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PROPOSAL FOR THE INCLUSION OF
THE WHALE SHARK (*Rhincodon typus*)
ON APPENDIX I OF THE CONVENTION

Summary:

The Governments of the Philippines, Israel and Sri Lanka have jointly submitted the attached proposal for the inclusion of the Whale shark *(Rhincodon typus)* on Appendix I of CMS.

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

PROPOSAL FOR INCLUSION OF THE WHALE SHARK (*Rhincodon typus)* ON THE APPENDIX I OF THE CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS

A. PROPOSAL:

Inclusion of the whale shark, species *Rhincodon typus*, on Appendix I while maintaining its existing status under Appendix II, on account of its Endangered conservation status and continuing population decline. The inclusion of whale sharks to the listing on Appendix I will promote improved protection of their main aggregation sites and to encourage concerted actions to address threats such as by-catch, vessel strikes and impacts of unsustainable tourism practices directed to the species.

B. PROPONENT: The Government of the Philippines, co-sponsored by the Governments of Israel and Sri Lanka

C. SUPPORTING STATEMENT

1. Taxonomy

1.1 Class:	Chondrichthyes
1.2 Order:	Orectolobiformes
1.3 Family:	Rhincodontidae
1.4 Species:	*Rhincodon typus* Smith, 1828
1.5 Scientific synonyms:	No current synonyms.
1.6 Common name(s):	English: whale shark; French: requin baleine; Spanish: tiburón ballena; Hebrew: *karish livyatan* כריש לוויתן

2. Overview

The whale shark (*Rhincodon typus*), the world's largest living fish, is a cosmopolitan tropical and warm temperate species.

Long-term, ocean-scale connectivity of whale sharks has been established by multiple genetic studies. Over shorter time frames, whale shark migrations orientate towards feeding areas, where they exploit predictable but ephemeral prey sources, and they will follow temperature and productivity gradients in the open ocean. Over their lifespan, the species also exhibits a predictable and pronounced habitat shift whereby adult sharks move away from coastal areas, presumably living almost exclusively in offshore habitats. Adults appear to exhibit directed reproductive migrations in the open ocean.

Whale sharks are migratory across national boundaries and move from national Exclusive Economic Zones into the high seas. Major contemporary threats to whale sharks include fisheries catches, bycatch in nets, and vessel strikes. Other threats affect whale sharks on local or regional scales.

A 2016 reassessment of the species' global conservation status for the IUCN Red List of Threatened Species classified the species as globally Endangered due to an overall population size reduction of greater than or equal to 50%. In the Indo-Pacific, a population reduction of 63% is inferred over the last three generations (75 years), and in the Atlantic a population reduction of more than 30% is inferred.

The whale shark was listed on Appendix II of CMS in 1999. This identifies it as a migratory species whose unfavourable conservation status would benefit from the implementation of international cooperative agreements. In 2010, the CMS Memorandum of Understanding on migratory shark species listed the whale shark on this agreement. The whale shark has also been listed in other international conventions and agreements. The species is included in Annex I (Highly Migratory Species) of the United Nations Convention on the Law of the Sea, and Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

Regional Fisheries Management Organisations (RFMOs) have banned the intentional setting of purse-seine nets around whale shark in the Eastern Pacific, Western Central Pacific (WCP) and Indian Oceans, though not yet in the Atlantic Ocean.

We propose that the whale shark should be upgraded to a listing on Appendix I of CMS, as well as maintaining their existing Appendix II listing. Whale shark meet the criteria for an Appendix I listing due to the species' clear migratory habit and their global Endangered status on the IUCN Red List.

Many CMS parties are also whale shark range states and have no protections currently in place for the species. Several of these countries are notable whale shark hotspots, including Gabon, Madagascar, Mozambique, Pakistan, Peru, Portugal, and Tanzania. Legislative protection of whale sharks or their habitat in other parties is compromised by threats in surrounding countries. An Appendix I listing is anticipated to lead to increased attention to legislative protection in range states, and heightened awareness of whale shark conservation requirements.

3. Migrations

3.1 Kinds of movement, distance, the cyclical and predictable nature of the migration

Whale sharks are migratory across national boundaries, and move from national Exclusive Economic Zones into the high seas (an expanded definition recommended for migratory sharks by Fowler 2014). Position-based satellite tagging studies have typically recorded mean or median horizontal movement rates of 24-38 km per day in whale sharks (Hueter et al. 2013, Hearn et al. 2016, Rohner et al. In revision). Over short to medium time frames, whale shark migrations orientate towards feeding areas, where sharks exploit predictable but ephemeral prey sources, and follow cyclical seasonal variations in temperature shifts and productivity (Mckinney et al. 2012, Sequeira et al. 2012). Over their lifespan, the species also exhibits a predictable and pronounced habitat shift whereby adult sharks move away from coastal areas, presumably living almost exclusively in off-shelf habitats (Ketchum et al. 2013, Ramírez-Macías et al. In revision), and appear to exhibit directed reproductive migrations in the open ocean (Hearn et at. 2016).

In the Atlantic subpopulation, satellite-linked tagging and photo-identification studies have demonstrated that whale sharks routinely migrate between national boundaries in the western Atlantic (Belize, Brazil, Cuba, Honduras, USA; Hueter et al. 2013, McKinney et al. In revision, Graham 2007), even crossing into the southern hemisphere (Hueter et al. 2013). Individual sharks have been recorded in up to four different countries in this region over decadal time periods (Norman et al. In revision).

In the Indian Ocean, whale sharks move routinely between Mozambique and South Africa (Rohner et al. 2015, Norman et al. In revision) and occasionally between Mozambique and Madagascar (Brunnschweiler and Sims 2011), the Seychelles (Andrzejaczek et al. 2016), and Tanzania (Norman et al. In revision). Satellite-tagged whale sharks from the Saudi Arabian Red Sea moved from Saudi Arabian waters into Egypt, Sudan, Eritrea, Djibouti, Yemen, Somalia and Oman (Berumen et al. 2014). In the Arabian / Persian Gulf region, photo-identification has shown that individual sharks move between Qatar, Iran, Saudi Arabia, Oman and the United Arab Emirates, with model results indicating that the Gulf and the adjacent Gulf of Oman in the Arabian Sea consists of a single functional unit (Robinson et al. 2016). In the Eastern Pacific, whale sharks have been tracked from the Galapagos Islands (Ecuador) to the EEZs of Costa Rica (Cocos Island), Colombia (Malpelo) and Peru (continental shelf), as well as into international waters (Hearn et al 2016). In the Gulf of Eilat (also known as the Gulf of 'Aqaba), which is the north-eastern arm of the Red Sea, whale sharks predictably occur annually in Israeli territorial coastal waters during the months of April and May, having necessarily crossed international boundaries and entered Israeli territorial waters from the

adjacent territorial waters of either Egypt, Jordan or Saudi Arabia.
Adult whale sharks, particularly mature females, are rarely sighted in coastal areas. Large female sharks are, however, predictably seen on a seasonal basis at some offshore seamounts and volcanic islands including Darwin Island in the Galapagos archipelago (Ecuador; Acuña-Marrero et al. 2014, Hearn et al. 2016), St Helena Island (UK; Clingham et al. Preprint), the São Pedro and São Paulo archipelago in the mid-Atlantic (Brazil; Macena and Hazin 2016), and off the Pacific coast of Mexico (Ramírez-Macías et al. 2012a). These migrations are thought to be associated with reproduction due to the consistent presence of pregnant female whale sharks and indications of mating behaviour (Clingham et al. Preprint, Macena and Hazin 2016).

In both cases, these aggregations or groupings are typically dominated by specific age classes: juvenile males in coastal feeding aggregations, and adult sharks at seamounts and volcanic islands (Rohner et al. 2015, Ketchum et al. 2013). The habitat shift this represents indicates that predictable migration is inherent within the whale shark life cycle (Hueter et al. 2013).

In the Philippines, movement between regions has been established through photo-ID (Araujo et al., 2014), though few individuals were resighted between Donsol in the north and the Visayas region. One international match between the Philippines and Taiwan was reported by Araujo et al. (2016) through photo-ID. Hsu et al. (2007) also documented some whale sharks moving south towards the Philippines, so some degree of movement must occur between the countries. Whale sharks tagged in the Philippines Sulu Sea have moved into Malaysian waters (LAMAVE & MMF, unpub. data). Similarly, whale sharks tagged in Donsol, Sorsogon, moved to the Pacific Ocean and to Sulawesi, Indonesia (WWF-Philippines, unpub. data). A whale shark tagged in Japan in May 2016 was tracked into Philippine waters when the tag popped up in San Fabian Bay, Luzon, on February 2017 (Dr. Matsumoto, pers. comm.)

3.2 Proportion of the population migrating, and why that is a significant proportion

The whale shark is one of a small number of true circumtropical fish species (Gaither et al. 2016). Long-term, ocean-scale connectivity of whale sharks has been established by multiple genetic studies that have found a lack of population structure within the Indian and Pacific oceans (Castro et al. 2007; Schmidt et al., 2009; Vignaud et al., 2014). This relatively homogenous group is sufficiently separate from the Atlantic Ocean to allow genetic drift (Vignaud et al. 2014), indicating that reproductive interchange between these subpopulations is infrequent enough to be inconsequential in management terms. Ocean-basin scale conservation strategies are required for effective management (Castro et al., 2007; Schmidt et al., 2009), with the probability that each aggregation contributes to the observed population-scale genetic diversity (Vignaud et al., 2014).

Over their lifespan, there appears to be a pronounced habitat shift. Juvenile sharks are commonly seen within coastal feeding aggregations (Rohner et al. 2015), whereas adult sharks are typically seen further offshore (Ketchum et al. 2013, Ramírez-Macías et al. 2012a), indicating that migration of this kind is inherent within the ecology of the species (Hueter et al. 2013) and involves the whole population.

Over shorter time-scales (days to weeks), satellite-tagging and photo-identification studies have demonstrated that a significant proportion of the population can move across national boundaries in some regions, particularly the Western Atlantic (Hueter et al. 2013, McKinney et al. In revision), Red Sea (Berumen et al. 2014) and the Arabian / Persian Gulf region (Robinson et al. 2016, Robinson et al. Submitted).

4. Biological data (other than migration)

4.1 Distribution (current and historical)

The whale shark has a circumtropical distribution through all tropical and warm temperate seas, apart from the Mediterranean (Rowat and Brooks 2012). Their core distribution is between approximately 30°N and 35°S, with occasional seasonal penetration to the north and south

(Colman 1997, Rowat and Brooks 2012, Sequeira et al. 2014a). The northernmost records are from 44°N in the Bay of Fundy, Canada (Turnbull and Randell 2006) and the Sea of Okhotsk off Japan (Tomita et al. 2014), with the southernmost from 37°S in Victoria, Australia (Wolfson 1986) and New Zealand (Duffy 2002). Whale shark distribution is likely to be temperature limited, as they are rarely sighted in surface temperatures of less than 21°C (Colman 1997, Duffy 2002, Afonso et al. 2014, Tomita et al. 2014).

Areas where 500 or more individuals have been documented through either counts or model estimates include the Arabian Gulf and Gulf of Oman (Robinson et al. 2016), Ningaloo Reef in Western Australia (Meekan et al. 2006, Norman et al. In revision), Quintana Roo in México (de la Parra Venegas et al. 2011, Ramírez-Macías et al. 2012b), Inhambane province in Mozambique (Norman et al. In revision), the Philippines (Schleimer et al. 2015), around Mahé in the Seychelles (Rowat et al. 2009, 2011; Brooks et al. 2010), and Darwin Island in the Galapagos (Acuña-Marrero et al. 2014), although the latter population estimate refers to a steady flow of migrating sharks over a period of months rather than a bona fide aggregation. Most aggregation sites are seasonal, with whale sharks migrating on a predictable basis to exploit ephemeral prey sources.

Evidence from fisheries catches indicates that the Gujarat coast of India (Akhilesh et al. 2012), Taiwan (Hsu et al. 2012) and southern China (Li et al. 2012) also had large numbers of whale sharks in the vicinity, at least prior to the initiation of targeted fisheries in those countries, with estimated catches from China of up to 1,000 individuals per year (Li et al. 2012).

In the Indian Ocean, data from the tuna purse-seine fleet has identified the Mozambique Channel as having a high density of whale shark-associated sets (Sequeira et al. 2012). In the Atlantic and Pacific Oceans, whale shark sightings were correlated with effort (Harley et al. 2013, Sequeira et al. 2014b). Modelled habitat suitability was highest in the eastern Atlantic in the area off Gabon and surrounding countries (Sequeira et al. 2014b), while the Bismark and Solomon Seas have relatively frequent whale shark sightings within the Western and Central Pacific (Harley et al. 2013).

4.2 Population (estimates and trends)

Global population size

Whale sharks are individually identifiable based on their characteristic spot patterns (Taylor 1994, Arzoumanian et al. 2005). A global database of whale shark sightings, comprising submitted photographs from both researchers and the public, is hosted online at Wildbook for Whale Sharks (www.whaleshark.org) (Wild Me 2017, Norman et al. In revision). As of January 2017, there were 7, 922 individual sharks on this database, identified from images submitted between 1964 and 2017, with 90% of individuals identified over the last 10 years. However, 70% of sexed individuals (n = 3, 910) were male (Wild Me 2017), with most likely to be immature based on length estimates (Norman and Stevens 2007, Ramírez-Macías et al. 2012b, Rohner et al. 2015). This dataset is assumed to not fully represent female, small juvenile or adult sharks (Norman et al. In revision) because they are not often seen by researchers and citizen scientists. Therefore, the total represents a minimum number of sharks alive over this period.

Two global-scale genetic studies on whale sharks have estimated genetic effective population size – the number of breeding adults – albeit based on small sample sizes of 70 (Castro et al. 2007) and 68 sharks (Schmidt et al. 2009), respectively. Castro et al. (2007) used mitochondrial DNA to estimate current genetic effective population size to be 119,000 – 238,000 sharks. Schmidt et al. (2009) estimated genetic effective population size to be 103,572, with a standard error of 27,401 – 179, 794, based on microsatellite analysis. However, lack of knowledge on species-specific mutation rates mean these estimates should not be used for management purposes (J. Schmidt pers. comm., T. Vignaud and S. Planes pers. comm).

While global connectivity of whale shark subpopulations has been postulated (Sequeira et al. 2013b), a large global genetic study using both mitochondrial DNA and microsatellite analysis

has demonstrated that the whale shark subpopulations in the Atlantic and Indo-Pacific are functionally separate (Vignaud et al. 2014).
Based on counts, modelled population estimates and habitat availability, it is inferred that approximately 75% of the global whale shark population occurs in the Indo-Pacific, and 25% in the Atlantic. In the Indo-Pacific, a population reduction of 63% is inferred over the last three generations (75 years), and in the Atlantic a population reduction of more than 30% is inferred (see the discussion for each subpopulation below). Combining data from both regions, it is likely that the global whale shark population has declined by >50% over the last 75 years, leading to an Endangered listing on the IUCN Red List of Threatened Species (Pierce and Norman 2016).

Atlantic subpopulation trend

This subpopulation was listed as Vulnerable on the 2016 IUCN Red List of Threatened Species (Pierce and Norman 2016). Pierce and Norman (2016) inferred a decline of ≥30% in the Atlantic subpopulation of whale sharks over the last three generations (75 years) based on data from tuna fleet observers off a likely centre of abundance for this subpopulation. Between 1980 and 2010 there was a decline in sightings per unit effort (SPUE) off western Africa, with SPUE peaking in 1995 and declining thereafter (Sequeira et al. 2014b). In absolute terms, sightings decreased from about 500 sharks over the 1990s to around 150 during the 2000s. Peak-month sightings also declined by approximately 50% over this time (Sequeira et al. 2014b).

At Gladden Spit in Belize, whale shark sightings declined from a mean of 4 to 6 sharks per day between 1998 and 2001 to less than 2 per day in 2003 (Graham and Roberts 2007), with reports from diving guides indicating that numbers have remained low until 2016 (R. Graham, pers. comm.).

In the Azores, there was a significant increase in sightings in 2008 and afterwards compared to the decade before (Afonso et al. 2014). This was strongly correlated with the location of the 22°C isotherm, indicating that this increasing sighting trend is due to environmental conditions (Afonso et al. 2014).

Atlantic subpopulation size

Regional counts of identified sharks or modelled abundance estimates are available from many of the larger known aggregation or feeding areas. Ramírez-Macías et al. (2012b) photo-identified 350 individual whale sharks from Holbox Island in Mexico between 2005 and 2008, and estimated that 521–809 sharks participate in this aggregation. Aerial surveys from this area and the adjacent Caribbean coast have counted up to 420 sharks in a single aerial survey (de la Parra Venegas et al. 2011). The largest-known aggregation occurs seasonally off the Yucatan coast of Mexico, with over 1,100 identified sharks (Norman et al. In revision). Satellite-tagged sharks from this aggregation have been tracked to the northern Gulf of Mexico (Hueter et al. 2013), where aggregations of up to 100 sharks have been reported (Hoffmayer et al. 2005), south to Belize where 106 individual sharks were identified between 1998 and 2003 (Graham and Roberts 2007), and off the island of Utila, Honduras, where 95 sharks were identified between 1999 and 2011 (Fox et al. 2013). One shark, tagged in 2007, was tracked swimming across the equator to the South Atlantic Ocean, near the Mid-Atlantic Ridge (Hueter et al. 2013). The end of this track was 543 km southeast from the Saint Peter and Saint Paul Archipelago, where 54 whale shark sightings were recorded between 2000 and 2005 (Hazin et al. 2008). This individual was subsequently photo-identified back off the Yucatan coast in 2011 and 2012 (Hueter et al. 2013).

Clingham et al. (Preprint) documented 931 encounters with whale sharks (with an unknown number of resightings in that total) from St Helena Island between 1999 and 2014. Forty-nine records were reported from the São Pedro and São Paulo archipelago between 2005 and 2014 (Macena and Hazin 2016). There have been few photographic records from elsewhere in the Atlantic (Wild Me 2017). There were, however, 2,297 records of whale sharks from the logbooks of tuna purse-seine vessels between 1980 and 2010, mostly from the eastern Atlantic (Sequeira et al. 2014b) and particularly off the coast of Gabon (Capietto et al. 2014). An additional 1,449 sightings were recorded from the Azores archipelago between 1998 and 2013 (Afonso et al. 2014).

Indo-Pacific subpopulation trend

Pierce and Norman (2016) inferred a decline of >50% (likely around 63%) in the Indo-Pacific whale shark subpopulation over the last three generations (75 years) based on relevant indices of abundance from Mozambique, the broader Western Indian Ocean, the Philippines, Taiwan, Thailand and the Western and Central Pacific, and actual levels of exploitation in mainland China, the Maldives, India, the Philippines and Taiwan. This subpopulation was thus listed as Endangered on the 2016 IUCN Red List of Threatened Species (Pierce and Norman 2016).

A commercial fishery for whale shark existed in Taiwan until 2007 (Hsu et al. 2012). Information provided by fishers operating from Hongchun harbour in southern Taiwan indicated that 50–60 sharks were caught each season in the mid-1980s, declining to less than 10 per year in each of 1994 and 1995 (Chen and Phipps 2002). Although definitive catch trends are not available, there was a significant (58%) decrease in the estimated annual catch in 1997 of 272 sharks (Chen and Phipps 2002) to a reported catch of 113 sharks over 15 months in 2001–2002 (Chen and Phipps 2002). A decline in the mean total length of landed sharks was noted between 2002 and 2007 (Hsu et al. 2012). A decline in the mean size of landed sharks was also noted in southern Chinese waters, from 8.27 m prior to 2004 to 6.3 m in 2008–2011 (Li et al. 2012).

Data from observers aboard the tuna purse-seine fleet in the Western and Central Pacific noted 1,073 whale shark sightings between 2003 and 2012, with most from the Bismark and Solomon Seas (Harley et al. 2013). The occurrence of whale sharks in free school sets decreased by approximately 50% between 2003 (1%) and 2012 (0.5%), potentially representing a fall in abundance (Harley et al. 2013), although a weak linear increase in occurrence probability was modelled by Sequeira et al. (2014) between 2000 and 2010. However, model performance for this latter dataset was poor (Sequeira et al. 2014b). In the Eastern Pacific, standardised time-series data from diver sightings at Cocos Island (Costa Rica) from 1993 to 2013 showed a slight increase in whale shark sightings, with odds of occurrence increasing by 4.5% annually (White et al. 2015).

The influence of environmental variability on sightings of whale shark can complicate the interpretation of trend data, particularly with the shortage of long-term datasets. A decline in whale shark sightings along the eastern coast of South Africa between 1993 and 1998 (Gifford 2001) was included in the proposal for listing the sharks on Appendix II of the Convention on International Trade in Endangered Species (CITES 2002). However, with the benefit of hindsight, the substantial variability in sighting data from this area over summer months (Cliff et al. 2007) and seasonal changes in their oceanic distribution (Sequeira et al. 2012), makes it unclear whether these earlier data are indicative of a true subpopulation decline. North of this area, in the northern Mozambique Channel and broader western Indian Ocean, a slight increase in whale shark sightings was noted between 1991 and 2000 based on tuna purse-seine vessel data, then a decrease from 2000 to 2007 (Sequeira et al. 2013a). In absolute terms, 600 sightings were reported from the 1990s decreasing to ~200 across 2000–2007 (Sequeira et al. 2014b). Peak monthly sightings decreased by around 50% over the study period (Sequeira et al. 2014b). In Inhambane, Mozambique, in the southern Mozambique Channel, sightings declined 79% between 2005 and 2011 (Rohner et al. 2013). This decreased rate of sightings has persisted to 2017 (S. Pierce, pers. comm.). Sharks routinely move between South Africa and southern Mozambique (Rohner et al. 2015, Norman et al. In revision), but there is limited connectivity between these and other known coastal feeding areas to the north in Djibouti, Seychelles and Tanzania (Andrzejaczek et al. 2016, Brooks et al. 2010, Norman et al. In revision). Prior to the species being protected in the Maldives in 1995, catches of whale shark declined from around 30 each year from one of the significant fishing locations up until the early 1980s to a catch of 20 or less whale sharks from the entire archipelago by 1993 (Anderson and Ahmed 1993).

Individual whale sharks identified by photo-identification in Seychelles remained relatively constant from 2005 to 2010 (148 individuals were recorded in 2010), but fell to only 32 in 2011 with a continuing decline through to the present day. Similarly, aerial surveys conducted over the same period recorded a decline in the number of sharks sighted per hour of survey time from 6.0 h^{-1} in 2010 down to 0.9 h^{-1} in 2011 and continued to decline until surveys stopped in 2013 (D. Rowat pers. comm.).

Two hundred and fifty-three whale shark sightings were recorded by a local dive charter company in the Andaman Sea, Thailand, between 1991 and 2001 (Theberge and Dearden 2006). Sightings per unit effort showed a significant decline over this period, with an overall decrease from 1.58 whale sharks per trip in 1992–1993 to 0.13 sharks per trip in 2000–2001 (Theberge and Dearden 2006). A low absolute number of sightings persisted until at least the 2002–2003 season, although effort data were not recorded (Theberge and Dearden 2006). Following the conclusion of data collection for that study, shark sightings have likely increased in frequency according to reports from dive operators. However, sharks are perceived to be smaller than those sighted in the 1990s (P. Dearden, pers. comm).

Bradshaw et al. (2008) analysed tourism sightings at Ningaloo Reef, Australia, between 1995 and 2004, corrected for search effort and environmental fluctuation, and identified a 40% decline in sighting rate and a decline in mean shark length of 1.6 m over this period, although seasonal shifts in peak abundance to outside observation months may also have contributed to this observed decline (Mau and Wilson 2007, Holmberg et al. 2009). Analysis of individual sighting data from 1995 to 2006 identified behavioural heterogeneity in the sharks at Ningaloo, with the majority showing some site fidelity in that they were sighted in multiple seasons (Holmberg et al. 2008). This (majority) subset of the study population was increasing over the course of this work (Holmberg et al. 2008). Follow-up analyses on a slightly longer dataset (1995 to 2008) confirmed this result, with smaller individuals contributing in larger numbers to recruitment, thereby potentially explaining the observed decline in mean size (Holmberg et al. 2009). However, a genetic study on Ningaloo sharks indicated declining genetic diversity over five consecutive years for mtDNA (2007–2012) and two (2010–2012) for microsatellites (Vignaud et al. 2014).

Whale sharks were fished in the Philippines prior to protection in 1998, with whale shark catch per unit effort (i.e., per boat) declining from 4.44 to 1.7 in Pamilacan and 10 to 3.8 in Guiwanon between two surveys conducted in 1993 and 1997 (Alava et al. 2002).

Indo-Pacific subpopulation size

Six hundred and seventy sharks were photo-identified in southern Mozambique between 2003 and 2014 (Norman et al. In revision). Off Mafia Island in Tanzania, 131 sharks were photo-identified between 2006 and 2014 (Norman et al. In revision). Off Djibouti, 297 individuals were photo-identified between 2003 and 2010 (Rowat et al. 2011), while 443 individuals were photo-identified off Mahe in the Seychelles between 2001 and 2009 (Rowat et al. 2011). A subset of the Seychelles dataset, comprising records from 2004 to 2009, was modelled to produce an abundance estimate of 469 to 557 sharks from that area (Brooks et al. 2010). Comparisons of identities collected from the Seychelles, Djibouti, Tanzania and Mozambique, comprising a total of 1,069 individual sharks sighted up to 2009, found no matches between these countries (Brooks et al. 2010). Andrzejaczek et al. (2016) updated the photo-identification comparison between the Seychelles and Mozambique to 2012, confirming one shark recorded in Mozambique was also sighted in the Seychelles, and added in comparisons with the Maldives, Christmas Island (Australia) and Ningaloo Reef (Australia), a total of 1724 sharks. No other international photo-matches were identified in their dataset. Norman et al. (In revision) updated these figures to 2014 and found three international matches between Mozambique and Tanzania. A significant aggregation of juvenile whale sharks occurs in the Red Sea off the Saudi Arabian coast, with 136 individuals identified to 2015 (Cochran et al. 2016) at least two of which have also been recorded in the Djibouti aggregation (D. Rowat pers. comm.). Aggregations of more than 100 sharks have been noted off the Qatar coast with 422 individual whale sharks photo-identified from the Arabian / Persian Gulf and the northern Gulf of Oman between 2011 and 2014 (Robinson et al. 2016). Three hundred and two sharks have been identified in the Maldives, mostly from around the South Ari atoll (J. Hancock pers. comm.). There were 1,184 whale shark sightings in the Indian Ocean recorded by tuna purse-seine vessel logbooks between 1991 and 2007, almost all from the Western Indian Ocean (Sequeira et al. 2013a).

One hundred and thirty-one sightings have been recorded off Christmas Island, Australia (Norman et al. In revision). Whale shark photo-identifications range back to the early 1990s off Ningaloo Reef in Western Australia (Meekan et al. 2006; Holmberg et al. 2008, 2009). Three hundred and eighty-six sharks were identified here between 1995 and 2008 (Holmberg et al. 2009), with over 1,000 sharks identified by 2015 (Norman et al. In revision). Although two satellite-tagged sharks were tracked moving from Ningaloo Reef to the vicinity of Christmas Island (Sleeman et al. 2010), no exchange of photo-identified sharks has been documented (Andrzejaczek et al. 2016, Norman et al. In revision). One photo-identified whale shark was, however, recorded from both Ningaloo Reef and Borneo (Kalimantan) (Norman et al. 2016).

Whale shark abundance at Ningaloo Reef, Australia has been modelled by two studies. Meekan et al. (2006) estimated super-population size to be 319 to 436 sharks between 1992 and 2004. Holmberg et al. (2009) estimated annual abundance to vary between 86 and 143 sharks in the years 2004 to 2007, when length was used as a covariate. whale shark abundance in this area is correlated with the Southern Oscillation Index and several other oceanographic variables, which potentially relate to the strength of ocean currents and local productivity (Wilson et al. 2001, Sleeman et al. 2010).

Over 1,000 individual sharks have now been photo-identified from the Philippines (Wildbook for Whale Sharks, February 2017), with large aggregations recorded from around Donsol (Quiros 2007), Oslob in Cebu Island (Araujo et al. 2014, Schleimer et al. 2015), Pintuyan in Southern Leyte (Araujo et al. 2016), and in Honda Bay and Tubbataha Reefs Natural Park, Palawan (Araujo et al. *in prep*). Excluding the Philippines, 326 sharks had been photo-identified from Southeast Asia (here including Cambodia [3], Indonesia [64], Malaysia [32], Myanmar [4], Taiwan [7] and both coasts of Thailand [216]) and added to the global database by February 2016 (Pierce and Norman 2016).

In the Eastern Pacific, whale sharks are seasonally present around Darwin and Wolf islands in the north of the Galapagos Archipelago. Acuña-Marrero et al. (2014) identified 82 individuals here from 2011–2013 and estimated an annual study population size of 695±166 individuals for the Galapagos Islands. Males and immature females are rarely observed at this location, so this estimate refers predominantly to large, apparently pregnant females (Acuña-Marrero et al. 2014). Two hundred and fifty-one individual sharks were photo-identified in the Gulf of California, Mexico, between 2003 and 2009: 129 from Bahía de Los Ángeles, 125 from Bahía de La Paz and smaller numbers from other sites (Ramírez-Macías et al. 2012a). Modelled abundance estimates from this dataset were 54 in 2008 and 94 sharks in 2009 from Bahía de Los Ángeles, and between 19 and 62 through 2005–2009 at Bahía de La Paz (Ramírez-Macías et al. 2012a). Outside of these areas (Galapagos Islands and Mexico), few photo-identified sharks have been added to the global database from the Eastern Pacific (Wild Me 2017). Twenty-five whale sharks were reported from tuna purse-seine vessel observers in 2014 (Clarke 2015).

4.3 Habitat (short description and trends)

Whale sharks are found in both coastal and oceanic habitats (Rowat and Brooks 2012). Oceanic sightings are strongly correlated with temperature in the Indian and Atlantic oceans (Sequeira et al. 2014b), with most occurring between 26.5° and 30°C in the Indian Ocean (Sequeira et al. 2012). Depth was an important predictor in the Atlantic and Pacific Oceans, but was not significant in the Indian Ocean (Sequeira et al. 2014b). Whale sharks are highly mobile, with mean daily movement rates of 24–38 km based on tethered geopositioning tags (Hueter et al. 2013, Hearn et al. 2016, Rohner et al. In revision). Cyclical or longer-term climate shifts affect whale shark occurrence and abundance (Sleeman et al. 2010, Sequeira et al.

2012), which needs to be considered when discussing local abundance trends. Whale sharks spend the most time in the epipelagic zone (0-200), but dive to at least 1,928 m in depth (Tyminsky et al. 2015) where they are temporarily exposed to temperatures as low as 2.2°C (Wilson et al. 2006).

4.4 Biological characteristics

Most whale shark sightings occur at a small number of known coastal feeding areas for the species, where the sharks aggregate on the surface to exploit seasonal productivity such as fish spawning events or zooplankton blooms (Rowat and Brooks 2012). A degree of inter-annual site fidelity has been documented in many locations (Cagua et al. 2015, Norman et al. In revision). Sexual- and size-based segregation is typical in these locations, with a bias towards juvenile males from 4–8 m length (Rohner et al. 2015, Norman et al. In revision). This pronounced segregation indicates that ontogenetic and sex-specific habitat or dietary shifts are present in the species.

In the Gulf of California, juvenile sharks, comprising 60% males, were found in shallower waters exploiting abundant prey. Larger sharks, composed of 84% females, occurred in oceanic waters where they fed on diffuse patches of euphasiids (Ketchum et al. 2012). An initial stable isotope study of Indian whale sharks showed a positive relationship between size and δ13C and δ15N, suggesting that larger sharks feed on prey items of a larger size and higher trophic level (Borrell et al. 2011). Females had lower values of δ13C and δ15N than males (Borrell et al. 2011) suggesting that they have a different, more pelagic diet, while individuals of <4 m total length (TL) also showed a lower δ13C than larger individuals suggesting a transition from pelagic to more coastal foraging habitats.

The largest recorded whale shark, approximately 20 m TL (Chen et al. 1997) and 42 t in mass (Hsu et al. 2014) have been reported from Taiwan. An individual extrapolated to be 18.8 m TL was caught in India (Borrell et al. 2011). Norman and Stevens (2007) found that 50% of males were mature, based on clasper morphology, at a visually estimated TL of 8.1 m in Western Australia, while 50% maturity was estimated to occur at 9.2 m TL using laser photogrammetry in Mozambique (Rohner et al. 2015). Robinson et al. (2016) found 50% of males visually assessed from Qatari waters attained maturity by 7.29 m, with 100% maturity by 9 m TL. In the Gulf of Mexico, Ramírez-Macías et al. (2012b) visually estimated 50% male maturity to occur at around 7 m TL. Size at maturity in female sharks is approximately 9 m TL, based on visual (Acuña-Marrero et al. 2014, Ramírez-Macías et al. 2012a) and laser photogrammetric estimates (Acuña-Marrero et al. 2014) from the Eastern Pacific, and a 9.6 m TL individual recorded from Taiwan (Hsu et al. 2014). All of seven stranded female specimens from 4.8 to 8.7 m TL in South Africa were immature (Beckley et al. 1997). The only confirmed pregnant female examined, from Taiwan, was 10.6 m TL (Joung et al. 1996).

Whale shark reproductive ecology is poorly known. Pregnant female sharks are seasonally found in the Eastern Pacific, particularly off Darwin Island in the Galapagos Archipelago (Acuña-Marrero et al. 2014) and the Gulf of California (Eckert and Stewart 2001, Ramírez-Macías et al. 2012), but rarely sighted outside this region. An exception is the mid-Atlantic, where pregnant female sharks have been observed on a seasonal basis at both St Helena Island (Clingham et al. Preprint) and the São Pedro and São Paulo archipelago (Macena and Hazin 2016). In the Indian Ocean, only two visibly pregnant females have been reported which were encountered in Qatari waters of the Arabian / Persian Gulf (Robinson et al, 2016). The single pregnant female that has been physically examined, from Taiwan, had 304 pups in various stages of development, the largest litter size reported from any shark species (Joung et al. 1996, Schmidt et al. 2010). This discovery established that whale sharks are aplacental viviparous. Paternity analysis on a subset of the offspring established that a single male might have sired the entire litter, suggesting that the species has the capacity to store sperm (Schmidt et al. 2010). The largest size class of embryos, 58–64 cm TL, appeared close to fully developed (Joung et al. 1996). The smallest free-swimming neonate found in the wild, from the Philippines, was 46 cm TL (Aca and Schmidt 2011).

Size at birth is therefore presumed to be around this range (Aca and Schmidt 2011). Reproductive periodicity is unknown: resightings rarely occur in the areas where pregnant sharks are observed (Norman et al. In revision).

Age and growth data on whale shark are sparse. Stranded sharks in South Africa (Wintner 2000) and fishery catches in Taiwan (Hsu et al. 2014), respectively, have been assessed. Both studies were limited by small sample sizes of predominantly juvenile sharks. Hsu et al. (2014) concluded that vertebral growth band deposition is likely to be biannual and, based on this, estimated that male sharks begin maturing at ~17 years and females at 19–22 years in the Indo-Pacific. However, these estimates have some important caveats: periodic biannual vertebral band deposition has not been conclusively demonstrated in other shark species, and other orectolobiform species have been shown to have aperiodic vertebral band pair formation (Huveneers et al. 2013). Validation through wild growth studies is important to confirm these results. Initial results from laser photogrammetric studies indicate that growth increments over periods of 1–3 years are too small to be accurately measured, but the technique may have value over longer time-frames (Rohner et al. 2015). Generation length is estimated to be 25 years (Pierce and Norman 2016).

4.5 Role of the taxon in its ecosystem

Whale sharks appear to feed primarily on pelagic invertebrates, fish spawn, and small schooling fishes (Rowat and Brooks 2012), inhabiting a lower trophic position than most shark species (Hussey et al. 2015). Although few species-specific data on the role of whale sharks in ocean ecosystems are available, inferences can be made from ecologically comparable marine megafauna species (Estes et al. 2016). Whale sharks are likely to influence the marine system as consumers, as prey, as detritus, and through energy storage and transport (Estes et al. 2016).

Whale sharks consume large quantities of biomass (Motta et al. 2010, Rohner et al. 2015, Tyminski et al. 2015), with peer-reviewed estimates of up to 142.5 kg tuna eggs per day - equating to around 43, 000 Kcal - off the Yucatan Peninsula in Mexico (Tyminski et al. 2015). This occurs within warm-water ecosystems that are typically considered to be low in productivity. This uptake of biomass may itself impact on trophic dynamics (Estes et al. 2016). The large size of whale sharks, along with their extensive vertical movements, from the surface to at least 1, 928 m depth (Tyminski et al. 2015), and broad horizontal movements, suggest that at their original biomass whale sharks would be important vectors of energy transport through ocean ecosystems (Estes et al. 2016). Individual whale sharks often range widely (Rowat and Brooks 2012), thereby connecting ocean ecosystems over large spatial scales and potentially stabilizing meta-ecosystem dynamics (Estes et al. 2016).

The role of pelagic species in cycling nutrients between the surface and the mesopelagic is greater than previously thought (Roman & McCarthy, 2010; Saba & Steinberg, 2012). Fatty acid studies from Mozambique (Rohner et al. 2013) and Western Australia (Marcus et al. 2016) indicate that deep water zooplankton are a significant prey item for whale sharks. Whale sharks likely play a role in opposing the downward flux of carbon to the deep ocean, while transferring energy and materials (including key limiting nutrients, such as nitrogen) from the mesopelagic into the euphotic zone. In areas that are resource-limited, phytoplankton growth is encouraged, perpetuating up trophic levels to create a positive feedback system and enhancing biodiversity (Estes et al. 2016).

After death, whale shark carcasses will sink to the seafloor where, because of their large size and high nutrient content, they provide food and habitat for deep-sea organisms (Estes et al. 2016). While whale shark carcasses have seldom been reported (Higgs et al. 2014), “whale falls” have been studied. Successional changes associated with whale carcass decomposition can proceed for decades, during which time hundreds of associated species are supported by this nutritionally rich and highly pulsed resource (Estes et al. 2016). More than 60 species of deep-sea macrofauna are known only from whale falls, and numerous species associated with cold seeps and hydrothermal vents have also been found to occur on whale falls (Estes et al.

2016). Given the inherently short-lived nature of vent systems, whale falls, and thus whale shark falls, are likely to be important stepping stones in the spatial ecology of the deep sea (Estes et al. 2016).

5. Conservation status and threats

5.1 IUCN Red List Assessment

Endangered A2bd+4bd (Pierce & Norman 2016)
Indo-Pacific Subpopulation: Endangered A2bd+4bd
Atlantic Subpopulation: Vulnerable A2b+4b

5.2 Equivalent information relevant to conservation status assessment

The revised Red List assessment for whale sharks was published recently, in June 2016. We are not aware of additional new information that changes the conclusions reached in that document (i.e. updated population trend analyses or new data on threats).

5.3 Threats to the population (factors, intensity)

Major contemporary threats to whale sharks include fisheries catches, bycatch in nets, and vessel strikes. Other threats affect whale sharks on local or regional scales, such as the emergence of unsustainable tourism practices.

Whale sharks are presently fished in several locations. In southern China, large-scale commercial take of whale sharks appears to be increasing (Li et al. 2012). Although whale sharks are not necessarily targeted, they are routinely captured and retained when sighted (Li et al. 2012). A small-scale opportunistic fishery for whale sharks is also present in Oman (D. Robinson, pers. comm).

Whale sharks have previously been targeted in large-scale fisheries from India, the Philippines and Taiwan, with hundreds of sharks caught annually in each country until species-level protections were implemented (Rowat and Brooks 2012). A smaller directed fishery occurred in the Maldives until whale sharks were protected in 1995 (Anderson and Ahmed 1993). 8Broader-scale subpopulation reduction caused by these fisheries was raised as a possible driver of declining sightings in Thailand (Theberge and Dearden 2006) and Western Australia (Bradshaw et al. 2008). Occasional directed catch or bycatch of whale sharks has been documented from many of their range states, particularly where large-mesh gillnets are in common use (Rowat and Brooks 2012).

Tuna are often associated with whale sharks, and tuna purse-seine fisheries often use whale sharks as an indicator of tuna presence, even setting nets around the sharks (Capietto et al. 2014). Direct mortality in purse-seine fisheries appears to generally be low, recorded as 0.91% (one of 107) and 2.56% (one of 38) of sharks where fate was reported by observers in the Atlantic and Indian Oceans, respectively (Capietto et al. 2014). However, estimated mortality rates in the Western Central Pacific purse-seine fishery were higher: 12% for 2007–2009 and 5% in 2010. This extrapolated to a total mortality of 56 sharks in 2009 and 19 in 2010 (Harley et al. 2013). Observer reports on release condition from this region from 2010–2014 were generally consistent, with 50–60% of encircled sharks released alive, 5–10% dying and 30–40% of status unknown (Clarke 2015). Assuming a poor outcome for the latter category, potential mortalities in 2014 range from a minimum of 11 to 42, with a higher number possible depending on longer-term survival of the sharks released alive (Clarke 2015). Available data on the number of whale sharks caught are likely to underestimate total catch (Clarke 2015). The longer-term survivorship of whale sharks released from nets has not been examined at this stage. Common release practices, such as being lifted or towed by the caudal peduncle, are likely to cause stress, injury and possibly death to the sharks.

Shipping lanes, where they are placed close to whale shark feeding areas, can create a serious risk of vessel strikes. Whale sharks routinely feed at the surface (Motta et al. 2010, Gleiss et al. 2013), and propeller injuries are commonly recorded during monitoring programs (Rowat et al. 2006, Speed et al. 2008, Fox et al. 2013).

While mortality events are seldom reported in the contemporary scientific literature, they were often noted from slower-moving vessels in the past (Gudger 1941). It is likely that fast-moving, large ships do not register or report impacts, and as whale sharks will typically sink upon death, these are unlikely to be documented (Speed et al. 2008). Areas where whale sharks appear to be at risk include the Mesoamerican reef countries in the Western Caribbean (Graham 2007, R. de la Parra-Venegas pers. comm.) and Gulf states (D. Robinson pers. comm.), where a high frequency of serious propeller injuries are observed during monitoring.

Inappropriate tourism may be an indirect threat to whale shark in some circumstances (for example from interference, crowding or provisioning). Marine pollution events occurring in whale shark hotspots, such as the Deepwater Horizon oil spill in the Gulf of Mexico in 2010 (Hoffmayer et al. 2005, McKinney et al. 2012), may result in mortality or displacement from preferred habitats. These more local threats, as well as potential future concerns such as climate change impacts (Sequiera et al. 2014), should be closely monitored.

5.4 Threats connected especially with migrations

Whale sharks are known to use specific movement corridors, such as the Inhambane coast in Mozambique (Rohner et al. In revision) and the Pacific Equatorial Front (Hearn et al 2016), and predictably migrate to form dense feeding aggregations in some areas, such as Al Shaheen off Qatar (Robinson et al. 2013, 2016) and Quintana Roo in México (de la Parra-Venegas et al. 2011). Human threats, such as gill net use or shipping lanes, could have disproportionately large impacts in these locations. Multiple CMS range states host significant whale shark populations but have no protections in place for the species.

In the high seas, where whale sharks spend a large proportion of their time, limited protection is in place. While purposefully setting purse-seine nets around whale sharks has now been banned in the Indian and Pacific oceans, this is still allowed in the Atlantic (Pierce and Norman 2016).

In the Philippines, provisioning of whale sharks at Oslob has been associated with changes in behaviour (Schleimer et al., 2015, Araujo et al., in prep.). Provisioned sharks have extended residency periods at the site, possibly affecting their highly mobile nature (Araujo et al., 2014). Restricted and/or altered vertical and/or horizontal movements should prompt caution when making management plans for endangered species, particularly in light of new provisioning sites developing in Indonesia.

5.5 National and international utilization

Whale sharks are subject to large- and small-scale bycatch in fisheries, with some national and international trade in products. They are also a focal species for marine tourism industries.

The only known targeted fishery for whale sharks to have existed in the Atlantic Ocean was in Santa Cruz, Cuba, where 8–9 sharks were caught each year until the fishery was banned in 1991 (Graham 2007). Aside from Venezuela, where whale sharks were occasionally harpooned by fishers (Romero et al. 2000), there are few other records of utilization or trade of individuals from this subpopulation.

Prior to 1985, there was little demand for whale shark meat in Taiwan, with specimens of several tonnes weight selling at between US$200–300 (Chen and Phipps 2002). No dedicated fishery was present, though whale sharks were caught as bycatch in set-net fisheries (Chen et al. 1997). A meat fishery developed during the 1990s, with annual catches estimated to be 272 individuals in 1996 from set-net and harpoon catches (Chen et al. 1997). Total catches were likely to be higher (Chen et al. 1997). Whale shark became the most expensive shark meat available in Taiwan by 1997, reaching prices of US$13.93/kg (Chen et al. 1997). A small 2 t whale shark could fetch US$14,000, with a larger 10 t shark selling for around US$70,000 in 1997 (Chen et al. 1997). Catches declined after this peak, potentially due to local stock depletion, to 80–100 sharks through the country each year after 1997 (Hsu et al. 2012). However, the annual volume of whale shark meat traded more than doubled between 1998 and 2000, to 60 t in 2000 (Chen and Phipps 2002). Market surveys in 2001 indicated that catch was under-reported in official statistics, and that significant quantities of meat were likely being imported through unofficial channels (Chen and Phipps 2002). Following the introduction of specific export codes for whale shark meat in 2001, 2 tonnes of exports (to Spain, valued at US$1.15/kg) and no imports were recorded over the following year (Chen and Phipps 2002). A total of 693 sharks were caught in Taiwan between 2001 and 2008 (Hsu et al. 2012). Total allowable catch quotas steadily reduced through to zero sharks from 2001 to 2007 (Hsu et al. 2012). A small international trade in live whale shark was also noted in Taiwan (Chen and Phipps 2002), and is also present in mainland China (Li et al. 2012).

Prior to the protection of whale shark in India (2001) and the Philippines (1998), whale shark meat was exported from those countries to Taiwan (Chen and Phipps 2002). From 1990 to 1997, 624–627 whale sharks were caught from four of the primary fishing sites in the Philippines (Alava et al. 2002). Whale shark meat from mainland China was also thought to be illegally exported to the Taiwanese market (Chen and Phipps 2002). While whale shark is not presently targeted off mainland China, there is a large bycatch, estimated to be more than 1,000 individuals per annum (Li et al. 2012). Whale shark is considered a high value catch in this fishery, so they may be actively targeted in the future (Li et al. 2012). Although the species is technically protected, catches are unmonitored and enforcement is minimal (Li et al. 2012). A reduction in the mean size of landings has been reported, from 8.27 m prior to 2004 to 5.5 m from 2004–2007 and 6.3 m from 2008–2011 (Li et al. 2012). It is unclear whether this apparent decrease in mean catch length reflects a decrease in landings of large sharks.

In the 1990s, whale shark fins were regarded as low value due to poor quality and the difficulty of preparation (Chen and Phipps 2002). Demand for fins within trade was minimal, although they were sometimes sold as display or trophy fins for shark-fin soup restaurants (Chen and Phipps 2002). More recent surveys have reported that whale shark fins are now demanding high prices, which is likely to result in increased targeting (Li et al. 2012). Whale shark fins are sporadically seen in Hong Kong markets (G. Curtis, pers. comm.), indicating that international trade in whale shark fins is still likely to be occurring. The source of these fins is unknown. A live shark was seen with a recently removed first dorsal fin in the Maldives (Riley et al. 2009). Whale shark were also opportunistically finned in Indonesia in the 2000s (White and Cavanagh 2007).

The whale shark fishery in India was reviewed by Akhilesh et al. (2013). A traditional small-scale seasonal harpoon fishery in India took whale shark for their liver oil, which was used to waterproof boats. In the mid 1990s, fishery effort increased along the Gujarat coast to meet demand for oil, meat and fins from countries in Europe and Southeast Asia. From 1990 until 2001, when whale sharks became legally protected in territorial waters, there was a targeted commercial fishery in Gujarat. Between 1889 and 1998, 1,974 sharks were recorded as landed through India. Some bycatch still occurs following the closure of this fishery, with 79 landings from 2001 to 2011 (Akhilesh et al. 2013).

A small opportunistic fishery is active in Oman (D. Robinson, pers. comm). Small-scale harpoon and entanglement fisheries for whale sharks have taken place in several other countries such as Iran and Pakistan (Rowat and Brooks 2012). Recent landings in these areas are unknown. Fishers in the Maldives used to take 20–30 individuals per year for their oil, but reported declining catches during the 1980s to early 1990s (Anderson and Ahmed 1993), and the fishery was banned in 1995. Occasional hunting may have continued following protection (Riley et al. 2009).

Tourism industries based on viewing whale shark have now developed in several countries or locations, including Australia, Belize, Cuba, Djibouti, Ecuador, Honduras, Indonesia, the Maldives, Mexico, Mozambique, Oman, Panama, the Philippines, St Helena, Saudi Arabia, the Seychelles, Tanzania and Thailand. These range in size between a maximum of 24 tourists at a time in Cuba (Graham 2007), to over 250 licensed tour operators off Quintana Roo in Mexico

(Ziegler et al. 2012). Direct expenditure for whale shark-focused tourism at South Ari Atoll in the Maldives was estimated at US$9.4 million in 2013 (Cagua et al. 2014), while payments for tours alone off Quintana Roo in Mexico were estimated to be US$7 million in 2013 (R. de la Parra Venegas, pers. comm). In Western Australia, whale shark tourists spent an estimated US$4.5 million in the Ningaloo region in 2006 (Catlin and Jones 2010). Tourist numbers have since doubled, from approximately 10,000 to 20,000 per year, so expenditure will also have substantially increased (B. Norman, pers. comm.). Graham (2007) projected that, globally, whale shark tourism was likely to be worth over US$42 million annually. Rapid increases in the numbers of tour participants in some key locations, such as in Mexico (R. de la Parra Venegas, pers. comm.), Australia (D. Robb, pers. comm.) and the Philippines, where over USD$5 million in ticket sales alone in 2015 at Oslob, Cebu (Araujo et al. Accepted), indicate that the industry is steadily growing in economic importance.

6. Protection status and species management

6.1 National protection status

National- or territory-level protection measures for whale sharks, via shark fishing bans or specific species protection, are in place in American Samoa, Australia, Bahamas, Belize, Cambodia, Chagos Archipelago (UK), China, Congo-Brazzaville, Cook Islands, Costa Rica, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, French Polynesia, Guatemala, Guadeloupe, Guyana, Honduras, Hong Kong SAR, Indonesia, India, Kuwait, Maldives, Malaysia, Marshall Islands, Mexico, Myanmar, New Caledonia, New Zealand, Nicaragua, Palau, Panama, Philippines, Reunion, Saudi Arabia, Seychelles, South Africa, St Helena Island (UK), Taiwan, Thailand, Tokelau, United Arab Emirates and USA. In Israel, all elasmobranchs are fully protected in Israel's territorial waters in both the Mediterranean and Red Sea.

The Philippines passed a Fisheries Administrative Order (FAO 193, Department of Agriculture) in 1998 protecting the species following the start of ecotourism activities in Donsol, Sorsogon. The FAO prohibits the catching, selling, transporting, processing, purchasing or exporting of whale shark and manta ray (*Manta birostris*).

6.2 International protection status

The whale shark has been listed in several international conventions and agreements. The species is included in Annex I (Highly Migratory Species) of the United Nations Convention on the Law of the Sea (UNCLOS), which provides a framework for the conservation and management of fisheries, and other uses of the seas. To date, no management initiatives enacted through UNCLOS have included the whale shark. Under the aegis of this convention, the United Nations Agreement on Straddling and Highly Migratory Fish Stocks was introduced in 1995, which has potential for direct actions to be taken in relation to species such as the whale shark, although none have yet been proposed (Rowat and Brooks 2012). Also in 1995, the FAO finalized a Code of Conduct for Responsible Fisheries, and then in 1998 the International Plan of Action for Conservation and Management of Sharks (Rowat and Brooks 2012). Davidson et al. (2015) noted that only 22 National Plans of Action had been published at that time, limiting the effectiveness of this initiative.

The whale shark was listed on Appendix II of CMS in 1999. This identifies it as a migratory species whose unfavourable conservation status would benefit from the implementation of international cooperative agreements. In 2010, the CMS Memorandum of Understanding on migratory shark species listed the whale shark on this agreement. There were 40 signatories to this memorandum as of February 2016 (Pierce and Norman 2016), which aims to improve scientific knowledge, ensure fisheries sustainability, protect critical habitats, movement corridors and life stages of sharks, while increasing public participation and national, regional and international cooperation towards these objectives.

The whale shark was listed on Appendix II of the Convention on International Trade in Endangered Species (CITES) in 2002. This requires fishing states to demonstrate that any exports were derived from a sustainably managed population, enabling exports and imports to be monitored through a permit system. Continued presence of whale shark fins in Hong Kong markets, a major international transit point, despite no records in the CITES Wildlife Trade Database (http://trade.cites.org) suggests that illegal trade is occurring outside the CITES permit system (Pierce and Norman 2016).

Regional Fisheries Management Organisations (RFMOs) have banned the intentional setting of purse-seine nets around whale shark in the Eastern Pacific, Western Central Pacific (WCP) and Indian Oceans, though not yet in the Atlantic Ocean (Capietto et al. 2014).

6.3 Management measures

Several range states have prepared a National Plan of Action on shark fisheries management and conservation. While these do not deal solely with whale sharks, the species is incorporated into such plans. At the last global review of implementation, in 2012, FAO reported that 18 of the top 26 shark fishing countries had developed such plans, with five more in preparation (Fowler 2016a).

Regional Fisheries Management Organisations (RFMOs) have banned the intentional setting of purse-seine nets around whale shark in the Eastern Pacific, Western Central Pacific (WCP) and Indian Oceans, though not yet in the Atlantic Ocean (Capietto et al. 2014, Fowler 2016a). However, a large proportion of entangled whale sharks (73% in WCP; SPC-OFP 2012) are not sighted prior to nets being deployed. The Inter-American Tropical Tuna Commission (IATTC) and Indian Ocean Tuna Commission require that best practices for safe release of whale sharks be followed when they are accidentally encircled (Capietto et al. 2014, Fowler 2016b), and similar guidelines were endorsed by Western and Central Pacific Fisheries Commission members in 2015. From 2018 it will not be allowable to tow whale sharks out of purse-seine nets within the IATTC fleet (Fowler 2016b).

Whale shark tourism is managed through legislation in Australia, Belize, Ecuador (Galapagos Islands but not mainland), Mexico and St Helena Island (UK). In the Philippines, local ordinances exist regulating tourism activities, namely at Donsol, Pintuyan and Oslob. A Joint Administrative Order is currently under review by the Departments under whose management the whale shark falls, that will regulate interactions nationally. At the time of writing, whale shark tourism was not legal in Qatar, where whale shark aggregations occur in a restricted oil field (Robinson et al. 2013). Voluntary codes of conduct exist in many other tourism locations.

6.4 Habitat conservation

Key habitats for whale sharks, in the form of coastal feeding locations or movement corridors, are protected in Australia (Ningaloo Reef), Belize (Gladden Spit), Costa Rica (Cocos Island), Ecuador (Galapagos Islands), Mexico (Yum-Balam Biosphere Reserve), Panama (Coiba Island) and the UK (St Helena Island). Site protection is necessary in some areas where high densities of whale sharks are present, as anthropogenic pressures on these sites could have disproportionate impact on subpopulation declines. Important aggregation areas for whale sharks in Mexico (de la Parra Venegas et al. 2011), Mozambique (Haskell et al. 2015) and Qatar (Robinson et al. 2013) are examples. Where whale sharks are routinely feeding on the surface, such as off Quintana Roo in Mexico (Motta et al. 2010, de la Parra Venegas et al. 2011), these areas should also be managed to reduce vessel strikes in nearby shipping lanes. This could entail either seasonal ‘go-slow zones’, or moving these routes to avoid the shark aggregations. Protection of the specific biological phenomena that influence whale shark presence at many aggregation sites, such as fish spawning events (Heyman et al. 2001, de la Parra Venegas et al. 2011, Robinson et al. 2013), would also help to safeguard these habitats.

In the Philippines the municipality of Donsol passed Resolution No. 16 (S-98, 1998) declaring the Bay of Donsol a whale shark sanctuary. Such an initiative eventually led to the national protection of the species under FAO 193. Tubbataha Reefs Natural Park in the Sulu Sea has been associated with whale sharks, possibly as an important migratory waypoint (LAMAVE & MMF, unpub. data), and has been a no-take marine protected area since 1988 (Proclamation

No. 306, President of the Philippines, 1988). Regional initiatives (e.g. Coral Triangle Initiative and the Sulu-Sulawesi Seascape) are also helping habitat conservation through the whale shark's range.

6.5 Population monitoring

Regional Fisheries Management Organisations**:**

- Indian Ocean Tuna Commission (web link).
- Western & Central Pacific Fisheries Commission (web link).
- Inter-American Tropical Tuna Commission (web link).

Global monitoring programs:

- Wildbook for Whale Sharks Photo-Identification Library (web link).

Local or national monitoring programmes:

- Australia: Dept. of Parks & Wildlife, Western Australia (web link).
- Colombia: Fundación Malpelo (web link).
- Djibouti: Marine Conservation Society, Seychelles (web link).
- Ecuador: Galapagos Whale Shark Project (web link).
- Honduras: Utila Whale Shark Research Project (web link); Whale Shark & Oceanic Research Center (web link).
- Indonesia: Whale Shark Indonesia (web link).
- Madagascar: Madagascar Whale Shark Project (web link).
- Maldives: Maldives Whale Shark Research Programme (web link).
- Mexico: Ch'ooj Ajauil; Whale Shark Mexico (web link).
- Mozambique: Marine Megafauna Foundation (web link).
- Oman: Sharkwatch Arabia (web link).
- Philippines: Department of Agriculture-Bureau of Fisheries and Aquatic Resources (web link), Large Marine Vertebrates Research Institute Philippines (web link), WWF-Philippines (web link).
- Qatar: Qatar Whale Shark Research (web link).
- Saudi Arabia: Reef Ecology Lab, KAUST (web link).
- Seychelles: Marine Conservation Society, Seychelles (web link).
- Tanzania: Marine Megafauna Foundation (web link).
- United Arab Emirates: Sharkwatch Arabia (web link).

7. Effects of the proposed amendment

7.1 Anticipated benefits of the amendment

There are multiple CMS parties that are also whale shark range states which do not have any protections currently in place for the species. Several of these countries are notable whale shark hotspots, including Madagascar (Jonahson and Harding 2007), Mozambique (Rohner et al. 2015), Tanzania (Rohner et al. 2015), Pakistan, Peru (Hearn et al. 2016), Gabon (Capietto et al. 2014), and Portugal (Afonso et al. 2014). Legislative protection of whale sharks or their habitat in other parties is compromised by threats in surrounding countries. Many CMS parties also have ongoing issues with bycatch and / or vessel strikes on whale sharks (Pierce and Norman 2016). An Appendix I listing is anticipated to lead to increased attention to legislative protection in range states and other whale shark conservation requirements.

International trade in whale sharks is still occurring, potentially illegally (Pierce and Norman 2016). Despite the species' listing on Appendix II of CITES, no research or management findings have been produced that support sustainable take at any level. An Appendix I listing on CMS is anticipated to lead to improved management and enforcement of existing fisheries legislation that affects whale sharks within their range states.

A whale shark listing on Appendix I of CMS is also anticipated to result in improved management of the species by regional fisheries management organisations, particularly those where members are also parties to CMS. A discrete impact may be to improve reporting on interactions within tuna purse seine fisheries, along with continued development of bycatch and injury mitigation strategies (A. Cook pers. comm.). Within the IOTC region it should increase support for greater monitoring and surveillance of gill net fisheries, which have minimal observer coverage or bycatch reporting in place at this stage (A. Cook pers. comm., Fowler 2016b).

The development of basic international interaction guidelines to mitigate potential impacts on the species should be pursued. This would promote conservation efforts across boundaries and promote non-signatory CMS parties to join. This is of particular importance to the Philippines seeing as neighbouring countries (namely Malaysia and Indonesia) are non-signatory to CMS and with whom some degree of connectivity has been established. The development of new provisioning sites in Indonesia, which has been shown to alter whale shark movements, should also warrant pursuit of standardised tourism practices.

Further protection would also promote increased management of whale shark tourism to ensure that potential negative impacts on the sharks are minimised.

7.2 Potential risks of the amendment

No potential risks to whale shark conservation are foreseen from an Appendix I listing.

7.3 Intention of the proponent concerning development of an Agreement or Concerted Action

The Philippines proposes a concerted action on the conservation of Whale Shark primarily on the following:

- Tagging and genetics studies to understand connectivity;
- Development of unified basic tourism guidelines to limit impacts on the species;
- Identify and minimise threats to the species (e.g. net entanglements, vessel collisions, establishment of protected areas regarding whale shark critical habitats, etc)
- Promote and enhance national, regional and international coordination, collaboration and partnership for whale shark conservation; and
- Support and encourage the designation of MPAs and MPA Networks

8. Range States

Angola, Antigua and Barbuda, Argentina, Australia, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Brazil, Brunei Darussalam, Cabo Verde, Cambodia, Cameroon, Canada, Chile, China, Colombia, Comoros, Congo (Brazzaville), Cook Islands, Costa Rica, Cuba, Côte d'Ivoire, Democratic People's Republic of Korea, Democratic Republic of the Congo (Kinshasa), Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Fiji, France, French Polynesia, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iraq, Islamic Republic of Iran, Israel, Jamaica, Japan, Jordan, Kenya, Kiribati, Kuwait, Liberia, Madagascar, Malaysia, Maldives, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Netherlands, New Zealand, Nicaragua, Nigeria, Oman, Pakistan, Palau, Panama, Papua New Guinea, Peru, Philippines, Portugal, Qatar, Republic of Korea, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, Spain, Sri Lanka, Sudan, Suriname, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tuvalu, United Arab Emirates, United Kingdom, United Republic of Tanzania, United States of America, Uruguay, Vanuatu, Venezuela, Viet Nam, Yemen.

9. Consultations

Consultations were undertaken with the Governments of Israel, Kenya and Sri Lanka and National Conservation Organizations working on the conservation of whale sharks such as the Large Marine Vertebrate (Lamave) Research Group Philippines, the Coastal Conservation and Education Foundation (CCEF) and the Marine Wildlife Watch.

10. Additional remarks

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