INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC–2022–SRB021–R

Report of the 21st Session of the IPHC Scientific Review Board (SRB021)

Meeting held electronically, 20-22 September 2022

Commissioners

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

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ACRONYMS

AM	Annual Meeting
CKMR	Close-Kin Mark recapture
CV	Coefficient of Variation
DMR	Discard Mortality Rate
FISS	Fishery-Independent Setline Survey
IPHC	International Pacific Halibut Commission
MSAB	Management Strategy Advisory Board
MSE	Management Strategy Evaluation
RAB	Research Advisory Board
SRB	Scientific Review Board
U.S.A.	United States of America

DEFINITIONS

A set of working definitions are provided in the IPHC Glossary of Terms and abbreviations: https://www.iphc.int/the-commission/glossary-of-terms-and-abbreviations

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

This report has been written using the following terms and associated definitions so as to remove ambiguity surrounding how particular paragraphs should be interpreted.

Level 1: **RECOMMENDED**; **RECOMMENDATION; ADOPTED** (formal); **REQUESTED; ENDORSED; ACCEPTED** (informal): A conclusion for an action to be undertaken, by a Contracting Party, a subsidiary (advisory) body of the Commission and/or the IPHC Secretariat.

Level 2: **AGREED**: Any point of discussion from a meeting which the Commission considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 above; a general point of agreement among delegations/participants of a meeting which does not need to be elevated in the Commission's reporting structure.

Level 3: **NOTED/NOTING**; **CONSIDERED**; **URGED**; **ACKNOWLEDGED**: General terms to be used for consistency. Any point of discussion from a meeting which the Commission considers to be important enough to record in a meeting report for future reference. Any other term may be used to highlight to the reader of an IPHC report, the importance of the relevant paragraph. Other terms may be used but will be considered for explanatory/informational purposes only and shall have no higher rating within the reporting terminology hierarchy than Level 3.

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EXECUTIVE SUMMARY

The 21st Session of the International Pacific Halibut Commission (IPHC) Scientific Review Board (SRB021) was held in Seattle, WA, USA from 20 to 22 September 2022. The meeting was opened by the Chairperson, Dr Sean Cox (Canada), and the Executive Director, Dr David Wilson.

The following are a subset of the complete recommendations/requests for action from the SRB021, which are provided in full at Appendix IV.

IPHC Fishery-independent setline survey (FISS)

(para. 19) The SRB **ENDORSED** the proposed 2023 FISS design as presented in Fig. 2, and provisionally **ENDORSED** the 2024-25 designs (Figs. 3 and 4), while also recognising that the 2023 design will need to be further optimised to ensure other Commission objectives are met, including but not limited to maintaining long-term revenue neutrality.

RECOMMENDATIONS

International Pacific Halibut Commission 5-year program of integrated research and monitoring (2022-26)

SRB021–Rec.01 (para. 14) The SRB **RECOMMENDED** that the Secretariat and Commission take a more deliberate and explicit approach in deciding which research programs to fund internally or externally, since internally funded research can: (i) utilize milestones and interim evaluations as possible "kill points" where a project may be discontinued if the marginal costs outweigh the benefits of a particular research stream or project; (ii) provide pilot data to support external research proposals; and (iii) support critical applied research that falls outside typical funding agency interests.

IPHC Fishery-independent setline survey (FISS)

SRB021–Rec.02 (para. 18) **NOTING** that the coefficient of variation (CV) for IPHC Regulatory Area 4B continued to exceed the 15% threshold in 2021, the SRB **RECOMMENDED** continuing to investigate potential means to mitigate these effects. For example, by increasing the pool of potential bidders by including vessel using snap-gear.

Management Strategy Evaluation: update

SRB021–Rec.05 (para. 26) **NOTING** the MSE results for size limit scenarios presented, the SRB **RECOMMENDED** further analysis of the economic implications of harvesting smaller fish (e.g. reduced yield and/or increased processing costs, changes in efficiency, and potential lower value for smaller fish).

SRB021–Rec.06 (para. 27) The SRB **RECOMMENDED** evaluating additional performance metrics including, for example, discard mortality and change in TCEY in assessment years for multi-year assessment MPs.

Pacific halibut stock assessment: 2022

SRB021–Rec.08 (para. 35) **NOTING** the integration between the stock assessment and biological research in evaluating the impact of genetic sex composition data (and the one-year lag in providing these data) on assessment results along with the resourcing implications, the SRB **RECOMMENDED** continued evaluation of the impact on stock assessment output of analyzing this genetic sex composition data on 1, 2, or 3 year intervals.

Biological and ecosystem sciences – Project updates

SRB021–Rec.09 (para. 41) **NOTING** the information on recent wire tagging of Pacific halibut as part of the recreational DMR study and intent to characterize movements of Pacific halibut among IPHC Regulatory Areas, the SRB **RECOMMENDED** that the data available be summarized to map and analyze existing trends in the data.

SRB021–Rec.10 (para. 44) **NOTING** the Secretariat's interest in applications of molecular markers for somatic growth and evaluation of growth patterns, the SRB **RECOMMENDED** that the Secretariat devote attention to annotation of sequence data that may be relevant to understanding spatial, temporal, and demographic (size/age) variation growth and maturation.

SRB021–Rec.11 (para. 47) **NOTING** the flow chart presented in Figure 1 of paper IPHC-2022-SRB021-09, the SRB **RECOMMENDED** that (i) additional analyses be conducted in areas of unsupervised clustering for individuals, and (ii) estimate measures of genetic variation among individuals within and among sampling groups to characterize inter-individual relationships, which could provide further indication of admixture. The coefficients of relationship among individuals within sampling location and levels of pair-wise variance in SNP allele frequency between sampling locations can be used to identify 'source' and 'sink' regions.

SRB021–Rec.15 (para. 51) The SRB **RECOMMENDED** that the Secretariat (i) develop a rapid screening panel of SNP markers (e.g. GTseq, RADcapture) for future use in Close-Kin Mark recapture (CKMR), population assignment, or other applications (CKMR applications may necessitate the development of microhaplotypes to achieve adequate accuracy in multi-generational pedigree analyses), and (ii) begin developing potential SNP panels and evaluate accuracy of population-based or pedigree-based assignment under scenarios likely to be encountered in future IPHC applications.

REQUESTS

Management Strategy Evaluation: update

SRB021–Req.02 (para. 30) The SRB **REQUESTED** that the Secretariat examine MPs based on a three-year assessment cycle with annual TCEY changes proportional to changes in the FISS index because (i) this approach would be simpler and more transparent than a model, which has not yet been developed); (ii) the high benefit to cost ratio for multi-year TCEYs; (iii) it matches the current three-year full assessment cycle; and (iv) the general approach has precedents in other fishery commissions (e.g. Southern Bluefin Tuna).

Biological and ecosystem sciences – Project updates

SRB021–Req.07 (para. 40) **NOTING** the progress update on Migration and Distribution and the specific research goal of creating a map of suitable juvenile Pacific halibut settlement habitat, the SRB **REQUESTED** (i) a clearer statement of the relevance of this research to management, MSE, and/or the stock assessment and (ii) clarification regarding the types of data to be collected and used to determine occupancy (and preference), and by what data sources.

1. OPENING OF THE SESSION

1. The 21st Session of the International Pacific Halibut Commission (IPHC) Scientific Review Board (SRB021) was held in Seattle, WA, USA from 20 to 22 September 2022. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Sean Cox (Canada), and the Executive Director, Dr David Wilson.

2. The SRB **RECALLED** its mandate, as detailed in Appendix VIII, Sect. I, para. 1-3 of the IPHC Rules of Procedure (2022):

    1. *The Scientific Review Board (SRB) shall provide an independent scientific peer review of Commission science/research proposals, programs, and products, including but not limited to:*
        a. *Data collection;*
        b. *Historical data sets;*
        c. *Stock assessment;*
        d. *Management Strategy Evaluation;*
        e. *Migration;*
        f. *Reproduction;*
        g. *Growth;*
        h. *Discard survival;*
        i. *Genetics and Genomics.*
    2. *Undertake periodic reviews of science/research strategy, progress, and overall performance.*
    3. *Review the recommendations arising from the MSAB and the RAB.*

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

3. The SRB **ADOPTED** the Agenda as provided at Appendix II. The documents provided to the SRB are listed in Appendix III. Participants were reminded that all documents for the meeting were published on the IPHC website, 30 days prior to the Session: https://www.iphc.int/venues/details/21st-session-of-the-iphc-scientific-review-board-srb021.

3. IPHC PROCESS

3.1 SRB annual workflow

4. The SRB **RECALLED** that the core purpose of the SRB021 is to review progress on the IPHC research and monitoring activities, including specific products, and to provide guidance for the delivery of products to the Commission at its Interim Meeting in November 2022, and Annual Meeting in January 2023.

3.2 Update on the actions arising from the 20th Session of the SRB (SRB020)

5. The SRB **NOTED** paper IPHC-2022-SRB021-03, which provided the SRB with an opportunity to consider the progress made during the intersessional period, on the recommendations/requests arising from the SRB020.

6. The SRB **AGREED** to consider and revise the actions as necessary, and to combine them with any new actions arising from SRB021 into a consolidated list for future reporting.

3.3 Outcomes of the 98th Session of the IPHC Annual Meeting (AM098)

7. The SRB **NOTED** paper IPHC-2022-SRB021-04 which detailed the outcomes of the 98th Session of the IPHC Annual Meeting (AM098), relevant to the mandate of the SRB, and **AGREED** to consider how best to provide the Commission with the information it has requested, throughout the course of the current SRB meeting.

3.4 Observer updates

8. The SRB **NOTED** the following areas of specific interest from the USA science advisor:

    a) Fishery-Independent Setline Survey:

        i. IPHC Regulatory Area 2A: the treaty tribes have questioned how representative the FISS is throughout 2A noting the described complexity in benthic habitats and would like clarification on how the FISS deals with this.

        ii. IPHC Regulatory Area 4B: noting the difficulty in securing charter vessels to fish in Regulatory Area 4B in 2022, how representative is the modelling for this area?

        iii. Given that catch rates and associated fish sale income in 2022 was lower than expected, and that this pattern may continue in 2023, what would be potential options to reduce the FISS in the future to make it more robust to such fluctuations in fish sale income?

        iv. The USA is keen to see the implementation of snap-gear into the FISS design in 2023, and would like to see how this could be implemented.

4. INTERNATIONAL PACIFIC HALIBUT COMMISSION 5-YEAR PROGRAM OF INTEGRATED RESEARCH AND MONITORING (2022-26)

9. The SRB **NOTED** and **APPRECIATED** paper IPHC-2022-SRB021-05 which provided the SRB with the IPHC 5-year program of integrated research and monitoring (the Plan) which takes into consideration the requested changes from the previous SRB meeting (ref. SRB020–Req.09).

10. The SRB **AGREED** that the Plan document is well organized and well written, and as a 'living document' has improved greatly since earlier versions were discussed in previous SRB meetings.

11. The SRB **AGREED** that future revisions of the Plan could combine knowledge building with the application of existing and emerging knowledge to provide for the management of Pacific halibut.

12. The SRB **NOTED** that future versions of the Plan could also resolve the apparent disconnect between some of the broad aims described and the evaluation criteria. For example, one aim was to undertake "ground-breaking methodological research" without an obvious criterion for evaluation.

13. The SRB **NOTED** in Appendix III of the Plan that some of the objectives would benefit from more detail on the proposed schedule of outputs, and a detailed assessment of funding and staffing capacity needed to complete the projects.

14. The SRB **RECOMMENDED** that the Secretariat and Commission take a more deliberate and explicit approach in deciding which research programs to fund internally or externally, since internally funded research can: (i) utilize milestones and interim evaluations as possible "kill points" where a project may be discontinued if the marginal costs outweigh the benefits of a particular research stream or project; (ii) provide pilot data to support external research proposals; and (iii) support critical applied research that falls outside typical funding agency interests.

15. The SRB **RECALLED** SRB020–Rec.05 (para. 36) (shown below) and **REQUESTED** that the Secretariat evaluate data collected during the FISS or other IPHC research programs that might be useful for the broader scientific community and potential existing external repositories that might house these data.

> SRB020–Rec.05 (para. 36) "*The SRB NOTED the exceptional level of transparency and commitment to the principles of open science represented by the Secretariat's data and code-sharing practices and, therefore, RECOMMENDED that the Secretariat consider producing peer-reviewed data report*

publications, which would (a) enhance outreach to potential external data users and (b) allow for tracking external use of IPHC data and resources."

5. IPHC FISHERY-INDEPENDENT SETLINE SURVEY (FISS)

5.1 2023 FISS design evaluation

16. The SRB **NOTED** paper IPHC-2022-SRB021-06, which proposed designs for the IPHC's Fishery-Independent Setline Survey (FISS) for the 2023-25 period, and an evaluation of those designs, for review by the Scientific Review Board.

17. The SRB **NOTED** the full FISS sampling grid that consists of 1,890 stations (Fig. 1) from which an optimal subset of stations can be selected when devising annual FISS designs. In the Bering Sea, the full FISS design does not provide complete spatial coverage, and FISS data are augmented with calibrated data from NOAA-Fisheries and Alaska Department of Fish and Game (ADFG) trawl surveys (stations vary by year based on the full designs shown in Fig. 1).

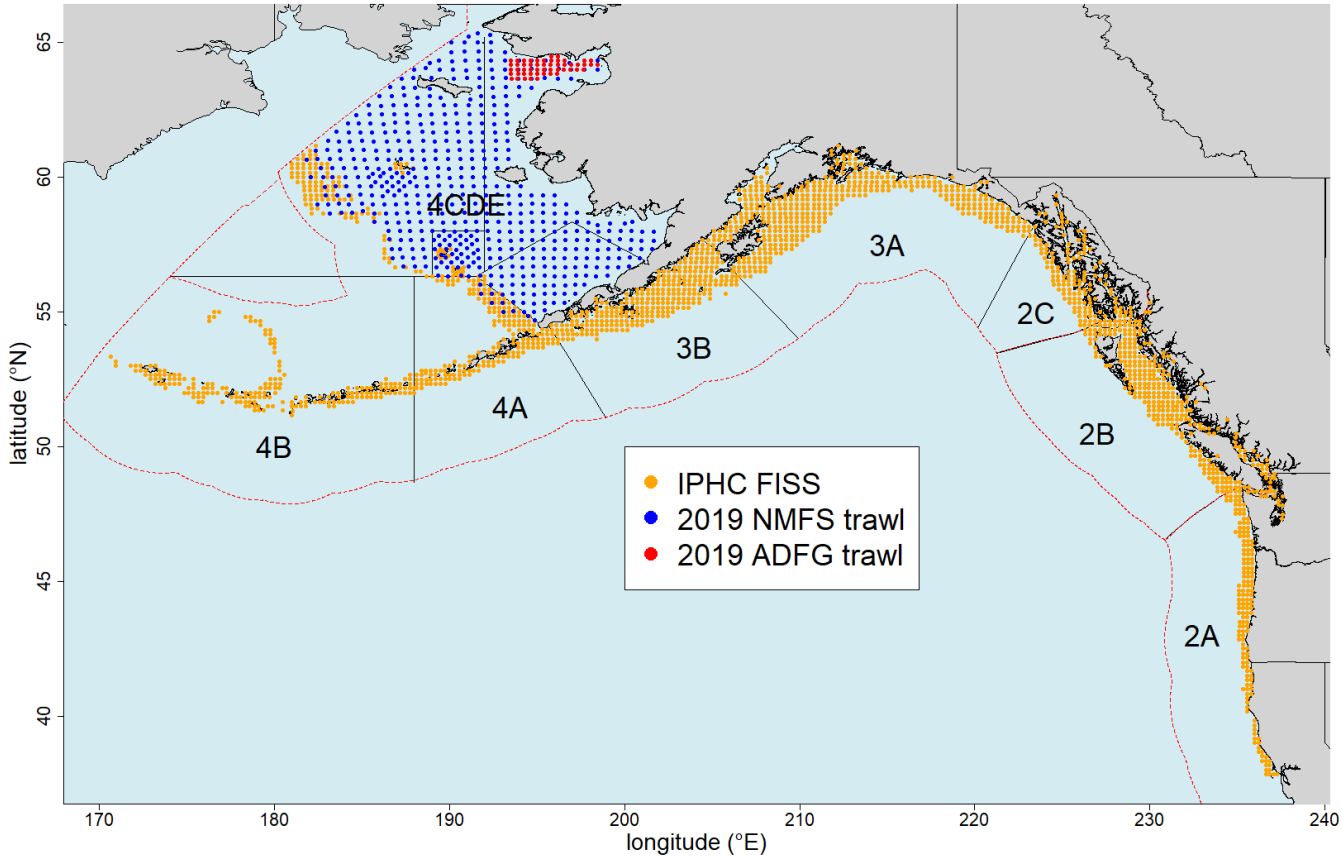

Figure 1. Map of the full 1890 station FISS design, with orange circles representing stations available for inclusion in annual sampling designs, and other colours representing trawl stations from 2019 NMFS and ADFG surveys used to provide complementary data for Bering Sea modelling.

18. **NOTING** that the coefficient of variation (CV) for IPHC Regulatory Area 4B continued to exceed the 15% threshold in 2021, the SRB **RECOMMENDED** continuing to investigate potential means to mitigate these effects. For example, by increasing the pool of potential bidders by including vessel using snap-gear.

19. The SRB **ENDORSED** the proposed 2023 FISS design as presented in Fig. 2, and provisionally **ENDORSED** the 2024-25 designs (Figs. 3 and 4), while also recognising that the 2023 design will need to be further

optimised to ensure other Commission objectives are met, including but not limited to maintaining long-term revenue neutrality.

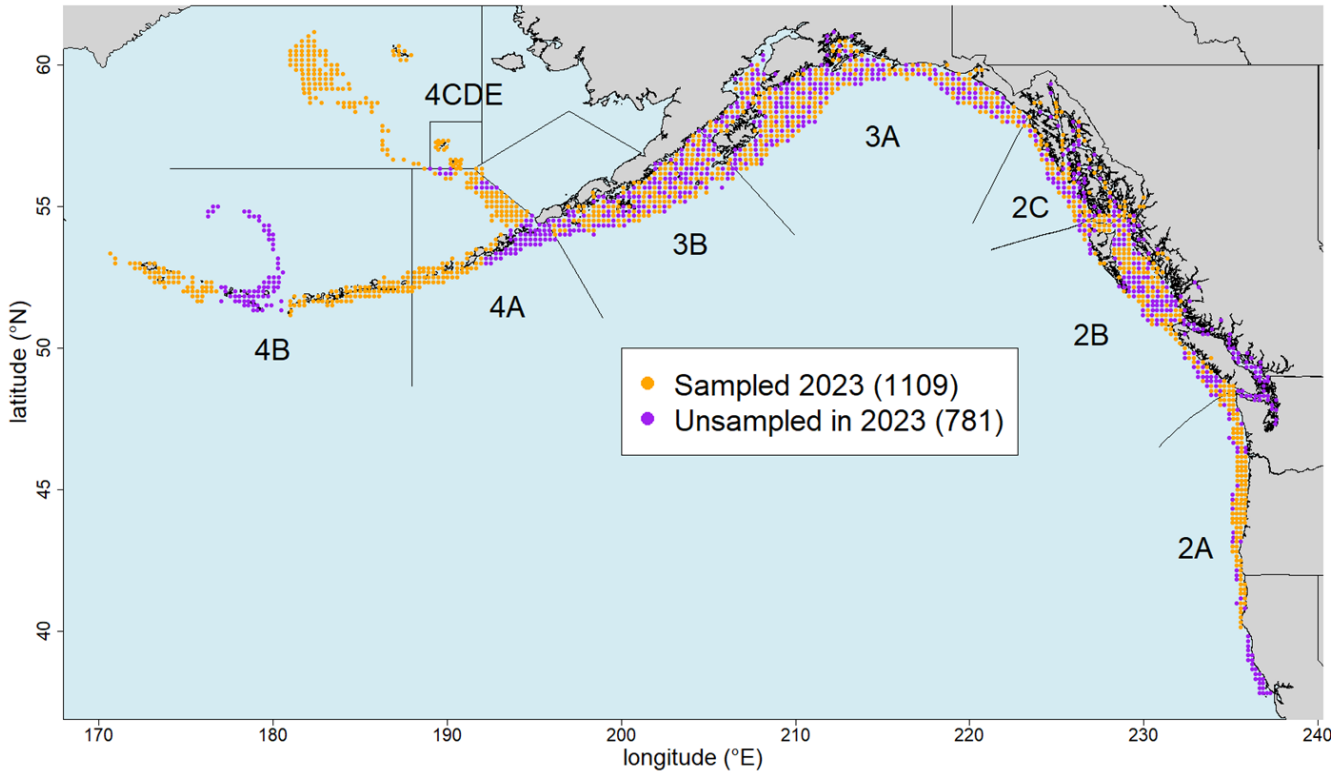

Figure 2. Proposed FISS design (pre-optimisation) in 2023 (orange circles) based on randomised sampling in 2B-3B, and a subarea design elsewhere. Purple circles are optional for meeting data quality criteria.

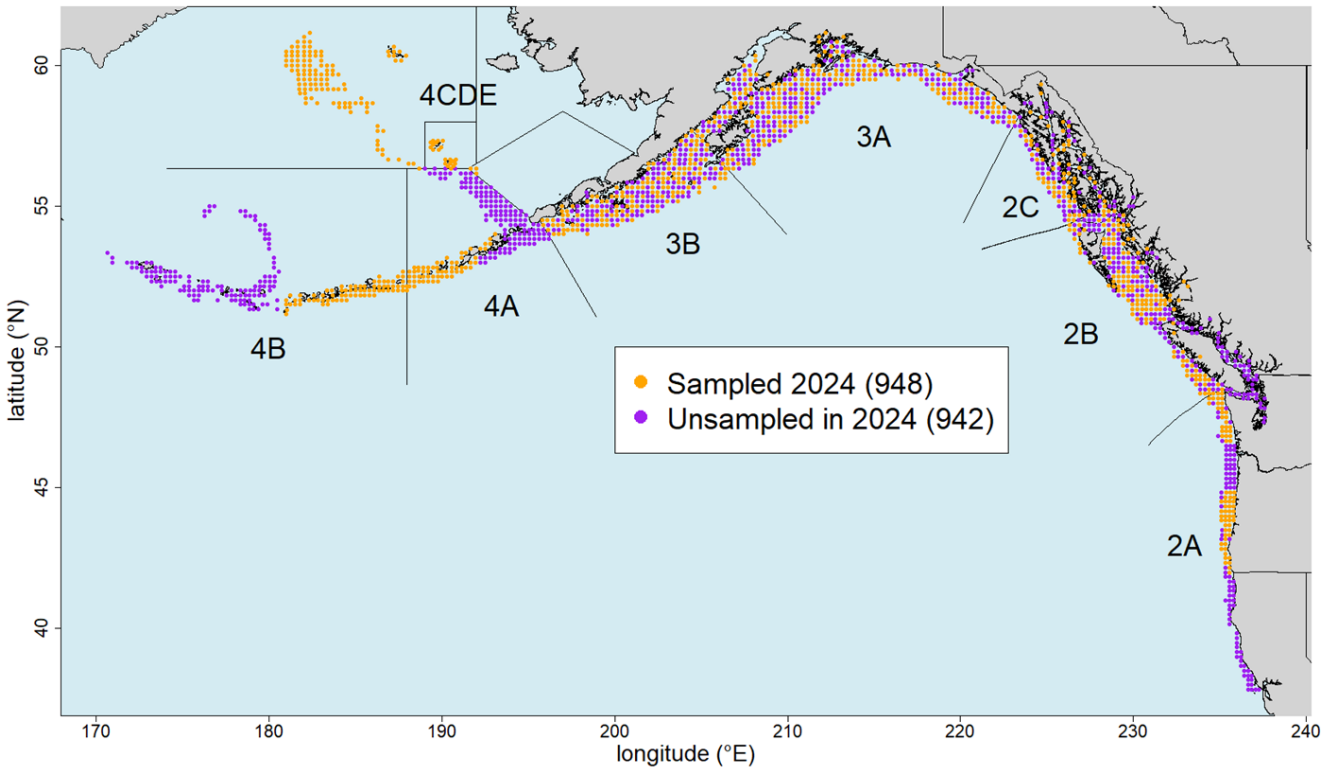

Figure 3. Proposed FISS design (pre-optimisation) in 2024 (orange circles) based on randomised sampling in 2B-3B, and a subarea design elsewhere. Purple circles are optional for meeting data quality criteria.

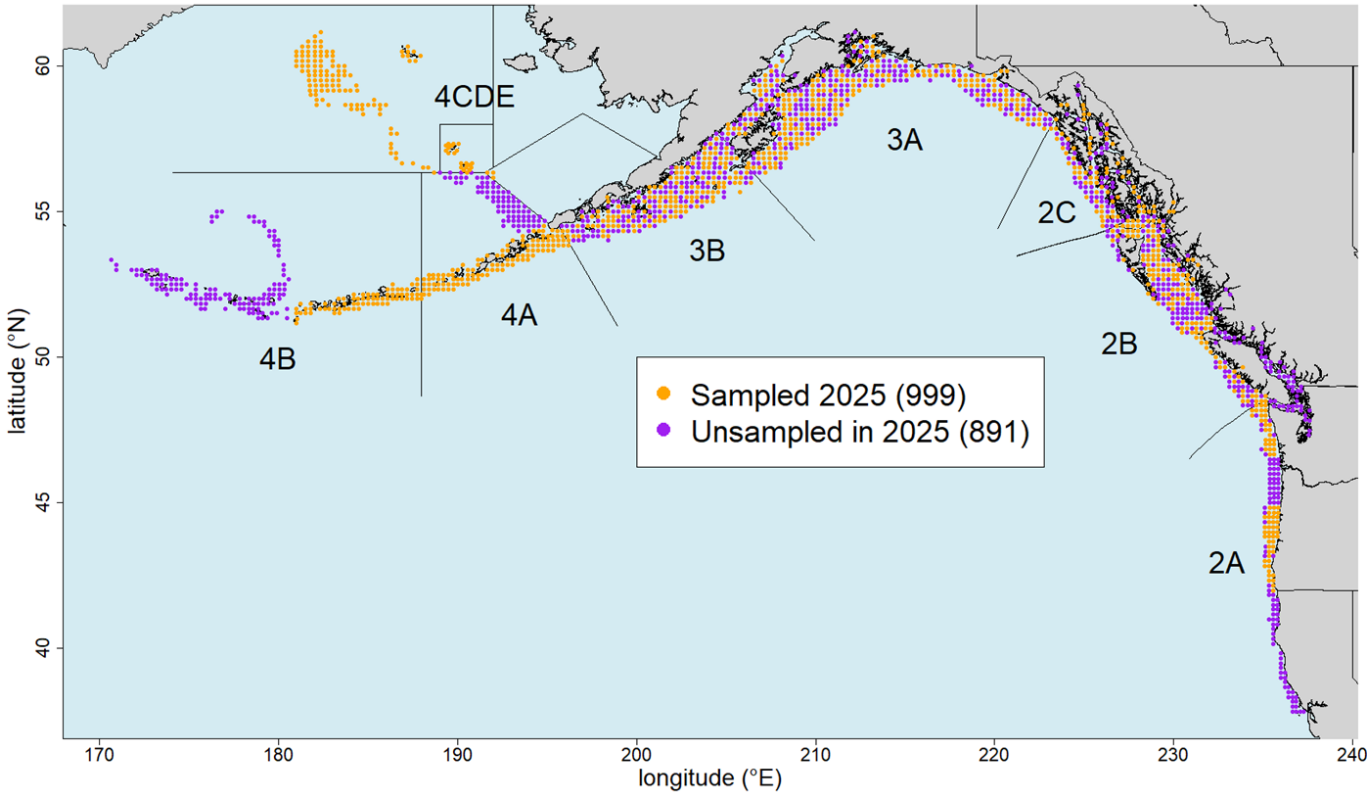

Figure 4. Proposed FISS design (pre-optimization) in 2025 (orange circles) based on randomized sampling in 2B-3B, and a subarea design elsewhere. Purple circles are optional for meeting data quality criteria.

5.2 Updates to space-time modelling

20. **NOTING** that the 'hurdle' model structure (separate modeling of presence/absence and abundance conditional on presence) of the space-time model used to analyze the FISS may not be the most efficient approach, the SRB **RECOMMENDED** that the Secretariat explore other approaches such as the use of mixture models or the 'Tweedie' distribution.

21. The SRB **ENDORSED** the proposed model-based approach to computing the probability of at least a 10% change in the FISS index within a given sub-area over a three-year period.

22. **NOTING** increasingly long computing times, limited available distributions, and space-time model instability in some cases, the SRB **RECOMMENDED** exploring alternatives to the R-INLA software package.

6. MANAGEMENT STRATEGY EVALUATION: UPDATE

23. The SRB **NOTED** paper IPHC-2022-SRB020-07 which provided the SRB with an update of progress on the Management Strategy Evaluation (MSE) program of work for 2022–2023.

24. **NOTING** the discrepancy between the operating models and ensemble assessment models for the most recent assessment, the SRB **AGREED** with the solution involving a lower M in the updated operating model to get a better match in recent estimates of SPR.

25. The SRB **ENDORSED** the approach to incorporating decision-making variability described in IPHC-2022-SRB020-07ppt.

26. **NOTING** the MSE results for size limit scenarios presented, the SRB **RECOMMENDED** further analysis of the economic implications of harvesting smaller fish (e.g. reduced yield and/or increased processing costs, changes in efficiency, and potential lower value for smaller fish).

27. The SRB **RECOMMENDED** evaluating additional performance metrics including, for example, discard mortality and change in TCEY in assessment years for multi-year assessment MPs.

28. The SRB **NOTED** that tight fits of the assessment model to the FISS indices mean that adjusting the TCEY proportionally to changes in the FISS model's WPUE is not substantially different than using the assessment to guide the TCEY in each year.

29. The SRB **RECALLED** paragraph 27 from IPHC-2022-SRB020-R (shown below):

    (Para. 27) "*The SRB **NOTED** that assessment research activities (e.g. paras. 23-26) are examples of work that could be done more extensively in non-assessment years within a multi-year assessment schedule. Other work could include investigating optimal sub-sampling designs for ages, sex-ratio, annual assessment methods to use within the MPs, and well as any of the several topics listed under Stock Assessment Research. The quantifiable costs of multi-year assessments could be estimated within the MSE, for example, of potentially lower average yield for longer assessment cycles to achieve the same levels of risk associated with annual assessments.*"

30. The SRB **REQUESTED** that the Secretariat examine MPs based on a three-year assessment cycle with annual TCEY changes proportional to changes in the FISS index because (i) this approach would be simpler and more transparent than a model, which has not yet been developed); (ii) the high benefit to cost ratio for multi-year TCEYs; (iii) it matches the current three-year full assessment cycle; and (iv) the general approach has precedents in other fishery commissions (e.g. Southern Bluefin Tuna).

7. PACIFIC HALIBUT STOCK ASSESSMENT: 2022

31. The SRB **NOTED** and **APPRECIATED** the extensive documentation and background perspective supporting paper IPHC-2022-SRB021-08, which provided an analyses in development of the 2022 Pacific halibut (*Hippoglossus stenolepis*) stock assessment. It follows the previous full stock assessment and independent peer review conducted in 2019, and subsequent updates to that assessment in 2020 and 2021.

32. The SRB **RECALLED** SRB020–Rec.02 (para. 23) and SRB020-Rec.04 (para. 25) (shown below), and **REQUESTED** an update at SRB022:

    SRB020–Rec.02 (para. 23) "*The SRB **NOTED** that most models within the ensemble produced reasonable and well-constrained estimates of natural mortality (M) and **RECOMMENDED** that estimation of M should be adopted in the short AAF assessment model with consideration in other models as part of the stock assessment research program.*"

    SRB020–Rec.04 (para. 25) "*The SRB **NOTED** apparent discrepancies in marine mammal prevalence among anecdotal reports, FISS observations, and preliminary evaluation of logbook data, and therefore **RECOMMENDED** further investigation of methods to better estimate marine mammal prevalence and impacts on the fishery.*"

33. **NOTING** the substantial interannual variation in MASE weightings of the four assessment models, the SRB **AGREED** that one-step-ahead predictive skill is a potentially promising basis for model weighting, and **REQUESTED** continued research into MASE weightings averaged over longer time periods as well as comparing these to alternative weighting metrics, for example, via cross-validation.

34. The SRB **RECOMMENDED** not implementing MASE weighting for the 2022 stock assessment advice and, instead, continuing to use the equal weighting approach to the ensemble components.

35. **NOTING** the integration between the stock assessment and biological research in evaluating the impact of genetic sex composition data (and the one-year lag in providing these data) on assessment results along with the resourcing implications, the SRB **RECOMMENDED** continued evaluation of the impact on stock assessment output of analyzing this genetic sex composition data on 1, 2, or 3 year intervals.

8. BIOLOGICAL AND ECOSYSTEM SCIENCES – PROJECT UPDATES

36. The SRB **NOTED** paper IPHC-2022-SRB021-09 which provided the SRB with a description of progress towards the finalization of IPHC's five-year Biological and Ecosystem Science Research Plan (2017-21) and the start of the IPHC's five-year Program of Integrated Research and Monitoring (2022-2026).

37. The SRB **REQUESTED** that the Secretariat amend the priorities under bullet "2. Reproduction" (IPHC-2022-SRB021-09) to include other avenues of investigations such as size/age specific fecundity and spatial variation in same.

38. The SRB **NOTED** and **APPRECIATED** the Secretariat's response to SRB020-Req.07 and SRB020-Req.08 including references to relevant research described or anticipated to Stock Assessment (SA) and MSE programs.

39. The SRB **NOTED** and **APPRECIATED** details provided concerning ongoing or anticipated statistical analyses of data that enhanced the SRB's ability to understand and critique methods to expected research outcomes and **REQUESTED** continued consistency in the presentation in these areas.

40. **NOTING** the progress update on Migration and Distribution and the specific research goal of creating a map of suitable juvenile Pacific halibut settlement habitat, the SRB **REQUESTED** (i) a clearer statement of the relevance of this research to management, MSE, and/or the stock assessment and (ii) clarification regarding the types of data to be collected and used to determine occupancy (and preference), and by what data sources.

41. **NOTING** the information on recent wire tagging of Pacific halibut as part of the recreational DMR study and intent to characterize movements of Pacific halibut among IPHC Regulatory Areas, the SRB **RECOMMENDED** that the data available be summarized to map and analyze existing trends in the data.

42. The SRB **AGREED** that tissue collections continue to be taken from all fish handled in surveys or research projects for use in future sexing and genotyping.

43. **NOTING** the Secretariat's interest in growth and size-at-age relationships, the SRB **REQUESTED** clarification of narrative regarding collection of environmental covariate data for projecting future short-term size-at-age trends.

44. **NOTING** the Secretariat's interest in applications of molecular markers for somatic growth and evaluation of growth patterns, the SRB **RECOMMENDED** that the Secretariat devote attention to annotation of sequence data that may be relevant to understanding spatial, temporal, and demographic (size/age) variation growth and maturation.

45. **NOTING** the Secretariat's interest in identification of evidence for spatial population structure, and given the IPHC manages stocks on the basis of biological reporting regions, the SRB **REQUESTED** clarification on how the Secretariat may alter assessments if 'functionally isolated components of the population are found'.

46. The SRB **NOTED** and **APPRECIATED** the background and methodological data presented regarding bioinformatic interrogation of the genomics data.

47. **NOTING** the flow chart presented in Figure 1 of paper IPHC-2022-SRB021-09, the SRB **RECOMMENDED** that (i) additional analyses be conducted in areas of unsupervised clustering for individuals, and (ii) estimate measures of genetic variation among individuals within and among sampling groups to characterize inter-individual relationships, which could provide further indication of admixture. The

coefficients of relationship among individuals within sampling location and levels of pair-wise variance in SNP allele frequency between sampling locations can be used to identify 'source' and 'sink' regions.

48. The SRB **NOTED** that in the sub-area of Population Genetics and Structure, the Secretariat intends to use Site Frequency Spectral (SFS) analyses. Both selection and population growth can produce similar SFS patterns in data. As such, the SRB **RECOMMENDED** testing using a 'Tajima D' analysis and estimate levels of excess of low frequency SNP alleles within sampling areas (or reporting units).

49. **NOTING** that Secretariat's intention to use Multiple Dimensional Scaling to visualise inter-individual and inter-location genetic similarity, the SRB **RECOMMENDED** that the Secretariat develop a data baseline of background information at the individual level to better develop hypotheses to explain visual patterns in data.

50. **NOTING** the Secretariat's interest in describing linkage relationships, and that descriptions of linkage disequilibrium can be fraught with difficulty in situations of admixture and due to vagaries in breeding structure, the SRB **RECOMMENDED** that the Secretariat explore other literature not cited in IPHC-2022-SRB021-09 in this area.

51. The SRB **RECOMMENDED** that the Secretariat (i) develop a rapid screening panel of SNP markers (e.g. GTseq, RADcapture) for future use in Close-Kin Mark recapture (CKMR), population assignment, or other applications (CKMR applications may necessitate the development of microhaplotypes to achieve adequate accuracy in multi-generational pedigree analyses), and (ii) begin developing potential SNP panels and evaluate accuracy of population-based or pedigree-based assignment under scenarios likely to be encountered in future IPHC applications.

9. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 21ST SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB021)

52. The SRB **AGREED** that the SRB022 should be held from 20-22 June 2023, and the SRB023 to be tentatively scheduled for the third week of September 2023. Exact dates would be announced early in 2023.

53. The report of the 21st Session of the IPHC Scientific Review Board (IPHC-2022-SRB021-R) was **ADOPTED** on 22 September 2022, including the consolidated set of recommendations and/or requests arising from SRB021, provided at Appendix IV.

APPENDIX I
LIST OF PARTICIPANTS FOR THE 21ST SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB021)

SRB Members

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APPENDIX II
AGENDA FOR THE 21ST SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB021)

Date: 20-22 September 2022
Location: Seattle, WA, USA, & Electronic Meeting
Venue: IPHC HQ & Adobe Connect
Time: 12:30-17:00 (20th), 09:00-17:00 (21-22nd) PDT
Chairperson: Dr Sean Cox (Simon Fraser University)
Vice-Chairperson: Nil

1. OPENING OF THE SESSION

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

- *IPHC-2022-SRB021-01: Agenda & Schedule for the 21st Session of the Scientific Review Board (SRB021)*
- *IPHC-2022-SRB021-02: List of Documents for the 21st Session of the Scientific Review Board (SRB021)*

3. IPHC PROCESS

3.1. SRB annual workflow (D. Wilson)
3.2. Update on the actions arising from the 20th Session of the SRB (SRB020) (D. Wilson)
- *IPHC-2022-SRB021-03: Update on the actions arising from the 21st Session of the SRB (SRB021) (IPHC Secretariat)*

3.3. Outcomes of the 98th Session of the IPHC Annual Meeting (AM098), and 12th Special Session of the IPHC (SS012) (D. Wilson)
- *IPHC-2022-SRB021-04: Outcomes of the 98th Session of the IPHC Annual Meeting (AM098), and 12th Special Session of the IPHC (SS012) (D. Wilson)*

3.4. Observer updates (e.g. Science Advisors)

4. INTERNATIONAL PACIFIC HALIBUT COMMISSION 5-YEAR PROGRAM OF INTEGRATED RESEARCH AND MONITORING (2022-26)

- *IPHC-2022-SRB021-05 International Pacific Halibut Commission 5-Year program of integrated research and monitoring (2022-26) (D. Wilson, J. Planas, I. Stewart, A. Hicks, R. Webster, B. Hutniczak, & J. Jannot)*

5. IPHC FISHERY-INDEPENDENT SETLINE SURVEY (FISS)

- *IPHC-2022-SRB021-06 2023-25 FISS design evaluation (R. Webster)*

5.1. 2023 FISS design evaluation (R. Webster)
5.2. Updates to space-time modelling (R. Webster)

6. MANAGEMENT STRATEGY EVALUATION: UPDATE

- *IPHC-2022-SRB021-07 IPHC Secretariat MSE Program of Work (2022–2023) and an update on progress (A. Hicks & I. Stewart)*

7. PACIFIC HALIBUT STOCK ASSESSMENT: 2022

- *IPHC-2022-SRB021-08 Development of the 2022 Pacific halibut (Hippoglossus stenolepis) stock assessment (I. Stewart & A. Hicks)*

8. BIOLOGICAL AND ECOSYSTEM SCIENCES – PROJECT UPDATES

- *IPHC-2022-SRB021-09 Report on current and future biological and ecosystem science research activities (J. Planas)*

9. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 21st SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB021)

APPENDIX III
LIST OF DOCUMENTS FOR THE 21ST SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB021)

Document	Title	Availability
IPHC-2022-SRB021-01	Agenda & Schedule for the 21st Session of the Scientific Review Board (SRB021)	✓ 22 Jun 2022 ✓ 19 Aug 2022
IPHC-2022-SRB021-02	List of Documents for the 21st Session of the Scientific Review Board (SRB021)	✓ 17 Aug 2022 ✓ 19 Aug 2022
IPHC-2022-SRB021-03	Update on the actions arising from the 20th Session of the SRB (SRB020) (IPHC Secretariat)	✓ 17 Aug 2022
IPHC-2022-SRB021-04	Outcomes of the 98th Session of the IPHC Annual Meeting (AM098), and 12th Special Session of the IPHC (SS012) (D. Wilson)	✓ 17 Aug 2022
IPHC-2022-SRB021-05	International Pacific Halibut Commission 5-Year program of integrated research and monitoring (2022-26) (D. Wilson, J. Planas, I. Stewart, A. Hicks, R. Webster, B. Hutniczak, & J. Jannot)	✓ 17 Aug 2022
IPHC-2022-SRB021-06	2023-25 FISS design evaluation (R. Webster)	✓ 19 Aug 2022
IPHC-2022-SRB021-07	IPHC Secretariat MSE Program of Work (2022–2023) and an update on progress (A. Hicks & I. Stewart)	✓ 18 Aug 2022
IPHC-2022-SRB021-08	Development of the 2022 Pacific halibut (*Hippoglossus stenolepis*) stock assessment (I. Stewart & A. Hicks)	✓ 17 Aug 2022
IPHC-2022-SRB021-09	Report on current and future biological and ecosystem science research activities (J. Planas)	✓ 18 Aug 2022
Information papers		
Nil to-date	Nil to-date	-

APPENDIX IV
CONSOLIDATED SET OF RECOMMENDATIONS AND REQUESTS OF THE 21ST SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB021)

RECOMMENDATIONS

International Pacific Halibut Commission 5-year program of integrated research and monitoring (2022-26)

SRB021–Rec.01 (para. 14) The SRB **RECOMMENDED** that the Secretariat and Commission take a more deliberate and explicit approach in deciding which research programs to fund internally or externally, since internally funded research can: (i) utilize milestones and interim evaluations as possible "kill points" where a project may be discontinued if the marginal costs outweigh the benefits of a particular research stream or project; (ii) provide pilot data to support external research proposals; and (iii) support critical applied research that falls outside typical funding agency interests.

IPHC Fishery-independent setline survey (FISS)

SRB021–Rec.02 (para. 18) **NOTING** that the coefficient of variation (CV) for IPHC Regulatory Area 4B continued to exceed the 15% threshold in 2021, the SRB **RECOMMENDED** continuing to investigate potential means to mitigate these effects. For example, by increasing the pool of potential bidders by including vessel using snap-gear.

Updates to space-time modelling

SRB021–Rec.03 (para. 20) **NOTING** that the 'hurdle' model structure (separate modeling of presence/absence and abundance conditional on presence) of the space-time model used to analyze the FISS may not be the most efficient approach, the SRB **RECOMMENDED** that the Secretariat explore other approaches such as the use of mixture models or the 'Tweedie' distribution.

SRB021–Rec.04 (para. 22) **NOTING** increasingly long computing times, limited available distributions, and space-time model instability in some cases, the SRB **RECOMMENDED** exploring alternatives to the R-INLA software package.

Management Strategy Evaluation: update

SRB021–Rec.05 (para. 26) **NOTING** the MSE results for size limit scenarios presented, the SRB **RECOMMENDED** further analysis of the economic implications of harvesting smaller fish (e.g. reduced yield and/or increased processing costs, changes in efficiency, and potential lower value for smaller fish).

SRB021–Rec.06 (para. 27) The SRB **RECOMMENDED** evaluating additional performance metrics including, for example, discard mortality and change in TCEY in assessment years for multi-year assessment MPs.

Pacific halibut stock assessment: 2022

SRB021–Rec.07 (para. 34) The SRB **RECOMMENDED** not implementing MASE weighting for the 2022 stock assessment advice and, instead, continuing to use the equal weighting approach to the ensemble components.

SRB021–Rec.08 (para. 35) **NOTING** the integration between the stock assessment and biological research in evaluating the impact of genetic sex composition data (and the one-year lag in providing these data) on assessment results along with the resourcing implications, the SRB

RECOMMENDED continued evaluation of the impact on stock assessment output of analyzing this genetic sex composition data on 1, 2, or 3 year intervals.

Biological and ecosystem sciences – Project updates

SRB021–Rec.09 (para. 41) **NOTING** the information on recent wire tagging of Pacific halibut as part of the recreational DMR study and intent to characterize movements of Pacific halibut among IPHC Regulatory Areas, the SRB **RECOMMENDED** that the data available be summarized to map and analyze existing trends in the data.

SRB021–Rec.10 (para. 44) **NOTING** the Secretariat's interest in applications of molecular markers for somatic growth and evaluation of growth patterns, the SRB **RECOMMENDED** that the Secretariat devote attention to annotation of sequence data that may be relevant to understanding spatial, temporal, and demographic (size/age) variation growth and maturation.

SRB021–Rec.11 (para. 47) **NOTING** the flow chart presented in Figure 1 of paper IPHC-2022-SRB021-09, the SRB **RECOMMENDED** that (i) additional analyses be conducted in areas of unsupervised clustering for individuals, and (ii) estimate measures of genetic variation among individuals within and among sampling groups to characterize inter-individual relationships, which could provide further indication of admixture. The coefficients of relationship among individuals within sampling location and levels of pair-wise variance in SNP allele frequency between sampling locations can be used to identify 'source' and 'sink' regions.

SRB021–Rec.12 (para. 48) The SRB **NOTED** that in the sub-area of Population Genetics and Structure, the Secretariat intends to use Site Frequency Spectral (SFS) analyses. Both selection and population growth can produce similar SFS patterns in data. As such, the SRB **RECOMMENDED** testing using a 'Tajima D' analysis and estimate levels of excess of low frequency SNP alleles within sampling areas (or reporting units).

SRB021–Rec.13 (para. 49) **NOTING** that Secretariat's intention to use Multiple Dimensional Scaling to visualise inter-individual and inter-location genetic similarity, the SRB **RECOMMENDED** that the Secretariat develop a data baseline of background information at the individual level to better develop hypotheses to explain visual patterns in data.

SRB021–Rec.14 (para. 50) **NOTING** the Secretariat's interest in describing linkage relationships, and that descriptions of linkage disequilibrium can be fraught with difficulty in situations of admixture and due to vagaries in breeding structure, the SRB **RECOMMENDED** that the Secretariat explore other literature not cited in IPHC-2022-SRB021-09 in this area.

SRB021–Rec.15 (para. 51) The SRB **RECOMMENDED** that the Secretariat (i) develop a rapid screening panel of SNP markers (e.g. GTseq, RADcapture) for future use in Close-Kin Mark recapture (CKMR), population assignment, or other applications (CKMR applications may necessitate the development of microhaplotypes to achieve adequate accuracy in multi-generational pedigree analyses), and (ii) begin developing potential SNP panels and evaluate accuracy of population-based or pedigree-based assignment under scenarios likely to be encountered in future IPHC applications.

REQUESTS

International Pacific Halibut Commission 5-year program of integrated research and monitoring (2022-26)

SRB021–Req.01 (para. 15) The SRB **RECALLED** SRB020–Rec.05 (para. 36) (shown below) and **REQUESTED** that the Secretariat evaluate data collected during the FISS or other IPHC research programs that might be useful for the broader scientific community and potential existing external repositories that might house these data.

> SRB020–Rec.05 (para. 36) "*The SRB **NOTED** the exceptional level of transparency and commitment to the principles of open science represented by the Secretariat's data and code-sharing practices and, therefore, **RECOMMENDED** that the Secretariat consider producing peer-reviewed data report publications, which would (a) enhance outreach to potential external data users and (b) allow for tracking external use of IPHC data and resources*."

Management Strategy Evaluation: update

SRB021–Req.02 (para. 30) The SRB **REQUESTED** that the Secretariat examine MPs based on a three-year assessment cycle with annual TCEY changes proportional to changes in the FISS index because (i) this approach would be simpler and more transparent than a model, which has not yet been developed); (ii) the high benefit to cost ratio for multi-year TCEYs; (iii) it matches the current three-year full assessment cycle; and (iv) the general approach has precedents in other fishery commissions (e.g. Southern Bluefin Tuna).

Pacific halibut stock assessment: 2022

SRB021–Req.03 (para. 32) The SRB **RECALLED** SRB020–Rec.02 (para. 23) and SRB020-Rec.04 (para. 25) (shown below), and **REQUESTED** an update at SRB022:

> SRB020–Rec.02 (para. 23) "*The SRB **NOTED** that most models within the ensemble produced reasonable and well-constrained estimates of natural mortality (M) and **RECOMMENDED** that estimation of M should be adopted in the short AAF assessment model with consideration in other models as part of the stock assessment research program.*"
>
> SRB020–Rec.04 (para. 25) "*The SRB **NOTED** apparent discrepancies in marine mammal prevalence among anecdotal reports, FISS observations, and preliminary evaluation of logbook data, and therefore **RECOMMENDED** further investigation of methods to better estimate marine mammal prevalence and impacts on the fishery.*"

SRB021–Req.04 (para. 33) **NOTING** the substantial interannual variation in MASE weightings of the four assessment models, the SRB **AGREED** that one-step-ahead predictive skill is a potentially promising basis for model weighting, and **REQUESTED** continued research into MASE weightings averaged over longer time periods as well as comparing these to alternative weighting metrics, for example, via cross-validation.

Biological and ecosystem sciences – Project updates

SRB021–Req.05 (para. 37) The SRB **REQUESTED** that the Secretariat amend the priorities under bullet "2. Reproduction" (IPHC-2022-SRB021-09) to include other avenues of investigations such as size/age specific fecundity and spatial variation in same.

SRB021–Req.06 (para. 39) The SRB **NOTED** and **APPRECIATED** details provided concerning ongoing or anticipated statistical analyses of data that enhanced the SRB's ability to understand and

critique methods to expected research outcomes and **REQUESTED** continued consistency in the presentation in these areas.

SRB021–Req.07 (para. 40) **NOTING** the progress update on Migration and Distribution and the specific research goal of creating a map of suitable juvenile Pacific halibut settlement habitat, the SRB **REQUESTED** (i) a clearer statement of the relevance of this research to management, MSE, and/or the stock assessment and (ii) clarification regarding the types of data to be collected and used to determine occupancy (and preference), and by what data sources.

SRB021–Req.08 (para. 43) **NOTING** the Secretariat's interest in growth and size-at-age relationships, the SRB **REQUESTED** clarification of narrative regarding collection of environmental covariate data for projecting future short-term size-at-age trends.

SRB021–Req.09 (para. 45) **NOTING** the Secretariat's interest in identification of evidence for spatial population structure, and given the IPHC manages stocks on the basis of biological reporting regions, the SRB **REQUESTED** clarification on how the Secretariat may alter assessments if 'functionally isolated components of the population are found'.