(English only / en inglés únicamente / Seulement en anglais)

Food and Agriculture Organization of the United Nations

NFISR/R1389 (En)

FAO Fisheries and Aquaculture Report

ISSN 2070-6987

Report of the

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

Rome, 18–22 July 2022

FAO Fisheries and Aquaculture Report No. 1389 NFISR/R1389 (En)

Report of the

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

Rome, 18–22 July 2022

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2022

Required citation:
FAO. 2022. *Report of the Seventh FAO Expert Advisory Panel for the assessment of the proposals to amend Appendices I and II of CITES concerning commercially-exploited aquatic species – Rome, 18–22 July 2022*. Rome. https://doi.org/10.4060/cc1931en

ISSN 2070-6987 [Print]
ISSN 2707-546X [Online]

ISBN 978-92-5-136844-2

PREPARATION OF THIS DOCUMENT

This is the report of the Seventh FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially-Exploited Aquatic Species (Expert Panel), held at FAO headquarters from 18 to 22 July 2022.

The meeting of the Expert Panel was funded by the FAO Regular Programme with extra assistance from the Government of Japan.

The figures presented in this document are reproduced as they appear in the source materials from which they were obtained: there is thus some variability in terms of languages, image quality and labelling styles.

ABSTRACT

The Seventh 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 18 to 22 July 2022. The Expert 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 following endorsement from the Twenty-Sixth Session of COFI to convene the Expert Panel for relevant proposals to future CITES Conference of the Parties.

The objectives of the Expert Panel were to:

i) assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria (Resolution Conf. 9.24 [Rev. CoP17]); and
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 Expert Panel considered the following six proposals submitted to the Nineteenth Conference of the Parties (CoP) to CITES:

- **CoP19 Proposal 37.** Proposal to include 19 shark species in the family Carcharhinidae in Appendix II in accordance with Article II, paragraph 2(a) of the Convention and satisfying criteria A and B in Annex 2a of CITES Resolution Conf. 9.24 (Rev. CoP17). This proposal included 35 to 40 species as “look-alikes”. Expert Panel decision: The proposal to list all 19 shark species of the family Carcharhinidae in Appendix II of CITES **Does not Meet** the CITES criteria as a single proposal. The FAO Expert Panel analysed available scientific data and technical information for the species in Proposal 37 and determined 3 species meet the CITES Appendix II listing criteria (grey reef shark, *Carcharhinus amblyrhynchos;* smalltail shark, *C. porosus*; and ganges shark, *Glyphis gangeticus*), and 12 species do not meet the CITES Appendix II listing criteria (borneo shark, *C. borneensis*; pacific smalltail shark, *C. cerdale*; pondicherry shark, *C. hemiodon*; lost shark, *C. obsoletus*; caribbean reef shark, *C. perezi*; night shark, *C. signatus*; daggernose shark, *Isogomphodon oxyrhynchus*; borneo broadfin shark, *Lamiopsis tephrodes*; whitenose shark, *Nasolamia velox;* whitecheek shark, *C. dussumieri;* dusky shark, *C. obscurus*; sandbar shark; *C plumbeus*). For a further 4 species there was insufficient data to make a determination (blacknose shark, *C. acronotus*; smoothtooth blacktip shark, *C. leiodon*; broadfin shark, *Lamiopsis temmincki*; and sharptooth lemon shark, *Negaprion acutidens*). The FAO Expert Panel recommended the consideration of separate proposals for the species assessed to meet the CITES Appendix II listing criteria.

- **CoP19 Proposal 38.** Proposal to include *Sphyrna tiburo* in accordance with Article II, paragraph 2(a) of the Convention and satisfying criteria A and B in Annex 2a, and all remaining species in the family Sphyrnidae as “look-alikes”. Expert Panel decision: **Does Meet**.

- **CoP19 Proposal 39.** Proposal to include *Potamotrygon wallacei* and *P. leopoldi* in CITES Appendix II in accordance with Article II of the Convention and satisfying criteria A and B in Annex 2a of CITES Resolution Conf. 9.24 (Rev. CoP17), and to include *Potamotrygon henlei*, *P. albimaculata*, *P. jabuti*, *P. marquesi* and *P. signata* as “look-alikes”. *P. wallacei* Expert Panel decision: **Does Meet**; *P. leopoldi* Majority Expert Panel decision: **Does not Meet**.

- **CoP19 Proposal 40.** Proposal to include the six species of guitarfish (*Acroteriobatus variegatus*; *Pseudobatos horkelii*; *Rhinobatos albomaculatus*; *R. irvinei*; *R. rhinobatos; R. schlegelii*) in Appendix II in accordance with Article II, paragraph 2(a) of the Convention, and satisfying criteria A and B in Annex 2a of CITES Resolution Conf. 9.24 (Rev. CoP17). In addition, to add 37 species as “look-alikes”. Expert Panel decision: **Does not Meet**.

- **CoP19 Proposal 41.** Proposal to include *Hypancistrus zebra* in Appendix I in accordance with Article II of CITES Convention paragraph 1, and by meeting Annex 1 B (iii; iv) and Annex 1 C (i; ii) of CITES Resolution Conf. 9.24 (Rev. CoP17). No "look-alikes". Expert Panel decision: **Does not Meet**.

- **CoP19 Proposal 42.** Proposal to include three species belonging to the genus *Thelenota* in Appendix II, in accordance with Article II, paragraph 2(a) of the Convention; the three species qualifying for Appendix II listing under criteria A and B in Annex 2a of CITES Resolution Conf. 9.24 (Rev. CoP17). No "look-alikes". Expert Panel decision: **Does not Meet**.

The report includes an assessment of each of the six proposals in-line with the objectives outlined above, highlighting the Expert 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

Tables

Figures

ABBREVIATIONS AND ACRONYMS

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COFI	Committee on Fisheries
CoP	Conference of the Parties
CPUE	catch per unit of effort
DW	disc width
EEZ	exclusive economic zone
F	fishery related mortality
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)
k	individual growth coefficient
M	natural mortality
MPA	marine protected area
MSY	maximum sustainable yield
NDF	non-detriment finding
nei	not elsewhere included
NPOA	National Plan of Action
r	population intrinsic growth rate
RFMO	regional fisheries management organization
SCUBA	Self-Contained Underwater Breathing Apparatus
SD	standard deviation
SE	standard error
SEAMAP	Southeast Area Monitoring and Assessment Program
SEDAR	Southeast Data, Assessment and Review
SPC	Pacific Community
SSF	spawning stock fecundity
VBGP	von Bertalanffy growth parameters

INTRODUCTION

Background and purpose of the Expert Panel

1. The Seventh 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 of the Twenty-Fifth Session of the FAO Committee on Fisheries (COFI) to 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) in February 2003. This agreement, to convene the Expert Panel for relevant proposals to future CITES Conference of the Parties, has received the endorsement of subsequent sessions of COFI. The Sixteenth Session of the Sub-Committee on Fish Trade of COFI (Mexico written correspondence procedure: April to June 2022) acknowledged the positive contribution made by FAO in convening the Expert Panel for the assessment of CITES proposals and unanimously supported the convening of the Expert Panel for the assessment of proposals to CITES CoP19, charged with listing or delisting commercially exploited aquatic species.

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

4. The Expert Panel's task 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; and

(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.

5. The Thirty-Fourth COFI (Italy, 1–5 February 2021, see FAO, 2022) called for FAO to continue cooperating with CITES and to help ensure that decisions made in CITES and their implementation are based on the best scientific information available and relevant technical information.

6. The Sixty-Ninth Standing Committee of CITES (Switzerland, 27 November–1 December 2017) noted the importance of Parties having access to the best available scientific information on species proposed for listing well in advance of the meeting of the Conference of the Parties (CoP), and encouraged Parties to consult with FAO as soon as possible when considering submissions of proposals for marine species. The CITES Secretariat was encouraged to consider ways to further enhance the communication of the FAO Expert Panel report. Additionally, at their most recent Seventy-Fourth CITES Standing Committee meeting (7–11 March 2022 in France) (CITES, 2022a). Parties asked the Secretariat to collaborate closely with FAO on information held by the FAO Secretariat and regional fisheries management organizations (RFMOs).

The Expert Panel meeting

7. The Expert Panel met in Rome from 18 to 22 July 2022, hosted by FAO with funding from the FAO Regular Programme, with specific funding allocations from the Government of Japan. The agenda adopted for the meeting is included as Appendix B.

8. The Expert Panel consisted of 21 specialists on the species under consideration, as well as on fisheries management and international trade. In addition, the CITES Secretariat and a fisheries assessment expert from FAO was invited to attend as observers. The list of participants at the meeting is included as Appendix C.

9. The meeting was opened by Mr Manuel Barange, Director of the Fisheries and Aquaculture Department, who welcomed participants and provided some background information to the convening of the meeting of the Expert Panel and the importance of its task. The welcome speech is included as Appendix D.

10. Mr Mark Dickey-Collas was elected Chair of the Expert Panel, and four informal working groups were formed to facilitate communication across teams of participants working on each of the six proposals, although all participants were encouraged to have input on the assessment of all proposals. Ms Monica Barone, Mr Kim Friedman and Ms Chiaki Yamada from FAO assisted as rapporteurs and facilitators. Ms Valérie Schneider provided general logistical and secretarial support.

11. Following adoption of the agenda of the meeting, Mr Kim Friedman, FAO Senior Fisheries Resources Officer, made a presentation on the Expert Panel Terms of Reference and FAO interpretation of the CITES criteria, and presented background and guidance on how the assessments and the logistics of the weeklong meeting might best proceed.

Proposals of commercial aquatic species for CoP19

1. Evaluation of the proposals

12. The Expert Panel considered the following six proposals submitted to CITES Nineteenth Conference of the Parties. The six proposals can be downloaded from the CITES website (CITES, 2022b).

CoP19 Proposal 37. To include blacknose shark (*Carcharhinus acronotus*); grey reef shark (*C. amblyrhynchos*); borneo shark (*C. borneensis*); pacific smalltail shark (*C. cerdale*); whitecheek shark (*C. dussumieri*); pondicherry shark (*C. hemiodon*); smoothtooth blacktip shark (*C. leiodon*); dusky shark (*C. obscurus*); lost shark (*C. obsoletus*); caribbean reef shark (*C. perezi*); sandbar shark (*C. plumbeus*); smalltail shark (*C. porosus*); night shark (*C. signatus*); ganges shark (*Glyphis gangeticus*); daggernose shark (*Isogomphodon oxyrhynchus*); broadfin shark (*Lamiopsis temmincki*); borneo broadfin shark (*L. tephrodes*); whitenose shark (*Nasolamia velox*) and sharptooth lemon shark (*Negaprion acutidens*) in Appendix II in accordance with Article II, paragraph 2(a) and all other species in the family Carcharhinidae: genus *Carcharhinus*, genus *Isogomphodon*, genus *Loxodon*, genus *Nasolamia*, genus *Lamiopsis*, genus *Negaprion*, genus *Prionace*, genus *Rhizoprionodon*, genus *Scoliodon*, genus *Triaenodon* and any other putative species of family Carcharhinidae, in Appendix II in accordance with Article II paragraph 2(b).

CoP19 Proposal 38. To include the bonnethead shark (*Sphyrna tiburo*) in Appendix II in accordance with Article II, paragraph 2(a) and all remaining species in the family Sphyrnidae that are not already listed in CITES Appendix II, including winghead shark (*Eusphyra blochii*), scalloped bonnethead (*S. corona*), carolina hammerhead (*S. gilberti*), scoophead shark (*S. media*) and smalleye hammerhead (*S. tudes*), as well as any other yet to be identified species of the family Sphyrnidae in Appendix II in accordance with Article II, paragraph 2(b).

CoP19 Proposal 39. To include the freshwater stingrays *Potamotrygon wallacei* and *P. leopoldi* in Appendix II in accordance with Article II, paragraph 2(a) of Resolution Conf. 9.24 (Rev. CoP17); and to include the endemic freshwater stingray species: *Potamotrygon henlei*, *P. albimaculata*, *P. jabuti*, *P. marquesi* and *P. signata* in Appendix II in accordance with criteria A of Annex 2b (Resolution Conf. 9.24, Rev. CoP17).

CoP19 Proposal 40. To include the stripenose guitarfish (*Acroteriobatus variegatus*), Brazilian guitarfish (*Pseudobatos horkelii*), whitespotted guitarfish (*Rhinobatos albomaculatus*), spineback guitarfish (*Rhinobatos irvinei*), common guitarfish (*Rhinobatos rhinobatos*), brown guitarfish (*Rhinobatos schlegelii*) in Appendix II in accordance with Article II, paragraph 2(a) and the rest of the species in family Rhinobatidae in accordance with Article II, paragraph 2(b).

CoP19 Proposal 41. To include *Hypancistrus zebra* in Appendix I in accordance with Article II of the CITES Convention text, paragraph 1, and by meeting Annex 1B and Annex 1C of CITES Resolution Conf. 9.24 (Rev. CoP17).

CoP19 Proposal 42. To include the three species belonging to the genus *Thelenota*, comprising *Thelenota ananas*, *T. anax* and *T. rubralineata* in Appendix II, in accordance with Article II, paragraph 2(a).

2. General comments and observations

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

13. In accordance with the Expert Panel's Terms of Reference, FAO Members and RFMOs were notified of the proposals submitted that dealt with commercially exploited aquatic species and were informed that FAO would be convening the Expert 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 datasets, scientific papers, reports and articles were held on a shared document drive for use by all the Expert Panel participants.

14. Other relevant information sourced by the FAO and Expert Panel participants were shared among the Expert Panel on a shared drive.

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

15. The Expert Panel applied the CITES Resolution Conf. 9.24 (Rev. CoP17) criteria interpreted in accordance with the initial advice provided to CITES by FAO on criteria suitable for commercially exploited aquatic species and as applied since the Second Meeting 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 Annex 2a criteria for the inclusion of species in Appendix II, as applied by the Expert Panel.

16. The Expert Panel also noted the conclusions of the "Workshop to review the application of CITES criterion Annex 2a (B) to commercially exploited aquatic species" (FAO, 2002; FAO, 2011), which confirmed the view expressed by FAO (2007) and in CoP14 Inf. 64; in other words, that the same definitions, explanations and guidelines in Annex 5 of the Resolution Conf. 9.24 (Rev. CoP17), including the "decline" criteria, apply for both criterion A and criterion B of Annex 2a. A broad range of key documentation on how the criteria evolved through time and discussions on the progress was also shared on a shared drive, along with a contexts page with descriptive annotations.

17. The Expert Panel was informed of the recommendations made by 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.

18. Other relevant process guidance information sourced by FAO and Expert Panel participants were shared among the Expert Panel on a shared drive, including information on how to characterize the quality of data used for analyses (Appendix E).

2.3. General comments raised in regards both proposals and the process for analysis and reporting the six proposals[1]

19. The Expert Panel noted a number of key challenges in reviewing the six proposals for listing commercially exploited aquatic species in Appendix I or II, here listed and addressed in the following paragraphs:

1. The general evolution of CITES Parties proposing commercially exploited aquatic species under CITES Annex 2 (a) criteria for the inclusion of species in Appendix II (CITES, 2022c) in accordance with Article II, paragraph 2 (a)A of the Convention to now include Article II, paragraph 2 (a)B;
2. CITES Party proposals including species where the status of various stocks of the commercially exploited aquatic species differs in regard to qualification against the criteria for listing amendment;
3. CITES Parties proposing a broad range of differing commercially exploited aquatic species in a single proposal;
4. The quality of scientific data and technical information presented to support listing amendment consideration in species amendment proposals;
5. CITES Party proposals using non-CITES relevant assessments (based on different criteria) as support for listing amendment of commercially exploited aquatic species;
6. CITES Party proposals presenting "catch all" look-alike lists that outnumber the species proposed for listing and that take no account of practicality, costs and socioeconomic impact of implementing the listing and look-alike controls;
7. Challenges when commodities from a commercially exploited aquatic species in trade come from an untargeted or incidental species mortality where the driver of fishing is food security not trade and a fishery is making an effort to "encourage full use of dead sharks", as is recommended as part of FAO's IPOA-Sharks; and
8. How to offer CITES protection to commercially exploited aquatic species in the wild while not impacting trade of hatchery-reared specimens of the same species.

[1] These comments are sourced from various conversations across Expert Panel Members and do not reflect a consensus position across all participants. Further comment can be found in correspondence from Expert Panel Chair — see Appendix F.

2.3.1. The general evolution of CITES Parties proposing commercially exploited aquatic species under CITES Annex 2a (criteria for the inclusion of species in Appendix II) in accordance with Article II, paragraph 2a (A) of the listing criteria to now include Article II, paragraph 2a (B).

20. Whereas for CITES CoP 15 two out of five commercially exploited aquatic species proposals were made under Article II, paragraph 2a (A), and another two and four proposals in CoP 16 and CoP17, respectively, Parties to CITES in the last two CITES CoPs have made all proposals using Article II, paragraph 2a (B). As a reminder, the wording of the two are:

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.

21. Annex 2a implicitly recognizes that there may be a need to regulate international trade in a species which, although not currently declining, is at a level close to that at which it would become eligible for inclusion in Appendix I (paragraph A) or at which its "survival might be threatened by continued harvesting or other influences" (paragraph B). These two concerns are well addressed by the Annex 5 fishery footnote for commercially exploited aquatic species in the following paragraph:

22. "Even if a population is not declining appreciably, it could be considered for listing in Appendix II if it is near the extent-of-decline guidelines recommended above for consideration for Appendix-I-listing. A range of between 5 percent and 10 percent above the relevant extent-of-decline might be considered as a definition of 'near', taking due account of the productivity of the species."

23. There are a range of reasons why the listing proposal target makes a difference to deliberations; most notably, there is a difference across the delegations and observers as to the meaning of Article II, paragraph 2 (a)B. FAO recalls that for commercially exploited aquatic species, application of paragraph B requires demonstration of either a reduction that will lead to the species reaching the Appendix I extent-of-decline guidelines within approximately a 10-year period, or that the species falls within the "buffer zone" extent-of decline (abundance) guidelines for Appendix II. The report of the second FAO Expert Panel Report (FAO, 2007) explains this clearly.

2.3.2. CITES Party proposals including species where the status of various stocks of the commercially exploited aquatic species differs with regard to qualification against the criteria for listing amendment.

24. As CITES makes Appendix amendments by species, while fisheries managers generally manage by populations or stocks, there is a recognized mismatch in focus. This mismatch is highlighted when a proposal is targeting a species where only a small proportion of the species populations meets the CITES criteria, and listing of the species in Appendix II would need to take account of the interest of the "species as a whole". Where this does occur, the proponents should look to be transparent in their approach as much as possible to assist the analysis of available information.

2.3.3. CITES Parties proposing a broad diversity of differing commercially exploited aquatic species in a single proposal.

25. Fisheries management and conservation interventions rarely approach decisions at a high taxonomic level. In most cases, management and conservation measures for fisheries are focused by place (ecosystem), fishing method and/or target species for the reason of delivering targeted and effective outcomes for sustainable use and conservation.

26. Where commercially exploited aquatic species are grouped within a single CITES proposals, proponents should only attempt to group species of similar importance to fisheries and trade, productivity and appearance (related to look-alike provisions). This allows proposal assessments and reviews to more easily make a single determination for a proposal and not be required to make a single decision that is not in the best interest of all species in the proposal, or recommend separate and differing outcomes for individual species within a multi-species submission.

27. Broad scoped proposals requiring a decision at the level of a higher order taxa will require some level of "triaging" in review, noting the time available for collation and analyses of the scientific data and technical information needed to make a determination relevant to the risk to the species and the trade control mechanism offered by a potential CITES listing. This is especially true for species with multiple spatially distributed fish stocks, where each can often be found at varying status.

28. Larger groupings of species with multiple contrasting attributes result in less in-depth analyses (it is a breadth versus depth issue for a time bound process). It is not possible to look through data and information on species, variance across stocks of a species, variance in data (methodology used for assessment, temporal and spatial anomalies in comparisons of resulting data) for each level in the analysis. Failing to deliver such a view for each species because there are too many and too much diversity across species in a single proposal is a failing of process that negatively impacts the ability of decision-makers to make informed decisions.

29. The complexity of describing varying status in multiple stocks for a single species requires a multifactorial approach to assessing data and information against CITES listing criteria. When multiples of species × stocks × variability in available data and information are added to a single proposal, linked to questions of multiple "look-alikes", then the time sensitive listing amendment review process is stretched too thin. If we are to have orderly decision-making to ensure we are making informed listing amendments, proponents who have a three-year inter CoP period to prepare proposals need to better recognize that short period for review of proposals. In practice, there is less than 150 days for the review process – review panels need time to be convened, need time to collate and analyse data and report, and Parties need time to assimilate results of reviews and establish their own interministerial processes for decision-making that affects a broad range of stakeholders in their countries.

2.3.4. The quality of scientific data and technical information presented to support listing amendment consideration in species amendment proposals

30. The six CITES proposals were typically not a clear reflection of the best available data and information. The Expert Panel noted that the quality of evidence provided in proposals (scientific data and technical information) could be markedly improved. Generally, many of the proposals would have benefited from a greater focus on presenting evidence that is related to the CITES criteria as articulated in Resolution Conf. 9.24 (Rev. CoP17), as well as the inclusion of the best available information, rather than the selective inclusion of more general arguments as to why the CITES criteria had been met.

31. 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. Participants of this Expert Panel found comments from previous panels were still applicable to a number of proposals.

32. Expert review is further complicated by the release of species arguments less than 150 days from voting at the CITES CoP, after proponents have had around 2+ years to prepare the proposal. The Expert Panel should not be required to spend a great deal of time rewriting arguments from those made in the proposals or conducting basic background research. Their task is expert review of information in proposals. Experts invited on the Panel, who volunteer their time, are faced with high workloads and stress in re-collating and assessing data and information. This short period available for proposal reviews (experts work over five days to fulfil the Panel Terms of Reference) is thus further rushed if further background researches is required.

33. Improvement in the data and information in proposals would greatly increase the ability of the Expert Panel to add value to proposals, which should add to the confidence of the decisions made by the CoP. It would also deliver downstream benefits for those involved in any implementation of decisions reached at the CoP. The situation outlined above could be ameliorated if FAO and CITES arranged for earlier expert intervention in the proposal writing stage (before proposals were lodged), and/or the period for scientific and technical reflection was adjusted to enable an orderly and proper, in-depth, scientific and technical review.

34. Most of the proposals relied, to some extent, on sources that are unpublished or difficult to access. The assessment of proposals would be easier if proponents provided access to copies of all source documents (in PDF format or similar) along with references within their listing proposals.

35. The Expert Panel gratefully acknowledges those proponents who provided copies of source materials during the meeting

2.3.5. CITES Party proposals using non-CITES relevant assessments (based on different criteria) as support for listing amendment of commercially exploited aquatic species.

36. Referencing Red List assessments of the International Union for Conservation of Nature (IUCN) in support statements for CITES aquatic species amendment proposals was common practice in CoP19 aquatic species proposals, and brings with it a number of complications. In many instances, support for generalized statements of historical extent of declines or recent rates of decline in the proposal references Red List assessments as evidence of that change in status. In many cases, this approach ignored well-established understanding of differences that exist in the theoretical and practical framework underlying Red List assessments versus fisheries assessments (ICES, 2018; FAO, 2020) (Figure 1).

37. CITES criteria for Appendix I and II (CITES Resolution Conf. 9.24 [Rev. CoP17]), describes specific measures and thresholds of decline that do not align to either Red List characterization of extinction risk (incl. threatened versus not threatened), or fisheries thresholds for sustainable utilization (e.g. maximum sustainable yield). A subset of how the intent and process approaches of Red List, fisheries and CITES approaches and criteria are mismatched are summarized as follows:

- Differences of community of practice;
- Differences in units of assessment;
- Timing and regularity of assessments;
- Use of rate versus absolute number in assessment of declines; and
- Awareness and communication.

38. These differences largely stem from each approach servicing overlapping but differing missions. The overlaps largely relate to each approach having a mission of promoting biodiversity conservation or mainstreaming of biodiversity across sectors that impact biodiversity. Whereas Red List assessments are in place to track and alert the community to possible danger of risk of extinction, fisheries assessments are in place and linked to more binding measures that relate to sustainability of food supply and livelihoods, while CITES measures also link to binding governance frameworks that require controls to be put in place on movements of species and commodities across international borders.

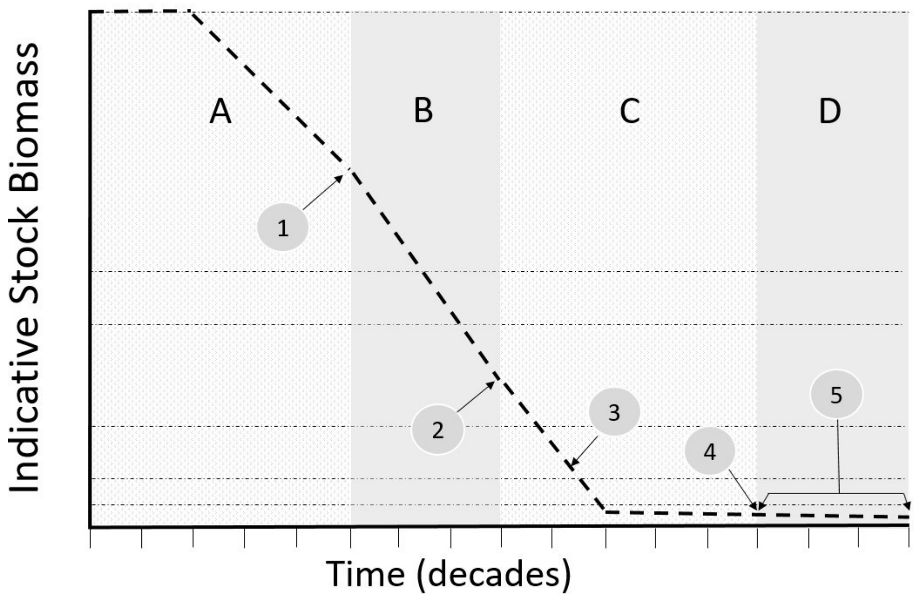
39. The Expert Panel noted that all species proposals depended heavily on IUCN Red List assessments as support for arguments to present trends and application of the decline criterion. This was especially the case for the requiem shark proposal (Family: Carcharhinidae), the proposal for guitarfishes (Family: Rhinobatidae) and for *Thelenota* sea cucumbers. The more generalized risk characterization of Red List categorization needs a lower level of supporting information than assessments used to set fishery thresholds and allocations, or whether a species meets or does not meet CITES criteria. The types of information accepted for use in Red List assessments (estimation, inference, projection and suspicion) can also be valuable in informing fishery and CITES assessments, but the latter two largely require a higher level of confidence due to the legally binding implications of their assessments (typically quantitative data or information that indicate threshold transgressions and drive decisions). As mentioned earlier, to meet the CITES's listing criteria as articulated in CITES Resolution Conf. 9.24 (Rev. CoP17), including use of the "Fisheries Footnote" in Annex 5, arguments need to present compelling evidence to support governance changes. This is needed, as the advice given is not

just a flag to highlight need for attention, but will likely result in impact to a broad number of dependent communities, some of which are wholly reliant on use of such species for their food security and source of income. As such, a numeric and quantifiable understanding of population decline over time is preferred to estimation, inference, and suspicion.

40. IUCN assessments are excellent starting points to understand which species are vulnerable and in guiding governments, academics and civil society to take notice and increase investment in gaining a better understanding of the changing status of those species (through more nuanced data collection, population trend analysis and more in-depth appraisal). The IUCN Red List classifications are intended to, and provide, an excellent warning signal for which taxa may be deemed vulnerable and in need of more specific population status and threats assessments.

41. A good example of the congruence, complementarities and differences between IUCN Red List, fishery and CITES criteria assessments can be seen in Figure 1.

Figure 1. Conceptual graph for a declining fish population where the species had a generation length of five years.



This shows alignment (and misalignment) between IUCN Red List extinction risk characterizations, with assessments of fishery stock status and CITES listing amendment criteria. The graph shows a hypothetical decline of a fish population's biomass in response to fishing and over-fishing (dotted line), with vertical Panels (A–D) and Points (1–5) added to help explain to the reader complementarities and differences across the three types of descriptions (Red List, Fisheries, CITES).

In Panel A, there is congruence across assessments as the IUCN Red List thresholds categorize the fish as not threatened, fisheries assessments define the species as not-overfished (B>BMSY), and CITES criteria are not met.

Arriving at Panel B (Point 1), a "mismatch" might occur as IUCN Red List can assess the species as 'threatened' due to a decline of 30 percent within the ascribed rules, while fisheries continue to fish within their maximum sustainable yield (MSY) thresholds and CITES criteria are not met. In Panel B, differential assessments continue until stock declines reach Point 2 and enter Panel C.

In Panel C, the stock biomass falls below the fisheries threshold (B<BMSY) and fisheries managers are no longer unconcerned. They join the IUCN Red List in being concerned, but CITES criteria are yet to be breached and only meet or exceed the CITES criteria at and after Point 3 (fish stock biomass falls to below 5–20 percent of baseline, depending on inherent productivity of the species).

On reaching Point 4 and Panel D, another "miss" could occur. In Panel D fisheries continue to consider the fish stock overfished (potentially depleted or collapsed); CITES criteria are still met, but IUCN Red List assessments may revert to characterize the fish as not "threatened" (Least Concern) when the ascribed rules relating to the inherent productivity of the species are taken into account (all of Panel D, Point 5).

42. It is important to note that the IUCN classifications were designed for nature conservation and are usually more precautionary in their approach to classifying risk. IUCN brings together experts from different regions, fills data gaps and assesses the species for which assessments are to cover, and these assessments regularly cover a wide range of species (e.g. 1100+ sharks and rays). As an example, the IUCN Red List assessed 1100+ sharks and ray species assessments over 17 long weekends – approximately 60 days (The Revelator, 2022). In this case it means that during active assessment times, 20 species were assessed each day, giving an understanding of the limited amount of time assessments could potentially have to cover pertinent issues. It should be noted that such an averaging of time period does not account for instances where the IUCN identifies species as data deficient, a decision which could be reached quickly and offer important understanding of species in need of more attention. IUCN also includes species not dealt with by fisheries authorities, RFMOs, or for which other multilateral conservation agreements such as the Convention on the Conservation of Migratory Species of Wild Animals (CMS) has any mandate, so they offer a special value in this arena.

43. Although the IUCN, fisheries and CITES communities have a common goal of helping/informing species conservation against impacting factors (including trade and extinction), the processes and criteria of listing species within each framework is different, and the threshold of the criteria also differs markedly. Additionally, awareness-raising and communication around Red List assessments often highlight stories of potential extinction to encourage further investment in conservation, while fisheries and CITES can leverage their messaging to service sustainable and orderly use and trade of fish stocks, and support for the livelihoods of people that depend on them. Thus, each of the assessments may help each other, but cannot fully be used as a substitution for the other.

2.3.6. CITES Party proposals presenting "catch all" look-alike lists that outnumber the species proposed for listing and that take no account of practicality, costs and socioeconomic impact of implementing the listing and look-alike controls.

44. Proposal 37 for CoP19 proposes 19 species for CITES Appendix II and to place a further number of species under CITES Appendix II provisions (over double the number are argued to qualify for CITES Appendix II under look-alike provisions). Additionally, the species suggested as "look-alikes" are significantly more important to international trade than all the trade of aquatic species requested to be listed (in terms of abundance or value).

45. In listing decisions, CITES does not much take into account socioeconomic factors. This is despite the second last preambular paragraph of CITES Resolution Conf. 9.24 (Rev. CoP17), stating:

> *PP14: NOTING the objective to ensure that decisions to amend the Convention's Appendices are founded on sound and relevant scientific information, take into account socioeconomic factors, and meet agreed biological and trade criteria for such amendments.* [underline added by report authors].

46. This one mention of socioeconomic factors in the foundational document of CITES opens the door to consideration of socioeconomic factors in assessing the likely merits of a listing, and its likelihood of causing socioeconomic disruption if and when a species is listed, or, when incorporating marginal look-alike species that are likely to cause large socioeconomic disruption (also see CITES CoP 19 Doc. 87.1 in CITES, 2022d).

47. CITES Parties would well take notice that suggestions to list large "catch all" lists of look-alike species of marginal merit are likely not going to deliver conservation outcomes that are needed and may cause large socioeconomic disruption further eroding the general trust in the CITES process, especially if that socioeconomic disruption is for a species of good status that do not meet CITES criteria.

2.3.7. Challenges when commodities from a commercially exploited aquatic species in trade comes from an untargeted or incidental species mortality where the driver in fishing is food security not trade and a fishery is making an effort to "encourage full use of dead sharks", as is recommended as part of FAO IPOA-Sharks.

48. This section discusses the use of CITES where sharks are primarily used by small-scale inshore coastal fishers for domestic consumption. Where shark commodities are only secondarily used for the international trade, and comprise only a small proportion of that trade, it is mostly unclear as to whether the fin trade would be a significant driver in exploitation.

49. If market data indicate that the fins or other commodities (e.g. meat, cartilage, skin, oil) were not an important part of international trade, use of such elasmobranch commodities in these instances could well be viewed in the context of efforts to "encourage full use of dead sharks", as per any national shark plans (FAO, 1999).

50. In such cases, the death rate of sharks from fishing is unlikely to be reduced by CITES provisions, and local, national or regional fisheries management measures are required to regulate fishing pressure and improve stock conservation.

2.3.8. How to offer CITES protection to commercially exploited aquatic species in the wild while not impacting trade of hatchery-reared specimens of the same species.

51. Trade in hatchery bred and captive reared specimens of CITES Appendix II listed species is allowed. CITES listings present requirements that are different for plants and animals and vary based on Appendix.

52. Aquaculture of aquatic animals can be an effective manner to reduce the demand for wild specimens. However, a CITES listing can also have a negative impact on the trade in aquacultured specimens. For Appendix I, listed species, breeders must be registered, and specimens must have identifying marks or tags. While these requirements are technically feasible for some larger species of aquatic animals, they are not possible for many small aquatic species. In addition, validation of the origin of broodstock for species in trade, especially those collected before CITES restrictions began, can be a challenge for producers to attain. Some importing countries do not allow commercial trade in Appendix I or Appendix II listed species. If the goal is to reduce demand for wild species through aquaculture, then an Appendix I listing especially would reduce that likelihood.

53. Because of the interpretations of "captive bred" and because the Appendix II listing poses a higher regulatory burden for aquaculture producers, any listing amendment for species taken both from the wild and traded from hatchery production needs to be considered carefully in the context of where the market sourced its products.

54. What is known from previous experience with other species that are taken both in the wild and bred in aquaculture facilities is that listing of these species in CITES has caused trade of hatchery-reared individuals to be temporarily halted or stopped altogether (e.g. seahorses and corals). In general, delays in achieving the process steps to comply with CITES provisions and extra compliance in transit of live product can delay both trade and shipments. Additionally some countries have legislation that makes trade of species listed on CITES Appendices illegal, irrespective of the Appendix they are listed on.

55. Where hatchery breeding of a species is active and delivers preferred product to international markets (e.g. due to health of fish, colour patterns or proximity of breeding facilities to market buyers), this production can replace most of the need for wild caught supply. Consideration will still need to be given for hatchery periodically needs for new broodstock from the wild.

56. However, any decrease in hatchery access to markets due to CITES barriers (hatchery production but also movement of products in transit) could end up decreasing hatchery production that could have a "backfire" impact by increasing illegal trade in wild caught specimens. Any decline of trade in aquacultured fish might have unintended negative consequences on wild stocks should illegal fishing of wild populations be increased to fill the market gap left by delays or declines in aquaculture production. Additionally, illegal undocumented trade may also increase for both wild caught and captive bred fish.

57. Should there be a CITES proposal for Appendix listing of species taken both from the wild and traded from aquaculture facilities, consideration of such backfires and needed support to continue operation of aquaculture facilities may be needed, to continue to catalyse any transition of the market away from commercialization of capture of vulnerable species in the wild.

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT: COP19 PROPOSAL 37
Nineteen species in the family Carcharhinidae and all other Requiem shark nei

Species

Blacknose shark (*Carcharhinus acronotus*)	Sandbar shark (*Carcharhinus plumbeus*)
Grey reef shark (*Carcharhinus amblyrhynchos*)	Smalltail shark (*Carcharhinus porosus*)
Borneo shark (*Carcharhinus borneensis*)	Night shark (*Carcharhinus signatus*)
Pacific smalltail shark (*Carcharhinus cerdale*)	Ganges shark (*Glyphis gangeticus*)
Whitecheek shark (*Carcharhinus dussumieri*)	Daggernose shark (*Isogomphodon oxyrhynchus*)
Pondicherry shark (*Carcharhinus hemiodon*)	Broadfin shark (*Lamiopsis temmincki*)
Smoothtooth blacktip shark (*Carcharhinus leiodon*)	Borneo broadfin shark (*Lamiopsis tephrodes*)
Dusky shark (*Carcharhinus obscurus*)	Whitenose shark (*Nasolamia velox*)
Lost shark (*Carcharhinus obsoletus*)	Sharptooth lemon shark (*Negaprion acutidens*)
Caribbean reef shark (*Carcharhinus perezi*)	

Proposal

To include blacknose shark (*Carcharhinus acronotus*); grey reef shark (*C. amblyrhynchos*); borneo shark (*C. borneensis*); pacific smalltail shark (*C. cerdale*); whitecheek shark (*C. dussumieri*); pondicherry shark (*C. hemiodon*); smoothtooth blacktip shark (*C. leiodon*); dusky shark (*C. obscurus*); lost shark (*C. obsoletus*); caribbean reef shark (*C. perezi*); sandbar shark (*C. plumbeus*); smalltail shark (*C. porosus*); Night shark (*C. signatus*); ganges shark (*Glyphis gangeticus*); daggernose shark (*Isogomphodon oxyrhynchus*); broadfin shark (*Lamiopsis temmincki*); borneo broadfin shark (*L. tephrodes*); whitenose shark (*Nasolamia velox*) and sharptooth lemon shark (*Negaprion acutidens*) in Appendix II in accordance with Article II paragraph 2(a) and all other species in the family Carcharhinidae: genus *Carcharhinus*, genus *Isogomphodon*, genus *Loxodon*, genus *Nasolamia*, genus *Lamiopsis*, genus *Negaprion*, genus *Prionace*, genus *Rhizoprionodon*, genus *Scoliodon*, genus *Triaenodon* and any other putative species of family Carcharhinidae, in Appendix II in accordance with Article II paragraph 2(b).

Assessment summary

This proposal included 19 species (effectively 19 sub-proposals). The Expert Panel found that for 9 of the 19 species there was no evidence of international trade and therefore these species were considered not to have met the CITES criteria for "affected by trade" (Article II 1 and 2 of the CITES Convention). These nine species were excluded from further review by the Expert Panel. The Expert Panel reviewed the remaining species and found that three species met the criteria for CITES listing, three did not, and data and information were insufficient for another four to allow evaluation. These four were evaluated as "unknown" in terms of the CITES criteria.

The Expert Panel also reviewed the list of look-alike species included in the proposal. The proposal failed to mention that the family Carcharhinidae have a range of distinctly different sizes and morphological appearances, which means many of the proposed species can be readily differentiated from each other when in trade. The Panel also noted the proposed list of "look-alikes" was more extensive than the species proposed (35 "look-alikes" to 19 proposed species), and if accepted will impact international trade to a greater degree than the species for which listing is proposed. Thus, any listing of this list of 35 species would have substantial socioeconomic, surveillance, enforcement and prosecution implications far in excess of those proposed for listing.

The proposal to list all 19 shark species in the family Carcharhinidae in Appendix II of CITES does not meet the CITES criteria as a single proposal. The Expert Panel recommended the consideration of separate proposals for the species assessed by the Panel to meet the CITES Appendix II listing criteria.

SPECIES	MEETS CITES CRITERIA	DOES NOT MEET CITES CRITERIA	OTHER
Grey reef shark *Carcharhinus amblyrhynchos*	✓		
Smalltail shark *Carcharhinus porosus*	✓		
Ganges shark *Glyphis gangeticus*	✓		
Whitecheek shark *Carcharhinus dussumieri*		✓	
Dusky shark *Carcharhinus obscurus*		✓	
Sandbar shark *Carcharhinus plumbeus*		✓	
Borneo shark *Carcharhinus borneensis*		✓*	
Pacific smalltail shark *Carcharhinus cerdale*		✓*	
Pondicherry shark *Carcharhinus hemiodon*		✓*	
Lost shark *Carcharhinus obsoletus*		✓*	
Caribbean reef shark *Carcharhinus perezi*		✓*	
Night shark *Carcharhinus signatus*		✓*	
Daggernose shark *Isogomphodon oxyrhynchus*		✓*	
Borneo broadfin shark *Lamiopsis tephrodes*		✓*	
Whitenose shark *Nasolamia velox*		✓*	
Blacknose shark *Carcharhinus acronotus*			Unknown**
Smoothtooth blacktip shark *Carcharhinus leiodon*			Unknown**
Broadfin shark *Lamiopsis temmincki*			Unknown**
Sharptooth lemon shark *Negaprion acutidens*			Unknown**

*Species considered not to have met the CITES criteria for “affected by trade” (Article II 1 and 2 of the CITES Convention).

**Insufficient data to make an assessment.

Summary of evaluation and assessment of biological listing criteria

In the summaries below, the Expert Panel assessed proposals from a scientific perspective in accordance with the biology-related CITES listing criteria, taking account of the recommendations on the criteria made to CITES by FAO. As such, declines take into account historical extent and recent rate of declines in combination. They also include a precautionary "buffer" where population declines fall 'near' extent of decline thresholds described in CITES Resolution Conf. 9.24 (Rev. CoP17) guidelines (paragraph 5 of Annex 5 footnote relevant to marine species). Some comments 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 are also provided.

Three species that were considered to meet criteria for CITES Appendix II

Three species that were considered to meet CITES biological criteria and "affected by trade" (Article II 1 and 2 of the CITES Convention) criteria:

- **Grey reef shark (*C. amblyrhynchos*):** owing to the observed reduction in the range and habitat of the species as well as sufficient signs of decrease in abundance, the Expert Panel determined that the species met the criteria for a CITES Appendix II listing.
- **Smalltail shark (*C. porosus*):** owing to the clear indication of substantial population decline from demographic analysis, as well as the anecdotal catch information indicating large decreases in catches over time, the Expert Panel determined that the species met the criteria for a CITES Appendix II listing.
- **Ganges shark (*G. gangeticus*):** owing to the very few recent sightings of the species and limited range (history of intense fishing as well as anthropogenic habitat degradation), the Expert Panel considered the depletion of the species (although not quantifiable) met the criteria for a CITES Appendix II listing.

Twelve species that were considered to not meet criteria for CITES Appendix II

Three species that were considered to not meet CITES biological criteria:

- **Whitecheek shark (*C. dussumieri*):** owing to its continued abundance in catches and anecdotal evidence only of declines in a part of its distribution, the Expert Panel determined that the species did not meet the criteria for a CITES listing.
- **Dusky shark (*C. obscurus*):** declines to the buffer were apparent in two areas (Northeast United States of America and Western Australia) of the species distribution, but information for a more recent period provided evidence that a decreasing trend in those regions was no longer apparent. Information from other regions did not show evidence of decline to the buffer. Therefore, the Expert Panel determined that, overall, the species did not meet the criteria for a CITES listing.
- **Sandbar shark (*C. plumbeus*):** declines to the buffer were apparent in one area (Atlantic Ocean, United States of America) of the species distribution, but information for a more recent period suggests recovery in that region. Information from other regions does not show clear evidence of decline to the buffer zone. Therefore, the Expert Panel determined that the species did not meet the criteria for a CITES listing.

Nine species considered not to have met the CITES criteria for "affected by trade" (Article II 1 and 2 of the CITES Convention) and were excluded from further consideration by the Expert Panel.

- For seven species, no verifiable information on international trade was available in the proposal: **borneo shark (*C. borneensis*)**; **pondicherry shark (*C. hemiodon*)**; **lost shark (*C. obsoletus*)**; **caribbean reef shark (*C. perezi*)**; **night shark (*C. signatus*)**; **daggernose shark (*Isogomphodon oxyrhynchus*)**; **borneo broadfin shark (*Lamiopsis tephrodes*)**.
- For a further two species, a statement on trade was included in the proposal; however, the Panel could find no evidence of the species entering international trade: pacific **smalltail shark (*C. cerdale*)** and **whitenose shark (*Nasolamia velox*)**.

Four species with insufficient information to make a determination

Four species for which scientific data and technical information provided or otherwise reviewed by the Expert Panel was insufficient to make a determination:

- **Blacknose shark (*C. acronotus*):** owing to the lack of sufficient quantifiable overall population trend information, the Expert Panel determined that relative to the CITES listing criteria the species status was unknown.
- **Smoothtooth blacktip Shark (*C. leiodon*):** the Panel noted that no species specific information is available for this species and therefore an evaluation relative to the CITES listing criteria is not possible. Therefore, its status is unknown.
- **Broadfin shark (*L. temmincki*):** owing to the lack of quantifiable overall population trend information, the Panel determined that relative to the CITES listing criteria the species status was unknown.
- **Sharptooth lemon shark (*Negaprion acutidens*):** owing to the lack of quantifiable overall population trend information, the Panel determined that relative to the CITES listing criteria the species status was unknown.

The Expert Panel found that assessing the Carcharhinidae as a family within the Proposal was difficult due to the heterogeneous nature of the species. This is further complicated when considering look-alike species. It would be more appropriate for the different species in Proposal 37 to be presented as separate proposals.

Approach of the FAO Expert Panel when considering the proposal

The proposal includes 54 shark species. The proponents state that 19 species meet the conditions in Annex 2a, criteria A and B of Resolution 9.24. Another 35–40 species in the family Carcharhinidae [Eschmeyer's Catalog of Fishes considers that there are 59 species in the family Carcharhinidae (Fricke, *et al*., 2022)] are included in the proposal because the proponents state they are "look-alikes" to the 19 shark species (Annex 2b, criteria A of Resolution 9.24). The FAO Expert Panel adopted the following steps as its approach to considering these shark species in Proposal 37.

Considering the broad scope of the proposal and the importance of making a decision at the level of a higher order taxa, the Expert Panel "triaged" the review of the available scientific and technical information to take account of proportionate risk to the species and the trade control mechanism offered by a potential CITES listing. As such, prioritization of effort resulted in:

(i) Of the first 19 shark species, only 12 for which international trade records were noted in the proposal were selected for further review (Proposal 37, Table 3). As CITES has jurisdiction over international trade, consideration of those species potentially "affected by trade" (CITES Resolution Conf. 9.24 (Rev. CoP17), Annex 5) and species for which there is no information on international trade were not considered further by the Expert Panel.

(ii) The Expert Panel examined scientific data and technical information (resource abundance, trends, productivity, etc.) for these 12 species alongside trade records, together with the reasons given in the proposal for their proposal inclusion in Appendix II. For these 12 species, the Expert Panel reviewed the rationale provided in the proposals for their listing amendment (mainly IUCN Red List information), and as much of any additional information that could be sourced in the time period available to the Expert Panel (18–22 July 2022).

(iii) Early in the review, two of the twelve species for which trade was mentioned in Proposal 37 were further reviewed by the Expert Panel, who could not find these two species in the original source documentation that was referenced. As the Panel found no further evidence of the species entering international trade, these two species were also considered not to have been "affected by trade" (CITES Resolution Conf. 9.24 (Rev. CoP17), Annex 5); this reduced the species review list from 12 to 10 species.

(iv) For the species that were included in the proposal based on CITES look-alike provisions (n = 35), stock status was not considered when assessing if the proposal met the CITES criteria. Therefore, the Expert Panel reviewed these species only for similarity to the 10 species in the form in which they are traded and whether they are distinguishable.

(v) Based on the above steps, the Expert Panel identified which species met the CITES listing criteria, and also commented on the likely conservation effectiveness of a CITES Appendix II listing for conservation.

(vi) In addition, the Expert Panel discussed measures that could be effective for the conservation of the full complement of the species proposed for listing, including enhanced management of small-scale fisheries in coastal areas.

The Expert Panel considered this approach a logical and efficient use of the limited information provided, considering the need for the Expert Panel to review and assess information provided and novel scientific data and technical information sourced within the time-limitations of the Expert Panel sitting.

Scientific assessment in accordance with CITES biological listing criteria

Species distribution

The grey reef shark (*C. amblyrhynchos*), a coastal shark that is found in coral reef habitats (Simpfendorfer *et al*., 2020), is widespread in the tropical Indo-West and Central Pacific Oceans and also occurs in some parts of the Eastern Tropical Pacific Ocean (Figure 2).

The smalltail shark (*C. porosus*) is a small shark that inhabits muddy inshore areas and estuaries (Pollom *et al*., 2020). Historically, it occurs in the Western Central and Southwest Atlantic Oceans from the central, western and southern Gulf of Mexico and along the Caribbean coast of Central and South America to the state of Paraná in southern Brazil, not including the Caribbean Islands (Figure 3).

The ganges shark (*G. gangeticus*), a medium-sized shark, has a patchy distribution across the Indo-West Pacific, from Pakistan to Borneo. It is difficult to ascertain its historical distribution (Rigby *et al*., 2021a) (Figure 4).

The whitecheek shark (*C. dussumieri*) is widespread along the north coast of the Arabian Sea and the Arabian/Persian Gulf in the Western and Eastern Indian Ocean. It is more patchily distributed along the southwest coast of India but has been recorded from the northern coast of Sri Lanka (Gulf of Mannar) and the east coast of India (Tamil Nadu State to Pondicherry where it was first described). It is a small species of the carcharhinid shark that is common in inshore waters over soft substrates (Simpfendorfer *et al*., 2019) (Figure 5).

The dusky shark (*C. obscurus*) has a cosmopolitan but patchy distribution in tropical and warm temperate seas. It is coastal and pelagic throughout its range, where it occurs from the surf zone to well offshore (Rigby *et al*., 2019) (Figure 6).

The sandbar shark (*C. plumbeus*) has a circumglobal distribution. The shark is demersal and pelagic in tropical and temperate seas on the continental shelf (Rigby *et al*., 2021b) (Figure 7).

The blacknose shark (*C. acronotus*) occurs in the Western Central and Southwest Atlantic Oceans ranging from North Carolina (United States of America) to southern Brazil, including the Gulf of Mexico and Caribbean Sea. It is demersal on continental and insular shelves, over sand, shell and coral, at depths of 18–64 m (Carlson, *et al*., 2021) (Figure 8).

The smoothtooth blacktip shark (*C. leiodon*) is endemic to the Arabian Seas region, occurring in the northern Indian Ocean, including the Gulf (Bahrain, Kuwait and the United Arab Emirates), Sea of Oman and Arabian Sea (Oman and Yemen). It is believed to occur in inshore waters; limited information is available on this species because of the low number of specimens recorded (Simpfendorfer *et al*., 2017) (Figure 9).

The broadfin shark (*L. temmincki*) occurs in the northern Indian Ocean where it ranges from Pakistan to Thailand. The easternmost distribution boundary is uncertain; there are two records of the broadfin shark from extensive landings surveys at Tanjung Luar (East Lombok), Indonesia. It is found inshore on the continental shelf (Dulvy *et al*., 2021) (Figure 10).

The sharptooth lemon shark (*N. acutidens*) is widespread in coastal waters of the tropical and subtropical Indian and Northwest and Western Central Pacific Oceans (Simpfendorfer *et al*., 2021) (Figure 11).

Species productivity

Productivity for the species reviewed by the Expert Panel was assessed based on the available life history parameters. The Expert Panel assessed productivity is summarized in Table 1. For each species, natural mortality (M), individual growth coefficient (k), population intrinsic growth rate (r), age at maturity (tmat), maximum age (tmax) and population generation time (G) were considered (Table 2). The panel agreed to use M as the primary parameter for determining productivity, using the other variables as supporting information. For whitecheek shark (*C. dussumieri*) and smoothtooth blacktip shark (*C. leiodon*), insufficient biological information was available, so values were obtained from closely related species.

Population numbers

Due to the data-limited nature of most of these species, comprehensive population estimates were not available throughout their known ranges. For the ganges shark (*G. gangeticus*), the IUCN assessment (Rigby *et al*., 2021a) noted that "In addition, given the rarity of contemporary records, it is estimated that the number of mature individuals of the ganges shark is very small (<250) with small numbers (<50) of mature adults in each subpopulation". The Expert Panel were, however, unable to determine how these estimates were made or confidence bounds (potential variance/error) in their number, as the assessment did not provide this information.

Trends and application of the decline criterion

The Expert Panel wished to review and classify the quality of the data considered in the proposal and the IUCN assessments for all the species in the proposal. However, for a large number of the species, the proposal listed multiple sources of data not immediately available to the Expert Panel and/or challenging to evaluate. Diverse sources included qualitative descriptions of potential trends, IUCN assessments and stock assessments (e.g. from National Marine Fisheries Service [NMFS], Southeast Data, Assessment and Review [SEDAR] update assessment). The Expert Panel did not have sufficient time to conduct a thorough review and classification of these data during the limited period available for their meeting, and thus prioritized their evaluations. In consequence, broadly speaking, the Panel accepted the judgements, and evaluation of data quality, made implicitly by the IUCN assessments. In a few instances where aspects of data quality were key to the Panel's final evaluation of a proposal, this is mentioned in the comments for the species in question.

*Grey reef shark (*Carcharhinus amblyrhynchos*)*

This reef associated species was reported to have a projected range reduction of 59.2 percent over 43.5 years, which is three generations (Simpfendorfer *et al.*, 2020). In this IUCN assessment, they assume a reference date of 2018 (when underwater baited video samples were collected), suggesting a start of the period for assessed reduction of the species as being 1974. The declines indicated have mostly occurred close to human habitation. Furthermore, 8 of 40 countries in the historical range of the species have failed to detect it over recent years, and sightings are rare in over half of the remaining countries. On balance, therefore, despite the mitigating aspect of recoveries being evident in some parts of the range, depletion to the buffer of 30 percent (20 percent plus 10 percent for a low productivity species) is indicated. Accordingly, the Expert Panel determined that the species met the criteria for inclusion in CITES Appendix II.

*Smalltail shark (*Carcharhinus porosus*)*

Evidence of decline because of overfishing is clear in Northern Brazil, based on catch rates (catch rate during demersal trawls declined from 2.87 kg/h in 1990 to 0.43 kg/h in the 2000s) and the demographic analysis of Santana, Feitosa and Lessa (2020) (current fishing mortality, F = 0.395 and exploitation rate, E = 0.602, estimated equilibrium fishing mortality, F_{eq} = 0.032, indicating a high degree of overfishing). Throughout the rest of the range (particularly the Southern Gulf of Mexico, Bolivarian Republic of Venezuela, and Eastern and Southern Brazil), evidence is anecdotal but appears to support a population decline, although this is impossible to quantify with the available information.

*Ganges shark (*Glyphis gangeticus*)*

From Pakistan to Borneo, the Indo-West Pacific region is home to a patchy population of ganges sharks. It inhabits tropical estuarine, inshore marine and riverine (including freshwater) ecosystems, rendering it especially vulnerable to fishing pressure and human effects on its natural habitats. No independently verified references are provided, despite the proposal's assertion of a population record of 240 mature individuals with less than 50 mature adults in each subpopulation. Although the historical population number is unknown, there is a reasonable likelihood that it has been drastically reduced due to extensive, generally unregulated riverine and coastal fishing in the past and other anthropogenic threats to its environment, especially when the productivity of the species is low.

Taxonomic data, records from fishers' observations, accounts of shark attacks and records of its historical existence in India's Hooghly estuary are all clear evidence of the species presence; however, it does not help to quantify the population. However, current data show that the species has not been detected during landing site inspections throughout many nations. For instance, there are no recent reports in Borneo, Myanmar or Pakistan; only sparse instances have been confirmed in Bangladesh and India (Jabado *et al*., 2018; Haque *et al*., 2019).

It is also important to note that there are taxonomic issues, and information depends on accurately separating this species from the similar looking euryhaline bull shark, a source of past misidentifications. The fishing, trading and other activities of this species are strictly prohibited in Bangladesh and India, although there is little species-specific enforcement. It is therefore unlikely that data or information on this species will improve. The Expert Panel nevertheless considered it appropriate to apply the decline criterion of CITES Appendix II listing to this rare and Critically Endangered shark even in the absence of quantifiable population trend data, given that fewer contemporary records and current sightings are even fewer, as well as considering the implications of restricted distribution in vulnerable habitats.

*Whitecheek shark (*Carcharhinus dussumieri*)*

The whitecheek shark is mostly found in the Western Indian Ocean, from the Gulf to the southeast coast of India. Different population trends have been noted in each part of the Gulf and the Arabian Sea. In one region, the Gulf, where the species is reported as constituting a good percentage of the shark catches in countries such as Kuwait (20–22 percent of catches), Iran (60 percent of catches) and Qatar (26 percent of catches), the Expert Panel determined it does not meet the CITES criteria for an Appendix II. In the Arabian Sea, most information is anecdotal with no quantifiable catches, but may have declined sufficiently for consideration. It would seem difficult to evaluate if the species as a whole fit the listing requirements with the current incomplete data. Viewed across its full range, the Expert Panel, determined that available data do not provide evidence that the species meets the CITES Appendix II listing criteria because of its sustained abundance in captures and anecdotal indications of decreases in parts of its distribution.

*Dusky shark (*Carcharhinus obscurus*)*

Information is available from four regions: Atlantic/Gulf of Mexico, Western Indian Ocean, Eastern Indian Ocean and Pacific Ocean. Declines have been recorded in two of the four regions (Atlantic/Gulf of Mexico, depending on the metric used, and Eastern Indian Ocean), but additional information provided indicates slow recovery in these two regions.

In the Atlantic/Gulf of Mexico, although the most recent SEDAR assessment (NMFS, 2016) estimated that the stock was overfished and overfishing was occurring in 2015, more recent information shows positive signs. Dusky shark has been designated as a prohibited species since 2000 and has only been taken as a minor bycatch component in some commercial and recreational fisheries. The species is under a rebuilding programme, and future population projections at F levels that will allow rebuilding with a 70 percent probability all indicate continued population recovery and that the stock does not meet the CITES criteria for historical extent and recent rate of declines.

In the Pacific, information would not indicate an extent of decline consistent with a CITES listing.

In South Africa, declines are noted, but recent trends indicate that the population will not fall below the CITES listing criteria in the near future.

In Australia's west coast stock, catch rates presented in the proposal indicate a decline that meets CITES criteria for a listing on Appendix II, but there is subsequent evidence that would indicate the stock is recovering. A risk-based weight of evidence approach estimated a Medium current risk level for this stock, with 46 percent, 73 percent and 100 percent of the simulated current (2015–2016) relative total biomass trajectories being above the target, threshold and limit biomass reference points, respectively (Braccini, Hesp and Molony, 2021). The current level of fishing mortality should allow the stock to recover from its recruitment impaired state. In addition, an abundance survey of the adult stock showed fluctuating albeit stable trends since 2002 (with a substantially increasing trend in the last three years, Braccini, unpublished), and standardized catch and effort series showed stable trends since 2009 (Braccini, Molony and Blay, 2020; Braccini *et al*., 2021a). In addition, current catches are <1/3 of the historic peak (~1 000 tonnes) of the 1980s (Braccini *et al*., 2021b), and a range of management measures have been adopted to reduced fishing mortality (Braccini, Hesp and Molony, 2021). On the basis of the evidence provided above, Australia's west coast stock is classified as a recovering stock (Woodhams *et al*., 2021).

For Australia's east coast stock, dusky shark catches are small (tens of tonnes per year or less). The total population size was estimated at ~35 000 individuals (Blower, 2020). Simulations at current fishing levels indicate observed fishery harvest volumes to be sustainable (Blower, 2020). The above evidence indicates that the biomass of this stock is unlikely to be depleted and recruitment is unlikely to be impaired. The evidence also indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired. On the basis of the evidence provided above, Australia's east coast stock is classified as a sustainable stock (Woodhams *et al*., 2021).

It is noted that apart from the SEDAR assessment (NMFS, 2016), the available abundance indices are relatively short. In other regions (East Atlantic and West Africa), there is anecdotal (catch) information that suggests a decline in the population abundance, but no quantifiable estimates were available.

*Sandbar shark (*Carcharhinus plumbeus*)*

Information is available from four regions: Atlantic/Gulf of Mexico, Western Indian Ocean, Eastern Indian Ocean (Australia's west coast) and Pacific Ocean. Declines have been reported in one of the four regions (Atlantic/Gulf of Mexico). In the other regions, declines would not indicate a level consistent with a CITES listing. Information from Australia's west coast catch rates indicates recovery.

In the Atlantic/Gulf of Mexico, sandbar shark has been designated as a prohibited species since 2008, with only small catches allowed under a "research fishery". The species is also in a rebuilding programme, and future population projections under a range of catch scenarios indicated population increase (NMFS, 2017) and not meeting the CITES criteria for historical or recent rate decline trends.

Catch rates in the West Indian Ocean show a decline but have been stable more recently, suggesting that the decline is not ongoing.

The Eastern Indian Ocean declined but did not meet the criteria for CITES Appendix II listing.

For Australia's east coast, catches have remained at low levels since management arrangements were introduced. Simulations at current fishing levels indicate fishery harvest to be sustainable, indicating that the stock is unlikely to be depleted and that recruitment is unlikely to be impaired (Blower, 2020; Braccini *et al*., 2021c).

For Australia's west coast, historical catches were deemed unsustainable, and considerable management measures were implemented to revert this. Since 2010, catches have remained well below the levels required to achieve a gradual recovery of the breeding stock. Latest stock assessment estimated a "Medium" current risk level for the stock, with 62 percent, 83 percent and 99 percent of the simulated current (2015–2016) relative total biomass trajectories being above the target, threshold and limit biomass reference points, respectively (Braccini, Hesp and Molony, 2021). In addition, recent indicators suggest a recovering stock. Hence, the current level of fishing mortality should allow the stock to recover from its historical recruitment impaired state (Braccini *et al*., 2021c).

Evidence in the Atlantic region noted that apart from the SEDAR assessment (NMFS, 2017), the available abundance indices are relatively short.

In other regions, there is anecdotal catch information that suggests a decline in the population abundance, but no quantifiable estimates are available. It would appear that based on the available information, throughout the species range, the decline in population does not meet the CITES criteria for an Appendix II listing.

*Blacknose shark (*Carcharhinus acronotus*)*

Information for two regions, Atlantic and Gulf of Mexico, was available from the 2011 SEDAR assessments (NMFS, 2011a, 2011b), which covered the period 1950–2009. More recent indices of abundance were shown in a publication by Peterson *et al*. (2017) and used in the IUCN assessment.

Evidence in the Atlantic region from the SEDAR assessment (NMFS, 2011a) would indicate an extent of decline that meets the CITES criteria for an appendix II listing. In addition, estimated fishing mortality at the final year (2009) was very high. However, the trawl survey catch per unit of effort (CPUE) series that extended beyond the assessment period showed an increasing trend (Peterson *et al*., 2017).

For the Atlantic region (souteastern United States of America), blacknose shark is also in a rebuilding programme following the latest stock assessment finding of the stock being overfished and overfishing occurring. The stock is subject to a total allowable catch that should allow recovery with a 70 percent probability by 2031 (NMFS, 2011a).

The evidence from the SEDAR assessment in the Gulf of Mexico (NMFS, 2011b) is inconclusive. The assessment would indicate that the decline may have pushed the species into the buffer zone, but the terminal F would indicate that fishing pressure is easing and, therefore, it could be expected that the population will move out of the buffer zone. In addition, the Gulf of Mexico assessment did not pass the external peer review, which noted large uncertainty in the assumptions (initial assumption that it started at virgin state could be erroneous, and the model could not fit catch and abundance indices simultaneously). More recent longline survey data plotted in the IUCN supplementary material show a sharp decrease since the early 2000s if the final two years of influential data are removed. If these points are included, the recent trends indicate a relatively moderate decrease.

In the Southwest Atlantic, there is evidence to indicate that the population has declined, but the data are insufficient to determine the absolute level of decline.

*Smoothtooth blacktip shark (*Carcharhinus leiodon*)*

Information available on this species is scanty, and IUCN Red List assessments of its population decline within its distribution range in the Arabian Seas region are based on declining trends of similar species in the region. (Simpfendorfer *et al*., 2017). There is no species-specific data to determine population trends for this species. The Expert Panel found that the inadequate information available on the species would not suffice to determine its suitability for listing and therefore determined that the status of the species in relation to the CITES Appendix II listing criteria was unknown.

*Broadfin shark (*Lamiopsis temmincki*)*

Data records of this species are poor and are limited to reports from Bangladesh, India and Pakistan within its distribution range from Pakistan to Thailand in the northern Indian Ocean. The IUCN Red List assessment (Dulvy *et al*., 2021) reports evidence of decline in Indian waters from estimates of 513 tonnes in 2003–2004 to 82 tonnes in 2016. However, the estimate of 513 tonnes (Raje *et al*., 2007) must be considered with caution as it may be an overestimate. Nevertheless, current catches and sightings reported are low (Dulvy *et al*., 2021), indicating decline although unquantifiable. There is only anecdotal evidence of depletion in Bangladesh and Pakistan waters with no quantifiable data (Dulvy *et al*., 2021). Reconstructed catch data at the large marine ecosystem (LME) scale pertain to carcharhinids in general, and the estimate in the proposal of a depletion of 50–70 percent should be treated with great caution as this comes mainly from LME data and range reduction (Bangladesh and Pakistan). Therefore, because of the lack of quantifiable data on overall population trend within its distribution range, the Expert Panel determined that the status of the species in relation to the CITES Appendix II listing criteria was unknown.

*Sharptooth lemon shark (*Negaprion acutidens*)*

Unfortunately, the FinPrint Project reports that this species was not seen sufficiently frequently to be able to estimate depletion quantitatively. Market surveys report reduction relative to historical levels, but without quantification. Similarly, diving surveys from the Red Sea, Saudi Arabia, the Sudan and Yemen report substantial declines over the past 30–40 years, but again without quantification. Other indications of declines come from catches: a 90 percent decline in Pakistan. There is, however, a clear difference in trends in different areas, with the situation in Australia different from other areas in the species' range in that no indications of reduction are evident there (Braccini *et al*., 2021b). However, based on catch and productivity information, it seems population abundance in the Australian region is low. Especially due to the lack of quantifiable overall population trend information, the Expert Panel determined that in relation to the CITES Appendix II listing criteria, the status of the species was unknown.

Modifying risk factors

Owing to the breadth of the proposal, which includes a large number of species with heterogenous characteristics in biology, distribution, habitats, fisheries and trade, it was not possible for the Expert Panel to consider modifying risk factors for each species in the proposal.

Comments on technical aspects relating to management, trade and likely effectiveness of implementation of a CITES listing

Owing to the diversity of species in the proposal, which includes a large number of species with heterogenous characteristics in biology, distribution, habitat, fisheries and trade, it was not possible for the Expert Panel to comment on the technical aspects relating to management, trade and likely effectiveness of implementation of CITES listing for each species.

Management comment

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

Many species in Proposal 37 are caught as bycatch, incidental catch, or in some cases targeted within coastal waters in subsistence or artisanal fisheries. Many countries' fisheries are often data limited, making management challenging.

No shark-related controls were noted at the taxonomic level of family in this management review. In most cases, management measures for fisheries are typically focused by place (ecosystem), fishing method and/or target species. Where fisheries measures are in place to conserve a species or group of species, these usually do not focus on family level due to the broad diversity of species and the spatial variance inherent in such a classification.

International/regional:

- The FAO IPOA-Sharks underscores the responsibilities of fishing and coastal states in sustaining shark populations, ensuring the full utilization of sharks that are retained and improving shark data collection and monitoring (see Appendix G, especially point 3 in FAO, 2019).
- Dusky shark is listed in Appendix II and in the Memorandum of Understanding of CMS.
- Sandbar shark is listed in Annex III "List of species whose exploitation is regulated" of the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean, of the Barcelona Convention (SPA/BD). In 2021, the General Fisheries Commission for the Mediterranean updated the recommendation related to the species listed in Annex III to the SPA/BD Protocol, as a result of which the fishing vessels catching shark species as bycatch or incidental catch will limit the bycatch of the sandbar shark to a maximum percentage of the total catch in weight by fishing trip or to no more than three specimens. Moreover, contracting parties are requested to assess the incidental and targeted catch rates of sandbar shark in all fisheries; to assess its survival rates when caught as bycatch in the different fisheries; to identify its critical habitats; to identify fishing technology solutions to reduce bycatch and increase post-release survival rates; to compile any fisheries management measures in place, including spatial measures, that can positively affect the conservation of sandbar shark, if any; and to assess priority market demand (domestic, export, etc.), if any.
- Smalltail shark is in the list of the reference species of the Data Collection Framework that the Western Central Atlantic Fishery Commission (WECAFC) encourages to report.

National measures

Nationally, management measures for the full list of species are too numerous to document here (e.g. catch and effort limits, commercial catch quotas, effort controls, recreational bag limits, minimum retention sizes, and time-area closures and spatial closures), and these can also centre around key species (e.g. dusky, sandbar, grey reef and sharptooth lemon sharks).

- A comprehensive range of management measures from catch and effort limits to spatial closures have been implemented in Australia (east and west coasts) for the sustainable management of sharks and rays, including specific management arrangements for dusky and sandbar sharks, and general arrangements applicable to grey reef and sharptooth lemon sharks (Kyne *et al.*, 2021). These management arrangements are not applicable to the remaining 15 species included in the proposal, as these species do not occur in Australia.
- A very wide array of sustainable management regulations is also in effect in the United States of America, including commercial catch quotas and effort controls, recreational bag limits, minimum retention sizes, time-area closures, designation of prohibited species, and obligation of landing shark carcasses with fins naturally attached. Of the species included in the proposal that occur in Atlantic United States of America waters, the sandbar and blacknose sharks are under a rebuilding plan, with the former only allowed to be landed under a shark research fishery, whereas the dusky, Caribbean reef, night and smalltail sharks are all prohibited species that cannot be landed.
- In India, since 2001, the Ganges shark (*Glyphis gangeticus*) and nine other species of sharks, guitarfishes and rays are protected under Schedule I of India's Wildlife (Protection) Act, 1972, whereby capture and trade in any form are punishable offences.
- Since August 2013, the removal of shark fins on board a vessel in the sea is prohibited in India through a policy advisory of the Ministry of Environment and Forests (Wildlife Division), advocating landing of the whole shark. Since 2015, export and import of shark fins in India is prohibited through a notification of the Department of Commerce of the Ministry of Commerce and Industry. These laws will apply to all species included in this proposal that are distributed in Indian waters.

- In addition to these specific measures, India has also regulated fishing practices through demarcation of marine protected areas, fixing minimum legal size for capture of common species, gear-specific mesh size regulations, restrictions on operation of certain gear such as ring seines, purse seines and pair trawling, introduction of bycatch reduction devices, and 61-day seasonal ban on mechanized fishing activities from 1 June to 31 July along the west coast and 15 April to 14 June along the east coast. These measures are generic but apply to exploited shark, ray and guitarfish resources, including those species listed in this proposal and distributed in Indian waters, since these are mostly landed as bycatch of other fisheries.

Many of the species listed in the proposal may be threatened by local, artisanal fisheries and/or as bycatch in other fisheries, but not by international trade. The proposed species occurring in, and managed by, the United States of America, even if overfished, are under sustainable management regulations and are rebuilding or have been designated as prohibited and are not continuing to decline due to international trade. It is also important to note that most of the high-quality scientific data (e.g. catch, fishing effort, discard rates, life history information) collected for sandbar sharks and other important commercial shark species come from the shark research fishery, which focuses on sandbar sharks. However, if sandbar sharks were listed under Appendix II, it is anticipated that many of the fishers would no longer participate in the research fishery and thus critical data would be lost.

Trade comment

The Expert Panel noted that domestic consumption and national trade were the primary reasons for fisheries retaining and landing many of the species proposed, with the component of the fin trade that comprised the species in Proposal 37 being low. International fin and meat trade of these species is rare in comparison with market demand, and export trade is not a major component or driver of fishing pressure. In cases where commodities such as shark fin originate from shark taken as subsistence catches, these could be viewed in the context of efforts to “encourage full use of dead sharks”, as is recommended as part of many national shark plans (FAO, 1999). Evidence for trade for the species in the proposals are summarised in Table 3.

The CITES provisions on trade in specimens of species listed in Appendix II require an export permit by the exporting country, which will 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.

The trade will be recorded in the CITES Trade Database, and this will improve recording of international trade information [see Appendix G, especially point 5 (iii) in FAO, 2019].

The proposal does not provide information on the impacts of trade and fishing on species of the Carcharhinidae family that are intended to be included (54), particularly for the blue shark, which is the most abundant and productive shark species globally and is subject to multiple management measures in different regional fisheries management organizations (RFMOs). Including the blue shark may well produce a global socioeconomic impact that should, at least, be considered in the proposal. In particular, the Expert Panel received anecdotal information from two external sources that strongly opposed the assertion in the proposal that there would be an issue of misidentifying blue shark products. The information provided identification guides as well as qualifying information as to why blue shark fins are easy to differentiate from the other species included in the proposal.

Basis for Article II paragraph 2(b) (“look-alikes’) Appendix II listing of the other species in the proposal

The Expert Panel noted that, in addition to the 19 species listed, over double that amount of shark species are included in Proposal 37 under CITES look-alike criteria.

The Expert Panel noted that the proposal indicated that all species in the family Carcharhinidae (n = 54) (Proposal, Annex I) should be included in Appendix II (in line with Article II, paragraph 2(b) of the CITES Convention) due to the challenges in distinguishing parts and derivatives of these species that might be traded internationally (look-alike provision). Moreover, following Eschmeyer's Catalog of Fishes, the number of species currently considered valid in the family Carcharhinidae is higher (n = 59).

The Expert Panel acknowledged that concerns about the status of many species of requiem sharks are growing (Carcharhinidae), but did not analyse population trends of look-alike species, despite the fact that the IUCN has classified several of these species as Threatened and that some (not all) had evidence of international trade.

The Expert Panel acknowledges the fact that there are several "look-alikes" within the family Carcharhinidae. However, morphological similarities may not often entail biological, productivity or abundance indices.

Noting the significant differences in morphological appearance, size, productivity and importance to trade, the best approach would be to deliberate over each look-alike species in detail, which considering the number presented is beyond the capacity of the Expert Panel. Going through all the "look-alikes" to validate their similarities and dissimilarities (between species proposed and "look-alikes", but even among the separate groups) given the vast number of species and the time necessary for this exhaustive task would require significant effort. However, after due deliberation, the panel has found that:

- If there is no evidence of a particular species entering the trade, there is no need to list it by virtue of it being a "look-alike".
- Some of the species in the family Carcharhinidae can be excluded from the list of "look-alikes", as they are distinctly different from other species in morphological appearance, size and productivity, e.g. sharks of the genera *Rhizoprionodon* and *Scoliodon* (Figures Figure 12 and Figure 13). The spadenose shark (*Scoliodon laticaudus*) is a small, relatively slender shark which can be easily distinguished at landing centre points (full shark) by several characteristics: the distinct depressed spadenose shape of the snout, small triangular pectoral fins, first dorsal fin short and broadly triangular, without any distinct colours or markings, second dorsal fin very small, and relatively long anal fin, with the insertion well ahead of the insertion of the second dorsal fin (Figure 12).
- The milk shark (*Rhizoprionodon acutus*) is also a relatively small shark with small fins. Distinctive characters include first dorsal fin triangular with a deeply concave posterior margin, second dorsal fin relatively very small, pectoral fins triangular in shape, insertion of the anal fin ahead of the insertion of the second dorsal fin (Figure 13).
- The Expert Panel also notes that blue sharks (*Prionace glauca*), the most prevalent species in the shark fin trade (not considered threatened by IUCN Red List), is easily identifiable due to body colour and morphological characteristics at landing sites. Meat may not be distinguishable once processed, but fin traders in market states report the size and characteristics of blue shark fins make it distinguishable in its market commodity form (Europêche, 2022), also see Figure 14.
- Within the genus *Carcharhinus*, which are mostly relatively smaller, more abundant and more productive than the larger species that have already been or are likely to be listed in CITES Appendix II, many of the coastal species support small-scale coastal fisheries and domestic markets in many parts of the globe. Management therefore requires further nuanced understanding before they can be added to the CITES Appendix II (e.g. *Scoliodon* spp.). For such species that are mostly used locally, and catch is not significantly driven by international trade, encouraging appropriate local management measures could help lead to better sustainable management and documentation of the catch and effort.
- Considering the challenges that surround the identification of sharks in general, and the carcharhinids in particular, it is necessary to improve awareness and capacities of all personnel involved in the supply chain, from the stakeholders to the enforcement teams. This should include promoting the use of best available resources and techniques to improve species identification and recording at landing sites, ports and trade points. Hereby, there is ample opportunity to use forensic tools (DNA analysis, 3D printed shark fins) to inform and help better monitoring and management.
- While the debate about the identification of meat and meat products is likely to continue (the meat for any shark and ray once processed is difficult if not practically impossible to identify without forensic tools), investing in forensic tools and capacity building in this regard, both in exporter and importer country locations, would be a better start to resolve the challenges posed by "look-alikes" in the trade

rather than listing all sharks in the family, as this may have several socio-ecological and managerial implications without the ability for many States to ensure compliance.

In summary, the Expert Panel stated that the extensive list of species included as "look-alikes" in Proposal 37 was insufficiently justified. In addition, by including so many new species in CITES Appendix II, this would place an unnecessary burden on existing monitoring capacity, resulting in a decrease in the effectiveness of controls for species for which the listing is justified.

Comment on the likely effectiveness for conservation of a CITES Appendix II listing

Establishing a new set of international trade controls on species where export values were found to be a limited or non-existent driver of exploitation could lead to a large investment of effort for limited returns in regard to ensuring survival of those species.

The CITES provisions on trade in specimens of species listed in Appendix II require an export permit by the exporting country, which will 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.

In many cases, fishery information for species in the family Carcharhinidae across range states was basic, and this would limit the ability for authorities to make positive non-detriment findings (NDFs), as evidenced by the situation encountered for shark and ray species already listed. This may lead to the following outcomes:

- legal trade in the species being delayed for a significant period or ceasing altogether;
- trade continuing without proper CITES documentation (also known as "illegal trade"); and/or
- trade continuing with inadequate NDFs.

On a positive note, legal trade will likely be recorded in the CITES Trade Database, and this will improve overall trade information. Compliance will remain an issue, especially where small numbers of commodities of newly listed species will be packaged among larger shipments of other fisheries commodities [see Appendix G, especially point 5 (iii) in FAO (2019)], and a large number of species groups, often originating from coastal fisheries, will need to be controlled.

For such species that are mostly used locally and catch is not significantly driven by international trade, encouraging and investing in appropriate local management measures could better expect to lead to improved management and documentation of the catch and effort. Given the potential susceptibility of some of these low and medium productivity species to overexploitation and localized depletion, improved fisheries management through national authorities and relevant regional fisheries bodies should be promoted.

Considering the challenges that surround the identification of sharks in general and carcharhinids in particular, it is necessary to generate awareness and capacities. To the extent possible, personnel involved in the supply chain, from the stakeholders to the enforcement teams, could be offered use of available resources and techniques to identify species better at landing sites, ports and trade points. Hereby, there is also ample opportunity to use forensic tools (DNA analysis, 3D printed shark fins) to inform and help better monitoring and management.

The proposal does not provide information on the impacts of CITES provisions on the remaining look-alike part of the family Carcharhinidae, a component that is over two times larger than species proposed for listing. Of particular importance in the look-alike species is the blue shark, a productive shark species that likely makes up around 90 percent of the shark fin market. The blue shark is subject to multiple management measures in different RFMOs, and its inclusion under provisions of CITES Appendix II would incur a large cost to management, fishers and markets that could produce a global socioeconomic impact. With regard to blue shark in particular, the Expert Panel received information from management and market authorities that strongly opposed the proposal's suggestion that there would be an issue of misidentifying blue shark and its products. The information provided included identification guides as well as qualifying information as to why blue shark fins are easy to differentiate from the other species (Europêche, 2022), also see Figure 14.

The Expert Panel noted that listing approximately 35 species proposed under look-alike provisions would have substantial socioeconomic, surveillance, enforcement and prosecution implications – far in excess of requirements and impacts for the 19 sharks singled out for addition to Appendix II listing in the proposal.

It is also important to note that some of the highest quality scientific data (e.g. catch, fishing effort, discard rates, life history information) are collected from shark research efforts. If sharks in these programmes were listed under Appendix II, it is anticipated that many of the fishers would no longer participate in the research fishery owing to the complexity of getting research permits and allowances for moving shark samples across international borders. Thus, critical data would go unreported or be lost.

In summary, the Expert Panel stated that the extensive list of species in the proposal and included as "look-alikes" was largely insufficiently justified. Including so many new species in CITES Appendix II would place an unnecessary burden on existing monitoring capacity, resulting in a decrease in available capacity and resources for fishery management generally and the effectiveness of controls for species for which the listing is justified.

References

Akhilesh, K.V., White, W.T., Bineesh, K.K., Purushottama, G.B., Singh, V.V. & Zacharia, P.U. 2016. Redescription of the rare and endangered broadfin shark *Lamiopsis temminckii* (Müller & Henle, 1839) (Carcharhiniformes: Carcharhinidae) from the northeastern Arabian Sea. *Zootaxa,* 4175(2): 155–166.

Barreto, R.R., Lessa, R.P., Hazin, F.H. & Santana, F.M. 2011. Age and growth of the blacknose shark, *Carcharhinus acronotus* (Poey, 1860) off the northeastern Brazilian Coast. *Fisheries Research,* 110 (1): 170–176.

Blower, D.C. 2020. *Estimating contemporary abundance, demography, and vulnerability to change for long-lived species with effective population size and population simulation*. School of Biological Sciences, p. 257. The University of Queensland. PhD thesis.

Braccini, M., Denham, A., Neill, M.F.O. & Lai, E. 2021a. Spatial and temporal patterns in catch rates from multispecies shark fisheries in Western Australia. *Ocean and Coastal Management*, 213: 105883.

Braccini, M., Hesp, A. & Molony, B. 2021. Risk-based weight of evidence assessment of commercial sharks in Western Australia. *Ocean and Coastal Management*, 205: 105501.

Braccini, M., Kangas, M., Jaiteh, V. & Newman, S. 2021b. Quantifying the unreported and unaccounted domestic and foreign commercial catch of sharks and rays in Western Australia. *Ambio*, 50:1337–1350.

Braccini, M., Molony, B. & Blay, N. 2020. Patterns in abundance and size of sharks in northwestern Australia: cause for optimism. *ICES Journal of Marine Science*, 77: 72–82.

Braccini, M., Pidd, A., Usher, M. & Peddemors, V. 2021c. Sandbar shark, *Carcharhinus plumbeus*. *In* T. Piddocke, C. Ashby, K. Hartmann, A. Hesp, P. Hone & J. Klemke, eds. *Status of Australian fish stocks reports 2020*. Fisheries Research and Development Corporation, Canberra.

Cardeñosa, D., Fields, A., Babcock, E., Shea, S., Feldheim, K. & Chapman, D. 2020. Species composition of the largest shark fin retail-market in mainland China. *Nature Scientific Reports*, 10: 12924. https://doi.org/10.1038/s41598-020-69555-1

Cardeñosa, D., Shea, S., Zhang, H., Fischer, G., Simpfendorfer, C. & Chapman, D., 2022. Two thirds of species in a global shark fin trade hub are threatened with extinction: conservation potential of international trade regulations for coastal sharks. *Conservation Letters*, e12910.

Carlson, J., Charvet, P., Avalos, C., Blanco-Parra, MP, Briones Bell-lloch, A., Cardenosa, D., Espinoza, E., Morales-Saldaña, J.M., Naranjo-Elizondo, B., Pérez Jiménez, J.C., Schneider, E.V.C., Simpson, N.J., Talwar, B.S., Crysler, Z., Derrick, D., Kyne, P.M. & Pacoureau, N. 2021. *Carcharhinus acronotus*. *The IUCN Red List of Threatened Species* 2021: e.T161378A887542. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T161378A887542.en

Carlson, J.K., Cortés, E. & Johnson, A. 1999. Age and growth of the blacknose shark, *Carcharhinus acronotus*, in the Eastern Gulf of Mexico. *Copeia.* 3: 684–691.

Compagno, L.J.V. 1984. *Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Carcharhiniformes*. FAO Species Catalogue. FAO Fisheries Synopsis No. 125, Vol. 4, Part 2: 251–655.

Driggers, W.B., Oakley, D.A., Ulrich, G., Carlson, J.K., Cullum, B.J. & Dean, J.M. 2004. Reproductive biology of *Carcharhinus acronotus* in the coastal waters of US South Atlantic. *Journal of Fish Biology*, 64: 1540–1551.

Dulvy, N.K., Al Mamari, T., Bineesh, K.K., Derrick, D., Haque, A.B., Maung, A., Moore, A. & VanderWright, W.J. 2021. *Lamiopsis temminckii*. *The IUCN Red List of Threatened Species* 2021: e.T169760690A124508850. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T169760690A124508850.en

Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.

Europêche. 2022. Europêche position paper on EU proposal to include blue shark in Appendix II of CITES [online]. In: Association of National Organizations of Fisheries Enterprises in the EU, Brussel. [Cited 20 July 2022]. http://europeche.chil.me/download-doc/415516

FAO. 1999. *International Plan of Action for reducing incidental catch of seabirds in longline fisheries. International Plan of Action for the conservation and management of sharks. International Plan of Action for the management of fishing capacity*. Rome, FAO. 1999. 26p.

FAO. 2019. *Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, Rome, 21–25 January 2019*. FAO Fisheries and Aquaculture Report No. 1255. Rome. Licence: CC BY-NC-SA 3.0 IGO.

Fields, A., Fischer, G., Shea S., Zhang H., Abercrombie, D., Feldheim, K., Babcock, E. & Chapman, D. 2017. Species composition of the international shark fin trade assessed through a retail-market survey in Hong Kong. *Conservation Biology*, 32(2): 376–389.

Fricke, R., Eschmeyer, W. N. & Van der Laan, R. (eds) 2022. Eschmeyer's Catalog of Fishes. In California Academy of scienc. California, USA. Cited 18 July 2022. http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp.

Haque, A.B. & Das, S.A. 2019. New records of the Critically Endangered Ganges shark Glyphis gangeticus in Bangladeshi waters: urgent monitoring needed. *Endangered Species Research*, 40: 65–73. https://doi.org/10.3354/esr00981

Hazin, F.H.V., Oliveira, P.G. & Broadhurst, M.K. 2002. Reproduction of blacknose shark (*Carcharhinus acronotus*) in the coastal waters off northeastern Brazil. *Fishery Bulletin U.S.,* 100: 143–148.

Jabado, R., Al Ghais, S., Hamza, W., Henderson, A., Spaet, J., Shivji, M. & Hanner, R. 2015. The trade in sharks and their products in the United Arab Emirates. *Biological Conservation*, 181: 190–198. ISSN 0006-3207

Jabado, R.W., Al Ghais, S.M., Hamza, W., Robinson, D.P. & Henderson, A.C. 2016. Biological data from sharks landed within the United Arab Emirates artisanal fishery. *African Journal of Marine Science*, 38(2): 217–232.

Jabado, R.W., Kyne, P.M., Nazareth, E. & Sutaria, D.N. 2018. A rare contemporary record of the Critically Endangered Ganges shark *Glyphis gangeticus*. *Journal of Fish Biology*, 92, 1663–1669. https://doi.org/10.1111/jfb.13619

Kyne, P.M., Heupel, M.R., White, W.T. & Simpfendorfer, C.A. 2021. *The action plan for australian sharks and rays 2021*. National Environmental Science Program, Marine Biodiversity Hub, Hobart.

Last, P.R. & Stevens, J.D. 2009. *Sharks and rays of Australia*. 2nd edition. Melbourne, Australia, CSIRO. 644 pp.

Lessa, R. & Santana, F.M. 1998. Age determination and growth of the smalltail shark, *Carcharhinus porosus*, from northern Brazil. *Marine and Freshwater Research*, 49: 705–711.

Lessa, R., Santana, F., Menni, R. & Almeida, Z. 1999. Population structure and reproductive biology of the smalltail shark (*Carcharhinus porosus*) off Maranhão, Brazil. *Marine and Freshwater Research,* 50: 383–388.

McAuley, R.B., Simpfendorfer, C.A., Hyndes, G.A., Allison, R.R., Chidlow, J.A., Newman, S.J. & Lenanton, R.C. 2006. Validated age and growth of the sandbar shark, *Carcharhinus plumbeus* (Nardo 1827) in the waters off Western Australia. *Environmental Biology of Fishes,* 77: 385–400.

Moore, A.B.M., McCarthy, I.D., Carvalho, G.R. & Peirce, R. 2012. Species, sex, size and male maturity composition of previously unreported elasmobranch landings in Kuwait, Qatar and Abu Dhabi Emirate. *Journal of Fish Biology*, 80: 1619–1642.

Natanson, L.J., Casey, J.G. & Kohler, N.E. 1995. Age and growth estimates of the dusky shark, *Carcharhinus obscurus,* in the western North Atlantic Ocean. *Fish. Bull.,* 93: 116–126.

NMFS. 2011a. *Southeast Data, Assessment and Review (SEDAR) 21: Stock assessment report – HMS Atlantic blacknose shark*. South Atlantic Fishery Management Cuncil, North Charleston, SC, USA. Cited 18 July 2022. http://sedarweb.org/docs/sar/Atl_Blacknose_SAR.pdf

NMFS. 2011b. *Southeast Data, Assessment and Review (SEDAR) 21: Stock assessment report – HMS Gulf of Mexico blacknose shark*. South Atlantic Fishery Management Cuncil, North Charleston, SC, USA. Cited 18 July 2022. http://sedarweb.org/docs/sar/GoM_Blacknose_SAR.pdf

NMFS. 2016. *Southeast Data, Assessment and Review Update assessment to SEDAR 21 – HMS dusky shark*. Addendum and post-review updates. South Atlantic Fishery Management Cuncil, North Charleston, SC, USA. Cited 18 July 2022. https://sedarweb.org/2016-update-sedar-21-hms-dusky-shark

NMFS. 2017. *Southeast Data, Assessment and Review (SEDAR) 54: Stock assessment report – HMS sandbar shark.* South Atlantic Fishery Management Cuncil, North Charleston, SC, USA. Cited 18 July 2022. http://sedarweb.org/docs/sar/S54_Final_SAR_with_exec_summary.pdf

Peterson, C. D., Belcher, N. D., Bethea, D. M., Driggers, W. B., Frazier, B. S., & Latour, R. J. 2017. Preliminary recovery of coastal sharks in the south-east United States. *Fish and Fisheries*, 18, 845–859. https://doi.org/10.1111/faf.12210.

Raje, S.G., Sivakami, S., Mohanraj, G., Manojkumar, P.P., Raju, A. & Joshi, K.K. 2007. An atlas on the Elasmobranch fishery resources of India. *CMFRI Special Publication*, 95: 1–253.

Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Carcharhinus obscurus*. *The IUCN Red List of Threatened Species* 2019: e.T3852A2872747. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T3852A2872747.en

Rigby, C.L., Derrick, D., Dulvy, N.K., Grant, I & Jabado, R.W. 2021a. *Glyphis gangeticus*. *The IUCN Red List of Threatened Species* 2021: e.T169473392A124398647. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T169473392A124398647.en

Rigby, C.L., Derrick, D., Dicken, M., Harry, A.V., Pacoureau, N. & Simpfendorfer, C. 2021b. *Carcharhinus plumbeus*. *The IUCN Red List of Threatened Species* 2021: e.T3853A2874370. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T3853A2874370.en

Santana, F.M., Feitosa, L.M. & Lessa R.P. 2020. From plentiful to critically endangered: demographic evidence of the artisanal fisheries impact on the smalltail shark (*Carcharhinus porosus*) from Northern Brazil. *PLoS ONE*, 15(8): e0236146. https://doi.org/10.1371/journal.pone.0236146

Seah, Y.G., Kibat, C., Hew, S. & Wainwright, B. 2022. DNA barcoding of traded shark fns in Peninsular Malaysia. *Rev Fish Biol Fisheries*, 32(3): 993–999. https://doi.org/10.1007/s11160-022-09713-y

Simpfendorfer, C., Derrick, D., Yuneni, R.R., Maung, A., Utzurrum, J.A.T., Seyha, L., Haque, A.B., Fahmi, Bin Ali, A., , D., Bineesh, K.K., Fernando, D., Tanay, D., Vo, V.Q. & Gutteridge, A.N. 2021. *Negaprion acutidens*. *The IUCN Red List of Threatened Species* 2021: e.T41836A173435545. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T41836A173435545.en

Simpfendorfer, C., Fahmi, Bin Ali, A., , D., Utzurrum, J.A.T., Seyha, L., Maung, A., Bineesh, K.K., Yuneni, R.R., Sianipar, A., Haque, A.B., Tanay, D., Gautama, D.A. & Vo, V.Q. 2020. *Carcharhinus amblyrhynchos*. *The IUCN Red List of Threatened Species* 2020: e.T39365A173433550. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T39365A173433550.en

Simpfendorfer, C., Jabado, R.W., Moore, A., Valinassab, T. & Elhassan, I. 2019. *Carcharhinus dussumieri*. *The IUCN Red List of Threatened Species* 2019: e.T70680197A68612632. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T70680197A68612632.en

Simpfendorfer, C., Jabado, R.W., Valinassab, T., Elhassan, I. & Moore, A. 2017. *Carcharhinus leiodon*. *The IUCN Red List of Threatened Species* 2017: e.T39371A109876922. In: International

Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T39371A109876922.en

Smart, J.J., Harry, A.V., Tobin, A.J. & Simpfendorfer, C.A. 2013. Overcoming the constraints of low sample sizes to produce age and growth data for rare or threatened sharks. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 23: 124–134.

Sulikowski, J.A., Driggers, W.B., Ford, T.S., Boonstra, R.K. & Carlson, J.K. 2007. Reproductive cycle of the blacknose shark *Carcharhinus acronotus* in the Gulf of Mexico. *Journal of Fish Biology*, 70: 428–440.

Thorson, J.T., Cope, J.M. & Patrick, W.S. 2014. Assessing the quality of life history information in publicly available databases. *Ecological Applications*, 24(1): 217–226. http://onlinelibrary.wiley.com/doi/10.1890/12-1855.1/abstract

Thorson, J.T., Munch, S.B., Cope, J.M. & Gao, J. 2017. Predicting life history parameters for all fishes worldwide. *Ecological Applications*, 27(8): 2262–2276. http://onlinelibrary.wiley.com/doi/10.1002/eap.1606/full

UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP

Villate-Moreno, M., Pollerspöck, J., Kremer-Obrock, F. & Straube, N. 2021. Molecular analyses of confiscated shark fins reveal shortcomings of CITES implementations in Germany. *Conservation Science and Practice*, 3: e398.

Wetherbee, B.M., Crow, G.L. & Lowe, C.G. 1997. Distribution, reproduction and diet of the grey reef shark, *Carcharhinus amblyrhynchos,* in Hawaii. *Marine Ecology Progress Series*, 151: 181–189.

Woodhams, J., Braccini, M., Peddemors, V. & Usher, M. 2021. Dusky whaler, *Carcharhinus obscurus*. *In* T. Piddocke, C. Ashby, K. Hartmann, A. Hesp, P. Hone & J. Klemke, eds. *Status of Australian fish stocks reports 2020*. Fisheries Research and Development Corporation, Canberra.

Tables and figures

Table 1. Productivity for the species reviewed by the Expert Panel

Species	**Productivity**
Grey reef shark (*Carcharhinus amblyrhynchos*)	Medium
Smalltail shark (*Carcharhinus porosus*)	Medium
Ganges shark (*Glyphis gangeticus*)	Low
Whitecheek shark (*Carcharhinus dussumieri*)	Medium
Dusky shark (*Carcharhinus obscurus*)	Low
Sandbar shark (*Carcharhinus plumbeus*)	Low
Blacknose shark (*Carcharhinus acronotus*)	Medium-Low
Smoothtooth blacktip shark (*Carcharhinus leiodon*)	Not assessed
Broadfin shark (*Lamiopsis temmincki*)	Low
Sharptooth lemon shark (*Negaprion acutidens*)	Medium

Table 2. Productivity of Requiem sharks nei in Panama proposal (M: male; F: female).

PARAMETER	STATUS	INFORMATION	AREA	SOURCE	COMMENTS
Grey reef shark *(C. amblyrhynchos*)					
TL max		265 cm	Indian Ocean: Western (FAO 51); Eastern (FAO 57); Pacific: Western Central (FAO 71), Eastern Central (FAO 77)	Ebert, Dando and Fowler, 2021	Rarely exceeds 180 cm
Longevity		25 years	FAO 51, 57, 71, 77	Compagno, 1984	
Maturity		M: 130–145 cm; F: 120–142	FAO 51, 57, 71, 77	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
Maturity		M and F: 130–140	FAO 57 and 71	Last and Stevens, 2009	
L50 maturity		M: 120–140; F: 125 cm TL	FAO 77, Hawaii	Wetherbee *et al.*, 1997	
Size at maternity		F: starting at 141 cm TL	FAO 77, Hawaii	Wetherbee *et al.*, 1997	
Time to maturity		6–11 years	FAO 51, 57, 71, 77	Ebert, Dando and Fowler, 2021	
Time to maturity		M: 9; F: 11 years	FAO 57 and 71, Australia	Last and Stevens, 2009	
Gestation period		12–14 months	FAO 51, 57, 71, 77	Last and Stevens, 2009; Ebert, Dando and Fowler, 2021	
Litter size		1–6 pups	FAO 51, 57, 71, 77	Last and Stevens, 2009; Ebert, Dando and Fowler, 2021	
Litter size		3–6 pups	FAO 77, Hawaii	Wetherbee *et al.*, 1997	
Reproduction cycle		Biennial	FAO 77, Hawaii	Wetherbee *et al.*, 1997	
Gestation period		12 months	FAO 51, 57, 71, 77	Compagno, 1984	
Time to maturity		7–7.5 years	FAO 51, 57, 71, 77	Compagno, 1984	
Mortality	Medium	0.41/M	FAO 51, 57, 71, 77	Thorson *et al.*, 2014; 2017	
***Smalltail shark (C. porosus*)**					
TL max		134 cm	Atlantic: Western Central (FAO 31), Southwest (FAO 41); Pacific: Eastern Central (FAO 77), Southeast (FAO 87).	Ebert, Dando and Fowler, 2021	
Longevity		12 years			
Maturity		M: 71–84; F: 70–78 cm TL	FAO 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
L50 maturity		M: 70; F: 71 cm	FAO 41, State of Maranhão, Brazil	Lessa *et al.*, 1999	
Litter size		2–9 (average 6) pups	FAO 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	
Litter size		2–7 pups	FAO 41, State of Maranhão, Brazil	Lessa and Santana, 1998	
Gestation period		~12 months	FAO 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	
Age at maturity		~6 years sex combined	FAO 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021; Lessa and Santana, 1998	
Growth (VB)		M and F; Linf 125.1, K 0.101, t0-2.89	FAO 41, State of Maranhão, Brazil	Lessa and Santana, 1998	From observed length-at-age

PARAMETER	STATUS	INFORMATION	AREA	SOURCE	COMMENTS
Growth (VB)		M and F: Linf 136.4, K, 0.077, t0-3.27	FAO 41, State of Maranhão, Brazil	Lessa and Santana, 1998	From back-calculated lengths
Growth (VB)		M and F: Linf 131.0, K 0.080, t0-3.40	FAO 41, State of Maranhão, Brazil	Lessa and Santana, 1998	From length-frequency distribution
Natural mortality		Average 0.261	FAO 41, State of Maranhão, Brazil	Santana *et al*., 2020	Estimated by 11 different methods
Mortality	Medium	0.34/M	FAO 31, 41, 77 and 87	Thorson *et al*., 2014; 2017	
Ganges shark (*Glyphis gangeticus*)					
TL max		at least 275 cm	Indian Ocean, Eastern (FAO 57); Pacific, Eastern Central (FAO 77).	Ebert, Dando and Fowler, 2021	
Maturity		M: ~178 cm	FAO 57 and 77	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
Mortality	Low	0.35/M	FAO 57 and 77	Thorson *et al*., 2014; 2017	
Whitecheek shark (*Carcharhinus dussumieri*)					
TL max		101 cm	Indian Ocean, Western (FAO 51)	Ebert, Dando and Fowler, 2021	
Maturity		M: 65–70; F: 70–75 cm TL	FAO 51	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
Maturity		M and F: 70 cm TL	Indian Ocean, Eastern (57), Australia	Last and Stevens, 2009	Maturity parameter not specified
L50 maturity		M: 63–80 cm TL	FAO 51, Persian Gulf	Moore *et al*., 2012	1004 specimens both sexes
L50 maturity		M: 73.1; F:<81.5 cm TL	FAO 51, Persian Gulf	Jabado *et al*., 2016	351 males; 210 females
Litter size		2 pups, exceptionally 4	FAO 51	Ebert, Dando and Fowler, 2021	
Litter size		2–4 pups	FAO 57, Australia	Last and Stevens, 2009	
Reproductive cycle		Annual	FAO 57, Australia	Last and Stevens, 2009	
Growth (k)		VB 3.042; GOM 3.581; LOG 4.177	Northeast Australia	Smart *et al*., 2013	In the paper this is referred to *C. coatesi* and it is relevant only if *C. coatesi* is considered synonym of *C, dussumieri,*(this reference is the proposal).
Mortality	Medium	0.26/M		Thorson *et al*., 2014; 2017	Value obtained from closely related species
***Dusky shark* (*Carcharhinus obscurus*)**					
TL max		420	Global	Ebert, Dando and Fowler, 2021	
Maturity		M: 265–280; F: 257–310 cm TL	Global	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
Maturity		M: 265–280; F: 295–310 cm TL	Indian Ocean, Eastern (FAO 57); Pacific: Western Central (FAO 71), Southwest (81).	Last and Stevens, 2009	Maturity parameter not specified
L50 maturity		M:231; F 235 cm FL	Atlantic, Northwest (FAO 21)	Natanson *et al*, 1995	
Maturity ogive		a=-19.76, b=0.99	Atlantic: Northwest (FAO 21), Western Central (31)	NMFS, 2016	
Time to maturity		M: 19; F: 21 years	FAO 21	Natanson *et al*, 1995	
Time to maturity		M: 18–20; F: 27–32 years	FAO 57, 71 and 81, Australia	Last and Stevens, 2009	
Litter size		2–18 pups	Global	Ebert, Dando and Fowler, 2021	
Litter size		10 maximum 14 pups	FAO 57, 71 and 81, Australia	Last and Stevens, 2009	

PARAMETER	STATUS	INFORMATION	AREA	SOURCE	COMMENTS
Litter size		7.13 pups	FAO 21 and 31	NMFS, 2016	
Reproductive cycle		2–3 years	Global	Ebert, Dando and Fowler, 2021	
Gestation time		16–22 months	Global	Ebert, Dando and Fowler, 2021	
Gestation time		12 months	FAO 21 and 31	NMFS, 2016	
Longevity		~17–24, maximum age 34–53	Global	Ebert, Dando and Fowler, 2021	
Longevity		33 years (old female)	FAO 21	Natanson *et al*, 1995	
Growth (VB)		M: Linf=373, K=O.038, t0=-6.28; F: Linf=349, K=O.039, to=-7.04	FAO 21	Natanson *et al*, 1995	
Growth (VB)		Linf 350.3 cm FL; k 0.039; t0 -7.04	FAO 21 and 31	NMFS, 2016	
Mortality	Low	0.07/L	Global	Thorson *et al*., 2014; 2017	
Sandbar shark (*Carcharhinus plumbeus*)					
TL max		243, possible 300 cm TL	Global	Ebert, Dando and Fowler, 2021	
Longevity		19–25 years	Global	Ebert, Dando and Fowler, 2021	
Longevity		31 years	Atlantic: Northwest (FAO 21), Western Central (31)	NMFS, 2017	
Longevity		M: 19; F 25 years	Indian Ocean, Eastern (FAO 57), Western Australia	McAuley *et al*, 2006	
Maturity		M: ~123–180; F: ~129–185 cm TL	Global	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
L50 maturity		M: 158.9–171.2; F <180.2 cm TL	FAO 51, Persian Gulf	Jabado *et al*., 2016	7 males, 5 females
Age at maturity		M: 8–14; F: 7.5–16 years	Global	Ebert, Dando and Fowler, 2021	
Age at maturity		13 years	FAO 21 and 31	SEDAR, 2017	
Age at maturity		M:13.8; F: 16.2years	FAO 57, Western Australia	McAuley *et al*, 2006	
Litter size		1–14 pups (5–12 common)	Global	Ebert, Dando and Fowler, 2021	
Gestation period		8–12 months	Global	Ebert, Dando and Fowler, 2021	
Reproductive cycle		2 or 3 years	Global	Ebert, Dando and Fowler, 2021	
Reproductive cycle		2.5 years	FAO 21 and 31	NMFS, 2017	
Growth (VB)		M: Linf=175.5cm; k=0.143; t0=-2.388 F: Linf=183.3cm; k=0.124; t0=-3.098	FAO 21 and 31	NMFS, 2017	
Growth (VB)		F: Linf 245.8 cm; K = 0.039; M: Linf 226.3 cm; K= 0.040;	FAO 57, Western Australia	McAuley *et al*, 2006	Vertebral ageing
Mortality	Low	0.125/M	Global	Thorson *et al*., 2014; 2017	
Blacknose shark (*Carcharhinus acronotus*)					
TL max		164 cm	Atlantic: Western Central (FAO 31), Southwest (FAO 41)	Ebert, Dando and Fowler, 2021	
TL max		132 cm	FAO 41, northeast Brazil	Barreto *et al*., 2011	
Growth		M: K= 0.59 - F K = 0.352	FAO 31, northwest Florida	Carlson *et al*, 1999	Backcalculated von Bertalanffy growth functions

PARAMETER	STATUS	INFORMATION	AREA	SOURCE	COMMENTS
Growth		M: K = 0.771 - F K = 0.237	FAO 31, Tampa Bay	Carlson *et al*, 1999	
Growth		L∞=130.69 cm, k=0.12–0.24	FAO 41, northeast Brazil	Barreto *et al*., 2011	Von Bertalanffy (VBGM), modified von Bertalanffy (VBGMb), Richards, Gompertz and Schnute models.
Longevity		10–19 years	FAO 31 and 41	Ebert, Dando and Fowler, 2021	
Longevity		15 years	FAO 41, northeast Brazil	Barreto *et al*., 2011	
Maturity		M: 97–110; F 101–120	FAO 31 and 41	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
L50 maturity		M: 896 mm FL; F: 964 mm FL	FAO 31, southeast USA	Driggers *et al*,, 2004	
Size at maternity		F: 114–130 cm TL	FAO 41, northeast Brazil	Hazin *et al*., 2002	
Time to maturity		from 2–6.6 years	FAO 31 and 41	Ebert, Dando and Fowler, 2021	
Time to maturity		M: 4.3; F: 4.5 years	FAO 31, southeast USA	Driggers *et al*,, 2004	
Time to maturity		M and F: 6 years	FAO 41, northeast Brazil	Barreto *et al*., 2011	
Gestation period		9–11 months	FAO 31 and 41	Ebert, Dando and Fowler, 2021	
Gestation period		11 months	FAO 31, southeast USA	Driggers *et al*,, 2004	
Gestation period		9–10 months	FAO 31	Sulikowski *et al*., 2007	
Reproductive cycle		Annual	FAO 31, southeast USA	Driggers *et al*,, 2004	
Reproductive cycle		Annual	FAO 31	Sulikowski *et al*., 2007	
Litter size		1–6 pups	FAO 31 and 41	Ebert, Dando and Fowler, 2021	
Litter size		2–4 pups	FAO 31	Sulikowski *et al*., 2007	
Mortality	Medium-Low	0.20/M	FAO 31 and 41	Thorson *et al*., 2014; 2017	Value obtained from closely related species
Smoothtooth blacktip shark (*Carcharhinus leiodon*)					
L max		165 cm	Indian Ocean: Western (FAO 51)	Ebert, Dando and Fowler, 2021	
Maturity		M: ~133; F: 125–135 cm TL	FAO 51	Ebert, Dando and Fowler, 2021	
L50 maturity		M: < 137.2	FAO 51, Persian Gulf	Jabado *et al*., 2016	2 males
L50 maturity		Range of distribution	FAO 51, Persian Gulf	Moore *et al*., 2012	32 specimens both sexes
Litter size		4–6 pups	FAO 51	Ebert, Dando and Fowler, 2021	
Mortality	Not assessed	0.26/M	FAO 51	Thorson *et al*., 2014; 2017	
Broadfin shark (*Lamniopsis temmincki*)					
TL max		178 cm	Indian Ocean, Western (FAO 51)	Ebert, Dando and Fowler, 2021	
Maturity		M: ~114; F: 150 cm	FAO 51	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
		M: 136.8 cm TL; F: 143 cm TL	FAO 51	Akhilesh *et al*. 2016	Maturity parameters - calcification of claspers for male and development of ovaries and uetri for females
Pregnancy		>150 cm TL	FAO 51	Akhilesh *et al*., 2016	
Litter size		4–8 pups (usually 6)	FAO 51	Ebert, Dando and Fowler, 2021; Akhilesh *et al*., 2016	

PARAMETER	STATUS	INFORMATION	AREA	SOURCE	COMMENTS
Gestation period		Possibly 8 months	FAO 51	Ebert, Dando and Fowler, 2021	
Sharkptooth lemon shark (*Negaprion acutidens*)					
TL max		310 cm	Indian Ocean; Western (FAO 51), Eastern (FAO 57); Pacific, Eastern Central (FAO 77).	Ebert, Dando and Fowler, 2021	
Maturity		~220–240 sex combined	FAO 51, 57 and 77	Ebert, Dando and Fowler, 2021	Maturity parameter not specified
Litter size		1–14 pups (average 9)	FAO 51, 57 and 77	Ebert, Dando and Fowler, 2021	
Gestation period		~10–11 months	FAO 51, 57 and 77	Ebert, Dando and Fowler, 2021	
Reproductive cycle		Biennial	FAO 51, 57 and 77	Ebert, Dando and Fowler, 2021	
L50 maturity		M: < 244.0; F: <257.6 cm TL	FAO 51, Persian Gulf	Jabado *et al*., 2016	23 males, 18 females
Mortality	Medium	0.46/M	FAO 51, 57 and 77	Thorson *et al*., 2014; 2017	

Table 3. Evidence for trade for the species in the proposals.

Species with international trade in shark fins	References in the proposal	Reference s review	Markets	Comments
Species included in the proposal with references in international trade according to the proponent				
Blacknose shark *Carcharhinus acronotus*	2,3	1,2,3	China; China, Hong Kong SAR.	The percentage of this species in the total samples varied between 0.12 and 0.21%
Grey reef shark *Carcharhinus amblyrhynchos*	2,3	1,2,3,4	China; China, Hong Kong SAR, Oman	The percentage of this species in the total samples varied between 0.06 and 0.31%
Whitecheek shark *Carcharhinus dussumieri*	1,2	1,2,3,4	China; China, Hong Kong SAR, Oman	The percentage of this species in the total samples varied between 0.06 and 0.31%
Smoothtooth blacktip shark *Carcharhinus leiodon*	2,3	1,2,4	China; China, Hong Kong SAR, Oman	The data are for blacktip complex (*Carcharhinus limbatus*, *C. leiodon, C. teilstoni* and *C. amblyrhyncoides*). The percentage of these species in the total samples varied between 0.28 and 4.66%.
Dusky shark *Carcharhinus obscurus*	2,3	1,2,3,5	China; China, Hong Kong SAR, Malaysia.	The data are for *C. galapagensis* and *C. obscurus.* The percentage of these species in the total samples varied between 0.12 and 0.8%
Sandbar shark *Carcharhinus plumbeus*	2,3	1,2,5,6	China; China, Hong Kong SAR, Malaysia.	The data are for *C. altimus* and *C. plumbeus.* The percentage of these species in the total samples varied between 0.35 and 3.18%. In the samples obtained in Germany (transit to China, Hong Kong SAR), the percentage was relatively high (17%), but the total number of samples was very low (110)

Species with international trade in shark fins	References in the proposal	Reference s review	Markets	Comments
Smalltail shark *Carcharhinus porosus*	2	1,2,3	China; China, Hong Kong SAR.	The percentage of this species in the total samples varied between 0.04 and 0.06%
Broadfin shark *Lamiopsis temmincki*	2,3	1,2,3	China; China, Hong Kong SAR.	The percentage of this species in the total samples varied between 0.07 and 0.08%
Sharptooth lemon shark *Negaprion acutidens*	2	1,2,3,4	China; China, Hong Kong SAR, Oman	The percentage of this species in the total samples varied between 0.46 and 0.61%
Pacific smalltail shark *Carcharhinus cerdale*	1,2,3			No information on this species was obtained in the references
Species included in the proposal with references in international trade according to the review of the Expert Panel				
Ganges shark *Glyphis gangeticus*		1	China; China, Hong Kong SAR.	The information obtained is for *Glyphis* spp. 0.05%
Caribbean reef Shark (*Carcharhinus perezi*)		6	China, Hong Kong SAR.	In the samples obtained in Germany (transit to China, Hong Kong SAR), the percentage was 7.3% but the total number of samples was very low (110)
Species in the family Carcharhinidae that did not present references of international trade in the proposal and for which the Expert Panel found no evidence: Pondicherry shark (*Carcharhinus hemiodon*); lost shark (*C. obsoletus*); night shark (*C. signatus*); daggernose shark (*Isogomphodon oxyrhynchus*); Borneo broadfin shark (*Lamiopsis tephrodes*); whitenose shark (*Nasolamia velox*).				

Source:

1. Cardeñosa, D., Fields, A., Babcock, E., Shea, S., Feldheim, K. & Chapman, D. 2020. Species composition of the largest shark fin retail-market in mainland China. *Nature Scientific Reports*, 10: 12924. https://doi.org/10.1038/s41598-020-69555-1; 2. Cardeñosa, D., Shea, S., Zhang, H., Fischer, G., Simpfendorfer, C. & Chapman, D., 2022. Two thirds of species in a global shark fin trade hub are threatened with extinction: conservation potential of international trade regulations for coastal sharks. *Conservation Letters*, e12910. 3. Fields, A., Fischer, G., Shea S., Zhang H., Abercrombie, D., Feldheim, K., Babcock, E. & Chapman, D. 2017. Species composition of the international shark fin trade assessed

through a retail-market survey in Hong Kong. *Conservation Biology*, 32(2): 376–389. 4. Jabado, R., Al Ghais, S., Hamza, W., Henderson, A., Spaet, J., Shivji, M. & Hanner, R. 2015. The trade in sharks and their products in the United Arab Emirates. *Biological Conservation*, 181: 190–198. ISSN 0006-3207. 5. Seah, Y.G., Kibat, C., Hew, S. & Wainwright, B. 2022. DNA barcoding of traded shark fns in Peninsular Malaysia. *Rev Fish Biol Fisheries*, 32(3): 993–999. https://doi.org/10.1007/s11160-022-09713-y. 6. Villate-Moreno, M., Pollerspöck, J., Kremer-Obrock, F. & Straube, N. 2021. Molecular analyses of confiscated shark fins reveal shortcomings of CITES implementations in Germany. *Conservation Science and Practice*, 3: e398. Markets: (China) Guangzhou; China, Hong Kong SAR (Sheung Wan and Sai Ying Pun) (Shipment from Mexico to China, Hong Kong SAR, Transit Frankfurt Airport); Malaysia (Dungun and Kuantan, Terengganu and Pahang States)].

Table 4. Trends in status of Requiem sharks nei in Panama proposal.

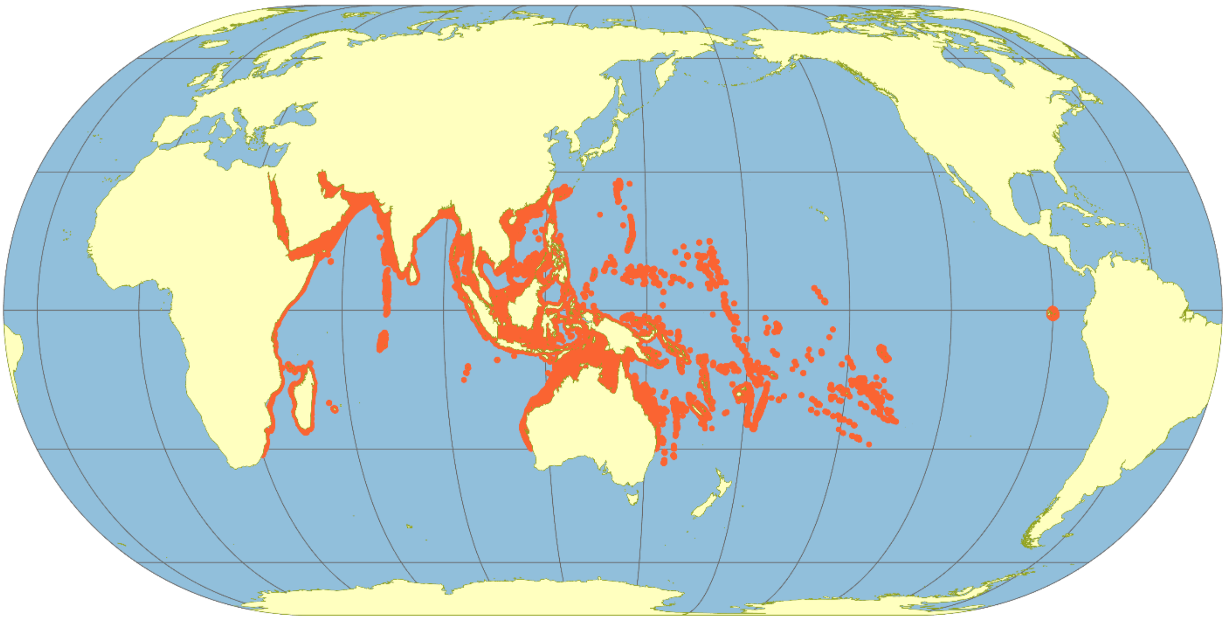
FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
Grey reef shark (*Carcharhinus amblyrhynchos*)							
Indian Ocean: Western (FAO 51); Eastern (FAO 57); Pacific: Western Central (FAO 71), Eastern Central (FAO 77)				IUCN Assessment		M	Simpfendorfer *et al.*, 2020
Smalltail shark (*Carcharhinus porosus*)							
Atlantic: Western Central (FAO 31), Southwest (FAO 41); Pacific: Eastern Central (FAO 77), Southeast (FAO 87).				IUCN Assessment		M	Pollom *et al.*, 2020
Ganges shark (*Glyphis gangeticus*)							
Indian Ocean, Eastern (FAO 57); Pacific, Eastern Central (FAO 77).				IUCN Assessment		M	Rigby *et al.*, 2021a
Whitecheek shark (*Carcharhinus dussumieri*)							
Indian Ocean, Western (FAO 51)				IUCN Assessment		M	Simpfendorfer *et al.*, 2019

FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
Dusky shark (*Carcharhinus obscurus*)							
Global				IUCN Assessment		M	Rigby *et al*., 2019
FAO 31	Western North Atlantic, including the Gulf of Mexico	1960-2015	Multiple, including demersal and pelagic longline commercial fisheries and recreational hook and line fishery	Relative spawning stock fecundity, biomass, and abundance. Relative fishing mortality also available: F_{2015}/F_{MSY} = 1.12	SSF_{2015}/SSF_0 = 0.18 B_{2015}/B_0 = 0.26; N_{2015}/N_0= 0.37	H	NMFS (2016)
FAO 57.5.2 and 57.5.1	Western Australia	1975-2015	Multiple, mostly Northern Shark Fisheries and Temperate Demersal Gillnet and Demersal Longline fisheries	Relative Total Biomass	46%, 73% & 100% chance of the current (2015–16) relative total biomass being above the target, threshold and limit biomass reference points	H	Braccini *et al*., 2021a
FAO 81	East coast of Australia	100 year projection from 2020	Ocean Trap and Line Fishery (NSW), East Coast Inshore Fin Fish Fishery (QLD)	Total population size (derived from NeOGen simulations of the Effective Population Size: Census Population Size relationship)	Between 52% and 82% depending on the future harvest assumed over a 100 period	H	Blower, 2020
FAO 51.8	Kwazulu Natal-S. Africa	1981-2019	Bather Protection Nets	Relative Index	55% relative to 1981	H	Dicken et. al. 2018
Area 71	Western Central Pacific	1995-2010	Longline	Nominal CPUE	7% increase relative to 1995	M-L	Tremblay-Boyer 2016
Sandbar shark (*Carcharhinus plumbeus*)							
Global				IUCN Assessment		M	Rigby *et al*., 2021b
FAO 31	Western North Atlantic,	1960-2015	Multiple, including demersal logline	Relative spawning stock fecundity,	SSB_{2015}/SSB_0 = 0.26	H	NMFS (2017)

FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
	including the Gulf of Mexico		commercial fishery, recreational hook and line fishery Mexican artisanal fisheries, and discards in menhaden commercial fishery	biomass, and abundance. Relative fishing mortality also available: $F_{2015}/F_{MSY} = 0.71$	$B_{2015}/B_0 = 0.30$; $N_{2015}/N_0 = 0.40$;		
FAO 57.5.2 and 57.5.1	Western Australia	1975-2015	Multiple, mostly Northern Shark Fisheries and Temperate Demersal Gillnet and Demersal Longline fisheries	Relative Total Biomass	62%, 83% & 99% chance of the current (2015–16) relative total biomass being above the target, threshold and limit biomass reference points	H	Braccini *et al.,* 2021a
FAO 81	East coast of Australia	100 year projection from 2020	Ocean Trap and Line Fishery (NSW), East Coast Inshore Fin Fish Fishery (QLD)	Total population size (derived from NeOGen simulations of the Effective Population Size: Census Population Size relationship)	Between 44% and 74% depending on the future harvest assumed over a 100 period	H	Blower 2020
Area 71	Western Central Pacific	1995-2014	Longline	Nominal CPUE	76% relative to 1995	M-L	Tremblay-Boyer, 2016
Blacknose shark (*Carcharhinus acronotus*)							
Atlantic: Western Central (FAO 31), Southwest (FAO 41)				IUCN Assessment		M	Carlson *et al.*, 2021
FAO 31	Western North Atlantic	1950-2009	Multiple, including demersal longline, gillnet, and line commercial fisheries, recreational hook and line fishery, and discards in shrimp trawl commercial fishery	Relative spawning stock fecundity, biomass, and abundance. Relative fishing mortality also available: $F_{2009}/F_{MSY} = 5.02$	$SSB_{2009}/SSB_0 = 0.24$ $B_{2009}/B_0 = 0.22$; $N_{2009}/N_0 = 0.33$;	H	NMFS (2011a)
FAO 31	Gulf of Mexico	1950-2009	Multiple, including demersal longline, gillnet,	Relative spawning stock fecundity,	$SSB_{2009}/SSB_0 = 0.19$;	L	NMFS (2011b)

FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
			and line commercial fisheries, recreational hook and line fishery, and mostly discards in shrimp trawl commercial fishery	biomass, and abundance. Relative fishing mortality also available: $F_{2009}/F_{MSY} = 0.62$	$B_{2009}/B_0 = 0.21$; $N_{2009}/N_0 = 0.19$;		
Smoothtooth blacktip Shark (*Carcharhinus leiodon*)							
Indian Ocean: Western (FAO 51)				IUCN Assessment		M	Simpfendorfer *et al.*, 2017
Broadfin shark (*Lamiopsis temmincki*)							
Indian Ocean, Western (FAO 51)				IUCN Assessment		M	Dulvy *et al.*, 2021
Sharptooth lemon shark (*Negaprion acutidens*)							
Indian Ocean; Western (FAO 51), Eastern (FAO 57); Pacific, Eastern Central (FAO 77).				IUCN Assessment		M	Simpfendorfer *et al.*, 2021

Figure 2. Distribution of grey reef shark (*Carcharhinus amblyrhynchos*)

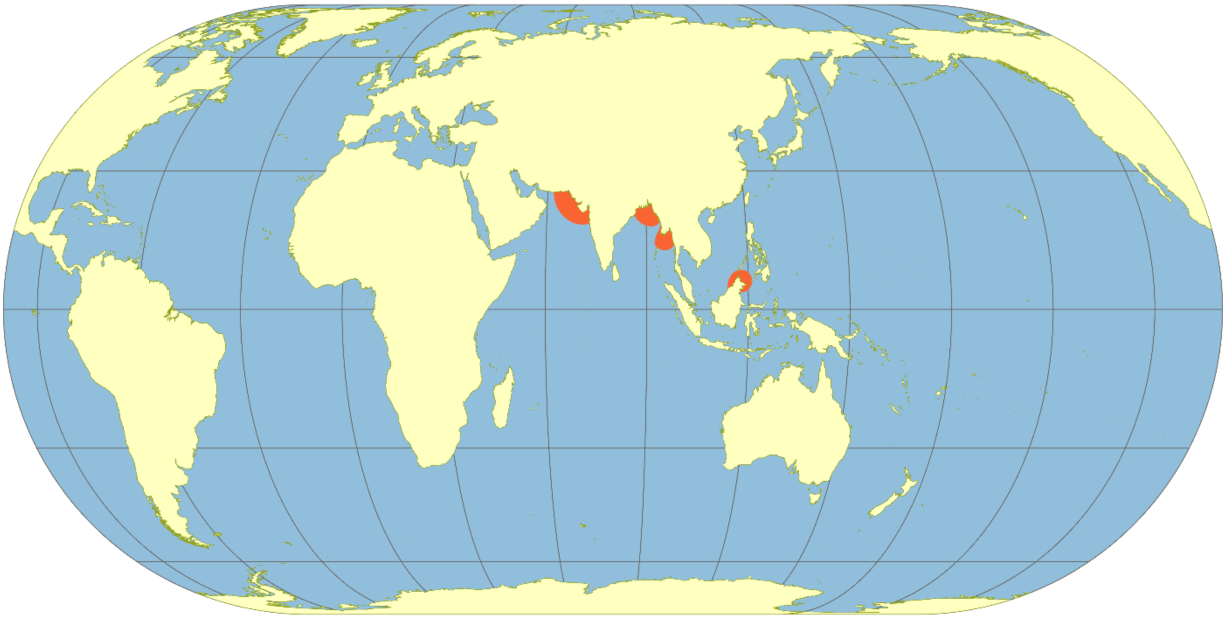


Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Simpfendorfer, C., Derrick, D., Yuneni, R.R., Maung, A., Utzurrum, J.A.T., Seyha, L., Haque, A.B., Fahmi, Bin Ali, A., , D., Bineesh, K.K., Fernando, D., Tanay, D., Vo, V.Q. & Gutteridge, A.N. 2021. *Negaprion acutidens*. *The IUCN Red List of Threatened Species* 2021: e.T41836A173435545. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T41836A173435545.en)

Figure 3. Distribution of smalltail shark (*Carcharhinus porosus*)

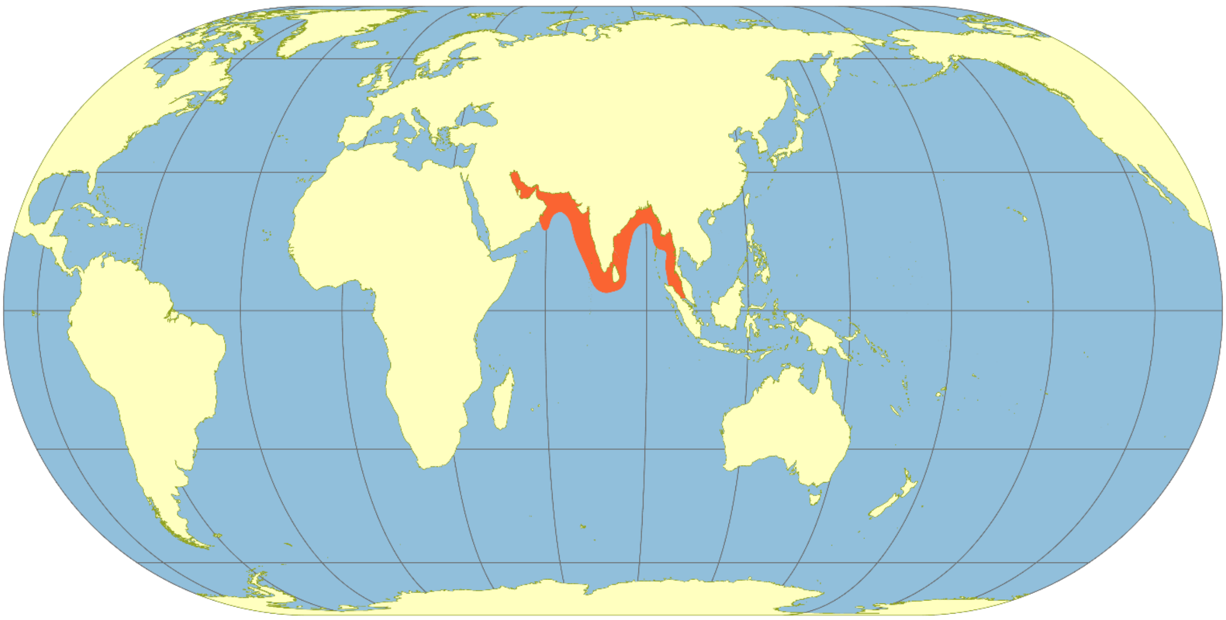
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Pollom, R., Charvet, P., Carlson, J., Derrick, D., Faria, V., Lasso-Alcalá, O.M., Marcante, F., Mejía-Falla, P.A., Navia, A.F., Nunes, J., Pérez Jiménez, J.C., Rincon, G. & Dulvy, N.K. 2020. *Carcharhinus porosus*. *The IUCN Red List of Threatened Species 2020*: e.T144136822A3094594. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T144136822A3094594.en)

Figure 4. Distribution of ganges shark (*Glyphis gangeticus*)



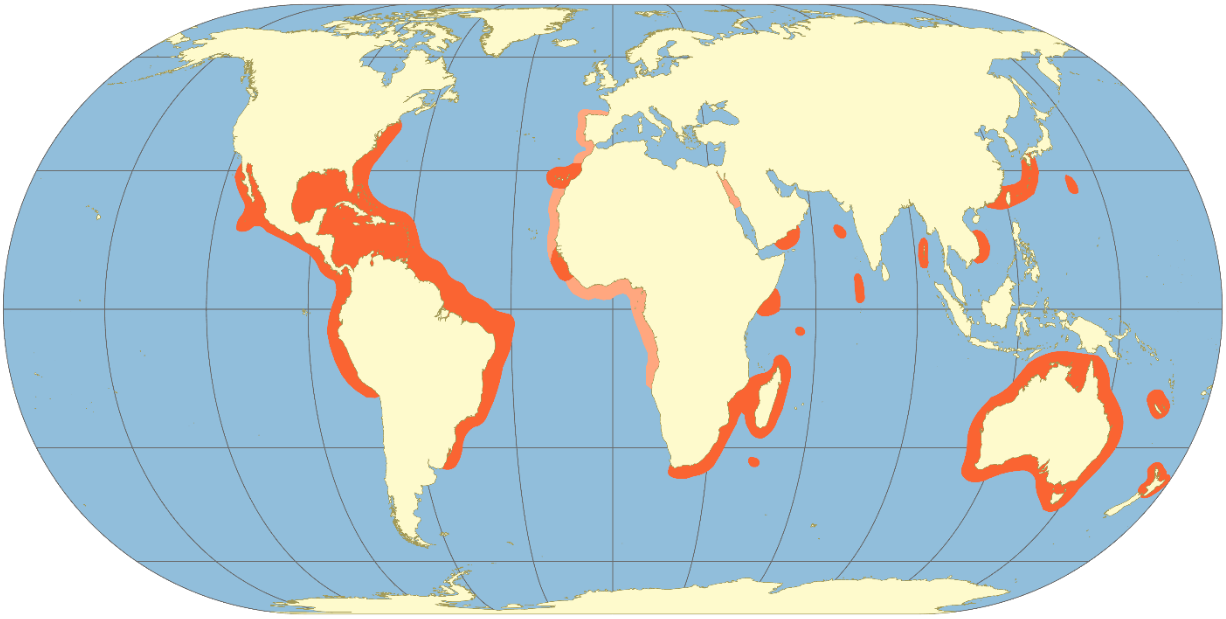
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Rigby, C.L., Derrick, D., Dulvy, N.K., Grant, I & Jabado, R.W. 2021. *Glyphis gangeticus*. *The IUCN Red List of Threatened Species 2021*: e.T169473392A124398647. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T169473392A124398647.en)

Figure 5. Distribution of whitecheek shark (*Carcharhinus dussumieri*)



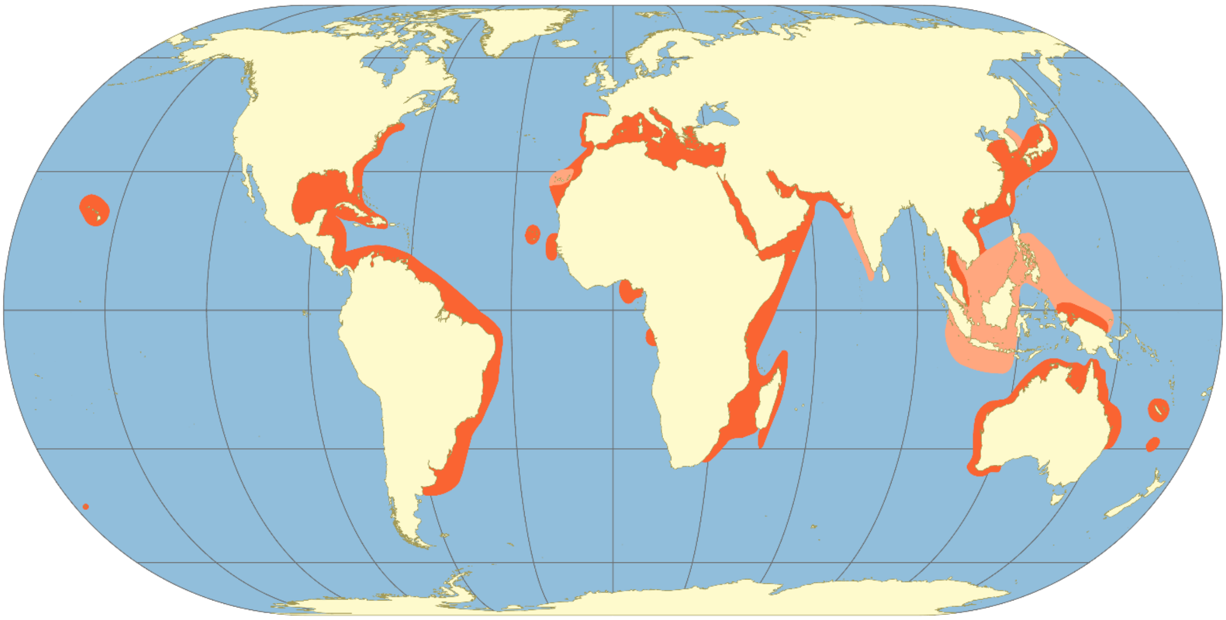
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Simpfendorfer, C., Jabado, R.W., Moore, A., Valinassab, T. & Elhassan, I. 2019. *Carcharhinus dussumieri*. *The IUCN Red List of Threatened Species 2019*: e.T70680197A68612632. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T70680197A68612632.en)

Figure 6. Distribution of dusky shark (*Carcharhinus obscurus*)



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Rigby, C.L., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Herman, K., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Carcharhinus obscurus*. *The IUCN Red List of Threatened Species* 2019: e.T3852A2872747. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T3852A2872747.en)
[orange = species distribution; light orange = presence uncertain]

Figure 7. Distribution of sandbar shark (*Carcharhinus plumbeus*)



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP;
modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Rigby, C.L., Derrick, D., Dicken, M., Harry, A.V., Pacoureau, N. & Simpfendorfer, C. 2021b. *Carcharhinus plumbeus. The IUCN Red List of Threatened Species 2021*: e.T3853A2874370. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T3853A2874370.en) **[orange = species distribution; light orange = presence uncertain]**

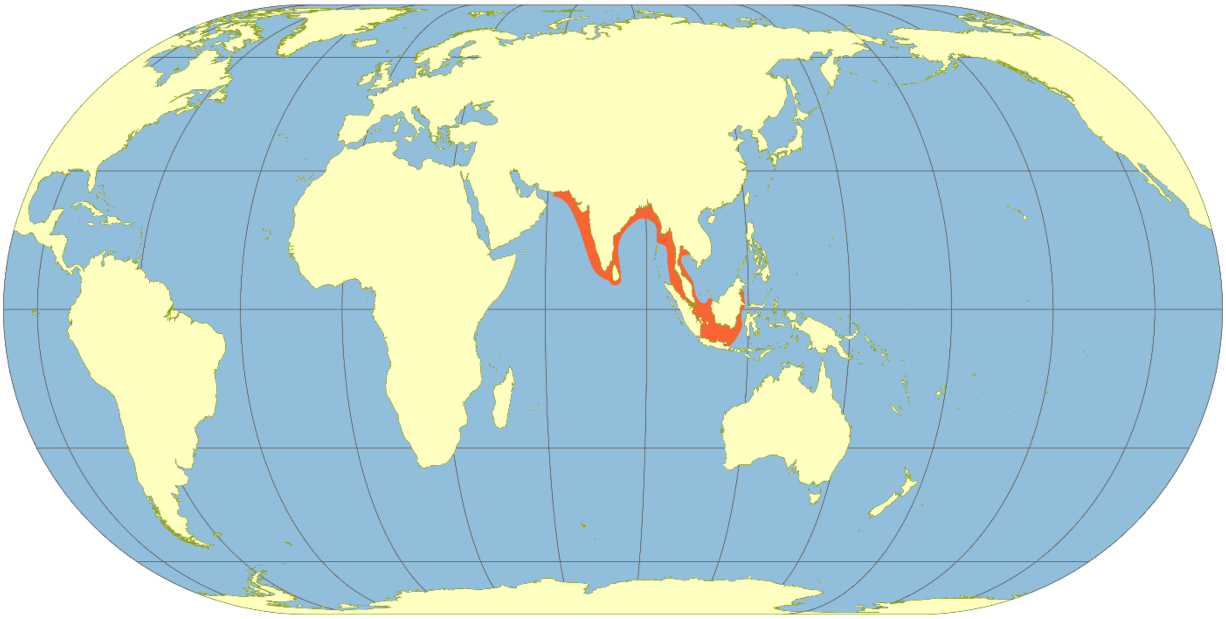
Figure 8. Distribution of blacknose shark (*Carcharhinus acronotus*)

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Carlson, J., Charvet, P., Avalos, C., Blanco-Parra, MP, Briones Bell-lloch, A., Cardenosa, D., Espinoza, E., Morales-Saldaña, J.M., Naranjo-Elizondo, B., Pérez Jiménez, J.C., Schneider, E.V.C., Simpson, N.J., Talwar, B.S., Crysler, Z., Derrick, D., Kyne, P.M. & Pacoureau, N. 2021. *Carcharhinus acronotus. The IUCN Red List of Threatened Species 2021*: e.T161378A887542. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T161378A887542.en)

Figure 9. Distribution of smoothtooth blacktip shark (*Carcharhinus leiodon*)

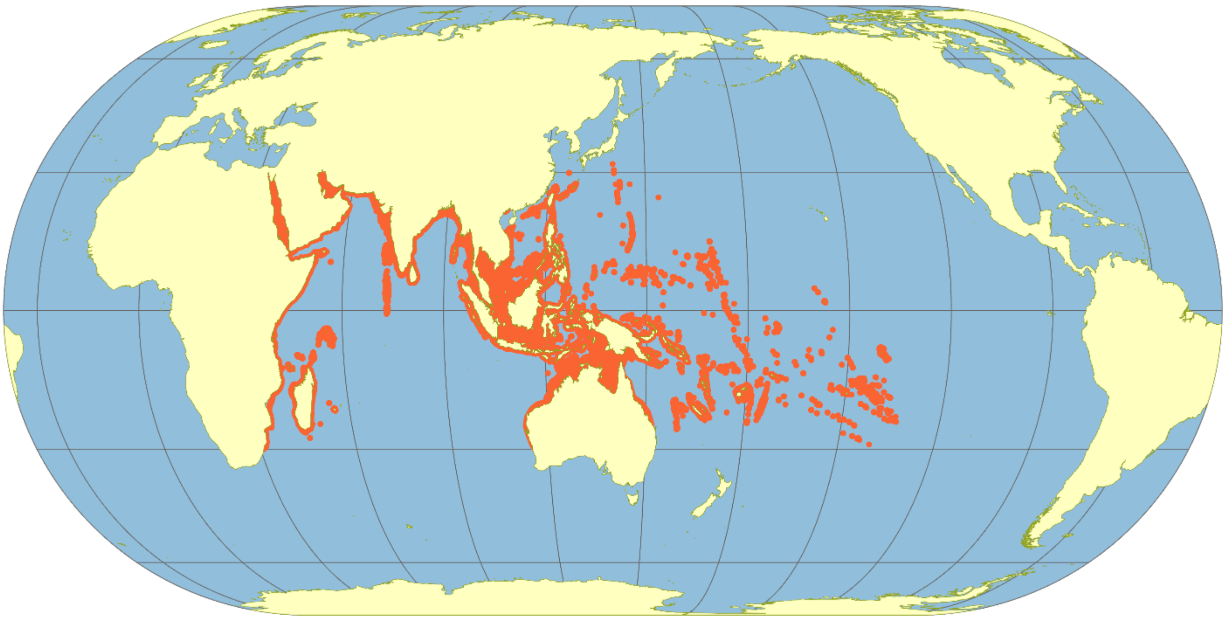
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Simpfendorfer, C., Jabado, R.W., Valinassab, T., Elhassan, I. & Moore, A. 2017. *Carcharhinus leiodon*. *The IUCN Red List of Threatened Species* 2017: e.T39371A109876922. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T39371A109876922.en)

Figure 10. Distribution of broadfin shark (*Lamiopsis temmincki*)



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Dulvy, N.K., Al Mamari, T., Bineesh, K.K., Derrick, D., Haque, A.B., Maung, A., Moore, A. & VanderWright, W.J. 2021. *Lamiopsis temminckii*. *The IUCN Red List of Threatened Species* 2021: e.T169760690A124508850. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T169760690A124508850.en)

Figure 11. Distribution of sharptooth lemon shark (*Negaprion acutidens*)



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Simpfendorfer, C., Derrick, D., Yuneni, R.R., Maung, A., Utzurrum, J.A.T., Seyha, L., Haque, A.B., Fahmi, Bin Ali, A., D., Bineesh, K.K., Fernando, D., Tanay, D., Vo, V.Q. & Gutteridge, A.N. 2021. *Negaprion acutidens. The IUCN Red List of Threatened Species 2021*: e.T41836A173435545. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T41836A173435545.en)

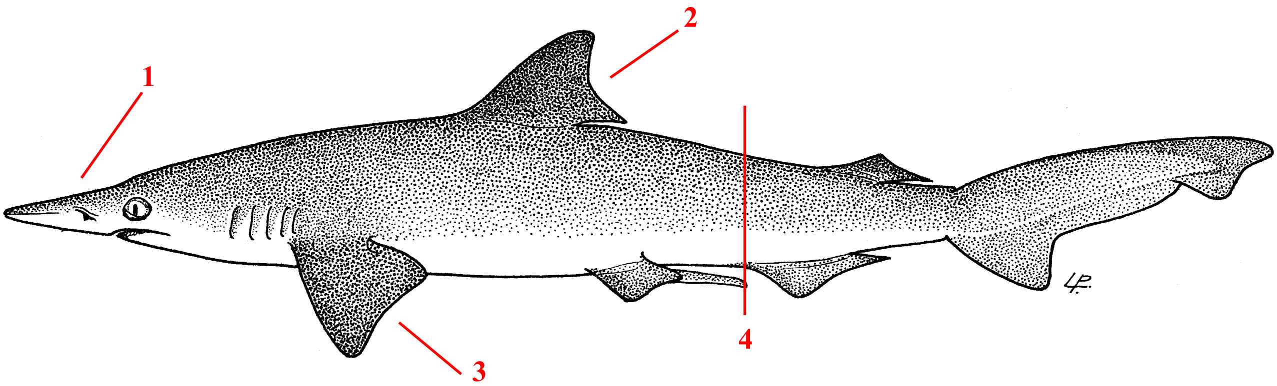


Figure 12. Identification characteristics of *Scoliodin laticaudus*: 1) depressed spadenose shape of the snout; 2) pectoral fin; 3) dorsal fin; 4) insertion of anal fin.

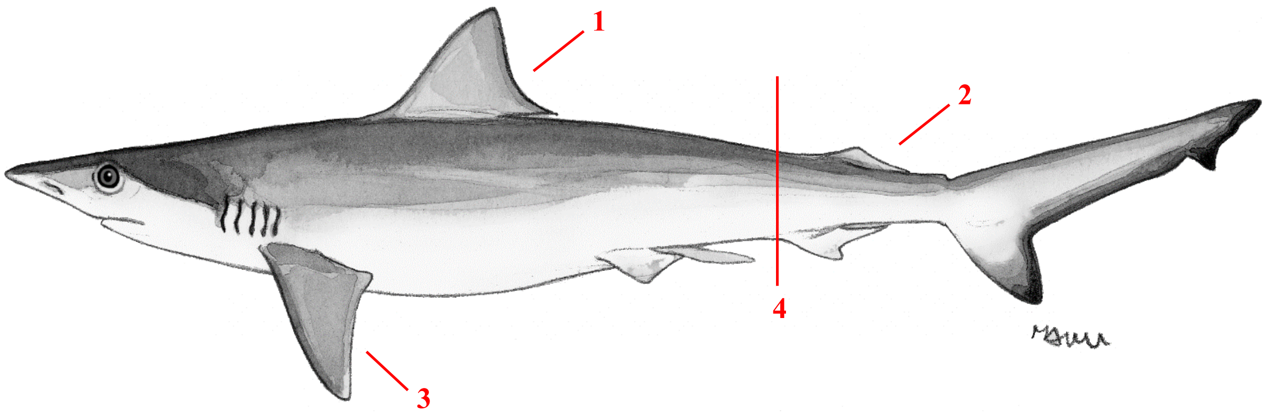


Figure 13. Identification characteristics of *Rhizoprionodon acutus*: 1) dorsal fin; 2) second dorsal fin; 3) pectoral fin; 4) insertion of the anal fin.

Figure 14. Letter from Dr. Cui He, President of China Aquatic Products Processing and Marketing Alliance

中国水产流通与加工协会

China Aquatic Products Processing and Marketing Alliance

地址：北京市朝阳区麦子店街40号富丽华园A-403 邮编：100125
Add Room A-403, Fuli Garden Residence, No. 40 Maizidian Street Chaoyang District Beijing 100125, China
Tel:(86-01)65082912 Fax:(86-01)65005270
Http://www.cappma.org E-mail:chinaseafood@vip.sina.com

19th July 2022

Mr. Kim Friedman
Senior Fishery Resources Officer
Fisheries and Aquaculture Division(NFI)
Food and Agriculture Organization of the United Nations (FAO)
Vialle delle Terme di Caracalla, 00153 Rome, Italy

Subject: Information relevant to sharks and sea cucumber proposal on CoP19

Dear Mr. Kim Friedman,

With reference to the CITES Panama Proposal to include a broad range of shark under CITES Appendix II, our membership offer FAO information on trade and industry management issues for these species, especially the ability of traders to differentiate commodities in trade, regarding to the sharks and rays, and sea cucumber species in CoP19 listing proposal.

China Aquatic Products Processing and Marketing Alliance (CAPPMA) has established a Sea Cucumber Committee, Shark Conservation and Sustainable Utilization Working Committee, which includes the main traders in domestic industry.

Based on our recent survey to one of the biggest dry seafood domestic market which located in Guangzhou, currently 90% shark fin in circulation on the market was blue shark (*Prionace glauca*), with Chinese trade name "Yajian Chi". The other 10% mainly include mako shark (Gaocha Chi), Silky Shark (Wuyang Chi), Thresher shark (Migu Chi), guitarfishes and wedgefishes (Qun Chi), Hammerhead shark (Chun Chi), Bull shark (Shaqing Chi) and grey reef shark (Heiweiqing Chi) and others. Among which most of the listed species were obtained before the convention, as RFMOs prohibit the retention of related species and limitation on NDF and IFS.

According to information from China's distant Ocean Fisheries Research Center, the assessment of the Central and Western Pacific Fisheries Commission (WCPFC) shows that the current status of blue sharks is stable and healthy. But China's tuna longline fishery takes measures to discard the by-catch sharks and records in the fishing log, with low utilization. The blue shark fin in domestic market is mainly sourced from imports.

The blue shark fins have obvious features, from the shape, it is long and thin, the thickness was about half of the other fin, and the texture is soft and flexible. From the color, it is black for the up and white for the down side. From the taste, the cartilage in blue shark fins could completely melts after a long time stewing, unlike other shark species. Thus the fins of blue shark can be easily identified by eye observation and hand touch in trade. See attachment for comparison of common shark fin pictures.

For the listing *Thelenota* species, they are low price and low consumer recognition, compared with the domestic popular farmed sea cucumber *(Apostichopus japonics)* and the fishing pressure on the species is quite limited. We believe that to list them into CITES appendix for restrictive trade management is not an effective mechanism for addressing the decline of this species in locations that are depleted.

We hold opinion that it is unwise to abuse the CITES 'look alike' principle by voting for the inclusion of other similar marine species where scientific data are insufficient for assessment. In the case of such listings, legal trade will be interrupted while illegal trade will remain un-affected or increased, which leads to the disruption of the normal global fishery trade chain. Improving the management mechanism of commercial fishery species in various countries is the key factor for the protection and sustainable use of marine species, rather than listing more related species in the appendix.

Thank you again for your consideration on the information we provided. If you have any other questions please do not hesitate to contact me.

Best Regards

Dr. Cui He
President of
China Aquatic Products Processing and Marketing Alliance

我国真鲨科鱼翅产品（部分）
Family Carcharhinidae species in China shark fin trade (part of)

物种名称及商品名 **Species and trade name**	图像 Image	
拉丁文名：*Prionace glauca* 英文名：Blue shark 中文名：大青鲨 鱼鳍制品中文名： 牙拣翅（Yajian Chi）		
拉丁文名：*Carcharhinus leucas* 英文名：Bull shark 中文名：白真鲨 鱼鳍制品中文名： 沙青翅（Shaqing Chi）		
拉丁文名：*Carcharhinus obscurus* 英文名：dusky shark 中文名：灰色真鲨 鱼鳍制品中文名： 海虎翅（Haihu Chi）		

拉丁文名：*Carcharhinus falciformis* 英文名：Silky Shark 中文名：镰状真鲨 鱼鳍制品中文名： 五羊翅（Wuyang Chi）		
拉丁文名：*Carcharhinus longimanus* 英文名：Oceanic white tip shark 中文名：长鳍真鲨 鱼鳍制品中文名： 琉球翅（Liuqiu Chi）		

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT – COP19 PROPOSAL 38
Bonnethead, *Sphyrna tiburo* and all other hammerhead sharks, etc. nei

Species

Bonnethead (*Sphyrna tiburo*)

Proposal

To include the bonnethead shark (*Sphyrna tiburo*) in Appendix II in accordance with Article II paragraph 2(a) and all remaining species in the family Sphyrnidae that are not already listed in CITES Appendix II, including winghead shark (*Eusphyra blochii*), scalloped bonnethead (*S. corona*), carolina hammerhead (*S. gilberti*), scoophead shark (*S. media*) and smalleye hammerhead (*S. tudes*), as well as any other yet to be identified species of the family Sphyrnidae in Appendix II in accordance with Article II paragraph 2(b).

Assessment summary

SPECIES	MEETS CITES CRITERIA	DOES NOT MEET CITES CRITERIA	OTHER
Bonnethead *Sphyrna tiburo*	✓		

Overall, the best available scientific data and technical information on bonnethead demonstrated that the historical extent, recent rate and projected future declines, when taken together, met the CITES listing criteria for Appendix II.

Bonnethead may be a species complex, and there was important variation in the status of different units of the population: (i) Northwest Atlantic and Gulf of Mexico; (ii) Southwest Atlantic; and (iii) Eastern Central and Southeast Pacific. Bonnethead in the Northwest Atlantic and Gulf of Mexico, for which there are stock assessments, were found to **not meet the listing criteria**. However, the populations of bonnethead in both the Southwest Atlantic and Eastern Pacific, where anecdotal reports indicate strong though unquantified declines, were both considered to potentially have **met the listing criteria**.

On balance, the FAO Expert Panel considered that consistent with the proportionate risk to the species as a whole, *S. tiburo* **met the CITES Appendix II listing criteria**.

Summary of evaluation and assessment of biological listing criteria

The Expert Panel noted the current taxonomic uncertainty of the medium productivity of *S. tiburo*, and that bonnethead may comprise a species complex. For the purposes of this review, the Expert Panel considered three population units: (i) Northwest Atlantic and Gulf of Mexico; (ii) Southwest Atlantic; and (iii) Eastern Central and Southeast Pacific.

The Expert Panel considered that fishing pressure is the main impact on the populations of bonnethead – hammerhead sharks often have higher rates of capture mortality (cf. other Carcharhiniformes sharks). The Expert Panel noted the outputs of the most recent stock assessments for bonnethead in the Northwest Atlantic and Gulf of Mexico regions and the increasing trends in relative abundance indices estimated from surveys. These populations did not meet the criteria to be listed under CITES Appendix II.

Quantitative data on the populations in the Southwestern Atlantic and the Eastern Pacific were more limited. There was strong qualitative evidence of historical declines in extent in both these areas, including the potential for localized depletion and extirpation. Given the inshore distribution of bonnethead, high levels of fishing activity in both these areas and localized impacts to the habitat of this species from other human pressures, the Expert Panel considered that there would likely be continued declines in bonnethead populations in these areas.

The Expert Panel noted that bonnethead is often used for domestic consumption, yet the fins of bonnethead are secondarily sold in the international fin trade. These fins comprise only a small proportion of the fins in trade at the current time – it is unclear as to whether the fin trade would be a significant driver in exploitation levels in comparison to domestic use.

The Expert Panel noted that the proposal indicated that all species in the family Sphyrnidae should be included in Appendix II (in line with Article II, paragraph 2(b) of the CITES Convention), due to the challenges in distinguishing parts and derivatives of hammerhead sharks that might be traded internationally (the look-alike provision). Owing to the evolving taxonomy of the family and known identification problems, the Expert Panel noted that any management measures developed by competent authorities for this group would generally be better applied at the family level (Sphyrnidae). Furthermore, the Expert Panel recalled the findings of an earlier FAO Expert Advisory Panel that reviewed the proposals for *S. zygaena*, *S. lewini* and *S. mokarran*, with that review stating: «It is not clear why the other species in the family Sphyrnidae were not proposed to be listed as "look-alikes" (FAO, 2013) ».

Scientific assessment in accordance with CITES biological listing criteria

Species distribution

S. tiburo occurs in the western Atlantic (FAO Areas 21, 31 and 41), extending from the Atlantic coasts of the United States of America to southern Brazil and northern Uruguay, including the coasts of the Gulf of Mexico and Central America, and also occurs in the eastern Pacific (FAO Areas 77 and 87) from Baja California to Peru (Figure 15).

Regional differences in life-history parameters have been documented, and it may even be a species complex (Fields *et al*., 2016), with discrete "elements" in (i) Northwest and Western Central Atlantic; (ii) Caribbean Sea and Southwest Atlantic; and (iii) Eastern Pacific (Pollom *et al*., 2021).

S. tiburo occurs in coastal waters, including estuaries, and the inner continental shelf seas and utilizes a range of habitat types.

Species productivity

MEDIUM PRODUCTIVITY

> There can be regional variation in some life-history parameters; however, due to the size of the species, and mortality information the Expert Panel classified *S. tiburo* to be of medium productivity.

The Southeast Data, Assessment and Review (NMFS, 2013) assessments for the Northwest Atlantic and Gulf of Mexico region used two scenarios for natural mortality, with respective average values equal to 0.2 and 0.25. The relatively small-bodied species *S. tiburo* (L_{max} = 150 cm) was classified by the Expert Panel to be of medium productivity.

There can be regional variation in some life-history parameters, with some parameters indicative of low productivity (Table 5), following the approach of Musick (1999).

Population numbers

The size of the population has only been estimated for the Northwest Atlantic coast and the Gulf of Mexico using an integrated age-structured production model.

Trends and application of the decline criterion

The population of *S. tiburo* in the Northwest Atlantic and Gulf of Mexico, assessed as a single stock unit in 2013, appeared to be increasing from an overfished state and would not meet the criteria to be listed under CITES Appendix II. However, for the other two regions considered – Southwest Atlantic and Eastern Central and Southeast Pacific – there is information indicating that the species has been extirpated from parts of its former range or suffered serious depletion.

While the recent rate of decline is unknown, the historical extent of decline is likely to have met or exceeded the threshold for listing on CITES. Given the coastal nature of the species, and overlap with ongoing fishing activities which are largely unregulated, future declines in abundance are likely to continue in these areas.

Based on the extent of decline in the southwestern Atlantic and the eastern Pacific, the Expert Panel considered that on balance, and consistent with the proportionate risk to the species as a whole, *S. tiburo* meets the CITES listing criteria for Appendix II.

Information of variable quality is available from three geographic regions: (i) Northwest Atlantic and Gulf of Mexico; (ii) Southwest Atlantic; and (iii) Eastern Central and Southeast Pacific. There are assessments for the Northwest Atlantic and Gulf of Mexico populations (SEDAR 34 from 2013). For the other two regions there is local anecdotal information that has been used in the IUCN assessment to classify the species in those regions as Critically Endangered (Pollom *et al*., 2021).

The information evaluated by the Expert Panel regarding population trends in different oceanic regions is summarized below and in Table 6 andTable 7.

Northwest Atlantic Ocean and Gulf of Mexico

In summary, for the Northwest Atlantic Ocean and Gulf of Mexico, the FAO Expert Advisory Panel concluded that, based on the estimates of depletion from the most recent assessments and the increasing trends observed in relative abundance indices estimated from surveys, the population in this region does not meet the criteria to be listed under CITES Appendix II.

The stocks in this area are assessed periodically, and there are a number of published studies providing life-history information.

The most recent assessment from SEDAR for Northwest Atlantic and Gulf of Mexico (NMFS, 2013) estimated a depletion in terms of spawning stock fecundity (SSF, defined as numbers × proportion mature × fecundity in numbers) in 2011 in the range of 0.36–0.39 compared to the unexploited level, not meeting the criteria for CITES listing. The baseline assessment estimates showed a decreasing trend that started in the 1970s and lasted until the late 1990s, reaching a minimum relative SSF of 0.23, followed by a progressive increase over the last decade covered by the assessment. In addition, fishing mortality estimates for the latter period were low, following a decrease in effort and catches in the shrimp trawl fisheries, where *S. tiburo* is caught as bycatch. The SEDAR assessment also indicated that the fishing mortality in 2011 was 0.50–0.54 of F_{MSY}. The index of relative abundance, derived from the Southeast Area Monitoring and Assessment Program (SEAMAP) coastal trawl survey provided by Peterson *et al*. (2017) for the period 1989–2014, showed an increasing trend since 2000, which was also supported by other state longline and gillnet surveys. The available time series of abundance indices provided good coverage of the Atlantic sector, but data were more limited for the Gulf of Mexico sector.

Based on the SEDAR assessment, the status of bonnethead sharks was assessed to be not overfished and with no overfishing occurring. However, the FAO Expert Advisory Panel noted that, while the stocks were assessed as a single stock unit, there was strong evidence for two separate stocks in the Atlantic and the Gulf of Mexico, which has led scientists to recommend that separate assessments be conducted for the two regions. Until that is done, the US National Marine Fisheries Service has decided to list the two stocks separately and classify their status as unknown.

Southwest Atlantic Ocean

> In summary, in the Southwest Atlantic Ocean, the FAO Expert Advisory Panel concluded that the extent of current depletion (although not quantifiable) is variable across the range and unknown for the overall population in the region. Continued unregulated fishing pressure in coastal sectors where the species is still encountered is likely to cause further declines in abundance. On this basis, the FAO Expert Advisory Panel considered that the population in this region meets the criteria to be listed under CITES Appendix II.

For the Southwest Atlantic of Central and South America, the existing anecdotal evidence indicates declines of concern. The extent of the declines in different regions are not quantifiable, although they may appear to be less extreme than in the Eastern Pacific coasts. In particular, while records have been increasingly rare in the Caribbean, in sectors where they used to be abundant, the species continues to be comparatively common in the catches from other regions (e.g. Venezuela, Bolivarian Republic of). In Brazil, on the other hand, the species has been classified as extinct, collapsed or depleted, depending on the state.

Eastern Pacific Ocean

> In summary, the FAO Expert Advisory Panel found that the evidence provided about the current extent of decline, although anecdotal, was sufficient to conclude that the species in the Eastern Pacific Ocean is likely to be below the threshold established for a CITES listing.

For the Eastern Central and Southeast Pacific, there are clear signs of a decline evidenced by lack of recent records of the species from large parts of Mexico and Central America, where it used to be abundant (e.g. Gulf of California, Pacific coast of Central America, Colombia and Ecuador). In Mexico, the species was targeted by artisanal fishers in the 1990s, but the last record was from Oaxaca in 2006.

Modifying risk factors

The Expert Panel considered whether there were any biological characteristics of *S. tiburo* that would modify its probability of being depleted to the point where it would meet the criteria for listing.

The Expert Panel noted the current uncertainty regarding the taxonomic status of bonnethead (Fields *et al*., 2016) and the potential for it being a species complex. If there are discrete "population units", or cryptic speciation, then the more limited geographical range of such units could make these units more susceptible to localized depletion.

Because of their size, body form (including the shape of the head), demersal lifestyle and feeding behaviour, this species is susceptible to being a bycatch of trawl, gill- and tangle-net, longline and other fisheries directed at a range of target species. There may also be some recreational fisheries. The Expert Panel also noted that the capture mortality (at-vessel and post-release mortality) of hammerhead sharks was often higher in comparison to other Carcharhiniformes sharks (Ellis *et al*., 2017).

The Expert Panel also noted that there was uncertainty in current exploitations levels for hammerhead sharks (Sphyrnidae), including *S. tiburo*, in many parts of the distributional range given that many commercial landings are often reported only at the taxonomic level of family. *S. tiburo* can be a bycatch in several fisheries, including gillnet fisheries and trawl fisheries for shrimps, and the levels of (dead) discards is uncertain. The Expert Panel did not have the time to make a detailed examination of all data that may be available in relevant national datasets, and considered that a more focused effort to collate relevant landings, discards and catch data could usefully be undertaken.

S. tiburo also has a coastal distribution, with coastal and estuarine nursery grounds. As such, gravid females and juveniles may be susceptible to capture in a variety of inshore fisheries. Its coastal distribution also suggests that other anthropogenic activities (e.g. habitat degradation, pollution) might impact on some populations, but the Expert Panel could not quantify such potential impacts.

Comments on technical aspects relating to management, trade and likely effectiveness of implementation of a CITES listing

Management comment

The FAO IPOA-Sharks underscores the responsibilities of fishing and coastal states in sustaining shark populations, ensuring the full utilization of sharks that are retained and improving shark data collection and monitoring. As a coastal species, management via other international or regional bodies generally does not apply to *S. tiburo*, although national management plans cover these coastal species in many regions. These include, for example, gear and size regulations in some states, and shark finning is banned across other states.

International/regional

- The FAO IPOA-Sharks underscores the responsibilities of fishing and coastal states in sustaining shark populations, ensuring the full utilization of sharks that are retained and improving shark data collection and monitoring (see Appendix G, especially point 3, in FAO, 2019).
- As a coastal species, management via other international or regional bodies does not apply to *S. tiburo*.

National measures

- Shark stocks in the United States of America are managed under the Highly Migratory Species Fisheries Management Plan, which includes separate quotas for all small coastal sharks combined, including *S. tiburo* and excluding blacknose shark (*Carcharhinus acronotus*), for the Atlantic and Gulf of Mexico regions. Additional gear and size regulations are established by the states.
- In Mexico, there are fishing season closures and gear restrictions in some areas and habitats. Shark sanctuaries have been established in some countries and regions (e.g. the Bahamas; Bonaire, Sint Eustatinus and Saba; and Honduras), and shark finning has been banned in others (e.g. Central American countries). Over the rest of the distributional range, artisanal fisheries throughout the Atlantic and Pacific coasts of South America are subject to minimum regulations.

Trade comment

A coastal species, *S. tiburo* is primarily utilized for meat in domestic markets with fins traded internationally. The Expert Panel notes that the comparatively smaller fins of *S. tiburo* made up a small proprtion of fins in international trade, and could not find evidence to indicate that the international trade in products derived from *S. tiburo* was a significant driver of current levels of exploitation.

Pollom *et al*. (2021) noted that *S. tiburo* is utilized for meat and fins, with the latter used in domestic markets and the fins traded internationally. However, based on available published studies, *S. tiburo* appears to contribute a small proportion of the species used in the fin trade (Table 8; 0.04–0.4 percent), with the highest value relating to the trade in smaller fins (Cardeñosa *et al*., 2020a). The Expert Panel could not find evidence to indicate that the international trade in products derived from *S. tiburo* was a significant driver of current levels of exploitation.

A CITES Appendix II listing applies only to international trade in listed species and their products. Domestic trade in bonnethead and its products would be unaffected by listing in CITES Appendix II. Landing and selling bonnethead could therefore continue in domestic markets without any changes to current practices.

Basis for Article II paragraph 2(b) ("look-alike") Appendix II listing of Sphyrnidae

The Expert Panel noted that the proposal indicated that all species in the family Sphyrnidae should be included in Appendix II (in line with Article II, paragraph 2(b) of the CITES Convention) owing to the challenges in distinguishing parts and derivatives of hammerhead sharks that might be traded internationally (the look-alike provision).

In a review of proposed CITES Appendix II listings for *Sphyrna lewini*, *S. mokarran* and *S. zygaena*, FAO (2013) had previously noted that: «It is not clear why the other species in the family Sphyrnidae were not proposed to be listed as "look-alikes"».

Given there is the potential for changes in the number of recognized species of hammerhead shark, the Expert Panel considered that it would be appropriate to list hammerhead sharks at the family level (Sphyrnidae).

Comment on the likely effectiveness for conservation of a CITES Appendix II listing

Because of the evolving taxonomy of the family and known identification problems, the Expert Panel supported management measures by competent authorities for this group at the family level (Sphyrnidae).

A requirement for conducting NDFs would address the need to determine and take all sources of mortality into account and would likely increase the requirement for reporting of bonnethead catches, where landing is permitted. However, noting the lack of *S. tiburo* fishery information across some of range states, this will likely limit the ability for these states to make a positive NDF (as evidenced by the situation encountered for shark and ray species already listed), which may lead to the following outcomes: i. previous trade is delayed for a significant period of time or ceases; ii. trade continues without proper CITES documentation (also known as "illegal trade"); and/or iii. trade continues with inadequate NDFs.

Because of the evolving taxonomy of the family and known identification problems, the Expert Panel noted that any management measures developed by competent authorities for this group would generally be better applied at the family level (Sphyrnidae). The Expert Panel noted that the proposal also stated that "A recent analysis presented to the Animals Committee as AC30 Inf.14 concluded that due to this newfound trade in non-CITES-listed hammerhead fins, it was highly recommended to list the remainder of the Sphyrnidae Family for compliance, enforcement and reporting purposes".

A requirement for conducting NDFs would address the need to determine and take all sources of mortality into account, and the reporting of bonnethead catches, where landing is permitted, would be likely be improved in some cases.

Appendix II listing may generate additional information and could assist in improving management and compliance in fisheries taking *S. tiburo* by providing an impediment to trading in bonnethead products illegally obtained from fisheries where retention bans are in place due to the requirement to supply CITES documentation.

As the CITES provisions on trade in specimens of species listed in Appendix II require an export permit by the exporting country, which will 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; then, should bonnethead be listed in Appendix II, the extension of the listing to all remaining species in the family Sphyrnidae on the basis of the look-alike provision in the proposal will require the same consideration and export permits for all species in the family.

Hence, legal trade will be recorded in the CITES Trade Database, with the benefit of improving overall trade information. However, noting the lack of *S. tiburo* fishery information across some range states, this will likely limit the ability for these states to make a positive NDF (as evidenced by the situation encountered for shark and ray species already listed), which may lead to the following outcomes: i. previous trade is delayed for a significant period of time or ceases; ii. trade continues without proper CITES documentation (also known as "illegal trade"); and/or iii. trade continues with inadequate NDFs.

References

Cardeñosa, D., Fields, A.T., Babcock, E.A., Zhang, H., Feldheim, K., Shea, S.K., Fischer, G.A. & Chapman, D.D. 2018. CITES-listed sharks remain among the top species in the contemporary fin trade. *Conservation Letters*, 11(4): e12457.

Cardeñosa, D., Shea, K.H., Zhang, H., Feldheim, K., Fischer, G.A. & Chapman, D.D. 2020a. Small fins, large trade: a snapshot of the species composition of low-value shark fins in the Hong Kong markets. *Animal conservation*, 23(2): 203–211.

Cardeñosa, D., Fields, A.T., Babcock, E.A., Shea, S.K., Feldheim, K.A. & Chapman, D.D. 2020b. Species composition of the largest shark fin retail-market in mainland China. *Scientific Reports*, 10(1): 1–10.

Chuang, P.S., Hung, T.C., Chang, H.A., Huang, C.K. & Shiao, J.C. 2016. The species and origin of shark fins in Taiwan's fishing ports, markets, and customs detention: a DNA barcoding analysis. *PloS ONE*, 11(1): e0147290.

Clarke, S.C., McAllister, M.K. & Michielsens, C.G. 2005. Estimates of shark species composition and numbers associated with the shark fin trade based on Hong Kong auction data. *Journal of Northwest Atlantic Fishery Science*, 35: 453–465.

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

Ellis, J.R., McCully Phillips, S.R. & Poisson, F. 2017. A review of capture and post-release mortality of elasmobranchs. *Journal of Fish Biology*, 90: 653–722.

Holmes, B.H., Steinke, D. & Ward, R.D. 2009. Identification of shark and ray fins using DNA barcoding. *Fisheries Research*, 95(2–3): 280–288.

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. 161 pp.

FAO. 2019. *Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, Rome, 21–25 January 2019*. FAO Fisheries and Aquaculture Report No. 1255. Rome. Licence: CC BY-NC-SA 3.0 IGO.

Fields, A.T., Feldheim, K.A., Gelsleichter, J., Pfoertner, C. & Chapman, D.D. 2016. Population structure and cryptic speciation in bonnethead sharks *Sphyrna tiburo* in the south-eastern USA and Caribbean. *Journal of Fish Biology*, 89(5): 2219–2233.

Fields, A.T., Fischer, G.A., Shea, S.K., Zhang, H., Abercrombie, D.L., Feldheim, K.A., Babcock, E.A. & Chapman, D.D. 2018. Species composition of the international shark fin trade assessed through a retail-market survey in Hong Kong. *Conservation Biology*, 32(2): 376–389.

Musick, J.A. 1999. Criteria to define extinction risk in marine fishes: The American Fisheries Society Initiative. *Fisheries*, 24: 12: 6–14.

NMFS. 2013. *Southeast Data, Assessment and Review (SEDAR 34) – HMS Bonnethead shark*. . South Atlantic Fishery Management Cuncil, North Charleston, SC, USA. Cited 18 July 2022. http://sedarweb.org/sedar-34-final-stock-assessment-report-bonnethead-shark.

Peterson, C.D., Belcher, C.N., Bethea, D.M., Driggers III, W.B., Frazier, B. S. & Latour, R.J. 2017. Preliminary recovery of coastal sharks in the south-east United States. *Fish and Fisheries*, 18(5): 845-859.

Pollom, R., Carlson, J., Charvet, P., Avalos, C., Bizzarro, J., Blanco-Parra, MP, Briones Bell-lloch, A., BurgosVázquez, M.I., Cardenosa, D., Cevallos, A., Derrick, D., Espinoza, E., Espinoza, M., Mejía-Falla, P.A., Morales-Saldaña, J.M., Navia, A.F., Pacoureau, N., Pérez Jiménez, J.C. & Sosa-Nishizaki, O. 2021. *Sphyrna tiburo (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2021*: e.T39387A205765567. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T39387A205765567.en

UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP

Tables and figures

Table 5. Productivity of bonnethead (M: male; F: female).

PARAMETER	STATUS	INFORMATION	AREA	SOURCE	COMMENTS
TL max		150 cm	Atlantic: Northwest (FAO 21), Western Central (FAO 31), Southwest (FAO 41); Pacific, Eastern Central (FAO 77), Southeast (FAO 87).	Ebert, Dando and Fowler, 2021	
K	Medium	0.18 (F), 0.29 (M)	Western North Atlantic (FAO areas 21, 31)	Frazier *et al*., 2014	
A max	Medium	M: 5–6; F: 7–8 years	FAO 31, Gulf of Mexico; Atlantic, Southeast (FAO 47)	Lombardi-Carlson *et al*. 2003; Frazier *et al*. 2014	
A max	Low	M: 16; F: 17.9 years	Western North Atlantic (FAO areas 21, 31)	Frazier *et al*., 2014	
A max		~8–12 years	FAO 21, 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	
Maturity		M: 52–85; F ~80–95	FAO 21, 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	Maturity parameters not specified
Litter size	Low	4–21 pups	FAO 21, 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	Varies by region
Age at maturity	Medium	M: 2–3 years	FAO 21, 31, 41, 77 and 87	Ebert, Dando and Fowler, 2021	
	Low	6.7 (F); 3.9 (M)	Western North Atlantic (FAO areas 21, 31)	Frazier *et al*., 2014	
Litter size		4–16 pups	(to be compiled)	Castro, 2011; Gonzalez *et al*. 2020	
Gestation period		~4.5–5 months	(to be compiled)	Parsons 1993, Lombardi-Carlson *et al*. 2003	
Maturity		M: 68–85; F: 80–95 cm TL	FAO 31, Florida, Gulf of Mexico;	Lombardi-Carlson *et al*. 2003	
Age at maturity		M: ~2; F: 2–3 years	FAO 31, Florida, Gulf of Mexico;	Lombardi-Carlson *et al*. 2003	
Generation time		12 years	(to be compiled)	Cortés and Parsons, 1996; Márquez-Farias *et al*. 1998	
rate of population growth		mean = 1.304 per yr (1.150 – 1.165 CI 95%)	FAO 31, Eastern Gulf of Mexico	Cortes, 2002	

Table 6. Trends in status of bonnethead.

FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
21; 31	North-west Atlantic Ocean and Gulf of Mexico	1950–2011		SSF2011/SSF0	0.36 - 0.39	M-H	SEDAR 34
31	From Cape Hatteras, North Carolina, to Cape Canaveral, Florida	1989–2014	Southeast Area Monitoring and Assessment Program Trawl	SEAMAP SA trawl survey	increasing since 2000	H	Peterson *et al*. 2017
31	South Carolina	2007–2014	South Carolina Coastal Longline	longline CPUE	increasing	M	Peterson *et al*. 2017
31	South Georgia and north Florida	2007–2014	Georgia red drum longline	longline CPUE	increasing	M	Peterson *et al*. 2017
31	Northwest Florida coast	1996–2014	Gulf of Mexico Shark Pupping and Nursery gillnet	gillnet CPUE	increasing	L	Peterson *et al*. 2017

Table 7. Description of information used in assessments of trends in status of bonnethead.

REFERENCE	INDICATOR Time-series data; other	EVIDENCE RELATIVE TO CITES CRITERIA	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT
SEDAR 34	Spawning stock fecundity relative to unexploited sock estimated based on an age-structured production model	does not meet	5	Spatial (limited/med/broad): limited to NW Atlantic and GOM Temporal (short/med/long): long Methods (basic/med/robust): med

Table 8. Examples of Sphyrnidae in the international fin trade

STUDY	AREA (YEARS)	COMMENTS
Clarke *et al*. (2005)	China, Hong Kong SAR (1999–2001)	*Sphyrna zygaena*, *S. lewini, S. mokarran* present. No mention of ***S. tiburo.***
Clarke *et al*. (2006)	China, Hong Kong SAR (2000–2002)	*Sphyrna zygaena*, *S. lewini, S. mokarran* present. No mention of ***S. tiburo.***
Chuang *et al*. (2016)	Taiwan Province of China (2012–2014)	*S. lewini* accounted for 6.3% and ***S. tiburo*** **0.3%** of fins identified
Cardeñosa *et al*. (2018)	China, Hong Kong SAR (2014–2016)	*Sphyrna zygaena*, *S. lewini, S. mokarran* present. No mention of ***S. tiburo.***
Fields *et al*. (2018)	China, Hong Kong SAR (2014–2015)	Various species of hammerhead present in samples, including *S. lewini* (4.08% of samples), *S. zygaena* (3.44%), *S. mokarran* (0.85%), ***S. tiburo*** **(0.06%)** and *Eusphyra blochii* (0.02%),
Cardeñosa *et al*. (2020a)	Mainland China and China, Hong Kong SAR (2015–2017)	Mainland China: Hammerhead species in samples were *S. lewini* (4.16% of samples), *S. zygaena* (3.63%), *S. mokarran* (0.29%) and *E. blochii* (0.06%) Hong Kong: Hammerhead species in samples were *S. lewini* (4.23% of samples), *S. zygaena* (3.61%), *S. mokarran* (0.92%), ***S. tiburo*** **(0.04%)**, *Sphyrna* sp. (0.4%), *S. tudes* (0.03) and *E. blochii* (0.01%)
Cardeñosa *et al*. (2020b)	China, Hong Kong SAR (2018–2019)	Hammerhead species observed in samples of small fins were *S. lewini* (16.2%), *S. zygaena* (2.5%), ***S. tiburo*** **(0.4%)** and *E. blochii* (0.4%)
Holmes *et al*. (2009)	Confiscated fins (Australian waters)	Whilst *S. tiburo* would not be expected in this study (as it was based on confiscated fins in Australian waters), samples did include *S. lewini* (6.7% of samples), *E. blochii* (3.1%) and *S. mokarran* (3.1%)

Figure 15. Distribution of bonnethead (*Sphyrna tiburo*)

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Ebert, A.D., Dando, M. & Fowler, S. 2021. *Sharks of the world. A fully illustrated guide*. Plymouth, UK, Wild Nature Press Ltd. 607 pp.; Pollom, R., Carlson, J., Charvet, P., Avalos, C., Bizzarro, J., Blanco-Parra, MP, Briones Bell-lloch, A., BurgosVázquez, M.I., Cardenosa, D., Cevallos, A., Derrick, D., Espinoza, E., Espinoza, M., Mejía-Falla, P.A., Morales-Saldaña, J.M., Navia, A.F., Pacoureau, N., Pérez Jiménez, J.C. & Sosa-Nishizaki, O. 2021. *Sphyrna tiburo* (amended version of 2020 assessment). *The IUCN Red List of Threatened Species 2021*: e.T39387A205765567. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T39387A205765567.en)

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT – COP19 PROPOSAL 39
Freshwater stingrays, *Potamotrygon wallacei* and *P. leopoldi*

Species

Wallace's freshwater or curucu stingray *(Potamotrygon wallacei*)

Black Xingu freshwater stingray (*Potamotrygon leopoldi*)

Proposal

To include the freshwater stingrays *Potamotrygon wallacei* and *P. leopoldi* in Appendix II in accordance with Article II of Annex 2a (criteria A and B) of Resolution Conf. 9.24 (Rev. CoP17); and to include the endemic freshwater stingray species: *Potamotrygon henlei*, *P. albimaculata*, *P. jabuti*, *P. marquesi* and *P. signata* in Appendix II in accordance with criteria A of Annex 2b (Resolution Conf. 9.24, Rev. CoP17).

Assessment summary

SPECIES	MEETS CITES CRITERIA	DOES NOT MEET CITES CRITERIA	OTHER
Curucu stingray *Potamotrygon wallacei*	✓		
Xingu river ray *Potamotrygon leopoldi*		✓	

The proposal of *Potamotrygon wallacei* and *P. leopoldi* comprises two endemic low productivity species from the Amazon Basin Region, and there is evidence of declines in their main area of distribution. The Expert Panel recognized that these species are subject to a number of anthropogenic pressures, predominantly habitat changes and degradation.

The FAO Expert Panel considered the available evidence of declines in *P. wallacei* met CITES Appendix II criteria.

In review of *P. leopoldi*, the majority of the Expert Panel concluded that the available data, which are limited to a set of three surveys (over a 16-year period), did not provide adequate evidence that the species meets CITES Appendix II listing criteria. Other members of the Expert Panel considered that the decline in catch rates for the ornamental trade to be sufficient to indicate decline in population density, which coupled with continued habitat degradation, could be considered to meet the CITES Appendix II listing criteria.

The Expert Panel noted that Brazil, as a CITES Party, has previously listed both species in Appendix III of the CITES Convention. Also, Brazil has included both species in the National Export Quota System, since 2003, which established the number and size limits for these and other species, but this control, however, is currently suspended.

The Expert Panel noted that captive bred specimens supply part of the ornamental market demand, potentially decreasing pressure on the fishery for wild caught specimens from range states. Therefore, the demand for wild caught specimens has diminished but has not ceased. The existence of fertile hybrids and look-alike species indicated in the proposal must be taken into account in reporting trade and captive breeding.

Scientific assessment in accordance with CITES biological listing criteria

Species distribution

Both species are South American (Neotropical) endemic freshwater stingray species from the Brazilian Amazon Region.

P. wallacei is endemic to the mid-Negro River Basin, Brazil, with a high habitat specificity (Oliveira *et al*., 2017; Duncan *et al*., 2016). Its range comprises the area from Santa Isabel (Téa River) down to Cuieiras River in the vicinity of Manaus (Carvalho, Rosa and Araújo, 2016). A new population of this species was established next to Manaus after 1997 due to discards from ornamental companies located in Manaus City (Duncan *et al*., 2016). The species is found in small creek areas and flooded forests (*igapós*) (Araújo, 1998; Carvalho, Rosa and Araújo, 2016; Carvalho, 2016) (Figure 16).

P. leopoldi is endemic to the Xingu River Basin, Brazil (states of Pará and Mato Grosso). It is found in the Xingu River and in part of three of its tributaries (Fresco, Iriri and Curuá rivers) (Rosa, 1985; Charvet-Almeida, 2006). Throughout its distribution range, it inhabits rivers' rocky bottoms and prefers rocky substrates such as flat rocky bottoms, stones, pebbles and sand, which leads the species to a patchy distribution pattern along the Xingu River area (Charvet-Almeida, 2006) (Figure 17).

Species productivity

P. wallacei was characterized as having low productivity.
P. leopoldi had a slightly higher productivity than *P. wallacei,* but still low.

P. wallacei was characterized as having low productivity. In 2020, the species was shown to have a low fecundity (1 pup/year) and k = 0.16 (Araújo, 2022). This fecundity was measured at 2.25 embryos per female in 1996 (Araújo, 2022) (Table 9).

P. leopoldi had a slightly higher productivity, averaging 4.84 pups/year and had a k = 0.12 (females) to 0.22 (males) (Charvet-Almeida, 2006). The natural mortality rates (*M*) of *P. leopoldi* varied from 0.192 to 0.365 (Santana and Charvet, forthcoming), with a mean of 0.269; it can be considered high among elasmobranchs, which generally have natural mortality rates of up to 0.2. When hypothetical fishing mortalities (*F*) were added to the stochastic natural mortality by age, it was possible to observe that only those lower than 0.150 allow the population to remain in equilibrium ($\lambda = 1$) (Figure 18). The intrinsic population growth rate (r_z) estimated for *P. leopoldi* was 0.065, caused by the strong relationship of this index with the early age at maturity of 5.3 years (Table 9).

Population numbers

The population numbers for both species is unknown.

Trends and application of the decline criterion

P. wallacei

A population dynamic model suggests a reduction in relative population size of the species now and over the next 10 years. Field sampling showed a concerning change in maximum age of the species (from 8 years to 5 years) and, therefore, negative impacts on fecundity and demographic structure of the population going forward. The demographic structure change is related to a reduction observed in litter size from an average of 2.25 pups per litter/female to 1 pup per litter per female. These factors coupled with reports of habitat loss for this species, which already has a fragmented population, were a concern to the Expert Panel.

P. leopoldi

The population density was reported to have declined in catches (average of 1.4 per hour of dip-net fishing in 2004–2005 to 0.7 per hour in 2021), a decline of approximately 50 percent over about 16 years (2004-2005 to 2021, Charvet, personal communication, 2022). Similar calculations using the other surveys (e.g. small cast net) show no clear trend. During this period, the habitat available to the species was impacted by the Belo Monte Hydroelectric Power Plant Dam, negatively impacting 30 percent of the main habitat.

Potamotrygon wallacei

Araújo (2020ab, 2022) used catch at length data to run a population dynamic model. Fishing mortality was estimated by catch-curve obtained from survey data from the ornamental fishery, based on ten years of monitoring (1996–2006) and a new estimative completed between 2017 and 2020. The study used species-specific life history information and sensitivity tests of key model assumptions (on reproductive potential and the effect of fishing mortality applied to different age classes) to determine the effect of fishing mortality empirically estimated from a catch-curve method on the intrinsic rate of population growth. The sensitivity test outcomes yielded a range of population growth outcomes, from population increase to population decrease through time (Table 10).

The population dynamics data for 2006–2020 deliver a scenario of a projected reduction of over 35 percent of the population over those 10 years (Araújo, 2022). Araújo (2020ab, 2022) suggests that there is a reduction in relative population size of 38 percent in the past 10 years and predicted a further decline of 87 percent over the next 10 years. The model shows a reduction in maximum age from 8 to 5 years between 1996 and the present time – with average fecundity reducing over this period from an average of 2.25 pups to 1 pup per mature female, a figure that accords with field studies (Araújo, 2020ab; Araújo, 2022).

The Expert Panel agreed that this modelled decline was concerning, as it suggests that over a breeding lifetime (which can be at most 3 years) a female of the population is unlikely to be able to produce sufficient offspring for population replacement.

Population growth is only observed if ornamental fishing mortality has no additive factor in age 0 to 2 years. Once fishing mortality rises above 0.5, it causes a population reduction, hence the relevancy of a quota policy limiting size (disc width, DW) and number of individuals taken from the wild.

The modelled scenario for a population decline was supported by new work completed in November 2020, when there was a reduction in the maximum observed population age from 8 to 5 years and a reduction in the reproductive potential. Fecundity, which had been previously considered among the lowest for potamotrygonids (2.25 pups per litter, Charvet-Almeida, Araújo and Almeida, 2005), dropped to a single pup per litter (Araújo, 2022). These recent population studies were reported to the Brazilian Government (Araújo, 2022), highlighting that a significant reduction on the *P. wallacei* export quota was needed – limiting exports to 2 500 individuals, which represents less than 50 percent of the current quota (Araújo, 2022). If trade control fails, Araújo (2022) suggests a ban on ornamental fishing of *P. wallacei*.

In 2015–2016, there were fires and deforestation in the flooded forest areas, which is the preferential habitat of *P. wallacei*. This habitat impact, combined with non-compliance with legislation (export of exceeding numbers of individuals and of individuals above the disc width size limit established in the Brazilian regulation), was the suggested cause of the reduction in the species' reproductive potential by reducing fecundity and the maximum age directly observed in the population.

Nevertheless, the current scenario since October 2021 is the continued capture and export of individuals of any size, with the productive sector not obeying the regulations. In this case, an estimated reduction in the population of over 85 percent in 10 years is estimated. If there is no effective enforcement concerning the size exported, there will be a compromise of the *P. wallacei* population.

Potamotrygon leopoldi

The main gear used in the fishery for *P. leopoldi* is dipnets. Specimens are usually collected at night, individually, during an average of a five-hour period of active searching, mainly using dipnets or very small cast nets, but also occasionally by diving (while searching for other Loricariidae). Handling specimens underwater can be challenging, and hook and line fishing is usually avoided because it may lethally harm the specimen. The finding and capturing of *P. leopoldi* depend on the experience, ability and visual acuity of the fisher.

A set of unpublished survey data across 16 years show a decline in average catches of *P. leopoldi* from 1.4 to 0.7 individuals per hour between 2004–2005 and 2021 (Charvet-Almeida, 2006; Charvet, personal communication, 2021). The data on CPUE of *P. leopoldi* by dipnets (Table 12) are for years 2004, 2005 and 2021. A rudimentary analysis of the annual rate of decline of the CPUE from 2004–2005 to 2021 was a 50 percent decline, with a 3.5% annual rate of decline. A similar analysis of the available datasets on CPUE of *P. leopoldi* by cast nets (Table 12) also indicated a decline of 7 percent (annual rate of decline 0.004 percent) over this same 16-year period. However, similar calculations using other catch-rate data from a less common fishing method (small cast net) show no clear trend (Table 10).

In demographic analysis, when the maximum limit of F for maintaining the population equilibrium (0.150) at different maximum capture ages (t_c) was added to the values of M, the scenario with catches up to 3 years of age resulted in positive population growth values (with an annual increase of 2.8 percent).

The most important age classes for *P. leopoldi* demography (37 percent of stable age distribution and 34.1 percent of survival elasticities) were exactly between the first and the second years of age, coinciding with the disc width and age class exploited by the aquarium fisheries. The stable age distribution and survival elasticity for juveniles (<5 years old) correspond respectively to 86.6 and 79.6 percent of all ages. The ornamental fishery for this species targets mainly young individuals that are sought by the aquarium trade. The young age classes exploited by fishers for the aquarium trade are the most sensitive in the model to changing *P. leopoldi* demography. These ages correspond to 200–300 mm DW and are considered in the model in all scenarios, where F values greater than 0.150 would lead to important population declines. For scenarios when t_c >3 years, this results in an annual population decline higher than 3.3 percent, with a population decline in the 10-year cohort near to 30 percent.

The decline in the population owing to habitat loss and in part from a perceived reduction in population density as evidenced by a decline in the catch rate are concerning. Over the 16-year period when three catch surveys were made, the habitat also declined. The Belo Monte Hydroelectric Power Plant Dam negatively impacted the habitat available to the species (reduced by 30 percent), as well as the main fishing areas. Moreover, other causes of habitat degradation is ongoing, particularly deforestation (forest burning).

Because of the loss and degradation of habitat (30 percent) and fishing (53 percent decline in catch rates, Charvet, personal communication, 2022), the population could potentially have fallen to 33 percent of the 2004–2005 population in 2021. If habitat destruction and illegal fishing continues it will lead to further serious reductions in the population.

P. leopoldi is of intermediate vulnerability among elasmobranch species (r_z. ranging between 0.04 and 0.08). Although it has a medium vulnerability compared to other sharks and rays, the targeting of mainly very young individuals for the ornamental trade, which combined with mortality rates from fishing and other habitat loss and degradation, adds to species vulnerability.

Modifying risk factors

The Expert Panel considered whether there were any biological characteristics of *P. leopoldi* and *P. wallacei* that would modify their probability of being depleted to the point where they would meet the criteria for listing (Table 13).

Notable risk factors

The Expert Panel noted important risk factors, such as habitat loss by the construction and operation of the hydroelectric power plant and degradation and loss by deforestation, Amazon Forest fires, agricultural expansion (including agricultural pesticides, fertilizers and cattle stamping on margins), fisheries for food and ornamental trade.

Moreover, both species are subject to climate change events, altering the rivers' hydrologic cycle and, consequently, the reproductive cycle since they are linked (Charvet-Almeida *et al*., 2002; Charvet-Almeida, Araújo and Almeida, 2005; Araújo, unpublished data; Santana and Charvet, forthcoming).

P. leopoldi populations are specifically under additional significant threats from mining, agricultural development, cattle grazing expansion (area with the highest level of agricultural development) and, notably, one dam already constructed in the Altamira region has already moved the main ornamental fisheries area to the São Félix do Xingu region from Altamira (Y. Torres and P. Charvet, personal observation, 2021).

Notable mitigating factors

Brazil has a mechanism to limit legal wild exports of freshwater stingrays. However, there is evidence of a sustained illegal trade (Charvet, personal communication, 2022; Prang 2020a, 2020b, 2020c). The extent of the illegal trade is unknown, and it is worth noting that in most years when Brazil has had legal export of the two species, the export quotas have not been met (Figure 19).

Identification of these species in trade is not complex, even for non-specialists, as their visual form and colours are very distinctive. This is somewhat complicated for cross-bred specimens, mostly traded from hatchery facilities distant from Brazil.

These species are bred in captivity in multiple locations, with breeding populations found mainly in Asia; smaller numbers of specimens are held in private and public aquaria globally. This mitigates some of the pressure on wild stocks.

Comments on technical aspects relating to management, trade and likely effectiveness of implementation of a CITES listing

Management comment

In 2003, Brazil established an ornamental export quota system for six species of potamotrygonins (including *P. leopoldi* and *P. wallacei*). This controls legal quantities and maximum disc-width catch sizes according to each species. Internationally, potamotrygonins have been listed under Appendix III since January 2017.

Since the end of April 2021, the fish export regulation from Brazil has prohibited all legal exports of CITES listed species (including all, i.e. all freshwater stingray populations).

It is reported that many of the controls are difficult to implement for management and conservation of freshwater stingrays because rays are taken illegally across the borders between Brazil and neighbouring countries.

International/regional

- Potamotrygonins have been listed under Appendix III since January 2017 (CITES, 2017). Currently, Colombia has listed *Paratrygon aiereba*, *P. constellata*, *P. magdalenae*, *P. motoro*, *P. orbignyi*, *P. schroederi*, *P. scobina* and *P. yepezi* in Appendix III, and Brazil has listed *Potamotrygon* spp. (population of Brazil).
- *P. wallacei* was a known undescribed species, which was used for ornamental purposes well before it was formally described in 2016 (Carvalho, Rosa and Araújo, 2016). Previously to its description and even in the Brazilian national export regulations, it was referred to as *Potamotrygon* cf. *histrix*,

Potamotrygon cf. *hystrix* and *Potamotrygon* sp., all tentative forms to refer to this Amazonian species. Notably, *Potamotrygon histrix* (Müler and Henle, 1836) is a described and valid species from the Paraná-Prata River basin drainage.

- There has been an effort led by the Amazonian Cooperation Treaty Organization (ACTO) to collect and improve data on ornamental freshwater stingray species and fisheries. ACTO is signed by eight Amazon countries (the Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador, Guyana, Peru, the Plurinational State of Bolivia and Suriname).

National measures

- Since the end of April 2021, the fish export regulation from Brazil has prohibited all CITES listed species (including all, i.e. all Brazilian freshwater stingray populations) to be exported.
- Brazil: The ornamental export quota system comprising two States was established in 2003 and in place for six species of potamotrygonins (including *P. leopoldi* and *P. wallacei*); quantities and maximum catch sizes were established according to the species. It has been reported that these controls are difficult to implement in a programme for management and conservation of freshwater stingrays because rays are taken illegally across the borders between Brazil and neighbouring countries (mainly Amazonian countries, such as Colombia and Peru).
  - 14 cm DW is the maximum limit established in the Brazilian quota regulation for *P. wallacei.*
  - 30 cm DW is the maximum limit established in the Brazilian quota regulation for *P. leopoldi*.
- Freshwater stingrays were cited only in a preliminary draft version of the Brazilian National Plan of Action (NPOA) and have not yet been included in the country's NPOA.
- *P. leopoldi* has been listed in the National Xingu Basin Commission, but no further details or recommendations for this species under this Commission are known to exist.

Trade comment

For many decades, the trade of some species of wild-caught freshwater stingrays has been regulated in the State of Amazonas through a quota system, with a national Brazilian quota system introduced in 2003.

Illegal trade is ongoing at a lower or higher scale, depending on market demand, and many sub-adult *P. wallacei* and *P. leopoldi* are illegally exported to be used in breeding (Prang unpublished reports; Charvet, personal communication, 2022). Illegal trade for both species typically passes from Brazil to neighbouring countries (mainly Colombia and Peru, but also Ecuador and the Plurinational State of Bolivia).

Trade also originates from small to large breeding facilities (aquaculture) in many countries, particularly in Asia (China, including Taiwan Province of China, Indonesia, Malaysia, Singapore, Thailand and Viet Nam). In order to obtain the desired colour patterns, interspecies breeding takes place involving several species in order to produce exotic dorsal colour patterns that yield high prices. Captive breeding operations are providing a wide range of colour patterns and distributing individuals at competitive prices owing to the product they produce and proximity to markets.

Trade has been regulated by national Brazilian laws since 1998, when a single State export quota (State of Amazonas) was established. Later a bi-State regulation was put in place starting in 2003 establishing export numbers × species and then numbers × species × maximum DW size.

Legal trade – even with the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) species-specific quota system regulations in place, in 2004 the number of *P. wallacei* officially exceeded the quota established (quota = 5 000; exported specimens = 6 041); in 2005, the number of *P. leopoldi* officially exceeded the quota established (quota = 1 200; exported specimens = 1 259). In all other years, the quotas for legal export were not filled.

Despite having national regulations with quotas for these two species for many years, illegal trade is ongoing at a lower or higher scale, depending on market demand, which varies greatly.

Many sub-adults of *P. leopoldi* and *P. wallacei* (above the authorized size limit) were illegally exported to be used in breeding farms (mainly between 2005 and 2011) (Prang 2021b; Charvet, personal communication, 2022).

Despite the CITES Appendix III listing (CITES, 2017), the illegal trade for both species has not ceased, with specimens taken from Brazil to neighbouring countries (mainly Colombia and Peru, but also Ecuador and the Plurinational State of Bolivia) (Prang, 2020b, 2020c; Charvet, personal communication, 2022). The nature of trafficking makes it very difficult to establish the routes precisely.

There are several small to large breeding facilities (aquaculture) in many countries, particularly in Asia (China, including Taiwan Province of China, Indonesia, Malaysia, Singapore, Thailand and Viet Nam). For example, in Thailand alone, there were 400 registered freshwater stingray breeders in 2018 (commercial breeder in Thailand, personal communication, 2022). In order to obtain the desired colour patterns, interspecies breeding takes place (the hybrid offspring of which are reportedly fertile) involving several species in order to produce exotic dorsal colour 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, which was held in Geneva, Switzerland (CITES, 2009) captive breeding operations are providing a wide range of colour patterns and distributing individuals at competitive prices owing to lower transportation costs from Asian centres to local markets compared with the cost of transportation from South America. The workshop concluded that the development and expansion of these activities have decreased dependence on fish taken from the wild (this also appears to be occurring with other ornamental freshwater fish species exported from Brazil, Anjos *et al*., 2009), but has not ceased trafficking.

Both nominal form, colour morphs (*P. leopoldi* and *P. wallacei* – smaller scale), and a high number of fertile hybrids involving several species are produced in these facilities.

Unit price varies according to colour, colour novelty, size and sex. *P. leopoldi* (mainly due to its dorsal colour pattern) has been a more valuable species than *P. wallacei* (mainly attractive to the trade due to its small size).

Basis for Article II paragraph 2(b) ("look-alike") Appendix II listing

Potamotrygon is the most diverse genus within the subfamily Potamotrygoninae, with 31 valid species. Even with several taxonomic studies, some difficulties in the precise delimitation of its species persist and could lead to inaccurate taxonomy and are often not the leading cause of illegal trade (Araújo, 2021; Fontenelle *et al*., 2021; Charvet, Prang and Araújo, 2022).

The identification of the "look-alikes" indicated in the proposal will require staff training and identification guides. Diagnostic characteristics of the species to be legally traded will be needed to differentiate them from the hybrids bred in captivity, and hybrids containing listed species under Appendix II would need to be identified.

Potamotrygon wallacei

"Look-alikes" of this endemic freshwater stingray species proposed are traded by the ornamental fish trade legally under the name of *P. orbignyi* (a species that has been authorized in the Brazilian regulation for export quotas). The species *P. marquesi* and sometimes *P. signata* (from the reticulated stingray group, but that were never covered by the Brazilian regulation for export quotas) have also been traded under the name *P. wallacei* (Prang, 2020b; Charvet, personal communication, 2022). The proposal lists these species as potential "look-alikes".

Potamotrygon leopoldi

"Look-alikes" of this endemic freshwater stingray species proposed are traded by the ornamental fish trade legally under the name of *P. henlei* and *P. motoro* (both of these species have been authorized in the Brazilian regulation for export quotas). The species *P. albimaculata* and *P. jabuti* (from the black stingray group, but that were never covered by the Brazilian regulation for export quotas) have also been traded under the name *P. leopoldi* (Charvet, personal communication, 2022). The proposal lists these species as potential "look-alikes".

Comment on the likely effectiveness for conservation of a CITES Appendix II listing

CITES uplisting from Appendix III to Appendix II could improve understanding of the status of the species in Brazil and compliance around take of freshwater stingrays. However, as collection, transportation and export of the species in and from Brazil are already regulated but illegal trade continues, there are questions on whether extra regulation of trade in Brazil (and elsewhere) will be successful.

What is known from previous experience with other species that are taken both in the wild and bred in aquaculture facilities is that listing of these species in CITES Appendix II can cause trade of hatchery-reared individuals to temporarily be halted or stopped altogether (e.g. seahorses and corals). In general, delays in achieving the process steps to comply with CITES provisions and extra compliance in transit of live product can delay both trade and shipments, while some countries have legislation that makes trade of species listed on CITES Appendices illegal, irrespective of the Appendix they are listed on.

Any decline of trade in aquacultured stingrays might have unintended negative consequences on wild stocks should illegal fishing of wild stingray populations be increased to fill the market gap left by delays or declines in aquaculture production.

Brazil's freshwater stingrays are low productivity species and do not recover quickly from degrading habitat, overfishing or other human pressures. The Expert Panel suggests increasing national on-ground management measures to ensure the remaining freshwater stingray habitat is well managed and increasing fishery compliance and water control management, especially around habitat in or close to protected areas in Brazil, offers two solutions. In addition to supporting governance and resilience of habitats that support stingrays in the wild, legal and sustainable servicing of trade demand through aquaculture should not be discouraged.

Listing Brazilian potamotrygonins under CITES Appendix III in 2017 did not improve the necessary trade data (CITES CoP19 Proposal 39, 2022). Under the current Appendix III listing, only export permits were required from Brazil and any non-detriments findings (NDFs) would be voluntary. Under Appendix II, a monitoring programme would need to be established (from fishery areas to export centres, see CITES Resolution Conf. 16.7 (Rev. CoP17)), and stricter trade control measures and improvements to species in transit are required. These measures could potentially reduce illegal trafficking of both species, and the proponents believe a CITES Appendix II listing will be more effective. Should trade be able to continue under the provisions of Appendix II, this could spur greater investment in research and management of freshwater stingrays in the wild and in culture, and offer improvements in understanding of their trade through documentation of species movements in the CITES Trade Database (CITES, 2003).

CITES provisions controlling trade in specimens of species listed in Appendix II require the issuance of an export permit by the exporting country, which will 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.

Because of the interpretations of "captive bred" for animal species, an Appendix II listing poses a higher regulatory burden for aquaculture producers and Parties. This burden can negatively impact aquaculture efforts, as has been the case for both seahorses and corals, both reared in aquaculture and taken from the wild. Through previous experience, some aquaculture facilities and/or States are unwilling or lacking the resources to comply with CITES provisions. This has led to:i. trade in the species being delayed or ceasing; ii. trade continuing without proper CITES documentation (also known as "illegal trade"); and iii. trade continuing with inadequate NDFs.

In the case of trade for a named stingray species that has a positive NDF that are part of the shipment containing hybrid stingrays (as stingrays in aquaculture are often interbred), this could bring up challenges for customs officers in their identification of species in shipments.

Legal trade should be recorded in the CITES Trade Database for both Appendix II and III listings (see CITES Article 8 of the Convention), but differences in export versus import records (Table 14) suggest that importing countries are not sufficiently reporting trade (see Pavitt *et al*., 2021 for the reasons). For example, shipments of CITES Appendix III *P. leopoldi* into the United States of America are 12 and 20 times lower than export values reported by Thailand during 2017 and 2018.

Because of the interpretations of “captive bred” and because Appendix II listing poses a higher regulatory burden for producers, any decrease in hatchery production could have a “backfire” impact by increasing illegal trade in wild caught specimens (and captive bred stingrays). Should there be a CITES Appendix II listing of *P. wallacei* and *P. leopoldi,* aquaculture facilities may need extra support to continue legal trade, trade that presently catalyses transition of the market away from stingrays taken from the wild.

Hatchery breeding of stingrays has been actively developed over almost two decades and delivers stingrays preferred due to their colour patterns and the proximity of breeding facilities to market buyers. Hatchery supply of stingrays can replace most of the need for wild caught supply of the ornamental trade but will not completely stop demand, as small numbers of stingrays from the wild are periodically needed as new broodstock for aquaculture.

References

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

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

Araújo, M.L.G. 1998. *Biologia de Potamotrygon sp. C (Chondrichthyes: Potamotrygonidae) no Médio Rio Negro, Amazonas*. Dissertação Mestrado. FUA/INPA, Manaus 171 pp.

Araújo, M.L.G. 2020a. *Produto 2. Dinâmica populacional e demográfica da espécie de raia de água doce* Potamotrygon wallacei *(Rio Negro*). Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

Araújo, M.L.G. 2020b. *Produto 3. Dinâmica populacional e demográfica da espécie de raia de água doce* Potamotrygon wallacei (*Rio Negro*). Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

Araújo, M.L.G. 2022. *Produto 5. Dinâmica populacional e demográfica da espécie de raia de água doce* Potamotrygon wallacei (*Rio Negro*). Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

Araújo, M.L.G., Charvet-Almeida, P., Almeida M.P, Pereira, H. 2004. *Freshwater Stingrays (Potamotrygonidae): status, conservation and management challenges*. Information document AC 20 info 08:1–6.

Araújo, M.V.G. 2021. *Revisão taxonômica e morfológica de Potamotrygon signata Garman, 1913*. Universidade Federal da Paraíba, Centro de Ciências Exatas e da Natureza, Bacharelado em Ciências Biológicas. In: Universidade Federal da Paraíba. Paraiba, Brazil. Cited 18 Luly 2022. https://repositorio.ufpb.br/jspui/handle/123456789/21679

Carvalho, M.D., Rosa, R.S. & Araújo, M.L. 2016. A new species of Neotropical freshwater stingray (Chondrichthyes: Potamotrygonidae) from the Rio Negro, Amazonas, Brazil: the smallest species of Potamotrygon. *Zootaxa*, 4107(4): 566–586.

Carvalho, M.R. 2016. Neotropical stingrays, Family Potamotrygonidae. *In* P.R. Last, W.T. White, M.R. de Carvalho, B. Séret, M.F.W Stehmann & G.J.P. Naylor, eds. *Rays of the World*, pp. 619–655. Melbourne, CSIRO Publishing.

Charvet, P., Prang, G. & Araújo, M.L.G. 2022. Unmanaged trade jeopardizes freshwater stingrays management and conservation. *Shark News*, 5: 59–60.

Charvet, P., Santana, F.M., De Lima, K.L. & Lessa, R. 2018. Age and growth of the endemic Xingu River stingray *Potamotrygon leopoldi* validated using fluorescent dyes. *Journal of Fish Biology*, 92: 1985–1999. doi:10.1111/jfb.13635

Charvet-Almeida, P. 2006. *História natural e conservação das raias de água doce (Chondrichthyes: Potamotrygonidae), no médio Rio Xingu, área de influência do Projeto Hidrelétrico de Belo Monte (Pará, Brasil)*. Universidade Federal da Paraíba. Paraiba, Brazil.

Charvet-Almeida, P., Araújo, M.D. & Almeida, M.P.D. 2005. Reproductive aspects of freshwater stingrays (Chondrichthyes: Potamotrygonidae) in the Brazilian Amazon Basin. *Journal of Northwest Atlantic Fishery Science*, 35: 165–171.

Charvet-Almeida, P., Araújo, M.L.G., Rosa, R.S. & Rincon, G. 2002. Neotropical freshwater stingrays: diversity and conservation status. *Shark News*, 14: 1–2.

Charvet-Almeida, P., Rosa, R.S. & Pinto de Almeida, M. 2009. *Potamotrygon leopoldi.* The IUCN Red List of Threatened Species 2009: e.T39403A10226180. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T39403A10226180.en

CITES. 2009. Regional Workshop on South American freshwater stingrays. Twenty-fourth meeting of the Animals Committee Geneva, (Switzerland), 20–24 April 2009. AC24 Doc. 14.2. II. In Convention on International Trade in Endangered Species of Wild Fauna and Flora, Geneva, Switzerland. Cited18 July 2022. https://cites.org/sites/default/files/common/com/ac/24/EFS24-14-02.pdf

CITES. 2017. Freshwater Stingrays (Family POTAMOTRYGONIDAE). Twenty-ninth meeting of the Animals Committee Geneva (Switzerland), 18–22 July 2017. AC29 Doc. 24. 5p In Convention on International Trade in Endangered Species of Wild Fauna and Flora, Geneva, Switzerland. Cited 18 July 2022. https://cites.org/sites/default/files/eng/com/ac/29/E-AC29-24.pdf

CITES. 2020. CITES Trade Database. In Convention on International Trade in Endangered Species of Wild Fauna and Flora, Geneva, Switzerland. Cited 18 July 2022. https://trade.cites.org

Duncan, W.P., Shibuya, A., Araújo, M.L.G. & Zuanon, J. 2016. Biologia e História Natural de *Potamotrygon wallacei* (Carvalho, Rosa e Araújo, 2016) na bacia do Rio Negro, Amazônia central, Brasil. *In:* C.A. Lasso, R.S. Rosa, M.A. Morales-Betancourt, D. Garrone-Neto & M.R. Carvalho, eds, XV. Rayas de agua dulce (Potamotrygonidae) de Suramérica. Parte II: Colombia, Brasil, Perú, Bolivia, Paraguay, Uruguay y Argentina. *Serie Editorial Recursos Hidrobiológicos y Pesqueros Continentales de Colombia*, pp. 289–302. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Bogotá.

Fontenelle, J.P., Lovejoy, N.R., Kolmann, M.A. & Marques, F.P. 2021. Molecular phylogeny for the Neotropical freshwater stingrays (Myliobatiformes: Potamotrygoninae) reveals limitations of traditional taxonomy. *Biological Journal of the Linnean Society*, 134(2): 381–401.

Oliveira, A.T., Araújo, M.L.G., Lemos, J.R.G., Santos, M.Q.C., Pantoja-Lima, J., Aride, P.H. R. & Marcon, J.L. 2017. Ecophysiological interactions and water-related physicochemical parameters among freshwater stingrays. *Brazilian Journal of Biology*, 77(3): 616–621.

Pavitt, A., Malsch, K., King, E., Chevalier, A., Kachelriess, D., Vannuccini, S. & Friedman, K. 2021. *CITES and the sea: trade in commercially exploited CITES-listed marine species*. FAO Fisheries and Aquaculture Technical Paper No. 666. Rome, FAO. https://doi.org/10.4060/cb2971en

Prang, G. 2020a. *Produto 3: o comércio internacional de espécies de raias constantes dos anexos da CITES, indicando a demanda internacional por tais espécies*. Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

Prang, G. 2020b. *Produto 4: o comércio internacional de espécies de raias constantes dos anexos da CITES, indicando a demanda internacional por tais espécies*. Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

Prang, G. 2020c. *Produto 5: o comércio internacional de espécies de raias constantes dos anexos da CITES, indicando a demanda internacional por tais espécies*. Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

Ramos, H.A., Barbosa, A. & Studart, J. 2009. *Reunião Nacional para o Ordenamento da Pesca e Comercialização de Raias de Água Doce do Brasil. Parte 1: Pesca Ornamental*. 21 pp. Relatório COOPE, IBAMA-DF.

Rosa, R.S. 1985. *A systematic revision of the South America stingrays (Chondrichthyes: Potamotrygonidae)*. PhD thesis. School of Marine Sciences. College of William and Mary, Virginia. University Microfilms International, Ann Arbor, Michigan. 523 pp.

Santana, F. M. and Charvet, P. (forthcoming). Population dynamics of the endemic Xingu Freshwater Stingray *Potamotrygon leopoldi* and implications for its management and conservation.

UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP

Tables and Figures

Table 9. Productivity of freshwater stingrays *Potamotrygon leopoldi* and *P. wallacei* (M: male; F: female).

PARAMETER	INFORMATION	AREA	SOURCE	COMMENTS
Maximum DW	720 mm	Xingu River Basin	Charvet-Almeida (2006)	
L 50 maturity (F)	431–460 mm	Xingu River Basin	Charvet-Almeida (2006)	
L 50 maturity (M)	341–370 mm	Xingu River Basin	Charvet-Almeida (2006)	
Litter size	1–11 embryos (mean 4.8)	Xingu River Basin	Charvet-Almeida (2006)	
Longevity (Tmax) (F)	M: 14.3 years; F: 7.2 years	Xingu River Basin	Charvet *et al.* (2018)	Observed age
Growth (VBF)	M: W_∞ = 536.4 mm WD; k = 0.22 and W_0 = 109 mm WD F: W_∞ = 763.1 mm WD; k = 0.12 and W_0 = 149 mm WD	Xingu River Basin	Charvet *et al.* (2018)	
Intrinsic rate or increase r	0.065	Xingu River Basin	Smith *et al*. (1998); (Santana and Charvet, forthcoming).	
Natural mortality	0.192–0.365 (Mean 0.269)	Xingu River Basin	(Santana and Charvet, forthcoming).	According 11 different equations of *M* (table 4).
Generation length	estimated to be 7.3 years		Charvet *et al*., 2018	
Maximum DW	310 mm		Araújo, 1998	
Generation length	estimated to be 3.9 years		Proposal	
Generational length	from 3.9 to 2.9 years		Araújo (2020)	30% of flooded forest in the area with the highest abundance of the species was lost

Table 10. Trends in status of freshwater stingrays *Potamotrygon leopoldi* and *P. wallacei*.

SPECIES	REFERENCE PERIOD	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
Potamotrygon leopoldi	From 2004–2005 to 2021	Annual rate of decline of the CPUE	50 percent over 16 years (annual rate of decline of CPUE calculated as 3.5 percent). 45 percent from 2004 – 2021, and 55percent from 2005 – 2021.	H	Charvet-Almeida, 2006; Charvet, personal communication, 2022
Potamotrygon leopoldi	2022–2032	Population dynamics analysis (projection)	3.3 percent of projected annual population decline (with F = 0.150 and t_c > 3 years), with a 30 per cent decline in the 10-year cohort.t	H	Santana and Charvet, (forthcoming)
Potamotrygon wallacei	2006–2020	Population dynamics, demographic analysis (including relative population size)	35–38 percent decline in the past 10 years	H	Araújo, 2020a, b; Araujo, 2022
Potamotrygon wallacei	2020–2030	Population dynamics and demographic analysis	further decline predicted of 87 percent over the next 10 years	H	Araújo, 2022

Table 11. Description of information used in assessments of trends in status of freshwater stingrays *Potamotrygon leopoldi* and *P. wallacei*.

SPECIES	REFERENCE	INDICATOR Time-series data; other	RELIABILITY INDEX SCORE 0-5 (see guide)
P. wallacei and *P. leopoldi*	Proposal	Both stingrays are k-strategy species, with slow growth, late sexual maturation, and low fecundity, which make them vulnerable.	4–5
P. leopoldi	Proposal	*P. leopoldi* characterized as DD (Charvet-Almeida et al., 2009), and *P. wallacei* never evaluated by IUCN RL assessments	4
P. wallacei	Araújo, 2020b	*P. wallacei* is more vulnerable to changes in its essential habitat than *P. leopoldi*. Recently after fires were observed in the flooded forest in Negro River basin, maintaining the populational equilibrium was compromised, and a reduction in population growth of 4.17 % per year was estimated.	4
P. wallacei	Araújo,2022	Companies requested an exportation quota of 4.498 for the export of *P. wallacei* to 2022 (MAPA-SAP, 2020) — 75% of the quota allowed for export (6000 units), but exceeding new quota suggestion for this species (2.500 individuals)	4

Table 12. *P. leopoldi*, minimum, average and maximum values of observed catches by ornamental fishers (CPUE), considering a 5 hour period of active searching, which is considered equivalent to a one night fisheries in the *P. leopoldi* distribution range (period from 2004–2005

UNITS CAUGHT IN 5 HOURS (Ornamental fishers CPUE)	**MINIMUM**			**AVERAGE**			**MAXIMUM**		
Fishery gear / year	**2004**	**2005**	**2021**	**2004**	**2005**	**2021**	**2004**	**2005**	**2021**
Dip net	0 (0)	0 (0)	0 (0)	6 (1,2)	8 (1,6)	3,3 (1,1)	16 (3,2)	15 (3)	9 (3,3)
Diving (with or without small cast net)	0 (0)	0 (0)	n.a.	5 (1,0)	4 (0,8)	n.a.	8 (1,6)	7 (1,4)	n.a.
Small cast net (beaches)	0 (0)	0 (0)	0 (0)	3 (0,6)	4 (0,8)	2,8 (0,5)	6 (1,2)	7 (1,4)	4,6 (1)
Line and hook	0 (0)	0 (0)	n.a.	2 (0,4)	2 (0,4)	n.a.	5 (1,0)	6 (1,2)	n.a.

Source: Charvet-Almeida, P. 2006. História natural e conservação das raias de água doce (Chondrichthyes: Potamotrygonidae), no médio Rio Xingu, área de influência do Projeto Hidrelétrico de Belo Monte (Pará, Brasil). Universidade Federal da Paraíba. Paraiba, Brazil.; and Charvet-Almeida, 2021, personal communication; all field observations, same methodology).

Table 13. Modyfying risk factors of *P. leopoldi* and *P. wallacei*

RISK FACTOR	DESCRIPTION	EFFECT
Selectivity of removal (Araújo, 1998; Araújo *et al*, 2004; Araújo, 2020a; Charvet-Almeida, 2006; Charvet *et al*., 2022)	Ornamental fishery - the *P. leopoldi* and *P. wallacei* 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 transportation space requirements), in most fishing areas stingrays with damaged discs or in poor shape are usually released back to the river. It can be considered a very selective fishery and catches may vary according to fishers experience and skills. 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. Food fishery - adult specimens of *P. leopoldi* are occasionally caught for food purposes when lacking a better catch option but these catches have been increasing in the past 5–6 years to the point that it can be nowadays found in regional restaurant menus. In portions of its range there are already overlapping ornamental and food fisheries having juveniles and adults taken from the same areas, significantly increasing risk for this species but still in limited areas of its range. Adult specimens of *P. wallacei* are very small when compared to *P. leopoldi* and are rarely taken as a food source due to their size. In addition *P. wallacei* is subject to removal from tourist areas to reduce the risk of interactions and accidents with tourists, is not selective with both juveniles and adults becoming subject to negative fishery (mutilations, or kill and discard - as per Compagno & Cook, 1995).	Positive effect for Ornamental fishery Negative effect for food and area clearance fishery
Social structure (sex ratio; social dominance; etc. (Araújo, 2020b; Charvet-Almeida, 2006)	Newborns and juveniles freshwater stingrays are often found in shallow areas (sand and rock beaches, etc.), where they hide from larger fish predators, but by remaining in shallow areas they can be easily caught by ornamental fishers and are subject to river shore impacts (trampling of cattle etc.).	Negative

RISK FACTOR	DESCRIPTION	EFFECT
Vulnerability at different life stages (movements, pupping grounds, etc.) (Araújo, 2022)	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 (see population dynamics data for species)	Negative
Specialized niche requirement (Araújo, 1998; Charvet-Almeida, 2006)	Both species are restricted to freshwater habitats. *P. lepoldi* prefers rocky bottoms and submerged rock slates but can also be found on sandy substrates. *P. wallacei* inhabits only creeks and flooded forest areas. In the Negro River region river margin deforestation and loss of flooded forest areas have been increasing.	Neutral/ Negative
Density and Aggregating behavior (Achenbach &Achenbach, 1976; Araújo, 2004)	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 (Araújo, 1998; Araújo *et al*., 2004; Charvet-Almeida *et al*, 2002; Santana and Charvet, forthcoming)	Since potamotrygonins are restricted to rivers and other freshwater habitats, impacts resulting from the construction of hydroelectric plants, ports, deforestation, forest fires, 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). Climate extreme events and extreme climate change effects (mainly associated with water temperature increase and drought events) are affecting these stingrays in both river basins, highlighting that the range distribution of *P. leopoldi* is located in two of the top three leading municipalities in terms of deforestation (Santana and Charvet, forthcoming).	Negative

Table 14. Trade volumes of *P. leopoldi* as reported on the CITES trade database from 2017–2020. Exports reported from both exporter and importer values. Note there are significant differences in reported values from importers and exporters, suggesting that importing countries are not monitoring trade of this species closely.

Exporting country	Exporter Reported	Importer Reported
Indonesia		25
Sri Lanka		46
Malaysia	791	154
Netherlands	34	
Singapore	211	
Thailand	11582	591
United States of America		15
Total Reported	**12618**	**831**

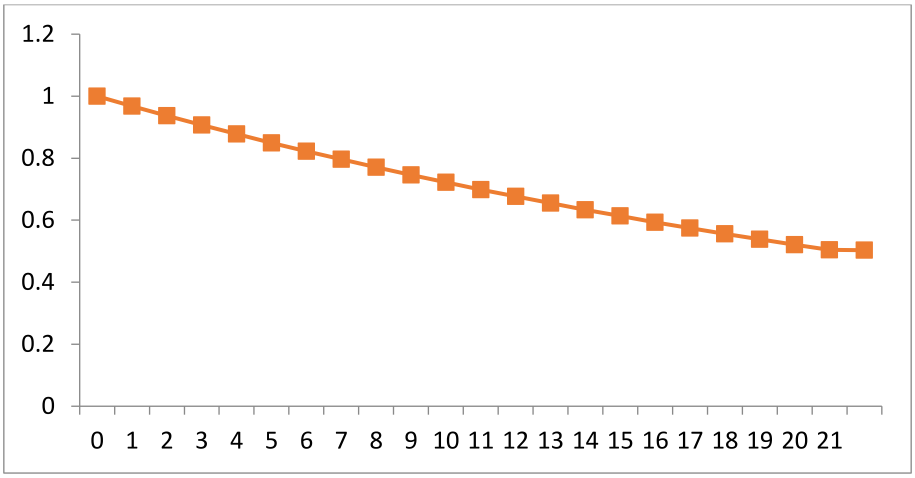
Figure 16. Distribution of *Potamotrygon wallacei*

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022.
https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP;
modified [Carvalho, M.D., Rosa, R.S. & Araújo, M.L. 2016. A new species of Neotropical freshwater stingray (Chondrichthyes: Potamotrygonidae) from the Rio Negro, Amazonas, Brazil: the smallest species of Potamotrygon. *Zootaxa*, 4107(4): 566–586]

Figure 17. Distribution of *Potamotrygon leopoldi*

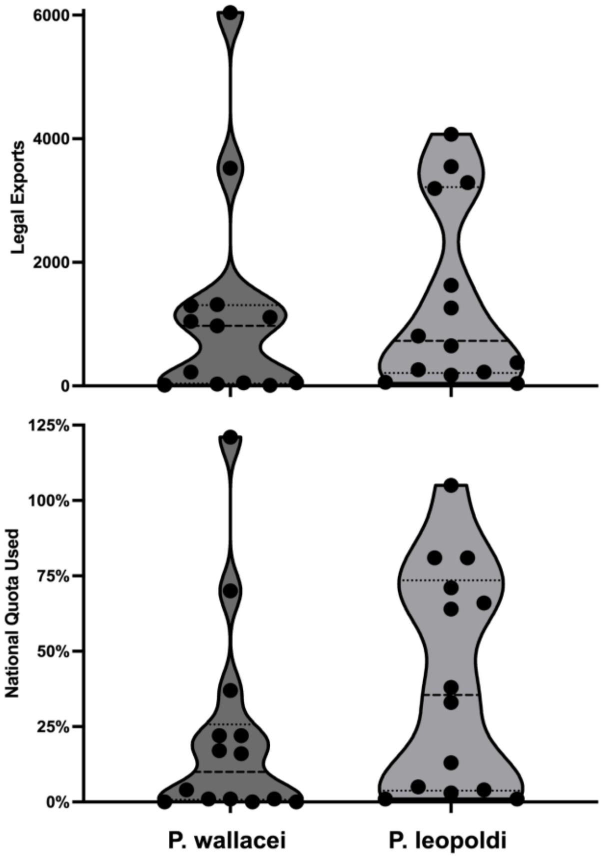
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022.
https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP;
modified [Carvalho, M.D., Rosa, R.S. & Araújo, M.L. 2016. A new species of Neotropical freshwater stingray (Chondrichthyes: Potamotrygonidae) from the Rio Negro, Amazonas, Brazil: the smallest species of Potamotrygon. Zootaxa, 4107(4): 566–586; Santana, F. M. and Charvet, P. (forthcoming). Population dynamics of the endemic Xingu Freshwater Stingray Potamotrygon leopoldi and implications for its management and conservation.]

Figure 18. *Potamotrygon leopoldi* projected declines considering population dynamics characteristics



[x = years; y = Nt number of surviving individuals at age t]
Source: Santana, F. M. and Charvet, P. (forthcoming). Population dynamics of the endemic Xingu Freshwater Stingray Potamotrygon leopoldi and implications for its management and conservation.

Figure 19. Summary of legal exports and quota used for exports of two species of freshwater stingrays from Brazil during the past 20 years



Source: CITES. 2020. CITES Trade Database. In Convention on International Trade in Endangered Species of Wild Fauna and Flora, Geneva, Switzerland. Cited 18 July 2022. https://trade.cites.org; Prang, G. 2020. Produto 4: o comércio internacional de espécies de raias constantes dos anexos da CITES, indicando a demanda internacional por tais espécies. Relatório apresentado a Organização do Tratado de Cooperação Amazônica, para o cumprimento do TDR.

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT – COP19 PROPOSAL 40
Six species in the family Rhinobatidae and all other guitarfishes, etc. nei

Species

Stripenose guitarfish (*Acroteriobatus variegatus*)

Brazilian guitarfish (*Pseudobatos horkelii*)

Whitespotted guitarfish (*Rhinobatos albomaculatus*)

Spineback guitarfish (*Rhinobatos irvinei*)

Common guitarfish (*Rhinobatos rhinobatos*)

Brown guitarfish (*Rhinobatos schlegelii*)

Proposal

To include the stripenose guitarfish (*Acroteriobatus variegatus*), Brazilian guitarfish (*Pseudobatos horkelii*), whitespotted guitarfish (*Rhinobatos albomaculatus*), spineback guitarfish (*Rhinobatos irvinei*), common guitarfish (*Rhinobatos rhinobatos*), brown guitarfish (*Rhinobatos schlegelii*) in Appendix II in accordance with Article II, paragraph 2(a) and the rest of the species in family Rhinobatidae in accordance with Article II, paragraph 2(b).

Assessment summary

SPECIES	MEETS CITES CRITERIA	DOES NOT MEET CITES CRITERIA	OTHER
Brazilian guitarfish *Pseudobatos horkelii*		✓*	No evidence that international trade is a key driver of exploitation.
Common guitarfish *Rhinobatos rhinobatos*		✓*	No evidence that international trade is a key driver of exploitation.
Stripenose guitarfish *Acroteriobatus variegatus*		✓	No evidence that international trade is a key driver of exploitation. Insufficient data to determine population trends.
Whitespotted guitarfish *Rhinobatos albomaculatus*		✓	No evidence that international trade is a key driver of exploitation. Insufficient data to determine population trends.
Spineback guitarfish *Rhinobatos irvinei*		✓	No evidence that international trade is a key driver of exploitation. Insufficient data to determine population trends.
Brown guitarfish *Rhinobatos schlegelii*		✓	No evidence that international trade is a key driver of exploitation. Insufficient data to determine population trends.

*Evidence of population decline that would meet or exceed the thresholds used by CITES.

Available scientific data and technical information indicated that domestic utilization (through target and mixed fisheries) was the primary reason for exploitation of all the guitarfish species assessed. Hence, these were considered not to have met the CITES criteria for “affected by trade” (Article II 1 and 2 of the CITES Convention).

The Expert Panel also determined that, in the cases of Brazilian guitarfish (*Pseudobatos horkelii*) and common guitarfish (*Rhinobatos rhinobatos*), scientific data and technical information on historical extent and recent rates of decline, taken together, indicated that they would have met the decline-related CITES listing criteria for Appendix II.

In the cases of stripenose guitarfish (*Acroteriobatus variegatus*), whitespotted guitarfish (*R. albomaculatus*), spineback guitarfish (*R. irvinei*) and brown guitarfish (*R. schlegelii*), there were insufficient data or information to quantify population trends.

Scientific assessment in accordance with CITES biological listing criteria

Species distributions

Pseudobatos horkelii occurs in the southwestern Atlantic (FAO Area 41) along the coasts of southern Brazil, Uruguay and northern Argentina (Last *et al.*, 2016; Pollom *et al.*, 2020) (Figure 20).

Rhinobatos rhinobatos occurs in the eastern Atlantic Ocean, from the Cantabrian Sea (southern Bay of Biscay) to Angola, including the Mediterranean Sea (Last *et al.*, 2016; Jabado *et al.*, 2021c), thus occurring in the southern part of FAO Area 27, as well as FAO Areas 34, 37 and 47 (Figure 21).

Acroteriobatus variegatus occurs around the coasts of southern India and Sri Lanka (Last *et al.*, 2016; Kyne *et al.*, 2017), with limited distributional range straddling parts of FAO Areas 51 and 57 (Figure 22).

Rhinobatos albomaculatus occurs along the western coasts of Africa from Mauritania to Angola (Last *et al.*, 2016; Jabado *et al.*, 2021a, in FAO Areas 34 and 47 (Figure 23).

Rhinobatos irvinei occurs along the western coasts of Africa from Morocco to Angola (Last *et al.*, 2016; Jabado *et al.*, 2021b), in FAO Areas 34 and 47 (Figure 24).

Rhinobatos schlegelii occurs in the northwestern Pacific (FAO Area 61), including the coasts of China, Taiwan Province of China, the Republic of Korea and Japan (Last *et al.*, 2016; Rigby *et al.*, 2021) (Figure 25).

All these species occur on the continental shelf, with most species occurring from coastal waters to depths of less than 150 m. Many species of guitarfish, including some of the proposed species, are known to display sexual segregation, including an inshore migration of gravid females to coastal waters (see below).

The Expert Panel also noted that the taxonomic knowledge of guitarfish is still evolving. There are currently 37 accepted species, as noted in the proposal, with other nominal species of uncertain taxonomic validity listed in Eschmeyer’s Catalog of Fishes (Fricke, *et al*., 2022). Several new species have been described in recent years and, of the 37 accepted species, nine (24.3 percent) have been described in the past decade (Figure 26). The changes in the taxonomy, and the potential for misidentifications between species occurring in the same regions, may confound some data. Furthermore, some potential data sources (e.g. landings data) may also confound data for the Rhinobatidae with other related families, including the families Trygonorrhinidae (banjo rays), Glaucostegidae (giant guitarfish) and, to a lesser extent, Rhinidae. Improved collection of commercial catch, landings and discards data is required.

Species productivity

PRODUCTIVITY – LOW-MEDIUM

Most members of the family Rhinobatidae are data limited, but based on the better-studied species (e.g. *Rhinobatos rhinobatos* and *Pseudobatos horkelii*), the members of this family considered within the current proposal may be considered to be of low to medium productivity (see detailed information in Table 15).

Acroteriobatus variegatus

The life history of this species is little studied. The fecundity has been reported as 5–6 pups (Wilson *et al.*, 2020) and, while based on only two specimens, is in the range of other guitarfish.

Pseudobatos horkelii

Recent studies of the age and growth of *P. horkelii* have reported the von Bertalanffy growth parameters (VBGP) to be L_{inf} = 126.93 cm, k = 0.19 y^{-1} and t_0 = −1.51 (Caltabellotta *et al.*, 2019). Males and females have a length at 50 percent maturity (L_{50}) of 70.2 cm and 79.6 cm, respectively (Martins, Pasquino and Gadig, 2018), while Lessa, Vooren and Lahave (1986) reported gravid females from 91 cm total length. Reproduction is annual, and embryonic development lasts about four months (though the reproductive cycle may be annual), with uterine fecundity being 4–12 pups (Lessa, Vooren and Lahave, 1986).

D'Alberto *et al.* (2019) estimated the maximum intrinsic rates of population increase (r_{max}) for a range of species within the order Rhinopristiformes, including *P. horkelii*, using four approaches. The mean r_{max} (± SD) for *P. horkelii* was estimated to be 0.12 ± 0.029 y^{-1} (Jensen's First estimator), 0.13 ± 0.035 y^{-1} (Hewitt and Hoeing's estimator), 0.25 ± 0.032 y^{-1} (Frisk's estimator), and 0.26 ± 0.031 y^{-1} (Reciprocal of lifespan estimator).

The estimated values of K (0.19 y^{-1}; Caltabellotta *et al.*, 2021) and the estimated rates of population increase (0.12–0.26 y^{-1}; D'Alberto *et al.*, 2019) suggest that this guitarfish species would be of low to medium productivity.

Rhinobatos rhinobatos

This is the better-studied guitarfish of the proposed species. Ismen, Yigin and Ismen (2007) estimated the VBGP (L_{inf} = 128.6 cm, K = 0.29 y^{-1} and t_0 = −0.89), although the sample sizes were very limited for larger fish and the maximum age observed was only five years in that study. Başusta *et al.* (2008) estimated the VBGP as L_{inf} = 137.7 cm, K = 0.159 y^{-1} and t_0 = −2.180, with this study having a higher number of larger individuals and the maximum age observed of 24 years. It should be noted that there is still a need to validate that the observed rings in vertebral sections are annual.

There have been several studies of the reproductive biology of *R. rhinobatos* (e.g. Abdel-Aziz, Khalil and Abded-Maguid, 1993; Çek *et al.*, 2009; Ismen, Yigin and Ismen, 2007), with the lengths at 50 percent maturity (based on total length) for females and males being reported as 87 cm and 70 cm (Abdel-Aziz, Khalil and Abded-Maguid, 1993); 79.1 cm and 68.9 cm (Enajjar, Bradai and Bouain, 2008); 69 cm and 68 cm (Ismen, Yigin and Ismen, 2007); and 84.7 cm and 78.6 cm (Lteif *et al.*, 2016). The reproductive cycle is annual with ovarian fecundity and uterine fecundity reported as 2–25 and 1–13, respectively (Enajjar, Bradai and Bouain, 2008).

D'Alberto *et al.* (2019) estimated the maximum intrinsic rates of population increase (r_{max}) for a range of species within the order Rhinopristiformes, including *R. rhinobatos*, using four approaches. The mean r_{max} (±SD) for *R. rhinobatos* was estimated as 0.10 ± 0.143 y^{-1} (Jensen's First estimator), 0.35 ± 0.153 y^{-1} (Hewitt and Hoeing's estimator), 0.53 ± 0.154 y^{-1} (Frisk's estimator), and 0.51 ± 0.152 y^{-1} (reciprocal of lifespan estimator).

The estimated values of K (0.159–0.29 y^{-1}; Ismen, Yigin and Ismen, 2007; Başusta *et al.*, 2008) and the estimated rates of population increase (0.1–0.53 y^{-1}; D'Alberto *et al.*, 2019) suggest that this guitarfish species would be of low to medium productivity.

Rhinobatos schlegelii

The fecundity of this species is reported as 1–14 (mean 8.5) (Schluessel, Giles and Kyne, 2015). While some biological data ostensibly relating to *R. schlegelii* were provided by Bintoro *et al.* (2021), that study was based on samples collected from the Prigi archipelago (Indonesia), which is outside the known distribution, and so were not considered here.

Rhinobatos albomaculatus and R. irvinei.

The Expert Panel was not aware of any robust biological studies that provided accurate, quantitative life-history information for *R. albomaculatus* or *R. irvinei*.

Population numbers

Some species of guitarfish (family Rhinobatidae) are suspected to have undergone population declines and even localized depletion, likely due to overexploitation by fisheries (e.g. Moore, 2017; Jabado, 2018). However, the Expert Panel recognized that species-specific time-series data are typically too limited to provide robust estimates of population size.

Trends and application of the decline criterion

The species of guitarfish (Rhinobatidae) considered here are species of low to medium productivity.

The Expert Panel also noted that appropriate demersal fish surveys to monitor trends in guitarfish are seemingly lacking for many areas, and improved monitoring of guitarfish populations should be considered by relevant range states.

Taxonomic and identification issues will also affect some datasets. Consequently, some of the information considered here that may relate to a "decline" (in either population number or geographical extent) could not be quantified.

Datasets of reported landings are often incomplete, and the interpretation of such data requires a detailed knowledge in temporal changes in data collection, fishing patterns and relevant management measures that may influence landings trends.

Given the coastal nature of many guitarfish species, fishery-independent surveys may not sample the preferred (inshore) habitat, and some of the species considered here are in areas without time-series data from appropriate fishery-independent surveys.

Given the inshore distribution of guitarfish, other anthropogenic activities (e.g. habitat degradation, pollution) may have also impacted on populations, but this is unquantified.

The Expert Panel was concerned with the lack of quantitative data available for the western coasts of Africa, with this applying to three of the proposed species. Improved data collection and collation in this region should be considered to be of high priority.

To summarize the assessment of scientific data and information across the decline criteria of CITES, there is some descriptive information on declines in population range for some species (e.g. *R. rhinobatos*) and quantitative data on catch rates for some species in parts of their respective species ranges (e.g. *P. horkelii* off the coast of Brazil and *R. rhinobatos* off the coast of Mauritania). While there may be local evidence of long-term declines in guitarfish catches in other areas (e.g. *R. rhinobatos* from west Africa), numerical evidence is more limited.

The Expert Panel considers that two of the nominated species (*Pseudobatos horkelii* and *R. rhinobatos*) are likely to have declined and that these declines will have reached or exceeded the thresholds for the decline-related criteria used by CITES, while there was insufficient evidence to make a determination against another four. Although some of the other proposed species may have declined, it is uncertain whether any of these species have declined to the extent of reaching or exceeding the thresholds for the decline-related criteria used by CITES.

Data on the extent of decline were of variable quality. The Expert Panel noted that some of the evidence of decline for the proposed species was based on “historical ecology”, whereby comparison of early descriptive accounts were compared with current perceptions. While such approaches provide an informative approach to describing historic reductions in broader geographical extent, such analyses do not provide quantitative data on the magnitude of population decline in relation to the thresholds used by CITES.

The information evaluated by the Expert Panel regarding population trends of the different species is summarized below and inTable 16. The datasets and information sources considered by the Expert Panel are detailed inTable 17.

Acroteriobatus variegatus

Data for this species were limited, and data available to the Expert Panel were insufficient to determine if there has been a population decline in relation to the CITES criteria or quantify the magnitude of any decline.

In summary, while fishing pressure in the range countries would be expected to have resulted in a decline in the population of *A. variegatus*, there were insufficient data to quantify either the historic or recent trends in the population, and it is uncertain whether it would have reached or exceeded the thresholds used by CITES.

Pseudobatos horkelii

The data available to the Expert Panel were indicative of there having been a decline in the population (seeFigure 27), with the more robust information indicative of there having been a decline of about 85–90 percent in part of the species range (Brazil) with a reported stock collapse in 2010. There was also some evidence of decreasing occurrence elsewhere in the species range, but this could not be quantified with the data available. No reliable time-series data were available to the Expert Panel for other parts of the species’ range (e.g. in the waters of Argentina and Uruguay).

In summary, *P. horkelii* has undergone a decline of 85–90 percent in parts of its range, and it could also have declined elsewhere in its range. There are indications that the declines in some core areas of the species distribution have reached or exceeded the thresholds used for marked declines in the CITES criteria.

Rhinobatos albomaculatus

The data available to the Expert Panel were indicative of there having been a decline in the population, with the more robust information indicative of there having been a decline of about 40–60 percent in part of the species range. There was also some evidence of decreasing occurrence elsewhere in the species range, but this could not be quantified with the data available.

In summary, *R. albomaculatus* might have undergone a decline of 40–60 percent in parts of its range, and there may also have been declines elsewhere in the range. There were insufficient data to quantify either the historic or recent trends in the wider population, and so it is uncertain whether declines would have reached or exceeded the thresholds used by CITES.

Rhinobatos irvinei

The data available to the Expert Panel were indicative of there having been a decline in the population, with the more robust information indicative of there having been a decline of about 40–60 percent in part of the species range. There was also some evidence of decreasing occurrence elsewhere in the species range, but this could not be quantified with the data available.

In summary, *R. irvinei* might have undergone a decline of 40–60 percent in parts of its range, and there may also have been declines elsewhere in the range. There were insufficient data to quantify either the historic or recent trends in the wider population and so it is uncertain whether declines would have reached or exceeded the thresholds used by CITES.

Rhinobatos rhinobatos

Data for *R. rhinobatos* indicated a longer-term decrease in distributional range, although the reduced range was from the northern limits of the species range (e.g. northwestern Mediterranean). No reliable time-series data were available to the Expert Panel for the southern and eastern Mediterranean. Data were also limited for the coasts of west Africa, although trawl survey data (Mauritanian waters; 1990–2010) indicated an initial decline followed by recent stability (Figure 28) and stakeholder surveys (Ghana) indicated a probable decline. Hence, the Expert Panel considered this species had declined, although the magnitude of the decline was uncertain.

In summary, *R. rhinobatos* has declined in geographical extent, with an apparent loss of the species from the northern limits of the species range. There is also evidence of declines along the coast of west Africa, and these declines may be in excess of 80 percent in some areas. There are indications that the declines in some areas of the distribution have reached or exceeded the thresholds used for the decline-related criteria by CITES.

Rhinobatos schlegelii

Data for this species were limited, and data available to the Expert Panel were insufficient to determine if there has been a population decline or quantify the magnitude of any decline.

In summary, while fishing pressure in the area would be expected to have resulted in a decline in the population of *R. schlegelii*, there were insufficient data to quantify either the historic or recent trends in the population, and it is uncertain whether it would have reached or exceeded the thresholds used by CITES.

The Expert Panel recognized that there is increasing concern over the status of many species of guitarfish (Rhinobatidae). The proposal indicated that of the 37 recognized species within the Rhinobatidae, two (5.4 percent) were Not Evaluated, five (13.5 percent) were assessed by the IUCN as Data Deficient, three (8.1 percent) as Least Concern, four (10.8 percent) as Near Threatened, eight (21.6 percent) as Vulnerable, five (13.5 percent) as Endangered, and ten (27.0 percent) as Critically Endangered. Although the Expert Panel noted that many of the other species of guitarfish (Rhinobatidae) were assessed as Threatened by the IUCN, the Expert Panel did not have the time to evaluate the relevant population trend data for these species.

Modifying risk factors

The Expert Panel considered whether there were any biological characteristics of Rhinobatidae that would modify their probability of being depleted to the point where they would meet the criteria for listing.

Because of their size, body form, demersal lifestyle and feeding behaviour, these species are susceptible to capture in trawl, gill- and tangle-net, longline and other fisheries directed at a range of target species. There may also be some recreational fisheries, although the degree of retention in recreational fisheries is unknown.

The Expert Panel also noted that many guitarfish species are associated with the inner continental shelf, and often with shallower waters. Guitarfish may be taken in a range of fishing gear, including trawl, longline, gill- and tangle-nets and beach seines. Gravid females of several species are known to move inshore at certain times of the year for pupping. In some areas, such aggregations may be, or may have been, subject to seasonal target fisheries, resulting in high levels of fishing pressure on gravid females and young (e.g. Larre *et al.*, 2021). In addition, guitarfish populations across the species range may display genetic differentiation, as reported for *Pseudobatos horkelii* (Cruz *et al.*, 2021), which indicates that such species may be at greater risk of localised depletions.

The Expert Panel noted that the inshore habitats of guitarfish may make them prone to other human-induced impacts, such as habitat degradation and contaminants (e.g. Martins *et al.*, 2020, 2022). The potential impacts of other anthropogenic impacts could not be examined for any of the proposed species during the Expert Panel meeting. Nevertheless, the Expert Panel considered that fishing pressure would be the main impact on the populations.

Like many other batoids, guitarfish often have concentrated nearshore spawning (pupping) behaviours that make them particularly easy to target using beach seines or bottom-set gillnets and similar entangling gear. Thus, they may suffer higher than the typical fishing mortality in such areas while being less able to sustain this than more productive species. Given time constraints, the Expert Panel were only able to provide examples of these problems, mostly drawn from the proposal rather than through undertaking a detailed review.

Uncertainty in current exploitations levels for all guitarfish (Rhinobatidae) and related families is also a concern. Preliminary examination of landings, as supplied to FAO, indicate inconsistent and likely incomplete reporting (Figures Figure 29; FAO. 2022. Fishery and Aquaculture Statistics. Global capture production 1950-2020 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2022. www.fao.org/fishery/statistics/software/fishstatj/en

Figure 30; Figure 31 andFAO. 2022. Fishery and Aquaculture Statistics. Global capture production 1950-2020 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2022. www.fao.org/fishery/statistics/software/fishstatj/en

Figure 32). The Expert Panel did not have the time to make a detailed examination of all data that may be available in relevant national datasets, and considered that a more focused effort to collate relevant landing data could usefully be undertaken.

Comments on technical aspects relating to management, trade and likely effectiveness of implementation of a CITES listing

Management comment

There are numerous examples documenting guitarfish as being taken as marketable bycatch in mixed demersal fisheries and also as being taken in some target fisheries.

The FAO IPOA-Sharks applies to chondrichthyans and therefore also applies to Rhinobatidae; it underscores the responsibilities of fishing and coastal states for sustaining chondrichthyan populations, ensuring full utilization of retained species and improving data collection and monitoring (see Appendix G, especially point 3 in FAO, 2019).

R. rhinobatos is listed in the Annex II List of Endangered or Threatened Species of the Protocol Concerning Specially Protected Area and Biological Diversity in the Mediterranean, of the Barcelona Convention (SPA/BD). The General Fisheries Commission for the Mediterranean (GFCM) adopted a measure related to the shark species listed in Annex II of the SPA/BD Protocol, as a result of which *R. rhinobatos* cannot be retained on board, transshipped, landed, transferred, stored, sold or displayed, or offered for sale. European Union regulations on annual fishing opportunities (e.g. Council Regulation (EU) 2022/109) list *R. rhinobatos* as a prohibited species in the Mediterranean.

There are general research efforts on sharks and rays at the regional and national levels that could apply to guitarfish. The proposal notes that the guitarfish species occur in the waters of about 110 countries and therefore the Expert Panel was unable to review all regulations. The Panel was likewise unable to provide a comprehensive review. However, national regulations protect some or all species of Rhinobatidae in Bangladesh, Brazil, European Union, Israel, Kuwait, Mexico, Pakistan, Saudi Arabia, and the United States of America.

Marine protected areas and other spatial measures to protect marine ecosystem have been established in several exclusive economic zones. For example, Guinea, Guinea-Bissau, Mauritania and Sierra Leone ban shark fishing (including for guitarfish) in their protected areas.

The Expert Panel noted that Newell (2017) reviewed the availability of national regulations that apply to *R. rhinobatos* (and to *Glaucostegus cemiculus*) throughout their ranges. However, many of these regulations were regarded by Newell (2017) as being ineffective.

Finning controls and fins-attached landing requirements have little relevance, however, as guitarfish are usually landed intact in coastal fisheries and are fully utilized. Requirements to record all landings by species at time of landing would assist long-term stock assessment and effective management.

There are numerous examples documenting guitarfish (Rhinobatidae, and also related families) as being taken as marketable bycatch in mixed demersal fisheries (e.g. Jaureguizar *et al.,* 2015; Jabado, 2018; Jannot *et al.*, 2021), as well as being taken in some target fisheries (Newell, 2017; Jabado, 2018; Chaikin, Belmaker and Barash, 2020; Leeney and Quayson, 2022; Seidu *et al.* 2022).

Despite the inconsistent and incomplete reporting of guitarfish (Rhinobatidae), as available to FAO, the preliminary examination of available landings data showed that guitarfish have been landed by various nations since the mid-1950s and 1960s. This indicates that there has been an extensive period of landings of members of this family over a protracted time.

International management

The FAO IPOA-Sharks applies to chondrichthyans and therefore also applies to Rhinobatidae; it underscores the responsibilities of fishing and coastal states for sustaining chondrichthyan populations, ensuring full utilization of retained species and improving data collection and monitoring (see Appendix G, especially point 3 in FAO, 2019).

The 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 should include verification that all species exploited have been taken in compliance with international law, international conventions and regional fisheries management organization (RFMO) measures (see Appendix G, especially point 4 in FAO, 2019).

Regional management

Rhinobatidae occupy coastal habitats and are caught in local and artisanal, mixed species fisheries. *R. rhinobatos* is listed in the Annex II List of Endangered or Threatened Species of the Protocol Concerning Specially Protected Area and Biological Diversity in the Mediterranean, of the Barcelona Convention (SPA/BD). The General Fisheries Commission for the Mediterranean (GFCM) adopted a measure related to the shark species listed in Annex II of the SPA/BD Protocol, as a result of which *R. rhinobatos* cannot be retained on board, transshipped, landed, transferred, stored, sold or displayed, or offered for sale. European Union regulations on annual fishing opportunities (e.g. Council Regulation (EU) 2022/109) list *R. rhinobatos* as a prohibited species in the Mediterranean.

Because of bycatch issues, the same type of fishing gear is operative in the coastal areas targeting RFMO target species (in which guitarfish are included); the same practices should therefore be applied to guitarfish under the RFMOs, which require catches of sharks to be recorded and reported annually, whether in groups or as individual species. This is complemented by observer programmes and discard reporting.

There are general research efforts on sharks and rays at the regional and national levels that could apply to guitarfish.

National measures

The proposal notes that the guitarfish species occur in the waters of about 110 countries and therefore the Expert Panel was unable to review all regulations. The Panel was likewise unable to provide a comprehensive review and can only point to illustrative examples of regulations.

The proposal notes that regulations protect some or all species of Rhinobatidae, for example, those of Bangladesh, Brazil, European Union, Israel, Kuwait, Mexico, Pakistan, Saudi Arabia, and the United States of America.

It was also noted that guitarfish are caught as bycatch of permitted fishing for white fish and shrimp in some West African countries. Catches are registered in records of catches of sharks and rays, but no distinction is made.

In response to concerns that foreign flagged vessels permitted to fish in the exclusive economic zones (EEZs) of some West African countries were excessively targeting sharks, including guitarfish, access to EEZs has been withdrawn. Coastal and artisanal fishers in that region have noted an absence of guitarfish in their local catches. Marine protected areas and other spatial measures to protect marine ecosystems have been established in several EEZs. For example, Guinea, Guinea-Bissau and Sierra Leone ban shark fishing (including for guitarfish) in their marine protected areas. Mauritania bans shark fisheries in the Banc d'Arguin National Park. Diop and Dossa (2011) provided a comprehensive list of shark management measures adopted in the Sub-Regional Fisheries Commission up to 2009, and also indicated where improvements might be made.

The Expert Panel noted that Newell (2017) reviewed the availability of national regulations that apply to *R. rhinobatos* (and to *Glaucostegus cemiculus*) throughout their ranges. However, many of these regulations were regarded by Newell (2017) as being ineffective.

In those areas where best practice includes the use of turtle exclusion devices or similar grids acting as bycatch reduction devices in finer-mesh trawl fisheries (e.g. for prawns), such measures may also be useful in reducing bycatch of larger guitarfish.

Some states implement regional management measures (stated above) through national action plans that include prohibiting the retention of guitarfish. Finning controls and fins-attached landing requirements have little relevance, however, as guitarfish are usually landed intact in coastal fisheries and are fully utilized.

Requirements to record all landings by species at time of landing would assist long-term stock assessment and effective management.

Trade comment

There are numerous examples documenting guitarfish (Rhinobatidae, and also related families) as being taken as marketable bycatch in mixed demersal fisheries and in some target fisheries. This is primarily to supply meat for human consumption and for the domestic (national) market, while fins are also used to supply international trade.

There was some information to indicate that some of the meat may be traded between nearby nations, and that the fins may also be processed and used in the international fin trade. However, the available data did not indicate that the fins of guitarfish (family Rhinobatidae) were an important part of the international fin trade, though this may change in the future.

Any proportional increase in the use of the fins of smaller elasmobranchs should also be viewed in the context of any efforts to "encourage full use of dead sharks", as per any national shark plan (FAO, 1999).

While the proposed species are commercially exploited, the Expert Panel did not find evidence that international trade was a major driver of mortality in these species. For the most part, the fishing pressure that guitarfish suffer seems to be driven from modifying risks (see above) rather than by international trade.

However, the Expert Panel acknowledged that if the main sources of the fin trade became more heavily limited, then fins from smaller elasmobranchs, such as guitarfish, might increase in value and the importance in the fin trade (and so international trade) might then become a more serious driver of overfishing.

In relation to trade of guitarfish (Rhinobatidae, and also related families), the Expert Panel noted that guitarfish were primarily landed to supply meat for human consumption and for the domestic (national) market (e.g. Lteif *et al.*, 2014; Leeney and Quayson, 2022) and that to supply international trade was not the main factor driving fisheries exploitation. There was also evidence of some fisheries discarding smaller-bodied guitarfish species, presumably due to low market value. Guitarfish are also generally associated with coastal waters and the inner continental shelf, and so "introduction from the sea" would not generally occur with members of this family.

There was some information to indicate that some of the meat may be traded between nearby nations, and that the fins are also processed and used in the international fin trade. However, the available data did not indicate that the fins of guitarfish (family Rhinobatidae) were an important part of the international fin trade. Any proportional increase in the use of the fins of smaller elasmobranchs should also be viewed in the context of any efforts to "encourage full use of dead sharks", as per any national shark plan (FAO, 1999).

Overall, the Expert Panel believed that domestic consumption of harvested guitarfish and national trade were the primary reasons for fisheries retaining and landing the proposed species of guitarfish, and also for other members of the family Rhinobatidae. While the proposed species are commercially exploited, the Expert Panel did not find evidence that international trade was a major driver of mortality in these species.

It is clear from the proposal and from the available literature that the fins of guitarfish (order (Rhinopristiformes) are subject to international trade, but this is more limited for members of the family Rhinobatidae in comparison to the families Rhinidae and Glaucostegidae (Tables Table 18 and Table 19; Holmes, Steinke and Ward, 2009; Chuang *et al.*, 2016; Fields *et al.*, 2018; Hau *et al.*, 2018; Cardeñosa *et al.*, 2020; Haque, Das and Biswas, 2019; Haque, *et al.*, 2021).

It has been reported that the international trade in the fins of Rhinopristiformes is, in many cases, driven by the size of the fins (Haque and Spaet, 2021) and their quality (Moore, 2017). Several of the proposed species (e.g. *Pseudobatos horkelii, Acroteriobatus variegatus*) are comparatively smaller in size and lack any quantifiable information on international trade. Indeed, *A. variegatus* has been identified as a non-commercial "trash fish" in the main parts of its range (Bhagyalekshmi and Kumar, 2021).

In terms of *R. rhinobatos,* Moore, Séret and Armstrong (2019) reported that "While fins were removed by fishers on some fresh specimens (including small individuals of ca. 50 cm TL), this practice did not appear to be consistent (or as consistent as that observed for *G. cemiculus*), as intact fins were sometimes observed on drying whole specimens".

Traded fins seem to be of mixed species of which guitarfish (Rhinobatidae) appear to be a very small proportion of the total, as indicated by genetic methods. Part of this trade from both West Africa and southeast Asia (e.g. Bangladesh) seems to be furtive and might also include IUU components (see below). Ongoing and past efforts by authorities and organizations (other than customs administrations) have monitored the species composition of the shark fin trade and these efforts may continue to provide further insights.

It is not at all clear from the proposal if international trade (e.g. fins) is a major driver of overfishing for these species, and the Expert Panel could find no indication from other sources that international trade was the driving force for current levels of fishing. The proposal provided no clear idea of the percentage of the landed value that international trade represented for these species, nor the socio-economic importance of the domestic product. Indeed, some of the fisheries relating to subsistence and recreational fisheries are unlikely to be driven by international trade.

Some studies (e.g. Alvarenga *et al.*, 2021; Bhagyalekshmi and Kumar, 2021) have indicated domestic trade, with a degree of discarding (e.g. of smaller individuals) and the indication that guitarfish were considered as "trash fish" that were increasingly landed and used for fish meal (Bhagyalekshmi and Kumar, 2021).

For *R. rhinobatos,* there is some information that international trade of the meat occurs within Africa, and that fins are purchased, presumably for export and then enter the global fin trade (Jabado *et al.*, 2021c; Seidu *et al.*, 2022). Some trade in guitarfish meat between neighbouring countries would also be expected elsewhere in the world.

The reported population declines in guitarfish populations are considered to be primarily due to high fishing pressure on guitarfish over much of their ranges (Moore, 2017), with some bycatch specimens being discarded (Bradai and Soldo, 2016), which might be related to the lower value of smaller individuals (Haque and Spaet, 2021).

For the most part, the fishing pressure that guitarfish suffer seems to be driven from modifying risks (see above) rather than by international trade. However, the Expert Panel acknowledged that if the main sources of the fin trade became more heavily limited, then fins from smaller elasmobranchs, such as guitarfish, might increase in value, and the importance in the fin trade (and so international trade) might then become a more serious driver of overfishing (Seidu *et al.*, 2022).

Overall, the Expert Panel could find no evidence that international trade was the major driver for the current levels of exploitation, and that inshore fisheries in warm-temperate to tropical seas would retain guitarfish, with domestic use as the main incentive.

Basis for Article II paragraph 2(b) ("look-alike") Appendix II listing of Rhinobatidae

The Expert Panel also stressed that the taxonomic knowledge of guitarfish is still evolving. There are currently 37 accepted species, as noted in the proposal, with other nominal species of uncertain taxonomic validity listed in Eschmeyer's Catalog of Fishes. Several new species have been described in recent years and, of the 37 accepted species, nine (24.3 percent) have been described in the past decade (Figure 26). The changes in the taxonomy, and the potential for misidentifications between species occurring in the same regions, may confound some data. Furthermore, some potential data sources (e.g. landings data) may also confound data for the Rhinobatidae with other related families, including the families Trygonorrhinidae (banjo rays), Glaucostegidae (giant guitarfish) and, to a lesser extent, Rhinidae. Improved collection of commercial catch, landings and discards data is required.

The Expert Panel noted that the proposal indicated that all species in the family Rhinobatidae should be included in Appendix II (in line with Article II, paragraph 2(b) of the CITES Convention) owing to the challenges in distinguishing parts and derivatives of guitarfish that might be traded internationally (the look-alike provision).

Because of the evolving taxonomy of the family, and known identification problems, the Expert Panel noted that any management measures developed by competent authorities for this group would generally be better applied at the family level (Rhinobatidae).

The Expert Panel evaluated relevant published information on species occurring in the fin trade, and expressed that there was no evidence of any look-alike species occurring in the international fin trade, though the Expert Panel recognized this was based on a limited number of studies.

The Expert Panel could not find robust evidence of major international trade in guitarfish (Rhinobatidae). The "look-alike" clause applies only to those species that are traded internationally.

Comment on the likely effectiveness for conservation of a CITES Appendix II listing

A CITES Appendix II listing applies only to international trade in listed species and their products. Domestic trade in guitarfish and their products would be unaffected by listing in CITES Appendix II. The landing and selling of guitarfish in domestic markets could therefore continue without any changes to current practices, as international trade was not found to be a major driver of exploitation for any of these species.

It is difficult to judge how effective control of international trade would prove to be for a CITES Appendix II listing of the Rhinobatidae, as management of international trade may not currently serve to substantially influence the level of exploitation of these species. In the present circumstances, it would seem likely that the national and regional legislative, conservation and fish management bodies have a better opportunity to effectively manage populations of guitarfish through local and regional interventions.

Given the potential susceptibility of guitarfish (Rhinobatidae), improved fisheries management through national authorities and/or regional fisheries bodies should be the primary focus for minimizing overexploitation and regulating fishing pressure on such species. Hence, listing such species on CITES is unlikely to reduce the current main impacts on their populations (i.e. fishing mortality and retention for national use).

Reporting of catches of Rhinobatidae species, where landing is permitted, could be improved in some cases. However, it is apparent to the Expert Panel that this task is difficult and expensive due to the nature of catches. Some Southeast Asian range states' responses to earlier CITES Appendix II listing decision have simply been to refuse permits to land listed species and to ban trade.

Appendix II listing could assist in improving compliance by providing an impediment to trading in Rhinobatidae products illegally obtained from fisheries where regulations prohibit catch and/or retention, given the requirement to supply CITES documentation to importing countries' border authorities.

A CITES listing would be expected to impact on those products that are traded, which includes fins and may include meat (trade in which can occur between neighbouring countries) as well as other products.

As CITES provisions require an export permit by the exporting country, which ensures 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.

The implementation of previous listing decisions for sharks has taken some time. Some of the delays are a result of legislative processes, but there can also be a lag of three or more years in the collection of local information and in transmission of trade data to the CITES Secretariat. Additionally, difficulties encountered in making NDFs are made more difficult by known taxonomic problems and the fact that there can be multiple co-occurring species in some areas, making it more difficult to prepare stock-specific NDFs. Under such conditions, trade in the species (or family) and its products often ceases, or continues without proper CITES documentation (also known as "illegal trade"). In most cases, it will take many years to develop adequate NDFs, and products from these species are likely to be included in trade shipments, which would be challenging for customs officers.

Improvements in management of inshore Rhinobatidae fisheries across developing countries and countries with economies in transition should remain a priority, with or without CITES Appendix II listing of the family.

It is difficult to judge how effective control of international trade would prove to be for a CITES Appendix II listing of the Rhinobatidae, as management of international trade may not currently serve to substantially influence the level of exploitation of these species. CITES listing would not affect domestic trade, and it would be expected that guitarfish would continue to be harvested for local consumption. In the present circumstances, it would seem likely that the national and regional legislative, conservation and fish management bodies have a better opportunity to effectively manage populations of guitarfish through local and regional interventions.

Given the potential susceptibility of guitarfish (Rhinobatidae), improved fisheries management through national authorities and/or regional fisheries bodies should be the primary focus for minimizing overexploitation and regulating fishing pressure on such species. This is because international trade was not found to be a major driver of exploitation for any of these species. Hence, listing such species on CITES is unlikely to reduce the current main impacts on their populations (i.e. fishing mortality and retention for national use).

Reporting of catches of Rhinobatidae species, where landing is permitted, could be improved in some cases. However, it is apparent to the Expert Panel that some Southeast Asian range states' responses to earlier CITES Appendix II listing decision have simply been to refuse permits to land listed species and to ban trade.

Appendix II listing could assist in improving compliance by providing an impediment to trading in Rhinobatidae products illegally obtained from fisheries where regulations prohibit catch and/or retention, given the requirement to supply CITES documentation to importing countries' border authorities.

CITES listing would be expected to impact on those products that are traded, which may include meat (trade in which trade can occur between neighbouring countries), as well as fins and other products.

CITES provisions on the trade of specimens of species listed in Appendix II require 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.

Should guitarfish (family Rhinobatidae) be listed in Appendix II, including the proposed extension of the listing to all species in the family on the basis of the look-alike provision in the proposal, then this will require the same considerations and export permitting for all species in the family.

The legal trade will be recorded in the CITES Trade Database, and this will improve overall trade information.

Examination of implementation of previous listing decisions shows that it has taken some time for trade to normalize and illegal trade is still ongoing. Some of the delays are a result of legislative processes, but there can also be a time lag for collection and transmission of fishery data in order to make an NDF. Equally, once legal trade is underway, CITES trade data can take an extended period to reach the CITES Trade Database.

States' abilities to make NDFs for data-limited species will be hampered by a lack of appropriate regional stock or national assessments. Given known taxonomic problems and that there can be multiple co-occurring species in some areas, it may be problematic to have stock-specific NDFs. Under these conditions, the following outcomes can occur:

- trade in the species (or family) and its products ceases;
- trade continues without proper CITES documentation (also known as "illegal trade");
- trade continues with inadequate NDFs; and/or
- trade continues for named species with an NDF, but that products from co-occurring species without NDFs may be included in trade shipments, which would be challenging for customs officers.

References

Abdel-Aziz, S.H., Khalil, A.N. & Abdel-Maguid, S.A. 1993. Reproductive cycle of the common guitarfish, *Rhinobatos rhinobatos* (Linnaeus, 1758), in Alexandria waters, Mediterranean Sea. *Marine and Freshwater Research*, 44: 507–517.

Alvarenga, M., Solé-Cava, A.M., & Henning, F. 2021. What's in a name? Phylogenetic species identification reveals extensive trade of endangered guitarfishes and sharks. *Biological Conservation*, 257, 109119. https://doi.org/10.1016/j.biocon.2021.109119

Anderson, A.B., Fiuza, T.M., Araujo, G.S., Canterle, A.M., Canto, L.M., Freitas, R.H., … & Floeter, S.R. 2021. A safe haven for potential reproductive aggregations of the critically endangered Brazilian guitarfish (*Pseudobatos horkelii*). *Journal of Fish Biology*, 99: 2030–2034.

Başusta, N., Demirhan, S.A., Çiçek, E., Başusta, A. & Kuleli, T. 2008. Age and growth of the common guitarfish, *Rhinobatos rhinobatos*, in Iskenderun Bay (north-eastern Mediterranean, Turkey). *Journal of the Marine Biological Association of the United Kingdom*, 88: 837–842.

Bhagyalekshmi, V. & Kumar, A.B. 2021. Bycatch of non-commercial batoids in the trawl fishery of south India: status and conservation prerequisites. *Regional Studies in Marine Science*, 44: 101738.

Bintoro, G., Lelono, T.D., Setyohadi, D., Maharani, H. & Rihmi, M.K. 2021. Species composition and biology reproductions aspects of stingray (Batoidea) in south coast of Prigi waters, Trenggalek, East Java, Indonesia. *IOP Conference Series*: *Earth and Environmental Science*, 919, (1): 012018.

Bradai, M.N. & Soldo, A. 2016. *Rhinobatos rhinobatos*. *The IUCN Red List of Threatened Species* 2016: e.T63131A16527789. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK . Cited 18 July 2022. www.iucnredlist.org/species/63131/16527789

Bunholi, I.V., da Silva Ferrette, B.L., De Biasi, J.B., de Oliveira Magalhães, C., Rotundo, M.M., Oliveira, C., ... & Mendonça, F.F. 2018. The fishing and illegal trade of the angelshark: DNA barcoding against misleading identifications. *Fisheries Research*, 206: 193–197.

Caltabellotta, F.P., Siders, Z.A., Murie, D.J., Motta, F.S., Cailliet, G.M., & Gadig, O.B. 2019. Age and growth of three endemic threatened guitarfishes *Pseudobatos horkelii, P. percellens* and *Zapteryx brevirostris* in the western South Atlantic Ocean. *Journal of Fish Biology*, 95: 1236–1248.

Cardeñosa, D., Shea, K.H., Zhang, H., Feldheim, K., Fischer, G.A. & Chapman, D.D. 2020. Small fins, large trade: a snapshot of the species composition of low-value shark fins in the Hong Kong markets. *Animal Conservation*, 23: 203–211.

Casselberry, G.A., & Carlson, J.K. 2015. Endangered Species Act Status Review of the Brazilian guitarfish (*Rhinobatos horkelii*). Report to the National Marine Fisheries Service, Office of Protected Resources. SFD Contribution PCB-15-08, 17 pp.

Çek, Ş., Karalar, M., Demirhan, S.A. & Başusta, N. 2009. Biological observations on the common guitarfish *Rhinobatos rhinobatos* from İskenderun Bay (Turkey, Eastern Mediterranean). *Animal Biology*, 59: 211–230.

Chaikin, S., Belmaker, J. & Barash, A. 2020. Coastal breeding aggregations of threatened stingrays and guitarfish in the Levant. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30: 1160–1171.

Chuang, P.S., Hung, T.C., Chang, H.A., Huang, C.K. & Shiao, J.C. 2016. The species and origin of shark fins in Taiwan's fishing ports, markets, and customs detention: a DNA barcoding analysis. *PloS ONE*, 11(1): p.e0147290.

Cruz, V.P., Adachi, A.M., Oliveira, P.H., Ribeiro, G.S., Paim, F.G., Souza, B.C., Rodrigues, A.S., Vianna, M., Delpiani, S.M., Díaz de Astarloa, J.M. & Rotundo, M.M. 2021. Genetic diversity in two threatened species of guitarfish (Elasmobranchii: Rhinobatidae) from the Brazilian and Argentinian coasts: an alert for conservation. *Neotropical Ichthyology*, 19.

D'Alberto, B.M., Carlson, J.K., Pardo, S.A. & Simpfendorfer, C.A. 2019. Population productivity of shovelnose rays: Inferring the potential for recovery. *PLoS One* 14(11): e0225183. https://doi.org/10.1371/journal.pone.0225183

Diop, M. & Dossa, J. 2011. 30 years of shark fishing. Development of fisheries, catch trends, and their conservation status in Sub-Regional Fishing Commission member countries. (CSRP) La Commission sous-régionale des pêches, PRCM, FIBA. ISBN: 978-2-918445-04-3 (English version). 93 pp.

Dulcic, J., Soldo, A. & Jardas, I. 2005. Adriatic fish biodiversity and review of bibliography related to Croatian small-scale coastal fisheries. *Adriatic Sea Small-Scale Fisheries. AdriaMed Technical Documents*, 15: 103–125.

Ebert, D.A., Carlson, P., Aitchison, R.M., Huerta-Beltran, B.L. & Kyne, P.M. 2021. Report on the American Elasmobranch Society Global Wedgefish and Guitarfish Symposium 2021.

Enajjar, S., Bradai, M.N. & Bouain, A. 2008. New data on the reproductive biology of the common guitarfish of the Gulf of Gabès (southern Tunisia, central Mediterranean). *Journal of the Marine Biological Association of the United Kingdom*, 88: 1063–1068.

FAO. 1999. *International Plan of Action for reducing incidental catch of seabirds in longline fisheries. International Plan of Action for the conservation and management of sharks. International Plan of Action for the management of fishing capacity*. Rome, FAO. 1999. 26p.

FAO. 2019. *Report of the Sixth FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Concerning Commercially Exploited Aquatic Species, Rome, 21–25 January 2019*. FAO Fisheries and Aquaculture Report No. 1255. Rome. Licence: CC BY-NC-SA 3.0 IGO.

Fernando, D., Bown, R.M., Tanna, A., Gobiraj, R., Ralicki, H., Jockusch, E.L., ... & Caira, J.N. 2019. New insights into the identities of the elasmobranch fauna of Sri Lanka. *Zootaxa*, 4585(2): 201–238.

Fields, A.T., Fischer, G.A., Shea, S.K., Zhang, H., Abercrombie, D.L., Feldheim, K.A., Babcock, E.A. & Chapman, D.D. 2018. Species composition of the international shark fin trade assessed through a retail-market survey in Hong Kong. *Conservation Biology*, 32: 376–389.

Fricke, R., Eschmeyer, W. N. & Van der Laan, R. (eds) 2022. Eschmeyer's Catalog of Fishes. In California Academy of scienc. California, USA. Cited 18 July 2022. http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp.

Haque, A.B. & Spaet, J.L. 2021. Trade in threatened elasmobranchs in the Bay of Bengal, Bangladesh. *Fisheries Research*, 243: p.106059.

Haque, A.B., Das, S.A. & Biswas, A.R. 2019. DNA analysis of elasmobranch products originating from Bangladesh reveals unregulated elasmobranch fishery and trade on species of global conservation concern. *PloS ONE*, 14(9): p.e0222273.

H**aque, A.B., Washim, M., D'Costa, N.G., Baroi, A.R., Hossain, N., Nanjiba, R., Hasan, S.J. & Khan, N.A.** 2021. Socio-ecological approach on the fishing and trade of rhino rays (Elasmobranchii: Rhinopristiformes) for their biological conservation in the Bay of Bengal, Bangladesh. *Ocean & Coastal Management*, 210: p.105690.

Hau, C.Y., Abercrombie, D., Ho, K.Y.K. & Shea, K.H.S. 2018. *King of shark fins: a rapid survey on the availability of shark-like batoid fins in Hong Kong SAR and Guangzhou*. HK Shark Foundation. 30 pp.

Holmes, B.H., Steinke, D. & Ward, R.D. 2009. Identification of shark and ray fins using DNA barcoding. *Fisheries Research*, 95: 280–288.

Ismen, A., Yıgın, C. & Ismen, P. 2007. Age, growth, reproductive biology and feed of the common guitarfish (*Rhinobatos rhinobatos* Linnaeus, 1758) in Iskenderun Bay, the eastern Mediterranean Sea. *Fisheries Research*, 84: 263–269.

Jabado, R.W. 2018. The fate of the most threatened order of elasmobranchs: shark-like batoids (Rhinopristiformes) in the Arabian Sea and adjacent waters. *Fisheries Research,* 204: 448–457.

Jabado, R.W., Dia, M., De Bruyne, G., Williams, A.B., Seidu, I., Chartrain, E., Leurs, G.H.L., Tamo, A., Metcalfe, K., Doherty, P., Soares, A., Dossa, J., VanderWright, W.J., Derrick, D. & Diop, M. 2021a. *Rhinobatos albomaculatus*. The IUCN Red List of Threatened Species 2021: e.T161320A124465045. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T161320A124465045.en

Jabado, R.W., Chartrain, E., Dia, M., De Bruyne, G., Doherty, P., Derrick, D., Williams, A.B., Seidu, I., Leurs, G.H.L., Metcalfe, K., Tamo, A., Soares, A., VanderWright, W.J., Ba, A., Dossa, J. & Diop, M. 2021b. *Rhinobatos irvinei*. The IUCN Red List of Threatened Species 2021b: e.T161409A124479989. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T161409A124479989.en

Jabado, R.W., Pacoureau, N., Diop, M., Dia, M., Ba, A., Williams, A.B., Dossa, J., Badji, L., Seidu, I., Chartrain, E., Leurs, G.H.L., Tamo, A., Porriños, G., VanderWright, W.J., Derrick, D., Doherty, P., Soares, A., De Bruyne, G. & Metcalfe, K. 2021c. *Rhinobatos rhinobatos*. The IUCN Red List of Threatened Species 2021c: e.T63131A124461877. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T63131A124461877.en

Jannot, J. E., Bjorkland, R., Somers, K. A., Mitchell, T., Tuttle, V. J., & McVeigh, J. 2021. Elasmobranch bycatch in US West Coast groundfish fisheries. *Endangered Species Research*, 45: 109–126.

Jaureguizar, A.J., Cortés, F., Milessi, A.C., Cozzolino, E. & Allega, L. 2015. A trans-ecosystem fishery: environmental effects on the small-scale gillnet fishery along the Río de la Plata boundary. *Estuarine, Coastal and Shelf Science* 166: 92–104.

Kyne, P.M., Simpfendorfer, C., Bineesh, K.K., Moore, A., Jabado, R. & Valinassab, T. 2017. *Acroteriobatus variegatus*. The IUCN Red List of Threatened Species 2017: e.T161476A109905030. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. http://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T161476A109905030.en

Laporta, M., Scarabino, F., Fabiano, G., Silveira, S., Pereyra, I. & Santana, O. 2018. Peces e invertebrados capturados en las pesquerías artesanales oceánicas de enmalle y palangre de fondo de Uruguay. *Frente Marítimo,* 25: 326–348.

Larre, G.G., Pinheiro, L.M., Santos, M.L.D., Danilewicz, D., Ott, P.H., & Sucunza, F. 2021. New data on bycatch of the Brazilian guitarfish, *Pseudobatos horkelii*, in Southern Brazil. *Journal of Applied Ichthyology*, 37: 971–974.

Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp.

Leeney, R.H. & Quayson, E. 2022. An assessment of the status of sawfishes and of guitarfish landings in artisanal fisheries in Ghana. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 32(7): 1217– 1224.

Lessa, R., Vooren, C.M. & Lahaye, J. 1986. Desenvolvimento e ciclo sexual das fêmeas, migrações e fecundidade da viola *Rhinobatus horkelii* (Müller e Henle, 1841) do sul do Brasil. *Atlântica,* 8: 5–34.

Lteif, M., Khalaf, G., Jarraya, M., Mouawad, R. & Lenfant, P. 2014. The status of the cartilaginous fish species in the Lebanese coastal waters. In *International Congress on "Estuaries and Coastal Marine Protected Areas" ECPA,* pp. 51–54.

Lteif, M., Mouawad, R., Khalaf, G., Lenfant, P. & Verdoit-Jarraya. M., 2016. Population biology of an endangered species: the common guitarfish *Rhinobatos rhinobatos* in Lebanese marine waters of the eastern Mediterranean Sea. *Journal of Fish Biology*, 88: 1441–1459.

Martins, M.F., Costa, P.G. & Bianchini, A. 2020. Contaminant screening and tissue distribution in the critically endangered Brazilian guitarfish *Pseudobatos horkelii*. *Environmental Pollution*, 265: 114923.

Martins, M.F., Costa, P.G. & Bianchini, A. 2022. Maternal transfer of pharmaceuticals and personal care products in the Brazilian guitarfish *Pseudobatos horkelii*. *Environmental Advances*, *8*: 100228.

Martins, M.F., Pasquino, A.F., & Gadig, O.B.F. 2018. Reproductive biology of the Brazilian guitarfish, *Pseudobatos horkelii* (Müller & Henle, 1841) from southeastern Brazil, western South Atlantic. *Journal of Applied Ichthyology*, 34: 646–652.

Meissa, B. & Gascuel, D. 2015. Overfishing of marine resources: some lessons from the assessment of demersal stocks off Mauritania. *ICES Journal of Marine Science,* 72: 414–427.

Moore, A., Séret, B. & Armstrong, R. 2019. Risks to biodiversity and coastal livelihoods from artisanal elasmobranch fisheries in a least developed country: The Gambia (West Africa). *Biodiversity and Conservation*, *28:* 1431–1450.

Moore, A.B.M. 2017. Are guitarfishes the next sawfishes? Extinction risk and an urgent call for conservation action. *Endangered Species Research,* 34: 75–88.

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

Newell, B.M. 2017. Status Review Report of Two Species of Guitarfish: *Rhinobatos rhinobatos* and *Rhinobatos cemiculus*. Report to US National Marine Fisheries Service, Office of Protected Resources.

Pollom, R., Barreto, R., Charvet, P., Chiaramonte, G.E., Cuevas, J.M., Herman, K., Martins, M.F., Montealegre-Quijano, S., Motta, F., Paesch, L. & Rincon, G. 2020. *Pseudobatos horkelii*. The IUCN Red List of Threatened Species 2020: e.T41064A2951089. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T41064A2951089.en

Raje, S.G., & Zacharia, P.U. 2009. Investigations on fishery and biology of nine species of rays in Mumbai waters. *Indian Journal of Fisheries*, 56: 95–101.

Remya, L., Mahesh, M., Akhilesh, K.V., Midhun, M., Rajkumar, R., Peter, J.R., ... & Jagan, J.S. 2021. Note on range extension of guitarfish *Acroteriobatus variegatus* in Indian seas. *Marine Fisheries Information Service, Technical and Extension Series*, 249: 40–41.

Rigby, C.L., Walls, R.H.L., Derrick, D., Dyldin, Y.V., Herman, K., Ishihara, H., Jeong, C.-H., Semba, Y., Tanaka, S., Volvenko, I.V. & Yamaguchi, A. 2021. *Rhinobatos schlegelii*. The IUCN Red List of Threatened Species 2021: e.T104005557A104006031. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T104005557A104006031.en

Schluessel, V., Giles, J. & Kyne, P.M. 2015. Notes on female reproductive biology and embryos of the brown guitarfish *Rhinobatos schlegelii* from the Penghu Islands, Taiwan. *Ichthyological Research*, 62: 347–350.

Seidu, I., Brobbey, L.K., Danquah, E.., Oppong, S.K., van Beuningen, D. & Dulvy, N.K. 2022. “Every fish in the sea is meat and so are guitarfishes”: Socio-economic drivers of a guitarfish fishery in Ghana. *Marine Policy* 143, 105159.

UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP

Venerus, L.A. & Cedrola, P.V. 2017. Review of marine recreational fisheries regulations in Argentina. *Marine Policy*, 81: 202–210.

Wilson, L., Zacharia, P.U., Kizhakudan, S.J., Najmudeen, T.M., Santhosh, B., Ambarish, G.P., ... & Pakkri Muthu, S. 2020. Report on the landing of the critically endangered Rhinobatid *Acroteriobatus variegatus* (Nair & Lal Mohan, 1973) with some insights into its reproductive biology. *Journal of the Marine Biological Association of India*, 62: 60–64.

Tables and figures

Table 15. Productivity of guitarfish (*Acroteriobatus variegatus*, *Pseudobatos horkelii*, *Rhinobatos albomaculatus*, *R. irvinei*, *R. rhinobatos* and *R. schlegelii*).

PARAMETER	STATUS*	INFORMATION	AREA	SOURCE	COMMENTS
Acroteriobatus variegatus					
L max		At least 75 cm TL	Indian Ocean, Western (FAO 51); Indian Ocean, Eastern (FAO 57)	Last *et al.*, 2016	Very restricted distribution in the Northern Indian Ocean, endemic to Southern India and Sri Lanka, with limited biological investigations
L mat		M: ~58; F: 62 cm TL			
A max		Unknown			
A mat		Unknown			
Fecundity (annual)	Very low	ca. 5– 6 pups per year			May be based on limited observations
K		Unknown			
r		Unknown			
Pseudobatos horkelii					
L max		~138 cm TL	Atlantic, Southwest (FAO 41)	Last *et al.*, 2016	D'Alberto *et al.* (2019) assumed Lmax to be 140 cm
L mat		F: 79.6 cm TL; M: 70.2 cm	South-eastern Brazil	Martins *et al.* (2018)	
A max		Unknown	South-eastern Brazil	Caltabellotta *et al.* (2021)	The length range examined was 45.5 to 100 cm, and the maximum age observed in the study (7 years) not expected to equate with A max
A mat	Very low	7–9 (mean = 8 ± 0.300)	Atlantic, Southwest (FAO 41)	D'Alberto *et al.*, 2019	
Fecundity (annual)	Low/very low	4–12 pups per year	South-eastern Brazil	Lessa *et al.*, 1986)	
K	Medium	0.19 ± 0.04	South-eastern Brazil	Caltabellotta *et al.* (2021)	
r	Low–Medium	0.12–0.26	Atlantic, Southwest (FAO 41)	D'Alberto *et al.*, 2019	

PARAMETER	STATUS*	INFORMATION	AREA	SOURCE	COMMENTS
Rhinobatos albomaculatus					
L max		80 cm TL	Atlantic, Eastern Central (FAO 34), Atlantic, Southeast (FAO 47)	Last *et al.*, 2016	
L mat		M: ~46; F: 52 cm TL			
A max		Unknown			
A mat		Unknown			
Fecundity (annual)	Very low	2–3 pups per year			May be based on limited observations
K		Unknown			
r		Unknown			
Rhinobatos irvinei					
L max		~100 cm TL	Atlantic, Eastern Central (FAO 34), Atlantic, Southeast (FAO 47)	Last *et al.*, 2016	
L mat		M: ~42 cm TL			
A max		Unknown			
A mat		Unknown			
Fecundity (annual)	Very low	1–3 pups			May be based on limited observations
K		Unknown			
r		Unknown			
Rhinobatos rhinobatos					
L max		147 cm	Atlantic, Northeast (FAO 27), Atlantic, Eastern Central (FAO 34), Atlantic, Southeast (FAO 47); Mediterranean (FAO 37)	Başusta *et al.* (2008)	Last *et al.* (2016) considered the maximum length to be ca. 100 cm, but biological studies have reported individuals up to 147 cm (Başusta *et al.*, 2008), 143 cm (Lteif *et al.,* 2016) and 120 cm (e.g. Ismen *et al.*, 2007).
L mat		M: 68–78.6 cm TL F: 69–87 cm TL	Mediterranean Sea	Abdel-Aziz *et al.* (1993) Enajjar *et al.* (2008) Ismen *et al.* (2009) Lteif *et al.* (2016)	Various published studies available

PARAMETER	STATUS*	INFORMATION	AREA	SOURCE	COMMENTS
A max	Low	24	Eastern Mediterranean Sea	Başusta *et al.* (2008)	
A mat	Low	ca. 4–6 years	Mediterranean Sea	Based on data in Başusta *et al.* (2008)	
Fecundity (annual)	Low/very low	1–13 pups per year	Mediterranean Sea	Enajjar *et al.* (2008)	
K	Low–Medium	0.159–0.29	Mediterranean Sea	Ismen *et al.* (2007) Başusta *et al.* (2008)	
r	Medium (low to high)	0.10–0.53	Unspecified	D'Alberto *et al.* (2019)	
Rhinobatos schlegelii					
L max		~100 cm TL	Pacific, Northwest (FAO 61), Pacific, Western Central (FAO 71)	Last *et al.*, 2016	
L mat		~55 cm			
A max		Unknown			
A mat		Unknown			
Fecundity (annual)	Low/very low	1–14 pups	Taiwan Province of China	Schluessel *et al.* (2015)	
K		Unknown			
r		Unknown			

This table provides details on the maximum total length (Lmax), the length at maturity (Lmat, given as L50 unless specified otherwise), maximum reported age (Amax), the age at 50 percent maturity (Amat), fecundity (annual), von Bertalanffy growth parameter K and the rate of population growth r). M = male; F = Female. Fecundity data may be limited and it should be recognised that some estimates may not have sampled the full length range (fecundity will increase with length) and some pups can be shed on capture.
*Status ratings based on Musick, J.A. 1999. Criteria to define extinction risk in marine fishes. Fisheries, 24: 6–14.

Table 16. Trends in the status of each of the six species of guitarfish included in the proposal (*Acroteriobatus variegatus*, *Pseudobatos horkelii*, *Rhinobatos albomaculatus*, *R. irvinei*, *R. rhinobatos* and *R. schlegelii*).

FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
Acroteriobatus variegatus							
Indian Ocean, Western (FAO 51); Eastern (FAO 57)	South coasts of India	2018–19	Trawl fishery	Identified as one of the common rays taken as a non-commercial bycatch,	Not reported	High	Bhagyalekshmi & Kumar , 2021
Pseudobatos horkelii							
FAO Area 41	Argentina; Brazil; Uruguay	-	All	Suspected population decline based on continuous landing decline	inferred >80% reduction over three generations (55.5 years)	Medium (cited important studies)	Pollom *et al.*, 2020
FAO Area 41	Santa Catarina, Rio Grande, and São Paulo, Brazil	1974–1999	Industrial	Declines in total catch and CPUE	-	Medium	Haimovici 1997, in Casselberry and carlson, 2015
FAO Area 41	Southern Brazil	*1975–1990*	Commercial elasmobranch fisheries	Decline in landing and CPUE	estimated 85% decline in abundance	High	Miranda and Vooren 2003
FAO Area 41	Rio Grande, Brazil.	1984–1997	otter trawls and pair trawls	declines in annual CPUE and total landings	stock biomass to decrease by about 90%,	High	Lessa and Vooren 2005
FAO Area 41	São Paulo, Brazil	July, 2010		exploitation that reduced biomass and reproductive potential to a level that severely compromised recovery	the stock of Brazilian guitarfish collapsed. This was due to intense	High	Act No 56.031
Rhinobatos albomaculatus							
FAO Area 34	Ghana	Last 10 years	Artisanal fisheries	Perceived changes in numbers caught	40–60%	Medium	Seidu *et al.* (2022)
FAO Areas 34 and 47	Various West Africa nations	Longer-term	Anecdotal information	Perceived changes in occurrence	Unquantified decline	Medium	Cited within Jabado *et al.* (2021a)

FAO AREA	SPATIAL COVERAGE	REFERENCE PERIOD	FISHERY	INDICATOR	EXTENT OF DECLINE (%)	CONFIDENCE (H/M/L)	SOURCES
Rhinobatos irvinei							
FAO Area 34	Ghana	Last 10 years	Artisanal fisheries	Perceived changes in numbers caught	40–60%	Medium	Seidu *et al.* (2022)
FAO Area 34 and 47	Various West Africa nations	Longer-term	Anecdotal information	Perceived changes in occurrence	Unquantified decline	Medium	Cited within Jabado *et al.* (2021b)
Rhinobatos rhinobatos							
FAO Area 27	Atlantic Iberian coasts	Longer-term	Anecdotal information	Perceived changes in occurrence	Unquantified decline	Medium	This study
FAO Area 37	Northern parts of Mediterranean	Longer-term	Anecdotal information	Perceived changes in occurrence	Unquantified decline	Medium	Jabado *et al.* (2021c)
FAO Area 34	Ghana	Last 10 years	Artisanal fisheries	Perceived changes in numbers caught	80–90%	Medium	Seidu *et al.* (2022)
FAO Area 34	Mauritania	1990–2010	Trawl survey data	Initial reduction (1990–1995) followed by stable catch rates at a lower level (1995–2010)	The ratio of 'current biomass' to the 'starting biomass' was 0.42	Medium	Meissa & Gascuel (2015)
Rhinobatos schlegelii							
FAO Area 61	-	-	-	-	-	-	No appropriate information for informing on population trends

See Table 3 for further details of other datasets considered but excluded.

Table 17. Description of information used in assessments of trends in status of guitarfish, etc. nei.

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
Acroteriobatus variegatus					
Kyne *et al*. 2017	IUCN status assessment- Inferred from other guitarfish landing decline Expert consultation, review of published literature	*"This is the equivalent of >97% decline for the Stripenose Guitarfish over the last three generation periods (15 years)"*.	Insufficient information	2	Spatial- NA Temporal - NA Methods- -Does not provide enough information to qualify species-specific population decline
Raje & Zacharia 2009	Catch data collected from trawlers from New Ferry Wharf during 1990–2004	It reports generic catch decline for several ray species but not *Acroteriobatus variegatus*	NA	0	Spatial- unknown (the paper doesn't look at spatially explicit catch) Temporal (long) Methods (basic) Excluded - As it doesn't include the species in question and there seems to remain major spatial uncertainty in catch effort analysis
Wilson *et al*., 2020	Opportunistic landing data	One specimen was collected from a tuna hook and line at Sakthikulangara, Kerala from a depth of 110–130 m. It provides a description of the species after its original description by Nair and Lal Mohan (1973)	Insufficient information- opportunistic specimen collection	1	Spatial- limited Temporal - short/NA Methods- Basic
Jabado *et al*., 2017	Regional red list assessment	*">97 % decline for the Stripenose Guitarfish over the past three generations (15 years)."*	Insufficient information	2	Spatial- NA Temporal – NA Methods- NA; Does not provide enough information to qualify species-specific population decline

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
Fernando *et al*., 2019	Landing site survey		Insufficient information- opportunistic specimen collection	2	Spatial- NA Temporal - short/NA Methods- Basic
Remya *et al* 2021	Descriptive data	*"Description of a bycatch of a single-day mechanised fish trawler off Mandapam (Gulf of Mannar)"*	Insufficient information- opportunistic specimen collection	1	Spatial- NA Temporal - short Methods- Basic
Bhagyalekshmi & Kumar *et al*., 2021	Landing data- "*Survey between July 2018- June 2019 in the major harbours and landing centres of the south coasts of India to monitor the non-commercial batoid species in the trawl bycatch*".	*"It is a regular landing by bottomset gillnet at Thengapattinam and Kanyakumari FLC, and occasional landing by trawls in Kochi, Neendakara, Colachel, Muttom and Tuticorin."*	Some important information regarding trade and by-catch scale are presented	2	Spatial- limited (harbours of the south coast of India) Temporal- Med Methods- Med Important as this paper says that the species in question is not of commercial importance.
Fernando and Tanna in Ebert *et al*., 2021	*Landing data*		Insufficient information- only the abstract was found	2	Spatial- Med (Sri Lanka) Temporal - long (since 2017) Methods- Med
Pseudobatos horkelii					
Pollom *et al*., 2020	IUCN Red List Assessment	*">99% reduction over three generations (55.5 years). In Uruguay, catches from research trawls there in the 1980s and early 1990s were on average around 1,400 kg/hr, and between 2013 and 2017 were only 480 kg/hr, the equivalent of a >92% reduction over three generations"*	Insufficient information	2	Spatial- NA Temporal – NA Methods- NA; Does not provide enough information to qualify species-specific population decline; Some important information to infer population status
Jaureguizar *et al.* 2015	Monthly field sampling, each one extending for eight days, occurred during the period from	*"In Uruguay, it is captured in gillnets and longlines, and is sometimes targeted (Jaureguizar et al. 2015). However, occurrence*	Insufficient information	3	Spatial- limited Temporal- Med Methods- Robust

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
	October 2009 to September 2010.	*was low (rare) comparative to other species reported in this study."*			
Venerus & Cedrola 2017	Review of the Marine recreational fisheries regulations in Argentina	*"Identifies this species as commonly encountered fish in recreational fishery."*	Insufficient information	2	Spatial- NA Temporal- NA Methods- Robust; Does not provide any abundance of population data/inference
L. Paesch unpubl. data 2018		*In Uruguay, the catches from research trawls in the 1980s and early 1990s were on average around 1,400 kg/hr, and between 2013 and 2017 were only just over 480 kg/hr (L. Paesch unpubl. data 2018), equivalent to a 94% reduction over three generations.*	Insufficient information		Spatial- limited Temporal- Med Methods- Does not provide enough information to quantify the population trend, as it is uncertain whether the catch rates were nominal or standardised indices, or whether the surveys were directly comparable in terms of sampling location and gear.
Laporta *et al*. 2018	This study analyzes the composition of the species of fishes and invertebrates captured by the oceanic gillnet, and bottom longline artisanal fisheries between 2014 and 2018.	Pseudobatos horkelii (25 .5%) was reported to be one of he highest frequencies of occurrence.	Insufficient information	2	Spatial- Med Temporal- long Methods- Robust; Insufficient for population trend analysis
Miranda and Vooren 2003	Landing data and CPUE	*"In Rio Grande do Sul, Brazil, total landings by fishery methods combined increased from 842 t in 1975 to 1,804 t in 1984 and then declined continuously to 157 t in 2001, which is equivalent to a reduction of >99% scaled over three generations (55.5 years). The average trawl catch-per-unit-effort (CPUE) of Brazilian Guitarfish in southern Brazil over the years 1993 to 1999 was 17% of that observed during 1975 to 1986, indicating a decline in*	Meets	4	Spatial- Med Temporal- long Methods- Robust

REFERENCE	**INDICATOR** Time-series data; other	**MAIN RESULTS OF THE STUDY**	**EVIDENCE RELATIVE TO CITES CRITERIA** meets; does not meet; insufficient information; or na = not appropriate	**RELIABILITY INDEX SCORE** 0-5 (see Appendix E)	**COMMENT** Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		abundance of >80% since 1986 in southern Brazil"			
Bunholi *et al*. 2018	Genetic analysis- The samples were obtained between 2015 and 2016 from industrial fishing boats that use bottom trawls and from regional fish distribution markets in the coastal regions of São Paulo, Brazil.	*"DNA barcoding revealed the continuous fishing and trafficking of these protected species. This study revealed the capture and commercialization of three species of Elasmobranchs, the angelsharks Squatina guggenheim and S. occulta and the Brazilian guitarfish Pseudobatos horkelii, all registered on the Brazilian List of Endangered Species – Fish and Aquatic Invertebrate."*	NA	1	No information regarding population change, however important for confirming domestic trade (no proof of international trade)
Silveira *et al*. 2018	Catch data and CPUE- *between 2014–2017 was estimated.*		Meets	4	Spatial- Med Temporal- long Methods- Robust
Martins *et al*., 2018	Samples were obtained from September 2007 to August 2009 from commercial fisheries off São Paulo State coast	A total of 143 specimens (71 males, 72 females) were analysed.	Insufficient information	2	Spatial- Med Temporal- Med Methods- Robust; No information regarding population change
Caltabellotta *et al*., 2019	Specimen collection	The age and growth of three endemic threatened guitarfish species were analysed using vertebrae of *Pseudobatos horkelii, P. percellens and Zapteryx brevirostris.* Specimens were collected throughout the year, between September 2007 and September 2009, as incidental by-catch from bottom pair-trawling in commercial fisheries off south-eastern Brazil.	Insufficient information	2	Spatial- Med Temporal- Med Methods- Med; No information regarding population change
Anderson *et al*., 2021	*Photographs were taken during routine reef fish surveys on Rancho Norte (Arvoredo Island no-take portion).*	*"The first Pseudobatos horkelii aggregation on 4 February 2014 at Rancho Norte (AR MPA no-take zone, northern portion of Arvoredo Is). Second P. horkelii aggregation on 15 December 2018 at Rancho Norte (AR MPA no-take zone, northern portion of Arvoredo Is). Third and much larger P. horkelii aggregation*	Insufficient information	1	Spatial- Limited Temporal- Med Methods- Med; No information regarding population change

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		on 10 December, 2019 at Rancho Norte (AR MPA no-take zone, northern portion of Arvoredo Is)".			
Casselberry and Carlson, 2015	Review (NOAA report)	*"Artisanal landings of Brazilian guitarfish came mainly from the beach seine fishery, which captured pregnant females and adult males on their inshore pupping migration (Miranda and Vooren 2003, Lessa and Vooren 2005). It has been reported that up to 98% of the artisanal fishery catch were pregnant females (Lessa and Vooren 2005). Miranda and Vooren (2003) reported artisanal landings declined from about 330 t in 1992 to 125 t in 1997".*	Meets	-	Spatial- broad Temporal- long Methods- Robust
Martins and Schwingel 2003 (in Casselberry and Carlson, 2015)		*"Landings of guitarfish in Rio Grande do Sul fell from 1,253 t in 1984 to 460 t in 1994, and CPUE declined from 0.76 t/trip in 1984 to 0.05 t/trip in 1992"*	Insufficient information (not species-specific)	0	Spatial- Limited Temporal- long Methods- Med
Miranda and Vooren 2003 (in Casselberry and Carlson, 2015)		*"The catch of Brazilian guitarfish in commercial elasmobranch fisheries in southern Brazil increased from 842 t in 1975 to 1,804 t in 1984 but then precipitously declined to 115 and 276 t between 1992 and 1997"*	Meets	4	Spatial- Limited Temporal- long Methods- Robust
Miranda and Vooren 2003 (in Casselberry and Carlson, 2015)		*"In southern Brazil, CPUE declined from 1.46 t/trip in 1975 to 0.2 t/trip in 1993 for paired trawls, from 0.53 t/trip in 1975–1977 to 0.1 t/trip in 1988 for single trawls, and from 3.1 t/trip in 1996 to 0.22 t/trip in 1999 for the gillnet fishery"*	Meets	4	Spatial- Limited Temporal- long Methods- Robust
Lessa and Vooren 2005 (in Casselberry and Carlson, 2015)		*"It is thought that high fishing pressure from both artisanal and industrial fisheries has caused stock biomass to decrease by about 90%, based on declines in annual CPUE from otter trawls and pair trawls and total landings in Rio Grande, Brazil.*	Meets	4	Spatial- Limited Temporal- long Methods- Robust

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		Otter trawl CPUE declined from 0.76 t/trip in 1984 to 0.10 t/trip in 1997, and pair trawl CPUE declined from 2.03 t/trip in 1984 to 0.14 t/trip in 1997. Total landings from all fishery methods increased from 850 t in 1975 to 1,927 t in 1984 before falling to 216 t in 1997"			
Rhinobatos rhinobatos					
Proposal	Descriptive information and historical ecology	R. rhinobatos "*was prevalent in the 1970s and 1980s along the north African coast and eastern basin of the Mediterranean. By 1990, this species was extinct from the western, and central regions of the Mediterranean (the coastal waters of Spain, France, and Italy), based on a combination of fishers' knowledge and data from the Mediterranean International Trawl Survey (MEDITS). This species is still caught in Tunisia and Egypt. It is not uncommon in Turkey, Lebanon and Israel (Chaikin et al. 2020)*".	Meets (in part)	3	Historically, the distribution of *R. rhinobatos* has included areas where there are no recent, authenticated records, including the Atlantic coasts of Portugal and Spain, and the north-western Mediterranean. However, it is unclear whether *R. rhinobatos* was a resident (and forming discrete stocks) or regular visitor to such areas, and so the importance of such grounds to the global populations is uncertain. For example, *R. rhinobatos* may only have been an occasional visitor to the Adriatic Sea (Dulcic *et al*., 2005). It should be noted that Chaiken *et al.* (2020) reported on *Glaucostegus cemiculus* in Israeli water (and not *R. rhinobatos*), although the presence of *R. rhinobatos* in the eastern Mediterranean is evident from other published studies. Overall, studies of historical ecology indicate a reduction in range, though it is uncertain as to whether the loss of *R. rhinobatos*

REFERENCE	**INDICATOR** Time-series data; other	**MAIN RESULTS OF THE STUDY**	**EVIDENCE RELATIVE TO CITES CRITERIA** meets; does not meet; insufficient information; or na = not appropriate	**RELIABILITY INDEX SCORE** 0-5 (see Appendix E)	**COMMENT** Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
					from the north-western parts of the Mediterranean Sea and from the Atlantic coasts of southern Europe relate to decreased visitors (which could be a function of reduced population size and/or environmental changes) and/or a loss of former stocks in that area.
Proposal Jabado *et al*. (2021c)	Trends from trawl surveys	"*In Mauritanian waters, species-specific population trend data show an annual rate of decrease of 4.6%, consistent with an estimated 85% reduction in population over three generation lengths (Meissa & Gascuel 2015)*".	Meets	3	Whilst Meissa & Gascuel (2015) reported on the catch rates of *R. rhinobatos*, their study did not state that there was an annual rate of decrease of 4.6%. Meissa & Gascuel (2015) noted that the slope of the trend in the stock biomass was -3.8% per year. Their study indicated a decline in CPUE from the start of the time-series (1990–1995), but that there was a more stable trend from 1995–2010. However, this survey only covers a small part of the distributional range. Meissa & Gascuel (2015) also estimated the then 'current fishing mortality' to be 0.12, the same as fishing mortality at MSY (Fmsy), and that the ratio of 'current biomass' to the 'starting biomass' was 0.42.
Proposal	Semi-structured interviews with fishers (n = 51 from four communities in Ghana	The proposal noted the work of Seidu *et al*. (2022), who reported that "*Most fishers (71 %) stated that catches of the two larger guitarfishes (blackchin guitarfish Glaucostegus cemiculus and common guitarfish Rhinobatos*	Meets	3	Seidu *et al* (2022) noted that "When asked to compare the abundance of guitarfish catch to 10 years ago, most fishers (71 %) stated that the abundance of the

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		rhinobatos) have declined by 80–90 % based on their recollection"			large guitarfishes have declined by a range of 80–90%", Seidu *et al* (2022) also noted "For the "large guitarfishes" (Glaucostegus cemiculus and Rhinobatos rhinobatos), 73 % of fishers indicated that the catch of these species have severely declined.
Jabado *et al*. (2021c)	Descriptive information and historical ecology	See above for examples of information	Meets		See comments above
Rhinobatos irvinei					
Jabado *et al*. (2021b)	Descriptive information	Mauritania: "*this species has not been recorded in regular fisheries monitoring surveys undertaken by the Institut Mauritanien de Recherches Oceanographiques et de Peches in the Parc National du Banc d'Arguin since 2009 and has likely disappeared from that area considering other species of guitarfish with the same catchability are still being landed ((e.g., Blackchin Guitarfish (Glaucostegus cemiculus) and Common Guitarfish (Rhinobatos rhinobatos)) (M. Dia unpubl. data 2020)*" Senegal: "*In Senegal, two to three individuals were recorded during surveys at Ouakam in Dakar in 2011–2012, but records have become increasingly rare (A. Ba unpubl. data 2020)*." The Gambia: "*this species was not recorded during landing site surveys conducted annually between 2010–2018 despite other species of guitarfish being present (Moore et al. 2019)*".	Descriptive and anecdotal data	1	Jabado *et al*. (2021b) compiled data for most nations across the species range, although most information only indicates whether there has been reported presence. Data on population trends are unavailable, though the recent absence of records from areas of their distribution would be indicative of there having been a decline.

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		Guinea-Bissau: "*there have been no recent records of this species in landing site surveys in Guinea-Bissau (Bijagos Archipelago) (last records from 2008 to 2009)*" Guinea: "*It was also recorded in trawl surveys undertaken in Guinea from 1985 to 2012 (Camara et al. 2016)*" Cote d'Ivoire: "*no recent records*" Ghana: "r*ecorded in demersal fish surveys undertaken by the Japan International Cooperation Agency between 2000–2003. These trawl surveys operated at depths between 20–100 m and recorded 10 specimens in six tows (3.1% of sets) (Ishihara and Kimoto 2006). Landing sites surveys in Western Ghana in 2019 and 2020 indicate that this species represents 5% of ray landings (I. Seidu unpubl. data 2020)*". Togo: "*Cruise reports from trawl surveys in Togo indicate that this species was caught in 12% of tows with up to five individuals in each tow in 1984 (Lhomme 1984).*" Nigeria: "*no recent records*" Cameroon: "*26 individuals have been recorded over two years of landing site surveys representing 1.2% of all shark and ray records (A. Tamo unpubl. data 2020)*". Gabon: "I*n the trawl fisheries observer data from Gabon, this species along with other Rhinopristiformes (Blackchin Guitarfish,*			

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		Whitepotted Guitarfish (R. albomaculatus), Common Guitarfish, and African Wedgefish (Rhynchobatus luebberti)) represented 1% of rays captured while it is regularly recorded in artisanal fisheries landings operating in Mayumba using demersal-set gillnets (G. De Bruyne and E. Chartrain unpubl. data 2020)." Republic of the Congo: "*65 individuals, representing less than 1% of landings were recorded during landing site surveys from January 2019 to December 2019 (P. Doherty unpubl. data 2020).*" Angola: "*seven individuals were recorded during opportunistic landing site surveys in 2018 (A.L. Soares unpubl. data 2020)"*.			
Seidu *et al*. (2022)	Semi-structured interviews with fishers (n = 51 from four communities in Ghana	Seidu *et al*. (2022) stated that "O*f the 49 fishers who categorized guitarfish into small and large 53% (n = 26) reported that the "small guitarfishes" (Rhinobatos irvinei and R. albomaculatus) have declined, while 43% (n = 21) indicated a stable catch in their number.*". Seidu *et al*. (2022) also stated that "*When asked to compare the abundance of guitarfish catch to 10 years ago… 59% indicated that the abundance of smaller guitarfishes have reduced by 40–60%*". Hence, this information is indicative of their possibly being declining trends.	Stakeholder perceptions of species abundance	3	This information is indicative of their possibly being declining trends.

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
Rhinobatos albomaculatus					
Proposal	Semi-structured interviews with fishers (n = 51 from four communities in Ghana	"*R. albomaculatus was reported in only half of guitarfish fishing communities surveyed in Ghana, where 59% of interviewed fishers reported their catches of the smaller guitarfish species, including R. albomaculatus, have declined by 40–60% (Seidu et al. 2022).*"	Stakeholder perceptions of species abundance	3	Seidu *et al*. (2022) stated that "*Of the 49 fishers who categorized guitarfish into small and large 53% (n = 26) reported that the "small guitarfishes" (Rhinobatos irvinei and R. albomaculatus) have declined, while 43% (n = 21) indicated a stable catch in their number.*". Seidu *et al*. (2022) also stated that "*When asked to compare the abundance of guitarfish catch to 10 years ago… 59% indicated that the abundance of smaller guitarfishes have reduced by 40–60%*". Hence, this information is indicative of their possibly being declining trends.
Jabado *et al*. (2021a)	Descriptive information	"*In Mauritania, between 2010–2019, only two specimens were recorded in regular fisheries monitoring surveys undertaken by the Institut Mauritanien de Recherches Océanographiques et de Pêches in the Parc National du Banc d'Arguin (M. Dia unpubl. data 2020).* *In The Gambia, this species was not recorded during landing site surveys conducted annually between 2010–2018 despite other species of guitarfish being present (Moore et al. 2019).*"	Distributional data	0	Both Mauritania and Gambia are at the northward limits of the distribution of this species, and it is uncertain whether records from these distributional limits relate to the outer limits of the population, or whether resident populations exist. Given this information may relate to the fringe of the population, such information may not be representative of population status., and so was excluded.

REFERENCE	**INDICATOR** Time-series data; other	**MAIN RESULTS OF THE STUDY**	**EVIDENCE RELATIVE TO CITES CRITERIA** meets; does not meet; insufficient information; or na = not appropriate	**RELIABILITY INDEX SCORE** 0-5 (see Appendix E)	**COMMENT** Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
Jabado *et al*. (2021a)	Descriptive information	"*there have been no recent records of this species in landing site surveys in Guinea-Bissau (Bijagos Archipelago), Côte d'Ivoire, Nigeria, Ghana, and Angola (G.H.L. Leurs, K. Metcalfe, I. Seidu, A.L. Soares and A.B. Williams unpubl. data 2020). Between 2004–2011, this species was only recorded in Guinea during landing site surveys across the Sub-Regional Fisheries Commission region (Diop and Dossa 2011) but more recently it has not been found despite regular monitoring (J. Dossa unpubl. data 2020). It was also recorded in trawl surveys undertaken in Guinea from 1985–2012 (Camara et al. 2016).*"	Confirmed visual observations and anecdotal impressions	1	This information might be indicative of a decline, but the magnitude and spatial extent of the decline is difficult to quantify.
Jabado *et al*. (2021a)	Anecdotal information from trawl surveys and market surveys	"*In Ghana, the Whitespotted Guitarfish was recorded in demersal fish surveys undertaken by the Japan International Cooperation Agency between 2000–2003. These trawl surveys operated at depths between 20–100 m and recorded four specimens in four tows (2.1% of sets)(Ishihara and Kimono 2006).* *Landing sites surveys in Western Ghana in 2019 and 2020 have failed to record this species (I. Seidu unpubl. data 2020)*"	Anecdotal impressions	1	The lack of observed individuals during surveys of Ghanain landings sites compared to the presence of the species in trawl surveys is potentially informative. However, as a smaller bodied species there is the potential for commercial captures being discarded, and the trawl surveys considered only reported a few individuals. Hence, several factors limit the utility of such information to inform on temporal trends.
Jabado *et al*. (2021a)	Anecdotal information from trawl surveys	"*Cruise reports from the "Dr. Fridtjof Nansen" surveys indicate that this species was frequently caught in 2004 (Congo, Gabon, and Angola), 2006 (Nigeria, Cameroon, Sao Tome and Principe, Gabon, and Congo), 2007 (Angola) and 2008 (Côte d'Ivoire, Ghana, Benin, Togo, Cameroon, Sao Tome and Principe, Gabon, and Congo) particularly in the waters of Gabon where, when captured, it represented between*	Survey catches	0	More detailed appraisal of these data are required before they can be used to inform on occurrence. The attributed sources relate to Research Vessel cruise reports for surveys that are described in relation to 'fish resources', pelagic and demersal resources'

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
		1.13–9.96% of the total catch per tow with up to 102 individuals caught in one tow (Krakstad et al. 2004, Krakstad et al. 2006, Krakstad et al. 2008a). *Subsequent surveys undertaken in Gabon and Congo in 2010 failed to record this species (Mehl et al. 2010).*"			or 'pelagic fish resources'. Hence, the sampling gear, potential differences in the gear deployments between stations (e.g. in relation to bottom contact) and the sampling effort of these surveys may not be informative. Whilst this information source was discounted at the present time, more detailed appraisal of the data might provide more useful information in the future.
Jabado *et al*. (2021a)	Descriptive information	"*In the trawl fisheries observer data from Gabon, this species along with other Rhinopristiformes (Blackchin Guitarfish (Glaucostegus cemiculus), Spineback Guitarfish (Rhinobatos irvinei), Common Guitarfish (R. rhinobatos), and African Wedgefish (Rhynchobatus luebberti)) represented 1% of rays captured and although captured throughout the year in artisanal fisheries operating in Mayumba using demersal-set gillnets, records were rare (G. De Bruyne and E. Chartrain unpubl. data 2020). In the Republic of the Congo, 89 individuals were recorded during landing site surveys from January to December 2019 representing less than 1% of all shark and ray landings (P. Doherty unpubl. data 2020).* *In Cameroon, 146 individuals have been recorded over two years of landing site surveys representing 6.6% of all shark and ray records (A. Tamo unpubl. data 2020).*"	Anecdotal information on occurrence	0	Whilst providing useful information on recent occurrences, it does not provide sufficient information for analyses of temporal changes in population size.

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
Rhinobatos schlegelii					
Rigby *et al*. 2021	Descriptive information	"*There used to be targeted guitarfish fisheries in Republic of Korea but rhinobatids are now rarely seen*"	Anecdotal information	0	Uncertain as to what species it may relate to, and as such this information was discounted.
Rigby *et al*. 2021	Descriptive information	"I*n Taiwan, the abundance of Brown Guitarfish has declined by 60–80% over the past 15–20 years at Penghu Island; previous landings of 50 or more individuals have now declined to 10–20 individuals*"	Anecdotal information	0	The utility of these data is uncertain, Taiwan Province of China introduced bans on some inshore fisheries (Liao *et al*., 2019), including that trawlers were banned within 3 nm from coast and large trawlers were banned within 12 nm of the coast since 1999, and bans on gillnetters within 3 nm have been introduced in various counties of Taiwan Province of China since 2001. A ban on such inshore fisheries would be expected to result in a decline in fishing pressure and landings of inshore species, which does not appear to have been included in the interpretation. Hence, this information was discounted at the present time.
Rigby *et al*. 2021	Landings data	"*The annual landings* [of all combined skate species in Taiwan] *rose from 560 t tonne in 1953 to a peak of 1,800 t in 1973, then declined steadily to 114 t in 2001 (Liao et al. 2019, H. Hsu Taiwan National Fisheries Statistics pers. comm. 28/08/2019)* "	Landings data	0	Landings data were based on 'all skates' and the proportion of the different species in the reported catches were unspecified. Issues relating to inshore fishing ban not addressed (see above)

REFERENCE	INDICATOR Time-series data; other	MAIN RESULTS OF THE STUDY	EVIDENCE RELATIVE TO CITES CRITERIA meets; does not meet; insufficient information; or na = not appropriate	RELIABILITY INDEX SCORE 0-5 (see Appendix E)	COMMENT Spatial (limited/med/broad): Temporal (short/med/long): Methods (basic/med/robust): If not used, summary for why excluded:
					Spatial extent of fisheries accounting for these landings was not unspecified. Information cited in account and attributed to Liao *et al*. (2019) were not seemingly provided in Liao er al. (2019). Whilst this information was discounted at the present time, a more detailed analysis of relevant national landings data could usefully be undertaken.

Table 18. Examples of guitarfish in the international fin trade, including studies that have reported rhino rays (Rhinidae) and giant guitarfish (Glaucostegidae).

Study	Family	Species	Quantities	Product	Market	Comments
Cardenosa *et al*., 2020	Rhinobatidae	*Acroteriobatus variegatus*	Unknown	Fins	China, Hong Kong SAR	Accounted for 0.2% of the fin samples analysed
Chuang *et al*., 2016	Rhinidae	Rhynchobatus australiae	Unknown	Fins	Taiwan Province of China	Accounted for 0.3% of the fin samples analysed
	Rhinobatidae	None	-	-	-	-
Field *et al*., 2017	Rhinidae	*Rhynchobatus australiae*	Unknown	Fins	China, Hong Kong SAR	Accounted for 0.54% of the fin samples analysed
		Rhynchobatus cf. *laevis*	Unknown	Fins	China, Hong Kong SAR	Accounted for 0.08% of the fin samples analysed

Study	Family	Species	Quantities	Product	Market	Comments
		Rhynchobatus djiddensis	Unknown	Fins	China, Hong Kong SAR	Accounted for 0.04% of the fin samples analysed
		Wedgefishes and *Rhynchobatus* spp.	Unknown	Fins	China, Hong Kong SAR	Modelled estimates indicated 0.1% (0.0–0.2) of fin samples analysed
	Rhinobatidae	None				
Holmes *et al.* (2009)	Rhinidae	*Rhynchobatus* cf. *laevis*				3.6% of confiscated fins
		Rhina ancylostoma				1.6% of confiscated fins
		Rhynchobatus australiae				1.6% of confiscated fins
	Glaucostegidae	*Glaucostegus typus*				1.0% of confiscated fins
	Rhinobatidae	None	-	-	-	-
Hau *et al.,* 2018	Rhinidae	*Rhina ancylostoma* *Rhynchobatus australiae* *Rhynchobatus* *djiddensis*	Unknown	Fins	China, Hong Kong SAR	Present in samples analysed
	Glaucostegidae	*Glaucostegus cemiculus*	Unknown	Fins	China, Hong Kong SAR	Present in samples analysed
	Rhinobatidae	None				

Table 19. Overview of guitarfish (Rhinobatidae) giving species-specific length (TL) (which potentially affects interest in international trade) and available trade information for the species.

	Species (Family: Rhinobatidae)	TL (cm)	Trade information (IUCN)	Overall comments based on IUCN information and Table 4 & 5A
1	*Acroteriobatus annulatus*	140 (usually much smaller)	*"The Lesser Guitarfish is likely to be utilized locally for its good quality meat with the valuable fins traded internationally (Moore 2017)."*	No species-specific trade (int.) amount or information could be found
2	*Acroteriobatus blochii*	96	*"This species is not known to be used or traded. It is likely to be utilized locally in some areas for meat and the fins are valuable in trade. Other members of the genus are often targeted for their fins in artisanal fisheries (Moore 2017)."*	Mostly locally used
3	*Acroteriobatus leucospilus*	120 commonly (92–96)	*"This species is sold fresh or dried and salted locally for meat. Like other guitarfishes, they are targeted in Madagascar and possibly other areas for their fins which are valuable and are exported to Asia. Individuals are often not landed in industrial fisheries and are instead transhipped at sea for subsequent transport to Asia (McVean et al. 2006, Cripps et al. 2015)."*	Mostly locally used. Species specific international trade was not reported/found
4	*Acroteriobatus ocellatus*	81	*"This species is likely to be utilized locally for meat and fins. Other members of the genus are often targeted for their fins in artisanal fisheries, which are valuable and traded internationally (Moore 2017)."*	No species-specific trade (int.) amount or information could be found
5	*Acroteriobatus omanensis*	60	*"Given the rarity of this species there is no information on use and trade beyond the fact that it is known from fishery landings. However, similar to other species of guitarfish in the region, its fins and meat likely enter international trade."*	No species-specific trade (int.) amount or information could be found
6	*Acroteriobatus salalah*	78	*"Given that this species is reportedly uncommon, there is no information on use and trade beyond the fact that it is known from fishery landings. However, similar to other species of guitarfish in the region, its fins and meat likely enter the international trade"*	No species-specific trade (int.) amount or information could be found
7	*Acroteriobatus variegatus*	75	*"The meat of this species is often sold fresh for human consumption at local markets and also enters the international trade in dried form. Ray meat is increasing in demand and therefore prices in India are also increasing."*	Accounted for 0.2% of the fin samples analysed (Cardenosa *et al*., 2020); however, reported as 'non-commercial' in India Bhagyalekshmi & Kumar *et al*., 2021)
8	*Acroteriobatus zanzibarensis*	75	*No information*	No information of any trade was found
9	*Pseudobatos glaucostigmus*	89	*"This guitarfish is retained in multi-species fisheries and the meat is dried and sold locally."*	Mostly locally used

	Species (Family: Rhinobatidae)	TL (cm)	Trade information (IUCN)	Overall comments based on IUCN information and Table 4 & 5A
10	*Pseudobatos horkelii*	~138	*"This guitarfish is utilized bycatch across its range, and in some areas is targeted (e.g. Silveira et al. 2018). The meat is consumed or sold locally, and can fetch a high price (P. Charvet unpubl. data 2018)."*	Mostly locally used
11	*Pseudobatos lentiginosus*	78	*"Guitarfishes are typically utilised for their meat. Fins are too small to be of value in the fin trade (Last et al. 2016)."*	Mostly locally used
12	*Pseudobatos leucorhynchus*	70	*"This guitarfish is retained in multi-species fisheries and the meat is dried and sold locally."*	Mostly locally used
13	*Pseudobatos percellens*	~100	*"Meat is sold for use as human food. Young small specimens are taken for the aquarium trade in northeastern South America (P. Charvet unpubl. data 2019)."*	Mostly locally used. No significant int. trade for meat or fin
14	*Pseudobatos planiceps*	114	*"This guitarfish is retained and the meat is consumed or sold locally."*	Mostly locally used
15	*Pseudobatos prahli*	90	*"This guitarfish is retained and the meat is consumed or sold locally."*	Mostly locally used
16	*Pseudobatos productus*	170	*"This species is utilized for its meat and fins."*	No species-specific trade (int.) amount or information could be found
17	*Rhinobatos albomaculatus*	80	*"The Whitespotted Guitarfish is heavily utilized across its range for the meat and fins. While little-species specific information is available, the meat of guitarfishes is consumed fresh across many coastal communities in the region as an important source of protein (Walker et al. 2005). It is also dried or dried and smoked and exported across West Africa to supply countries such as Ghana, Guinea, Nigeria, Mali, and Burkina Faso. Fins are dried and appear to mostly be destined to Asian markets through complex regional trade routes (e.g., from Cameroon to Nigeria and then exported to Asia (A. Takoukam pers. comm. 14 July 2020)). In the past, guitarfishes were sometimes discarded as bycatch in artisanal and industrial fisheries (Ishihara and Kimoto 2006) but they are now increasingly retained (M. Diop unpubl. data 2020)."*	Overall about guitarfish trade within the country and with neighbouring countries with some notes on Asian trade (no species-specific trade (int.) amount or information could be found)
18	*Rhinobatos annandalei*	80	*"Guitarfishes are heavily utilized across their range for their meat which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). In Bangladesh, the meat is mostly consumed in tribal areas, but it also exported to Myanmar (A.B. Haque unpubl. data 2020). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins*	No significant species-specific trade (int.) amount or information could be found. Some notes on Rhinobatidae trade from Bangladesh, however the same study also mentioned- "Guitarfish fins are utilised, however, due to their smaller size their

	Species (Family: Rhinobatidae)	TL (cm)	Trade information (IUCN)	Overall comments based on IUCN information and Table 4 & 5A
			from Giant Guitarfishes or Wedgefishes and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018).”	value is lower than the value of fins from Giant Guitarfishes or Wedgefishes and fins from smaller individuals are generally discarded”.
19	*Rhinobatos borneensis*	90	*“Guitarfishes are heavily utilized across their range for their meat which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins from Giant Guitarfishes or Wedgefishes and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018).”*	No species-specific trade (int.) amount or information could be found
20	*Rhinobatos holcorhynchus*	127	*“This species is likely to be utilized locally in some areas for meat and the fins are valuable and traded internationally. Other members of the genus are often targeted for their fins in artisanal fisheries (Moore 2017). Traders in Madagascar are known to pay up to $70/kg for guitarfish fins incentivizing target fisheries for rhinobatids (Cripps et al. 2015).”*	Mostly locally used
21	*Rhinobatos hynnicephalus*	62	*“This species is used for the meat, fins, cartilage, and skin. In Taiwan, the meat is of relatively low value at US$2/kg and considered lower quality than the meat of wedgefish. Individuals too small for human consumption are used for fish meal in Taiwan, and likely China (H. Ho unpubl. data 2019). However, the fins of the smaller Ringed Guitarfish are of lower value due to their small size and are consumed domestically in China, rather than traded internationally (Zhu and Meng 2001, J. Zhang unpubl. data 2019). In Taiwan, the fins of the larger individual Ringed Guitarfish are removed for consumption, but similar to China, it may be for domestic consumption, as fins of this species or other small Rhinobatos have not been recorded in trade surveys in Hong Kong or Singapore (R.W. Jabado pers. comm. 31/01/2020).”*	No species-specific trade (int.) amount or information could be found
22	*Rhinobatos irvinei*	~100	*“The Spineback Guitarfish is heavily utilized across its range for the meat and fins. While little-species specific information is available, the meat of guitarfishes is consumed fresh across many coastal communities in the region as an important source of protein (Walker et al. 2005). It is also dried or dried and smoked and exported across West Africa to supply countries such as Ghana, Guinea, Nigeria, Mali, and Burkina Faso. Fins are dried and appear to mostly be destined to Asian markets through complex regional trade routes (e.g., from Cameroon to Nigeria and then exported to Asia (A. Takoukam pers. comm. 14 July 2020)). In the past, guitarfishes were sometimes discarded as bycatch in artisanal and industrial fisheries (Ishihara and Kimoto 2006) but they are now increasingly retained (M. Diop unpubl. data 2020).”*	Overall about guitarfish trade within the country and with neighbouring countries with some notes on Asian trade (no species-specific trade (int.) amount or information could be found)

	Species (Family: Rhinobatidae)	TL (cm)	Trade information (IUCN)	Overall comments based on IUCN information and Table 4 & 5A
23	*Rhinobatos jimbaranensis*	99	*"Guitarfishes are heavily utilized across their range for their meat, which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins from Giant Guitarfishes or Wedgefishes, and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018)."*	No species-specific trade (int.) amount or information could be found
24	*Rhinobatos lionotus*	~75	*"Guitarfishes are heavily utilized across their range for their meat which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). In West Bengal, they are traded to other regions where there is a demand for elasmobranch meat (Sen et al. 2018). In Bangladesh, the meat is mostly consumed in tribal areas, but it also exported to Myanmar (A.B. Haque unpubl. data 2020). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins from Giant Guitarfishes or Wedgefishes, and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018)."*	No species-specific trade (int.) amount or information could be found
25	*Rhinobatos nudidorsalis*	50	*"Guitarfishes are generally taken for their meat and fins. Meat is utilized locally; fins are highly valuable internationally and are among the most lucrative on the market (Cripps et al. 2015, Moore 2017)."*	No species-specific trade (int.) amount or information could be found
26	*Rhinobatos penggali*	99	*"Guitarfishes are heavily utilized across their range for their meat which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins from Giant Guitarfishes or Wedgefishes and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018)."*	No species-specific trade (int.) amount or information could be found
27	*Rhinobatos punctifer*	88	*"The meat of this species is sold fresh for human consumption at local markets across the region and also enters the international trade in dried form. In countries such as Pakistan, it is highly valued for its fins and high-quality flesh."*	Mostly locally used. No species-specific trade (int.) amount or information could be found

	Species (Family: Rhinobatidae)	TL (cm)	Trade information (IUCN)	Overall comments based on IUCN information and Table 4 & 5A
28	*Rhinobatos rhinobatos*	~100	*"The Common Guitarfish is heavily utilized across its range for the meat and fins. The meat of guitarfishes is consumed fresh across many coastal communities in the Mediterranean and West Africa as an important source of protein (Walker et al. 2005). It is also dried or dried and smoked and regionally exported across West Africa to supply countries such as Ghana, Guinea, Nigeria, Mali, and Burkina Faso. Fins are dried and appear to mostly be destined to Asian markets through complex regional trade routes (e.g., from Cameroon to Nigeria and then exported to Asia (A. Takoukam pers. comm. 14 July 2020) or from Mauritania to Senegal (Dakar) (G.H.L. Leurs unpubl. data 2020). In the past, guitarfishes were sometimes discarded as bycatch in artisanal and industrial fisheries but they are now increasingly retained (M. Diop unpubl. data 2020)."*	Some notes on regional trade (regionally exported across West Africa)
29	*Rhinobatos sainsburyi*	60	*"Not known to be utilized."*	No information
30	*Rhinobatos schlegelii*	~100	*"This species is used for the meat, fins, cartilage, and skin. In Japan, the meat is valuable and used for sashimi in Kyushu, Shikoku, and Seto Inland Sea regions (A. Yamaguchi unpubl. data 2019). The meat is also desired and valuable in South Korea (C.-H. Jeong unpubl. data 2019). Based on the congener, the Ringed Guitarfish (R. hynnicephalus), individuals too small for human consumption are used for fish meal in Taiwan, and likely China. In Taiwan, the fins of the larger individual Brown Guitarfish are removed for consumption, but similar to China, it may be for domestic consumption, as fins of this species or other small Rhinobatos spp. have not been recorded in trade surveys in Hong Kong or Singapore (R.W. Jabado pers. comm. 31/01/2020)."*	Mostly locally used
31	*Rhinobatos whitei*	84	*"Guitarfishes are heavily utilized across their range for their meat which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins from Giant Guitarfishes or Wedgefishes, and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018)."*	No species-specific trade (int.) amount or information could be found

	Species (Family: Rhinobatidae)	TL (cm)	Trade information (IUCN)	Overall comments based on IUCN information and Table 4 & 5A
32	*Rhinobatos ranongensis*		*"Guitarfishes are heavily utilized across their range for their meat which is of good quality and is consumed fresh locally, although it also enters the international trade in dried and salted form (e.g. Moore 2017, Jabado 2018). Guitarfish fins are utilised, however, due to their smaller size their value is lower than the value of fins from Giant Guitarfishes or Wedgefishes, and fins from smaller individuals are generally discarded. The skin may be traded internationally as a luxury leather product to be made into accessories (e.g. handbags) (Haque et al. 2018)."*	Newly described species. No species-specific trade (int.) amount or information could be found
33	*Acroteriobatus andysabini*		*Not assessed*	Newly described species. No species-specific trade (int.) amount or information could be found
34	*Acroteriobatus stehmanni*		*Not assessed*	Newly described species. No species-specific trade (int.) amount or information could be found
35	*Pseudobatos buthi*		*"There is no use or trade information for this species but its close relative and regional congener, the Shovelnose Guitarfish, is used for its meat and fins (Farrugia et al. 2016), and it is likely this species is also used for the meat and fins."*	No species-specific trade (int.) amount or information could be found
36	*Pseudobatos glaucostigma*		*Not assesses*	No species-specific trade information could be found
37	*Rhinobatos austini*		*"This species is not known to be used or traded. It is likely to be utilized locally in some areas for meat and the fins are valuable and likely traded. Other members of the genus are often targeted for their fins in artisanal fisheries, which are valuable and traded internationally (Moore 2017)."*	Some notes on local use

Trade information as provided in the relevant IUCN assessment. The species proposed to be listed in CITES App. II are highlighted in yellow, with other species "look-alikes" in unshaded rows.

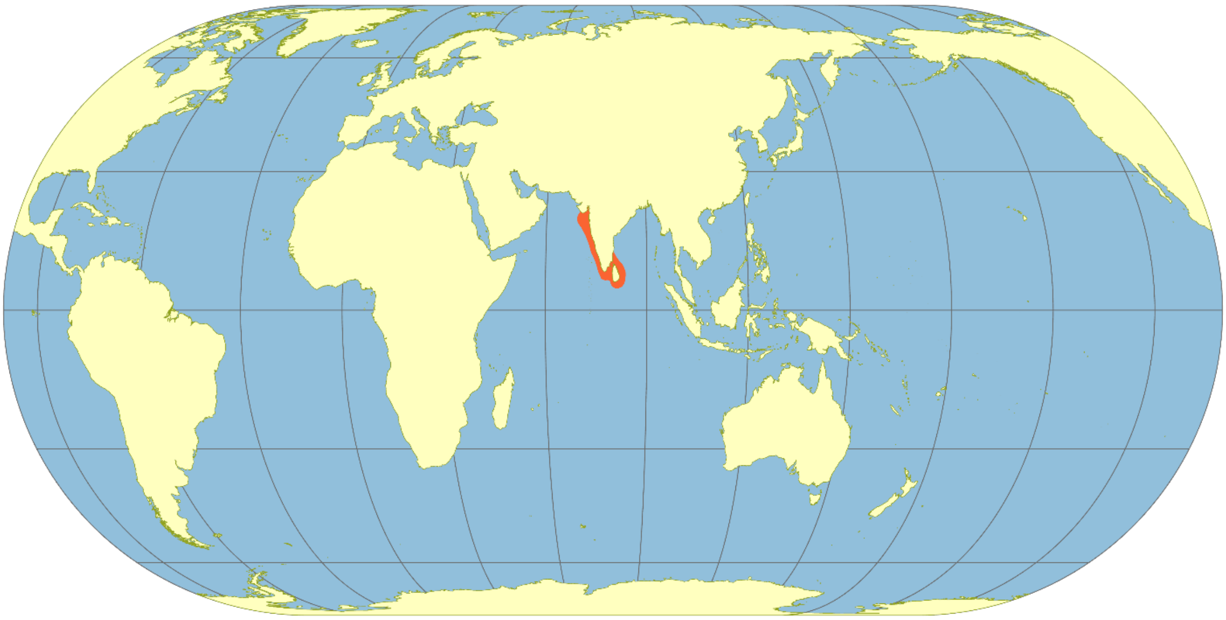
Figure 20. Distribution of brazilian guitarfish (*Pseudobatos horkelii*)

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp; Pollom, R., Barreto, R., Charvet, P., Chiaramonte, G.E., Cuevas, J.M., Herman, K., Martins, M.F., Montealegre-Quijano, S., Motta, F., Paesch, L. & Rincon, G. 2020. *Pseudobatos horkelii*. *The IUCN Red List of Threatened Species 2020*: e.T41064A2951089. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T41064A2951089.en)

Figure 21. Distribution of common guitarfish (*Rhinobatos rhinobatos*)

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp; Jabado, R.W., Pacoureau, N., Diop, M., Dia, M., Ba, A., Williams, A.B., Dossa, J., Badji, L., Seidu, I., Chartrain, E., Leurs, G.H.L., Tamo, A., Porriños, G., VanderWright, W.J., Derrick, D., Doherty, P., Soares, A., De Bruyne, G. & Metcalfe, K. 2021. *Rhinobatos rhinobatos*. *The IUCN Red List of Threatened Species 2021*: e.T63131A124461877. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T63131A124461877.en)
[orange = species distribution; light orange = areas of known former distribution].

Figure 22. Distribution of stripenose guitarfish (*Acroteriobatus variegatus*)



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp; Kyne, P.M., Simpfendorfer, C., Bineesh, K.K., Moore, A., Jabado, R. & Valinassab, T. 2017. *Acroteriobatus variegatus*. The IUCN Red List of Threatened Species 2017: e.T161476A109905030. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. http://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T161476A109905030.en)

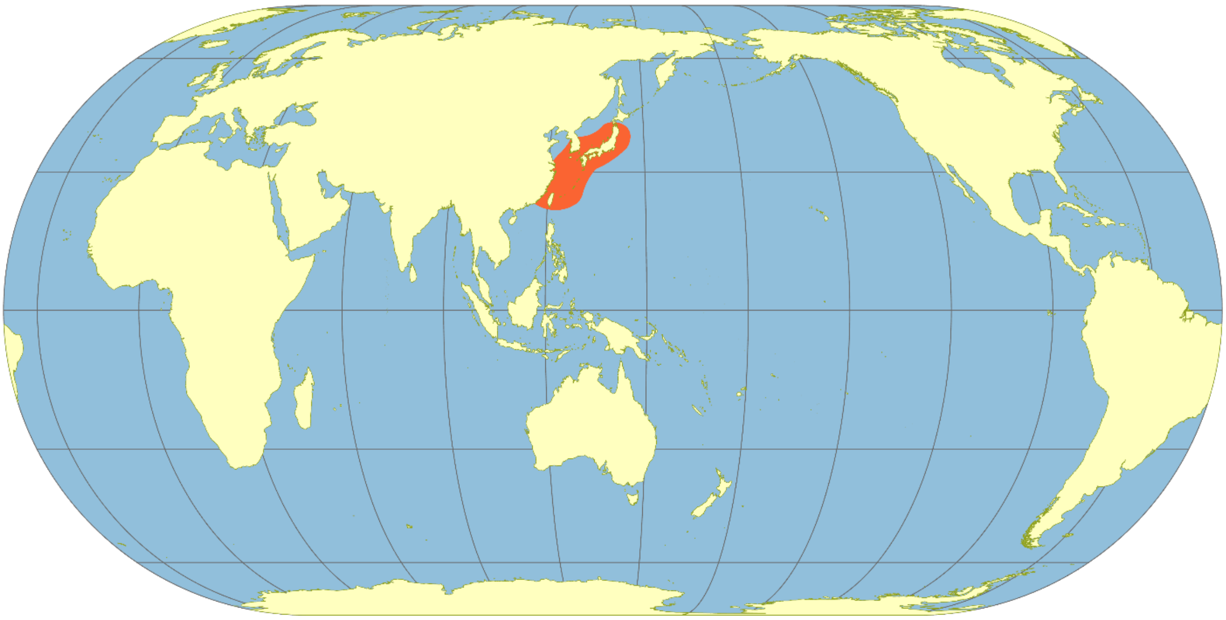
Figure 23. Distribution of whitespotted guitarfish (*Rhinobatos albomaculatus*)

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp; Jabado, R.W., Dia, M., De Bruyne, G., Williams, A.B., Seidu, I., Chartrain, E., Leurs, G.H.L., Tamo, A., Metcalfe, K., Doherty, P., Soares, A., Dossa, J., VanderWright, W.J., Derrick, D. & Diop, M. 2021a. *Rhinobatos albomaculatus*. The IUCN Red List of Threatened Species 2021: e.T161320A124465045. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T161320A124465045.en)

Figure 24. Distribution of spineback guitarfish (*Rhinobatos irvinei*)

Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp; Jabado, R.W., Chartrain, E., Dia, M., De Bruyne, G., Doherty, P., Derrick, D., Williams, A.B., Seidu, I., Leurs, G.H.L., Metcalfe, K., Tamo, A., Soares, A., VanderWright, W.J., Ba, A., Dossa, J. & Diop, M. 2021b. *Rhinobatos irvinei*. *The IUCN Red List of Threatened Species 2021*: e.T161409A124479989. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T161409A124479989.en)

Figure 25. Distribution of brown guitarfish (*Rhinobatos schlegelii*)



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Last, P., White, W., De Carvalho, M., Séret, B., Stehmann, M & Naylor, G. 2016. *Rays of the World*. CSIRO, Hobart, 800 pp; Rigby, C.L., Walls, R.H.L., Derrick, D., Dyldin, Y.V., Herman, K., Ishihara, H., Jeong, C.-H., Semba, Y., Tanaka, S., Volvenko, I.V. & Yamaguchi, A. 2021. *Rhinobatos schlegelii*. *The IUCN Red List of Threatened Species 2021*: e.T104005557A104006031. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2021 1.RLTS.T104005557A104006031.en)

Figure 26. Cumulative number of recognised species of guitarfish (Rhinobatidae) based on the years of the descriptions.

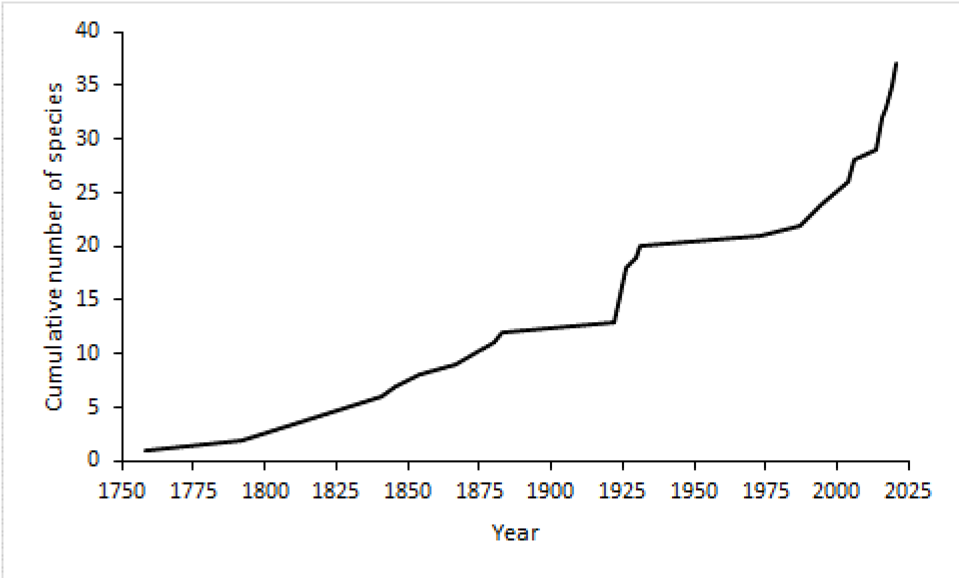
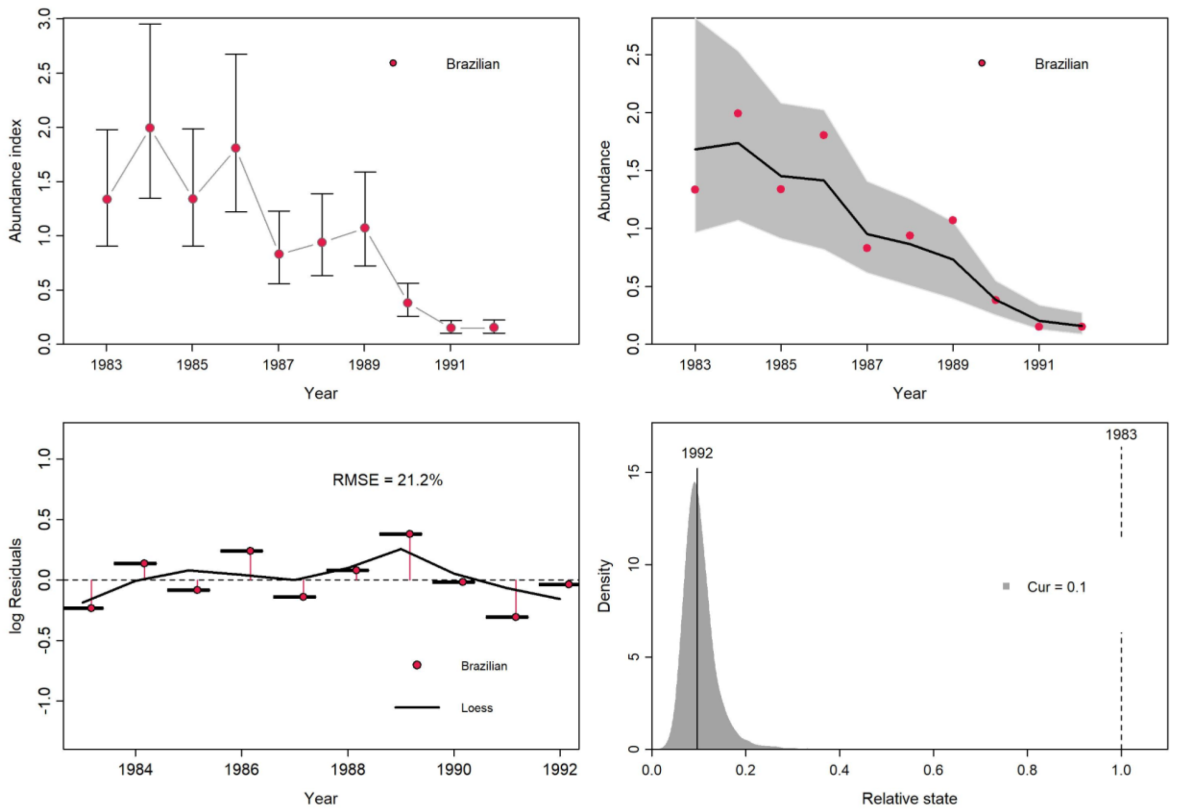
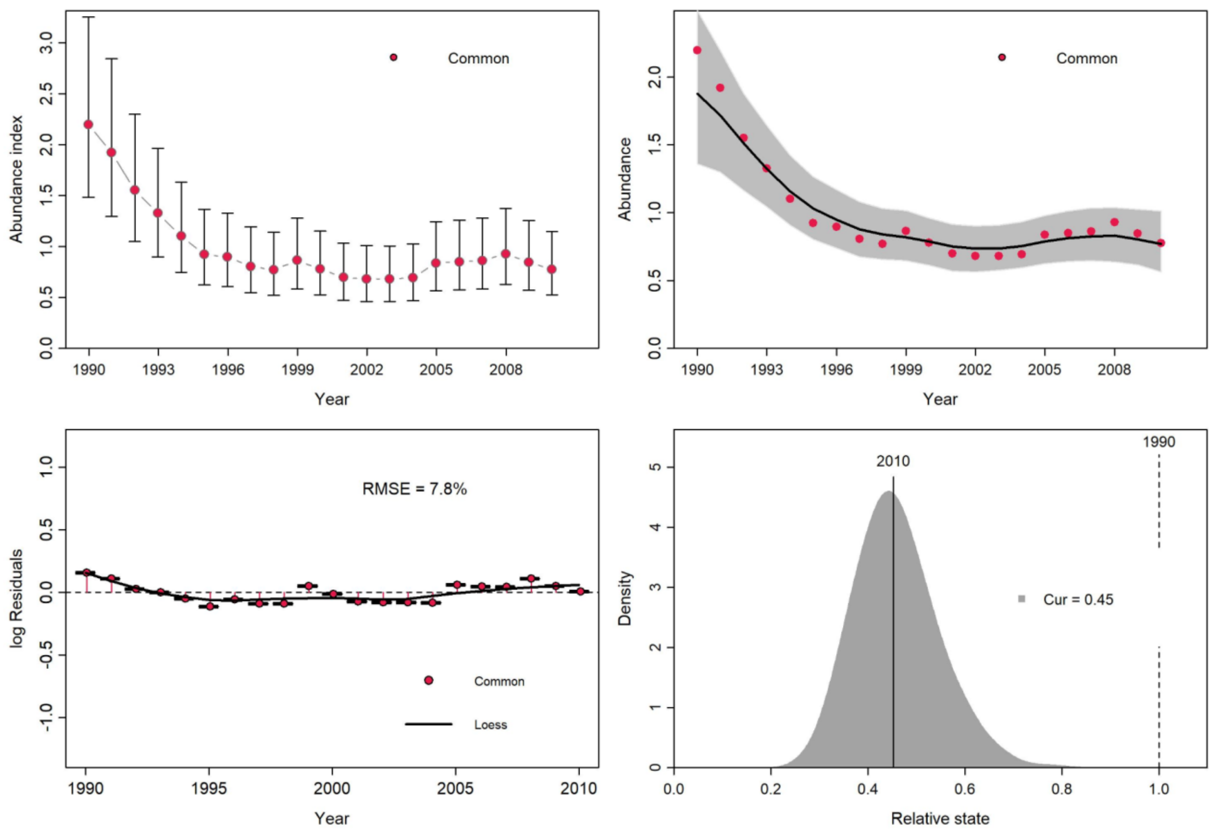


Figure 27. Temporal trends in Brazilian guitarfish *Pseudobatos horkelii* (1983–1992).



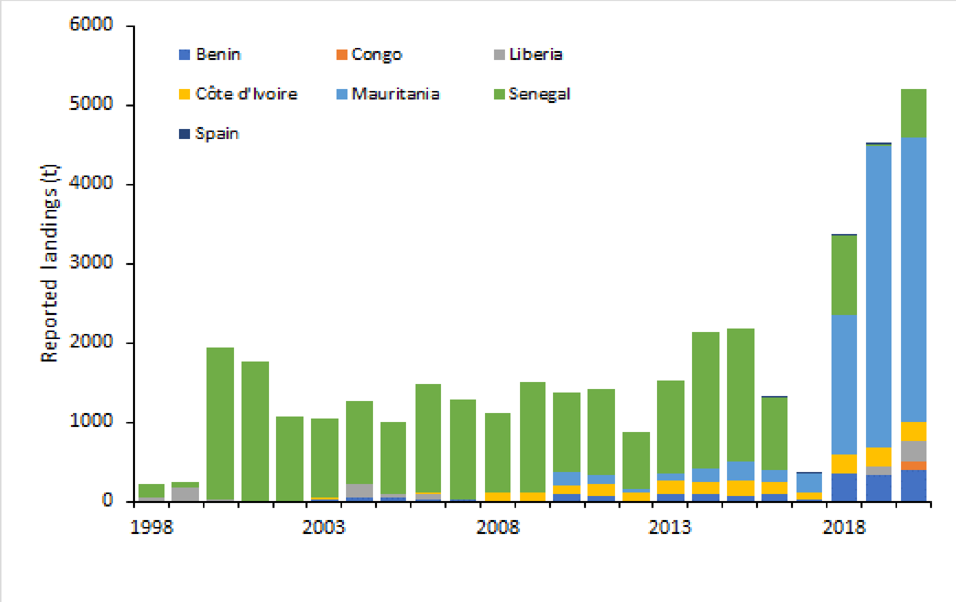
Data source: Haimovici *et al.* 1998, *In*: Casselberry, G.A., & Carlson, J.K. 2015. Endangered Species Act Status Review of the Brazilian guitarfish (*Rhinobatos horkelii*). Report to the National Marine Fisheries Service, Office of Protected Resources. SFD Contribution PCB-15-08, 17 pp.). Based on average annual CPUE of Brazilian guitarfish from trawlers moored at the port of Rio Grande.

Figure 28. Temporal trends in the catch rates of common guitarfish *Rhinobatos rhinobatos* (1990–2010).



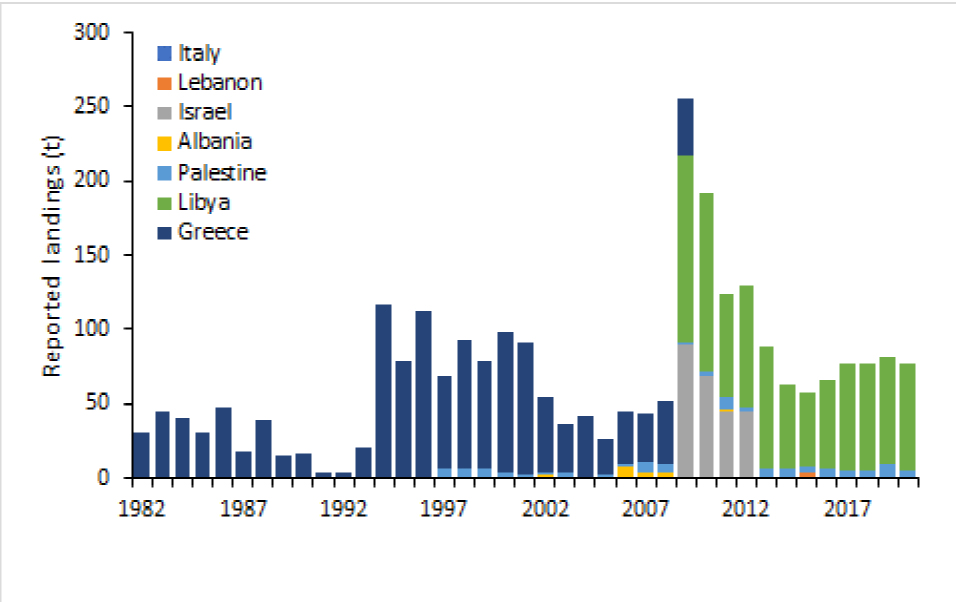
Based on survey data from Mauritania.
Source: Meissa, B. & Gascuel, D. 2015. Overfishing of marine resources: some lessons from the assessment of demersal stocks off Mauritania. *ICES Journal of Marine Science*, 72: 414–427.

Figure 29. National landings of 'guitarfish' from the Eastern Central Atlantic, as reported to FAO.



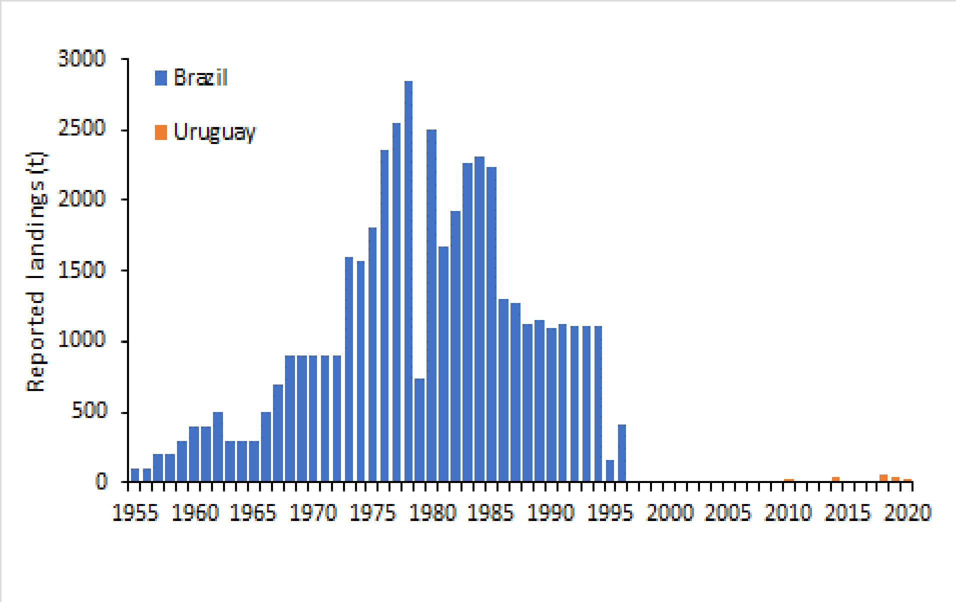
Data reported by Benin (2003–2020), Congo (2020 only), Liberia (1998–2020, intermittent), Côte d'Ivoire (2003–2020), Mauritania (2010–2020), Senegal (1998–2020) and Spain (2016–2019). Data relate to *Rhinobatos cemiculus* (now *Glaucostegus cemiculus*; Glaucostegidae), *Rhinobatos rhinobatos*, *Rhinobatos* spp. and Rhinobatidae. Reported landings of guitarfish may be reported inconsistently and landings may change in relation to any national management measures.
Source: Source: FAO. 2022. Fishery and Aquaculture Statistics. Global capture production 1950-2020 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2022. www.fao.org/fishery/statistics/software/fishstatj/en

Figure 30. National landings of 'guitarfish' from the Mediterranean Sea, as reported to FAO.



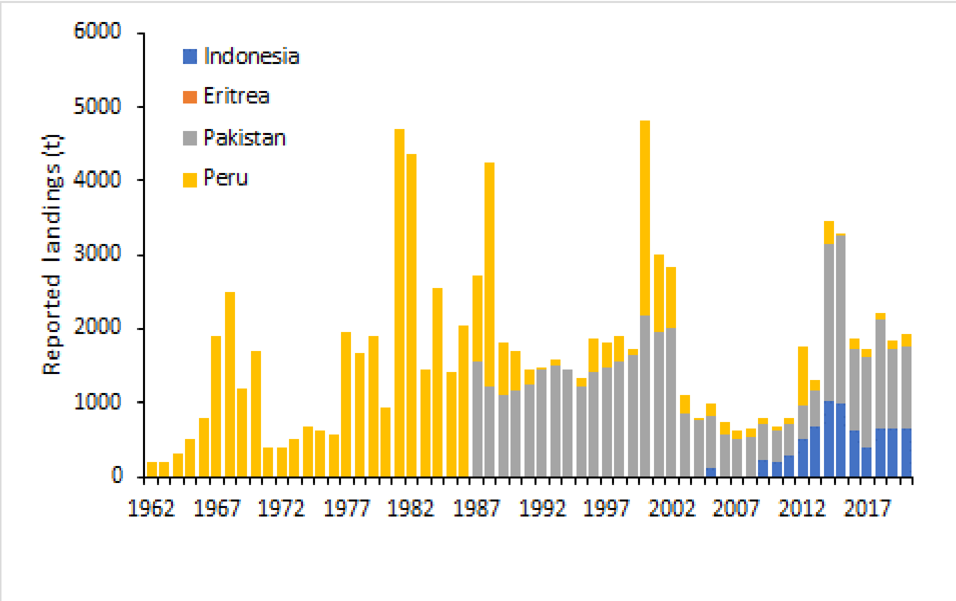
Data reported by Italy (2019 only), Lebanon (2014–2015), Israel (2009–2012), Albania (1996–2011, intermittent), Palestine (1997–2020), Libya (2009–2020) and Greece (1982–2009). Data relate to *Rhinobatos cemiculus* (now *Glaucostegus cemiculus*; Glaucostegidae), *Rhinobatos rhinobatos* and Rhinobatidae. Reported landings of guitarfish may be reported inconsistently and landings may change in relation to any national management measures.
Source: FAO. 2022. Fishery and Aquaculture Statistics. Global capture production 1950-2020 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2022. www.fao.org/fishery/statistics/software/fishstatj/en

Figure 31. National landings of 'guitarfish' from the south-western Atlantic, as reported to FAO.



Data reported by Brazil (1955_1996) and Uruguay (2000–2020). Data relate to *Pseudobatos percellens*. Reported landings of guitarfish may be reported inconsistently and landings may change in relation to any national management measures.
Source: FAO. 2022. Fishery and Aquaculture Statistics. Global capture production 1950-2020 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2022. www.fao.org/fishery/statistics/software/fishstatj/en

Figure 32. National landings of 'guitarfish' from the Indian and Pacific Oceans, as reported to FAO.



Data relate to Indonesia (Rhinobatidae, eastern Indian Ocean and western Central Pacific), Eritrea (Rhinobatidae, western Indian Ocean), Pakistan (Rhinobatidae, western Indian Ocean) and Peru (*Rhinobatos planiceps* (currently recognised as *Pseudobatos planiceps*), Southeast Pacific). Reported landings of guitarfish may be reported inconsistently and landings may change in relation to any national management measures.
Source: FAO. 2022. Fishery and Aquaculture Statistics. Global capture production 1950-2020 (FishStatJ). In: FAO Fisheries and Aquaculture Division [online]. Rome. Updated 2022. www.fao.org/fishery/statistics/software/fishstatj/en

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT – COP19 PROPOSAL 41
Zebra catfish, *Hypancistrus zebra*

Species

Hypancistrus zebra.

Hypancistrus genus is a relatively recent one, described in 1991. Since 2002, eight new species of *Hypancistrus* have been described, and many more undescribed but related species are expected (Fricke *et al*., 2022).

Proposal

To include *Hypancistrus zebra* in Appendix I in accordance with Article II of the CITES Convention text paragraph 1, and by meeting Annex 1B and Annex 1C of CITES Resolution Conf. 9.24 (Rev. CoP17).

Assessment summary

SPECIES	MEETS CITES CRITERIA	DOES NOT MEET CITES CRITERIA	OTHER
Hypancistrus zebra		✓	

Proposal 41 provides some information about the current and historical habitat of *Hypancistrus zebra,* but it lacks population data or other data to support the stated projections for population declines that would meet CITES listing criteria for Appendix I and support an uplisting of *H. zebra* from CITES Appendix III to Appendix I.

With regard to species distribution, the proponents state that the species should be listed in CITES Appendix I because of B: restricted area of distribution, being highly sensitive to intrinsic or extrinsic factors. Proposal 41 argues that the range of the species has changed, as the habitat for the species has been decreased and disturbed by the establishment of a hydroelectric dam. However, there is no clear description of how much of the original habitat has been disturbed. Because the proponents observed a decrease in the area of distribution caused by the placement of a hydroelectric dam cutting across the habitat of the species, they infer that the number of individuals has declined over time, but provide no information on the level of impact of the dam project or its impact on the new and reduced habitat for *H. zebra*. The proponents project further declines of the species due to degradation in the quality of the remaining habitats, yet no evidence was provided by the proponents and no literature can be found to support the assumption that changes to the habitats have markedly reduced the *H. zebra* population and to support the suggested projection of an 80 percent reduction over the 2016–2026 period proposed or over the course of the next 10 years.

Members of the Expert Panel, a CITES Secretariat observer and technical FAO staff virtually met with one of the key scientists working on the species, Dr Leandro Melo de Sousa, to further discuss the Proposal during the week of Expert Panel deliberations. At the meeting, Dr de Sousa reported that 33 percent of the historical habitat has been negatively altered by the dam, stating that water-flow change and flooding caused by the dam made him uncertain of the long-term viability of the *H. zebra* population. Dr de Sousa confirmed there was a lack of quantifiable data collected or assessments made as a result of the COVID-19 disruptions.

Dr de Sousa made it known that a smaller remnant population remains upstream of the dam, around Altamira. He also confirmed that the population seen downstream of the dam represents 66 percent of the previous habitat of H. zebra. Here, the population was reported as very large, and it was easy to find H. zebra, as the rocky habitat was suitable to support the species. Additionally, there was evidence of recent recruitment, there being anecdotal observations that fish were producing good numbers of juveniles. Lastly, Dr de Sousa informed the Expert Panel that although there was ongoing concern for illegal fishing because the water level is now low (making fishing easier), a large portion of this downstream population is found in protected areas.

Dr de Sousa asked for clarification on the differences between the IUCN Red List and CITES Appendix lists. It seemed there was some confusion among the experts in Brazil, with proponents assuming a species characterized as “endangered” on the IUCN Red List was or should be rated as CITES Appendix I (i.e. the two were synonymous). The differences were shared by the CITES Expert Panel observer and the experts on the call.

Additionally, Dr de Sousa asked what a CITES Appendix I listing would mean for commercial trade of captive bred species. The Expert Panel and CITES Secretariat observer explained changes that would have to be put in place by breeding enterprises to meet CITES provisions and enable continued commercial breeding, and what is required to enable both non-commercial and commercial movements and trade in specimens of taxa with populations in Appendix I. The Panel also provided information on real-world examples of this situation for other species, using examples from Norway, the European Union and the United States of America.

There was also a clarification by the authors of a well-referenced scientific study on reports of illegal trade. Dr de Sousa confirmed that his 2021 statements quoted in the proposal were not based on the figures of *H. zebra* in trade, but were based on the “projected” availability from illegal traders in Colombia, as they were asked “How many fish could they supply?” and not “How many fish were traded?” Therefore, the numbers in the proposal did not provide an estimate number of fish being illegally traded.

An unknown amount of illegal trade occurs from fish illegally collected in Brazil and smuggled into neighbouring countries, mainly Colombia. Illegally traded specimens are known to end up in China, the European Union and the United States of America. In the interview, Dr de Sousa stated that the CITES Appendix III listing, which Brazil established in 2017, has been effective in helping to reduce illegal trade. He also stated that there had been some arrests of key traffickers in both Brazil and Colombia.

Estimates of the volumes of illicit trade stated in the proposal were derived from illegal traders’ statements about their ability to “supply” specific volumes and not reports of the number of fish that are illegally traded. Seizure data appear to show a peak in illegal trade occurring prior to the inclusion of the species under Appendix III of CITES. Parties are encouraged to better monitor imports of aquarium fish from Brazil, Colombia and Peru for illegal CITES listed species.

The Expert Panel noted that international trade in the species is now dominated by fish sourced from breeding in aquaculture facilities, mainly originating from Indonesia. Aquaculture suppliers are producing significant numbers of fish in these breeding facilities and have the facilities and capacity to currently meet global demand. As *H. zebra* is on CITES Appendix III, exports of *H. zebra* from breeding facilities are currently exported from Indonesia under source code F (*H. zebra* apparently should be traded under source code C, as they are past the code F2 stage). Expert Panel knowledge of these facilities indicates that they have the capacity to increase production to meet any growth in the ornamental fish market if demand should increase.

The Expert Panel agrees that some decline is likely due to the construction of the hydroelectric dam and resultant habitat loss and change. This, combined with illegal trade in the species, has put pressure on wild populations. However, the Expert Panel did not agree that the species was threatened with extinction. Given a large, but fragmented, population and the unknown magnitude of population decline caused by habitat disruption, the Expert Panel concludes that *H. zebra* does not meet the criteria for listing under Appendix I.

Scientific assessment in accordance with CITES biological listing criteria

Species distribution

The species *H. zebra* is endemic to the middle region of the Xingu River in Brazil (Figure 33).

Species productivity

The proposal does not assess the productivity of the species.

H. zebra matures at 2.5–3 years of age and has a long 10-month spawning season, with females spawning multiple times each year. Females produce approximately 15 eggs per spawn with males of the species offering a high level of parental care. There is limited information available to model life history traits of *H. zebra* to determine minimum population doubling time. However, taking into account available information on known life history traits of the species from published sources and anecdotal information from aquaculturists, the Expert Panel conservatively documented the species productivity moderate to high.

Aquaculture facility managers report that *H. zebra* breeds at 2.5–3 years of age in culture environments, but body size is also of importance (Rajanta Sinardja Rahardja, Bellenz Fish Farm, personal communication). This is in line with other species of *Hypancistrus* that mature, on average, between 1.5 years and 4 years of age. *H. zebra* have a long spawning season each year, with multiple spawning per female per year (aquaculture reports state breeding occurs up to twice a month). The species produces, on average, 15 eggs per spawning (largest anecdotal clutch size reports from aquaculture is 34); however, larvae are supplied with large yolk sacs and there is a high level of parental care improving the chance of survival of juveniles. In the reproduction and rearing of the young, females deposit eggs in rocky spaces and males intensively tend the clutch. Anecdotal reports from aquaculture facilities in Indonesia claim the juveniles are hardy compared to other pleco species.

The productivity of a fish species should not be solely based on clutch size, but more at the rate at which a population can increase in number if there are no density-dependent forces regulating the population (also known as the intrinsic rate of increase). *H. zebra* are seen to produce offspring regularly over the year with high parental care and can sexually reproduce for more than 10 years in their adult life (anecdotal report from aquaculture facility in Indonesia).

The Expert Panel was not able to collate much peer reviewed published information on the life history and productivity for *H. zebra*; however, the IUCN noted a generational time estimated at 2.5 years (ICMBio, 2022) while FishBase lists the L_{50} maturity for females at 3.9 cm and L_{50} maturity for males at 3 cm maximum length 7 cm TL male/unsexed; and maximum published weight at 3.99 g (Giarrizzo *et al*., 2015). FishBase did not have a model of life history traits of *H. zebra* to determine a minimum population doubling time, but it did have one record of fecundity from an aquarium (n = 15). Taking known life history traits into account, the Expert Panel conservatively characterized *H. zebra* productivity as moderate to high (Table 22).

Population numbers

Proposal authors characterize the current population as “high”, yet no population assessment is provided in the proposal. Modeling effort to explore species probability of extinction used a population size estimate of 100 000 fish (da Silva *et al*., 2022; the simple birth/death rate model did not take into account habitat changes).

Trends and application of the decline criterion

H. zebra is endemic to a localized river system in Brazil but occurs over a large area. No evidence was provided in the proposal, conversations with local species experts, or found in the literature to support claims of a 80 percent reduction in the number of fish over the course of 2016–2026 or in projections over the next 10 years.

The Expert Panel notes that the population of *H. zebra* has become fragmented by the construction of the hydroelectric dam, yet large numbers of *H. zebra* remain in about 66 percent of the original habitat downstream of the dam, with 33 percent impacted by flooding and reduction in flow. A large portion of this downstream population is found in protected areas, and a population of *H. zebra* remains in waters upstream of the dam.

Illegal fishery and habitat fragmentation by damming presents a challenge for the populations, but large-scale aquaculture in Indonesia and other countries, as well as hobby-scale breeding, provides sufficient numbers of fish to supply the global demand for the species in the aquarium trade.

The Expert Panel could not assess the validity of the 80 percent population decline that was stated in the proposal because no quantitative data on population size and size of restricted habitat and habitat fragmentation were given in the proposal. These population trends were likely estimated/assumed in context of the absence of quantitative data.

In an email from one of Brazil's species authorities (Mr Daniel Pinho, personal communication) to the Expert Panel, the following explanation is given: "*The construction of the Belo Monte Hydroelectric Power Plant significantly altered the species' habitat, with its operation diverting 80% of the water from the Volta Grande do Xingu. Thus, it was estimated that the habitat loss and its support capacity occurred declined in the same proportion or would be very close. It was considered that the Area of Direct Influence (AID) of the Belo Monte Hydroelectric Power Plant covers the entire Area of Occupation (AOO) of the species and the impact of the construction of the HPP has significantly altered the habitat of the species, causing a decline in the quality of the habitat throughout its area of occupation. Additionally, it was taken in consideration the impact caused by the increase in the capture of the species for the illegal ornamental fish trade (actual or potential levels of exploration), which was recorded after the habitat restriction resulting from the impact of the Belo Monte HPP. In this manner by adding the impact of the 80% loss of habitat to the increase in illegal capture of specimens in the remaining areas, there was suspected population decline of more than 80%, with a very high risk of extinction in a 10-year term, between 2016 and 2026 (estimated generational time of 2.5 years).*"

Modifying risk factors

The Expert Panel considered whether there were any characteristics of *H. zebra* that would risk or mediate risk of the species being depleted to the point where they would meet the criteria for listing on Appendix I of CITES.

Notable risk factors

H. zebra distribution is restricted to the middle and lower portions of the Xingu River basin, Brazil, a region greatly affected by the Belo Monte Hydroelectric Power Plant. The plant has reduced water flow and deteriorated the habitat quality, which impacts its ability for the species to be fished (proposal).

Wild populations are endemic to Xingu River and are subject to key threats of habitat loss, destruction and degradation associated with the building of the Belo Monte Hydroelectric Power Plant in 2016 (da Silva *et al*., 2022; de Lucena *et al*., 2021; Evers, Pinnegar and Taylor, 2019), and proposed mining operations (Tófoli *et al*., 2017) and trafficking of illegal wild-caught specimens for the aquarium trade.

H. zebra is a sedentary and territorial species (proposal) that makes it more likely that it will not move to new locations when its habitat is disrupted by fishing or other pressures.

The establishment of the Hydroelectric Power Plant in 2016 impacted part of the *H. zebra* population (upstream of the Pimental dam) by the transformation of its habitat. Downstream of Pimental, the species is being impacted by the reduction of the original flow and the loss of the natural regularity of the hydrological cycle, probably having consequences on the reproductive cycle of the species that will lead to the decrease of the population in the coming years (ICMBio, 2022ab).

The main reservoir of the Xingu River transformed the environment of the population of the region of "Gorgulho da Rita" from lotic (aquatic systems characterized by having running waters, with constant flow, such as rivers and streams) to lentic (systems characterized by calm or low-flow waters, such as lakes, lagoons, puddles and reservoirs). The river's permanent flooding, with the water above the natural level, has been submerging the rapids and rocks, consequently reducing surface turbulence and water speed. The accumulation of fine sediments in rocks disfigures benthic environments, restricting the availability of space and food, which affects the reproductive process and increases population mortality (Proposal).

Notable mitigating factors

Brazil has had a ban on wild exports of *H. zebra* since 2005, and listed the species on Appendix III of CITES in 2017 (de Sousa *et al*., 2021). There is evidence of a sustained illegal trade with fish trafficked to western Brazil, entering Colombia and then smuggled along with large shipments of other legal aquarium fish. CITES Appendix III listing has likely reduced this illegal trade by raising awareness of importing countries.

Identification of this species in trade is easy, even for non-specialists, as its visual form and colours are distinctive.

The species has been bred in captivity for over three decades (since the late 1990s in Europe and the United States of America). Starting in 2000, species breeding began on a large scale in Indonesia (de Sousa *et al.,* 2021); currently, it is being bred commercially on a large scale in Czechia and Ukraine (L.M. de Sousa, personal communication, 2022). Breeding populations of the species is also found globally in private and public aquaria.

Comments on technical aspects relating to management, trade and likely effectiveness of implementation of a CITES listing

Management comment

Since 2005, there has been a national ban on the collection, transportation and export of *H. zebra* from Brazil. Since 2017, Brazil included *H. zebra* in CITES Appendix III, which placed provisions on management and reporting of international trade of the species (both legal and practical controls).

Despite the ban on the collection, transportation and exports for over 20 years and the Appendix III listing being in place over the past five years, there appears to be a lack of sustained enforcement on the prohibition of collection, transport and trade of the species in Brazil. Some enforcement actions have been taken between Brazil, Colombia and the United States of America, but illegal trade is ongoing because management control mechanisms are not always effective.

International/regional measures

In 2008, the State of Pará listed *H. zebra* in the regional list of endangered species as "Vulnerable" (Secretaria de Meio Ambiente e Sustentabilidade, 2008). In late 2018, an IUCN Red List global assessment reclassified the species as "Critically Endangered" (criteria A3c), with the A3c criteria stating: based on population reduction projected, inferred or suspected and a decline in area of occupancy, extent of occurrence and/or habitat quality. The IUCN Red List highlights two threats: (i) biological resource use (fishing and harvesting aquatic resources as ongoing but of low impact; and (ii) natural system modifications (dam and water management/use), noting the pressure from the damming was ongoing but also of low impact.

On 3 January 2017, its inclusion in Appendix III of CITES took effect, further controlling its international trade (CITES, 2016; UNEP, 2020). In Brazil, addition of the species to CITES Appendix III was thought to assist authorities in controlling trade of species originating from Brazil and documenting movements of the fish in international trade. In an email to the Expert Panel, a species expert, Daniel Pinho (personal communication), points out that although authorities are aware that the CITES Appendix III listing provides countries with legal authority to enforce controls on the species, the control mechanisms are not sufficient to prevent trafficking.

H. zebra is, by consequence, also listed in Annex C of the European Union Wildlife Trade Regulations.

National measures

Since 2005, the collection, transportation and export of *H. zebra* have been illegal in Brazil; however, few management or control mechanisms are in place to stop illegal activities. It has been reported (de Sousa *et al*., 2021) that owing to "the high pressure of fishing for this highly endemic species for the ornamental industry … by Brazilian environmental authorities …, *H. zebra* was categorized as 'critically endangered' (Ministerio do Estado do Meio Ambiente, MAPA, 2004)". Before the categorization, the species had been declared as *Peckoltia* spp. for export, i.e. species that were allowed to be exported on Brazil's limited positive (export) list. Subsequentlly, Brazil no longer allowed *H. zebra* to be exported from the country (Instrução Normativa MMA No. 05, 21 May 2004). See Proposal *"*In Brazil, the species is protected from capture in the wild, being considered threatened since 2005, initially by Normative Instruction MMA No. 05, of 21 May 2004, and later by Ordinance MMA No. 445, of 17 December 2014. The species is included in the National Action Plan for the Conservation of Threatened Species of Amazonian Fish – PAN Peces Amazónicos, approved by ICMBio Ordinance No. 374/2019, coordinated by the National Center for Research and Conservation of Amazonian Biodiversity (ICMBio/CEPAM). Many national laws and regulations are also in place to control the use of aquarium species and endangered species. Some examples are the Federal Constitution, Environment Chapter (Article 225); Federal Wildlife Law 5.197 of 1967; CITES Federal Ordinance 76.623 of 1975; Law 6.938 of 1981, which dictates the National Environmental Policy; Environmental Criminal Law (Federal) 9.605 of 1998.*"*

Despite the Appendix III listing in 2017, there appears to be a lack of sustained enforcement on the prohibition of collection, transport and export of the species in Brazil (Leandro Melo de Sousa, personal communication). Although some enforcement actions have been taken between Brazil, Colombia and the United States of America, illegal trading is ongoing.

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

An uplisting amendment for *H. zebra* from Appendix III to Appendix I means that there are certain requirements that captive breeding enterprises will have to meet to allow them to continue commercial breeding activity, as set out in a CITES resolution on specimens of animal species bred in captivity (CITES Resolution Conf. 10.16 (Rev.) – 2). Such requirements put significant barriers to producing these species that are both administrative and practical.

The requirements for marking as set out in the conference resolution for marking requirements for trade in specimens of taxa with populations in both Appendix I and Appendix II [CITES Resolution Conf. 7.12 (Rev. CoP15) – 1] require specimens to have some form of standardized mark "only with due regard for the humane care, well-being and natural behaviour of the specimen concerned". Currently, there are no viable markers that could be considered "humane" available for fish species as small as the zebra pleco. Tags or chips that are employed on larger fish species would hinder the species' ability to swim and therefore behave naturally. In effect, the requirement for marking would mean that no captive-bred specimens could be traded as it would not be possible to mark them.

In addition, there is an administrative and practical burden in proving legal acquisition of parental stock: "5. Evidence that the parental stock has been obtained in accordance with relevant national measures and the provisions of the Convention (e.g. dated capture permits or receipts, CITES documents, etc.)". Given that these captive breeding set-ups have been operating prior to the export ban on *H. zebra* and prior to CITES listing on Appendix III, it is quite possible they would not be able to supply the necessary evidence on legal acquisition of founder stock due to the length of time passed since acquisition of founder stock.

When we consider small-scale breeding that occurs domestically in many countries around the world by enthusiastic fishkeepers, any uplisting to Appendix I could also impact the legality of their activities, even though they are actively reducing demand for wild-caught specimens. Due consideration should be taken for these individuals and the animals in their care in consideration of whether to list *H. zebra* on Appendix I of CITES.

Trade comment

A local expert (De Sousa *et al*. 2021) speculated that 60 000–75 000 individuals are kept by fishkeepers worldwide. It is likely the total trade of *H. zebra* comes predominantly from aquaculture. Since 2017, legal trade of *H. zebra* is documented on the CITES database, but unreported trade is ongoing, so the data captured in the CITES trade database are likely an underestimate of the ongoing trade.

In the CITES trade database, to date, 83.3 percent of trades reported by importers are listed as source code "F" (captive bred), with smaller numbers of reported trades made under source codes "C" – five instances of specimens bred in captivity in accordance with CITES Resolution Conf. 10.16 (Rev.); "W" – one instance of specimens reported as taken from the wild (likely an error as its movement of fish between Indonesia and the United States of America); "I" – two instances of confiscated or seized specimens; and one instance of "source unknown" (source code "U").

The main exports are from aquaculture facilities in Indonesia, although captive bred commercial production facilities also exist in several other countries in Asia, Europe and North America. Indonesian breeders provided the Expert Panel reports that their production of F2 and F3 generation was approximately 9 000–12 000 fish annually over the past five years. Current industry data suggest that a single supplier from Indonesia alone already supplies the trade with over 10 000 fish a year.

Given that this is not the only supplier of captive bred fish for the ornamental trade, it would seem that there is more than an adequate capacity to supply the current market with captive bred fish from culture facilities.

Since 2017, legal trade of *H. zebra* is documented on the CITES databaseOn the CITES trade database, to date, 83.3 percent are listed as source code "F" captive bred, but small numbers of trades are also made under source codes "C" – five instances animals bred in captivity in accordance with CITES Resolution Conf. 10.16 (Rev.); "W" – one instance of specimens taken from the wild; "I" – two instances confiscated or seized specimens, plus one instance of "source unknown" (source code "U").

The main exporter is of the captive bred *H. zebra* from Indonesia (the only source country listed in CITES trade records); however, commercial breeding in several other countries in Asia, Europe and North America is also known to occur, albeit for domestic markets and internally in the European Union. Indonesian breeders provided the Expert Panel evidence that their production of F2 and F3 generations amounted to 9 000–12 000 specimens annually over the past five years. The average number of individual fish recorded as moving across international borders a year in the CITES Trade Database is complicated by the non-matching records of imports and exports and the potential for intermediary countries to re-export the same fish, but appears to be somewhere between 5 000 and 10 000 a year (Table 20). Information from the two major breeders in Indonesia (personal communication) suggests that the export figures are closer to reality than are the import figures.

De Sousa *et al*. (2021) speculated that 60 000–75 000 individuals are kept by fishkeepers worldwide. Current industry data suggest that one supplier from Indonesia alone already supplies the trade with over 10 000 fish a year. Given that this is not the only supplier of captive bred fish for the ornamental trade, it would seem that there is more than an adequate supply of captive bred fish to meet demand.

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

Significant effort has been made in developing breeding and rearing techniques for *H. zebra.* Local capacity and facilities, plus breeding stock of *H. zebra*, have been sourced and developed years before this proposal to list the species on Appendix I of CITES. As the source of these fish were acquired pre-CITES, many operators may have difficulties in providing legal acquisition for the source fish behind the *H. zebra* held in their facilities. This might delay the opportunity for trade of legal and sustainable producers of *H. zebra*, affecting the profitability of these operations and livelihoods of staff that manage them.

As this species is already listed under Appendix III, export of any *H. zebra* from any State which has included that species in Appendix III requires an export permit. All imports of any specimens require the prior presentation of a certificate of origin and, where the import is from a State which has included that species in Appendix III, an export permit (except in circumstances of re-export, a certificate granted by the Management Authority of the State of re-export that the specimen was processed in that State or is being re-exported shall be acceptable).

Trade in a species in Appendix I is more limited. Export permits are only to be granted when a NDF and LDF are in place, when the importing Scientific Authority of the State of import is satisfied that the proposed recipient of a living specimen is suitably equipped to house and care for it, and when the Management Authority of the State of import is satisfied that the specimen is not to be used for primarily commercial purposes. Additionally, the re-export of any specimen of a species included in Appendix I shall require the prior grant and presentation of a re-export certificate. A re-export certificate shall only be granted when the following conditions have been met: a Management Authority is satisfied that the specimen was imported into that State in accordance with the provisions of the present Convention, and is satisfied that any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment; a Management Authority of the State of re-export is satisfied that an import permit has been granted for any living specimen; a Scientific Authority of the State of introduction advises that the introduction will not be detrimental to the survival of the species involved; a Management Authority of the State of introduction is satisfied that the proposed recipient of a living specimen is suitably equipped to house and care for it; and a Management Authority of the State of introduction is satisfied that the specimen is not to be used for primarily commercial purposes. As can be seen, the hurdles to frictionless trade for legal and sustainable fish are significant.

Additionally, many countries have stricter nationally legislated measures that make commercial trade in CITES Appendix I listed species, also from captive breeding, very difficult or (in some countries) impossible. This combined increase in official paperwork, and therefore increased transaction costs, including the issues related to pre-Convention fish, may make commercial breeding unsustainable and thereby possibly increase demand for trafficked wild-caught specimens.

Currently, no viable marking methods have been identified for the species, which is typically traded at very small size. Until a functioning marking method can be found, registration of captive breeding will not be possible under CITES Resolution Conf. 12.10 (Rev. CoP15). In some countries, the ownership of specimens would be impossible.

CITES does have exemptions and other special provisions relating to trade, transit or transshipment of listed species. One is that where the Management Authority of the State of export or re-export is satisfied that a specimen was acquired before the provisions of the present Convention where the Management Authority issues a certificate to that effect. There is some confusion as how this relates to progeny of these specimens (Management Authority is satisfied that the specimens were acquired before the provisions of the present Convention applied to such specimens). Equally, a specimen included in Appendix I bred in captivity for commercial purposes shall be deemed to be specimens of species included in Appendix II, and require those provisions plus the controls on the breeding facility and ultimate recipient in the market country as stated before. Where a Management Authority of the State of export is satisfied that a species was bred in captivity, a certificate by that Management Authority to that effect shall be accepted in lieu of any of the permits or certificates required under the provisions of CITES Article III, IV or V.

Basis for Article II paragraph (2b) (look-alike) Appendix I listing of H. zebra

The form and colouration of this species is unique and easily distinguishable from others, presenting a white body with horizontal black stripes (proposal).

Comment on the likely effectiveness for conservation of a CITES Appendix II listing of the species H. zebra

CITES uplisting from Appendix III to Appendix I would unlikely improve understanding of the status of the species in Brazil, or compliance around take of *H. zebra*, as collection, transportation and export of the species in and from Brazil is already banned (banned for more than 20 years).

An Appendix I listing could potentially halt or delay aquaculture operations, due to their inability or unwillingness to conduct the necessary process steps required to continue trading in an environment where there would be costs and uncertainty in achieving compliance with CITES provisions, and shipments of live fish may be delayed because of increase requirements for paperwork checks. This would mean the expertise developed in aquaculture and production of *H. zebra* may halt, or would continue without proper CITES documentation (i.e. illegal trade). Both outcomes could mean a loss of investment and a loss to local aquaculture-related livelihoods. Additionally, a decline in the aquaculture sector could have unintended negative consequences on wild stocks should illegal fishing of wild *H. zebra* populations be increased to fill the market gap left by aquaculture facilities no longer continuing to produce *H. zebra*.

H. zebra is a medium-high productivity species that can recover quickly from short-term shocks. However, chronic human pressures as a result of the establishment of the hydroelectric dam will require further governance and investment to support resilience of habitats that support fish in the wild and the legal and sustainable servicing of trade demands through aquaculture.

The Expert Panel suggests increasing national on-ground management measures to ensure the remaining *H. zebra* habitat is well managed. Increasing fishery compliance and water control management, especially around *H. zebra* habitats that already partially receive high levels of management in protected areas in Brazil, offers two solutions. Additionally, encouraging international, regional and local support for aquaculture of the species requires continued support for legal and sustainable aquaculture production of *H. zebra*. Such support will continue to catalyse the transition of trade from wild-captured individuals to trade in captive bred fish, fish preferred by the market, and which current suppliers assure the Expert Panel that they can satisfy global demand now and into the future.

H. zebra, the zebra pleco and endemic ornamental fish in Brazil, is being proposed for CITES Appendix I listing in accordance with Resolution Conf. 9.24 (Rev. CoP17) by meeting the parts of criteria Annex 1B and 1C. Annex 1B regards wild populations that have a restricted range and high sensitivity to intrinsic or extrinsic factors, and where a decrease is found, deduced or foreseen in the range of the species (the number of copies and/or habitat quality). Annex 1C lists a verified marked decrease in population size in the wild is deduced or foreseen, taking into account a decrease in habitat quality and or levels or types of holding.

Changes to the aquatic habitat of *H. zebra* owing to the construction of the Belo Monte Hydroelectric Power Plant is presented as the main reason for the concern for the species, although illegal fishing to supply the international ornamental fish trade is also recognized as a negative influence.

A CITES uplisting from Appendix III to Appendix I could potentially assist in increasing understanding of trade and encourage more effort in compliance. However, the export of wild caught *H. zebra* would unlikely improve, as collection, transport and export of *H. zebra* from Brazil has already been banned for over 20 years.

The potential inability or delay in aquaculture facilities to conduct the necessary process steps required to get certifications and export paperwork in place may mean that trade of live aquaculture bred *H. zebra* halts, halts for an extended period, or continues without proper CITES documentation (i.e. illegal trade). Such events would mean loss of investment and livelihoods and decline of this sector that could have unintended negative consequences for stocks in the wild if illegal fishing of wild *H. Zebra* populations increases to fill the market gap left by a decline in aquaculture supply.

H. zebra has a medium-high productivity that bodes well for recovery of populations after short-term shocks. However, chronic human pressures as a result of the establishment of the hydroelectric dam will not be rectified solely by putting in further governance measures to make already illegal trade "more" illegal. What is needed are support for alternative opportunities that support fish in the water and legal and sustainable options for servicing of global demand – aquaculture of *H. zebra*. The Expert Panel suggests increasing national on-ground management measures to ensure the remaining *H. zebra* habitat is well managed. Increasing fishery compliance and water control management, especially around *H. zebra* habitats that already exist in protected areas in Brazil, offers this solution, as does international, regional and local support for aquaculture of the species. Continued support for legal and sustainable aquaculture production of *H. zebra* will continue to catalyse the transition of trade from wild captured individuals to trade in captive bred fish, fish preferred by the market, and production which suppliers assure the Expert Panel they can satisfy global demand.

References

Bellenz. 2022. Ornamental Fish Farm, Export & Import. Cited 28 July 2022. www.facebook.com/CV-Bellenz-1375260365958887

CITES. 2016. *Amendment to Appendix III*. Notification to the Parties, No. 2016/056. In Convention on International Trade in Endangered Species of Wild Fauna and Flora [online]. Genera, Swizerland . Cited 18 July 2022 https://cites.org/sites/default/files/notif/E-Notif-2016-056.pdf

da Silva L.C.N., de Sousa, L.M., de Marco, P. Jr. & Vieira, T.B. 2022. Viability of natural populations of Hypancistrus zebra (Siluriformes, Loricariidae), Xingu, Brazil. *Research Square* (preprint) https://doi.org/10.21203/rs.3.rs-1233118/v1

de Lucena, M.D.L., Pereira1, T.S., Gonçalves, A.P., Silva, K.D. & de Sousa, L.M. 2021. Diversity of Loricariidae (Actinopterygii: Siluriformes) assemblages in two conservation areas of the Middle Xingu River, Brazilian Amazon, and their suitability for sustainable ornamental fisheries. *Neotropical Ichthyology*, 19 (2). https://doi.org/10.1590/1982-0224-2020-0100

de Sousa, L.M., Lucas, O., Arroyu-Morra, J.P. & Kalascka, M. 2021. Conservation and trade of the endangered *Hypancistrus zebra* (Siluriformes, Loricariidae), one of the most trafficked Brazilian fish. *Global Ecology and Conservation*, 27: e 01570. https://doi.org/10.1016/j.gecco.2021.e01570

Evers, H.-G., Pinnegar, J.K. & Taylor, M.I. 2019. Where are they all from? Sources and sustainability in the ornamental freshwater fish trade. *J. Fish. Biol*. 94: 909–916.

Fricke, R., Eschmeyer, W. N. & Van der Laan, R. (eds) 2022. Eschmeyer's Catalog of Fishes. In California Academy of scienc. California, USA. Cited 18 July 2022. http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp.

Giarrizzo, T., de Sena Oliveira, R.R., Andrade, M.C., Gonçalves, A.P., Barbosa, T.A.P., Martins, A.R., Marques, D.K., dos Santos, J.L.B., R. de P., da S. Frois, T.P.O. de Albuquerque, L.F. de A. Montag, Camargo, M. & de Sousa, L.M. 2015. Length-weight and length-length relationships for 135 fish species from the Xingu River (Amazon basin, Brazil). *J. Appl. Ichthyol*, 31: 514–424.

Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). 2022. *Sistema de evaluación del riesgo de extinción de la biodiversidad – SALVE*. In Instituto Chico Mendes de Conservação da Biodiversidade [online] Brasilia, Brazil. Cited 18 July 2022 https://salve.icmbio.gov.br/salve.

Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). 2022. *Hypancistrus zebra*. *The IUCN Red List of Threatened Species* 2022: e.T135926196A135926211. In Convention on International Trade in Endangered Species of Wild Fauna and Flora [online]. Genera, Swizerland. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T135926196A135926211.pt.

Maju Aquarium. 2022. Exporter of Ornamental Fish, Aquatic Bettle & Frozen Bloodworm. Cibinong - West Java, Indonesia. Cited 28 July 2022. www.majuaquarium.com/contactus.html

Plecoceramics. 2022. Plecoceramics. Ukraine, Kharkiv. Cited 28 July 2022.

Secretaria de Meio Ambiente e Sustentabilidade. 2008. Especies ameacadas. In Governo do Estato do Pará [online] Belem, PA. Cited 18 July 2022. www.semas.pa.gov.br/2009/03/27/9439

Tófoli, R.M., Dias, R.M., Zaia Alves, G.H., Hoeinghaus, D.J., Gomes, L.C., Baumgartner, M.T. & Agostinho, A.A. 2017. Gold at what cost? Another megaproject threatens biodiversity in the Amazon. *Perspect. Ecol. Conserv*., 15 : 129–131. https://doi.org/10.1016/j.pecon.2017.06.003

UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP

UNEP-WCMC. 2022. *The species + website*. Environment Programme World Conservation Monitoring Centre. Cambridge, UK. Cited 18 July 2022. www.speciesplus.net

Tables and Figures

Table 20. Trade volumes of *H. zebra* reported on the CITES trade database from 2016–2020.

	CITES TRADE DATA	
Reported Countries	**Exporter Values**	**Importer Values**
China		307
Colombia		69
Indonesia	30 012 (29 782)	9 819
India		50
Netherlands	(85)	
Singapore	(145)	30
Taiwan Province of China		122
Total Reported	**30 012**	**10 397**

Countries reported from exporter values reported as Origin (Exporter). Countries reported from importer values reported as Exporter (also see Table 2 for full dataset).

Table 21. Trade volumes of *H. zebra* reported on the CITES trade database from 2016–2020 (full datatset).

Year	Importer	Exporter	Origin	Importer reported quantity	Exporter reported quantity	Term	Unit	Purpose	Source
2017	CH	ID			20	live		T	F
2017	GB	ID			1060	live		T	F
2017	GB	ID		108		live			
2017	JP	ID			1500	live		T	F
2017	JP	ID			30	unspecified		T	F
2017	KR	ID			300	live		T	F
2017	NL	ID			370	live		T	F
2017	NL	ID		50		live			
2017	PL	ID			5	live		T	F
2017	SE	ID			150	live		T	F
2017	SG	ID			1755	live		T	F
2017	TH	ID		250	350	live		T	F
2017	US	CO		9		live		T	I
2017	US	ID		580		live		T	C
2017	US	ID			1280	live		T	F
2017	US	ID		123		live		T	I
2017	US	TW		2		live		T	C
2018	CA	ID			105	live		T	F
2018	CA	NL	ID		85	live		T	F
2018	DE	ID		1400	2400	live		T	F
2018	DE	ID		300		live		T	U
2018	DK	ID		200	550	live		T	F
2018	ES	ID			200	live		T	F
2018	FR	CN		112		live			
2018	FR	ID		50		live			
2018	GB	CO		60		live			
2018	GB	ID			845	live		T	F
2018	GB	ID		963		live			

Year	Importer	Exporter	Origin	Importer reported quantity	Exporter reported quantity	Term	Unit	Purpose	Source
2018	NL	CN		25		live			
2018	NL	ID			350	live		T	F
2018	NL	ID		475		live			
2018	NZ	SG	ID	30	55	live		T	F
2018	SE	ID			50	live		T	F
2018	SG	ID			2800	live		T	F
2018	TH	ID		150	500	live		T	F
2018	US	ID	XX	175		live		T	W
2018	US	ID		570		live		T	C
2018	US	ID		160	1670	live		T	F
2018	US	TW		100		fingerlings		T	C
2018	US	TW		20		live		T	C
2019	CA	ID			50	live		T	F
2019	DE	ID		900	720	live		T	F
2019	DK	ID		200		live		T	F
2019	DK	IN		50		live		T	F
2019	ES	ID			50	live		T	F
2019	FR	CN		130		live			
2019	FR	ID		15		live			
2019	GB	ID			649	live		T	F
2019	GB	ID		996		live			
2019	NL	ID			100	live		T	F
2019	NL	ID		304		live			
2019	SE	ID			100	live		T	F
2019	SG	ID			1770	live		T	F
2019	TH	ID		100		live		T	F
2019	US	ID			1260	live		T	F
2020	BN	SG	ID		10	live	# ind.	T	F
2020	DE	ID		600	700	live		T	F
2020	DK	ID			200	live		T	F
2020	FR	CN		40		live	# ind.		
2020	FR	ID		6		live	# ind.		
2020	GB	ID		553		live	# ind.		
2020	GB	ID			700	live		T	F
2020	NL	ID			210	live		T	F
2020	NL	ID		391		live			
2020	SE	ID			100	live		T	F
2020	SG	ID			2596	live		T	F
2020	TH	ID		200		live	# ind.	T	F
2020	TH	ID			850	live		T	F
2020	US	ID			3437	live		T	F
2020	VN	SG	ID		80	live	# ind.	T	F

Table 22. Productivity of *Hypancistrus zebra* (M: male; F: female).

PARAMETER	INFORMATION	SOURCE
Generational time: 2.5 years		Proposal
L 50 maturity (F)	3.9 cm	
L 50 maturity (M)	3 cm	

Table 23. Trends in status of *Hypancistrus zebra*.

REFERENCE PERIOD	INDICATOR	CONFIDENCE (H/M/L)	SOURCES
Period of 10 years (2016–2026)	Estimate population will decline of more than 80%, with a very high risk of extinction	L	Proposal
1990–1997	Trend of sharp population decline attributed to overfishing for the aquarium market	M	J.A.S. Zuanon, com. pers., 2012
2004–2014	In 2004, in the assessment of threatened species in Brazil, the species was considered Vulnerable(VU) due to the impacts generated mainly by its commercial extraction and the capture of the species was prohibited. In 2014, the species was recategorized as Critically Endangered (CR).	H	Proposal
H. zebra seized between 2006 and 2019	Average of 741 individuals/year between 2006-2019, with no increasding trendline overall but an increase between 2016-2019 from 0-1402 individuals/year	H	IBAMA, records the seizure of 4115 specimens of *H. zebra;* Beltrão 2021 and IBAMA records collated
H. zebra as % of seizures 2003– 2020, 44.6% of the seizures made		H	Beltrão *et al*., (2021)

Table 24. Description of information used in assessments of trends in status of *Hypancistrus zebra*.

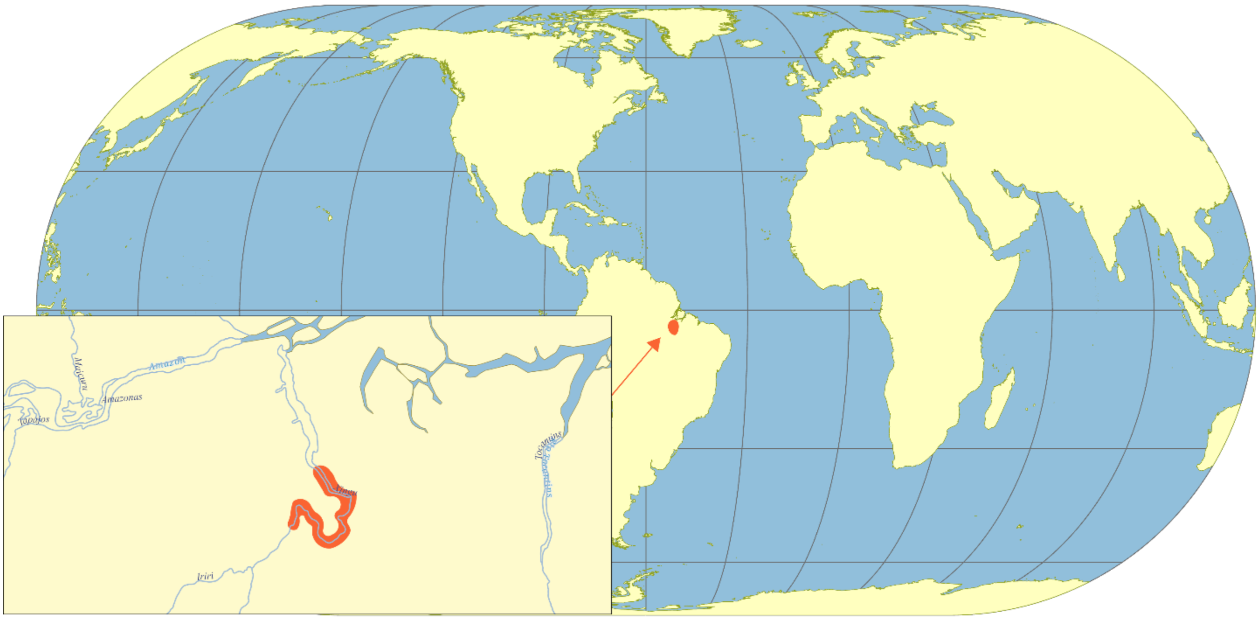
REFERENCE	**INDICATOR** Time-series data; other	**EVIDENCE RELATIVE TO CITES CRITERIA**	**RELIABILITY INDEX SCORE** 0–5 (Appendix E)	**COMMENT**
Proposal	Slow growth rate, high mortality rate and low fertility	Does not meet	3	If not used, summary for why excluded: Authors do not provide any information or data on natural mortality rate. Low fecundity with parental care, does not automatically result in low productivity.
De Sousa *et al*., 2021	• 10,000 individuals/month are trafficked for international trade via Colombia • Extensive investigation on trafficking showed main route is through Colombia and Peru. — smuggled by air and/or river from Altamira (PA) to Tabatinga and/or Santo Antônio do Içá, (AM), from where they cross the border to the municipality of Leticia, Colombia	• Insufficient Information • Meets	0 4	If not used, summary for why excluded: Extrapolation of volumes of illegal trade is anecdotal and based on informal surveys of illegal trader Colombia and Peru. These numbers are based on the assumption that traffickers can supply up to 10,000 fish for month if demand requested it. Published seizer data suggests that illegal trade has not increased after the CITES III listed period. With a peak in seizer data occurring in 2014-2015. No evidence is presented in the proposal, nor is the literature cited in the proposal supporting that illegal trade is increasing post-App III listing. There is little question that smuggling of specimens out are likely via established route through Peru and Colombia. There is not indication in trade data nor in the hobbyist social media or literature of a large number of wild caught specimens reaching markets. There is sufficient supply of captive bred specimens from Indonesia to support legal trade. Further, prices on the market are very high indicating that there is not a large supply of animals, as market price is very sensitive to volume, strong hysteresis of supply demand curves exists. Breeders have commented that they can produce larger quantities if market demand was in place.
Proposal	Between 2016–2026 Estimate population will decline of more than 80%, with a very high risk of extinction	Insufficient Information	1	If not used, summary for why excluded: There is no data or methods to support this statement of fact, query was sent to proponents to ask for clarification of this estimate of decline. There has been a disruption of the natural habitat, flooding, by construction of a hydroelectric dam.
Fisch-Muller, 2003; ICMBio, 2022;	Distribution is restricted to the middle and lower part of the Xingu	Meets	5	If not used, summary for why excluded: Publication and natural history observations support these claims

REFERENCE	INDICATOR Time-series data; other	EVIDENCE RELATIVE TO CITES CRITERIA	RELIABILITY INDEX SCORE 0–5 (Appendix E)	COMMENT
Roman,2011; De Sousa *et al.,* 2021	River basin, from the region downstream of the Belo Monte waterfalls to upstream of the city of Altamira, in the region known as "Gorgulho da Rita", in the State of Pará.			
ICMBio, 2022	Occurrence Range (EOO) calculated at 6,930 km2, and an Occupation Area (AOO) of 528^{km2}, which includes registration sites and nearby potential habitats	Meets	4	If not used, summary for why excluded: Likely to be a maximum range due to habitat specificity.
Roman, 2011	Benthic associated with rock — isolated in shelters, in crevices and cavities in the submerged rocks of the Xingu River inhabit shallow places (up to 3 to 4 m deep), with moderate to strong sediments and with the eventual presence of few deposited sediments	Meets	5	If not used, summary for why excluded: Publication and natural history observations support these claims
Roman, 2011	Slow growth and a high mortality rate, a minimum longevity of five years is estimated in the natural environment	Insufficient information	1–2	If not used, summary for why excluded: Determination based on population dynamics modeling, not biological data is provide to support the claim.
ICMBio, 2022; De Sousa *et al.,* 2021	Reaches a total body length of 80 mm to 100 mm	Meets	5	
Román, 2011	Generational time is 2.5 years,	Meets	3	
Román, 2011	Seasonal spawning and the reproductive period is long with two peaks throughout the year, in the transitions between the	Meets	4–5	If not used, summary for why excluded: Publication and natural history observations support these claims

REFERENCE	INDICATOR Time-series data; other	EVIDENCE RELATIVE TO CITES CRITERIA	RELIABILITY INDEX SCORE 0–5 (Appendix E)	COMMENT
	flood/drought periods of the Xingu River			
De Sousa *et al.,* 2021	Fecundity of *H. zebra* is very low, with 8 to 30 eggs per clutch	Meets Based on this and other references.	5	If not used, summary for why excluded: While fecundity is low, parental investment is high. Survival of offspring in breeding is very high. Unknown if fecundity is higher or lower in breeding operations.
ICMBio, 2022	Females reach sexual maturity between the first and second year of life	Meets Based on Román 2011	4	
Román, 2011	Body size of 40 mm and males 30 mm		5	
Proposal	Omnivorous species with a carnivorous tendency. It feeds on plant matter, detritus and invertebrates.	Meets Based on information from other references and hobbyist breeding sites.	4	
Roman, 2011 ; L.M. De Sousa, pers. comm., 2022	2011–2022 Species is not rare however, nowadays it is not frequently found and not abundant (tranlation from spanish to english, could be slight differences)	Insufficient Information	2	If not used, summary for why excluded: Literature and data likely support a decline in abundance due to alterations of the habitat. via a hydroelectric dam and from fishing pressure. Fishing pressure was likely higher in 2011 than present (2022) due to CITES III listing.
Proposal	Seizures made by the Federal Police in the years 2021 and 2022 present many juvenile specimens, certainly born after the implementation of the CH. This fact shows that, currently, populations are managing to stay in remnant areas of the Volta	Insufficient Information	1	If not used, summary for why excluded: There is no data presented to support the quantity of animals seizured nor information about these seizures. The statement claims that the species is able to utilize “remnant areas” but is being harvested at illegally. This type of claim should have some sort of supporting documentation in the proposal.

REFERENCE	**INDICATOR** Time-series data; other	**EVIDENCE RELATIVE TO CITES CRITERIA**	**RELIABILITY INDEX SCORE** 0–5 (Appendix E)	**COMMENT**
	Grande do Xingu rapids and that illegal harvesting is being a strong pressure and threat to the species			
Proposal	Population structure data are still scarce		5	If not used, summary for why excluded: There is no detailed population data presented for the current time period for this species.
Proposal	Tendency to reduce its distribution area as a result of the changes derived from the CH Belo Monte in the region		2	If not used, summary for why excluded: Likely true, but anecdotal. Hydroelectric damning bisected habitat.
De Sousa *et al.,* 2021; 2022	Captive breeding, techniques have been perfected for decades. The species has been bred in captivity since the late 1990s in Europe and the United States. Starting in 2000, the species began to breed on a large scale in Indonesia and currently also breeds on a large scale in Ukraine and the Czech Republic (L.M. de Sousa, com. pers., 2022).		5	If not used, summary for why excluded: Amble data supports large scale breeding at both the hobbyist level since the introduction into the aquarium trade. There is a robust breeding efforts in hobbyists community. Further large scale commercial breeding is occurring in Indonesia and significant investment has been made. There is evidence of breeding beginning to development color morphs through selective breeding, indicating large quantities for offspring. Further sustained commercial breeding operation in the Ukraine are documented but the operation lost most of its breeding stock due to the Russian invasion (Facebook post March 9). The owners have begun setting up facilities in Belgium. There indications that breeding efforts in Czech Republic but it is difficult to substantiate volumes of commercial production from the Czech due to the dispersed nature of breeding operations there. Czech has a very robust aquarium aquaculture sector, but few public facing websites or information. Indonesia Commercial Breeding (Bellenz, 2022; Maju Acquarium, 2022). Ukraine Commercial Breeding (distrubed by Russian invasion) (Plecoceramics, 2022).

Figure 33. Distribution of *Hypancistrus zebra*



Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). 2022. *Hypancistrus zebra*. *The IUCN Red List of Threatened Species* 2022: e.T135926196A135926211. In Convention on International Trade in Endangered Species of Wild Fauna and Flora [online]. Genera, Swizerland. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T135926196A135926211.pt.)

FAO EXPERT ADVISORY PANEL ASSESSMENT REPORT – COP19 PROPOSAL 42
The three sea cucumber species in the genus *Thelenota*

Species

Three sea cucumber species belonging to the genus *Thelenota*

Thelenota ananas

Thelenota anax

Thelenota rubralineata

Proposal

To include the three species belonging to the genus *Thelenota*, comprising *Thelenota ananas*, *T. anax* and *T. rubralineata* in Appendix II, in accordance with Article II paragraph 2 (a).

Expert Panel Assessment summary

SPECIES	MEETS CITES CRITERIA	DOES NOT MEET CITES CRITERIA
Thelenota spp.		✓

The Expert Panel assessed *Thelenota spp*. resilience across 27 range states. From an analysis of the best available scientific data and technical information on historical extent and short-term rates of decline taken together, including on levels of the genus in trade, *Thelenota spp* did not meet the CITES listing criteria for Appendix II.

At a species level the analyses of *T. anax*, *T. rubralineata* and *T. ananas* did not meet the CITES listing criteria for Appendix II. However, a reduction in the range of *T. ananas* was recorded in Egypt and recent records of *T. ananas* densities in some localities of the Solomon Islands met recent rate decline criteria. Due to differences across the species within the genus, a species by species summary is given below and seeTable 25.

Thelenota ananas

An analysis was made using the available scientific data and technical information on the trade of *T. ananas*, as well as historical extent and short-term rates of decline taken together. The species is seen in international trade, although reports of its high value in the CITES proposal are incorrect based on current and historical buying prices, being roughly about 33 percent less of other high value species such as *Holothuria whitmaei*, *H. lessoni* and *H scabra* (Pacific Community [SPC] unpublished data). A current wholesale value of USD 55 per kilo for large, A grade, dried weight was reported by a market trader, which equates to less than USD 9 per individual, not considering fishing, processing or shipping costs.

T. ananas is a conspicuous species that commonly reaches a length of over half a metre. The species is recorded across a wide range of habitats (e.g., coral patches, coral rubble and reef slopes) at depths which makes harvesting difficult for most breath hold divers. It is mostly not aggregated in patches and has an inherent productivity conservatively assessed as moderate.

Information on the status of *T. ananas* stocks shows that they have largely been resilient to extirpation across their range, and examples of long time-series of fisheries data spanning decades show regular and consistent exports of *T. ananas* from range countries (e.g., Australia, New Caledonia, Papua New Guinea, and Tonga). However, there was concern over the marked range reduction in Egypt and the recent rates of decline combined with future projected declines in density of the species from parts of Solomon Islands (where stock sustainability measures were from time-series and snapshot studies in a limited number of locations). In

Solomon Islands, boom-and-bust cycles in density records correlate to periods of fishery closures (stock recovery), followed by declines associated with periods of high fishing pressure (fishery openings).

In addition, non-quantified anecdotal reports of concern for the sustainability of *T. ananas* stocks were noted in Fiji, Mayotte, Samoa (Samoan exports of sea cucumbers have been banned since 1994) and Viet Nam (a single site study by Hung *et al*., 2017). Given all these factors above, it was considered that *T. ananas* does meet the CITES criteria for a limited part of its range, but, due to general resilience indicators of consistent exports and densities across most of its range, the Expert Panel concluded that *T. ananas* does not meet the criteria for listing on Appendix II of CITES.

Thelenota anax

T. anax is a large conspicuous sea cucumber species. Its distribution can be patchy, with *T. anax* often found in high-density patches on sandy substrates. Like *T. ananas, T. anax i*s also large in body size and can be often found at depths beyond breath-hold diving. Like *T. ananas,* broadcast spawning in *T. anax* results in the release of millions of gametes over multiple spawning periods a year, its reproductive biology (e.g., size-at-maturity) and productivity measures are also not well documented.

The species is seen in international trade, although it is of low value. An assessment was made of the best available scientific data and technical information on the trade in *T. anax*, as well as the historical extent and short-term rates of decline taken together. Information on the status of *T. anax* stocks shows that they have been resilient to species extirpation, and long-time-series records of density measures indicate stocks are robust across their range. The Expert Panel analysis noted *T. anax* did not meet the CITES listing criteria for Appendix II.

Thelenota rubralineata

Because this species has limited trade and would be unlikely to support future growth in trade volumes due to its rare and patchy distribution, low value and high cost of extraction, *T. rubralineata* was considered not to have met the CITES criteria for listing.

In Solomon Islands, *T. rubralineata* is called "lemonfish", and, because of its body shape, there is likely some confusion in species identified for export (e.g., similar appearance *Stichopus* spp. are probably marketed under the same trade name). All information assessed found the stocks of *T. rubralineata* to be recorded at extremely low population densities, i.e., the species is naturally rare, and distribution is patchy over its range, reinforcing the fact that there is a very limited volume of this species available for trade. This is supported by historical reports from over 30 years ago, which reveal that the low population density is not due to recent overexploitation (Massin and Lane, 1991; Lane, 1999ab).

The CITES instrument relies on control of international trade to offer biodiversity conservation and sustainable development benefit, and subsequently *T. rubralineata* does not meet the CITES Appendix II listing criteria because a species can only meet the CITES criteria if it may (now or in the future) become threatened with extinction because of international trade in specimens. Subsequently, listing *T. rubralineata* would be an academic rather than a practical solution for its conservation in the wild. The absence of any findings of densities at scale that could support a commercial fishery excludes the likelihood that trade threats could be foreseen.

General sea cucumber comment

Maintaining an effective population density is critical for successful reproduction of sea cucumbers as their sexes are separate and their mode of releasing gametes (broadcast spawning) can be negatively impacted by "depensatory effects" (i.e., fertilisation success being proportional to the number of mature adults) that occur when stock densities in the wild decline. Therefore, low stock densities may result in negative population growth.

Scientific assessment in accordance with CITES biological listing criteria

Natural species distribution

Thelenota sea cucumber species are non-migratory, relatively sedentary aquatic invertebrates that live in the tropical and subtropical waters across a range of depths and habitats. The range of the species are the following:

T. ananas: Red Sea, Mascarene Islands, Maldives, East Indies, North Australia, the Philippines, Indonesia, China and southern Japan, and the islands of the Central Western Pacific as far east as French Polynesia, Western Indian Ocean region including island states (Madagascar, Mayotte and Seychelles) (Figure 34).

T. anax: Tropical Indo-west Pacific. In the tropical Indian Ocean, this species is known from East Africa, the Comoros and Glorioso Islands. It is present in much of Southeast Asia, including Indonesia, the Philippines and the South China Sea. In the tropical Pacific, the species is present from northwestern Australia to Enewetok, Guam and the Ryukyu Islands southwards to most of the islands of the Central Western Pacific and as far east as French Polynesia (Figure 35).

T. rubralineata: "Coral Triangle" and extends into the Pacific Ocean. In Southeast Asia, the species has been recorded in Indonesia, the Philippines, east Malaysia, the islands of the South China Sea, and in the Pacific region, Guam, Papua New Guinea and Solomon Islands. It has also been sighted in New Caledonia and possibly Fiji (Figure 36).

All *Thelenota* occur within country economic exclusion zones in coastal ecosystems, so the introduction from the sea is unlikely, although movement of sea cucumbers in trading boats could mean the product arrives by sea.

Species productivity

MODERATE PRODUCTIVITY

Scientific studies provide little data about the productivity of sea cucumbers generally and *Thelonota* spp. species specifically. However, they are known to rapidly increase in number when conditions are suitable (Uthicke, Schaffelke and Byrne, 2009).

Life history information is difficult to assess in sea cucumbers because they have few hard body parts, are not generally amenable to conventional measuring, weighing or tagging methods and can undergo shrinkage and regrowth in body weight as adults. In addition, because of the lower value of this genus, there is no information available from aquaculture of this group of species.

Thelenota time to maturity is unknown; however, analogous sea cucumber species for which information is known show they mature early (approximately one year in culture). *Thelenota* species are known to have multiple spawning periods per year, releasing millions of eggs on each occasion. While they do have high fecundity, the fertilization of broadcast spawned gametes, larval survival and recruitment success are highly variable.

Growth rates for *Thelenota* species are largely unrecorded, with longevity of the species group also unknown. It is thought that rates of natural mortality are low. Applying a precautionary approach to consideration of the available scientific information on productivity, *Thelenota* spp. were estimated to have moderate to high productivity. Owing to the low confidence in some of the metrics used to estimate productivity, this was classified by the Expert Panel as moderate.

An analysis by the Western Australian Fisheries Joint Authority suggests sea cucumbers are inherently robust due to early age at maturity and high fecundity, although unmanaged and unregulated fishing are a major contributor to the poor track record for sea cucumber fisheries worldwide (Hart, Murphy and Fabris, 2022). Little information on natural mortality exists, although Western Australia fishery management scientists use a medium to low rate (annual mortality rate (M of 0.35 to 0.4) in their assessment models. Although settlement and early juvenile mortality is thought to be high, there are very few predators of adult stages in the wild (Hamel and Mercier, 2022; Mercier, Battaglene and Hamel, 2000).

Studies on the reproduction of analogous sea cucumber species – *H. scabra* (sandfish) and *Actinopyga echinites* (redfish) – show that female sea cucumbers can produce up to 18–25 million viable eggs and spawn year-round, although main spawning seasons are noted (Mercier, Battaglene and Hamel, 2000). Sexual maturity occurs at approximately one to two years of age. Successful fertilization of broadcast gametes can be disproportionately lowered because of harvesting pressure and various environmental stressors thinning out numbers of sea cucumber on the benthos, which impacts their ability to fertilize their gametes when broadcast spawning (Uthicke, Welch and Benzie, 2004; Bell, Purcell and Nash, 2008).

Data on the size of *Thelenota* species are commonly recorded. Characteristics of *Thelenota* species in the Western Pacific region show that the average lengths of *T. ananas* are 45 cm, *T. anax* at 55 cm and *T. rubralieneata* at 50 cm (SPC, 2003; Kerr, Netchy and Gawel, 2006; Kerry, Netchy and Hoffman, 2007). Reported mean sizes of *T. ananas* were 37.3 cm for Solomon Islands (n = 22, Pakoa *et al*., 2014); 54.5 cm (n = 23) in Yap State (Kerr, Netchy and Gawel, 2006); 52.5 cm also in in Yap State (n = 2, Tardy and Pakoa, 2009); 59.1 cm (n = 73, Fufudate, 1999) in Kiribati; *T. ananas* 30.5 cm (n=29), *T. anax* 53.4 cm (n=189) in Tonga (Shedrawi *et al*., 2020); 36.0 cm ± 1.41 cm in Sri Lanka (Gamage *et al*., 2021), and 31.0 cm in Samoa (n =2, in Sapatu and Pakoa, 2013). *T. ananas* has been shown to reach a size of 80 cm, whereas *T. anax,* in Kiribati, has an average length of 58.0 cm (n = 9, see Fufudate, 1999); and 59 cm in the Philippines (De Guzman and Quinones, 2021). In Indonesia *T ananas* reach 80 cm and *T. anax* reach 100 cm (Hartati, 2021). *T. anax* grows to over 1 metre. It is one of the largest sea cucumbers and can weigh over 5 kg. *T. rubralineata* was first described in the late 1980s (Massin and Lane, 1991) and is an uncommon sea cucumber species that can grow to 50 cm in length.

Past estimates of holothuroid age based on size frequency data (e.g. Conand, 1988, 1989) should be regarded as underestimates. Among animals, growth rates are mostly related to mortality rates, which are negatively related to longevity and more recent studies on the growth of sea cucumbers in aquaculture show growth to be faster than first estimated, suggesting higher productivity. Hamel and Mercier (2022) report *H. scabra* growth of 10 to 15 cm/month. According to Long and Skewes (1997), *H. scabra* individuals ~18 cm long are ~2 years old. However, more studies are needed to establish a growth curve in the field over the entire life cycle of the species. Thicker skinned (tegument) sea cucumbers such as teatfish reportedly grow more slowly maturing at 3–7 years. In studies using genetic fingerprinting for mark-recapture of other species of sea cucumbers, large individuals did not grow at all or shrank in size over the observation periods (Uthicke, Welch and Benzie, 2004). Photographically marked individuals of *T. ananas* over a two-year period revealed that growth over the two years was highly variable among individuals. On average, *T. ananas* lost approximately 8 percent of their body weight (individual with the greatest weight loss of 1 790 g, from direct weights) and measured 17 cm shorter and 2.5 cm narrower in 2012 compared to 2010. What was clear from Purcell *et al*. (2006) study is that age estimates of *H. whitmaei* from modelling of length or weight data are unreliable at adult body sizes. Purcell *et al*., (2016) findings suggest slow growth for *T. ananas*, which indicates that these large coral reef holothuroids might be longer lived and have lower mortality rates, but he clarifies that more data are needed for a definitive understanding.

When considering longevity of sea cucumbers, James *et al*. (1994) and MPEDA (1989) reported that analogous inshore species could live up to 10 years of age, while Purcell (2010) noted that they could live longer as sea cucumbers probably do not experience senescence. At present, longevity studies are not reliable for sea cucumbers.

Uthicke, Welch and Benzie (2004) and Uthicke, Schaffelke and Byrne (2009) have noted "plasticity" in the abundance of echinoderm populations over time, which is thought to be a result of a high-risk–high-gain larval strategy that results in occasional large rapid population increases. Stock monitoring over periods of moratoriums have recorded intrinsic population growth rates showing sea cucumber stocks can recover quickly from overexploitation (Friedman *et al*., 2011; Toral-Granda, Lovatelli and Vasconcellos, 2008). Lane (1992) reported records of range extensions of *T. anax*.

Taking the above information into account, considering the inherent productivity thresholds listed in Musick (1999: Table 3), and taking a precautionary approach to making a determination of productivity – because much of the basic life history information is still absent – the Expert Panel returned a result towards the lower end of medium productivity for *Thelenota* as a whole.

Population number

There are no total population estimates for *Thelenota* stocks, although measures of *T. ananas* and *T. anax* density estimates have been used in some cases to produce standing stock estimates to s*et al*lowable catches. *T. rubralineata* are found rarely and overall population estimates are unknown.

Trends and application of the decline criterion examining sea cucumber range and density data and information by place

Throughout our analysis, the Expert Panel encountered problems when assessing the information in CITES listing proposal 42. Many statements made were unqualified in relation to the CITES criteria. Additionally, many referenced the IUCN Red List as support for statements of concern. In talking with the IUCN Red List Authority to find the evidence on which statement of extinction vulnerability was made, the Expert Panel noted many inconsistencies in data that were compared in their assessment, by spatial, temporal and methodological approach. Additionally, the quality, quantity, availability and consistency of data related to *Thelenota* species were not strong. Much of the information examined by the Expert Panel involved single snapshot fishery related surveys that included *Thelenota* species, and longer term regular standardized surveys were not available for many locations.

Oceania and Pacific Islands Region

General

From shallow reef and lagoon survey records collected across Pacific Island countries (Pinca *et al*., 2010), *T. ananas* and *T. anax* density records were collected both in locations subject to low fishing pressure and/or in protected areas. This information was used by SPC to define a "rule of thumb" baseline threshold for what would be considered as "healthy" *T. ananas* and *T. anax* stocks in their most suitable habitat (Pakoa *et al*., 2014). These reference densities are based on two separate methods of assessments (manta tows and belt transects on reef slopes and tops). For *T. ananas*, the reference density was thought to be approximately 10 ind/ha (using manta tow) and approximately 30 ind/ha (on reef slopes and tops using transects). For *T. anax,* a species not usually recoded on reefs, the manta tow reference density was estimated at approximately 20 ind/ha (Pakoa *et al*., 2014). It should be noted that *Thelenota* spp. are habitat specific, and besides *T. anax,* which can be observed in aggregations, each assessment method did not target habitat specific to these two species. Additionally, it is known that the carrying capacity of extensive and complex reefs of high island environments is normally greater than those in for isolated atoll reefs where nutrient availability can be lower, which means that even without fishing, records of low density can be a response to habitat suitability and not depletion by sea cucumber removal.

Fiji

T. anax was reported from Lau Province in Fiji in 2012 on transects (on reef slopes and tops), while both *T. ananas* and *T. anax* were observed on manta tows (Jupiter, Saladrau and Vave, 2013). Data from this assessment were compared with the data collected from Kubulau and Bua Districts of Bua Province (Table 26). From a comparison between these two surveys for the two areas, the combined densities were similar for *T. ananas* and *T. anax,* though considerably sparser than reported in the surveys conducted across sites in Viti Levu and Vanua Levu in 2003 and 2009 (Friedman *et al*., 2010).

Average sea cucumber species densities (ind/ha) recorded in Tabu and in open areas using belt transects collected by snorkel, Self-Contained Underwater Breathing Apparatus (SCUBA) and manta tows in Bua, Kubulau, Nakorotubo and Vuya Districts of Fiji in 2014 reported no *T. ananas* (Mangubhai, Lalavanua and Purcell, 2017). Similar assessments for *T. anax* in Bua, Nakorotuba and Ovalau Districts recorded only 3 ind/ha for Ovalau District only (Mangubhai, Lalavanua and Purcell, 2017).

In 2017, the fishery was placed under a moratorium because of concerns over stock depletions. Unpublished[1] data indicate that the low densities for *T. ananas* populations in Viti Levu Island are observed because of heavy fishing pressure, although densities were consistent with those recorded in 2009 at some sites. However, while low densities of *T. ananas* were recorded in 2017 and the following years, these data did not come from surveys carried out in preferred *T. ananas* habitats, but focused on near-shore shallow water habitats of *H. scabra*. In contrast, *T. anax* showed recovery in later years, in 2018 and 2021, with recorded densities greater than those recorded in previous surveys. These improvements may be the result of recovery over the moratorium period or, just as *T. ananas,* were due to inconsistent survey locations.

Vanuatu

Léopold *et al*. (2015) assessed stock biomass (tonnes) for commercial sea cucumber species across 13 sites with a range of 4.5 km² to 18.6 km² in Vanuatu, which included both *T. ananas* and *T. anax.* Estimates for stock biomass for *T. anax* across eight sites were estimated to be less than 1 tonne at each site; for *T. ananas*, stock biomass was estimated at seven sites to be between 5.5 tonnes and 16 tonnes. In 2013, the PROCFish programme found densities of 6.4 and 5.2 ind/ha during transect surveys at Aneityum and Efate islands, respectively. In the same year, Pakoa *et al*. (2013) recorded densities of approximately 5.5 [+/-] 0.5 standard error (SE). Historical records published in Pakoa *et al*. (2013) show densities at 0.75 and 4.3 ind/ha in 1998 and 2000, respectively, which were at similar levels to those recorded in 2011. These data indicate that populations did not decline during those periods of unregulated fisheries, and, although data are not available for later years, it is expected that densities have not declined further given the active management plan and improvements in fisheries management in Vanuatu.

Solomon Islands

Ramohia (2006) conducted a rapid ecological assessment across Solomon Islands and reports that *T. ananas* occurred at 6.1 percent of shallow habitats surveyed and at 15.9 percent of deep habitats surveyed. *T. anax* was reported at 4.5 percent of shallow habitats and 33.3 percent of deep habitats (Ramohia, 2006). All species of *Thelenota* had higher densities on exposed reefs rather than sheltered areas. *T. ananas* was recorded to have densities of 2.0 ind/ha on shallow reefs and 1.2 ind/ha on deep slopes; *T. anax* was recorded to have densities of 1.0 ind/ha on shallow reefs and 4.4 ind/ha on deep slopes; and *T. rubralineata* was recorded to be 0.4 ind/ha on deep slopes only (Ramohia, 2006).

Buckius *et al*. (2010) surveyed 11 sites in the Marovo Lagoon of Western Province. Notably, of the 11 sites assessed, only *T. ananas* was observed at one site only, which was at Karinka Deep. *T. anax* and *T. rubralineata* were not observed at all. Previous surveys in the Marovo Lagoon have shown low densities of sea cucumbers in the lagoon, with patchy distribution (Manioli, 2004; Ramohia, 2006).

In deep slope habitats, a marine protected area (MPA) in the Arnavon Islands showed no effects on abundances of *T. anax* (Lincoln-Smith *et al*., 2000). Before the MPA was established, there were an estimated 12 ind/ha; a survey conducted after the MPA had been established showed there was an estimated 11.5 ind/ha (Lincoln-Smith *et al*., 2000). The low market value of the species and absence of heavy harvesting are the reasons densities of the species may not have increased with protection.

Pakoa *et al*. (2014) report mean densities of *Thelenota* species for sites across Solomon Islands in 2011–2012 at Chubikopi (Western Province), Kia and Tatamba (Isabel Province), Marau (Guadalcanal Province), Ngella (Ngella Province), Taro (Choisel Province), Russell Island (Central Province), Santa Cruz (Temotu Province), and Star Harbour and Ugi (Makira Province) (Table 27).

Densities per station from fishery independent censuses across the Solomon Islands revealed declines between 2012 and 2019 for *T. ananas* but not for *T anax*. (Figure 37). The number of stations where *Thelenota* species were observed (a proxy measure of range or extent) out of the total number of stations within each survey, were consistent through time for *T. anax* but declined for *T. ananas* (Table 28).

At the sites surveyed in Solomon Islands, there was an observable increase in density for *T. ananas* from 2006 to 2012. The general increase in *Thelenota* stocks occurred when the fishery had a moratorium on harvesting. There was a significant decline in densities from 2012 to 2019 linked to a period when fishing was allowed. A decline in *T. ananas* density was significant between 2012 and 2019 and between 2006 and 2019. The latter decline from 2012 to 2019 was partly driven by a decline at Kia in the Isabel Province where surveys carried out over 26 transect (six 100 × 2 m) and 11 manta tow stations (variable survey area) recorded relatively low densities when compared with 2012. While this decline can reflect differences in survey effort across habitat of differing appropriateness for the species, it is likely a real effect attributed to harvesting pressure given that total exports declined over a similar period and that prevalence also declined from 10.8 percent to 1.3 percent of the stations surveyed (Table 29).

Papua New Guinea

T. ananas is reported by Lokani and Chapau (1992) from 10 sites surveyed in Manus in 1992 to have had densities of between 0 to 5.63 ind/ha with a mean density of 1.63 ind/ha in the early 1990s.

In the New Ireland Province, all species of *Thelenota* were observed during a survey in 2006 of the northern part of New Ireland Island, *T. ananas* (n = 43), *T. anax* (n = 22) and *T. rubralineata* (n = 2) (Kaly *et al*., 2007). In comparison with a survey conducted in 1992 (Lokani, 1996), *T. ananas* was recorded at 8 ind/ha in 1992 and 1.4 ind/ha in 2006, *T. anax* was 1 ind/ha in 1992 to 0.72 ind/ha in 2006, and *T. rubralineata* which was not observed in 1992, but had a density of 0.07 ind/ha in 2006 (Kaly *et al*., 2007). The difference can be largely attributed to assessments conducted in different locations. Lokani (1996) surveyed islands in the Kavieng lagoon system while Kaly *et al*. (2007) included fringing reefs of the main island of New Ireland. Potuku (1992) reports densities of 3.14 ind/ha for *T. ananas* for the West Coast area of the New Ireland Province and a density of 1.21 ind/ha for *T. anax*.

Massin and Lane (1991) recorded the sighting of a single individual of *T. rubralineata* during 1 200 dives at Laing Island in PNG. This species is known to be naturally rare, and therefore unlikely to be a significant target of fishers now or in the past.

In a survey of the Milne Bay Province in 2001, which covered 1 126 sites covering a surveyed area of 256 000 km², Skewes *et al*. (2002) report that the mean density for *T. ananas* was 0.47 ind/ha and *T. anax* was reported to be 0.63 ind/ha. During this survey, only four specimens of *T. rubralineata* were also recorded during 1,126 dives, (Skewes *et al*., 2002). Even though *T. rubralineata* has been recorded on the south coast of Papua New Guinea, the species has not yet been recorded in any surveys in the Torres Strait of northern Australia (Skewes *et al*., 2002).

In the autonomous region of Bougainville, Hamilton *et al*. (2010) report mean densities of 1.5 ind/ha for *T. ananas* on shallow reef slopes and 0.5 ind/ha in the lagoon. *T. anax* was reported as having 3.4 ind/ha on shallow reef slopes, 8.9 ind/ha on deep reef slopes and 3.0 ind/ha in the lagoon (Hamilton *et al*., 2010). *T. rubralineata* was reported only for deep reef slope with 5.0 ind/ha (Hamilton *et al*., 2010).

Unpublished National Fisheries Authority data show that densities declined and then recovered between 2018 and 2021 for *T. ananas* but stayed low for *T. anax* (Figure 38, Table 30). However, these differences in densities are the result of changes in survey effort at key locations (e.g., Madang and Manus) rather than being a true decline in stock density given the consistency of exports and anecdotal reports on variation in the methodology of surveys.

New Caledonia

Over 30 years ago Conand (1989) reported densities of *T. ananas* to be 18 ind/ha. Purcell *et al*. (2009) 20 plus years later found in an assessment for New Caledonia, that *T. ananas* was found at half of the study sites and in low abundances, with individuals sparsely scattered. From the assessment, *T. ananas* was reported to be a little more abundant in Province Nord with the highest abundance reported at Passe de Koné with >10 ind/ha reported.

Overall, *T. ananas* was found most densely in deeper areas surrounding lagoon reefs, and on the exposed slopes of barrier reefs though populations of *T. ananas* were regarded to be generally sparse, and rarely exceeded 50 ind/ha. Overall average densities for *T. ananas* were pooled among all 50 reef sites assessed. *T. ananas* were found to be more abundant on passes and deep slopes followed by front slopes and lagoonal areas. *T. ananas* were assessed with a density of 4.1 ind/ha for passes and deep slopes, 2.0 ind/ha for front slopes and 2.1 ind/ha for lagoonal areas (Purcell *et al*., 2009). Densities for barrier reef sites were higher on the front slope with 8.9 ind/ha, passes and deep slopes with 7.9 ind/ha and the lagoonal side having 3.1 ind/ha (Purcell *et al*., 2009). Both *T. ananas* and *T. anax* were reported to make up only 1.2 percent (n = 76) and 0.7 (n = 45) of the total number of all sea cucumbers species observed (Purcell *et al*., 2009).

From the most recent survey conducted in 2021 (Gilbert *et al*., forthcoming), collating records collected across all appropriate habitats from various geographic zones in three provinces, the unweighted average density was 10.52 for *T. ananas* and 13.27 ind/ha for *T. anax* (Gilbert, A., Georget, S., Guillemot, N., Ton, C., Léopold, M., Purcell, S., Van Wynsberge, S. & Andréfouët, S. (forthcoming). *État des lieux des stocks d'holothuries commerciales de Nouvelle-Calédonie (2021–2022).*

Table 31). Notably, the maximum density was 44 ind/ha in deep terrace reef zones for *T. ananas* and 53 ind/ha in shallow terrace reef zones for *T. anax* (Gilbert *et al*., forthcoming). These findings are consistent with historical records (Conand, 1993; Purcell, Gossuin and Agudo, 2009) and reveal changes in density that do not meet Appendix II of CITES recent decline listing criteria.

Samoa

Eriksson (2006) did not find any *T. ananas* during assessments in Samoa as the assessment did not survey reef-fronts and deeper waters where *T. ananas* are known to inhabit. However, Shedrawi *et al*. (2021) surveying shallow back reef zones, which encompasses only marginal habitats, recorded overall average densities of 0.5 ind/ha, which include 0.55 and 0.45 at Upolu and Savaii, respectively. A maximum density of 4.1 ind/ha was found in Vaitoloa. Friedman *et al*. (2006) found *T. ananas* at all four assessment sites surveyed under the PROCFish-C project in both shallow (with the exception of Manono) and deeper water areas. Densities were generally low with < 4 ind/ha observed at all sites, with one patch density of 25 ind/ha in Vaisala, in Savaii. *T. anax* is rare in Samoa with only a single specimen recorded during the PROCFish-C assessments (Friedman *et al*., 2006).

In their assessment of sea cucumber stocks at Vaisala, Salevalu, Faala, Manono, Faleula, Aliepata and Falealili, Sapatu and Pakoa (2013) report *T. ananas* only at Vaisala and Aleipata with mean densities of 3.5 ind/ha at Vaisala and 0.5 ind/ha at Aleipata, which is consistent with densities recorded in 2019 (Shedrawi *et al*., 2020). These data indicate that there has not been any recent decline in densities.

Tonga

The earliest surveys in 1990 show that the density for *T. ananas* was 2.97 ± 1.17 SE (Preston and Lokani, 1990). A later survey completed in 1996 (six years between surveys) shows that densities significantly declined, prompting the Ministry of Fisheries to close the fishery to allow stocks to rest and recover (Lokani, 1996). Nearly eight years later, in early 2004, densities had again increased to levels found in the 1990s (Friedman *et al*., 2004). The fishery remained active for approximately 11 years until, in 2016, the Ministry of Fisheries again closed the fishery after its surveys reported declines. After three and a half years of resting the fishery, densities in 2019 again returned to be on par with those found in 1990, at 2.33 ± 0.92 SE, and there were observable increases in the number of *T. ananas* in the Vava'u group of islands, with associated increases of *T. anax* in both Vava'u and Ha'apai groups of islands (Shedrawi *et al*., 2020).

For *T. anax,* the earliest surveys in 1990 show that density for *T. anax* was 13.34 ± 5.66 SE. with a noticeable decline when re-surveyed in 1996 (3.57 ± 1.55 SE, Lokani *et al*., 1996). In 2004, stocks had recovered to be just below 1990 levels (Friedman *et al*., 2004). Survey results in 2019 showed that densities had returned to be on par with those found in 1990.

When the fishery had been active for 11 years (2004 to 2015), *Thelenota* stocks were low, prompting the Ministry of Fisheries to close the fishery. After a single year, however, stocks had doubled for *T. anax* and by at least 10 times for *T. ananas* (Table 32, Figure 39) (Shedrawi *et al*., 2020). While not at regional "high status" reference densities during the 2019 survey, the population increase after resting stocks for only after four years suggests that *Thelenota* populations are resilient and can recover quickly if fishing is halted for a sufficient time.

French Polynesia

Following a moratorium implemented in 2012 and 2013, surveys were conducted across French Polynesia. The results of these surveys show that *T. ananas* was dominant on fore reefs, at all depth ranges, at all sites (atolls and islands) and in varying densities, from low to medium at Moorea and Tahiti and high at Fakarava (Andréfouët *et al*., 2019). High densities of *T. ananas* were also observed at Huon and Surprise on pavement bottoms (Andréfouët and Tagliaferro, 2020). Aratika, which is reported to have never been fished, also had high densities of *T. ananas* even at sites close to the village and could be found even in shallow water (5 m) (Andréfouët *et al*., 2019). Tetiaroa had the highest count of *T. ananas* per dive for this species with an average of 9.3 ind/ha (Andréfouët *et al*., 2019). In addition, *T. ananas* (n = 142) was commonly found on both fore reefs and lagoons, especially at Huon, Portail and Surprise (Andréfouët and Tagliaferro, 2020). Densities ranged from one to four individuals observed per minute of survey swim at all atolls surveyed (Andréfouët and Tagliaferro, 2020).

T. anax was found mostly on exposed eastward facing fore reefs and in the deeper sand plains in depths of at least 30 m, albeit not in high densities, though *T. anax* was found in higher densities in the central part of Raraka Lagoon, which is also reported to have never been fished (Andréfouët *et al*., 2019). Densities were less than two individuals observed per minute of survey swim at all atolls surveyed (Andréfouët and Tagliaferro, 2020).

T. rubralineata was also recorded but was regarded as being extremely rare (Andréfouët *et al*., 2019).

The Federated States of Micronesia

In assessments conducted in Yap State in 1986 at Ngulu, *T. ananas* was reported to be much more abundant than the more valuable teatfish species, with the highest densities reported at Jalangachel Island, where 12 *T. ananas* were easily collected within a 100 m² (Moore and Marieg, 1986). *T. anax* is also reported to be present in Yap State as is *T. rubralineata* (Tardy and Pakoa, 2009).

Kerr, Netchy and Hoffman (2007) recorded *T. ananas* to be in moderate numbers in Yap. In contrast, in an assessment conducted in 2009, *T. ananas* was rarely seen, with only a 2 percent presence observed across survey sites (Tardy and Pakoa, 2009).

In assessments conducted in Pohnpei State, several differences in densities were observed when compared with other previous assessments (Bourgoin and Pelep, 2017). In 2017, *T. ananas* was observed in both marine protected areas and open fishing areas, whereby *T. anax* was only observed at Ant Islands, again in both marine protected areas and open fishing areas but not on the main island of Pohnpei. The main differences were that *T. anax* was observed in 2017 but was not seen in earlier assessments (Bosserelle *et al*., 2017). Both *T. ananas* and *T. anax* were reported in low numbers, making up only 0.7 percent (n = 173) and 0.1 (n = 13) of the total number of all sea cucumbers species observed (Bosserelle, Singh and Bertram, 2017). This percentage is not unexpected as some smaller high productivity shallow water species (e.g., *Holothuria atra*) are naturally orders of magnitude more abundant in comparison to *Thelenota* species.

Stock populations of *T. ananas* were found in relatively high numbers within the area surveyed in Kosrae State, which Lindsay (2001) suggested had experienced past commercial harvesting that had not greatly reduced stocks, at least on the reefs surveyed.

Marshall Islands

T. ananas was found at the Jaluit Atoll at low densities using manta tows, which was considered the direct result of commercial harvesting with 15 *T. ananas* observed in 7 manta tows conducted during the assessment (Lindsay, 2000). In contrast, *T. anax* was dominant in assessment counts with 503 *T. anax* reported in 44 manta tows undertaken (Lindsay, 2000).

Unpublished data from transect-based surveys conducted in 2018 recorded densities of 3.2 ind/ha and 0.32 ind/ha using manta tows. These values indicate that the populations of *T. ananas* have not declined. Similarly, *T. anax* was not recorded in 2013 but was found at 3.7 ind/ha in 2018 using manta tows. This result is indicative of species that can be found aggregated in patches on sand making it possible that none are seen during sampling, especially when sandy lagoon floors are not targeted in surveys. Pooling the two methods with data standardized by survey area shows an increase in density from 2013 to 2018 for *T. ananas* and no change for *T. anax*.

Palau

Sampling across the main islands of Palau has revealed a rich sea cucumber assemblage (Friedman *et al*., 2009; Pakoa *et al*., 2009). In these 2007 surveys and reports of sustainability of sea cucumber stocks (Friedman *et al*., 2011), *T. ananas* was recorded in deeper water SCUBA assessments at 3.16 (±1.69 SE) ind/ha, while *T. anax* was recorded at 7.16 (±3.12 SE) ind/ha. Both these records exceeded similar methodology abundance records noted in Papua New Guinea (Friedman *et al*., 2011). In manta assessments, *T. ananas* was recorded at 6.07 (±1.50 SE) ind/ha, while *T. anax* was noted at 1.62 (±0.80 SE) ind/ha. Again, manta surveys on reef sides and broken reefal areas are not ideal for quantifying *T. anax*.

Birkeland *et al*. (2000) found at Helen Reef in Palau that densities of *T. ananas* never exceeded five individuals and were observed at two out of nine survey sites.

Niue

Dalzell, Lindsay, and Patiale (1993) assessed *T. ananas* in Niue on the subtidal reef to be 17.5 ind/ha and on the intertidal reef 3.9 ind/ha.

Guam

Row and Doty (1977) report the distribution of *T. ananas* to be around the island of Guam as patchy.

Southeast Asia region

The Republic of the Philippines

In a survey of sea cucumber stocks in the central Philipines in 2006, *T. ananas* was not observed in any of the locations surveyed: Alona Reef, Gakang Island, Balicasag, Nalusu-an, Hilutungan, Zaragosa, Moalboal, Saavedra, Apo Island, Poblacion, Bais, Sumilon, Dumanguete and Cang-alwang. *T. anax* was only observed at Nalusu-an and *T. rubralineata* was observed only at Hilutungan (Kerr, Netchy and Gawel, 2006).

In 2008, Dolorosa and Jontila (2012) used a belt transect at seven permanent monitoring sites established in 2006 in the shallow subtidal (~1.0 m deep at low tide) areas, as well as additional transects in intertidal (exposed at low tide) areas and at ~5 m deep reef slope in the Tubbataha Reefs Natural Park in Cagayancillo Municipality. *T. ananas* was observed, but not in transects.

Olavides, Edullantes and Juinio-Meñez (2010) report *T. ananas* and *T. anax* as medium-value species. They conducted surveys in the Bolinao-Anda reef system in western Luzon and observed *T. ananas* and *T. anax* as processed specimens only, not live on the reefs. *T. ananas* and *T. anax* were reported to be harvested by hookah gear (i.e. air compressors).

Jontila *et al*. (2018a) compared populations between the exploited and unexploited sites in three islands of Palawan Province. Arrecife Island was selected as the unexploited site, and the Johnson and Green Islands represented exploited sites. Of the three *Thelenota* spp., only *T. anax* was observed at Arrecife Island (Jontila *et al*., 2018a).

De Guzman and Quinones (2021) observed *T. anax* at five sites across Mindanao at Laguindingan, Lopez Jaena, Hinatuan, Rizal Zambo and Tabina Zambo.

Indonesia

At the site near Manado (Bunaken-Manado Tua National Marine Reserve) in Sulawesi, a small population of *T. rubralineata* was recorded by Lane (1999a, 1999b) in 1997. Lane (1999a, 1999b) used a reef-face survey plot of area 3 750 m² (depth range of 14 m to 30 m) to survey a mixture of alternating slopes and coral rock spurs, harbouring 17 individuals, giving an average density of 1 per 220 m² at this locality, equating to 45 ind/ha (Lane, 2008). A single dive on 20 December 2007 revealed the continued presence of significant numbers of *T. rubralineata* at the site surveyed 10 years previously with all animals observed being adult and of similar size to those measured in 1997 (Lane, 2008).

Hartati *et al*. (2021) report the presence of both *T. ananas* and *T. anax* for the Karimunjawa Islands in the Java Sea.

Viet Nam

Hung *et al*., (2017) note that numbers of *T. ananas* in the Khanh Hoa and Binh Thuan marine areas of Vietnam have decreased when compared to previous years. Hung *et al*., (2017) surveyed *T. ananas* in Khanh Hoa and Binh Thuan areas of Vietnam, and reported that fishers in these regions normally catch *T. ananas* at depths ranging from 20 m to greater than 40 m. Similarly, catches of *T. ananas* in both the Phu Quy and Nha Trang areas of Vietnam were reduced between 20 12 and 2017 from 5 to 2 tonnes/trip (Hung *et al*., 2017).

Sri Lanka

In 2008, sea cucumber stocks off the east and northwest coasts of Sri Lanka were estimated by surveying 500 sites randomly selected, covering 1 307 km² and 1 779 km² respectively (Dissanayake and Stefansson, 2010). *T. anax* was not observed off the east coast, though reported densities for the northwest coast was reported to be 26 (±47 SE) ind/ha, yielding a total biomass of 2 141 tonnes (Dissanayake and Stefansson, 2010).

The diversity of sea cucumber species was surveyed at Bandaramulla, Mirissa and Weligama in 2019, with *T. ananas* reported as having a lower individual number and relative species abundance (Gamage *et al*., 2021).

In another survey in 2019, Dalpathadu (2021) evaluated sea cucumber fisheries in the coastal waters of the Trincomalee District in eastern Sri Lanka using fisheries log-books. Results from the study showed that there was population depletion of most species in the shallow waters with *T. anax* being the dominant species harvested. From the results, Dalpathadu (2021) suggest that stocks of *T. anax* along with other species might be moving towards extinction if the fishery was to continue without proper management.

India

In India, sea cucumbers are distributed mainly in the Gulf of Mannar, Palk Bay, Lakshadweep Islands, Andaman and Nicobar Islands and the Gulf of Kachchh, including some places along the mainland coasts. However, the fishery and trade exist mainly in the Gulf of Mannar and Palk Bay. Concern with exploitation led to regulatory measures, with the Ministry of Environment, Forests and Climate Change, of the Government of India, implementing a size regulation on the export of bêche-de-mer in 1982, restricting the export of sea cucumbers below 75 mm in length. As the regulation was not effective, the government imposed a blanket ban in 2001 by listing all species of holothurians under Schedule I of the Indian Wildlife (Protection) Act, 1972, which has been under implementation since 2003.

The genus *Thelenota* is known by only one species – *T. ananas* – in Indian waters, from Lakshadweep Atoll, and Andaman and Nicobar Islands (James, 1969, 2001; Sastry, 2005; Sastry, Marimuthu and Rajan, 2019). *T. ananas* is recorded from the lagoons of Lakshadweep (Asha *et al*., 2017). Bruckner, Johnson and Field (2003) note a decline in CPUE, but no data are available to provide direct inference to stock densities in India. In a recent assessment, Idreesbabu and Sureshkumar (2017) surveyed 15 species of sea cucumbers at six locations at Lakshadweep Atoll and described their distribution pattern and densities in different substrata to provide an average (number of ind/ha). The sites selected were the western seagrass bed, western sandy area, western reef flat, outer reef slope, eastern rocky area and eastern seaweed area. *T. ananas* was reported to have densities of 0.33 (± 0.58 SE) in the western sandy area, 0.11 (± 0.58 SE) in the western reef flat, and 2.33 (± 0.58 SE) in the eastern rocky area (Idreesbabu and Sureshkumar, 2017). While densities of *T. ananas* are present in Laskshadweep Atoll, there is also illicit harvesting that continues, which includes targeting *T. ananas* known to be exploited (Asha *et al*., 2017; Bondaroff, 2020).

T. ananas is a predominant sea cucumber species at Andaman Island (Chandra and Raghunathan, 2018). Koushik and Raghunathan (2012) report *T. ananas* present at Rail and North Reef Islands on the northern side of Andaman Island. Rao and Kumar (2014) observed *T. ananas* as present at Marina Park, South Point, Barmanella, Pongibalu and North Bay on the southern side of Andaman Island.

Mohammednowshad, Idreesbabu and Sureshkumar (2021) conducted 324 transects with a dimension of 20 m in length and 5 m wide, which were repeatedly visited from 2016 to 2019 at 11 inhabited and 1 uninhabited atoll at Andaman Island. All five habitat zones of the atolls have been covered: the intertidal zone (eastern side), inner reef lagoon and intermediate lagoon (western side), and the outer reef flats and outer reef slope. *T. ananas* was observed at Agatti, Amini, Androth, Bangaram, Bitra, Chetlat, Kadmath, Kalpeni, Kavaratti, Kiltan and Mincoy (Mohammednowshad, Idreesbabu and Sureshkumar, 2021). Average abundance for *T. ananas* was reported at 0.04 ± 0.19 ind/ha for inner lagoonal areas, 0.14 ± 0.42 ind/ha for intermediate lagoonal areas, and 0.16 ± 0.37 ind/ha for outer reef flats (Mohammednowshad, Idreesbabu and Sureshkumar, 2021).

East African region

Egypt

Hasan (2019) notes a decrease in densities of *T. ananas*, which decreased from 48.1 ind/ha in 2000 to only 5.6 ind/ha in 2006 and completely disappeared in 2016. Due to the report of species' loss from the above studies, the Expert Panel contacted a range of diving organizations in Egypt during the Expert Panel's sitting period to ascertain if *T. Ananas* or *T. anax* were being observed during tourists' recreational diving activities.

A responseto the Expert Panel from the Oonas Dive Club (Karen Bruce, personal communication, 2022), Na'ama Bay, Sharm El Sheikh, Egypt stated *T. ananas* had not been seen in the past 15 years, but Elite Diving also in South Sinai responded with notification that *T. ananas* had been seen in 2021, but in general was rare (Alun Evans, personal communication, 2022).

A web search revealed unconfirmed and undated imagery of *T. ananas* from the Red Sea (Dreamstime, 2022), while 2022 news reports from Cairo reported that the Environmental Protection Police apprehended suspects collecting and processing sea cucumbers (Egypt Independent, 2022). That Egypt is struggling with issues of compliance with regard to take and trade of sea cucumbers is made clear by other reports of illegal shipments being stopped in market countries (Customs and Excise Department. 2022).

Eritrea

Kalaeb *et al*. (2008) surveyed three areas of Eritrea's coast, which was divided into northern, central and southern zones. A total of 150 sites were selected: 60 sites in the central fishing grounds, 45 sites in the southern fishing grounds, and 45 sites in the northern fishing grounds. Of these, 91 sites were surveyed using 100-m-long transects. From this assessment, Kalaeb *et al*. (2008) report densities of *T. ananas* of 3.5 ind/ha.

Seychelles

T. ananas has historically been a significant sea cucumber species for export in the Seychelles (Aumeeruddy and Payet, 2004).

Aumeeruddy *et al*. (2005) reported on survey results from 2004, taken across 246 sites throughout the Amirantes and Mahé Plateau. Dive transects were carried out by two divers swimming along a 100-m-long transect measured using a chainman measuring device. In addition, video transects were also conducted, which were nominally 15 minutes in duration. Results from this assessment estimated that densities for *T. ananas* ranged from 0.52 to 0.8 ind/ha and *T. anax* 0.02 to 0.15 ind/ha.

Cariglia *et al*. (2013) conducted assessments at seven regions in the inner islands of Seychelles in 2008. These regions represented areas previously used by the Seychelles Fishing Authority for its assessment of the artisanal fishery and have been the basis of ongoing assessments. Within each region, three sites were selected haphazardly, and at each site the number of holothurians within 16 count areas was assessed. Each count area was delineated by a 7-m length of rope, which acted as the radius for a circular area of 154 m², and replicate counts were separated by approximately 15 m (Cariglia *et al*., 2013). Nine of the 21 sites surveyed were situated within MPAs. These included three sites within the Cousin Special Reserve (Cousin region), three sites within the St. Anne Marine National Park (St. Anne region), one site at the Baie Ternay Marine National Park (Mahé northwestern region), and two sites within the Curieuse Marine National Park (Praslin northeast region). Results showed that *T. ananas* was at 6 ind/154 m² in fished areas and 9 ind/154 m² (Cariglia *et al*., 2013).

Koike (2017) conducted transect surveys to identify species density, size and habitat from 2011 to 2013. Survey sites were grouped into two categories, general areas and MPAs. Results were compared against the surveys conducted by Aumeeruddy *et al*. (2005), where average density was 0.22 ind/ha and Koike (2017) reporting an average density of 0.27 ind/ha.

The Principal Secretary for Fisheries at the Ministry of Fisheries and the Blue Economy, Mr Roy Clarisse (personal communication, 2022) highlighted *T. ananas* as one the main target species of the local fishery. Mr Clarisse informed the Expert Panel that the Ministry of Fisheries has recently concluded an independent survey and took an assessment of local sea cucumber populations, a comparative study of sites previously surveyed in 2004. The 2021–2022 survey results indicated a substantial increase in *T. ananas* densities since 2004, giving a positive signal on the sustainability of the fishery. These results will be published shortly.

Mayotte

Pouget (2005) surveyed 20 sites in 2003 for sea cucumber stocks, looking at the outer reef flat and the inner reef flat. At each station, two transects (inner and outer reef flat) 50 m in length and 5 m in width were made at random, parallel to the shore, resulting in a sampled area of 250 m² for each habitat type. Results from this assessment show that the relative abundance of *T. ananas* (number of individuals from one species/total number of holothurian specimens) over an area of 250 m² was 2 percent and only found on the outer reef flat (Pouget, 2005).

In 2010, sea cucumber species distribution in the Mayotte reef system was assessed using manta tows covering a transect size of 300 m × 2 m (Eriksson, Torre-Castro and Olsson, 2012). A single *T. anax* was observed on the lagoon islands' fringing reefs at one site, which was a lagoonal fringing reef. There was a significant difference in density between areas for *T. ananas,* found at all sites surveyed (n = 16 observed), which included fringing reefs and lagoonal inside and outside barrier reefs (Eriksson, Torre-Castro and Olsson, 2012).

Mulochau (2018) sampled eight stations across Mayotte using manta tows covering 300 m × 2 m transects. *T. ananas* and *T. anax* were observed in 25 percent and 12.5 percent of the stations, respectively. Relative abundances in the observed site for *T. ananas* was 1.16 percent, while that of *T. anax* was 1.94 species recorded. The average abundance of *T. ananas* was at 0.17 ind/600 m^2 in west Choizil Island and 0.33 ind/600 m^2 at south Sada Pass, whereas *T. anax* had an abundance of 0.83 ind/600 m^2 also at South Sada Pass.

Réunion

Conand and Mangion (2002) report that *T. ananas* is rare on Réunion's outer reef flats with only one specimen recorded at Grand Fond at a depth of 15 m. In a publication of a list of holothuroid species recorded from Réunion, the diversity of the holothuroid fauna (Echinodermata) was listed, including *T. ananas* by Conand *et al*. (2010). No *T. anax* was listed.

Kenya

Research and in water assessments of sea cucumbers along the Kenyan coast whereby the distribution of sea cucumbers was surveyed in different habitats by snorkelling in shallow areas, walking on reef flats and shallow mangrove channels, and SCUBA diving in deeper areas has been completed (Muthiga and Ndirangu, 2000; Muthiga, Ochiewo and Kawaka, 2007; Odhiambo, 2007). In total, 31 locations and 130 sites were surveyed from Kiunga in the north to Kisite in the south. At each location, between two and ten sites were surveyed depending on the diversity of habitats. From this assessment, *T. ananas* was only observed at one location at Mtwapa Channel. Muthiga *et al*. (2010) monitored catch landings in two sites, Gazi and Shimoni, South Coast Kenya, to determine the catch composition and reported that *T. ananas* was 10–13 percent of the sea cucumber landings. Ochiewo *et al*. (2010) studies on the Southern Coast (Vanga, Shimoni and Gazi) revealed *T. ananas* contributed to 2–17% of sea cucumber landings while *T. anax* was 42% of the sea cucumber catch in Gazi. Samyn (2000) reports sightings of *T. ananas* and *T. anax* in the Kiunga Marine National Reserve in Kenya, with *T. ananas* being reported in other parts of Kenya but not *T. anax*. *T. anax* was reported in tables of Muthiga and Conand (2014).

Madagascar

T. ananas was reported to have limited harvesting based on studies conducted in 1992, 1996 and 2002 (Conand & Muthiga, 2007).

The United Republic of Tanzania

Eriksson *et al.,* (2012) reports the availability of *T. ananas* and *T. anax* in Zanzibar from monitoring of scuba divers catch records. In the same study, *T. ananas* is regarded as high commercial value species while *T. anax* if of medium value based on fisher interviews (Eriksson *et al*., 2012).

Examining sea cucumber size structure data and information by place

Length data from grouped into size categories are plotted as size-frequency histograms. Length-at-maturity estimates were added to the plots where available. Calculating the proportion of individuals greater than length-at-maturity provides an assessment of the proportion of the population that can reproduce and therefore contribute to recruitment and stock recovery, as well as assists with tracking the relative abundance of length cohorts through time to assess whether adults have reproduced sufficiently to supply recruits. This is especially important in heavily fished populations where fertilisation and recruitment potential are dependent on the density of breeding adults (Shepherd and Partington, 1995).

Fiji

The size of *T. ananas* surveyed in 2013 by Jupiter, Saladrau and Vave (2013) for the Lau Province in Fiji ranged from 17.6 cm to 22.8 cm (n = 44) and *T. anax* ranging from 19.8 cm to 24.0 cm (n = 52). In contrast, nearly a decade prior, the mean sizes across Viti Levu and Vanua Levu of *T. ananas* were reported to be 33.6 cm (n = 31) and *T. anax* to be 42.2 cm (n = 17) (Pakoa *et al*., 2013).

Solomon Islands

Unpublished data from the ministry of Fisheries and Marine Resources show length structure for *T. ananas* in 2012 appeared to be normally distributed with a large proportion of individuals above length at first maturity. The mean length of 41.5 cm in 2006 and 37.3 cm in 2012, where mean length was 1.38 and 1.37 times greater than size at maturity, respectively (Table 33). These values likely indicate that fished populations were healthy at that time. Insufficient length measurements were made in 2019 to assess *T. ananas* population length structure in the Solomon Islands. Although the surveys in 2019 did not focus on optimal *T. ananas* habitats, the lack of length measurements probably indicates that this species had declined in abundance.

New Caledonia

Conand (1988) reports a mean length for *T. ananas* in New Caledonia to be 45 cm with a mean weight of 2 500 g. Purcell, Gossuin and Agudo (2009) found a large variation in sizes of *T. ananas* among the study regions assessed in New Caledonia with *T. ananas* averaging between 2 405 g and 3 081 g among the regions assessed. The average sizes of *T. ananas* in New Caledonia also varied greatly within the regions assessed by Purcell, Gossuin and Agudo (2009) with *T. ananas* harvested from or near Nouméa being the smallest of the regions (averaging 3 056 g); harvested size was largest in the northeast (averaging 4 530 g). Given that the W90 for size at first maturity of *T. ananas* was determined to be about 2 200 g (Conand, 1989), most of the harvested *T. ananas* were considered to be mature. However, 45 percent of *T. ananas* in landings from Nouméa were smaller than this estimated W90 size. In comparison with the study regions around La Grande Terre, the *T. ananas* captured in the Surprise Islands and Chesterfield Archipelago were relatively small, with the average body weights of *T. ananas* in those areas were only just above the size at first maturity with a weight between 2 619 g (n = 39) at Surprise Islands and 2 979 g (n =37) at the Chesterfield Archipelago (Purcell, Gossuin and Agudo, 2009).

Surveys across New Caledonia in 2021 (Gilbert *et al*., forthcoming) show that length distributions of *T. ananas* and *T. anax* reflect healthy populations (Figure 40). A relatively high number of adults, those above length at maturity, were found, indicating that there are sufficient adults within each species populations. The ratio between mean size and size at maturity was ~1.38 for *T. ananas* and 1.4 for *T. anax,* although 400 mm (likely between 400mm and 450 mm) size at maturity for *T. anax* is only indicative and calculated as 50 percent of the maximum recorded size. This indicates that reproductively mature adults persist and continue to contribute to stock replenishment. It is rare to record individuals of this species below 200 mm and hence their absence in length frequency plots.

Tonga

The length distributions of *T. ananas* had approximately 75 percent and 50 percent of individuals above length-at-first maturity (L_{50}) in 2004 and 2019, respectively (Figure 41). The percentage of the population above mean length was approximately 50 percent for both 2004 and 2019. The ratio between mean length and L_{50} was 1.35 and 1.03 for 2004 and 2019, respectively. Values greater than 1 reflect a population mean larger than $L_{50,}$ so there are proportionally more mature adults within the population. While this is lower in 2019 than in 2004, it does not reflect a decline in density, but a relatively greater number of smaller (possibly younger) cohorts recorded within the population.

Size at maturity was not available for *T. anax,* however it is assumed to be approximately 400 mm which is the mid-length of the maximum recorded length for this species. The length distributions of *T. anax* had approximately 55 percent and 85 percent of individuals above length-at-first maturity (L_{50}) in 200 and 2019 respectively. The percentage of the population above mean length was ~ 50 percent and 40 percent, for both 2004 and 2019. The ratio between mean length and L_{50} was approximately 1.10 and 1.35 for 2004 and 2019 respectively. Values greater than one reflect an estimated population mean larger than $L_{50,}$ meaning there are proportionally more mature adults within the population. The ratio between mean length and L_{50} increased between 2004 and 2019 reflecting an increase in adult densities between the two time periods, two periods when the sea cucumber fishery was active (2004) or closed (2019).

Examining sea cucumber Exports/Harvest data and information by place

Oceania and Pacific Islands region

Australia (Queensland)

The catches of *Thelenota* species in the Queensland fishery represent the largest current catch of this genera of sea cucumbers in Australia and have been stable at around 35 tonnes for the last decade. *Thelenota* spp. are taken only from designated fishing zones from across the Great Barrier Reef Marine Park, within which many regions are closed to commercial fishing. There are 26+ years of harvesting statistics available for *T. ananas* in this fishery (1995 to 2021), derived from mandatory catch and effort logbook information. Small amounts of *T. anax* are taken, but the commercial value of this species is too low to merit regular take and trial catches to test the market have not continued.

The species is widely dispersed across the fishery but distribution is highly patchy, with >91 percent of the catch taken from <20 percent of the fishery grid areas, while 37 percent of the available habitat for *Thelenota* spp. is permanently closed to fishing (Great Barrier Reef Marine Park green zones). For the areas that are open to fishing, the fishery has operated for 18 years (since 2004) on a rotational harvest arrangement across 158 zones, where each zone is fished only once every three years for a maximum of 18 days, and take is "hand take only".

What is readily apparent from the logbook data is that CPUE (expressed as kg/day), a common index of relative abundance, shows no evidence of decline. In fact, average catch rates, particularly for reporting grids with the highest catches, increased after the late 2000s and have remained variable but stable, generally above the upper 2 x baseline average (upper dotted line) (Figure 42). The catch rates are relatively high compared to management reference points.

Landed weight is also known as processed weight, which is gutted and salted, and differs from both live weight and dry weight at which sea cucumbers are sent to market in their dried form. The live gutted ratio is approximately 0.496 ± 0.014 SE (Skewes *et al*., 2004), while gutted and salted to dried conversion ratios yield about 15 percent (Queensland Sea Cucumber Association processors).

Catches of *Thelenota* spp. are taken only from designated fishing zones from across the Great Barrier Reef Marine Park (GBRMP); within which, many regions are closed to commercial fishing. There are 27 years of trade related data available for *T. ananas*, that isn't shared here. The data was seen by the Expert Panel and shows that in the region of 30 tonne salted weight of *T. ananas* is traded annually. There was no trendline indicating that this trade weight was declining over time. No *T. anax* is traded due to its low value.

Western Australia

In Western Australia >99 percent of the harvest in the managed fishery is of two main species, *H. scabra* and *A. echinites* (redfish). There are six other commercial species that fishers in the Western Australian Sea Cucumber Fishery may retain: *H. whitmaei*), *Holothuria fuscogilva*, *T. ananas*, *H. atra*, *Stichopus vastus* and *S. hermanni*. Small quantities of sea cucumber species not targeted by the Western Australia fishery have been collected and the Marine Aquarium Fish Managed Fishery also collects small amounts for aquarium display purposes, with some discarded in trawl fisheries (Hart *et al*. 2022).

The sea cucumber fishery in the Great Barrier Reef from 1995 to 2020 is a strong example where *T. ananas* catch rates have been relatively stable since 2011–2012, accounting on average of 10 percent of catch (Wolfe and Byrne, 2022).

No information was shared from Western Australia.

Solomon Islands

Although export numbers are variable between years, the trend indicates that exports have declined across the Solomon Islands (Figure 43). Noting that the duration of open and closed seasons and intensity of harvesting pressure vary, export quantities appear to decline from 2013 to 2021 for *T. ananas* but not for *T. anax*. Comparing exports from 2013 to 2021 with a 10-year baseline average from 2003 to 2013, *T. ananas* remain above the baseline average in 2021, while *T. anax* remain within the lower baseline average confidence interval. In 2022, given only half of the open season data was recorded at the time of this report, export quantities are nearing the lower confidence interval of the baseline average, which implies that as more data is collected exports for both *T. ananas* and *T. anax* will reach the average and not decline further. Additionally, open seasons were shorter in later years and the apparent decline could be attributed to these factors rather than declines stock density (e.g. less effort). However, given the uncertainty about the projected exports reaching the target average and the observed declines in range and extent described above, the expert panel, as a precautionary interpretation, concludes a decline may eventuate consistent with recent decline criteria.

Tonga

Harvests during the open seasons were controlled at the national level via licensing, total allowable catches and minimum harvest lengths. Export numbers are variable, increasing and decreasing over five-year blocks (Figure 44). However, exports have been consistent since 2012 and do not appear to have declined below ~50 percent of baseline averages for both species. Export quantities of both *T. ananas* and *T. anax* are therefore generally consistent since 2008, and fluctuations in exports are likely due to the differences in the number of days the fishery was open (i.e. effort).

Papua New Guinea

Exports of both *T. ananas* and *T. anax* have remained relatively consistent over the past 30 years. Some growth in exports were recorded during the early 2000’s as new Asian markets matured with some fluctuations according to market demand and pricing structures (Figure 45). A moratorium was imposed from 2009 to 2017, with no fishing occurring in 2019, 2021 and 2022. The export values for 2021 are left over stock from 2020 that were not able to be exported in that year due to the late opening of the sea cucumber fishery; therefore, if 2020 and 2021 exports are included together then exports quantities are above the upper confidence internal of the baseline average and no decline is evident.

New Caledonia

Export quantities of *T. ananas* were variable between years yet the trend does not indicate that exports of Beche-De-Mer (BDM) have declined in New Caledonia (FiguresFigure 46 andFigure 47). Exports in 2021 were significantly higher than the 10-year baseline average. Three possible explanations for the recorded increase are that:

1. harvesters and processors have shifted focus away from two high-value teatfish species (*Holothuria whitmaei* and *H. fuscogilva*) and towards the lower value *T. ananas,*
2. a reduction in export shipments because of travel restrictions during the COVID-19 pandemic which resulted in overstocking, thus exports numbers may represent a longer fishing and processing period before shipments could be reported and logged, and
3. historical exports numbers are under reported.

Harvesting of *T. anax* was banned from 2008 to October 2021 hence export records stop in 2008.

Fiji

Pakoa *et al.* (2013) published *T. ananas* and *T. anax* bêche-de-mer export composition for Fiji from 2003 to 2012. Published data show variable exports of *T. ananas* between 3 and 7 tonnes from 2003 to 2012 but no declines in export quantities. Large increases in export quantities for *T. anax* ranged from an average of approximately 5 tonnes between 2003 and 2009 to 30 tonnes from 2009 to 2012. The fishery was active for another four years, until 2017, and export data were not available for assessment. Given the consistent export volumes of *T. ananas*, it is unlikely that declines occurred after 2012. However, the large volumes exported for *T. anax* between 2010 and 2012 is unclear if this resulted in a decline. Except for Lau Province, which recorded higher densities, the declining densities in other provinces and continued harvesting of this species may have resulted in population decline; without time series information after 2012, the level of decline cannot be determined.

Modifying factors

The Expert Panel considered whether there were any specific considerations that would markedly and substantially modify the probability of the species group becoming depleted to a point where they would meet the criteria for listing on CITES Appendices.

Notable risk factors

A risk factor for slow-moving sea cucumber species that elevates concern for the sustainability of stocks is in maintenance of their "effective" population size for successful reproduction. For "depensatory effects" not to occur, stock densities need to be sufficient to ensure males and females are not separated on the benthos at distances that negatively impact successful fertilization of their broadcast gametes. Stocked widely dispersed and at low density, they can experience negative population growth, despite individuals having a high output of gametes. The Expert Panel noted some examples of recovery of overfished *Thelenota* stocks; however, the rebuilding of stocks required multiple years, and recovery was variable across locations. Medium to higher values for *T. ananas* are a risk factor, as artisanal fishers have the incentive to continue harvesting, even at low densities.

Notable mitigating risk factors

A mitigating risk factor is the surrogate protection of depth, as these three species are found at depths beyond most free divers.

The genus *Thelenota* remains low value in market states because it has a more bitter taste compared with other species when processed. In correspondence seen by the Expert Panel, a trader in China, Hong Kong SAR (Easy Well, China, Ltd., Philip Ung Kuok Chun) explained that *T. ananas* was considered a tier 3 species in the markets of China and China, Hong Kong SAR, mainly because of its bitterness and poor eating characteristics compared to tier 1 species such as *H. fuscogilva*. He went on to explain that *T. ananas* is used only in specific kinds of Chinese cooking such as Szechuan, cooking that masks the bitterness of the flesh. As a tier 3 species, the trader confirmed the wholesale price of USD 55 a kilo dried weight, explaining the species market is limited to a niche part of the total sea cucumber trade.

The lower market value of *T. anax* and *T. rubralineata* species is a mitigating risk factor, as the cost of processing sea cucumbers, even for artisanal fishers, means there is a negative incentive to continue harvesting at low densities.

Lastly, potential mitigation could arise from attempts to hatchery produce and farm sea cucumbers, which is underway for related species (commercial production is accepted in markets: Hair, Pickering and Mills, 2012; Hair *et al*., 2016; Hair *et al*., 2020; Eriksson *et al*., 2012; Friedman and Tekanene, 2005; Purcell *et al*., 2012b). A potential shift of focus for a small number of species from wild capture to aquaculture and ranching could mitigate pressures on wild stocks. Offering opportunities for restocking of hatchery produce for both farming into adults (through the pen, pond, mono or co-culture), export and restocking would require country authorities to provide regulated permits for collection of broodstock of threatened species for establishing hatchery and aquaculture programmes and certification that exports come from farmed stocks.

Comments on technical aspects relating to management, trade and likely effectiveness of implementation of a CITES listing

Management comment

Sea cucumber fisheries are inherently difficult to manage, in part because many sea cucumber fisheries occur in regions where strong governance is lacking, the product is fished from many locations by non-documented fishers, and purchases are made in small quantities in often remote locations. In many poorer countries, there is a lack of transparency and accountability in management and regulatory requirements of sea cucumber fisheries, exacerbated by the extensive and small-scale nature of these fisheries.

Harvesting and trading of sea cucumbers at national and subnational scales continue to prove difficult to manage across much of the genus' range, with booms in fishing typically followed by fishery closures or moratoriums on fishing once stocks are depleted.

Regulated fishing for sea cucumbers includes the use of mechanisms for management, such as licensing and catch quotas, minimum legal-size limits, seasonal closures, rotational fishing, no-take zones, gear limitation, trade management, and restocking through hatchery seed production and aquaculture. Noting that in many developing countries sea cucumbers are fished in multiple locations by artisanal fishers across extensive and often remote areas, the challenge for awareness raising, implementation of management and in enforcing compliance cannot be underestimated. This gives insight into why past management often reverts to simple but "blunt" closures of their fisheries and exports for extended periods, alternating with short periods of fishery openings.

Researchers note that more conservative management and more rigorous enforcement of regulations would likely increase the average annual value of countries' bêche-de-mer exports by 80 to 105 percent. As has been seen in countries such as Australia, investment in management frameworks results in regular and long-term sustainable harvests. Australia has a 27-year record for managing and adapting its management framework to ensure reliable and sustainable returns from its fishery, which harvests one species of the genus *Thelenota*.

International management

There are no known international protections for the *Thelenota* species.

Regional and national management

Given the distribution of *Thelenota* species throughout the tropical Indo-Pacific, SPC put forward ideas for a regional approach to management of the sea cucumber trade (Friedman, 2008). More recently, the IUCN is in the process of establishing a Species Survival Commission Sea Cucumber Specialist Group (Pollom, 2022).

There are a range of intergovernmental, non-governmental and governmental organizations with remits in the Indian and Pacific Oceans that promote and support the research and governance of sea cucumbers by range states.

The Western Indian Ocean project was funded by the Western Indian Ocean Marine Science Association to focus on sea cucumbers to build knowledge on management practices and identify challenges for several countries of this region (Conand and Muthiga, 2007; Muthiga and Conand, 2014; Muthiga *et al.*, 2010). A similar approach was also adopted for the entire Indian Ocean (Eriksson, Torre-Castro and Olsson, 2012).

The recognition that development is a foundational value for coastal fisheries has been articulated in policy documents from intergovernmental organizations, such as the international Small-Scale Fisheries Guidelines (FAO, 2015); and, for the Pacific Islands, the Noumea Strategy (SPC, 2015) and the Melanesian Spearhead Group Roadmap for Inshore Fisheries Management and Sustainable Development 2014–2023 (MSG Secretariat, 2015a, 2015b). There are significant challenges for national adoption and implementation of these policy ideas in Pacific Island countries (Govan Kinch, & Brjosniovschi, 2013; CFWG, 2019).

The Australian Centre for International Agricultural Research presented the "manager's toolbox" (Friedman *et al*., 2008), with a section to help assess the health of sea cucumber fisheries using six indicators: (i) presence of breeding groups (areas with adult sea cucumbers); (ii) fishing gear used; (iii) global sea cucumber abundance; (iv) ratio of species abundance; (v) size of sea cucumbers; and (vi) fishers profiting (benefits going to the fishing community); it is followed by a subsection on management practices.

At the country level, the main management measures (Muthiga *et al*., 2010; Purcell *et al*., 2013; Baker-Médard and Ohl, 2019) that should be recommended in national management plans include:

- establishing a minimum size limit for capture;
- introducing strict total allowable catches;
- implementing temporal and spatial closures;
- limiting the number of export businesses;
- implementing gear restrictions, especially a ban on underwater breathing devices or specialized apparatus for harvesting;
- establishing reserves; and
- promoting stock enhancement (via aquaculture production).

The most common gear restrictions limit the use of underwater breathing apparatuses (UBAs, e.g. hookah, SCUBA gear), dredge nets and the use of lights (flashlights, or torches) at night. Kenya and Papua New Guinea have bans on the use of SCUBA for sea cucumber fishing, which would partially protect deep water *Thelenota* species,

Size and weight restrictions in fisheries are based on the understanding that larger and older individuals of a species contribute more to stock productivity and stability compared to younger and smaller individuals. The potential benefit of this management strategy is that it can be relatively simple to enforce at multiple points in the value chain and it can help fishers earn more for each sea cucumber they catch (Purcell, 2014; Govan, 2017). Lee *et al*. (2018) demonstrate, for the three species they assessed, that if minimum size limits are adequately enforced, long-term harvest will likely increase by 97 percent, and revenue for fishers could increase by up to 144 percent. In 2017, the Pacific Melanesian Spearhead Group member countries proposed minimum size limits for harvesting live sea cucumbers and selling dried bêche-de-mer (Govan, 2017); however, these measures have not been adopted by all members (Table 33).

In the Philippines, the Bureau of Fisheries and Aquatic Resources establishes size limits and are proposed in Administrative Order AC 248, which sets the minimum size for all dried sea cucumbers at 5 cm (Jontila *et al*., 2018ab). While this provision favours the conservation of sea cucumbers that mature at small size, it also promotes the exploitation of large species such as *T. ananas* and *T. anax*. Subsequently, size limits should be species specific as they are in the Pacific. The Palawan Council for Sustainable Development has also included *T. ananas* as a threatened sea cucumber (Jontila *et al*., 2018ab).

In Papua New Guinea, total allowable catches (TACs) were previously determined for individual species, including *Thelenota* species; however, these have not implemented per se beyond a total allowable catch which is determined for each province (Government of Papua New Guinea, 2018). The process has not been overly successful for Papua New Guinea owing to delays in reporting and poor enforcement over infringing companies (Barclay *et al*., 2016; Barclay, Fabinyi and Kinch, 2017; Barclay *et al*., 2019; Kinch, 2020). While TACs are a mechanism for management, TACs do have problems for reasons relating to the artisanal nature of most fisheries, shortcomings in catch reporting and monitoring by national fisheries agencies, and the intractable problem of communicating closures to remote village fishers when TACs are reached (Purcell, 2010). In Australia and Seychelles, the quota regulations operate more effectively, mainly because there are fewer fishers than in most other tropical sea cucumber fisheries and catch reporting is unusually better organized.

Licensing requirements have greater potential to help manage sea cucumber stocks in a developing country context; however, multiple challenges exist to successfully implement this strategy noting various governance and capacity issues.

Seasonal and spatial closures of a fishery are often used to protect species during a vulnerable period, such as during the spawning season. For many sea cucumber species, however, this biological reasoning for short-term closures does not apply because there is no specific spawning season. Issues raised around seasonal closures include the possibility of increased harvest pressure that may occur prior to a closure that could result in a lower overall breeding biomass, thus being more detrimental to sea cucumber populations than having no closure at all (Purcell, 2010). In Kenya, several MPAs have been implemented which help regulate harvesting of sea cucumber species.

In India, all species of sea cucumbers are protected under Part IV C of Schedule I of the Indian Wildlife Act, 1972. According to the provisions of this Act, no person shall acquire, receive, keep in his or her control, custody or possession, sell, offer for sale or otherwise transfer or transport any animal or any uncured trophy or meat derived from such animal, or the salted or dried skins of such animal, except with the previous permission in writing of the Chief Wildlife Warden or an authorized officer. Sea cucumbers are the only echinoderms protected under the Indian Wildlife Act, 1972. Part IV C of Schedule I of the Act containing sea cucumbers was included in an amendment in 2001. The inclusion has been challenged by several fisher associations of the Tamil Nadu region (e.g., Syed Ahamed Kabir *v.* Union of India SCC, March 2003; M/s. Marine Products Exporters Association *v.* Union of India Madras HC, 2015; Negai Sea Foods Catching *v.* The Secretary to Government, Madras HC, 2016) for whom the fishing of holothuroids was a traditional sustenance activity. Nevertheless, the provisions of the Act prevailed.

With regard to compliance and legality, it would be worthwhile to examine compliance with the 2001 ban on in India, as news reports on the confiscation of the sea cucumbers caught by fishers exist [e.g. June 2022 confiscation of 650 kg of processed sea cucumbers (The Indu, 2022; Wion, 2021)]. It is evident that the blanket ban has increased informal trade. A study conducted by ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI) in India indicates that after the declaration of the ban in 2001, 31 percent of the respondents discontinued the activity; others, however, are continuing the sea cucumber fishing/trade. At present, sea cucumbers from India find illegal market access via Sri Lanka, which remains open to trade and is a hub of trade for the Southeast Asian countries and China (The News Minute, 2020).

In India, those who discontinued fishing or trading after the ban reported that the control affected their livelihood. Before the ban on fishing sea cucumbers, most of the fishers (85 percent) sold sea cucumbers in the form of bêche-de-mer (processed) and the remaining (15 percent) sold them in fresh form. During the ban, while only 5 percent of fishers continued processing their catch, most fishers (95 percent) were selling their catch in fresh form. This has implications for fishers share of value since they receive a smaller value for sea cucumbers sold compared to processors under the ban. The illegal trade of sea cucumbers in Palk Bay and the Gulf of Mannar was reported to involve a complex and lengthy market chain of fishers, intermediaries, traders and exporters. It is suggested that if a regulated fishery for sea cucumbers were permitted (catch quota and licensing, minimum legal size, seasonal closures, rotational fishing, no-take zones, gear limitation, species protection, habitat protection, trade management, and restocking through hatchery seed production and aquaculture), fishers would receive a fair share of the export value (Asha *et al*., 2015).

In the Lakshadweep Islands, a conservation area for sea cucumbers was designated in 2020. Known as Dr KK Mohammed Koya Sea Cucumber Conservation Reserve, it encompasses 239 square kilometres at the Cheriyapani reef (Mongabay, 2020). It is the first sea cucumber conservation area in the world. Recent confiscations (Range Forest Officer *v.* Mohammed Ali Kerala HC, 2021; Mohammed Rais Melayillam *v.* U.T. of Lakshadweep, Kerala HC, 2022) indicate that local fishers are illegally collecting sea cucumber and subsequently transferring them to larger vessels as part of international trade, which is still high in the region.

In Annex II of the Mozambican General Regulation on Maritime Fisheries (Decree 89/2020) a minimum size and weight for all live species of sea cucumbers is set at 20 cm and 250 g, respectively. In addition, the regulation also prohibits the harvesting of *T. ananas* (Conand *et al*., 2022).

Australia

In Queensland Australia, the current fishery management and harvest strategy has been in place since 2004, and a 2021–2026 harvest strategy has been established. It is a limited entry fishery using input and output controls, including catch limits, gear restrictions, vessel tracking and zonal catch limits, and spatial closures. The maximum catch for *T. ananas* is 40 000 kg (landed weight) per 12-month fishing season.

Western Australia uses a fully integrated ecosystem-based fisheries management approach, which ensures that fishing impacts on the overall ecosystems are appropriately assessed and managed. A weight-of-evidence assessment approach is adopted. In 2022, stocks were analysed using: (i) catch; (ii) catch distribution; (iii) abundance indices (catch rates); (iv) fishery independent surveys; (v) mean size of catch; (vi) PSA (Productivity Susceptibility Analysis); and (vii) model-based biomass estimates of depletions relative to unfished biomass (virgin biomass = B0). Current risk levels to stocks are considered low to medium. These findings indicate that the status of sea cucumber stocks in Western Australia is adequate and that current management settings are maintaining risk at acceptable levels (Hart, Murphy and Fabris, 2022).

Local measures

Fishery management occurs predominantly at the national level, and regulatory measures are, for the most part, decided and implemented by national government fishery ministries. Nevertheless, some co-management arrangements exist in some range states.

Management of sea cucumber stocks at the local level is usually done through co-management arrangements with non-governmental organizations or other partners. There are other examples of communities managing their sea cucumber stocks either by their own governance arrangements or in partnerships, but these have failed due to intense economic pressure. For example, at Ontong Java Atoll in Solomon Islands, when the Area Council was strong, the sea cucumber fishery proved to be a sustainable and reliable income source. The collapse of the Area Council's authority in 1996 resulted in a lack of compliance with the former closed-season restrictions, which in turn led to sea cucumbers being harvested in greater quantities, leading to an eventual collapse of wild stocks (Bayliss-Smith *et al*., 2010; Christensen, 2011). More recently, the Solomon Islands Ministry of Fisheries and Marine Resources and Ontong Java community leaders, are in the process of a fishery management improvement program at the atoll that will lead to the development of a community-based sea cucumber fishery management plan (Shedrawi *et al*., 2022).

Cohen and Steenbergen (2015) note that Indonesia's decision to open the sea cucumber fishery and the quantities harvested were dictated by social and economic factors, influenced by community needs or agreements with intermediaries without reviewing data from monitoring, and this despite data on stock densities sent to the church council by a non-governmental organization to inform harvesting regimes.

In a different approach, Rasmussen (2015) describes an attempt by the Mbuke Islanders in Manus Province of Papua New Guinea to form a community-based business enterprise in the mid-to-late 2000s. Although the business focused on benefiting from the post-capture component of the in-country market chain (on buying and processing bêche-de-mer) in order to have some influence on management and increase economic returns, the enterprise failed owing to overfishing of sea cucumber stocks and the poor quality of the bêche-de-mer produced.

Trade comment

> *Thelenota* species are low to moderate value species predominantly taken by small-scale and artisanal fisheries across their range, with little international or regional coordination in management. For products coming from small-scale fishers, sea cucumber post-harvest processing is often poorly executed, and governance frameworks are under pressure from largely foreign buyers. In more developed countries, better trade frameworks are in place and long-term trade relationships at more equitable levels can be better maintained.
>
> The gross value return from the most valuable species of the genus, *T. ananas,* from even the most organized trading country is less than USD 9 per individual. Considering the fishing, processing and transport costs of marketing *Thelenota*, this offers some surrogate protection of stocks when they fall to low densities, as processing requirements and costs of international trade only make commercial sense when a sufficient number of individuals can be caught.
>
> Booms in trade, followed by moratoriums, can impact the nature and legality of trade, as traders cannot always maintain long-term relationships with fishing communities.
>
> The market for the most commercial species, *T. ananas,* is limited, mainly because this species is bitter and has poor eating characteristics compared to tier 1 sea cucumber species. *T. ananas* as a tier 3 species has a current wholesale price for the Australian product of USD 55 a kilo for its dried form bêche-de-mer. This price is likely lower for less well-processed products from countries that have lower awareness and capacity for bêche-de-mer preparation.

Clarke (2002) introduces market preferences based on the interviews with five sea cucumber traders in China, Hong Kong SAR that spiked forms of bêche-de-mer, particularly *T. ananas, Apostichopus japonicus* and *Stichopus* spp., the most valuable species. Trade in *A. japonicus* may be traced through trade statistics from Japan, the Republic Korea and other producing countries since *A. japonicus* has limited habitat and is a single fishery. However, no concrete trade data on *T. ananas* from Indo-Pacific regions are available. Their harvests are part of the multiple-species fisheries.

International market prices for sea cucumbers have risen sharply in recent years; Purcell (2014) and Purcell, Williamson and Ngaluafe (2018) provide price changes of sea cucumbers at retail shops in China, Hong Kong SAR and Guangzhou (Canton) between October 2011 and November 2016. In Guangzhou, the centre of sea cucumber distribution in China, Purcell, Williamson and Ngaluafe (2018) list 22 species of sea cucumbers that are commercially distributed in retail shops, which include *T. ananas* and *T. anax*. Of the 20 species sampled in both 2011 and 2016, the average prices of 14 species (70 percent) and the maximum prices of 15 species (75 percent) increased between the two sampling periods. The average prices across the 20 species resampled in 2016 had increased by an average of 16.6 percent (± 7.6) over the five-year sampling period. This translates to an annual increase of 2.4 percent (± 1.4). In Guangzhou, while prices of the 13 species increased, those of six decreased (no such decreases are observed in retail shops in China, Hong Kong SAR). *T. ananas* is one of the species whose average retail value per kilogram dropped from RMB 130 in 2011 to RMB 107 in 2016. Purcell, Williamson and Ngaluafe (2018) provide a unique perspective on the pricing of *T. ananas*. Normally, larger specimens of the dried product fetch higher prices; however, the price of *T. ananas* shows relatively stability in pricing beyond the 14 cm length of the dried form.

Eriksson and Clarke (2015) clearly point out that re-exports of sea cucumbers from China, Hong Kong SAR, to Viet Nam have exceeded those from China, Hong Kong SAR to China since 2004. This is due to the recent development of the free trade agreement between the Association of Southeast Asian Nations (ASEAN) countries and China.

As of this writing, there are no scientific analyses available on the impact of COVID-19 on sea cucumber trade and markets. International and national flow of people and commodities slowed down because of COVID-19, and freight has become more expensive. Larger cities in China are still coping with COVID-19, which possibly affects trade and markets of sea cucumbers.

Australia

In trade, *T. ananas* is sold after being gutted and salted and then dried for wholesale export to China. The average price for dried *T. ananas* paid to Australian producers is USD 55 per kilogram. It must be noted that wholesale values available to fishers are vastly different from the low volume retail Asian market prices. The USD 55 per kilogram value reflects a dry weight product. A rough equivalent value of wet weight is USD 2.5 per kilogram (not considering processing costs). As the mean live weight of *T. ananas* has been reported to be in excess of 3 kg (Pakoa *et al*., 2014; Skewes *et al*., 2004), this equates to less than USD 9 per individual (gross value – not including fishing, processing and export costs). In Australia, PRF is considered a lower value "tier 2" species of the 18 species fished in Queensland. This value is reflective of lower demand (one buyer for PRF compared to 20 to 40 buyers for other species, personal communication, 2022, Queensland Sea Cucumber Association spokesperson).

T. anax's low value means that, although it has historically been fished in small quantities to test the market, it is not considered a commercial stock at present.

Basis for Article II paragraph (2b) (look-alike) Appendix II listing

Responsible government agencies do not have difficulty identifying *Thelenota* species from other sea cucumbers, and between the three species of *Thelenota*, in both live and dried forms. The possible exception is *T. rubralineata,* which may include other species from the genus *Stichopus* in reported trade data, such as for lemonfish in Solomon Islands.

Comment on the likely effectiveness for conservation of a CITES Appendix II listing of the genus Thelenota

CITES offers an opportunity for improved governance of trade in *Thelenota*. Experience with previous listing of sea cucumbers shows that illegal, unreported and unregulated trade in sea cucumbers is common; this is expected to continue unless there is significant improvement in transparency, traceability and surveillance along the value and market chain.

Country ability to service the provisions of CITES differs. Countries with capacity and resources have sufficient ability to deliver the required positive NDF and the legal acquisition finding needed to maintain sustainable and legal experts, although even in these countries time delays occur and significant costs are diverted from other management to service this need.

For countries with fewer resources and less capacity, difficulties in delivering a positive NDF have been reported; this shows that a need for greater investment in collection of the stock status information is needed to prepare NDFs.

Should the genus *Thelenota* be listed in CITES, there are significant implications for small-scale and artisanal fishers with a dependence on fisheries that take sea cucumbers. In some cases, inequitable and deleterious impacts would occur in places where fishing is sustainable and legal, and, in many cases, small-scale and artisanal fishers reliant on these resources for their food security and livelihoods would be unaware of the changes to international norms until after the resource had been fished and marketed in-country.

The physical attributes of *Thelenota* species mostly allow fishery-independent surveys, but capacity and resource constraints hamper their delivery, including recording, analysis and storage of stock status information. With investment, collection of sufficient fishery data to assess the status of *Thelenota* stocks could be achieved in a relatively short period of time.

Improvement in the management of sea cucumber species in developing countries and countries with economies in transition remains a priority, with or without CITES Appendix II listing. Studies note that if basic controls were enforced, countries could increase their average annual value of bêche-de-mer exports by 80 to 105 percent.

Novel techniques such as sea cucumber aquaculture are becoming more advanced, but they do not yet include research or production of the genus *Thelenota*.

An Appendix II listing on CITES could, if supported appropriately, can result in improved governance, as well as the collection and reporting of domestic and international trade data and in assisting in the refinement of TACs and export quotas. Illegal, unreported and unregulated trade in sea cucumbers is common, and this is expected to continue unless there is significant improvement in transparency, traceability and surveillance along the value and market chain.

Experience of the impacts following the CITES listing of teatfish species on Appendix II at CITES CoP18 in 2019 informs us of the benefits and challenges from CITES listing sea cucumbers. Before a species listed in Appendix II can be exported, the CITES Scientific Authority of a particular country must determine that the proposed export will not be detrimental to the survival of that species in the wild and that the trade is legal. A positive assessment of a NDF and the secondary requirement termed a legal acquisition finding are therefore needed.

The teatfish example offers insights into several range states attempts to develop NDFs for the teatfish fisheries. It reveals that, under the conditions that are currently in place, an Appendix II listing of the genus *Thelenota* could result in the trade of these species ceasing as was observed in some range states, as there was an inability (e.g., financial or technical) or delay in national fisheries agencies' ability to conduct the necessary process to get a positive NDF. In such cases, trade continued without proper CITES documentation (i.e., illegal trade) in some countries and/or trade continued with inadequate CITES NDFs.

Australia prepared an NDF for one of the two species listed in 2019, *H. fuscogilva,* while a lack of an NDF for *H. whitmaei* means that this species cannot be exported. Even for a developed country such as Australia, the *H. fuscogilva* NDF assessment took around a year to complete. As noted through the NDF report for *H. fuscogilva*, the Australian sea cucumber fishery is professionally managed, yet the CITES listing impacted the opportunity for sustainable and legal fishery exports, using capacity and funds that otherwise may have been invested in further sea cucumber fishery management. The impact on trade and the cost of the NDF process (estimated to be about AUD 300 000 [USD 208 674 equivalent], Mr Chauncey Hammond, personal communication) were significant. The experience of a wealthy country with a well-managed sea cucumber fishery, which had 27 years of fishery CPUE and trade information, was a partially successful outcome that many poorer nations have struggled to emulate.

In the case of some Small Island Developing States, there is lower capacity and resource base for preparing a positive NDF to allow legal and sustainable sea cucumber trade. In the Pacific Islands region, several range states that have limited quantifiable data on the status of their resources have attempted to prepare NDFs. Solomon Islands and Vanuatu tried to establish an NDF, but did not complete the process, and in one case, continued its exports. Some range states have been given support from SPC, the Pacific Regional Environment Programme (SPREP) and the IUCN Oceania office, yet still struggle with the technical and financial burdens of producing an NDF.

Although Tonga conducted an NDF, it still does not allow the export of teatfish species. Fiji simply banned the export of teatfish in line with their fisheries regulations prohibiting the export of all CITES listed species. New Caledonia conducted an NDF, which was valid for a 12-month period; the NDF is currently being updated with new data at significant cost. French Polynesia have not completed an NDF and implemented a ban on teatfish exports, reporting that even with technical capacity the financial burden was too high (George Remoissenet Pers. Comm. 2022). Papua New Guinea conducted an NDF establishment process and established TACs of 4 tonnes for *H. whitmaei* and 16 tonnes for *H. fuscogilva* (Gisawa *et al*., 2020). Through monitoring, it was noted that these TACs, however, exceeded when the fishery reopened, resurfacing the question of capacity and resource base for national fisheries agencies to manage requirements for exploitation of these species. Because in many Small Island Developing States, sea cucumbers are fished by artisanal fishers in multiple locations across extensive and often remote areas, the challenge is large. This gives some insight into why past management has adopted the very simple but "blunt" tools for managing their fishers and exports, adopting closures for extended periods alternating with shorter periods of fishery openings.

Should the genus *Thelenota* be listed in CITES, there will be significant implications for small-scale and artisanal fishers with a dependence on fisheries that take sea cucumbers. CITES listing would impact the livelihood of the poor and remote small-scale and artisanal fishing communities. In some cases, inequitable and deleterious impacts would occur in places where fishing is sustainable and legal. In many cases, small-scale and artisanal fishers reliant on these resources for their food security and livelihoods would be unaware of the changes to international norms. The first they hear about these changes might be when they experience added hurdles to accessing legal avenues to market products already taken and processed into the dry form, bêche-de-mer. For disadvantaged communities, difficulties overcoming barriers in accessing market opportunities can result in unintended negative consequences for both people (see the India example above) and aquatic resource status (as fishers turn to other forms of income to which they are not suited). In many cases, fishers turn to the informal economy, which makes their catches invisible to authorities except through compliance surveillance.

CITES listing of any species requires significant investment in the capacity of range state fisheries and conservation agencies to successfully provide NDFs to ensure that appropriate management and trade can continue. To improve the ability of range states to conduct NDFs, there is a need for improving stock status information with the intent of delivering better targeted management and assessing the effectiveness of that management. The complexity of population assessments for *T. ananas* and *T. anax* is low, which means fisheries and conservation agencies can relatively easily obtain a measure on the population status of these two species (*T. rubralineata* cannot be sampled using fishery independent surveys due to its natural low density).

Additionally, the physical attributes of *Thelenota* species are such that they are found in predictable locations, are slow-moving and easily identified (size, shape and colouration), which simplifies the task of doing fishery-independent surveys. A qualifier on this is that a fishery agency with the skills to perform this work will require appropriate financial, technical and human resources to achieve such surveys, including subsequent assessment and reporting of the data. collected (Purcell, Lovetelli & Pakoa., 2014). In addition, as *Thelenota* species occur in deeper waters and on differing habitats, this makes conducting population surveys of deeper water components of the populations more of a health and safety issue. Uncontrolled and uncoordinated sea cucumber diving with insufficient training have led to accidents (Pakoa *et al*., 2014; Jupiter, Saladrau and Vave, 2013; Tabunakawai-Vakalalabure *et al*., 2017). In Fiji and other countries, local divers have lost their lives or suffered from permanent disabilities as a direct result of diving too deep or for too long

Data recording, analysis and storage of information are also areas to improve. Of importance for NDFs is the accurate and timely reporting of surveys and fishery catches and the size classes of individual animals being sold. Buyers and exporters purchase products by "grade", and these grades equate to sea cucumber length and weight (number of pieces per kilo), including quality of processing technique. By assessing the grade of animals being sold, assumptions can be made on the stock status. For example, if there is a decline in the grade of animals in trade, the assumption is that the stocks of that species are in decline – if smaller animals are being purchased, then the assumption is that stocks are under greater pressure from fishing (see Yap management plan, Friedman *et al*., 2008). Buyers and exporters should also be encouraged to only market high grade sea cucumbers (as a sustainability measure) and record products by location, sharing that information with authorities. Knowing the location of where CITES listed species are being purchased and their grade allows managers to get an indirect measure of shifting status that could drive targeted stock surveys or controls.

With investment, collection of sufficient fishery data to assess the status of genus *Thelenota* stocks could be achieved in a relatively short period of time. Noting the lack of opportunity to achieve temporal trends in less than five years for countries where data are largely absent, opportunities exist for comparing snapshot information on local densities of these benthic slow-moving species across their range, allowing managers to contrast results from suitable habitats where fishing is absent or light to results from areas experiencing greater amounts of active fishing. This delivers some indication of populations in unfished condition in comparison to populations under higher levels of fishing pressure.

An important part of any fishery improvement programme is the requirement for extensive education and awareness raising to be conducted along the whole value chain (fishers, buyers and exporters). Challenges exist, however, in transmitting information of the changes in international governance (e.g., a CITES listing) to remote communities that harvest sea cucumbers and maintaining the collection of data on fishing once fishers become aware of new trade controls. Even education in species or bêche-de-mer identification is an ongoing need. For government agencies and traders, several species identification guides are available (Purcell, Hair and Mills, 2012; Purcell, Samyn & Conand, 2012; Purcell, 2014). FAO plans to shortly release a new version of their identification guide, *Commercially Important Sea Cucumbers of the World*.

If through technical assistance to national fisheries and conservation agencies, data on the status of *Thelenota* spp. populations were to be collected, collated and shared on a national or regional basis, all range states would be able to benefit from having a clearer understanding of how stocks respond to fishing pressures, and would provide an opportunity to update the "rules of thumb" estimates of what constitutes a healthy stock (Pakoa *et al*., 2014). This could be utilized on a regional basis to improve management (Friedman *et al*., 2011, also see SPC Policy Brief 2 SPC, 2008).

At the fisher level, a focus on co-management arrangements between fishing communities and fisheries authorities or other supporting non-governmental organizations should be promoted for management of sea cucumber stocks. Another area of focus will be on sustaining sea cucumber stocks at the community level through simple sea ranching techniques to enhance spawning potential.

Improvement in the management of sea cucumber species in developing countries and countries with economies in transition remains a priority with or without CITES Appendix II listing. Training for fishers and post-harvest capacity development requirements remain, which can be overcome with investment in capacity development of fishers and managers. It is suggested that if regulated fishing for sea cucumbers were permitted (catch quota and licensing, minimum legal size, seasonal closures, rotational fishing, no-take zones, gear limitation, species protection, habitat protection, trade management, and restocking through hatchery seed production and aquaculture), information on fishing activities would be easier to collect and fishers would receive a fairer share of the export value. Lee *et al*. (2018) note that if minimum legal-size limits alone were enforced, the entire long-term harvest of some species could increase by up to 97 percent, while Carleton *et al*. (2013) state that more conservative management and more rigorous enforcement of regulations would likely increase the average annual value of countries' bêche-de-mer exports by 80 to 105 percent. In other words, some fishers and governments are currently losing significant revenue through management shortfalls in putting in place and enforcing science-based management of sea cucumber fishery value chains.

As a future outlook, sea cucumber aquaculture is becoming more advanced (Hair, Pickering and Mills, 2012; Hair, *et al*., 2016; Hair, *et al*., 2020; Eriksson, Byrne and de la Torre-Castro, 2012), and there is some experimentation in rearing and ranching (Friedman and Tekanene, 2005; Purcell, Hair and Mills, 2012). A potential shift of focus for a small number of species from wild capture to aquaculture and ranching has begun and could be hindered (or potentially helped) by a CITES listing. The extra governance requirements for trade in CITES species could deter or spur such investment in the future.

References

Andréfouët, S. & Tagliaferro, A. 2020. A comparison of commercial sea cucumber communities in the French Polynesia and New Caledonia atolls listed as UNESCO Man and Biosphere and World Heritage Areas. *SPC Bêche-de-mer Information Bulletin*, 40: 5–10.

Andréfouët, S., Tagliaferro, A., Chabran-Poete, L., Campanozzi-Tarahu, J., Tertre, F., Haumani, G. & Stein, A. 2019. An assessment of commercial sea cucumber populations in French Polynesia just after the 2012 moratorium. *SPC Bêche-de-mer Information Bulletin,* 39: 8–18.

Asha, P.S., Johnson, B., Ranjith, L., Vivekanandan, E., Subin, C.S & Mohamed, M.S. 2015. Status of sea cucumber resources and impact of fishing ban on the livelihood of fishers in Gulf of Mannar and Palk Bay. Mar. Fish. Infor. Serv., T & E Ser., 226, 7p.

Asha, P.S., Vinod, K., Ranjith, L., Johnson, B. & Vivekanandan, E. 2017. *Conservation and sustainable use of sea cucumber resources in India: suggestions and way forward.* CMFRI Marine Fisheries Policy Series No. 7. Kochi, Central Marine Fisheries Research Institute.

Aumeeruddy R. and Payet, R. 2004. Management of the Seychelles sea cucumber fishery: status and prospects. In: Lovatelli, A., Conand, C., Purcell, S., Uthicke, S., Hamel, J. and Mercier, A. (eds) *Advances in sea cucumber aquaculture and management*. pp 239–246: FAO Fisheries Technical Paper 463. Rome: FAO.

Aumeeruddy, R., Skewes, T., Carocci, J., de Lion, F., Harris, A., Henriette, C. & Cedras, M. 2005. *Resource assessment and management of the Seychelles sea cucumber fishery.* FAO Project No. TCP/SEY/2902. Mahe, Seychelles Fishing Authority.

Baker-Médard, M. & Ohl, K. 2019. Sea cucumber management strategies: challenges and opportunities in a developing country context. *Environmental Conservation*, 46(4), 267–277. doi: 10.1017/S0376892919000183

Barclay, K., Fabinyi, M. & Kinch. J. 2017. Governance and the Papua New Guinea bêche-de-mer value chain. *SPC Bêche-de-mer Bulletin,* 37: 3–8.

Barclay, K., Fabinyi, M., Kinch, J. & Foale, S. 2019. Governability of high-value fisheries in low-income countries: a case study of sea cucumbers in Papua New Guinea. *Human Ecology*, 47: 381–396. https://doi.org/10.1007/s10745-019-00078-8

Barclay, K., Kinch, J., Fabinyi, M., EDO NSW, Waddell, S., Smith, G., Sharma, S., Kichawen, P., Foale, S. & Hamilton, R. 2016. *Interactive governance analysis of the bêche-de-mer 'fish chain' from Papua New Guinea to Asian markets*. Sydney, University of Technology.

Bayliss-Smith, T., Gough, K., Christensen, A. & Kristensen, S. 2010. Managing Ontong Java: social institutions for production and governance of atoll resources in Solomon Islands. *Singapore Journal of Tropical Geography,* 31: 55–69.

Bell, J.D., Purcell, S.W., & Nash, W.J. 2008. Restoring small-scale fisheries for tropical sea cucumbers. *Ocean & Coastal Management*, 51(8–9): 589–593.

Birkeland, C., Green, A., Guilbeaux, M., Donaldson, T., Emilio, D., Kirkendale, L., Mangel, J., Myers, R., Wemg, K. & van Woesik, R. 2000. *Helen Reef Marine Resources in the Year 2000 – Results of Scientific and Community Monitoring Surveys: 24 April–3 May 2000, Hatohobei State, Republic of Palau.* Report prepared for the Helen Reef Marine Resource Management Program, Koror, Republic of Palau.

Bondaroff, T. 2020. Sea cucumber crime in India and Sri Lanka during the period 2015–2020. *SPC Bêche-de-mer Information Bulletin,* 41: 55–63.

Bosserelle, P., Singh, N. & Bertram, I. 2017. SPC assists Federated States of Micronesia with a sea cucumber assessment in Pohnpei. *SPC Fisheries Newsletter*, 153: 7–9.

Bosserelle, P., Singh, N., Fred, I., Hedson, C., Moses, P., Ladore, R., Damian, D., Dewey, J., Alfred, M., Santos, T., Malakai, S., Elias, B., Mathias, D., Martin, V. & Moore, B. 2017. *The status of sea cucumbers at Pohnpei Island and Ant Atoll, Federated States of Micronesia, in 2017.* Noumea, Pacific Community.

Bourgoin, A. & Pelep, P. 2017. *Assessing the abundance and mean size composition of commercial valued sea cucumber species in Pohnpei Lagoon, Federated States of Micronesia.* Technical Report. Kolonia, College of Micronesia.

Bruckner, A.W., Johnson, K.A. & Field, J.D. 2003. Conservation strategies for sea cucumbers: Can a CITES Appendix II listing promote sustainable international trade? *SPC Bêche-de-mer Information Bulletin,* 18: 24–33.

Buckius, C., Albert, S., Tibbetts, I. & Udy, J. 2010. Effect of diel activity patterns and harvesting pressure on the diversity and biomass of sea cucumbers in Marovo Lagoon, Solomon Islands. *Environmental Management,* 45: 963–973.

Cariglia, N., Wilson, S., Graham, N., Fisher, R., Robinson, J. Aumeeruddy, R., Quatre, R., & Polunin, N. 2013. Sea cucumbers in the Seychelles: effects of marine protected areas on high-value species. *Aquatic Conservation: Marine and Freshwater Ecosystems,* 23(3): 418-428. doi: 10.1002/aqc.2316

Carleton, C., Hambrey, J., Govan, H., Medley, P. & Kinch, J. 2013. Effective management of sea cucumber fisheries and the bêche-de-mer trade in Melanesia. *SPC Fisheries Newsletter*, 140: 24–42.

CFWG. 2019. *A call to leaders: most urgent actions required for sustaining or increasing the contribution of coastal fisheries to our communities.* Noumea, Pacific Community.

Chandra, K. & Raghunathan, C. 2018. *Faunal diversity of biogeographic zones: islands of India*. Kolkata, Ministry of Environment, Forest and Climate Change.

Christensen, A. 2011. Marine gold and atoll livelihoods: the rise and fall of the bêche-de-mer trade on Ontong Java, Solomon Islands. *Natural Resources Forum,* 35(1): 9–20.

Clarke, S. 2002. Trade in Asian dried seafood: characterization, estimation and implications for conservation. Wildlife Conservation Society Working Paper No. 22.

Cohen, P. & Steenbergen, D. 2015. Social dimensions of local fisheries co-management in the Coral Triangle. *Environmental Conservation,* 42 (3): 278–288.

Conand, C. 1988. *Bêche-de-mer in New Caledonia: biology and fishing*. Paper prepared for the South Pacific Commission's Workshop on Pacific Inshore Fishery Resources, 14–25 March 1988, Noumea, New Caledonia.

Conand, C. 1989. *Les Holothuries Aspidochirotes du Lagon de Nouvelle-Caledonie: Biologie, Ecologie et Exploitation.* Ètudes et thèses, ORSTROM, Paris, France.

Conand, C. 1993 Reproductive biology of the holothurians from the major communities of the New Caledonian Lagoon. *Marine Biology,* 116: 439–450.

Conand, C. 1998. Holothurians (sea cucumbers, Class Holothuroidea). In: Carpenter, K.E. & Niem, V.H. (eds). *The living marine resources of the Western Central Pacific. Vol. 2: Cephalopods, crustaceans, holothurians and sharks*. FAO species identification guide for fishery purposes. Rome, FAO. 1998. 676–1396 pp.

Conand, C. 2006. Ecology and biology of New Caledonia's main sea cucumber species. Sections of Chantal Conand's thesis: *Les holothuries Aspidochirotes du lagon de Nouvelle-Calédonie : écologie, biologie et exploitation, originally*. Published by ORSTOM (1989). Translated and published by the Secretariat of the Pacific Community's Reef Fisheries Observatory, and Information and Translation Sections. Noumea: SPC, New Caledonia. 98 p. Cited 18 July 2022. www.spc.int/DigitalLibrary/Doc/FAME/Reports/Conand_06_Thesis.pdf

Conand, C., Gamboa, R. & Purcell, S. 2013a. *Thelenota ananas*. The IUCN Red List of Threatened Species 2013: e.T180481A1636021. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180481A1636021.en

Conand, C., Purcell, S. & Gamboa, R. 2013b. *Thelenota anax*. The IUCN Red List of Threatened Species 2013: e.T180324A1615023. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180324A1615023.en

Conand, C., Gamboa, R. & Purcell, S. 2013c. *Thelenota rubralineata*. The IUCN Red List of Threatened Species 2013: e.T180285A1610697. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180285A1610697.en

Conand, C. & Mangion, P. 2002. Sea cucumbers on La Réunion Island fringing reefs: diversity, distribution, abundance and structure of the populations. *SPC Bêche-de-mer Information Bulletin*, 17: 27–33.

Conand, C., Michonneau, F., Paulay, G. & Bruggemann, H. 2010. Diversity of the holothuroid fauna (Echinodermata) at La Réunion (Western Indian Ocean). *Western Indian Ocean Journal of Marine Science*, 9(2): 145–151.

Conand, C. & Muthiga, N. eds. 2007. *Commercial sea cucumbers: a review for the Western Indian Ocean.* WIOMSA Book Series No. 5.

Conand, C., Claereboudt, M., Dissayanake, C., Ebrahim, A., Fernando, S., Godvinden, R., Lavitra, T., Léopold, M., Mmbaga, T., Mulochau, T., Naaem, S., Shea, S., Vaitilingon, D., Yahya, S. and Friedman, F. 2022. Review of fisheries and management of sea cucumbers in the Indian Ocean. *WIO Journal of Marine Science.* 21 (1): 125–148.

Customs and Excise Department. 2022. Hong Kong Customs seizes suspected smuggled dried sea cucumbers (with photo). Customs and Exceise Department. The Government of the Hong Kong Special Administrative Region. Cited 18 July 2022. www.customs.gov.hk/en/publication_press/press/index_id_1839.html

Dalpathadu, K. 2021. Evaluation of the fisheries and resource of sea cucumbers in the coastal waters of Trincomalee district, Eastern Sri Lanka. *International Journal Aquatic Biology*. 9: 297–308.

Dalzell, P., Lindsay, S. R. & Patiale, H. 1993. Fisheries resources survey of the island of Niue. Noumea, New Caledonia: South Pacific Commission. xiii, 68 p. https://purl.org/spc/digilib/doc/336u4

De Guzman, A. & Quinones, M. 2021. Sea cucumbers (Holothuroidea) of North-eastern and Western Mindanao, Philippines: the potential role of marine protected areas in maintaining diversity and abundance. *Journal of Environment and Aquatic Resources*, 6: 47–70.

Dissanayake, D. & Stefansson, G. 2010. Abundance and distribution of commercial sea cucumber species in the coastal waters of Sri Lanka. *Aquatic Living Resources*, 23: 303–313.

Dissanayake, D. C. T., & Stefansson, G. 2012. Present status of the commercial sea cucumber fishery off the north-west and east coasts of Sri Lanka. Journal of the Marine Biological Association of the United Kingdom, 92 (04), 831–841.

Dolorosa, R. & Jontila, J. 2012. Notes on common macrobenthic reef invertebrates of Tubbataha Reefs Natural Park, Philippines. *Science Diliman*, 24 (2): 1–11.

Dreamstime. 2022. Archiweb Design. Romania. Cited 22 July 2022. https://www.dreamstime.com/

Egypt Independent. 2022. Egypt authorities seize large quantity of endangered sea cucumbers. Egypt Independent. CAiro, Egypt. Cited 18 July 2022. www.egyptindependent.com/egypt-authorities-seize-large-quantity-of-endangered-sea-cucumbers/

Eriksson, H. 2006. *Sea cucumber abundance, diversity and fishery in Samoa: an assessment of lagoon occurring species*. Uppsala University Minor Field Study, No. 122.

Eriksson, H. & Clarke, S. 2015. Chinese market responses to overexploitation of sharks and sea cucumbers. *Biological Conservation,* 184: 163–173.

Eriksson, H., Byrne, M. & de la Torre-Castro, M. 2012. Sea cucumber (Aspidochirotida) community, distribution and habitat utilization on the reefs of Mayotte, Western Indian Ocean. *Marine Ecology Progress Series*, 452: 159–170.

Eriksson, H., de la Torre-Castro, M. & Olsson, P. 2012. Mobility, expansion and management of a multi-species scuba diving fishery in East Africa. *PLoS ONE*, 7(4): e35504.

Eriksson, H., Robinson, G., Slater, M. & Troell, M. 2012. Sea cucumber aquaculture in the Western Indian Ocean: challenges for sustainable livelihood and stock improvement. *Ambio,* 41(2): 109–121.

FAO. 2015. *Voluntary guidelines for securing sustainable small-scale fisheries in the context of food security and poverty eradication.* Rome.

Friedman, K., Lokani, P., Fale, P., Mailau, S., Ramohia, P. & Ramofafia, C. 2004. *Survey of the sea cucumber resources of Ha'apai, Tonga*. Report prepared for the Tongan Ministry of Fisheries, Tonga'tapu, Tonga.

Friedman, K. & Tekanene, M. 2005. White teatfish at Kiribati sea cucumber hatchery 'local technicians getting them out again'. *SPC Bêche-de-mer Information Bulletin,* 21: 32–33.

Friedman, K., Eriksson, H., Pakoa, K., Lasi, F., Solofa, A. & Mulipola, A. 2006. *Samoa Sea Cucumber Fishery Status Assessment 2006*. Noumea, Pacific Community.

Friedman, K. 2008. *A regional approach to invertebrate export fisheries*. SPC Policy Brief No. 2/2008. Noumea, Pacific Community.

Friedman, K., Purcell, S., Bell, J. & Hair, C. 2008. *Sea cucumber fisheries: a manager's toolbox.* ACIAR Monograph No. 135. Canberra, ACIAR.

Friedman, K., Ropeti, E. & Tafileichig, A. 2008. Development of a management plan for Yap's sea cucumber fishery. *Bêche-De-Mer Information Bulletin*, 28:7–13.

Friedman, K.J., Kronen, M., Pinca, S., Lasi, F., Pakoa, K., Awira, R., Boblin, P., Tardy, E., Chapman, L.B. & Magron, F. 2009. *Palau country report: profiles and results from survey work at Ngarchelong, Ngatpang, Airai and Koror (April to June 2007).* Pacific Regional Oceanic and Coastal Fisheries Development Programme (PROCFish/C/CoFish). Noumea, New Caledonia, Secretariat of the Pacific Community (SPC). 411 pp.

Friedman, K.J., Kronen, M., Vunisea, A., Pinca, S., Pakoa, K., Magron ,F., Chapman, L., Sauni, S., Vigliola, L., Tardy, E. & Labrosse, P. 2010. *Fiji Islands country report: profiles and results from survey work at Dromuna, Muaivuso, Mali and Lakeba (September to November 2002, April to June 2003, June and July 2007, and February 2009).* Pacific Regional Oceanic and Coastal Fisheries

Development Programme (PROCFish/C/CoFish). Noumea, New Caledonia, Secretariat of the Pacific Community (SPC). xxxv, 467 pp.

Friedman, K., Eriksson, H., Tardy, E. & Pakoa, K. 2011. Management of sea cucumber stocks: patterns of vulnerability and recovery of sea cucumber stocks impacted by fishing. *Fish and Fisheries*, 12(1): 75–93. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-2979.2010.00384.x

Fufudate, K. 1999. *Field survey of sea cucumber's resources in the Gilbert Islands, the Republic of Kiribati.* Tokyo: Overseas Fishery Cooperation Foundation.

Gamage, L., Thushari, G., Atapaththu, K., Kumara, H. & Senevirathna, J. 2021. Diversity, length-weight relations, and condition factor of sea cucumbers in three coastal areas along the Southern Coast of Sri Lanka. *Turkish Journal of Fisheries and Aquatic Sciences,* 21(12): 575–588.

Gilbert, A., Georget, S., Guillemot, N., Ton, C., Léopold, M., Purcell, S., Van Wynsberge, S. & Andréfouët, S. (forthcoming). *État des lieux des stocks d'holothuries commerciales de Nouvelle-Calédonie (2021–2022).*

Gisawa, L., Kinch, J., Ugufa, S., Shedrawi, G., Lis, R. & Pakop, N. 2020. *Non-detriment finding (NDF) for two teatfish species* Holothuria witmaei *and* Holothuria fuscogilva *in Papua New Gui*nea. Port Moresby, National Fisheries Authority.

Govan, H., Kinch, J. & Brjosniovschi, A. 2013. *Strategic Review of Inshore Fisheries Policies and Strategies in Melanesia. Part II: Country Reports.* Port Vila: Melanesian Spearhead Group.

Govan, H. 2017. A review of sea cucumber fisheries and management in Melanesia. *SPC Fisheries Newsletter,* 154: 31–42.

Government of Papua New Guinea. 2018. *National Bêche-de-mer Fishery Management Plan.* Port Moresby, Government of Papua New Guinea.

Hair, C., Militz, T., Daniels, N. & Southgate, P. 2020. Comparison of survival, growth and burying behavior of cultured and wild sandfish (*Holothuria scabra*) juveniles: implications for ocean mariculture. *Aquaculture,* 526: 18.

Hair, C., Mills, D., McIntyre, R. & Southgate, P. 2016. Optimising methods for community-based sea cucumber ranching: experimental releases of cultured juvenile *Holothuria scabra* into seagrass meadows in Papua New Guinea. *Aquaculture Reports,* 861 (3): 198–208.

Hair, C., Pickering, T. & Mills, D., eds. 2012. *Asia–Pacific tropical sea cucumber aquaculture symposium.* ACIAR Proceedings No. 136. Canberra, Australian Centre for International Agricultural Research.

Hamel, J.-F. & A. Mercier, eds. 2022. Global knowledge on the commercial sea cucumber *Holothuria scabra*. *Advances in Marine Biology*, 91.

Hamilton, R., Paiva, F., Aitsi, J., Potuku, P., Siota, C. & Lokani, P. 2010. *Northern Bougainville Marine Resource Assessment, Autonomous Region of Bougainville*. Technical report of survey conducted from 1–25 November 2008. The Nature Conservancy Report No. 2/10. Brisbane, The Nature Conservancy.

Hartati, R Ambariyanto, A., Widianingsih, W., Mahendrajaya, R.T., Mustagfirin, M., & Prihatinningsih, P. 2021. Stichopodidae (Holothuroidea: Echinodermata) from Nyamuk Island, Karimunjawa National Park, Central of Java, Indonesia. *IOP Conf. Ser.: Earth Environ. Sci.* 919 012024. (https://iopscience.iop.org/article/10.1088/1755-1315/919/1/012024).

Hart, A.M., Murphy, D.M. & Fabris, F.F. 2022. Western Australian Sea Cucumber Resource. Resource Assessment Report (2022). Fisheries Research Report No. 324: Department of Primary Industries and Regional Development, Western Australia. 113 pp.

Hartati, R., Ambariyanto, A., Widianingsih, W., Mahendrajaya, R., Mustagfirin, M. & Prihatinningsih, P. 2021. *Stichopodidae* (*Holothuroidea*: *Echinodermata*) from Nyamuk Island, Karimunjawa National Park, Central of Java, Indonesia. *IOP Conference Series: Earth and Environmental Science,* 919: 012024.

Hasan, M. 2019. Destruction of sea cucumber populations due to overfishing at Abu Ghosoun area, Red Sea. *The Journal of Basic and Applied Zoology*, 80: 5.

Hung, N., Nga, T. & Hao, D. 2017. A survey of resources of white teatfish (*Holothuria fuscogilva* Cherbonnier, 1980) and prickly red fish (*Thelenota ananas* Jaeger, 1833). *Journal Fisheries Science and Technology,* 3: 28–35.

Idreesbabu, K. & Sureshkumar, S. 2017. Distribution pattern and community structure of sea cucumbers (Class: Holothuroidea) in different biogeographic regions of the selected islands of Lakshadweep Archipelago, India. *Indian Journal of Geo Marine Sciences,* 46(03): 569–575.

James, D.B. 1996. Conservation of sea cucumbers. *In* Menon, N.G. & Pillai, C.S.G., eds. *Marine Biodiversity Conservation and Management*, 80–88.

James, D. 2001. Twenty sea cucumbers from seas around India. *Naga,* 24(1–2): 4–8.

James, D., Gandhi, A., Palaniswamy, N. & Rodrigo, J. 1994. Hatchery techniques and culture of the sea-cucumber *Holothuria scabra*. *CMFRI Special Publications,* 57: 1–40.

Jontila, J., Monteclaro, H., Quinitio, G., Santander-de Leon, S. & Altamirano, J. 2018a. Status of sea cucumber fishery and populations across sites with different levels of management in Palawan, Philippines. *Ocean and Coastal Management,* 165: 225–234.

Jontila, J., Monteclaro, H., Quinitio, G., Santander-de Leon, S. & Altamirano, J. 2018b. The sea cucumber fishery in Palawan, Philippines. *Kuroshio Science,* 12(1): 84–88.

Jupiter, S., Saladrau, W. & Vave, R. 2013. *Assessment of sea cucumber fisheries through targeted surveys of Lau Province, Fiji.* Suva, Wildlife Conservation Society.

Kalaeb, T., Ghirmay, D., Semere, Y. & Yohannes, F. 2008. Status and preliminary assessment of the sea cucumber fishery in Eritrea. *SPC Bêche-de-mer Information Bulletin*, 27: 8–12.

Kaly, U., Preston, G., Opnai, J. & Aini, J. 2007. Sea cucumber survey in New Ireland Province. Kavieng, National Fisheries Authority.

Kerr, A., Netchy, K. & Gawel, A-M. 2006. *Survey of the shallow-water sea cucumbers of the Central Philippines.* University Of Guam Marine Laboratory Technical Report No. 119. Guam, University of Guam.

Kerr, A., Netchy, K. & Hoffman, S. 2007. *The shallow-water echinoderms of Yap – results of a survey performed from 27 July to 9 August 2007, including a stock assessment of commercially valuable species*. University of Guam Marine Laboratory Technical Report No. 121. Guam, University of Guam.

Kerr, A.M., Miller, A.K., Brunson C., & Gawel, A.M. 2017. Commercially valuable sea cucumbers of Guam. University of Guam Marine Laboratory Technical Report 162: i - xii, 1–45.

Kinch, J., Purcell, S., Uthicke, S., & Friedman, K. 2008. Population status, fisheries and trade of sea cucumbers in the Western Central Pacific. Sea cucumbers. A global review of fisheries and trade. FAO Fisheries and Aquaculture Technical Paper, 516, 7–55.

Kinch, J. 2020. *Changing lives and livelihoods: culture, capitalism and contestation over marine resources in Island Melanesia.* Australian National University, Canberra, Australian Capital District, Australia. Unpublished PhD thesis.

Koike, H. 2017. *Fishery Ecology of Seychelles' sea cucumber fishery*. University of Hawaii, United States of America. Unpublished PhD thesis.

Koushik, S. & Raghunathan, C. 2012. A general account on community structure of echinoderms in north Andaman. *International Journal of Biology, Pharmacy and Applied Science*, 1(1): 44–56.

Lane, D. 1992. Biogeographical notes on the northward extension of the known latitudinal range for the tropical stichopodid sea-cucumber Thelenota anax HL Clark (Echinodermata: Holothurioidea). Raffles Bulletin of Zoology, 40: 175–8.

Lane, D. 1999a. Distribution and abundance of *Thelenota rubralineata* in the Western Pacific: some conservation issues. *SPC Bêche-de-mer Information Bulletin*, 11: 19–21.

Lane, D. 1999b. A population survey of the 'rare' stichopodid sea cucumber, *Thelenota rubralineata,* off northern Sulawesi, Indonesia. *In* Carnevali, M. & Bonasoro, F., eds. *Echinoderm Research 1998: Proceedings of the 5th European Conference on Echinoderms, Milan,* pp. 499–503. Rotterdam, A.A. Balkema.

Lane, D.J. 2000. Actualisation des données sur la répartition et l'abondance de *Thelenota rubralineata* dans le Pacifique occidental et réflexion sur l'hypothèse d'une niche vacante. LA BÊCHE-DE-MER, 1(20), 29.

Lane, D. 2008. Distribution and abundance records updated for *Thelenota rubralineata* in the western Pacific, with notes on the "vacant niche" hypothesis. *SPC Bêche-de-mer Information Bulletin*, 27: 29–32.

Lane, D. J., & Limbong, D. 2015. Catastrophic depletion of reef-associated sea cucumbers: resource management/reef resilience issues for an Indonesian marine park and the wider Indo-Pacific. Aquatic Conservation: Marine and Freshwater Ecosystems, 25(4), 505–517.

Lee, S., Govan, H., Wolff, M. & Purcell, S. 2018. Economic and other benefits of enforcing size limits in Melanesian sea cucumber fisheries. *SPC Fisheries Newsletter,* 155: 29–36.

Léopold, M., Ham, J., Kaku, R., Gereva, S., Raubani, J. & Moenteapo, Z. 2015. Spatial sea cucumber management in Vanuatu and New Caledonia. *SPC Bêche-de-mer Information Bulletin*, 35: 3–9.

Lincoln-Smith, M., Pitt, K., Bell, J. & Ramohia, P. 2000. *Testing the use of marine protected areas to restore and manage tropical multi-species invertebrate fisheries at the Arnavon Islands, Solomon Islands.* Research Publication No. 69. Report prepared for the Great Barrier Reef Marine Park Authority, Townsville, Queensland, and the Australian Centre for International Agricultural Research, Sydney, New South Wales, Australia.

Lindsay, S. 2000. *Marine resource survey of Jaluit Atoll, Republic of the Marshall Islands.* Report prepared for the Conservation Society of Pohnpei, Kolonia, Pohnpei, Federated States of Micronesia.

Lindsay, S. 2001. *Resource evaluation of the current populations of two commercially harvested sea cucumber species (*Actinopyga mauritiana *and* Stichopus chloronotus*), Kosrae State, FSM*. Report prepared for the Kosrae Island Resource Management Program, Kosare, Federated States of Micronesia.

Lokani, P. 1996. *Fishery dynamics and biology of Bêche-de-mer in the Tigak Islands, Papua New Guinea*. Report prepared for the Department of Fisheries and Marine Resources, Port Moresby, Papua New Guinea.

Lokani, P. & Chapau, M. 1992. *Survey of commercial sedentary resources of Manus Island.* Technical Paper No. 92–04. Port Moresby, Department of Fisheries and Marine Resources.

Long, B. & Skewes, T. 1997. Distribution and abundance of bêche-de-mer on Torres Strait reefs. *SPC Bêche-de-mer Inf. Bull*. 9, 17–22.

Mangubhai, S., Lalavanua, W. & Purcell, S., eds. 2017. *Fiji's sea cucumber fishery: advances in science for improved management*. Wildlife Conservation Society, Report No. 01/17. Suva, Wildlife Conservation Society.

Manioli, J. 2004. *Baseline survey report – invertebrates – 8–17 September 2004*. Report prepared for the International Waters Programme, Honiara, the Solomon Islands.

Massin C. & Lane, D. 1991. Description of a new species of sea cucumber (Stichopodidae, Holothuroidea, Echinodermata) from the Eastern Indo-Malayan Archipelago: *Thelenota rubralineata* n. sp. *Micronesica.* 24 (1): 57–64.

Mercier, A., Battaglene, S.C. & Hamel, J.-F. 2000. Settlement preferences and early migration of the tropical sea cucumber *Holothuria scabra*. *Journal of Experimental Marine Biology and Ecology*, 249: 89–110.

Mohammednowshad, B., Idreesbabu, K. & Sureshkumar, S. 2021. Habitat-wise variability in the diversity of sea cucumbers in Lakshadweep Archipelago, North-Western Indian Ocean. *Regional Studies in Marine Science*, 45: 101805

Moore, B., Bosserelle, P., Mailau, S., Siaosi, V., Siaosi, F., Havea, T., & Malimali, S. 2017 The status of sea cucumbers in the Kingdom of Tonga in 2016. Pacific Community, Noumea

Moore, J. & Marieg, F. 1986. *Yap Fishing Authority Sea cucumber Development Project: Ngulu Atoll, 12 February to 29 April 1986*. Yap Fishing Authority, Kolonia.

Mongabay. 2020. Lakshadweep unveils world's first sea cucumber conservation reserve. Mngabay Environmental News, India. https://india.mongabay.com/2020/05/lakshadweep-unveils-worlds-first-sea-cucumber-conservation-reserve.

MPEDA. 1989. *Seaweed, sea urchin and sea cucumber: handbook on aquafarming*. Marine Products Export Development Authority, Kochi, India.

MSG Secretariat. 2015a. *MSG roadmap for inshore fisheries management and sustainable development 2015–2024.* SPC, Pacific Community.

MSG Secretariat. 2015b. *Memorandum of understanding on technical cooperation in coastal fishery and aquaculture development.* Port Vila, Melanesian Spearhead Group.

Mulochau, T. 2018. Monitoring commercially important sea cucumber populations in the reefs of Mayotte (Indian Ocean). *SPC Bêche-de-mer Information Bulletin*, 38: 21–28.

Musick, J.A. 1999. Criteria to define extinction risk in marine fishes: *The American Fisheries Society Initiative*, 24(12): 6–14.

Muthiga, N.A., Ochiewo, J., Kawaka, J.A. 2010. Strengthening Capacity to sustainably manage sea cucumber fisheries in the Western Indian Ocean. *SPC Bêche-de-mer Information Bulletin*, 30: 3–9

Muthiga, N.A. & Conand, C., ed. 2014. *Sea cucumbers in the western Indian Ocean: improving management of an important but poorly understood resource*. WIOMSA Book Series No. 13. 74 pp.

Ndirangu, S. 2000. Village based larviculture and stock enhancement of sea cucumbers (Echinodermata:Holothuroidea) on the Kenyan coast. Final Technical Report, Biodiversity Support Fund, 66pp

Ochiewo, J, de la Torre-Castro M, Muthama C., Nthuta JM (2010) Socio-economic features**Odhiambo, P.** 2007. Population aspects of sea cucumber fisheries (Echinodermata: Holothuroidea) in protected and unprotected reefs along the southern Kenya coast. MSc University of Kenya. Ocean & Coastal Management 53(4):192-202 Nairobi.

Olavides, R., Edullantes, C. & Juinio-Meñez, M. 2010. Assessment of the sea cucumber resource and fishery in the Bolinao-Anda reef system. *Science Diliman*, 22 (2): 1–12.

Pakoa, K., Lasi, F., Tardy, E. & Friedman, K. 2009. The status of sea cucumbers exploited by Palau's subsistence fishery. PROCFish/C and CoFish report to the Palau Bureau of Marine Resources. Secretariat of the Pacific Community, Noumea, New Caledonia.

Pakoa, K., Saladrau, W., Lalavanua, W., Valotu, D., Tuinasavusavu, I., Sharp, M. & Bertram, I. 2013. *The status of sea cucumber resources and fisheries management in Fiji: September 2013*. Noumea, Pacific Community.

Pakoa, K., Teri, J., Leqata, J., Tua, P., Fisk, D. & I. Bertram. 2014. *Solomon Islands sea cucumber resource status and recommendations.* Noumea, Pacific Community.

Pinca, S., Kronen, M., Friedman, K., Magron, F., Chapman, L., Tardy, E., Pakoa, K., Awira, R., Boblin, P. & Lasi, F. 2010. *Regional assessment report: profiles and results from survey work at 63 sites across 17 Pacific Island countries and territories (1 March 2002 to 31 December 2009).* Secretariat of the Pacific Community, Noumea, New Caledonia.

Pollom, R. 2022. *Proposal to establish IUCN SSC sea cucumber specialist group*. Report prepared for the IUCN, the Gland, Switzerland.

Potuku, T. 1992. *Assessment of sedentary resources at the West Coast of Kavieng, New Ireland Province, Papua New Guinea*. Report prepared for the Department of Fisheries and Marine Resources, Port Moresby, Papua New Guinea.

Pouget, A. 2005. Abundance and distribution of holothurians on the fringing reef flats of Grande Terre, Mayotte, Indian Ocean. *SPC Bêche-de-mer Information Bulletin*, 21: 22–26.

Preston, G.L. & Lokani, P. 1990. *Report of a survey of the sea cucumber resources of Ha'apai, Tonga (No. 1)*. South Pacific Commission, Noumea, New Caledonia.

Purcell, S. 2010. *Managing Sea cucumber fisheries with an ecosystem approach*. Fisheries and Aquaculture Technical Paper No. 520, Rome, FAO.

Purcell, S. 2014. Value, market preferences and trade of bêche-de-mer from Pacific Island sea cucumbers. *PLoS ONE,* 9(4): e95075. doi:10.1371/journal.pone.0095075

Purcell, S.W., Blockmans, B.F. & Nash, W.J. 2006. Efficacy of chemical markers and physical tags for large-scale release of an exploited holothurian. *J. Exp. Mar. Biol. Ecol.*, 334, 283–293.

Purcell, S., Gossuin, H. & Agudo, N. 2009. *Status and management of the sea cucumber fishery of La Grande Terre, New Caledonia.* Penang, WorldFish.

Purcell, S., Hair, C. & Mills, D. 2012. Sea cucumber culture, farming and sea ranching in the tropics: progress, problems and opportunities. *Aquaculture,* 368–369: 68–81.

Purcell, S., Mercier, A., Conand, C., Hamel, J.-F., Toral-Granda, M., Lovatelli, A. & Uthicke, S. 2013. Sea cucumber fisheries: global analysis of stocks, management measures and drivers of overfishing. *Fish and Fisheries*, 14: 34–59.

Purcell, S.W., Samyn, Y. & Conand, C. 2012. Commercially important sea cucumbers of the world. FAO Species Catalogue for Fishery Purposes. No. 6. Rome, FAO. 150 pp. 30 colour plates.

Purcell S.W., Lovatelli A., and Pakoa K. 2014 Constraints and solutions for managing Pacific Island sea cucumber fisheries with an ecosystem approach. Marine Policy 45:240–250 (Available at https://doi.org/10.1016/j.marpol.2013.11.005)

Purcell, S.W., Piddocke, T.P., Dalton, S.J. & Wang, Y.-G. 2016. Movement and growth of the coral reef holothuroids *Bohadschia argus* and *Thelenota ananas*. *Mar. Ecol. Prog. Ser*., 551: 201–214.

Purcell, S., Williamson, D. & Ngaluafe, P. 2018. Chinese market prices of bêche-de-mer: implications for fisheries and aquaculture. *Marine Policy,* 91: 58–65.

Ramohia, P. 2006. Fisheries resources: commercially important macro-invertebrates. *In* Green, A., Lokani, P., Atu, W., Ramohia, P., Thomas, P. & Almany, J., eds. 2006. *Solomon Islands marine assessment: technical report of survey conducted May 13 to June 17, 2004.* TNC Pacific Island Countries Report No. 1/06. Brisbane, The Nature Conservancy.

Rao, M. & Kumar, T. 2014. Studies on the diversity and shallow waters of echinoderms from Port Blair Bay, South Andaman Island, India. *Journal of Marine Biology and Oceanography,* 3 (2): 1–8.

Rasmussen, A. 2015. *In the absence of the gift: new forms of value and personhood in a Papua New Guinea Community.* New York, Berghahn Books.

Row, F. & Doty, J. 1977. The shallow-water holothurians of Guam. *Micronesica,* 13 (2): 217–250.

Samyn, Y. 2000. Conservation of aspidochirotid holothurians in the littoral waters of Kenya. *SPC Bêche-de-mer Information Bulletin*, 13: 12–17.

Sapatu, M. & Pakoa, K. 2013. *The status of sea cucumber resources and recommendations for management in Samoa.* Noumea, Pacific Community.

Sastry, D.R.K. 2005. Echinodermata of Andaman and Nicobar Islands, Bay of Bengal: an annotated list. *Rec. Zool. Surv. India*, Occasional Paper No. 233: 1–207.

Sastry, D.R.K., Marimuthu, N. & Rajan R. 2019. Echinodermata of Lakshadweep, Arabian Sea with the description of a new genus and a species. *Rec. Zool, Surv. India*, 119(4): 348–372.

Shedrawi, G., Bosserelle, P., Malimali, S., Fatongiatau, V., Mailau, S., Magron, F., Havea, T., Finau, S., Finau, S., Aleamotua, P. & Halford, A. 2020. *The status of sea cucumber stocks in the Kingdom of Tonga*. Noumea, Pacific Community. ISBN 978-982-00-1280-6.

Shedrawi, G., Molai, C., Tanielu, E., Fepuleai, F., Taulapapa, L.J., Tiitii, S., Falemai, S., La'anna, R., Lesa, M., Kora, J., Bosserelle, P., Gislard, S. & Halford, A. 2021. The status of sea cucumber populations in Samoa in 2019. Noumea, Pacific Community. ISBN 978-982-00-1382-7. https://www.spc.int/DigitalLibrary/Doc/FAME/Reports/Shedrawi_21_status_sea_cucumber_Samoa.pdf

Shedrawi G., Tua P., Aram D., Posala R., Buarafi A., Rachna P.P., Magron F., Bosserelle P., Gislard S., and Halford A.R. 2022. An assessment of sea cucumber populations at Lord Howe Atoll (Ontong Java), Solomon Islands, to inform the development of the community-based fisheries management plan.

Shepherd S. & Partington D. 1995. Studies on southern Australian abalone (Genus Haliotis), 16. Recruitment, habitat and stock relations. Marine and Freshwater Research 46:669.

Skewes, T., Kinch, J., Polon, P., Dennis, D., Seeto, P., Taranto, T., Lokani, P., Wassenberg, T., Koutsoukos, A. & Sarke, J. 2002. *Research for the sustainable use of bêche-de-mer resources in the Milne Bay Province, Papua New Guinea*. Report prepared for the National Fisheries Authority, Port Moresby, Papua New Guinea, and the Australian Centre for International Agricultural Research, Sydney, New South Wales, Australia.

Skewes, T., Smith, L., Dennis, D., Rawlinson, N., Donovan, A. & Ellis, N. 2004. *Conversion ratios for commercial bêche-de-mer species in Torres Strait*. AFMA Project No. R02/1195. Australian Fisheries

Management Authority Torres Strait Research Program Final Report. Canberra. ISBN 1 876996 74 9. doi: 10.13140/RG.2.1.3352.0167

Soliman, T., Reimer, J., Kawamura, I., van der Meij. S., Reijnen, B. & Paulay, G. 2019. Description of the juvenile form of the sea cucumber *Thelenota anax* HL Clark, 1921. *Marine Biodiversity,* 49: 547– 554.

SPC (Secretariat of the Pacific Community). 2003. *Pacific Island sea cucumber and bêche-de-mer identification cards*. Noumea, SPC.

SPC (Secretariat of the Pacific Community). 2015. *A new song for coastal fisheries – pathways to change: the Noumea strategy*. Noumea, Pacific Community.

Sweet, M. J., & Bateman, K. S. 2016. Diseases in marine invertebrates associated with mariculture and commercial fisheries. Journal of sea research, 113, 28–44.

Tabunakawai-Vakalalabure M., Kuridrani N., Lalavanua, W., Mangubhai S. and Bertram I. 2017. Pre-export sizes of bêche-de-mer in Fiji. pp. 38–46. In: S. Mangubhai, W. Lalavanua and S.W. Purcell (eds). Fiji's Sea Cucumber Fishery: Advances in Science for Improved Management. Wildlife Conservation Society. Report No. 01/17. Suva, Fiji.

Tardy, E. & Pakoa, K. 2009. *The status of sea cucumbers in Yap State, Federated States of Micronesia.* Noumea, Secretariat Community.

The Hindu. 2022. 650 kgs of processed sea cucumbers seized in Ramanathapuram. THG PUBLISHING PVT LTD. Cited 18 July 2022. www.thehindu.com/news/cities/Madurai/650-kg-of-processed-sea-cucumbers-seized/article65558289.ece

The News Minute. 2020. Lakshadweep unveils world's first sea cucumber conservation reserve. www.thenewsminute.com/article/lakshadweep-unveils-world-s-first-sea-cucumber-conservation-reserve-124095.

Toral-Granda, V., Lovatelli, A. & Vasconcellos, M., eds. 2008. *Sea cucumbers: a global review of fisheries and trade*. FAO Fisheries Technical Paper No. 516, pp. 7–55. Rome, FAO.

UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP

Uthicke, S., Benzie, J.A. 2003. Gene flow and population history in high dispersal marine invertebrates: mitochondrial DNA analysis of Holothuria nobilis (Echinodermata: Holothuroidea) populations from the Indo-Pacific. *Mol Ecol*., 12(10): 2635–48. doi: 10.1046/j.1365-294x.2003.01954.x.

Uthicke, S., Welch, S.D. & Benzie, J.A.H. 2004. Slow growth and lack of recovery in overfished holothurians on the Great Barrier Reef: evidence from DNA fingerprints and repeated large-scale surveys. *Cons Biol*., 18(5): 1395–1404.

Uthicke, S., Schaffelke, B. & Byrne, M. 2009. A boom-bust phylum? Ecological and evolutionary consequences of density variations in echinoderms. *Ecol. Mon.,* 79(1): 3–24. https://doi.org/10.1890/07-2136.1

WION. 2021. Indian Coast Guard seizes two tonnes of endangered sea cucumber worth Rs 80 million. Wion, Chennai, India. Cited 28 July 2022. www.wionews.com/india-news/indian-coast-guard-seizes-two-tonnes-of-endangered-sea-cucumber-worth-rs-80-million-414256

Wolfe, K. & Byrne, M. 2022. Overview of the Great Barrier Reef sea cucumber fishery with focus on vulnerable and endangered species. *Biological Conservation,* 266: 109451.

Tables and figures

Table 25. Trends and application of the decline criterion, summary of species trend information.

Oceania

Country	Indicator	Indicative reflection to criteria		Confidence
		T. ananas	***T. anax***	
Australia	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	Does not meet	High
	Size/weight	-	-	-
	Trade	Does not meet	Does not meet	High
Fiji	Range	Does not meet	Does not meet	High
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	High
Vanuatu	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	Does not meet	Medium
	Size/weight	-	-	
	Trade	Does not meet	Does not meet	High
Solomon Islands	Range	Meets	Insufficient data	Medium
	Abundance/density	Meets	Does not meet	Medium
	Size/weight	Insufficient data	Insufficient data	
	Trade	Does not meet	Does not meet	
Papua New Guinea	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	Does not meet	Low
	Size/weight	-	-	
	Trade	Does not meet	Does not meet	
New Caledonia	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	Does not meet	High
	Size/weight	Does not meet	Does not meet	High
	Trade	Does not meet	Does not meet	High
Samoa	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	-	High
	Size/weight	-	-	
	Trade	-	-	
Tonga	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	Does not meet	High
	Size/weight	Does not meet	Does not meet	High
	Trade	Does not meet	Does not meet	High
French Polynesia	Range	Does not meet	Does not meet	High
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
Federated States of Micronesia	Range	Does not meet	Does not meet	High
	Abundance/density	-	-	
	Size/weight	-		
	Trade	-	-	
The Marshall Islands	Range	Does not meet	Does not meet	Moderate
	Abundance/density	Does not meet	Does not meet	Medium
	Size/weight	-	-	

Country	Indicator	Indicative reflection to criteria		Confidence
	Trade	-	-	
Palau	Range	Does not meet	Not present?	Low
	Abundance/density	Does not meet	-	Medium
	Size/weight	-	-	
	Trade	-	-	
Niue	Range	Does not meet	Not present?	High
	Abundance/density	Does not meet	Insufficient data	High
	Size/weight	-	-	
	Trade	-	-	
Guam	Range	Does not meet	-	High
	Abundance/density	-	Not present?	
	Size/weight	-	-	
	Trade	-	-	

Indian Ocean East

Country	Indicator	Indicative reflection to criteria		Confidence
		T. ananas	***T. anax***	
Philippines (the)	Range	Does not meet	Does not meet	Low
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
Indonesia	Range	Does not meet	Does not meet	Moderate
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	Insufficient data	-	Low
Viet Nam	Range	Insufficient data	Not present?	Low
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	Insufficient data	-	Low
Sri Lanka	Range	Does not meet	Does not meet	Moderate
	Abundance/density	-	Does not meet	
	Size/weight	-	-	
	Trade	-	-	
India	Range	Does not meet	Not present?	Moderate
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	

Indian Ocean West

Country	Indicator	Indicative reflection to criteria		Confidence
		T. ananas	***T. anax***	
Egypt	Range	Meets	-	High
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
Eritrea	Range	Does not meet	Not present?	Low
	Abundance/density	-	-	
	Size/weight	-	-	

Country	Indicator	Indicative reflection to criteria		Confidence
	Trade	-	-	
Seychelles	Range	Does not meet	Does not meet	High
	Abundance/density	Does not meet	Does not meet	Moderate
	Size/weight	-	-	
	Trade	-	-	
Réunion	Range	Does not meet	-	High
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
Mayotte	Range	Does not meet	Does not meet	Low
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
Kenya	Range	Does not meet	Does not meet	Medium
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
United Republic of Tanzania	Range	Present (Insufficient data)	Present (Insufficient data)	Low
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	
Madagascar	Range	Present (Insufficient data)	Present (Insufficient data)	Low
	Abundance/density	-	-	
	Size/weight	-	-	
	Trade	-	-	

Table 26. Density data taken from published reports of snapshot surveys in Fiji

Year	Location	*T. ananas*		*T. anax*	
		Manta tow	Transect	Manta tow	Transect
2003	Viti Levu and Vanua Levu	0.6 ± 0.2		0.3 ± 0.2	
2009	Viti Levu and Vanua Levu	0.5 ± 0.3	1.5 ± 0.9		
2012	Kubulau District	0.14		0.27	
2012	Bau District	0.29		1	
2013	Lau Province	0.23 ± 0.13		0.69 ± 0.33	1.54 ± 1.54

Source: Jupiter, S., Saladrau, W. & Vave, R. 2013. *Assessment of sea cucumber fisheries through targeted surveys of Lau Province, Fiji.* Suva, Wildlife Conservation Society.

Table 27. Mean density records calculated from two different methods (Manta tow and transect) across provinces in the Solomon Islands.

	T. ananas		*T. anax*		*T. rubralineata*	
Province	**Manta tow**	**Transects**	**Manta tow**	**Transects**	**Manta tow**	**Transects**
Chupokopi	2.1		2.1			
Kia	24.4	1.0	7.2	0.4		
Marau MPA	5.2	8.9		0.6		
Marau	2.9	1.9		0.9		
Ngella MPA	6.9			2.8		
Negalla		1.3				
Russel Island				0.4		
Santa Cruz				0.3		
Star Harbour		0.9				
Taro	3.2	2.0		1.8		
Tatamba	11.6				39.4	
Ugi		4.2				
West Guadalcanal	19.6	0.8		0.8		

Source: Pakoa, K., Teri, J., Leqata, J., Tua, P., Fisk, D. & I. Bertram. 2014. *Solomon Islands sea cucumber resource status and recommendations.* Noumea, Pacific Community.
Note: MPA = marine protected area.

Table 28. Percentage of stations where *Thelenota* species were observed out of the total number of stations within each survey.

Species	**Year**	**Stations observed (%)**	**Stations (N)**
Thelenota ananas	2006	6.87	131
	2012	10.81	370
	2019	***1.27***	***314***
Thelenota anax	2006	1.53	131
	2012	5.14	370
	2019	3.18	314
Thelenota rubralineata	2006	0	131
	2012	0.27	370
	2019	0.32	314

Bold and italicized indicates a decline in prevalence.

Source: Solomon Islands Ministry of Fisheries and Marine Resources.

Table 29. Mean ± SE of density (ind/ha) of *T. ananas* and *T. anax* in Papua New Guinea.

Species	Year	Mean	Standard error	Regions surveyed
T. ananas	2018	1.94	1.01	8
	2019	0.21	0.07	8
	2020	0.11	0.06	4
	2021	1.04	0.40	13
T. anax	2018	1.26	0.43	7
	2019	0.25	0.09	8
	2020	0.08	0.01	3

Source: Papua New Guinea National Fisheries Authority.

Table 30. Mean ± SE of density (ind/ha) unweighted by area of habitat of *T. ananas* and *T. anax* in New Caledonia in 2021.

Species	Density	SE	Provincial zones(N)
T.ananas	10.52	3.98	7
T.anax	13.27	5.94	5

Source: Gilbert, A., Georget, S., Guillemot, N., Ton, C., Léopold, M., Purcell, S., Van Wynsberge, S. & Andréfouët, S. (forthcoming). *État des lieux des stocks d'holothuries commerciales de Nouvelle-Calédonie (2021–2022).*

Table 31. Mean ± SE of density (ind/ha) of *T. ananas* and *T. anax* in Tonga.

Year (survey method)	*T. ananas*	*T. anax*
1990[1]	2.97 ± 1.17	13.34 ± 5.66
1996 (lagoon)[2]	0.44 ± 0.44	3.57 ± 1.55
2004 (reef flat)[2]	3.92 ± 0.32	4.13 ± 0.35
2004 (lagoon)[3]	1.25 ± 0.44	14.89 ± 1.40
2016[4,5]	0.82 ± 0.36	2.59 ± 0.68
2019[5]	2.33 ± 0.92	9.2 ± 2.71

Source: Tonga Ministry of Fisheries; Friedman, K., Lokani, P., Fale, P., Mailau, S., Ramohia, P. & Ramofafia, C. 2004. *Survey of the sea cucumber resources of Ha'apai, Tonga*. Report prepared for the Tongan Ministry of Fisheries, Tonga'tapu, Tonga. Shedrawi, G., Bosserelle, P., Malimali, S., Fatongiatau, V., Mailau, S., Magron, F., Havea, T., Finau, S., Finau, S., Aleamotua, P. & Halford, A. 2020. *The status of sea cucumber stocks in the Kingdom of Tonga*. Noumea, Pacific Community. ISBN 978-982-00-1280-6.

[1) Survey year (1990) SPC (45 × 5 min swim searches, area estimates from flowmeter available; (Preston and Lokani 1990); 2) Survey year (1996) Fishery just before closure, SPC (100 m transects using fishing line, 4 m each side of the line;(Lokani 1996). 3) Survey year (2004) SPC manta tow deep water (top mean) and lagoon transects (bottom mean) (each transect 300 × 2) (Friedman et al. 2011). 4) Survey year (2016) SPC Sea Cucumber Day Searches (timed swim with 5 m belt transect width; start and end recorded with GPS) (Moore et al. 2017); 5) Survey year (2019) SPC reef benthos transect (six 40 m × 2 m belt transect at each station)].

Table 32. Mean sizes of *T. ananas* in 2006 and 2012. Very few length measurements were made and confidence is low for estimates of mean length of the population.

Scientific.name	Year	mean length (mm)	N	SE	Relative to Length at first maturity
Thelenota ananas	2006	415	10	49.47	1.38
	2012	373	22	24.60	1.24

Source: Solomon Islands Ministry of Fisheries and Marine Resources.

Table 33. Live and Dry size limits for Thelenota species agreed by the Melanesian Spearhead Group members. (Govan, 2017).

English name	Scientific name	Live length (cm)	Dry length (cm)
Prickly redfish	*Thelenota ananas*	45	20
Amberfish	*T. anax*	40	15
Candy cane	*T. rubralineata*	30	15

Table 34. Productivity of genus *Thelenota*.

SPECIES	PARAMETER	INFORMATION	SOURCE	COMMENTS
DISTRIBUTION				
T. ananas	widely distributed throughout Indo-Pacific		Conand *et al*., 2013a; Kinch *et al*., 2008	
T. anax	widely distributed throughout Indo-Pacific		Conand *et al*., 2013a; Kinch *et al*., 2008	
T. rubralineata	distributed throughout E-Pacific		Kinch., 2005; Lane, 2008	
REPRODUCTION				
T. ananas		Year round		
T. ananas & *T. anax*		late sexual maturity	Proposal	
T. ananas		potential fecundity	Conand *et al*., 2013a; Conand, 1998	Suggested to be low
GENERATION LENGTH				
T. ananas & *T. anax*		not known	Proposal Conand *et al*., 2013a	echinoderms are not considered to go through senescence, and therefore generation length may exceed several decades.
T. ananas & *T. anax*		not known	Conand *et al*., 2013a	echinoderms do not go through senescence and therefore no end of life suggested
T. rubralineata		not known		Unknown
All		Juvenile sea cucumbers are rarely observed in the field	Conand, 1989; Sweet *et al*., 2016, also see Soliman *et al*. 2019	

Table 35. Trends in status of genus *Thelenota*.

SPATIAL COVERAGE	INDICATOR/ PERIOD	EXTENT OF DECLINE	CONFIDENCE (H/M/L)	SOURCES
T. ananas				
Many	Per ha density	Population density 6 indiv./ha in species' most preferred habitat	H	Conand *et al*., 2013a; Purcell *et al*., 2009; Andréfouët & Tagliaferro, 2020 ; Conand *et al*., 2022
French Polynesia		Population density 7.13 indiv./ha	H	Andréfouët & Tagliaferro, 2020
Eritrea		Population density 3.5 indiv./ha	M/L	Conand *et al*., 2013a; Kaeleb *et al*., 2008
Torres Strait	2019–2020	(1.81 to 2.41) 1.73 indiv./ha	H	Hart *et al*., 2022, generally consistent with densities of 1–2 indiv./ha reported elsewhere (Conand *et al*., 2013a; Skewes, 2010).
T. anax				
French Polynesia		<0.2 of individuals per diving minute	H	Andréfouët, 2019
Papua New Guinea, Many	1992 to 2006	1 to 0.7 indiv./ha	M	Conand *et al*., 2013b; Kaly *et al*., 2007
Indoneisa		2.5 to 7.6 indiv./ha	M	Lane & Limbong, 2015
French Polynesia: 23 islands and atolls in Society, Tuamotu and Gambier archipelagos		0.5 individuals per minute diving	H	Andréfouët *et al*., 2019
Samoa		absent	L	Vunisea *et al*., 2008
Tonga	1996–2019 (moratorium on fishing and export of sea cucumbers)	3.57 ± 1.55 indiv./ha to 9.2 ± 2.71 indiv./ha No decline	H	Shedrawi, 2020
New Caledonia		14 indiv./ha 2021 (waiting on analysis - unpublished data)	M	Conand, 2006
Sri Lanka		26 indiv./ha	H	Dissanayake & Stefansson, 2012
Guam		1 specimen from 74 sites		Kerr *et al*., 2017

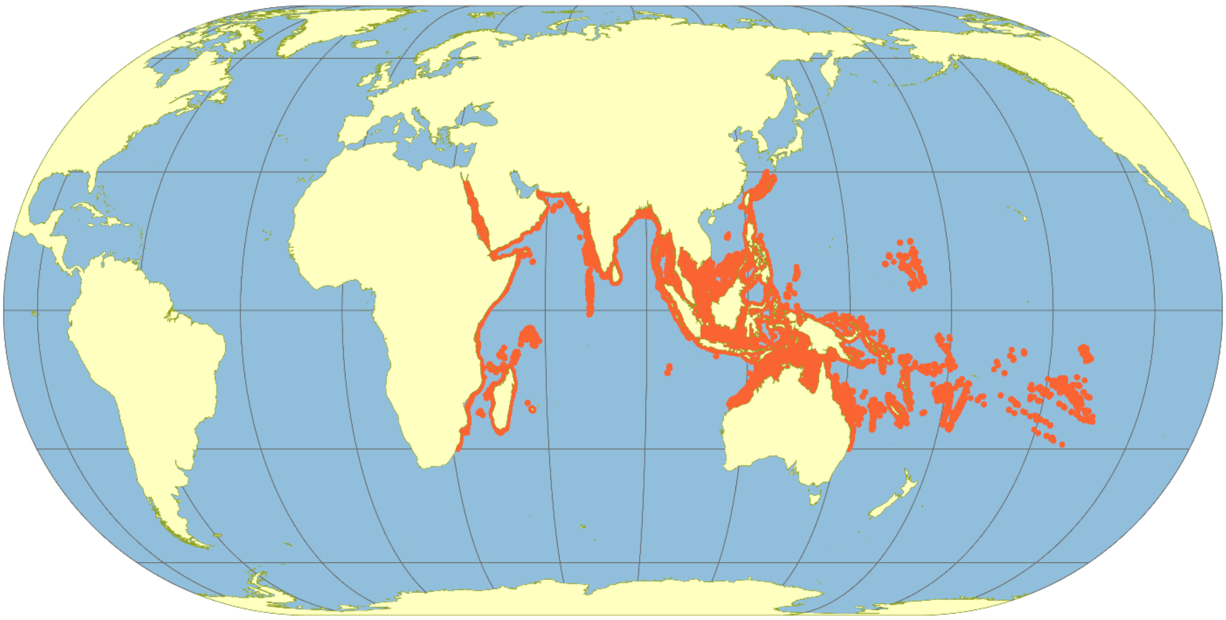
SPATIAL COVERAGE	INDICATOR/ PERIOD	EXTENT OF DECLINE	CONFIDENCE (H/M/L)	SOURCES
T. rubralineata				
Many		less than 1 indiv./ha	H	Conand *et al*., 2013b; Lane, 1999ab; Pinca at el., 2010
Many		0.1 indiv./ha. 4 specimens in 1000 survey dives	H	Conand *et al*., 2013b; Skewes *et al*., 2002; Kinch 2005
Indonesia		1 indiv./220m2	M	Conand *et al*., 2013b; Lane, 1999ab
Papua New Guinea, Milne Bay		4 specimens of *T. rubralineata* from 1126 dives over an area of 256,000 km^2	M	Lane, 2000
Solomon Islands		45 indiv./ha	L	Lane, 2000
Guam		Single ind.	H	Kerr *at al.,* 1992 cited in Kerr *et al.,* 2017

Table 36. Description of information used in assessments of trends in status of genus *Thelenota*.

SPECIES	REFERENCE	INDICATOR Time-series data; other	RELIABILITY INDEX SCORE 0–5 (see Annex E)	COMMENT
T. ananas	IUCN Red List : Conand *et al*., 2013a;	IUCN estimates decline of 80– 90% in at least 50% of its range	0	Spatial (limited/med/broad): 50 percent of its range If not used, summary for why excluded: There is no supporting information or data to support this finding; this includes a lack of data and/or citations in the IUCN estimates and Conand *et al* 2013a
T. anax and *T. rubralineata*	Conand *et al*., 2013b; Conand *et al*., 2013c	Data Deficient	Not scored	Basic. Relies on market perception due to rarity and price If not used, summary for why excluded:
T. ananas	IUCN RL Statement (2013)	Depleted in at least 50 percent of many parts its range	0	Spatial (limited/med/broad): 50 percent of its range (Philippines, PNG, India, Indonesia, Madagascar) If not used, summary for why excluded: Found no supporting information or data to support this finding; this includes a lack of data and/or citations in the IUCN estimates (Conand *et al.,* 2013a)
T. ananas	Conand *et al*., 2013a	Overexploited in the majority if its range	0	If not used, summary for why excluded: No supporting information/records supporting over exploitation of *Thelenota* species, citation Conand *et al* 2013a indicate statistical records not well known.
T. ananas	Bruckner, 2006	"generally overfished"	Not scored	If not used, summary for why excluded: No supporting information/records There is no supporting information or data to support this finding. No reference is presented.
T. ananas	Conand *et al*., 2013a; Purcell *et al*., 2009	New Caledonia 1980s surveys 10–30 ind/ha to 2010s surveys 6 ind/ha 60 percent decline	3–5	Spatial (limited/med/broad): Not the same locations surveyed Methods (basic/med/robust): robust methods
T. ananas	(Friedman *et al*., 2011)	Tonga, deep-water occurrence declined from 48 in 1984 (1 h search period at 21 sites) to just 4 in 2004 (100 m transects, even after a fishing moratorium)	4–5	

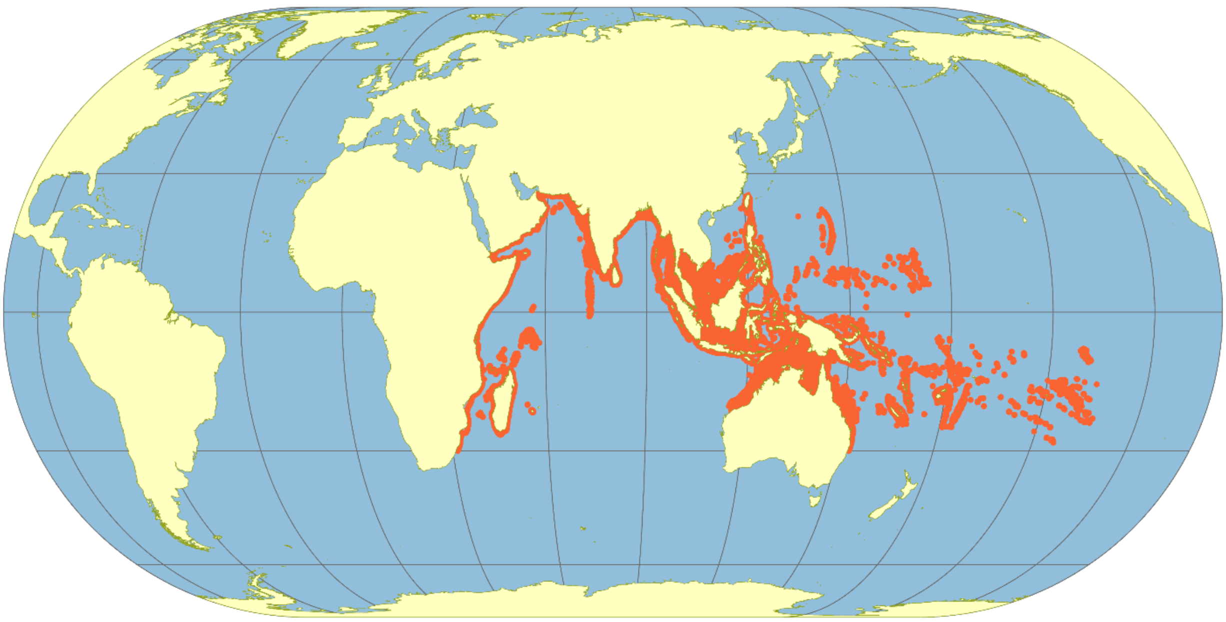
SPECIES	REFERENCE	INDICATOR Time-series data; other	RELIABILITY INDEX SCORE 0–5 (see Annex E)	COMMENT
T. ananas	Conand, *et al*. 2013a; Skewes, 2010	Torres Strait Stable at 1–2 ind/ha	4–5	
T. ananas	Conand *et al*., 2013a; Bruckner *et al*., 2003	India, catch per unit effort and size of specimens declined	Not scored	
T. ananas	Aumeeruddy & Conand, 2008; Conand, 2008	Seychelles; considered fully exploited	Not scored	
T. ananas	Hasan, 2019	48.1 indiv./100 m2 in 2000 5.6 indiv./100 m2 in 2006 not recorded in 2016	3–5	Spatial (limited/med/broad): Spatially restricted
T. anax	Conand *et al*., 2013c; Kaly *et al*., 2007	1 indiv./ha to 0.7 indiv./ha 1992– 2006 in Papua New Guinea	3–5	
T. anax	Choo, 2008	Average size decline	Not scored	
T. anax	Friedman *et al*., 2011	Tonga, 48 occurrences in 1984 (1 h search period at 21 sites) 21 in 1996 41 in 2004 (100 m transects, 7 years after a moratorium.	3–5	
All sea cucumbers	Purcell *et al*. 2013	10 percent global sea cucumber fisheries depleted 38 percent over exploited, 14 percent fully exploited.	Not scored	
T. anax	Dissanayake and Stefansson, 2010	Total biomass (t) and maximum sustainable yield, MSY (t y−1) as 10 percent of total stock	4–5	Methods (basic/med/robust): robust: estimated by surveying 1307 km2 and 1779 km2 by an underwater visual census (UVC) in June and October 2008
T. ananas	Bruckner, 2006	Densities are generally low. Its potential fecundity is low and sexual maturity late	Not scored	If not used, summary for why excluded: There is no supporting information or data to support this finding. No reference is cited.

Figure 34. Distribution of prickly redfish (*Thelenota ananas*)



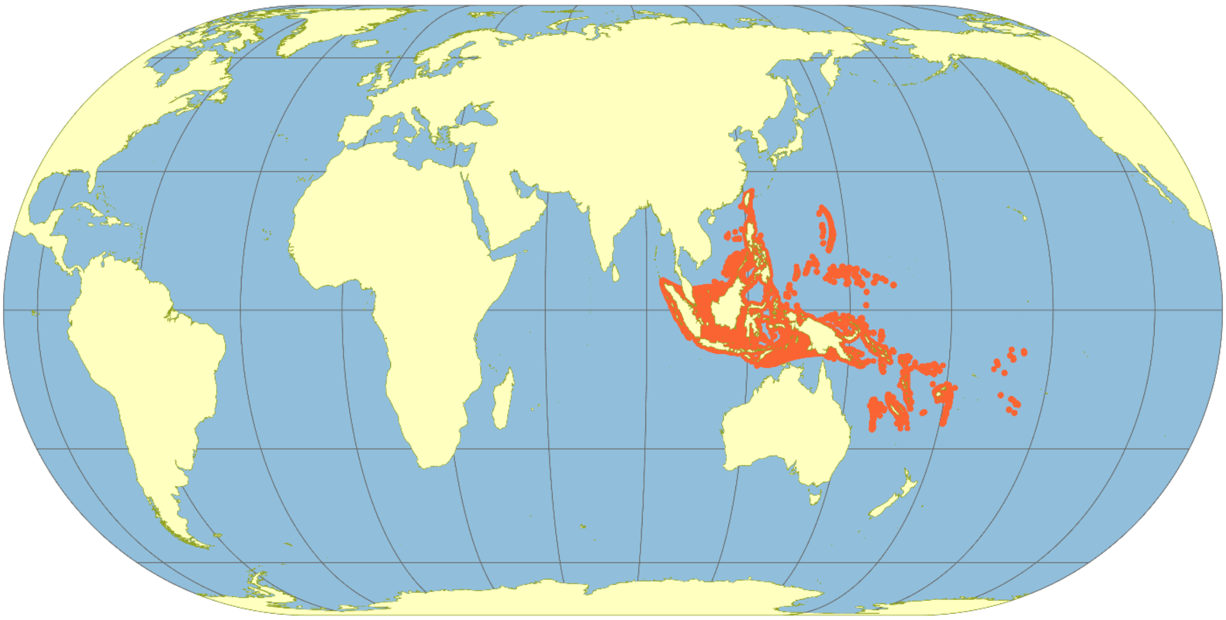
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Purcell, S.W., Samyn, Y. & Conand, C. 2012. *Commercially important sea cucumbers of the world*. FAO Species Catalogue for Fishery Purposes. No. 6. Rome, FAO. 150 pp. 30 colour plates.; Conand, C., Gamboa, R. & Purcell, S. 2013a. *Thelenota ananas*. *The IUCN Red List of Threatened Species 2013*: e.T180481A1636021. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180481A1636021.en)

Figure 35. Distribution of amberfish (*Thelenota anax*)



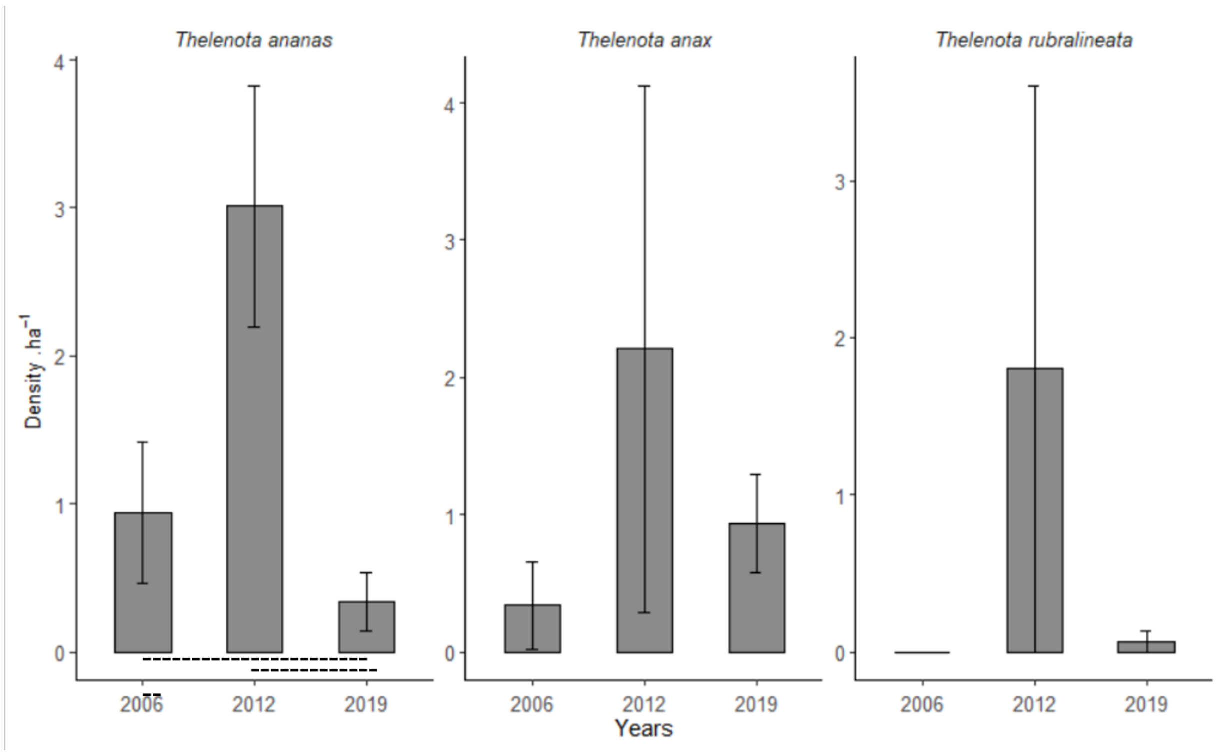
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Purcell, S.W., Samyn, Y. & Conand, C. 2012. *Commercially important sea cucumbers of the world*. FAO Species Catalogue for Fishery Purposes. No. 6. Rome, FAO. 150 pp. 30 colour plates.; Conand, C., Purcell, S. & Gamboa, R. 2013b. *Thelenota anax*. *The IUCN Red List of Threatened Species 2013:* e.T180324A1615023. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180324A1615023.en)

Figure 36. Distribution of candy-canefish/lemonfish (*Thelenota rubralineata*)



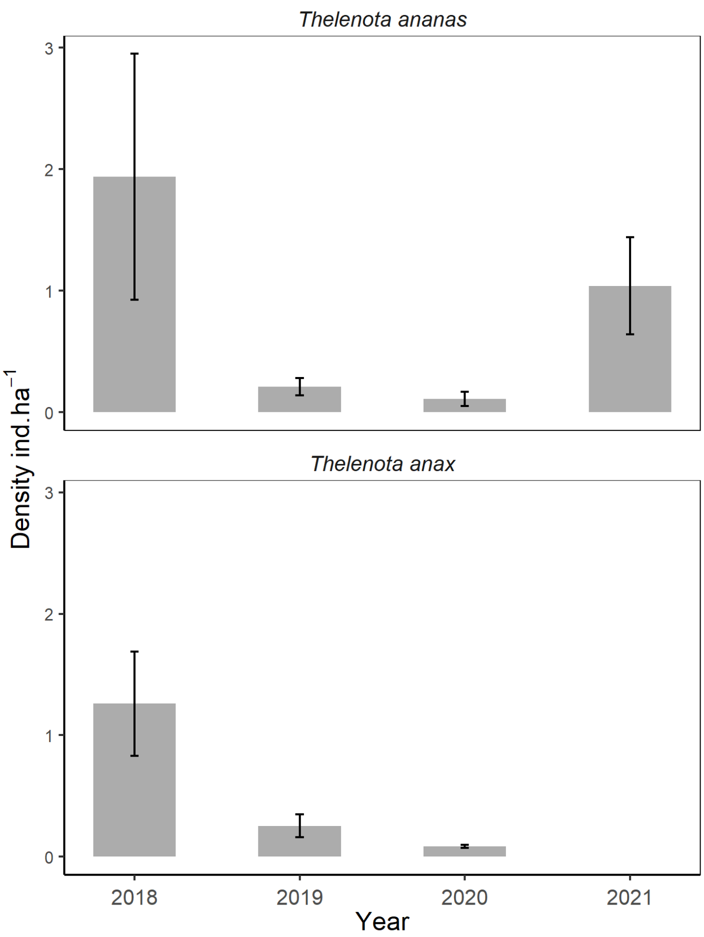
Source: UN. 2022. Map of the World [online]. Cited 25 August 2022. https://geoapps.dfs.un.org/Html5Viewer/index.html?viewer=CLEARMAP; modified (Purcell, S.W., Samyn, Y. & Conand, C. 2012. *Commercially important sea cucumbers of the world*. FAO Species Catalogue for Fishery Purposes. No. 6. Rome, FAO. 150 pp. 30 colour plates.; Conand, C., Gamboa, R. & Purcell, S. 2013c. *Thelenota rubralineata*. *The IUCN Red List of Threatened Species 2013*: e.T180285A1610697. In: International Union for Conservation of Nature and Natural Resources [online]. Cambridge, UK. Cited 18 July 2022. https://dx.doi.org/10.2305/IUCN.UK.2013-1.RLTS.T180285A1610697.en)

Figure 37. Means (ind/ha) ± standard error from surveys carried out in 2006, 2012 and 2019 across the Solomon Islands. Black dashed lines below bars indicate significant differences (P<0.05; generalized linear mixed effect model).



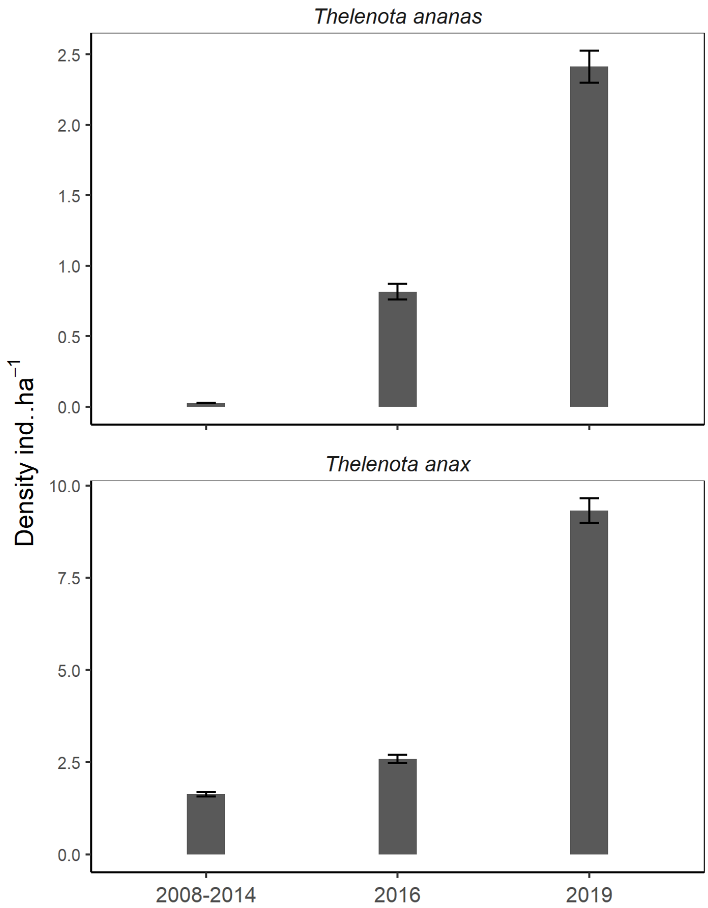
Source: Solomon Islands Ministry of Fisheries and Marine Resources.

Figure 38. Density of sea cucumbers in Papua New Guinea. Means (ind/ha) ± standard error.



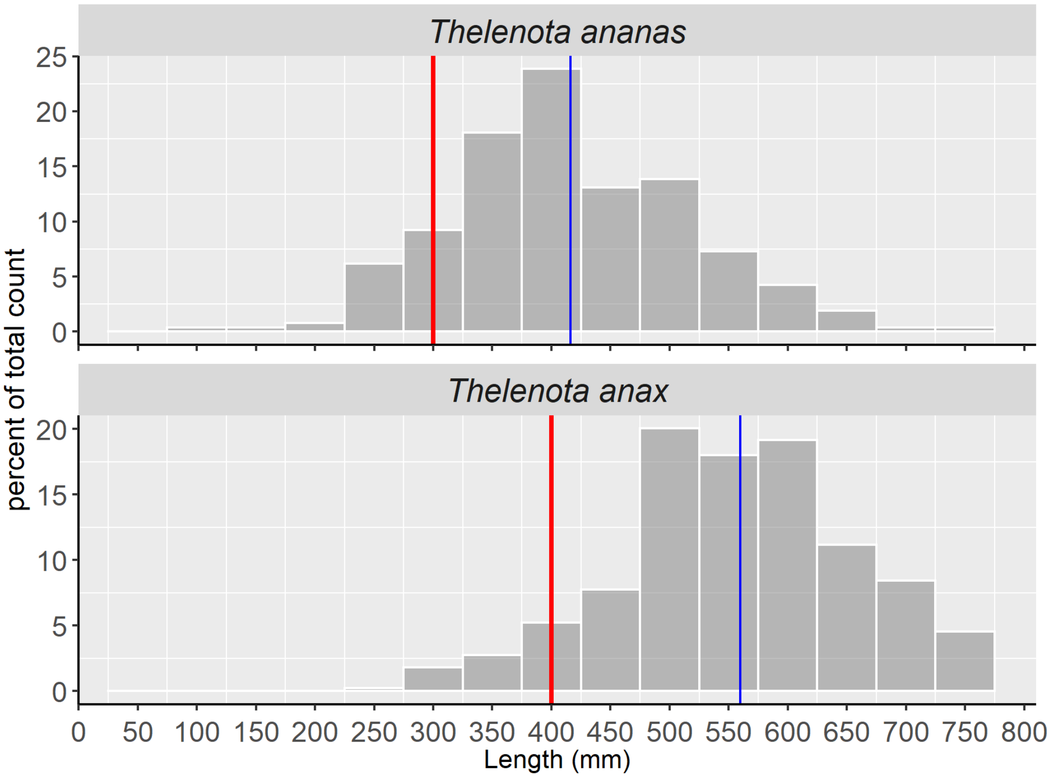
Source: National Fisheries Authority of Papua New Guinea.

Figure 39. Density of *Thelenota ananas* and *T. anax* in Tonga (Vava'u, Tongatapu, Ha'apai).



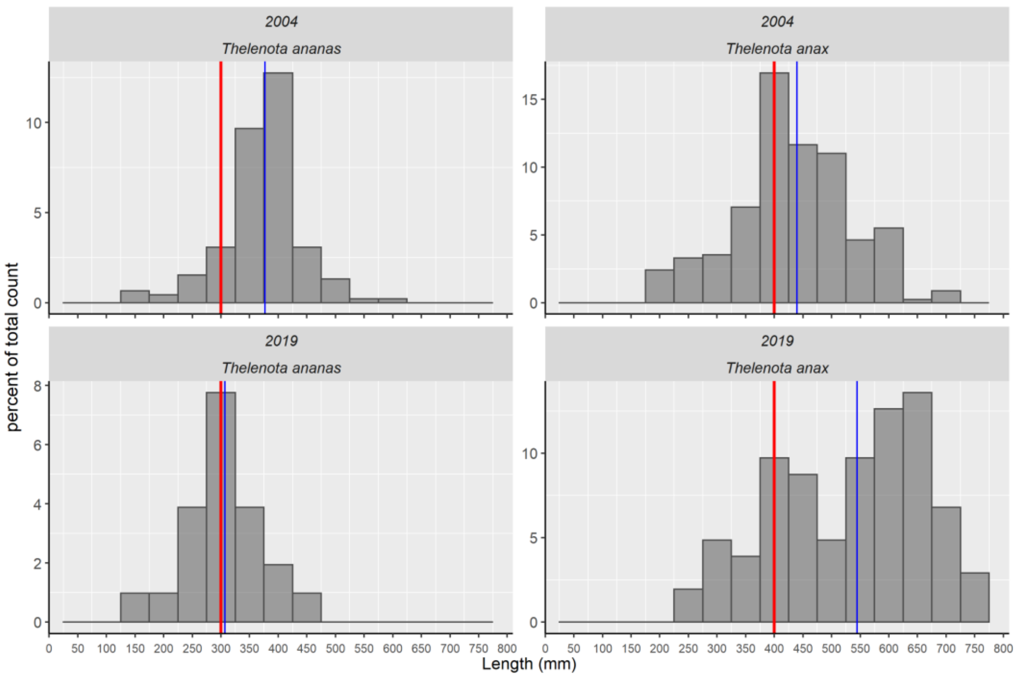
Note: 2008 to 2014 is a baseline average (n= 126); 2016 (n=202); 2019 (n = 188).
Source: Tonga Ministry of Fisheries; Shedrawi *et al*. (2020)

Figure 40. Length frequency (counts in each size class) of *T. ananas* and *T. anax* across all sea cucumber habitat in New Caledonia in 2021.



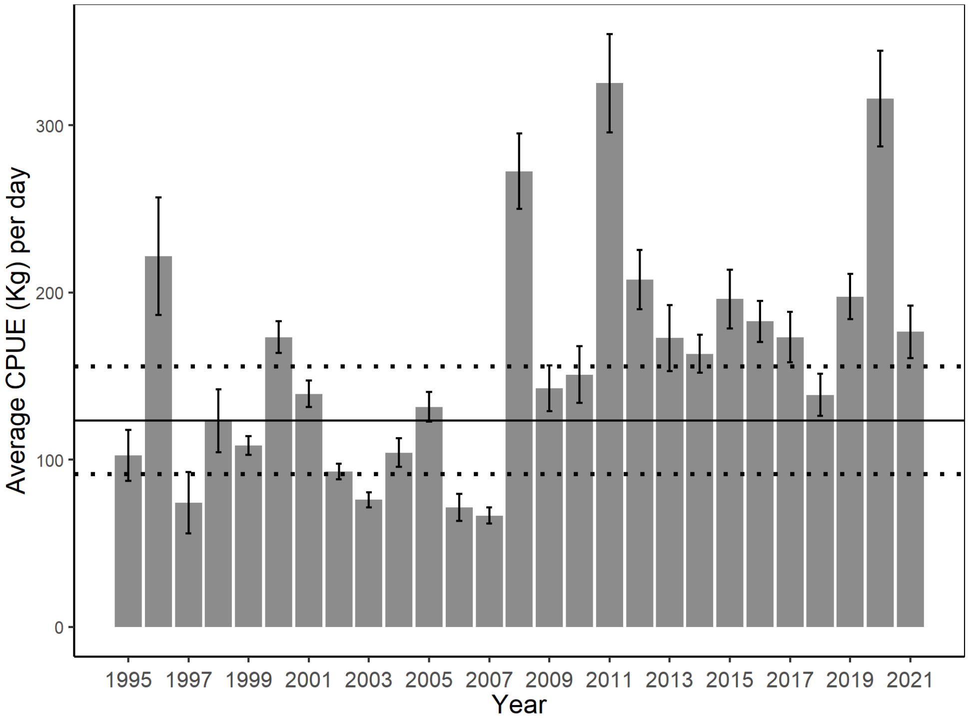
Red and blue vertical lines indicate length at maturity (Conand, 1993) and mean length, respectively.
Source: Gilbert, A., Georget, S., Guillemot, N., Ton, C., Léopold, M., Purcell, S., Van Wynsberge, S. & Andréfouët, S. (forthcoming). État des lieux des stocks d'holothuries commerciales de Nouvelle-Calédonie (2021–2022).

Figure 41. Length frequency (counts in each size class) of *T. ananas* and *T. anax* across all sea cucumber habitats in Tonga in 2019. Red and blue vertical lines indicate length at maturity (Conand, 1993) and mean length, respectively.



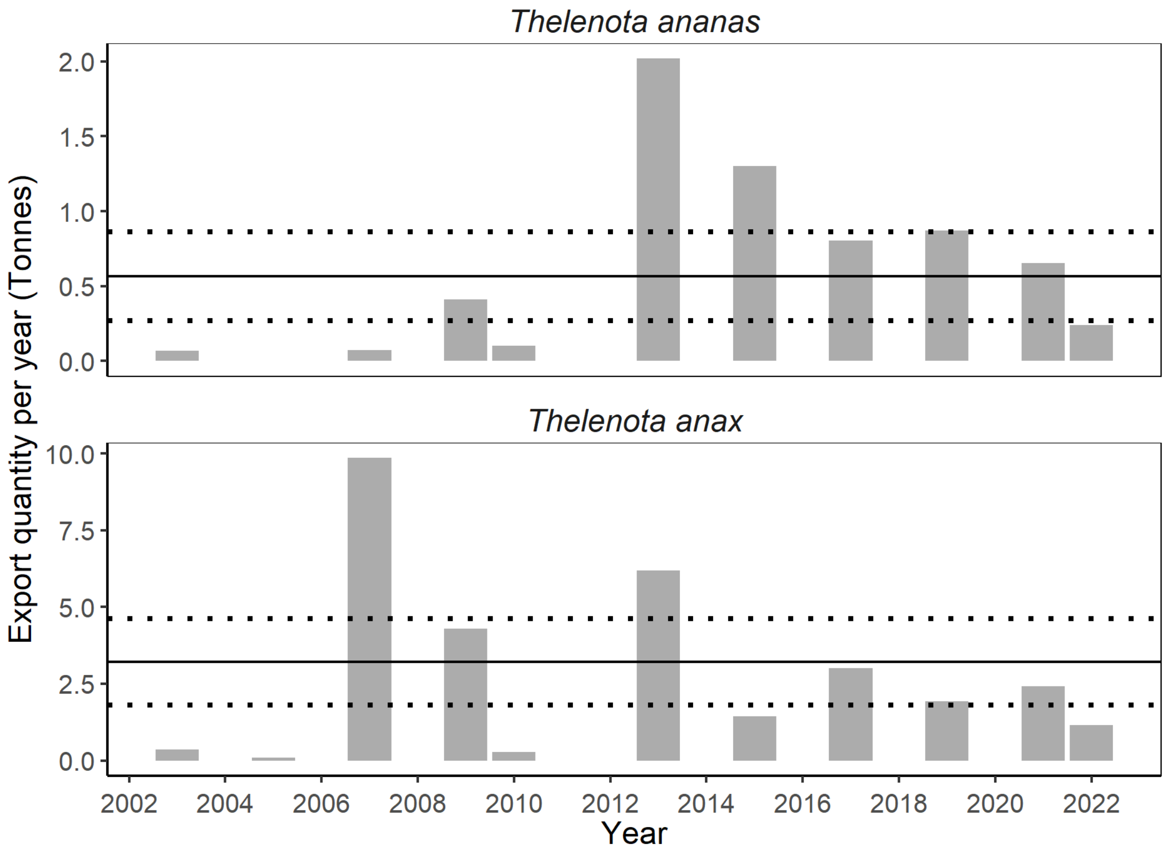
Source: Ministry of Fisheries, Tonga; Shedrawi, G., Bosserelle, P., Malimali, S., Fatongiatau, V., Mailau, S., Magron, F., Havea, T., Finau, S., Finau, S., Aleamotua, P. & Halford, A. 2020. The status of sea cucumber stocks in the Kingdom of Tonga. Noumea, Pacific Community.

Figure 42. Average catch per unit effort (Kg/day) from designated fishing zones across the Great Barrier Reef Marine Park (GBRMP), Queensland, Australia.



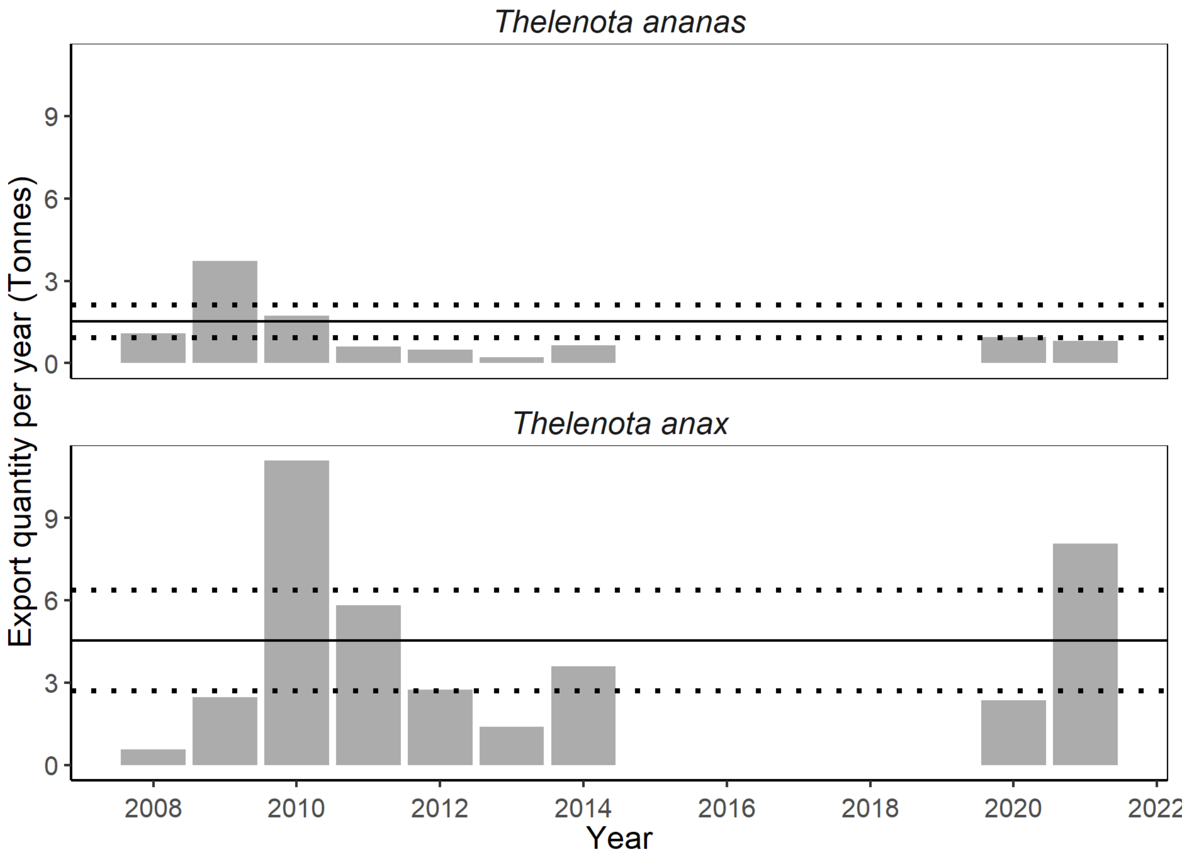
Annual CPUE (kg/day) ± 1 SE of *T. ananas* in the Queensland sea cucumber fishery. The solid horizontal and dotted lines represent the mean, upper and lower 95 percent confidence interval of the 10-year (1995 to 2004 inclusive) baseline CPUE. Note that the catch disposal record of catches from 2000–2001 to 2021–2022 (the most accurate data on the abundance of catch) reveals the annual catch averages 34.1 (plus minus) 2.98 tonnes processed (gutted and salted) weight. Note also that 2021–2022 is only from a part of that year.
Source: Queensland Sea Cucumber Fishery government catch and effort logbook data.

Figure 43. Time series of exports for two sea cucumber species, *T. ananas* and *T. anax*, exported during open seasons compared with a six open-season baseline calculated by averaging export quantities from 2005 to 2015.



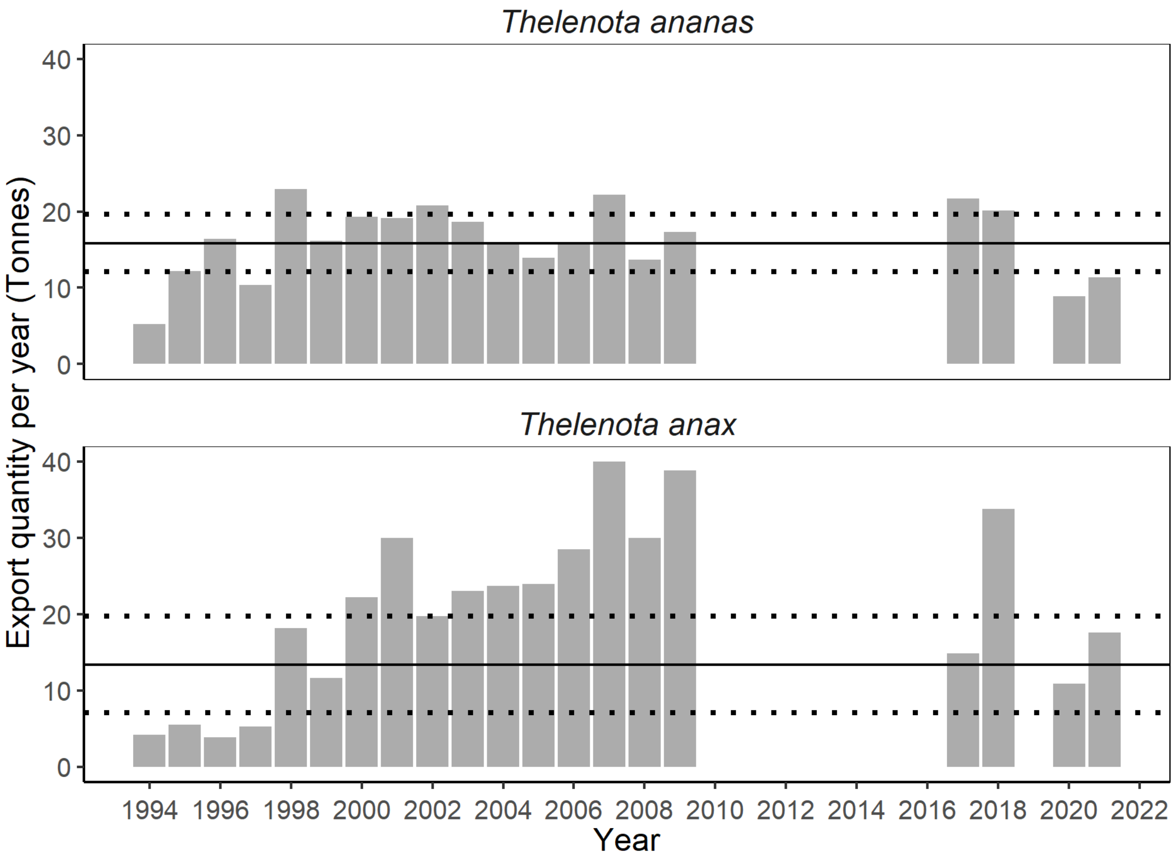
Solid horizontal and dotted lines represent the mean, upper and lower 95 percent confidence interval.
Source: Ministry of Fisheries and Marine Resources, Solomon Islands.

Figure 44. Time series of exports for two sea cucumber species, *T. ananas* and *T. anax*, exported during open seasons compared with a 5-year open-season baseline calculated by averaging export quantities from 2008 to 2012.



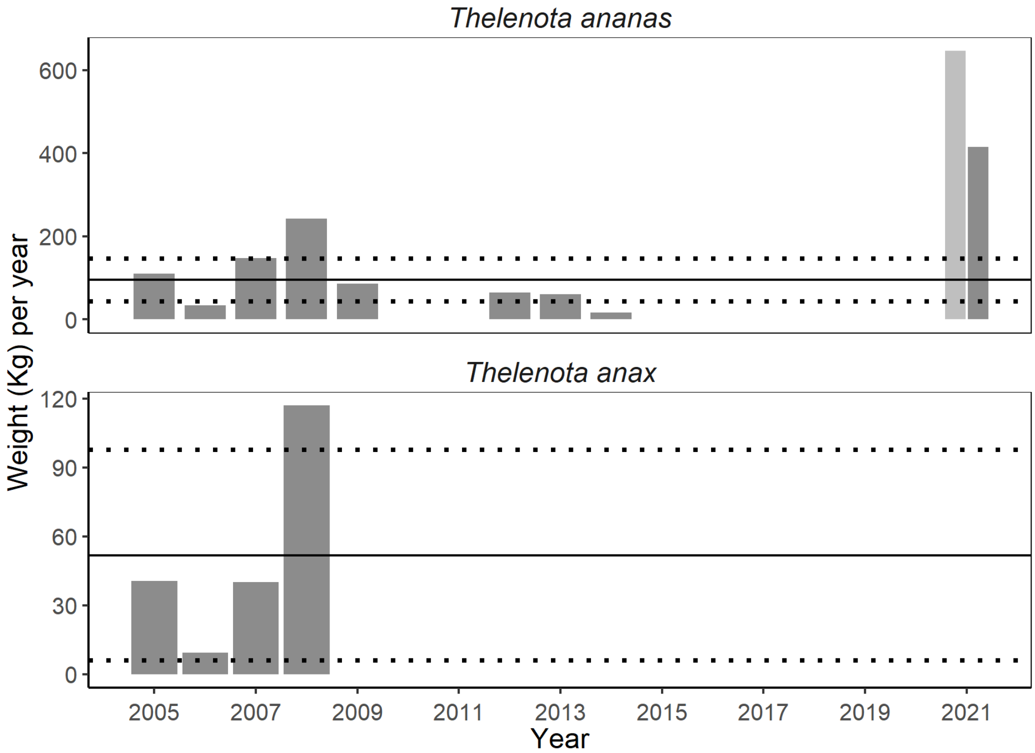
Source: Ministry of Fisheries, Tonga.

Figure 45. Solid horizontal and dotted lines represent the mean, upper and lower 95 percent confidence interval of the 10-year (1994 to 2003 inclusive) baseline export quantity.



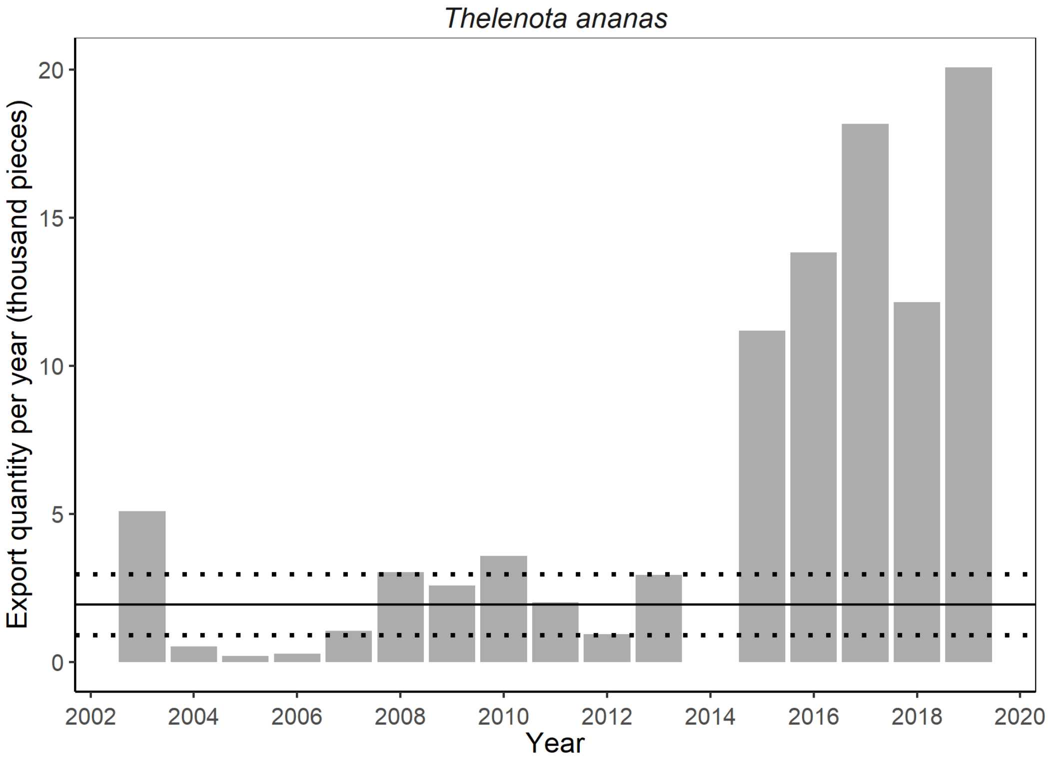
Source: National Fisheries Authority, Papua New Guinea.

Figure 46. Solid horizontal and dotted lines represent the mean, upper and lower 95 percent confidence interval of the 5-year (2005 to 2009 inclusive) baseline export quantity. Light and dark shaded bars include data from two exporters in 2021.



Source: (2021, light shaded bar, Observatoire des pêches côtières de Nouvelle-Calédonie; Dark grey shaded bars include data kindly supplied by Wigrial Mouzin HRT SARL)

Figure 47. Solid horizontal and dotted lines represent the mean, upper and lower 95 percent confidence interval of the 10-year (1995 to 2004 inclusive) baseline export quantity.



Source: Gouvernement de la Nouvelle-Calédonie, Statistiques annuelles de pêche et d'aquaculture en Nouvelle-Calédonie.

APPENDIX A

Terms of Reference for an "Ad Hoc Expert Advisory Panel for Assessment of Proposals to CITES" (Appendix E in FAO, 2003).

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:

- 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; and

- 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 is requested to finalize the advisory report by X, X days 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; and
- Panel report reviewed by FAO Secretariat, published and forwarded to FAO Members, RFMOs and CITES Secretariat.

APPENDIX B

Agenda for the Expert Advisory Panel for Assessment of Proposals to CITES*

FAO Headquarters, Rome, Italy, 18 to 22 July 2022
Viale delle Terme di Caracalla, 00153 Rome, Italy

Mon 18 July	Introductions, the CITES Listing Amendment Process
9.00–10.30	Welcome by Mr Manuel Barange, Deputy Director, Fisheries and Aquaculture Department; Introduction of participants, observers and FAO staff; Selection of Panel Chair and Proposal leads; Overview and orientation by Mr Kim Friedman: CITES, listing amendment criteria; FAO Expert Panel Terms of Reference: meeting objectives and work programme
11.00–12.45	Presentation on options for further standardizing the discussion and outputs from the Expert Panel with the aim of making the process more predictable and systematic as well as efficient Presentation by proponents of CITES CoP19 proposals.
14.15–15.45	Breakout into working groups
16.15–17.30	Continue Breakout working groups Plenary discussions to sum up progress, and discuss forward planning
Tues 19 July	Shark, Ornamental fish and Sea Cucumbers: Ongoing review
9.00–10.30	Breakout working groups
11.00–12.30	Breakout working groups sessions interspersed with Plenary discussions
14.00–15.30	Breakout working groups
16.00–18.30	Continue Breakout working groups Plenary discussions to sum up progress, and discuss forward planning
Wed 20 July	Shark, Ornamental fish and Sea Cucumbers: Ongoing review
9.00–10.30	Breakout working groups
11.00–12.30	Breakout working groups sessions interspersed with Plenary discussions
14.00–15.30	Breakout working groups
16.00–18.30	Continue Breakout working groups Plenary discussions to sum up progress, and discuss forward planning
Thurs 21 July	Shark, Ornamental fish and Sea Cucumbers: Ongoing review
9.00–10.30	Breakout working groups
11.00–12.30	Breakout working groups sessions interspersed with Plenary discussions
14.00–15.30	Breakout working groups
16.00–18.30	Plenary discussion as determined during the meeting Clearance and draft adoption of single report by working groups
Fri 22 July	Review and Clearance of the Report
9.00–10.30	Drafting in working groups alternating with plenary discussion of single reports as determined during the meeting
11.00–12.30	Drafting in working groups alternating with plenary discussion of single reports as determined during the meeting
14.00–15.30	Clearance and draft adoption of single reports by working groups
14.00–19.30	Clearance and adoption of the full report by Panel Mr Manuel Barange, Deputy Director, Fisheries and Aquaculture Department, address and meeting closure

***Some logistical detail removed**

APPENDIX C

List of Panel Members, Invitees, Observers, and FAO Staff Participants

PANEL MEMBER PARTICIPANTS	
ARGENTINA ARGENTINE ARGENTINA	Ms Ana Parma Centro para el Estudio de Sistemas Marinos Centro Nacional Patagónico CONICET Puerto Madryn, Chubut
AUSTRALIA AUSTRALIE AUSTRALIA	Mr George Shedrawi Coastal Fisheries Scientist Pacific European Union Marine Partnership Programme (PEUMP) Division of Fisheries, Aquaculture and Marine Systems Pacific Community Noumea New Caledonia Mr Matias Braccini Senior Research Scientist (Shark and Ray Sustainability) Department of Primary Industries and Regional Development Government of Western Australia Perth
BANGLADESH BENGLADESH BANGLADESH	Ms Alifa Bintha Haque Assistant Professor Department of Zoology University of Dakha Dakha
BRAZIL BRÉSIL BRASIL	Ms Patricia Charvet Collaborator Researcher and Professor PPGSis - Universidade Federal do Ceará (UFC) Fortaleza, Ceará
INDIA INDE INDIA	Ms Shoba Joe Kizhakudan Principal Scientist ICAR - Central Marine Fisheries Research Institute Madras Regional Station Chennai
JAPAN JAPON JAPÓN	Mr Joji Morishita Professor Tokyo University of Marine Science and Technology Department of Marine Policy and Culture Tokyo

JAPAN JAPON JAPÓN	Mr Jun Akamine Professor Hitotsubashi University Tokio
KENYA KENYA KENIA	Ms Elizabeth Mueni Musyoka Deputy Director of Fisheries Kenya Fisheries Service State Department for Fisheries and the Blue Economy Mombasa Regional Office Mombasa
MEXICO MEXIQUE MEXICO	Mr Javier Tovar Avila Senior Researcher National Fisheries and Aquaculture Institute Bahía de Banderas, Nayarit
MOROCCO MAROC MARRUECOS	Mr Lahsen Ababouch Senior advisor UNCTAD, fish and seafood international trade Italy
NORWAY NORVÈGE NORUEGA	Mr Svein A. Fosså Fisheries Consultant Fladefjell 15 Grimstad
SOUTH AFRICA AFRÍQUE DU SUD SUDÁFRICA	Mr Doug Butterworth Emeritus Professor Department of Mathematics and Applied Mathematics University of Cape Town Cape Town Mr Paul DeBruyn Science Manager IOTC Secretariat Victoria, Mahé Seychelles
UNITED KINGDOM ROYAUME-UNI REINO UNIDO	Mr Jim Ellis Principal Scientist – Fisheries ecology & elasmobranch fishes CEFAS, Lowestoft Laboratory, Pakefield Road Lowestoft Suffolk Mr Mark Dickey-Collas Ecosystem Professional Officer International Council for the Exploration of the Sea Copenhagen Denmark

	Mr John Pope Consultant NRC (Europe) Ltd Norfolk
UNITED STATES OF AMERICA ÉTATS-UNIS D'AMÉRIQUE ESTADOS UNIDOS DE AMÉRICA	Mr Enric Cortés Senior Scientist NOOA/National Marine Fisheries Service Panama City, Florida, USA Mr Andrew Rhyne Associate Professor Roger Williams University Research Faculty Bristol
PAPUA NEW GUINEA PAPOUASIE NOUVELLE GUINÉE PAPÚA NUEVA GUINEA	Mr Jeffrey Paul Kinch Principal National Fisheries College National Fisheries Authority Kavieng New Ireland Province
URUGUAY URUGUAY URUGUAY	Mr Andrés Domingo Balestra Director Adjunto Dirección Nacional de Recursos Acuáticos Ministerio de Ganadería, Agricultura y Pesca Montevideo

PANEL MEMBER INVITEES	
AUSTRALIA AUSTRALIE AUSTRALIA	Mr Steven Purcell Associate-Professor Southern Cross University Coffs Harbour
INDIA INDE INDIA	Mr Akhilesh K.V Scientist ICAR-Central Marine Fisheries Research Institute Mumbai Regional Station Maharashtra
UNITED STATES OF AMERICA ÉTATS-UNIS D'AMÉRIQUE ESTADOS UNIDOS DE AMÉRICA	Ms Elizabeth A. Babcock Associate Professor Department of Marine Biology and Ecology University of Miami Florida Mr John Carlson Research Biologist NOAA/National Marine Fisheries Service Panama City, FL 32408 Ms Shelley Clarke Technical Coordinator-Sharks and Bycatch Common Oceans (ABNJ) Tuna Project Rome Italy

MOROCCO MAROC MARRUECOS	Mr Taoufik El Ktiri Directeur des Affaires Générales et Juridiques Ministère de l'Agriculture et de la Pêche Maritime Département de la Pêche Maritime Rabat
NEW ZEALAND NOUVELLE ZÉLANDE NUEVA ZELANDA	Mr Alastair Macfarlane International Fisheries Management International Policy and Trade Ministry for Primary Industries Wellington

OBSERVERS & FAO STAFF	
CITES Secretariat Secrétariat CITES Secretaría CITES	Mr David Morgan Science Unit, CITES Secretariat Geneva Switzerland Ms Hyeon Jeong Kim Science Unit, CITES Secretariat Geneva Switzerland
FAO Staff Personnel FAO Personal FAO	Mr Kim Friedman Senior Fishery Resources Officer Fisheries and Aquaculture Division (NFI) Rome Italy Ms Monica Barone Consultant Fisheries and Aquaculture Division (NFI) Rome Italy Mr Rishi Sharma Senior Fishery Resources Officer Fisheries and Aquaculture Division (NFI) Rome Italy
FAO Support Assistance FAO Asistencia FAO	Ms Valérie Schneider Office Assistant Fisheries and Aquaculture Division (NFI) Rome Italy Ms Chiaki Yamada Fishery Officer Fisheries and Aquaculture Division (NFI) Rome Italy
Media Assistant (Video) Assistant Média (Vidéo) Asistente Media (Video)	Mr Mathew Walsh Consultant Fisheries and Aquaculture Division (NFI) Rome Italy

APPENDIX D

Welcome speech by Mr Manuel Barange, Director - FAO Fisheries and Aquaculture Division

18 July 2022

It is my pleasure to welcome you to this 7th 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 (CITES).

As many of you know, the 1975 CITES treaty brings 184 country Parties together to offer a mechanism for regulating international trade where such trade puts the survival of threatened or near threatened species into harm. You may also know that since 1994, CITES Parties have increasingly chosen to list marine species taken by commercial and artisanal fisheries in their Appendices.

Recognizing FAO's global role in supporting the sustainable management and conservation of fisheries resources, FAO and CITES – under an MOU signed in 2006 – have continued to work together to refine mechanisms to support CITES decision processes, but also in assisting fisheries and environmental authority managers in implementation of CITES provisions, where appropriate.

In November this year, CITES Party delegations will meet in Panama City, Panama, to consider a further suite of commercially exploited species that have been proposed for listing under CITES Appendix II, including a broad range of sharks, sea cucumbers and ornamental fish. The importance of this CITES CoP should not be underestimated, as the decisions made in Panama have the potential to impact the operation of fisheries globally, their management, and thus the livelihood and food security of many dependent communities.

The role of your work as the FAO Expert Advisory Panel is to provide scientific and technical information to the Parties of CITES. The Panel is made up of a broad range of experts on commercial fisheries species, their management and conservation, and their local and international trade, and is convened to negotiate a common understanding on the status of species proposed for CITES listing, supported by the best available information we have to hand.

You're understanding on the status of the species proposed for CITES listing provides a unique assessment, valued by CITES delegations, which are rarely represented by Officers that have fisheries expertise.

You have been selected for the FAO Expert Advisory Panel because of your expertise, but you are here in your individual capacity and not as a representative of any country or organization. This is crucial. Only scientific evidence presented against the CITES listing criteria matters in your assessment decisions.

For many of you, this will be your first experience in the Panel, but several of you also participated in one or more of the former meetings that were able to deliver a comprehensive and unanimously supported review of the status of species under consideration, plus insights into the likely effectiveness for conservation, of a CITES listing. Those of you who have experience of the CITES listing process know that FAO Expert Panel reports are welcomed and taken very seriously.

Our assessment of species status against the CITES criteria stops at whether a species "meets" the CITES criteria or not. It is a sovereign decision for CITES Parties whether they adopt listings, independent of whether they meet or do not meet the CITES listing criteria. Experience of previous CITES Party decisions should not change in any way the role of the Panel completes its function, which is to ensure that its report provides the best scientific and technical advice based on the information available.

The Panel process in 2022 has a large task in front of it. Some proposals include a vast number of species, with many other species proposed under CITES "look-alike" clause irrespective of whether there is any concern over their extinction risk. This will challenge you in the one week you will have together and might require you to look for innovative solutions in delivering your review. Whatever approach the Panel takes in reporting, I also urge you to work closely with FAO in broadening the way we communicate Panel findings, so that we "reach" the full range of end users with the knowledge gained during this week of deliberations.

We are very grateful that you have accepted the challenge of participating and have dedicated your time and expertise to assist in the FAO Panels' work. And in delivery of this work, please remember, our task is not to evaluate the merits of CITES criteria. Our role is to use the expertise of the Panel to apply the CITES criteria against the best available information, 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 is best, and has so far been possible, for the Panel to reach a consensus agreement on the evaluation of proposals. 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 their own conclusions.

I thank you all again for giving up your time to help in this important task, especially as I know you are all busy and some of you have had to rearrange your schedules and travel long hours to be able to attend. I also thank Mr David Morgan and Ms Hyeon Kim of the CITES Secretariat for joining us at this meeting and for the cooperation and assistance of the Secretariat in the work we have been jointly undertaking in relation to the management and conservation of commercially exploited aquatic species.

Before I close, please consider that the real success of these meetings can be hard to measure in immediate results, as the evidence you provide will be used long beyond the present CITES CoP cycle. However, in my mind, a useful real-time indicator of success is the level of engagement across the diverse viewpoints and experience brought to the Panel by its Members – how well you as participants can listen to others and be heard, and then stand side by side to defend the Panel's final report. In a world increasingly focused on what divides us, the search for consensus is made even more important and valuable.

Before I go, let me just make some further acknowledgements. This meeting of the 7th Expert Advisory Panel benefits greatly from the hard work and financial support provided by the FAO Regular Programme, but also from extra budgetary support by the Government of Japan. I would especially like to thank Japan for its generous gesture that allows us to invite experts from all continents and improve the gender balance of the Panel.

Finally, I sincerely hope that your 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, despite the heat and challenges that COVID-19 presents. 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).

APPENDIX F

Email correspondence from Mr Mark Dickey-Collas, the Chair of the Expert Advisory Panel to FAO

Dear FAO,

It was a privilege and honour to be selected by the Experts convened at FAO headquarters, to chair the FAO Expert Advisory Panel for the assessment of proposals to amend CITES Appendices. The panel assembled by FAO was experienced, with an extensive portfolio of knowledge of the biology, management and trade of commercially exploited aquatic species.

The objective of the panel was to assess each proposal from a scientific perspective in accordance with the CITES biological listing criteria, and comment, on technical aspects of the proposal in relation to biology, trade, management and conservation issues. I felt that the panel welcomed the position of trust and responsibility bestowed upon them.

The Chair of the previous panel raised concerns about the quality and referencing of the evidence-base in the proposals, and the compressed time to evaluate the proposals. This impacted both the assessments and the ability of the panel to provide further comment on the technical aspects of the proposals. These issues remained relevant to operation of the seventh panel.

I wish to raise four further issues with FAO in order for the CITES proposal review process to adequately fulfil its function on behalf of FAO Members and CITES Parties:

(i) Best available evidence. Many of the proposals had inadequate and ambiguous referencing of the evidence base. The assessments of rate of decline against the listing criteria, the application of the precautionary principle and the evaluation of future risk requires evidence that can be attributed and sourced. The panel requires clear referencing of qualitative information and findable sources for quantitative data. Some proposals lacked clear trails of evidence to support statements made about population decline, changes in geographic distribution, changes in habitat or importance of international trade.

(ii) Use of IUCN Red List criteria. Many of the proposals reported species decline based on the decisions of IUCN Red List assessments without evaluating themselves the underlying information sources. This infers that the Red List methodology is in some way synonymous with CITES biological listing criteria. The panel considers the agreed CITES and FAO criteria for listing; these include specific methods and thresholds of decline (historical, recent and projected) which do not directly align with either Red List characterization of extinction risk nor fisheries thresholds for sustainable utilization. IUCN Red List assessments are excellent tools to guide authorities and the public as to which species are vulnerable or threatened with extinction. However, proposals to CITES should be attentive to the differing information requirements, thus amenable to an assessment of the merit of a species status in relation to criteria that guide amendment of CITES Appendices.

(iii) Evidence of trade. Some of the proposals included species for which the panel could find no verifiable evidence of international trade (in the proposal or in the literature). The panel excluded these species from the assessment of accordance with “affected by trade” components in the CITES listing criteria. With a large number of species to consider, the effort required to verify trade information for these species reduced the available time for the assessment of those species in international trade.

(iv) Broad brush proposals. Some of the proposal aggregated species with very different life strategies, morphologies, trade status and availability of evidence on populations trends. This approach was also applied to the look-alike species for the Carcharhinidae. This devalued the credibility of some proposals. This aggregation also ignored the differences of the consequences of CITES listing in

Appendix II between species across the social, economic or scientific arenas. It also challenged the panel, to source and document the best available evidence.

Finally, I welcome the inclusion of tables in the report that illustrate the panel's deliberation of sources of information cited in the proposals. I also welcome the increased effort by FAO to explain and communicate how the panel carries out its work, the criteria agreed to amend CITES Appendices for commercially exploited aquatic species and the decisions of the panel.

I am pleased that the report is a consensus report that documents the decisions of the panel. I enjoyed acting as chair which was greatly helped by the commitment and professionalism of the invited Experts, FAO staff and CITES Secretariat Observers.

Best regards,

Mark Dickey-Collas
Chair,
Expert Panel

BIBLIOGRAPHY

Brito, D., Ambal, R.G., Brooks, T., De Silva, N., Foster, M., Hao, W., Hilton-Taylor, C., Paglia, A., Rodríguez, J.P. & Rodríguez, J.V. 2010. How similar are national red lists and the IUCN Red List? *Biological Conservation*, 143(5): 1154–1158. https://doi.org/10.1016/j.biocon.2010.02.015.

Davies, T.D. & Baum, J.K. 2021. Extinction risk and overfishing: reconciling conservation and fisheries perspectives on the status of marine fishes. *Sci. Rep.* 2:561. doi: 10.1038/srep00561.

del Monte-Luna, P., & Lluch-Belda, D. 2003. Vulnerability and body size: Tetrapods versus fish. *Population Ecology*, 45: 257–262. https://doi.org/10.1007/s10144-003-0160-x.

CITES. 2022a. Summary Record. Seventy-fourth meeting of the Standing Committee Lyon (France), 7–11 March 2022. SC74 SR. In Convention on International Trade in Endangered Species of Wild Fauna and Flora. Geneva, Switzerland. Cited 18 July 2022. https://cites.org/sites/default/files/eng/com/sc/74/exsum/E-SC74-SR-DRAFT.pdf

CITES. 2022b. Provisional list of proposals for amendment of Appendices I and II AS RECEIVED. In Convention on International Trade in Endangered Species of Wild Fauna and Flora. Geneva, Switzerland. Cited 18 July 2022. https://cites.org/eng/cop/19/amendment-proposals/provisional

CITES. 2022c. Criteria for amendment of Appendices I and II. In Convention on International Trade in Endangered Species of Wild Fauna and Flora, Geneva, Switzerland. Cited 18 July 2022. https://cites.org/eng/res/09/09-24R16.php

CITES. 2022d. Proposed amendment to Resolution Conf. 9.24 (REV. COP17). In Convention on International Trade in Endangered Species of Wild Fauna and Flora, Geneva, Switzerland. Cited 18 July 2022. https://cites.org/sites/default/files/documents/COP/19/agenda/E-CoP19-87-01.pdf

FAO. 1999. *International Plan of Action for reducing incidental catch of seabirds in longline fisheries. International Plan of Action for the conservation and management of sharks. International Plan of Action for the management of fishing capacity*. Rome. 26 pp (also available at https://www.fao.org/3/Y1455E/Y1455E.htm).

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. 87 pp. (also available at www.fao.org/3/Y1455E/Y1455E.htm)

FAO. 2003. Report of the twenty-fifth session of the Committee on Fisheries. Rome, 24–28 February 2003. FAO Fisheries Report. No. 702. Rome, FAO. 2003. 88p (also available at www.fao.org/3/y5025e/y5025e.pdf).

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 https://www.fao.org/3/y5523e/y5523e.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 https://www.fao.org/3/a1143e/a1143e.pdf).

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 https://www.fao.org/3/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. 23 pp. (also available at www.fao.org/docrep/014/i2235e/i2235e00.pdf).

FAO. 2020. *Opportunities and challenges in the harmonization of criteria used to define the status of commercially-exploited aquatic resources across international bodies and multilateral environmental agreements*. COFI Thirty-Fourth Session Background Document, COFI/2020/SBD.18, 17 pp. https://www.fao.org/3/cb1489en/cb1489en.pdf

FAO. 2022. *Report of the Thirty-Fourth Session of the Committee on Fisheries. Rome, 1–5 February 2021*. FAO Fisheries and Aquaculture Report No. 1336. Rome. https://doi.org/10.4060/cb8322en

Friedman, K., Garcia, S.M. and Rice, J. 2018. Mainstreaming biodiversity in fisheries. *Marine Policy*, 95: 209–220. https://doi.org/10.1016/j.marpol.2018.03.001

Garcia, S.M, Rice, J. & Charles, A., eds. 2014. Governance of Marine Fisheries and Biodiversity Conservation: Interaction and Coevolution. 511 pp. John Wiley & Sons, Ltd. DOI:10.1002/9781118392607

Godfrey, M.H.& Godley, B.J. 2008. Seeing past the red: flawed IUCN global listings for sea turtles. *Endangered Species Research*, 6:155–159. https://doi.org/10.3354/esr00071

Hilton-Taylor, C., Stuart, S.N. & Vié, J.-C., eds. 2009. Wildlife in a changing world : an analysis of the 2008 IUCN Red List of Threatened Species. IUCN Publication. Gland, Swizerland. 155 pp. https://doi.org/10.2305/IUCN.CH.2009.17.en

ICES. 2018. EU request on analysis of the IUCN process for the assessment of the conservation status of marine species in comparison to the process used by fisheries management bodies. *ICES Special Request Advice, Ecoregions in the Northeast Atlantic, sr.2018.26*, 8 pp. https://doi.org/10.17895/ices.pub.4621

Isaac, N.J.B. & Mace, G.M. 1998. *The IUCN Criteria Review: Report of the Scoping Workshop*. IUCN Species Survival Commission, Gland, Switzerland. 34 pp. (also available at https://portals.iucn.org/library/node/46399).

Mace, G.M. & Lande, R. 1991. Assessing Extinction Threats: Toward a Reevaluation of IUCN Threatened Species Categories. *Conservation Biology*, 5(2): 148–157. https://doi.org/10.1111/j.1523-1739.1991.tb00119.x

Mace, G.M., Collar, N.J., Gaston, K.J., Hilton-Taylor, C., Akçakaya, H.R., Leader-Williams, N., Milner-Gulland, E.J. & Stuart, S.N. 2008. Quantification of Extinction Risk: IUCN's System for Classifying Threatened Species. *Conservation Biology*, 22(6), 1424–1442. DOI: 10.1111/j.1523–1739.2008.01044.x

Regan, T.J., Burgman, M.A:, McCarthy, M.A., Master, L.L., Keith, D.A.m Mace, G.M. & Andelman, S.J. 2005. The Consistency of Extinction Risk Classification Protocols. *Conservation Biology*, 19(6): 1969–1977. https://doi.org/10.1111/j.1523–1739.2005.00235.x

The Revelator. 2022. Behind the Science: How Do We Know How Many Shark Species Are at Risk? In The Revelator. Wild, Incisive, Fearless. https://therevelator.org/behind-science-sharks-risk

The Seventh 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 18 to 22 July 2022. 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 assess each proposal from a scientific perspective in accordance with CITES biological listing criteria (Resolution Conf. 9.24 [Rev. CoP17]; and 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 six proposals submitted to the Nineteenth Conference of the Parties to CITES.

ISBN 978-92-5-136844-2 ISSN 2070-6987

9 789251 368442

CC1931EN/1/09.22