

Whale Shark (*Rhincodon typus*) Recovery Plan

Issues Paper



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The recovery plan linked to this paper is obtainable from:

<http://www.deh.gov.au/biodiversity/threatened/publications/recovery/whale-shark/index.html>

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Abbreviations

| | |
|---------|---|
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| CMS | Convention on Migratory Species |
| DEH | The Department of the Environment and Heritage |
| EPBC | Environment Protection and Biodiversity Conservation Act, 1999 |
| IUCN | The World Conservation Union |
| TSSC | Threatened Species Scientific Committee |
| UNCLOS | The United Nations Convention on the Law of the Sea |
| WA | Western Australia |
| WA CALM | The Western Australian Department of Conservation and Land Management |

Biology

Taxonomy

| | |
|---------|--------------------------------------|
| Class | Elasmobranchii |
| Order | Orectolobiformes |
| Family | Rhincodontidae |
| Species | <i>Rhincodon typus</i> (Smith, 1828) |

Common names

Whale Shark

Life characteristics

The Whale Shark is the world's largest fish, and one of only three filter-feeding shark species, along with the Basking Shark (*Cetorhinus maximus*), and the Megamouth Shark (*Megachasma pelagios*). The Whale Shark is easily recognizable due to its broad, flattened head, its large mouth, and its pattern of light spots and stripes on a dark background (Last & Stevens 1994). The ventral surface is typically whitish (Norman, 2002).

The only member of the family Rhincodontidae, the largest Whale Shark found to date measured 20 metres and weighed 34 tonnes (Chen et al.1997, in Chen & Phipps, 2002). Despite its immense size, the Whale Shark is harmless to humans. It has few defences, although its ability to reach a very large size combined with a tough (thick) skin present on the dorsal surface can be used for protection (Norman, 1999). It is generally encountered singly, though occasionally in aggregations of up to hundreds of sharks (Compagno, 1984; Norman, 1999). The Whale Shark has typical “K” selected life history characteristics, including slow growth, late maturation and extended longevity (Colman, 1997a).

Lifespan

Data on the lifespan of the Whale Shark is limited. Taylor (1994) indicates that based on the late age of sexual maturity in Whale Sharks (estimated at around 30 years of age), the Whale Shark may be one of the longest living animals in the world, with an estimated lifespan of over 100 years.

There have been two reviews of Whale Shark growth rates ie Wintner (2000) and Uchida (2000). In both data has come from studies of captive individuals held in aquaria, as well as from the vertebrae of stranded Whale Sharks from South Africa. Wintner (2000)

studied the growth rate of two animals held in aquaria and found that growth rates of Whale Sharks kept in captivity were 1.1 –1.3 times higher than would be expected from an animal in the wild, possibly due to the reliable availability of food in an aquarium. Uchida (2000) notes life span in aquaria range from three to 2056 days, with mean growth rate in the latter specimen at 29.5cm per year. Norman (2004) reports on another juvenile Whale Shark with a growth rate of 46cm per year over the 630 days while held in captivity.

It is likely that due to their very small size at birth (~ 0.5m) (Joung *et al.*, 1996) and hence lack of defence to predation in the early stages of life, Whale Sharks grow very fast initially and then the rate of growth would decline (Norman, 1999). Some evidence of this rapid growth has been collected from a newborn Whale Shark that grew 143cm over 143 days while in captivity in a Taiwanese aquarium (Chang *et al.*, 1997).

Diet

The Whale Shark is primarily a suction filter feeder (Compagno, 1984). It feeds on a wide variety of planktonic and nektonic prey, including small crustaceans, small schooling fishes such as sardines, anchovies and mackerel, and occasionally on small tuna and squid (Compagno, 1984; Last and Stevens, 1994). Whale Sharks at Ningaloo Reef have been observed actively feeding on swarms of the tropical krill *Pseudeuphausia latifrons* (Taylor, 1994; Norman, 1999). On a separate occasion, a Whale Shark was seen sucking the surface slick of coral spawn into its mouth while orientated at 45° to the surface (Norman, 1999). At Christmas Island, Indian Ocean the Whale Sharks have been observed feeding on localised concentrations of mysids (*Anisomysis spinata*) and crab magalopa (*G. natalis*) (Norman, 1999).

Three faecal samples analysed by Norman (1999) revealed exoskeletal remains of calanoid and harpacticoid copepods, larval decapods and the scales of small fishes. A further two Whale Shark faecal samples from Ningaloo Reef contained eyes, legs, and fragments of exoskeleton from crustacean prey, namely *P. latifrons*, suggesting that Whale Sharks aggregating seasonally off Ningaloo Reef feed predominantly on this tropical krill (Wilson & Newbound, 2001). Whale Sharks have been observed feeding passively by swimming forward with mouth agape, and feeding actively by opening their mouths and sucking in prey. Whale Sharks are also reported as hanging vertically in the water while feeding (Colman, 1997a).

Reproduction

The Whale Shark is a livebearer with an ovoviviparous mode of development (Joung *et al.*, 1996). It may be the most fecund of all live bearing sharks. The only pregnant female found to date measured 10.6m, weighed 16t, and contained 307 embryos. The embryos measured between 42 and 63 cm in length (Joung *et al.*, 1996).

There is scant information on the age at which Whale Sharks become reproductive, although Norman (1999) presents evidence (collected during an intensive study of this

species at NMP between 1995-97) that the length at maturity of male Whale Sharks is approximately 8.6m TL. Alternatively, examination of two female Whale Sharks (TL = 7.9 and 8.6m) by researchers in India revealed immature ovaries in each specimen (Pai *et al.*, 1983; Satyanarayana Rao, 1986 in Colman, 1997). Taylor (1994) indicates that the Whale Shark may not reach sexual maturity until 30 years of age. There is currently limited evidence with which to accurately determine age at maturity or the maximum age for this species (Wintner, 2000).

Information on the frequency at which Whale Sharks are able to reproduce is not available. Likewise, it is not known where Whale Shark mating takes place, although it is considered likely in the waters surrounding Taiwan, Philippines and India where sightings of juvenile Whale Sharks have been recorded (Norman, 2004).

Population

Size

Yearly numbers of Whale Sharks in Ningaloo Marine Park is estimated to vary between 200 and 400 individuals (Davis *et al.* 1997). These sharks appear to congregate on Ningaloo Reef between March and May, and reach peak densities roughly two weeks after the coral has undergone mass spawning (Taylor, 1996) although further analysis of records from the ecotourism industry will confirm this. Figures for the global population of Whale Sharks are not available, although an advanced monitoring program using photo-identification has been implemented with sighting information (and identification photographs) of Whale Sharks from 16 separate countries currently included in the ECOCEAN Whale Shark Photo-identification Library (see www.ecocean.org). The methodology used to enable the identification of individual Whale Sharks has been subjected to vigorous testing and established that natural markings on the skin of Whale Sharks (in particular the spot patterning behind the gill slits) does not change over time and can be used for population monitoring using mark-recapture studies (Brad Norman, pers. comm.).

Trends

Despite relatively limited information being available on population trends for the Whale Shark, the World Conservation Union's Red List (2003) classifies the species as "Vulnerable" (A1bd+2d).

"The life history of this relatively scarce but cosmopolitan tropical and warm temperate species is poorly understood, but it may be relatively fecund and migrates extremely large distances. Catches have declined and populations apparently been depleted by harpoon fisheries in several countries targeting localised concentrations of this huge, slow-moving and behaviourally-vulnerable species, and there is incidental capture in other fisheries. Directed fisheries, high value in international trade, a K-selected life history, highly migratory nature, and low abundance make this species vulnerable to

exploitation. In recent years dive tourism involving this species has developed in a number of locations around the world.” (IUCN Red list 2003).

Fishery data for the Whale Shark, though quite scarce, points to a decline in seasonal catches, with the declines often occurring in the space of only a few years since the establishment of directed commercial fisheries, for example in the Philippines and in India (CITES Prop. 12.35). Catches from Taiwan’s commercial fishery have declined by 30-90% from the 1960s – 1980s, 50-80% from the mid 1980s to the 1990s, and around 70% during the four years from 1997 to 2001 (CITES Prop. 12.35). The annual Whale Shark catch in Taiwan declined by 58% (from 272 to 113 Whale Sharks) in the period of January 2001 to March 2002, although Chen and Phipps (2002) indicate that this decline may also be attributed to confusion over the introduction of a new Whale Shark catch reporting system. Since 2002/03, officials in Taiwan have implemented a Total Allowable Catch (TAC) on the number of Whale Sharks permitted to be killed each year (80) (Chen and Phipps, 2002). This number has been taken each year, although it is believed that there is still a level of misreporting and that the catch maybe slightly higher (Brad Norman, pers. comm.).

Data from the Philippines and India, although over much shorter time scales, indicate similarly steep reductions in catches. In the Philippines, catches declined on average 27% per year during the 1990’s before the Government closed the fishery. In Gujarat, India, Whale Shark catches appear to have declined by 40% in 1999-2000 before the Government closed the fishery (CITES Prop. 12.35).

Due to the whale shark’s tendency to migrate from one region to another, apparent declines in numbers of seasonal sightings (for example in South Africa and Thailand) may be due to unsustainable fishing in other parts of the whale shark’s range (CITES Prop 12.35), or to inter-annual variability (Stevens, pers. comm. 2004).

Of particular concern is the apparent reduction in the frequency of sightings of large individual Whale Shark in Taiwan. Until the late 1990’s, the average size of Whale Sharks caught in northeastern Taiwan was significantly larger (e.g. 10-20m specimens). This is in contrast to records from 2000 to present, indicating that the mean total length of Whale Sharks captured in Taiwan has declined to approximately 4.6m (Chen & Phipps, 2002; S.J. Joung, pers. comm. to Brad Norman, 2004). It is likely that this reduction in mean length of Whale Sharks in Taiwan is a direct result of the larger (breeding) females being ‘fished out’ from the Whale Shark ‘population’ in the waters surrounding Taiwan (Brad Norman, pers. comm.).

Distribution & migration

The Whale Shark occurs in approximately 124 countries worldwide (Fowler, 2000 in Chen & Phipps, 2002). They have a broad distribution usually between latitudes 30°N and 35°S in tropical and warm temperate seas, both oceanic and coastal (Compagno, 1984). Although Compagno (1984) suggests that this species prefers waters with temperatures between 21-25⁰C, the Whale Sharks sighted at Ningaloo Marine Park in

Western Australia are predominantly found in waters with temperatures averaging 27°C (Norman, 1999).

Global Whale Shark distribution



Source: Fisheries Global Information System (2004)

Information on distribution of Whale Sharks in Australia is based primarily on seasonal surveys at Ningaloo Marine Park, with very limited records collected elsewhere. Whale Sharks are known to occur in New South Wales, Queensland, Northern Territory, Western Australia, Christmas Island, Indian ocean and occasionally South Australia and Victoria (Compagno, 1984; Last and Stevens, 1994, in Pogonoski, Pollard and Paxton, 2002; Norman, 1999).

In 1999, a Whale Shark was tagged with a satellite tag at Ningaloo Marine Park in Western Australia and tracked for 420km away from the Australian shores towards Indonesia before the signal was lost (Norman, 1999). A further two Whale Sharks were tracked from Ningaloo Marine Park in 2002: the first travelled more than 2000 km to Christmas Island before the signal was lost; a second shark travelled approximately 1800km over a 35 day period towards Indonesia (Norman, 2004). However, longer term information on the movement and distribution of Whale Sharks in Australia is limited. Satellite telemetry studies off the Malaysian and Philippine coastline indicate that Whale Sharks swim an average of 24 km/day and have a minimum range of 2000 km (Eckert *et al.*, 2002). Eckert and Stewart (2001) also found an average 24 km/day swim rate for Whale Sharks in the Sea of Cortez, Mexico, and the north Pacific Ocean.

Eckert and Stewart (2001) report the movement of one tagged whale shark of 13 000 km over 37 months as it migrated from the Sea of Cortez to the western north Pacific Ocean. The IUCN Shark Specialist Group affirms that the whale shark migrates extremely large distances (Cavanagh *et al.* 2003). Whale shark movements within a region may be precisely timed to coincide with localised productivity events and/or behavioural changes in their prey that allow for more efficient exploitation (Taylor, 1994; Norman, 1999; Wilson, Taylor & Pearce, 2001).

There appears to be spatial and seasonal segregation of Whale Shark populations according to size and sex (Norman, 1999 in CITES Prop. 12.35). It is possible that juvenile Whale Sharks exploit different ranges to that of more mature sharks, and that different age classes of males and females undertake alternative migration paths.

Whale Sharks have a tendency to be site-faithful (philopatric), returning regularly to the same seasonal feeding locations (CITES Prop. 12.35). For example, it has been possible to identify particular individuals (using photographic identification) returning to Ningaloo Marine Park and the Maldives in successive seasons (Norman, 2004). This tendency to form what are effectively discrete stocks makes the species particularly vulnerable to localised depletion by directed fishing activity (CITES Prop. 12.35). Range States for the Whale Shark are listed in Appendix 1.

Critical habitat

In Australian waters, Whale Sharks seasonally aggregate in coastal waters off Ningaloo Reef between March and July each year, at Christmas Island between December and January, and in the Coral Sea between November and December. (Taylor, 1994; Norman, 1999; Wilson, Taylor & Pearce, 2001; Norman, 2004; John Stevens, pers. comm.). Evidence suggests that seasonal aggregations off Ningaloo Reef are due to migratory behaviour associated with climatic and oceanographic processes, with a possible link between the abundance of aggregating Whale Sharks and the physical and biological oceanography of the region (Wilson, Taylor & Pearce, 2001). The importance of the plankton bloom and high productivity of the waters surrounding Christmas Island at the time of the mass spawning of the red land crab (*Gecarcoidia natalis*) in attracting Whale Sharks to this Australian External Territory cannot be underestimated.

The species is generally encountered in areas where the water surface temperature is between 21° and 25°C with upwellings of colder (17°C or less) water, and a salinity range of 34 to 34.5 ppt (Iwasaki, 1970 in Colman, 1997). These conditions may produce localised concentrations of the planktonic and nektonic prey on which the Whale Sharks feed (Colman, 1997).

Whale Sharks aggregate in certain areas rich in nutrients to feed on seasonal aggregations of tropical krill and baitfishes (Ningaloo Reef), red land crab (*G. natalis*) megalopa (Christmas Island), fish spawn (Belize), and shrimps (northern Borneo and Philippines) (CITES Prop. 12.35). It could therefore be suggested that these areas form a portion of the Whale Shark's critical habitat.

Legal Status

Commonwealth

The Australian Government Minister for the Environment and Heritage listed the Whale Shark as Vulnerable under Section 178 of the EPBC Act on 16 October 2001. The

Minister’s decision to list the Whale Shark as a threatened species was based on advice from the Threatened Species Scientific Committee. The Committee found evidence for past and probable future substantial reductions in the Australian Whale Shark population, primarily due to fishing pressures in the waters of other regional fishing nations such as the Philippines, Taiwan and India. Catch data from these three countries indicated declining catch rates for the Whale Shark over the last ten to fifteen years.

Considering that Australia is likely to share Whale Shark populations with these regional nations, and that hunting pressure on Whale Shark populations would be expected to continue in the Philippines, Taiwan and India, the Committee concluded that a decline in the Australian population over time could be inferred or suspected

The full text of the Committee’s recommendation is included in Appendix 2.

States

In Western Australia (WA), Whale Sharks are fully protected under the *Conservation and Land Management Act, 1984* and the *Fish Resources Management Act 1994* as a ‘totally protected fish’. In WA, the Department of Conservation and Land Management (WA CALM) is responsible for the day to day management of Whale Sharks within Commonwealth Waters under a memorandum of understanding between WA CALM and DEH (WA CALM, 2003). Whale Sharks are also protected in Queensland waters under the *Great Barrier Reef Marine Park Act 1975*. In Tasmanian waters the species is protected under the *Fisheries Regulation 1996*.

Australian Legislation on Whale Shark conservation

| Jurisdiction | Act |
|---------------------|--|
| Commonwealth | <i>Environment Protection and Biodiversity Conservation Act 1999</i> |
| Western Australia | <i>Conservation and Land Management Act, 1984</i> <i>Fish Resources Management Act 1994</i> |
| Queensland | <i>Great Barrier Reef Marine Park Act 1975</i> |
| Tasmania | <i>Fisheries Regulation 1996</i> |

Adapted from: Pogonoski, Pollard, and Paxton, 2002.

International

The Whale Shark is covered by protective legislation in a number of countries. It is unclear how successful national legislation has been in protecting the Whale Shark from exploitation. There are indications that underreporting of catches and illegal poaching occurs despite national legislation being in place banning the take of Whale Sharks, as is the case in the Philippines (Alava, 2002 in Chen & Phipps, 2002).

National regulations on Whale Shark harvesting

| State | Action, effective date |
|--------------|---|
| Belize | Habitat protection, 18 May 2000 |
| Honduras | Ban on fishing, 28 October 1999 |
| Maldives | Ban on fishing, 24 June 1995 |
| Philippines | Ban on fishing, 25 March 1998 |
| Thailand | Ban on fishing, 28 March 2000 |
| India | Ban on fishing, 28 May 2001 |
| Mexico | Ban on fishing, 2000 |
| USA | Ban on fishing on Eastern seaboard |
| Australia | Protected in Commonwealth, Western Australian, and Tasmanian State waters (and the waters of the Great Barrier Reef Marine Park in Queensland). |

Adapted from: Chen & Phipps, 2002 (and Norman, 2004).

The Whale Shark is also included in a number of international conventions and agreements, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Migratory Species (CMS), and the United Nations Convention on the Law of the Sea (UNCLOS).

CITES

The Whale Shark is listed on Appendix II of the Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES), having been nominated for inclusion by India and the Philippines in 2002. The case presented for listing under Appendix II of CITES included evidence of targeted fishing pressure supplying a growing demand for Whale Shark products, including meat and fins.

Trade in Specimens of Species included in Appendix II of the convention is subject to strict regulations, as detailed in Appendix 3. The full text of the Whale Shark nomination to CITES Appendix II is available from (<http://www.cites.org/eng/cop/12/prop/E12-P35.pdf>).

CMS

The Whale Shark is listed on Appendix II on the Convention on Migratory Species (CMS) as detailed in Appendix 4. Appendix II of the Convention lists “*migratory species which have an unfavourable conservation status and which require international agreements for their conservation and management, as well as those which have a conservation status which would significantly benefit from the international cooperation*”

that could be achieved by an international agreement” (Convention on Migratory Species, 2004).

UNCLOS

The Whale Shark is included in Annex I (Highly Migratory Species) of the United Nations Convention on the Law of the Sea (UNCLOS). The Convention recognises that a coordinated management and assessment of shared migratory populations would promote an understanding of the cumulative impacts of fishing effort on the status of shared populations (Prop 12.35 CITES). The full text of the convention is available from (http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm).

Threats

Information on threats faced by Whale Sharks is relatively poor. Indeed, aside from the threat posed by directed take of Whale Sharks to supply trade in Whale Sharks products, other threats that may be faced by Whale Sharks are less easily monitored, quantified or assessed.

Known predators of juvenile Whale Sharks include the blue shark (*Prionace glauca*), the blue marlin (*Makaira nigricans*) and the killer whale (*Orcinus orca*) (Kukuyev, 1996; O’Sullivan & Mitchell, 2000; A. Goorah pers. comm. to Brad Norman). Although unconfirmed, it is believed that an attack on a sub-adult Whale Shark photographed in northwestern Western Australia in 2003 may have been from a great white shark (*Carcharodon carcharias*) (R. Mau pers comm. to Brad Norman).

Possible threats to the Whale Shark include threats to the habitat on which they rely. While important information has been collected on this species at Ningaloo and more recently from Christmas Island, there still remains a general lack of knowledge on many aspects of Whale Shark biology, including definitive migration patterns and habitat critical to the survival of this species. The task of identifying possible threats to the survival of the Whale Shark is reduced to little more than an educated guess. In the first instance therefore, the following list of identified threats should be treated with caution – other threats may exist, and the threats listed may not significantly impact on the survival of Whale Sharks in Australian waters.

Migration disturbance

Whale Sharks are known to be highly migratory, with studies demonstrating migrations of at least 13,000 km over 37 months (Eckert and Stewart, 2001). Current information on migration patterns is scarce, though Norman (2004) is currently investigating movements of Whale Sharks from Ningaloo Reef to Christmas Island to coincide with the mass spawning of the red land crab (*G. natalis*). Currently there is no information available regarding threats to the migration patterns followed by Whale Sharks.

It is possible that increased levels of noise and pollution resulting from an increase in boat traffic may have a negative impact on the migration patterns normally followed by Whale Sharks, through disturbance to habitat or through disturbance of individual sharks.

Damage to ecosystems on which Whale Sharks rely along their migration routes could negatively impact on the migration patterns normally followed by the sharks. Current information on migration routes followed by Whale Sharks is insufficient to make an informed judgement on the main threats to the migratory behaviour of Whale Sharks, nor on the likelihood of those threats occurring, or of the possible consequences of migration disturbance on the survival of Whale Sharks.

Sound disturbance

Unlike cetaceans, sharks do not use sound to communicate with each other. However, sharks do sense sound as pressure through their lateral line system, and it is possible that high decibel sounds may negatively impact on Whale Sharks. Experiments have demonstrated that sharks can hear sounds with frequencies ranging from about 10 Hertz to about 800 Hertz (Martin, 2004). The effects of very loud sounds on shark behaviour are not well documented, however it is possible that they could potentially disrupt normal behaviours such as feeding, mating, or migrating from one place to another.

Tourism

In the past two decades, there has been a global increase in the number of tourism operations providing the opportunity for tourists to swim with Whale Sharks. Tourism operations are generally located where Whale Sharks are reliably found, notably in Ningaloo Reef, the Galapagos Islands, islands off the west coast of Thailand, the Sea of Cortez and Baja California in the eastern Pacific (Colman, 1997), the Philippines, the Maldives, Seychelles and Belize (Norman, 2004). Tourism operations generally involve snorkelling or scuba diving with Whale Sharks.

Taylor (1994) suggests that Whale Sharks do not generally feed during the daytime, when most divers are present, whereas Norman (1999) presents conflicting data, with many sharks observed 'passively' feeding with mouth partly or fully distended to take in prey items. Whale Sharks do show reaction to tourists in particular circumstances, including avoidance to SCUBA bubbles and 'duck-diving' of swimmers near the head of the shark (Norman, 1999). Whale Sharks have the ability to avoid a tourist interaction by diving or swimming away. In general however, provided the tourism industry adhere to guidelines in place to ensure minimal impact, broad behavioural patterns do not seem affected by the presence of humans (Norman, 1999). Taylor (1994) suggests it is unlikely that Whale Sharks would be harmed in any biological sense by being in close proximity to swimmers, especially since the riding and touching of Whale Sharks is illegal in Western Australia. However, it will be important to determine the 'natural behaviours' of Whale Sharks in order to ensure that human activities are not having an adverse effect on the sharks.

The WA Department of CALM has developed a Code of Conduct for Whale Shark interactions (see Appendix 5). The Code includes guidelines on the number of vessels allowed around the shark at any time, the maximum length of time a vessel may interact with a shark, the minimum distance from the shark that vessels are permitted to keep, the number of divers in the water with the shark at any moment, and minimum distances that must be respected between divers and the shark. The dive industry at Christmas Island in the Indian Ocean use similar guidelines (Brad Norman, pers. comm.).

While unregulated tourism activity has the potential to disrupt feeding patterns and to drive Whale Sharks away from critical seasonal feeding grounds (Prop 12.35 CITES), considering the above, it is unlikely that tourism operations in Australia currently pose a threat to Whale Sharks.

Boat strike

The Whale Shark's skin is thicker and tougher than any other species in the world, reaching up to 14cm in thickness, and is covered by dermal denticles (Taylor, 1994). This thick covering is not sufficient to negate the threat posed by boat strike with several reports of Whale Sharks being impaled on the bows of larger ships in other regions (Norman, 1999). However, Whale Sharks may be behaviourally vulnerable to boat strike. They spend considerable periods of time at or close to the surface of the water (Norman, 1999; Gunn *et al.*, 1999) and several sharks bear scars likely resulting from boat contact (see Norman 2004). It is likely that high numbers of boat strikes would discourage the movement of Whale Sharks to a particular area. However, at present there is limited data on the level of disturbance faced by Whale Sharks from boat traffic (*i.e.* the total number of boat strikes and whether this number is increasing or decreasing).

Trade

As detailed in the "Population trends" section of this paper, catch data indicates alarming declines in Whale Shark populations, due to (likely) unsustainable directed take of Whale Sharks (and trade in Whale Shark products). Trade in Whale Shark specimens and products is prohibited in Australia under the EPBC Act. International trade in Whale Shark specimens and products thereof is subject to very strict regulations under the Appendix II CITES listing that the species has enjoyed since 2002. The continued directed take of Whale Sharks in other range states is likely to negatively impact on the Australian population (Norman, 2000).

Whale Shark meat is readily available in Taiwan (Chen & Phipps, 2002). It is reputed to be the world's most expensive shark meat. The main products traded include liver oil, meat, fins, cartilage, skin, stomach and intestines (Joung *et al.* 1996). Taiwan's Fisheries Administration has recently implemented a system to monitor catch and trade of Whale Sharks (Chen & Phipps, 2002). Data available to date indicates that Whale Sharks caught in Taiwan are relatively small in size, a possible indicator of overfishing (Chen & Phipps, 2002).

Habitat damage

Official estimates indicate that up to 100,000 kg of fish are removed from the Ningaloo Reef lagoon every year by commercial and recreational fishers (Taylor 1994). Taylor (1994) speculates that a link may exist between high catch rates of targeted species, and subsequent population increases of *Drupella cornus*, a gastropod known to cause reef damage. Pogonoski indicates that this may also be linked to high catch rates of carnivorous and/or omnivorous reef fishes such as wrasses (pers. comm. 2004).

The health of the reef ecosystem may impact on Whale Shark numbers in the Ningaloo Reef region. Declining Whale Shark numbers in the late 1980's and early 1990's may have been linked to high rates of coral destruction by the gastropod *D. cornus* (Taylor, 1996).

Surveys conducted during 1991 indicated that live coral cover was as low as 3.8% and 11.1% at two sites, due to a population explosion of the gastropod *D. cornus*. The corals destroyed by *D. cornus* were principally the fast growing *Acropora sp* which make a major contribution to the amount of coral spawn present in the water during spawning, and act as an important habitat for coral-dependant species (Taylor, 1996).

Although not fully researched, it is clear that the presence and aggregation of Whale Sharks in Australian waters is dependent on healthy marine ecosystems, particularly coral reefs. At Christmas Island, Indian Ocean where there is a very limited coral reef, a major contributing factor for the annual Whale Shark appearance is the spawning *en masse* of the red land crab (*G. natalis*). Large volumes of the megalopa of this crab can be found in the waters surrounding Christmas Island in certain years (during the short Whale Shark 'season'), with Whale Sharks observed feeding at night on this prey (Brad Norman, pers. comm.). Threats to the population of this crab on Christmas Island (e.g. crazy ant infestation) if too great, may ultimately affect the appearance of Whale Sharks to this isolated Australian Territory.

Damage caused to the marine environment by pollution, overfishing, the introduction of invasive species, and global warming, present very real threats to the survival of the Whale Sharks in Australian waters.

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Appendix 1

Whale Shark Range States

| | | |
|--|------------------------------------|--|
| American Samoa | Gambia | Nigeria |
| Angola | Ghana | Niue |
| Anguilla | Grenada | Northern Mariana Islands |
| Antigua and Barbuda | Guadeloupe | Oman |
| Aruba | Guam | Pakistan |
| Australia | Guatemala | Panama |
| Bahamas | Guinea | Papua New Guinea |
| Bahrain | Guinea-Bissau | Peru |
| Bangladesh? | Guyana | Philippines |
| Barbados | Haiti | Portugal |
| Belize | Honduras | Puerto Rico |
| Benin | Hong Kong | Saint Pierre and Miquelon |
| Bermuda | India | Saint Vincent and the Grenadines |
| Brazil | Indonesia | Sao Tomé and Príncipe |
| British Indian Ocean Territory | Iran (Islamic Republic of) | Saudi Arabia |
| Brunei Darussalam | Iraq | Senegal |
| Cambodia | Israel | Seychelles |
| Cameroon | Jamaica | Singapore |
| Cape Verde | Japan | Somalia |
| Cayman Islands | Jordan | South Africa |
| Chile | Kenya | Sri Lanka |
| China | Kiribati | Sudan |
| Christmas Island | Korea, Republic of | Taiwan, Province of China |
| Colombia | Kuwait | Tanzania, United Republic of |
| Comoros | Liberia | Thailand |
| Congo | Macao | Timor-Leste |
| Congo, The Democratic Republic of the | Madagascar | Togo |
| Cook Islands | Malaysia | Tokelau |
| Costa Rica (Cocos I.) | Maldives | Tonga |
| Cuba | Marshall Islands | Trinidad and Tobago |
| Côte d'Ivoire | Martinique | Turks and Caicos Islands |
| Djibouti | Mauritania | Tuvalu |
| Dominica | Mauritius | United Arab Emirates |
| Dominican Republic | Mexico | United States (Hawaiian Is.) |
| Ecuador (Galápagos) | Micronesia, Federated States of | United States Minor Outlying Islands (Johnston I.; Wake Is.) |
| Egypt | Montserrat | Vanuatu |
| El Salvador | Mozambique | Venezuela |
| Equatorial Guinea | Myanmar | Viet Nam |
| Eritrea | Namibia | Virgin Islands, British |
| Fiji | Nauru | Virgin Islands, U.S. |
| French Guiana | Netherlands Antilles (Curaçao) | Wallis and Futuna Islands |
| French Polynesia (Marquesas; Tuamotu Is.) | New Caledonia | Yemen |
| Gabon | New Zealand | |
| | Nicaragua | |

Source: IUCN Redlist 2003 (<http://www.redlist.org/search/details.php?species=19488>)

Appendix 2

Advice to the Threatened Species Scientific Committee (TSSC) from Wildlife Scientific Advice Section (EA) on Amendments to the list of Threatened Species under the Environment Protection and Biodiversity Conservation Act 1999 (the Act)

1. Scientific name, common name, major taxon group

Rhincodon typus, (Whale Shark)

2. How judged by EA in relation to the *Environment Protection and Biodiversity Conservation Act 1999* criteria.

EA judges the Australian population of *Rhincodon typus* to be eligible for listing under the *Environment Protection and Biodiversity Conservation Act 1999* based on relevant information on threats to its populations.

Criterion 1: It has undergone, is suspected to have undergone or is likely to undergo in the immediate future a substantial reduction in numbers.

It is estimated that there has been a substantial decline of Whale Sharks due to fishing pressures in the waters of other regional nations (Philippines, Taiwan, India). In the Philippines the catch per unit effort (CPUE) between 1993 to 1997 declined from 4.4 sharks per boat to 1.7 sharks per boat. Catch data from India (where CPUE has declined between 1998 and 2000), Philippines (as mentioned above) and Taiwan (where the number of Whale Sharks caught each year has declined from 250 pa to 10 pa with similar effort levels) all point to declining populations.

There is no population estimate for Whale Sharks in Australia but they are known to grow slowly and also be slow to mature, and as such are vulnerable to overexploitation. The population appears to fluctuate annually, with the nominee identifying that 85% of the sharks at Ningaloo were immature males. This data would indicate a population dominated by juveniles, but it is unclear whether this is evidence of a decline in the Australian population as a consequence of age partitioning.

The species is wide ranging with individual animals known to migrate in the order of 12,000 kilometres over the course of a year. It is almost certain that the Australian population is shared with regional countries where there are strong indications of a decline in the species. The impacts of this decline regionally have however not been documented for the Australian population. The documented decline regionally in a shared stock could however be taken to meet this criterion as suspected to have undergone a decline.

With the global demand for shark fin being sustained, it is unlikely that the pressure on Whale Sharks will be relieved in the short to medium term. In spite of the recent protection of Whale Sharks in the Philippines hunting pressure on some regional stocks is likely to continue. The likelihood of a sustained decline exists if exploitation continues and a decline in Australian stocks over time can be inferred or suspected.

Therefore the nomination is **eligible** for listing as **vulnerable** under this criterion.

Criterion 2: Its geographic distribution is precarious for the survival of the species and is limited.

The proponent has identified the major threat as fishing in the waters of other regional nations. This contention is supported by data collected by nongovernment. There is no threat to the species habitat or food sources.

Therefore the nomination is **not eligible** for listing under this criterion.

Criterion 3: The estimated total number of individuals is limited: and (a) evidence suggests that the number will continue to decline at a substantial rate; or (b) the number is likely to continue to decline and its geographic distribution is precarious for its survival.

There are no reliable population numbers or indices that can be used to assess this criterion. The Whale Shark is uncommon, and numbers appear to fluctuate locally on an annual basis at Ningaloo with the nominee identifying that 85% of the sharks being immature males. This data would indicate a population dominated by juveniles but does not answer whether this is a consequence of age partitioning.

Due to a lack of quantitative data the TSSC is unable to assess the eligibility of this species under this criterion.

Criterion 4: The estimated total number of mature individuals is low.

There are no reliable population numbers or indices that can be used to assess this criterion. The structure of the population that has been monitored at Ningaloo strongly suggests a bias in the population towards juvenile male animals. This indicates that the number of mature animals is likely to be low and there will be a male bias. The numbers of mature animals has however not been estimated.

Due to a lack of quantitative data the TSSC is unable to assess the eligibility of this species under this criterion.

Criterion 5: The probability of its extinction in the wild is at least 10% in the medium-term future.

Without reliable population estimates the TSSC is unable to assess the eligibility of this species under this criterion.

3. Conclusion

The evidence presented in the nomination is judged to meet the criteria in the EPBC Act and Regulations.

The highly migratory nature of the species and the evidence of decline of the species in regional nations probably sharing the Australian stock of the species is recognised. The decline regionally is considered as likely to have lead to a decline in the Australian population that has not yet been documented.

4. Recommendation

TSSC recommends that the list referred to in section 178 of the EPBC Act be amended by including in the list of **vulnerable** species:

Rhincodon typus, (Whale Shark)

Source: Department of the Environment and Heritage, 2003
(<http://www.deh.gov.au/biodiversity/threatened/species/r-typus.html>).

Appendix 3

Convention on International Trade in Endangered Species of Wild Fauna and Flora: Article IV: Regulation of Trade in Specimens of Species included in Appendix II

1. All trade in specimens of species included in Appendix II shall be in accordance with the provisions of this Article.
2. The export of any specimen of a species included in Appendix II shall require the prior grant and presentation of an export permit. An export permit shall only be granted when the following conditions have been met:
 - (a) a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species;
 - (b) a Management Authority of the State of export is satisfied that the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora; and
 - (c) a Management Authority of the State of export is satisfied that any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment.
3. A Scientific Authority in each Party shall monitor both the export permits granted by that State for specimens of species included in Appendix II and the actual exports of such specimens. Whenever a Scientific Authority determines that the export of specimens of any such species should be limited in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs and well above the level at which that species might become eligible for inclusion in Appendix I, the Scientific Authority shall advise the appropriate Management Authority of suitable measures to be taken to limit the grant of export permits for specimens of that species.
4. The import of any specimen of a species included in Appendix II shall require the prior presentation of either an export permit or a re-export certificate.
5. The re-export of any specimen of a species included in Appendix II shall require the prior grant and presentation of a re-export certificate. A re-export certificate shall only be granted when the following conditions have been met:
 - (a) a Management Authority of the State of re-export is satisfied that the specimen was imported into that State in accordance with the provisions of the present Convention; and
 - (b) a Management Authority of the State of re-export is satisfied that any

living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment.

6. The introduction from the sea of any specimen of a species included in Appendix II shall require the prior grant of a certificate from a Management Authority of the State of introduction. A certificate shall only be granted when the following conditions have been met:

(a) a Scientific Authority of the State of introduction advises that the introduction will not be detrimental to the survival of the species involved; and

(b) a Management Authority of the State of introduction is satisfied that any living specimen will be so handled as to minimize the risk of injury, damage to health or cruel treatment.

7. Certificates referred to in paragraph 6 of this Article may be granted on the advice of a Scientific Authority, in consultation with other national scientific authorities or, when appropriate, international scientific authorities, in respect of periods not exceeding one year for total numbers of specimens to be introduced in such periods.

Source: Convention on International Trade in Endangered Species of Wild Fauna and Flora (<http://www.cites.org/eng/disc/text.shtml#IV>)

Appendix 4

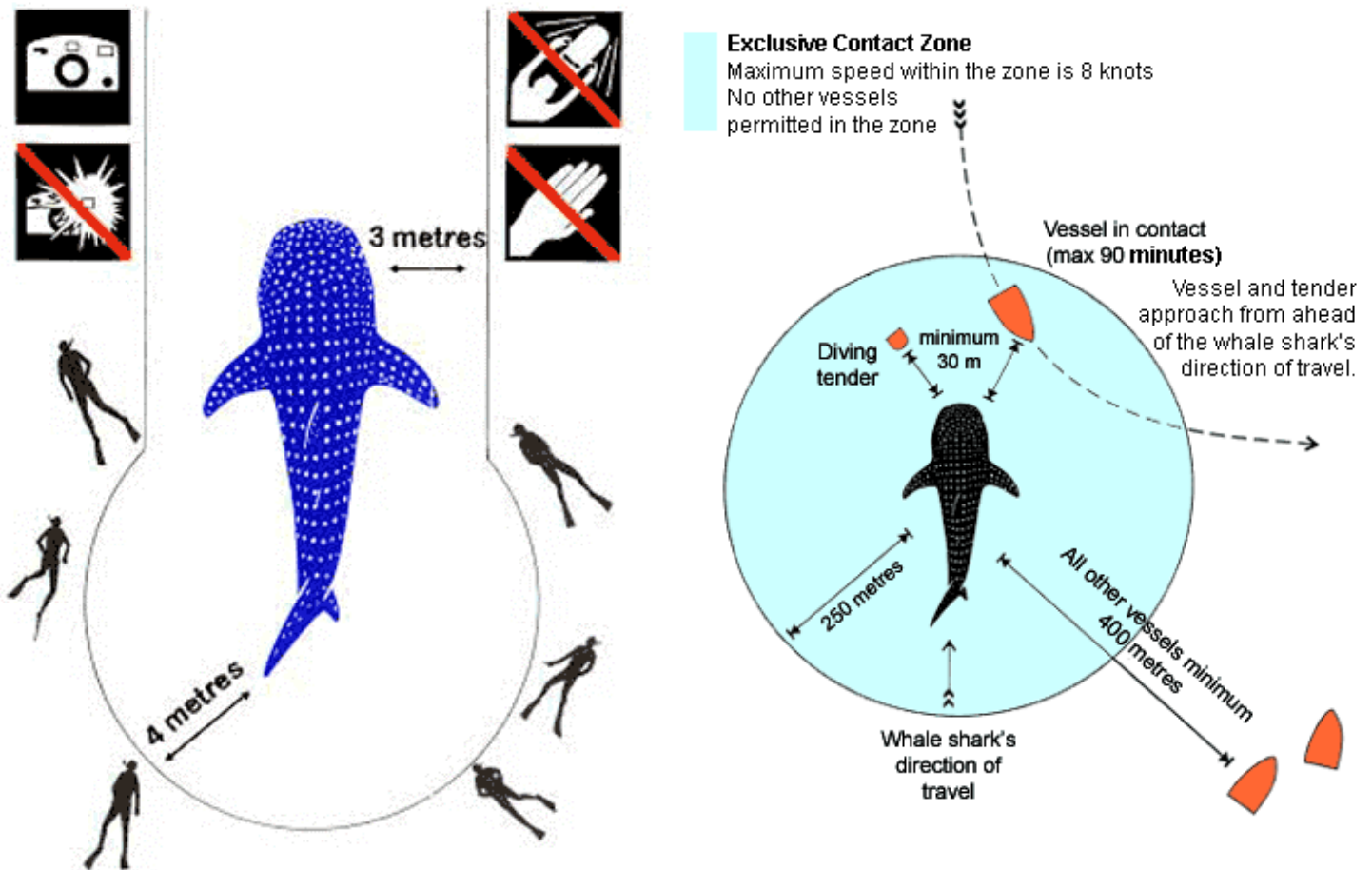
Convention on Migratory Species: Article IV: Migratory Species to be the Subject of Agreements: Appendix II

1. Appendix II shall list migratory species which have an unfavourable conservation status and which require international agreements for their conservation and management, as well as those which have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement.
2. If the circumstances so warrant, a migratory species may be listed both in Appendix I and Appendix II.
3. Parties that are Range States of migratory species listed in Appendix II shall endeavour to conclude Agreements where these should benefit the species and should give priority to those species in an unfavourable conservation status.
4. Parties are encouraged to take action with a view to concluding agreements for any population or any geographically separate part of the population of any species or lower taxon of wild animals, members of which periodically cross one or more national jurisdiction boundaries.
5. The Secretariat shall be provided with a copy of each Agreement concluded pursuant to the provisions of this Article.

Source: Convention on Migratory Species (<http://www.wcmc.org.uk/cms/>)

Appendix 5

Western Australian Department of Conservation and Land Management Code of Conduct for Whale Shark tourism operations.



Source: Western Australian Department of Conservation and Land Management (http://www.calm.wa.gov.au/tourism/whalesharks_swimming.html)