NPFC

North Pacific Fisheries Commission

**9th Meeting of the Small Scientific Committee
on Pacific Saury
REPORT**

30 August - 2 September 2022

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WebEx

REPORT

Agenda Item 1. Opening of the Meeting

1. The 9th Meeting of the Small Scientific Committee on Pacific Saury (SSC PS09) 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 participants. 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 PS08 and SC06 meeting

4. The Chair presented the outcomes and recommendations from the SSC PS08 meeting and the 6th meeting of the Scientific Committee (SC06).

3.2 SWG MSE PS01

5. The Chair presented the outcomes and recommendations from the 1st meeting of the joint SC-TCC-COM Small Working Group on Management Strategy Evaluation for Pacific saury (SWG MSE PS01).

6. The Science Manager explained that the Commission was scheduled to meet in March but that the meeting was postponed. The Commission has therefore not been able to consider the recommendations of the SC or its subsidiary bodies.

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 catch-per-unit-effort (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. Member's fishery status including 2022 fishery

10. Canada presented its Pacific saury catch information (NPFC-2022-SSC PS09-IP01). Canada does not have a commercial fishery targeting Pacific saury, but occasionally takes Pacific saury as bycatch. No bycatch of Pacific saury was taken by commercial fishing in 2020 or 2021, nor by research surveys in recent years. Pacific saury has been found to be a part of the diet of Rhinoceros Auklets and in some years, Pacific saury constitutes a substantial part of Rhinoceros Auklet prey. This year, Canada also found Pacific saury in the diet of adult salmon.

11. Russia suggested that it may be useful to conduct genetic studies of Pacific saury in the Eastern Pacific Ocean. Canada suggested that it could arrange for tissue and other samples from Pacific saury taken in the Eastern Pacific Ocean to be shared with any Members interested in conducting such studies.

12. Russia presented its fisheries status (NPFC-2022-SSC PS09-IP02). Total catch in 2021 was approximately 600 metric tons (MT), the lowest after 1991. Since 2014, the number of Russian saury fishing vessels has decreased every year. In 2020, the number of fishing vessels was 2, the lowest since 1991. 3 vessels operated in 2021. Nominal CPUE in 2021 was 4.2 MT/vessel/day, the lowest since 2000. In 2020 and 2021, the fishing grounds were mainly outside the Russian exclusive economic zone (EEZ) and were further east in 2021 compared to 2020.

13. China presented its fisheries status (NPFC-2022-SSC PS09-IP04). Total catch in 2021 was 33,511 MT, the lowest since 2018. As of 25 July, the total catch in 2022 is 6,902 MT. A total

of 59 vessels are operating in 2022, a decrease of 7 from 2021. Accumulated catch in 2022 has so far been lower than 2021, but still at an average level compared to historical levels. Seasonal catch in 2022 has so far been similar to that of 2021. The nominal CPUE has declined since 2018. So far in 2022, it has been 4.79 MT/vessel/day, the lowest since 2013. The fishing grounds so far in 2022 have been similar to those in 2021.

14. Vanuatu presented its fisheries status (NPFC-2022-SSC PS09-IP09 (Rev.1)). Total annual catch peaked at 8,231 MT in 2018. Total catch in 2021 was 1,270 MT. Vanuatu's Pacific saury fishery began in 2004. In total, it has authorized 16 vessels. The number of operating vessels has been 4 since 2015. A comparison of accumulated catch in recent years shows a trend of abundance increasing from October. Annual comparison of the seasonal catch shows that the main fishing season has been shifting to later in the year in recent years. Nominal CPUE in 2021 was 5.3 MT/day, the lowest since 2013. The main fishing grounds are between 150°E and 170°E. They are mainly in east early in the season, before shifting to the west. In 2021, the fishing season started late due to port measures related to COVID-19.

15. Japan presented its fisheries status (NPFC-2022-SSC PS09-IP06 (Rev. 1)). In 2021, 125 vessels were registered, a decrease of 2 from the previous year. The annual catch was 18,407 MT, the lowest since 1950. Accumulated catch until September in 2021 was higher than in 2019 and 2020 but was the lowest after the middle of October. 10-day catches were higher than 2020 until early October but lower than 2021 from mid-October. Nominal CPUE was 0.57 MT/haul, the lowest since 2000. Most of the fishing grounds were located on the high seas. Since 2010, the fishery ground has gradually moved east, particularly after 2019. Most of the fish caught in 2021 were age-1 fish. In 2022, the Japanese fishing season for Pacific saury started in August. 113 vessels are registered, a decrease of 8 from 2021. The vessels are mainly operating in the high seas. As of 26 August, the accumulated catch in 2022 is only 70 MT.

16. Korea presented its fisheries status (NPFC-2022-SSC PS09-IP07). Total catch in 2021 was 4,365 MT, a new historical low following the historical low in 2020. As of the end of July, the accumulated catch in 2022 is 862 MT. The number of vessels operating has gradually decreased from 2015 to 2022, and has decreased from 10 in 2021 to 8 in 2022. A yearly comparison of seasonal catch showed similar trends across years. Nominal CPUE was 4.5 MT/vessel/day in 2021, the historical low. Fishing grounds are usually west of 170°E at the start of the fishing season and tend to move westwards over time.

17. Chinese Taipei presented its fisheries status (NPFC-2022-SSC PS09-IP08). The catch recovered to around 180,000 tons in 2018 and has shown a declining trend since then. 93

vessels operated in 2021, compared to 87 in 2020. In 2022, the accumulated catch as of the end of July was 4,069 MT, compared to 4,895 MT for the same period last year. Through July, the seasonal catch in 2022 has been the lowest since 2001. From May to July 2022, the nominal CPUE has been about 1 MT/haul, which is less than that of the same periods in 2021 (1.21 MT/haul) and 2022 (1.32 MT/haul). Compared to 2021, fishing grounds are observed to be located further north in 2022.

18. The Science Manager presented the compiled data on Pacific saury catches in the northwestern Pacific Ocean from 1950 to 2021 (NPFC-2022-SSC PS09-WP01).

19. The Science Manager presented the cumulative catch of Pacific saury as of mid-August in 2020, 2021 and 2022. The cumulative catch in 2022 is approximately 14,342 MT compared to 23,701 MT in 2021 and 9,875 MT in 2020. Although the accumulated catch as of mid-August was higher in 2021 compared to 2020, the total annual catch was actually lower in 2021 than in 2020.

Agenda Item 6. Fishery-independent abundance indices
6.1 Review of results of abundance estimation including 2022 Japanese biomass survey

20. Japan presented the results of 2022 Japanese biomass survey and the Japanese survey biomass index of Pacific saury up to 2022 estimated using the Vector Autoregressive Spatio-temporal (VAST) model (NPFC-2022-SSC PS09-WP07). The 2022 survey area covered 143°E to 165°W and Pacific saury occurred in the area between 155°E and 165°W. The survey was conducted by three ships (Kaiyo-maru, Hokko-maru and Hokuho-maru). The survey area of the Hokko-maru and Hokuho-maru covered the main distribution area of Pacific saury in 2022. The Kaiyo-maru, which has not ever been used for the previous surveys for Pacific saury, used a different-sized trawl net to the Hokko-maru and Hokuho-maru. The relative fishing efficiency of this net was estimated using a statistical model, and the value was used to calibrate the input for the VAST analysis. The effect of the relative fishing efficiency was confirmed to be small and negligible for the final outcomes of the abundance index. A VAST model was applied to the Japanese fishery-independent survey data to predict the Pacific saury distribution and estimate the biomass index from 2003 to 2022. The VAST model with a quadratic function of sea surface temperature (SST) and log(SST) for encounter probability and positive catch rate, respectively, was selected by AIC. The estimated biomass index from the selected VAST model with minimum AIC indicated similar year trends with the index from the swept area method. In 2020, the estimated biomass index dropped to its lowest level since 2003. In 2022, it recovered but remained at a low level.

21. The SSC PS agreed to use the Japanese survey biomass index of Pacific saury up to 2022 estimated using VAST as an input for the stock assessment.

6.2 Review of plans of future biomass surveys
22. Japan stated that it would present its future biomass survey plans at the SSC PS10 meeting.

6.3 Recommendations for future work
23. The SSC PS commended Japan for using the new vessel nearshore in the 2022 survey where catch rates were very low so that the uncertainty in fishing efficiency had little effect on the VAST analysis. The SSC PS encouraged Japan to conduct additional work on the relative fishing efficiency and size selectivity of the new vessel if it is to be used more extensively in future.

24. The SSC PS noted that the use of the Kaiyo-maru for this year's biomass survey was due to exceptional circumstances and that Japan does not envision having to use the vessel for next year's survey. The SSC PS suggested that, if the Kaiyo-maru or another vessel with a different net to the usual survey vessels is to be used for the survey in the future, calibration of the different net should be built into the survey. For example, Japan could consider conducting experimental surveys to increase data availability or designing overlapping survey areas between the new vessel and one of the reference vessels to enable analyses of relative catchability between the two vessels.

25. The SSC PS noted that there was higher uncertainty in the earlier time period in the VAST model and suggested that Japan investigate the reason for the difference in the CV over time.

26. The SSC PS encouraged Japan to continue to conduct its biomass survey and Members to conduct Pacific saury or multispecies research surveys or share data from existing research surveys that could complement the Japanese biomass survey and provide useful information for understanding the abundance, spatio-temporal distribution, and migration patterns of Pacific saury.

27. Russia explained that it conducts annual multi-species surveys that mostly take place in the Russia EEZ but occasionally partially cover the Convention Area. The SSC PS noted that these surveys could provide useful information for the Pacific saury stock assessment and encouraged Russia to share further details about the surveys at the SSC PS10 meeting, if possible.

Agenda Item 7. Fishery-dependent abundance indices

7.1 Review of Members' standardized CPUEs

28. Russia presented a standardization of CPUE data for Pacific saury from 1994 to 2021 using a generalized linear model (GLM) (NPFC-2022-SSC PS09-WP03). Russia recommended using the standardized CPUE derived from GLM as input for the stock assessment.

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

30. Chinese Taipei presented a standardization of CPUE data for Pacific saury from 2001 to 2021 using GLM and a generalized additive model (GAM) on the assumption of lognormal distribution of errors (NPFC-2022-SSC PS09-WP04). Chinese Taipei recommended using the standardized CPUE derived from GAM as input for the stock assessment.

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

32. China presented a standardization of CPUE data for Pacific saury from 2013 to 2021 using GLM and GAM on the assumption of lognormal distribution of errors (NPFC-2022-SSC PS09-WP06). China recommended using the standardized CPUE derived from GAM as an input for the stock assessment.

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

34. Japan presented a standardization of CPUE data for Pacific saury from 1994 to 2021 using GLM (NPFC-2022-SSC PS09-WP08). Japan recommended using the standardized CPUE derived from GLM as input for the stock assessment.

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

36. Korea presented a standardization of CPUE data for Pacific saury from 2001 to 2021 using GLM (NPFC-2022-SSC PS09-WP09 (Rev. 2)). 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. Vanuatu explained that it has not been able to conduct a standardization of its CPUE data for Pacific saury and has instead submitted its nominal CPUE data from 2013 to 2021 as part of NPFC-2022-SSC PS09-IP05.

7.2 Review of joint CPUE

39. Chinese Taipei presented a joint CPUE standardization of Pacific saury in the Northwestern Pacific Ocean from 2001 to 2021 using a VAST model (NPFC-2022-SSC PS09-WP05). 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 2021. The correlation analysis indicated that the joint index could resolve the issue of inconsistency among individual indices.

40. At the suggestion of the SSC PS, Chinese Taipei conducted further analysis to investigate any potential CPUE-SST effect on the joint CPUE standardization. The analysis showed that using categorical SST effects improved the fitting, but there was a lack of clear evidence for interactions between SST and Month, which some Members thought was surprising. The SSC PS agreed that this should be the subject of future research. However, the SSC PS agreed that the estimated joint CPUE seems robust to the uncertainty and is acceptable for use in this assessment.

41. At the suggestion of the SSC PS, Chinese Taipei conducted a comparison of the standardized joint CPUE indices beginning in 1994 with that beginning in 2001. The indices were found to be comparable. Chinese Taipei also conducted a comparison of the standardized joint CPUE indices beginning in 1994 with both the Russian and Japanese standardized CPUEs beginning in 1994.

42. The SSC PS agreed to use the standardized joint CPUE beginning in 1994 as an input for the stock assessment.

43. The SSC PS expressed its appreciation to Chinese Taipei for conducting the joint CPUE standardization and encouraged other Members to collaborate with Chinese Taipei on future joint CPUE standardization work.

44. 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.

7.3 Recommendations for future work

45. Chinese Taipei presented an evaluation of the influence of spatial treatments on CPUE standardization using a real-world application and a simulation based on the Taiwanese stick-held dip net fishery for Pacific saury in the Northwestern Pacific Ocean (NPFC-2022-SSC PS09-IP03). Several spatial treatments to standardize CPUE data were evaluated using Generalized Linear Mixed Models (GLMMs). The performance of three spatially stratified approaches in GLMMs were compared. An influence analysis was constructed to quantify discrepancies between unstandardized and standardized indices and assist in identifying the annual influence of explanatory variables in GLMMs. A simulation to corroborate the results from the case study was developed and the four spatial treatments were evaluated. Results from the real-world application indicated that VAST was statistically superior to the other approaches. The influence analysis indicated that the interaction of year and spatial effect or spatio-temporal variable had a major influence on the standardized CPUE. Both simulation scenarios showed that VAST performed the best, with the lowest model error and bias, for estimating relative abundance indices. Although the spatial clustering approach created a flexible shape for the area strata, the simulation results under preferential samplings showed that clustering with a stronger emphasis placed on average CPUE could lead to bias in estimated abundance indices. However, spatial clustering that balanced average CPUE with spatial proximity could be a reasonable alternative if it is not possible to apply a spatio-temporal approach. The study highlighted importance of conducting influence analysis and the better performance of a spatio-temporal approach.

46. The SSC PS encouraged Members to conduct future CPUE standardizations using two methods, their existing one and one applying VAST, and compare the results, if possible.

47. The SSC PS agreed to conduct further research on the potential CPUE-SST effect on the joint CPUE standardization.

Agenda Item 8. Biological information on Pacific saury

8.1 Review of any updates and progress

48. No updates were provided.

8.2 Distribution and migration patterns of juvenile Pacific saury

49. No information on distribution and migration patterns of juvenile Pacific saury was provided.

8.3 Recommendations for future work

50. The SSC PS encouraged Member scientists to continue to engage in research on the biology of Pacific saury and to provide any new information at future SSC PS meetings.

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

9.1 Review and update of the existing specification

51. The SSC PS reviewed and revised the existing specification of the stock assessment BSSPM (Annex F). One previous base case model (former B1) was downgraded to a sensitivity case because the Japanese early CPUE series seemed less informative for population dynamics. The former B2 remained as a base case (NB1). Conversely, a previous sensitivity case model with the joint CPUE (former S2) was elevated to another base case model (NB2), while another former sensitivity case S1 was kept for the continuity analysis.

52. China noted that frequent changes of base case scenarios were made in the past few years and suggested the new base case scenarios should be as stable as possible in the future for easier comparison of interannual benchmark stock assessments unless substantial improvement is necessary.

53. The invited expert suggested that technical improvements to models are also important, and it is sometimes necessary to sacrifice comparability with previous assessments.

54. The SSC PS agreed about the importance of maintaining a record of changes and their effects as progress is made.

55. The SSC PS noted that the mode trends estimated for years prior to 1994 are based on catch data only and may be highly uncertain. The SSC PS agreed to include a sentence to that effect in the stock assessment report wherever results from the early years are presented.

9.2 Recommendations for future work

56. The SSC PS agreed to continue to evaluate models through diagnostics and finalize base-case model(s) at the next SSC PS meeting.

Agenda Item 10. New stock assessment models

10.1 Data available

10.2 Review of any progress on new stock assessment models

57. Chinese Taipei presented a study to develop a preliminary stock assessment model in Stock Synthesis 3.30 for Pacific saury in the Northwestern Pacific Ocean (NPFC-2022-SSC PS09-

WP10). The model incorporated historical catch, standardized CPUE, and length composition data. Various model diagnostics were conducted, including virgin recruitment (R0) likelihood profile, a runs test to evaluate randomness of residuals, and residual plots of the observed versus expected data. The study recognized that there is still uncertainty in life history parameters including maturation, growth, natural mortality, as well as the input length composition data. To improve the stock assessment in the future, it is recommended that model development work continue, that data conflicts and modelling uncertainties be reduced, and that input assessment data be re-evaluated and improved. The preliminary results produced by the study should not be used to determine stock status and conservation of Pacific saury in the Northwestern Pacific Ocean.

10.3 Finalization of specification for new stock assessment models
10.4 Recommendations for future work

58. The SSC PS welcomed the work done by Chinese Taipei and offered a number of technical suggestions. The SSC PS encouraged Chinese Taipei to continue to develop the model and interested Members to collaborate with Chinese Taipei to conduct this work.

Agenda Item 11.   Development and evaluation of an interim harvest control rule (HCR) as a short-term task

11.1 Management objectives, reference points and tuning criteria
11.2 Conditioning of operating models (OMs)
11.3 Possible/candidate HCR
11.4 Simulation platform

59. The Chair summarized the discussions of the 1st SWG MSE PS meeting and the intersessional meeting of the SSC PS in relation to management objectives, reference points, tuning criteria, conditioning of operating models, possible/candidate HCRs, and the simulation platform. Although no major points requiring change were raised, it was pointed out that, with regard to the application of the HCR, it is necessary to prepare an explanation in the SWG MSE PS and the Commission meetings so that the participants will have a clear understanding of the data to be used, timing of stock assessment and TAC decisions as well as revisions, if any, during the fishing season.

11.5 Recommendations for future work

60. The SSC PS agreed to continue to progress its work in line with the schedule and recommendations agreed to at the SWG MSE PS01 meeting (SWG MSE PS01 Report, Annex D). This project will use a simulation platform (computer program) that is working but needs some modification and reprogramming. The SSC PS emphasized the importance of securing

funding to complete work on the program so that harvest control rule work can be completed comprehensively and successfully. The SSC PS noted that clear instruction and work schedule for SSC PS is desirable.

Agenda Item 12. Other matters

12.1 Observer Program

61. The Science Manager reminded the SSC PS of the SC's discussions on the establishment of an NPFC observer program. The SC agreed that collecting information on non-targeted species is important for facilitating the work and research of the SC and that the establishment of an observer program in the NPFC Convention Area would facilitate the collection of more data for such non-targeted species and for NPFC priority species. Furthermore, the SC has tasked its subsidiary bodies with identifying data needs and data gaps for non-target species and priority species, outlining methods (e.g. human or electronic observers) that could be used to collect necessary data, and reporting this information at SC07.

62. The Science Manager also presented a table compiled by the SSC PS04 of scientific data which can be collected and/or validated by at-sea observers, fishermen, electronic reporting systems and other means for Pacific saury (SSC PS04 Report, Annex E).

63. The SSC PS noted that the assessment of non-targeted species may not fall within the ToR of the SSC PS while by-catch information of Pacific saury in fisheries targeting other species could be useful for its research. The SSC PS requested the Secretariat to prepare a paper with the relevant background information and the aforementioned table and to present it at the next SSC PS meeting to facilitate fuller discussions.

12.2 Draft agenda and priority issues for next meeting

64. The SSC PS agreed on the following priorities for the next meeting:
    (a) Conduct the updated stock assessment.
    (b) Discuss progress on the development of age-structured stock assessment models.
    (c) Discuss the scientific aspects of developing HCRs.

12.3 Other

65. The next SSC PS meeting will be held virtually by default due to the uncertainty brought about by the pandemic, unless any significant development arises.

Agenda Item 13. Adoption of the Report

66. The SSC PS09 Report was adopted by consensus.

Agenda Item 14. Close of the Meeting

67. The meeting closed at 11:30 on 2 September 2022, 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, joint standardized CPUE and Japanese survey index from 1980-2021

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

Agenda

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11.3 Possible/candidate HCR
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Agenda Item 12. Other matters
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12.3 Other

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List of Documents

MEETING INFORMATION PAPERS

Symbol	Title
NPFC-2022-SSC PS09-MIP01	Meeting Information
NPFC-2022-SSC PS09-MIP02	Provisional Agenda
NPFC-2022-SSC PS09-MIP03 (Rev. 1)	Annotated Indicative Schedule

WORKING PAPERS

Symbol	Title
NPFC-2022-SSC PS09-WP01	Compiled data on Pacific saury catches in the northwestern Pacific Ocean
NPFC-2022-SSC PS09-WP02	SSC PSint01 Meeting summary
NPFC-2022-SSC PS09-WP03	CPUE standardization for the Pacific saury Russian catches in the Northwest Pacific Ocean
NPFC-2022-SSC PS09-WP04	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Chinese Taipei stick-held dip net fishery up to 2021
NPFC-2022-SSC PS09-WP05 (Rev. 1)	Joint CPUE standardization of the Pacific saury in the Northwest Pacific Ocean during 2001 - 2021 by using the spatio-temporal modelling approach
NPFC-2022-SSC PS09-WP06	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the China's stick-held dip net fishery up to 2021
NPFC-2022-SSC PS09-WP07	Japanese survey biomass index of Pacific saury up to 2022 using VAST model
NPFC-2022-SSC PS09-WP08	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Japanese stick-held dip net fishery up to 2021
NPFC-2022-SSC PS09-WP09 (Rev. 2)	Standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Korean's stick-held dip net fishery up to 2021
NPFC-2022-SSC PS09-WP10	Preliminary stock assessment model in Stock Synthesis 3.30 for the Pacific saury in Northwestern Pacific Ocean

INFORMATION PAPERS

Symbol	Title
NPFC-2022-SSC PS09-IP01	Saury Catch in Canada (updated for 2021)
NPFC-2022-SSC PS09-IP02	Fishery for Pacific saury by Russian vessels in 2021
NPFC-2022-SSC PS09-IP03	Evaluation of the influence of spatial treatments on catch-per-unit-effort standardization: A fishery application and simulation study of Pacific saury in the Northwestern Pacific Ocean
NPFC-2022-SSC PS09-IP04	Fishery status information of Pacific saury-China
NPFC-2022-SSC PS09-IP05	Catch data of Pacific saury by Vanuatu Pacific saury fishing fleets in the North Pacific Ocean during 2013 - 2021
NPFC-2022-SSC PS09-IP06 (Rev. 1)	Pacific saury fishing condition in Japan in 2021 and 2022
NPFC-2022-SSC PS09-IP07	Korean Stick-held dip net Fishery Status up to 2022
NPFC-2022-SSC PS09-IP08	Fishery status for Pacific saury Report of Chinese Taipei
NPFC-2022-SSC PS09-IP09 (Rev. 1)	Fishery Status for Pacific saury

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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/ vessel/ day)	CPUE JPN_early (metric tons/ net haul)	CPUE JPN_late (metric tons/ net haul)	CPUE KOR (metric tons/ vessel/ day)	CPUE RUS (metric tons/ vessel/ day)	CPUE CT (metric tons/ net haul)	Joint CPUE (VAST)	CV (%)
1980	238510				0.72						
1981	204263				0.63						
1982	244700				0.46						
1983	257861				0.87						
1984	247044				0.81						
1985	281860				1.4						
1986	260455				1.13						
1987	235510				0.97						
1988	356989				2.36						
1989	330592				3.06						
1990	435869				1.95						
1991	399017				3.13						
1992	383999				4.32						
1993	402185				3.25						
1994	332509					3.91		16.97		1.29	0.35
1995	343743					2.12		20.10		1.60	0.36
1996	266424					1.76		16.10		0.67	0.35
1997	370017					3.65		11.69		1.34	0.36
1998	176364					0.98		12.47		0.79	0.37
1999	176498					0.82		12.57		0.50	0.39
2000	286186					1.24		17.30		0.91	0.37
2001	370823					1.63	7.75	21.09	1.57	0.90	0.29
2002	328362					1.08	9.59	20.02	1.63	0.68	0.28
2003	444642	1263.3	22.5			2.05	14.03	35.92	2.67	1.18	0.28
2004	369400	725.7	20.4			2.61	9.61	47.06	1.45	1.08	0.28
2005	473907	962.7	30.9			4.32	17.32	49.53	2.38	1.63	0.27
2006	394093	644.9	27.4			4.52	7.89	34.60	1.27	0.59	0.27
2007	520207	700.5	29.9			4.17	7.50	43.16	2.37	1.05	0.27
2008	617509	1007.1	26.1			5.15	16.04	42.40	2.90	1.95	0.28
2009	472177	427.8	21.9			4.22	7.80	21.29	1.57	1.03	0.28
2010	429808	570.8	27.1			1.78	8.13	23.66	1.93	1.07	0.27
2011	456263	938.2	36.3			2.47	9.08	28.46	2.50	1.26	0.29
2012	460544	330.4	20.2			2.72	8.08	24.47	2.47	1.14	0.27

Year											
2013	423790	756.4	25.3	11.39		1.83	11.52	22.13	2.80	1.02	0.27
2014	629576	528.6	21.8	12.47		3.28	17.64	25.35	3.72	1.32	0.27
2015	358883	299.5	19.2	14.49		1.68	6.97	16.48	2.33	0.99	0.28
2016	361688	425.2	25.2	6.81		1.74	9.38	17.76	2.44	0.72	0.27
2017	262639	164.7	25.5	6.66		1.13	4.71	8.59	1.79	0.79	0.27
2018	439079	336.8	26.7	12.78		1.89	10.08	25.92	3.12	1.38	0.28
2019	192377	231.4	21.4	6.71		0.70	2.27	8.47	1.41	0.54	0.27
2020	139646	44.5	112.0	4.81		0.49	2.61	7.20	1.23	0.33	0.29
2021	92206	200.9	31.6	5.04		0.33	2.31	2.82	0.81	0.22	0.28
2022		380.6	19.8								

Time series of Members' standardized CPUE, joint standardized CPUE and Japanese survey index from 1980-2021
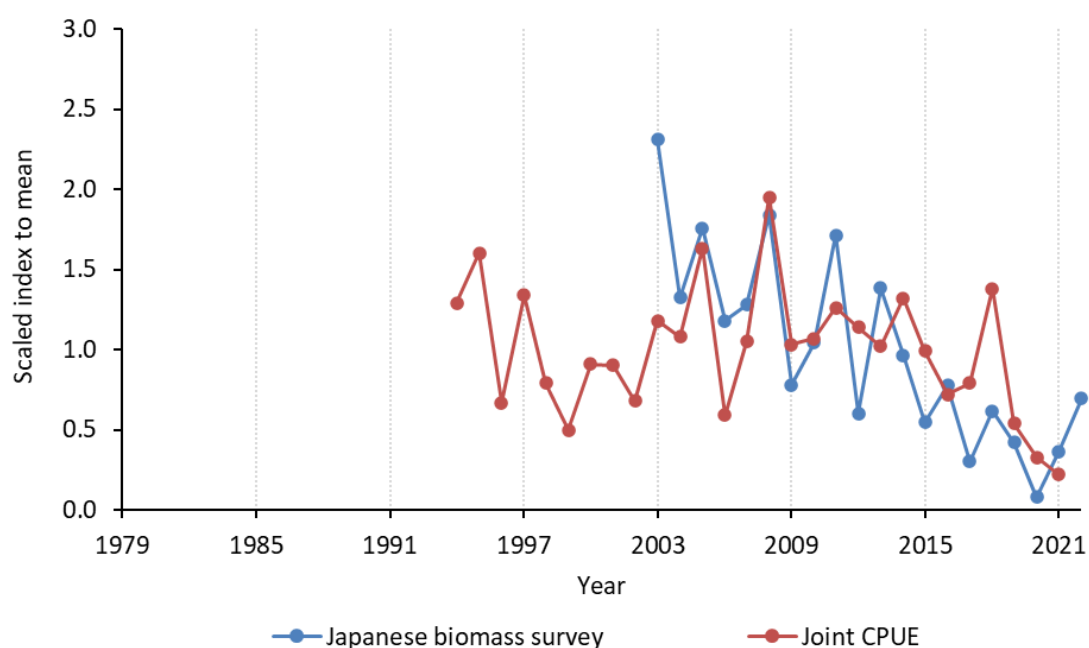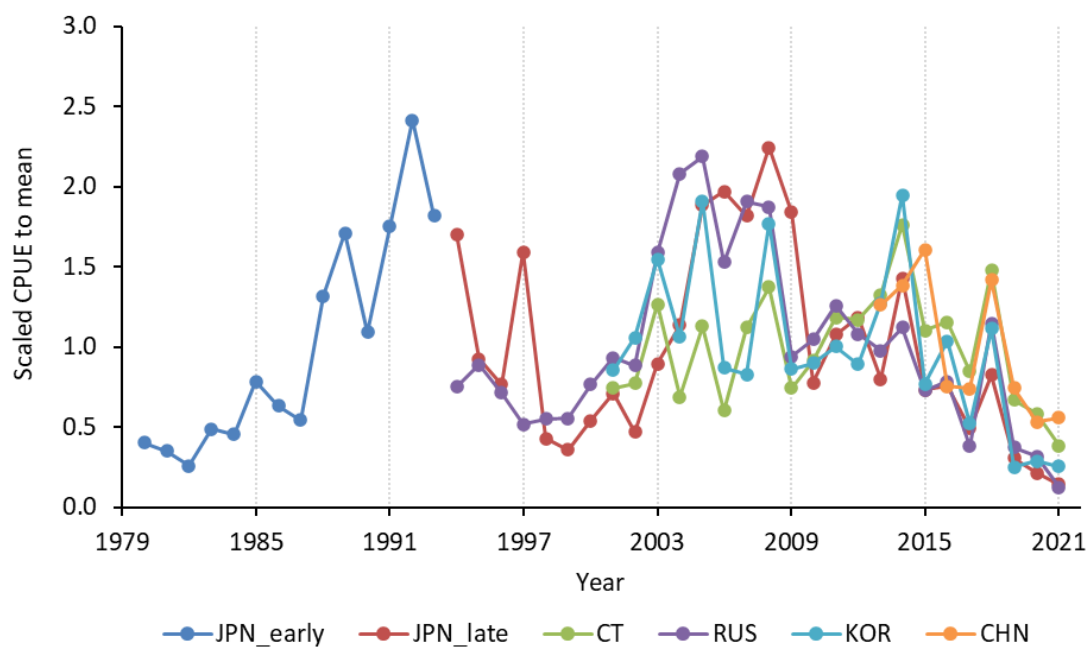
Specifications of the BSSPM for the updated stock assessment

	Base case (NB1)	Base case (NB2)	Sensitivity case (NS1)	Sensitivity case (NS2)
Initial year	1980	1980	1980	1980
Biomass survey	$I_{t,bio} = q_{bio}\, B_t e^{v_{t,bio}}$ $v_{t,bio} \sim N(0, cv_{t,bio}^2 + \sigma^2)$ $q_{bio} \sim U(0,1)$ (2003-2022)	Same as left	Same as left	Same as left
CPUE	CHN(2013-2021) JPN_late(1994-2021) KOR(2001-2021) RUS(1994-2021) CT(2001-2021) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_{t,bio}^2) + \sigma^2)$, where $ave(cv_{t,bio}^2)$ is computed except for 2020 survey $(c = 5)$	Joint CPUE (1994-2021) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$	CHN(2013-2021) JPN_early(1980-1993, time-varying q) JPN_late(1994-2021) KOR(2001-2021) RUS(1994-2021) CT(2001-2021) $I_{t,f} = q_f B_t^b e^{v_{t,f}}$ $v_{t,f} \sim N(0, \sigma_f^2)$ $\sigma_f^2 = c \cdot (ave(cv_{t,bio}^2) + \sigma^2)$, where $ave(cv_{t,bio}^2)$ is computed except for 2020 survey $(c = 6)$	JPN_early(1980-1993, time-varying q) $I_{t,JE} = q_{t,JE} B_t^b e^{v_{t,JE}}$ $v_{t,JE} \sim N(0, \sigma_{JE}^2)$ $\sigma_{JE}^2 = c\, ave(cv_{t,joint}^2 + \sigma^2)$ Joint CPUE (1994-2021) $I_{t,joint} = q_{joint} B_t^b e^{v_{t,joint}}$ $v_{t,joint} \sim N(0, cv_{t,joint}^2 + \sigma^2)$
Hyper-depletion / stability	A common parameter for all fisheries with a prior distribution, $b \sim U(0, 1)$	$b \sim U(0, 1)$	A common parameter for all fisheries but JPN_early, with a prior distribution, $b \sim U(0, 1)$ [b for JPN_early is fixed at 1]	$b \sim U(0, 1)$ for joint CPUE. [b for JPN_early is fixed at 1]
Prior for other than q_{bio}	Own preferred options	Own preferred options	Own preferred options	Own preferred options