Report of the 19th Session of the IPHC Scientific Review Board (SRB019)

Meeting held electronically, 21-23 September 2021

Commissioners

Canada	United States of America
Paul Ryall	Chris Oliver
Neil Davis	Robert Alverson
Peter DeGreef	Richard Yamada

Executive Director
David T. Wilson, Ph.D.

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

Contact details:

International Pacific Halibut Commission
2320 W. Commodore Way, Suite 300
Seattle, WA, 98199-1287, U.S.A.
Phone: +1 206 634 1838
Fax: +1 206 632 2983
Email: secretariat@iphc.int
Website: https://www.iphc.int

ACRONYMS

AM	Annual Meeting
COVID-19	Novel Coronavirus 2019
CPUE	Catch Per Unit Effort
DMR	Discard Mortality Rate
FISS	Fishery-Independent Setline Survey
IPHC	International Pacific Halibut Commission
MP	Management Procedure
MSAB	Management Strategy Advisory Board
MSE	Management Strategy Evaluation
OM	Operating Model
PCR	Polymerase Chain Reaction
PDO	Pacific Decadal Oscillation
PHMEIA	Pacific Halibut Multiregional Economic Impact Assessment
SRB	Scientific Review Board
TCEY	Total Constant Exploitable Yield
U.S.A.	United States of America
WPUE	Weight-Per-Unit-Effort

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** (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 19th Session of the International Pacific Halibut Commission (IPHC) Scientific Review Board (SRB019) was held electronically from 21 to 23 September 2021. The meeting was opened by the Chairperson, Dr Sean Cox (Canada).

The following are a subset of the complete recommendations/requests for action from the SRB019, which are provided in full at Appendix V.

RECOMMENDATIONS

2022-24 IPHC Fishery-independent setline survey (FISS) design evaluation

SRB019–Rec.01 (para. 13) The SRB **RECOMMENDED** that the Commission note the SRB018 endorsement of the proposed 2022 design and provisional endorsement of the proposed 2023-24 designs, as provided at Appendix IV, recognizing that the designs for 2023-24 will be reviewed again at subsequent SRB meetings.

SRB019–Rec.02 (para. 14) **NOTING** the presentation of three alternative 2022 sampling designs (Figs. 1, 2, and 3) that optimize the SRB018-endorsed proposed 2022 design for cost, thereby meeting the goals of long-term revenue neutrality (Secondary Objective), without compromising the scientific goals of the FISS (Primary Objective), the SRB **RECOMMENDED** that the Secretariat prioritize 2022 sampling designs that include IPHC Regulatory Area 4CDE despite the relatively low contribution of this area to overall biomass and variance. This region is an important area to monitor for future range shifts and biological samples collected here are likely to be important for understanding the biology of Pacific halibut at their leading range edge.

Modelling of IPHC length-weight data

SRB019–Rec.03 (para. 18) The SRB **RECOMMENDED** that the IPHC provide a revised length-net weight relationship for each IPHC Regulatory Area based on modelling of combined FISS and commercial sample data to be used for the calculation of all non-IPHC mortality estimates where individual weights cannot be collected, for 2021 and until further notice.

Management Strategy Evaluation: Update

SRB019–Rec.05 (para. 34) The SRB **RECOMMENDED** the investigation of empirical procedures to inform mortality limits in non-assessment years of a multi-year assessment MP.

SRB019–Rec.06 (para. 35) **NOTING** the inclusion of uncertainty stemming from implementation ***uncertainty***, the SRB **RECOMMENDED** that the IPHC Secretariat develop, for presentation at SRB020, alternative scenarios that represent implementation ***bias***, i.e. the potential for quota reductions called for by the management procedure to be less likely implemented than quota increases.

IPHC Secretariat MSE Program of Work (2021-23)

SRB019–Rec.07 (para. 38) The SRB **RECOMMENDED** that the initial management procedure be evaluated on the basis of the current operating model.

SRB019–Rec.08 (para. 39) The SRB **RECOMMENDED** that the IPHC Secretariat develop alternative OMs from various hypotheses related to population processes or environmental covariates for implementation in the MSE framework, noting paragraph 38, and that tasks leading to the adoption of a well-defined MP should be prioritized.

1. OPENING OF THE SESSION

1. The 19th Session of the International Pacific Halibut Commission (IPHC) Scientific Review Board (SRB019) was held electronically from 21 to 23 September 2021. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Sean Cox (Canada).

2. The SRB **RECALLED** its mandate, as detailed in Appendix VIII, Sect. I, para. 1-3 of the IPHC Rules of Procedure (2021):

    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/19th-session-of-the-iphc-scientific-review-board-srb019.

3. IPHC PROCESS

3.1 SRB annual workflow

4. The SRB **RECALLED** that the core purpose of the SRB019 is to review progress on the IPHC science and research program, including specific products, and to provide guidance for the delivery of products to the Commission at its Interim Meeting in November 2021, and Annual Meeting in January 2022.

3.2 Update on the actions arising from the 18th Session of the SRB (SRB018)

5. The SRB **NOTED** paper IPHC-2021-SRB019-03, which provided the SRB with an opportunity to consider the progress made during the intersessional period, on the recommendations/requests arising from the SRB018.

6. The SRB **NOTED** that most actions from SRB018 remain either ‘In Progress’ or ‘Pending’.

7. The SRB **AGREED** to consider and revise the actions as necessary, and to combine them with any new actions arising from SRB019 into a consolidated list for future reporting.

8. The SRB **RECALLED** three actions for delivery at SRB020 as follows:

    a) SRB018–Req.1 (para. 13) IPHC Fishery-independent setline survey (FISS): 2022-24 FISS design evaluation. The SRB **REQUESTED** plots by survey area of WPUE vs. depth from both FISS and commercial fisheries to help understand if there is part of the Pacific halibut stock in deeper waters not covered by the FISS.

b) SRB018–Req.2 (para. 14) The SRB **REQUESTED** that the IPHC Secretariat conduct a preliminary comparison, to be presented at SRB020, between male, female, and sex-aggregated analysis of the FISS data using the spatial-temporal model.

c) SRB018–Req.14 (para. 52) The SRB **NOTED** that, without a clearer understanding of the Commissions purpose for future use of this work, it is difficult to provide guidance on prioritising model development (e.g. improve spatial resolution, incorporate dynamic / predictive processes, adding more detail on subsistence and recreational fisheries, including uncertainty in the assessment). The SRB therefore **REQUESTED** specific guidance and clarification from the Commission on the objectives and intended use of this study.

3.3 Outcomes of the 97th Session of the IPHC Annual Meeting (AM097)

9. The SRB **NOTED** paper IPHC-2021-SRB018-04 which detailed the outcomes of the 97th Session of the IPHC Annual Meeting (AM097), 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

10. The SRB **NOTED** updates from the two science advisors, who provided context that may help with SRB discussions/deliberations. These included, but were not limited to: 1) linking the 5-year plan to information provided to Commissioners; 2) How economic analysis will be implemented into advice; 3) How to improve communication within MSE process; 4) Whether a three-year schedule for a full stock assessment still makes sense; 5) How is climate change effecting Pacific halibut biology and assessment and what are the implications for management; and 6) What stakeholder advisory boards in the MSE processes, or the MSAB itself, have (or haven't) been able to accomplish.

4. IPHC FISHERY-INDEPENDENT SETLINE SURVEY (FISS) AND COMMERCIAL DATA MODELLING

4.1 2022-24 FISS design evaluation

11. The SRB **NOTED** paper IPHC-2021-SRB019-05, which provided an opportunity to further review the 2022-24 FISS designs presented at SRB018 and endorsed by the Scientific Review Board (SRB) at that meeting.

12. The SRB **NOTED** and applauded the IPHC Secretariat, field staff (Setline Survey Specialists), and contracted vessels for successfully executing the 2021 FISS under the continuing and potentially overwhelming circumstances of the COVID-19 pandemic. Despite such challenges, the FISS was still able to achieve the intended range of precision set in the FISS Objectives. This achievement speaks to both the dedication of the entire IPHC Secretariat and the flexibility of the spatio-temporal analysis framework to accommodate changes in FISS design.

13. The SRB **RECOMMENDED** that the Commission note the SRB018 endorsement of the proposed 2022 design and provisional endorsement of the proposed 2023-24 designs, as provided at Appendix IV, recognizing that the designs for 2023-24 will be reviewed again at subsequent SRB meetings.

14. **NOTING** the presentation of three alternative 2022 sampling designs (Figs. 1, 2, and 3) that optimize the SRB018-endorsed proposed 2022 design for cost, thereby meeting the goals of long-term revenue neutrality (Secondary Objective), without compromising the scientific goals of the FISS (Primary Objective), the SRB **RECOMMENDED** that the Secretariat prioritize 2022 sampling designs that include IPHC Regulatory Area 4CDE despite the relatively low contribution of this area to overall biomass and variance. This region is an important area to monitor for future range shifts and biological samples collected here are likely to be important for understanding the biology of Pacific halibut at their leading range edge.

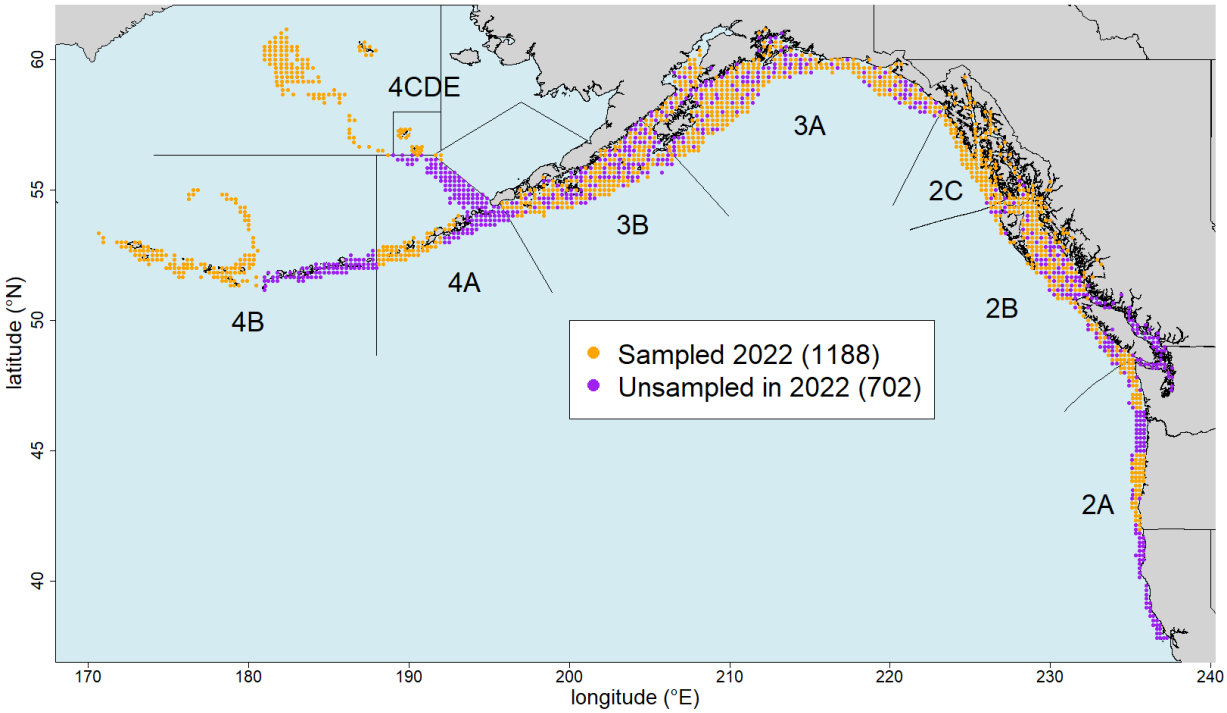

Fig. 1. Potential optimized FISS design for 2022, with original design endorsed at SRB018 augmented with additional stations in IPHC Regulatory Areas 2B, 2C, 3A, and 3B in order to help achieve the secondary objective of long-term revenue neutrality.

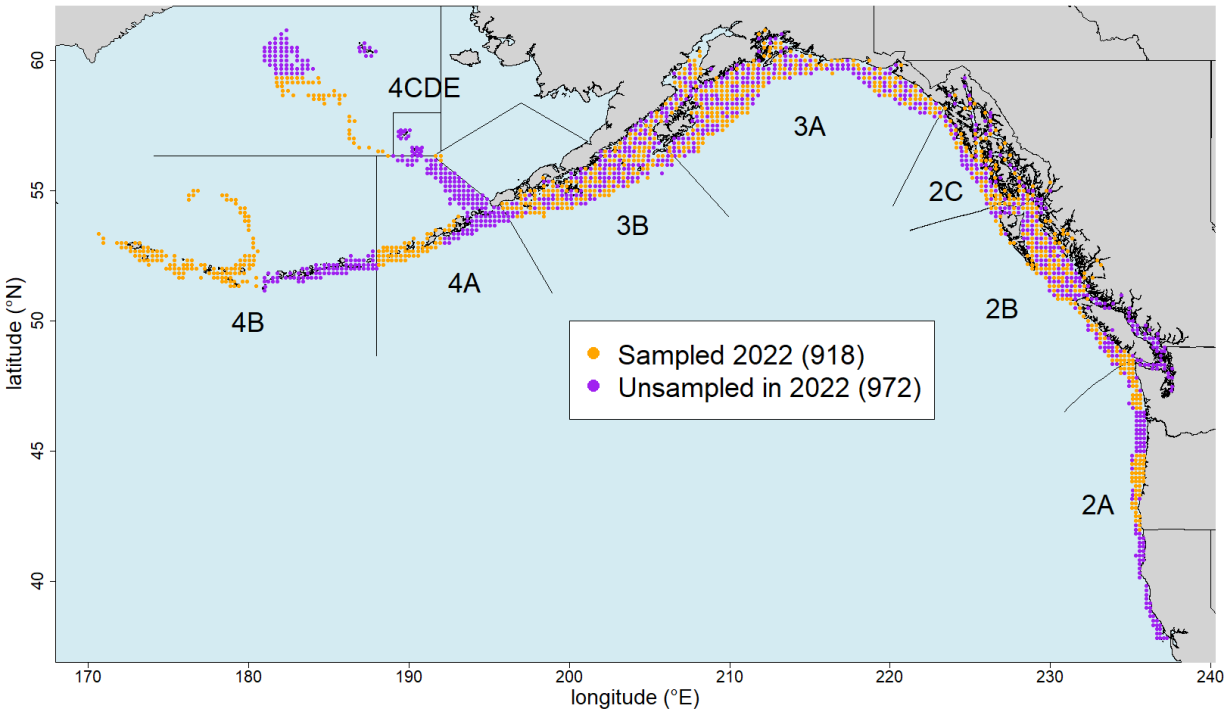

Fig. 2. Potential FISS design for 2022, with original design endorsed at SRB018 modified to remove northern Bering Sea shelf edge stations fished in 2021 to help achieve the secondary objective of long-term revenue neutrality.

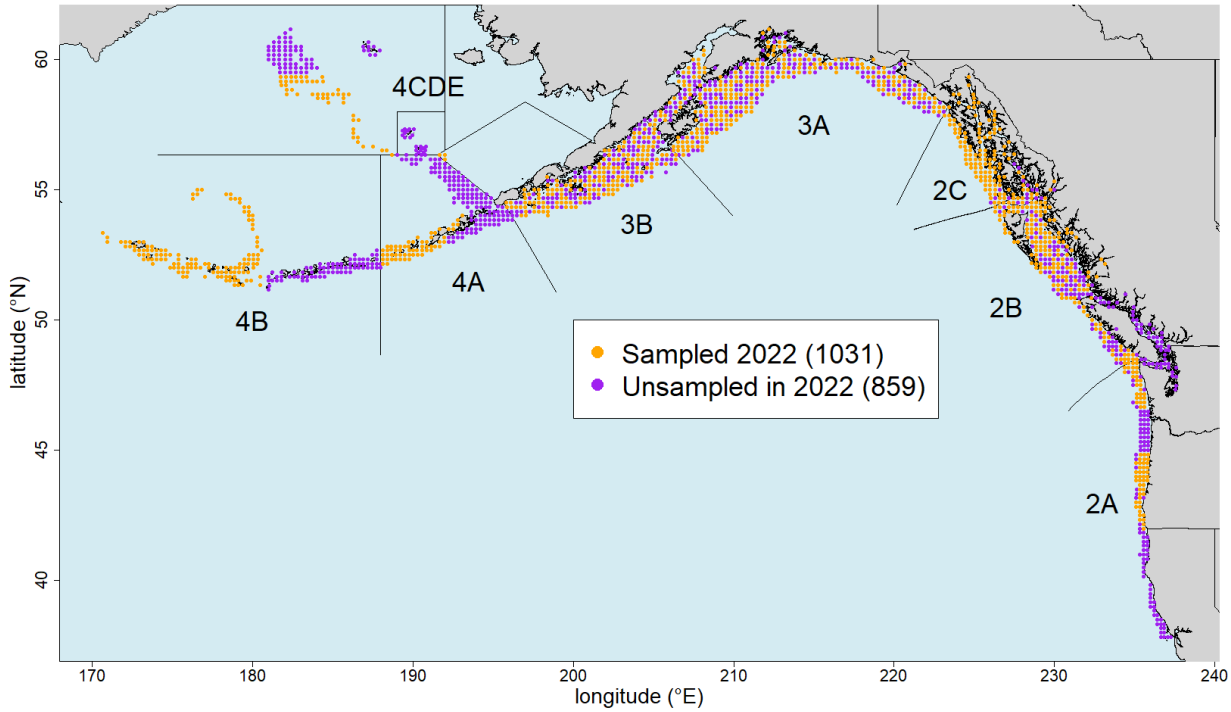

Fig. 3. Potential optimized FISS design for 2022, with original design endorsed at SRB018 modified to remove northern Bering Sea shelf edge stations fished in 2021 augmented with additional stations in IPHC Regulatory Areas 2B, 2C, 3A, and 3B in order to help achieve the secondary objective of long-term revenue neutrality.

4.2 Modelling of IPHC length-weight data

15. The SRB **NOTED** paper IPHC-2021-SRB019-05.2 that presented methods for revised the length-net weight relationships from FISS and commercial sampling data.

16. The SRB **NOTED** that such length-weight relationships may vary with sex, and that changes over time may be affected by changes in environmental variables including temperature.

17. The SRB **NOTED** that any revised length-weight relationship will affect the estimates of a high proportion of overall Pacific halibut mortality that results from recreational catch and Pacific halibut discards.

18. The SRB **RECOMMENDED** that the IPHC provide a revised length-net weight relationship for each IPHC Regulatory Area based on modelling of combined FISS and commercial sample data to be used for the calculation of all non-IPHC mortality estimates where individual weights cannot be collected, for 2021 and until further notice.

19. **NOTING** the emerging difference between length-weight regressions based on historical vs. recent data, the SRB **REQUESTED** further investigation of the underlying processes (whether in the observation process - e.g. timing of sample collection - or biological changes - e.g. changes in somatic growth) driving these differences. While the suggested solution provides a numerical solution it also annually requires significant sampling and analysis efforts which could potentially be reduced through a better understanding of the processes involved.

4.3 Review of IPHC hook competition standardization

20. The SRB **NOTED** paper IPHC-2021-SRB019-05.3 that presented an overview of the IPHC standardization for hook competition on FISS sets.

21. The SRB **NOTED** that such a standardization is not applied to commercial CPUE, but would in any case be of limited value given the weighting of commercial CPUE in IPHC stock assessment.

22. **NOTING** the presentation of methods used for hook competition standardization, the SRB **REQUESTED** continued analysis of this phenomenon and incorporation of these corrections in the FISS data analysis, including potential use of hook timer studies if the technology permits.

4.4 Accounting for the effects of whale depredation on the FISS

23. The SRB **NOTED** paper IPHC-2021-SRB019-05.4 that presented an approach to accounting for the effects of whale interactions on FISS catch rates through the space-time modelling.

24. **NOTING** the presentation of methods used for accounting for whale depredation, and the limited impact of the correction at this point, the SRB **REQUESTED** that the IPHC Secretariat continue to monitor the influence of whale depredation on the FISS and the stock assessment. If the whale depredation correction becomes more important in the future, it will become important to conduct a broader investigation of ways that this phenomenon could be described and accounted for, if at all, in the FISS. Also, the impact / treatment of the associated compositions should be better explained within the stock assessment.. While the SRB generally supports the idea to use all possible data there is a question as to whether the simple time covariate approach risks introducing bias through changes in density of Pacific halibut and / or whales and through ignoring possible depredation selectivity by size and sex.

5. PACIFIC HALIBUT STOCK ASSESSMENT: 2021

5.1 Modelling updates

25. The SRB **NOTED** paper IPHC-2021-SRB019-06, which provided a summary of stock assessment development, including responses to previous SRB requests and an update on data sources and planning for the final 2021 stock assessment.

26. The SRB **NOTED** that:

    a) the 2021 stock assessment represents an update to the 2020 stock assessment with no changes to model structure or primary sources of data;

    b) preliminary trends in the time-series of commercial fishery sex ratio-at-age, that now includes 2020, the 4th year of consecutive data.

27. The SRB **AGREED** that the final 2021 stock assessment would include new data and updated data for all standard data sources, including:

    a) 2021 FISS results: modelled trends and biological data (ages, lengths, weights, weight-at-age);

    b) 2020 Commercial fishery sex ratios-at-age and 2021 logbook and biological sampling;

    c) Biological information from other sources (non-directed commercial and recreational);

    d) Mortality estimates for 2021 and updates to 2020 where necessary.

28. The SRB **NOTED** and appreciated the thorough and informative response to the SRB018 (Req.04) providing five ways in which surplus production could be considered in the Pacific halibut assessment and highlighting that three of these have been previously evaluated (fitting surplus production models directly, reporting the '3-year surplus' in the decision table, and the standard reporting of empirical harvest rates).

29. The SRB **NOTED** that the FISS index-based analysis of relative harvest rates among regions (option 5 of the 5 analyses of surplus production presented in IPHC-2021-SRB019-06) could be considered as a potential metric for defining "Exceptional Circumstances" in the management procedures evaluated in the MSE.

30. **NOTING** that the surplus production analysis revealed a recent pattern of harvest exceeding surplus production despite current biomass being below the target biomass, the SRB **RECOMMENDED** that the IPHC Secretariat continue to report on surplus production in addition to trends and scale of surplus production and fishing intensity as part of the annual assessment.

31. The SRB **REQUESTED** that the IPHC Secretariat consider the following topics for inclusion in the 2022 full stock assessment and presentation for SRB evaluation at SRB020 in June 2022:

    a) Sensitivity analysis of the assessment to processes being investigated by the Biological and Ecosystem Research Program, e.g. spatiotemporal differences in maturity schedules, discard mortality, and length-weight relationships;

    b) Continued exploration of data weighting;

    c) Evaluation of treatment of commercial sex ratio;

    d) Use of the Pacific Decadal Oscillation (PDO) and other environmental covariates to predict recruitment;

    e) Estimation of whale depredation mortality for potential explicit inclusion in the assessment model; and

    f) Other factors discussed since the last stock assessment.

32. The SRB **AGREED** that the IPHC Secretariat should continue on a three-year schedule for conducting a full stock assessment.

6. MANAGEMENT STRATEGY EVALUATION: UPDATE

33. The SRB **NOTED** paper IPHC-2021-SRB019-07 describing the MSE Program or Work for 2021–23, sources of variability in the MSE framework, and results from simulations with a biennial mortality limit specification.

6.1 A summary of the MSE outcomes to date

34. The SRB **RECOMMENDED** the investigation of empirical procedures to inform mortality limits in non-assessment years of a multi-year assessment MP.

35. **NOTING** the inclusion of uncertainty stemming from implementation ***uncertainty***, the SRB **RECOMMENDED** that the IPHC Secretariat develop, for presentation at SRB020, alternative scenarios that represent implementation ***bias***, i.e. the potential for quota reductions called for by the management procedure to be less likely implemented than quota increases.

36. The SRB **NOTED** that the primary coastwide objectives do not specify the short to medium-term risk of low mortality limits, and that reporting lower quantiles of TCEY, such as the 5th percentile, may be informative to distinguish between MPs.

6.2 IPHC Secretariat MSE Program of Work (2021-23)

37. The SRB **NOTED** that tasks for the MSE Program of Work prioritize the adoption of a well-defined management procedure, taking into account interdependencies among tasks and that exploration and development of alternative OMs is likely to compete with the simulation and evaluation of MPs, potentially delaying the adoption of a well-defined management procedure.

38. The SRB **RECOMMENDED** that the initial management procedure be evaluated on the basis of the current operating model.

39. The SRB **RECOMMENDED** that the IPHC Secretariat develop alternative OMs from various hypotheses related to population processes or environmental covariates for implementation in the MSE framework, noting paragraph 38, and that tasks leading to the adoption of a well-defined MP should be prioritized.

7. BIOLOGICAL AND ECOSYSTEM SCIENCE RESEARCH

7.1 IPHC 5-Year biological and ecosystem science research plan (2017-21)

40. The SRB **NOTED** paper IPHC-2021-SRB019-08 which provided the SRB with an update on progress on IPHC's five-year Biological and Ecosystem Sciences Research Plan (2017-21).

41. The SRB **NOTED** and commended the IPHC Secretariat for their continued attention to place current and future Biological and Ecosystem Science Research activities into the context of Stock Assessment (SA) and Management Strategy Evaluation (MSE) data needs. Information provided in Appendices I, II, III, and IV of IPHC-2021-SRB019-08 integrated components across areas of the IPHC research, monitoring, and assessment portfolios. This effort was greatly appreciated, and will foster greater appreciation of the impacts of the IPHC research program on Pacific halibut management.

42. The SRB **NOTED** that:

    a) in previous SRB meetings, conclusions from the reproduction focal area were based on data from a single region collected from a relatively small sample size in a single year;

    b) the IPHC-2021-SRB019-08 document lacked many of the forward-looking planning the SRB had requested during previous meetings;

    c) the plans described by the IPHC Secretariat during the SRB019 oral presentations regarding the expanded spatial and temporal sampling design to collect samples during the 2022 FISS to produce histologically-based maturity ogives by biological region. The SRB **ACKNOWLEDGED** that this effort is needed before information from the existing data can be integrated into a formalized effort to inform the SA and MSE.

43. The SRB **RECOMMENDED** that the Secretariat consider the value of other opportunistically collected samples that would facilitate further downstream analyses in a cost effective manner.

7.2 Progress on ongoing research projects

7.2.1 Reproduction

44. The SRB **NOTED** the completion of studies in one location, which provide information on the seasonal characteristics of reproductive development in female Pacific halibut. This is one step toward the intended goal of providing maturation schedules based on samples from across the species range.

45. The SRB **NOTED** the plans described by the IPHC Secretariat for the sampling design to collect samples during the 2022 FISS to produce histologically-based maturity schedules by biological region. The SRB is pleased to see the detailed practical and scientific considerations that have gone into the development of the plan to ensure the best possible chance of success in addressing the objectives of this study. However, the SRB also **NOTED** that the conclusion that July-August is an acceptable sampling period is based on an analysis from a single location (Portlock, region 3) which may or may not represent seasonal reproductive timing in other regions.

46. The SRB **NOTED** that the IPHC Secretariat is finalising a proposed sampling design for the collection of ovaries in the 2023 FISS, for providing precise estimates of fecundity and **REQUESTED** for SRB020 in June 2022, more detail on the considerations taken to ensure the sampling maximises the opportunity to address the objectives.

7.2.2 Growth and Physiological Condition

47. The SRB **NOTED** ongoing studies aimed at characterizing previously-identified physiological growth genetic gene expression markers as potentially useful indicators of growth patterns in Pacific halibut that could also assist in understanding growth variation at a genomic level.

48. The SRB **ACKNOWLEDGED**:

    a) that there are multiple sources of variability in physiological condition that can affect growth;

    b) progress in development of quantitative (q)PCR assays to quantify expression levels of genes that have been demonstrated by the IPHC Secretariat as associated with Pacific halibut body size.

49. The SRB **NOTED** the information on associations of wild-caught age-4 Pacific halibut body size and gene expression patterns characterized by the IPHC Secretariat under experimental conditions.

50. The SRB **REQUESTED** that the IPHC Secretariat pause further pursuit of this research until it can articulate specifically how this approach will inform the stock assessment or MSE and why this approach is preferable to investigation of age-length-weight information which is available at a much broader geographic and temporal scale.

7.2.3 Discard Mortality Rates (DMRs) and Survival

51. The SRB **NOTED** ongoing studies aimed at providing updated estimates of DMRs in both the commercial longline and recreational fisheries. Of interest is the apparently low (approaching natural mortality) and very delayed mortality of longline discarded fish.

7.2.4 Genetics and Genomics

52. The SRB **NOTED** ongoing studies aimed at describing the genetic structure of the Pacific halibut population by low-coverage whole genome resequencing with particular emphasis on stock structure in IPHC Regulatory Area 4B.

53. The SRB **ACKNOWLEDGED** progress made in the area of low-coverage whole genome resequencing and the promising preliminary data showing discrimination among spawning aggregations. Less clear is how sampling at other times of the year would allow estimation of the spawning site contribution to catches, when likely not all spawning sites have been included. This may hamper the development of a complete picture of the stock structure and migration patterns.

54. The SRB **NOTED** that the IPHC Secretariat would benefit from further consultation with the SRB regarding additional analyses that attempt to characterize spatial structure and applications of this information.

7.3 Research integration

55. The SRB **NOTED** that the IPHC Secretariat have embraced past SRB recommendations to integrate the research program with stock assessment and MSE information needs.

56. The SRB **RECOMMENDED** that the IPHC Secretariat identify those research areas with uncertainty and indicate research questions that would require the SRB to provide input and/or decision in future documentation and presentations provided to the SRB.

8. PACIFIC HALIBUT FISHERY ECONOMICS UPDATE

57. The SRB **NOTED** paper IPHC-2021-SRB019-09 which provides the SRB with an update on the development of the Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA), including the addition of the recreational sector, and responds to comments made during the SRB018 (IPHC-2021-SRB018-R).

58. The SRB **NOTED** the long-term objectives of the Fishery Economics program presented in Section 5.3: "*To provide stakeholders with an accurate and all-sectors-encompassing assessment of the socioeconomic impact of the Pacific halibut resource in Canada and the United States of America.*"

59. The SRB **NOTED** that substantial uncertainties surround our understanding of recreational fishing effort dynamics (e.g. the expected change in effort with changes in season length or size limits and the availability of alternative target species such as Pacific salmon) and **REQUESTED** that the IPHC Secretariat assess and present at SRB020, the feasibility and value of various stated preference (e.g. a discrete choice experiment) and revealed preference (e.g. time series analysis of fishing effort patterns with respect to regulatory changes) approaches to understanding recreational effort dynamics.

60. The SRB **REQUESTED** that the IPHC Secretariat assess and present at SRB020, the potential of using data from the Guided Angler Fish Program (USA) and Pacific Region Experimental Recreational Halibut Program (Canada) as inputs to the economic analysis of Pacific halibut, particularly the trade-offs between the commercial and the recreational sector.

61. The SRB **REQUESTED** further information (e.g. inverse demand curves), to be presented at SRB020, on the regional supply-price relationships for commercial landings, as well as localized importance of the Pacific halibut fishery to communities.

9. INTERNATIONAL PACIFIC HALIBUT COMMISSION 5-YEAR PROGRAM OF INTEGRATED SCIENCE AND RESEARCH (2021-26)

62. The SRB **NOTED** paper IPHC-2021-SRB019-10 which described research priorities, integration across programs, and performance metrics for 2022-26 and applauded the progress toward integration across core areas.

63. The SRB **REQUESTED** that the IPHC Secretariat consider the following changes (in no particular order) to this document by SRB2020:

    a) Add an Executive Summary;

    b) Change the title, the overall statement of purpose section, and Fig. 4 to better reflect the goals and intent of the research program;

    c) Enhance stock assessment section to reflect research in this area including some of the priorities from the external review etc.;

    d) Include the intent to use the MSE to provide research direction and prioritisation (feedback) to the biological research program;

    e) Keep monitoring section separate as is, but demonstrate the linkage to the research through resource sharing etc.;

    f) Add a performance metric related to the provisioning of high-quality management advice that meets the Commission's needs;

    g) Include specific subsections on implications for integration with other core areas and relevance to management;

    h) Draft the section on climate change.

10. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 19TH SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB019)

64. The SRB **THANKED** outgoing board member, Dr Sven Kupschus, for his service to the IPHC over the past years and wished him well in his future endeavours.

65. The report of the 19th Session of the IPHC Scientific Review Board (IPHC-2021-SRB019-R) was **ADOPTED** on 23 September 2021, including the consolidated set of recommendations and/or requests arising from SRB019, provided at Appendix V.

APPENDIX I
LIST OF PARTICIPANTS FOR THE 19TH SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB019)

SRB Members

Dr Sean **Cox**:	spcox@sfu.ca; Professor, School of Resource and Environmental Management, Simon Fraser University, 8888 University Dr., Burnaby, B.C., Canada V5A 1S6
Dr Olaf **Jensen:**	olaf.p.jensen@gmail.com; Associate Professor, Center for Limnology, University of Wisconsin - Madison, 680 N Park St., Madison, WI 53706
Dr Sven **Kupschus**:	sven@kupschus.net; Principal Fisheries Research Scientist, CEFAS, Pakefield Road, Lowestoft NR33 0HT, UK
Dr Kim **Scribner**:	scribne3@msu.edu; Professor, Department of Fisheries and Wildlife, Michigan State University, 2E Natural Resources Building, East Lansing, MI, U.S.A., 48824

Observers

Canada	United States of America
Ms Ann-Marie **Huang**: Ann-Marie.Huang@dfo-mpo.gc.ca	Dr Carey **McGilliard** carey.mcgilliard@noaa.gov
	Sarah **Marrinan**, sarah.marrinan@noaa.gov
	Anna **Henry**, anna.henry@noaa.gov
	Sarah **Webster**, sara.webster@noaa.gov

IPHC Secretariat

Name	Position and email
Dr David **Wilson**	Executive Director, david.wilson@iphc.int
Dr Josep **Planas**	Biological and Ecosystem Sciences Branch Manager, josep.planas@iphc.int
Dr Barbara **Hutniczak**	Fisheries Policy and Economics Branch Manager, barbara.hutniczak@iphc.int
Dr Allan **Hicks**	Quantitative Scientist, allan.hicks@iphc.int
Dr Ian **Stewart**	Quantitative Scientist, ian.stewart@iphc.int
Dr Ray **Webster**	Quantitative Scientist, ray.webster@iphc.int
Dr Tim **Loher**	Research Scientist, tim.loher@iphc.int
Mr Claude **Dykstra**	Research Biologist, claude.dykstra@iphc.int
Mr Andy **Jasonowicz**	Research Biologist, andy.jasonowicz@iphc.int
Mr Thomas **Kong**	Fisheries Data Specialist, tom.kong@iphc.int
Mr Afshin **Taheri**	Programmer, afshin.taheri@iphc.int
Ms Lauri **Sadorus**	Research Biologist, lauri.sadorus@iphc.int
Ms Kayla **Ualesi**	Setline Survey Coordinator, kayla.ualesi@iphc.int
Mr Colin **Jones**	Setline Survey Specialist, colin.jones@iphc.int
Mr Tyler **Jack-McCollough**	Setline Survey Specialist, ralph.jack-mccollough@iphc.int
Mr Edward **Henry**	Communications Specialist, edward.henry@iphc.int
Ms Crystal **Simchick**	Biological Science Laboratory Technician, anna.simeon@iphc.int
Ms Kelly **Chapman**	Snr. Administrative Specialist, kelly.chapman@iphc.int
Ms Erin **Salle**	Administrative Specialist, erin.salle@iphc.int
Ms Ola **Wietecha**	Administrative Specialist, ola.wietecha@iphc.int
Ms Tara **Coluccio**	Administrative Specialist/Communications, tara.coluccio@iphc.int

APPENDIX II
AGENDA FOR THE 19TH SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB019)

Date: 21-23 September 2021
Location: Electronic Meeting
Venue: Adobe Connect
Time: 12:00-17:00 (21st), 09:00-17:00 (22-23)
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-2021-SRB019-01: Agenda & Schedule for the 19th Session of the Scientific Review Board (SRB019)
- IPHC-2021-SRB019-02: List of Documents for the 19th Session of the Scientific Review Board (SRB019)

3. IPHC PROCESS

3.1. SRB annual workflow (D. Wilson)
3.2. Update on the actions arising from the 18th Session of the SRB (SRB018) (D. Wilson)
- IPHC-2021-SRB019-03: Update on the actions arising from the 18th Session of the SRB (SRB018) (IPHC Secretariat)

3.3. Outcomes of the 97th Session of the IPHC Annual Meeting (AM097) (D. Wilson)
- IPHC-2021-SRB019-04: Outcomes of the 97th Session of the IPHC Annual Meeting (AM097) (D. Wilson)

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

4. IPHC FISHERY-INDEPENDENT SETLINE SURVEY (FISS) AND COMMERICAL DATA MODELLING

4.1. 2022-24 FISS design evaluation (R. Webster)
4.2. Modelling of IPHC length-weight data (R. Webster)
4.3. Review of IPHC hook competition standardization (R. Webster)
4.4. Accounting for the effects of whale depredation on the FISS (R. Webster)
- IPHC-2021-SRB019-05: IPHC Fishery-Independent Setline Survey (FISS) and commercial data modelling (R. Webster)

5. PACIFIC HALIBUT STOCK ASSESSMENT: 2021

5.1. Modelling updates (I. Stewart)
- IPHC-2021-SRB019-06: Update on the development of the 2021 stock assessment: Development (I. Stewart & A. Hicks)

6. MANAGEMENT STRATEGY EVALUATION: UPDATE

- IPHC-2021-SRB019-07: IPHC Secretariat MSE Program of Work (2021–2023) and an update on progress (A. Hicks & I. Stewart)

6.1. A summary of the MSE outcomes to date (A. Hicks)
6.2. IPHC Secretariat MSE Program of Work (2021-23) (A. Hicks)

7. BIOLOGICAL AND ECOSYSTEM SCIENCES RESEARCH

- IPHC-2021-SRB019-08: Report on current and future biological research activities (J. Planas)

7.1. IPHC 5-Year biological and ecosystem science research plan (2017-21) (J. Planas)

7.2. Progress on ongoing research projects (J. Planas)

8. PACIFIC HALIBUT FISHERY ECONOMICS UPDATE

- IPHC-2021-SRB019-09: Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): summary of progress (B. Hutniczak)

9. INTERNATIONAL PACIFIC HALIBUT COMMISSION 5-YEAR PROGRAM OF INTEGRATED SCIENCE AND RESEARCH (2021-26)

- IPHC-2021-SRB019-10: International Pacific Halibut Commission 5-Year program of integrated science and research (2021-26) (D. Wilson, J. Planas, I. Stewart, A. Hicks, B. Hutniczak, & R. Webster)

10. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 19TH SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB019)

APPENDIX III
LIST OF DOCUMENTS FOR THE 19TH SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB019)

Document	Title	Availability
IPHC-2021-SRB019-01	Agenda & Schedule for the 19th Session of the Scientific Review Board (SRB019)	✓ 19 Aug 2021
IPHC-2021-SRB019-02	List of Documents for the 19th Session of the Scientific Review Board (SRB019)	✓ 19 Aug 2021
IPHC-2021-SRB019-03	Update on the actions arising from the 18th Session of the SRB (SRB018) (IPHC Secretariat)	✓ 19 Aug 2021
IPHC-2021-SRB019-04	Outcomes of the 97th Session of the IPHC Annual Meeting (AM097) (D. Wilson)	✓ 19 Aug 2021
IPHC-2021-SRB019-05	IPHC Fishery-Independent Setline Survey (FISS) and commercial data modelling (R. Webster)	✓ 21 Aug 2021
IPHC-2021-SRB019-06	Update on the development of the 2021 stock assessment (I. Stewart & A. Hicks)	✓ 19 Aug 2021
IPHC-2021-SRB019-07	IPHC Secretariat MSE Program of Work (2021–2023) and an update on progress (A. Hicks & I. Stewart)	✓ 19 Aug 2021
IPHC-2021-SRB019-08	Report on current and future biological and ecosystem science research activities (J. Planas)	✓ 20 Aug 2021
IPHC-2021-SRB019-09	Pacific Halibut Multiregional Economic Impact Assessment (PHMEIA): update for SRB019 (B. Hutniczak)	✓ 19 Aug 2021
IPHC-2021-SRB019-10	International Pacific Halibut Commission 5-Year program of integrated science and research (2021-26) (D. Wilson, J. Planas, I. Stewart, A. Hicks, R. Webster, B. Hutniczak)	✓ 19 Aug 2021
Information papers		
Nil to-date	Nil to-date	-

APPENDIX IV

IPHC FISHERY-INDEPENDENT SETLINE SURVEY (FISS) DESIGN PROPOSED FOR 2022, AND TENTATIVELY PROPOSED FOR 2023-24

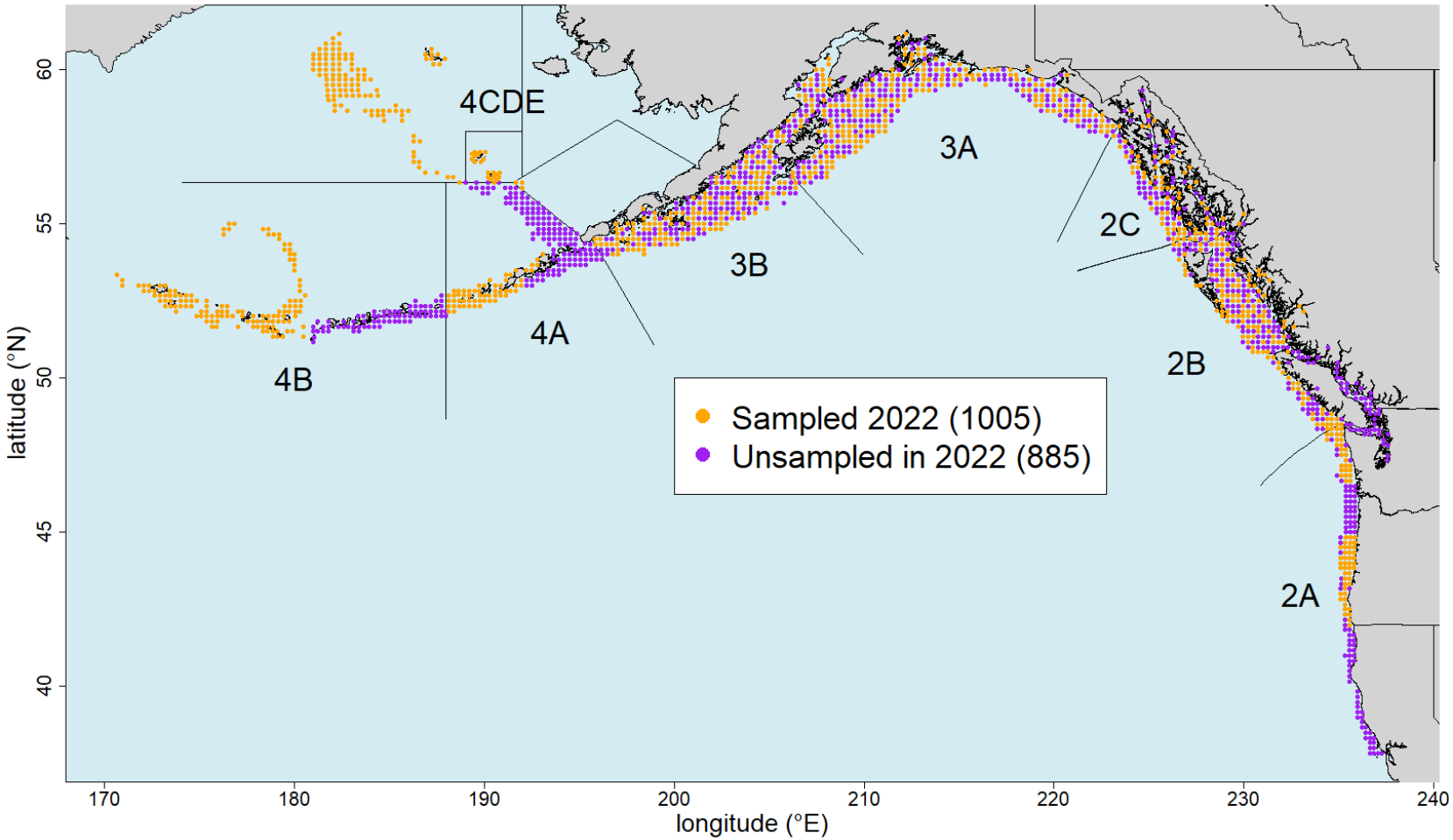

Fig.1. Proposed minimum FISS design in 2022 (orange circles) based on randomized sampling in 2B-3B, and a subarea design elsewhere. Purple circles are optional for meeting data quality criteria.

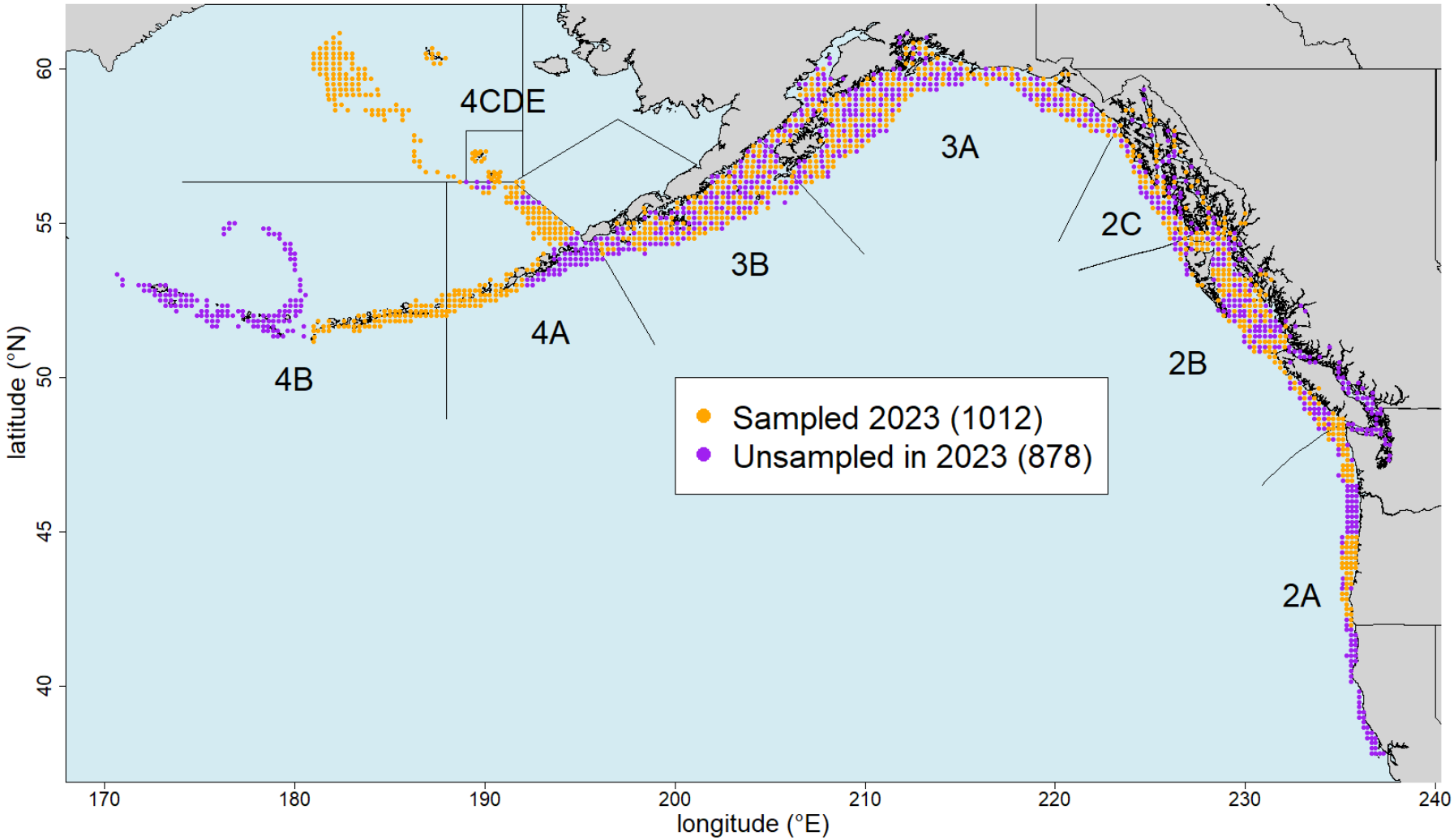

Fig. 2. Proposed minimum FISS design in 2023 (orange circles) based on randomized sampling in 2B-3B, and a subarea design elsewhere. Purple circles are optional for meeting data quality criteria.

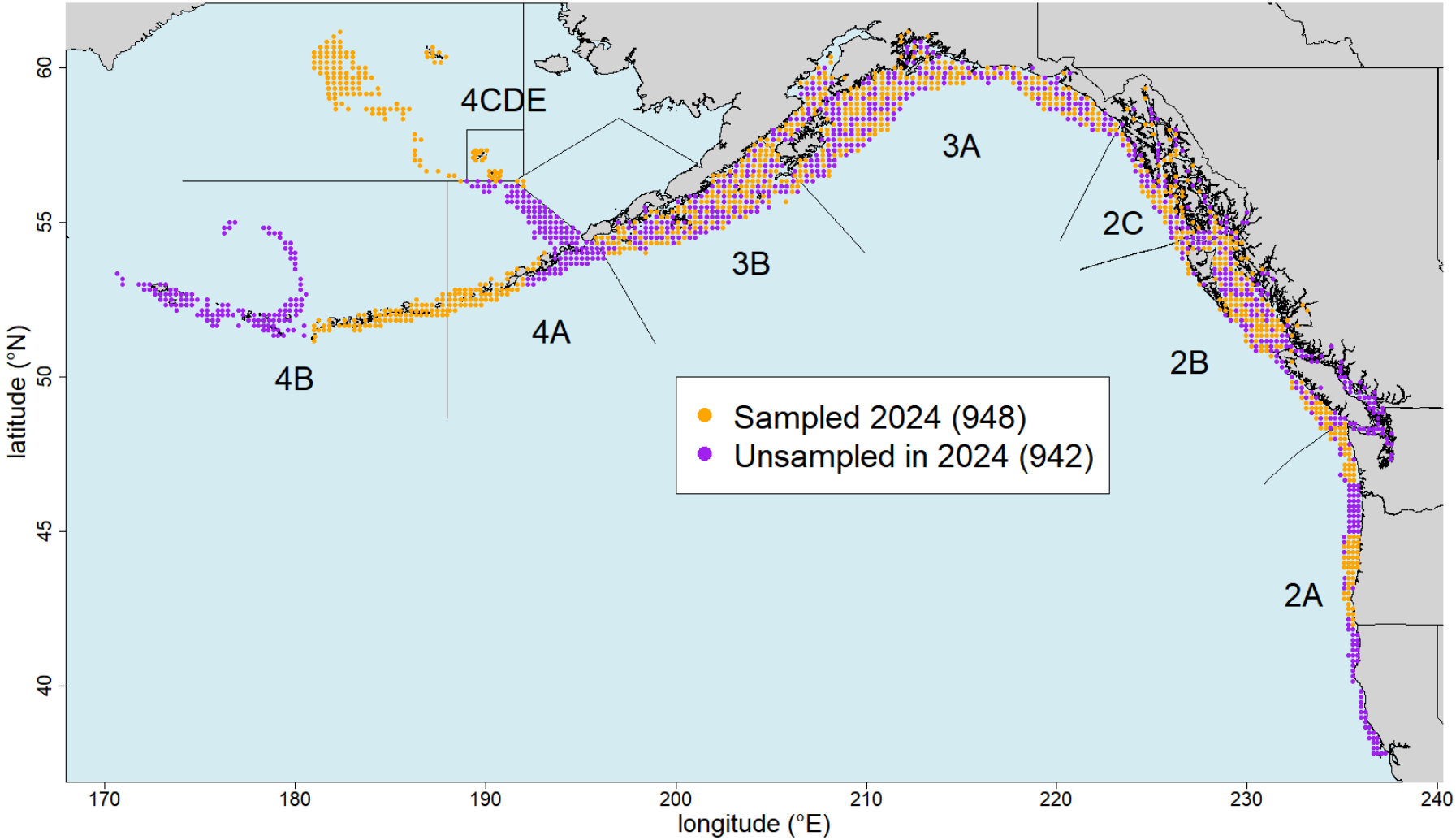

Fig. 3. Proposed minimum FISS design in 2024 (orange circles) based on randomized sampling in 2B-3B, and a subarea design elsewhere. Purple circles are optional for meeting data quality criteria.

APPENDIX V
CONSOLIDATED SET OF RECOMMENDATIONS AND REQUESTS OF THE 19TH SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB019)

RECOMMENDATIONS

2022-24 IPHC Fishery-independent setline survey (FISS) design evaluation

SRB019–Rec.01 (para. 13) The SRB **RECOMMENDED** that the Commission note the SRB018 endorsement of the proposed 2022 design and provisional endorsement of the proposed 2023-24 designs, as provided at Appendix IV, recognizing that the designs for 2023-24 will be reviewed again at subsequent SRB meetings.

SRB019–Rec.02 (para. 14) **NOTING** the presentation of three alternative 2022 sampling designs (Figs. 1, 2, and 3) that optimize the SRB018-endorsed proposed 2022 design for cost, thereby meeting the goals of long-term revenue neutrality (Secondary Objective), without compromising the scientific goals of the FISS (Primary Objective), the SRB **RECOMMENDED** that the Secretariat prioritize 2022 sampling designs that include IPHC Regulatory Area 4CDE despite the relatively low contribution of this area to overall biomass and variance. This region is an important area to monitor for future range shifts and biological samples collected here are likely to be important for understanding the biology of Pacific halibut at their leading range edge.

Modelling of IPHC length-weight data

SRB019–Rec.03 (para. 18) The SRB **RECOMMENDED** that the IPHC provide a revised length-net weight relationship for each IPHC Regulatory Area based on modelling of combined FISS and commercial sample data to be used for the calculation of all non-IPHC mortality estimates where individual weights cannot be collected, for 2021 and until further notice.

Pacific halibut stock assessment: 2021 - Modelling updates

SRB019–Rec.04 (para. 30) **NOTING** that the surplus production analysis revealed a recent pattern of harvest exceeding surplus production despite current biomass being below the target biomass, the SRB **RECOMMENDED** that the IPHC Secretariat continue to report on surplus production in addition to trends and scale of surplus production and fishing intensity as part of the annual assessment.

Management Strategy Evaluation: Update

SRB019–Rec.05 (para. 34) The SRB **RECOMMENDED** the investigation of empirical procedures to inform mortality limits in non-assessment years of a multi-year assessment MP.

SRB019–Rec.06 (para. 35) **NOTING** the inclusion of uncertainty stemming from implementation ***uncertainty***, the SRB **RECOMMENDED** that the IPHC Secretariat develop, for presentation at SRB020, alternative scenarios that represent implementation ***bias***, i.e. the potential for quota reductions called for by the management procedure to be less likely implemented than quota increases.

IPHC Secretariat MSE Program of Work (2021-23)

SRB019–Rec.07 (para. 38) The SRB **RECOMMENDED** that the initial management procedure be evaluated on the basis of the current operating model.

SRB019–Rec.08 (para. 39) The SRB **RECOMMENDED** that the IPHC Secretariat develop alternative OMs from various hypotheses related to population processes or environmental covariates for implementation in the MSE framework, noting paragraph 38, and that tasks leading to the adoption of a well-defined MP should be prioritized.

IPHC 5-Year biological and ecosystem science research plan (2017-21)

SRB019–Rec.09 (para. 43) The SRB **RECOMMENDED** that the Secretariat consider the value of other opportunistically collected samples that would facilitate further downstream analyses in a cost effective manner.

Research integration

SRB019–Rec.10 (para. 56) The SRB **RECOMMENDED** that the IPHC Secretariat identify those research areas with uncertainty and indicate research questions that would require the SRB to provide input and/or decision in future documentation and presentations provided to the SRB.

REQUESTS

Update on the actions arising from the 18th Session of the SRB (SRB018)

SRB019–Req.01 (para. 8) The SRB **RECALLED** three actions for delivery at SRB020 as follows:

a) SRB018–Req.1 (para. 13) IPHC Fishery-independent setline survey (FISS): 2022-24 FISS design evaluation. The SRB **REQUESTED** plots by survey area of WPUE vs. depth from both FISS and commercial fisheries to help understand if there is part of the Pacific halibut stock in deeper waters not covered by the FISS.

b) SRB018–Req.2 (para. 14) The SRB **REQUESTED** that the IPHC Secretariat conduct a preliminary comparison, to be presented at SRB020, between male, female, and sex-aggregated analysis of the FISS data using the spatial-temporal model.

c) SRB018–Req.14 (para. 52) The SRB **NOTED** that, without a clearer understanding of the Commissions purpose for future use of this work, it is difficult to provide guidance on prioritising model development (e.g. improve spatial resolution, incorporate dynamic / predictive processes, adding more detail on subsistence and recreational fisheries, including uncertainty in the assessment). The SRB therefore **REQUESTED** specific guidance and clarification from the Commission on the objectives and intended use of this study.

Modelling of IPHC length-weight data

SRB019–Req.02 (para. 19) **NOTING** the emerging difference between length-weight regressions based on historical vs. recent data, the SRB **REQUESTED** further investigation of the underlying processes (whether in the observation process - e.g. timing of sample collection - or biological changes - e.g. changes in somatic growth) driving these differences. While the suggested solution provides a numerical solution it also annually requires significant sampling and analysis efforts which could potentially be reduced through a better understanding of the processes involved.

Review of IPHC hook competition standardization

SRB019–Req.03 (para. 22) **NOTING** the presentation of methods used for hook competition standardization, the SRB **REQUESTED** continued analysis of this phenomenon and incorporation of these corrections in the FISS data analysis, including potential use of hook timer studies if the technology permits.

Accounting for the effects of whale depredation on the FISS

SRB019–Req.04 (para. 24) **NOTING** the presentation of methods used for accounting for whale depredation, and the limited impact of the correction at this point, the SRB **REQUESTED** that the IPHC Secretariat continue to monitor the influence of whale depredation on the FISS and the stock

assessment. If the whale depredation correction becomes more important in the future, it will become important to conduct a broader investigation of ways that this phenomenon could be described and accounted for, if at all, in the FISS. Also, the impact / treatment of the associated compositions should be better explained within the stock assessment.. While the SRB generally supports the idea to use all possible data there is a question as to whether the simple time covariate approach risks introducing bias through changes in density of Pacific halibut and / or whales and through ignoring possible depredation selectivity by size and sex.

Pacific halibut stock assessment: 2021 - Modelling updates

SRB019–Req.05 (para. 31) The SRB **REQUESTED** that the IPHC Secretariat consider the following topics for inclusion in the 2022 full stock assessment and presentation for SRB evaluation at SRB020 in June 2022:

a) Sensitivity analysis of the assessment to processes being investigated by the Biological and Ecosystem Research Program, e.g. spatiotemporal differences in maturity schedules, discard mortality, and length-weight relationships;

b) Continued exploration of data weighting;

c) Evaluation of treatment of commercial sex ratio;

d) Use of the Pacific Decadal Oscillation (PDO) and other environmental covariates to predict recruitment;

e) Estimation of whale depredation mortality for potential explicit inclusion in the assessment model; and

f) Other factors discussed since the last stock assessment.

Biological and ecosystem science research

Reproduction

SRB019–Req.06 (para. 46) The SRB **NOTED** that the IPHC Secretariat is finalising a proposed sampling design for the collection of ovaries in the 2023 FISS, for providing precise estimates of fecundity and **REQUESTED** for SRB020 in June 2022, more detail on the considerations taken to ensure the sampling maximises the opportunity to address the objectives.

Growth and Physiological Condition

SRB019–Req.07 (para. 50) The SRB **REQUESTED** that the IPHC Secretariat pause further pursuit of this research until it can articulate specifically how this approach will inform the stock assessment or MSE and why this approach is preferable to investigation of age-length-weight information which is available at a much broader geographic and temporal scale.

Pacific halibut fishery economics update

SRB019–Req.08 (para. 59) The SRB **NOTED** that substantial uncertainties surround our understanding of recreational fishing effort dynamics (e.g. the expected change in effort with changes in season length or size limits and the availability of alternative target species such as Pacific salmon) and **REQUESTED** that the IPHC Secretariat assess and present at SRB020, the feasibility and value of various stated preference (e.g. a discrete choice experiment) and revealed preference (e.g. time series analysis of fishing effort patterns with respect to regulatory changes) approaches to understanding recreational effort dynamics.

SRB019–Req.09 (para. 60) The SRB **REQUESTED** that the IPHC Secretariat assess and present at SRB020, the potential of using data from the Guided Angler Fish Program (USA) and Pacific Region Experimental Recreational Halibut Program (Canada) as inputs to the economic analysis of

Pacific halibut, particularly the trade-offs between the commercial and the recreational sector.

SRB019–Req.10 (para. 61) The SRB **REQUESTED** further information (e.g. inverse demand curves), to be presented at SRB020, on the regional supply-price relationships for commercial landings, as well as localized importance of the Pacific halibut fishery to communities.

International Pacific Halibut Commission 5-year program of integrated science and research (2021-26)

SRB019–Req.11 (para. 63) The SRB **REQUESTED** that the IPHC Secretariat consider the following changes (in no particular order) to this document by SRB2020:

a) Add an Executive Summary;

b) Change the title, the overall statement of purpose section, and Fig. 4 to better reflect the goals and intent of the research program;

c) Enhance stock assessment section to reflect research in this area including some of the priorities from the external review etc.;

d) Include the intent to use the MSE to provide research direction and prioritisation (feedback) to the biological research program;

e) Keep monitoring section separate as is, but demonstrate the linkage to the research through resource sharing etc.;

f) Add a performance metric related to the provisioning of high-quality management advice that meets the Commission's needs;

g) Include specific subsections on implications for integration with other core areas and relevance to management;

h) Draft the section on climate change.