Report of the 23rd Session of the IPHC Scientific Review Board (SRB023)

Meeting held in Seattle, WA, USA, 25-26 September 2023

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INTERNATIONAL PACIFIC HALIBUT COMMISSION

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ACRONYMS

AI	Artificial Intelligence
AK	Alaska
AM	Annual Meeting
CV	Coefficient of Variation
DIC	Deviance Information Criterion
Fis	Deviation of observed and expected heterozygosity
FISS	Fishery-Independent Setline Survey
He	Expected heterozygosity
Ho	Observed heterozygosity
IPHC	International Pacific Halibut Commission
MP	Management Procedure
MSAB	Management Strategy Advisory Board
MSE	Management Strategy Evaluation
NPUE	Number-Per-Unit-Effort
OM	Operating Model
RFMO	Regional Fisheries Management Organisation
SA	Stock Assessment
SNP	Single nucleotide polymorphisms
SRB	Scientific Review Board
SSB	Spawning Stock Biomass
TCEY	Total Constant Exploitation 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; 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 23rd Session of the International Pacific Halibut Commission (IPHC) Scientific Review Board (SRB023) was held in Seattle, WA, USA from 25 to 26 September 2023. 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 SRB023, which are provided in full at Appendix IV.

RECOMMENDATIONS

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

SRB023–Rec.01 (para. 17) The SRB **AGREED** that AI techniques may improve efficiency of age estimation and **RECOMMENDED** continued research and cross-validation of AI-based aging.

Research: Pacific halibut stock assessment

SRB023–Rec.02 (para. 19) **NOTING** that the inclusion of whale depredation in the assessment requires many assumptions and results in only small changes to the TCEY, the SRB **RECOMMENDED** that whale depredation not be included in the 2023 stock assessment model.

SRB023–Rec.03 (para. 20) The SRB **RECOMMENDED** that the Secretariat investigate approaches (e.g. simulation testing) to estimating uncertainty (or bounding the minimum level of uncertainty) in different assessment outputs: e.g. coastwide and Biological Region spawning stock biomass (see related actions under Section 4.2).

SRB023–Rec.04 (para. 21) The SRB **RECOMMENDED** continuing annual sex ratio sampling while the stock is declining given that estimated SSB remains sensitive to these data.

Research: Management strategy evaluation

SRB023–Rec.05 (para. 24) The SRB **RECOMMENDED** that an objective to maintain spatial population structure be added or redefined to maintain the spawning biomass in a Biological Region above a defined threshold relative to the dynamic unfished equilibrium spawning biomass in that Biological Region with a pre-defined tolerance. The percentage and tolerance may be defined based on historical patterns and appropriate risk levels recognizing the limited fishery control of biomass distribution.

SRB023–Rec.06 (para. 25) The SRB **RECOMMENDED** that the Commission re-evaluate the target objective for long-term coastwide female spawning stock biomass given that estimated 2023 female spawning biomass (and associated WPUE), which was well-above the current target B36%, in part triggered harvest rate reductions from the interim harvest policy. Such ad-hoc adjustments limited the value of projections and performance measures from MSE.

SRB023–Rec.07 (para. 26) The SRB **RECOMMENDED** continued examination, within the MSE, of FISS scenarios that are better representative of the levels of uncertainty and bias that may result from future reductions in FISS sampling.

SRB023–Rec.08 (para. 27) **RECOGNIZING** the spatial variability of environmental factors that influence population dynamics, the SRB **RECOMMENDED** that an exceptional

	circumstance be defined based on regional as well as stock-wide deviations from expectations. For example, an exceptional circumstance could be declared if any of the following are met: a) The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years. b) The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years. c) Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations.
SRB023–Rec.09 (para. 28)	The SRB **RECOMMENDED** that if an exceptional circumstance occurred the following actions would take place: a) A review of the MSE simulations to determine if the OM can be improved and MPs should be re-evaluated. b) If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE. c) Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM. d) Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.
SRB023–Rec.10 (para. 29)	The SRB **RECOMMENDED** evaluating fishing intensity and frequency of the stock assessment elements of management procedures and FISS uncertainty scenarios using the MSE framework. MP elements related to constraints on the interannual change in the TCEY and calculation of stock distribution may be evaluated for a subset of the priority management procedures as time allows.
SRB023–Rec.11 (para. 30)	The SRB **RECOMMENDED** that the Commission consider revising the harvest policy to (i) determine coastwide TCEY via a formal management procedure and (ii) negotiate distribution independently (e.g. during annual meetings). Such separated processes are used in other jurisdictions (e.g. most tuna RFMOs, Mid Atlantic Fishery Management Council, AK Sablefish, etc.).
Research: Biology and ecology	
SRB023–Rec.15 (para. 45)	The SRB **RECOMMENDED** that the compensatory assumption of the stock recruitment models be critically evaluated via a MSE stress test scenario in which recruitment is depensatory at some low spawning biomass.
Monitoring: 2024 FISS design evaluation	
SRB023–Rec.19 (para. 59)	The SRB **RECOMMENDED** that the Secretariat continue exploring ways of estimating the impacts of different FISS designs and efficiency decisions on stock assessment outputs and fishery performance objectives. The end goal

should be to provide a decision support tool that can frame decisions about FISS design in terms of costs and benefits in comparable currencies.

SRB023–Rec.20 (para. 62) The SRB **RECOMMENDED** that the life-histories, particularly population age structure, lengths-at-age, and weight-at-age continue to be monitored in the FISS and fishery to obtain a proxy of total mortality, cohort resonance, and reproductive potential as well as to detect longer term trends in life histories.

Updates to space-time modelling

SRB023–Rec.21 (para. 63) The SRB **NOTED** that the switch from a hurdle model to a Tweedie distribution reduces model parameters and overall Deviance Information Criterion (DIC) and reduces run times and **RECOMMENDED** that the Secretariat continue investigating whether the space-time model can be successfully transitioned to a Tweedie distribution for all regulatory areas.

Management Supporting Information

SRB023–Rec.22 (para. 64) **NOTING** the presentation demonstrating how secondary FISS objectives influence choices for future FISS designs that may have already been endorsed by the SRB based only on primary objectives, the SRB **RECOMMENDED** that the MSE include some scenarios in which the FISS is skipped (as similarly requested above in paras. 62 and 63) because of occasional (or functional) economic constraints on executing full FISS designs. Such simulation scenarios would provide some indication of the potential scale of impacts on MP performance of maintaining long-term revenue neutrality of the FISS.

REQUESTS

Research: Biology and ecology

SRB023–Req.01 (para. 37) **NOTING** that future applications of genomic data will necessitate more expansive sampling geographically and demographically to achieve IPHC goals, the SRB **REQUESTED** that the Secretariat establish explicit long-term objectives for use of genomic data and work with staff, fishermen, and agency collaborators to establish a short and long-term sampling program and data and sample archival plan to ensure samples are available to address Secretariat objectives.

Monitoring: 2024 FISS design evaluation

SRB023–Req.06 (para. 57) The SRB **REQUESTED** that the Commission **NOTE** the addition of cost estimates to the presentation of alternative FISS designs. The short-term risk implications in 2024 to the stock and TCEY of a drastically reduced FISS design (e.g. approx. revenue neutral Design 9 with efficiencies) are probably not profound given that the estimated current abundance is still above the implied B36% target. Impacts may appear more in the estimates of stock distribution since unsampled areas will be more dependent on the space-time model than actual data.

SRB023–Req.07 (para. 60) The SRB **REQUESTED** that the Commission **NOTE** that some longer-term (2025 and beyond) implications of reduced FISS designs are predictable and potentially consequential. For instance, higher FISS CVs will generally result in

	higher inter-annual variation in TCEY under the current decision-making process. This would occur for two reasons: (1) biomass estimates and projections from the assessment model will have greater uncertainty and therefore greater variability in outputs and (2) ad hoc management adjustments to the interim harvest policy recommendations would be more frequent and/or more variable for greater input uncertainty. The SRB therefore **REQUESTED** the following analyses for SRB024: a) Assessment of reduced FISS designs (2025-2027) via simulation tests of assessment model outputs (e.g. probability of decline, estimated stock abundance and status, TCEY) under alternative revenue-neutral FISS designs using the existing stock assessment ensemble; b) Mitigation options of reduced FISS designs (short-term and long-term) via MSE simulations of management procedures that deliberately aim to reduce inter-annual variability in TCEY via multi-year TCEYs and (possibly) fixed stock distribution schemes; c) Components (a,b) above would be integrated since (a) will need to inform simulations in (b).
SRB023–Req.08 (para. 61)	The SRB **REQUESTED** that simulations above (para. 60) include: a) a relationship in which the FISS CV is relatively higher at lower stock abundance (i.e. the current CV issue is a function of stock abundance rather than a short-term condition); b) target regulatory area CVs of 15%, 20%, 25%, and 30%; c) coastwide target CV of 15% without controlling specific regulatory area CVs.

1. OPENING OF THE SESSION

1. The 23rd Session of the International Pacific Halibut Commission (IPHC) Scientific Review Board (SRB023) was held in Seattle, WA, USA from 25 to 26 September 2023. 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, who welcomed the newest member of the SRB, Dr Anna Kuparinen.

2. The SRB **RECALLED** its mandate, as detailed in Appendix VIII, Sect. I, para. 1-3 of the IPHC Rules of Procedure (2023):

    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 in accordance with the IPHC Rules of Procedure, all documents and presentations for the meeting were published on the IPHC website 30 days and 10 days prior to the Session, respectively: https://www.iphc.int/venues/details/23rd-session-of-the-iphc-scientific-review-board-srb023.

3. IPHC PROCESS

3.1 SRB annual workflow

4. The SRB **RECALLED** that the core purpose of the SRB023 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/December 2023, and Annual Meeting in January 2024.

3.2 Update on the actions arising from the 22nd Session of the SRB (SRB022)

5. The SRB **NOTED** paper IPHC-2023-SRB023-03, that provided the SRB with an opportunity to consider the progress made during the intersessional period on the recommendations/requests arising from the SRB022.

6. The SRB **AGREED** to consider and revise the actions as necessary, and to combine them with any new actions arising from SRB023 into a consolidated list for future reporting.

7. The SRB **NOTED** that recommendation 10 from the SRB022 report (IPHC-2023-SRB022-R; SRB022 Rec. 10) included a transcription error, specifically the word included should be replace with excluded.

3.3 Outcomes of the 99th Session of the IPHC Annual Meeting (AM099)

8. The SRB **NOTED** paper IPHC-2023-SRB023-04 that detailed the outcomes of the 99th Session of the IPHC Annual Meeting (AM099), 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

9. The SRB **NOTED** the following updates (paraphrased) from the Canadian science advisor:

   a) ***Artificial Intelligence (AI)*** *– Are there any plans for the Secretariat to take advantage of AI?*

   b) ***Climate Change*** *– How well positioned are we to detect changes in Pacific halibut as a result of climate change?*

   c) ***Fishery-Independent Setline Survey (FISS)***

   - *Two main concerns: 1) longer term financial viability of the FISS, and 2) how changes made to the FISS design to meet secondary & tertiary objectives impact science.*

10. The SRB **NOTED** the following updates (paraphrased) from the USA science advisor: *None*

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

11. The SRB **NOTED** paper IPHC-2023-SRB023-05 and IPHC-2023-SRB023-INF01, that provided the SRB with the IPHC 5-year Program of Integrated Research and Monitoring (2022-26), including a draft research tracking tool, which takes into consideration the recommendation from the previous SRB meeting (ref. IPHC-2023-SRB022-R; SRB022–Rec.01).

12. The SRB **RECALLED** that:

    a) the IPHC Secretariat conducts activities to address key issues identified by the Commission, its subsidiary bodies, the broader stakeholder community, and the IPHC Secretariat;

    b) the process of identifying, developing, and implementing the IPHC's science-based activities involves several steps that are circular and iterative in nature, but result in clear project activities and associated deliverables;

    c) the process includes developing and proposing projects based on direct input from the Commission, the experience of the IPHC Secretariat given its broad understanding of the resource and its associated fisheries, and concurrent consideration by relevant IPHC subsidiary bodies (including the SRB), and where deemed necessary, including by the Commission, additional external peer review;

    d) the IPHC Secretariat commenced implementation of the new Plan in 2022 and will keep the Plan under review on an ongoing basis.

13. The SRB **RECALLED** that an overarching goal of the IPHC 5-year Program of Integrated Research and Monitoring (2022-26) is to promote integration and synergies among the various research and monitoring activities of the IPHC Secretariat in order to improve knowledge of key inputs into the Pacific halibut stock assessment, and Management Strategy Evaluation (MSE) processes, thereby providing the best possible advice for management decision making processes.

14. The SRB **NOTED** that at the 13th Special Session of the Commission (SS013; IPHC-2023-SS013-R), the Commission provided the following directive to the Secretariat based on their interpretation of SRB021-Rec.01:

    SS013-Req.01 (para. 9) *"The Commission REQUESTED that, as part of the annual reporting to the Commission on the Biological and Ecosystem Science Branch activities, that the Secretariat provide a summary table that incorporates the following elements for Commission review:*

    a) Current project abstract, including objectives, links to IPHC's core mandate and how it will inform Commissioner's decisions;

    b) Related Commission decisions and directives;

    c) Timeline for deliverables;

    d) Funding sources;

    e) Progress report."

15. The SRB **NOTED** that the IPHC is investigating the potential use of artificial intelligence (AI) for determining the age of Pacific halibut from images of collected otoliths. The IPHC is in the process of creating a database comprising images with expert-provided labels for aging use. This database will be utilized to train and test a Convolutional Neural Network (CNN), a type of AI model renowned for its efficacy in image classification tasks.

16. The SRB **NOTED** the substantial potential of incorporating AI techniques to supplement the IPHC's current aging protocol informing on the population age structure and serving as input to the Pacific halibut stock assessment. A project update will be provided at the SRB024 meeting in June 2024.

17. The SRB **AGREED** that AI techniques may improve efficiency of age estimation and **RECOMMENDED** continued research and cross-validation of AI-based aging.

4.1 Research

4.1.1 Pacific halibut stock assessment

18. The SRB **NOTED** paper IPHC-2023-SRB023-06, that provided a response to recommendations and requests made during SRB022 (IPHC-2023-SRB022-R) and to provide an update of the 2023 stock assessment development.

19. **NOTING** that the inclusion of whale depredation in the assessment requires many assumptions and results in only small changes to the TCEY, the SRB **RECOMMENDED** that whale depredation not be included in the 2023 stock assessment model.

    The SRB **RECALLED** SRB022-Rec.02 from IPHC-2023-SRB022-R, that equal weighting be applied to the four stock assessment models:

    SRB022–Rec.02 (para. 19) *"NOTING that the scale of impact from different model weighting approaches presented here is small relative to the impact of other factors in the MSE (e.g. two- vs. three-year assessment intervals and TCEY), the SRB RECOMMENDED that the Secretariat continue using the equal weighting approach for model averaging."*

20. The SRB **RECOMMENDED** that the Secretariat investigate approaches (e.g. simulation testing) to estimating uncertainty (or bounding the minimum level of uncertainty) in different assessment outputs: e.g. coastwide and Biological Region spawning stock biomass (see related actions under Section 4.2).

21. The SRB **RECOMMENDED** continuing annual sex ratio sampling while the stock is declining given that estimated SSB remains sensitive to these data.

4.1.2 Management strategy evaluation

22. The SRB **NOTED** paper IPHC-2023-SRB023-07 presenting an updated operating model, potential new MSE objectives, evaluation of FISS data scenarios, an examination of how to equalize management procedure performance across conservation objectives, possible exceptional circumstances, and potential management procedures to evaluate in 2023–2025.

23. The SRB **ENDORSED** the 2023 operating model containing four individual models to represent structural uncertainty identified in the ensemble stock assessment.

24. The SRB **RECOMMENDED** that an objective to maintain spatial population structure be added or redefined to maintain the spawning biomass in a Biological Region above a defined threshold relative to the dynamic unfished equilibrium spawning biomass in that Biological Region with a pre-defined tolerance. The percentage and tolerance may be defined based on historical patterns and appropriate risk levels recognizing the limited fishery control of biomass distribution.

25. The SRB **RECOMMENDED** that the Commission re-evaluate the target objective for long-term coastwide female spawning stock biomass given that estimated 2023 female spawning biomass (and associated WPUE), which was well-above the current target B36%, in part triggered harvest rate reductions from the interim harvest policy. Such ad-hoc adjustments limited the value of projections and performance measures from MSE.

26. The SRB **RECOMMENDED** continued examination, within the MSE, of FISS scenarios that are better representative of the levels of uncertainty and bias that may result from future reductions in FISS sampling.

27. **RECOGNIZING** the spatial variability of environmental factors that influence population dynamics, the SRB **RECOMMENDED** that an exceptional circumstance be defined based on regional as well as stock-wide deviations from expectations. For example, an exceptional circumstance could be declared if any of the following are met:

    a) The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.

    b) The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years.

    c) Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations.

28. The SRB **RECOMMENDED** that if an exceptional circumstance occurred the following actions would take place:

    a) A review of the MSE simulations to determine if the OM can be improved and MPs should be re-evaluated.

    b) If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE.

    c) Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM.

    d) Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.

29. The SRB **RECOMMENDED** evaluating fishing intensity and frequency of the stock assessment elements of management procedures and FISS uncertainty scenarios using the MSE framework. MP elements related to constraints on the interannual change in the TCEY and calculation of stock distribution may be evaluated for a subset of the priority management procedures as time allows.

30. The SRB **RECOMMENDED** that the Commission consider revising the harvest policy to (i) determine coastwide TCEY via a formal management procedure and (ii) negotiate distribution independently (e.g. during annual meetings). Such separated processes are used in other jurisdictions (e.g. most tuna RFMOs, Mid Atlantic Fishery Management Council, AK Sablefish, etc.).

4.1.3 Biology and ecology

31. The SRB **NOTED** paper IPHC-2023-SRB023-08 which provided the SRB with a description of progress towards research activities described in the IPHC's five-year Program of Integrated Research and Monitoring (2022-2026).

32. The SRB **ACKNOWLEDGED** and **APPRECIATED** Secretariat efforts to develop genomic resources for IPHC applications associated with stock assessment (SA) and management strategy evaluation (MSE) needs. The work conducted by the Secretariat, including work associated with Requests/Recommendations from SRB022 during the inter-sessional period have been extensive.

33. The SRB **NOTED** that genetic marker development proceeds in stages associated with genetic markers ascertainment, and filtering based on established protocols and research/management questions.

34. The SRB **RECOGNIZED** that given the Secretariat was interested in interrogating the entire Pacific halibut genome, this process has taken considerable time. Further, the use of low coverage whole genome sequencing to acquire genetic markers precludes use of many 'off-the-self' analytical methods. Next tasks will include use of genetic markers, or of the most informative subsets of markers to address specific questions.

35. The SRB **RECALLED** SRB022–Rec.22 from IPHC-2023-SRB022-R:

> SRB022–Rec.22 *(para. 55) "The SRB NOTED the continuing gap within the Secretariat of research scientist expertise in both population genomics and life history modelling. In terms of prioritizing future hires, e.g. re-opening previous hiring attempts for a research scientist life-history modeller, the SRB RECOMMENDED prioritizing a research scientist position in population genomics given the investments and future potential contribution of this research to the overall goals of the Commission*."

36. **NOTING** that the genomics research is and will continue to be a key element of the Biological and Ecosystem Science Research program, and that the Secretariat wishes to (i) document stock structure, (ii) use genetic markers to quantify movements, (iii) assign individuals of any age, location, season to a genetic population, (iv) annotate markers and use genomic data to between understand genetic and environmental sources of variation in growth, maturity and fecundity, (v) engage in close-kin capture-recapture to estimate stock abundance, the SRB **RECOMMENDED** adding qualified staff to help address these diverse and important activities in a timely fashion.

37. **NOTING** that future applications of genomic data will necessitate more expansive sampling geographically and demographically to achieve IPHC goals, the SRB **REQUESTED** that the Secretariat establish explicit long-term objectives for use of genomic data and work with staff, fishermen, and agency collaborators to establish a short and long-term sampling program and data and sample archival plan to ensure samples are available to address Secretariat objectives.

38. The SRB **ACKNOWLEDGED** and **APPRECIATED** Secretariat efforts to produce Appendices I, II, and III in paper IPHC-2023-SRB023-08 where the Secretariat continue the development of rationale for biological

research prioritization and cross-disciplinary coordination of ideas and priorities that explicitly integrate biological research, stock assessment (SA) and management strategy evaluation (MSE).

39. The SRB **RECOGNIZED** that Appendices II and III in IPHC-SRB023-08 in IPHC-2023-SRB023-08 are designed to identify biological uncertainties and parameters for stock assessment (SA) and management strategy evaluation (MSE), and their links to biological research areas and research activities over a defined period (2022-2026). However, the SRB **ENCOURAGED** the Secretariat to be more forward looking, and develop longer-term strategic planning, and devote internal inter-disciplinary staffing infrastructure, time, and resources to better prepare for contingencies that will likely develop over longer time periods. The SRB believes these actions would better position the IPHC to engage in informed actions in response to potential future negative environmental and ecological scenarios, including 'exceptional circumstance' to be evaluated under the MSE.

40. The SRB **NOTED** that the biological research programme focuses on rather narrow aspects of physiology and population dynamics, while it lacks longer term evolutionary perspective as well as broad ecosystems perspective.

41. **NOTING** paper IPHC-2023-SRB023-08 (subsection 1.1 - Identification of Pacific halibut juvenile habitat), and that the narrative describes work to be conducted but does not explicitly identify research objectives or hypotheses that the data would be used to address, the SRB **REQUESTED** that objectives/hypotheses be developed for SRB024 where hypotheses could include:

    a) regions with larger amounts of juvenile rearing habitat and larger number of juveniles would realize numerically larger levels of recruitment to the adult population;

    b) genotypes of juveniles from rearing habitats could be assigned to specific spawning areas.

42. The SRB **RECOMMENDED** that the Secretariat continue to work with collaborators to collect and process genetic samples from juveniles. Collections of younger (pre-reproductive) age classes would be particularly important for anticipated future close-kin capture-recapture work.

43. **NOTING** paper IPHC-2023-SRB023-08 (subsection 1.2 - wire tagging of U32 Pacific halibut), where the narrative describes numbers of fish tagged and recovered, no information is provided summarizing distances moved by size/age and location, the SRB **REQUESTED** that information be provided during SRB024, including background on statistical methods for analysis of data.

44. The SRB **RECOMMENDED** to apply the genetic sampling more broadly, to estimate genetic diversity of the (sub)populations, for example through the effective number of breeding adults by cohort.

45. The SRB **RECOMMENDED** that the compensatory assumption of the stock recruitment models be critically evaluated via a MSE stress test scenario in which recruitment is depensatory at some low spawning biomass.

46. The SRB **NOTED** the sampling program for maturity stages described in paper IPHC-2023-SRB023-08 and **RECALLED** recommendation SRB022-Rec.08 from IPHC-2023-SRB022-R, that a broader spatial sampling design was required:

    SRB022–Rec.08 (para. 32) "*The SRB NOTED that the current maturity sampling design does not determine whether the high rate of individuals at the cortical alveoli stage in the southeastern portion of the study area is a function of differences in seasonal reproductive timing or in size/age at maturity. The SRB RECOMMENDED additional investigations on the region-specific seasonal reproductive cycles and evaluating the extent to which differences among regions can be explained by size or age of the sampled individuals."*

47. The SRB **NOTED** the Secretariat response that a geographically more expansive sampling was conducted in 2022 addresses the SRB recommendation that analysis be conducted to explore variation by size or age of sampled individuals.

48. The SRB **NOTED** Figure 3 in paper IPHC-2023-SRB023-08 describing analyses to identify the most supported estimate of the number of genetically distinct clusters (K) based on the genomic data. The analyses were based on a 'filtered' data set of ~4.7M SNPS. Many unsupervised clustering approaches base estimation of K on levels of model improvement (e.g. BIC or WSS with increasing K, as in Figure 3).

49. The SRB **RECOMMENDED** that Secretariat proceed to the next step of individual assignment based on K of 4 or K of 5. Based on the large number of loci with low levels of divergence among reporting regions (Manhattan plot in Figure 4 of paper IPHC-2023-SRB023-08) that posterior probabilities of cluster assignment (in a Bayesian context) may be low when all loci are used. The Secretariat should conduct a comparable analysis using only 'outlier loci'.

50. **RECOGNIZING** that future applications of 'outlier loci' to address SA and MSE objectives will necessitate development of more 'rapid screening approaches' and screening based on fewer loci, the SRB **RECOMMENDED** that the Secretariat work to identify the numbers of loci and locus characteristics (e.g. high levels of diversity and high level of allele frequency variation) so loci may be applied.

51. The SRB **ACKNOWLEDGED** Table 1 in paper IPHC-2023-SRB023-08, produced in response to SRB022 inquiry, and that discrepancies in the genetic diversity measure Fis (deviation of observed and expected heterozygosity) across collection years within reporting regions. The Secretariat estimates Fis on a collection year by year basis and overall years for each region. The SRB **REQUESTED:**

    a) further investigation of the disparity in Fis for reporting regions (yearly vs total). Higher positive Fis could indicate admixture of individuals from genetically differentiated groups;

    b) investigations into discrepancies between estimates of Fis, observed heterozygosity (Ho), and expected heterozygosity (He).

52. The SRB **NOTED** that the Secretariat proposes to conduct individual admixture (i.e. among IPHC reporting regions) estimation using software NGSadmix and individual assignment testing using WGSassign, both of which are amenable to low coverage sequence data, to estimate proportional contributions of reporting groups to unknown individuals. This analysis would be conducted after 'best supported' number of genetic groups (K) has been established. The SRB **REQUESTED** that admixture analyses and assignment testing be conducted and reported at SRB024, including estimates of assignment accuracy.

53. The SRB **RECOMMENDED** that the Secretariat:

    a) conduct simulations as a means of assessing the accuracy of group or admixture assignments;

    b) establish criteria for acceptable group assignment accuracy and that is relevant for assignment of individuals as a 'pure' or 'admixed'. Thus, observations, though made with some error would be used as 'observed' estimates to tally over space and across age classes.

    c) should evaluate what the uncertainty in classification (errors) will mean to their estimates. The SRB draws the Secretariat's attention to a widely cited paper by Manel et al. (2005) in Trends in Ecology and Evolution, where authors compare individual assignment tests to a widely used alternative method (mixed stock analysis). These authors point out that use of individual assignment tests for relative population (or reporting group) compositional estimation can be fraught with problems because assignment error compounds across all individuals.

54. The SRB **ENCOURAGED** the Secretariat to investigate whether methods are available to conduct mixed stock analyses that also provide measures of uncertainty in group compositional estimation that are amenable to low-coverage sequencing data.

4.2 Monitoring

4.2.1 Fishery-dependent data

Nil.

4.2.2 Fishery-independent data

4.2.2.1 2024 FISS design evaluation

55. The SRB **NOTED** paper IPHC-2023-SRB023-09, which proposed designs for the IPHC's Fishery-Independent Setline Survey (FISS) for the 2024-26 period, presented previously at SRB022, along with 2024 design options accounting for the FISS objective of long-term revenue neutrality.

56. The SRB **NOTED** the full FISS sampling grid which consists of 1890 stations 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.

57. The SRB **REQUESTED** that the Commission **NOTE** the addition of cost estimates to the presentation of alternative FISS designs. The short-term risk implications in 2024 to the stock and TCEY of a drastically reduced FISS design (e.g. approx. revenue neutral Design 9 with efficiencies) are probably not profound given that the estimated current abundance is still above the implied B36% target. Impacts may appear more in the estimates of stock distribution since unsampled areas will be more dependent on the space-time model than actual data.

58. The SRB **NOTED** that the Secretariat has developed several powerful tools that can be used to carry through the impact of alternative FISS designs from FISS CVs to several aspects of fishery performance: The space-time model simulations allow estimates of the CV of WPUE coming from the FISS; the stock assessment can be used to determine the impact of different CVs of WPUE from the FISS on estimates of, for example, the TCEY; and the MSE can be used to determine the impact of uncertainty in stock assessment outputs on all of the fishery performance objectives.

59. The SRB **RECOMMENDED** that the Secretariat continue exploring ways of estimating the impacts of different FISS designs and efficiency decisions on stock assessment outputs and fishery performance objectives. The end goal should be to provide a decision support tool that can frame decisions about FISS design in terms of costs and benefits in comparable currencies.

60. The SRB **REQUESTED** that the Commission **NOTE** that some longer-term (2025 and beyond) implications of reduced FISS designs are predictable and potentially consequential. For instance, higher FISS CVs will generally result in higher inter-annual variation in TCEY under the current decision-making process. This would occur for two reasons: (1) biomass estimates and projections from the assessment model will have greater uncertainty and therefore greater variability in outputs and (2) ad hoc management adjustments to the interim harvest policy recommendations would be more frequent and/or more variable for greater input uncertainty. The SRB therefore **REQUESTED** the following analyses for SRB024:

    a) Assessment of reduced FISS designs (2025-2027) via simulation tests of assessment model outputs (e.g. probability of decline, estimated stock abundance and status, TCEY) under alternative revenue-neutral FISS designs using the existing stock assessment ensemble;

b) Mitigation options of reduced FISS designs (short-term and long-term) via MSE simulations of management procedures that deliberately aim to reduce inter-annual variability in TCEY via multi-year TCEYs and (possibly) fixed stock distribution schemes;

c) Components (a,b) above would be integrated since (a) will need to inform simulations in (b).

61. The SRB **REQUESTED** that simulations above (para. 60) include:

a) a relationship in which the FISS CV is relatively higher at lower stock abundance (i.e. the current CV issue is a function of stock abundance rather than a short-term condition);

b) target regulatory area CVs of 15%, 20%, 25%, and 30%;

c) coastwide target CV of 15% without controlling specific regulatory area CVs.

62. The SRB **RECOMMENDED** that the life-histories, particularly population age structure, lengths-at-age, and weight-at-age continue to be monitored in the FISS and fishery to obtain a proxy of total mortality, cohort resonance, and reproductive potential as well as to detect longer term trends in life histories.

4.2.2.2 Updates to space-time modelling

63. The SRB **NOTED** that the switch from a hurdle model to a Tweedie distribution reduces model parameters and overall Deviance Information Criterion (DIC) and reduces run times and **RECOMMENDED** that the Secretariat continue investigating whether the space-time model can be successfully transitioned to a Tweedie distribution for all regulatory areas.

5. MANAGEMENT SUPPORTING INFORMATION

64. **NOTING** the presentation demonstrating how secondary FISS objectives influence choices for future FISS designs that may have already been endorsed by the SRB based only on primary objectives, the SRB **RECOMMENDED** that the MSE include some scenarios in which the FISS is skipped (as similarly requested above in paras. 62 and 63) because of occasional (or functional) economic constraints on executing full FISS designs. Such simulation scenarios would provide some indication of the potential scale of impacts on MP performance of maintaining long-term revenue neutrality of the FISS.

65. The SRB **NOTED** that the 15% CV threshold for each regulatory area is more important for stock distribution than it is for coastwide assessment.

66. The SRB **NOTED** that as reduced FISS designs are implemented, the stock assessment and stock distribution procedures will necessarily rely more heavily on fishery-dependent data with a potential for bias to the extent that fishery-dependent data may not accurately reflect true abundance and distribution.

6. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 23RD SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB023)

67. The SRB **NOTED** that the 24th Session of the IPHC Scientific Review Board (SRB024) will be held in June 2024 (dates to be decided), in Seattle, WA, USA.

68. The SRB **ACKNOWLEDGED** the retirement of Dr Kim Scribner from the SRB and thanked him for his invaluable support, review, and advice to the IPHC.

69. The Report of the 23rd Session of the IPHC Scientific Review Board (IPHC-2023-SRB023-R) was **ADOPTED** on 26 September 2023, including the consolidated set of recommendations and/or requests arising from SRB023, provided at Appendix IV.

APPENDIX I
LIST OF PARTICIPANTS FOR THE 23RD SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB023)

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 Anna **Kuparinen**:	anna.k.kuparinen@jyu.fi; Professor, University of Jyväskylä (Finland), PO Box 35 FI-40014
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

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Ms Ann-Marie **Huang**: Ann-Marie.Huang@dfo-mpo.gc.ca	Mr Kurt Iverson: kurt.iverson@noaa.gov
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IPHC Secretariat

Name	Position	Email
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Dr Josep **Planas**	Biological and Ecosystem Sciences Branch Manager	josep.planas@iphc.int
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Ms Kayla **Ualesi**	Setline Survey Coordinator	kayla.ualesi@iphc.int

APPENDIX II
AGENDA FOR THE 23RD SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB023)

Date: 25-26 September 2023
Location: Seattle, WA, USA, & Electronic Meeting
Venue: IPHC HQ & Adobe Connect
Time: 09:00-17:00 (25-26th)
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

3. IPHC PROCESS

3.1. SRB annual workflow (D. Wilson)
3.2. Update on the actions arising from the 22nd Session of the SRB (SRB022) (D. Wilson)
3.3. Outcomes of the 99th Session of the IPHC Annual Meeting (AM099) (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)

4.1. Research
- 4.1.1. Pacific halibut stock assessment
- 4.1.2. Management strategy evaluation
- 4.1.3. Biology and ecology

4.2. Monitoring
- 4.2.1. Fishery-dependent data
- 4.2.2. Fishery-independent data
  - IPHC Fishery-Independent Setline Survey (FISS)
    - 2024 FISS design evaluation (R. Webster)
    - Updates to space-time modelling (R. Webster)

5. MANAGEMENT SUPPORTING INFORMATION

6. REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 23rd SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB023)

APPENDIX III
LIST OF DOCUMENTS FOR THE 23RD SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB023)

Document	Title	Availability
IPHC-2023-SRB023-01	Agenda & Schedule for the 23rd Session of the Scientific Review Board (SRB023)	✓ 26 Jun 2023
IPHC-2023-SRB023-02	List of Documents for the 23rd Session of the Scientific Review Board (SRB023)	✓ 26 Jun 2023
IPHC-2023-SRB023-03	Update on the actions arising from the 22nd Session of the SRB (SRB022) (IPHC Secretariat)	✓ 22 Aug 2023
IPHC-2023-SRB023-04	Outcomes of the 99th Session of the IPHC Annual Meeting (AM099) (D. Wilson)	✓ 26 Jun 2023
IPHC-2023-SRB023-05	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)	✓ 23 Aug 2023
IPHC-2023-SRB023-06	Development of the 2023 Pacific halibut (*Hippoglossus stenolepis*) stock assessment (I. Stewart & A. Hicks)	✓ 22 Aug 2023
IPHC-2023-SRB023-07	IPHC Secretariat MSE Program of Work (2023) and an update on progress (A. Hicks & I. Stewart)	✓ 23 Aug 2023
IPHC-2023-SRB023-08	Report on current and future biological and ecosystem science research activities (J. Planas)	✓ 25 Aug 2023
IPHC-2023-SRB023-09	2024-26 FISS design evaluation (R. Webster, I. Stewart, K. Ualesi, & D. Wilson)	✓ 25 Aug 2023
Information papers		
IPHC-2023-SRB023-INF01	Research projects (IPHC Secretariat)	✓ 23 Aug 2023

APPENDIX IV
CONSOLIDATED SET OF RECOMMENDATIONS AND REQUESTS OF THE 23RD SESSION OF THE IPHC SCIENTIFIC REVIEW BOARD (SRB023)

RECOMMENDATIONS

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

SRB023–Rec.01 (para. 17) The SRB **AGREED** that AI techniques may improve efficiency of age estimation and **RECOMMENDED** continued research and cross-validation of AI-based aging.

Research: Pacific halibut stock assessment

SRB023–Rec.02 (para. 19) **NOTING** that the inclusion of whale depredation in the assessment requires many assumptions and results in only small changes to the TCEY, the SRB **RECOMMENDED** that whale depredation not be included in the 2023 stock assessment model.

SRB023–Rec.03 (para. 20) The SRB **RECOMMENDED** that the Secretariat investigate approaches (e.g. simulation testing) to estimating uncertainty (or bounding the minimum level of uncertainty) in different assessment outputs: e.g. coastwide and Biological Region spawning stock biomass (see related actions under Section 4.2).

SRB023–Rec.04 (para. 21) The SRB **RECOMMENDED** continuing annual sex ratio sampling while the stock is declining given that estimated SSB remains sensitive to these data.

Research: Management strategy evaluation

SRB023–Rec.05 (para. 24) The SRB **RECOMMENDED** that an objective to maintain spatial population structure be added or redefined to maintain the spawning biomass in a Biological Region above a defined threshold relative to the dynamic unfished equilibrium spawning biomass in that Biological Region with a pre-defined tolerance. The percentage and tolerance may be defined based on historical patterns and appropriate risk levels recognizing the limited fishery control of biomass distribution.

SRB023–Rec.06 (para. 25) The SRB **RECOMMENDED** that the Commission re-evaluate the target objective for long-term coastwide female spawning stock biomass given that estimated 2023 female spawning biomass (and associated WPUE), which was well-above the current target B36%, in part triggered harvest rate reductions from the interim harvest policy. Such ad-hoc adjustments limited the value of projections and performance measures from MSE.

SRB023–Rec.07 (para. 26) The SRB **RECOMMENDED** continued examination, within the MSE, of FISS scenarios that are better representative of the levels of uncertainty and bias that may result from future reductions in FISS sampling.

SRB023–Rec.08 (para. 27) **RECOGNIZING** the spatial variability of environmental factors that influence population dynamics, the SRB **RECOMMENDED** that an exceptional circumstance be defined based on regional as well as stock-wide deviations from expectations. For example, an exceptional circumstance could be declared if any of the following are met:

a) The coastwide all-sizes FISS WPUE or NPUE from the space-time model falls above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index for two or more consecutive years.

b) The observed FISS all-sizes stock distribution for any Biological Region is above the 97.5th percentile or below the 2.5th percentile of the simulated FISS index over a period of 2 or more years.

c) Recruitment, weight-at-age, sex ratios, other biological observations, or new research indicating parameters that are outside the 2.5th and 97.5th percentiles of the range used or calculated in the MSE simulations.

SRB023–Rec.09 (para. 28) The SRB **RECOMMENDED** that if an exceptional circumstance occurred the following actions would take place:

a) A review of the MSE simulations to determine if the OM can be improved and MPs should be re-evaluated.

b) If a multi-year MP was implemented and an exceptional circumstance occurred in a year without a stock assessment, a stock assessment would be completed as soon as possible along with the re-examination of the MSE.

c) Consult with the SRB and MSAB to identify why the exceptional circumstance occurred, what can be done to resolve it, and determine a set of MPs to evaluate with an updated OM.

d) Further consult with the SRB and MSAB after simulations are complete to identify whether a new MP is appropriate.

SRB023–Rec.10 (para. 29) The SRB **RECOMMENDED** evaluating fishing intensity and frequency of the stock assessment elements of management procedures and FISS uncertainty scenarios using the MSE framework. MP elements related to constraints on the interannual change in the TCEY and calculation of stock distribution may be evaluated for a subset of the priority management procedures as time allows.

SRB023–Rec.11 (para. 30) The SRB **RECOMMENDED** that the Commission consider revising the harvest policy to (i) determine coastwide TCEY via a formal management procedure and (ii) negotiate distribution independently (e.g. during annual meetings). Such separated processes are used in other jurisdictions (e.g. most tuna RFMOs, Mid Atlantic Fishery Management Council, AK Sablefish, etc.).

Research: Biology and ecology

SRB023–Rec.12 (para. 36) **NOTING** that the genomics research is and will continue to be a key element of the Biological and Ecosystem Science Research program, and that the Secretariat wishes to (i) document stock structure, (ii) use genetic markers to quantify movements, (iii) assign individuals of any age, location, season to a genetic population, (iv) annotate markers and use genomic data to between understand genetic and environmental sources of variation in growth, maturity and fecundity, (v) engage in close-kin capture-recapture to estimate stock abundance, the SRB **RECOMMENDED** adding qualified staff to help address these diverse and important activities in a timely fashion.

SRB023–Rec.13 (para. 42) The SRB **RECOMMENDED** that the Secretariat continue to work with collaborators to collect and process genetic samples from juveniles. Collections of younger (pre-reproductive) age classes would be particularly important for anticipated future close-kin capture-recapture work.

SRB023–Rec.14 (para. 44) The SRB **RECOMMENDED** to apply the genetic sampling more broadly, to estimate genetic diversity of the (sub)populations, for example through the effective number of breeding adults by cohort.

SRB023–Rec.15 (para. 45) The SRB **RECOMMENDED** that the compensatory assumption of the stock recruitment models be critically evaluated via a MSE stress test scenario in which recruitment is depensatory at some low spawning biomass.

SRB023–Rec.16 (para. 49) The SRB **RECOMMENDED** that Secretariat proceed to the next step of individual assignment based on K of 4 or K of 5. Based on the large number of loci with low levels of divergence among reporting regions (Manhattan plot in Figure 4 of paper IPHC-2023-SRB023-08) that posterior probabilities of cluster assignment (in a Bayesian context) may be low when all loci are used. The Secretariat should conduct a comparable analysis using only 'outlier loci'.

SRB023–Rec.17 (para. 50) **RECOGNIZING** that future applications of 'outlier loci' to address SA and MSE objectives will necessitate development of more 'rapid screening approaches' and screening based on fewer loci, the SRB **RECOMMENDED** that the Secretariat work to identify the numbers of loci and locus characteristics (e.g. high levels of diversity and high level of allele frequency variation) so loci may be applied.

SRB023–Rec.18 (para. 53) The SRB **RECOMMENDED** that the Secretariat:

a) conduct simulations as a means of assessing the accuracy of group or admixture assignments;

b) establish criteria for acceptable group assignment accuracy and that is relevant for assignment of individuals as a 'pure' or 'admixed'. Thus, observations, though made with some error would be used as 'observed' estimates to tally over space and across age classes.

c) should evaluate what the uncertainty in classification (errors) will mean to their estimates. The SRB draws the Secretariat's attention to a widely cited paper by Manel et al. (2005) in Trends in Ecology and Evolution, where authors compare individual assignment tests to a widely used alternative method (mixed stock analysis). These authors point out that use of individual assignment tests for relative population (or reporting group) compositional estimation can be fraught with problems because assignment error compounds across all individuals.

Monitoring: 2024 FISS design evaluation

SRB023–Rec.19 (para. 59) The SRB **RECOMMENDED** that the Secretariat continue exploring ways of estimating the impacts of different FISS designs and efficiency decisions on stock assessment outputs and fishery performance objectives. The end goal should be to provide a decision support tool that can frame decisions about FISS design in terms of costs and benefits in comparable currencies.

SRB023–Rec.20 (para. 62) The SRB **RECOMMENDED** that the life-histories, particularly population age structure, lengths-at-age, and weight-at-age continue to be monitored in the FISS and fishery to obtain a proxy of total mortality, cohort resonance, and reproductive potential as well as to detect longer term trends in life histories.

Updates to space-time modelling

SRB023–Rec.21 (para. 63) The SRB **NOTED** that the switch from a hurdle model to a Tweedie distribution reduces model parameters and overall Deviance Information Criterion (DIC) and reduces run times and **RECOMMENDED** that the Secretariat continue investigating whether the space-time model can be successfully transitioned to a Tweedie distribution for all regulatory areas.

Management Supporting Information

SRB023–Rec.22 (para. 64) **NOTING** the presentation demonstrating how secondary FISS objectives influence choices for future FISS designs that may have already been endorsed by the SRB based only on primary objectives, the SRB **RECOMMENDED** that the MSE include some scenarios in which the FISS is skipped (as similarly requested above in paras. 62 and 63) because of occasional (or functional) economic constraints on executing full FISS designs. Such simulation scenarios would provide some indication of the potential scale of impacts on MP performance of maintaining long-term revenue neutrality of the FISS.

REQUESTS

Research: Biology and ecology

SRB023–Req.01 (para. 37) **NOTING** that future applications of genomic data will necessitate more expansive sampling geographically and demographically to achieve IPHC goals, the SRB **REQUESTED** that the Secretariat establish explicit long-term objectives for use of genomic data and work with staff, fishermen, and agency collaborators to establish a short and long-term sampling program and data and sample archival plan to ensure samples are available to address Secretariat objectives.

SRB023–Req.02 (para. 41) **NOTING** paper IPHC-2023-SRB023-08 (subsection 1.1 - Identification of Pacific halibut juvenile habitat), and that the narrative describes work to be conducted but does not explicitly identify research objectives or hypotheses that the data would be used to address, the SRB **REQUESTED** that objectives/hypotheses be developed for SRB024 where hypotheses could include:

a) regions with larger amounts of juvenile rearing habitat and larger number of juveniles would realize numerically larger levels of recruitment to the adult population;

b) genotypes of juveniles from rearing habitats could be assigned to specific spawning areas.

SRB023–Req.03 (para. 43) **NOTING** paper IPHC-2023-SRB023-08 (subsection 1.2 - wire tagging of U32 Pacific halibut), where the narrative describes numbers of fish tagged and recovered, no information is provided summarizing distances moved by size/age and location, the SRB **REQUESTED** that information be provided during SRB024, including background on statistical methods for analysis of data.

SRB023–Req.04 (para. 51) The SRB **ACKNOWLEDGED** Table 1 in paper IPHC-2023-SRB023-08, produced in response to SRB022 inquiry, and that discrepancies in the genetic diversity measure Fis (deviation of observed and expected heterozygosity) across collection years within reporting regions. The Secretariat estimates Fis on a collection year by year basis and overall years for each region. The SRB **REQUESTED:**

a) further investigation of the disparity in Fis for reporting regions (yearly vs total). Higher positive Fis could indicate admixture of individuals from genetically differentiated groups;

b) investigations into discrepancies between estimates of Fis, observed heterozygosity (Ho), and expected heterozygosity (He).

SRB023–Req.05 (para. 52) The SRB **NOTED** that the Secretariat proposes to conduct individual admixture (i.e. among IPHC reporting regions) estimation using software NGSadmix and

individual assignment testing using WGSassign, both of which are amenable to low coverage sequence data, to estimate proportional contributions of reporting groups to unknown individuals. This analysis would be conducted after 'best supported' number of genetic groups (K) has been established. The SRB **REQUESTED** that admixture analyses and assignment testing be conducted and reported at SRB024, including estimates of assignment accuracy.

Monitoring: 2024 FISS design evaluation

SRB023–Req.06 (para. 57) The SRB **REQUESTED** that the Commission **NOTE** the addition of cost estimates to the presentation of alternative FISS designs. The short-term risk implications in 2024 to the stock and TCEY of a drastically reduced FISS design (e.g. approx. revenue neutral Design 9 with efficiencies) are probably not profound given that the estimated current abundance is still above the implied B36% target. Impacts may appear more in the estimates of stock distribution since unsampled areas will be more dependent on the space-time model than actual data.

SRB023–Req.07 (para. 60) The SRB **REQUESTED** that the Commission **NOTE** that some longer-term (2025 and beyond) implications of reduced FISS designs are predictable and potentially consequential. For instance, higher FISS CVs will generally result in higher inter-annual variation in TCEY under the current decision-making process. This would occur for two reasons: (1) biomass estimates and projections from the assessment model will have greater uncertainty and therefore greater variability in outputs and (2) ad hoc management adjustments to the interim harvest policy recommendations would be more frequent and/or more variable for greater input uncertainty. The SRB therefore **REQUESTED** the following analyses for SRB024:

a) Assessment of reduced FISS designs (2025-2027) via simulation tests of assessment model outputs (e.g. probability of decline, estimated stock abundance and status, TCEY) under alternative revenue-neutral FISS designs using the existing stock assessment ensemble;

b) Mitigation options of reduced FISS designs (short-term and long-term) via MSE simulations of management procedures that deliberately aim to reduce inter-annual variability in TCEY via multi-year TCEYs and (possibly) fixed stock distribution schemes;

c) Components (a,b) above would be integrated since (a) will need to inform simulations in (b).

SRB023–Req.08 (para. 61) The SRB **REQUESTED** that simulations above (para. 60) include:

a) a relationship in which the FISS CV is relatively higher at lower stock abundance (i.e. the current CV issue is a function of stock abundance rather than a short-term condition);

b) target regulatory area CVs of 15%, 20%, 25%, and 30%;

c) coastwide target CV of 15% without controlling specific regulatory area CVs.