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FINAL DETERMINATION

The Great Hammerhead - *Sphyrna mokarran,* as a Vulnerable Species

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a final determination to list the great hammerhead shark, *Sphyrna mokarran*, as a VULNERABLE SPECIES in Part 1 of Schedule 5 of the Act.

The listing of Vulnerable Species is provided for by Part 7A, Division 2 of the Act.

The Fisheries Scientific Committee, with reference to the criteria relevant to this species, prescribed by Part 16 of the *Fisheries Management (General) Regulation 2010* (the Regulation) has found that:

Background

1) *Sphyrna mokarran* Ruppell, 1837 is a valid, recognised taxon and is a species as defined in the Act.

2) *Sphyrna mokarran* is nomadic, generally solitary, highly migratory and ranges widely throughout the tropical and warm temperate seas of the world, from latitudes 40°N to 35°S (Compagno et al. 2005, Last and Stevens 2009). It is a coastal-pelagic and semi-oceanic species of hammerhead occurring close inshore and well offshore, over the continental shelves, island terraces, and in passes and lagoons of coral atolls, as well as over deep water near land, at depths ranging from near-surface to over 80 m (Compagno et al. 2005).

3) The maximum total size of the species is reported as 550 to 610 cm (Compagno 1998, Compagno et al. 2005), though 450 cm is more common for a mature adult (Last and Stevens 2009). In Australia, males mature at about 225 cm and females at about 210 to 228 cm (Last and Stevens 2009). Studies on the east coast of Australia (Harry *et al.* 2011) show there was no significant difference in length and age at maturity of male and female *S. mokarran*, which reached 50% maturity at 2279 mm *L*ST and 8·3 years. 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 $L\infty$ = 4027 mm and k = 0·079. Females attained a maximum age of 39·1 years and grew to at least 4391 mm *L*ST. The oldest male *S. mokarran* was 31·7 years old and 3691 mm *L*ST. In South Africa, 50% of males and females are mature at 309 cm and 336 cm respectively (Cliff 1995).

4) *Sphyrna mokarran* is viviparous, with a yolk-sac placenta. Litter size ranges from 6 to 33 (maximum 42) and pups are born after 11 months gestation (Stevens and Lyle 1989). Size at birth is 50 to 70 cm. Pups are born in late spring to summer in the Northern Hemisphere and between December and January off Australia (Last and Stevens 2009). Females breed only once every two years thus increasing the susceptibility to population depletion (Stevens and Lyle 1989).

5) The diet includes fish (mainly demersal species), other elasmobranchs, crustacea and cephalopods (Last and Stevens 2009). Strong *et al.* (1990) observed a large (*ca* 4 m) great hammerhead feeding on a southern stingray *Dasyatis americana* (disc width 1.5 m).

6) The species is listed on Annex I, Highly Migratory Species, of the UN Convention on the Law of the Sea, which urges States to cooperate over the management of these species.

Criteria – reduction in abundance, geographic distribution or genetic diversity (Regulation clause 274)

1) The IUCN assessment for each of the major geographic regions where the great hammerhead occurs outside of NSW is presented below (Sections a to d) and is reprinted from (Denham et al. 2010).

"a) West Africa
Mainly taken by drift gillnets, bottom gillnets and on longlines, hook and line, pelagic and bottom trawls (Schneider 1990). The Subregional workshop for sustainable management of sharks and rays in West Africa, 26-28 April 2000 in St Louis, Senegal (Ducrocq 2002) noted the high threat to sharks in the west African region and a noticeable decline in the CPUE of total sharks and rays. This workshop identified *Sphyrna mokarran* as particularly threatened. The subsequent sub-regional plan of action for sharks of West Africa (member states of the Sub Regional Fishing Commission) states that landings of *Sphyrna mokarran* have collapsed and lists this as one of the four most threatened species, deserving the greatest attention in the whole region (Ducrocq 2002).

Previously observed from Mauritania to Angola, reportedly abundant from November to January in Senegal, and in October in Mauritania (Cadenat and Blache 1981). However, recent scientific trawl surveys off Guinea-Bissau, Mauritania, Senegal, Gambia and Guinea-Conakry between 20 to 1,000 m have failed to record it, except in very low numbers off Guinea-Conakry and one record from Senegal in 1995 (FISA unpublished data). Anecdotal evidence from interviews with fishermen in Senegal, Guinea-Bissau and Guinea suggest there was a large decline in all shark species during the 1990s and that *Sphyrna mokarran* is almost extirpated from these areas (M. Ducrocq pers. obs.).

Data are lacking as there is little species specific data collection in the region, however this is a very distinctive species with a large dorsal fin which is highly valued for the shark fin trade. Increased targeting of sharks began in the 1970s, when a Ghanaian fishing community settled in the 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 specialising in catching sharks, resulting in a decline in overall shark populations (Walker *et al.* 2005). There has been rapid growth in the shark fin market in this region, for export to the Far East, and yearly production of dried fins exported from Guinea-Bissau alone is estimated at 250 tonnes (dry weight) (Walker *et al.* 2005). *Sphyrna* species combined represented 42% of bycatch in the European industrial pelagic trawl fishery off Northwest Africa (Zeeberg 2006).

Although there are very little species specific data available, the absence of recent records and region-wide recognition of the extent of the decline, give cause to suspect that the population has decreased by least 80% in the past 25 years. Fisheries in this region remain largely unmonitored and unmanaged, leading to an assessment of Critically Endangered in the Eastern Atlantic.

b) Southwest Indian Ocean
This species is widely distributed in the SW Indian Ocean and is a summer migrant to KwaZulu-Natal (KZN) (east coast of South Africa), where the annual catch in the KZN shark nets is 11 sharks (1978 to 1999), consisting mainly of adolescents and adults. Over this period there has been a significant decline in annual catch (18 to 4 sharks) and catch rate (0.5 to 0.2 sharks.km-net^{-1}.yr^{-1} ($p = 0.000$) (Dudley 2002). A continued decline in catch rate was reported for the period 1978 to 2003 (Dudley and Simpfendorfer 2006). Over this period, regression of catch and catch rate against

year revealed a significant decline in annual catch from 18 to 2 sharks (89%) and in catch rate from 0.44 to 0.09 sharks.km-net^{-1}.yr^{-1} (79%) (S. Dudley pers. obs. 2006). It is uncertain whether these declines reflect highly localized stock depletion or whether they reflect a general decline in the Southwest Indian Ocean, but large numbers of longline vessels have been reported to be operating illegally in coastal waters of the western Indian Ocean where they are targeting primarily hammerhead sharks and giant guitarfish *Rhynchobatus djiddensis* (IOTC 2005 in Dudley and Simpfendorfer 2006). This species is generally regarded as solitary, and is therefore unlikely to be abundant wherever it occurs. This is in contrast to other large hammerheads, such as *Sphyrna lewini* which forms large schools. *Sphyrna mokarran*, like other hammerheads, readily takes baited hooks and is sought after for its fins. Based on these characteristics, together with the decline of 79% in catch rates in the KZN shark nets, this species is assessed as Endangered in the southwest Indian Ocean.

c) Northwest Atlantic

This species is caught primarily as a bycatch in the pelagic longline, bottom longline and net fisheries along the northwest Atlantic and Gulf of Mexico. It is also caught in the recreational fishery. The species represents 0.7% of the species catch and suffers from greater than 90% at-vessel fishing mortality in the U.S. bottom longline fishery (Commercial Shark Fishery Observer Program unpubl. data). The U.S. pelagic fishery logbook data has shown a decline close to 90%, however this data-set is known for inaccurate data reporting (Beerkircher *et al.* 2002). There is probably a lack of reporting of the catch of great hammerheads because this species is routinely finned and discarded, which is illegal in the US Atlantic Federal Waters (Commercial Shark Fishery Observer Program unpub. data). Both the pelagic and bottom longline observer programs have recorded a 2 to 3:1 ratio for *Sphyrna lewini* to *Sphyrna mokarran*. The meat is not valuable but the fins are high grade and bring in a good price, thus finning still occurs in the U.S. fishery. Interview with shark fishermen in Belize indicate that hammerheads (*Sphyrna mokarran* in particular) are a favoured target species for their large fins (R.T. Graham pers. obs.). Fin prices are rising above US$50/lb in the neighbouring countries of Guatemala, driven by Asian buyers, according to these interviews (R.T. Graham pers. obs). This species is probably caught in other fisheries but is usually placed in a combined "hammerhead" category. Species identification (*Sphyrna mokarran* vs. *Sphyrna lewini*) a large obstacle in the proper assessment of this species. The high at-vessel fishing mortality for both species of hammerhead makes the threat of fishing even greater for this species. In the Pacific Ocean off of Guatemala this species is caught as by-catch in the commercial longline fishery.

There appear to be little data for landings and catch effort for this species in Central America and the Caribbean. Off the coast of Belize hammerheads were fished heavily by longline in the 1980s and early 1990s. Interviews with fishermen indicate that the abundance and size of Sphyrnids has declined dramatically in the past 10 years as a result of over exploitation, leading to a halt in the Belize based shark fishery (R.T. Graham pers. obs). However, the pressure is still sustained by fishers driving into Belizean waters from Guatemala (R.T. Graham pers. obs). The Cuban directed shark fishery (longline) between 1983 and 1991 recorded *Sphyrna mokarran* (subadults and juveniles) as one of 23 species caught. Since 1992 small increases in mean sizes were noted, indicating partial recovery of the species. In Mexico between November 1993 and December 1994 (Tamaulipas, Veracruz, Tabasco, Campeche and Yucatan) 901 vessels were monitored every day. *Sphyrna mokarran* represented 86% of the total catch.

The difficulty in species identification and accurate recording make an assessment of this species very difficult. However, low survival at capture makes this species very vulnerable to fishing pressure, whether directed or incidental. This species is listed as Endangered in the Northwest Atlantic under criterion A2 based on a suspected decline of at least >50% over the past 10 years. The decline is poorly documented and has not been curtailed.

d) Australia

There has been a large increase in the illegal, unregulated and unreported (IUU) fishing in northern Australia in the last few years (J. Stevens pers. obs.). Several initiatives are underway to identify which species are being taken and in what quantities. Hammerheads are known to feature in the catches, and are suspected targets for their large valuable fins, although no specific data are available. Some domestic boats are also suspected to be targeting species for their fins in the Northern Territory, and this likely includes hammerheads (J. Stevens pers. obs). It is not a productive species and is coming out at the 'high-risk' end in recent Risk Assessments of northern Australian elasmobranchs (J. Stevens pers. obs). There is concern that this species is being increasingly targeted, and therefore an urgent need to obtain data to form an accurate assessment of the population in this region."

In summary the above IUCN global assessment for the Red List has determined the great hammerhead to be Endangered under criteria A2bd +4bd ver3.1, (Denham *et al.* 2007).

Available data for NSW

1) Three species of hammerhead are found in NSW waters and all three (the smooth, scalloped and great hammerhead) are caught in the State's recreational and commercial fisheries. As in most other parts of the world the hammerhead sharks are not generally identified to species in the available NSW data but combined at the genus level.

2) In the NSW recreational and beach meshing fishery the great hammerhead is not a commonly caught species. From 1997 to 2000, 421 sharks were sampled off the NSW coast from NSW recreational fishers (327) and from the Sydney beach meshing program (94). Of these sharks 43 were hammerheads and 2 were identified as great hammerheads (Chan 2001).

3) Recreational and gamefishing data in NSW from 1961 to 1999 has been analysed by Chan (2001) and Pepperell (1992), but as stated above the hammerhead catch is not identified to species.

   "The annual catch of hammerheads landed has varied with large numbers being caught in the mid 1960's, early 1970's, 1980's and 1990s. From 1972/73 to 1976/77 more than 200 hammerheads were landed annually, but have since decreased to be between 50 – 120/year on average. The proportion of hammerheads being tagged increased to above 50% in 1983/84, with more than 200 sharks tagged annually in the late 1980s and early 1990s." (Chan 2001).

4) The annual recreational harvest of hammerhead sharks in NSW is likely to lie between 10 and 50t, based on the results of the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003). No species specific data for great hammerheads is available.

5) In the NSW protective beach meshing program, located off Sydney beaches, 4,666 hammerhead sharks were caught in the period January 1950 to July 2008, representing 29% of the total sharks and rays caught (Green *et al.* 2009). Excluding the period of the early 1970's when the netting protocols were modified, there has been a generally consistent decline in the total numbers of sharks and CPUE in the shark meshing program from 1950 to 2008 (Green *et al.* 2009, Reid and Krogh 1992). This decline is similar to the results from the Queensland shark meshing program (Paterson, 1990). The hammerheads are generally not identified to species, but limited observer and anecdotal information suggests the minority are great hammerheads. Since 1972, hammerheads have averaged approximately 50% (ranged from 34 - 67%) of the annual catch, although in the five years 2002/03 -2007/08 hammerheads have averaged only 35% (range 20 - 42%) of the average annual catch from 2002/03 -2007/08 of 107 sharks (Green *et al.* 2009).

6) The total commercial catch of hammerhead peaked in 1993/94 at 15.7t. Annual commercial catches have averaged approximately 3t in the five years to 2006/2007. The scalloped and smooth hammerheads form the majority of the catch with a much smaller number of great hammerheads (Scandol *et al*. 2008). Landings of hammerhead sharks (all three species) in NSW commercial fisheries were 7.3 tonnes in 2008/09 and 7.2 tonnes in 2009/2010 (NSW DPI data).

7) The observer based study of the targeted commercial fishing for large shark species in waters off northern NSW shows that 9 great hammerhead sharks were caught between 1 September 2008 and 30 June 2009 during 81 fishing trips (114 fishing days), representing 0.5% of the total shark catch observed (Macbeth *et al*. 2009). Over the same time period fisher dependant catch reporting for the commercial fishery reported 41 great hammerhead sharks caught, representing 1.1% of the total shark catch (Macbeth *et al*. 2009).

8) In light of the above, the Fisheries Scientific Committee has found that it is inferred or reasonably suspected that the species has undergone, or is likely to undergo, within a time frame appropriate to the life cycle and habitat characteristics of the taxon: a large reduction in an index of abundance appropriate to the taxon, meeting the criteria of a Vulnerable Species.

   The Fisheries Scientific Committee has had regard to the following in determining the extent of the reduction referred to above:-

   (a) Evidence of declining populations across the species range for this wide ranging or naturally uncommon species in NSW waters: - IUCN report (and references therein) for the eastern Atlantic, southwest Indian Ocean, Northwest Atlantic and northern Australia.
   (b) The status of the species outside the State as appropriate for the taxon: - IUCN global assessment of the species as Endangered.
   (c) The potential of the species to maintain relatively stable abundance under high levels of mortality: - The collapse of the hammerhead stocks off the west coast of Africa, Belize, Central America and the Caribbean when fished heavily.
   (d) The ability of the species to recover rapidly from low numbers: - See (c) above.
   (e) The reproductive potential of the species in relation to its reproductive ecology and behaviour and the relationship of these to any threatening process or processes: - Restricted reproductive potential due to viviparity, small litter sizes and females breeding once every 2 years.
   (f) The current management strategies in relation to life history and reproductive ecology: - The existing management of the large shark fishery (including hammerhead sharks) in NSW with a total allowable catch of 126.5t per annum. This total allowable catch relates to processed weight (i.e. headed and gutted) and excludes school, gummy, wobbegong and some dogfish species, which are subject to separate management arrangements. Also shark finning at sea by any commercial or recreational fisher is prohibited.
   (g) The precautionary principle, namely, that if there are threats of serious or irreversible damage to the species, lack of full scientific certainty should not be used as a reason for postponing measures to prevent that damage.

Criteria – threatening processes (Regulation clause 272)

1) The threatening processes for this highly migratory species are continued harvest in recreational, commercial and bather protection fisheries.

2) Internationally this species like most elasmobranch fisheries is susceptible to overfishing (Burgess and Morgan 2003, Bonfil 1994). In the USA it is managed as a Large Coastal Shark

Fishery under the Highly Migratory Species Fishery Management Plan (National Marine Fisheries Service: Federal Fisheries Management Plan for Atlantic Tuna, Swordfish and Sharks). In South Africa there is a shark bycatch limit in the tuna longline fishery of 10% of the weight of tuna landed, and a recreational line fishery Bag Limit of one shark per angler per day. Shark finning bans are being adopted and implemented in a range of situations by fishing states (USA, Australia), regional entities (EU) and regional fisheries organisations (ICCAT).

In NSW there is a recreational bag limit of one hammerhead shark per person per fishing trip.

In NSW the total allowable commercial catch for large sharks (which includes hammerhead sharks) is 126.5t per annum.

The 2009/10 annual performance report for the NSW Shark Meshing (Bather Protection) Program off Newcastle – Sydney – Wollongong NSW reports the capture of 16 hammerheads with 11 identified as smooth hammerheads.

3) For *Sphyrna mokarran*, there is observed, inferred or reasonably suspected to be, historical, current and potential threatening process, or threatening processes affecting the species.

The Fisheries Scientific Committee has had regard to the following in determining the relevant extent of the effect of the threatening process or processes:
(a) The number and nature of the threatening processes,
(b) The potential for synergistic effects between threatening processes,
(c) The extent of the threatening processes relative to the geographic distribution of the species,
(d) The level of protection offered to the species within existing reserve systems, other forms of refuge or by current management strategies.

4) In light of the above, the Fisheries Scientific Committee has found that these threatening processes continue to operate within the geographic distribution of the species and existing reserve systems or other forms of refuge do not protect the species.

Conclusion pursuant to section 220F(4) of the Act

In the opinion of the Fisheries Scientific Committee:
(a) *Sphyrna mokarran* the great hammerhead shark, is facing a high risk of extinction in New South Wales in the medium-term future, as determined in accordance with the criteria prescribed by the Regulation as discussed above, and
(b) it is not eligible to be listed as an endangered or critically endangered species.

The species is eligible to be listed as a VULNERABLE SPECIES.

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