures 2–3). The species has the widest temperature tolerance of all hammerhead species, allowing for a broader geographical range compared to other species of hammerhead (Compagno, 1984; Ebert *et al.*, 2013).

In the Eastern Atlantic, *S. zygaena* occurs from the south of the British Isles to Angola, including the Mediterranean Sea and Cape Verde Islands (Ebert *et al.*, 2013). Very few specimens have been reported from the southern British Isles, where it is considered a very occasional vagrant (Southall and Sims, 2008). Within the Mediterranean Sea, it is likely more common in the western basin. In the Western Atlantic, *S. zygaena* occurs from Canada (vagrants) to Florida, U.S., parts of the Caribbean, including the Virgin Islands, and as far south as southern Argentina (Ebert *et al.*, 2013). Although the Caribbean Islands are often included in the range of this species, based on local species-lists, this cannot be confirmed (Miller, 2016).

In the Indo-Pacific, the distribution of *S. zygaena* extends from South Africa to Madagascar, Arabian Sea, around southern India and Sri Lanka, and from south-eastern Russia and Japan to Vietnam (Ebert *et al.*, 2013). In addition, the species also occurs around Australia, New Zealand and Hawaii, U.S. (Ebert *et al.*, 2013). In the eastern Pacific, *S. zygaena* occurs from northern California to Chile, including the waters of the Galapagos Islands (Ebert *et al.*, 2013). Brito (2004) reported *S. zygaena* to be rare in Chilean waters, and that the southern range limit is central Chile.

Figure 2. Distribution of *Sphyrna zygaena*. (Source: Casper *et al.*, 2005)

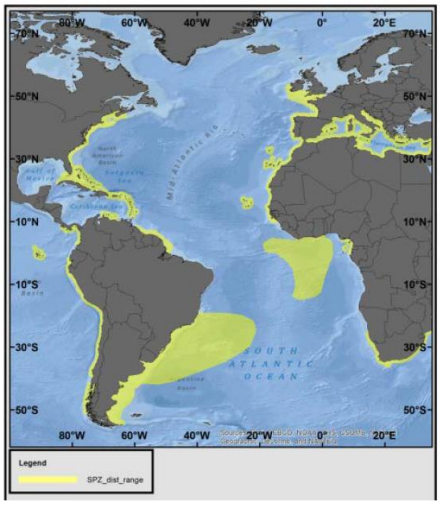

Figure 3. Revision of the distribution of *S. zygaena* in ICCAT area (Source: Cortés *et al*. 2015)

2.2. Population (estimates and trends)

Misidentifications or the lack of species-specific data for hammerhead sharks result in many studies examining trends for the *Sphyrna*-complex (*Sphyrna* spp.: a combination of scalloped hammerhead *Sphyrna lewini*, great hammerhead *Sphyrna mokarran* and *S. zygaena*). As Miller (2016) noted, an accurate abundance estimate for this species on a global scale is not feasible at this stage, based on the available data for different regions.

2.2.1 Atlantic Ocean

Given the absence of reliable data on *S. zygaena*, there is no stock assessment available on this species that has been accepted by the National Oceanic and Atmospheric Administration (Miller, 2016).

An exploratory assessment was undertaken by Hayes (2007; cited by Miller, 2016) that suggested a 91% decline from 1982 to 2005 (Figure 4), with this study highlighting a number of uncertainties in the input data. As noted by Miller (2016) and Burgess *et al*. (2005), logbook-data have certain inherent inaccuracies (i.e. misidentification and inadequate sampling) and inferences based on such data should be treated with caution.

A subsequent study by Jiao *et al.* (2009) estimated a 72% decline in the abundance of hammerhead sharks (species-complex) in the Northwest Atlantic and Gulf of Mexico (1981–2005), using a Bayesian hierarchical surplus production model and NMFS fisheries data. However, most of the underlying data referred to scalloped hammerhead *Sphyrna lewini.*

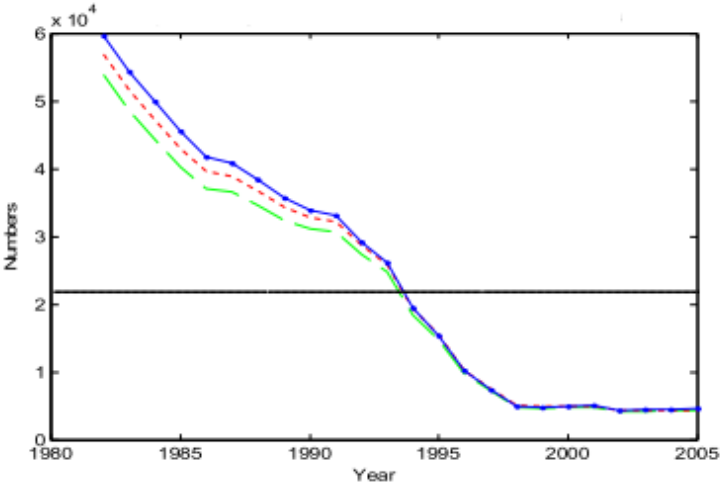

Figure 4. Modelled abundance for *Sphyrna zygaena* in the Northwestern Atlantic. Source: Hayes (2007), as cited by Miller (2016)

Throughout the other regions of the Atlantic, hammerhead shark catches have been documented as a complex of at least three species, with *S. lewini* accounting for the majority of the catches (Miller, 2016). Catches of hammerhead sharks off Brazil indicated a decline of 80% over the period 2000–2008 (FAO, 2010; Miller, 2016). However, these declines were based on nominal catch-per-unit-effort calculations not corrected for fishery dependant effects, and were based largely on catches of *S. lewini* (Miller, 2016). It should be noted that as *S. lewini* has a more coastal distribution compared to the more oceanic distribution of *S. zygaena*, and so is likely subject to different types of fisheries and pressures.

In the Eastern Atlantic, specifically off Northwest Africa, hammerhead sharks can make up 42% of the bycatch in pelagic trawl fisheries, with catches of hammerhead sharks peaking in July and August (Zeeberg *et al.*, 2006). Within the same region, Dia *et al.* (2012; cited by Miller, 2016) indicated that catches of hammerhead species by the artisanal fleet comprised mostly *S. lewini*.

For the Mauritanian artisanal fleet in 2009, *S. lewini* and *S. zygaena* accounted for 8.1% and 1.8% of the total shark catch (by weight) (Dia *et al*., 2012; Miller 2016).

Sphyrna zygaena is the more common of the three large-bodied hammerhead shark species recorded in the Mediterranean Sea. Although Ferretti *et al.* (2008) concluded that hammerhead sharks had declined in the Mediterranean Sea, the magnitude of the purported decline has been questioned, and Miller (2016) indicated that two of the data sources used (i.e. public observations and catches within tuna trap logbook data) were inappropriate for the analyses. A more recent study by Sperone *et al.* (2012) summarised observations of Sphyrnidae off southern Italy between 2000 and 2009, indicating that hammerhead sharks still occur in the Mediterranean Sea.

2.2.2 Pacific Ocean

Studies available on the abundance of hammerhead sharks in the Pacific also lack robust species-specific data (Miller, 2016). Rice *et al*. (2015) concluded that hammerhead species (not defined at species level) had increased in the Western and Central Pacific Ocean between 1997 and 2001, based on standardized catch-per-unit-effort time series, corrected for the fishery-dependant effects. After this period (2002–2013) the catch-per-unit-effort for hammerhead species remained stable (Rice *et al.*, 2015). Rice *et al.* (2015) also noted that species-specific stock assessments were not possible, as most of the available data referred to generic "hammerhead sharks".

Catches of *S. zygaena* in Mexican fisheries are low (1.8% of the catch; Cruz *et al.*, 2011), but 11% of the total shark landings off Ecuador (2003–2006) consisted of *S. zygaena*, and 5% of *S. lewini.* There was also seasonal variation in *S. zygaena* landings, which peaked in June (Martínez-Ortíz *et al.*, 2007).

2.2.3 Indian Ocean

Results on the abundance trends of *S. zygaena* within the Indian Ocean are limited to two studies in South African waters, and one from Western Australia.

A tag-recapture study off South Africa (1984–2009) seemed to indicate a steep decline of smooth hammerhead (Figure 5; Diemer *et al.,* 2011). However, tagging programmes are not robust indicators of abundance. Furthermore, the authors of this study highlighted that "*The general absence of S. lewini and unspecified Sphyrna spp. tags at the beginning of the study period and large numbers of S. zygaena during this time suggests that before 1988 Sphyrna spp. may have been grouped as S. zygaena. If so, this may have skewed the annual tagging distributions for S. lewini and S. zygaena*", which may affect the results and conclusions of the study (Diemer *et al.,* 2011).

A study of the shark catches in beach protection nets (1978–2003) along the South African coast noted that catches of other hammerhead sharks (*Sphyrna lewini* and *Sphyrna mokarran*) declined over the 25-year period, but no clear trend could be determined for *S. zygaena* (Dudley and Simpfendorfer, 2003).

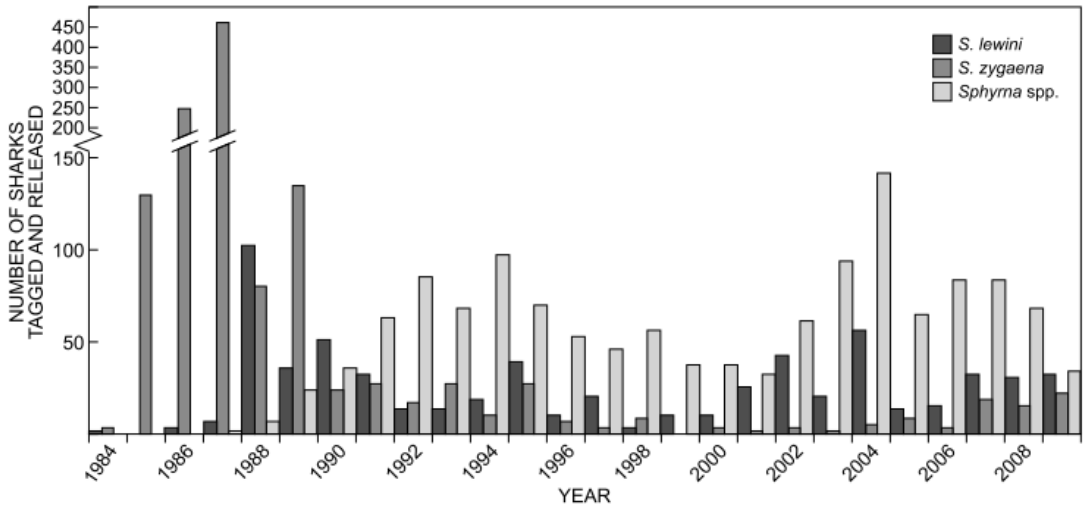

Figure 5. Catches of *Sphyrna zygaena*, *Sphyrna lewini* and unidentified hammerhead sharks (*Sphyrna* spp.) along the South African coast between 1984 and 2009. Source: Diemer *et al.* (2011)

For Western Australia, Heupel and McAuley (2007) reported a 50–75% decline in catches of hammerhead shark (*Sphyrna* spp.) in the Western Australian shark fishery by comparing catches of 2004–2005 to 1998–1999.

In summary, species-specific data on hammerhead sharks are lacking for many regions, as also highlighted by Miller (2016), making trend analyses on a species-levels inaccurate. Based on the results of the cited studies above, it is likely that populations of hammerhead sharks, as a group, have declined. The magnitude of any decline in *S. zygaena*, however, is unknown.

2.3. Critical habitat(s)

Accurate data on the global range of *S. zygaena* is limited. It is a pelagic species that occurs in both coastal and oceanic waters, thus occurring along the continental shelves (at depths of 20–200 m) and also making excursions into more oceanic habitats (Smale, 1991; Ebert, 2003).

Young individuals occur in coastal habitats in the first years of their life, with their habitat range extending out to oceanic zones as they grow (Smale, 1991; Diemer *et al.*, 2011; Clarke *et al.*, 2015). According to Clarke *et al.* (2015), this is the most oceanic of all hammerhead sharks, as well as the most temperature tolerant species. It is most common in waters of 16–22°C, but has also been reported in cooler waters of 13–19°C off South Africa (Diemer *et al.*, 2011).

Coastal developments may have resulted in habitat degradation and destruction of potential nursery areas (Knip *et al.*, 2010), although there is no direct evidence that such habitat degradation has negatively impacted on the abundance or range of this species (Miller, 2016). Miller (2016) also noted that, given the migratory and opportunistic nature of *S. zygaena*, it may possibly adapt its range according to its physiological tolerance and ecological needs in response to changing environmental conditions (e.g. climate change).

2.4. Migration pattern

Sphyrna zygaena is a large-bodied and highly mobile hammerhead shark with active and strong swimming capacities.

Little is known on the migratory behaviour of *S. zygaena*, and how the parts of the population migrate. Bass *et al.* (1975) documented juveniles of this species moving along the coast of South Africa in high numbers, but there was no evidence of migration in groups (Miller, 2016). In contrast, other sources indicate migrations of juvenile aggregations (Diemer *et al.*, 2011; Ebert, 2013).

Kohler and Turner (2001) reported the largest distance travelled for *S. zygaena* was 919 km in just over two years, averaging a speed of 4.8 km/day. The Southwest Fisheries Science Center of the National Oceanic and Atmospheric Administration reported that one *S. zygaena* fitted with a satellite-tag moved from San Clemente Island (California) to central Baja Peninsula (Mexico) and back, covering over 1,000 miles in two months (SWFSC, 2015). Whilst based on one individual, this finding is indicative of a return movement that crossed jurisdictional boundaries. Seasonal migrations towards cooler waters in summer and towards warmer waters in winter have also been suggested by other authors (Ebert *et al.,* 2013).

Smale and Cliff (1998) suggested that *S. zygaena* migrates along the east coast of South Africa, based on distinct species of cephalopods found in the stomach of this species. The oceanic cephalopods reported in the stomach contents indicate that *S. zygaena* range offshore, which suggests they may cross into international waters. Subsequent tagging studies of South Africa by Diemer *et al.* (2011) reported that out of 60 recaptured individuals, nine moved north along the east coast of South Africa. One juvenile shark travelled 384 km north with an estimated maximum speed of 5.1 km/day. No clear seasonal pattern was evident from this study for *S. zygaena* (Diemer *et al.*, 2011).

Off southern Brazil, female *S. zygaena* migrate inshore between October and February, most likely for parturition (Amorim *et al.*, 2011). Clarke *et al.* (2015) mentioned a study from New Zealand which recorded the species to move over long distances (1,200 nautical miles) in the Pacific Ocean.

In a recent study in the Atlantic Ocean, Santos & Coelho (2018) presented data from seven satellite-tagged smooth hammerheads caught and released from the Portuguese longline fishery in the tropical NE Atlantic. No clear movement patterns could be discerned, though these individuals roamed widely from shelf seas of West Africa and through to more oceanic waters, with a range that straddled national and international waters. This study also recorded the longest migration ever documented for this species (> 6600 km) across hemispheres.

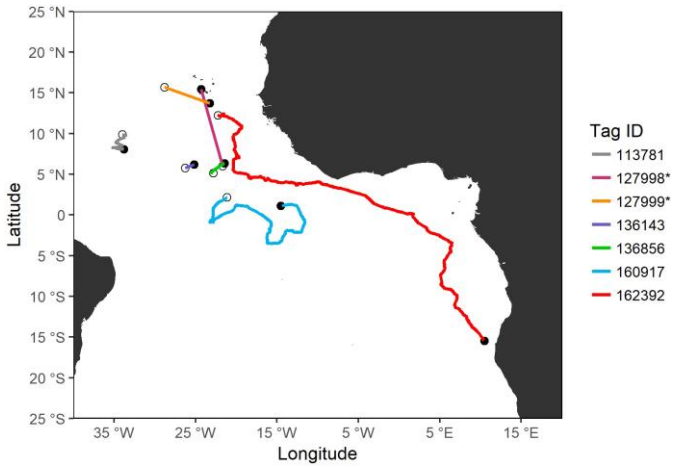

Figure 6: Tagging and pop-up locations of smooth hammerhead sharks, *Sphyrna zygaena*, with the respective most likely tracks estimated for each specimen (Santos & Coelho, 2018)

In summary, although scientific studies on the movements and migrations of this species are limited (and more research is needed), the data available are indicative of *S. zygaena* making inshore-offshore migrations. This is evidenced by the presence of juvenile stages in more coastal areas, and that larger individuals have been found with oceanic squid in their stomach contents. Such migrations would lead to *S. zygaena* moving from national to international waters and across jurisdictional boundaries. There is also evidence of north-south movements, which may be seasonal migrations. The scale of potential movements from tagging programmes (well above 1000 km) would also indicate that *S. zygaena* are capable of moving through different national waters, as was reported from the specimen moving from California to Mexico and back, or across several countries off west Africa.

3. Threat data

3.1. Direct threat(s) to the population (factor, intensity)

3.1.1 Biological characteristics

Sphyrna zygaena is a large species of hammerhead shark, growing to a maximum reported size of 420 cm. However, the average size for this species is 2.5 to 3.0 m total length (Miller, 2016). Like many other shark species, this species reaches sexual maturity relatively late, at a total length between 210 and 260 cm for males and 250 and 290 cm for females (Castro and Mejuto, 1995; Miller, 2016). In the Gulf of California, both sexes of *S. zygaena* appear to mature earlier, at a total length of 194 cm for males and 200 cm for females (Nava Nava and Marquez-Farias, 2014). Age at maturity is estimated to be 9 years (Cortés *et al.*, 2015).

Like other hammerhead shark species, *S. zygaena* are viviparous (i.e. live-bearing) (Compagno, 1984; Ebert *et al.*, 2013). After a gestation period of 10–11 months, females give birth to 20 to 50 pups (average litter size of 33 pups), with pups 49–64 cm in total length (Compagno, 1984; Castro and Mejuto, 1995; White *et al.*, 2006; Miller, 2016). Juveniles of this species have been observed to form large aggregations (Smale, 1991). Reproduction likely occurs annually, but this is still to be confirmed (Clarke *et al.*, 2015).

Within the first four years, the young sharks grow approximately 25 cm per year, with growth reducing every year after (Coelho *et al.*, 2011). Rosa *et al.* (2017) compared growth rates with other species in the genus, and estimated that the growth coefficients for *S. zygaena* were in the low to middle range. Growth curves for this species differ between populations in the Atlantic and Pacific Oceans, with individuals reaching smaller sizes in the Pacific Ocean (Clarke *et al.*, 2015; Miller, 2016). Longevity is unknown, but the species has been aged to at least 18 years for males and 21 years for females (Coelho *et al.*, 2011).

Like many large-bodied shark species, *S. zygaena* is among the top predators (feeding at trophic level 4.2) in the marine food web (Cortés, 1999). The species feeds on a large variety of teleosts (i.e. bony fish), elasmobranchs, crustaceans and cephalopod species (Smale and Cliff, 1998; Cortés, 1999).

3.1.2 Fisheries

Hammerhead sharks are taken as direct catch or incidental catch in domestic and artisanal fisheries, as well as industrial pelagic fisheries on the high seas. Catches of hammerhead shark are often amalgamated as Sphyrnidae spp. Whilst the meat is deemed of low quality because of the high level of urea, the fins are among the most valuable in the shark fin trade because of their large size and high fin-ray count (Rose, 1996).

It is difficult to make accurate assumptions of the catch level of *S. zygaena*, as few countries and organisations collect species-specific data on hammerhead sharks. The United Nations FAO database allows the separate reporting of smooth hammerhead and scalloped hammerhead, but most catches are still reported as Sphyrnidae spp. Some data may also be reported at higher groupings (e.g. sharks). Whilst some nations do report species-specific landings for *S. lewini* and *S. zygaena,* the accuracy of these data is uncertain.

The global overview by the FAO shows a significant increase in reported landings of hammerheads in the past decade (Table 1), although this could be partly attributed to increased species-specific reporting of landings.

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

Table 1: Global hammerhead shark landings [source FishstatJ]

It needs to be noted here that the quality of the data present in the FAO database is highly variable and depends greatly on national data collection which differs strongly between countries.

3.1.2.1 Atlantic Ocean

Miller (2016) made an extensive overview of all available fisheries data for the Atlantic, concluding that *S. zygaena* has a depleted but stable population in the area, with a high degree of uncertainty regarding decline in abundance. As species-specific data are lacking for the central and southwest Atlantic, any estimates would have to be made based on the proportion of *S. zygaena* in the total hammerhead catch in the area. Generally, the species is harvested at low levels in this area, with no species-specific information to suggest overutilization is leading to a risk of extinction in the region (Miller, 2016).

ICCAT

The International Commission for the Conservation of Atlantic Tunas collects species specific-catch information on all hammerhead species caught by the fisheries operating in its area (Table 2). Records should also be kept of the status of sharks upon release (alive or dead). Hammerhead sharks are recorded as part of the 'other' sharks (separate from the main commercial species) which includes all shark bycatch.

	YEAR																
Species	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
SPK (*Mokkoran*)					0		0	1	1	1	7	0	14	2	5	5	2
SPL (*Lewini*)	272	319	16	22	20	0		0	56	63	0	21	1	3	35	34	40
SPN (Hammerheads nei)	690	2018	583	1003	917	599	474	657	337	435	219	609	528	48	1304	485	458
SPY (hammerheads & bonnetheads)					0				198		2	13	4	0	4		244
SPZ (*Zygaena*)	40	38	44	58	40	56	360	57	6	17	9	190	168	459	4	25	5
other sharks total	**12630**	**21930**	**16581**	**16013**	**27601**	**33463**	**15619**	**25495**	**23073**	**18870**	**19059**	**18241**	**12258**	**20356**	**5468**	**4033**	**3783**

Table 2: Hammerhead shark catches (t) in ICCAT area [source ICCAT]

In 2010, ICCAT adopted measures that prohibit fishing of hammerhead sharks, genus *Sphyrna* (except *S. tiburo*) in ICCAT fisheries and that those captured should be released quickly and unharmed. There are exceptions for developing countries for local consumption, but they should submit data to ICCAT, and to the extent possible they should endeavour not to increase coastal catches of hammerhead sharks and to guarantee that these catches are not internationally traded.

ICCAT undertook a productivity-susceptibility analysis (PSA) for 15 species of elasmobranch (by)-caught in the pelagic longline tuna and swordfish fisheries in the Convention area. The analysis compared the productivity (based on age at maturity, lifespan, age specific-natural mortality and fecundity) to susceptibility to the fishery, which was calculated taking into account: availability of the species to the fleet, encounterability of the gear with the given species, vertical distribution, gear selectivity and post-capture mortality. In this Ecological Risk Assessment, scalloped hammerhead *Sphyrna lewini*, smooth hammerhead *S. zygaena* and pelagic stingray *Pteroplatytrygon violacea* had the lowest vulnerabilities (Cortés, *et al.*, 2015). The analysis also highlighted the need for better basic biological information for species included in the analysis, for which several life-history variables are still poorly understood.

3.1.2.2 Pacific Ocean

For the Western and Central Pacific, there are again limited data available to base any species-specific assessment for smooth hammerhead on. Miller (2016) considered that extraction of hammerheads by nations in the region was not aggravating the risk of extinction for the species.

The Western and Central Pacific Fisheries Commission (WCPFC) regulates the fisheries in this area and, whilst there are provisions for bycatch reduction and a finning ban in place, the low observer coverage (5%) in the longline fisheries does not provide sufficient data for by-catch species caught in these fisheries. Miller (2016) indicated that there seemed to be no evidence for overutilization, although this was a tentative conclusion due to the limited data.

Data on catches and landings of hammerhead sharks is also limited for the Eastern Pacific. Historically, sharks have been an important part of artisanal fisheries for some countries (e.g. Mexico and Chile) and a reduction in landings has been noted. Catches of *S. zygaena* in the tuna purse seine fishery operating in the Eastern Pacific declined from 1,205 specimens in 2004 to 436 in 2011 (IATTC, 2012).

3.1.2.3 Indian Ocean

Smooth hammerhead sharks are caught in the area for fins and meat, but data on catch levels are severely lacking. General fisheries data indicate that most fisheries concentrate in the tropical part of this area, and are more likely to encounter *S. lewini* than *S. zygaena.*

IOTC

The Indian Ocean Tuna Commission (IOTC) has been collecting species-specific information on hammerhead catches since 1985. Recent data (2014–2016) show greatly increased catches of *S. zygaena*, but it is unclear if this is due to improved species-specific reporting, or actual increase in catches.

	YEAR																
Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
SPK (*Mokkoran*)														8	1	5	0
SPL (*Lewini*)	417	243	156	244	129	69	55	42	41	53	104	90	81	119	24	44	76
SPN (Hammerheads nei)	588	613	573	615	792	1088	1001	1099	1296	1547	1561	1598	1573	1783	1675	1495	2369
SPY (hammerheads & bonnetheads)	1663	1663	1661	1661	1660	1657	1657	1643	1628	1628	1628	1628	1628	1628	1628	1628	1628
SPZ (*Zygaena*)	136	81	52	80	42	20	16	12	12	11	31	27	129	136	666	1163	1192

Table 3: Hammerhead shark catches (t) in IOTC area [source IOTC]

The majority of catches are from longline and gillnet fisheries, with sporadic catches reported in purse seine fisheries.

In 2012 a PSA was carried out for the sharks taken in various longline and purse seine fleets operating in the Indian Ocean (Murua *et al.* 2012), based on the methodology developed by Cortés *et al.* (2010). Similar to the analysis carried out in ICCAT, *S. zygaena* had a relatively low PSA score compared to other shark species. However, the authors also noted that: "*due to time constrains and lack of data the analysis presented here should be considered as preliminary and a starting point for future analysis as soon as biological information for Indian Ocean sharks as well as observer data compilation becomes available*".

3.1.2.4 Post-release mortality

Reducing bycatch mortality for hammerhead sharks is hampered by the high mortality rates for these sharks after being caught in fishing gears. A study by Coelho *et al*. (2012) found an at-vessel mortality of 71% in longline fisheries, and post-release mortality would increase this number further. Effective management for this species should therefore focus on avoiding unintended capture.

3.2. Destruction of critical habitat(s) (quality of changes, quantity of loss)

Like many other shark species smooth hammerhead sharks rely on inshore areas for pupping and nursery grounds. Habitat degradation and pollution affect coastal ecosystems that juvenile *S. zygaena* sharks occupy during early life stages. However, the effects of these changes and their ultimate impact on populations of *S. zygaena* are currently unknown.

3.3. Indirect threat(s) (e.g. reduction of reproduction success by climate change, pollutants)

There are no direct studies on climate change effects on *S. zygaena.* Miller (2016) noted that, as this species has a broad geographic range, large-scale impacts such as global climate change affecting water temperature, currents and potentially food chain dynamics could have a detrimental effect on the species. However, Miller (2016) also noted that the migratory behaviour of the species may provide some resilience against any risks climate change posed.

Several studies have examined levels of contaminants in sharks, as they are long lived, top-predators that can bioaccumulate and bio-magnify contaminants in their tissues. Whilst a study from Baja California found elevated levels of mercury in *S. zygaena* tissue, these were below the levels deemed safe for human consumption (Garcia-Hernandez *et al.* 2007).

3.4. National and international utilization

Although there is a limited market for smooth hammerhead meat in some areas, as stated earlier the main driver for hammerhead fisheries (directed and bycatch) is the high value of the fins on the international market. The fins of *S. zygaena* are large and have a high fin-ray content, which is the essential element adding the gelatinous quality to shark fin soup. This makes them one of the most valuable fins on the Hong Kong market (the largest international shark fin market). Abercrombie (2015) estimated a value of $88/kg for 2003.

In an analysis of the trade through the Hong Kong fin market, Clarke *et al.* (2006a) estimated that 4–5% of all fins traded were from *S. zygaena* or *S. lewini* each year. This would account for an estimate of between 49000 and 90000 tons of smooth hammerhead shark which would amount to between 1.3 and 2.7 million individual animals (Clarke *et al.* 2006b).

4. Protection status and needs

4.1. National protection status

In the USA, *S. zygaena* is included in the Large Coastal Shark complex management unit on the US Highly Migratory Species Fishery Management Plan, however there are no management measures specific to this species and no stock assessments have been performed.

Brazilian law restricts the length of pelagic gillnets and bans trawl fishing at a distance of less than 3 nautical miles from shore as a measure to protect smooth hammerhead, but as enforcement has been difficult such trawling in inshore nursery grounds has persisted.

4.2. International protection status

4.2.1 FAO:
In 1998 the International Plan of Action for Conservation and Management of Sharks (IPOA Sharks) was agreed for all species of sharks and rays.

The IPOA-Sharks is a voluntary international instrument, developed within the framework of the 1995 FAO Code of Conduct for Responsible Fisheries, which provides guidance for ensuring the conservation and management of sharks and their long-term sustainable use, with emphasis on improving species-specific catch and landings data collection, and the monitoring and management of shark fisheries. The code sets out principles and international standards of behaviour for responsible fishing practices to enable effective conservation and management of living aquatic organisms while considering impacts on the ecosystem and biodiversity. The IPOA-Sharks recommends that FAO member states 'should adopt a national plan of action for the conservation and management of shark stocks (NPOA-Sharks), if their vessels conduct directed fisheries for sharks or if their vessels regularly catch sharks in non-directed fisheries'.

Several range states have developed national plans of action: Australia, Brazil, Canada, Egypt, Democratic People's Republic of Korea; Japan; Mexico; New Zealand; Oman; South Africa; United States, as well as regional plans of action for: Pacific Island States, the Central American Isthmus (OSPESCA) and the European Union.

4.2.2 Finning Bans:

One of the main priorities in shark management and conservation in the past two decades has been the prohibition of shark finning. Many countries have already adopted finning bans in their waters and/or in their fisheries, that are in general implemented through an obligation to land all sharks with fins attached to the corresponding carcasses, or through a "fins to carcass ratio". All t-RFMOs have adopted finning bans with these two possible implementation means. NAFO and NEAFC have adopted the fins naturally attached policy as only possible means for implementing the finning ban in the areas under their purview.

Area	Finning ban (implementation means)	Year established	Other provisions relevant for SPZ
ICCAT	5% fins to carcass ratio or fins naturally attached	2004	Prohibits the retention onboard, transhipment, landings, storing, selling and offering for sale any part or whole carcass of hammerhead sharks (except for the *Sphyrna tiburo*).
IOTC	Fins naturally attached, exemption for sharks landed frozen (apply 5% fin to carcass ratio in that case)	2017	Additional data gathering obligations, no other conservation measures for *S. zygaena.*
IATTC	5% fins to carcass ratio or fins naturally attached	2005	Will complete a full stock assessment for *S. zygaena* in 2018. All unwanted sharks caught should be promptly released from purse seine or longline. No shark lines in longline fisheries targeting tuna or swordfish.
WCPFC	5% fins to carcass ratio or fins naturally attached	2010	Prohibition of one of the following: wire traces as branch lines/leaders, or shark lines, in longline fisheries targeting tuna and billfishes. Development of management plan including TACs in fisheries targeting sharks.
OSPESCA	Fins naturally attached policy	2011	No specific conservation measures apply to *S. zygaena.*
USA	Fins naturally attached policy	2008	Included in the Large Coastal Shark complex management, no specific conservation measures for *S. zygaena.*
EU	Fins naturally attached policy	2013	Prohibits the retention onboard, transhipment, landings, storing, selling and offering for sale any part or whole carcass of hammerhead sharks of the family Sphyrnidae (implementation of ICCAT recommendation).

4.2.3 ICCAT:

In 2010, a recommendation was adopted which prohibits the retention onboard, transhipment, landing, storing, selling and offering for sale any part or whole carcass of hammerhead sharks of the family Sphyrnidae (expert for *Sphyrna tiburo*) taken in the Convention area in association with ICCAT fisheries (ICCAT recommendation 10-08). The ban has an exemption for local consumption in developing coastal states, but these are not allowed to trade hammerheads internationally.

4.2.4 CITES:

CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.

The species covered by CITES are listed in three Appendices, according to the degree of protection they need. *S. lewini, S. mokarran*, and *S. zygaena* were added to Appendix II of CITES in March 2013.

Appendix-II specimens require:

- An export permit or re-export certificate issued by the Management Authority of the State of export or re-export is required.
- An export permit may be issued only if the specimen was legally obtained and if the export will not be detrimental to the survival of the species.

4.2.5 CMS:

The Convention on the Conservation of Migratory Species of Wild Animals is an environmental treaty under the aegis of the United Nations Environment Programme. The CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally-coordinated conservation measures throughout the migratory range.

Sphyrna lewini and *Sphyrna mokarran* were listed on CMS Appendix II – this list includes migratory species with an unfavourable conservation status or those that would significantly benefit from international co-operation. Parties that are range states for Appendix II-listed species "*shall endeavour to conclude agreements where these should benefit the species and should give priority to those species in an unfavourable conservation status*". As hammerhead are commonly misidentified and reported jointly, and considering that scalloped hammerhead *Sphyrna lewini* and great hammerhead *Sphyrna mokarran* have already been listed on the CMS MoU sharks, it would be sensible to encourage the same level of attention to all three species.

4.2.6 Barcelona Convention (Mediterranean) and GFCM:

Sphyrna zygaena is listed in Appendix II of the Barcelona Convention, affording it protection from fishing activities taking place in the Mediterranean region. GFCM adopted a recommendation according to which, all species listed in Appendix II of the Barcelona Convention must be released unharmed and alive to the extent possible, therefore cannot be retained on board, transhipped, landed, transferred, stored, sold, displayed or offered for sale (Recommendation GFCM/36/2012/1). This recommendation also stipulates that all vessels encountering these species must record information on fishing activities, catch data, incidental taking, release and/or discarding events in a logbook or similar document, then all logged information must be reported to national authorities. Finally, additional measures should be taken to improve such data collection in view of scientific monitoring of the species.

4.3. Additional protection needs

Listing on international resource management agreements, such as the CMS-MoU Sharks, should help improving national and regional management and facilitate collaboration between states for this species. It is evident that lack of species-specific data collection is hampering management for this species. There is still a lack of understanding of the basic data needed to understand the life-history, habitat utilisation and migration patterns of this species.

The comparison in management measures between RFMO's in section 4.2 illustrates differences in policy between areas reflecting different needs at regional level for improving the effective management of this species.

As noted in section 3.1 hammerhead sharks have a high bycatch mortality rate (71% at-vessel mortality in longline) in nets, trawls and long lines. Measures aimed at reducing unwanted mortality should incorporate avoidance measures as well as gear adaptations that lead to reduced bycatches of this species.

5. Range States (see official names of UN member states)

Albania; Algeria; Argentina; Australia; Bahrain; Brazil; Canada; Chile; China; Croatia; Cyprus; Egypt; France, Greece; Iceland; India; Iran, Islamic Republic of Iraq; Ireland; Israel; Italy; Japan; Korea, Democratic People's Republic of Korea, Republic of Kuwait; Lebanon; Libya; Madagascar; Mexico; Montenegro; Morocco; Mozambique; Namibia; New Zealand; Oman; Pakistan; Peru; Portugal; Qatar; Russian Federation; Saudi Arabia; Slovenia; South Africa; Spain; Syrian Arab Republic; Tunisia; Turkey; United Arab Emirates; United Kingdom; United States; Uruguay.

6. Additional remarks

The IUCN (World Conservation Union) has classified the global population of *S. zygaena* as Vulnerable (Casper *et al*., 2005).

Whilst species-specific data are lacking to provide robust indices of stock size, an exploratory assessment for *S. zygaena* indicates a decline in the Northwest Atlantic. Whilst the conservation status is uncertain, the Sharks-MoU does state that "*Lack of scientific certainty should not be used as a reason for postponing measures to enhance the conservation status of sharks*".

There is evidence from ecological studies that *S. zygaena* migrate, with latitudinal migrations across range states, and offshore migrations from shelf seas into oceanic waters, indicating that the species would cross jurisdictional boundaries. This would support the need for cooperation and action at both International level (through RFMO's) as well as national level (through the management of sensitive coastal habitats).

Given the limited data available for *S. zygaena,* there is a need for more coordinated studies on this species by parties that are range states.

Two other hammerhead species, scalloped hammerhead *Sphyrna lewini* and great hammerhead *Sphyrna mokarran* have already been listed on the CMS MoU sharks. Due to similarities between the species fins, and because identification after processing is severely hampered, it would be prudent to encourage the same level of attention to all three species.

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