North Pacific Fisheries Commission

NPFC-2021-SSC PS07-Final Report

7th Meeting of the Small Scientific Committee on Pacific Saury REPORT

8-11 October 2021

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North Pacific Fisheries Commission
7th Meeting of the Small Scientific Committee on Pacific Saury

8-11 October 2021
WebEx

REPORT

Agenda Item 1. Opening of the Meeting

1. The 7th Meeting of the Small Scientific Committee on Pacific Saury (SSC PS07) took place in the format of video conferencing via WebEx, and was attended by Members from Canada, China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, and Vanuatu. 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 SSC PS. The Science Manager, Dr. Aleksandr Zavolokin, outlined the procedures for the meeting. Mr. Alex Meyer was selected as rapporteur.

Agenda Item 2. Adoption of Agenda

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

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

3.1 SSC PS06, SC05 and SCsm01 meetings

4. The Chair presented the outcomes and recommendations from the SSC PS06, SC05 and SCsm01 meetings.

3.2 COM06 meeting

5. The Science Manager presented the outcomes from the sixth Commission meeting and an overview of Conservation and Management Measure (CMM) 2021-08 For Pacific Saury.

3.3 Joint SC-TCC-COM Small Working Group on MSE for Pacific saury (SWG MSE PS)

6. The Science Manager reported on the intersessional activities towards the establishment of a joint SC-TCC-COM Small Working Group on Pacific saury (SWG MSE PS).

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

7. The SSC PS reviewed the Terms of References of the SSC PS and determined that no revisions are currently necessary.

4.2 CPUE Standardization Protocol

8. The SSC PS reviewed the CPUE Standardization Protocol and determined that no revisions are currently necessary.

4.3 Stock Assessment Protocol

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

Agenda Item 5. Review of Member's fishery status including 2021 fishery

10. Canada presented information about Pacific saury catch by its commercial and research vessels. There is only a single record of Pacific saury bycatch in commercial fishing gear. This record was from the hook and line halibut fishery in 2006. From research vessels, the CPUE of Pacific saury in survey catches (bottom trawl, midwater and surface trawls) is zero in most years. In 2006, 2009 and 2012 there were a total of 5 bottom trawl survey tows capturing Pacific saury (1, 7, 1, 1 and 3 individuals, respectively). The Pacific saury were mostly captured on the outer coast surveys and inside Queen Charlotte Sound in the eastern North Pacific. However, this mostly reflects the areas where the surveys are conducted (on the shelf and continental slope exclusively), rather than representing the distribution of Pacific saury in the northeast Pacific Ocean. There are also reports of juvenile and adult Pacific saury being captured on oceanographic cruises to Ocean Station P using bongo nets. However, this data was not available.

11. China presented its fisheries activities. Annual catch and nominal CPUE of Chinese fishery in 2020 were 44,006 tons and 9.51 tons/vessel/day, respectively, which were both the lowest values after 2014. The number of vessels in 2020 was 57. In 2021, Chinese accumulated catch from May to September was about 21,000 metric tons.

12. Japan presented its fisheries activities. Annual catch was 29,562 tons in 2020, which is the lowest after 1950. In 2021, Japanese accumulated catch from August to September was 5,317 metric tons, which was the third lowest after 2000. Nominal CPUE from August to September in 2021 was 0.50 tons/haul, which was the second lowest value after 2000. The fishing conditions in 2021 also continue to be low. The fishing grounds in August and September 2021

were mainly distributed in the high seas area between 150°E and 163°E longitude.

13. Korea presented its fisheries activities. Annual catch was 5,993 tons in 2020 which was the historical low. In 2021, Korean accumulated catch from June to September was 2,818 metric tons, which was the second lowest after 2001. Nominal CPUE from June to September in 2021 was 3.6 tons/vessel/day, which was the lowest value after 2001. The start of fishing was delayed around a month in 2020 and 2021. The Korean fleet started its fishing around 168°E longitude and gradually moved to the west.

14. Russia presented its fisheries activities. Annual catch was 753 tons in 2020, which is the lowest since 1959. Three Russian fishing vessels operated in the Convention Area in June-August 2021. The fishing grounds were mainly distributed in the high seas area between 156°E and 173°E longitude. The total catch by the end of August 2021 was 320 tons.

15. Chinese Taipei presented its fisheries activities. The catch recovered to around 180,000 tons in 2018 and showed a declining trend since then. In 2021, fishing vessels began operations in fishing grounds earlier than previous years. The saury distribution in 2021 was noted to be more northerly in comparison with the same period of 2020, and the nominal CPUE from June to September was 5.2 tons/vessel/day in 2021.

16. Vanuatu presented its fisheries activities. The Pacific saury fishery was first developed in 2004, and the total number of authorized fishing vessel at its historical level is 16. Annual catch in 2020 was the lowest recorded since 2015. Nominal CPUE in 2020 was historically low at 9.64 tons/vessel/day. The current estimated catch amount for 2021 by September is 542 tons. Fishing grounds shifted to the west earlier in 2021. Vanuatu also presented its development aspiration to rebuild its number of fishing vessels to 16 in the future and increase catches accordingly, and requested the SSC PS to consider its aspiration when making recommendations to the SC and the Commission.

17. The SSC PS agreed that each Member will submit its fisheries status information to SSC PS08 in accordance with the agreed template. The information will include:
    (a) Time series of annual catch
    (b) Time series of number of vessels and, if available, other relevant information such as size of vessel
    (c) Accumulated catch by 10-day period for current and past years
    (d) Catch by 10-day period for current and past years
    (e) Time series of nominal CPUE with the most recently available data

(f) Spatial pattern of fishing grounds over current and past years and a summary of the spatial pattern based on the catch-weighted average latitude and longitude by month
(g) Size and age compositions, if possible

18. The SSC PS encouraged Members to present their nominal CPUE data up to the end of November 2021 to SSC PS08.

Agenda Item 6. Biological and environmental information relevant to Pacific saury

6.1 Review of new biological information

19. Japan presented an estimation of the proportion of Pacific saury spawned during their first spawning season (PSFS) based on histological observations of ovary tissues (NPFC-2021-SSC PS07-WP03). Ovaries were sampled by surveys covering the distribution area of Pacific saury widely during the end of the spawning season (June and July) in 2013-2019. Combining these histological results with the biomass estimates derived from a swept area method, Japan estimated the annual PSFS, which varied from 13.0% to 63.1%, with a mean of 31.1% and a median of 28.3%. Japan found no evidence of spawning-related mortality and considered its estimates of PSFS to be plausible. Japan suggested that PSFS could be regarded as the maturity ratio of age-0 in the age-structured model.

20. China pointed out the wide range of results (13-63%) with low precision in the PSFS estimation. The results also indicated the significant spatial and temporal variations of PSFS. China suggested that Japan conduct further analysis to evaluate the potential reasons and influencing factors. Additionally, the strong assumptions of the radius of the otolith annual ring and sex ratio cannot support the hypothesis of spawning-related mortality. China suggested that future studies focus more on improving the estimation of PSFS based on further analysis of the influencing factors.

21. Japan explained that the wide variation of PSFS might be explained by interannual variation of prey environment and/or dominant seasonal cohorts of Pacific saury.

22. Japan provided a short summary of NPFC-2021-SSC PS07-WP10, which describes the length-weight relationship and weights at age information for Pacific saury for summer, autumn, and winter.

6.2 Review of environmental information relevant to Pacific saury distribution and migration

23. Japan presented a review of the effects of environmental factors on distribution, migration and recruitment of Pacific saury (NPFC-2021-SSC PS07-WP04). The distribution and migration

route of Pacific saury in autumn fluctuated from west to east depending on the period. In general, a suitable environment for the distribution of Pacific saury is formed along the Oyashio in autumn, thus they migrate through the Oyashio. The mechanism of the eastward shift of the distribution and migration route in autumn has recently been explained by two factors: 1) the change of the pathway of Oyashio making it difficult to form a suitable habitat of Pacific saury in the waters around east of Hokkaido, and 2) eastward shift of the distribution of Pacific saury in early summer. There might also be other unknown factors affecting distribution and migration. The environment in the spawning/nursery ground would be important for the recruitment variation. It should be noted that the relationship between environmental factors and the ecology of Pacific saury may not be consistent in the long term, given the complex life history of Pacific saury.

24. Japan presented a study of the effects of the environment on Pacific saury recruitment (NPFC-2021-SSC PS07-WP05). The study was conducted using a state space population dynamics model with robust estimation of environmental effects by selecting random effect variance via retrospective forecasting. Japan found that, among several candidate environmental indices (Pacific decadal oscillation (PDO) index, North Pacific gyre oscillation (NPGO), Southern oscillation index (SOI), Kuroshio position index (KPI), and local sea surface temperature (SST)), KPI, which explains the position of the Kuroshio axis, improved the prediction performance of the Pacific saury recruitment. The other environmental indices did not improve the prediction which suggests that recruitment is a relatively local event, rather than an oceanic-level event.

25. The SSC PS noted that the KPI in particular may be useful and could be examined in environmental recruitment studies.

26. China suggested that the SSC PS conduct further analyses of which environmental factors would be useful to include in future stock assessment models.

6.3 Distribution and migration patterns of juvenile Pacific saury

27. The Chair reminded participants about a request from the Commission to submit relevant scientific information on the geographical distribution of juvenile fish in the Convention Area, and its migration patterns in order to develop management measures to protect juvenile fish (CMM 2021-08, paragraph 14). The request was first addressed by SSC PS04. The SSC PS encouraged Members to present further scientific information relevant to the distribution and migration of juvenile Pacific saury to subsequent meetings.

6.4 Recommendations for future work

28. The SSC PS encouraged Members to continue analyses on Pacific saury that spawned during their first spawning season and the effects of environmental factors on distribution, migration and recruitment of Pacific saury.

Agenda Item 7. Review of the statistical data available

7.1 Annual catch

29. The SSC PS reviewed the compiled data on Pacific saury catches in the Northwestern Pacific Ocean up to 2020 (NPFC-2021-SSC PS07-WP01 (Rev. 1)) and agreed to use the data for the stock assessment (Annex D).

30. The SSC PS noted NPFC-2021-SSC PS07-WP12 (Rev. 1), which summarizes Vanuatu's Pacific saury catch and CPUE data from its stick-held dip net fishery in the North Pacific Ocean during 2013-2020. The SSC PS noted the usefulness of the information in the paper and encouraged Vanuatu to continue to provide such information at future meetings.

7.2 Size and age composition

31. Dr. Wen-Bin Huang, the SWG co-lead, reported on the progress of the SWG for estimating each Member's catch-at-size (CAS) data on behalf of Dr. Satoshi Suyama, the SWG co-lead. Most Members have submitted their CAS data updated to 2020 by SSC PS07, but two Members have not submitted 2019 and 2020 CAS data. Members employed two methods for CAS estimation: random sampling from fishing vessel catch (China, Japan, and Russia) and estimation from the total number of each size box (Korea, Chinese Taipei, and Vanuatu). The CAS data can be converted to catch-at-age data using age-length keys. These data will contribute to the development of the age structured models.

32. The SWG co-lead outlined the protocols for calculating CAS data used by Japan (NPFC-2021-SSC PS07-IP01), China (NPFC-2021-SSC PS07-WP19), Russia (NPFC-2021-SSC PS07-WP20), and Chinese Taipei (NPFC-2021-SSC PS07-15 & 18), and the methods used by Korea and Vanuatu.

33. Japan provided a supplementary explanation of NPFC-2021-SSC PS07-IP01 and reminded the SSC PS that this was previously submitted as a working paper to SSC PS05.

34. Chinese Taipei provided a short summary of NPFC-2021-SSC PS07-IP02, which describes body length distributions and age compositions of the Pacific saury caught by the Chinese Taipei saury fishery in 2007-2018 and was submitted as a working paper to SSC PS06.

35. Preliminary information on size and age composition data of Pacific saury from Members were provided to the SSC PS07 meeting for the purpose of developing the age-structured model. Chinese Taipei visualized the size and age composition data from Japan (2000-2018), Chinese Taipei (2007-2018), Russia (2000-2018), and Korea (2001-2019). Seasonal changes of size and age compositions of the Members were also developed. Since the updated size and age composition data in 2020 have been made available at this meeting, the preliminary results could be improved by including the latest dataset.

7.3 Others

36. The SSC PS agreed to continue the intersessional work of the SWG for further development of a standardized approach to determining, collecting and sharing age and size data.

Agenda Item 8. Review of fishery-independent abundance indices

8.1 Review of outcomes of Japanese biomass survey including 2021 estimate

37. Japan presented the historical biomass/number estimates and weight/number-based indices of Pacific saury from the Japanese fishery independent survey up to 2021 (NPFC-2021-SSC PS07-WP08 (Rev. 1)). The total biomass estimated by swept area method was 845 thousand metric tons, which consisted of 537 thousand and 458 thousand metric tons of age-0 and age-1 fish, respectively. Japan noted that the sum of age-0 and age-1 fish weight does not equal the total weight because Japan used a tentative length-weight relationship in 2021.

38. The estimated total biomass in 2021 was the lowest level recorded but was probably underestimated because the easternmost and a part of the second easternmost lines were not surveyed due to the unavoidable return of the vessel. For an equitable comparison, Japan also estimated the time series of biomass for only the area surveyed in 2021 and the trend was generally the same. The Vector Autoregressive Spatio-temporal (VAST) modeling procedure described below was used to account for the incomplete sampling.

39. Japan presented the Japanese survey biomass index of Pacific saury up to 2021 (NPFC-2021-SSC PS07-WP06). Japan applied a VAST model to Japanese fishery-independent survey data to predict the Pacific saury distribution and estimate the biomass index from 2003 to 2021 including the unsampled area. The estimated biomass index from the selected VAST model with minimum AIC indicated similar year trends with the index from a design-based approach after 2010. The estimated biomass index dropped to a low level in 2020 but was highly uncertain. It remained low in 2021 and had typical precision. Japan recommended using the biomass index estimated by the VAST model as the input for the stock assessment, pointing

out that the VAST model has the advantage of being able to estimate the abundance of missing survey areas and the non-zero risk of surveys being suspended or disrupted in the future due to unpredictable circumstances like the COVID-19 pandemic or an injury to a crew member.

40. The SSC PS thanked Japan for continuing to conduct its biomass survey, which has contributed greatly to understanding the Pacific saury stock, and for continuing to conduct the technical work to improve the abundance estimates.

8.2 Conclusion as inputs for stock assessments

41. The SSC PS agreed to use the biomass index estimated by the VAST model as the input for the stock assessment (Annex D) and to include the 2020 estimate but reflect the higher level of uncertainty compared to other years using the CV as shown in Annex F.

8.3 Plans for future surveys by Members

42. Japan indicated that it plans to conduct its biomass survey in 2022 and the following years.

8.4 Recommendations for future work

43. The SSC PS noted the high percentage of missing biomass in the biomass survey in recent years, which suggests that age-0 fish may have shifted to eastern areas further offshore. The SSC PS suggested that it would be worthwhile considering extending the Japanese biomass survey further east, while recognizing that there may be logistical constraints that make this difficult. The SSC PS encouraged Japan to present next year's survey plan at the December meeting for further discussion.

44. The SSC PS encouraged Members to conduct research surveys or share data from existing research surveys that could complement the Japanese large-scale biomass survey and provide useful information for understanding the Pacific saury abundance, spatio-temporal distribution, and any other relevant biological or ecological information.

45. The SSC PS suggested that Japan use a species distribution model to try to identify any distribution patterns in the early, middle and late biomass survey years, and investigate if there is a suitable habitat for Pacific saury beyond the current survey area.

46. The SSC PS noted the continual improvements that have been made to the VAST-based method for estimating biomass indices and agreed to continue to estimate the biomass indices using the VAST model.

Agenda Item 9. Review of fishery-dependent abundance indices

9.1 Member's CPUE standardization up to 2020 fishery

47. Russia presented a standardization of CPUE data for Pacific saury from 1994 to 2020 using generalized linear model (GLM) (NPFC-2021-SSC PS07-WP02). Russia recommended using the standardized CPUE derived from GLM as input for the stock assessment.

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

49. Japan presented a standardization of CPUE data for Pacific saury from 1994 to 2020 using GLM (NPFC-2021-SSC PS07-WP07). Japan recommended using the standardized CPUE derived from GLM as input for the stock assessment. Japan also pointed out that the standardized CPUE in 2020 had decreased to the lowest level since 1994.

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

51. China presented a standardization of CPUE data for Pacific saury from 2013 to 2020 using a GLM and a generalized additive model (GAM) on the assumption of lognormal distribution of errors (NPFC-2021-SSC PS07-WP13 (Rev. 1)). China recommended using the standardized CPUE derived from GAM as the input for the stock assessment.

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

53. Chinese Taipei presented a standardization of CPUE data for Pacific saury from 2001 to 2020 using GLM and GAM on the assumption of lognormal distribution of errors (NPFC-2021-SSC PS07-WP14). Chinese Taipei recommended using the standardized CPUE derived from GAM as input for the stock assessment.

54. The SSC PS agreed to use Chinese Taipei's standardized CPUE derived from GAM as the input for the stock assessment.

55. Korea presented a standardization of CPUE data for Pacific saury from 2001 to 2020 using GLM (NPFC- 2021-SSC PS07-WP18). Korea recommended using the standardized CPUE derived from GLM as input for the stock assessment.

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

57. The SSC PS noted that China and Korea did not extract the CPUE using a method that can account for spatial heterogeneity of effort, as required by the CPUE Standardization Protocol, but recognized that this would not affect the stock assessment. The SSC PS encouraged China and Korea to follow the CPUE Standardization Protocol fully in future.

58. In future, Members should fully adhere to the CPUE Standardization Protocol barring any special reason not to.

59. The finalized table of abundance indices is attached to the report as Annex D. A plot of Members' standardized CPUEs is attached to the report as Annex E.

9.2 Joint CPUE standardization up to 2020 fishery

60. Chinese Taipei presented a joint CPUE standardization of Pacific saury in the Northwest Pacific Ocean from 2001 to 2020 using a VAST model (NPFC-2021-SSC PS07-WP16). The spatio-temporal effect had the largest influence on the time series of estimated CPUE among all variables. The results indicated that the annual standardized CPUE trend had a fluctuating pattern over the studied periods, and the annual standardized CPUE value was at the lowest level below average (2001-2020) in 2020. Correlation analysis indicated that the joint index could resolve the issue of inconsistency among individual indices (p=0.5-0.8).

61. The SSC PS agreed to use the standardized joint CPUE as an input for the stock assessment.

9.3 Recommendations for future work

62. The SSC PS agreed that each Member will continue to submit their standardized CPUEs as inputs for the stock assessment.

63. The SSC PS agreed to continue to discuss issues related to the method of extracting the CPUE in the CPUE standardization intersessionally.

64. The SSC PS agreed to continue the joint CPUE standardization work, while further investigating how to account for issues such as size/age-selectivity and fleet type effects.

Agenda Item 10. Stock assessment using "provisional base models" (BSSPM)

10.1 Review of the key considerations and recommendations from the SCsm01 meeting

65. The SSC PS reviewed the outcomes of the SCsm01 meeting, including the agreed upon updated BSSPM specification.

10.2 Specification of models

66. The SSC PS further updated the BSSPM specification (Annex F). The two sensitivity cases with q_{bio}~$U(0,2)$ were eliminated because it seems clear that q_{bio} values larger than 1 are unlikely for the Japanese survey.

67. The SSC PS agreed to use the existing template for stock status information and future projection developed by SSC PS05 (NPFC-2019-SSC PS05-Final Report, Annex H), with a two year adjustment to use the most recent available information.

10.3 Workplan and timeline until the SSC PS08

68. The SSC PS agreed on a workplan and timeline as follows:
    (a) Conduct updated stock assessments based on the updated BSSPM specifications and submit the results by November 10.
    (b) If possible, test the incorporation of environmental effects in the BSSPM model and submit the results by November 30.
    (c) If possible, conduct trial analyses with consideration of different uses of indices in the BSSPM model and submit the results by November 30.

Agenda Item 11. New stock assessment models

11.1 Specification of models and development of software

69. Japan proposed an example state-space age-structured stock assessment model for Pacific saury (NPFC-2021-SSC PS07-WP21). Japan tested several treatments of the natural mortalities and age-0 spawning. Based on the obtained results, Japan did not recommend free-estimation of the age-specific natural mortalities without validation of the biological plausibility of the obtained results. Japan suggested that introducing some assumptions on the natural mortalities would be a potential option. It also suggested carefully considering the assumptions on the spawning ability of age-0 fish.

70. The SSC PS welcomed the work done by Japan and suggested some issues for further investigation, including the assumption of natural mortality, measurement error in observed catch, and estimation of age-based selectivity.

71. A report was provided on the joint study conducted by scientists of China, Japan and Chinese Taipei to propose the use of Stock Synthesis 3 (SS3) as a candidate age-structured model for

the Pacific saury stock assessment (NPFC-2021-SSC PS07-WP22). The work is still in the early stages so the specification has been kept simple in order to set up a framework for using the available data sets. The structure of the model will continue to be improved by diagnosing convergence, goodness of fit, consistency of model via retrospective analysis and model predictability, which will take into account uncertainties in parameters and other assumptions to produce a set of plausible scenarios and robustness scenarios. Better spatial and temporal resolutions will also be considered to account for the effects of environmental changes and temporal patterns of migration and fishing activities. The advantages of using the existing SS3 software include the ease with which results can be shared without having to check the code and features such as the availability of diagnostic tools, simulation platforms and links to activities for Management Strategy Evaluation (MSE). Further results will be presented at SSC PS08.

72. The SSC PS welcomed the joint work and suggested some issues for further investigation, including the estimation of fecundity and the maturity ratio.

11.2 Workplan and timeline until the SSC PS08

73. The SSC PS encouraged Members to provide further updates on the development of potential age-structured models by November 30.

Agenda Item 12. Toward setting of biological reference points (RPs) and development of Management Strategy Evaluation (MSE)

12.1 Initial discussions on RPs and MSE

74. The Chair presented the draft Terms of Reference (TOR) of the SWG MSE PS, which was circulated to Commission Members on 13 September 2021, and the tentative timeline for the MSE development work.

75. Full MSE analyses for Pacific saury will require years of work but there is a need to reconsider the harvest control rule (HCR) more quickly given declines in the Pacific saury stock over the last two decades. Therefore, the SSC PS supports development of an interim HCR in the near term based on currently available information as outlined in the draft TOR. There are a number of general approaches that can be considered outside of a full and elaborate MSE analysis.

12.2 Recommendations for future work

76. The SSC PS suggested that it could assist the SWG MSE PS in developing draft interim management objectives and a draft interim HCR by developing the current BSSPM further by incorporating environmental effects or developing a preliminary age-structured model and

using said model to test potential simple HCRs based on the model functions.

Agenda Item 13. Other matters

13.1 Draft agenda and priority issues for next meeting

77. The Chair informed participants that the agenda of the SSC PS08 had been approved by the Commission Members. The agenda is available on the meeting webpage. The priorities for the next meeting are to finalize the BSSPM results, review the updated stock assessments, investigate environmental effects on the stock that might be useful in providing management advice, and provide routine scientific advice on the management of the Pacific saury stock.

13.2 Other

78. Japan expressed its intention to continue the research described in NPFC-2021-SSC PS07-WP05 and publish it as a paper in a scientific journal. The research uses CAA calculated based on CAS data submitted by each Member for the purpose of developing age-structured models and Japan stated that it would submit formal requests to use such data to the relevant data providers, in accordance with the Regulations for Management of Scientific Data and Information.

79. Canada informed participants of two upcoming opportunities for collaboration and engagement related to small pelagic fishes. In November 2022, there will be an ICES-PICES-FAO Small Pelagic Fish Symposium covering a broad range of relevant topics (in particular the impacts of the environment on small pelagic fishes) held in Lisbon, Portugal. Topic and workshop sessions can be found at the symposium webpage. Secondly, some participants had submitted a proposal for a topic session at the 2022 PICES meeting in Busan, Korea titled "Environmental variability and small pelagic fishes in the North Pacific: exploring mechanistic and pragmatic methods for integrating ecosystem considerations into assessment and management." Last year the NPFC had agreed to jointly sponsor the session if accepted. This will follow on the PICES-NPFC workshop held in 2019 and would be expected to be very useful and hopefully informative for SSC PS members. Finally, Canada requested participation in completing a questionnaire of information about small pelagic fish surveys that was circulated by the NPFC Secretariat.

Agenda Item 14. Adoption of the Report

80. The SSC PS07 Report was adopted by consensus.

Agenda Item 15. Close of the Meeting

81. The meeting closed at 10:38 on 11 October 2021, Tokyo time.

Annexes:

Annex A – Agenda

Annex B – List of Documents

Annex C – List of Participants

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

Annex E – Time series of Members' standardized CPUE from 1980-2020

Annex F – Specifications of the BSSPM for the updated stock assessment

Annex A

Agenda

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- 3.1 SSC PS06, SC05 and SCsm01 meetings
- 3.2 COM06 meeting
- 3.3 Joint SC-TCC-COM Small Working Group on MSE for Pacific saury (SWG MSE PS)

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
- 4.2 CPUE Standardization Protocol
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Agenda Item 6. Biological and environmental information relevant to Pacific saury
- 6.1 Review of new biological information
- 6.2 Review of environmental information relevant to Pacific saury distribution and migration
- 6.3 Distribution and migration patterns of juvenile Pacific saury
- 6.4 Recommendations for future work

Agenda Item 7. Review of the statistical data available
- 7.1 Annual catch
- 7.2 Size and age composition
- 7.3 Others

Agenda Item 8. Review of fishery-independent abundance indices
- 8.1 Review of outcomes of Japanese biomass survey including 2021 estimate
- 8.2 Conclusion as inputs for stock assessments
- 8.3 Plans for future surveys by Members
- 8.4 Recommendations for future work

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- 9.1 Member's CPUE standardization up to 2020 fishery
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Agenda Item 10. Stock assessment using "provisional base models" (BSSPM)
- 10.1 Review of the key considerations and recommendations from the SCsm01 meeting
- 10.2 Specification of models
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Agenda Item 12. Toward setting of biological reference points (RPs) and development of Management Strategy Evaluation (MSE)
- 12.1 Initial discussions on RPs and MSE
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Agenda Item 13. Other matters
- 13.1 Draft agenda and priority issues for next meeting
- 13.2 Other

Agenda Item 14. Adoption of Report

Agenda Item 15. Close of the Meeting

Annex B

List of documents

MEETING INFORMATION PAPERS

Symbol	Title
NPFC-2021-SSC PS07-MIP01	Details for the Virtual Meetings of the Small Scientific Committee on Pacific Saury
NPFC-2021-SSC PS07-MIP02	Provisional Agenda
NPFC-2021-SSC PS07-MIP03 (Rev. 1)	Annotated Indicative Schedule

REFERENCE DOCUMENTS

Symbol	Title
NPFC-2020-SSC PS06-Final Report NPFC-2020-SC05-Final Report NPFC-2021-SCsm01-Final Report	SSC PS06, SC05 and SCsm01 Reports
NPFC-2021-COM06-Final Report	COM06 Report
	Terms of Reference for the Small Scientific Committee on Pacific Saury (SSC PS)
	CPUE Standardization Protocol for Pacific Saury
	Stock assessment protocol for Pacific Saury

WORKING PAPERS

Symbol	Title
NPFC-2021-SSC PS07-WP01 (Rev. 1)	Compiled data on Pacific saury catches in the Northwestern Pacific Ocean
NPFC-2021-SSC PS07-WP02	CPUE standardization for the Pacific saury Russian catches in the Northwest Pacific Ocean
NPFC-2021-SSC PS07-WP03	Proportion of Pacific saury spawned during their first spawning season estimated by the histological observations of ovary tissues
NPFC-2021-SSC PS07-WP04	A short review of the effects of environmental factors on distribution, migration and recruitment of Pacific saury
NPFC-2021-SSC PS07-WP05	Identifying effects of environment on Pacific saury recruitment
NPFC-2021-SSC PS07-WP06	Japanese survey biomass index of Pacific saury up

	to 2021 using VAST model
NPFC-2021-SSC PS07-WP07	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Japanese stick-held dip net fishery up to 2020
NPFC-2021-SSC PS07-WP08 (Rev. 1)	Historical biomass/number estimates and weight/number based indices of Pacific saury from Japanese fishery independent survey up to 2021
NPFC-2021-SSC PS07-WP09	Age-determination and age-length keys for Pacific saury, *Cololabisa saira*, in 2019 and 2020
NPFC-2021-SSC PS07-WP10	Seasonal length-weight relationships and weights at age of Pacific saury
NPFC-2021-SSC PS07-WP11	Information of the surveys for Pacific saury conducted during winter season in 2007 and 2011
NPFC-2021-SSC PS07-WP12 (Rev. 1)	Catch data of Pacific saury by Vanuatu Pacific saury fishing fleets in the North Pacific Ocean during 2013 - 2020
NPFC-2021-SSC PS07-WP13 (Rev. 1)	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the China's stick-held dip net fishery up to 2020
NPFC-2021-SSC PS07-WP14	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Chinese Taipei stick-held dip net fishery up to 2020
NPFC-2021-SSC PS07-WP15	Estimation of catch-at-size/age data of Pacific saury using stratified random sampling with proportional allocation
NPFC-2021-SSC PS07-WP16	Joint CPUE standardization of the Pacific saury in the Northwest Pacific Ocean during 2001 - 2020 using the Vector-Autoregressive Spatiotemporal Model
NPFC-2021-SSC PS07-WP17	Outline of the protocol for catch at size (CAS) data for the Chinese Taipei stick-held dip net fishery
NPFC-2021-SSC PS07-WP18	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Korean's stick-held dip net fishery up to 2020
NPFC-2021-SSC PS07-WP19	Preliminary methods of estimating the catch at size (CAS) based on China's Pacific saury fishery and sampling data
NPFC-2021-SSC PS07-WP20	Outline of the protocol for catch at size (CAS) data for Russian stick-held dip net fishery
NPFC-2021-SSC PS07-WP21	An example state-space age-structured stock assessment model for Pacific saury

NPFC-2021-SSC PS07-WP22	Preliminary specification for stock assessment for the Pacific saury using Stock Synthesis 3

INFORMATION PAPERS

Symbol	Title
NPFC-2021-SSC PS07-IP01	Estimation of catch at size (CAS) for Japanese stick-held dip net fishery
NPFC-2021-SSC PS07-IP02	Body length distributions and age compositions of the Pacific saury caught by the Chinese Taipei saury fishery in 2007-2018
NPFC-2021-SSC PS07-IP03 (Rev. 1)	Summary of calculation methods for CAS data of each member
NPFC-2021-SSC PS07-IP04	Difference between Fork length and Knob length for Pacific saury
NPFC-2021-SSC PS07-IP05	Preliminary information on size and age composition data of Pacific saury for the development of age-structured model using Stock Synthesis

Annex C

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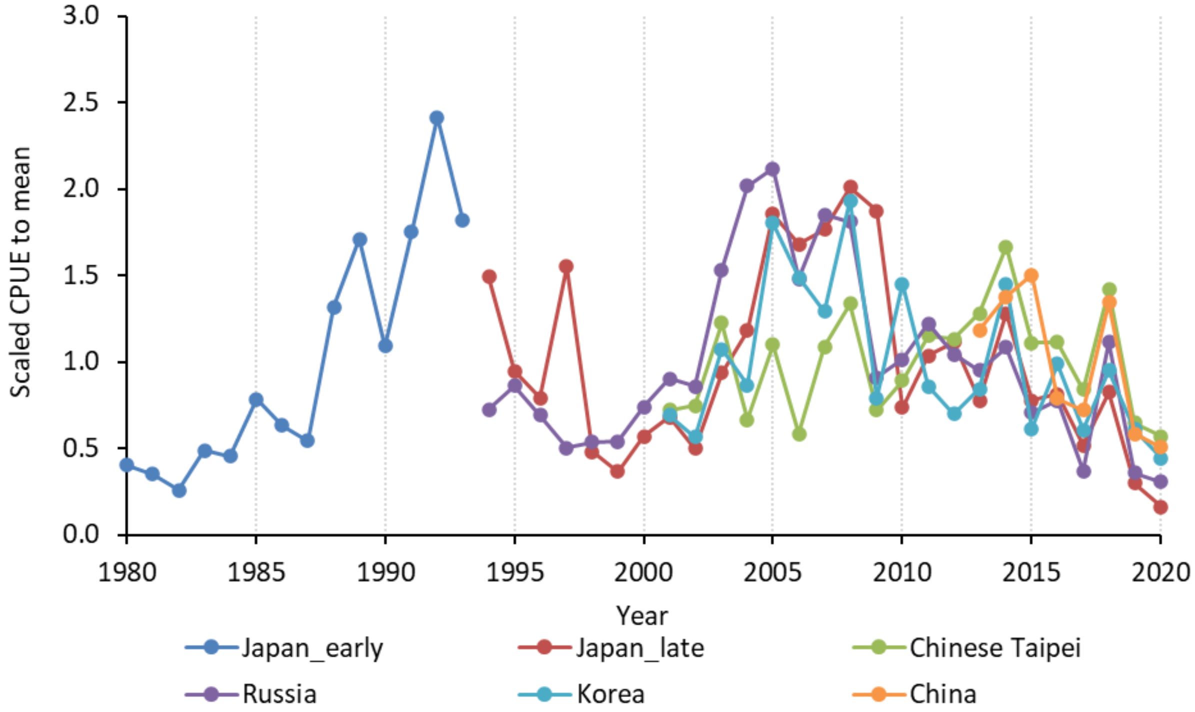
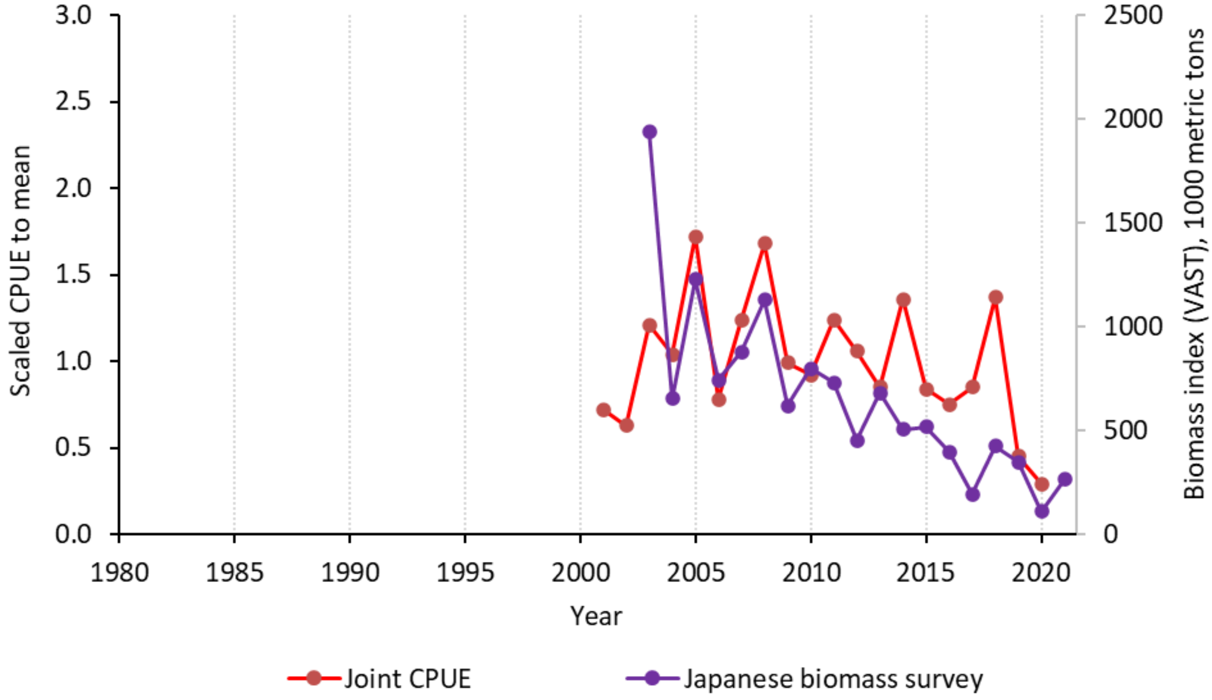
Updated total catch, CPUE standardizations and biomass estimates for the stock assessment of Pacific saury

Year	Total catch (metric tons)	Biomass JPN (VAST, 1000 metric tons)	CV (%)	CPUE_CHN (metric tons per vessel per day)	CPUE JPN_early (metric tons per net haul)	CPUE JPN_late (metric tons per net haul)	CPUE KOR (metric tons per vessel per day)	CPUE RUS (metric tons per vessel per day)	CPUE CT (metric tons per net haul)	Joint CPUE (VAST)
1980	238510				0.72					
1981	204263				0.63					
1982	244700				0.46					
1983	257861				0.87					
1984	247044				0.81					
1985	281860				1.4					
1986	260455				1.13					
1987	235510				0.97					
1988	356989				2.36					
1989	330592				3.06					
1990	435869				1.95					
1991	399017				3.13					
1992	383999				4.32					
1993	402185				3.25					
1994	332509					3.19		16.89		
1995	343743					2.03		20.15		
1996	266424					1.69		16.15		
1997	370017					3.31		11.74		
1998	176364					1.03		12.49		
1999	176498					0.78		12.61		
2000	286186					1.22		17.31		
2001	370823					1.46	3.82	21.05	1.57	0.72
2002	328362					1.07	3.13	20.01	1.63	0.63
2003	444642	1939.9	29.0			2.00	5.93	35.76	2.67	1.21
2004	369400	652.6	20.7			2.52	4.78	47.10	1.45	1.04
2005	473907	1228.3	30.4			3.96	9.97	49.50	2.39	1.72
2006	394093	744	27.0			3.59	8.22	34.57	1.27	0.78
2007	520207	878.4	27.4			3.77	7.15	43.21	2.37	1.24
2008	617509	1129.2	28.8			4.29	10.69	42.31	2.91	1.68
2009	472177	619.2	24.6			4.00	4.37	21.26	1.57	0.99
2010	429808	797.9	27.5			1.57	8.02	23.68	1.94	0.92
2011	456263	730.2	32.6			2.21	4.74	28.49	2.51	1.24
2012	460544	452.5	23.5			2.38	3.86	24.36	2.47	1.06
2013	423790	680.4	25.7	13.96		1.66	4.67	22.20	2.79	0.85
2014	629576	506.7	23.0	16.24		2.74	8.01	25.37	3.63	1.36

2015	358883	516.2	21.3	17.73		1.66	3.4	16.52	2.42	0.84
2016	361688	396.4	28.1	9.29		1.74	5.47	18.17	2.43	0.75
2017	262639	192.8	27.9	8.5		1.11	3.36	8.59	1.83	0.85
2018	439079	424.9	27.0	15.84		1.76	5.25	26.06	3.09	1.37
2019	192377	347.2	27.3	6.89		0.64	3.37	8.39	1.41	0.45
2020	139676	109.5	158.1	5.95		0.35	2.45	7.19	1.24	0.29
2021		265.8	33.1							

Time series of Members' standardized CPUE from 1980-2020





Annex F

Specifications of the BSSPM for the updated stock assessment

	Base case (B1)	**Base case (B2)**	**Sensitivity case (S1)**	**Sensitivity case (S2)**
Initial year	1980	Same as left	Same as left	Same as left
Biomass survey	$I_{t,bio} = q_{bio} B_t e^{v_{t,bio}}$ $v_{t,bio} \sim N(0, cv_t^2 + \sigma_{bio}^2)$ $q_{bio} \sim$ U(0,1) (2003-2021)	Same as left	Same as left	Same as left
CPUE	CHN(2013-2020) JPN_early(1980-1993, time-varying q) JPN_late(1994-2020) KOR(2001-2020) RUS(1994-2020) CT(2001-2020) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_t^2) + \sigma_{bio}^2)$, where $ave(cv_t^2)$ is computed except for 2020 survey	CHN(2013-2020) JPN_late(1994-2020) KOR(2001-2020) RUS(1994-2020) CT(2001-2020)	JPN_early(1980-1993, time-varying q) Joint CPUE (2001-2020) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, \sigma_{joint}^2)$ $\sigma_{joint}^2 = c \cdot (ave(cv_t^2) + \sigma_{bio}^2)$, where $ave(cv_t^2)$ is computed except for 2020 survey	Joint CPUE (2001-2020)
Variance component	Variances of logCPUEs are assumed to be common and 6 times of that of log biomass (*c* = 6)	Variances of logCPUEs are assumed to be common and 5 times of that of log biomass (*c* =5)	Same weight between biomass and joint CPUE	Same as left
Hyper-depletion/ stability	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]	A common parameter for all fisheries with a prior distribution, *b* ~ *U*(0, 1)	*b* ~ *U* (0, 1)	*b* ~ *U* (0, 1)
Prior for other than q_{bio}	Own preferred options	Own preferred options	Own preferred options	Own preferred options