North Pacific Fisheries Commission

NPFC-2024-SC09-Final Report

9th Scientific Committee Meeting
REPORT

17-20 December 2024

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North Pacific Fisheries Commission
9th Meeting of the Scientific Committee

17–20 December 2024

Tokyo, Japan (Hybrid)

REPORT

Agenda Item 1. Opening of the Meeting

1.1 Welcome Address and Introductions

1. The 9th Meeting of the Scientific Committee (SC) was held in a hybrid format, with participants attending in-person in Tokyo, Japan, or online via WebEx, on 17–20 December 2024. The meeting 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. The Deep Sea Conservation Coalition (DSCC), the United Nations Food and Agriculture Organization (FAO), the North Pacific Anadromous Fish Commission (NPAFC), the Ocean Foundation, the Pew Charitable Trusts (Pew), the North Pacific Marine Science Organization (PICES), and the World Wide Fund for Nature (WWF) attended as observers.

2. The meeting was opened by Dr. Janelle Curtis (Canada), who served as the SC Chair. She noted that this operational year marks the 10th anniversary of the NPFC and shared her memories of participating in the NPFC, dating back to the third Preparatory Conference. The Chair highlighted the progress the NPFC's Scientific Committee has made, not only in terms of advancing its conservation and management work, but also in fostering collaboration and strong bonds.

3. The Executive Secretary, Dr. Robert Day, welcomed the participants to the meeting. He reflected on the contributions of past and present members of the Secretariat, including secondees, interns, and consultants, which he too has benefited from, previously as a delegate and now as the Executive Secretary. He noted that the work of the SC and the Commission has continued to expand and expressed the Secretariat's continued commitment to supporting that work.

4. The inaugural SC Chair, Dr. Joji Morishita, looked back on the history of science developments and progress since the 1st SC meeting in 2016. Dr. Morishita expressed his pride

to have chaired the inaugural SC meeting and his sincere gratitude for the contributions of all participants. He also offered particular thanks to the first Executive Secretary, Dr. Dae-Yeon Moon, and the Science Manager, Dr. Aleksandr Zavolokin, for their support. Dr. Morishita explained that, to support the NPFC, as a relatively young regional fisheries management organization (RFMO), he tried to introduce good practices and habits, which have been further enhanced and become well-established under the current SC Chair, and he also endeavored to ensure good communication, noting the importance of ensuring adequate information-sharing and preventing misunderstanding. Having served also as a panel member of the NPFC Performance Review, Dr. Morishita noted that the SC was found to be performing its function very well. At the same time, the work of the SC continues to grow due to the increased number of fish species to be assessed and challenges such as climate change. To navigate this, the SC must continue to set priorities, work efficiently, and review its direction and change course as necessary. More than that, however, the SC's success to date has been due to the presence of excellent scientists, as well as the good division of labor and collaboration among Members, and these will surely be vital for the SC's continued success going forward.

5. At the invitation of the Chair, participants shared their reflections and congratulations on the 10th anniversary of the NPFC's establishment.

1.2 Appointment of Rapporteur

6. Mr. Alex Meyer was selected as the rapporteur.

1.3 Meeting Arrangements

7. The Science Manager and the Data Coordinator, Mr. Sungkuk Kang, outlined the meeting procedures and logistics.

Agenda Item 2. Adoption of Agenda

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

Agenda Item 3. Key milestones to achieve for NPFC stock assessment of priority species and provision of management advice

3.1 A process for reviewing and possibly endorsing domestic stock assessments for priority species

9. The Co-Leads of the Small Working Group on Milestones (SWG Milestones), Dr. Chris Rooper (Canada) and Ms. Karolina Molla Gazi (EU), presented a report of the SWG Milestones' work in the intersessional period (NPFC-2024-SC09-WP08). The SWG Milestones has:
   (a) developed a general schematic of the current status of the assessment process for priority

fish stocks that are currently targeted in the Convention Area, including standardized milestones and indications of species for which a domestic stock assessment incorporating NPFC Convention Area data is in place.

(b) developed a flow chart of proposed pathways for stock assessment and provision of advice to the Commission on NPFC priority species.

(c) developed a flow chart of a proposed pathway for reviewing domestic stock assessments on NPFC priority species without an NPFC stock assessment being completed.

(d) developed a flow chart of current and proposed pathways for data processing, submission and compilation for NPFC stocks.

(e) drafted a Terms of Reference (TOR) for the establishment of a Small Working Group on Data Management (SWG Data).

10. The SC reviewed the recommendations of the SWG Milestones and endorsed the following recommendations:

(a) Endorse the prioritization of the development of stock assessment activity for stocks without domestic assessments.

(b) Endorse streamlined stock status reporting to the Commission from the SC consisting of the following:

   i. statements of status for each species (e.g. saury text, NPA text)
   ii. time series of catch, effort for all species (with figures)
   iii. CPUE standardized or biomass (if model) where available

(c) Review the scientific data workflow proposed by SWG Milestones and prioritize future tasks.

(d) Consider collecting additional biological data from new surveys and the catch in the Convention Area for species with a stock assessment (both domestic and NPFC)

(e) Consider assessing the impacts of climate change on the ecosystem as well as stocks and fisheries in the species summary for each species.

11. The SC considered the recommendation that it share data using standardized data sharing templates to streamline the process for the Secretariat to compile and store data and held further discussions under agenda item 8.1.2.

12. The SC endorsed the SWG Milestones' recommendation to implement a stock assessment review cycle for species assessed by the NPFC. However, whereas the SWG Milestone suggested a 5–10-year cycle, one Member suggested a shorter cycle, such as 3–5 years, would be more appropriate, especially for shorter-lived pelagic species.

13. The SC endorsed the SWG Milestones' recommendation to share existing biological data from

the fisheries catch in the Convention Area and the adjacent exclusive economic zones (EEZs). However, noting the NPFC Data Sharing and Data Security Protocol and one Member's concerns about sharing its domestic data with another Member for that Member's domestic stock assessment, the SC agreed that the data should be shared from all Members to the Secretariat and from the Secretariat to the relevant SC subsidiary body with the data-owning Member's permission based on the Regulations for Management of Scientific Data and Information.

14. The SC considered the SWG Milestones' recommendation for the establishment of an SWG Data and held further discussions, including reviewing the proposed terms of reference, under Agenda Item 8.1.5.

15. The SC considered the SWG Milestones' recommendation to endorse a process of using domestic assessments to monitor species for which such assessments exist. The SC agreed that for species for which there is no NPFC stock assessment, it would be useful to receive information from Members' domestic stock assessments for those species. Some Members suggested that the SC could consider the information in such domestic stock assessments, which represents the best available science, and share any relevant stock status information with the Commission, while taking care to make clear that the information is from a single Member's domestic stock assessment and does not represent the SC's endorsed view. Other Members expressed concern that even if precautions were taken when sharing the information with the Commission, it would be misleading and unduly influence the Commission's discussions. Based on the discussion, the SC requested the Commission's guidance on how the SC should provide advice for priority species for which work towards an NPFC stock assessment is not currently being conducted.

16. The EU emphasized that while domestic stock assessments currently represent the best available scientific information, it is essential for scientists from other Members to review these assessments as part of the proper scientific process. To support this work, additional information, as outlined in the SWG Milestones report, is required from the Members who present these domestic stock assessments. Considering the large number of priority species and the limited capacity to carry out stock assessments, which leads to delays in providing advice, it is essential to establish a formal process to integrate the domestic stock assessments into the workflow as an interim way forward.

17. The SC endorsed the meeting report provided by the SWG Milestones (Annex D).

18. The SC agreed that the SWG Milestones has achieved all of its tasks and could therefore be

disbanded.

Agenda Item 4. Review of reports and recommendations from the Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA) and the Small Scientific Committees (SSC BF-ME, SSC NFS, and SSC PS)

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

19. The TWG CMSA Chair, Dr. Kazuhiro Oshima (Japan), summarized the outcomes and recommendations of the 8th and 9th TWG CMSA meetings (NPFC-2024-TWG CMSA08-Final Report & NPFC-2024-TWG CMSA09-Final Report). The TWG CMSA Chair also presented the chub mackerel stock assessment report (NPFC-2024-SC09-WP20 (Rev. 1)), which was finalized in the intersessional period following TWG CMSA09.

20. The SC reviewed the recommendations of the TWG CMSA and endorsed the following recommendations:
    (a) adopt the Work Plan of the TWG CMSA (NPFC-2024-TWG CMSA09-WP08 (Rev. 2)).
    (b) adopt the updated species summary for chub mackerel (Annex E).
    (c) consider the TWG CMSA's comments on the NPFC Performance Review recommendations that concern chub mackerel (NPFC-2024-SC09-WP01 (Rev. 1)).
    (d) continue to hire an invited expert to support the TWG CMSA in 2025.

21. Regarding the chub mackerel stock assessment, the TWG CMSA Chair explained that there were discrepancies between a subset of the input data and the footprint data, which were noticed on 6 December, and there was therefore no time for the TWG CMSA to address them. The effect of those input data on the output of the stock assessment is uncertain, and whether or not those sources of uncertainty are influential on the model outputs can only be confirmed when the TWG CMSA updates its stock assessment.

22. The SC endorsed the stock assessment executive summary and stock assessment report (Annex P), as the best available scientific information, while noting that there were discrepancies in the input data, whose impact on the output of the stock assessment is uncertain.

23. Based on the current stock assessment, the SC recommended that the Commission note the status of the chub mackerel stock and management advice in the chub mackerel stock assessment report (Annex P).

24. The SC requested that Members revise their data and submit the revised data to the TWG CMSA by 4 February and that the TWG CMSA re-run the stock assessment and update the model output, ideally before the next TWG CMSA meeting in February, or at least before the

Commission meeting in March, if possible. The SC further tasked the TWG CMSA to investigate the source of the discrepancies and to recommend quality assurance and quality control measures to prevent the recurrence of similar issues in the future.

25. The SC endorsed the meeting reports provided by the TWG CMSA.

26. The SC Chair explained that she would report the outcomes of SC09, including the SC's endorsement of the TWG CMSA's stock assessment report and other discussions related to the chub mackerel assessment, to the Commission in March. She noted that the draft meeting report for TWG CMSA10 would become available to Commission Members on 19 March (15 days after the conclusion of said meeting), ahead of the start of the Commission meeting on 24 March, and suggested that if any Members wished to comment on the outcomes of the TWG CMSA10 meeting, such as updated stock assessment outputs if they are available, they could do so upon the circulation of the TWG CMSA10 report.

27. The SC agreed that if the review of the updated stock assessment results were to proceed less smoothly than hoped and take up time set aside for other tasks, such as data preparation for the next stock assessment, that are to be completed during TWG CMSA10, the TWG CMSA would work virtually and intersessionally to complete any outstanding tasks.

4.2 Small Scientific Committee on Bottom Fish and Marine Ecosystems

28. 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 5th SSC BF-ME meeting (NPFC-2024-SSC BFME05-Final Report).

29. 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 (NPA) (Annex F), splendid alfonsino (SA) (Annex G), sablefish (Annex H), blackspotted and rougheye rockfishes (Annex I), and skilfish (Annex J).
    (b) Continue to hire external experts to support the work of the Small Working Group on NPA and SA (SWG NPA-SA).
    (c) Request Members that conduct or seek to conduct bottom fishing in the Convention Area to provide updated assessments on bottom fishing activities' SAIs on VMEs (following CMM 2024-05 and CMM 2024-06 Annex 2) and submit them for review by the SC and its subsidiary bodies at or before SC11.
    (d) Endorse the revised CMM 2024-05 (Annex R), including the following updates:

i. Translation table of VME indicator corals between common and scientific names of cold-water corals among the VME indicator taxa.

ii. Two new area closures: (1) Northwestern part of Yuryaku Seamount: 32–42.75’N, 172–12.90’E; 32–42.75’N, 172–13.65’E; 32–43.50’N, 172–13.65’E; 32–43.50’N, 172–12.90’E, and (2) Southeastern part of Yuryaku Seamount: 32–37.80’N, 172–18.00’E; 32–37.80’N, 172–18.60’E; 32–38.40’N, 172–18.60’E; 32–38.40’N, 172–18.00’E.

(e) Endorse the revised CMM 2024-06 (Annex S), including the following update:

i. Translation table of VME indicator corals between common and scientific names of cold-water corals among the VME indicator taxa.

(f) Endorse the updated 2024-2028 SSC BF-ME 5-Year Rolling Work Plan (NPFC-2024-SSC BFME05-WP01 (Rev. 1)).

(g) Consider the SSC BF-ME’s comments on the NPFC Performance Review recommendations that concern bottom fishing and marine ecosystems (NPFC-2024-SC09-WP01 (Rev. 5)).

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

31. The United States made a statement regarding its ongoing call for closure of the bottom fisheries on the Emperor Seamount Chain and Northwestern Hawaiian Ridge. The United States reiterated concerns regarding protection of VMEs and stock status of target fish stocks. The statement included specific discussion of Yuryaku VMEs and highlighted the deleterious implications for the SA stock from new findings by SWG NPA-SA for the bottom trawl gear selection curve. The full US statement is attached as Annex T.

32. The DSCC stated that the US proposal is an opportunity for the NPFC to effectively align its science and management measures with the provisions of the UN General Assembly resolutions related to the management of bottom fisheries and protection of VMEs, as well as growing political commitments to halt and reverse biodiversity loss and enhance the resilience and recovery of deep-sea ecosystems as called for in Sustainable Development Goals, the Kunming-Montreal Global Biodiversity Framework and other instruments, and encouraged NPFC Members to support the US proposal.

33. The Deep-sea Fisheries (DSF) Project (FAO) informed the SC that it plans to work with the International Council for the Exploration of the Sea (ICES) to advance stock assessment work on data-limited species and suggested that it could collaborate with the NPFC to support stock assessments of NPA and SA.

4.3 Small Scientific Committee on Neon Flying Squid

34. The Chair of the SSC on Neon Flying Squid (SSC NFS), Dr. Luoliang Xu (China), summarized the outcomes and recommendations of the 1st SSC NFS meetings (NPFC-2024-SSC NFS01-Final Report).

35. The SC reviewed the recommendations of the SSC NFS and endorsed the following recommendations:
    (a) endorse the Terms of Reference for the Small Scientific Committee on Neon Flying Squid (Annex U).
    (b) endorse the CPUE Standardization Protocol for neon flying squid (Annex V).
    (c) endorse the Stock Assessment Protocol for neon flying squid (Annex W).
    (d) adopt the Work Plan of the SSC NFS (NPFC-2024-SSC NFS01-WP04 (Rev. 1)).
    (e) adopt the updated species summary for neon flying squid (Annex K).
    (f) consider the SSC NFS's comments on the NPFC Performance Review recommendations that concern neon flying squid (NPFC-2024-SC09-WP01 (Rev. 2)).
    (g) continue to hire an invited expert in 2025 to support the SSC NFS during its meetings and conduct other work to support the SSC NFS as appropriate.

36. The SC endorsed the report provided by the SSC NFS.

4.4 Small Scientific Committee on Pacific Saury

37. The Chair of the SSC on Pacific Saury (SSC PS), Dr. Toshihide Kitakado (Japan), summarized the outcomes and recommendations of the 13th and 14th SSC PS meetings (NPFC-2024-SSC PS13-Final Report, NPFC-2024-SSC PS14-Final Report).

38. The SC reviewed the recommendations of the SSC PS and endorsed the following recommendations:
    (a) Endorse the stock assessment report (Annex Q).
    (b) Endorse the SSC PS Work Plan (NPFC-2024-SSC PS14-WP01 (Rev. 1)).
    (c) Consider the SSC PS's comments on the NPFC Performance Review recommendations that concern Pacific saury (NPFC-2024-SC09-WP01 (Rev. 6)).
    (d) Allocate funds for the participation and technical support (e.g., development of a new stock assessment model (NSAM)) of an invited expert in the next SSC PS and Working Group on NSAM meetings.
    (e) Adopt the updated species summary of Pacific saury (Annex L).
    (f) Recommend that the SWG MSE PS explore options for beginning the MSE process prior to the completion of the age-structured model.

39. As recommended by the SSC PS, the SC considered the stock summary slide for Pacific saury suggested for inclusion in the SC Chair's report to the Commission. The SC agreed that a one-slide summary would be inadequate for conveying all the key stock status information and management advice for Pacific Saury.

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

Agenda Item 5. Update from the Joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific Saury (SWG MSE PS)

41. 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 5th meeting (NPFC-2024-SWG MSE PS05-Final Report).

42. The SC Chair emphasized the SSC PS's and the SC's commitment to supporting the work of the SWG MSE PS.

Agenda Item 6. Other pelagic priority species

6.1 Summary of progress on the remaining three priority species

43. The Leads of the Small Working Groups (SWGs) on Japanese sardine (JS), Japanese flying squid (JFS), and blue mackerel (BM) reported on the SWGs' intersessional activities, including the relevant outcomes of the 1st and 2nd joint virtual meetings of these SWGs in 2024, in the respective sections below (6.1.1 – 6.1.3). Detailed summaries of the joint SWG meetings are available in NPFC-2024-SC09-RP01 (1st meeting) and NPFC-2024-SC09-RP02 (2nd meeting).

6.1.1 Blue mackerel

44. The SWG BM Lead, Dr. Kazunari Higashiguchi (Japan), reported on the SWG BM's intersessional activities (NPFC-2024-SC09-IP03). The SWG BM has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, JS, and BM). It reviewed methods for distinguishing BM and chub mackerel, reviewed the feasibility of calculating the proportion of BM and chub mackerel catch by gear and sharing data to that end, updated Members' estimated catch and effort, updated the species summary, shared and reviewed data on BM fork length and age, updated the ratio of BM in the mackerel catch by China and Japan, and reviewed the catch-per-unit-effort (CPUE) standardization for indices used in Japan's domestic stock assessment.

45. The SC noted the importance of having separate BM and chub mackerel catch information for

the stock assessments of the two species, which are conducted separately. The SC agreed to add review of Members' methodologies for calculating the ratio of BM and chub mackerel catch to the TWG CMSA's workplan. The SC recommended that the Commission request Members to provide data on BM biological data and the ratio of BM to chub mackerel catch to the Secretariat for analyses in accordance with the agreed work plan.

6.1.2 Japanese flying squid

46. The SWG JFS Lead, Dr. Hajime Matsui (Japan), reported on the SWG JFS' intersessional activities (NPFC-2024-SC09-IP07). The SWG JFS has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, JS, and BM). It updated Members' catch and effort data, reviewed a report from China on the availability of more biological information from the nursery area for Japan's domestic stock assessment, reviewed a monitoring program of the oceanographic conditions in the JFS spawning grounds conducted by Japan, reviewed a study on the effect of fisheries management when the stock-recruitment (SR) relationship could change with a regime shift (regime-based fisheries management), considered whether there is a need for a regional observer program (ROP) in the Convention Area to collect data on JFS and/or bycatch species from squid jigging fisheries and concluded that there is not, reviewed the CPUE standardization for the winter spawning stock of JFS that is used in Japan's domestic stock assessment, and updated the species summary.

47. The SC recommended that the Commission request Members to provide JFS biological data to the Secretariat for analyses in accordance with the agreed work plan.

6.1.3 Japanese sardine

48. The SWG JS Lead, Dr. Chris Rooper (Canada), reported on the intersessional activities of the SWG JS (NPFC-2024-SC09-WP14). The SWG JS has met twice intersessionally (as part of the joint meetings of the SWGs on JFS, JS, and BM). It updated Members' catch and effort data, shared and reviewed Members' size frequency (age), length-weight relationships and other relevant data, incorporated data from China and Russia into the JS stock assessment conducted by Japan, shared code for the Virtual Population Analysis (VPA) assessment model used for JS via GitHub, reviewed Japan's CPUE standardization for the JS assessment and developed a workplan to conduct similar standardization for other Members fisheries for JS in 2025, and updated the species summary.

49. The SC recommended that the Commission request Members to provide JS biological data to the Secretariat for analyses in accordance with the agreed work plan.

6.2 Review of species summaries

50. The SC reviewed, further revised, and endorsed the updated species summary document for JFS (Annex M).

51. The SC reviewed, further revised, and endorsed the updated species summary document for JS (Annex N).

52. The SC reviewed, further revised and endorsed the updated species summary document for BM (Annex O).

6.3 Domestic stock assessments of BM, JFS, and JS

53. The SC invited Members to share the results of their domestic stock assessments for the purpose of information sharing. The SC observed, but did not formally review, domestic stock assessments of BM, JFS, and JS.

54. Japan presented its domestic stock assessment of BM (NPFC-2024-SC09-IP04 (Rev. 1)). The assessment is conducted using tuned VPA. The MSY-based reference points were estimated from the stochastic simulation from the Ricker stock-recruitment relationship. Biomass and SSB have been decreasing since 2011 and recruitment has been greatly lower than the expectation from the stock-recruitment relationship. The current status is that overfishing is occurring ($F > F_{MSY}$) and that the stock is overfished ($SSB < SSB_{MSY}$). As future work, it is necessary to reflect actual age composition outside the Japanese EEZ.

55. Japan presented its domestic stock assessment of JS (NPFC-2024-SC09-IP05 (Rev. 1)). The assessment is conducted using a tuned VPA with ridge penalty. The MSY-based reference points were estimated from the stochastic simulation from the normal-regime SR relationship of the hockey stick function. In 2023, estimated total biomass was 4.24 million mt and SSB was 2.79 million. SSB exceeded SSB_{MSY}. The current F (F2021–2023) exceeded F_{MSY}. As future work, it is necessary to reflect actual age composition outside the Japanese EEZ, and more consideration should be given to consider how to treat regimes for future projection and biological reference points.

56. Japan presented its domestic stock assessment of JFS (NPFC-2024-SC09-IP06). The estimated total biomass of the winter spawning stock decreased largely from 2015 to 2016 and has remained at a low level since then. The MSY-based reference points were estimated by a stochastic simulation with the Beverton-Holt stock-recruitment relationship. In 2023, the estimated total biomass was 101,000 mt and SSB was 41,000 mt. SSB was lower than SSB_{MSY} and F was lower than F_{MSY} in 2022. In terms of future issues, there are uncertainties such as using fixed q value in the current stock assessment method. State-space Assessment Model

Used for IKA (SAMUIKA) or Stochastic Surplus Production Model in Continuous Time (SPiCT) could be potential stock assessment models for future domestic JFS stock assessments.

57. The SC expressed its appreciation to Japan for conducting domestic stock assessments of BM, JFS, and JS and sharing them with the SC.

6.4 Future roles and activities of SWG BM, SWG JFS, and SWG JS

58. The SC developed a table of future tasks for the SWG BM, SWG JFS, and the SWG JS (Annex X).

Agenda Item 7. Climate change effects on NPFC's priority species and associated ecosystems

7.1 Tools for incorporating climate change considerations into scientific advice

59. Dr. Tom Carruthers (Ocean Foundation) presented the results of robustness trials for climate-ready management procedures (MPs) for multiple species of highly migratory tunas, sharks and billfish (NPFC-2024-SC09-OP02). The research on climate change impacts on pelagic fish species was reviewed and organized into the theoretical linkages between climatological processes, oceanographic properties affecting habitat, mechanisms of impact and relevant operating model dynamics. The most cited impacts on species biology, ecology and behavior relate to spatial distribution, larval survival, range contraction, adult survival and condition factor. Since few quantitative predictions of climate impacts have been made with regard to these aspects, expert judgement was used to specify proof-of-concept climate tests that included moderate and extreme cases of declining somatic growth, condition factor, adult survival and mean recruitment strength. A range of MP archetypes were tested for their robustness to the climate scenarios including empirical index-target and index-ratio MPs, and model-based stock assessment MPs with and without harvest control rules. MPs that specified effort controls or size limits provided more robust conservation performance for climate tests than their equivalents providing catch advice. Stock assessment model MPs providing catch advice were substantially more robust to declining survival and recruitment when also incorporating a harvest control rule. In general, the most challenging climate tests involved declining survival and recruitment with these leading to larger impacts on yield outcomes than biomass outcomes.

60. Dr. Carruthers presented performance metrics of climate robustness for Atlantic bigeye tuna (NPFC-2024-SC09-OP03). Operating models were developed from the 2021 stock assessment of bigeye tuna. Four types of projected climate impact were simulated: increasing natural mortality rate, and decreases in recruitment strength, somatic growth and condition factor. Defining a robustness threshold enabled the calculation of a performance metric of climate

robustness that was calculated for each type of climate impact for three MP archetypes and two MP derivatives. Shifting the focus away from establishing defensible climate forecasts and towards climate robustness performance metrics provided information that could support the selection of MPs accounting for climate impacts. It was not necessary to know the exact type of impact or the exact level of forecasted impact to identify an MP that clearly and consistently outperformed the rest in terms of climate robustness.

7.2 Current knowledge

61. Pew presented a review of recent literature on harvest strategies and climate change (NPFC-2024-SC09-OP04). In particular, Pew highlighted the following points. First, harvest strategies are an effective adaptation tool for managing stocks under changing climate conditions. Opportunities and limitations exist to incorporate explicit climate-related environmental factors into MPs and MSE. “Climate-informed” MPs can be designed to include extreme events as “Exceptional Circumstances.” “Climate-informed” MPs can account for shifts in geographic distribution across management regimes. There are management options available for data-rich and data-poor fisheries.

7.2.1 FAO consultancy report on climate change in the North Pacific

62. Dr. Joel Rice (DSF Project, FAO) presented a report on pathways for the incorporation of climate change into the work of the NPFC (NPFC-2024-SC09-OP01). The report provided an overview of the literature and data available to evaluate and address climate change related impacts on managed stocks, the Intergovernmental Panel on Climate Change (IPCC) ocean climate change predictions, and potential strategies for the NPFC to integrate climate change into its fisheries management. Addressing the effects of climate change on a basin wide scale should include collaboration among the NPFC, other regional organizations, and NPFC Members’ management agencies; enhanced monitoring of fish stocks and bycatch species through an increase in fisheries independent surveys; development of a regional observer program; expansion of fisheries-independent surveys to older individuals for the NPFC priority species surveyed only in the pre-recruit to juvenile stage; and adoption of an iterative program of work that begins with a literature review, prioritization of research, and the creation of a workplan.

63. The SC Chair pointed out that besides understanding the impacts of climate change on fisheries resources and related ecosystems, the NPFC’s Resolution on Climate Change calls on Members to also consider climate change impacts on fishing activities and the associated socio-economics. She noted that the SC’s scientific activities are therefore likely to become much broader and expressed her hope that Members and observers will continue to work collaboratively on even more challenging issues in the future.

7.3 Ongoing research activities

7.3.1 PICES' Basin-scale Events to Coastal Impacts (BECI) project

64. The Science Director of the Basin-scale Events to Coastal Impacts (BECI) project, Dr. Kathryn Berry, provided an overview and an update on the project (NPFC-2024-SC09-OP10). BECI aims to unite knowledge from around the North Pacific to help NPFC and other organizations across the North Pacific use climate and ocean science in their decision-making. It plans to connect these organizations with environmental data they can use by linking existing monitoring networks and databases; providing tools to help make climate-informed decisions, such as by building and/or enhancing practical analysis tools and exploring artificial intelligence applications to support analysis and prediction; sharing best practices that work; and supporting collaboration across organizations. As next steps, BECI hopes to provide its Science Plan, scheduled for completion in April 2025, to the NPFC SC for broader distribution, establish a process to send a questionnaire to NPFC SC subsidiary bodies, and develop a plan for continued communication with the NPFC.

7.4 Research priorities and potential scientific projects

65. The SC discussed potential research activities to address climate change effects on NPFC's priority species and associated ecosystems, such as monitoring changes in the distribution or productivity of stocks, and how the health of one stock might affect the health of another associated stock.

Agenda Item 8. Data Collection and Management

66. The EU explained its proposal for the establishment of a Conservation and Management Measure on Standards for the Collection, Reporting, Verification and Exchange of Data (NPFC-2024-SC09-WP15), which is aimed at ensuring consistency, fostering collaboration, and supporting quality control and validation. The EU sought views and suggestions from the SC on its proposal.

67. The SC considered the EU's proposal. Members provided feedback and agreed to provide any additional feedback before COM09. The EU thanked Members for their input and expressed its intention to refine its proposal based on Members' comments.

8.1 Data Management System

68. The Data Coordinator reported on the progress in the development of the SC-related data management system (NPFC-2024-SC09-IP01). The Data Coordinator explained updates to the Members Home, Significant dates/Events, Pacific Saury Weekly Report, Chub Mackerel Monthly/Weekly Report, Collaboration, Annual reports sections, as well as updates to the

NPFC GIS Maps for Pacific saury catch and effort data, and for bottom fishing with combined, gear-specific footprints.

69. The SC expressed its appreciation to the Secretariat for continuing to update and enhance the NPFC data management system.

70. The SC suggested that the Secretariat explore options for further enhancing the data management system as follows:
   (a) Enable Members to download annual reports in machine-readable formats.
   (b) Restore/improve Members' access to the NPFC GeoServer.

8.1.1 Update on GitHub Plan for NPFC

71. The Data Coordinator explained that the Secretariat has successfully applied for the GitHub Nonprofit Plan and is now coordinating with GitHub to complete the transition. Currently, 7 Members, an invited expert and the Secretariat are active within this group. The Data Coordinator has prepared a user manual in cooperation with Members outlining basic steps for utilizing the Git Repository (https://www.npfc.int/git-repository-user-manual). This manual can be continuously enhanced based on Members' feedback. Currently, the Repository supports the TWG CMSA and SSC BF-ME, with plans to expand support to other groups, such as SSC PS, upon Member request. The Secretariat will continue to enhance the data management systems to support efficient and secure data handling for NPFC Members. Members' feedback and comments are greatly appreciated and will guide future improvements.

8.1.2 Evaluation of biological data provision templates

72. The Science Manager explained that the SC's subsidiary bodies have not reported any specific issues with the use of the draft biological data provision templates.

73. The SC agreed to work intersessionally towards finalizing the biological data provision templates (NPFC-2023-SC08-IP13 (Rev. 1)) by SC10 and using the templates from the 2026 operational year.

8.1.3 Data inventory

74. The Science Manager and the Data Coordinator presented a data inventory policy, a data inventory table summarizing information about data submitted by Members, and suggestions for improving data management/organization (NPFC-2024-SC09-WP03).

75. The SC endorsed the data inventory policy and the data inventory table structure.

8.1.4 Establishment of a new database to manage and archive scientific data

76. The Science Manager presented a concept paper for the establishment of a database to manage and archive scientific data (NPFC-2024-SC09-WP06). He explained that the purpose of the database would be to efficiently and securely store, organize, and retrieve scientific data to facilitate data analyses and modeling, that it would house data for stock assessment (catch, effort, size, age, maturity, etc.), VME identification, assessment of significant adverse impact (SAI) on marine ecosystems, annual catch and effort statistics and other data which may be shared in future to fulfill the SC's functions, and that it would be maintained and developed by the Secretariat, with support from a contractor(s). The Science Manager invited the SC to provide feedback on the database's business requirements, the data flow, and next steps, and explained that the development of the database would be an iterative process with regular opportunities for Members to provide their input.

77. The SC endorsed the development of a database to manage and archive scientific data, noting that it would facilitate more efficient management and use of scientific data for scientific analyses.

8.1.5 Potential establishment of a new Small Working Group on Data (SWG Data)

78. The SC considered the proposal for the establishment of a new SWG Data. The SC noted the value of having a dedicated body addressing data matters that are common to all subsidiary groups, in particular the immediate need for such a body to provide guidance to the Secretariat on the planned development of a database to manage and archive scientific data. The SC also noted that further discussions are needed on various aspects of the proposed SWG Data, including the potential long-term scope of the SWG, its membership, and the roles of Members, Secretariat and a contractor(s).

79. The SC agreed to establish the SWG Data for 1 year, and to task it to focus primarily on assisting the Secretariat in creating a data management system, including data collection, verification, reporting, storing, and dissemination, and secondarily to identify the scope of the SWG Data, its membership and roles of Members, Secretariat and a contractor(s). The SC elected Ms. Karolina Molla Gazi (EU) to serve as the Lead of the SWG Data. The SC agreed that the SWG Data will meet virtually.

80. The SC revised the draft TOR accordingly and endorsed the TOR for the SWG Data (Annex Y).

81. The SC agreed to initially appoint Chris Rooper (Canada), Qiuyun Ma (China), Karolina Molla Gazi (EU), Kazuhiro Oshima (Japan), Hyejin Song (Korea), Vladimir Kulik (Russia),

Wen-Bin Huang (Chinese Taipei), Don Kobayashi (United States), and Mei-Chin Juan (Vanuatu) as members and/or contact persons of the SWG Data. The SC requested the Chairs of the SSCs and the TWG CMSA to nominate members of the SWG Data from their respective groups.

82. The SC agreed to discuss the potential continued need for, and long-term role of, the SWG Data at SC10.

8.1.6 Review of need of GIS maps with catch and effort data for NFS and JS

83. The consultant, Dr. Jihwan Kim, presented an updated prototype Neon Flying Squid map (NPFC-2024-SC09-WP13). The proposed map will resemble the Pacific Saury Catch and Effort Map, incorporating detailed data on catch volume, fishing effort, and spatial distribution. It will also include datasets on Extended Reconstructed Sea Surface Temperature (ERSST) sourced from National Oceanic and Atmospheric Administration (NOAA). Key features of the map will enable users to filter data by Member, year, and month, and to view catch or effort data alongside sea surface temperature (SST) and SST anomalies. Additionally, the "All Members Catch" feature will allow access to aggregated catch data from all Members contributing to catch, namely China, Japan, Korea, Chinese Taipei, and Vanuatu.

84. The SC noted the value of the Neon Flying Squid map for visualizing the distribution of NFS catch and effort and recommended that the Commission consider making the maps available on the NPFC website, at a spatial resolution of 1^o x 1^o and a monthly temporal resolution, with access restricted to NPFC Members only.

85. The SC noted that Dr. Kim's term as a consultant to the NPFC Secretariat will end in March and expressed their appreciation for his contributions to the NPFC.

8.2 NPFC Data Sharing and Data Security Protocol

8.2.1 Revision of Regulations for Management of Scientific Data and Information

86. The Science Manager presented proposed revisions to the Regulations for Management of Scientific Data and Information to align it with the revisions to the NPFC Data Sharing and Data Security Protocol that were adopted by the Commission at its 8^{th} meeting (NPFC-2024-SC09-WP07).

87. The SC made further revisions to the Regulations for Management of Scientific Data and Information to reflect the need to seek the formal approval of data providers prior to conducting analyses outside the activities outlined in the work plans of the SC's subsidiary bodies or prior to publishing data in an external publication (NPFC-2024-SC09-WP07

(Rev. 2)).

88. The SC endorsed the proposed revisions (Annex Z).

8.3 Data needs, data gaps, and strategies to fill gaps

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

89. The Chair reminded the SC that, in accordance with Article 10, paragraph 4(d) of the NPFC Convention, 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. She further pointed out that the NPFC Performance Review Panel has recommended that the SC and Technical and Compliance Committee (TCC) should coordinate formal efforts to collect standardized data and validate bycatch of associated and dependent species, and that the SC develop strategies that address the lack of information needed to take ecosystem considerations into account for NPFC pelagic fisheries in the Convention Area, and include these in the SC's Research Plan, data collection procedures and obligations. The Chair also reminded the SC that SC06 agreed that the establishment of an observer program in the NPFC Convention Area would facilitate the collection of more data for such non-targeted species, as well as for NPFC priority species.

90. China presented an overview of 2024 Chinese survey by its fishery research vessel "Song Hang" in the NPFC Convention Area (NPFC-2024-SC09-WP21). In 2024, the Chinese fishery research vessel Song Hang embarked on its fourth year of scientific surveys by Shanghai Ocean University in the Northwest Pacific Ocean. The improved survey program in 2024 continues to cover fisheries resources, larval and juvenile stages of marine species, plankton, and environmental surveys, consistent with previous years. Research included studies of distribution by acoustic surveys, biodiversity by environmental-DNA, feeding ecology, ecosystem modelling, and plastic analysis. The data collected will continue to contribute to a deeper understanding of the marine ecosystem within the NPFC Convention Area.

91. The SC expressed its appreciation for the valuable survey conducted by China and encouraged it to continue conducting such surveys.

92. China informed the SC that it will conduct the survey again in 2025 and expressed its intention to share the detailed data from its surveys with the relevant SC subsidiary bodies.

93. China presented the results of a study on the ecosystem structure and trophodynamics in the Kuroshio-Oyashio Extension (KOE) area (NPFC-2024-SC09-WP22). China analyzed the

trophic structure and characteristics of this pelagic ecosystem using the Ecopath model and data collected in its 2023 KOE fishery resources survey. The overall ecosystem characteristics suggested that the KOE pelagic ecosystem was at a low level of maturity and vulnerable to disturbance from external activities. Given the significance of the KOE pelagic ecosystem, China suggested conducting long-term and stable ecosystem-level surveys and assessments. It also recommended conducting collaborative work with more biological data to enhance the quality of the KOE pelagic ecosystem model.

8.3.1.1 Historical information about species captured in surveys and/or discarded bycatch from fisheries in the Convention Area

94. China presented a summary of the species in the Northwest Pacific ecosystem based on Chinese surveys and bycatch from Chinese fisheries (NPFC-2024-SC09-WP23). China operates four kinds of fleet in the Convention Area, i.e. stick-held dip net, squid-jigging fishery, pelagic trawl net and light purse seine. The first three gears are highly selective, with few bycatch. Pacific saury is the only catch species in the stick-held dip net fishery, with low bycatch of squid. Most of the catch from the squid-jigging fishery is neon flying squid, with a low incidental catch of Japanese flying squid catch. The catch of pelagic trawl fishery includes chub mackerel, Japanese sardine and blue mackerel, with low incidental catch of Pacific saury. In the light purse fishery, the main recorded catch species are chub mackerel, blue mackerel, and Japanese sardine. Other species, such as neon flying squid, Pacific saury, Japanese anchovy, lanternfish, tuna, sharks, marine mammals, were incidentally captured and in some cases released based on the CMMs of the NPFC or other RFMOs.

95. The SC requested that Members continue to share historical information about species captured in surveys and/or discarded bycatch from fisheries in the Convention Area and that the SSCs and the TWG CMSA continue to discuss such information.

8.3.1.2 Potential impacts on species belonging to same ecosystem or dependent/associated with target stocks

96. The SC noted that none of its subsidiary bodies reported assessments on potential impacts on species belonging to the same ecosystem or dependent/associated with target stocks.

97. The DSF Project (FAO) informed the SC that it will hold a Symposium on Applying the Ecosystem Approach to Fisheries Management in Areas Beyond National Jurisdiction (ABNJ) on 11–13 March 2025 and that the Symposium will include discussion of ways in which information from research surveys and fisheries can answer questions about effects on associated/dependent species.

8.3.1.3 Status of current non-target catch, definitions of bycatch applied in other RFMOs, and options for defining bycatch within NPFC

98. The SC Chair explained that the Science Manager has held discussions with the Secretariats of other RFMOs and heard that other RFMOs have found it similarly challenging to develop a unified definition of bycatch for both scientific and compliance purposes.

99. The SC requested Members to consider potential definitions of bycatch for use within the SC and present their proposals to SC10.

100. The FAO suggested that for the SC, it may be more useful to consider catch as a whole and to subdivide that into retained or discarded catch, rather than trying to define and distinguish between targeted catch and bycatch.

8.3.2 Potential roles of a regional observer program

8.3.2.1 Summary of scientific objectives of an observer program

101. The SC agreed that, in accordance with Article 10, paragraph 4(d), one of the scientific objectives of an observer program could 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.

8.3.2.2 Summary of the kinds of data that would need to be collected and the level of observer coverage that would be needed on fishing vessels to achieve those scientific objectives by gear type

102. The SC noted that it needs a more in-depth understanding of the characteristics of Members' fleets and the implications for feasible observer coverages and for appropriate coverage levels to ensure that reliable and representative data are collected. The SC agreed that it is too early for the SC to be able to provide scientifically defensible input on the kinds of data that would need to be collected from a regional observer program and the level of observer coverage that would be needed on fishing vessels by gear type. The SC agreed to continue to discuss this matter at the SC and its subsidiary bodies.

103. The WWF called for the need for observer data to ensure transparency in fishery and improve the accuracy of stock assessments, and also called for the need for the SC to discuss the appropriate level of observer coverage from a purely scientific perspective, rather than from a feasibility perspective.

8.3.2.3 Review of template for collecting qualitative information about Members' sampling programs

104. The Science Manager presented a report on the existing observer programs of NPFC Members and those of other RFMOs (NPFC-2024-SC09-WP02 (Rev. 4)). The report summarized Members' existing observer programs for pelagic and bottom fisheries in the Convention Area, including observer training programs and observer program design and coverage, observer data collected, and how collected data are reported and stored; the observer programs of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and other general RFMOs, namely Northwest Atlantic Fisheries Organization (NAFO), North East Atlantic Fisheries Commission (NEAFC), South East Atlantic Fisheries Organisation (SEAFO), Southern Indian Ocean Fisheries Agreement (SIOFA), South Pacific Regional Fisheries Management Organisation (SPRFMO); and the FAO Guidelines for Developing an At-Sea Fishery Observer Programme.

8.3.2.4 Summary of SC responses to six questions from the TCC Chair

105. The SC reviewed and updated the responses by its subsidiary bodies to the following questions from the TCC Chair to the SC and its subsidiary bodies: 1. Are there different needs for the different fisheries regarding data collection? 2. What new data would the SC prioritize/need from a ROP? 3. What new data would be nice to have (i.e. not needed/priority)? 4. Whether this data could be collected through electronic monitoring (EM)? 5. Whether the observer needs to be a scientist, or can data be collected by a non-scientist? The SC requested that the SC Chair forward the responses (NPFC-2024-SC09-WP04 (Rev. 4)) to the TCC Chair.

106. The SC agreed to continue to discuss data needs and data gaps that could be filled by a regional observer program and inform the TCC about progress in these developments.

8.3.3 Potential use of NPFC Vessel Monitoring System (VMS) data for scientific purposes

107. The Science Manager presented a summary of the VMS data from NPFC Members and potential ways in which the SC could use these data (NPFC-2024-SC09-WP05). Members have provided data from January 2022 to the present at a temporal resolution of 1-hour interval for each vessel and a spatial resolution of 0.001° latitude and longitude. China, Korea, Russia, Chinese Taipei, and Vanuatu also optionally provide vessel heading and speed data. The Science Manager suggested that the SC could use VMS data for estimating distribution of fishing effort, examining tradeoffs, modelling fishing effort for use in stock assessment and fisheries management activities, estimating abundance indices or undertaking stock assessments, evaluating the impact of management changes, planning for and implementing scientific programs, and validating logbook data. VMS reporting could also be enhanced for more comprehensive analysis, including by classifying vessel activities into distinct types; integrating the catch data from logbooks, including identification of target species; and collecting sea surface temperature (SST) and salinity (SSS) data from vessel uptake, and

making these data available to the Global Ocean Observing System.

108. The SC noted that currently, NPFC does not have specific regulations for the use of VMS data for scientific purposes.

Agenda Item 9. Scientific projects for 2025 and 2026

9.1 Report on capacity building project

109. Ms. Jhen Hsu (Chinese Taipei) reported on her training supported by the SC capacity building project. Ms. Hsu attended a 5-day ICES training course, held in Nanaimo, British Columbia, Canada, on advanced stock assessment with R Template Model Builder (RTMB). RTMB is a new package that provides a native R interface for a subset of TMB, which is particularly popular in fisheries science and ecological modeling because it can efficiently handle state-space models, mix-effects models, complex likelihood functions, and large datasets with multiple random effects. RTMB provides all necessary components for building complex spatio-temporal models and all materials from the RTMB training course have been made available on the NPFC collaboration website.

110. The SC thanked Ms. Hsu for providing the capacity building materials to the SC and wished her well on her PhD defense.

9.2 Ongoing/planned projects

9.3 New projects

9.3.1 Potential project(s) for PS, CM, NPA, SA, and NFS

9.3.2 Independent review of stock assessments

9.3.3 Other potential projects

9.4 Review, prioritization and funding of projects

111. The Science Manager presented a draft list of scientific projects that were discussed during the meetings of the SC and its subsidiary bodies (NPFC-2024-SC09-WP09).

112. The SC reviewed the list of proposed scientific projects, finalized the list, and endorsed it for consideration by the Commission (Annex AA).

113. The SC agreed to continue to discuss the development of an independent peer review process for its stock assessments and to discuss adjustments to its stock assessment and management cycles for individual species to accommodate such an independent peer review process.

Agenda Item 10. Cooperation with other organizations

10.1 Reports on the joint NPFC-PICES activities since the SC08 meeting, including a report from *the PICES Secretariat*

114. The Executive Secretary of the North Pacific Marine Science Organization (PICES), Dr. Sonia Batten, reported on recent and upcoming planned joint activities between PICES and NPFC (NPFC-2024-SC09-OP07), highlighting the following:
   (a) Participation by NPFC and PICES representatives at each other's annual meetings
   (b) Renewal of the NPFC-PICES Collaborative Framework
   (c) NPFC representation to the joint PICES/ICES Working Group (WG) on Small Pelagic Fish (WG 43)
   (d) NPFC representation to the joint PICES/ICES Working Group on Sustainable Pelagic Forage Communities (WG 53)
   (e) Involvement by some NPFC scientists, including the Chair of the NPFC SC, in the Working Group on the Ecology of Seamounts (WG 47)
   (f) Potential for collaboration on the BECI project
   (g) PICES External Review Process

10.2 SC representation at PICES meetings

115. The SC Chair reported on her attendance of the PICES 2024 Annual Meeting (NPFC-2024-SC09-IP08). The SC Chair participated in the Seamount Science Summit – Ecological Insights Workshop, which was convened by the Deep Ocean Stewardship Initiative (DOSI), participated in the Biological Oceanography Committee and Science Board meetings, co-chaired the Working Group on Ecology of Seamounts (WG47), and worked on renewal of the PICES-NPFC Framework for Enhanced Scientific Collaboration in the North Pacific Ocean for another 5 years, which has since been endorsed by PICES.

116. The SC Chair proposed revisions to the NPFC's method to evaluate and rank nominations for SC representatives to be financially supported to participate in relevant scientific meetings, including opportunities that build capacity to undertake scientific analyses (NPFC-2024-SC09-WP18).

117. The SC endorsed the proposed revisions (Annex BB).

10.2.1 SC representation in the Joint ICES-PICES Working Group on Sustainable Pelagic Forage Communities (WG SPF) and SPF symposium in 2026

118. Dr. Chris Rooper (Canada) provided an overview of the Joint ICES-PICES Working Group on Sustainable Pelagic Forage Communities (WG SPF) and its activities (NPFC-2024-SC09-IP09). The WG SPF aims to foster international and interdisciplinary collaboration; assess recent progress on understanding fluctuations of forage species; identify, prioritize, and recommend research to forecast ecosystem responses; recommend strategies to improve

ecosystem-based management; and describe how climate change and other anthropogenic factors impact forage species. It consists of two Task Forces, one on Ecological Process Knowledge and the other on Translating Process Knowledge. The WG SPF also plans to hold a Small Pelagic Fishes Symposium on May 4–8, 2026, in La Paz, Mexico. NPFC scientists can get involved by participating in planning, submit a session/workshop/abstract, join an activity group, or contribute to reviewing papers/analyses. The NPFC has also been invited to co-sponsor the Symposium.

119. The official invitation for NPFC to co-sponsor the PICES/ICES/FAO International Symposium, titled "Navigating Changes in Small Pelagic Fish and Forage Communities: Climate, Ecosystems, and Sustainable Fisheries," to be convened on May 4–8, 2026, in La Paz, Mexico is detailed in NPFC-2024-SC09-OP06.

10.2.2 Report on renewal of the NPFC – PICES Framework for Enhanced Scientific Collaboration in the North Pacific

120. The SC Chair presented a proposal for the renewal of the NPFC – PICES Framework for Enhanced Scientific Collaboration in the North Pacific for 2025–2029 (NPFC-2024-SC09-WP19), prepared by the SC Chair, the SC vice-Chair (Dr. Jie Cao), and the NPFC and PICES Secretariats. She explained that the updated framework updates the scientific interests and objectives of each organization; identifies potential areas and specific topics for scientific cooperation; identifies potential collaborative methods (such as representation at each other's meetings, holding of joint workshops or symposia, development of a Memorandum of Understanding (MOU) between the organizations or other formal agreements, establishment of joint working groups); clarifies practical steps to advance the cooperative activities identified above; and provides advice on how information produced by PICES can be shared and applied in the NPFC.

121. The SC endorsed the proposal and recommended that the Commission adopt the renewed NPFC – PICES Framework for Enhanced Scientific Collaboration in the North Pacific for 2025–2029.

10.3 Report on cooperation between NPFC and NPAFC

122. The NPAFC Executive Director, Mr. Yoshikiyo Kondo, reported the updates in the implementation of the Five-year Work Plan. In the report, Mr. Kondo expressed NPAFC's appreciation for NPFC's contribution to the North Pacific high seas Expedition in 2022 and NPFC's adoption of its CMM on anadromous fish at COM08 in 2024. He explained NPAFC's proposal to co-host a joint workshop on interaction between fisheries and anadromous fish in the North Pacific high seas as a potential further collaboration between the NPFC and NPAFC,

and asked for the SC's support for holding such a joint workshop. He emphasized NPAFC's strong and continued willingness to cooperate with the NPFC.

123. The SC reviewed the concept paper on a Joint NPAFC/NPFC workshop on interactions between fisheries and anadromous fish in the North Pacific high seas. The SC endorsed the scientific elements of the paper, while noting that most of the workshop topics concern matters of compliance, and recommended that the NPAFC also present the concept paper to the TCC.

124. The SC reviewed and had no feedback on the Terms of Reference for an NPAFC/NPFC Data Sharing Platform.

10.4 FAO ABNJ Deep-sea fisheries project

125. Dr. Tony Thompson, the DSF Project (FAO), presented an update on its activities (NPFC-2024-SC09-OP12). In its current phase, the DSF Project's objective is to ensure deep-sea fisheries are managed under an ecosystems-based approach, focusing on data-limited stocks, deepwater sharks, and VMEs. The DSF Project has been working on the application of the precautionary approach to deep-sea fisheries, engagement with deep-sea fishing industry, assessing data-limited deep-sea stocks, assessing impacts of deep-sea fisheries on deepwater sharks, VME identification methods, support for observers, RFMO websites and outreach messaging, new technologies, and climate change work. The DSF Project will also hold a Symposium on Applying the Ecosystem Approach to Fisheries Management in Areas Beyond National Jurisdiction on 11–13 March 2025.

126. The DSF Project (FAO) made a request for fishing effort data by position and gear for fisheries using bottom contact gears, at 1° latitude by 1° longitude resolution, for the last 5 years to develop a global map of spatial bottom fishing effort (NPFC-2024-SC09-OP08). The DSF Project explained that if there are restrictions on the release of data at the scales outlined above, it would welcome advice on alternative approaches to spatial and/or temporal aggregation that would facilitate data being available for this mapping exercise.

127. The SC requested Members to consult with data owners on whether the NPFC could share the requested data with the DSF Project in the aggregated form that was previously prepared by the SSC BF-ME. If the data owners give their approval for the sharing of the data, the SC requested Members to collaborate with the DSF Project on the data-sharing process intersessionally.

128. The SC Chair reminded the SC that CMM 2023-14 On Sharks requires all Members to annually report all shark catches, to the extent possible by species, and that at SC08, the DSF

Project (FAO) offered to help the NPFC to develop a key for shark identification.

129. The DSF Project (FAO) presented an overview of preliminary identification keys for deepwater sharks and a review of deepwater shark species known or likely to occur within the NPFC Convention Area (NPFC-2024-SC09-OP05). The DSF Project is also working on a new style of digital identification key with enhanced usability. FAO will produce a pelagic shark identification key in 2025.

130. The SC expressed its appreciation for the preliminary identification keys and expressed interest in collaborating with the FAO on working on a new style of digital identification key.

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

131. Mr. Aureliano Gentile (FAO) provided an update on FIRMS' support for the FAO SOFIA Status of Stocks Index (SoSI) biennial updates and the partnership between FIRMS and NPFC (NPFC-2024-SC09-OP11). Mr. Gentile provided an overview of the objectives and outcomes of the Ninth FIRMS Technical Working Group (TWG9) Meeting that was held on 10–13 December 2024. He also outlined the requirements and good practices for responding to the biennial FIRMS data call for the SoSI updates. Mr. Gentile also reported the status of progress in conducting the SoSI biennial updates, including the new SoSI methodology and data flow, and shared other news from FIRMS.

10.6 Partnership with WCPFC and ISC

132. The Executive Secretary informed the SC that, following the 8th meeting of the Commission, the NPFC has concluded Memoranda of Understanding with the Western and Central Pacific Fisheries Commission (WCPFC) and the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), which will facilitate consultation, cooperation, and collaboration between the NPFC and these two organizations.

10.7 Partnership with SPRFMO

133. The Science Manager presented the Memorandum of Understanding concluded between the NPFC and the SPRFMO in 2023 and outlined the objectives of the SPRFMO. He also reported on his recent attendance of the 12th meeting of the SPRFMO Scientific Committee, which was a valuable opportunity to learn more about SPRFMO and its good practices, as well as to identify areas of similarity and common interest between NPFC and SPRFMO.

10.8 Cooperation with other organizations

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

Agenda Item 11. SC Terms of Reference (TOR) and 2024-2028 Research Plan and Work Plan

11.1 Review of the Scientific Committee TOR

135. The SC reviewed its TOR and determined that no revisions are currently needed.

11.2 Five-year Research Plan

11.3 Five-year Work Plan

136. The SC reviewed its 2024-2028 Five-Year Rolling Research Plan (NPFC-2024-SC09-WP16) and Work Plan (NPFC-2024-SC09-WP17). The Research Plan and the Work Plan of the SC and its subsidiary bodies are attached as Annex CC.

137. Members agreed to share data for scientific activities in accordance with the agreed SC Research Plan and SC Work Plan. The SC tasked the Secretariat to send an official call for data to Members.

11.4 Progress on addressing NPFC PR recommendations for SC

138. The SC's progress on addressing the NPFC Performance Review Panel's recommendations, as well as the SC's ongoing and future actions, are described in NPFC-2024-SC09-WP01 (Rev. 6).

Agenda Item 12. Other matters

12.1 Coordination between SC and TCC

139. The Compliance Manager, Ms. Judy Dwyer, provided an update on coordination between the TCC and the SC (NPFC-2024-SC09-IP11). The TCC has been developing a proposal for a regional transshipment observer program, clarifying language for CMM 2024-03 on Transshipment to ensure all transshipped fish products are recorded by species, addressing technical issues to establish a process for entry and exit notification in the Convention Area, addressing technical issues for incorporating aerial surveillance in high seas boarding and inspections (HSBIs) and updating HSBI support material on the NPFC website, and gathering data from Members to assist in the establishment of the "historic existing level" that is referenced in a number of CMMs.

140. Based on the discussions above, the SC identifies the following as matters for coordination between the SC and the TCC and requests the Secretariat to inform the TCC that:
    (a) The SC proposed revisions to CMM 2024-05 (Annex R) for two new bottom fishing area closures to protect VMEs on Yuryaku Seamount.
    (b) The SC responded to the questions from the TCC Chair (NPFC-2024-SC09-WP04 (Rev. 4)).
    (c) The SC will continue to discuss data needs and data gaps that could be filled by a regional

observer program and inform the TCC about progress in these developments.

12.2 Other issues

141. The SC discussed and agreed on a process for considering the extension of the contracts of invited experts as follows:
   (a) In advance of the completion of an invited expert's term, the Secretariat will circulate a survey among Members in which they will assess the performance of the invited expert and express any concerns they may have.
   (b) The Secretariat will compile Members' responses to the survey and share them with all Members.
   (c) At the meeting of the SC or relevant subsidiary body that is to consider the extension of the contract of the invited expert, the invited expert and observers will be asked to leave the room, and the SC or relevant subsidiary body will hold its deliberations and make its recommendation.

142. As the scope of the scientific activities of the NPFC continues and will continue to grow, as illustrated by the intensive schedule of scientific meetings and projects planned for 2025–2026, the SC recognized the potential need to provide greater support for the Secretariat in the future, for example through the enhanced capacity of the Secretariat itself, support from external suppliers, in-kind assistance from Members, or streamlining its workplan.

143. The FAO informed the SC that the Secretariats at other RFMOs have experienced similar challenges handling intensive meeting and project schedules. The FAO suggested it would be worthwhile for the NPFC Secretariat to discuss these common challenges with other RFMO Secretariats, for example through the Regional Fishery Body Secretariats' Network (RSN).

144. The SC noted that occasionally documents submitted to the SC may require significant modification after being reviewed by the SC. In these rare cases, the SC requests the Commission to allow submission of revised documents which are to be approved intersessionally by the SC up to 14 days prior to Commission meetings.

Agenda Item 13. Advice and recommendations to the Commission

145. Based on the recommendations from its SSCs, the TWG CMSA, and its SWGs, the SC recommends that the Commission:
   (a) Endorse the SC's 5-Year Rolling Research and Work Plans (Annex CC).
   (b) Endorse the proposed scientific projects (Annex AA).
   (c) Consider the species summary documents and stock status summaries as reference information when taking decisions on the management of the NPFC priority species

(Annexes E–Q).

(d) Consider the scientific meetings schedule for 2025-2026 as described in paragraph 149.

Stock Assessment Process

(e) Endorse the prioritization of the development of stock assessment activity for stocks without domestic assessments.

(f) Endorse streamlined stock status reporting to the Commission from the SC consisting of the following:

i. statements of status for each species (e.g. saury text, NPA text)

ii. time series of catch, effort for all species (with pictures)

iii. CPUE standardized or biomass (if model) where available

(g) Provide guidance on how the SC should provide advice for priority species for which work towards an NPFC stock assessment is not currently being conducted.

(h) Allow submission of revised documents which are to be approved intersessionally by the SC up to 14 days prior to Commission meetings, as described in paragraph 144.

Chub Mackerel

(i) Endorse the stock assessment executive summary and stock assessment report (Annex P) as the best available scientific information, while noting that there were discrepancies in the input data, whose impact on the output of the stock assessment is uncertain.

(j) Note, based on the current stock assessment, the status of the chub mackerel stock and management advice in the chub mackerel stock assessment.

(k) Note that Members will revise their data and submit the revised data to the TWG CMSA by 4 February and that the TWG CMSA will re-run the stock assessment and update the model output, ideally before the next TWG CMSA meeting in February, or at least before the Commission meeting in March, if possible.

(l) Allocate funds for the participation of an invited expert in the TWG CMSA meetings to support the TWG CMSA (Scientific Projects, Annex AA).

Bottom Fish and Marine Ecosystems

(m) Allocate funds for the participation of invited experts in the SWG NPA-SA meetings to support the SA and NPA stock assessments (Scientific Projects, Annex AA).

(n) Request Members that conduct or seek to conduct bottom fishing in the Convention Area to provide updated assessments on bottom fishing activities' SAIs on VMEs (following CMM 2024-05 and CMM 2024-06 Annex 2) and submit them for review by the SC and its subsidiary bodies at or before SC11.

(o) Endorse proposed revisions to CMM 2024-05 (Annex R), including the following updates:

i. Translation table of VME indicator corals between common and scientific names of cold-water corals among the VME indicator taxa

ii. Two new bottom fishing area closures: (1) Northwestern part of Yuryaku Seamount:

32–42.75’N, 172–12.90’E; 32–42.75’N, 172–13.65’E; 32–43.50’N, 172–13.65’E; 32–43.50’N, 172–12.90’E, and (2) Southeastern part of Yuryaku Seamount: 32–37.80’N, 172–18.00’E; 32–37.80’N, 172–18.60’E; 32–38.40’N, 172–18.60’E; 32–38.40’N, 172–18.00’E.

(p) Endorse proposed revisions to CMM 2024-06 (Annex S), including the following update:

i. Translation table of VME indicator corals between common and scientific names of cold-water corals among the VME indicator taxa

Neon Flying Squid

(q) Allocate funds for the participation of an invited expert in the SSC NFS meetings to support the SSC NFS (Scientific Projects, Annex AA).

(r) Task the Secretariat to make the maps available on the NPFC website, at a spatial resolution of 1º x 1º and a monthly temporal resolution for catch and effort, with access restricted to NPFC Members only.

Pacific Saury

(s) Endorse the stock assessment report (Annex Q).

(t) Allocate funds for the participation and technical support (e.g., development of a new stock assessment model) of an invited expert(s) in the next SSC PS and WG NSAM meetings (Scientific Projects, Annex AA)

Other Priority Species

(u) Request Members to provide JS biological data, JFS biological data, and BM biological data and the ratio of BM to chub mackerel catch to the Secretariat for analyses in accordance with the agreed work plan.

Data Sharing

(v) Adopt the revised Regulations for Management of Scientific Data and Information (Annex Z).

(w) Update the data shared by the SC, TWG CMSA, SSC BF-ME, SSC PS, SSC NFS in accordance with their work plans.

Cooperation with Other Organizations

(x) Adopt the renewed NPFC – PICES Framework for Enhanced Scientific Collaboration in the North Pacific for 2025–2029.

Performance Review

(y) Note that the SC reviewed the Performance Review recommendations and provided comments on SC-related recommendations (NPFC-2024-SC09-WP01 (Rev. 6)).

146. In relation to other tasks for the SC specified in CMMs and the Convention, the SC informs the Commission of the following:

(a) The SC agreed to disband the SWG Milestones as the SWG has achieved all of its tasks.

Stock Assessment Process

(b) The SC agreed to implement a stock assessment review cycle for species assessed by the NPFC.

Chub Mackerel

(c) The SC tasked the TWG CMSA to investigate the source of the discrepancies in the input data in the stock assessment and to recommend quality assurance and quality control measures to prevent the recurrence of similar issues in the future.

Neon Flying Squid

(d) The SC endorsed the Terms of Reference for the Small Scientific Committee on Neon Flying Squid (Annex U).

(e) The SC endorsed the CPUE Standardization Protocol for neon flying squid (Annex V).

(f) The SC endorsed the Stock assessment protocol for neon flying squid (Annex W).

Pacific Saury

(g) The SC noted the plans of the WG NSAM to continue developing Stock Synthesis model.

Data Collection and Sharing

(h) The SC endorsed the scientific data inventory policy and the data inventory table structure.

(i) The SC endorsed the development of a database to manage and archive scientific data.

(j) The SC agreed to share existing biological data from the fisheries catch in the Convention Area and the adjacent EEZs with the Secretariat.

(k) The SC endorsed Terms of Reference for an SWG Data (Annex Y), agreed to establish the SWG Data for 1 year, and agreed to elect Ms. Karolina Molla Gazi (EU) as the SWG Data Lead.

(l) The SC agreed that it is too early for the SC to be able to provide scientifically defensible input on the kinds of data that would need to be collected from a regional observer program and the level of observer coverage that would be needed on fishing vessels by gear type and agreed to continue to discuss this matter at the SC and its subsidiary bodies.

Climate Change

(m) The SC noted the analyses on climate change effects conducted by the SSC PS.

(n) The SC reviewed the report on potential climate change impacts on NPFC stocks funded by the FAO DSF project.

Cooperation with Other Organizations

(o) The SC re-affirmed its support for the development and implementation of the BECI project, which will provide valuable information for the SC's analyses, including those related to climate change.

(p) The SC continued to cooperate with the FAO DSF Project on the development of a shark ID guide.

(q) The SC revised its policy on evaluation and ranking of nominations for SC representatives to be financially supported to participate in relevant scientific meetings.

147. The SC recommends that the SWG MSE PS:
   (a) Explore options for beginning the MSE process prior to the completion of the age-structured model.

Agenda Item 14. Next meetings of SC and its subsidiary bodies

14.1 Meeting Schedule for 2025/2026

148. The Science Manager presented a proposed meeting schedule for 2025-2026 (NPFC-2024-SC09-IP02).

14.2 Meeting format and location

149. The SC suggested the following provisional meeting schedule for the 2025 operational year, subject to further update before COM09:
   (a) SSC NFS02: 8-10 July 2025 in China (3 days, hybrid)
   (b) WG NSAM: 12-14 July 2025 in China (3 days, hybrid)
   (c) TWG CMSA11: 16-19 July 2025 in China (4 days, hybrid)
   (d) SSC PS15: 1–5 September 2025 (5 days, virtual)
   (e) SSC BF-ME06: 8–9 or 8–10 December 2025 in Japan (2-3 days, hybrid)
   (f) SSC PS16: 10–13 or 11–13 and 15 December 2025 in Japan (4 days, hybrid)
   (g) SC10: 15–18 or 16–19 December 2025 in Japan (4 days, hybrid)
   (h) SSC NFS03: January 2026 (3 days, virtual)
   (i) TWG CMSA12: January/February 2026 (4 days, virtual)

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

151. Members were invited to consider hosting scientific meetings in the 2026 operational year and inform the Secretariat preferably by summer 2025.

Agenda Item 15. Press release

152. The SC endorsed the press release for publication on the NPFC website after the meeting (NPFC-2024-SC09-IP10 (Rev. 1)).

Agenda Item 16. Adoption of the Report

153. The SC09 Report was adopted by consensus.

Agenda Item 17. Close of the Meeting

154. The SC expressed its sincere thanks to the SC Chair for leading the meeting, the Secretariat for its organization and preparations, and Japan for hosting the meeting.

155. The SC Chair thanked the participants for their hard work, the Secretariat for its support, the rapporteur for his assistance, and Japan for its hospitality.

156. The meeting closed at 16:40 on 20 December 2024, Tokyo time.

Annexes:

Annex A – Agenda
Annex B – List of Documents
Annex C – List of Participants
Annex D – SWG Milestones report
Annex E – Species summary for chub mackerel
Annex F – Species summary for North Pacific armorhead
Annex G – Species summary for splendid alfonsino
Annex H – Species summary for sablefish
Annex I – Species summary for blackspotted and rougheye rockfishes
Annex J – Species summary for skilfish
Annex K – Species summary for neon flying squid
Annex L – Species summary for Pacific saury
Annex M – Species summary for Japanese flying squid
Annex N – Species summary for Japanese sardine
Annex O – Species summary for blue mackerel
Annex P – Stock assessment report for chub mackerel
Annex Q – Stock assessment report for Pacific saury
Annex R – Revised CMM 2024-05 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northwestern Pacific Ocean
Annex S – Revised CMM 2024-06 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northeastern Pacific Ocean
Annex T – US statement on its ongoing call for closure of the bottom fisheries on the Emperor Seamount Chain and Northwestern Hawaiian Ridge
Annex U – Terms of Reference for the Small Scientific Committee on Neon Flying Squid
Annex V – CPUE Standardization Protocol for neon flying squid
Annex W – Stock Assessment Protocol for neon flying squid
Annex X – Table of tasks for the SWG JFS, the SWG JS, and the SWG BM in 2025
Annex Y – Terms of Reference for the Small Working Group on Data (SWG Data)
Annex Z – Revised Regulations for Management of Scientific Data and Information

Annex AA – Scientific projects

Annex BB – Evaluation and ranking of nominations for SC representatives to be financially supported to participate in relevant scientific meetings

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

Annex A

Agenda

Agenda Item 1. Opening of the Meeting

1.1 Welcome Address and Introductions

1.2 Appointment of Rapporteur

1.3 Meeting Arrangements

Agenda Item 2. Adoption of Agenda

Agenda Item 3. Key milestones to achieve for NPFC stock assessment of priority species and provision of management advice

3.1 A process for reviewing and possibly endorsing domestic stock assessments for priority species

Agenda Item 4. Review of reports and recommendations from the Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA) and the Small Scientific Committees (SSC BF-ME, SSC NFS, and SSC PS)

4.1 Technical Working Group on Chub Mackerel Stock Assessment

4.2 Small Scientific Committee on Bottom Fish and Marine Ecosystems

4.3 Small Scientific Committee on Neon Flying Squid

4.4 Small Scientific Committee on Pacific Saury

Agenda Item 5. Update from the Joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific Saury (SWG MSE PS)

Agenda Item 6. Other pelagic priority species

6.1 Summary of progress on the remaining three priority species

6.1.1 Blue mackerel (BM)

6.1.2 Japanese flying squid (JFS)

6.1.3 Japanese sardine (JS)

6.2 Review of species summaries

6.3 Domestic stock assessments of BM, JFS, and JS

6.4 Future roles and activities of SWG BM, SWG JFS, and SWG JS

Agenda Item 7. Climate change effects on NPFC’s priority species and associated ecosystems

7.1 Tools for incorporating climate change considerations into scientific advice

7.2 Current knowledge

7.2.1 FAO consultancy report on climate change in the North Pacific

7.3 Ongoing research activities

7.3.1 PICES' Basin-scale Events to Coastal Impacts (BECI) project

7.4 Research priorities and potential scientific projects

Agenda Item 8. Data Collection and Management

8.1 Data Management System

8.1.1 Update on GitHub Plan for NPFC

8.1.2 Evaluation of biological data provision templates

8.1.3 Data inventory

8.1.4 Establishment of a new database to manage and archive scientific data

8.1.5 Potential establishment of a new Small Working Group on Data (SWG Data)

8.1.6 Review of need of GIS maps with catch and effort data for NFS and JS

8.2 NPFC Data Sharing and Data Security Protocol

8.2.1 Revision of Regulations for Management of Scientific Data and Information

8.3 Data needs, data gaps and strategies to fill gaps

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

8.3.1.1 Historical information about species captured in surveys and/or discarded bycatch from fisheries in the Convention Area

8.3.1.2 Potential impacts on species belonging to same ecosystem or dependent/associated with target stocks

8.3.1.3 Status of current non-target catch, definitions of bycatch applied in other RFMOs, and options for defining bycatch within NPFC

8.3.2 Potential roles of a regional observer program

8.3.2.1 Summary of scientific objectives of an observer program

8.3.2.2 Summary of the kinds of data that would need to be collected and the level of observer coverage that would be needed on fishing vessels to achieve those scientific objectives by gear type

8.3.2.3 Review of template for collecting qualitative information about Members' sampling programs

8.3.2.4 Summary of SC responses to six questions from the TCC Chair

8.3.3 Potential use of NPFC Vessel Monitoring System (VMS) data for scientific purposes

Agenda Item 9. Scientific projects for 2025 and 2026

9.1 Report on capacity building project

9.2 Ongoing/planned projects

9.3 New projects

9.3.1 Potential project(s) for PS, CM, NPA, SA, and NFS

9.3.2 Independent review of stock assessments

9.3.3 Other potential projects

9.4 Review, prioritization and funding of projects

Agenda Item 10. Cooperation with other organizations

10.1 Reports on the joint NPFC-PICES activities since the SC08 meeting, including a report from the PICES Secretariat

10.2 SC representation at scientific meetings

10.2.1 SC representation in the joint ICES-PICES Working Group on Sustainable Pelagic Forage Communities (WG SPF) and SPF symposium in 2026

10.2.2 Report on renewal of the NPFC – PICES Framework for Enhanced Scientific Collaboration in the North Pacific

10.3 Report on cooperation between NPFC and NPAFC

10.4 FAO ABNJ Deep-sea fisheries project

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

10.6 Partnership with WCPFC and ISC

10.7 Partnership with SPRFMO

10.8 Cooperation with other organizations

Agenda Item 11. SC Terms of Reference (TOR) and 2024-2028 Research Plan and Work Plan

11.1 Review of the Scientific Committee TOR

11.2 Five-year Research Plan

11.3 Five-year Work Plan

11.4 Progress on addressing NPFC PR recommendations for SC

Agenda Item 12. Other matters

12.1 Coordination between SC and TCC

12.2 Other issues

Agenda Item 13. Advice and recommendations to the Commission

Agenda Item 14. Next meetings of SC and its subsidiary bodies

14.1 Meeting schedule for 2025/2026

14.2 Meeting format and location

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

Number	Title
NPFC-2024-SC09-MIP01 (Rev. 5)	Meeting Information
NPFC-2024-SC09-MIP02	Provisional Agenda
NPFC-2024-SC09-MIP03 (Rev. 2)	Annotated Indicative Schedule

WORKING PAPERS

Number	Title
NPFC-2024-SC09-WP01 (Rev. 6)	Performance Review Recommendations update
NPFC-2024-SC09-WP02 (Rev. 4)	Report on the existing observer programs of NPFC Members and those of other RFMOs
NPFC-2024-SC09-WP03	Data inventory
NPFC-2024-SC09-WP04 (Rev. 4)	Request from the TCC Chair on the development of an ROP and responses from SC
NPFC-2024-SC09-WP05	Potential use of NPFC Vessel Monitoring System (VMS) data for scientific purposes
NPFC-2024-SC09-WP06	SC database: concept paper
NPFC-2024-SC09-WP07 (Rev. 2)	Revised Regulations for Management of Scientific Data and Information
NPFC-2024-SC09-WP08	SWG Milestones Report
NPFC-2024-SC09-WP09 (Rev. 2)	Scientific projects
NPFC-2024-SC09-WP10 (Rev. 2)	Blue Mackerel Species Summary
NPFC-2024-SC09-WP11 (Rev. 1)	Japanese Flying Squid Species Summary
NPFC-2024-SC09-WP12 (Rev. 2)	Japanese Sardine Species Summary
NPFC-2024-SC09-WP13	Prototype of NPFC Neon Flying Squid map
NPFC-2024-SC09-WP14	Summary of progress by the Japanese Sardine SSC in 2024
NPFC-2024-SC09-WP15	Exploring the opportunity for developing common standards for the collection, reporting, verification and exchange of data in NPFC
NPFC-2024-SC09-WP16 (Rev. 1)	SC 2024-2028 Research Plan
NPFC-2024-SC09-WP17 (Rev. 1)	Five-Year Work Plan of the Scientific Committee
NPFC-2024-SC09-WP18	Evaluation and ranking of nominations for SC representatives to be financially supported to participate in relevant scientific meetings
NPFC-2024-SC09-WP19	NPFC – PICES Framework for Enhanced Scientific Collaboration in the North Pacific

NPFC-2024-SC09-WP20 (Rev. 1)	Stock Assessment of Chub Mackerel in the Northwest Pacific Ocean
NPFC-2024-SC09-WP21	An overview of 2024 Chinese survey by fishery research vessel "Song Hang" in the NPFC convention area
NPFC-2024-SC09-WP22	Study in the ecosystem structure and trophodynamics in the Kuroshio-Oyashio Extension area
NPFC-2024-SC09-WP23	Species in the Northwest Pacific ecosystem from Chinese survey and bycatch in fishery

INFORMATION PAPERS

Number	Title
NPFC-2024-SC09-IP01	NPFC Data Management Systems: Progress and Operational Guidelines
NPFC-2024-SC09-IP02 (Rev. 4)	Meeting schedule 2025-2026
NPFC-2024-SC09-IP03	Summary of Progress on Blue Mackerel
NPFC-2024-SC09-IP04 (Rev.1)	Domestic Stock Assessment of Blue Mackerel in Japan in 2022 FY (July-June)
NPFC-2024-SC09-IP05 (Rev.1)	Domestic Stock Assessment of Japanese Sardine in Japan in 2023 FY (January-December)
NPFC-2024-SC09-IP06	Domestic stock assessment of Japanese flying squid in Japan
NPFC-2024-SC09-IP07	Summary of progress on Japanese flying squid
NPFC-2024-SC09-IP08	Summary of NPFC’s SC representation at PICES 2024 Annual Meeting
NPFC-2024-SC09-IP09	PICES-ICES WG53 (WGSPF) Sustainable Pelagic Forage Communities
NPFC-2024-SC09-IP10 (Rev.1)	Press Release
NPFC-2024-SC09-IP11	TCC update to SC09
NPFC-2023-SC08-IP13(Rev 1)	2023 Biological Data Provision Templates

OBSERVER PAPERS

Number	Title
NPFC-2024-SC09-OP01	Pathways for the incorporation of climate change into the work of the North Pacific Fisheries Commission
NPFC-2024-SC09-OP02	Developing the climate test: robustness trials for climate-ready management procedures
NPFC-2024-SC09-OP03	Developing the climate test: performance metrics of climate robustness

NPFC-2024-SC09-OP04	Harvest Strategies and Climate Change - A Review of the Literature
NPFC-2024-SC09-OP05	A review of deep-water shark species (superorder Selachimorpha) known or likely to occur within the North Pacific Fisheries Commission's Convention Area, including preliminary identification keys
NPFC-2024-SC09-OP06	Invitation to the PICES/ICES/FAO International Symposium “Navigating Changes in Small Pelagic Fish and Forage Communities: Climate, Ecosystems, and Sustainable Fisheries
NPFC-2024-SC09-OP07	Report on Joint NPFC-PICES activities for SC-09
NPFC-2024-SC09-OP08	Request for deep-sea fishing effort data by position and gear for fisheries using bottom contact gears
NPFC-2024-SC09-OP09	Progress on the Five-year Work Plan to implement NPAFC/NPFC Memorandum of Cooperation (MOC) (endorsed by NPFC and NPAFC in 2023)
NPFC-2024-SC09-OP10	Basin-Scale Events & Coastal Impacts (BECI) Project: Making Climate and Ocean Science Work for You
NPFC-2024-SC09-OP11	FIRMS at NPFC-SC09
NPFC-2024-SC09-OP12	Deep-sea fisheries project

REFERENCE DOCUMENTS

Number	Title
NPFC-2024-SC09-RP01	Summary of the 1st joint meeting of the Small Working Groups on JFS, JS, and BM
NPFC-2024-SC09-RP02	Summary of the 2nd joint meeting of the Small Working Groups on JFS, JS, and BM
NPFC-2024-TWG CMSA08-Final Report	TWG CMSA08 meeting report
NPFC-2024-TWG CMSA09-Final Report	TWG CMSA09 meeting report
NPFC-2024-SSC NFS01-Final Report	SSC NFS meeting report
NPFC-2024-SWG MSE PS05-Final Report	SWG MSE PS05 report
NPFC-2024-SSC BFME05-Final Report	SSC BFME05 report
	MOU between NPAFC and NPFC
	Partnership Arrangement between FIRMS and NPFC
	NPFC's MOUs with WCPFC and ISC
	MOU between SPRFMO and NPFC
	Materials from ICES RTMB training course

Annex C

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Annex D

SWG Milestones report

Background and objectives

The North Pacific Fisheries Commission (NPFC) is responsible for managing fisheries for fish and invertebrate species (not including tuna, tuna-like species and Pacific salmon) in international waters of the North Pacific. The NPFC has identified 10 priority species that are harvested in the Convention Area (CA) using a variety of gears. Four species of pelagic fish; Pacific saury, chub mackerel, blue mackerel and Japanese sardine, four species of bottom fish species; North Pacific armorhead, splendid alfonsino, skilfish, and sablefish and two species of squid; neon flying squid and Japanese flying squid constitute the priority species.

For each of these species the Scientific Committee (SC) of the NPFC is charged with determining the status of the stock and providing this information to the Commission. This will enable the Commission to make informed decisions on sustainable levels of harvest for each stock and/or implement harvest controls that meet other management or conservation objectives for each stock.

The Small Working Group on Milestones (SWG Milestones) was tasked by the Scientific Committee at SC08 to develop a set of common milestones for determining stock status for NPFC priority species. Additionally, the SWG Milestones was asked to develop a plan and timeline to achieve the assessment of stock status. One of the requested tasks was to develop and implement a common set of data sharing templates that would enable the NPFC to more efficiently manage and distribute data on each of the stocks. Finally, the SWG Milestones was asked to present the outcomes of their work at SC09 in December 2024.

General framework for assessment milestones

Most modern single species stock assessments utilize three main data streams to determine the status of a fish stock. The catch and effort data from commercial fisheries is the most basic data collected on a stock. Biological data on the species, including length, weight, age and maturity data from the catch and other sources is the second piece of important data. Finally, an index of abundance generated from a non-fishery source (e.g. a fishery independent survey) is sometimes available and always useful in stock assessments. The available data is then integrated into a data-appropriate model that describes the dynamics of the population and from which reference points on the status of the stock can be generated. It is important to note that in some cases the data may limit the type of assessment model that can be used.

In general, once a stock assessment model has been developed, it can be simulation tested to determine its robustness to the data. A stock assessment model (or other model that describes the population dynamics) can also be used as an operating model in a management strategy evaluation

(MSE) to determine the performance of different harvest strategies against management and conservation objectives.

Depending on the data available, a more complex (full MSE based on age structured operating model) or a more simple (catch and effort data depicted over time) may be preferred or attainable for NPFC priority species. There is also a different pathway (at least currently) for NPFC priority species that are assessed domestically by Japan and Canada, in that these species are lower priorities for the NPFC SC to develop full stock assessments and MSE processes. A general diagram depicting this pathway from the most simple to most complex scenarios is shown in Figure 1 with NPFC priority species current location along that pathway.

Pathways for priority species

A depiction of the planned pathways for assessment within the NPFC are shown in the flow chart in Figures 2 and 3. Which priority stock is chosen for assessment can be determined by direct request of the Commission, or roughly determined by a set of indicators ranked by importance (e.g., stock nearing collapse based on auxiliary information like indices or domestic stock assessments, ecological importance, existing high harvest levels, effective managements with technical measures already in place etc.). In previous years, the stocks chosen for assessment were Pacific saury and chub mackerel and the choice was made by the Commission. At SC08 the Scientific Committee recommended that neon flying squid would be the next species to be assessed based on its importance and the absence of information on its status. The current logistics are that the SC establish a small scientific committee (or technical working group) with representatives from each Member to undertake assessment of a species.

The data available to the NPFC for each stock determines which model or method can be used to assess the stock (Figures 2 and 3). One way to divide the stocks are those that are data rich, data moderate and data poor. For data rich stocks there are two where the fishery occurs predominantly or extensively in the CA (Pacific saury and chub mackerel). There are also data rich stocks where the primary stock distribution is inside domestic waters and a domestic stock assessment is available (Japanese sardine, blue mackerel, Japanese flying squid, sablefish). The data moderate stocks in the NPFC priority species list are splendid alfonsino and neon flying squid, while the data limited stocks are skilfish and North Pacific armorhead.

A proposed set of pathways for assessment within the NPFC are shown in the flow chart in Figure 2. Requests from the Commission, in particular the request for an interim HCR for Pacific saury have led to a different pathway than is proposed in Figure 2 (for Pacific saury an HCR was simulation tested and adopted as an interim measure). The pathway in Figure 2 shows the more accepted practice of conducting MSE on management procedures prior to implementation (rather than implementing an HCR prior to full MSE). Figure 3 shows the proposed pathway for NPFC priority species that currently have a domestic assessment by a Member. We would propose the pathways in Figures 2 and 3 be adopted for future work by the NPFC.

Data rich stocks (Pacific saury, chub mackerel)

Data available for Pacific saury include catch and effort data from multiple fishery components (different Members), a juvenile fishery independent survey conducted annually by Japan, and biological data from some fishery catch and the survey data. More complete biological data from the catch of most fishery sectors would be useful for this species. Pacific saury is currently assessed using a Bayesian state-space surplus production model. The model has been simulation tested against the data, reference points have been calculated and a harvest control rule has been implemented by the Commission based on the simulation output. The next steps for the Pacific saury are to implement an age-structured stock assessment model and use this as the operating model in a full MSE for the species.

The status of the Pacific saury stock is currently communicated to the Commission at its annual meeting.

Table 1. Pacific saury milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Age structured assessment/operating model	SC10 (2025)?	SSC PS
Full MSE	SC10 (2025)?	SWG MSE, SSC PS
Assessment update	Annually	SSC PS
MSE update	3-5 year cycle	SWG MSE, SSC PS

Data available for chub mackerel include catch and effort data from multiple fishery components (both different gear types and different Members), two juvenile fishery independent surveys (summer and autumn) and egg survey conducted annually by Japan, and biological data from some fishery catch and the survey data. Additionally, recent data from fishery independent surveys conducted by China and Japan are potentially available. More complete biological data from the catch of most fishery sectors would be useful for this species. The chub mackerel stock assessment using a state-space assessment is currently being parameterized and estimated. The model has been tested and evaluated against simulated data. The next steps for the chub mackerel stock are to implement an age-structured stock assessment model, estimate reference points and report status of the stock.

The status of the chub mackerel stock is not currently communicated to the SC and the Commission.

Table 2. Chub mackerel milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Age structured assessment	SC09 (2024)	TWG CMSA
Reference points estimated	SC09 (2024)	TWG CMSA
Stock status communicated to the SC and Commission	SC09 (2024)?	TWG CMSA, SC
Assessment update	Annually	TWG CMSA

Data rich stocks with domestic assessments (Japanese sardine, Japanese flying squid, blue mackerel, Sablefish)

Data available for Japanese sardine include catch and effort data from fishery components (both domestic and in the CA by all Members), fishery independent surveys conducted annually by Japan and biological data from some fishery catch and the survey data. More complete biological data from the catch of the CA fishery sectors would be useful for this species. A domestic assessment of the population is conducted annually by Japan using a virtual population analysis and includes annual catch amount from the CA components of the fishery. The next steps for the Japanese sardine assessment would be to collect and incorporate catch-at-age and biological data from the CA fishery components and report status of the stock to the Commission for the CA fishery based on the Japanese domestic stock assessment.

The status of the Japanese sardine stock is not currently communicated to the Commission.

Table 3. Japanese sardine milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Collect and share biological data from CA catch of Japanese sardine	SC09 (2024)	SWG JS
Stock status based on domestic assessment communicated to the SC and Commission	SC09 (2024)	SWG JS, SC

Data available for Japanese flying squid include catch and effort data from fishery components (both domestic and in the CA by all Members), fishery independent surveys conducted annually by Japan (winter and spring) and historically by Russia, and biological data from some fishery catch and the survey data. More complete biological data from the catch of the CA fishery sectors would be useful for this species. A domestic assessment of the population is conducted annually by Japan based on abundance indices. The next steps for the Japanese flying squid assessment would be to collect and incorporate biological data from the CA fishery components and report status of the stock to the Commission for the CA fishery based on the Japanese domestic stock assessment.

The status of the Japanese flying squid stock is not currently communicated to the Commission.

Table 4. Japanese flying squid milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Collect and share biological data from CA catch of Japanese flying squid	SC09 (2024)	SWG JFS
Stock status based on domestic assessment communicated to the SC and Commission	SC09 (2024)	SWG JFS, SC

Data available for blue mackerel include catch and effort data from fishery components (both domestic and in the CA by all Members), fishery independent surveys conducted annually by Japan and biological data from some fishery catch and the survey data. More complete biological data from the catch of the CA fishery sectors would be useful for this species. A domestic assessment of the population is conducted annually by Japan using a virtual population analysis and includes catch and effort data from the CA components of the fishery. The next steps for the blue assessment would be to collect and incorporate catch-at-age and biological data from the CA fishery components and report status of the stock to the Commission for the CA fishery based on the Japanese domestic stock assessment.

The status of the blue mackerel stock is not currently communicated to the Commission.

Table 5. Blue mackerel milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Collect and share biological data from CA catch of blue mackerel	SC09 (2024)	SWG BM
Stock status based on domestic assessment communicated to the SC and Commission	SC09 (2024)	SWG BM, SC

Data available for sablefish include catch and effort data from fishery components (both domestic and in the CA), fishery independent surveys conducted annually by the USA and Canada and biological data from fishery catch and the survey data. A domestic assessment of the population is conducted annually by the USA for Alaska, and on a 3-5 year cycle for the USA West Coast using an age structured model. A full MSE is conducted on the Canadian portion of the stock on a 3-5 year cycle and a coastwide MSE was conducted in 2023 for sablefish. The next steps for the sablefish would be to report status of the stock to the Commission based on the Canadian MSE and USA stock assessments.

The status of the sablefish stock is not currently communicated to the Commission.

Table 6. Sablefish milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Stock status based on Canadian MSE assessment communicated to the SC and Commission	SC09 (2024)	SSC BFME, SC

Data moderate stocks (splendid alfonsino, neon flying squid)

Data available for splendid alfonsino are more limited. They include catch data from the bottom trawl fishery (Japan and Korea) and the bottom gillnet fishery (Japan) and biological data from the fisheries catch including length, weight, age and maturity. Importantly, there is no fishery independent survey conducted for this species and effort data is not split from effort for the North Pacific armorhead, which makes calculating CPUE problematic. Due to these issues with the data, a data limited-life history based approach to determining stock status is being undertaken. This analysis will focus on calculating yield per recruit and spawner per recruit indices of the stock and attempting to use length data to estimate selectivity by age. The next steps for the splendid alfonsino stock are to conduct the life-history based analyses, develop reference points and report the status of the stock to the SC and the Commission.
The status of the splendid alfonsino stock is not currently communicated to the Commission.

Table 7. Splendid alfonsino milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Develop indicators of stock status using life-history based methods	SC09 (2024)	SSC BFME
Develop reference points and HCRs or suitable alternatives	SC10 (2025)	SSC BFME
Stock status reported to SC and Commission	SC09 (2024)	SSC BFME, SC

Data available for neon flying squid include catch and effort data from fishery components (different Members), fishery independent surveys conducted annually by Japan (winter and spring) and historically by Russia, and biological data from some fishery catch and the survey data. Although neon flying squid has the potential to be considered as a data rich species, at the moment, only data on catch and effort has been shared among members, so we consider it data moderate at this time. More complete biological data from the catch of most fishery sectors would be useful for this species. The SSC NFS was recently formed by the Commission and has begun its work this year (2024). The next steps for the SSC NFS are to share Member data, select and assess a suitable population dynamics model, conduct the analytical stock assessment, estimate reference points and

report status of the stock.
The status of the neon flying squid stock is not currently communicated to the SC and the Commission.

Table 8. Neon flying squid milestones, timeline and deliverables [**this table will be updated with agreed upon timelines at the conclusion of the 1st SSC NFS in August**]

Deliverable	Anticipated timeline	Responsible group
Share all neon flying squid data	SC09 (2024)	SSC NFS
Test/evaluate? and choose appropriate assessment model	SC10 (2025)	SSC NFS
Conduct stock assessment	SC11 (2026)	SSC NFS
Reference points estimated	SC11 (2026)	SSC NFS
Stock status communicated to the SC and Commission	SC11 (2026)?	SSC NFS, SC

Data limited stocks (north pacific armorhead, skilfish)

Data available for North Pacific armorhead are also limited. They include catch data from the bottom trawl fishery (Japan and Korea) and the bottom gillnet fishery (Japan) and limited biological data from the fisheries catch including length, weight, and fatness index. There is no regular fishery independent survey conducted for this species, although there is a monitoring survey conducted since 2019 and consisting of a single tow conducted per month from March to June at a predesignated block. As with splendid alfonsino, the effort data is not easily resolved, which makes calculating CPUE problematic. Due to these issues with the data, a data limited approach is needed to assess the status of this stock. Two methods have been proposed, using a depletion method to determine an annual and historical biomass and an individual based modeling approach to attempt to indicate future recruitment. The next steps for the North Pacific armorhead stock are to explore the depletion estimate and individual based model to determine if one of these methods is sufficient to develop reference points. It may be that these methods will not prove suitable and robust, so the current species summary approach that documents the annual catch trends is the only information that is reported to the SC and the Commission.
The status of the North Pacific Armorhead stock is not currently communicated to the Commission.

Table 9. North Pacific armorhead milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Trends in catch reported to SC and Commission	SC09 (2024)	SSC BFME, SC
Develop indicators of historical	SC10 (2025)	SSC BFME

and current biomass based on depletion method		
Develop indicators of recruitment from individual based model	SC10 (2025)	SSC BFME
Stock status and/or trends in catch reported to SC and Commission	SC10 (2025)	SSC BFME, SC

Table 10. Rougheye and blackspotted rockfish milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Continue to report trends in catch and effort to SC and begin reporting to the Commission	SC09 (2024)	SSC BFME, SC

There is very little data available for the longline fishery conducted by Russia for skilfish. The fishery is intermittent in occurrence, but there are catch and effort data reported. There is some biological data (length and weight) recorded by observers on the catch. There is no fishery independent survey conducted for this species or other biological data collected. Due to the lack of data, a data limited approach is needed to assess the status of this stock. Currently there is no plan to conduct an assessment for this species, so the next steps are to develop a species summary that documents the annual catch and effort trends is reported to the SC and the Commission.
The status of the skilfish stock is not currently communicated to the SC or the Commission.

Table 11. Skilfish milestones, timeline and deliverables

Deliverable	Anticipated timeline	Responsible group
Develop species summary document for skilfish	SC09 (2024)	SSC BFME
Report trends in catch and effort to SC and Commission	SC09 (2024)	SSC BFME, SC

Data and data sharing templates

Data from fisheries and research surveys are the backbone of stock assessment. Currently, the scientific data workflow in the NPFC involves the steps outlined in Figure 4. Data is collected by Members, cleaned and processed and then shared with SC's expert groups in accordance with the agreed data sharing templates. Data is stored on the Collaboration site managed by the Secretariat. Expert groups review data, compile/process them and use for stock assessment and other analyses. Efficient data workflow from data collection to management advice requires clearly defined responsibilities and agreed regulations for data collection, sharing and use. Table 12 summarizes the status of this process and identifies missing elements and potential steps forward. Other RFMOs and international management bodies have standing working groups to deal with data and provide guidance on data related issues as they arise. It would be useful to establish a Small Working Group within NPFC to fill this gap in resolving data and data issues. A draft Terms of Reference for such a group are attached as Annex 1.

Table 12. Scientific data workflow status and potential future tasks

Data workflow step	Responsibility	Regulations	Note
Collection	Members	Data requirements Data collection templates	Status: data requirements for BF (CMMs 05 and 06), Data Information Template for PS (link). [Future tasks: Data requirements and Data collection templates for other species.]
Cleaning	Members	Data collection quality control Data cleaning requirements	Status: conducted by M individually. [Future tasks: Data collection quality control and Data cleaning requirements guidelines]
Submission	Members	Data sharing regulations Data provision templates Data provision deadlines	Status: Data sharing regulations in place (link). Expert group-specific data provision templates. [Future tasks: Common/standardized data submission templates and data submission process. Data for domestic stock assessment. Data provision deadlines on website.]
Storage	Secretariat / Members	Database management system	Status: data is stored in different locations and different formats.

			[Future tasks: Relational database. Online data submission tools]
Inventory	Secretariat	Data inventory policy	Status: Data inventory policy and template in preparation. [Future tasks: final draft, review by SC]
Quality review and compilation	Expert groups	Agreed process for data quality check	Status: Data quality review at meetings. [Future tasks: Data quality review for domestic stock assessments]
Analysis/modelling	Expert groups	CPUE Standardization Protocol Stock Assessment Protocol	Status: CPUE Standardization Protocols and Stock Assessment Protocols for PS and CM are in place. [Future tasks: Regular review/update for PS and CM. Protocols for other priority species.]
Scientific advice	Expert groups/SC	Scientific Advice Format	Status: Stock Assessment Report incl. Executive Summary for PS. In preparation for CM. [Future tasks: Common Scientific Advice Format]
Workflow review	SWG Data/SC	Part of SWG Data TOR	[Future tasks: regular review]

Recommendations to the SC

The following recommendations are made with regards to milestones for achieving stock assessment and status updates for NPFC priority species:

- Prioritize development of stock assessment activity for stocks without domestic assessments
- Use domestic assessments to monitor those species for which these exist

- Streamline reporting to Commission from the SC
    - Statements of status for each species (e.g. saury text, NPA text)
    - Time series of catch, effort for all species (with pictures)
    - CPUE standardized or biomass (if model) where available
- Review scientific data workflow (Table 12) and prioritize future tasks
- Establish [SWG] Data with the attached terms of reference (Annex 1)
- Share data using standardized data sharing templates to streamline process for Secretariat to compile and store data
- Implement a 5-10 year stock assessment review cycle for species assessed by the NPFC
- Share existing biological data from the fisheries catch in the CA and the adjacent EEZs with those conducting domestic stock assessments
- Consider collecting additional biological data from new surveys and the catch in the CA for species with a stock assessment (both domestic and NPFC)
- Consider assessing the impacts of climate change on the ecosystem as well as stocks and fisheries in the species summary for each species

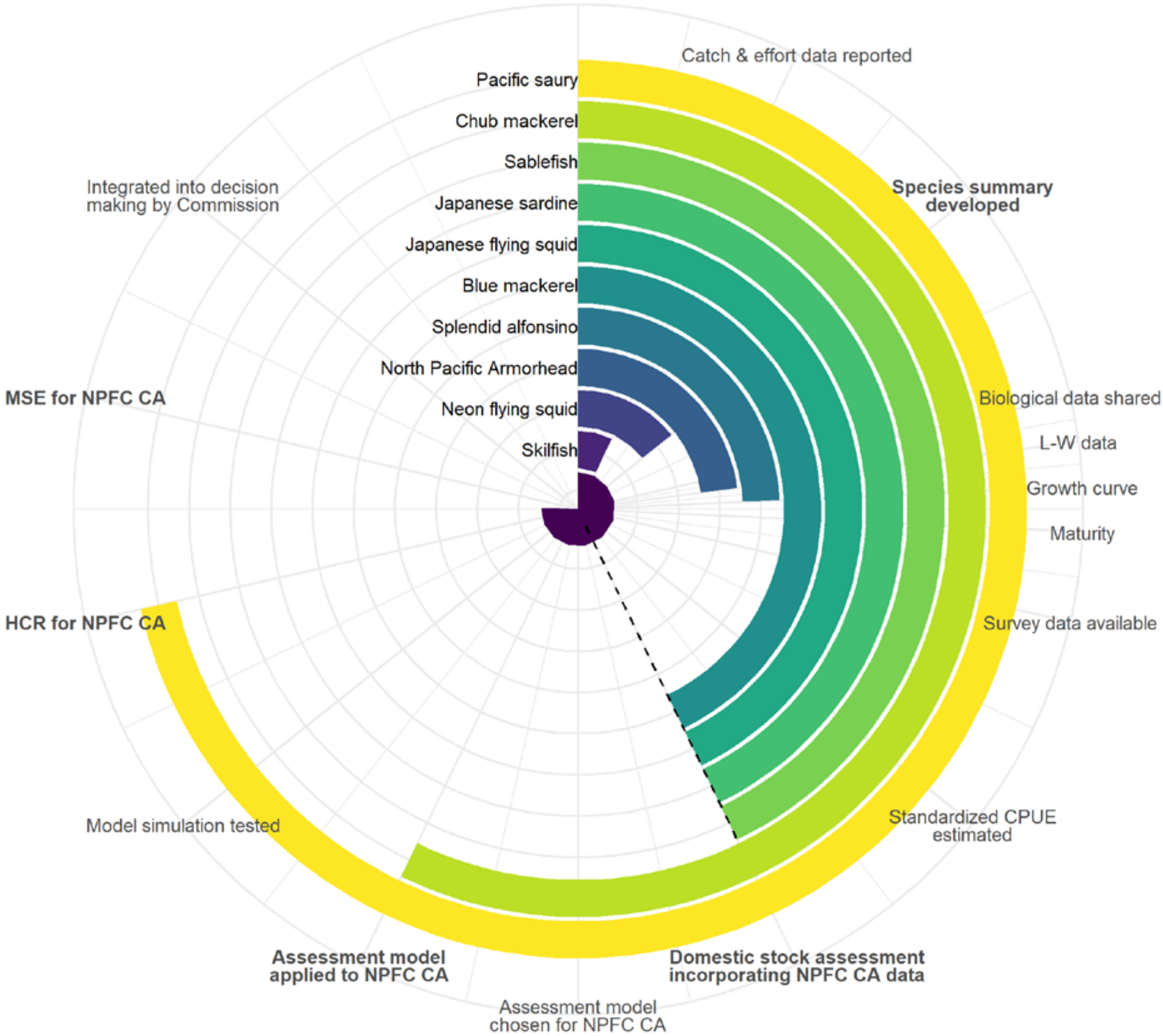

Figure 1. General schematic of current status of the assessment process for priority fish stocks that are currently targeted in the NPFC Convention Area. Milestones in bold demarcate products that can be provided to the Commission to inform about stock status. The dashed line indicates a domestic stock assessment is in place for the species that incorporates NPFC CA data and moving forward with a separate NPFC assessment may not be a priority.

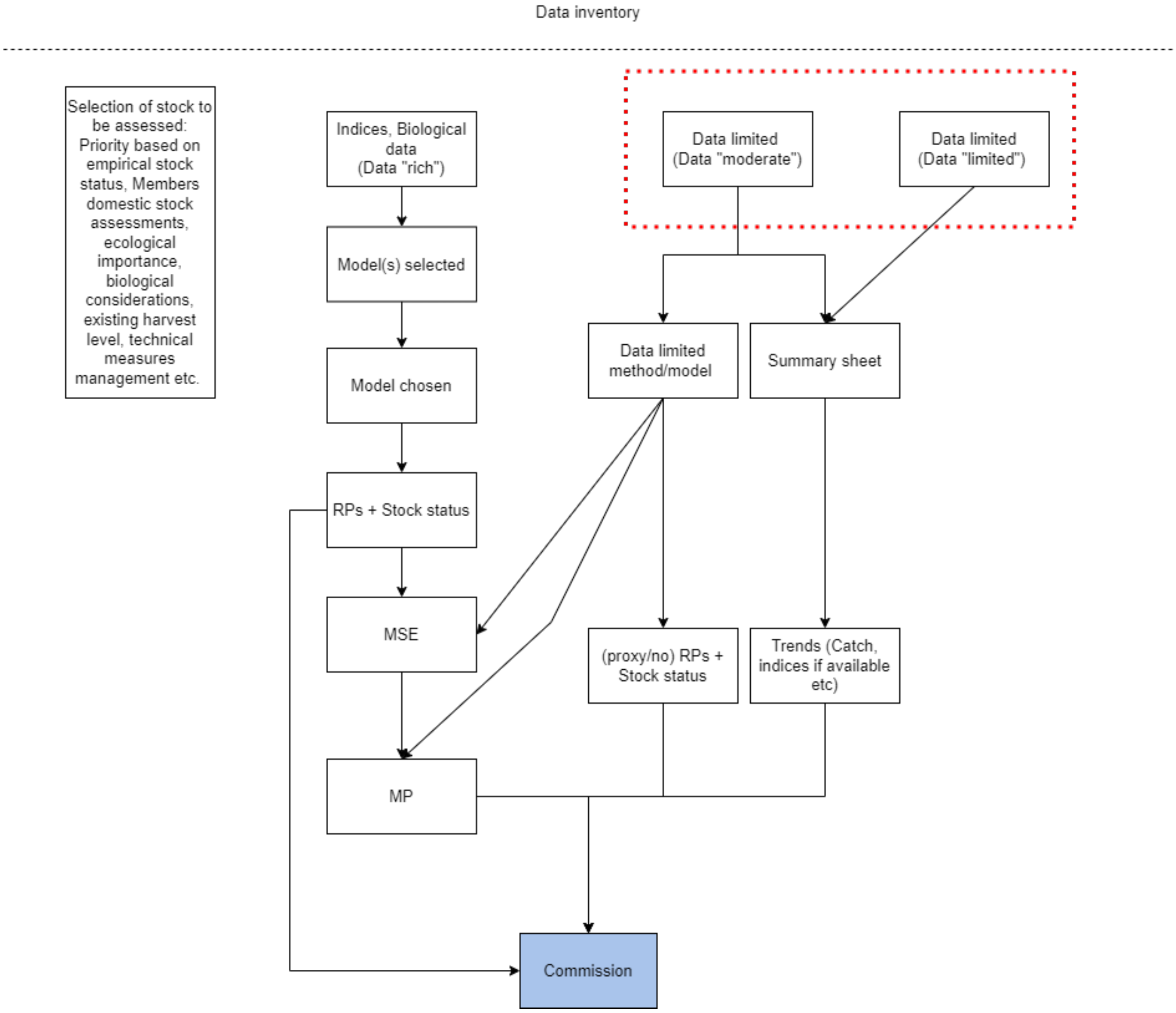

Figure 2. Flow chart of proposed pathways for stock assessment and provision of advice to the Commission on priority species for the NPFC.

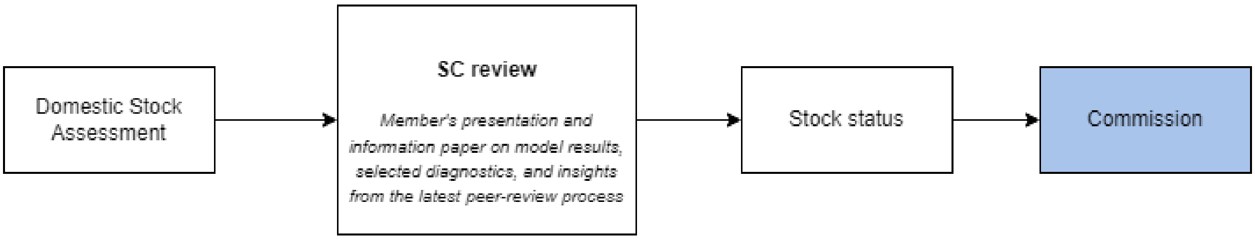

Figure 3. Flow chart of proposed pathway for reviewing domestic stock assessment on NPFC priority species without an NPFC stock assessment completed.

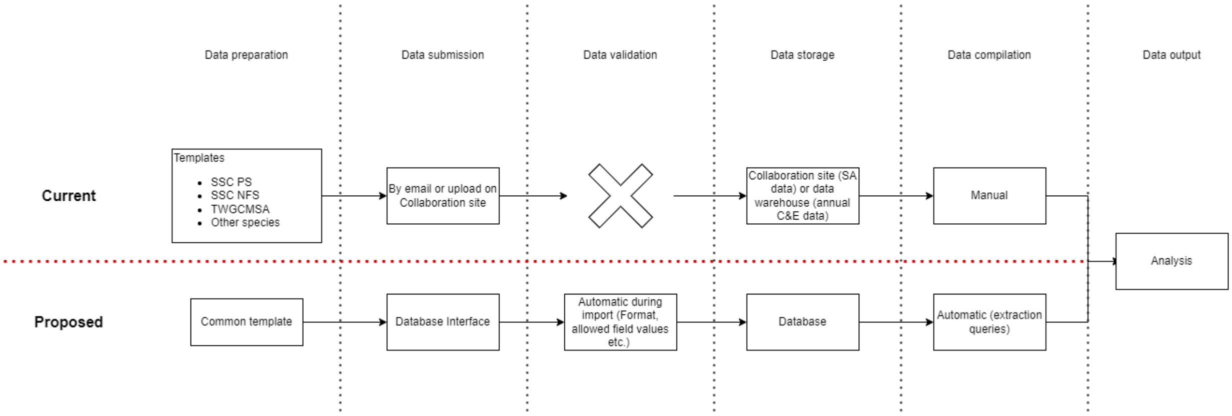

Figure 4. Flowchart of current and proposed pathways for data processing, submission and compilation for NPFC stocks.

Annex 1. Draft Terms of reference for new small working group on data management ([SWG] Data)

1) Compile an inventory of Members' data collection programs
    a. Review existing observer programs of Members and other RFMOs
    b. Update the inventory when needed to reflect changes in Members' sampling schemes.
2) Assist the SC's subsidiary groups in collecting information on data needs
    a. Develop a template for the subsidiary groups to quickly report the required information
    b. Assist the subsidiary groups in filling data gaps where they exist
3) Assist the secretariat in creating a data management system, including data collection, verification, reporting, storing, and dissemination
    a. Discuss the creation of a relational database for data storage and what the necessary steps would be
    b. Continue developing data provision templates, incorporating feedback from the SC's subsidiary bodies.

Annex E

Species summary for chub mackerel

Chub mackerel (*Scomber japonicus*)

Common names:

鮐鱼, Taiyu (China)

マサバ, Masaba (Japan)

고등어, Godeungeo (Korea)

Японская скумбрия, Yaponskaya skumbriya (Russia)

白腹鯖, Bai-Fu-Qing (Chinese Taipei)

Management

Active NPFC Management Measures

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

- CMM 2024-07 For Chub Mackerel

Available from https://www.npfc.int/cmm-2024-07-chub-mackerel

Management Summary

The current conservation and management measure (CMM) for Chub mackerel specifies catch limits. The CMM states that Members and Cooperating non-Contracting Parties currently harvesting Chub mackerel should refrain from expansion of the number of fishing vessels authorized to fish Chub mackerel in the Convention Area.

Additionally, the Commission established the annual total allowable catch of chub mackerel in the Convention Area as a provisional measure until the Scientific Committee adopts NPFC stock assessment of chub mackerel and the Commission accordingly revises this CMM. The annual total allowable catch of chub mackerel in the Convention Area, excluding the amount in paragraph 11, shall be set at 94,000 tons for each of the 2024 and 2025 fishing seasons. Of this annual total allowable catch, the catch for trawlers shall not exceed 14,000 tons and the catch for purse seiners shall not exceed 80,000 tons for each of the 2024 and 2025 fishing seasons. China shall not authorize more than 3 trawlers and the EU shall not authorize more than 1 trawler to conduct fishing operations at the same time. In addition to the above fishing opportunities, the EU shall be entitled to fish an additional 6,000 tons of chub mackerel for each of the 2024 and 2025 fishing seasons.

To comply with this provisional measure, Members of the Commission shall report to the Executive Secretary, in electronic format, their monthly catches of chub mackerel in the Convention Area.

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	🔴	The TWG CMSA agreed to base its future discussions on the following candidate biological reference points: (a) F-based reference points i. F_{MSY} ii. $F_{\%SPR}$ iii. $F_{0.1}$, F_{max} (b) Biomass-based reference points (including SSB, summary biomass, etc.) i. B_{MSY} ii. $\%B_0$ iii. Certain historical level of B
Stock status	⚪	Status determination criteria not established.
Catch limit	🟡	100,000 mt for CA

Harvest control rule	🔴	Not established.
Other	🟡	Encouragement to refrain from expansion, in the Convention Area, of the number of fishing vessels.

🟢 OK 🟡 Intermediate 🔴 Not accomplished ⚪ Unknown

Assessment

The Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA) completed the first stock assessment at its 9th meeting in July 2024. A State-space Stock Assessment Model (SAM) was used for the stock assessment. China, Japan and Russia submitted age-specific input data and abundance indices up to the 2022 fishing year (June 2023) for the base case scenario. The TWG agreed on the stock assessment results (see TWG CMSA09 report for details).

Japan annually conducts an assessment on the Pacific stock of Chub mackerel using tuned VPA (Yukami et al. 2024).

Data

Surveys

China has been conducting a five-year scientific survey program using its fishery research vessel "Song Hang" with mid-trawl as the main survey gear in the NPFC convention area from 2021 to 2025 (Ma et al. 2023).

Japan annually conducts two mid-water trawls surveys in summer (2001-2024) and autumn (1995-2023) that serve information on recruitment abundance indices of age-0 fish to the Japanese domestic stock assessment of the Pacific stock of Chub mackerel (Table 1) (Yukami et al. 2024). The autumn mid-water trawl survey also provides age-1 fish abundance indices for the stock assessment. Japan also conducts a year-round egg survey providing egg density as index of spawning stock biomass for the stock assessment. 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 Chub mackerel.

Fishery

China, Japan and Russia catch Chub mackerel (Figure 1). China harvests this species dominantly by light purse seine fishery in the NPFC Convention Area. A smaller component of the catch is taken by pelagic trawl. Chinese catch statistics on mackerels in the NPFC Convention Area are available from 2015. The Chinese mackerel fisheries in the NPFC Convention Area initiated in 2014 mainly caught the three fish species such as Chub mackerel, blue mackerel, and Japanese sardine (Zhang et al. 2023). Blue mackerel catch accounts for 6% to 15.2%, about 10% on average, in the mackerels catch up to 2021. In 2022, the proportion increased to 22.5%.

Japan's fishery for Chub mackerel occurs inside their Exclusive Economic Zone (EEZ) and is mostly conducted by large purse seine vessels (≥50% of the catch). Additional components of the fishery include set nets, dip nets and other gears. Proportion of Chub mackerel catch in mackerels catch is obtained through extensive port sampling. The Chub mackerel catch accounts for 69% to 91%, 84% on average, of the mackerels catch in 2014-2023.

The Russian fisheries catching mackerels are operated in their EEZ and is prosecuted primarily by mid-water trawling (>90% of the catch), with a smaller component of the catch coming from purse seiners and bottom trawlers. The Russian mackerels catch, comprising approximately 100% of Chub mackerel, are available in the NPFC Annual Summary Footprint since 2014.

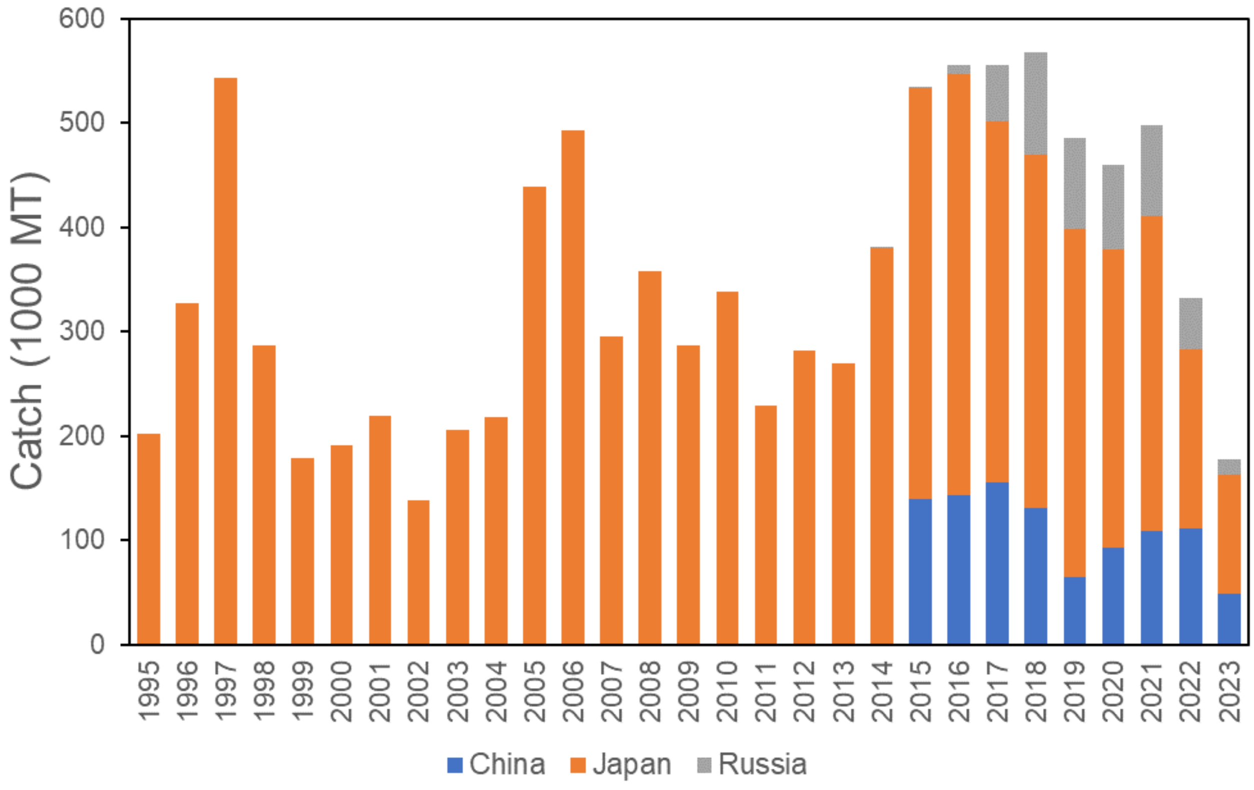

Figure 1. Historical catch of mackerels obtained from annual summery footprint of Chub and Blue mackerels.

Other NPFC Members (Canada, EU, Korea, Chinese Taipei, USA and Vanuatu) do not have Chub mackerel catch records in the NPFC Convention Area.

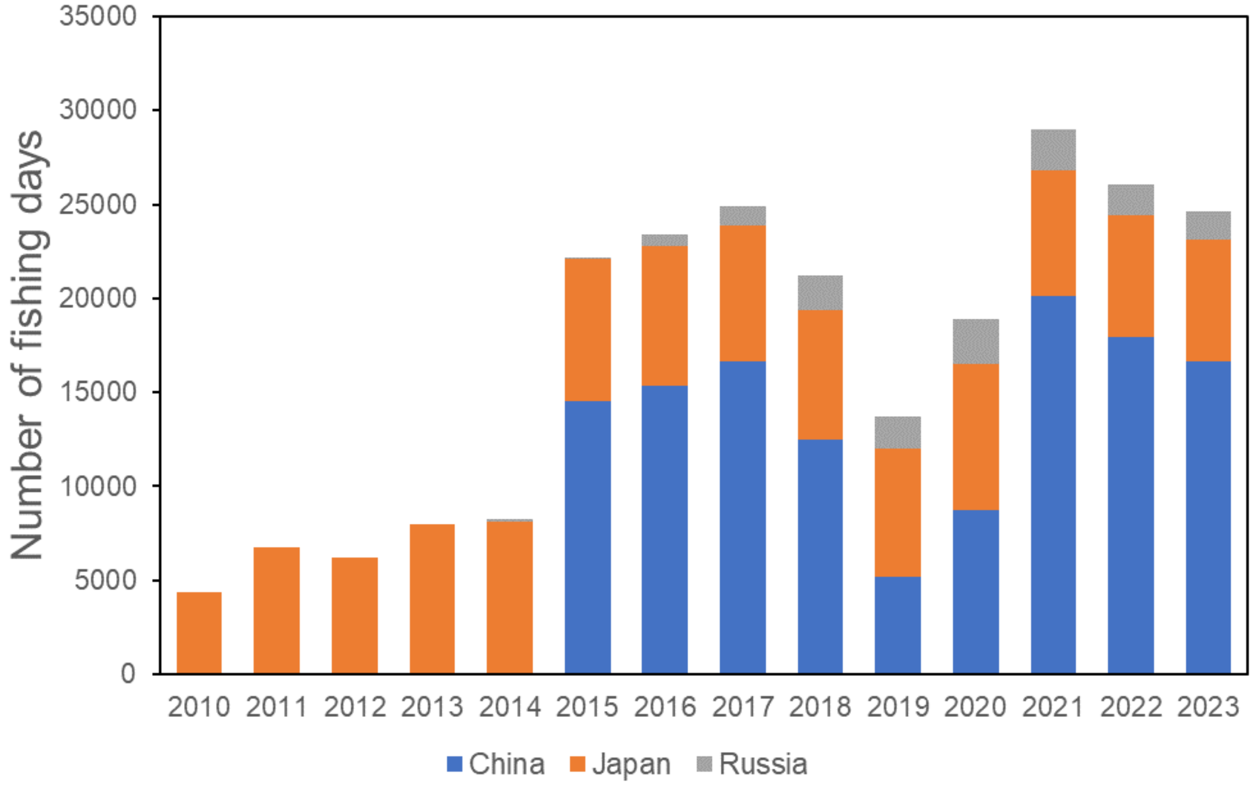

Figure 2. Historical fishing effort for mackerels obtained from annual summary footprint of Chub and Blue mackerels.

Biological collections

China has collected length frequency data of commercial catch through onboard and port samplings since 2016. Aging of the samples has been started since 2017.

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

Russian length frequency and aging data of commercial catch are available since 2016. The length frequency data obtained through research surveys are available since 2010.

Table 1: Data availability from Members regarding Chub mackerel.

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: 1950-2023, other reports: 1970-2023	Coverage=100%	The Chub mackerel catches are estimated from Chub and blue mackerel catches based on port sampling data for purse seine and set net fisheries. No detailed information of the ratio is presented.
Dip net fishery				
Set net				
Size composition data				
Length measurements	Port sampling by 17 local fishery institutes in 17 prefectures	1970-2023	20,000-120,000 (average 40,000) fish/year (ca. 100 measurements per sampling)	Detailed information in NPFC-2020-TWG CMSA03-WP02.
Aging	Port sampling by 17 local fishery institutes in 17 prefectures	1970-2023	500-1000 fish/year	Detailed information in NPFC-2020-TWG CMSA03-WP02.
Catch at age (CAA)	Estimate CAA from the above data	1970-2023	Age-length keys are created approximately by quarter and local regions	Evaluate uncertainty of catch at age; Changes of growth depending on recruitment abundance is reviewed in NPFC-

				2022-TWG CMSA05-IP06 and published as Kamimura et al (2022, https://doi.org/10.1093/icesjms/fsab191)
Abundance indices (survey)				
Spring survey for recruitment	Mainly for sardine and Chub mackerel of pre-recruits. This research is conducted for biological research of early life history. Mid-water trawl	1995-2023	30-60 stations/year	Too early for the use of abundance index
Summer survey for recruitment	Mainly for saury, mid-water trawl	2001-2023	60-80 stations/year	Detailed information on data and standardization is in NPFC-2022-TWG CMSA06-WP11 (Rev.1). Detailed sampling design and method are shown in Hashimoto et al. (2020, https://doi.org/10.1007/s12562-020-01407-3).
Autumn survey for recruitment and age 1 fish	Mainly for sardine and Chub mackerel, mid-water trawl	1995-2023	30-60 stations/year	Detailed information on data and standardization for recruitment is in NPFC-2022-TWG CMSA06-WP11 (Rev.1). That for age 1 has not been presented.

Year-round for egg density	Almost all local fishery institutes join this survey program. NORPAC net. Not only for Chub mackerel.	1978-2023 (2005-, species identification between Chub and blue mackerel)	ca. 6000 stations in total, 1000-4000 stations with Chub mackerel eggs/year	Detailed information on data and standardization is in NPFC-2022-TWG CMSA06-WP10
Abundance indices (commercial)				
Dip net fishery	Log book data are collected from fishermen in Kanagawa prefecture since 2003 and Shizuoka prefecture since 2013 (ca. 10 and 90% of total dip net catch in 2017, respectively)	2003-2023	10-100/year	Detailed information on its data and standardization is in NPFC-2022-TWG CMSA06-WP09
RUSSIA				
Catch statistics				
Purse seine fishery	Official statistics, reports from fisheries associations	Official statistics: 1980-1993, 2015-2023, 1994-2014 (no data available); publications: 1970-2023	Coverage 1980-1993 ?%; Coverage 2015-2023 =100%	Data coverage details to be reviewed
Pelagic trawl fishery				
Size composition data				
Length measurements	Sampling from commercial fishing vessels. Sampling during research surveys.	2016-2023 2010-2023	1,000-10,000 fish/year (ca. 100 measurements per sampling)	Data coverage details to be reviewed
Aging	Sampling during research surveys and from commercial fishing vessels	2016-2023	300-500 fish/year	Details to be reviewed

Catch at age (CAA)	Estimate CAA from the above data	2016-2023	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)				
Summer trawl and acoustic (echointegration) surveys to assess pelagic fish abundance and recruitment	Mid-water upper epipelagic surveys	2010-2023 (June-July) 2015-2023 (July-September)	60-80 stations/year 60-80 stations/year	Changes in abundance and migration patterns; development survey protocol and conduct standardization
Abundance indices (fishery)				
Daily reports of catch by each vessel	Target (>50%) Mid-water trawls	2015-2023 May-December		Test the effect of targeting
CHINA				
Catch statistics				
Purse seine fishery	Official statistics, reports from annual report	Official statistics：2014-2023	Coverage=100%	The Chub mackerel catches are from the fishing catch provided by the fishery company
Trawl fishery	Official statistics, reports from annual report	Official statistics: 2014-2023	Coverage=100%	Catches are from the fishing catch provided by the fishery company
Size composition data				
Length measurements	Port sampling by Institute and technology group.	2016-2022	550-800 fish/year	Details to be reviewed
Length measurements	Purse seine vessel sampling from	2016-2022	530-1050 fish/year	Details to be reviewed

	commercial vessel			
Aging	Sampling during research surveys and from commercial fishing vessels	2017-2022	30-180 fish/year	Details to be reviewed
Abundance indices (commercial)				
Purse seine fishery	Purse seine logbook (Technical group for Chub mackerel Fishery, Distant-water Fishery Society of China)	2014-2022 April-December	10-105/year	Review survey protocol and conduct standardization

Special Comments

None

Biological Information

Distribution

The Pacific stock of Chub mackerel is distributed from the southern coastal waters on the Pacific side of Japan to offshore area off the Kuril Islands (Figure 3). This stock corresponding to straddling one is harvested in both national waters of Japan and Russia and the NPFC Convention Area. Adult fish spawn in Izu Islands waters in spring and then engage northward feeding migration to waters of Sanriku to east Hokkaido from summer to autumn.

Life history

Longevity of Chub mackerel is estimated to be 7 or 8 years old. There was the oldest record of 11 years old. It is known that growth of this stock could be changed according to recruitment abundance and oceanic environment (Watanabe and Yatsu 2004). Recent decrease in mean weight by age was highly likely induced by feeding competition in conjunction with intra-/inter-specific increase of density resulted from biomass increases of Chub mackerel and Japanese sardine (Kamimura et al. 2021). Adult female spawns more than once during a spawning season. Maturity at age was changed depending on changes in growth (Watanabe and Yatsu 2006).

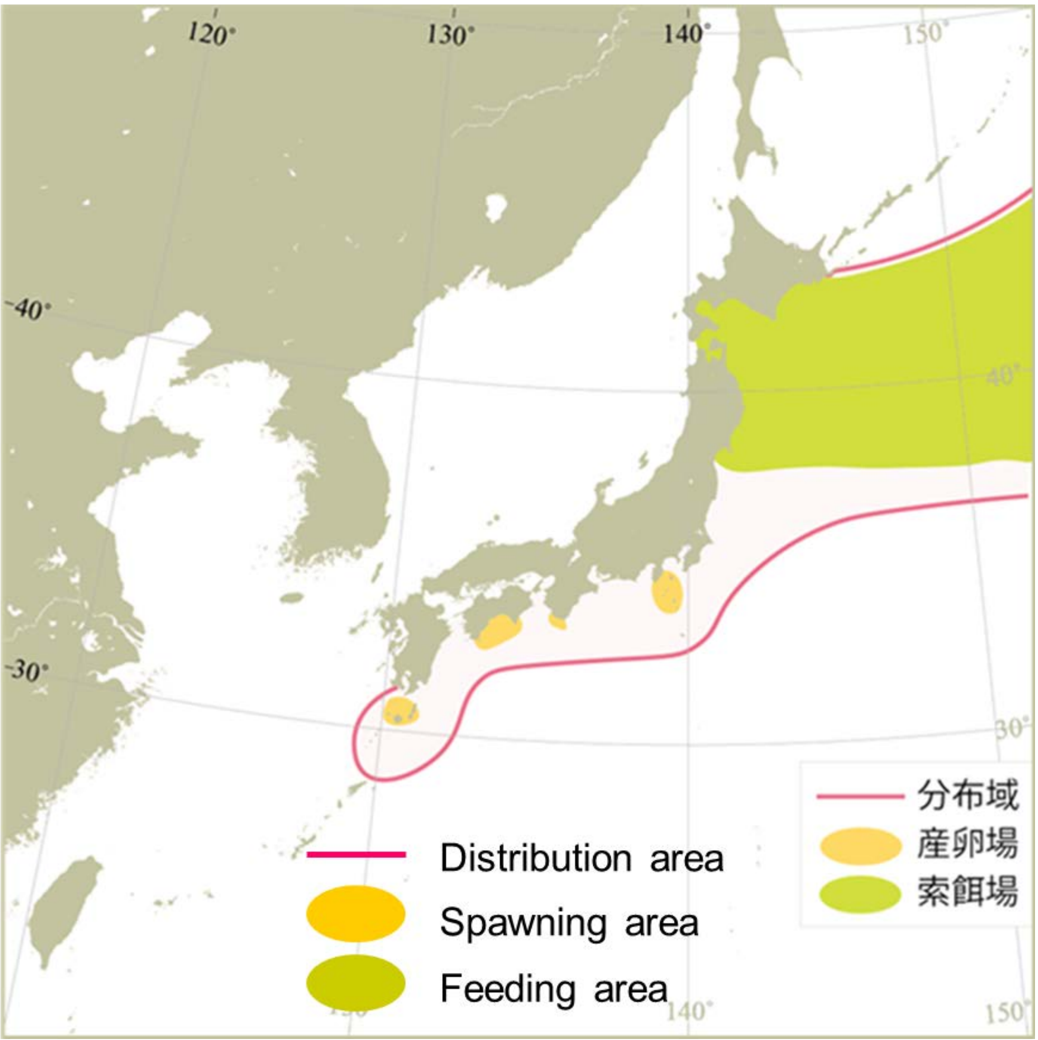

Figure 3. Map of distribution of Chub mackerel in the North Pacific (Yukami et al. 2024).

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Annex F

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.

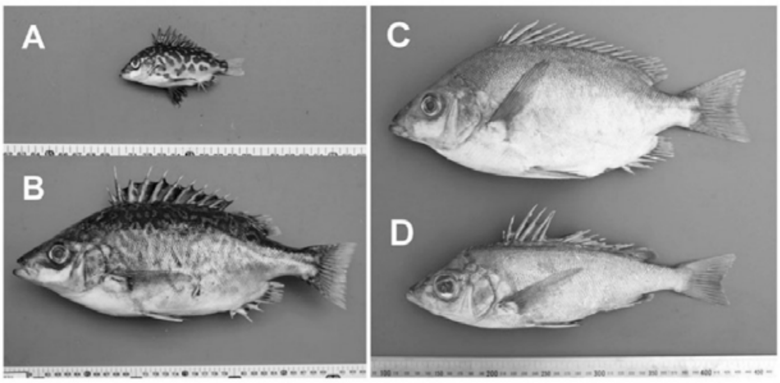

Figure 1: Photographs of Pentaceros wheeleri. *A) Pelagic juvenile, B) pelagic subadult, C) demersal adult (fat type), D) demersal adult (lean type) (from Kiyota et al. 2016)*

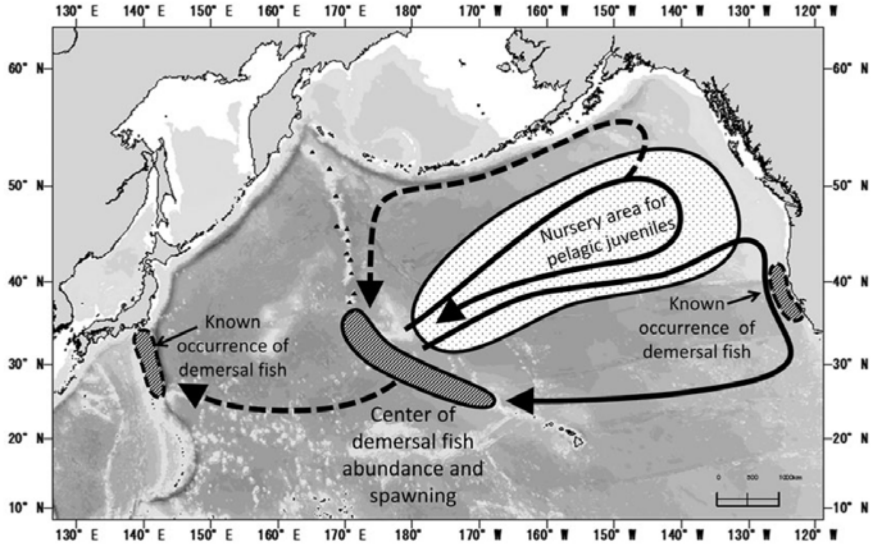

Figure 2: Known demersal habitats and hypothesized pelagic migration routes of Pentaceros wheeleri *(Kiyota et al. 2016 Figure 4, modified from Boehlert and Sasaki 1988).*

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.

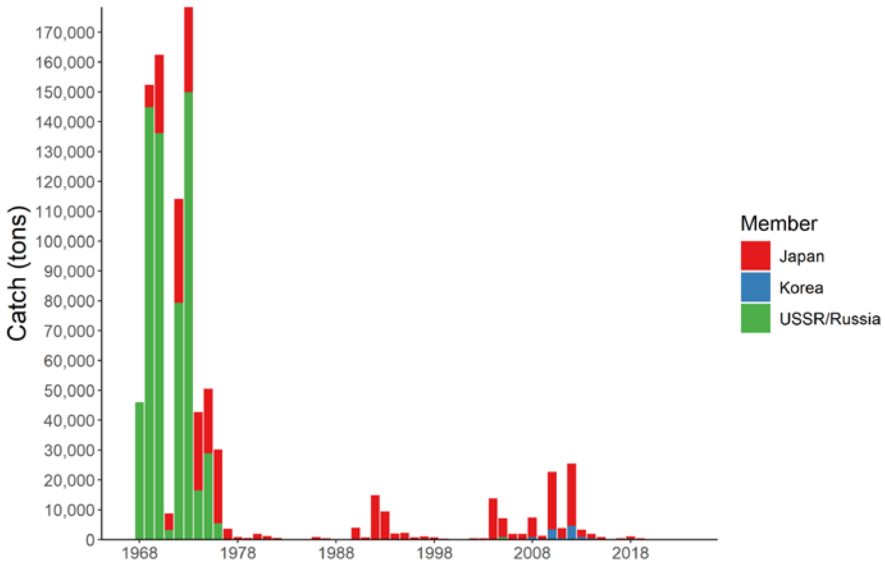

Figure 3: Historical trends of North Pacific armorhead catches in NPFC waters. *The annual amounts of catch by each Member and gear are shown by the bar plot.*

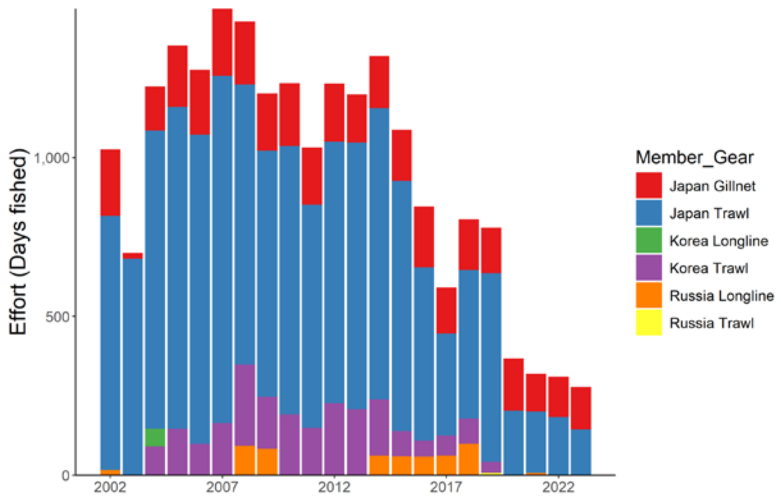

Figure 4. Historical fishing effort for North Pacific armorhead. *The annual fishing efforts by each country are shown by barplot. The efforts are calculated by the total fishing days operated during the year*

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 2024-05 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

Item	Status	Description
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	Member	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	Member	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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Annex G

Species summary for splendid alfonsino

Splendid alfonsino (*Beryx splendens*)

Common names: Splendid alfonsino (English); 红金眼鲷 (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).

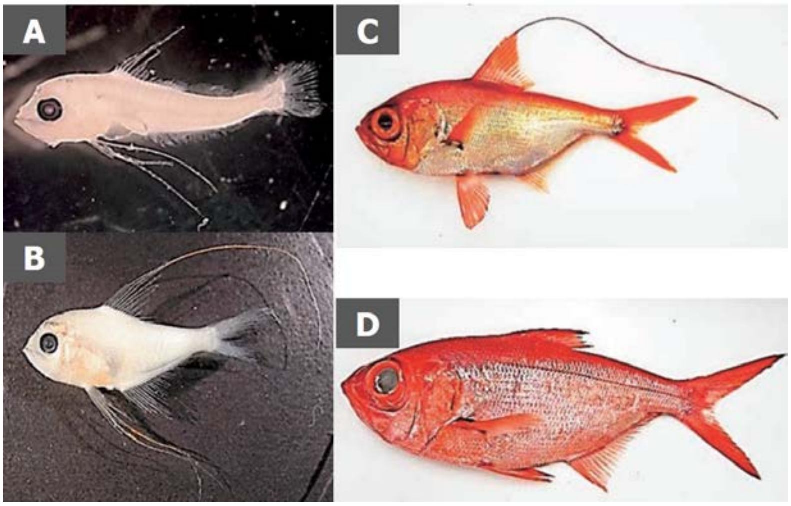

***Figure 1: Photographs of Beryx splendens on different developmental stages** A) postlarva, B) juvenile, C) young, D) adult (from Watari et al. 2017)*

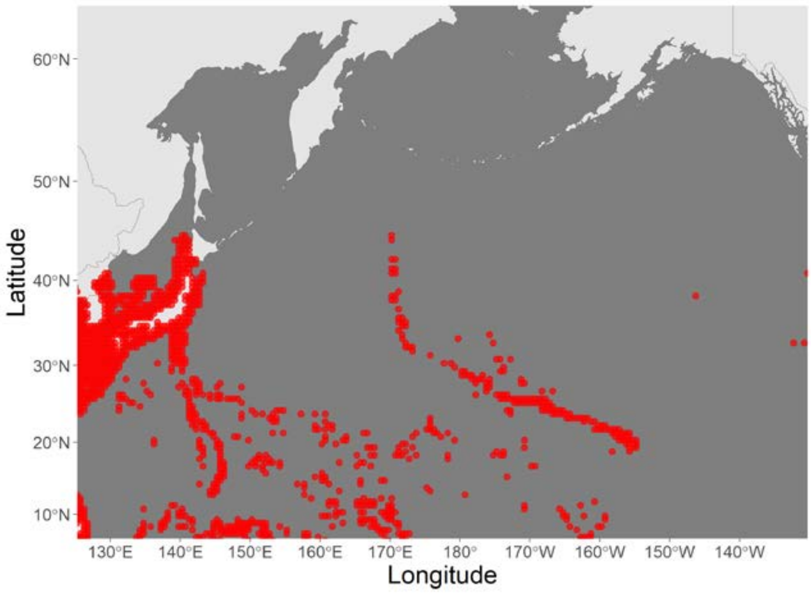

Figure 2: Known distribution of Beryx splendens around NPFC waters. *Points indicate observation data from original sources (AquaMaps 2019, October)*

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).

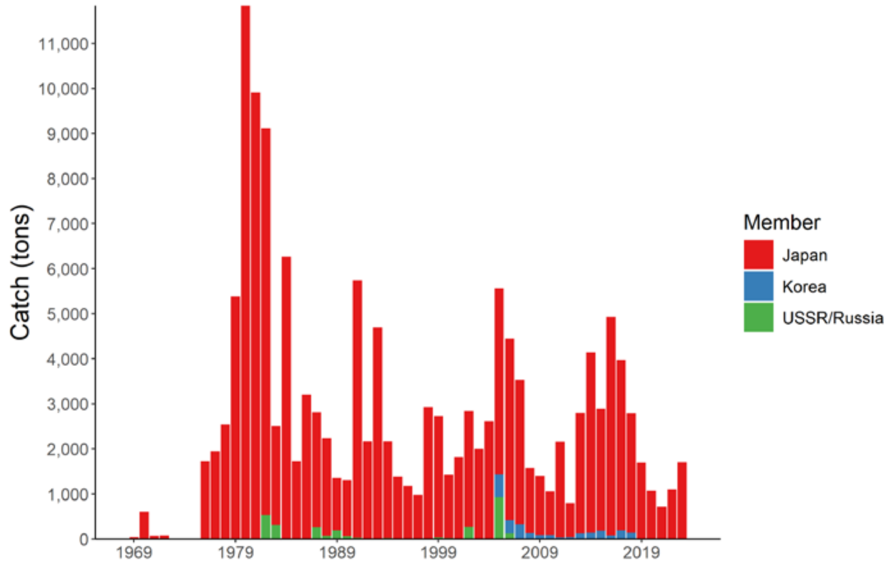

Figure 3: Historical trends of Splendid alfonsino catches in NPFC waters. *The annual amounts of catch by each country are shown by the bar plot.*

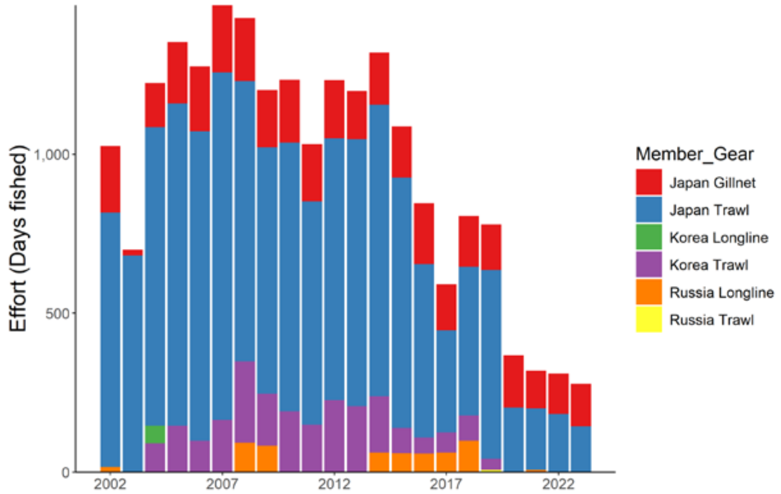

Figure 4. Historical fishing efforts for Splendid alfonsino. *The annual fishing efforts by each country and each gear are shown by the bar plot. The efforts are calculated by the total fishing days operated during the year*

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 2024-05 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	Member	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 availabe
		Gillnet	2008-present	Logbook data available
	Korea	Trawl	2013-2019	Logbook data available
	Russia	Trawl	1969-1988; 2010; 2019	

Table 3: Biological data

Data	Member	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	

Data	Member	Year	Comments
	Korea	2013-2017, 2019	
	Russia	1969-1988; 2010; 2011; 2013; 2019	

References

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Annex H

Species summary for sablefish

Sablefish (*Anoplopoma fimbria*)

Common names:

Black cod (USA & Canada)
ギンダラ, Gindara (Japan)
은대구, Eun-Daegu (Korea)

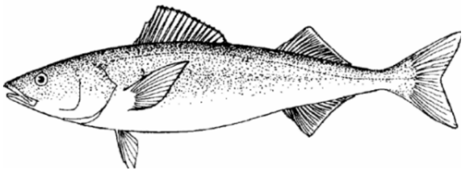

Figure 1. Sablefish (Anaplopoma fimbria).

Management

Active NPFC Management Measures

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

- CMM 2024-06 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.

Current status of management measures

Convention.or.Management.Principle	Status	Comment.or.Consideration
Biological reference point(s)	Unknown	Established for USA and Canada assessments

Convention.or.Management.Principle	Status	Comment.or.Consideration
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 revision of the operating model by Canada was completed in 2022 (DFO 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. 2022) and most recent USA West Coast assessment (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-present 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.

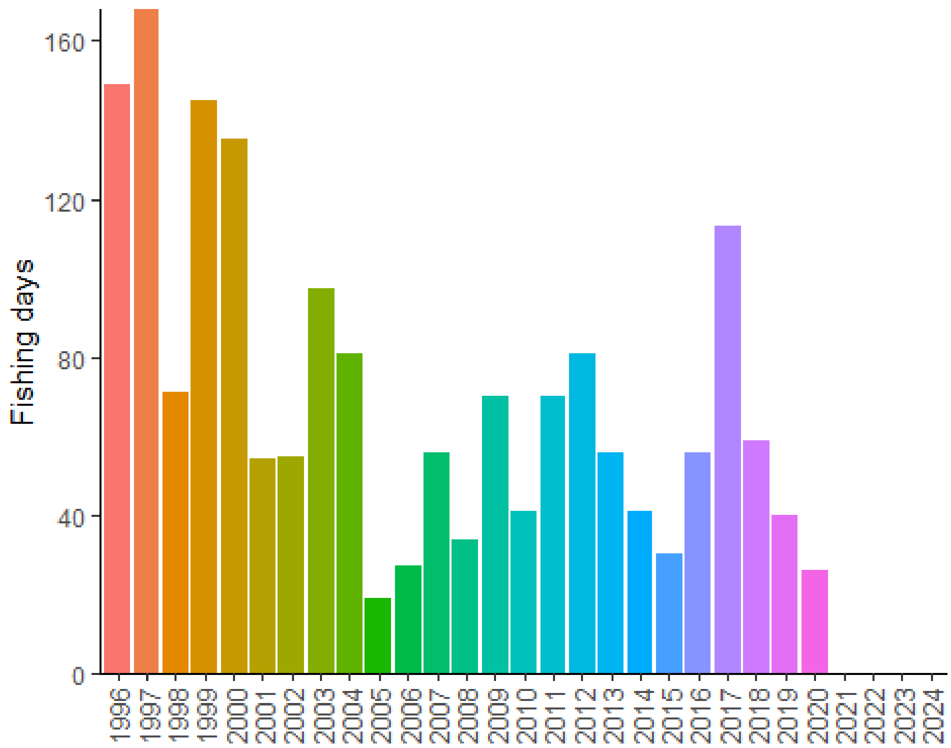

Figure 2. Fishing effort (in number of fishing days) for the Sablefish longline trap fishery conducted in NPFC waters (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

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 has been no fishing effort at seamounts from 2021-2024 resulting in no catch.

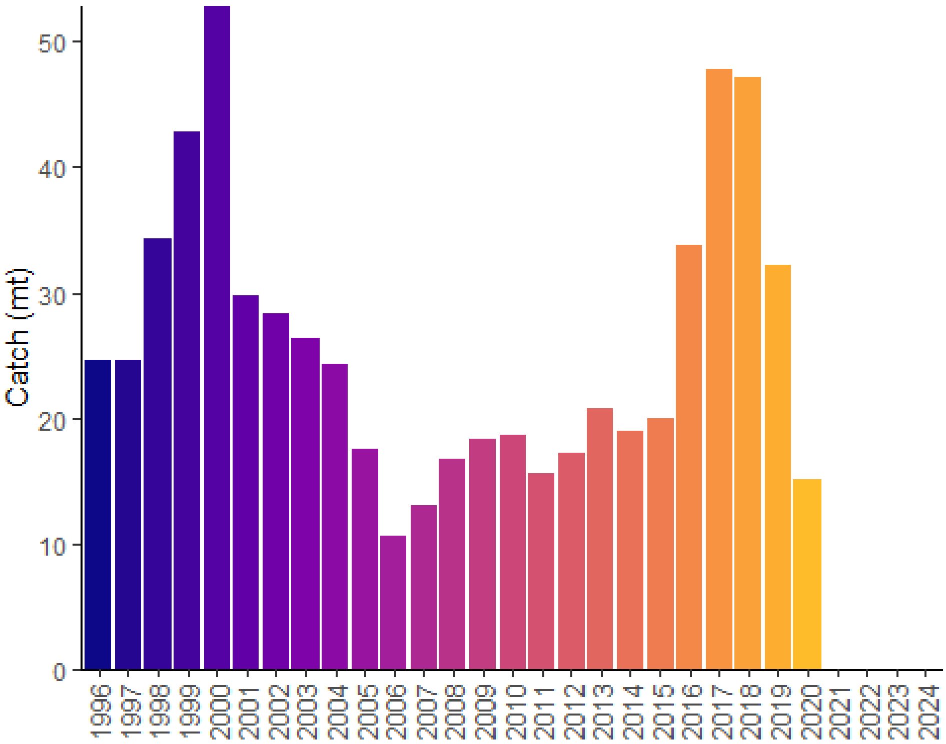

Figure 3. Landings of sablefish in the Canadian Sablefish fishery in NPFC region (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

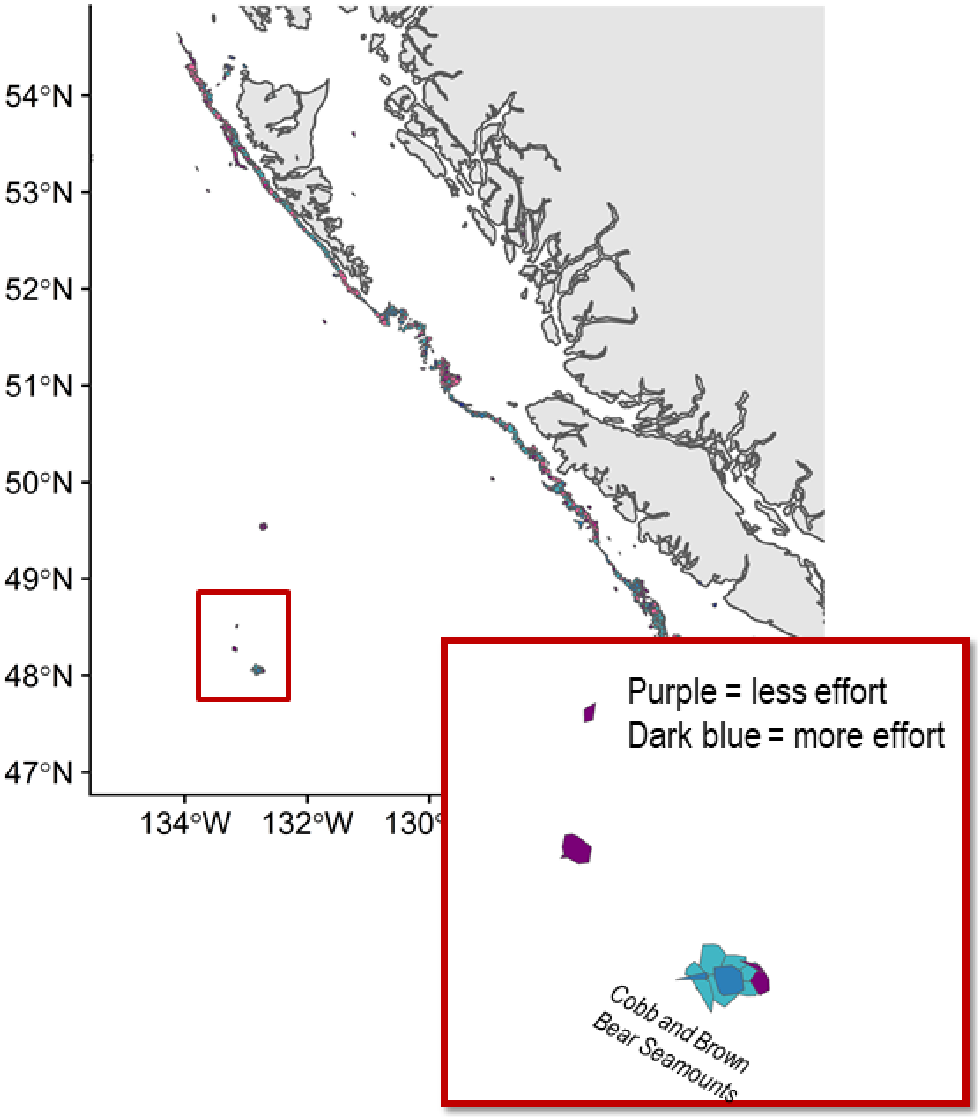

Figure 4. Relative change in spatial distribution of effort for Sablefish trap fishery from 2010-2017 to 2018-2019. Inset shows seamounts in the NPFC Convention Area.

Catch per unit of effort (mt/fishing days) for Sablefish has been increasing over the last 10 years (Figure 5), averaging 0.35 mt/fishing day (CV = 56%). CPUE was not calculated in 2024, but has generally been increasing from 2012 - 2020.

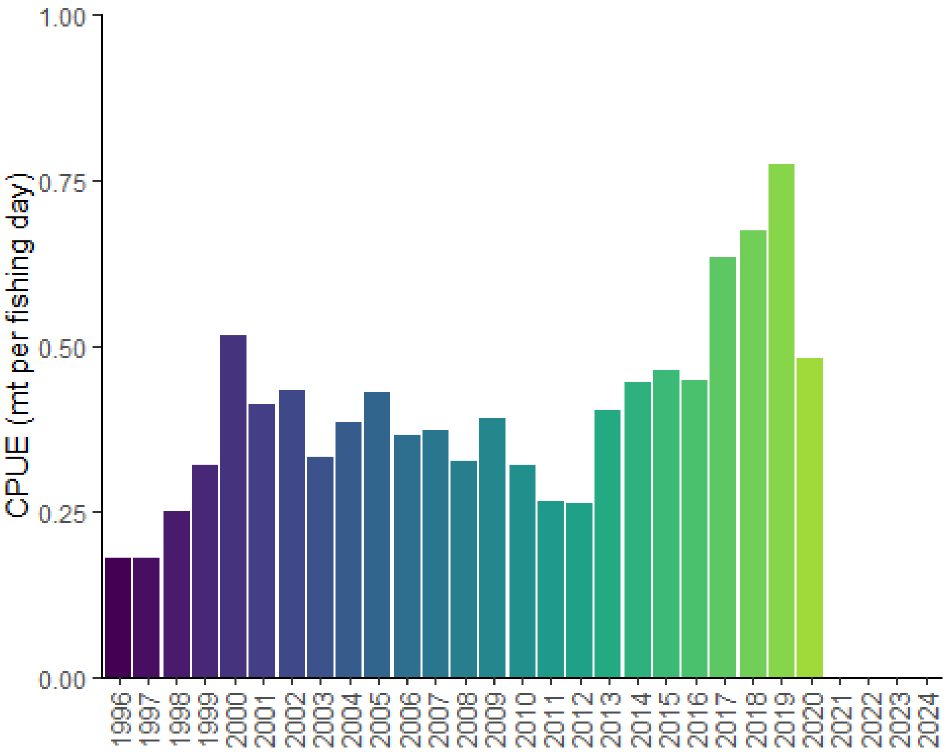

Figure 5. Catch per unit of effort for Canadian Sablefish fishery in NPFC region. Data are averaged across 3 years to comply with data privacy restrictions.

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.

Data availability from Members regarding blackspotted and rougheye rockfishes

Data	Source	Years	Comment
Catch	Canada	1965-present	Catches from national waters and convention area

Data	Source	Years	Comment
	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

The most recent stock assessments from the USA and Canada indicate the spawning stock biomass has been increasing since about 2018, supported by a large coastwide recruitment in ~2016 (data from Gothel et al. 2022, DFO 2023, Kapur et al 2021).

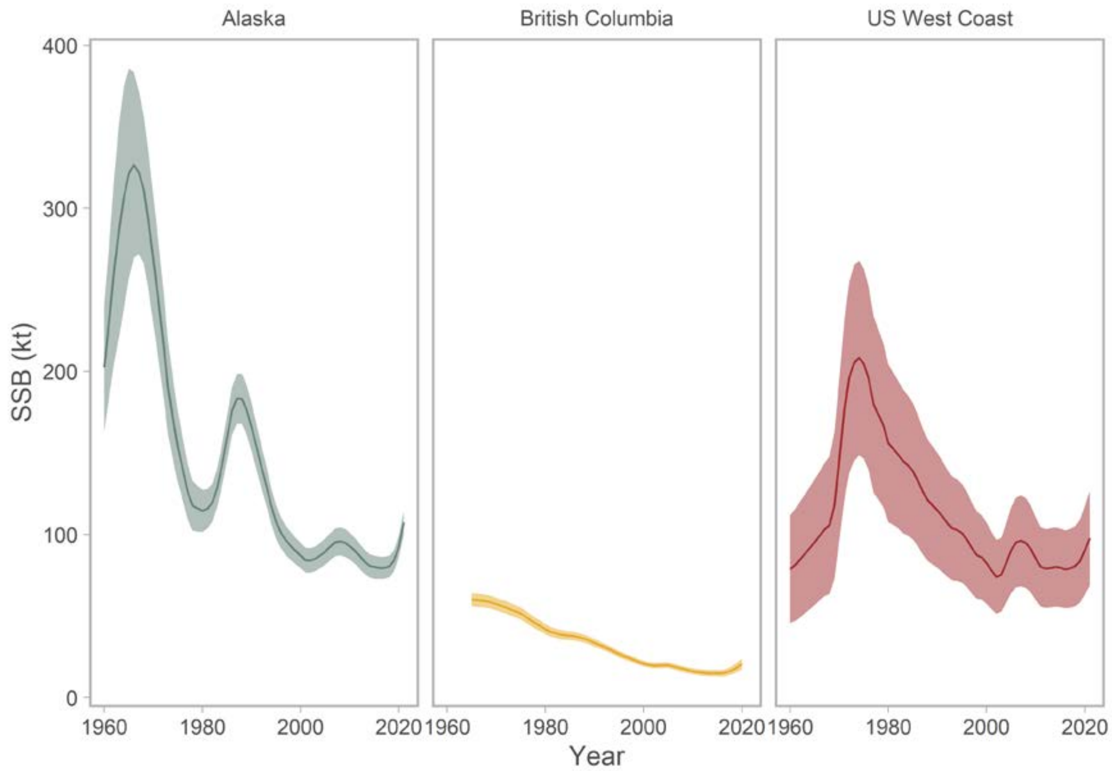

Figure 6. Sablefish (Anaplopoma fimbria) biomass estimated from stock assessments in Alaska, Canada and the US West Coast.

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 7; 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.

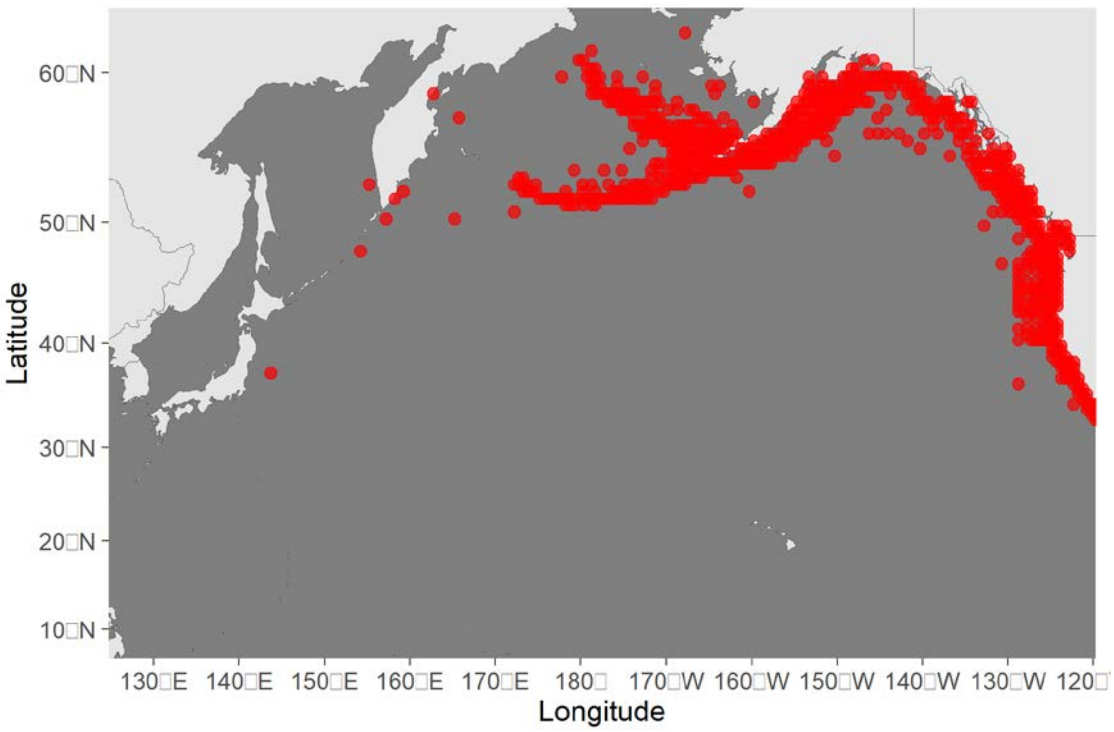

Figure 7. Map of distribution of sablefish in the North Pacific.

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Annex I

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)

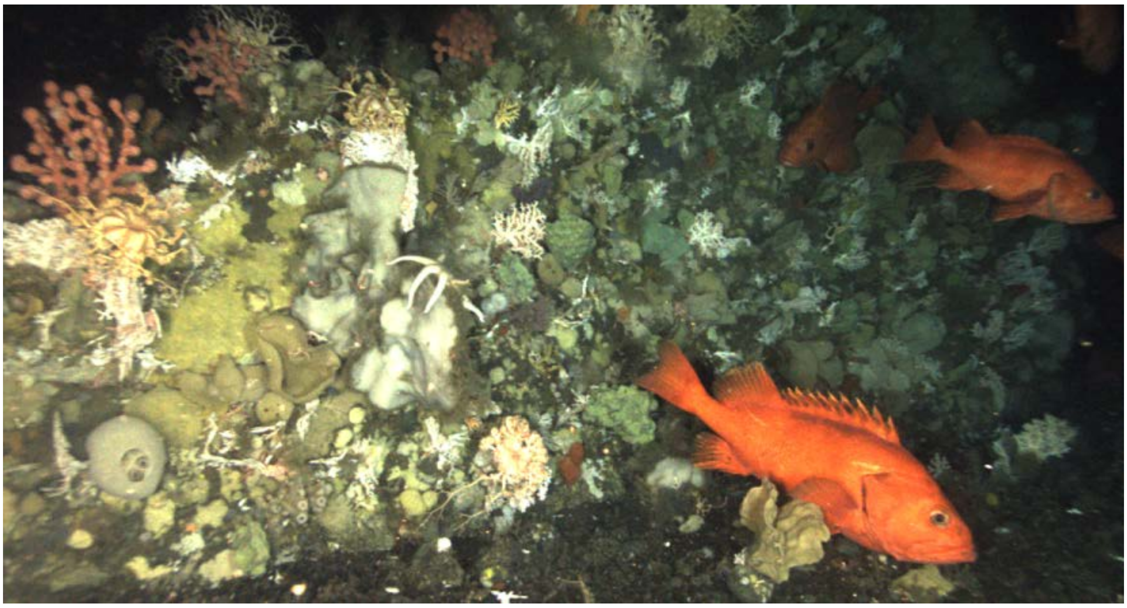

Figure 1. Blackspotted rockfish (Sebastes melanostictus).

Management

Active NPFC Management Measures

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

- CMM 2024-06 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.

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 (Sullivan 2022, Spencer et al. 2022).

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.

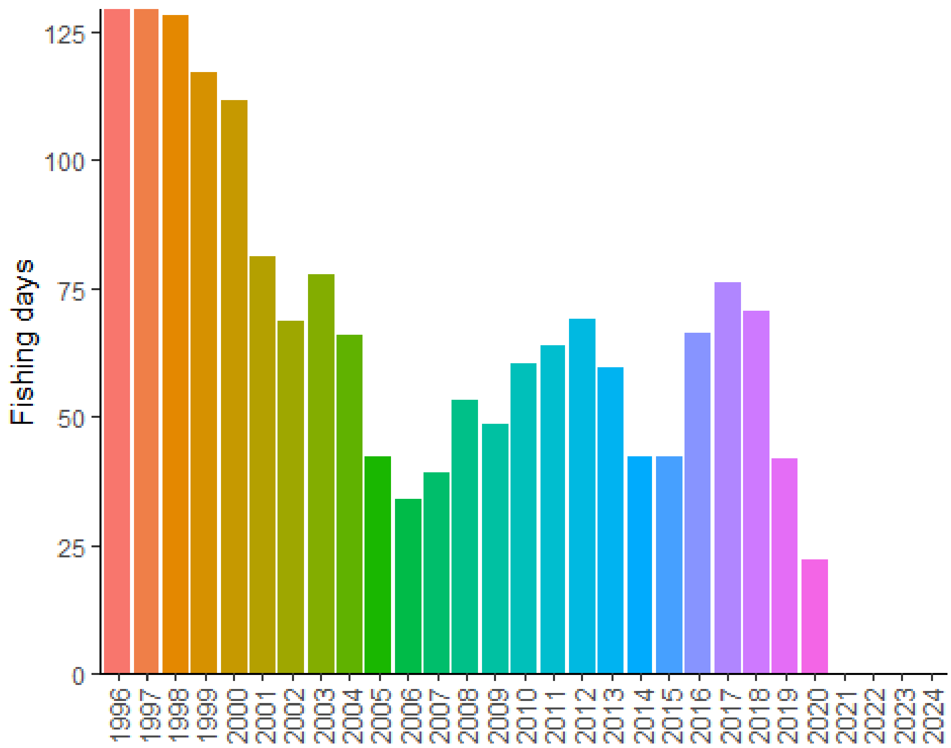

Figure 2. Fishing effort (in number of fishing days) for the Sablefish longline trap fishery conducted in NPFC waters (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

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 has been no fishing effort at seamounts from 2021-2024 resulting in no catch.

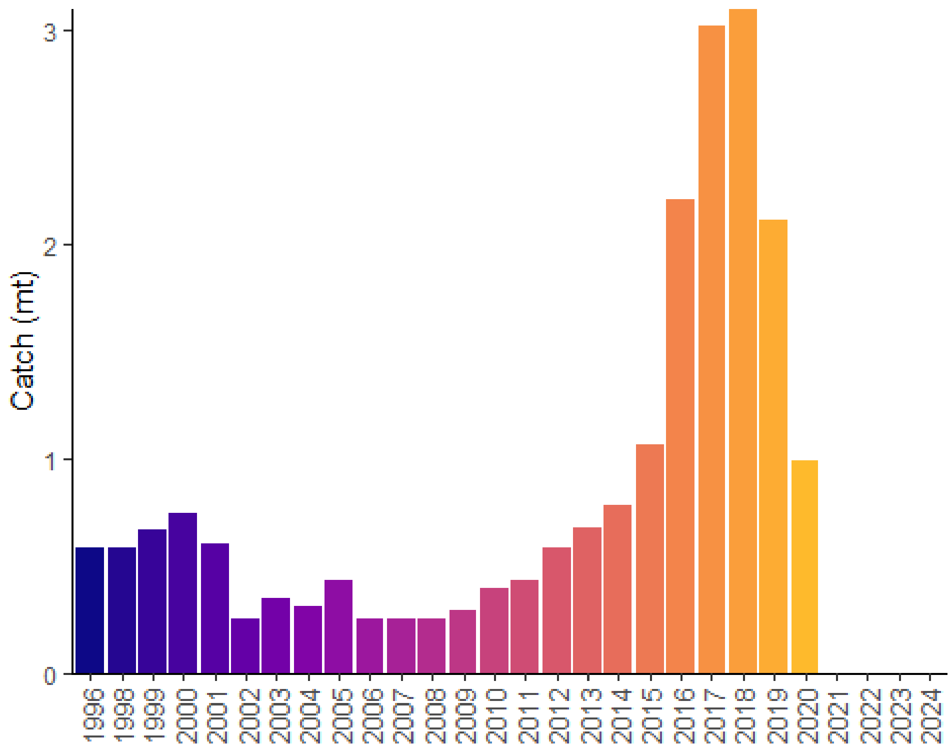

Figure 3. Landings of blackspotted and rougheye rockfishes in the Canadian Sablefish fishery in NPFC region (1996-present). Data are averaged across 3 years to comply with data privacy restrictions.

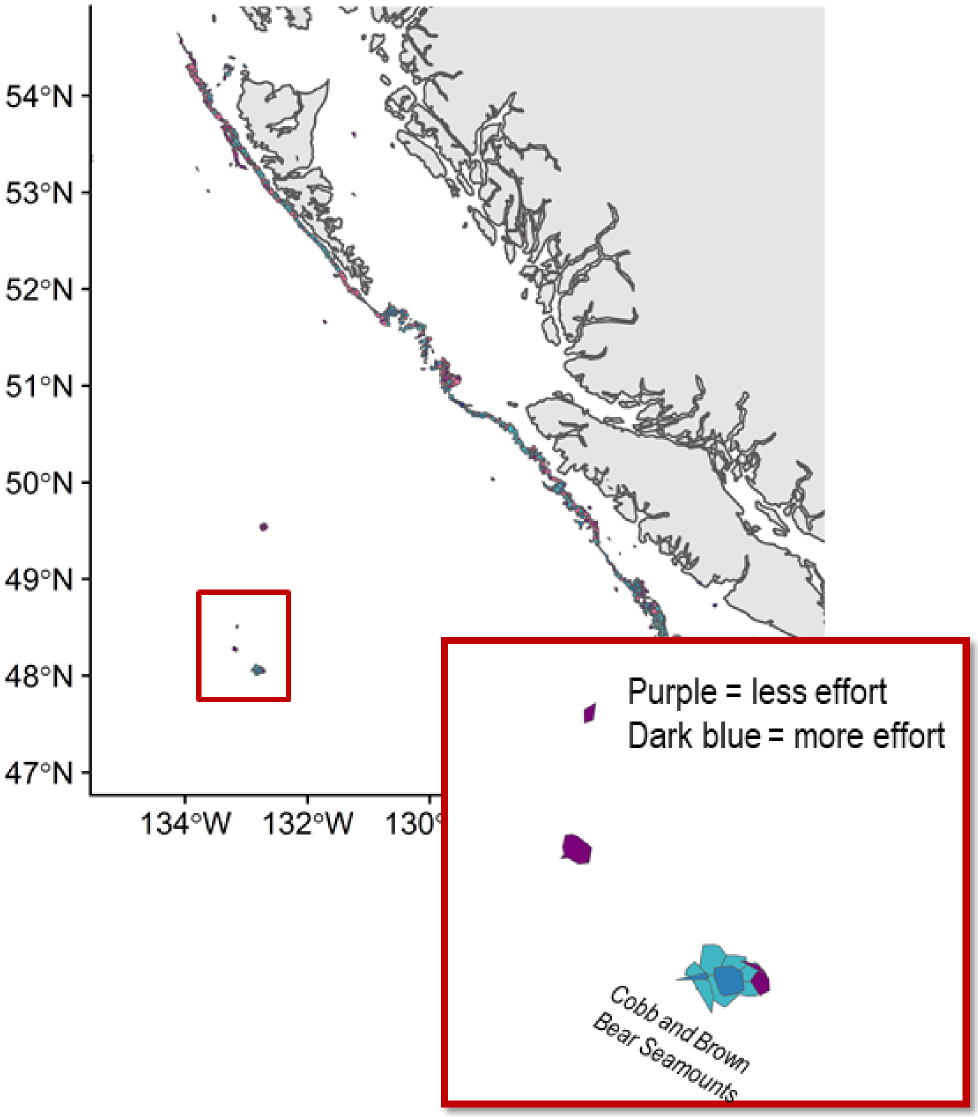

Figure 4. Relative change in spatial distribution of effort for Sablefish trap fishery from 2010-2017 to 2018-2019. Inset shows seamounts in the NPFC Convention Area.

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 = 114%). CPUE was not calculated in 2024 due to the absence of fishing in the Convention Area, but has generally been increasing since 2012.

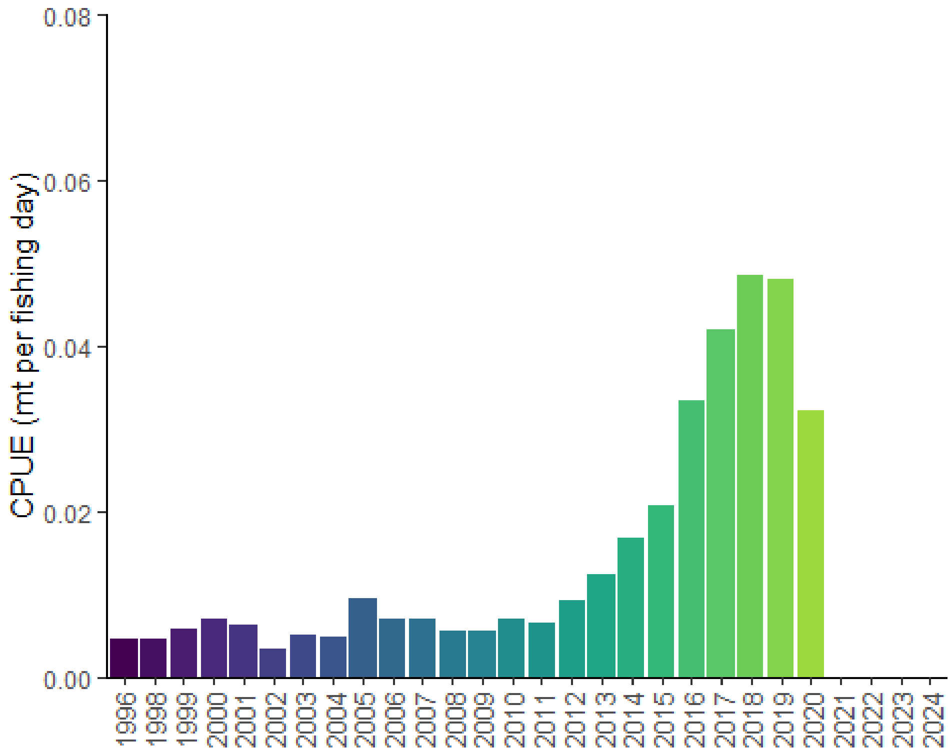

Figure 5. Catch per unit of effort for blackspotted and rougheye rockfishes in the Canadian Sablefish fishery in NPFC region. Data are averaged across 3 years to comply with data privacy restrictions.

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.

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
Age data	None		Data available from Canada and U.S.A. domestic

Data	Source	Years	Comment
			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).

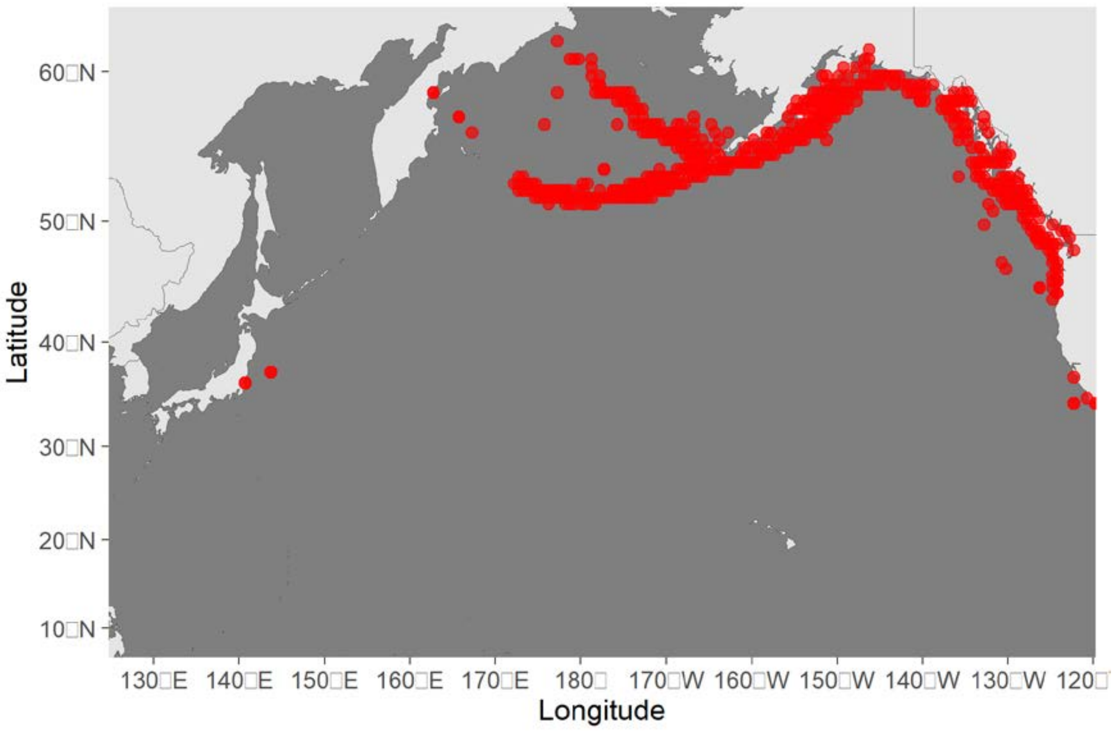

Figure 6. Map of distribution of blackspotted and rougheye rockfishes in the North Pacific.

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Annex J

Species summary for skilfish

Skilfish (*Erilepis zonifer*)

Common names: Skilfish (English); 白斑裸盖鱼(Chinese); アブラボウズ (Japanese); 큰은대구 (Korean); эрилепис или морской монах (Russian)

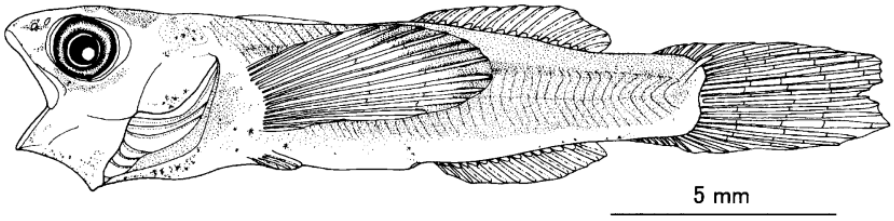
Biological Information

Skilfish *Erilepis zonifer* (Lockington, 1880) is one of the two species belonging to the family Anoplopomatidae, and the only species of the genus *Erilepis*. Published data suggest that juvenile fish are found in the surface water layer, among floating algae, and are distributed in the open ocean, where they live 4 - 6 years, reaching the length of about 50 cm, after which they switch to the bottom lifestyle. Adult fish inhabit deep rocky bottoms. Young fish have bright white spots on their bodies, but with age their color changes to dark gray, and bright markings become duller and less visible as the fish grows. Skilfish has a dark body, nearly black fins, and large blue eyes above a prominent, cavernous mouth like that of a rockfish (fig. 1). It also has a strong tail fin that is equal to or higher than the fish's head. The fish is a predator, and consumes different species of bony fish, cephalopod mollusks and crustaceans, and may also feed on jellyfish.

Global distribution ranges from the central Japan north to the Commander and Aleutian Islands; Gulf of Alaska south to Monterey Bay (California, U.S.A.). Skilfish were registered on all south Emperor Seamounts (south of 42° E). Skilfish were captured mainly on the seamounts T365+A and Koko using bottom longlines (fig. 2). Skilfish are also captured occasionally on longlines and in pots on seamounts in the Cobb Seamount chain in the eastern North Pacific.

This species lives at depth range from 340 to 1150 meters, according to research surveys, and were captured even at 1438 m depth during commercial fishing. The analysis of changes in the fish body length with depth (fig. 3) shows positive correlation in the research area^ larger fish tend to live deeper [Zolotov et al., 2014].

Skilfish size (body length) in commercial catches ranged from 55 to 201 cm, with an average length of 103.5 cm as recorded by Russian scientific observers in 2014-2018 (fig. 4). The body weight ranged from 4.0 kg to 102 kg, with an average weight of 20.8 kg. Published size composition differed on different seamounts (fig. 5).



A)

B)

Figure 1: ***Erilepis zonifer at different developmental stages:*** *A) larva [Okamoto et al., 2010], B) adult (picture made by Igor Maltsev)*

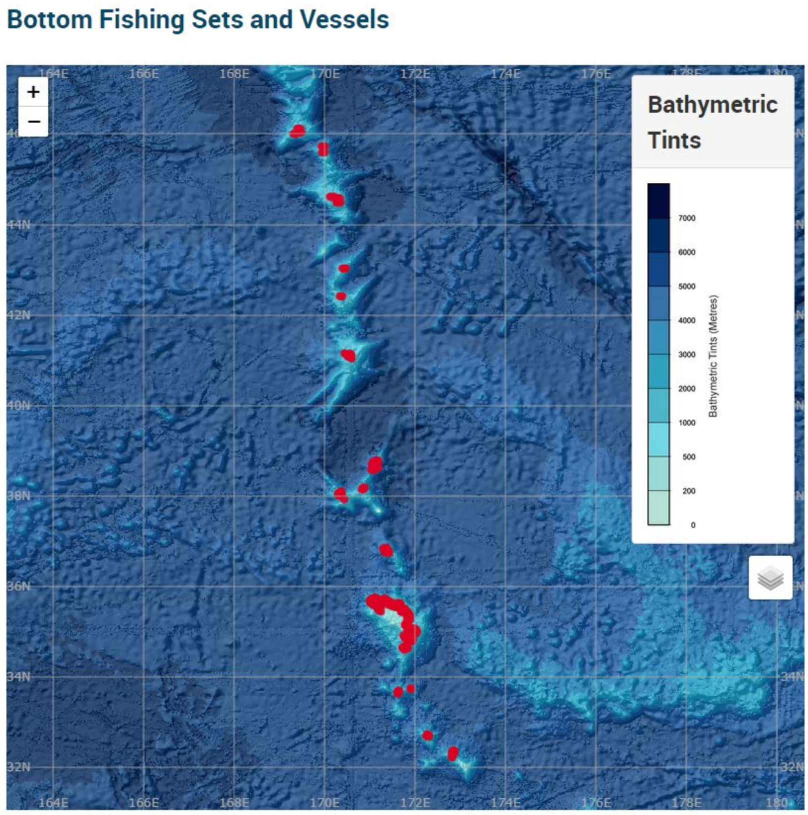


Figure 2: Surveyed area by Russian Long-Liners [https://www.npfc.int/science/gis/bottom_fishing]

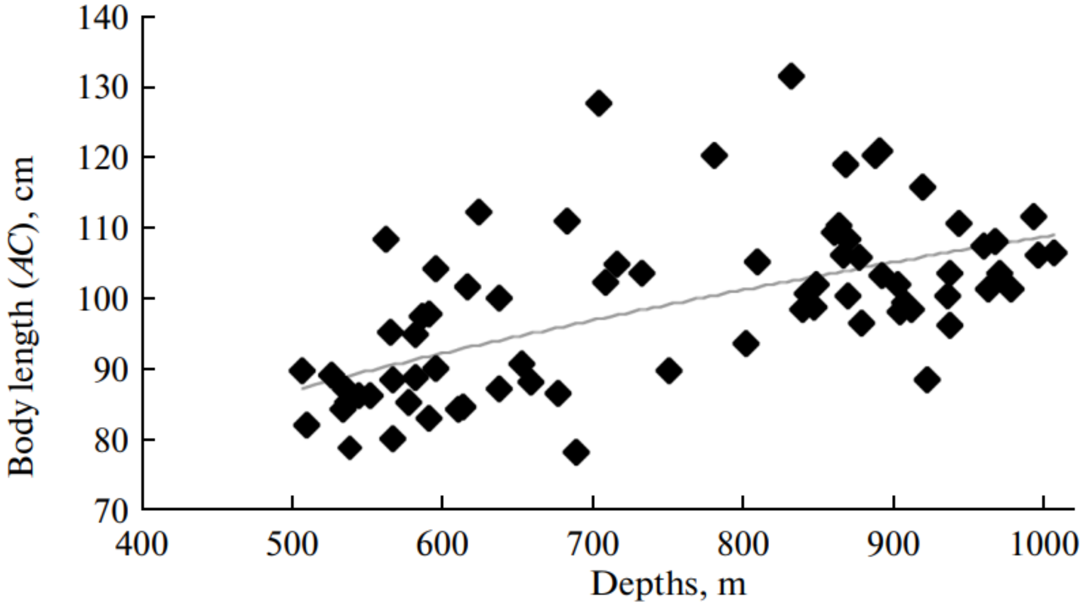


Figure 3: Skilfish body length versus habitat depth at the Emperor Seamounts, June–July 2009: $y = 11.632x^{0.3239}$, $R^2 = 0.3692$ [Zolotov et al., 2014]

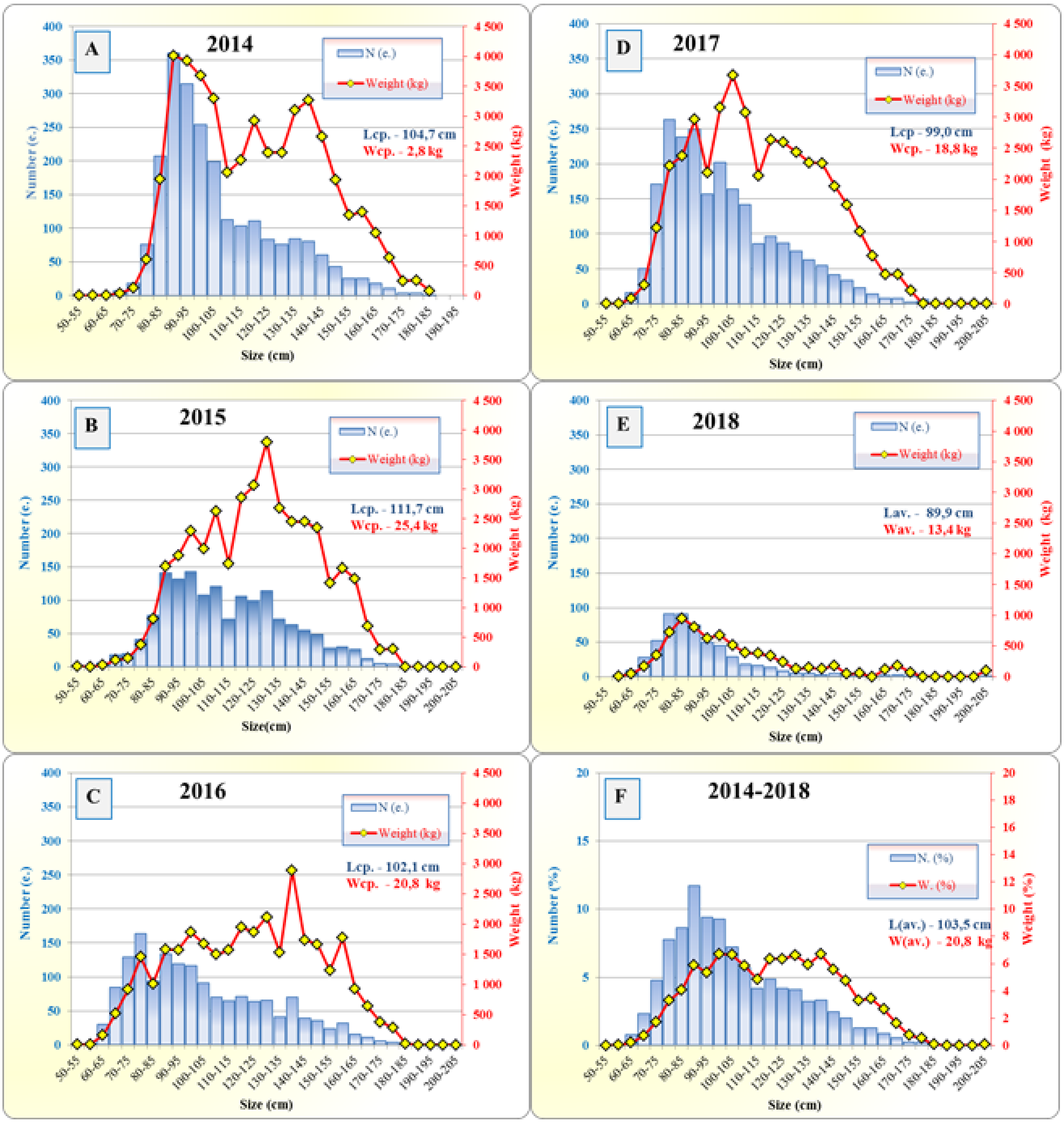


Figure 4: Skilfish body length and weight at the Emperor Seamounts based on longline catches during 2014-2017 (fishing vessel "Palmer") and in 2018 (fishing vessel "Vostok-7"); F – average long-term data, %

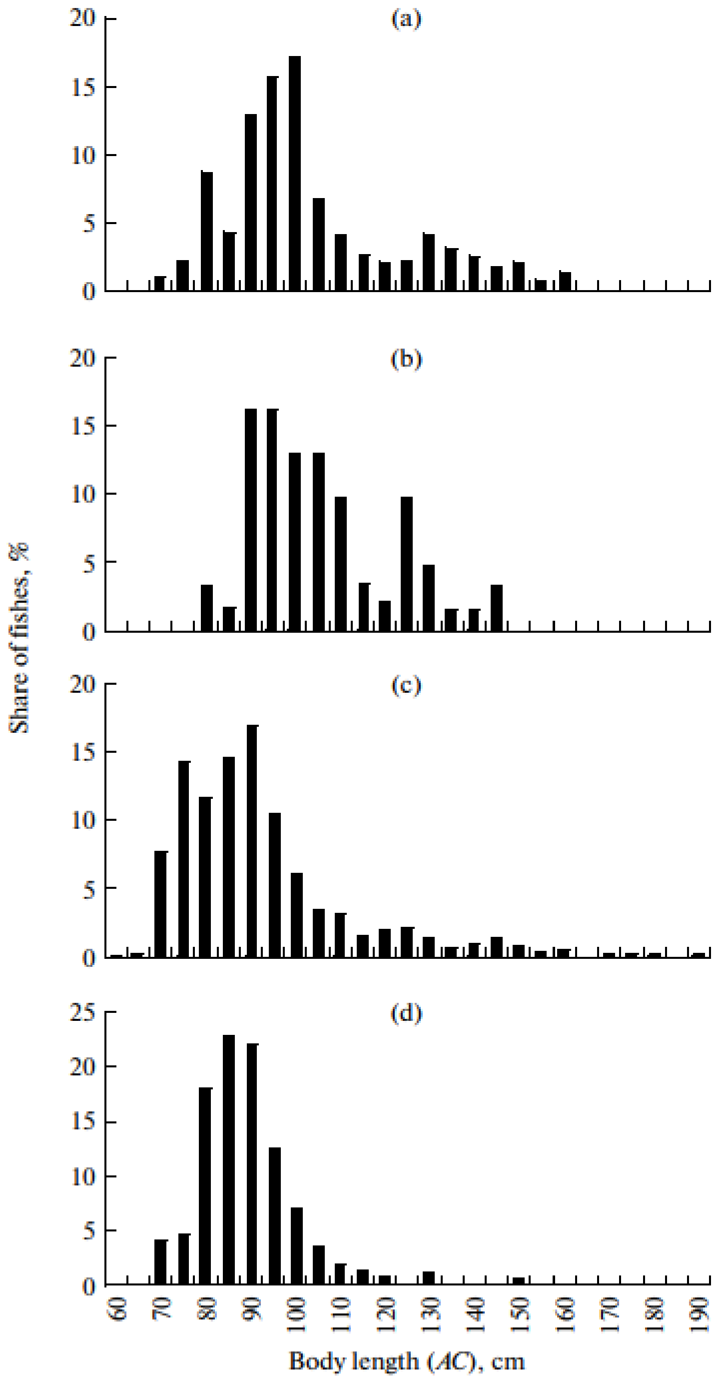


Figure 5: Skilfish body length at the Emperor Seamounts, June–July of 2009: (a) Jingu (M = 103.28 cm, n = 762); (b) Ojin (M = 105.74 cm, n = 61); (c) Northern Koko (M = 92.40 cm, n = 573); (d) Koko (M = 89.07 cm, n = 199)

Fishery

Skilfish was one of the priority species in the Japanese [Belyaev and Darnitskiy, 2005] long-line catches. The fish aggregations of commercial importance were found at several guyots [Baytalyuk et al., 2010; Monakhtina, 2010]. It is also caught by Japanese trawl and gillnet fisheries primarily as bycatch. For several years (2001–2007) this fish was commercially fished by bottom long-lines on a number of Emperor Seamounts. On some markets, this fish was sold under the name "grouper". In 2009, data on skilfish biology and distribution at the Emperor Seamounts were collected and analyzed by Kamchatka Research Institute of Fisheries and Oceanography (KamchatNIRO) observers on two long-liners [Zolotov et al., 2014]. Later, in 2014-2018, observations were conducted by observers from TINRO, now the Pacific branch of Russian Federal Institute of Fisheries and Oceanography (VNIRO). Catch data for skilfish in Korea is available for the period 2013–2019.

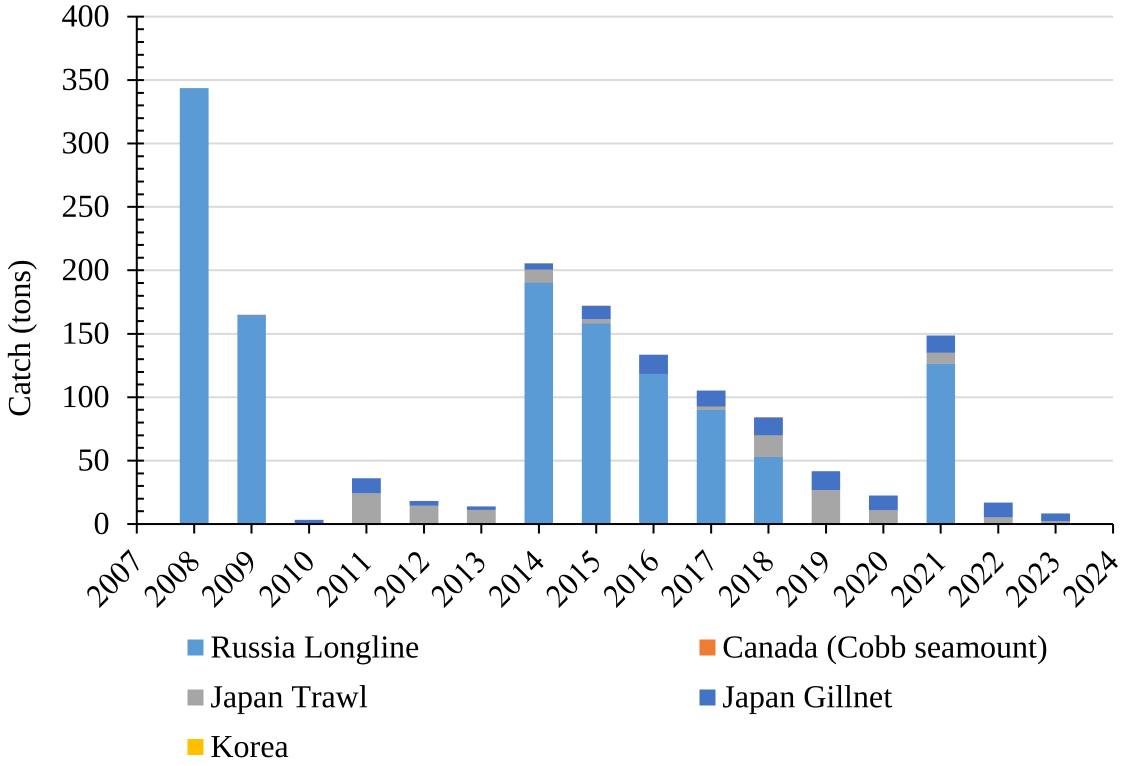


Figure 6: Historical catches of Skilfish in NPFC waters (metric tons)

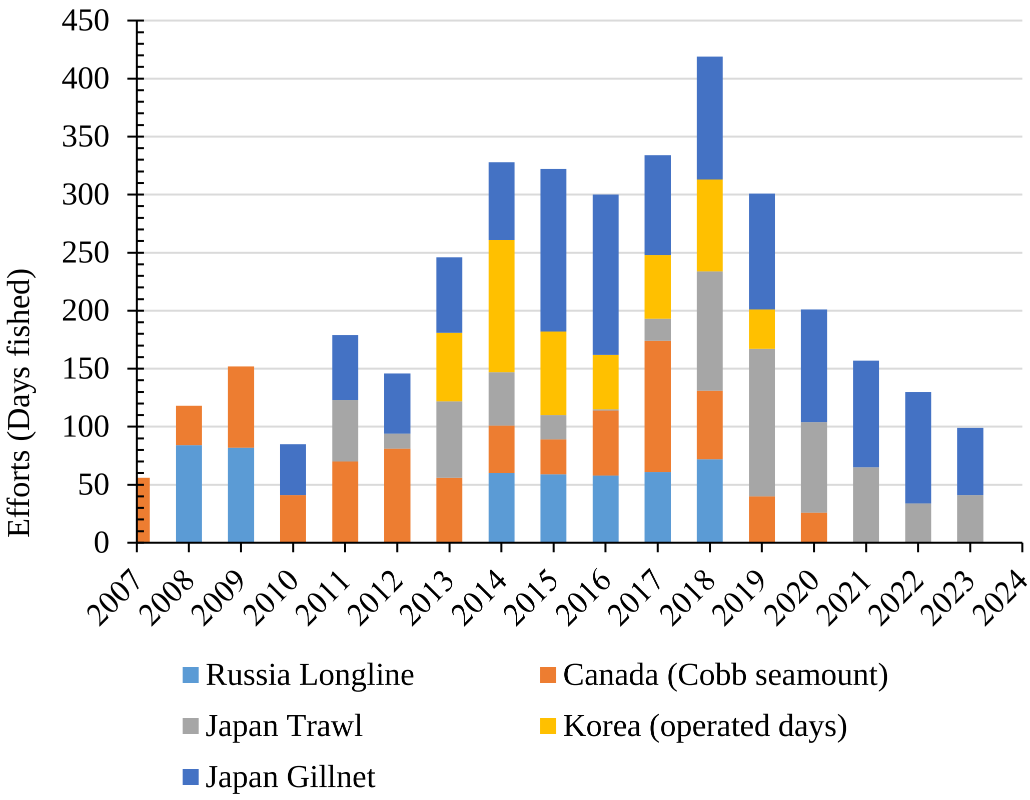


Figure 7: Historical fishing efforts for Skilfish (days with catches)

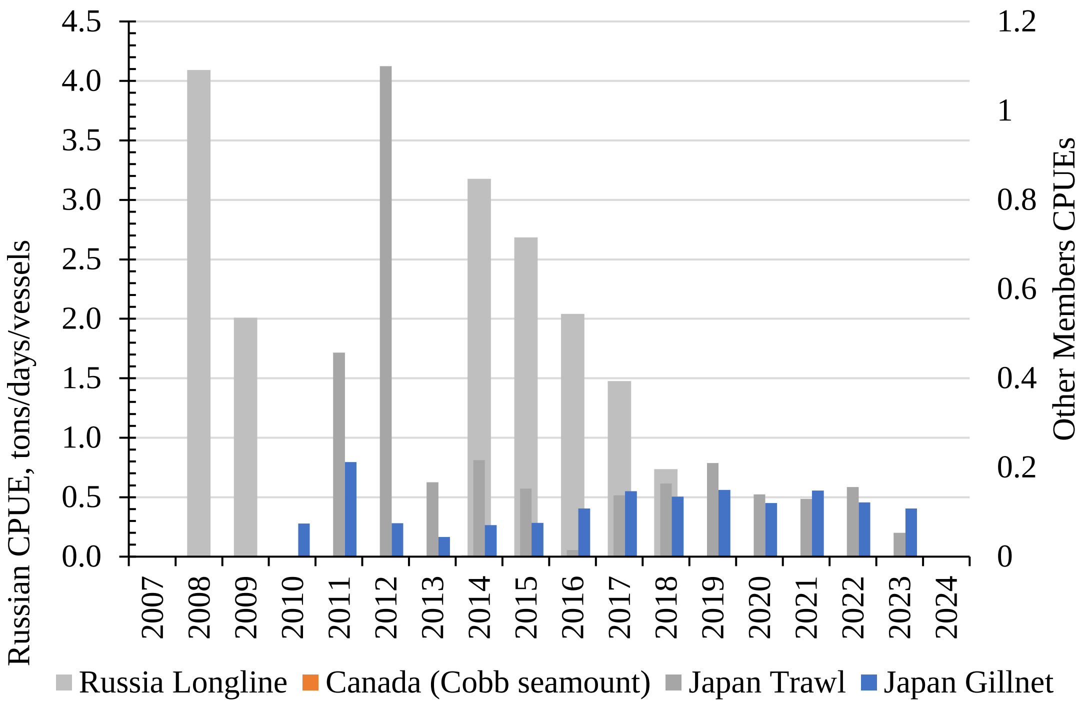


Figure 8: Historical CPUE for Skilfish (Cath per day per vessel)

Assessment

The initial biomass of skilfish at Nintoku, Jingu, Ojin, Koko, and Northern Koko seamounts calculated by the Leslie method was assessed at approximately 203.5 tons in 2009 [Zolotov et al., 2014].

An age- or length-structured stock assessment for Skilfish may be feasible considering life history of this species when more data on age-size structure are available (see fig. 4, 5 & 6). At present, given small amount of data, it is impossible to suggest reliable size-age keys for Skilfish. Available data yielded the following traditional von Bertalanffy equation: $L_t = 183.0\ [1 - e^{-0.0411(t + 4.1172)}]$, where L is the fish body length (AC), cm, and t is fish age, years. According to this equation, skilfish at the age of 10, 20, and 30 years reach body length of 105, 115, and 138 cm, respectively [Zolotov et al., 2014].

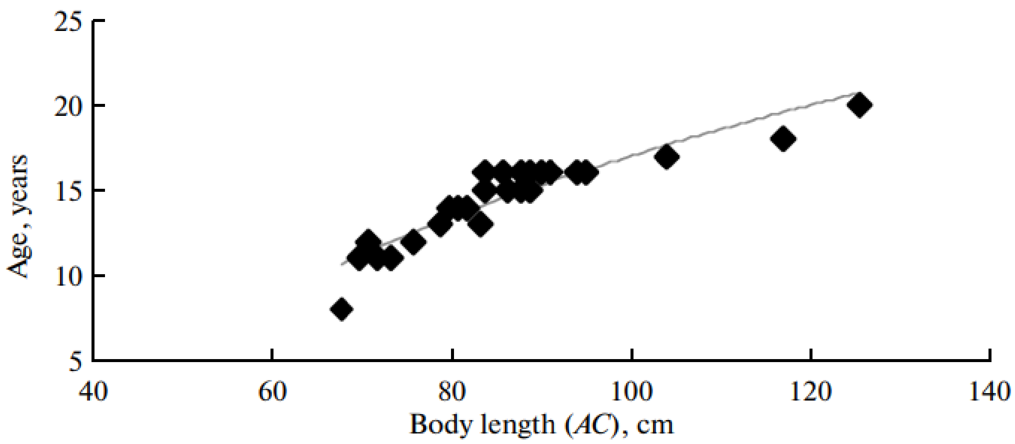


Figure 9: Growth curve of skilfish Erilepis zonifer at the Emperor Seamounts: $y = 16.337\ln(x) - 58.222$, $R^2 = 0.8592$ [Zolotov et al., 2014]

Management

Active Management Measures

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

- CMM 2024-05 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	Not	Not established

Item	Status	Description
point	accomplished	
Stock status	Unknown	Status determination criteria not established
Catch limit	Not accomplished	Not established
Harvest control rule	Not accomplished	Not established
Other	Intermediate	No expansion of fishing beyond 1500 m, No more increase in the fishing vessels

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

Data Availability

Table 2: Catch data

Data	Member	Fishery	Year	Comments
Annual catch	Japan	Trawl	2010-present	
		Gillnet	2010-present	
	Korea	Trawl	2013-2019	Bycatch less than 1% of total catch
	Russia	Long-Line	2000	
CPUE	Japan	Trawl	2010-present	
		Gillnet	2010-present	
	Korea	Trawl	2013-2019	Logbook data available
	Russia	Long-Line	2014-2018	

Table 3: Biological data

Data	Member	Year	Comments
Age	Japan		
	Korea		
	Russia	2009	annual ring analysis
Length	Japan		
	Korea		
	Russia	2014-2018	
Maturity	Japan		
	Korea		
	Russia	2014-2018	

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Belyaev, V.A. and Darnitskiy, V.B., Features of oceanography and ichthyofauna composition on the Emperor Ridge, in *Deep Sea 2003: Conference Governance and Management of Deep-Sea Fisheries*, Shotton, R., Ed., Queenstown, New Zealand: FAO Fish. Proc., 2005, nos. 3/1, part 1, pp. 107–124. http://www.fao.org/docrep/009/a0210e/a0210e09.htm

Monakhtina, S., Skilfish (*Erilepis zonifer*): traits of biology from a fishery near the Emperor Seamounts in the north-west Pacific Ocean, in *14th PICES Annual Meeting, Abstracts of Papers*, Portland, OR, 2010, p. 22.

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Zolotov, O.G., Spirin, I.Y. & Zudina, S.M. New data on the range, biology, and abundance of skilfish Erilepis zonifer (Anoplopomatidae). J. Ichthyol. 54, 251–265 (2014). https://doi.org/10.1134/S0032945214020131

Annex K

Species summary for neon flying squid

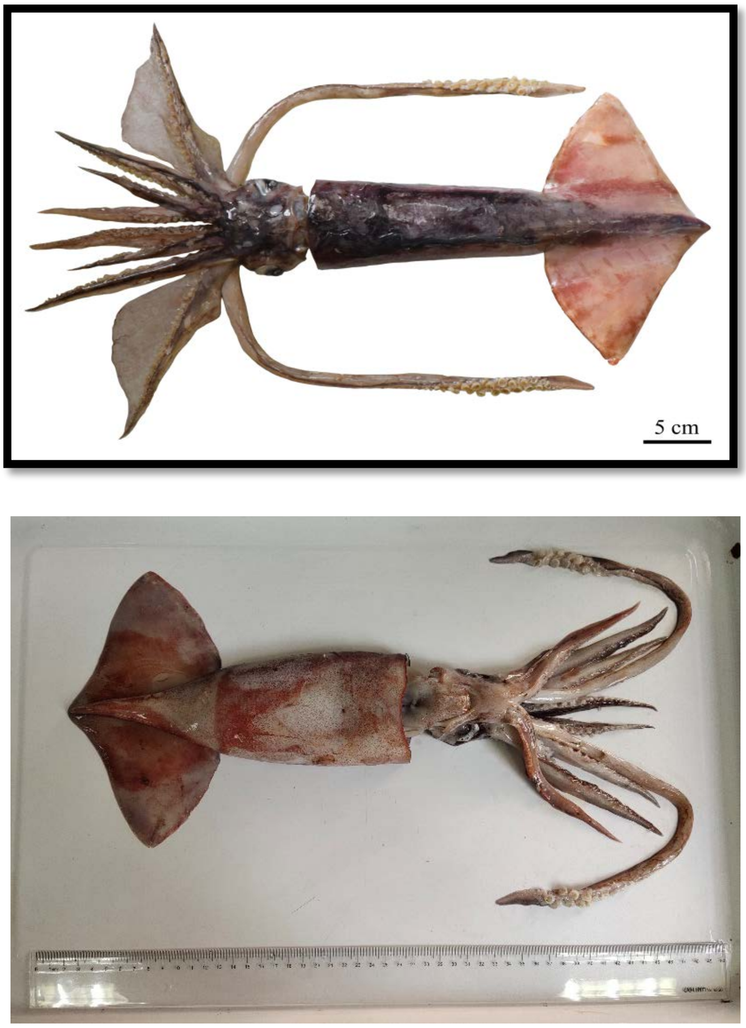

Figure 1. The pictures of neon flying squid

Neon Flying Squid (*Ommastrephes bartramii*)

Common names:

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

Other common names: Red flying squid; Webbed flying squid; Red ocean squid (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 2024-11 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, in the Convention Area, of the number of fishing vessels authorized to fish such species from the historical existing level.

Members of the Commission and CNCPs without substantial harvest of the neon flying squid in the Convention Area are encouraged to refrain from expansion, in the Convention Area, of the number of fishing vessels entitled to fly their flags and authorized to fish for 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.

Table1. Management Summary

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	● (red)	Not established.
Stock status	○	Status determination criteria not established.
Catch or effort limits	● (yellow)	Recommended effort limits.
Harvest control rule	● (red)	Not established.
Other		

● 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.

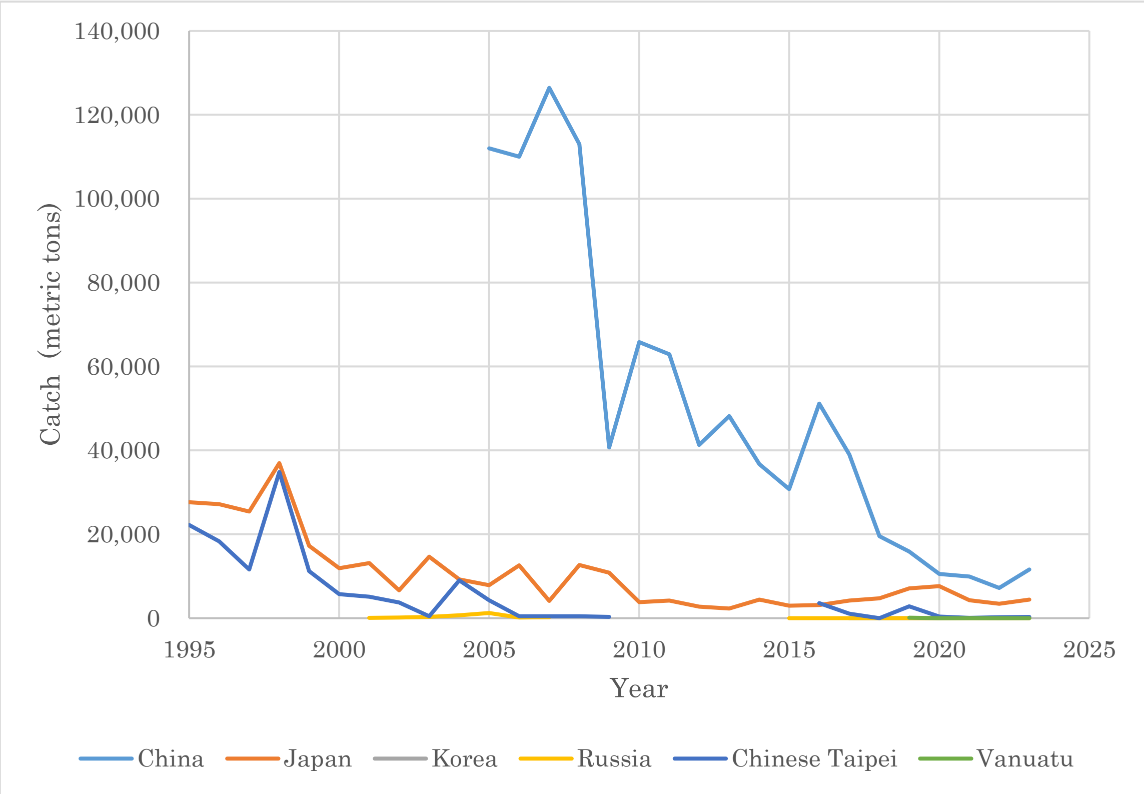

Figure 2. The historical catch of neon flying squid reported by members.

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: 2005-2023 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	2010-2018 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	1995-2022 Fishery data before 2005 (need to be confirmed)	Coverage= 100%	

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	1995-2023	Coverage=100%	
Size composition data				
Length and weight measurements	Drift net survey (Summer)	1999-2023	500-600 squid/year	
	Jigging survey (Winter)	2018-2023	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)	1999-2023	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)	2018-2023	12-16 stations/year	
Abundance indices (commercial)				
Jigging fishery	Logbook Standardized CPUE of the winter-spring cohort	1995-2023	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, 2019 and 2021-2023	Coverage =100%	
Size composition data				
Length measurements	Measured by observers while onboard	2017, 2021, 2022	1000 squid/year	Measurement details to be reviewed
Abundance indices (commercial)				

Jigging	Logbook data available	2017, 2021, 2022	30-40 stations/year	Data coverage details to be reviewed

Category and data sources	Description	Years with available data	Average sample size/year or data coverage	Potential issues to be reviewed
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 squid 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 2018-2023 was the statistics on landings. (No fishery: 2010, 2012-2015)	Coverage =100%	
Size composition data				
Length measurements	Sampling from a research survey (1997). Sampling from commercial fishing vessels.	1997; 1998-2003	200-300 squids /year	Data coverage details to be reviewed
Abundance indices (commercial)				
Squid-jigging fisheries	Squid-jigging logbook	2001-2023 (No fishery: 2010, 2012-2015)	Data Coverage 2001-2016 = 87.3% Data Coverage 2017-2023 =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
VANUATU				
Catch statistics				
Squid jigging fishery	from logbook	2019	logbook from 2013 to now, coverage 100%	Vanuatu has authorized 4 vessels to conduct Pacific saury and squid jigging fishery in NPFC Convention Area. These vessels can target both neon flying squid and Pacific saury, and mainly target Pacific saury.

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.

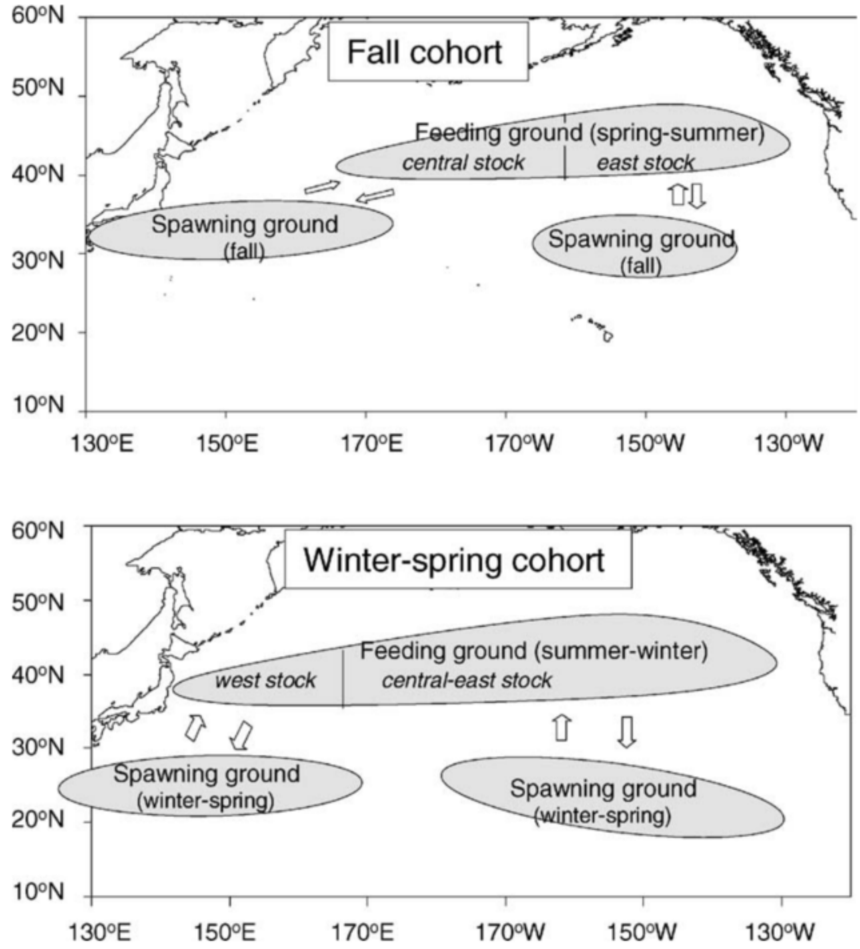

Figure 3. Migration patterns of the fall and winter–spring cohorts of neon flying squid in the North Pacific.

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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Annex L

Species summary for Pacific saury

Pacific saury (*Cololabis saira*)

Common names:

秋刀鱼, Qiū dāoyú (China)
サンマ, 秋刀魚, Sanma (Japan)
꽁치, kkongchi (Korea)
сайра, Saira (Russia)
秋刀魚, Chiu-dao-yu or 山瑪魚, San-ma-hi (Chinese Taipei)

Figure 1. Pacific Saury (Cololabis saira).

Management

Active NPFC Management Measures

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

- CMM 2024-08 For Pacific Saury

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

Management Summary

The current management measure for Pacific Saury specifies both catch and effort limits. Catch limits are guided by science advice based on the calculated annual catch level in the entire area of Pacific saury in accordance with the interim HCR. For 2024, Members of the Commission agree that the annual catches of Pacific saury in the Convention Area and the areas under their jurisdiction adjacent to the Convention Area should not exceed 225,000 metric tons. In this year, the annual total allowable catch (TAC) of Pacific saury in the Convention Area shall be limited to 135,000 metric tons. Each Member of the Commission shall reduce the annual total catch of Pacific saury by the fishing vessels entitled to fly its flag in 2024 by 55% from its reported catch in 2018.

In the event that the total reported catch of all Members reaches 90% of the TAC for the Convention Area, the Executive Secretary shall notify all Members without delay. Those

Members with more than 10,000 mt of catch limits shall close the fishery within 72 hours from the receipt of the notification. Those Members with less than 10,000 mt of catch limits may continue operations, but their total catch shall not exceed 90% of their catch limits.

The current management measure also states that each Member of the Commission participating in Pacific saury fisheries shall implement either of the following measures:

(a) to reduce the number of fishing vessels flying its flag and fishing for Pacific saury in the Convention Area by 10% from the number of its fishing vessels that fished for Pacific saury in the Convention Area in 2018; or

(b) to prohibit fishing vessels flying its flag from engaging in fishing for Pacific saury in the Convention Area outside its designated fishing period of no longer than 180 consecutive days each year.

In order to protect juvenile fish, Members of the Commission shall take measures for fishing vessels flying their flags to refrain from fishing for Pacific saury in the areas east of 170°E from June to July.

Table 1. Current status of NPFC management measures

Convention or Management Principle	**Status**	**Comment or Consideration**
Biological reference point(s)	Established	Updated annually in stock assessment
Stock status	Established	Updated annually in stock assessment
Catch limit	Established	Recommended catch limits updated routinely by Commission
Harvest control rule	Established	Interim HCR (in place until a management procedure is established by the Commission)
Other	Not accomplished	Management strategy evaluation in progress, age structured model development in progress

Assessment

A stock assessment for Pacific Saury is conducted annually by the NPFC's Small Scientific Committee on Pacific Saury (SSC PS) available at: https://www.npfc.int/stock-assessment-reports. The assessment has been a collaborative effort among Members of SSC PS based on a Bayesian state-space production model (BSSPM) since 2019 (Figure 2).

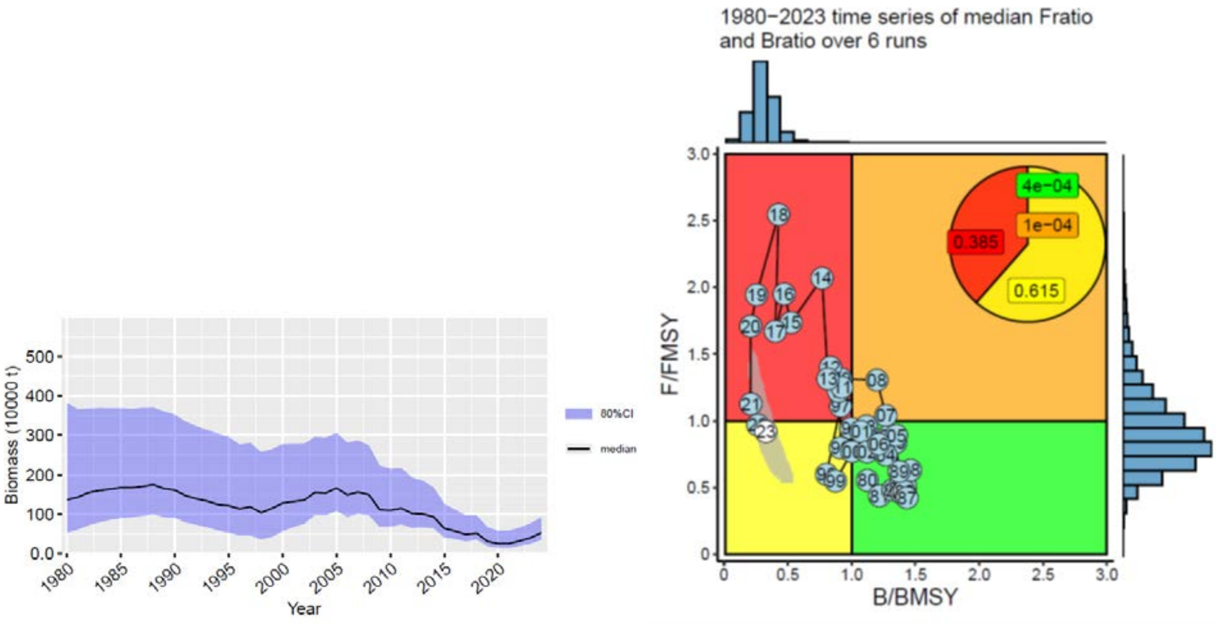

Figure 2. Time series of biomass (left panel) and Kobe plot (right panel) for Pacific Saury stock assessment.

The total catch of Pacific saury has been in decline since approximately 2010 (Figure 3). Similarly, the biomass estimated by the BSSPM stock assessment has also generally declined from its peak during the past two decades.

Data

Surveys

Since 2003, Japan has been conducting a biomass survey covering a wide area of the NPFC Convention area with several research vessels before its main fishing season (Hashimoto et al., 2020). The main purpose of the surveys is to understand the distribution and abundance of Pacific saury and to develop abundance indices for use in stock assessments. Fish sampling also contributes to the understanding of length composition and its inter-annual change.

Fishery

The fishing grounds are west of 180° E but differ among Members who fish for Pacific saury: China, Japan, Korea, Russia, Chinese Taipei, and Vanuatu. The stick-held dip net gear has become the dominant fishing technique to catch Pacific saury in the northwest Pacific Ocean. Near the coast Japan also catches Pacific Saury with setnet gear. The fishing is mainly carried out from June-November with peaks typically in the late summer or fall. Other NPFC Members (Canada and USA) do not target Pacific saury.

Standardized catch per unit effort (CPUE) is calculated by all Members participating in the Pacific saury fishery and a joint standardized CPUE is calculated across all Member each year and utilized in the assessment (Hsu et al. 2023).

Updated data on Pacific saury catches in the northwestern Pacific Ocean from 1995 are available on the NPFC website: https://www.npfc.int/pacific-saury-catches. 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).

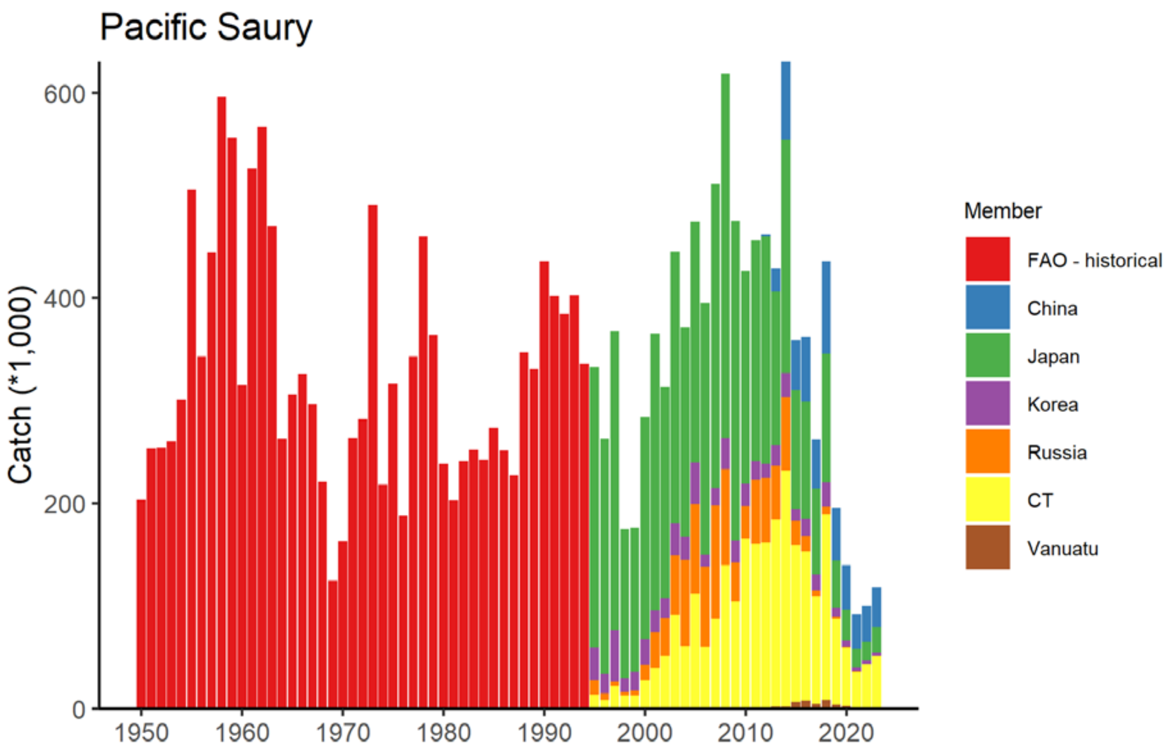

Figure 3. Historical catch of Pacific Saury.

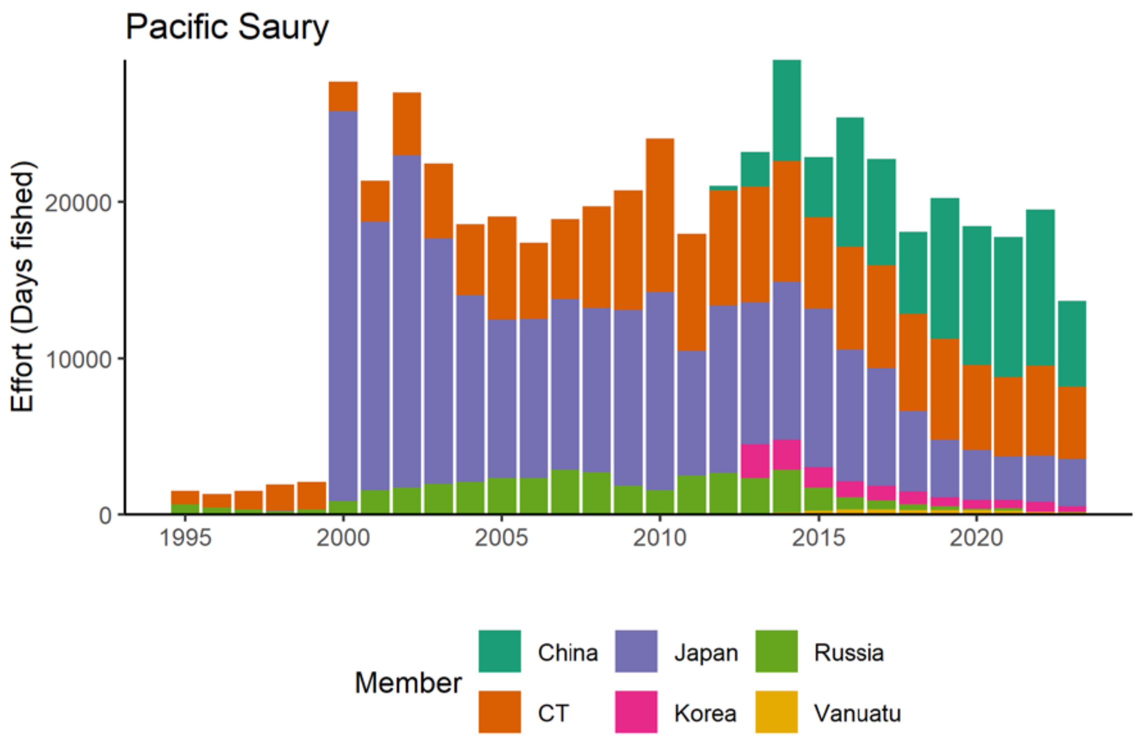

Figure 4. Historical fishing effort for Pacific saury.

Biological collections

All Members collect some size data from fishery catches of Pacific saury. These collections included length data as well as maturity and age structures from some Members.

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

Data availability from Members regarding Pacific Saury

Data	**Source**	**Years**	**Comment**
Catch	China	2013-present	Catches from convention area
	Japan	1950-present	Japan<92>s time series of catch data are broken into Early (1980-1993) and Late (1994-2021) CPUE because of time-varying q in the early part of the time series
	Korea	2001-present	
	Russia	1994-present	

Data	Source	Years	Comment
	Chinese Taipei	2001-present	
	Vanuatu	2011-present	
CPUE			CPUE calculated individually by China, Japan, Korea, Russian, Chinese Taipei, and Vanuatu and as a joint CPUE
Survey	Japan		Fishery-independent biomass survey
Length data	All Members		Fishery-independent biomass survey (Japan), fishery data
	Japan		Commercial catch
Maturity/fecundity	Japan		Fishery-independent biomass survey
Age	Japan		Fishery-independent biomass survey

Special Comments

None

Biological Information

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). In recent years, the age-0 fish have mainly been distributed in the eastern region east of 170°E in June and July.

Life history

Pacific saury are short-lived and fast growing. 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 called 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). 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). 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 (Kosaka 2000). Pacific saury is a highly migratory species that 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. 2012a). 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 Ocean, central North Pacific Ocean, and northeast Pacific Ocean) (Chow et al. 2009). 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).

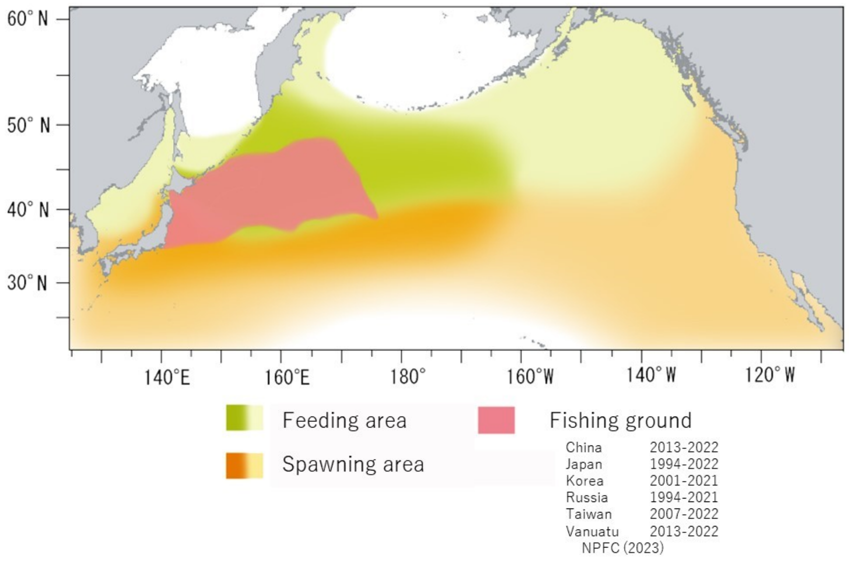

Figure 5. Map of distribution of Pacific saury in the North Pacific.

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Annex M

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 2024-11 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 1. Management Summary

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	● (red)	Not established for NPFC CA (Established in Japan EEZ).
Stock status	○	Status determination criteria not established for NPFC CA (Established in Japan EEZ).
Catch limit	● (red)	Not established for NPFC CA (Established in Japan EEZ).
Harvest control rule	● (red)	Not established for NPFC CA (Established in Japan EEZ).
Other		

● (green) OK ● (yellow) Intermediate ● (red) Not accomplished ○ Unknown

Stock Assessment

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

Japan conducts annual stock assessments for the autumn-spawning stock and winter-spawning stock of JFS (Figure 1, Miyahara et al. 2024, Okamoto et al. 2024). The latest stock assessment for the winter-spawning stock in Japan included overseas catch from Russia, China and Korea (Fig. 1a). Estimated biomass and spawning stock biomass (SSB) have decreased drastically since 2015 (Fig. 1b). Japan uses a Beverton–Holt stock-recruitment relationship (Fig. 1c). In 2022, SSB was estimated lower than SSBmsy and F was lower than Fmsy (Fig. 1d).

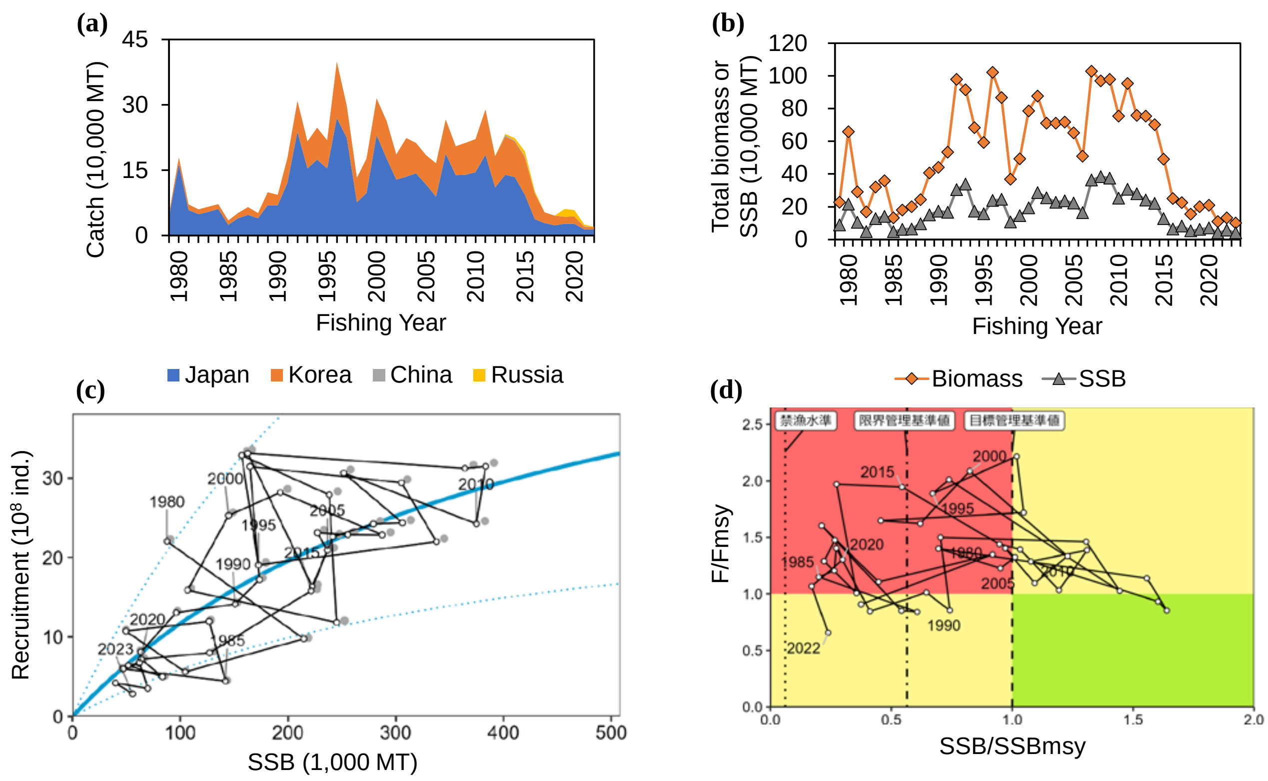

Figure 1. Summary of the stock assessment for the winter-spawning stock Japanese flying squid by Japan (Okamoto et al. 2024). (a) Time series of catch of each Member from fishing year 1979 to 2022. (b)Estimated biomass and SSB. (c) Stock-recruitment relationship. (d) Kobe plot.

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 paralarvae (winter survey), recruits (May-June), and adults (July-September). 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 stock 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/2023-04/NPFC-2023-AR-Annual%20Summary%20Footprint%20-%20Squids%20%28Rev.%201%29_0.xlsx). Catches of JFS in the Convention Area are low, less than 3% of total catches in each year, as the majority of catches comes from Japanese and Russian national waters (Fig. 2). 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 abundance indices of the winter spawning stock of JFS to use in the domestic stock assessment (Okamoto et al. 2016, 2024).

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 (Nakamura and Sakurai 1991).

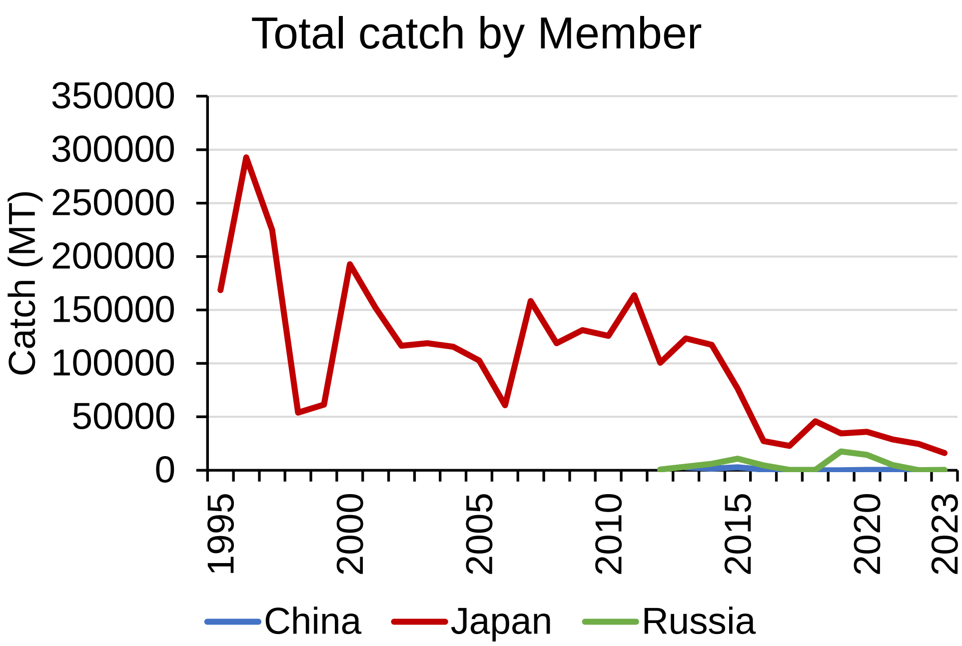

Figure 2. Total catch (MT) for each Member reporting Japanese flying squid catches during 1995-present.

Data table

Table 2. 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	Potential issues to be reviewed

			coverage	
JAPAN				
Catch statistics				
Coastal jigging fishery	Official statistics; Reports from fisheries associations and markets	1979-2023 (only after 1995 at some ports)	Coverage = 100%	
Offshore jigging fishery	Logbook	1979-2023	Coverage = 100%	
Trawl fishery	Logbook	1980-2023	Coverage = 100%	
Purse seine fishery	Official statistics; Reports from fisheries associations and markets (only at Hachinohe and Mie);	1995-2023	Coverage = 100%	
Set net	Official statistics; Reports from fisheries association	1995-2023	Coverage = 100%	
Size composition data				
Length measurements	Port sampling by eight local fisheries research bodies at major ports on the Pacific side	1979-2023	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	2012-2023	500-1200 fish/year	Data coverage in the eastern Hokkaido (Nemuro Strait)
Abundance indices (survey)				

Winter survey for larvae	BONGO net	2001-2023	65-204 stations/year	Review survey protocol and conduct standardization
Survey for recruitment from May to June	Midwater trawl	1996-2023	24-63 stations/year	Review survey protocol and conduct standardization
Survey for recruitment in June	Jigging	1972-2023	25-83 stations/year	Review survey protocol and conduct standardization
Survey for recruitment from June to July	Midwater trawl mainly targeting saury	2001-2023	33-136 stations/year	Review survey protocol and conduct standardization
Survey for recruitment in July	Midwater trawl	2019-2023	20-40 stations/year	Short time series (five years) and ended in 2023
Survey for recruitment in August	Jigging	1979-2023	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	1979-2023	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 Midwater trawl fishery	Official statistics, reports from fisheries associations	Official statistics: 1964-1970, 2013-2023, 1971-2012 (no data available); publications: 1967-2018	Coverage 1964-1970 ?%; Coverage 2013-2023 =100%	Data coverage details to be reviewed
Size composition data				
Length measurements	Sampling from commercial fishing vessels. Sampling during research surveys.	1966-1975 1992-2023	500-3,000 squids /year (ca. 50 measurements per sampling)	Data coverage details to be reviewed
Aging	-	-	-	-
Abundance indices (survey)				
Summer trawl and acoustic (echo integration) surveys to assess pelagic squids abundance	Mid-water upper epipelagic surveys	1992-2023 (June-July) 1992-2023 (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 3 and 4) and their northward/southward shifts in distribution range occur in response to changes in water temperature (Murata 1990, 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 (Jereb and Roper 2010, Okutani 2015).

The autumn- and winter-spawning stocks have spatially different nursery areas and migration patterns (Fig. 4). 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 towards each spawning ground. The main spawning grounds of the autumn-spawning stock are off the northwestern Honshu Island to north of the East China Sea (Fig. 3, Goto 2002, Yamamoto et al. 2002), while those of the winter-spawning stock are in the East China Sea (Okutani and Watanabe 1983, Bower et al. 1999).

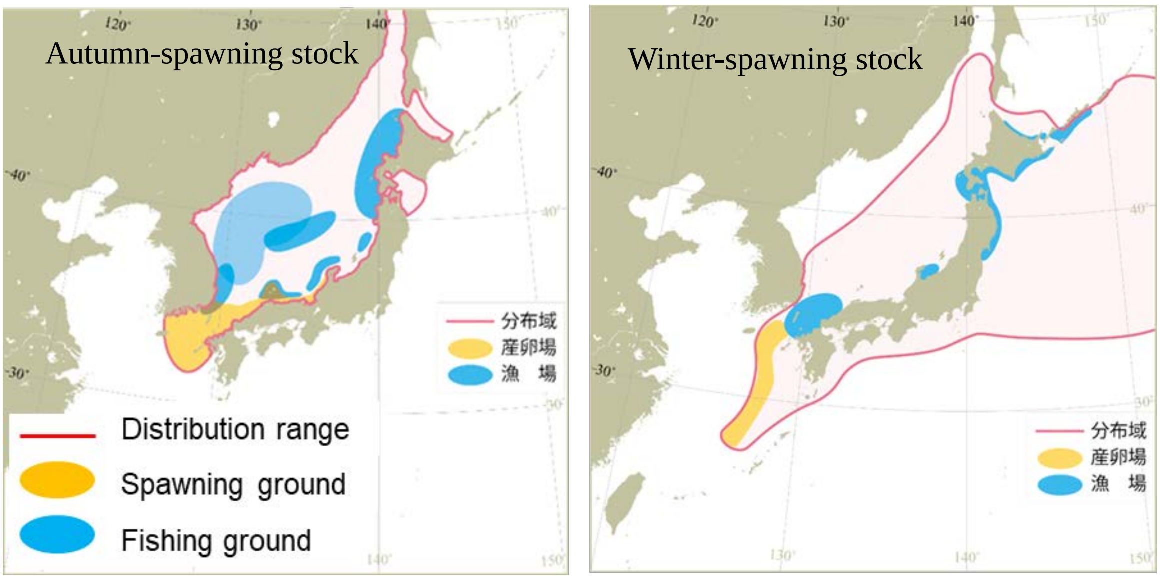

Figure 3. Distribution ranges, spawning grounds, and fishing grounds of the autumn- and winter-spawning stocks. These figures were modified based on Miyahara et al. (2024) and Okamoto et al. (2024).

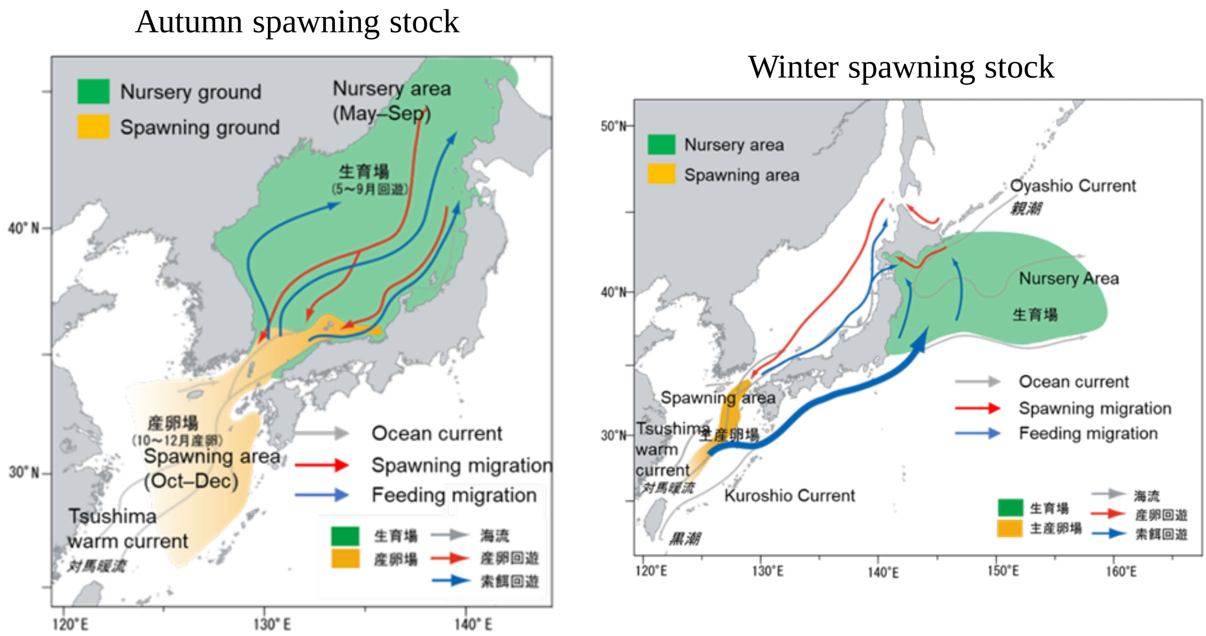

Figure 4. Seasonal migration of the autumn- and winter-spawning stocks. These figures were modified based on Miyahara et al. (2024) and Okamoto et al. (2024).

Stock Structure

There are distinct sub-populations (stocks) which spawn during different seasons (Murata 1990, Sakurai et al. 2013). The autumn-spawning stock is most abundance, followed by the winter-spawning stock which is distributed in the waters off eastern Japan Oyashio region (Sakurai et al. 2013, Miyahara et al. 2024, Okamoto et al. 2024). 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 (Jereb and Roper 2010), but both are generally less than 30 cm (Murata 1990, Sakurai et al. 2013). Females are thought to mature around 20-25 cm (mantle length). The JFS lifespan is approximately one year (Murata 1990, Sugawara et al. 2013). Mature female JFS spawns a large egg mass at a time which contains up to 200,000 eggs and is considered to float above the thermocline (Bower et al. 1996, Sakurai et al. 2000, Puneeta et al. 2015). After the paralarvae hatches from the egg, they will swim to the sea surface and are transported to their nursery areas by ocean currents (Fig. 4, Kon et al. 2006, Sakurai et al. 2013). JFS prey on myctophids, anchovies, crustaceans, gastropod larvae, and chaetognaths, and are preyed upon by rays and several marine mammals (Jereb and Roper 2010, Uchikawa and Kidokoro 2013).

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Annex N

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)

Figure 1. Japanese Sardine (Sardinops melanostictus).

Management

Active NPFC Management Measures

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

- CMM 2024-11 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.

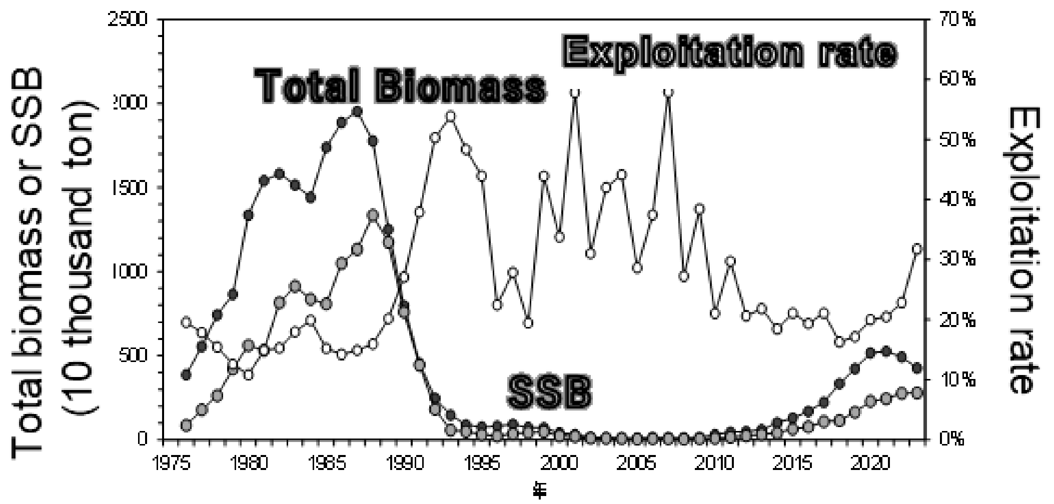
Table 1. Current status of NPFC management measures

Convention or Management Principle	Status	Comment or Consideration
Biological reference point(s)	Not accomplished	Not established for NPFC CA (Established in Japan EEZ)
Stock status	Unknown	Status determination criteria not established for NPFC CA (Established in Japan EEZ)
Catch limit	Intermediate	Not established for NPFC CA (Recommended catch, effort limits in Japan EEZ)
Harvest control rule	Not accomplished	Not established for NPFC CA (Established in Japan EEZ)
Other	Intermediate	No expansion of fishing beyond currently fished 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 ridge VPA and a number of data sources described below (Hiroshi and Nishida 2005). The catch and biomass estimated by Japan's stock assessment have both been increasing since 2010 (Figure 3). The spawning stock biomass is currently estimated to be higher than SSB_{msy}, but fishing mortality is higher than F_{msy} indicating overfishing in the most recent 3 years (Figure 3). Japan's stock domestic assessment includes catch data from the NPFC CA by China and Russia. Information on the size, weight and age of the catch from the NPFC CA would be useful if it were made available for Japan's stock assessment.



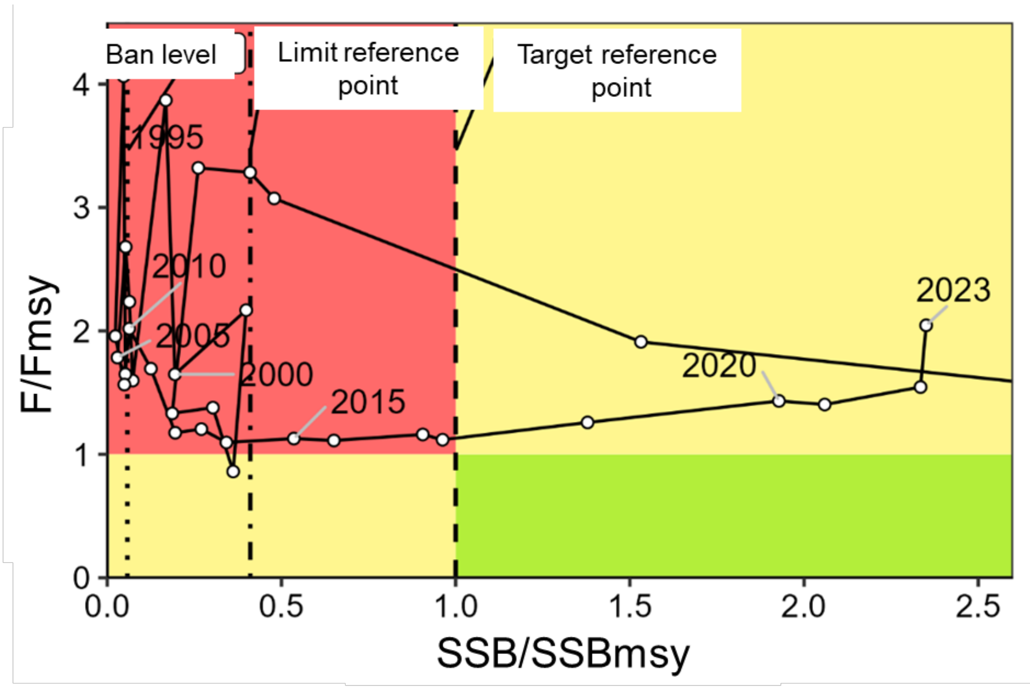


Figure 3. Time series of catch by age in the Japanese Sardine fishery and time series of spawning stock biomass, total biomass and exploitation rate from the domestic Japanese Sardine stock assessment (top panels). Kobe plot indicating historical and current status of Japanese sardine in relation to MSY-based reference points (reprinted from Japan's domestic stock assessment of Japanese Sardine (bottom panel).

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 (1995-2024), summer (2001-2024) and fall (2005-2024) 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. China has been conducting a scientific survey using its fishery research vessel Song Hang in the convention area of NPFC since 2021. The survey is conducted during June-August, with methods of mid-trawling, acoustic and squid jigging, covering about 70 stations per year.

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 2024 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.

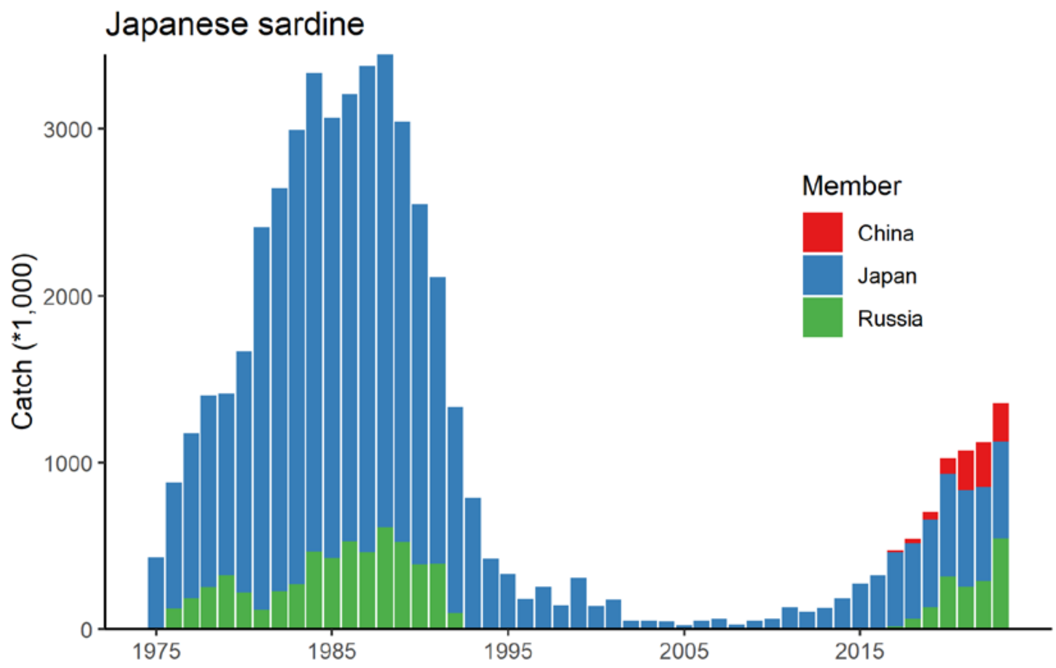


Figure 4. Historical catch of Japanese Sardine by Members in both the CA and inside Members EEZs.

Other NPFC Members (Canada, EU, 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, EU and Canada have no record of Japanese Sardine catches. However, there have been recent (since 2022) occurrences of Japanese Sardine along the USA west coast.

Fishery catch data is available for Members from the NPFC website (https://www.npfc.int/system/files/2024-04/NPFC-2024-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).

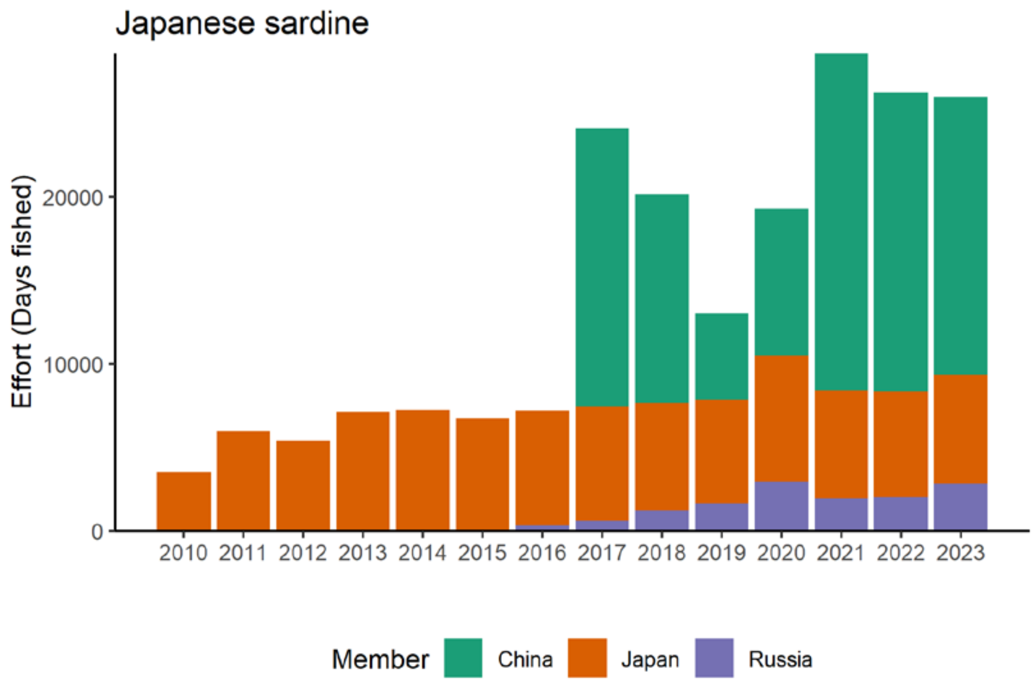


Figure 5. Historical fishing effort for Japanese Sardine.

Biological collections

China has collected biological data from fishery catches of Japanese Sardine since 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.

Data availability from Members regarding Japanese sardine

Data	Source	Years	Comment
Catch	China	2015-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
	Russia	2016-present	Catches primarily in national waters, not convention area
	Chinese		Minor bycatch in Pacific saury fishery

Data	Source	Years	Comment
	Taipei		
CPUE			not developed
Survey	Japan		Pre-recruit survey
	Japan		Juvenile survey
	Japan		Monthly egg and larval survey
	Russia	2010-present	Acoustic-trawl survey
	China	2021-present	Midwater trawling and acoustics
Age data	China	2020-present	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches
Length data	China	2020-present	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches
Maturity/fecundity	China	2020-present	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 (Whitehead 1985) and their maximum age is 7 years (Furuichi et al, 2024). 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.

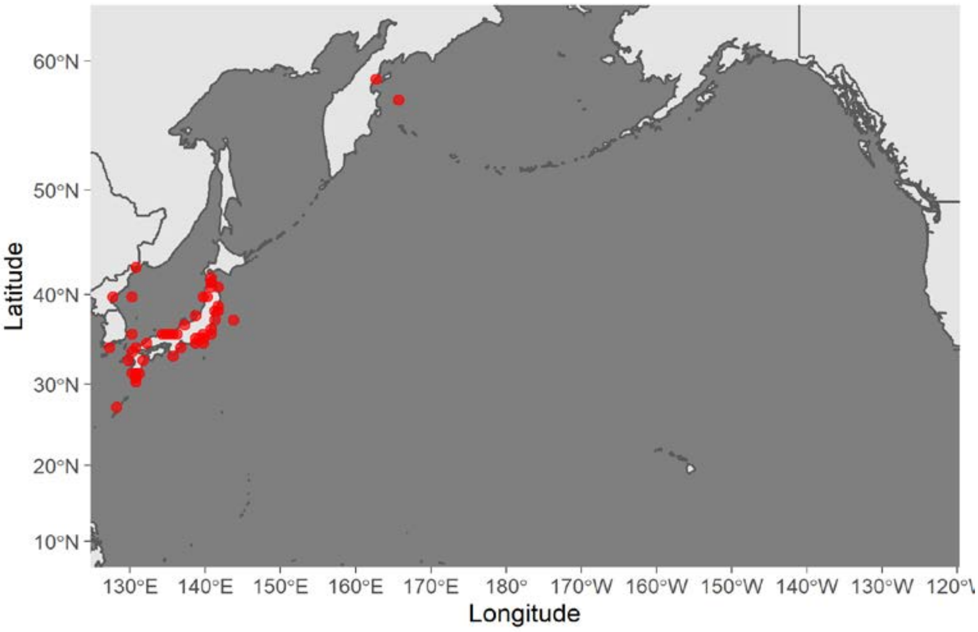


Figure 4. Map of distribution of Sardine species in the North Pacific.

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Appendix: Sardine and the environment

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	correlation

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
										biomass	
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
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	2020	journal paper	China	Pacific	Kuoshio current	Japanese sardine	Adult	Abundance/Catch	Basin scale climate (ALPI, SST,	Climate variability introduced	time series analyses

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
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.									Current patterns)	nonlinearity and nonstationarity to pelagic fish	
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
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

Annex O

Species summary for blue mackerel

Blue mackerel (*Scomber australasicus*)

澳洲鮐 [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)	● (red)	Not established.
Stock status	○	Status determination criteria not established.
Catch limit	● (yellow)	Not established for NPFC CA (Established in Japan EEZ)
Harvest control rule	● (red)	Not established.
Other	● (yellow)	No expansion of fishing beyond established areas.

● (green) OK ● (yellow) Intermediate ● (red) 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 (BM) using tuned virtual population analysis (VPA) and MSY-based reference points (Yukami et al. 2019a, Hayashi et al. 2019). Only the Pacific stock is distributed in the NPFC convention area. The latest stock assessment in Japan included overseas catch from China under a few assumptions on the compositions of mackerel species and ages (Fig. 1a). The Russian catch was excluded from the stock assessment, as there was no blue mackerel catch reported by Russia. Estimated recruitment, biomass, and spawning stock biomass (SSB) drastically decreased since the 2010s (Fig. 1b). A Ricker-type stock-recruitment curve was applied. In the most recent year (2022), spawning stock biomass (SSB) was estimated lower than SSBmsy and F was higher than Fmsy (Fig. 1d).

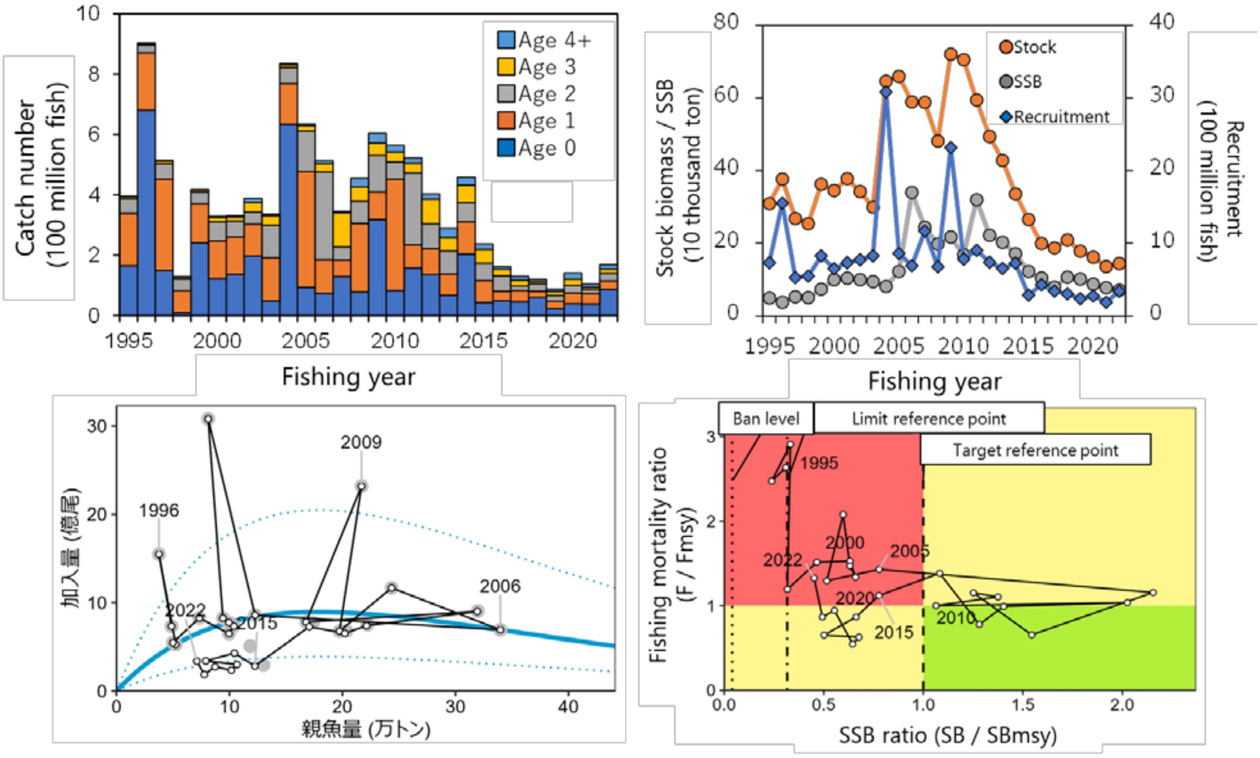

Figure 1: Summary of the stock assessment for the Pacific stock of BM in Japan (Kamimura et al. 2024). (a) Time series of catch number by age. (b) Estimated biomass, SSB, and recruitment. (c) Stock-recruitment relationship. (d) Kobe plot.

Data

Survey

Japan conducts three surveys: (1) egg and larval distribution survey (every month), (2) juvenile survey (May-Jul from 2001), and (3) pre-recruit fish survey (Aug-Oct from 2001). The egg survey has been used as an abundance index for SSB in the Japan's domestic stock assessment (Figs. 2,

3). Other members do not conduct any survey on blue mackerel.
China has been conducting scientific survey using its fishery research vessel Song Hang in the convention area of NPFC since 2021. The survey is conducted during June-August, with methods of mid-trawling, acoustic and squid jigging, covering about 70 stations per year.

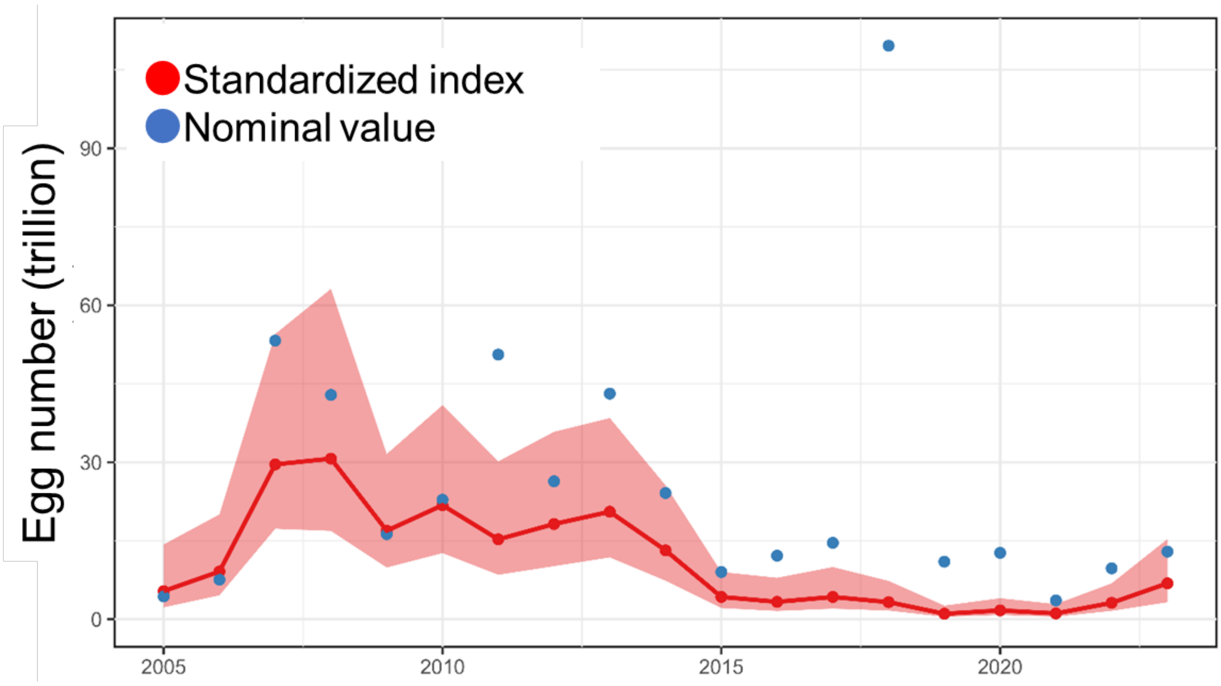

Figure 2: Time series of egg abundance indices. Nominal index and standardized index are shown. This standardization incorporates the effect of species misidentification of chub mackerel as blue mackerel, which is a reason why standardized values are lower than nominal values in most years typically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

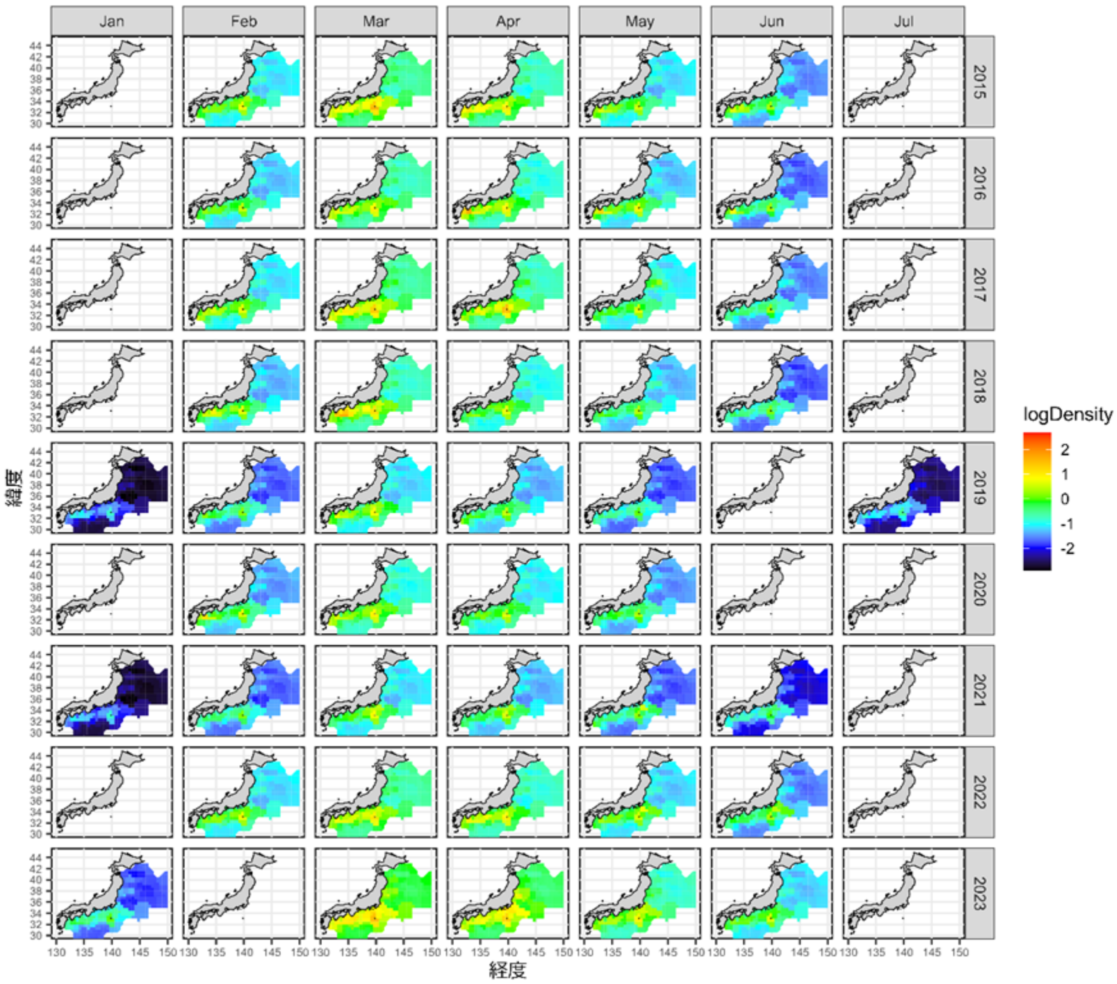

Figure 3: Spatial distributions of blue mackerel eggs on the Pacific coast of Japan by month (column) by year (row), estimated from the seasonal VAST model (Thorson et al. 2020) with the egg survey data. The sign of X in red represents the center of gravity.

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 the 2010s (Fig. 4). 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 2021, although the

proportion of blue mackerel was 26% in 2022.
China operates a blue mackerel fishery in the NPFC Convention Area only, on the same fishing grounds as for chub mackerel. 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.

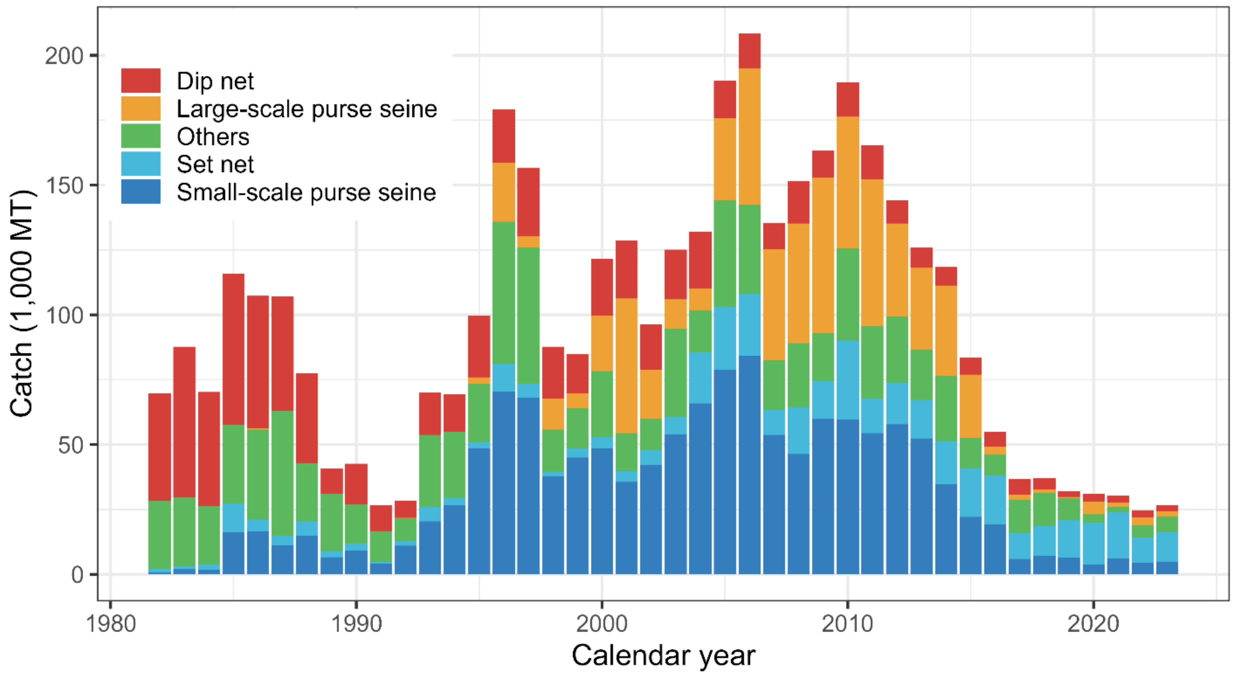

Figure 4: Time series of catch weight from 1982 to 2023 calendar year for the Pacific stock of BM. The colors represent different fisheries in Japan. Due to data accessibility issues, the Chinese catch is not included in the figure. It assumed that Russia caught no fish of BM.

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: 2015-2023	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.	2018-2023	550-800 fish/year	Details to be reviewed
Aging	Sampling during research surveys and from commercial fishing vessels	2020-2023	30-180 fish/year	Details to be reviewed
Catch at age (CAA)	Estimate CAA from the above data	2020-2023	Age-length keys are to be developed	Evaluate uncertainty of catch at age, especially on changes of growth depending on recruitment abundance
Abundance indices (commercial)				
Purse seine fishery	Purse seine logbook	2015-2023	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 Dip net fishery Set net	Official statistics; reports from fisheries associations and markets	Official statistics: 1950-2023, other reports: 1982-2023	Coverage=100 %	The blue mackerel catches are estimated from chub and blue mackerel catches based on port sampling data
Size composition data				
Length measurements	Port sampling by 17 local fishery institutes in 17 prefectures	1995-2023	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	1995-2023	500-1000 fish/year	Data coverage review
Catch at age (CAA)	CAA is estimated with length measurement and aging data	1995-2023	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	2005-2023	ca. 6000 stations in total, 1000-4000 stations with blue mackerel eggs/year	Review survey protocol and conduct standardization

	pelagic species.			
Abundance indices (commercial)				
Stick-held dip net fishery	Logbook data are collected from fishermen in Shizuoka prefecture since 1995	1995-2023	100-500/year	Standardization

Special Comments

Although the Small Working Group (SWG) previously 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).

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. 5). Below we describe biological information based on the Pacific stock of blue mackerel.

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.

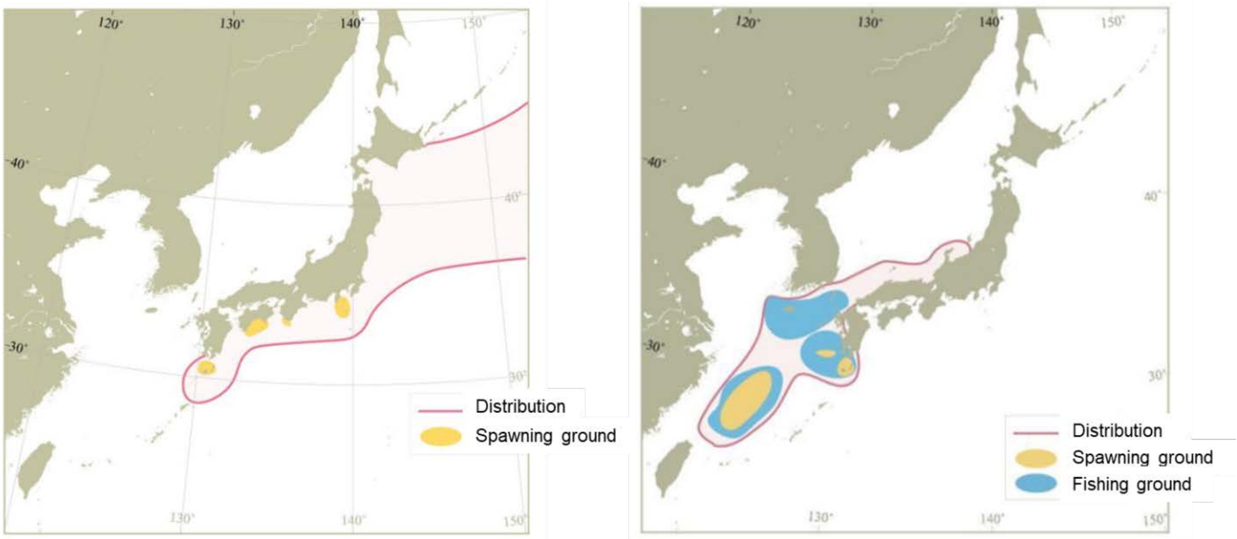

Figure 5: Distribution and spawning ground of the Pacific stock (left) and the East China Sea stock (right) of blue mackerel.

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. It is suggested that 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 (the averages in caught fish in 2017 to 2021) by age are shown in Fig. 6.
The length-weight (LW) relationships in Japan and China are shown in Fig. 7 (see also Furuichi et al. 2021). Although the estimated parameters from Chinese samples in 2021 and 2022 were

different from the others probably due to the small sample sizes and narrow sampling ranges of length (Table 3), their forms are almost identical. This suggests that the degrees of obesity for BM were little different between Chinese and Japanese fishing grounds.

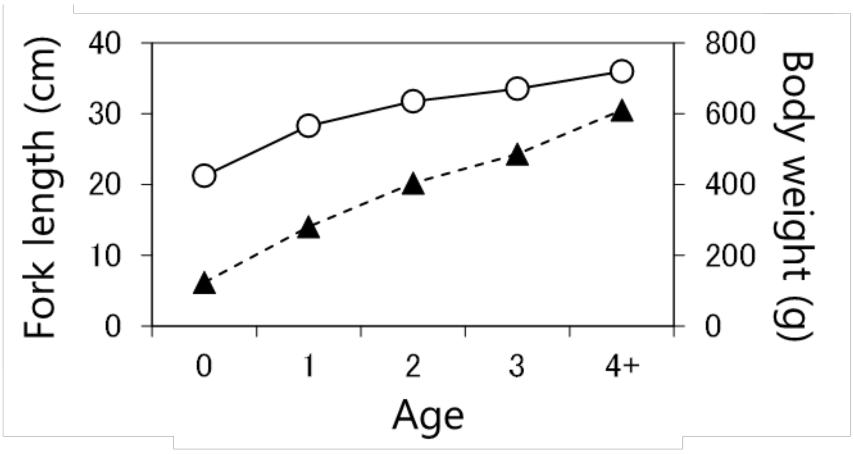

Figure 6: Relationship between age and fork length and relationship between age and body weight of BM (the averages of caught fish for the latest five years 2018-2022).

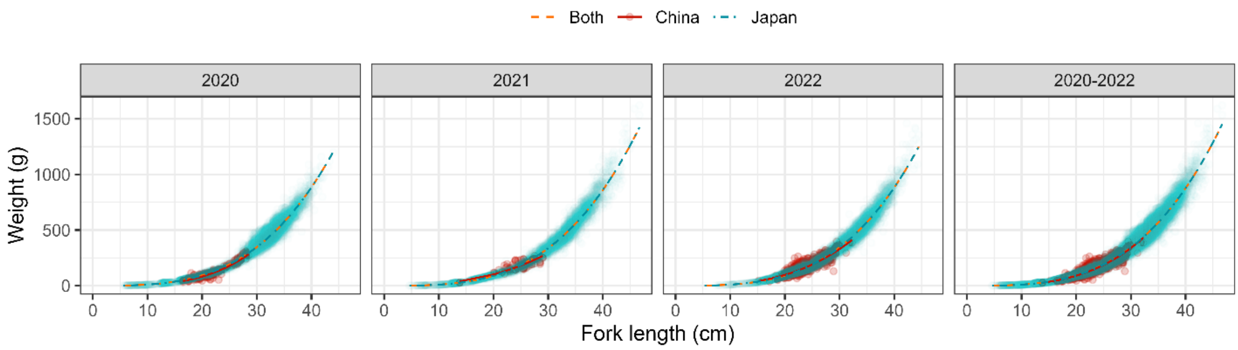

Figure 7: Relationships between fork length and weight from 2020 to 2022 of BM in Japan.

Table 3: Parameters of the relationship between fork length (cm) and weight (g) by Member from 2020 to 2022. The parameters are estimated by the least square method from the equation $W = aL^b$. 'Both' in the 'Member' column represents China + Japan and *N* represents sample size.

Year	Member	*a*	*b*	*N*
2020	Both	0.0054	3.25	9818
2020	China	0.0024	3.49	218
2020	Japan	0.0056	3.25	9600
2021	Both	0.0053	3.25	7711
2021	China	0.0398	2.62	56
2021	Japan	0.0052	3.26	7655
2022	Both	0.0051	3.27	12405

2022	China	0.0117	3.01	632
2022	Japan	0.0051	3.27	11773
2020-2022	Both	0.0053	3.26	29934
2020-2022	China	0.0049	3.28	906
2020-2022	Japan	0.0053	3.26	29028

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. 6. 8). The spawning grounds are found from the waters southern Kyusyu and cape Ashizuri to the Kuroshio current water near Izu Islands (Fig5). 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.

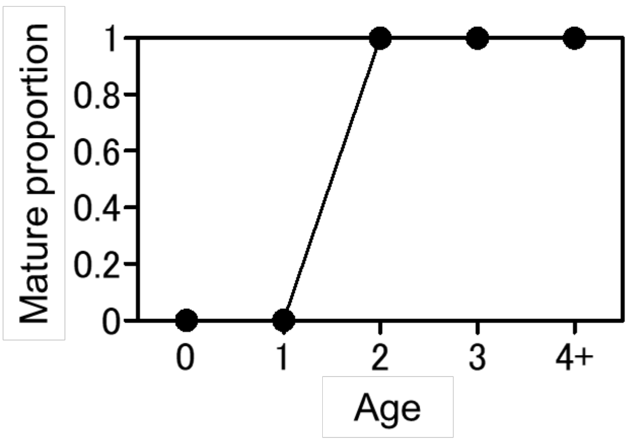

Figure 8: Mature proportion by age.

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 P

Stock assessment report for chub mackerel

EXECUTIVE SUMMARY

Background information

Chub mackerel (*Scomber japonicus*) in the Northwest Pacific Ocean (NWPO) is distributed from the coast of southern Japan to offshore waters of Kuril Islands. It is considered that both adults and juveniles are distributed as far east as the 170-degree East longitude line. The feeding migration of adults has expanded to the northeast recently, and since 2018 the distribution of adults during summer and fall has reached 47-degree North, 166-degree East, east offshore of Kuril Island. The spawning ground is known to be located within the range of the Japanese Exclusive Economic Zone (EEZ), with the main spawning ground located in Izu Island waters.

Chub mackerel are harvested by China, Japan and Russia (Figure E-1). Chinese light purse seine and pelagic trawl fisheries are operated in the NPFC Convention Area. Japanese chub mackerel fisheries consist mainly of purse seine and set net fisheries within the Japanese national waters. Russian chub mackerel fisheries mainly operated in the Russian national waters consist of mid-water trawl, purse seine and bottom trawl gears with operations in the Japanese national waters. The historical total landings have largely fluctuated and recently decreased from approximately 516,000 mt in 2018 to 151,000 mt in the most recent calendar year (CY) 2023. The Conservation and Management Measure for chub mackerel (CMM 2024-07) includes a catch limit of 100,000 mt set in the Convention Area for each of the 2024 and 2025 fishing seasons.

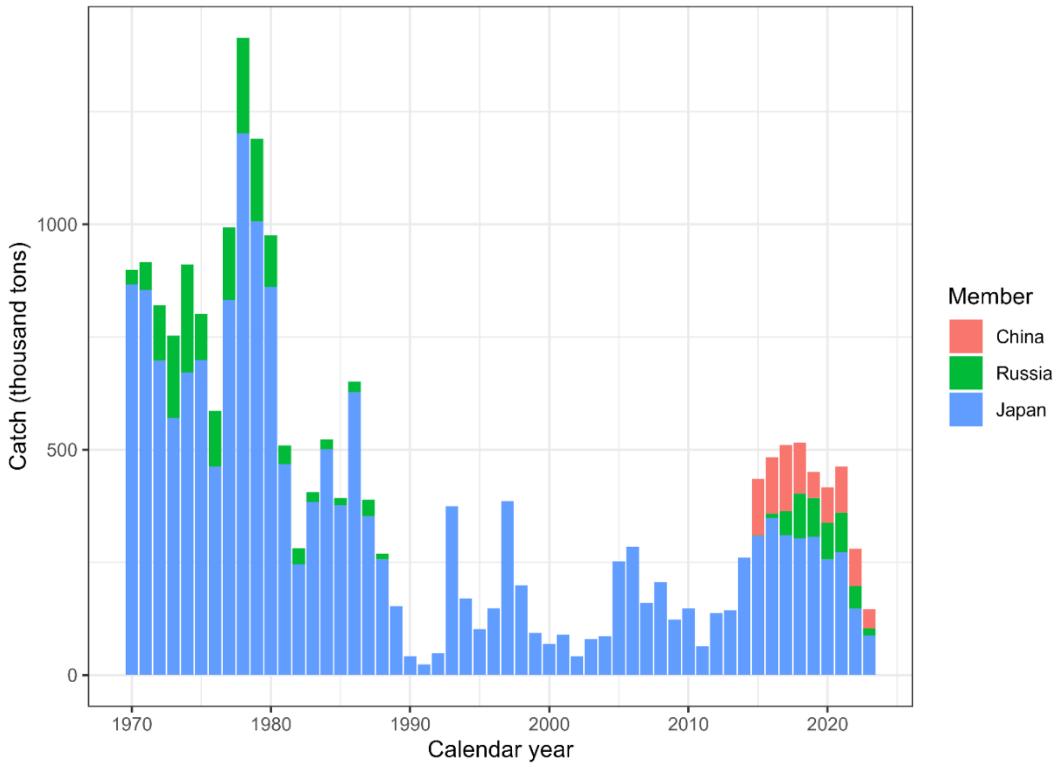

Figure E-1. Historical chub mackerel catch in weight by Member. The provisional Chinese catch for 2023 is estimated using the historical ratio for chub mackerel and blue mackerel.

Stock assessment model

A state-space stock assessment model (SAM) was agreed to be used for the chub mackerel stock assessment by the Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA). SAM accounts for observation errors in catch-at-age data and abundance indices. It uses age-specific data on catch numbers, stock weight, and maturity rate in each year. Recruitment was defined as numbers at age 0, and spawning stock biomass (SSB) was calculated through multiplication of numbers-at-age by maturity-at-age and weight-at-age. SAM consists of two subparts: a population dynamics model and an observation model.

Age-structured population dynamics for chub mackerel estimated by SAM are driven through survival processes such as natural and fishing mortalities, and reproduction is calculated by a Beverton-Holt stock recruitment relationship. Fishing mortality coefficients by year and age group are assumed to follow a multivariate random walk, consequently allowing estimation of time-varying selectivity.

In the observation model of SAM, the catch-at-age is estimated though the fitting of the Baranov equation to the observed catch-at-age under a lognormal error distribution. SAM also fits to abundance indices with a lognormal error assumption. Non-linear relationships to population abundance estimates were estimated for abundance indices specific to ages 0 and 1, linear relationships were applied to the other abundance indices.

Data and biological parameters used in the assessment model

Data are included from the NPFC Convention Area and Members' EEZs.

A fishing year (FY) starting from July and ending in June of the following year was applied in the stock assessment of chub mackerel. The TWG CMSA agreed for the stock assessment period to be FY1970 to FY2022. Seven age groups of ages 0 to 5 and 6+ were defined in the stock assessment. The historical catch-at-age, which was constructed from the quarterly data from each Member, is shown in Figure E-2. Time series of mean weight-at-age are illustrated in Figure E-3. Annual maturity-at-age with decadal time-varying changes is shown in Figure E-4. These data were available up to FY2022.

Although seven time series were available, only six time series of abundance indices were used during model development (Figure E-5): relative number of age 0 fish from the summer survey by Japan; relative number of age 0 fish from the autumn survey by Japan; relative number of age 1 fish from the autumn survey by Japan; relative SSB from the egg survey by Japan; relative SSB from the dip-net fishery by Japan; and relative vulnerable stock biomass from the light purse-seine fishery by China.

Russian CPUE data were not used for model development although the abundance indices from Japan and Russia were available until FY2023 and until FY2022 for China. While the FY2023 Japanese abundance indices were not used for the base case, as agreed in the TWG CMSA08, they were used for sensitivity runs.

An age-specific natural mortality (M), corresponding to 0.80 for age 0, 0.60 for age 1, 0.51 for age 2, 0.46 for age 3,0.43 for age 4, 0.41 for age 5, and 0.40 for age 6+, is applied for the stock assessment by the TWG CMSA.

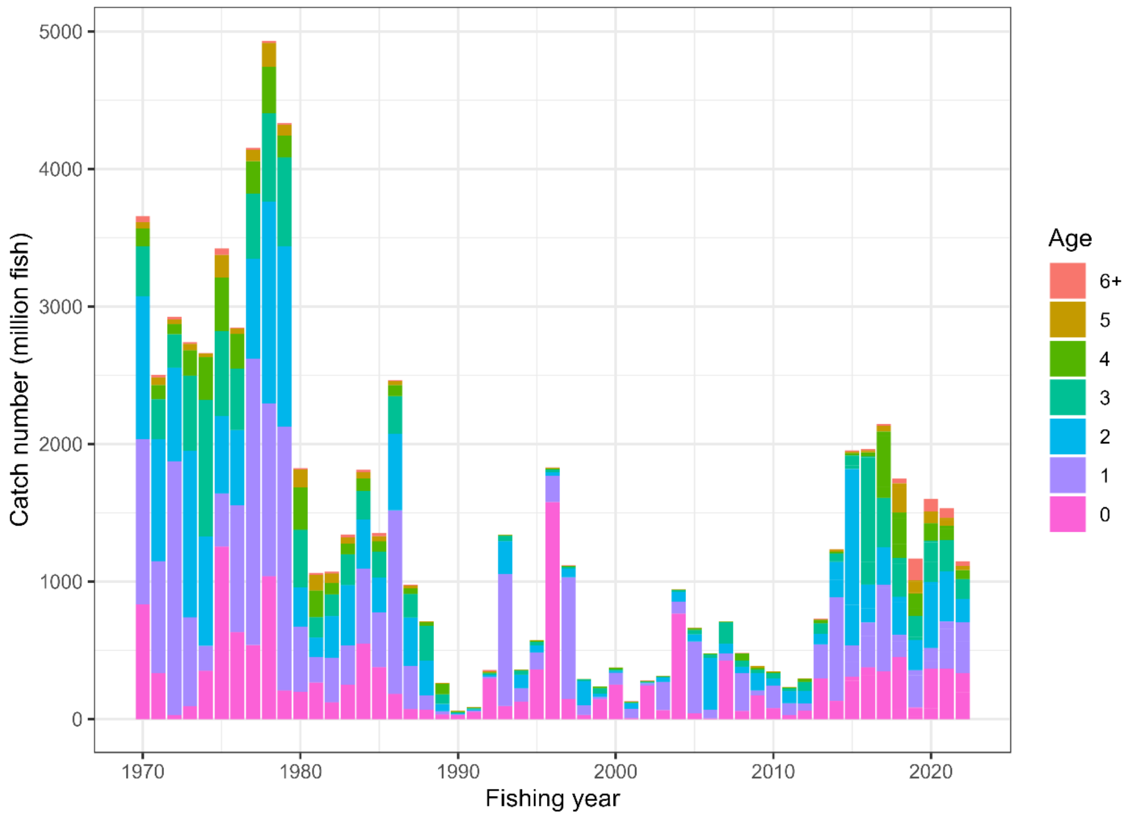

Figure E-2. Historical observed catch-at-age.

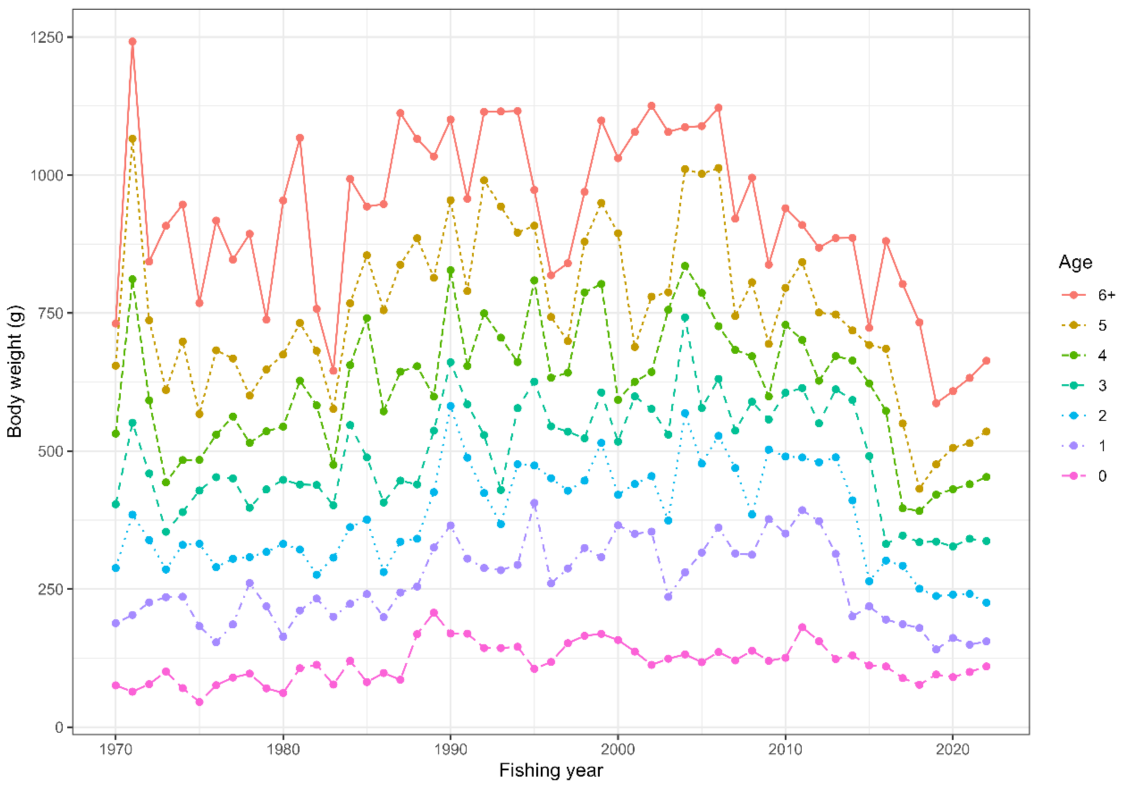

Figure E-3. Time series of weight-at-age.

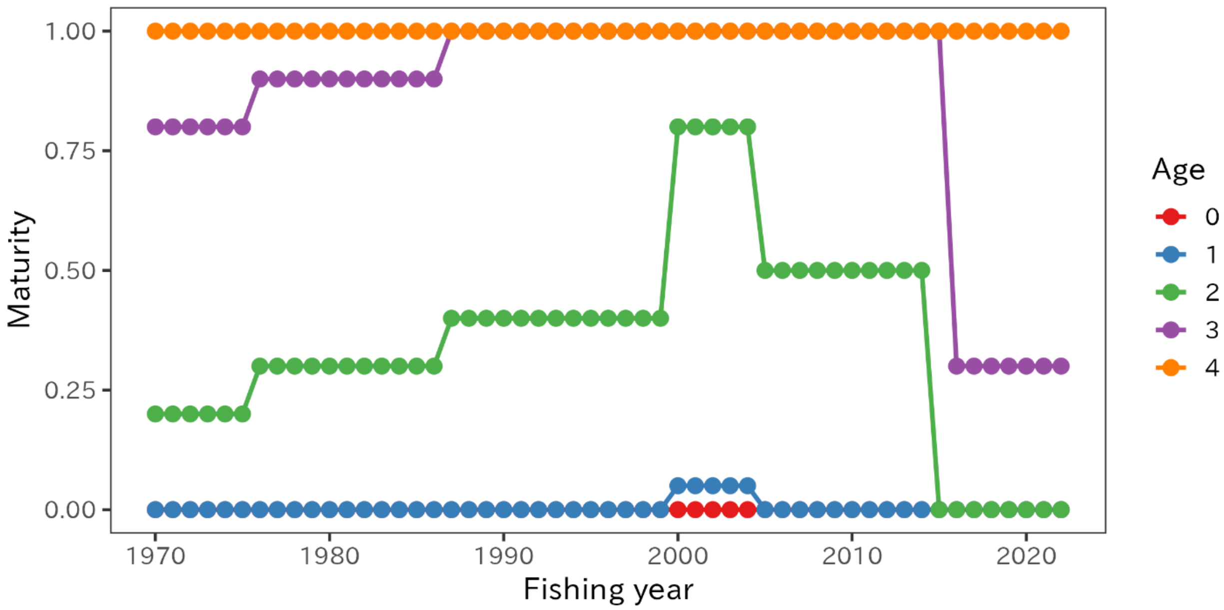

Figure E-4. Time series of maturity-at-age. Ages are simplified up to age 4 due to the similarity of maturity at age 4 and above.

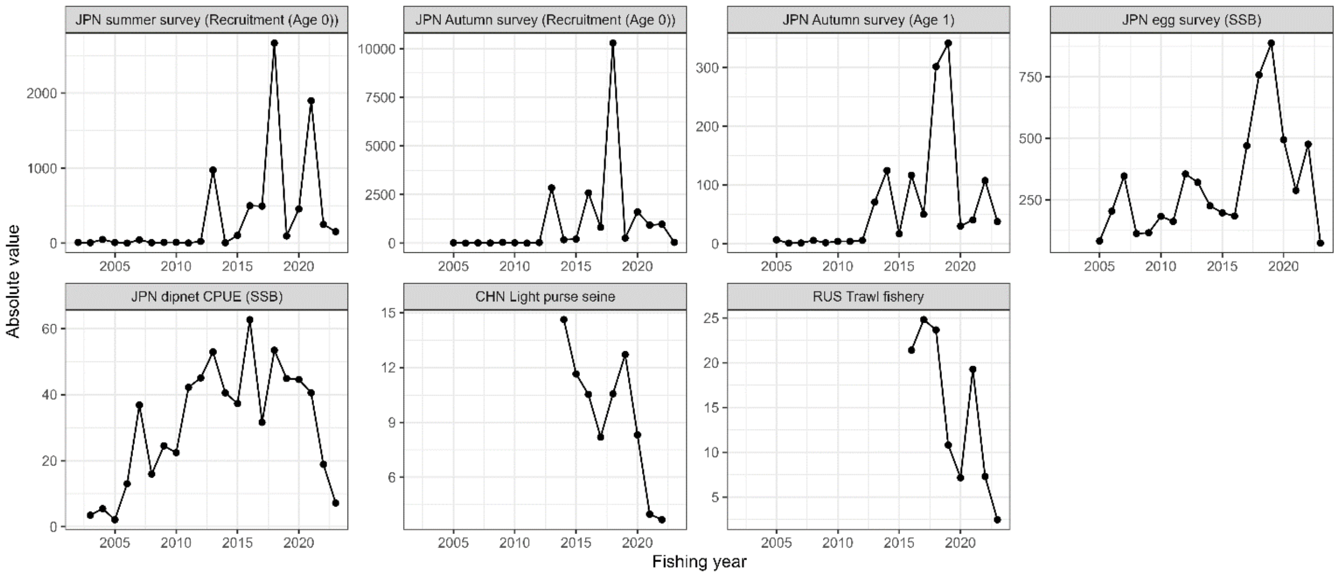

Figure E-5. Time series of abundance indices. The Russian CPUE data were not used in model estimation.

Stock assessment scenarios
In order to improve the SAM fit to abundance indices and retrospective patterns, the TWG CMSA recognized the necessity of introduction of estimation of process error in survival of age groups older than age 0. The TWG CMSA also considered inclusion of FY2023 from the Japanese abundance indices, which had a large impact on the stock status of the most recent years. As a result, the following four scenarios were employed as representative cases:

1) B2, Estimate process error for only age 0 (recruitment);
2) S28-ProcEst, Estimate process error for all age groups;
3) S32-JP23, Estimate process error for only age 0 and use Japanese indices up to FY2023; and
4) S34-ProcEst23, Estimate process error for all age groups and use Japanese indices up to FY2023

TWG CMSA agreed to select S28-ProcEst as a base case scenario because of the better diagnostics than the model only with recruitment process error and agreement of data usage up to FY2022. The other three scenarios were employed to show possible range of uncertainty.

Reference points
Using stock assessment results from the base case scenario, the TWG CMSA calculated commonly used biological reference points such as F%SPR (30%, 40%, 50%, 60% and 70%), F0.1, maximum sustainable yield (MSY)-based reference points, i.e. F_{MSY} and SSB_{MSY}, with mean biological parameters and selectivity of current F (mean F in FY2020 to FY2022). In particular, the biological parameters such as weight-at-age and maturity-at-age used for calculation of biological reference points are assumed as the average values during the most recent 7 years (FY2016 to FY2022), which represents the recent change in biological parameters. As a control, the average of the biological parameters was calculated over the stock assessment period. Reference points for the base case scenario are listed in Table E-1.

Description of specification of future projections
The population dynamics model for stochastic future projections is the same as is used in SAM. The future harvesting scenario was predetermined as a total catch of 50, 100, 150, 200, 300 and 400 thousand tons after FY2023, compared with another future harvesting scenario under Fcur.

Future biological parameters are assumed to equal the average of the recent seven years. Mean biological parameters for the entire model time period (FY1970-FY2022) are used as a control.

Stock status overview
The chub mackerel stock in the NWPO has experienced large changes in biological parameters over the time period of the model. The main temporal changes are a recent decrease in maturity at age, along with a recent decrease in the weight at age, both of which were observed to change over the model time period to cause temporal changes of biological reference points. MSY-based reference points are highly variable over the timeseries of the assessment because the weight- and maturity-at age of chub mackerel has varied widely (Figures E-3 and E-4), which impacts the productivity of the stock. Unfished spawning biomass per recruit (SPR0) represents the theoretical equilibrium productivity per fish assuming no fishing. SPR0 has varied remarkably over time (Figure E-6).

In addition, as there is little recruitment compensation in the stock-recruitment relationship within the range of historically observed SSB and recruitment (Figure E-8), estimates of biomass-based MSY reference points are extreme explorations that are highly sensitive to model configuration.

Because of the above reasons, commonly used reference points such as MSY-related or SPR-related reference points vary over time and are uncertain, and they are potentially misleading with respect to stock status. For example, the MSY-based reference points have varied by the assumption of biological parameters to be used (Table E-1). The exploitation rates corresponding to the MSY was 10% when assuming biological parameters during the whole historical period, but it dropped to 5% when using the most recent 7 years biological parameters.

As such, at this time, the TWG CMSA does not recommend the use of MSY-based reference points for management advice. Instead, the TWG CMSA provides information of current estimates of chub mackerel SSB and F (average FY2020-FY2022) relative to the minimum, 25th, 50th, 75th and maximum value of the SSB and F values over the entire time period (FY1970-FY2022; Table E-2). Values relating to the most recent time period (FY2016-FY2022) are also shown in order to describe the current stock relative to recent conditions.

The abundance estimated by the Japanese egg survey and the CPUEs from the Japanese dipnet and Russian trawl decreased over recent years, showing that they were simultaneously reduced to about half the level of recent years in FY2023. The sensitivity run of the stock assessment model including Japanese CPUE for FY2023 shows substantial decline in biomass and SSB in FY2022 and further in FY2023 and higher fishing mortality in the last few years (Figure E-7).

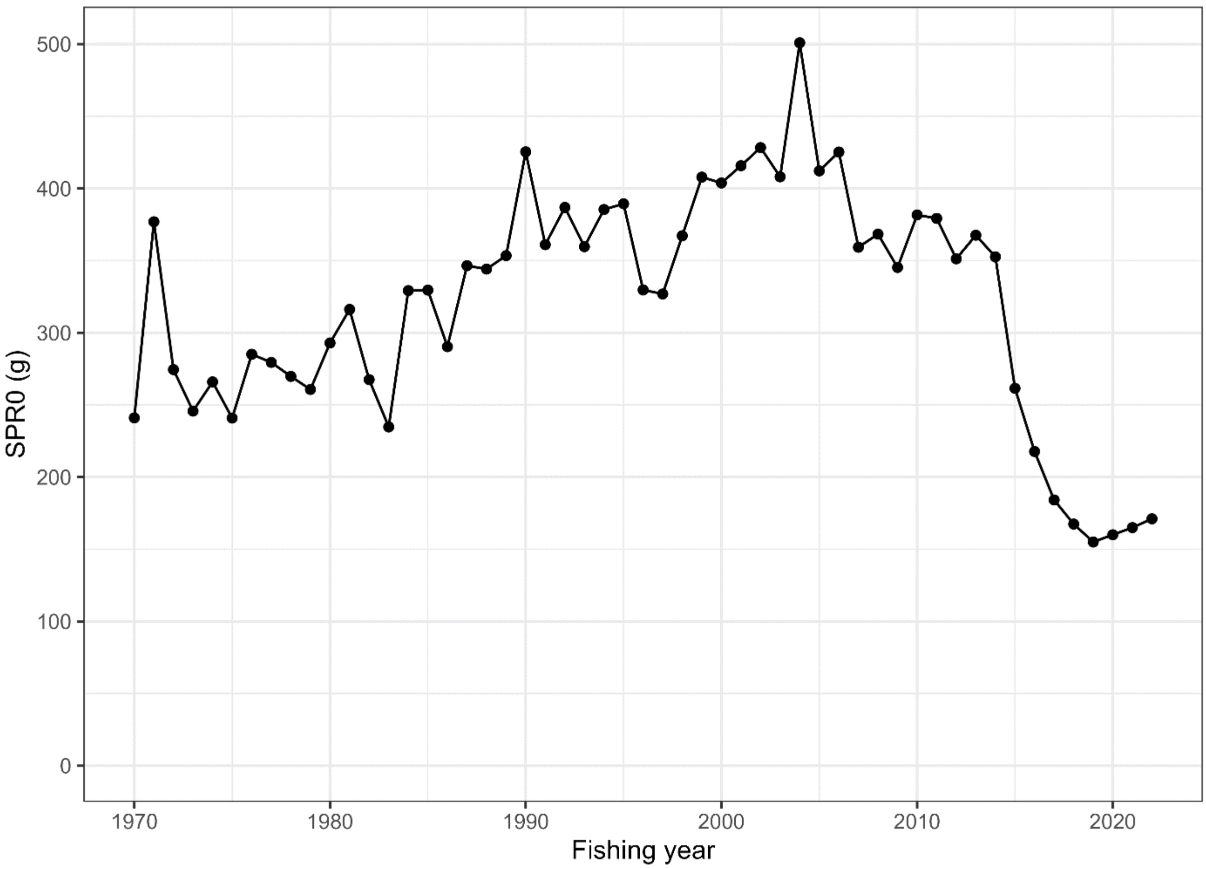

Figure E-6. Trajectories of spawners per recruit without fishing (SPR0).

Table E-1. Reference points for the base case scenario (S28-ProcEst). Reference point values in this table are calculated by holding Fcur the same for all calculations, but by varying the time period (either FY2016-FY2022 or FY1970-FY2022) over which the biological parameters are estimated. Refer to Glossary in the stock assessment report for the definitions.

Biological parameters used	**FY2016-FY2022**	FY1970-FY2022
	S28-ProcEst	S28-ProcEst
current%SPR	**28.3**	40.3
Fmed/Fcur	**0.478**	1.629
F0.1/Fcur	**1.344**	1.344
FpSPR.30.SPR/Fcur	**0.942**	1.498
FpSPR.40.SPR/Fcur	**0.673**	1.010
FpSPR.50.SPR/Fcur	**0.484**	0.696
FpSPR.60.SPR/Fcur	**0.342**	0.475
FpSPR.70.SPR/Fcur	**0.230**	0.311
F_{MSY}/Fcur	**0.258**	0.668
B_{MSY}	**9396.157**	17179.502
SSB_{MSY}	**2904.704**	6084.597
h	**0.358**	0.501
SSB0	**7123.476**	17441.919
SSB_{MSY}/SSB0	**0.408**	0.349
F_{MSY}SPR	**0.673**	0.511
MSY	436.8467	1713.406
MSY/B_{MSY} (exploitation rate at MSY)	0.046	0.10

Table E-2. Stock status summary from the base case scenario.

Stock Status Summary Table	SSB (Thousand MT)	Total Biomass (Thousand MT)	Recruitment (Million Individuals)	F	Exploitation	SPR_0
2022 Estimate	447	2,825	9,839	0.23	0.089	171.1
Current (Average 2020-2022)	526	2,888	11,097	0.28	0.119	165.4

Values relative to the all years of the time series (i.e. 1970-2022)	SSB (Thousand MT)	Total Biomass (Thousand MT)	Recruitment (million individuals)	F	Exploitation	SPR_0
Historical Minimum (Min)	45	172	365	0.23	0.071	155
Historical 25 percentile (25%)	97	634	1,308	0.36	0.136	266
Historical Median (Med)	335	1,566	4,353	0.61	0.185	344
Historical 75 percentile (75%)	744	3,177	9,839	0.71	0.25	379
Historical Maximum (Max)	1,394	6,050	23,579	1.11	0.422	501

Ratios Relative to 1970-2022	Stock Status Related to Biomass			Stock Status Related to Fishing Intensity		
Current /Historical Minimum	11.694	16.81	30.436	1.21	1.674	1.067
Current /25%_Historical	5.418	4.554	8.483	0.79	0.874	0.622
Current /Med_Historical	1.569	1.844	2.55	0.47	0.643	0.481
Current /75%_Historical	0.707	0.909	1.128	0.40	0.475	0.436
Current /Max_Historical	0.377	0.477	0.471	0.25	0.282	0.33

Values relative to 2016-2022	SSB (Thousand MT)	Total Biomass (Thousand MT)	Recruitment (million individuals)	F	Exploitation	SPR_0
Recent Minimum (Min)	447	2,825	6,043	0.23	0.089	155.0
Recent 25th percentile (25%)	486	2,919	10,154	0.26	0.112	162.5
Recent Median (Med)	620	3,018	11,077	0.29	0.123	167.5
Recent75 percentile (75%)	748	3,605	12,622	0.30	0.130	177.6
Recent Maximum (Max)	774	4,108	22,898	0.31	0.143	217.7

Ratios Relative to 2016-2022	Stock Status Related to Biomass			Stock Status Related to Fishing Intensity		
Current / Recent Min	1.18	1.02	1.84	1.21	1.34	1.07
Current /25%_Recent	1.08	0.99	1.09	1.10	1.06	1.02
Current /Med_Recent	0.85	0.96	1.00	0.98	0.97	0.99
Current /75%_Recent	0.70	0.80	0.88	0.94	0.91	0.93
Current /Max_Recent	0.68	0.70	0.48	0.92	0.83	0.76

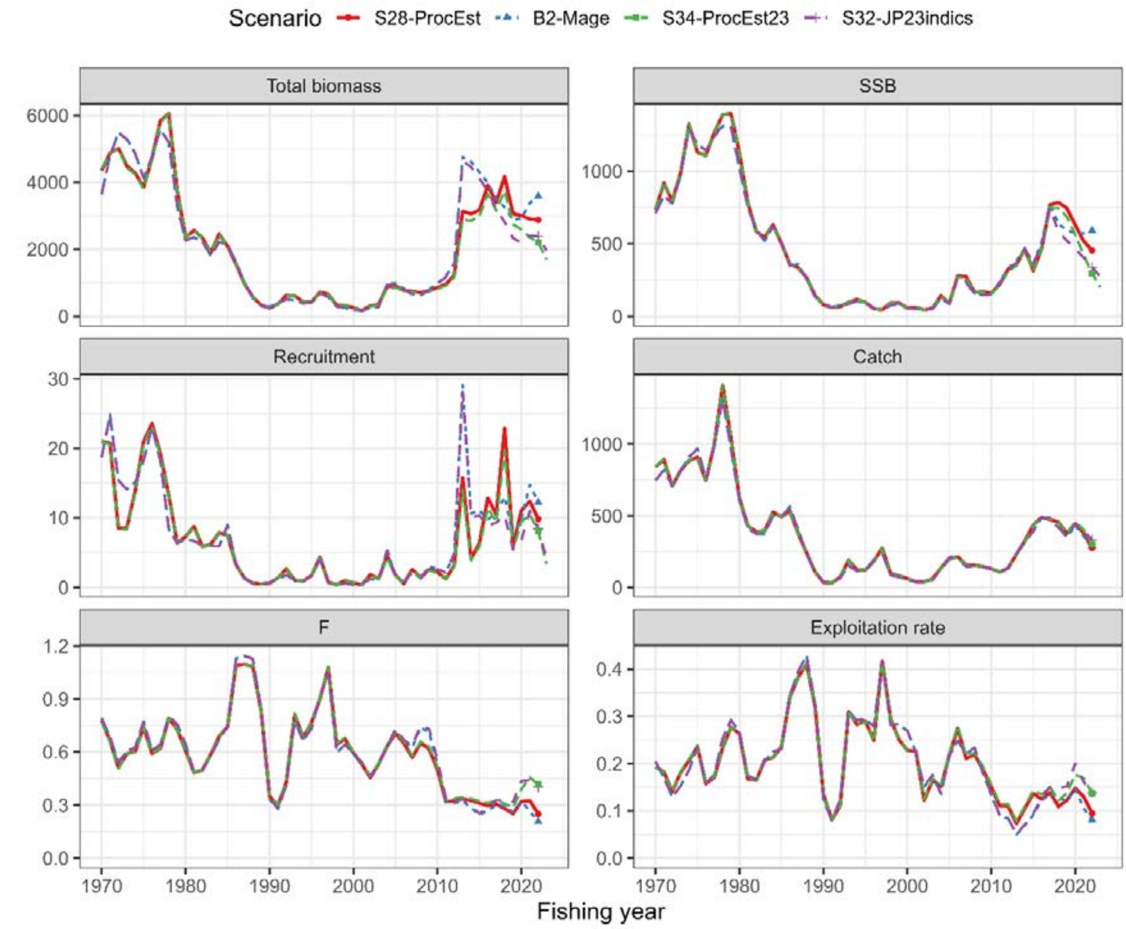

Figure E-7. Time series of estimates of total biomass (thousand mt), SSB (thousand mt), recruitment (billion fish), catch (thousand mt), mean fishing mortality (F) and exploitation rate (catch divided by total biomass) under the four representative scenarios. S28-ProcEst was selected as the base case scenario.

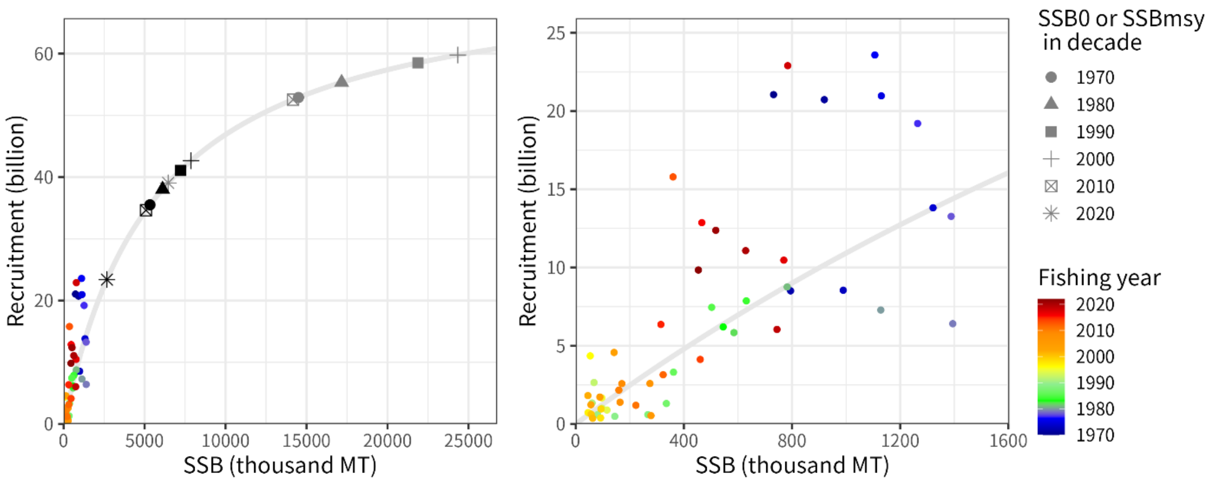

Figure E-8. Estimated stock-recruitment curve (gray lines) and estimated SSB and number of recruits (colored circles). Although both figures are same, in the left figure, estimated SSB0 (equilibrium spawning biomass without fishing, gray symbols) and SSB_{MSY} (black symbols) by decade are overlapped. The reference points are calculated using biological parameters averaged during the decades. The right panel also shows estimated recruitment and SSB by year along with the estimated stock recruitment curve.

Total biomass, Spawning Stock Biomass

The time series of estimated chub mackerel total biomass and SSB from the base case model used to inform managers generally declined from the 1970s through the 1990s and the stock began to recover in the early 2000s, peaking in FY2018, after which it has generally declined over the last decade (total biomass and SSB are shown in Figure E-7 and Table E-2). The level of SSB in the 1970s was estimated to be approximately 1,104 thousand mt on average. SSB for FY2022 is estimated to be 450 thousand mt for the base case but varies from 300 thousand to 590 thousand mt among the sensitivity cases.

Recruitment

Time series of estimated recruitment (age-0, billions of fish) abundance is presented in Figure E-7 and summary values in Table E-2 for the base model. The level of recruitment in the 1970s was estimated to be high (~16 billion individuals on average) and that in the most recent decade (FY2013-FY2022) was also high (=11 billion on average).

Stock-recruitment relationship

Although the estimated stock recruitment relationship has not changed over time, the estimated average by decade of the SSB0 (equilibrium spawning biomass without fishing, blue symbols) and SSB_{MSY} (red symbols) are varied and decreased to the lowest points of the time series owing to the changes of biological parameters (Figure E-8).

Exploitation status

Estimated rates of exploitation (fishing year catch/fishing year total biomass) time series generally fluctuated between 5 and 20% and followed the estimated Fs over time, with annual removal rates that ranged from roughly 10 to 30% over the modeled timeframe (Figure E-7), with some larger annual removals in excess of 40%.

Harvest Recommendations

Given the uncertainty in biological parameters in future, which have a large impact on the projection results, the TWG CMSA considers it is not appropriate to provide long-term harvesting recommendations at this time. A short-term (towards FY2028) projection was undertaken to assess the effects of varying catch levels, ranging from 50 to 400 thousand tons, based on the most recent seven years' biological data (Figure E-9) and the entire time series of biological data (Figure E-10) for management considerations. Projections based on the most recent seven years' biological data showed that Fcur leads to future constant decline of SSB and it is necessary to reduce current fishing mortality (Table E-3).

Data and Research needs

The assessment results, including projections, are dependent on biological parameters and processes which are uncertain. Therefore, future studies should be focused on collecting and analyzing biological information, e.g., maturity-at-age, weight-at-age, which would improve the assessment. Fisheries-dependent data, such as fleet-specific catch-at-age, are also critical to develop Member-specific fishing fleet and age-specific abundance indices.

A critically important recommendation that should be carried out in 2-3 years is to develop a harvest control rule (HCR) specific to this stock via a Management Strategy Evaluation (MSE) process. This HCR should be dynamic and able to adjust annual total catches depending on the stock abundance as well as the target and limit reference points. During the process of the development of MSE, uncertainties in parameter estimates, time-varying or density-dependent biological parameters, and stock-recruitment assumptions should be considered.

Timely collection of biological information and further research on biological parameters and processes, including the effect of environment and climate change, are critically important to facilitate the accurate estimation of reference points.

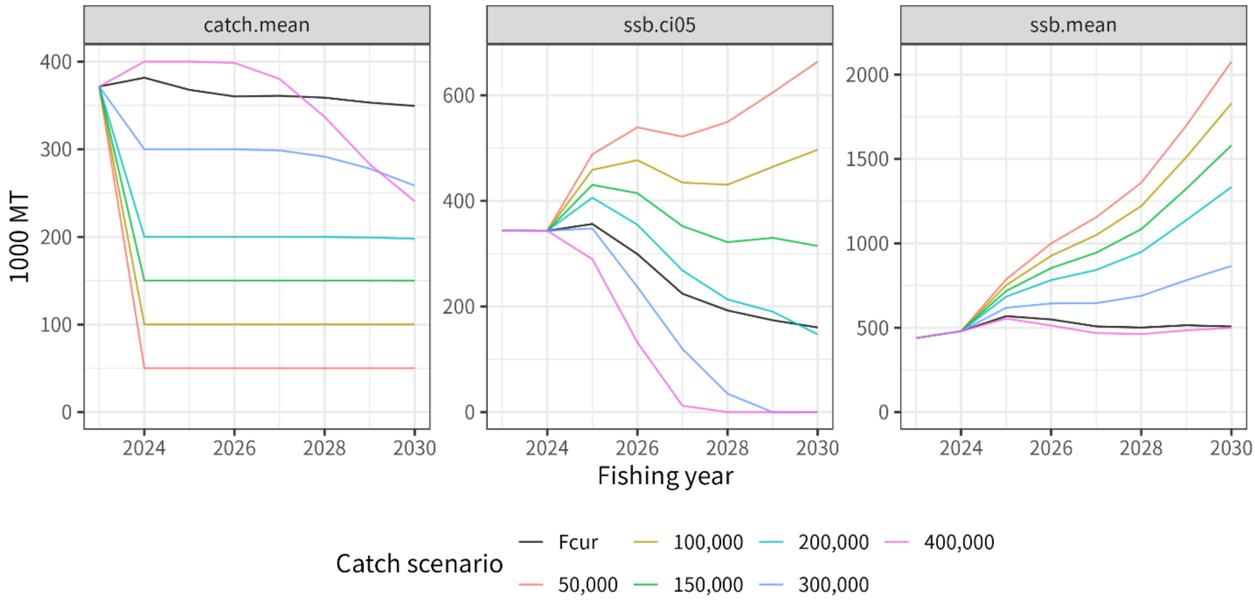

Figure E-9. Future trajectories of mean catch (left), 5% lower limit of predictive interval for SSB (middle) and mean SSB (right) with mean biological parameters in recent 7 years. Numbers and "Fcur" in "Catch scenarios" indicate total amount of catches (mt) in constant catch scenario and current fishing morality, respectively.

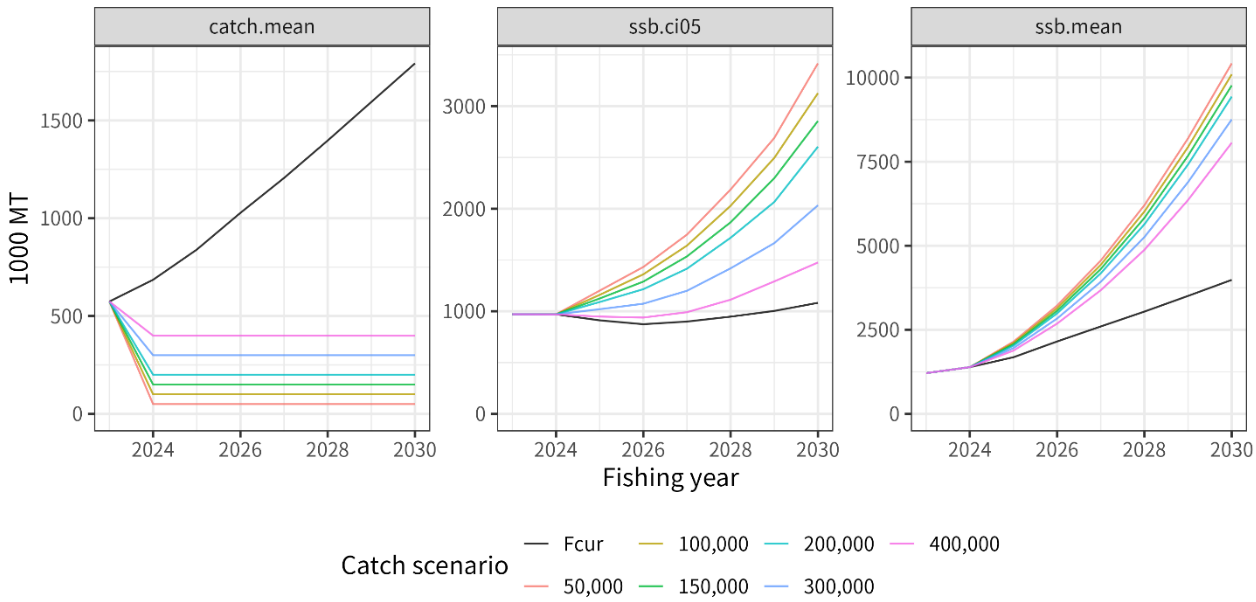

Figure E-10. Future trajectories of mean catch (left), 5% lower limit of predictive interval for SSB (middle) and mean SSB (right) with mean biological parameters for the entire time series. Numbers and "Fcur" in "Catch scenarios" indicate total amount of catches (mt) in constant catch scenario and current fishing morality, respectively.

Table E-3. Probability that future SSB on July 1, at the beginning of the fishing year, is above latest (FY2022) SSB under the base case scenario. The projection towards FY2028 is shown below.

Catch level	FY2025	FY2026	FY2027	FY2028
Fcur	76	64	48	44
50	97	99	98	98
100	96	96	94	94
150	93	92	88	88
200	89	87	80	78
300	79	70	58	56
400	66	49	38	36

INTRODUCTION

1.1 Distribution and population structure

Chub mackerel (*Scomber japonicus*) is widely distributed throughout in the northwest Pacific, including in the waters of Japan, Korea, China, and Russia. The species exhibits highly migratory behavior, with distinct spawning, feeding, and wintering grounds. Spawning occurs primarily from spring to early summer in the subtropical waters, and the larvae and juveniles are often carried by ocean currents to feeding grounds further north. This migration pattern leads to a dynamic population structure that varies seasonally and spatially, reflecting the species' adaptation to environmental conditions.

In the northwest Pacific, two stocks of chub mackerel are recognized. Although there are no clear genetic differences between the two stocks, they are treated as different stocks due to their biological differences, distribution and spawning grounds. The first is the Tsushima Warm Current stock, which is distributed in the East China Sea and the Sea of Japan, and the latter is the Pacific stock, which can be defined as a straddling stock and is harvested in both national waters of Japan and Russia and the NPFC Convention Area. The Pacific stock, hereafter called chub mackerel in this report, is distributed from the coast of southern Japan to offshore waters of Kuril Islands (Figure 1). It is considered that both adults and juveniles are distributed as far east as 170°E longitude in periods of high abundance. During the low abundance period of 1990s-2000s, juvenile distributes from Japan to around 170°E, but adults were only found to 150°E due to the possible contraction of the feeding ground. The feeding migration of adult extends northeast, with the recent (since 2010) increase of stock abundance, the distribution of adult during the summer to fall season has expanded to 47° N, 166° E, east offshore of Kuril Island, after 2018. Adult fish spawn in Izu Islands waters in spring and then engage northward feeding migration to waters of Sanriku to east Hokkaido from summer to autumn.

1.2 Migration

Adult move to north (March to June) after spawning at Izu Islands area, which is the main spawning ground, and migrate to offshore area of Northeast of Japan (Sanriku and Hokkaido) from summer to fall for feeding (Meguro et al., 2002) (Figures 1 and 2). Larvae distribute broadly from the Pacific side of southern Japan to Kuroshio extension and Kuroshio-Oyashio transition area in spring. Larvae occurred at Kuroshio-Oyashio transition area and move to offshore of Kuril Island in summer and subadults migrate down south in fall to offshore of Chiba and Ibaraki prefecture for wintering (Kawasaki, 1968; Iizuka, 1974; Nishida et al., 2001; Kawasaki et al., 2006). Portion of adult and subadult migrate to Kii strait, Bungo strait and Seto inland sea, while the main spawning adults migrate to waters around Izu Islands area. Because of the occurrence of larvae originated upstream of Kuroshio current at the spawning ground of Izu Islands (Koizumi, 1992), spawning ground extended from offshore of southern Japan to northern Japan (Kuroda, 1992).

1.3 Reproduction

Chub mackerel mature at about age 2 or 3 and all fish at age 4 and above are supposed to be fully matured (Watanabe and Yatsu, 2006). One functional matured female produces 30–90 thousand eggs several times during a spawning season (Murayama et al., 1995; Watanabe et al., 1999; Yamada et al., 1999). The main spawning grounds are in the Japanese Exclusive Economic Zone (EEZ), in waters around the Izu Islands but also in areas off the Pacific coast of southern Japan, including the Kinan area, Cape Muroto and Cape Ashizuri (Figure 1). The waters around the Izu Islands are considered the main spawning ground (Watanabe, 1970; Usami, 1973). Although spawning occurs from offshore of southern Japan to northern Japan (Kuroda, 1992) and it has also been observed in the Tohoku waters (Kanamori et al., 1999).

The spawning season for chub mackerel is from January to June. In the main spawning ground of Izu Islands, spawning occurs in March and April, which historically are the peak spawning months. In the 2000s, the peak spawning timing has shifted to May and June because of the high fraction of younger adults, which tend to spawn eggs at later season (Watanabe, 2010). Additionally, the spawning ground is reported to exhibit northward shifting with extended spawning period associated with climate change (Kanamori et al., 2019).

The growth of chub mackerel is density dependent, and changes according to the recent recruitment and ocean environment (Watanabe and Yatsu, 2006). Maturity at age has changed depending on changes in growth (Watanabe and Yatsu, 2006). The maturity at age for chub mackerel has changed over time, for example the maturity rate of age 3 fish has decreased from 100% to 30% since 2015 (Figure 5).

1.4 Prey and predators

Larvae feed on the eggs of copepods and nauplii, whereas juvenile prey on small zooplankton such as small copepods, noctilucines, cercariae, and salpae (Kato and Watanabe, 2002). The feeding behaviors of immature and adult fish differ depending on the waters and lifecycle, but they mainly prey on other fishes (e.g., anchovies and lantern fish), crustaceans (e.g., krill and copepods) and salpae. In the Sanriku waters, the main prey are mysid shrimp and anchovies.

Before the 1980s, when stock abundances were high, chub mackerel were often observed to be eaten by large fishes such as the mackerel shark, blue shark, pomfret, albacore, and skipjack tuna (Kawasaki, 1965; Nagasawa, 1999), as well as the minke whale (Kasamatsu and Tanaka, 1992). In the 1990s, the lower abundance period, predation of minke whales was not reported (Tamura et al., 1998). From the research report of baleen whale predations, composition of anchovy decreased in the stomach contents after 2012, but mackerels and sardine increased. Especially in the case of sei whale, the main prey item shifted from anchovy in early 2000s to mackerel and sardine in late 2000s and after 2010 (Tamura et al., 2016; Konishi et al., 2016). When the abundance of mackerels is high, they appear to be main prey items for whales.

1.5 Age and growth

Longevity of chub mackerel is estimated to be approximately 8 years, based on age determination of sampled catch, and maximum age was recorded at 11year-old (Iizuka, 2002). Fish at age 6 and above are very rare in the catches in recent years. There is no significant difference in growth between sex. Growth of chub mackerel is density dependent, and the parameters of growth function are variable among the year classes. According to Kamimura et al. (2021), the asymptotic body length *Linf* and growth coefficient *k* of von Bertalanffy growth function varied between 339.9 to 440.5 mm and 0.25 to 0.55 (/year), respectively, for each year class of 2006-2016.

Average size (fork length) and weight of catch in 2018 are shown in Figure 3, with comparison of those at 2011-2014 which did not show any slow growth. Average weight of 2018 was low comparing with those of 2011-2014 and 1970s, especially for age 5 (extremely high recruitment in the 2013 year class). It is considered that density dependence may be the cause for this change. (Kamimura et al., 2021). However, slower growth has been observed at periods of high abundance, this may be due to poor environmental conditions (i.e. lower temperatures due to range expansion), or feeding competition with Japanese sardine, or other factors (Kamimura et al., 2021).

FISHERIES AND SCIENTIFIC SURVEYS

2.1 Overview of fisheries

Chub mackerel are harvested by China, Japan and Russia (Figure 4). Chinese light purse seine and pelagic trawl fisheries are operated in the NPFC Convention Area. Japanese chub mackerel fisheries consist mainly of purse seine and set net fisheries within the Japanese national waters. Russian chub mackerel fisheries mainly operate in the Russian national waters, consist of mid-water trawl, purse seine and bottom trawl gears with operations in the Japanese national waters. The historical total landings have largely fluctuated. In last decade, the total catch was stable at higher level and subsequently decreased from approximately 498 thousand mt in 2021 to 151 thousand mt in the most recent calendar year (CY) 2023. The Conservation and Management Measure for chub mackerel (CMM 2024-07) includes a catch limit of 100,000 mt set in the Convention Area for each of the 2024 and 2025 fishing seasons (1 June to 31 May).

China harvests this species dominantly by light purse seine fishery in the NPFC Convention Area. A smaller component of the catch is taken by pelagic trawl. Chinese catch statistics on mackerels in the NPFC Convention Area are available from 2015. The Chinese mackerel fisheries in the NPFC Convention Area initiated in 2014 mainly caught the three fish species such as chub mackerel, blue mackerel, and Japanese sardine (Zhang et al., 2023). The fishing seasons of Chinese fleet is from April to December.

The major Japanese fisheries for chub mackerel are purse seine, set net and dip-net fishing, and stick-held dip-net fishing. Large-scale purse seiners, accounting for more than 50% of total catch in Japan, operate all the year over during the main fishing season from September to February in the offshore waters off Joban and Sanriku coasts on the Pacific side of Japanese main island. Small-scale purse seiners operate year-round in the coastal waters south of Chiba Prefecture. Set net fisheries are deployed extensively along the Japanese coast and yield a large catch from Sanriku coast. Dip-net and stick-held dip-net fisheries which target adult fish in spawning season (age 2 to 4 fish) are mainly operated from January to June in the Izu Islands waters. Chub mackerel is also caught by angling all over Japan.

Russian fisheries targeting mackerel species and sardine operate in the NW area of the NPFC Convention area and operate both purse seine vessels and pelagic trawl vessels. Russian fisheries first exploited mackerel in the Far East in the early 1960s and harvested it until the late 1980s, when its stocks in areas accessible to the domestic fleet were completely depleted (Baryshko, 2009). Out of 26 years of mackerel fishery for 13 years more than 50 thousand tonnes per year was harvested, including 9 years when the catch was more than 100 thousand mt. Commercial fishing of mackerel in the North-West Pacific Ocean by vessels under the Russian (Soviet) flag began in 1968. Since the second half of the 1980s, due to a sharp decline in mackerel abundance, its commercial fishing for mackerel in the Russian EEZ has been rare. Until recently, there has been no target fishing for mackerel by Russia in the Northwest Pacific. Russian fisheries resumed fishing in 2015. In 2021, the chub mackerel catch by the Russian fleet totaled to 87 thousand mt.

2.2 Overview of scientific surveys

China has been conducting a scientific survey program using its fishery research vessel "Song Hang" in the NPFC convention area since 2021 (Ma et al., 2023). The survey is conducted during June-August, with methods of mid-trawling, acoustic and squid jigging, covering about 70 stations per year. The results indicated that Chub mackerel is one of the dominant species in the four years survey.

In Japan, monthly egg surveys have been intensively conducted off the Pacific coast of Japan in the western North Pacific since 1978 by a historical cooperative system among many national and regional fisheries research bodies (Nishijima et al., 2024a). The survey protocol can be found at Oozeki et al. (2007). The objective of this egg survey is to monitor egg abundance of major small pelagic fish species such as Japanese sardine, Japanese anchovy, chub mackerel, etc. The survey area roughly covered the major spawning grounds of small pelagic fish off the Pacific coast, mainly inshore waters but also offshore waters related to the warm Kuroshio and cold Oyashio currents. In addition, Japan has conducted the surface trawl net surveys in summer (June to July) and autumn (September to October) to monitor abundance of ages 0 and 1 (Nishijima et al., 2024b; 2024c; Yukami et al., 2024). The summer survey has been initiated in 2001 and annually carried out, covering the waters approximately from 141.5º E to 170.0º W and from 32.0º to 45.0º N. It provides information on abundance of age 0 fish. The autumn survey was started in 2005 and has been conducted annually, covering the area approximately of 141.5º–175º E and 37.0º–50.0º N. This survey provides abundance information on ages 0 and 1.

Russia has conducted a summertime acoustic-trawl survey since 2010 that examines mid-water and upper epipelagic species including chub mackerel. This survey completes 60-80 stations per year and aims to assess changes in abundance and migration patterns. Data collected include catch and effort, catch at length, and data for ageing.

DATA

3.1 Data preparation for stock assessment model

The Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA) agreed to apply a State-space Stock Assessment Model (SAM; Nielsen and Berg, 2014) for its stock assessment (TWG CMSA, 2023). It requires age-specific input data such as catch-at-age, maturity-at-age and weigh-at-age and abundance indices. A fishing year (FY) starting from July and ending in June of the following year was applied in the stock assessment of chub mackerel. The TWG CMSA agreed for the stock assessment period to be FY1970 (CY1970/quarter 3 (Q3)) to FY2022 (CY2023/Q2). Seven age groups of ages 0 to 5 and 6+ were defined in the stock assessment. The Members submitted their data on quarter basis and then, they were compiled for construction the input data based on the fishing year. Manabe et al., (2024a; 2024b) comprehended the age-specific input data.

China has collected length frequency data of commercial catch through onboard and port samplings since CY2016, and aging of the samples has been started since CY2017. Japan also collects length, weight, maturity and age data from the survey and fishery to support their stock assessment. Russian length frequency and aging data of commercial catch are available since CY2016. The length frequency data obtained through research surveys are available since CY2010.

3.2 Catch-at-age

The catch-at-age is prepared for each Member on quarterly-basis for China and Russia. Japanese catch-at-age is prepared for Eastern Japan and Western Japan due to its difference in catch, size, and season in which the border of two regions is located at Mie-Shizuoka prefectural border.
The Members provided their quarterly catch-at-length data on calendar year basis as follows:

1) China, CY2016 to CY2022/Q2 ;

2) Eastern and Western Japan, CY2014 to CY2023/Q2;
3) Russia, CY2016 to CY2022.

The Members provided their quarterly age-length key (ALK) on calendar year basis as follows:

1) China, CY2018 to CY2022;
2) Eastern and Western Japan, CY2014 to CY2023/Q2.

For the catch-at-age prior to CY2014, Japan provided fishing year-based catch-at-age data for FY1970-FY2013 from the Japanese domestic stock assessment (Yukami et al. 2024). The data contains Russian catch in FY1967-1988 however due to the difficulty of separation into two Members, the catch is incorporated as Japanese catch. For the period of CY2014-2023/Q2, the TWG CMSA has agreed to calculate catch-at-age based on the catch-at-length data and corresponding ALK data of each quarter and region, which the detailed procedures are described in Manabe et al. (2024b). The ALK of Russia is substituted by the Eastern Japanese ALK due to the similarity in the area of catch.

For the period with missing catch-at-length, the procedures to supplement the data are as follows:

1) For China CY2015, use mean catch-at-length of China of CY2016-2018 for equivalent quarter;
2) For Russia CY2014-2015, use mean catch-at-length of Russia of CY2016-2018 for equivalent quarter;
3) For Russia CY2022-2023/Q2, use Eastern Japanese catch-at-length of the equivalent quarter/year.

For the period with missing ALK, Eastern Japanese ALK of the equivalent quarter/year is applied to calculate catch-at-length. The calculated catch-at-length from each quarter is converted to fishing year basis by setting the data of age incrementation as July 1st. Ages are subtracted by 1 for the first and second quarters and early caught age 0 fish in those quarters, which are calculated as age -1, are incorporated into the third quarter as age 0. The detailed procedures are described in Manabe et al. (2024b).

Through the procedures described above, catch-at-age data had been prepared for the stock assessment (Figure 5a). Chub mackerel catch was historically composed mainly of fish younger than age 3. In the periods of FY1970s, FY1980s and late-FY2010s to beginning of FY2020s, the catch of fish older than age 3 was prominent. There were differences in age compositions in catch by year and by member from FY2014 to FY2022 (Figure 6). Catches of ages 1 to 3 were prominent in FY2014 to FY2016, respectively. In addition, dominant age classes of catch were different among China and Japan.

3.3 Weight-at-age

The Members provided their quarterly weight-at-age data on calendar year basis as follows:

1) China, CY2018 to CY2023/Q2;

2) Eastern and Western Japan, CY2014 to CY2023/Q2;
3) Russia, CY2016 to CY2022.

The TWG CMSA has agreed to calculate a single weight value for each age to convert stock number into biomass (NPFC, 2024). The single weight-at-age were calculated through the following procedure, as described in Manabe et al. (2024b). The proportion of catch number for each quarter is calculated for four regions: China, Eastern Japan, Western Japan, and Russia, using the following equation, where P is proportion of catch number, $N_{a,t,r}$ represents the catch number of age a at year t, and region r.

$$P_{a,t,r} = \frac{N_{a,t,r}}{\sum N_{a,t,r}}$$

The yearly catch number ratio for each region is then averaged between FY2014-2022 to calculate the constant ratio of catch number across the members.

$$P_{a,r} = \frac{\sum_{t=2014}^{2022} P_{a,t,r}}{9}$$

The weighted mean of weight W at age a at quarter q of year t is then calculated as:

$$W_{a,q,t} = \frac{P_{china} W_{a,q,t,china} + P_{japan} W_{a,q,t,japan} + P_{russia} W_{a,q,t,russia}}{3}$$

The quarterly weight-at-age within a single fishing year is taken an arithmetic mean to calculate the annual weight-at-age, which is used for the stock assessment.

$$W_{a,t} = \frac{\sum W_{a,q,t}}{4}$$

Through this procedure, annual weight-at-age were calculated for FY2014 to FY2022 (Figure 5b). Since the weight-at-age prior to FY2014 was not reported by other members, the weight-at-age of CM in FY1970 to FY2013 was sourced from the Japanese domestic stock assessment of the Pacific stock of chub mackerel. Historical weight-at-age showed time-varying attributes and decreased obviously in last decade in age groups older than age 0.

3.4 Maturity-at-age

The TWG CMSA has agreed to use the annual maturity-at-age data from Japanese domestic stock assessment (NPFC, 2024) (Figure 5c). The Japanese maturity-at-age data is derived from the observation of catch from the spawning area, and based on previous studies (Watanabe and Yatsu, 2006; Watanabe, 2010). Chinese maturity-at-age data submitted on a quarterly basis were not included in the base-case maturity-at-age however the alternative maturity-at-age data are prepared for the sensitivity analysis, which the data preparation and data are described in NPFC-2024-TWG CMSA9-WP02.

Annual maturity-at-age used for base case showed decadal time-varying changes from FY1970 to FY2022 (Figure 5c). The maturity rate of age 2 and 3 fish is expected to be lower after FY2015 than in the period before FY2014, due to the slow growth of the 2013-year class. In the recent years, maturity rate of age 2 is zero, and that of age 3 is 0.3 in the Japanese national waters.

3.5 Natural mortality

Initially the assessment investigated set two cases of natural mortality (TWG CMSA, 2024). One is M = 0.5 for all age classes while the other is age-specific M (0.80 for age 0, 0.60 for age 1, 0.51 for age 2, 0.46 for age 3,0.43 for age 4, 0.41 for age 5, and 0.40 for age 6+) (Figure 7). These natural mortality coefficients have been determined according to different natural mortality estimators with biological parameters from various samples (Ma et al., 2024; Nishijima et al., 2021). It is assumed that the natural mortalities are time-invariant throughout all years. The TWG CMSA agreed to use the age specific natural mortality estimates for all models at its 9th meeting.

3.6 Abundance indices

The inventory of abundance indices time series shown in Figure 6d was as follows.

1) Relative number of age 0 fish from the summer survey by Japan from FY2002 to FY2023 (Nishijima et al., 2024a (NPFC-2024-TWG CMSA08-WP06 (Rev. 1)))
2) Relative number of age 0 fish from the autumn survey by Japan from FY2005 to FY 2023 (Nishijima et al., 2024c (NPFC-2024-TWG CMSA09-WP06))
3) Relative number of age 1 fish from the autumn survey by Japan from FY2005 to FY 2023 (Nishijima et al., 2024c (NPFC-2024-TWG CMSA09-WP06))
4) Relative spawning stock biomass (SSB) from the egg survey by Japan from FY2005 to FY2023 (Ishida et al., 2024 (NPFC-2024-TWG CMSA09-WP07))
5) Relative SSB from the dip-net fishery by Japan from FY2003 to FY2023 (Nishijima et al. 2024b (NPFC-2024-TWG CMSA08-WP03))
6) Relative vulnerable stock biomass from the light purse seine fishery by China from FY2014 to FY2022 (Shi et al., 2024 (NPFC-2024-TWG CMSA09-WP13 (Rev. 1)))
7) Relative vulnerable stock biomass from the trawl fishery by Russia from FY2016 to FY2023 (Chernienko and Chernienko, 2024 (NPFC-2024-TWG CMSA09-WP11))

Six time series except for the Russian abundance indices were used during model development and applied for the base case. The Russian ones were used for a sensitivity run. The abundance indices from Japan and Russia were available until FY2023 and until FY2022 for China. The FY2023 Japanese abundance indices were applied in two of the representative runs.

SPECIFICATION OF STOCK ASSESSMENT

4.1 State-space Stock Assessment Model (SAM)

SAM is a statistical catch-at-age model that accounts for observation errors in catch at age, which was originally developed by Nielsen and Berg (2014). Furthermore, in order to match the nature of data of this stock, improvements have been made to allow more flexible settings (Nishijima and

Ichinokawa, 2023), and this assessment used the modified version. The detailed settings are described as follows. SAM consists of two subparts: population dynamics model and observation model.

4.1.1 Population dynamics model

The population dynamics of chub mackerel in SAM basically follows an age-structured model:

$$\log(N_{0,y}) = \log[f(SSB_y)] + \eta_{0,y}, \qquad a = 0 \qquad (1)$$

$$\log(N_{a,y}) = \log(N_{a-1,y-1}) - F_{a-1,y-1} - M_{a-1,y-1} + \eta_{a,y}, \qquad 1 \le a \le 5 \qquad (2)$$

$$\log(N_{6+,y}) = \log\left(N_{5,y-1}e^{-F_{5,y-1}-M_{5,y-1}} + N_{6+,y-1}e^{-F_{6+,y-1}-M_{6+,y-1}}\right) + \eta_{6+,y}, \qquad a = 6+ \qquad (3)$$

where $\eta_{a,y}$ is the process error at age a in year y following $\eta_{a,y} \sim N(0, \omega_a^2)$. The recruitment of chub mackerel occurs at age 0, described by a function of SSB and process errors (Eqn. 1). We use a Beverton-Holt stock-recruitment relationship (Beverton and Holt, 1957):

$$f(SSB_y) = \frac{\alpha \times SSB_y}{1 + \beta \times SSB_y}, \qquad (4)$$

where SSB_y is the sum-product of number (N), weight (w), and maturity (g) at age:

$$SSB_y = \sum_{a=0}^{6+} g_{a,y} w_{a,y} N_{a,y}. \qquad (5)$$

For fish older than age 0, the number of each cohort decreases by fishing mortality coefficient ($F_{a,y}$) and natural mortality coefficient ($M_{a,y}$) from the previous year and also be affected by process errors $\eta_{a,y}$ (Eqn. 2). For the plus-age group (6+), the number is described as the sum of surviving numbers of age 5 and age 6+ from the previous year (Eqn. 3).

In SAM, fishing mortality coefficients are assumed to follow a multivariate random walk:

$$\log(\boldsymbol{F_y}) = \log(\boldsymbol{F_{y-1}}) + \boldsymbol{\xi}_y, \qquad (6)$$

where $\boldsymbol{F_y} = (F_{1,y}, \dots, F_{A+,y})^T$, $\boldsymbol{\xi_y} \sim \mathrm{MVN}(0, \boldsymbol{\Sigma})$, and $\boldsymbol{\Sigma}$ is the variance-covariance matrix of multivariate normal distribution (MVN). The diagonal elements of matrix $\boldsymbol{\Sigma}$ were σ_a^2, while off-diagonal elements represent covariance of F process errors between age classes. This assumption of F random walk allows us to estimate time-varying selectivity (Nielsen and Berg 2014). For the covariance of MVN, we assume that the correlation coefficient of F between ages a and a' decreases along with their age differences: $\rho^{|a-a'|}\sigma_a\sigma_{a'}$ ($a \neq a'$).

4.1.2 Observation model

SAM is fitted to the data of catch-at-age and abundance indices. SAM uses the Baranov equation for estimates in catch-at-age:

$$\hat{C}_{a,y} = \frac{F_{a,y}}{F_{a,y} + M_{a,y}} \left(1 - \exp\left(-F_{a,y} - M_{a,y}\right)\right) N_{a,y} \, . \qquad (7)$$

In this equation, $F_{a,y}$ and $\underline{N_{a,y}}$ are estimated parameters by random effects, while $\underline{M_{a,y}}$ is the natural mortality coefficient. That is, the predicted catch at age in number ($\hat{C}_{a,y}$) is a derived parameter. SAM then fit to observed catch-at-age in a lognormal assumption:

$$\log\left(C_{a,y}\right) = \log\left(\hat{C}_{a,y}\right) + \varepsilon_{a,y} \, , \qquad (8)$$

where $\varepsilon_{a,y} \sim \mathrm{N}(0, \tau_a^2)$.

We have agreed to use six abundance indices (Figure 5d) which represent, respectively,

1. Relative number of age 0 fish from the summer survey by Japan,
2. Relative number of age 0 fish from the autumn survey by Japan,
3. Relative number of age 1 fish from the autumn survey by Japan,
4. Relative spawning stock biomass (SSB) from the egg survey by Japan,
5. Relative SSB from the dip-net fishery by Japan, and
6. Relative vulnerable stock biomass to Chinese fleet from the light purse-seine fishery by China.

The predicted values of these abundance indices can be expressed in the following general equation:

$$\hat{I}_{k,y} = q_k \left[\sum_{a=0}^{6+} \left(\chi_{a,y,k} N_{a,y}\right)\right]^{b_k} . \qquad (9)$$

The subscripts *k*, *y*, *a* represent index, year, and age, respectively. q_k and b_k are the proportionality constant and the nonlinear coefficient, respectively, for index *k*. Note that this equation does not mean that all the abundance indices are all nonlinear against abundance but includes a linear case (b_k =1). The parameter $\chi_{a,y,k}$ is a multiplier on the number of fish in age a and year y ($N_{a,y}$) for index *k*. For the abundance indices for age 0 fish number (*k*=1,2),

$$\chi_{a,y,k} = \begin{cases} 1, & a = 0 \\ 0, & \text{otherwise} \end{cases} . \qquad (10)$$

For the abundance index for age 1 fish number (*k*=3),

$$\chi_{a,y,k} = \begin{cases} 1, & a = 1 \\ 0, & \text{otherwise} \end{cases} . \qquad (11)$$

For the abundance indices for SSB (*k*=4,5),

$$\chi_{a,y,k} = g_{a,y} w_{a,y} \, . \qquad (12)$$

The abundance indices for vulnerable stock biomass to Chinese fleet (*k*=6) would represent a part of the stock for each fleet or each member’s fishery. For the abundance indices for vulnerable stock biomass (*k*=6), therefore,

$$\chi_{a,y,k} = \hat{s}_{a,y,k} w_{a,y,k} , \quad (13)$$

where $\hat{s}_{a,y,k}$ is the estimated fishery selectivity in age *a* and year *y* for index (or fleet) *k*. We cannot estimate fleet-specific *F* in the current setting of SAM or, therefore, derive fleet-specific predicted catch at age (see Eqn. 1). Since the fleet-specific catch-at-age data is available (Figure 5a), however, we can approximate the fleet-specific *F* as follows:

$$F_{a,y,k} \doteqdot \frac{C_{a,y,k}}{\sum_f C_{a,y,f}} F_{a,y} , \quad (14)$$

where $C_{a,y,k}$ are the observed catch number in age *a* and year *y* for fleet *k*. This approximation assumes that the fleet-specific *F* is proportional to fleet-specific "observed" catch at age in number. We then obtain the fleet-specific selectivity:

$$\hat{s}_{a,y,k} = \frac{F_{a,y,k}}{\max[\boldsymbol{F_{y,k}}]} , \quad (15)$$

where $\boldsymbol{F_{y,k}} = (F_{0,y,k}, F_{1,y,k}, \dots, F_{6+,y,k})^{\boldsymbol{T}}$. It is important to note that $\chi_{k,a,y}$ for k=6 include the estimated parameters ($F_{a,y,k}$), whereas $\chi_{k,a,y}$ for k=1-5 are provided from input data. We used the ratios of catch numbers of China to the total catch numbers as input data to fit the CPUE of Chinese light purse seine fishery. In calculating the vulnerable biomass, fleet- and age- specific weight ($w_{a,y,k}$ in Eqn. 12) is needed. However, since there are no agreed data of fleet- and age- specific weights in fishing year by Chinese fishery, we took a simp approach to using the stock weights for biomass calculation: $w_{a,y,k} = w_{a,y}$ (Figure 5b).

The list of fixed-effect and random-effect parameters is shown in Table 1. The parameters are estimated to maximize the marginal likelihood of summing process-error components and observation error components. The marginal likelihood is computed by the numerical integration using the Laplace approximation via Template Model Builder (TMB: Kristensen et al., 2016). We applied a generic bias-correction estimator for derived quantities calculated as a nonlinear function of random effects (e.g., $N_{a,y}$ is a derived quantity calculated from the random effect of $\log(N_{a,y})$), which is implemented in TMB (Thorson and Kristensen, 2016). Estimation uncertainties including standard errors (SEs) and confidence intervals were computed from the delta method in TMB. In this stock of chub mackerel, the period from July to the following June is treated as a fishing year (Manabe et al., 2024a (NPFC-2024-TWG CMSA08-WP15)), and the estimated abundance is that at the beginning of the fishing year (i.e., July).

4.2 Model settings of process and observation errors and nonlinearity of abundance indices

SAM estimates multiple fixed-effect parameters of process and observation errors (Table 1). Estimating these parameters by age may cause the failure to converge or over-parameterization. Furthermore, CPUE does not always respond linearly to the stock abundance, and the presence of these indices can lead to overestimation or underestimation of resources (Nishijima et al., 2019; Rose and Kulka, 1999). One way to solve this problem is to estimate nonlinearity parameters, which may improve model performance such as the fit to the abundance index and retrospective analysis (Hashimoto et al., 2018). We therefore conduct model selection for process and observation errors and nonlinearity of abundance indices based on AIC (see Nishijima et al. 2024d for details).

The following model settings were chosen for the base case scenario:
(1) all the six abundance indices have difference standard deviations (SDs) for observation errors,
(2) the nonlinear coefficients are estimated for the age-0 index from the Japanese summer survey, the age-0 index from the Japanese autumn survey, and the age-1 index from the Japanese autumn survey, while they are fixed at 1 (i.e., linear) for the other indices,
(3) SDs of catch-at-age observation errors differ for ages 0-1, ages 2-3, ages 4-5, and ages 6+,
(4) SDs of F random walk process errors differ between ages 0-1 and ages 2-6+, and
(5) SDs of N process errors differ for age 0, age 1, ages 2-4, and ages 5-6+.

Regarding N process errors, we set two cases depending on whether the SDs for age 1 and older are fixed at
a very small value (0.01) or estimated. The former case means that process errors occur only for age 0 recruitment (i.e., recruitment variability, while the latter means that the population size in a cohort fluctuates after recruitment by unknown factors other than fishery and pre-determined natural mortality.

4.3 Model diagnostics

For the selected models, we applied several model diagnostics to check the reliability from a statistical view. Firstly, we performed a jitter analysis in which the initial values of the parameters were varied and re-estimated to confirm that the estimated parameters reach the global optimum. We checked whether the final gradients of the fixed effect parameters are close to zero, which is a necessary condition for model convergence.

We then plotted residuals in the catch number by age and in abundance indices to examine whether the residuals have temporal patterns. We also examined residuals in process errors for numbers by age ($\eta_{a,y}$ in Eqns. 1-3) and F by age (diagonal components of $\boldsymbol{\xi}_y$ in Eqn. 6). to show the stock abundance historically changed by these process errors.

A five-year retrospective analysis was performed to examine if the estimates had systematic bias for the removal (updating) of data. Mohn’s rho was calculated for total biomass, SSB, recruitment, and mean F. We also performed a retrospective forecasting, which excludes the stock index values and catch number by age from the latest year and compares the results of a one-year-ahead forecasting from the terminal year of those data (in which age-specific weight and maturity rates were used) with estimates from the model using all data.

The leave-one-out (LOO) index analysis was next conducted by excluding the six abundance indices one by one and comparing the estimates with the results obtained when all indices were used This analysis allows us to examine the impact of each index on abundance estimates and check their robustness.

To evaluate systematic under or over fitting One Step Ahead (OSA, Trijoulet et al., 2023) residuals were used. OSA residuals can assess how well a model fits the data, while not relying on assumptions of normality in the underlying data. These residuals represent the difference between the observed value at a particular time step and the value predicted by the model based on all prior information. OSA residuals were calculated for the indices of abundance and age composition data.

4.4 Agreed base case scenario

In order to improve the SAM fit to abundance indices and retrospective patterns, the TWG CMSA recognized the necessity of introduction of estimation of process error in survival of age groups older than age 0. The TWG CMSA also considered inclusion of FY2023 from the Japanese abundance indices, which had a large impact on the stock status of the most recent years. As a result, the following four scenarios were employed as representative cases:

1) B2, Estimate process error for only age 0 (recruitment) ;
2) S28-ProcEst, Estimate process error for all age groups;
3) S32-JP23, Estimate process error for only age 0 and use Japanese indices up to FY2023; and
4) S34-ProcEst23, Estimate process error for all age groups and use Japanese indices up to FY2023

TWG CMSA agreed to select S28-ProcEst as a base case scenario because of the better diagnostics than the model only with recruitment process error and agreement of data usage up to FY2022. The other three scenarios were employed to show possible range of uncertainty.

4.5 *Setting and equations for future projection and biological reference points*

Projections were carried out using parameter estimates from the models of B2-Mage (B2), S28-ProcEst, S32-JP23, and S34-PRocEst23. The model S28-ProcEst was agreed to be used as the base case, while the settings of the other models are found to be the most other plausible representations of current stock status. Biological parameters such as weight-at-age and maturity-at-age used for calculation of biological reference points are assumed as the average values during the most recent 7 years (FY2016 to FY2022), which represents the recent change in biological parameters. As a control, the average of the biological parameters was calculated over the stock assessment period.

The future harvesting scenario was predetermined as a total catch (CC) of 50, 100, 150, 200, 300 and 400 thousand tons after FY2023, compared with another future harvesting scenario under F_{CUR} (average of F values from FY2020-2022).

4.5.1 Biological reference points and evaluation of spawning potential

We calculated commonly used biological reference points such as F%SPR (20%, 30%, 40%, and 50%), F0.1, Fmsy, and SSB_{MSY} with the biological parameters described above (bio2020 and bio2010) and selectivity of Fcur. As for the F-based reference points, relative values to Fcur are shown in the results (e.g. Fmsy/Fcur). The equations to derive these reference points are described in Annex D in the past report for developing an operating model for this stock (https://www.npfc.int/summary-2nd-meeting-small-working-group-operating-model-chub-mackerel-stock-assessment) and definitions of these performance measures are same as the working paper for the sensitivity analysis (NPFC-2024-TWG CMSA09-WP04).

We also calculated annual spawner per recruit (SPR) with historically changing weight and maturity rate at age of this stock (Figures 5b and 5c) to evaluate the historically changing spawning potential of this species. SPR is the cumulative weight of equilibrium spawning biomass (g) along its life history (growth, maturity, and natural mortality) of a recruit of fish under a certain fishing mortality coefficient of F. Usually, SPR(F) is defined as

$$\mathrm{SPR(F)} = \sum_{a=0}^{\infty} \exp(-M_a - F_a)\, g_a w_a$$

where M_a, g_a and w_a is natural mortality rate, maturity rate, and weight at age a. With this equation, we defined annually changing SPR without fishing as $SPR0_y$ where $F_a = 0, g_a = g_{a,y}$, and $w_a = w_{a,y}$ $(y = \mathrm{FY1970, FY1971, \ldots, FY2022})$. Similarly, we also calculated MSY reference points under the selectivity of Fcur and $SSB0_y$ with biological parameters averaged during each decade (y=FY1970-1979, 1980-1989, etc.…) to evaluate the effect of the changes in biological parameters on MSY reference points.

4.5.2 Equations for calculating and population dynamics in future projection

The population dynamics model for future projections is the same as that used in SAM. The calculation was conducted by an R package named frasyr (https://github.com/ichimomo/frasyr), which has been developed for the stock assessment of Japanese domestic fisheries resources. In particular, we used the functions for future projection and the calculation of biological reference points in frasyr. The general equations of the forward calculation of the population dynamics are

$$N_{a,y}^{i} = \begin{cases} \dfrac{\hat{\alpha} SSB_y^i}{1+\hat{\beta} SSB_y^i} \exp(\eta_{0,y}^i) \quad (a=0) \\ N_{a-1,y-1}^i \exp(-M_{a-1} - F_{a-1,y-1}^i) \exp(\eta_{a,y}^i) \ (0 < a < 6) \\ N_{a-1,y-1}^i \exp(-M_{a-1} - F_{a-1,y-1}^i) \exp(\eta_{a,y}^i) + N_{a,y}^i \exp(-M_a - F_{a,y}^i) \exp(\eta_{a,y}^i) \quad (a = 6+) \end{cases}$$

where $\hat{\alpha}$ and $\hat{\beta}$ are stock recruitment parameters estimated by SAM, $N_{a,y}^i$ is the number of fish in year y and age a at ith iteration, $F_{a,y}^i$ is fishing mortality coefficient in year y and age a at ith iteration, $\eta_{a,y}^i \sim \mathrm{N}(0, \hat{\omega}^2)$ where $\hat{\omega}^2$ is the variance of process error at recruitment estimated by SAM, and SSB_y^i is SSB defined as $\sum_{a=0}^{6} N_{a,y}^i w_{a,y} g_{a,y}$. The equations are generally applied from the end year of the stock assessment period with the initial conditions of $N_{a,2022}^i = \hat{N}_{a,2022}$ in B1 and B2 and $N_{a,2023}^i = \hat{N}_{a,2023}$ in S7 and S8, where $\hat{N}_{a,y}$ is the point estimates by SAM. The fishing mortality in the initial and future years is assumed as $F_{a,2022}^i = \hat{F}_{a,2022}$ ($\hat{F}_{a,y}$ is point estimates by SAM), $F_{a,2023}^i = \text{Fcur}$, and $F_{a,y}$ $(y > \text{FY2023})$ is determined by future harvesting scenarios. The future biological parameters of $w_{a,y}$ and $m_{a,y}$ are given according to the scenarios described above (bio2020 or bio2010) for $y \geq \text{FY2023}$.

The future harvesting scenario was predetermined as a total catch (*CC*) ranging from 50 to 400 thousand tons (along with a CC=0 scenario, Table 5). When catch number at age $C_{a,y}^i$ in year *y* and age a is calculated with the Baranov catch equation as $C_{a,y}^i = \frac{F_{a,y}^i}{F_{a,y}^i + M_a}\left(1 - \exp\left(-F_{a,y}^i - M_a\right)\right) N_{a,y}^i, F_{a,y}^i$ is equal to be $x_y^i \text{Fcur}$ with the same selectivity as Fcur and adjustment factor of x_y^i that is determined to satisfy the equation of $\sum_{a=0}^{6+} w_a C_{a,y}^i = CC$. If we cannot find x_y^i to satisfy the equation because of too small number of fishes, we took the smaller of the two numbers, $x_i = \exp(10)$ or fishing mortality corresponding to 99% of total catches when $x_i = \exp(100)$. The stochastic simulations were conducted 5,000 times for each model and scenario.

STOCK ASSESSMENT RESUTS

5.1 Base case model results

TWG CMSA agreed to select S28-ProcEst as a base case scenario because of the better diagnostics than the model only with recruitment process error and agreement of data usage up to FY2022. The chub mackerel stock in the NWPO has experienced large changes in biological parameters over the time period of the model. The main temporal changes are a recent decrease in maturity at age, along with a recent decrease in the weight at age, both of which were observed to change over the model time period to cause temporal changes of biological reference points. Fixed Effects parameter estimates are shown in Table 2, and the management related quantities are listed in Table 3.

5.1.1 Parameter estimates

The estimated fixed effects parameters are shown in Tables 2 for S28-ProcEst (the other representative runs B2-Mage (B2), S32-JP23, and S34-PRocEst23 are shown in Appendix 2.). For all parameters, the final gradient values were very close to 0 and the SE values were less than 3. Correlation coefficients from the covariance matrices of the fixed effects parameters showed that q_k and b_k for age-0 and age-1 fish in the Japanese trawl surveys were highly negatively correlated (Figure 8). In addition, the parameters α and β of the Beverton-Holt stock-recruitment relationship were highly positively correlated, however since β can affect the estimation of α and vice versa, this is to be expected (Beverton and Holt 1957). These strong correlations are explained by the scales of abundance and SSB (see Discussion for details), and there were no problems with model convergence, as indicated by the absolute values of the final gradients approaching zero and sufficiently small SEs for these parameters (Table 2 and Appendix 1). The nonlinear coefficients in the Japanese trawl survey indices were estimated in the range of 1.6-2.4 (Table 2), suggesting that they have a tendency toward hyperdepletion (Figure 9).

5.1.2 Time-series estimates for abundances and fishing impacts

Since 1970, total biomass, SSB, and recruitment of chub mackerel have fluctuated widely from high to low to high (Table 4 and Figure 10). Specifically, stock levels were high in the 1970s, but declined in the 1980s, and stock levels were maintained at fairly low levels from the 1990s to the early 2000s; stock levels gradually recovered in the late 2000s and increased rapidly after the occurrence of the strong year class in FY2013. However, total biomass and SSB during the most recent 10-year period (FY2013-2022) did not reach the same high level as in the 1970s. In SAM, the estimated catch (sum product of estimated age-specific catch and age-specific weight) and the observed catch (sum product of observed age-specific catch and age-specific weight) do not match because of the assumption of observational error in the age-specific catch numbers, but the difference between these values was small, except in some years. Exploitation rate (estimated catch biomass / total biomass) and mean F remained constant, with some fluctuations, until the 2000s, but decreased thereafter. The overall trajectory, scale and trend of the runs were quite similar across all representative scenarios. The inclusion of the FY2023 data in the scenarios S32-JP23, and S34-PRocEst23 led to lower estimated SSB in the terminal years and higher F and exploitation rate since approximately 2019. Recruitment was higher in these scenarios as well over the years of FY2013-2015. In recent years, SSB had been increasing since the beginning of the 2010s, but after peaking in FY2017 it declined, slightly for the B2-Mage scenario, and significantly for the other three scenarios.

5.1.3 Stock-recruitment relationship

The estimated Beverton-Holt stock-recruitment relationship is shown in Figure 11 In the final base case scenario (S28-PRocEst), recruitment tended to increase in proportion to the increase in SSB, suggesting that the density-dependent effect in the stock-recruitment relationship is little found in the historical range of estimated SSB for chub mackerel. SD of recruitment variability was 0.8 S28-Proc-Est, 0.75 for B2-Mage (B2), 0.74 for S32-JP23, and 0.79 for S34-PRocEst23.

5.2 Model diagnostics

5.2.1 Residual plots

Observation errors in catch number by age were largest for young and old age groups and smallest for intermediate age group 3 fish (Figures 12 and 13, see also Table 2). The time-series trend of the residuals was weak.

For abundance index values, observation error was largest for the Japanese trawl survey indices and smallest for the spawning egg index (Figure 14). The summer and autumn age-0 indices tended to have positive residuals in recent years (Figure 15).

Process errors in log(*N*) for age-0 fish (deviation from the stock-recruitment relationship) were highly variable, but those for age-1 fish and older were reasonably variable (Figure 16, left). Since the occurrence of the strong year class in 2013, process errors for age-0 fish have been positive, except for 2014 and 2019. After the 2018 class, the process errors for age-1 fish and older were mostly negative.

Process errors for log(*F*) (deviation from random walk) were larger in ages 0 and 1 than in the other ages (Figure 16, right). The pattern of random walks for each age was very similar, as evidenced by the very high correlation coefficient of 0.97 between the closely adjacent ages (Table 2).

5.2.2 Retrospective analysis

In the retrospective analysis, recruitment was slightly positively biased for the 2018 and, and as a result, total biomass also tended to be overbiased (i.e., revised downward as the data were updated) (Figure 17). Mohn's rho values for SSB were close to zero, and had small positive biases for the last three years; the mean F in 2017 tended to be higher.

In the retrospective forecasting, the retrospective bias for recruitment was reduced due to the loss of positive bias for the 2018 and 2020 year-classes (since they are predicted from the stock-recruitment relationship and therefore no longer takes extreme values), but retrospective patterns for other state variables were similar to those when no future forecasting was done (Figure 18).

5.2.3 Leave-one-out index analysis

The LOO index analysis showed that the abundance and exploitation rate did not change much regardless of which index was removed, indicating that the stock estimates are very robust (Figure

19). A closer look shows that the SSB estimates increased slightly in recent years when the dipnet fishery CPUE and spawning egg indices were excluded, and the SSB estimates decreased slightly when the age-0 and age-1 fish indices were excluded. This may be because the age-0 and age-1 fish indices have had high values in many years since 2013 and have a role in increasing SSB, whereas the two SSB indices have tended to decrease slowly in recent years and thus decrease SSB (Figure 19). Although there were conflicting trends in the indices for age 0-1 fish and the indices for SSB, the effect of a single index was small because there were multiple indices for young and old fish, respectively. The influence of the Chinese purse seine CPUE was small.

5.2.4 Evaluation of the One Step Ahead residuals

OSA residuals were calculated for the age composition data the indices of abundance (Figures 20 and 21). The largest age composition residual was in the first year of the model for age 2 fish. In general, the age composition OSA residuals tended to be small and lacked any consistent patterning. The OSA residuals from the fits to the indices of abundance showed a similar lack of patterning and did not suggest systematic model deficiencies such as underfitting or overfitting. Overall, the OSA residuals indicate no issues with the model's performance. The residuals are appropriately centered around zero and show no significant persistent patterning, the quantile plot (Figure 22) indicates a good git.

5.3 Reference points

5.3.1 Historical change in spawning potential of SPR0

SPR0 has changed annually according to the biological parameters that changed each year (Figure 23). In particular, SPR0 decreased significantly from FY2015 onwards, reaching a minimum in 2019 and remaining low during the FY2020-2023 period. The average SPR0 for the 2020s (FY2020-2022) was 165 g in scenario S28-ProcEst which is about half of the SPR0 averaged for other decades.

5.3.2 MSY-based reference points

In the stock-recruitment relationship estimated by the base case model (S28-ProcEst), there was almost no density dependence effect within the range of spawning stock biomass and recruitment numbers observed in past, so the SSB0 and SSB_{MSY} calculated based on this stock-recruitment relationship are extrapolated values that greatly exceed the past recruitment and spawning stock biomass (Fig. 10). Furthermore, since the productivity of this stock, represented by SPR0, has changed significantly over the years as seen in Fig. 6, the estimated values of SSB0 and SSB_{MSY} (even under the single stock-recruitment relationship) varied greatly depending on which year's biological parameters were used. For example, the SSB_{MSY} estimated using the biological parameters from 2016-2022 was about half of the estimate by using the biological parameters from all of the years (Table 3). In addition, the MSY reference points differed greatly among the different model specifications owing to the extreme extrapolation (Table ANNEX 2).

5.4 Future projections

The future projection under a constant catch scenario has a much wider prediction interval for future spawning biomass than the projection with a constant F_{cur} (Figure 24). Because there is a trade-off between fluctuations in stock abundance and catch, it is impossible to avoid these high fluctuations in stock abundance under the scenario of constant catches. Therefore, in future projections, it is necessary to focus not only on the average values of SSB but also on the lower confidence interval (e.g. lower 5%) of SSB to evaluate the probability of the future SSB falling below a level below which we do not want to fall.

The future projection under a constant catch scenario has a very different outlook depending on whether the biological parameters are based on the recent years (FY2016-2022) or all years (FY1970-2022) (Figures 25 and 26).

The 5th percentile of the future SSB and average catch and SSB were compared among various harvesting scenarios (Figures 25 and 26). The results of the projections from the base case differed greatly based on choice of the biological parameters. These results suggest that the future projection of the stock depends greatly on the assumption of future biological parameters, whether or not the delay in growth and maturation will continue in the future. In detail, Table 5 shows the probabilities that future SSB is above the estimated SSB in FY2022 based on the results of 5000 times stochastic projections.

DISCUSSION

In this working paper, a stock assessment of Northwestern Pacific chub mackerel was conducted using SAM with existing agreed data. SSB gradually decreased from the high period in the 1970s to the 1980s, and SSB remained at a low level from the 1990s to the early 2000s; the beginning of the decreasing trend in SSB in the 1980s can be explained by a reversal from the positive recruitment residuals that often appeared until FY1977 to negative residuals that often appeared thereafter, shown in the plot for process errors (Figure 18). High fishing mortalities were found since FY1986 thorough the 1990s, causing the extremely low levels of SSB for this time period. In the late 2000s, SSB gradually recovered as fishing pressure slowly decreased, and after the occurrence of the strong year class in FY2013. Although SSB recovered in the 2010s, it was still lower than in the late 1970s.

In SAM, it is possible to account for process errors for age-specific stock numbers, but we assumed that process errors after recruitment (for age-1 fish and older) would be much smaller. This is due to the difficulty of interpreting process errors for age-1 and older fish and the complexity of population dynamics, which makes it difficult to predict the future. The results of relaxing this assumption are presented in a separate working paper (NPFC-2024-TWG CMSA09-WP04).

SAM requires estimating the process error in age-specific F and the observation error in age-specific catch number. Since attempting to calculate these standard deviations (SDs) by age may lead to the failure of model convergence and overfitting, model selection based on AIC was performed. As a result, the observation errors in age-specific catch numbers were common for age-5 fish in the selected model, showing high SD for young and old age groups and low SD for intermediate age groups (minimum for 3-year-old fish). On the other hand, the process error for F was estimated to be larger for 0-1 year old fish than for older fish, suggesting that the change in fishing pressure is greater for younger age groups.

Because it is known that estimating nonlinearities in stock abundance index in an age-structured model improves model performance, such as reducing retrospective bias (Hashimoto et al. 2018), we examined whether to estimate nonlinear coefficients. We showed that AICs were significantly reduced in models with nonlinear coefficients estimated for age-0 and age-1 fish indices from the Japanese trawl surveys. AIC was only slightly reduced in the model with estimated nonlinear coefficients for the spawning egg index, but since the estimation of nonlinear coefficients can make the model estimation unstable, a simpler model assuming linearity for spawning egg was chosen here as the model for the base case scenarios. Nonlinear coefficients were estimated larger than 1 for the Japanese trawl survey indices and had a tendency toward hyperdepletion. The reason for this is not clear, but it may be because the survey was conducted at a particular time of year, and thus the variation in the index values is larger than the actual variation in recruitment. In addition, there was a strong negative correlation between this nonlinear coefficient and the proportionality constant, which can be explained by the relationship between the intercept and slope in the simple regression. The relationship between the index value and the number of stock tails is expressed as $\log(I_{k,y}) = \log(q_k) + b_k \log(N_{a,y}) + \varepsilon_{k,y}$. In this equation $\log(q_k)$ and b_k correspond to the intercept and slope, respectively, in the linear regression model having $\log(I_{k,y})$ as the response variable and $\log(N_{a,y})$ as the explanatory variable. In the current specification, Na,y has very large values (in millions) and is far from zero in the range of $\log(N_{a,y})$. Therefore, a small difference in slope bk can greatly change the value of intercept $\log(q_k)$, resulting in a high correlation between these parameters, and relatively large estimation errors and confidence intervals for $\log(q_k)$. As a test, when the unit of Na,y was made larger (1 billion fish) and $\log(N_{a,y})$ was made closer to zero, the correlation became weaker and the estimation error smaller, but the estimated parameters remained the same except for $\log(q_k)$. Thus, the high correlation between the nonlinear coefficients and the proportionality constant and the relatively larger SE of the proportionality constant are considered to be a matter of abundance scale and not a threat to estimability or identifiability for these parameters.

Retrospective analysis revealed a positive bias in recruitment and total biomass. This is because recent high recruitment (especially for the 2018 and 2020 classes), elevated by high recruitment index values, has been revised downward by low catch numbers and low SSB index values. In other words, there is a conflict between the age-0 and age-1 fish indices, which have been high since FY2013, and the SSB indices, which have been declining in recent years. The LOO index analysis showed that the effect of excluding one index was small, suggesting that the age-0 and age-1 fish indices have similar information to each other and the two SSB have similar information to each other. In a nutshell, this situation means that the high recruitment expected in the survey has disappeared, never showing up as catch or SSB. Unfortunately, the reason for this curious phenomenon is unknown at this moment.

In this stock, the choice of the stock-recruitment relationship is a difficult issue. In this case, we used the Beverton-Holt model, which is the simplest model and fits well with chub mackerel, but recruitment shows almost proportional relationship with SSB and the density-dependent effect is very small. Therefore, the uncertainty of the parameters related to the density dependence was large. Such low density-dependent effects and large uncertainties greatly affect the calculation of biological reference points and future projections (NPFC-2024-TWG CMSA09-WP05). Estimating stock recruitment relationships in an assessment model is inherently challenging due to the complex interplay of biological and environmental factors that influence fish population dynamics. Variability in recruitment can result from factors such as fluctuating environmental conditions, changes in predator-prey interactions, and genetic diversity within the stock (Myers, 1998). Additionally, data limitations, such as insufficient time series data, measurement errors, and biases in sampling methods, further complicate the estimation process (Maunder & Deriso, 2013). These difficulties are exacerbated by the non-linear and often unpredictable nature of recruitment, making it hard to develop reliable models that accurately capture the true dynamics of fish populations (Hilborn & Walters, 1992). Another possible stock-recruitment relationship is the use of the hockey-stick model, but it cannot be applied as is in SAM using TMB, where optimization is performed by automatic differentiation. From the viewpoint of stock assessment and management for chub mackerel, it will be necessary to consider how the stock-recruitment relationship should be characterized in the future.

This is the first chub mackerel stock assessment in NPFC since the TWG CMSA was established in 2017. Although it has taken a very long time to select the stock assessment model by simulation, the data and model to be used this time have been determined with the agreement of all Members. The stock of chub mackerel was increasing in the 2010s, but the situation has changed since the beginning of the 2020s, and at least the period of increase is considered to have passed. Furthermore, the abundance indices for SSB in 2023 for Japan, which was not used in the base case analysis, is significantly reduced (Figure 1), and a sensitivity analysis using these indices would reduce SSB more recently than in the base case (NPFC-2024-TWG CMSA09-WP04), so this SSB in this working paper may also be an overestimate. Although there are still issues to be resolved, such as retrospective bias and highly uncertain parameters, it is hoped that the results of the stock assessment in the base case scenario while taking into account the results of sensitivity analysis will provide effective scientific advice for the sustainable use of chub mackerel in the Northwestern Pacific Ocean.

The chub mackerel stock in the NWPO has experienced large changes in biological parameters over the time period of the model. The main temporal changes are a recent decrease in maturity at age, along with a recent decrease in the weight at age, both of which were observed to change over the model time period to cause temporal changes of biological reference points. Maximum sustainable yield (MSY)-based reference points are highly variable over the time series of the assessment because the weight- and maturity- at age of chub mackerel has varied widely (Figures 3 and 4), which impacts the productivity of the stock. Unfished spawning biomass per recruit (SPR0) represents the theoretical equilibrium productivity per fish assuming no fishing. SPR0 has varied remarkably over time (Figure 5).

In addition, as there is little recruitment compensation in the stock-recruitment relationship within the range of historically observed SSB and recruitment (Figure 8), estimates of biomass-based MSY reference points are extreme explorations that are highly sensitive to model configuration.

Because of the above reasons, commonly used reference points such as MSY-related or SPR-related reference points vary over time and are uncertain, and are potentially misleading with respect to stock status. For example, the MSY based reference points have varied by the assumption of biological parameters to be used (Table 31). The exploitation rates corresponding to the MSY as 10% when assuming biological parameters during the whole historical period, but it dropped to 5% when using the most recent 7 years biological parameters.

As such, at this time, the TWG CMSA does not recommend the use of MSY-based reference points for management advice. Instead, the TWG CMSA provides information of current estimates of chub mackerel SSB and F (average FY2020-2022) relative to the minimum, 25th, 50th, 75th and maximum value of the SSB and F values over the entire time period (FY1970-2022; Table 6). Values relating to the most recent time period (FY2016-2022) are also shown in order to describe the current stock relative to recent conditions.

The abundance estimated by the Japanese egg survey and the CPUEs from the Japanese dipnet and

Russian trawl decreased over recent years, showing that they were simultaneously reduced to about half the level of recent years in 2023. Therun of the stock assessment model including Japanese CPUE for FY2023 shows substantial decline in biomass and SSB in FY2022 and further in FY2023 and higher fishing mortality in the last few years (Figure 7).

SUMMARY

Exploitation status

Estimated rates of exploitation (fishing year catch/fishing year total biomass) time series generally fluctuated between 5 and 20% and followed the estimated Fs over time, with annual removal rates that ranged from roughly 10 to 30% over the modeled timeframe (Figure 9), with some larger annual removals in excess of 40%.

Harvest Recommendations

Given the uncertainty in biological parameters in future, which have a large impact on the projection results, the TWG CMSA considers it is not appropriate to provide long-term harvesting recommendations at this time. A short-term (towards 2028) projection was undertaken to assess the effects of varying catch levels, ranging from 50 to 400 thousand tons, based on the most recent seven years' biological data (Figure 9) and the entire time series of biological data (Figure 10) for management considerations. Projections based on the most recent seven years' biological data showed that Fcur leads to future constant decline of SSB and it is necessary to reduce current fishing mortality (Table 3).

Data and Research needs

The assessment results, including projections, are dependent on biological parameters and processes which are uncertain. Therefore, future studies should be focused on collecting and analyzing biological information, e.g., maturity-at-age, weight-at-age, which would improve the assessment. Fisheries-dependent data, such as fleet-specific catch-at-age, are also critical to develop Member-specific fishing fleet and age-specific abundance indices.

A critically important recommendation that should be carried out in 2-3 years is to develop a harvest control rule specific to this stock via an MSE process. This HCR should be dynamic and able to adjust annual total catches depending on the stock abundance as well as the target and limit reference points. During the process of the development of MSE, uncertainties in parameter estimates, time-varying or density-dependent biological parameters, and stock-recruitment assumptions should be considered.

Timely collection of biological information and further research on biological parameters and processes, including the effect of environment and climate change, are critically important to facilitate the accurate estimation of reference points.

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TABLES

Table 1

The list of mathematical notations for SAM, including the symbol used, its type (Index, Data, random effects: RE, fixed effects: FE, and derived quantities: DQ, and its description).

Symbol	**Type**	**Description**
a	Index	Age class (from 0 to 6+)
y	Index	Fishing year (from 1970 to 2022)
k	Index	Fleet ID for abundance index (from 1 to 6)
$C_{a,y}$	Data	Observed catch number at age *a* in a year *y*
$w_{a,y}$	Data	Stock weight at age *a* in a year *y* (also used as catch weight for simplicity)
$g_{a,y}$	Data	Maturity at age *a* in a year *y*
$M_{a,y}$	Data	Natural mortality coefficient at age *a* in a year *y*
$N_{a,y}$	RE	Number at age *a* in a year *y*
$F_{a,y}$	RE	Fishing mortality coefficient at age *a* in a year *y*
ω_a	FE	SD for the process error in number at age *a*
σ_a	FE	SD for the process error in F at age *a*
ρ	FE	Correlation coefficient in MVN of F random walk between adjacent age classes
τ_a	FE	SD for the measurement error in catch at age *a*
q_k	FE	Catchability coefficient for abundance index *k*
ν_k	FE	SD for the measurement error in abundance index *k*
b_k	FE	Nonlinear coefficient for abundance index *k*
α	FE	Slope of stock-recruitment relationship at the origin
β	FE	Strength of density dependence in stock-recruitment relationship
$\hat{C}_{a,y}$	DQ	Predicted catch number at age *a* in a year *y*
$\hat{s}_{a,y}$	DQ	Selectivity at age *a* in a year *y*

Table 2

Fixed-effect parameters (FE), their maximum likelihood estimates (MLE), their standard errors (SE), their final gradients, symbols including the information on age class and index fleet, and unlinked value (inverse link function of MLE) in the selected model (see Table 4) under Scenario S28-ProcEst.

FE	MLE	SE	Gradient	Unlinked value	Symbol
logQ	-14.65	2.15	0.0000	4.36E-07	q_1
logQ	-15.54	2.25	0.0001	1.79E-07	q_2
logQ	-10.10	1.68	0.0000	4.12E-05	q_3
logQ	-0.23	0.14	-0.0001	0.7926	q_4
logQ	-2.50	0.17	-0.0001	0.0818	q_5
logQ	-4.85	0.24	0.0000	0.0078	q_6
logB	0.80	0.12	0.0001	2.2251	b_1
logB	0.89	0.11	0.0025	2.4281	b_2
logB	0.54	0.13	0.0003	1.7182	b_3
logSdLogFsta	-0.89	0.18	0.0000	0.4101	$\sigma_{0\text{-}1}$
logSdLogFsta	-1.24	0.17	0.0000	0.2894	$\sigma_{2\text{-}6+}$
logSdLogN	-0.22	0.13	0.0001	0.7993	ω_0
logSdLogN	-1.06	0.29	0.0000	0.3475	ω_1
logSdLogN	-1.31	0.22	-0.0001	0.2698	ω_{2-4}
logSdLogN	-1.27	0.60	0.0000	0.2814	$\omega_{5\text{-}6+}$
logSdLogObs	-0.41	0.11	0.0001	0.6624	$\tau_{0\text{-}1}$
logSdLogObs	-1.31	0.19	0.0000	0.2695	$\tau_{2\text{-}3}$
logSdLogObs	-0.90	0.17	0.0000	0.4067	$\tau_{4\text{-}5}$
logSdLogObs	-0.12	0.14	-0.0001	0.8842	τ_{6+}
logSdLogObs	-0.27	0.23	0.0000	0.7603	v_1
logSdLogObs	-0.58	0.39	0.0000	0.5595	v_2
logSdLogObs	-0.33	0.23	0.0000	0.7166	v_3

logSdLogObs	-1.06	0.20	0.0000	0.3455	v_4
logSdLogObs	-0.56	0.17	0.0000	0.5721	v_5
logSdLogObs	-0.51	0.25	0.0000	0.5987	v_6+
rec_loga	-4.36	0.20	0.0001	0.0128	α
rec_logb	-8.66	2.17	0.0000	0.0002	β
logit_rho	3.65	0.80	0.0000	0.9747	ρ

Table 3

Reference points for the base case scenario. Reference point values in this table are calculated by holding $F_{current}$ the same for all calculations, but by varying the time period (either FY1970-FY2022 or FY2016-FY2022) over which the biological parameters are estimated. Refer to Glossary in the body of the assessment for the definitions. For the description of the biological parameters, see Table ANNEX 3.

Biological parameters used	**FY2016-FY2022**	FY1970-FY2022
	S28-ProcEst	S28-ProcEst
current%SPR	**28.3**	40.3
Fmed/Fcur	**0.478**	1.629
F0.1/Fcur	**1.344**	1.344
FpSPR.30.SPR/Fcur	**0.942**	1.498
FpSPR.40.SPR/Fcur	**0.673**	1.010
FpSPR.50.SPR/Fcur	**0.484**	0.696
FpSPR.60.SPR/Fcur	**0.342**	0.475
FpSPR.70.SPR/Fcur	**0.230**	0.311
F_{MSY}/Fcur	**0.258**	0.668
B_{MSY}	**9396.157**	17179.502
SSB_{MSY}	**2904.704**	6084.597
h	**0.358**	0.501
SSB0	**7123.476**	17441.919
SSB_{MSY}/SSB0	**0.408**	0.349
F_{MSY}SPR	**0.673**	0.511
MSY	436.8467	1713.406
MSY/B_{MSY} (exploitation rate at MSY)	0.046	0.10

Table 4

Time series of estimates of total biomass, spawning stock biomass, recruitment, catch, and exploitation rate (catch/biomass) and their standard error (SE) under Scenario S28-ProcEst. The SEs were derived using the delta method.

Fishing	Biomass (1000 MT)		SSB (1000 MT)		Recruitment (billion)		Catch (1000 MT)		Exploitation rate	
year	Estimate	SE	MLE	SE	MLE	SE	MLE	SE	MLE	SE
1970	4,019	749	678.8	99.3	18.991	7.573	782.6	133.2	0.195	0.040
1971	4,547	771	863.4	124.8	18.903	7.061	842.6	123.2	0.185	0.033
1972	4,700	830	749.4	113.0	7.774	3.115	668.9	107.6	0.142	0.026
1973	4,224	659	937.1	137.5	7.824	2.953	780.2	110.7	0.185	0.030
1974	4,026	590	1253.2	191.4	12.672	4.621	846.4	115.6	0.210	0.034
1975	3,616	534	1070.1	158.5	19.237	6.994	867.6	119.3	0.240	0.037
1976	4,417	765	1046.2	147.7	21.643	7.800	708.0	98.0	0.160	0.029
1977	5,481	887	1200.8	163.1	17.649	6.316	947.0	139.1	0.173	0.029
1978	5,700	868	1322.2	171.6	12.187	4.505	1345.9	208.5	0.236	0.036
1979	3,563	485	1327.6	184.9	5.883	2.137	996.9	138.1	0.280	0.038
1980	2,228	302	1068.2	160.1	6.684	2.414	594.3	81.6	0.267	0.039
1981	2,392	409	734.4	116.7	8.037	2.880	404.5	58.2	0.169	0.032
1982	2,203	357	551.1	82.2	5.372	1.916	365.5	52.2	0.166	0.028
1983	1,795	261	517.9	71.7	5.721	2.020	374.6	51.4	0.209	0.032
1984	2,322	379	601.2	80.3	7.272	2.565	498.0	69.2	0.214	0.035

1985	1,978	299	480.7	62.3	6.889	2.416	468.5	70.6	0.237	0.036
1986	1,486	218	347.0	45.0	3.056	1.075	509.2	86.8	0.343	0.043
1987	937	124	322.3	41.3	1.206	0.431	362.0	55.8	0.386	0.041
1988	554	71	256.0	37.6	0.549	0.208	230.7	34.1	0.416	0.045
1989	313	48	137.0	20.5	0.446	0.166	102.9	15.1	0.329	0.051
1990	237	48	75.3	13.8	0.548	0.209	32.4	4.9	0.137	0.030
1991	342	83	56.5	10.5	1.230	0.448	28.2	4.7	0.082	0.020
1992	589	139	63.4	10.1	2.436	0.910	65.8	13.1	0.112	0.025
1993	581	105	92.5	14.9	0.923	0.322	181.2	45.1	0.312	0.051
1994	407	61	110.4	15.4	0.825	0.294	116.1	19.0	0.285	0.041
1995	395	69	92.2	12.5	1.544	0.544	115.6	21.7	0.292	0.045
1996	677	183	51.2	6.6	4.024	1.507	169.6	46.8	0.250	0.048
1997	621	139	43.7	5.8	0.671	0.233	262.1	80.0	0.422	0.062
1998	316	47	87.9	15.1	0.358	0.129	94.6	17.0	0.300	0.041
1999	298	58	89.3	14.0	0.883	0.313	75.8	12.6	0.255	0.042
2000	248	49	54.0	7.3	0.574	0.225	57.2	12.7	0.230	0.044
2001	161	27	59.4	9.3	0.336	0.128	36.9	6.3	0.229	0.039
2002	299	56	42.5	6.3	1.743	0.469	36.2	7.2	0.121	0.025
2003	345	61	53.6	7.2	1.183	0.332	56.6	12.4	0.164	0.032

2004	854	160	137.3	20.9	4.418	1.147	128.3	24.0	0.150	0.028
2005	894	153	86.4	11.5	1.692	0.395	194.4	45.4	0.217	0.038
2006	759	106	272.3	44.2	0.525	0.142	209.2	36.2	0.275	0.039
2007	728	104	268.2	44.5	2.545	0.644	153.1	22.6	0.210	0.033
2008	692	99	158.8	25.4	1.367	0.290	150.6	25.8	0.218	0.035
2009	754	104	165.7	26.4	2.539	0.535	139.5	21.4	0.185	0.032
2010	846	127	155.0	27.6	2.130	0.438	124.3	21.6	0.147	0.029
2011	941	143	217.8	39.1	1.176	0.271	102.0	16.4	0.108	0.021
2012	1,206	176	317.3	54.3	3.103	0.712	129.2	18.2	0.107	0.020
2013	3,093	541	352.9	59.5	15.566	3.718	220.4	37.7	0.071	0.015
2014	3,004	570	453.2	75.4	4.067	1.092	309.9	60.5	0.103	0.021
2015	3,126	484	309.9	58.3	6.271	1.404	420.0	67.9	0.134	0.023
2016	3,850	574	459.8	84.3	12.688	3.016	471.9	68.8	0.123	0.022
2017	3,360	464	762.4	145.3	10.329	2.364	457.1	62.4	0.136	0.022
2018	4,108	666	774.4	151.4	22.590	5.807	435.8	59.7	0.106	0.020
2019	3,018	462	734.2	154.9	5.963	1.257	358.4	51.4	0.119	0.022
2020	2,971	445	619.7	125.0	10.933	2.537	423.9	55.9	0.143	0.026
2021	2,868	516	512.0	106.9	12.216	3.355	357.4	48.7	0.125	0.026
2022	2,825	555	446.9	109.5	9.695	2.397	252.3	39.6	0.089	0.022

Table 5

Probability that future SSB is above 2022 SSB in each model.

Name	HCR_name	2023	2024	2025	2026	2027	2028	2029	2030
B2-Mage	Catch000	0	100	100	90	44	43	45	43
B2-Mage	Catch050	0	100	100	100	100	100	100	100
B2-Mage	Catch100	0	100	100	100	100	100	100	100
B2-Mage	Catch150	0	100	100	100	100	98	98	98
B2-Mage	Catch200	0	100	100	100	98	92	93	94
B2-Mage	Catch300	0	100	100	100	72	68	69	70
B2-Mage	Catch400	0	100	100	66	42	43	42	40
S32-JP23indics	Catch000	0	0	0	0	1	3	3	2
S32-JP23indics	Catch050	0	0	100	100	100	100	100	100
S32-JP23indics	Catch100	0	0	100	100	100	97	95	96
S32-JP23indics	Catch150	0	0	100	100	92	67	71	73
S32-JP23indics	Catch200	0	0	100	100	31	35	41	42
S32-JP23indics	Catch300	0	0	5	1	4	8	8	6
S32-JP23indics	Catch400	0	0	0	0	1	2	1	1
S28-ProcEst	Catch000	38	57	76	64	48	44	46	43
S28-ProcEst	Catch050	38	57	97	99	98	98	98	99
S28-ProcEst	Catch100	38	57	96	96	94	94	95	96
S28-ProcEst	Catch150	38	57	93	92	88	88	89	90
S28-ProcEst	Catch200	38	57	89	87	80	78	79	80
S28-ProcEst	Catch300	38	57	79	70	58	56	56	56
S28-ProcEst	Catch400	38	57	66	49	38	36	34	32
S34-ProcEst23	Catch000	0	7	47	26	10	12	14	12
S34-ProcEst23	Catch050	0	7	95	98	97	96	97	98
S34-ProcEst23	Catch100	0	7	89	93	88	84	86	88
S34-ProcEst23	Catch150	0	7	80	81	69	64	67	68
S34-ProcEst23	Catch200	0	7	70	63	45	42	44	45
S34-ProcEst23	Catch300	0	7	45	25	13	14	14	12
S34-ProcEst23	Catch400	0	7	24	7	3	5	4	3

Table 6

Stock status summary from the base case scenario.

Stock Status Summary Table	SSB (Thousand MT)	Total Biomass (Thousand MT)	Recruitment (Million Individuals)	F	Exploitation	SPR_0
2022 Estimate	447	2,825	9,839	0.23	0.089	171.1
Current (Average 2020-2022)	526	2,888	11,097	0.28	0.119	165.4

Values relative to the all years of the time series (i.e. 1970-2022)	SSB (Thousand MT)	Total Biomass (Thousand MT)	Recruitment (million individuals)	F	Exploitation	SPR_0
Historical Minimum (Min)	45	172	365	0.23	0.071	155
Historical 25 percentile (25%)	97	634	1,308	0.36	0.136	266
Historical Median (Med)	335	1,566	4,353	0.61	0.185	344
Historical 75 percentile (75%)	744	3,177	9,839	0.71	0.25	379
Historical Maximum (Max)	1,394	6,050	23,579	1.11	0.422	501

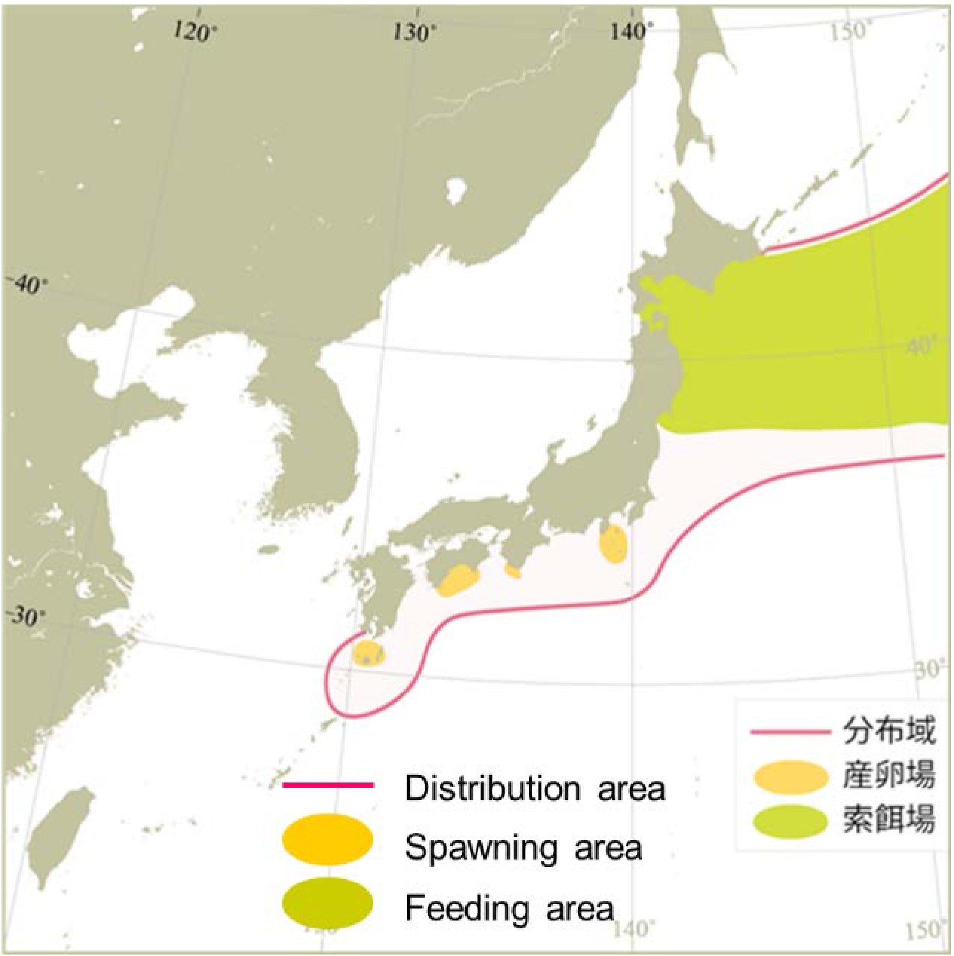
Ratios Relative to 1970-2022	Stock Status Related to Biomass			Stock Status Related to Fishing Intensity		
Current /Historical Minimum	11.694	16.81	30.436	1.21	1.674	1.067
Current /25%_Historical	5.418	4.554	8.483	0.79	0.874	0.622
Current /Med_Historical	1.569	1.844	2.55	0.47	0.643	0.481
Current /75%_Historical	0.707	0.909	1.128	0.40	0.475	0.436
Current /Max_Historical	0.377	0.477	0.471	0.25	0.282	0.33

Values relative to 2016-2022	SSB (Thousand MT)	Total Biomass (Thousand MT)	Recruitment (million individuals)	F	Exploitation	SPR_0
Recent Minimum (Min)	447	2,825	6,043	0.23	0.089	155.0
Recent 25th percentile (25%)	486	2,919	10,154	0.26	0.112	162.5
Recent Median (Med)	620	3,018	11,077	0.29	0.123	167.5
Recent75 percentile (75%)	748	3,605	12,622	0.30	0.130	177.6
Recent Maximum (Max)	774	4,108	22,898	0.31	0.143	217.7

Ratios Relative to 2016-2022	Stock Status Related to Biomass			Stock Status Related to Fishing Intensity		
Current / Recent Min	1.18	1.02	1.84	1.21	1.34	1.07
Current /25%_Recent	1.08	0.99	1.09	1.10	1.06	1.02
Current /Med_Recent	0.85	0.96	1.00	0.98	0.97	0.99
Current /75%_Recent	0.70	0.80	0.88	0.94	0.91	0.93
Current /Max_Recent	0.68	0.70	0.48	0.92	0.83	0.76

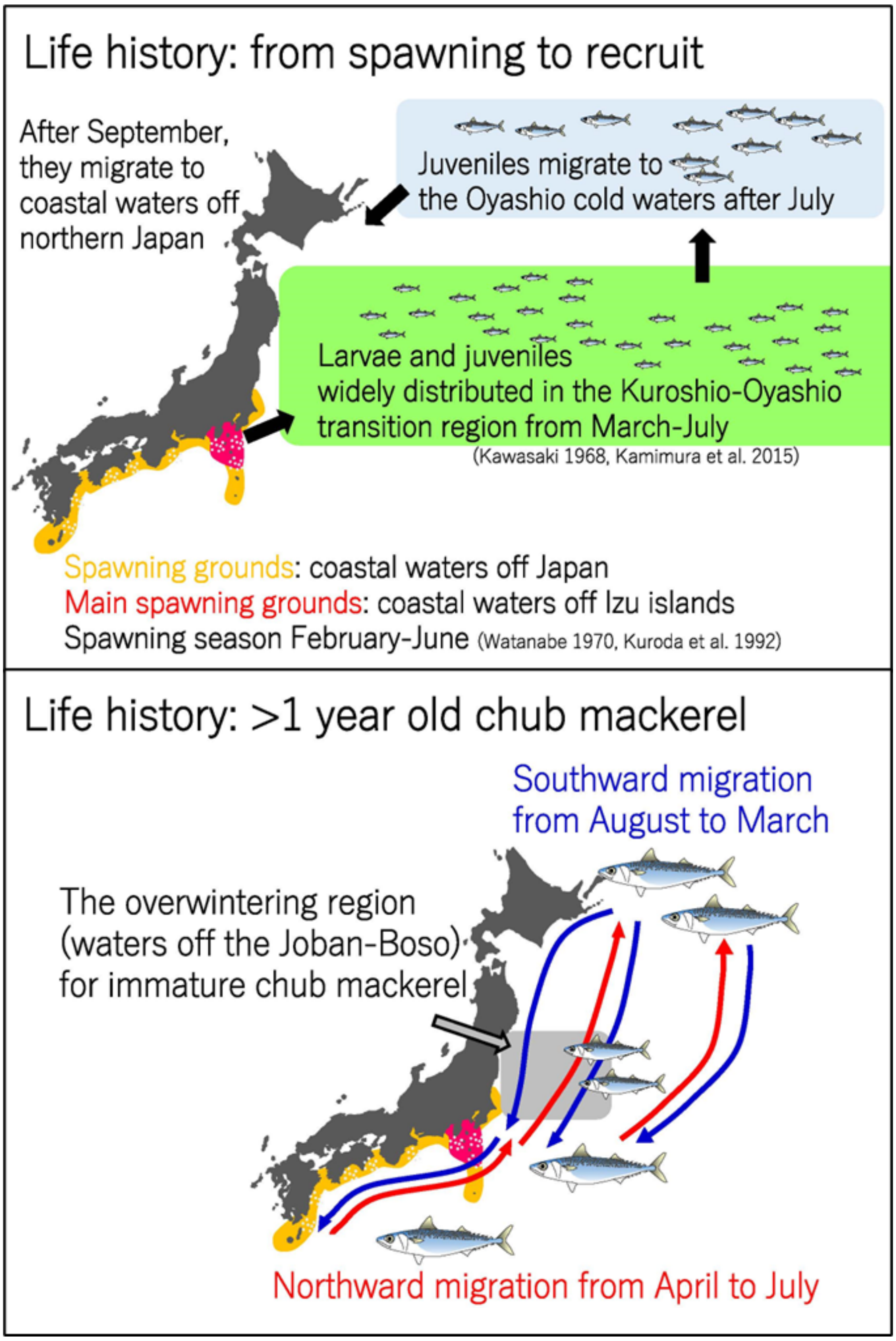
FIGURES

Figure 1



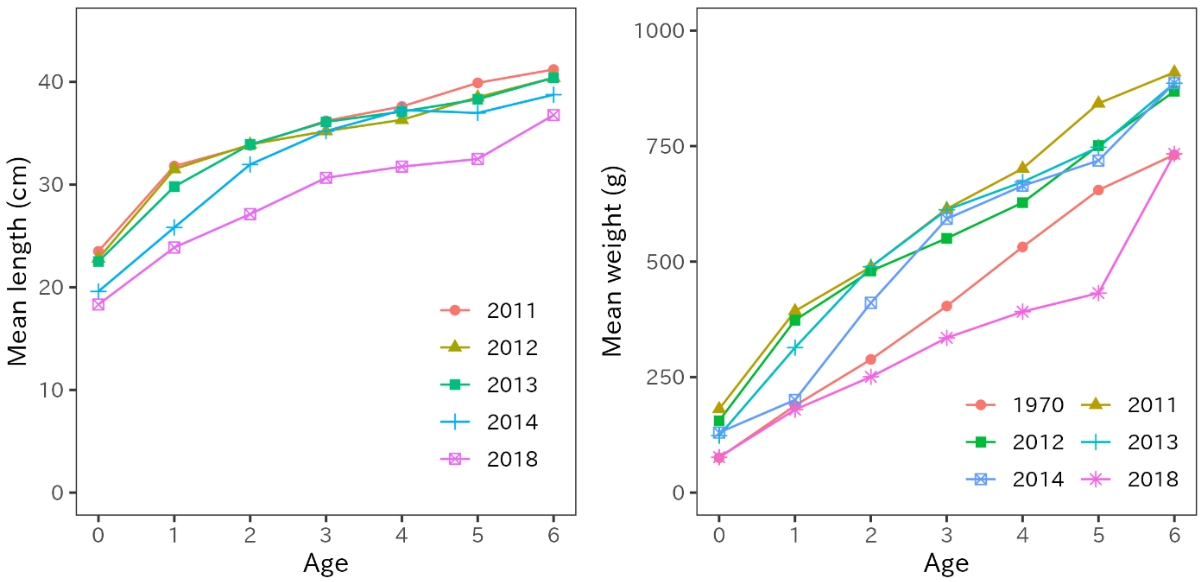
Map of distribution of chub mackerel in the North Pacific (Yukami et al. 2024).

Figure 2



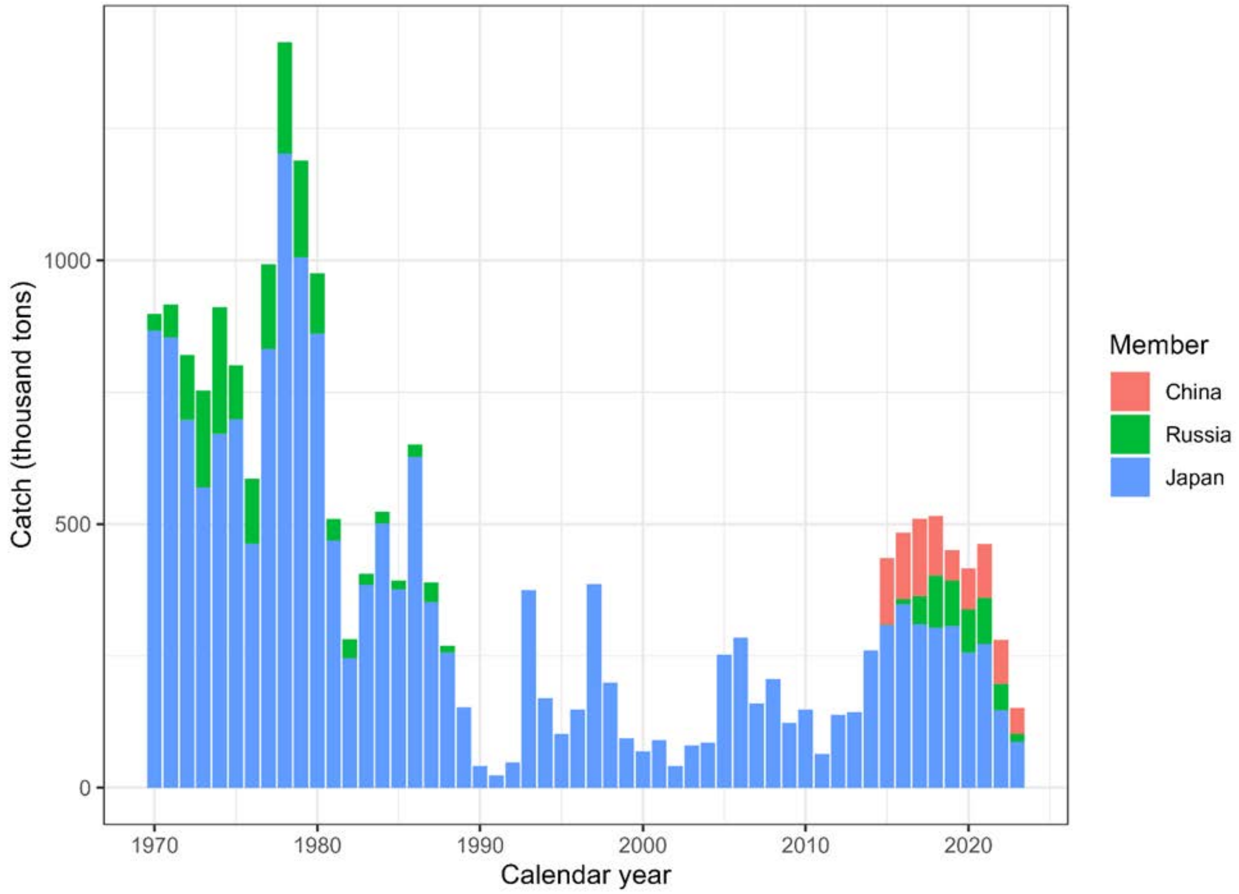
Migration pattern of chub mackerel by growth stage. The upper and bottom panels show seasonal movement of age 0 fish from spawning to recruitment and fish at age 1 and older, respectively (Kamimura, 2017).

Figure *3*



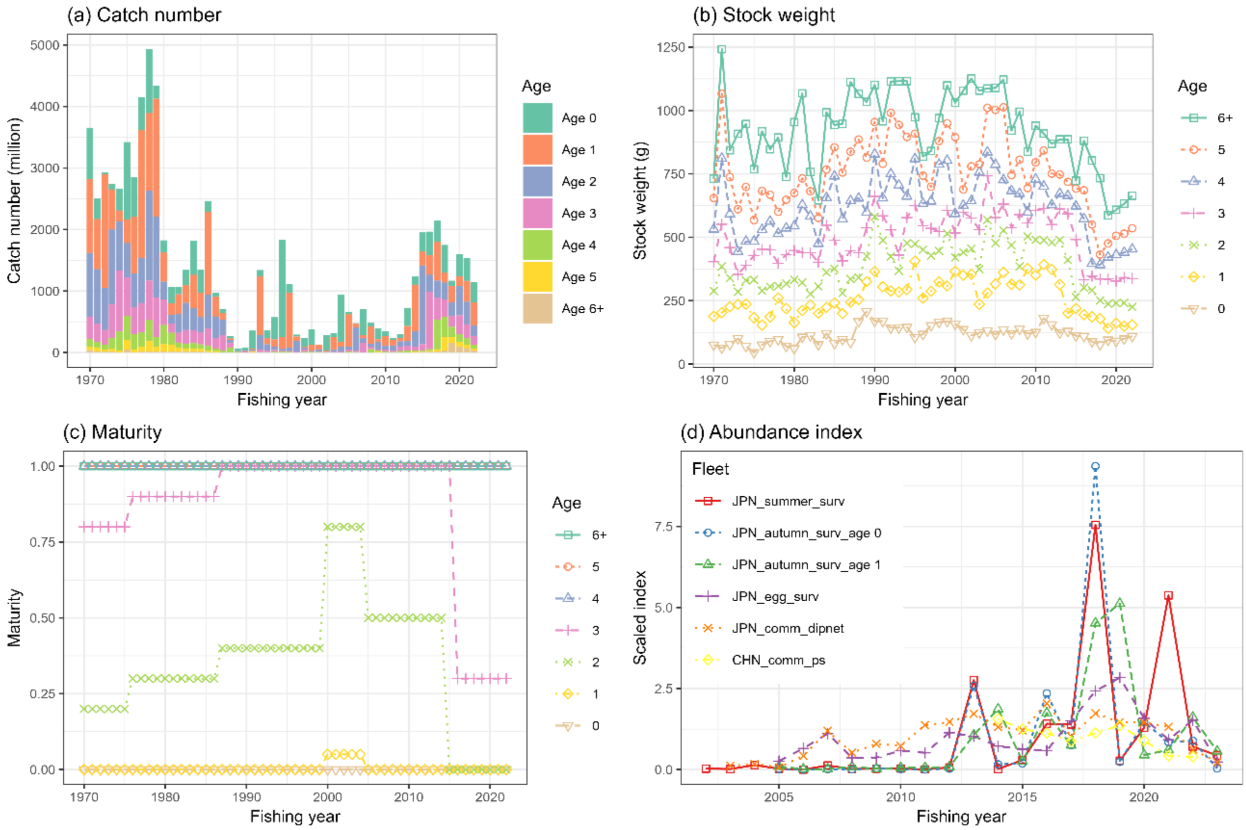
Mean fork lengths of chub mackerel at ages 0 to 6 in FY2011-2014 and FY2018 (left panel). Mean weight at age in FY1970s, FY2011-2014 and FY2018 (right panel).

Figure 4



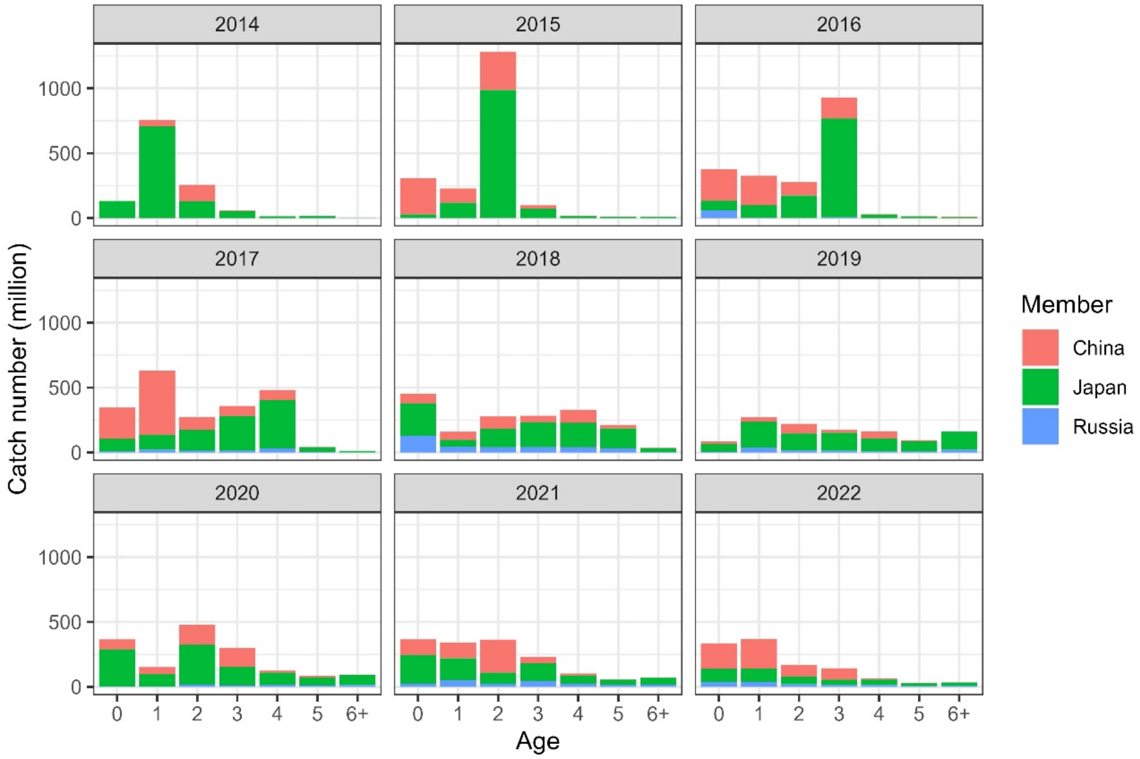
Historical chub mackerel catch in weight by Member. The provisional Chinese catch for CY2023 is estimated using the historical ratio for chub mackerel and blue mackerel. Blue mackerel has been excluded from the catch using the chub-to-blue-mackerel ratio. Catch data for China was obtained from the Annual Summary Footprint, which is available at https://www.npfc.int/summary-footprint-chub-mackerel-fisheries and adjusted using this ratio. Russia's catch data is sourced from the Annual Summary Footprint which reflects no blue mackerel catches. Japan's catch data was collected from coastal prefectures along the Pacific Ocean, where chub mackerel are typically captured. The catch data of this figure is different from the catch data described in the data section above.

Figure 5



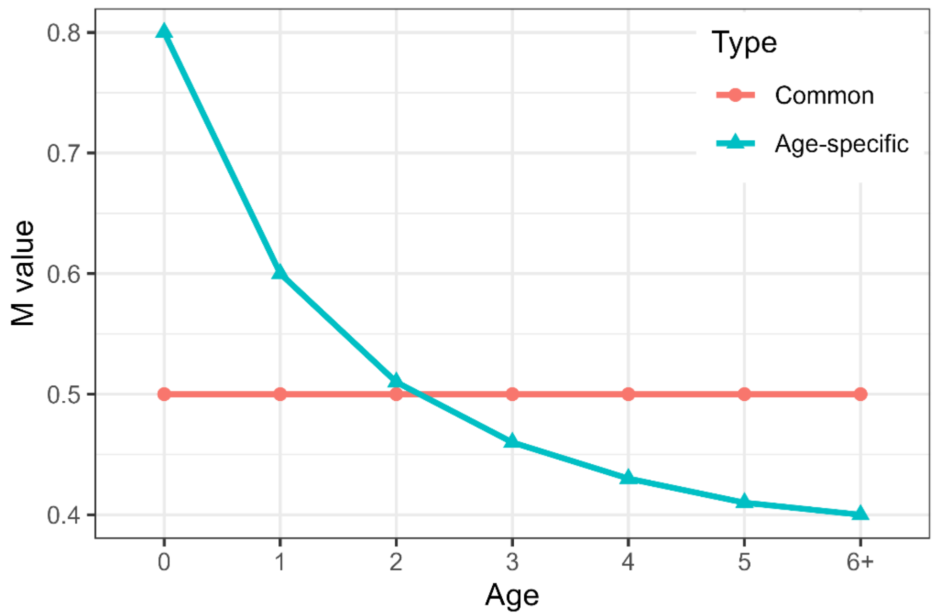
The time series data used for the base case scenario of chub mackerel stock assessmnet. (a) catch number by age, (b) weight by age, (c) maturity by age, (d) abundance index. Each abundance index is scaled by its mean value for visualization. Note that the five Japanese abundance indices are included through FY2023, but are not used in the base case analysis.

Figure 6



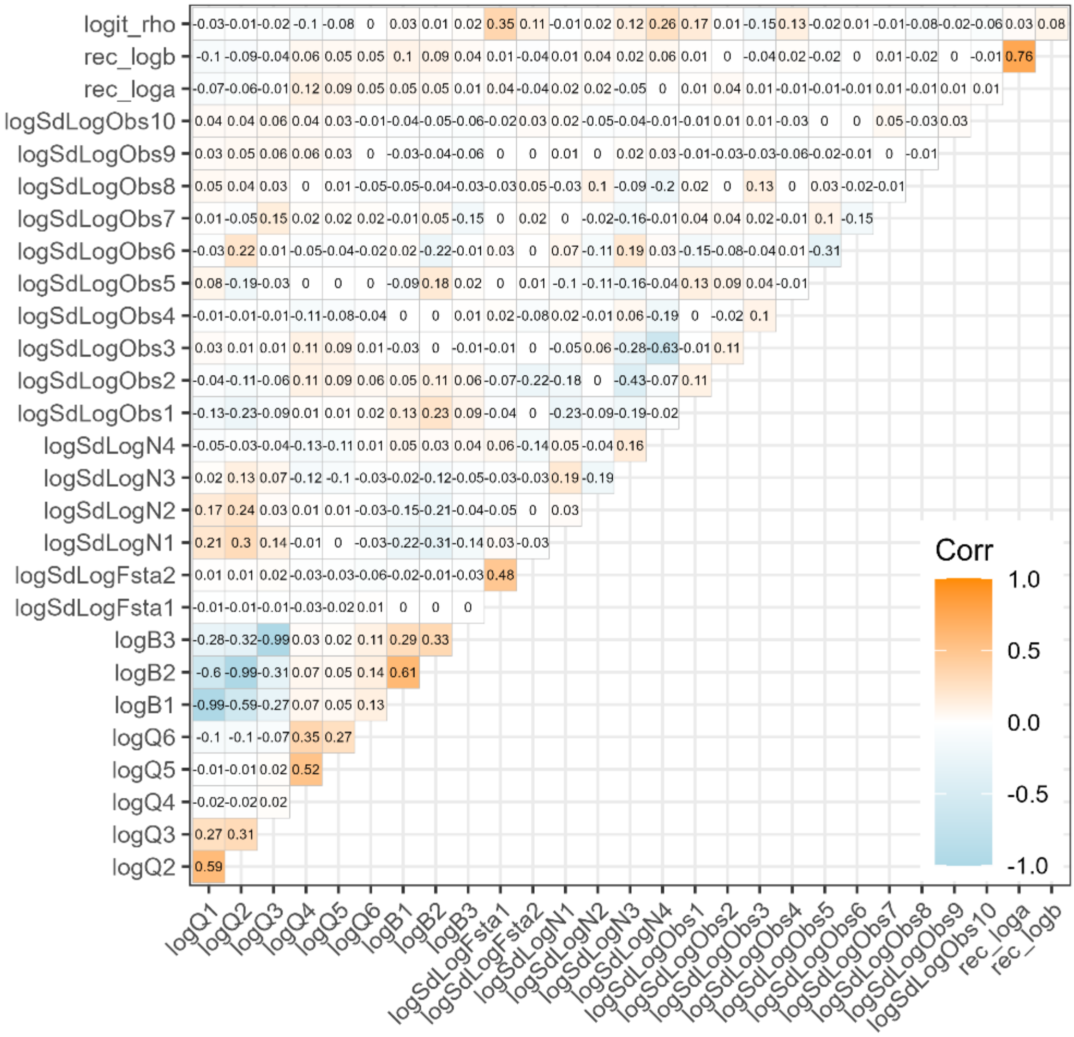
Catch number of chub mackerel by member by age by year from CY2014 to CY2022.

Figure 7



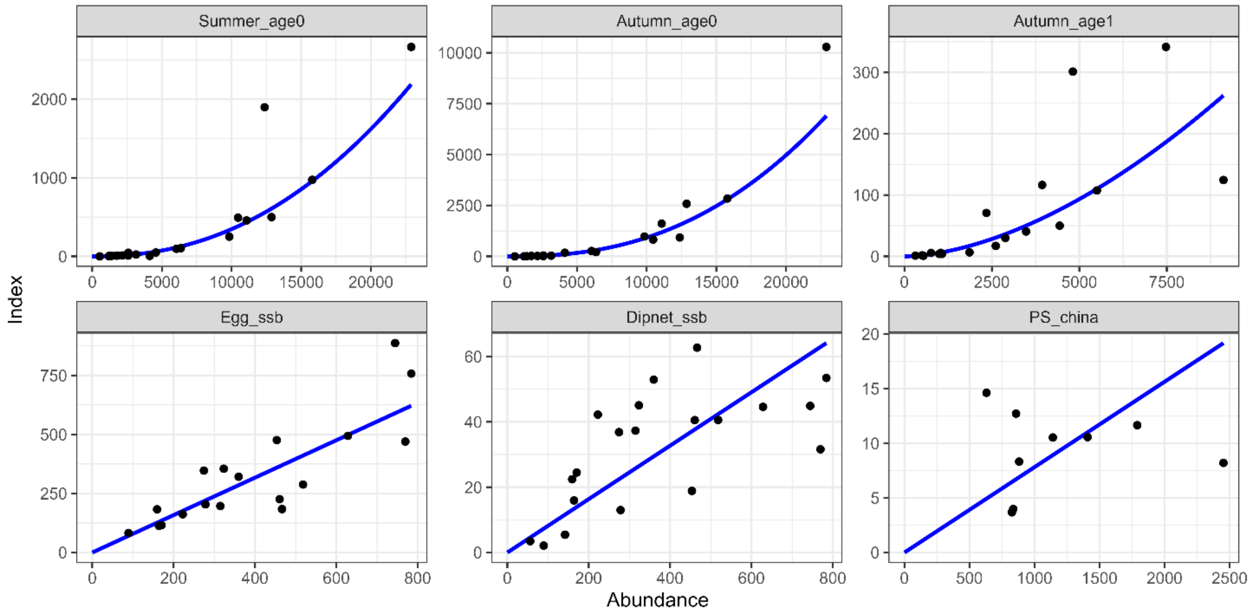
Natural mortality (M) values of chub mackerel under the two base case scenarios. The age-specific M was applied to the base case and representative scenarios.

Figure 8



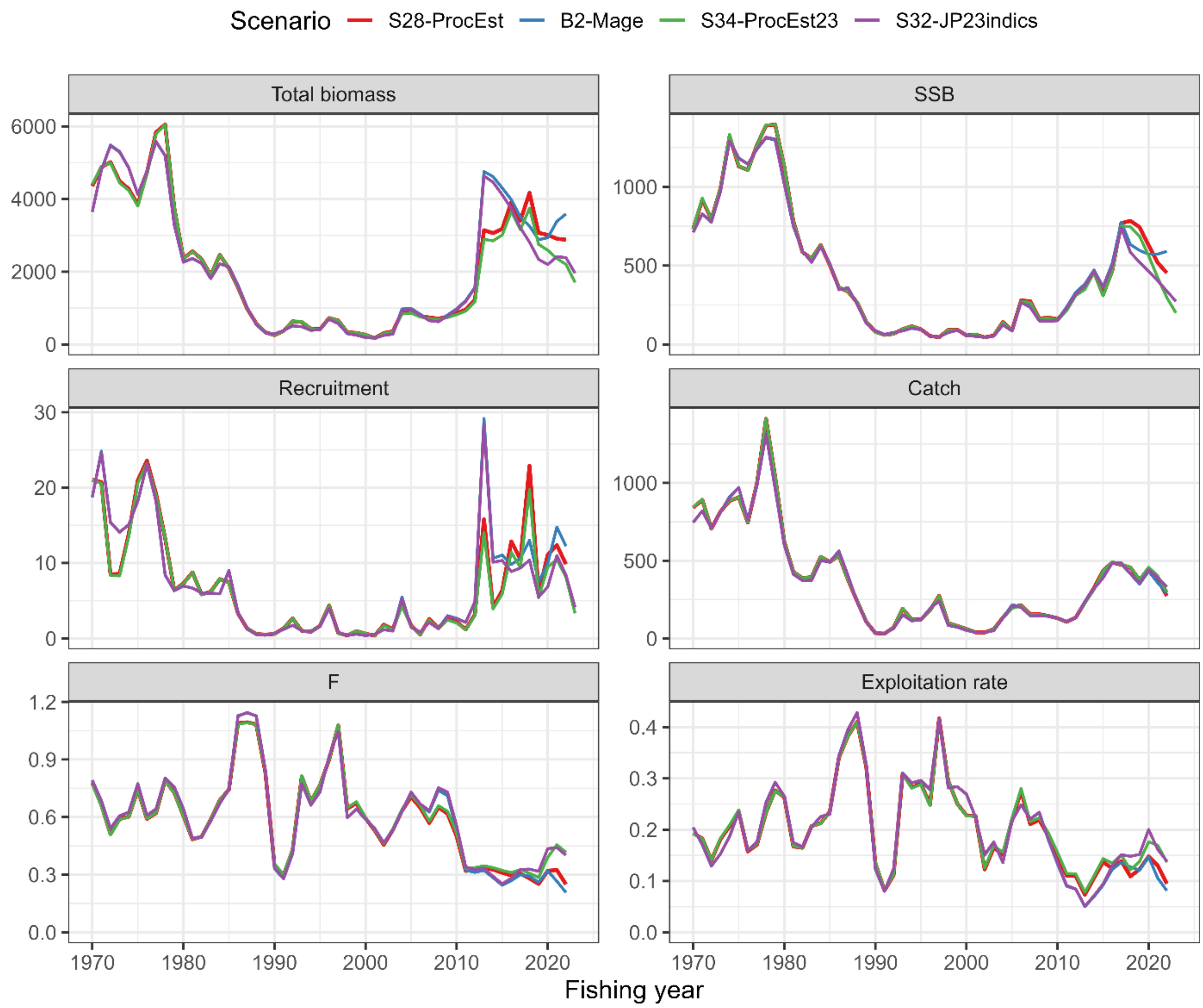
Plot of the correlation matrix obtained from the covariance matrix of the fixed effects parameter estimates, for the base case scenario (S28-ProcEst). Orange colors indicate positive correlation, while light blue indicates negative correlation.

Figure 9



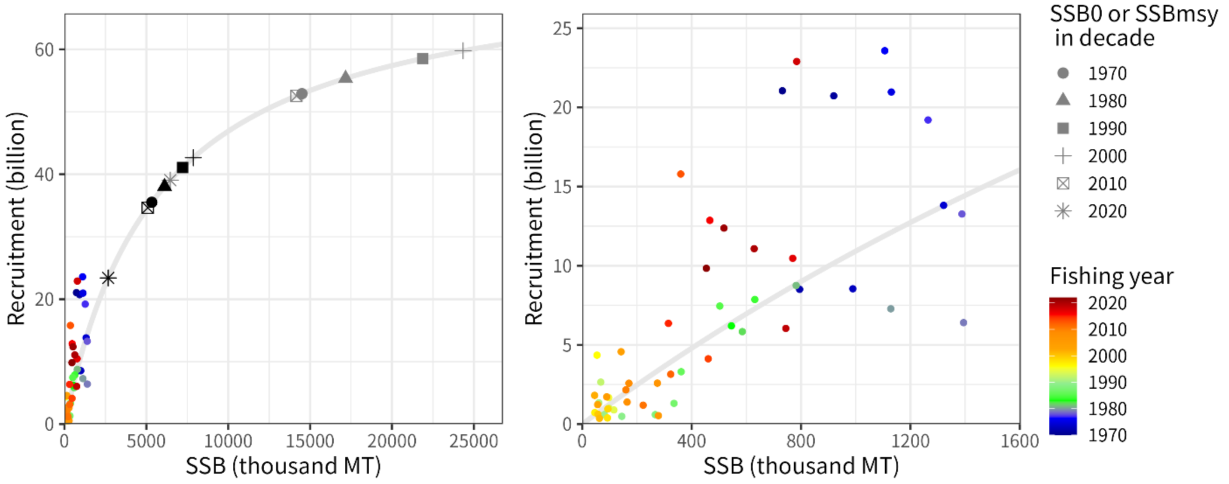
Relationship between six abundance index and their corresponding abundance estimates under the base case scenario (S28-ProcEst). The blue lines indicate the precited relationships.

Figure 10



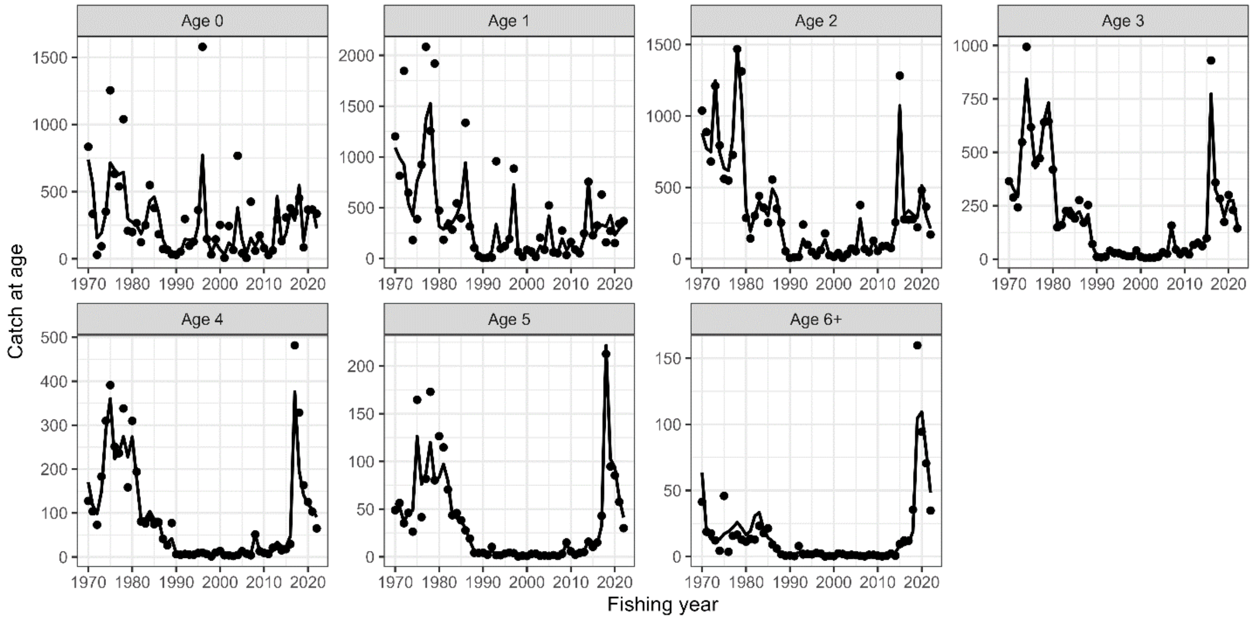
Time series of estimates of total biomass (1,000 MT), SSB (1,000 MT), recruitment (billion), catch (1,000 MT), mean F, and exploitation rate (catch divided by total biomass) of chub mackerel under the initial base case scenario (B2-Mage), the final base case S28-ProcEst and the representative case scenarios of S32-JP23, and S34-PRocEst23.

Figure 11



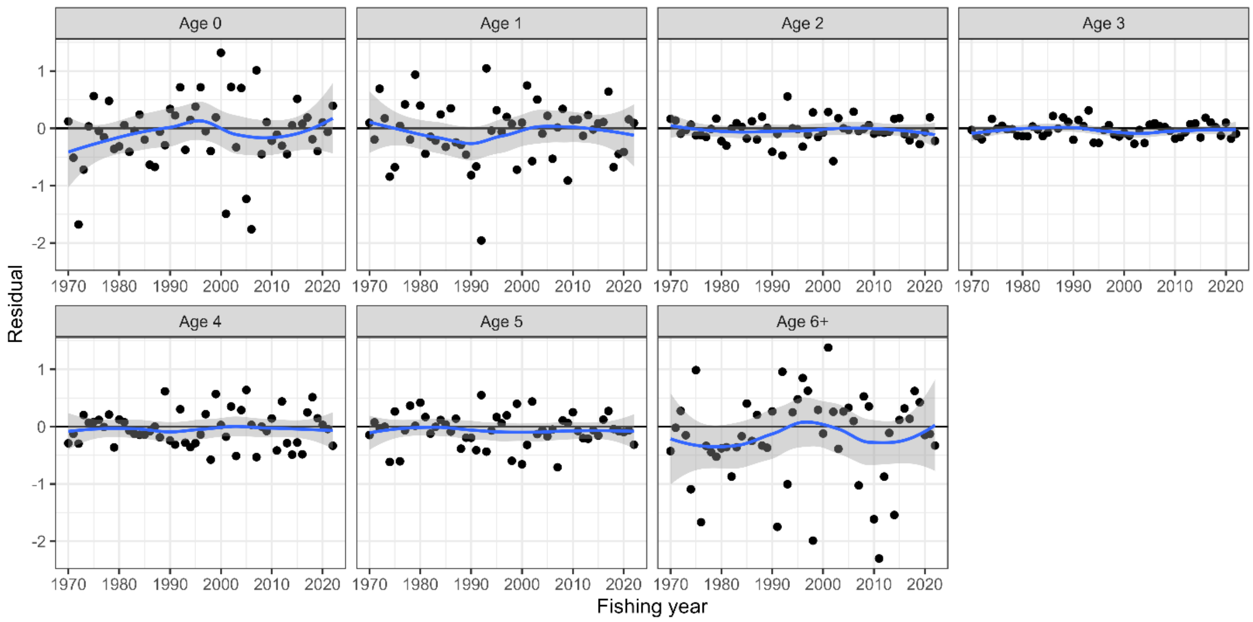
Estimated Beverton-Holt stock recruitment relationship of chub mackerel under the base case scenario (S28-ProcEst) (gray lines) and estimated past SSB and number of recruits (colored circles) overplotted with estimated SSB0 (equilibrium unexploited spawning biomass, grey symbols) and SSB_{MSY} (black symbols). The reference points are calculated using biological parameters averaged during the decades. The unit of SSB on the x-axis is 1000 mt and the unit of subscription on the y-axis is billions.

Figure 12



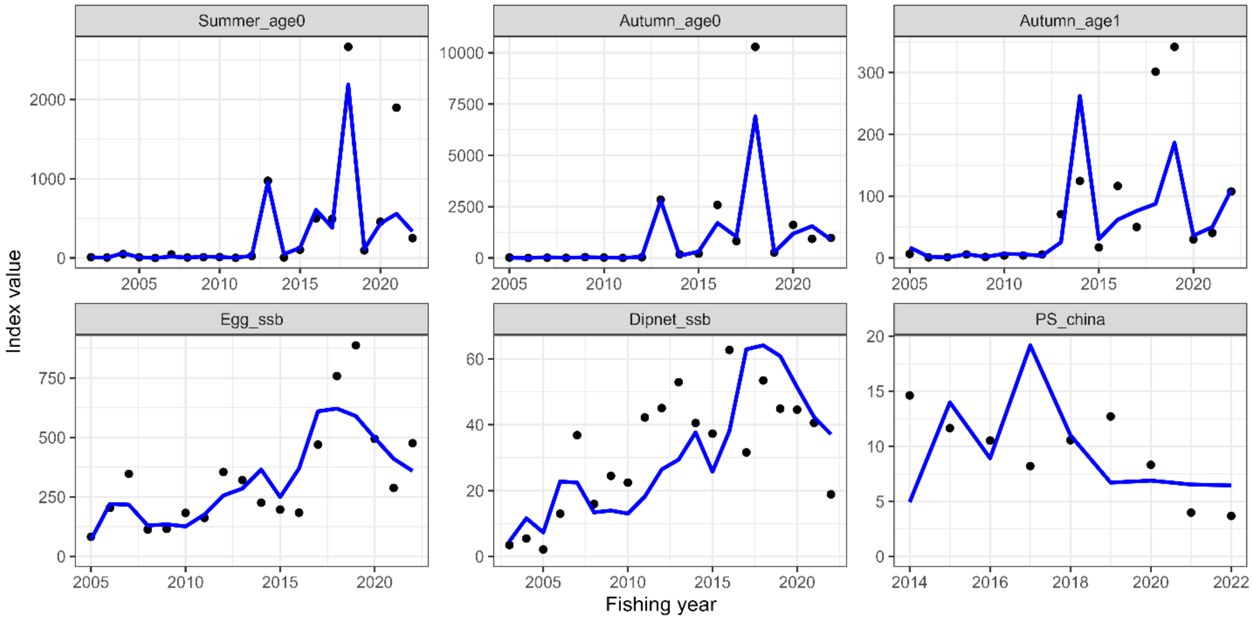
Observed catch numbers by age (dots) and their predicted values (lines)of chub mackerel under the base case scenario of S28-ProcEst.

Figure 13



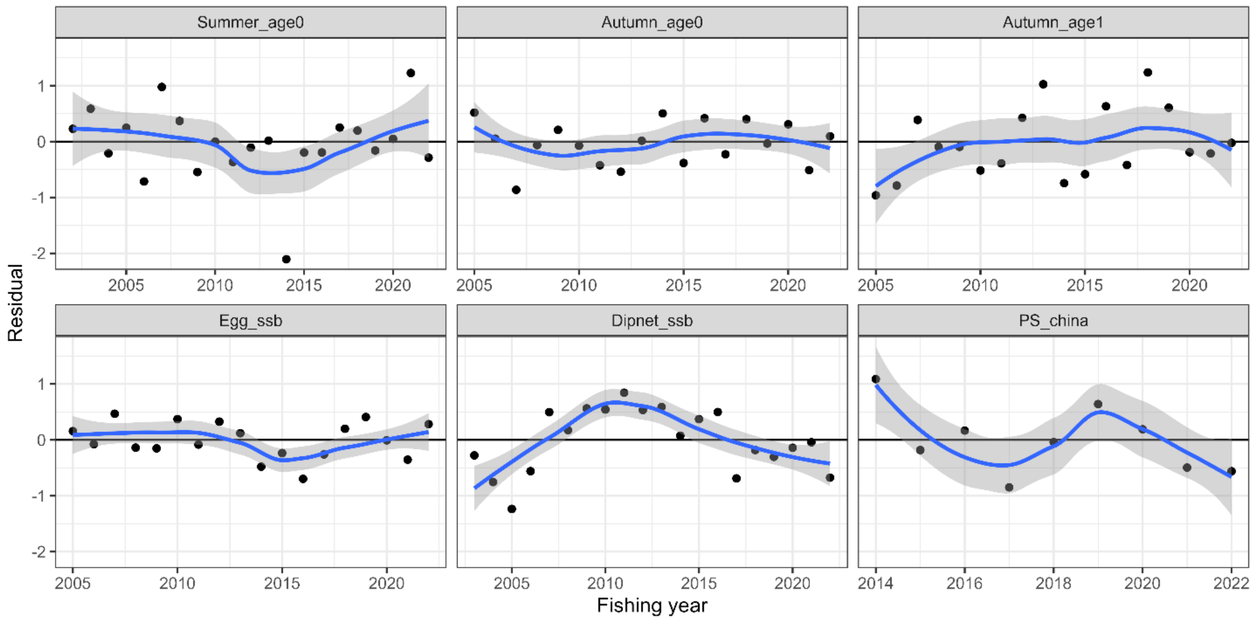
Residual plot for catch numbers of chub mackrel by age under the base case scenario of S28-ProcEst. Blue curves and shaded areas indicate smoothed curves estimated by LOESS and their 95% confidence intervals.

Figure 14



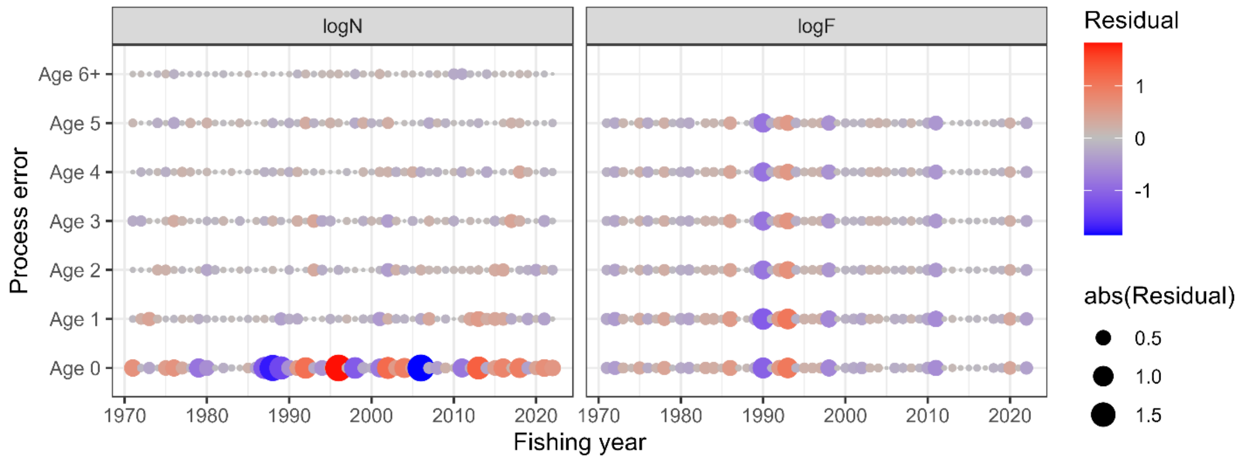
Trends of abundance indices used (dots) and their predicted values (lines) of chub mackerel under the base case scenario of S28-ProcEst.

Figure 15



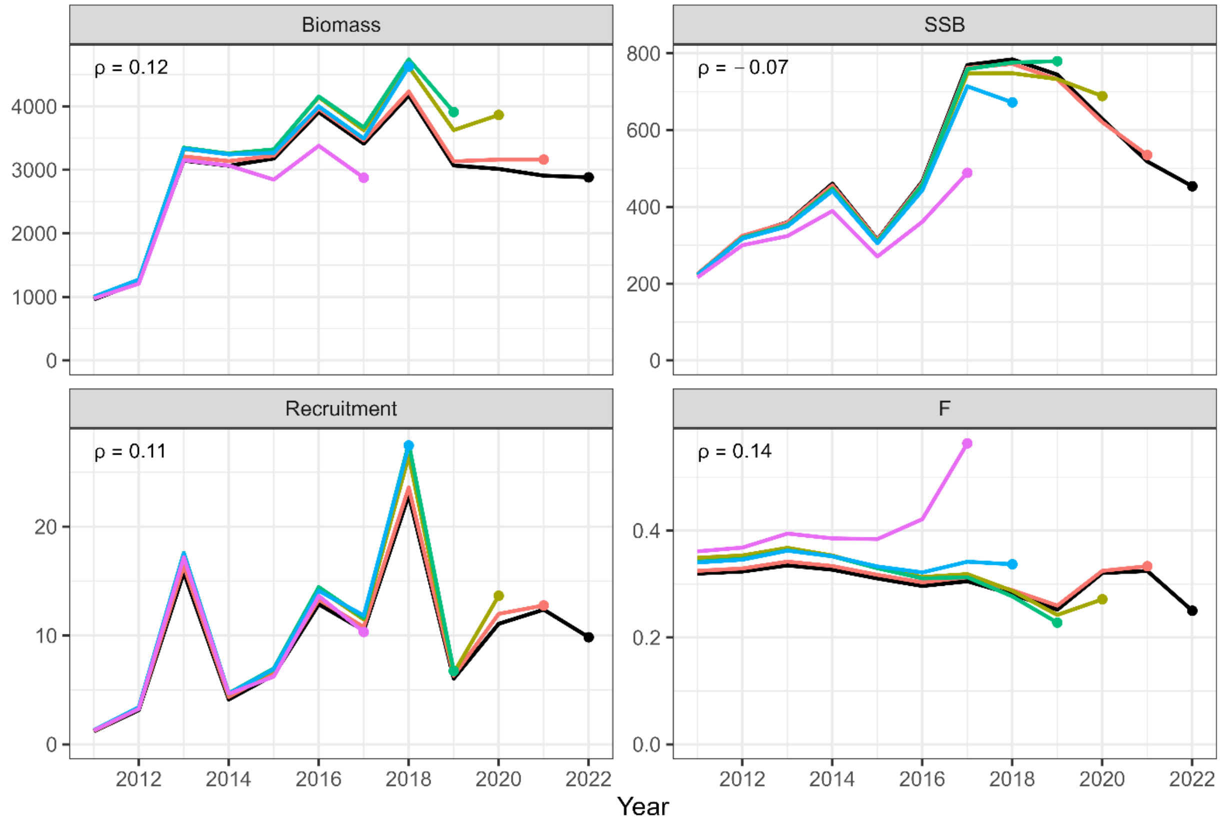
Residual plot for abundance indices of chub mackerel under the base case scenario of S28-ProcEst. Blue curves and shaded areas indicate smoothed curves estimated by LOESS and their 95% confidence intervals.

Figure 16



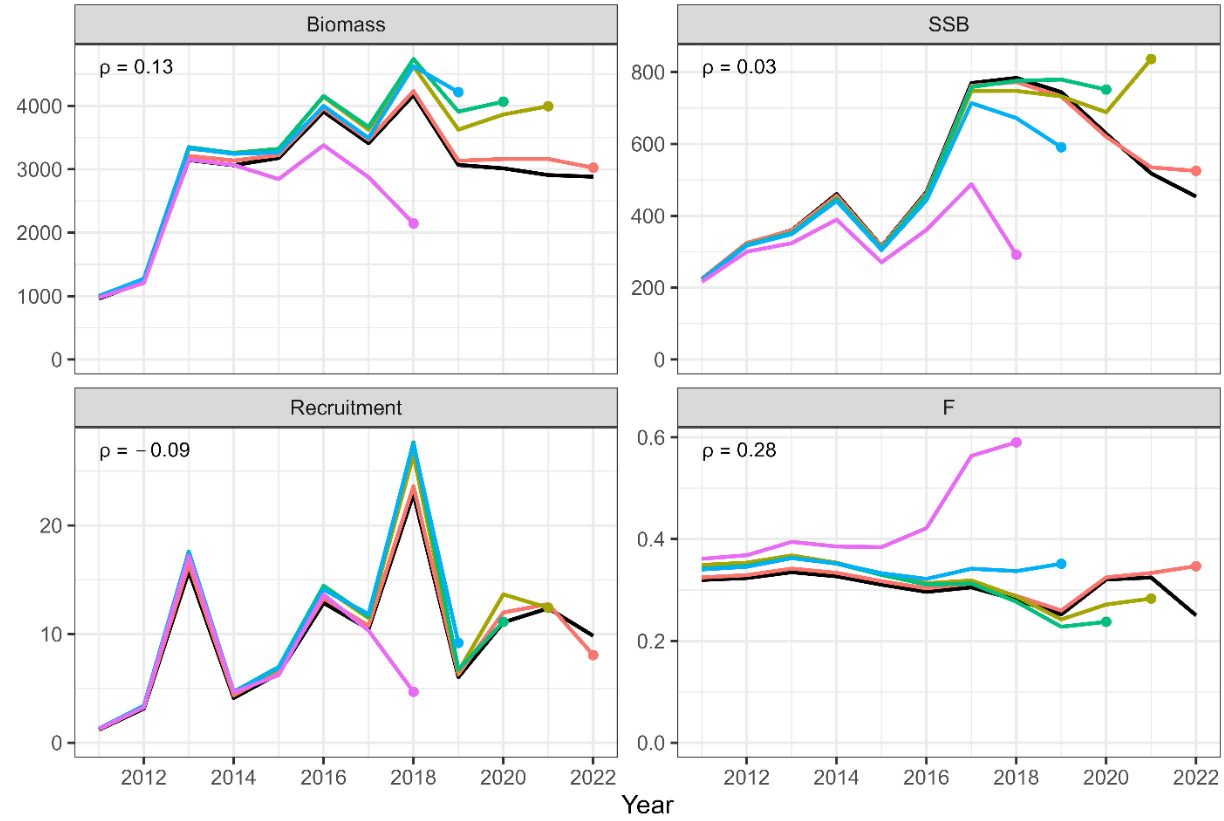
Process errors log(N) (left) and log(F) (right) of chub mackerel under the base case scenario (S28-ProcEst). Note that the process error in the number of individuals is almost zero, since the number of fish above one year of age is fixed to a small value, and the residuals of zero-year-old recruitment are shown as scattered up and down.

Figure 17



Retrospective patterns for total biomass (top left), SSB (top right), recruitment (bottom left), and mean F (bottom right) of chub mackerel under the base case scenario of S28-ProcEst. Black Lines represent models with all data, and colored lines represent models with the most recent data trimmed. Mohn's rho is shown in the upper left corner. The dots indicate the terminal year for the calculation of Mohn’s rho.

Figure 18

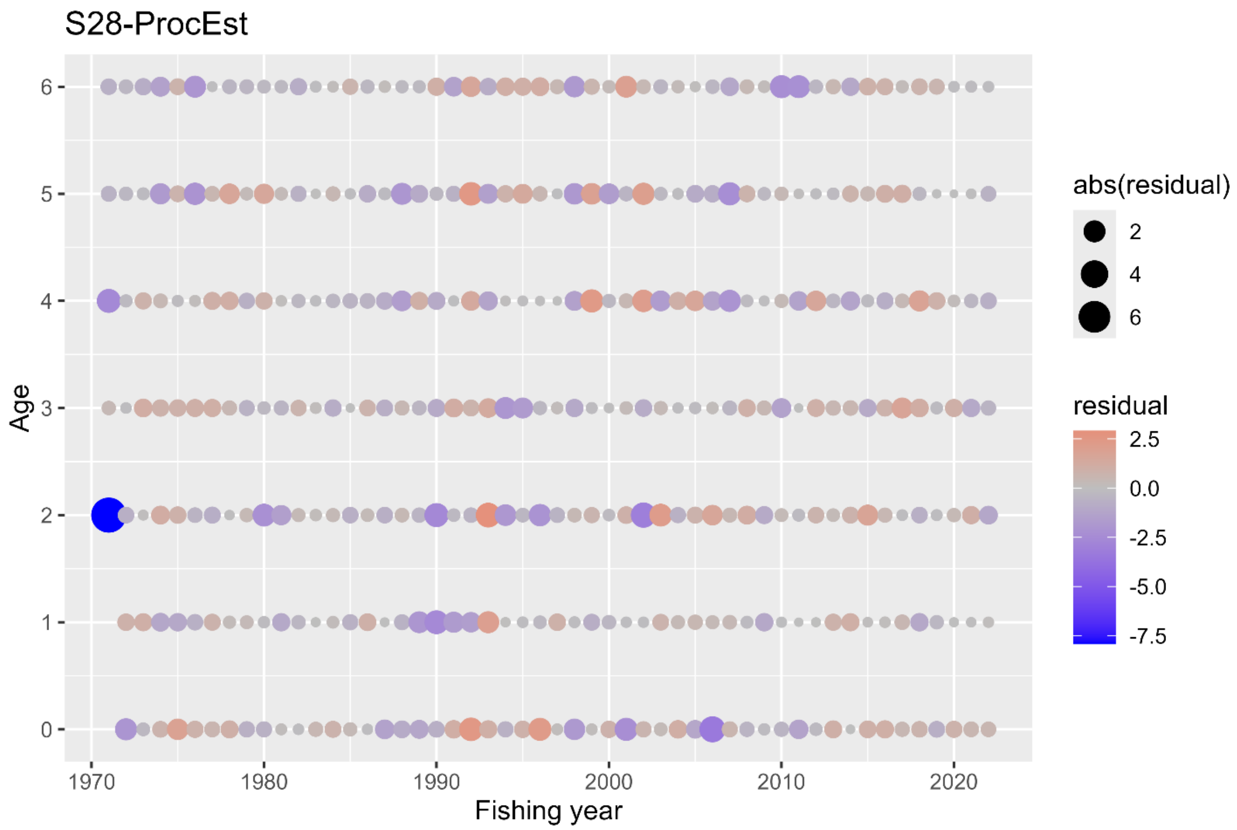


Patterns of retrospective forecasting for total biomass (top left), SSB (top right), recruitment (bottom left), and mean F (bottom right) of chub mackerel under the base case scenario of S28-ProcEst. Black Lines represent models with all data, and colored lines represent models with the most recent data trimmed. Mohn's rho is shown in the upper left corner. The dots indicate the year of one-year-ahead forecasting, used for the calculation of Mohn's rho.

Figure 19

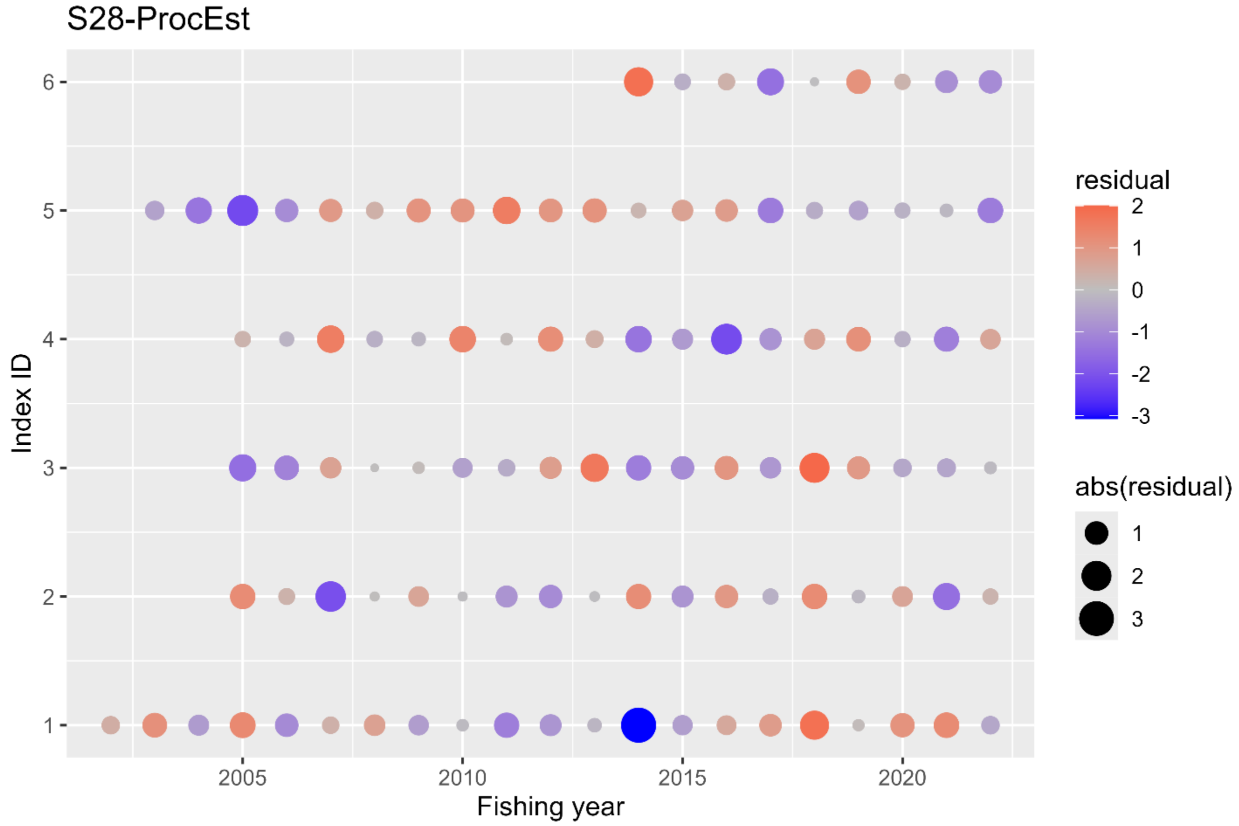
Comparison of the results of the estimates of chub mackerel when all index values are used and when each indicator is excluded for the base case scenario of S28-ProcEst S28-ProcEst. The IDs of the index are as follows: (1) relative stock number of age 0 from the summer survey by Japan, (2) relative stock number of age 0 from the autumn survey by Japan, (3) relative stock number of age 1 from the autumn survey by Japan, (4) relative SSB from the egg survey by Japan, (5) relative SSB from the dip-net fishery by Japan, and (6) relative vulnerable stock biomass from the light purse-seine fishery by China.

Figure 20



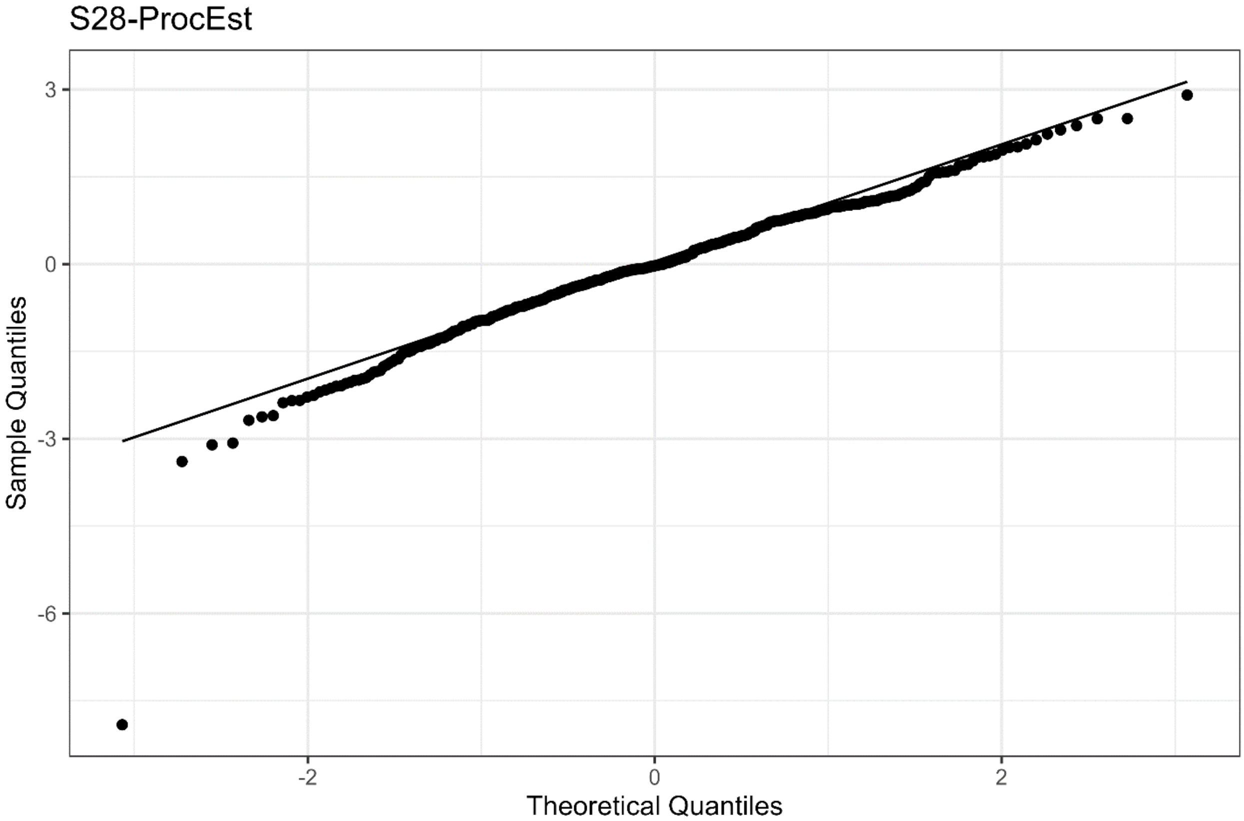
One-Step-Ahead residuals for the age composition for the base case scenario of S28-ProcEst.

Figure 21



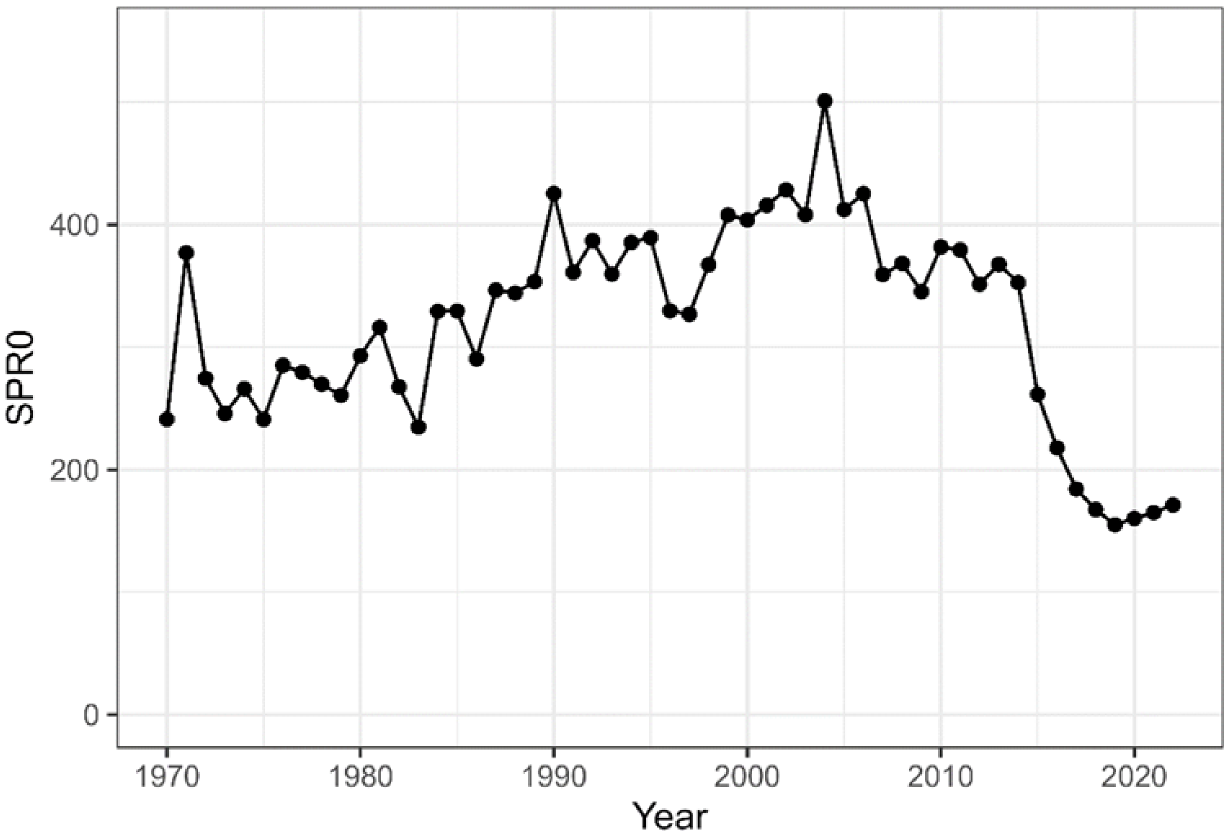
One-Step-Ahead residuals for the indices of abundance for the base case scenario of S28-ProcEst. The IDs of the index are as follows: (1) relative stock number of age 0 from the summer survey by Japan, (2) relative stock number of age 0 from the autumn survey by Japan, (3) relative stock number of age 1 from the autumn survey by Japan, (4) relative SSB from the egg survey by Japan, (5) relative SSB from the dip-net fishery by Japan, and (6) relative vulnerable stock biomass from the light purse-seine fishery by China.

Figure 22



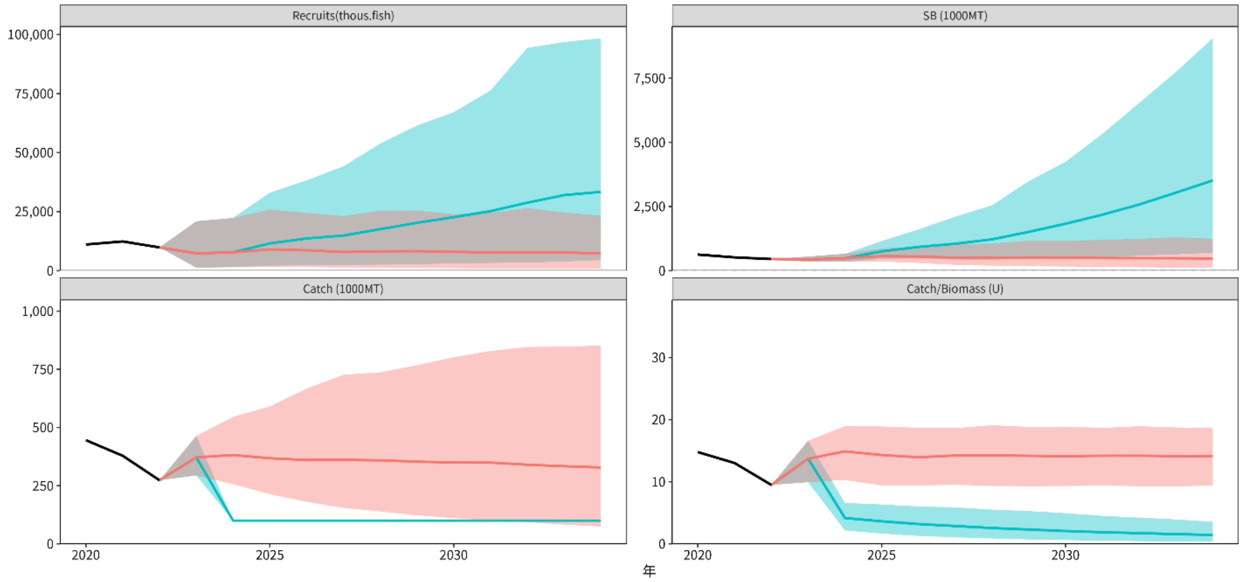
QQplot of the One-Step-Ahead residuals from the indices for the base case scenario of S28-ProcEst .

Figure 23



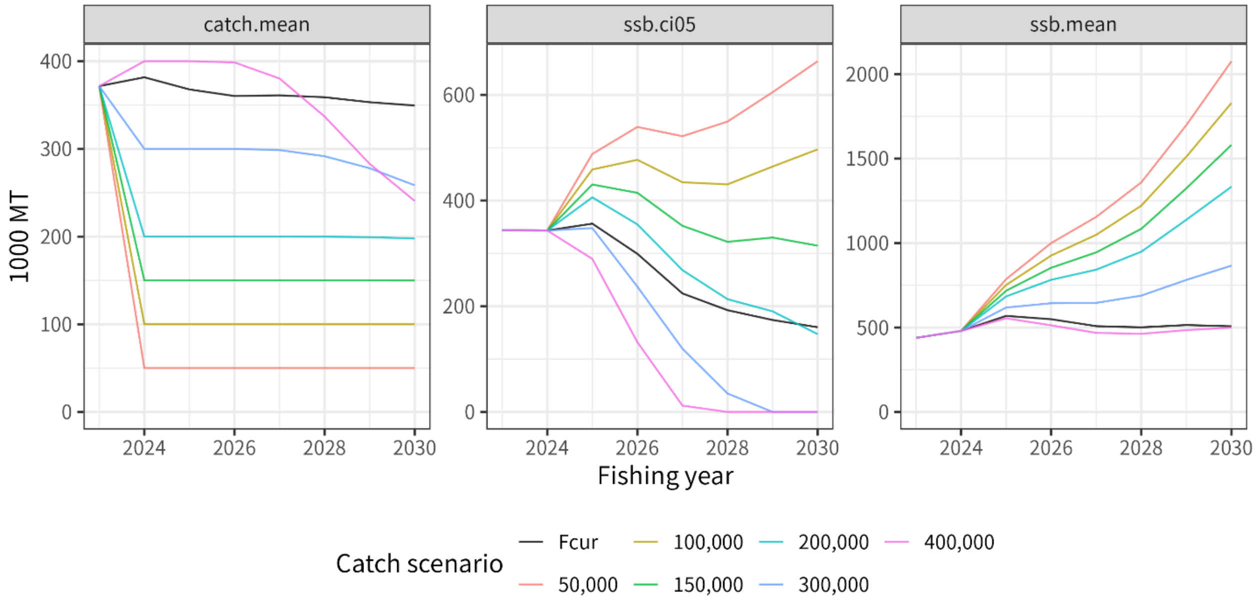
Trajectories of spawners per recruit without fishing (SPR0 in grams).

Figure 24



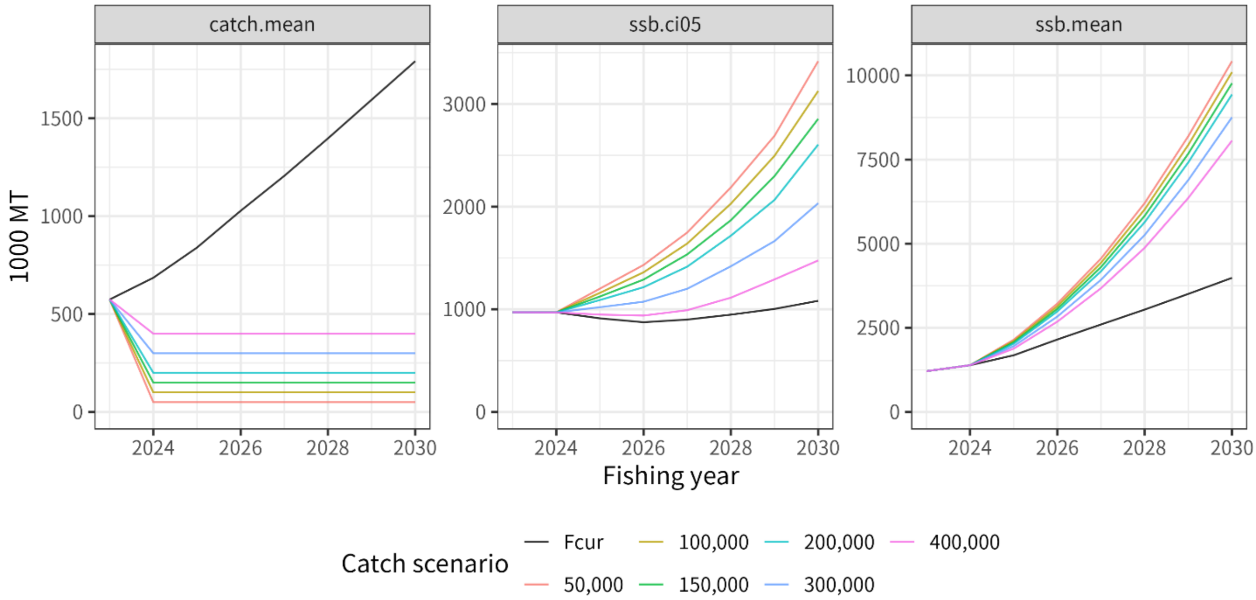
Examples of stochastic future projection results of chub mackerel. In this figure, results based on constant catch=100,000MT (blue) and current F (red) are compared. The shaded areas represent 90% prediction intervals, black solid lines are estimates by SAM, and colored solid lines are average.

Figure 25



Comparison of future trajectories in different future harvest scenarios ("Catch100" means 100,000MT constant catch) for future average catch (left, catch.mean), lower 5 percentile of spawning biomass (middle, ssb.ci05) and average spawning biomass (right, ssb.mean) of chub mackerel.

Figure 26



Comparison of future trajectories in different future harvest scenarios using all the biological parameter from 1970-2022. ("Catch100" means 100,000MT constant catch) for future average catch (left, catch.mean), lower 5 percentile of spawning biomass (middle, ssb.ci05) and average spawning biomass (right, ssb.mean) of chub mackerel..

APPENDIX 1

Results for representative case runs of B2-Mage (B2), S32-JP23, and S34-PRocEst23

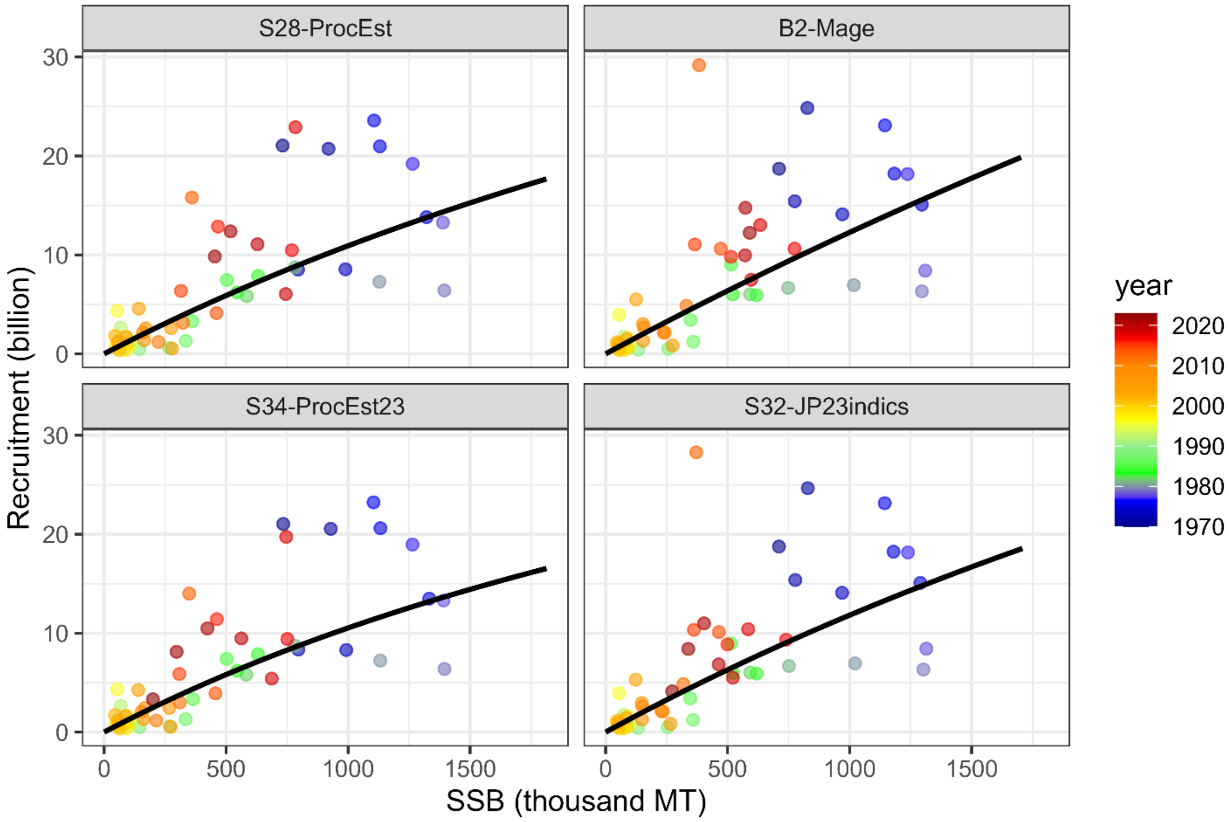
Stock assessment scenarios

In order to improve the SAM fit to abundance indices and retrospective patterns, the TWG CMSA recognized the necessity of introduction of estimation of process error in survival of age groups older than age 0. The TWG CMSA also considered inclusion of FY2023 from the Japanese abundance indices, which had a large impact on the stock status of the most recent years. As a result, the following four scenarios were employed as representative cases:

1) B2, Estimate process error for only age 0 (recruitment) ;
2) S28-ProcEst, Estimate process error for all age groups;
3) S32-JP23, Estimate process error for only age 0 and use Japanese indices up to FY2023; and
4) S34-ProcEst23, Estimate process error for all age groups and use Japanese indices up to FY2023

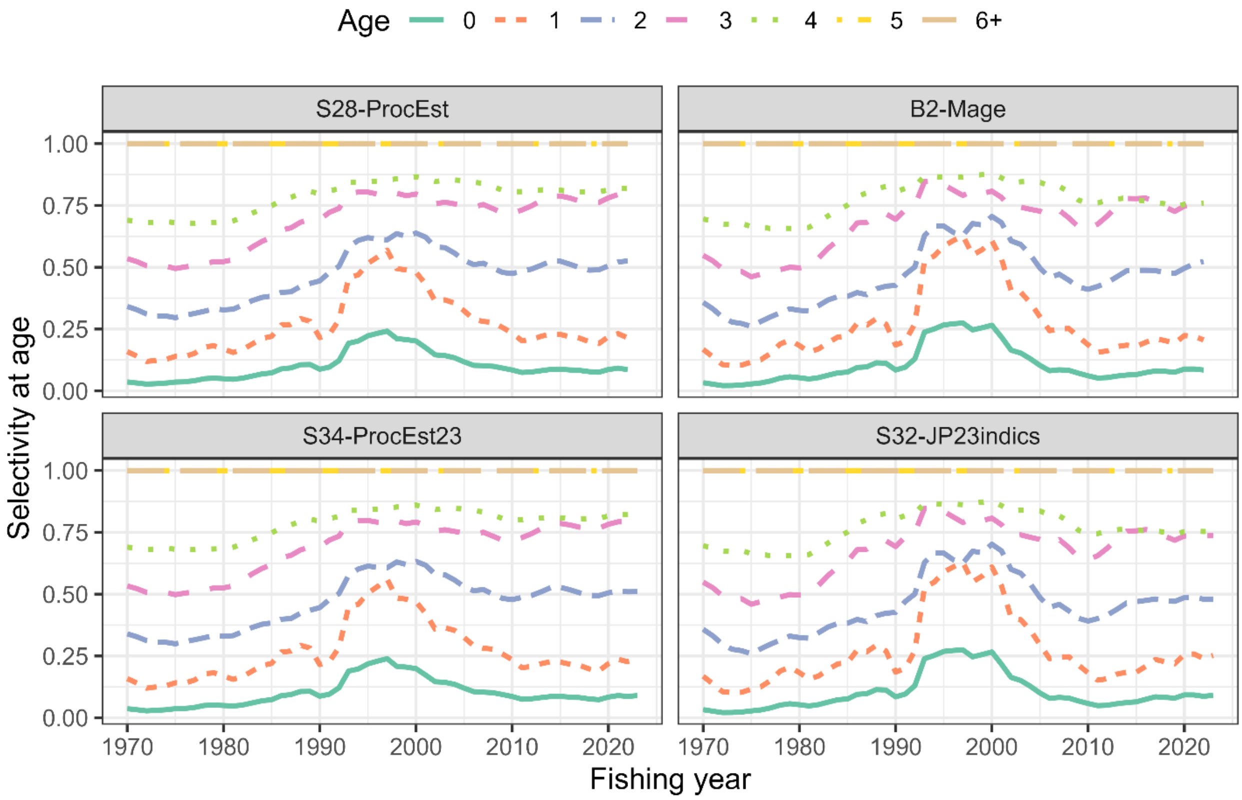
TWG CMSA agreed to select S28-ProcEst as a base case scenario because of the better diagnostics than the model only with recruitment process error and agreement of data usage up to FY2022. This Annex shows the comparison of the above four models along with the following models B1-Mcom, S31-JP23indics,27-ProcEst and S33-ProcEst23.

Figure ANNEX 1



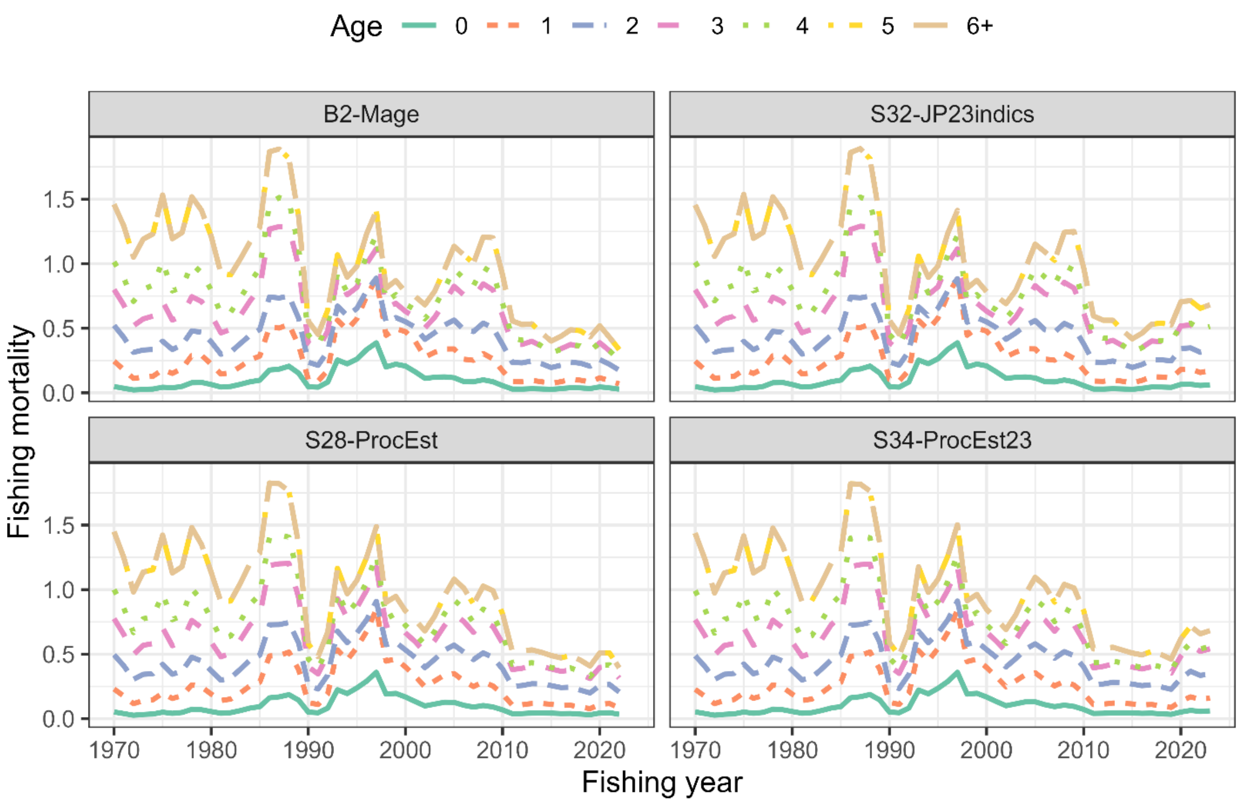
Estimated Beverton-Holt stock recruitment relationship (black lines) and estimated past SSB and number of recruits (colored circles) of chub mackerel under the final base case S28-ProcEst, the initial base case scenario B2-Mage, and other representative cases of S34-ProcEst23 and S32-JP23indics.

Figure ANNEX 2



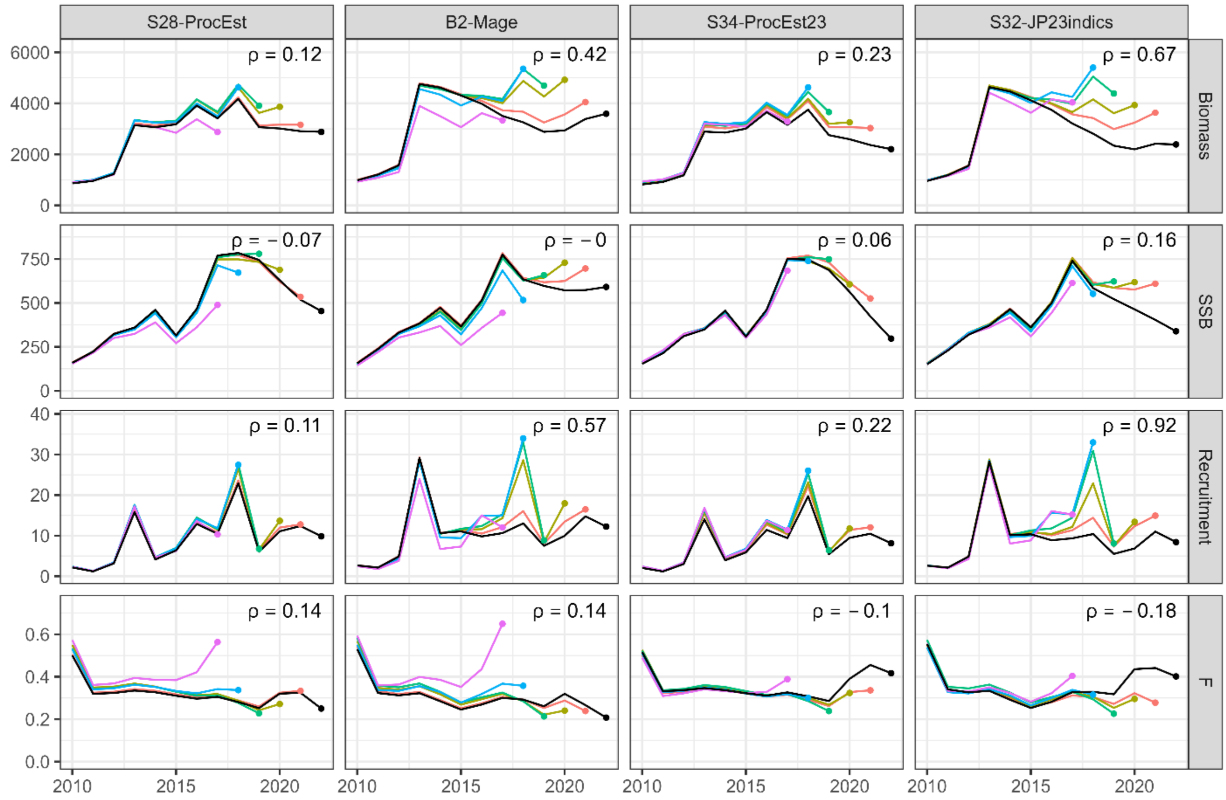
Estimated annual selectivity at age under the final base case S28-ProcEst, the initial base case scenario (B2-Mage), and the other representative cases of S34-ProcEst23 and S32-JP23indics.

Figure ANNEX 3



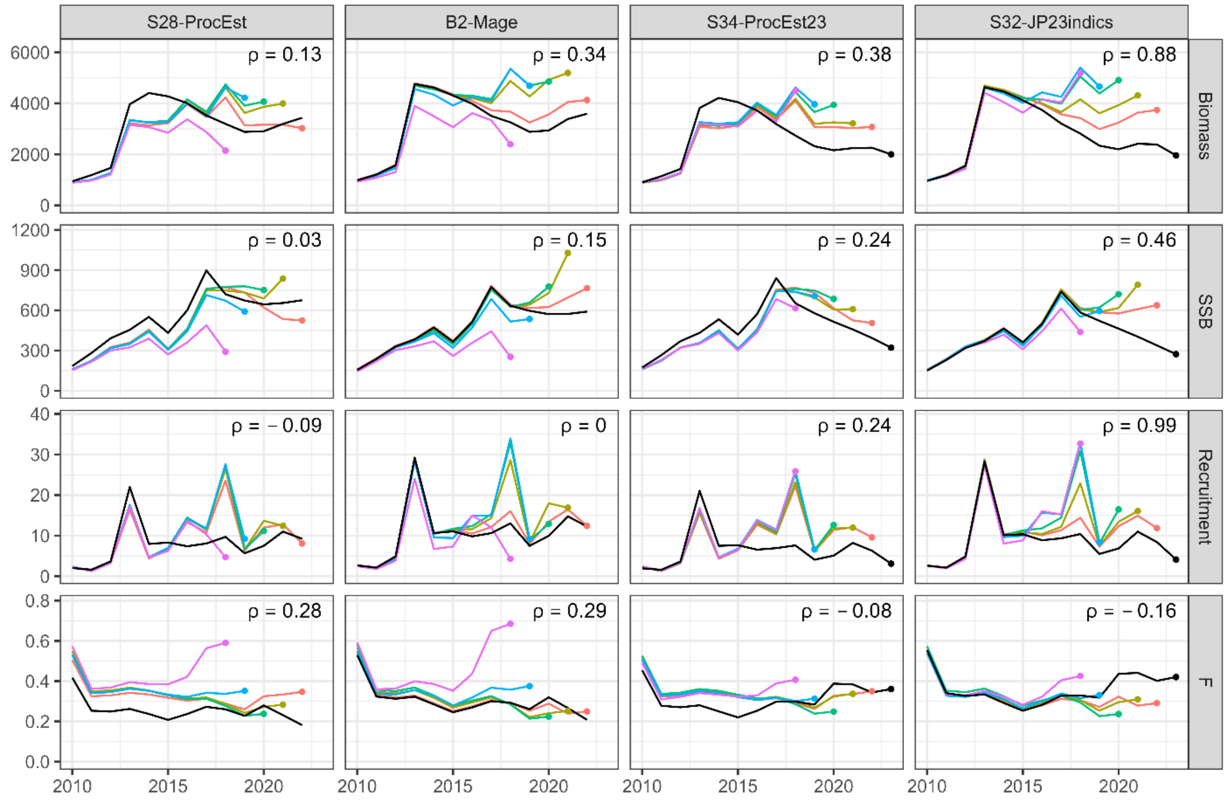
Time series of estimates of F at age for the final base case S28-ProcEst, the initial base case scenario B2-Mage, and the other representative cases of S34-ProcEst23 and S32-JP23indics.

Figure ANNEX 4



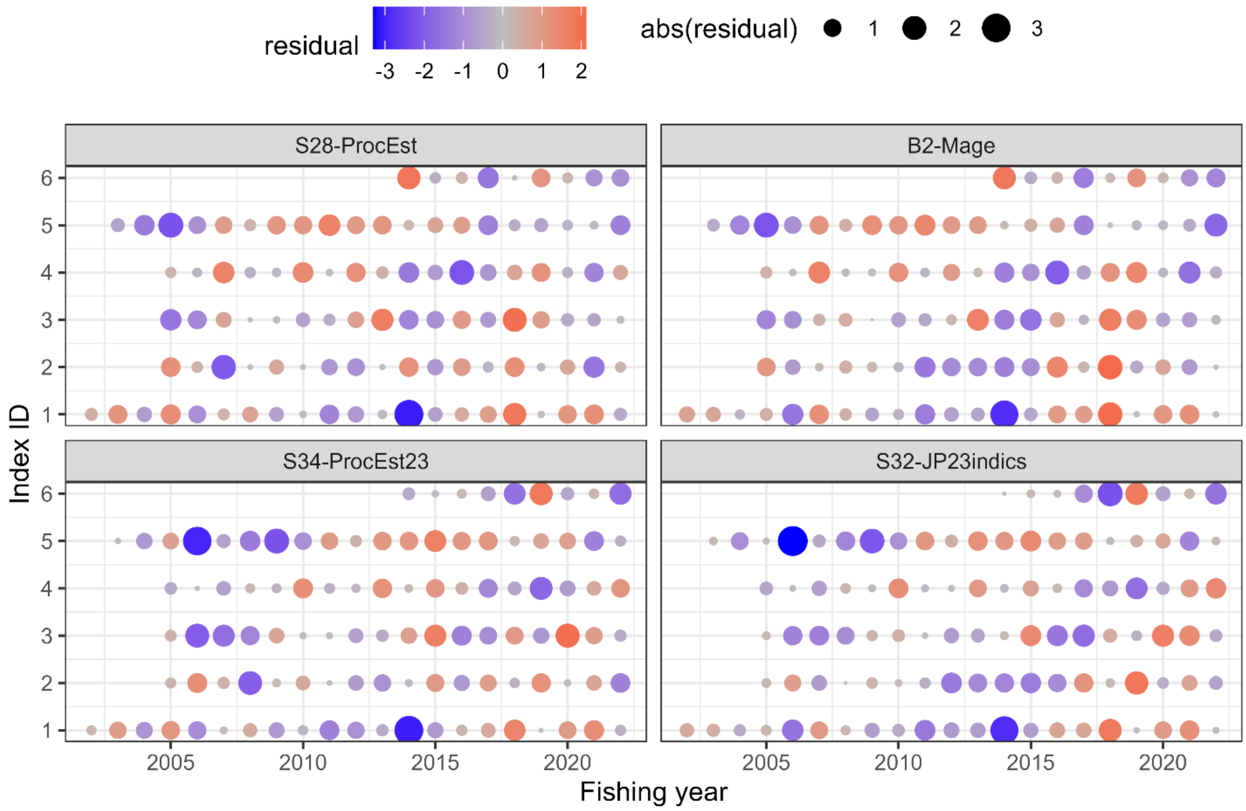
Retrospective patterns for total biomass (top row), SSB (second row), recruitment (third row), and mean F (bottom) of chub mackerel. Black Lines represent models with all data, and colored lines represent models with the most recent data trimmed. Mohn's rho is shown in the upper right corner. The dots indicate the terminal year for the calculation of Mohn's rho. Scenarios shown here are the final base case S28-ProcEst, the initial base case scenario B2-Mage, the other representative cases of S34-PRocEst23 and S32-JP23indics.

Figure ANNEX 5



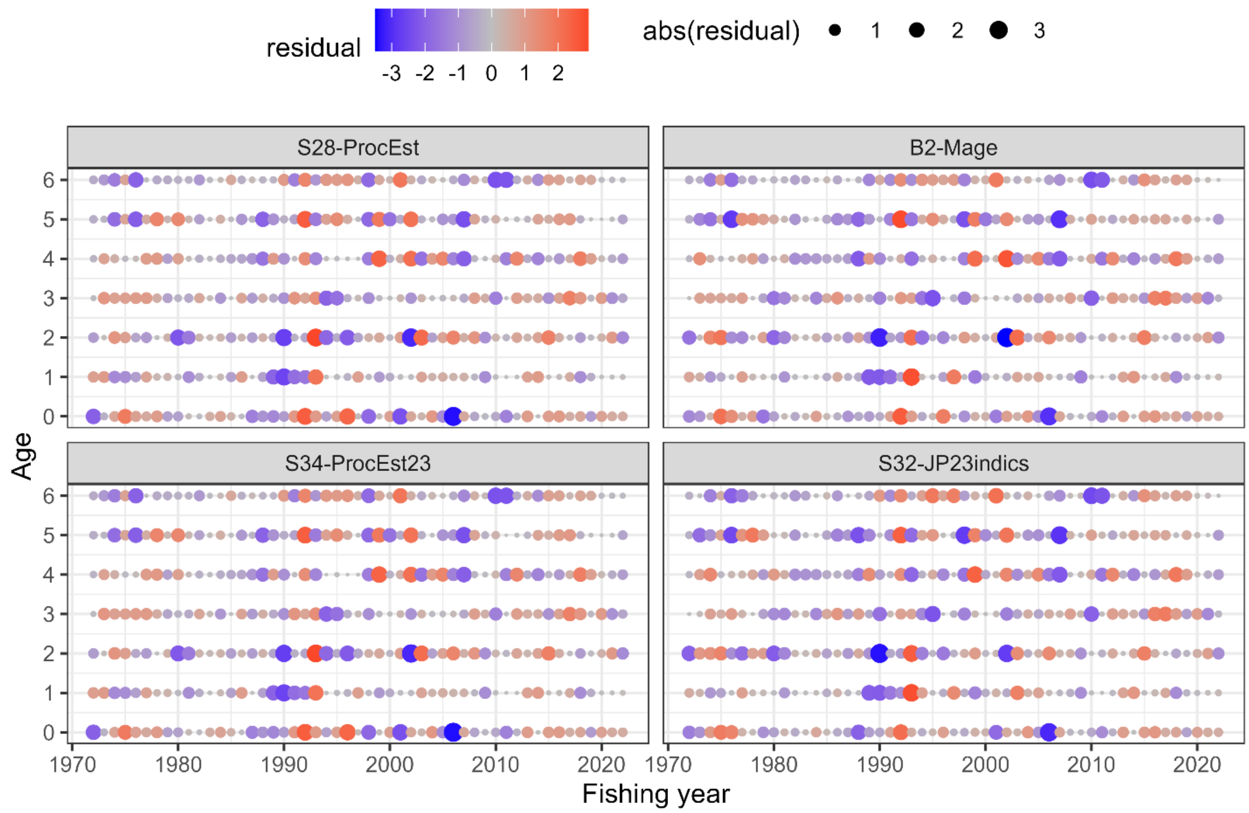
Patterns of retrospective forecasting for total biomass of chub mackerel. Black Lines represent models with all data, and colored lines represent models with the most recent data trimmed. Mohn's rho is shown in the upper right corner. The dots indicate the year of one-year-ahead forecasting, used for the calculation of Mohn's rho. Retrospective patterns for total biomass (top row), SSB (second row), recruitment (third row), and mean F (bottom). Black Lines represent models with all data, and colored lines represent models with the most recent data trimmed. Mohn's rho is shown in the upper right corner. Scenarios shown here are the final base case S28-ProcEst, the initial base case scenario B2-Mage, and the other representative cases of S34-PRocEst23 and S32-JP23indics.

Figure ANNEX 6



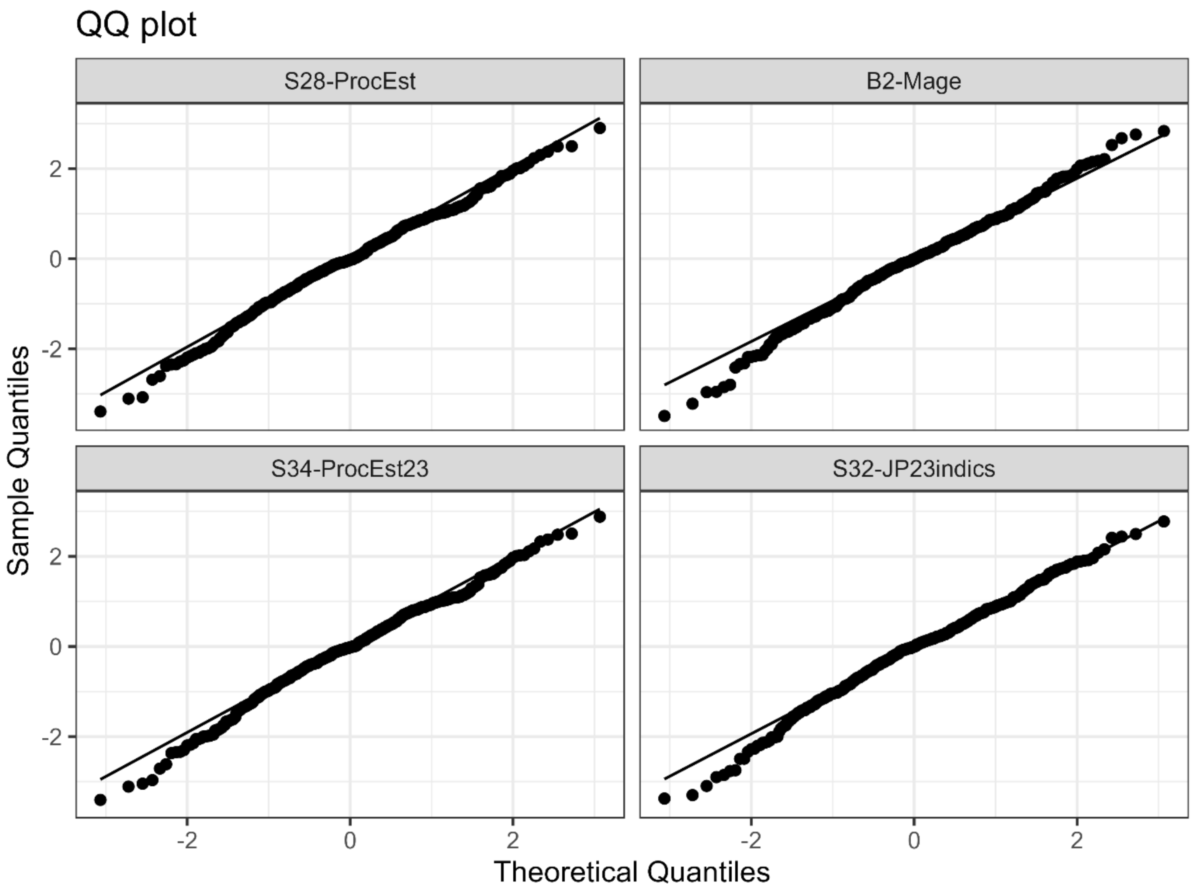
One-Step-Ahead residuals for the indices of abundance. The IDs of the index are as follows: (1) relative stock number of age 0 from the summer survey by Japan, (2) relative stock number of age 0 from the autumn survey by Japan, (3) relative stock number of age 1 from the autumn survey by Japan, (4) relative SSB from the egg survey by Japan, (5) relative SSB from the dip-net fishery by Japan, and (6) relative vulnerable stock biomass from the light purse-seine fishery by China. Scenarios shown here are the final base case S28-ProcEst, the initial base case scenario B2-Mage, and the other representative cases of S34-PRocEst23 and S32-JP23indics.

Figure ANNEX 7



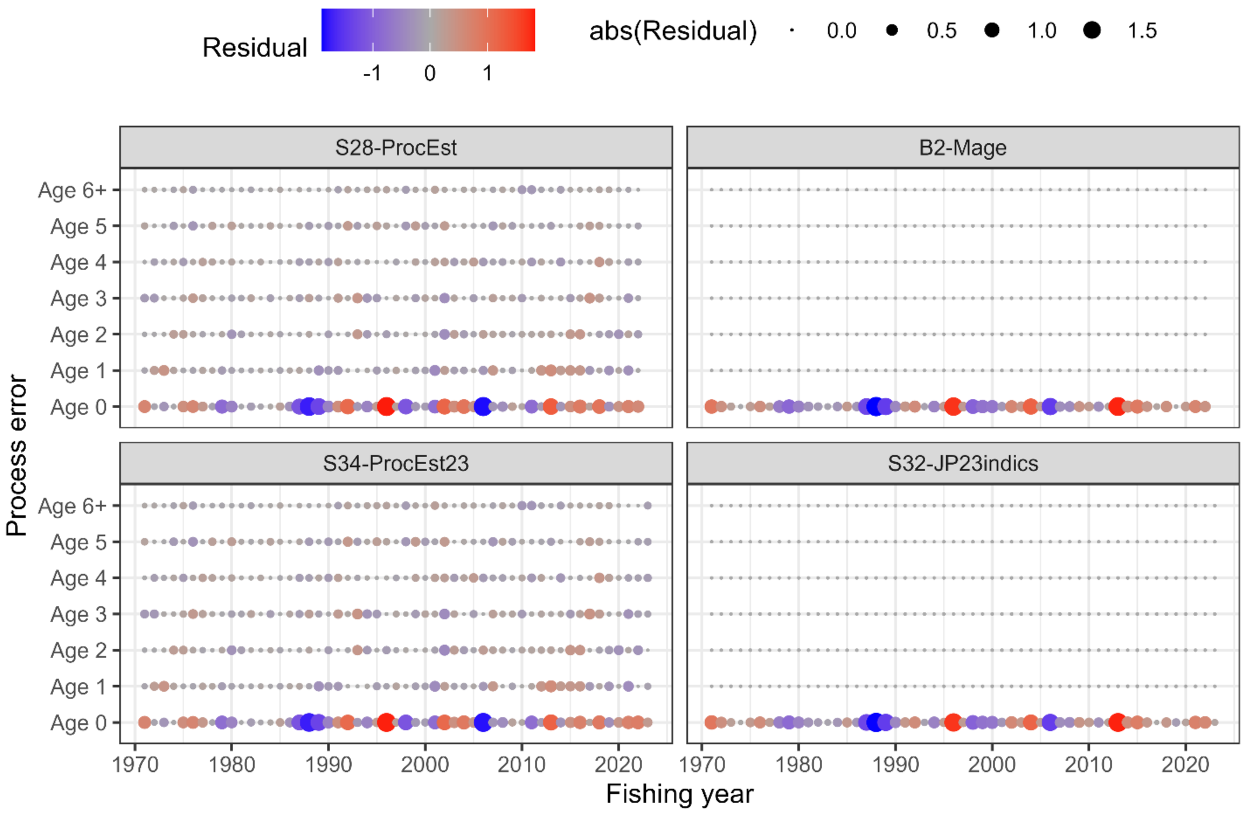
One-Step-Ahead residuals for the Catch at Age data. Scenarios shown here are the final base case S28-ProcEst, the initial base case scenario B2-Mage, and the other representative cases of S34-PRocEst23 and S32-JP23indics.

Figure ANNEX 8



QQ plot of the One-Step-Ahead residuals Scenarios shown here are the final base case S28-ProcEst, the initial base case scenario B2-Mage, and the other representative cases of S34-PRocEst23 and S32-JP23indics.

Figure ANNEX 9



Estimated process error in the numbers at age by year and model. Scenarios shown here are the final base case S28-ProcEst, the initial base case scenario B2-Mage, and the other representative cases S34-PRocEst23 and S32-JP23indics.

Table ANNEX 1

Convergence diagnostics by model. Scenarios shown here are the initial base case scenario B2-Mage, the final base case S28-ProcEst, and the other representative cases of S31-JP23indics and S34-PRocEst23. Bold values indicate the selected base case.

Model	**convergence**	**pdHess**	**maxGrad**
B2-Mage	✓	✓	0.000107
S32-JP23indices	✓	✓	0.001964
S28-ProcEst	**✓**	**✓**	**0.002456**
S34-ProcEst23	✓	✓	0.001749

Table ANNEX 2

Performance measures by model. Scenarios shown here are the initial base case scenario B2-Mage, the final base case S28-ProcEst, and the other representative cases of S31-JP23indics and S34-PRocEst23. Bold values indicate the selected base case.

PM	B2-Mage	S32-JP23indics	S28-ProcEst	S34-ProcEst23
TBy2022	3,591	2,388	**2,882**	2,204
Sby2022	591	339	**454**	297
Ry2018	13,019	10,398	**22,898**	19,737
Ry2019	7,490	5,496	**6,043**	5,405
Ry2020	9,960	6,840	**11,077**	9,464
Ry2021	14,760	10,989	**12,377**	10,479
Ry2022	12,234	8,407	**9,839**	8,120
AFy2018	0.306	0.344	**0.294**	0.326
AFy2019	0.274	0.333	**0.276**	0.315
AFy2020	0.329	0.446	**0.342**	0.420
AFy2021	0.268	0.427	**0.333**	0.462
AFy2022	0.202	0.356	**0.243**	0.376
Ey2018	0.128	0.148	**0.109**	0.122
Ey2019	0.121	0.152	**0.123**	0.138
Ey2020	0.147	0.200	**0.148**	0.176
Ey2021	0.106	0.162	**0.130**	0.170
Ey2022	0.081	0.139	**0.095**	0.136
currentSPR	0.319	0.191	**0.283**	0.193
deple_median_last3	1.609	1.172	**1.591**	1.382
Fmed/Fcur	0.787	0.490	**0.478**	0.367
F0.1/Fcur	1.516	0.964	**1.344**	0.970
FpSPR.30.SPR/Fcur	1.069	0.664	**0.942**	0.668
FpSPR.40.SPR/Fcur	0.764	0.474	**0.673**	0.478
FpSPR.50.SPR/Fcur	0.549	0.341	**0.484**	0.344
FpSPR.60.SPR/Fcur	0.387	0.240	**0.342**	0.243
FpSPR.70.SPR/Fcur	0.260	0.162	**0.230**	0.163
Fmsy/Fcur	0.306	0.194	**0.258**	0.187
Bmsy	21517	12592	**9396**	7127
SBmsy	6582	3834	**2905**	2193
h	0.366	0.370	**0.358**	0.362
SB0	16292	9542	**7123**	5400
SBmsy/SB0	0.404	0.402	**0.408**	0.406
FmsySPR	0.662	0.656	**0.673**	0.668

B/Bmsy	0.167	0.190	**0.307**	0.309
SB/SBmsy	0.090	0.088	**0.156**	0.135
SBmsy/SBmax	5.024	2.917	**2.083**	1.572

Table ANNEX 3

Description of performance measures (PM). The most recent three-year averages (FY2020-2022) of F-at-age and the biological parameters (maturity at age and weight at age) are used for PMs related to current F, F reference points, stock-recruitment relationship, and MSY.

PM	Description
TBy2022	Total stock biomass in FY2022 (1,000 MT)
Sby2022	Spawning stock biomass in FY2022 (1,000 MT)
Ry2018	The number of recruits in FY2018 (million)
Ry2019	The number of recruits in FY2019 (million)
Ry2020	The number of recruits in FY2020 (million)
Ry2021	The number of recruits in FY2021 (million)
Ry2022	The number of recruits in FY2022 (million)
AFy2018	Weighted average of F-at-age by estimated catch-at-age in FY2018
AFy2019	Weighted average of F-at-age by estimated catch-at-age in FY2019
AFy2020	Weighted average of F-at-age by estimated catch-at-age in FY2020
AFy2021	Weighted average of F-at-age by estimated catch-at-age in FY2021
AFy2022	Weighted average of F-at-age by estimated catch-at-age in FY2022
Ey2018	Exploitation rate (estimated catch divided by stock biomass) in FY2018
Ey2019	Exploitation rate in FY2019
Ey2020	Exploitation rate in FY2020
Ey2021	Exploitation rate in FY2021
Ey2022	Exploitation rate in FY2022
currentSPR	Spawners per recruit (SPR) in the average of FY2020-2022 (%)
deple_median_last3	Ratio of the average of spawning biomass in FY2020-2022 to its historical median
Fmed/Fcur	Ratio of F median to current F (average F in FY2020-2022)
F0.1/Fcur	Ratio of F0.1 to current F (average F in FY2020-2022)
FpSPR.30.SPR/Fcur	Ratio of F30%SPR to current F (average F in FY2020-2022)
FpSPR.40.SPR/Fcur	Ratio of F40%SPR to current F (average F in FY2020-2022)
FpSPR.50.SPR/Fcur	Ratio of F50%SPR to current F (average F in FY2020-2022)
FpSPR.60.SPR/Fcur	Ratio of F60%SPR to current F (average F in FY2020-2022)
FpSPR.70.SPR/Fcur	Ratio of F70%SPR to current F (average F in FY2020-2022)

Fmsy/Fcur	Ratio of F_{MSY} to current F (average F in FY2020-2022)
Bmsy	Deterministic MSY reference point for total biomass (1,000 MT)
SBmsy	Deterministic MSY reference point for spawning biomass (1,000 MT)
h	Steepness
SB0	Virgin spawning stock biomass (1,000 MT)
SBmsy/SB0	Ratio of SB_{MSY} to SB0
FmsySPR	%SPR for F_{MSY}
B/Bmsy	Ratio of total biomass in FY2022 to B_{MSY}
SB/SBmsy	Ratio of spawning biomass in FY2022 to SB_{MSY}
SBmsy/SBmax	Ratio of SB_{MSY} to the historical maximum of spawning biomass

Stock assessment report for Pacific saury

EXECUTIVE SUMMARY

Data used in the assessment modeling

Data are included from the NPFC Convention Area and Members' Exclusive Economic Zones (EEZs). 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 180º 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.

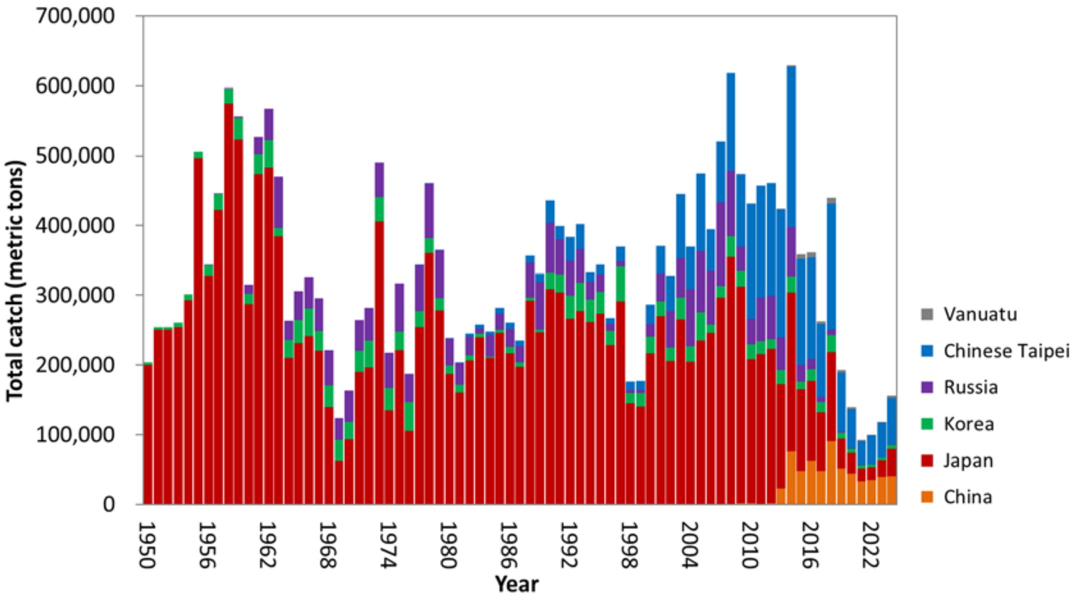


Figure 1. Time series of catch by Member during 1950-2024. The catch data for 1950-1979 are shown but not used in stock assessment modeling. Catch data in 2024 are preliminary (as of 29 November 2024) and not used in the assessment.

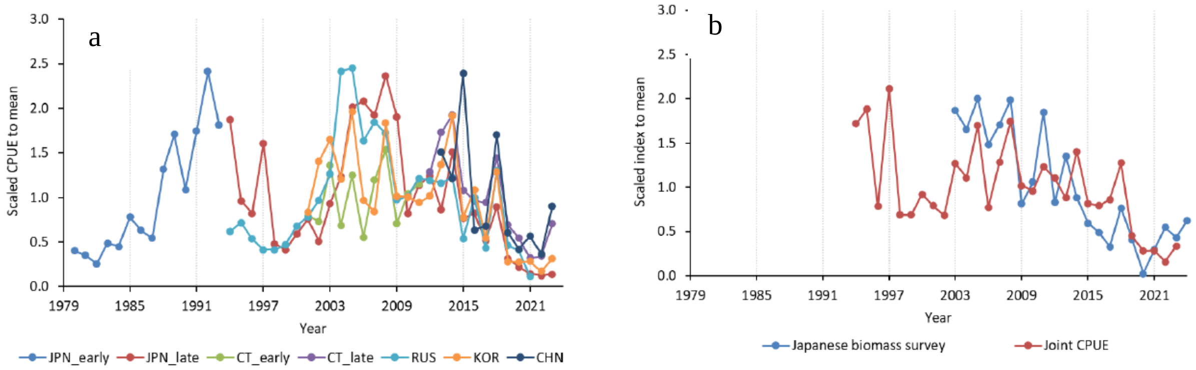


Figure 2. Time series of (a) Japanese survey biomass index and joint CPUE and (b) Member's standardized CPUE indices used in the assessment modeling.

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 1980-2024. 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 PS13 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 1a (The aggregated results for 2023 are shown in Table 1b). 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. Medians and credible intervals for the aggregated results are presented. In addition, median values of Member's combined results (over B1 and B2) are shown.

a. 2024 assessment

	Median	Lower10%	Upper10%	Median_CHN	Median_JPN	Median_CT
C_2023 (10000 t)	11.836	11.836	11.836	11.836	11.836	11.836
AveC_2021_2023	10.352	10.352	10.352	10.352	10.352	10.352
AveF_2021_2023	0.328	0.158	0.528	0.352	0.339	0.302
F_2023	0.297	0.155	0.469	0.313	0.307	0.277
FMSY	0.330	0.139	0.543	0.357	0.336	0.310
MSY (10000 t)	39.440	32.021	47.010	40.155	39.284	39.010
F_2023/FMSY	0.920	0.656	1.411	0.915	0.942	0.903
AveF_2021_2023/FMSY	1.008	0.755	1.435	1.013	1.026	0.988
K (10000 t)	248.067	151.766	565.726	234.100	253.396	254.500
B_2023 (10000 t)	39.875	25.214	76.394	37.830	38.599	42.720
B_2024 (10000 t)	52.763	35.130	91.631	50.920	52.120	55.155
AveB_2022_2024	41.563	27.387	77.406	39.705	40.555	44.165
BMSY (10000 t)	120.100	78.060	253.481	113.800	119.008	125.100
BMSY/K	0.485	0.392	0.604	0.480	0.471	0.505
B_2023/K	0.161	0.101	0.228	0.158	0.154	0.169
B_2024/K	0.212	0.122	0.315	0.212	0.206	0.219
AveB_2022_2024/K	0.169	0.106	0.236	0.168	0.163	0.175
B_2023/BMSY	0.328	0.225	0.452	0.323	0.322	0.339
B_2024/BMSY	0.435	0.270	0.628	0.433	0.431	0.440
AveB_2022_2024/BMSY	0.345	0.235	0.470	0.341	0.341	0.352

b. 2023 assessment

	Median	Lower10%	Upper10%	Median_CHN	Median_JPN	Median_CT
C_2022 (10000 t)	10.009	10.009	10.009	10.009	10.009	10.009
AveC_2020_2022	11.066	11.066	11.066	11.066	11.066	11.066
AveF_2020_2022	0.337	0.141	0.621	0.328	0.376	0.316
F_2022	0.245	0.113	0.426	0.231	0.270	0.237
FMSY	0.314	0.108	0.576	0.305	0.350	0.297
MSY (10000 t)	39.657	30.473	48.874	40.434	39.856	38.940
F_2022/FMSY	0.806	0.519	1.436	0.810	0.799	0.809
AveF_2020_2022/FMSY	1.111	0.770	1.748	1.159	1.106	1.079
K (10000 t)	264.054	147.520	702.181	285.000	251.768	260.100
B_2022 (10000 t)	40.820	23.503	88.382	43.290	37.073	42.300
B_2023 (10000 t)	54.940	33.227	108.300	57.340	52.284	55.320
AveB_2021_2023	42.410	25.270	90.015	44.623	39.042	43.883
BMSY (10000 t)	128.100	74.289	317.407	136.900	118.580	130.150
BMSY/K	0.481	0.389	0.604	0.469	0.469	0.506
B_2022/K	0.155	0.089	0.233	0.150	0.151	0.163
B_2023/K	0.209	0.105	0.341	0.200	0.210	0.214
AveB_2021_2023/K	0.163	0.092	0.244	0.156	0.160	0.170
B_2022/BMSY	0.316	0.195	0.474	0.306	0.316	0.323
B_2023/BMSY	0.426	0.227	0.698	0.412	0.441	0.424
AveB_2021_2023/BMSY	0.331	0.201	0.496	0.320	0.336	0.337

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	136.290	0.175	1.123	0.554	0.549
1981	143.000	0.143	1.217	0.438	0.594
1982	154.500	0.158	1.321	0.482	0.646
1983	159.818	0.161	1.364	0.490	0.671
1984	163.400	0.151	1.391	0.459	0.685
1985	167.300	0.168	1.422	0.511	0.701
1986	167.100	0.156	1.413	0.475	0.697
1987	170.216	0.138	1.434	0.424	0.706
1988	174.700	0.204	1.461	0.630	0.719
1989	164.800	0.201	1.372	0.621	0.677
1990	160.800	0.271	1.346	0.838	0.661
1991	146.700	0.272	1.225	0.849	0.601
1992	138.900	0.276	1.166	0.867	0.567
1993	132.866	0.303	1.115	0.962	0.539
1994	124.225	0.268	1.040	0.860	0.498
1995	121.400	0.283	0.993	0.944	0.473
1996	113.402	0.235	0.911	0.798	0.434
1997	118.500	0.312	0.913	1.110	0.435
1998	103.500	0.170	0.802	0.600	0.383
1999	114.500	0.154	0.873	0.549	0.419
2000	127.800	0.224	1.002	0.769	0.481
2001	131.800	0.281	1.071	0.920	0.518
2002	135.296	0.243	1.120	0.768	0.545
2003	155.200	0.286	1.292	0.890	0.631
2004	153.300	0.241	1.269	0.744	0.625
2005	166.208	0.285	1.350	0.892	0.668
2006	148.600	0.265	1.213	0.826	0.599
2007	155.978	0.334	1.268	1.040	0.629
2008	149.101	0.414	1.198	1.305	0.595
2009	111.116	0.425	0.917	1.315	0.451
2010	109.500	0.393	0.897	1.220	0.442
2011	114.800	0.397	0.924	1.250	0.458
2012	101.700	0.453	0.834	1.402	0.411
2013	100.373	0.422	0.814	1.314	0.404
2014	93.029	0.677	0.768	2.068	0.380
2015	63.708	0.563	0.525	1.736	0.259
2016	56.762	0.637	0.471	1.950	0.232
2017	48.322	0.543	0.402	1.670	0.197
2018	51.780	0.842	0.427	2.545	0.212
2019	30.715	0.636	0.255	1.944	0.126
2020	25.040	0.558	0.209	1.709	0.103
2021	25.250	0.365	0.209	1.127	0.103
2022	31.970	0.313	0.264	0.969	0.130
2023	39.875	0.297	0.328	0.920	0.161
2024	52.763		0.435		0.212

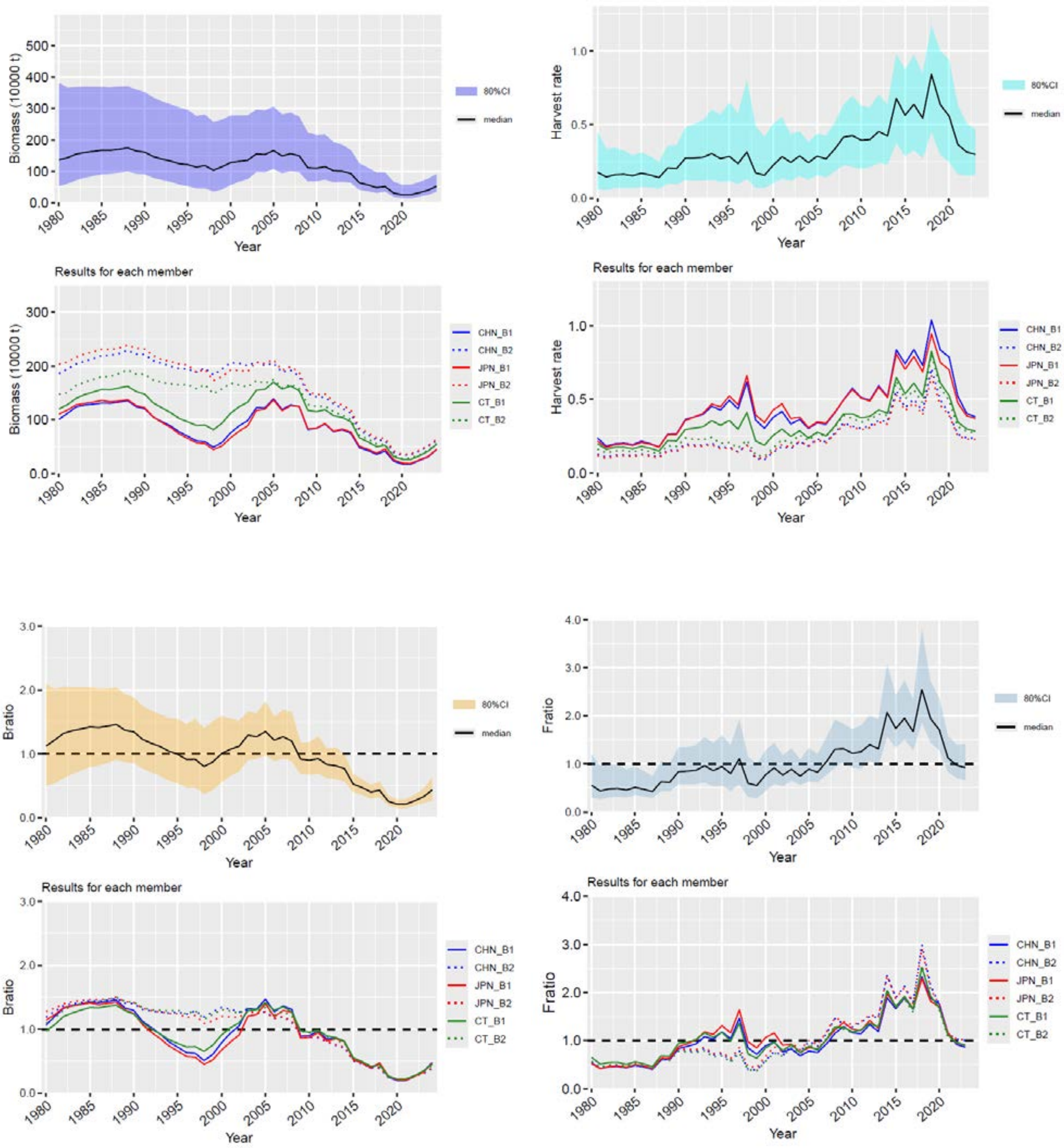


Figure 3. Time series of median estimated values of six runs for biomass, harvest rate, B-ratio, F-ratio and depletion level relative to K. The solid and shaded lines correspond to B1 and B2, respectively.

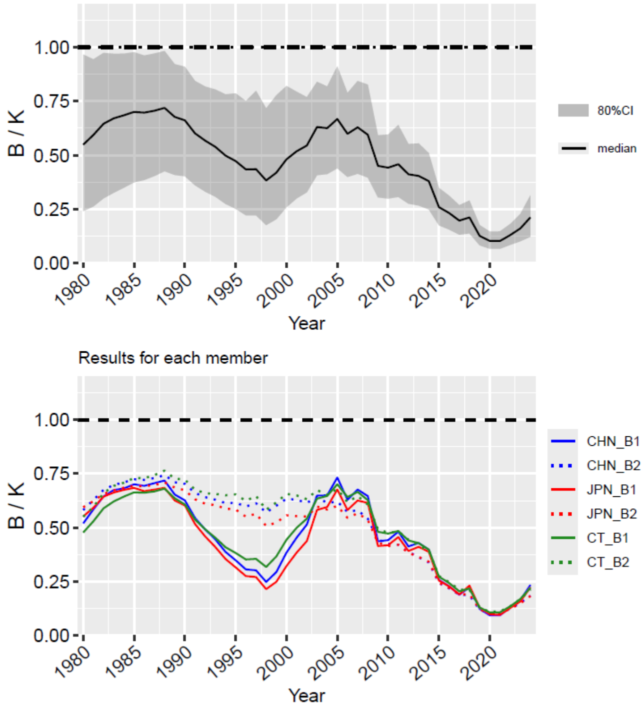
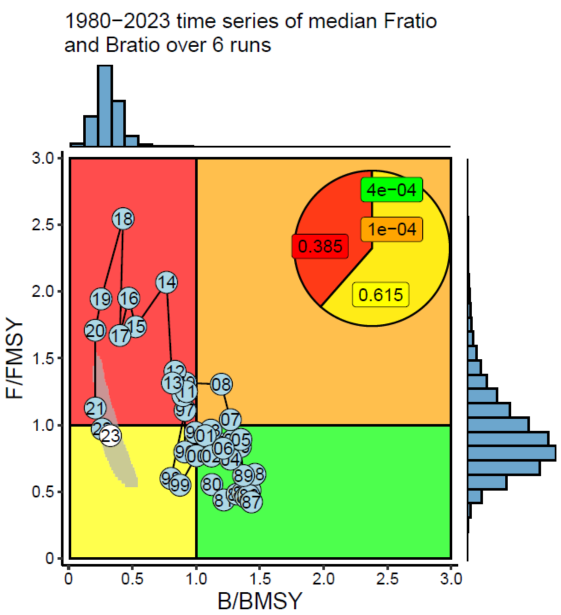


Figure 3 (Continued).

2024 assessment



2023 assessment

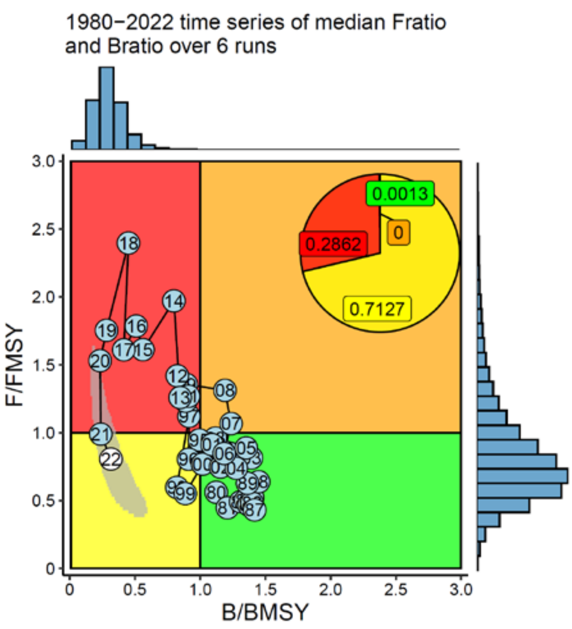


Figure 4. Kobe plot with time trajectory in 2024 (left) and 2023 (right) assessments. The data are aggregated across 6 model results (2 base-case models by 3 Members).

Current stock condition and management advice

Summary of stock status

Results of all Members' and combined model estimates indicate the stock declined with high interannual variability from a high biomass level in the mid-2000's after a period of high productivity to the current low biomass levels. Combined results show that average B was below B_{MSY} during 2022–2024 (median average B/B_{MSY} during 2022–2024 = 0.345, 80%CI = 0.235–0.470) and average F was above F_{MSY} (average F/F_{MSY} during 2021–2023 = 1.008, 80%CI = 0.755–1.435). Thus, stock biomass remained at low levels in recent years. Biomass may have increased modestly during 2022–2024 based on the abundance indices and higher recruitment that may be evident in the Japanese fishery size composition. Based on CPUE, survey data, and model results, the condition of the Pacific saury stock and fishery improved in recent years although biomass remains below B_{MSY}. Harvest rates decreased while biomass and catch increased during 2020–2024. The improvement could be due at least in part to reductions in catch since 2020 and potentially due to unidentified environmental variability.

Uncertainty in assessment

Uncertainty in estimated biomass for the terminal year for Pacific saury translates into uncertainty about unconstrained TAC recommendations for the next fishing season. The estimated biomass for Pacific saury during 2023 in the 2023 assessment (549,400 mt) was substantially higher than the updated estimate (398,750 mt) for 2023 in 2024 assessment. As a result, the recommended 2024 TAC without restriction was 73,490 mt based on the 2023 assessment results, but would have been 75,741 mt based on the 2024 assessment results. Such changes occur because new data bring additional information about recent conditions. Ideally, positive and negative changes are equally likely, and the changes are small. Retrospective patterns in some runs for Pacific saury may have affected the HCR calculations. This is an important topic for work in the next assessment (see "Research Recommendations").

The average ensemble 2024 biomass estimate from all three Members and both base case runs was similar (527,630 mt) to estimates from the Member with no retrospective patterns (Chinese Taipei's average of two base case runs 551.450 mt). The agreement suggests that the ensemble average is precise enough for use in 2025 management.

Management advice

An interim harvest control rule (HCR) for Pacific saury was adopted under CMM 2024-08 For Pacific Saury by the NPFC in April 2024 (Figure 5). The HCR states that the unconstrained Total Annual Catch (TAC) in the following year ($year_{t+1}$) is a function of the biomass, fishing mortality, and B_{MSY} calculated in the current year (t): $TAC_{t+1} = B_t * F_{MSY,} * (B_t/B_{MSY})$. In addition, the HCR constrains changes in TAC to no more than 10% from one year to the next. The unconstrained 2025 TAC based on the results of the 2024 stock assessment is $B_{2024} * F_{MSY} * (B_{2024}/B_{MSY})$ = 75,741 tons, which is smaller than the 90% of the 2024 TAC of 225,000 mt. Following the application of the maximum 10% change aspect of the HCR, the final TAC for 2025 is 202,500 tons.

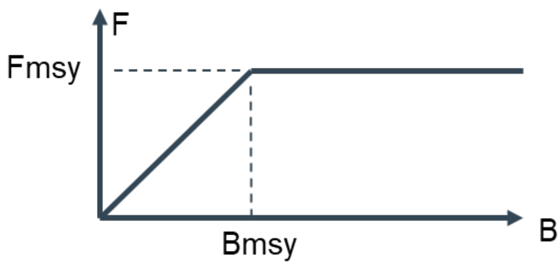


Figure 5. Shapes of the function used in the harvest control rule adopted in 2024 Commission meeting.

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. This section highlights several important aspects of the stock assessment procedure and results.

1) Standardized CPUE data were assumed to be hyperstable and thus less likely to react to changes in biomass. Thus, standardized CPUE 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) Estimated trends in relative stock size measures and reference points from Chinese Taipei (CT), Japan (JPN), China (CHN) and combined models were similar to one another. CPUE, survey trends and model results suggest that stock size is still low but increased since 2020. The F_{MSY} * B * Bratio for 2024 based on the combined models in this assessment is similar to the F_{MSY} * B *Bratio calculated for 2023 in the last assessment despite the recent increasing trend in biomass. The two F_{MSY} * B *Bratio values are similar because recent biomass estimates are lower in the 2024 assessment.

3) Biomass estimates from the 2023 and 2024 assessments are similar in spite of suggestion from the data that stock size increased. This is because the estimated scale of recent biomass is lower in this assessment than in the last assessment. Such uncertainties and shifts in scale can occur because results for most recent years are relatively uncertain and because of retrospective patterns. Retrospective patterns (estimated biomass declined with additional years of data) were noted in results for two Members. Changes were also made in the handling of some CPUE time series in the current model that improved model fit. These changes and the retrospective patterns may have contributed to lower estimated biomass in this assessment for Pacific saury in 2023.

4) Oceanographic or biological factors responsible for changes in Pacific saury 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) Experience with the HCR rule this year suggests that the use of more current data might improve management advice. Currently, the HCR for 2025 is based on CPUE and catch data through 2023 and survey data through 2024. However, catch data are nearly complete for the most recent year when the assessment for that year is completed and reasonably precise CPUE standardization could probably be completed early as well. It would be advisable for the SSC PS to consider approaches to using the most recent data in the assessment. One approach to demonstrating potential benefits would be to do a retrospective analysis of HCR calculations based on the actual terminal year and the year before.

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 18 thousand tons were recorded in 2008 and 2022, 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.

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).

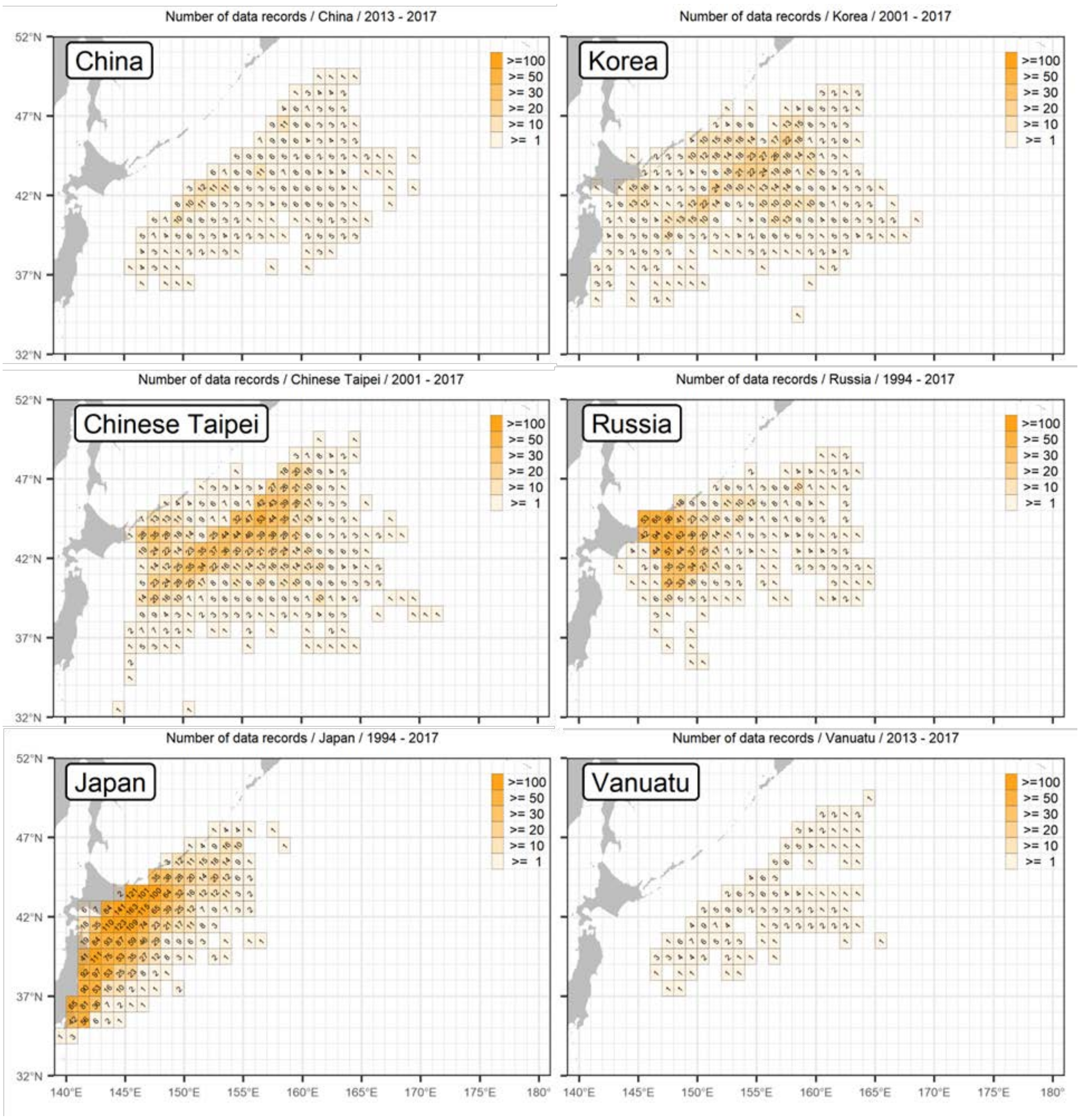


Figure 1 (a). Main fishing grounds for Pacific saury by fishing members in the western North Pacific Ocean during 1994-2017. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

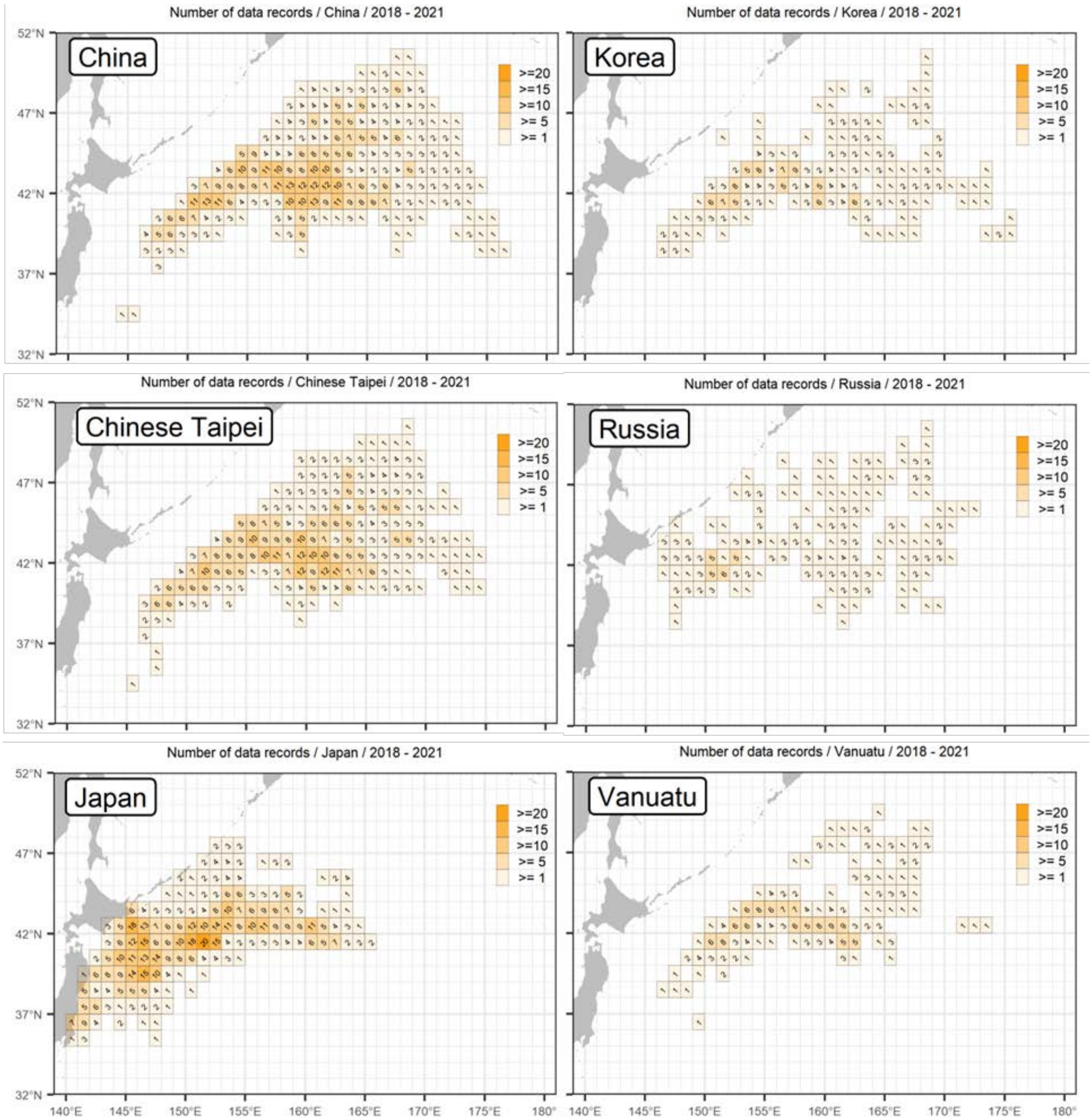


Figure 1 (b). Main fishing grounds for Pacific saury by fishing members in the western North Pacific Ocean during 2018-2021. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

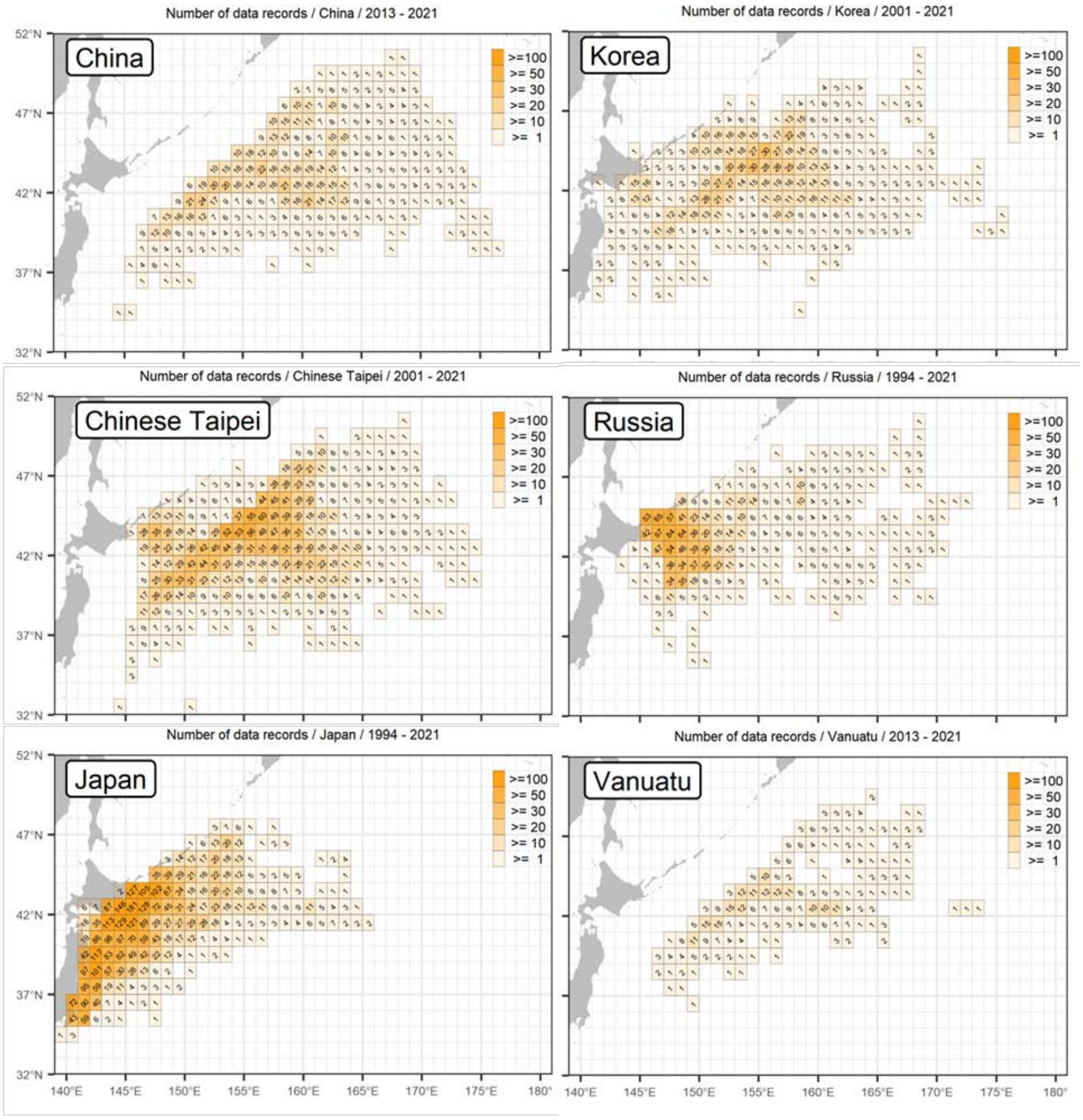


Figure 1 (c). Main fishing grounds for Pacific saury by fishing members in the western North Pacific Ocean during 1994-2021. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

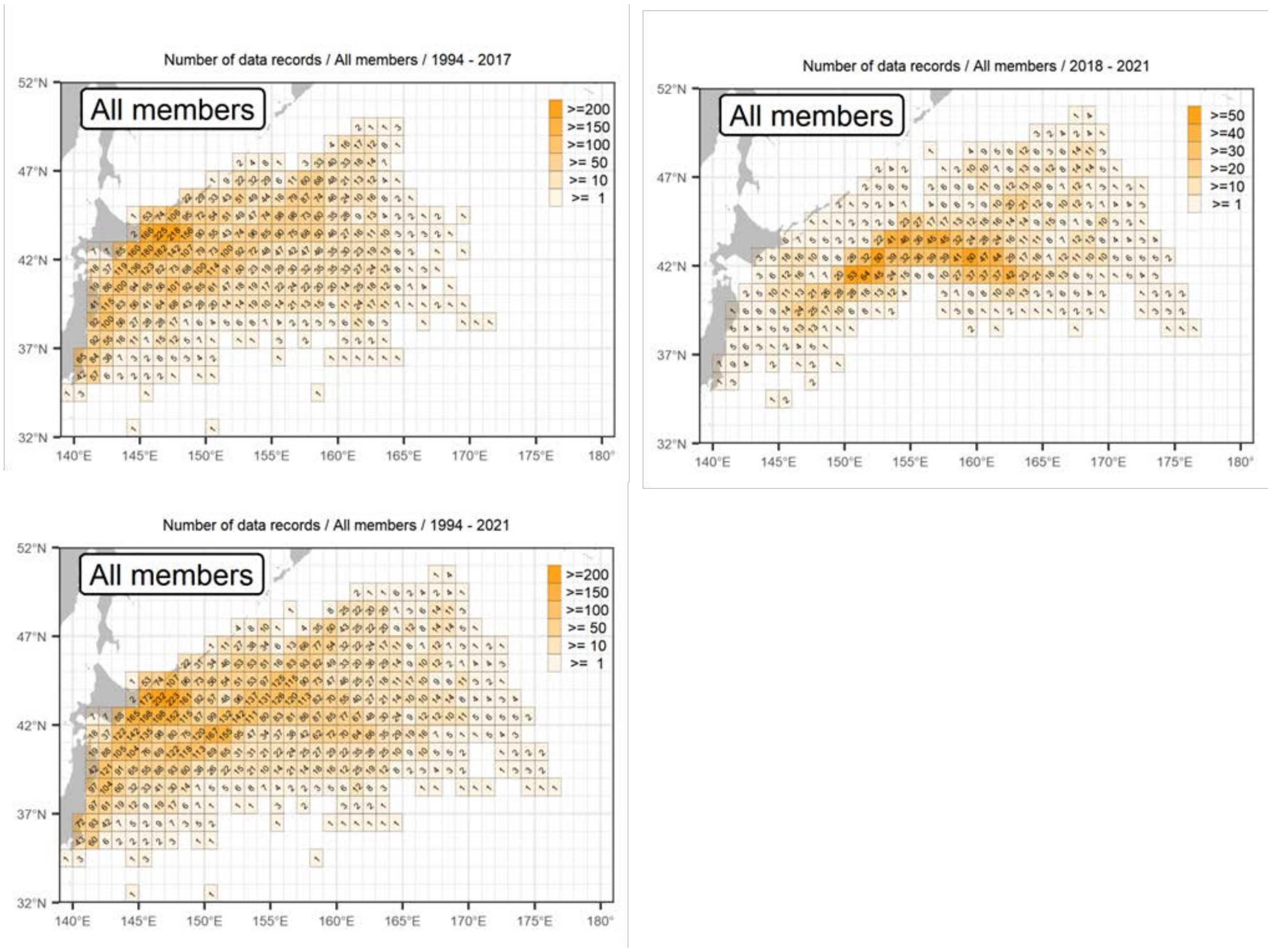


Figure 1 (d). Main fishing grounds for Pacific saury in the western North Pacific Ocean. The legend shows the number of data records. This figure is based on the data shared by the Members for the development of a joint CPUE index

2.2 Catch records

Figure 2 shows the historical catches of Pacific saury in the northwest Pacific Ocean by Member.

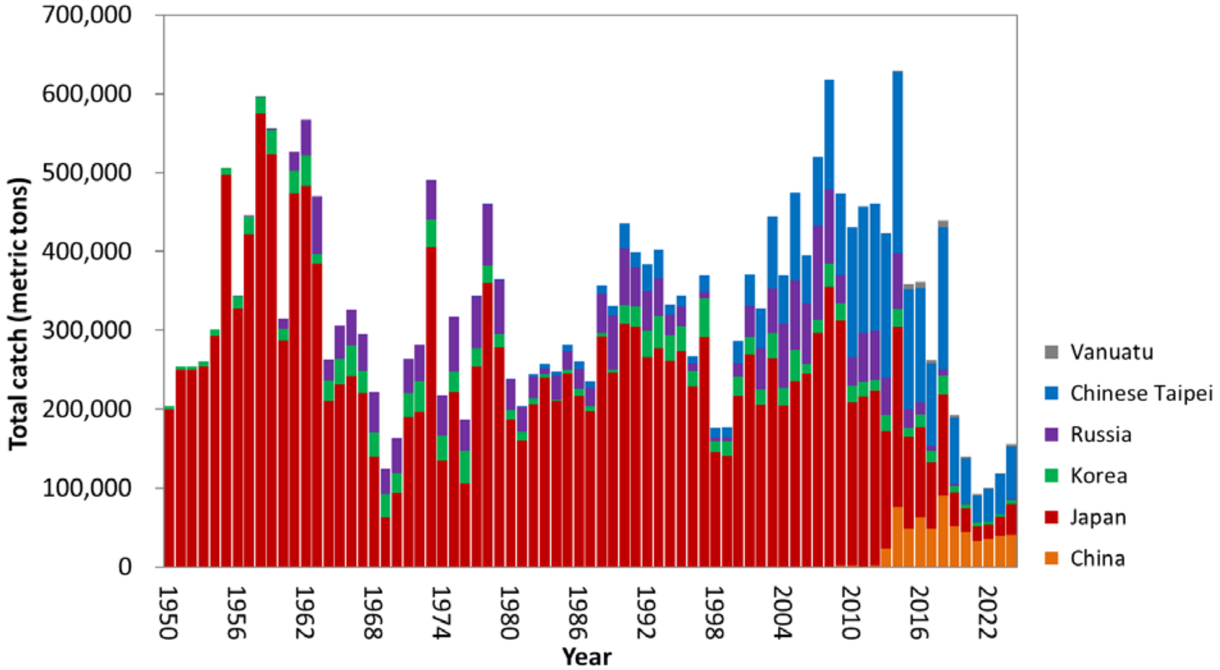


Figure 2. Time series of catch by Member during 1950-2024. The catch data for 1950-1979 are shown but not used in stock assessment modeling. Catch data in 2024 are preliminary (as of 29 November 2024) and not used in the assessment.

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 1980-2024. 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 G, SSC PS13 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

$$I_{t,biomass} = q_{biomass} B_t \, exp(\, v_{t,biomass}), \quad \text{where} \quad v_{t,biomass} \sim N\left(0, \sigma^2_{biomass}\right)$$

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

$$I_{t,f} = q_f B_t^b \, exp(\, v_{t,f}), \quad \text{where} \quad v_{t,f} \sim N\left(0, \sigma_f^2\right)$$

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-2024-SSC PS14-WP10 and NPFC-2024-SSC PS14-WP11; for the non-uniform priors used in Chinese Taipei, see document NPFC-2024-SSC PS14-WP09.

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	$I_{t,bio} = q_{bio}\, B_t e^{v_{t,bio}}$ $v_{t,bio} \sim N(0, cv^2_{t,bio} + \sigma^2)$ $q_{bio} \sim \mathrm{U}(0,1)$ (2003-2024)	Same as left	Same as left	Same as left
CPUE	CHN(2013-2023) JPN_late(1994-2023) KOR(2001-2023) RUS(1994-2023) CT(2001-2011, 2012-2023) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv^2_{t,bio}) + \sigma^2)$, where $ave(cv^2_{t,bio})$ is computed except for 2020 survey (c = 5)	Joint CPUE (1994-2023) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, cv^2_{t,joint} + \sigma^2)$	CHN(2013-2023) JPN_early(1980-1993, time-varying q) JPN_late(1994-2023) KOR(2001-2023) RUS(1994-2023) CT(2001-2011, 2012-2023) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv^2_{t,bio}) + \sigma^2)$, where $ave(cv^2_{t,bio})$ is computed except for 2020 survey (c = 6)	JPN_early(1980-1993, time-varying q) $I_{t,JE} = q_{t,JE} B_t^b e^{v_{t,JE}}$ $v_{t,JE} \sim N(0, \sigma_{JE}^2)$ $\sigma_{JE}^2 = c\ ave(cv^2_{t,joint} + \sigma^2)$ Joint CPUE (1994-2023) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, cv^2_{t,joint} + \sigma^2)$
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

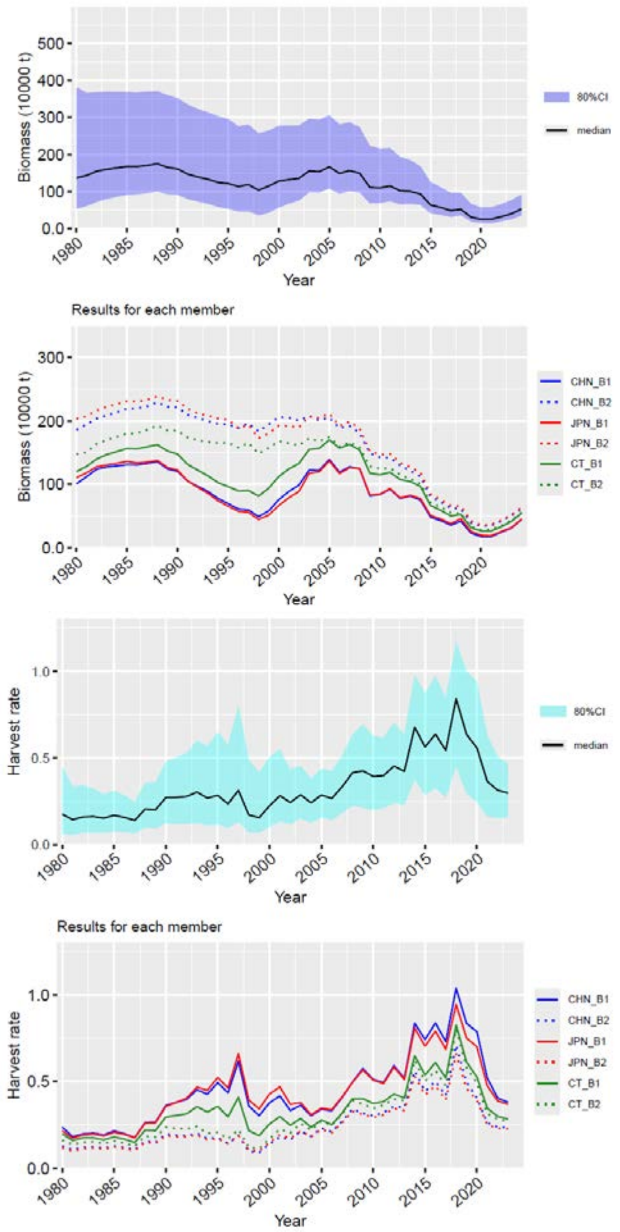
Symbol	Description
C_{2023}	Catch in 2023
$AveC_{2021\text{-}2023}$	Average catch for a recent period (2021–2023)
$AveF_{2021\text{-}2023}$	Average harvest rate for a recent period (2021–2023)
F_{2023}	Harvest rate in 2023
F_{MSY}	Annual harvest rate producing the maximum sustainable yield (MSY)
MSY	Equilibrium yield at F_{MSY}
F_{2023}/F_{MSY}	Average harvest rate in 2023 relative to F_{MSY}
$AveF_{2021\text{-}2023}/F_{MSY}$	Average harvest rate for a recent period (2021–2023) relative to F_{MSY}
K	Equilibrium unexploited biomass (carrying capacity)
B_{2023}	Stock biomass in 2023 estimated in the model
B_{2024}	Stock biomass in 2024 estimated in the model
$AveB_{2022\text{-}2024}$	Stock biomass for a recent period (2022–2024) 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_{2023}/K	Stock biomass in 2023 relative to K[a]
B_{2024}/K	Stock biomass in 2024 relative to K[a]
$B_{2022\text{-}2024}/K$	Stock biomass in the latest time period (2022-2024) relative to the equilibrium unexploited stock biomass[a]
B_{2023}/B_{MSY}	Stock biomass in 2023 relative to B_{MSY}[a]
B_{2024}/B_{MSY}	Stock biomass in 2024 relative to B_{MSY}[a]
$B_{2022\text{-}2024}/B_{MSY}$	Stock biomass for a recent period (2022–2024) relative to the stock biomass that produces maximum sustainable yield (MSY) [a]

[a]calculated as the average of the ratios.

4 SOME AGGREGATED RESULTS FOR VISUALIZATION PURPOSE

.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.



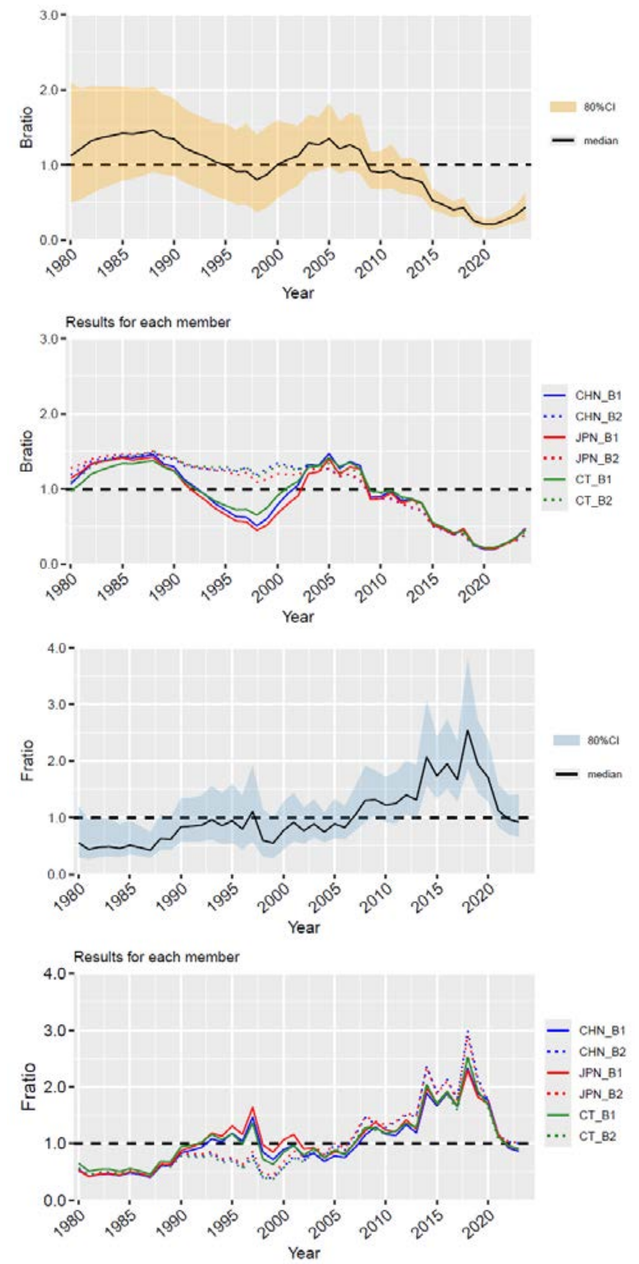


Figure 3. Time series of median estimated values of six runs for biomass, harvest rate, B-ratio, F-ratio and depletion level relative to K. The solid and shaded lines correspond to B1 and B2, respectively.

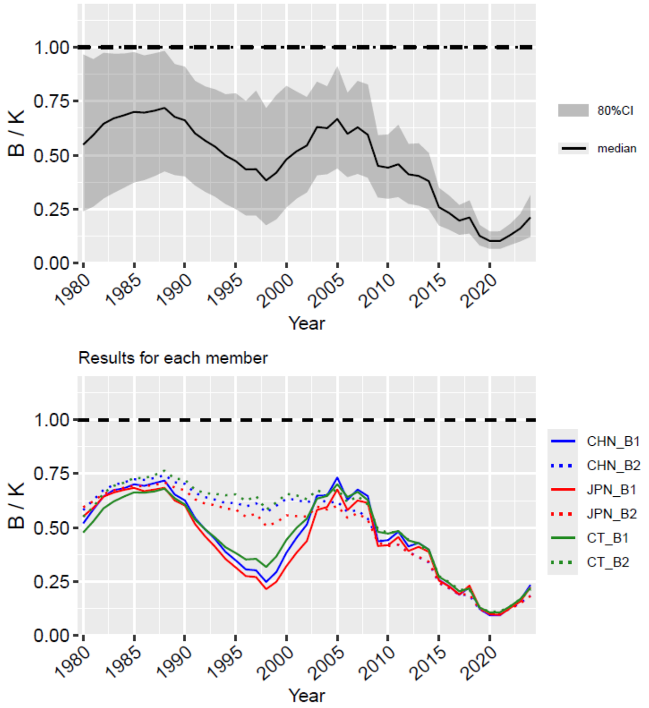


Figure 3 (Continued).

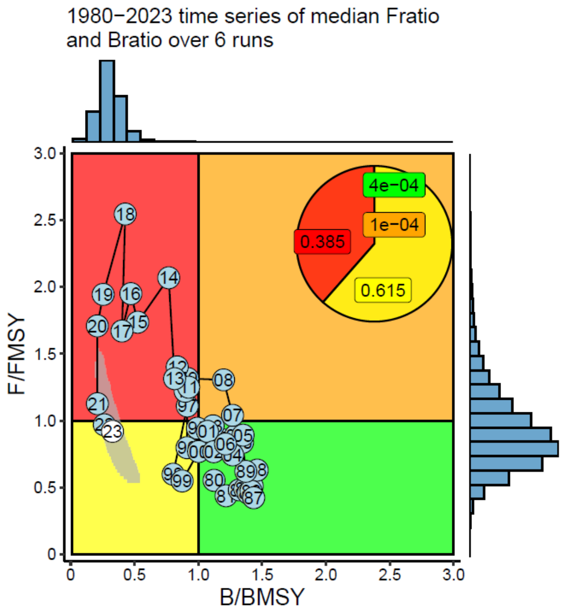


Figure 4. Kobe plot with time trajectory. The data are aggregated across 6 model results (2 base-case models by 3 Members).

4.2 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_2023 (10000 t)	11.836	11.836	11.836	11.836	11.836	11.836
AveC_2021_2023	10.352	10.352	10.352	10.352	10.352	10.352
AveF_2021_2023	0.328	0.158	0.528	0.352	0.339	0.302
F_2023	0.297	0.155	0.469	0.313	0.307	0.277
FMSY	0.330	0.139	0.543	0.357	0.336	0.310
MSY (10000 t)	39.440	32.021	47.010	40.155	39.284	39.010
F_2023/FMSY	0.920	0.656	1.411	0.915	0.942	0.903
AveF_2021_2023/FMSY	1.008	0.755	1.435	1.013	1.026	0.988
K (10000 t)	248.067	151.766	565.726	234.100	253.396	254.500
B_2023 (10000 t)	39.875	25.214	76.394	37.830	38.599	42.720
B_2024 (10000 t)	52.763	35.130	91.631	50.920	52.120	55.155
AveB_2022_2024	41.563	27.387	77.406	39.705	40.555	44.165
BMSY (10000 t)	120.100	78.060	253.481	113.800	119.008	125.100
BMSY/K	0.485	0.392	0.604	0.480	0.471	0.505
B_2023/K	0.161	0.101	0.228	0.158	0.154	0.169
B_2024/K	0.212	0.122	0.315	0.212	0.206	0.219
AveB_2022_2024/K	0.169	0.106	0.236	0.168	0.163	0.175
B_2023/BMSY	0.328	0.225	0.452	0.323	0.322	0.339
B_2024/BMSY	0.435	0.270	0.628	0.433	0.431	0.440
AveB_2022_2024/BMSY	0.345	0.235	0.470	0.341	0.341	0.352

5 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_early (metric tons/ net haul)	CPUE CT_late (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					4.08		0.747			1.720	0.37
1995	343743					2.10		0.869			1.882	0.37
1996	266424					1.79		0.646			0.786	0.37
1997	370017					3.49		0.501			2.112	0.37
1998	176364					1.05		0.501			0.688	0.41
1999	176498					0.90		0.568			0.688	0.39
2000	286186					1.28		0.822			0.921	0.36
2001	370823					1.65	8.51	0.947	1.44		0.792	0.31
2002	328362					1.11	14.28	1.172	1.33		0.679	0.30
2003	444642	990.8	25.7			2.03	16.80	1.526	2.47		1.272	0.29
2004	369400	879.4	21.3			2.69	12.23	2.914	1.24		1.109	0.29
2005	473907	1064.5	30.4			4.39	19.94	2.963	2.27		1.700	0.27
2006	394093	786.1	30.1			4.53	9.86	1.975	1.00		0.768	0.25
2007	520207	906.3	32.4			4.19	8.54	2.231	2.17		1.285	0.27

2008	617509	1055.6	29.1			5.15	18.70	2.083	2.79		1.742	0.26
2009	472177	433.2	20.7			4.15	10.27	1.175	1.29		1.019	0.28
2010	429808	561.7	28.3			1.78	10.24	1.224	1.89		0.958	0.27
2011	456263	979.3	32.9			2.48	9.61	1.467	2.09		1.235	0.29
2012	460544	439.6	19.7			2.71	10.36	1.442		2.61	1.103	0.30
2013	423790	716.7	27.8	15.63		1.89	13.90	1.407		3.50	0.883	0.27
2014	629576	466.9	22.6	12.60		3.28	19.50	1.479		3.90	1.405	0.25
2015	358883	316.9	20.6	24.81		1.67	7.90	0.652		2.19	0.817	0.28
2016	361688	261.4	26.4	6.60		1.80	11.08	1.208		1.95	0.791	0.27
2017	262640	173.4	27.6	7.06		1.12	5.54	0.525		1.91	0.862	0.27
2018	435881	406.9	28.2	17.70		1.95	13.06	1.577		2.92	1.276	0.28
2019	195251	217.0	21.3	6.29		0.69	2.86	0.558		1.40	0.451	0.22
2020	139779	11.9	99.2	4.37		0.48	2.81	0.497		1.11	0.279	0.27
2021	92117	158.7	31.1	5.85		0.32	2.89	0.141		0.65	0.283	0.29
2022	100085	290.7	22.4	3.82		0.27	1.77			0.69	0.159	0.28
2023	118355	230.0	29.4	9.37		0.30	3.18			1.43	0.335	0.33
2024		331.8	17.2									

Annex R

Revised CMM 2024-05 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northwestern Pacific Ocean

CMM 2024-05

(Entered into force 1 January 2025)

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; paragraphs 113, 117 and 119 to 124 of resolution 64/72 in 2009, paragraphs 121, 126, 129, 130 and 132 to 134 of resolution 66/68 in 2011, paragraphs 156, 171, 175, 177 to 188 and 219 of resolution 71/123 in 2016 and paragraphs 181 and 203-219 of resolution 77/118 in 2022;

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 UNGA's calls to identify and overcome barriers to the implementation of the relevant paragraphs of General Assembly resolutions such as data availability, especially with regard to baseline data and the spatial distribution and connectivity of vulnerable marine ecosystems, including their associated and dependent species; periodically review and revise impact assessments whenever a substantial change in the fishery has occurred or there is relevant new information; and ensure that the precautionary approach is applied, including in the utilization of impact assessments to inform management decisions and consideration of significant adverse impacts on vulnerable marine ecosystems, including their associated and dependent species;

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 bottom fisheries on marine species and VMEs;

Recognizing that scientific literature indicates the likely occurrence of VMEs on most seamounts in the area and has documented significant adverse impacts to VMEs resulting from bottom fishing in the area, which reinforces the importance of regularly updating impact assessments and considering the adequacy of the existing management framework through the SC and the Commission*;*

Concerned about potential significant adverse impacts of bottom fisheries on marine species and VMEs in the western part of the Convention Area.

Recognizing Article 2 of the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean (the Convention), which provides that the objective of the Convention 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;

Recognizing further Articles 3 (c) and (e) of the Convention, which call on the Commission to adopt and implement measures in accordance with the precautionary approach and ecosystem approach to fisheries and protect biodiversity in the marine environment, including by preventing significant adverse impacts on vulnerable marine ecosystems;

Re-affirming NPFC's commitment to the precautionary approach and to implementing an ecosystem approach to fisheries management;

Noting the ongoing work of the Scientific Committee to address the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas, including the identification of VMEs;

Underscoring the ecological importance of the Emperor Seamounts to the fisheries resources and biodiversity of the NPFC convention area;

Adopts the following Conservation and Management Measure:

Scope

1. This CMM applies to all bottom fishing activities for fisheries resources 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 (hereinafter called “the western part of the Convention Area”).

General purpose

2. The objective of this CMM 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 measures in this CMM aim 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 regularly review, and as appropriate, revise this CMM considering the best available science and the recommendations of the NPFC Scientific Committee, and with reference to relevant guidance adopted by UNGA and FAO.

Principles

3. 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.

Measures

4. Members of the Commission shall implement 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 not allow 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: black coral (Antipatharia), gorgonians, pennatulaceans, stony corals (Scleractinia), soft corals, 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. The translation table of VME indicator corals between common and scientific names is attached to the VME taxa identification guide (link) [to this CMM (Annex 7)].

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 or sponges more than 350Kg 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 nautical mile, 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 shall, within one business day, notify the other Members of the Commission and at the same time implement a temporary closure in the area to prohibit fishing vessels from contacting the sea floor with their fishing gear. 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 five groups of cold water corals, specifically black corals (Antipatharia), gorgonians, pennatulaceans, stony coral (Scleractinia), and soft corals. The VME indicator taxa also include the classes of Hexactinellida and Demospongiae in the phylum Porifera.

H. 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.

I. C-H seamount, the Southeastern part of Koko seamount (specifically, 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 to prevent potential significant adverse impacts on VMEs consistent with the precautionary approach. Fishing in these areas requires exploratory fishery protocol (Annex 1).

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

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K. Apply a bottom fisheries closure from November to January.

L. Limit annual catch of North Pacific armorhead consistent with the precautionary approach. In years when strong recruitment of North Pacific armorhead is not detected by the monitoring survey (Annex 6), Japan shall limit the catch of North Pacific armorhead by vessels flying its flag to 500 tons, and Korea shall limit its 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), Japan shall limit its annual catch of North Pacific armorhead by vessels flying its flag to 10,000 tons, and Korea shall limit its annual catch of North Pacific armorhead by vessels flying its flag to 2,000 tons. The catch overages for any given year shall be subtracted from the applicable annual catch limit in the following year, and catch underages during any given year shall not be added to the applicable annual catch limit during the following year.

M. 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.

N. Catch in the monitoring surveys shall not be included in the catch limits specified in paragraphs L but shall be reported to the Secretariat.

O. 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. 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.

Q. 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. 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. Prohibit its bottom fishing vessels from contacting the sea floor with their fishing gear in the following ~~two~~ four 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
Northwestern part of	32-42.75 N 172-12.90 E	32-42.75 N 172-13.65 E

Yuryaku Seamount	32-43.50 N 172-13.65 E	32-43.50 N 172-12.90 E
Southeastern part of Yuryaku Seamount	32-37.80 N 172-18.00 E	32-37.80 N 172-18.60 E
	32-38.40 N 172-18.60 E	32-38.40 N 172-18.00 E

Contingent Action

5. 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 paragraph 4 (C).

Scientific Information

6. 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

      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) Members shall ensure each bottom fishing vessel operating in the western part of the Convention Area collects the following scientific information. Members shall provide the scientific information to the Secretariat.

         (a) Catch and effort data

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

(ii) As appropriate, Members should encourage the collection of information from research vessels operating in the western part of the Convention Area and provide updates to the Commission to the extent possible.

(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.

Vessel Monitoring System

7. 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.

Observers

8. Members shall ensure that all vessels authorized to bottom fish in the western part of the Convention Area shall carry an observer on board. Members shall ensure that observers are independent, impartial, and qualified to fulfill the requirements of this measure and to enhance data collection. An observer is deemed to be independent, impartial, and qualified if the observer:

(a) is deployed from a Commission Member's, or Cooperating non-Contracting Party's, national observer program, and familiar with NPFC fisheries resources, fishing activities, and CMMs;

(b) is neither part of the crew, nor has any employment or family relationship to the

ownership or operator of the fishing vessel; and
(c) does not have any shared business interests with the owner or operator of the fishing vessel.

An observer shall be provisioned, accommodated, and provided safe working conditions and access to independent communications in accordance with the Commission requirements and the Member's domestic laws and regulations.

Final Clauses

9. This CMM shall enter into force on January 1st, 2025, replacing CMM 2023-05.

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.

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.

[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.

(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 only sustain low exploitation rates; and
   (c) The fishing gear is likely to contact the seafloor during the normal course of fishing operations.

3. <u>Definition of VMEs</u>

(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. <u>Template for assessment report</u>

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), gorgonians, 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

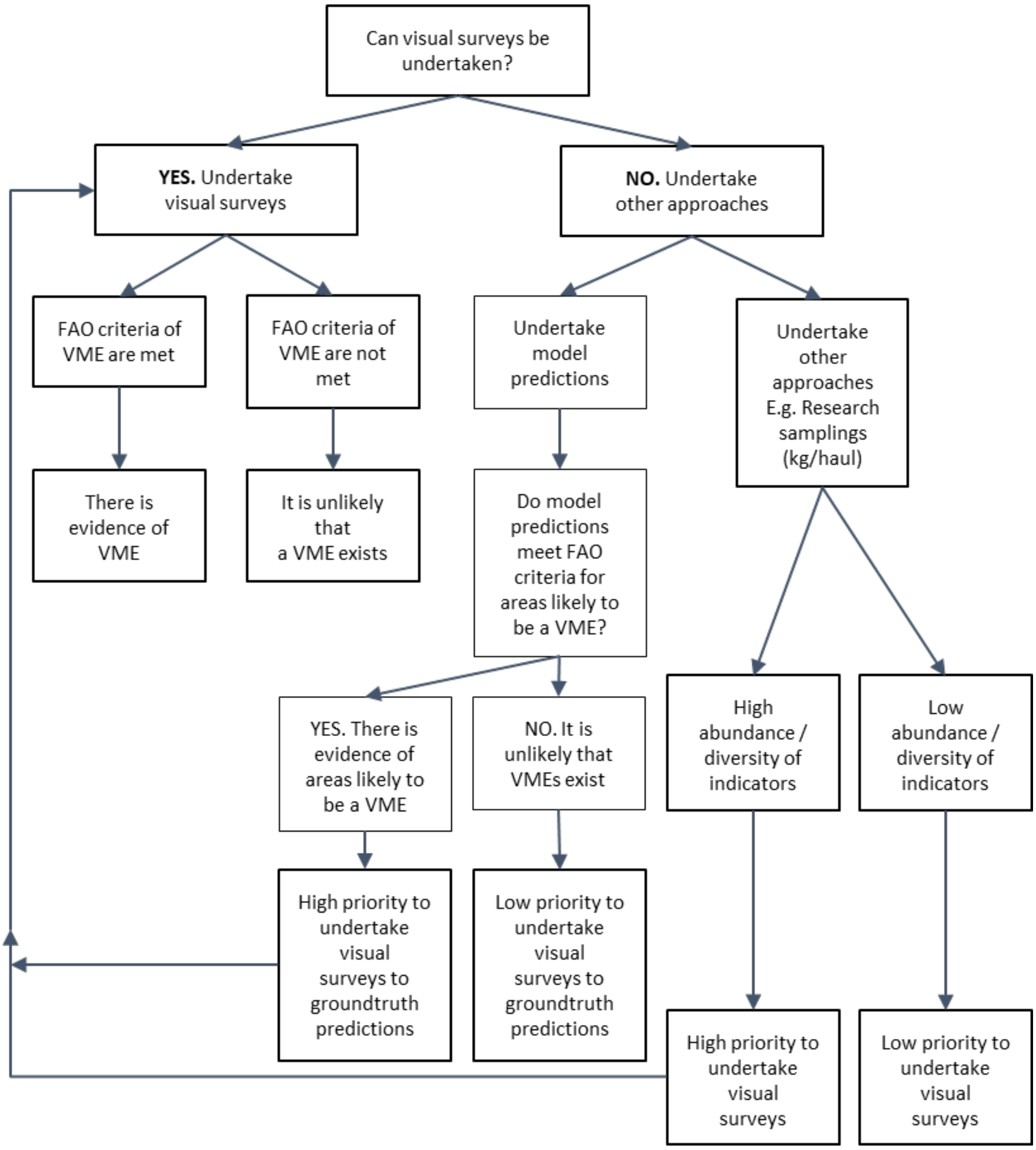
11. Impact assessment of fishing activities on VMEs or marine species including cumulative impacts, and identification of SAIs on VMEs or marine species, as detailed in Section 5 above, Assessment of SAIs on VMEs or marine species

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

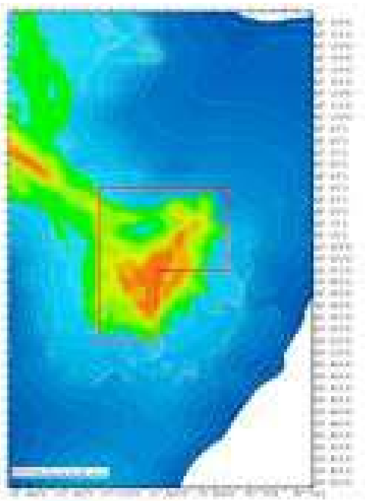
1. Monitoring survey for the detection of strong recruitment of North Pacific armorhead

(1) Location of monitoring surveys

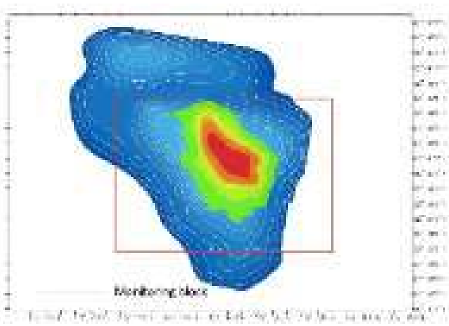
Monitoring surveys for the detection of strong recruitment of North Pacific armorhead will be conducted by trawl fishing vessels in the pre-determined four (24) monitoring blocks of Koko (South eastern), Yuryaku, Kammu (North western) and/or Colahan seamounts.

Monitoring blocks

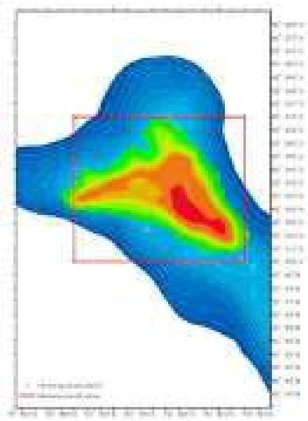
(1) Koko seamount (34°51’ –35°04’N, 171°49’ –172°00’ E)



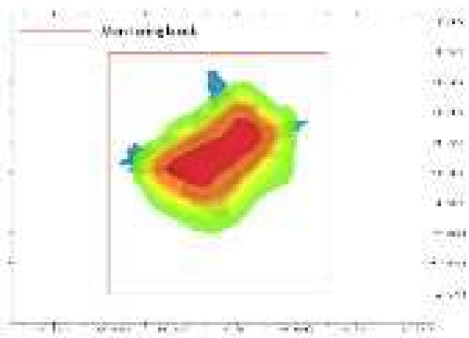
(2) Yuryaku seamount (32°35’ –32°45’N, 172°10’ –172°24’E)



(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.

2. 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 7

Translation table of VME indicator corals between common and scientific names

VME Indicator Corals from Emperor Seamounts: Present Classification *1, Taxa, and Common (nominal) Names in NPFC

Subphylum	Class	Order	Superfamily	Family	Genus/Subgenus	NPFC_～2023	NPFC_2024~ *2	Guide Cat. *3
Anthozoa	Hexacorallia	Antipatharia		Antipathidae	——	Black Corals (Antipatharia)		Black Corals
				Aphanipathidae	——	Black Corals (Antipatharia)		Black Corals
				Cladopathidae	——	Black Corals (Antipatharia)		Black Corals
				Leiopathidae	——	Black Corals (Antipatharia)		Black Corals
				Schizopathidae	——	Black Corals (Antipatharia)		Black Corals
		Scleractinia		Caryophylliidae	——	Stony Corals (Scleractinia)		Hard Corals
				Deltocyathidae	——	Stony Corals (Scleractinia)		Hard Corals
				Dendrophylliidae	——	Stony Corals (Scleractinia)		Hard Corals
				Flabellidae	——	Stony Corals (Scleractinia)		Hard Corals
				Fungiacyathidae	——	Stony Corals (Scleractinia)		Hard Corals
				Micrabaciidae	——	Stony Corals (Scleractinia)		Hard Corals
				Oculinidae	——	Stony Corals (Scleractinia)		Hard Corals
				Turbinoliidae	——	Stony Corals (Scleractinia)		Hard Corals
				Madreporidae	——	Stony Corals (Scleractinia)		Hard Corals
	Octocorallia *4	**Scleralcyonacea** ≒Calcaxonia-Pennatulacea	Pennatuloidea *5	Anthoptilidae	——	NA	Pennatulaceans *5	NA
				Balticinidae	——	NA	Pennatulaceans *5	NA
				Funiculinidae	——	NA	Pennatulaceans *5	NA
				Kophobelemnidae	——	NA	Pennatulaceans *5	NA
				Pennatulidae	——	NA	Pennatulaceans *5	NA
				Protoptilidae	——	NA	Pennatulaceans *5	NA
				Scleroptilidae	——	NA	Pennatulaceans *5	NA
				Stachyptilidae	——	NA	Pennatulaceans *5	NA
				Umbellulidae	——	NA	Pennatulaceans *5	NA
				Veretillidae	——	NA	Pennatulaceans *5	NA
				Virgulariidae	——	NA	Pennatulaceans *5	NA
				Chrysogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Keratoisididae	——	Gorgonacea	Gorgonians	Gorgonians
				Primnoidae	——	Gorgonacea	Gorgonians	Gorgonians
				Briareidae	——	Gorgonacea	Gorgonians	Gorgonians
				Clavulariidae>> **Briareidae**	*Pachyclavularia*>>***Briareum***	Alcyonacea	Soft Corals	Soft Corals
				Alcyoniidae>> **Coralliidae** *6	*Anthomastus*	Alcyonacea	Soft Corals	Soft Corals
					Paraminabea	Alcyonacea	Soft Corals	Soft Corals
				Paragorgiidae>> **Coralliidae** *6	——	Gorgonacea	Gorgonians	Gorgonians
				Coralliidae *6	——	Gorgonacea	Gorgonians	Gorgonians
		Malacalcyonacea ≒Holaxonia-Alcyoniina		Clavulariidae	——	Alcyonacea	Soft Corals	Soft Corals
				——	*Pseudocladochonus* *7	Alcyonacea	Soft Corals	Soft Corals
				Tubiporidae	——	Alcyonacea	Soft Corals	Soft Corals
				Nidaliidae	——	Alcyonacea	Soft Corals	Soft Corals
				Siphonogorgiidae	——	Alcyonacea	Soft Corals	Soft Corals
				Anthothelidae>> **Alcyoniidae** *8	*Anthothela*	Gorgonacea	Gorgonians	Gorgonians
				Nephtheidae>> **Alcyoniidae** *8	*Gersemia*	Alcyonacea	Soft Corals	Soft Corals
				Alcyoniidae *8	——	Alcyonacea	Soft Corals	Soft Corals
				Nephtheidae	——	Alcyonacea	Soft Corals	Soft Corals
				Paralcyoniidae	——	Alcyonacea	Soft Corals	Soft Corals
				Gorgoniidae	——	Gorgonacea	Gorgonians	Gorgonians
				Isididae	——	Gorgonacea	Gorgonians	Gorgonians
				Keroeididae	——	Gorgonacea	Gorgonians	Gorgonians
				Astrogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Euplexauridae	——	Gorgonacea	Gorgonians	Gorgonians
				Anthogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Acanthogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Victorgorgiidae	——	Gorgonacea	Gorgonians	NA
				Plexauridae	——	Gorgonacea	Gorgonians	NA
				——	*Calcigorgia* *9	Gorgonacea	Gorgonians	NA

*1 Classification is based on WoRMS (in July 2024)
*2 Nominal names of VME indicator corals agreed by NPFC for adoption after 2025 (NPFC-2024-COM08-Final Report-ANNEX O-G)
*3 Coral Morphology Categories of "NPFC VME Taxa Identification Guide (Western North Pacific Ocean)"
*4 See WoRMS based on McFadden *et al*. (2022) for the present octocorallian classificaton, and McFadden *in* Daly *et al*. (2007) for the former one
The current families of octocorals and their correspondence to former suborders/systems are well summarized *in* Table 2 of McFadden *et al*. (2022)
*5 2024_9th_COM has agreed to add pennatulaceans (sea pens) to the VME indicator taxa (entered into force 1 January 2025)
***6** The family Coralliidae is originally gorgonians (Gorgonacea), but the current classification includes some soft corals (formerly Alcyonacea) (e.g. Anthomastus)
*7 *Pseudocladochonus* is the genus Octocorallia *incertae sedis* in McFadden *et al*. (2022) and in also WoRMS. (See Table 3 *in* McFadden *et al*., 2022)
***8** The family Alcyoniidae is originally soft corals (former Alcyonacea), but the current classification includes some gorgonians (Gorgonacea) (e.g. Anthothela)
*9 *Calcigorgia* is a gorgonian genus in Octocorallia *incertae sedis* in McFadden *et al*. (2022) and in also WoRMS. (See Table 3 *in* McFadden *et al*., 2022)
>> pink= former Gorgonacea (Gorgonians); yellow= former Alcyonecea (Soft Corals)

WoRMS(World Register of Marine Species) https://www.marinespecies.org/index.php
Daly *et al*. (2007) The phylum Cnidaria: A review of phylogenetic patterns and diversity 300 years after Linnaeus. *Zootaxa*, 1668: 127-182.
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Annex S

Revised CMM 2024-06 - Conservation and Management Measure for Bottom Fisheries and Protection of Vulnerable Marine Ecosystems in the Northeastern Pacific Ocean

CMM 2024-06

(Entered into force 24 July 2024)

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 taxa: black corals (Antipatharia), gorgonians, pennatulaceans, stony corals (Scleractinia), soft corals, the classes of Demospongiae and Hexactinellida 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. The translation table of VME indicator corals between common and scientific names is attached to the VME taxa identification guide (link) [to this CMM (Annex 6)].
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 with pot gear, cold water corals that exceed 2Kg or sponges (Demospongiae and Hexactinellida) that

exceed 5Kg 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 the course of fishing operations with all other gears, cold water corals that exceed 50Kg or sponges (Demospongiae and Hexactinellida) that exceed 350Kg 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 nautical mile, 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 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. 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 black corals (Antipatharia), gorgonians, pennatulaceans, stony corals (Scleractinia), and soft corals. The VME indicator taxa also include the classes of Demospongiae and Hexactinellida in the phylum Porifera.

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.

l. Prohibit bottom fishing vessels from fishing in the following areas in order to achieve sustainable protection of VMEs in the eastern part of the Convention Area:

Area	Latitude	Longitude
Northwestern Cobb Seamount	46.8178 N	130.872 W
	46.7703 N	130.861 W
	46.8277 N	130.825 W
	46.7802 N	130.814W
Northeastern Cobb Seamount	46.7759 N	130.735 W
	46.7675 N	130.694 W
	46.7482 N	130.756 W
	46.7399 N	130.716 W

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

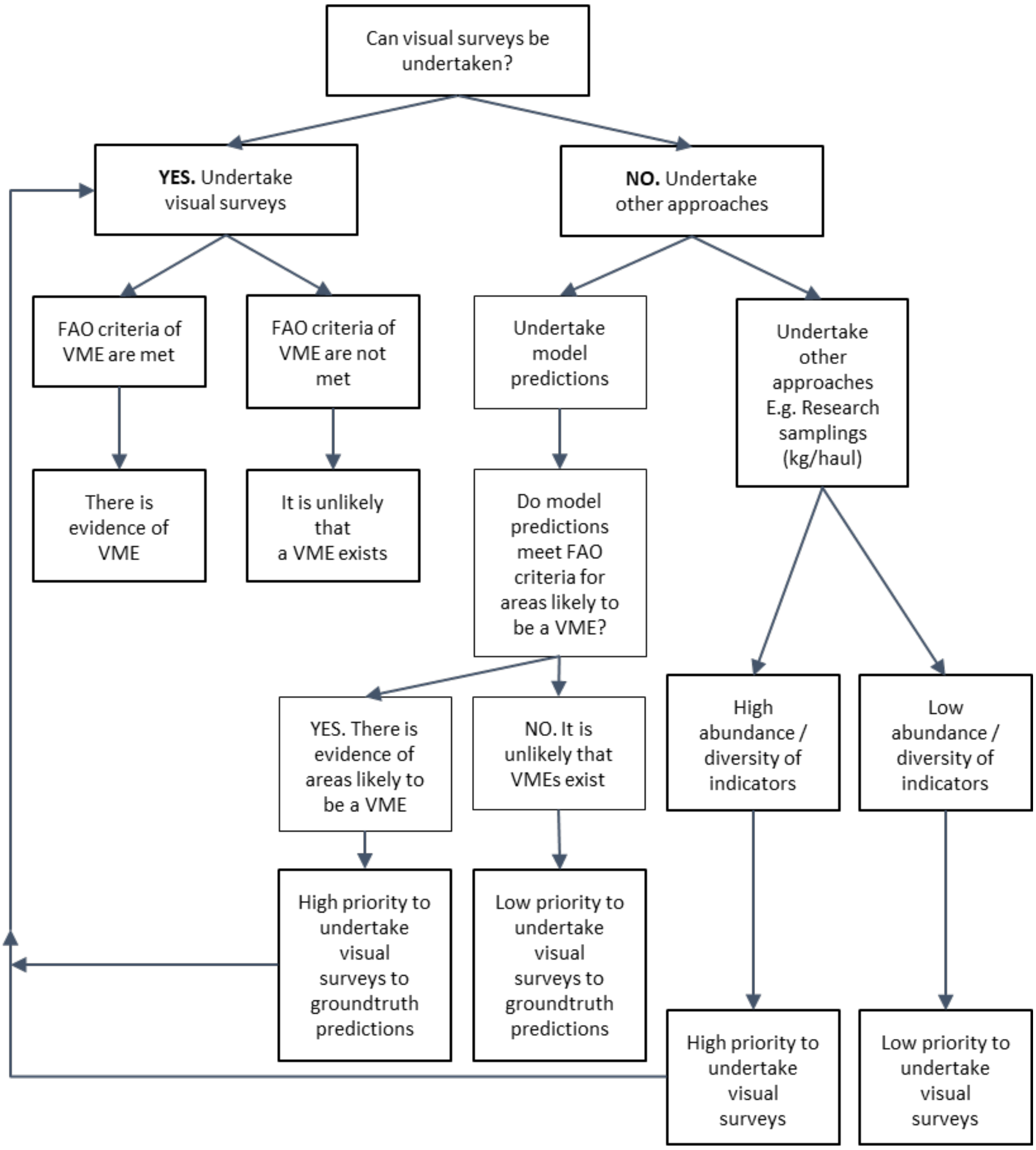
11. Impact assessment of fishing activities on VMEs or marine species including cumulative impacts, and identification of SAIs on VMEs or marine species, as detailed in Section 5 above, Assessment of SAIs on VMEs or marine species

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 6

Translation table of VME indicator corals between common and scientific names

VME Indicator Corals from Emperor Seamounts: Present Classification *1, Taxa, and Common (nominal) Names in NPFC								
Sub phylum	Class	Order	Superfamily	Family	Genus/Subgenus	NPFC_～2023	NPFC_2024~ *2	Guide Cat. *3
Anthozoa	Hexacorallia	Antipatharia		Antipathidae	——	Black Corals (Antipatharia)		Black Corals
				Aphanipathidae	——	Black Corals (Antipatharia)		Black Corals
				Cladopathidae	——	Black Corals (Antipatharia)		Black Corals
				Leiopathidae	——	Black Corals (Antipatharia)		Black Corals
				Schizopathidae	——	Black Corals (Antipatharia)		Black Corals
		Scleractinia		Caryophylliidae	——	Stony Corals (Scleractinia)		Hard Corals
				Deltocyathidae	——	Stony Corals (Scleractinia)		Hard Corals
				Dendrophylliidae	——	Stony Corals (Scleractinia)		Hard Corals
				Flabellidae	——	Stony Corals (Scleractinia)		Hard Corals
				Fungiacyathidae	——	Stony Corals (Scleractinia)		Hard Corals
				Micrabaciidae	——	Stony Corals (Scleractinia)		Hard Corals
				Oculinidae	——	Stony Corals (Scleractinia)		Hard Corals
				Turbinoliidae	——	Stony Corals (Scleractinia)		Hard Corals
				Madreporidae	——	Stony Corals (Scleractinia)		Hard Corals
	Octocorallia *4	**Scleralcyonacea** ≒Calcaxonia-Pennatulacea	Pennatuloidea *5	Anthoptilidae	——	NA	Pennatulaceans *5	NA
				Balticinidae	——	NA	Pennatulaceans *5	NA
				Funiculinidae	——	NA	Pennatulaceans *5	NA
				Kophobelemnidae	——	NA	Pennatulaceans *5	NA
				Pennatulidae	——	NA	Pennatulaceans *5	NA
				Protoptilidae	——	NA	Pennatulaceans *5	NA
				Scleroptilidae	——	NA	Pennatulaceans *5	NA
				Stachyptilidae	——	NA	Pennatulaceans *5	NA
				Umbellulidae	——	NA	Pennatulaceans *5	NA
				Veretillidae	——	NA	Pennatulaceans *5	NA
				Virgulariidae	——	NA	Pennatulaceans *5	NA
				Chrysogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Keratoisididae	——	Gorgonacea	Gorgonians	Gorgonians
				Primnoidae	——	Gorgonacea	Gorgonians	Gorgonians
				Briareidae	——	Gorgonacea	Gorgonians	Gorgonians
				Clavulariidae>> **Briareidae**	*Pachyclavularia*>>***Briareum***	Alcyonacea	Soft Corals	Soft Corals
				Alcyoniidae>> **Coralliidae** *6	*Anthomastus*	Alcyonacea	Soft Corals	Soft Corals
					Paraminabea	Alcyonacea	Soft Corals	Soft Corals
				Paragorgiidae>> **Coralliidae** *6	——	Gorgonacea	Gorgonians	Gorgonians
				Coralliidae *6	——	Gorgonacea	Gorgonians	Gorgonians
		Malacalcyonacea ≒Holaxonia-Alcyoniina		Clavulariidae	——	Alcyonacea	Soft Corals	Soft Corals
				——	*Pseudocladochonus* *7	Alcyonacea	Soft Corals	Soft Corals
				Tubiporidae	——	Alcyonacea	Soft Corals	Soft Corals
				Nidaliidae	——	Alcyonacea	Soft Corals	Soft Corals
				Siphonogorgiidae	——	Alcyonacea	Soft Corals	Soft Corals
				Anthothelidae>> **Alcyoniidae** *8	*Anthothela*	Gorgonacea	Gorgonians	Gorgonians
				Nephtheidae>> **Alcyoniidae** *8	*Gersemia*	Alcyonacea	Soft Corals	Soft Corals
				Alcyoniidae *8	——	Alcyonacea	Soft Corals	Soft Corals
				Nephtheidae	——	Alcyonacea	Soft Corals	Soft Corals
				Paralcyoniidae	——	Alcyonacea	Soft Corals	Soft Corals
				Gorgoniidae	——	Gorgonacea	Gorgonians	Gorgonians
				Isididae	——	Gorgonacea	Gorgonians	Gorgonians
				Keroeididae	——	Gorgonacea	Gorgonians	Gorgonians
				Astrogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Euplexauridae	——	Gorgonacea	Gorgonians	Gorgonians
				Anthogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Acanthogorgiidae	——	Gorgonacea	Gorgonians	Gorgonians
				Victorgorgiidae	——	Gorgonacea	Gorgonians	NA
				Plexauridae	——	Gorgonacea	Gorgonians	NA
				——	*Calcigorgia* *9	Gorgonacea	Gorgonians	NA

*1 Classification is based on WoRMS (in July 2024)
*2 Nominal names of VME indicator corals agreed by NPFC for adoption after 2025 (NPFC-2024-COM08-Final Report-ANNEX O-G)
*3 Coral Morphology Categories of "NPFC VME Taxa Identification Guide (Western North Pacific Ocean)"
*4 See WoRMS based on McFadden *et al*. (2022) for the present octocorallian classificaton, and McFadden *in* Daly *et al*. (2007) for the former one
The current families of octocorals and their correspondence to former suborders/systems are well summarized *in* Table 2 of McFadden *et al*. (2022)
*5 2024_9th_COM has agreed to add pennatulaceans (sea pens) to the VME indicator taxa (entered into force 1 January 2025)
*6 The family Coralliidae is originally gorgonians (Gorgonacea), but the current classification includes some soft corals (formerly Alcyonacea) (e.g. Anthomastus)
*7 *Pseudocladochonus* is the genus Octocorallia *incertae sedis* in McFadden *et al*. (2022) and in also WoRMS. (See Table 3 *in* McFadden *et al*., 2022)
*8 The family Alcyoniidae is originally soft corals (former Alcyonacea), but the current classification includes some gorgonians (Gorgonacea) (e.g. Anthothela)
*9 *Calcigorgia* is a gorgonian genus in Octocorallia *incertae sedis* in McFadden *et al*. (2022) and in also WoRMS. (See Table 3 *in* McFadden *et al*., 2022)
>> pink= former Gorgonacea (Gorgonians); yellow= former Alcyonecea (Soft Corals)

WoRMS(World Register of Marine Species) https://www.marinespecies.org/index.php

Daly *et al*. (2007) The phylum Cnidaria: A review of phylogenetic patterns and diversity 300 years after Linnaeus. *Zootaxa*, 1668: 127-182.
McFadden *et al*. (2022) Revisionary systematics of Octocorallia (Cnidaria: Anthozoa) guided by phylogenomics. *Bull. Soc. Syst. Biol*., 1: 1-79.

Annex T

US statement on its ongoing call for closure of the bottom fisheries on the Emperor Seamount Chain and Northwestern Hawaiian Ridge

The US has several points to add regarding our ongoing efforts calling for closure of the bottom fisheries on the Emperor Seamount Chain and Northwestern Hawaiian Ridge at various points since 2015 - first to allow recovery of NPA and SA, then to protect VMEs and now, since 2023, for stronger, scientifically supported concerns regarding both VMEs and the target fish stocks.

The USA expressed concerns about the methodology used to support the claim that no VMEs are present at the other survey sites on Yuryaku seamount as discussed in Japan's paper (NPFC-2024-SSC BFME05-WP11 (Rev. 1)), despite visible VME patches in the GoPro footage, and notably despite the camera's highly limited field of view.

Additionally, the expert thresholds applied by Japan for closures are relatively high and solely density based (thus only partially capturing 1 of the 5 FAO criteria for designating a VME) and have not been validated in a peer review process unlike other methods previously presented to the SSC BF-ME (in particular, NPFC-2022-SSC BFME03-OP02). This raises a serious question about the methodology and criteria used to dismiss other VME patches on Yuryaku (as well as Koko and Kammu VME patches in the same report).

The US also notes an alternative possibility for how areas that were previously identified as VMEs in the peer-reviewed scientific literature, on Koko, Kammu and Yuryaku, during AUV surveys in 2014-2015, were not found during the Japanese surveys 2021-2024. This raises concerns that the VMEs were lost to fishing in the intervening 7-10 years between the 2 sets of surveys of these sites, constituting SAIs to each of these sites and further emphasizing the urgent need for immediate action to protect VME areas on the ESC and NWHR seamounts before any more are lost.

The SWG review of Global Habitat Suitability Models, NPFC-2024-SSC BFME05-RP02, concluded that the Tong et al (2023) habitat suitability model for scleractinians had a reasonable match to the data, implying this is an accurate way to predict suitable habitat for unexplored areas in the NPFC convention area. Using this model almost the entire area of Yuryaku shallower than ~750 m had highly suitable habitat (defined as >75% suitable) for at least two species (of the 4 reef-forming species of Pacific scleractinian corals for which there were available models). In some areas there was high suitability for 3-4 species. This implies that an extensive area of Yuryaku is a "likely VME" which requires protective action based on the UNGA resolutions and FAO Guidelines.

In support of this broader view of the distribution of the VMEs on Yuryaku, surveys conducted by US scientists in 2021 and 2022 showed extensive areas of reefs just outside of the boxes proposed by Japan.

Larger-scale, more comprehensive surveys using ROVs, AUVs, and other advanced tools—whose findings have undergone peer review—have consistently demonstrated the presence of VMEs in other areas in Yuryaku (as well as on additional seamounts). The best available science must be applied along with the precautionary approach in decision-making processes (CMM 2024-05) and integrating existing VME mapping by ROV/AUV surveys on Yuryaku and other seamounts of the Emperor Seamount Chain and Northwest Hawaiian Ridge are warranted.

Considering these scientific lines of evidence for VMEs, the US requests that the Commission close bottom fishing on the entirety of Yuryaku seamount. At minimum the closure areas should be expanded considerably to include locations of known VMEs.

As a separate issue, the SSC BF-ME presentation by the invited experts Maite Pons, Ricardo Amoroso and SWG NPA-SA Chair Kota Sawada (NPFC-2024-SSC BFME05-WP09) indicated that trawl fishing for SA was capturing reproductively immature individuals with a very pronounced size targeting gear selection curve. A fundamental principle of fisheries science is that a fishery that targets individuals prior to the chance to reproduce erodes the base of the population. Although the focus of the discussion was on selectivity of the gear, and/or selective targeting of habitat, the critical result remains that bottom trawling for SA targets and captures immature fish. This data came out too late to include in the US proposal for closure, but adds an entire extra layer of reasoning for full closure of the bottom trawl fishery, further supporting the US proposal. A temporary closure would allow time to redesign gear and/or change fishing practices such that the fishery targets larger individuals and/or adult populations rather than juveniles as well as allow recovery from growth and recruitment overfishing. The NPFC convention text clearly establishes the obligation, in article 3(f) to take actions, individually or collectively as appropriate, to prevent or eliminate overfishing and ensure that levels of fishing effort or harvest levels are based on the best scientific information available and do not exceed those commensurate with the sustainable use of the fisheries resources. Articles 3(a) and 3(b) further obligate the NPFC to ensure the optimum utilization and long term sustainability of fisheries resources and measures and that fisheries resources are maintained at or restored to levels capable of producing maximum sustainable yield. Therefore, with regard to bottom fishing target fish stocks, this additional concern, coupled with scientific findings of overfishing, align and support the US proposal for closure of all bottom fishing in the Emperor Seamount Chain and Northwestern Hawaiian Ridge.

Annex U

Terms of Reference for the Small Scientific Committee on Neon Flying Squid

1. To review and evaluate fishery data
    - Catch and efforts (including spatial-temporal distribution of landings and discards)
    - Age/size composition data
    - Evaluation of data quantity, data quality, sources of uncertainty
    - Others
    - Recommendation for future works

2. To review and evaluate fishery-dependent and fishery-independent indices
    - Evaluate/update sampling design for fishery-independent survey
    - Characterize the source of uncertainty for the fishery-dependent and fishery-independent data
    - Review/update the CPUE standardization Protocol
    - Conduct CPUE standardization
    - Review and update fishery-dependent and fishery-independent indices
    - Recommendation for future works

3. To review and update biological and other information/data relevant to stock assessment
    - Stock structure
    - Growth
    - Reproduction and maturity schedule
    - Natural mortality
    - Migration pattern
    - Environmental influences (e.g. oceanographic, habitat, or species interactions)
    - Others
    - Evaluation of data quantity, data quality, sources of uncertainty
    - Recommendation for future works

4. To conduct the stock assessment
    - Review existing/potential stock assessment methods or develop new methods
    - Application of candidates of stock assessment models and comparison of the results (if needed)
    - Determine models for the stock assessment
    - Conduct stock assessment following the Stock Assessment Protocol
    - Create the scientific advice on management based on the results of the stock assessment
    - Recommendation for future works

5. To facilitate data- and code- sharing processes and potentially primary publication

6. To review/improve presentation of stock assessment results (including stock status summary report in a format to be determined by the SSC NFS)

7. To explore and develop alternative approaches, such as the management strategy evaluation framework and data-limited management procedures, to provide effective management advice

Annex V

CPUE Standardization Protocol for neon flying squid

CPUE is catch per unit effort obtained either from fishery independent or fishery dependent data. The use of CPUE in a stock assessment implicitly assumes that CPUE is proportional to stock abundance/biomass. However, many factors other than stock abundance/biomass may influence CPUE. Thus, any other factors, other than stock abundance/biomass, that may influence CPUE should be removed from the CPUE index. The process of reducing/removing the impacts of these factors on CPUE is referred to as CPUE standardization.

The following protocol is developed for the CPUE standardization:

(1) Provide a description of the type of data (logbook, observer, survey, etc.), and the "resolution" of the data (aggregated, set-by-set etc..).

(2) Identify potential explanatory variables (i.e., spatial, temporal, environmental, and fisheries variables) that may influence CPUE values.

(3) Plot annual/monthly spatial catch, effort and nominal CPUE distributions and determine temporal and spatial resolution for CPUE standardization.

(4) Make scatter plots (for continuous variables) and/or box plots (for categorical variables) and present correlation matrix if possible to evaluate correlations between each pair of those variables.

(5) Describe selected explanatory variables based on (2)-(4) to develop full model for the CPUE standardization.

(6) Specify model type and software (packages) and fit the data to the assumed statistical models (i.e., GLM, GAM, Delta-lognormal GLM, Neural Networks, Regression Trees, Habitat based models, and Statistical habitat based models).

(7) Evaluate and select the best model(s) using methods such as likelihood ratio test, information criterions, cross validation etc.

(8) Provide diagnostic plots to support the chosen model is appropriate and assumption are met (QQ plot and residual plots along with predicted values and important explanatory variables, etc.).

(9) Extract yearly standardized CPUE and standard error by a method that is able to account for spatial heterogeneity of effort, such as least squares mean or expanded grid. If the model includes area and the size of spatial strata differs or the model includes interactions between time and area, then standardized CPUE should be calculated with area weighting for each time step. Model with interactions between area and season or month requires careful consideration on a case by case basis. Provide details on how the CPUE index was extracted.

(10) Calculate uncertainty (SD, CV, CI) for standardized CPUE for each year. Provide detailed explanation on how the uncertainty was calculated.

(11) Provide a table and a plot of nominal and standardized CPUEs over time. When the trends between nominal and standardized CPUE are largely different, explain the reasons (e.g. spatial shift of fishing efforts), whenever possible.

Annex W

Stock Assessment Protocol for neon flying squid

(1) Identify the data that will be available to the stock assessment;

(2) Evaluate data quality and quantity and potential error sources (e.g., sampling errors, measurement errors, and associated statistical property (e.g., biased or random errors, statistical distribution) to ensure that the best available information is used in the assessment;

(3) Select population models describing the dynamics of the stock and observational models linking population variables with the observed variables;

(4) Develop base case scenarios and alternative scenarios for sensitivity analyses;

(5) For each scenario, fit the model to the data, diagnostics of model convergence, plot and evaluate residual patterns, and evaluate biological implications of the estimated parameters;

(6) Develop retrospective analysis to verify whether any possible systematic inconsistencies exist among model estimates of biomass and fishing mortality;

(7) For each scenario, estimate and plot exploitable stock biomass and fishing mortality (and their relevant credibility distributions) over time;

(8) For each scenario, estimate biological reference points (e.g., MSY, B_{MSY}, F_{MSY}) and its associated uncertainty;

(9) Have the Kobe plot for each scenario;

(10) Develop alternative ABCs for the projection (e.g., 2-year projection);

(11) Include relevant ecosystem considerations regarding the stock for future assessment, including data and results from other scientific studies regarding potential impacts on the stock due to climate change, non-stationary population and fisheries processes, predator-prey dynamics, or impacts of distribution and phenological changes on assessment data.

Annex X

Table of tasks for the SWG JFS, the SWG JS, and the SWG BM in 2025

Tasks	**BM**	**JFS**	**JS**
Update shared data (monthly catch and effort, biological data) among members			☑
Update catch and effort data among members	☑	☑	
Start on joint review paper of impacts of climate change on JS			☑
Calculate ratio of BM and CM in catches	☑		
Evaluate the influence of environmental variables on the life history, biology, and population dynamics (lower priority)	☑	☑	☑
Revise and update species summary document	☑	☑	☑
Japan: provide a summary of its 2024 stock assessment at SC10	☑	☑	☑
SWG Leads: prepare slide(s) to SC Chair for presentation to COM	☑	☑	☑
Prepare stock assessment summary	☑	☑	☑

Annex Y

Terms of Reference for the Small Working Group on Data (SWG Data)

1) Guide the Secretariat in creating a data management system, including data collection, verification, reporting, storing, and dissemination

    a. Discuss the creation of a relational database for data storage and what the necessary steps would be

    b. Continue developing data provision templates, incorporating feedback from the SC's subsidiary bodies.

2) Identify the scope of the SWG, its membership and roles of Members, Secretariat and a contractor(s)

Annex Z

Revised Regulations for Management of Scientific Data and Information

These Regulations are intended to govern the security of, exchange of, access to and dissemination of scientific 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. These Regulations supplement the NPFC Data Sharing and Data Security Protocol which is an overall Commission policy for data management and security.

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 process for 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. In order not to reveal the individual activities of any vessel, catch and effort data in the public domain shall be made up of observations from a minimum of three vessels, unless the owner of the data decides otherwise.

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 to the public in accordance with paragraph 4.

Members, cooperating non-contracting Parties (CNCPs) or contractors (invited experts and/or consultants), within the scope of its contract with the Secretariat, may cite and/or use such data and/or code for the purpose of consideration by the Scientific Committee and its subsidiary bodies, including informal working groups, in accordance with the relevant rules including the Terms of References of informal working groups. Before a Member, CNCP or contractor accesses data and/or code for analyses outside the activities outlined in the workplans of SC subsidiary bodies, the party should obtain prior consent with the provider(s) for the use 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.

If a Member, CNCP or contractor, within the scope of its contract with the Secretariat, wishes to cite and/or use these data and/or code for work that is intended to be conducted or shared outside of the NPFC, such Member, CNCP or contractor 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 and 3) who the data or code will be shared with. 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 and/or code further nor use it for a purpose not declared.

In addition to the above paragraph, if a Member, CNCP or contractor after presentation and review at NPFC Scientific meetings, wishes to publish a scientific article in an external journal using the requested data and/or code, such Member, CNCP or contractor should ensure that all data/code providers have reviewed the results and approved using them in the external publication.

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

In accordance with the NPFC Document Policy from COM09, the SC recommends making the above named documents available to the public through the NPFC website to enhance and encourage collaborations with researchers, scientists, RFMOs, and science organizations, and to encourage transparency of the NPFC processes. The default rule would be that all the above named documents would be posted on the public domain of the NPFC website upon receipt 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 to the public 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 the 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 AA

Scientific projects

#	Project	Time	Status	Next step: activities, required funds
1	Pacific saury stock assessment meetings (meeting costs)	Every year	*TWG PSSA meetings: Feb 2017, Dec 2017, Nov 2018, Mar 2019.* *SSC PS meetings: Nov 2019, Aug 2023.*	WG NSAM meeting. Jul 2025. *2025 FY: 2mil JPY* *Source: China's Voluntary Contribution Fund (VCF)* SSC PS15 meeting. Sep 2025. *2025 FY: virtual, no funds required.*
2	Chub mackerel stock assessment meeting (meeting costs)	Every year	*TWG CMSA meetings: Dec 2017, Mar 2019, Sep 2023, Jul 2024.*	TWG CMSA11 meeting. Jul 2025. *2025 FY: 1.5mil JPY (10,000USD)* *Source: SC fund.* TWG CMSA12. Early 2026. *2025 FY: virtual, no funds required.*
3	Neon flying squid stock assessment meeting (meeting costs)	Every year		SSC NFS02 meeting. Jul 2025. *2025 FY: 1.5mil JPY (10,000USD)* *Source: SC fund.*
4	Invited expert to support TWG CMSA (consultancy fee and travel costs for one in-person meeting)	2020-current	An external expert has been contracted to support TWG CMSA.	*2025 FY:* *0.6mil JPY - SC fund, and 0.8mil JPY - US VCF.*
5	Invited expert to support SSC PS (consultancy fee and travel costs for two in-person meeting)	2019-current	An external expert has been contracted to support SSC PS and its subsidiary WG NSAM.	*2025 FY: 2.4mil JPY* *Source: SC fund.*

6	Invited expert to support WG NSAM (consultancy fee and travel costs for one in-person meeting)	2024-		*2025 FY: 3.3mil JPY* *Source: SC fund.*
7	Invited expert to support SSC NFS (consultancy fee and travel costs for two in-person meetings)	2024-current	An external expert has been contracted to support SSC NFS.	*2025 FY: 2.2mil JPY* *Source: SC fund.*
8	Invited expert to support SA and NPA stock assessments	2024-current	Two external experts were contracted in 2024 as a separate project covered by the Special Project Fund.	*2025 FY: 2.2mil JPY* *Source: SC fund.*
9	PICES Annual meeting	Every year	Travel support to a participant of the SC or its subsidiary bodies to attend PICES Annual meeting.	*2025 FY: 0.75mil JPY (5,000USD)* *Source: SC fund.*
10	Other science meetings / capacity development	2024	Training for capacity building or travel support to attend other relevant science meetings.	*2026 FY: 0.75mil JPY (5,000USD)* *Source: SC fund.*
11	PICES/ICES/FAO Small Pelagic Fish Symposium. 4-8 May 2026, La Paz, Mexico	2025& 2026	An invitation from PICES for co-sponsorship and participation in the symposium.	*2025 FY: 0.75mil JPY (5,000USD)* *2026 FY: 0.75mil JPY (5,000USD)* *Source: SC fund.*
12	Database for scientific data	2025-2026	A proposal to develop a database for scientific data.	*2025 FY: 10,000 EUR* *2026 FY: 20,000 EUR* *Source: EU's VCF and Members' in kind contribution*
	Total			*2025 FY: 15.2mil JPY* *Source: SC fund.*

** 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 make a proposal for the Special Project Fund or other funds subject to the decision by the Commission.*

Past projects

#	Project	Time	Status
P1	NPFC/FAO VME workshop	2018-2019	*Concluded.*
P2	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.*
P3	Workshop on biological reference points (BRP), harvest control rule (HCR) and management strategy evaluation (MSE)	2019	*Concluded.*
P4	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.*
P5	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.*
P6	VME taxa identification guide	2017-2022	*Concluded.* VME taxa ID guide has been printed out and distributed to Members.
P7	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.*
P8	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.

P9	GIS database/module as a part of NPFC database management system for spatial management of bottom fisheries and VMEs	2018-	*Regular update.* *Fund source: Database management.*
P10	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-	*Regular update.* *Fund source: Database management.*
P11	Expert to review Pacific saury stock assessment (consultant fee and travel costs)	TBD	*Removed. May be revisited in future.*
P12	Observer Program	2018-	*Removed. May be revisited in future.*
P13	Promotion of cooperation with NPAFC including macro-scale multinational survey in the North Pacific in 2022	2021-	*Completed*. The NPAFC reported on the 2022 IYS Winter High Seas Research Expedition which was co-sponsored by NPFC.
P14	Standardization of bycatch species list and fish species identification guides (translation of the existing fish ID guide from Japanese to additional languages)	2019-2023	*Completed.*
P15	PICES 2023 session on Seamount Ecology and VME Identification	2023	*Completed.*
P16	Understanding the basis by which other RFMOs' VME encounter thresholds were determined by taxa and gear-type	2023	*Completed.*

Annex BB

Evaluation and ranking of nominations for SC representatives to be financially supported to participate in relevant scientific meetings

At SC-05, Members recommended that the Commission provide financial support for three members of the SC or its subsidiary bodies to attend the PICES-ICES small pelagic fish (SPF) symposium (NPFC-2020-SC05-OP04). The SC also recommended that the Commission financially support the travel of two members of the SC or its subsidiary bodies to participate in the PICES Annual Meetings in 2021, if financial support was necessary.

At SC-06, Members recommended that the Commission financially support the travel of one member of the SC or its subsidiary bodies to participate in the PICES Annual Meeting, if financial support was necessary. During the same meeting, the SC agreed that Members would provide nominations for NPFC representatives to be supported financially to participate in those meetings. Nominations would specify the scientific meeting in question, the name of the proposed participant, and one or two sentences about how the participant meets each of the six criteria endorsed by the SC. Those criteria are:

- part of a member's delegation to NPFC
- anticipated contributions
- expertise
- financial need
- early career scientist
- willingness to report back to the SC on key meeting outcomes of interest

At SC-08, Members agreed that capacity building was important and support for scientists to attend training and meetings should be supported as much as possible. With financial support for capacity building would come an obligation to transmit the skills and knowledge to the SC through reports, workshops, or shared scientific products (e.g. modeling methods or code).

In this information paper, a method is proposed to evaluate and rank nominations for SC representatives to be financially supported to participate in relevant scientific meetings, including opportunities that build capacity to undertake scientific analyses.

Step 1

The SC Chair and the Secretariat receive nominations by a date agreed by the SC. If no nominations are received by the agreed date, the SC Chair may extend the deadline.

Step 2

The SC Chair evaluates and scores nominees according to Table 1 below. Nominees are ranked according to their total score such that the nominee with the highest score is offered financial support first.

Table 1. Six selection criteria and description of scores assigned to each criterion.

Criterion	**Score = 1**	**Score = 2**	**Score = 3**
Part of a Member's delegation	No	Invited expert or other relevant colleague	Yes
Anticipated role / contribution	One point for each role or contribution (to a maximum of 3)		
Expertise	One point for each relevant subject matter of expertise (to a maximum of 3)		
Financial Need	Would be able to participate without financial support	Alternative funding may be available	Would not be able to participate without financial support
Early Career Scientist	>5 years since PhD	<5 years since PhD	PhD in progress, or no PhD
Report back to NPFC	Unwilling / unable to report back to the NPFC's SC	No experience reporting back to the NPFC's SC	Experience reporting back to the NPFC's SC

Step 3

The SC Chair works with the Chairs of the SC's subsidiary bodies (currently the SSC PS, the SSC BF-ME, the SSC NFS, and the TWG CMSA) to review assigned scores and rankings, and agree on one or more SC representatives in the order of the summed scores. If the Chairs differ in their assessment of nominees, each Chair shall score the nominee using Table 1. Then the scores from all Chairs shall be summed, and nominees ranked according to their summed scores.

Step 4

The rankings are shared with the Secretariat who contacts the successful nominees and arranges for financial support, if it is needed by the nominees. In the case that a nominee declines the financial support, then the support is offered to the next most highly ranked nominee.

Below is an example of scores for two potential SC representatives nominated to participate in the PICES-ICES SPF symposium: Nominee A (Table 2) and Nominee B (Table 3). These scores are simply meant to illustrate the method of evaluating and ranking nominees.

Table 2. Potential scores assigned by the SC Chair to each criterion for Nominee A to participate in the SFP symposium.

Criterion	**Score = 1**	**Score = 2**	**Score = 3**	**Score**

Part of a Member's delegation			Yes	3
Anticipated role / contribution	Representing the NPFC's SC			1
Expertise	Knowledge of the ecology and stock assessment of the NPFC's small pelagic fish			1
Financial Need		Alternative funding may be available		2
Early Career Scientist	>5 years since PhD			1
Report back to the NPFC			Experience reporting back to the NPFC	3

The total score for Nominee A would be 11 out of a potential 18.

Table 3. Potential scores assigned by the SC Chair to each criterion for Nominee B to participate in the SPF symposium.

Criterion	**Score = 1**	**Score = 2**	**Score = 3**	**Score**
Part of a Member's delegation			Yes	3
Anticipated role / contribution	Member of the SPF symposium's Steering Committee Member of joint PICES/ICES WG43 on Small Pelagic Fish Representing the NPFC's SSC PS Representing the NPFC's SC			3
Expertise	Ecological research on small pelagic fishes Stock assessment and management advice for pelagic fishes Knowledge of or research on NPFC's pelagic priority species			3
Financial Need		Alternative funding may be available		2
Early Career Scientist	>5 years since PhD			1
Report back to the NPFC			Experience reporting back to NPFC	3

The total score for Nominee B would be 15 out of a potential 18.

In this example, all Chairs of the SC subsidiary bodies agree with the SC Chair’s scoring and ranking of the two nominees. Nominee B ranks more highly than Nominee A to represent the NPFC’s SC at the SPF symposium. Therefore, they would first be offered financial support. If they accepted the financial support and the Commission had adopted a recommendation from the SC to financially support the travel of more than one SC representative to the SPF symposium, Nominee A would also be offered financial support. If the Commission had only agreed to support one SC representative, Nominee A would only be offered financial support to participate in the meeting if Nominee B declined the offer of financial support from the NPFC.

Annex CC

Five-Year Research Plan and Work Plan of the Scientific Committee

North Pacific Fisheries Commission
Scientific Committee
2024-2028 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 the priority areas 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

At its 7th meeting, the Commission adopted a resolution on climate change and tasked the SC to identify relevant data availability and needs and integrate analyses of climate change relevant to NPFC fisheries into its work plan. The resolution also requires SC to include climate change as a standing agenda item of its meetings.

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, NPFC's 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. Four fishes are recognized as priority species: North Pacific armorhead (NPA) *Pentaceros wheeleri,* splendid alfonsino (SA) *Beryx splendens,* sablefish *Anonoploma fimbria,* and skilfish *Erilepsis zonifer*.

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 that 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 2024-05 and CMM 2024-06), 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 2024-05 and CMM 2024-06)
• 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

Annex 1

Five-Year Work Plan of the Scientific Committee and its subsidiary bodies

Small Scientific Committee on Pacific Saury

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. Continue exploring climate indices to explain impacts on Pacific saury stock productivity
10. Support any technical work on MSE under SWG MSE PS

ITEM	2024	2025	2026	2027	2028	Progress
Regular update of inputs						
Update & improvement of biomass survey index	Continue regular review 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	Same as on the left	Same as on the left	Same as on the left	Completed annually
Update & improvement of CPUE indices	Continue review of outcomes of regular update and	Same as on the left	Same as on the left	Same as on the left	Same as on the left	Completed annually

ITEM	2024	2025	2026	2027	2028	Progress
	analytical works					
Development of joint CPUE index	Continue review of outcomes of regular update and analytical works	Same as on the left	Same as on the left	Same as on the left	Same as on the left	Completed annually
Regular update of the existing SA						
Routine update BSSPM as a benchmark	Continue review of outcomes of regular BSSPM update [1)]	Same as on the left	Same as on the left	Same as on the left	Same as on the left	Completed annually
Improvement and further investigation of BSSPM	Review any outcomes of improvements, inter alia in light of possible incorporation of environmental information and reduction of retrospective pattern	Same as on the left	Same as on the left	Same as on the left	Same as on the left	Completed annually
Toward age/size-structured models (ASSMs)						
Data preparation/update	Explore age-specific abundance indices and recruitment indices. Conditional age at length information. Spatio-temporal variation of size composition.	TBD[2)]	TBD[2)]	TBD[2)]	TBD[2)]	Completed annually
Summarizing available information on PS biology	Update regularly, specifically maturity ogive and growth function	Continue	Continue	Continue	Continue	Collaboration between modelers and biologists has been done well and it will continue for updates.
Development of models	Review preliminary models to be evaluated	Finalize development of a new stock assessment model	Test the age-structured model capabilities for Bayesian estimation,	External review		SS3 model was reviewed. WG NSAM will continue to work on the development of

ITEM	2024	2025	2026	2027	2028	Progress
			simulation testing and MSE work			the SS3 model.
Uncertainty in models (possible link with OM grid under MSE)	Refine the plausible range of values of key biological parameters. Refine assumptions about prior distributions and the ranges for model parameters.	Continue	Continue	Continue	Continue	On going with in the work on new stock assessment
Other key matters						
Spatio-temporal modelling	Explore better modelling approaches to understand distribution patterns and produce more reliable indices, possibly including several key environmental variables	Continue	Continue	Continue	Continue	Modelling with VAST and sdmTMB has been conducted and the work to be continued
Climate impact assessment	Explore models for assessing climate impacts on distribution and productivity	Continue	Continue	Continue	Continue	Modelling has been conducted and the work to be continued
HCR		Evaluate the performance of the interim HCR in the presence of retrospective pattern	Continue			Start in 2025

[1)] Until any new stock assessment models other than the BSSPM are accomplished, the outcome will produce key inputs for the Harvest Control Rule (HCR).

Small Scientific Committee on Bottom Fish and Marine Ecosystems

Priority list:

1. NPA: Review monitoring survey
2. NPA: Conduct stock assessment and provide management advice
3. SA: Conduct stock assessment and provide management advice
4. NPA, SA and Sablefish: Develop and implement harvest control rule
5. Sablefish: Evaluate historical harvest relative to trip limits and update trip limits if necessary
6. Sablefish and VME: Conduct trade-off analysis between commercial fishing and VME protection
7. VME: Assess the relative risk of SAI for VME as a step towards standardize approach to SAI

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
North Pacific Armorhead						
Assess and monitor status of stock	Update catch data for NPA	Update catch data for NPA	Update catch data for NPA	Update catch data for NPA	Update catch data for NPA	Completed annually
	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	Completed annually
	~~Implement alternative methods for stock status~~	Implement alternative methods for stock status	Implement alternative methods for stock status	Update status of stock	Update status of stock	Exploring alternative methods for stock status
	Evaluate trend in directed effort relative to NPA catch		~~Compare CPUE and acoustic estimates~~			Completed summary of trend in directed effort (to be presented at BFME05)

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
	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	Completed annually
	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	Completed annually
Conserve stock	~~Develop conservation objective(s)~~		Develop conservation objective(s)			Not completed
	~~Implement adaptive management~~		Implement adaptive management			Not completed
	~~Develop HCR and implement~~	~~Update data and implement HCR~~	Develop HCR and implement	Update data and implement HCR	Update data and implement HCR	Not completed
Splendid alfonsino						
Assess and monitor status of stock	Update catch data for SA	Update catch data and CPUE standardization for SA	Update catch data and CPUE standardization for SA	Update catch data and CPUE standardization for SA	Update catch data and CPUE standardization for SA	Completed annually
	Implement life history based approach, and provide management advice	Update life history based approach and provide management advice if necessary	Update life history based approach and provide management advice if necessary	Update life history based approach and provide management advice if necessary	Update life history based approach and provide management advice if necessary	Completed life history based approach (to be presented at BFME05)

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
		Apply data-limited integrated approach	Complete data-limited integrated approach			Not completed
	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		Completed annually
Conserve stock	~~Develop conservation objective(s);~~ ~~Define and implement harvest control rule~~	Develop conservation objective(s); Define and implement harvest control rule based on stock synthesis approach	Update data and implement HCR	Update data and implement HCR	Update data and implement HCR	Not completed
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	Completed annually
	Provide an update on USA-Canada stock assessment models for	Provide an update on USA-Canada stock assessment models for	Provide an update on USA-Canada stock assessment models for	Provide an update on USA-Canada stock assessment models for	Provide an update on USA-Canada stock assessment models for	Completed annually

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
	Sablefish and joint research on Sablefish	Sablefish and joint research on Sablefish	Sablefish and joint research on Sablefish	Sablefish and joint research on Sablefish	Sablefish and joint research on Sablefish	
	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	Completed annually
Conserve stock	~~Design HCR specific to NPFC Sablefish (joint intersessional work with Canada and USA assessment authors~~	[Design HCR specific to NPFC Sablefish (joint intersessional work with Canada and USA assessment authors]	Update data and implement HCR	Update data and implement HCR	Update data and implement HCR	Not completed
Other research	~~Update trade-off analysis for Sablefish fishing and VME protection (as new data is available)~~		Update trade-off analysis for Sablefish fishing and VME protection (as new data is available)			Not updated (no new data available)
Vulnerable marine ecosystems						
Defining and Identifying VMEs	Summarize VME indicator taxa observation data from		Consolidate other potential data sources and clarify gaps and			Completed mapping (SWG VME report)

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
	various sources and map for NPFC area		deficiencies in VME data			
	Review and update quantitative definition of VMEs as needed	Review and update quantitative definition of VMEs as needed	Review and update quantitative definition of VMEs as needed	Review and update quantitative definition of VMEs as needed	Review and update quantitative definition of VMEs as needed	Completed annually
		Update identification of new VME and areas likely to be VMEs as new data becomes available	Update identification of new VME and areas likely to be VMEs as new data becomes available	Update identification of new VME and areas likely to be VMEs as new data becomes available	Update identification of new VME and areas likely to be VMEs as new data becomes available	Completed annually
	Review updated taxonomy for corals and VME indicator taxa as needed (Hydrocorals)	Review updated taxonomy for corals and VME indicator taxa as needed	Review updated taxonomy for corals and VME indicator taxa as needed	Review updated taxonomy for corals and VME indicator taxa as needed	Review updated taxonomy for corals and VME indicator taxa as needed	Completed annually
Identifying and defining SAI's	Determine data requirements and spatial/temporal resolution for SAI assessment and continue developing risk assessment for SAI	Determine data requirements and spatial/temporal resolution for SAI assessment and continue developing risk assessment for SAI	Assess risk of SAI for bottom fisheries	Conduct integrated SAI assessment	Conduct integrated SAI assessment	Work in progress

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
		Develop standardized and measurable metrics to assess cumulative impacts of fisheries on VME	Assess other threats to VME, such as climate change and lost fishing gear			
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		Completed annually
	Use data-based methods applied to Japan and Korea's indicator taxa bycatch to further refine encounter thresholds	Develop or research alternative methods to apply to Japan and Korea's indicator taxa bycatch to further refine encounter thresholds that are taxon and gear specific				Completed - To be presented at BFME05?
	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	Completed annually

ITEM	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
Conserving VMEs	~~Refine framework for future monitoring of recovering VMEs~~	Refine framework for future monitoring of recovering VMEs	Periodic review of VME management	Periodic review of VME management	Periodic review of VME management	Not completed
Other ecosystem components						
Assess the impact of fisheries on other ecosystem components	Examine discards over time (species composition, weight of discards) for bottom fisheries in CA		Work towards assessment of fishing impacts on other (non-target) ecosystem components			Completed - To be presented at BFME05
Climate Change	SSC BFME05 (2024)	SSC BFME06 (2025)	SSC BFME07 (2026)	SSC BFME08 (2027)	SSC BFME09 (2028)	Progress
Preparing for climate change effect on bottom fish		Literature review for SA, NPA (SWG NPA&SA) Or Sablefish (Canada)				NA

Small Scientific Committee on Neon Flying Squid

Priority list:

11. Conduct research to appropriately separate two cohorts using spatial and age/size characteristics
12. Continue CPUE standardization work
13. Conduct research and literature reviews to better understand the biological characteristic (e.g., growth rate, natural mortality), life history (e.g., cohorts associated with spawning timing and location, feeding and spawning migration) of the species and population structure (e.g. genetic analysis)
14. Conduct a stock assessment based on surplus production model
15. Further investigate improvements to the surplus production model
16. Explore and develop alternative approaches, such as the management strategy evaluation framework and data-limited management procedures, to provide effective management advice
17. Conduct research and literature reviews to better understand the factors driving abundance fluctuations (including climate change) in this short-lived species
18. Review other successful (or unsuccessful) stock assessment and management practices for squid or other short-lived species globally to inform SSC NFS work
19. Develop other models e.g., age/size-structured model
20. Develop databases to support age/size-structured models

ITEM	2024	2025	2026	2027	2028	Progress
Regular update of inputs						
Update & improvement of CPUE indices	Continue review of outcomes of regular update and analytical works	Same as on the left	Same as on the left	Same as on the left	Same as on the left	
Joint CPUE standardization		Conduct joint CPUE standardization	TBD	TBD	TBD	
Regular update of the surplus production model						
Update and review of surplus production model and other stock assessment models	Continue review of outcomes of surplus production model	Conduct preliminary stock assessment	Finalize stock assessment	Same as on the left	Same as on the left	
Improvement and further investigation of surplus production model	Review any outcomes of improvements, inter alia in light of possible incorporation of environmental information	Same as on the left	Same as on the left	Same as on the left	Same as on the left	
Toward age/size-structured models						
Data inventory (CPUE and size/age in space and time)				Explore age-specific abundance indices or recruitment indices. Conditional age at length information. Spatio-temporal variation of size composition.	TBD	
Summarizing available information on neon				Update regularly, specifically maturity	Continue	

ITEM	2024	2025	2026	2027	2028	Progress
flying squid biology				ogive and growth function		
Development of models				Develop models to be evaluated	TBD	
Toward other approaches to provide management advises						
MSE or data-limited management procedures				Develop framework to provide management advices (MSE or data-limited management procedures)	TBD	
Review other successful (or unsuccessful) stock assessment and management practices for squid or other short-lived species globally to inform SSC NFS work	Review by the invited expert	TBD	TBD	TBD	TBD	

Technical Working Group on Chub Mackerel Stock Assessment

Priority list:

1. Data preparation and review of biological information
2. Conduct stock assessment of chub mackerel
3. Set biological reference points
4. Provide scientific advice on the management of chub mackerel stock to the Commission
5. Explore the influence of climate changes on chub mackerel stock
6. Regularly update and refine inputs

ITEM	2024 summer	2025 winter	2025 summer	2026	2027	2028	Progress
Regular update of inputs							
Research survey indices	Finalize data used for the stock assessment	Update		Update	Update	Update	Research survey indices have been finalized and used for stock assessment.
CPUE indices	Finalized CPUE standardization	Update		Update	Update	Update	CPUE standardization has been finalized and used for stock assessment.
Catch data/catch composition	Finalize data used for the stock assessment	Update CAA data		Update	Update	Update	Catch data and catch composition have been finalized and used for stock assessment.
Biological parameters (maturity, M, weight)	Finalize assumptions for the stock assessment	• Review biological parameters • Discuss setting of natural mortality at age for future		Review biological parameters	Review biological parameters	Review biological parameters	Assumptions on biological parameters have been finalized and used for stock

ITEM	2024 summer	2025 winter	2025 summer	2026	2027	2028	Progress
		base cases • Explore mechanisms of temporal change of maturity at age and weight at age used for calculation of reference points and future projections • Bridge the gaps in maturity at age data among Members					assessment.
Quarterly fishery data (CAA, WAA, Maturity-at-age)	• Submit quarterly fishery data • Share and standardize age-counting rule	• Update quarterly fishery data • Share and standardize age-counting rule		Update	Update	Update	Quarterly fishery data has been submitted.
Stock assessment							
Benchmark stock assessment	Complete stock assessment with the selected SA model		Update SA	Update SA	Update SA	Update SA	Benchmark stock assessment has been conducted.
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	Review and improve, if needed, the SA model	Review and improve, if needed, the SA model	
New stock assessment models			Explore new stock assessment models, if available	Explore new stock assessment models, if available	Explore new stock assessment models, if available	Explore new stock assessment models, if available	
Reference points, HCR, future projections and MSE							

ITEM	2024 summer	2025 winter	2025 summer	2026	2027	2028	Progress
Set biological reference points (limit and target)	Review and calculate reference points	Discuss how to calculate biological reference points in consideration of nature of temporal changes in biological parameters	Review and calculate reference points	Review and calculate reference points	Review and calculate reference points	Review and calculate reference points	Commonly used reference points are reviewed, and calculation with the results of SA have been completed
Develop future projections	Provide preliminary results of future projection, if possible	• Initiate discussion of harvest control rule (HCR) to determined future catch, according to traits of CM biological parameters • Explore more sophisticated method for conducting future projections with more uncertainties	Candidates of HCR are tested in future projections	Selection of HCR	Improvement	Improvement	Preliminary results of future projection have been provided.
Develop Management Strategy Evaluation (MSE)		Start discussion	Development	Trial to be used for selection of HCR	Improvement	Improvement	

Scientific Committee - other

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	2024	2025	2026	2027	2028	Progress
Priority Species						
Summaries of priority species	Update summary sheets as needed	Update summary sheets as needed	Update summary sheets as needed	Update summary sheets as needed	Update summary sheets as needed	Summary sheets are complete for 10 priority species
Assessment of Blue (Spotted) Mackerel and associated bycatch	Update data on Blue Mackerel and provide relevant data for stock assessment	Update data on Blue Mackerel and provide relevant data for stock assessment	Update data on Blue Mackerel and provide relevant data for stock assessment	Update data on Blue Mackerel and provide relevant data for stock assessment	Update data on Blue Mackerel and provide relevant data for stock assessment	Data on Blue Mackerel up to 2022 fishing year have been collated and provided for stock assessment

ITEM	2024	2025	2026	2027	2028	Progress
	Compile data on the catch composition of Chub Mackerel and Blue Mackerel and provide information to TWG CMSA and SWG BM Observe Japan's stock assessment of Blue Mackerel Provide management advice to the Commission as needed.	Compile data on the catch composition of Chub Mackerel and Blue Mackerel and provide information to TWG CMSA and SWG BM Observe Japan's stock assessment of Blue Mackerel Provide management advice to the Commission as needed. Develop data collection templates	Compile data on the catch composition of Chub Mackerel and Blue Mackerel and provide information to TWG CMSA and SWG BM Observe Japan's stock assessment of Blue Mackerel Provide management advice to the Commission as needed.	Compile data on the catch composition of Chub Mackerel and Blue Mackerel and provide information to TWG CMSA and SWG BM Observe Japan's stock assessment of Blue Mackerel Provide management advice to the Commission as needed. Collate data on associated bycatch species	Compile data on the catch composition of Chub Mackerel and Blue Mackerel and provide information to TWG CMSA and SWG BM Observe Japan's stock assessment of Blue Mackerel Provide management advice to the Commission as needed. Assess impacts of fishery on dependent or associated species	Data on catch composition are compiled up to 2022 fishing year and were provided to TWG CMSA and SWG BM The SC observed Japan's stock assessment of Blue Mackerel. Stock assessment results were communicated to the Commission
Assessment of Japanese Sardine and associated bycatch	Update data on Japanese Sardine	Update data on Japanese Sardine	Update data on Japanese Sardine	Update data on Japanese Sardine	Update data on Japanese Sardine	Data on Japanese Sardine have been collated

ITEM	2024	2025	2026	2027	2028	Progress
	Observe Japan's stock assessment of Japanese sardine Provide management advice to the Commission as needed.	Observe Japan's stock assessment of Japanese sardine Provide management advice to the Commission as needed.	Observe Japan's stock assessment of Japanese sardine. Provide management advice to the Commission as needed.	Observe Japan's stock assessment of Japanese sardine. Provide management advice to the Commission as needed. Collate data on associated bycatch species	Observe Japan's stock assessment of Japanese sardine. Provide management advice to the Commission as needed. Assess impacts of fishery on dependent or associated species	The SC observed Japan's stock assessment of Japanese Sardine Stock assessment results were communicated to the Commission
Assessment of Japanese Flying Squid and associated bycatch	Update data on Japanese Flying Squid Observe Japan's stock assessment of Japanese Flying Squid	Update data on Japanese Flying Squid Observe Japan's stock assessment of Japanese Flying Squid	Update data on Japanese Flying Squid Observe Japan's stock assessment of Japanese Flying Squid	Update data on Japanese Flying Squid Observe Japan's stock assessment of Japanese Flying Squid	Update data on Japanese Flying Squid Observe Japan's stock assessment of Japanese Flying Squid	Data on Japanese Flying Squid have been collated The SC observed Japan's domestic stock assessment

ITEM	2024	2025	2026	2027	2028	Progress
	Provide management advice to the Commission as needed.	Provide management advice to the Commission as needed. Develop data collection templates	Provide management advice to the Commission as needed. Collate data on associated bycatch species	Provide management advice to the Commission as needed. Collate data on associated bycatch species	Provide management advice to the Commission as needed. Assess impacts of fishery on dependent or associated species	of Japanese Flying Squid Stock assessment results were communicated to the Commission
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	The SC/SSC PS supported NPFC's SWG MSE PS
Ecosystem approach to fisheries management						
Ecological Interactions	Understand ecological interactions among species in the North	Understand ecological interactions among species in the North	Understand ecological interactions among species in the North	Understand ecological interactions among species in the North	Understand ecological interactions among species in the North	

ITEM	2024	2025	2026	2027	2028	Progress
	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	
Impacts of fishing on ecosystem components	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	No assessment of the impacts of fishing on bycatch or discards were reported.
Climate change	Consider possible key vulnerabilities and management implications of changing oceanographic conditions resulting from climate change on NPFC fisheries resources and species belonging to the same ecosystem or dependent upon or associated with target stocks.	Consider possible key vulnerabilities and management implications of changing oceanographic conditions resulting from climate change on NPFC fisheries resources and species belonging to the same ecosystem or dependent upon or associated with target stocks.	Consider possible key vulnerabilities and management implications of changing oceanographic conditions resulting from climate change on NPFC fisheries resources and species belonging to the same ecosystem or dependent upon or associated with target stocks.	Consider possible key vulnerabilities and management implications of changing oceanographic conditions resulting from climate change on NPFC fisheries resources and species belonging to the same ecosystem or dependent upon or associated with target stocks.	Consider possible key vulnerabilities and management implications of changing oceanographic conditions resulting from climate change on NPFC fisheries resources and species belonging to the same ecosystem or dependent upon or associated with target stocks.	SC discussed implications of climate change and received three presentations including Tools for incorporating climate change considerations into scientific advice by Tom Carruthers, a FAO consultancy report on climate change in the

ITEM	2024	2025	2026	2027	2028	Progress
	Make recommendations to help adapt to climate change and promote resilience in NPFC fisheries	Make recommendations to help adapt to climate change and promote resilience in NPFC fisheries	Make recommendations to help adapt to climate change and promote resilience in NPFC fisheries	Make recommendations to help adapt to climate change and promote resilience in NPFC fisheries	Make recommendations to help adapt to climate change and promote resilience in NPFC fisheries	North Pacific and Ongoing research activities PICES' Basin-scale Events to Coastal Impacts (BECI) project
Collaboration with other Organizations						
PICES	Review implementation of NPFC-PICES Framework for Collaboration; Consider renewing this Framework for another 5 years Review ICES-PICES WGSPF activities (PICES WG43)	Review implementation of NPFC-PICES Framework for Collaboration	Review implementation of NPFC-PICES Framework for Collaboration	Review implementation of NPFC-PICES Framework for Collaboration	Review implementation of NPFC-PICES Framework for Collaboration	SC reviewed implementation of NPFC-PICES Framework for Collaboration and endorsed its renewal SSC BFME reviewed PICES WG43 activities

ITEM	2024	2025	2026	2027	2028	Progress
	Review ICES-PICES WGSPF activities (PICES WG53) Identify other opportunities for collaboration with PICES.	Review ICES-PICES WGSPF activities (PICES WG53) Identify other opportunities for collaboration with PICES.	Review ICES-PICES WGSPF activities (PICES WG53) Identify other opportunities for collaboration with PICES	Review ICES-PICES WGSPF activities (PICES WG53) Identify other opportunities for collaboration with PICES	Identify other opportunities for collaboration with PICES	SC reviewed PICES WG53 activities
FAO	Review NPFC's involvement with the ABNJ Deep-sea fisheries project Review NPFC's partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)	Review NPFC's involvement with the ABNJ Deep-sea fisheries project Review NPFC's partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)	Review NPFC's involvement with the ABNJ Deep-sea fisheries project Review NPFC's partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)	Review NPFC's involvement with the ABNJ Deep-sea fisheries project Review NPFC's partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)	Review NPFC's involvement with the ABNJ Deep-sea fisheries project Review NPFC's partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)	SC reviewed its collaboration with the ABNJ Deep-sea fisheries project SC reviewed its partnership with the Fisheries and Resources Monitoring System of FAO (FIRMS)

ITEM	2024	2025	2026	2027	2028	Progress
NPAFC	Undertake scientific activities to achieve relevant deliverables of the NPFC/NPAFC work plan	Undertake scientific activities to achieve relevant deliverables of the NPFC/NPAFC work plan	Undertake scientific activities to achieve relevant deliverables of the NPFC/NPAFC work plan	Undertake scientific activities to achieve relevant deliverables of the NPFC/NPAFC work plan	Undertake scientific activities to achieve relevant deliverables of the NPFC/NPAFC work plan	SC reviewed NPFC/NPAFC activities
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	SC was updated on the MOU with SPRFMO and n collaboration with ISC and WCPFC
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	SC reviewed its TOR and agreed it did not need to be revised
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	SC updated its 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	SC updated its rolling 5-year work plan
Projects	Review completed	Review completed	Review completed	Review completed	Review completed	SC reviewed its

ITEM	2024	2025	2026	2027	2028	Progress
	and ongoing projects Identify and prioritize new projects and recommend sources of funding	and ongoing projects Identify and prioritize new projects and recommend sources of funding	and ongoing projects Identify and prioritize new projects and recommend sources of funding	and ongoing projects Identify and prioritize new projects and recommend sources of funding	and ongoing projects Identify and prioritize new projects and recommend sources of funding	completed and ongoing projects, and recommended new projects and sources of funding
Data Management						
	Review data inventories and the status of data gaps Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data	Review data inventories and the status of data gaps Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data	Review data inventories and the status of data gaps Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data	Review data inventories and the status of data gaps Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data	Review data inventories and the status of data gaps Review data standards in relation to stock assessment of priority species Discuss need for additional sources of data for scientific analyses and associated data	SC discussed data standards in relation to stock assessment of priority species. SC discussed the need for additional sources of data for scientific analyses and associated data management policy

ITEM	2024	2025	2026	2027	2028	Progress
	management policy	management policy	management policy	management policy	management policy	
Recommendations						
Advice	Develop recommendations for the Commission, TCC, and FAC	Develop recommendations for the Commission, TCC, and FAC	Develop recommendations for the Commission, TCC, and FAC	Develop recommendations for the Commission, TCC, and FAC	Develop recommendations for the Commission, TCC, and FAC	SC made 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	SC drafted and endorsed a press release about SC activities during its SC09 meeting