

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

# **IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21): update**

Agenda Item 6

IPHC-2021-RAB022-08



# Description of IPHC research activities

1. Overview of IPHC 5-year Biological and Ecosystem Sciences Research Plan (2017-2021)
2. Updates on specific topics: Whale depredation and chalky Pacific halibut
3. Core research streams: Updates for key ongoing research activities (Project leaders)
  - **Reproduction:** *Reproductive assessment of the Pacific halibut population* (J. Planas)
  - **Discard mortality rates:** *Discard mortality rates and post-release survival in the Pacific halibut fisheries* (C. Dykstra)
  - **Genetics and genomics:** Application of genetics and genomics to improve our knowledge on population structure and distribution (A. Jasonowicz)

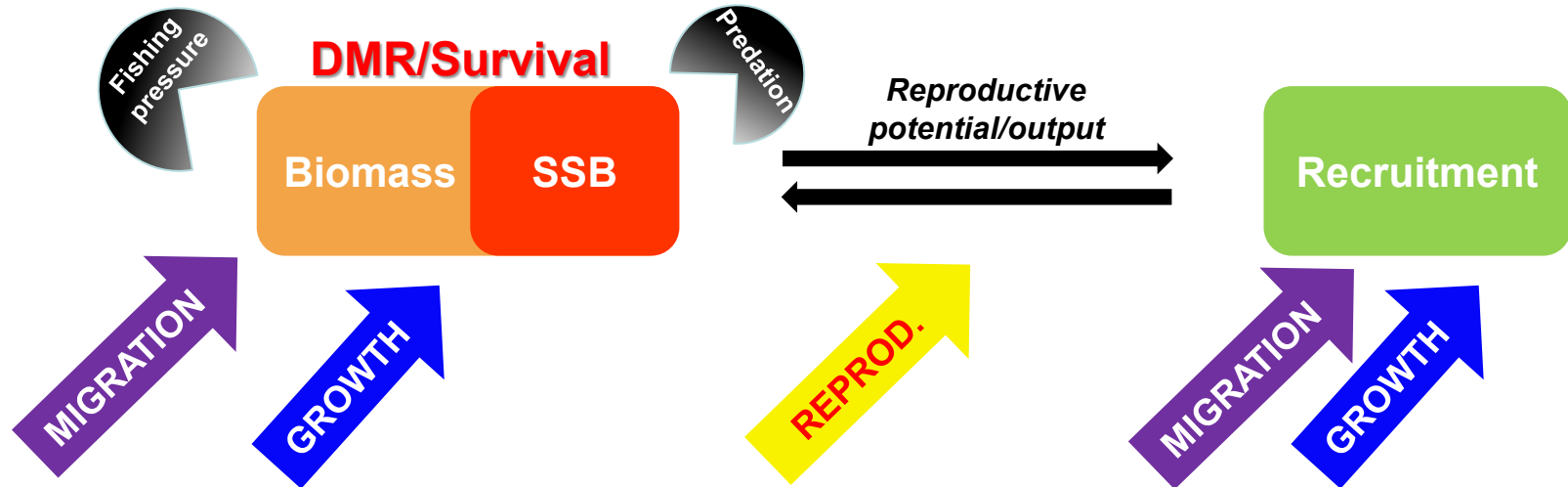


# Primary research activities at IPHC



## Primary objectives

- Identify and address *critical knowledge gaps* in the biology of Pacific halibut
- Understand the influence of *environmental conditions* on Pacific halibut biology
- Apply resulting knowledge to reduce *uncertainty* in current stock assessment models



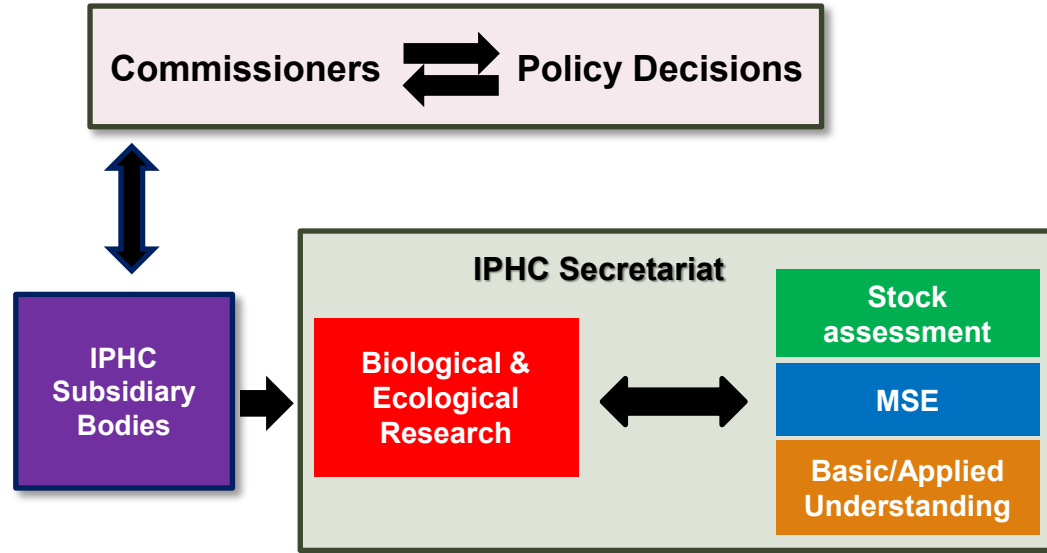
# Five-year research plan and management implications

## 5-Year Biological and Ecosystem Science Research Plan

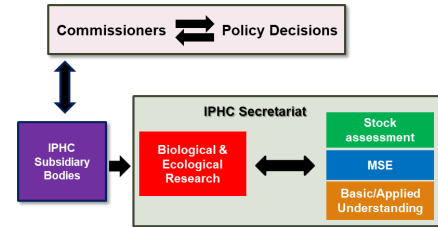
<i>Primary Research Areas</i>
<b>Migration</b>
<b>Reproduction</b>
<b>Growth</b>
<b>DMRs and discard survival</b>
<b>Genetics and genomics</b>



# Integration of biological research, stock assessment, and policy



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## Biological research

Research areas	Research outcomes
<b>Migration</b>	Larval distribution Juvenile and adult migratory behavior and distribution
<b>Reproduction</b>	Sex ratio Spawning output Age at maturity
<b>Growth</b>	Identification of growth patterns Environmental effects on growth Growth influence in size-at-age variation
<b>Discard Survival</b>	Bycatch survival estimates Discard mortality rate estimates
<b>Genetics and Genomics</b>	Genetic structure of the population Sequencing of the Pacific halibut genome

## Stock assessment

Relevance for stock assessment
Geographical selectivity Stock distribution
Spawning biomass scale and trend Stock productivity Recruitment variability
Temporal and spatial variation in growth Yield calculations Effects of ecosystem conditions Effects of fishing
Scale and trend in mortality Scale and trend in productivity
Spatial dynamics Management units

## Stock assessment MSE

Inputs to stock assessment and MSE development
Information for structural choices Recruitment indices Migration pathways and rates Timing of migration
Sex ratio Maturity schedule Fecundity
Predicted weight-at-age Mechanisms for changes in weight-at-age
Bycatch and discard mortality estimates Variability in bycatch and uncertainty in discard mortality estimates
Information for structural choices



# Description of IPHC research activities

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## 2. Updates on specific topics: whale depredation and chalky Pacific halibut

## 3. Core research streams: Updates for key ongoing research activities (Project

- **Action Item 6.1.1: Whale depredation (Claude Dykstra)**
  - **Action Item 6.1.2: Chalky Pacific halibut (Lauri Sadorus)**
- *Discard mortality rates: Discard mortality rates and post-release survival in the Pacific halibut fisheries (C. Dykstra)*
  - **Genetics and genomics:** Application of genetics and genomics to improve our knowledge on population structure and distribution (A. Jasonowicz)





# 6.1.1. Whale depredation: Catch Protection

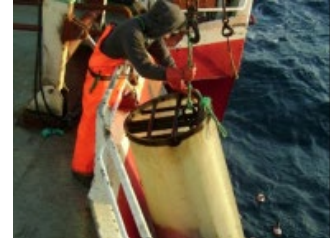
- Depredation of catch an increasing problem in hook and line fisheries.
- Auditory deterrents, and spatial or temporal avoidance – variable success.
- Terminal gear modification and catch protection - highest likelihood of 'breaking the reward cycle' in depredation
- BREP Funding
  - Workshop → 2-3 prototype tools
  - Field Trials





# 6.1.1. Whale depredation: Catch Protection

- Workshop – early 2022
  - Under water shuttles
  - Shrouding devices
  - Spring coils
- Field trials – summer 2022



[Document IPHC-2021-RAB022-12](#)



# 6.1.2. Chalky Pacific halibut

## Revisit of chalky prevalence:

- Solicited processors for three years: 2019, 2020, 2021
- Response progressively lower over time
- Processors are simply not looking – staffing shortages noted as the most common reason

	1996	1997	1998	2019	2020	2021
No. reports received	22	14	27	2	3	1
Chalky fish reported (lbs)	58,000	124,000	375,000	92,000	3,317	603
Landings represented (Mlbs)	11.8	17	57.8	1.4	1.9	0.1
% chalky of represented landings	0.50%	0.70%	0.60%	6.60%	<0.1%	<0.1%
Total landings (Mlbs)	43.9	47.3	65	23.9	22.4*	28
% of fish landings represented in reports	26.90%	35.90%	88.90%	5.90%	8.50%	0.25%



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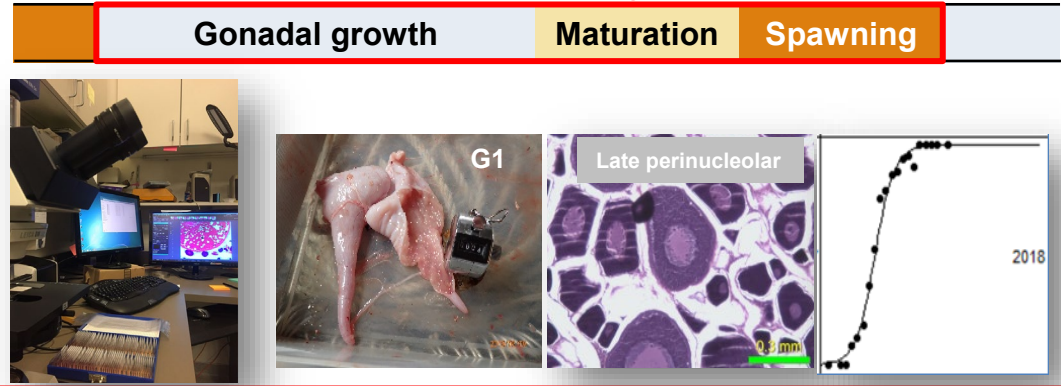
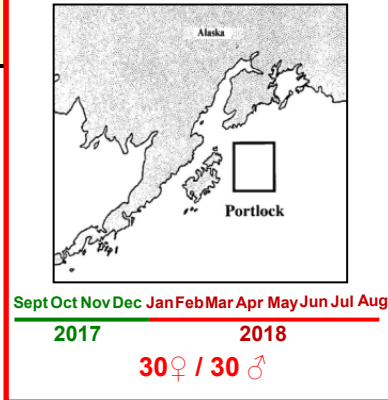
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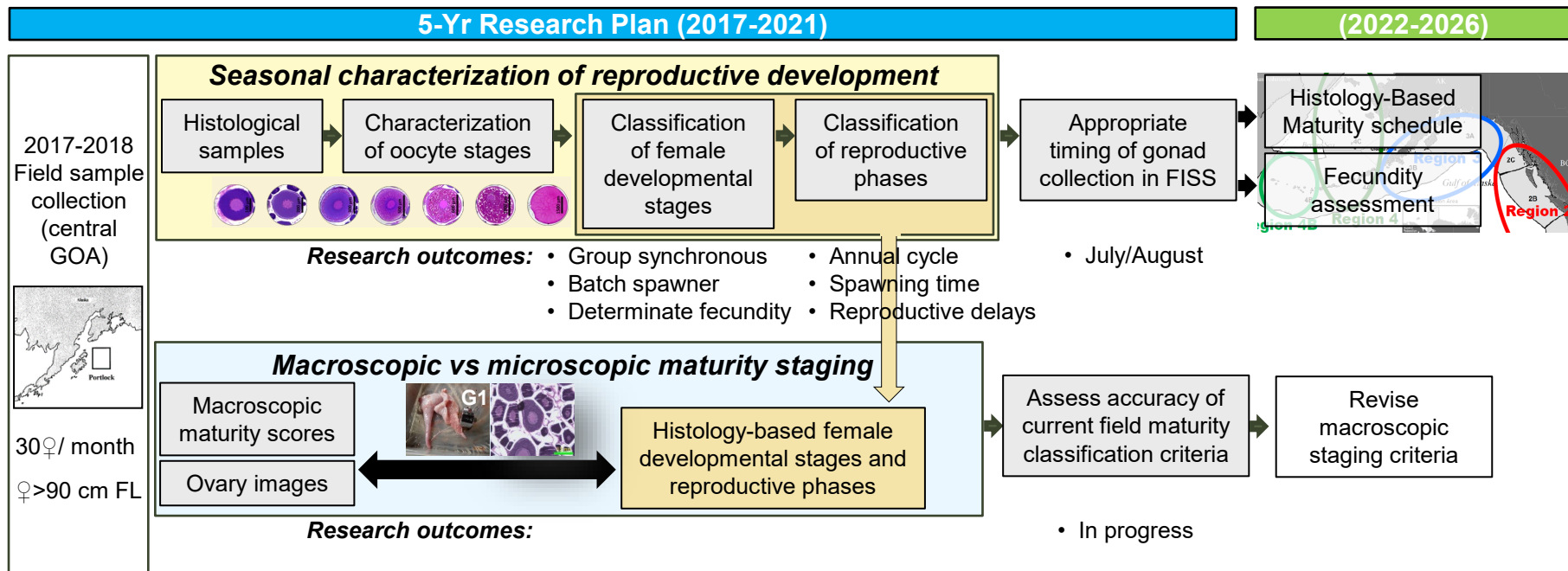
# Reproduction

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE
Reproduction	Histological maturity assessment	Updated maturity schedule	Scale biomass and reference point estimates	1. Biological input	Improve simulation of spawning biomass in the Operating Model
	Examination of potential skip spawning	Incidence of skip spawning			
	Fecundity assessment	Fecundity-at-age and -size information			
	Examination of accuracy of current field macroscopic maturity classification	Revised field maturity classification			

## Reproductive cycle



# Reproduction



- Staff involved: Teresa Fish (MSc candidate APU (2018-2020)), Crystal Simchick, Tim Loher, Ian Stewart, Allan Hicks, Josep Planas
- Publications: Fish *et al.* (2020) *J. Fish Biol.* **97**: 1880–1885 ; Fish *et al.* (in review)

[Document IPHC-2021-RAB022-10](#)



# DMRs and Survival Assessment

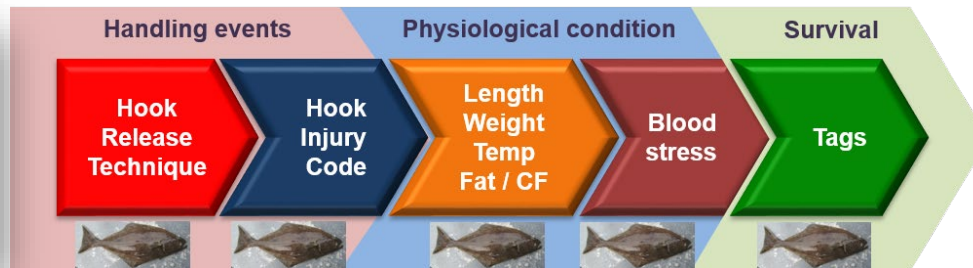
Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	MSE Rank
Mortality and survival assessment	Discard mortality rate estimate: longline fishery	Experimentally-derived DMR	Improve estimates of unobserved mortality		Improve estimates of stock productivity	1. Fishery parameterization
	Discard mortality rate estimate: recreational fishery					2. Fishery parameterization
	Best handling practices: longline fishery	Guidelines for reducing discard mortality		2. Fishery yield		
	Best handling practices: recreational fishery	Guidelines for reducing discard mortality		3. Fishery yield		

- Directed longline fishery**



NOAA FISHERIES

Saltonstall – Kennedy Grant NA17NMF4270240 (2017-2020)



**DMR**  
**Best predictors of mortality**  
**Best practices**



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# DMRs and Survival Assessment

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- Guided recreational fishery**



NFWF National Fish and Wildlife Foundation



UNIVERSITY OF ALASKA FAIRBANKS



NPRB Grant No. 2009



1. Collect information on hook types and sizes and handling practices
2. Investigate the relationship between gear types and capture conditions and size composition of captured fish
3. Injury profiles and physiological stress levels of captured fish
4. Assessment of mortality of discarded fish

- Sitka, AK (2C): 21 – 27 May 2021

Size classes (cm)				
≤ 68	69-77	78-93	≥ 94	Total
63	75	66	39	243

- Two gear sizes: 12/0 and 16/0 hooks
- Observations and samples: hooking time, time on deck, weight, length, hook injury type and picture, viability, fat content, fish temperature, blood sample, fin clip, wire tag.



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4. Assessment of mortality of discarded fish

- Seward, AK (3A): 11 – 17 June 2021

Types of tags		
Wire	sPATs	Total
38	80	118

- Two gear sizes: 12/0 and 16/0 hooks
- Observations and samples: hooking time, time on deck, weight, length, hook injury type and picture, viability, fat content, fish temperature, blood sample, fin clip, wire tag.



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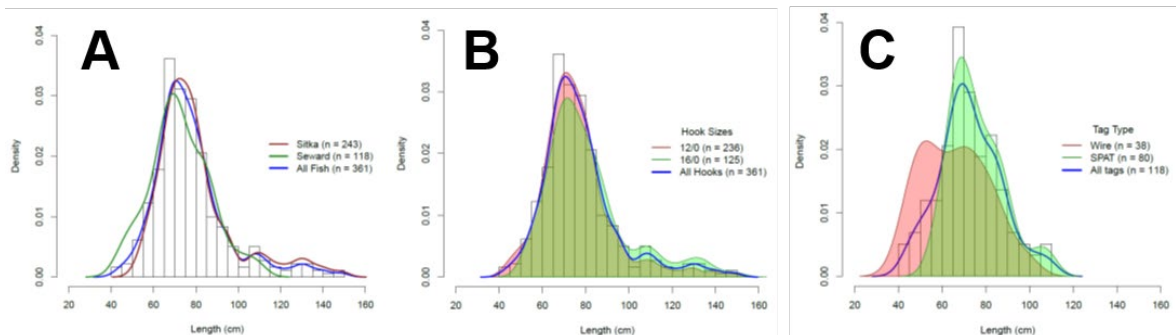
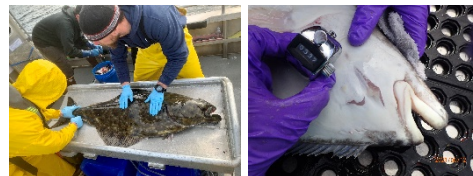
# DMRs and Survival Assessment

- Discard mortality rates currently derived from other gear / species
- Generate data on hook sizes and handling practices of charter fleet
  - Survey (Homer, Seward, Juneau, Sitka)



# DMRs and Survival Assessment

- Field investigations of typical gear and handling to:
  - Investigate relationships between gear types and catch size composition
  - Develop injury and physiological stress profiles.
  - Quantify and characterize survival



# DMRs and Survival Assessment

## 5-Yr Research Plan (2017-2021)

Fall 2017  
field  
experiment  
(GOA)



### ***Discard mortality rate estimation: longline fishery***

#### **Capture and handling conditions**

- Careful shake
- Gangion cut
- Hook strip

#### **Injury and viability assessment**

#### **Physiological condition assessment**

#### **Analysis of capture-related variables**

#### **Survival assessment by tagging**

Best handling practices  
in longline fishery

#### **Research outcomes:**

- Injury and viability profiles of hook release methods
- Physiological profile of fish under different capture and handling conditions
- Longline DMR

Summer  
2021 field  
experiments  
(Sitka, AK  
Seward, AK)



### ***Discard mortality rate estimation: charter recreational fishery***

#### **Capture and handling conditions**

- 12/0 and 16/0 hooks

#### **Injury, viability and physiological assessment**

#### **Survival assessment by tagging**

#### **Analysis of capture-related variables**

Best handling practices  
in recreational fishery

#### **Research outcomes:**

- In progress

[Document IPHC-2021-RAB022-11](#)

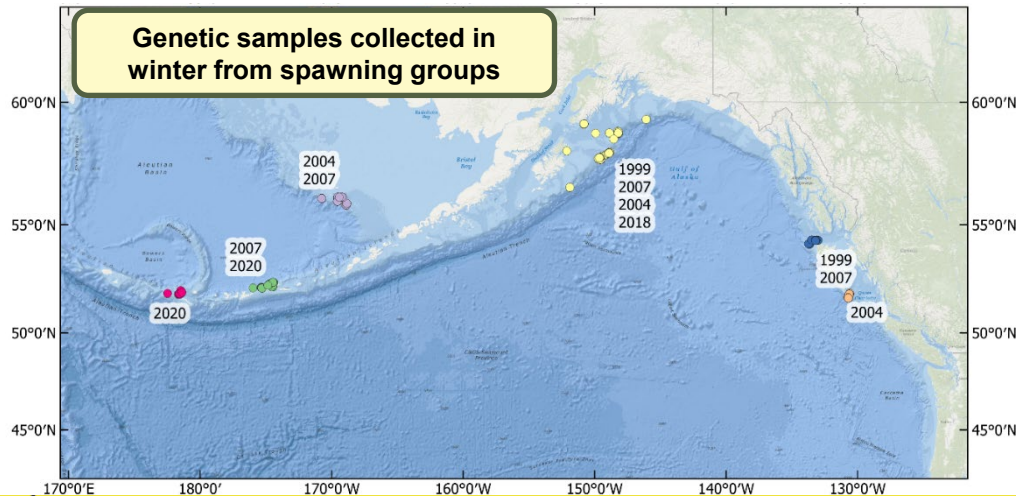
- Staff involved: Claude Dykstra, Crystal Simchick, Tim Loher, Allan Hicks, Ian Stewart, Josep Planas
- Funding: Saltonstall-Kennedy NOAA (Sept. 2017-Aug. 2020); NFWF (Apr. 2019-Nov. 2021); NPRB (Jan 2021-Mar 2022)
- Publications: Kroska *et al.* (2021) *Conserv. Physiol.*; Loher *et al.* (2021) *North Amer. J. Fish. Manag.* (In Press)



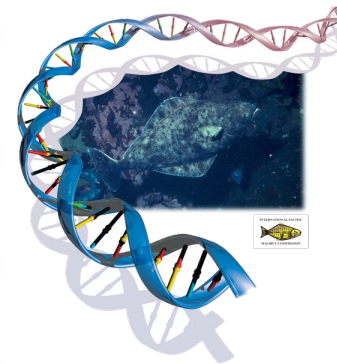
# Genetics and Genomics

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	MSE Rank
Genetics and genomics	Population structure	Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area	Altered structure of future stock assessments	2. Biological input	Improve parametrization of the Operating Model	1. Biological parameterization and validation of movement estimates.
	Distribution	Assignment of individuals to source populations and assessment of distribution changes		3. Biological input		2. Biological parameterization and validation of recruitment distribution

## 1. Re-evaluate genetic structure of the Pacific halibut population



## Pacific halibut genome



- Genomic analyses of population dynamics: stock structure and spatial connectivity.
- Identifying potential local and/or environmental adaptations.
- Provide genetic basis for life-history traits (e.g. growth, maturity, migratory behavior, etc.).





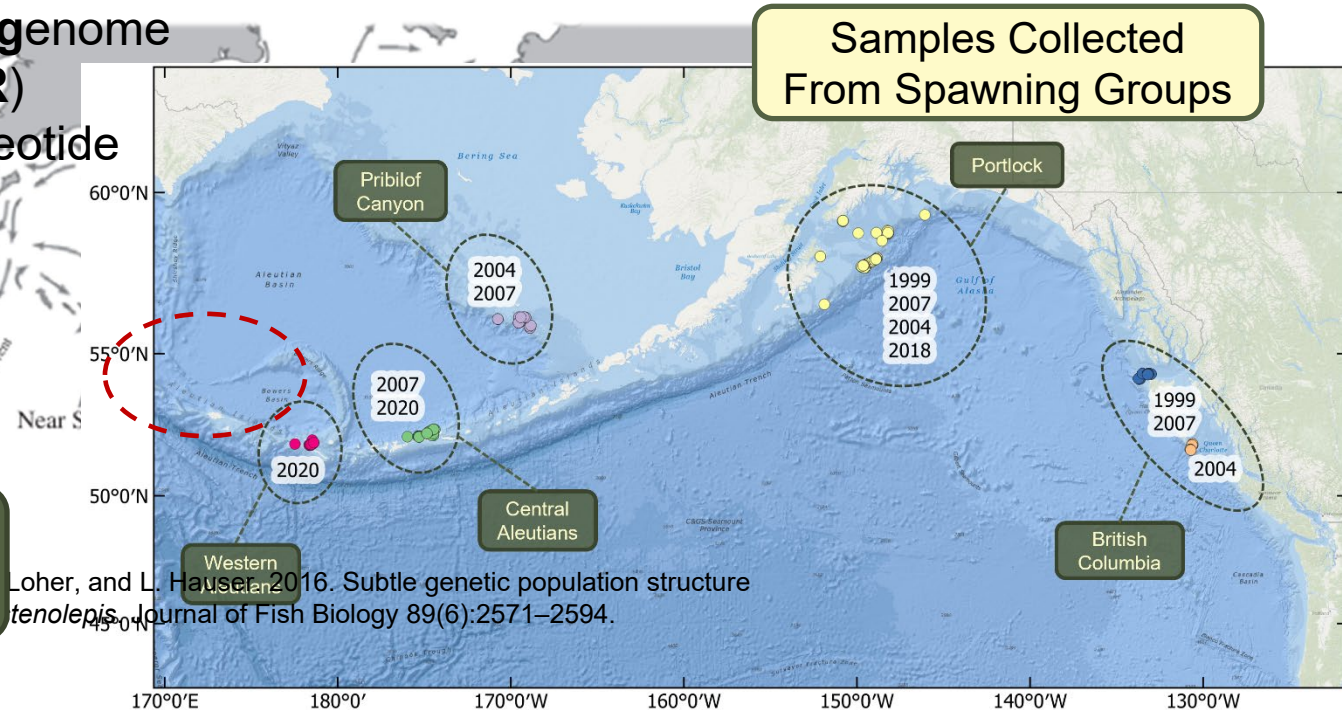
# Genetics and Genomics

## Re-evaluate previous findings of population structure (Area 4B)

- Low-coverage whole-genome resequencing (**lcWGR**)
- Millions of single nucleotide polymorphisms (**SNPs**)
- 5 geographic areas
  - 1999-2020
- 600 individuals

Establish Genetic Baseline

Samples Collected From Spawning Groups



Loher, and L. Hauser. 2016. Subtle genetic population structure in *tenolenis*. Journal of Fish Biology 89(6):2571–2594.



# Genetics and Genomics

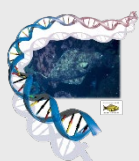
## 5-Yr Research Plan (2017-2021)

Collection of genetic samples of spawning aggregations spanning the Gulf of Alaska, Bering Sea and Aleutian Islands (1999-2020)



### Development and application of genomic approaches

#### Chromosome-level genome assembly



Development of methods based on low-coverage whole genome resequencing

Establishment of a bioinformatic pipeline in the cloud (Microsoft Azure)

Population structure analyses

Establishment of a baseline of genetic diversity

Delineation of fine-scale stock structure

#### Research outcomes:

- Sequenced genome (size=586 Mbp)
- Full annotation (NCBI) (27,422 genes)
- 24 chromosome-length scaffolds
- SNP detection and genotyping

- Staff involved: Andy Jasonowicz, Crystal Simchick, Josep Planas
- Funding: IPHC, NPRB

[Document IPHC-2021-RAB022-13](#)



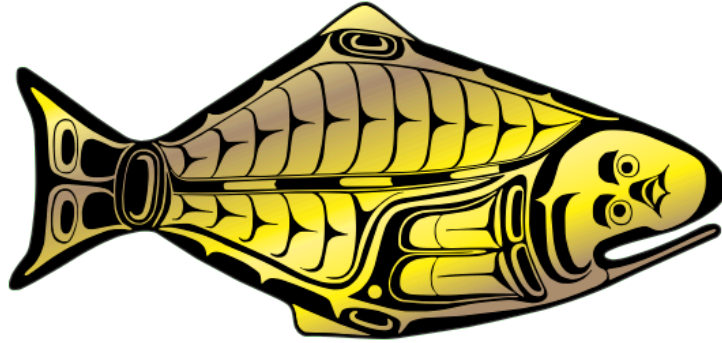


# Externally-funded collaborative research

Project #	Grant agency	Project name	PI	Partners	IPHC Budget (\$US)	Management implications	Grant period
1	National Fish & Wildlife Foundation	Improving the characterization of discard mortality of Pacific halibut in the recreational fisheries (NFWF Award No. 61484)	IPHC Dr J. Planas and Mr Claude Dykstra	Alaska Pacific University, U of A Fairbanks, charter industry	\$98,902	Bycatch estimates	1 April 2019 – 1 November 2021
2	North Pacific Research Board	Pacific halibut discard mortality rates (NPRB Award No. 2009)	IPHC Dr. J. Planas	Alaska Pacific University	\$210,502	Bycatch estimates	1 January 2021 – 31 March 2022
3	Bycatch Reduction Engineering Program-NOAA	Gear-based approaches to catch protection as a means for minimizing whale depredation in longline fisheries (NOAA Award Number NA21NMF4720534)	IPHC Mr. Claude Dykstra and Dr. I. Stewart	Deep Sea Fishermen's Union, Alaska Fisheries Science Center-NOAA, industry representatives	\$99,700	Whale depredation	1 November 2021 – 30 April 2022
4	North Pacific Research Board	Pacific halibut population genomics (NPRB Award No. 2110)	IPHC Dr. J. Planas	Alaska Fisheries Science Center-NOAA	\$193,685	Stock structure	1 February 2022 – 31 January 2024
Total awarded (\$)					\$602,789		



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