



North Pacific Fisheries Commission

NPFC-2017-TWG PSSA02-Final Report

**2nd Meeting of the Technical Working Group
on Pacific Saury Stock Assessment
REPORT**

6-8 December 2017

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North Pacific Fisheries Commission
2nd Meeting of the Technical Working Group on Pacific Saury Stock
Assessment

6-8 December 2017
Vladivostok, Russia

REPORT

Agenda Item 1. Opening of Meeting

1. The 2nd Meeting of the Technical Working Group on Pacific Saury Stock Assessment (TWG PSSA02) took place in Vladivostok, Russia on 6-8 December 2017, and was attended by Members from China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, and Vanuatu.
2. The meeting was opened by the TWG PSSA Chair, Dr. Toshihide Kitakado, who outlined the objectives and procedures for the meeting.
3. Russia warmly welcomed the participants to Vladivostok.

Agenda Item 2. Adoption of Agenda

4. The participants agreed to add three subsections under Agenda 5.2: 5.2.1 Data collection template; 5.2.2 Data security regulations; and 5.2.3 Data sharing.
5. The revised agenda was adopted (Annex A). Document List (Annex B) and Participants List (Annex C) are attached to the report.

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

6. The Chair briefed the participants on the outcomes of the 1st Pacific Saury Stock Assessment Workshop, the 1st TWG PSSA meeting (TWG PSSA01), the 2nd meeting of the Small Scientific Committee on Pacific Saury (SSC PS02) and Scientific Committee (SC02) meeting in 2016 and 2017. According to an agreement in the TWG PSSA01, a stock assessment was conducted by three Members (China, Japan and Chinese Taipei) based on three base case scenarios as well as one sensitivity scenario, and the TWG PSSA compiled the results as the provisional stock assessment results. The SSC PS concluded that despite small variations

among the three Members' stock assessments and among the three base-case scenarios, it is likely that the Pacific saury stock is not overfished and is not experiencing overfishing. It also recommended maintaining CMM 15-02 in its current form and not expanding fishing efforts in 2018. These recommendations were endorsed by the SC and adopted by the Commission.

7. The Science Manager pointed out Paragraph 5 of CMM 2017-08 for Pacific saury, which tasks the SC, SSC PS and TWG PSSA to continue their work 1) to improve the current stock assessment and other analysis and 2) to provide advice and recommendations to the Commission at the next Commission meeting in 2018. He also noted Paragraph 7 of the same CMM which stipulates that CMM 2017-08 shall be effective for one year, subject to review at the next Commission meeting in 2018.

Agenda Item 4. Review of the Terms of References of the TWG PSSA for 2017-2021

8. The participants reviewed the Terms of Reference and agreed that it does not require any revisions on the substance, but does require minor editing.

Agenda Item 5. Review of fishery data and their availability

5.1 Catch series, age/size composition data and others

9. Japan presented its review of Pacific saury fishery data and their availability (NPFC-2017-TWG PSSA02-WP04). Japan touched upon its historical Pacific saury fisheries, current fishing grounds and landing sites, raw and compiled data collected from fisheries from 1980-2016, and the fisheries condition in 2017. In particular, Japan expressed concern over the extreme decline in the levels of its Pacific saury catch and catch per unit effort (CPUE) in 2017.
10. China expressed its concern over the increase of fishing effort by one Member, which mainly conducts Pacific saury fishery in its area of jurisdiction, in the Convention area since 2015. In response, the Member explained that the migratory pattern and fishery grounds of Pacific saury have changed.
11. Russia presented the results of its fisheries for Pacific saury in 2016 (NPFC-2017-TWG PSSA02-WP14). There was a very low catch of Pacific saury by Russian vessels in 2016 compared to 2014 and 2015. This could result from a significant number of stormy days and a decline in the number of fishing vessels, as well as from changes in oceanography and Pacific saury migration patterns.
12. Russia informed the participants that its data on catch and size composition of Pacific saury in 2016 were available and could be shared (NPFC-2017-TWG PSSA02-WP01).

13. Chinese Taipei presented the results of its fisheries for Pacific saury in 2011-2016.
14. Russia raised the issue of possible duplicate catch reporting from its EEZ, and Members agreed to work intersessionally to resolve this issue.
15. Chinese Taipei presented the size category/body length/age composition data from its fishing fleets.
16. Vanuatu presented the results of its fisheries for Pacific saury. The participants thanked Vanuatu for bringing such information to the table as this is the first opportunity to review it under the TWG PSSA.
17. The participants agreed to create a joint spatial/temporal map of Members' catch and effort on Pacific saury with a spatial resolution of one degree grids and a temporal resolution of one month. To conduct this work, the participants proposed establishing a small working group with the same membership as the Corresponding Group on Data Collection Template for Pacific saury (Chuanxiang Hua, Satoshi Suyama, Eunjung Kim, Dmitrii Antonenko, Wen-Bin Huang, Toshihide Kitakado, Aleksandr Zavolokin). The participants agreed to submit the necessary data.
18. The participants reviewed a table of Members' annual Pacific saury catch in the Northwestern Pacific Ocean. Vanuatu agreed to provide its updated annual catch data by the end of February 2018. The updated file will be posted on the NPFC website.

5.2 Recommendations on data collection and data sharing

5.2.1 Data collection template

19. Korea presented the current status of the development of fisheries report templates for the stick-held dip net fishery.
20. The participants discussed the template and suggested that the name of the template be changed from "fisheries report templates" to "fisheries information templates."

5.2.2 Data security regulations

21. As information for the discussions on data security regulations, the Science Manager presented the North Pacific Fisheries Commission's (NPFC) Interim Guidance for Management of Scientific Data Used in Stock Assessments adopted by the Commission in July 2017 and

outlined that it provides the basis for the sharing of scientific data among Members.

5.2.3 Data sharing.

22. The participants recognized the necessity to share data for the Pacific saury stock assessment and agreed that such data should only be shared within the TWG PSSA and be disseminated in accordance with the above Interim Guidance.

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

6.1 Review of the existing protocol

23. The participants reviewed and revised the CPUE Standardization Protocol for Pacific Saury. The participants endorsed the revised CPUE Standardization Protocol for Pacific Saury (Annex D).

6.2 Review/update of the indices

24. Japan presented an update on the standardized CPUE for its stick-held dip net fishery for Pacific saury and its modification (NPFC-2017-TWG PSSA02-WP06). Japan explained that it has divided its CPUE data into two periods: data from 1980 to 1993 and 1994 to 2016. This is to reflect the impact of the improvement of fishing efficiency resulting from innovation in fishing equipment in the 1980s, and the impact of the entry into force of the United Nation's moratorium on large-scale drift net fisheries in 1993 at the same time as the significance of Pacific saury fisheries in Japan was rapidly increasing.
25. Korea presented an update on its work to standardize its stick-held dip net fishery in the Northwestern Pacific Ocean from 2001-2016. The participants requested Korea to submit its working paper describing methods and results of standardized CPUE for review by the TWG PSSA.
26. Chinese Taipei presented the Pacific saury CPUE standardization for its stick-held dip net fishery in the Northwestern Pacific Ocean (NPFC-2017-TWG PSSA02-WP03). Chinese Taipei used four models, including year, month, area, latitude, longitude, gross register tonnage, and water temperature as variables. The results were very similar and, in general, the standardized CPUE showed a slight increase from 2001-2010, followed by a sharp increase through to 2014, and then a decline until 2016. Chinese Taipei recommended the standardized CPUE derived from Model-1.
27. Russia presented the standardization of the Pacific saury CPUE records by Russian VMS and ERP system (NPFC-2017-TWG PSSA02-WP02). Russia selected optimum GAM by minimum

value of AIC. It included year, month and their interaction, vessel code as categorical factors, and sea surface temperature (SST) and proxy for the moonlight intensity as continuous variables smoothed with thin plate splines.

28. China presented the standardization of CPUE data of Pacific saury caught by its stick-held dip net fishery (NPFC-2017-TWG PSSA02-WP08). China used two models, which included latitude, longitude, year, month, vessel length, SST, sea surface temperature gradient, sea surface height, and lunar day.
29. Japan presented the results of the Japanese fishery-independent surveys for Pacific saury, which have been conducted since 2003, and the verification in biomass estimating method (NPFC-2017-TWG PSSA02-WP05). Based on the SC's request that Japan should reduce the uncertainty in its fishery-independent survey, Japan verified and modified its biomass estimation method in the survey area. Japan concluded that the Pacific saury biomass estimates based on the Japanese fishery-independent surveys are indispensable data to the stock assessment. Furthermore, the survey results in 2016 and 2017 suggest that the biomass of Pacific saury has decreased since 2016 and more abruptly in 2017.

6.3 Evaluation of the quality of the indices

30. The participants noted there were a few fishing efforts before 2012 in China's CPUE data. China agreed to submit a revised standardized CPUE covering 2003 to 2016 for the stock assessment update, documenting the rationale for its revisions.
31. Some participants expressed concern over the time series of Japan's standardized CPUE, noting the bias in the data in the 1980s due to unresolved catchability changes across those years. The participants shared the concern. Since use of these data may be influential to the stock assessment, Japan stated its intention to reconsider the handling of the data and estimation of standardized CPUE. Japan suggested removing the earlier period of its CPUE data. Other participants expressed the concern that Japan's standardized CPUE did not have descriptions following the CPUE Standardization Protocol and it is therefore difficult to judge its quality. Japan agreed to submit its updated CPUE data, including data for 2017, with better documentation for the stock assessment update and document its rationale for suggesting the deletion of the earlier period.
32. China suggested including the CPUE as two indices in the stock assessment model with different catchability of q to resolve the problems in Japan's standardized CPUE.

33. Korea agreed to submit its updated CPUE data up to 2016 for the stock assessment update.
34. The participants agreed to use the CPUE data for 2001-2016 that Chinese Taipei has submitted to the TWG PSSA02 for the stock assessment update.
35. Russia agreed to submit two separate sets of CPUE data by extending its coverage to include the years back to 1994 for the stock assessment update, resulting in one set of CPUE data for 1994-2000 and one for 2001-2017. Russia will document the rationale for dividing the CPUE data.
36. The participants discussed Members' CPUE indices and compiled a comparison table with each Member's CPUE to evaluate if the indices meet the CPUE Standardization Protocol (Annex E).
37. China pointed out that the sampling design and estimation method of Japan's biomass index are unclear. China suggested that Japan use a different formula for the abundance estimation. Japan explained that it already showed the methodology at the previous TWG PSSA and therefore did not fully describe it at this meeting. Nevertheless, Japan agreed to recalculate the biomass estimate, compare it with the initial estimate, and select the best estimate, documenting the rationale for the selection.
38. When reviewing each Member's CPUE indices, the participants noted that Japan's biomass index should also be reviewed. The participants agreed that Japan will submit detailed papers on its biomass index for review by the TWG PSSA, and that, if necessary, the TWG PSSA will develop a protocol for fisheries-independent index at its next meeting.

6.4 Recommendations on future work

39. China, Japan, Korea and Russia agreed to submit their revised national CPUE standardization data by the end of February 2018 (see more details under Agenda Item 10).
40. Japan agreed to submit its revised fishery-independent index by the end of February 2018.
41. The participants proposed holding an informal meeting of the TWG PSSA on the sidelines of the SSC PS, in order to update the stock assessment and develop scientific advice on the management of Pacific saury fisheries (see Agenda Item 8).
42. The participants agreed to move forward in a new direction to aggregate catch and effort data

over Member's fishery to draw a joint CPUE index. The intention is to resolve different patterns in standardized indices among Members and to increase spatial and temporal coverage of catch and effort data. Considering the difficulty in sharing raw data on catch and effort, the participants agreed to share them by submitting catch and effort data by month and one degree grids, and to conduct a joint CPUE standardization based on the data after the 2018 SC meeting.

Agenda Item 7. Review and update of biological information/data

43. Japan presented on the stock identity, spawning ground, maturation, and migration of Pacific saury (NPFC-2017-TWG PSSA02-WP07).
44. The participants encouraged Japan to continue its research on the biological size and maturation schedule of Pacific saury, which will be important for the development of age-structured models. The TWG PSSA encouraged Members to report on any such research.
45. Japan reported that it has established a group on "Mendeley" for TWG PSSA members to share literature on Pacific saury amongst themselves, and encouraged them to join the group.

Agenda Item 8. Update of the stock assessment using "provisional base models" (BSSPM)

8.1 Review of the existing model, stock assessment protocol and specification

46. China presented a comparison of conventional and state-space production models using jumbo flying squid data as a case study (NPFC-2017-TWG PSSA02-WP09), which suggested that 1) the state-space model produced more accurate and precise parameter estimates; 2) the precision and accuracy of the process error estimation should be carefully reviewed.

8.2 Update of the analyses using a new set of data

47. Chinese Taipei presented a stock assessment update for Pacific saury (NPFC-2017-TWG PSSA02-WP15).
48. Japan presented a stock assessment update for Pacific saury (NPFC-2017-TWG PSSA02-WP11).
49. China presented a stock assessment update for Pacific saury (NPFC-2017-TWG PSSA02-WP12).

8.3 Implication for management of Pacific saury fisheries

8.3.1 Stock biomass, fishing mortality and associated uncertainties

8.3.2 Biological reference points

8.3.3 Risk analyses of alternative catch levels

50. The participants noted that, due to the last minute changes in some Members' data and various other issues with the CPUE data, they were not able to present and revise the results and conclusions of the current stock assessment at the current meeting and agreed to defer discussions on the implications for the management of Pacific saury fisheries to the SSC PS meeting in April 2018.
51. China noted that the current stock status of Pacific saury is likely not overfished and overfishing is not occurring, which is derived from the current updated stock assessment report, whose data and approaches have been approved by TWG PSSA01. China also expressed its disappointment that there is no agreement on the stock status of the Pacific saury at the TWG PSSA02 due to last minute changes to the input data by one Member during the meeting. Such last minute changes are not professional, unacceptable, and should not be allowed. This is a breach of trust and delayed the progress of the stock assessment for Pacific saury.
52. Japan noted that the participants of the present TWG PSSA meeting could critically and successfully examine the Pacific saury abundance indices provided by fishing Members and could detect some improvable parts in the indices. Japan therefore considered that the Members will be able to continue updating the previous provisional stock assessment of Pacific saury, even though the working papers on Pacific saury stock assessment submitted to the present TWG will need further revision. This is a significant scientific achievement of the meeting. In response to China's statement, Japan clarified that the present TWG PSSA meeting could not complete the update of the stock assessment of Pacific saury due to a last minute change and also various issues in the abundance indices of several Members.

8.4 Possible improvements of the models within BSSPM

53. In discussions on the presentations on stock assessment by China, Japan and Chinese Taipei, the participants noted the usefulness of further analyses of the sensitivity of stock assessment results to the assumptions of priors and selection of abundance indices, and encouraged the stock assessment scientists to conduct such analyses and report on the results.

8.5 Recommendations on future work

54. China, Japan, and Chinese Taipei agreed to submit their updated stock assessment papers by 6 April 2018, if possible.

Agenda Item 9. Exploration of stock assessment models other than existing "provisional base models"

55. Russia presented a stock assessment of Pacific saury in the Northwestern Pacific Ocean using a state-space biomass dynamic model that incorporates seasonality (NPFC-2017-TWG PSSA02-WP13).

9.1 Data invention/availability (including the identification of potential covariates)

9.2 Initial discussion on age/size/stage-structured models

9.3 Identification of information/data gaps and limits

56. The participants compiled a table of each Member's data availability on size composition and catch/CPUE data for Pacific saury (Annex F) for future consideration of new stock assessment.

9.4 Recommendations on future work

57. The participants encouraged stock assessment scientists to construct new models for future stock assessments based on the data identified during the meeting, the biological information presented by Japan, and the Mendeley group developed by Japan.

Agenda Item 10. Other matters

10.1 Review of presentation of stock assessment results

58. The participants reviewed the presentation of the stock assessment results. They agreed to update the formats of the stock assessment report and results intersessionally, if needed.

10.2 Facilitation of code-sharing processes

59. The participants agreed to defer discussion on code-sharing processes until the next TWG PSSA meeting.

10.3 Initial discussion on management strategy evaluation

60. The participants agreed to defer discussion on management strategy evaluation until the next TWG PSSA meeting.

10.4 Priorities for next meeting

61. The participants discussed and decided on the work schedule for the TWG PSSA up to the 3rd SSC PS and 3rd SC meetings (Annex G).

62. The participants discussed the 2017-2021 Work Plan for the TWG PSSA.

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

63. The following recommendations were made:

- a. The TWG PSSA agreed to create a joint spatial/temporal map of Members' catch and effort

on Pacific saury with a spatial resolution of one degree grids and a temporal resolution of one month. To conduct this work, the participants proposed establishing a small working group with the same membership as the Corresponding Group on Data Collection Template for Pacific saury.

- b. The TWG PSSA endorsed the revised CPUE Standardization Protocol for Pacific Saury (Annex D).
- c. The TWG PSSA recognized the necessity to share data for the Pacific saury stock assessment, and agreed that such data should only be shared within the TWG PSSA and be disseminated in accordance with the Interim Guidance for Management of Scientific Data used in Stock Assessments.
- d. The TWG PSSA agreed to move forward in a new direction to aggregate catch and effort data over Member's fishery to draw a joint CPUE index to resolve different patterns in standardized indices among Members and to increase spatial and temporal coverage of catch and effort data. The TWG PSSA agreed to share catch and effort data by month and one degree grids, and to conduct a CPUE standardization based on the data after the 2018 SC meeting.
- e. The TWG PSSA noted that, due to the last minute changes in some Members' data and various other issues with the CPUE data, they were not able to present and revise the results and conclusions of the current stock assessment at the current meeting and proposed deferring discussions on the implications for the management of Pacific saury fisheries to the SSC PS meeting in April 2018. For this, the TWG PSSA proposed holding an informal meeting on the sidelines of the SSC PS.
- f. The TWG PSSA requested the SC to consider revision of the 2017-2021 Work Plan with regards to detailed processes to enable the TWG PSSA to fulfil its duties more efficiently.
- g. The TWG PSSA recommended holding its next meeting in the last quarter of 2018, preferably after 5 November, and, if necessary, extending the duration of the meeting to 4-5 days.

Agenda Item 12. Adoption of the Report

64. The TWG PSSA02 Report was adopted by consensus.

Agenda Item 13. Close of the Meeting

65. The TWG PSSA02 closed at 18:30 on 8 December 2017.

Annexes

Annex A – Agenda

Annex B – List of Documents

Annex C – Participants List

Annex D – CPUE Standardization Protocol for Pacific Saury

Annex E – Comparison table for evaluation of the Members’ standardized CPUE indices against the CPUE Standardization Protocol

Annex F – Data availability on size composition and catch/CPUE for Pacific saury

Annex G – Schedule of TWG PSSA intersessional work between the 2nd TWG PSSA meeting (December 2017) and 3rd SC meeting (April 2018)

AGENDA

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

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5.2 Recommendations on data collection and data sharing

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5.2.2 Data security regulations

5.2.3 Data sharing

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

6.1 Review of the existing protocol

6.2 Review/update of the indices

6.3 Evaluation of the quality of the indices

6.4 Recommendations on future works

Agenda Item 7. Review and update of biological information/data

Agenda item 8. Update of the stock assessment using “provisional base models” (BSSPM)

8.1 Review of the existing model, stock assessment protocol and specification

8.2 Update of the analyses using a new set of data

8.3 Implication for management of Pacific saury fisheries

8.3.1 Stock biomass, fishing mortality and associated uncertainties

8.3.2 Biological reference points

8.3.3 Risk analyses of alternative catch levels

8.4 Possible improvements of the models within BSSPM

8.5 Recommendations on future works

Agenda item 9. Exploration of stock assessment models other than existing “provisional base models”

9.1 Data invention/availability (including the identification of potential covariates)

9.2 Initial discussion on age/size/stage-structured models

9.3 Identification of information/data gaps and limits

9.4 Recommendations on future works

Agenda item 10. Other matters

10.1 Review of presentation of stock assessment results

10.2 Facilitation of code-sharing processes

10.3 Initial discussion on Management Strategy Evaluation

10.4 Priorities for next meeting

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

LIST OF DOCUMENTS**MEETING INFORMATION PAPERS**

Symbol	Title
NPFC-2017-TWG PSSA02-MIP02	Provisional Agenda
NPFC-2017-TWG PSSA02-MIP03	Provisional Annotated Agenda
NPFC-2017-TWG PSSA02-MIP04 (Rev. 2)	Indicative Schedule
NPFC-2017-TWG PSSA02-MIP05	Provisional List of Documents

REFERENCE DOCUMENTS

Symbol	Title
CMM 2017-08	CMM For Pacific Saury
NPFC-2017-SSC PS02-WP03(Rev 2)	Compiled data on Pacific saury catches in the NWPO
	Interim Guidance for Management of Scientific Data Used in Stock Assessments
	Protocol for CPUE standardization
	Stock assessment protocol
	Terms of Reference for TWG PSSA

WORKING PAPERS

Symbol	Title
NPFC-2017-TWG PSSA02-WP01	Draft Data list for stock assessments (Russia)
NPFC-2017-TWG PSSA02-WP02	CPUE standardization of the Pacific saury in Russian EEZ in the Pacific Ocean (Russia)
NPFC-2017-TWG PSSA02-WP03	CPUE standardization of Pacific saury (<i>Cololabis saira</i>) for the Taiwanese stick-held dip net fishery in the Northwestern Pacific Ocean (Chinese Taipei)
NPFC-2017-TWG PSSA02-WP04	Serious status of Japanese Pacific saury fishery in 2017 and change in formation of fishing grounds since 2010 (Japan)
NPFC-2017-TWG PSSA02-WP05	Results of Japanese fishery independent surveys for Pacific saury conducted in 2016 and 2017, and verification in biomass estimating method (Japan)
NPFC-2017-TWG PSSA02-WP06	Update of Japanese standardized CPUE of stick-held dipnet fishery for Pacific saury and its modification corresponding to the changing status of the fishery (Japan)
NPFC-2017-TWG PSSA02-WP07	Stock identity, spawning ground, maturation, and migration of Pacific saury, <i>Cololabis saira</i> (Japan)
NPFC-2017-TWG PSSA02-WP08 (Rev. 1)	Standardization of CPUE data of Pacific saury (<i>Cololabis saira</i>) caught by the Chinese stick-held dip net fishery (China)
NPFC-2017-TWG PSSA02-WP09	A comparison of conventional and state-space production models in fisheries stock assessment and management (China)
NPFC-2017-TWG PSSA02-WP10 (Rev. 1)	Compiled data for Pacific saury stock assessment
NPFC-2017-TWG PSSA02-WP11	Updates of provisional stock assessment of Pacific saury in the North Pacific Ocean by using state-space biomass dynamics models (Japan)
NPFC-2017-TWG PSSA02-WP12	Pacific Saury Stock Assessment Update (China)
NPFC-2017-TWG PSSA02-WP13	Stock assessment of Pacific saury in the Western North Pacific Ocean using state-space biomass dynamic model which incorporates seasonality (Russian Federation)
NPFC-2017-TWG PSSA02-WP14	Results of Russian fisheries for Pacific saury in 2016 (Russia)
NPFC-2017-TWG PSSA02-WP15	Stock assessment of Pacific saury (Chinese Taipei)

INFORMATION PAPERS

Symbol	Title
NPFC-2017-TWG PSSA02-IP01	Fishery Report of Chinese Taipei to NPFC

REPORTS FROM WORKING GROUPS AND SSCs

Symbol	Title
NPFC-2017-TWG PSSA01-Final Report	Report of the 1st Meeting of the Technical Working Group on Pacific Saury Stock Assessment
NPFC-2017-SSC PS02-Final Report	Report of the 2nd Meeting of the Small Scientific Committee on Pacific Saury
NPFC-2017-SC02-Final Report	Report of the 2nd Scientific Committee Meeting
NPFC-2017-COM03-Final Report	Report of the 3rd Commission Meeting

PARTICIPANTS LIST

CHAIR

Toshihide KITAKADO
 Professor, Tokyo University of Marine Science
 and Technology
 Tel: +81-3-5463-0568
 E-mail: kitakado@kaiyodai.ac.jp

Jiaqi WANG
 Shanghai Ocean University
 Tel: 214329421@qq.com

Luoliang XU
 University of Maine
 xllxxlxy@yeah.net

CHINA

Siquan TIAN
 Head of Delegation
 Shanghai Ocean University
 Tel: +86-21-61900221
 E-mail: sqtian@shou.edu.cn

Lianyong FANG
 Alternate Representative
 China Overseas Fisheries Association
 Tel: +86-10-65853488
 E-mail: tomfang71@hotmail.com

Chuanxiang HUA
 Alternate Representative
 Shanghai Ocean University
 Tel: +86-18512186362; +86-21-61900221
 E-mail: cxhua@shou.edu.cn

Bai LI
 Research Associate
 Shanghai Ocean University
 Tel: +86-21-61900221
 E-mail: bai.li@maine.edu

JAPAN

Toshihide IWASAKI
 Head of Delegation
 Division Director, Fisheries Management
 Division, Tohoku National Fisheries Research
 Institute
 Tel: +81-178-33-1500
 E-mail: tiwasaki@affrc.go.jp

Naohito OKAZOE
 International Affairs Division, Fisheries
 Agency
 Tel: +81-3-3591-1086
 E-mail: naohito_okazoe980@maff.go.jp

Shota NISHIJIMA
 Alternate Representative
 Researcher, Research Center for Fisheries
 Management, National Research Institute of
 Fisheries Science
 Tel: +81-45-788-7645
 E-mail: nishijimash@affrc.go.jp

Yasuhiro KAMIMURA

Researcher, Research Center for Fisheries
Management, National Research Institute of
Fisheries Science
Tel: +81-45-788-7633
E-mail: yasukami@affrc.go.jp

Midori HASHIMOTO
Alternate Representative
Japan Fisheries Research and Education
Agency
E-mail: mhashimoto@affrc.go.jp

Hideaki KIDOKORO
Head, Pelagic Fishes and Squids Research
Group, Tohoku National Fisheries Research
Institute
Tel: +81- 178-33-1500
E-mail: kidokoro@affrc.go.jp

Satoshi SUYAMA
Senior Researcher, Pelagic Fishes and Squids
Research Group, Tohoku National Fisheries
Research Institute
Tel: +81-178-33-1500
E-mail: suyama@affrc.go.jp

Taiki FUJI
Alternate Representative
Researcher, Pelagic Fishes and Squids
Research Group, Tohoku National Fisheries
Research Institute
Tel: +81-178-33-1500
E-mail: Tfuji114@affrc.go.jp

Natsuko CHIBA
Graduate student, Tokyo University of Marine
Science and Technology

Tel: +81-3-5463-0568
E-mail: hattivatit725@gmail.com

KOREA

Eunjung KIM
Head of Delegation
Distant Water Fisheries Resources Research
Division, National Institute of Fisheries
Science
Tel: +82-51-720-2328
E-mail: eunjungkim@korea.kr

Sanggyu SHIN
Distant Water Fisheries Resources Division,
National Institute of Fisheries Science
E-mail: gyuades82@gmail.com

RUSSIA

Aleksei BAITALIUK
Head of Delegation
Acting Director, Pacific Research Fisheries
Center
E-mail: aleksei.baitaliuk@tinro-center.ru

Oleg KATUGIN
Head, Department for International Scientific
Cooperation
Pacific Research Fisheries Center
Tel: +7-914-792-4364
E-mail: oleg.katugin@tinro-center.ru

Vladimir KULIK
Head, Laboratory for Regional Data Center,
Pacific Research Fisheries Center
Tel: +7-999-057-9969

E-mail: vladimir.kulik@tinro-center.ru

Alexander ZOLOTOV

Pacific Research Fisheries Center

Tel: +79147883778

E-mail: Alk-90@yandex.ru

Dmitrii ANTONENKO

Chief Researcher, Laboratory for Pelagic Resources, Pacific Research Fisheries Center

Tel: +7-914-697-8130

E-mail: dmantonenko@yandex.ru

Elena USTINOVA

Pacific Research Fisheries Center

E-mail: eustinova@mail.ru

CHINESE TAIPEI

Wen-Bin HUANG

Head of Delegation

Professor, National Dong Hwa University

Tel: +886-3-8635191

E-mail: bruce@mail.ndhu.edu.tw

Yi-Jay CHANG

Alternate Representative

Assistant Professor, National Taiwan

University

Tel: +886-2-33661392

E-mail: yjchang@ntu.edu.tw

VANUATU

Kevin LIN

Alternate Representative

Ming Dar Fishery (Vanuatu) Co., Ltd.

E-mail: kevin.mdfc@msa.hinet.net

NPFC SECRETARIAT

Aleksandr ZAVOLOKIN

Science Manager, NPFC

Tel: +81-3-5479-8717

E-mail: azavolokin@npfc.int

Peter FLEWWELLING

Compliance Manager, NPFC

Tel: +81-3-5479-8717

E-mail: pflewwelling@npfc.int

Alexander MEYER

Rapporteur, Urban Connections

Tel: +81-3-6432-5691

E-mail: meyer@urbanconnections.jp

CPUE Standardization Protocol for Pacific Saury

The use of CPUE in a stock assessment implicitly assumes that CPUE is proportional to stock abundance/biomass. However, many factors other than stock abundance/biomass may influence CPUE. Thus, any other factors, other than stock abundance/biomass, that may influence CPUE should be removed from the CPUE index. The process of reducing/removing the impacts of these factors on CPUE is referred to as CPUE standardization.

The following protocol is proposed for the CPUE standardization:

- (1) Conduct a thorough literature review to identify key factors (i.e., spatial, temporal, environmental, and fisheries variables) that may influence CPUE values;
- (2) Determine temporal and spatial scales for data grouping for CPUE standardization;
- (3) Plot spatio-temporal distributions of fishing efforts and catch to evaluate spatio-temporal patterns of fishing effort and catch;
- (4) Calculate correlation matrix to evaluate correlations between each pair of those variables;
- (5) Identify potential explanatory variables based on (1)-(4) as well as interaction terms to develop full model for the CPUE standardization;
- (6) Make statistical assumptions on the full models and fit the data to the assumed statistical models (i.e., GLM, GAM, Delta-lognormal GLM, Neural Networks, Regression Trees, Habitat based models, and Statistical habitat based models);
- (7) Select and evaluate the models using methods such as likelihood ratio, AIC/BIC and cross validation;
- (8) Evaluate if distributional assumptions are satisfied and if there is a consistent spatial/temporal distribution of residuals in CPUE standardization modeling;
- (9) Determine the optimal model to estimate yearly standardized CPUE and their associated uncertainty;
- (10) Plot nominal and standardized CPUEs over time.

Comparison table for evaluation of the Members' standardized CPUE indices against the CPUE Standardization Protocol

CPUE Standardization Protocol	China	Japan	Korea	Russia	Chinese Taipei
(1) Conduct a thorough literature review to identify key factors (i.e., spatial, temporal, environmental, and fisheries variables) that may influence CPUE values;	Yes (supplement figures 1-4 and Table 1)	Yes (see Sakai et al. 2017)	Yes (see Sakai et al. 2017)	Yes	Yes (see Sakai et al. 2017)
(2) Determine temporal and spatial scales for data grouping for CPUE standardization;	Yes	Yes	No, not available	Yes	Yes; Huang et al. (2007)
(3) Plot spatio-temporal distributions of fishing efforts and catch to evaluate spatio-temporal patterns of fishing effort and catch;	Yes (supplement figure5)	WP04; Fig. 3	No, not available	Yes (WP14)	Yes; Figs. 2 and 3
(4) Calculate correlation matrix to evaluate correlations between each pair of those variables;	Yes (supplement Table 2)	No, not available	No, not available	Yes (see Fig. 5)	Fig. 1
(5) Identify potential explanatory variables based on (1)-(4) to develop full model for the CPUE standardization;	Yes (WP08)	No, not available	No, not available	Yes	4 models, Page 3
(6) Make statistical assumptions on the full models and fit the data to the assumed statistical models (i.e., GLM, GAM, Delta-lognormal GLM, Neural Networks, Regression Trees, Habitat based models, and Statistical habitat based models);	Yes	No, not available	No, not available	Yes	Log-normal; Page 3
(7) Select and evaluate the models using methods such as likelihood ratio, AIC, BIC or cross validation;	Yes (WP08 Table 1 and 2)	No information was given	No, not available	Yes (see Table 1)	AIC and R2; Table 1

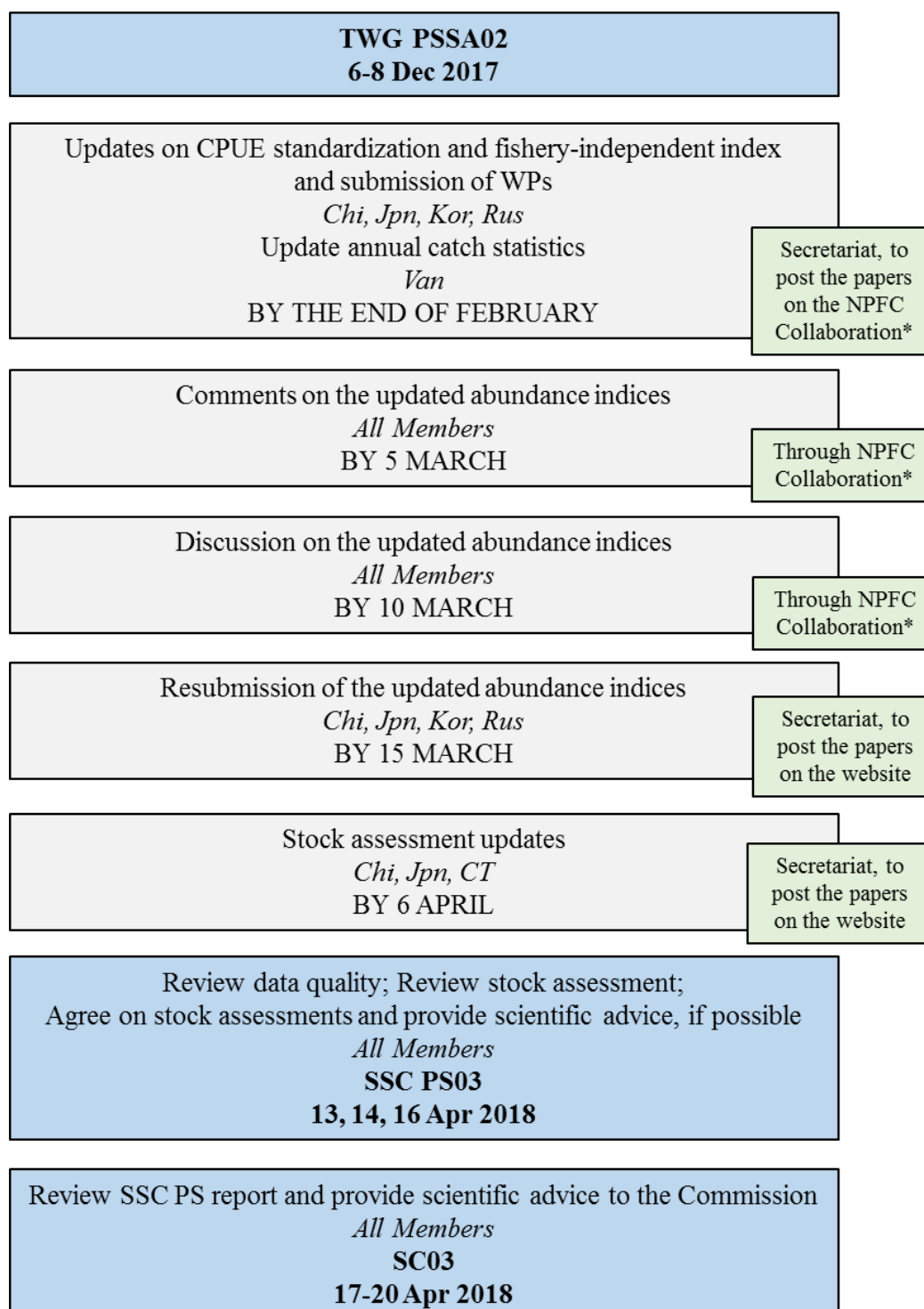
(8) Evaluate if distributional assumptions are satisfied and if there is a consistent spatial/temporal distribution of residuals in CPUE standardization modeling;	Yes (WP08, Fig.1 and 2)	No, not available	No, not available	Yes (see Fig. 8,9)	Fig. 4 and 5
(9) Determine the optimal model to estimate yearly standardized CPUE and their associated uncertainty.	Yes	Year effects are extracted by LSmeans	Year effect is the aggregated mean of predictions by year	Yes	Model 1; year effect is the aggregated mean of predictions by year; CV in Table 2
(10) Plot nominal and standardized CPUEs over time.	Yes (WP08, Fig.5)	Yes, Table 1	Fig. 6	Yes (see Fig 10, Tables 2,3)	Fig. 6
Note for revision of index	Up to 2016	Will be available up to 2017 in next TWG	Will be available up to 2016 in next TWG	Will be available up to 2017 in next TWG (upon domestic consultation)	No revision
Reference	NPFC-2017-TWG PSSA02-WP08	NPFC-2017-TWG PSSA02-WP06	NPFC-2017-TWG PSSA01-WP03	NPFC-2017-TWG PSSA02-WP02	NPFC-2017-TWG PSSA02-WP03

*Sakai et al. 2017 NPFC-2017-TWG PSSA01-WP01

Data availability on size composition and catch/CPUE for Pacific saury

Length composition	China	Japan	Korea	Russia	Chinese Taipei	Vanuatu
Size category	1cm bin	a) Com fish: 1cm bin b) Survey: 1cm bin	a) Catch by size group (3 classes) b) 1cm	a) Catch by size group (3 classes) b) Catch by size group (5 classes) c) 1cm	a) Catch by size group (5 classes) b) Catch by size group (6 classes) c) 1cm	a) Catch by size group (5 classes)? b) Catch by size group (6 classes)?
Period of data	2013-	a) 1950- b) 2003-	a) 2001-2015 b) 2001-	a) 1956- b) 1960- c) 2003-	a) 2001-2008 b) 2009- c) 2006-	To be checked
Sampling fraction	little	a) 5,000 (/yr) b) 100 (/sampling station)	a) 20-100%* b) a little	a), b), c) sample size 3,700-56,700	a), b) 100%* c) sample size 360-400 (/yr)	To be checked
Spatial coverage	Fishing grounds in CA	a) mostly in NW b) Lat 38-48N & Long 143E-165W	a),b) Fishing grounds in CA	a), b), c) Mostly in fishing grounds in Russian EEZ	a), b), c) Fishing area in CA	To be checked
Temporal coverage	By month (Aug-Oct)	a) by day (Aug-Dec) b) by sampling occasion (Jun)	a),b) By month in fishing season (May-Dec)	a), b) by year c) by month (Aug-Nov)	a), b) by month (Jun-Dec) c) by month (Oct-Nov)	To be checked
Comment			*from log book		*from log book	
Catch/CPUE	China	Japan	Korea	Russia	Chinese Taipei	Vanuatu
Spatial coverage	By 1-deg grid in CA	NW and CA (1-deg grid)	By 1-deg grid in CA	NW and CA (1-deg grid)	By 1-deg grid in CA	By 1-deg grid in CA?
Temporal coverage	By month (Aug-Dec)	By month (Aug-Dec)	By month (May-Dec)	By month (Aug-Nov)	By month (Jun-Dec)	By month (Aug-Nov)?

Schedule of TWG PSSA intersessional work between the 2nd TWG PSSA meeting
(December 2017) and 3rd SC meeting (April 2018)



*NPFC Collaboration (<https://collaboration.npfc.int/>) is a tool developed to facilitate intersessional discussions among members. Secretariat will create a topic “Updated abundance indices” which will be accessible by the TWG PSSA members only. Please create your individual account on the NPFC website (<https://www.npfc.int/user/login?destination=members>) if you do not have it yet, so Secretariat will add you to the Group.