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PROPOSED DETERMINATION
The Scalloped Hammerhead – *Sphyrna lewini* as an Endangered Species

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), is proposing to list the scalloped hammerhead shark, *Sphyrna lewini* as an ENDANGERED SPECIES in Part 1 of Schedule 4 of the Act.

The listing of Endangered 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 lewini* (Griffith & Smith 1834), the scalloped hammerhead, is a valid recognised taxon and is a species as defined in the Act. However, DNA analyses indicate substantial genetic divergence between various populations and that a cryptic species exists in sympatry with *Sphyrna lewini* in the north-west Atlantic Ocean (Quattro *et al*. 2006; Duncan *et al.* 2006).

2) *Sphyrna lewini* is cosmopolitan in tropical and warm temperate seas between 45^{o}N and 34^{o}S, but occurs more frequently during the warmer months at higher latitudes (Bass *et al.* 1975; Last & Stevens 2009). The species occurs in NSW between at least November and June (and perhaps longer) (Reid & Krogh 1992; Macbeth *et al*. 2009). It occurs inshore and over the continental shelf and in adjacent deep water from the surface to at least 275 m depth (Last & Stevens 2009). However, there is sexual niche separation, with females occupying offshore waters and only moving onto the continental shelf to mate and give birth (Klimley 1987; Stevens & Lyle 1989). Stevens (1984) and Macbeth *et al.* (2009) suggested that few mature females occur in NSW.

3) The maximum reported size of the *Sphyrna lewini* is 367 cm (Dudley & Simpfendorfer 2006). In northern Australia, males mature at about 140 to 160 cm and females mature at 200 - 220 cm (Stevens & Lyle 1989). This corresponds to ages of 7 – 10 years for males and 15 years for females (V. Peddemors, pers. comm.). However, maximum size and size at maturity differ amongst other populations and these northern Australian data are at the smaller end of the spectrum of reported values (Chen et al. 1988; Hazin *et al.* 2001; Dudley & Simpfendorfer 2006; Piercy *et al.* 2007; White *et al.* 2008). Maximum age is 30 years (Dudley & Simpfendorfer 2006).

4) *Sphyrna lewini* is viviparous. Pupping occurs between October and January in northern Australia after a 9 – 10 month gestation (Stevens & Lyle 1989). Litter size ranges from 14 – 41 (mean = 25) pups, with fecundity increasing with length (White *et al.* 2008). Size at birth is 39 to 57 cm (White *et al.* 2008). Pupping occurs in shallow inshore waters and juveniles stay in nursery environments (bays and estuaries with muddy substratum (Clarke 1971; Holland *et al.* 1993; Duncan & Holland 2006)) for up to one year or more, within which time mortality of young of year is high (85 – 93%) (Duncan & Holland 2006). There is no evidence of pupping occurring in NSW waters.

5) *Sphyrna lewini* sometimes forms dense aggregations and large migratory schools (Last & Stevens 2009). During the day, adults aggregate around sea-mounts and pups aggregate in shallow inshore waters (Holland et al. 1993). These non-feeding diurnal aggregations disperse at night to hunt (Clark 1971; Klimley & Nelson 1984; Klimley *et al.* 1988; Holland *et al.* 1993).

6) The diet of adults is dominated by teleost fishes (61.9%), crustaceans (22%) and cephalopods (15.5%) (Cortés 1999) and suggests pelagic foraging (Stevens and Lyle 1989). Pups feed on fish and nocturnally active crustaceans (Clarke 1971).

7) Assessment of population rebound potential of 26 shark species in the Pacific Ocean ranked *Sphyrna lewini* as one of the species with the poorest ability to recover from increased mortality (Smith *et al.* 1998).

8) 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 scalloped hammerhead occurs outside of NSW is presented below (Sections a to f) and is reprinted from (Baum *et al.* 2007).

"a) Northwest and Western Central Atlantic (including Caribbean Sea)
Estimates of trends in abundance are available from two long-term research surveys conducted on the U.S. east coast, both of which indicate this species has undergone substantial declines in this region (98% between 1972 and 2003, and an order of magnitude between 1975 and 2005). A third survey comparing catch rates between 1983/84 with those in 1993-95 showed a decline of two-thirds, while a survey beginning more recently showed increases in catch rates of juveniles. Standardized catch rates from the U.S. pelagic longline fishery show declines in *Sphyrna* spp. Of 89% between 1986 and 2000 (according to the logbook data) and declines of 76% between 1992 and 2005 (according to observer data). The other information for this species from this region comes from Belize, where it has been heavily fished since the 1980s and fishermen have reported dramatic declines, which led to the end of the fishery. Fishing pressure is sustained in Belize by Guatemalan fishermen.

b) Southwest Atlantic
Sphyrna lewini faces two main threats related to fisheries in this region: 1) fishing of juveniles and neonates on the continental shelf by gillnets and trawl nets and 2) fishing of adults by gillnets (only in Brazil) and longlines on the continental shelf and oceanic waters, mostly for fins. Catches are inadequately recorded and landings data do not reflect the numbers finned and discarded at sea. The species is taken by fisheries throughout all parts of its life-cycle and greater demand for shark fins and flesh has resulted in a substantial increase in retention rates and targeting of sharks. In view of the intensive fisheries in the coastal and offshore areas where *Sphyrna lewini* occurs in this region and documented declining trends where the species has been heavily fished in other areas of its range, the species is assessed as Vulnerable in the Southwest Atlantic.

c) Western Indian Ocean
Catch per unit effort of *Sphyrna lewini* declined significantly from 1978-2003 in shark nets off the beaches of Kwa-Zulu Natal, South Africa, suggesting a 64% decline over this period. *Sphyrna lewini* is captured throughout much of its range in the Indian Ocean, including illegal targeting of the species in several areas. Landings reported to FAO in Oman, surveys of landings sites in Oman and interviews with fishermen there also suggest that catches of *Sphyrna lewini* have declined. The

species faces heavy fishing pressure in this region, and similar declines in abundance are also inferred in other areas of its range in this region. Given continued high fishing pressure, observed and inferred declines, the species is assessed as Endangered in this region.

d) Eastern Central and Southeast Pacific
This species is heavily exploited through its range in the Eastern Pacific. Of particular concern is increasing fishing pressure at adult aggregating sites such as Cocos Island (Costa Rica) and the Galapagos Islands (Ecuador), and along the slopes of the continental shelf where high catch rates of juveniles can be obtained. The number of adult individuals at a well-known *Sphyrna lewini* aggregation site in the Gulf of California (Espiritu Santo seamount) has declined sharply since 1980. Large hammerheads were also formerly abundant in coastal waters off Central America, but were reportedly depleted in the 1970s. A comparison of standardized catch rates of pelagic sharks (species-specific information was not available) in the EEZ of Costa Rica from 1991-2000 showed a decrease of 60%. In Ecuador, landings (grouped for the family Sphyrnidae) peaked in 1996 and declined until 2001. Illegal fishing for shark fins is occurring around the Galapagos. There are no species specific data for these fisheries, but *Sphyrna lewini* is one of the most common species around the Galapagos and given the high value of its fins, it is very likely being targeted. Divers and dive guides in the Galapagos have noted a severe decrease in shark numbers and schools of hammerhead sharks. Given continued high fishing pressure, observed and inferred declines, the species is assessed as Endangered in this region.

e) Eastern Central Atlantic
Although there are no data on species-specific trends in abundance for *Sphyrna lewini* in this region, fishing pressure from pelagic longline fleets in this area is high and potentially comparable to that in the Northwest and Western Central Atlantic, where significant declines in abundance of *Sphyrna lewini* have been documented. The larger hammerhead shark, *Sphyrna mokarran*, is assessed as Critically Endangered in this region, from which it has apparently virtually disappeared. There is also concern for *Sphyrna lewini* in this area and although it is still present in the catches, catches are comprised entirely of juveniles in some areas. Given continued high fishing pressure throughout this species shelf habitat off Western Africa and the declining trends observed in other areas of this species range where it is fished, it is considered to meet the criteria for at least Vulnerable in this region.

f) Australia
There has been a large increase in the illegal, unregulated and unreported (IUU) fishing in northern Australia recently. Hammerheads are known to feature in the catches, and are suspected targets for their large valuable fins, although no specific data are available. Further study is urgently required to determine the status of *Sphyrna lewini* in this region."

In summary, the above IUCN global assessment dated for the Red List has determined the scalloped hammerhead to be Endangered under criteria A2bd+4bd ver 3.1 (Baum *et al.* 2007).

Available data for Australia
1) Data from NSW, Queensland and international waters summarised below suggest declines of hammerhead sharks of the order of between 75 % to > 90 % over a period of time representing less than two *Sphyrna lewini* generations. We consider that this rate of decline represents a very high risk of extinction in the near future – relative to the generation interval of the species.

2) Catch-per-unit-effort data from the NSW Shark Meshing Program collected between 1950 and 2007/08 indicates that hammerhead sharks (*Sphyrna lewini*, *Sphyrna mokarran* and *Sphyrna zygaena*) have declined substantially in NSW (Reid & Krogh 1992; Green *et al.* 2009). Hammerheads made up 29% of the animals caught by the shark meshing program between 1950 and 2007/08 and are the most numerous species group caught (Green *et al.* 2009). However,

because species identity was not recorded, we cannot gauge change in *Sphyrna lewini* relative to that of the other two hammerhead species (although Reid and Krogh (1992) suggest that a majority of the NSW hammerhead catch was likely to be *Sphyrna zygaena*). Further complicating longer-term analysis are changes in methods and the level of effort of the shark meshing program in 1972/73, making comparison of pre 1972 versus post 1973 changes difficult. Despite these limitations, the shark meshing program has documented major declines in hammerhead sharks since 1972/73. The number of hammerheads caught per year has declined from > 300 individuals per annum when the new method-effort regime was initiated in 1972/73 to < 30 in 2007/08. This represents a greater than 90% decline over a 35 year period.

3) Data from the Queensland Shark Control Program indicates that the catch of hammerhead species has declined by approximately 75% between 1985/86 and 2009/10 (QLD DEEDI 2010) from > 200 individuals per annum to < 50 per year. However, prior to 1997/98 a majority of the catch was not reported to species level, making interpretation regarding *Sphyrna lewini* alone problematic. However, from 1997/98 onwards, where catch of both *Sphyrna lewini* and *Sphyrna mokarran* are reported, *Sphyrna lewini* make up 78 ± 13% (Mean ± SD) of the catch.

4) Detailed summaries of population trends for *Sphyrna lewini* in international waters are summarised by Baum *et al.* (2007) and CITES (2010). Most populations assessed have undergone substantial declines over the last 30 years, with the scale of decline averaging 5.6 ± 5.7% per year over 19 ± 14 year periods (calculated from data presented in Annex 2 of CITES (2010)).

5) In light of the above, the Fisheries Scientific Committee has found that it is estimated, 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 very large reduction in an index of abundance appropriate to the taxon, meeting the criteria of a Endangered 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 species,
(b) The status of the species outside the State as appropriate for the taxon,
(c) The potential of the species to maintain relatively stable abundance under high levels of mortality,
(d) The ability of the species to recover rapidly from low numbers,
(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.
(f) The current management strategies in relation to life history and reproductive ecology,
(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) All life-stages are vulnerable to capture as both target and bycatch in commercial and recreational fisheries. Pups are susceptible to trawling (prawn) in nursery habitats (Fennessy 1994; Stobutzki *et al.* 2002) and angling (Holland *et al.* 2003). Juveniles are susceptible to most fishing methods in inshore waters and adults are taken in gillnets and long-line fisheries (Baum *et al.* 2007; Scandol *et al.* 2008; White *et al.* 2008).

2) The fins of *Sphyrna lewini* are of high value (Baum *et al.* 2007; Last & Stevens 2009; CITES 2010).

3) The species aggregating habit make large schools highly vulnerable to fishing. Large CPUEs can be recorded even when stocks are severely depleted (Baum *et al.* 2007).

4) Commercial landings of hammerhead sharks (all three species) in NSW between 1990/91 and 2006/07 have fluctuated between a high of 15.7 tonnes and a low of 2.16 tonnes (Scandol *et al.* 2008). Most are harvested by the Ocean Trap and Line fishery (~74%) with some hammerheads also captured by the Estuarine General and Ocean Trawl fisheries. Most sharks harvested are immature. Mortality in gill nets and long-lines is very high (Reid & Krogh 1992; Macbeth *et al.* 2009).

5) The annual recreational harvest of hammerheads sharks (all three species) is suggested to lie between 10 and 50 tonnes (Henry & Lyle 2003; Scandol *et al.* 2008) and is therefore likely to be greater than mortality arising through commercial fisheries. In NSW there is a recreational bag limit of one hammerhead shark per person per fishing trip.

6) The annual catch of hammerheads from the NSW Shark meshing program averaged 80 individuals per year between 1950 and 2008. More than 85% of those individuals caught are < 1.5 m and almost all are < 2 m (Reid & Krogh 1992), and consequently a majority of the catch are immature sharks. Mortality in shark mesh nets is very high 98.3% (Reid & Krogh 1992).

7) For *Sphyrna lewini*, there is observed, estimated, 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 impact of the threatening processes on the diversity and quality of the species' habitat,
(e) The level of protection offered to the species within existing reserve systems, other forms of refuge or by current management strategies.

8) 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(3) of the Act

In the opinion of the Fisheries Scientific Committee:

(a) *Sphyrna lewini* the scalloped hammerhead shark, is facing a very high risk of extinction in New South Wales in the near 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 a critically endangered species.

The species is eligible to be listed as an ENDANGERED SPECIES.

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