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Assessment of the whale shark as a key shark species

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Summary

The whale shark (*Rhincodon typus*) has been the focus of considerable discussion within the WCPF Commission in recent years and two separate proposals relating to reducing fishery impacts on whale sharks were considered at WCPFC8 in March 2012. During this meeting the development of a stock assessment for whale sharks was suggested, but it was concluded that the adoption of a criteria for the determination of key shark species, provided the best procedure to assess the risks to whale sharks and its importance relative to other shark species taken in WCPO fisheries.

In this paper we have summarized some basic scientific understanding of whale sharks and evaluated it against the criteria adopted by the Commission at WCPFC8. Whilst there is a paucity of biological studies on whale sharks, it is likely that this species is very long lived and has a late age at maturity which would make the species vulnerable to fishing-related mortality.

Observer records clearly demonstrate impacts by WCPFC tuna fisheries, but it is also likely that there are other tuna-fishery related interactions for which we currently do not have observer records. An important consideration for whale shark is the significant non-tuna related fishing mortality that is likely to have occurred historically, particularly in the coastal waters of the northwest Pacific Ocean.

Given the very high levels of observer coverage in the tropical purse seine fishery, and the ease of identification of whale sharks, it should be feasible to estimate CPUE which may reflect the abundance for a significant component of the stock. Therefore, we conclude that it meets the criteria for consideration as a key shark species and recommend that the Scientific Committee consider this, and the relatively importance of further work on this species relative to other already defined key shark species.

1. Background

The whale shark (*Rhincodon typus*) is the world's largest fish and, while there is a paucity of biological studies, it is thought to be one of the latest maturing and longest living animals on earth. While they have potentially the highest fecundity of all the worlds sharks (Joung et al. 1996) this is countered by estimates of age at maturity around 30 years (Taylor 1994) and size at maturity over 8m (Norman 1999). While these later estimates are uncertain, and in fact there is limited evidence to accurately determine age, growth, and maturity of wild whale sharks (Wintner 2000), it is concluded that they are likely to be a species with low population growth (Colman 1997) and therefore be vulnerable to fishing-related mortality.

OFP (2012) provides a summary of available information on purse seine interactions with whale sharks based on observer data. Observer data is restricted in its coverage of the WCPO purse seine fishery with no coverage for the within EEZ fisheries in Indonesia and the Philippines nor the Japanese purse seine fisheries that operate in the North. Nevertheless there is clear evidence of whale shark interactions in the tropical purse seine fishery through either 1) the direct targeting of tunas that are found in association with whale sharks

(though not all of these sets conclude with encirclement of the whale shark), and 2) through interactions (whale shark encircled) that often occur when whale sharks were not observed prior to the set taking place.

Over 200 whale shark targeted sets were observed over the period 2007-2009 representing five in every 1000 sets made (OFP 2012). Eighty of these sets resulted in whale shark interactions covering 107 individuals. A larger number of whale shark interactions were coincident with unassociated set types (173 sets representing 229 individuals) indicating that the vessel did not know of the whale sharks presence prior to the set. A total of 397 interactions were observed over the period 2007-2010. Estimated mortality (scaled to total effort) from the tropical purse seine fishery is 75 individuals over the period 2007-2010 and this does not include whale sharks that may have died as a result of their interaction.

Tuna fisheries are by no means the sole source of fishing related mortality on whale sharks. Non-tuna related fisheries interactions, and in fact directed fisheries, are well documented from the waters of the western and central Pacific Ocean (Chen 1997, Chen et al. 2002, CITES 2000) so it is likely that there are (or have been as many countries have now banded direct fisheries) other impacts on this population outside the WCPFC tuna fisheries.

There have been recent moves within the WCPFC with respect to protection of whale sharks. The Parties to the Nauru Agreement (PNA), through the Third Implementing Arrangement (3IA; PNA 2010), passed a measure that no purse seine vessel shall engage in fishing or related activity in order to catch tuna associated with whale sharks (*Rhincodon typus*).

More broadly, concerns about the potential status of the whale shark and the potential impacts of WCPFC tuna fisheries have been discussed on many occasions with the WCPFC, most recently during the Eighth Regular Session of the Commission in March 2012. The Commission considered two proposals relating to guidelines for safe handling and release² as well as a specific measure relating to whale shark interactions in the purse seine fishery³. Neither proposal was adopted at WCPFC8, but it was agreed that these would be further considered through the subsidiary bodies and revisited at WCPFC9 in December 2012.

During discussions at WCPFC8, one CCM specifically requested that a whale shark stock assessment be undertaken, however, other CCMs noted that decisions to conduct stock assessments should be taken following the process for designating WCPFC key shark species which can then be prioritized for stock assessment. It was concluded that "*further consideration of an assessment for whale sharks should be taken up by the Scientific Committee*".

It is with this background that this paper seeks to assess the whale shark against the criteria (Clarke 2012a; 2012b) adopted by WCPFC 8 in Guam 2012. If it is determined that it does meet the criteria as a key shark species, consideration will be necessary as to how it might fit into the WCPFC Shark Research Plan (Clarke and Harley 2010; Rice and Harley 2012).

² <http://www.wcpfc.int/doc/wcpfc8-2011-dp-17/guideline-safe-and-live-release-encircled-whale-sharks-during-purse-seine-fish>

³ <http://www.wcpfc.int/doc/WCPFC8-2011-DP-15A-%28Rev-1%29/WCPFC8-2011-DP-15A-%28Rev-1%29-Australia-Proposals-Address-Impact-Purse-S>

2. Assessment against criteria

PROPOSAL FOR DESIGNATION OF WCPFC KEY SHARK SPECIES		
<i>Nomination for (check all that apply):</i>		
<input checked="" type="checkbox"/> Key Species - Data Provision	<input checked="" type="checkbox"/> Key Species –Assessment	
<i>Species/Taxa Nominated</i>		
Scientific Name(s): <i>Rhincodon typus</i>	Common Name(s): Whale shark	
If more than one species is included in this nomination explain why:		
<i>In WCPF Convention Area? (see Section 2.1)</i>		
<input checked="" type="checkbox"/> Yes	No	Explain: Whale sharks are found in all tropical and warm-temperate seas in all the world's oceans – including the WCPO (Compagno 1984) and are extremely mobile being capable of long movements (Eckert et al. 2002). OFP (2012) provided details of observed whale shark sets and interactions and these were distributed throughout the area of the tropical purse seine fishery with 397 individual interactions over the period 2007-2010.
<i>Impacted by Fishing?</i>		
<input checked="" type="checkbox"/> Yes	No	<p>As reported by OFP (2012) whale sharks are impacted by fishing through two ways: 1) the direct targeting of tunas that are found in association with whale sharks (though not all of these sets conclude with encirclement of the whale shark), and 2) through interactions (whale shark encircled) that often occur when whale sharks were not observed prior to the set.</p> <p>Over 200 whale sharks targeted sets were observed over the period 2007-2009 representing five in every 1000 sets made and a total of 397 interactions (encirclements) were observed over the period 2007-2010. Estimated mortality (scaled to total effort) from the tropical purse seine fishery is 75 individuals over the period 2007-2010 and this does not include whale sharks that may have died as a result of their interaction.</p> <p>Whale sharks are more likely to be taken in unassociated or free school sets than FAD sets (OFP 2012), therefore the increasing trend towards FAD closures as management measures could lead to increased effort in the free school fishery which could further impact on whale sharks.</p>

<i>Particular Ecological Concern?</i>		
✓ Yes	No	Whale sharks are most likely the longest lived and latest maturing of all fish species impacted by WCPO tuna fisheries and while they are likely to be the most fecund of the shark species, their late maturation in particular will make them extremely susceptible to any additional mortality (i.e. related to fishing) and rebuilding of depleted populations could take tens of years. The whale shark has been included in several Ecological Risk Assessments undertaken for the WCPFC. The results differ depending on the specific metrics including in the ERA from a medium risk (Kirby and Hobday 2007) to a higher risk (Kirby 2006, WCPFC 2006 (see Figure 2 below).
<i>Adequate Data to Support Detailed Assessment?</i>		
✓ Yes	No If no, is additional logsheet data collection practical? ✓ Yes No	<p>Observer reporting of whale shark interactions is thought to be of good and there is a time series of observer data which should be sufficient to estimate CPUE for the equatorial purse seine fishery. It is not necessary that the CPUE series cover the enter stock and there is value in a good index of abundance which covers a constant area through time.</p> <p>Total fishery removals will be more difficult to estimate as there is likely fishing related mortality from non-tuna fisheries in southern and northern Asia, and possibly from the northern purse seine fisheries off Japan. Some historical estimates of non-tuna fishery catches of whale sharks do exist (CITES 2000)</p> <p>There is already some logsheet reporting of whale shark interactions, though there is not yet a specific field to enter this (it is under a “other” species heading). If the decision is made to include whale shark as a key shark species, making this reporting mandatory would seem advisable for the tropical purse seine fishery at least and this could be addressed with a minor amendment to the regional logsheet form. Given the rarity of encounter and ease of identification this reporting seems practical.</p>

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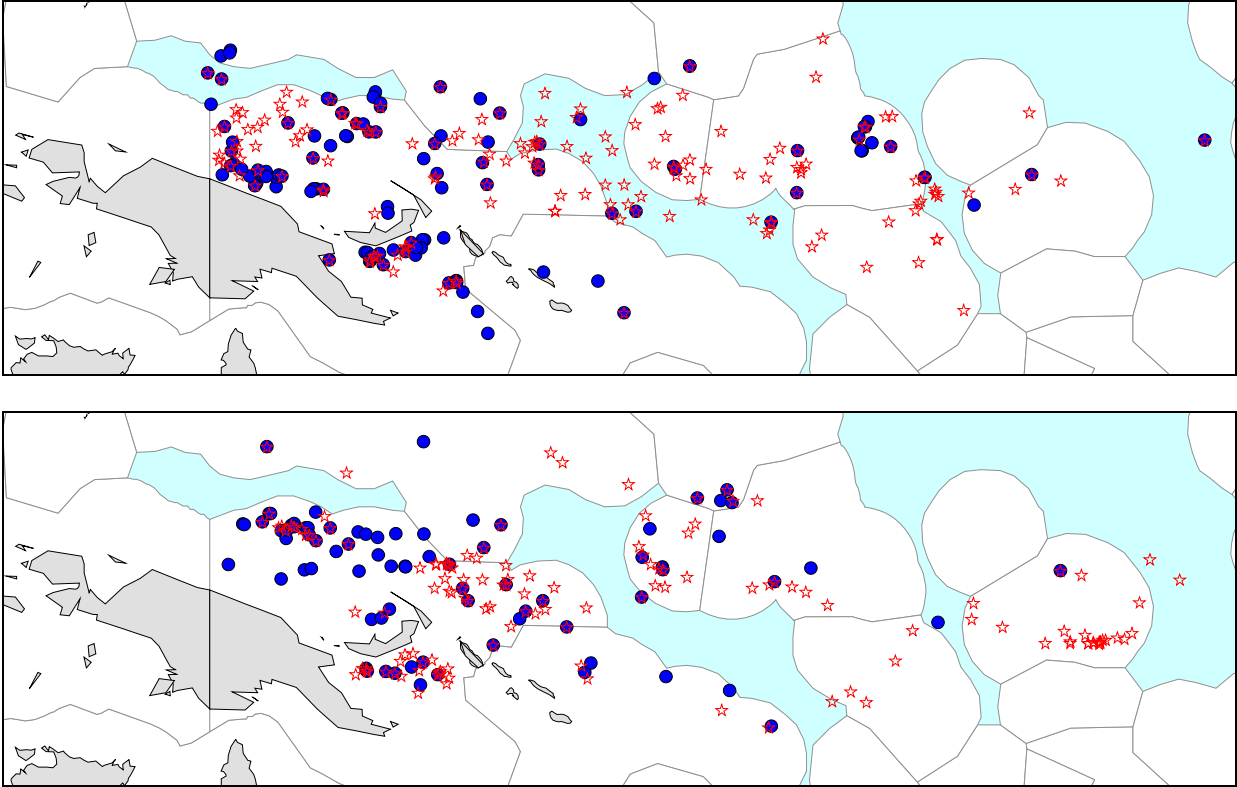


Figure 1. Locations of observed whale shark interactions (red stars) and whale shark-associated sets (blue circles) in the WCPFC tropical purse seine fishery, 2007-09 (top) and 2010 (bottom) (Source: Observer data – reproduced from OFP, 2012)

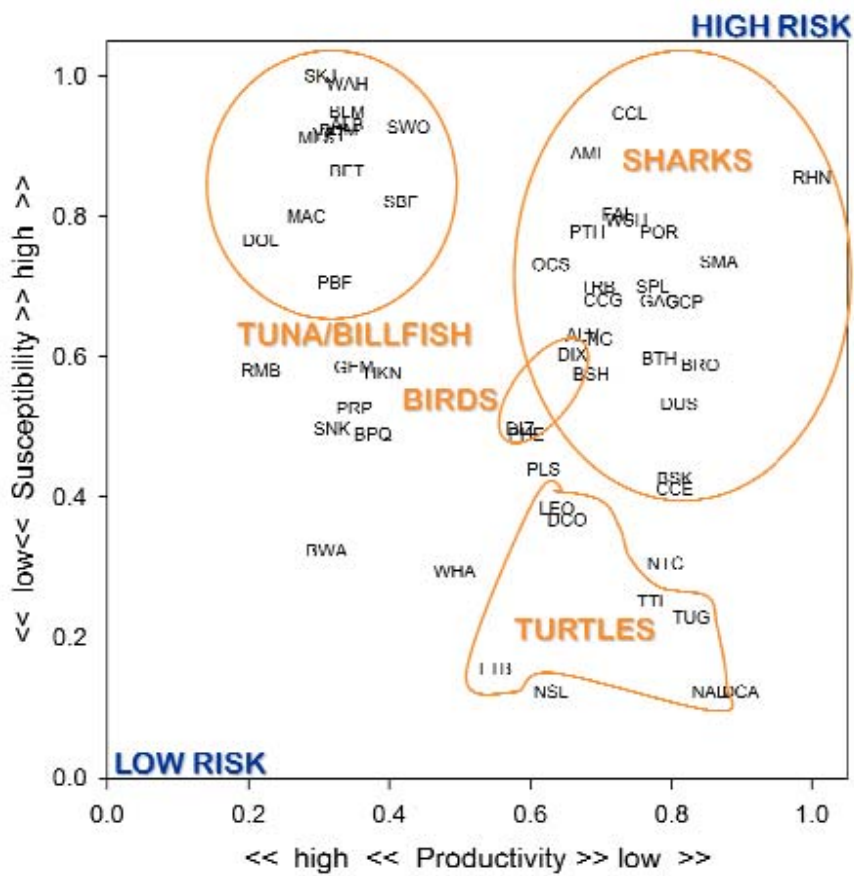


Figure 2: Productivity susceptibility analysis (PSA) based on age at maturity, maximum age, proportion retained (including fins only) and numbers of observed encounters (WCPFC, 2006; page 104). Note whale sharks (RHN) appear in the upper right corner.