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## Overview: IPHC 5-year Biological and Ecosystem Sciences Research Program (2017-21)

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### PURPOSE

To provide the RAB with a description of the research projects proposed by IPHC Secretariat and contemplated within the Five-year Biological and Ecosystem Science Research Program (2017-21).

### 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.

The primary biological research activities at the IPHC that follow Commission objectives are identified and described in the [Five-Year Research Plan for the period 2017-21](#). These activities can be summarized in five broad categories: 1) Migration, 2) Reproduction, 3) Growth and Physiological Condition, 4) Discard Mortality Rates (DMRs) and Survival, and 5) Genetics and Genomics, and have been selected for their important management implications, as follows. The studies conducted on Migration are aimed at further understanding reproductive migration and identification of spawning times and locations as well as larval and juvenile dispersal. 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 DMRs is aimed at providing updated estimates of DMRs in both the longline and the trawl fisheries. 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 continuing projects proposed by the IPHC Secretariat for the coming year.

### DISCUSSION

**Project updates:** Projects are listed in [Appendix I](#) and current grants are listed in [Appendix II](#). An update on progress on continuing projects is provided below.

**Project 621.16 (“*Genetic sex identification*”)** has as its main objective the identification of molecular markers for sex in order to provide a genetic method for sex identification in settings in which direct observations of sex cannot be obtained (i.e., fish at commercial offloads). In addition, this project was designed to provide genetic validation of the physical marking of sex at sea. Three single nucleotide polymorphisms (SNPs) were identified to be associated with sex and molecular assays were developed for two of the identified SNPs. These assays were estimated to have an accuracy of 97.5% in a comparison between assayed sex and visually-determined sex in a sample of 199 fish, based on an assumption that no process or recording errors existed within the visually determined data (Drinan et al., 2018). The assay was subsequently used to evaluate the accuracy of commercial sex-marking at sea in an initial phase and has now been successfully applied to provide sex information from biological samples (fin clips) collected from sampled fish from the 2017 and 2018 commercial landings. A full description of this project is included in paper [IPHC-2020-RAB021-08](#).

**Project 621.17 (“*Integrating migration and genetics research to refine Pacific halibut population structure, distribution and movement*”)** involves performing studies to improve our understanding of spawning site contributions to nursery areas in relation to year-class and recruit survival and strength, as well as of the relationship between nursery origin and adult distribution and abundance over temporal and spatial scales through the application of genetic approaches to address management-relevant questions on population structure, distribution and movement. A full description of this first portion of the project is included in paper [IPHC-2020-RAB021-12](#).

**Project 642.00 (“*Assessment of mercury and other contaminants*”)** is the continuation of a project monitoring the prevalence of heavy metal and persistent organic pollutant contamination in the Pacific halibut population. Tissue samples for monitoring have been collected in IPHC’s fishery-independent setline survey since 2002.

**Project 670.11: “*Wire tagging of Pacific halibut on NMFS trawl and IPHC setline surveys*”** involves the wire tagging of U32 Pacific halibut in order to further understand coastwide migratory and growth patterns of young Pacific halibut. Since 2015, 10,560 Pacific halibut have been tagged on both the NMFS trawl survey and the IPHC’s fishery-independent setline survey, with a total of 123 tags recovered to date. A full description of this project is included in paper [IPHC-2020-RAB021-11](#).

**Project 672.13 (“*Discard mortality rates and discard survival assessment*”)** is continuing to investigate the relationship between three hook release methods (careful shake, gangion cut, and hook stripper) 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 (DMR) in the directed longline Pacific halibut fishery. Furthermore, this project is also conducting investigations on the applicability and accuracy of electronic monitoring in capturing release methods and fish condition in vessels without observer coverage. This project has received funding from the Saltonstall-Kennedy NOAA grant program under project number NA17NMF4270240 ([Appendix II](#)). A full description of this first portion of the project is included in paper [IPHC-2020-RAB021-10](#). A second component of this project involves determining mortality rates of discarded Pacific halibut in the Pacific halibut guided recreational fisheries. This study is being conducted with partial funding from a grant from the National Fish and Wildlife Foundation awarded to IPHC ([Appendix II](#)) in collaboration with academic and industry partners.

**Project 673.13 (“*Sequencing the Pacific halibut genome*”)** aims at characterizing for the first time the genome of the Pacific halibut to support studies on population genetics, to assist in the identification of genomic regions and genes responsible for temporal and spatial adaptive phenotypic and behavioral characteristics in response to environmental and anthropogenic influences and to provide genomic resolution to genetic markers for sex, reproduction and growth that are currently being investigated. Sequencing efforts are currently under way.

**Project 673.14 (“*Identification and validation of markers for growth in Pacific halibut*”)** has continued efforts to identify and validate molecular and biochemical markers 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 trajectories. Initial studies have involved evaluating molecular responses of white skeletal muscle to temperature- and density-induced growth manipulations in juvenile Pacific halibut in captivity. Potential applicable molecular (gene and/or protein) markers for growth are currently being validated for their use in detecting growth trajectories using muscle samples from adult Pacific halibut. The results of this study will contribute to our understanding of the possible role of somatic growth variation in the observed changes in size-at-age in the Pacific halibut population. This project has also received funding from a grant from the North Pacific Research Board under project number 1704 ([Appendix II](#)). A full description of this project is included in paper [IPHC-2020-RAB021-09](#).

**Project 674.11 (“*Full characterization of the annual reproductive cycle in adult female Pacific halibut*”)** aims at fully characterizing the annual reproductive cycle of female and male Pacific halibut in order to advance our understanding of sexual maturation in this species and to improve maturity assessments and maturity-at-age estimates. Sample collection in the Portlock area in the central Gulf of Alaska began in September 2017 and continued on a monthly basis through its successful completion in August 2018. A variety of biological measures and samples were collected from thirty males and thirty females at each month for physiological analyses of reproductive parameters throughout an entire annual reproductive cycle. The results of this project will greatly assist in improving our estimates of the actual spawning biomass. A full description of this project is included in paper [IPHC-2020-RAB021-07](#).

**Project 2019-06 (“*Assessing the incidence of chalky Pacific halibut*”)** involved collecting information from stakeholders on the incidence of chalky flesh in Pacific halibut through surveys in order to understand the nature and timing of possible causes leading to its development. A questionnaire was distributed among processing plants in the spring of 2019 and the results are currently being summarized.

#### RECOMMENDATION

- 1) That the RAB **NOTE** paper IPHC-2020-RAB021-05, which outlined the research projects proposed by the IPHC Secretariat to the Commission and provided an overview of the 5-year research program (2017-21).

#### APPENDICES

[Appendix I](#): Summary of research projects proposed to the Commission for FY2020.

[Appendix II](#): Summary of current awarded research grants.

**APPENDIX I****Summary of research projects proposed for FY2020**

<b>Project #</b>	<b>Project Name</b>	<b>Priority</b>	<b>Budget (\$US)</b>	<b>Management implications</b>
621.16	Genetic sex identification - Genomics	High	20,496	Sex composition of commercial catch
621.17	Migration and genetics	High	210,285	Population structure, distribution and movement
642.00	Assessment of mercury and other contaminants	Medium	6,741	Environmental effects
670.11	Wire tagging of halibut on NMFS trawl survey and FISS	High	15,301	Juvenile and adult distribution
672.13	Discard mortality rates and discard survival assessment	High	142,832	DMR estimates
673.13	Pacific halibut genome sequencing	High	34,000	Population changes
673.14	Identification and validation of markers for growth	High	26,369	Changes in biomass/size-at-age
673.15	Influence of thermal history on growth	High	12,500	Changes in biomass/size-at-age
674.11	Full characterization of the annual reproductive cycle	High	81,477	Maturity assessment
<b>Overall Total (all projects) (\$US)</b>			<b>\$550,000</b>	

**APPENDIX II****Summary of current awarded research grants**

<b>Project #</b>	<b>Grant agency</b>	<b>Project name</b>	<b>PI</b>	<b>Partners</b>	<b>IPHC Budget (\$US)</b>	<b>Management implications</b>	<b>Grant period</b>
1	<b>Saltonstall-Kennedy NOAA</b>	Improving discard mortality rate estimates in the Pacific halibut by integrating handling practices, physiological condition and post-release survival (Award No. NA17NMF4270240)	IPHC	Alaska Pacific University	\$286,121	Bycatch estimates	September 2017 – August 2020
2	<b>North Pacific Research Board (NPRB)</b>	Somatic growth processes in the Pacific halibut ( <i>Hippoglossus stenolepis</i> ) and their response to temperature, density and stress manipulation effects (Award No. 1704)	IPHC	AFSC-NOAA-Newport, OR	\$131,891	Changes in biomass/size-at-age	September 2017 – February 2020
4	<b>National Fish &amp; Wildlife Foundation</b>	Improving the characterization of discard mortality of Pacific halibut in the recreational fisheries	IPHC	Alaska Pacific University, U of A Fairbanks, ACA	\$98,902	Bycatch estimates	2020
<b>Total awarded (\$)</b>					<b>\$516,914</b>		