INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC Research Advisory Board (RAB019) – A Collection of Published Meeting Documents

28 February 2018, Seattle, WA

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DRAFT: AGENDA & SCHEDULE FOR THE 19TH SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB19)

Date: 28 February 2018
Location: Seattle, Washington, U.S.A.
Venue: IPHC Training Room, Salmon Bay
Time: 09:00-17:30 (Schedule below)
Chairperson: Dr David T. Wilson (IPHC Executive Director)
Vice-Chairperson: Dr Josep Planas (IPHC Biological & Ecosystem Science Branch Manager)

DRAFT: AGENDA FOR THE 19TH SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB19)

1. **OPENING OF THE SESSION** (Chairperson)

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chairperson)

3. **IPHC PROCESS**
   - 3.1 IPHC Rules of Procedure (2017)
   - 3.2 Update on the actions arising from the 18th Session of the RAB (RAB18)
   - 3.3 Outcomes of the 94th Session of the IPHC Annual Meeting (AM094)

4. **SEASON OVERVIEW: RAB MEMBERS**

5. **DESCRIPTION OF IPHC RESEARCH ACTIVITIES** (J. Planas & Project leaders)
   - 5.1 Brief overview of IPHC 5-year Biological Research Program (J. Planas)
   - 5.2 Ongoing research activities (Project leaders)
     - 5.2.1 IPHC fishery-independent setline survey expansion and densification (R. Webster)
     - 5.2.2 Reproductive assessment of the Pacific halibut population (J. Planas)
     - 5.2.3 Sex-marking at sea and genetic validation of sex identification (T. Loher)
     - 5.2.4 Factors affecting somatic growth in juvenile Pacific halibut (J. Planas)
     - 5.2.5 Discard mortality rates and post-release survival in the directed Pacific halibut fishery (C. Dykstra)
     - 5.2.6 Migratory behavior and distribution of Pacific halibut (T. Loher, L. Sadorus)
   - 5.3 IPHC research topics selected for 2018 (J. Planas)

6. **GUIDANCE ON, AND DISCUSSION OF, OTHER POTENTIAL APPLIED RESEARCH PROJECTS** (Chairperson)
   - Review of minimum size limit and discussion of maximum size limit
   - Calibration of snap versus fixed gear

- Whale depredation
- Alterations of flesh characteristics: chalky and mushy Pacific halibut
- Other topics of interest suggested by the Board

7. **OTHER BUSINESS**
   7.1 Date and place of the 20th and 21st Sessions of the IPHC Research Advisory Board (Chairperson)

8. **REVIEW OF THE DRAFT AND ADOPTION OF THE REPORT OF THE 19th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB19)** (Chairperson)

DRAFT: SCHEDULE FOR THE 19th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB19)

Wednesday, 28 February 2018		
Time	**Agenda item**	**Lead**
09:00-09:05	1. Opening of the Session	Chairperson
09:05-09:15	2. Adoption of the agenda and arrangements for the Session	Chairperson
09:15-09:30	3. IPHC Process	Chairperson
09:30-10:30	4. Season overview: RAB members	RAB Members
10:30-10:45	Break	
10:45-12:30	5. Description of IPHC research activities & Discussion 5.1. Brief overview of IPHC 5-year Biological Research Program (J. Planas) 5.2. Ongoing research activities (Project leaders) 5.2.1. Survey expansion and densification (R. Webster) 5.2.2. Reproductive assessment of the Pacific halibut population (J. Planas). 5.2.3. Sex-marking at sea and genetic validation of sex identification (T. Loher) 5.2.4. Factors affecting somatic growth in juvenile Pacific halibut (J. Planas) 5.2.5. Discard mortality rates and post-release survival in the directed Pacific halibut fishery (C. Dykstra). 5.2.6. Migratory behaviour and distribution of Pacific halibut (T. Loher, L. Sadorus) 5.3. IPHC research topics selected for 2018 (J. Planas)	J. Planas
12:30-13:30	Lunch	
13:30-15:30	6. Guidance on, and discussion of, other potential applied research projects (examples below): • Review of minimum size limit and discussion of maximum size limit • Calibration of snap versus fixed gear • Whale depredation • Alterations of flesh characteristics: chalky and mushy Pacific halibut • Other topics of interest suggested by the RAB	Chairperson & RAB Members
15:30-15:45	Break	

15:45-16:30	6. Guidance on, and discussion of, potential applied research projects (cont.)	RAB Members
16:30-16:40	7. Other business 7.1 Date and place of the 20th and 21st Sessions of the IPHC Research Advisory Board	Chairperson
16:40-17:30	8. Review of the draft and adoption of the report of the 19th Session of the IPHC Research Advisory Board (RAB19)	Chairperson

DRAFT: LIST OF DOCUMENTS FOR THE 19th SESSION OF THE IPHC RESEARCH ADVISORY BOARD (RAB019)

LAST UPDATED: 22 FEBRUARY 2018

Document	Title	Availability
IPHC-2018-RAB019-01	Draft: Agenda & Schedule for the 19th Session of the IPHC Research Advisory Board (RAB019)	✓ 30 Nov 2017
IPHC-2018-RAB019-02	Draft: List of Documents for the 19th Session of the IPHC Research Advisory Board (RAB019)	✓ 18 Jan 2018 ✓ 22 Feb 2018
IPHC-2018-RAB019-03	Update on the actions arising from the 18th Session of the RAB (RAB18) (IPHC Secretariat)	✓ 26 Jan 2018
IPHC-2018-RAB019-04	Outcomes of the 94th Session of the IPHC Annual Meeting (AM094) (IPHC Secretariat)	✓ 22 Feb 2018
IPHC-2018-RAB019-05	Overview: IPHC 5-year research program (2018-2023) (J. Planas)	✓ 26 Jan 2018
IPHC-2018-RAB019-06	IPHC fishery-independent setline survey expansion and densification (R. Webster)	✓ 29 Jan 2018
IPHC-2018-RAB019-07	Reproductive assessment of the Pacific halibut population (J. Planas)	✓ 26 Jan 2018
IPHC-2018-RAB019-08	Sex-marking at sea and genetic validation of sex identification (T. Loher)	✓ 29 Jan 2018
IPHC-2018-RAB019-09	Factors affecting somatic growth in juvenile Pacific halibut (J. Planas)	✓ 26 Jan 2018
IPHC-2018-RAB019-10	Discard mortality rates and post-release survival in the directed Pacific halibut fishery (C. Dykstra)	✓ 26 Jan 2018
IPHC-2018-RAB019-11	Migratory behavior and distribution of Pacific halibut (T. Loher, L. Sadorus)	✓ 29 Jan 2018
IPHC-2018-RAB019-12	IPHC research topics selected for 2018 (J. Planas)	✓ 26 Jan 2018

Update on actions arising from the 18th Session of the IPHC Research Advisory Board (RAB018)

PREPARED BY: IPHC SECRETARIAT (26 JANUARY 2018)

PURPOSE

To provide the RAB with an opportunity to consider the progress made during the inter-sessional period, in relation to the recommendations and requests of the 18th Session of the IPHC Research Advisory Board (RAB018).

BACKGROUND

At the RAB018 meeting, a series of actions were agreed upon for implementation by the IPHC Secretariat. These action items and progress made on their implementation are detailed in Appendix A.

DISCUSSION

Noting that best practice governance requires the prompt delivery of core tasks assigned by the Commission, at each subsequent session of the Commission and its subsidiary bodies, attempts will be made to ensure that any recommendations and requests for action are carefully constructed so that each contains the following elements:

1) a specific action to be undertaken (deliverable);
2) clear responsibility for the action to be undertaken (i.e. a specific Contracting Party, the IPHC Secretariat, a subsidiary body of the Commission or the Commission itself);
3) a desired time frame for delivery of the action (i.e. by the next session of an subsidiary body, or other date).

This involves numbering and tracking all action items (see Appendix A) from the RAB, as well as including clear progress updates and document reference numbers.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-03 which provided the RAB with an opportunity to consider the progress made during the inter-sessional period, in relation to the recommendations and requests of the 18th Session of the IPHC Research Advisory Board (RAB018).
2) **AGREE** to consider and revise as necessary, the actions, and for these to be combined with any new actions arising from the RAB019.

APPENDICES

Appendix I: Update on actions arising from the 18th IPHC Research Advisory Board (RAB018)

APPENDIX A

Update on actions arising from the 18th Session of the Research Advisory Board (RAB018)

Action No.	Description	Update
RECOMMENDATIONS		
RAB18–01 (para. 11)	***Survey expansion*** The RAB18 **RECOMMENDED** that the IPHC Staff develop an information paper associated with the survey expansion, which details the likely implications of periodic survey expansion on the stock assessment and apportionment, taking into consideration potential population variability of Pacific halibut in expansion areas which are infrequently surveyed.	Completed: Presented to the IM093 (IPHC-2017-IM093-07). For the latest update see the AM094 paper: IPHC-2018-AM094-07 Space-time modelling of IPHC fishery-independent setline survey data (R. Webster)
RAB18–02 (para. 27)	***Bycatch handling practices on all fleets catching Pacific halibut*** The RAB18 **RECOMMENDED** that the IPHC Staff undertake a project to develop '*Best practice handling guidelines'* for each of the primary gear types which catch Pacific halibut, both directed and non-directed.	In progress: Endorsed by the Commission as AM093-Rec.10. The IPHC is currently conducting a research project evaluating handling practices associated with physiological condition and survival of discarded Pacific halibut in the longline fishery that will produce, as deliverables, best practice handling guidelines for the reduction or control of discard mortality rates by late 2019.
RAB18–03 (para. 37)	***IPHC Closed Area review*** The RAB18 **RECOMMENDED** that as the IPHC Closed Area was designated to protect juvenile Pacific halibut, there is no scientific justification for retaining the closure in its current form. Thus, the IPHC Closed Area should either be removed, noting that it would be unlikely that much longline fishing would occur in the area as most fish are below the legal size limit, or it should only apply to gear which would interact with juvenile Pacific halibut.	In progress: Considered at the AM093 and AM094. AM094 deferred direct action until 2019.
RAB18–04 (para. 53)	***Chalky Pacific halibut*** The RAB18 **RECOMMENDED** that the IPHC Staff undertake research to answer the following: a) What causes chalky flesh in Pacific halibut? Are there particular environmental signatures (temperature, dissolved oxygen, etc.) that characterize areas with incidence of chalky flesh? b) Why does the occurrence of chalky flesh in Pacific halibut appear to be reappearing	In progress: The IPHC is in the process collecting information from stakeholders regarding the incidence of chalkiness in Pacific halibut.

Action No.	Description	Update
	after a period of limited occurrence in regulatory areas 3A and 3B? c) Are there differences in the occurrence of chalky flesh in males and female, as well as fish of different sizes?	
RAB18–05 (para. 59)	***The report of the 18th Session of the IPHC Research Advisory Board (RAB18)*** The RAB18 **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from RAB18, provided at Appendix IV.	Completed: Considered at the 93rd Session of the Annual Meeting in 2017.
REQUESTS		
Nil	Nil	N/A

OUTCOMES OF THE 94TH SESSION OF THE IPHC ANNUAL MEETING (AM094)

PREPARED BY: IPHC SECRETARIAT (22 FEBRUARY 2018)

PURPOSE

To provide the RAB with the outcomes of the 94th Session of the IPHC Annual Meeting (AM094) relevant to the mandate of the RAB.

BACKGROUND

The agenda of the Commission's Annual Meeting (AM094) included an agenda item dedicated to the IPHC's 5-year Biological and Ecosystem Science Research Program.

The Report of the 94th Session of the IPHC Annual Meeting was adopted via correspondence on 19 February 2018 and is available for download from the IPHC website: https://iphc.int/

DISCUSSION

During the course of the Annual Meeting (AM094) the Commission made a number of specific requests and recommendations regarding the IPHC research programs. Relevant sections from the report of the meeting are provided in Appendix A for the RAB's consideration.

The Commission made a single Recommendation of specific interest to the RAB as follows:

Evaluation of the IPHC's 32" minimum size limit

AM094–Rec.04 (para. 89) *The Commission **NOTED** report IPHC-2018-AM094-14, which indicated that the performance of the management procedure is dominated by management decisions other than the size limit, (e.g. removal of the size limit is likely to result in minimal changes in yield) and **RECOMMENDED** that the size limit remain unchanged*.

The Commission also approved a three-year calendar of IPHC meetings, which includes the following planned dates for RAB meetings, all currently planned to be held in the IPHC Offices in Seattle, USA.

RAB No.	Date	Location
RAB19	28 Feb 2018	Seattle, WA, U.S.A.
RAB20	27 Feb 2019	Seattle, WA, U.S.A.
RAB21	26 Feb 2020	Seattle, WA, U.S.A.

RECOMMENDATION

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-04 which provides the outcomes of the 94th Session of the IPHC Annual Meeting (AM094) relevant to the mandate of the RAB.

APPENDICES

Appendix A: Outcomes of the AM094 relevant to the mandate of the RAB

APPENDIX A
Outcomes of the AM094 relevant to the mandate of the RAB

(numbering refers to those contained in the AM094 report)

10.3 IPHC 5-year Biological & Ecosystem Science research program: update

78. The Commission **NOTED** paper IPHC-2018-AM094-13 which provided an overview of the new and continuing research projects proposed by IPHC Secretariat and contemplated within the 5-year Biological and Ecosystem Science Research Program.

79. The Commission **NOTED** the summary of research projects proposed for 2018 and the summary of research projects awarded for external funding in 2017, as detailed in the paper.

80. The Commission **NOTED** that the IPHC Secretariat will conduct genetic validation of collected biological samples of sex-marked fish from the 2017 coastwide sex-marking project in order to evaluate its success and possible future implementation, and will therefore not request fishers' participation in 2018.

81. The Commission **NOTED** that the IPHC Secretariat was informed about concerns from vessels conducting sex-marking at sea that did not have their offloads sampled due to the random nature of the sampling process and the suggestion that all trips are sampled independently of whether they fall in the randomized sample or not.

82. The Commission **NOTED** that the SRB recommendation on the usefulness of a life-history modeller is under consideration by the IPHC Secretariat and that a first step in that direction is the temporary hire of a modeller to work on Pacific halibut larval connectivity between the Gulf of Alaska and the Bering Sea.

83. The Commission **NOTED** that the IPHC Secretariat is working towards clearly demonstrating how biological research objectives and stock assessment are integrated in order to inform the policy decision-making process.

84. The Commission **NOTED** that the IPHC Secretariat is undertaking studies on growth in Pacific halibut that by addressing responses to temperature and density could inform on potential changes in overall fitness, as has been observed in the Pacific cod.

85. The Commission **NOTED** that the IPHC Secretariat clarified the start date and termination dates of the proposed new and continuing research projects proposed by IPHC.

10.4 Evaluation of the IPHC's 32" minimum size limit

86. The Commission **NOTED** paper IPHC-2018-AM094-14 which provided a response to the Commission request made during the 2016 Interim Meeting (IPHC 2016):

> IM092–Req.07 (para. 73) "*The Commission REQUESTED that a review of the analysis of the effectiveness of size limits be undertaken by the IPHC Staff throughout 2017, for consideration by the Commission at its annual meeting in 2018*."

87. The Commission **NOTED** the work of the IPHC Secretariat during 2017, and the challenges to an evaluation of the Minimum Size Limit (MSL).

88. The Commission **AGREED** that consideration of the magnitude of current discard mortality, the potential change in fishery yield, uncertainty in the market value of Pacific halibut below the current MSL and potential changes in fishery practices in response to a change in the MSL represent the primary trade-offs identified.

89. The Commission **NOTED** report IPHC-2018-AM094-14, which indicated that the performance of the management procedure is dominated by management decisions other

than the size limit, (e.g. removal of the size limit is likely to result in minimal changes in yield) and **RECOMMENDED** that the size limit remain unchanged.

90. The Commission **AGREED** that the work of the IPHC Secretariat has satisfied the Commission's request, and directed the IPHC Secretariat to postpone further investigation of the MSL until such time as either additional information or changes in the fishery, markets, or Pacific halibut stock warrant additional work.

Overview: IPHC 5-year Biological and Ecosystem Science Research Program (2018 - 2023)

PREPARED BY: IPHC SECRETARIAT (J. PLANAS, 26 JANUARY 2018)

PURPOSE

To provide the RAB with a description of the new and continuing research projects proposed by IPHC Secretariat and contemplated within the 5-year Biological and Ecosystem Science Research Program.

BACKGROUND

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology of the Pacific halibut (*Hippoglossus stenolepis*). At the present time, the main objectives of the Biological and Ecosystem Science Research Program at IPHC are to:

1) identify and assess critical knowledge gaps in the biology of the Pacific halibut;

2) understand the influence of environmental conditions; and

3) apply the resulting knowledge to reduce uncertainty in current stock assessment models.

Traditionally, IPHC staff propose new projects annually that are designed to address key biological issues as well as the continuation of certain projects initiated in previous years. Proposals are based on their own input as well as input from the Commissioners, stakeholders, and specific subsidiary bodies to the IPHC such as the Research Advisory Board (RAB) and the Scientific Review Board (SRB). Proposed research projects are presented to the Commissioners for feed-back and subsequent approval. Importantly, biological research activities at IPHC are guided by a Five-Year Research Plan that is put forward by the Program Head identifying key research areas that follow Commission objectives. As described in the Five-Year Research Plan for the period 2018-2023, the primary biological research activities at IPHC can be summarized in five main areas:

1) Reproduction
2) Growth and Physiological Condition
3) Discard Mortality and Survival
4) Distribution and Migration
5) Genetics and Genomics

These research areas have been selected for their important management implications. The studies conducted on Reproduction are aimed at providing information on the sex ratio of the commercial catch and to improve current estimates of maturity. The studies conducted on Growth are aimed at describing the role of some of the factors responsible for the observed changes in size-at-age and to provide tools for measuring growth and physiological condition in Pacific halibut. The proposed work on Discard Mortality and Survival is aimed at providing updated estimates of discard mortality rates in both the longline and the trawl fisheries. The

studies conducted on Distribution and Migration are aimed at further understanding larval and juvenile dispersal, distribution of all life stages in relation to the environment, and reproductive and seasonal migration and identification of spawning times and locations. The studies conducted on Genetics and Genomics are aimed at describing the genetic structure of the Pacific halibut population and at providing the means to investigate rapid adaptive changes in response to fishery-dependent and fishery-independent influences.

In this document, we present an outline of the new and continuing projects proposed by IPHC staff for the coming year.

DISCUSSION

For 2018, four new projects are proposed to the Commission that cover specific research needs (Appendix I).

Project 2018-01 ("*Influence of thermal history on growth*") proposes to study the thermal profile experienced by fish at sea as assessed by archival tagging and otolith microchemistry in order to investigate the relationship between growth patterns (or productivity) and both spatial and temporal variability in environmental conditions for growth.

Project 2018-02 ("*Adult captive holding studies*") proposes performing studies on captive adult Pacific halibut to establish or validate measures or protocols required for other ongoing projects, such as (1) determining the permanence of individual tail markings for tracking individual movement rates, (2) calibrating measures of fat content for condition factor determinations and of stable isotope (C^{13} and N^{15}) ratios for inferring growth and dietary information and (3) calibrating O^{18} otolith signatures with environmental temperature.

Project 2018-3 ("*Whale detection methods*") proposes testing electronic monitoring-based methods to detect whale presence in the directed longline Pacific halibut fishery.

Project 2018-04 ("*Larval connectivity*") proposes to study the movement and connectivity of Pacific halibut larvae both within and between the Gulf of Alaska and the Bering Sea.

In addition to the new projects, thirteen continuing projects are proposed to the Commission (Appendix I).

Project 621.16 ("*Development of genetic sexing techniques*") is the continuation of the project dealing with genetic sex identification of the commercial catch that will entail the testing and application of the recently developed genetic assays for sex identification.

Projects 642.00 ("*Assessment of mercury and other contaminants*") and **661.11** ("*Ichthyophonus incidence monitoring*") represent the continuation of projects monitoring the prevalence of heavy metal contamination and *Ichthyophonus* infection in the Pacific halibut population, respectively.

A total of four projects will continue migration-related studies. Three of these projects involve tagging and include: **Project 650.18:** "*Archival tags: tag attachment protocols*", **Project 650.21:** "*Investigation of halibut dispersal in Area 4B*"; and **Project 670.11:** "*Wire tagging of halibut on NMFS trawl and setline surveys*". A fourth migration-related project, **Project 675.11** ("Tail pattern recognition"), is investigating the identification of individual tail markings in U32 fish through the collection of tail images from IPHC's fishery-independent setline survey.

Project 669.11 ("*At-sea collection of halibut weight to reevaluate conversion factors*") will continue to collect weights at sea to improve estimation of the weight-length relationship in adult Pacific halibut.

Project 672.12 ("*Condition Factors for Tagged U32 Fish*") will continue to study the relationship between the physiological condition of fish and migratory performance and growth as assessed by tagging in U32 fish in order to better understand the potential use of quantitative physiological indicators in predicting migratory performance and growth.

Project 673.13 ("*Sequencing the Pacific halibut genome*") will continue to characterize for the first time the genome of the Pacific halibut and provide genomic resolution to genetic markers for sex, reproduction, and growth that are currently being investigated.

Project 673.14 (*"Identification and validation of markers for growth in Pacific halibut"*) will continue to identify and validate molecular and biochemical profiles that are characteristic of specific growth patterns and that will be used to identify different growth trajectories in the Pacific halibut population and evaluate potential effects of environmental influences on growth patterns. This project has also received funding from the North Pacific Research Board under project number 1704 (Appendix II).

Project 672.13 ("*Discard mortality rates and injury classification profile by release method*") will continue to study the relationship between hook release methods in the longline fishery and associated injuries with the physiological condition of fish and with post-release survival in order to update current estimates of discard mortality rates in the directed longline Pacific halibut fishery. This project has also received funding from the Saltonstall-Kennedy NOAA grant program under project number NA17NMF4270240 (Appendix II).

Project 674.11 ("*Full characterization of the annual reproductive cycle*") will continue to characterize the annual reproductive cycle of male and female Pacific halibut in order to improve our understanding of sexual maturation in this species and to improve maturity assessments and maturity-at-age estimates.

In addition to the new and continuing proposed projects at IPHC, we note the participation of IPHC in an externally-funded and coordinated project entitled "*Survival of Pacific halibut released from Bering Sea flatfish trawl catches through expedited sorting*". This project will continue to study the efficacy of expedited release as a method for reducing Pacific halibut discard mortality following trawl capture and the development of methods for the estimation of discard mortality rates without the need for fish-by-fish vitality estimation. This project is funded by the Saltonstall-Kennedy program under project number 15AKR013 and by the North Pacific Research Board under project number NPRB 1510.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-05 which outlined the research projects proposed by IPHC staff to the Commission and provided an overview of the 5-year research program.

APPENDICES

Appendix I: Summary of research projects proposed to the Commission for 2018.

Appendix II: Summary of research projects awarded for external funding in 2017.

APPENDIX I

Summary of research projects proposed to the Commission for 2018

Project #	Project Name	Priority	Budget ($US)	External funding for FY2018 ($US)	Management implications
New Projects					
2018-01	Influence of thermal history on growth	High	136,004	-	Changes in biomass/size-at-age
2018-02	Adult captive holding studies	High-Medium	58,395	-	Changes in biomass/size-at-age/distribution
2018-03	Whale detection methods	High	37,511	-	Mortality estimation
2018-04	Larval connectivity	High	20,000	-	Larval distribution
Continuing Projects					
621.16	Development of genetic sexing techniques	High	33,928	-	Sex composition of catch
642.00	Assessment of mercury and other contaminants	Medium	8,600	-	Environmental effects
650.18	Archival tags: tag attachment protocols	High	800	-	Adult distribution
650.21	Investigation of halibut dispersal in Area 4B	High	6,800	-	Spawning areas
661.11	*Ichthyophonus* incidence monitoring	Medium	8,755	-	Environmental effects
669.11	At-sea collection of halibut weight to reevaluate conversion factors	High	7,645	-	Length-weight relationship
670.11	Wire tagging of halibut on NMFS trawl and setline surveys	High	12,840	-	Juvenile and adult distribution
672.12	Condition factors for tagged U32 Fish	High	9,116	-	DMR estimates
672.13	Discard mortality rates and injury classification profile by release method	High-Medium	1,037	255,402	DMR estimates
673.13	Sequencing the Pacific halibut genome	High	32,500	-	Environmental effects
673.14	Identification and validation of markers for growth	High	25,681	57,773	Changes in biomass/size-at-age
674.11	Full characterization of the annual reproductive cycle	High	121,488	-	Maturity assessment
675.11	Tail pattern recognition	High	3,900	-	Juvenile and adult distribution
	Total - New Projects ($US)		**$251,910**		
	Total - Continuing Projects ($US)		**$273,090**		
	Overall Total (all projects) ($US)		**$525,000**		
	External Funding (for FY2018) ($US)			**$313,175**	

APPENDIX II

Summary of research projects awarded for external funding in 2017

Project #	Grant agency	Project name	Partners	IPHC Budget ($US)	PI	Management implications	Grant period
1	**S-K NOAA**	Improving discard mortality rate estimates in the Pacific halibut by integrating handling practices, physiological condition and post-release survival (Award No. NA17NMF4270240)	Alaska Pacific University, Anchorage, AK	$286,121	Planas (lead PI) Dykstra Loher Stewart Hicks	Bycatch estimates	September 2017 – August 2019
2	**NPRB**	Somatic growth processes in the Pacific halibut (*Hippoglossus stenolepis*) and their response to temperature, density and stress manipulation effects (Award No. 1704)	AFSC-NOAA-Newport, OR	$131,891	Planas (lead PI) Rudy Loher	Changes in biomass/size-at-age	September 2017 – August 2019
			Total awarded ($)	**$418,012**			

IPHC fishery-independent setline survey expansion and densification

PREPARED BY: IPHC SECRETARIAT (R. WEBSTER; 29 JANUARY 2018)

PURPOSE

To provide the Research Advisory Board (RAB) with a summary of the results of 2017's IPHC fishery-independent setline survey expansions in Regulatory Areas 4B and 2A.

INTRODUCTION

The IPHC fishery-independent setline survey (FISS or setline survey) provides data used to compute indices of Pacific halibut density for use in monitoring stock trends and estimating stock distribution, and as an important input in the stock assessment. Stock distribution estimates are based on the annual mean weight-per-unit effort (WPUE) for each Regulatory Area, computed as the average of WPUE of O32 (greater than or equal to 32" or 81.3cm in length) Pacific halibut estimated at each survey station. Mean numbers-per-unit-effort (NPUE) is used to index the trend in Pacific halibut density in the stock assessment models. In 2016, the IPHC Secretariat moved to a space-time modelling approach for estimating these indices and calculating estimates of stock distribution (Webster 2017), an approach that was continued in 2017.

In most IPHC Regulatory Areas, the standard, annual setline survey's 18.5 km (10 nmi) grid is fished in waters within the 37-503 m (20-275 fm) depth range. Information from commercial fishery data and other fishery-independent sources showed the presence of Pacific halibut down to depths of 732 m (400 fm) and in waters shallower than 37m in some Regulatory Areas. Further, most Regulatory Areas had significant gaps in coverage within the standard 37-503 m depth range. The incomplete coverage of Pacific halibut habitat by the setline survey likely led to biased estimates of WPUE and NPUE density indices in some Regulatory Areas that were then used in the stock assessment modelling and for stock distribution estimation. For this reason, the IPHC has been undertaking a sequence of setline survey expansions since 2014 (following a 2011 pilot), with stations added to the standard grid to cover habitat not previously sampled in our setline survey. The expansions involve adding stations to one or two Regulatory Areas each year, and reverting to the annual grid for those areas in subsequent years. In 2017, setline survey expansions took place in Areas 4B and 2A.

Regulatory Area 2A's 2017 expansion had three components: a repeat of the 2014 expansion, including deep (503-732 m) and shallow (18-37 m) stations, stations within the Salish Sea, and stations in California from 39°N to 42°N; new stations in California from 37.75°N to 39°N; and additional stations off the north Washington coast (north of 46°53.3' N, within 37-503 m) resulting in a doubling of station density in that region. The new stations in California allowed the IPHC to get direct information on density in a region that Pacific halibut are known to inhabit (albeit at low densities), as shown by catches of Pacific halibut on the National Marine Fisheries Service (NMFS) West Coast trawl survey (Webster 2016). The increased station density off the north Washington Coast was motivated by stakeholder concerns that the standard 18.5 km station spacing may be missing localised patches of relatively high Pacific halibut density in that region, and that a denser grid would be more likely to detect such patches if they exist.

RESULTS OF THE 2017 SETLINE SURVEY EXPANSIONS

Figure 1 shows a map of observed setline survey O32 WPUE at each fished station in Area 4B. The station catch rates varied greatly among the regions covered by expansion stations. Eastern

stations had the highest WPUE, with several stations having values close to or above 180 kg/skate (400 lb/skate). Elsewhere, new stations had relatively low catch rates on average, with the majority catching no Pacific halibut. Average WPUE at the new expansion stations was 26.4 kg/skate (58.2 lb/skate), while at annually fished stations, it was 20.5 kg/skate (45.2 lb/skate). These results imply that at current Pacific halibut densities, the annual Area 4B setline survey was undersampling high-density habitat relative to low-density habitat. Prior to the use of the space-time model, this would have led to a negative bias in estimates of mean WPUE in Area 4B. Instead, the time series of estimated mean O32 WPUE from the 2017 modelling was very similar to the one estimated in 2016 prior to the expansion (Figure 2). This implies that, at least on average, the model predictions of WPUE in previously unsurveyed parts of Area 4B had little bias. This was not the case for total NPUE, which was underestimated in last year's modelling (Figure 3), and therefore the setline survey expansion led to a correction in the bias of previous estimates of NPUE in Regulatory Area 4B.

The observed setline survey O32 WPUE at each station in Area 2A in 2017 is shown in Figures 4-5. The California expansion south of 39°N captured a single Pacific halibut on a station outside of San Francisco Bay (Figure 4). This confirms that while Pacific halibut are present in this region, densities are very low.

Central Oregon stations had the highest O32 WPUE in Area 2A during 2017 (Figure 5), but catch rates north of there, particularly off Washington (Figure 6), appear to have been greatly affected by a large, intense area of low dissolved oxygen centered off the Washington coast (Figure 7). WPUE was zero at almost all stations within the area that had dissolved oxygen less than 0.9 ml/l, and lower than in recent years on average elsewhere off the Washington coast. The area of low dissolved oxygen encompassed the region covered by the dense grid expansion, and so likely affected catches on the new expansion stations, along with neighbouring stations on the annual grid. In 2016, mean O32 WPUE at stations off the north Washington coast was 15.0 kg/skate (33.0 lb/skate). The same annually fished stations in 2017 had mean WPUE of 4.5 kg/skate (9.9 lb/skate), and the new dense grid expansion stations had mean of 7.4 kg/skate (16.3 lb/skate). We made no adjustment for the effect of the hypoxic zone on catches in the modelling, which assumes that Pacific halibut were able to avoid areas of extremely low oxygen and therefore became available to the setline survey elsewhere.

The effect the inclusion of data from the dense grid expansion stations on estimated mean O32 WPUE was small (Figure 8). Estimated mean WPUE for Regulatory 2A in 2017 was 2.8% higher with the dense grid data included in the modelling than it was without, a difference that is well within the uncertainly in the estimates shown by the 95% intervals in Figure 8. Note that the model output used for stock assessment and stock distribution estimation comes from fitting models that include the dense grid data, along with all other setline survey expansion data.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-06 which provided a summary of the results of the IPHC fishery-independent setline survey expansions in Regulatory Areas 4B and 2A in 2017.

References

Webster, R. A. 2016a. Indexing density in southern Area 2A using West Coast trawl survey data. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2015: 544-551.

Webster, R. A. 2017. Results of space-time modelling of survey WPUE and NPUE data. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016: 241-257.

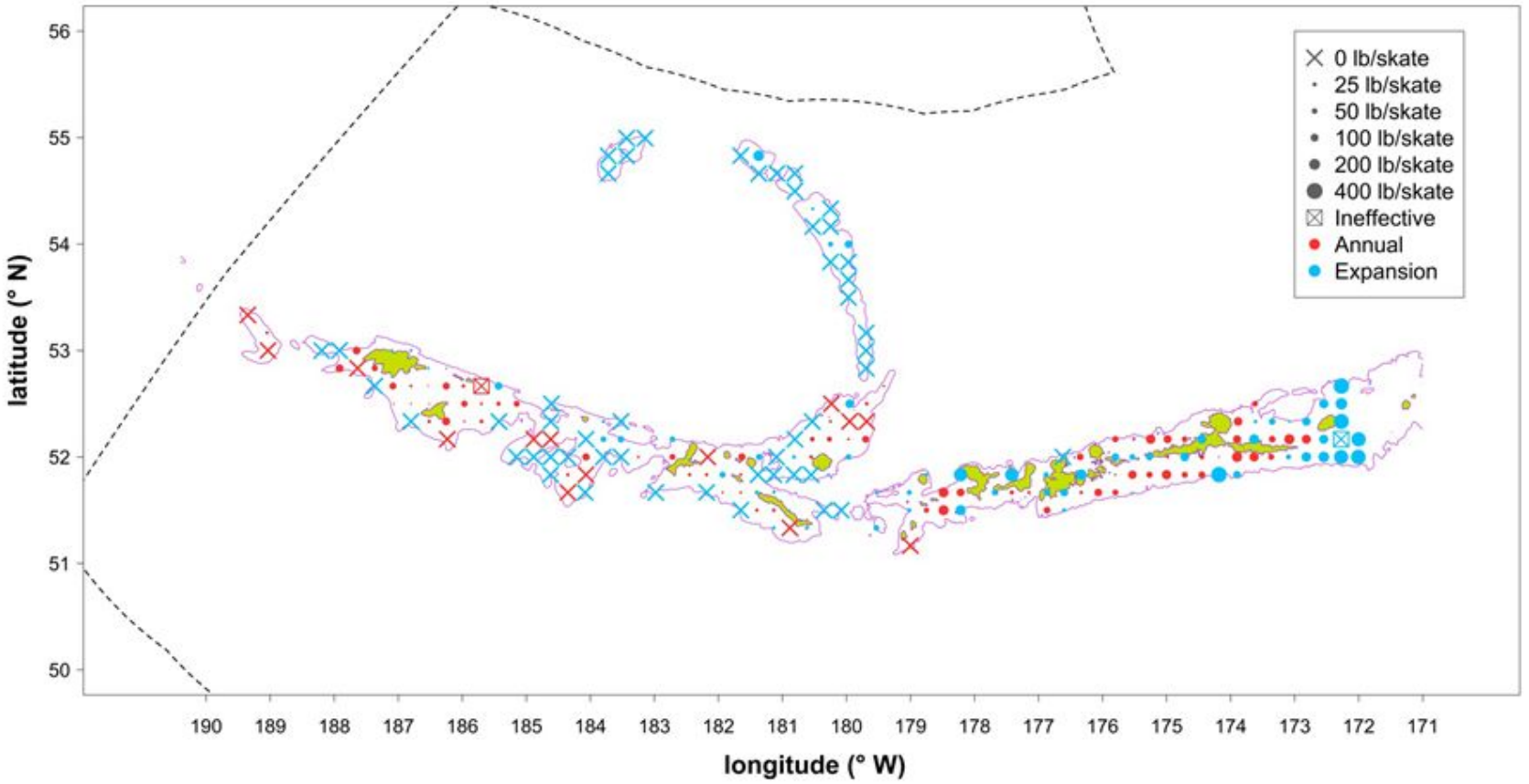

Figure 1. Map of O32 Pacific halibut WPUE by station in Regulatory Area 4B in 2017.

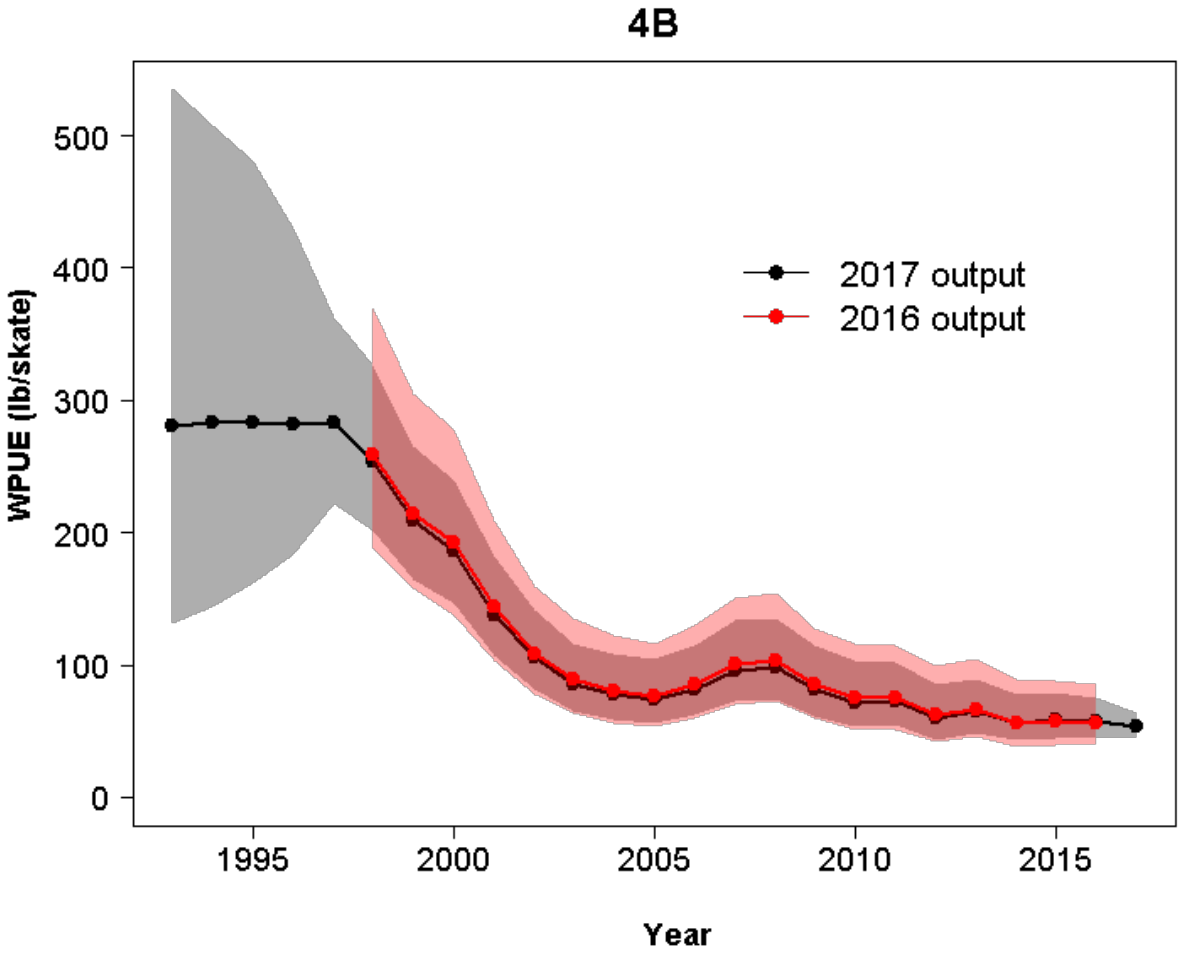

Figure 2. Comparison of the time series of estimated mean O32 Pacific halibut WPUE in Regulatory Area 4B from the 2017 modelling with the output from the 2016 modelling.

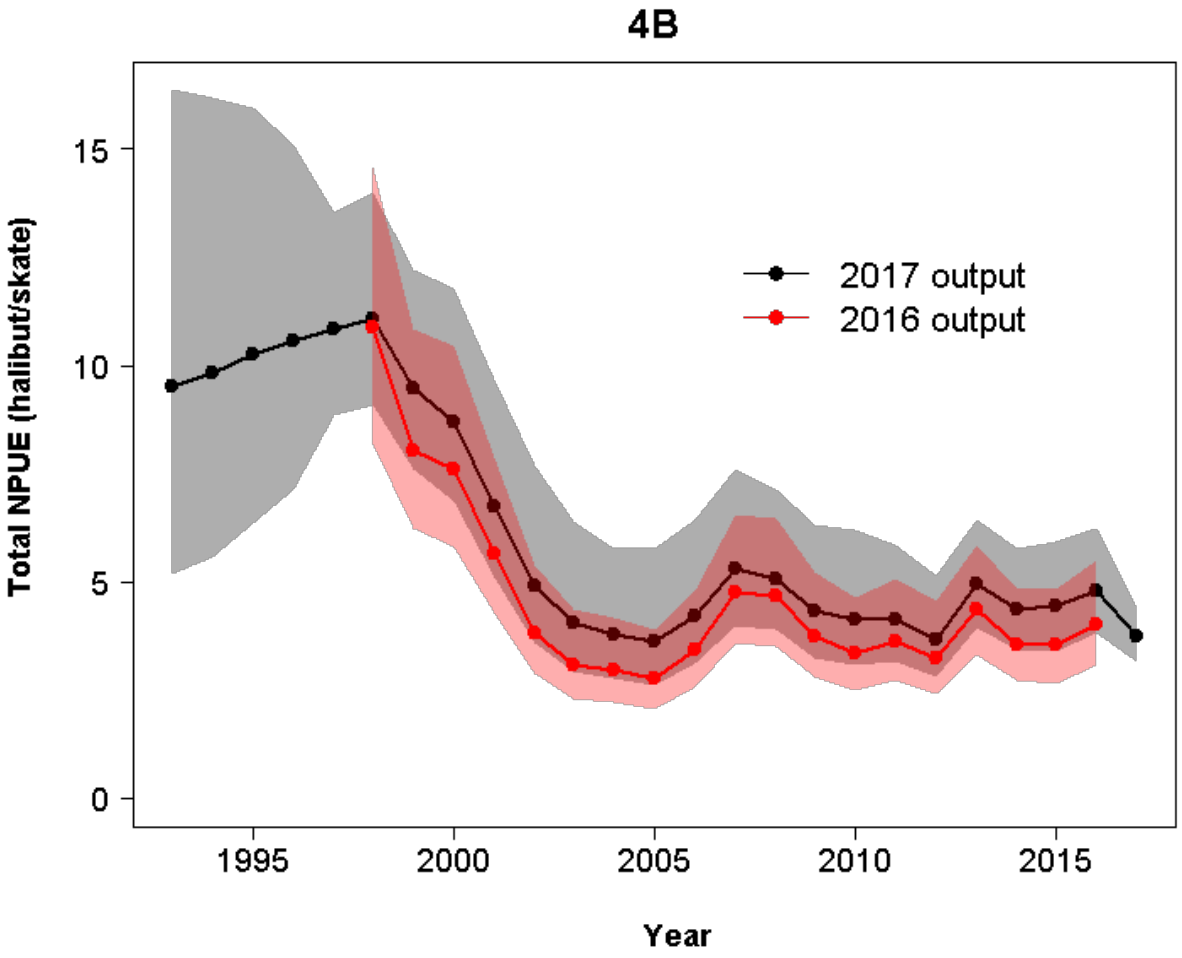

Figure 3. Comparison of the time series of estimated mean total Pacific halibut NPUE in Regulatory Area 4B from the 2017 modelling with the output from the 2016 modelling.

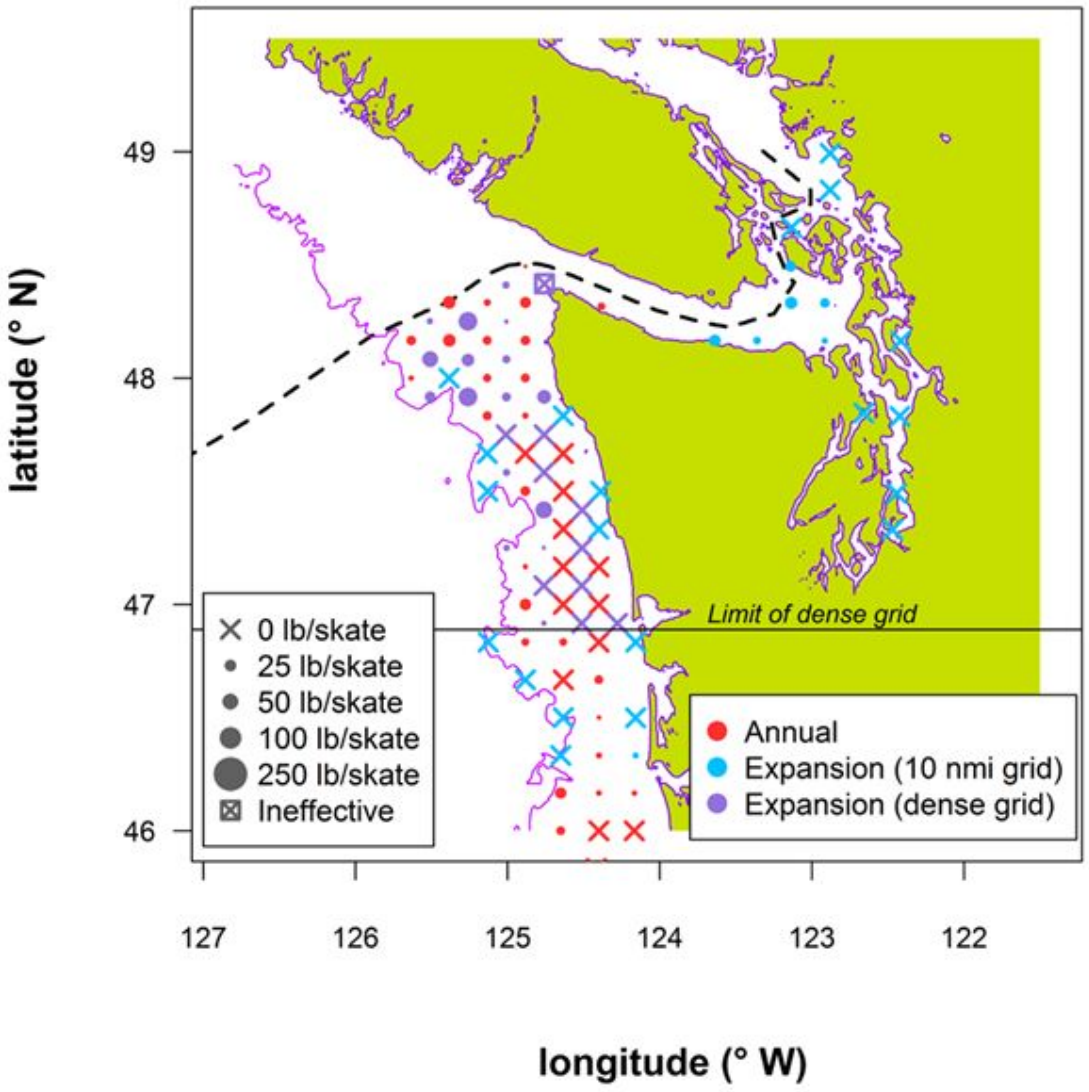

Figure 4. Map of O32 Pacific halibut WPUE by station in northern Regulatory Area 2A in 2017.

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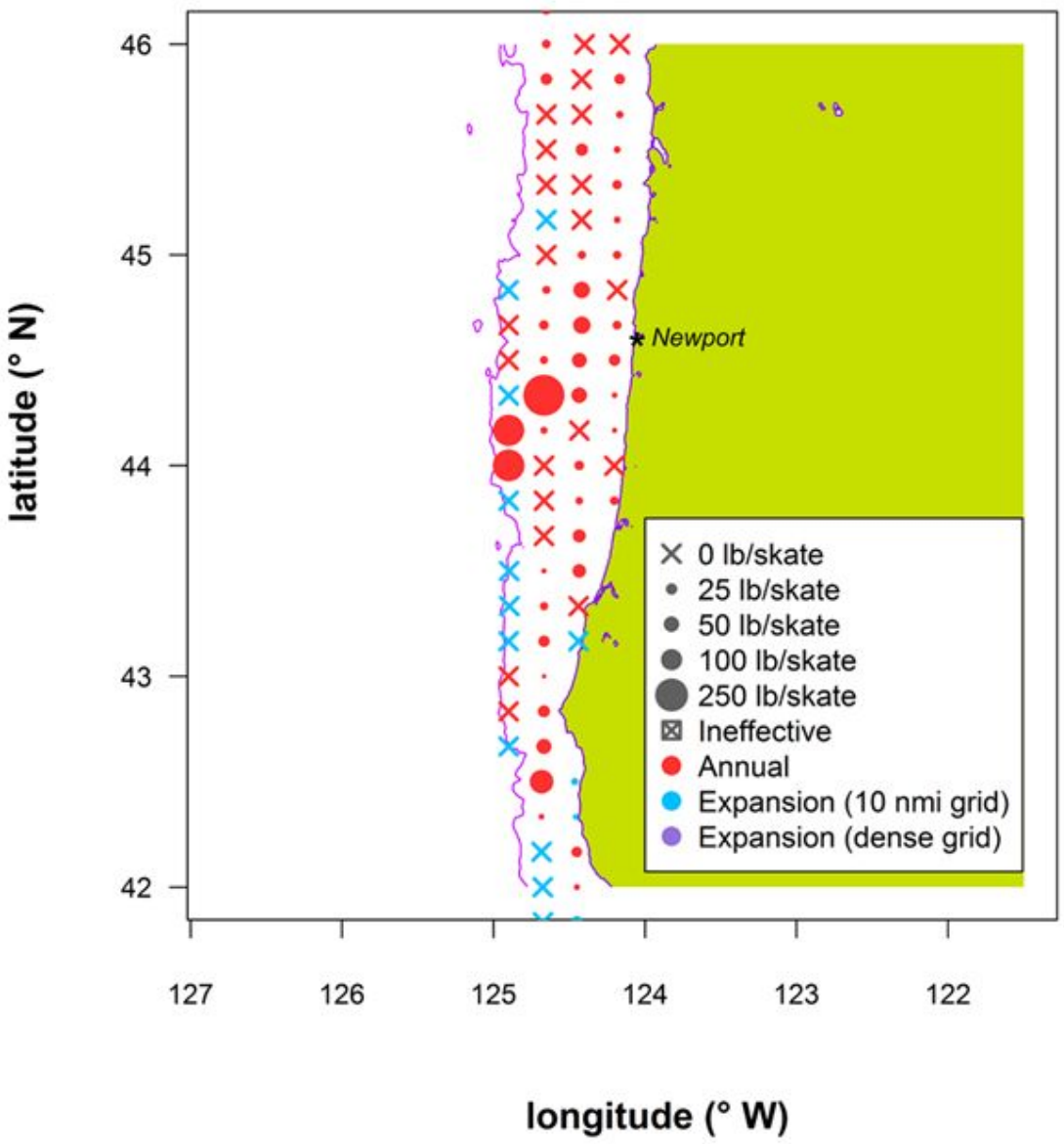


Figure 5. Map of O32 Pacific halibut WPUE by station in central Regulatory Area 2A in 2017.

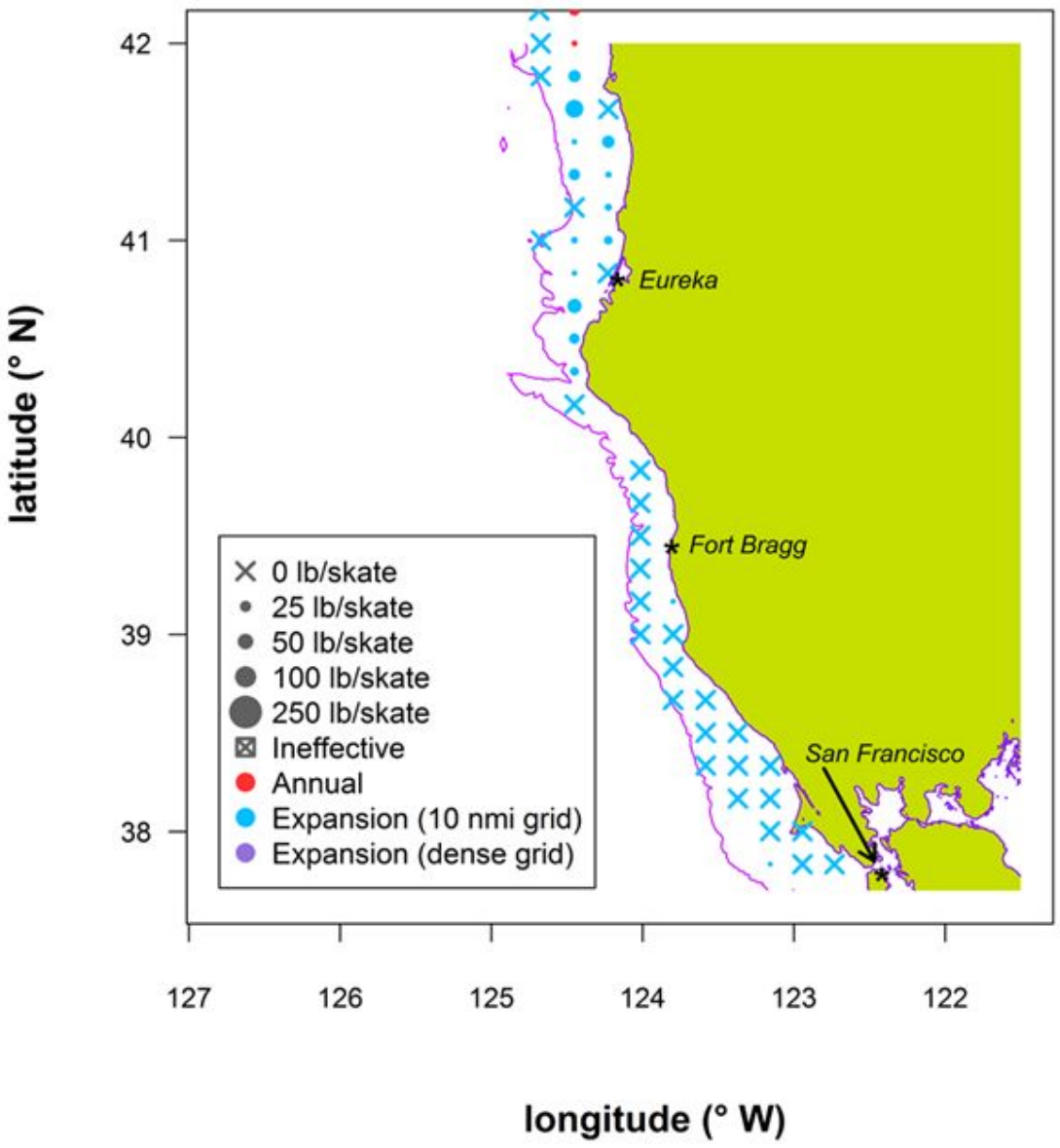


Figure 6. Map of O32 Pacific halibut WPUE by station in southern Regulatory Area 2A (California) in 2017.

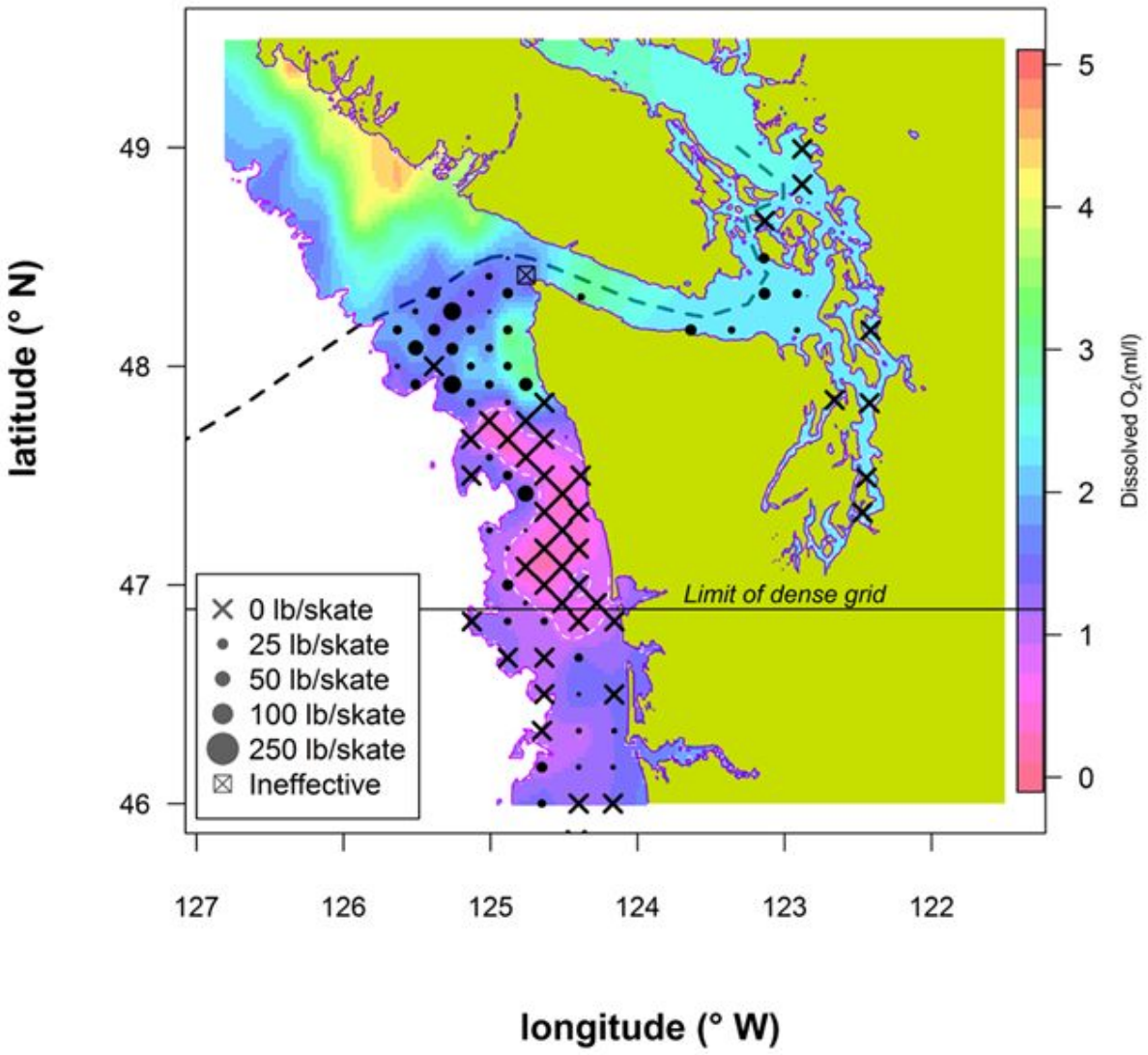


Figure 7. Estimated dissolved oxygen in northern Regulatory Area 2A in 2017. Values are model predictions from a spatial model fitted to the 2017 IPHC water column profiler data. O32 WPUE values from the setline survey are overlaid with black symbols.

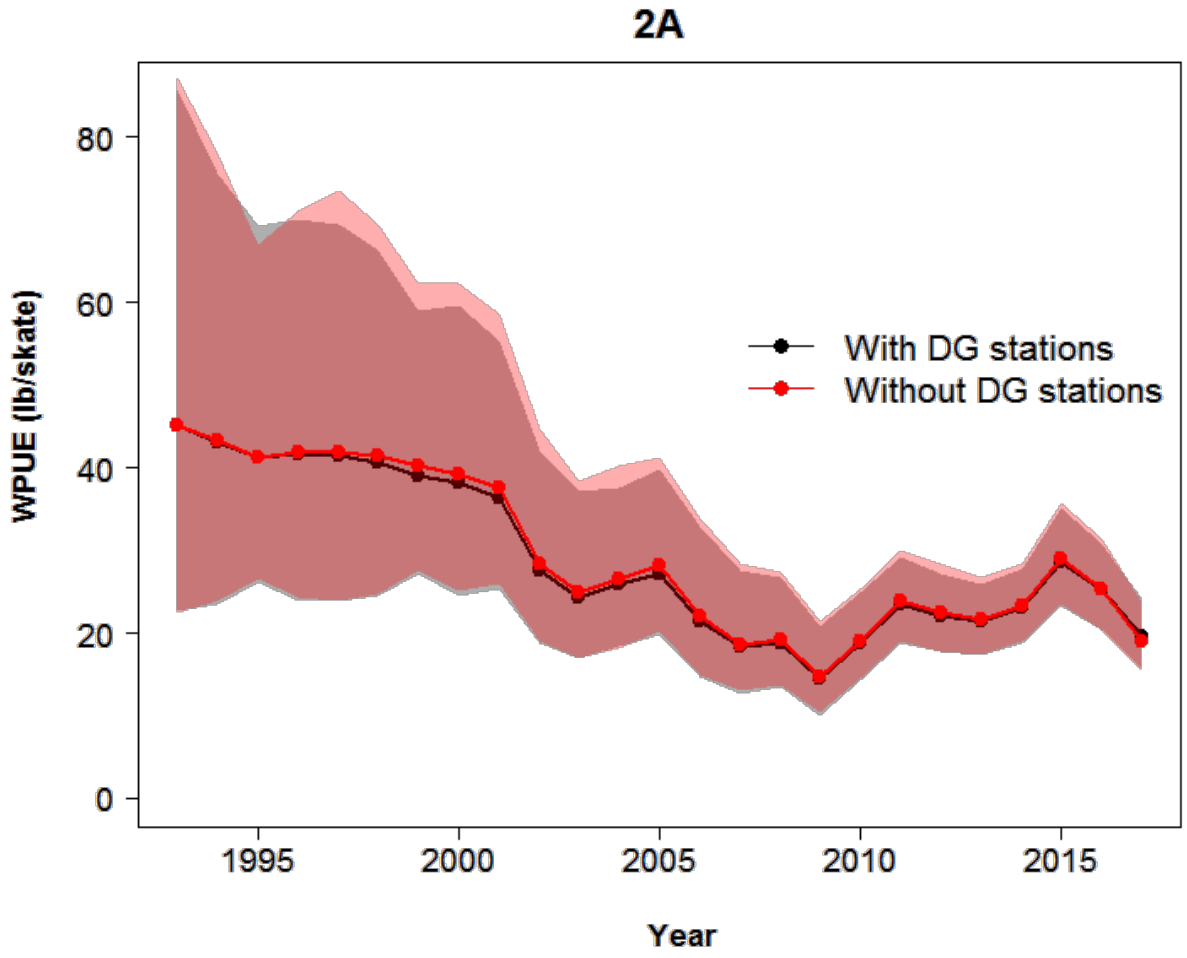


Figure 8. Posterior means (points) and 95% posterior credible intervals (shaded regions) for mean O32 WPUE from the space-time modelling for Regulatory Area 2A from models fitted with data from the dense grid (DG) stations (black) and without those data (red).

Reproductive assessment of the Pacific halibut population

PREPARED BY: IPHC SECRETARIAT (J. PLANAS, 26 JANUARY 2018)

PURPOSE

To provide the RAB with a description of the studies designed to improve our knowledge on reproductive development in female and male Pacific halibut.

BACKGROUND

Each year, the fishery-independent setline survey (FISS) collects biological data on the maturity of female Pacific halibut that are used in the stock assessment. In particular, the female maturity schedule is used to estimate spawning stock biomass. Currently-used estimates of maturity-at-age indicate that the age at which 50% of female Pacific halibut are sexually mature is 11.6 years on average. However, maturity is estimated with the use of macroscopic visual criteria, implying a relative level of uncertainty associated with the employed semi-quantitative assessment, but the maturity schedules for both sexes have not been revised in recent years and may be outdated. For this reason, research efforts are needed to improve our understanding of reproductive maturity in female Pacific halibut. Unfortunately, relatively little is known regarding the physiological changes that take place in the ovary during reproductive development leading to spawning in this species. The objective of this study is to understand and report the progression of reproductive development in both female and male Pacific halibut during an entire annual reproductive cycle.

DISCUSSION

Female and male Pacific halibut have been successfully collected from September 2017 through January 2018. In September 2017, 30 females and 27 males were collected, whereas in October, November and December 2017 and January 2018, 30 females and 30 males were collected. Biological samples collected from these fish are currently being stored at the Kodiak Marine Science Center in Kodiak, AK. Fish collection will take place on a monthly basis until August 2018.

Photographic images of all staged gonads will be contrasted with gonadosomatic index (GSI; gonad weight/round weight X 100) determinations and histological examination of ovarian and testicular staging. This will allow us to revise the morphological criteria currently used for staging the maturity status of the gonads (ovary and testis). Blood samples are being collected on all fish in order to conduct a thorough endocrinological assessment of reproductive status and development in order to correlate levels of reproductive hormones and reproductive genetic markers with morphological and histological assessment of the gonads. Finally, we will be collecting functional data on the energy stored in the fish in order to relate energy storage to sexual maturity. Energy storage will be determined by the hepatosomatic index (HSI; liver weight/round weight X 100) and the muscle lipid content as measured with the Fatmeter device.

The ongoing collection of morphological, histological, endocrine, and functional data from female and male Pacific halibut throughout an entire annual meeting will provide us with a better

understanding of the temporal and spatial progression of sexual maturation in Pacific halibut, and will allow for a better estimation of maturity for stock assessment purposes.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-07 which outlined the research project describing studies designed to improve our knowledge on reproductive development in female and male Pacific halibut.

Sex-marking at sea and genetic validation of sex identification

PREPARED BY: IPHC SECRETARIAT (T. LOHER, 29 JANUARY 2018)

PURPOSE

To provide an update regarding the status of studies designed to provide information regarding sex ratios in commercial landings of Pacific halibut.

BACKGROUND

Declining size-at-age of Pacific halibut since ~2002 in conjunction with larger size-at-age in females and a constant minimum size limit have led to the expectation that directed Pacific halibut harvests have become increasingly composed of females. Understanding the sex ratio of commercial catches is critical for accurate estimation of parameters such as female spawning stock biomass; but sex data cannot be obtained from commercial landings due to the requirement that halibut be dressed at sea. In 2014, the IPHC initiated a program to generate commercial sex-ratio data that included: 1) the development of at-sea sex-marking protocols for commercial vessels, 2) testing of sex-marking methods suitable for use on commercial vessels; first in a single port (Homer: 2015), then a single regulatory area (2B: 2016), and finally coastwide (2017), and 3) the development of a genetic sex assay.

DISCUSSION

At-sea sex marking

At-sea sex marking is accomplished by marking individual Pacific halibut during dressing, as follows: for females, two knife cuts made in the dorsal (upper) fin; for males, a single cut through the white-side gill plate. At-sea sex-mark data were voluntarily obtained from two vessels in 2015 resulting in 288 fish sampled; from 16 sampled offloads (317 samples) in Regulatory Area 2B in 2016; and from 84 offloads (929 samples) coastwide in 2017. To date, the data from the marking program have suggested that commercial vessels may capture Pacific halibut that are larger at-age than are encountered in the IPHC's fishery-independent setline survey, resulting in a higher proportion of female catch that would be predicted using those survey data.

Tissue samples collected during the 2017 fishing season have been archived and validation of individual sexes will be determined in 2018 using genetic tests (see next section). Following these assays a determination will be made regarding the degree to which the program as-conceived will satisfy assessment needs or will require modification. We will not pursue at-sea marking during the 2018 fishing season, but will refine the program in 2019 as informed by the analyses.

Genetic assay

Genetic assay development employed restriction-site associated DNA sequencing (RADseq) to identify single nucleotide polymorphisms (SNPs) that are linked to sex in Pacific halibut. Three genetic markers limited to females were investigated for use in sexing Pacific halibut and two were developed into simple TaqMan assays that can be conducted at the IPHC's Seattle

laboratory. Each genetic assay was in agreement with the visually-determined sex in 97.5% of the fish (n = 199) that were tested. The current cost of each assay is estimated to be $0.60-0.70 US per fish, not including equipment and salary costs.

Additional information on the progress of studies designed to provide information on sex ratios in commercial landings of Pacific halibut can be found in IPHC-2017-RARA27-2.6.1.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB19-08 which outlined current progress of the at-sea sex marking project and the development of genetic assays for sex identification.

Factors affecting somatic growth in juvenile Pacific halibut

PREPARED BY: IPHC SECRETARIAT (J. PLANAS, 26 JANUARY 2018)

PURPOSE

To provide the Commission with a description of the studies conducted by IPHC Secretariat on factors affecting somatic growth in juvenile Pacific halibut.

BACKGROUND

The recent decrease in size-at-age (SAA) of Pacific halibut since 1990s, combined with low recruitment of cohorts spawned at the time of the initial decrease in SAA in the 1990s have contributed to a decrease in exploitable Pacific halibut biomass. Despite the importance of this decrease in exploitable biomass for fisheries management, our understanding of the potential causes for the historical change in SAA is still rather scarce. Changes in SAA in Pacific halibut have been hypothesized as being attributable to a variety of causes, including a fisheries-dependent effect through size-selective harvest, changes in population dynamics of the Pacific halibut stock due to a density effect, or changes in somatic growth as a result of environmental and ecological influences. Of the different possible environmental influences, temperature is believed to play a predominant role in influencing somatic growth in the Pacific halibut. Therefore, research activities at the IPHC in this area are devoted to further understand the potential effects of environmental conditions on somatic growth by evaluating the effects of temperature, among others, on spatial, temporal, and age-specific growth patterns in the Pacific halibut.

DISCUSSION

In order to provide information on the effects of factors that may influence growth in the Pacific halibut, the IPHC is engaged in research activities designed to develop and validate physiological tools for measuring and monitoring growth patterns. The strategy that was chosen initially involved the identification of potential molecular markers for growth studies by identifying genes expressed in growth-relevant tissues such as white and red skeletal muscle and liver. The second strategy involved the manipulation of growth rates in juvenile Pacific halibut by temperature manipulation. Through acclimation at a low temperature (2C), growth was suppressed, whereas through temperature-induced growth compensation, growth was stimulated, resulting in two opposite growth patterns (suppressed versus induced) that could be compared in order to identify those genes that respond to temperature and that, therefore, could be considered acceptable growth markers. This strategy has resulted in the identification of a large set of potential growth markers that could be useful for the detection of different growth patterns in the wild.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-09 which outlined the studies on growth in juvenile Pacific halibut by IPHC staff.

Discard mortality rates and post-release survival in the directed Pacific halibut fishery

PREPARED BY: IPHC SECRETARIAT (C. DYKSTRA, 26 JANUARY 2018)

PURPOSE

To provide the RAB with a description of the studies designed to improve our knowledge on discard mortality rates in the directed longline Pacific halibut fishery and application of electronic monitoring.

BACKGROUND

Due to regulatory requirements, all Pacific halibut that are caught as sublegal size in the targeted fishery, and those exceeding quota limits of the vessel, cannot be retained and must be returned to the sea with minimal injury. However, through the process of capture and release, Pacific halibut incur a range of injuries and are subjected to a variety of factors that will affect their survival potential after release. Discard mortality rates (DMRs) are calculated from data collected by observers from the injury characteristics (also known as release vitality) of Pacific halibut post-capture and are used to estimate the percentage of incidentally-caught fish that are expected to die after release. Currently, post-capture DMR estimates are based on qualitative assessments of the physical condition of the fish (e.g., minor/moderate/severe/dead for longline gear) and have a certain degree of uncertainty associated with them, which in turn is a source of uncertainty in the estimation of total mortality within current International Pacific Halibut Commission (IPHC) stock assessment models. In practice, assigned DMRs and their uncertainty translate into *a priori* adjustments to expected mortality in each upcoming year, and to the catch limits that are thereafter assigned to each harvest sector. Given current low halibut yields relative to long-term mean productivity, uncertain estimates can result in undue hardship on some harvest sector(s) relative to others. Therefore, there is an urgent need to improve our estimates of DMR as well as to provide strategies to improve survival of incidentally-caught Pacific halibut after release.

Individual variability in terms of mortality after release to the sea is expected depending on the level of injuries and stresses incurred during the discarding process as well as on the basal physiological condition of the fish. Therefore, an accurate understanding of the types and relative levels of injuries and stresses that fish are exposed to during the discarding process in relation to the biological characteristics of the fish can be instrumental in helping better estimate the probability of survival during the discarding process. It has been well recognized that fish condition assessments that incorporate additional levels of information on the physiological characteristics of captured fish have improved the power to predict survival in discarded fish. It is important to indicate, on one hand, that the physiological condition of the captured fish may influence their susceptibility to the stress associated with capture and handling events and, hence, their potential for survival after release. On the other hand, different capture and handling procedures can elicit different physiological responses in the fish to cope with the ensuing stress, which may also influence their survival after release. These two aspects are important because they drive most of the variability associated with discard mortality.

Traditional observer programs require examining the fish (which includes looking at both sides of the fish, testing muscle tone and opercular responses) to determine vitality; something that cannot be achieved with cameras. Development of electronic monitoring (EM) systems as an alternative to human observers highlights a need to develop the capability to convert imagery into actionable data. It has been demonstrated (Smith et al. 2017) that EM provides information on Pacific halibut hook-release techniques (e.g., careful shake, gangion cut, hook stripper) for close to 95% of events, however the suite of vitalities incurred by each hook-release technique is unknown.

DISCUSSION

The main objective of the present project is to improve our understanding of the types and relative levels of injuries and stresses that fish are exposed to during the discarding process in relation to the biological characteristics of the fish in order to improve our estimates of the probability of survival during the discarding process. We will measure physiological indicators of stress and condition in a quantitative manner in relation to capture and handling events in order to understand their influence on mortality after release. Full condition assessments incorporating physiological parameters can then be used as a predictive tool to estimate DMRs if properly calibrated with the results of direct survival or behavioral studies (e.g., tagging and telemetry studies).

The work proposed involved the random assignment of hook-release methods: 5 skates of careful shaking, 2 skates of hook stripping, and 1 skate of gangion cutting per set, using a commercial fishing vessel operating in an area southeast of Chignik, AK. All captured Pacific halibut were measured, weighed, assessed for current hooking injury, and evaluated for vitality (or release condition). Pacific halibut less than or equal to 84 cm (33 inches) fork length (FL) were sampled (blood, tissue for genetic analysis, muscle fat content and body temperature) and ocean temperature was recorded using temperature data loggers attached to each set of gear. Fish survival is being assessed by the use of pop-up archival transmitting tags (sPAT) tags containing accelerometer sensors that were deployed randomly on Pacific halibut ≤ 84 cm FL in excellent release condition and by the use of wire tags on Pacific halibut ≤ 84 cm of any release condition. Electronic monitoring equipment was also deployed during the project to collect data on the accuracy of its ability to capture release methods.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-10 which outlined the research project describing studies designed to improve our estimates of discard mortality rates in the directed Pacific halibut longline fishery.

Migratory behavior and distribution of Pacific halibut

PREPARED BY: IPHC SECRETARIAT (L. SADORUS, T. LOHER, J. FORSBERG; 29 JANUARY 2018)

PURPOSE

To provide the RAB with a description of the studies designed to improve our knowledge on distribution and migration of Pacific halibut in the northeast Pacific Ocean and eastern Bering Sea.

BACKGROUND

The IPHC is currently investigating Pacific halibut distribution and migration that encompasses all life stages via three different research projects.

U32 wire tagging

Of specific interest to the IPHC is the movement of juvenile Pacific halibut both within ocean basins (i.e. Gulf of Alaska and Bering Sea) and between them. The timing and distance traveled between nursery grounds to the adult feeding grounds varies over time and was last studied in the 1980s. Sampling platforms already being utilized for other investigations, the fishery-independent setline survey (FISS) and the NMFS trawl survey, are ideal vehicles for tagging and releasing U32 Pacific halibut during the summer months throughout their geographic range, and are currently the platform for a spatially large scale wire tagging effort.

Larval dispersal and connectivity

Unlike juvenile Pacific halibut which are demersal, larvae are pelagic for the first six months of life and are distributed largely based on where they originated (i.e. where they were spawned) and where the currents carry them during their pelagic life stage. Of particular interest to the IPHC is the connectivity of larvae that are spawned in the Gulf of Alaska but settle in the Bering Sea, and the environmental drivers that may affect the magnitude of this connectivity. Note that it has been established that the counter clockwise Alaska Coastal Current in the Gulf of Alaska flows into the Bering Sea via Aleutian Island passes. The IPHC does not conduct larval surveys, but National Oceanic and Atmospheric Administration (NOAA) icthyoplankton (larval) surveys are conducted annually and IPHC has teamed with NOAA to examine these data spanning from 1972-2015.

PAT tagging

The IPHC has conducted a series of pop-up archival transmitting (PAT) tag studies in the Bering Sea and Aleutian Islands (BSAI) region in order to identify winter spawning locations, determine the timing of seasonal movements, and investigate mixing within the BSAI and between the Bering Sea and Gulf of Alaska of adult Pacific halibut. Until 2017, no tagging had been conducted on Bowers Ridge (located in IPHC Regulatory Area 4B) because this region had not been previously surveyed by the IPHC. In 2017, we took advantage of the setline survey expansion onto Bowers Ridge in order to generate data for this region.

DISCUSSION

U32 wire tagging

Each summer IPHC deploys sea samplers on board the NMFS trawl surveys conducted in the Gulf of Alaska, Bering Sea, and Aleutian Islands. Pacific halibut from 20-100 cm fork length are readily captured and sampled. In 2015, a pilot project was initiated on the trawl surveys to test the practicality of tagging and releasing a subsample of the Pacific halibut captured with minimal impact to the regular sampling. The pilot project was considered a success and the program was fully implemented in 2016 going forward. Of the Pacific halibut captured, half are randomly selected as possible candidates for tagging. Within that subsample, a fish is tagged if it is U32 and viability is not assessed as "dead" using observer criteria.

In 2016, the IPHC investigated the practicality of adding U32 tagging to the FISS by conducting a pilot project in one survey region (Area 4D). The pilot project was successful and in 2017 the effort to tag and release U32 Pacific halibut was extended to the FISS in all areas where sampling rates were less than 100 percent (i.e. Areas 2B, 2C, 3A, 3B, 4A, and 4B), and will be continued for the next several years. As in the trawl survey, a subsample of U32 fish are assessed using observer viability criteria and are subsequently tagged and released if not considered "dead".

Additional information can be found in paper IPHC-2017-RARA27-R Chapters 2.5.1 and 2.5.4.

Table 1. Release and recovery information of Pacific halibut tagged and released on board the NMFS trawl and IPHC fishery-independent setline surveys.

Wire tagging project	Years of tagging	Tags released	Tags recovered (as of 1/25/18)
Bering Sea trawl survey	2015, 2016, 2017	1,666	8
Gulf of Alaska trawl survey	2015, 2017	2,204	14
Aleutian Islands trawl survey	2016	170	0
IPHC FISS	2016, 2017	2,097	7
Total		6,137	29

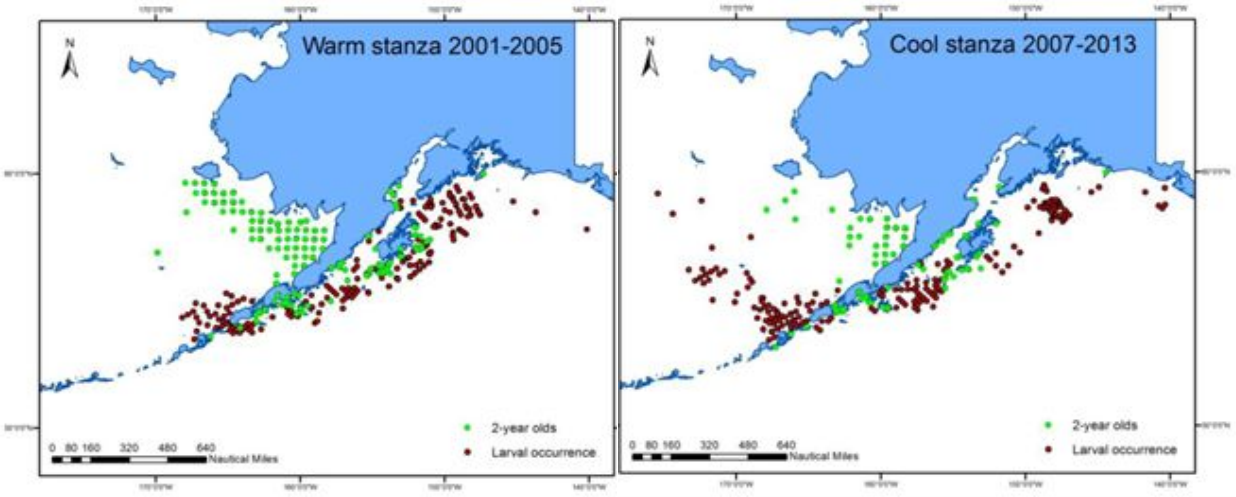
Larval dispersal and connectivity

To date, analyses have been focused on fully describing the ichthyoplankton dataset, and preliminary testing to examine whether connectivity via Unimak Pass may be a significant contributor to larval dispersal between ocean basins. Products from these analyses include: distribution maps, calculation of catch weighted average size by month, the estimation of larval age in each month, a preliminary analysis of factors that may be affecting larval length and

abundance, and recruitment to the eastern Bering Sea settled population. Currently underway is an analysis of the differences in larval size, abundance, and recruitment between warm and cold stanzas. In 2018, the IPHC will work with a modeler from NOAA to answer a number of questions including: 1) to what degree do Gulf of Alaska larvae contribute to the eastern Bering Sea settled population and does it vary with temperature and climatic regime?, 2) to what degree do Bering Sea larvae contribute to the eastern Bering Sea settled population?, and 3) what larvae (geographically) in the Gulf of Alaska are most and least likely to be transported to the Bering Sea?

For more information, refer to paper IPHC-2017-RARA27-R Chapter 2.5.3.

Figure 1. Larval distribution and resulting 2-year-old distribution in the eastern Bering Sea during warm and cold stanzas.



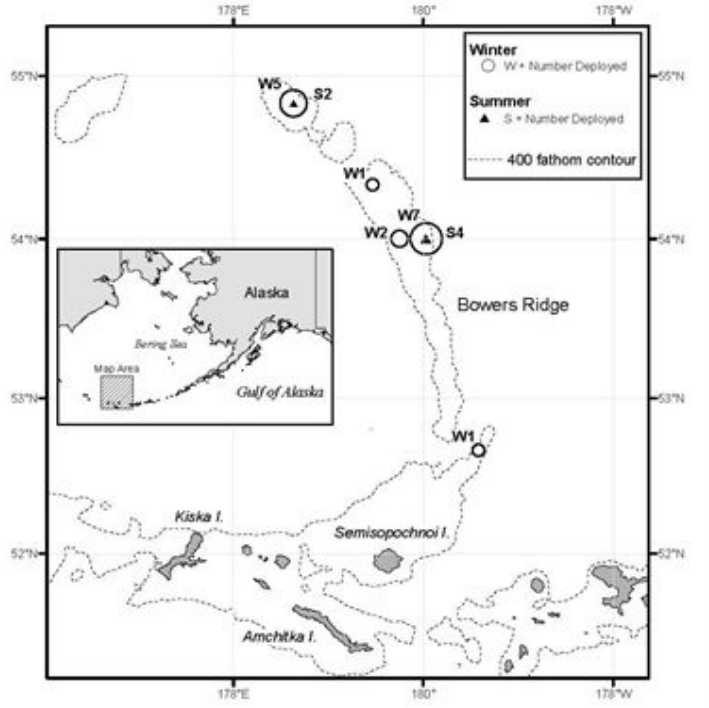
PAT tagging

A total of 22 Pacific halibut were tagged with miniPAT tags (manufactured by Wildlife Computers, Redmond, Washington) in IPHC Regulatory Area 4B. Tagging occurred on dates ranging from 05-10 July 2017. Sixteen Pacific halibut (four male, 11 female, and one of unknown sex) ranging from 117-170 cm FL were tagged with PAT tags scheduled to detach and report on 15 January 2018. Six Pacific halibut (four male, two female) ranging from 117-144 cm FL were tagged with PAT tags programmed to detach after 365 days, resulting in scheduled reporting dates of 5 and 10 July 2018.

As of 25 January 2018, 15 tags had broadcast during the winter spawning season: one on 24 December and 14 on dates ranging from 15-22 January. Eleven of these tags generated transmissions of sufficient strength to determine their locations. Ten fish were located very close to where they had been tagged, on Bowers Ridge and northern Petrel Bank; the eleventh fish had migrated to the central 4D Edge. The tags' environmental data (i.e. depth, temperature, and light-based locations during time at liberty) will be decoded and fully analyzed when all tag data are available.

For more detailed information about the project, refer to paper IPHC-2017-RARA27-R Chapter 2.5.2.

Figure 2. Release locations of Pacific halibut tagged with miniPAT tags in 2017.



RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-11 which outlined the research projects describing studies designed to improve our knowledge on Pacific halibut distribution and migration at all life stages.

IPHC research topics selected for 2018

PREPARED BY: IPHC SECRETARIAT (J. PLANAS, 26 JANUARY 2018)

PURPOSE

To provide the Commission with a description of the new research projects proposed by IPHC Secretariat for 2018 and contemplated within the 5-year Biological and Ecosystem Science Research Program.

BACKGROUND

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology of the Pacific halibut (*Hippoglossus stenolepis*). At the present time, the main objectives of the Biological and Ecosystem Science Research Program at IPHC are to:

1) identify and assess critical knowledge gaps in the biology of the Pacific halibut;

2) understand the influence of environmental conditions; and

3) apply the resulting knowledge to reduce uncertainty in current stock assessment models.

Traditionally, IPHC staff propose new projects annually that are designed to address key biological issues as well as the continuation of certain projects initiated in previous years. Proposals are based on their own input as well as input from the Commissioners, stakeholders, and specific subsidiary bodies to the IPHC such as the Scientific Review Board (SRB) and the Research Advisory Board (RAB). Proposed research projects are presented to the Commissioners for feed-back and subsequent approval. Importantly, biological research activities at IPHC are guided by a Five-Year Research Plan that is put forward by the Program Head identifying key research areas that follow Commission objectives. As described in the Five-Year Research Plan for the period 2017-2021, the primary biological research activities at IPHC can be summarized in five main areas:

1) Reproduction
2) Growth and Physiological Condition
3) Discard Mortality and Survival
4) Distribution and Migration
5) Genetics and Genomics

These research areas have been selected for their important management implications. The studies conducted on Reproduction are aimed at providing information on the sex ratio of the commercial catch and to improve current estimates of maturity. The studies conducted on Growth are aimed at describing the role of some of the factors responsible for the observed changes in size-at-age and to provide tools for measuring growth and physiological condition in Pacific halibut. The proposed work on Discard Mortality and Survival is aimed at providing updated estimates of discard mortality rates in both the longline and the trawl fisheries. The studies conducted on Distribution and Migration are aimed at further understanding larval and juvenile dispersal, distribution of all life stages in relation to the environment, and reproductive

and seasonal migration and identification of spawning times and locations. The studies conducted on Genetics and Genomics are aimed at describing the genetic structure of the Pacific halibut population and at providing the means to investigate rapid adaptive changes in response to fishery-dependent and fishery-independent influences.

In this document, we present an outline of the new projects proposed by IPHC staff for the coming year.

DISCUSSION

For 2018, four new projects are proposed that cover specific research needs (Appendix I).

Project 2018-01 ("*Influence of thermal history on growth*") proposes to study the thermal profile experienced by fish at sea as assessed by electronic archival tagging and otolith microchemistry in order to investigate the relationship between growth patterns (or productivity) and both spatial and temporal variability in environmental conditions for growth. These studies will allow to relate temperature histories to individual growth patterns and to extend thermal analyses to untagged Pacific halibut via otolith analysis.

Project 2018-02 ("*Adult captive holding studies*") proposes performing studies on captive adult Pacific halibut to establish or validate measures or protocols required for other ongoing projects (Appendix II), such as (1) determining the permanence of individual tail markings for tracking individual movement rates (Project 675.11, "*Tail pattern recognition*"), (2) calibrating measures of fat content for condition factor determinations (Project 672.12, *Condition factors for tagged U32 fish*) and of stable isotope (C^{13} and N^{15}) ratios for inferring growth and dietary information (Project 673.14, "*Identification and validation of markers for growth*") and (3) calibrating O^{18} otolith signatures with environmental temperature (Project 673.14 "*Identification and validation of markers for growth*").

Project 2018-3 ("*Whale detection methods*") proposes testing electronic monitoring-based methods to detect whale presence in the directed longline Pacific halibut fishery. Specifically, this project aims at testing acoustic, optical and thermal technologies for whale detection. A second objective is to relate whale detection with longline Pacific halibut captures.

Project 2018-04 ("*Larval connectivity*") proposes to study the movement and connectivity of Pacific halibut larvae both within and between the Gulf of Alaska and the Bering Sea. Larval abundance and size distribution in the Gulf of Alaska and the Bering Sea will be modeled over time and over oceanographic and environmental conditions.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-12 which outlined the new research projects proposed by IPHC staff.

APPENDICES

Appendix I: Summary of new research projects proposed for 2018.

APPENDIX I

Summary of research projects proposed for 2018

Project #	Project Name	Priority	Budget ($US)	Management implications
2018-01	Influence of thermal history on growth	High	136,004	Changes in biomass/size-at-age
2018-02	Adult captive holding studies	High-Medium	58,395	Changes in biomass/size-at-age/distribution
2018-03	Whale detection methods	High	37,511	Mortality estimation
2018-04	Larval connectivity	High	20,000	Larval distribution
	Total - New Projects ($US)		**$251,910**	