North Pacific Fisheries Commission
8th Meeting of the Technical Working Group on Chub Mackerel Stock Assessment

22–25 January 2024
Niigata, Japan (Hybrid)

REPORT

Agenda Item 1. Opening of the Meeting

1. The 8th Meeting of the Technical Working Group on Chub Mackerel Stock Assessment (TWG CMSA) was held in a hybrid format, with participants attending in-person in Niigata, Japan, or online via WebEx on 22–25 January 2024. The meeting was attended by Members from Canada, China, the European Union (EU), Japan, the Russian Federation, and the United States of America. An invited expert, Dr. Joel Rice, participated in the meeting.

2. The meeting was opened by Dr. Kazuhiro Oshima (Japan), the TWG CMSA Chair, who welcomed the participants.

3. Dr. Hiroshi Nishida, Director, Fisheries Stock Assessment Center, Fisheries Resources Institute, Japan Fisheries Research and Education Agency, Japan, welcomed the participants and expressed his appreciation to them for travelling all the way to Niigata. He noted that the TWG CMSA is expected to continue to tackle important challenges and make significant progress towards conducting its first chub mackerel stock assessment, which will require continued international collaborative efforts. Dr. Nishida hoped that the participants would engage in forward-looking discussions leveraging their wealth of experience and knowledge, and wished them a fruitful meeting and pleasant stay in Niigata.

4. The Science Manager, Dr. Aleksandr Zavolokin, outlined the procedures for the meeting. He also thanked China for providing a voluntary contribution for purchasing the Secretariat's hybrid meeting equipment and the United States for providing a voluntary contribution to facilitate scientific analyses on the NPFC priority species, in particular chub mackerel and Pacific saury.

5. Mr. Alex Meyer was selected as rapporteur.

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Agenda Item 2. Adoption of Agenda

6. The TWG CMSA agreed to change the name of Agenda Item 5.1 from "Weight-length relationships" to "Length-weight relationships." The revised agenda was adopted (Annex A). The List of Documents and List of Participants are attached (Annexes B, C).

Agenda Item 3. Overview of the recommendations and outcomes of previous NPFC meetings relevant to chub mackerel

3.1 TWG CMSA07

7. The Chair provided an overview of the outcomes and recommendations of the 7th TWG CMSA meeting (TWG CMSA07).

3.2 Intersessional meetings of TWG CMSA

8. The Chair provided an overview of the 3rd intersessional meeting of the TWG CMSA held in November 2023 (NPFC-2024-TWG CMSA08-RP01).

3.3 SC08

9. The Science Manager presented the outcomes from the 8th Meeting of the Scientific Committee (SC08) of relevance to chub mackerel.

Agenda Item 4. Members fishery status and research activities, inter alia in 2023

10. China presented a review of its chub mackerel fishery and research activities (NPFC-2024-TWG CMSA08-IP04). In 2023, China operated about 95 purse seine and trawl vessels in the Convention Area. The estimated catch in 2023 of chub mackerel and blue mackerel was about 50,000–71,000 MT. The distribution of chub mackerel in 2023 was similar to that in 2022. Catch per unit of effort (CPUE) has been decreasing in recent years. The average length of caught individuals was 231 mm, slightly larger than in 2022 (approximately 221 mm). The main ages at catch in 2022 were from 1 to 3. China collects and analyzes fishing logbooks every year, sends specialist research staff to fishing vessels or ports to collect sample data, monitors the monthly ratio of chub mackerel and blue mackerel in catch, and conducts monitoring of biological features. From 2023, China has increased sample collection for large pelagic trawl nets in the North Pacific and found that the fork length frequency in trawl nets is similar to that in the purse seine fishery. Chub mackerel and Japanese sardine are caught in high proportions in China's fisheries without any change in gear setting, but fishermen prefer catching chub mackerel because of its slightly higher price.

11. Japan presented a review of the recent fishery and stock status of chub mackerel (NPFC-2024-TWG CMSA08-IP05). Japan's catch comes from large-scale purse seine vessels, small-scale

purse seine vessels, set nets, and dip nets and other gears. The majority of the catch is from large-scale purse seine vessels. Catch declined substantially in fishing year (FY) 2022 (July 2022 to June 2023) to approximately 98,500 MT. In FY2023, the catch has been 31,200 MT up to November, which is very low compared to past years. There is usually substantial catch between November and spring months, with catch in November tending to be high, but that was not the case in FY2023. Japan's 2023 summer surface trawl survey showed broad distribution of age-0 and age-1 fish. Japan's 2023 autumn surface trawl survey was data-limited but showed that the distribution of the chub mackerel is offshore. The egg survey shows that the main spawning ground exists near the Izu Islands and coastal Japan. The strong northward insertion of the Kuroshio extension might play a key role in the declining catch by shifting the distribution of chub mackerel.

12. Russia presented a review of its chub mackerel fishery and research activities in 2023 (NPFC-2024-TWG CMSA08-IP02). In 2023, the main fishing grounds were in the Japanese exclusive economic zone (EEZ) from January to February, before shifting to the Russian EEZ in May through to the end of the fishing season. Average CPUE (catch per vessel per day) was high during the winter, but was well below 2022 levels. Monthly catches were also highest during the winter in 2023. In the summer, catches were minimal and increased in the fall as the number of fishing vessels increased. However, the 2023 catch is significantly lower than the 2022 catch. The Russian targeted mackerel fishery was started in 2016 when 6,700 MT of mackerel were caught. In 2018, the maximum catch was reached (98,800 MT) and catch started to decrease thereafter. In 2023, the catch was 15,500 MT. In terms of research activities, Russian vessels carry out surveys of the Northwest Pacific Ocean, covering both the Russian EEZ and open waters to the east of the Kuril Islands. Surveys are carried out in June-July annually, and in some years a second survey is carried out in August-September. Surveys are carried out in two ways: pelagic trawls and hydroacoustic surveys. In the survey in the first half of summer 2023, the biomass of mackerel in Pacific waters was estimated as 116,800 MT by trawl survey and 439,000 MT by hydroacoustic survey data.

13. China presented estimates of abundance and distribution for chub mackerel and blue mackerel in the Northwest Pacific based on scientific research surveys that it conducted during 2021–2023 (NPFC-2024-TWG CMSA08-IP03). There are obvious temporal and spatial variations for the catch and abundance of mackerels. The catch, density and relative biomass estimates were much lower in 2022 and 2023 than those in 2021. Generally, blue mackerel accounted for about 17% of China's mackerel catch in 2023.

14. The TWG CMSA encouraged China to continue to collect and analyze data from its scientific research surveys and to continue its ongoing age determination work.

Agenda Item 5. Biological information

15. The Science Manager presented draft biological data provision templates for age, age-length keys (ALKs), length, and maturity at age that were prepared by the EU and Canada and presented at SC08 (NPFC-2023-SC08-IP13). He explained that the SC requested Members to test the templates when submitting data to the SC's subsidiary bodies, including the TWG CMSA, to evaluate the templates and present feedback to SC09, and discuss the appropriateness of having a standardized approach for sharing data and present the outcomes of their discussions to SC09. The TWG CMSA requested the Chair and the Secretariat to evaluate the data provision templates intersessionally and provide feedback at the next TWG CMSA meeting.

5.1 Length-weight relationships

16. Japan presented a comparison of the chub mackerel length-weight relationships based on Chinese catch data, Japanese catch data for eastern Japan, and Japanese catch data for western Japan (NPFC-2024-TWG CMSA08-WP13). The relationships were found to be similar, and Japan concluded that further comparative studies for the three regions would be feasible.

5.2 Natural mortalities

17. Japan presented updated age-common and age-specific natural mortality (M) estimators obtained from life-history parameters for chub mackerel in the Northwest Pacific Ocean (NPFC-2024-TWG CMSA08-IP06). Japan explained that it first presented such estimators at TWG CMSA04 (NPFC-2021-TWG CMSA04-WP05) and has updated those estimators based on more recent data (up to 2016). Many M estimators exhibited higher values than previously due to a higher growth coefficient of fork length. Based on its analysis, Japan concluded that there is little impact in incorporating the difference of year classes as random effects on the M estimators and recommended using the results with no random effect as the base case in the next benchmark stock assessment, specifically: the median of various updated estimators as the age-common M (0.53) and the mean between Gislason1 and Gislason2 as the age-specific M (0.80 for age 0, 0.60 for age 1, 0.51 for age 2, 0.46 for age 3, 0.43 for age 4, 0.41 for age 5, and 0.40 for age 6+).

18. The TWG CMSA suggested that, as future work, Japan could update the estimates further using as up to date data as possible, and that it could also estimate the natural mortality for each extent of time and compare the yearly estimates to evaluate their robustness.

19. China presented growth and mortality estimates based on the data from the Chinese survey and fishery in the Convention Area (NPFC-2024-TWG CMSA08-WP12). The parameters in the

length-weight relationship of 2021-2023 were estimated to be 1.886~9.441×10^{-6} for the condition factor *a*, and 3.03~3.32 for the growth parameter *b*, with significant temporal variations. Von Bertalanffy growth parameters were estimated to be K=0.33~0.78, L_∞=31~34 cm, and t_0= −0.82 ~ −0.34. Both constant and age-specific natural mortality were calculated based on several empirical methods, while the M estimates ranged from 0.26 to 0.62 in different years, with a geometrical mean of 0.47. The results show that chub mackerel has tended to grow faster with smaller size in recent years and in the high seas. They suggest obvious variations among different regions and years, indicating the non-stationarity of chub mackerel's life history traits. Therefore, China recommended that the stock assessment for chub mackerel use time-varying growth and mortality considering spatial heterogeneity.

20. The TWG CMSA considered and compared the M estimates presented by Japan and China. The TWG CMSA agreed to explore two scenarios for M for the forthcoming chub mackerel stock assessment:
    (a) The TWG CMSA noted the similarity between the Chinese and Japanese age-common M estimates, which were 0.47 and 0.53 respectively, and agreed to explore the use of an age-common M estimate of 0.5 (the mean of the Chinese and Japanese estimates).
    (b) The TWG CMSA noted that M varied across different age-classes and that there is potential value in applying age-specific M estimates. The TWG CMSA noted that the Chinese and Japanese estimates were similar for ages 2 to 4, but slightly different for age 1. Because of the larger number of samples used in the Japanese estimates, the TWG CMSA agreed to use the Japanese age-specific estimates in NPFC-2024-TWG CMSA08-IP06.

21. The TWG CMSA noted that there is temporal variation in chub mackerel growth and mortality and that there is potential value of using time-varying estimates of M. However, it also noted that doing so would be complex and time-consuming, both in terms of data collection/preparation and model configuration. The TWG CMSA agreed to explore time-varying estimation of M as future work. The TWG CMSA also recommended conducting likelihood profiles and sensitivity analyses on natural mortality.

5.3 Maturity-at-age

22. Japan presented a comparison of Chinese and Japanese maturity-at-age data (NPFC-2024-TWG CMSA08-WP14). For 1970–2016, only Japanese maturity-at-age data are available. For 2017 onwards, both Chinese and Japanese data showed age-0 fish to be fully immature and age-4+ to be fully mature, but they differed on the maturity determination for age-1 to age-3 fish. Japan noted that China's estimates of maturity-at-age, which were based on samples from offshore areas, were significantly higher than Japanese estimates of maturity-at-age, which

were based on samples from the spawning ground, which seemed implausible.

23. The TWG CMSA suggested that Japan should investigate the consistency of the methodology used to determine the maturity and derive the maturity ogive from 1970 to 2023, and report its findings at the TWG CMSA meeting.

24. The TWG CMSA noted that China's maturity determination method differed slightly from the method applied in Japan (NPFC-2024-TWG CMSA08-IP07) and may be resulting in an over-estimation of maturity-at-age. The TWG CMSA requested China to review the data and resubmit them by 10 February 2024.

25. The TWG CMSA agreed to use Japanese maturity-at-age data from 1970 to 2023 as an input for the base case of the stock assessment. The TWG CMSA also agreed to consider other options when China resubmits its data.

5.4 Finalization of biological parameters for stock assessment in TWG CMSA09

26. The TWG CMSA discussed biological parameters for the stock assessment of chub mackerel under Agenda Item 8.

Agenda Item 6. Fishery and biological data for stock assessment

27. Russia presented calculations of quarterly catches and average weights by age group for the period 2016 through 2023 (NPFC-2024-TWG CMSA08-WP11). Russia used mackerel catch data from the Russian Center of Fisheries Monitoring, and the Russian Federal Research Institute of Fisheries and Oceanography (VNIRO) surveys and fishery observers catch-at-length data and Japanese age-length keys for the Northwest Pacific Ocean.

6.1 Catch-at-age

6.1.1 Length frequency, catch-at-length/size and age-length key

6.1.2 Calculation of catch-at-age

28. Japan presented a comparison of Chinese, Japanese, and Russian catch-at-length/size data, age determination methods, ALKs, and catch-at-age data (NPFC-2024-TWG CMSA08-WP15). The three Members prepare catch-at-age data using adjusted age and fishing year. The three Members use three ALKs. Japan uses Eastern and Western ALKs and Russia, which catches chub mackerel in coastal areas, uses the Eastern Japanese ALK, while China, which catches chub mackerel in offshore areas, use the Chinese ALK. There is similarity between the Chinese and Eastern Japanese ALKs, and the two age determination methods may be comparable by adjusting the date of age incrementation as 1 July. Comparison of Members' annual catch-at-age data showed that the Japanese and Russian catch number has declined from 2020 to 2022,

while the Chinese catch number has remained at above 450 million. The Chinese catch is mainly composed of smaller and younger fish, while the Japanese catch and Russian catch are mainly composed of older fish.

29. Japan presented an analysis of possible methods for calculating the missing catch-at-age data, which are Chinese catch-at-age and ALK data in 2015; Chinese ALK data in 2016 and 2017; and Russian catch-at-length data in 2014 and 2015 (NPFC-2024-TWG CMSA08-WP15). Japan provided three scenarios for calculating the missing catch-at-age data and recommended the following scenario. For the Chinese 2015–2017 estimates, Japan recommended using the Eastern Japanese ALK from the equivalent quarter/year. For the Russian 2014 and 2015 estimates, Japan recommended using the Eastern Japanese ALK from the equivalent quarter/year. For the years where the catch-at-length (2015 for China, 2014–2015 for Russia) data were missing, Japan recommended using mean catch-at-length from 2016 to 2018.

30. The TWG CMSA agreed to use the Eastern Japanese ALK from the equivalent quarter/year for the missing Chinese data in 2015–2017, and the mean catch-at-length from 2016 to 2018 for the missing Chinese data in 2015 and the missing Russian data in 2014 and 2015. The TWG CMSA agreed to use Japanese catch-at-length and the Eastern Japanese ALK to substitute the missing Russian data in 2022 Q1/Q2 and 2023 Q1/Q2.

31. The TWG CMSA suggested that, as future work, Members could investigate developing a calibration co-efficient between the Eastern Japanese ALK and the Chinese ALK to further improve the estimation of the missing Chinese data in 2016 and 2017.

32. The TWG CMSA discussed a sensitivity scenario in which the estimates of the missing Chinese catch-at-age data in 2015 are not included and the other two scenarios for catch-at-age data for China in 2015 under Agenda Item 8.

6.2 Weight-at-age

33. Japan presented a comparison of Chinese, Japanese, and Russian weight-at-age data (NPFC-2024-TWG CMSA08-WP13). A single weight value for each age is needed to convert stock number into biomass. Comparison showed that Chinese, Eastern Japanese, and Russian weight-at-age data were similar, while Western Japanese data showed heavier and outlying values. Therefore, Japan calculated and compared the arithmetic means of weight-at-age for all weight-at-age data, and all except the Western Japanese weight-at-age data. Japan found that Western Japanese weight-at age, ALK, and catch-at-length data differ from Chinese, Eastern Japanese, and Russian data. Therefore, Japan recommended using the arithmetic average of only the Chinese, Eastern Japanese, and Russian data for the forthcoming stock assessment.

34. The TWG CMSA considered Japan's recommendation and held further discussions. The TWG CMSA tested a number of options for calculating a single weight value for each age for converting stock number into biomass in the forthcoming stock assessment and compared the results. Specifically, it tested the arithmetic average with or without Western Japanese data, the average weighted by catch weight, and the age-specific average weighted by the catch number. Based on the results, the TWG CMSA agreed to use the average, weighted by age-specific catch number with the same ratio across all years (FY2014–FY2022) by Member, of the Chinese, Eastern Japanese, Western Japanese and Russian weight-at-age data.

35. The TWG CMSA agreed to document the methodology for the aforementioned calculation of the average weight-at-age weighted by age-specific catch by Member.

6.3 Finalization of fishery and biological data for stock assessment in TWG CMSA09

36. The TWG CMSA discussed the fishery and biological data to be used for the chub mackerel stock assessment and their specification under Agenda Item 8.

Agenda Item 7. Abundance indices

7.1 Finalization of CPUE document template

37. The TWG CMSA reviewed the Document Template for Presenting Standardized CPUE of Chub Mackerel (NPFC-2024-TWG CMSA08-WP04).

38. The TWG CMSA agreed that Members must present at least one of Table 4 and Table 5 when presenting their CPUE standardization results, but it is not obligatory to present both. The TWG CMSA updated the Document Template for Presenting Standardized CPUE of Chub Mackerel accordingly, which is annexed to the CPUE Standardization Protocol for Chub mackerel.

7.2 Update of abundance indices submitted by Members

39. Japan presented a standardization of CPUE data from surface trawl surveys in summer for Pacific chub mackerel using the vector-autoregressive spatio-temporal (VAST) model (NPFC-2024-TWG CMSA08-WP06 (Rev. 1)). The survey covers a broad area in the Northwest Pacific Ocean. Japan estimated local densities of young-of-the-year fish in the Northwest Pacific from 2002 to 2023 with consideration for environmental factors of sea surface temperature (SST) and 50m-depth temperature as well as spatial autocorrelation. The analysis showed high levels of recruitment index have frequently occurred since 2013. This standardized index covers a long time series from periods of poor recruitment to high recruitment. Model diagnostics found no serious problems in residual patterns and showed favorable results. Japan recommended using this standardized recruitment index as the abundance index of age-0 fish in the

forthcoming chub mackerel stock assessment.

40. The TWG CMSA agreed to use Japan's standardized recruitment index as the abundance index of age-0 fish in the stock assessment.

41. Japan presented a standardization of CPUE data from surface trawl surveys in autumn for Pacific chub mackerel using the VAST model (NPFC-2024-TWG CMSA08-WP08 (Rev. 1)). The survey covers a moderately broad area in the Northwest Pacific Ocean. Japan estimated local densities of 0-year-old fish and 1-year-old fish in the Northwest Pacific from 2005 to 2023 with consideration for environmental factors of SST and 30m-depth temperature as well as spatial autocorrelation. The analysis showed high levels of abundances frequently occurred since 2013. This standardized index covers a long time series from periods of poor recruitment to high recruitment. Model diagnostics found no serious problems in residual patterns and showed favorable results. Japan recommended using these standardized abundance indices as the abundance indices for age-0 fish and age-1 in the forthcoming chub mackerel stock assessment.

42. The TWG CMSA agreed to use Japan's standardized abundance indices for age-0 fish and age-1 fish as inputs for the stock assessment.

43. The TWG CMSA noted that there was a lower level of sampling in 2023 compared to previous years and abundances of lower age-0 and age-1 fish. The TWG CMSA noted that the 2023 autumn survey data was outside the temporal scope of the forthcoming chub mackerel stock assessment but suggested that it would nevertheless be worthwhile, as future work, for Japan to investigate what impact, if any, the lower level of sampling may have had.

44. The TWG CMSA suggested that, as future work, Japan could compare the effect of assuming an autoregressive process or an independent and identically distributed process in the CPUE standardization for its autumn survey.

45. Japan presented a standardization of egg abundances from monthly egg density data obtained by research surveys for the Pacific stock of chub mackerel (NPFC-2024-TWG CMSA08-WP05 (Rev. 1)). Japan applied the VAST model to the monthly egg survey data from 2005 to 2023 off the Pacific coast of Japan to cover the spawning ground of chub mackerel. The standardized CPUE reached its peak in 2019, but has been on a downward trend since then, reaching its lowest level in 2023 since 2005. Japan found no serious problems in the diagnostics of the spatio-temporal model. Japan recommended using the estimated index as a spawning stock biomass (SSB) abundance index for the forthcoming chub mackerel stock assessment.

46. Japan explained that it will update its CPUE standardization with the latest available egg density data (July 2023).

47. The TWG CMSA agreed to use Japan's standardized chub mackerel egg abundance index, updated with the July 2023 data, as an input for the stock assessment.

48. Japan presented a standardization of CPUE data for Pacific chub mackerel from 2003 to 2023 from its commercial dip-net fishery using a generalized linear mixed-effect model (NPFC-2024-TWG CMSA08-WP03). The analysis showed that the dip-net fishery CPUE was affected by month, area, sea surface temperature, and ship as well as year. The abundance index standardizing these influential variables except for year showed a great decline in 2022-2023 after a high-level decade from 2011 to 2021. Model diagnostics suggested some areas in which the model could be improved. Nevertheless, the CPUE of the dip-net fishery targeting the spawners represents valuable information regarding the abundance of spawning fish of chub mackerel because it is believed that the majority of spawning chub mackerel migrate around the Izu Islands. Japan recommended using the standardized CPUE derived from a generalized linear mixed-effect model as an input for the forthcoming chub mackerel stock assessment.

49. The TWG CMSA agreed to use Japan's standardized CPUE derived from a generalized linear mixed-effect model as an input for the stock assessment.

50. China presented a standardization of CPUE data for chub mackerel caught by the China's lighting purse seine fishery from 2014 to 2022 using a generalized additive model (GAM) (NPFC-2024-TWG CMSA08-WP07 (Rev. 1)). Four groups of independent variables were considered in the CPUE standardization: spatial variables (latitude and longitude), temporal variables (year and month), fishery variables (vessel length and proportion of chub mackerel) and environmental variables (SST and chlorophyll-a concentration (Chla)). China recommended using the standardized CPUE derived from GAM as an input for the forthcoming chub mackerel stock assessment.

51. China explained that it had received technical suggestions from Japan for further improving the CPUE standardization and that it is in the process of incorporating these suggestions.

52. The TWG CMSA noted China's CPUE standardization had included the proportion of chub mackerel in the catch as an explanatory variable, but that Chinese vessels do not in fact change their targeting based on the proportion of chub mackerel in the catch. Therefore, the TWG CMSA suggested that China not include this variable in its CPUE standardization.

53. The TWG CMSA agreed to review China's standardized CPUE data derived from GAM again intersessionally once they have been updated based on the suggested improvements and to consider their inclusion as an input for the stock assessment.

54. Russia presented chub mackerel abundance indices in the Northwest Pacific Ocean based on the results of stock surveys carried out by Russian research vessels from 2014 to 2023 (NPFC-2024-TWG CMSA08-WP09). The Russian research vessels have been conducting multipurpose trawl surveys of the upper epipelagic zone of the Northwest Pacific Ocean annually. Surveys are carried out according to the standard scheme of trawl stations which covers a large area to the east of the Kuril Islands but the number of stations in each survey varies from year to year. According to survey data, mackerel was found sporadically and in small quantities before 2014, but large schools of mackerel have migrated to Kuril waters and adjacent open water areas since 2014.

55. The TWG CMSA encouraged Russia to continue to develop its CPUE standardization work and to present further explanation of the details in future, including the method by which it estimates the chub mackerel biomass from its survey data.

56. The TWG CMSA recalled that Russia had presented a standardization of CPUE data for chub mackerel caught by its trawl fishery at TWG CMSA07 (NPFC-2023-TWG CMSA07-WP04) and that the TWG CMSA had requested Russia to make a number of improvements (TWG CMSA07 Report, paragraph 45). Russia explained that it had not yet been able to make the requested improvements. The TWG CMSA noted that because Russia had not submitted a revised CPUE standardization, it could not review this work and agreed that it could not include this abundance index as an input for the base case of the forthcoming chub mackerel stock assessment. The TWG CMSA requested Russia to submit its revised CPUE standardization as soon as possible in the intersessional period. The TWG CMSA agreed to review the revised CPUE standardization when it is submitted and to consider including it in a sensitivity analysis for the forthcoming chub mackerel assessment if the necessary improvements have been made and if the CPUE Standardization Protocol has been followed.

7.3 Finalization of abundance indices for stock assessment in TWG CMSA09

57. The TWG CMSA discussed the abundance indices to be used and their specification under Agenda Item 8.

Agenda Item 8. Settings and specifications of SAM

8.1 Review of current settings and specifications

58. The TWG CMSA agreed that the assessment period will be FY1970–FY2022 (from 1 July 1970 to 30 June 2023). In addition, preliminary analysis using the five abundance indices of FY2023 will be conducted to check the sensitivity of the most recent data.

59. The TWG CMSA compiled a table of age-specific data to be used in the stock assessment and their specification (Annex D).

60. The TWG CMSA compiled a table of abundance indices to be used in the stock assessment and their specification (Annex E).

61. The TWG CMSA discussed the treatment of selectivity for the standardized CPUE data for the Chinese lighting purse seine fishery. The TWG CMSA agreed to compute selectivity based on the catch-at-age from China. The Chinese standardized CPUE could be used as an abundance index for younger ages. The TWG CMSA agreed that, as a future task, it would be worthwhile exploring the feasibility of estimating the selectivity for this fishery in SAM.

62. The TWG CMSA considered a single fleet configuration for the forthcoming stock assessment and suggested the exploration of calculation of F by fleet.

63. The TWG CMSA agreed that, as a future task, it would be worthwhile exploring a multiple-fleet configuration with estimation of F by fleet.

8.2 Review of preliminary results from SAM

64. Japan presented preliminary results from the use of SAM in the supplementary material of its most recent domestic chub mackerel stock assessment to illustrate the effects of different stock-recruitment relationship assumptions.

65. The TWG CMSA considered the preliminary results and discussed a range of stock-recruitment relationship options for configuring SAM for the NPFC's chub mackerel stock assessment. The TWG CMSA agreed to explore the following two options for the forthcoming chub mackerel stock assessment:
    (a) Parameterized Beverton-Holt stock-recruitment relationship with α and β estimated in the model
    (b) Beverton-Holt stock-recruitment relationship with fixed parameters such as α and β or steepness parameter h, exploring the fit of the model to a range of values that would give low, intermediate, and high steepnesses that seem plausible

66. The TWG CMSA encouraged Japan to continue to explore the use of a bent hockey stick stock-

recruitment relationship as future work.

8.3 Discussion towards finalization of settings and specifications

67. The TWG CMSA reviewed and updated the draft table of settings and specification of SAM (Annex F). The TWG CMSA agreed to use this table for the forthcoming chub mackerel stock assessment.

Agenda Item 9. Biological reference points

9.1 Methods to calculate biological reference points

68. The TWG CMSA reviewed the detailed configurations for calculating performance measures that were discussed at TWG CMSA05 (NPFC-2022-TWG CMSA05-WP01, Annex D). The TWG CMSA agreed to generally follow those configurations, while giving Japan, which will conduct the modeling work, a level of flexibility. The TWG CMSA noted a number of outstanding matters that needed to be addressed and agreed to the following:
    (a) Reference year:
        i. Average of three years or more
        ii. Inclusion or exclusion of terminal year to be determined
    (b) Yield per recruit:
        i. Use calculated partial F for each Member and weight-at-age for each Member to calculate yield per recruit
        ii. Refine details intersessionally
    (c) F_{MSY}: Deterministic

69. The TWG CMSA agreed that, as future work, it could be worthwhile exploring dynamic reference points, such as time-varying F_{MSY}, in light of the changing chub mackerel biological parameters, and encouraged Members to conduct and share research in this area.

Agenda Item 10. Future projection of chub mackerel

10.1 Review of the table of options for the basic specifications of conducting future projections for chub mackerel

70. The TWG CMSA reviewed and updated the table of possible options for the basic specifications for conducting future projections for chub mackerel (Annex G). The TWG CMSA agreed to continue to discuss and develop the table and determine provisional specification and setting towards TWG CMSA09.

71. The TWG CMSA requested Japan to share the code which is used for conducting the future projections for chub mackerel in its domestic stock assessment with the invited expert. The TWG CMSA requested the invited expert to work with Japan to develop the code further for

conducting the NPFC's future projections.

Agenda Item 11. Review of the Work Plan of the TWG CMSA

72. The TWG CMSA reviewed and updated the Work Plan of the TWG CMSA (NPFC-2024-TWG CMSA08-WP01 (Rev. 1)). The TWG CMSA reaffirmed its intention to complete the first chub mackerel assessment in 2024.

73. The TWG CMSA reviewed the NPFC Performance Review recommendations that concern chub mackerel and the summary of comments made by the SC at SC08 (NPFC-2023-SC08-WP04 (Rev. 1)). The TWG CMSA updated the document with further comments (NPFC-2023-SC08-WP04 (Rev. 2)).

Agenda Item 12. Other matters

12.1 Timeline and intersessional activities before TWG CMSA09

74. The TWG CMSA drafted a timeline and activities from the conclusion of TWG CMSA08 to the next TWG CMSA meeting in mid-July (Annex H).

75. The TWG CMSA agreed to hold its next meeting on 17-20 July 2024.

12.2 Observer Program

76. The Science Manager reminded the TWG CMSA of background information regarding the establishment of a regional observer program. He also summarized the relevant discussions from SC08. In particular, the SC tasked its subsidiary bodies to review summaries of any historical information that Members may have about species captured in surveys and/or discarded bycatch from their fisheries in the Convention Area and report any potential impacts on species belonging to same ecosystem or dependent/associated with target stocks during SC09, as well as to review and update data needs and gaps that could be filled by a regional observer program. However, the SC also agreed that this latter task is a lower priority for the TWG CMSA, which is working on the high priority task of the chub mackerel assessment.

77. The EU suggested that the sampling coverage for chub mackerel fisheries in the Convention Area could be increased and that the sampling quality could be improved. A template for data reporting from existing national programmes similar to the one in Annex 4 of Conservation and Management Measure 2023-05 For Bottom Fisheries and Protection of VMEs in the NW Pacific Ocean could be implemented for chub mackerel.

12.2.1 Review data or data description on fisheries bycatch in the chub mackerel fisheries

78. Russia had prepared a description of bycatch data from the mackerel fisheries in the Northwest

Pacific, which was provided as an information paper (NPFC-2024-TWG CMSA08-IP08). The TWG CMSA requested Russia and other Members to present any historical information about species captured in surveys and/or discarded bycatch from their fisheries in the Convention Area at TWG CMSA09 for summarizing and reporting to SC09.

12.3 Species summary

79. The TWG CMSA reviewed the species summary of chub mackerel (NPFC-2024-TWG CMSA08-WP02) and agreed to continue to update it as appropriate in the future.

12.4 Space and methods to share data and codes

80. The Data Coordinator, Mr. Sungkuk Kang, reported on the GIT repository plan for the TWG CMSA (NPFC-2024-TWG CMSA08-IP01). He explained that at SC08, the SC expressed its preference to use the GitHub Team plan, that the Secretariat is in ongoing communication with GitHub to assess the NPFC's eligibility for a non-profit organization account and preparing the application for the complimentary GitHub Team plan as requested by the SC, and that upon acquiring the GitHub Free Team Plan, the Secretariat will promptly set up the GIT repository and inform Members. The Data Coordinator also presented a timeline with the respective tasks/responsibilities of the Secretariat and Members, as well as contingency plans for if the NPFC is unsuccessful in applying for the complimentary GitHub Team plan.

81. Japan expressed its intention to share the code for its SAM model on the GIT repository. Japan explained that China has agreed to double-check the code and encouraged any other interested Members to do so as well.

82. The TWG CMSA noted that the NPFC collaboration site will continue to be used for the sharing of data, and model inputs.

12.5 Other issues

83. The TWG CMSA agreed that Members should share information on the ratio of chub mackerel to blue mackerel in their mackerel catch, for inclusion in the species summary documents for chub mackerel and blue mackerel.

Agenda Item 13. Recommendations to the Scientific Committee

84. The TWG CMSA agreed to:
    (a) continue to work intersessionally in accordance with the agreed timeline (Annex H).
    (b) complete the first chub mackerel stock assessment in 2024.

85. The TWG CMSA recommended that the SC:

(a) adopt the Work Plan of the TWG CMSA (NPFC-2024-TWG CMSA08-WP01 (Rev. 1)).
(b) consider the TWG CMSA's comments on the NPFC Performance Review recommendations that concern chub mackerel (NPFC-2023-SC08-WP04 (Rev. 2)).

Agenda Item 14. Adoption of Report

86. The report was adopted by consensus.

Agenda Item 15. Close of the Meeting

87. The Chair expressed his appreciation to the participants for their constructive and fruitful discussions and their collaborative spirit.

88. The meeting closed at 13:20 on 25 January 2024, Niigata time.

Annexes

Annex A – Agenda
Annex B – List of Documents
Annex C – List of Participants
Annex D – Age-specific data to be used in the stock assessment and their specification
Annex E – Abundance indices to be used in the stock assessment and their specification
Annex F – Settings and specification of SAM
Annex G – Options for the basic specifications for conducting future projections for chub mackerel
Annex H – Timeline and activities for intersessional work from the conclusion of TWG CMSA08 to the next TWG CMSA meeting in mid-July

Annex A

Agenda

Agenda Item 1. Opening of the Meeting

Agenda Item 2. Adoption of Agenda

Agenda Item 3. Overview of the recommendations and outcomes of previous NPFC meetings relevant to chub mackerel

- 3.1 TWG CMSA07
- 3.2 Intersessional meetings of TWG CMSA
- 3.3 SC08

Agenda Item 4. Members fishery status and research activities, inter alia in 2023

Agenda Item 5. Biological information

- 5.1 Length-weight relationships
- 5.2 Natural mortalities
- 5.3 Maturity-at-age
- 5.4 Finalization of biological parameters for stock assessment in TWG CMSA09

Agenda Item 6. Fishery and biological data for stock assessment

- 6.1 Catch-at-age
  - 6.1.1 Length frequency, catch-at-length/size and age-length key
  - 6.1.2 Calculation of catch-at-age
- 6.2 Weight-at-age
- 6.3 Finalization of fishery and biological data for stock assessment in TWG CMSA09

Agenda Item 7. Abundance indices

- 7.1 Finalization of CPUE document template
- 7.2 Update of abundance indices submitted by Members
- 7.3 Finalization of abundance indices for stock assessment in TWG CMSA09

Agenda Item 8. Settings and specifications of SAM

- 8.1 Review of current settings and specifications
- 8.2 Review of preliminary results from SAM
- 8.3 Discussion towards finalization of settings and specifications

Agenda Item 9. Biological reference points

9.1 Methods to calculate biological reference points

Agenda Item 10. Future projection of chub mackerel

10.1 Methods to conduct future projection

Agenda Item 11. Review of the Work Plan of the TWG CMSA

Agenda Item 12. Other matters

12.1 Timeline and intersessional activities before TWG CMSA09

12.2 Observer Program

12.2.1 Review data or data description on fisheries bycatch in the chub mackerel fisheries

12.3 Species summary

12.4 Space and methods to share data and codes

12.5 Other issues

Agenda Item 13. Recommendations to the Scientific Committee

Agenda Item 14. Adoption of Report

Agenda Item 15. Close of the Meeting

Annex B

List of Documents

MEETING INFORMATION PAPERS

Document Number	Title
NPFC-2024-SWG MSE PS05-MIP01 (Rev. 2)	Meeting Information
NPFC-2024-TWG CMSA08-MIP02	Provisional Agenda
NPFC-2024-TWG CMSA08-MIP03 (Rev. 1)	Annotated Indicative Schedule

WORKING PAPERS

Document Number	Title
NPFC-2024-TWG CMSA08-WP01 (Rev. 1)	TWG CMSA Work Plan, 2023-2027
NPFC-2024-TWG CMSA08-WP02	Species summary for chub mackerel
NPFC-2024-TWG CMSA08-WP03	Standardized CPUE of Japanese commercial dip-net fishery targeting spawners of chub mackerel in the Northwest Pacific up to 2023
NPFC-2024-TWG CMSA08-WP04 (Rev. 1)	CPUE Standardization Protocol for Chub Mackerel
NPFC-2024-TWG CMSA08-WP05 (Rev. 1)	Standardizing monthly egg survey data as an abundance index for spawning stock biomass of chub mackerel in the Northwest Pacific
NPFC-2024-TWG CMSA08-WP06 (Rev. 1)	Standardized abundance index for recruitment of chub mackerel from Northwest Pacific summer surveys up to 2023
NPFC-2024-TWG CMSA08-WP07 (Rev. 1)	Standardized CPUE of Chub mackerel (*Scomber japonicus*) caught by the China's lighting purse seine fishery up to 2022
NPFC-2024-TWG CMSA08-WP08 (Rev. 1)	Standardized Abundance Indices for Ages 0 and 1 Fish of Chub Mackerel from Northwest Pacific Autumn Surveys up to 2023
NPFC-2024-TWG CMSA08-WP09	Chub mackerel abundance indices in the North-Western Pacific Ocean based on the results of stocks surveys carried out by Russian research vessels in 2014-2023
NPFC-2024-TWG CMSA08-WP11	Quarterly catches and average weights by age groups
NPFC-2024-TWG CMSA08-WP12	Growth and Mortality Estimation for Chub Mackerel based on Chinese data in the Convention Area of NPFC
NPFC-2023-SC08-WP04 (Rev. 1)	Performance Review recommendations_SC08

NPFC-2023-TWG CMSA07-WP07 (Rev. 1)	On the description and flexibility of state-space assessment model

INFORMATION PAPERS

Document Number	Title
NPFC-2024-TWG CMSA08-IP01	Report on GIT Repository Plan for TWG CMSA
NPFC-2024-TWG CMSA08-IP02	Chub mackerel Russian fishery in the northwest Pacific Ocean Pacific Ocean, research activities in 2023
NPFC-2024-TWG CMSA08-IP03	Abundance and Distribution Estimation for Chub Mackerel and Blue mackerel in the Northwest Pacific Based on Scientific Research Surveys
NPFC-2024-TWG CMSA08-IP04	Review of chub mackerel fishery in China and research activities
NPFC-2024-TWG CMSA08-IP05	Recent fishery and stock status of chub mackerel from Japan
NPFC-2024-TWG CMSA08-IP06	Update on natural mortality estimators for chub mackerel in the Northwest Pacific Ocean
NPFC-2024-TWG CMSA08-IP07	Spawning of chub mackerel (*Scomber japonicus*) in the northwestern Pacific
NPFC-2024-TWG CMSA08-IP08	By-catch data from Japanese mackerel fisheries in the Northwest Pacific
NPFC-2023-SC08-IP13(Rev 1)	Biological Data Provision Template

REFERENCE DOCUMENTS

Document Number	Title
NPFC-2023-TWG CMSA07-Final Report	7th TWG CMSA meeting report
NPFC-2024-TWG CMSA08-RP01	Summary of the 3rd Intersessional Meeting of the Technical Working Group on Chub Mackerel Stock Assessment
NPFC-2023-SC08-Draft Report	SC08 Draft Report

Annex C

List of Participants

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Annex D

Age-specific data to be used in the stock assessment and their specification

Data	CHINA		JAPAN		RUSSIA	
	Starting year	**Terminal year**	**Starting year**	**Terminal year**	**Starting year**	**Terminal year**
CAL	2016 Q1 (CY)	2023 Q2 (CY)	1970 Q3 (CY)	2023 Q2 (CY)	2016 Q2 (CY)	2023 Q2 (CY)
ALK	2018 Q1 (CY)	2023 Q2 (CY)	1970 Q3 (CY)	2023 Q2 (CY)	-	-
CAA	2015 Q1 (CY)*1	2023 Q2 (CY)	1970 Q3 (CY)	2023 Q2 (CY)	2014 Q1 (CY)*1	2023 Q2 (CY)
WAA	2018 Q1 (CY)	2023 Q2 (CY)	1970 Q3 (CY)	2023 Q2 (CY)	2016 Q2 (CY)	2023 Q2 (CY)
MAA	2018 Q1 (CY)	2023 Q2 (CY)	1970 Q3 (CY)	2023 Q2 (CY)	-	-

*1 For 2016, compute catch-at-age data based on Chinese catch-at-length data using Eastern Japanese ALK. For 2015 for China and 2014-2015 for Russia, compute catch-at-age based on the average of 2016-2018 catch-at-length data using Eastern Japanese ALK. For 2018-2022, compute catch-at-age based on the catch-at-age from China.

Annex E

Abundance indices to be used in the stock assessment and their specification

Member	Gear/Survey	Ages	Starting year	Terminal year
CHINA	Lighting purse seine	Multiple ages (See paragraph 61 of the report)	2015 FY	2022 FY
JAPAN	Summer survey	Age 0	2002 FY	2022 (2023) FY*1
	Autumn survey	Age 0	2005 FY	2022 (2023) FY*1
		Age 1	2005 FY	2022 (2023) FY*1
	Egg survey	SSB	2005 FY	2022 (2023) FY*1
	Dip net	SSB	2003 FY	2022 (2023) FY*1
RUSSIA	Trawl	TBD	TBD	TBD

*1 The 2023FY values for the five Japanese indices will be considered for inclusion or not after the updating and validation of CPUE standardization and preliminary analysis of SAM.

Annex F

Settings and specification of SAM

Model configuration	Parameter	Option(s) to be addressed after input data fixed by TWG CMSA09	Potential option(s) requiring revision or development (long-term work)	Note
Recruitment	$N_{0,y}$	• Parameterized Beverton-Holt stock-recruitment relationship with α and β estimated in the model • Beverton-Holt stock-recruitment relationship with fixed parameters such as α and β or steepness parameter h, exploring the fit of the model to a range of values that would give low, intermediate, and high steepnesses that seem plausible	• Bent hockey-stick SRR • Consider other possible options	Analyzing HS SRR is difficult in SAM
Nonlinear coefficient for abundance indices	b_k	Searching the best option(s) about how constraints are imposed on which indices based on AIC etc		
Years of F random walk	-	• Include the Markov process for all years as the base case • Conduct sensitivity analyses if possible		

Correlation of age classes in F random walk	ρ	Searching the best option(s) about how constraints are imposed on which indices based on AIC etc		
Process errors in numbers older than age 0	ω_a $(a>0)$	• Fix at a very small value (0.01) • Estimate process errors for older than age 0		
SD in F random walk	σ_a	Searching the best option(s) about how constraints are imposed on which age classes based on AIC etc	Consider other structures of random errors	
SD in measurement errors of catch at age	τ_a	• Searching the best option(s) about how constraints are imposed on which age classes based on AIC etc • Sensitivity analysis for 2014 and 2015 data may be needed	Consider other structures of random errors	
SD in measurement errors of abundance indices	v_a	Searching the best option(s) about how constraints are imposed on which age classes based on AIC etc	Consider other structures of random errors	
Number of fleets	-	Single fleet (explore calculation of F by fleet)	Multiple	• A relatively large revision is required • Extension to multi-fleets may be useful in fitting fishery-dependent CPUE and for a management purpose

Natural mortality	M	• Age-common M (0.5) • Age-specific M (0.80 for age 0, 0.60 for age 1, 0.51 for age 2, 0.46 for age 3, 0.43 for age 4, 0.41 for age 5, and 0.40 for age 6+) • Likelihood profiles and sensitivity analyses on natural mortality	Time varying M	
Maturity-at-age		• Jpn MAA • Chn MAA by 10Feb and may compile Chn and Jpn data	Incorporate density dependence in weight growth and maturity	
Catch-at-age	$C_{a.y}$	• See Annex D • Conduct sensitivity analysis by excluding 2015 data • Conduct sensitivity analyses for the other two scenarios for catch-at-age data for China in 2015	Put different weights based on data uncertainty	SAM allows missing data in catch at age
Weight-at-age		To compute total biomass and SSB using an average, weighted by age-specific catch number with the same ratio across all years (FY2014–FY2022) by Member, of Chn, E/WJpn and Rus WAA		
Summer survey index (age 0)		Agreed to be used for SA (WP06 Rev 1)		

Autumn survey indices (ages 0, 1)		Agreed to be used for SA (WP08 Rev 1)	Compare the effect of assuming an autoregressive process or an independent and identically distributed process in the CPUE standardization	
Egg abundance (SSB)		Agreed to be used for SA (WP05 Rev 1) after it is updated with July 2023 data		
Dipnet fishery (SSB)		Agreed to be used for SA (WP03)		
Chinese fishery CPUE		To be updated intersessionally and submitted for review by 10Feb		
Russian fishery CPUE		To be updated and submitted for review for potential use as a sensitivity scenario		

Annex G

Options for the basic specifications for conducting future projections for chub mackerel

Items	Option A	Option B	Option C	Option D	Issue to be clarified
Type of simulation	**Stochastic (Run Numbers depending on SRR settings. Analyst to determine.)**	Deterministic			Model uncertainty, Management objective
Duration	Short (<5 years)	**Medium (5-10 years)**	Long (>10 years)	Equilibrium (related to projection levels of Fref)	Ask the COM to consider management objective and methods. Consider appropriate duration for chub mackerel
Catch or F levels	F-based (Current F/Mean F for reference period) **Fmsy, % of Current Catch Based**	C-based (What is HCR?)	Other MP?	Include terminal year's F or not	Management Method, HCR
Estimation of catch from terminal year (FY 2022) to current year	**Terminal year (**total catch, or **recent F)**	Last year of harvest	Average of 2 or 3 recent years		
Type of uncertainties					

Other parameters (not recruitment)	**Parameter estimates without uncertainty**	Parameter estimates with uncertainty (future study)			
Process error other than Age 0	Depending on SAM settings and if this is estimated. Keep small				Note that SAM includes process error on all ages
Recruitment level	Model-based approach using S-R relations (**BH**/**HS**)	Empirical approach by resampling past recruitments (what duration?)			Model uncertainty
Error structure in recruitment	**Parametric with process error**	Non-parametric (resampling of deviations)	Recruitment (Process error)		Future work could consider that future recruitment is lower and possibly link to an environmental signal

Note: Bold font indicates recommended settings for projections.

Annex H

Timeline and activities for intersessional work from the conclusion of TWG CMSA08 to the next TWG CMSA meeting in mid-July

<table>
<tr><th colspan="2">Month</th><th>Catch@Age</th><th>Weight@Age</th><th>Maturity@Age</th><th>Abundance Indices</th><th>SAM/Future projection</th><th>BRP</th></tr>
<tr><td rowspan="4">Feb</td><td>Early</td><td>CHN submit CAL and CAA up to 2nd quarter 2023 by 10 Feb</td><td>RUS submit WAA up to 2nd quarter 2023 by 10 Feb</td><td>CHN submit revised and updated MAA up to 2nd quarter 2023 by 10 Feb</td><td>CHN submit revised abundance indices by 10 Feb</td><td rowspan="4">After GIT repository becomes available, SAM codes are posted.</td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>25-Feb</td><td colspan="4">Finalization of input data</td><td></td></tr>
<tr><td>Late</td><td colspan="4" rowspan="2">(one-day) intersessional meeting to check finalized input data</td><td></td></tr>
<tr><td rowspan="3">Mar</td><td>Early</td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Late</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Apr</td><td>Early</td><td></td><td></td><td></td><td></td><td></td><td>Update of OMutility, if possible</td></tr>
<tr><td>Mid</td><td colspan="6" rowspan="2">(one/two-day(s)) intersessional meeting to check progress of stock assessment works</td></tr>
<tr><td>Late</td></tr>
<tr><td rowspan="2">May</td><td>Early</td><td></td><td></td><td></td><td></td><td rowspan="2">Future projection codes are posted in</td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	Late					GIT repository no later than end of May	Share updated OMutility with Members
Jun	Early						
	Mid	Working papers due					
	Late						
Jul	Early						
	Mid						
	17-20	TWG CMSA09					