NPFC
North Pacific Fisheries Commission

NPFC-2024-SSC PS13-Final Report

North Pacific Fisheries Commission
13th Meeting of the Small Scientific Committee on Pacific Saury

26–29 August 2024
WebEx

REPORT

Agenda Item 1. Opening of the Meeting

1. The 13th Meeting of the Small Scientific Committee on Pacific Saury (SSC PS13) took place as a virtual meeting via WebEx, and was attended by Members from Canada, China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, the United States of America, and the Republic of Vanuatu. The Ocean Foundation and the Pew Charitable Trusts attended as observers. Dr. Larry Jacobson participated as an invited expert.

2. The meeting was opened by Dr. Toshihide Kitakado (Japan), the SSC PS Chair, who welcomed the participants.

3. The Science Manager, Dr. Aleksandr Zavolokin, outlined the procedures for the meeting.

4. Mr. Alex Meyer was selected as rapporteur.

Agenda Item 2. Adoption of Agenda

5. The agenda was adopted (Annex A). The List of Documents and List of Participants are attached (Annexes B, C).

Agenda Item 3. Overview of the outcomes of previous NPFC meetings

3.1 SSC PS12 and SC08

6. The Chair presented the outcomes and recommendations from the SSC PS12 meeting and the 8th meeting of the Scientific Committee (SC08).

3.2 SWG MSE PS05

7. The Chair presented the outcomes and recommendations from the 5th meeting of the joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific saury (SWG MSE PS05).

3.3 COM08

8. The Science Manager presented the outcomes from the 8th Commission meeting of relevance to Pacific saury, highlighting the discussions related to the establishment of a regional observer program (ROP), climate change, and Conservation and Management Measure (CMM) 2024-08 for Pacific Saury.

3.3.1 CMM 2024-08 for Pacific Saury

9. The Science Manager highlighted key aspects of CMM 2024-08 for Pacific Saury, including the incorporation of the interim harvest control rule (HCR); plans to establish implementation rules for the interim HCR; and catch management provisions related to the overall total allowable catch (TAC), the TAC for the Convention Area, and the reduction of each Member's total annual catches by 55% from 2018 levels.

3.3.2 Others

10. The Science Manager explained that the SC and its subsidiary bodies, including the SSC PS, are requested to provide guidance to the Technical and Compliance Committee (TCC) on necessary observer coverage and data needs for an ROP, which the SSC PS will address under agenda item 12.2. He also explained that regarding the Resolution on Climate Change, since COM08, the Food and Agriculture Organization of the United Nations (FAO) has agreed to fund a consultancy on climate change with the NPFC.

Agenda Item 4. Review of the Terms of References of the SSC PS and existing protocols

4.1 Terms of References of the SSC PS

11. The SSC PS reviewed the Terms of References (ToR) of the SSC PS and determined that no revisions are currently necessary.

4.2 CPUE Standardization Protocol

12. The SSC PS recommended an update to the catch-per-unit-effort (CPUE) Standardization Protocol in relation to model evaluation (Annex D).

4.3 Stock Assessment Protocol

13. The SSC PS reviewed the Stock Assessment Protocol and determined that no revisions are currently necessary.

Agenda Item 5. Member's fishery status including 2024 fishery

14. Chinese Taipei presented its fisheries status (NPFC-2024-SSC PS13-IP01). The catch returned to around 180,000 MT in 2018 after a 3-year consecutive decline, but a consecutive decline

since then has been observed. In 2024, fishing vessels began operations in fishing grounds later than in previous years, and the catch distribution was further north than in the same period of 2023. Although the accumulated catch, 6,811 MT, by the end of July of 2024 is lower than that of the same period of 2023, the nominal CPUE is 1.68 MT/haul in 2024, which is lower than the 2.32 MT/haul in 2023. Regarding the size box composition (S: less than 6 pcs/kg; 1: 7-9 pcs/kg; 2: 10-12 pcs/kg; 3: 13-15 pcs/kg; 4: 16-18 pcs/kg; 5: more than19 pcs/kg), the mode size boxes for Pacific saury caught in each month from June to October were 3, 5, 4, 4, and 5, respectively. Overall, the size of Pacific saury caught in 2023 was smaller than in 2022.

15. Vanuatu presented its fisheries status (NPFC-2024-SSC PS13-IP02). Total annual catch peaked at 8,231 MT in 2018. Total catch in 2023 was 1,108 MT. The 2024 fishing season began in mid-August and the catch so far has been around 85 MT. Vanuatu's Pacific saury fishery began in 2004. In total, it has authorized 16 vessels. The number of operating vessels was 4 from 2015 to 2021 and was 3 in 2022. Only 2 vessels were active in 2023. So far in 2024, only two vessels are active. An annual comparison of accumulated catch shows a trend of abundance increasing from September. The main part of the fishing season is from mid-September to the end of October. An annual comparison of the relative seasonal catch shows that there are usually two peaks in the fishing season. In 2023, the peaks were around mid-to-late September and late October. Nominal CPUE in 2023 was 9.8 MT/day. The main fishing grounds began in the east early in the season, before shifting to the west. In 2023, the fishing grounds were further north than in 2022 and like in 2022, they did not cross 165^{o}E longitude. Looking at the monthly size box compositions in 2023 (S: less than 6 pcs/kg; 1: 6-9 pcs/kg; 2: 10-12 pcs/kg; 3: 13-15 pcs/kg; 4: 15-18 pcs/kg; 5: more than 18 pcs/kg), there were no size box S catches and the percentage of size box 1 catches was very low.

16. Korea presented its fisheries status (NPFC-2024-SSC PS13-IP03). In 2023, total catch was 3,107 MT, a historical low, and annual catch has continued to decrease since 2018. In 2024, the total catch up to July was 1,403 MT, a decrease of 18% compared to the same period in 2023. The number of vessels operating has gradually decreased each year from 2015 to 2023 and has decreased from 6 in 2023 to 4 in 2024 due to the continued low level of Pacific saury catch. The nominal CPUE was 4.65 MT/vessel/day in 2023, around double that of the previous year. Standardized effort was 928 days in 2023, less than half of that in 2022. In June and July 2024, the fishing grounds were between 160^{o}E and 170°E longitude. In June and July of 2023 and 2024, the fishing grounds shifted northward compared to 2022. In 2023, the overall body length range was 20–32 cm. In June and July 2024, the overall body length range was 25–32 cm. By size box composition (S: 18–30cm; M: 23–33cm; L: 27–34cm; 2L: 29–34cm (fork length)) the S ratio was dominant for most of the 2023 fishing season, except from May to July. In June 2024, the S ratio was dominant, while in July, the M ratio became dominant. An annual

comparison of body length composition shows no significant overall change, but the number of large individuals has been negligible in recent years.

17. China presented its fisheries status (NPFC-2024-SSC PS13-IP04). The annual catch decreased continuously after 2018, bottoming out in 2021. Total catch in 2023 was 39,252 MT. In 2024, total catch up to 3 August was 20,327 MT and a total of 56 vessels have been operating, a decrease of 1 from 2023. However, 3 more vessels are reportedly on their way to the fishing grounds. As of 3 August, nominal CPUE has been 9.85 MT/vessel/day in 2024. Standardized effort was 4,189 vessel days in 2023. The fishing grounds in 2024 have moved to the north and the west in June and July. A yearly comparison of body length compositions has been conducted up to 2022.

18. Japan presented its fisheries status (NPFC-2024-SSC PS13-IP05). Landings and nominal CPUE in 2023 were 24,465 MT and 0.59 MT/haul, respectively, slightly higher than in 2021 and 2022, but remaining at low levels. In 2019–2023, relative accumulated catch reached 50% by mid-October and 99% by the end of November. The highest seasonal catch in 2023 was at the end of October, at 23,636 MT. The seasonal catch at the end of October 2023 reached 18% of the total catch. By month, catch in October was the largest at 39%. Standardized effort was 81,770 hauls in 2023, the highest level in the last 5 years. The fishing grounds in August and September were mainly formed in the high seas, but from October the main fishing grounds moved into Japan's exclusive economic zone (EEZ). After mid-October, fishing grounds were also formed in the Sea of Okhotsk. The percentage of age-1 fish in 2023 was 20.3%, the lowest percentage since 2000. The mean body length of age-1 fish has been gradually decreasing since 2000. The fishing season in 2024 started on 10 August. 97 fishing vessels were registered in 2024, compared to 109 fishing vessels in 2023.

19. The Chair informed the SSC PS that Canada's Pacific saury catch information is available in NPFC-2024-SSC PS13-IP07. Canada does not have a commercial fishery targeting Pacific saury, but occasionally takes Pacific saury as bycatch.

20. The Science Manager informed the SSC PS that the compiled data on Pacific saury catches in the northwestern Pacific Ocean from 1950 to 2023 are available in NPFC-2024-SSC PS13-WP01.

21. The Science Manager presented the cumulative catch of Pacific saury as of mid-August in 2020, 2021, 2022, 2023, and 2024. The cumulative catch in 2024 is approximately 34,760 MT compared to 36,487 MT in 2023, 14,342 MT in 2022, 23,701 MT in 2021, and 9,875 MT in 2020.

Agenda Item 6. Fishery-independent abundance indices

6.1 Review of results of abundance estimation including 2024 Japanese biomass survey

22. Japan presented a report of its 2024 biomass survey (NPFC-2024-SSC PS13-IP06). The Japanese biomass survey was conducted with three research vessels, all using the same type of trawl (NST-99). The survey was conducted at 137 stations from 15 June to 13 July and covered the area from 143°E to 165°W. 40,044 individuals were caught in the survey. Pacific saury occurred between 155°E and 165°W. The age-1 fish were mainly distributed between 155°E and 159°E. Comparing the surveys in 2023 and 2024, the abundance in the survey area increased west of 160°E in 2024, while Pacific saury were less abundant around the date line in 2024.

23. Japan presented the Japanese survey biomass index of Pacific saury up to 2024 using the Vector Autoregressive Spatio-temporal (VAST) model (NPFC-2024-SSC PS13-WP06). Japan applied the VAST model to Japanese fishery-independent survey data to predict the Pacific saury distribution and estimate the biomass index from 2003 to 2024. The estimated biomass index from the selected VAST model with minimum Akaike information criterion (AIC) indicated similar year trends with the index from a design-based approach. In 2020, the estimated biomass index dropped to the lowest level historically since 2003. It subsequently recovered but remained at a low level in 2024. Japan recommended using the estimated biomass index in the Bayesian State-Space Production Model (BSSPM) stock assessment because the retrospective analysis indicated that the biomass index estimates derived from the VAST model would be robust to data updates.

24. The SSC PS agreed to use the Japanese survey biomass index of Pacific saury up to 2024 using the VAST model as an input for the stock assessment.

6.2 Review of plans of future biomass surveys

25. Japan informed the SSC PS that it plans to conduct its biomass survey with the usual method in 2025.

6.3 Recommendations for future work

26. The SSC PS noted that in the latest biomass estimates using the VAST model with data up to 2024, the year trend from 2022 to 2023 shows a decrease, whereas in the previous biomass estimates using the VAST model with data up to 2023, the trend in those years showed an increase. The SSC PS encouraged Japan to conduct further analyses to better understand the reason for this difference.

27. The SSC PS encouraged Japan to conduct further analyses to test the robustness of its VAST model against spatial changes in the surveyed area, such as by testing the fit of the model to historical data if the data from the area that was not surveyed in 2023 is excluded from past years as well.

28. The SSC PS encouraged Japan to continue to conduct its biomass survey and other Members to conduct research surveys or share data from existing research surveys that could complement the Japanese biomass survey and provide useful information for better understanding the Pacific saury stock.

Agenda Item 7. Fishery-dependent abundance indices

7.1 Review of Members' standardized CPUEs up to 2023

29. China presented a standardization of CPUE data for Pacific saury from 2013 to 2023 using generalized linear model (GLM) and generalized additive model (GAM) on the assumption of lognormal distribution of errors (NPFC-2024-SSC PS13-WP02 (Rev. 1)). China recommended using the standardized CPUE derived from GAM as an input for the stock assessment.

30. The SSC PS noted that China's fishing season was shortened in 2023 due to regulatory reasons, resulting in a shorter month window in 2023 compared to other years in the CPUE standardization. At the request of the SSC PS, China presented the results of a CPUE standardization conducted with a common month window (June to September) for comparison with its original CPUE standardization. The SSC PS noted that the results between the two CPUE standardizations were generally consistent. The SSC agreed that the originally presented CPUE standardization could be used for the stock assessment and encouraged China to conduct further analyses on how to treat this issue in its future CPUE standardizations.

31. The SSC PS agreed to use China's standardized CPUE derived from GAM as an input for the stock assessment.

32. Japan presented a standardization of CPUE data for Pacific saury from 1994 to 2023 using GLM (NPFC-2024-SSC PS13-WP03). Japan recommended using the standardized CPUE derived from GLM as input for the stock assessment.

33. The SSC PS agreed to use Japan's standardized CPUE derived from GLM as an input for the stock assessment.

34. Japan presented a progress report on its ongoing efforts to develop a VAST model for conducting CPUE standardizations for Pacific saury (NPFC-2024-SSC PS13-WP04). Japan

has improved the VAST model presented at SSC PS11 (NPFC-2023-SSC PS11-WP07) by incorporating essential explanatory variables (interactions between year and month) and has used it to conduct a preliminary standardization of CPUE data for Pacific saury from 1994 to 2023. The standardized CPUE derived from the selected VAST model with minimum AIC indicated similar year trends with that derived from GLM. One concern with the constructed model is that it does not take advantage of the VAST model to consider the distributional similarities between adjacent times (i.e., months in this analysis). Nevertheless, although a model using, for example, a year-month time step may be necessary for capturing reliable interannual seasonal changes in spatial distribution and discussing their plausibility, the VAST model selected in this analysis would be sufficient for CPUE standardization objectives.

35. The SSC PS welcomed Japan's progress report and its ongoing efforts to develop a VAST model for conducting CPUE standardizations for Pacific saury.

36. Korea presented a standardization of CPUE data for Pacific saury from 2001 to 2023 using GLM (NPFC-2024-SSC PS13-WP07). Korea recommended using the standardized CPUE derived from GLM as input for the stock assessment.

37. The SSC PS agreed to use Korea's standardized CPUE derived from GLM as an input for the stock assessment.

38. Chinese Taipei presented a standardization of CPUE data for Pacific saury from 2001 to 2023 using GLM on the assumption of lognormal distribution of errors (NPFC-2024-SSC PS13-WP08 (Rev. 1)). The analysis employed two approaches: a non-divided period approach and a two-divided period approach. Chinese Taipei recommended using the standardized CPUE derived from GLM with the two-divided period approach as an input for the stock assessment, as this approach accounted for the impact of fishing efficiency changes due to the significant replacement of older fishing vessels with new ones.

39. The SSC PS agreed to use Chinese Taipei's standardized CPUE derived from GLM using the two-divided period approach as an input for the stock assessment.

40. Russia explained that there was only one active Russian vessel fishing for Pacific saury in 2023, that this vessel was unable to conduct full operations due to technical issues, and that it only operated for 11 fishing days across October and December catching around 51 MT of Pacific saury. Russia explained that it did not consider this vessel to be representative of the overall Russian Pacific saury fleet and therefore did not conduct an updated CPUE standardization with the 2023 data.

41. The SSC PS noted Russa’s explanation and agreed that the lack of an updated Russian CPUE standardization for 2023 would be unlikely to have a substantive impact on the Pacific saury stock assessment.

42. Vanuatu provided an update on its ongoing work to conduct a CPUE standardization for 2014 to 2023 using GLM.

43. The SSC PS welcomed Vanuatu’s efforts as a good first step towards incorporating Vanuatu’s standardized CPUE data in the Pacific saury stock assessment.

7.2 Review of joint CPUE

44. Chinese Taipei presented a joint CPUE standardization of Pacific saury in the Northwestern Pacific Ocean from 1994 to 2023 using a VAST model (NPFC-2024-SSC PS13-WP09). Step plots indicated that the spatio-temporal variable had a large influence on the time series of estimated CPUE compared to other effects in VAST. The results indicated that the annual standardized CPUE trend had a fluctuating pattern over the studied periods, and the annual standardized CPUE value in 2023 was slightly increased compared to 2022. For future joint CPUE standardizations, it is recommended that the use of other catchability covariates, such as vessel ID, be explored.

45. At the request of the SSC PS, Chinese Taipei presented further analyses in which Chinese Taipei’s CPUE data are divided into two periods in the joint CPUE standardization. The SSC PS noted that the updated joint CPUE standardization and the one originally presented by Chinese Taipei showed generally consistent trends. The SSC PS indicated its preference to use the updated joint CPUE standardization because its treatment of Chinese Taipei’s CPUE data is consistent with the treatment in Chinese Taipei’s standardized CPUE index.

46. The SSC PS agreed to use the standardized joint CPUE with Chinese Taipei’s CPUE data divided into two periods as an input for the stock assessment.

47. The finalized table of abundance indices is attached to the report as Annex E. A plot of Members’ standardized CPUEs is attached to the report as Annex F.

7.3 Recommendations for future work

48. The SSC PS noted that there may be instances in the future where Members have to shorten their fishing seasons for regulatory reasons, as was the case for China in 2023. The SSC PS noted the need to hold further discussions on how to treat such shortened fishing seasons in

future CPUE standardizations. The SSC PS agreed to investigate the sensitivity and robustness of Members' CPUE standardizations to changes in the duration of their fishing seasons over time.

49. The SSC PS encouraged Japan to continue its efforts to develop a VAST model for conducting CPUE standardizations for Pacific saury.

50. The SSC PS encouraged Chinese Taipei to continue to investigate approaches for modeling the effect of the replacement of old fishing vessels with new vessels of differing sizes, shapes, and technical capabilities in its CPUE standardization.

51. The SSC PS encouraged Vanuatu to continue its work to conduct a CPUE standardization and to submit a working paper detailing this work to SSC PS14 and/or SSC PS15.

Agenda Item 8. Biological information on Pacific saury

8.1 Review of any updates and progress

52. No updates were provided.

8.2 Recommendations for future work

53. The SSC PS encouraged Members' biologists to continue their collaboration with modelers and to participate in meetings of the Working Group on New Stock Assessment Models (WG NSAM).

Agenda Item 9. Stock assessment using "provisional base models" (BSSPM)

9.1 Review and update of the existing specification

54. The SSC PS agreed to maintain the framework of the existing specification of the stock assessment using BSSPM but with the Chinese Taipei standardized CPUE index split into two periods with separate fixed catchability coefficients for each period, and to include an additional year of data for all indices (Annex G).

9.2 Recommendations for future work

55. The SSC PS encouraged Chinese Taipei to conduct sensitivity analyses comparing the impact of the following assumptions of catchability for the Chinese Taipei standardized CPUE index: 1. separate fixed catchability coefficients for two time periods, and 2. a gradual time-varying catchability coefficient for the combined period.

Agenda Item 10. New stock assessment models

10.1 Review of the outcomes of WG NSAM01 meeting

56. The WG NSAM Lead, Dr. Libin Dai, presented a progress report of the first and second WG NSAM meetings in 2024 (NPFC-2024-SSC PS13-IP09). The individual meeting reports are available in NPFC-2024-SSC PS13-RP01 & RP02.

10.2 Review of any progress on new stock assessment models

10.2.1 Stock Synthesis 3

57. The WG NSAM Lead presented exploratory work to try to improve the fit of the Stock Synthesis 3 model developed in the Shanghai meeting to size data. The key settings were to estimate the growth within the model, apply two time-varying catchability coefficients for the early Japanese standardized CPUE index and the Chinese Taipei standardized CPUE index, and estimate all double normal selectivity parameters. The modified settings improved the model fit to the Japanese and Chinese size data, but some lack of fit remained. The WG NSAM Lead pointed out that the model remained unstable in terms of its prediction skill. He also noted that even minor changes to the settings may affect the selectivity or growth function.

58. The SSC PS welcomed the work conducted by the WG NSAM Lead and Members. The SSC PS agreed on the need to exercise caution when making changes to the model settings, especially to the growth function.

10.2.2 State-space age-structured model

59. Japan presented its ongoing work to develop a state-space stock assessment model (SAM) for Pacific saury (NPFC-2024-SSC PS13-WP05). Japan tested the usefulness of including temporally-lagged North Pacific Gyre Oscillation (NPGO) indices in the stock recruitment relationship of SAM for future prediction of Pacific saury recruitment and population dynamics. Japan tested several annual NPGO indices with different lags and found that 12-month-lagged time series increased the goodness-of-fit of the model the best. With this time series, SAM showed a better hindcasting performance relative to one without any environmental information.

60. The SSC PS thanked Japan and encouraged it to continue its work to investigate the impact of the environment on the Pacific saury population, noting that such work could also inform other modeling frameworks, including Stock Synthesis 3.

10.3 Recommendations for future work

61. The SSC PS encouraged Members to continue to develop the Stock Synthesis 3 model through the WG NSAM, particularly improving the model’s prediction skill and the model fitting. The SSC PS emphasized the importance of further collaboration between modelers and biologists to support the continued model development work.

Agenda Item 11. Toward development of management procedures (MPs) as a mid-term goal

11.1 Work plan

62. The Chair summarized the work done to develop and adopt an interim harvest control rule (HCR) as a short-term task and the progress made to date towards the development of MPs as a mid-term goal.

63. The SSC PS requested that the Chair draft a proposed timeline for the development of MPs for further discussion at SSC PS14 and SWG MSE PS06 and for the consideration and potential endorsement of the Commission.

11.2 Other

64. The SSC PS reaffirmed that the recommended total allowable catch for Pacific saury in the Convention Area in 2025 will be determined based on the adopted interim HCR.

Agenda Item 12. Other matters

12.1 Data provision templates and data inventory

65. The SSC PS reviewed the data provision templates from SC08 (NPFC-2023-SC08-IP13 (Rev 1)). The SSC PS had no specific feedback about the templates. The SSC PS encouraged Members to review and test the templates and provide their feedback by SC09.

66. The Science Manager informed the SSC PS that the Secretariat has developed a data inventory policy and has begun populating the inventory. The details are available in NPFC-2024-SC09-WP03. A further update will be provided at SSC PS14.

12.2 Observer Program

67. The Science Manager informed the SSC PS that the Commission requested that the SC provide guidance to the Technical and Compliance Committee (TCC) on what level of observer coverage would be needed on fishing vessels and what kinds of data would need to be collected to achieve the scientific objectives of an ROP. Following this, the SC Chair has requested the SC's subsidiary bodies, including the SSC PS, to consider the scientific objectives, data needs, and level of observer coverage, and to come to SC09 prepared to discuss these. In addition, the TCC Chair has asked the SC and its subsidiary bodies to answer the following questions: 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?

68. The Science Manager reminded the SSC PS that some Members have noted that an ROP could be supplemented with national observer programs and presented a summary table showing the existence and type of Members' national observer programs in the Convention Area and adjacent exclusive economic zones (NPFC-2024-SC09-WP02 (Rev. 4)).

69. The Science Manager presented the proposed responses to the TCC Chair's questions drafted during the meeting. The SSC PS reviewed and finalized its responses to the TCC Chair's questions (NPFC-2024-SC09-WP04 (Rev. 1)).

12.3 Draft agenda, priority issues and timeline for next meeting

70. The SSC PS outlined an agenda and timeline for SSC PS14 which includes regular work and new topics such as climate change and Pacific saury bycatch. An updated timeline with a list of expected documents will be circulated to SSC PS Members shortly after the meeting.

71. The SSC PS agreed on the following priorities for the next meeting:
    (a) Review progress on the development of age-structured stock assessment models.
    (b) Review progress on the BSSPM analyses and provide management advice, including annual catch level based on the interim HCR.
    (c) Review Pacific saury bycatch information from Members.

12.4 Other

72. The consultant, Dr. Jihwan Kim, presented the results of a study on the spatio-temporal variability of density distribution of Pacific saury and its relationship to basin-scale ocean environmental variability in the North Pacific (NPFC-2024-SSC PS13-IP08 (Rev. 2)). In the study, the integration and spatio-temporal decomposition of gridded data from all Members were performed to analyze variability in the nominal CPUE of Pacific saury. The results reveal three leading CPUE modes linked to basin-scale environmental factors: subsurface temperature in the Oyashio Current region, Kuroshio Extension dynamics, and biological productivity in the Kuroshio-Oyashio Extension region. These modes reflect long-term trends and shifts in the density distribution of Pacific saury across the Northwestern Pacific. The first mode reveals a distinct seasonal fishing pattern, while the second and third modes indicate zonal and meridional distribution shifts, respectively. The results also suggest a correlation between CPUE variability and the North Pacific Gyre Oscillation, implying a connection to basin-scale ocean environmental variability. The results are valuable for refining Pacific saury stock assessments and understanding the wider marine ecosystem's relationship to ocean environmental change.

73. The SSC PS welcomed the work done by the consultant, suggested potential improvements to

the study, and encouraged him to conduct further analyses.

74. The SSC PS noted the plans to publish this work in a scientific journal and discussed data access considerations related to Members' monthly 1 x 1 degree CPUE data used in the study. The SSC PS recalled that at SSC PS12, Members agreed that monthly 1 x 1 degree CPUE data and time series of biomass estimates would be shared with the consultant for analyses on the relationship between Pacific saury abundance indices and basin-scale ocean environmental variability in the North Pacific. The SSC PS agreed that the results presented by the consultant could be posted on the public domain of the NPFC website as part of the NPFC's work. The SSC PS agreed that these results could only be presented publicly as part of an external publication, such as a journal paper, if formal approval is provided by the data owners.

75. The SSC PS requested the Secretariat to draft a proposed revision to the Regulations for Management of Scientific Data and Information to reflect the need to seek the formal approval of data owners when publishing their data in an external publication and to present the proposed revision to SC09.

76. The Data Coordinator, Mr. Sungkuk Kang, provided an update on the GitHub repository and user manual (NPFC-2024-SSC PS13-IP10). He explained that the Secretariat officially submitted the application for the GitHub Nonprofit Plan on 5 February 2024. However, the Secretariat was informed that due to a high volume of tickets, the approval process may be delayed. The Secretariat will continue to try to get the approval from GitHub for the use of the Nonprofit Team Plan. As a contingency plan, the Secretariat has established a GitHub Free Plan to be used until then. The Secretariat has also developed a user manual that is available on the NPFC website and can be continuously enhanced based on feedback from Members.

Agenda Item 13. Adoption of the Report

77. The SSC PS13 Report was adopted by consensus.

Agenda Item 14. Close of the Meeting

78. The Chair thanked the participants for their engagement and cooperation, the invited expert for his guidance, and the Secretariat and rapporteur for their support.

79. The meeting closed at 09:40 on 29 August 2024, Tokyo time.

Annexes:

Annex A – Agenda

Annex B – List of Documents

Annex C – List of Participants

Annex D – Revised CPUE Standardization Protocol for Pacific Saury

Annex E – Updated total catch, CPUE standardizations and biomass estimates for the stock assessment of Pacific saury

Annex F – Time series of Members' standardized CPUE and joint standardized CPUE from 1980-2023 and Japanese survey index from 2003-2024

Annex G – Specifications of the BSSPM

Annex A

Agenda

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  - 3.3.1 CMM 2024-08 for Pacific Saury
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- 4.1 Terms of References of the SSC PS
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Agenda Item 5. Member's fishery status including 2024 fishery

Agenda Item 6. Fishery-independent abundance indices
- 6.1 Review of results of abundance estimation including 2024 Japanese biomass survey
- 6.2 Review of plans of future biomass surveys
- 6.3 Recommendations for future work

Agenda Item 7. Fishery-dependent abundance indices
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Agenda Item 8. Biological information on Pacific saury
- 8.1 Review of any updates and progress
- 8.2 Recommendations for future work

Agenda Item 9. Stock assessment using "provisional base models" (BSSPM)
- 9.1 Review and update of the existing specification
- 9.2 Recommendations for future work

Agenda Item 10. New stock assessment models
- 10.1 Review of the outcomes of WG NSAM01 meeting
- 10.2 Review of any progress on new stock assessment models
  - 10.2.1 Stock Synthesis 3 (SS3)
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Agenda Item 11. Toward development of management procedures (MPs) as a mid-term goal
- 11.1 Work plan

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Agenda Item 12. Other matters

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Annex B

List of Documents

MEETING INFORMATION PAPERS

Number	Title
NPFC-2024-SSC NFS01-MIP01	Meeting Information
NPFC-2024-SSC PS13-MIP02	Provisional Agenda
NPFC-2024-SSC PS13-MIP03	Annotated Indicative Schedule

WORKING PAPERS

Number	Title
NPFC-2024-SSC PS13-WP01	Compiled data on Pacific saury catches in the NWPO
NPFC-2024-SSC PS13-WP02 (Rev. 1)	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the China's stick-held dip net fishery up to 2023
NPFC-2024-SSC PS13-WP03	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Japanese stick-held dip net fishery up to 2023
NPFC-2024-SSC PS13-WP04	Progress report on application of the VAST model in CPUE standardization for the Japanese fishery of Pacific saury
NPFC-2024-SSC PS13-WP05	Temporally-lagged North Pacific Gyre Oscillation index improved prediction of recruitment and population status of Pacific saury
NPFC-2024-SSC PS13-WP06	Japanese survey biomass index of Pacific saury up to 2024 using VAST model
NPFC-2024-SSC PS13-WP07	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Korean's stick-held dip net fishery up to 2023
NPFC-2024-SSC PS13-WP08 (Rev. 1)	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Chinese Taipei stick-held dip net fishery up to 2023
NPFC-2024-SSC PS13-WP09	Joint CPUE standardization of the Pacific saury in the Northwest Pacific Ocean by using the spatio-temporal modelling approach
NPFC-2024-SC09-WP02 (Rev. 4)	Report on the existing observer programs of NPFC Members and those of other RFMOs
NPFC-2024-SC09-WP03	Scientific data management system: data inventory
NPFC-2024-SC09-WP04 (Rev. 1)	Request from the TCC Chair and responses from SC

INFORMATION PAPERS

Number	Title
NPFC-2024-SSC PS13-IP01	Fishery status for Pacific saury - Report of Chinese Taipei
NPFC-2024-SSC PS13-IP02	Fishery Status for Pacific saury - Report from Vanuatu Fisheries Department
NPFC-2024-SSC PS13-IP03	Korean Stick-held dip net (SHDN) Fishery Status up to 2024
NPFC-2024-SSC PS13-IP04	Fishery Status of Pacific Saury in China Including 2024
NPFC-2024-SSC PS13-IP05	Pacific saury fishing condition in Japan in 2023 and 2024
NPFC-2024-SSC PS13-IP06	2024 Japanese biomass survey
NPFC-2024-SSC PS13-IP07	Saury Catch in Canada (updated for 2024)
NPFC-2024-SSC PS13-IP08 (Rev. 2)	Spatio-temporal variability of density distribution of Pacific saury (*Cololabis saira*) and its relationship to basin-scale Ocean environmental variability in the North Pacific
NPFC-2024-SSC PS13-IP09	Progress report of WG NSAM01&02
NPFC-2024-SSC PS13-IP10	Update on NPFC Git Repository and User Manual
NPFC-2023-SC08-IP13 (Rev 1)	Biological Data Provision Templates

REFERENCE DOCUMENTS

Number	Title
NPFC-2024-SSC PS13-RP01	Summary of the 1st Meeting of the Working Group on New Stock Assessment Models
NPFC-2024-SSC PS13-RP02	Summary of the 2nd meeting of the Working Group on New Stock Assessment Models
	Terms of References of the SSC PS
	CPUE Standardization Protocol for Pacific Saury
	Stock Assessment Protocol for Pacific Saury
	SSC PS12 and SC08 reports
	SWG MSE PS05 report
	CMM 2024-08 for Pacific Saury

Annex C

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Annex D

Revised CPUE Standardization Protocol for Pacific Saury

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.

<u>The following protocol is proposed for the CPUE standardization:</u>

(1) Conduct a thorough literature review to identify key factors (i.e., spatial, temporal, environmental, and fisheries variables) that may influence CPUE values;

(2) Determine temporal and spatial scales for data grouping for CPUE standardization;

(3) Plot spatio-temporal distributions of fishing efforts and catch to evaluate spatio-temporal patterns of fishing effort and catch;

(4) Calculate correlation matrix to evaluate correlations between each pair of those variables;

(5) Identify potential explanatory variables based on (1)-(4) as well as interaction terms to develop full model for the CPUE standardization;

(6) Fit candidate statistical models to the data (e.g., GLM, GAM, Delta-lognormal GLM, Neural Networks, Regression Trees, Habitat based models, and Statistical habitat based models);

(7) Evaluate the models using methods such as likelihood ratio, AIC/BIC and cross validation;

(8) Evaluate if distributional assumptions are satisfied and if there is a significant spatial/temporal pattern of residuals in CPUE standardization modeling;

(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;

(10) Recommend a time series of yearly standardized CPUE and associated uncertainty;

(11) Plot nominal and standardized CPUEs over time;

(12) This protocol can be used for joint CPUE standardization.

DOCUMENT TEMPLATE FOR PRESENTING STANDARDIZED CPUE OF PACIFIC SAURY

Title: Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the MEMBER's stick-held dip net fishery up to 20XX

Author's Name(s)

Affiliation(s)

Background of the Pacific saury fishery

- Description of the Pacific saury fishery of corresponding member.

METHOD

The data

- Spatial and temporal patterns of catch and effort (Fig. 1)
- Available covariates with explanation on resolution and coverage (Table 1)
- Correlations among the variables (Fig. 2)
- If there are any candidate environmental covariates, describe explanations and the reason for including them.

Full model description and model selection

- Type and assumptions of the model
- Response and explanatory variables and interactions
- Assumed error distribution
- Formulation of full model
- Model selection method

Yearly trend extraction

- How to extract yearly trend from the selected model
- How to evaluate uncertainty of the extracted trend, if necessary

RESULT and DISCUSSION

- Result of the model selection, at least for the full, null and best models (Table 2)
- Interpretation of the selected model
- Model diagnosis: Analysis of deviance table (Table 3), tendencies of the residuals (Fig. 3) and percentage of the deviance explained
- The extracted yearly trend (Table 4), comparing with the nominal CPUE (Fig. 4)
- Further discussion

REFERENCES

APPENDICES

- **Appendix I:** Checklist for the CPUE standardization protocol
- Further information in forms of description, figures, or table

Table 1 Summary of explanatory variables used in GLM*.

Variables		Number of categories	Detail	Note
Year	*Year*	25	1994–2018	
Month	*Month*	5	August–December	
Fishing area	*Area*	5	I–V	*see* Fig. 1
Vessel size	*Grt1*	10	$Grt<20$, $20\leqq Grt<40$, ..., $180\leqq Grt<200$ tons	at intervals of 20 tons
	Grt2	5	$Grt<40$, $40\leqq Grt<80$, ..., $160\leqq Grt<200$ tons	at intervals of 40 tons
Sea surface temperature	*Sst1*	12	$Sst<10$, $10\leqq Sst<11$, ..., $20\,^{o}\mathrm{C}\leqq Sst$	at intervals of 1ºC
	Sst2	5	$Sst<10$, $10\leqq Sst<13$, ..., $19\,^{o}\mathrm{C}\leqq Sst$	at intervals of 3ºC

**All of the tables and figures in this document template are presented as an example.*

Table 2 Result of model selection

No	$\eta(t_i)$	ϕ	Adj. R^2	Dev. expl. %	BIC	*d*
1	$\beta_0+\beta^Y_{year_i}$	0.84	0.122	13.9	211201	26
2	$\beta_0+\beta^Y_{year_i}+\beta^M_{month_i}$	0.83	0.132	15.1	210828	29
3	$\beta_0+\beta^Y_{year_i}+\beta^M_{month_i}\middle|\beta^Y_{year_i}$	0.79	0.155	18.7	210330	97
4	$\beta_0+\beta^Y_{year_i}+\beta^M_{month_i}\middle|\beta^Y_{year_i}+\beta^V_{Idves_i}$	0.73	0.194	23.0	**209391**	148
5	$\beta_0+\beta^Y_{year_i}+\beta^M_{month_i}+\beta^V_{Idves_i}$	0.76	0.171	19.3	209958	80

β_0 – intercept, $\beta^Y_{year_i}$ – coefficient of *i*-th year ($year_i$), $\beta^M_{month_i}$ – coefficient of *i*-th month ($month_i$), $\beta^V_{Idves_i}$ – coefficient of *i*-th unique ID of a vessel ($Idves_i$).

Table 3 Analysis of deviance table

	SS	Df	F	Pr(>F)	Signif. codes
Year	453.8	24	39.35	< 2.2e-16	***
Month	117.3	1	244.06	< 2.2e-16	***
Grt1	265.9	7	79.03	< 2.2e-16	***
Sst2	51.1	4	26.60	< 2.2e-16	***
Year:Month.int	1067.4	72	30.85	< 2.2e-16	***
Year:Area.int	296.3	48	12.85	< 2.2e-16	***
Year:Grt.int	258.6	48	11.21	< 2.2e-16	***
Month.int:Area.int	45.4	6	15.734	< 2.2e-16	***
Month.int:Grt.int	33.5	6	11.624	4.74E-13	***
Area.int:Grt.int	39.4	6	13.651	1.50E-15	***
Residuals	19277.7	40113			

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table 4 Nominal and standardized CPUEs of Japanese stick-held dip net fishery for Pacific saury from 1994 to 2018.

Year	Nominal CPUE (metric ton / hauls)	Standardized CPUE	CV (%)	95% CI	
				Lower	Upper
1994	5.38	2.93	3.53	2.74	3.14
1995	4.41	2.16	6.53	1.90	2.44
1996	2.40	1.62	4.69	1.48	1.77
1997	4.77	3.58	12.93	2.79	4.63
1998	1.44	1.02	3.86	0.94	1.09
1999	1.45	0.75	3.97	0.70	0.81
2000	2.18	1.37	4.38	1.26	1.49
2001	3.18	2.06	5.64	1.84	2.32
2002	1.93	1.15	5.66	1.02	1.29
2003	3.21	2.17	4.27	2.01	2.37
2004	3.65	2.51	3.95	2.33	2.71
2005	6.63	4.38	4.05	4.03	4.72
2006	6.03	3.93	4.30	3.61	4.28
2007	7.81	4.05	4.31	3.73	4.40
2008	7.81	4.93	4.06	4.56	5.31
2009	4.60	3.58	4.43	3.29	3.92
2010	2.73	1.49	3.66	1.37	1.59
2011	4.45	2.36	4.01	2.19	2.55
2012	3.65	2.31	4.31	2.12	2.52
2013	3.04	1.43	3.88	1.33	1.55
2014	5.42	2.49	3.64	2.32	2.67
2015	2.65	1.34	4.43	1.23	1.46
2016	2.82	1.50	5.94	1.33	1.68
2017	1.40	1.08	4.23	1.00	1.17
2018	2.96	1.40	3.91	1.30	1.52

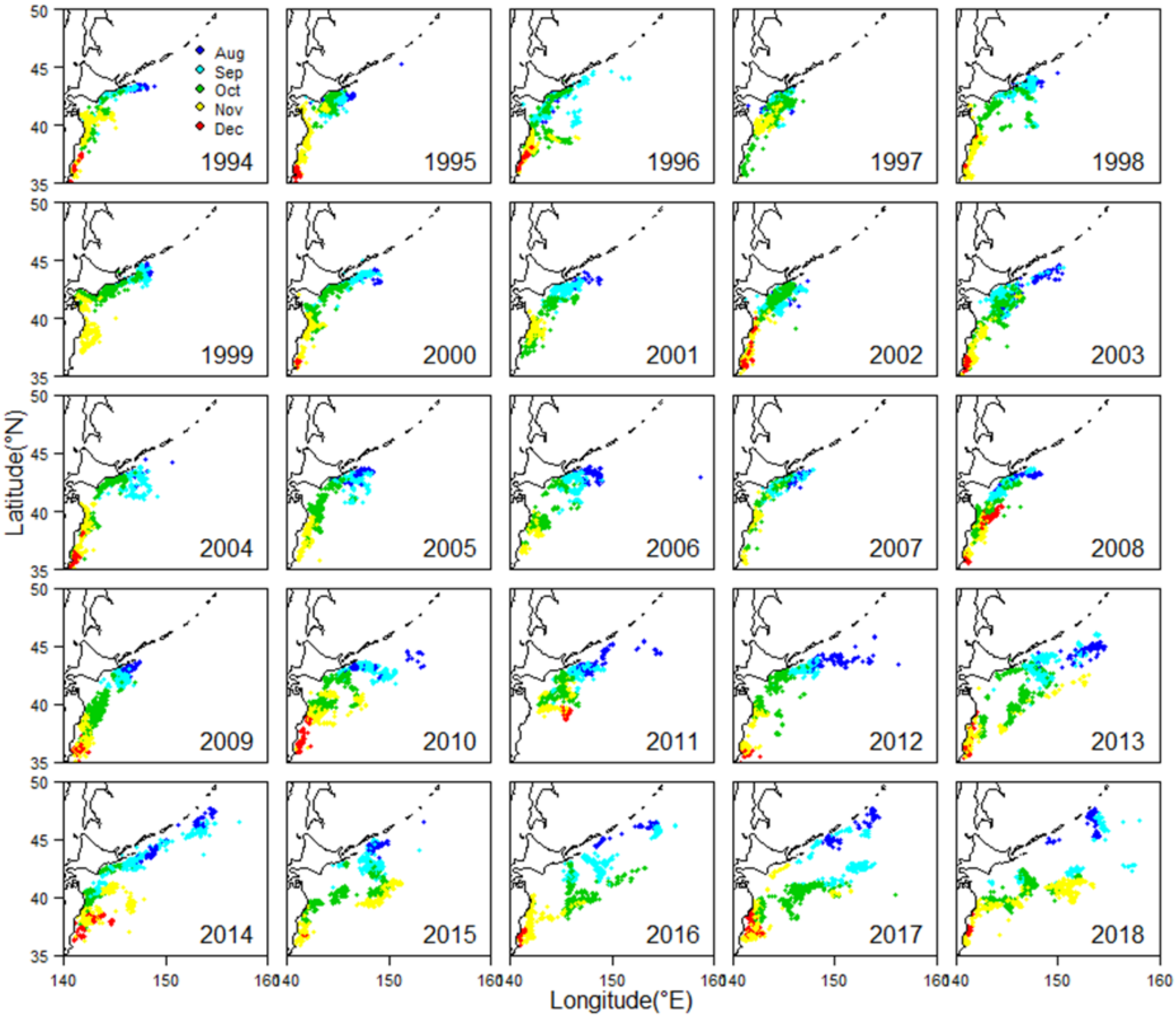


Fig. 1 Inter-annual variation of monthly fishing ground of Japanese stick-held dip net fishery for Pacific saury from 1994 to 2018.

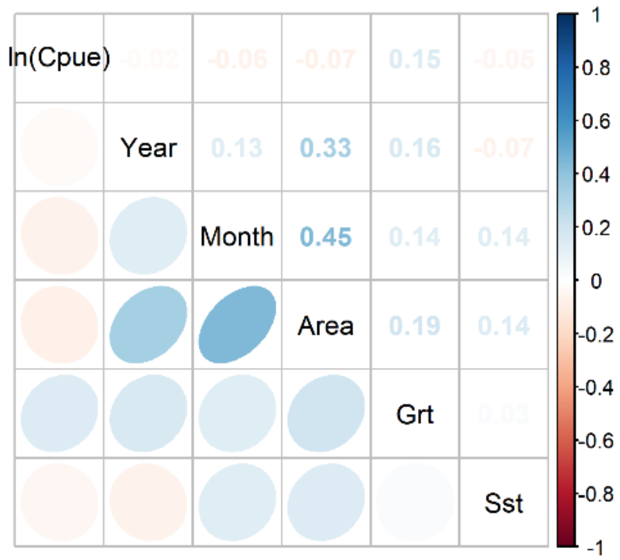


Fig. 2 Correlation matrix of explanatory variables used in the analysis.

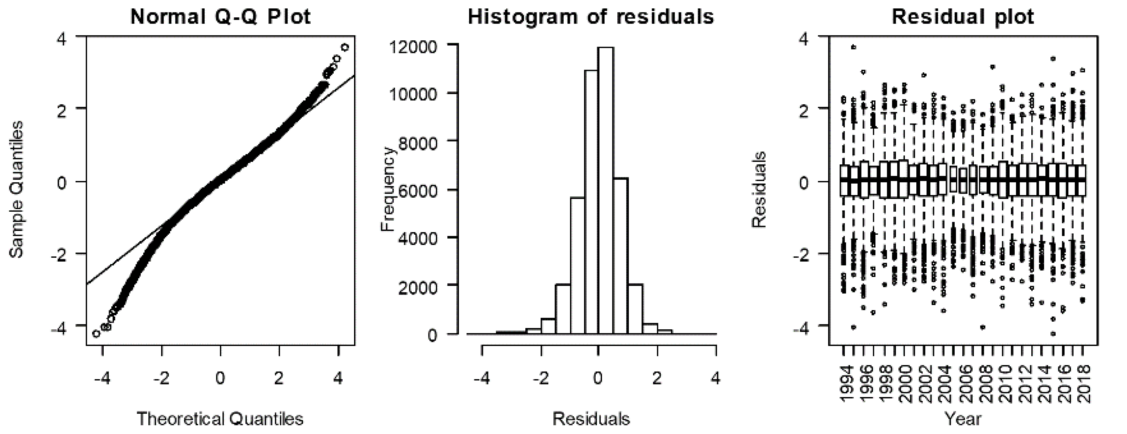


Fig. 3 Q-Q plot, histogram of residuals and residual plots across years for the best GLM.

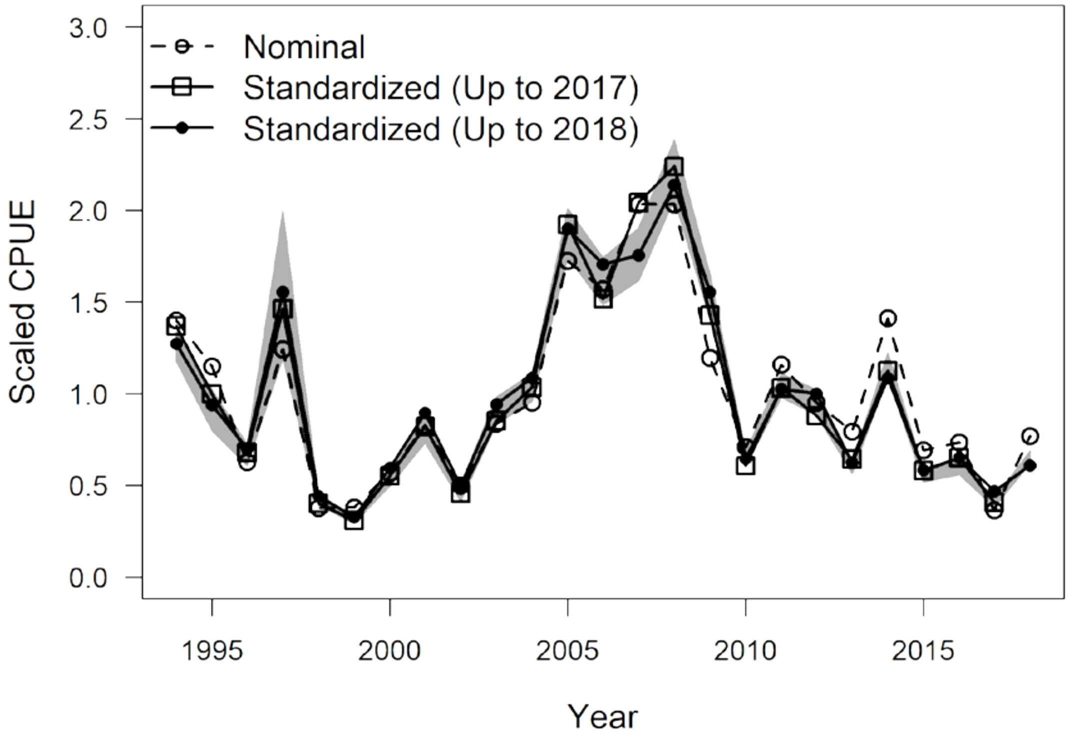


Fig. 4 A scaled nominal CPUE series and two scaled standardized CPUE series with catch and effort data up to 2017 and 2018. Gray zone indicates 95% confidence band for the standardized CPUE up to 2018.

Appendix I Checklist for the CPUE standardization protocol

(1)	Conduct a thorough literature review to identify key factors (i.e., spatial, temporal, environmental, and fisheries variables) that may influence CPUE values;	
(2)	Determine temporal and spatial scales for data grouping for CPUE standardization;	
(3)	Plot spatio-temporal distributions of fishing efforts and catch to evaluate spatio-temporal patterns of fishing effort and catch;	
(4)	Calculate correlation matrix to evaluate correlations between each pair of those variables;	
(5)	Identify potential explanatory variables based on (1)-(4) as well as interaction terms to develop full model for the CPUE standardization;	
(6)	Fit candidate statistical models to the data (e.g., GLM, GAM, Delta-lognormal GLM, Neural Networks, Regression Trees, Habitat based models, and Statistical habitat based models);	
(7)	Evaluate the models using information criteria like AIC or BIC. If the candidate models employ distinct parameter estimation methods (e.g. GLM with maximum likelihood vs. GAM with penalized likelihood), evaluate the models through cross-validation;	
(8)	Evaluate if distributional assumptions are satisfied and if there is a significant spatial/temporal pattern of residuals in CPUE standardization modeling;	
(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;	
(10)	Recommend a time series of yearly standardized CPUE and associated uncertainty;	
(11)	Plot nominal and standardized CPUEs over time;	

Annex E

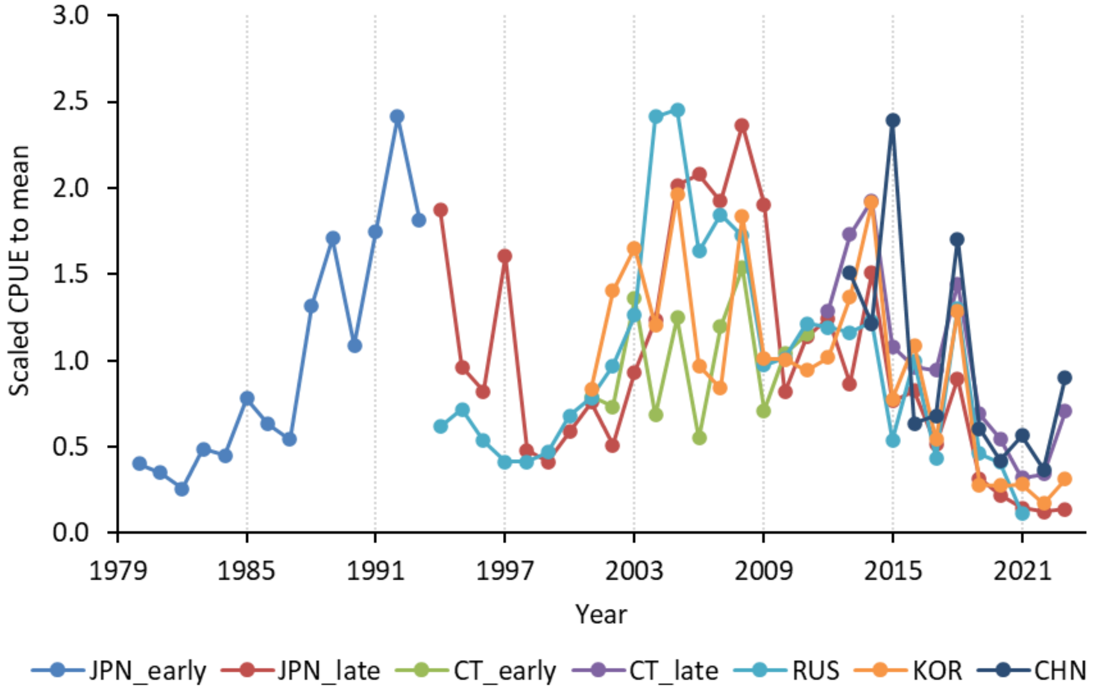
Updated total catch, CPUE standardizations and biomass estimates for the stock assessment of Pacific saury

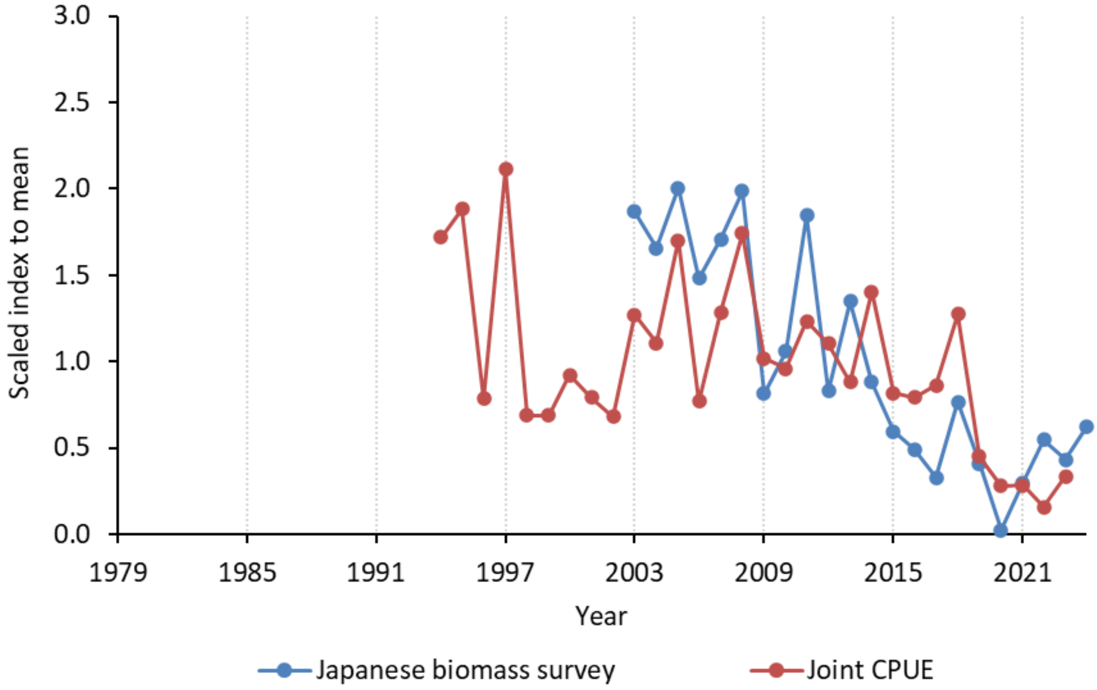
Year	Total catch (metric tons)	Biomass JPN (VAST, 1000 metric tons)	CV (%)	CPUE CHN (metric tons/ vessel/ day)	CPUE JPN_early (metric tons/ net haul)	CPUE JPN_late (metric tons/ net haul)	CPUE KOR (metric tons/ vessel/ day)	CPUE RUS (metric tons/ vessel/ day)	CPUE CT_early (metric tons/ net haul)	CPUE 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 F

Time series of Members' standardized CPUE and joint standardized CPUE from 1980-2023 and Japanese survey index from 2003-2024





Specifications of the BSSPM

	Base case (B1)	**Base case (B2)**	**Sensitivity case (S1)**	**Sensitivity case (S2)**
Initial year	1980	1980	1980	1980
Biomass survey	$I_{t,bio} = q_{bio}\, B_t e^{v_{t,bio}}$ $v_{t,bio} \sim N\left(0, cv_{t,bio}^2 + \sigma^2\right)$ $q_{bio} \sim$ 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(1994-2021) CT(2001-2011, 2012-2023) $I_{t,f} = q_f B_t^b e^{v_{t,f}}, \quad v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot \left(ave\left(cv_{t,bio}^2\right) + \sigma^2\right)$ c=5 $ave(cv_{t,bio}^2)$ is computed except for 2020 survey	Joint CPUE (1994-2023) $I_{t,ioint} = q_{Joint} B_t^b e^{v_{t,joint}},$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$	CHN(2013-2023) JPN_early(1980-1993, time-varying q) JPN_late(1994-2023) KOR(2001-2023) RUS(1994-2021) CT(2001-2011, 2012-2023) $I_{t,f} = q_f B_t^b e^{v_{t,f}}, \quad v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot \left(ave\left(cv_{t,bio}^2\right) + \sigma^2\right)$ c=6 $ave(cv_{t,bio}^2)$ is computed except for 2020 survey	JPN_early(1980-1993, time-varying q) $I_{t,JE} = q_{t,JE} B_t^b e^{v_{t,JE}}$ $v_{t,JE} \sim N(0, \sigma_{JE}^2)$ $\sigma_{JE}^2 = c \cdot \left(ave\left(cv_{t,joint}^2\right) + \sigma^2\right)$ Joint CPUE (1994-2023) $I_{t,ioint} = q_{Joint} B_t^b e^{v_{t,joint}},$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$
Hyper-depletion/ stability	A common parameter for all fisheries with a prior distribution, b ~ U(0, 1)	b ~ U(0, 1)	A common parameter for all fisheries but JPN_early, with a prior distribution, b ~ U(0, 1) [b for JPN_early is fixed at 1]	b ~ 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