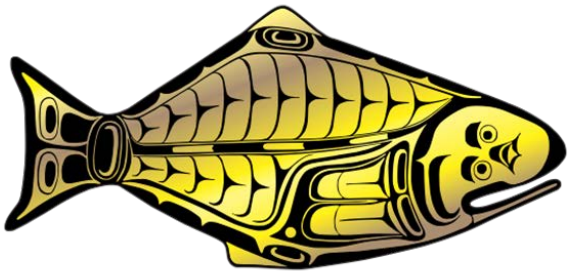
INTERNATIONAL PACIFIC HALIBUT COMMISSION

5-YEAR BIOLOGICAL AND ECOSYSTEM SCIENCE RESEARCH PLAN

(2017-21)

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

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Contact details:

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

ACRONYMS

DMR	Discard Mortality Rate
IPHC	International Pacific Halibut Commission
MSE	Management Strategy Evaluation
RAB	Research Advisory Board
SB	Spawning Biomass (female)
SRB	Scientific Review Board
U.S.A.	United States of America

DEFINITIONS

A set of working definitions are provided in the IPHC Glossary of Terms and abbreviations: https://iphc.int/the-commission/glossary-of-terms-and-abbreviations

Contents

1 Introduction and Major Objectives

Since its inception, the International Pacific Halibut Commission (IPHC) has had a long standing history of conducting research activities devoted to describe and understand the biology and ecology of the Pacific halibut (*Hippoglossus stenolepis*). At the present time, the main objectives of the Biological and Ecosystem Science Research Plan 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 and to provide biological inputs that inform the management strategy evaluation process.

2 Scope

Biological research activities at the IPHC are guided by a 5-Year Research Plan that is developed within the organization, led by the Biological and Ecosystem Sciences Branch, and that identifies key research areas that follow Commission objectives. The successful pursuit of these objectives is aligned with the Commission's strategic goals to position IPHC as a global leader in scientific excellence and science-based decision making and to foster collaboration (within Contracting parties and internationally) to enhance IPHC's science and management advice.

3 Established and Emerging Research Concepts and Foci

The IPHC 5-Year Research Plan for the period 2017-21 contemplates biological and ecological research activities in five (5) main areas that were selected based on their relative management implications:

1) **Migration**. Studies aimed at improving our knowledge of Pacific halibut migration throughout all life stages (i.e. larval dispersal, adult and reproductive migrations) in order to achieve a complete understanding of stock distribution and the factors that influence it. Specific topics of study in this area include:
    - Improving our understanding of the mechanisms and magnitude of larval connectivity between the Gulf of Alaska and the Bering Sea. Identify environmental and biological predictors for larval abundance and recruitment.
    - Improving our understanding of spawning site contributions to nursery/settlement areas in relation to year-class and recruit survival and strength.

- Improving our understanding of the relationship between nursery/settlement origin and adult distribution and abundance over temporal and spatial scales.
- Improving our understanding of off-shore spawning migrations, spawning site fidelity and their relationship with environmental viability.
- Integrating analysis of migratory patterns by incorporating tagging, genetic and otolith microchemical composition analyses.

2) **Reproduction**. Studies aimed primarily at addressing two critical issues for stock assessment analysis based on estimates of female spawning biomass: the sex ratio of the commercial catch and maturity estimations. Specific topics of study in this area include:

- Providing accurate sex identification of commercial landings in order to incorporate sex-at-age information into the stock assessment process.
- Investigating possible environmental effects on the establishment of the phenotypic sex and their relationship with skewed sex ratios in the Pacific halibut population.
- Improving our understanding of the temporal progression of reproductive development and gamete production during an entire annual reproductive cycle in male and female Pacific halibut.
- Updating current maturity-at-age estimates.
- Providing estimates of fecundity.
- Providing evidence for the presence of skipped spawning in Pacific halibut females.
- Improving accuracy in current staging criteria of maturity status used in the field.

3) **Growth**. Studies 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. Specific topics of study in this area include:

- Identification of physiological (molecular and biochemical) markers for growth in growth-relevant tissues in Pacific halibut.
- Establishment of physiological growth signatures of somatic growth under experimental growth manipulations.
- Application of physiological growth markers to monitor growth patterns in the Pacific halibut population.
- Investigating the effects of environmental and ecological factors and conditions that affect somatic growth.
- Reconstructing the thermal growth history of Pacific halibut through oxygen isotope ratio determinations in otoliths.

- Providing biological inputs for improving estimates of regional and temporal stock productivity.
- Developing tools for assessing fish condition and its relationship with growth performance.

4) **Discard mortality rates**. Studies aimed at providing updated estimates of discard mortality rates (DMRs) for Pacific halibut in the directed, trawl and recreational fisheries. Specific topics of study in this area include:

- Improving estimations of DMRs in the directed longline Pacific halibut fishery by linking fish handling practices with injury levels, fish physiological condition and survival of discarded Pacific halibut in the directed longline Pacific halibut fishery.
- Investigating the potential applicability of electronic monitoring for capturing fish handling events and deriving estimations of DMRs in the non-observed directed longline Pacific halibut fishery.
- Improving estimations of DMRs for Pacific halibut in the trawl fishery and moving towards DMR estimates based on measurable covariates.
- Providing information on the types of fishing gear and fish handling practices used in the Pacific halibut recreational (charter) fishery as well as on the number and size composition of discarded Pacific halibut in this fishery.
- Providing estimations of DMRs in the Pacific halibut recreational fishery by investigating the role of fishing practices and capture conditions on injury profile, physiological stress levels and survival of discarded Pacific halibut.

5) **Genetics and Genomics**. Studies 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. Specific topics of study in this area include:

- Improving current knowledge of the genetic structure of the Pacific halibut population by performing genetic analyses on spawning fish coast wide with state-of-the-art genomic techniques.
- Investigating possible genetic differentiation of distinct geographic groups of Pacific halibut throughout its distribution range and its application to assist in understanding distribution of Pacific halibut.
- Sequencing of the Pacific halibut genome to support studies on population genetics and 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.

4 Targets and Goals

An overarching goal of the 5-Year Research Plan is to promote integration and synergies among the various research activities led by the IPHC in order to improve our knowledge of key biological inputs that feed into the stock assessment and MSE process (Appendix I). The goals of the main activities of the 5-Year Research Plan are aligned and integrated with the IPHC stock assessment and MSE processes (Appendix II) with specific timelines (Appendix III). Traditionally, the IPHC Secretariat propose new and continuing projects annually, designed to address key biological issues based on the IPHC Secretariat's own input as well as input from the IPHC Commissioners, stakeholders and particularly from specific subsidiary bodies to the IPHC such, including the Scientific Review Board (SRB) and the Research Advisory Board (RAB). Proposed research projects are evaluated and proposed internally by the IPHC Secretariat and presented to IPHC Commissioners for feed-back and potential approval (Appendix IV).

5 Measures of Success

The success in the implementation of the IPHC 5-Year Research Plan will be measured according to the following criteria:

- Timely delivery of specific research products (i.e. biological information) that constitute useful inputs into the stock assessment and the management strategy evaluation process and their implementation in the IPHC management process.
- Endorsement of current and proposed research activities by the Scientific Review Board and the Research Advisory Board.
- Publication of research outcomes from activities contemplated in the IPHC 5-Year Research Plan in the peer-reviewed literature.

6 Future Strategic Research Plans

Along with the implementation of the medium- and long-term research activities contemplated in the IPHC 5-Year Research Plan, the following future strategic research plans are indicated:

- Establish a world-leading research program in fisheries research.
- Establish new collaborative agreements and interactions with research agencies and academic institutions.
- Promote the international involvement of the IPHC by continued and new participation in international scientific organizations and by leading international research collaborations.

- Incorporation of talented students and early researchers in research activities contemplated in the IPHC 5-Year Research Plan.

APPENDICES

Appendix I: Summary diagram of the major research areas identified in the 5-Year Research Plan and their interactions.

Appendix II: Integration of biological research activities contemplated in the 5-Year Research Plan, stock assessment and harvest strategy policy.

Appendix III: Temporal integration of outputs from biological research into stock assessment (SA) and management strategy evaluation (MSE).

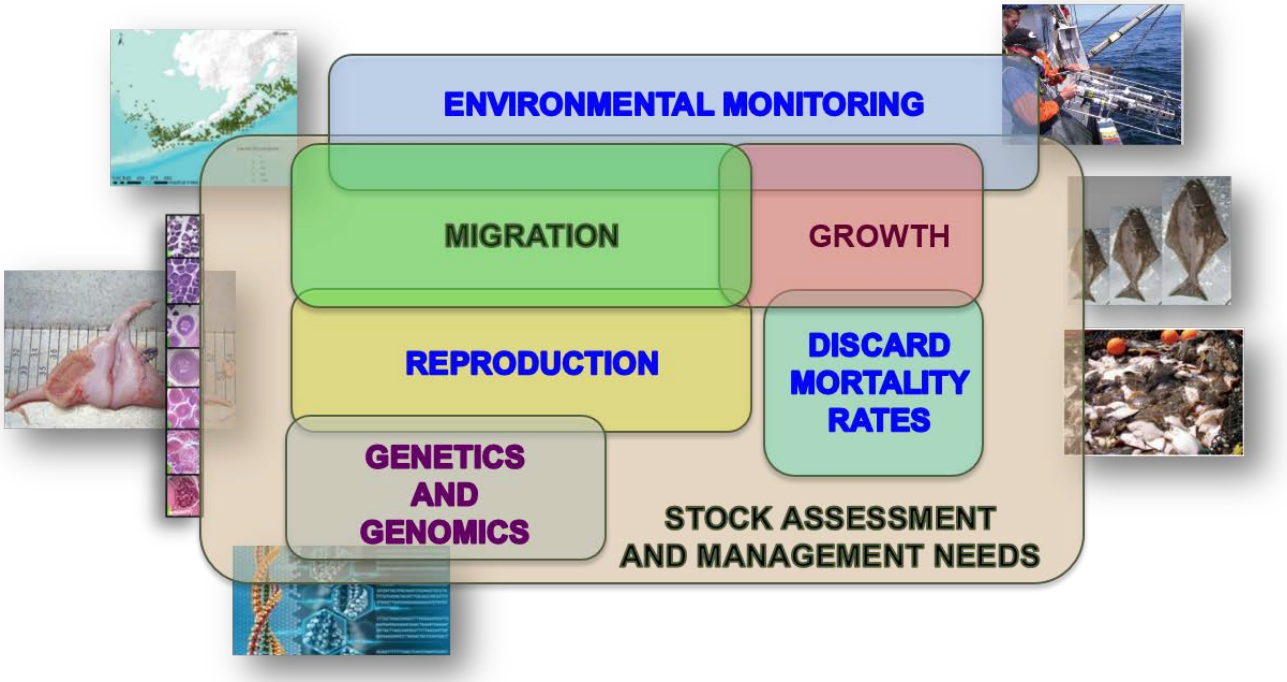
Appendix IV: Research proposal topic development and selection process and integration with the IPHC meeting calendar.

ACKNOWLEDGEMENTS

This 5-year plan was developed by Dr. Josep Planas, Biological and Ecosystem Sciences Branch Manager, in collaboration with Dr. David Wilson (Executive Director), and current members of the IPHC Secretariat staff: Dr. Ian Stewart, Dr. Allan Hicks, Dr. Tim Loher, Dr. Ray Webster, Mr Claude Dykstra, Ms Lauri Sadorus, and Ms Joan Forsberg.

APPENDIX I

Summary diagram of the major research areas identified in the 5-Year Research Plan and their interactions



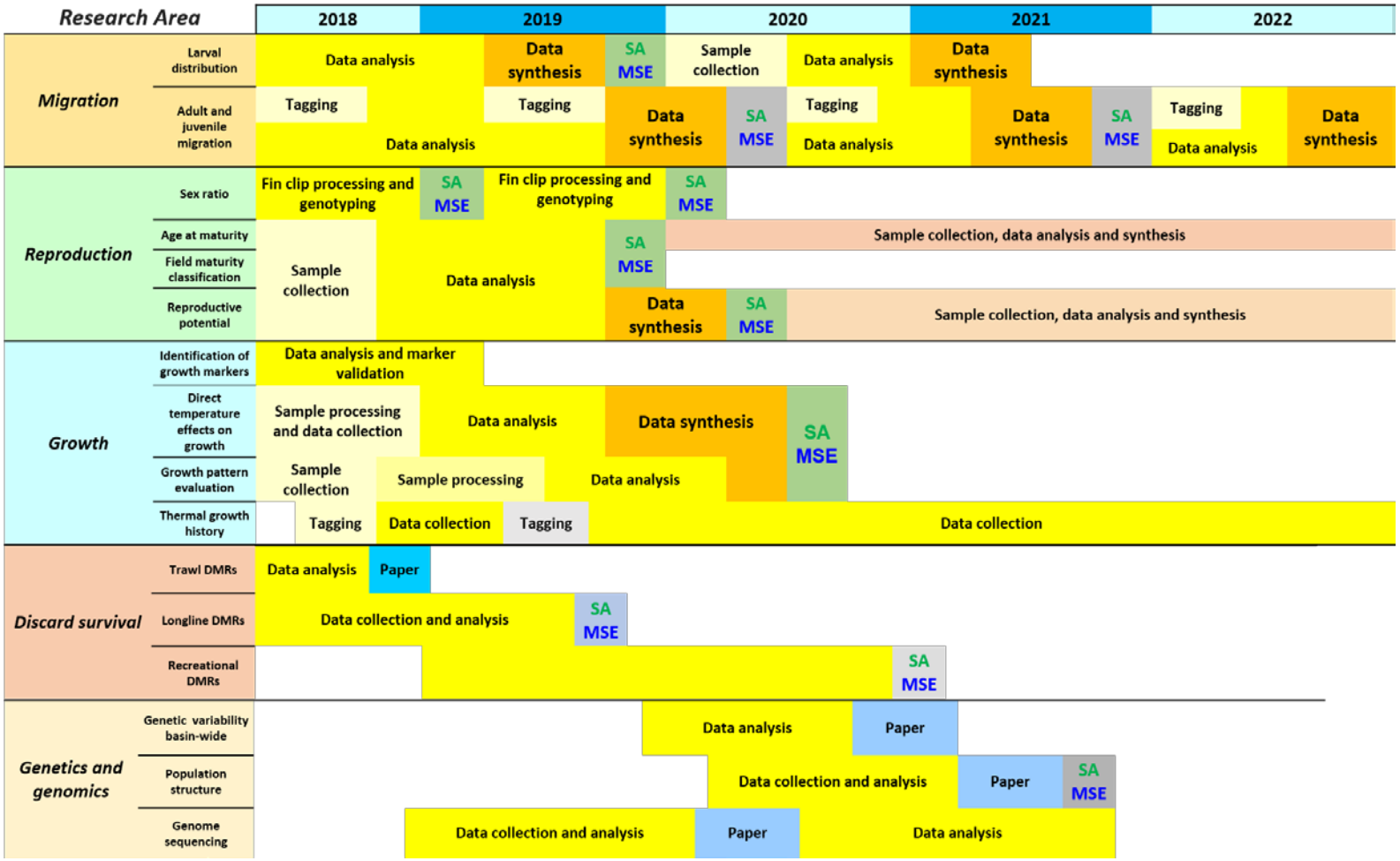
APPENDIX II

Integration of biological research activities contemplated in the 5-Year Research Plan, stock assessment and harvest strategy policy

Biological research		Stock assessment	Stock assessment MSE
Research areas	Research outcomes	Relevance for stock assessment	Inputs to stock assessment and MSE development
Migration	Larval distribution Juvenile and adult migratory behavior and distribution	Geographical selectivity Stock distribution	Information for structural choices Recruitment indices Migration pathways and rates Timing of migration
Reproduction	Sex ratio Spawning output Age at maturity	Spawning biomass scale and trend Stock productivity Recruitment variability	Sex ratio Maturity schedule Fecundity
Growth	Identification of growth patterns Environmental effects on growth Growth influence in size-at-age variation	Temporal and spatial variation in growth Yield calculations Effects of ecosystem conditions Effects of fishing	Predicted weight-at-age Mechanisms for changes in weight-at-age
Discard Survival	Bycatch survival estimates Discard mortality rate estimates	Scale and trend in mortality Scale and trend in productivity	Bycatch and discard mortality estimates Variability in bycatch and uncertainty in discard mortality estimates
Genetics and Genomics	Genetic structure of the population Sequencing of the Pacific halibut genome	Spatial dynamics Management units	Information for structural choices

APPENDIX III

Temporal integration of outputs from biological research into stock assessment (SA) and management strategy evaluation (MSE)



APPENDIX IV

Research proposal topic development and selection process and integration with the IPHC meeting calendar