North Pacific Fisheries Commission
1st Meeting of the Small Scientific Committee on Neon Flying Squid

22–23 August 2024
WebEx

REPORT

Agenda Item 1. Opening of the Meeting

1. The 1st Meeting of the Small Scientific Committee on Neon Flying Squid (SSC NFS01) took place as a virtual meeting via WebEx, and was attended by Members from Canada, China, Japan, the Republic of Korea, the Russian Federation, Chinese Taipei, the United States of America, and the Republic of Vanuatu. The Pew Charitable Trusts attended as an observer. An invited expert, Dr. Rujia Bi, participated in the meeting.

2. The meeting was opened by the SSC NFS Chair, Dr. Luoliang Xu (China), who welcomed the participants.

3. The Science Manager, Dr. Aleksandr Zavolokin, outlined the procedures for the meeting.

4. Mr. Alex Meyer was selected as rapporteur.

Agenda Item 2. Adoption of Agenda

5. The agenda was adopted (Annex A). The List of Documents and List of Participants are attached (Annexes B, C).

Agenda Item 3. Review of the draft Terms of Reference of the SSC NFS

6. The Chair presented the draft Terms of Reference of the SSC NFS (NPFC-2024-SSC NFS01-WP01).

7. The SSC NFS reviewed and revised the draft. The SSC NFS recommended that the Scientific Committee (SC) endorse the Terms of Reference of the SSC NFS (Annex D).

8. The SSC NFS requested that the Secretariat set up a GitHub site for the SSC NFS for data/code-sharing.

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Agenda Item 4. Overview of the outcomes of previous NPFC meetings

4.1 Joint meeting of the Small Working Groups on NFS, JFS, JS, and BM

9. The Chair presented the NFS-related outcomes and recommendations from previous joint meetings of the Small Working Groups on NFS, Japanese flying squid (JFS), Japanese sardine (JS), and blue mackerel (BM).

4.2 SC08 and COM08

10. The Science Manager presented the outcomes from the 8th Commission meeting (COM08) of relevance to NFS, highlighting discussions related to the Performance Review Panel Report, the development of a regional observer program (ROP), and the Resolution on Climate Change. The SC and its subsidiary bodies, including the SSC NFS, are requested to provide responses on the Performance Review Panel recommendations. They are also requested to provide guidance to the Technical and Compliance Committee (TCC) on necessary observer coverage and data needs for an ROP, which the SSC NFS will address under agenda item 9.1. Regarding, the Resolution on Climate Change, since COM08, the Food and Agriculture Organization of the United Nations (FAO) has agreed to fund a consultancy on climate change with the NPFC.

Agenda Item 5. Updates on Member's fishery status and fishery-dependent abundance indices

5.1 Presentation prepared by each member in advance

11. Korea presented its NFS fishery status up to 2023 (NPFC-2024-SSC NFS01-IP01). Korea has conducted exploratory fishing in the North Pacific Ocean in 2017 (1 vessel), 2021 (1 vessel) and 2022 (2 vessels). All Korean NFS catch is by stick-held dipnet vessels which have squid jigging licenses, but NFS is not their primary target species. The number of stick-held dipnet vessels fishing for squid has gradually decreased since 2016 to 6 in 2023. The NFS fishery is operated alongside the Pacific saury fishery and catches of NFS are most abundant from the end of July through August. Fishing grounds have consistently been situated east of 160°E longitude. In 2022, the average mantle length was lowest in August and highest in June, in 2021, it was similar between August and September and the highest in July, and in 2017, it was lowest in July and similar for September and October.

12. China presented its NFS fishery status up to 2023 (NPFC-2024-SSC NFS01-IP02 (Rev. 1)). Chinese jigging fishing fleets catch two cohorts of NFS in the Northwest Pacific Ocean: the autumn cohort and the winter-spring cohort, which are separated by the 170°E longitude line. During 2005–2008, the annual catch and vessel number for the winter-spring cohort were higher. After 2008, the catch and vessel number decreased gradually. The catch and vessel number for the autumn cohort increased year by year from 2012. In recent years, the catch and vessel number for the two cohorts decreased year by year. During 2018–2022, the winter-spring

cohort were mainly caught in 37°N – 45°N, 146°E – 170°E, whereas the autumn cohort were mainly caught in 37°N – 45°N, 170°E – 160°W. The fishing area of the winter-spring cohort decreased from 2020 to 2021 and increased in 2022. The fishing area of the autumn cohort has gradually expanded since 2018. Generally, the catch per unit effort (CPUE) of the winter-spring cohort peaked in July and August, and then gradually decreased, while the CPUE of autumn cohort decreased rapidly after July. The CPUE trend for the winter-spring cohort fluctuated slightly in the early years, then increased significantly after 2001. It suddenly decreased after 2007, with the lowest value in 2009. In recent years, the CPUE has remained at a relatively low level. For the autumn cohort, the CPUE has been stable relative to the winter-spring cohort.

13. Japan presented its NFS fishery status up to 2023 (NPFC-2024-SSC NFS01-IP03). Since the entry into effect of the High Seas Driftnet Fishing Moratorium in 1992, squid jigging has become Japan's main NFS fishery, with more than 99% of NFS caught by squid jigging. The total catch in 2023 was 4,396 MT. In general, Japanese fishing vessels mainly operate in the Convention Area east of 170°E from May to July. They have also operated in Japanese national waters in January and February. Most of the catch was taken in the Convention Area east of 170°E. There was almost no catch in national waters because fishing vessels operating in national waters in January and February targeted JFS. The number of vessels operating in the Convention Area east of 170°E has been stable since 2011 at around 25 vessels. The number of vessels operating in national waters has been decreasing in recent years. Nominal CPUE was 0.8 MT/day in the Convention Area west of 170°E and national waters, and 2.2 MT/day in the Convention Area east of 170°E.

14. Chinese Taipei presented its NFS fishery status up to 2023 (NPFC-2024-SSC NFS01-IP04). The NFS fishery is a part-time fishery. A total of 47 vessels were involved in the fishery with a catch of 319 MT in 2023. The highest annual catch was in 2004 at 9,022 MT. Vessels can target both NFS and Pacific saury and from 2001 to 2011, they mainly targeted NFS, but after 2016 they mainly targeted Pacific saury. In early years, NFS catch has occurred earlier in the fishing season, but in recent years, it has occurred later in the season. The nominal CPUE was 1.51 MT/day in 2023. The historical high was 10.69 MT/day in 2008. Fishing grounds were wider in 2022 compared to 2023. For size composition, NFS catch is categorized by commercial weight categories and larger NFS are caught later in the season.

15. Vanuatu presented its NFS fishery status up to 2023 (NPFC-2024-SSC NFS01-IP06). Vanuatu's NFS vessels have multiple gears onboard, are able to target both NFS and Pacific saury, and mainly target Pacific saury. Annual catch of NFS declined from 118 MT in 2019 to 2 MT in 2023. There were two active vessels fishing for NFS in 2023. Nominal CPUE was 0.2 MT/day in 2023. The fishing grounds are mainly between 150°E longitude and 160°E longitude,

similar to the fishing grounds for Pacific saury.

16. Russia informed the SSC NFS that its vessels caught around 2 MT of NFS in 2023 as part of experimental fishing in the Russian exclusive economic zone (EEZ) east of the Kuril Islands. On average, there was less than 100 kg of catch per day per vessel.

17. The SSC NFS noted that some Members' vessels have multiple gears onboard and can switch between targeting Pacific saury and NFS based on various considerations. This should be taken into consideration in future work on stock assessment and management of NFS. The SSC NFS suggested that spatio-temporal models would be able to incorporate the impacts of Pacific saury fisheries when standardizing the NFS CPUE for fishery-dependent data.

18. The SSC NFS agreed that it would be useful to have a protocol and standardized presentation format for sharing NFS fishery status information. The SSC NFS requested the Chair and the invited expert to draft a protocol for sharing fishery status information and present it at the next meeting. The SSC NFS agreed to develop a template for fishery status information for neon flying squid based on the template for Pacific saury.

19. China presented a CPUE standardization of NFS caught by the Chinese squid jigging fishery up to 2022 in the Northwest Pacific Ocean (NPFC-2024-SSC NFS01-WP06 (Rev. 1)). China conducted the CPUE standardization using a generalized additive model (GAM) and Xtreme gradient boosting model (XGB) and used the variance inflation factors (VIF) to screen out the variables with high multicollinearity. The performance differed between models and cohorts. The performance of the XGB was found to be better than that of the GAM. The trends for the nominal CPUE and the standardized CPUEs are generally consistent with each other, and the standardized CPUEs are more stable than the nominal CPUE for the two cohorts.

20. Japan suggested that in future CPUE standardizations, China should present the results using scaled values to enable better comparison of the XGB and GAM models.

21. The SSC NFS noted that China also has catch data from before 2005. The SSC NFS noted that these data would be useful for future stock assessment work and requested China to share them. China explained that the catch and effort data prior to 2005 were collected via logbooks, which represent only a portion of the total data.

22. China presented a summary of squid jigging surveys conducted between 2021 and 2023 by R/V Songhang, Shanghai Ocean University's pelagic fishery resources survey vessel (NPFC-2024-SSC NFS01-WP07 (Rev. 1)). Based on the surveys, the predominant squid species in the

Northwest Pacific Ocean were found to be boreal clubhook squid, Boreopacific armhook squid, NFS, and luminous flying squid. Catch data from the surveys were collected and mapped. Basic biological characteristics of the squid species, including the mantle length (ML) composition, body weight (BW) composition, ML-BW relationship, and sexual maturity composition, were also recorded. NFS was the most abundant species in the surveys and had a high concentration of immature individuals. The catch data between 2021 and 2023 showed an increased squid species diversity and increased total catch. The R/V Songhang's surveys for NFS will be continually improved going forward, and the fishery-independent biology information from the surveys will be provided to support NFS stock assessment work.

23. Japan presented a CPUE standardization for the autumn and winter-spring cohorts of NFS based on Japanese driftnet surveys conducted in the summer in the Northwest Pacific Ocean (NPFC-2024-SSC NFS01-WP09). The size of squid caught with driftnets showed a bimodal distribution, and Japan assumed that individuals smaller than the boundary separating the two peaks represented the winter-spring cohort, while larger individuals represented the autumn cohort. The autumn cohort was mainly caught at stations east of 170^{o}E, while the winter-spring cohort had a wider distribution. Japan estimated the standardized CPUE using GAM with temporal, spatial, and environmental variables, which showed large interannual variation for both cohorts. However, there were no clear increasing or decreasing trends over the years for either cohort. Japan suggested that a standardized survey CPUE may provide a fishery-independent abundance index for a future stock assessment by the SSC NFS. It also recommended that size information is essential for separating the two cohorts of NFS.

24. The SSC NFS suggested that Japan explore approaches that could account for spatio-temporal changes in the survey stations, for example applying a spatio-temporal model such as tinyVAST. The SSC NFS suggested that tinyVAST would also support a multi-cohort model and that the covariance between the autumn and winter-spring cohorts could be used to improve the standardized CPUE estimates for both cohorts. Furthermore, the SSC NFS suggested that spatio-temporal models would allow Japan to check for spatial residual patterns.

25. The SSC NFS suggested that in the future, Japan and China could consider sharing survey data to create one dataset with increased coverage or coordinate with each other when designing their respective surveys to maximize their combined survey coverage.

26. Japan presented an analysis of the differences in the distribution of the NFS by spawning cohort in the North Pacific Ocean (NPFC-2024-SSC NFS01-WP10). Japan estimated the hatching month and spawning cohort composition of NFS in the North Pacific Ocean by age determination using the statoliths of squid caught by Japanese surveys. Japan found that NFS

caught in the waters east of 170°E includes both the autumn and the winter-spring cohorts. Therefore, to enable reliable separation of Member-specific commercial catch into two cohorts, it is important to clarify the size and age compositions of the catch. Japan recommended that the SSC NFS review Member-specific information on size and age of commercial NFS catch in parallel with confirmation of spatial and temporal changes in fishing ground by Member.

27. Japan presented a summary of its surveys for NFS spawning grounds in the North Pacific Ocean (NPFC-2024-SSC NFS01-WP11). Japan examined information on the distribution of NFS paralarvae based on the results of its spawning ground surveys. The information indicates that NFS could be distributed in the waters both west and east of 170°E. In particular, the winter-spring cohort squid were distinctly distributed east of the 170°E boundary line, which the SSC NFS has applied as a tentative criterion for splitting catch data into two cohorts. Japan suggested that, to validate this criterion, it is necessary to confirm the cohort composition of the commercial catch of NFS towards conducting stock assessments of each cohort.

28. The SSC NFS agreed to hold further discussions at its next meeting on how to separate the two NFS cohorts for conducting stock assessments of each. The SSC NFS agreed that the 170°E longitudinal line is a useful general approach for separating the two cohorts but agreed that further information, such as size data, is needed to more accurately estimate the catch data by cohort.

5.2 CPUE standardization protocol

29. The Chair presented the draft CPUE Standardization Protocol for NFS (NPFC-2024-SSC NFS01-WP02).

30. The SSC NFS reviewed the draft and recommended the SC endorse the CPUE Standardization Protocol for NFS (Annex E).

31. The SSC NFS agreed to develop a template document for Members' CPUE standardizations and requested the SSC NFS Chair to present a draft template at the next meeting.

Agenda Item 6. Review of biological information for NFS

32. China presented the ML composition, BW composition, ML-BW relationship, and the sexual maturity composition for NFS caught in surveys by Chinese squid jigging vessels in the Northwest Pacific Ocean between 2007 and 2018 (NPFC-2024-SSC NFS01-WP08 (Rev. 1)). The data revealed that between 2007 and 2018, there was an interannual variability in ML and BW of NFS, showing a downward and then upward trend, and there was a shift in the individual size from short and fat to tall and thin, a phenomenon that may be related to the frequent

occurrence of extreme weather events. These biological data can provide complementary information for an NFS stock assessment.

Agenda Item 7. Stock assessment modelling

7.1 Review of any updates and progress

7.1.1 Potential updates on the surplus production models

33. Japan presented a preliminary application of the stochastic surplus production model in continuous time (SPiCT) to the autumn and winter-spring cohorts of NFS in the North Pacific for demonstration purposes (NPFC-2024-SSC NFS01-WP12). NPFC statistics, including annual catch and effort from NFS fisheries in the North Pacific between 1995 and 2023, were used. CPUE standardized with a generalized linear mixed model including year and Member was used as a biomass index. The relationship between the biomass index and effort was found to be not represented by a negative slope in both NFS cohorts, contrary to the assumption of the surplus production model. At present, Members' available catch time series are for different time periods, which is one area that could be improved. Possibly due to such problems with the input data, results from the autumn cohort assessment were unacceptable, with wide confidence intervals of estimates, such as relative biomass and fishing mortality. In the winter-spring cohort model, the estimated values appeared acceptable as the model diagnostics were satisfactory and showed consistent retrospective patterns for relative biomass and fishing mortality. Input data preparation and the estimation of biomass indices will be important for NFS stock assessments. The main advantage of SPiCT is that it incorporates seasonality, so it can be a potential tool for assessing the NFS stock status using seasonal datasets, as has already been applied to other cephalopod stocks.

7.2 Stock assessment protocol

34. The Chair presented the draft Stock Assessment Protocol for NFS (NPFC-2024-SSC NFS01-WP03).

35. The SSC NFS reviewed the draft and recommended that the SC endorse the Stock Assessment Protocol for NFS (Annex F).

7.3 Recommendations for future work

36. The SSC NFS suggested that the issue of different data periods among Members' available catch time series could potentially be resolved by developing a joint standardized CPUE index.

37. The SSC NFS encouraged Japan to conduct further work to develop the SPiCT model, such as incorporating survey data and considering additional scenarios for separating the two NFS cohorts besides spatial structure, e.g., size structure.

38. China suggested that the autumn and winter-spring NFS cohorts could be two subpopulations and that migration might occur between them. China suggested a surplus production model that incorporates spatial components could be appropriate for assessing the status of such a stock.

Agenda Item 8. Review of the Work Plan of the SSC NFS

8.1 Work Plan of the SSC NFS

39. The SSC NFS reviewed, revised, and endorsed the 2024-2028 SSC NFS 5-Year Rolling Work Plan (NPFC-2024-SSC NFS01-WP04 (Rev. 1)).

8.2 NPFC Performance Review recommendations

40. The Science Manager presented the proposed responses, drafted by the SSC NFS Chair with the SC Chair and the Secretariat, to the recommendations from the Performance Review report that concern NFS. The SSC NFS reviewed and further developed the proposed responses (NPFC-2024-SC09-WP01 (Rev. 3)).

Agenda Item 9. Other matters

9.1 Observer Program

41. The Science Manager informed the SSC NFS that the Commission requested that the SC provide guidance to the TCC on what level of observer coverage would be needed on fishing vessels and what kinds of data would need to be collected to achieve the scientific objectives of an ROP. Following this, the SC Chair has requested the SC's subsidiary bodies, including the SSC NFS, to consider the scientific objectives, data needs, and level of observer coverage, and to come to SC09 prepared to discuss these. In addition, the TCC Chair has asked the SC and its subsidiary bodies to answer the following questions: 1. Are there different needs for the different fisheries regarding data collection? 2. What new data would the SC prioritize/need from a ROP? 3. What new data would be nice to have (i.e. not needed/priority)? 4. Whether this data could be collected through electronic monitoring (EM)? 5. Whether the observer needs to be a scientist, or can data be collected by a non-scientist?

42. The SSC NFS noted the importance of collecting age and size composition data for more accurately separating the two cohorts of NFS. Size data can be collected by onboard observers or by port sampling. Such data could potentially be collected by electronic monitoring, but further study and technical work is needed to confirm whether this would indeed be possible. An observer collecting size composition data would not necessarily need to be a scientist but would need to be able to distinguish between different squid species, which could be achieved with the appropriate training and could possibly be further supported by the development of a species identification guidebook by the SSC NFS.

43. The SSC NFS agreed to develop a common sampling protocol for collecting NFS age and size data, taking into account individual Members' protocols. The SSC NFS requested Members to initiate this work via correspondence in the intersessional period.

44. The Science Manager reminded the SSC NFS that some Members have noted that an ROP could be supplemented with national observer programs and presented a summary table showing the existence and type of Members' national observer programs in the Convention Area and adjacent EEZs (NPFC-2024-SC09-WP02 (Rev. 3)).

45. Vanuatu provided additional information about its national observer program and offered to work with the Secretariat to update the summary table on Members' national observer programs in the intersessional period.

9.2 Discussion on biological information/data sharing

46. The SSC NFS reviewed the data provision templates from SC08 (NPFC-2023-SC08-IP13 (Rev. 1)). The SSC NFS had no specific feedback about the templates. The SSC NFS encouraged Members to review and test the templates and provide their feedback by SC09.

9.3 Other

47. The SSC NFS reviewed and updated the species summary for NFS (NPFC-2024-SSC NFS01-WP05 (Rev. 1)). The SSC NFS agreed to continue to update the species summary further in the intersessional period leading up to SC09. The SSC NFS recommended that the SC adopt the updated species summary (Annex G) or a further updated version that will be presented at SC09.

48. The Science Manager provided an update on SC project #5: Invited expert to support SSC NFS, including the status of the project and proposals for future work in 2024 (NPFC-2024-SSC NFS01-IP06). The Science Manager invited the SSC NFS to review the proposal from the Chair and make other proposals for future work as appropriate.

49. The SSC NFS agreed to task the invited expert to:
    (a) assist the Chair in drafting a template for fishery status information, and
    (b) draft an overview summarizing the stock assessment methods and management measures that have been used for squids or other short-lived species with similar biological characteristics as NFS and present the overview at the next SSC NFS meeting, either in-person or remotely.

50. The SSC NFS recommended that the SC continue to hire an invited expert in 2025 to support

the SSC NFS during its meetings and to conduct other work to support the SSC NFS as appropriate.

51. The SSC NFS agreed to hold two hybrid or in-person meetings in 2025, for three or four days each, with the dates to be determined at SC09.

52. The SSC NFS agreed to include climate change as a standing agenda item in future meetings.

Agenda Item 10. Recommendations to the Scientific Committee

53. The SSC NFS agreed to:
    (a) develop a template for fishery status information for neon flying squid based on the template for Pacific saury.
    (b) hold further discussions at its next meeting on how to separate the two NFS cohorts for conducting stock assessments of each.
    (c) develop a template document for Members' CPUE standardizations.
    (d) develop a common sampling protocol for collecting NFS age and size data, taking into account individual Members' protocols.
    (e) task the invited expert to:
        i. assist the Chair in drafting a template for fishery status information, and
        ii. draft an overview summarizing the stock assessment methods and management measures that have been used for squids or other short-lived species with similar biological characteristics as NFS and present the overview at the at the next SSC NFS meeting, either in-person or remotely.
    (f) hold two hybrid or in-person meetings in 2025, for three or four days each, with the dates to be determined at SC09.
    (g) include climate change as a standing agenda item in future meetings.

54. The SSC NFS recommended that the SC:
    (a) endorse the Terms of Reference for the Small Scientific Committee on Neon Flying Squid (Annex D).
    (b) endorse the CPUE Standardization Protocol for neon flying squid (Annex E).
    (c) endorse the Stock assessment protocol for neon flying squid (Annex F).
    (d) adopt the Work Plan of the SSC NFS (NPFC-2024-SSC NFS01-WP04 (Rev. 1)).
    (e) adopt the updated species summary for neon flying squid (Annex G) or a further updated version that will be presented at SC09.
    (f) consider the SSC NFS's comments on the NPFC Performance Review recommendations that concern neon flying squid (NPFC-2024-SC09-WP01 (Rev. 3)).
    (g) continue to hire an invited expert in 2025 to support the SSC NFS during its meetings and

conduct other work to support the SSC NFS as appropriate.

Agenda Item 11. Adoption of the Report

55. The SSC NFS01 Report was adopted by consensus.

Agenda Item 12. Close of the Meeting

56. The meeting closed at 12:40 on 23 August 2024, Tokyo time.

Annexes:

Annex A – Agenda

Annex B – List of Documents

Annex C – List of Participants

Annex D – Terms of Reference for the Small Scientific Committee on Neon Flying Squid

Annex E – CPUE standardization protocol for neon flying squid

Annex F – Stock assessment protocol for neon flying squid

Annex G – Species summary for neon flying squid

Annex A

Agenda

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Agenda Item 2. Adoption of Agenda

Agenda Item 3. Review of the draft Terms of Reference of the SSC NFS

Agenda Item 4. Overview of the outcomes of previous NPFC meetings related to NFS
- 4.1 Joint meeting of the Small Working Groups on NFS, JFS, JS, and BM
- 4.2 SC08 and COM08

Agenda Item 5. Updates on Members' fishery status and fishery-dependent abundance indices
- 5.1 Presentation prepared by each member in advance
- 5.2 CPUE standardization protocol

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Agenda Item 7. Stock assessment modelling
- 7.1 Review of any updates and progress
  - 7.1.1 Potential updates on the surplus production models
- 7.2 Stock assessment protocol
- 7.3 Recommendations for future work

Agenda Item 8. Review of the Work Plan of the SSC NFS
- 8.1 Work Plan of the SSC NFS
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Agenda Item 9. Other matters
- 9.1 Observer Program
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- 9.3 Other

Agenda Item 10. Recommendations to the Scientific Committee

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Annex B

List of Documents

MEETING INFORMATION PAPERS

Number	Title
NPFC-2024-SSC NFS01-MIP01	Meeting Information
NPFC-2024-SSC NFS01-MIP02	Provisional Agenda
NPFC-2024-SSC NFS01-MIP03 (Rev. 1)	Annotated Indicative Schedule

WORKING PAPERS

Number	Title
NPFC-2024-SSC NFS01-WP01 (Rev. 1)	Draft Terms of Reference for SSC NFS
NPFC-2024-SSC NFS01-WP02	Draft CPUE Standardization Protocol for Neon Flying Squid
NPFC-2024-SSC NFS01-WP03	Stock Assessment Protocol for Neon Flying Squid
NPFC-2024-SSC NFS01-WP04 (Rev. 1)	Draft Five-Year Work Plan of the SSC NFS
NPFC-2024-SSC NFS01-WP05 (Rev. 1)	Species summary for neon flying squid
NPFC-2024-SSC NFS01-WP06 (Rev. 1)	CPUE standardization of Neon flying squid caught by the Chinese squid jigging fishery up to 2022 in the Northwest Pacific Ocean
NPFC-2024-SSC NFS01-WP07 (Rev. 1)	Surveys on Squid Jigging in the High Sea of Northwest Pacific Ocean
NPFC-2024-SSC NFS01-WP08 (Rev. 1)	Basic Biological Characteristics of Neon Flying Squid Collected by Chinese Squid Jigging Vessels in the Northwest Pacific Ocean
NPFC-2024-SSC NFS01-WP09	Standardizing catch per unit effort for the autumn and winter-spring cohorts of neon flying squid based on Japanese driftnet surveys
NPFC-2024-SSC NFS01-WP10	Differences in the distribution of the neon flying squid by spawning cohort in the North Pacific Ocean based on the results of age determination using statoliths
NPFC-2024-SSC NFS01-WP11	Brief summary of the Japanese surveys for spawning grounds of the neon flying squid in the North Pacific Ocean
NPFC-2024-SSC NFS01-WP12	Preliminary application of the stochastic surplus production model in continuous time (SPiCT) to neon flying squid in the North Pacific
NPFC-2024-SC09-WP01 (Rev. 3)	Performance Review Recommendations update

NPFC-2024-SC09-WP02 (Rev. 4)	Report on the existing observer programs of NPFC Members and those of other RFMOs
NPFC-2024-TWG CMSA09-WP10	Scientific data management system: data inventory

INFORMATION PAPERS

Number	Title
NPFC-2024-SSC NFS01-IP01	Korean Neon Flying Squid Fishery Status up to 2023
NPFC-2024-SSC NFS01-IP02 (Rev. 1)	Updates on the Chinese jigging fisheries status of neon flying squid in the Northwest Pacific Ocean
NPFC-2024-SSC NFS01-IP03	Neon flying squid fishing condition in Japan in 2023
NPFC-2024-SSC NFS01-IP04	Neon Flying Squid Fishery - Chinese Taipei
NPFC-2024-SSC NFS01-IP05	Fishery Status for Neon flying squid - Report from Vanuatu Fisheries Department
NPFC-2024-SSC NFS01-IP06	Update on the SC project #5: Invited expert to support SSC NFS
NPFC-2023-SC08-IP13 (Rev 1)	Biological Data Provision Templates

Annex C

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Annex D

Terms of Reference for the Small Scientific Committee on Neon Flying Squid

(drafted in August 2024)

1. To review and evaluate fishery data
   - Catch and efforts (including spatial-temporal distribution of landings and discards)
   - Age/size composition data
   - Evaluation of data quantity, data quality, sources of uncertainty
   - Others
   - Recommendation for future works

2. To review and evaluate fishery-dependent and fishery-independent indices
   - Evaluate/update sampling design for fishery-independent survey
   - Characterize the source of uncertainty for the fishery-dependent and fishery-independent data
   - Review/update the CPUE standardization Protocol
   - Conduct CPUE standardization
   - Review and update fishery-dependent and fishery-independent indices
   - Recommendation for future works

3. To review and update biological and other information/data relevant to stock assessment
   - Stock structure
   - Growth
   - Reproduction and maturity schedule
   - Natural mortality
   - Migration pattern
   - Environmental influences (e.g. oceanographic, habitat, or species interactions)
   - Others
   - Evaluation of data quantity, data quality, sources of uncertainty
   - Recommendation for future works

4. To conduct the stock assessment
   - Review existing/potential stock assessment methods or develop new methods
   - Application of candidates of stock assessment models and comparison of the results (if needed)
   - Determine models for the stock assessment
   - Conduct stock assessment following the Stock Assessment Protocol
   - Create the scientific advice on management based on the results of the stock assessment
   - Recommendation for future works

5. To facilitate data- and code- sharing processes and potentially primary publication

6. To review/improve presentation of stock assessment results (including stock status summary report in a format to be determined by the SSC NFS)

7. To explore and develop alternative approaches, such as the management strategy evaluation framework and data-limited management procedures, to provide effective management advice

Annex E

CPUE standardization protocol for neon flying squid

(drafted in August 2024)

CPUE is catch per unit effort obtained either from fishery independent or fishery dependent data. 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 developed for the CPUE standardization:

(1) Provide a description of the type of data (logbook, observer, survey, etc.), and the "resolution" of the data (aggregated, set-by-set etc..).

(2) Identify potential explanatory variables (i.e., spatial, temporal, environmental, and fisheries variables) that may influence CPUE values.

(3) Plot annual/monthly spatial catch, effort and nominal CPUE distributions and determine temporal and spatial resolution for CPUE standardization.

(4) Make scatter plots (for continuous variables) and/or box plots (for categorical variables) and present correlation matrix if possible to evaluate correlations between each pair of those variables.

(5) Describe selected explanatory variables based on (2)-(4) to develop full model for the CPUE standardization.

(6) Specify model type and software (packages) 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) Evaluate and select the best model(s) using methods such as likelihood ratio test, information criterions, cross validation etc.

(8) Provide diagnostic plots to support the chosen model is appropriate and assumption are met (QQ plot and residual plots along with predicted values and important explanatory variables, etc.).

(9) Extract yearly standardized CPUE and standard error by a method that is able to account for spatial heterogeneity of effort, such as least squares mean or expanded grid. If the model includes area and the size of spatial strata differs or the model includes interactions between time and area, then standardized CPUE should be calculated with area weighting for each time step. Model with interactions between area and season or month requires careful consideration on a case by case basis. Provide details on how the CPUE index was extracted.

(10) Calculate uncertainty (SD, CV, CI) for standardized CPUE for each year. Provide detailed

explanation on how the uncertainty was calculated.

(11) Provide a table and a plot of nominal and standardized CPUEs over time. When the trends between nominal and standardized CPUE are largely different, explain the reasons (e.g. spatial shift of fishing efforts), whenever possible.

Annex F

Stock assessment protocol for neon flying squid

(drafted in August 2024)

(1) Identify the data that will be available to the stock assessment;

(2) Evaluate data quality and quantity and potential error sources (e.g., sampling errors, measurement errors, and associated statistical property (e.g., biased or random errors, statistical distribution) to ensure that the best available information is used in the assessment;

(3) Select population models describing the dynamics of the stock and observational models linking population variables with the observed variables;

(4) Develop base case scenarios and alternative scenarios for sensitivity analyses;

(5) For each scenario, fit the model to the data, diagnostics of model convergence, plot and evaluate residual patterns, and evaluate biological implications of the estimated parameters;

(6) Develop retrospective analysis to verify whether any possible systematic inconsistencies exist among model estimates of biomass and fishing mortality;

(7) For each scenario, estimate and plot exploitable stock biomass and fishing mortality (and their relevant credibility distributions) over time;

(8) For each scenario, estimate biological reference points (e.g., MSY, B_{MSY}, F_{MSY}) and its associated uncertainty;

(9) Have the Kobe plot for each scenario;

(10) Develop alternative ABCs for the projection (e.g., 2-year projection);

(11) Include relevant ecosystem considerations regarding the stock for future assessment, including data and results from other scientific studies regarding potential impacts on the stock due to climate change, non-stationary population and fisheries processes, predator-prey dynamics, or impacts of distribution and phenological changes on assessment data.

Annex G

Species summary for neon flying squid

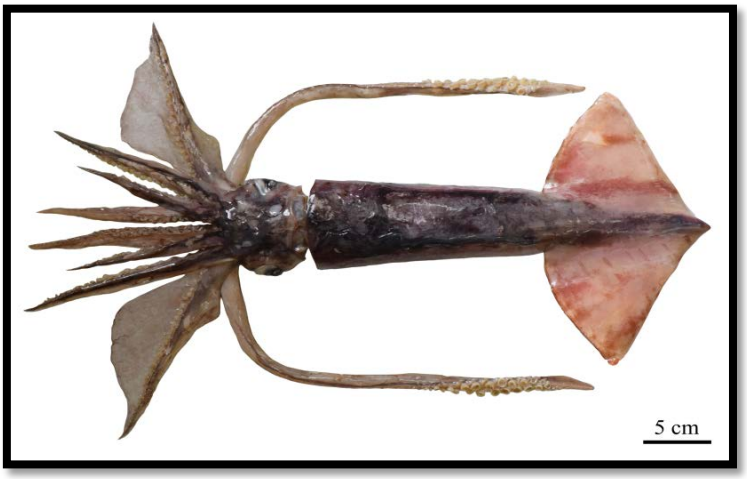

Figure 1. The pictures of neon flying squid

Neon Flying Squid (*Ommastrephes bartramii*)

Common names:

柔鱼 [rou yu] (Chinese); neon flying squid (English); アカイカ [akaika] (Japanese); 빨강오징어 [ppalgangojingeo] (Korean); Кальмар Бартрама [kalmar bartrama] (Russian); 赤魷 [chi-you] (Chinese Taipei).

Other common names: Red flying squid; Webbed flying squid; Red ocean squid (https://www.sealifebase.ca/comnames/CommonNamesList.php?ID=58132&GenusName=Ommastrephes&SpeciesName=bartramii&StockCode=3971)

Management

Active management measures

The following NPFC conservation and management measure (CMM) pertains to this species:
CMM 2024-11 For Japanese Sardine, Neon Flying Squid and Japanese Flying Squid
Available from https://www.npfc.int/active-conservation-and-management-measures.

Management summary

Does not specify catch limits.

Members of the Commission and CNCPs with substantial harvest of neon flying squid in the Convention Area shall refrain from expansion, in the Convention Area, of the number of fishing vessels authorized to fish such species from the historical existing level.

Members of the Commission and CNCPs without substantial harvest of the neon flying squid in the Convention Area are encouraged to refrain from expansion, in the Convention Area, of the number of fishing vessels entitled to fly their flags and authorized to fish for such species from the historical existing level.

Members of the Commission participating in fishing for the neon flying squid in areas under their jurisdiction adjacent to the Convention Area are requested to take compatible measures.

Table1. Management Summary

Convention/Management Principle	Status	Comment/Consideration
Biological reference point(s)	🔴	Not established.
Stock status	○	Status determination criteria not established.
Catch or effort limits	🟡	Recommended effort limits.
Harvest control rule	🔴	Not established.
Other		

🟢 OK 🟡 Intermediate 🔴 Not accomplished ○ Unknown

Stock assessment

No unified stock assessment has been conducted by NPFC for the species.

Some members have conducted stock assessment or related studies for neon flying squid based on the information only from their own fisheries or surveys (Ichii et al. 2006; Chen, 2010; Cao et al. 2014).

Data

Survey

Japan conducted drift net survey in summer from 1999-2020 and jigging survey in winter from 2018~2020. Russia conducted upper epipelagic surveys from 1984-1992 and from 1999-2019 (see details in Table 2).

Fishery

Neon flying squid was harvested by China, Japan, Korea, Russia, Chinese Taipei and Vanuatu. Fishing methods included jigging, drift net, dip net and set net.

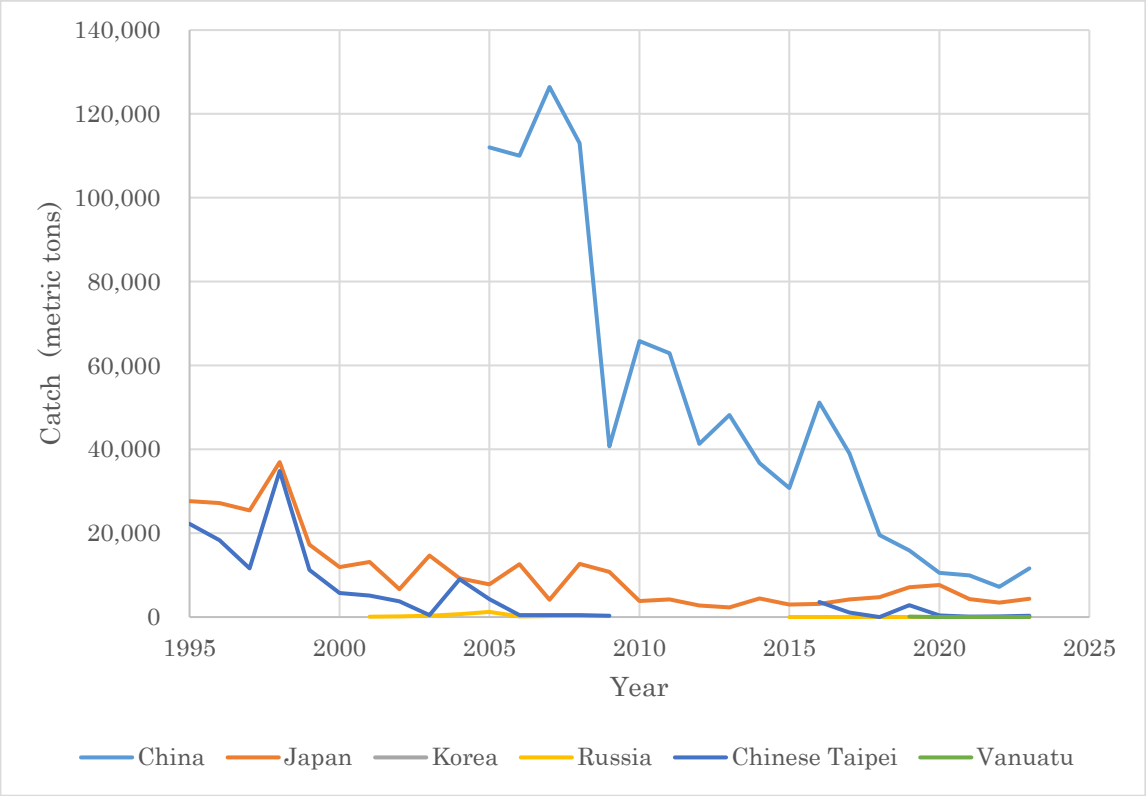

Figure 2. The historical catch of neon flying squid reported by members.

Data availability

Table 2. Data availability from Members regarding neon flying squid

Category and data sources	Description	Years with available data	Average sample size/ year or data coverage	Potential issues to be reviewed
CHINA				
Catch statistics				

Squid-jigging fisheries	Official statistics, reports from annual report	Official statistics: 2005-2023 Fishery data before 2005 (need to be confirmed)	Coverage = 100%	The neon flying squid catches are obtained from the fisheries logbook data provided by the fisheries company
Size composition data				
Length measurements	Sampling from commercial squid-jigging fishing vessels	2010-2018 Data before 2005 (need to be confirmed)	800-1000 fish/year	May lack representativeness
Aging	Sampling from commercial squid-jigging fishing vessels	2010-2016 Data before 2005 (need to be confirmed)	80-200 fish /year	May lack representativeness
Abundance indices (commercial)				
Squid-jigging fisheries	Squid-jigging logbook	1995-2022 Fishery data before 2005 (need to be confirmed)	Coverage= 100%	

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
JAPAN				
Catch statistics				
Jigging fishery	Logbook	1995-2023	Coverage=100%	
Size composition data				
Length and weight measurements	Drift net survey (Summer)	1999-2023	500-600 squid/year	
	Jigging survey (Winter)	2018-2023	300-400 squid/year	
Abundance indices (survey)				

Summer survey on abundance of the autumn and winter-spring cohorts	Drift net survey CPUE for each cohort (individuals/panel)	1999-2023	20-30 stations/year	Small samples of male and matured female for the autumn cohort
Winter survey on abundance of the winter-spring cohort	Jigging survey CPUE (individuals/line)	2018-2023	12-16 stations/year	
Abundance indices (commercial)				
Jigging fishery	Logbook Standardized CPUE of the winter-spring cohort	1995-2023	Coverage=100%	Standardize CPUE for the autumn cohort

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
KOREA				
Catch statistics				
Jigging	Official statistics, reports from fisheries	2017, 2019 and 2021-2023	Coverage =100%	
Size composition data				
Length measurements	Measured by observers while onboard	2017, 2021, 2022	1000 squid/year	Measurement details to be reviewed
Abundance indices (commercial)				
Jigging	Logbook data available	2017, 2021, 2022	30-40 stations/year	Data coverage details to be reviewed

Category and data sources	**Description**	**Years with available data**	**Average sample size/year or data coverage**	**Potential issues to be reviewed**
RUSSIA				
Catch statistics				

Drift net fishery	Official statistics, reports from fisheries associations	Official statistics: 1982-1990, 1999-2007, 2011 1985-1998, 2008-2010 and 2012-2020 (no data available); publications: 1972-2012	Coverage 1982-1984 ?%, 1999-2007, 2011 =100%	Data coverage details to be reviewed
Size composition data				
Length measurements	Sampling from commercial fishing vessels. Sampling during research surveys.	1999-2007, 2011 2012-2019	100-4,000 squids /year (ca. 50 measurements per sampling)	Data coverage details to be reviewed
Abundance indices (survey)				
Summer-autumn surveys to assess pelagic squid abundance	Upper epipelagic surveys	1984-1992, 1999-2019 (August-November)	60-80 stations/year 60-80 stations/year	Changes in abundance and migration patterns; development survey protocol and conduct standardization

Category and data sources	**Description**	**Years with available data**	**Average sample size/ year or data coverage**	**Potential issues to be reviewed**
CHINESE TAIPEI				
Catch statistics				
Dip net fishery Set net	Fishing gear used in different periods: 1977-1979: jigging 1980-1983: jigging and gillnet 1984-1992: gillnet 1993 till now: jigging	Data from 1977-1996 was provided by Taiwan Squid Fishery Association, data from 1997-2017 was based on logbook, and data from 2018-2023 was the statistics on landings.	Coverage =100%	

		(No fishery: 2010, 2012-2015)		
Size composition data				
Length measurements	Sampling from a research survey (1997). Sampling from commercial fishing vessels.	1997; 1998-2003	200-300 squids /year	Data coverage details to be reviewed
Abundance indices (commercial)				
Squid-jigging fisheries	Squid-jigging logbook	2001-2023 (No fishery: 2010, 2012-2015)	Data Coverage 2001-2016 = 87.3% Data Coverage 2017-2023 =100%	Will conduct standardization

Category and data sources	Description	Years with available data	Average sample size/ year or data coverage	Potential issues to be reviewed
VANUATU				
Catch statistics				
Squid jigging fishery	from logbook	2019	logbook from 2013 to now, coverage 100%	Vanuatu has authorized 4 vessels to conduct Pacific saury and squid jigging fishery in NPFC Convention Area. These vessels can target both neon flying squid and Pacific saury, and mainly target Pacific saury.

Biological Information

Distribution and migration

Neon flying squid is an oceanic squid distributed in temperate and subtropical waters of the Pacific, Indian and Atlantic Oceans. The North Pacific population occurs mainly between 20◦ and 50◦N, and comprises two cohorts: a fall cohort with a hatching period from September to February and a

winter–spring cohort with a hatching period mainly from January to May, but extending to August. Neon flying squid makes an annual round-trip migration between its subtropical spawning grounds and its northern feeding grounds near the Subarctic Boundary.

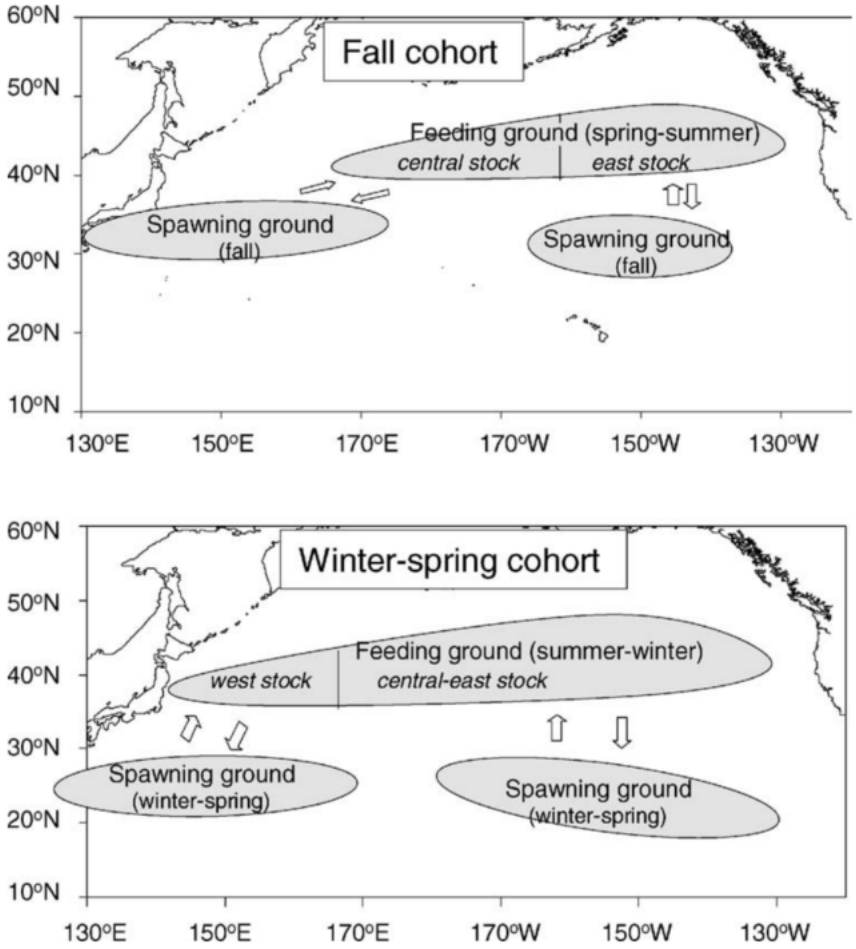

Figure 3. Migration patterns of the fall and winter–spring cohorts of neon flying squid in the North Pacific.

Life history

Growth is exponential during the first 30 days after hatching and then becomes more or less linear. It is suggested that this shift in growth accompanies a change in the feeding behavior that is thought to occur once the fused tentacles, which form a proboscis in the hatchlings, separate and become functional.

Neon flying squid at 7-10 months of age and has an estimated 1-year life span. Size at maturity is about 30–33 cm ML in males and 40–55 cm ML in females. The maximum ML is around 45 cm in males and 60 cm in females.

During its northward migration and at the feeding grounds in the central North Pacific, neon flying

squid feeds mainly on fishes, squids and crustaceans. Many marine mammals feed on neon flying squid. It is an important prey of northern fur seals in the central North Pacific, and a minor prey of short-beaked common dolphins (Bower and Ichii 2005).

Literature cited

John R. Bower; Taro Ichii. The red flying squid (*Ommastrephes bartramii*): A review of recent research and the fishery in Japan. 2005. Fisheries Research.

Chih-Shin Chen. Abundance trends of two neon flying squid (*Ommastrephes bartramii*) stocks in the North Pacific. 2010. ICES Journal of Marine Science.

Cao, Jie; Chen, Xinjun; Tian, Siquan. A Bayesian hierarchical DeLury model for stock assessment of the west winter-spring cohort of neon flying squid (*Ommastrephes bartramii*) in the northwest Pacific Ocean. 2015. Bulletin of Marine Science.

Taro, Ichii; Kedarnath, Mahapatra; Hiroshi, Okamura; Yoshihiro, Okada. Stock assessment of the autumn cohort of neon flying squid (*Ommastrephes bartramii*) in the North Pacific based on past large-scale high seas driftnet fishery data. 2006. Fisheries Research.