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Report of the

FIFTH FAO EXPERT ADVISORY PANEL FOR THE ASSESSMENT OF PROPOSALS TO AMEND APPENDICES I AND II OF CITES CONCERNING COMMERCIALLY-EXPLOITED AQUATIC SPECIES

Rome, 6–10 June 2016

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS DOCUMENT

This is the report of the Fifth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species, held at FAO headquarters from 6 to 10 June 2016.

The meeting of the Panel was funded by FAO Regular Programme with extra assistance from the Governments of Japan and the United States of America.

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ABSTRACT

The fifth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species was held at FAO headquarters from 6 to 10 June 2016. The Panel was convened in response to the agreement by the twenty-fifth session of the FAO Committee on Fisheries (COFI) on the terms of reference for an expert advisory panel for assessment of proposals to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and to the endorsement of the twenty-sixth session of COFI to convene the Panel for relevant proposals to future CITES Conference of the Parties.

The objectives of the Panel were to:

i. assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria (Resolution Conf. 9.24 [Rev. CoP16];

ii. comment, as appropriate, on technical aspects of the proposal in relation to biology, ecology, trade and management issues, as well as, to the extent possible, the likely effectiveness for conservation.

The Panel considered the following seven proposals submitted to the seventeenth Conference of the Parties to CITES:

- CoP17 Prop. 42. Proposal to include silky shark, *Carcharhinus falciformis* in Appendix II in accordance with Article II paragraph 2(a).
- CoP17 Prop. 43. Proposal to include bigeye thresher shark, *Alopias superciliosus* in Appendix II in accordance with Article II paragraph 2(a). If listed, this would include all other species of thresher sharks, genus *Alopias* spp. in Appendix II in accordance with Article II paragraph 2(b).
- CoP17 Prop. 44. Proposal to include sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica* in Appendix II in accordance with Article II paragraph 2(a). If listed, this would include all other species of mobula rays, genus *Mobula* spp. in Appendix II in accordance with Article II paragraph 2(b).
- CoP17 Prop. 45. Proposal to include Raya, *Potamotrygon motoro* in Appendix II in accordance with Article II paragraph 2(a).
- CoP17 Prop. 46. Proposal to include the Banggai cardinalfish, *Pterapogon kauderni* in Appendix II in accordance with Article II paragraph 2(a).
- CoP17 Prop. 47. Proposal to include clarion angelfish, *Holacanthus clarionensis* in Appendix II in accordance with Article II paragraph 2(a).
- CoP17 Prop. 48. Proposal to include the Family Nautilidae in Appendix II in accordance with Article II paragraph 2(a).

The Panel report includes an assessment of each of the seven proposals following the objectives presented above, highlighting the Panel's determination of whether information on the species in question meet the CITES Appendix criteria, and noting biology, ecology, trade and management issues, as well as, to the extent possible, the likely effectiveness of a listing for conservation.

CONTENTS

Preparation of this document ..... **iii**
Abstract ..... **iv**
Contents ..... **v**
Abbreviations and acronyms ..... **vii**
Introduction **1**
Background and Purpose of the Expert Advisory Panel 1
The Panel Meeting 1
Aquatic Commercial Species Proposals for CoP 17 2
FAO Expert Advisory Panel assessment report: CoP17 Proposal 42 ..... **5**
Silky shark, *Carcharhinus falciformis*. 5
Assessment Summary 5
Scientific assessment in accordance with CITES biological listing criteria 5
Comments on technical aspects in relation to trade, management and implementation 8
References 12
Tables and figures 15
FAO Expert Advisory Panel assessment report: CoP17 Proposal 43 ..... **20**
Bigeye thresher shark, *Alopias superciliosus.* 20
Assessment Summary 20
Scientific assessment in accordance with CITES biological listing criteria 20
Comments on technical aspects in relation to trade, management and implementation 23
References 27
Table and figures 30
FAO Expert Advisory Panel assessment report: CoP17 Proposal 44 ..... **36**
Sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica*. 36
Assessment Summary 36
Scientific assessment in accordance with CITES biological listing criteria 36
Comments on technical aspects in relation to trade, management and implementation 38
References 42
Tables and figures 44
FAO Expert Advisory Panel assessment report: CoP17 Proposal 45 ..... **46**
Raya, *Potamotrygon motoro.* 46
Assessment Summary 46
Scientific assessment in accordance with CITES biological listing criteria 46
Comments on technical aspects in relation to trade, management and implementation 48
References 53
Tables and figures 55
FAO Expert Advisory Panel assessment report: CoP17 Proposal 46 ..... **57**

Banggai cardinalfish, *Pterapogon kauderni*. 57
Assessment Summary....57
Scientific assessment in accordance with CITES biological listing criteria 57
Comments on technical aspects in relation to trade, management and implementation 59
References 65
Tables and Figures 67
FAO Expert Advisory Panel assessment report: CoP17 Proposal 47....73
Clarion angelfish, *Holacanthus clarionensis*. 73
Assessment Summary....73
Scientific assessment in accordance with CITES biological listing criteria 73
Comments on technical aspects in relation to trade, management and implementation 75
References 78
Tables and Figures 79
FAO Expert Advisory Panel assessment report: CoP17 Proposal 48....81
Family Nautilidae. 81
Assessment Summary....81
Scientific assessment in accordance with CITES biological listing criteria 81
Comments on technical aspects in relation to trade, management and implementation 83
References 89
Tables and figures 92
Appendix A 100
Terms of Reference for an “Expert Advisory Panel for Assessment of Proposals to CITES”....100
Appendix B....101
Agenda, for the Expert Advisory Panel for Assessment of Proposals to CITES, FAO Headquarters, Rome 6-10 July 2016. 101
Appendix C 102
List of participants....102
Appendix D 107
Welcome speech by Mr Árni Mathiesen, Assistant Director-General, FAO Fisheries and Aquaculture Department 107
Appendix E....109
Criteria used by the FAO Expert Advisory Panel to assign a measure of the reliability of information derived from different sources for use as indices of abundance....109
REFERENCES....110

ABBREVIATIONS AND ACRONYMS

BCF	Banggai cardinalfish
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Sharks
COFI	FAO Committee on Fisheries
CPUE	catch per unit of effort
DW	disk width
EEZ	exclusive economic zone
EPO	Eastern Pacific Ocean
FAD	Fish Aggregating Device
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IFS	Introduction from the Sea (provisions of CITES)
IPOA-Sharks	International Plan of Action for Conservation and Management of Sharks
IUCN	International Union for Conservation of Nature
IUU	illegal, unreported and unregulated (fishing)
LEMIS	U.S. Fish and Wildlife Service Law Enforcement Management Information System
MPA	marine protected area
NDF	non-detriment finding
NPOA	National Plan of Action
NPOA-Sharks	National Plan of Action for Conservation and Management of Sharks
RFMO	regional fisheries management organization
WCO	World Customs Organization
WCPFC	Western and Central Pacific Fisheries Commission

INTRODUCTION

Background and Purpose of the Expert Advisory Panel

1. The fifth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species was held in response to the agreement by the Twenty-fifth Session of the FAO Committee on Fisheries (COFI), February 2003, on the Terms of Reference for an expert advisory panel for assessment of proposals to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This agreement, to convene the Panel for relevant proposals to future CITES Conference of the Parties, has received endorsement of subsequent sessions of COFI and the fifteenth session of the Sub-Committee on Fish Trade of COFI (Morocco, 22–26 February 2016). The fifteenth Sub-Committee acknowledged FAO's positive contribution in convening the FAO Expert Advisory Panel for the Assessment of CITES proposals and unanimously supported the convening of the FAO's Expert Advisory Panel for the Assessment of Proposals to CITES CoP-17 for listing or delisting commercially-exploited aquatic species.

2. The FAO Panel also falls within the agreement between CITES and FAO, as elaborated in the Memorandum of Understanding between the two organizations, for FAO to carry out a scientific and technical review of all relevant proposals for amendment of Appendices I and II. The results of this review are to be taken into account by the CITES Secretariat when communicating their recommendations on the proposals to the Parties to CITES.

3. The FAO Panel also falls within the agreement between CITES and FAO, as elaborated in the Memorandum of Understanding between the two organizations, for FAO to carry out a scientific and technical review of all relevant proposals for amendment of Appendices I and II. The results of this review are to be taken into account by the CITES Secretariat when communicating their recommendations on the proposals to the Parties to CITES.

4. The Terms of Reference agreed at the Twenty-fifth Session of COFI are attached to this report as Appendix A. In accordance with those Terms of Reference, the Panel was established by the FAO Secretariat, according to its standard rules and procedures and observing the principle of equitable geographical representation, drawing from a roster of recognized experts.

5. The task of the Panel was to:

i) assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria, taking account of the recommendations on the criteria made to CITES by FAO;
ii) comment, as appropriate, on technical aspects of the proposal in relation to biology, ecology, trade and management issues, as well as, to the extent possible, the likely effectiveness for conservation.

The Panel Meeting

6. The Panel met in Rome from 6 to 10 June 2016, hosted by FAO with funding from the FAO regular programme and the Governments of Japan and the United States of America. The agenda adopted for the meeting is included as Appendix B.

7. The Panel consisted of a core group made of ten members and nine specialists on the species being considered and aspects of fisheries management and international trade. In addition, observers were invited to attend the 2016 Panel, two from the CITES Secretariat, one from the Portuguese Institute for the Ocean and Atmosphere (IPMA), plus a further four with specific knowledge to contribute for species under consideration. The list of participants to the meeting is included as Appendix C.

8. The meeting was opened by Mr Árni Mathiesen, Assistant Director-General, FAO Fisheries and Aquaculture Department, who welcomed the participants and provided some background information to the convening of the meeting of the Expert Advisory Panel, and the importance of its task. The welcome speech is included as Appendix D.

9. Mr Paul Bannerman was elected Chair of the Panel, and two working groups were formed; the first

led by Mr John Carlson with assistance of Ms Anna Willock, the second by Mr Andy Dunstan. Mr Marcelo Vasconcellos and Ms Monica Barone from FAO assisted as rapporteurs, while Ms Manuela D'Antoni assisted with required artwork and Mr Fabio Carocci created mapping products. Ms Luigia Sforza provided secretarial support.

10. The agenda of the meeting was adopted as tabled.

11. Mr Kim Friedman, FAO Senior Fisheries Officer, made a presentation on the Terms of Reference of the FAO Expert Advisory Panel and on the FAO interpretation of the CITES criteria for the inclusion of commercially-exploited aquatic species in the CITES Appendices.

12. Proponents of the seven proposals for listing in CITES Appendices were invited to present the proposals in person or via voice over internet protocol to the Panel, and to answer any questions of clarification by Panel participants. For this purpose, the proponents were represented by the following individuals:

- CoP17 Prop. 42. Mr M. Shiham Adam spoke to the Proposal for inclusion of silky shark, *Carcharhinus falciformis*. He was assisted by Ms Sarah Fowler.
- CoP17 Prop. 43. Mr Daniel Fernando spoke to the Proposal for inclusion of bigeye thresher shark, *Alopias superciliosus*. He was assisted by Ms Sarah Fowler.
- CoP17 Prop. 44. Ms Eleni Rova Marama Tokaduadua of Fiji spoke to the Proposal for inclusion of the sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica*. Ms Rova Marama Tokaduadua was assisted by Ms Sarah Fowler and Mr Josh Stewart and Mr Guy Stevens on voice over internet protocol.
- CoP17 Prop. 45. The Proposal to include Raya, *Potamotrygon motoro* did not have a presentation.
- CoP17 Prop. 46. Proposal to include the Banggai cardinalfish, *Pterapogon kauderni* did not have a presentation, but information was presented by Mr Alejandro Vagelli on behalf of the Proponents.
- CoP17 Prop. 47. On behalf of Mr Hesiquio Benitez D. (leader of the Mexican CITES Scientific Authority, CONABIO) and in coordination with the Mexican CITES Management Authority (SEMARNAT), Mr Hector Reyes Bonilla (consultant of the Clarion´s fish project) and Ms Laura Gomez made a presentation on Clarion angelfish, *Holacanthus clarionensis*.
- CoP17 Prop. 48. Ms Patricia De Angelis of USA spoke to the Proposal for inclusion of the Family Nautilidae. She was assisted with information by Mr Gregory Barord.

13. Kim Friedman and Monica Barone presented the methods used and the results of a preliminary assessment of the key criteria for each species. This work involved Panel participants pre-filling an MS Excel file with information and preliminary thoughts on each Proposal, noting information relevant to the CITES criteria. These pre-assessments (and related information sources) were used in the Panel's deliberations between the 6–10 June 2016.

Aquatic Commercial Species Proposals for CoP 17

1. Evaluation of the proposals

The Panel considered the following seven proposals submitted to the CITES seventeenth Conference of the Parties (proposals can be downloaded from CITES website: https://cites.org/eng/cop/17/prop/index.php):

CoP17 Prop. 42. Proposal to include silky shark, *Carcharhinus falciformis* in Appendix II in accordance with Article II paragraph 2(a).

CoP17 Prop. 43. Proposal to include bigeye thresher shark, *Alopias superciliosus* in Appendix II in accordance with Article II paragraph 2(a). If listed, this would include of all other species of thresher sharks, genus Alopias spp. in Appendix II in accordance with Article II paragraph 2(b).

CoP17 Prop. 44. Proposal to include sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica* in Appendix II in accordance with Article II paragraph 2(a). If listed, this would include of all other species of mobula rays, genus Mobula spp. in Appendix II in accordance with Article II paragraph 2(b).

CoP17 Prop. 45. Proposal to include Raya, *Potamotrygon motoro* in Appendix II in accordance with Article II paragraph 2(a).

CoP17 Prop. 46. Proposal to include the Banggai cardinalfish, *Pterapogon kauderni* in Appendix II in accordance with Article II paragraph 2(a).

CoP17 Prop. 47. Proposal to include clarion angelfish, *Holacanthus clarionensis* in Appendix II in accordance with Article II paragraph 2(a).

CoP17 Prop. 48. Proposal to include the Family Nautilidae in Appendix II in accordance with Article II paragraph 2(a).

2. General comments and observations

2.1. Comments from Members and Organizations received by the FAO Secretariat

14. In accordance with the Terms of Reference for the Panel, FAO Members and regional fishery management organizations (RFMOs) were notified of the proposals submitted that dealt with commercially exploited aquatic species and were informed that FAO would be convening the Expert Advisory Panel. They were invited to send any comments or relevant information to the FAO Secretariat, for consideration by the Panel. All information received from this call for information and datasets, scientific papers, reports and articles were held on a document sharing drive for use by all the Panel participants.

15. Publically available information sourced by FAO conveners and Panel participants were also shared with IUCN-Traffic on a separate document sharing drive, as IUCN and Traffic jointly run an analogous process of assessing CITES listing proposals. It is the intention for FAO to continue to develop this sharing arrangement, considering that the FAO Panel has a greater range of access to species, management and trade expertise and more time to assess commercially-exploited aquatic species proposals than IUCN-Traffic staff. Due to the time constraints on the assessment process, and the fact that securing sufficient resources to complete assessments can be a challenge, development of better links between these two processes has the potential to offer CITES Parties clearer advice.

2.2. Interpretation of the Annex 2a Criteria for inclusion of species in Appendix II in accordance with Article II, paragraph 2(a) of the Convention

16. The Panel applied the CITES Res. Conf. 9.24 (Rev. CoP16) criteria interpreted in accordance with FAO's initial advice to CITES on criteria suitable for commercially-exploited aquatic species and as applied since the second Meetings of the Expert Advisory Panel in 2007. CITES Document CoP14 Inf. 64, prepared by the FAO Secretariat and submitted to the fourteenth Conference of the Parties to CITES in 2007, also provides an explanation of the interpretation of the Annex 2a criteria for inclusion of species in Appendix II as applied by the Panel.

17. The Panel also noted the conclusions of the "Workshop to review the application of CITES criterion Annex 2 a B to commercially-exploited aquatic species" (FAO, 2002; FAO, 2011), which confirmed the view expressed in FAO (2007) and in CoP14 Inf. 64 that the same definitions, explanations and guidelines in Annex 5 of the Res. Conf. 9.24 (Rev. CoP16), including the decline criteria, apply both for Criterion A and for Criterion B of Annex 2 a.

18. The Panel was informed about the recommendations of the CITES Animals Committee and Standing Committee in 2012 (SC62 Doc. 39, see Appendix D) regarding the application of Annex 2a criterion B and the introductory text to commercially-exploited aquatic species, in particular the following: "The Animals Committee finds that there are diverse approaches to the application of Annex 2a criterion B

in Resolution Conf. 9.24 (Rev. CoP16). The Animals Committee finds that it is not possible to provide guidance preferring or favouring one approach over another. The Animals Committee recommends that Parties, when applying Annex 2a criterion B when drafting or submitting proposals to amend the CITES Appendices, explain their approach to that criterion, and how the taxon qualifies for the proposed amendment."

2.3. General comments by the Panel on the proposals

19. The Panel welcomed the presentations by representatives of the proponents of the seven proposals. Both the presentations of the key issues presented in the proposals and the opportunity to ask questions or make clarifications after initial Panel deliberations improved the Panels ability to make informed assessments of proposals.

20. In relation to the proposals, the Panel noted that the quality of the data and the information varied, some being particularly poor. Proposals in general would benefit from greater focus on the CITES criteria as articulated in Res. Conf. 9.24 (Rev. CoP16), and inclusion of the best available information rather than selective inclusion of supporting information. Presentation of reliable indices, quantitative wherever possible, is central to determining whether species meet criteria for inclusion in the Appendices, and the basis for such indices should be presented clearly and concisely. Even where information is difficult to quantify, all efforts should be made to present the information in a form that can be objectively assessed. For this Panel, participants found comments from previous Panels were still relevant for several proposals.

21. Most of the proposals relied to some extent on sources that are unpublished or difficult to access. Assessment of proposals would be facilitated if proponents provided access to copies of all source documents (in pdf format or other) along with references within their listing proposals. The Panel gratefully acknowledges those proponents who provided copies of source materials during the Panel meeting.

22. Assessing proposals against the listing criteria requires an assessment of the importance of international trade in driving exploitation and in affecting species status. Little information on the relative importance of international trade in driving exploitation was presented in some proposals. This is often due in part to the lack of information on this subject, resulting from the lack of species level reporting or data collection.

23. As requested by the Thirty-second Session of COFI in 2012, the Panel has made efforts to improve the comments on the technical aspects of the proposals and their likely effectiveness for conservation, based on the inputs from experts on trade, management and implementation issues. However, the Panel noted that the technical aspects involved in the implementation of CITES listings are context-specific and need to be considered on a case-by-case basis. To improve knowledge on these technical aspects, the Panel welcomes the current effort to further understand implementation, through the delivery of more empirical studies on the impacts and factors influencing the successful implementation of CITES listings of commercially-exploited aquatic species.

2.4. For consideration in reading the reports

24. As was done in the previous Panels, in considering trends in abundance reported in the proposals, the Panel attempted to evaluate the reliability of each source of information. This was done by assigning a score between zero (no value) and five (highly reliable) to each item of information used to demonstrate population trends. The criteria used to assign a score are included in Appendix E. For evaluations, the Panel recommends that when using the reliability index, participants also consider the scientific quality of the references used, giving higher reliability to sources that have been subjected to a robust peer review.

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 42

Species:

Silky shark, *Carcharhinus falciformis*.

Proposal:

To include silky shark, *Carcharhinus falciformis* in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention.

Assessment Summary

Silky shark are wide-ranging, highly migratory species and globally distributed. The Panel considered this a low productivity species and determined that available information on the status of silky shark did not meet the Appendix II listing criteria. The only data series that demonstrated a decline matching the listing criteria, was for the southern Eastern Pacific Ocean stock, but only if the most recent two years of data were not included in the assessment. Considering the importance of this dataset to the global population of silky shark, and taking into account all available valid information, the Panel considered that a CITES Appendix II listing would be inconsistent with the proportionate risk to the species as a whole. If a CITES Appendix II listing was adopted and implemented effectively, this could act as a complementary measure for regulations implemented by Regional Fisheries Management Organisations. However, the Panel noted that where a States' abilities to complete CITES provisions was limited then trade might cease, or continue without adequate CITES documentation.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

Silky shark, *Carcharhinus falciformis* (Müller & Henle 1839), is an oceanic and coastal species with circumtropical distribution found along continental shelves and slopes from the surface to 500 m of depth. Silky shark are often associated with seamounts, and juveniles with floating objects. They are found in the following FAO Areas; 21, 31, 34, 37, 41, 47, 51, 57, 61, 71, 77, 81, 87 (see http://www.fao.org/fishery/area/search/en).

Tagging studies have shown silky shark move between open ocean and coastal systems and between northern and southern regions (Galván-Tirado *et al*., 2013). The maximum distance travelled based on tagging information was 1,339 km (Bonfil, 2008). In the Northwest Atlantic, silky shark were found to have left the exclusive economic zone of the United States, moved into and out of the Gulf of Mexico, and moved into the Caribbean Sea, with a maximum distance of 449 km travelled (Kohler *et al*., 1998). In the Eastern Pacific Ocean, tagged *C. falciformis* crossed the EEZs of six countries and went into international waters (Kohin *et al*., 2006).

As overall population parameters and indices were not available, the Panel considered four main areas in the review: i) Atlantic Ocean, ii) Indian Ocean, iii) Eastern Pacific and iv) Central Western Pacific, based on the availability of life history and indices.

Generally, there is good information about general biological parameters. After reviewing the available parameter estimates for the species, the Panel concluded that the species generally meets the low productivity criteria (Table 1). Some biological parameters, e.g. longevity are more consistent with a medium productivity species, however, the Panel considered that the longevity estimates could be underestimated because of uncertainty in aging methods for sharks in general and also because the estimates of maximum age of the exploited populations are likely underestimates of the true longevity. Considering that the majority of the biological parameters points to low productivity values, the Panel concluded that the species has a low productivity.

It should be noted, that because demographic parameters estimated using data from a fished population, the values reported for r (continuous rate of population increase) and lambda (the finite rate of population increase) are likely to be underestimates.

Trends and application of the decline criterion

Under the CITES criteria for commercially exploited aquatic species (Res. Conf. 9.24 Rev. CoP16), a decline to 15–20 percent of the historical baseline for a low-productivity species might justify consideration for an Appendix I listing. For listing on Appendix II, being "near" this level might justify consideration for a listing, which for a low-productivity species would be 20–30 percent of the historical level (15–20 percent + 5–10 percent precautionary measure).

Some of the references in relation to population decline presented in the CITES Proposal are incomplete, outdated and/or mis-cited. The Panel updated this information with scientific information on status of silky stocks.

A number of abundance indices are available from different parts of the range, but these are of varying reliability as indices for this species. Information evaluated by the Panel regarding population trends from different oceanic regions is summarised below and in Table 2.

Atlantic Ocean

The Proposal reported declines of 50–91% for silky shark or a combined "coastal shark group" in the northwest Atlantic Ocean. Three studies (Cramer, 2000; Baum *et al.*, 2003; Cortes *et al*., 2007) analyzed commercial self-reported pelagic longline logbook program for the period 1992–1997, 1992–2003 and 1992–2005. The Panel deemed Cortes *et al.*, (2007) to be the most appropriate study to consider, as it is the most recent data analysis and has the longest time series. Moreover, the study by Baum *et al*., (2003) analyzed silky shark as part of an "aggregate coastal shark group" rather than by species and the Panel believed that one or two species could overly influence the time series and not be reflective of silky shark abundance. Cortes *et al*. (2007) reported a 50% decline in silky shark abundance over 13 years.

Analysis of data collected by on-board observers also from the same fishery found a 46% decline from 1992–2005 (Cortes *et al*., 2007). Baum and Blanchard (2010) also analyzed observer data from 1992–2005 and reported a 76% decline in the population trend over the time period. However, again silky shark data were considered as an "aggregate coastal shark group" rather than by species and the Panel believed that the series was not reflective of silky shark abundance. Data from the US shark bottom longline fishery was also analyzed by the Panel using methodology described by Carlson *et al.* (2012) and the Panel found no significant trend in abundance of silky sharks from 1994–2015 (Figure 2). Applying the CITES criterion to these data for a species with low productivity indicates the recent extents of decline did not conform to the Appendix II decline criterion (70–80% over 2 generations).

A study comparing abundance of silky shark in the 1950s from fishery independent surveys in the Gulf of Mexico with abundance in the 1990s from pelagic longline observer data reported a 91.2% decline in abundance (Baum and Myers 2004). The methods and results of Baum and Myers (2004) were critiqued by Burgess *et al*. (2005), who agreed that the abundance of large pelagic sharks had declined but presented arguments that the population declines were probably less severe than indicated by that study. Of particular relevance, Burgess *et al*. (2005) noted that the change from steel to monofilament leaders between the 1950s and 1990s could have reduced the catchability of all large sharks. In responding to the critique, Baum *et al*. (2005) agreed that the change in catchability resulting from a change in the material used in leaders needed further study. Driggers *et al*. (2011) conducted a study on the effects of different leader materials on the catch-per-unit-effort (CPUE) of pelagic sharks. Comparing the estimate of silky shark CPUE on wire leaders (5.34 ±16.54) in Driggers *et al*. (2011) with the estimate of Baum and Myers (2004) for the historic period (1.71 ±3.49) indicates an increase in abundance not a decrease. However, silky shark average size did decline from 102 kg in the 1950s to 23 kg in the study by Driggers *et al*. (2011).

Indian Ocean

The Panel considered and discussed the estimated stock decline reported in the Proposal (Anderson and Juaharee, 2009). The Panel agreed that the information presented in that work is based on anecdotal information with a limited sample size and that represents only a small area of the Indian Ocean and a specific fishery. The Panel also noted that the information provided in the interviews was mostly qualitative, and that only on some cases quantitative estimates were provided. For those reasons, the Panel agreed that the information provided for the Indian Ocean should not be used as evidence of the suggested declines, and should not be extrapolated for the entire Indian Ocean region. The Panel also noted that the Indian Ocean is the region with the least data on reliable catch and effort statistics for pelagic sharks.

Eastern Pacific

The Panel considered several references pertaining to catch rates of silky sharks in the Eastern Pacific Ocean (EPO). The paper by Galvan-Tirado *et al.* (2013) referenced in the Proposal was noted to use genetics-based effective population size estimates over time scales which are not considered relevant to the Panel's deliberations.

The Panel noted that while the Inter-American Tropical Tuna Commission (IATTC) Secretariat staff has suspended their efforts on a stock assessment for this species, it is continuing to update and monitor silky shark catch rate trends in the EPO purse seine fishery. These catch rate trends were presented in Minami *et al.* (2007) which showed a decline of 60–80% for the eastern Pacific Ocean during the period 1994–2004. The most recent updated analysis for this data series is provided in Lennert-Cody *et al.* (2016) which contains data for 1994–2015 under the assumption of separate stocks in the northern and southern EPO. No percentage decline was reported in that paper but the Panel calculated from the figures presented in the paper (using the difference between the average of the first three data points and the last three data points) that there was an 37% decline in silky shark catch rates in floating objects sets for the northern EPO stock and 65% for the southern EPO stock. In addition, the Panel noted that over the entire time series for the southern EPO stock that a decline of 77% was observed (based on the difference between the average CPUE in 1994–1996 and 2004–2013). This 77% decline for the southern stock would meet the criteria for CITES Appendix II listing, however it should be noted that the most recent CPUE values (2014-2015) show a slight increase. The Panel noted that IATTC staff does not consider the more optimistic recent trends to be strong enough to offset the urgent need for precautionary management actions, and therefore the shorter series (1994–2013) showing the larger decline (77%) was considered by the Panel to be more indicative of stock status. The Panel thus concluded that the evidence for a decline that meets the CITES Appendix II listing criteria is limited to the southern EPO stock and would apply only if the most recent data points are discounted.

Western Central Pacific

The Panel considered that Rice and Harley (2013) included the relevant observer-based CPUE series for silky shark in the Western and Central Pacific Ocean available at the time they conducted their assessment (i.e. Walsh and Clarke 2011, which is an update and standardization of data contained in Walsh *et al*. (2009), Clarke *et al*., 2011a, Clarke *et al*., 2011b). In the Rice and Harley (2013) assessment, the reference case shows a decline from spawning biomass in 1995 (SB1995) to current spawning biomass (SBcurr) such that SBcurr is 0.667 of SB1995. This equates to a recent rate of decline of 33% which was mis-cited in the Proposal as a 67% decline. Furthermore, the results of the grid of 2,592 scenarios (Table 8 in Rice and Harley, 2013) show that the current median spawning biomass (median SBcurr) is 0.93 of the SB1995. This would equate to a recent rate of decline of 7%, or, if the confidence interval is taken into account, the ratio of the median SBcurr to the SB1995 would be somewhere between 0.61 and 1.67, equating to a potential recent rate of change somewhere between a 39% decline and a 67% increase. Furthermore, an updated standardized CPUE series for the Secretariat of the Pacific Community (SPC) dataset, which was the main basis for the reference case used in the Rice and Harley (2013) assessment, concluded that the data series exhibited high fluctuations throughout the study period with no overall trend (Rice *et al*., 2015) (Figure 3). The Panel considered that these factors when applied

to the criteria contained in Table 2 (FAO, 2002) for combining a historical extent of decline and recent rate of decline showed that the Rice and Harley (2013) results did not indicate that the WCPO silky shark stock meets the criteria for Appendix II listing.

The Panel discussed that the only Western and Central Pacific study that showed a decline meeting the criteria for CITES Appendix II listing is the Ward and Myers (2005) analysis. However, as discussed for bigeye thresher shark, the methods used in this paper are not adequately described and there may be biases when comparing the 1950s and 1990s data given the different areas and types of fishing operations sampled. The sample size appears adequate for the silky shark abundance estimates (although not for the silky shark size estimates) but the figure for the actual decline in abundance, i.e. 92%, does not appear in the paper itself (only in the Appendix) and was mis-cited in the Proposal. The Panel concluded that although this study's estimated decline meets the CITES Appendix II listing criterion there are substantial questions about its methods that result in a relatively low level of credibility being attached to its results.

Modifying factors and risk

The Panel considered whether there were any biological characteristics of silky sharks that would modify their probability of being depleted to the point where they would meet the criteria for listing. The low productivity of the species is considered in a previous section. That the species is circumglobal and wide-ranging is probably a positive modifying factor. Silky sharks, particularly juveniles, tend to aggregate around fish aggregating devices (FAD), where they may be entangled in the FAD (Filmalter, 2013) or caught as bycatch in fisheries where their discard survival is low (less than 20%; Poisson *et al.*, 2014, Hutchinson *et al*., 2015).

Summary of evaluation and assessment of biological listing criteria

No global population estimates of silky shark are available; however the population is unlikely to be small. The species is wide-ranging and globally distributed so it does not meet the criteria for a restricted distribution. The Panel considered the productivity for the species as low, and so considered declines of 70% or more over 2 generations (about 30 years) would meet the criteria for listing. Of the indices considered, most did not meet this decline criterion. The only series that demonstrated a decline that matched the criteria was for the southern EPO stock taken in the purse seine fishery, but only when the final two years of data were not considered. Therefore, the Panel concluded that there is evidence supporting a decline in only one fishery from one region. As mentioned above, two other studies that showed a decline that met the criterion involved comparing catch rates from different gears in different periods, and so were not considered reliable. In conclusion, the Panel considers that a global CITES Appendix II listing would be inconsistent with the proportionate risk to the species as a whole, because most of the silky shark population does not meet the CITES Appendix II listing criteria.

Comments on technical aspects in relation to trade, management and implementation

The following comments are in response to statements in the Proposal related to management and trade and are not a comprehensive summary of management regimes or trade of silky sharks. The Panel found that much of the information necessary to thoroughly evaluate the management and trade aspect of the Proposal were not available for the review, therefore for the comments presented below, the Panel needed to rely largely on its own expert knowledge which at times was anecdotal and or qualitative.

Management comment

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International / Regional:
    - The FAO IPOA-Sharks underscores the responsibilities of fishing and coastal states for sustaining shark populations, ensuring full utilisation of retained shark species and improving shark data collection and monitoring.
    - The formally adopted FAO Port State Measures Agreement is an agreement on port state measures to prevent, deter and eliminate Illegal, Unreported and Unregulated (IUU) fishing. This agreement requires that any inspections conducted on fishing vessels entering ports includes verification that all species exploited have been taken in compliance with international law, international conventions and measures of RFMOs.
- Regional management:
    - All Tuna RFMOs have adopted prohibitions on finning and encourage the release of live sharks where possible.
    - Some RFMOs already include oceanic, pelagic and highly migratory elasmobranchs in the scope of their Conventions, while ICCAT is amending its Convention scope so that they are included.
    - Retention of silky sharks is prohibited in ICCAT and WCPFC. Those measures were adopted following ecological risk assessment or analysis of observer data in those RFMOs.
    - The Panel noted that the ICCAT prohibition on retaining silky sharks excludes developing coastal States on the condition that these States not increase their silky shark catches, refrain from international trade in silky shark products, and provide catch data.
    - Some tuna RFMOs require that catches of sharks are recorded and reported annually at the species level. This is complemented by observer programmes and discard reporting.
    - There are research efforts on sharks at regional and national levels that include silky sharks.
- National measures:
    - Some States implement regional management measures (above) through, e.g. national plans of action and or finning controls, including requiring fins to be attached and prohibiting retention of silky sharks.
    - Some States have protected silky sharks throughout their EEZs.
    - Some States require catches of silky sharks, as an individual species, to be recorded and reported annually.
    - MPAs and other spatial measures to protect sharks are established in several EEZs.
    - Catches of silky sharks only reported to FAO by a small number of States; others report shark catches at more generic levels.
    - Where there are prohibitions on retention of silky sharks, they are still caught and information suggests high mortality rates that may be in the order of 80% in purse seine fisheries. Mortality rates in long line fisheries are lower but still substantial (Clarke, 2011; Coelho *et al*., 2011, 2012; Gallagher *et al*., 2014).

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES

- Limited information and compliance shortfalls makes it difficult to evaluate the effectiveness of the above measures, both regionally and nationally.
- It is possible for silky sharks to be confused with similar Carcharhinid species and these identification issues need to be resolved.
- A requirement for conducting Non Detriment Findings (NDFs) is to address all sources of mortality. Entanglement in FADs would be an issue that would need to address among other fisheries related sources of mortality.
- Appendix II listing may generate additional information that can assist fisheries managers to assess fishing mortality rates. Reporting of silky shark catches, where landing is permitted, would be improved in some cases.
- Appendix II listing could assist in improving compliance by providing an impediment to trading in silky shark products illegally obtained from fisheries where retention bans are in place, due the requirement to supply CITES documentation.
- All catches landed from the high seas would require Introduction from the Sea Certification or Export Permits which require NDFs and legal acquisition findings or the corresponding requirements under Introduction from the Sea. This applies not only to landings for commercial purposes but also to the taking of samples for scientific purposes.
- CITES Parties have raised implementation issues, including short falls in available data, at FAO Workshops (e.g. FAO Expert Consultation on Impacts of CITES Listing of Sharks and Rays Species in the South and Southeast Asia Region. Penang, Malaysia. 19-20 April 2016), many of which are cited as limitations on conducting NDFs. CITES Animals Committee and Standing Committee shark working groups have been tasked to work on the issues. The work is on-going.
- FAO has a project to assess the impact of CITES shark listings (Contribution to responsible and appropriate application of CITES provisions to assist in the conservation and sustainable use of commercially-exploited aquatic species, Component 9 of a FAO/Government Cooperative Program, "Improved Fisheries Management for Sustainable Use of Marine Living Resources in the Face of Changing Systems") which is on-going.

Trade comment

Silky sharks are largely caught during target fishing for tunas in both purse seine and long line fisheries. Retention, where permitted, is for local consumption and international trade. Silky shark fins are documented in international trade and there is other evidence that silky shark meat is commonly used (based on silky shark retention statistics in Clarke *et al*., 2013). Silky shark fins are considered by traders to be of moderate value, but the "Wu Yang" category of fins has been shown to contain several other species. (Clarke *et al*., 2006).

Trade (market transparency, documentation and level of IUU)

- In general there are no specific catch or trade documentation schemes for sharks. Existing general catch documentation systems in some countries could facilitate the issuing of legal acquisition findings (e.g. the EU's Catch Certification requirements).
- There is a finite capacity in the commonly used of the World Customs Organization (WCO) harmonized system (HS) of tariff classification to identify products of silky shark in trade, much of which has been used alreadycts of silky sharkcts of silky shark (http://www.wcoomd.org/en/faq/harmonized_system_faq.aspx#q9).
- There are historical and current efforts to monitor the species composition of the shark fin trade and these may continue to provide insights into the trade.

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES

- CITES provisions on trade in specimens of species listed on Appendix II require the issuance of an export permit by the exporting country, which shall only be granted if the national CITES authorities are satisfied that: 1) the export is not detrimental to the survival of the species in the wild; and 2) the specimens were not obtained in contravention of the national laws of that state.
- The trade will be recorded in the CITES trade database, and this will improve overall trade information.
- States' abilities to make NDFs for highly migratory species is limited in the absence of region-wide assessments as evidenced by difficulties encountered in making NDFs for shark species that have already been listed. Under these conditions the following outcomes can occur.
    - Previous trade ceases;
    - Trade continues without proper CITES documentation (also known as "illegal trade"); and/or
    - Trade continues with inadequate NDFs.
- There may be specific challenges for some purse seine fleets landing in port or transhipping at sea due to the fact that non-target species, including silky sharks, are not separated from target tuna catches until final landing.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

Silky shark is being proposed for CITES Appendix II listing in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states '*It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future'*.

It is difficult to draw clear conclusions regarding the effectiveness of existing and future management and trade measures due to the lack of data available to be able to assess these measures. However, it is noted that if properly implemented, a CITES Appendix II listing would be expected to result in better monitoring and reporting of catches entering international trade from silky shark populations. Improved monitoring should enable new or enhanced assessments of stock status and the subsequent adoption of management measures that ensure the sustainability of harvests where these are still permitted. Harvests from international waters would fall under the 'Introduction From the Sea' (IFS) provisions of the Convention. These would require CITES documentation to the species level for specimens entering the jurisdiction of a State from international waters, along with a NDFs indicating that the harvest was sustainable and consistent with relevant measures under international law.

Listing would also provide an additional control to ensure that products entering international trade are derived from legal and sustainable fisheries. A CITES Appendix II listing, if implemented effectively, could also act as a complementary measure for regulations implemented by fisheries management authorities; in particular, where RFMOs have adopted measures prohibiting retention of silky sharks.

It should be noted that States' abilities to make NDFs for highly migratory species is limited in the absence of region-wide assessments as evidenced by difficulties encountered in making NDFs for shark species that have already been listed. Under these conditions the following outcomes can occur; previous trade ceases, trade continues without proper CITES documentation (i.e. illegal trade) and/or trade continues with inadequate NDFs.

References

Aires-da-Silva, A., Lennert-Cody, C., Maunder, M.N., & Roman-Verdesoto, M. 2014. Stock status indicators for silky sharks in the Eastern Pacific ocean. IATTC, SAC-05-11.

Anderson, R.C. & Juaharee, R. 2009. Opinions Count: Declines in Abundance of Silky Sharks in the Central Indian Ocean Reported by Maldivian Fishermen. Indian Ocean Tuna Commission, IOTC-2009-WPEB-08.

Baum, J.K. & Blanchard, W. 2010. Inferrring shark population trends from generalized linear mixed models of pelagic longline catch and effort data. *Fisheries Research*. 102: 229–239.

Baum, J.K. & Myers, R.A. 2004. Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico. *Ecology Letters* 7: 135-145.

Baum, J.K., Kehler, D. & Myers, R.A. 2005. Robust estimates of decline for pelagic shark populations in the northwest Atlantic and Gulf of Mexico. Fisheries 30: 27-29.

Baum, J.K., Myers, R.A., Kehler, D.G., Worm, B., Harley, S.J. & Doherty, P.A. 2003. Collapse and conservation of shark populations in the northwest Atlantic. *Science*, 299: 389–392.

Bonfil, R. 2008. The Biology and Ecology of the Silky Shark, *Carcharhinus falciformis*. *In* Camhi, M., Pikitch, E.K. & Babcock, E.A. 2008. Sharks of the Open Ocean: *Biology, Fisheries and Conservation*, Blackwell Science, 2008, pp. 114–127.

Bonfil, R., Mena, R. & de Anda, D. 1993. Biological parameters of commercially exploited silky sharks, , from the Campeche Bank, México. *In:* Conservation Biology of Elasmobranchs (ed. S. Branstetter). NOAA Technical Report NMFS 115. NOAA/NMFS, Silver Spring, MD, pp. 73–86.

Branstetter, S. 1987. Age, growth and reproductive biology of the silky shark, Carcharhinus falciformis, and the scalloped hammerhead, *Sphyrna lewini*, from the northwestern Gulf of Mexico. Environmental Biology of Fishes 19, 161–173.

Burgess, G. H., Beerkircher, L.R., Cailliet, G.M., Carlson, J.K., Cortés, E., Goldman, K.J., Grubbs, R.D., Musick, J.A., Musyl, M.K. & Simpfendorfer, C. A. 2005. Is the collapse of shark populations in the Northwest Atlantic Ocean and Gulf of Mexico real? *Fisheries* 30(10):19-26.

Carlson, J.K., Hale, L.F., Morgan, A. & Burgess, G. 2012. Relative abundance and size of coastal sharks derived from commercial shark longline catch and effort data. *Journal of Fish Biology,* 80(5):1749-64.

Clarke, S., Harley, S., Hoyle, S. & Rice, J. 2011a. An Indicator based analysis of key shark species based on data held by SPC-OFP. WCPFC-SC7-EB –WP-04.

Clarke, S., Yokawa, K. Matsunaga, H. & Nakano, H. 2011b. Analysis of North Pacific Shark Data from Japanese Commercial Longline and Research/Training Vessel Records. WCPFC-SC7-EB-WP-04.

Clarke, S.C., Harley, S.J., Hoyle, S.D. & Rice, J.S. 2013. Population trends in Pacific oceanic sharks and the utility of regulations on shark finning. *Conservation Biology*, 143: 131-135.

Coelho R., Fernandez-Carvalho J., Lino P.G. & Santos, M.N. 2012. An overview of the hooking mortality of elasmobranchs caught in a swordfish pelagic longline fishery in the Atlantic Ocean. *Aquatic Living Resources*, 25: 311-319.

Coelho, R., Lino, P.G. & Santos, M.N. 2011. At-haulback mortality of elasmobranchs caught on the Portuguese longline swordfish fishery in the Indian Ocean. Indian Ocean Tuna Commission. Technical Document IOTC–2011–WPEB07–31.

Cortés, E. 2002. Incorporating uncertainty into demographic modelling: Application to shark populations and their conservation. *Conservation Biology* 16, 1048–1062.

Cortés, E. Domingo, A., Miller, P., Forselledo, R., Mas, F., Arocha, F., Campana, S., Coelho, R., Da Silva, C., Hazin, F.H.V., Hotzhausen, H., Keene, K., Lucena, F., Ramirez, K., Santos, M.N., Semba-

Murakami, Y. & Yakowa, K. 2015. Expanded Ecological Risk Assessment of Pelagic Sharks Caught in Atlantic Pelagic Longline Fisheries. Collected Volume of Scientific Papers. ICCAT. 71(6): 2637-2688.

Cortés, E., Brown, C.A. & Beerkircher, L.R. 2007. Relative abundance of pelagic sharks in the western north Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea. *Gulf and Caribbean Research* 19(2): 37-52.

Cramer, J. 2000. Large pelagic logbook catch rates for sharks. ICCAT Collective Volume of Scientific Papers 51(6), 1842–1848.

Driggers, W.B., Carlson, J.K., Cortéz, E. & Ingram Jr, G.W. 2011. Effects of wire leader use and species specific distributions on shark catch rates off the southeaster United States [online]. IOTC-2011-SC14-INF08.

FAO. 2002. Report of the second Technical Consultation on the Suitability of the CITES Criteria for Listing Commercially-exploited Aquatic Species. Windhoek, Namibia, 22-25 October 2001. *FAO Fisheries Report.* No. 667. Rome 2002. 87p.

Filmarter, J.D., Capello, M.M. Deneubourg, J., Cwley, P.D. & Dagorg, L. 2013. Looking behind the curtain: quantifying massive shark mortality in fish aggregating devices. *Front. Ecol. Environ.,* 11(6): 291–296.

Gallagher, A.J., Orbensen, E.S., Hammerschlag, N., Serafy, J.E. 2014. Vulnerability of oceanic sharks as pelagic longline bycatch. *Global Ecology and Conservation,* (1)50–59.

Galván-Tirado, C., P. Díaz-Jaimes, F.J. García-de León, F., Galván-Magan˜a & Uribe-Alcocer, M. 2013. Historical demography and genetic differentiation inferred from the mitochondrial DNA of the silky shark (Carcharhinus falciforms) in the Pacific Ocean. *Fisheries Research* 147: 36-46.

Hall, N.G., Bartron, C., White, W.T., Dharmadi & Potter, I.C. 2012. Biology of the silky shark Carcharhinus falciformis (Carcharhinidae) in the eastern Indian Ocean, including an approach to estimating age when timing of parturition is not well defined. *Journal of Fish Biology* 80: 1320–1341.

Hutchinson, M., Itano, D.G., Muis, J.A. & Holland, K.N. 2015. Post-release survival of juvenile silky sharks captured in a tropical tuna purse seine fishery. *Marine Ecology Progress Series*, Vol. 521: 143–154.

IATTC. 2014. Tunas and billfishes in the Eastern Pacific Ocean in 2013. *Fishery Status Report* No. 12.

Joung, S.J., Chen, C.T., Lee, H.H. & Liu, K.M. 2008. Age, growth, and reproduction of silky sharks, Carcharhinus falciformis, in northeastern Taiwan waters. *Fisheries Research* 90(1-3): 78-85.

Kohin, S., Arauz, R., Holts, D. & Vetter, R. 2006. Preliminary results: Behavior and habitat preferences of silky sharks (*Carcharhinus falciformis*) and a bigeye thresher shark (*Alopias superciliosus*) tagged in the Eastern Tropical Pacific. *In:* Rojas and Zanela (editors). Memoria ier semin ario-taller del estado del conocimiento de la condrictiofauna de Cost Rica. Instituto Nacional de Biodiversidad INBIO. Santo Domingo de Heredia, Costa Rica. 2 de Febrero, 2006. Índice de Contenidos 17-19.

Kohler, N.E., Casey, J.G. & Turner, P.A. 1998. NMFS Cooperative Tagging Program, 1962-93: An atlas of shark tag and recapture data. *Marine Fisheries Review* 60(2): 1-87. Available online at: http://spo.nwr.noaa.gov/mfr6021.pdf.

Lennert-Cody, C., Aires-da-Silva, A., Maunder, M.N. & Román, M.H. 2016. Updated stock status indicators for silky sharks in the Eastern Pacific ocean (1994-2015). IATTC, Document SAC-07-06b.i.

Minami, M., Lennert, C., Gao, W. & Román, M. 2007. Modelling shark bycatch: the zero-inflated negative binomial regression model with smoothing. *Fisheries Research*. 84: 210-221.

Oshitani, S., Nakano, H. & Tanaka, S. 2003. Age and growth of the silky shark *Carcharhinus falciformis* from the Pacific Ocean. *Fisheries Science,* 69: 456–464.

Poisson, F., Filmalter, J.D., Vernet, A-L. & Dagorn, L. 2014. Mortality rate of silky sharks (*Carcharhinus falciformis*) caught in the tropical tuna purse seine fishery in the Indian Ocean. *Canadian Journal of Fisheries and Aquatic Sciences.* June 2014, Volume 71, Issue 6, Pages 795–798.

Rice, J. & Harley. S. 2013. Updated stock assessment of silky sharks in the western and central Pacific Ocean. Western and Central Pacific Fisheries Commission Scientific Committee WCPFC-SC-2013/SA- WP-03.

Rice, J., Tremlay-Boyer, L., Scott, R., Hare, S. & Tidd, A. 2015. Analysis of stock status and related indicators for key shark species of the Western Central Pacific Fisheries Commission. WCPFC-SC11-2015/EB-WP-04-Rev 1 (also available at https://www.wcpfc.int/node/21719).

Walsh, W. A. & Clarke, S.C. 2011. Analyses of catch data for silky and silky sharks reported by fishery observers in the Hawaii-based longline fishery in 1995−2010. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-11-10, 43 p. + Appendices.

Walsh, W.A., Bigelow, K.A. & Sender, K. 2009. Decreases in Shark Catches and Mortality in the Hawaii-Based Longline Fishery as Documented by Fishery Observers. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 1:270–282.

Ward, P. & Myers, R. A. 2005. Shifts in open-ocean fish communities coinciding with the commencement of commercial fishing. *Ecology* 86:835–847.

Tables and figures

Table 1. Information for assessing productivity of silky shark

PARAMETER	STATUS[1]	INFORMATION	AREA	SOURCE
growth	low	VBGF Linf (TL) 332; K 0.0838	WC Pacific	Joung *et al.*, 2008
growth	low	VBGF Linf (PL) 216.4; K 0.148	NW Pacific	Oshitani *et al.*, 2003
growth	low	VBGF Linf 299 (TL); K 0.066	E Indian Ocean	Hall *et al.*,2012
growth	medium	(TL) 291; K 0.153	NW Atlantic	Brandstetter, 1987
growth	low	(TL) 311; K 0.101	NW Atlantic	Bonfil *et al.*, 1993
generation time	low	14.4	N Atlantic	Cortes *et al.*, 2015
generation time	low	16.5	S Atlantic	Cortes *et al.*, 2015
generation time	low	11–16	E Indian Ocean	Hall *et al.*, 2012
intrinsic growth rate of pop	low	r 0.078	N Atlantic	Cortes *et al.*, 2015
intrinsic growth rate of pop	low	r 0.042	S Atlantic	Cortes *et al.*, 2015
natural mortality	low-med	0.17–0.21	WC and NW Atlantic	Cortés, 2002
TMAX_longevity	medium	22 males only	N Atlantic	Bonfil, 1993
TMAX_longevity	medium	20 females only	S Atlantic	Bonfil, 1993
TMAX_longevity	medium	14	WC Pacific	Joung *et al.*, 2008
TMAX_longevity	medium	19–20	E Indian Ocean	Hall *et al.*, 2012
TMAT_time to maturity	medium	6–7 Male 7–9 Female	Gulf of Mexico	Branstetter, 1987
TMAT_time to maturity	low	13 Male, 15 Female	Indian Ocean	Hall *et al.*, 2012
TMAT_time to maturity	low	10 Male, 12 Female	NW Atlantic	Bonfil *et al.*, 1993
TMAT_time to maturity	low	9.3 Male, 9.2–10.2 Female	WC Pacific	Joung *et al.*, 2008

[1] See Musick *et al* 1999.

Table 2. Information on silky shark trends from different oceanic regions. Information in bold was used in the final assessment. Also refer to Figure 1.

REF #	AREA	COVERAGE	INDICATOR	FISHERY	EXTENT OF DECLINE (%)	REFERENCE PERIOD	REFERENCES
1	Indian Ocean	Indian	catches	mixed	50	1999-2009	Andersen & Juaharee (2009) - interview survey
2	Pacific Ocean	WC Pacific	standardized CPUE	longline	92	1951–1954; 1999–2002	Ward & Meyers (2005) - abundance
3	Pacific Ocean	WC Pacific	other	longline	38	1951–1954; 1999–2002	Ward & Meyers (2005) - mean of body mass
4	Pacific Ocean	WC Pacific	CPUE	longline	54	1995–2000; 2004–2006	Walsh *et al*., (2009)
5	Pacific Ocean	WC Pacific	standardized CPUE	longline	0	1995–2010	Walsh & Clarke (2011)
6	**Pacific Ocean**	**WC Pacific**	**spawning biomass**	**mixed**	**33**	**1995–2009**	**Rice & Harley (2013)**
7	**Pacific Ocean**	**WC Pacific**	**standardized CPUE**	**longline**	**0**	**1995–2014**	**Rice (2015)**
8	Pacific Ocean	E Pacific	catches	purse seine	60	1994–2004	Minami *et al*., (2007)
9	Pacific Ocean	E Pacific	CPUE	purse seine	69	1994–2013	IATTC (2014) - CPUE-OBJ
10	**Pacific Ocean**	**E Pacific - N stock**	**CPUE**	**purse seine**	**37**	**1994–2013**	**Lennert-Cody *et al.* (2016)**
11	**Pacific Ocean**	**E Pacific - S stock**	**CPUE**	**purse seine**	**63**	**1994–2013**	**Lennert-Cody *et al.* (2016)**
12	**Pacific Ocean**	**E Pacific - S stock**	**CPUE**	**purse seine**	**77**	**1994–2013**	**Lennert-Cody *et al.* (2016)**
13	Atlantic Ocean	N Atlantic	CPUE	longline	91.2	1954–1957; 1995–1999	Baum & Myers (2004) - abundance
14	Atlantic Ocean	N Atlantic	other	longline	84	1954–1957;1995–1999	Baum & Myers (2004) - mean body mass
15	**Atlantic Ocean**	**NW Atlantic**	**standardized CPUE**	**longline**	**50**	**1986–2005**	**Cortes (2007) - logbooks**
16	**Atlantic Ocean**	**NW Atlantic**	**standardized CPUE**	**longline**	**46**	**1992–2005**	**Cortes (2007) - observers**
17	**Atlantic Ocean**	**NW Atlantic (GOM)**	**standardized CPUE**	**longline**	**48**	**1986–2005**	**Cortes (2007) - logbooks**
18	**Atlantic Ocean**	**N Atlantic**	**standardized CPUE**	**longline**	**0**	**1994–2015**	**Carlson *et al.* (2012)**

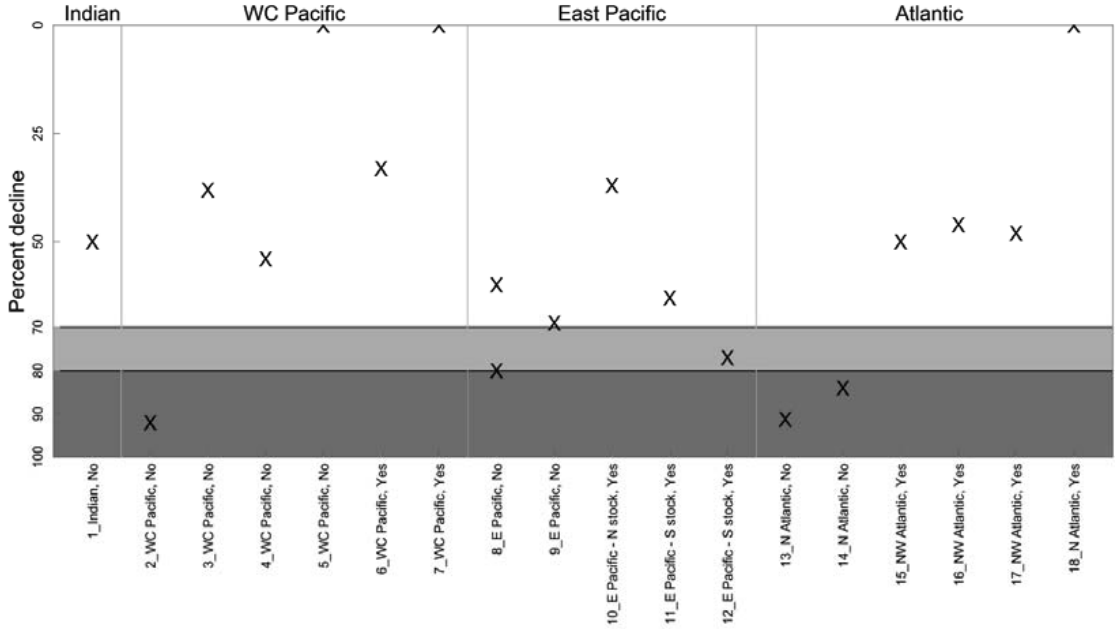

Figure 1. Percent of baseline stock declines (note data reference number from Table 2). A species with a low productivity that has declined by over 80% of baseline (dark band) can be considered for listing in Appendix I, or with a precautionary approach (light band) 5-10 % less (see full description in footnote to Annex 5 of Res. Conf. 9.24 (Rev. CoP16)). 'Yes' and 'No' in the X axis titles denotes datasets adopted for use, or excluded from the final assessment. Note Minami *et al.*, (2007) states: "When $\theta = 0.01$ the standardized average bycatch per set for 2004 was less than 20% of the 1994 value, while for the Poisson regression model, the standardized average bycatch per set in 2004 was about 40% of the 1994 value." This gives a range of 60%-80% decline (80% point added here for E. Pacific, dataset 8).

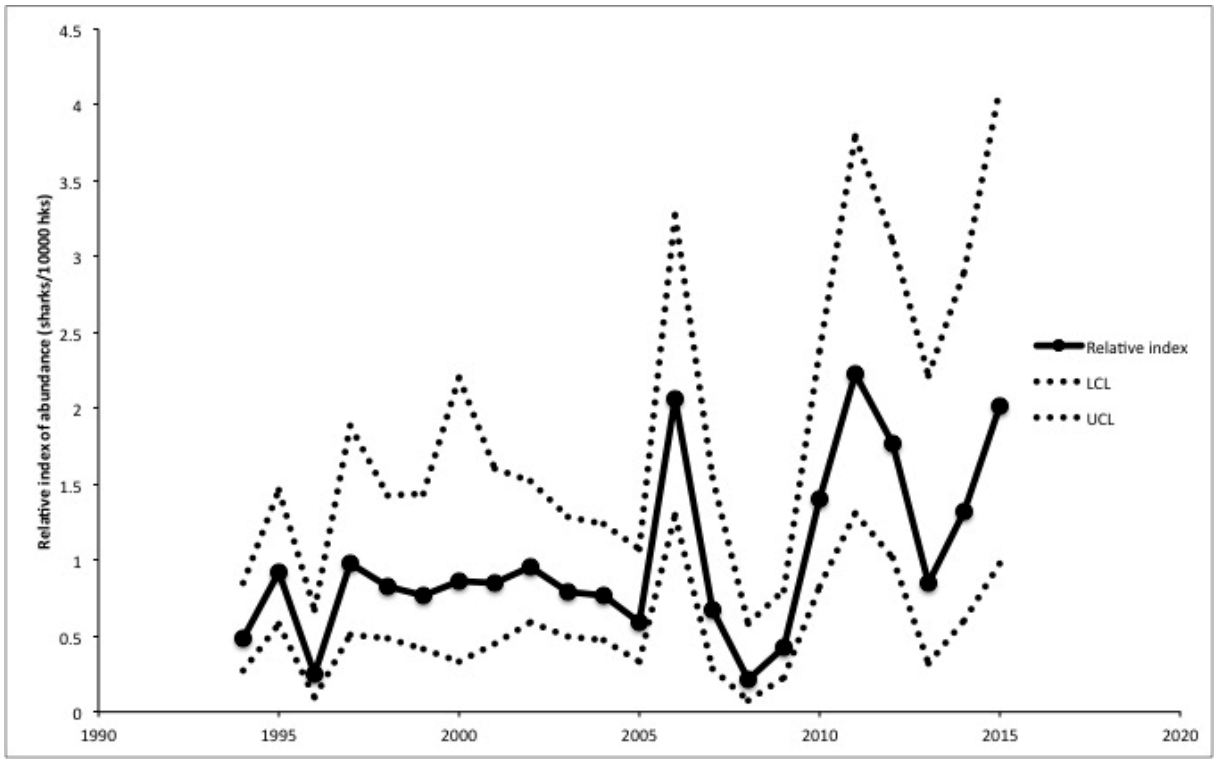

Figure 2. Standardized CPUE for silky shark with 5% and 95% confidence intervals. Data from the US shark bottom longline fishery analyzed following the methodology described by Carlson *et al.* (2012).

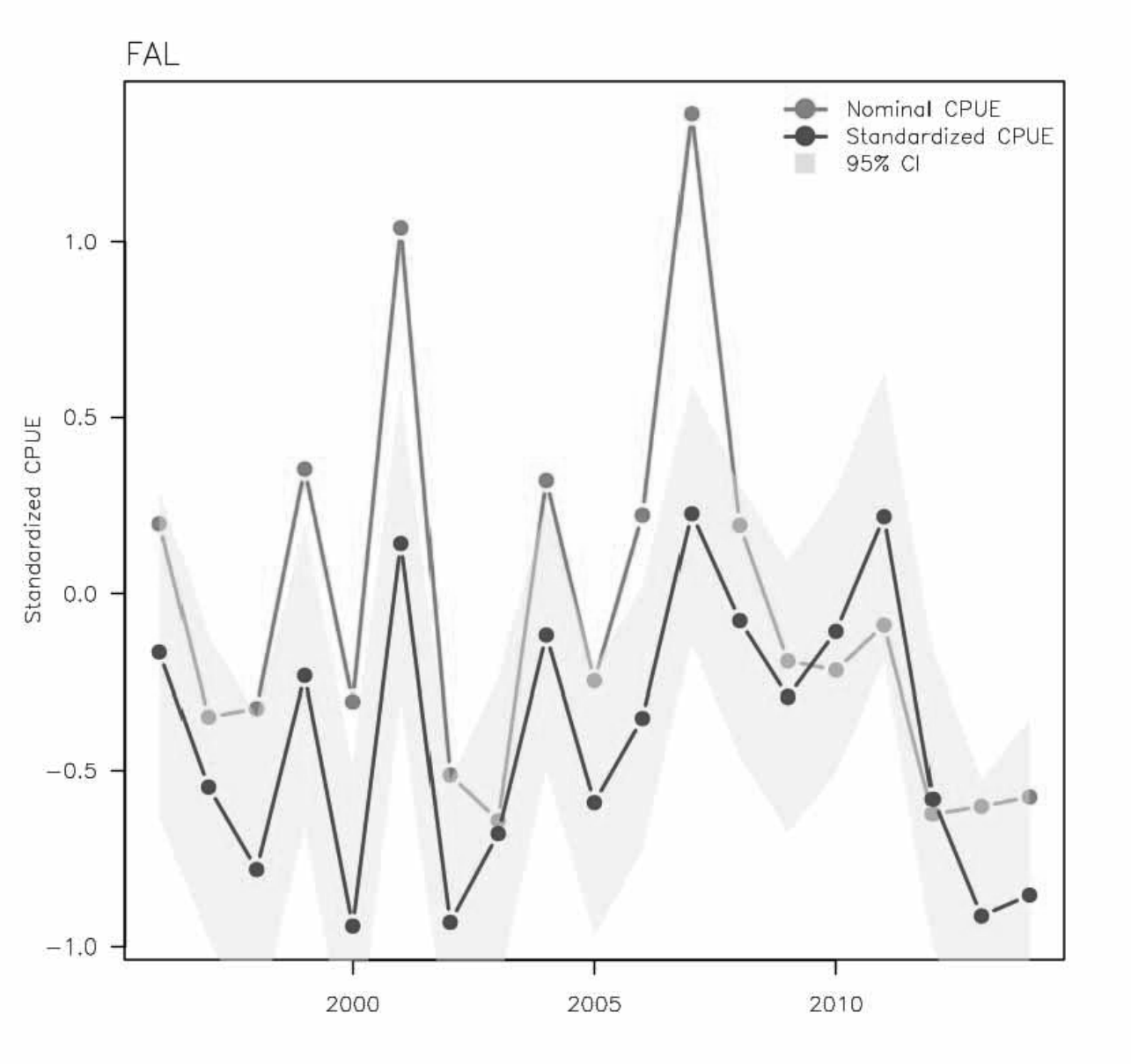

Figure 3. Nominal and standardized CPUE for silky shark. Grey shaded area indicates the limits of the 5% and 95% confidence intervals (In Rice *et al.*, 2015; Figure 37).

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 43

Species:

Bigeye thresher shark, *Alopias superciliosus*.

Proposal:
To include bigeye thresher shark, *Alopias superciliosus* in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention. If listed, this would result in the inclusion of all other species of thresher sharks, genus *Alopias* spp. in accordance with Article II paragraph 2(b) of the Convention and satisfying Criterion A in Annex 2b of Resolution Conf. 9.24 (Rev. CoP14).

Assessment Summary

Bigeye thresher are wide-ranging and globally distributed. The Panel considered this a low productivity species and determined that there is no reliable evidence of a decline of bigeye thresher that would meet Appendix II listing criteria. Related indices that did meet the criterion were not specific to bigeye thresher, suffered from methodological problems or were older analyses that were not consistent with recent studies using the same datasets. If CITES Parties did adopt an Appendix II listing of the bigeye thresher, it would include all other species of thresher sharks under 'look alike' provisions. If this listing was implemented effectively, this could act as a complementary measure for regulations implemented by Regional Fisheries Management Organisations, in particular, where these authorities have adopted measures prohibiting retention of thresher sharks. The Panel also noted that where a States' ability to complete CITES provisions for highly migratory species was limited, then trade might cease or continue without adequate CITES documentation.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

Bigeye thresher, *Alopias superciliosus* (Lowe 1841), is a species with a worldwide circumglobal distribution in tropical and temperate oceanic and coastal seas. Bigeye thresher occurs in FAO fishing areas 21, 27, 31, 34, 37, 41, 47, 51, 57, 61, 67, 71, 77, 81, 87. Trejo (2005) conducted a global population genetic study of bigeye thresher from nine locations (n=64 samples) that supported links in the population structure between Indo-Pacific and Atlantic populations, but not among populations spanning the entire Indo-Pacific Ocean. However, due to the preliminary nature of these data, and low sample size throughout the study, these results cannot be relied upon to confirm one or more genetically distinct stocks of the common or bigeye thresher shark. There are no estimates of total population numbers for the species.

Bigeye thresher is highly migratory. Long-range horizontal movements were found in two bigeye thresher sharks tagged with pop-up satellite archival tags (PSAT) off Hawaii. Both sharks made movements towards Mexico, with one shark moving 2465.5 km in 181 days and the other 3014.3 km over 240 days (Musyl *et al*., 2011). Two bigeye thresher sharks tagged in the Gulf of Mexico moved from the northeast coast of the United States to the southern Gulf of Mexico, a straight-line distance of 2,767 km and 51 km, respectively (Weng and Block, 2004; Carlson and Gulak, 2012). The largest satellite tagging study was conducted in the tropical northeast Atlantic where 12 bigeye threshers were tagged, showing up to 1439.9 km straight-line distances over 122 days (Coelho *et al*., 2015). Conventional tag and recapture studies have recorded movements from the US to and Central American (Kohler *et al*., 1998).

Based on this information, the panel decided to use the following management areas as a basis to compare trends in abundance: i) the Atlantic Ocean, as there is no information to differentiate within it; ii) Indian Ocean and ii) Western Central Pacific. There was not information for the Eastern Pacific.

Generally there is good information about biological parameters. After reviewing the available parameter estimates for the species (Table 1), the Panel concluded that the species generally meets the low productivity criteria. Longevity estimates for the Atlantic and Pacific are consistent with a medium

productivity. However, the Panel considered that the longevity estimates could be underestimated because of uncertainty in aging methods for sharks in general and also because the estimates of maximum age of the exploited populations are likely underestimates of the true longevity. Considering that the majority of the parameters points to very low productivity values, the Panel concluded that the species has a low productivity.

It should be noted, that because demographic parameters estimated using data from a fished population, the values reported for r (continuous rate of population increase) and lambda (the finite rate of population increase) are likely to be underestimates.

Trends and application of the decline criterion

Under the CITES criteria for commercially exploited aquatic species (Res. Conf. 9.24 Rev. CoP16), a decline to 15–20 percent of the historical baseline for a low-productivity species might justify consideration for an Appendix I listing. For listing on Appendix II, being "near" this level might justify consideration for a listing, which for a low-productivity species would be 20–30 percent of the historical level (15–20 percent + 5–10 percent precautionary measure).

In some cases, indices are species-specific for bigeye thresher, in others for common thresher (*A. vulpinus*) or a complex of thresher shark species (*Alopias* spp.). The Panel evaluated the information and trends for the bigeye thresher shark and commented on the others.

Some of the references in relation to population decline presented in the Proposal are incomplete, outdated and/or mis-cited. The Panel updated this information to include scientific information on status of thresher stocks.

Information evaluated by the Panel regarding population trends from different oceanic regions is summarized below and in Table 2.

Atlantic Ocean

In regards to trends in abundance, the Proposal noted declines of 70–80% for *Alopias* (not specific to *A. superciliosus*) for the period 1992–2003 in the northwest Atlantic Ocean from a commercial self-reported pelagic longline logbook program (Baum *et al.*, 2003). The Proposal also notes a 99% decline in thresher shark from the Mediterranean Sea (Ferretti *et al*., 2008). However, several studies (e.g. Cortes *et* al., 2007; Baum and Blanchard, 2010) have updated the former data series and the Panel thus considered the most recent analyses. Moreover, an examination of the species analyzed by Ferretti *et al*. (2008) indicates the decline in abundance was for *A. vulpinus* (common thresher) and did not present any information relative to bigeye thresher.

In the more recent re-analysis of the same commercial fishery logbook dataset used by Baum *et al*. (2003), Cortés *et al.* (2007) reported a 63% decline from 1986–2005 for *Alopias* sp. (Figure 2) In addition, analysis of data collected by on-board observers from the same fishery found a 28% increase in *Alopias* spp. from 1992–2005. Baum and Blanchard (2010) also analyzed observer data from 1992–2005 and reported no change in the population trend over the time period, concluding that for thresher sharks the population has potentially stabilized. A recent status review of bigeye thresher shark conducted by the US National Marine Fisheries Service (Young *et al.*, 2016) using an update of the observer data used by Cortés *et al.* (2007) and Baum and Blanchard (2010) found the trend in bigeye thresher abundance to be relatively flat from 1992–2014.

The Panel also noted that the Proposal draws a conclusion about a decline in bigeye thresher from a comparison in Beerkircher *et al.* (2002) involving Beerkircher *et al.* (2002)'s own data and a previous survey (Berkeley and Campos, 1998). However, the Beerkircher *et al.* (2002) paper expresses some caveats about the comparability of the two studies and presents the comparison for information rather than as a basis for drawing a firm conclusion about a population decline for bigeye thresher. Given these aspects of the Beerkircher *et al*. (2002) paper, this reference does not credibly support a decline of 70% from the historic baseline.

For the southwest Atlantic Ocean, the Proposal also reports a consistent decline in bigeye thresher CPUE over the preceding 30 years from the IUCN Red List assessment (Amorim *et al*., 1998). However, the Red List assessment actually reported that the landed catch and CPUE of bigeye thresher shark increased

from 1971 to 1989, and then gradually decreased from 1990 to 2001. Amorim *et al*. (1998) further concluded the decrease does not necessarily reflect stock abundance because changes in the depth of fishing operations also occurred, which may have affected the catchability along the time series.

Most catch rates (CPUEs) available for bigeye threshers in the Atlantic Ocean began in the late 1980s to early 1990s. However, it was noted that the exploitation of this stock began at least two decades prior to this time. The Panel suggested that the majority of bigeye thresher sharks were probably caught in association with bigeye tuna or swordfish targeting fleets. As such the Panel looked at historical catches of these two species obtained from the ICCAT Task 1 nominal catch database (ICCAT, 2015) and noted that the peak of catches occurred in the early 1990s with declines in recent times implying that the start of the available abundance indices coincide with the peak of potential exploitation of the bigeye thresher species.

Indian Ocean

The Panel considered and discussed the Fishstat statistics from Sri Lanka (FAO, 2016) that were listed in the Proposal. The Panel noted that the statistics represent only reported landings and do not include effort or discards information. The Panel also noted that no logbook or observer based information on this data were provided. This can be a problem in cases where there are changes in effort or fishery-dependent factors during the period that can affect the catches, including changes in targeting and operational patterns. The Panel also noted that the statistics are shown for the *Alopias* genus and are not species-specific, which can cause biased interpretations if there are changes in the species composition through time. Finally, the Panel noted that the two final years plotted and used in the analysis (Figure 2 of the Proposal, years 2012-2013) are represented as zeros but refer to data that is not available in FishStat (likely data that has not been submitted), and that those zero's at the end of the series are causing bias in the interpretation. The Panel agreed that the information provided for the Indian Ocean should not be used as evidence of the suggested declines. The Panel also noted that the Indian Ocean is the region with the largest deficiency of reliable catch and effort statistics.

Western Central Pacific

The Panel considered the most recent standardized CPUE series available from the Pacific. They included Rice *et al*. (2015), that reflects longline observer data for *Alopias* spp. across the entire Western and Central Pacific, and a recent standardized CPUE series specific to bigeye thresher for the Hawaii longline fishery presented in Young *et al.* (2016), which shows no trend in abundance.

The Rice *et al*. (2015) *Alopias* spp. time series suggested a potential decline in the most recent years (3 most recent years in the standardized series and 5 most recent years in the nominal series) (Figure 3), acknowledging that, as in most observer time series, the recent years' data often suffer from incomplete reporting and the analysis excluded the important Hawaiian longline observer data (Rice *et al*, 2015).

Young *et al*. (2016) reported the standardized CPUE of bigeye thresher shark using Hawaiian longline observer data for the period between 1995 and 2014, which shows general flat trend with large increase of the nominal CPUE in most recent years (Figure 4). Given the fact that the standardized CPUE by Young *et al*. (2016) is specific to bigeye thresher shark and data collected from one of the areas where bigeye thresher shark is most abundant, the Panel recognized that standardized CPUE of bigeye thresher shark by Young *et al*. (2016) is better representing the dynamics of population of bigeye thresher shark in the WCPFC area.

Given the species' very low productivity, the Western and Central Pacific Fisheries Commission decided to explore stock status further by initiating a Pacific-wide assessment for the bigeye thresher. This study will be completed in time for the next WCFPC Scientific Committee meeting in August 2016. If endorsed, this document can be provided as an information document to the CITES CoP17 in September 2016. The study incorporates data from Rice *et al*. (2015), Young *et al*. (2016) and new data from the Japanese observer programme.

The Panel noted that the Proposal cites Ward and Myers (2005) finding of an 83% decline in biomass for all threshers between the 1950s and the 1990s. However, a close review of the Ward and Myers (2005) paper identified that there was an increase in nominal CPUE between the two periods and the details of how the standardization converted this nominal increase to a standardized decrease of 83%

were not clear. It was also noted that the confidence interval for the thresher biomass estimate given in the appendix was very large and not shown in the paper itself. Furthermore, the sample sizes in the earlier period were very small, i.e. as few as n=2 for the size estimates, and the paper was inconsistent about whether thresher sharks should or shouldn't be analysed differently due to their potential association with land masses. For all of these reasons, the Panel had little confidence in confirming a decline in thresher sharks based on this paper. The Panel also recalled that the WCPFC scientific Committee critiqued the Ward and Myers (2005) paper in 2005, and noted the advice of Polachek (2006) regarding the tendency of long CPUE series to overestimate abundance declines in large pelagic species.

One of the papers by Walsh *et al.* cited in the Proposal as "in press" was published in 2009. The Proposal states that this paper demonstrates a 9.5% decline in deep sets and 43% decline in shallow sets but the results in the published paper show a 28% decline in the deep sets and no catch of bigeye thresher sharks in the shallow set sector. The published paper also showed a significant increase in the mean size of bigeye threshers in the later period. While Walsh *et al*. (2009) does show a significant, species-specific decline for the bigeye thresher, the analysis is based on nominal catch rates only. The Panel noted that this same data series was updated and standardized in Young *et al*. (2016) and showed no discernible trend in bigeye thresher shark abundance.

The Panel considered an unpublished manuscript on species composition in the shark fin trade and agreed that it provides a useful and novel baseline against which to monitor future changes in trade flows (Andrew Fields, in review, from State University of New York, Stony Brook, Demian Chapman Laboratory). However, the panel identified a number of important differences between the manuscript's "trimmings" samples and previous sampling by Clarke *et al*. (2006a,b) which were based on auction records classified by Chinese trade names and fin positions. These differences included the method of sample collection, estimates based on numbers versus weights, and potential differences in composition of trimmings given the extent of trimming needed for fins from different fisheries. For these reasons, the panel considered that comparisons between the two studies were problematic and could not be used as valid evidence for changes in population abundance.

Modifying factors and risk

Vulnerability factors such as life-history parameters and susceptibility to multiple threats, including to fisheries bycatch are addressed in the decline criterion threshold for a low productivity species. Circumglobal distribution could be a positive modifying factor, whereas the high at-vessel mortality could be negative. Panelists did not consider other potential biological or ecological factors that would alter the conclusions regarding biological listing criteria.

Summary of evaluation and assessment of biological listing criteria

No global population estimates of bigeye thresher shark are available, however, the population is unlikely to be small. The species is wide-ranging and globally distributed so it does not meet the criteria for a restricted distribution. The Panel considered this a low productivity species and so considered that a decline of 70% or more over 2 generations (about 30 years) might meet the criteria for listing. Of the indices considered, most did not meet the CITES decline criterion. The indices that did meet the criteria were not specific to bigeye thresher shark, suffered from methodological problems or were older analyses that were not consistent with recent studies using the same datasets. Therefore, the Panel concluded that there is no reliable evidence to support a decline of bigeye thresher that would meet the CITES Appendix II listing criteria.

Comments on technical aspects in relation to trade, management and implementation

The following comments are in response to statements in the Proposal related to management and trade and are not a comprehensive summary of management regimes or trade of thresher sharks. The Panel found that much of the information necessary to thoroughly evaluate the management and trade aspect of the Proposal were not available for the review therefore for the comments presented below the Panel needed to rely largely on its own expert knowledge which at time was anecdotal and or qualitative.

The scope of the Proposal also includes all other species of thresher sharks, genus *Alopias* spp. for "look alike" reasons, i.e. species whose specimens in trade look like those of species listed for conservation reasons (see Article II, paragraph 2 of the CITES Convention). If bigeye threshers were to be listed on Appendix II, CITES measures would have to be applied to all the genus *Alopias* spp.

Management comment

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International management:
    - The FAO IPOA-Sharks underscores the responsibilities of fishing and coastal States for sustaining shark populations, ensuring full utilisation of retained shark species and improving shark data collection and monitoring.
    - The formally adopted FAO Port State Measures Agreement is an agreement on port state measures to prevent, deter and eliminate IUU fishing. This agreement requires that any inspections conducted on fishing vessels entering ports includes verification that all species exploited have been taken in compliance with international law, international conventions and measures of RFMOs
- Regional management:
    - All Tuna RFMOs have adopted prohibitions on finning and encourage the release of live sharks where possible
    - Some RFMOs already include oceanic, pelagic and highly migratory elasmobranchs in the scope of their Conventions, while ICCAT is amending its Convention scope so that they are included.
    - Retention of bigeye thresher sharks is prohibited in ICCAT and GFCM except for a measure enabling the retention of 110 specimens annually by Mexico. IOTC does not permit retention of any thresher shark species. These measures have been adopted following ecological risk assessments by the RFMOs.
    - Some tuna RFMOs require catches of threshers as a group or as individual species to be recorded and reported annually. This is complemented by observer programmes and discard reporting.
    - There are research efforts on sharks at regional and national levels that include thresher sharks.
- National measures:
    - Some States implement regional management measures (above) through, e.g. national plans of action and or finning controls, including requiring fins to be attached and prohibiting retention of thresher sharks.
    - Some States require catches of threshers as a group or as individual species to be recorded and reported annually.
    - MPAs and other spatial measures to protect sharks are established in several EEZs.
    - Catches of thresher sharks only reported to FAO by a small number of States, others report shark catches at more generic levels.
    - Where there are prohibitions on retention of thresher sharks, they are still caught and information suggests that mortality rates may be in the order of 50% (Clarke, 2011; Coelho *et al*., 2011, 2012; Gallagher *et al*., 2014).

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES

- Limited information and compliance shortfalls makes it difficult to evaluate the effectiveness of the above measures, both regionally and nationally.

- Appendix II listing may generate additional information that can assist fisheries managers to assess fishing mortality rates. Reporting of thresher species catches, where landing is permitted, would be improved in some cases.
- Appendix II listing could assist in improving compliance by providing an impediment to trading in thresher shark products illegally obtained from fisheries where retention bans are in place, due the requirement to supply CITES documentation.
- All catches landed from the high seas would require IFS Certification or Export Permits which require NDFs and legal acquisition findings or the corresponding requirements under Introduction from the Sea. This applies not only to landings for commercial purposes but also to the taking of samples for scientific purposes.
- CITES Parties have raised implementation issues, including short falls in available data, at FAO Workshops (e.g. FAO Expert Consultation on Impacts of CITES Listing of Sharks and Rays Species in the South and Southeast Asia Region. Penang, Malaysia. 19-20 April 2016) many of which are cited as limitations on conducting NDFs. CITES Animals Committee and Standing Committee shark working groups have been tasked to work on the issues. The work is on-going.
- FAO has a project to assess the impact of CITES shark listings (Contribution to responsible and appropriate application of CITES provisions to assist in the conservation and sustainable use of commercially-exploited aquatic species, Component 9 of a FAO/Government Cooperative Program, "Improved Fisheries Management for Sustainable Use of Marine Living Resources in the Face of Changing Systems") which is on-going.

Trade comment

Thresher sharks are largely caught during target fishing for tunas. Retention, where permitted, is for local consumption and international trade. Thresher shark products are in international trade in different forms, including meat and fins. Thresher shark fins are considered by traders to be one of the least valuable types of shark fins used for shark fin products. (Clarke pers. comm., 2016)

Trade (market transparency, documentation and level of IUU)

- In general there are no specific catch or trade documentation schemes for sharks. Existing general catch documentation systems in some countries could facilitate the issuing of legal acquisition findings (e.g. the EU's Catch Certification requirements).
- There is a finite capacity in the commonly used of the WCO harmonized system (HS) of tariff classification to identify products of thresher sharks in trade, much of which has been used already (www.wcoomd.org/en/faq/harmonized_system_faq.aspx#q9).
- There are historical and current efforts to monitor the species composition of the shark fin trade and these may continue to provide insights into the trade.

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES

- CITES provisions on trade in specimens of species listed on Appendix II require the issuance of an export permit by the exporting country, which shall only be granted if the national CITES authorities are satisfied that: 1) the export is not detrimental to the survival of the species in the wild; and 2) the specimens were not obtained in contravention of the national laws of that state.
- If implemented effectively, the trade will be recorded in the CITES trade database, and this will improve overall trade information.
- States' abilities to make NDFs for highly migratory species is limited in the absence of region-wide assessments as evidenced by difficulties encountered in making NDFs for shark species that have already been listed. Under these conditions the following outcomes can occur:
    - Previous trade ceases;

- Trade continues without proper CITES documentation (also known as 'illegal trade'); and/or
- Trade continues with inadequate NDFs.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

Bigeye thresher shark is being proposed for CITES Appendix II listing in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states 'It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future'. In this case, if listed, all other thresher sharks will also be included (all genus Alopias spp.) in accordance with Article II paragraph 2(b) of the Convention and satisfying Criterion A in Annex 2b of Resolution Conf. 9.24 (Rev. CoP 14).

It is difficult to draw clear conclusions regarding the effectiveness of existing and future management and trade measures due to the lack of data available to be able to assess these measures. However, it is noted that if properly implemented, a CITES Appendix II listing could be expected to result in better monitoring and reporting of catches entering international trade of bigeye thresher shark and look-alike species. Improved monitoring should enable new or enhanced assessments of stock status and the subsequent adoption of management measures that ensure the sustainability of harvests where these are still permitted. Harvests from international waters would fall under IFS provisions of the CITES convention. These would require CITES documentation to the species level for specimens entering the jurisdiction of a State from international waters, along with a NDF indicating that the harvest was sustainable and consistent with relevant measures under international law.

Listing would also provide an additional control to ensure that products entering international trade are derived from legal and sustainable fisheries. A CITES Appendix II listing, if implemented effectively, could also act as a complementary measure to regulations implemented by fisheries management authorities, in particular, where RFMOs have adopted measures prohibiting retention of thresher sharks.

It should be noted that States' abilities to make NDFs for highly migratory species is limited in the absence of region-wide assessments as evidenced by difficulties encountered in making NDFs for shark species that have already been listed. Under these conditions the following outcomes can occur, previous trade ceases, trade continues without proper CITES documentation (i.e. illegal trade) and/or trade continues with inadequate NDFs.

References

Amorim, A., Baum, J., Cailliet, G.M., Clò, S., Clarke, S.C., Fergusson, I., Gonzalez, M., Macias, D., Mancini, P., Mancusi, C., Myers, R., Reardon, M., Trejo, T., Vacchi, M. & Valenti, S.V. 2009. *Alopias superciliosus*. The IUCN Red List of Threatened Species 2009: e.T161696A5482468. http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T161696A5482468.en. Downloaded on 22 June 2016.

Baum, J.K. & Blanchard, W. 2010. Inferring shark population trends from generalized linear mixed models of pelagic longline catch and effort data. *Fisheries Research*. 102: 229–239.

Baum, J.K., Myers, R.A., Kehler, D.G., Worm, B., Harley, S.J. & Doherty, P.A. 2003. Collapse and conservation of shark populations in the northwest Atlantic. *Science*, 299: 389–392.

Baum, J.K., Kehler, D. & Myers, R.A. 2005. Robust estimates of decline for pelagic shark populations in the northwest Atlantic and Gulf of Mexico. *Fisheries* 30: 27-29.

Beerkircher, L.R., Cortés, E. & Shivji, M. 2002. Characterisitics of shark bycatch observed on pelagic longlines off the southeastern United States, 1992–2000. *Mar. Fish. Rev.* 64 (4): 40–49.

Berkeley, S.A. & Campos, W.L. 1988. Relative abundance and fishery potential of pelagic sharks along Florida's East Coast. *Mar. Fish. Rev.* 50(1):9–16.

Carlson, J.K. & Gulak, S.J.B. 2012. Habitat use and movements patterns of oceanic whitetip, bigeye thresher and dusky sharks based on archival satellite tags. Collective Volume of Scientifics Papers ICCAT, 68 (5): 1922–1932.

Chen, P. & Yuan, W. 2006. Demographic analysis based on the growth parameter of sharks. *Fisheries Research*, 78:374–379.

Clarke, S. 2011. A Status Snapshot of Key Shark Species in the Western and Central Pacific and Potential Management Options. WCPFC-SC7-2011/EB-WP-04.

Clarke, S.C., Magnussen, J.E., Abercrombie, D.L., McAllister, M.K. & Mahmood, S.S. 2006a. Identification of shark species composition. Proportion in the Hong Kong shark fin market based on molecular genetics and trade records. *Conservation Biology*, 20(1): 201–211.

Clarke, S.C., McAllister, M.K., Milner-Gulland, E.J., Kirkwood, G.P., Michielsens, C.G.J., Agnew, D.J., Pickitch, E.K., Nakano, H. & Mahmood, S.S. 2006b. Global estimates of shark catches using trade records from commercial markets. *Ecology Letters*, 9: 1115–1126.

Coelho R., Fernandez-Carvalho J., Lino P.G. & Santos M.N. 2012. An overview of the hooking mortality of elasmobranchs caught in a swordfish pelagic longline fishery in the Atlantic Ocean. *Aquatic Living Resources*, 25: 311–319.

Coelho, R., Fernandez-Carvalho, J., & Santos, M.N. 2015. Habitat use and diel vertical migration of bigeye thresher shark: overlap with pelagic longline fishing gear. *Marine Environmental Research*, 112: 91–99.

Coelho, R., Lino, P.G. & Santos, M.N. 2011. At-haulback mortality of elasmobranchs caught on the Portuguese longline swordfish fishery in the Indian Ocean. Indian Ocean Tuna Commission. Technical Document IOTC–2011–WPEB07–31.

Cortés, E. Domingo, A., Miller, P., Forselledo, R., Mas, F., Arocha, F., Campana, S., Coelho, R., Da Silva, C., Hazin, F.H.V., Hotzhausen, H., Keene, K., Lucena, F., Ramirez, K., Santos, M.N., Semba-Murakami, Y. & Yakowa, K. 2015. Expanded Ecological Risk Assessment of Pelagic Sharks Caught in Atlantic Pelagic Longline Fisheries. Collected Volume of Scientific Papers. ICCAT. 71(6): 2637–2688.

Cortés, E., Brown, C.A., & Beerkircher, L.R. 2007. Relative abundance of pelagic sharks in the western north Atlantic Ocean, including the Gulf of Mexico and Caribbean Sea. *Gulf and Caribbean Research* 19(2): 37–52.

FAO. 2016. Fishery and Aquaculture Statistics. Global capture production 1950–2014. FishStatJ.

Fernandez-Carvalho, J., Coelho, R., Mejuto, J., Cortés, E., Domingo, A., Yokawa, K., Liu, K.M., García-Cortés, B., Forselledo, R., Ohshimo, S., Ramos-Cartelle, A.M., Tsai, W.P., & Santos, M.N. 2015. Pan-Atlantic distribution patterns and reproductive biology of the bigeye thresher, *Alopias superciliosus*. *Reviews in Fish Biology and Fisheries*, 25: 551–568.

Ferretti, F., Myers, R. A., Serena, F. & Lotze, H. K. 2008, Loss of Large Predatory Sharks from the Mediterranean Sea. *Conservation Biology*, 22: 952–964.

Gallagher, A.J.Orbensen, E.S., Hammerschlag, N., & Serafy, J.E. 2014. Vulnerability of oceanic sharks as pelagic longline bycatch. *Global Ecology and Conservation*, (1)50–59.

Kohler, N.E., J.G. Casey, & P.A. Turner. 1998. NMFS Cooperative Tagging Program, 1962–93: An atlas of shark tag and recapture data. *Marine Fisheries Review* 60(2): 1–87. Available online at: http://spo.nwr.noaa.gov/mfr6021.pdf.

ICCAT. 2015. Web-based application to view nominal catches of Atlantic tunas and tuna-like fish (including sharks), by gear, region and flag in web application [version 11/2015] (available at www.iccat.int/en/accesingdb.htm).

Lawson, T. 2011. Estimation of Catch Rates and Catches of Key Shark Species in Tuna Fisheries of the Western and Central Pacific Ocean Using Observer Data. WCPFC–SC7–2011 / EB–IP–02.

Liu K.M., Chin C.P., Chen C.H., & Chang J.H. 2015. Estimating Finite Rate of Population Increase for Sharks Based on Vital Parameters. *PLoS ONE* 10 (11): e0143008. doi:10.1371/journal.pone.0143008.

Liu, K.M., Chiang, P. J., & Chen, C.T. 1998. Age and growth estimates of the bigeye thresher shark, *Alopias superciliosus*, in northeastern Taiwan waters. *Fishery Bulletin* 96**,** 482–491.

Matsunaga. H. & Nakano, H. 1999. Species composition and CPUE of Pelagic Sharks Caught by Japanese Longline Research and Training Vessels in the Pacific Ocean. *Fisheries Science*, 65(1), 16–22.

Matsunaga. H., Hosono, T. & Shono H. 2006. Analysis of longline CPUE of major pelagic shark species collected by Japanese research and training vessels in the Pacific Ocean. WCPFC-SC2-2006/EB WP-10.

Murua, H., Coelho, R., Santos, M.N., Arrizabalaga, H., Yokawa, K., Romanov, E., Zhu, J.F., Kim, Z.G., Bach, P., Chavance, P., Delgado de Molina, A.& Ruiz J. 2012. Preliminary Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC-2012-WPEB-31: 16p.

Musyl, M.k., Brill, R.W., Curran, D.S., McNaughton, L.M., Nielsen, A., Kikkawa, B.S., Moyes, C.d. 2011. Postrelease survival, vertical and horizontal movements, and thermal habitats of five species of pelagic sharks in the central Pacific Ocean. *Fish. Bull.* 109(4):341–368.

Polacheck, T. 2006. Tuna longline catch rates in the Indian Ocean: Did industrial fishing result in a 90% rapid decline in the abundance of large predatory species? *Marine Policy* 30:470–482.

Rice, J., Tremlay-Boyer, L., Scott, R., Hare, S. & Tidd, A. 2015. Analysis of stock status and related indicators for key shark species of the Western Central Pacific Fisheries Commission. WCPFC-SC11-2015/EB-WP-04-Rev 1 (also available at https://www.wcpfc.int/node/21719).

Trejo, T. 2005. Global phylogeography of thresher sharks (*Alopias* spp.) inferred from mitochondrial DNA control region sequences. M.Sc. thesis. Moss Landing Marine Laboratories, California State University.

Walsh, W.A., Bigelow, K.A., & Sender, K. 2009. Decreases in Shark Catches and Mortality in the Hawaii-Based Longline Fishery as Documented by Fishery Observers. *Marine and Coastal Fisheries: Dynamics, Management and Ecosystem Science* 1:270–282.

Ward, P., & Myers, R. A. 2005. Shifts in open-ocean fish communities coinciding with the commencement of commercial fishing. *Ecology* 86:835–847.

Weng, K.C. & Block, B.A. 2004. Diel vertical migration of the bigeye thresher shark (Alopias superciliosus), a species possessing orbital retia mirabilia. *Fish. Bull.* 102:221–229.

Young, C.N., Carlson, J., Hutchinson, M., Kobayashi, D., McCandless, C., Miller, M.H., Teo, S., & T. Warren. 2016. Status review report: common thresher shark (*Alopias vulpinus*) and bigeye thresher shark (*Alopias superciliosus*). Final Report to National Marine Fisheries Service, Office of Protected Resources. March 2016. 199 pp.

Table and figures

Table 1. Information for assessing productivity of bigeye thresher shark

PARAMETER	STATUS	INFORMATION	AREA	SOURCE
TMAT_time to maturity	low	9–10 Males / 12.3–13.4 Females	Pacific Ocean	Liu *et al*., 1998
TMAX_longevity	medium	20	Pacific Ocean	Liu *et al*., 1998
TMAX_longevity	medium	25	Atlantic Ocean	Fernandez-Carvalho *et al*., 2015
growth	low	k 0.09 Males; 0.06 Females	Atlantic Ocean	Fernandez-Carvalho *et al*., 2015
intrinsic growth rate of pop	low	r 0.009 (-0.001–0.018)	Atlantic Ocean	Cortes *et al*., 2015
intrinsic growth rate of pop	low	λ 1.033 (1.017–1.047)	Indian Ocean	Murua *et al*., 2012
intrinsic growth rate of pop	low	λ 1.008	Global	Liu *et al*., 2015
generation time	low	17.8 years	Atlantic Ocean	Cortes *et al*., 2015
generation time	low	14.199 years	Pacific Ocean	Chen and Yuan, 2006
natural mortality	low	0.147	Pacific Ocean	Chen and Yuan, 2006

Table 2. Information on thresher shark trends from different oceanic regions. Information in bold was used in the final assessment. Also refer to Figure1.

REF #	AREA	COVERAGE	INDICATOR	FISHERY	EXTENT OF DECLINE %	REFERENCE PERIOD	OTHER SUPPORTING COMMENT(S), REFERENCE(S)
1	Indian Ocean	Indian	landings	others	70	1995–2014	FAO (2016) *Alopias* spp. in Sri Lanka
2	Pacific Ocean	C Pacific	CPUE	longline	0	1967–1970; 1992–1995	Matsunaga and Nakano (1999)
3	Pacific Ocean	C Pacific	CPUE	longline	30	1992 – 2003	Matsunaga *et al.* (2006)
4	**Pacific Ocean**	**C Pacific (Hawaii)**	**CPUE**	**longline**	**0**	**1995–2015**	**Young *et al.* (2016)**
5	Pacific Ocean	WC Pacific	CPUE	longline	25	1995 –2009	Lawson (2011)
6	Pacific Ocean	WC Pacific	CPUE	longline	0	2002–2014	Rice *et al.* (2015)
7	Pacific Ocean	WC-EC Pacific	catches	longline	28	1995–2000; 2004–2005	Walsh *et al.* (2009)
8	Pacific Ocean	WC-EC Pacific	CPUE	longline	83	1951–1958; 1999–2000	Ward and Myers (2004) - abundance
9	Pacific Ocean	WC-EC Pacific	other	longline	43	1951–1958; 1999–2000	Ward and Myers (2004) - sizes
10	Atlantic Ocean	NW Atlantic	CPUE	longline	70	1992–2000; 1981–1983	Berkeley and Campos(1988); Beerckircher *et al.* (2002)
11	**Atlantic Ocean**	**NW Atlantic**	**standardized CPUE**	**longline**	**63**	**1986–2005; 1992–2005**	**Cortés (2007)**
12	**Atlantic Ocean**	**NW Atlantic**	**CPUE**	**longline**	**0**	**1992–2005**	**Baum and Blanchard (2010)**
13	**Atlantic Ocean**	**NW Atlantic**	**CPUE**	**longline**	**0**	**1992–2014**	**Young *et al.* (2016)**
14	Global	Global	trade	others	99	2000–2015	Clarke *et al.* (2006a,b); Fields (submitted)

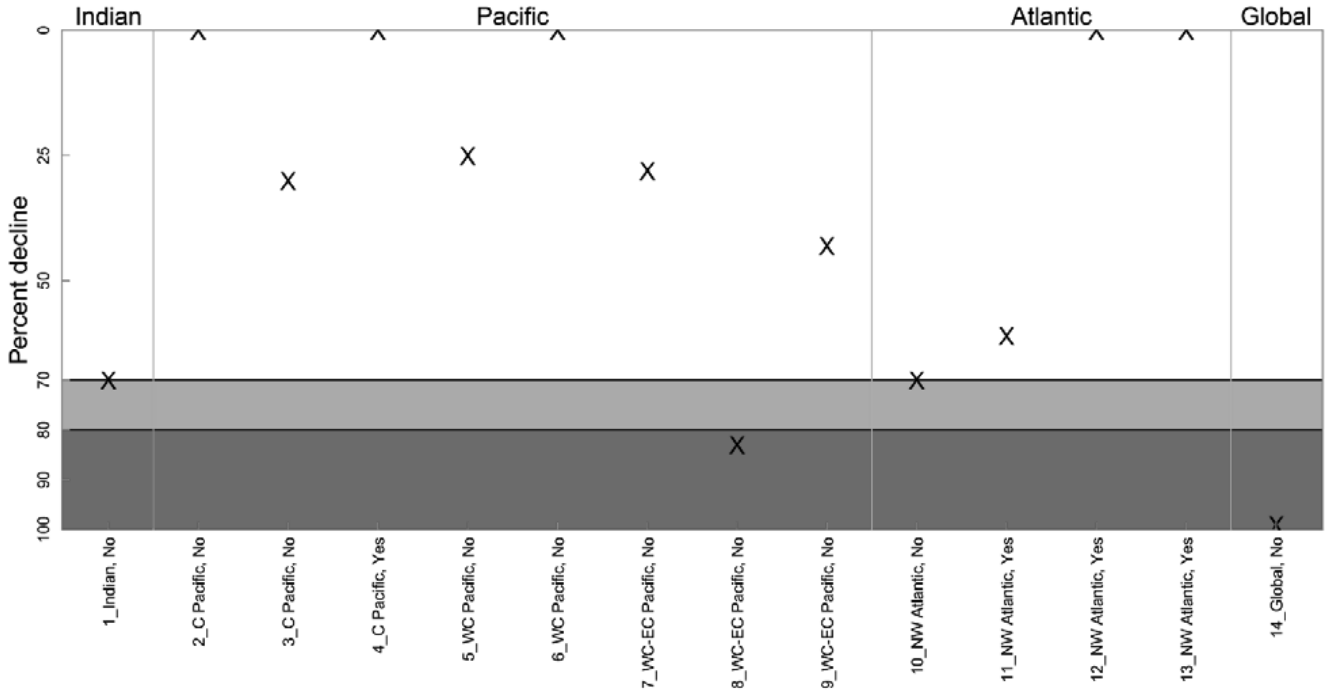

Figure 1. Percent of baseline stock declines (note data reference numbers from Table 2). A species with a low productivity that has declined by over 80% of baseline (dark band) can be considered for listing in Appendix I, or with a precautionary approach (light band) 5–10 % less (see full description in footnote to Annex 5 of Res. Conf. 9.24 (Rev. CoP16)). 'Yes' and 'No' in the X axis titles denotes datasets adopted for use, or excluded from the final assessment.

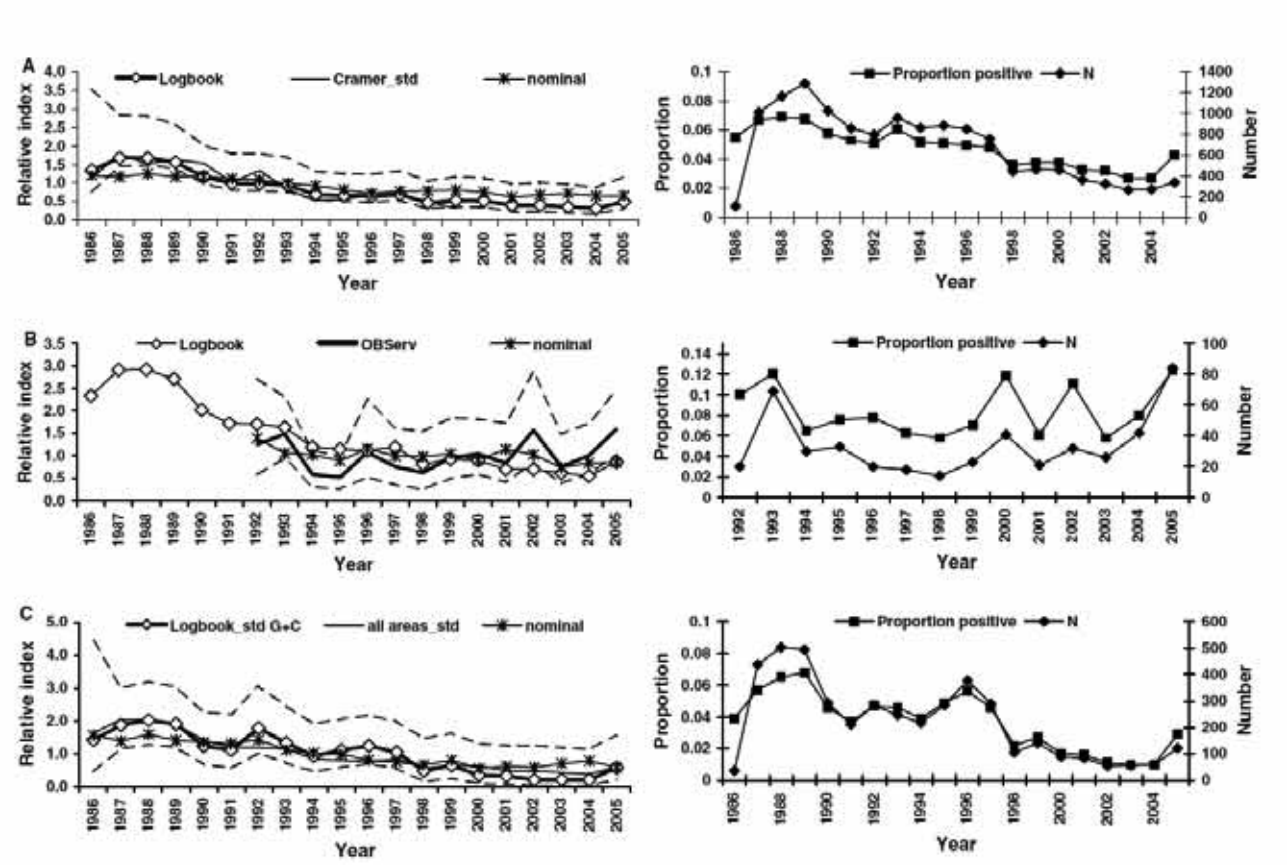

Figure 2. Nominal and standardized CPUE (in number) with 95% confidence intervals (dashed lines). A) thresher sharks, the pelagic longline logbook compared to a previous study by Cramer (2000), B) the pelagic longline observer program and C) the pelagic longline logbook restricted to areas 1 and 2 (Gulf of Mexico and Caribbean Sea). All indices are standardized to the mean of the overlapping years: The right Panels show the proportion of positive sets and sample size by year (In Cortes *et al*., 2007; Figure 5).

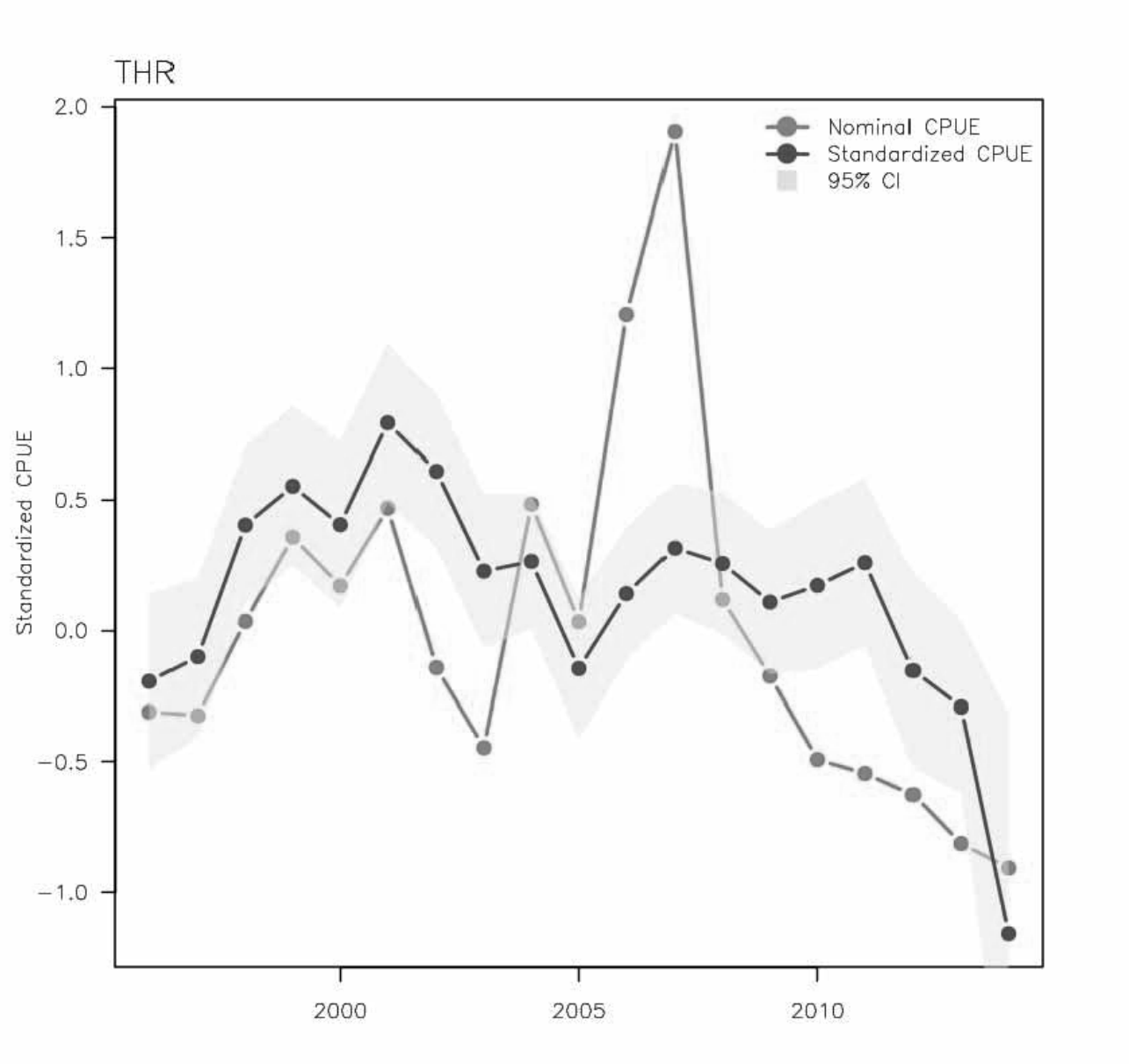

Figure 3. Nominal and standardised CPUE for thresher shark. Grey shaded area indicates the limits of the 5% and 95% confidence intervals (In Rice *et al*., 2015; Figure 43).

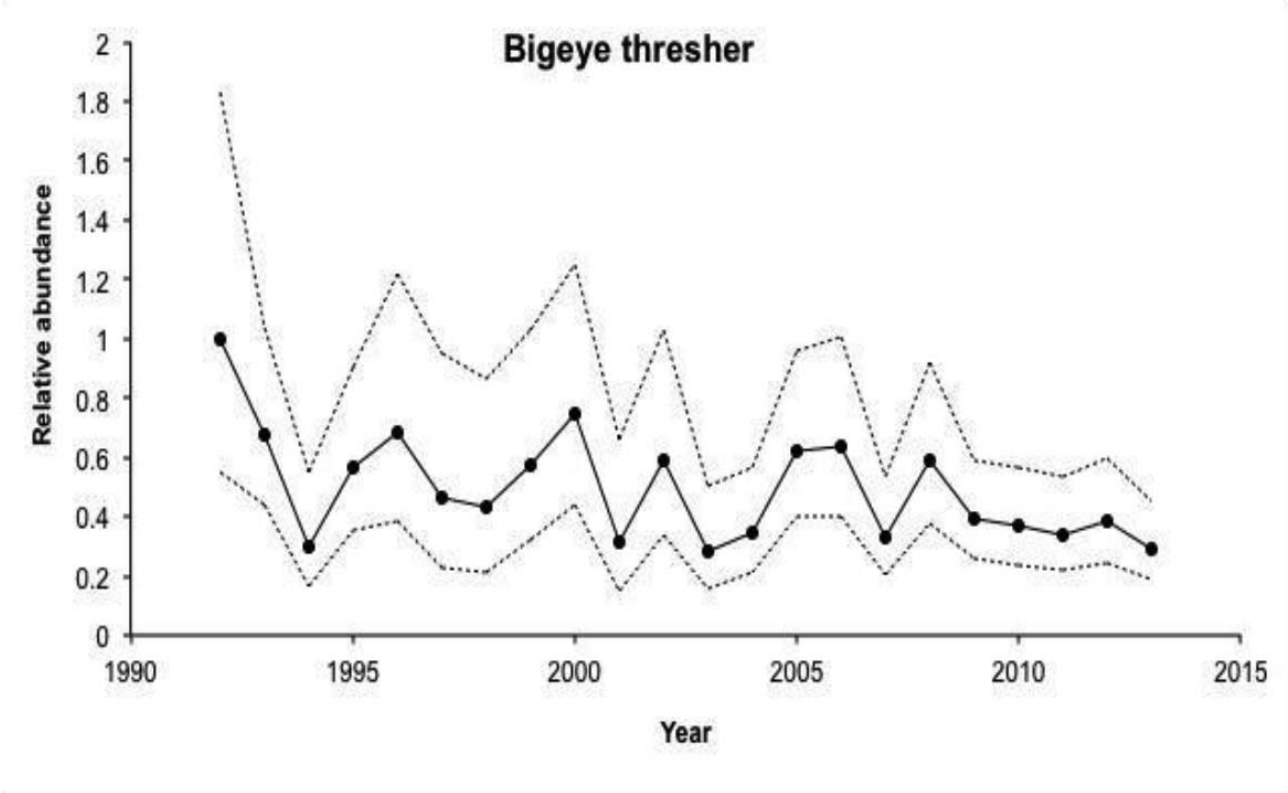

Figure 4. Estimated change in relative abundance (standardized catch per 1000 hooks) between 1992 and 2013 based on the observer data for thresher sharks. Relative abundance is expressed as the year's estimated mean index divided by the maximum estimated yearly mean index in each time series. Dotted lines represent upper and lower 95% confidence limits (Young *et al*., 2016; Figure 41).

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 44

Species:

Sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica*.

Proposal:

To include sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica* in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention. If listed, this would result in the inclusion all other species of mobula rays, genus *Mobula* spp. in Appendix II in accordance with Article II paragraph 2(b).

Assessment Summary

Both of the proposed mobula ray species are wide-ranging and globally distributed, but no global population estimates are available and there is little known about their stock structure. The Panel considered these species to have low productivity, and based on the 'best available evidence' suggested the data on decline meets the CITES Appendix II listing criteria. However, the Panel recognised that most of the available data was of low reliability, and limited to the eastern Pacific and Indo-Pacific regions, so the panel could not determine the status across other areas. Improved monitoring under Appendix II requirements should enable new or enhanced assessments to be made. Listing of the two mobulids in Appendix II would include the entire Mobulidae family under 'look alike' provisions, while assisting in resolving 'look alike' issues with products derived from CITES listed manta rays.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

The spinetail devil ray, *Mobula tarapacana* (Philippi 1892) and the sicklefin devil ray, *Mobula japanica* (Müller and Henle 1841) are slow-growing, large-bodied animals that have worldwide distributions in the tropical and temperate waters of the Pacific, Atlantic and Indian Oceans (Clark *et al*., 2006, White *et al*., 2006a, Couturier *et al*., 2012, Bustamante *et al*., 2012). Within this broad range, *M. tarapacana* and *M. japanica* populations are distributed into smaller populations with the species tending to aggregate in specific areas (Clark *et al*. 2006, White *et al*. 2006a).

Both species of mobula rays are highly migratory. For example, a *M. tarapacana* tagged in the Azores travelled straight-line distances up to 3,800 km over 7 months (Thorrold *et al*., 2014). Tagging data using pop-off satellite archival tags found *M. japanica* captured off southern Gulf of California moved to the Pacific coastal waters of Baja California and pelagic waters between the Revillagigedos Islands and Baja California (Croll *et al*., 2015). *M. japanica* travelled 1,400 – 1,800 km, at minimum speeds of 47 and 63 km per day, crossing high seas from New Zealand to Vanuatu and south of Fiji (Francis and Jones, 2016).

As overall population parameters and indices were not available to definitively categorise stocks, the Panel considered four main geographic areas: i) Atlantic Ocean, ii) Indian Ocean, iii) Eastern Pacific and iv) Central Western Pacific; based on the availability of indices.

Generally, there is little information about biological parameters of mobula rays. After reviewing the available parameter estimates for the species (Table 1), the Panel concluded that these species meet the low productivity criteria. While some individual life history estimates suggest medium productivity (e.g. age of maturity), the Panel considered its very low fecundity (one individual pup every 2-3 years) and the resulting estimate of maximum population increase and concluded that the species have a very low productivity.

Trends and application of the decline criterion

Under the CITES criteria for commercially-exploited aquatic species (Res. Conf. 9.24 Rev. CoP16), a decline to 15–20 percent of the historical baseline for a low-productivity species might justify consideration for an Appendix I listing. For listing on Appendix II, being "near" this level might justify consideration for a listing, which for a low-productivity species would be 20–30 percent of the historical level (15–20 percent + 5–10 percent precautionary measure).

As data for mobulids was extremely limited, the Panel considered several references pertaining to catches of the genus *Mobula* spp., the sicklefin devil ray, *M. tarapacana* and the spinetail devil ray, *M. japonica*. Data was available for the Indo-Pacific region, eastern Atlantic and eastern Pacific Ocean. One study, referenced in the Proposal for the eastern Atlantic Ocean (Doumbouya, 2009), could not be evaluated because the Panel could not obtain a copy of the report (Table 2).

Indian Ocean

Information for the Indian Ocean was also available in Raje and Zacharia (2009) but there was no evidence of decline and the information was only for *Mobula diabolus* which was not proposed for listing. The Proposal also references a study by Fernando and Stevens (in preparation) that document unspecified trends in abundance for a fishery off Sri Lanka. The Panel was provided a draft of this manuscript and the raw data, however an email from the authors to the Panel confirmed this paper was still very much in draft form so the Panel did not consider this manuscript.

Pacific, Indo Pacific Ocean

Several indices of catch information were derived from White *et al*. (2006b) and compared to more recent data in Lewis *et al*. (2015). Declining trends were inferred based on differences in landings of Indonesian fisheries in Lamakera for *Mobula* spp. (75% decline), Tanjung Luar for *M. tarapacana* (99% decline) and *M. japanica* (96% decline) and Cilacap, Indonesia *M. tarapacana* (77% decline), and *M. japanica* (50% decline). The Panel felt this information may more accurately reflect abundance as this data was for fishers that targeted mobulids with harpoons and declines in catch may reflect the inability to find mobulids. The Panel also noted that in Lamakera there was change in effort from 18–30 boats in the late 1990s to 57 boats in 2015. However, the increase in boats also was accompanied by a change in targeting. In Tanjung Luar, fishing effort fluctuated over the time series but there was an increased targeting of mobulids in 2010. In Cilacap, mobulids are caught as bycatch in tuna longline fisheries so less inference can be drawn on the declines in abundance. In the last three years of the time series, the take of manta rays were prohibited which could have either reduced the harpoon fleet or increased effort towards mobulids.

In the eastern Pacific Ocean, catches from 1999–2005 in Llanos *et al*. (2010) were compared with updated information in IMARPE (2014) to infer a decline of 89% in catches of mobulid rays. No effort information was presented and the Panel could not determine if any fishery related activities (e.g. change in targeting or markets) or environmental conditions (e.g. El Niño Southern Oscillation, ENSO) could have influenced the time series.

Although limited in geographic scope, the Panel felt the statistically standardized 21 year time series of SCUBA diving encounters (White *et al*., 2015) was the most reliable series. White *et al*. (2015) reported a 78% decline in mobula from 1993-2013 at Cocos Island, Costa Rica (Eastern tropical Pacific).

Atlantic Ocean

Gillnet landings data from the fisheries monitoring program in Senegal from 2005 to 2014 (DPM Senegal, 2005) were also analyzed by the Panel. From 2005 to 2009, unspecified mobula landings significantly increased thereafter drastically decreasing to 2014. The overall trend in landings information was a decline of 9% based on comparing the average of the first three years to the last three years.

Modifying factors and risk

Vulnerability factors such as life-history parameters and susceptibility to multiple threats, including to fisheries bycatch are addressed in the decline criterion threshold for a low productivity species. Circumglobal distribution could be a positive modifying factor. Low at-vessel mortality for longline fisheries may also be positive but for other fisheries such as gillnet, bycatch mortality may be higher. Mobulid rays have extremely low productivity, which would limit their capacity to recover from high fishing pressure. Both species also aggregate which makes them more vulnerable to fisheries. Panelists did not consider other potential biological or ecological factors that would alter the conclusions regarding biological listing criteria.

Summary of evaluation and assessment of biological listing criteria

No global population estimates are available and little is known about stock structure for the proposed mobula ray species. Both species are wide-ranging and globally distributed so they do not meet the criteria for a restricted distribution. The Panel considered these low productivity species and so considered that declines of 70% now or within the next 10 years (there is no information available on generation time) might meet the criteria for listing. The Panel concluded that the evidence of decline in the data meets the CITES Appendix II listing criteria. However, most of the declines in abundance for mobulids were derived from catch information that the Panel deemed to be of low reliability as the format of the information makes it difficult to take into account the effects of changes in targeting, effort and environmental conditions. Moreover, the evidence for decline is limited to the eastern Pacific and Indo-Pacific regions and the Panel could not determine the status of these species in other areas of its range.

Comments on technical aspects in relation to trade, management and implementation

The following comments are in response to statements in the Proposal related to management and trade and are not a comprehensive summary of management regimes or trade of mobula rays. The Panel found that much of the information necessary to thoroughly evaluate the management and trade aspect of the proposals were not available for the review, therefore for the comments presented below the Panel needed to rely largely on its own expert knowledge which at time was anecdotal and or qualitative.

The scope of the Proposal includes all mobula species for “look alike” reasons, i.e. species whose specimens in trade look like those of species listed for conservation reasons (see Article II, paragraph 2 of the CITES Convention). If *M. tarapacana* (sicklefin devil ray) and *M. japanica* (spinetail devil ray) were to be listed on Appendix II, CITES measures would have to apply to all mobula species. In relation to the implementation of the existing CITES listings of the manta rays, the CITES Animals Committee (AC28) recognised there were problems of species identification, look-alike issues and traceability with the Mobulidae that need to be resolved.

Management comment

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International management:
    - The FAO IPOA-Sharks applies to chondrichthyans and therefore also applies to rays. It underscores the responsibilities of fishing and coastal States for sustaining chondrichthyan populations, ensuring full utilisation of retained species and improving data collection and monitoring.
    - The obligations of the ‘Convention on the Conservation of Migratory Species of Wild Animals’ (CMS) on its 123 member parties require them to fully protect mobula species. CMS includes mobulids on Appendix I and II and Annex I of the CMS MOU on the conservation of migratory sharks.

- *M. mobular* is included on Annex II of the Barcelona and Berne Conventions respectively.
- The newly formally adopted FAO Port State Measures Agreement is an agreement on port state measures to prevent, deter and eliminate IUU fishing. This agreement requires that any inspections conducted on fishing vessels entering ports includes verification that all species exploited have been taken in compliance with international law, international conventions and measures of RFMOs.

- Regional management:
  - IATTC will prohibit retention of mobulids, with an exemption for developing CPCs', small-scale (less than 1.99 net tonnage) and artisanal fisheries exclusively for domestic consumption from 1 August 2016.
  - Some tuna RFMOs require catches of mobulids as a group or as individual species to be recorded and reported annually. This is complemented by observer programmes and discard reporting.
  - There are research efforts on sharks and rays at regional and national levels that include mobulids.
- National measures:
  - MPAs and other spatial measures to protect sharks and rays are established in several EEZs
  - Catches of mobula are reported to FAO by a small number of States, others report catches at more generic levels while some do not report.

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES?

- It was not possible to evaluate the effectiveness of the above measures, both regionally and nationally, as there was no reported data on implementation or effectiveness was known to the Panel.
- Appendix II listing may generate additional information that can assist fisheries managers to assess fishing mortality rates. Reporting of mobula species catches, where landing is permitted, would be improved in some cases.
- Appendix II listing could assist in improving compliance by providing an impediment to trading in mobula products illegally obtained from fisheries where regulations prohibit catch and/or retention, due the requirement to supply CITES documentation.
- All catches landed from the high seas would require IFS or Export Permits which require NDFs and legal acquisition findings or the corresponding requirements under IFS. This applies not only to landings for commercial purposes but also to the taking of samples for scientific purposes.
- CITES Parties have raised implementation issues, including short falls in available data, at FAO Workshops (e.g. FAO Expert Consultation on Impacts of CITES Listing of Sharks and Rays Species in the South and Southeast Asia Region. Penang, Malaysia. 19–20 April 2016) many of which are cited as limitations on conducting NDFs. CITES Animals Committee and Standing Committee shark working groups have been tasked to work on the issues. The work is on-going.
- FAO has a project to assess the impact of CITES shark listings (Contribution to responsible and appropriate application of CITES provisions to assist in the conservation and sustainable use of commercially-exploited aquatic species, Component 9 of a FAO/Government Cooperative Program, "Improved Fisheries Management for Sustainable Use of Marine Living Resources in the Face of Changing Systems") which is on-going.

Trade comment

CITES trade documentation is not required for CITES listed species obtained from within waters under national jurisdiction and traded only in the domestic market of the coastal State, including all parts and derivatives, as this does not constitute international trade.

Mobula rays are caught in target fisheries in coastal state small-scale and artisanal fisheries. They are also caught during target fishing for other species. Target fishing is primarily for local consumption and international trade of the gill-plates. While the trade in gill plates may have expanded in recent years, in the absence of an historical base-line, the Panel considered that this trade may have been in existence for longer than is referenced in the Proposal.

Trade (market transparency, documentation and level of IUU)

- The Panel considered that mobula gill rakers were the most frequently traded product form.
- In general there are no specific catch or trade documentation schemes for mobula. Existing general catch documentation systems in some countries could facilitate the issuing of legal acquisition findings (e.g. the EU's Catch Certification requirements).
- There is a finite capacity in the commonly used of the WCO harmonized system (HS) of tariff classification to identify products of mobula in trade, much of which has been used already (www.wcoomd.org/en/faq/harmonized_system_faq.aspx#q9). There may be some greater capacity in the HS of tariff classification to identify mobula gill rakers in trade, separate from other shark products.
- There are current efforts to monitor the mobula gill raker trade and if these continue, they may provide further insights.

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES

- CITES provisions on trade in specimens of species listed in Appendix II require the issuance of an export permit by the exporting country, which shall only be granted if the national CITES authorities are satisfied that: 1) the export is not detrimental to the survival of the species in the wild; and 2) the specimens were not obtained in contravention of the national laws of that state.
- The trade will be recorded in the CITES trade data base, and this will improve overall trade information.
- States' abilities to make NDFs for the range of fisheries from which mobula may be obtained in the absence of region-wide assessments as evidenced by difficulties encountered in making NDFs for shark and ray species that have already been listed. Under these conditions the following outcomes can occur
    - Previous trade ceases;
    - Trade continues without proper CITES documentation (also known as 'illegal trade'); and/or
    - Trade continues with inadequate NDFs.
- The listing of mobula species would assist in resolving the look-alike issue with products from manta rays (*Manta* spp.) raised by the CITES Animals Committee as the requirement for NDFs and appropriate permits/certificates would apply to the entire Mobulidae family.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

The two mobula rays, the sicklefin devil ray, *M. tarapacana* and the spinetail devil ray, *M. japanica* are being proposed for CITES Appendix II listing in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states '*It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid*

it becoming eligible for inclusion in Appendix I in the near future'. If they were to be listed, all other mobulid rays, genus *Mobula* spp., would be included in accordance with Article II paragraph 2(b) of the Convention and satisfying Criterion A in Annex 2b of Resolution Conf. 9.24 (Rev. CoP 16).

It is difficult to draw clear conclusions regarding the effectiveness of existing and future management and trade measures due to the lack of data available to be able to assess these measures. However, it is noted that, if properly implemented, a CITES Appendix II listing could be expected to result in better monitoring and reporting of catches entering international trade. Improved monitoring should enable new or enhanced assessments of stock status and the subsequent adoption of management measures that ensure the sustainability of harvests where these are still permitted. Harvests from international waters would fall under IFS provisions of the CITES Convention. These would require catch documentation to the species level for specimens entering the jurisdiction of a State from international waters, along with a NDF indicating that the harvest was sustainable.

The listing of mobula species would assist in resolving the look-alike issue with manta rays (*Manta* spp.) raised by the CITES Animals Committee, as the requirement for NDFs and appropriate permits/certificates would apply to the entire Mobulidae family.

It should be noted that States' abilities to make NDFs for highly migratory species is limited in the absence of region-wide assessments as evidenced by difficulties encountered in making NDFs for shark and ray species that have already been listed. Under these conditions the following outcomes can occur, previous trade ceases, trade continues without proper CITES documentation (i.e. illegal trade) and/or trade continues with inadequate NDFs.

References

Bustamante, C., Couturier, L. & Bennett, M. 2012. First record of *Mobula japanica* (Rajiformes: Myliobatidae) from the south-eastern Pacific Ocean. *Marine Biodiversity Records*; Volume 5; e48; 4 pages.

Clark, T.B., Smith, W.D. & Bizzarro, J.J. 2006. *Mobula tarapacana*. The IUCN Red List of Threatened Species 2006: e.T60199A12309970.http://dx.doi.org/10.2305/IUCN.UK.2006.RLTS.T60199A12309970.en. Downloaded on 24 June 2016.

Couturier, L.I.E., Marshall, A.D., Jaine, F.R.A., Kashiwagi, T., Pierce, S.J., Townsend, K.A., Weeks, S.J., Bennet, M.B., & Richardson, A.J. 2012. Biology, ecology and conservation of the Mobulidae. *Journal of Fish Biology*, 80: 1075–1119.

Croll, D.A., Dewar, H., Dulvy, N.K., Fernando, D., Francis M., Galván-Magaña, F., Hall, M., Heinrichs, S., Marshall, A., McCauley, D., Newton, K.M., Notarbartolo di Sciara, G., O'Malley, M., O'Sullivan, J., Poortvliet, M., Roman, M., Stevens, G., Tershy, B.R. & Withe, W.T. 2015. Vulnerabilities and fisheries impacts: The Uncertain Future of Manta and Devil Rays. *Aquatic Conservation: Marine and Freshwater Ecosystems*. http://dx.doi.org/10.1002/aqc.2591.

Cuevas-Zimbrón, E., Sosha-Nishizaki, O., Pérez-Jiménez, J.C. & O'Sullivan, J.B. 2012. An analysis of the feasibility of using caudal vertebrae for ageing the spinetail devil ray, *Mobula japanica* (Muller and Henle, 1841). *Environmental Biology of Fishes*: DOI 10.1007/s10641-012-0086-2.

Doumbouya F. 2009. Rapport sur l'actualisation des etudes sure les raies mantas en Guinee. Centre National des Sciences Halieutiques de Boussoura. Ministère de la Pêche et de l'Aquaculture. Republique de Guinee.

DPM Sénégal, 2015. Résultats généraux des pêches maritimes du Sénégal. Direction des Pêches maritimes (available at: www.oceandocs.org/handle/1834/97).

Fernando, D., Stevens, G. & Svensson, A. In preparation. Data on the non-discarded bycatch fishery of mobulid rays (Myliobatiformes) in Sri Lanka: outlining catch rates and demographics of species caught.

Francis, M. P., & Jones, E. G. 2016. Movement, depth distribution and survival of spinetail devilrays (*Mobula japanica*) tagged and released from purse-seine catches in New Zealand. *Aquatic Conservation*: *Marine and Freshwater Ecosystems*. Published online in Wiley Online Library. DOI: 10.1002/aqc.2641.

IMARPE 2014. Boletin Informativo Pesquero Abril 2014 No. 9, Instituto del Mar del Peru Laboratorio Costero de Tumbes.

Lewis, S.A., Setiasih, N., Fahmi, Dharmadi, O'Malley, M.P., Campbell, S.J., Yusuf, M. & Sianipar, A. 2015. Assessing Indonesian Manta and Devil Ray Populations Through Historical Landings and Fishing Community Interviews. Peerj PrePrint (available at: https://dx.doi.org/10.7287/peerj.preprints.1334v1).

Llanos, J., Inga, C., Ordinola, E. & Rujel, J. 2010. Investigaciones Biológico Pesqueras en la Región Tumbes, Perú. 1996 – 2005. *Informe IMARPE* 37 (3-4): 95-112.

Notarbartolo di Sciara, G. 1987. A revisionary study of the genus Mobula Rafinesque 1810 (Chondrichthyes, Mobulidae) with the description of a new species. *Zoological Journal of the Linnean Society* 91: 1–91.

Pardo, S. A., Kindsvater, H. K., Cuevas-Zimbrón, E., Sosa-Nishizaki, O., Pérez-Jiménez, J. C., & Dulvy, N. K. 2016. Devil in the details: growth, productivity, and extinction risk of a data-sparse devil ray. bioRxiv, 043885.

Raje, S.G. & Zacharia, P.U. 2009. Investigations on fishery and biology of nine species of rays in Mumbai waters. *Indian J. Fish.*, 56(2): 95-101.

Thorrold S.R., Afonso P., Fontes J., Braun C.D., Santos R.S., Skomal G.B. & Berumen, M.L. 2014. Extreme diving behaviour in devil rays links surface water and the deep ocean. *Nature Communications* 5(474): doi:10.1038/ncomms5274.

White, E. R., Myers, M. C., Flemming, J. M. & Baum, J. K. 2015. Shifting elasmobranch community assemblage at Cocos Island, an isolated marine protected area. *Conservation Biology*. 29:4, 1186–1197. doi: 10.1111/cobi.12478.

White, W.T., Clark, T.B., Smith, W.D. & Bizzarro, J.J. 2006a. *Mobula japanica*. The IUCN Red List of Threatened Species 2006: e.T41833A10576180. http://dx.doi.org/10.2305/IUCN.UK.2006.RLTS.T41833A10576180.en. Downloaded on 14 July 2016.

White, T.W., Giles, J., Dharmadi & Potter, I.C. 2006b. Data on the bycatch fishery and reproductive biology of mobulid rays (Myliobatiformes) in Indonesia. *Fisheries Research* 82: 65–73.

Tables and figures

Table 1. Information for assessing productivity of mobulid rays.

PARAMETER	STATUS	INFORMATION	AREA	SOURCE
TMAT_age of maturity	medium	5–6 years	Global	Pardo *et al*., 2016
TMAX_longevity	medium	15–20 years	Global	Pardo *et al*., 2016
intrinsic growth rate of pop	low	0.077 year-1	Global	Pardo *et al*., 2016
no of young (litter size)	low	1 new-born/ 2–3 year	Global	Notarbartolo di Sciara, 1987
growth	low-medium	k 0.28 *M. japanica*; k 0.12 *M. japanica*	Global	Cuevas-Zimbron, 2012; Pardo *et al*., 2016

Table 2. Information on mobulids trends. Information in bold was used in the final assessment. Also refer to Figure 1.

REF #	AREA	INDICATOR	FISHERY	EXTENT OF DECLINE (%)	REFERENCE PERIOD	REFERENCE(S), OTHER SUPPORTING COMMENT(S)
	Indian Ocean					
	Eastern (57)	landings	Gillnet	unspecified	2002–12; 2010–15	Fernando and Stevens, in prep
1	Eastern (57)	landings	Trawlers	>50 %	1993–95 to 2002–04	Raje and Zacharia, 2009
	Indo-Pacific Ocean					
2	Indo-Pacific Ocean (57;71)	landings	Harpoon	75 %	2002-14	Lewis *et al.*, 2015, Lamakera, Indonesia
3	**Indo-Pacific Ocean (57;71)**	**landings**	**Harpoon**	**99 %(*M. tarapacana*),**	**2001–05 to 2013–14**	**Lewis *et al*., 2015, Tanjung Luar, Indonesia**
4	**Indo-Pacific Ocean (57;71)**	**landings**	**Harpoon**	**96 % (*M. japanica*)**	**2001–05 to 2013-14**	**Lewis *et al.*, 2015, Tanjung Luar, Indonesia**
5	**Indo-Pacific Ocean (57;71)**	**landings**	**Gillnet**	**77 % (M. *tarapacana*),**	**2001–05 to 2014**	**Lewis *et al*., 2015 Cilacap, Indonesia**
6	**Indo-Pacific Ocean (57;71)**	**landings**	**Gillnet**	**50 % (*M. japanica*)**	**2001–05 to 2014**	**Lewis *et al*., 2015 Cilacap, Indonesia**
	Pacific Ocean					
7	**Cocos Island (87)**	**Standardised sightings**	**Not applicable**	**78 %**	**1993–2013**	**White *et al*., 2015**
8	Pacific South East (87)	landings	Not available	89 %	1999–2013	Llanos *et al.*, 2010; IMARPE, 2014
	Atlantic Ocean					
9	Eastern Central (34)	landings	Not available	61 %	2004–2008	Doumbouya, 2009
10	Eastern Central 34 (Senegal)	landings	Gillnet	9 %	2005–2014	DPM Sénégal (2015)

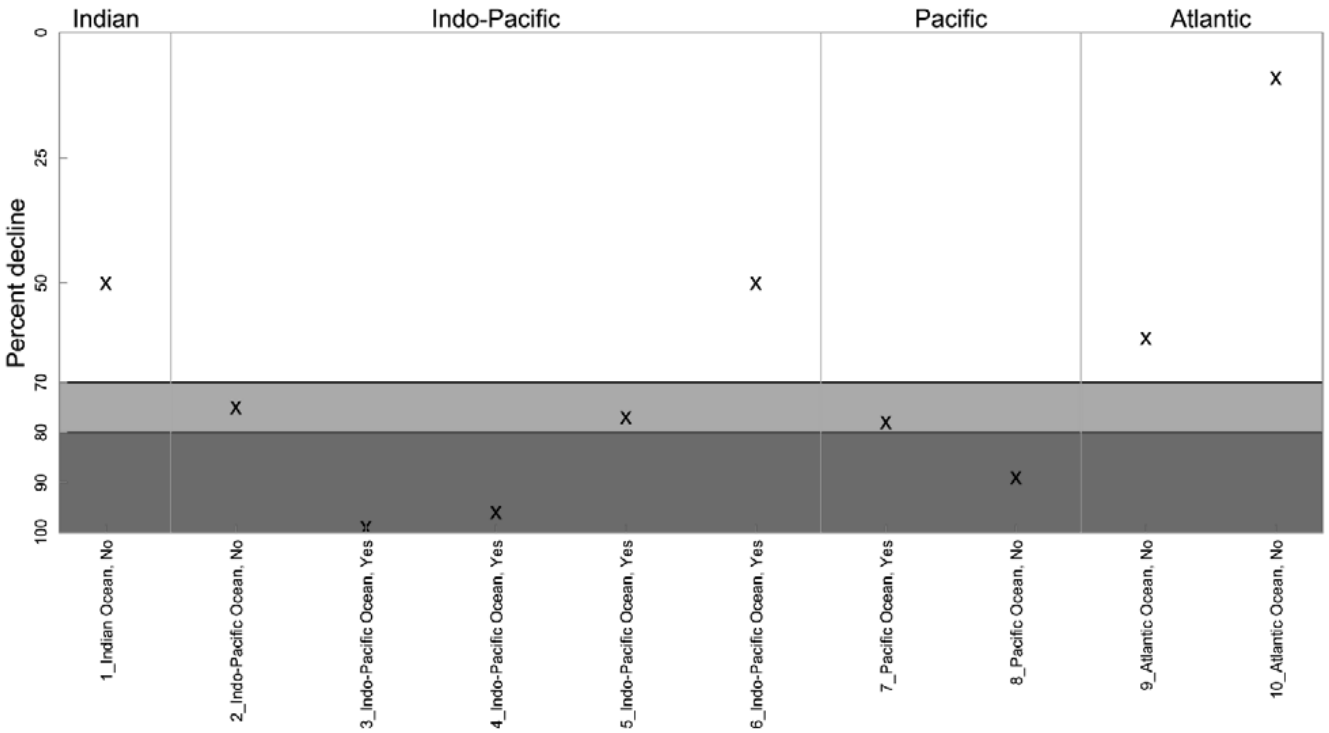

Figure. 1 Percent of baseline stock declines (note data reference number from Table 2). A species with a low productivity that has declined by over 80% of baseline (dark band) can be considered for listing in Appendix I, or with a precautionary approach (light band) 5-10 % less (see full description in footnote to Annex 5 of Res. Conf. 9.24 (Rev. CoP16)). Yes and No in the X axis titles denotes datasets accepted for use, or excluded from the final assessment.

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 45

Species:

Raya, *Potamotrygon motoro.*

Proposal:

To include Raya, *Potamotrygon motoro* in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention.

Assessment Summary

Raya are distributed across a large area of South America, with no evidence of decline of the species' area of distribution. The Panel recognised that this species is subject to a number of vulnerability factors but found no population decline information for comparison with the CITES guidelines for listing commercially-exploited aquatic species. Therefore, the Panel determined that Raya did not meet the CITES Appendix II (two) criteria, but noted that CITES Parties have previously recommended range States consider including Raya in Appendix III (three) of the CITES Convention. The Panel joins CITES in encouraging range States to consider listing of Raya in this lower Appendix, to help improve the collection of trade data. Under such a scenario, specific measures would be required to adequately separate Raya from two 'look alike' Brazilian endemic species (*Potamotrygon henlei* and *Potamotrygon leopoldi*), that can have similar dorsal colour patterns. Lastly the Panel notes the increasing importance of trade in captive bred Raya to supply the Asian ornamental market, that is potentially decreasing pressure on the fishery for wild caught specimens from range States.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

Raya or ocellate river stingrays, *Potamotrygon motoro* (Müller & Henle, 1841) belongs to a family of freshwater stingrays (Potamotrygonidae) that are the only group of elasmobranchs fully restricted to the freshwater environment (Compagno and Cook, 1995). The taxonomy of freshwater stingrays (Potamotrygonidae) has not been resolved yet, although a significant number of species have recently been described. The lack of clarity around the taxonomy and population structure of this South American native species means there is a possibility that subpopulations or more than one species are currently being classified under the name *P. motoro* (Proposal, CITES AC28 doc18). The colour variation for different species of Potamotrygonidae has not been exhaustively studied, partly because of the highly variable nature of patternation (CITES AC24 doc.14.2). Juvenile specimens of *P. motoro* present dorsal color patterns similar to *P. henlei* and *P. leopoldi* and might also be mistaken for *P. boesemani* and *P. ocellata*. In a recent revision of freshwater stingrays for ornamental purposes in Colombia, the authors pointed out that there was a shortage of information and a need of further studies (Mejía-Falla *et al*., 2009).

The Raya has a wide distribution, occurring in the major South American river basins (Amazon, Orinoco, Parana, Paraguay, Uruguay and La Plata). It is found in rivers, floodplains, floodplain lakes and some lakes of the neotropical region. In Bolivia, it is reported as being present in the Orthon, Madre de Dios, Beni, Madera, Yata, Mamoré, Iténez river basins and possibly in the Paraguay, Pilcomayo and Bermejo rivers (Proposal). In addition to the Plurinational State of Bolivia, its distribution includes Brazil, Colombia, the Bolivarian Republic of Venezuela, Guyana, Suriname, Brazil, French Guiana, Ecuador, Peru, Paraguay, Uruguay and Argentina (Drioli and Chiaramonte, 2005; Panel, 2012). Therefore, it is a widely distributed species, including an introduced population in Singapore (Upper Seletar Reservoir), where the species has now become established and self sustaining (Ng *et al*., 2010).

There is currently no population size estimate for the Raya, with little in the way of survey data to estimate abundance, although new methods are being developed to survey freshwater stingrays such as the Raya (Morales-Betancourt 2016). Because very little data is presently available, the possibility exists

that Raya may be present in small size populations in some of the tributaries of the Orinoco, Amazon and La Plata river basins (CITES Conf. Res. 9.24 Rev. CoP16).

In general, the biology of freshwater stingrays is poorly known and life-history parameters are very sparse (Charvet-Almeida, Araujo and Almeida, 2005). *P. motoro* is long-living, has internal extended periods of gestation and slow growth (Araujo *et al.,* 2004). Martinez Achenbach (1976) consider that *Potamotrygon* species as ovoviviparous. The reproductive mode is matrotrophic viviparity (with trophonemata), with annual reproductive cycles closely synchronized with the hydrologic cycle of the river basins that they inhabit (Charvet-Almeida, Araujo and Almeida, 2005).

There seems to be some variation in life-history data reported from the Paraná-La Plata and Amazon basins. Considering the range of age at maturity of wild populations, it is possible to infer that *P. motoro* has a medium level of productivity (Table 1). FishBase (http://www.fishbase.org/summary/Potamotrygon-motoro.html) notes litter sizes can be up to 15 pups born to a single female. Minimum estimates of the growth parameter K, obtained from the available maximum size, size and age at maturity, indicate that the species grow at rates consistent with a medium-productivity species (Table 1). Productivity of the species was previously determined as medium during the 2012 FAO Expert Advisory Panel (FAO 2013), and since no further data was made available or found in the literature, a medium productivity determination was again adopted by the Panel (Table 1).

Trends and application of the decline criterion

The Proposal does not present information regarding population trends and decline. The Proposal indicates that based on IUCN criteria (Lasso and Sánchez-Duarte 2012, Mojica *et. al*. 2012) overfishing for ornamental or commercial purposes are among the main threats to Raya in Colombia, and points that the same applies to a significant degree in Bolivia. However, no further supporting data on declines was provided.

There are no catch statistics for freshwater stingrays in FAO FishStat. In Brazil, landings for human consumption were reported at the family level (Potamotrygonidae) that also include whiptail stingrays (family Dasyatidae) found in the mid-Amazon River (Araujo *et al*., 2004). The available data show an increasing trend in landings from 2001 to 2010, with production in recent years in the order of 750 tons/year.

Evidence of decline in abundance has been reported in the past (CITES 2012 CoP16 Prop. 48, listing amendment Proposal included *P. motoro*. CITES Notification No. 2012/063, Proponents: Colombia and Ecuador) for Colombia, but not for Brazil (Lasso and Sanchez-Duarte, 2012), and in neither case were records sufficient to qualify the freshwater rays for consideration in Appendix II. The previous 2012 Proposal (CITES 2012 CoP16 Prop. 48) it stated there was a 30% decline in Colombia. This result was not verified and insufficient for the species to be considered for listing in Appendix II. In Conf. 9.24 (Rev. CoP16) it states, "*there should rarely be a need for concern for populations that have exhibited an historical extent of decline of less than 50%, unless the recent rate of decline has been extremely high*". The data provided in this current Proposal added no more new information on declines, and therefore the Panel again decided that the level of decline is not considered sufficient for consideration in Appendix II.

Araujo *et al*., (2004) found a strong relationship between fishing pressure and the water level of the rivers. In very dry years (during El Niño events), when the water level of the rivers is low, the species habitat changes, influencing fishing and CPUE. Therefore, following trends in CPUE would be made even more difficult, as results may partially be explained by fluctuations in river flooding regimes and its impacts on fisheries rather than by shifts in population abundance alone.

Modifying factors and risk

Raya is subject to many factors, including their requirement for niche habitats and vulnerability of certain life stages, many of which increase risk to the species. These vulnerability and resistance/resilience factors are listed in Table 2.

Summary of evaluation and assessment of biological listing criteria

Raya are distributed across a large area of South America and thus cannot be considered under the restricted area criterion. There is no evidence of Raya populations meeting the criterion of a small population. The Raya are of medium productivity being among the freshwater stingray, a species, for which there is more data on life history and biology, than other species.

No supportable data on historical extent of declines or recent rate of declines were presented in this Proposal. Populations of Raya (and Rosette river stingray) were proposed for CITES Appendix II listing on a previous occasion (CITES 2012 CoP16 Prop. 48, CITES Notification No. 2012/063, Proponents: Colombia and Ecuador). In that case the Panel noted the lack of information to make a determination of whether the species qualified under the CITES Appendix II decline criteria. The Panel noted that the present Proposal does not provide any additional data or information on population status and trends from Bolivia or elsewhere on which to make an improved assessment.

Other sources of information were used to indicate the current low abundance of the species in important ornamental fishing areas in the nearby country Colombia, but these do not provide any evidence of decline. Researchers also noted a relationship between fishing (fishing pressure and CPUE) and water levels in rivers, especially in dry years (during El Niño events), noting trends in CPUE can be influenced by fluctuations in river flooding regimes in addition to fishing.

Comments on technical aspects in relation to trade, management and implementation

The following comments are in response to statements in the Proposal related to management and trade and are not a comprehensive summary of management regimes or trade of Raya. The Panel found that much of the information necessary to thoroughly evaluate the management and trade aspects of the Proposal were not available for review. Research and monitoring of freshwater stingray species is recognised as being expensive and conflicts limit access across some of the species range, which increase security concerns for fisheries staff. The Panel partially relied on previous CITES work (an expert workshop held in Bogotá, Colombia, on 28 and 29 October 2014, AC28 Doc.18, Decisions 16.131 and 16.132) and from other related documents (FAO 2013), for information on management and trade.

Management comment

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International management:
    - There are no international regimes/measures related to freshwater stingrays. One specific reference to biodiversity and sustainable use that could be relevant, is articulated by the Andean Community (CAN), formed by Colombia, Ecuador, Peru and the Plurinational State of Bolivia) and the Amazon Cooperation Treaty (ACT), signed by the 8 Amazon countries (the Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador, Guyana, Peru, the Plurinational State of Bolivia and Suriname).
- National measures:
    - **Argentina**: Freshwater stingrays not covered in the NPOA (PAN-Tiburones, 2009). CONICET and the Universidad Nacional de Misiones Institute for Subtropical Biology started doing research on Potamotrygonidae in 2013, while trade in live specimens of Potamotrygonidae was discouraged as a precautionary measure based on the outcomes of CoP16.
    - **Bolivia**: There is not an established mechanism to support legal trade in ornamental fish. The Proposal cites that Bolivia has a preliminary version of the Reglamento para la comercialización de peces ornamentales (Regulation on trade in ornamental fish) prepared by the Ministry of the Environment and Water and that this instrument, which will include ornamental fish trade. This

document is close to being approved. There is also a decree, imposing temporal controls on taking of wildlife (AC28 Doc.18).

- **Brazil**: Ornamental export quota system was established in 2004 and in place for six species of Potamotrygon (including *P. motoro*), maximum catch sizes were established according to species. It is reported that these controls are difficult to implement in a program for conservation of freshwater stingrays, since rays are taken illegally across the borders between Brazil and Colombia and Brazil and Peru. Freshwater stingrays are included in the draft Brazilian NPOA, which is not yet officially recognised.
- **Colombia**: Freshwater stingrays were included in a NPOA, PAN Tiburones Colombia (Caldas *et al*., 2010). In 2009, a quota of 29,000 specimens of Potamotrygonidae was established for ornamental fish species. In 2011 this quota (which included *P. motoro*) was reduced to 23,200 (Ajiaco-Martinez *et al*., 2012). Minimum catch sizes were established according to species.
- **Ecuador**: Fishing permits are required but no further data available.
- **Paraguay**: Reported that fishery for aquarium use is rare. Regulations prohibit exports.
- **Peru**: Fishing permits required for ornamental species and there is regulation controlling the operation of commercial aquaria. Raya is included in their NPOA.
- **Uruguay**: The three species *P. motoro*, *P. brachyura* and *P. hystrix* are covered by the NPOA (PAN Condríctios, revised in 2013).
- **Venezuela**: No records on the ornamental trade exist. Activities related to live specimens of fish of commercial value are regulated and catches of inland ornamental fish are prohibited from May 15 - July 15 (Sánchez-Duarte *et al*., 2013).

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES?

- At present the limited range and quality of information available across the range States, and issues with compliance impact the effectiveness of the few established measures that are in place. Listing the Raya under Appendix II would require additional information to be collected regarding the trends in status and trade of this species.
- If trade was to continue legally under provisions of Appendix II, non-detrimental findings (NDFs) and legal acquisition findings would need to be made. Improvements in the knowledge about the population dynamics and fisheries of freshwater stingrays will be required in order to make scientifically sound NDFs.
- In order to comply with CITES provisions range States would be required to have specific National catch and trade regulations in order to continue exporting for the ornamental trade.

Trade comment

River stingrays have been captured for ornamental export purposes for decades, but are also a subsistence food source (Araujo *et al*., 2004, CITES AC20 Inf. 8). River stingrays are also affected by changes in land and river management (Lucifora *et al.*, 2015), and indirectly affected by tourism, as they are ‘cleared’ from areas used for tourists, to avoid tourist having interactions with freshwater rays. Lastly they are also taken in small quantities to be utilized directly for their fat (for oil to be used in traditional medicine to control asthma and influenza), while their tails are used as whips and dorsal skin as sandpaper. This section on trade is not a full summary of all issues, but a response to the Proposal and an opportunity to highlight pertinent and related trade issues.

There is country reporting of illegal ornamental fishing and trade, including cross border movements of endemic wild caught freshwater rays (Regional Expert Workshop on Freshwater Stingrays, 28-29 October 2014, Bogota, Colombia). This trade is recognised as posing a threat to the adequate management and sustainable fishery of this and other freshwater stingray species.

Trade (market transparency, documentation and level of IUU)

- **Argentina**: Exports have been recorded since 2004, reaching a total of 751 specimens (Division for National Fisheries and Aquaculture). Lately documented exports have decreased and in 2013 only two captive bred specimens were known to have been exported.
- **Bolivia**: There are anecdotal reports of illegal trade, cross border exports to/from Colombia, Brazil and Peru. Domestically, freshwater rays have traditional, artisanal and medicinal uses. There are not any export data reported from Bolivian airports.
- **Brazil**: From 2003–2005, Brazil exported 17,840 *P. motoro* specimens. *P. leopoldi* and *P. henlei* (Brazilian endemic). The later two are sometimes illegally exported under the name *P. motoro*.
- **Colombia**: Export data is available for the period 1994–2013 but there is uncertainty on species identification. Since 2014, a photographic guide for species identification has been available. A study on ornamental fish reports noted that between 1994–2012, an average of 2,000 and 3,000 specimens were exported, peaking with 4,000 and 6,000 specimens (2007–2009). Other authors cited in the Proposal indicated that more than 500,000 specimens of Potamotrygonidae were exported from Colombia in the period 1995–2012 (Barreto *et al*., 2009; CEP 2010; Barreto *et al*., 2011), but this information could not be verified. This species was considered vulnerable (VU) in Colombia, based on the IUCN Red List criteria.
- **Ecuador**: There are no export records, but captures were reported to occur upon demand in Ecuador. There is no information on the illegal trade either, however anecdotal reports indicate prices being received locally are low.
- **Paraguay**: Report of by-catch but no commercial fisheries. Also reported to be taken for food.
- **Peru**: Reported catch of between 10,000–50,000 specimens (2000–2013), peaking with 40,000–50,000 (2006–2009), with *P. motoro* showing the highest catch level of approx. 88%.
- **Uruguay**: Human consumption considered rare and no information available on international trade.
- **Venezuela**: Ornamental trade reported with what was considered a significant movement of species (including *P. motoro*) from Venezuela to Colombia.
- **Asia:** Large-scale captive breeding of freshwater stingrays occurs in Asian countries (mainly Thailand, Taiwan Province of China and Malaysia), supplying unusual colour patterns, especially for the Asian ornamental trade. In order to obtain the desired colour patterns, interspecies breeding takes place, the hybrid offspring of which are reportedly fertile (e.g. *P. motoro* and *P. leopoldi* are crossbred to produce exotic dorsal color patterns, which can subsequently be bred with other species or hybrids). According to the information presented at the South American Freshwater Stingray Workshop, 15–17 April 2009, that was held in Geneva, Switzeraland (CITES AC24 Doc. 14.2, https://cites.org/common/com/ac/24/EFS24-14-02.pdf), captive breeding operations are providing a wide range of color patterns and distributing individuals at competitive prices, owing to lower transportation costs from Asian centers to local markets compared with the cost of transportation from South America. The workshop concluded that the development and expansion of these activities has decreased dependence on fishes taken from the wild. This phenomenon also appears to be occurring with other ornamental freshwater fish species exported from Brazil (Anjos *et al*., 2009).
- Prices of *P. motoro* specimens average 200 USD (range 140 to 350 USD) and the highest valuations on the market are for *P. motoro* with rare patternation, which retail for over US$ 1,000. The species are normally recognized by their dorsal colour pattern. The variability of colour patterns of some species (inter- and intra-specific polychromatism) can require specific guides and training for their adequate identification.
- Some of these captive bred species, including *P. motoro*, have been released in the wild in the region of Singapore and now represent the first record of freshwater stingrays established out of South America (Ng *et al*., 2010). The possibility of having these hybrids released in natal areas is unlikely, but should be of concern for range States.

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES?

- CITES provisions on trade in specimens of species listed in Appendix II require the issuance of an export permit by the exporting country, which shall only be granted if the national CITES authorities are satisfied that i) the export is not detrimental to the survival of the species in the wild; and ii) the specimens were not obtained in contravention of the national laws of that state.
- If Raya were listed in Appendix II, and CITES provisions were effectively implemented, then trade would be recorded in the CITES trade database, and that should help to ensure traceability of Raya in international trade. Increasing the reliability and volume of export and import recording should help to inform priorities for managing and controlling Raya fishing. In some cases where a States' ability to make NDFs was a challenge because of an absence of information, capacity and/or resources, the following outcomes can occur: i) all trade ceases, ii) trade continues without proper CITES documentaion (aka illegal trade), and/or iii) trade continues with inadequate NDFs. Considering the lack of available stock data and appropriate capacity for assessments and enforcement, there is the risk of trade continuing without adequate CITES documentation (illegal trade) and without adequate NDFs.
- The correct identification of the species in ornamental trade is expected to be an implementation challenge should this proposal be successful. However, experience showed that this challenge can be overcome with identification training for enforcement and officers charged with recording shipments at airports and border crossings. In order for this to be implemented successfully, specific measures would need to be taken to adequately train officers to identify *P. motoro*, especially in relation to two similar Brazilian endemic species (*P. helnlei* and *P. leopoldi*). The 2012 Colombian proposal for an Appendix II listing of *P. motoro* and *P. schroederi* (CITES 2012 CoP16 Prop. 48) indicated that *P. motoro* presents colour patterns similar to four other species: *P. boesemani*, *P. brachyura*, *P. henlei* and *P. ocellata*. Despite misidentifications of *P. motoro*, the most valuable dorsal colour patterns for this species are known and can be identified, and experience shows that species identification training has been completed for Brazilian enforcement officers, with positive results in identifying the species in the quota system, including *P. motoro*.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

The Raya is being proposed for CITES Appendix II listing in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states '*It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future'*.

No trade information or data from Bolivia was presented to support the Proposal. Information was reported from nearby Colombia, where overexploitation for commercial and ornamental use was reported as the main threat to the species (Lasso and Sanchez-Duarte, 2012). However, this was not supported by the information available to the Panel, and considering the export numbers provided (216 individuals between 2007 and 2011), the Panel concluded that trade is not currently a substantial threat. This conclusion was supported by CPUE data from Amazonas State that shows no trend in abundance for Raya from an ornamental fishing area between 1998 to 2001. Unfortunately, no more recent data was presented to evaluate declines in the last decade.

Discussions over the conservation and management and trade in freshwater stingrays (Potamotrygonidae) in relation to CITES listings has a long history. At the 20th meeting of the CITES Animals Committee in 2004, Brazil tabled an information document, "*Report by Brazil on the freshwater stingrays (Potamotrygonidae): status, conservation and management challenges*" (Araujo *et al*., 2004, CITES AC20 Inf.8, Johannesburg 2004). Based on the problems of cross-border trade, Brazil proposed possible listing of this group of species in CITES Appendix III (three). The listing issue has subsequently been taken up again on many occasions (e.g. CoP13 in Bangkok 2004, CoP14 in the Hague 2007, Regional Workshop in Geneva 2009, an expert workshop held in Colombia 2014), with a direction to range States to consider listing endemic and threatened species of freshwater stingrays

(Potamotrygonidae) in CITES Appendix III (three), to facilitate the cooperation of Parties in the control of trade (CoP15 Decision 15.85c in 2010). This has been reiterated many times since (CITES CoP16 and especially AC28 doc.18, https://cites.org/sites/default/files/eng/com/ac/28/E-AC28-18.pdf). Unlike the listing of Raya in Appendix II (two), listing of Raya in CITES Appendix III (three) is a measure that can be unilaterally instituted by a range State, without requiring a vote at the CITES CoP. The Panel noted that the various recommendation for listing South American freshwater ray species in Appendix III (three) has, to date, not been adopted by any range State, and considers that this recommendation a useful step to improve collection of trade data, which at present is scarce.

Currently there is a lack of evidence to show if there is a decline in abundance of the *P. motoro* to support listing in Appendix II. However, Raya was considered a priority species in the Amazon basin by the Freshwater Stingray Expert Workshop, CITES Working Group (AC28 Doc.18) and range States (experts and authorities) recognize that there has been and still is illegal transboundary trade. Because of the lack of available stock and trade data it is not known how much of an effect, the increasing trade of captive bred Raya from Asia, is having through decreasing trade in wild caught specimens from range States.

This repeat Proposal for inclusion of *P. motoro* in CITES Appendix II (first proposal was CITES 2012 CoP16 Prop. 48, CITES Notification No. 2012/063, Proponents: Colombia and Ecuador), if successful, has the potential to enhance the existing measures to control harvest for the ornamental trade. The Panel recognizes that strengthening management at range States level is required in order to address the existing concerns about the sustainability of the species.

It should be noted that due to the lack of information on the stocks, local marketing and trade of this species the States will find it a challenge to make NDFs for this migratory species. If a listing was to proceed without access to data to comply with CITES provisions, the following outcomes could occur: i) States could invest in collecting this data so as to be able to comply with CITES provisions, ii) trade ceases, iii) trade continues without proper CITES documentation (i.e. illegal trade) and/or iv) trade continues with inadequate NDFs.

If a listing was to proceed, specific measures would be required to assist in capacity development to ensure there was adequate identification of Raya in trade. This is especially in relation to two Brazilian endemic species (*P. henlei* and *P. leopoldi*) that can have similar dorsal colour patternation. Harvesting for other uses, including for food and population control will not be affected by a CITES Appendix II listing, however data on this activity would still be required to make NDFs for exports.

References

Ajiaco-Martínez, R.E., Ramírez-Gil, H., Sánchez-Duarte, P., Lasso, C.A. & Trujillo, F. 2012. Diagnóstico de la pesca ornamental de Colombia. V. Diagnóstico de la pesca ornamental de Colombia. Serie Editorial Recursos Hidrobiológicos *and Pesqueros Continentales de Colombia. Instituto de Investigation* de los Recursos Biológicos Alexander von Humboldt. Bogotá, D. C., Colombia.

Anjos, H. D. B., Amorim, R. M. S. Siqueira, J. A. & C. R. Anjos. 2009. Exportação de peixes ornamentais do Estado do Amazonas, bacia amazônica, Brasil. *Boletim do Instituto de Pesca*, 39: 259-274.

Araujo, M.L.G., P. Charvet-Almeida, M. Pinto, & Pereira, H. 2004. Freshwater stingrays (Potamotrygonidae): status, conservation and management challenges. Information Document AC20: 8, 1-6.

Barreto, C., Borda, C. A., Otto J. C., Sánchez-Páez, C. L., Sanabria-Ochoa, A. I., Puentes, V. & S. Muñoz. 2009. Propuesta de cuotas globales de pesca and otras medidas de manejo para el aprovechamiento de los recursos pesqueros colombianos, vigencia 2010. ICA.

Barreto, C., C. A. Borda, L. Guillot, L. F. Maldonado, C. Bustamante, C. L. Sánchez-Páez, A. I. Sanabria-Ochoa & S. Muñoz. 2011. Documento Técnico de Cuotas Globales de Pesca para.

Caldas, J.P., Castro, E., Puentes, V., Rueda, M., Lasso, C.A., Duarte, L.O., Grijalba-Bendeck, M., Gómez, F., Navia, A.F., Mejia- Falla, P.A., Bessudo, S., Diazgranados, M.C. & y.L. Alonso. 2010. Plan de Acción Nacional para la conservación y manejo de tiburones, rayas y quimeras de Colombia (PAN – tiburones Colombia). Ministerio de Agricultura y Desarrollo Rural. Dirección de pesca y acuicultura. ICA subgerencia de pesca y acuicultura. 60p.

CEP-Comité Ejecutivo para la Pesca. 2010. Documento Técnico de Evaluation de las Species Efectivamente Aprovechadas -propuesta de cuotas globales de pesca para la vigencia 2011. *Incoder*. 339 pp.

Charvet-Almeida, P., De Araujo, G. & M.P. De Almeida. 2005. Reproductive Aspects of Freshwater Stingrays (Chondrichthyes: Potamotrygonidae) in the Brazilian Amazon Basin. *Journal of Northwest Atlantic Fishery Science, 35: 165-171.* DOI: 10.2960/J.v35.m502.

Compagno, L.J.V. & S.D. Cook, 1995. The exploitation and conservation of freshwater elasmobranches: status of taxa and prospects for the future. p. 62-90. In M.I. Oetinger and G.D. Zorzi (eds.) The Biology of Freshwater Elasmobranchs, a Symposium to Honor Thomas B. Thorson. Journal of Aquariculture & Aquatic Sciences, vol. VII.

Drioli, M. & G. Chiaramonte. 2005. Potamotrygon motoro. En: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1. <www.iucnredlist.org>. Accessed on 24 August 2012.

FAO. 2013. Report of the fourth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species, Rome, 3–8 December 2012. *FAO Fisheries and Aquaculture Report* No. R1032. Rome, FAO. 161 pp.

Lasso, C.A. & P. Sánchez-Duarte. 2012. Potamotrygon schroederi. Pp. 139. In: Mojica, J. I.; J. S. Usma; R. Álvarez-León and C. A. Lasso (Eds). 2012. Libro rojo de peces dulceacuícolas de Colombia (2012). Instituto de Investigation de Recursos Biológicos Alexander von Humboldt, Instituto de Ciencias Naturales de la University Nacional de Colombia, WWF Colombia and University de Manizales Bogotá, D. C., Colombia, 317 pp.

Lucifora, L.O., De CArvalho, R., Kyne, P.M. & W.T. White, 2015. Freshwater sharks and rays. *Current Biology* 25(20): R971-R973.

Martinez Achenbach, G.M. & S.V. Martinez Achenbach, 1976. Notas acerca de algunas especies de "raya fluvial" (Batoidei, Potamotrygonidae), que frecuntam el sistema hidrografico del Rio Parana medio en el Departamento La Capital (Santa Fe – Argentina). Comunicaciones del Museo Provincial de Ciencias Naturales "Florentino Ameghino", *Zoologia* 8: 1–34.

Mejía-Falla, P.A., V. Ramirez-Luna, J.S. Usma, L.A. Muñoz-Osorio, J.A. Maldonado-Ocampo, A. Isabel Sanabria & J.C. Alonso. 2009. Estado del conocimiento de las rayas dulceacuícolas de Colombia. In: V. Puentes, A.F. Navia, P.A. Mejía-Falla, J.P. Caldas, M.C. Diazgranados & L.A. Zapata-Padilla (eds.). Avances en el conocimiento de tiburones, rayas y quimeras de Colombia. Fundación SQUALUS, Ministerio de Ambiente Vivienda y Desarrollo Territorial, Instituto Colombiano Agropecuario, CONCIENCIAS, Conservación Internacional, WWF Colombia, Bogotá, pp. 197-245.

Mojica, J. I.; J. S. Usma, R., Álvarez-León y, & C. A. Lasso (Eds). 2012. Libro rojo de peces dulceacuícolas de Colombia (2012). Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Instituto de Ciencias Naturales de la Universidad Nacional de Colombia, WWF Colombia y Universidad de Manizales. Bogotá, D. C., Colombia, 320 pp.

Morales-Betancourt, M.A. & C.A. Lasso Alcalá. 2016. Proposal of a non-lethal visual census method to estimate freshwater stingray abundance. *Universitas Scientiarum*, *21*(1), 23-32. https://dx.doi.org/10.11144/Javeriana.SC21-1.poan.

Ng, H.H., Tan, H.H., Yeo, D.C.J. y & P.K.L. Ng. 2010. Stingers in a strange land: South American freshwater stingrays (Potamotrygonidae) in Singapore. Biol Invasions 12:2385–2388 PAN Condríctios, revised in 2013.

Tables and figures

Table 1. Information for assessing productivity of the Raya, *Potamotrygon motoro*, and other South American freshwater stingrays.

PARAMETER	STATUS[2]	INFORMATION	REFERENCE(S), OTHER SUPPORTING COMMENT(S)
TMAT_maturity	medium	age: 20 months to 4 years female: male, 31–39 : 35-44 cm DW respectively	Charvet-Almeida, Goes de Araujo and Almeida 2005; Drioli and Chiaramonte 2005
	medium	DW 30–35cm Age 3 yrs	Drioli and Chiaramonte, 2005
	medium	DW 39 (M) /44cm(F) Age 3,5 y	Charvet-Almeida, Araujo and Almeida, 2005
	medium	DW 31 (M) /35cm (F)	CITES Proposal, 2012
	medium	Age 20 mon.	Castex, 1963b
	medium	Age 3 yrs	Achenbach and Achenbach, 1976
	medium	Age 4 Age 7,5 yrs (captivity)	Thorson *et al*., 1983
No. of young (litter Size)	low	4–15 pups	FishBase; CITES Proposal 2012; Charvet-Almeida, Goes de Araujo and Almeida 2005; Drioli and Chiaramonte, 2005
	low	3–21 pups	Achenbach and Achenbach, 1976
	low	4-11 pups	Charvet-Almeida, Araujo and Almeida, 2005
	low	9–15 pups	Drioli and Chiaramonte, 2005
	low	25–30 pups	CITES Proposal 2016
TMAX_longevity		Age: unknown 50cm DW	Amazon (Brazil). CITES Proposal 2012; Araujo, 2009
K (year-1)	medium	Vonn Bertalanfy k=0.24, Estimated assuming K = –ln (1–Lm/Linf)/(tm–t0); 31 cm <Lm> 44 cm; 2 years <tm>4 years; Linf = 50 cm; t0 =0	FAO Panel Report 2013
Generation time		6 months	Amazon (Brazil). Charvet-Almeida, Araujo and Almeida, 2005

[2] See Musick *et al* 1999.

Table 2. Information on modifying factors and risk for the Raya.

RISK FACTOR	DESCRIPTION	EFFECT
Selectivity of removal	Ornamental fishery - the *P. motoro* fishery for ornamental purpose is artisanal and prioritizes juvenile specimens that present dorsal color patterns considered as attractive to the ornamental fish trade. Since for freshwater stingrays there is a high unit value to each specimen (specific handling and for more transportation space requirements), in most fishing areas stingrays with damaged discs are usually released back to the river. It can be considered a very selective fishery. Food fishery - *P. motoro* is also taken from the wild by bottom trawl nets and bottom longlines as a protein source to be used as fillet and as minced fish along with other fish (in the Amazon, mainly catfish and other freshwater stingrays). Along with *Paratrygon aireba* and *Heliotrygon* spp., *P. motoro* presents one of the best carcass ratio. Until now, a clear overlapping of ornamental and food fisheries has not been documented but if juveniles and adults are taken from the same area the risks for the species would be significantly increased. In addition removal of stingrays from tourist areas to reduce the risk of interactions and accidents with tourists, is not selective.	Positive effect for Ornamental fishery Negative effect for food and area clearance fishery
Social structure (sex ratio; social dominance; etc.	Newborns and juveniles are often found in shallow areas (beaches, rocks, etc.), where they hide from larger fish predators, but by remaining in shallow areas they can be easily caught by ornamental fishermen.	Negative
Vulnerability at different life stages (migration, spawning, etc.)	Some authors have pointed that elasmobranch species are more vulnerable at the juvenile life stages, when they are more subject to predation and fisheries pressure and, as indicated before, the ornamental trade targets juvenile specimens found in shallow waters.	Negative
Specialized niche requirement	*P. motoro* is restricted to freshwater habitats and does not seem to tolerate low salinity brackish water as some other potamotrygonids do (e.g. *P. scobina*).	Negative
Density and Aggregating behavior	Unknown, but anecdotal observations (diving) and research sampling point towards low densities, as would be expected for freshwater (restricted habitat) predators (Araujo *et al.*, 2004). There is evidence of maternal care among freshwater stingrays.	Negative
Others	Since potamotrygonids are restricted to rivers and other freshwater habitats, impacts resulting from the construction of hydroelectric plants, ports, mining activities, drainage of pesticide to rivers (runoff) and others are considered as threats for these species. In the Amazon region, in periods of severe drought (Rio Negro basin), fecundity decreases were identified for some species of freshwater stingrays (Araújo, 1998).	Negative
	The human consumption fishery is limited to some countries and areas, mainly large rivers, where bottom trawl nets can be used. In most areas the species are only taken as a food source if other options are unavailable, and part of their distribution range is in very remote areas, where fisheries are unlikely to happen.	Positive

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 46

Species:

Banggai cardinalfish, *Pterapogon kauderni*.

Proposal:

To include Banggai cardinalfish, *Pterapogon kauderni* in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention.

Assessment Summary

The Banggai cardinalfish is endemic to Indonesia, being found mainly in the Banggai archipelago. The high productivity of the Banggai cardinalfish and its relocation to new sites across Indonesia ensures the species has a good capacity to recover from natural and human pressures. However, the Panel noted the local extinction at five sites across the Banggai archipelago, with a further seven sites where declines in abundance meet the CITES criteria for listing in Appendix II. International trade is considered the main driver behind declines in abundance of the species, although change in abundance and quality of micro-habitat is also a threat. Captive breeding currently supplies approximately half of total demand of the international market, and the only range state, Indonesia, has stated it would prefer to manage Banggai cardinalfish through use of national controls rather than CITES trade regulations.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

The Banggai cardinalfish, *Pterapogon kauderni* (Koumans, 1933), here shortened to BCF, is endemic to Indonesia and is found in isolated populations across shallow coastal waters of the Banggai archipelago (approx. 30km^2), plus various locations across Indonesia where more recent introductions have been made (Figure 1). The intentional release by collectors, of fish near their trading facilities but outside their geographical range, has created new self-sustaining populations (Figure 1, Table 1). These subpopulations generally comprise of a mix of fish, sourced from various locations across the Banggai archipelago.

In the small subpopulations that have been introduced elsewhere across Indonesia, the density of fishes can be higher than in the locations in Banggai district, e.g. Palu, Lembeh Straits (Makatipu *et al*., 2013) and Ambon (Basir pers. comm., 2016). There is a suggestion that some of these new recordings have been confused with another similar species, the Pajama cardinalfish, *Sphaeramia nematoptera* (Bleeker, 1856). Ndobe *et al*., (2012) suggested this was unlikely, as the two species look quite different.

Microhabitat is critical for these site-attached fish, especially as juveniles, as they find protection from predators when in the spines of urchins, tentacles of anemones and branches of live coral. Vagelli (pers comm., 2016) observed a generalized decline in the abundance of long-spine sea urchins (and anemones) in 2015, and both natural and human pressures have been noted to effect habitat and microhabitat in Indonesia (Moore *et al*., 2012; Ndobe *et al*., 2012; Yahya *et al.*, 2012). Lilley (2008) observed that there was a lack of no-take zones as part of a coordinated regional plan and how locally implemented spatial controls are not well respected by fishers from distant locations.

The lack of planktonic dispersal phase coupled with its adult sedentary behavior where it is restricted to reef patches and seagrass beds ensures there is spatial isolation among populations. The extreme phylopatry of BCF is reflected by the possession of very high population structuring for a marine fish, with populations separated by a few km, or even the same islands, being genetically distinct from each other (Bernardi and Vagelli, 2004; Hoffman *et al*., 2005; Vagelli *et al*., 2009). Hence, the concept of “Evolutionary Significant Unit” as defined by the National Marine Fisheries Service of the USA "a population or a group of populations that (1) is substantially reproductively isolated from other

conspecific units and (2) represents an important component in the evolutionary legacy of the species" (Musik, 1999) can be thought to apply to BCF populations.

The Panel collated life history information on the productivity of BCF (Table 2). The Panel also referred to FishBase (http://www.fishbase.org/), which modelled life history traits to determine productivity of BCF, recording a minimum population doubling time of 1.4 - 4.4 years (tm<1; Fec=12-40; assuming multiple spawning), with the vulnerability was listed as moderate (Musick 1999, Cheung *et al*., 2005).

More recent assessments made in 2016, confirmed the previous FAO panel assessment (FAO, 2007) of BCF productivity as being high. The research that BCF productivity was high, noted BCF's productivity was more similar to mammals and chondrichthyans in terms of survival and reproduction than to the majority of teleosts (see, http://sebpardo.github.io/banggai-rmax/). The author Sebastián Pardo obtained an estimate of productivity (r_{max}) for the BCF higher than the majority of teleosts examined by Hutchings *et al*. (2012), at values ranging from 0.86 to 2.23 year^{-1}. This species, that starts to reproduce in less than a year, can rear multiple batches of eggs within a year, and double its population annually in the absence of density dependent controls.

Trends and application of the decline criterion

Population size estimates for the BCF are available for the Banggai archipelago but not for introduced populations in the rest of Indonesia. Population estimates at Banggai archipelago suggest that there were 2.4 million individuals in 2004 (CITES listing Proposal; Vagelli 2005), 2.2 million individuals in 2007 (Vagelli, 2008). This figure was again revised down to 1.4 million individuals last year (Vagelli, 2015). These figures were taken from fishery independent surveys of BCF (Figure 2), the last estimate being based on fishery independent surveys of 52 sites, covering 90% of the species' natural geographic range in March 2015 (Table 3, Figure 3).

The Panel recognised the loss of one subpopulation in 2007 and that sequential serial depletion has occurred, with continued decline in a number of other sites (Table 3). Evidence presented in this 2016 Proposal shows significant historical extent of declines and recent rate of declines for a large proportion of the subpopulations surveyed; five sites reported a local extinction, with a further seven having population declines of 90% or more (Table 3, Figure 3).

Populations monitored over several years also showed a significant decline in the CPUE. Between 2000 and 2004, the reported mean catch in Banggai archipelago declined from over 1000 fish/hour to 25–330 fish/hour (Vagelli, 2011). Prior to 2003, fishers from the Bone Baru collection centre typically required one day to capture ~2000 specimens (Vagelli, 2011). In 2007, they reported requiring one week for capturing the same number (Vagelli, 2011). Similar declines were recorded in other sites (EC-Prep, 2005). No new data on current CPUE was presented in the 2016 Proposal.

Modifying factors and risk

A review of the published literature and research show that BCF are endangered, rare, have a restricted range [endemic], have a low reproductive capacity, and their critical habitat is currently in decline. There are also a range of sites were wild population(s) have significantly declined or been lost. Factors that may increase or decrease the risk to this unusual site-attached, mouth brooding fish species are listed in Table 4.

Summary of evaluation and assessment of biological listing criteria

The Banggai cardinalfish is endemic to Indonesia, being found in isolated populations in the Banggai archipelago plus some locations across Indonesia where more recent species introductions have been made. Among approximately 100 families (>2000 species) of teleost fish only three lack a pelagic interval. Even those without a pelagic dispersing larval stage typically have broader geographical range, due to their capacity of post-recruitment stages to disperse. This is not the case for BCF that are largely site-attached. This results in greater isolation among populations reflected by the possession of very high population structuring across populations separated by a few km, or even the same islands.

As the life-history does not involve a dispersal stage (planktonic larvae or post-recruitment dispersal stage), this limits the opportunity for BCF to re-establish at sites where there has been local extinction,

as natural dispersal is a challenge for exchange of propagules over the species entire distribution. In addition, their site-attached behavior, linked to vulnerable habitat and micro-habitat makes BCF susceptible to both fishing and coastal degradation, even in absence of a heavy collection pressure.

The high productivity of the Banggai cardinalfish and its relocation to new sites in Indonesia ensures the species has a good capacity to recover from natural and human pressures. However, the Panel recognised when reviewing the data that the loss of BCF at one site in 2007 had increased to five sites in 2015, with a further seven sites recording declines of 90% or more. The Panel determined this sequential serial depletion (historical extent of decline and recent rate of decline) of a large proportion of BCF subpopulations, met the CITES Appendix II listing criteria.

The Panel also took into account other ecological characteristics of BCF that makes them particularly vulnerable to overharvesting, considering BCF form groups in shallow habitats and exibit highly site-attached behavior. The panel also recorded evidence (Ndobe *et al*., 2008; Yahya *et al*., 2012) of decline in the abundance and quality of Banggai cardinalfish micro-habitat (e.g. long-spine sea urchins, anemones and branching corals) from both direct exploitation and degradation of coastal habitats, which further elevates the level of threat.

Comments on technical aspects in relation to trade, management and implementation

The following comments are in response to statements in the Proposal related to management and trade and are not a comprehensive summary of management regimes or trade of BCF. The Panel found that much of the information necessary to thoroughly evaluate the management and trade aspects of the Proposals was difficult to review, as there was conflicting anecdotal information on the management and trade. Therefore, for the review presented below the Panel needed to rely largely on a combination of information presented in the Proposal and its own expert knowledge, which at times was also anecdotal or qualitative.

Management comment

This section will not present a full summary of all management information, but will respond to the Proposal and highlight pertinent issues in regards the BCF.

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International / Regional management:
    - This species is only found in the wild in isolated areas of Indonesia, although aquaculture of the species is on-going in both Indonesia and other countries, including Thailand.
    - BCF was included in Annex D of Commission Regulation (EU) No. 318/2008 in April 2008 and most recently, in Commission Regulation (EU) No. to 1320/2014. This requires imports of BCF into the EU to be well documented and enumerated.
- National:
    - Fishery Law No. 31 Year 2004 article 6 states that fishery management should:
        i) achieve sustainable utilization and ensure fish resources are preserved.
        ii) consider traditional law and local wisdom as well as community participation (for fish capture and aquaculture).
    - BCF is not listed on the Government Regulation no 7/1999. The appendix of PP 7/1999 is now being amended by the Ministry of Environment and Forestry (MoEF) with recommendation from Scientific Authority. Furthermore, it is planned that all aquatic species will no longer be listed on PP 7/1999 and will be regulated under the regulation of the Ministry of Marine Affairs and Fisheries (MMAF).

- The Ministry of Fisheries and Marine Affairs did propose BCF to be given restricted protection status under Indonesian domestic law; limited protected status under Indonesian Government Regulation No. 60/2007, regarding the conservation of fishery resources. This was not gazetted, as there was an argument that BCF was now more widely distributed across Indonesia through translocation and aquaculture, in areas distant from its home range in Banggai Islands.
- The Ministry of Marine Affairs and Fisheries published a book: Sumberdaya Ikan Hias Laut Indonesia. 2009. Directorate of Fishery Resources. Directorate of Capture Fisheries. The Ministry of Marine Affairs and Fisheries. 150 pp. This publication lists BCF as an ornamental species, that can be subject to regulation of listed ornamental species (Conant, 2015).
- BCF is a priority species in the Ministry of Marine Affairs and Fisheries planning (2014–2019). The Ministry of Marine Affairs and Fisheries has proposed a National Plan of Action (NPOA) for BCF. The NPOA process started in 2014 with a draft proposed for adoption in 2016. It has also produced a 54 page 'awareness raising' booklet, to highlight the biology, ecology, monitoring and rehabilitation of BCF and its habitat, in order to inform local communities (Anon 2010).
- The draft NPOA highlights includes plans for rebuilding BCF populations across their natural range. The approach focusses on awareness raising, restocking, aquaculture and short-term moratoriums for wild collection.
- Stocking of new locations across Indonesia has yielded successful results to date. For example an Ambon Bay, a site stocked in November 2014 with 20 fishes, held in excess of 1000 fish the following October (Basir, pers com 2016, hatchery manager in Ambon). This reflects the species ability for rapid recovery, if conditions are suitable.

- Local:
  - The establishment of BCF center through the decree of The Regent of Kepulauan Banggai (No.168 year 2007) and the decree of The Regent of Kepulauan Banggai on Local Marine Conservation Area (Kawasan Konservasi Laut Daerah or KKLD, No. 540 year 2007) determined an allowed quota for BCF harvest of 15,000 individuals/month.
  - In 2008, the local government decided to establish only three BCF collection zones: Bone Baru, Toropot and Bone Bone. In these zones fish are collected in a radius covering several islands, as a mechanism to separate and manage collection across three areas (Hartati *et al*., 2012).
  - There are local initiatives to regulate the size of BCF for capture from the wild, to a maximum size of 4-5 cm TL. (Hartati *et al*., 2012). On-site observations made in 2015 failed to note this rule being followed (A. Vagelli, pers comm., 2016).
  - The Proposal suggests that regulations for the collection of ornamental fish do not include fishing areas in the Banggai archipelago. The inadequacies of District government to implement existing local regulatory arrangements is well described (Conant, 2015), and these have been complicated by a split of the Banggai Archipelago into two new administrative districts (Banggai Kepulauan and Banggai Laut). However, a new regulation to halt all ornamental fishing and trading activities was issued by the Bupati Banggai Laut (Regent) in 2014. This regulation covers the main Banggai fishing collection sites for Banggai Laut. This information seems to directly contradict the Proposal, although anecdotal reports suggest the regulation was not complied with (Vagelli, pers comm. 2016).
  - In the Banggai archipelago, community actions have included the closure of fishing by fishers from outside the archipeligo (2004 in Masoni Village, pers comm. Alejandro Vagelli 2016).
  - The new Banggai Laut regional government, in place since 2014, believes wild populations can be rebuilt the in a relatively short period (18 months, G. Lilley pers com., 2015; G.; Kasim *et al*., 2013).
  - Representatives from Bone Baru (a Banggai fishing community) are being funded to learn more about the BCF conservation with Indonesian Nature Foundation (LINI), who continue to train community representatives in BCF conservation issues, including aquaculture. There is also a

plan for instituting a more general education, awareness and community development program for local fishers across the Banggai Islands.

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES?

- Indonesia does not have an on-going national program to monitor the health of BCF despite these activities being outlined in Indonesia's National Plan of Action for the Coral Triangle Initiative (National Secretariat of CTI-CFF Indonesia, 2009) and its new draft NPOA for BCF. However some introduced populations outside Banggai archipelago, e.g. in Palu, are monitored regularly (by the faculty of animal husbandry and fisheries, Tadulako University). This monitoring started in 2014 and is conducted routinely on a 3-month basis, which is proving the subpopulation to be enduring and stable (Ndobe, pers comm., 2016).
- If Indonesia were required to create NDF's for exports, it has the capacity within the Ministry of Marine Affairs and Fisheries to complete assessment work, but would need to find the funds to deliver reliable on-going assessments. If funds were not available for the completion of NDF requirements, another option would be for the Government to declare a moratorium on exports, with resulting loss of income for rural fishers, and potentially a disincentive for future investment in BCF aquaculture.
- With numerous new shipping opportunities available to a wide range of isolated fishing communities, achieving a framework for effective surveillance of a BCF fishery and trade would be difficult and costly to achieve (Yahya *et al*., 2012).
- The only range State for BCF, Indonesia, has indicated through its Ministry of Marine Affairs and Fisheries that it would not like CITES II listing of BCF as a conservation management measure, preferring to institute national controls. There is however anecdotal reports that some local communities in Banggai Archipelago are more supportive, as they believe the CITES listing would increase the price they receive for sales of the species.

Trade comment

International trade is recognised as the main driver of BCF exploitation, with live individuals the only product in trade, and these are very easy to identify to species level. There is currently a shift in trade, from wild caught BCF to captive bred product. Despite this shift, trade in fish from the wild continues across the Banggai archaepeligo.

Trade (market transparency, documentation and level of IUU)

- BCF trade begun in the 1990's (Vagelli, 2011) and data show that historically, exports of wild caught BCF have been significant, with approx. 650,000 fish/year exported in the early 2000's (Vagelli Erdmann, 2002; Lunn and Moreau, 2004), rising to 900,000 fish/year in 2009. In 2015, holding nets containing thousands of BCF were encountered in several islands, including at Banggai, Bangkuru and Telopo (A. Vagelli, pers comm., 2015) which indicates collection pressures are still on-going, despite some moves towards a moratorium on fishing. Lastly there is also some anecdotal reports of fishing on BCF to use as a feed source to grow out food fish (Lilley, 2015), although the quantity taken is not thought to be significant.
- The local price paid for BCF in the Banggai archipelago is US$ 0.50 - US$ 1.00 (A. Vagelli, pers comm. 2015), with fishing for BCF generally considered an alternative livelihood, not a main income for the local community (Vagelli, 2008; 2011).
- In 2007 there were just three centralized collection centers for shipping BCF, but now with greater access to transportation, particularly shipping to Luwuk (central Sulawesi), captures are less well able to be recorded by the local fisheries/quarantine office (A. Vagelli, pers comm. 2015). With the arrival of cellular phone access, and more access to vessels (small and medium size boats and speed boats), trade routes have decentralized, further hampering the efforts of authorities to record and quantify trade (A. Vagelli, pers comm. 2016).

- Movement of BCF through trade is extending the range of BCF, with the development of exotic subpopulations outside of the Banggai Islands. For example, in Lembeh Straits there is considered to be a high-density population compared to current densities noted in the Banggai Islands (Makatipu *et al*., 2013). According to Ndobe (pers.comm. 2016), the population in Palu is stable with no utilization of BCF and no exploitation of microhabitat.
- The Banggai Laut District government issued a moratorium of wild population in 2014, after being split into two districts (Banggai Kepulauan and Banggai Laut). Banggai Laut (the main collection site for ornamental fish) declaration (based on surat edaran no 047/109/2014 about Pelarangan Usaha Ikan Hias dan Komoditas Perikanan Dilindungi) is still in force, but compliance is proving a challenge.
- There is anecdotal reports of trading of BCF from sites where wild caught BCF have been introduced. For example in Tumbak (Manado), Kendari and Luwukare yielding 10,000, 20,000 and 5,000 individuals fish/month respectively (Private Company C.V. Cahaya Baru, pers.comm., 2016).
- Hatchery production from captive bred BCF was established in the late 1990's and this product is exported for the aquarium market, and unlike wild caught product is guarenteed 'disease free'.
- Production from Ambon and Bali is yielding around 20,000 fish/year for Ambon (since 2009), whereas in Bali one of three recognized breeders, trades a similar amount each month (since July 2015, Private Company C.V. Cahaya Baru, pers. comm. 2016).
- Captive breeding of BCF in Indonesia is also conducted from facilities located on Bali's north east coast. This aquaculture and training centre started in 2015.
- Since 2012, trade for the aquarium market seems to be more and more covered by captive bred specimens from large-scale production in Thailand (Talbot *et al*., 2013). The scale of captive bred BCF production is now at a scale where around half the aquarium market capacity is supplied with captive bred product.
- As a large amount of exports now comprise market preferred, 'disease free' captive bred stock. This should in theory, decrease pressure on wild stocks. The available quarantine data does shows a recent decline in trade of wild caught BCF from the Banggai archipelago, whereas the demand for BCF from cultured sources has increased (G.Lilley, pers com 2016). To counter this assumption, Vagelli (2011) argues that the low price of wild caught fish will ensure they are still targeted and traded.

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES?

- CITES provisions on trade in specimens of species listed in Appendix II require the issuance of an export permit by the exporting country, which is only be granted if the national CITES authorities are satisfied that i) the export is not detrimental to the survival of the species in the wild ; and ii) the specimens were not obtained in contravention of the national laws of that state.
- If BCF were listed in Appendix II and CITES provisions were effectively implemented, then trade would be recorded in the CITES trade database, and that that should help to ensure traceability of BCF in trade. Increasing the reliability and volume of export and import recording should help to inform priorities for managing and controlling BCF fisheries and captive breeding. If a States' ability to make NDFs was limited because of an absence of information or resources, under these conditions the following outcomes can occur; i) previous trade ceases, ii) trade continues without proper CITES documentation (also known as 'illegal trade'), and/or iii) Trade continues with inadequate NDFs.
- The decentralization and diversification of shipping opportunities from Banggai archipelago in recent times, makes quarantine surveillance of shipments of wild caught BCF more difficult prior to export (before crossing administrative borders). This would likely continue to present a problem for local compliance and enforcement of any new CITES requirements.

- Currently there is a decline in wild capture BCF trade data (quarantine records), whereas the availability and demand for BCF from cultured sources has increased (G. Lilley pers comm. 2016). It is uncertain how an Appendix II listing would further impact this development of capture breeding of the species. In other such situations, where a species group was CITES listed, e.g. seahorses, there was an increase in captive breeding, but this occurred outside of the range States.
- If BCF are listed in Appendix II, and Indonesia wishes to continue to trade captive bred BCF, aquaculture facilities will need to ensure standards meet CITES captive breeding facility requirements.
- Indonesia has expressed concern that listing the species will result in illegal trade of the species, and has some experience with related issues. For example, following the Appendix II listing of Humphead wrasse, *Cheilinus undulatus* in 2004, illegal trade from Indonesia was a challenge for authorities to control, despite the implementation of a regulated export quota.
- As the identification of BCF is relatively simple and few fish species can be considered look-alikes, the production of some simple identification guide tools would probably be adequate for customs, port and fisheries officials to use when identifying the species in trade.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

The Banggai cardinalfish is being proposed for CITES Appendix II listing in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion A and B in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states *A)'It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future', and B) 'It is known, or can be inferred or projected, that regulation of trade in the species is required to ensure that the harvest of specimens from the wild is not reducing the wild population to a level at which its survival might be threatened by continued harvesting or other influences'*.

International trade is considered the main driver behind fishing, although natural and man-made changes to the habitat and micro-habitat of the species, driven by local exploitation and degradation of coastal habitats, is also an important negative influence. Although CITES listing would potentially assist in upgrading the understanding of trade of BCF from the wild and through captive rearing, the listing would not assist in the management of BCF micro-habitat that is important for juvenile and early adult fish.

Although the Banggai cardinalfish has been identified as a high productivity species, with an excellent ability to recover from natural and man-made pressures, long term and current estimates show population declines, and in some cases, loss of this species from sites where Banggai cardinalfish once flourished. The biological assessment highlights declines in the status of the Banggai cardinalfish stocks, and the biological and ecological modifying factors, which potentially increases risk for the species. Despite being a species of high productivity, Banggai cardinalfish is an unusual site attached species with no free larval phase in the life cycle and limited post recruitment movement. These characteristics limits its ability to recover to areas that have been overfished, and the high level of genetic structuring of the population, with sub-units separated by a few km, could mean there is a loss of genetic diversity if sites lose fish through serial depletion.

It is difficult to draw clear conclusions regarding the effectiveness of existing and future management and trade measures due to the lack of data available to be able to assess these measures. However, it is noted that if Banggai cardinalfish were listed in Appendix II and CITES provisions were properly implemented, it would provide an additional control to ensure that products entering international trade are derived from legal and sustainable fisheries. Trade of wild caught and captive bred Banggai cardinalfish would require CITES documentation, along with a NDFs indicating that harvests from the wild were sustainable and consistent with relevant measures under international law. Compliance with CITES requirements would result in improved monitoring, that would help enable new or enhanced assessments of stock status and the subsequent adoption of management measures that ensure the sustainability of harvests, where these are still permitted.

In order to offer effective management for this resource, one needs to consider the local administrative and social conditions found in the only range state, Indonesia. It should be noted that States' ability to make NDFs is limited in the absence of on-going assessments, as evidenced by difficulties encountered in making NDFs for other reef fish that have already been listed. Under these conditions the following outcomes can occur, previous trade ceases, trade continues without proper CITES documentation (i.e. illegal trade) and/or trade continues with inadequate NDFs.

Indonesia has requested that more time be given for the implementation of national and local solutions to the declines of Banggai cardinalfish, as the requirements for trade regulation that would accompany a CITES listing would divert capacity and resources away from the delivery of management initiatives that are currently underway. Indonesia also recognises the challenge of ensuring compliance with internationally led trade regulations, in contrast with developing better local awareness and governance solutions that have an element of self-enforcement. The Directorate of Conservation (Ministry of Marine Affairs and Fisheries) stated in 2016 that it would prefer to include the Banggai cardinalfish in national and local regulations to restrict utilization, such as moratorium of wild collection from its (considered) native habitat in Banggai archipelago. When stocks recover, this would then be followed by the establishment of an orderly chain of custody framework, to monitor and regulate trade.

References

Allen, G.R. & T.B. Werner. 2002. Coral reef fish assessment in the ‘coral triangle’ of southeastern Asia. *Environmental Biology of Fishes*, 65**:** 209-214. http://dx.doi.org/10.1023/A:1020093012502.

Anon. 2010. Pedoman Rehabilitaasi Banggai Cardinal fish (Pteropogon kauderni). Direktorat Konservasi Kawasandan JenisIkan. Direktorat Jendral Kelautan, Pesisirdan Pulau-pulau Kecil. Kementrian Kelautan Dan Periknan. 54 p.

Bernardi, G. & A. Vagelli. 2004. Population structure in Banggai cardinalfish, *Pterapogon kauderni*, a coral reef species lacking a pelagic larval phase. *Marine Biology*, 145: 803–810.

Cheung, W.W.L., Pitcher, T.J., & D. Pauly. 2005. A fuzzy logic expert system to estimate intrinsic extinction vulnerability ofmarine fishes to fishing. *Biol Conserv* 124:97–111.

CITES 2016. CoP17 Prop. 46, Consideration of Proposals for Amendment of Appendices I and II. CITES Secretariat, 16p.

Conant, T.A. 2015. Endangered species act status review report: Banggai cardinalfish, *Pterapogon kauderni*. National Marine Fisheries Service, National Oceanic and Atmospheric Administration. 40p.EC-Prep Project EP/RO3/R14, 2004.

EC-PREP. 2005. The Indonesian ornamental fish trade: Case studies and options for improving livelihoods while promoting sustainability in Banggai and Banyuwangi. EC-PREP Project EP/RO3/R14. 286 p.

Erdmann, M.V. & A. Vagelli. 2001. Banggai cardinalfish invade Lembeh Strait. *Coral Reefs* 20:252-253.

FAO. 2007. FAO Fisheries Report No. 833 Second FAO ad hoc expert advisory Panel for the assessment of proposals to amend Appendices I and II of CITES concerning commercially-exploited aquatic species. Food and Agriculture Organization of the United Nations, Rome. 141 pp.

Hartati, S.R., Wudianto & L. Sadiyah. 2012. Management for Banggai Cardinal Fish (*Pterapogon kauderni*) In Banggai Islands Waters. J. Kebijak. Perikan. Ind. vol.4 No.1: 1-7.

Hoffman, E.A., Kolm, N., Berglund, A., Arguello, J.R. & A.G. Jones. 2005. Genetic structure in the coral-reef-associated Banggai cardinalfish, *Pterapogon kauderni*. *Molecular ecology*, 14(5): 1367–75.

Hutchings, J. A., Myers, R. A., García, V. B., Lucifora, L. O. & A. Kuparinen. 2012. Life-history correlates of extinction risk and recovery potential. *Ecological Applications*, 22: 1061–1067. doi:10.1890/11-1313.1.

Indrawan, M. & Suseno. 2008. The complications of CITES inclusion of endemic species in Indonesia: Lessons learned from an in-country deliberation on protecting the Banggai cardinalfish, *Pterapogon kauderni*. *SPC Live Reef Fish Information Bulletin*, 18: 13-16.

Kasim, Kamaluddin, S.T. Hartati, Prihatingsih, and Gudmundur Thordarson. 2014. Impact of Fishing and Habitat Degradation on the Density of Banggai Cardinal Fish (*Pteropogon kauderni*, Koumans 1933), in Banggai Archipelago, Indonesia. Ind.Fish.Res.J, vol 1.no 2:29-36.

Lilley, R. 2008. The Banggai cardinalfish: An overview of conservation challenges. *SPC Live Reef Fish Information Bulletin* #18:3-12.

Lilley, G. 2015. Concerns about the conservation of the Banggai cardinalfish. *OFI Journal* 78: 8-9.

Lunn, K.E. & M.A. Moreau. 2004. Unmonitored trade in marine ornamental fishes: the case of Indonesia’s Banggai cardinalfish (*Pterapogon kauderni*). *Coral Reefs*, 23: 344-351.

Makatipu. P.C., T. Peristiwady, N. Manik, I. Pulukadang, M. PanduRisqi, M. Jabar and N.Mahmud. 2013. Standing Stock dan Pemeliharaan IndukIkan Capungan “Banggai Cardinalfish” (*Pterapogon kauderni*, Koumans, 1933) Di Selat Lembeh, Bitung, Sulawesi Utara. LaporanAkhir. Unit Pelaksana TeknisLoka Konservasi Biota Laut Pusat Penelitian Oseanografi, LembagaIlmu Pengetahuan Indonesia Bitung.

Moore, A. & S.Ndobe. 2007. Discovery of an introduced Banggai Cardinalfish population in Palu Bay, Central Sulawesi, Indonesia. *Coral Reefs* 26:569.

Moore, A., S. Ndobe, A.I. Salanggon, Erdeyan and A. Rahman. 2012. Banggai cardinalfish Ornamental Fishery: The important of Microhabitat. Proc.of International Coral Reef Symposium, Cairns, Australia: 1-6.

Moore A, Ndobe S, & M. Zamrud. 2011. Monitoring the Banggai Cardinalfish, an Endangered Restricted Range Endemic Species. *Journal of Indonesia Coral Reefs* 1(2) (2011) 99-113.

Musick, J.A. 1999. Criteria to define extinction risk inmarine fishes. *Fisheries* 24, 6–14.

Ndobe, S. & A.Moore. 2005. *Pterapogon kauderni*, Banggai Cardinalfish: Beberapa Aspek Biologi, Ekologidan Pemanfaatan Spesies Endemik di Sulawesi Tengah yang Potensiluntuk Dibudidayakan. Prosiding Seminar Perbenihan Nasional (National Seminar on Breeding) 2005, Palu, Indonesia, hal. 389-404.

Ndobe, S., Madinawati, N, and A. Moore. 2008. Pengkajian Ontogenetic shift pada ikan endemic Pteropogon kauderni. *Journal Mitra Bahari* 2: 32-55.

Ndobe, S., Setyohadi, D., Herawati, E.Y., Soemarno & A. Moore. 2012. An ecological and social approach to Banggai cardinalfish conservation management. *In:* Proceedings of the 12th International Coral Reef Symposium, 9-13 July 2012. Cairns, Australia.

Ndobe, S., Moore, A., Madinawati, N. & N. Serdiati. 2013. The Banggai cardinalfish: An overview of local research (2007-2009). *Galaxea, Journal of Coral Reef Studies*, 243–252.

Vagelli, A.A. & M.V. Erdmann. 2002. First Comprehensive Survey of the Banggai Cardinalfish, *Pterapogon kauderni.* Environmental Biology of Fishes 63:1-8.

Vagelli, A.A. & A.V. Volpedo. 2004. Reproductive ecology of *Pterapogon kauderni*, an endemic apogonid from Indonesia with direct development. *Environmental Biology of Fishes*, 70: 235–245.

Vagelli, A.A. 2005. Reproductive biology, geographic distribution and ecology of the Banggai cardinalfish *Pterapogon kauderni*, Koumans 1933 (Perciformes, Apogonidae), with Considerations on the Conservation Status of this Species on its Natural Habitat. PhD Thesis. University of Buenos Aires. 276 pp.

Vagelli, A.A. 2008. The unfortunate journey of *Pterapogon kauderni*: A remarkable apogonid endangered by the international ornamental fish trade, and its case in CITES. *SPC Live Reef Fish Information Bulletin*, 18: 17–28.

Vagelli, A.A. 2011. The Banggai cardinalfish: natural history, conservation, and culture of *Pterapogon kauderni*. Wiley-Blackwell, UK. 203 pp. Vagelli, 2015.

Weber, S., Waltzek, T., Young, D., Twitchell, E., Gates A., Vagelli, A., Risatti, G., Hedrick, R. & S. Frasca. 2009. Systemic Iridovirus Infection in the Banggai Cardinalfish (*Pterapogon kauderni*). *J.Vet. Diag. Invest*., 21(3): 306-320.

Yahya, Y., Mustain, A., Artiawan, N., Reksodihardjo-Lilley, G. & M.F. Tlusty. 2012. Summary of results of population density surveys of the Banggai cardinalfish in the Banggai Archipelago, Sulawesi, Indonesia, from 2007-2012. AACL Bioflux, 5(5): 303–308.

Tables and Figures

Table 1. Locations where Banggai cardinalfish are found across Indonesia.

REF #	LOCATION	REFERENCE(S), OTHER SUPPORTING COMMENT(S)
1	Gilimanuk Bay, NW Bali	Lilley, 2008
2	Les NE Bali	Ms. Gayatri Reksodihardjo-Lilley (pers. comm., 2016). Founder of the Indonesian Nature Foundation (LINI), Director Aquaculture and Training Centre, Bali, Indonesia
3	Kendari, SE Sulawesi	Moore *et al.*, 2011
4	Palu Bay (several locations), Sulawesi	Vagelli and Erdmann, 2002; Ndobe and Moore, 2005; Moore and Ndobe, 2007
5	Banggai archipelago	Endemic location
6	Tumbak Bay, NE Sulawesi	Ndobe and Moore, 2005
7	Lembeh Straight (several locations), N Sulawesi	Erdmann and Vagelli, 2001; Makatipu *et al.*, 2013
8	Ternate Area (Tidore Island), Moluccas	Mr. Indra Bayu Vimono, Researcher (pers comm., 2016), Research Centre for Oceanography, Indonesian Institute of Sciences (LIPI).
9	Ambon Bay, Moluccas	Mr. Basir, Ministry of Marine Affairs and Fisheries (pers comm., 2016), Ambon, Indonesia.

Table 2. Productivity of the Banggai cardinalfish

PARAMETER	STATUS[3]	REFERENCE(S), OTHER SUPPORTING COMMENT(S)
Intrinsic growth rate of population	high	FishBase (http://www.fishbase.org/) and Sebastián Pardo study: http://sebpardo.github.io/banggai-rmax/. High confidence
Growth	medium	Vonn Bertalanfy k=0.21 (±0.016). (Vagelli, 2011). High confidence
TMAX_longevity	high	3–5 years. Wild: 2 years, Captivity: 4 years (Vagelli, pers. comm.; Ndobe *et al*., 2013). High confidence
TMAT_maturity	high	Female: minimum size at maturity in the wild 41mm, 8–9 months old. (Vagelli and Volpedo, 2004). High confidence
Linf		7.1cm. (Ndobe *et al.*, 2013). High confidence
No. of young (litter size)	v low	30-40 eggs. High confidence
Fecundity		58.87 (Ndobe *et al.*, 2013). High confidence

[3]See Musick *et al* 1999

Table 3. Information on trends in decline of BCF sourced from fishery independent counts conducted by researchers between 2001 and 2015. Refer to Figure 2 for position of sites and Figure 3 for graphed decline data.

REF #	SITE NAME	EXTENT OF DECLINE %	REFERENCE PERIOD	METHOD	OTHER SUPPORTING COMMENT(S), REFERENCE(S)
Star 1	Limbo 1	100% loss	2001–2015	Dive Survey[4]	In 2015 extensive patches of "Ulva-like algae" covering all hard substrates and high abundance of lion fishes, *Pterois* spp. Site data also available for 2002, 2004 and 2007. (Vagelli, 2005; 2008; 2015). Data reliability assessed as 5 (high).
Star 2	Limbo 3	100% loss	2004–2015	Dive survey	Vagelli 2015, Small population <500 fish. Site data also available for 2007.Data reliability assessed as 5 (high).
Star 3	Masoni 1	100% loss	2001–2015	Dive survey	Dramatic change in physiography/ high current bottom became mostly sandy no urchins. Reduced to 37 fish in 2007 Site data also available for 2002, 2004 and 2007. (Vagelli 2008; 2015). Data reliability assessed as 5 (high).
Star 4	Bakakan S	100% loss	2001–2015	Dive survey	Reduced to 20 fish in 2007. Site data also available for 2002, and 2007. (Vagelli, 2015). Data reliability assessed as 5 (high).
Star 5	Peleng Liang	100% loss	2004–2015	Dive survey	(Vagelli, 2015; Moore *et al*., 2011). Data reliability assessed as 5 (high).
Tri 6	Peleng 1	99.9% decline	2001–2015	Dive survey	Reduced to 27 fish in 2007, then 1 in 2015. Site data also available for 2002 and 2007. (Vagelli, 2008; 2015). Data reliability assessed as 5 (high).
Tri 7	Masoni (rest Isl)	99.7% decline	2001–2015	Dive survey	Reduced from 15,600 to 150 fish in 2007 and 50 fish by 2015. (Vagelli, 2008; 2005; 2015). Data reliability assessed as 5 (high).
Tri 8	Bakakan	95.0% decline	2001–2015	Dive survey	Reduced from ~ 4000 to 200 fish in 2007. Site data also available for 2002 and 2007. (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 9	Melilis	96.5% decline	2007–2015	Dive survey	Decline in sea urchin population noted. Site data also available for 2004, and 2007. (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 10	Bangko 1	93.7% decline	2002–2015	Dive survey	No anemone present on site. Site data also available for 2007. (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 11	Peleng s Liang	93.7% decline	2007–2015	Dive survey	Reduced to < 30 fish (Vagelli, 2015). Site data also available for 2007 (~500 fish). Data reliability assessed as 5 (high).
Tri 12	Labobo 1	90.0% decline	2001–2015	Dive survey	One of the 6 populations with density of 0.1 or higher in 2007 (0.1ind/m^2 to 0.01ind/m^2). Large decline in sea urchin presence, only one anemone found. Site data also available for 2002, 2004, 2007. (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 13	Bangko 2	80.0% decline	2007–2015	Dive survey	Site data also available for 2004. (Vagelli, 2015). Data reliability assessed as 5 (high).

[4]Fishery Independent Dive survey. Dive survey covers 4800 m2 (same method utilized on all 2015 and all previous surveys by the same researcher and same assistants)

REF #	SITE NAME	EXTENT OF DECLINE %	REFERENCE PERIOD	METHOD	OTHER SUPPORTING COMMENT(S), REFERENCE(S)
Tri 14	Bangkuru 5	73.7% decline	2004–2015	Dive survey	This population had the 3rd highest density in 2007 (0.19ind/m^2 declined to 0.05ind/m^2). Large decline in urchin abundance (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 15	Tempaus	68.8% decline	2001–2015	Dive survey	In 2001 the largest ever group encountered in this population was at least 500 fish. Entire island reduced to <200 fish in total by 2015. Virtual disappearance of urchins from site (Vagelli & Erdmann, 2002; Vagelli, 2011; 2015). Data reliability assessed as 5 (high).
Tri 16	Seku 1	60.0% decline	2001–2015	Dive survey	One of the 6 populations with a density of 0.1 or higher in 2007 declined to 0.04ind/m^2. Large decline in urchin presence. Site data also available for 2002, 2004, 2007 (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 17	Banggai 3	53.4 % decline	2007–2015	Dive survey	One of the 6 populations with a density of 0.1ind/m^2 or higher in 2007 (0.15ind/m^2) declined to 0.07 ind/m^2. Data reliability assessed as 5 (high).
Tri 18	Bokan	52.2% decline	2001–2015	Dive survey	Pop w highest density in 2007 (0.23ind/m^2), declined to 0.11ind/m^2 by 2015. Large decline in sea urchin presence (Vagelli, 2015). Data reliability assessed as 5 (high).
Tri 19	Seku 2	48.4% decline	2007–2015	Dive survey	Vagelli (2015). Data reliability assessed as 5 (high).
Tri 20	Bangkuru 6	40.4% decline	2007–2015	Dive survey	This population had the 2nd highest density in 2007 (0.22ind/m^2) but declined to 0.13ind/m^2 by 2015. Large decline in urchin abundance (Vagelli, 2015). Data reliability assessed as 5 (high).
Cir 21	Banggai 1	25.4% decline	2001–2007	Dive survey	Baseline Site[5]. Decline to 0.47ind/m^2 in 2005 when "poaching" began at this site (only de-facto protected population, see Vagelli, 2011; 2015). Data reliability assessed as 5 (high).
Tri 22	Teropot 1	74.8% decline	2004–2010	Transect[6]	Kasim *et al.* (2014). Data reliability assessed as 1-3 (low to moderate[7]).
Tri 23	Teropot 2	~50% decline	2009–2012	Transect	Yaya *et al.* (2012). Data reliability assessed as 2 (low).
Tri 24	Banggai Bone Baru	~50% decline	2004–2010	Transect	Kasim *et al.* (2014). Data reliability assessed as 1-3 (low to moderate).
Tri 25	Banggai Bone Baru	~50% decline	2009–2012	Transect	Yaya *et al.* (2012). Data reliability assessed as 2 (low).

[5]Site covers 4800 m^2 and results all using same methods by the same researcher and same assistants.
[6] Transect conducted over various distances.
[7] Given low reliability because random transects are not appropriate for these species. Whereas placement of transects over 'colonies' presents issues for reliability of density estimates.

Table 4. Factors that may increase or decrease risk to Banggai cardinalfish.

FACTOR	DESCRIPTION	EFFECT
Selectivity of removal	BCF are hand captured allowing careful selection of sizes and abundances, as required	Positive Effect
Social structure (sex ratio; social dominance; etc.	Mating requires females to successfully compete for a receptive male. Consequently, not all mature females in a population are able to mate at a given time, resulting in a reduction of the potential population fecundity. Although this is the case there are more males than females;1.67 males per female (Ndobe *et al*., 2013).	Negative Effect
Vulnerability at different life stages (migration, spawning, etc.)	The species is site and microhabitat attached facilitating targeted fishing. Additionally the species has no larval phase as males mouth brood eggs. While mouth brooding, males have limited ability to feed.	Negative Effect
Specialized niche requirement	Microhabitat requirement (sea urchin, *Diadema setosum*, anemone and small branching corals), especially for juveniles and young adult. These are fragile habitats effected by coastal pollution, development and fishing. Sea urchins are also targeted as a food and fishfood source.	Negative Effect
Aggregating behaviour	Yes, Aggregated which facilitates targeted fishing	Negative Effect
Fragmentation	See Population structure section	Negative Effect
Vulnerability to diseases	A recently described *Megalocytivirus* virus affecting wild specimens imported in the USA, which is likely contracted at export/import centers, but also possibly occurring in the wild, is causing high mortality in imported specimens, further increasing the waste of wild-caught specimens (Weber *et al.*, 2009).This Iridovirusis making disease free hatchery stock more desirable by the markets (Weber *et al.*. 2009).	Negative effect on wild stock, although might decrease demand for wild stock, in which case this could have a positive effect.
Species associations and other forms of co-dependency	BCF is commensal with living benthic substrates, and seaurchins *Diadema setosum*. Surveys in 2015, showed how 41 (79%) of 52 sites had low densities of *D. setosum* (Vagelli 2015), moreover, 53% of re-visited sites (21 islands) showed a decline in seaurchin abundance	Negative Effect
Habitat loss	Blast and cyanide fishing for ornamentals and the live-fish food trade have been and remain widespread in the Banggai archipelago, diminishing essential substrates for this species (Indrawan, 1999; Allen & Werner, 2002; Vagelli, 2011).	Negative Effect
Degree of endemism	BCF presents an extremely limited geographic range. Its natural distribution (the Banggai Archipelago, Indonesia) has maximum distances of ~130km and ~70km W-E, N-S respectively. Within this area, its native stocks are restricted to the shallows of 34 islands, 21 of which are < 6 km in length, with a total area of occupancy approx.30km^2	Negative Effect

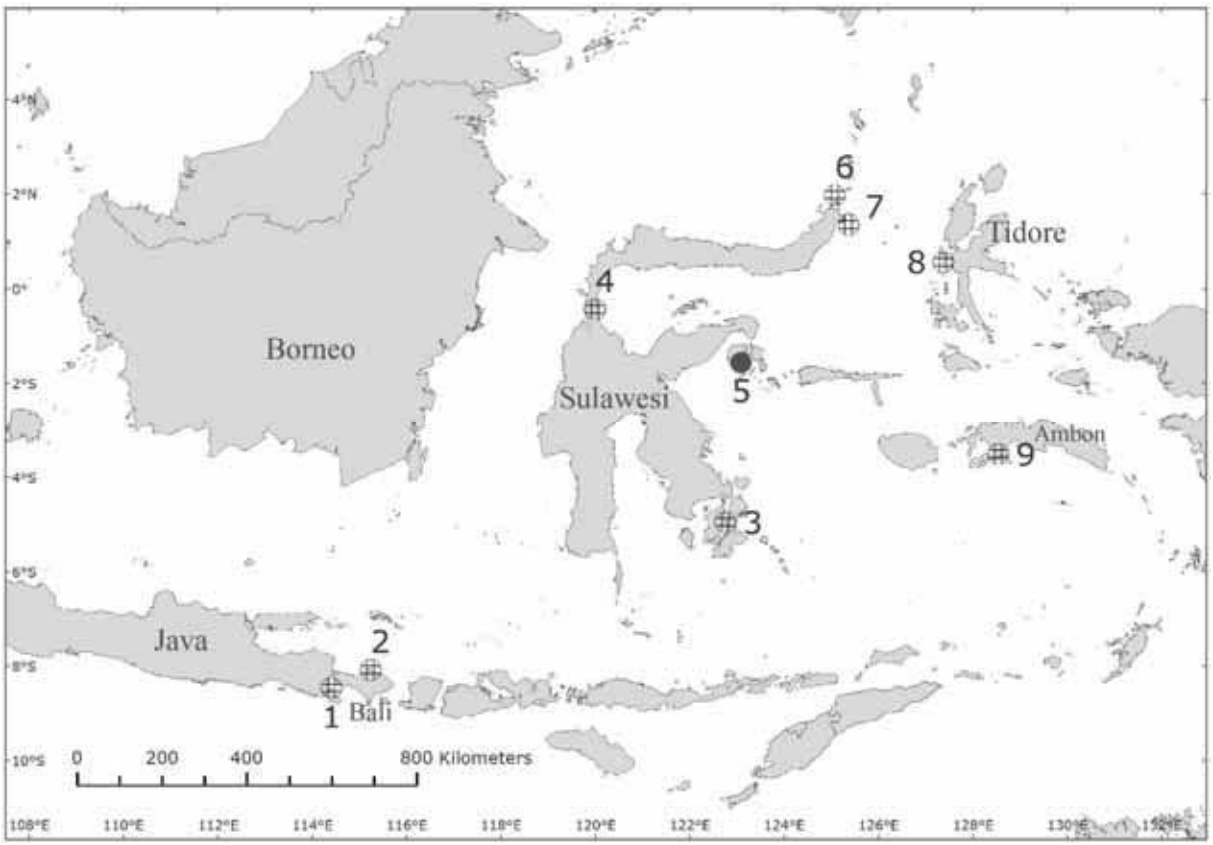

Figure 1. Locations where Banggai cardinalfish are found across Indonesia. See Table 1 for references to numbers. Note Banggai archipelago the endemic location is marked as a solid circle.

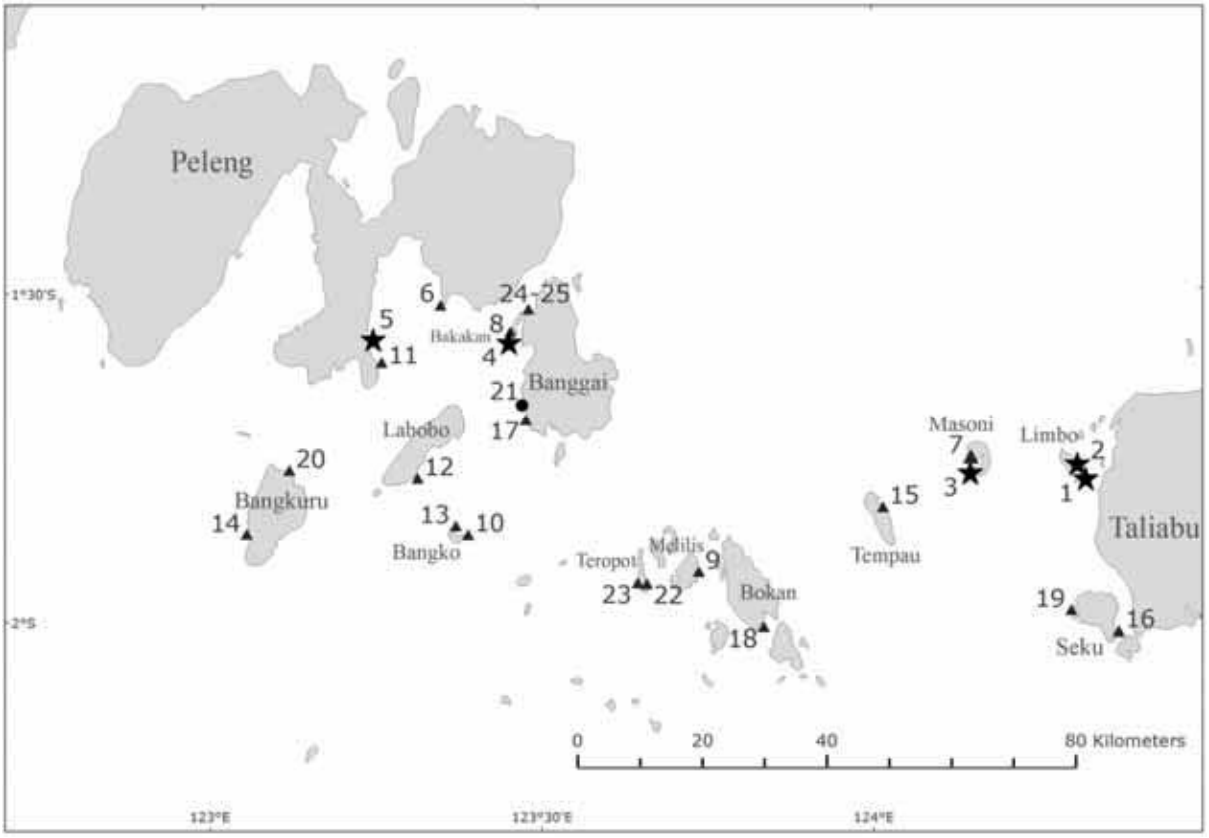

Figure 2. Survey locations across the Banggai archipelago, Eastern Indonesia (For numbers please refer to Table 3 and Figure 3.)

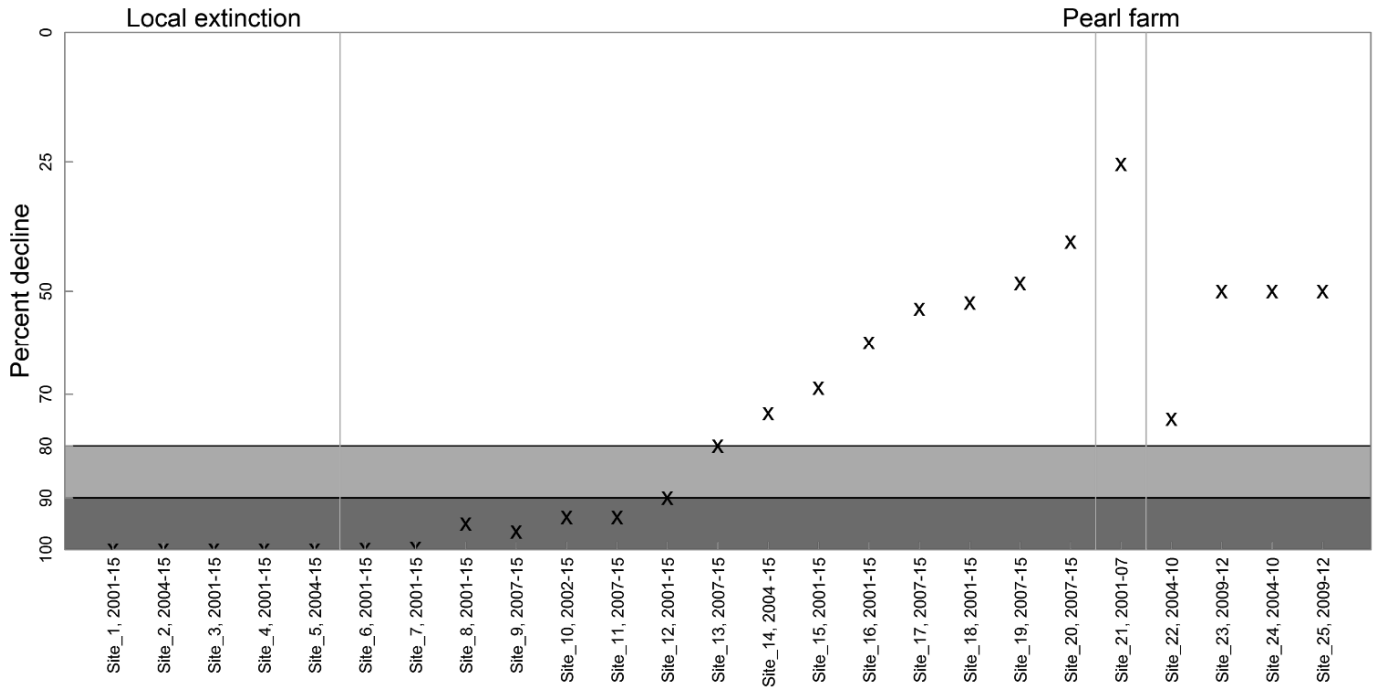

Figure 3. Graph showing percent decline of Banggai cardinalfish from fishery independent surveys. A species with a high productivity that has declined by over 90% of baseline (dark band) can be considered for listing in Appendix I, or with a precautionary approach (light band) 5–10 % less (see full description in footnote to Annex 5 of Res. Conf. 9.24 (Rev. CoP16)).

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 47

Species:

Clarion angelfish, *Holacanthus clarionensis*.

Proposal:

To include clarion angelfish, *Holacanthus clarionensis* in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention.

Assessment Summary

The Clarion angelfish is a medium productivity fish endemic to Mexico. The greater part of the population of Clarion angelfish is found in the Revillagigedo Archipelago, but it is also found off the coasts of Baja California Sur. No decline in the overall population was demonstrated and therefore the Panel determined that Clarion angelfish do not meet the criteria for a CITES Appendix II listing. The Proposal for listing Clarion angelfish reports a significant increase in the abundance of Clarion angelfish at Islas Revillagigedo between 2010–2013. In addition the species is predominantly found within designated 'no take' MPAs and no known collection or export has been registered or reported since 2015. Lastly, captive breeding of the species is presently able to supply the total demand of the international market.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

The Clarion angelfish, *Holacanthus clarionensis* (Gilbert, 1890) is native to Mexico (Figure 1) and is found in the Revillagigedo Archipelago (comprising the islands of Socorro, Clarión, San Benedicto and Roca Partida) and off the coasts of Baja California Sur (at latitudes below 25ºN). The greater part of the population of Clarion angelfish is found in the Revillagigedo Archipelago, but it is also found off the coasts of other areas (Jalisco, Nayarit and Baja California) and there are reports from Clipperton Island (France) with records of transient sightings. There is uncertainty concerning the species presence in Clipperton Island and Guadalupe Island where sightings have not been recorded on recent government surveys. In Clipperton Island, the authors of the Proposal (Reyes-Bonilla, pers. comm., 2016) have not seen any specimens in the last ten years and suggest that the previous sighting may well have been mis-identifications of another species with similar colouration (possibly the Garibaldi damselfish, *Hypsypops rubicundus*).

The potential range of the species is estimated at 13,365 km^2 (Figure 1) and according to the IUCN Red List assessment (Pyle *et al*., 2010), 99 % of the population found across the Revillagigedo Islands. For all the distribution, the known habitable area only covers coastal areas from 0-30 meters deep, with fish predominantly found in shallow water.

Reyes-Bonilla and Martínez (2016) estimated that the total population size for Clarion angelfish was approximately 60,700 individuals, of which around 82.4% were found at Revillagigedo archipelago and the rest off the coasts of Baja California Sur (the remaining 10,700 or 17.6%). If this population size is divided across the total distribution range area for the species given in the Proposal (13.365 km^2), this gives a population density three orders of magnitude smaller than the 0.00454 figure repeatedly stated in the Proposal. The Panel has no way of ascertaining where the probable error lies.

Almenara-Roldan (pers. comm., 2016) consider the juvenile-adult ratio from field observations (Reyes-Bonilla & Martinez, 2016) as 1:10 (presented in the Proposal) which is likely an effect of census methods used. It is argued that to get an accurate census of each component of the population, different survey methods would be needed to assess juveniles versus adults, as small Clarion angelfish inhabit different

parts of the reef, and have different levels of detectability which would need to be taken into account when deciding, for example, the scale of the survey transect.

Due to the limited amount of productivity information and data provided in the Proposal the Panel was only able to estimate productivity of the species based on that of known information for Clarion angelfish and information from FishBase for similar species (Table 1). FishBase, using modelling of life history traits to determine traits, noted high resilience of Clarion angelfish, suggesting a minimum population doubling time of less than 15 months, while vulnerability was listed as low to moderate; vulnerability listed as 27 of 100 (Musick 1999, Cheung *et al*., 2005). The Panel interpreted the available data and FishBase information as indicating a medium productivity level for Clarion angelfish.

Trends and application of the decline criterion

The Proposal indicates a 95% decline of the population of Clarion angelfish in Revillagigedo Archipeligo, based on an anecdotal reference in Almenara-Roldan & Ketchum (1994). While the Proposal states "end of the 1990's", it must necessarily have been prior to 1994, rather than the date of the reference it quotes due to the references publication date. On contacting the senior author, (Almenara-Roldan, pers. comm., 2016), he stated that the 95% decline was an anecdotal observation of intense harvesting (observations within 1 week) in the immediate location of fishing and not a decrease of Clarion angelfish populations across the archipelago. On the contrary, in Almenara-Roldan (2001) the author writes on the species (quote): "In the Revillagigedo… the number of Clarion Angels are so enormous that, if you are diving, or even snorkeling there and look at the reef profile, you can see only orange fishes swimming around".

The most recent study (Reyes-Bonilla & Martinez, 2016) estimates a total population size of Clarion angelfish to be 60,701 individuals, from across 13,365 km^2 of its known range. Almenara-Roldan (pers. comm., 2016) question this figure being the total population size, saying it must be an underestimate. The calculations from Reyes-Bonilla & Martinez (2016) suggest a general average density of 0.00454 ind/m^2. The only earlier study on population size states an average density only marginally higher, at 0.0049 ind/m^2 (Chávez Comparán & al., 2010).

The overall population density of Clarion angelfish reported by Chavez Comparan (2010) was 0.0001 ind/m^2 in Baja California and 0.0049 ind/m^2 in Revillagigedo Archipelago, while as mentioned, Reyes-Bonilla & Martinez (2016) estimates a general average density of 0.00454 ind/m^2 across the total range. Given that the habitable area for the species in Baja California is estimated as 9248 km^2 and 4114 km^2 for Revillagigedo (Reyes-Bonilla, pers. comm., 2016), the population density across the whole area according to Chavez Comparan's density estimates (2010) would be 0.001578 ind/m^2, indicating an overall population increase of approximately 188% over six years between 2010 – 2016 (0.001578 ind/m^2 to 0.00454 ind/m^2).

The Proposal reported a mixed picture with increases in abundance of Clarion angelfish from the Revillagigedo Archipeligo and fluctuating populations from coastal areas (Table 2, also see Proposal's Table 1). The data for Isla Revillagigedo, where 82–99% of the population is found, shows that the population density increased 260% over the three years between 2010–2013 (from 0.03808 ind/m^2 to 0.1370 ind/m^2).

Reyes-Bonilla & Martinez (2016) show that the near shore populations of Cabo Pulmo, Baja California Sur fluctuate greatly. In 5 of the 9 years of surveys conducted between 1998–2008, there was no detection of Clarion angelfish. In subsequent years (2009–2011), no fish were recorded in the latter two of the three year period. In the Proposal (see Proposal's Table 1), strong annual fluctuations in the population densities at Cabo Pulmo were noted; these inter-annual increases and decreases were considered by the Panel, but were thought to reflect natural inter-annual fluctuations of populations in a marginal area of its distribution, rather than local extinction of the species. The Panel did contact Reyes-Bonilla to discuss this result, and received two examples of localised areas in Baja California where the species has been practically lost since 2006 (pers. comm., 2016); sites in Cabo Pulmo and La Paz (Table 2).

Modifying factors and risk

Factors that may increase or decrease the risk to the species centres largely on the fluctuations of oceanographic cycles and their impacts resulting from the ENSO cycle, especially when warm water predominates for extended periods (see Table 3).

Summary of evaluation and assessment of biological listing criteria

Due to the limited amount of published information on the fishes productivity, the Panel was only able to estimate the productivity of this species, based on that of known information from the literature (including the Proposal) and information published for similar species. The Panel concluded that the species meets the medium productivity estimate. No decline in the overall population of the Clarion angelfish was demonstrated. Data presented is conflicting in its interpretation within the Proposal, with density calculations not accurately corresponding to total number of individuals and total area used in these calculations.

The Proposal reported a mixed picture increases in abundance of Clarion angelfish from the most populous location, the Revillagigedo Archipeligo and fluctuating populations from coastal areas where densities were historically low and unstable (see Proposal's table 1). The data for Isla Revillagigedo, where 99% of the population is found, shows that the population density increased in abundance approximately 260%, from 0.03808 ind/m^2 to 0.137 ind/m^2 between 2010-2013. Reyes-Bonilla & Martinez (2016) show fluctuations in the near shore populations of Cabo Pulmo, Baja California Sur between 1998–2011.

Comments on technical aspects in relation to trade, management and implementation

The following comments are in response to statements in the Proposal related to management and trade and are not a comprehensive summary of management regimes or trade of Clarion angelfish. The Panel found that much of the information necessary to thoroughly evaluate the management and trade aspects were not provided for review. Therefore, for the review presented below the Panel needed to rely largely on its own expert knowledge, which at times was anecdotal or qualitative.

Management comment

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International / Regional management:
    - No specific management noted.
- National measures:
    - Prior to 1995, a legal framework of "Commercial Fishery Permits" were issued by the Fisheries Office of each State but these proved to be of limited use for high value ornamental fish as they reported by weight.
    - Since 1995 the Official Gazette of the Federation, in accordance with the Fisheries Act and its implementing regulations, implemented a system for "Promotional Fishery Permits", that were targeted at the market for aquarium fish.
    - In 2002, the Official Mexican Regulations on endangered species were updated, and both NOM-059-ECOL-2001 and NOM-059-SEMARNAT-2010 currently in force placed *H. clarionensis* into the category of "Subject to Special Protection". Consequently it is regulated under the General Wildlife Act (1997) and it's implementing regulations and compliance, which is the responsibility of the Ministry of the Environment and Natural Resources.
    - In Mexico, the General Wildlife Act (LGVS) establishes it as a federal responsibility to regulate the utilization of all the species listed in NOM-059-SEMARNAT-2010, including

H. clarionensis, which is placed in the category of "Subject to Special Protection" of that instrument. In Article 82, Title VII "Sustainable Utilization of Wildlife", Chapter I "Extractive Utilization", the LGVS stipulates that extractive utilization may only be practised under the conditions of sustainability laid down in Articles 83 to 85.

- Clarion Angelfish live in core zones of a biosphere reserve (Revillagigedo Archipelago, Colima) and a national park (Cabo Pulmo, Baja California Sur) and therefore its habitat is being indirectly protected (Endoh, 2007).
- Clarion Angelfish are almost entirely limited to the core zones of the Revillagigedo Archipelago Biosphere Reserve and Cabo Pulmo National Marine Park protected areas, in which productive activities are prohibited, including harvesting of fish for ornamental purposes (Chávez-Comparán *et al*., 2010). The marine protected areas where Clarion angelfish is found are: Revillagigedo Archipelago (4,321.46 km2 of potential range of the fish are located within the natural protected area), Balandra (9.54 km2), the Espíritu Santo Archipelago marine zone (79.42 km2), Cabo Pulmo (35.52 km2) and Cabo San Lucas (38.74 km2).

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES?

- No specific changes noted.

Trade comment

CITES provisions on trade in specimens of species listed in Appendix II require the issuance of an export permit by the exporting country, which shall only be granted if the national CITES authorities are satisfied that: i) the export is not detrimental to the survival of the species in the wild; and ii) the specimens were not obtained in contravention of the national laws of that state.

There has been no legal trade or reports of illegal trade of Clarion angelfish, except for scattered reports of illegal trade, mainly from the 1990's. The Proposal suggests that "it is possible that the illegal trade continues to exist", but no examples newer than 1994 were noted (over a decade prior to the first recorded legal export).

Trade (market transparency, documentation and level of IUU)

- There was legal export of wild caught Clarion angelfish (2751 individuals) from Mexico between 2008–2015 (out of a total authorized quota of 3171 individuals). The export was mainly, or possibly, all done through the company, Cortez Tropical Marine, which exported fish to the US market.
- Trade data records a stable market demand of around 400 individual Clarion angelfish per year between 2008 and 2015.
- Several US based importers give the information that their only known source of marketable Clarion angelfish today is from the company Bali Aquarich in Indonesia, that has been breeding the species in captivity since at least 2013.
- Bali Aquarich's first recorded commercial export of captive bred Clarion angelfish to the USA occurred in August 2013 (Blank, 2013: Quality Marine brings aquacultured Clarion Angel to US market https://reefbuilders.com/2013/08/08/quality-marine-clarion-angelfish/ Accessed 07.06.2016).
- Since 2013, the market for the species seems to be more or less covered by captive bred specimens from Indonesia. Bali Aquarich reports in 2016 (Mr Vincent Chalias, pers. comm. 2016) that their annual production is around 400 individuals, which equates to market demand from wild sources over the period from 2008–2015. This number is limited by market absorption and not production constraints, i.e. Bali Aquarich could produce more, but presently are unable to sell more.

- Previous collector (Steve Robinson, pers. comm. June 2016) says there has not been any collection, legal or illegal since 2015, and that the costs involved with wild collection at the Revillagigedo Archipelago (above US$ 1,000, just to produce FOB LAX, California) are potentially prohibitive for further wild collection, when this is considered in comparison to captive bred specimens from Indonesia.
- Captive bred Clarion angelfish are exported from Indonesia for USD 1,000-1,500 per piece (Vincent Chalias, pers. comm. June 2016).

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES?

- No specific changes noted.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

Clarion angelfish, *H. clarionensis* are being proposed for CITES Appendix II listing in accordance with Article II paragraph 2(a) of the Convention, satisfying Criterion A in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states '*It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future'*.

The Clarion angelfish is a medium productivity species that has a restricted distribution. The most recent study (Reyes-Bonilla & Martinez, 2016) estimated the total population size at 60,701 individuals. This estimate is questioned by Almenara-Roldan (pers. comm., 2016) who suggests the number is an underestimate. Almenara-Roldan, the author of the original comment about declines of Clarion angelfish at fishing locations in 1994, has since highlighted the large number of Clarion angelfish present at the Revillagigedo Archipelago, where most of this species are found.

The Proposal's anecdotal record of a 95% decline in the species in the late 1990's was shown to be incorrect in its timing (the article referred to was published in 1994) and inference (Almenara-Roldan, pers. comm., June 2016). The Proposal reported a mixed picture of change in abundance of Clarion angelfish, with increases in abundance at the Revillagigedo Archipelago (increased by 260% between 2010–2013) and a small but fluctuating population from coastal areas of Baja California Sur.

Currently, the majority of Clarion angelfish are found within designated MPA's where commercial harvest is prohibited and there are no recent documented cases of illegal export. The last registered legal trade was in 2015.

Captive breeding which was initiated in Indonesia in 2013, now supplies around 400 individuals to international trade annually, which equates to the annual market demand from wild sources over the period from 2008–2015. This production is thought to satiate the market, with no indication that illegal harvest is a current or major threat to the species.

The Panel did not recognise the benefit of a CITES Appendix II listing for support of management of the Clarion angelfish, and noted that the Proposal presented no evidence that qualifies the species for CITES Appendix II listing under the proscribed criteria (Criterion A in Annex 2a of Resolution Conf. 9.24, Rev. CoP16).

References

Almenara-Roldan, S. & J.T. Ketchum. 1994. Forgotten islands of the Mexican Pacific. *OFI Journal*, 9: 12-14.

Almenara-Roldan. S. 2001. The current status of the aquarium industry in Mexico. *OFI Journal*, 35: 1-3.

Bailly, N. 2014. Holacanthus clarionensis (Gilbert, 1890). Available at: http://www.marinespecies.org/aphia.php?p=taxdetailsandid=276013. Consulted June 2016.

Chávez-Comparán, J. C., Patiño-Barragán, M., Calderón-Riveroll, G., Lezama-Cervantes, B., IbarraCasillas, M. & S.Bautista-Laureano. 2010. List of fishes generated by visual submarines censuses in the Socorro Island Colima, Mexico, México. *Revista Cubana de Investigaciones Pesqueras*, 27(1):72-78.

Cheung, W. W. L., Pitcher, T. J. & D. Pauly. 2005. A fuzzy logic expert system to estimate intrinsic extinction vulnerability of marine fishes to fishing. *Biol Conserv* 124: 97–111.

Endoh, K. 2007. Angelfishes of the World. Two Little Fishies. Inc., Florida. pp 168.

Froese, R., D, Pauly. 2014. Fishbase. Disponible en: http://fishbase.org. Consulted June 2016.

Musick, J.A. 1999. Criteria to define extinction risk in marine fishes. *Fisheries* 24, 6–14.

Pyle, R., Myers, R., Rocha, L.A. & R. Robertson. 2010. *Holacanthus clarionensis*. The IUCN Red List of Threatened Species 2010: e.T165861A6151012. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T165861A6151012.en

Reyes-Bonilla, H. & M. Martínez. 2016. Situación actual del pez endémico Holacanthus clarionensis (Ángel Clarión) y perspectivas de conservación en México. CONABIO proyecto MM003.

Tables and Figures

Table 1. Information for assessing productivity of the Clarion angelfish

PARAMETER	STATUS[8]	REFERENCE(S), OTHER SUPPORTING COMMENT(S)
growth	MEDIUM	0.46 individual growth rate (k) Froese and Pauly (2014)
Tmax, longevity	MEDIUM	10 Yrs Bailly (2014)
Tmat, maturity	HIGH	1.5 and 2.5 years of age (lengths of 10 to 13 cm) Bailly (2014)
Linf	-	211 mm, Froese and Pauly (2014)
nat mortality	-	M = 0.825, Froese and Pauly (2014)
Number of young, litter size	-	sex ratio of 1:1

Table 2. Trends in abundance of Clarion angelfish

AREA	INDICATOR	TREND	REFERENCE PERIOD	REFERENCE(S) AND SUPPORTING COMMENT(S)
One site in Revillagigedo Archipeligo	Anecdotal Fishery Independent Survey	95% decline	Period of fishing in early 1990's	Almenara and Ketchum (1994) Data reliability assessed as 1 (low).
Revillagigedo Archipeligo	Fishery Independent Survey x Habitat Area Calculation	260% increase	2010-2013	CITES CoP17 Proposal. Reyes-Bonilla and Martínez 2016 (No access to report despite requests to Author). Data reliability could not be assessed.
Baja California: Sites in Cabo Pulmo and La Paz	Fishery Independent Survey	100% loss	1998-2011	Reyes-Bonilla per comm., 2016, Data reliability could not be assessed.

Table 3. Factors that may increase or decrease risk to Clarion angelfish

FACTORS	DESCRIPTION	EFFECT
Habitat changes	Plausible threat of the increased duration and frequency of ENSO events (warm nutrient poor water for extended periods, Glynn and Ault, 2000; Soto, 2001) that can cause severe and rapid declines for this restricted-range, shallow-water species (Pyle *et al*., 2010). Increased intensity of storms which reduce salinity and increase sedimentation, may result in habitat loss	Negative

[8] See Musick *et al* 1999

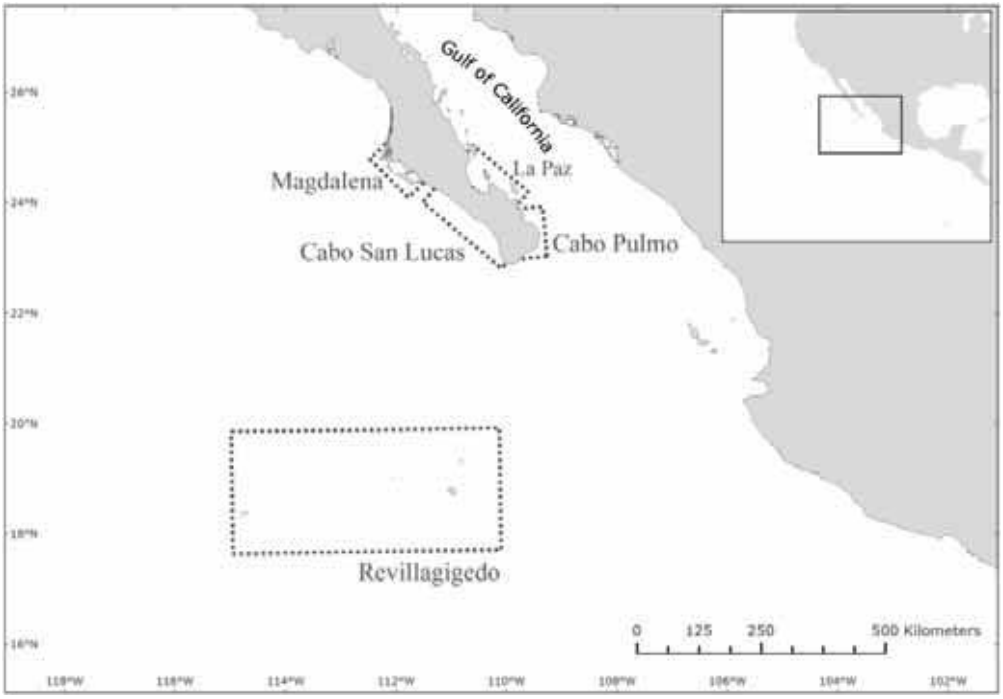

Figure 1. The Clarion angelfish is recorded at the Revillagigedo Archipelago and the coast of Baja California Sur. The main distribution areas (figures for habitable area) are: The Revillagigedo Archipelago (4,114 km2 total) comprises four Islands; Clarión (1,027 km2), San Benedicto (343 km2), Socorro (2,740 km2) and Roca Partida (4 km2). The Baja California Peninsula (9,248 km2 total) has four sub areas: La Paz (2,740 km2), Cabo Pulmo (1,712 km2), Cabo San Lucas (4,453 km2) and Magdalena Bay (343 km2).

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP17 PROPOSAL 48

Species:

Family Nautilidae.

Proposal:

To include the Family Nautilidae in Appendix II in accordance with Article II paragraph 2(a) of the CITES Convention.

Assessment Summary

The family Nautilidae are found in the tropical Asia Pacific region, restricted fore-reef slopes that extend into deepwater. Data on major declines at locations where long-term fishing has occurred, was determined by the Panel to meet the Appendix II listing criteria. New Caledonia and Fiji did not follow similar trends (discussed in the report). If a CITES Appendix II listing was adopted and implemented effectively, this could help in ceasing serial depletion of independent populations in areas where fishing was most active. In States with less capacity, where CITES provisions may prove a challenge to implement, trade might cease or continue without adequate CITES documentation. The Panel noted that an adopted Appendix II listing would impact rural fisher communities, curio manufacturers and traders. The use of shell fragments, taken predominantly from natural mortality, commonly called 'drift' shell, is thought to have minimal impact on wild nautilid populations. If listing a listing of Nautilidae is adopted, Parties may consider establishing a mechanism to allow continued trade of small shell fragments, that would be difficult to distinguish in trade.

Scientific assessment in accordance with CITES biological listing criteria

Population distribution and productivity

All species of the family Nautilidae (Blainville, 1825) are included in this Proposal (*Allonautilus* spp.; *Allonautilus perforatus, A. scrobiculatus,* and *Nautilus* spp.; *Nautilus belauensis, N. macromphalus, N. pompilius, N. repertus, N. stenomphalus*). Nautilids are distributed throughout south-east Asia and Oceania and are restricted to fore-reef slopes from 200m – 700m in depth (Figure 1). *N. pompilius* has the most widespread distribution from the Andaman Islands to American Samoa and from Japan to Australia. Other species demonstrate limited distribution; *N. belauensis* (Palau), *N. macromphalus* (New Caledonia), *N. repertus* (Western Australia) and *A. scobiicularis* (Manus Island, Papua New Guinea). *A. perforatus* is also reported from Bali Indonesia, however there is no population data for this species.

Nautilids are typically found within 500m of the reef edges, where reefs drop-off to greater than 400m (Figure 2 shows sampling locations). *N. pompilius* populations have also been recorded at seamounts in Australia's Coral Sea (Osprey, Bouganville Flinders, Holmes and Dart Reefs) and the Great Barrier Reef (North and South Small Detached Reefs), as well as in the Philippines and other seamounts within their distribution (A. Dunstan pers. comm., 2016). *N. stenomphalus* is also found on the seamounts of the far northern Great Barrier Reef (North and South Small Detached Reefs) while *N. repertus* has been recorded on seamounts off the coast of north west Western Australia, specifically Ashmore Reef and Scott Reef.

Populations of nautilids are generally isolated by deep ocean, as water depth greater than 800m is a geographic barrier to movement and connectivity, except for rare shallow or mid-water vicarious drifting events (Wray *et al*., 1995). Information on the genetics of nautilids suggests that they may comprise a single population of populations (Vandepas *et al*., 2016), comprising numerous as yet "unrecognized but separate sibling species". These sibling species are either genetically distinct, geographically and reproductively isolated populations (Barord *et al*., 2014; Bonacum *et al*., 2011; Dunstan *et al*., 2011c; Sinclair *et al*., 2011; Williams *et al*., 2012, 2015) or as more recent assessments show, morphotypes or subspecies of N. pompilius with interesting phenotypic plasticity (Vandepas *et al*., 2016). Whatever the final result, current assessments indicate that populations are relatively isolated from one another, with high variation across their range (Vandepas *et al*., 2016). Sampling of populations using traps reveals

that there is also strong community structuring in catches (see Figure 3), with the majority of specimens caught being male (80%) and mature (80%).

Nautilid populations are typically found at a low density of 1–13.6 individuals / km^2 (Dunstan *et al.*, 2011a, Barord *et al*., 2014), and there is high confidence that the productivity status of all Nautilidae species' is low (Table 1). This is because these oligotrophic, deep-water tropical species, have late maturity, long lifespan, low fecundity and slow growth with no larval phase. There is no data present or available for natural mortality, although fishing pressure is recognised as the major human pressure. Potential was noted by the Panel for mortality through habitat degradation and pollution (mining impacts resulting in sedimentation) and climate change (ocean warming and acidification). The 'desert' habitat of fore reef slopes may be especially vulnerable to minor impacts creating major change (Dunstan *et. al*., 2011).

Trends and application of the decline criterion

The references in relation to population decline presented in the CITES Proposal were incomplete. The Panel updated this information to include scientific information on status of nautilids from sources where data was reported (Figure 2, Table 2). A number of abundance indices are available from different parts of the range, but these are of varying reliability as indices for these species. Information evaluated by the Panel regarding population trends from different regions is summarised in Table 2 and Figures 2 and 4.

The CPUE data presented in the Proposal adequately demonstrated the stability of un-fished *N. pompilius* populations at Osprey Reef, Coral Sea, Australia (Figure 5) and Palau and marked declines in fished populations in the Philippines in two locations, Tanon and Palawan. Data investigation by the panel provided further information on declines in CPUE for fished locations in PNG (Manus Island), Indonesia (Lombok, Bali and East Nusa Tengarra) and the Philippines (Siquijor and Visaya) and CPUE data for fished locations in New Caledonia that did not show a decline. Survey CPUE data was also sourced for an un-fished site at Fiji, and in this case declines were noted (Table 2). Information is also referenced, that show harvesting selects mature individuals and results in a changed population age structure, skewed to younger animals (Ward *et al*., 2016, see Figure 3).

New Caledonia provided dissimilar results from other fished locations. In this case declines in CPUE were not recorded despite fishing over extended periods. This result was an exception, and the Panel proposed that the unusual conditions found in New Caledonia might explain the outcome, as New Caledonia has a very large contiguous area of suitable nautilus habitat, with no deep-water channels preventing nautilid movements around its entirety. Such an area, it was proposed, may provide a large enough population to have sustained the fishery in contrast to the other fished locations.

In Fiji, the data shows the opposite trend, with no reported fishery, but a 60% decline over a period of 25 years. Fiji is a nation where islands are separated by deep channels, which would result in more fragmented nautilus populations. The study site with fishery independent CPUE data borders a landmass that is three times smaller than the size of the mainland mass in New Caledonia, and close to a major port near Suva. The effects of degradation and pollution to local habitat, and the proximity to a port may have contributed to the decline in fishery independent CPUE for this un-fished nautilid population during the 25-year period between sampling events.

The use of Baited Remote Underwater Video Systems (BRUVS) to collect data on nautilids (Barord *et al* 2014, Table 3), reinforces the evidence for low density of nautilid populations relating to lower CPUE data in fished (e.g. Tanon, Philippines) versus un-fished locations. This data does not yet provide information on changes in CPUE over time, due to the recent introduction of this technique.

Modifying factors and risk

The panel noted biological and behavioural factors that should considered in relation to whether nautilids should be considered for listing in CITES appendices, beyond the species' low productivity which is already noted above (see Table 4).

Summary of evaluation and assessment of biological listing criteria

Populations of nautilids found associated with deepwater, fore-reef habitat are likely to be genetically distinct on relatively small scales, with many geographically and reproductively isolated populations (Barord *et al.*, 2014; Bonacum *et al.*, 2011; Dunstan *et al.*, 2011c; Sinclair *et al.*, 2011; Williams *et al.*, 2012, 2015). This Proposal for Nautilidae to be listed in CITES appendix II provides high confidence in the evidence that nautilids are low productivity species.

To date no global population estimates for nautilids are available. What data is available demonstrates a range of declines in heavily fished locations and some local extinctions, with other areas remaining stable when not fished or fished over large well-connected fishing grounds. The Proposal highlighted rapid population declines (70–90% in CPUE) of isolated populations with only low level trapping effort where fishing has occurred for greater than 10 years. This is a direct result of nautilids keen sense of smell and natural scavenging behavior, making trapping over extended soak times highly effective in removing most individuals from a large area. The Panel also noted the stability of populations where fishing had not occurred (in Australia and Palau). Data from New Caledonia was an exception, as the islands have experienced fishing effort over an extended period, but declines were not recorded. It was suggested by the Panel that New Caledonia was exceptional in that it has a very large area of contiguous nautilus habitat, with no deep-water channels preventing nautilus movement. Data from Fiji shows the opposite trend with no reported fishery, but a 60% decline in fishery independent CPUE over a period of 25 years. The location of the surveys in Fiji, close to the major port near Suva, may have affected the population over the 25-year sampling interval.

The Panel were presented solid CPUE fishing data and population density and abundance information on the overall trend of population decline in exploited areas and population stability in unexploited nautilid habitats. The low population density and geographically isolated nature of populations with little or no connectivity was considered a factor to preclude the chance for recovery of severely depleted locations. This makes nautilids particularly vulnerable for serial depletion, an outcome already observed in the Philippines.

Comments on technical aspects in relation to trade, management and implementation

Management comment

The Panel agreed with the management issues as outlined in the Proposal and summarised below. Where new information was known to the Panel, it was added.

Nautilid species are not part of any known fishery management programs, and there is no on-going population monitoring of these species. Permits are required in some areas and management may be occurring at local levels. However, the Panel is not aware of studies conducted by fisheries or natural resource authorities to determine the status or impact of harvests. There do not appear to be any harvest seasons or quotas in countries where commercial harvest occurs (del Norte-Campos, 2005; del Norte-Campos *et al.*, 2000; Dunstan *et al.*, 2010; Freitas and Krishnasamy 2016; Nijman *et al.*, 2015). Thus, existing measures would not appear to be effective in managing these fisheries. Because of nautilid's unique life history traits, that differ from other cephalopods, species experts emphasize that they cannot be managed like fisheries for related species, such as octopus (NMFS 2014).

Management regimes/measures related to governance, population monitoring and compliance, currently adopted

- International /Regional management:
    - There are no known international protections for these species.
- National measures:

- *N. pompilius* is protected in some portions of its range (Australia, China, Philippines, and Indonesia), along with N. stenomphalus (endemic to Australia).
- *N. belauensis* (endemic to Palau) and N. macromphalus (endemic to New Caledonia) may also be protected.
- **Australia**: Australia recognizes two native species, *N. pompilius* (syn. *N. repertus*) and *N. stenomphalus* have domestic protection under state and territory legislation and all native species are regulated under the Environment Protection and Biodiversity Act 1999.
- **China**: N. pompilius is included as a 'Class I' species under the national Law of the People's Republic of China on the Protection of Wildlife, 1989. Harvest is regulated under Article 16, which allows national level authorities to evaluate and grant permission to harvest the species.
- **India**: In 2000, *N. pompilius* was protected under Schedule I of the Indian Wildlife (Protection) Act of 1972. According to CITES Authorities, domestic law prohibits all trade in nautilids.
- **Indonesia**: All domestic or international trade in *N. pompilius* is prohibited. *A. perforatus* is not protected, as detailed in Government Regulation 7/1999 and No. 8/1999 and also under the Fisheries Law Act No. 31/2004.
- **New Caledonia**: *N. macromphalus* is reportedly protected (Freitas & Krishnasamy, 2016).
- **Palau**: The only species of nautilids in Palau, N. belauensis, is reportedly protected. Declaration forms are required for export.
- **Philippines**: *N. pompilius* is reportedly protected under the Fisheries Administrative Order no. 168, enacted in 1990. Fishery restrictions are generally poorly enforced and naitlid harvest is essentially unregulated.

- Local measures:
  - **Indonesia**: Exploitation of nautilids is also banned by some Provincial governments (e.g. South Sulawesi).
  - **Philippines**: In Palawan Province, *N. pompilius* is classified as Vulnerable under Palawan Council for Sustainable Development Resolution No. 15-521 and permits are required for all uses, including collection from the wild. There are reports of local ordinances to conserve and protect nautilids in some municipalities in Cebu and Western Visayas Provinces. Fishery restrictions are generally poorly enforced and nautilid harvest is essentially unregulated.

Comment on anticipated change (positive and negative) in these management measures (and requirement for additional management), if species were listed under App II of CITES?

- There is recognised gap in data on the population status of most nautilid populations. Advice from nautilid experts would need to be provided to establish sustainable fishing management programs and practices.
- There are a number of baselines available and recognised sampling methodologies to allow relatively inexpensive status assessments to be conducted. Nautilid resource monitoring data, linked to evaluation of the effectiveness and level of implementation of regulations, level of take and trade would need to be collected, analysed and acted upon to effectively manage nautilid fisheries. Once established, this assessment could provide CITES in-country scientific authorities on-going assessments of sustainable levels of take that would facilitate the making of non-detriment findings, which are a pre-requisite for trade in order to comply with CITES provisions.

Trade comment

The Expert Panel agreed with the trade data, interpretation and their issues as outlined in the Proposal. Where new information was known to the Panel, it was added.

The distinctive coiled shells of nautilids are well-known in trade, traded internationally as souvenirs to tourists and shell collectors, as jewellery and home décor items ranging from whole-shell decorative

objects to shell-inlay lacquer ware and live specimens for in aquaria and research institutions. In the early 2000's pearls were also a driver of trade in central Philippines and Indonesia (pers comm. P. Ward 2016). The shell trade is the predominant driver of international demand, although the meat may be eaten locally or traded internationally as a by-product of the shell trade.

Nautilidae are unique in shape and coloration and are readily distinguishable by lay people. Fishermen, traders and species experts are generally able to distinguish the species and experts, at least, can identify the sexes of individual specimens based on the shell (Freitas & Krishnasamy, 2016; Nijman *et al*., 2015; NMFS, 2014). Genetic analysis and possibly unique morphology can distinguish geographically isolated populations.

The thickness of the shell might be a distinguishing characteristic in nautilids shells, which is used as inlay; though it would currently be impossible to identify inlay to the species level based on morphological characteristics (NMFS 2014). Nautilid shells are also characterized by growth lines that would be visible even if the shell is polished; "no other mollusk has these lines" (NMFS 2014).

Trade (market transparency, documentation and level of IUU)

All of the currently recognized species in both genera have been reported in trade and the consumer market for nautilids and nautilid products includes North and South America, Eastern and Western Europe, Eastern and Southeast Asia, Africa, the Middle East, and Oceania. Many non-range countries are also involved in the international trade of nautilus shells and products. The Proposal states that 'at least 104,476 individuals are represented by the trade in whole shells, live specimens, biological specimens, and bodies and that this equates to just over 1,000 individuals annually'. Panel investigation of the data confirms the total figure but suggests a typo error; the Proposal should read just over 10,000 individuals annually. Approximately 99 percent of this trade was reported as wild. *N. pompilius* is the species most reported in trade.

While global quantitative trade data do not exist, information is available in published and unpublished market surveys, web-based advertisements and personal communications. A trade study conducted by TRAFFIC and WWF (Freitas and Krishnasamy, 2016) in several major exporting and importing countries, and U.S. trade data obtained from the U.S. Fish and Wildlife Service Law Enforcement Management Information System (LEMIS) is a useful source for information. Internationally recognised specific trade codes for nautilids do not exist and would need to be assigned.

The meat market for nautilids is thought to be a by-product of the shell trade. Trade in meat is most notable within Asia, with as many as 25,000 specimens exported from Indonesia to China between 2007 and 2010.

- **American Samoa (USA)**: There is no known local utilization of this species and no known history of commercial harvest.
- **Australia**: The Proposal presents that there is no known local utilization of this species and no known commercial harvest. Further investigation by the panel may suggest that *N. repertus* in Western Australia is targeted, possibly by Indonesian fishers known to fish illegally for sharks in this region.
- **China**: Meat and shells may be found in local seafood markets and curio shops. Harvest may occur on Hainan Island. The panel found other trade data in reports referenced in the Proposal for export and import trade in China.
- **Fiji**: There is no known local utilization of this species and there have been no known commercial fisheries. Drift shells have been incidentally collected for use in making jewellery and wood inlays. LEMIS (2016) reports recent U.S. imports of whole shells and fragments (not differentiated) from Fiji between 2011 and 2014.
- **India**: According to the Scientific Authority of India, *N. pompilius* has been exploited for decades in Indian waters and is also caught as bycatch by deep sea trawlers.
- **Indonesia**: Nautilids are commercially harvested throughout the Indonesian islands despite being protected from harvest since 1990. Nautilid meat, whole shells and worked products

(including furniture inlaid with shell) are sold locally. Shells are sold whole and carved, or used in jewellery and inlays to be sold internationally.

- **New Caledonia**: Nautilids are sold to tourists and shells of *N. macromphalus*, which is endemic to New Caledonia, are sold online. The panel found no other data for export /import trade from this location despite the reported high level of take prior to 2011.
- **Palau**: Significant past collection and an intensive fishery were reported (Aguiar 2000; HSUS & HSI 2008) in the Proposal. The panel found these references to be unsubstantiated (in fact the HSUS reference was based on Aguiar popular magazine article reference). Based on researcher knowledge of the location (Ward pers. comm., 2016) there is no evidence of a past fishery.
- **Papua New Guinea**: Low-level of trade in drift shells may exist. Shells are also used as inlay and the species may be caught as bycatch in deep-slope fisheries (Kailola, 1995). The Proposal indicates new fishing sites may have opened in at least two locations around 2008, but no reference was available to validate this.
- **Philippines**: Trade of nautilids has occurred since at least the 1970's. Fishermen in Palawan and Bohol report that harvesting of nautilids is not a traditional subsistence fishing activity and that trapping techniques were learned from demand-driven shell traders. More than 18,500 whole shells were encountered in a survey of 162 shops visited in Luzon, Visayas, Mindanao, Manila, Cebu, and Zamboanga in 2016. Many of the shells are processed in Cebu City, Philippines, where there are many factories as well as an international airport that facilitates export. The meat is less valuable but rather than discard it, fishermen will eat it or occasionally sell some of the meat in local markets. Traders indicate that international demand for nautilids is primarily for the whole shell, including shells that are incorporated whole as curios.
- **Samoa (Western)**: CITES Authorities in Samoa are not aware of any trade in these species. The presence or absence of nautilids in Samoa remains inconclusive.
- **Solomon Islands**: There is no known commercial fishery. Drift shells are collected and used for jewellery and wood inlays that are sold to expatriate international workers and tourists.
- **Thailand**: Minimal local trade noted.
- **USA**: Between 2005 and 2014, U.S. trade was comprised of more than 900,000 nautilid commodities. These were mostly imports, along with some re-exports. Most trade consisted of jewellery, trim, and shell products, such as buttons, along with whole shells. At least thirteen range countries traded nautilid commodities with the United States during the ten years of examined data. The exports from Fiji and Solomon Islands are worked items, and may be derived from drift shells. The Philippines exported the most products, about 85% of the trade, as reported by quantity and the greatest variety of products including, bodies, jewellery, live specimens, meat, shell products, trim, and whole shells. Indonesia was the second largest exporter to the United States, about 12% of the trade, as reported by quantity of a variety of mostly worked products including, jewellery, shell products, trim, and whole shells. Exports from China and India were responsible for most of the remaining items.
- **Vanuatu**: Nautilid shells are sold to tourists and to shell collectors. Species experts note that a large-scale commercial fishery has existed here.

Although illegal trade is difficult to verify by its nature, illegal trade from some range countries where trade in nautilids is prohibited or where required permits are reportedly evaded is reported (Freitas & Krishnasamy, 2016; LEMIS, 2016). Some other examples are listed below.

- **China**: Harvest of *N. pompilius* requires a permit, however trade is reported.
- **Indonesia**: Despite being protected from harvest under Indonesian law, harvest and trade in *N. pompilius* is ongoing, as well as trade in species endemic to other countries, including *N. belauensis* and *N. repertus* (Freitas & Krishnasamy, 2016; LEMIS, 2016; Nijman & Nekaris, 2014). The Proposal provides data from Indonesian authorities showing that more than 3,000 shells of N. pompilius were seized between 2008 and 2013, nearly all of which were destined for foreign markets. This demonstrates some level of implementation of compliance and

enforcement of regulations, however data from the same period demonstrates this to be only a small percentage of the overall Indonesian nautilid trade.

- **New Caledonia**: Wildlife smugglers have been known to use New Caledonia as a transit point for the smuggling of nautilid shells (Freitas & Krishnasamy, 2016).
- **Philippines**: Despite being protected from harvest under Philippines law, Bohol (where nautilid fishing occurs) and Cebu (the center of shell trade) are known as transit points for legal and illegal trade, including wildlife products (Freitas & Krishnasamy, 2016). Nautilid shells are reportedly included in shipments moving through privately-owned seaports that are apparently not subjected to regular inspection procedures (Freitas & Krishnasamy, 2016).

Comment on anticipated change (positive and negative) in trade related issues, if species were listed under App II of CITES?

- CITES provisions on trade in specimens of species listed on Appendix II require the issuance of an export permit by the exporting country, which shall only be granted if the national CITES authorities are satisfied that: i) the export is not detrimental to the survival of the species in the wild; and ii) the specimens were not obtained in contravention of the national laws of that state.
- If the CITES listing Proposal is adopted and effectively implemented and the countries concerned have the necessary capacity to implement the required measures, then, trade will be recorded in the CITES trade database, and that that should help to ensure sustainability, legality and traceability of nautilids in trade. Increasing the reliability and volume of export and import recording should help to inform priorities for managing and controlling nautilid fisheries; and increase control of the market importing and exporting the product.
- If a States' ability to make NDFs for nautilids is limited in the absence of information on stocks, as evidenced by difficulties encountered in making NDFs for other Appendix II listed species, under these conditions the following outcomes can occur: i) previous trade ceases; ii) trade continues without proper CITES documentaion (also known as 'illegal trade'); and/or iii) trade continues with inadequate NDFs.
- Permits and certificates will need to be issued for international trade in nautilids, even permits for low level sustainable take would need to be gained to provide specimens for public aquaria and research requirements. Both whole and fragment nautilid identification guides would need to be developed and disseminated to relevant enforcement agencies (in appropriate formats and languages). Education and awareness programs of the CITES appendix II listing will need to be implemented to inform fishers, traders and manufacturers (using whole shells and fragments) and the general public. The same applies to government agencies responsible for regulation and management.
- In a number of localities (e.g. Melanesia) small fragment of nautilid species, usually from drift shells that wash-up when nautilids die from natural causes, are used in the curio and handicrafts trade and are important to local communities. Consideration could be given to mechanisms that allows such use to continue, due to its minimal impact on nautilid populations, the difficulty in identification of these fragments in trade and the resulting issues associated with trade compliance. Information will also need to be provided on how to deal with pre-convention specimens.

Likely effectiveness for conservation: summary comment in relation to technical aspects of biology, ecology, management and trade.

The Proposal highlights a case for nautilids to be included in Appendix II, under the name of the higher taxon' Family Nautilidae. All species of the Family Nautilidae are proposed, in accordance with Article II paragraph 2 (a) of the Convention and satisfying Criterion B in Annex 2a of Resolution Conf. 9.24 (Rev. CoP16), that states 'It is known, or can be inferred or projected, that the regulation of trade in the species is necessary to avoid it becoming eligible for inclusion in Appendix I in the near future'.

The Panel considered the productivity for these species to be low, and considered that declines of 70% or more over two generations would meet the criteria for listing. Fishery independent trapping data and anecdotal reports showed most data from fished locations e.g. Philippines, Indonesia met the CITES decline criteria. The low population density and geographically isolated nature of populations, with little connectivity, was thought to largely preclude recovery of severely depleted locations.

The review of information from the Proposal and the literature, provided CPUE fishing data and population density and abundance on the trend of nautilid population decline in exploited areas and population stability in unexploited habitats. The Proposal demonstrates the rapid population declines of isolated populations with only low level trapping effort. This is a direct result of nautilids keen sense of smell and natural scavenging behavior, making trapping over extended soak times highly effective in removing most individuals from a large area. Although Nautilidae are not limited in their distribution, they were considered particularly vulnerable to serial depletion, a phenomenon already observed in the Philippines. The only fishery independent time-series taken from targeted populations that did not demonstrate a decline that met the CITES criteria was recorded in New Caledonia, where extensive and well-connected reef habitat was postulated by the Panel as possible factors to explain the result.

For all nautilid species the Panel also noted the potential negative effects of other human pressures, including climate change (increased temperature and pH) and habitat degradation (water, pollution and sedimentation), especially as the range of nautilids is generally restricted to coastal reef-slopes where human activity and development is greatest.

If the CITES listing Proposal is adopted and effectively implemented, this trade regulation has the potential to benefit the conservation of nautilid species. CITES provisions seek to ensure only legal and sustainable harvest of nautilids supplies international demand. If listing in CITES Appendix II comes into effect, it would seek to deliver the following conservation outcomes:

- Arrest the serial depletion of independent populations;
- Recovery of some partially depleted populations where levels population decline are <90%, at a decadal time frames, because of nautilids k-selected life history traits;
- Little to no recovery in populations where decline is >95%; and
- Un-fished populations to remain stable.

A States' ability to comply with CITES provisions for trade will require investment in some level of data collection to describe the activity and impacts of the fishery. At present information on the status of stocks of nautilids is limited, and in the absence of information for management this could result in a cessation of trade, or trade continuing, but being non-compliant with CITES requirements.

The available data in trade of nautilids to the United States indicates a reduction in trade from 2009 to 2014. This doesn't reflect reported, but un-quantified, trade to other consumer markets or known timing of fishery collapses in the Philippines. Recent reports indicate trade demand for nautilid shells and products is still strong, with international trade the driver behind fishing, with local and domestic use recognised as a minor influence.

In order to trade a CITES II Appendix species, countries will need to ensure regulations are in place to support CITES provision, and NDFs are completed prior to exports. As nautilids are recognised as an iconic species, support for Parties required to implement a possible listing might help to concentrate and highlight CITES engagement with Small Island Development States that have, or might be considering fisheries for nautilids.

Should nautilids be listed under Appendix II, there will be impact on local communities that are fishers, sellers, curio manufacturers or traders. This was only superficially addressed in the Proposal. The expert panel considers that it would be important to assess the impact on local livelihoods, and in some cases, mitigating measures might be considered appropriate, for example, where fragments of nautilus from natural mortality (drift shell) is used as inlay in traditional items and curios.

Lastly a CITES Appendix II listing of nautilids would potentially generate interest in further research and monitoring of nautilids and deep sea ecosystems more generally, which are extremely data poor. This may provide valuable information to aid management of both sustainable fisheries and the deep ocean resources and habitats in the future.

References

Aguiar J. 2000. Nautilus in the Pacific. *Tentacle* 9: 15–16.

Alcala, A.C. & G.R. Russ. 2002. Status of Philippine Coral Reef Fisheries. *Asian Fisheries Science* 15:177-192.

Arnold, J.M., Landman, N.H. & H. Mutvei. 2010. Development of the embryonic shell of Nautilus. Pp 373-400, *In*: Saunders WB and Landman NH (eds.), Nautilus: The Biology and Paleobiology of a Living Fossil. Dordrecht, Germany: Springer Science+Business Media.

Barord, G.J., Dooley, F., Dunstan, A., Ilano, A., Keister, K.N., Neumeister, H., Preuss, T., Schoepfer, S., & P.D. Ward. 2014. Comparative population assessments of Nautilus sp. in the Philippines, Australia, Fiji, and American Samoa using baited remote underwater video systems. *PLOS ONE* 9(6): e100799.

Bonacum, J., Landman, N.H., Mapes, R.H., White, M.M., White, A.J., & J. Irlam. 2011. Evolutionary radiation of present-day Nautilus and Allonautilus. *American Malacological Bulletin* 29(1/2): 77-93.

Carlson, B.A. & M. Awai. 2015. Nautilus research – Palau 2015 [Video]. Coral Reef Research Foundation. <https://www.youtube.com/watch?v=dM9TFKUxnYc>. [Accessed April 26, 2016].

Carlson, B.A. 1985. The first known embryos of the chambered nautilus. *Hawaiian Shell News* 33(6): 1, 11.

del Norte-Campos, A.G.C. 2005. “The Chambered Nautilus Fishery of Northwestern Panay Island, West Central Philippines: Fishing Practices and Yield.” *Phuket Marine Biology Center Research Bulletin* 66:299-305.

del Norte-Campos, A.G.C., Beldia, R.A., Villarta, K.A., & M.A. Tad-y. 2000. An inventory and market survey of commercially-important invertebrates around Panay Island and use of the data to prioritize research. *University of the Philippines Visayas Journal of Natural Sciences* 5(1): 9–11.

Dunstan, A. 2010. Current state of knowledge and implications for conservation of nautilis populations: Assessing the conservation status of Nautilus and Allonautilus. Unpublished. 36 pp.

Dunstan, A., Bradshaw, C., & J. Marshall. 2011a. Nautilus at risk--estimating population size and demography of Nautilus pompilius. *Plos ONE* 6(2): e16716.

Dunstan, A., Ward, P., & N.J. Marshall. 2011b. Vertical distribution and migration patterns of Nautilus pompilius. *Plos ONE* 6(2): e16311.

Dunstan, A., Ward, P., & N. Marshall. 2011c. Nautilus pompilius life history and demographics, Osprey Reef, Coral Sea, Australia. *Plos ONE* 6(2): e16312.

Dunstan, A., Alanis, O., & J. Marshall. 2010. Nautilus pompilius fishing and population decline in the Philippines: A comparison with an unexploited Australian Nautilus population. *Fisheries Research* 106(2): 239–247.

Freitas, B. & K. Krishnasamy. 2016. An Investigation into the Trade of Nautilus. TRAFFIC, World Wildlife Fund. Washington DC. USA.

Hamada, T., Mikami, S., & T. Okutani. 2010. Experience with the aquarium rearing of Chambered nautilus in Japan. Pp 579–583, In: Saunders WB, Landman NH, eds. Chambered nautilus: the biology and paleobiology of a living fossil. Dordrecht, Germany: Springer Science and Business Media.

Haven, N. 1977. The reproductive biology of Nautilus pompilius in the Philippines. *Marine Biology* 42: 177-184.

Hayasaka, S. 1985. Outline of the project. *Kagoshima Univ. Res. Center S. Pac, Occasional Papers* 4: 4-8.

Hayasaka, S., Ōki, K., & A. Shinomiya. 1985. Environmental background of the habitat of Chambered nautilus off the Southeast Coast of Viti Levu, Fiji. *Kagoshima University Research Center South Pacific, Occasional Papers* 4: 18-30.

HSUS and HSI (The Humane Society of the United States and Humane Society International). 2008. Letter to U.S. Fish & Wildlife Service in response to Public Request for CoP15 Proposals, received November 27, 2008. Based in large part on a draft prepared by Dr. Sandra Altherr and Dr. Heike Neumeister in 2005.

Kailola, P. 1995. Fisheries Resources Profiles: Papua New Guinea. Report No. 95/45, Forum Fisheries Agency, Honiara, Solomon Islands. Landman and Cochran 2010.

LEMIS (Law Enforcement Management Information System). 2016. All import and exports of Allonautilus and Nautilus sp. from January 1, 2005 through December 31, 2014. Unpublished. U.S. Fish and Wildlife-Office of Law Enforcement: Arlington, Virginia.

Martin, A. W., Catala-Stucki, I., & P. Ward. 1978. The growth rate and reproductive behavior of *Nautilus macromphalus*. *N. Jb. Geol. Paleont. Abh*. 156:207–225.

Meekan, M., Cappo, M., Carleton, J. & R. Mariott. 2006. Surveys of Shark and fin-Fish Abundance on Reefs within the MOU Box and the Rowley Shoals Using Baited Remote Underwater Video Systems. Australian Institute of Marine Science, Townsville, 28.

Nijman V & K.A.I. Nekaris. 2014. Trade in wildlife in Bali, Indonesia, for medicinal and decorative purposes. *TRAFFIC Bulletin* 26(1): 31-36.

Nijman, V., Spaan, D., & K.A.I. Nekaris. 2015. Large-scale trade in legally protected marine mollusc shells from java and Bali, Indonesia. *PLoS ONE* 10(12): e0140593. doi:10.1371/journal.

NMFS (National Marine Fisheries Service). 2014. Chambered nautilus experts workshop report summary. Silver Spring, MD: National Marine Fisheries Service. <http:// www.nmfs.noaa.gov/ia/species/Chambered nautilus/2014 percent20Workshop/2014_chambered nautilus_wkshp_report.pdf>. [Accessed April 26, 2016].

Saunders, W.B. & C. Spinosa. 1979. Nautilus movement and distribution in Palau, Western Caroline Islands. *Science* 204: 1199-1201.

Saunders, W.B. 1983. Natural rates of growth and longevity of Nautilus belauensis. *Paleobiology* 9(3):280-288.

Saunders, W.B. & P.D. Ward. 1987. “Sympatric occurrence of living Nautilus (N. pompilius and N. stenomphalus) on the Great Barrier Reef, Australia”. *The Nautilus* 101(4): 188-193.

Saunders WB, & P. Ward. 2010. Ecology, distribution, and population characteristics of *Nautilus*. In: Saunders W B, Landman N H (Eds.), Nautilus: Biology and Paleobiology of a Living Fossil. New York: Plenum Press. pp. 137–162.

Saunders, W.B. & N.H. Landman (eds.). 2010. Nautilus: Biology and Paleobiology of a Living Fossil. Dordrecht, Germany: Springer Science and Business Media.

Sinclair, W., Newman, S.J., Vianna, G.M.S., Williams, S., & W.J. Aspden. 2011. Spatial Subdivision and Genetic Diversity in Populations on the East and West Coasts of Australia: The Multi-Faceted Case of Nautilus pompilius (Mollusca, Cephalopoda). *Reviews in Fisheries Science* 19(1):52-61.

Tanabe, K. 1988. Record of trapping experiment. In: Hayasaka, S., ed., Marine Ecology studies on the habitat of *Nautilus pompilius*, if Fiji (the second operation). *Kagoshima University Research Centre for the South Pacific, Occassional Papers*, 15:5-14.

Vandepas, L.E., Dooley, F.D., Barord, G.J., Swalla, B.J., & P.D. Ward. 2016. A revisited phylogeography of *Nautilus pompilius*. *Ecology and Evolution*. On-line edition, http://onlinelibrary.wiley.com/doi/10.1002/ece3.2248/full. DOI: 10.1002/ece3.2248.

Ward, P.D. 1988. In Search of Nautilus. New York: Simon and Schuster. 220 pp.

Ward, P.D., & W.B. Saunders. 1997. Allonautilus: A New Genus of Living Nautiloid Cephalopod and Its Bearing on Phylogeny of the Nautilida. *Journal of Paleontology* 71(6):1054-1064.

Ward, P., Dooley, F. & G. Barord. 2016. Nautilus: biology, systematics and paleobiology as viewed from 2015. *Swiss J Palaeontol*. 135:169–185.

Williams, R.C., Newman, S.J., & W. Sinclair. 2012. DNA barcoding in Nautilus pompilius (Mollusca: Cephalopoda): evolutionary divergence of an ancient species in modern times. *Invertebrate Systematics* 26: 548-560.

Williams, R.C., Jackson, B.C., Duvaux, L., Dawson, D.A., Burke, T., & W. Sinclair. 2015. The genetic structure of *Nautilus pompilius* populations surrounding Australia and the Philippines. *Molecular Ecology* 24: 3316-3328.

Wray, C.G., Landman, N.H., Saunders, W.B., & J. Bonacum. 1995. Genetic divergence and geographic diversification in Nautilus. *Paleobiology* 21:220–228.

Zann, L.P. 1984. The rhythmic activity of *Nautilus pompilius*, with notes on its ecology and behavior in Fiji. *The Veliger* 27: 19–28.

Tables and figures

Table 1. Information for assessing productivity of nautilids

PARAMETER	STATUS[9]	REFERENCE(S), OTHER SUPPORTING COMMENT(S)
fecundity	low	Sexually dimorphic (Saunders and Landman, 2010). One egg at a time (up to 3 a month) with long incubation period of at least 12 months (Martin *et al.*, 1978). <10 percent of the trapped population are juveniles (Saunders and Ward, 2010, Dunstan *et al*., 2011c).
short/absent planktonic phase	low	No larval phase (Martin *et al* 1978; Carlson, 1985), Juveniles hatch at about 22-26 millimeters (Carlson 1985; Arnold *et al*., 2010).
extended parental care	low	Hatching of viable juvenile and no parental care (Hamada *et al.*, 2010).
competency of offspring	high	Offspring viable as juveniles behaving similarly to adults by deep water camera data (Barord and Dunstan pers comm., 2016). Hatchery juveniles take food.
tmax_longevity	med	20+ years (Dunstan *et al*., 2011; Saunders, 1983; Saunders and Ward, 1987).
tmat_time to maturity	low	10–15 years (Saunders, 1983; Landman and Cochran, 2010; Dunstan *et al*., 2011c).
growth	low	Slow (Saunders, 1983; Landman and Cochran, 2010; Dunstan *et al*., 2011).
intrinsic growth rate of pop	low	Low population density of <1–13.6 individuals per km^2 (Dunstan *et al*., 2011a, Barord *et al*., 2014) and stable (Dunstan *et al*., 2011a) or slow recovery of depleted populations (Ward *et al.* 2016).
natural mortality		No data, although octopus bore holes and marks noted on shells (Saunders *et al*., 2010).

[9] See Musick *et al* 1999

Table 2. Trends in abundance of nautilids

REF #	INDICATOR	TREND	REFERENCE PERIOD	OTHER SUPPORTING COMMENT(S), REFERENCE(S)
Philippines (FAO 71)				
1	CPUE Trap	97% decline	40 years	Tañon Strait, Philippines, *N. pomilius* locally extinct (Alcala & Russ, 2002; Dunstan, 2010; Saunders pers. comm., 2009; Saunders & Ward, 2010; Ward, 1988, Barord *et al*., 2014) CPUE of 3.1 individuals/trap in 1971 (Haven *et al*., 1977) has been reduced to 0.08 individuals/trap in 2011, 0.1 individuals/trap in 2012 and 0.125 in 2013 (Barord *et al*., 2014). Data reliability assessed as 5 (high).
2	CPUE Anecdotal reports	70–94% decline	8–20 years	*N. pompilius* in Palawan, Philippines (Dunstan, 2010). Surveys of fishers in 7 locations in Palawan recording their anecdotal information on CPUE from 1988 (or when nautilus fishing commenced) to 2008. No fishing reported prior to 1988. CPUE was reduced from a mean of 1.0 individuals per trap to 0.2 individuals per trap over periods from 8-20 years. Fishing introduced to Palawan by shell traders from Cebu. Data reliability assessed as 3 (moderate).
3	CPUE Trap	100% loss	30 years	In Siquijor, Philippines, specimen records from 1985 (Hayasaka, 1985). The detailed trapping information for Siquijor are unknown because only shells purchases recorded. Fishery active 1985 to sometime before 2014 (Job Veloso, pers comm., local current nautilus fisherman). Catch became unavailable, requiring an 80km move to fish Panglao. Local extinction confirmed at Siquijor by Baited remote underwater video systems (BRUVS) in 2013 and trapping trials in 2014, no records on video and no captures in traps (80 traps, Barord and Ward 2014 pers comm). Data reliability assessed as 5 (high).
Palau (FAO 71)				
4	CPUE Trap	Stable	30 years	Palau, *N. belauensis* (Carlson & Awai, 2015; Saunders, 1983; Saunders & Spinosa, 1979). 2387 individuals trapped over multiple years 1977–1982, average of 34 individuals/trap (Saunders and Ward, 2010). In 1982, average of 21.1 individuals/trap Ward *et al*., 2016 in press). A direct comparison of replicated 2 nights soak time traps yielded average catches of 8 individuals/trap in 1977-82 compared with 9.8 individuals/trap in 2015. Data reliability assessed as 5 (high).
Indonesia (FAO 57/71)				
5	CPUE Trap	70–90% decline		*N. pompilius* in North Lombok, Indonesia. Formerly in the 1990's, fishermen could get from 10 to 15 nautilus in one night, but now they reportedly catch only from 1 to 3. Data reliability assessed as 3 (moderate).
	CPUE Trap	Decline	10 years	*N. pompilius* in Bali, Indonesia, Some fishermen claimed that until 2005, 10 to 20 nautilus could be caught in one night but yields more recently have been much less. Data reliability assessed as 3 (moderate).
6	Landings Anecdotal report	90% decline		*N. pompilius* in Nusa Tenggara, Indonesia. Local people claimed that 10 years ago, they could find up to 30 empty shells on the beach after a storm, while today, they may only find one or two on the beach. Data reliability assessed as 3 (moderate).
Australia (FAO 71)				
7	CPUE Trap	Stable	12 years	*N. pompilius* at Osprey Reef (Dunstan *et al*., 2011). Study with trapping data each year for 12 years from 1997 to 2008 showing no significant change in CPUE of 6.4 individuals/trap. Data reliability assessed as 5 (high).

REF #	INDICATOR	TREND	REFERENCE PERIOD	OTHER SUPPORTING COMMENT(S), REFERENCE(S)
New Caledonia (FAO 71)				
8	Landings Trap	Stable	30 years	*N. macromphalus* in New Caledonia. Fishery began 1979 (P. Ward pers comm., present 1979-84) and fishery active with one 40-50' boat every night using 4-8 large 1.5m^3 traps. 100 -200 individuals per 3 day trip per each week. 7000+ caught in 1990's by French scientific researchers (P. Ward pers comm. unpublished manuscript in French language, Aguiar *et al.*, 2000). Fishery in last 2 yrs of activity had take of up to 10,000 (P. Ward pers. comm. 2016). New Caledonia is a huge *N. macromphalus* habitat with no deep channels segregating populations except to Loyalty Islands. Data reliability assessed as 3 (moderate).
Fiji (FAO 71)				
9	CPUE Trap	60% decline	30 years	*N. pompilius* in Fiji in 1976 (Ward *et al*., 1977) 30 nautilus from 11 trap events - 2.9 individuals/trap, 1983 (Hayasaka *et al* 1985) 101 traps, 162 nautilus, 1.6 individuals/trap, (Tanabe *et al*., 1988), 84 traps, 222 individuals, 2.5 individuals/trap, and in. 1983 - 163 individuals, 3.1 individuals/trap (Zann, 1984). 2013 - 1 individual/trap for 7 traps total over 3 nights (Barord and Ward pers comm., 2016). Data reliability assessed as 5 (high).
PNG (FAO 71)				
10 11	CPUE Trap	90% decline	30 years	*N. pompilius* and *A. scrobiculatus* in Manus Island, Papua New Guinea 1984, (Ward and Sanders 2010) average 20 individuals/trap, 10:1 *N. pompilius*:*A. scrobiculatus* (100's total). 2015 - 1.5 per trap still 10:1 ratio (17 individuals total for 2 traps for night 4 nights. No fishing effort records sought so fishing effort for Nautilus over 1984 – 2015 is unknown. Data reliability assessed as 5 (high).
India (FAO 57)				
	Landings Trap	?	several decades	*N. pompilius* in India (K. Venkataraman, pers. comm., 2011). Only species in Indian waters, reported as depleted due to over exploitation over several decades. Presently very few beached dead specimens observed on SE coast of India or in Andaman Island. Moreover, few live specimens in by-catch of deep sea fishing trawlers (Dept of Fisheries Andaman and Nicobar Islands, pers comm.). Data reliability 3 (moderate).

Table 3. Population abundance values of locations sampled including prior data from Osprey Reef, Australia, from Barord *et al*., 2014.

LOCATION	FISHED / UNFISHED (F/U)	POPULATION DENSITY (Ind/Km^2)	INDIVIDUALS / TRAP
Osprey Reef, Australia	U	13.6	6.4
Great Barrier Reef, Australia	U	0.34	1.2
Beqa Passage, Fiji	U	0.21	0.5
Taena Bank, American Samoa	U	0.16	0.5
Tanon, Philippines	F	0.03	0.1

Table. 4. Factors that may increase or decrease risk to nautilids.

FACTOR	DESCRIPTION	EFFECT
Selectivity of removal	Harvesting selects mature individuals and results in a changed population age structure skewed to younger animals (Ward *et al*., 2016). Reduction in reproductive output and reduced ability for population to recover.	Negative
Genetically distinct populations	Genetics data suggests that nautilids may be comprised of numerous yet "unrecognized but separate sibling species" that exist as genetically distinct, geographically-and reproductively-isolated populations (Barord *et al.*, 2014, p. 1; Bonacum *et al.*, 2011; Dunstan *et al.* 2011c; Sinclair *et al.*, 2011; Williams *et al.*, 2012, 2015). Local extinctions reduce gene pool and due to low productivity, lack of a free larval phase and geographic barriers to movement, are unlikely to recolonize.	Negative
Density	Low population density within a restricted geographic range and with strict habitat regimes are factors that may increase vulnerability to population decline. Reduced resilience to habitat degradation or changes.	Negative
Specialized niche requirement	Nautilids are fore reef dwellers susceptible to impacts by habitat degradation, pollution and ocean acidification as well as fishing.	Negative
Aggregating behaviour	Nautilids are readily attracted to bait over long distances (Dunstan *et al*., 2011) making them vulnerable to rapid depletion of a low-density stock if they are fished and serial depletion of populations as baited traps introduced to new locations.	Negative
Fishery introduction to new locations	Impacted by foreign introduced fisheries, similar to the situation for sharks and beche de mer, with potential to impact nautilid populations throughout their entire range. In Philippines introduction of fisheries and training by shell traders suggests that if sufficient demand is present then the fishing effort could spread throughout the full range of nautilid distribution. There is evidence of trade in *N. repertus*, which may emanate from illegal fishing in distant waters, e.g.Indonsian fishing for sharks and corresponding major decline in shark populations at offshore reefs in Western Australia, which are known *N. repertus* habitat (Meekan *et al*., 2006).	Negative

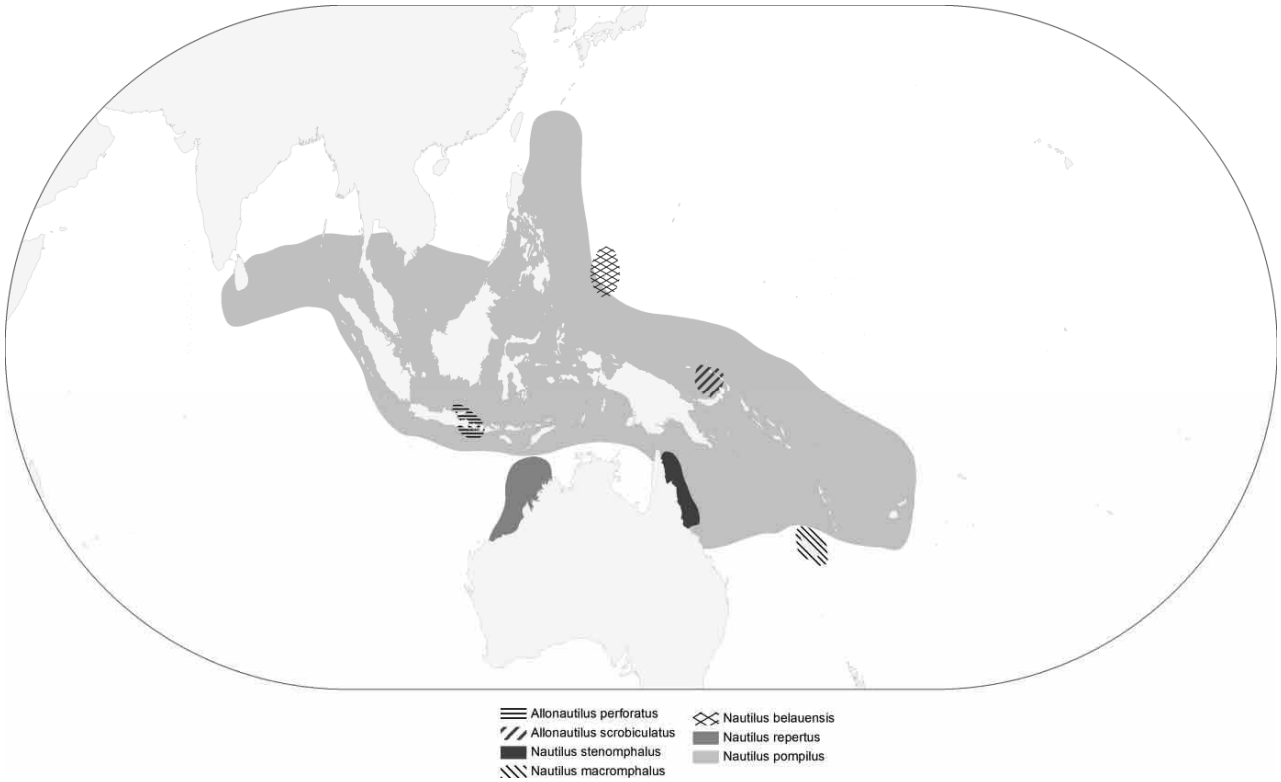

Figure 1. Distribution of Nautilids.

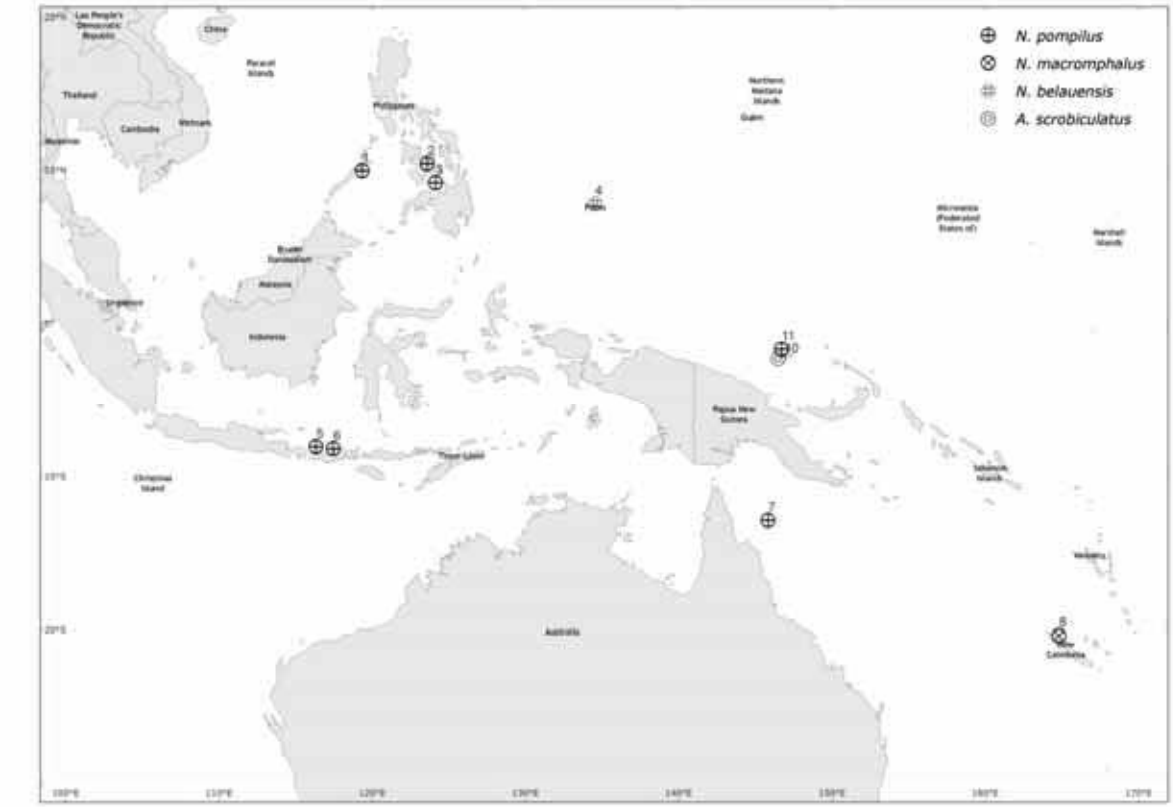

Figure 2. Sites where nautilid sampling is reported in this assessment.

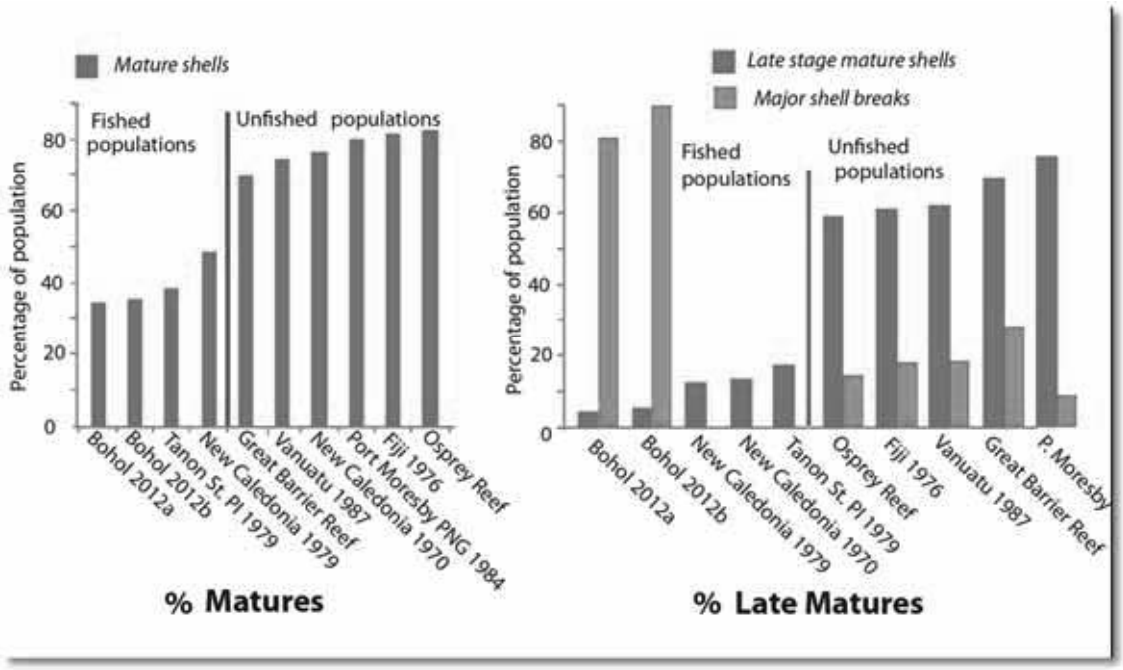

Figure 3. Harvesting selects mature individuals and results in a changed population age structure skewed to younger animals (Ward *et al*., 2016).

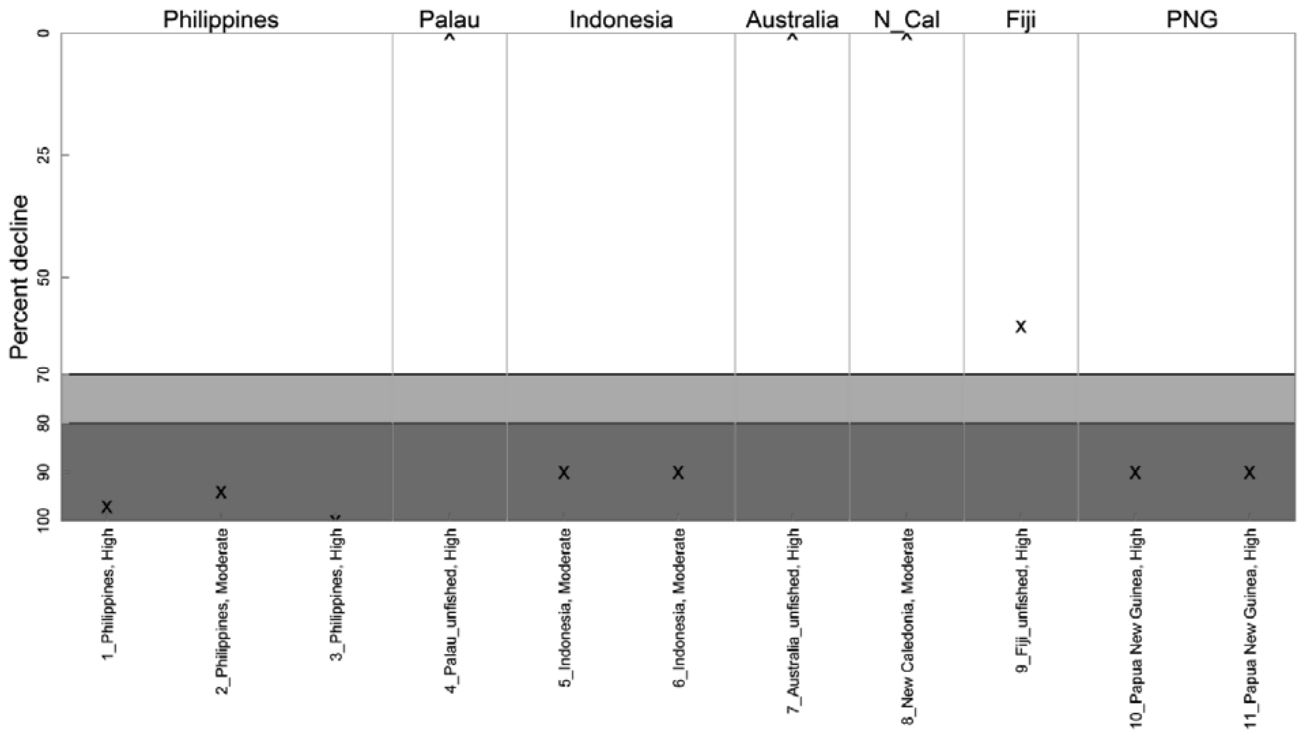

Figure 4. Trends in trap data CPUE for Nautilidae through time, with assessment of data confidence in labels on X axis (numbers on X axis refer to datasets described in Table 2). A species with a low productivity that has declined by over 80% of baseline (dark band) can be considered for listing in Appendix I, or with a precautionary approach (light band) 5–10 % less (see full description in footnote to Annex 5 of Res. Conf. 9.24 (Rev. CoP16)).

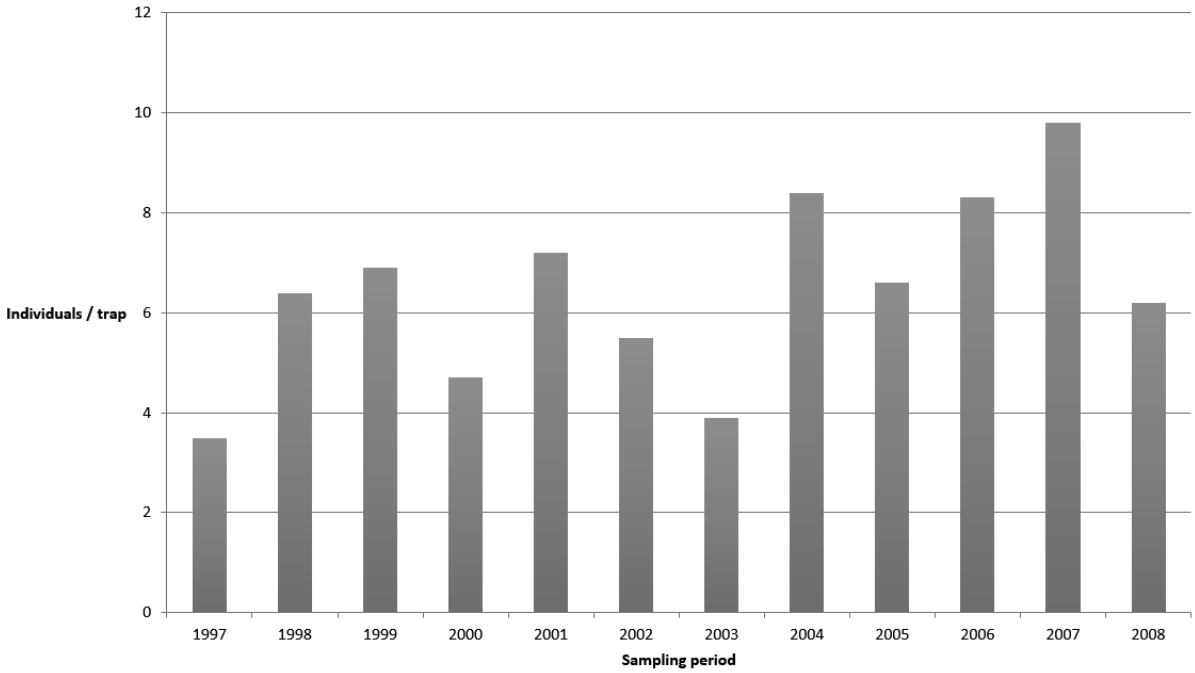

Figure 5. Stable *Nautilus pompilius* population at Osprey Reef, Australia (unfished). Reported at Chambered Nautilus Experts Workshop, June 4-5, 2014, Silver Spring, MD, USA: www.nmfs.noaa.gov/ia/species/Nautilus/2014%20Workshop/2014_nautilus_workshop.html. Also see Dunstan *et al*., 2011c.

APPENDIX A

Terms of Reference for an "Expert Advisory Panel for Assessment of Proposals to CITES"[10]

1. FAO will establish an Ad Hoc Expert Advisory Panel for the Assessment of Proposals to Amend CITES Appendices I and II.
2. The Panel shall be established by the FAO Secretariat in advance of each Conference of the Parties, according to its standard rules and procedures and observing, as appropriate, the principle of equitable geographical representation, drawing from a roster of recognized experts, to be established, consisting of scientific and technical specialists in commercially-exploited aquatic species.
3. The Panel members shall participate in the Panel in their personal capacity as experts, and not as representatives of governments or organizations.
4. The Panel will consist of a core group of no more than 10 experts, supplemented for each proposal by up to 10 specialists on the species being considered and aspects of fisheries management relevant to that species.
5. For each proposal the Panel shall:
    i. assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria, taking account of the recommendations on the criteria made to CITES by FAO;
    ii. comment, as appropriate, on technical aspects of the proposal in relation to biology, ecology, trade and management issues, as well as, to the extent possible, the likely effectiveness for conservation.
6. In preparing its report, the Panel will consider the information contained in the proposal and any additional information received by the specified deadline from FAO Members and relevant regional fisheries management organizations (RFMOs). In addition, it may ask for comments on any proposed amendment, or any aspect of a proposed amendment, from an expert who is not a member of the Panel if it so decides.
7. The Advisory Panel shall make a report based on its assessment and review, providing information and advice as appropriate on each listing proposal. The Panel shall finalize the advisory report no later than ?? days[11] before the start of the CITES Conference of the Parties where the proposed amendment will be addressed. The advisory report shall be distributed as soon as it is finalized to all Members of FAO, and to the CITES Secretariat with a request that they distribute it to all CITES Parties.
8. The general sequence of events will be as follows:
    - Proposals received by CITES
    - Proposals forwarded by CITES Secretariat to FAO
    - FAO forwards proposals to FAO Members and RFMOs and notifies them of deadline for receipt of comments
    - Member and RFMO comments and input received by FAO
    - Panel meets and prepares advisory report on each proposal
    - Panel report reviewed by FAO Secretariat and forwarded to FAO Members, RFMOs and CITES Secretariat.

[10] Taken from Appendix E of the Report of the twenty-fifth Session of COFI, FAO, Rome, 24-28 February 2003. The words 'Ad Hoc' were dropped in 2009, to reflect the more established and regular nature of this Panel.

[11] To be discussed and negotiated with CITES Secretariat, but typically 60 days.

APPENDIX B

Agenda[12], for the Expert Advisory Panel for Assessment of Proposals to CITES, FAO Headquarters, Rome 6-10 July 2016.

Mon 6 June	Introductions, Threshers, Silky and Mobula
8h00-8h15	Receive Building Passes at FAO Headquarters (met by Ms. Luigia Sforza) move to Mexico Room
9h00-10h30	Welcome by Mr Árni Mathiesen, Assistant Director-General, FAO Fisheries and Aquaculture Department Introduction of participants Selection of Panel Chair Panel terms of reference, objectives and work programme for the meeting Overview of the CITES listing criteria
11h00-12h45	Presentation on options for further standardising the discussion and outputs from the Expert Panel with the aim of making the process more predictable and systematic as well as efficient Presentation of proposal on sharks and rays
14h15–15h45	Plenary discussion on sharks and ray information collected from proposals and delegates. Break out into working groups
16h15-18h30	Continue Break out working groups Plenary discussions to sum up progress, and discuss forward planning
Tues 7 June	Threshers, Silky and Mobula (cont.), Nautilidae
9h00-10h30	Plenary discussion on sharks and rays Break out into working groups
11h00-12h30	Presentation of proposal: Nautilidae Plenary discussion on Nautilidae information collected from proposals and delegates. Break out working groups
14h00-15h30	Break out working groups
16h00-18h30	Continue Break out working groups Plenary discussions to sum up progress, and discuss forward planning
Wed 8 June	Threshers, Silky & Mobula (cont.), Ornamentals (Cardinal, Angel, Potamotrygonidae)
9h00-10h30	Presentation of proposals: Ornamentals (Mexico Room, D-213bis) Plenary discussion on Ornamentals information collected from proposals and delegates Break out into working groups
11h00-12h30	Break out into working groups
14h00-15h30	77. On-going break out working groups Drafting in working groups alternating with plenary discussion as determined during the meeting
16h00-17h30	78. On-going break out working groups Drafting in working groups alternating with plenary discussion as determined during the meeting
Thurs9 June	On-going review
9h00-10h30	Plenary discussion on progress of species deliberations by Panel Drafting in working groups alternating with plenary discussion as determined during the meeting
11h00-12h30	79. On-going break out working groups
14h00-15h30	80. TBD
16h00-17h30	81. Plenary discussion as determined during the meeting 82. Clearance and adoption of the report by working groups
Fri 10 June	Review and Clearance of the Report
9h00-10h30	Plenary discussion on progress of species deliberations by Panel Drafting in working groups alternating with plenary discussion as determined during the meeting
11h00-12h30	Clearance and adoption of the report by working groups
14h00-15h30	83. Clearance and adoption of the report by Panel
14h00-17h30	84. Clearance and adoption of the report by Panel

[12] Room numbers, Lunch and Coffee Breaks removed

APPENDIX C

List of participants

PANEL MEMBERS	
AUSTRALIA AUSTRALIE	Andy Dunstan (Species Expert) Researcher Deep Ocean Australia Project School of Biomedical Science University of Queensland Brisbane Glenn Sant (Trade, Species Expert) Director University of Wollongong Wollongong Ms Anna Willock (Core) Director International Fisheries Australian Fisheries Management Authority Department of Agriculture, Fisheries and Forestry Canberra
BRAZIL BRÉSIL BRASIL	Ms Patricia Charvet (Species Expert) Expert Serviço Nacional de Aprendizagem Industrial (SENAI-PR) Curitiba Paraná
GHANA	Paul Bannerman (Chair, Core) Deputy Director Marine Fisheries Research Division Fisheries Commission Ministry of Food and Agriculture Tema
INDONESIA INDONÉSIE	Dharmadi Dharmadi (Species Expert) Senior Scientist Agency for Research and Development of Marine Affairs and Fisheries Ministry of Marine Affairs and Fisheries Jakarta Ms Sasanti Retno Suharti (Species Expert) Researcher Research Center for Oceanography Indonesian Institute of Sciences Jakarta
JAPAN JAPON JAPÓN	Kotaro Yokawa (Species Expert) Researach Coordinator Oceanography and Resources National Research National Research Institute of Far Seas Fisheries Orido Japan

PANEL MEMBERS (continued)	
UNITED STATES OF AMERICA ÉTATS-UNIS D'AMÉRIQUE ESTADOS UNIDOS DE AMÉRICA	Ms Elizabeth Babcock (Core) Associate Professor Department of Marine Biology and Ecology University of Miami Miami USA Mr John Carlson (WG Lead, Species Expert) Research Fishery Biologist National Marine Fisheries Service National Oceanic and Atmospheric Administration Panama City, Florida
URUGUAY	Andrés Domingo Balestra (Species Expert) Director Adjunto Dirección Nacional de Recursos Acuáticos Ministerio de Ganadería, Agricultura y Pesca Montevideo
JOINT TECHNICAL COMMISSION OF THE MARINE FRONT COMMISSION TECHNIQUE MIXTE DU FRONT MARITIME COMISIÓN TÉCNICA MIXTA DEL FRENTE MARÍTIMO	Ramiro Sánchez (Core) Technical Secretary Comisión Técnica Mixta del Frente Marítimo Montevideo Uruguay
INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS COMMISSION INTERNATIONALE POUR LA CONSERVATION DES THONIDÉS DE L'ATLANTIQUE COMISIÓN INTERNACIONAL PARA LA CONSERVACIÓN DEL ATÚN ATLÁNTICO	Paul De Bruyn (Core) Coordinator Department of Research and Statistics ICCAT Secretariat Madrid Spain
INFOPESCA	Ms Graciela Pereira (Trade Expert) Director INFOPESCA Montevideo Uruguay
INTERNATIONAL COALITION OF FISHERIES ASSOCIATIONS COALITION INTERNATIONALE DES ASSOCIATIONS HALIEUTIQUES COALICIÓN INTERNACIONAL DE ASOCIACIONES PESQUERAS	Alastair MacFarlane (Trade Expert) Executive Secretary International Coalition of Fisheries Associations New Zealand Seafood Industry Council Wellingon New Zealand

PANEL MEMBERS (continued)	
MARINE AREAS BEYOND NATIONAL JURISDICTION	Ms Shelley Clarke (Core, Species, Trade Expert) Technical Coordinator - Sharks and Bycatch Marine Areas Beyond National Jurisdiction (ABNJ) (Common Oceans) Tuna Project Western and Central Pacific Fisheries Commission Kolonia, Pohnpei State Federated States of Micronesia
ORNAMENTAL FISH INTERNATIONAL	Svein Fossa (Core) Member of Executive Board Ornamental Fish International Montfoort The Netherlands
SOUTHEAST ASIAN FISHERIES DEVELOPMENT CENTRE CENTRE DE DEVELOPPEMENT DES PECHES DE L'ASIE DU SUD-EST CENTRO DE DESARROLLO DE LA PESCA EN ASIA SUDORIENTAL	Ahmad Bin Ali (Species Expert) Senior Research Officer Marine Fishery Resources Development and Management Department Southeast Asian Fisheries Development Center Terengganu Malaysia
SUB-REGIONAL FISHERIES COMMISSION COMMISSION SOUS-RÉGIONALE DES PÊCHES COMISIÓN SUBREGIONAL DE PESCA	M. Mika Diop (Core) Coordinateur du projet PSRA-Requins Secrétariat Permanent de la Commission Sous-Régionale des Pêches Dakar Sénégal

INVITED OBSERVERS	
UNITED STATES OF AMERICA ÉTATS-UNIS D'AMÉRIQUE ESTADOS UNIDOS DE AMÉRICA	Gregory Barord Marine Biology Instructor Central Campus and Save the Nautilus Des Moines, Iowa USA Alejandro Vagelli Director of Science & Conservation Center for Aquatic Sciences Camden USA Peter Ward Professor University of Washington College of Environment USA
CITES SECRETARIAT	Tom De Meulenaer Chief Scientific Services CITES Secretariat Geneva Switzerland Daniel Kachelriess Marine Species Officer (JPO) Scientific Services CITES Secretariat Geneva Switzerland
IPMA	Rui Coelho Portuguese Institute for the Ocean and Atmosphere, I.P. Division of Modelling and Management of Fishery Resources Olhão Portugal
GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN COMMISSION GENERALE DES PECHES POUR LA MEDITERRANEE COMISIÓN GENERAL DE PESCA DEL MEDITERRÁNEO	Miguel Bernal Fishery Resources Officer General Fisheries Commission for the Mediterranean (GFCM) Fisheries and Aquaculture Department Rome Italy

PROPONENTS	
FIJI	Ms. Eleni Rova Marama Tokaduadua Principal Environment Officer Ministry of Local Government and Environment Suva Fiji
MALDIVES	M. Shiham Adam Director-General Marine Research Center Ministry of Fisheries and Agriculture Male Maldives
UNITED KINGDOM ROYAUME UNI REINO UNIDO	Sarah Fowler Scientific Advisor to Sri Lanka and Maldives Plymouth United Kingdom
UNITED STATES OF AMERICA ÉTATS-UNIS D'AMÉRIQUE ESTADOS UNIDOS DE AMÉRICA	Patricia S. De Angelis, Ph.D. Botanist, Division of Scientific Authority US Fish & Wildlife Service Falls Church, VA USA
BLUE RESOURCES SRI LANKA	Daniel Fernando Advisor to Minister Department of Wildlife Conservation, Colombo Sri Lanka
FAO	
FAO SECRETARIAT	Kim Friedman Senior Fishery Resources Officer Marine and Inland Fisheries Branch (FIAF) Fisheries and Aquaculture Policy and Resources Division (FIA) Fisheries and Aquaculture Department Rome Italy Marcelo Vasconcellos Fishery Resources Officer Marine and Inland Fisheries Branch (FIAF) Fisheries and Aquaculture Policy and Resources Division (FIA) Fisheries and Aquaculture Department Rome Italy Monica Barone Consultant Fishery Resources Officer Marine and Inland Fisheries Branch (FIAF) Fisheries and Aquaculture Policy and Resources Division (FIA) Fisheries and Aquaculture Department Rome Italy

APPENDIX D

Welcome speech by Mr Árni Mathiesen, Assistant Director-General, FAO Fisheries and Aquaculture Department

It is my pleasure to welcome you to this fifth meeting of the FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Concerning Commercially-Exploited Aquatic Species.

As you all know, CITES offers a mechanism for regulating international trade, with the purpose of ensuring that trade does not threaten a species survival. You also know that since 1994, CITES has increasingly moved its attention to aquatic and marine species, with notable increases in listings of species under commercial and artisanal fisheries management. Recognising FAO's global role in supporting productive and sustainable fisheries, FAO and CITES developed an MOU in 2006, and have, and are continuing, to work together to refine the mechanism for deciding on how these trade regulation tools can support fisheries management, where appropriate.

In September, the CITES Conference of Parties (17th), with representatives from over 180 States will meet in Johannesburg to decide on a suite of species proposals for CITES listings. This includes sharks, rays, ornamental fish and invertebrates. The importance of the CITES Conference of Parties should not be underestimated. Held approximately every 3 years, decisions from this meeting impact global trade, that influences the operation of fisheries, fisheries management, livelihoods and food security.

The CITES CoP needs guidance from experts. The FAO Expert Advisory Panel, now in its fifth sitting, brings together a broad range of experts on commercial fisheries species, their management and trade, to advise on such governance. Your work this week, to provide science based guidance, on the status of these species, is critically important.

You have been selected for the FAO Expert Advisory Panel because of your particular expertise and are here in your individual capacity and not as a representative of any country or organisation. For many of you this will be your first experience of the Panel, but several of you also participated in one or more of the former meetings that were able to deliver very satisfactory reports.

Those of you who were present at the previous CITES CoPs know that FAO Panel reports are welcomed and taken very seriously. For CoP 14, 15 and 16, Parties have followed almost all of FAO's recommendations, even in some controversial cases, with the only exceptions being Parties delaying listings, even when data was deemed to have met the listing criteria. This shows the extent to which the advice of the Panel is trusted and respected by the Parties. This respect puts a big responsibility on all of us to ensure that the Panel produces reliable, objective and thorough advice for use in Johannesburg later this year.

We are very grateful that you have accepted this challenge and have dedicated your time and expertise to assist us. To help the current Panel to keep up with the good work of the previous ones, we have with your help, prepared preliminary status evaluations that will be refined in the week to come. We hope the process facilitates orderly, focussed deliberation, so that the Panel can efficiently work through proposals to formulate solid and justified conclusions. Please remember, your task is not to evaluate the merits of CITES criteria, but to use your expertise to apply them and, in doing so, adhere to the science-based interpretation that is the 'FAO understanding' of what the majority of CITES Parties adopted in 2004.

It may not always be possible for the Panel to reach agreement on the evaluation of all proposals and there may be differing views in some instances. I do urge you to do all that you can to achieve consensus and to express your agreed conclusions clearly and unambiguously. Where consensus is not possible, the Panel report should equally clearly describe differing opinions, to support CITES Parties in coming to a conclusion.

I thank you all for giving up your time to help us in this important meeting, especially as I know you are all very busy and some of you have had to rearrange your schedules to be able to attend. I also thank Mr. Tom De Meulenaur and Mr. Daniel Kachelriess of the CITES Secretariat for joining us at this meeting and for the cooperation and assistance given by CITES in the work we have been undertaking in relation to CITES and commercially-exploited aquatic species. FAO is continuing to build a close and positive working relationship with the CITES Secretariat, which I believe is valued by both organizations.

So how can we measure the success of this meeting? Firstly, it is not by making recommendations on whether to list or not list a species or species group. That is a job for the Parties. The measure of success by which you can judge the success of the Panel will be the level of engagement in the process of determining whether the criteria for listing is supported, or not supported, by the best available information, while secondly, and most importantly, having the Panel stand side by side to defend the Panel's final report.

The meeting of this Expert Advisory Panel benefits greatly from financial support provided by the FAO Regular Programme, but also from extra budgetary support by Japan and the United States of America. I would especially like to thank these two countries for their generous gesture.

Finally, I sincerely hope that the hard work on the Panel leaves you some time to relax in Rome and to enjoy some of the many attractions that the Eternal City has to offer. I wish you a fruitful and enjoyable meeting.

APPENDIX E

Criteria used by the FAO Expert Advisory Panel to assign a measure of the reliability of information derived from different sources for use as indices of abundance

Reliability index of population abundance information	Source of data or information
5	Statistically designed, fishery-independent survey of abundance
4	Consistent and/or standardized catch-per-unit effort data from the fishery
3	Unstandardized catch-per-unit effort data from the fishery; scientifically-designed, structured interviews; well-specified and consistent anecdotal information on major changes from representative samples of stakeholders.
2	Catch or trade data without information on effort
1	Confirmed visual observations; anecdotal impressions
0	Information that does not meet any of the above, or equivalent, criteria; flawed analysis or interpretation of trends

Notes: A score of 0 indicates that the information was not considered reliable, while a score of 5 indicates that it was considered highly reliable. Any information on abundance allocated a non-zero value was considered useful. These scores could be adjusted up or down in any particular case, depending on the length of the time series and the amount of information available on the sources and methods.

Sources: FAO (2004, 2007, 2010).

REFERENCES

FAO. 2002. Report of the second Technical Consultation on the Suitability of the CITES Criteria for Listing Commercially-exploited Aquatic Species. Windhoek, Namibia, 22-25 October 2001. FAO Fisheries Report. No. 667. Rome 2002. 87p. (also available at www.fao.org/docrep/MEETING/003/Y1455E.HTM)

FAO. 2004. Report of the FAO Ad Hoc Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species. Rome, 13–16 July 2004. FAO Fisheries Report No. 748. Rome. 51 pp. (also available at ftp://ftp.fao.org/docrep/fao/007/y5523e/y5523e00.pdf).

FAO. 2007. Report of the Second FAO Ad Hoc Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species. Rome, 26–30 March 2007. FAO Fisheries Report No. 833. Rome. 134 pp. (also available at www.fao.org/docrep/010/a1143e/a1143e00.htm).

FAO. 2010. Report of the Third FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species. Rome, 7–12 December 2009. FAO Fisheries and Aquaculture Report No. 925. Rome. 150 pp. (also available at www.fao.org/docrep/013/i1899e/i1899e.pdf).

FAO. 2011. Report of the FAO Workshop to review the application of CITES criterion Annex 2 a B to commercially-exploited aquatic species. Rome, 19−21 April 2011. FAO Fisheries and Aquaculture Report. No. 976. Rome, FAO 2011. 4 pp (also available at www.fao.org/docrep/014/i2235e/i2235e00.pdf).

FAO. 2013. Report of the fourth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species, Rome, 3–8 December 2012. FAO Fisheries and Aquaculture Report No. R1032. Rome, FAO. 161 pp (also available at www.fao.org/3/a-ap999e.pdf).

The fifth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-exploited Aquatic Species was held at FAO headquarters from 6 to 10 June 2016. The Panel was convened in response to the agreement by the twenty-fifth session of the FAO Committee on Fisheries (COFI) on the terms of reference for an expert advisory panel for assessment of proposals to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and to the endorsement of the twenty-sixth session of COFI to convene the Panel for relevant proposals to future CITES Conference of the Parties. The objectives of the Panel were to: i) assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria (Resolution Conf. 9.24 [Rev. CoP16]; ii) comment, as appropriate, on technical aspects of the proposal in relation to biology, ecology, trade and management issues, as well as, to the extent possible, the likely effectiveness for conservation. The Panel considered the following seven proposals submitted to the seventeenth Conference of the Parties to CITES: CoP17 Prop. 42. Proposal to include silky shark, *Carcharhinus falciformis* in Appendix II in accordance with Article II paragraph 2(a); CoP17 Prop. 43. Proposal to include bigeye thresher shark, *Alopias superciliosus* in Appendix II in accordance with Article II paragraph 2(a), if listed, this would include all other species of thresher sharks, genus *Alopias* spp. in Appendix II in accordance with Article II paragraph 2(b); CoP17 Prop. 44. Proposal to include the sicklefin devil ray, *Mobula tarapacana* and spinetail devil ray, *Mobula japanica* in Appendix II in accordance with Article II paragraph 2(a), if listed, this would include all other species of mobula rays, genus *Mobula* spp. in Appendix II in accordance with Article II paragraph 2(b); CoP17 Prop. 45. Proposal to include Raya, *Potamotrygon motoro* in Appendix II in accordance with Article II paragraph 2(a); CoP17 Prop. 46. Proposal to include the Banggai cardinalfish, *Pterapogon kauderni* in Appendix II in accordance with Article II paragraph 2(a); CoP17 Prop. 47. Proposal to include clarion angelfish, *Holacanthus clarionensis* in Appendix II in accordance with Article II paragraph 2(a); CoP17 Prop. 48. Proposal to include the Family Nautilidae in Appendix II in accordance with Article II paragraph 2(a).

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