North Pacific Fisheries Commission

7th Scientific Committee Meeting
REPORT

16-20 December 2022

February 2023

This paper may be cited in the following manner:

Scientific Committee. 2022. 7th Meeting Report. NPFC-2022-SC07-Final Report. 250 pp. (Available at www.npfc.int)

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North Pacific Fisheries Commission
7th Meeting of the Scientific Committee

16-20 December 2022
WebEx

REPORT

Agenda Item 1. Opening of the Meeting

1. The 7th Meeting of the Scientific Committee (SC) took place as a virtual meeting via WebEx, and was attended by Members from Canada, China, the European Union (EU), Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, the United States of America and Vanuatu. Panama attended as a Cooperating non-Contracting Party. The Deep Sea Conservation Coalition (DSCC), the United Nations Food and Agriculture Organization (FAO), the North Pacific Anadromous Fish Commission (NPAFC), the North Pacific Marine Science Organization (PICES), the Pew Charitable Trusts (Pew), and the Southern Indian Ocean Fisheries Agreement (SIOFA) attended as observers. Dr. Penelope Ridings attended as a Secretariat Guest in her role as the Chair of the NPFC Performance Review Panel. The meeting was opened by Dr. Janelle Curtis (Canada), who served as the SC Chair.

2. The Executive Secretary, Dr. Robert Day, welcomed the participants to the meeting. He expressed appreciation for the contributions of Members and observers to the work of the NPFC, and commended the SC and its subsidiary bodies for the dedicated efforts they have made to advance the scientific work of the NPFC, despite the challenging conditions posed by the pandemic. The Executive Secretary also emphasized the value of the NPFC's cooperation with other organizations. In closing, he encouraged the SC and its subsidiary bodies to continue to work collaboratively and cooperatively to produce the best scientific information possible.

3. Mr. Alex Meyer was selected as rapporteur.

Agenda Item 2. Adoption of Agenda

4. The SC agreed to hear an update from the EU on its chub mackerel fisheries operation plan and impact assessment under Agenda Item 12.3 Other issues.

5. The agenda was adopted without revision (Annex A). The List of Documents and List of Participants are attached (Annexes B, C).

Agenda Item 3. Meeting arrangements

6. The Science Manager, Dr. Aleksandr Zavolokin, outlined the meeting arrangements.

Agenda Item 4. NPFC Performance Review recommendations for the Scientific Committee

7. The Chair of the NPFC Performance Review Panel, Dr. Penelope Ridings, summarized the outcomes and recommendations of the Performance Review applicable to the SC. The Performance Review found that the SC has initiated a comprehensive and ambitious program of scientific research, that the scientific research draws not only on Members' scientific experts but also on independent experts, that the SC is working on the development of management strategy evaluations (MSEs) leading to harvest control rules (HCRs) and has initiated a science-management dialog to that end, and that the SC has done valuable work-planning in relation to the NPFC's large number of priority stocks. The Performance Review has also identified, as the main issues, the poor or unknown status of some stocks, issues with data collection and data gaps, and the unknown extent of bycatch. Of the Performance Review Recommendations, 25 are of relevance to the SC.

8. The SC noted that the Performance Review report will be formally reviewed and endorsed by the Commission at its next meeting in March 2023. The SC tasked its subsidiary bodies, including the four informal small working groups, pending the approval of the report by the Commission, to review relevant recommendations from the Performance Review report at their intersessional meetings or through email correspondence in 2023, evaluate their ability and necessary timelines to achieve the objectives in those recommendations, and to report on the outcomes of their reviews at the SC08 meeting.

Agenda Item 5. Review of reports and recommendations from the Small Scientific Committees (SSC BF-ME and SSC PS) and the Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA)

5.1 Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA)

9. The TWG CMSA Vice Chair, Dr. Kazuhiro Oshima (Japan), summarized the outcomes and recommendations of the 5th and 6th TWG CMSA meetings (NPFC-2022-TWG CMSA05-Final Report, NPFC-2022-TWG CMSA06-Final Report).

10. The SC reviewed the recommendations of the TWG CMSA and endorsed the following recommendations:
    (a) The TWG CMSA recommended the Work Plan of the TWG CMSA (NPFC-2022-TWG CMSA05-WP02 (Rev. 1)).
    (b) The TWG CMSA recommended that the SC select Dr. Kazuhiro Oshima (Japan) to serve

as the TWG CMSA Chair.

(c) The TWG CMSA recommended that the SC select Dr. Qiuyun Ma (China) to serve as the TWG CMSA Vice Chair.

(d) The TWG CMSA recommended extending the consultancy agreement with the external expert to support the TWG CMSA in selecting a model for stock assessment of chub mackerel in 2023.

11. The SC considered the request from the TWG CMSA to provide clarification on whether national waters fall under the scope of the task assigned by the SC to its subsidiary bodies of reporting the data needs and outlining methods that could be used to collect the necessary data. The SC agreed that national waters do fall under the scope of this task as the data from national waters are important for understanding the life history of the NPFC priority species, especially migratory species, and species belonging to the same ecosystem or dependent upon or associated with target stocks.

12. The SC endorsed the reports provided by the TWG CMSA.

13. The SC noted that the TWG CMSA intends to select a stock assessment model(s) for chub mackerel at its next meeting in 2023.

14. The SC tasked the TWG CMSA with preparing a species summary document for chub mackerel.

5.2 SSC on Bottom Fish and Marine Ecosystems

15. The Chair of the SSC on Bottom Fish and Marine Ecosystems (SSC BF-ME), Dr. Chris Rooper (Canada), summarized the outcomes and recommendations of the 3rd SSC BF-ME meeting (NPFC-2022-SSC BFME03-Final Report).

16. The SC reviewed the recommendations of the SSC BF-ME and endorsed the following recommendations:

(a) Adopt the updated species summaries of North Pacific armorhead (Annex D), splendid alfonsino (Annex E), sablefish (Annex F), and blackspotted and rougheye rockfishes (Annex G), and inform the Commission about the trends in catch and effort and other scientific information relevant to management of NPA and SA.

(b) Endorse the field guide for identification of fishes of the Emperor Seamount Chain captured by bottom fisheries (NPFC-2022-SSC BFME03-WP08).

(c) Endorse the use of the scientific name *Allocyttus folletti*, instead of *A. verrucosus*, when referring to the oreosomatid fish in the Emperor Seamounts area.

(d) Establish a formal procedure for changing species' scientific and common names used by the NPFC.
(e) Endorse the process proposed by Canada in NPFC-2022-SSC BFME03-WP03 as one of the NPFC's processes for identifying VMEs and areas likely to be VMEs in the Convention Area, and Canada's application of this method in the eastern part of the Convention Area.
(f) Establish a project for understanding the basis by which other RFMOs' encounter thresholds were determined by taxa and gear-type.
(g) Recommend to the Commission that a move-on rule of 1 nautical mile be set for all bottom fishing gear.
(h) Endorse the Hexactinellida and Demospongiae sponge classes as VME indicator taxa.
(i) Adopt the terms of reference for sharing VME data.
(j) Adopt the template for sharing VME data.
(k) Endorse the updated 2022-2026 SSC BF-ME 5-Year Rolling Work Plan (NPFC-2022-SSC BFME03-WP01 (Rev. 1)).
(l) Endorse the revised CMM 2021-05 (Annex L).
(m) Endorse the revised CMM 2019-06 (Annex M).
(n) Recommend that the Commission consider amending CMM 2021-05 to address the ambiguity around the referenced effort limits of February 2007 in Paragraph 4A in addition to the revisions recommended in paragraph 16(l).
(o) Recommend that the Commission co-sponsor the PICES 2023 session on "Seamount biodiversity: VMEs and species associated with seamounts in the North Pacific Ocean" by contributing the equivalent of $5,000 USD.

17. The SC agreed to discuss the establishment of a formal procedure for changing species' scientific and common names used by the NPFC, including how to handle the issue of a species not having a 3-letter ASFIS code in FAO, as is the case with *Allocyttus folletti*, at SC08.

18. The SC endorsed the report provided by the SSC BF-ME.

5.3 SSC on Pacific Saury

19. The Chair of the SSC on Pacific Saury (SSC PS), Dr. Toshihide Kitakado (Japan), summarized the outcomes and recommendations of the 9th and 10th SSC PS meetings (NPFC-2022-SSC PS09-Final Report, NPFC-2021-SSC PS10-Final Report).

20. The SC reviewed the recommendations of the SSC PS and endorsed the following recommendations:
(a) Endorse the revised Terms of Reference of the SSC PS.
(b) Endorse the stock assessment report (Annex N).

(c) Endorse the SSC PS Work Plan (NPFC-2022-SSC PS10-WP01 (Rev. 1)).
(d) Allocate funds for the participation of an invited expert in the next SSC PS meetings.
(e) Consider and endorse the following rationale and approach in its scientific advice to the Commission:
   i. The current annual TAC for 2021-2022 specified in CMM 2021-08 for Pacific saury (333,750 tons) based on historical catch is much larger than a TAC that would be based on the F_{MSY} catch approach (B_{2022}*F_{MSY} = 205,000 tons). The current biomass is much lower than B_{MSY} and the TAC for 2021-2022 did not reduce fishing mortality in recent years. A harvest control rule (HCR) that reduces F when biomass is low may increase the probability of achieving long-term sustainable use of Pacific saury (i.e. higher long-term catch closer to MSY of around 403,000 tons). A reduction to the TAC for 2021-2022 would increase the probability of higher biomass and catch levels in the Pacific saury stock.
   ii. An HCR that reduces the target harvest rate and TAC when biomass falls below its target level may be appropriate for Pacific saury. This type of HCR is used in managing many fisheries around the world. For example, if an HCR that reduces F linearly when biomass is below B_{MSY} is applied, the TAC calculated based on such an HCR (B_{2022}*F_{MSY}*(B_{2022}/B_{MSY}) = 101,000 tons) could be similar with the current catch (98,000 tons, preliminary as of mid-December 2022).
   iii. Note, however, the performance of the above HCRs has not been evaluated by a formal MSE framework for Pacific saury. They were used as simple illustrations of common approaches used elsewhere.

21. The SC endorsed the reports provided by the SSC PS.

22. The SC Chair expressed her intention to work with the Secretariat and the SSC PS to develop a summary of species information about Pacific saury that is similar in format to the species summary documents prepared for other priority species.

5.3.1 Selection of vice-chair of SSC PS

23. No nominations were received for the position of vice-chair of the SSC PS.

Agenda Item 6. Report and recommendations from the Joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific Saury (SWG MSE PS)

24. The co-Chair of the joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific saury (SWG MSE PS), Dr. Toshihide Kitakado (Japan), informed participants about progress of the SWG MSE PS including the outcomes and recommendations of its 1st and 2nd meetings (NPFC-2022-SWG MSE PS01-Final Report, NPFC-2022-SWG

MSE PS02-Final Report).

Agenda Item 7. Priority species

7.1 Summary of progress on the remaining four priority species

25. The Leads of the Small Working Groups (SWGs) on neon flying squid (NFS), Japanese flying squid (JFS), Japanese sardine (JS), and blue mackerel (BM) reported on the SWGs' intersessional activities, including the relevant outcomes of the 1st and 2nd joint meetings of these SWGs, in the respective sections below (7.1.1 – 7.1.4). Detailed summaries of the joint SWG meetings are available in NPFC-2022-SC07-WP05 (1st meeting) and NPFC-2022-SC07-WP06 (2nd meeting).

7.1.1 Neon flying squid

26. The SWG NFS Lead, Dr. Luoliang Xu (China), reported on the SWG NFS' intersessional activities. The SWG NFS has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, NFS, BM, and JS), developed a data template and shared catch and effort data in accordance with the template, evaluated the population dynamics and environmental impacts on NFS and developed a template for sharing relevant information/literature on the subject, reviewed previous stock assessment methods used on NFS (swept area, depletion model, surplus-production models) or other similar species (SAM model for JFS), discussed potential strategies for effective management, and updated the species summary document for NFS.

27. The SWG NFS Lead presented the updated species summary document for NFS (NPFC-2022-SC07-WP07).

28. The SC reviewed and endorsed the species summary document for NFS (Annex H).

29. The SC discussed future tasks for the SWG NFS and agreed on the following:
    (a) Update the species summary
    (b) Discuss potential data sharing needs
    (c) Share data for NFS, including unpublished data if possible
    (d) Update catch and effort data
    (e) Calculate nominal CPUE
    (f) Evaluate environmental variables on recruitment, life history parameters, and fisheries population dynamics
    (g) Share literature relevant to understanding the fishery population dynamics of NFS, including unpublished literature if possible
    (h) Discuss the possibility of linking footprint and effort data on NFS using GIS tools
    (i) Explore the application of existing stock assessment models or develop a new stock

assessment model for NFS

(j) Share JFS stock assessment code for developing a stock assessment model for NFS

(k) Conduct other research that may contribute to the provision of management advice

7.1.2 Japanese sardine

30. The SWG JS Lead, Dr. Chris Rooper (Canada), reported on the intersessional activities of the SWG JS. The SWG JS has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, NFS, BM, and JS), evaluated the spatial structure for Japanese sardine, developed a data sharing template and shared catch and effort data in accordance with the template, evaluated the population dynamics and environmental impacts on JS and developed a template for sharing relevant information/literature on the subject, reviewed the methods and results of Japan's domestic stock assessment of JS conducted since 1976, and updated the species summary document for JS.

31. The SWG JS Lead presented the updated species summary document for JS (NPFC-2022-SC07-WP08).

32. The SC reviewed and endorsed the species summary document for JS (Annex I).

33. The SC discussed future tasks for the SWG JS and agreed on the following:

(a) Update the species summary

(b) Discuss potential data sharing needs

(c) Share data for JS, including unpublished data if possible

(d) Update catch and effort data

(e) Calculate nominal CPUE

(f) Share literature relevant to understanding the fishery population dynamics of JS, including unpublished literature if possible

(g) Discuss the possibility of linking footprint and effort data on sardines using GIS tools

(h) Evaluate environmental variables on recruitment, life history parameters, and fisheries population dynamics

(i) Review the latest domestic JS stock assessment conducted by Japan

7.1.3 Japanese flying squid

34. The SWG JFS Lead, Dr. Kazuhiro Oshima (Japan), reported on the SWG JFS' intersessional activities. The SWG JFS has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, NFS, BM, and JS), evaluated the spatial structure of JFS life history stages and stocks relative to fisheries, conducted a literature review about the influence of environmental variables on the life history and biology of JFS, reviewed the results of Japan's JFS domestic

stock assessment conducted since 1999, summarized potential challenges to conducting a stock assessment for JFS in the Convention Area, and updated the species summary document for JFS.

35. The SWG JFS Lead presented the species summary document for JFS (NPFC-2022-SC07-WP09).

36. The SC reviewed and endorsed the species summary document for JFS (Annex J).

37. The SC discussed future tasks for the SWG JFS and agreed on the following:
    (a) Update the species summary
    (b) Discuss potential data sharing needs
    (c) Share data, including unpublished data if possible
    (d) Update and review Members' JFS catch and effort data
    (e) Share literature relevant to understanding the fishery population dynamics of JFS, including unpublished literature if possible
    (f) Continue research on the spatial structure of the JFS life history and stock relative to the fishing footprint
    (g) Evaluate environmental variables on recruitment, life history parameters, and fisheries population dynamics
    (h) Discuss the possibility of linking footprint and effort data on JFS using GIS tools
    (i) Review the latest domestic JFS stock assessment conducted by Japan

7.1.4 Blue mackerel

38. The SWG BM Lead, Dr. Shota Nishijima (Japan), reported on the SWG BM's intersessional activities. The SWG BM has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, NFS, BM, and JS), reviewed the species identification method used by Japan to distinguish BM and chub mackerel, discussed a data sharing template for BM, reviewed the catch composition of BM and chub mackerel in the Chinese and Japanese fisheries, reviewed research by Russia to differentiate chub mackerel and blue mackerel using the Japanese species identification method, updated the species summary document, reviewed the methods and results of Japan's domestic BM stock assessment, summarized the potential challenges to conducting a stock assessment for BM in the Convention Area, and discussed and agreed to the separation of fishery data such as catch-at-age and abundance indices by chub mackerel and BM.

39. The SWG BM Lead presented the species summary document for BM (NPFC-2022-SC07-WP10).

40. The SC reviewed and endorsed the species summary document for BM (Annex K).

41. The SC discussed future tasks for the SWG BM and agreed on the following:
    (a) Update the species summary
    (b) Discuss potential data sharing needs
    (c) Share data, including unpublished data if possible
    (d) Update Members' estimated catch and effort for BM
    (e) Update Members' data on catch composition of BM and chub mackerel
    (f) Review historical catch and estimate the proportion of BM and chub mackerel, if possible
    (g) Review the feasibility of calculating the proportion of BM and chub mackerel catch by gear
    (h) Collect data on size and/or age composition of BM, if possible
    (i) Continue to explore options for distinguishing BM and chub mackerel catch
    (j) Evaluate environmental variables on recruitment, life history parameters, and fisheries population dynamics
    (k) Review the latest domestic BM stock assessment conducted by Japan

42. China informed the SC about its research on the proportion of BM and chub mackerel catch. The SC requested China and other Members to provide information about catch composition of BM and chub mackerel to the next SWG BM and TWG CMSA07 meetings.

43. The SC agreed that the four SWGs on NFS, JS, JFS, and BM would discuss leadership of those groups intersessionally.

7.2 Identification of data needs and data gaps and strategies to fill those gaps

7.2.1 Spatial data summarized by year and 1 x 1 degree resolution

44. The SC noted the importance of spatial information to inform the Commission's management decisions and that this is reflected in the tasks of its SWGs on NFS, JS, JFS, and BM as well as the workplans of SSC PS and SSC BF-ME.

45. The SWG JS Lead presented annual and monthly CPUE indices for JS (NPFC-2022-SC07-WP11 (Rev. 1)). For the annual index, CPUE was calculated for each year by gear type for each Member. For the monthly index, CPUE was calculated two ways: for each month by gear type for each Member with effort being either the number of operational days or the number of sets of gear type.

46. The SC discussed the value of different measures of fishing effort to calculate CPUE, including

the number of days fished and total number of sets. CPUE based on the number of sets may be more stable than a CPUE based on the number of days fished, although a decision on which measure of fishing effort to use should be made on a case by case basis. It was pointed out that the number of sets may be a hyperstable measure of effort, so more analysis may be needed in order to determine the best measure of effort.

7.3 Stock assessment of NFS, JS, JFS, and BM

7.3.1 Top-down prioritization

47. The SC agreed that NFS is a priority for stock assessment, but that it was difficult to rank the four species according to top-down prioritization for stock assessment.

48. The SC agreed to task the SWGs for NFS, JS, JFS, and BM to work collectively to assess capacity to build stock assessment models for each species, and to present recommendations for the top-down prioritization of the stock assessment of these species at SC08.

7.3.2 Capacity

7.3.3 Funding availability

49. The SC agreed to defer discussions of the capacity and funding availability for the stock assessment of these species until SC08, when it will have received the recommendations of the respective SWGs.

Agenda Item 8. Progress in data collection, management and security

8.1 Information management and security regulations

50. The Compliance Manager, Ms. Judy Dwyer, provided an update on the ongoing work to develop an overarching policy for data use and management that pertains to the Commission and its subsidiary bodies (NPFC-2022-SC07-IP05).

8.1.1 Procedures for sharing code

51. The Chair presented a proposal to revise the SC's Regulations for Management of Scientific Data and Information aimed at facilitating the sharing of computer code (NPFC-2022-SC07-WP03).

52. The SC reviewed and endorsed the proposal. The SC recommends that the Commission adopt the revised Regulations for Management of Scientific Data and Information (Annex O).

8.2 Data collection

8.2.1 Information about species belonging to the same ecosystem or dependent/associated with target stocks

53. The SC noted that, in accordance with Article 10, paragraph 4(d), one of the functions of the SC shall be to assess the impacts of fishing activities on fisheries resources and species belonging to the same ecosystem or dependent upon or associated with the target stocks. The SC also noted, however, that the Commission has not made specific requests for advice on these topics.

8.2.2 Data gaps and needs that could be filled by an observer program

54. The Science Manager presented a summary of information regarding the existing scientific observer programs of Members and those of other RFMOs (NPFC-2018-SC03-WP03 (Rev. 1)) as of April 2018. For pelagic fisheries, there is no coordination in the Members' observer programs neither in terms of the type of observer program nor in coverage and data requirements. Russia, Korea and Chinese Taipei collect data on fishing vessels at sea by observers and electronic reporting system, respectively, while other Members carry out in-port scientific observations. Specifications for observer training, observer program design, number of observers and required data differ among Members. All "general" RFMOs (NAFO, NEAFC, SEAFO, SIOFA, SPRFMO) and CCAMLR have developed at least one observer program. Most general RFMO Observer Programs have been set up primarily to collect scientific data, but in three of six cases, it includes compliance tasks with one general RFMO focusing on a compliance observer program. Almost all RFMOs for highly migratory species have observer programs with both science and compliance components, but with different balances. The SSC PS has previously developed a template for identification of scientific data which can be collected and/or validated by at-sea observers, fishermen, electronic reporting systems and other means, dividing the different types of data into four categories: data that can only be collected by observers at sea; data that can be collected by fishermen at sea; data which are preferably collected by observers, but a degree of cover can be achieved by other means; and data which can be collected equally well by other means.

8.2.3 Scientific needs for electronic monitoring

55. The SC noted that there remain some issues with electronic monitoring, including data storage, that require further discussion.

8.3 NPFC data management system (DMS)

56. The Data Coordinator, Mr. Sungkuk Kang, reported on the progress in the development of the SC-related data management system (NPFC-2022-SC07-IP02). Updates have been made to the Members Home, Significant dates/Events, Pacific Saury Weekly Report, Collaboration, and Annual reports sections. The NPFC GIS Map has recently been updated to include Pacific saury catch and effort data with sea surface temperature per grid from 1994 to 2021. At the request of the SSC BF-ME, the Secretariat has developed bottom fishing maps of combined, gear-

specific footprints by different gear types and time periods. These maps are available on the NPFC website. Work is ongoing to overlay VME maps over the bottom fishing maps.

57. The SC requested the Data Coordinator to add specific dates to the timestamps for posts on the Collaboration site.

Agenda Item 9. Scientific projects for 2023 and 2024

9.1 Ongoing/planned projects

9.2 New projects

9.3 Review and prioritization of projects

58. The Science Manager presented a draft list of scientific projects that were discussed during the meetings of the SC and its subsidiary bodies (NPFC-2022-SC07-WP04 (Rev.1)).

59. The SC reviewed the list of proposed scientific projects and endorsed it for consideration by the Commission (Annex P).

Agenda Item 10. Cooperation with other organizations

60. The Science Manager presented a compiled list of cooperation opportunities and requests from other organizations, for consideration by the SC (NPFC-2022-SC07-IP04 (Rev. 1)).

10.1 Reports on the joint NPFC-PICES activities since the SC06 meeting, including a report from PICES Secretariat

61. The Executive Secretary of the North Pacific Marine Science Organization (PICES), Dr. Sonia Batten, reported on recent and upcoming PICES activities of relevance to the NPFC (NPFC-2022-SC07-OP05), highlighting the following:
    (a) Participation by NPFC and PICES representatives at each other's annual meetings
    (b) NPFC representation to the joint Working Group on Small Pelagic Fish (WG 43)
    (c) Involvement by some NPFC scientists, including the Chair of the NPFC SC, in the Working Group on the Ecology of Seamounts (WG 47)
    (d) Co-sponsoring of a topic session, "Environmental variability and small pelagic fishes in the North Pacific: exploring mechanistic and pragmatic methods for integrating ecosystem considerations into assessment and management" by the NPFC at the PICES-2022 Annual Meeting in Busan, Korea in September 2022.
    (e) Co-convening by NPFC SC members of a workshop at PICES-2022 with members of WG 47 on "Distributions of pelagic, demersal and benthic species associated with seamounts in the North Pacific Ocean and factors influencing their distributions"
    (f) Co-sponsoring of the PICES-ICES-FAO Small Pelagic Fish Symposium
    (g) Plans to hold a PICES 2023 session on "Seamount biodiversity: VMEs and species

associated with seamounts in the North Pacific Ocean"

(h) Agreement by the NPFC and PICES to hold a joint international course/workshop on VME indicator taxa identification, and approval of financial contributions of US$15,000 from each organization

62. The Executive Secretary of PICES presented information about the Basin Scale Events to Coastal Impacts (BECI) project. The goal of BECI is to develop a coordinated monitoring system for the North Pacific Ocean that supports regional downscaled models that would help understand the effects of climate change on fisheries production. BECI is anticipated to be run as a PICES special project. The Executive Secretary of PICES invited the NPFC to support and cooperate with BECI and help it to achieve its goals that in turn would support greater understanding of the marine ecosystem and its effects on species of interest to the NPFC.

63. The SC expressed its support for the development and implementation of the BECI project in line with the *NPFC-PICES Framework for Enhanced Scientific Collaboration*.

10.2 Joint NPFC-PICES workshop/course on VME indicator identification

64. The Science Manager informed the SC that the VME indicator taxa identification course had been postponed due to the Covid-19 pandemic. The SC agreed to postpone the course further and suggested that if any Members other than the original planned host (Russia) are interested in hosting the course, they could express their interest to the Secretariat and initiate intersessional discussions on the subject.

10.3 SC representation at PICES meetings

10.3.1 Report on joint PICES-ICES-FAO small pelagic fish (SPF) symposium

65. The Science Manager provided a report on the PICES-ICES-FAO SPF symposium held in Lisbon, Portugal from 7 to 11 November 2022 (NPFC-2022-SC07-IP03). The theme of the symposium was "Small Pelagic Fish: New Frontiers in Science for Sustainable Management." The NPFC co-sponsored the symposium and was represented by the SSC PS Chair (who was also a member of the Steering Committee of the SPF symposium) and the Science Manager.

10.3.2 SC representation in the joint PICES/ICES Working Group on Small Pelagic Fish (WGSPF)

66. Dr. Chris Rooper (Canada) provided a report on the activities of the joint PICES/ICES Working Group on Small Pelagic Fish in 2022 of relevance to the NPFC. These include:

(a) The PICES topic session on "Environmental variability and small pelagic fishes in the North Pacific: exploring mechanistic and pragmatic methods for integrating ecosystem considerations into assessment and management" co-sponsored by the NPFC

(b) A WGSPF Business meeting prior to the PICES-2022 Annual Meeting
(c) The PICES-ICES-FAO SPF symposium on "Small Pelagic Fish: New Frontiers in Science for Sustainable Management" co-sponsored by the NPFC
(d) A workshop to plan reporting and follow-up projects to the PICES-ICES-FAO SPF Symposium
(e) A proposal to hold a topic session on "improved detection and understanding of factors affecting changes in North Pacific forage communities and implications to ecosystems" at the 2023 PICES Annual Meeting

67. The SC noted the need for a new NPFC representative to the WGSPF, in addition to the SSC PS Chair, Dr. Toshihide Kitakado. The SC agreed to appoint the TWG CMSA Chair, Dr. Kazuhiro Oshima, as the NPFC's representative.

10.3.3 Report on PICES topic session on SPF

68. Jhen Hsu provided a report on the PICES topic session on Small Pelagic Fish held in Busan, Korea on 27 September 2022. The session was co-sponsored by the NPFC and its theme was "Environmental variability and small pelagic fishes in the North Pacific." The session comprised 12 talks and two posters in the poster session. At the session, Jhen Hsu presented research related to the joint CPUE standardization collaborative work done by the SSC PS.

69. The SC congratulated Jhen Hsu for winning the best oral presentation award from PICES' Fisheries Science Committee for her presentation.

10.3.4 Process for selecting SC representatives at future scientific meetings

70. The SC Chair presented a proposal for a method to evaluate and rank nominations for SC representatives to be financially supported to participate in relevant scientific meetings (NPFC-2022-SC07-IP01).

71. The SC endorsed the proposed method and agreed that if there is any discrepancy among the rankings by the Chairs of the SC and its subsidiary bodies, they will work together to determine the best candidate to support.

72. The SC agreed to recommend that the Commission financially support the travel of one member of the SC or its subsidiary bodies to participate in the 2023 PICES Annual meeting in Seattle, USA, if necessary.

10.4 NPFC/NPAFC Memorandum of Cooperation and Work Plan

73. The Science Manager reminded the SC of the suggested revisions it made at the SC06 meeting

to the draft five-year Work plan to implement NPAFC/NPFC Memorandum of Cooperation, 2021-2025 (NPFC-2022-SC07-OP02).

74. The SC reviewed and reaffirmed its endorsement of the revised science-related items in the work plan. The SC recommends that the Commission endorse the revised science-related items of the five-year Work Plan to implement the NPAFC/NPFC Memorandum of Cooperation (Annex Q).

10.4.1 Report on the NPAFC's multinational IYS survey in the North Pacific Ocean

75. The Executive Director of the NPAFC, Dr. Vladimir Radchenko, presented a progress report on the 2022 International Year of the Salmon (IYS) Winter High Seas Research Expedition in the North Pacific Ocean (NPFC-2022-SC07-OP01). Five expedition vessels from Canada, Russia, and the United States covered more than 1.5 million km^2 by a regular integrated survey to study Pacific salmon distribution and winter ecology from February to April 2022. These vessels spent 182 days at sea including 96 days on survey, completed 126 survey stations, and caught 1,623 salmon, mostly sockeye (46.1%) and chum (35.5%). Catches of NPFC species of interest were rare due to the survey's limitation to northern and eastern parts of the NPAFC Convention Area. The Executive Director of the NPAFC expressed the NPAFC's appreciation for the financial, planning and information-sharing contributions made by the NPFC to the research expedition.

10.5 FAO ABNJ Deep-sea fisheries project

76. Dr. Tony Thompson (FAO) presented an update on the ABNJ Deep Sea Fisheries (DSF) Project (NPFC-2022-SC07-OP04). The work of the project has four main components: strengthening and implementing regulatory frameworks, strengthening effective management of deep-sea fisheries, cross-sectoral interactions on deep-sea fisheries, and knowledge management and communication. An inception workshop will be held in January 2023. The initial activities include development of an e-learning package for the *Step-wise guide for the implementation of international legal and policy instruments related to deep-sea fisheries and biodiversity conservation in the areas beyond national jurisdiction*, review of the implementation of the Deep-sea Fisheries Guidelines, rapid assessment of stock status (including armorhead, alfonsino and sablefish), and preparation for a symposium on ecosystem production models and the prevention of ecosystem overfishing with RFMO partners. An overarching focus in year 1 of the project will be improved data collection by onboard observers for compliance and scientific purposes. The NPFC SC is invited to consider the planned activities of the DSF Project and to identify areas of common interest and cooperation.

10.6 Partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)

77. The Science Manager reminded the SC that at SC06, it recommended that the Commission consider entering into an arrangement with FIRMS and decide whether to do so under a Partnership Arrangement or a Collaborative Arrangement. However, due to postponement of the NPFC's 7th Commission meeting, the Commission has not yet been able to consider the recommendation.

78. The SC re-affirmed its support for the NPFC entering into an arrangement with FIRMS. The SC recommended that the Commission consider entering into an arrangement with FIRMS and decide whether to do so under a Partnership Arrangement or a Collaborative Arrangement.

10.7 Cooperation with other organizations

79. There was no discussion of cooperation with any other organizations.

Agenda Item 11. 2022-2026 Research Plan and Work Plan

11.1 Five-year Research Plan

11.2 Five-year Work Plan

80. The SC reviewed its 2022-2026 Five-Year Rolling Research Plan (NPFC-2022-SC07-WP01) and Work Plan (NPFC-2022-SC07-WP02). The Research Plan and the Work Plan of the SC and its subsidiary bodies are attached as Annex R.

Agenda Item 12. Other matters

12.1 Review of the Scientific Committee Terms of Reference (TOR)

81. The SC reviewed its TOR and determined that no changes are currently needed.

12.2 Coordination between SC and TCC

82. Based on the discussion above, the SC identifies the following as matters for coordination between the SC and the TCC and requests the Secretariat to inform the TCC:
    (a) Revision of CMMs 2021-05 and 2019-06 (Annexes L and M)
    (b) Ambiguity around the referenced effort limits in Paragraph 4A, CMM 2021-05
    (c) Draft Work plan to implement NPAFC/NPFC Memorandum of Cooperation (Annex Q)

12.2.1 Fishing effort indicators

83. No updates were provided.

12.3 Other issues

84. The EU provided an updated fisheries operation plan (FOP) and impact assessment for a chub mackerel fishery within the NPFC Convention Area (NPFC-2022-SC07-WP12). The updated fisheries operation plan and impact assessment include the most recent scientific information

available and take into account comments and suggestions made during previous Technical Working Group on Chub Mackerel Stock Assessment, Scientific Committee and Commission meetings. The EU FOP takes into account the current state of the art and information available regarding potential impacts of the fishing operations proposed on target and possible bycatch species, as well as on the marine ecosystem. In addition, the proposed EU FOP would allow, through a dedicated sampling program, the data collection and provision of valuable scientific information in a data-poor zone of the Convention Area, therefore it would contribute to more robust future stock assessments of chub mackerel in the Convention Area.

85. The SC reviewed the EU's updated fisheries operation plan and impact assessment for a chub mackerel fishery within the NPFC Convention Area and noted that the EU has provided all the requested information. The SC recommends that the Commission note the updated EU FOP submitted to SC7.

86. The SC noted that, without a stock assessment of chub mackerel in the Convention Area, it is difficult to provide scientific advice on the EU's proposed fisheries operation plan.

87. Japan stated that the Japanese Government has implemented MSY-based management since 2020 for chub mackerel. Effort control of purse seiners operating in the Japanese EEZ under the stock recovery program has been carried out since 2003. The Kobe plot provided from the latest stock assessment result showed that the stock was overfished and overfishing occurred in the terminal year (2020). Future SSB (in 2030) was projected under catch by not only Japan but also China and Russia, which reported their catch to the NPFC. The proposed 20,000 mt of EU chub mackerel catch would not allow the achievement of the management objective of recovery of SSB to above SSB_{MSY} with a probability of 50% or more in light of the current stock status.

Agenda Item 13. Advice and recommendations to the Commission

88. Based on the recommendations from its SSCs and TWG CMSA, the SC recommends that the Commission:
    (a) Endorse its 5-Year Rolling Research and Work Plans (Annex R).
    (b) Endorse the proposed scientific projects (Annex P).
    (c) Make the species summary documents publicly available on the NPFC's website.
    (d) Consider the species summary documents as reference information when taking decisions on the management of the NPFC priority species (Annexes D-K), including the information about the trends in catch and effort and other scientific information relevant to management of NPA and SA.
    (e) Consider the scientific meetings schedule for 2023 as described in paragraph 90.

Chub Mackerel

(f) Extend the consultancy agreement with the external expert to support the TWG CMSA in selecting a model for stock assessment of chub mackerel in 2023.

(g) Note the updated EU fisheries operation plan submitted to SC07.

Bottom Fish and Marine Ecosystems

(h) Endorse the revised CMM 2021-05 (Annex L).

(i) Endorse the revised CMM 2019-06 (Annex M).

(j) Consider amending CMM 2021-05 to address the ambiguity around the referenced effort limits of February 2007 in Paragraph 4A in addition to the revisions recommended in paragraph 88(h).

(k) Establish a scientific project for understanding the basis by which other RFMOs' encounter thresholds were determined by taxa and gear-type.

(l) Co-sponsor the PICES 2023 session on "Seamount biodiversity: VMEs and species associated with seamounts in the North Pacific Ocean" by contributing the equivalent of $5,000 USD.

Pacific Saury

(m) Endorse the stock assessment report (Annex N).

(n) Allocate funds for the participation of an invited expert in the next SSC PS meetings.

(o) Consider the following to improve conservation and management of Pacific saury:

i. The current annual TAC for 2021-2022 specified in CMM 2021-08 for Pacific saury (333,750 tons) based on historical catch is much larger than a TAC that would be based on the F_{MSY} catch approach (B_{2022}*F_{MSY} = 205,000 tons). The current biomass is much lower than B_{MSY} and the TAC for 2021-2022 did not reduce fishing mortality in recent years. A harvest control rule (HCR) that reduces F when biomass is low may increase the probability of achieving long-term sustainable use of Pacific saury (i.e. higher long-term catch closer to MSY of around 403,000 tons). A reduction to the TAC for 2021-2022 would increase the probability of higher biomass and catch levels in the Pacific saury stock.

ii. An HCR that reduces the target harvest rate and TAC when biomass falls below its target level may be appropriate for Pacific saury. This type of HCR is used in managing many fisheries around the world. For example, if an HCR that reduces F linearly when biomass is below B_{MSY} is applied, the TAC calculated based on such an HCR (B_{2022}*F_{MSY}*(B_{2022}/B_{MSY}) = 101,000 tons) could be similar with the current catch (98,000 tons, preliminary as of mid-December 2022).

iii. Note, however, the performance of the above HCRs has not been evaluated by a formal MSE framework for Pacific saury. They were used as simple illustrations of common approaches used elsewhere.

Data Sharing

(p) Adopt the revised Regulations for Management of Scientific Data and Information (Annex O).

(q) Update the data shared by the SC, TWG CMSA, SSC BF-ME and SSC PS, including subsidiary SWGs, in accordance with their Work Plans.

Cooperation with Other Organizations

(r) Financially support the travel of one member of the SC or its subsidiary bodies to participate in the 2023 PICES Annual meeting in Seattle, USA, if necessary.

(s) Endorse the revised science-related items of the five-year Work Plan to implement the NPAFC/NPFC Memorandum of Cooperation (Annex Q).

(t) Consider entering into an arrangement with FIRMS and decide whether to do so under a Partnership Arrangement or a Collaborative Arrangement.

89. In relation to other tasks for the SC specified in CMMs, SC's rolling five-year work plan, SC's TOR, and the Convention, the SC informs the Commission of the following:

Chub Mackerel

(a) The SC selected Dr. Kazuhiro Oshima (Japan) to serve as the TWG CMSA Chair.

(b) The SC selected Dr. Qiuyun Ma (China) to serve as the TWG CMSA Vice Chair.

(c) The TWG CMSA will select a model(s) for stock assessment of chub mackerel at its next meeting in 2023.

(d) The TWG CMSA will develop a species summary document for chub mackerel.

(e) The SC noted that, without a stock assessment of chub mackerel in the Convention Area, it is difficult to provide scientific advice on the EU's proposed fisheries operation plan.

Bottom Fish and Marine Ecosystems

(f) The SC endorsed the field guide for identification of fishes of the Emperor Seamount Chain captured by bottom fisheries (NPFC-2022-SSC BFME03-WP08).

(g) The SC endorsed the use of the scientific name *Allocyttus folletti*, instead of *A. verrucosus*, when referring to the oreosomatid fish in the Emperor Seamounts area.

(h) The SC will discuss the establishment of a formal procedure for changing species' scientific and common names used by the NPFC, including how to handle the issue of a species not having a 3-letter ASFIS code in FAO, at SC08.

(i) The SC endorsed the process proposed by Canada in NPFC-2022-SSC BFME03-WP03 as one of the NPFC's processes for identifying VMEs and areas likely to be VMEs in the Convention Area, and Canada's application of this method in the eastern part of the Convention Area.

Pacific Saury

(j) The SC endorsed the revised Terms of Reference of the SSC PS.

(k) The SC Chair expressed her intention to work with the Secretariat and the SSC PS to develop a summary of species information about Pacific saury that is similar in format to

the species summary documents prepared for other priority species.

Other Priority Species

(l) The SC will update the species summaries of NFS, JFS, JS and BM.

(m) The SC will discuss the top-down prioritization of the stock assessment of NFS, JFS, JS and BM, as well as the capacity and funding availability for the stock assessment of these species, at its next meeting.

Data Collection and Sharing

(n) The SC adopted the terms of reference for sharing VME data.

(o) The SC adopted the template for sharing VME data.

(p) The SC will continue discussions on the establishment of an observer program in the NPFC Convention Area.

Cooperation with Other Organizations

(q) The SC expressed its support for the development and implementation of the BECI project in line with the *NPFC-PICES Framework for Enhanced Scientific Collaboration*.

(r) The SC agreed to postpone the joint NPFC-PICES course on VME indicator identification.

(s) The SC selected Dr. Kazuhiro Oshima as a NPFC representative to the PICES/ICES WGSPF in addition to the SSC PS Chair, Dr. Toshihide Kitakado.

(t) The SC developed a guideline for the evaluation and ranking of nominations for SC representatives to be financially supported to participate in relevant scientific meetings.

Performance Review

(u) The SC tasked its subsidiary bodies, including the four informal small working groups, pending the approval of the report by the Commission, to review relevant recommendations from the Performance Review report at their intersessional meetings or through email correspondence in 2023, evaluate their ability and necessary timelines to achieve the objectives in those recommendations, and to report on the outcomes of their reviews at the SC08 meeting.

Agenda Item 14. Next meeting

90. The SC suggested the following meeting schedule for 2023:

(a) TWG CMSA07: at a date to be further discussed intersessionally

(b) SSC PS11: 28-31 August 2023

(c) SSC-BF-ME04: 7-9 December 2023

(d) SSC PS12: 11-14 December 2023

(e) SC08: 15-16 and 18-19 December 2023

(f) TWG CMSA08: Late January 2024

91. The SC noted the dates of the 3rd SWG MSE PS meeting, 28 February – 1 March 2023, and recommends that the 4th SWG MSE PS meeting be held back-to-back with the next SSC PS meeting (e.g. on 1-2 September 2023).

92. The Secretariat will liaise with Chairs and Members to determine the format and venue of the scientific meetings scheduled for 2023.

93. The SC's subsidiary bodies will hold informal web meetings to check progress and plan intersessional work, when needed.

Agenda Item 15. Press release

94. The SC endorsed the press release for publication on the NPFC website after the meeting.

Agenda Item 16. Adoption of the Report

95. The SC07 report was adopted by consensus.

Agenda Item 17. Close of the Meeting

96. The meeting closed at 10:55 on 20 December 2022, Tokyo time.

Annexes:

Annex A – Agenda
Annex B – List of documents
Annex C – List of participants
Annex D – Species summary for North Pacific armorhead
Annex E – Species summary for splendid alfonsino
Annex F – Species summary for sablefish
Annex G – Species summary for blackspotted and rougheye rockfishes
Annex H – Species summary for neon flying squid
Annex I – Species summary for Japanese sardine
Annex J – Species summary for Japanese flying squid
Annex K – Species summary for blue mackerel
Annex L – Revised CMM 2021-05 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northwestern Pacific Ocean
Annex M – Revised CMM 2019-06 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northeastern Pacific Ocean
Annex N – Stock Assessment Report for Pacific Saury

Annex O – Revised Regulations for Management of Scientific Data and Information

Annex P – Scientific projects

Annex Q – Five-year Work Plan to implement NPAFC/NPFC Memorandum of Cooperation

Annex R – Five-Year Research Plan and Work Plan of the Scientific Committee

Annex A

Agenda

Agenda Item 1. Opening of the Meeting

Agenda Item 2. Adoption of Agenda

Agenda Item 3. Meeting arrangements

Agenda Item 4. NPFC Performance Review recommendations for the Scientific Committee

Agenda Item 5. Review of reports and recommendations from the Small Scientific Committees (SSC BF-ME and SSC PS) and the Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA)

- 5.1 Technical Working Group on Chub Mackerel Stock Assessment
- 5.2 SSC on Bottom Fish and Marine Ecosystems
- 5.3 SSC on Pacific Saury
  - 5.3.1 Selection of vice-chair of SSC PS

Agenda Item 6. Report and recommendations from the Joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific Saury (SWG MSE PS)

Agenda Item 7. Priority species

- 7.1 Summary of progress on the remaining four priority species
  - 7.1.1 Neon flying squid
  - 7.1.2 Japanese sardine
  - 7.1.3 Japanese flying squid
  - 7.1.4 Blue mackerel
- 7.2 Identification of data needs and data gaps and strategies to fill those gaps
  - 7.2.1 Spatial data summarized by year and 1 x 1 degree resolution
- 7.3 Stock assessment of NFS, JS, JFS, and BM
  - 7.3.1 Top-down prioritization
  - 7.3.2 Capacity
  - 7.3.3 Funding availability

Agenda Item 8. Progress in data collection, management and security

- 8.1 Information management and security regulations
  - 8.1.1 Procedures for sharing code
- 8.2 Data collection
  - 8.2.1 Information about species belonging to same ecosystem or dependent/associated with target stocks
  - 8.2.2 Data gaps and needs that could be filled by an observer program
  - 8.2.3 Scientific needs for electronic monitoring

8.3 NPFC data management system (DMS)

Agenda Item 9. Scientific projects for 2023 and 2024
- 9.1 Ongoing/planned projects
- 9.2 New projects
- 9.3 Review and prioritization of projects

Agenda Item 10. Cooperation with other organizations
- 10.1 Reports on the joint NPFC-PICES activities since the SC06 meeting, including a report from the PICES Secretariat
- 10.2 Update on the joint NPFC-PICES workshop/course on VME indicator identification
- 10.3 SC representation at scientific meetings
  - 10.3.1 Report on joint PICES-ICES-FAO small pelagic fish (SPF) symposium
  - 10.3.2 SC representation in joint PICES/ICES Working Group on Small Pelagic Fish (WGSPF)
  - 10.3.3 Report on PICES topic session on SPF
  - 10.3.4 Process for selecting SC representatives at future scientific meetings
- 10.4 NPFC/NPAFC Memorandum of Cooperation and Work Plan
  - 10.4.1 Report on the NPAFC's multinational IYS survey in the North Pacific Ocean
- 10.5 FAO ABNJ Deep-sea fisheries project
- 10.6 Partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)
- 10.7 Cooperation with other organizations

Agenda Item 11. 2022-2026 Research Plan and Work Plan
- 11.1 Five-year Research Plan
- 11.2 Five-year Work Plan

Agenda Item 12. Other matters
- 12.1 Review of the Scientific Committee Terms of Reference (TOR)
- 12.2 Coordination between SC and TCC
  - 12.2.1 Fishing effort indicators
- 12.3 Other issues

Agenda Item 13. Advice and recommendations to the Commission

Agenda Item 14. Next meeting

Agenda Item 15. Press release

Agenda Item 16. Adoption of the Report

Agenda Item 17. Close of the Meeting

Annex B

List of documents

MEETING INFORMATION PAPERS

Document Number	Title
NPFC-2021-SC07-MIP01	Meetings Information
NPFC-2021-SC07-MIP02	Provisional Agenda
NPFC-2021-SC07-MIP03 (Rev. 2)	Annotated Indicative Schedule

REFERENCE DOCUMENTS

Document Number	Title
NPFC-2018-SC03-WP03 (Rev. 1)	Report on the existing observer programs of NPFC Members and those of other RFMOs
	Terms of Reference for SC
	Report of the NPFC Performance Review Panel

WORKING PAPERS

Document Number	Title
NPFC-2022-SC07-WP01	Revised NPFC SC Research Plan
NPFC-2022-SC07-WP02	Five-Year Work Plan of the Scientific Committee
NPFC-2022-SC07-WP03	Revised Regulations for Management of Scientific Data and Information
NPFC-2022-SC07-WP04 (Rev. 1)	Scientific projects
NPFC-2022-SC07-WP05	Summary of the 1st joint meeting of SWG NFS, JS, JFS, and BM
NPFC-2022-SC07-WP06	Summary of the 2nd joint meeting of SWG NFS, JS, JFS, and BM
NPFC-2022-SC07-WP07	Species summary for neon flying squid
NPFC-2022-SC07-WP08	Species summary for Japanese sardine
NPFC-2022-SC07-WP09	Species summary for Japanese flying squid
NPFC-2022-SC07-WP10	Species summary for blue mackerel
NPFC-2022-SC07-WP11 (Rev. 1)	Catch per unit effort calculations: Japanese Sardine
NPFC-2022-SC07-WP12	Fisheries Operation Plan and impact assessment for a Chub mackerel fishery within the NPFC Convention area

INFORMATION PAPERS

Document Number	Title
NPFC-2022-SC07-IP01	Evaluation and ranking of nominations for SC representatives to be financially supported to participate in relevant scientific meetings
NPFC-2022-SC07-IP02	NPFC Data Management System
NPFC-2022-SC07-IP03	Report on joint PICES-ICES-FAO small pelagic fish (SPF) symposium
NPFC-2022-SC07-IP04 (Rev. 1)	A compiled list of cooperation opportunities and requests from other organizations
NPFC-2022-SC07-IP05	NPFC data sharing and data security protocol

OBSERVER PAPERS

Document Number	Title
NPFC-2022-SC07-OP01	Progress report on the 2022 IYS Winter High Seas Research Expedition
NPFC-2022-SC07-OP02	Five-year Work Plan (2021–2025) to Implement NPAFC/NPFC Memorandum of Cooperation
NPFC-2022-SC07-OP03	Partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)
NPFC-2022-SC07-OP04	Deep-sea Fisheries Project – Update
NPFC-2022-SC07-OP05	Report on Joint NPFC-PICES activities for SC07, December 2022

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Species summary for North Pacific armorhead

North Pacific armorhead (*Pentaceros wheeleri*)

Common names: Pelagic armorhead, Slender armorhead (English); 五棘鲷 (Chinese); クサカリツボダイ (Japanese); 북방돗돔 (Korean); кабан-рыба (Russian)

Biological Information

North Pacific armorhead has a unique life history consisting of a pelagic larva phase and a demersal adult stage on the seamounts (Kiyota et al. 2016). Distribution of the larva includes Gulf of Alaska to North Pacific Ocean off central California and south of Japan, with center of abundance at the Emperor Seamounts. Following their settlements in the seamounts, adults make morphological changes from the "fat" type to the "lean" type concurrent with their dietary shifts. Vertical distribution of the adults ranges from 300-500 m. Juveniles at the epipelagic stage mainly feeds on copepods, shifting the targets towards fish and large crustaceans with growth.

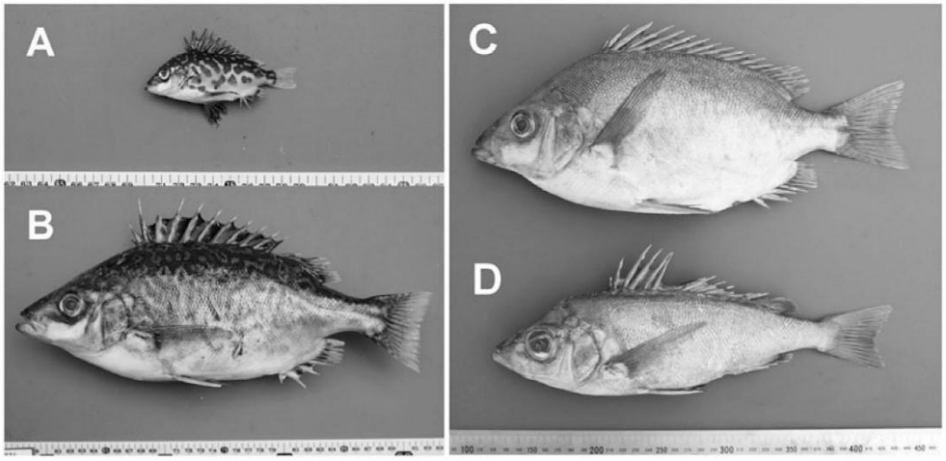

Figure 1: Photographs of Pentaceros wheeleri. *A) Pelagic juvenile, B) pelagic subadult, C) demersal adult (fat type), D) demersal adult (lean type) (from Kiyota et al. 2016)*

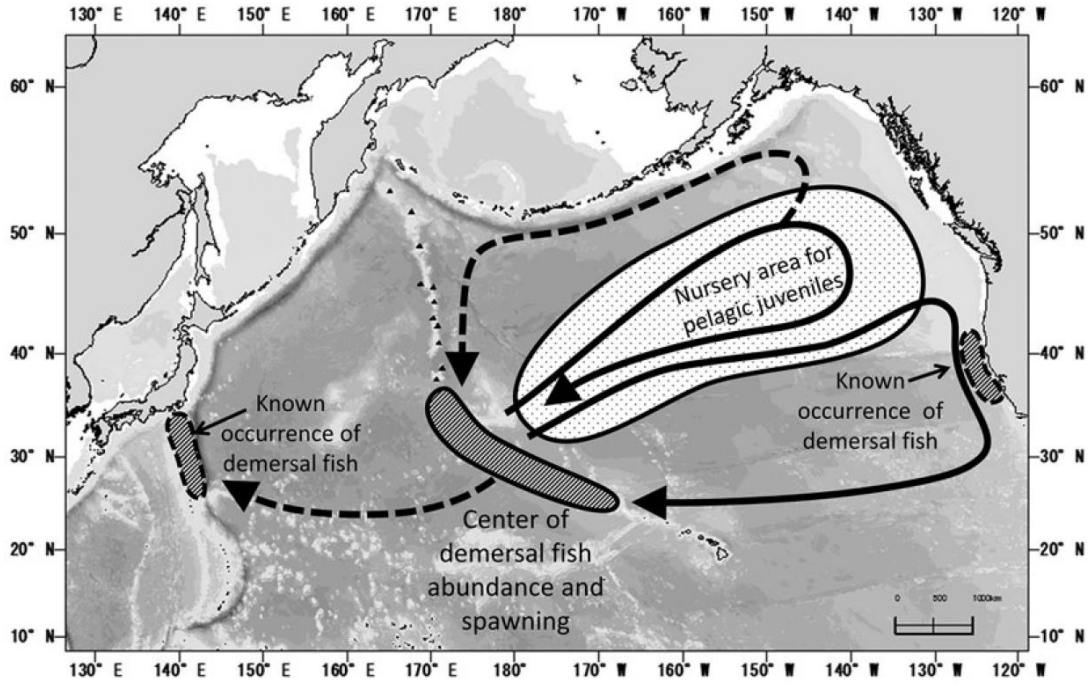

Figure 2: Known demersal habitats and hypothesized pelagic migration routes of Pentaceros wheeleri *(Kiyota et al. 2016 Figure 4, modified from Boehlert and Sasaki 1988).*

Fishery

Historical catches by Russia and Japan from the combined Emperor Seamounts were high and reached 100 thousand tons in 1970s, followed by a crash (Figure 3). Currently North Pacific armorhead is caught by Japan and Korea on the Emperor Seamounts using bottom trawls and gillnets. This fishery is a potential source of significant adverse impacts on vulnerable marine ecosystems due to bottom contact gear.

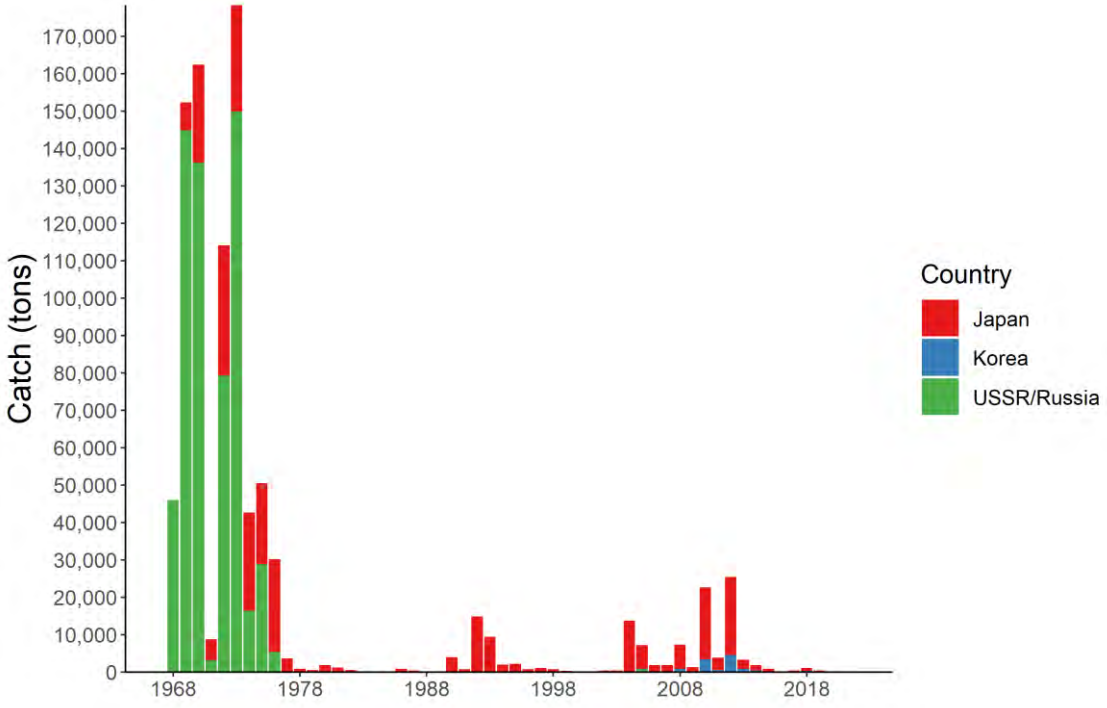

Figure 3: Historical trends of North Pacific armorhead catches in NPFC waters. *The annual amounts of catch by each country are shown by the bar plot.*

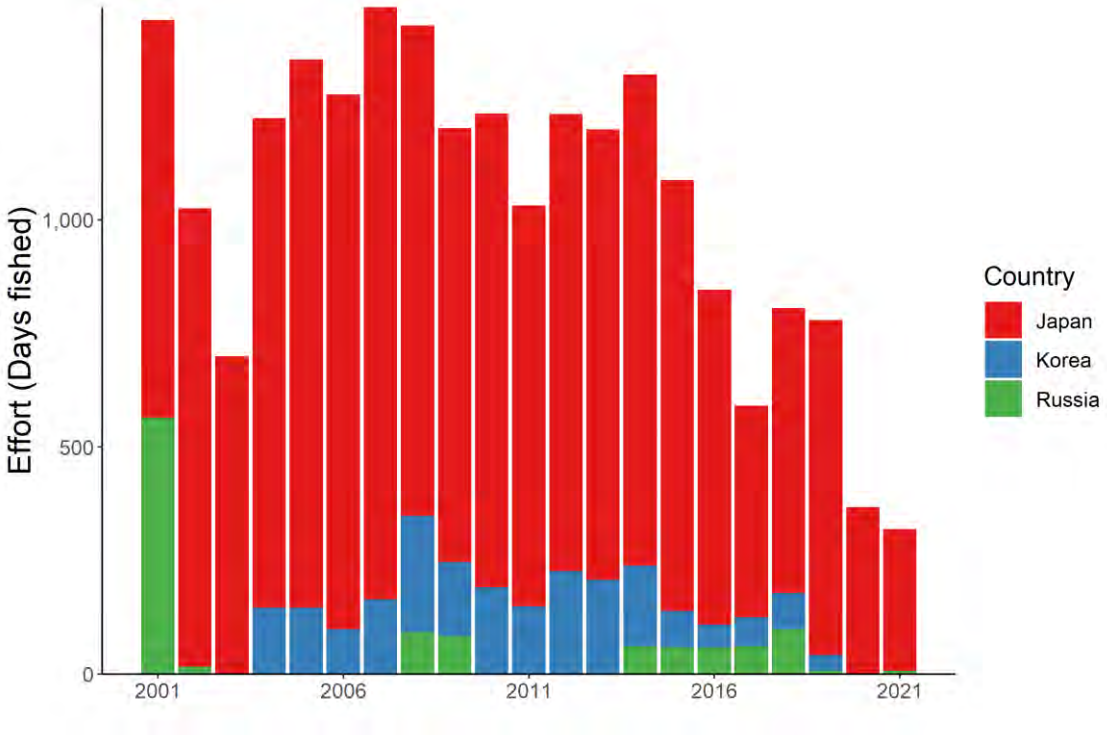

Figure 4. Historical fishing effort for North Pacific armorhead. *The annual fishing efforts by each country are shown by barplot. The efforts are calculated by the total fishing days operated during the year*

Assessment

There is no current or accepted assessment for North Pacific armorhead.

There are no biomass estimates available for this species in NPFC waters. An age- or length-structured stock assessment is unlikely to be feasible given the life history of North Pacific armorhead. Data limited approaches may be examined in the future.

Management

Active Management Measures

The following NPFC conservation and management measures pertain to this species:

- CMM 2021-05 For Bottom Fisheries and Protection of VMEs in the NW Pacific Ocean

Available from https://www.npfc.int/active-conservation-and-management-measures

Table 1: Current status of management measures

Item	Status	Description
Biological reference point	Not accomplished	Not established
Stock status	Unknown	Status determination criteria not established
Catch limit	Intermediate	Upper limit: 15,000 tons (only for Japan), No operation from November to December, Restriction of trawl mesh size
Harvest control rule	Not accomplished	Catch limit depending on the recruitment strength
Other	Intermediate	No expansion of fishing beyond established areas, No operation in the designated areas, No more increase in the fishing vessels

In 2019, an adaptive management plan was implemented for North Pacific armorhead (NPFC-2019-SSC BF02-WP05, CMM 2019-05). This plan specifies data collection via an annual monitoring survey to be conducted in March-June each year on Koko, Yuryaki, Kammu and/or Colahan Seamounts. If the survey finds evidence of strong recruitment (see CMM 2021-05 and NPFC-2019-SSC BF02-IP01 for details) some areas in the Emperor Seamounts are closed and a 12,000 ton catch limit is encouraged. In low recruitment years, a 700 ton catch limit is encouraged.

Data Availability

Table 2: Catch data

Data	Country	Fishery	Year	Comments
Annual catch	Japan	Trawl	1969-present	
		Gillnet	1990-present	
	Korea	Trawl	2004-2019	
	Russia	Trawl	1970-1987; 1997; 2001-2002; 2005-2006; 2011; 2013	
CPUE	Japan	Trawl	1970-present	Logbook data availabe
		Gillnet	2008-present	Logbook data available
	Korea	Trawl	2013-2019	Logbook data available
	Russia	Trawl	2001-2002; 2005-2006; 2011; 2013	

Table 3: Biological data

Data	Country	Year	Comments
Age	Japan		A preliminary daily ring analysis for ca. 300 fish
	Korea	2013-2019	
	Russia		
Length	Japan	2009-present	Protocol revised (see NPFC-2018-SSC BF01-WP03)
	Korea	2013-2019	
	Russia		
Maturity	Japan	2013-present	
	Korea	2013-2019	
	Russia	1970-1987; 1997; 2011; 2013	

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Species summary for splendid alfonsino

Splendid alfonsino (*Beryx splendens*)

Common names: Splendid alfonsino (English); 红眼金鲷 (Chinese); キンメダイ (Japanese); 빛금눈돔 (Korean); Низкотелый берикс (Russian)

Biological Information

Global distribution ranges from tropical to temperate oceans. Historical catch records in the Emperor Seamount suggest the distribution from Nintoku (45 °N) to Hancock (30 °N). Settlement occurs following a certain period of the pelagic life stage. Adults show a vertical distribution from 200 to 800 m with diel vertical migration, feeding on crustaceans, cephalopods, and fish during the night. Limited information is available for recruitment and reproduction processes in the Emperor Seamounts, whereas the population in the Japanese coast shows 4–5 years to sexually mature and spawning occurs during summer (Shotton 2016).

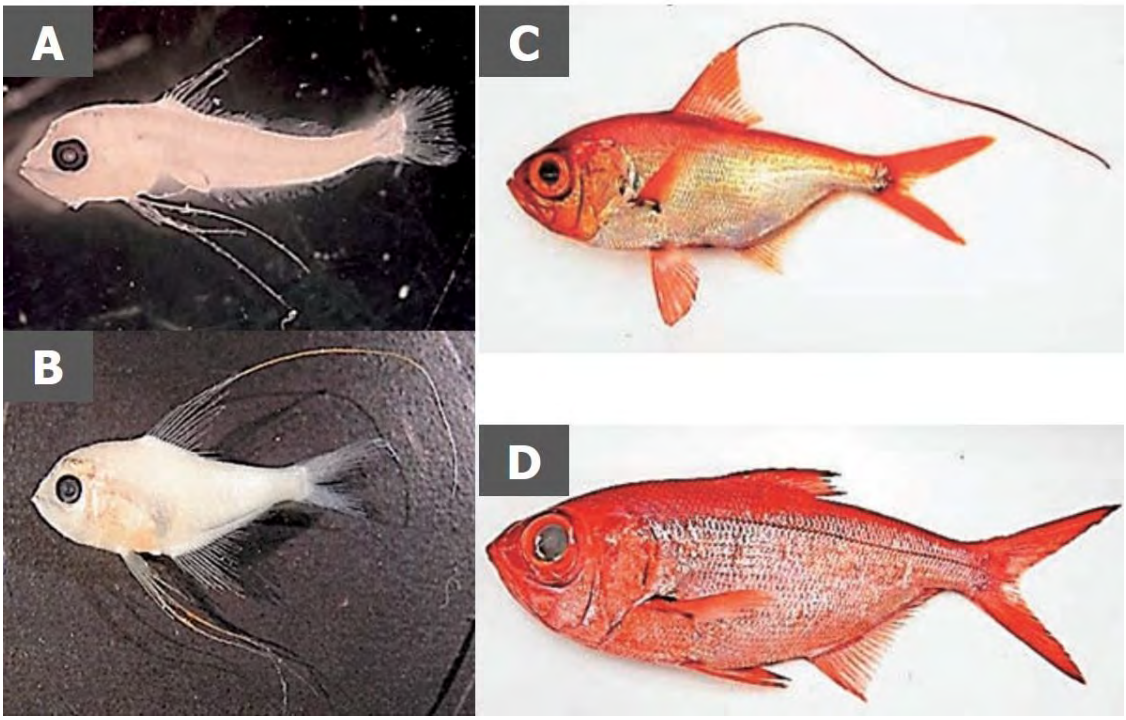

Figure 1: Photographs of Beryx splendens on different developmental stages *A) postlarva, B) juvenile, C) young, D) adult (from Watari et al. 2017)*

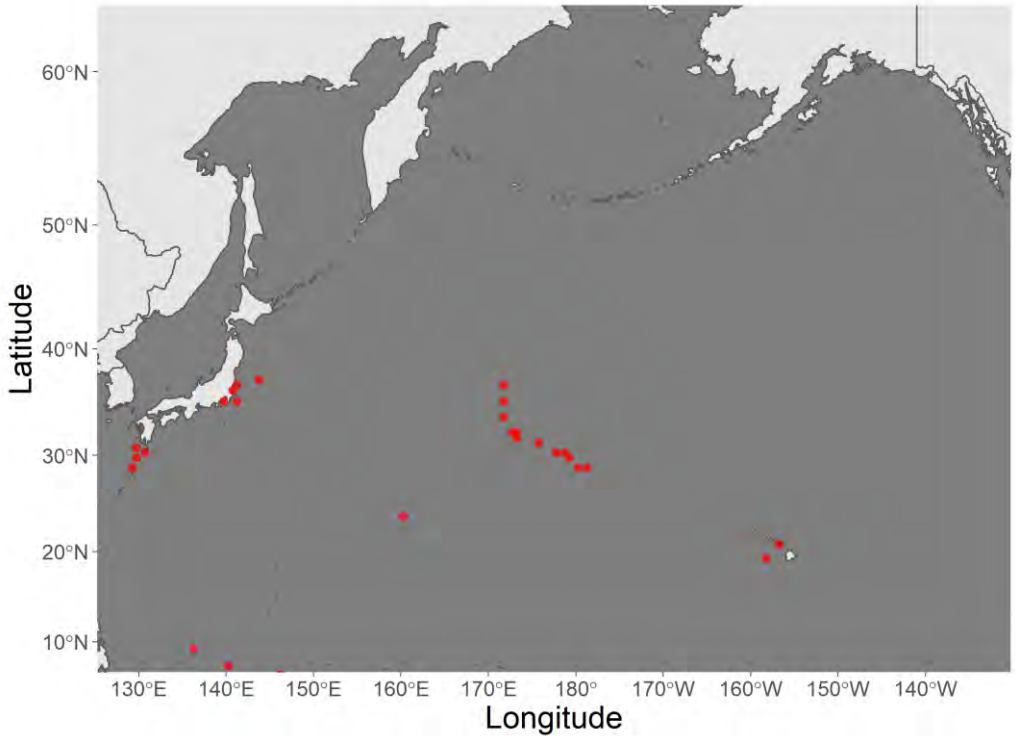

Figure 2: Known distribution of Beryx splendens around NPFC waters. *Points indicate observation data from original sources (AquaMaps 2019, October)*

Fishery

Since the discovery of large populations of North Pacific armorhead in the Emperor Seamount in the late 1960s, Splendid alfonsino has been exploited as an alternative resource to the armorhead due to the large temporal fluctuation of the armorhead population. The main fishing methods are bottom trawls and gillnets.

Historical catch record (Figure 3) shows the highest catch proportion by Japan, followed by Korea and Russia. Russia terminated their fishery nearly a decade ago. Fishing pressure somewhat reflects the recruitment condition of North Pacific armorhead. In 2010 and 2012, when high recruitment of the armorhead occurred, the annual catch decreased below 1,000 tons, whereas it increased up to 4,000 tons ever since then.

Size composition analysis from the catch data by Japanese trawlers suggests the substantial decrease in size of fish in catches over the past decade, raising the concern about growth and recruitment overfishing (Sawada et al. 2018).

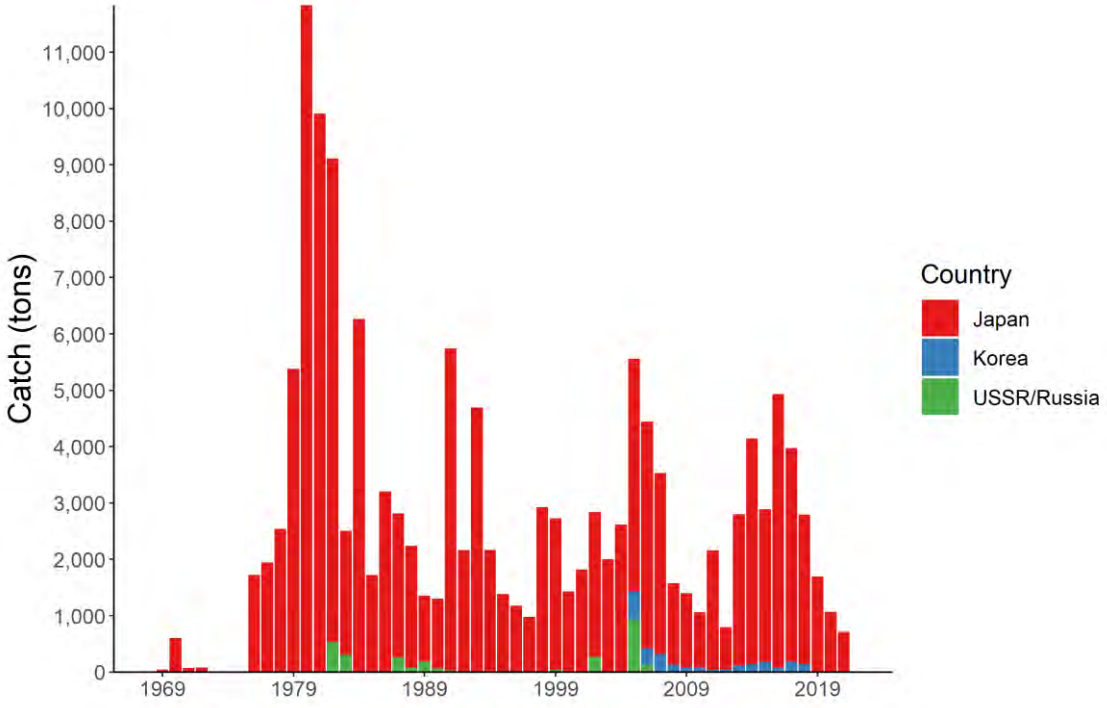

Figure 3: Historical trends of Splendid alfonsino catches in NPFC waters. *The annual amounts of catch by each country are shown by the bar plot.*

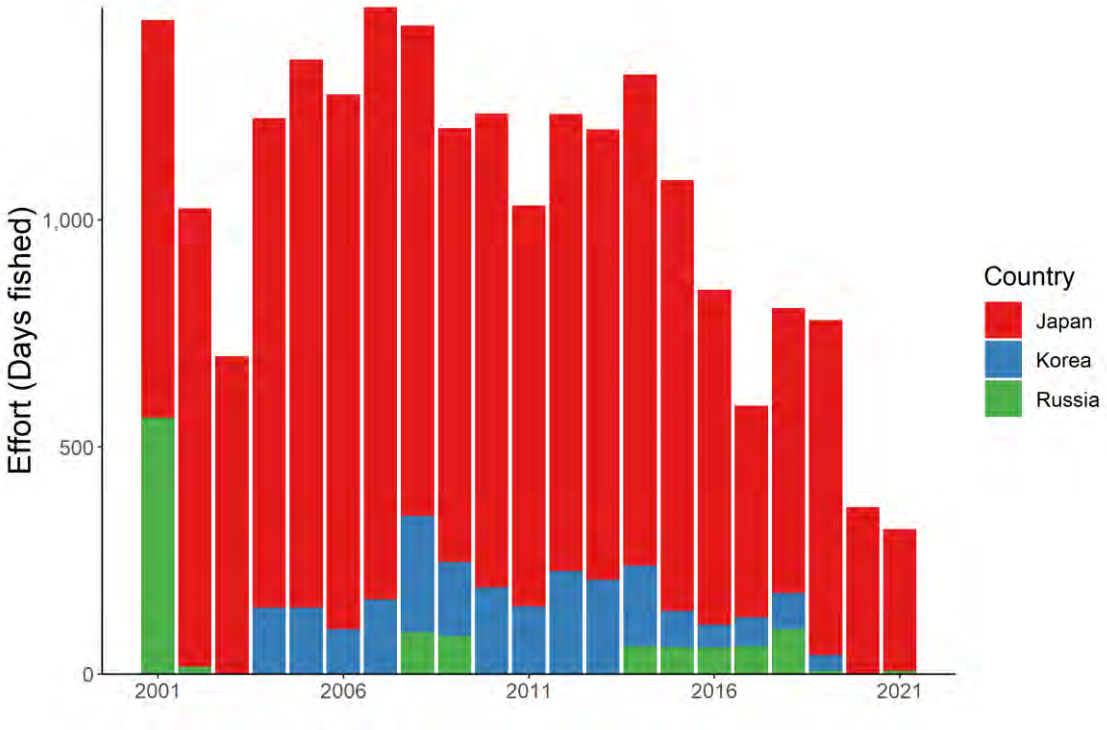

Figure 4. Historical fishing efforts for Splendid alfonsino. *The annual fishing efforts by each country are shown by barplot. The efforts are calculated by the total fishing days operated during the year*

Assessment

There are no biomass estimates available for Splendid alfonsino in NPFC waters.

An age- or length-structured stock assessment may be feasible given the life history of this species. Surplus production models developed by Japan in 2008 showed that the average fishing mortality is 20–28 % higher than the MSY level (Nishimura and Yatsu 2008). This analysis, however, remains unreliable as the estimated CPUE is biased due to target shifts between North Pacific armorhead and Splendid alfonsino and the estimated intrinsic population growth rate parameter was too high for long-lived deep-sea fish.

Data limited approaches, such as YPR or SPR analysis that do not require detailed resource parameters or fishing data, should be explored in the future.

Management

Active Management Measures

The following NPFC conservation and management measures pertain to this species:

- CMM 2021-05 For Bottom Fisheries and Protection of VMEs in the NW Pacific Ocean

Available from https://www.npfc.int/active-conservation-and-management-measures

Table 1: Current status of management measures

Item	Status	Description
Biological reference point	Not accomplished	Not established
Stock status	Unknown	Status determination criteria not established
Catch limit	Intermediate	No operation from November to December, Restriction of trawl mesh size
Harvest control rule	Not accomplished	Not established
Other	Intermediate	No expansion of fishing beyond established areas, No operation in the designated areas, No more increase in the fishing vessels

Currently, there is no accepted harvest control rule for this species.

In 2016, the management measures were implemented, which includes limiting the fishing effort to the 2007's level, prohibiting fisheries from November to December (which corresponds to the spawning season for North Pacific armorhead) and not allowing fisheries in C-H Seamount and the southeastern part of Koko Seamount (for the protection of VMEs)

In 2019, an additional measure was adopted, which includes the regulation of the mesh size (trawl: > 13 cm) to protect juvenile fish of this species. Effectiveness of this measure yet to be clearly demonstrated (Sawada and Ichii 2020).

Data Availability

Table 2: Catch data

Data	Country	Fishery	Year	Comments
Annual catch	Japan	Trawl	1969-present	
		Gillnet	1990-present	
	Korea	Trawl	2004-2019	
	Russia	Trawl	1969-1988; 2002; 2005; 2006; 2010; 2011; 2013; 2019	
CPUE	Japan	Trawl	1970-present	Logbook data available
		Gillnet	2008-present	Logbook data available
	Korea	Trawl	2013-2019	Logbook data available
	Russia	Trawl	1969-1988; 2010; 2019	

Table 3: Biological data

Data	Country	Year	Comments
Age	Japan	2013-present	annual ring analysis
	Korea	2013-2017, 2019	
	Russia		
Length	Japan	2009-present	Protocol revised (see NPFC-2018-SSC BF01-WP03)
	Korea	2013-2019	
	Russia		
Maturity	Japan	2013-present	
	Korea	2013-2017, 2019	
	Russia	1969-1988; 2010; 2011; 2013; 2019	

References

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Sawada, K., and Ichii, T. (2020) Catch size composition of splendid alfonsino in the Emperor Seamounts area before and after the implementation of the mesh size regulation. NPFC-2020-SSC BFME01-WP05 (Rev. 1). 3 pp.

Nishimura, A., & Yatsu, A. (2008, October). Application of surplus-production models to splendid alfonsin stock in the Southern Emperor and Northern Hawaiian Ridge (SE-NHR). In Fifth Intergovernmental Meeting on Establishment of New Mechanism for Management of High Seas Bottom Trawl Fisheries in the North Western Pacific Ocean (NWPBT/SWG-05), Tokyo, 17-18 October 2008 (pp. 1-11).

Species summary for sablefish

Sablefish (*Anoplopoma fimbria*)

Common names:

Black cod (USA & Canada)

ギンダラ, Gindara (Japan)

은대구, Eun-Daegu (Korea)

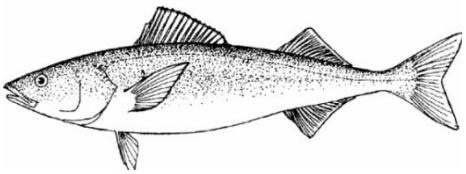

Figure 1. Sablefish (Anaplopoma fimbria).

Management

Active NPFC Management Measures

The following NPFC conservation and management measures (CMM) pertain to this species:

- CMM 2019-06 For Bottom Fisheries and Protection of VMEs in the NE Pacific Ocean
- CMM 2019-10 For Sablefish in the Northeastern Pacific Ocean

Available from https://www.npfc.int/active-conservation-and-management-measures

Management Summary

The current management measure for sablefish specifies both catch and effort limits. The allowable catch of sablefish in the eastern portion of the Convention Area is based on a long-term mean of historical catches from seamounts by Canada. It allows for 34 mt to be landed each month for the 6 months of the fishing season (April to September). The fishery is also managed through input controls by only allowing a single vessel to fish in each month. The 1-3 Canadian vessels licensed to fish in the NPFC Convention Area are submitted to the NPFC Secretariat annually.

Table 1:Current status of management measures

Convention or Management Principle	Status	Comment or Consideration
Biological reference point(s)	Unknown	Established for USA and Canada assessments
Stock status	Known	Healthy (in USA and Canada assessments)
Catch limit	Known	Allowable catch of 34 mt per month (6 month season)
Harvest control rule	Undefined	Established for USA and Canada assessments
Other	Known	Effort control (single vessel per month)

Assessment

Although genetic and other evidence indicates there is a single stock of sablefish in the eastern North Pacific Ocean (including the NPFC Convention Area), three stock assessments are carried out in the three domestic jurisdictions Alaska (U.S.A.), British Columbia (Canada) and the U.S. West Coast (U.S.A.) where sablefish are harvested.

Canada uses a management strategy evaluation (MSE) process to generate recommended harvest each year. Underlying the MSE is a statistical catch-at-age structured operating model (stock assessment model) that gets updated on a 3 – 5 year cycle (DFO 2016, DFO 2020). A new assessment by Canada is scheduled to be released in early 2023. The USA conducts two stock assessments (one for Alaska and one for the US West Coast). Both are conducted using age-structured models and are routinely updated. The current Alaska assessment (Goethel et al. 2021) and most recent USA West Coast assessment (Haltuch et al. 2019, Kapur et al. 2021) are available online.

No stock assessment is conducted for the portion of the sablefish population found in the NPFC Convention area.

Data

Surveys

Canada has conducted two longline trap surveys in British Columbia waters. From 1990-2009 a standardized trap survey was conducted at set stations annually. From 2003 to the present DFO conducts a stratified random trap survey along the outer shelf and slope of the BC coast. Both of these surveys generate a fishery independent CPUE as well as biological data that is used in the assessment. In Alaska, three survey indices are available for use in assessing the status of the

sablefish population. There is a longline survey conducted at standard survey stations that provides a relative index of abundance. It has been conducted at depths from 200-1000 m annually since 1978 (cooperatively with Japan from 1978-1994). Bottom trawl surveys are conducted annually or biennially in the three main ecosystems in Alaska since 1982. The U.S. West Coast primarily uses fishery independent survey data from the west coast groundfish bottom trawl survey conducted from 2003-2018 over depths of 55 to ~1300 m as an index of sablefish abundance. The bottom trawl survey follows a random-stratified survey design with four vessels (in most years) conducting the survey annually. The trawl survey data is analyzed with the VAST model (Thorson 2019) to produce the index of abundance for sablefish.

There is currently no survey conducted in the eastern NPFC Convention Area that captures or monitors sablefish populations.

Fishery

The Canadian high seas Sablefish fishery typically operates at 1-4 seamounts in the commission area (Cobb, Eickleberg, Warwick and Brown Bear seamounts). Historically other seamounts have been fished for sablefish both inside and outside Canada's EEZ.

Fishing is conducted with longlined traps. Since 2014 a maximum of 3 vessels per year have been allowed to fish in NPFC waters. Historically the number of fishing vessels has averaged <3 per year (since 2008). The number of fishing days is the number of unique calendar days during which gear was set. The number of fishing days has averaged from about 25 to greater than 100, but in most years has averaged between 50 and 75 (Figure 2).

No Canadian vessels have chosen to fish for Sablefish in the Convention Area since 2020. This is likely due to a combination of economics (high fuel prices and the large distance to the seamounts), the availability of quota in the domestic fishery which is easier to access and hesitancy about the requirements under the implementation of the new NPFC AIS policy.

Both Canada and the U.S.A. have large domestic fisheries that target sablefish inside their EEZ's. Sablefish is also captured as bycatch in domestic trawl fisheries in Canada and the U.S.A.

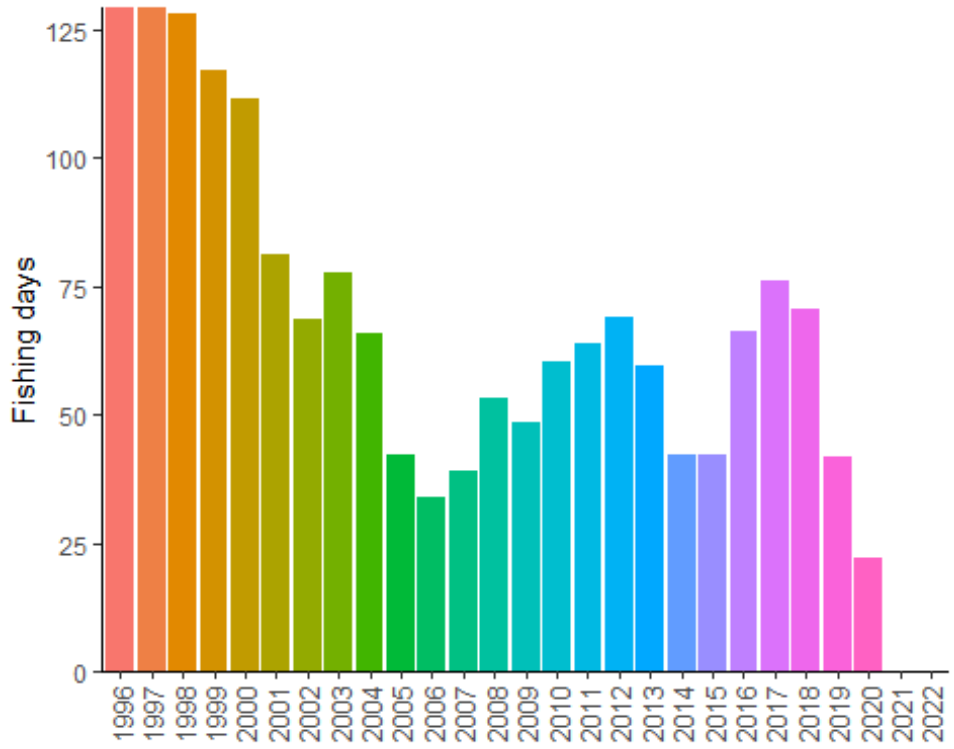

Figure 2. Fishing effort (in number of fishing days) for the Sablefish longline trap fishery conducted in NPFC waters (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

Output controls limit the amount of fish that can be landed during a trip. Authorized vessels are subject to monthly vessel limits of 34 mt of Sablefish, 2.3 mt of combined Rougheye and Blackspotted rockfish and 0.45 mt of other rockfish, sole and flounder (all in round weight). These measures have been in place since 2011.

Catches of Sablefish from NPFC region seamounts has ranged from an average of about 10 mt per year in 2005-2008 to about 67 mt in 2017 (Figure 3). Average annual catches were relatively low from 2002 to 2016 at NPFC seamounts and then increased in 2017-2018, with a decline to low levels in the last years. This increase in part probably reflects shifting effort due to closures of seamounts within Canada's EEZ. An examination of coastwide shifts in the spatial pattern of fishing effort showed that fishing effort has become concentrated on Cobb Seamount, with increasing effort in shallower waters relative to the past (Figure 4).

There was no fishing effort at seamounts during 2021 or 2022 resulting in no catch.

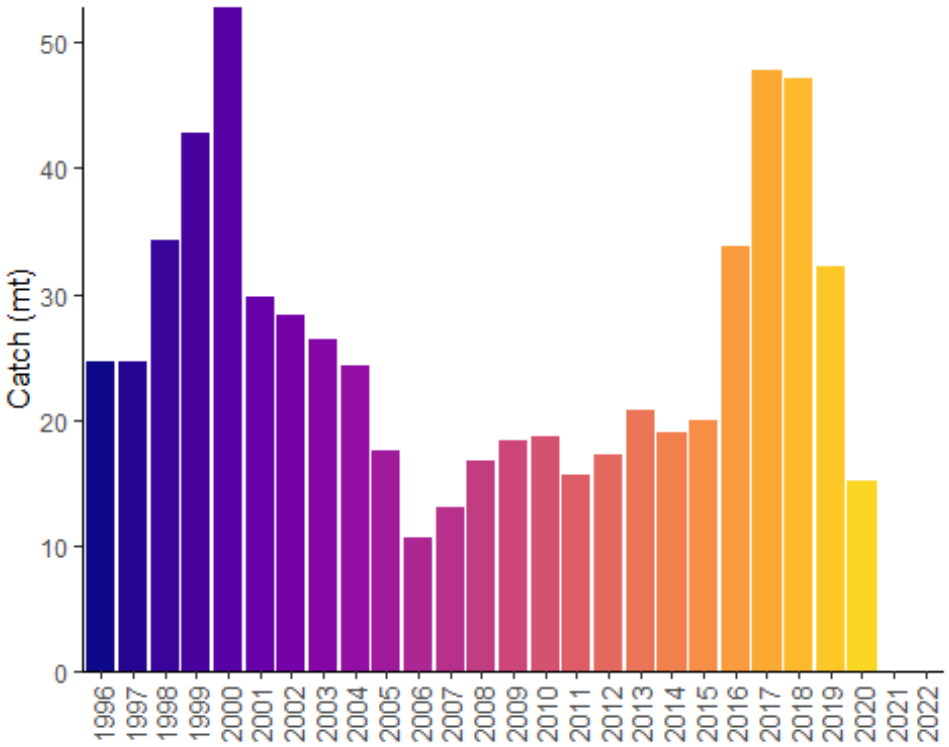

Figure 3. Landings of sablefish in the Canadian Sablefish fishery in NPFC region (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

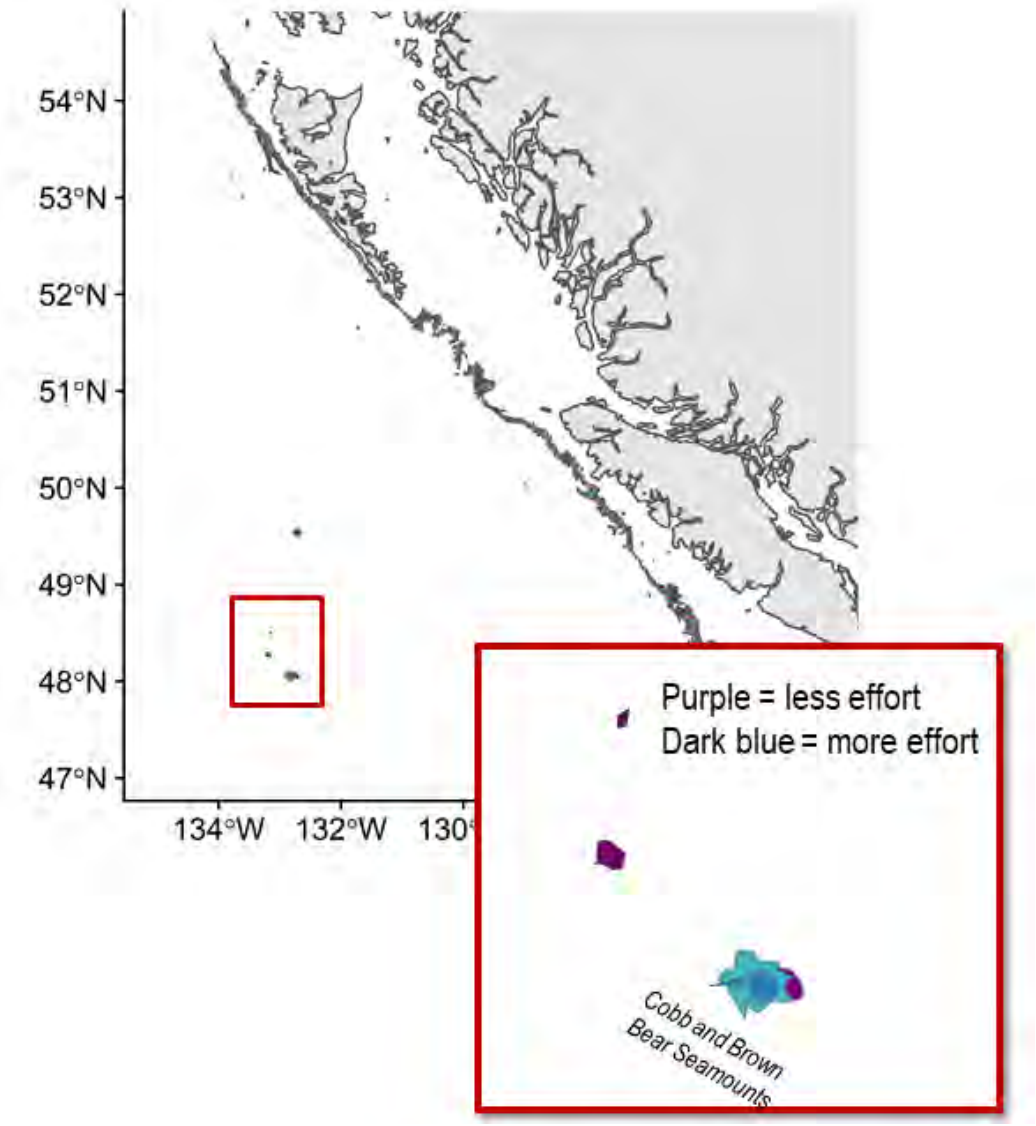

Figure 4. Relative change in spatial distribution of effort for Sablefish trap fishery from 2010-2017 to 2018-2019. Inset shows seamounts in the NPFC Convention Area.

Catch per unit of effort (mt/fishing days) for Sablefish has been increasing over the last 10 years (Figure 5), averaging 0.37 mt/fishing day (CV = 48%). CPUE was not calculated in 2022, but has generally been increasing since 2012.

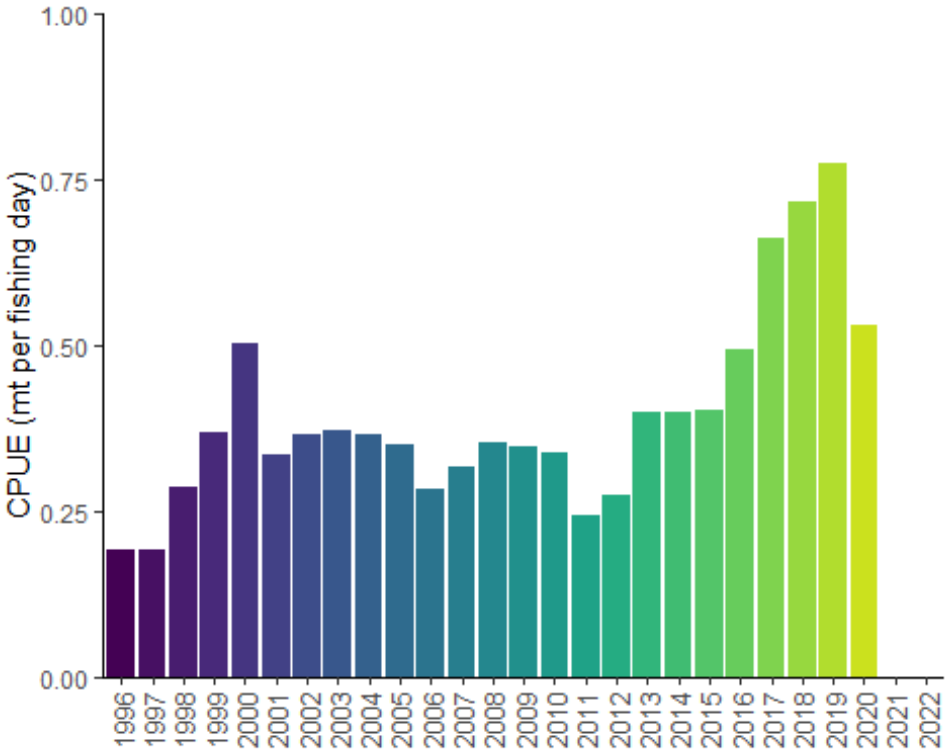

Figure 5. Catch per unit of effort for Canadian Sablefish fishery in NPFC region. Data are averaged across 3 years to comply with data privacy restrictions.

Biological collections

Under the seamount fishing protocol, 5 randomly selected fish per trip are saved by the vessel for sampling when it returns to port. These sablefish are sampled for length, weight and sex. Otoliths are collected for age estimation.

In 2020 due to COVID 19 restrictions, there were no biological samples collected from Sablefish captured in the Convention Area. Historical data will be provided to the NPFC Science Committee, when and as required, in conjunction with the NPFC's Interim Guidance for Management of Scientific Data Used in Stock Assessments.

Domestic fisheries in the U.S.A. and Canada also collect biological data. Data including length, weight and sex are collected from the scientific survey and by observers and dockside samplers from the commercial fisheries. Otoliths for estimating fish ages are also collected from both the surveys and the fisheries.

Table 2:Data availability from Members regarding blackspotted and rougheye rockfishes

Data	Source	Years	Comment
Catch	Canada	1965-present	Catches from national waters and convention area
	USA	~1960-present	Catches in national waters
CPUE	Canada	~1988-present	
	USA	~1988-present	
Survey	Canada	1990-2009	Longline trap standard survey
	Canada	2003-present	Longline trap random survey
	USA	1978-present	Alaska longline survey
	USA	1982-present	Alaska bottom trawl surveys
	USA	2003-present	West Coast bottom trawl survey
Age data	Canada	variable	Commercial and survey catches, including NPFC Convention Area
	USA	variable	Commercial and survey catches
Length data	Canada	variable	Commercial and survey catches, including NPFC Convention Area
	USA	variable	Commercial and survey catches
Maturity/fecundity	Canada	variable	Commercial and survey catches in national waters
	USA	variable	Research cruises in national waters

Special Comments

None

Biological Information

Distribution

Sablefish are widely distributed throughout the Pacific Ocean from northern Mexico to the Gulf of Alaska, westward to the Aleutian, and northward into the Bering Sea (Figure 6; Wolotira et al. 1993). They are also found along the western margin of the Pacific Ocean from southern Japan through the Kamchatka Peninsula and northward into the Bering Sea. Adult sablefish occur along the continental slope, shelf gullies, and in deep fjords, generally at depths greater than 200 m. Juvenile sablefish spend their first two to three years on the continental shelf at shallower depths. Spawning is generally in the winter and spring (October-April) and occurs near the shelf break. Spawning timing generally occurs earlier in the south (October-February in California) and later in the north (January – April in Alaska). Eggs are found at depth and larvae are found in surface waters (Shotwell et al. 2020).

Life history

Larval sablefish feed on zooplankton prey. Juveniles shift from pelagic to benthic prey including fishes and invertebrates. Adults consume mostly benthic fishes and invertebrates. Sablefish mature at 4 to 5 years. In the eastern Pacific, Sablefish have traditionally been thought to form two populations based on differences in growth rate, size at maturity, and tagging studies. The northern population inhabits Alaska and northern British Columbia waters and the southern population inhabits southern British Columbia, Washington, Oregon, and California waters, with mixing of the two populations occurring off southwest Vancouver Island and northwest Washington. However, recent genetic work by Jasonowicz et al. (2017) found no population sub-structure throughout their range along the US West Coast to Alaska, and suggested that observed differences in growth and maturation rates may be due to phenotypic plasticity or are environmentally driven. Tagging evidence suggests that the sablefish inhabiting seamounts in the NPFC Convention Area are not distinct from the coast wide sablefish population.

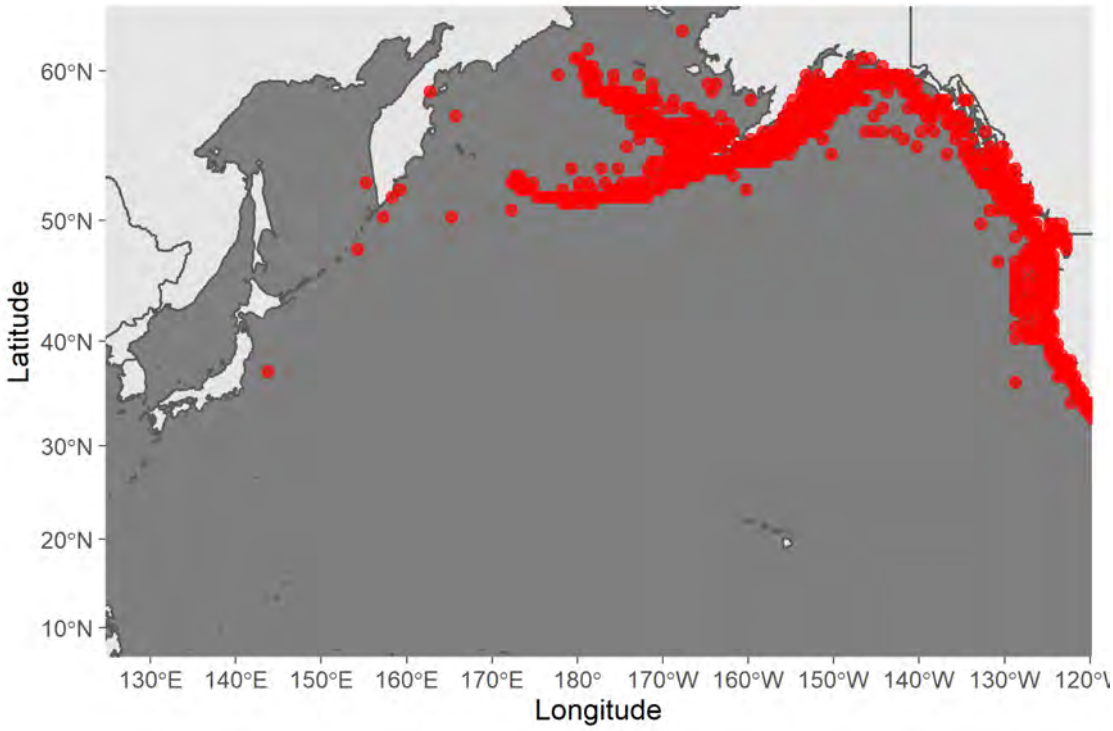

Figure 6. Map of distribution of sablefish in the North Pacific.

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Wolotira, R. J. J., T. M. Sample, S. F. Noel, and C. R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984. NOAA Tech. Memo. NMFS-AFSC-6. 184 pp.

Species summary for blackspotted and rougheye rockfishes

Blackspotted and Rougheye Rockfishes

(*Sebastes melanostictus* and *Sebastes aleutianus*)

Common names:

アラメヌケ, Aramenuke (Japan)

한볼락, Han Bollak (Korea)

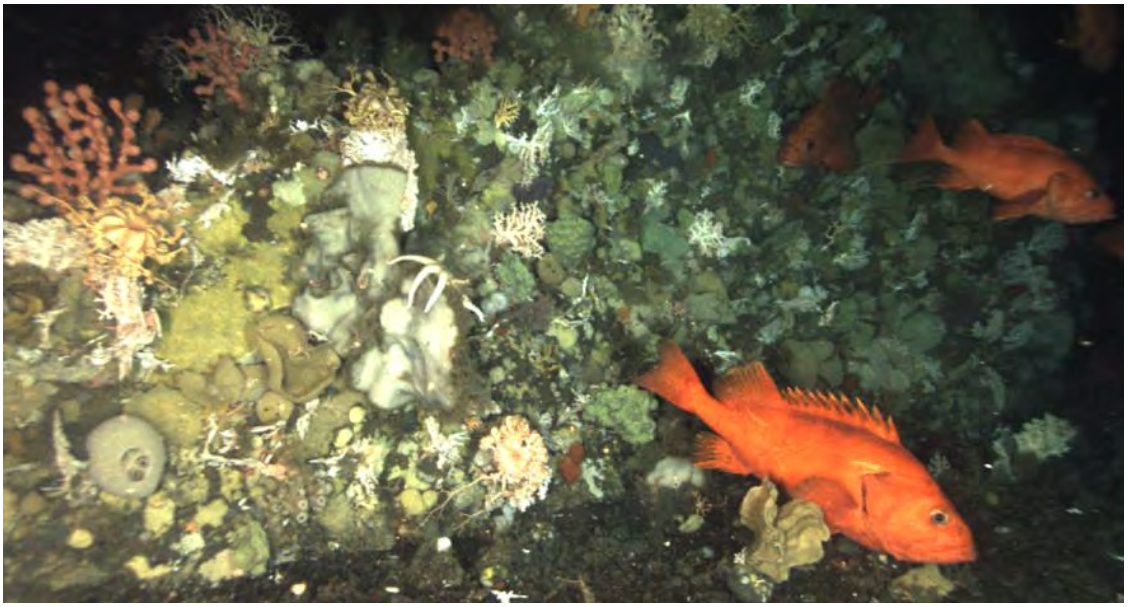

Figure 1. Blackspotted rockfish (Sebastes melanostictus).

Management

Active NPFC Management Measures

The following NPFC conservation and management measures (CMM) pertain to this species:

- CMM 2019-06 For Bottom Fisheries and Protection of VMEs in the NE Pacific Ocean
- CMM 2019-10 For Sablefish in the Northeastern Pacific Ocean

Available from https://www.npfc.int/active-conservation-and-management-measures

Management Summary

Blackspotted and rougheye rockfishes are captured in the longline trap fishery that targets sablefish (*Anaplopoma fimbria*) at seamounts in the eastern part of the NPFC Convention Area. The current management measure for blackspotted and rougheye rockfishes specifies both catch and effort limits. The allowable catch of blackspotted and rougheye rockfishes in the eastern portion of the Convention Area is based on a long-term mean of historical catches from seamounts by Canada. It allows for 2.3 mt to be landed each month for the 6 months of the fishing season (April to September). The fishery is also managed through input controls by only allowing a single vessel to fish in each month. The 1-3 Canadian vessels licensed to fish in the NPFC Convention Area are submitted to the NPFC Secretariat annually.

Table 3:Current status of management measures

Convention or Management Principle	Status	Comment or Consideration
Biological reference point(s)	Not accomplished	Not established
Stock status	Unknown	Status determination criteria not established
Catch limit	Known	Allowable catch of 2.3 mt per month (6 month season)
Harvest control rule	Not accomplished	Not established
Other	Known	Effort control (single vessel per month)

Assessment

No stock assessment is conducted for blackspotted and rougheye rockfishes in the NPFC Convention area.

It is unclear if the blackspotted and rougheye rockfish population on seamounts in the NPFC Convention Area is distinct from the population on the continental shelf of Canada. There is evidence of population structure in other regions, such as Alaska, where population trends and genetics indicate some structure on the order of ~1000 km (Shotwell and Hanselman 2019, Gharrett et al. 2007, Shotwell et al. 2014). This is about twice the distance from the continental shelf to the fished seamounts in the NPFC Convention Area, however there is potentially a large barrier to dispersal of deepwater between the shelf and the seamounts. There is no available tagging data to indicate whether the blackspotted and rougheye rockfishes at seamounts are

connected to populations in domestic waters on the continental shelf. It is likely that the seamount populations are distinct stocks with distinct population trajectories.

Domestic stock assessments for blackspotted and rougheye rockfishes conducted in Canada assume there are two populations in domestic waters. These are assessed using a statistical catch at age model (DFO 2020). Assessments are also carried out in Alaska (Shotwell and Hanselman 2019, Spencer et al. 2018).

Data

Surveys

There is currently no survey conducted in the eastern NPFC Convention Area that captures or monitors blackspotted and rougheye rockfish populations.

Fishery

The Canadian high seas sablefish fishery typically operates at 1-4 seamounts in the commission area (Cobb, Eickleberg, Warwick and Brown Bear seamounts). Historically other seamounts have been fished for blackspotted and rougheye rockfishes both inside and outside Canada's EEZ.

Fishing is conducted with longlined traps. Since 2014 a maximum of 3 vessels per year have been allowed to fish in NPFC waters. Historically the number of fishing vessels has averaged <3 per year (since 2008). The number of fishing days is the number of unique calendar days during which gear was set. The number of fishing days has averaged from about 25 to greater than 100, but in most years has averaged between 50 and 75 (Figure 2).

No Canadian vessels have chosen to fish for Sablefish in the Convention Area since 2020. This is likely due to a combination of economics (high fuel prices and the large distance to the seamounts), the availability of quota in the domestic fishery which is easier to access and hesitancy about the requirements under the implementation of the new NPFC AIS policy.

Both Canada and the U.S.A. have domestic fisheries that target blackspotted and rougheye rockfishes inside their EEZ's. Blackspotted and rougheye rockfishes is also targeted in domestic trawl fisheries in Canada and the U.S.A.

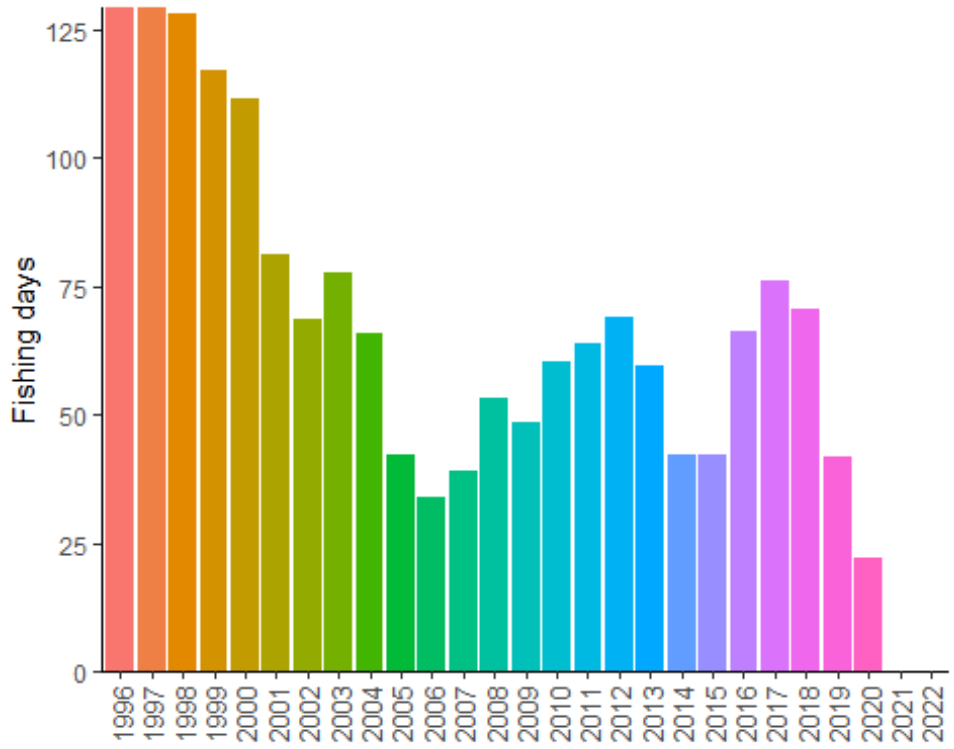

Figure 2. Fishing effort (in number of fishing days) for the Sablefish longline trap fishery conducted in NPFC waters (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

Output controls limit the landings of combined rougheye and blackspotted rockfish to 2.3 mt (in round weight). These measures have been in place since 2011.

Catches of blackspotted and rougheye rockfishes from NPFC region seamounts has ranged from an average of about 0.5 mt per year in 1996-2014 to about 4 mt in 2017 (Figure 3). Average annual catches were relatively low from 1996 to 2016 at NPFC seamounts and then increased in 2017-2018, with a decline to low levels in the last years. This increase in part probably reflects shifting sablefish effort due to closures of seamounts within Canada's EEZ. An examination of coastwide shifts in the spatial pattern of fishing effort showed that fishing effort has become concentrated on Cobb Seamount, with increasing effort in shallower waters perhaps reflecting increased targeting of blackspotted and rougheye rockfishes relative to the past (Figure 4).

There was no fishing effort at seamounts during 2021 or 2022 resulting in no catch.

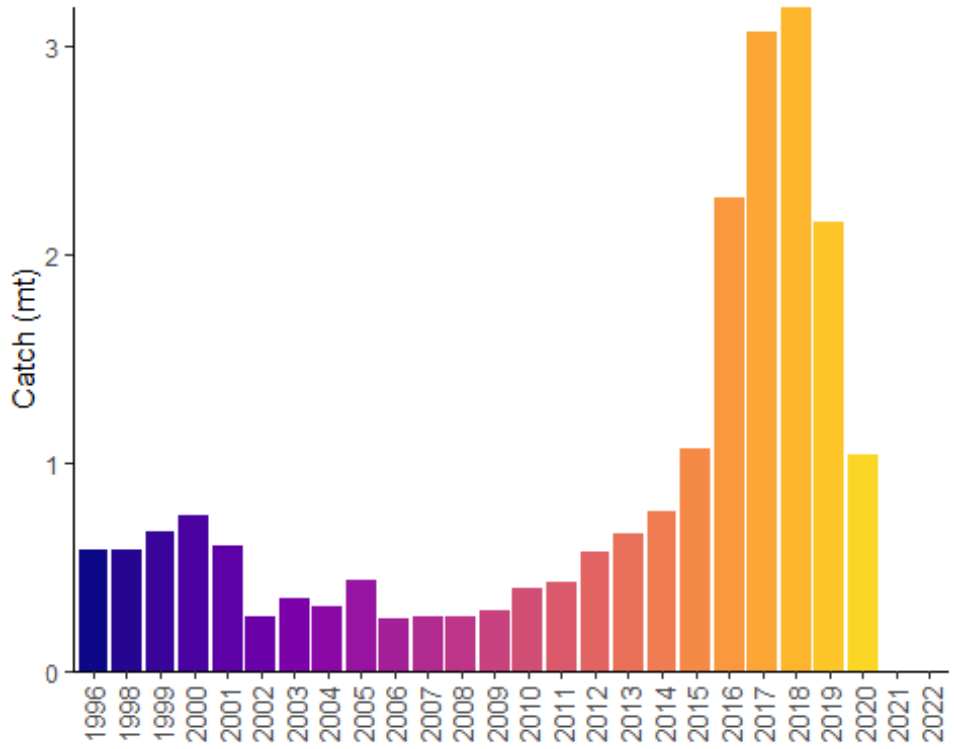

Figure 3. Landings of blackspotted and rougheye rockfishes in the Canadian Sablefish fishery in NPFC region (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

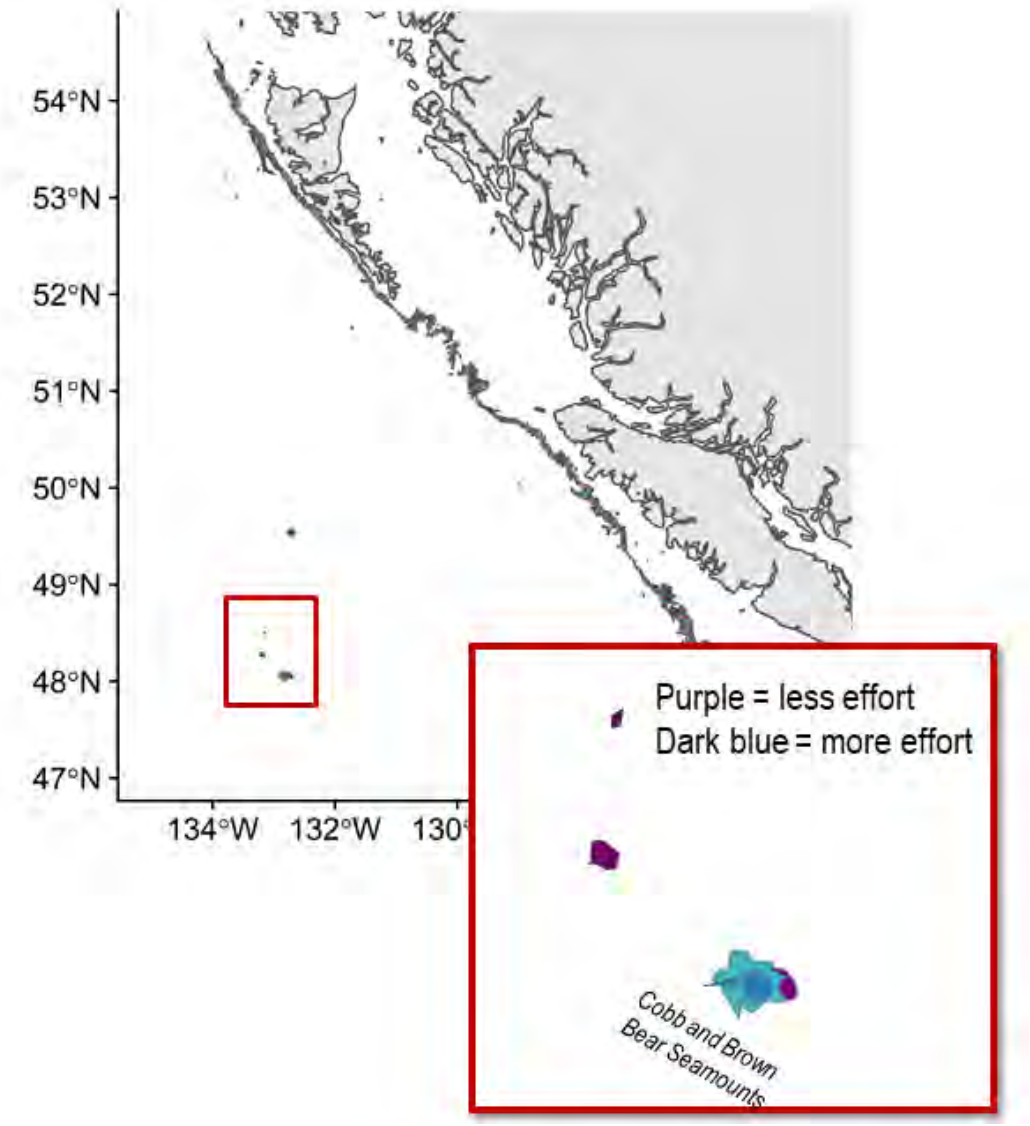

Figure 4. Relative change in spatial distribution of effort for Sablefish trap fishery from 2010-2017 to 2018-2019. Inset shows seamounts in the NPFC Convention Area.

Catch per unit of effort (mt/fishing days) for blackspotted and rougheye rockfishes has been increasing over the last 10 years (Figure 5), averaging 0.01 mt/fishing day (CV = 108%). CPUE was not calculated in 2022 due to the absence of fishing in the Convention Area, but has generally been increasing since 2012.

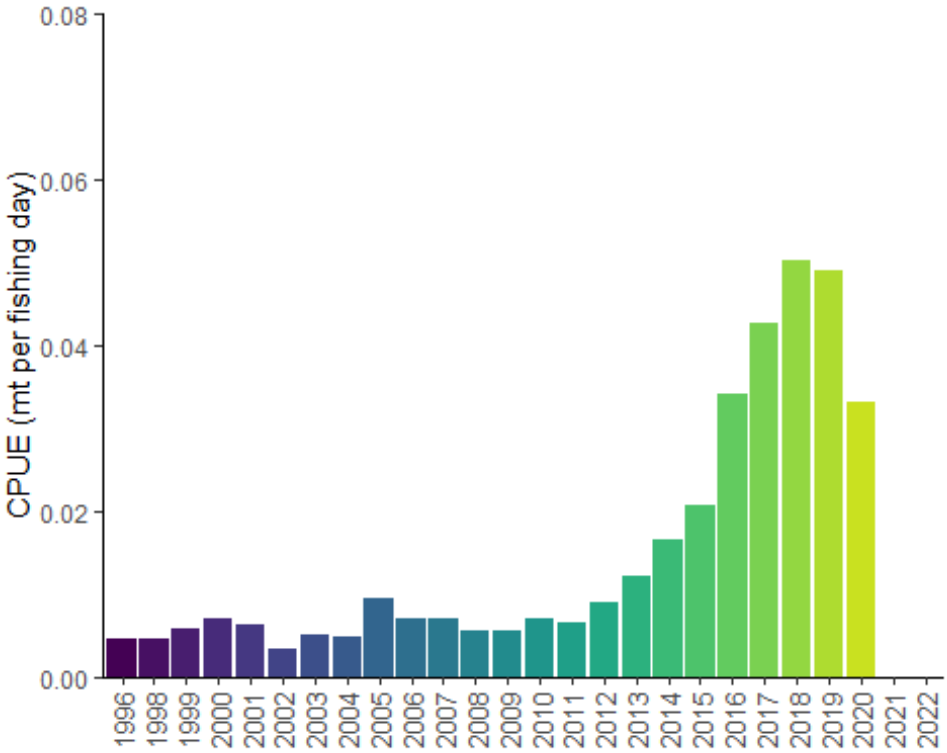

Figure 5. Catch per unit of effort for blackspotted and rougheye rockfishes in the Canadian Sablefish fishery in NPFC region. Data are averaged across 3 years to comply with data privacy restrictions.

Biological collections

No biological collections are taken from blackspotted and rougheye rockfishes captured in the NPFC Convention Area. Biological data are available from domestic fisheries and surveys in Canada.

Table 4:Data availability from Members regarding blackspotted and rougheye rockfishes

Data	Source	Years	Comment
Catch	Canada	1996-present	Catches from national waters and convention area
CPUE	Canada	1996-present	
Survey	None		Survey data are available from Canada and U.S.A. national waters

Data	Source	Years	Comment
Age data	None		Data available from Canada and U.S.A. domestic fisheries and surveys
Length data	None		Data available from Canada and U.S.A. domestic fisheries and surveys
Maturity/fecundity	None		Data available from Canada and U.S.A. domestic fisheries and surveys

Special Comments

None

Biological Information

Distribution

Blackspotted and rougheye rockfishes are widely distributed throughout the Pacific Ocean from California to the Gulf of Alaska, westward to the Aleutian, and northward into the Bering Sea (Figure 6; Love et al. 2002). They are also found along the western margin of the Pacific Ocean from the Kuril Islands through the Kamchatka Peninsula and northward into the Bering Sea. Adult blackspotted and rougheye rockfishes occur in rocky habitat along the continental slope, shelf gullies, and in deep fjords, generally at depths from 150 to 450 m (Love et al. 2002). Juvenile blackspotted and rougheye rockfishes are found at shallower depths (250-300 m) at the continental shelf break. Until recently, these species were considered a single species (rougheye rockfish; Orr and Hawkins 2008).

Life history

Blackspotted and rougheye rockfishes are extremely long-lived, with maximum ages > 200 years. They mature late at about 20 years of age. These characteristics make them vulnerable to overfishing. The species are live-bearing, extruding larvae generally in the spring (February-June). Blackspotted and rougheye rockfishes are benthic feeders, consuming mostly shrimps, crabs and fishes (Yang and Nelson 2000).

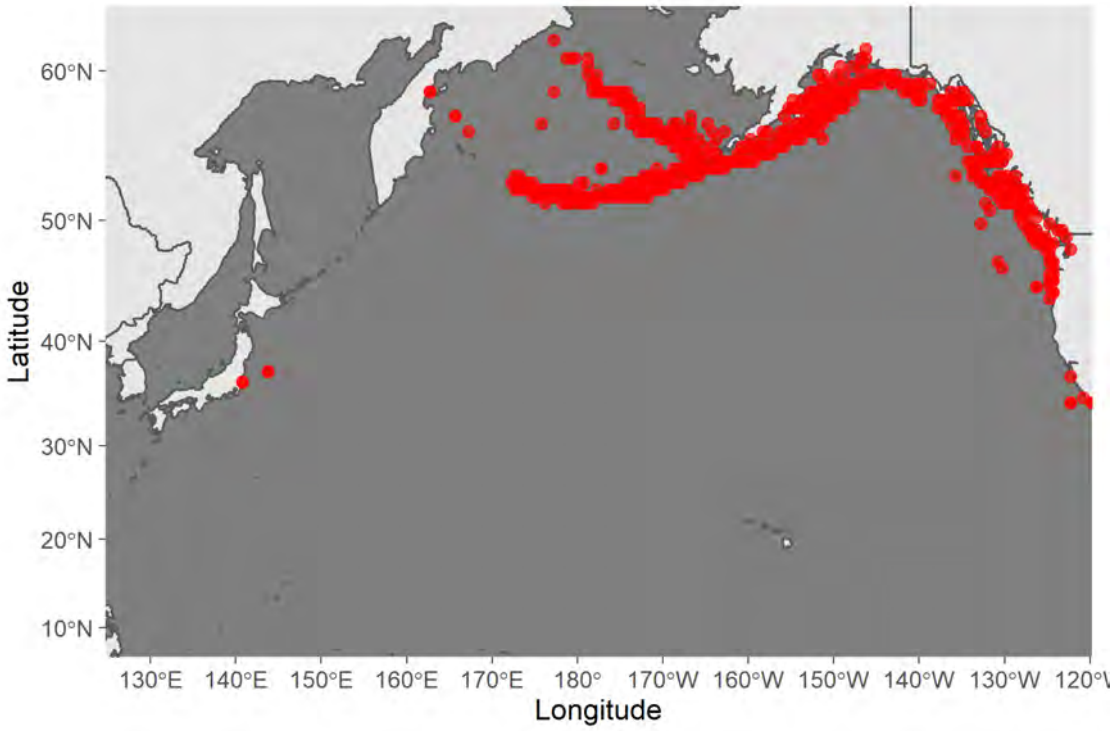

Figure 6. Map of distribution of blackspotted and rougheye rockfishes in the North Pacific.

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Yang, M.S. and M.W. Nelson. 2000. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990, 1993, and 1996. NOAA Tech. Memo. NMFS-AFSC-112. 174 p.

Species summary for neon flying squid

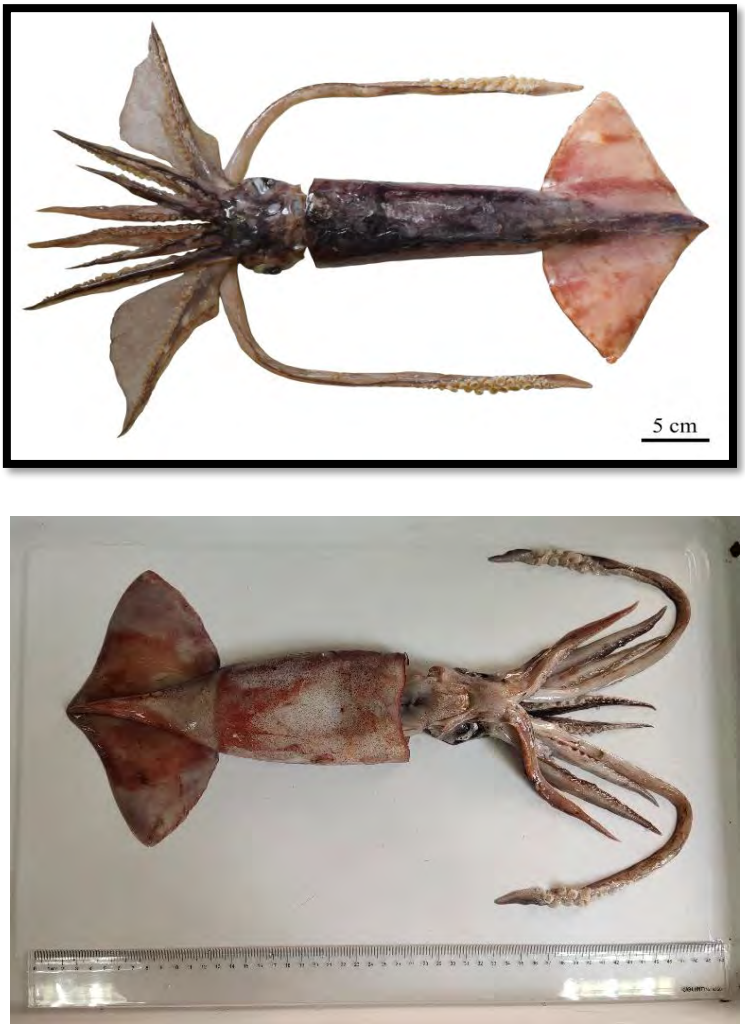

Figure 1. The pictures of neon flying squid

Neon Flying Squid (*Ommastrephes bartramii*)

Common names:

柔鱼 [rou yu] (Chinese); neon flying squid (English); アカイカ [akaika] (Japanese); 빨강오징어(Korean); Кальмар Бартрама [kalmar bartrama] (Russian); 赤魷 [chi-you] (Chinese Taipei).

Other common names: Red flying squid; Webbed flying squid; Red ocean squid; Kalmar (https://www.sealifebase.ca/comnames/CommonNamesList.php?ID=58132&GenusName=Ommastrephes&SpeciesName=bartramii&StockCode=3971)

Management

Active management measures

The following NPFC conservation and management measure (CMM) pertains to this species:
CMM 2021-11 For Japanese Sardine, Neon Flying Squid and Japanese Flying Squid
Available from https://www.npfc.int/active-conservation-and-management-measures.

Management summary

Does not specify catch limits.

Members of the Commission and CNCPs with substantial harvest of neon flying squid in the Convention Area shall refrain from expansion of the number of fishing vessels authorized to fish such species from the historical existing level. Members of the Commission participating in fishing for the neon flying squid in areas under their jurisdiction adjacent to the Convention Area are requested to take compatible measures.

Table 1. Management Summary

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	🔴	Not established.
Stock status	○	Status determination criteria not established.
Catch or effort limits	🟡	Recommended catch, effort limits.
Harvest control rule	🔴	Not established.
Other	🔴	MSE…

🟢 OK 🟡 Intermediate 🔴 Not accomplished ○ Unknown

Stock assessment

No unified stock assessment has been conducted by NPFC for the species.

Some members have conducted stock assessment or related studies for neon flying squid based on the information only from their own fisheries or surveys (Ichii et al. 2006; Chen, 2010; Cao et al. 2014).

Data

Survey

Japan conducted drift net survey in summer from 1999-2020 and jigging survey in winter from 2018~2020. Russia conducted upper epipelagic surveys from 1984-1992 and from 1999-2019 (see details in Table 2).

Fishery

Neon flying squid was harvested by China, Japan, Korea, Russia, Chinese Taipei and Vanuatu. Fishing methods included jigging, drift net, dip net and set net.

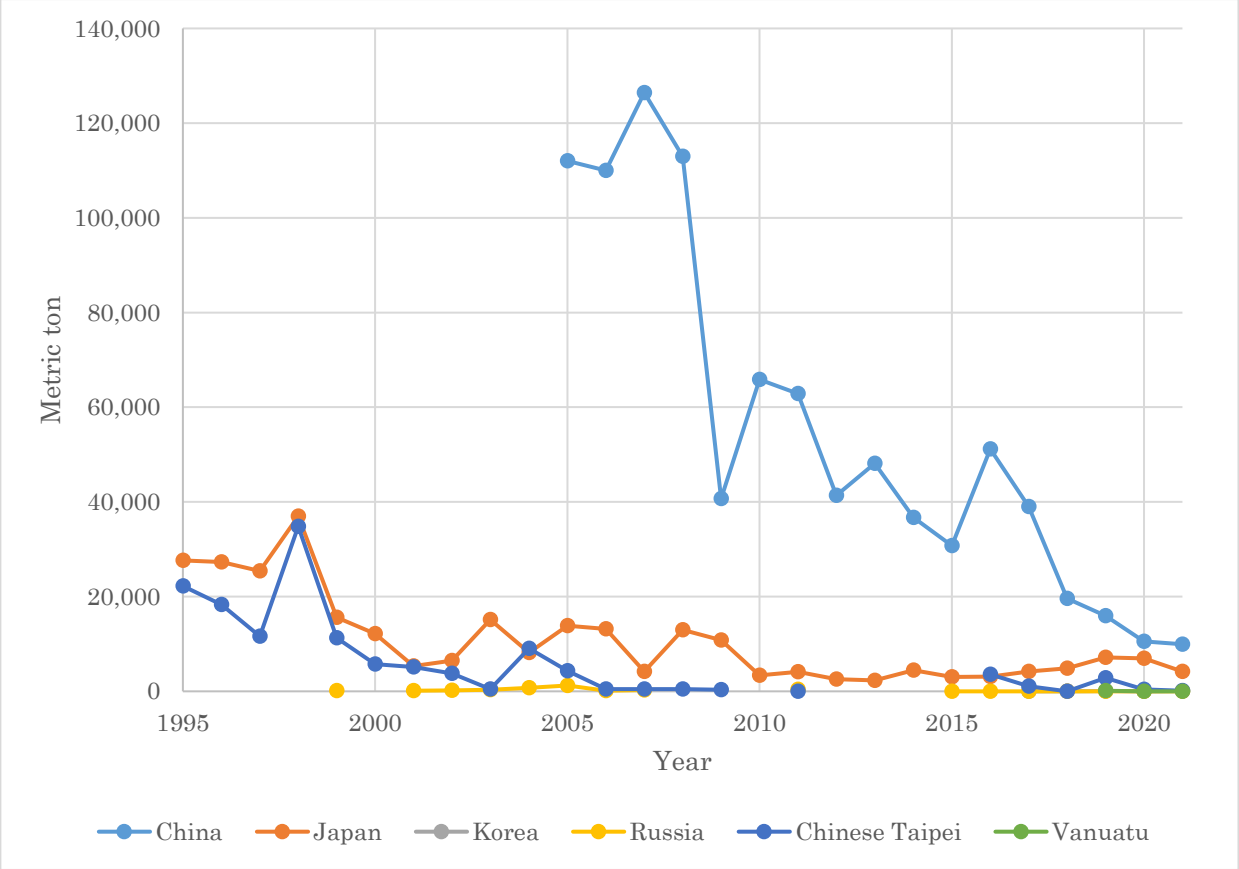

Figure 2. The historical catch of neon flying squid reported by members.

Data availability

Table 2. Data availability from Members regarding neon flying squid

Category and data sources	Description	Years with available data	Average sample size/ year or data coverage	Potential issues to be reviewed
CHINA				
Catch statistics				
Squid-jigging fisheries	Official statistics, reports from annual report	Official statistics: 2005-2019 Fishery data before 2005 (need to be confirmed)	Coverage = 100%	The neon flying squid catches are obtained from the fisheries logbook data provided by the fisheries

				company
Size composition data				
Length measurements	Sampling from commercial squid-jigging fishing vessels	2010-2016 Data before 2005 (need to be confirmed)	800-1000 fish/year	May lack representativeness
Aging	Sampling from commercial squid-jigging fishing vessels	2010-2016 Data before 2005 (need to be confirmed)	80-200 fish /year	May lack representativeness
Abundance indices (commercial)				
Squid-jigging fisheries	Squid-jigging logbook	1995-2019 Fishery data before 2005 (need to be confirmed)	Coverage=100%	Will conduct standardization

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
JAPAN				
Catch statistics				
Jigging fishery	Logbook	1995-2020	Coverage=100%	
Size composition data				
Length and weight measurements	Drift net survey (Summer)	1999-2020	500-600 squid/year	
	Jigging survey (Winter)	2018-2020	300-400 squid/year	

Abundance indices (survey)				
Summer survey on abundance of the autumn and winter-spring cohorts	Drift net survey CPUE for each cohort (individuals/panel)	1999-2020	20-30 stations/year	Small samples of male and matured female for the autumn cohort
Winter survey on abundance of the winter-spring cohort	Jigging survey CPUE (individuals/line)	2018-2020	12-16 stations/year	
Abundance indices (commercial)				
Jigging fishery	Logbook Standardized CPUE of the winter-spring cohort	1995-2020	Coverage=100%	Standardize CPUE for the autumn cohort

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
KOREA				
Catch statistics				
Jigging	Official statistics, reports from fisheries	2017 and 2019	Coverage =100%	
Size composition data				
Length measurements	Measured by observers while onboard	2017	3100 fish	Measurement details to be reviewed
Abundance indices (commercial)				
Jigging	Logbook data available	2017	60 set 2017	Data coverage details to be reviewed

Category and data sources	**Description**	**Years with available data**	**Average sample size/year or data**	**Potential issues to be reviewed**

			coverage	
RUSSIA				
Catch statistics				
Drift net fishery	Official statistics, reports from fisheries associations	Official statistics: 1982-1990, 1999-2007, 2011 1985-1998, 2008-2010 and 2012-2020 (no data available); publications: 1972-2012	Coverage 1982-1984 ?%, 1999-2007, 2011 =100%	Data coverage details to be reviewed
Size composition data				
Length measurements	Sampling from commercial fishing vessels. Sampling during research surveys.	1999-2007, 2011 2012-2019	100-4,000 squids /year (ca. 50 measurements per sampling)	Data coverage details to be reviewed
Abundance indices (survey)				
Summer-autumn surveys to assess pelagic squids abundance	Upper epipelagic surveys	1984-1992, 1999-2019 (August-November)	60-80 stations/year 60-80 stations/year	Changes in abundance and migration patterns; development survey protocol and conduct standardization

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**

CHINESE TAIPEI				
Catch statistics				
Dip net fishery Set net	Fishing gear used in different periods: 1977~1979: jigging 1980~1983: jigging and gillnet 1984~1992: gillnet 1993 till now: jigging	Data from 1977~1996 was provided by Taiwan Squid Fishery Association , data from 1997~2017 was based on logbook, and data from 2018~2020 was the statistics on landings.	Coverage 1977-1996 = ? % Coverage 1997-2017 = ? % Coverage 2017-2020 =100%	Only catch data is available before 1997.

Category and data sources	Description	Years with available data	Average sample size/ year or data coverage	Potential issues to be reviewed
VANUATU				
Catch statistics				
squid jigging fishery	from logbook	2019	logbook from 2013 to now, coverage 100%	VU has authorized 4 vessels to conduct Pacific saury and squid jigging fishery in NPFC Convention Area. However, the vessel only targets neon flying squid by hand when they couldn't catch Pacific saury. Until now, we have only had squid catch information in 2019.

Biological Information

Distribution and migration

Neon flying squid is an oceanic squid distributed in temperate and subtropical waters of the Pacific, Indian and Atlantic Oceans. The North Pacific population occurs mainly between 20◦ and 50◦N, and comprises two cohorts: a fall cohort with a hatching period from September to February and a winter–spring cohort with a hatching period mainly from January to May, but extending to August. Neon flying squid makes an annual round-trip migration between its subtropical spawning grounds and its northern feeding grounds near the Subarctic Boundary.

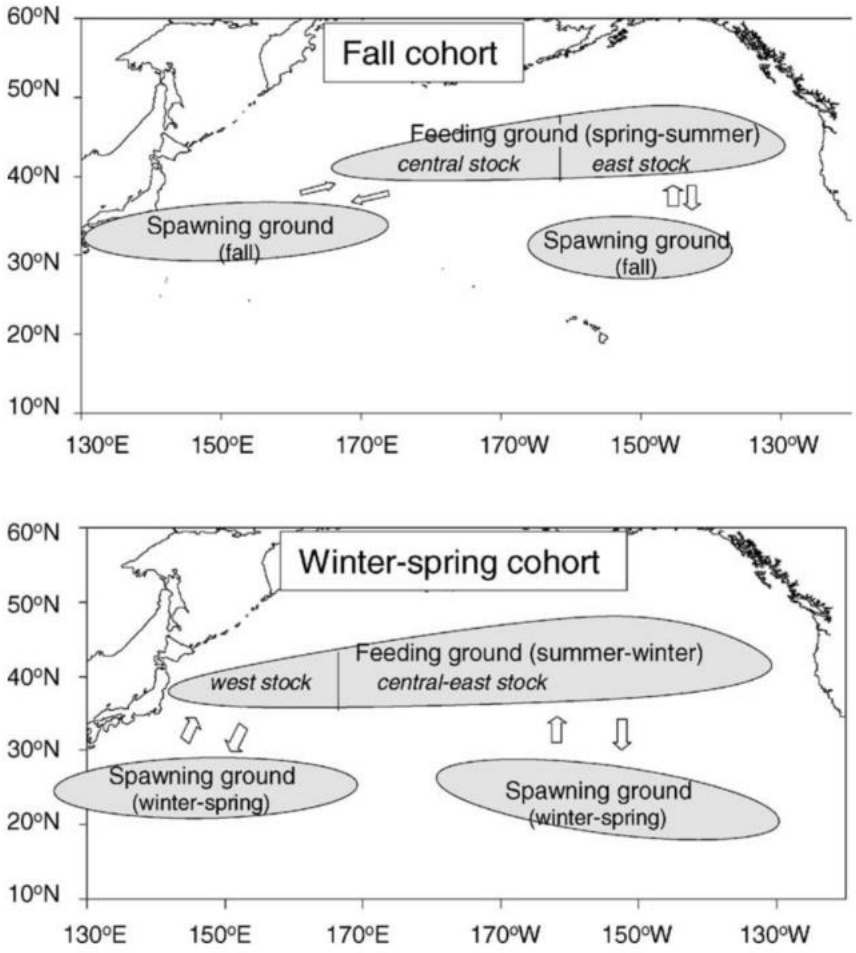

Figure 3. Migration patterns of the fall and winter–spring cohorts of neon flying squid in the North Pacific.

Life history

Growth is exponential during the first 30 days after hatching and then becomes more or less linear. It is suggested that this shift in growth accompanies a change in the feeding behavior that is thought to occur once the fused tentacles, which form a proboscis in the hatchlings, separate and become

functional.

Neon flying squid at 7-10 months of age and has an estimated 1-year life span. Size at maturity is about 30–33 cm ML in males and 40–55 cm ML in females. The maximum ML is around 45 cm in males and 60 cm in females.

During its northward migration and at the feeding grounds in the central North Pacific, neon flying squid feeds mainly on fishes, squids and crustaceans. Many marine mammals feed on neon flying squid. It is an important prey of northern fur seals in the central North Pacific, and a minor prey of short-beaked common dolphins (Bower and Ichii 2005).

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Species summary for Japanese sardine

Japanese sardine (*Sardinops melanostictus*)

Common names:

拟沙丁鱼, Ni Sha Ding Yu (China)

マイワシ, Maiwashi (Japan)

정어리, Jeong-eoli (Korea)

Дальневосточная сардина (Russia)

遠東擬沙丁魚, Yuan-Dong-Ni-Sha-Ding-Yu (Chinese Taipei)

Management

Active NPFC Management Measures

The following NPFC conservation and management measure (CMM) pertains to this species:

- CMM 2021-11 For Japanese Sardine, Neon Flying Squid and Japanese Flying Squid

Available from https://www.npfc.int/active-conservation-and-management-measures

Management Summary

The current management measure for Japanese Sardine does not specify catch or effort limits. The CMM states that Members and Cooperating non-Contracting Parties currently harvesting Japanese Sardine should refrain from expansion of the number of fishing vessels authorized to fish Japanese Sardine in the Convention Area. New harvest capacity should also be avoided until as stock assessment has been completed.

A stock assessment for Japanese Sardine is conducted by Japan within their EEZ and used for management of the domestic fishery.

Table 5:Current status of management measures

Convention or Management Principle	Status	Comment or Consideration
Biological reference point(s)	Not accomplished	Not established
Stock status	Unknown	Status determination criteria not established
Catch limit	Intermediate	Recommended catch, effort limits
Harvest control rule	Not accomplished	Not established
Other	Intermediate	No expansion of fishing beyond established areas

Assessment

There is currently no stock assessment for Japanese Sardine conducted by NPFC for the Convention Area.

Japan conducts an assessment of the Japanese Sardine stock using VPA and a number of data sources described below (Hiroshi and Nishida 2005).

Data

Surveys

Japan conducts three surveys that estimate recruitment for a number of pelagic species, including Japanese Sardine (Table 2). The surveys target pre-recruits and juveniles to determine an index of recruitment. Japan also conducts a monthly egg and larval survey that is used to estimate spawning stock biomass. Surveys are conducted in spring (1995-2020), summer (2001-2020) and fall (2005-2020) at 30-80 stations per year. The survey protocol can be found at (Oozeki et al. 2007). Russia has conducted a summertime acoustic-trawl survey since 2010 that examines mid-water and upper epipelagic species including Japanese Sardine.

Fishery

China, Japan and Russia catch Japanese sardine. China does not target the species, but it is captured as bycatch in other fisheries (e.g. chub mackerel). Catches are primarily by purse seine, with a smaller component of the catch taken by pelagic trawl. China's catch of Japanese Sardine is taken exclusively from the Convention Area from April to December. China's existing catch records are from 2016 to 2020 and show increasing catches during that time period as the stock may have been increasing. The historical catches (prior to 2016) are unknown, thought to be low and likely need to be confirmed.

Japan's fishery for Japanese Sardine occurs inside their EEZ and is mostly conducted by large purse seine vessels (>90% of the catch). Additional components of the fishery include set nets, dip nets and other gears. The fishery experienced very high catches in the 1980's and early 1990's, a decline to very low catches from 1995 to ~2010 and has been recovering since then. The fishery is conducted year round, but mainly during the summer season.

The Russian fishery occurs inside their EEZ and is prosecuted primarily by pelagic trawling (>90% of the catch), with a smaller component of the catch coming from purse seines. The success of Russian fishery depends on the migration patterns and overall abundance of Japanese Sardine, as the sardine move into Russian waters when their abundance is high. For this reason, there was no catch from 1994-2011 when the stock abundance was low, but in recent years (since 2016) as the stock has recovered and water temperatures have been warm there have been increasing catches in Russia. The Russian fishery occurs primarily from June to November.

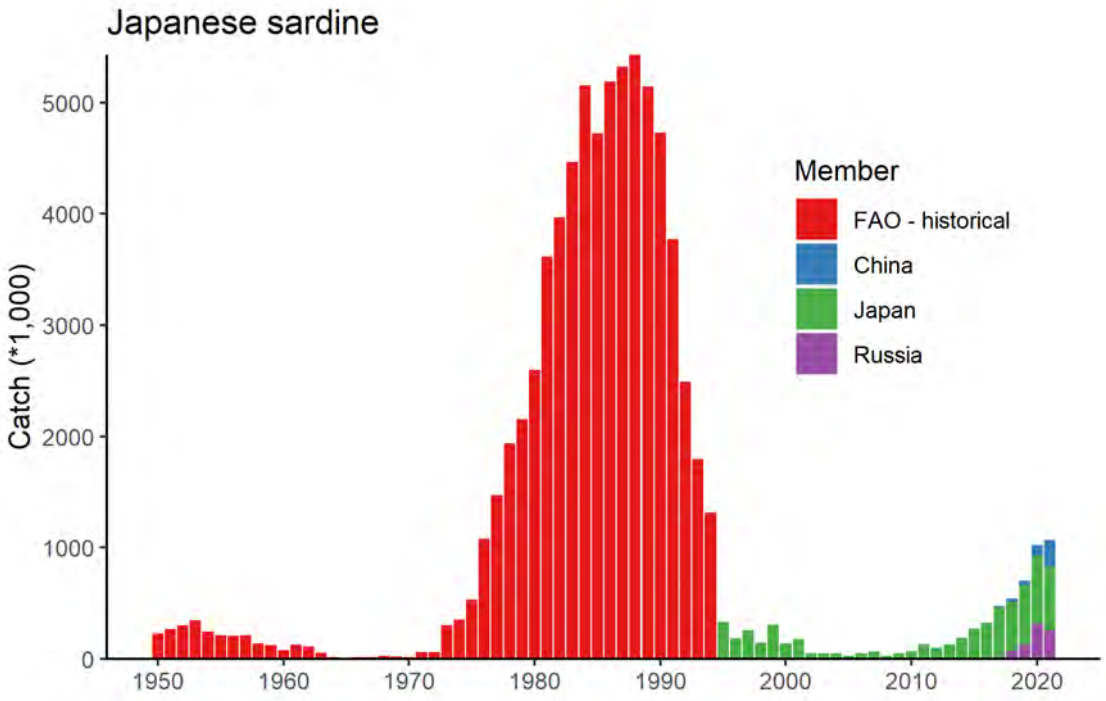

Figure 2. Historical catch of Japanese Sardine.

Other NPFC Members (Canada, Korea, Chinese Taipei, USA and Vanuatu) do not target Japanese Sardine. Chinese Taipei has some historical records of Japanese Sardine bycatch in the Pacific Saury fishery (~100 mt) and Korea has a small amount of historical bycatch data from the bottom trawl fishery. Vanuatu, USA and Canada have no record of Japanese Sardine catches.

Fishery catch data is available for Members from the NPFC website (https://www.npfc.int/system/files/2022-03/NPFC-2023-AR-Annual%20Summary%20Footprint%20-%20Japanese%20Sardine.xlsx) since 2001. Prior years fishery catch data was downloaded from FAO data collections at https://www.openfisheries.org using rfisheries package (Karthik Ram, Carl Boettiger, and Dyck 2013).

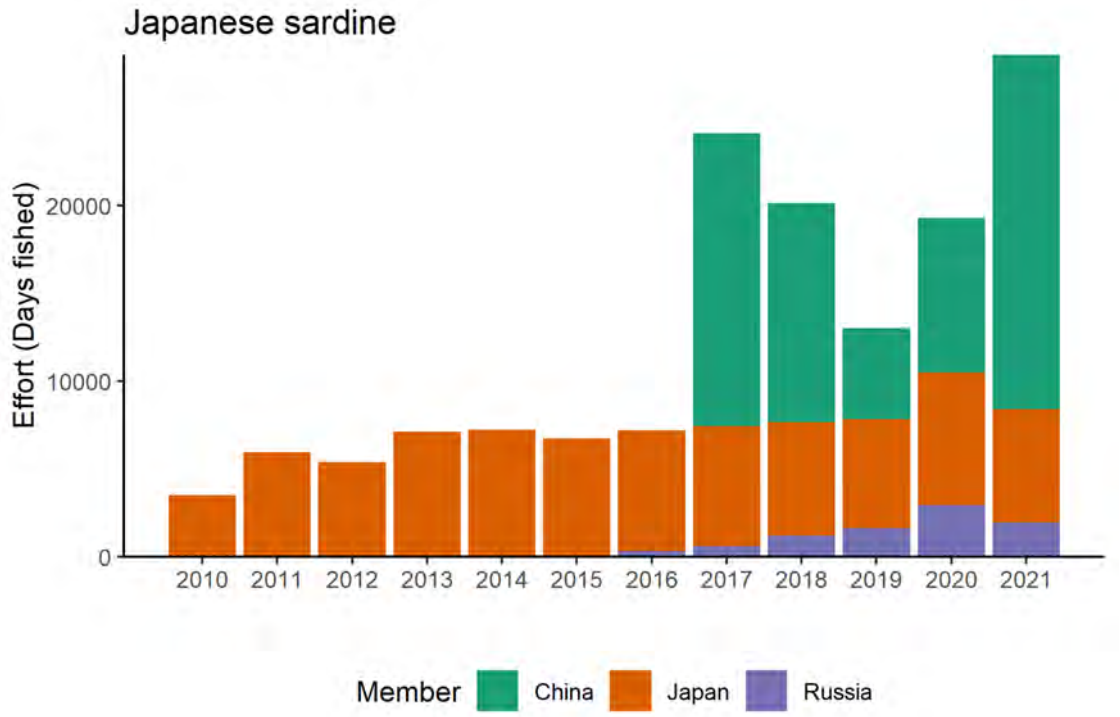

Figure 3. Historical fishing effort for Japanese Sardine.

Biological collections

China collected biological data from fishery catches of Japanese Sardine in 2020. These collections included length data as well as maturity and age structures.

Russia collects length and weight data, age structures (scales) and maturity data from both commercial catches and surveys.

Japan also collects length, weight, maturity and age data from the survey and fishery to support their stock assessment.

Table 6:Data availability from Members regarding Japanese sardine

Data	Source	Years	Comment
Catch	China	2016-present	Catches from convention area
	Japan	1995-present	Historical catch data from 1968 available, catches in national waters
	Korea		Minor bycatch in bottom trawl fishery

Data	Source	Years	Comment
	Russia	2016-present	Catches primarily in national waters, not convention area
	Chinese Taipei		Minor bycatch in Pacific saury fishery
CPUE			not developed
Survey	Japan		Pre-recruit survey
	Japan		Juvenile survey
	Japan		Monthly egg and larval survey
	Russia	2010-present	Acoustic-trawl survey
Age data	China	2020	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches
Length data	China	2020	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches
Maturity/fecundity	China	2020	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches

Special Comments

None

Biological Information

Distribution

Japanese sardine (*Sardinops melanostichtus*; Figure 1) are a pelagic species that occurs in large migratory schools in the coastal waters of China, Chinese Taipei, Japan, Korea and Russia (Figure

4, (Kaschner et al. 2019)). They generally migrate from the south to the north during summer, returning to inshore areas in the south to spawn in the winter. Japanese sardine feed mainly on zooplankton and phytoplankton.

Life history

Japanese sardine are short-lived and fast growing, maturing early at 2-years old. Their maximum length is ~24 cm and their maximum reported age is 25 years (Whitehead 1985). Their growth rates and spawning patterns are highly influenced by the environment (Niino et al. 2021)

Taxonomically, the Japanese sardine are closely related to other species around the globe including Sardinops from southern Africa, Australia, South America and California.

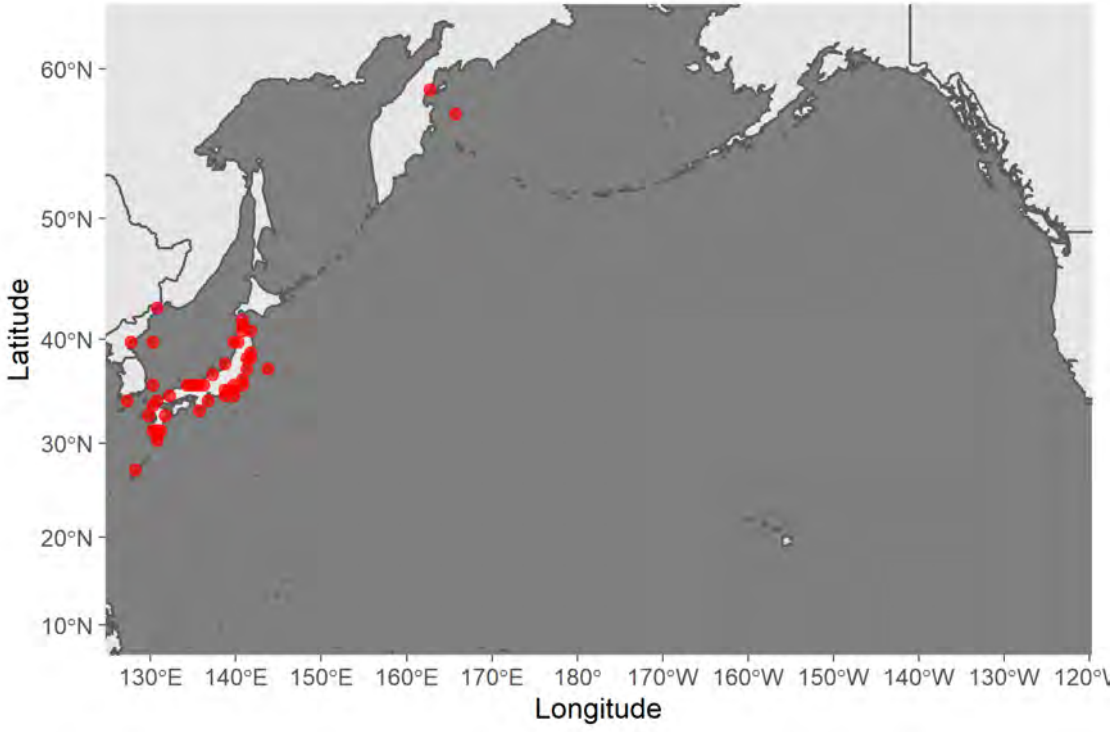

Figure 4. Map of distribution of Sardine species in the North Pacific.

Literature cited

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Oozeki, Yoshioki, Akinori Takasuka, Hiroshi Kubota, and Manuel Barange. 2007. “Characterizing Spawning Habitats of Japanese Sardine (Sardinops Melanostictus), Japanese Anchovy (Engraulis Japonicus), and Pacific Round Herring (Etrumeus Teres) in the Northwestern Pacific.” *CalCOFI Rep.* 48 (December).

Whitehead, Peter J. P. 1985. “FAO Species Catalogue. Vol. 7. Clupeoid Fishes of the World (Suborder Clupeoidei). An Annotated and Illustrated Catalogue of the Herrings, Sardines, Pilchards, Sprats, Shads, Anchovies and Wolf-Herrings.” *FAO Fish. Synop.* 125(7/1): 1–303.

Appendix: Sardine and the environment

Table 7:Studies examining the relationship between Japanese sardine and the environment

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
Kodama, T, Wagawa T, Ohshimo S, Morimoto H, Iguchi N, Fukudome KI, Goto T, Takahashi T, Yasuda T. 2018. Improvement in Recruitment of Japanese Sardine with Delays of the Spring Phytoplankton Bloom in the Sea of Japan. Fisheries Oceanography 27 (4): 289–301. https://doi.org/10.1111/fog.12252.	2018	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	Larvae	Recruitment	Sea surface chlorophyl a	delay in start and end dates of spring bloom were positively correlated with recruitment	Correlation, empirical orthoganal function
Yasuda, Tohya, Satoshi Kitajima, Akira Hayashi, Motomitsu Takahashi, and Masa aki Fukuwaka. 2021. "Cold Offshore Area Provides a Favorable Feeding Ground with Lipid-Rich Foods for Juvenile Japanese Sardine." Fisheries Oceanography, no. January: 1–16. https://doi.org/10.1111/fog.12530.	2021	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	juvenile	Body condition	Prey species and temperature	higher condition in offshore distributed fish due to lower temperature and higher lipid content prey	correlation
Nishikawa, Haruka. 2019. "Relationship between Recruitment of Japanese Sardine (Sardinops Melanostictus) and Environment of Larval Habitat in the Low-Stock Period (1995–2010)." Fisheries Oceanography 28 (2): 131–42. https://doi.org/10.1111/fog.12397.	2019	journal paper	Japan	Pacific	Kuoshio current	Japanese sardine	Larvae	Recruitment	water temperature and larval drift	warmer temperature related to lower recruitment	correlation
Niino, Yohei, Sho Furuichi, Yasuhiro Kamimura, and Ryuji Yukami. 2021. "Spatiotemporal Spawning Patterns and Early Growth of Japanese Sardine in the Western North Pacific during the Recent Stock Increase." Fisheries Oceanography, no. April: 1–10. https://doi.org/10.1111/fog.12542.	2021	journal paper	Japan	Pacific	Kuoshio current	Japanese sardine	Larvae	growth	spawning distribution and timing (temperature)	early spawning in eastern area contributed to higher recruitment during time of increasing sardine biomass	correlation
Muko, Soyoka, Seiji Ohshimo, Hiroyuki Kurota, Tohya Yasuda, and Masa Aki Fukuwaka. 2018. "Long-Term Change in the Distribution of Japanese Sardine in the Sea of Japan during Population Fluctuations." Marine Ecology Progress Series 593: 141–54. https://doi.org/10.3354/meps12491.	2018	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	Adult	Distribution (SDM)	sea surface temperature	dome shaped relationship between sea surface temperature and the probability of presence, with peak between 10-20 C	generalized additive models

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
Sogawa, Sayaka, Kiyotaka Hidaka, Yasuhiro Kamimura, Masanori Takahashi, Hiroaki Saito, Yuji Okazaki, Yugo Shimizu, and Takashi Setou. 2019. "Environmental Characteristics of Spawning and Nursery Grounds of Japanese Sardine and Mackerels in the Kuroshio and Kuroshio Extension Area." Fisheries Oceanography 28 (4): 454–67. https://doi.org/10.1111/fog.12423.	2019	journal paper	Japan	Pacific	Kuoshio current	Japanese sardine	Egg	Distribution	water temperature, larval drift, zooplankton	little variability in environment where eggs were found, copepod community structure was important	correlation
Kuroda, Hiroshi, Toshihiko Saito, Toshiki Kaga, Akinori Takasuka, Yasuhiro Kamimura, Sho Furuichi, and Takuya Nakanowatari. 2020. "Unconventional Sea Surface Temperature Regime Around Japan in the 2000s–2010s: Potential Influences on Major Fisheries Resources." Frontiers in Marine Science 7 (October): 1–21. https://doi.org/10.3389/fmars.2020.574904.	2020	journal paper	Japan	Pacific	Pacific	Japanese sardine	Adult	Recruitment	PDO, SST	spawning was earlier during SST increases	correlation
Ma, Shuyang, Yongjun Tian, Caihong Fu, Haiqing Yu, Jianchao Li, Yang Liu, Jiahua Cheng, Rong Wan, and Yoshiro Watanabe. 2021. "Climate-Induced Nonlinearity in Pelagic Communities and Non-Stationary Relationships with Physical Drivers in the Kuroshio Ecosystem." Fish and Fisheries 22 (1): 1–17. https://doi.org/10.1111/faf.12502.	2020	journal paper	China	Pacific	Kuoshio current	Japanese sardine	Adult	Abundance/Catch	Basin scale climate (ALPI, SST, Current patterns)	Climate variability introduced nonlinearity and nonstationarity to pelagic fish	time series analyses
Kurota, Hiroyuki, Cody S. Szuwalski, and Momoko Ichinokawa. 2020. "Drivers of Recruitment Dynamics in Japanese Major Fisheries Resources: Effects of Environmental Conditions and Spawner Abundance." Fisheries Research 221 (September 2019): 105353. https://doi.org/10.1016/j.fishres.2019.105353.	2020	journal paper	Japan	Pacific	Pacific	Japanese sardine	Adult	Recruitment	"Environment" other than SSB	Regime shifts were detected in pelagic species	time series analyses, change point analysis
Furuichi, Sho, Tohya Yasuda, Hiroyuki Kurota, Mari Yoda, Kei Suzuki, Motomitsu Takahashi, and Masa Aki Fukuwaka. 2020. "Disentangling the Effects of Climate and Density-Dependent Factors on Spatiotemporal Dynamics of Japanese Sardine Spawning." Marine Ecology Progress Series 633: 157–68. https://doi.org/10.3354/meps13169.	2020	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	Egg	Abundance and distribution	SST	Cold water led to decreased egg abundance over larger area, warm temperatures led to earlier spawning	correlation

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
Okazaki, Yuji, Kazuaki Tadokoro, Hiroshi Kubota, Yasuhiro Kamimura, and Kiyotaka Hidaka. 2019. “Dietary Overlap and Optimal Prey Environments of Larval and Juvenile Sardine and Anchovy in the Mixed Water Region of the Western North Pacific.” Marine Ecology Progress Series 630: 149–60. https://doi.org/10.3354/meps13124.	2019	journal paper	Japan	Pacific	Kuoshio current		larvae and juvenile	prey habits	SST	Temperature influences abundance of prey with effect on recruitment	correlation

Species summary for Japanese flying squid

Japanese Flying Squid (*Todarodes pacificus*)

Common names:

太平洋褶柔鱼 [tai ping yang zhe rou yu] (Chinese); Japanese flying squid (English); スルメイカ [surume-ika] (Japanese); 살오징어 [sal-o-jing-eo] (Korean); тихоокеанский кальмар [tihookeanskiy Kalmar] (Russian); 日本魷 [ri-ben-you] (Chinese Taipei).

Other common names: Japanese common squid, Pacific flying squid.

Management

Active NPFC Management Measures

The following NPFC conservation and management measure pertains to this species:

CMM 2021-11 For Japanese Sardine, Neon Flying Squid and Japanese Flying Squid

Available from https://www.npfc.int/active-conservation-and-management-measures.

Management Summary

The current management measure for Japanese flying squid (JFS) does not specify catch or effort limits. The CMM states that Members and Cooperating non-Contracting Parties currently harvesting JFS should refrain from expansion of the number of fishing vessels authorized to fish JFS in the Convention Area. New harvest capacity should also be avoided until as stock assessment has been completed.

Japan has been conducted stock assessment annually for two stocks of JFS such as the Autumn-

and Winter-spawning stocks since 1997. Japanese domestic total allowable catch (TAC) has been annually set for JFS based on acceptable biological catch (ABC) determined based on the stock assessment results.

Table 8. Management Summary

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	🔴	Not established.
Stock status	○	Status determination criteria not established.
Catch limit	🟡	Recommended catch, effort limits.
Harvest control rule	🔴	Not established.
Other	🟡	No expansion of fishing beyond established areas.

🟢 OK 🟡 Intermediate 🔴 Not accomplished ○ Unknown

Stock Assessment

No stock assessment has been conducted by NPFC for the Convention Area.

Japan conducts annual stock assessments for JFS for the Autumn- and Winter-spawning stocks (Kaga et al. 2020, Kubota et al. 2020).

Data

Survey

JFS are encountered in several surveys conducted by Japan and Russia. Japanese surveys encounter multiple life history stages of one or more seasonal stocks, including larvae (winter survey), recruits (May-June), and adults. Russia conducts a survey of JFS during their feeding migration into Krill Islands waters, this results in number and biomass estimated by area swept method for Krill Islands waters (annual, for winter cohort only). While this survey captures only a portion of the stock so not fully representing stock biomass, it may help identify environmental impact on migration patterns, timing, etc.

Fishery

The winter-spawning stock of JFS is harvested in the NPFC Convention Area (see Biological Information).

JFS are caught by Members in both the Convention Area and National Waters. Catch tables are available at the NPFC website (https://www.npfc.int/system/files/2021-07/NPFC-2021-AR-Annual%20Summary%20Footprint%20-%20Squids%20%28Rev.%202%29.xlsx). Catches of JFS

in the Convention Area are low, as the majority of catches comes from Japanese and Russian national waters (Figure 1). JFS are caught using a variety of gears, most commonly squid jigging and trawl, but purse seine and set net are also used. They are predominantly caught as a targeted species, not as bycatch in other fisheries. However, in some seasons, they can be caught as bycatch in the Japanese sardine fishery. Chinese fishing fleets do not target JFS but encounter them in low quantities as bycatch in other fisheries.

There is no fishery CPUE index developed for this species in the Convention Area. Japan has already developed fishery-dependent/independent abundance indices to use in the domestic stock assessment.

Age data are collected by port samplers from a subset of Japanese fishing ports and for several Japanese prefectural research bodies. The squid's statolith is used for counting daily ages and estimating hatching dates.

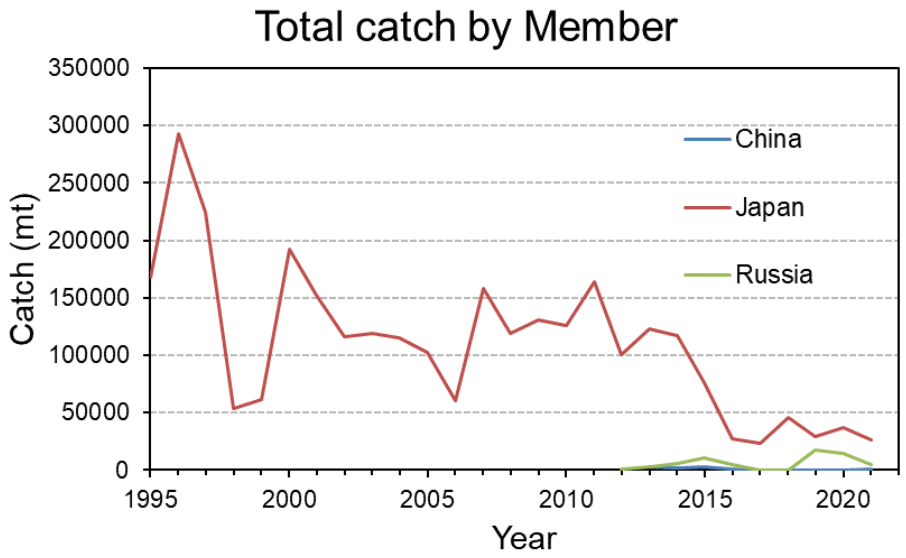

Figure 1. Total catch (mt) for each Member reporting Japanese flying squid catches during 1995-present.

Data table

Table 9. Data availability from Members regarding Japanese flying squid

Japanese flying squid: China*, Japan, Russia.

* No fishery targets Japanese flying squid. No relevant data.

Category and data sources	Description	Years with available data	Average sample size/ year or data coverage	Potential issues to be reviewed
JAPAN				

Catch statistics				
Coastal jigging fishery	Official statistics; Reports from fisheries associations and markets	1979-2021 (only after 1995 at some ports)	Coverage = 100%	
Offshore jigging fishery	Logbook	1979-2021	Coverage = 100%	
Trawl fishery	Logbook	1980-2021	Coverage = 100%	
Purse seine fishery	Official statistics; Reports from fisheries associations and markets (only at Hachinohe and Mie);	1995-2021	Coverage = 100%	
Set net	Official statistics; Reports from fisheries association	1995-2021	Coverage = 100%	
Size composition data				
Length measurements	Port sampling by eight local fisheries research bodies at major ports on the Pacific side	1979-2021	3000-15000 fish/year (about 50 individuals measured per a single size sampling)	Data coverage in the eastern Hokkaido (Nemuro Strait)
Aging	Port sampling by three local fisheries associations and nine fisheries research bodies	2012-2021	700-1400 fish/year	Data coverage in the eastern Hokkaido (Nemuro Strait)
Abundance indices (survey)				
Winter survey for larvae	BONGO net	2001-2021	65-204 stations/year	Review survey protocol and conduct standardization

Survey for recruitment from May to June	Midwater trawl	1996-2021	24-63 stations/year	Review survey protocol and conduct standardization
Survey for recruitment in June	Jigging	1972-2021	25-83 stations/year	Review survey protocol and conduct standardization
Survey for recruitment from June to July	Midwater trawl mainly targeting saury	2001-2021	33-136 stations/year	Review survey protocol and conduct standardization
Survey for recruitment in July	Midwater trawl	2018-2021	28-39 stations/year	Short time series (three years)
Survey for recruitment in August	Jigging	1979-2021	28-66 stations/year	Review survey protocol and conduct standardization
Abundance indices (commercial)				
Coastal jigging fishery	Monthly catch and effort data reported by fisheries associations and markets in the seven major regions during fishing season from July to December; Standardized CPUE for domestic stock assessment	1979-2021	25-37 observations/year	

Category and data sources	**Description**	**Years with available data**	**Average sample size/year or data coverage**	**Potential issues to be reviewed**
RUSSIA				

Catch statistics				
Jigging fishery	Official statistics, reports from fisheries associations	Official statistics: 1964-1970, 2013-2020, 1971-2012 (no data available); publications: 1967-2018	Coverage 1964-1970 ?%; Coverage 2013-2020 =100%	Data coverage details to be reviewed
Midwater trawl fishery				
Size composition data				
Length measurements	Sampling from commercial fishing vessels. Sampling during research surveys.	1966-1975 1992-2020	500-3,000 squids /year (ca. 50 measurements per sampling)	Data coverage details to be reviewed
Aging	-	-	-	-
Catch at age (CAA)	-	-	-	-
Abundance indices (survey)				
Summer trawl and acoustic (echointegration) surveys to assess pelagic squids abundance	Mid-water upper epipelagic surveys	1992-2020 (June-July) 1992-2020 (July-August)	60-80 stations/year 60-80 stations/year	Changes in abundance and migration patterns; development survey protocol and conduct standardization

Biological Information

Distribution and migration

JFS are distributed mainly in the northwest Pacific (Figs 2 and 3) and their northward/southward shifts in distribution range occur in response to changes in water temperature (Sakurai et al. 2013). JFS extent their distribution up to 50° N in September. There are northmost (eastmost) and southmost occurrences recorded in Canada and Hong Kong, respectively (Cuttlefishes and Squids of the World, FAO.org).

The autumn- and winter-spawning stocks have spatially different nursery areas and migration

patterns (Fig 3). Although the nursery area of the autumn-spawning stock is located in the Sea of Japan, the winter-spawning stock has the nursery area east of Hokkaido and Tohoku regions of Japan, of which a part overlaps the NPFC Convention Area. Both stocks conduct southward migration via the Sea of Japan towards each spawning grounds.

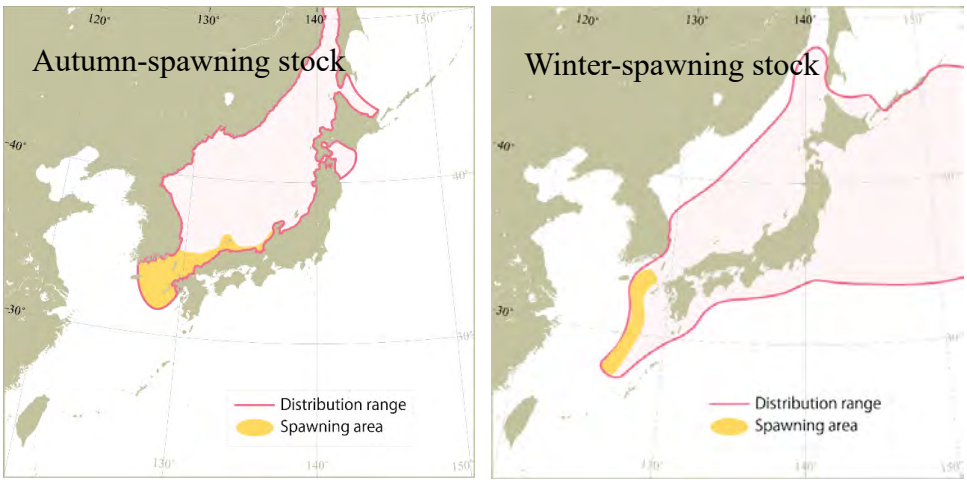

Figure 2. Distribution ranges and spawning areas of autumn- and winter-spawning stocks. These figures were modified based on Kubota et al. (2020) and Kaga et al. (2020).

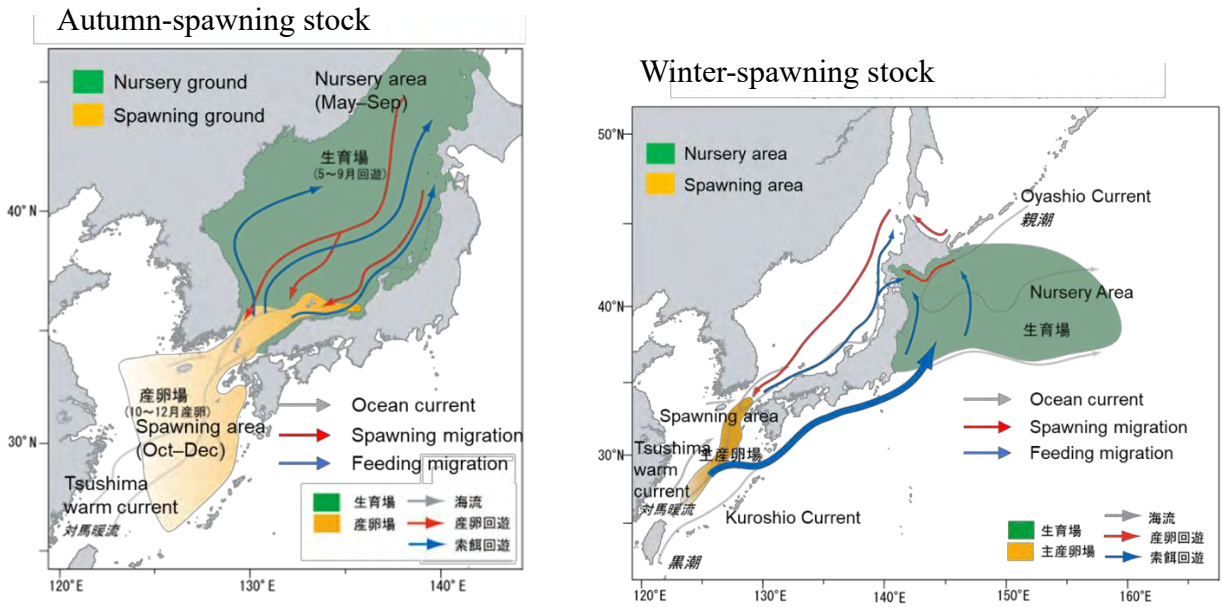

Figure 3. Seasonal migration of autumn- and winter-spawning stocks. These figures were modified based on Kubota et al. (2019) and Okamoto et al. (2021).

Stock Structure

There are distinct sub-populations (stocks) which spawn during different seasons (FAO.org, Sakurai et al. 2013). An autumn-spawning stock is most abundance, followed by a winter-spawning stock which is distributed in the waters off eastern Japan Oyashio region (Sakurai et al. 2013, Kaga et al. 2020, Kubota et al. 2020). There is, in addition, minor stock of spring/summer spawned squid.

Life history

Maximum size thought to be 50 cm (mantle length) for females, smaller for males. Females are thought to mature around 20-25 cm (mantle length). The JFS lifespan is approximately one year (FAO.org). According to FAO, JFS prey on myctophids, anchovies, crustaceans, gastropod larvae, and chaetognaths, and are preyed upon by rays and several marine mammals.

Literature Cited

Cuttlefishes and Squids of the World http://www.zen-ika.com/zukan/index-e.html

FAO.org http://www.fao.org/fishery/species/3567/en

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Kubota, H., Miyahara, H., Matsukura, Okamoto S. and Nishijima, S. (2019) Stock assessment and evaluation for autumn-spawning stock of Japanese flying squid (fiscal year 2019). In Marine Fisheries Stock Assessment and Evaluation for Japanese Waters (fiscal year 2019/2020). Fisheries Agency and Fisheries Research and Education Agency of Japan. http://abchan.fra.go.jp/digests2019/details/201919.pdf (in Japanese)

Kubota, H., Miyahara, H., Kaga, T., Okamoto, S., Nishijima, S., Matsukura, R., Matsui, H., Abo, J., Takasaki, K., Saito, T and Inagake, D. (2021) Stock assessment and evaluation for autumn-spawning stock of Japanese flying squid (fiscal year 2021). In Marine Fisheries Stock Assessment and Evaluation for Japanese Waters (fiscal year 2021/2022). Fisheries Agency and Fisheries Research and Education Agency of Japan. http://abchan.fra.go.jp/digests2021/details/202119.pdf (in Japanese)

Sakurai, Y., Kidokoro, H., Yamashita, N., Yamamoto, J., Uchikawa, K., & Takahara, H. (2013). *Todarodes pacificus*, Japanese common squid. Advances in Squid Biology, Ecology and Fisheries. Part II Oegopsid Squids. Nova Biomedical, New York, 249-272.

Species summary for blue mackerel

Blue mackerel (*Scomber australasicus*)

澳洲鲐 [ao-zhou-tai] (Chinese), ゴマサバ [gomasaba] (Japanese), 망치고등어 [Mang-chi-go-deung-eo] (Korean), пятнистая скумбрия [pyatnistaya skumbriya] (Russian), 花腹鯖 [Hua-Fu-Ching] (Chinese Taipei)

Other common names: Spotted mackerel

Management

Active NPFC Management Measures

None

Management Summary

- ✓ Conservation and Management Measure has not been set for blue mackerel in the NPFC.
- ✓ In Japan, total allowable catch (TAC) has been introduced to management of mackerels (blue mackerel and chub mackerel) since 1997.

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	🔴	Not established.
Stock status	○	Status determination criteria not established.
Catch limit	🟡	Recommended catch, effort limits.
Harvest control rule	🔴	Not established.
Other	🟡	No expansion of fishing beyond established areas.

🟢 OK 🟡 Intermediate 🔴 Not accomplished ○ Unknown

Stock Assessment

- ✓ No stock assessment has been conducted by NPFC.
- ✓ Japan conducts stock assessments on the Pacific stock and the East China Sea stock of blue mackerel using VPA (Yukami et al. 2019a, Hayashi et al. 2019). Only the Pacific stock is distributed in the NPFC convention area.

Data

Survey

Japan conducts three surveys: (1) egg and larval distribution survey (every month, Figs. 1, 2), (2) juvenile survey (May-Jul from 2001), and (3) pre-recruit fish survey (Aug-Oct from 2001). Other members do not conduct any survey on blue mackerel.

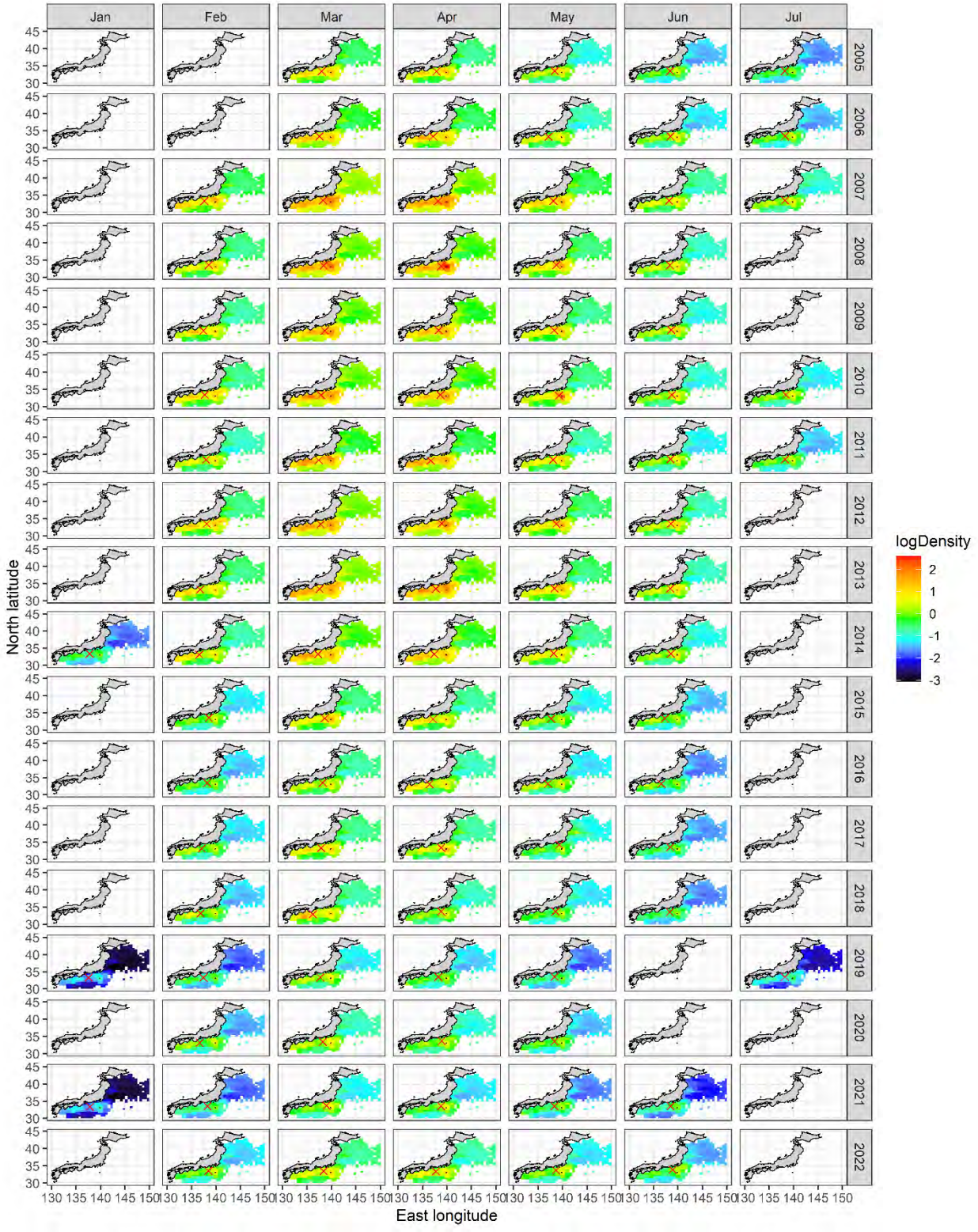

Figure 1: Spatial distributions of blue mackerel eggs on the Pacific coast of Japan by month (column) by year (row), estimated from the seasonal VAST model (Thorson et al. 2020) with the egg survey data. The sign of X in red represents the center of gravity.

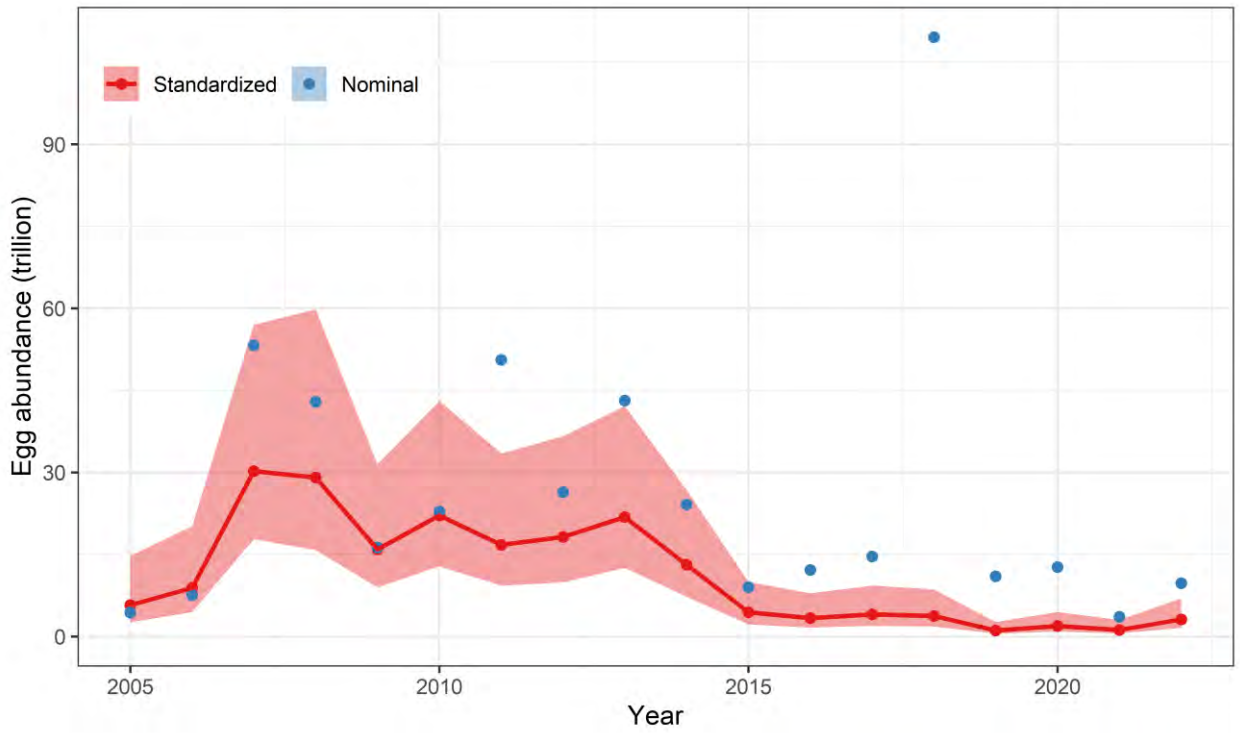

Figure 2: Time series of egg abundance indices. Nominal index and standardized index are shown. This standardization incorporates the effect of species misidentification of chub mackerel as blue mackerel, which is a reason why standardized values are lower than nominal values in most years typically 2018. See Kanamori et al. (2021) for details.

Fishery

The fishing grounds of Japanese fisheries are located in the water on continental shelves and slopes, around water of Islands within Japan's EEZ. The primary fishing gears of Japan are purse-seine (large-scale >40GRT and small-scale <40GRT vessels), set net and dip net. In the 1980s, blue mackerel were caught mostly by dip net. From the 1990s, large- and small-scale purse-seine fisheries dominated the catch. The blue mackerel catch has decreased since 2010s and remains at low levels in recent years (Fig. 3). Chub and blue mackerels are caught together by the fisheries and summed together as "mackerels" in fishery statistics of Japan. The blue mackerel catch was estimated from the mixing ratio survey of landing. Japan conducts the identification of each species by external form; blue mackerel has clear black spots on both sides of body, and the interval between splines of first dorsal fin of blue mackerel is narrower than that of chub mackerel. The proportion of blue mackerel catch in the total mackerel catch was around 10% from 2016 to 2020.

China operates a blue mackerel fishery in the NPFC Convention Area only, on the same fishing grounds as for chub mackerel. The portion of blue mackerel is about 10% of the mackerel catch, although it varies from year to year. China takes samples to determine the composition of mackerel species in the catch and collects biological information.

In Russia, there are no accurate catch statistics on the proportion of blue and chub mackerels.

However, the portion of blue mackerel is very small and probably comprises less than 1% of the total mackerel catch by Russia.

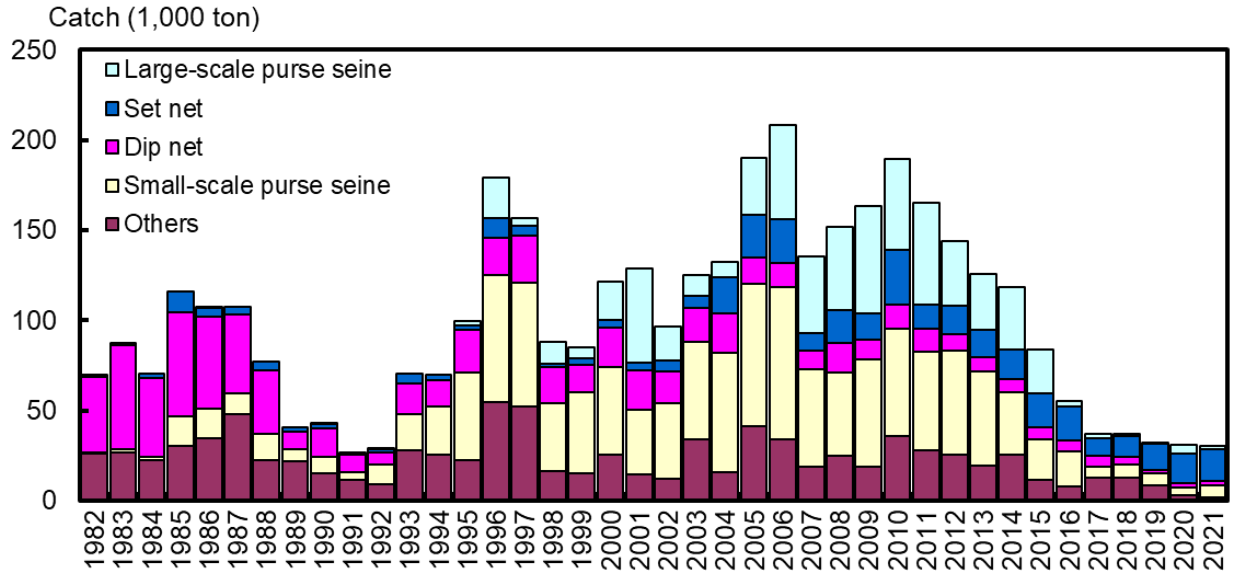

Figure 3: Catch weight by fishery from 1982 to 2021 in Japan.

Data table

Data availability tables which include information about catch, abundance indices and biological data from China and Japan are respectively shown below (Tables 1, 2). For Russia, no relevant data are available.

Table 1: Data availability table from China.

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
CHINA				
Catch statistics				
Purse seine fishery Trawl fishery	Official statistics, reports from annual report	Official statistics: 2015-2022	Coverage=100 %	The blue mackerel and Japanese sardine catches are from the fishing catch provided by the fishery company
Size composition data				

Length measurements	Port sampling by Institute and technology group.	2018-2022	550-800 fish/year	Details to be reviewed
Aging	Sampling during research surveys and from commercial fishing vessels	2020-2022	30-180 fish/year	Details to be reviewed
Catch at age (CAA)	Estimate CAA from the above data	2020-2022	Age-length keys are to be developed	Evaluate uncertainty of catch at age, especially on changes of growth depending on recruitment abundance
…				
Abundance indices (survey)				
Abundance indices (commercial)				
Purse seine fishery	Purse seine logbook	2015-2022	10-60/year	Should separate blue mackerel and chub mackerel Will conduct standardization

Table 2: Data availability table from Japan.

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
JAPAN				
Catch statistics				

Purse seine fishery	Official statistics; reports from fisheries associations and markets	Official statistics: 1950-2021, other reports: 1982-2021	Coverage=100 %	The spotted mackerel catches are estimated from chub and spotted mackerel catches based on port sampling data
Dip net fishery				
Set net				
Size composition data				
Length measurements	Port sampling by 17 local fishery institutes in 17 prefectures	1995-2021	4,000-40,000 (average 10,000) fish/year (ca. 100 measurements per sampling)	Data coverage review
Aging	Port sampling by 17 local fishery institutes in 17 prefectures	1995-2021	500-1000 fish/year	Data coverage review
Catch at age (CAA)	CAA is estimated with length measurement and aging data	1995-2021	Age-length keys are created approximately by quarter and local regions	Evaluation of uncertainty in catch at age, especially on changes in growth depending on recruitment abundance
Abundance indices (survey)				
Year-round for egg density	Almost all local fisheries research bodies join this survey program. NORPAC net is sampling gear. This survey is conducted for small pelagic species.	2005-2022	ca. 6000 stations in total, 1000-4000 stations with spotted mackerel eggs/year	Review survey protocol and conduct standardization
Abundance indices (commercial)				

Dip net fishery	Logbook data are collected from fishermen in Shizuoka prefecture since 1995	1995-2022	100-500/year	Standardization

Special Comments

Although the Small Working Group (SWG) used 'spotted mackerel' as the common name of this species, the SWG recommended to SC to change the common name to 'blue mackerel' for consistency with the FAO database of fish species.

Catch statistics specific to blue mackerel in the NPFC Convention Area are not available because combined catch of chub and blue mackerels have been reported to NPFC (https://www.npfc.int/summary-footprint-chub-mackerel-fisheries). Separation of chub and blue mackerels in catch data including historical data will be necessary for a stock assessment by NPFC.

Biological Information

The below descriptions are mostly extracted from Yukami et al. (2019b).

Distribution and migration

Blue mackerel is distributed from Japan to Australia and New Zealand in the Indo-West Pacific (Frose and Pauly 2022). Blue mackerel around Japan is divided into two stocks by spatial distributions in Japanese stock assessments: Pacific stock and East China Sea stock (Hayashi et al. 2019, Yukami et al. 2019; Fig. 4). Below we describe biological information based on the Pacific stock of blue mackerel, mostly extracted from Yukami et al. (2019b).

Blue mackerel tends to distribute in warm offshore waters. The main distribution area for adults is around water of the Kuroshio current. The larvae hatch around the Kuroshio current and are distributed from the coastal water of southern Honsyu to the transition water between Kuroshio and Oyashio currents located 165 to 170 East longitude, the same as the chub mackerel larvae. The juveniles sized at 5 to 15cm fork length (FL) transferred to transition water, migrate to north as they grow, feed at the area from coastal water of eastern Hokkaido and Kurill Islands to the subarctic water around 165 degree East longitude where the surface temperature around 13°C in summer to fall. They reach 20 to 25cm FL in fall to winter, and migrate south to the coastal waters of Joban and Boso to offshore water around Kuroshio current for wintering. A wintering ground in the water near Emperor Seamounts was observed for 2004 year class which had high recruitment. Age 1 fish did not appear in the water north of Sanriku district after wintering until 1980, but they have migrated to the water from Tohoku to Hokkaido with the increase of surface temperature since 2001. They return south for wintering and migrate to the Izu Islands water for spawning in spring. Many schools distribute near Kuroshio current at the coastal water of southern Honshu all the year and are targeted by many fisheries. These are different from the schools that largely migrate from near

the Kuroshio current at the Izu Island to Tohoku and Hokkaido waters. It is suggested that many fish above age 3 do not migrate north of Sanriku district and stay at the western water near the cape Ashizuri with small migrations or stay near the spawning grounds. Furthermore, it is considered that the observation of schools mainly consisting of age 8 fish at the Emperor seamounts area in 2008 to 2015 were due to the dominant recruitment spawned at the water south of Hachijo Island.

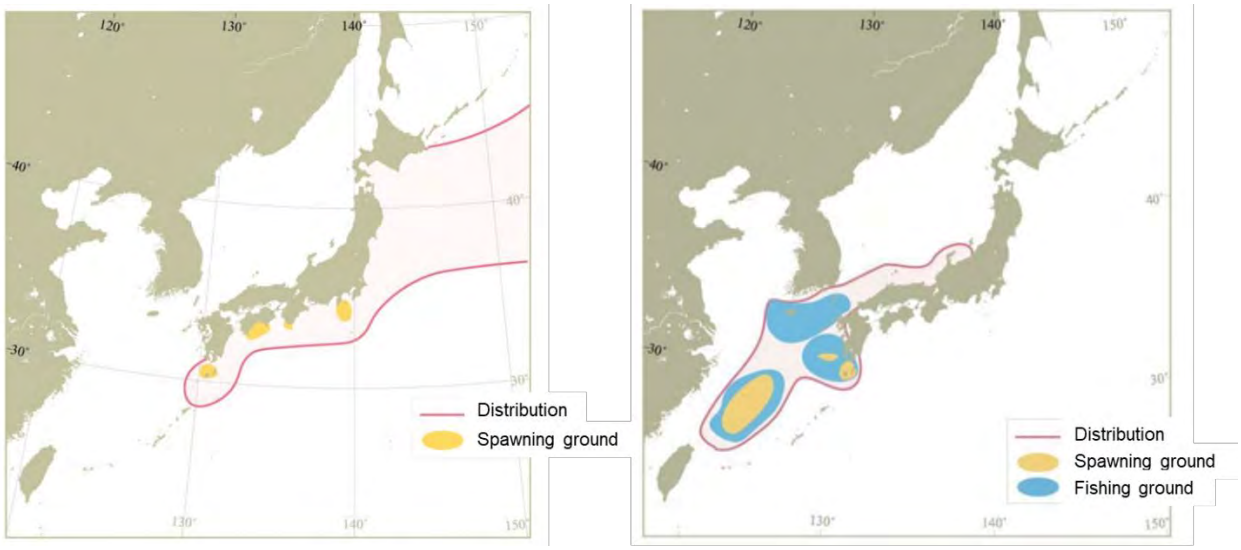

Figure 4: Distribution and spawning ground of the Pacific stock (left) and the East China Sea stock (right) of blue mackerel.

Age and growth

The larvae grow 1mm per day until 5cm FL after hatching observed by otolith reading, then it grows 15cm after 80days, and over 20cm of 120 days after hatching. The scale annuli reading is practical for the fish after subadult stage, it is used for the survey. Otolith annuli and daily ring readings are also effective for age determination. Recent analysis for age and growth from sampling of catch indicates fish becoming 20-25cm FL at age 0 in fall, 28-31cm at age 1 in summer, 30-34cm at age 2, 33-36cm at age 3, around 37cm at age 4, and 45cm at the maximum. The longevity was estimated around age 6 from size composition of catch, but the oldest age 11 was reported. The growth at younger ages is different by area, and in the western area of offshore Kumano there is a tendency for faster growth than fish occur in the water north of Izu Islands. The average length (FL), weight (average weight in catch in 2014 to 2018) by age are shown in Fig. 5.

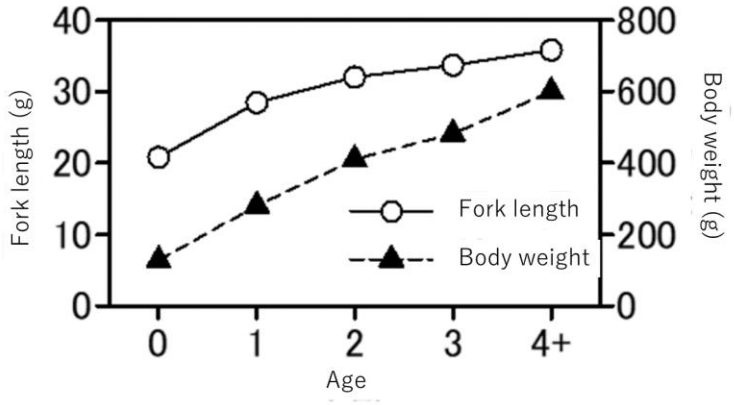

Figure 5: Relationship between age and fork length and relationship between age and body weight of blue mackerel.

Reproduction

The blue mackerel mature and spawn above 30cm FL from the observation of ovary tissue. The mature age was considered age 2 and above and it is assumed that all the fish age 2 and above are mature and spawn (Figs. 5. 6). The spawning grounds are found from the waters southern Kyusyu and cape Ashizuri to the Kuroshio current water near Izu Islands (Fig4). The recruitments hatched at the larger spawning ground in the East China sea supposed to migrate into the Pacific water. A spawning season are from December to June next year at the western waters of cape Ashizuri, January to March in the East China sea, and February to March near the water of cape Ashizur. The spawning season of main spawning ground of blue mackerel near Izu Island are March to June, but it considered that it is not suitable as spawning grounds by the short spawning season from the ovary tissue observation and small amount of spawning eggs sampled. However, it is supposed that larvae and juvenile occurring in the north of transition area consist of the fish hatched at the Izu Island spawning grounds in March to June, same as chub mackerel.

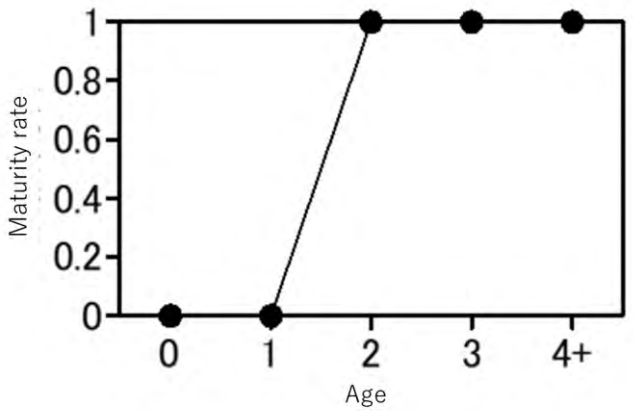

Figure 6: Maturity rate by age.

Predator-prey relationship

Larvae feed on planktonic crustaceans and larvae of anchovy or sardines. Juveniles feed on small teleost and cephalopods with preys mentioned above. It preys on fishes including anchovy, benttooth and lantern fishes, crustaceans like krill and cephalopods at the Kumano Nada fishing ground, horned krill and anchovy at Sanriku fishing ground and copepod, krill, anchovy, lantern fishes, cephalopod like Enoploteuthidae and salpa in the transition area between Kuroshio and Oyashio where located offshore of Joban and Sanriku. Predation on blue mackerel by whales is observed during periods of high abundance.

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Annex L

Revised CMM 2021-05 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northwestern Pacific Ocean

CMM 2021-05
(Entered into force 10 July 2021)

CONSERVATION AND MANAGEMENT MEASURE FOR BOTTOM FISHERIES AND PROTECTION OF VULNERABLE MARINE ECOSYSTEMS IN THE NORTHWESTERN PACIFIC OCEAN

The North Pacific Fisheries Commission (NPFC),
Strongly supporting protection of vulnerable marine ecosystems (VMEs) and sustainable management of fish stocks based on the best scientific information available;

Recalling the United Nations General Assembly Resolutions (UNGA) on Sustainable Fisheries, particularly paragraphs 66 to 71 of the UNGA59/25 in 2004, paragraphs 69 to 74 of UNGA60/31 in 2005, and paragraphs 69 and 80 to 91 of UNGA61/105 in 2006;

Noting, in particular, paragraphs 66 and 69 of UNGA59/25 that call upon States to take action urgently to address the issue of bottom trawl fisheries on VMEs and to cooperate in the establishment of new regional fisheries management organizations or arrangements;

Recognizing further that fishing activities, including bottom fisheries, are an important contributor to the global food supply and that this must be taken into account when seeking to achieve sustainable fisheries and to protect VMEs;

Recognizing the importance of collecting scientific data to assess the impacts of these fisheries on marine species and VMEs;

Concerned about possible adverse impacts of unregulated expansion of bottom fisheries on marine species and VMEs in the western part of the Convention Area.

Adopts the following Conservation and Management Measure:

1. Scope

A. Coverage

These Measures are to be applied to all bottom fishing activities throughout the high seas areas of the Northwestern Pacific Ocean, defined, for the purposes of this document, as those occurring in the Convention Area as set out in Article 4 of the Convention text to the west of the line of 175 degrees W longitude (here in after called “the western part of the Convention Area”) including all such areas and marine species other than those species already covered by existing international fisheries management instruments, including bilateral agreements and Regional Fisheries Management Organizations or Arrangements.

B. Management target
Bottom fisheries conducted by vessels operating in the western part of the Convention Area.

2. General purpose
Sustainable management of fish stocks and protection of VMEs in the western part of the Convention Area.

The objective of these Measures is to ensure the long-term conservation and sustainable use of the fisheries resources in the Convention Area while protecting the marine ecosystems of the North Pacific Ocean in which these resources occur.

These measures shall set out to prevent significant adverse impacts on VMEs in the Convention Area of the North Pacific Ocean, acknowledging the complex dependency of fishing resources and species belonging to the same ecosystem within VMEs.

The Commission shall re-evaluate, and as appropriate, revise, the definition based on further consideration of the work done through FAO and by NPFC.

3. Principles
The implementation of this CMM shall:
(a) be based on the best scientific information available,
(b) be in accordance with existing international laws and agreements including UNCLOS and other relevant international instruments,
(c) establish appropriate and effective conservation and management measures,
(d) be in accordance with the precautionary approach, and
(e) incorporate an ecosystem approach to fisheries management.

4. Measures
Members of the Commission shall take the following measures in order to achieve sustainable management of fish stocks and protection of VMEs in the western part of the Convention

Area:

A. Limit fishing effort in bottom fisheries on the western part of the Convention Area to the level agreed in February 2007 in terms of the number of fishing vessels and other parameters which reflect the level of fishing effort, fishing capacity or potential impacts on marine ecosystems.

B. Not allow bottom fisheries to expand into the western part of the Convention Area where no such fishing is currently occurring, in particular, by limiting such bottom fisheries to seamounts located south of 45 degrees North Latitude and refrain from bottom fisheries in other areas of the western part of the Convention Area covered by these measures and also not allow bottom fisheries to conduct fishing operation in areas deeper than 1,500m.

C. Notwithstanding subparagraphs A and B above, exceptions to these restrictions may be provided in cases where it can be shown that any fishing activity beyond such limits or in any new areas would not have significant adverse impacts (SAIs) on marine species or any VME. Such fishing activity is subject to an exploratory fishery protocol (Annex 1).

D. Any determinations pursuant to subparagraph C that any proposed fishing activity will not have SAIs on marine species or any VME are to be in accordance with the Science-based Standards and Criteria (Annex 2), which are consistent with the FAO International Guidelines for the Management of Deepsea Fisheries in the High Seas.

E. Any determinations, by any flag State or pursuant to any subsequent arrangement for the management of the bottom fisheries in the areas covered by these measures, that fishing activity would not have SAIs on marine species or any VMEs, shall be made publicly available through agreed means.

F. Prohibit its vessels from engaging in directed fishing on the following taxa: *Alcyonacea, Antipatharia, Gorgonacea,* and *Scleractinia*, the classes of *Hexactinellida* and *Demospongiae* in the phylum Porifera as well as any other indicator species for VMEs as may be identified from time to time by the SC and approved by the Commission.

G. Further, considering accumulated information regarding fishing activities in the western part of the Convention Area, in areas where, in the course of fishing operations, cold water corals more than 50Kg and sponges more than 500 kg are encountered in one gear retrieval, Members of the Commission shall require vessels flying their flag to cease

bottom fishing activities in that location. In such cases, the vessel shall not resume fishing activities until it has relocated a sufficient distance, which shall be no less than 12 ~~2~~ nautical miles, so that additional encounters with VMEs are unlikely. All such encounters, including the location, gear type, date, time and name and weight of the VME indicator species , shall be reported to the Secretariat, through the Member, within one business day.~~,~~ The Executive Secretary~~who~~ shall, within one business day, ~~immediately~~ notify the other Members of the Commission and at the same time implement a temporary closure in the area to prohibit bottom fishing vessels from contacting the sea floor with their trawl nets.~~so that appropriate measures can be adopted in respect of the relevant site~~. Members shall inform their fleets and enforcement operations within one business day of the receipt of the notification from the Executive Secretary. It is agreed that the VME indicator taxa include cold water corals~~:~~ *Alcyonacea, Antipatharia, Gorgonacea*, and *Scleractinia*~~,~~ and the classes of *Hexactinellida* and *Demospongiae* in the phylum Porifera.

Gbis Based on all the available data, including data on the VME encounter and distribution received from the fishing vessel(s), research survey data, visual survey data, and/or model results, the Scientific Committee (SC) shall assess and conclude if the area has a VME. If so, the SC shall recommend to the Commission that the temporary closure be made permanent, although the boundary of the closure may be adjusted, or suggest other appropriate measures. Otherwise, the Executive Secretary shall inform the Members that they may reopen the area to their vessels.

H. C-H seamount and Southeastern part of Koko seamount, specifically for the latter seamount, the area South of 34 degrees 57 minutes North, East of the 400m isobaths, East of 171 degrees 54 minutes East, North of 34 degrees 50 minutes North, are closed precautionary for potential VME conservation. Fishing in these areas requires exploratory fishery protocol (Annex 1).

I. Ensure that the distance between the footrope of the gill net and sea floor is greater than 70 cm.

J. Apply a bottom fisheries closure from November to December.

K. Limit annual catch of North Pacific armorhead to 15,000 tons for Japan. In years when strong recruitment of North Pacific armorhead is not detected by the monitoring survey (Annex 6), the Commission encourages Japan to limit their catch of North Pacific armorhead by vessels flying its flag to 500 tons, and encourages Korea to limit their catch of North Pacific armorhead by vessels flying its flag to 200 tons. When a strong

recruitment of North Pacific armorhead is detected by the monitoring survey (Annex 6), the Commission encourages that Japan limit the annual catch of North Pacific armorhead by vessels flying its flag to 10,000 tons, and that Korea limit the annual catch of North Pacific armorhead by vessels flying its flag to 2,000 tons. The Commission encourages that catch overages for any given year be subtracted from the applicable annual catch limit in the following year, and that catch underages during any given year not be added to the applicable annual catch limit during the following year.

~~L.~~A. ~~Development of new fishing activity for the North Pacific armorhead and splendid alfonsino in the Convention Area by Members without documented historical catch for North Pacific armorhead and splendid alfonsino in the Convention Area shall be determined in accordance with relevant provisions, including but not limited to Article 3, paragraph (h) and Article 7, subparagraphs 1(g) and (h) of the Convention.~~

~~M. In years when strong recruitment of North Pacific armorhead is not detected (Annex 6), the Commission encourages Japan to limit the annual catch of North Pacific armorhead by vessels flying its flag to 500 tons, and encourages Korea to limit the annual catch of North Pacific armorhead by vessels flying its flag to 200 tons. The Commission encourages that catch overages for any given year be subtracted from the applicable annual catch limit in the following year, and that catch underages during any given year not be added to the applicable annual catch limit during the following year.~~

~~N.~~L. ~~Notwithstanding subparagraph K, when a strong recruitment of North Pacific armorhead is detected through the monitoring surveys as specified in Annex 6, the Commission encourages that Japan limit the annual catch of North Pacific armorhead by vessels flying its flag to 10,000 tons, and that Korea limit the annual catch of North Pacific armorhead by vessels flying its flag to 2,000 tons. The Commission encourages that catch overages for any given year be subtracted from the applicable annual catch limit in the following year, and that catch underages during any given year not be added to the applicable annual catch limit during the following year.~~ During a year when high recruitment is detected, bottom fishing with trawl gear shall be prohibited in specific areas in the Emperor seamounts where half of the catch occurred in 2010 and 2012 (Annex 6). Determination of a strong recruitment year and of the specific areas where bottom fishing with trawl gear is prohibited shall be communicated to all Members and Cooperating Non-Contracting Parties following the procedure specified in Annex 6.

~~O.~~M. Catch in the monitoring surveys shall not be included in the catch limits specified in paragraphs M and N but shall be reported to the Secretariat.

N. Development of new fishing activity for the North Pacific armorhead and splendid alfonsino in the Convention Area by Members without documented historical catch for North Pacific armorhead and splendid alfonsino in the Convention Area shall be determined in accordance with relevant provisions, including but not limited to Article 3, paragraph (h) and Article 7, subparagraphs 1(g) and (h) of the Convention.

~~P.~~O. Fishing activity for the North Pacific armorhead and splendid alfonsino in the Convention Area by Members with documented historical catch for North Pacific armorhead and splendid alfonsino in the Convention Area is not precluded.

~~O.~~P. Members shall require vessels flying their flags to use trawl nets with mesh size greater than or equal to 130mm of stretched mesh with 5kg tension in the codend when conducting fishing activities for North Pacific armorhead or splendid alfonsino.

~~R.~~Q. Task the Scientific Committee with reviewing the appropriate methods for establishing catch limits, and the adequacy and practicability of the adaptive management plan described in subparagraphs K, L, M, N, O, P, Q and Annex 6 from time to time and recommending revisions and actions, if necessary.

~~S.~~R. Prohibit its bottom fishing vessels from contacting the sea floor with their trawl nets in the following two sites with VME indicator species. A Member of the Commission whose fishing vessels entered these areas shall report to the TCC as to how it ensured the compliance of this measure.

Sites with VME indicator species (Areas surrounded by the straight lines linking the 4 geographical points below)

Northwestern part of Koko Seamount	35-44.75 N 171-07.60 E	35-44.75 N 171-07.80 E
	35-43.80 N 171-07.80 E	35-43.80 N 171-08.00 E
Northern Ridge of Colahan Seamount	31-03.85 N 175-53.40 E	31-03.85 N 175-53.65 E
	31-03.5 N 175-53.50 E	31-03.05 N 175-53.85 E

5. Contingent Action

Members of the Commission shall submit to the SC their assessments of the impacts of fishing activity on marine species or any VMEs, including the proposed management measures to prevent such impact. Such submissions shall include all relevant data and information in support of any such assessment. Procedures for such reviews including procedures for the

provision of advice and recommendations from the SC to the submitting Member are attached (Annex 3). Members will only authorize bottom fishing activity pursuant to para 4 (C).

6. Scientific Information

To facilitate the scientific work associated with the implementation of these measures, each Member of the Commission shall undertake:

A. Reporting of information for purposes of defining the footprint

In implementing paragraphs 4A and 4B, the Members of the Commission shall provide for each year, the number of vessels by gear type, size of vessels (tons), number of fishing days or days on the fishing grounds, total catch by species, and areas fished (names of seamounts) to the Secretariat. The Secretariat shall circulate the information received to the other Members consistent with the approved Regulations for Management of Scientific Data and Information. To support assessments of the fisheries and refinement of conservation and management measures, Members of the Commission are to provide updated information on an annual basis.

B. Collection of information

(i) Collection of scientific information from each bottom fishing vessel operating in the western part of the Convention Area.

(a) Catch and effort data

(b) Related information such as time, location, depth, temperature, etc.

(ii) As appropriate, the collection of information from research vessels operating in the western part of the Convention Area.

(a) Physical, chemical, biological, oceanographic, meteorological, etc.

(b) Ecosystem surveys.

(c) Seabed mapping (e.g. multibeam or other echosounder); seafloor images by drop camera, remotely operated underwater vehicle (ROV) and/or autonomous underwater vehicle (AUV).

(iii) Collection of observer data

Duly designated observers from the flag member shall collect information from bottom fishing vessels operating in the western part of the Convention Area. Observers shall collect data in accordance with Annex 5. Each Member of the Commission shall submit the reports to the Secretariat in accordance with Annex 4. The Secretariat shall compile this information on an annual basis and make it available to the Members of the Commission.

7. Control of bottom fishing vessels

To strengthen its control over bottom fishing vessels flying its flag, each Member of the

Commission shall ensure that all such vessels operating in the western part of the Convention Area be equipped with an operational vessel monitoring system.

8. Observers
   All vessels authorized to bottom fishing in the western part of the Convention Area shall carry an observer on board.

Annex 1

EXPLORATORY FISHERY PROTOCOL IN THE NORTH PACIFIC OCEAN

1. From 1 January 2009, all bottom fishing activities in new fishing areas and areas where fishing is prohibited in a precautionary manner or with bottom gear not previously used in the existing fishing areas, are to be considered as "exploratory fisheries" and to be conducted in accordance with this protocol.

2. Precautionary conservation and management measures, including catch and effort controls, are essential during the exploratory phase of deep sea fisheries. Implementation of a precautionary approach to sustainable exploitation of deep sea fisheries shall include the following measures:
   (i) precautionary effort limits, particularly where reliable assessments of sustainable exploitation rates of target and main by-catch species are not available;
   (ii) precautionary measures, including precautionary spatial catch limits where appropriate, to prevent serial depletion of low-productivity stocks;
   (iii) regular review of appropriate indices of stock status and revision downwards of the limits listed above when significant declines are detected;
   (iv) measures to prevent significant adverse impacts on vulnerable marine ecosystems; and
   (v) comprehensive monitoring of all fishing effort, capture of all species and interactions with VMEs.

3. When a member of the Commission would like to conduct exploratory fisheries, it is to follow the following procedure:
   (i) Prior to the commencement of fishing, the member of the Commission is to circulate the information and assessment in Appendix 1.1 to the members of the Scientific Committee (SC) for review and to all members of the Commission for information, together with the impact assessment. Such information is to be provided to the other members at least 30 days in advance of the meeting at which the information shall be reviewed.
   (ii) The assessment in (i) above is to be conducted in accordance with the procedure set forth in "Science-based Standards and Criteria for Identification of VMEs and Assessment of Significant Adverse Impacts on VMEs and Marine Species (Annex 2)", with the understanding that particular care shall be taken in the evaluation of risks of the significant adverse impact on vulnerable marine ecosystems (VMEs), in line with the precautionary approach.
   (iii) The SC is to review the information and the assessment submitted in (i) above in accordance with "SC Assessment Review Procedures for Bottom Fishing Activities (Annex 3)."
   (iv) The exploratory fisheries are to be permitted only where the assessment concludes that they would not have significant adverse impacts (SAIs) on marine species or any VMEs and on the basis of comments and recommendations of SC. Any determinations, by any Member of the

Commission or the SC, that the exploratory fishing activities would not have SAIs on marine species or any VMEs, shall be made publicly available through the NPFC website.

4. The member of the Commission is to ensure that all vessels flying its flag conducting exploratory fisheries are equipped with a satellite monitoring device and have an observer on board at all times.

5. Within 3 months of the end of the exploratory fishing activities or within 12 months of the commencement of fishing, whichever occurs first, the member of the Commission is to provide a report of the results of such activities to the members of the SC and all members of the Commission. If the SC meets prior to the end of this 12-month period, the member of the Commission is to provide an interim report 30 days in advance of the SC meeting. The information to be included in the report is specified in Appendix 1.2.

6. The SC is to review the report in 5 above and decide whether the exploratory fishing activities had SAIs on marine species or any VME. The SC then is to send its recommendations to the Commission on whether the exploratory fisheries can continue and whether additional management measures shall be required if they are to continue. The Commission is to strive to adopt conservation and management measures to prevent SAIs on marine species or any VMEs. If the Commission is not able to reach consensus on any such measures, each fishing member of the Commission is to adopt measures to avoid any SAIs on VMEs.

7. Members of the Commission shall only authorize continuation of exploratory fishing activity, or commencement of commercial fishing activity, under this protocol on the basis of comments and recommendations of the SC.

~~7.~~8. The same encounter protocol should be applied in both fished and unfished areas specified in Annex 2, paragraph 4(1)(a).

Appendix 1.1

Information to be provided before exploratory fisheries start

1. A harvesting plan
- Name of vessel
- Flag member of vessel
- Description of area to be fished (location and depth)
- Fishing dates
- Anticipated effort

- Target species
- Bottom fishing gear-type used
- Area and effort restrictions to ensure that fisheries occur on a gradual basis in a limited geographical area.

2. A mitigation plan
   - Measures to prevent SAIs to VMEs that may be encountered during the fishery

3. A catch monitoring plan
   - Recording/reporting of all species brought onboard to the lowest possible taxonomic level
   - 100% satellite monitoring
   - 100% observer coverage

4. A data collection plan
   - Data is to be collected in accordance with "Type and Format of Scientific Observer Data to be Collected" (Annex 5)

Appendix 1.2

Information to be included in the report

- Name of vessel
- Flag member of vessel
- Description of area fished (location and depth)
- Fishing dates
- Total effort
- Bottom fishing gear-type used
- List of VME encountered (the amount of VME indicator species for each encounter specifying the location: longitude and latitude)
- Mitigation measures taken in response to the encounter of VME
- List of all organisms brought onboard
- List of VMEs indicator species brought onboard by location: longitude and latitude

Annex 2

SCIENCE-BASED STANDARDS AND CRITERIA FOR IDENTIFICATION OF VMES AND ASSESSMENT OF SIGNIFICANT ADVERSE IMPACTS ON VMES AND MARINE SPECIES

1. Introduction

Members of the Commission have hereby established science-based standards and criteria to guide their implementation of United Nations General Assembly (UNGA) Resolution 61/105 and the measures adopted by the Members in respect of bottom fishing activities in the North Pacific Ocean (NPO). In this regard, these science-based standards and criteria are to be applied to identify vulnerable marine ecosystems (VMEs) and assess significant adverse impacts (SAIs) of bottom fishing activities on such VMEs or marine species and to promote the long-term sustainability of deep sea fisheries in the Convention Area. The science-based standards and criteria are consistent with the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas, taking into account the work of other RFMOs implementing management of deep-sea bottom fisheries in accordance with UNGA Resolution 61/105. The standards and criteria are to be modified from time to time as more data are collected through research activities and monitoring of fishing operations.

2. Purpose

(1) The purpose of the standards and criteria is to provide guidelines for each member of the Commission in identifying VMEs and assessing SAIs of individual bottom fishing activities[1] on VMEs or marine species in the Convention Area. Each member of the Commission, using the best information available, is to decide which species or areas are to be categorized as VMEs, identify areas where VMEs are known or likely to occur, and assess whether individual bottom fishing activities would have SAIs on such VMEs or marine species. The results of these tasks are to be submitted to and reviewed by the Scientific Committee with a view to reaching a common understanding among the members of the Commission.

(2) For the purpose of applying the standards and criteria, the bottom fisheries are defined as follows:

(a) The fisheries are conducted in the Convention Area;

(b) The total catch (everything brought up by the fishing gear) includes species that can

[1] "individual bottom fishing activities" means fishing activities by each fishing gear. For example, if ten fishing vessels operate bottom trawl fishing in a certain area, the impacts of the fishing activities of these vessels on the ecosystem are to be assessed as a whole rather than on a vessel-by-vessel basis. It should be noted that if the total number or capacity of the vessels using the same fishing gear has increased, the impacts of the fishing activities are to be assessed again.

only sustain low exploitation rates; and

(c) The fishing gear is likely to contact the seafloor during the normal course of fishing operations.

3. Definition of VMEs

(1) Although Paragraph 83 of UNGA Resolution 61/105 refers to seamounts, hydrothermal vents and cold-water corals as examples of VMEs, there is no definitive list of specific species or areas that are to be regarded as VMEs.

(2) Vulnerability is related to the likelihood that a population, community or habitat will experience substantial alteration by fishing activities and how much time will be required for its recovery from such alteration. The most vulnerable ecosystems are those that are both easily disturbed and are very slow to recover or may never recover. The vulnerabilities of populations, communities and habitats are to be assessed relative to specific threats. Some features, particularly ones that are physically fragile or inherently rare may be vulnerable to most forms of disturbance, but the vulnerability of some populations, communities and habitats may vary greatly depending on the type of fishing gear used or the kind of disturbance experienced. The risks to a marine ecosystem are determined by its vulnerability, the probability of a threat occurring and the mitigation means applied to the threat. Accordingly, the FAO Guidelines only provide examples of potential vulnerable species groups, communities and habitats as well as features that potentially support them (Annex 2.1).

(3) A marine ecosystem is to be classified as vulnerable based on its characteristics. The following list of characteristics is used as criteria in the identification of VMEs.

(a) Uniqueness or rarity - an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by other similar areas. These include:

(i) Habitats that contain endemic species;

(ii) Habitats of rare, threatened or endangered species that occur in discrete areas;

(iii)Nurseries or discrete feeding, breeding, or spawning areas.

(b) Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species.

(c) Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities

(d) Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics:

(i) Slow growth rates
(ii) Late age of maturity
(iii)Low or unpredictable recruitment
(iv)Long-lived

(e) Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems. Further, such ecosystems often have high diversity, which is dependent on the structuring organisms.

(4) Management response may vary, depending on the size of the ecological unit in the Convention Area. Therefore, the spatial extent of the ecological unit is to be decided first. That is, whether the ecological unit is the entire Area, or the current fishing ground, namely, the Emperor Seamount and Northern Hawaiian Ridge area (hereinafter called "the ES-NHR area"), or a group of the seamounts within the ESNHR area, or each seamount in the ES-NHR area, is to be decided using the above criteria.

4. Identification of potential VMEs

(1) Fished seamounts

(a) Identification of fished seamounts

It is reported that four types of fishing gear are currently used by the members of the Commission in the ES-NHR area, namely, bottom trawl, bottom gillnet, bottom longline and pot. A fifth type of fishing gear (coral drag) was used in the ES-NHR area from the mid-1960s to the late 1980s and is possibly still used by non-members of the Commission. These types of fishing gear are usually used on the top or slope of seamounts, which could be considered VMEs. It is therefore necessary to identify the footprint of the bottom fisheries (fished seamounts) based on the available fishing record. The following seamounts have been identified as fished seamounts: Suiko, Showa, Youmei, Nintoku, Jingu, Ojin, Northern Koko, Koko, Kinmei, Yuryaku, Kammu, Colahan, and CH. Since the use of most of these gears in the ES-NHR area dates back to the late 1960s and 1970s, it is important to establish, to the extent practicable, a time series of where and when these gears have been used in order to assess potential long-term effects on any existing VMEs.

Fishing effort may not be evenly distributed on each seamount since fish aggregation may occur only at certain points of the seamount and some parts of the seamount may be physically unsuitable for certain fishing gears. Thus, it is important to know actual fished areas within the same seamount so as to know the gravity of the impact of fishing activities on the entire seamount.

Due consideration is to be given to the protection of commercial confidentiality when

identifying actual fishing grounds.

(b) Assessment on whether a specific seamount that has been fished is a VME

After identifying the fished seamounts or fished areas of seamounts, it is necessary to assess whether each fished seamount is a VME or contains VMEs in accordance with the criteria in 3 above, individually or in combination using the best available scientific and technical information as well as Annex 2.1. A variety of data would be required to conduct such assessment, including pictures of seamounts taken by an ROV camera or drop camera, biological samples collected through research activities and observer programs, and detailed bathymetry map. Where site-specific information is lacking, other information that is relevant to inferring the likely presence of VMEs is to be used. The flow chart to identify data that can be used to identify VMEs is attached in Annex 2.3.

(2) New fishing areas

Any place other than the fished seamounts above is to be regarded as a new fishing area. If a member of the Commission is considering fishing in a new fishing area, such a fishing area is to be subject to, in addition to these standards and criteria, an exploratory fishery protocol (Annex 1).

5. Assessment of SAIs on VMEs or marine species

(1) Significant adverse impacts are those that compromise ecosystem integrity (i.e., ecosystem structure or function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types. Impacts are to be evaluated individually, in combination and cumulatively.

(2) When determining the scale and significance of an impact, the following six factors are to be considered:

(a) The intensity or severity of the impact at the specific site being affected;

(b) The spatial extent of the impact relative to the availability of the habitat type affected;

(c) The sensitivity/vulnerability of the ecosystem to the impact;

(d) The ability of an ecosystem to recover from harm, and the rate of such recovery;

(e) The extent to which ecosystem functions may be altered by the impact; and

(f) The timing and duration of the impact relative to the period in which a species needs the habitat during one or more life-history stages.

(3) Temporary impacts are those that are limited in duration and that allow the particular ecosystem to recover over an acceptable timeframe. Such timeframes are to be decided on a case-by-case basis and be on the order of 5-20 years, taking into account the specific features of the populations and ecosystems.

(4) In determining whether an impact is temporary, both the duration and the frequency with which an impact is repeated is to be considered. If the interval between the expected disturbances of a habitat is shorter than the recovery time, the impact is to be considered more than temporary.

(5) Each member of the Commission is to conduct assessments to establish if bottom fishing activities are likely to produce SAIs in a given seamount or other VMEs. Such an impact assessment is to address, *inter alia*:

(a) Type of fishing conducted or contemplated, including vessel and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing;

(b) Best available scientific and technical information on the current state of fishery resources, and baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes are to be compared;

(c) Identification, description and mapping of VMEs known or likely to occur in the fishing area;

(d) The data and methods used to identify, describe and assess the impacts of the activity, identification of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment;

(e) Identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs and low-productivity fishery resources in the fishing area;

(f) Risk assessment of likely impacts by the fishing operations to determine which impacts are likely to be SAIs, particularly impacts on VMEs and low-productivity fishery resources (Risk assessments are to take into account, as appropriate, differing conditions prevailing in areas where fisheries are well established and in areas where fisheries have not taken place or only occur occasionally);

(g) The proposed mitigation and management measures to be used to prevent SAIs on VMEs and ensure long-term conservation and sustainable utilization of low-productivity fishery resources, and the measures to be used to monitor effects of the fishing operations.

(6) Impact assessments are to consider, as appropriate, the information referred to in these Standards and Criteria, as well as relevant information from similar or related fisheries, species and ecosystems.

(7) Where an assessment concludes that the area does not contain VMEs or that significant adverse impacts on VMEs or marine species are not likely, such assessments are to be repeated when there have been significant changes to the fishery or other activities in the area, or when natural processes are thought to have undergone significant changes.

6. Proposed conservation and management measures to prevent SAIs

As a result of the assessment in 5 above, if it is considered that individual fishing activities are causing or likely to cause SAIs on VMEs or marine species, the member of the Commission is to adopt appropriate conservation and management measures to prevent such SAIs. The member of the Commission is to clearly indicate how such impacts are expected to be prevented or mitigated by the measures.

7. Precautionary approach

If after assessing all available scientific and technical information, the presence of VMEs or the likelihood that individual bottom fishing activities would cause SAIs on VMEs or marine species cannot be adequately determined, members of the Commission are only to authorize individual bottom fishing activities to proceed in accordance with:

(a) Precautionary, conservation and management measures to prevent SAIs;
(b) Measures to address unexpected encounters with VMEs in the course of fishing operations;
(c) Measures, including ongoing scientific research, monitoring and data collection, to reduce the uncertainty; and
(d) Measures to ensure long-term sustainability of deep sea fisheries.

8. Template for assessment report

Annex 2.2 is a template for individual member of the Commission to formulate reports on identification of VMEs and impact assessment.

Annex 2.1

Examples of potential vulnerable species groups, communities and habitats as well as features that potentially support them

The following examples of species groups, communities, habitats and features often display characteristics consistent with possible VMEs. Merely detecting the presence of an element itself is not sufficient to identify a VME. That identification is to be made on a case-by-case basis through application of relevant provisions of the Standards and Criteria, particularly Sections 3, 4 and 5.

Examples of species groups, communities and habitat forming species that are documented or considered sensitive and potentially vulnerable to deep-sea fisheries in the high-seas, and which may contribute to forming VMEs:	
a.	certain cold-water corals, e.g., reef builders and coral forest including: stony corals (scleractinia), alcyonaceans and gorgonians (octocorallia), black corals (antipatharia),

	and hydrocorals (stylasteridae),
b.	Some types of sponge dominated communities,
c.	communities composed of dense emergent fauna where large sessile protozoans (xenophyophores) and invertebrates (e.g., hydroids and bryozoans) form an important structural component of habitat, and
d.	seep and vent communities comprised of invertebrate and microbial species found nowhere else (i.e., endemic).

Examples of topographical, hydrophysical or geological features, including fragile geological structures, that potentially support the species groups or communities referred to above:

a. submerged edges and slopes (e.g., corals and sponges)
b. summits and flanks of seamounts, guyots, banks, knolls, and hills (e.g., corals, sponges and xenophyphores)
c. canyons and trenches (e.g., burrowed clay outcrops, corals),
d. hydrothermal vents (e.g., microbial communities and endemic invertebrates), and
e. cold seeps (e.g., mud volcanoes, microbes, hard substrates for sessile invertebrates).

Annex 2.2

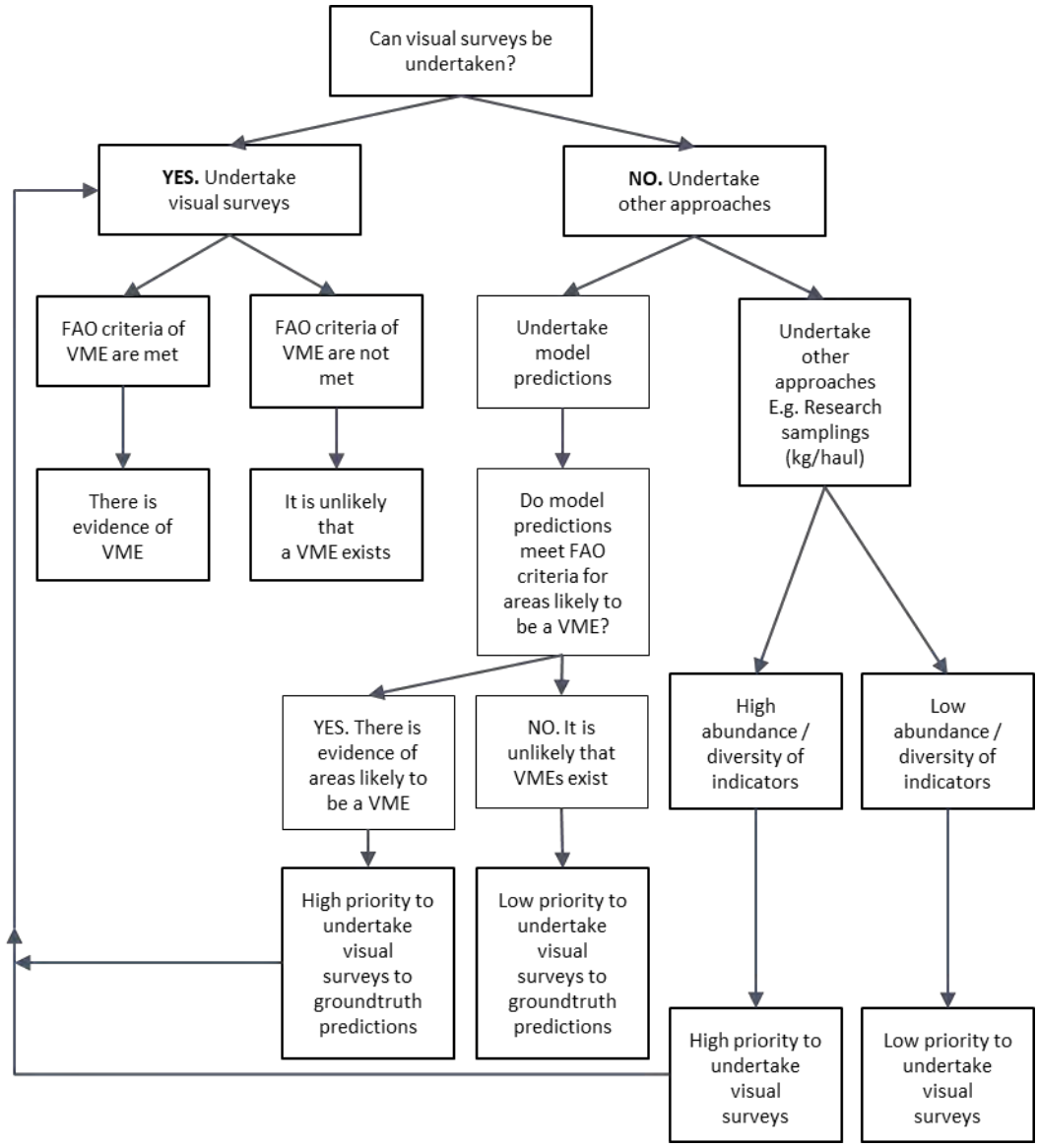
Template for reports on identification of VMEs and assessment of impacts caused by individual fishing activities on VMEs or marine species

1. Name of the member of the Commission
2. Name of the fishery (e.g., bottom trawl, bottom gillnet, bottom longline, pot)
3. Status of the fishery (existing fishery or exploratory fishery)
4. Target species
5. Bycatch species
6. Recent level of fishing effort (every year at least since 2002)
   (1) Number of fishing vessels
   (2) Tonnage of each fishing vessel
   (3) Number of fishing days or days on the fishing ground
   (4) Fishing effort (total operating hours for trawl, # of hooks per day for long-line, # of pots per day for pot, total length of net per day for gillnet)
   (5) Total catch by species
   (6) Names of seamounts fished or to be fished
7. Fishing period

8. Analysis of status of fishery resources
   (1) Data and methods used for analysis
   (2) Results of analysis
   (3) Identification of uncertainties in data and methods, and measures to overcome such uncertainties
9. Analysis of status of bycatch species resources
   (1) Data and methods used for analysis
   (2) Results of analysis
   (3) Identification of uncertainties in data and methods, and measures to overcome such uncertainties
10. Analysis of existence of VMEs in the fishing ground
   (1) Data and methods used for analysis
   (2) Results of analysis
   (3) Identification of uncertainties in data and methods, and measures to overcome such uncertainties
11. Impact assessment of fishing activities on VMEs or marine species including cumulative impacts, and identification of SAIs on VMEs or marine species, as detailed in Section 5 above, Assessment of SAIs on VMEs or marine species
12. Other points to be addressed
13. Conclusion (whether to continue or start fishing with what measures, or stop fishing).

Annex 2.3

Flow chart to identify data that can be used to identify VMEs in the NPFC Convention Area



Annex 3

SCIENTIFIC COMMITTEE ASSESSMENT REVIEW PROCEDURES FOR BOTTOM FISHING ACTIVITIES

1. The Scientific Committee (SC) is to review identifications of vulnerable marine ecosystems (VMEs) and assessments of significant adverse impact on VMEs, including proposed management measures intended to prevent such impacts submitted by individual Members.

2. Members of the Commission shall submit their identifications and assessments to members of the SC at least 21 days prior to the SC meeting at which the review is to take place. Such submissions shall include all relevant data and information in support of such determinations.

3. The SC will review the data and information in each assessment in accordance with the Science-based Standards and Criteria for Identification of VMEs and Assessment of Significant Adverse Impacts on VMEs and Marine Species (Annex 2), previous decisions of the Commission, and the FAO Technical Guidelines for the Management of Deep Sea Fisheries in the High Seas, paying special attention to the assessment process and criteria specified in paragraphs 47-49 of the Guidelines.

4. In conducting the review above, the SC will give particular attention to whether the deep-sea bottom fishing activity would have a significant adverse impact on VMEs and marine species and, if so, whether the proposed management measures would prevent such impacts.

5. Based on the above review, the SC will provide advice and recommendations to the submitting Members on the extent to which the assessments and related determinations are consistent with the procedures and criteria established in the documents identified above; and whether additional management measures will be required to prevent SAIs on VMEs.

6. Such recommendations will be reflected in the report of the SC meeting at which the assessments are considered.

Annex 4

FORMAT OF NATIONAL REPORT SECTIONS ON DEVELOPMENT AND IMPLEMENTATION OF SCIENTIFIC OBSERVER PROGRAMMES

Report Components

Annual Observer Programme implementation reports should form a component of annual National Reports submitted by members to the Scientific Committee. These reports should provide a brief overview of observer programmes conducted in the NPFC Convention Area. Observer programme reports should include the following sections:

A. Observer Training

An overview of observer training conducted, including:

- Overview of training programme provided to scientific observers.
- Number of observers trained.

B. Scientific Observer Programme Design and Coverage

Details of the design of the observer programme, including:

- Which fleets, fleet components or fishery components were covered by the programme.
- How vessels were selected to carry observers within the above fleets or components.
- How was observer coverage stratified: by fleets, fisheries components, vessel types, vessel sizes, vessel ages, fishing areas and seasons.

Details of observer coverage of the above fleets, including:

- Components, areas, seasons and proportion of total catches of target species, specifying units used to determine coverage.
- Total number of observer employment days, and number of actual days deployed on observation work.

C. Observer Data Collected

List of observer data collected against the agreed range of data set out in Annex 5, including:

- Effort Data: Amount of effort observed (vessel days, net panels, hooks, etc), by area and season and % observed out of total by area and seasons
- Catch Data: Amount of catch observed of target and by-catch species, by area and season, and % observed out of total estimated catch by species, area and seasons
- Length Frequency Data: Number of fish measured per species, by area and season.
- Biological Data: Type and quantity of other biological data or samples (otoliths, sex, maturity, etc.) collected per species.
- The size of length-frequency and biological sub-samples relative to unobserved quantities.

D. Detection of Fishing in Association with Vulnerable Marine Ecosystems

- Information about VME encounters (species and quantity in accordance with Annex 5, H, 2).

E. Tag Return Monitoring

- Number of tags returns observed, by fish size class and area.

F. Problems Experienced

- Summary of problems encountered by observers and observer managers that could affect the NPFC Observer Programme Standards and/or each member's national observer programme developed under the NPFC standards.

Annex 5

NPFC BOTTOM FISHERIES OBSERVER PROGRAMME STANDARDS: SCIENTIFIC COMPONENT

TYPE AND FORMAT OF SCIENTIFIC OBSERVER DATA TO BE COLLECTED

A. Vessel & Observer Data to be collected for Each Trip

1. Vessel and observer details are to be recorded only once for each observed trip.
2. The following observer data are to be collected for each observed trip:
   (a) NPFC vessel ID.
   (b) Observer's name.
   (c) Observer's organisation.
   (d) Date observer embarked (UTC date).
   (e) Port of embarkation.
   (f) Date observer disembarked (UTC date).
   (g) Port of disembarkation.

B. Catch & Effort Data to be collected for Trawl Fishing Activity

1. Data are to be collected on an un-aggregated (tow by tow) basis for all observed trawls.
2. The following data are to be collected for each observed trawl tow:
   (a) Tow start date (UTC).
   (b) Tow start time (UTC).
   (c) Tow end date (UTC).
   (d) Tow end time (UTC).
   (e) Tow start position (Lat/Lon, 1 minute resolution).
   (f) Tow end position (Lat/Lon, 1 minute resolution).
   (g) Type of trawl, bottom or mid-water.
   (h) Type of trawl, single, double or triple.
   (i) Height of net opening (m).
   (j) Width of net opening (m).
   (k) Mesh size of the cod-end net (stretched mesh, mm) and mesh type (diamond, square, etc).
   (l) Gear depth (of footrope) at start of fishing (m).
   (m) Bottom (seabed) depth at start of fishing (m).
   (n) Gear depth (of footrope) at end of fishing (m).
   (o) Bottom (seabed) depth at end of fishing (m).

(p) Status of the trawl operation (no damage, lightly damaged*, heavily damaged*, other (specify)).
*Degree may be evaluated by time for repairing (<=1hr or >1hr).
(q) Duration of estimated period of seabed contact (minute)
(r) Intended target species.
(s) Catch of all species retained on board, split by species, in weight (to the nearest kg).
(t) Estimate of the amount (weight or volume) of all living marine resources discarded, split by species.
(u) Record of the numbers by species of all marine mammals, seabirds or reptiles caught.

C. Catch & Effort Data to be collected for Bottom Gillnet Fishing Activity

1. Data are to be collected on an un-aggregated (set by set) basis for all observed bottom gillnet sets.
2. The following data are to be collected for each observed bottom gillnet set:
   (a) Set start date (UTC).
   (b) Set start time (UTC).
   (c) Set end date (UTC).
   (d) Set end time (UTC).
   (e) Set start position (Lat/Lon, 1 minute resolution).
   (f) Set end position (Lat/Lon, 1 minute resolution).
   (g) Net panel ("tan") length (m).
   (h) Net panel ("tan") height (m).
   (i) Net mesh size (stretched mesh, mm) and mesh type (diamond, square, etc)
   (j) Bottom depth at start of setting (m).
   (k) Bottom depth at end of setting (m).
   (l) Number of net panels for the set.
   (m) Number of net panels retrieved.
   (n) Number of net panels actually observed during the haul.
   (o) Actually observed catch of all species retained on board, split by species, in weight (to the nearest kg).
   (p) An estimation of the amount (numbers or weight) of marine resources discarded, split by species, during the actual observation.
   (q) Record of the actually observed numbers by species of all marine mammals, seabirds or reptiles caught.
   (r) Intended target species.
   (s) Catch of all species retained on board, split by species, in weight (to the nearest kg).

(t) Estimate of the amount (weight or volume) of all marine resources discarded* and dropped off, split by species. * Including those retained for scientific samples.
(u) Record of the numbers by species of all marine mammals, seabirds or reptiles caught (including those discarded and dropped-off).

D. Catch & Effort Data to be collected for Bottom Long Line Fishing Activity

1. Data are to be collected on an un-aggregated (set by set) basis for all observed longline sets.
2. The following fields of data are to be collected for each set:
   (a) Set start date (UTC).
   (b) Set start time (UTC).
   (c) Set end date (UTC).
   (d) Set end time (UTC).
   (e) Set start position (Lat/Lon, 1 minute resolution).
   (f) Set end position (Lat/Lon, 1 minute resolution).
   (g) Total length of longline set (m).
   (h) Number of hooks or traps for the set.
   (i) Bottom (seabed) depth at start of set.
   (j) Bottom (seabed) depth at end of set.
   (k) Number of hooks or traps actually observed during the haul.
   (l) Intended target species.
   (m) Actually observed catch of all species retained on board, split by species, in weight (to the nearest kg).
   (n) An estimation of the amount (numbers or weight) of marine resources discarded* or dropped-off, split by species, during the actual observation. * Including those retained for scientific samples.
   (o) Record of the actually observed numbers by species of all marine mammals, seabirds or reptiles caught (including those discarded and dropped-off).

E. Length-Frequency Data to Be Collected

1. Representative and randomly distributed length-frequency data (to the nearest mm, with record of the type of length measurement taken) are to be collected for representative samples of the target species and other main by-catch species. Total weight of length-frequency samples should be recorded, and observers may be required to also determine sex of measured fish to generate length-frequency data stratified by sex. The length-frequency data may be used as potential indicators of ecosystem changes (for example, see: Gislason, H. et al. (2000. ICES J Mar Sci 57: 468-475), Yamane et al. (2005. ICES J Mar Sci, 62: 374-379), and Shin, Y-J. et al. (2005. ICES J Mar Sci, 62: 384-396)).

2. The numbers of fish to be measured for each species and distribution of samples across area and month strata should be determined, to ensure that samples are properly representative of species distributions and size ranges.

F. Biological sampling to be conducted (optional for gillnet and long line fisheries)

1. The following biological data are to be collected for representative samples of the main target species and, time permitting, for other main by-catch species contributing to the catch:
   (a) Species
   (b) Length (to the nearest mm), with record of the type of length measurement used.
   (c) Length and depth in case of North Pacific armorhead.
   (d) Sex (male, female, indeterminate, not examined)
   (e) Maturity stage (immature, mature, ripe, ripe-running, spent)
2. Representative stratified samples of otoliths are to be collected from the main target species and, time permitting, from other main by-catch species regularly occurring in catches. All otoliths to be collected are to be labelled with the information listed in 1 above, as well as the date, vessel name, observer name and catch position.
3. Where specific trophic relationship projects are being conducted, observers may be requested to also collect stomach samples from certain species. Any such samples collected are also to be labelled with the information listed in 1 above, as well as the date, vessel name, observer name and catch position.
4. Observers may also be required to collect tissue samples as part of specific genetic research programmes implemented by the SC.
5. Observers are to be briefed and provided with written length-frequency and biological sampling protocols and priorities for the above sampling specific to each observer trip.

G. Data to be collected on Incidental Captures of Protected Species

1. Flag members operating observer programs are to develop, in cooperation with the SC, lists and identification guides of protected species or species of concern (seabirds, marine mammals or marine reptiles) to be monitored by observers.
2. The following data are to be collected for all protected species caught in fishing operations:
   (a) Species (identified as far as possible, or accompanied by photographs if identification is difficult).
   (b) Count of the number caught per tow or set.
   (c) Life status (vigorous, alive, lethargic, dead) upon release.
   (d) Whole specimens (where possible) for onshore identification. Where this is not possible, observers may be required to collect sub-samples of identifying parts, as specified in biological sampling protocols.

H. Detection of Fishing in Association with Vulnerable Marine Ecosystems

1. The SC is to develop a guideline, species list and identification guide for benthic species (e.g. sponges, sea fans, corals) whose presence in a catch will indicate that fishing occurred in association with a vulnerable marine ecosystem (VME). All observers on vessels are to be provided with copies of this guideline, species list and ID guide.
2. For each observed fishing operation, the following data are to be collected for all species caught, which appear on the list of vulnerable benthic species:
   (a) Species (identified as far as possible or accompanied by a photograph where identification is difficult).
   (b) An estimate of the quantity (weight (kg) or volume (m^3)) of each listed benthic species caught in the fishing operation.
   (c) An overall estimate of the total quantity (weight (kg) or volume (m^3)) of all invertebrate benthic species caught in the fishing operation.
   (d) Where possible, and particularly for new or scarce benthic species which do not appear in ID guides, whole samples should be collected and suitable preserved for identification on shore.

I. Data to be collected for all Tag Recoveries

1. The following data are to be collected for all recovered fish, seabird, mammal or reptile tags:
   (a) Observer name.
   (b) Vessel name.
   (c) Vessel call sign.
   (d) Vessel flag.
   (e) Collect, label (with all details below) and store the actual tags for later return to the tagging agency.
   (f) Species from which tag recovered.
   (g) Tag colour and type (spaghetti, archival).
   (h) Tag numbers (The tag number is to be provided for all tags when multiple tags were attached to one fish. If only one tag was recorded, a statement is required that specifies whether or not the other tag was missing)
   (i) Date and time of capture (UTC).
   (j) Location of capture (Lat/Lon, to the nearest 1 minute)
   (k) Animal length / size (to the nearest cm) with description of what measurement was taken (such as total length, fork length, etc).
   (l) Sex (F=female, M=male, I=indeterminate, D=not examined)
   (m) Whether the tags were found during a period of fishing that was being observed (Y/N)
   (n) Reward information (e.g. name and address where to send reward)

(It is recognised that some of the data recorded here duplicates data that already exists in the previous categories of information. This is necessary because tag recovery information may be sent separately to other observer data.)

J. Hierarchies for Observer Data Collection

1. Trip-specific or programme-specific observer task priorities may be developed in response to specific research programme requirements, in which case such priorities should be followed by observers.
2. In the absence of trip- or programme-specific priorities, the following generalised priorities should be followed by observers:
   (a) Fishing Operation Information
      - All vessel and tow / set / effort information.

   (b) Monitoring of Catches
      - Record time, proportion of catch (e.g. proportion of trawl landing) or effort (e.g. number of hooks), and total numbers of each species caught.
      - Record numbers or proportions of each species retained or discarded.

   (c) Biological Sampling
      - Length-frequency data for target species.
      - Length-frequency data for main by-catch species.
      - Identification and counts of protected species.
      - Basic biological data (sex, maturity) for target species.
      - Check for presence of tags.
      - Otoliths (and stomach samples, if being collected) for target species.
      - Basic biological data for by-catch species.
      - Biological samples of by-catch species (if being collected)
      - Photos
3. The monitoring of catches and biological sampling procedures should be prioritised among species groups as follows:

Species	**Priority (1 highest)**
Primary target species (such as North Pacific armorhead and splendid alfonsino)	1
Other species typically within top 10 in the fishery (such as mirror dory, and oreos)	2
Protected species	3
All other species	4

The allocation of observer effort among these activities will depend on the type of operation and setting. The size of sub-samples relative to unobserved quantities (e.g. number of hooks/panels examined for species composition relative to the number of hooks/panels retrieved) should be explicitly recorded under the guidance of member country observer programmes.

K. Coding Specifications to be used for Recording Observer Data

1. Unless otherwise specified for specific data types, observer data are to be collected in accordance with the same coding specifications as specified in this Annex.
2. Coordinated Universal Time (UTC) is to be used to describe times.
3. Degrees and minutes are to be used to describe locations.
4. The following coding schemes are to be used:
   (a) Species are to be described using the FAO 3 letter species codes or, if species do not have a FAO code, using scientific names.
   (b) Fishing methods are to be described using the International Standard Classification of Fishing Gear (ISSCFG - 29 July 1980) codes.
   (c) Types of fishing vessel are to be described using the International Standard Classification of Fishery Vessels (ISSCFV) codes.
5. Metric units of measure are to be used, specifically:
   (a) Kilograms are to be used to describe catch weight.
   (b) Metres are to be used to describe height, width, depth, beam or length.
   (c) Cubic metres are to be used to describe volume.
   (d) Kilowatts are to be used to describe engine power.

Annex 6

Implementation of the Adaptive Management for North Pacific armorhead (in 2021)

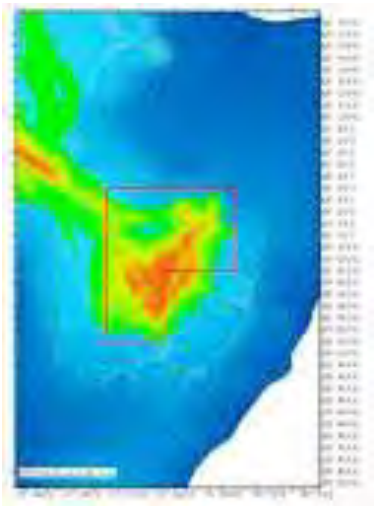
1. Monitoring survey for the detection of strong recruitment of North Pacific armorhead

(1) Location of monitoring surveys

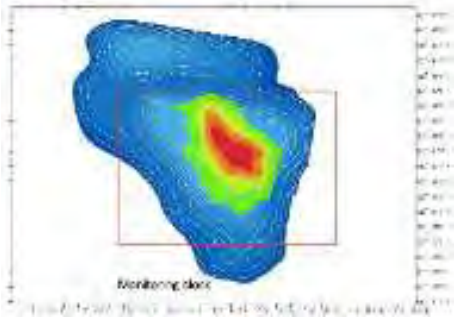
Monitoring surveys for the detection of strong recruitment of North Pacific armorhead will be conducted by trawl fishing vessels in the pre-determined four (24) monitoring blocks of Koko (South eastern), Yuryaku, Kammu (North western) and/or Colahan seamounts.

Monitoring blocks

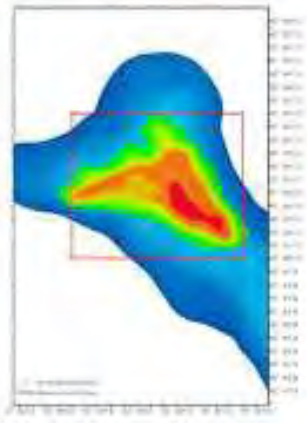
(1) Koko seamount (34°51' –35°04'N, 171°49' –172°00' E)



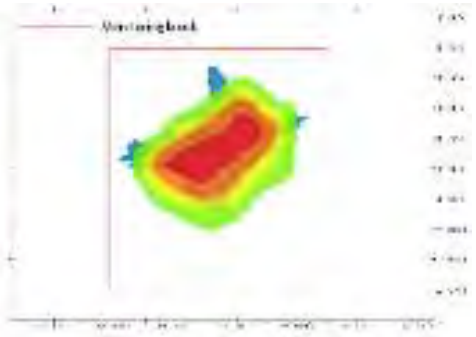
(2) Yuryaku seamount (32°35' –32°45'N, 172°10' –172°24'E)



(3) Kammu seamount (32°10’–32°21’N, 172°44’–172°57’E)



(4) Colahan seamount (30°57’–31°05’N, 175°50’–175°57’E)



(2) Schedule for monitoring surveys

Monitoring surveys will be conducted from March 1st to June 30th each year, with at least a one

week interval between monitoring surveys. For each survey, a trawl fishing vessel will conduct a monitoring survey in one of the four monitoring blocks that is the nearest from the location of the trawl fishing vessel at the time of prior notification in (4) below. The base schedule for monitoring surveys will be notified to the Executive Secretary by the end of February of each year. The base schedule may be revised during the year subject to prior notification to the Executive Secretary.

(3) Data to be collected during monitoring surveys

For each monitoring survey, a trawl net will be towed for one hour. A scientific observer onboard the trawl fishing vessel will calculate nominal-CPUE (kg/hour) of North Pacific armorhead. The scientific observer will also calculate fat index* (FI) of randomly sampled 100 individuals of North Pacific armorhead by measuring fork length (FL) and body height (BH) of each individual.
(*fat index (FI) = body height (BH) / fork length (FL))

(4) Prior notifications and survey results

At least three (3) days before each survey, a prior notification with monitoring date/time, location and trawl fishing vessel name will be provided by the flag state of the trawl fishing vessel to the Executive Secretary.

No later than three (3) days after each survey, the survey result including date/time, location, catch, nominal-CPUE (kg/hour) and percentage of fish with fat index (FI)>0.3 will be provided by the flag state to the Executive Secretary.

The Executive Secretary will circulate these prior notifications and survey results to all Members of the Commission without delay.

1. Areas where bottom fishing with trawl gear is prohibited when high recruitment is detected

(1) Criteria for a high recruitment

It is considered that high recruitment has occurred if the following criteria are met in four (4) consecutive monitoring surveys.

- Nominal CPUE > 10t/h
- Individuals of fat index (FI)> 0.3 account for 80% or more

(2) Areas where bottom fishing with trawl gear is prohibited

Bottom fishing with trawl gear shall be prohibited in the following two (2) seamount areas (*) during the year when high recruitment is detected. In such a case, all monitoring surveys scheduled during the year will be cancelled.

- Northern part of Kammu seamount (north of 32°10.0′ N)
- Yuryaku seamount

(*) The catch of North Pacific armorhead in the above two seamounts accounts for a half of the total catch in the entire Emperor Seamounts area based on the catch records in 2010 and 2012.

(3) Notification by the Secretariat

When the criteria for high recruitment are met as defined in 2(1) above, the Executive Secretary will notify all Members of the Commission of the fact with a defined date/time from which bottom fishing with trawl gear is prohibited in the areas as defined in 2(2) above until the end of the year.

Annex M

Revised CMM 2019-06 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northeastern Pacific Ocean

CMM 2019-06

(Entered into force 29 November 2019)

CONSERVATION AND MANAGEMENT MEASURE FOR BOTTOM FISHERIES AND PROTECTION OF VULNERABLE MARINE ECOSYSTEMS IN THE NORTHEASTERN PACIFIC OCEAN

The North Pacific Fisheries Commission (NPFC):

Seeking to ensure the long term conservation and sustainable use of the fishery resources of the Northeastern Pacific Ocean and, in so doing, protect the vulnerable marine ecosystems that occur there, in accordance with the Sustainable Fisheries Resolutions adopted by the United Nations General Assembly (UNGA) including, in particular, paragraphs 66 to 71 of the UNGA59/25 in 2004, paragraphs 69 to 74 of UNGA60/31 in 2005, paragraphs 69 and 80 to 91 of UNGA61/105 in 2006, and paragraphs 113 to 124 of UNGA64/72 in 2009;

Recalling that paragraph 85 of UNGA 61/105 calls upon participants in negotiations to establish regional fisheries management organizations or arrangements with the competence to regulate bottom fisheries to adopt permanent measures in respect of the area of application of the instruments under negotiation;

Noting that North Pacific Fisheries Commission has previously adopted interim measures for the Northeastern Pacific Ocean;

Conscious of the need to adopt permanent measures for the Northeastern Pacific Ocean to ensure that this area is not left as the only major area of the Pacific Ocean where no such measures are in place;

Hereby adopt the following Conservation and Management Measure (CMM) for bottom fisheries of the Northeastern Pacific Ocean while working to develop and implement other permanent management arrangements to govern these and other fisheries in the North Pacific Ocean.

Scope

1. These Measures are to be applied to all bottom fishing activities throughout the high seas areas of the Northeastern Pacific Ocean, defined, for the purposes of this document, as those

occurring in the Convention Area as set out in Article 4 of the Convention text to the east of the line of 175 degrees W longitude (here in after called "the eastern part of the Convention Area") including all such areas and marine species other than those species already covered by existing international fisheries management instruments, including bilateral agreements and Regional Fisheries Management Organizations or Arrangements.

For the purpose of these Measures, the term vulnerable marine ecosystems is to be interpreted and applied in a manner consistent with the International Guidelines on the Management of Deep Sea Fisheries on the High Seas adopted by the FAO on 29 August 2008 (see Annex 2 for further details).

2. The implementation of these Measures shall:
   a. be based on the best scientific information available in accordance with existing international laws and agreements including UNCLOS and other relevant international instruments,
   b. establish appropriate and effective conservation and management measures,
   c. be in accordance with the precautionary approach, and
   d. incorporate an ecosystem approach to fisheries management.

3. Actions by Members of the Commission
   Members of the Commission will take the following actions in respect of vessels operating under its Flag or authority in the area covered by these Measures:
   a. Conduct the assessments called for in paragraph 83(a) of UNGA Resolution 61/105, in a manner consistent with the FAO Guidelines and the Standards and Criteria included in Annex 2;
   b. Submit to the SC their assessments conducted pursuant to subparagraph (a) of this paragraph, including all relevant data and information in support of any such assessment, and receive advice and recommendations from the SC, in accordance with the procedures in Annex 3;
   c. Taking into account all advice and recommendations received from the SC, determine whether the fishing activity or operations of the vessel in question are likely to have a significant adverse impact on any vulnerable marine ecosystem;
   d. If it is determined that the fishing activity or operations of the vessel or vessels in question would have a significant adverse impact on vulnerable marine ecosystems, adopt conservation and management measures to prevent such impacts on the basis of advice and recommendations of the SC, which are subject to adoption by the Commission;
   e. Ensure that if any vessels are already engaged in bottom fishing, that such assessments have been carried out in accordance with paragraph 119(a)/UNGA RES 2009, the determination

called for in subparagraph (c) of this paragraph has been rendered and, where appropriate, managements measures have been implemented in accordance with the advice and recommendations of the SC, which are subject to adoption by the Commission;

f. Further ensure that they will only authorize fishing activities on the basis of such assessments and any comments and recommendations from the SC;

g. Prohibit its vessels from engaging in directed fishing on the following orders: *Alcyonacea, Antipatharia, Gorgonacea,* and *Scleractinia*, the classes of *Hexactinellida* and *Demospongiae* in the phylum Porifera as well as any other indicator species for vulnerable marine ecosystems as may be identified from time to time by the SC and approved by the Commission;

h. In respect of areas where vulnerable marine ecosystems are known to occur or are likely to occur, based on the best available scientific information, ensure that bottom fishing activities do not proceed unless conservation and management measures have been established to prevent significant adverse impacts on vulnerable marine ecosystems;

i. Limit fishing effort in bottom fisheries on the Eastern part of the Convention Area to the level of a historical average (baseline to be determined through consensus in the SC based on information to be provided by Members) in terms of the number of fishing vessels and other parameters which reflect the level of fishing effort, fishing capacity or potential impacts on marine ecosystems dependent on new SC advice;

j. Further, considering accumulated information regarding fishing activities in the Eastern part of the Convention Area, in areas where, in the course of fishing operations, cold water corals ~~or other indicator species as identified by the SC~~ that exceed 50Kg and 500 kg of *Hexactinellida* and *Demospongiae* are encountered in one gear retrieval, Members of the Commission shall require vessels flying their flag to cease bottom fishing activities in that location. In such cases, the vessel shall not resume fishing activities until it has relocated a sufficient distance, which shall be no less than 1~~2~~ nautical miles, so that additional encounters with VMEs are unlikely. All such encounters, including the location, gear type, date, time and name and weight of the VME indicator species ~~in question~~, shall be reported to the Secretariat, through the Member, within one business day. ~~as soon as possible,~~ The Executive Secretary~~who~~ shall notify the other Members of the Commission and at the same time implement a temporary closure in the area to prohibit its bottom fishing vessels from contacting the sea floor with their trawl nets. ~~so that appropriate measures can be adopted in respect of the relevant site~~. Members shall inform their fleets and enforcement operations within one business day of the receipt of the notification from the Executive Secretary. It is agreed that the VME indicator taxa include cold water corals ~~include:~~ *Alcyonacea, Antipatharia, Gorgonacea*, and *Scleractinia,* and the classes of *Hexactinellida* and *Demospongiae* in the phylum Porifera. ~~as well as any other indicator species for vulnerable marine ecosystems as may be identified from time to time by the SC and approved by the~~

~~Commission.~~

~~j.~~k. Based on all the available data, including data on the VME encounter and distribution received from the fishing vessel(s), research survey data, visual survey data, and/or model results, the Scientific Committee (SC) shall assess and conclude if the area has a VME. If so, the SC shall recommend to the Commission that the temporary closure be made permanent, although the boundary of the closure may be adjusted, or suggest other appropriate measures. Otherwise, the Executive Secretary shall inform the Members that they may reopen the area to their vessels.

4. All assessments and determinations by any Member as to whether fishing activity would have significant adverse impacts on vulnerable marine ecosystems, as well as measures adopted in order to prevent such impacts, will be made publicly available through agreed means.

Control of Bottom Fishing Vessels

5. Members will exercise full and effective control over each of their bottom fishing vessels operating in the high seas of the Northeastern Pacific Ocean, including by means of fishing licenses, authorizations or permits, and maintenance of a record of these vessels as outlined in the Convention and applicable CMM.

6. New and exploratory fishing will be subject to the exploratory fishery protocol included as Annex 1.

Scientific Committee (SC)

7. Scientific Committee will provide scientific support for the implementation of these CMMs.

Scientific Information

8. The Members shall provide all available information as required by the Commission for any current or historical fishing activity by their flag vessels, including the number of vessels by gear type, size of vessels (tons), number of fishing days or days on the fishing grounds, total catch by species, areas fished (names or coordinates of seamounts), and information from scientific observer programmes (see Annexes 4 and 5) to the NPFC Secretariat as soon as possible and no later than one month prior to SC meeting. The Secretariat will make such information available to SC.

9. Scientific research activities for stock assessment purposes are to be conducted in accordance with a research plan that has been provided to SC prior to the commencement of such activities.

Annex 1

EXPLORATORY FISHERY PROTOCOL IN THE NORTH PACIFIC OCEAN

1. From 1 January 2009, all bottom fishing activities in new fishing areas and areas where fishing is prohibited in a precautionary manner or with bottom gear not previously used in the existing fishing areas, are to be considered as "exploratory fisheries" and to be conducted in accordance with this protocol.

2. Precautionary conservation and management measures, including catch and effort controls, are essential during the exploratory phase of deep sea fisheries. Implementation of a precautionary approach to sustainable exploitation of deep sea fisheries shall include the following measures:

i. precautionary effort limits, particularly where reliable assessments of sustainable exploitation rates of target and main by-catch species are not available;
ii. precautionary measures, including precautionary spatial catch limits where appropriate, to prevent serial depletion of low-productivity stocks;
iii. regular review of appropriate indices of stock status and revision downwards of the limits listed above when significant declines are detected;
iv. measures to prevent significant adverse impacts on vulnerable marine ecosystems; and
v. comprehensive monitoring of all fishing effort, capture of all species and interactions with VMEs.

3. When a member of the Commission would like to conduct exploratory fisheries, it is to follow the following procedure:

(1) Prior to the commencement of fishing, the member of the Commission is to circulate the information and assessment in Appendix 1.1 to the members of the Scientific Committee (SC) for review and to all members of the Commission for information, together with the impact assessment. Such information is to be provided to the other members at least 30 days in advance of the meeting at which the information shall be reviewed.

(2) The assessment in (1) above is to be conducted in accordance with the procedure set forth in "Science-based Standards and Criteria for Identification of VMEs and Assessment of Significant Adverse Impacts on VMEs and Marine Species (Annex 2)", with the understanding that particular care shall be taken in the evaluation of risks of the significant adverse impact on vulnerable marine ecosystems (VMEs), in line with the precautionary approach.

(3) The SC is to review the information and the assessment submitted in (1) above in accordance

with “SC Assessment Review Procedures for Bottom Fishing Activities (Annex 3).”

(4) The exploratory fisheries are to be permitted only where the assessment concludes that they would not have significant adverse impacts (SAIs) on marine species or any VMEs and on the basis of comments and recommendations of SC. Any determinations, by any Member of the Commission or the SC, that the exploratory fishing activities would not have SAIs on marine species or any VMEs, shall be made publicly available through the NPFC website.

4. The member of the Commission is to ensure that all vessels flying its flag conducting exploratory fisheries are equipped with a satellite monitoring device and have an observer on board at all times.

5. Within 3 months of the end of the exploratory fishing activities or within 12 months of the commencement of fishing, whichever occurs first, the member of the Commission is to provide a report of the results of such activities to the members of the SC and all members of the Commission. If the SC meets prior to the end of this 12-month period, the member of the Commission is to provide an interim report 30 days in advance of the SC meeting. The information to be included in the report is specified in Appendix 1.2.

6. The SC is to review the report in 5 above and decide whether the exploratory fishing activities had SAIs on marine species or any VME. The SC then is to send its recommendations to the Commission on whether the exploratory fisheries can continue and whether additional management measures shall be required if they are to continue. The Commission is to strive to adopt conservation and management measures to prevent SAIs on marine species or any VMEs. If the Commission is not able to reach consensus on any such measures, each fishing member of the Commission is to adopt measures to avoid any SAIs on VMEs.

7. Members of the Commission shall only authorize continuation of exploratory fishing activity, or commencement of commercial fishing activity, under this protocol on the basis of comments and recommendations of the SC.

8. The same encounter protocol should be applied in both fished and unfished areas specified in Annex 2, paragraph 4(1)(a).

Appendix 1.1

Information to be provided before exploratory fisheries start

1. A harvesting plan
  - Name of vessel

- Flag member of vessel
- Description of area to be fished (location and depth)
- Fishing dates
- Anticipated effort
- Target species
- Bottom fishing gear-type used
- Area and effort restrictions to ensure that fisheries occur on a gradual basis in a limited geographical area.

2. A mitigation plan
- Measures to prevent SAIs to VMEs that may be encountered during the fishery

3. A catch monitoring plan
- Recording/reporting of all species brought onboard to the lowest possible taxonomic level
- 100% satellite monitoring
- 100% observer coverage

4. A data collection plan
- Data is to be collected in accordance with "Type and Format of Scientific Observer Data to be Collected" (Annex 5)

Appendix 1.2

Information to be included in the report

- Name of vessel
- Flag member of vessel
- Description of area fished (location and depth)
- Fishing dates
- Total effort
- Bottom fishing gear-type used
- List of VME encountered (the amount of VME indicator species for each encounter specifying the location: longitude and latitude)
- Mitigation measures taken in response to the encounter of VME
- List of all organisms brought onboard
- List of VMEs indicator species brought onboard by location: longitude and latitude

Annex 2

SCIENCE-BASED STANDARDS AND CRITERIA FOR IDENTIFICATION OF VMES AND ASSESSMENT OF SIGNIFICANT ADVERSE IMPACTS ON VMES AND MARINE SPECIES

1. Introduction

Members of the Commission have hereby established science-based standards and criteria to guide their implementation of United Nations General Assembly (UNGA) Resolution 61/105 and the measures adopted by the Members in respect of bottom fishing activities in the North Pacific Ocean (NPO). In this regard, these science-based standards and criteria are to be applied to identify vulnerable marine ecosystems (VMEs) and assess significant adverse impacts (SAIs) of bottom fishing activities on such VMEs or marine species and to promote the long-term sustainability of deep sea fisheries in the Convention Area. The science-based standards and criteria are consistent with the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas, taking into account the work of other RFMOs implementing management of deep-sea bottom fisheries in accordance with UNGA Resolution 61/105. The standards and criteria are to be modified from time to time as more data are collected through research activities and monitoring of fishing operations.

2. Purpose

(1) The purpose of the standards and criteria is to provide guidelines for each member of the Commission in identifying VMEs and assessing SAIs of individual bottom fishing activities[2] on VMEs or marine species in the Convention Area. Each member of the Commission, using the best information available, is to decide which species or areas are to be categorized as VMEs, identify areas where VMEs are known or likely to occur, and assess whether individual bottom fishing activities would have SAIs on such VMEs or marine species. The results of these tasks are to be submitted to and reviewed by the Scientific Committee with a view to reaching a common understanding among the members of the Commission.

(2) For the purpose of applying the standards and criteria, the bottom fisheries are defined as follows:

[2] "individual bottom fishing activities" means fishing activities by each fishing gear. For example, if ten fishing vessels operate bottom trawl fishing in a certain area, the impacts of the fishing activities of these vessels on the ecosystem are to be assessed as a whole rather than on a vessel-by-vessel basis. It should be noted that if the total number or capacity of the vessels using the same fishing gear has increased, the impacts of the fishing activities are to be assessed again.

(a) The fisheries are conducted in the Convention Area;
(b) The total catch (everything brought up by the fishing gear) includes species that can only sustain low exploitation rates; and
(c) The fishing gear is likely to contact the seafloor during the normal course of fishing operations

3. Definition of VMEs

(1) Although Paragraph 83 of UNGA Resolution 61/105 refers to seamounts, hydrothermal vents and cold water corals as examples of VMEs, there is no definitive list of specific species or areas that are to be regarded as VMEs.

(2) Vulnerability is related to the likelihood that a population, community or habitat will experience substantial alteration by fishing activities and how much time will be required for its recovery from such alteration. The most vulnerable ecosystems are those that are both easily disturbed and are very slow to recover, or may never recover. The vulnerabilities of populations, communities and habitats are to be assessed relative to specific threats. Some features, particularly ones that are physically fragile or inherently rare may be vulnerable to most forms of disturbance, but the vulnerability of some populations, communities and habitats may vary greatly depending on the type of fishing gear used or the kind of disturbance experienced. The risks to a marine ecosystem are determined by its vulnerability, the probability of a threat occurring and the mitigation means applied to the threat. Accordingly, the FAO Guidelines only provide examples of potential vulnerable species groups, communities and habitats as well as features that potentially support them (Annex 2.1).

(3) A marine ecosystem is to be classified as vulnerable based on its characteristics. The following list of characteristics is used as criteria in the identification of VMEs.
(a) Uniqueness or rarity - an area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by other similar areas. These include:
(i) Habitats that contain endemic species;
(ii) Habitats of rare, threatened or endangered species that occur in discrete areas;
(iii) Nurseries or discrete feeding, breeding, or spawning areas
(b) Functional significance of the habitat – discrete areas or habitats that are necessary for the survival, function, spawning/reproduction or recovery of fish stocks, particular life-history stages (e.g. nursery grounds or rearing areas), or of rare, threatened or endangered marine species.
(c) Fragility – an ecosystem that is highly susceptible to degradation by anthropogenic activities

(d) Life-history traits of component species that make recovery difficult – ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics:

(i) Slow growth rates

(ii) Late age of maturity

(iii) Low or unpredictable recruitment

(iv) Long-lived

(e) Structural complexity – an ecosystem that is characterized by complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems. Further, such ecosystems often have high diversity, which is dependent on the structuring organisms.

(4) Management response may vary, depending on the size of the ecological unit in the Convention Area. Therefore, the spatial extent of the ecological unit is to be decided first. For example, whether the ecological unit is a group of seamounts, or an individual seamount in the Convention Area, is to be decided using the above criteria.

4. Identification of potential VMEs

(1) Fished seamounts

(a) Identification of fished seamounts

It is reported that two types of fishing gear are currently used by members of the Commission in the NE area, namely long-line hook and long-line trap. The footprint of the bottom fisheries (fished seamounts) is identified based on the available fishing record. The following seamounts have been identified as fished seamounts at some point in the past: Brown Bear, Cobb, Warwick, Eickelberg, Pathfinder, Miller, Murray, Cowie, Surveyor, Pratt, and Durgin. It is important to establish, to the extent practicable, a time series of where and when these gears have been used in order to assess potential long-term effects on any existing VMEs.

Fishing effort may not be evenly distributed on each seamount since fish aggregation may occur only at certain points of the seamount and some parts of the seamount may be physically unsuitable for certain fishing gears. Thus, it is important to know actual fished areas within the same seamount so as to know the gravity of the impact of fishing activities on the entire seamount.

Due consideration is to be given to the protection of commercial confidentiality when identifying actual fishing grounds.

(b) Assessment on whether a specific seamount that has been fished is a VME

After identifying the fished seamounts or fished areas of seamounts, it is necessary to assess whether each fished seamount is a VME or contains VMEs in accordance with the criteria in 3 above, individually or in combination using the best available scientific and technical information as well as Annex 2.1. A variety of data would be required to conduct such assessment, including pictures of seamounts taken by an ROV camera or drop camera, biological samples collected through research activities and observer programs, and detailed bathymetry map. Where site-specific information is lacking, other information that is relevant to inferring the likely presence of VMEs is to be used. The flow chart to identify data that can be used to identify VMEs is attached in Annex 2.3.

(2) New fishing areas

Any place other than the fished seamounts above is to be regarded as a new fishing area. If a member of the Commission is considering fishing in a new fishing area, such a fishing area is to be subject to, in addition to these standards and criteria, an exploratory fishery protocol (Annex 1).

5. Assessment of SAIs on VMEs or marine species

(1) Significant adverse impacts are those that compromise ecosystem integrity (i.e., ecosystem structure or function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types. Impacts are to be evaluated individually, in combination and cumulatively.

(2) When determining the scale and significance of an impact, the following six factors are to be considered:

(a) The intensity or severity of the impact at the specific site being affected;
(b) The spatial extent of the impact relative to the availability of the habitat type affected;
(c) The sensitivity/vulnerability of the ecosystem to the impact;
(d) The ability of an ecosystem to recover from harm, and the rate of such recovery;
(e) The extent to which ecosystem functions may be altered by the impact; and
(f) The timing and duration of the impact relative to the period in which a species needs the habitat during one or more life-history stages.

(3) Temporary impacts are those that are limited in duration and that allow the particular ecosystem to recover over an acceptable timeframe. Such timeframes are to be decided on a case-by-case basis and be on the order of 5-20 years, taking into account the specific features

of the populations and ecosystems.

(4) In determining whether an impact is temporary, both the duration and the frequency with which an impact is repeated is to be considered. If the interval between the expected disturbances of a habitat is shorter than the recovery time, the impact is to be considered more than temporary.

(5) Each member of the Commission is to conduct assessments to establish if bottom fishing activities are likely to produce SAIs in a given seamount or other VMEs. Such an impact assessment is to address, *inter alia*:

(a) Type of fishing conducted or contemplated, including vessel and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing;

(b) Best available scientific and technical information on the current state of fishery resources, and baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes are to be compared;

(c) Identification, description and mapping of VMEs known or likely to occur in the fishing area;

(d) The data and methods used to identify, describe and assess the impacts of the activity, identification of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment

(e) Identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs and low-productivity fishery resources in the fishing area;

(f) Risk assessment of likely impacts by the fishing operations to determine which impacts are likely to be SAIs, particularly impacts on VMEs and low-productivity fishery resources (Risk assessments are to take into account, as appropriate, differing conditions prevailing in areas where fisheries are well established and in areas where fisheries have not taken place or only occur occasionally);

(g) The proposed mitigation and management measures to be used to prevent SAIs on VMEs and ensure long-term conservation and sustainable utilization of low-productivity fishery resources, and the measures to be used to monitor effects of the fishing operations.

(6) Impact assessments are to consider, as appropriate, the information referred to in these Standards and Criteria, as well as relevant information from similar or related fisheries, species and ecosystems.

(7) Where an assessment concludes that the area does not contain VMEs or that significant adverse impacts on VMEs or marine species are not likely, such assessments are to be repeated

when there have been significant changes to the fishery or other activities in the area, or when natural processes are thought to have undergone significant changes.

6. Proposed conservation and management measures to prevent SAIs

As a result of the assessment in 5 above, if it is considered that individual fishing activities are causing or likely to cause SAIs on VMEs or marine species, the member of the Commission is to adopt appropriate conservation and management measures to prevent such SAIs. The member of the Commission is to clearly indicate how such impacts are expected to be prevented or mitigated by the measures.

7. Precautionary approach

If after assessing all available scientific and technical information, the presence of VMEs or the likelihood that individual bottom fishing activities would cause SAIs on VMEs or marine species cannot be adequately determined, members of the Commission are only to authorize individual bottom fishing activities to proceed in accordance with:

(a) Precautionary, conservation and management measures to prevent SAIs;

(b) Measures to address unexpected encounters with VMEs in the course of fishing operations;

(c) Measures, including ongoing scientific research, monitoring and data collection, to reduce the uncertainty; and

(d) Measures to ensure long-term sustainability of deep sea fisheries.

8. Template for assessment report

Annex 2.2 is a template for individual member of the Commission to formulate reports on identification of VMEs and impact assessment.

ANNEX 2.1

EXAMPLES OF POTENTIAL VULNERABLE SPECIES GROUPS, COMMUNITIES AND HABITATS AS WELL AS FEATURES THAT POTENTIALLY SUPPORT THEM

The following examples of species groups, communities, habitats and features often display characteristics consistent with possible VMEs. Merely detecting the presence of an element itself is not sufficient to identify a VME. That identification is to be made on a case-by-case basis through application of relevant provisions of the Standards and Criteria, particularly Sections 3, 4 and 5.

Examples of species groups, communities and habitat forming species that are documented or considered sensitive and potentially vulnerable to deep-sea fisheries in the high-seas, and which

may contribute to forming VMEs:	
a.	certain coldwater corals, e.g., reef builders and coral forest including: stony corals (scleractinia), alcyonaceans and gorgonians (octocorallia), black corals (antipatharia), and hydrocorals (stylasteridae),
b.	Some types of sponge dominated communities,
c.	communities composed of dense emergent fauna where large sessile protozoans (xenophyophores) and invertebrates (e.g., hydroids and bryozoans) form an important structural component of habitat, and
d.	seep and vent communities comprised of invertebrate and microbial species found nowhere else (i.e., endemic).

Examples of topographical, hydrophysical or geological features, including fragile geological structures, that potentially support the species groups or communities, referred to above:	
a.	submerged edges and slopes (e.g., corals and sponges),
b.	summits and flanks of seamounts, guyots, banks, knolls, and hills (e.g., corals, sponges, xenophyphores),
c.	canyons and trenches (e.g., burrowed clay outcrops, corals),
d.	hydrothermal vents (e.g., microbial communities and endemic invertebrates), and
e.	cold seeps (e.g., mud volcanoes, microbes, hard substrates for sessile invertebrates).

ANNEX 2.2

TEMPLATE FOR REPORTS ON IDENTIFICATION OF VMEs AND ASSESSMENT OF IMPACTS CAUSED BY INDIVIDUAL FISHING ACTIVITIES ON VMEs OR MARINE SPECIES

1. Name of the member of the Commission
2. Name of the fishery (e.g., bottom trawl, bottom gillnet, bottom longline, pot)
3. Status of the fishery (existing fishery or exploratory fishery)
4. Target species
5. Bycatch species
6. Recent level of fishing effort (every year at least since 2002)
   (1) Number of fishing vessels
   (2) Tonnage of each fishing vessel
   (3) Number of fishing days or days on the fishing ground
   (4) Fishing effort (total operating hours for trawl, # of hooks per day for long-line, # of pots per

day for pot, total length of net per day for gillnet)

(5) Total catch by species

(6) Names of seamounts fished or to be fished

7. Fishing period
8. Analysis of status of fishery resources

(1) Data and methods used for analysis

(2) Results of analysis

(3) Identification of uncertainties in data and methods, and measures to overcome such uncertainties

9. Analysis of status of bycatch species resources

(1) Data and methods used for analysis

(2) Results of analysis

(3) Identification of uncertainties in data and methods, and measures to overcome such uncertainties

10. Analysis of existence of VMEs in the fishing ground

(1) Data and methods used for analysis

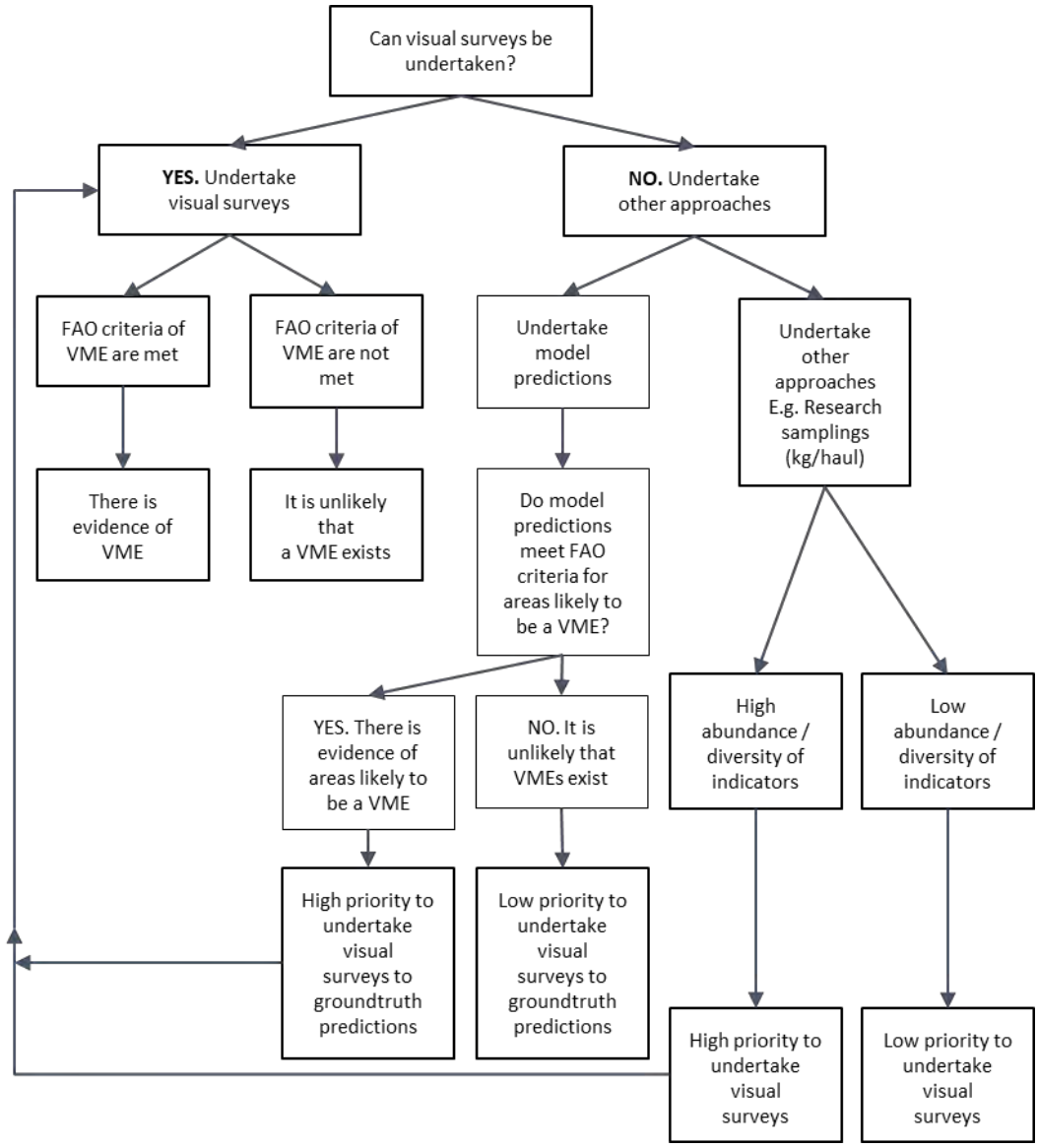
(2) Results of analysis

(3) Identification of uncertainties in data and methods, and measures to overcome such uncertainties

11. Impact assessment of fishing activities on VMEs or marine species including cumulative impacts, and identification of SAIs on VMEs or marine species, as detailed in Section 5 above, Assessment of SAIs on VMEs or marine species
12. Other points to be addressed
13. Conclusion (whether to continue or start fishing with what measures, or stop fishing).

Annex 2.3

Flow chart to identify data that can be used to identify VMEs in the NPFC Convention Area



Annex 3

SCIENTIFIC COMMITTEE ASSESSMENT REVIEW PROCEDURES FOR BOTTOM FISHING ACTIVITIES

1. The Scientific Committee (SC) is to review identifications of vulnerable marine ecosystems (VMEs) and assessments of significant adverse impact on VMEs, including proposed management measures intended to prevent such impacts submitted by individual Members.

2. Members of the Commission shall submit their identifications and assessments to members of the SC at least 21 days prior to the SC meeting at which the review is to take place. Such submissions shall include all relevant data and information in support of such determinations.

3. The SC will review the data and information in each assessment in accordance with the Science-based Standards and Criteria for Identification of VMEs and Assessment of Significant Adverse Impacts on VMEs and Marine Species (Annex 2), previous decisions of the Commission, and the FAO Technical Guidelines for the Management of Deep Sea Fisheries in the High Seas, paying special attention to the assessment process and criteria specified in paragraphs 47-49 of the Guidelines.

4. In conducting the review above, the SC will give particular attention to whether the deep-sea bottom fishing activity would have a significant adverse impact on VMEs and marine species and, if so, whether the proposed management measures would prevent such impacts.

5. Based on the above review, the SC will provide advice and recommendations to the submitting Members on the extent to which the assessments and related determinations are consistent with the procedures and criteria established in the documents identified above; and whether additional management measures will be required to prevent SAIs on VMEs.

6. Such recommendations will be reflected in the report of the SC meeting at which the assessments are considered.

Annex 4

FORMAT OF NATIONAL REPORT SECTIONS ON DEVELOPMENT AND IMPLEMENTATION OF SCIENTIFIC OBSERVER PROGRAMMES

Report Components

Annual Observer Programme implementation reports should form a component of annual National Reports submitted by members to the Scientific Committee. These reports should provide a brief overview of observer programmes conducted in the NPFC Convention Area. Observer programme reports should include the following sections:

A. Observer Training

An overview of observer training conducted, including:

- Overview of training programme provided to scientific observers.
- Number of observers trained.

B. Scientific Observer Programme Design and Coverage

Details of the design of the observer programme, including:

- Which fleets, fleet components or fishery components were covered by the programme.
- How vessels were selected to carry observers within the above fleets or components.
- How was observer coverage stratified: by fleets, fisheries components, vessel types, vessel sizes, vessel ages, fishing areas and seasons.

Details of observer coverage of the above fleets, including:

- Components, areas, seasons and proportion of total catches of target species, specifying units used to determine coverage.
- Total number of observer employment days, and number of actual days deployed on observation work.

C. Observer Data Collected

List of observer data collected against the agreed range of data set out in Annex 5, including:

- Effort Data: Amount of effort observed (vessel days, net panels, hooks, etc), by area and season and % observed out of total by area and seasons

- Catch Data: Amount of catch observed of target and by-catch species, by area and season, and % observed out of total estimated catch by species, area and seasons
- Length Frequency Data: Number of fish measured per species, by area and season.
- Biological Data: Type and quantity of other biological data or samples (otoliths, sex, maturity, etc) collected per species.
- The size of length-frequency and biological sub-samples relative to unobserved quantities.

D. Detection of Fishing in Association with Vulnerable Marine Ecosystems

- Information about VME encounters (species and quantity in accordance with Annex 5, H, 2).

E. Tag Return Monitoring

- Number of tags returns observed, by fish size class and area.

F. Problems Experienced

- Summary of problems encountered by observers and observer managers that could affect the NPFC Observer Programme Standards and/or each member's national observer programme developed under the NPFC standards.

Annex 5

NPFC BOTTOM FISHERIES
OBSERVER PROGRAMME STANDARDS: SCIENTIFIC COMPONENT

TYPE AND FORMAT OF SCIENTIFIC OBSERVER DATA TO BE COLLECTED

A. Vessel & Observer Data to be collected for Each Trip

1. Vessel and observer details are to be recorded only once for each observed trip.

2. The following observer data are to be collected for each observed trip:
   a) NPFC vessel ID
   b) Observer's name.
   c) Observer's organisation.
   d) Date observer embarked (UTC date).
   e) Port of embarkation.
   f) Date observer disembarked (UTC date).
   g) Port of disembarkation.

B. Catch & Effort Data to be collected for Trawl Fishing Activity

1. Data are to be collected on an un-aggregated (tow by tow) basis for all observed trawls.

2. The following data are to be collected for each observed trawl tow:
   a) Tow start date (UTC).
   b) Tow start time (UTC).
   c) Tow end date (UTC).
   d) Tow end time (UTC).
   e) Tow start position (Lat/Lon, 1 minute resolution).
   f) Tow end position (Lat/Lon, 1 minute resolution).
   g) Type of trawl, bottom or mid-water.
   h) Type of trawl, single, double or triple.
   i) Height of net opening (m).
   j) Width of net opening (m).
   k) Mesh size of the cod-end net (stretched mesh, mm) and mesh type (diamond, square, etc).
   l) Gear depth (of footrope) at start of fishing (m).
   m) Bottom (seabed) depth at start of fishing (m).

n) Gear depth (of footrope) at end of fishing (m).
o) Bottom (seabed) depth at end of fishing (m).
p) Status of the trawl operation (no damage, lightly damaged*, heavily damaged*, other (specify)). *Degree may be evaluated by time for repairing (<=1hr or >1hr)
q) Duration of estimated period of seabed contact (minute)
r) Intended target species.
s) Catch of all species retained on board, split by species, in weight (to the nearest kg).
t) Estimate of the amount (weight or volume) of all living marine resources discarded, split by species.
u) Record of the numbers by species of all marine mammals, seabirds or reptiles caught.

C. Catch & Effort Data to be collected for Bottom Gillnet Fishing Activity

1. Data are to be collected on an un-aggregated (set by set) basis for all observed bottom gillnet sets.

2. The following data are to be collected for each observed bottom gillnet set:
   a) Set start date (UTC).
   b) Set start time (UTC).
   c) Set end date (UTC).
   d) Set end time (UTC).
   e) Set start position (Lat/Lon, 1 minute resolution).
   f) Set end position (Lat/Lon, 1 minute resolution).
   g) Net panel ("tan") length (m).
   h) Net panel ("tan") height (m).
   i) Net mesh size (stretched mesh, mm) and mesh type (diamond, square, etc)
   j) Bottom depth at start of setting (m).
   k) Bottom depth at end of setting (m).
   l) Number of net panels for the set.
   m) Number of net panels retrieved.
   n) Number of net panels actually observed during the haul.
   o) Actually observed catch of all species retained on board, split by species, in weight (to the nearest kg).
   p) An estimation of the amount (numbers or weight) of marine resources discarded, split by species, during the actual observation.
   q) Record of the actually observed numbers by species of all marine mammals, seabirds or reptiles caught.

r) Intended target species.
s) Catch of all species retained on board, split by species, in weight (to the nearest kg).
t) Estimate of the amount (weight or volume) of all marine resources discarded* and dropped-off, split by species. * Including those retained for scientific samples.
u) Record of the numbers by species of all marine mammals, seabirds or reptiles caught (including those discarded and dropped-off).

D. Catch & Effort Data to be collected for Bottom Long Line Fishing Activity

1. Data are to be collected on an un-aggregated (set by set) basis for all observed longline sets.

2. The following fields of data are to be collected for each set:
   a) Set start date (UTC).
   b) Set start time (UTC).
   c) Set end date (UTC).
   d) Set end time (UTC).
   e) Set start position (Lat/Lon, 1 minute resolution).
   f) Set end position (Lat/Lon, 1 minute resolution).
   g) Total length of longline set (m).
   h) Number of hooks or traps for the set.
   i) Bottom (seabed) depth at start of set.
   j) Bottom (seabed) depth at end of set.
   k) Number of hooks or traps actually observed during the haul.
   l) Intended target species.
   m) Actually observed catch of all species retained on board, split by species, in weight (to the nearest kg).
   n) An estimation of the amount (numbers or weight) of marine resources discarded* or dropped-off, split by species, during the actual observation. * Including those retained for scientific samples.
   o) Record of the actually observed numbers by species of all marine mammals, seabirds or reptiles caught (including those discarded and dropped-off).

E. Length-Frequency Data to Be Collected

1. Representative and randomly distributed length-frequency data (to the nearest mm, with record of the type of length measurement taken) are to be collected for representative samples of the target species and other main by-catch species. Total weight of length-frequency samples should be recorded, and observers may be required to also determine sex of measured fish to

generate length-frequency data stratified by sex. The length-frequency data may be used as potential indicators of ecosystem changes (for example, see: Gislason, H. et al. (2000. ICES J Mar Sci 57: 468-475), Yamane et al. (2005. ICES J Mar Sci, 62: 374-379), and Shin, Y-J. et al. (2005. ICES J Mar Sci, 62: 384-396)).

2. The numbers of fish to be measured for each species and distribution of samples across area and month strata should be determined, to ensure that samples are properly representative of species distributions and size ranges.

F. Biological sampling to be conducted (optional for gillnet and long line fisheries)

1. The following biological data are to be collected for representative samples of the main target species and, time permitting, for other main by-catch species contributing to the catch:
   a) Species
   b) Length (to the nearest mm), with record of the type of length measurement used.
   c) Length and depth in case of North Pacific armorhead.
   d) Sex (male, female, indeterminate, not examined)
   e) Maturity stage (immature, mature, ripe, ripe-running, spent)

2. Representative stratified samples of otoliths are to be collected from the main target species and, time permitting, from other main by-catch species regularly occurring in catches. All otoliths to be collected are to be labelled with the information listed in 1 above, as well as the date, vessel name, observer name and catch position.

3. Where specific trophic relationship projects are being conducted, observers may be requested to also collect stomach samples from certain species. Any such samples collected are also to be labelled with the information listed in 1 above, as well as the date, vessel name, observer name and catch position.

4. Observers may also be required to collect tissue samples as part of specific genetic research programmes implemented by the SC.

5. Observers are to be briefed and provided with written length-frequency and biological sampling protocols and priorities for the above sampling specific to each observer trip.

G. Data to be collected on Incidental Captures of Protected Species

1. Flag members operating observer programs are to develop, in cooperation with the SC, lists and identification guides of protected species or species of concern (seabirds, marine mammals or marine reptiles) to be monitored by observers.

2. The following data are to be collected for all protected species caught in fishing operations:
   a) Species (identified as far as possible, or accompanied by photographs if identification is difficult).
   b) Count of the number caught per tow or set.
   c) Life status (vigorous, alive, lethargic, dead) upon release.
   d) Whole specimens (where possible) for onshore identification. Where this is not possible, observers may be required to collect sub-samples of identifying parts, as specified in biological sampling protocols.

H. Detection of Fishing in Association with Vulnerable Marine Ecosystems

1. The SC is to develop a guideline, species list and identification guide for benthic species (e.g. sponges, sea fans, corals) whose presence in a catch will indicate that fishing occurred in association with a vulnerable marine ecosystem (VME). All observers on vessels are to be provided with copies of this guideline, species list and ID guide.

2. For each observed fishing operation, the following data are to be collected for all species caught, which appear on the list of vulnerable benthic species:
   a) Species (identified as far as possible, or accompanied by a photograph where identification is difficult).
   b) An estimate of the quantity (weight (kg) or volume (m^3)) of each listed benthic species caught in the fishing operation.
   c) An overall estimate of the total quantity (weight (kg) or volume (m^3)) of all invertebrate benthic species caught in the fishing operation.
   d) Where possible, and particularly for new or scarce benthic species which do not appear in ID guides, whole samples should be collected and suitable preserved for identification on shore.

I. Data to be collected for all Tag Recoveries

1. The following data are to be collected for all recovered fish, seabird, mammal or reptile tags:
   a) Observer name.
   b) Vessel name.
   c) Vessel call sign.

d) Vessel flag.
e) Collect, label (with all details below) and store the actual tags for later return to the tagging agency.
f) Species from which tag recovered.
g) Tag colour and type (spaghetti, archival).
h) Tag numbers (The tag number is to be provided for all tags when multiple tags were attached to one fish. If only one tag was recorded, a statement is required that specifies whether or not the other tag was missing)
i) Date and time of capture (UTC).
j) Location of capture (Lat/Lon, to the nearest 1 minute)
k) Animal length / size (to the nearest cm) with description of what measurement was taken (such as total length, fork length, etc).
l) Sex (F=female, M=male, I=indeterminate, D=not examined)
m) Whether the tags were found during a period of fishing that was being observed (Y/N)
n) Reward information (e.g. name and address where to send reward)

(It is recognised that some of the data recorded here duplicates data that already exists in the previous categories of information. This is necessary because tag recovery information may be sent separately to other observer data.)

J. Hierarchies for Observer Data Collection

2. Trip-specific or programme-specific observer task priorities may be developed in response to specific research programme requirements, in which case such priorities should be followed by observers.

3. In the absence of trip- or programme-specific priorities, the following generalised priorities should be followed by observers:

a) Fishing Operation Information
- All vessel and tow / set / effort information.

b) Monitoring of Catches
- Record time, proportion of catch (e.g. proportion of trawl landing) or effort (e.g. number of hooks), and total numbers of each species caught.
- Record numbers or proportions of each species retained or discarded.

c) Biological Sampling

- Length-frequency data for target species.
- Length-frequency data for main by-catch species.
- Identification and counts of protected species.
- Basic biological data (sex, maturity) for target species.
- Check for presence of tags.
- Otoliths (and stomach samples, if being collected) for target species.
- Basic biological data for by-catch species.
- Biological samples of by-catch species (if being collected)
- Photos

4. The monitoring of catches and biological sampling procedures should be prioritised among species groups as follows:

Species	**Priority (1 highest)**
Primary target species (such as North Pacific armorhead and splendid alfonsino)	1
Other species typically within top 10 in the fishery (such as mirror dory, and oreos)	2
Protected species	3
All other species	4

The allocation of observer effort among these activities will depend on the type of operation and setting. The size of sub-samples relative to unobserved quantities (e.g. number of hooks/panels examined for species composition relative to the number of hooks/panels retrieved) should be explicitly recorded under the guidance of member country observer programmes.

K. Coding Specifications to be used for Recording Observer Data

1. Unless otherwise specified for specific data types, observer data are to be collected in accordance with the same coding specifications as specified in this Annex.

2. Coordinated Universal Time (UTC) is to be used to describe times.

3. Degrees and minutes are to be used to describe locations.

4. The following coding schemes are to be used:

a. Species are to be described using the FAO 3 letter species codes or, if species do not have a FAO code, using scientific names.
b. Fishing methods are to be described using the International Standard Classification of Fishing Gear (ISSCFG - 29 July 1980) codes.
c. Types of fishing vessel are to be described using the International Standard Classification of Fishery Vessels (ISSCFV) codes.

5. Metric units of measure are to be used, specifically:
    a. Kilograms are to be used to describe catch weight.
    b. Metres are to be used to describe height, width, depth, beam or length.
    c. Cubic metres are to be used to describe volume.
    d. Kilowatts are to be used to describe engine power.

Annex N

Stock Assessment Report for Pacific Saury

Abstract:
This report presents the results of stock assessment of Pacific saury updated at the 10th Small Scientific Committee on Pacific saury meeting held virtually during December 12-15, 2022.

EXECUTIVE SUMMARY

Data used in the assessment modeling

Pacific saury (*Cololabis saira*) is widely distributed from the subarctic to the subtropical regions of the North Pacific Ocean. The fishing grounds are west of 180° E but differ among Members (China, Japan, Korea, Russia, Chinese Taipei, and Vanuatu). Figure 1 shows the historical catches of Pacific saury by Member. Figure 2 shows CPUE and Japanese survey biomass indices used in the stock assessment. Appendix 1 shows data used for the updated stock assessment.

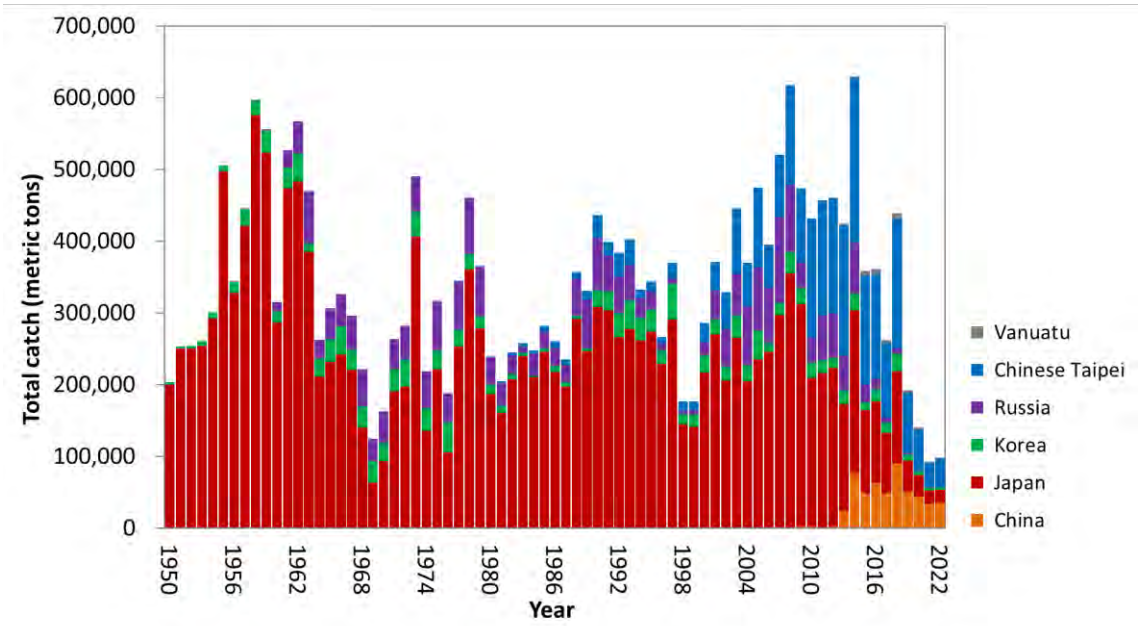


Figure 1. Time series of catch by Member during 1950-2022. The catch data for 1950-1979 are shown but not used in stock assessment modeling. Catch data in 2022 are preliminary (as of 17 December 2022) and not used in the assessment.

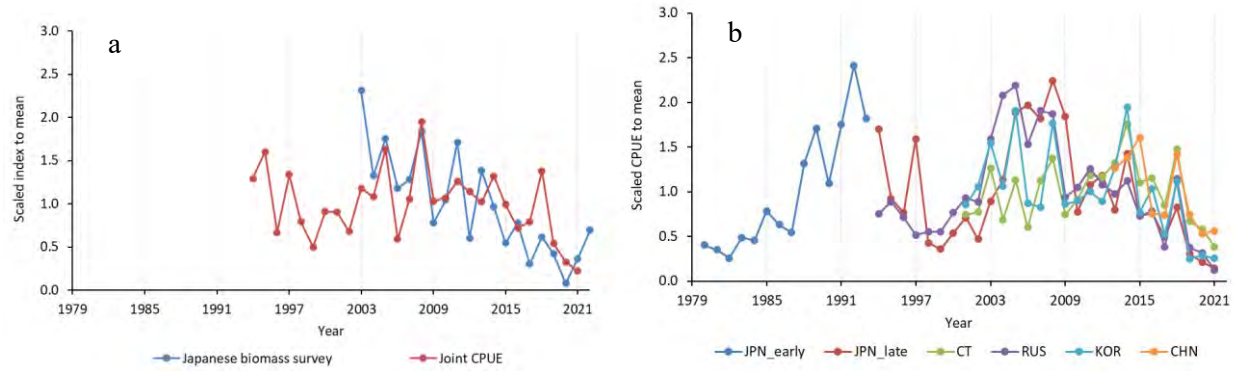


Figure 2. Time series of (a) Japanese survey biomass index and joint CPUE and (b) Member's standardized CPUE indices used in the assessment modeling.

Brief description of specification of analysis and models

A Bayesian state-space production model (BSSPM) used in previous stock assessments was employed as an agreed provisional stock assessment model for Pacific saury during 1980-2022. Scientists from three Members (China, Japan and Chinese Taipei) each conducted analyses following the agreed specification which called for two base case scenarios and two sensitivity scenarios (see Annex F, SSC PS09 report for more details). The two base case scenarios differ in using each Member's standardized CPUEs (base case B1) or standardized joint CPUEs (base case B2). For the two sensitivity cases with Japanese early CPUE (1980-1994), time-varying catchability was assumed to account for potential increases in catchability. A higher weight was given to the Japanese biomass survey estimates than to Members' CPUEs in B1 while comparable weights were given to the Japanese biomass survey estimates and the joint CPUEs in B2. The CPUE data were modeled as nonlinear indices of biomass. Members used similar approaches with some differences in the assumption of the time-varying catchability and prior distributions for the free parameters in the model.

Summary of stock assessment results

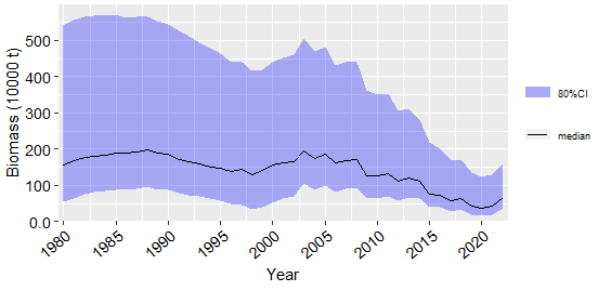
The SSC PS considered the BSSPM results and noted the agreement in trends among Members' results for each base case model. However, there was a marked difference in the biomass level between B1 and B2 due to the different CPUE trends used. The SSC PS discussed and recognized that the results covered a wide range of uncertainties in data, model and estimation, and it therefore concluded the outcomes of MCMC runs could be aggregated over the 6 models (2 base case models x 3 Members) as in the previous assessments. The aggregated results for assessing the overall median values and their associated 80% credible intervals are shown in Table 1. The graphical presentations for times series of a) biomass (B), b) B-ratio (=B/B_{MSY}), c) harvest rate (F), d) F-ratio (F/F_{MSY}) and e) B/K are shown in Figure 3. The Kobe plot with time trajectory using aggregated model outcomes is shown in Figure 4. Time series of median estimated values for biomass, harvest rate, B-ratio, F-ratio and depletion level relative to K are shown in Table 2.

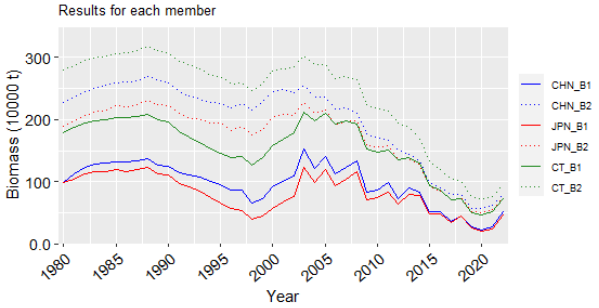
Table 1. Summary of estimates of reference quantities. Median and credible interval for the aggregated results are presented. In addition, median values of Member's combined results (over B1 and B2) are shown.

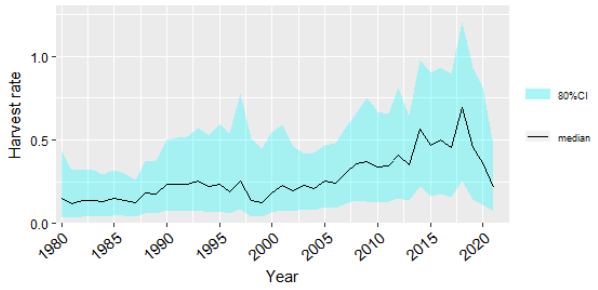
	Median	Lower10%	Upper10%	Median_CHN	Median_JPN	Median_CT
C_2021 (10000 t)	9.221	9.221	9.221	9.221	9.221	9.221
AveC_2019_2021 (10000 t)	14.141	14.141	14.141	14.141	14.141	14.141
AveF_2019_2021	0.350	0.111	0.733	0.402	0.456	0.238
F_2021	0.213	0.071	0.467	0.241	0.287	0.149
FMSY	0.313	0.084	0.619	0.363	0.407	0.206
MSY	40.281	29.911	51.100	41.316	40.649	38.850
F_2021/FMSY	0.739	0.452	1.259	0.729	0.740	0.751
AveF_2019_2021/FMSY	1.192	0.757	1.883	1.203	1.169	1.211
K (10000 t)	281.400	142.200	919.083	249.200	224.579	398.200
B_2021 (10000 t)	43.260	19.750	129.400	38.260	32.149	61.950
B_2022 (10000 t)	65.500	36.900	162.000	62.190	56.264	82.035
AveB_2020_2022 (10000 t)	49.147	25.386	138.103	44.845	39.111	66.877
BMSY (10000 t)	131.800	70.360	409.910	118.800	104.432	186.400
BMSY/K	0.469	0.386	0.621	0.465	0.460	0.503
B_2021/K	0.151	0.088	0.240	0.149	0.147	0.159
B_2022/K	0.237	0.122	0.385	0.243	0.251	0.216
AveB_2020_2022/K	0.177	0.103	0.270	0.176	0.179	0.175
B_2021/BMSY	0.315	0.198	0.499	0.310	0.311	0.327
B_2022/BMSY	0.494	0.272	0.810	0.499	0.532	0.447
AveB_2020_2022/BMSY	0.368	0.232	0.564	0.364	0.377	0.360

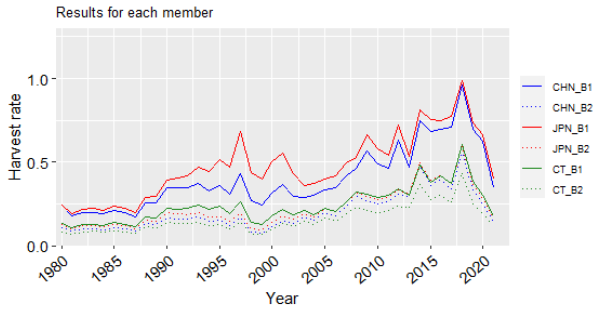
Table 2. Time series of median estimated values for biomass, harvest rate, B-ratio, F-ratio and depletion level relative to K. The unit of biomass is 10,000 tons.

Year	Biomass	HarvestRate	Bratio	Fratio	Depletion
1980	157.678	0.151	1.197	0.524	0.571
1981	167.400	0.122	1.291	0.415	0.614
1982	177.300	0.138	1.376	0.461	0.658
1983	181.800	0.142	1.409	0.473	0.676
1984	184.700	0.134	1.422	0.447	0.683
1985	188.600	0.149	1.447	0.498	0.695
1986	188.600	0.138	1.436	0.464	0.691
1987	191.800	0.123	1.450	0.414	0.698
1988	197.056	0.181	1.481	0.613	0.714
1989	188.700	0.175	1.397	0.602	0.676
1990	185.474	0.235	1.379	0.805	0.664
1991	171.300	0.233	1.274	0.803	0.613
1992	164.900	0.233	1.230	0.807	0.590
1993	159.400	0.252	1.194	0.879	0.569
1994	151.300	0.220	1.137	0.774	0.536
1995	147.519	0.233	1.100	0.838	0.516
1996	138.900	0.192	1.022	0.704	0.478
1997	143.700	0.258	1.026	0.978	0.479
1998	129.800	0.136	0.914	0.526	0.427
1999	141.000	0.125	0.970	0.493	0.453
2000	157.200	0.182	1.099	0.699	0.513
2001	161.700	0.229	1.165	0.838	0.548
2002	165.100	0.199	1.213	0.703	0.575
2003	196.220	0.227	1.452	0.768	0.703
2004	174.200	0.212	1.287	0.720	0.622
2005	187.100	0.253	1.367	0.869	0.663
2006	161.752	0.244	1.194	0.829	0.575
2007	169.900	0.306	1.253	1.037	0.606
2008	172.155	0.359	1.236	1.248	0.604
2009	127.900	0.369	0.939	1.262	0.451
2010	127.100	0.338	0.924	1.167	0.447
2011	133.195	0.343	0.948	1.206	0.463
2012	112.500	0.409	0.828	1.392	0.398
2013	119.329	0.355	0.866	1.219	0.424
2014	111.200	0.566	0.821	1.889	0.403
2015	76.535	0.469	0.563	1.589	0.275
2016	72.586	0.498	0.528	1.704	0.260
2017	57.634	0.456	0.429	1.538	0.206
2018	63.360	0.693	0.469	2.295	0.230
2019	42.200	0.456	0.310	1.562	0.151
2020	38.040	0.367	0.279	1.271	0.134
2021	43.260	0.213	0.315	0.739	0.151
2022	65.500		0.494		0.237


Biomass (10000 t)
500
400
300
200
100
0.0
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
80%CI
median


Results for each member
Biomass (10000 t)
300
200
100
0.0
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
CHN_B1
CHN_B2
JPN_B1
JPN_B2
CT_B1
CT_B2


Harvest rate
1.0
0.5
0.0
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
80%CI
median


Results for each member
Harvest rate
1.0
0.5
0.0
1980
1985
1990
1995
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2020
Year
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JPN_B1
JPN_B2
CT_B1
CT_B2

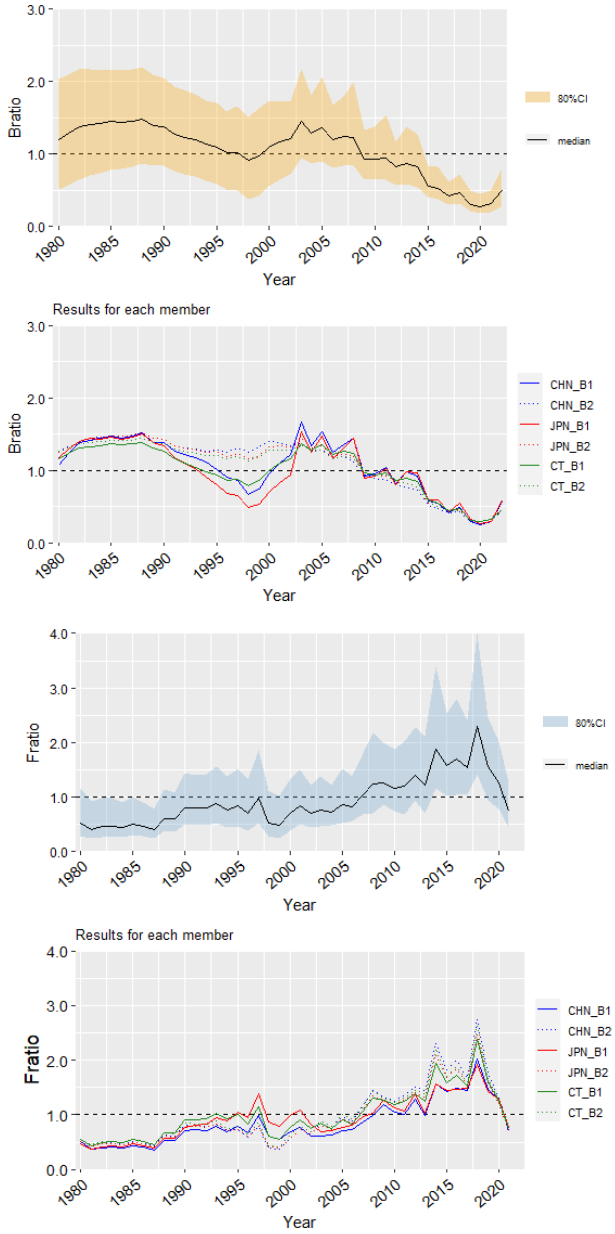


Figure 3. Time series of median estimated values of six runs for biomass, harvest rate, B-ratio, F-ratio and depletion level relative to K. The solid and shaded lines correspond to B1 and B2, respectively.

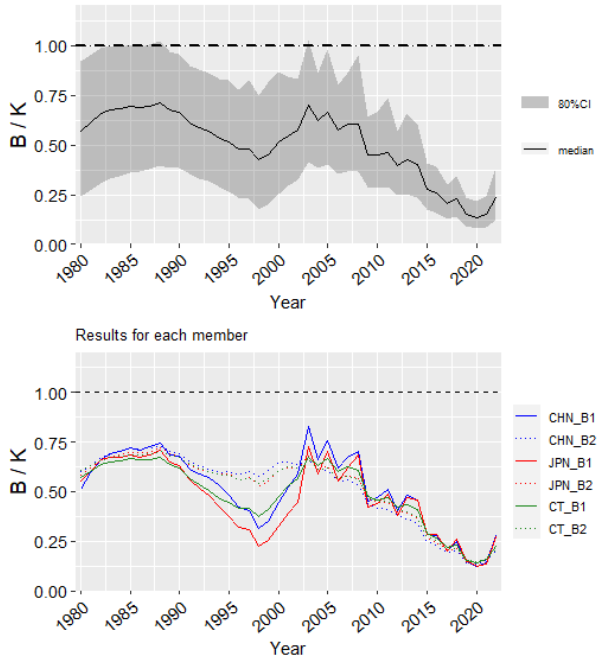


Figure 3 (Continued).

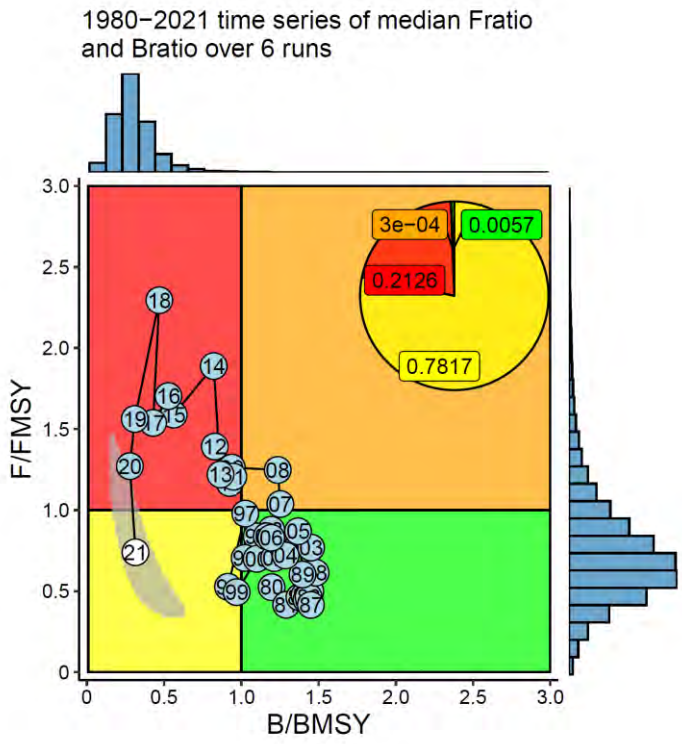


Figure 4. Kobe plot with time trajectory. The data are aggregated across 6 model results (2 base-case models by 3 Members).

Current stock condition and management advice

Summary of stock status

Results of combined model estimates indicate that the stock declined with an interannual variability from near carrying capacity in the mid-2000's after a period of high productivity to current low levels. The results also indicated that B was below B_{MSY} (median average B/B_{MSY} during 2020-2022 = 0.368, 80%CI=0.232-0.564) and F was above F_{MSY} (average F/F_{MSY} during 2019-2021 = 1.192, 80%CI= 0.757-1.883). The results further indicated that recent stock biomass remains at a historically low level in recent years. The biomass trend shows a small increase in recent years through 2021 and a marked increase in the Japanese biomass survey between 2021 and 2022. The harvest rate has also been declining from a peak in 2018 and was less than F_{MSY} during 2021. However, caution is required in interpreting these results, given historically low nominal CPUEs (see Fig. 5) through 2022, relatively high fishing effort in 2021, and variability inherent in fisheries-independent surveys.

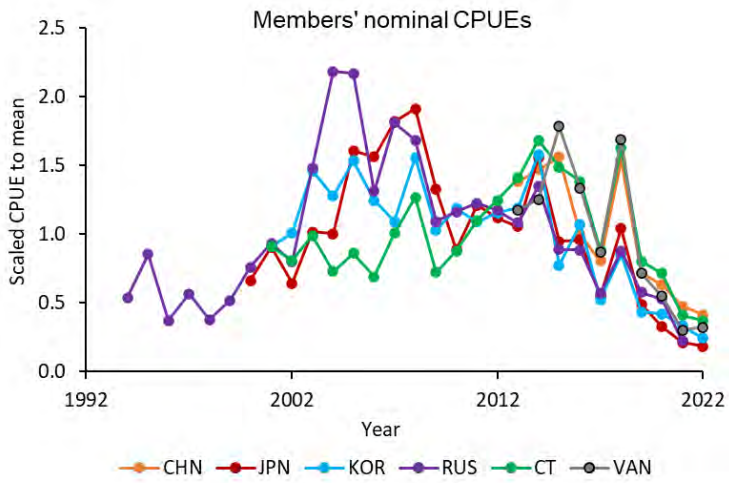


Figure 5. Time series of Member's nominal CPUE indices. Data in 2022 are preliminary (as of November 2022).

Robustness to scale uncertainty

Retrospective analyses for base case models in this assessment show considerable scale uncertainty with the magnitude (but not trend) of biomass and fishing mortality estimates changing substantially in some models as the terminal year in the model was reduced sequentially from 2022 to 2018. Members agreed that there was little or no retrospective pattern in trend because the overall trends in biomass and fishing mortality were relatively consistent (see Figure 3). Poor retrospective patterns estimate dramatic changes in recent trends when the terminal year is changed, as demonstrated in Figure 6 showing retrospective patterns for other species. However, the scale uncertainty surprised some Members and was a concern because unscaled biomass estimates are used in TAC calculations. It also seemed possible that uncertain scale in biomass estimates would make TAC calculations uncertain and affect conclusions about stock biomass and fishing mortality. Ensuing discussion and some calculations led the group to conclude that TAC advice based on BSSPM results are relatively unaffected by scale uncertainty.

Scale uncertainty is common in stock assessment modeling based on forward projecting models like the BSSPM that do not converge to stable historical biomass levels. Scale uncertainty is exacerbated for Pacific saury because the model is biomass based (so that mortality and growth are confounded), there are only two age groups, age zero saury are not fully selected by either the survey or fishery, and growth and natural mortality change rapidly. Scale uncertainty for Pacific saury is probably inevitable until reliable estimates of survey selectivity are developed. A new age-structured assessment model currently under development may help as well.

Stock status for Pacific saury in this assessment based on the BSSPM model is described in terms of robust biomass and fishing mortality ratio trends to avoid problems with scale uncertainty. The biomass ratio B/B_{MSY} can be expressed as true B times an error divided by true B_{MSY} times an error. The two errors tend to be similar

and cancel in the ratio so that B/B_{MSY} and true B/true B_{MSY} are similar, and the status measure is robust. The tendency to robust trend estimation has always been evident in Pacific saury assessments because the trends estimated in models fit by members with different assumptions tend to be similar. The robustness property applies to Kobe plots and similar means for status determination because the comparison is F/F_{MSY} to F_{MSY} and B/B_{MSY} to B_{MSY}.

TAC calculations like TAC = F_{MSY} * B are robust to scale uncertainty because errors in estimates of productivity and biomass tend to cancel in the product of F_{MSY} and B. In practical terms, scale uncertainty means that assessment scientists cannot determine if the stock is larger and less productive or smaller and more productive. Fishing mortality and productivity are related in simple Schaefer surplus production models because $F_{MSY} = r/2$ where r is the intrinsic rate of productivity which is the maximum rate of population growth. Reported catch C = F * B is not affected by scale uncertainty. If the estimated biomass estimates are too large, then the model must underestimate fishing mortality and productivity to obtain the observed catch, so the stock appears to be relatively large and unproductive. Similarly, if the estimated biomass is too small, then the model must overestimate fishing mortality and productivity so that the stock appears to be smaller and more productive.

The over (or under) estimation of biomass tends to be cancelled out by an under (or over) estimation of F_{MSY}. The SSC PS demonstrated this pattern by calculating TAC = F_{MSY} x B based on estimates from two base models by three Member. The TAC results were more similar than the original biomass estimates, which had substantially different scales (Table 3). TAC calculated from any harvest control rule based on F_{MSY} (e.g. with the target F reduced when $B/B_{MSY} < 1$) should also be robust.

Robust trend estimation and robust TAC calculations based on model biomass estimates are not related to predicting future trends in the Pacific saury fishery. Robust properties to scale uncertainty do not alleviate any other problems that may exist in the model. Rather, robust means that similar results will be obtained from results with different scales.

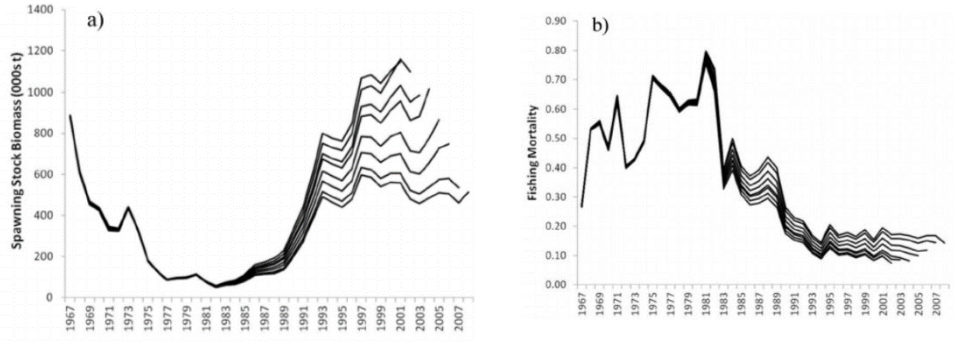


Figure 6. Retrospective patterns in stock assessment results (not Pacific saury).

Management advice

The Commission has responsibility for choosing the TAC and the TAC approach for the Pacific saury fishery. The method used by the Commission in 2019 to set the 2020 TAC for saury was F_{MSY} * B, which is a standard approach used previously in many fisheries. However, it was noted in the last assessment that the original method is seldom used in modern fishery management because it maintains a high (F_{MSY}) fishing mortality level as stock biomass becomes low, as is currently the case for Pacific saury. Simulation studies for many fisheries show better performance (higher average catch and less frequent low biomass conditions) using harvest control rules such as a new standard approach now used in many fisheries. The newer standard reduces fishing mortality in a simple linear fashion when stock size falls below B_{MSY} to help rebuild stocks at low biomass and increase catches (Figure 7). It gives the same F and same TAC for stocks at biomass levels B_{MSY} and higher (the original and new approaches are identical when stock biomass is at least B_{MSY}). The new approach is generally regarded as better on technical grounds at maintaining productive stock levels, avoiding low biomass conditions and obtaining relatively high long-term catch. Both approaches are based on the same underlying reference points (F_{MSY} and B_{MSY}) that are estimable for Pacific saury in the BSSPM and likely future models. Both approaches use robust trend-based stock status measures and reference points.

TAC calculations were carried out in this assessment for illustrative purposes using the original and newer standard approaches. Such calculations may serve as a means for communication between scientists and managers, provide another approach to calculate TAC on an interim manner, or as a basis for further work. Results show that the newer approach results in TAC for 2023 (101,885 tons) that is close to the 2022 catch (98,000 tons, preliminary as of 17 December 2022) and better matches current surplus production in the stock. Results for the original approach yield TAC for 2023 (205,015 tons), which is substantially higher than recent catches.

The current annual TAC for 2021-2022 specified in CMM 2021-08 for Pacific saury (333,750 tons) based on historical catch is much larger than a TAC that would be based on the F_{MSY} catch approach (B_{2022}*F_{MSY} = 205,015 tons). The current biomass is much lower than B_{MSY} and the TAC for 2021-2022 did not reduce fishing mortality in recent years. A harvest control rule that reduces F when biomass is low may increase the probability of achieving long-term sustainable use of Pacific saury (i.e. higher long-term catch closer to MSY of around 403,000 tons). A reduction to the TAC for 2021-2022 would increase the probability of higher biomass and catch levels in the Pacific saury stock.

An HCR that reduces the target harvest rate and TAC when biomass falls below its target level may be appropriate for Pacific saury. This type of HCR is used in managing many fisheries around the world. For example, if an HCR that reduces F linearly when biomass is below B_{MSY} (Figure 8) is applied, the TAC calculated based on such an HCR (B_{2022}*F_{MSY}*(B2022/B_{MSY}) = 101,885 tons) could be similar with the current catch (98,000 tons, preliminary as of 17 December 2022).

Note, however, the performance of the above HCRs has not been evaluated by a formal MSE framework for Pacific saury. They were used as simple illustrations of common approaches used elsewhere.

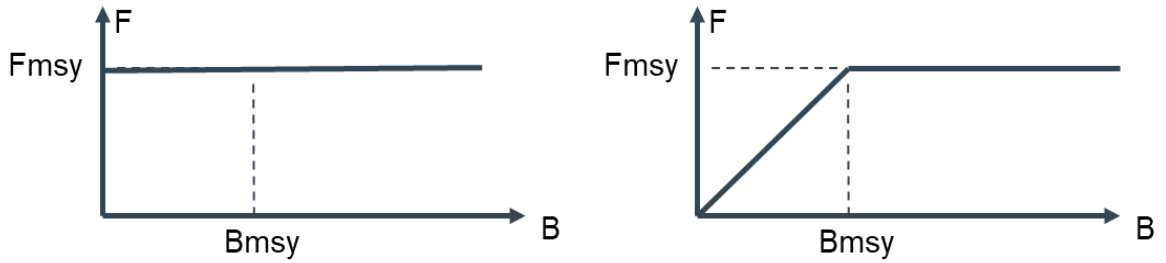


Figure 7. Shapes of harvest rates used in the 2019 Commission meeting for setting the TAC for 2020 (left) and a standard HCR (right).

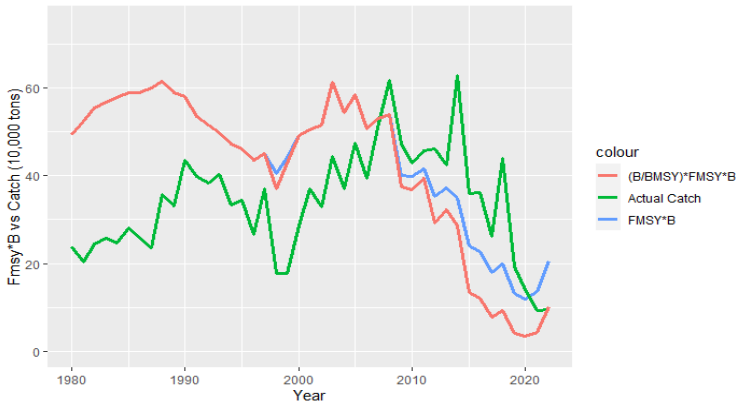


Figure 8. Median time series of F_{MSY}*B, min(1, B/B_{MSY})*F_{MSY}*B, and the actual catch. The first calculation was used by the Commission in 2019 and the second calculation is a common HCR used elsewhere that reduces F when biomass falls below B_{MSY}. Note that the catch in 2022 is a preliminary number as of 17 December 2022. Note that these two calculations are the same when B > B_{MSY}. Also the second calculation is shown as an example application of an HCR.

The HCR used in the second calculation above is a relatively simple approach widely used in many fisheries, but only one example from the range of potential harvest control rules of the same or other types. The SWG MSE PS is currently evaluating options that would work well for short lived Pacific saury.

Table 3. Summary of results for application of TAC calculations as an example manner.

	Base case 1			Base case 2			Aggregated
	CHN	JP	CT	CHN	JP	CT	over 6 runs
Fmsy	0.49	0.52	0.25	0.21	0.26	0.16	0.313
B2022	51.78	46.5	72.59	79.17	74.8	95.12	65.5
B2022/Bmsy (=c)	0.57	0.58	0.46	0.42	0.48	0.43	0.494
Fmsy*B2022	25.37	24.18	18.15	16.63	19.45	15.22	20.50
c*Fmsy*B2022	14.46	14.02	8.35	6.98	9.34	6.54	10.13

Special comments regarding the procedures and stock assessment results

The SSC PS worked collaboratively to produce this consensus stock assessment, which includes significant technical improvements.

1) Standardized CPUE data were assumed to change more slowly than biomass and were down-weighted relative to the Japanese survey in the first base case (B1), which used CPUE from individual Members. In B1, a single non-linear parameter was used for the CPUEs for each Member. Model results support this decision.

2) Retrospective analyses have shown that BSSPM model projections are not suitable for use by managers and they have therefore been omitted by most Members (See discussion in the 2019 assessment (NPFC-2019-SSC PS04-Final Report)). Projections are problematic because recruits and older Pacific saury are not distinguished in the model, environmental effects are important but not predictable and because the species is short-lived.

3) The 2020 biomass index from the Japanese survey has large uncertainties due to incomplete survey coverage. Potential Covid-19 effects on CPUE and catches were not considered in this assessment but may be important. Members should consult fishermen regarding possible impacts of COVID-19 on the fishery.

4) The relative importance of fishing and environmental factors on the population dynamics of Pacific saury is unknown and an important area for research. However, changing environmental conditions may have contributed to the decline and current low stock size of Pacific saury. However oceanographic or biological factors responsible for changes in productivity have not yet been determined. Development of modeling procedures to incorporate environmental change is an important area for future research. The work should include refinements to stock assessment models to better reflect and estimate environmental effects on recruitment and biology. This work should be coordinated among Members and folded into the development of age-structured and improved BSSPM models.

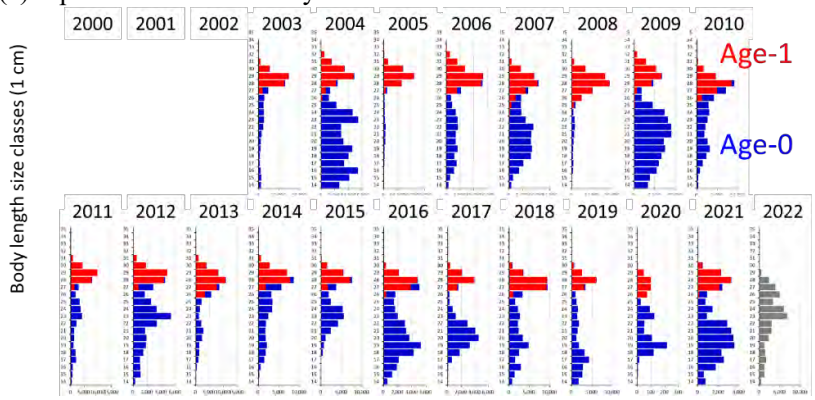
5) The Commission should consider defining overfishing and overfished status and identify actions taken when such conditions occur in the future.

6) In the next assessment, the geographic area to which data and assessment estimates apply (Convention Area, Members' EEZ or both) should be described.

7) Nominal CPUE trends (Figure 5) and standardized CPUEs (Figure 2) used in assessment modeling were similar. Preliminary catch (around 98,000 mt as of 17 December 2022) and preliminary nominal CPUE in 2022 for each Member were at the lowest levels historically. CPUE declines more slowly than stock biomass as demonstrated in all BSSPM results for Pacific saury. Thus, the decline in stock biomass was probably greater than the decline in CPUE.

8) Time series of size and age composition data from the Japanese survey and fishery (Figures 9 and 10) showed the occurrence of weak year classes (i.e. 2005, 2008) consistently. Such consistency will facilitate application of new age and/or size structured model.

(a) Japanese biomass survey



(b) Japanese commercial fishery between August and November

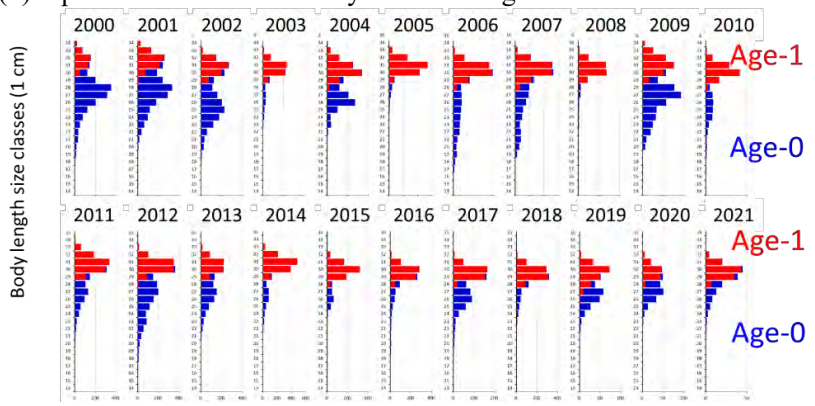


Figure 9. Time series of age and length composition of samples taken from the Japanese survey and commercial fishery (August-November) in Japan.

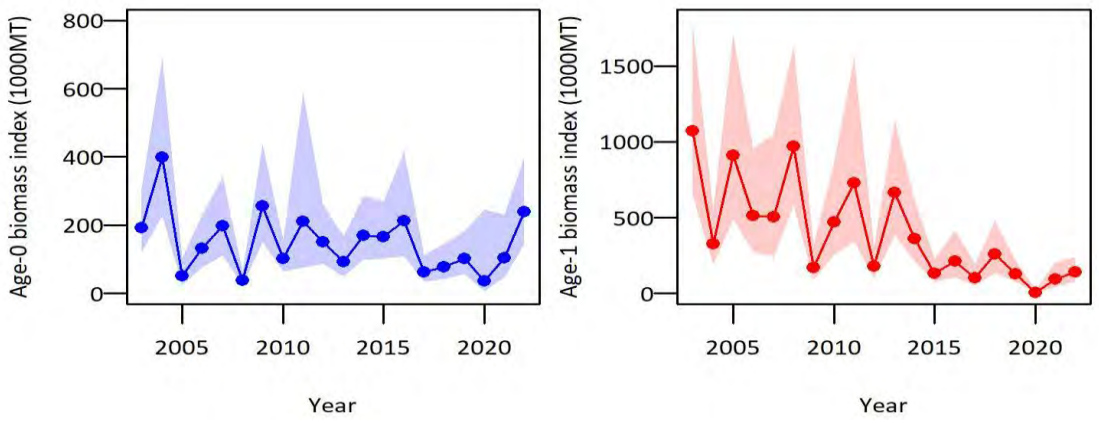


Figure 10. Time series of Japanese survey biomass index by age.

9) In this assessment, trends in effective annual fishing effort were calculated as catch divided by standardized CPUE (nominal CPUE was used for Vanuatu because standardized CPUE was not available, Figure 11). Standardized CPUE is theoretically the catch rate for a single type of vessel operating across the range of the fishery during the fishing season. Standardized CPUE = catch / standardized fishing effort so

standardized fishing effort = catch / standardized CPUE. Thus, the effort calculation measures the amount of fishing effort theoretically required for a representative type of vessel in each year to take the observed catch. Results for the entire fishery show that effort increased beginning in 1994 and has been variable and relatively high since about 2000 despite strong trends in fishing effort by individual members. In particular, declines in Japanese and Russian fishing effort have been offset by increases in fishing effort by China since 2015, Korea since 2011, Chinese Taipei since 2001 and, to a lesser extent, Vanuatu since 2011.

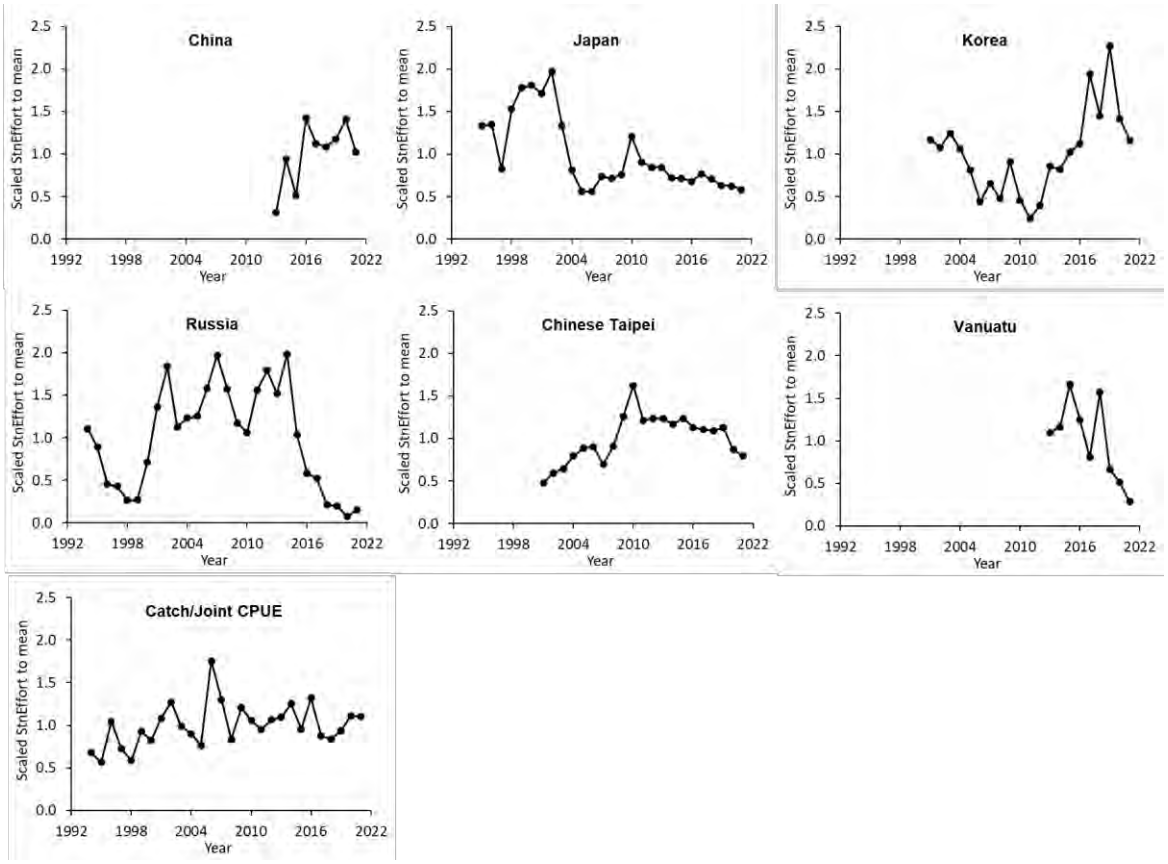


Figure 11. Time series of standardized efforts for the total fishery and Members' fishery calculated by a simple formula of Catch/standardized CPUE. Note that the effort for Vanuatu is the nominal effort.

STOCK ASSESSMENT REPORT FOR PACIFIC SAURY

1. INTRODUCTION

1.1 Distribution

Pacific saury (*Cololabis saira* Brevoort, 1856) has a wide distribution extending in the subarctic and subtropical North Pacific Ocean from inshore waters of Japan and the Kuril Islands to eastward to the Gulf of Alaska and southward to Mexico. Pacific saury is a commercially important fish in the western North Pacific Ocean (Parin 1968; Hubbs and Wisner 1980).

1.2 Migration

Pacific saury migrates extensively between the northern feeding grounds in the Oyashio waters around Hokkaido and the Kuril Islands in summer and the spawning areas in the Kuroshio waters off southern Japan in winter (Fukushima 1979; Kosaka 2000). Pacific saury in offshore regions (east of 160°E) also migrate westward toward

the coast of Japan after October every year (Suyama et al. 2012).

1.3 Population structure

Genetic evidence suggests there are no distinct stocks in the Pacific saury population based on 141 individuals collected from five distant locales (East China Sea, Sea of Okhotsk, northwest Pacific, central North Pacific, and northeast Pacific) (Chow et al. 2009).

1.4 Spawning season and grounds

The spawning season of Pacific saury is relatively long, beginning in September and ending in June of the following year (Watanabe and Lo 1989). Pacific saury spawns over a vast area from the Japanese coastal waters to eastern offshore waters (Baitaliuk et al. 2013). The main spawning grounds are considered to be located in the Kuroshio-Oyashio transition region in fall and spring and in the Kuroshio waters and the Kuroshio Extension waters in winter (Watanabe and Lo 1989).

1.5 Food and feeding

The Pacific saury larvae prey on the nauplii of copepods and other small-sized zooplankton. As they grow, they begin to prey on larger zooplankton such as krill (Odate 1977). The Pacific saury is preyed on by large fish ranked higher in the food chain, such as *Thunnus alalunga* (Nihira 1988) and coho salmon, *Oncorhynchus kisutsh* (Sato and Hirakawa 1976) as well as by animals such as minke whales *Balaenoptera acutorostrata* (Konishi et al. 2009) and sea birds (Ogi 1984).

1.6 Age and growth

Based on analysis of daily otolith increments, Pacific saury reaches approximately 20 cm in knob length (distance from the tip of lower jaw to the posterior end of the muscular knob at the base of a caudal peduncle; hereafter as body length) in 6 or 7 months after hatching (Watanabe et al. 1988; Suyama et al. 1992). There is some variation in growth rate depending on the hatching month during this long spawning season (Kurita et al. 2004) and geographical differences (Suyama et al. 2012b). The maximum lifespan is 2 years (Suyama et al. 2006). The age 1 fish grow to over 27 cm in body length in June and July when Japanese research surveys are conducted and reach over 29 cm in the fishing season between August and December (Suyama et al. 2006).

1.7 Reproduction

The minimum size of maturity of Pacific saury has been estimated at about 25 cm in the field (Hatanaka 1956) or rearing experiments (Nakaya et al. 2010). In rare cases, saury have been found to mature at 22 cm (Sugama 1957; Hotta 1960). Under rearing experiments, Pacific saury begins spawning 8 months after hatching, and spawning activity continues for about 3 months (Suyama et al. 2016). Batch fecundity is about 1,000 to 3,000 eggs per saury (Kosaka 2000).

2. FISHERY

2.1 Overview of fisheries

Western North Pacific

In Japan, the stick-held dip net fishery for Pacific saury was developed in the 1940s. Since then, the stick-held dip net gears have become the dominant fishing technique to catch Pacific saury in the northwest Pacific Ocean. Since 1995, more than 97% of Japan's total catch is caught by the stick-held dip net. The annual catch of Pacific saury for stick-held dip net fishery has fluctuated. Maximum and minimum catches of 355 thousand tons and 30 thousand tons were recorded in 2008 and 2020, respectively.

Pacific saury fisheries in Korea have been operated with gillnet since the late 1950s in Tsushima Warm Current region. Korean stick-held dip net fishery started from 1985 in the Northwest Pacific Ocean. The largest catch of 50 thousand tons was recorded in 1997 (Gong and Suh 2013).

Russian fishery for Pacific saury has been conducted using stick-held dip nets in the northwest Pacific Ocean in the area that includes national waters (mainly within the Russian EEZ) and adjacent NPFC Convention Areas. Russian catch statistics for saury fishery exists, beginning from 1956, and standardized CPUE indices from that fishery were calculated since 1994. Saury fishery traditionally occurred from August to November; however, in recent years, the onset of fishing for saury shifted to the early summer period. Peak catch of saury of over 100 thousand tons was in 2007. Since then, the annual catch has been decreasing, and was about 2.4 thousand tons in 2019 and about 750 tons in 2020.

China commenced its exploratory saury fishing using stick-held dip nets in the high seas in 2003, but only started to develop this fishery in 2012. The fishing seasons mainly cover the period from June-November.

Chinese Taipei's Pacific saury fishery can date back to 1975 and had its first commercial catch in 1977. Over the past decade, the number of active Pacific saury fishing vessels has been increasing from 68 to 91 and the catch has fluctuated between 39,750 tons and 229,937 tons since 2001. Aside from Pacific saury fishery, most of the Pacific saury fishing vessels also conduct flying squid jigging operations in the Northwest Pacific Ocean.

Vanuatu commenced its development of Pacific saury fishery by using stick-held dip net in the high seas in 2004. Currently there are four vessels operating in the Northwest Pacific targeting saury, but the total accumulative number of its authorized Pacific saury fishing vessels from 2004 to 2020 is 16. The fishing season mainly covers the period from July to November each year.

Eastern North Pacific

Although Pacific saury occur in the Canada EEZ, there is no targeted fishery for the species. There is no historical record of Canadian participation in international fisheries for saury. Domestic fisheries sometimes capture saury as bycatch in pelagic and bottom trawls and there are a handful of records from other gear types including commercial longlines. The most recently compiled estimates indicate around 300 kg of saury were captured by Canadian commercial fisheries over 17 years from 1997-2013 (Wade and Curtis 2015; NPFC-2022-SSC PS09-IP01). There are also records of saury catches from research trawls (surface, pelagic and bottom trawls) in Canadian waters, but the catches have been minimal.

Management plans developed by the United States' National Marine Fisheries Service currently prohibit targeted fishing on marine forage species including the Pacific saury. In the 1950's to mid-1970's there were sporadic attempts to commercially fish for Pacific saury off of California with limited success using purse seines and light attraction (Kato 1992). Catches from 1969-1972 averaged 450 tons. Currently landings are only "occasionally" reported as bycatch in fisheries on the US west coast. Landings of Pacific saury as bycatch on the US west coast averaged 5.5 kg per year from 2011-2015 (NOAA Fisheries National Bycatch Report Database System, https://www.st.nmfs.noaa.gov/, accessed March 8, 2019)

Historically, Japanese and Russian vessels operated mainly within their own EEZs, but they have shifted into the Convention Area in recent years. Chinese, Korean and Chinese Taipei vessels operate mainly in the high seas of the North Pacific (Figure 1).

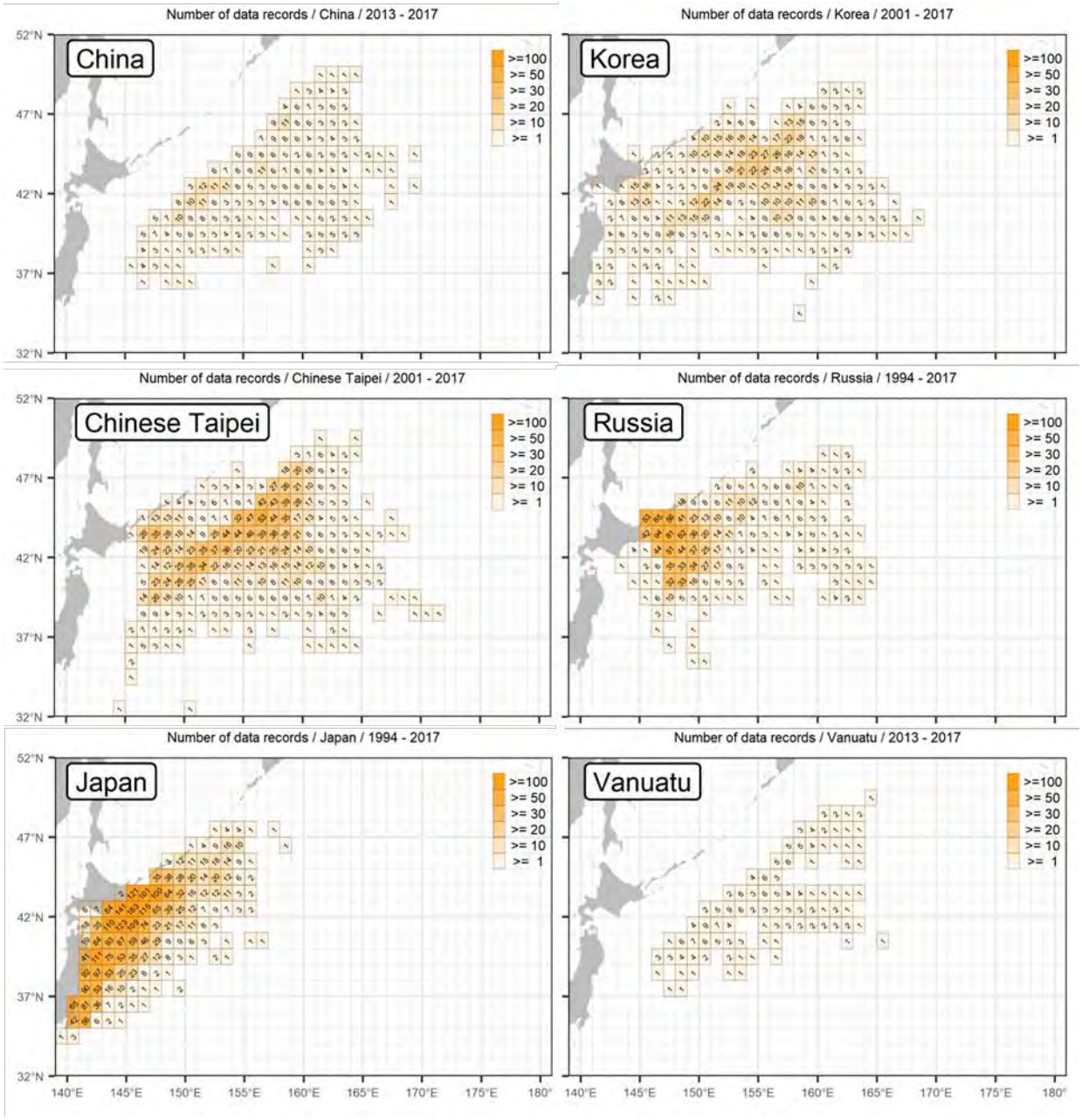


Figure 1 (a). Main fishing grounds for Pacific saury by fishing members in the western North Pacific Ocean during 1994-2017. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

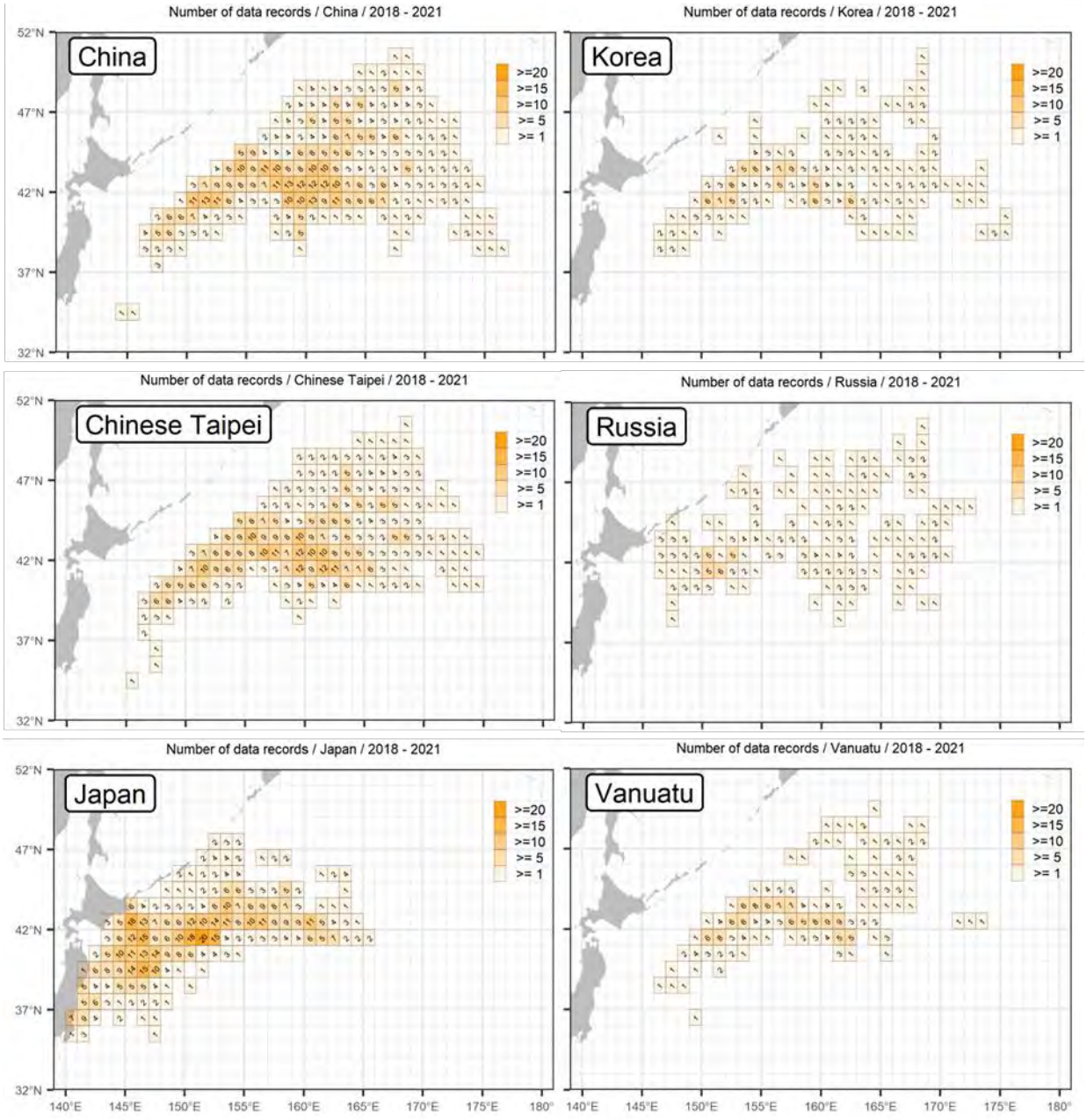


Figure 1 (b). Main fishing grounds for Pacific saury by fishing members in the western North Pacific Ocean during 2018-2021. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

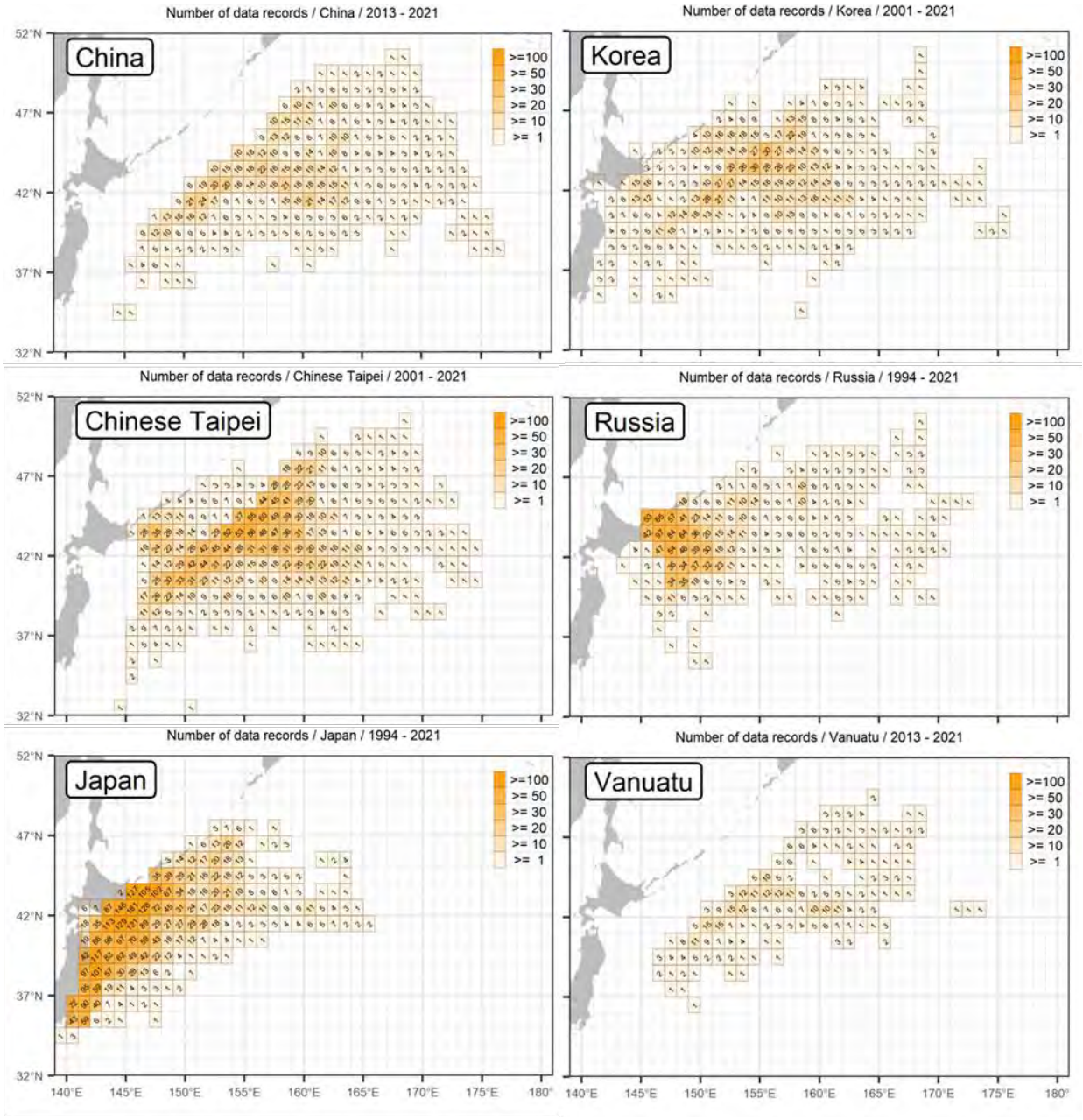


Figure 1 (c). Main fishing grounds for Pacific saury by fishing members in the western North Pacific Ocean during 1994-2021. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

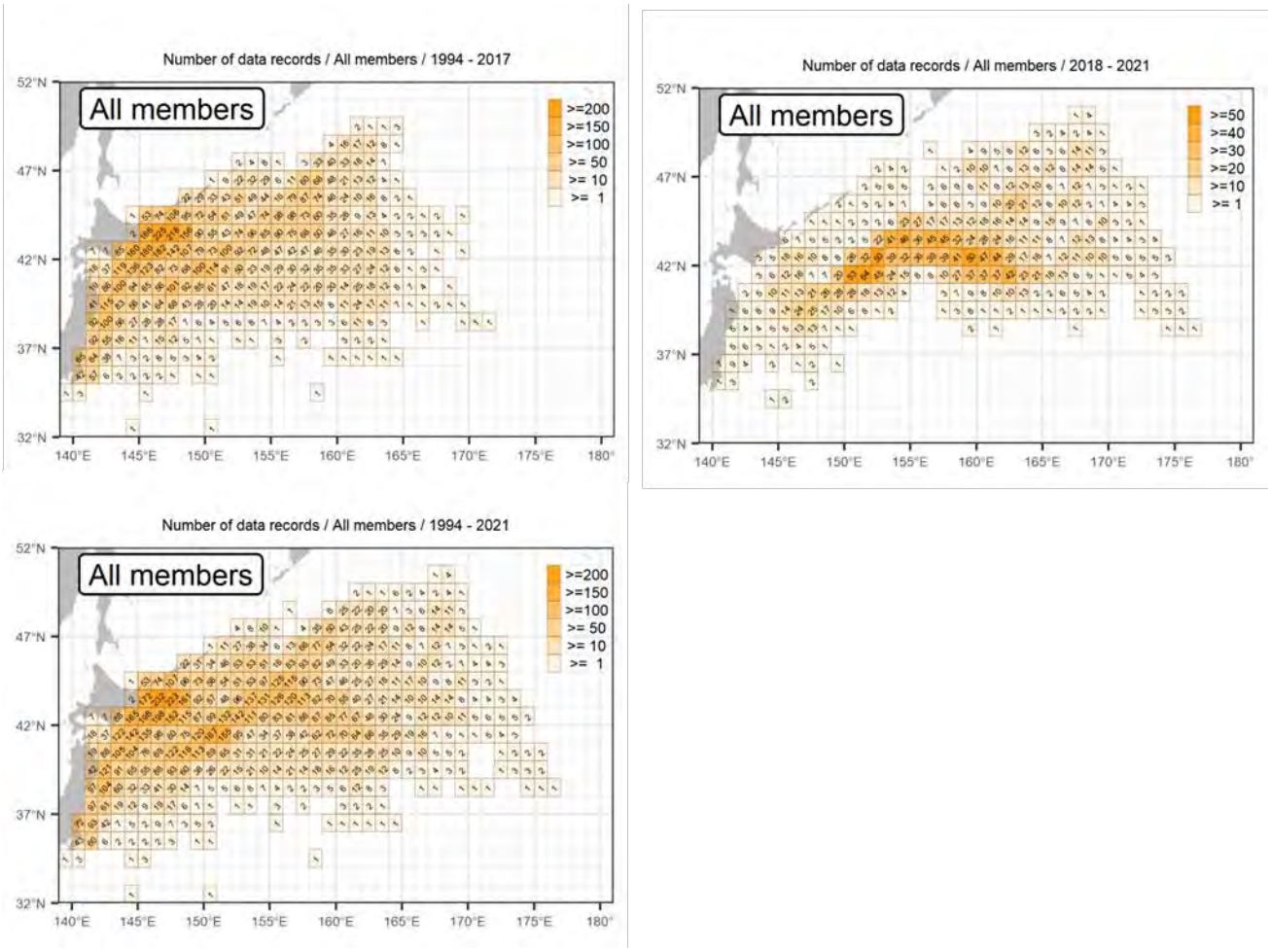


Figure 1 (d). Main fishing grounds for Pacific saury in the western North Pacific Ocean. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

2.2 Catch records

Figure 2 shows the historical catches of Pacific saury in the northwest Pacific Ocean by Member.

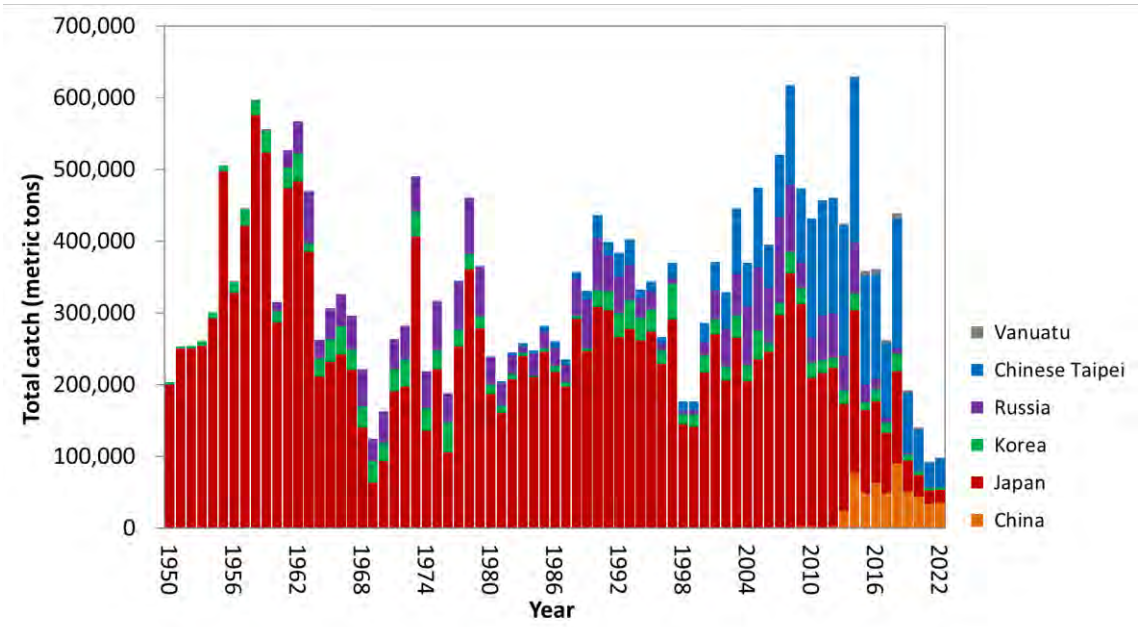


Figure 2. Time series of catch by Member during 1950-2022. The catch data for 1950-1979 are shown but not used in stock assessment modeling. Catch data in 2022 are preliminary (as of 17 December 2022) and not used in the assessment.

3. SPECIFICATION OF STOCK ASSESSMENT

A Bayesian state-space production model (BSSPM) used in previous stock assessments was employed as an agreed provisional stock assessment model for Pacific saury during 1980-2022. Scientists from three Members (China, Japan and Chinese Taipei) each conducted analyses following the agreed specification which called for two base case scenarios and two sensitivity scenarios (see Annex F, SSC PS09 report for more details). The two base case scenarios differ in using each Member's standardized CPUEs (base case B1) or standardized joint CPUEs (base case B2). For the two sensitivity cases with Japanese early CPUE (1980-1994), time-varying catchability was assumed to account for potential increases in catchability. A higher weight was given to the Japanese biomass survey estimates than to Members' CPUEs in B1 while comparable weights were given to the Japanese biomass survey estimates and the joint CPUEs in B2. The CPUE data were modeled as nonlinear indices of biomass. Members used similar approaches with some differences in the assumption of the time-varying catchability and prior distributions for the free parameters in the model.

3.1 Bayesian state-space production model

The population dynamics is modelled by the following equations:

$$B_t = \{B_{t-1} + B_{t-1} f(B_{t-1}) - C_{t-1}\} e^{u_t}, \quad u_t \sim N(0, \tau^2)$$

$$f(B_t) = r\left[1 - \left(\frac{B_t}{K}\right)^z\right]$$

where

B_t : the biomass at the beginning of year t

C_t : the total catch of year t

u_t : the process error in year t

$f(B)$: the production function (Pella-Tomlinson)

r : the intrinsic rate of natural increase

K : the carrying capacity
z: the degree of compensation (shape parameter; different symbols were used by the 3 members)

The multiple biomass indices are modelled as follows:

Survey biomass estimate

$$I_{t,biomass} = q_{biomass} B_t \, exp(\, v_{t,biomass}), \qquad \text{where} \quad v_{t,biomass} \sim N\left(0, \sigma^2_{biomass}\right)$$

where

$q_{biomass}$: the relative bias in biomass estimate
$v_{t,biomass}$: the observation error term in year t for survey biomass estimate
$\sigma^2_{biomass}$: the observation error variance for survey biomass estimate

CPUE series

$$I_{t,f} = q_f B_t^b \, exp(\, v_{t,f}), \qquad \text{where} \quad v_{t,f} \sim N\left(0, \sigma_f^2\right)$$

where

$I_{t,f}$: the biomass index in year t for biomass index f

q_f : the catchability coefficient for biomass index f

b: the hyper-stability/depletion parameter
$v_{t,f}$: the observation error term in year t for biomass index f
σ_f^2: the observation error in year t for biomass index f

For the estimation of parameters, Bayesian methods were used with Member-specific differences in preferred assumptions for the prior distributions for the free parameters. MCMC methods were employed for simulating the posterior distributions. For the assumptions of uniform priors used in China and Japan, see documents NPFC-2020-SSC PS06-WP08 and NPFC-2020-SSC PS06-WP10; for the non-uniform priors used in Chinese Taipei, see document NPFC-2020-SSC PS06-WP17.

3.2 Agreed scenarios

Table 1. Definition of scenarios

	Base case (NB1)	**Base case (NB2)**	**Sensitivity case (NS1)**	**Sensitivity case (NS2)**
Initial year	1980	1980	1980	1980
Biomass survey	$I_{t,bio} = q_{bio}\, B_t e^{v_{t,bio}}$ $v_{t,bio} \sim N(0, cv_{t,bio}^2 + \sigma^2)$ $q_{bio} \sim$ U(0,1) (2003-2022)	Same as left	Same as left	Same as left
CPUE	CHN(2013-2021) JPN_late(1994-2021) KOR(2001-2021) RUS(1994-2021) CT(2001-2021) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_{t,bio}^2) + \sigma^2)$, where $ave(cv_{t,bio}^2)$ is computed except for 2020 survey (c = 5)	Joint CPUE (1994-2021) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$	CHN(2013-2021) JPN_early(1980-1993, time-varying q) JPN_late(1994-2021) KOR(2001-2021) RUS(1994-2021) CT(2001-2021) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_{t,bio}^2) + \sigma^2)$, where $ave(cv_{t,bio}^2)$ is computed except for 2020 survey (c = 6)	JPN_early(1980-1993, time-varying q) $I_{t,JE} = q_{t,JE} B_t^b e^{v_{t,JE}}$ $v_{t,JE} \sim N(0, \sigma_{JE}^2)$ $\sigma_{JE}^2 = c\, ave(cv_{t,joint}^2 + \sigma^2)$ Joint CPUE (1994-2021) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$
Hyper-depletion / stability	A common parameter for all fisheries with a prior distribution, $b \sim U(0, 1)$	$b \sim U(0, 1)$	A common parameter for all fisheries but JPN_early, with a prior distribution, $b \sim U(0, 1)$ [b for JPN_early is fixed at 1]	$b \sim U(0, 1)$ for joint CPUE. [b for JPN_early is fixed at 1]
Prior for other than q_{bio}	Own preferred options	Own preferred options	Own preferred options	Own preferred options

Table 2. Description of symbols used in the stock assessment

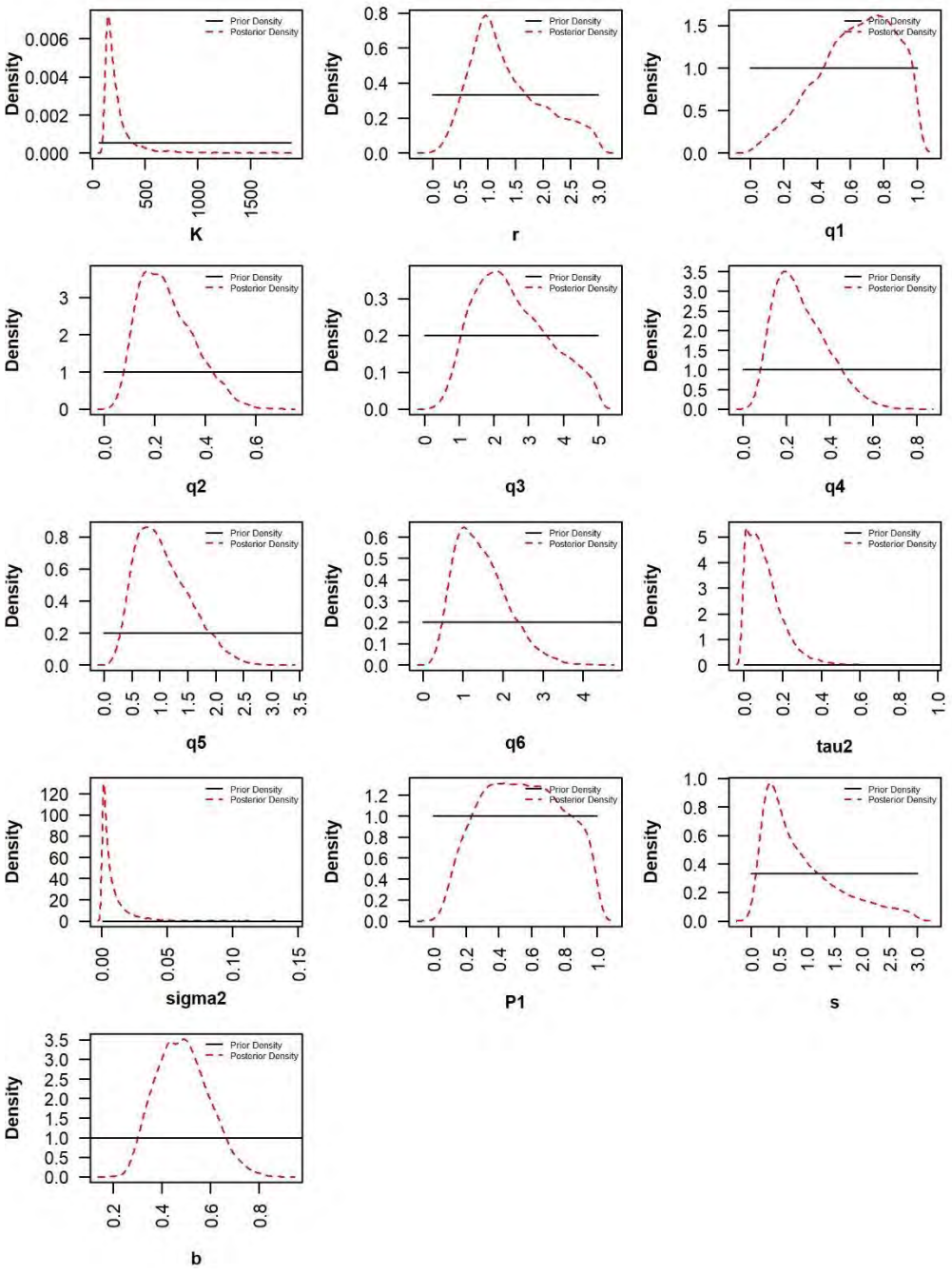
Symbol	Description
C_{2021}	Catch in 2021
$AveC_{2019\text{-}2021}$	Average catch for a recent period (2019–2021)
$AveF_{2019\text{-}2021}$	Average harvest rate for a recent period (2019–2021)
F_{2021}	Harvest rate in 2021
F_{MSY}	Annual harvest rate producing the maximum sustainable yield (MSY)
MSY	Equilibrium yield at F_{MSY}
F_{2021}/F_{MSY}	Average harvest rate in 2021 relative to F_{MSY}
$AveF_{2019\text{-}2021}/F_{MSY}$	Average harvest rate for a recent period (2019–2021) relative to F_{MSY}
K	Equilibrium unexploited biomass (carrying capacity)
B_{2021}	Stock biomass in 2021 estimated in the model
B_{2022}	Stock biomass in 2022 estimated in the model
$AveB_{2020\text{-}2022}$	Stock biomass for a recent period (2020–2022) estimated in the model
B_{MSY}	Stock biomass that will produce the maximum sustainable yield (MSY)
B_{MSY}/K	Stock biomass that produces the maximum sustainable yield (MSY) relative to the equilibrium unexploited biomass[a]
B_{2021}/K	Stock biomass in 2021 relative to K[a]
B_{2022}/K	Stock biomass in 2022 relative to K[a]
$B_{2020\text{-}2022}/K$	Stock biomass in the latest time period (2020-2022) relative to the equilibrium unexploited stock biomass[a]
B_{2021}/B_{MSY}	Stock biomass in 2021 relative to B_{MSY}[a]
B_{2022}/B_{MSY}	Stock biomass in 2022 relative to B_{MSY}[a]
$B_{2020\text{-}2022}/B_{MSY}$	Stock biomass for a recent period (2020–2022) relative to the stock biomass that produces maximum sustainable yield (MSY) [a]

[a]calculated as the average of the ratios.

4. RESULTS by CHINA, JAPAN and CHINESE TAIPEI

4.1 CHINA

4.1.1 Prior and posterior distributions for Base case model 1 (as an illustrative example)

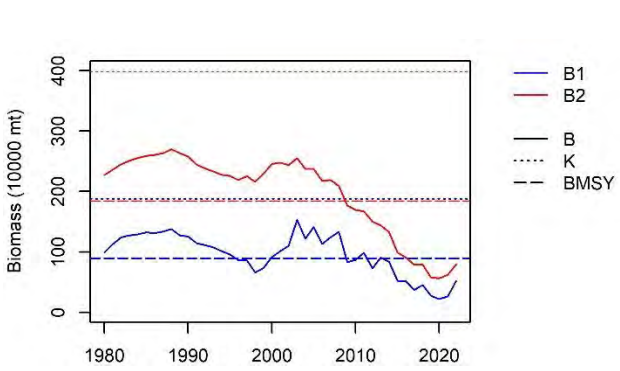


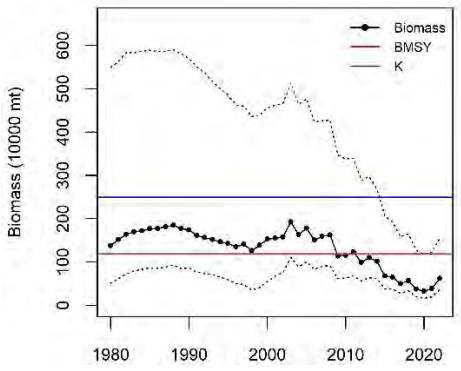
4.1.2 Summary of estimates of parameters and reference points

	Base case 1	Base case 2	Over all 2
C2021	9.22	9.22	9.22
AveC2019-2021	14.14	14.14	14.14
AveF2019-2021	0.57	0.24	0.40
F2021	0.35	0.15	0.24
F_{MSY}	0.49	0.21	0.36
MSY	43.89	38.11	41.32
F2021/F_{MSY}	0.71	0.76	0.73
AveF2019-2021/F_{MSY}	1.16	1.26	1.20
K	187.70	398.20	249.20
B2021	26.63	62.28	38.26
B2022	51.78	79.17	62.19
AveB2020-2022	33.74	66.36	44.85
B_{MSY}	89.28	184.10	118.80
B_{MSY}/K	0.47	0.46	0.46
B2021/K	0.14	0.15	0.15
B2022/K	0.28	0.20	0.24
B2020-2022/K	0.18	0.17	0.18
B2021/B_{MSY}	0.30	0.32	0.31
B2022/B_{MSY}	0.57	0.42	0.50
B2020-2022/B_{MSY}	0.38	0.35	0.36

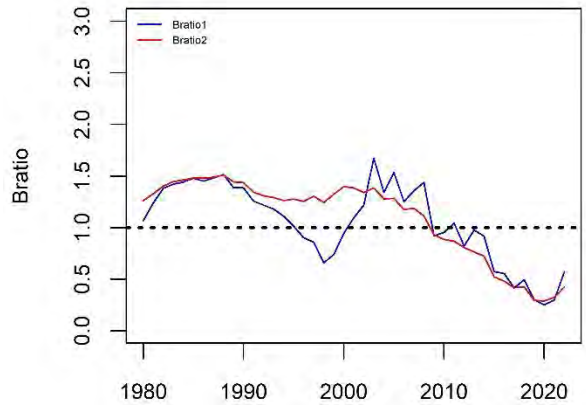
4.1.3 Time series plots for base case models and aggregated results

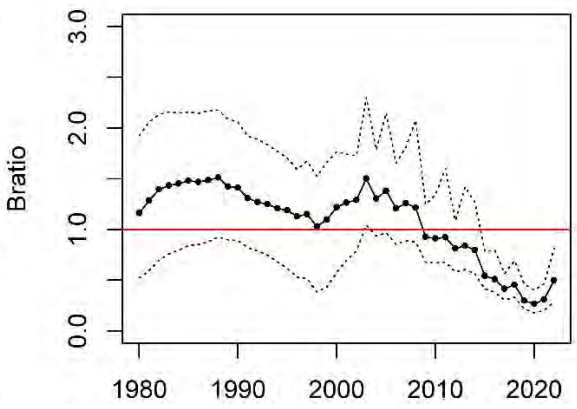
(a) Biomass



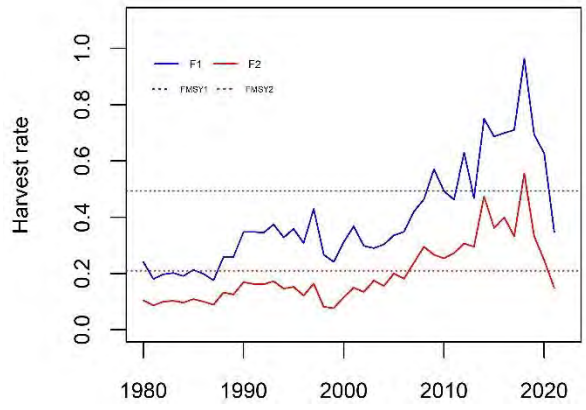


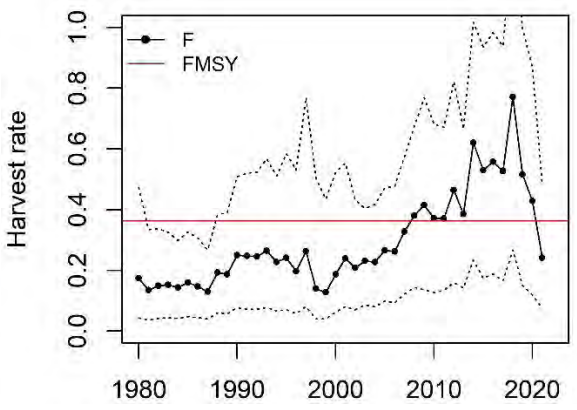
(b) B-ratio (B/B_{MSY})



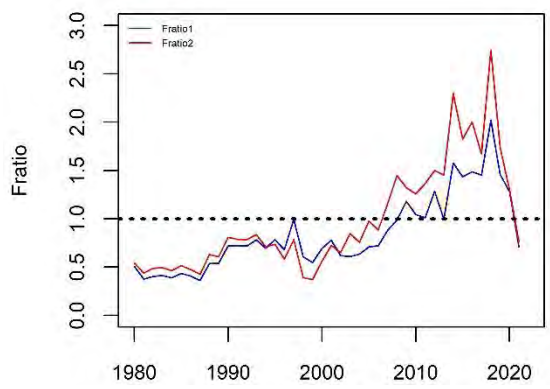


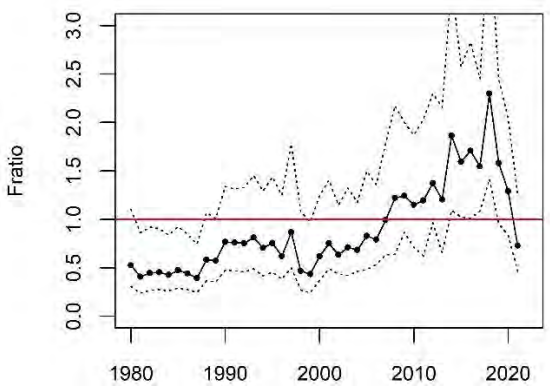
(c) Exploitation rate (F)



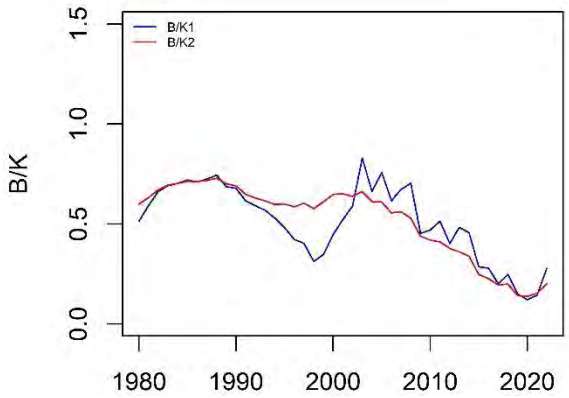


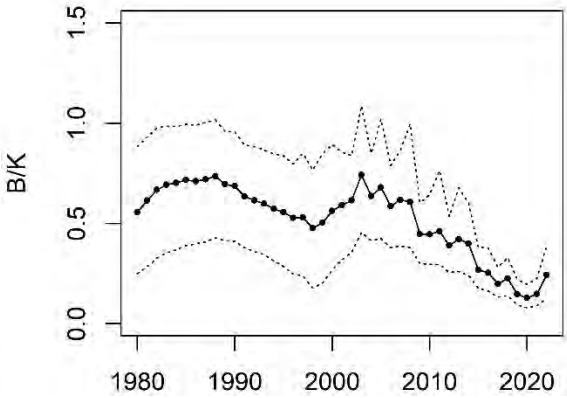
(d) F-ratio (F/F_{MSY})



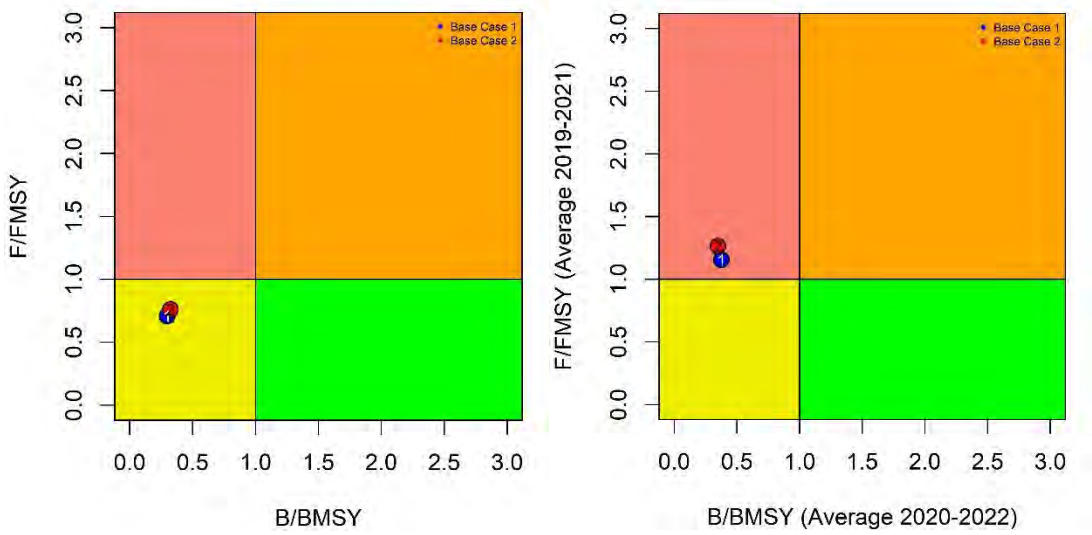


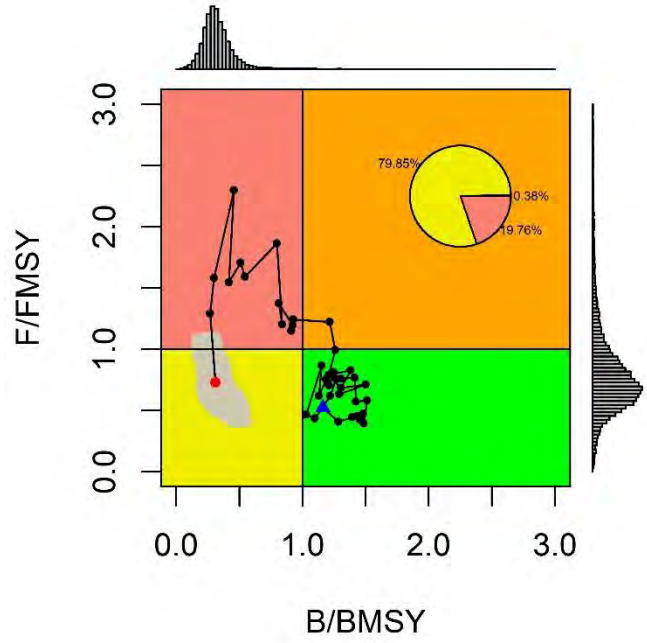
(e) B/K





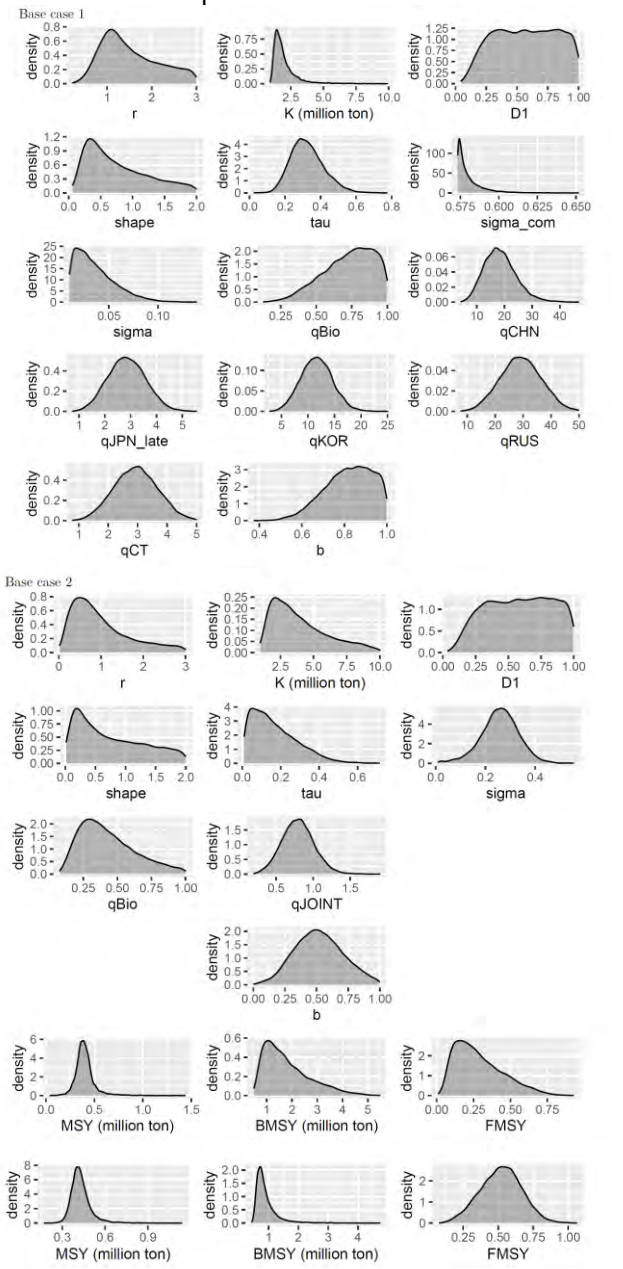
4.1.4 Kobe plots





4.2 JAPAN

4.2.1 Prior and posterior distributions for Base case models



Note: Prior for each free parameter is assumed to be uniform over the shown horizontal range.

4.2.2 Summary of estimates of parameters and reference points

Over the two base cases.

	Mean	Median	Lower10th	Upper10th
C_2020	0.140	0.140	0.140	0.140
AveC_2018_2020	0.257	0.257	0.257	0.257
AveF_2018_2020	0.526	0.515	0.290	0.775
F_2020	0.378	0.355	0.188	0.595
FMSY	0.368	0.357	0.179	0.563
MSY (million ton)	0.415	0.405	0.339	0.498
F_2020/FMSY	1.097	1.033	0.641	1.625
AveF_2018_2020/FMSY	1.543	1.480	0.973	2.187
K (million ton)	2.915	2.421	1.548	4.949
B_2020 (million ton)	0.455	0.393	0.235	0.742
B_2021 (million ton)	0.545	0.480	0.284	0.868
AveB_2019_2021	0.498	0.433	0.274	0.792
BMSY (million ton)	1.336	1.144	0.751	2.189
BMSY/K	0.469	0.463	0.398	0.552
B_2020/K	0.168	0.161	0.094	0.248
B_2021/K	0.205	0.195	0.108	0.314
AveB_2019_2021/K	0.185	0.179	0.106	0.269
B_2020/BMSY	0.358	0.339	0.212	0.526
B_2021/BMSY	0.440	0.412	0.238	0.673
AveB_2019_2021/BMSY	0.396	0.378	0.238	0.574

Base case 1

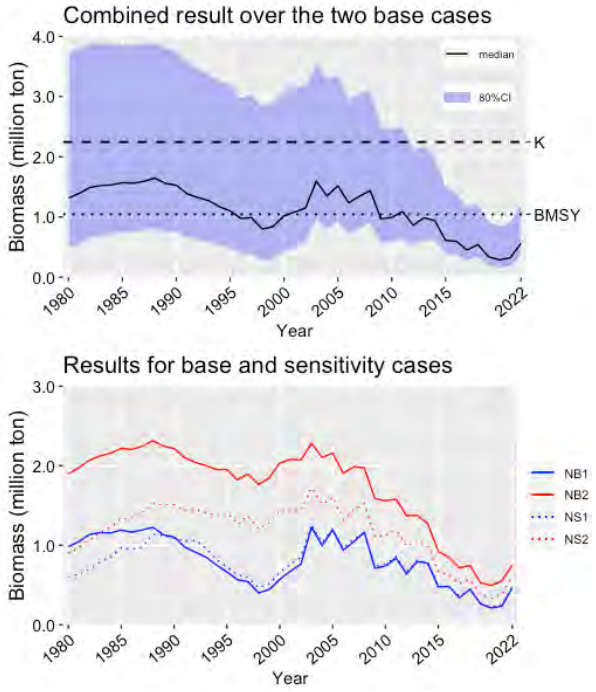
	Mean	Median	Lower10th	Upper10th
C_2021	0.092	0.092	0.092	0.092
AveC_2019_2021	0.141	0.141	0.141	0.141
AveF_2019_2021	0.606	0.609	0.374	0.831
F_2021	0.405	0.399	0.243	0.574
FMSY	0.519	0.524	0.324	0.704
MSY (million ton)	0.429	0.419	0.358	0.508
F_2021/FMSY	0.806	0.768	0.542	1.113
AveF_2019_2021/FMSY	1.205	1.167	0.844	1.596
K (million ton)	1.978	1.712	1.246	2.975
B_2021 (million ton)	0.257	0.231	0.161	0.379
B_2022 (million ton)	0.514	0.465	0.332	0.748
AveB_2020_2022	0.335	0.302	0.224	0.481
BMSY (million ton)	0.908	0.800	0.605	1.309
BMSY/K	0.468	0.460	0.408	0.544
B_2021/K	0.138	0.136	0.085	0.193
B_2022/K	0.279	0.272	0.171	0.396
AveB_2020_2022/K	0.181	0.180	0.117	0.246
B_2021/BMSY	0.295	0.288	0.191	0.406
B_2022/BMSY	0.597	0.575	0.382	0.839
AveB_2020_2022/BMSY	0.387	0.377	0.263	0.518

Base case 2

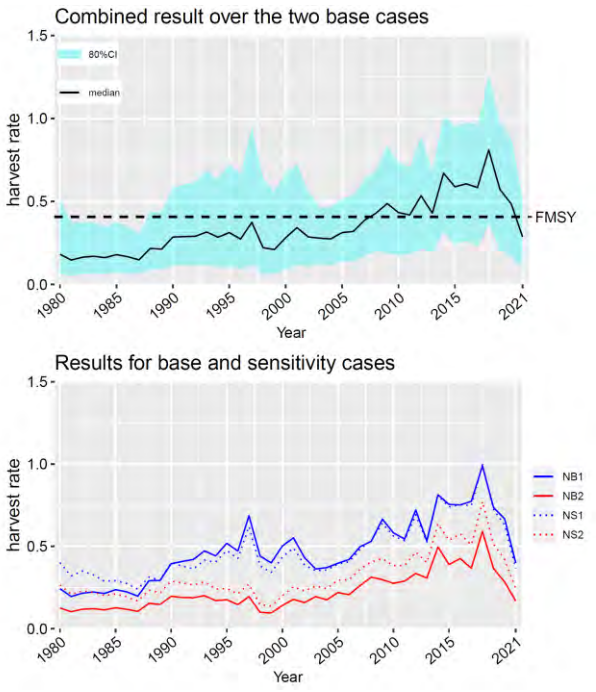
	Mean	Median	Lower10th	Upper10th
C_2021	0.092	0.092	0.092	0.092
AveC_2019_2021	0.141	0.141	0.141	0.141
AveF_2019_2021	0.322	0.275	0.126	0.589
F_2021	0.196	0.168	0.080	0.352
FMSY	0.288	0.255	0.106	0.525
MSY (million ton)	0.402	0.390	0.302	0.504
F_2021/FMSY	0.759	0.700	0.399	1.165
AveF_2019_2021/FMSY	1.218	1.173	0.664	1.785
K (million ton)	3.980	3.448	1.718	7.268
B_2021 (million ton)	0.646	0.549	0.262	1.148
B_2022 (million ton)	0.879	0.748	0.409	1.510
AveB_2020_2022	0.706	0.602	0.307	1.234
BMSY (million ton)	1.812	1.588	0.839	3.177
BMSY/K	0.466	0.459	0.391	0.553
B_2021/K	0.170	0.160	0.097	0.253
B_2022/K	0.244	0.223	0.125	0.393
AveB_2020_2022/K	0.189	0.178	0.107	0.284
B_2021/BMSY	0.366	0.340	0.219	0.539
B_2022/BMSY	0.526	0.478	0.277	0.837
AveB_2020_2022/BMSY	0.407	0.377	0.242	0.606

4.2.3 Time series plots for base case models and aggregated results

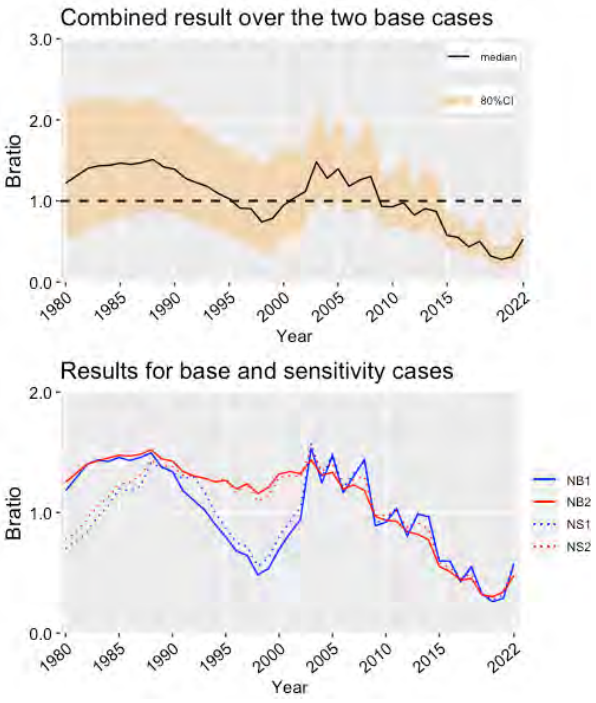
(a) Biomass



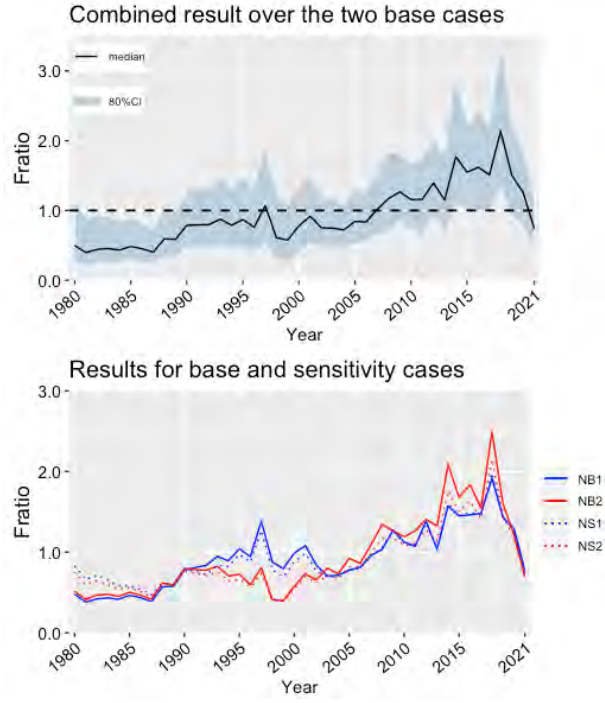
(b) Harvest rate



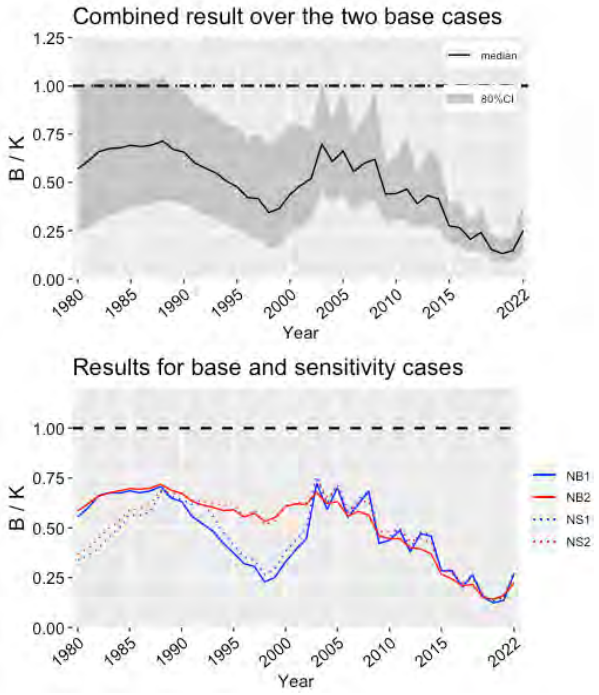
(c) B-ratio



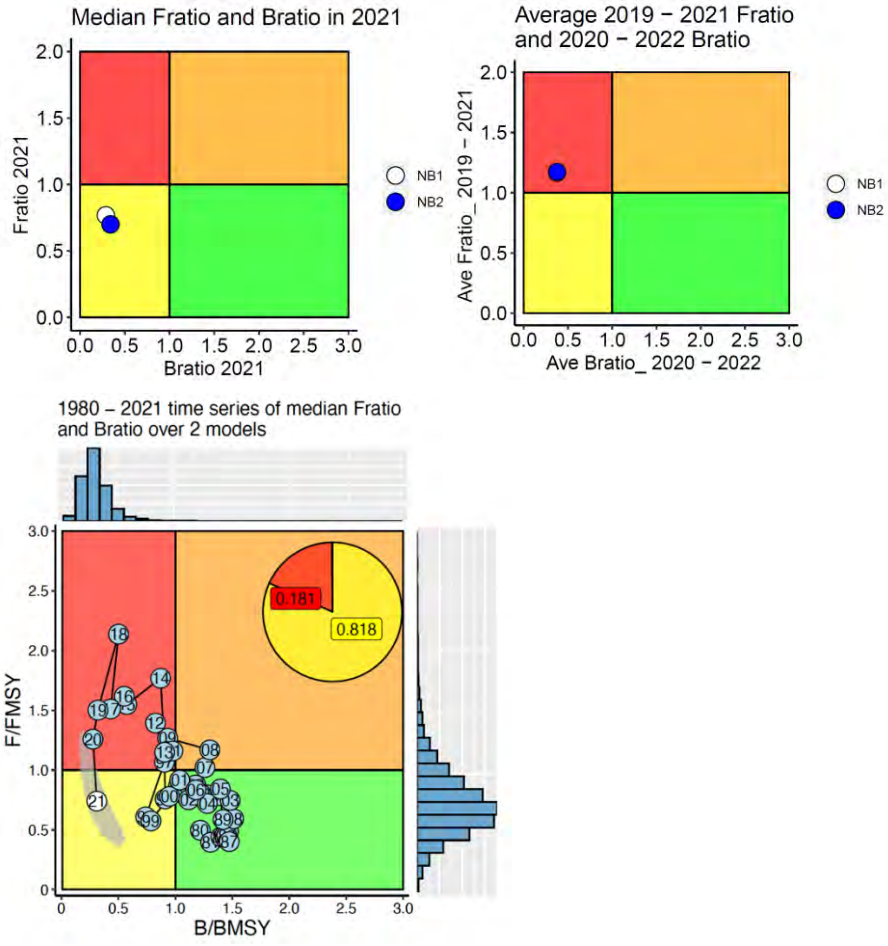
(d) F-ratio



(e) Depletion level relative to *K*

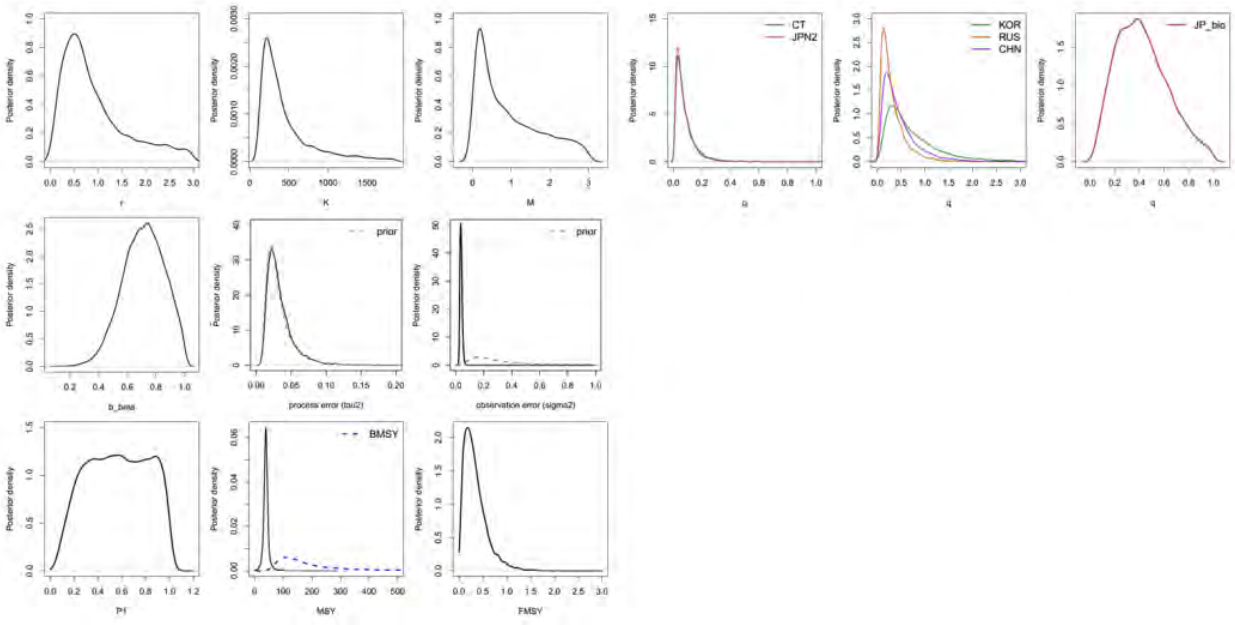


4.2.4 Kobe plots



4.3 CHINESE TAIPEI

4.3.1 Prior and posterior distributions for Base case model 1 (as an illustrative example)



4.3.2 Summary of estimates of parameters and reference points

(a) Base case1

	Mean	Median	Lower 10th	Upper 10th
$Catch_{2021}$	9.22	9.22	9.22	9.22
$F_{2019\text{-}2021}$	0.32	0.29	0.11	0.57
F_{2021}	0.20	0.18	0.07	0.35
F_{MSY}	0.27	0.25	0.09	0.48
MSY	39.83	39.03	29.72	48.79
F_{2021}/F_{MSY}	0.87	0.74	0.47	1.25
$F_{2019\text{-}2021}/F_{MSY}$	1.37	1.20	0.78	1.90
K	461.13	334.05	168.60	979.08
B_{2021}	69.86	51.39	26.69	126.30
B_{2022}	95.83	72.59	40.91	165.99
$B_{2020\text{-}2022}$	76.86	57.03	30.93	137.56
B_{MSY}	212.03	155.50	86.45	425.58
B_{MSY}/K	0.48	0.47	0.39	0.59
B_{2021}/K	0.17	0.16	0.09	0.25
B_{2022}/K	0.24	0.23	0.12	0.37
$B_{2020\text{-}2022}/K$	0.18	0.18	0.10	0.28
B_{2021}/B_{MSY}	0.35	0.32	0.20	0.51
B_{2022}/B_{MSY}	0.50	0.46	0.26	0.75
$B_{2020\text{-}2022}/B_{MSY}$	0.39	0.36	0.22	0.56

(b) Base case2

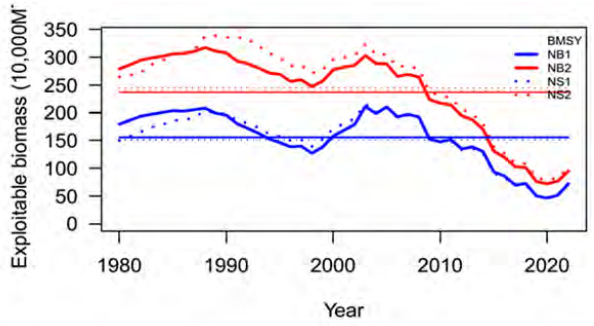
	Mean	Median	Lower 10th	Upper 10th
$Catch_{2021}$	9.22	9.22	9.22	9.22
$F_{2019\text{-}2021}$	0.24	0.19	0.06	0.51
F_{2021}	0.15	0.12	0.04	0.30
F_{MSY}	0.21	0.16	0.05	0.44
MSY	38.69	38.56	23.23	50.81
F_{2021}/F_{MSY}	1.57	0.76	0.39	1.68
$F_{2019\text{-}2021}/F_{MSY}$	2.35	1.22	0.66	2.47
K	668.95	513.95	192.71	1447.90
B_{2021}	111.16	77.03	30.72	219.30
B_{2022}	133.06	95.12	43.84	252.99
$B_{2020\text{-}2022}$	116.93	81.91	34.34	228.55
B_{MSY}	310.02	237.25	97.47	645.28
B_{MSY}/K	0.48	0.47	0.38	0.60
B_{2021}/K	0.18	0.16	0.08	0.29
B_{2022}/K	0.23	0.21	0.09	0.38
$B_{2020\text{-}2022}/K$	0.19	0.17	0.08	0.31
B_{2021}/B_{MSY}	0.37	0.33	0.18	0.61
B_{2022}/B_{MSY}	0.48	0.43	0.21	0.80
$B_{2020\text{-}2022}/B_{MSY}$	0.40	0.36	0.19	0.65

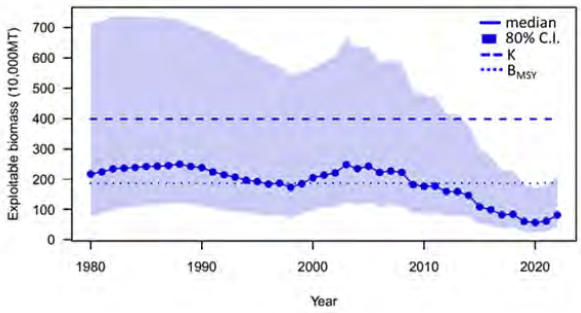
(c) Joint estimates of the base cases 1 and 2

	Mean	Median	Lower 10th	Upper 10th
$Catch_{2021}$	9.22	9.22	9.22	9.22
$F_{2019\text{-}2021}$	0.28	0.24	0.08	0.55
F_{2021}	0.17	0.15	0.05	0.33
F_{MSY}	0.24	0.21	0.06	0.46
MSY	39.26	38.85	26.61	49.79
F_{2021}/F_{MSY}	1.22	0.75	0.43	1.45
$F_{2019\text{-}2021}/F_{MSY}$	1.86	1.21	0.71	2.16
K	565.04	398.25	177.80	1274.00
B_{2021}	90.51	61.96	28.19	176.10
B_{2022}	114.45	82.04	42.16	212.07
$B_{2020\text{-}2022}$	96.89	66.88	32.23	185.61
B_{MSY}	261.02	186.40	90.58	563.27
B_{MSY}/K	0.62	0.47	0.20	1.12
B_{2021}/K	0.17	0.16	0.08	0.27
B_{2022}/K	0.23	0.22	0.10	0.37
$B_{2020\text{-}2022}/K$	0.19	0.18	0.09	0.29
B_{2021}/B_{MSY}	0.36	0.33	0.19	0.56
B_{2022}/B_{MSY}	0.49	0.45	0.23	0.77
$B_{2020\text{-}2022}/B_{MSY}$	0.39	0.36	0.20	0.60

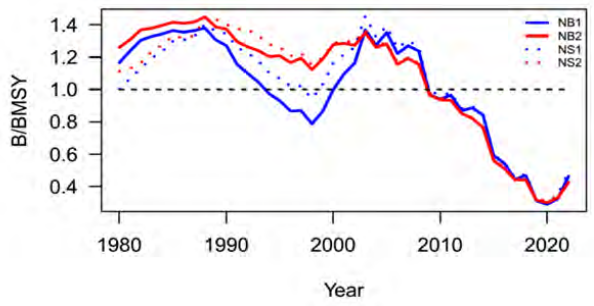
4.3.3 Time series plots for base case models and aggregated results

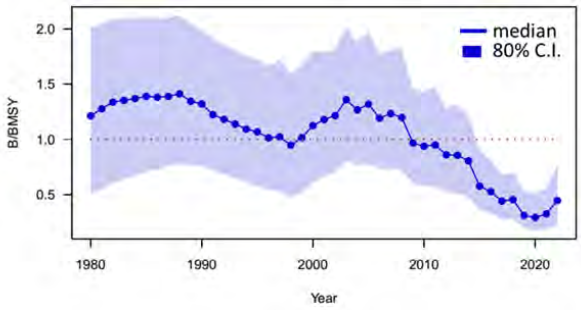
(a) Biomass



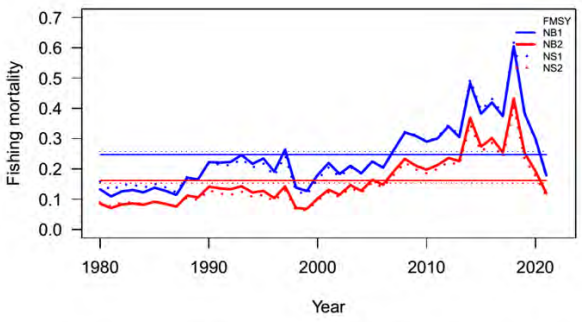


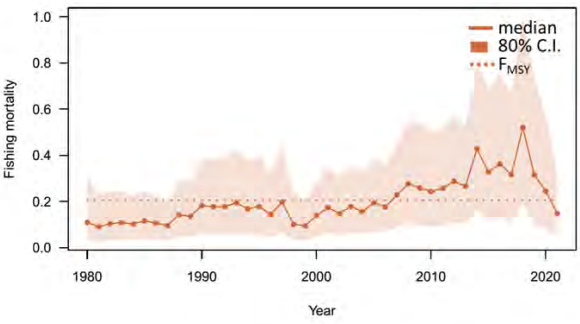
(b) B-ratio (B/B_{MSY})



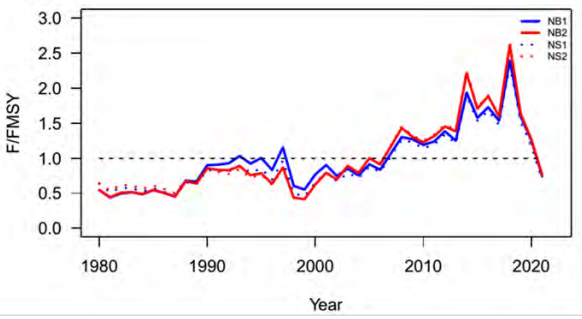


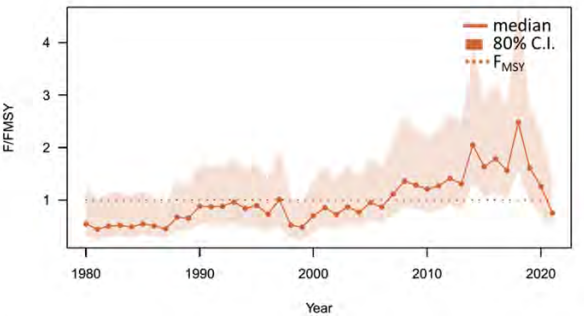
(c) Exploitation rate (F)



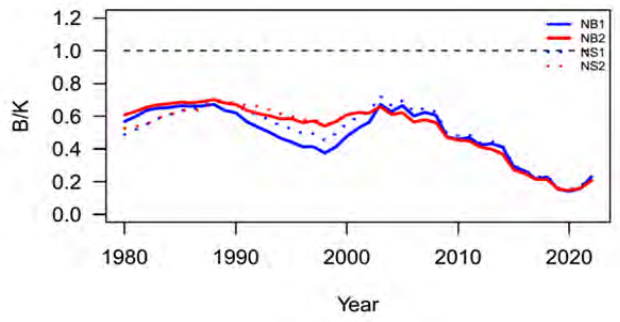


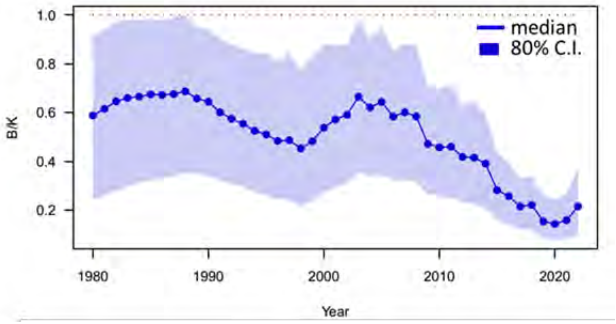
(d) F-ratio (F/F_{MSY})



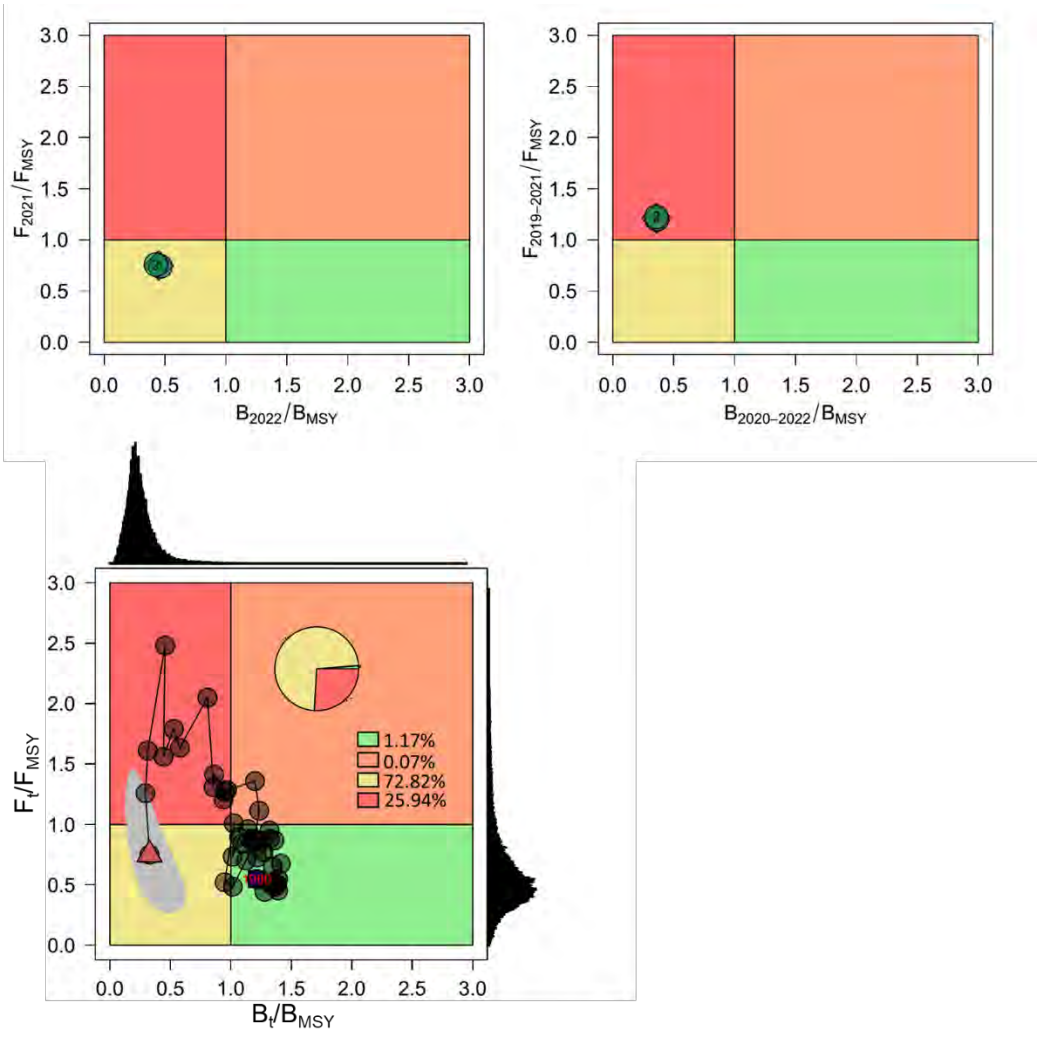


(e) B/K





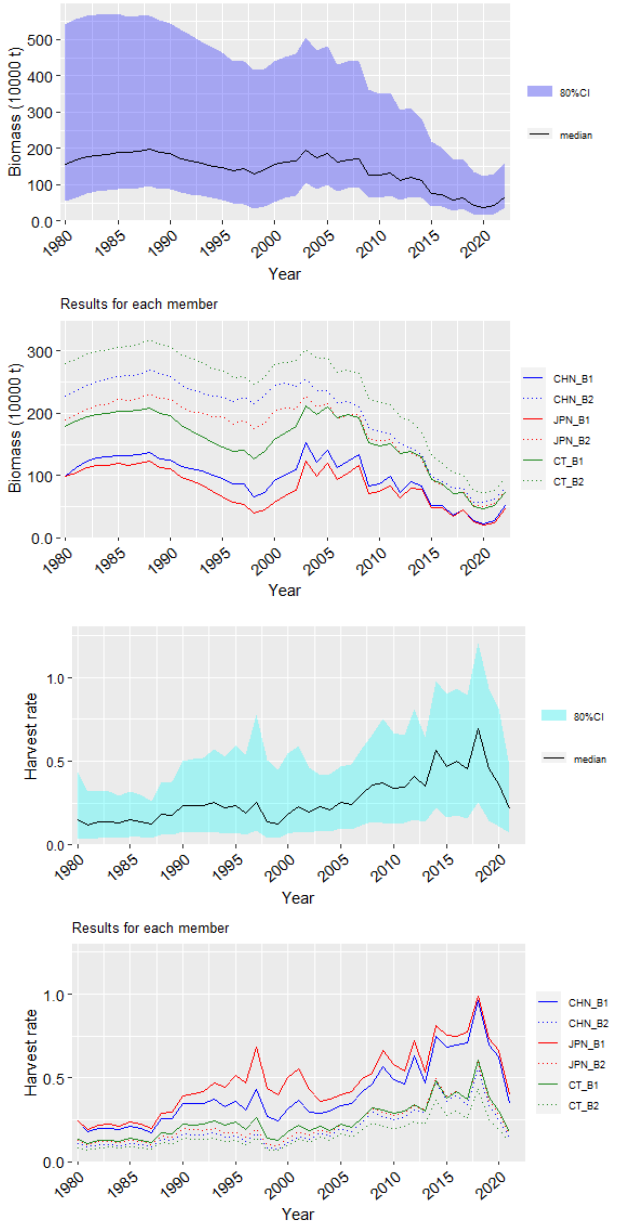
4.3.4 Kobe plots



5 SOME AGGREGATED RESULTS FOR VISUALIZATION PURPOSE

5.1 Visual presentation of results

The graphical presentations for times series of biomass (B), B-ratio (B/B_{MSY}), exploitation rate (F), F-ratio (F/F_{MSY}) and B/K are shown in Figure 3.



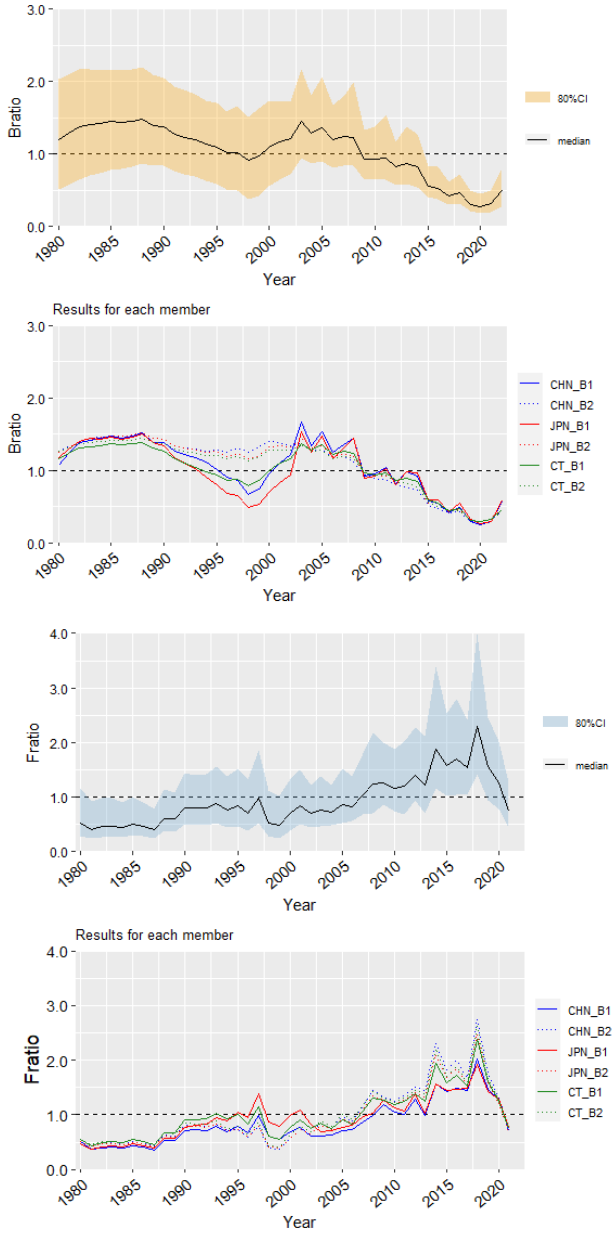


Figure 3. Time series of median estimated values of six runs for biomass, harvest rate, B-ratio, F-ratio and depletion level relative to K. The solid and shaded lines correspond to B1 and B2, respectively.

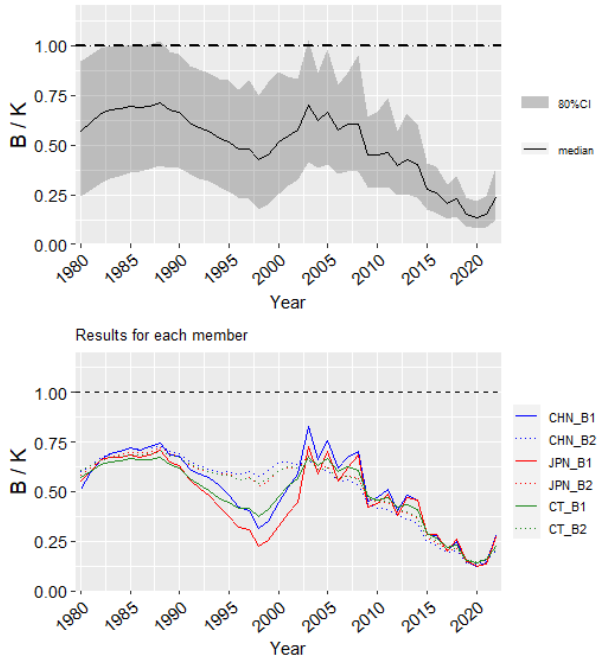


Figure 3 (Continued).

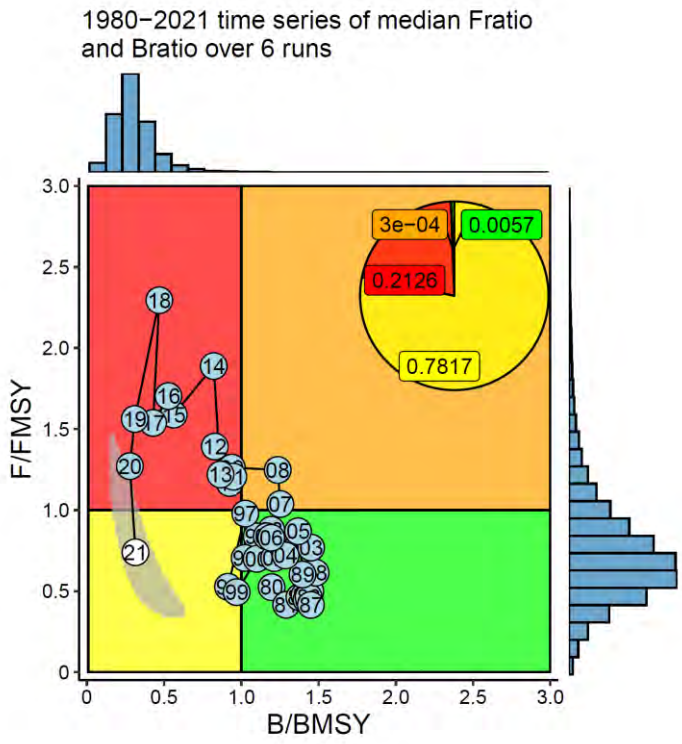


Figure 4. Kobe plot with time trajectory. The data are aggregated across 6 model results (2 base-case models by 3 Members).

5.2 Summary table

Table 3. Summary of estimates of reference quantities. Median and credible interval for the aggregated results are presented. In addition, median values of Member's combined results (over B1 and B2) are shown.

	Median	Lower10%	Upper10%	Median_CHN	Median_JPN	Median_CT
C_2021 (10000 t)	9.221	9.221	9.221	9.221	9.221	9.221
AveC_2019_2021 (10000 t)	14.141	14.141	14.141	14.141	14.141	14.141
AveF_2019_2021	0.350	0.111	0.733	0.402	0.456	0.238
F_2021	0.213	0.071	0.467	0.241	0.287	0.149
FMSY	0.313	0.084	0.619	0.363	0.407	0.206
MSY	40.281	29.911	51.100	41.316	40.649	38.850
F_2021/FMSY	0.739	0.452	1.259	0.729	0.740	0.751
AveF_2019_2021/FMSY	1.192	0.757	1.883	1.203	1.169	1.211
K (10000 t)	281.400	142.200	919.083	249.200	224.579	398.200
B_2021 (10000 t)	43.260	19.750	129.400	38.260	32.149	61.950
B_2022 (10000 t)	65.500	36.900	162.000	62.190	56.264	82.035
AveB_2020_2022 (10000 t)	49.147	25.386	138.103	44.845	39.111	66.877
BMSY (10000 t)	131.800	70.360	409.910	118.800	104.432	186.400
BMSY/K	0.469	0.386	0.621	0.465	0.460	0.503
B_2021/K	0.151	0.088	0.240	0.149	0.147	0.159
B_2022/K	0.237	0.122	0.385	0.243	0.251	0.216
AveB_2020_2022/K	0.177	0.103	0.270	0.176	0.179	0.175
B_2021/BMSY	0.315	0.198	0.499	0.310	0.311	0.327
B_2022/BMSY	0.494	0.272	0.810	0.499	0.532	0.447
AveB_2020_2022/BMSY	0.368	0.232	0.564	0.364	0.377	0.360

6 CONCLUDING REMARKS

See the Executive Summary.

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Appendix 1

Updated total catch, CPUE standardizations and biomass estimates for the stock assessment of Pacific saury

Year	Total catch (metric tons)	Biomass JPN (VAST, 1000 metric tons)	CV (%)	CPUE CHN (metric tons/ vessel/ day)	CPUE JPN_early (metric tons/ net haul)	CPUE JPN_late (metric tons/ net haul)	CPUE KOR (metric tons/ vessel/ day)	CPUE RUS (metric tons/ vessel/ day)	CPUE CT (metric tons/ net haul)	Joint CPUE (VAST)	CV (%)
1980	238510				0.72						
1981	204263				0.63						
1982	244700				0.46						
1983	257861				0.87						
1984	247044				0.81						
1985	281860				1.4						
1986	260455				1.13						
1987	235510				0.97						
1988	356989				2.36						
1989	330592				3.06						
1990	435869				1.95						
1991	399017				3.13						
1992	383999				4.32						
1993	402185				3.25						
1994	332509					3.91		16.97		1.29	0.35
1995	343743					2.12		20.10		1.60	0.36
1996	266424					1.76		16.10		0.67	0.35
1997	370017					3.65		11.69		1.34	0.36
1998	176364					0.98		12.47		0.79	0.37
1999	176498					0.82		12.57		0.50	0.39
2000	286186					1.24		17.30		0.91	0.37
2001	370823					1.63	7.75	21.09	1.57	0.90	0.29
2002	328362					1.08	9.59	20.02	1.63	0.68	0.28
2003	444642	1263.3	22.5			2.05	14.03	35.92	2.67	1.18	0.28
2004	369400	725.7	20.4			2.61	9.61	47.06	1.45	1.08	0.28
2005	473907	962.7	30.9			4.32	17.32	49.53	2.38	1.63	0.27
2006	394093	644.9	27.4			4.52	7.89	34.60	1.27	0.59	0.27
2007	520207	700.5	29.9			4.17	7.50	43.16	2.37	1.05	0.27

2008	617509	1007.1	26.1		5.15	16.04	42.40	2.90	1.95	0.28
2009	472177	427.8	21.9		4.22	7.80	21.29	1.57	1.03	0.28
2010	429808	570.8	27.1		1.78	8.13	23.66	1.93	1.07	0.27
2011	456263	938.2	36.3		2.47	9.08	28.46	2.50	1.26	0.29
2012	460544	330.4	20.2		2.72	8.08	24.47	2.47	1.14	0.27
2013	423790	756.4	25.3	11.39	1.83	11.52	22.13	2.80	1.02	0.27
2014	629576	528.6	21.8	12.47	3.28	17.64	25.35	3.72	1.32	0.27
2015	358883	299.5	19.2	14.49	1.68	6.97	16.48	2.33	0.99	0.28
2016	361688	425.2	25.2	6.81	1.74	9.38	17.76	2.44	0.72	0.27
2017	262639	164.7	25.5	6.66	1.13	4.71	8.59	1.79	0.79	0.27
2018	439079	336.8	26.7	12.78	1.89	10.08	25.92	3.12	1.38	0.28
2019	192377	231.4	21.4	6.71	0.70	2.27	8.47	1.41	0.54	0.27
2020	139646	44.5	112.0	4.81	0.49	2.61	7.20	1.23	0.33	0.29
2021	92206	200.9	31.6	5.04	0.33	2.31	2.82	0.81	0.22	0.28
2022		380.6	19.8							

Annex O

Revised Regulations for Management of Scientific Data and Information

These Regulations are intended to apply while the NPFC develops comprehensive rules and procedures governing the security of, exchange of, access to and dissemination of data and computer code (referred to as code hereafter) held by, or accessed by Members of the Commission, its subsidiary bodies, the Secretariat, and by service providers, contractors, or consultants acting on their behalf or others so authorized for access by the Secretariat.

I. Guidance for Management of Scientific Data and Code

1. Objectives

The objectives of this Guidance are (1) to support stock assessments, ecosystem assessments and accumulation of scientific knowledge of fisheries resources under the Commission's jurisdiction, (2) to encourage cooperation on scientific analyses among Members, and (3) to establish a guidance on handling scientific data and code.

2. Scientific Data included in Members' Annual Reports

Scientific data (e.g., catch amount, number of vessels, number of fishing days and so on) included in Members' Annual Reports should be uploaded to the public section of the NPFC website for public access and use.

3. Other scientific data and code, not included in Members' Annual Reports, submitted for use in stock assessments and ecosystem assessments

The Secretariat should not disclose Members' scientific data or code submitted by means other than Members' Annual Reports or meeting documents open for the public in accordance with paragraph 4.

Members may cite and/or use such data or code when working on matters under consideration by the Scientific Committee and its subsidiary bodies, including informal working groups.

If a Member or cooperating non-Member wishes to cite and/or use these data or code for work that is intended to be conducted or shared outside of the NPFC, such Member or non-Member should consult with the provider(s) of the data or code through the Secretariat, stating 1) the data or code subject to the request, and 2) the purpose for which the data or code is intended to be used. The Secretariat should immediately notify the provider(s) of the request. The provider(s) should inform the Secretariat within 30 calendar days whether to accept or reject the request. If the provider(s) reject the request, the provider(s) should state the reason(s) for the rejection. If the provider(s) accept the request, the provider(s) may request an agreed-upon credit line in any subsequently-created product. Those who cited/used data or code should not distribute the data or code further nor use it for the purpose not declared.

II. Regulations for management of scientific meeting documents, meeting reports and intersessional communications on the NPFC website

4. Working Papers, Meeting Info Papers, Information Papers, Reference Documents/Papers, Observer Papers

To enhance and encourage collaborations with researchers, scientists, RFMOs, and science organizations, and to encourage transparency of the NPFC processes, the SC recommends making the above named documents available to the public through the NPFC website. The default rule would be that all the above named documents would be released to the public 45 days (inclusive of weekends and holidays) following the closure of the meeting to which they were submitted. All meeting papers submitted to any NPFC scientific meetings through the Secretariat should indicate how they should be cited in accordance with the NPFC Document Rules. If the document author(s) or submitting Member do not authorize the release of the document, they must indicate that clearly on the cover page or first page of the document, OR they may request to the Secretariat in writing of their desire to not release the document during the 44 days prior to document publication on the website.

5. SC Meeting Reports, SC Subsidiary Body Reports (SSC, TWG) and Other Scientific Reports (Workshop)

5.1. The SC recommends that the above named documents be released to the public after acceptance by the Commission Members within 45 days in accordance with the procedures stated in Paragraph 8.2 of Rules of Procedure.

5.2. For SC subsidiary body reports: If there are portions of the report which are deemed by the subsidiary body to be too sensitive to release prior to the SC report, the specific sensitive portions may be redacted, and the report released as described in #5.1 above. Following the SC meeting, the entire report (inclusive of redacted portions) will be released in conjunction with the SC report. If the report as a whole is deemed too sensitive to release, the report may be held and released to the public in conjunction with the SC Meeting Report. Decisions about which portion or whether the whole report is to be redacted shall be made during the subsidiary body meeting.

6. Intersessional Communication using the NPFC Collaboration website

The NPFC has made available a web-based tool to facilitate discussion of its subsidiary bodies, informal working groups, discussion groups, and other temporary groups on a project-by-project basis. Access to this tool is restricted to members of a specific project/topic. Following the completion of the discussion, the group facilitator/chair may summarize the discussions to make them available and accessible to the appropriate Commission body (TCC, SC, SWG MSE PS, Commission). At the conclusion of the discussions of the group and after summary is complete, the discussion text and documents will be archived by the Secretariat but not maintained on the website except for a summary made by the group facilitator/chair.

7. Redaction or withdrawal of Working Papers, Meeting Info Papers, Information Papers, Reference Documents/Papers, Observer Papers which were submitted to workshop or meeting

Documents of the types listed above may not be redacted or withdrawn from the public or Member-only area of the website by a Member or the Secretariat once it has been published unless notification is provided to all Members which details the reason for the withdrawal request. If an error is identified in a publicly available document, the member responsible for the document submission can submit a cover letter or document text which describes the error and the resolution to be prepended to the original document. Errors identified in documents prior to publication on the public website or during meetings or workshops can be revised or documents withdrawn before or during the meeting, but other members or meeting participants must be notified of the specifics of the changes as soon as possible.

Annex P

Scientific projects

#	Project	Time	Status	Next step: activities, required funds
1.1	GIS database/module as a part of NPFC database management system for spatial management of bottom fisheries and VMEs	2018-	*In progress* A map of bottom fishing footprint has been deployed on the NPFC website.	Further development of the map. *2023 FY: 0,7mil JPY (5,000USD).* *Source: Database management.*
1.2	Joint spatial/temporal map of Members' catch and effort on Pacific saury with a spatial resolution of one-degree grids and a temporal resolution of one month.	2018-	*In progress.* Spatial/temporal map of Members' Pacific saury catch and effort has been updated up to 2021.	Update the map up to 2022. *2023 FY: 0,2mil JPY (1,500USD).* *Source: Database management.*
2	Pacific saury stock assessment meeting (meeting costs)	Every year	*TWG PSSA meetings: Feb 2017, Dec 2017, Nov 2018, Mar 2019.* *SSC PS meetings: Nov 2019, Nov 2020, Oct 2021.*	SSC PS11 meeting. Dates TBD. *2023 FY: 1.4mil JPY (10,000USD)* *Source: SC fund.*
3	Chub mackerel stock assessment meeting (meeting costs)	Every year	*TWG CMSA meetings: Dec 2017, Mar 2019, Nov 2020, Jun 2021.*	TWG CMSA07 and 08 meetings. Dates TBD. *2023 FY: 4.2mil JPY (15,000USD x 2 mtngs)* *Source: SC fund.*
4	Expert to review Pacific saury stock assessment (consultant fee and travel costs)	TBD	*Under consideration.* SSC PS: to determine time and format.	*2023 FY: No funds required.*

5	Observer Program	2018-	*In progress* A study on the existing observer programs of Members and those of other RFMOs has been done. Scientific data which can be collected and/or validated by at-sea observers, fishermen, electronic reporting systems and other means for Pacific saury have been reviewed (SSC PS04 report, Annex E).	Identify data gaps which can be fulfilled by an observer program. *2023 FY: No funds required.*
6	Promotion of cooperation with NPAFC including macro-scale multinational survey in the North Pacific in 2022	2021-	*In progress*. The SC provided suggestions to the work plan to implement the MOC between the NPFC and NPAFC. The NPAFC reported on the 2022 IYS Winter High Seas Research Expedition which was co-sponsored by NPFC.	*2023 FY: No funds required.*
7	Invited expert to support TWG CMSA (consultant fee and travel costs)	2020-	An external expert has been contracted to support the TWG CMSA in testing candidate stock assessment models.	*2023 FY: 1,4mil JPY (10,000USD)* *Source: SC fund.*
8	Invited expert to support SSC PS (consultant fee and travel costs)	2019-	An external expert has been contracted to support SSC PS during its meetings.	*2023 FY: 2.1mil JPY (15,000USD)* *Source: SC fund.*

9	Standardization of bycatch species list and fish species identification guides (translation of the existing fish ID guide from Japanese to additional languages)	2019-2022	*In progress.* Bycatch species list has been compiled. The fish ID guide has been submitted to SSC BF-ME for review.	Printing costs. *2022 FY: 1.4mil JPY (10,000USD).* *Source: SC fund.*
10	PICES Annual meeting	Every year		*Travel support to a participant of the SC or its subsidiary bodies.* *2023 FY: 1mil JPY (7,000USD)* *Source: SC fund.*
11	SWG MSE PS (meeting costs)	2022-	*Proposed.*	SWG MSE PS04. Dates TBD. *2023 FY: 1.4mil JPY (10,000USD)* *Source: Special Project fund.*
12	PICES 2023 session on Seamount Ecology and VME Identification	2023	*Proposed.* This session will be co-convened by SC participants, and WG47 co-chairs and members.	*2023 FY: 0.7mil JPY (5,000USD)* *Source: SC Fund*
13	Understanding the basis by which other RFMOs' VME encounter thresholds were determined by taxa and gear-type	2023	*Proposed.*	*2023 FY: 0.7mil JPY (5,000USD)* *Source: SC Fund*
	Total			*2022 FY: SC Fund 1.4mil JPY.* *2023 FY: SC Fund 11,5mil.* *Database management 0.9mil.* *2023 FY: Special Project Fund 1.4mil JPY.*

** The recurrent projects should be funded annually from the SC Fund allocated by the Commission. If total costs exceed the SC Fund, the SC may propose to use the Special Project Fund subject to the decision by the Commission.*

Past projects

#	Project	Time	Status	Next step: activities, required funds
1	NPFC/FAO VME workshop	2018-2019	*Concluded.*	
2	Workshop to address data requirements and data sharing for SAI assessment and other tasks identified in the Work Plan by SSC VME and SSC BF	2018	*Concluded.*	
3	Workshop on biological reference points (BRP), harvest control rule (HCR) and management strategy evaluation (MSE)	2019	*Concluded.*	
4	Literature review of target and limit reference points used in pelagic species fisheries by other general RFMOs and other fishery management bodies	2018	*Done.* *Available on the NPFC website.*	
5	Joint PICES-NPFC workshop (W11) on *The influence of environmental changes on the potential for species distributional shifts and subsequent consequences for estimating abundance of Pacific saury*	2019	*Concluded.*	

6	VME taxa identification guide	2017-2022	*Concluded.* VME taxa ID guide has been printed out and distributed to Members.	Test the VME taxa ID guide by observers and revise if needed.
7	International Course for NPFC observers for VME indicator taxa identification (consultant fees and travel costs for two lecturers, meeting costs)	2022	*Postponed until further notice.*	
8	PICES-ICES-FAO Small Pelagic Fish Symposium, 7-11 November 2022, Lisbon, Portugal.	2022	*Concluded.* NPFC contributed 15,000USD to the organizers for the symposium logistics.	

Five-year Work Plan to implement NPAFC/NPFC Memorandum of Cooperation

Exchange of data and information in accordance with the information-sharing and data confidentiality policies of each Commission;

- Create a SharePoint inter-commission communication system to share news, reports, guideline documents, and other information relevant to the management of the mutual area of interest in an easily accessible form.

Timeline	Deliverables	Milestones
August 2021–June 2022	NPAFC/NPFC Sharepoint Terms of Reference to describe structure, capabilities, access rights, and control issues NPAFC/NPFC Sharepoint service in a test mode NPAFC/NPFC Sharepoint service in full operational mode	Terms of Reference (ToR) agreed by both commissions – September 15, 2021 Test mode – December 31, 2021 Full operational mode – June 30, 2022

- Establish a mechanism of general information exchange (e.g., MCS activity information, fleet activity information, map of catch and fishing efforts).

Timeline	Deliverables	Milestones
August 2021–December 2022	NPAFC/NPFC communication and information exchange plan Regular mutual email conferences to exchange MCS and enforcement activities information	A plan agreed by the commissions – First half of 2022 Summer–autumn of 2022
2022–2025	NPFC historical footprint (catch and fishing efforts) of the fisheries Annual data reporting/sharing of Pacific salmon as by-catch by NPFC fishing vessels	Pacific saury – available on the NPFC website Japanese sardine – … Mackerel – … Japanese flying squid – …

	Interactive Mapping System (IMS) for the INPFC/NPAFC High-Seas Salmonid Tag-Recovery Database	IMS in a test mode with limited access – May 2022. IMS in full operational mode – May 2023

- Establish a practice of sharing information on suspicious fishing vessels identified in overlapping convention area including stateless vessels and unregistered vessels.

Timeline	Deliverables	Milestones
August 2021–June 2022	Vessel of Interest folder which has been treated as confidential at the NPAFC/NPFC Sharepoint	Vessel of Interest folder description is included in the ToR agreed by the commissions – September 15, 2021 Vessel of Interest information is included in the folder – June 30, 2022

Collaboration on research efforts relating to stocks and species of mutual interest, including stock assessments;

- Implement Pan-Pacific research survey plans in winter 2022, organize a comprehensive study of its outcome at the special session of the IYS Synthesis Symposium.

Timeline	Deliverables	Milestones
August 2021–February 2022	NPFC proposal to the Pan-Pacific High Seas Research Expedition cruise plans NPFC participation in the country leads meetings to coordinate/contribute to the Expedition plans	NPFC proposal submitted to the NPAFC – November 2021 [Status: The proposal was presented at the NPFC country leads meeting on 13 October and then revised by the NPFC SC following the feedback from the meeting.]

		NPFC Science Manager / Scientific Committee Chairperson participates in the country leads meetings in August 2021–February 2022 NPAFC presents a report on the expedition finding after its completion in 2022

- ~~Harmonize~~ Coordinate research activities identified in the NPFC/PICES and NPAFC/PICES Frameworks for Enhanced Scientific Cooperation in the North Pacific Ocean.

Timeline	Deliverables	Milestones
October 2021–May 2023	~~Harmonization~~ Coordination of ~~the~~research activities identified in the NPFC/PICES and NPAFC/PICES Frameworks ~~agreed with PICES~~ ~~First draft and final version of the NPAFC/NPFC/PICES Framework for Enhanced Scientific Cooperation in the North Pacific Ocean~~	~~PICES Annual Meeting in October 20212022, a Study Group is created~~ ~~First draft Framework is produced by the Study Group July 20222023~~ ~~Final version of Framework is adopted by NPAFC, NPFC, and PICES May 20232024~~

Implementation of conservation and management measures for stocks and species of mutual interest;

- Establish a mechanism to share the IUU vessel list of each Commission and its related information.

Timeline	Deliverables	Milestones
August 2021–May 2022	Accessible links to the NPAFC and NPFC IUU vessel list on both Commissions' website	NPAFC is developing the IUU vessel listing process with a study group, and the

		NPAFC IUU vessel list is expected to be established for the first time – May 2022

- Expand cooperation to collect and share information relating to species of special interest for each Commission.

Timeline	Deliverables	Milestones
August 2021–December 2025	Information exchange on research cruise plans that can collect information on Pacific salmon and NPFC priority species Mutual scientific documents and publications on Pacific salmon and NPFC priority species distribution, relationships, and potential impact	Lists of scientific cruise plans are exchanged – May 2022 NPAFC/NPFC/PICES Topic Session (or Workshop) on this issue is proposed for October ~~2022~~ 2023 at the PICES Annual Meeting Mutual scientific documents and publications on Pacific salmon and NPFC priority species are published in 2023–2025

- Develop, publish, and distribute public information about conservation on the high seas and consequences of IUU activity.

Timeline	Deliverables	Milestones
2021–2025	News releases and journal articles on the Commissions activities related to high seas resources conservation, MCS, and law enforcement	Secretariats annually exchange information on the relevant publications

For each agreed item a timeline, milestones, and deliverables will be mutually developed. Work plan will be discussed by the commissions and mutually agreed before June 2022.

Note: SC-related items are highlighted with grey.

Five-Year Research Plan and Work Plan of the Scientific Committee

North Pacific Fisheries Commission
Scientific Committee
2022-2026 Research Plan

1.0 BACKGROUND

Article 10, Section 4(a) of the *Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean* states that the Scientific Committee (SC) will "recommend to the Commission a research plan including specific issues and items to be addressed by the scientific experts or by other organizations or individuals, as appropriate, and identify data needs and coordinate activities that meet those needs."

An initial draft of this research and accompanying work plan was presented for review during the 4th Preparatory Conference and a subsequent discussion was held by a small working group to establish science priorities for the NPFC. This plan draws on those discussions and was updated by the SC Chair based on the progress made by the NPFC since that Conference.

The development of multi-year science research or work plans is common across regional fisheries management organizations as well as domestic fisheries science agencies. This draft plan draws on such examples, and has been developed for consideration by the SC before it may be adopted by the Commission.

2.0 OBJECTIVES

The research plan is intended to guide the work of the Scientific Committee by identifying key research priorities and associated areas of work to be undertaken or maintained. The plan should also serve to: ensure efficient utilization of scarce resources within the Commission; inform Parties' domestic research planning as a means of complementing the Commission's science activities; and help the Commission identify potential sources of external funding.

It is not intended as an exhaustive plan describing all research activities that may be carried out by Parties, nor is it intended to preclude work already taking place. The plan should support the Commission's primary objective (*Article 2* in the Convention), which is to "ensure the long-term conservation and sustainable use of the fisheries resources in the Convention Area while protecting the marine ecosystems of the North Pacific Ocean in which these resources occur". The plan should also help the Scientific Committee fulfill its functions as specified in the Convention.

3.0 PRIORITY RESEARCH AREAS

In addition to discussions held during the Preparatory Conference (referenced above) followed by the Commission and Scientific Committee after their establishment, the identification of priority research areas draws largely from the Commission's Convention, which outlines specific functions for the Scientific Committee in *Article 10, Section 4*. These priority research areas are subject to the approval of the Commission, and may be revisited and/or revised as deemed appropriate by the Commission. Proposed rolling five-year work plans for each priority area are available in the attached (Annex 1).

The proposed priority research areas are:
1. Stock assessments for target fisheries and bycatch species
2. Ecosystem approach to fisheries management
3. Data collection, management and security

3.1 Stock Assessments

Rationale

Accurate stock assessments are critical in helping to ensure the long-term conservation and sustainable use of fisheries resources in the Convention Area. One of the primary functions of the Commission is setting total allowable catch or total allowable level of fishing effort, and as per *Article 7-1(b)*, this is to be in "accordance with the advice and recommendations of the Scientific Committee".

Consistent with this, *Article 10-4(b)* states that one of the functions of the Scientific Committee is to "regularly plan, conduct and review the scientific assessments of the status of fisheries resources in the Convention Area, identify actions required for their conservation and management, and provide advice and recommendations to the Commission".

Finally, *Article 10-4(i)* states that the Scientific Committee shall also "develop rules and standards, for adoption by the Commission, for the collection, verification, reporting, and the security of, exchange of, access to and dissemination of data on fisheries resources, species belonging to the same ecosystem, or dependent upon or associated with the target stocks and fishing activities in the Convention Area".

The Scientific Committee should endeavor to understand the current status and trends in production of populations of priority species as agreed by the 2nd Commission meeting in 2016, as well as

factors that may affect future trends.

Areas of work

• Development of baseline assessment of the status of priority stocks
• Review of existing data standards in relation to stock assessments (e.g. Annual Report template, future vessel monitoring system)
• Stock delineation of important commercial species for the purpose of providing advice for the determination of management units
• For each commercial species, determination of data requirement, including data availability and data gaps; identification, where possible, of strategies to fill the data gaps, including for bycatch
• Development of a standardized method to provide advice to the Commission
• Development of assessment models by species and research as required to determine various assessment parameters

3.1.1. Pelagic fish stock assessment

Rationale

Pelagic fish and squids are primary fisheries resources for NPFC Members. They comprised more than 99% of total catch of species covered by the Convention. Many of them are migratory species with wide geographical distributions which include both EEZs of the North Pacific Rim countries and High Seas. Management of such stocks requires close cooperation among Members concerned to ensure sustainable use and conservation of fisheries resources.

Four fish species and two squid species were recognized by the Scientific Committee as priority species: Pacific saury *Cololabis saira*, Chub mackerel *Scomber japonicus*, Blue mackerel *Scomber australasicus*, Japanese sardine *Sardinops melanostictus*, Neon flying squid *Ommastrephes bartramii*, Japanese flying squid *Todarodes pacificus*.

Areas of work

• Completion of stock assessment for Pacific saury and development of the framework and timeline for its regular improvement and update
• Conducting stock assessment for Chub mackerel and other priority species considering their top-down prioritization (Spotted mackerel - Japanese sardine - Neon flying squid – Japanese flying squid) and available funds and capacity
• Identification of data gaps, determination of activities to address those gaps and development of

standards and mechanisms for data collection and verification

• Develop a management strategy evaluation (MSE) for Pacific saury in collaboration with NPFC's Commission, Small Working Group on Management Strategy Evaluation for Pacific Saury (SWG MSE PS), Technical and Compliance Committee (TCC),, fishery managers, fishers, stakeholders, and observers.

3.1.2. Bottom fish stock assessment

Rationale

Data used for traditional stock assessment are sparse for bottom fish, and it is unlikely that traditional methods will be applicable for most deepwater species in the Convention Area. In addition, some bottom species have unique life cycles, sporadic recruitment patterns and irregular spawning-recruitment relationships that also makes difficult accurate stock assessment. All these require specific approaches for management and sustainable use of bottom fisheries resources. More than ten bottom species have been exploited by fisheries in the Convention Area during the last two decades. Two fish are recognized as priority species: North Pacific armorhead (NPA) *Pentaceros wheeleri* and splendid alfonsino (SA) *Beryx splendens*.

Areas of work

• Review of approaches applicable for stock assessment of target bottom species and investigate various management strategies
• Further development of the Adaptive Management approach for NPA and mechanism for its implementation
• Identification of data needs and establishment of activities to fill data gaps

3.2 Ecosystem Approach to Fisheries Management

Rationale

Article 3 (c) in the Convention states that: "In giving effect to the objective of this Convention, the following actions shall be taken individually or collectively as appropriate: (c) adopting and implementing measures in accordance with the precautionary approach and an ecosystem approach to fisheries, and in accordance with the relevant rules of international law, in particular as reflected in the 1982 Convention, the 1995 Agreement and other relevant international instruments".

Article 7-1 (c,d) in the Convention states that the Commission shall: "adopt, where necessary, conservation and management measures for species belonging to the same ecosystem or dependent upon or associated with the target stocks"; and, "adopt, where necessary, management strategies for any fisheries resources and for species belonging to the same ecosystem or dependent upon or associated with the target stocks, as may be necessary to achieve the objective of this Convention."

Article 10-4 (d) states that the Scientific Committee shall *"*assess the impacts of fishing activities on fisheries resources and species belonging to the same ecosystem or dependent upon or associated with the target stocks."

Areas of work

• Formulation of a work plan on how to implement the ecosystem approach to fisheries management in the Convention Area
• Vulnerable Marine Ecosystems
• Understand ecological interactions among species
• Ecosystem modelling
• Evaluate impacts of fishing on fisheries resources and their ecosystem components, including bycatch species
• Other issues related to marine ecosystems including marine debris and pollution

3.2.1 Vulnerable Marine Ecosystems

Rationale

The identification of vulnerable marine ecosystems is a necessary precursor to implementing measures to protect these ecosystems, and such measures are explicitly called for in the Convention (e.g. *Article 7-1(e)*).

Article 10-4 (e) states that the Scientific Committee shall "develop a process to identify vulnerable marine ecosystems, including relevant criteria for doing so, and identify, based on the best scientific information available, areas or features where these ecosystems are known to occur, or are likely to occur, and the location of bottom fisheries in relation to these areas or features, taking due account of the need to protect confidential information."

Article 7-1 (e) states that the Commission shall "adopt conservation and management measures to prevent significant adverse impacts on vulnerable marine ecosystems in the Convention Area, including but not limited to: measures for conducting and reviewing impact assessments to

determine if fishing activities would produce such impacts on such ecosystems in a given area; measures to address unexpected encounters with vulnerable marine ecosystems in the course of normal bottom fishing activities; and as appropriate, measures that specify locations in which fishing activities shall not occur."

To date, Japan, Russia, Korea, the US and Canada have completed a report on identification of VMEs and an assessment of impacts caused by bottom fishing activities on VMEs and marine species. The Scientific Committee may build on these reports, which will be kept up to date by respective Parties.

Areas of work

• Review existing NPFC standards on VME data collection, including guidelines set forth in the CMMs for bottom fisheries and protection of vulnerable marine ecosystems in the northwestern and northeastern Pacific Ocean (CMM 2021-05 and CMM 2019-06), and determine if any modifications to these standards are needed in the short-term and/or longer term
• Review of Encounter Protocol for bottom fisheries on Vulnerable Marine Ecosystems
• Determination of data requirements and identification of what data may be collected through commercial fishing operations
• Develop consensus on criteria used to identify VMEs and how this might be applied in the NPFC (note that guidelines from the FAO are already referenced in Annex 2 of the CMM 2021-05 and CMM 2019-06)
• Analysis of known or suspected VMEs in the Convention Area
• Visual surveys of VMEs for data collection
• Development of a framework to conduct assessments of Impacts of Bottom Fishing Activities on Vulnerable Marine Ecosystems

3.2.1.1 Review of Encounter Protocol for bottom fisheries on Vulnerable Marine Ecosystems

Rationale

The purposes of VME encounter protocols in NPFC Convention Area include:
• Ensuring early detection and protection of potential VMEs within an existing fishing area;
• Ensuring early detection and protection of potential VME within an unfished area;
• Documenting information on known occurrences of VME indicators within the Convention Area.

Development of the Encounter Protocol progressed through Scientific Committee meetings as well

as intersessional activities. VME encounter protocols are incorporated in the CMMs for bottom fisheries and protection of vulnerable marine ecosystems in the northwestern and northeastern Pacific Ocean, specifically in Para 4(g) and 3(j), respectively.

Areas of Work

Consideration of the following subjects of research and analyses are recommended to further refine encounter protocols in the Convention Area (as notified in Appendix C, NPFC01-2016-SSCVME01- Final Report):

• Other taxa, topographical, geographical and geological features that may indicate the presence of VMEs;
• Taxon-specific encounter thresholds and reporting;
• Framework for evaluating the effectiveness of encounter protocols;
• Tiered approach with different encounter protocols associated with different thresholds;
• Gear-specific thresholds to reflect differences in catchability;
• Gear-specific move-on distances to reflect type of gear;
• Different reporting requirements for different catches;
• Tiered approach to reporting bycatch of VME indicator taxa;
• Different encounter protocols for existing and new fishing areas

3.3 Data collection, management and security

Rationale

Article 10, paragraph 4 (i) in the Convention states that the functions of the Scientific Committee shall be to: "develop rules and standards, for adoption by the Commission, for the collection, verification, reporting, and the security of, exchange of, access to and dissemination of data on fisheries resources, species belonging to the same ecosystem, or dependent upon or associated with the target stocks and fishing activities in the Convention Area".

Areas of work

• Review of data standards related to stock assessments and other relevant data, including VME data collection and vessel monitoring systems
• Identify data sources to meet data needs for priority areas of work above and develop programs for data collection
• Develop data security policy including data handling and sharing protocol, information

confidentiality classification and access control security guideline

4.0 IMPLEMENTATION AND REVIEW

The SC will review the Research Plan and update it as necessary on an annual basis. The Research Plan will form the foundation of SC's rolling five-year Work Plan. Monitoring the implementation of this Research Plan will be the responsibility of the Chair of the Scientific Committee in collaboration with the Chairs of the Scientific Committees' subsidiary groups and the Executive Secretary. Members of the Commission and the Secretariat will share responsibility for implementation of the Research Plan.

Full implementation of the Research Plan will likely be beyond the means of the Commission's core budget. Extra-budgetary funds from voluntary contributions of Members and other sources will be required and actively sought by the Commission. Nevertheless, adoption of the Plan by the Scientific Committee and subsequent strong support from the Commission is a prerequisite to securing the necessary extra-budgetary funds.

An independent external review of the Plan may periodically be requested by the SC. The Scientific Committee will be responsible for preparing the terms of reference for the review. The Scientific Committee will present the report of the review to the next regular session of the Commission.

5.0 SCIENTIFIC COLLABORATION WITH OTHER ORGANIZATIONS

While not included as a priority, *Article 21* of the Convention addresses cooperation with other organizations or arrangements. It calls on the Commission to cooperate, as appropriate, on matters of mutual interest with the Food and Agriculture Organization (FAO), other specialized agencies of the FAO and relevant Regional Fisheries Management Organizations (RFMOs). Further, the Commission is called on to develop cooperative working relationships, including potential agreements, with intergovernmental organizations that can contribute to its work.

Article 10 also speaks to this issue in clauses five and six, stating that the Scientific Committee may exchange information on matters of mutual interest with other relevant scientific organizations or arrangements, and that the Committee shall not duplicate the activities of other scientific organizations and arrangements that cover the Convention Area.

The impetus to collaborate is made stronger by the prospect of limited research funding in the Commission, at least in the short-term, but it is also in the best interests of the Commission to seek synergies with other organizations with mutual interests and similar membership (e.g. North Pacific

Marine Science Organization (PICES) and North Pacific Anadromous Fish Commission (NPAFC)).

Activities could include:

• Evaluate reports of International Organizations that may be relevant to the functioning of the Scientific Committee
• Identify other organizations with relevant mandates and activities
• Formalize relationships with these organizations (e.g. MOUs, standing invitations to meetings)
• Identify potential funding opportunities

Five-Year Work Plan of the Scientific Committee and its subsidiary bodies

Small Scientific Committee on Pacific Saury (SSC PS)

Priority list:

1. Conduct a stock assessment update based on BSSPM analyses
2. Further investigate improvements to the BSSPM
3. Develop an age/size-structured model
4. Develop a list of plausible ranges for biological parameters
5. Develop databases to support age/size-structured models
6. Continue joint CPUE work to incorporate broader spatial and temporal coverage
7. Update the biomass estimate using the existing method (swept area method)
8. Develop spatio-temporal model for the biomass estimate
9. Further refine the catchability coefficient of the Japanese survey and characterize its variance
10. Develop a longer-term roadmap for work related to Pacific saury stock assessment
11. Set biological reference points
12. Support any technical work on MSE under SWG MSE PS

[H] and [M] indicate high and medium priorities. Cells with "TBD" depend on the progress of data preparation and analytical works.

ITEM	2022	2023	2024	2025	2026
Regular update of inputs					
Update & improvement of biomass survey index	Continue regular review [H] of 1) survey plan 2) analytical work 3) any related issues	Continue regular review [H] of 1) survey plan 2) analytical work 3) any related issues including experiments to produce absolute biomass index and additional surveys by other Members to increase coverage	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]
Update & improvement of CPUE indices	Continue review of outcomes of regular update and analytical works [H]	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]
Development of joint CPUE index	Continue review of outcomes of regular update and analytical works [H]	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]
Regular update of the existing SA					
Routine update BSSPM as a benchmark	Continue review of outcomes of regular BSSPM update [H]	Same as on the left [H] [1)]	Same as on the left [H] [1)]	Same as on the left [H] [1)]	Same as on the left [H][1)]
Improvement and further investigation of BSSPM	Review any outcomes of improvements, inter alia in light of possible incorporation of environmental information [H]	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]	Same as on the left [H]
Toward age/size-structured models (ASSMs)					
Data inventory (CPUE	Continue update of data	TBD[2)]	TBD[2)]	TBD[2)]	TBD[2)]

ITEM	2022	2023	2024	2025	2026
and size/age in space and time)	for stock assessment with ASSMs [H]				
Summarizing available information on PS biology	Continue update of information for stock assessment with ASSMs [H]	TBD[2)]	TBD[2)]	TBD[2)]	TBD[2)]
Development of models	Finalize models and results of analyses by ASSMs [H]	TBD[2)]	TBD[2)]	TBD[2)]	TBD[2)]
Uncertainty in models (possible link with OM grid under MSE)	Finalize the procedure of assessing model uncertainty [H]	TBD[2)]	TBD[2)]	TBD[2)]	TBD[2)]
Examination of estimation performance and finalization of models	Finalize simulation works [H]	TBD[2)]	TBD[2)]	TBD[2)]	TBD[2)]

[1)] As a backup method as well as an underlying assessment method used in a management procedure, it seems sensible to keep this as one of reference assessment models.

[2)] These items might be re-structured depending on the progress of preparation of data and biological information as well as the development of models.

Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA)

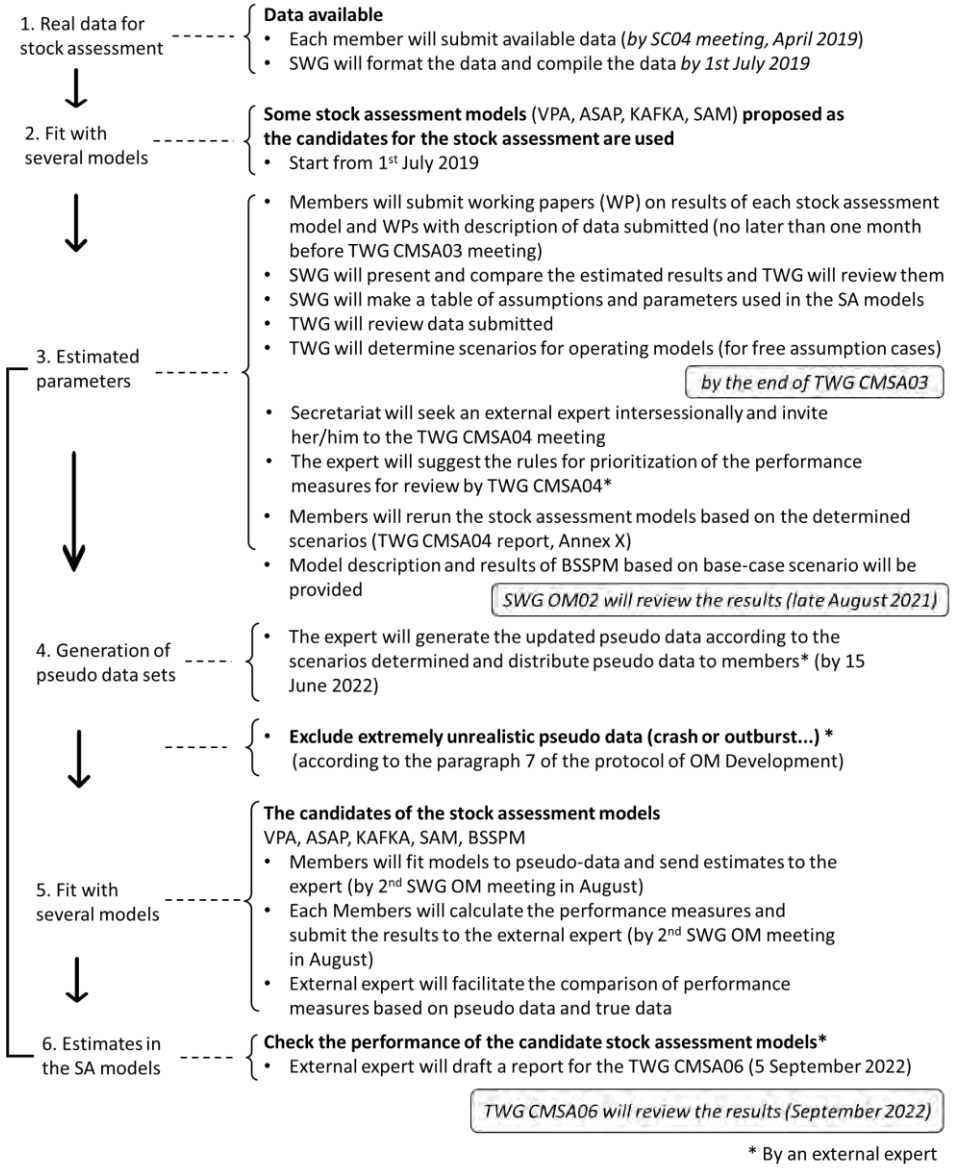
Priority list:

1. Data preparation and review of biological information
2. Develop an operating model
3. Test stock assessment models (VPA, ASAP, KAFKA, SAM, state-space production model)
4. Conduct stock assessment of chub mackerel
5. Set biological reference points
6. Provide scientific advice on the management of chub mackerel stock to the Commission
7. Regularly update and refine inputs

ITEM	2022 autumn	2023 1st half	2023 2nd half	2024	2025	2026
Regular update of inputs						
Research survey indices	Review (Finalize) the data used for the stock assessment	Finalize the data used for the stock assessment	Update	Update	Update	Update
CPUE indices	Review standardized CPUE indices for stock assessment	Finalized CPUE standardization	Update	Update	Update	Update
Catch data/catch composition	Review the data used for the stock assessment	• Finalize the data used for the stock assessment • Submit historical annual CAA data	Update	Update	Update	Update
Biological parameters (maturity, M, weight)	Determine the range of assumption for preliminary stock assessment	Finalize assumptions for the stock assessment	Review biological parameters	Review biological parameters	Review biological parameters	Review biological parameters
Quarterly fishery data (CAA, WAA, Maturity-at-age)		● Summit quarterly fishery data ● Share and standardize age-counting rule				
Operating model (OM)						

ITEM	2022 autumn	2023 1st half	2023 2nd half	2024	2025	2026
Development of operating model						
Testing stock assessment models	• Determine how to rank the stock assessment model candidates based on the performance measures • Choose the best SA model(s)	• Determine performance measures/metrics to choose the best SA model(s) • Determine how to rank the stock assessment model candidates based on the performance measures • Choose the best SA model(s)				
Stock assessment						
Benchmark stock assessment		• Determine the method for future projection • Conduct preliminary stock assessment with the selected model (intersessionally after TWG CMSA07)	Complete stock assessment with the selected SA model(s)	Update SA model	Update SA model	
Improvement and further investigation of the selected model				Review and improve, if needed, the SA model	Review and improve, if needed, the SA model	Review and improve, if needed, the SA model
Toward development of reference points						
Set biological reference points (limit and target)		• Review RPs report • Develop a short list of reference points • Compare robustness of reference points	Choose reference points	Review reference points		

Flowchart for the development of operating models and testing stock assessment models



Small Scientific Committee on Bottom Fish and Marine Ecosystems (SSC BF-ME)

Priority list:

1. NPA and SA: Develop catch and CPUE time series for commercial fisheries
2. NPA: Review survey
3. NPA: Conduct comprehensive stock assessment and provide management advice
4. SA: Conduct comprehensive stock assessment and provide management advice
5. NPA, SA and Sablefish: Develop and implement harvest control rule
6. Sablefish: Evaluate historical harvest relative to trip limits and update trip limits if necessary
7. Sablefish and VME: Conduct trade-off analysis between commercial fishing and VME protection
8. VME: Develop a process for establishing quantitative definitions of VMEs
9. VME: Develop standardized approach to SAI determination

ITEM	SSC BFME03 (2022)	SSC BFME04 (2023)	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)
North Pacific Armorhead					
Assess and monitor status of stock	Update catch data and CPUE index for NPA	Update catch data and CPUE index for NPA	Update catch data and CPUE index for NPA	Update catch data and CPUE index for NPA	Update catch data and CPUE index for NPA
	Review results of NPA monitoring surveys	Review results of NPA monitoring surveys	Review results of NPA monitoring surveys	Review results of NPA monitoring surveys	Review results of NPA monitoring surveys
	Life history based DLM approach	Implement alternative methods for stock status	Update status of stock	Update status of stock	Update status of stock
	Review acoustic survey and research	Compare CPUE and acoustic estimates			

ITEM	SSC BFME03 (2022)	SSC BFME04 (2023)	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)
	Identify and conduct additional research on NPA	Identify and conduct additional research on NPA	Identify and conduct additional research on NPA	Identify and conduct additional research on NPA	Identify and conduct additional research on NPA
	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice
Conserve stock		Develop conservation objective(s)			
		Implement adaptive management			
	Refine harvest control rule if needed	Develop HCR and implement	Update data and implement HCR	Update data and implement HCR	
Splendid alfonsino					
Assess and monitor status of stock	Update catch data and CPUE index for SA	Update catch data and CPUE index for SA	Update catch data and CPUE index for SA	Update catch data and CPUE index for SA	
	DLM approach life history	Update comprehensive stock assessment or data limited approach, and provide management advice	Update comprehensive stock assessment or data limited approach, and provide management advice	Update comprehensive stock assessment or data limited approach, and provide management advice	

ITEM	SSC BFME03 (2022)	SSC BFME04 (2023)	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)
	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	
Conserve stock		Develop conservation objective(s); Define and implement harvest control rule	Update data and implement HCR	Update data and implement HCR	
Sablefish					
Assess and monitor status of stock	Update catch data and CPUE index	Update catch data and CPUE index	Update catch data and CPUE index	Update catch data and CPUE index	Update catch data and CPUE index
	Provide an update on USA-Canada stock assessment models for Sablefish and joint research on Sablefish	Provide an update on USA-Canada stock assessment models for Sablefish and joint research on Sablefish	Provide an update on USA-Canada stock assessment models for Sablefish and joint research on Sablefish	Provide an update on USA-Canada stock assessment models for Sablefish and joint research on Sablefish	Provide an update on USA-Canada stock assessment models for Sablefish and joint research on Sablefish
	Review fisheries observer program data collection for adequacy to produce data	Review fisheries observer program data collection for adequacy to produce data	Review fisheries observer program data collection for adequacy to produce data	Review fisheries observer program data collection for adequacy to produce data	Review fisheries observer program data collection for adequacy to produce data

ITEM	SSC BFME03 (2022)	SSC BFME04 (2023)	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)
	streams to support management advice	streams to support management advice	streams to support management advice	streams to support management advice	streams to support management advice
Conserve stock	Update catch limits relative to stock status	Update catch limits relative to stock status			
Other research	Conduct analysis of sablefish associations with VME (intersessional)				
	Conduct trade-off analysis for Sablefish fishing and VME protection (intersessional)	Update trade-off analysis for Sablefish fishing and VME protection (as new data is available)			
Vulnerable marine ecosystems					
Defining and Identifying VMEs	Bring together VME indicator taxa observation data from various sources and map for NPFC area	Bring together VME indicator taxa observation data from various sources and map for NPFC area			

ITEM	SSC BFME03 (2022)	SSC BFME04 (2023)	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)
	Determine a quantitative definition of VMEs	Review and update quantitative definition of VMEs			
Identifying and defining SAI's	Determine data requirements and resolution for SAI assessment	Apply the standardized approach for SAI assessments and conduct integrated SAI assessment	Conduct integrated SAI assessment	Conduct integrated SAI assessment	Conduct integrated SAI assessment
	Discuss VME indicator taxa and whether species/taxa should be added/subtracted	Review updated taxonomy for corals relative to VME indicator taxa			
Quantifying interactions between fisheries and VMEs	Update spatially explicit fishing effort data	Update spatially explicit fishing effort data	Update spatially explicit fishing effort data	Update spatially explicit fishing effort data	Update spatially explicit fishing effort data
	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice	Review fisheries observer program data collection for adequacy to produce data streams to support management advice
Conserving VMEs	Develop management objectives for recovering VME sites	Develop management objectives for	Periodic review of VME management	Periodic review of VME management	Periodic review of VME management

ITEM	SSC BFME03 (2022)	SSC BFME04 (2023)	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)
		recovering VME sites (lower priority)			
	Literature review on impacts and impact rates by fishing gears				
Other ecosystem components					
	Publication of fish ID guide for scientific observers in the NW Pacific Ocean				

Scientific Committee (SC)

Priority list

As stipulated in the Convention, Article 10, the Scientific Committee shall provide scientific advice and recommendations to the Commission which is considered the highest priority task of the SC. The following priority areas have been identified for SC:

1. Priority species summaries and stock assessments for management advice
2. Management Strategy Evaluation (MSE) for priority species
3. Ecosystem approach to fisheries management: understand ecological interactions among species and impacts of fishing on fisheries resources and their ecosystem components
4. Collaboration with other organizations
5. Regular review of the research plan and work plan
6. Data collection, management, and security

ITEM	2022	2023	2024	2025	2026
Priority Species					
Summaries of priority species	Draft summary sheet	Update summary sheets as needed	Update summary sheets as needed	Update summary sheets as needed	Update summary sheets as needed
Assessment of Blue (Spotted) Mackerel and associated bycatch	Collate data Compile data on the catch composition of Chub Mackerel and Blue Mackerel	Collate data Develop data collection templates and share data	Collate data Determine spatial structure of stocks Undertake baseline stock assessment and provide management advice	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules

ITEM	2022	2023	2024	2025	2026
			including harvest control rules	Collate data on associated bycatch species	Assess impacts of fishery on dependent or associated species
Assessment of Japanese Sardine and associated bycatch	Collate data Develop data collection templates and share data	Collate data Determine spatial structure of stocks Undertake baseline stock assessment and provide management advice including harvest control rules	Collate data Undertake baseline stock assessment and provide management advice including harvest control rules	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules Collate data on associated bycatch species	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules Assess impacts of fishery on dependent or associated species
Assessment of Neon Flying Squid and associated bycatch	Collate data Develop data collection templates Determine spatial structure of stocks	Collate data Undertake baseline stock assessment and provide management advice including harvest control rules	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules Collate data on associated bycatch	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules

ITEM	2022	2023	2024	2025	2026
			species	Collate data on associated bycatch species	Assess impacts of fishery on dependent or associated species
Assessment of Japanese Flying Squid and associated bycatch	Collate data Develop data collection templates	Collate data Determine spatial structure of stocks	Collate data Undertake baseline stock assessment and provide management advice including harvest control rules Collate data on associated bycatch species	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules Develop baseline stock assessment of associated bycatch species	Collate data Update baseline stock assessment as needed and provide management advice including harvest control rules Assess impacts of fishery on dependent or associated species
Management Strategy Evaluation (MSE)					
Pacific Saury	Support NPFC's SWG MSE PS in achieving its goals	Support NPFC's SWG MSE PS in achieving its goals	Support NPFC's SWG MSE PS in achieving its goals	Support NPFC's SWG MSE PS in achieving its goals	Support NPFC's SWG MSE PS in achieving its goals
Ecosystem approach to fisheries management					
Ecological Interactions	Understand ecological interactions among	Understand ecological interactions among	Understand ecological interactions among	Understand ecological interactions among	Understand ecological interactions among

ITEM	2022	2023	2024	2025	2026
	species in the North Pacific Ocean	species in the North Pacific Ocean	species in the North Pacific Ocean	species in the North Pacific Ocean	species in the North Pacific Ocean
Impacts of fishing on ecosystem component	Evaluate impacts of fishing on fisheries resources and their ecosystem components, including bycatch species and discards	Evaluate impacts of fishing on fisheries resources and their ecosystem components, including bycatch species and discards	Evaluate impacts of fishing on fisheries resources and their ecosystem components, including bycatch species and discards	Evaluate impacts of fishing on fisheries resources and their ecosystem components, including bycatch species and discards	Evaluate impacts of fishing on fisheries resources and their ecosystem components, including bycatch species and discards
Collaboration with other Organizations					
PICES	Review implementation of NPFC-PICES Framework for Collaboration Review ICES-PICES WGSPF activities Review PICES WG43 activities	Review implementation of NPFC-PICES Framework for Collaboration Identify other opportunities for collaboration with PICES. Review PICES WG43 activities Review NPFC-PICES	Review implementation of NPFC-PICES Framework for Collaboration Identify other opportunities for collaboration with PICES	Review implementation of NPFC-PICES Framework for Collaboration Identify other opportunities for collaboration with PICES	Review implementation of NPFC-PICES Framework for Collaboration Identify other opportunities for collaboration with PICES

ITEM	2022	2023	2024	2025	2026
		workshop on VME indicator identification			
FAO		Review NPFC's involvement in the 2nd Phase of the GEF-FAO Common Oceans Programme	Review NPFC's involvement in the 2nd Phase of the GEF-FAO Common Oceans Programme	Review NPFC's involvement in the 2nd Phase of the GEF-FAO Common Oceans Programme	Review NPFC's involvement in the 2nd Phase of the GEF-FAO Common Oceans Programme
NPAFC	Review work plan to implement NPFC/NPAFC Memorandum of Cooperation Review NPAFC- NPFC multinational survey program	Undertake scientific activities to achieve relevant deliverables of the work plan	Undertake scientific activities to achieve relevant deliverables of the work plan	Undertake scientific activities to achieve relevant deliverables of the work plan	Undertake scientific activities to achieve relevant deliverables of the work plan
Other organizations	Review collaborations with other organizations	Review collaborations with other organizations	Review collaborations with other organizations	Review collaborations with other organizations	Review collaborations with other organizations
Research and Work Plans					
Terms of Reference	Review SC's Terms of Reference, as needed	Review SC's Terms of Reference, as needed	Review SC's Terms of Reference, as needed	Review SC's Terms of Reference, as needed	Review SC's Terms of Reference, as needed

ITEM	2022	2023	2024	2025	2026
Research Plan	Update SC's rolling 5-year research plan	Update SC's rolling 5-year research plan	Update SC's rolling 5-year research plan	Update SC's rolling 5-year research plan	Update SC's rolling 5-year research plan
Work Plan	Update SC's rolling 5-year work plan	Update SC's rolling 5-year work plan	Update SC's rolling 5-year work plan	Update SC's rolling 5-year work plan	Update SC's rolling 5-year work plan
Projects	Review completed and ongoing projects Identify and prioritize new projects and recommend sources of funding	Review completed and ongoing projects Identify and prioritize new projects and recommend sources of funding	Review completed and ongoing projects Identify and prioritize new projects and recommend sources of funding	Review completed and ongoing projects Identify and prioritize new projects and recommend sources of funding	Review completed and ongoing projects Identify and prioritize new projects and recommend sources of funding
Data Management					
	Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data management policy	Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data management policy	Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data management policy	Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data management policy	Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data management policy
Recommendations					
Advice	Develop	Develop	Develop	Develop	Develop

ITEM	2022	2023	2024	2025	2026
	recommendations for the Commission, TCC, and FAC	recommendations for the Commission, TCC, and FAC	recommendations for the Commission, TCC, and FAC	recommendations for the Commission, TCC, and FAC	recommendations for the Commission, TCC, and FAC
Media Communication					
Press Release	Prepare and publish a press release about SC activities during its meeting	Prepare and publish a press release about SC activities during its meeting	Prepare and publish a press release about SC activities during its meeting	Prepare and publish a press release about SC activities during its meeting	Prepare and publish a press release about SC activities during its meeting