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## Report on Current Biological Research Activities and Progress on Discussions Regarding New Research Topics at IPHC

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### PURPOSE

To provide the Scientific Review Board with an update of current progress on research projects conducted by the Biological and Ecosystem Science Research Program and on discussions regarding new research topics at IPHC.

### BACKGROUND

The primary biological research activities at IPHC that follow Commission objectives are identified and described in the proposed Five-Year Research Plan for the period 2017-2021, as summarized in a previous document IPHC-2017-SRB010-INF02. These activities are summarized in five broad categories, as follows:

- 1) Reproduction. Studies are aimed at providing information on the sex ratio of the commercial catch and to improve current estimates of maturity.
- 2) Growth and Physiological Condition. Studies 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.
- 3) Discard Mortality Rates (DMRs) and Survival. Studies are aimed at providing updated estimates of DMRs in both the longline and the trawl fisheries.
- 4) Migration. Studies are aimed at further understanding reproductive migration and identification of spawning times and locations as well as larval and juvenile dispersal.
- 5) Genetics and Genomics. Studies 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.

### UPDATE ON PROGRESS ON THE MAIN RESEARCH ACTIVITIES

1. Reproduction. Efforts at IPHC are currently underway to address two critical issues in stock assessment based on estimates of female spawning biomass: the sex ratio of the commercial catch and maturity estimations.
  - 1.1. Sex ratio of the commercial catch. In 2017, the sex-marking project requested voluntary participation from the commercial longline fleet coastwide. During the course of the commercial season, a total of 929 samples were obtained from 84 sex-marked offloads coastwide. Sex (SNP) assays on these samples have been finalized at the new biological laboratory at IPHC and the results are being currently analyzed and expressed as a function of age. The results of this study will be written up for publication in the Fall of 2018.
  - 1.2. Maturity estimations. In order to characterize the gonadal maturation schedule, the IPHC is conducting a full characterization of the annual reproductive cycle in female

and male Pacific halibut. Biological samples (gonads, blood, pituitary, otolith, fat content) have been collected at monthly intervals from female (N=30) and male (N=30) Pacific halibut captured from the Portlock region in the central Gulf of Alaska throughout an entire calendar year. Sample processing will begin in late Summer and early Fall of 2018. Analysis of a portion of this study will be conducted by a MSc student from Alaska Pacific University and will constitute the basis of her MSc thesis.

2. Growth. Investigations on the effects of **temperature** variation on growth potential are being continued by describing changes in the skeletal muscle proteome (in collaboration with the Environmental Proteomics laboratory at the Department of Genome Sciences, University of Washington). At the present time, we are in the process of evaluating methods for the preparation of Pacific halibut skeletal muscle samples for mass spectrometry. Proteomic analyses are planned for the fall of 2018. In addition, we are also currently conducting RNAseq analyses to identify differentially expressed genes in liver, another important tissue in relation to growth, in response to temperature-induced growth manipulations. We have also conducted experiments on the effects of **density** on growth. Growth data is currently being analyzed and, based on the results, skeletal muscle tissue samples will be processed for RNA extraction and the expression of selected growth markers previously identified by RNAseq will be assessed by quantitative real-time PCR.
  
3. Discard Mortality Rates (DMRs) and Survival. Within framework of a 2-yr project partially funded by the Saltonstall-Kennedy Grant Program that is led by IPHC in partnership with the Alaska Pacific University, we are conducting investigations to understand the relationship between fish handling practices and fish physical and physiological condition and survival post-capture as assessed by tagging in order to better estimate post-release survival in Pacific halibut caught incidentally in the directed and bycatch longline fisheries.
  - 3.1. Evaluation of the effects of **hook release techniques** on injury levels and association with the physiological condition of captured Pacific halibut. The work involved evaluating the effects of different release techniques on injury levels and associated physiological condition levels from the large (16/0) circle hooks used in the Pacific halibut longline fishery. Physiological condition measures as well as physiological disturbance indicators in the blood of captured fish are being currently analyzed.
  - 3.2. Investigations on the effects of fish handling methods and associated injury level and physiological condition on **post-release survival**. In order to evaluate the survival of discarded fish, two types of tagging approaches were used. 1) Classical mark-and-recapture of released fish with wire tags: 1,027 fish (under 33 inches in length) were tagged. 2) Biotelemetric monitoring of released fish with the use of satellite-transmitting electronic archival tags equipped with accelerometers: results from a total of 79 Pacific halibut ranging from 53-81 cm FL allowed us to estimate that the DMR of U32 Pacific halibut under excellent-condition is approximately 4%.
  - 3.3. Application of **electronic monitoring** (EM). Evaluation of EM data whereby reviewers recorded the release method and condition of released fish evidenced a high degree

(95%-100%) of agreement between the actual release method used and that captured by EM was observed. Assessment of injury profiles by release method evidenced that careful shake and gangion cutting are the release methods resulting in the highest proportion of fish in excellent condition (> 70%) for both small and large Pacific halibut).

#### 4. Migration

Knowledge of Pacific halibut migration throughout all life stages is necessary in order to gain a complete understanding of stock distribution and the factors that influence it.

- 4.1. Larval distribution and connectivity between the Gulf of Alaska and Bering Sea. Work has continued on the application of the IPHC-developed spatial model on assessing possible changes in larval density and distribution between warm (2001-2005) and cold (2007-2013) stanzas and differences between the ocean basins. The advection modeling portion of this project is still scheduled for Fall 2018.
- 4.2. Wire tagging of U32 Pacific halibut. Wire tagging of Pacific halibut caught in the NMFS trawl surveys and during 2018 IPHC fisheries-independent setline survey is still being conducted.
- 4.3. Electronic archival tagging. Electronic archival tags that allow for daily light-based geolocation and depth recording are being deployed in Pacific halibut caught in the 2018 IPHC fishery-independent setline survey.

#### **PROGRESS ON DISCUSSIONS REGARDING NEW RESEARCH TOPICS AT IPHC**

- In order to begin discussions regarding the three topics that the IPHC Secretariat solicited guidance from the SRB, as indicated in document IPHC-2018-SRB12-09, the SRB has shared with the IPHC Secretariat relevant scientific literature. A discussion on approaches to determine the level of genetic variation in the sampled Pacific halibut population and, therefore, infer possible contributions of genetically distinct spawning groups was recently initiated.
- Furthermore, in response to comments by the SRB, the IPHC Secretariat (L. Sadorus) has produced a summary of research projects and activities conducted by IPHC since 1995 in which biological samples were collected in addition to maps indicating the geographic location of the sampling sites in the IPHC fisheries-independent setline and NMFS trawl surveys during the period 1995-2017. The research project summary will be useful for identifying sources of biological samples that could potentially be used in genetic studies and is found in document IPHC-2018-SRB013-INF01. The maps showing the sampling locations are found in document IPHC-2018-SRB013-INF02.