UNITED NATIONS

EP

Distr. LIMITED

UNEP(DEPI)/CAR WG.43/INF.19
19 December 2022

Original: ENGLISH

Tenth Meeting of the Scientific and Technical Advisory Committee (STAC) of the Protocol Concerning Specially Protected Areas and Wildlife (SPAW) in the Wider Caribbean Region

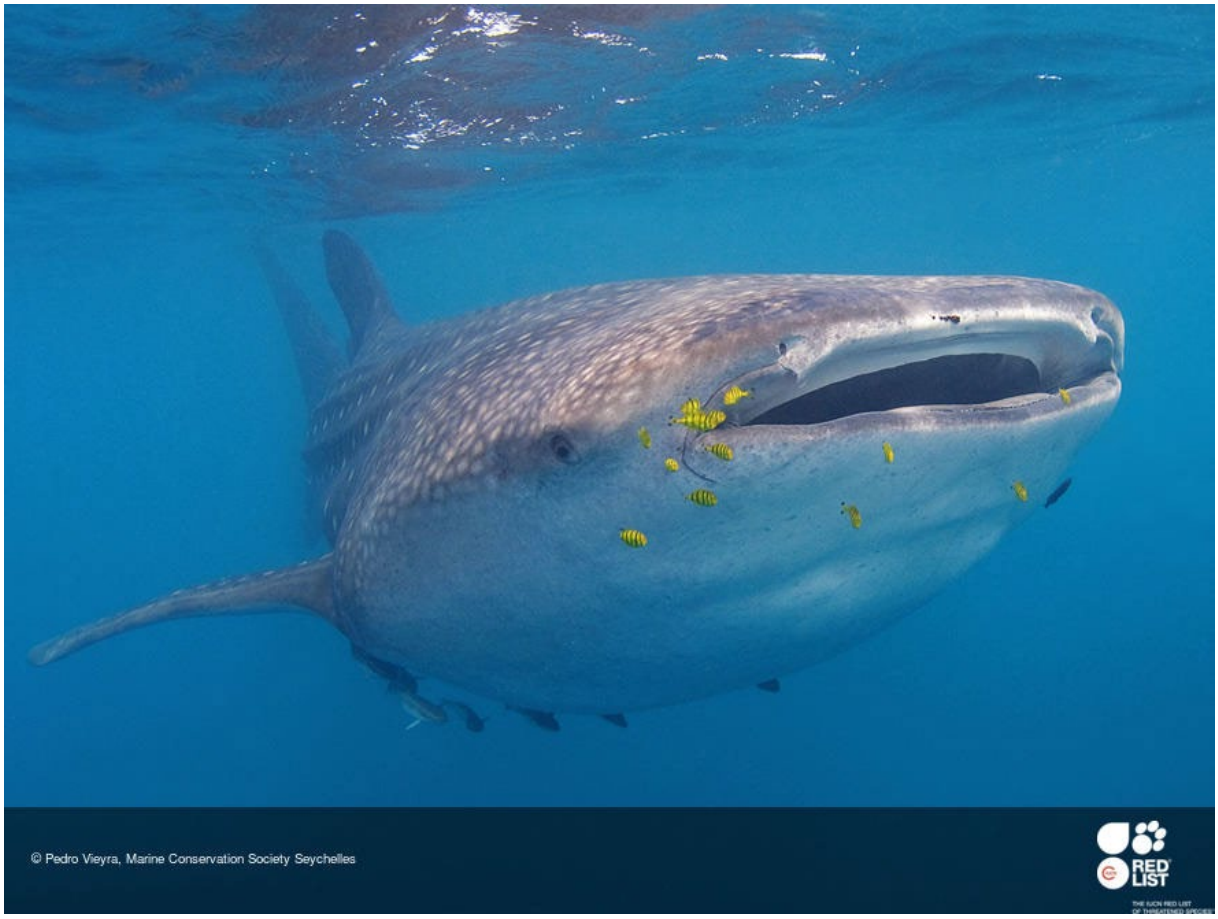
Virtual, 30 January – 1 February 2023

PROPOSAL BY THE REPUBLIC OF FRANCE AND THE KINGDOM OF NETHERLANDS FOR THE UPLISTING OF THE WHALE SHARK *RHINCODON TYPUS* FROM ANNEX III TO ANNEX II OF THE SPAW PROTOCOL

This meeting is being convened virtually. Delegates are kindly requested to access all meeting documents electronically for download as necessary.

*This has been reproduced without formal editing.

Proposal by the Republic of France and the Kingdom of Netherlands for the uplisting of the whale shark *Rhincodon typus* from Annex III to Annex II of the Protocol concerning Specially Protected Areas and Wildlife (SPAW Protocol).



From IUCN redlist website: https://www.iucnredlist.org/species/19488/2365291

Contents

I. Nomination Requirements

1. Requirements regarding species nomination are set forth in Specially Protected Areas and Wildlife (SPAW) Protocol Articles 11, 19, and guidelines and criteria adopted by the Parties pursuant to Article 21. The procedures to amend the annexes, contained in Article 11(4), state that "any Party may nominate an endangered or threatened species of flora or fauna for inclusion in or deletion from these annexes," and that, after review and evaluation by the Scientific and Technical Advisory Committee, the Parties shall review the nominations, supporting documentation and the reports of the Scientific and Technical Advisory Committee and shall consider the species for listing. Such a nomination is to be made in accordance with guidelines and criteria adopted by the Parties pursuant to Article 21. As such, this nomination addresses the 2014 "Revised criteria for the listing of species in the Annexes of the Protocol Concerning SPAW and Procedure for the submission and approval of nominations of species for inclusion in, or deletion from Annexes I, II and III." Finally, Article 19(3) lists the type of information that should be included, to the extent possible, in reports relevant to protected species.
2. Article 1 of the SPAW Protocol defines Annex II as "the annex to the Protocol containing the agreed list of species of marine and coastal fauna that fall within the category defined in Article 1 and that require the protection measures indicated in Article 11(1)(b). The annex may include terrestrial species as provided for in Article 1(c)(ii)." Further, Article 11 of the Protocol specifies that "each Party shall, in cooperation with other Parties, formulate, adopt and implement plans for the management and use of such species…"
3. Listing of species can be justified based on a variety of criteria set out in the Revised criteria for the listing of species in the Annexes of the SPAW Protocol, in particular:
    - *Criterion #1. For the purpose of the species proposed for all three annexes, the scientific evaluation of the threatened or endangered status of the proposed species is to be based on the following factors: size of populations, evidence of decline, restrictions on its range of distribution, degree of population fragmentation, biology and behaviour of the species, as well as other aspects of population dynamics, other conditions clearly increasing the vulnerability of the species, and the importance of the species to the maintenance of fragile or vulnerable ecosystems and habitats.*
    - *Criterion #2. When evaluation of the factors enumerated above clearly indicates that a species is threatened or endangered, the lack of full scientific certainty about the exact status of the species is not to prevent the listing of the species on the appropriate annex.*
    - *Criterion #4. When compiling a case for adding a species to the Annexes, application of the IUCN criteria in a regional (Caribbean) context will be helpful if sufficient data are available. The*

- *evaluation should, in any case, use best available information, and expertise, including traditional ecological knowledge.*
- *Criterion #5. The evaluation of a species is also to be based on whether it is, or is likely to be, the subject of local or international trade, and whether the international trade of the species under consideration is regulated under CITES or other instruments.*
- *Criterion #6. The evaluation of the desirability of listing a species in one of the annexes should be based on the importance and usefulness of regional cooperative efforts on the protection and recovery of the species.*

II. Substantiated Nomination Requirements to Support Inclusion in Annex II

Article 19(3) – Information to be included in reports relevant to protected species, to the extent possible

A. Article 19(3)(a) – Scientific and Common Names of the Species

a.1. Scientific and common name of the species

1.1 Classis: Elasmobranchii

1.2 Ordo: Orectolobiformes

1.3 Familia: Rhincodontidae

1.4 Genus/species: *Rhincodon typus*

1.5 Common name:

English: Whale shark

Spanish: Tiburón ballena, pez dama

French: Requin-baleine

Dutch: Walvishaai

Papiamentu: Tribon bayena or tintorero

a.2 Biological data

4. Whale sharks are the largest of all fish, with a maximum total length (TL) of 18–20 m (McClain et al. 2015). Maturity is attained at 9–10 m TL in females (estimated to be reached at 30–40 years; Pierce et al. 2021b) and 7–9 m in males (estimated at 25 years; Perry et al. 2018). Male maturity typically occurs at 7–8 m in the Caribbean region (Ramírez-Macías et al. 2012). The species has an exceptionally slow growth rate, with their growth parameter *k* estimated to be 0.02 $year^{-1}$ (Pierce et al. 2021b). Longevity is currently unknown, as whale sharks appear to have determinate growth (Meekan et al. 2020), but the species has been validated to attain at least 50 years old (Ong et al. 2020), and maximum age may exceed 100 years (Perry et al. 2018).
5. Whale shark reproduction is poorly-known, with only one pregnant female having been examined (Joung et al. 1996). This specimen showed whale sharks to be yolk-sac viviparous with ~300 pups, the largest litter documented from any shark species. Their reproductive cycle is likely to be biennial, at a minimum, and probably longer (Pierce et al. 2021b). While they have a large litter, their pups emerge free-swimming at a small (~50–70 cm TL) size, and are assumed to face a high initial mortality rate. The species' estimated maximum intrinsic rate of population increase (r_{max}) is one of the lowest obtained from sharks to date, at 0.08–0.12 $year^{-1}$ (Pierce et al. 2021b).

a.3 Habitat

6. Whale sharks are distributed circum-tropically from approximately 30°N to 35°S with seasonal penetration into temperate waters (Rowat & Brooks 2012; Sequeira et al. 2014). Important aggregation sites have been reported in the Atlantic, Indian and Pacific Oceans, (Sequeira et al. 2013). Two genetic subpopulations are currently recognised for conservation management purposes, in the Indo-Pacific and the Atlantic (including the Caribbean), respectively (Pierce & Norman 2016). The whale shark is primarily epipelagic and can be encountered in both coastal and oceanic environments, but they are capable of diving to bathypelagic depths (maximum documented 1,928 m; Tyminski et al. 2015). Productive coastal waters often constitute seasonally important feeding grounds particularly for juvenile male whale sharks (3–8 m TL). Adult sharks of both sexes are primarily oceanic (Ramirez-Macias et al. 2017; Rohner et al. 2021).
7. Whale sharks can be found in all states having tropical or warm-temperate marine coasts and particularly the contracting Parties to the Protocol, which are 17 countries from the Caribbean region: Bahamas, Barbados, Belize, Colombia, Cuba, Dominican Republic, France (Guadeloupe, Honduras, Guyane, Martinique, Saint-Barthélémy, Saint-Martin), Grenada, Guyana, Netherlands (Aruba, Bonaire, Curaçao, Saba, Sint-Eustatius, Sint Maarten), Panama, Saint-Lucia, St Vincent and the Grenadines, Trinidad and

Tobago, United States (States bordering the Gulf of Mexico; U.S. Virgin Islands; Puerto Rico), and Venezuela.

8. In the Wider Caribbean region, sightings are more common in the Meso-American Barrier Reef area (MABR) and, later in the year, in the northern Gulf of Mexico. The largest-known aggregation of whale sharks in the world occurs near Isla Contoy each summer, with hundreds of individuals coming together to feed on tuna spawn (de la Parra Venegas et al. 2011). Adjacent to this area, near Isla Holbox, whale sharks also feed on dense zooplankton blooms (Motta et al. 2010). Large aggregations have also been documented in the northern Gulf of Mexico (Hoffmayer et al. 2021). Photo-identification of individual sharks shows high connectivity between sites, e.g. between Gladden Spit (Belize), Isla Contoy (Mexico) and Utila (Honduras) (Figure 1, McKinney et al 2017), also corroborated by telemetry studies in the region (e.g. Hueter et al. 2013; Hoffmayer et al. 2021).

9. The southeastern Caribbean Sea, off Margarita Island (Venezuela), is an important upwelling area of the Caribbean and supports commercial fisheries for clupeids. The prevailing currents transport this nutrient-rich water towards the islands of Curacao and Bonaire, and this area displays an elevated marine productivity compared to many other areas of the Caribbean (Debrot, 2013). Debrot (2013) suggested that this may be the reason for whale shark sightings around these islands. Romero et al. (2000) found a bimodal annual pattern for whale shark records in the Gulf of Curacao (Venezuela). The highest concentration of whale shark records occurred during the months of August-October, while a lesser peak in records occurred in January-February. The principal peak in occurrence coincided with the period of wind-driven seasonal upwellings and inflow of freshwater from the Orinoco (Romero et al., 2000). There are more sporadic reports of whale sharks from the Bahamas, Cuba and Turks & Caicos and from the islands of the Lesser Antilles. Cuba formerly had a whale shark fishery which suggests sizeable aggregations at one time.

10. Most sightings in the region are no longer associated with fisheries, but occur as a result of coastal whale shark watching for tourism purposes (Graham, 2007). There are significant dive operations as well. These operations allow people to come in close contact with sharks.However, a recent report highlighted twenty-one whale sharks were reportedly killed in Venezuela between 2014–17 (Sánchez et al. 2020). Each whale shark has a characteristic and unique white-spotted pattern on their dorsal surfaces. These create the opportunity for photo-identifying individual sharks and have enabled non-invasive population, movement, and growth studies on the species in the Caribbean region and elsewhere.

11. Photo ID studies demonstrate that whale sharks show some site fidelity, at least as juveniles (Graham and Roberts, 2007; McKinney et al. 2017), to seasonal feeding areas. Their high mobility means that local abundance of whale sharks is usually related to the ephemeral presence of high prey densities. For instance, whale sharks are mainly seen in Belize from March-May which coincides with the peak period of

snapper spawning (Graham & Roberts 2007) and in Quintana Roo, Mexico from June-September during zooplankton blooms and tuna spawning activity (Motta et al. 2010; de la Parra Venegas et al. 2011). Water quality, seawater temperature, current patterns, weather, sea state, and other characteristics may also determine where aggregations are reported. Sightings of adult males with fully calcified claspers have been seen in coastal areas of the MABR, suggesting that reproduction may occur in the western Caribbean (Graham and Roberts 2007).

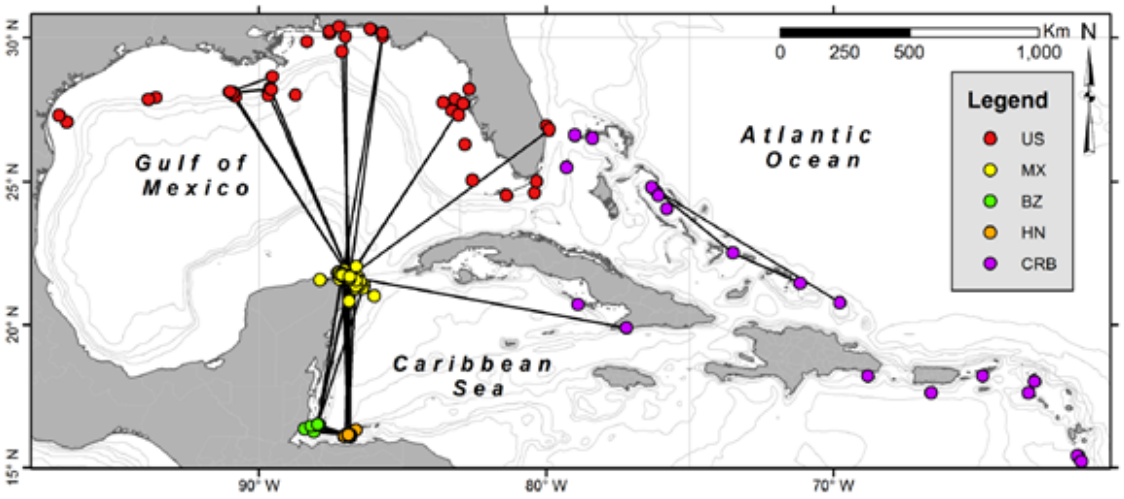


Fig 1. Spatial distribution of sightings data collected through Wildbook for Whale Sharks in the Western Central Atlantic Ocean during 1999–2015. Movements between whale shark sightings within the Gulf of Mexico and Caribbean, including Honduras (HN), Belize (BZ), Mexico (MX), United States of America (US), and the greater Caribbean region (CRB) based on photo-identification data.

https://doi.org/10.1371/journal.pone.0180495.g001

Figure 1. *From McKinney et al (2017)*

12. Whale shark aggregation sites are typically dominated by specific age classes (e.g. juvenile males in coastal feeding aggregations, and adult sharks at seamounts and volcanic islands; Ramirez-Macias et al. 2017; Rohner et al. 2021) and migration corridors. The Wider Caribbean population is most often seen as aggregations in coastal areas and is dominated by juvenile and sub-adult males, with 89% below the estimated size of sexual maturity (McKinney et al 2017). In the Leeward Dutch islands of St Eustatius and Saba, whale sharks are most often seen in blue water in association with feeding tuna schools (Debrot et al. 2013), as is also the case off Utila, Honduras (Fox et al. 2013). In the northeastern Gulf of Mexico, individuals as small as 3 m in length have been reported, with 50% below 7.5 m in length (Hoffmayer et al. 2005). Around Curaçao and Bonaire, most sightings have been of large animals (≥10 m), and the few available records related to solitary individuals (Debrot et al 2013). In the French West Indies, large individuals (<10m) are rarely observed in coastal and pelagic waters (< 5 observations recorded per year). To date, the species has not been observed in landings.

B. Article 19(3)(b) - Estimated Populations of Species and their Geographic Ranges

b.1. Size of Populations

13. Two global-scale studies on whale sharks have estimated genetic effective population size. Castro et al. (2007) estimated global genetic effective population size to be 119,000 – 238,000 sharks, while Schmidt et al. (2009) estimated global genetic effective population size to be approximately 103,000. An estimated 63% of whale sharks currently inhabit the Indo-Pacific, while 37% are thought to occur in the Atlantic (Yagishita et al. 2020).

14. McKinney et al (2017) identified 1,361 unique whale sharks from four distinct areas over the period 1999 to 2015 in the Wider Caribbean region: the Yucatan Peninsula, Mexico (n = 1,115); Honduras (n = 146); northern Gulf of Mexico, United States (n = 112), and Belize (n = 49). While 70 sharks were sighted in more than one area, the majority of resightings occurred in the area where the respective sharks were first identified. This was true for the WCA as a whole, with the exception of Belize. Site fidelity was highest in Mexico. Maximum likelihood modelling resulted in a population estimate of only 2,167 (95% c.i. 1585.21–2909.86) sharks throughout the study region. Updated numbers of identified sharks are 1,313 individuals from the Yucatan coast of Mexico (up to December 2019), 51 from Belize (up to October 2018), and 150 from Honduras (up to January 2020). Limited photo-identification work has been undertaken in the northern Gulf of Mexico, as this is a less accessible (offshore) population, although a large number of whale sharks can be seasonally present (Hoffmayer et al. 2005).

b.2. Evidence of Decline

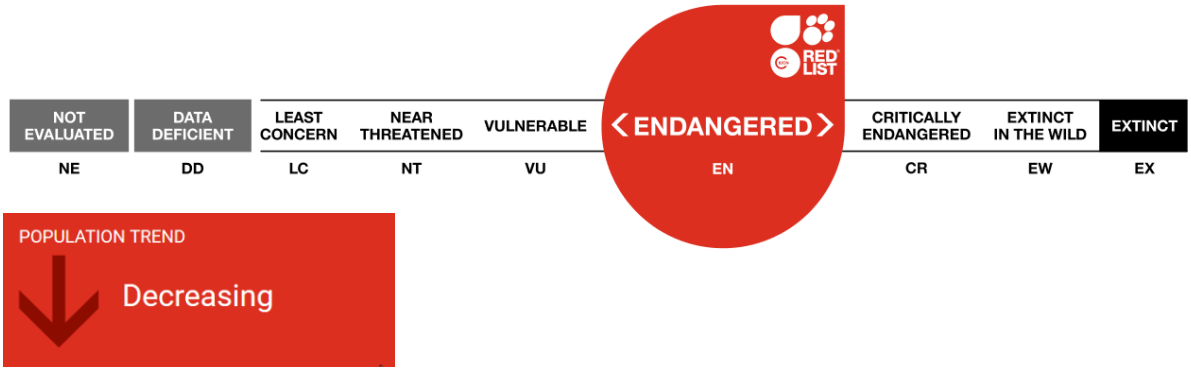


***Figure 2**. IUCN global status from https://www.iucnredlist.org/species/19488/2365291*

15. Overall, the global whale shark population was inferred to have declined by ≥50% over the last three generations (75 years), resulting in an Endangered global listing on the IUCN Red List (Pierce & Norman 2016).

16. The Atlantic subpopulation was provisionally assessed as Vulnerable during that process based on an inferred decline of ≥30% over the last three generations (75 years). This was 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. 2014). In absolute terms, sightings decreased from about 500 during the 1990s to around 150 during the 2000s. Peak-month sightings also declined by approximately 50% over this time (Sequeira et al. 2014). 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 through 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; Table 1 in the supplementary material). This was strongly correlated with the location of the 22°C isotherm, indicating that this increasing sighting trend is likely due to environmental conditions (Afonso et al. 2014).

17. Limited trend data are available from the Caribbean region, aside from the anecdotal data from Belize noted above. However, a recent global threat prioritisation exercise for whale sharks (Rowat et al. 2021) identified shipping traffic to be the primary contemporary threat to their global population, with the Gulf of Mexico explicitly noted as a high-risk area. A provisional IUCN Green Status assessment for whale sharks estimated the species' current Species Recovery Score to be only 29% of a possible 100% in a pre-impact population (Pierce et al. 2021a).

b.3. Restrictions on its Range of Distribution

18. Over their lifetimes, adult whale sharks migrate away from coastal areas and live, almost exclusively, in off-shelf oceanic habitats. They exhibit site fidelity to feeding and possibly to pupping and mating grounds.

b.4 Degree of Population Fragmentation

19. Whale sharks are divided into two different subpopulations – Atlantic and Indo-Pacific. Approximately 37% of the global population lives in the Atlantic and 63% lives in the Indo-Pacific (Yagishita et al 2020). Satellite-linked tagging shows that the Atlantic subpopulation routinely migrates across the boundaries of Belize, Brazil, Cuba, Honduras, and the United States. They have also been known to cross into the Southern

Hemisphere (Hueter et al. 2013). This indicates that there is likely to be some connectivity with populations in the equatorial mid-Atlantic islands, such as St Helena (Perry et al. 2020). The Indo-Pacific populations commonly migrate between Mozambique and South Africa in the Indian Ocean. They occasionally migrate between Mozambique, Madagascar, the Seychelles and Tanzania (Castro et al. 2007; Norman et al. 2017).

C. Article 19(3)(c) - Status of Legal Protection, with Reference to Relevant National Legislation or Regulation

c.1. Bahamas Honduras the BVI St Maarten and the Cayman Islands

20. In the Bahamas (2011), Honduras (2011), the British Virgin Islands (2014), St. Maarten (2016), and the Cayman Islands (2016) all sharks of the superorder Selachimorpha (which include the whale shark and related nurse shark) were declared legally protected when the new Island Nature Ordinance (AB. 2010, 15, Annex I) went into effect.

c.2. Belize

21. The recent Fisheries Resources Act No. 7 of 2020 states that no person shall fish or have in possession any of the species prescribed in the Schedule of the Act. Whale shark (Rhincodon typus) is listed.

c.3. Colombia

22. Through Resolution 1743 of 2017, among other actions, the exercise of industrial fishing directed at chondrichthyans is prohibited throughout the territory, allowing a percentage of incidental capture of up to 35%. Likewise, the use of steel wires in longlines, the modification of bait and the use of other unspecified methods that are aimed at attracting cartilaginous fish to fishing operations are prohibited.

23. The Whale shark is included in the Colombian red list of threatened marine fishes, as a species with deficient data, but it has a very high priority for conservation actions in the National Action Plan for Sharks, Rays and Chimaeras.

c.4. Kingdom of the Netherlands

24. In the Caribbean Netherlands, the whale shark has been protected in Bonaire since 2010 (Debrot et al 2013). With the establishment of the Yarari Sanctuary in all waters of Bonaire, St. Eustatius and Saba in 2015, whale sharks are fully protected in those waters.

c.5. Republic of France .

25. COUNCIL REGULATION (EU) 2022/109 of 27 January 2022 fixing for 2022 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in Union waters and for Union fishing vessels in certain non-Union waters prohibits EU vessels from fishing for, retaining or selling whale shark in all waters.

26. No species of shark or ray is protected under the Environmental Code in Guadeloupe and Saint-Martin. Only management measures for sea fishing exist at the local level, as presented below.

a. Recreational fishing

It is regulated by decree 971-2019-08-20-003 regulating the exercise of recreational sea fishing in Guadeloupe and Saint-Martin. Fishing for sharks and rays of all species is prohibited at all times and in all places.

b. Professional fishing

Professional sea fishing is governed by order 2002/1249 / PREF / SGAR / MAP of August 19, 2002 regulating coastal sea fishing in the waters of the Department of Guadeloupe (pj2). This decree also applies to St-Martin, which was still a municipality of Guadeloupe in 2002.

27. This text does not provide for any specific measure for Elasmobranchs.

c.6. United States

28. The United States manages the commercial and recreational harvest of sharks. Through its extensive regulations (e.g., permits, minimum sizes, quotas), the United States primarily coordinates the management of highly migratory species (HMS) fisheries in Federal waters (domestic) and the high seas (international), while individual states establish regulations for HMS in state waters. Under federal commercial and recreational fishing regulations, whale sharks are listed as a prohibited species. Under the Shark Conservation Act of 2010, the United States requires, with one exception, for all sharks to be landed with their fins naturally attached (81 FR 42285, June 29, 2016). Additionally, a number of U.S. states prohibit the sale or trade of shark fins (Somma, pers. comm.).

29. The United States has implemented domestic measures consistent with CITES to regulate trade in whale sharks. Any export from or import into the United States must be accompanied by the appropriate CITES documentation.

30. In addition, the United States has domestic regulations to implement all of the ICCAT provisions in ICCAT fisheries (50 CFR 635, August 29, 2011).

c.7 International protection status

31. The species was added to CITES (Convention on International Trade in Endangered Species) Appendix II in 2003. Appendix II listing aims to ensure that international trade does not threaten the survival of the species.

32. The Whale shark was listed on Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) in 2017. Contracting Parties to CMS should strictly protect species on Appendix I where they are a range state. Whale sharks are also listed on Annex I of the CMS Sharks MoU (2010).

33. The IUCN defines the Whale shark's global conservation status as 'Endangered' and its trend 'decreasing'.

D. Article 19(3)(d) - Ecological Interactions with Other Species and Specific Habitat Requirements

d.1 Migration

34. The whale shark is highly migratory. Within the Caribbean region, migratory behavior of whale sharks has been documented (Hueter et al., 2013; Hoffmayer et al. 2021). After remaining in the feeding area near Quintana Roo (Mexico) for approximately 24–33 days, with maximum residency up to about 6 months, individual sharks showed horizontal movements in multiple directions throughout the Gulf of Mexico basin, the northwestern Caribbean Sea, and the Straits of Florida. Individual sharks returning to the feeding area in subsequent years were common, with some animals returning for six consecutive years. One female shark moved at least 7,213 km in 150 days, traveling through the northern Caribbean Sea and across the equator to the South Atlantic Ocean, where her satellite tag popped up near the Mid-Atlantic Ridge (Hueter et al., 2013). Other authors have also reported seasonal, feeding-related whale shark migrations in the Caribbean region (Graham and Roberts, 2007; de la Parra et al., 2011; Hacohen-Domené et al., 2015).

35. Whale sharks are likely to be important transporters of nutrients from productive coastal waters (Rohner et al. 2018), and offshore frontal regions (Ryan et al. 2017; Ramírez-Macías et al. 2017), to nutrient-poor areas, such as most tropical oceanic habitats (Estes et al. 2016). Assessment of the whale sharks' contribution to ecosystem processes is at an early stage, but they are thought to contribute to the resilience of tropical marine systems, as modeled for the Yucatan coast of Mexico (Ibarra-García et al. 2017). Whale sharks are also closely associated with tuna in many areas (Fox et al. 2013; Escalle et al. 2016b; Fontes et al. 2020), which may represent a mutually-beneficial interaction with these important oceanic predators.

36. It is not known whether all components of the population(s) (adults, juveniles, males, females) undergo these migrations, but it is clear that the migratory sharks are shared by two or more nations, particularly in the WCR (Hueter et al. 2013; Hoffmayer et al. 2021). The broad movements of whale sharks observed to

cross multiple jurisdictional boundaries corroborate genetics data supporting gene flow between geographically distinct areas and underscores the need for management and conservation strategies for this species on a global scale.

E. Article 19(3)(e) - Management and Recovery Plans for Endangered and Threatened Species

e.1. Colombia

37. There is the "National Action Plan for the Conservation and Management of Sharks, Rays and Chimaeras of Colombia (PAN - Tiburones Colombia)", as the Policy instrument that establishes the guidelines for the conservation and sustainable management of the species of sharks, rays and chimaeras in the marine and continental waters of the country and for interactions with tourist and cultural activities and the different fisheries on artisanal and industrial scales. Its objectives include the following:

- Identify and evaluate the threats to the populations of sharks, rays and chimaeras in Colombia, associated with the extraction of individuals from their natural environment and the deterioration or modification of critical habitats.
- Determine and develop a regulatory and normative framework that allows the proper management and management of sharks, rays and chimaeras in Colombia.
- Structure and guide an efficient program for the surveillance and control of fishing or other activities that impact sharks, rays and chimaeras of marine and continental waters, by the competent entities.

e.2. Republic of France

38. Several ongoing projects :

- establishment of the list of species present,
- development of identification sheets on state of knowledge on biology,
- state of fishing activity on these species in Guadeloupe
- sensitization of marine stakeholders (via participatory sciences in particular via a network of observers), including the animation of a network of observers, the Reguar network
- identification of coastal nursery areas

39. One of the study projects, based on the use of baited cameras, was part of an international project that resulted in publication in the scientific journal Nature in 2020.

40. The improvement of knowledge on elasmobranchs aims to establish red lists of this group of species, a necessary prerequisite for the implementation of firm management measures at the national or local level. The intentions at the local level being to intervene on fishing regulations when the threat is linked to this activity, otherwise to set up protection under the environmental code when other threats are identified (disturbance of individuals, alteration of habitats…). The CSRPN of Guadeloupe has undertaken an initial analysis of candidate species for protection. The Kap Natirel association has issued recommendations for the management of these species in the Antilles.

41. The challenges of preserving Elasmobranchs in Guadeloupe have also been taken into account since 2017 in the fishery control plan and the preservation of the marine environment with clearly displayed dedicated objectives, on the proposal of the DEAL. The sea control services received theoretical training in the challenges of preserving Elasmobranchs and their identification, delivered by the Kap Natirel association alongside the DEAL.

e.3. Costa Rica

42. There is a "National Action Plan for the Conservation and Management of Sharks, Rays and Chimeras of Costa Rica (PAN - Tiburones Costa Rica)", as the Policy instrument that establishes the guidelines for the conservation and sustainable management of the species of sharks, rays and chimeras in the marine and continental waters of the country and for interactions with tourist and cultural activities and the different fisheries on artisanal and industrial scales. Its objectives include the following:

    i. Promote sustainable fishing to improve shark conservation.
    ii. Conduct scientific research to improve the understanding of the biology, ecology, and fisheries of shark populations, information that is needed for effective management and suitable fishing practices.
    iii. Improve coordination among key stakeholders.
    iv. Adjust the legal framework with the needs for sustainable fishing and conservation of shark species.
    v. Develop an international platform to support suitable fishing practices and shark conservation.
    vi. Prioritize, improve and expand coordination among local stakeholders and fishing/environmental institutions of Costa Rica.

e.4. United States

43. Data is limited on the population status of whale sharks. Because whale sharks have not been listed under the ESA, the United States has not developed a recovery plan.

F. Article 19(3)(g) - Threats to the Protected Species, their Habitats and their Associated Ecosystems, Especially Threats which Originate Outside the Jurisdiction of the Party

f.1. Direct threats to the populations

44. Whale sharks are often caught accidentally in large nets set for other species (Pierce and Norman 2016). While some are released alive, others are dead when found, or killed for their meat or fins, as noted in Venezuela (Sánchez et al. 2020). This is likely to occur across much of their distribution, with frequent reports coming from gillnet fisheries. Whale sharks are a common bycatch in tuna purse-seine fisheries (Clarke 2015; Román et al. 2018). The sharks, which are often associated with tuna in oceanic waters, are encircled in huge nets along with the tuna species that are the intended catch. While the whale sharks are usually released, a few are accidentally killed (Clarke 2015; Román et al. 2018), although more recent application of safe release practices appears to minimize at least short-term mortality (Capietto et al. 2014; Escalle et al. 2016a, 2018). Where poor release practices are used, though, such as lifting the sharks from the water by their tails or leaving ropes attached to the sharks following release, longer-term mortality may still be an issue. An expert survey estimated a 10% post-release mortality rate in the Western Central Pacific, although uncertainty was large (Neubauer et al. 2018).

f.2 Fisheries and international trade

45. The whale shark is hunted or has been hunted for its fins and meat in several places in Asia (India, Pakistan, China, Indonesia, Philippines, Taiwan, Japan, Maldives and elsewhere). In the Caribbean, the whale shark has reportedly occasionally been fished in Venezuela (Gines, 1972, as cited in Sturm, 1991) and in Mexico (Bonfil, 1997). There are recent reports of whale sharks caught in Venezuela.

46. Also of note is that whale shark gill plate products have been increasingly encountered at Asian fish markets, raising the issue of whether whale shark gills are now also entering trade because of a specific demand, or their occurrence is simply an attempt at surreptitious substitution for mobulid gills (Steinke et al., 2017).

47. The numbers of whale sharks incidentally captured in tuna purse seine or gillnet fisheries, are believed to have a more significant population-level impact than targeted fisheries (Pierce & Norman 2016). There is

the possibility of IUU high seas captures in tuna fisheries that may impact on the WCR population (Graham 2003). Surveys have indicated that whale shark fins demand high prices, which could lead to increased targeted fisheries and trade (Li et al. 2012; Steinke et al., 2017).

48. Furthermore, the perceived value of whale shark fins for display purposes appears to have increased over the years, and there have been reports of live individuals being finned in the Maldives (Riley et al., 2009). It is not known to what degree hunting in one area affects population(s) in other areas, although the fact that the sharks migrate both short and long distances suggests that the effects may not be purely local (Hueter et al., 2013).

49. Overfishing of the spawning fish species may also have reduced the attraction of some locations for whale sharks, since they are known to feed on fish eggs (Graham, pers comm).

f.3 Habitat destruction and pollution

50. Whale sharks may seasonally frequent more inshore areas near estuaries and river mouths. These waters are highly vulnerable to contamination with sewage and industrial effluent and alteration due to human activities.

51. The Deepwater Horizon oil spill in 2010 in the northern Gulf of Mexico affected a known whale shark habitat (Campagna et al. 2011; Frias-Torres and Bostater 2011), potentially causing mortalities or changes in movement behavior (Hueter et al. 2013). 'Red tides,' caused by toxic blooms of *Karenia* spp. dinoflagellates, are associated with nutrient run-off and are increasing in frequency along the southern US coast (Brand and Compton 2007). These often result in shark kills (Flewelling et al. 2010), among many other marine species, and the first probable whale shark mortality from this cause was reported in Florida in 2018 (Furby 2018). Plastic pollution is a significant, ubiquitous threat to ocean health, and filter-feeding elasmobranchs are particularly vulnerable (Fossi et al 2017; Germanov et al. 2018). Whale sharks can accidentally ingest large quantities of microplastics while feeding in some areas, with up to ~137 pieces per hour reported from Java in Indonesia (Germanov et al. 2019). Whale shark mortalities from plastic ingestion have been reported from Japan (Matsumoto et al. 2017), Malaysia (Lee 2019), the Philippines (Abreo et al. 2019), and Thailand (Haetrakul et al. 2009), and a variety of other sublethal effects are possible, such as endocrine disruption or toxicosis (Germanov et al. 2018). Entanglement, particularly in discarded or lost fishing gear, is also a likely source of mortality (Wilcox et al. 2016; Parton et al. 2019).

f.4 Vessel strikes

52. Whale sharks are exposed to the threat of vessel strikes due to their frequent surface feeding behaviour. Rapid increases in both the speed and quantity of marine traffic means that mortality from ship strikes has probably supplanted fisheries as the main contemporary threat to whale sharks through much of their distribution (Pierce et al. 2021a; Rowat et al. 2021). Direct records of mortality are rare, as the sharks sink if killed, but the frequency of injuries from small and large vessels seen in live whale sharks (e.g., Ramírez-Macías et al. 2012; Fox et al. 2013) suggests a high prevalence of ship strikes in some areas of the Caribbean. These documented injuries are likely to be the 'tip of the iceberg' in terms of the real mortality risk, as whale sharks are unlikely to survive propeller or impact wounds from large vessels.

53. However, the total scope of this issue remains largely unexplored. The increase in cruise ship traffic in the WCR may have exposed the population to greater threats of vessel strike.

f.5 Tourism

54. Whale shark tourism is growing in popularity. Six weeks of whale shark tourism in Belize was estimated to be worth US$3.7 million to the country (Graham 2003).

55. Tourism activities may increase the risk of vessel strikes, local disturbance from interference, crowding or provisioning. Too much anthropogenic disturbance of whale sharks or their spawning fish prey, despite restrictions on boats and dive depths, might deter whale sharks,and spawning fish from sites (Graham, pers. comm.) The fish might spawn in deeper water, which may impact the survival of fertilized eggs, which are food items for whale sharks. Research to date suggests that in areas with large numbers of boats and swimmers sharks may be subjected to disturbance that prevents them from behaving as they would naturally (Quiros, 2007, Haskell et al. 2014, Araujo et al. 2017). Recent work on Mexican whale sharks suggests that foraging bouts generally last several hours (Cade et al 2020), and that interruptions to foraging during critical feeding periods may represent a substantial energetic cost.

f.6 Climate change

56. Climate change might have adverse effects on prey availability, ocean acidification and currents. Whale sharks are ectothermic and therefore need to thermoregulate their body temperature depending on their outer environment. For example, they may return to warm surface waters after deep dives into colder water (Thums et al. 2013), or alternatively move into deeper, cooler waters after feeding in the warm surface layer (Robinson et al. 2017, Araujo et al. 2020). It is likely, therefore, that temperature change in future will influence the vertical movements of the species. The potential impacts of ocean warming may

result in a broadening of the range of whale sharks into waters that were previously too cold for regular use. Already there have been sightings of whale sharks in 'new' locations such as the Azores and mainland Portugal, significantly further north in the Atlantic than they were known to occur previously, suggesting a possible range expansion (Afonso et al. 2014). Warming seas may also lead to range contraction if the species' upper thermal tolerance is reached, without a cooler depth refuge as offered by the Arabian Gulf (Robinson et al. 2017). Climate change species distribution modelling, which is a technique based on extrapolating modelled habitat suitability into future oceans, has suggested that we may see a slight shift of suitable whale shark habitat towards the poles as a response to changes in sea surface temperature, accompanied by an overall range contraction (Sequeira et al. 2014).

III. Conclusion

57. As developed in section 1 of the document, the listing of species is to be justified based on a variety of criteria set out in the Revised criteria for the listing of species in the Annexes of the SPAW Protocol.

58. In particular, regarding the evidence of decline (criterion #1 in the guidelines) "the scientific evaluation of the threatened or endangered status of the proposed species is to be based on the following factors: size of populations, evidence of decline, restrictions on its range of distribution, degree of population fragmentation, biology and behavior of the species, as well as other aspects of population dynamics, other conditions clearly increasing the vulnerability of the species, and the importance of the species to the maintenance of fragile or vulnerable ecosystems and habitats". Criterion #2 states that: "When evaluation of the factors enumerated above clearly indicates that a species is threatened or endangered, the lack of full scientific certainty about the exact status of the species is not to prevent the listing of the species on the appropriate annex". Criterion #4 states the importance of considering the IUCN red list listing for the Caribbean region, criterion #5 the interest of alignment with CITES and other international instruments and criterion #6 the importance and usefulness of regional cooperative efforts on the protection and recovery of the species.

59. Whale sharks are listed as Endangered globally on the IUCN Red List (criterion #4). and have been listed on Annex III of the SPAW Protocol since 2017 (Criterion #8). They are mainly threatened by fisheries, international trade, vessel strikes and climate change. In particular, their populations are highly vulnerable to decline because of their slow growth, longevity, and delayed maturation (criterion #1) and considering they are highly migratory, are very susceptible to benefit from collaborative regional efforts (criterion #6). . For these reasons, they have been protected though several international agreements (criterion #5) and

sometimes national legislation but still insufficiently as they are estimated to have declined by 50% over the last three generations (75 years) (criterion #1).

60. This species meet all the relevant criteria to justify uplisting to Annex II and that it is a necessity to increase the regional protection of this species and its habitats considering current trends, scientific acknowledgement of global decline, important vulnerability to threats and the endangered status (IUCN) of the species.

61. France and Netherlands are convinced that uplisting is necessary to bring national conservation efforts of various Caribbean Nations to the right level.

Annex 1: Acknowledgments

Twan Stoffers, Independent expert (sharks), Fish Ecologist, Wageningen University and Research

Andrea Pauly, Associate Programme Management Officer, Coordinator Sharks MOU

†Paul Hoetjes, Nature Conservation Policy Advisor at Dutch Ministry of Agriculture, Nature and Food Quality, Netherlands

Irene Kingma, Program Lead Nature and Sustainable Food at Stichting De Noordzee

Susan Millward, Director, Marine Animal Program at Animal Welfare Institute

Heins Bent-Hooker Directorate of Marine, Coastal and Aquatic Resources Affairs, Ministry of Environment, Colombia

Julia Horrocks, Professor, University of the West Indies (UWI) Cave Hill Campus, Barbados.

Jean Vermot SPAW Focal Point and European and International Coordinator Marine Environment, Ministry for an Ecological Transition, France

Elisabeth Fries, Former Support officer SPAW-RAC

Sandrine Pivard, Former Executive Director, SPAW-RAC

with the contribution of :

Jim Ellis, Managing Director at Compass Marine and Offshore

Océane Beaufort, French West Indies sharks network coordinator / Environmental consultant

Simon Pierce, Principal Scientist at the Marine Megafauna Foundation; Wildlife Photographer & Writer at Nature Tripper Magazine

Mario Espinosa, Professor/Researcher at Universidad de Costa Rica

Gonzalo Araujo, Executive director for the Large Marine Vertebrates Research Institute Philippines

References

Abreo, N. A. S., Blatchley, D., & Superio, M. D. (2019). Stranded whale shark (*Rhincodon typus*) reveals vulnerability of filter-feeding elasmobranchs to marine litter in the Philippines. *Marine Pollution Bulletin* 141:79–83.

Afonso, P., McGinty, N., & Machete, M. (2014). Dynamics of whale shark occurrence at their fringe oceanic habitat. *PloS One* 9:e102060.

Araujo, G., Vivier, F., Labaja, J. J., et al. (2017). Assessing the impacts of tourism on the world's largest fish *Rhincodon typus* at Panaon Island, Southern Leyte, Philippines. *Aquatic Conservation: Marine and Freshwater Ecosystems* 27:986–994.

Araujo, G., Labaja, J., Snow, S., et al. (2020). Changes in diving behaviour and habitat use of provisioned whale sharks: Implications for management. *Scientific Reports* 10:16951.

Bonfil, R. (1997). Trends and patterns in world and Asian elasmobranch fisheries. In Elasmobranch biodiversity, conservation and management: Proceedings of the International Seminar and Workshop, Sabah, Malaysia (pp. 15-24).

Brand, L. E., & Compton, A. (2007). Long-term increase in *Karenia brevis* abundance along the southwest Florida coast. *Harmful Algae* 6:232–52.

Cade, D. E., Levenson, J. J., Cooper, R., de la Parra, R., Webb, D. H., & Dove, A. D.M. (2020). Whale sharks increase swimming effort while filter feeding, but appear to maintain high foraging efficiencies. *Journal of Experimental Biology* 223:jeb224402.

Campagna, C., Short, F. T. Polidoro, B. A. et al. (2011). Gulf of Mexico oil blowout increases risks to globally threatened species. *Bioscience* 61:393–97.

Capietto, A., Escalle, L., Chavance, P., et al. (2014). Mortality of marine megafauna induced by fisheries: Insights from the whale shark, the world's largest fish. *Biological Conservation,* 174:147–51.

Castro, A. L. F., Stewart, B. S., Wilson, S. G., Hueter, R. E., Meekan, M. G., Motta, P. J., & Karl, S. A. (2007). Population genetic structure of Earth's largest fish, the whale shark (Rhincodon typus). Molecular Ecology, 16(24), 5183-5192.

Chen Che-Tsung, Liu Kwang-Ming and Joung Shoou-Jeng. 1998. Preliminary report on Taiwan's whale shark fishery. TRAFFIC East Asia, Taipei.

Clarke, S. (2015). Understanding and mitigating impacts to whale sharks in purse seine fisheries of the Western and Central Pacific Ocean. Western and Central Pacific Fisheries Commission. WCPFCSC11-2015/EB-WP-03 Rev. 1. Pohnpei, Federated States of Micronesia.

Debrot, A. O., De Leon, R., Esteban, N., & Meesters, H. W. G. (2013). Observations on the whale shark (Rhincodon typus) in the Dutch Caribbean. *Caribbean Journal of Science*, 47(2–3), 344-349.

De la Parra Venegas, R., Hueter, R., Cano, J. G., Tyminski, J., Remolina, J. G., Maslanka, M., & Dove, A. (2011). An unprecedented aggregation of whale sharks, Rhincodon typus, in Mexican coastal waters of the Caribbean Sea. PLoS One, 6(4).

Escalle, L. H., Murua, J. M., Amande, et al. (2016a). Post-capture survival of whale sharks encircled in tuna purse-seine nets: Tagging and safe release methods. *Aquatic Conservation: Marine and Freshwater Ecosystems* 26:782–89.

Escalle, L., Pennino, M. G., Gaertner, D., et al. (2016b). Environmental factors and megafauna spatio-temporal co-occurrence with purse-seine fisheries. *Fisheries Oceanography* 25:433–47.

Estes, J. A., Heithaus, M., McCauley, D. J., Rasher, D. B., & Worm, B. (2016). Megafaunal impacts on structure and function of ocean ecosystems. *Annual Review of Environment and Resources,* 41:83–116.

Flewelling, L. J., Adams, D. H., Naar, J. P. et al. (2010). Brevetoxins in sharks and rays (Chondrichthyes, Elasmobranchii) from Florida coastal waters. *Marine Biology* 157:1937–53.

Fontes, J., McGinty, N., Machete, M., & Afonso, P. (2020). Whale shark-tuna associations, insights from a small pole-and-line fishery from the mid-North Atlantic. *Fisheries Research,* 229:105598.

Fossi, M. C., Baini, M., Panti, C., Galli, M., Jiménez, B., Muñoz-Arnanz, J., & Ramírez-Macías, D. (2017). Are whale sharks exposed to persistent organic pollutants and plastic pollution in the Gulf of California (Mexico)? First ecotoxicological investigation using skin biopsies. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, *199*, 48-58.

Fox, S., Foisy, I., De La Parra Venegas, R., Galván Pastoriza, B. E., Graham, R. T., Hoffmayer, E. R., & Pierce, S. J. (2013). Population structure and residency of whale sharks Rhincodon typus at Utila, Bay Islands, Honduras. *Journal of fish biology*, *83*(3), 574-587.

Frias-Torres, S., & Bostater Jr., C. R. (2011). Potential impacts of the Deepwater Horizon oil spill on large pelagic fishes. In *Remote Sensing of the Ocean, Sea Ice, Coastal Waters, and Large Water Regions 2011*, 8175:81750F. International Society for Optics and Photonics.

Furby, K. (2018). A red tide ravaging Florida may have killed a whale shark for the first known time. *The Washington Post*, https://www.washingtonpost.com/news/speaking-of-science/wp/2018/08/03/a-red-tide-ravaging-florida-may-have-killed-a-whale-shark-for-the-first-known-time/ (accessed November 17, 2020).

Germanov, E. S., Marshall, A. D., Bejder, L., et al. (2018). Microplastics: No small problem for filter-feeding megafauna. *Trends in Ecology & Evolution,* 33:227–32.

Germanov, E. S., Marshall, A. D., Hendrawan, I. G., et al. (2019). Microplastics on the menu: Plastics pollute Indonesian manta ray and whale shark feeding grounds. *Frontiers in Marine Science* 6:679.

Gines, H. (1972). Carta pesquera de Venezuela. 1. Areas del Noriente y Guayana. Monografia 16. Fund La Salle de Ciencias Naturales. Caracas. 328 pp.

Graham, R.T. (2003). Behaviour and conservation of whale sharks on the Belize Barrier Reef. PhD thesis, University of York, York. 401pp.

Graham, R.T., & Roberts, C.M. (2007). Assessing the size growth rate and structure of a seasonal population of whale sharks (*Rhincodon typus* Smith 1828) using conventional tagging and photo identification. *Fisheries Research,* 84: 71-80.

Graham, R.T. (2007). Whale sharks of the western Caribbean: an overview of current research and conservation efforts and future needs for effective management of the species. *Gulf and Caribbean Research*, *19*(2), 149-159.

Graham, R. T., & Roberts, C. M. (2007). Assessing the size, growth rate and structure of a seasonal population of whale sharks (Rhincodon typus Smith 1828) using conventional tagging and photo identification, *Fisheries Research*, Volume 84, Issue 1, 2007,pPp 71-80.

Hacohen-Domené, A., Martínez-Rincón, R. O., Galván-Magaña, F., Cárdenas-Palomo, N., de la Parra-Venegas, R., Galván-Pastoriza, B., & Dove, A. D. (2015). Habitat suitability and environmental factors affecting whale shark (Rhincodon typus) aggregations in the Mexican Caribbean. *Environmental biology of fishes*, 98(8), 1953-1964.

Haetrakul, T., Munanansup, S., Assawawongkasem, N., & Chansue, N. (2009). A case report: Stomach foreign object in whaleshark (*Rhincodon typus*) stranded in Thailand. *Proceedings of the 4th International Symposium on SEASTAR 2000 and Asian Bio-Logging Science (The 8th SEASTAR 2000 Workshop)*:83–85.

Haskell, P. J., McGowan, A., Westling, A., et al. (2014). Monitoring the effects of tourism on whale shark *Rhincodon typus* behaviour in Mozambique. *Oryx* 49:492–99.

Hoffmayer, E. R., Franks, J. S., & Shelley, J. P. (2005). Recent observations of the whale shark (Rhincodon typus) in the northcentral Gulf of Mexico. *Gulf and Caribbean Research*, 17(1), 117-120.

Hoffmayer, E., McKinney, J., Franks, J., Hendon, J., Driggers, W., Falterman, B., Galuardi, B. & Byrne, M. (2021). Seasonal Occurrence, Horizontal Movements, and Habitat Use Patterns of Whale Sharks (Rhincodon typus) in the Gulf of Mexico. *Frontiers in Marine Science*. 7. 10.3389/fmars.2020.598515.

Hueter, R. E., Tyminski, J. P., & de la Parra, R. (2013). Horizontal movements, migration patterns, and population structure of whale sharks in the Gulf of Mexico and northwestern Caribbean Sea. *PLoS One*, 8(8).

Ibarra-García, E. C., Ortiz, M., Ríos-Jara, E., Cupul-Magaña, A. L., Hernández-Flores, Á., & Rodríguez-Zaragoza, F. A. (2017). The functional trophic role of whale shark (*Rhincodon typus*) in the northern Mexican Caribbean: Network analysis and ecosystem development. *Hydrobiologia* 792:121–35.

Joung, S-J., Chen, C-T., Clark, E., Uchida, S., & Huang, W. Y. P. (1996). The whale shark, Rhincodon typus, is a livebearer: 300 embryos found in one 'megamamma' supreme. *Environmental Biology of Fishes,* 46:219–23.

Lee, S. (2019). Plastic bag causes death of whale shark in Sabah. https://www.thestar.com.my/news/nation/2019/02/08/plastic-bag-causes-death-of-whale-shark-in-sabah/ (accessed January 5, 2021).

Li, W., Wang, Y., & Norman, B. (2012). A preliminary survey of whale shark Rhincodon typus catch and trade in China: an emerging crisis. *Journal of Fish Biology*, *80*(5), 1608-1618.

Matsumoto, R., M. Toda, Y. Matsumoto, et al. (2017). Notes on husbandry of whale sharks, *Rhincodon typus*, in aquaria. In *The elasmobranch husbandry* manual II: Recent advances in the care of sharks, rays and their relatives, ed. Smith, M., D. Warmolts, D. Thoney, R. Hueter, M. Murray, and J. Ezcurra, 15–22. Columbus: Special Publication of the Ohio Biological Survey.

McClain, C.R., Balk, M.A., Benfield, M.C., Branch, T.A., Chen, C., Cosgrove, J., Dove, A.D., Gaskins, L.C., Helm, R.R., Hochberg, F.G. and Lee, F.B., (2015). Sizing ocean giants: patterns of intraspecific size variation in marine megafauna. PeerJ, 3, p.e715.McKinney, J.A. Hoffmayer, E.R., Holmberg, J., Graham, R. T., Driggers, W.B., de la Parra-Venegas, R., Galvan-Pastoriza, B.E.,Fox, S., Pierce, S.J., & Dove, A.D.M. (2017). Long term assessment of whale shark population demography and connectivity using photo-identification in the Western Atlantic Ocean. *PLoS One* 12(8): e0180495

Meekan, M. G., B. M. Taylor, E. Lester, et al. (2020). Asymptotic growth of whale sharks suggests sex-specific life-history strategies. *Frontiers in Marine Science* 7:774.

Mckinney, J., Hoffmayer, E., Wu, W., Fulford, R., & Hendon, J. (2012). Feeding habitat of the whale shark Rhincodon typus in the northern Gulf of Mexico determined using species distribution modelling. *Marine Ecology Progress Series*. 458. 199-211. 10.3354/meps09777.

McKinney, J.A., Hoffmayer, E.R., Holmberg, J., Graham, R.T., Driggers, W.B. 3rd, de la Parra-Venegas, R., Galván-Pastoriza, B.E., Fox, S., Pierce, S.J., & Dove, A.D.M., (2017). Long-term assessment of whale shark population demography and connectivity using photo-identification in the Western Atlantic Ocean. *PLoS One*. 17;12(8):e0180495. doi: 10.1371/journal.pone.0180495. PMID: 28817569; PMCID: PMC5560665.

Motta, P.J., Maslanka, M., Hueter, R.E., Davis, R.L., De la Parra, R., Mulvany, S.L., Habegger, M.L., Strother, J.A., Mara, K.R., Gardiner, J.M. & Tyminski, J.P., (2010). Feeding anatomy, filter-feeding rate, and diet of whale sharks Rhincodon typus during surface ram filter feeding off the Yucatan Peninsula, Mexico. *Zoology*, *113*(4), pp.199-212.

Neubauer, P., Richard, Y., & Clarke, S. (2018). Risk to the Indo-Pacific Ocean whale shark population from interactions with Pacific Ocean purse-seine fisheries. WCPFC-SC14-2018/SA-WP-12 (rev. 2). Western and Central Pacific Fisheries Commission.

Norman, B. M., Holmberg, J. A., Arzoumanian, Z., Reynolds, S. D., Wilson, R. P., Rob, D., Pierce, S. J., Gleiss, A. C., de la Parra, R., Galvan, B., Ramirez-Macias, D., Robinson, D., Fox, S., Graham, R., Rowat, D., Potenski, M., Levine, M., Mckinney, J. A., Hoffmayer, E., Dove, A. D. M., Hueter, R., Ponzo, A., Araujo, G., Aca, E., David, D., Rees, R., Duncan, A., Rohner, C. A., Prebble C. E. M., Hearn A., Acuna, D., Berumen, M. L., Vázquez, A., Green, J., Bach, S.S., Schmidt, J.V., Beatty, S.J., Morgan, D.L. (2017). Undersea Constellations: The Global Biology of an Endangered Marine Megavertebrate Further Informed through Citizen Science, *BioScience*, Volume 67, Issue 12, Pages 1029–1043, https://doi.org/10.1093/biosci/bix127

Ong, J. J. L., Meekan, M. G., Hsu, H. H., Fanning, L. P., & Campana, S. E. (2020). Annual bands in vertebrae validated by bomb radiocarbon assays provide estimates of age and growth of whale sharks. *Frontiers in Marine Science,* 7:188.

Parton, K. J., Galloway, T. S., & Godley, B. J. (2019). Global review of shark and ray entanglement in anthropogenic marine debris. *Endangered Species Research,* 39:173–90.

Perry, C. T., E., Clingham, D. H., Webb, et al. (2020). St. Helena: An important reproductive habitat for whale sharks (*Rhincodon typus*) in the south central Atlantic. *Frontiers in Marine Science,* 7:899.

Perry, C. T., Figueiredo, J., Vaudo, J. J., Hancock, J., Rees, R., & Shivji, M. (2018). Comparing length-measurement methods and estimating growth parameters of free-swimming whale sharks (Rhincodon typus) near the South Ari Atoll, Maldives. *Marine and Freshwater Research,* 69:1487–95.

Pierce, S.J., & Norman, B. (2016). *Rhincodon typus*. *The IUCN Red List of Threatened Species* 2016

Pierce, S. J., Grace, M. K., & Araujo, G. (2021a). Whale shark conservation. In *Whale Sharks: Biology, Ecology, & Conservation*. Taylor & Francis.

Pierce, S. J., Pardo, S. A., Rohner, C. A., Matsumoto, R., Murakumo, K., Nozu, R., Dove, A. D. M., & Meekan, M. G. (2021b). Whale shark reproduction, growth, and demography. In *Whale Sharks: Biology, Ecology, & Conservation*. Taylor & Francis.

Quiros, A. L. (2007). Tourist compliance to a code of conduct and the resulting effects on whale shark (*Rhincodon typus*) behavior in Donsol, Philippines. *Fisheries Research,* 84:102–08.

Ramírez-Macías, D., M., Meekan, R., De La Parra-Venegas, F., Remolina-Suárez, M., Trigo-Mendoza, & R., Vázquez-Juárez. (2012). Patterns in composition, abundance and scarring of whale sharks Rhincodon typus near Holbox Island, Mexico. *Journal of Fish Biology,* 80:1401–16.

Ramírez-Macías, D., N. Queiroz, S. J., Pierce, N. E., Humphries, D. W., Sims, J. & Brunnschweiler, M. (2017). Oceanic adults, coastal juveniles: Tracking the habitat use of whale sharks off the Pacific coast of Mexico. PeerJ 5:e3271

Riley, M. J., Harman, A., & Rees, R. G. (2009). Evidence of continued hunting of whale sharks Rhincodon typus in the Maldives. *Environmental Biology of Fishes*, *86*(3), 371.

Robinson, D. P., Jaidah, M. Y., Bach, S., et al. (2017). Some like it hot: Repeat migration and residency of whale sharks within an extreme natural environment. *PloS One* 12:e0185360.

Rohner, C., Norman, B., Reynolds, S., Araujo, G., Holmberg, J., & Pierce, S. (2021). Population ecology of whale sharks. In *Whale Sharks: Biology, Ecology, & Conservation*. Taylor & Francis.

Rohner, C. A., Richardson, A. J., Jaine, F. R. A., et al. (2018). Satellite tagging highlights the importance of productive Mozambican coastal waters to the ecology and conservation of whale sharks. PeerJ 2018:e4161.

Román, M. H., Aires-Da-Silva, A., & Vogel, N. W. (2018). Whale shark interactions with the tuna purse-seine fishery in the Eastern Pacific Ocean: Summary and analysis of available data. BYC-08 INF-A. Inter-American Tropical Tuna Commission.

Romero, A., Agudo, A. I., & Salazar, C. (2000). Whale shark records and conservation status in Venezuela. *Biodiversity,* 3(1):11-15

Rowat, D., & Brooks, K. S. (2012). A review of the biology, fisheries and conservation of the whale shark Rhincodon typus. *Journal of fish biology*, 80(5), 1019-1056.

Rowat, D., Womersley, F., Norman, B. M., & Pierce, S. J. (2021). Human threats to whale sharks. In *Whale Sharks: Biology, Ecology, & Conservation*. Taylor & Francis.

Ryan, J. P., Green, J. R., Espinoza, E., & Hearn, A. R. (2017). Association of whale sharks (*Rhincodon typus*) with thermo-biological frontal systems of the eastern tropical Pacific. *PloS One* 12:1–22.

Sánchez, L., Briceño Y., Tavares R., Ramírez-Macías D., and Rodríguez J. P. (2020). "Decline of Whale Shark Deaths Documented by Citizen Scientist Network along the Venezuelan Caribbean Coast." Oryx: *The Journal of the Fauna Preservation Society,* 54 (5): 600–601.

Sequeira, A. M., Mellin, C., Meekan, M. G., Sims, D. W., & Bradshaw, C. J. (2013). Inferred global connectivity of whale shark Rhincodon typus populations. *Journal of Fish Biology*, *82*(2), 367-389.

Sequeira, A. M., Mellin, C., Fordham, D. A., Meekan, M. G., & Bradshaw, C. J. (2014). Predicting current and future global distributions of whale sharks. *Global Change Biology*, *20*(3), 778-789.

Schmidt, J. V., Schmidt, C. L., Ozer, F., Ernst, R. E., Feldheim, K. A., Ashley, M. V., & Levine, M. (2009). Low genetic differentiation across three major ocean populations of the whale shark, Rhincodon typus. *PloS one*, 4(4).

Steinke, D., Bernard, A. M., Horn, R. L., Hilton, P., Hanner, R., & Shivji, M. S. (2017). DNA analysis of traded shark fins and mobulid gill plates reveals a high proportion of species of conservation concern. *Scientific reports*, 7(1), 1-6.

Sturm, M. L. (1991). The living resources of the Caribbean Sea and adjacent regions. *Caribbean marine studies. Carenage*, *2*(1), 18-44.

Thums, M., Meekan, M. G., Stevens, J. D., et al. (2013). Evidence for behavioural thermoregulation by the world's largest fish. *Journal of the Royal Society Interface* 10:20120477.

Tyminski, J.P., de la Parra-Venegas, R., González, Cano, J. & Hueter, R.E., (2015). Vertical movements and patterns in diving behavior of whale sharks as revealed by pop-up satellite tags in the eastern Gulf of Mexico. *PloS one*, 10(11), p.e0142156.

Wilcox, C., N. J. Mallos, G. H. Leonard, et al. (2016). Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife. *Marine Policy* 65:107–14.

World Conservation Monitoring Centre, IUCN. (1998). Species under threat. Whale shark - Rhincodon typus Smith, 1828. Internet Website.

Yagishita, N., Ikeguchi, S.I. and Matsumoto, R., (2020). Re-Estimation of Genetic Population Structure and Demographic History of the Whale Shark (*Rhincodon typus*) with Additional Japanese Samples, Inferred from Mitochondrial DNA Sequences. *Pacific Science*, 74(1), pp.31-47.