North Pacific Fisheries Commission

3rd Meeting of the Technical Working Group on Pacific Saury Stock Assessment

REPORT

12-15 November 2018

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North Pacific Fisheries Commission
3rd Meeting of the Technical Working Group on Pacific Saury Stock Assessment

12-15 November 2018
Xiamen, China

REPORT

Agenda Item 1. Opening of the Meeting

1. The 3rd Meeting of the Technical Working Group on Pacific Saury Stock Assessment (TWG PSSA) of the North Pacific Fisheries Commission (NPFC) took place in Xiamen, China on 12-15 November 2018, and was attended by Members from China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, and Vanuatu. Dr. Larry Jacobson, an invited expert, also attended the meeting.

2. The meeting was opened by the TWG PSSA Chair, Dr. Toshihide Kitakado, who outlined the objectives and procedures for the meeting.

3. China sincerely welcomed the participants to Xiamen.

4. The Executive Secretary, Dr. Dae-Yeon Moon, reminded the TWG PSSA that at its fourth meeting, the Commission requested the Scientific Committee (SC) and the Small Scientific Committee on Pacific Saury (SSC PS) to work to provide consensus stock assessments for Pacific saury beginning in 2019 in order to advance efforts to ensure the sustainable management of the Pacific saury stock as described in the SC Work Plan. The Executive Secretary also thanked the United States for providing a voluntary contribution to support the stock assessment for Pacific saury.

Agenda Item 2. Adoption of Agenda

5. The participants discussed and revised Agenda Item 7 as follows: 7.1 Review of the background of joint CPUE standardization, 7.2 Review of available data, 7.3 Review of progress on the intersessional work, 7.4 Development of the Protocol for the joint CPUE standardization, 7.4.1 Data quality, 7.4.2 Statistical modelling and estimation, 7.4.3 Diagnostics, 7.5 Toward finalization of single joint CPUE series, and 7.6 Conclusion and recommendations for future

work.

6. The revised Agenda was adopted (Annex A). List of Documents and List of Participants are attached (Annexes B, C).

Agenda Item 3. Overview of the outcomes of previous NPFC meetings relevant to Pacific saury

7. The Chair provided an overview of the outcomes relevant to Pacific saury from previous meetings of the TWG PSSA, SSC PS, SC, and the Commission. In particular, the Chair pointed out that the mandate of the current meeting of the TWG PSSA is to finalize the data set and specifications of the models for the updated stock assessment of Pacific saury.

8. The Secretariat provided an overview of CMM 2018-08, highlighting the task of the SC and SSC PS to provide the Commission with a consensus stock assessment result beginning in 2019 and scientific guidance necessary for the development of harvest control rules, as well as to submit to the Commission relevant scientific information on geographical distribution of juvenile fish in the Convention Area and migration patterns for the protection of juvenile fish.

9. The participants noted that Members need to further discuss and clarify the definition of juvenile fish.

Agenda Item 4. Review of the Terms of Reference of the TWG PSSA

10. The participants reviewed the Terms of Reference of the TWG PSSA and determined that no revisions are currently required.

Agenda Item 5. Review of fishery data and their availability

5.1 Catch series

5.1.1 Review of data quality of catch series

11. The Secretariat presented a summary of the discussions on data quality of catch series from the SSC PS03 meeting.

12. The participants identified differences between the monthly 1 degree by 1 degree grid data, and the total reported catch and effort data, and noted that there are still uncertainties with the data. The participants agreed to proceed with the stock assessment and preliminary joint CPUE standardization work using the available data, while recognizing that Members should continue to investigate data uncertainties and improve the quality of the data.

5.1.2 Review of progress on update/refinement of catch series

13. The Secretariat presented updated data on Pacific saury catches in the northwestern Pacific Ocean in 1950-2017 (NPFC-2018-TWG PSSA03-WP15 (Rev. 2)).

14. China reported that it has provided the NPFC with monthly 1 degree by 1 degree grid data which should be used to fill the gap in China's catch statistics for 2003-2011.

15. Japan explained that there are three possible sources of its catch data: Statistics Department (SD), Ministry of Agriculture, Forestry and Fisheries report; survey by fishing industry; and total allowable catch (TAC) system. The SD data and TAC data have the same coverage and there is negligible difference between them. The reporting of the industry data and TAC data is prompt, but the industry data has slight coverage gaps. The disadvantage of the SD data is the two-year reporting lag. Based on this, Japan recommended that SD data should continue to be used for the period up to and including 2016, but that TAC data should be used from 2017 onward for catch series.

16. Russia explained that, as was discussed at the SSC PS03 meeting, there are two sources of data, that reported from vessels to the Centre of Fishery Monitoring and Communication, and that reported by Russia to FAO. The FAO data are most accurate and should be used in the updated stock assessment. However, there is a discrepancy between the two data sources for 2017. This is currently being verified. For the time being, the 2017 data that Russia reported to the SSC PS03 meeting should be used.

17. Chinese Taipei reported that it has updated the catch amount for 2017 after cross-checking its e-logbook data and landing data.

18. China requested that, whenever a Member's data are updated intersessionally, the Secretariat should inform all Members of the update and clarify what specifically has been updated.

5.1.3 Finalization of catch series for updating BSSPM

19. The participants reviewed the catch series data and agreed to use the updated data listed in NPFC-2018-TWG PSSA03-WP15 (Rev. 2) and Annex D for the updated stock assessment.

5.1.4 Recommendations for future work

20. The participants recommended that Members continue to investigate data uncertainties and hold further discussions on this subject at future meetings of the TWG PSSA to improve the quality of the data.

5.2 Review of progress on the recommended work on data collection and data sharing

5.2.1 Data security regulations

21. The participants reviewed the Interim Guidance for Management of Scientific Data Used in Stock Assessments and determined that no revisions are currently required.

5.2.2 Data sharing

22. China, Japan, Korea, Russia, Chinese Taipei and Vanuatu shared data for a single joint CPUE index and joint map (NPFC-2018-TWG PSSA03-WP02 (Rev. 2), WP03, WP04, WP06a,b, WP08 (Rev. 1), WP12). The participants discussed the shared data under Agenda Item 7.

Agenda Item 6. Review of fishery-dependent and fishery-independent indices

6.1 Review of the existing CPUE Standardization Protocol

23. The participants reviewed the CPUE Standardization Protocol. They agreed to use the existing Protocol for the current stock assessment update. They also considered revising the Protocol to include coefficient-distribution-influence (CDI) analysis for each independent variable in the CPUE standardization in the future.

6.2 Review of data quality of abundance indices

24. The Secretariat presented a summary of the discussions on data quality of abundance indices from the SCC PS03 meeting. Participants reviewed the quality and updates of the abundance indices under Agenda Item 6.3.

6.3 Review any new/updated information on the indices

25. Japan presented the updated biomass estimate through Japanese fishery independent survey for Pacific saury in 2018 (NPFC-2018-TWG PSSA03-WP09 (Rev. 1)). Japan conducted surface-trawling surveys using the area-swept method and two research vessels. The surveys were conducted in June and July, in the North Pacific between 143^0 E and 165^0 W. Survey stations were placed every 4 degrees along the longitude line. Sea surface temperature (SST) was approximately 8-18 degrees Celsius. The estimated biomass was 2,346 thousand metric tons, a similar level to 2015 and 2016. The percentage of age-1 fish caught in the eastern portion of the survey area was relatively high compared to the western portion.

26. The participants reviewed and agreed to use the updated biomass estimate from the Japanese fishery independent survey for Pacific saury for the input of the stock assessment update.

27. Japan presented additional information regarding changes in the Japanese stick-held dip net fishery for Pacific saury, especially from 1980 to 1993 (NPFC-2018-TWG PSSA03-WP11).

New fishing equipment (sonar, side thruster, fish pump, and auxiliary electrical generator) was installed on vessels in this fishery from 1980 to 1993. This contributed to an increase in catchability from 1980 to 1993. However, comprehensive data that could be incorporated into CPUE standardization are not available. Therefore, Japan suggested using only the CPUE data from 1994 onwards for the base case scenario.

28. China requested that Japan make the monthly 1 degree by 1 degree grid CPUE data from 1980 to 1993 available to the Commission for the further improvement of the stock assessment work. Japan agreed to share the data among the members of the TWG PSSA.

29. Japan presented an update of the standardized CPUE of Pacific saury caught by its stick-held dip net fishery during 1994 to 2017 (NPFC-2018-TWG PSSA03-WP10).

30. The participants reviewed Japan's standardized CPUE data and determined that the data should be separated into two time series, one before 1994 (1980-1993) and one from 1994 onwards, due to the change in catchability between 1980 and 1993. They agreed to use both time series for the updated stock assessment. The standardized CPUE index for 1980-1993 is accessible on the webpage of the TWG PSSA02 meeting (NPFC-2017-TWG PSSA02-WP06).

31. China presented the standardization of CPUE data of Pacific saury caught by its stick-held dip net fishery (NPFC-2018-TWG PSSA03-WP05 (Rev. 1)).

32. The participants reviewed China's standardized CPUE data and noted that the Pacific saury fishery was a developing fishery before 2013 and then became a targeted fishery from 2013 onwards. The participants agreed to use the 2013-2017 time series data for the updated stock assessment.

33. Chinese Taipei presented the CPUE standardization of Pacific saury for its stick-held dip net fishery in the northwestern Pacific Ocean from 2001-2017 (NPFC-2018-TWG PSSA03-WP13 (Rev. 1)).

34. The participants reviewed and agreed to use Chinese Taipei's updated standardized CPUE data for the updated stock assessment.

35. Russia presented the CPUE standardization for its Pacific saury catches in the northwestern Pacific Ocean (NPFC-2018-SSC PS03-WP08) and for all Pacific saury catches in the Russian EEZ in the northwestern Pacific Ocean (NPFC-2018-SSC PS03-WP09).

36. Russia recommended that, for the updated stock assessment, Members should use the standardized CPUE data for Russian catches in the northwestern Pacific Ocean rather than for all Pacific saury catches in the Russian EEZ, to avoid double-counting other Members' catches. The participants reviewed Russia's recommendation and agreed to use the standardized CPUE data for Russian catches only in the northwestern Pacific Ocean.

37. Korea presented information about the status of its CPUE standardization for its Pacific saury catches in the northwestern Pacific Ocean for Members' reference.

38. As Korea's updated CPUE standardization work is still ongoing, the participants agreed to use the standardized CPUE data up to 2016 that Korea previously submitted to the SSC PS03 meeting (NPFC-2018-SSC PS03-WP07). Korea agreed to continue to work on its CPUE standardization and present the updated data by the next update of the stock assessment.

39. Vanuatu presented the nominal CPUE data for its Pacific saury catches in the northwestern Pacific Ocean.

40. The participants reviewed Vanuatu's nominal CPUE data. They agreed that, given the number of vessels and spatial coverage, it would be prudent not to include the data in the current stock assessment update, but it may be possible to include them in future stock assessment updates.

6.4 Finalization of abundance indices for updating BSSPM

41. The finalized table of abundance indices is attached to the report as Annex D.

6.5 Recommendations for future work

42. The participants suggested that Japan might incorporate age truncation to calculate the relative biomass, rather than the absolute biomass, for consistency with the catch data.

43. The participants recognized the importance of Japan's biomass survey and recommended that this work be continued and, if possible, augmented.

44. It was agreed that Japan should continue to further evaluate the uncertainty in the estimated catchability coefficient for Japan's biomass survey.

45. The Japanese survey is now recognized as a primary and very important part of the assessment. The TWG PSSA encouraged Japan to continue the survey and explore enhancements.

46. Russia highlighted the importance of area-swept surveys for biomass assessment of marine living resources, in particular, pelagic fish species, such as Pacific saury, and informed the participants that Russian research vessels conduct regular pelagic surveys in the northwestern Pacific Ocean in summer. The possibility of the use of data from these surveys for the purpose of Pacific saury stock assessment could be further explored.

47. Japan agreed to further investigate and clarify the cause of the spike in the AIC value in its GAM model to better understand and improve its CPUE data.

48. China agreed to further investigate its CPUE data for standardization from 2003 to 2012, in addition to the data from 2013 onwards.

49. The participants encouraged Chinese Taipei to explore the cross-validation of CPUE prediction.

50. Korea agreed to continue collaborating with other Members to improve the quality of its CPUE standardization for future stock assessments.

51. The participants agreed to establish a small working group (SWG) to share, review and finalize the common R script for GLM and GAM by the next TWG PSSA meeting. The participants recommended the SSC PS to provide the SWG with a secure working space on the web such as GitHub or a new tool for code reviewing under the NPFC Collaboration website.

Agenda Item 7. Work toward joint CPUE series

7.1 Review of the background of joint CPUE standardization

52. The participants reviewed the background of the joint CPUE standardization and recognized that joint CPUE standardization would enable the calculation of the CPUE with higher spatial and temporal coverage. They also considered the possibility of developing multiple joint CPUE series in addition to the single joint CPUE index adopted by the SC.

53. China presented a summary of important points to consider in conducting joint CPUE standardization, including different measures of effort, environmental variables, scenarios for combining CPUEs, and models. China also raised further points that could be considered, including cluster analysis, catchability of vessels, vessel-year interaction and data coverage. China noted that the data coverage for CPUE standardization for some Members changes over time, which may confound interpretation of the CPUE trend.

7.2 Review of available data

54. The participants reviewed the available Pacific saury data shared in accordance with the template (NPFC-2018-TWG PSSA03-WP01).

7.3 Review of progress on the intersessional work

55. Russia presented a preliminary analysis of the generalized additive models (GAMs) using the Gamma and Tweedie distributions for selected GAMs and shared a formatted with markdown R code at the NPFC collaboration website for reproducing the results, further refactoring and improvements of common R script or markdown notebook.

56. Japan presented a preliminary analysis of the GAMs by log normal distribution.

57. Japan presented a preliminary analysis of the generalized linear models (GLMs) by log normal distribution and gamma distribution.

58. The participants noted that some preliminary results from the four different configurations are similar with the nominal CPUE, suggesting that the models are robust or could possibly be simplified.

59. Chinese Taipei presented a preliminary evaluation of the spatio-temporal distributions and abundance index of the Members' aggregated monthly 1 degree by 1 degree grid data using geostatistical delta-generalized mixed models.

60. China presented a preliminary analysis of three scenarios for joint CPUE standardization: (1) One combined CPUE; (2) CPUE for exclusive economic zones vs. CPUE for Convention Area; and (3) CPUE by operation days vs. CPUE by net haul.

61. China presented a preliminary analysis of CPUE standardization with consideration of spatial autocorrelation by spatial-GLM.

7.4 Development of the Protocol for the joint CPUE standardization

62. Due to time constraints, the participants were unable to develop a finalized Protocol for the joint CPUE standardization and instead developed preliminary specifications and a plan for the joint CPUE standardization (Annex E).

7.5 Toward finalization of single joint CPUE series

63. As a first step, the participants agreed to conduct an initial single joint CPUE standardization

according to the preliminary specifications, share their initial results through the Collaboration website by 20 January 2019, and submit working papers on their initial joint CPUE standardization results to the next TWG PSSA meeting by 6 February 2019. To facilitate this work, the TWG PSSA tasked the Secretariat to prepare SST, sea surface temperature gradient (SSTG) and sea surface height (SSH) data by the end of November 2018.

7.6 Conclusion and recommendations for future work

64. The participants agreed to continue working on the development and finalization of the single joint CPUE index for use in the next stock assessment.

65. The participants considered incorporating environmental variables for improvement of the joint CPUE analysis.

66. The participants requested that the Secretariat prepare and regularly update the following data sets which should be uploaded on the NPFC website for Members for quick access: monthly SST, monthly SSTG, monthly SSH by 1 degree by 1 degree grid.

67. The participants considered the possibility of calculating a joint nominal CPUE as a trial. The participants agreed that such work could be done as a voluntary exercise by interested Members and not as a sensitivity analysis in the stock assessment report.

Agenda Item 8. Review and update of biological information/data

68. No reviews or updates of biological information/data were presented, and the participants agreed to defer discussions to future meetings of the TWG PSSA.

Agenda Item 9. Toward update of the stock assessment using "provisional base models" (BSSPM)

9.1 Review of the existing model and stock assessment protocol

69. The participants agreed to continue to use the existing model and stock assessment protocol.

9.2 Finalization of specification of BSSPM

9.2.1 Common data set

9.2.2 Base and robustness cases of statistical and population dynamics models

70. The participants reviewed the BSSPM specifications and agreed on a common data set for catch, abundance indices, and six base and six sensitivity cases. The finalized BSSPM specification is attached to the report as Annex F.

9.2.3 Common output forms to provide management advice including risk analyses of alternative catch levels

71. Chinese Taipei presented possible ways to summarize the outcomes of the stock assessment. The participants discussed the possibilities and finalized a template for the presentation of stock assessment results, stock status information and future projection (Annex G).

72. The participants agreed that the six base cases will be given equal weight.

73. The participants agreed that stock assessment working papers must include 12 scenarios (six base cases and six sensitivity cases) and may include models fit to nominal joint CPUE. Such models are for exploration only and will not be used as sensitivity analyses in this assessment.

9.3 Timeline toward the 4th TWG PSSA meeting

74. Stock assessment working papers must be complete with all six base case models and six sensitivity models, and must be submitted no later than 20 February. Incomplete papers and papers submitted after the deadline will be treated as information papers. Based on established NPFC Document Rules, information papers may or not be reviewed depending on consensus among the Members. Papers should not be revised after submission unless requested by the TWG PSSA.

75. In discussion of this procedural issue, the TWG PSSA recommended that the SC draft rules to address submission, revision and treatment of scientific papers before and during meetings, and submit the rules to the Commission for consideration.

Agenda Item 10. Other matters

76. Given the importance of the Japanese survey, it may be desirable to utilize scientists from other Members during the survey as scientific crew. Japan agreed to explore this idea.

77. Participants recognized the contribution by invited expert in facilitating the work of the TWG PSSA and agreed to invite Dr. Larry Jacobson to also attend the TWG PSSA04 meeting in March 2019.

10.1 Discussion of draft literature review of the TRPs and LRPs

78. Due to time constraints, the participants were unable to discuss the ongoing review of target and limit reference points prepared by the consultant, Dr. Laurence Kell (NPFC-2018-TWG PSSA03-WP14 (Rev. 1)). The participants agreed to assess the ongoing review intersessionally, and submit any comments and suggestions by the end of November 2018.

Agenda Item 11. Recommendations to the Small Scientific Committee on Pacific Saury

79. The TWG PSSA will continue working to update the BSSPM and, based on the outcomes of this work, will provide recommendations on the status of Pacific saury and scientific advice for management of Pacific saury stock to the SSC PS at the TWG PSSA04 meeting in March 2019. Regarding the matters other than the BSSPM, the TWG PSSA recommended the following to the SSC PS:
    (a) Continue developing a single joint CPUE index to resolve different patterns in standardized indices among Members and to enable the calculation of the CPUE with higher spatial and temporal coverage;
    (b) Update the shared data for a single joint CPUE index for future stock assessment; and
    (c) Provide the TWG PSSA with a secure space for collaborative work, such as GitHub.

Agenda Item 12. Adoption of the Report

80. The report was adopted by consensus.

Agenda Item 13. Close of Meeting

81. The meeting closed at 18:05 on 15 November 2018.

82. The Chair thanked the participants for their hard work and cooperation, China for hosting the meeting, Dr. Jacobson for his advice and the Secretariat for facilitating the meeting. The participants thanked the Chair for his guidance.

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 – Preliminary specifications and plan for the single joint CPUE standardization
Annex F – Specifications of the BSSPM for the updated stock assessment
Annex G – Template for stock status information and future projection

Annex A

Agenda

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Agenda Item 2. Adoption of Agenda

Agenda Item 3. Overview of the outcomes of previous NPFC meetings relevant to Pacific saury

Agenda Item 4. Review of the Terms of References of the TWG PSSA

Agenda Item 5. Review of fishery data and their availability
- 5.1 Catch series
  - 5.1.1 Review of data quality of catch series
  - 5.1.2 Review of progress on update/refinement of catch series
  - 5.1.3 Finalization of catch series for updating BSSPM
  - 5.1.4 Recommendations for future work
- 5.2 Review of progress on the recommended work on data collection and data sharing
  - 5.2.1 Data security regulations
  - 5.2.2 Data sharing

Agenda item 6. Review of fishery-dependent and fishery-independent indices
- 6.1 Review of the existing CPUE Standardization Protocol
- 6.2 Review of data quality of abundance indices
- 6.3 Review any new/updated information on the indices
- 6.4 Finalization of abundance indices for updating BSSPM
- 6.5 Recommendations for future work

Agenda item 7. Work toward joint CPUE series
- 7.1 Review of the background of joint CPUE standardization
- 7.2 Review of available data
- 7.3 Review of progress on the intersessional work
- 7.4 Development of the Protocol for the joint CPUE standardization
  - 7.4.1 Data quality
  - 7.4.2 Statistical modelling and estimation
  - 7.4.3 Diagnostics
- 7.5 Toward finalization of single joint CPUE series
- 7.6 Conclusion and recommendations for future work

Agenda Item 8. Review and update of biological information/data

Agenda item 9. Toward update of the stock assessment using "provisional base models" (BSSPM)

9.1 Review of the existing model and stock assessment protocol

9.2 Finalization of specification of BSSPM

9.2.1 Common data set

9.2.2 Base and robustness cases of statistical and population dynamics models

9.2.3 Common output forms to provide management advice including risk analyses of alternative catch levels

9.3 Timeline toward the 4th TWG PSSA meeting

Agenda item 10. Other matters

10.1 Discussion of draft literature review of the TRPs and LRPs

Agenda Item 11. Recommendations to the Small Scientific Committee on Pacific Saury

Agenda Item 12. Adoption of Report

Agenda Item 13. Close of the Meeting

Annex B

List of Documents

MEETING INFORMATION PAPERS

Symbol	Title
NPFC-2018-WS DATA01-MIP01 (Rev. 1)	Meeting Notice and Information
NPFC-2018-TWG PSSA03-MIP02	Provisional Agenda
NPFC-2018-TWG PSSA03-MIP03	Provisional Annotated Agenda
NPFC-2018-TWG PSSA03-MIP04	Indicative Schedule

REFERENCE DOCUMENTS

Symbol	Title
CMM 2018-08	CMM for Pacific Saury
Annex D, NPFC-2018-SSC PS03-Final Report	Summary of the discussions on data quality from the SSC PS03 meeting
	Interim Guidance for Management of Scientific Data Used in Stock Assessments
	Terms of Reference for TWG PSSA
	CPUE Standardization Protocol for Pacific Saury
	Stock Assessment Protocol for Pacific Saury

WORKING PAPERS

Symbol	Title
NPFC-2018-TWG PSSA03-WP01	Pacific saury data sharing template
NPFC-2018-TWG PSSA03-WP02 (Rev. 2)	Data for joint CPUE index and joint map of catch and effort of Pacific saury by Russia
NPFC-2018-TWG PSSA03-WP03	Data for joint CPUE index and joint map of catch and effort of Pacific saury by Vanuatu
NPFC-2018-TWG PSSA03-WP04	Data for joint CPUE index and joint map of catch and effort of Pacific saury by China
NPFC-2018-TWG PSSA03-WP05 (Rev. 1)	Standardization of CPUE data of Pacific saury (*Cololabis saira*) caught by the Chinese stick-held dip net fishery
NPFC-2018-TWG PSSA03-WP06a	Description for monthly catch and effort data of the Japanese stick-held dip net fishery during 1994-2017 in the North Pacific Ocean with 1-degree geographical resolution

NPFC-2018-TWG PSSA03-WP06b	Data for joint CPUE index and joint map of catch and effort of Pacific saury by Japan
NPFC-2018-TWG PSSA03-WP07	Catch data of the Japanese Pacific saury fishery during 1950-2017
NPFC-2018-TWG PSSA03-WP08 (Rev. 1)	Data for joint CPUE index and joint map of catch and effort of Pacific saury by Korea
NPFC-2018-TWG PSSA03-WP09 (Rev. 1)	Update of biomass estimate through Japanese fishery independent survey for Pacific saury in 2018
NPFC-2018-TWG PSSA03-WP10	Update of standardized CPUE of Pacific saury (*Cololabis saira*) caught by the Japanese stick-held dip net fishery during 1994 to 2017
NPFC-2018-TWG PSSA03-WP11	Additional information regarding changes in the Japanese stick-held dip net for Pacific saury, especially in 1980s
NPFC-2018-TWG PSSA03-WP12	Data for joint CPUE index and joint map of catch and effort of Pacific saury by Chinese Taipei
NPFC-2018-TWG PSSA03-WP13 (Rev. 1)	CPUE standardization of Pacific saury (*Cololabis saira*) for the Chinese Taipei's stick-held dip net fishery in the Northwestern Pacific Ocean from 2001-2017
NPFC-2018-TWG PSSA03-WP14 (Rev. 1)	Review of Target and Limit Reference Points
NPFC-2018-TWG PSSA03-WP15 (Rev. 2)	Pacific saury catches by all NPFC Members in 1950-2017
NPFC-2018-SSC PS03-WP08	CPUE standardization for the Pacific saury Russian catches in the Northwest Pacific Ocean
NPFC-2018-SSC PS03-WP09	CPUE standardization for the Pacific saury international catches in the Russian EEZ in the Northwest Pacific Ocean

Annex C

List of Participants

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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 (th. metric tons)	CPUE_ CHN (metric tons per day)	CPUE JPN_early (metric tons per net haul)	CPUE JPN_late (metric tons per net haul)	CPUE KOR (metric tons per day)	CPUE RUS (metric tons per day)	CPUE CT (metric tons per net haul)
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				3.07		16.86	
1995	343743				2.24		20.11	
1996	266424				1.52		16.03	
1997	370017				3.28		11.63	
1998	176364				0.9		12.41	
1999	176498				0.69		12.54	
2000	286186				1.24		17.06	
2001	370823				1.84	8.5	21.03	1.79
2002	328362				1.02	9.53	19.94	1.59
2003	445053.1	5970			1.91	14.16	35.82	2.31
2004	369675.8	5394			2.32	12.35	46.99	1.58
2005	474366	5061			4.31	16.27	49.48	1.94
2006	394840.2	4268			3.4	12.31	34.48	1.34
2007	520207	3615			4.58	10.54	43.08	2.13

2008	617816.9	4870		5.02	15.01	42.34	2.71
2009	473622.7	3641		3.2	9.56	21.28	1.47
2010	431177.2	2631		1.36	11.19	23.72	1.88
2011	456937.5	3623		2.31	10.67	28.43	2.36
2012	460544	2355		1.97	10.1	24.44	2.66
2013	423790.3	3654	14.44	1.44	11.99	22.23	3.06
2014	629576.4	2824	16.56	2.52	16.84	25.41	3.54
2015	358882.7	2357	18.07	1.3	3.35	16.49	3.3
2016	361687.6	1997	9.56	1.46	5.09	18.04	2.78
2017	261789.4	987	8.67	0.91		8.66	1.86
2018		2346					

Annex E

Preliminary specifications and plan for the single joint CPUE standardization

1) **Data cleaning and preparation**
   - Remove the zero data;
   - Effort data: fishing day;
   - Starting time is 2001;
   - Area (1 by 1 grid);
   - SST, SSH and SSTG
2) **CPUE standardization**

   One candidate model for the entire stock using all available CPUE data to the extending possible
   - Compare the results of GLM and GAM models (GLMM is another option)
   - Covariate effect:
     - Year
     - Month
     - Member
     - Latitude
     - Longitude
     - SST, SSTG and SSH
   - Error structure assumptions: log-normal, Tweedie
   - Model selection: BIC and cross validation
   - Model diagnosis: residual distribution and Q-Q plots
   - Extract the year-effect
   - Plot nominal and standardized CPUEs over time

Note: Additional analysis (e.g. starting from 1980) are welcome as time allows

Specifications of the BSSPM for the updated stock assessment

(See Table 2 for definition of scenarios B1-B6 and S1-S6))

Table 1. BSSPM specifications

	Base case (B1-B3)	**Base case (B4-B6)**	**Sensitivity case (S1-S6)**
Initial year	1980	1980	1980
Relative bias in biomass estimate	U(0.1, 1), 1, U(0.1, 3) for JPNbio(2003-2018)	U(0.1, 1), 1, U(0.1, 3) for JPNbio(2003-2018)	U(0.1, 1), 1, U(0.1, 3) for JPNbio(2003-2018)
CPUE	CHN(2013-2017) JPN_early(1980-1993) with assumptions of time-varying q JPN_late(1994-2017) KOR(2001-2016) RUS(1994-2017) CT(2001-2017)	CHN(2013-2017) JPN_late(1994-2017) KOR(2001-2016) RUS(1994-2017) CT(2001-2017)	Two sets as on the left
Variance component	Variances of CPUEs are assumed to be common and 6 times of that of biomass	Variances of CPUEs are assumed to be common and 5 times of that of biomass	Variances are assumed to be free parameters
Hyper-depletion/ stability	A common parameter for all fisheries but JPN_early, with a prior distribution, b ~ U(0, 1) but [b_JPN_early=1]	A common parameter for all fisheries with a prior distribution, b ~ U(0, 1)	No (b=1)
Prior	Own preferred options	Own preferred options	Own preferred options

Table 2. Definition of scenarios

Case	Relative bias in biomass estimate	Fishery dependent index	Variance component	Hyper-depletion/ stability
Base case 1 (B1)	U~(0.1, 1)	A1	V1	H1
Base case 2 (B2)	1 (unbiased)	A1	V1	H1
Base case 3 (B3)	U~(0.1, 3)	A1	V1	H1
Base case 4 (B4)	U~(0.1, 1)	A2	V2	H2
Base case 5 (B5)	1 (unbiased)	A2	V2	H2
Base case 6 (B6)	U~(0.1, 3)	A2	V2	H2
Sensitivity case 1 (S1)	U~(0.1, 1)	A1	V3	H3
Sensitivity case 2 (S2)	1 (unbiased)	A1	V3	H3
Sensitivity case 3 (S3)	U~(0.1, 3)	A1	V3	H3
Sensitivity case 4 (S5)	U~(0.1, 1)	A2	V3	H3
Sensitivity case 5 (S5)	1 (unbiased)	A2	V3	H3
Sensitivity case 6 (S6)	U~(0.1, 3)	A2	V3	H3

A1: With JPN early CPUE (1980-1993) with assumptions of time-varying q

A2: Without JPN early CPUE (1980-1993)

V1: Variances of CPUEs are assumed to be common and 6 times of that of biomass

V2: Variances of CPUEs are assumed to be common and 5 times of that of biomass

V3: Variances of CPUEs are assumed to be separate free parameters

H1: b is a common parameter for all fisheries but JPN_early, with a prior distribution, b ~ U(0, 1) [b_JPN_early=1]

H2: b is a common parameter for all fisheries, with a prior distribution, b ~ U(0, 1)

H3: b=1

Template for stock status information and future projection

Table 1. Description of symbols used in the stock assessment

Symbol	Description
C_{2017}	Catch in 2017
$AveC_{2015\text{-}2017}$	Average catch for a recent period (2015–2017)
$AveF_{2015\text{-}2017}$	Average harvest rate for a recent period (2015–2017)
F_{2017}	Harvest rate in 2017
F_{MSY}	Annual harvest rate producing the maximum sustainable yield (MSY)
MSY	Equilibrium yield at FMSY
F_{2017}/F_{MSY}	Average harvest rate in 2017 relative to FMSY
$AveF_{2015\text{-}2017}/F_{MSY}$	Average harvest rate for a recent period (2015–2017) relative to FMSY
K	Equilibrium unexploited biomass (carrying capacity)
B_{2017}	Stock biomass in 2017 estimated in the model
B_{2018}	Stock biomass in 2018 estimated in the model[b]
$AveB_{2016\text{-}2018}$	Stock biomass for a recent period (2016–2018) estimated in the model[b]
B_{MSY}	Stock biomass that will produce the maximum sustainable yield (MSY)
B_{MSY}/K	Stock biomass that produces the maximum sustainable yield (MSY) relative to the equilibrium unexploited biomass[a]
B_{2017}/K	Stock biomass in 2017 relative to K[a]
B_{2018}/K	Stock biomass in 2018 relative to K[a,b]
$B_{2016\text{-}2018}/K$	Stock biomass in the latest time period (2016-2018) relative to the equilibrium unexploited stock biomass[a,b]
B_{2017}/B_{MSY}	Stock biomass in 2017 relative to BMSY[a]
B_{2018}/B_{MSY}	Stock biomass in 2018 relative to BMSY[a,b]
$B_{2016\text{-}2018}/B_{MSY}$	Stock biomass for a recent period (2016–2018) relative to the stock biomass that produces maximum sustainable yield (MSY) [a,b]

[a]calculated as the average of the ratios,

[b]Japanese biomass survey available but no CPUE available in 2018.

Table 2. Summary of reference points based on the 60,000 MCMC iterations (10,000 times 6 base case models) over all 6 base case models

Appendix Table 1. Summary of reference points based on the 10,000 MCMC iterations base case model (I-A).

Appendix Table 2. Summary of reference points based on the 10,000 MCMC iterations base case model (II-A).

Symbol	Mean	Median	Lower 10th	Upper 10th
C_{2017}				
$AveC_{2015\text{-}2017}$				
$AveF_{2015\text{-}2017}$				
F_{2017}				
F_{MSY}				
MSY				
F_{2017}/F_{MSY}				
$AveF_{2015\text{-}2017}/F_{MSY}$				
K				
B_{2017}				
B_{2018}				
$AveB_{2016\text{-}2018}$				
B_{MSY}				
B_{MSY}/K				
B_{2017}/K				
B_{2018}/K				
$B_{2016\text{-}2018}/K$				
B_{2017}/B_{MSY}				
B_{2018}/B_{MSY}				
$B_{2016\text{-}2018}/B_{MSY}$				

Table 3. Description of symbols used in stock assessment models

Symbol	Description	Axis
r	Intrinsic growth rate	B1-B6; S1-S6
qCHN	Catchability CHN	Ditto
qJPN1	Time-varying catchability JPN1	B1-B3; S1-S3
qJPN2	Catchability JPN2	B1-B6; S1-S6
qKOR	Catchability KOR	Ditto
qRUS	Catchability RUS	Ditto
qCT	Catchability CT	Ditto
qBio	Catchability JPN biomass	Ditto
M	Shape parameter	Ditto
σcom	Common observation SD of CPUE	B1-B6
σCHN	Observation SD of CHN CPUE	S1-S6
σJPN1	Observation SD of JPN1 CPUE	S1-S3
σJPN2	Observation SD of JPN2 CPUE	S1-S6
σKOR	Observation SD of KOR CPUE	Ditto
σRUS	Observation SD of RUS CPUE	Ditto
σCT	Observation SD of CT CPUE	Ditto
σBio	Observation SD of JPN biomass	B1-B6; S1-S6
τ	Process error	Ditto
b	Hyperstability of 1994-2017 CPUE	B1-B6

Appendix Table 3. Summary of parameter estimates based on the 10,000 MCMC iterations base case model (I-A).

Symbol	Mean	Median	Lower 10th	Upper 10th
r				
K				
qCHN				
qJPN1				
qJPN2				
qKOR				
qRUS				
qCT				
qBio				
Shape				
σ				
σCHN				
σJPN1				
σJPN2				
σKOR				
σRUS				
σCT				
σBio				
τ				
FMSY				
BMSY				
MSY				
b				

DIAGNOSTICS

- Standardized residuals of CPUEs and JPNbio for each of 6 base case models (in Appendix)
- Retrospective plots removing data for years 2018-2013. Each run should replicate the terminal year in base case models with survey biomass only in last year. Single plot for each model (in Appendix). Time trajectories for Bratios and Fratios with 2,000 MCMC iterations for each of the retrospective years.

TIME SERIES PLOT

- Time series of biomass (with reference lines of K and BMSY), harvest rate (with reference line of FMSY), Bratio (B/Bmsy)[a], Fratio (F/Fmsy)[a], B/K[a],
- Plot posterior median of each base case model (10,000 MCMC iterations) in one figure
- Plot the posterior median over all 6 base case models (60,000 MCMC iterations) in one figure with 80% credible intervals.

[a]calculated as the median (with 80% C.I.) of the ratios

KOBE PLOT

- Kobe plot showing median Fratio2017 and Bratio2017 calculated from 6 base case models (10,000 MCMC iterations of each base case model).
- Kobe plot showing average 2015-2017 Fratio and average 2016-2018 Bratio calculated from 6 base case models (10,000 MCMC iterations of each base case model).
- Kobe plot showing 1980-2017 time series of median Fratio and Bratio. Each point is the median value calculated from 60,000 MCMC iterations (10,000 MCMC iterations of each base case model).
  - With the contour of 80% C.I. in the 2017 and pie chart of the proportion of 60,000 MCMC iterations in each of four quadrants.

FUTURE PROJECTION

- Recent catch projection
  - Average of 2015-2017
- Projections assuming constant catch during 2019-2022. All scenarios assume 2018 catch equals X metric tons which is the average of 2015-2017 catches
  - +30% of X

- +20% of X
- +10% of X
- X (average of 2015-2017)
- -10% of X
- -20% of X
- -30% of X
- No catch

- Projection years
  - 2019-2023
- Projection plot (over 6 base case model)
  - Median of biomass trajectories (1980-2023) from 8 catch scenarios. Results of each scenario are median of 60,000 MCMC iterations calculated over 6 base case models.
- Risk table (over all 6 models)
  - Columns (probability of each quadrant of the Kobe plot)
  - Rows (8 catch scenarios)