



INTERNATIONAL PACIFIC



HALIBUT COMMISSION

# Biological and Ecosystem Science Research Update

Agenda Item 7.1

IPHC-2020-AM096-11

# Outline



INTERNATIONAL PACIFIC



HALIBUT COMMISSION



- **Five-year research plan and management implications**
- **Progress on ongoing research projects**
- **Externally-funded collaborative research**



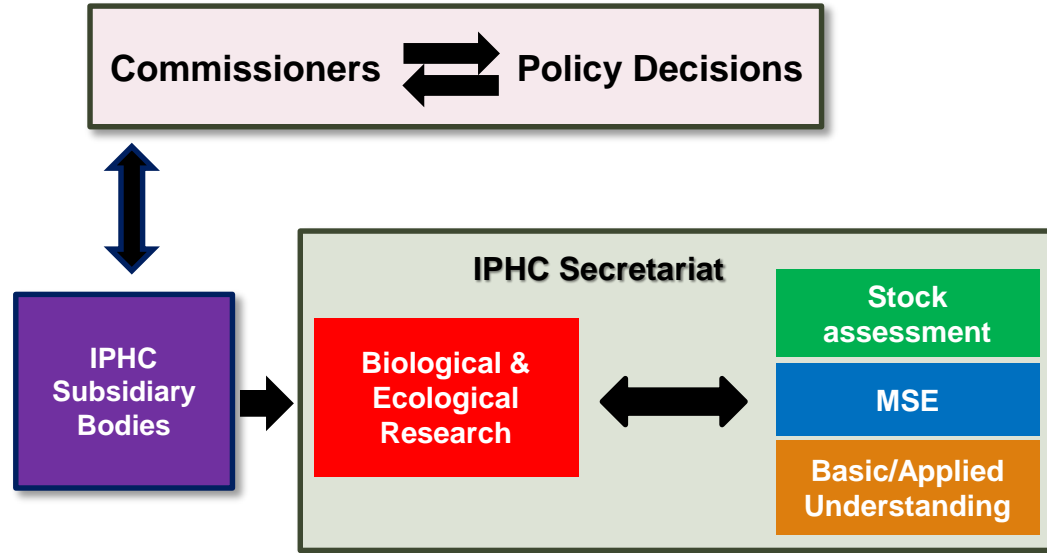
# Five-year research plan and management implications

## 5-Year Biological and Ecosystem Science Research Plan

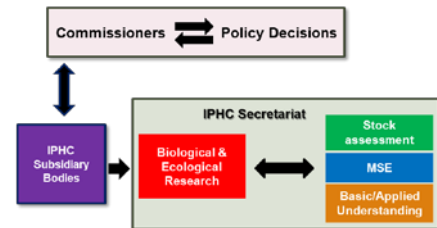
<i>Primary Research Areas</i>	<i>Main Objectives</i>	<i>Management implications</i>
<b>Migration</b>	Improve understanding of migration throughout all life stages (larval, juvenile, adult feeding and reproductive migrations)	Stock distribution, regional management
<b>Reproduction</b>	Information on sex ratios of commercial landings and improved maturity estimates	Female stock spawning biomass
<b>Growth</b>	Improve understanding of factors responsible for changes in size-at-age and development of tools for monitoring growth and physiological condition	Biomass estimates
<b>DMRs and discard survival</b>	Improve estimates of DMRs in the directed longline and guided recreational fisheries	Discard mortality estimates
<b>Genetics and genomics</b>	Improve understanding of the genetic structure of the population and create genomic tools (genome)	Stock distribution, local adaptation



# Integration of biological research, stock assessment, and policy



# Integration of biological research, stock assessment, and policy



## Biological research

Research areas	Research outcomes
Migration	Larval distribution Juvenile and adult migratory behavior and distribution
Reproduction	Sex ratio Spawning output Age at maturity
Growth	Identification of growth patterns Environmental effects on growth Growth influence in size-at-age variation
Discard Survival	Bycatch survival estimates Discard mortality rate estimates
Genetics and Genomics	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



# Integration of biological research, stock assessment, and policy: timelines

Research Area		2018	2019	2020	2021	2022					
Migration	Larval distribution	Data analysis		Data synthesis	SA MSE	Data analysis	Data synthesis				
	Adult and juvenile migration	Tagging	Tagging	Data synthesis	SA MSE	Tagging	Data synthesis	SA MSE	Tagging	Data analysis	Data synthesis
Reproduction	Sex ratio	Fin clip processing and genotyping	SA MSE	Fin clip processing and genotyping	SA MSE						
	Age at maturity				SA MSE	Sample collection, data analysis and synthesis					
	Field maturity classification	Sample collection	Data analysis			SA MSE					
	Reproductive potential				Data synthesis	SA MSE	Sample collection, data analysis and synthesis				
Growth	Identification of growth markers	Data analysis and marker validation									
	Direct temperature effects on growth	Sample processing and data collection	Data analysis		Data synthesis		SA MSE				
	Growth pattern evaluation	Sample collection	Sample processing	Data analysis							



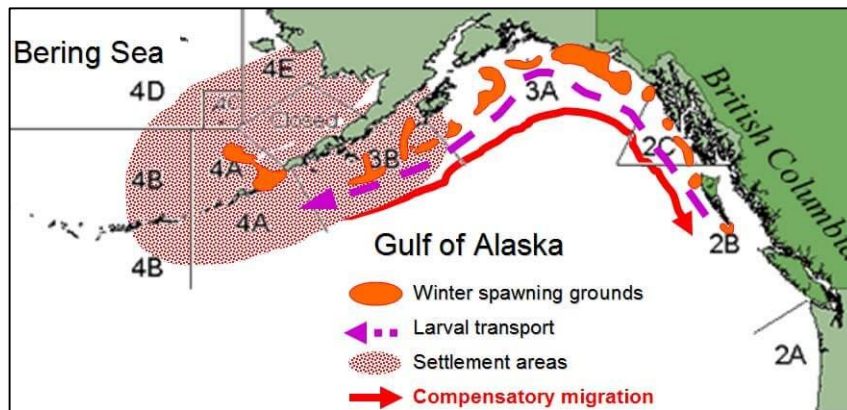
# Progress on ongoing research projects

## 1. Migration and distribution

Projects:

*1. Larval and early juvenile dispersal*

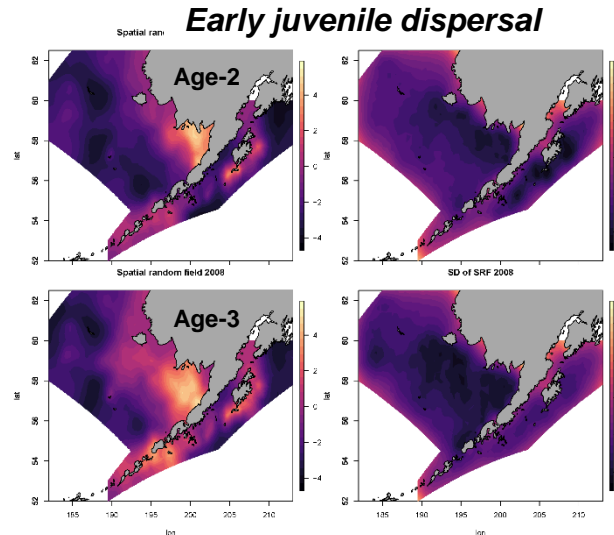
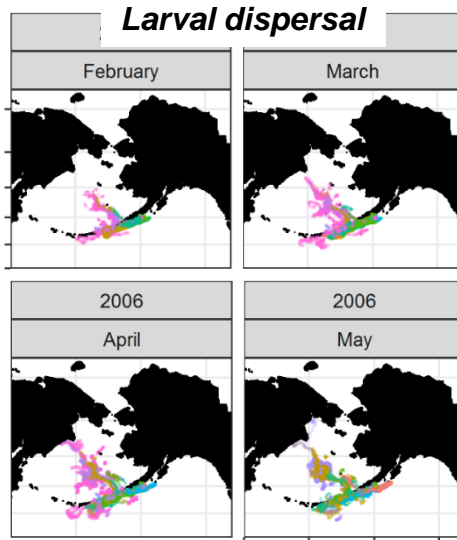
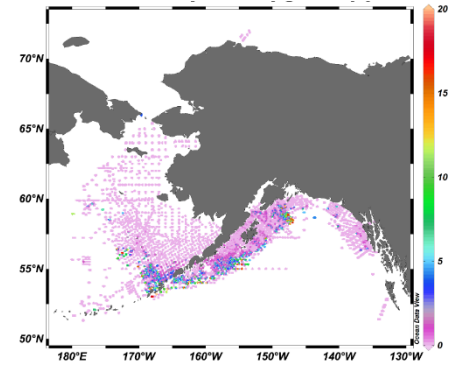
*2. Late juvenile and adult migration*



# 1. Migration and Distribution

## 1. Larval and early juvenile dispersal

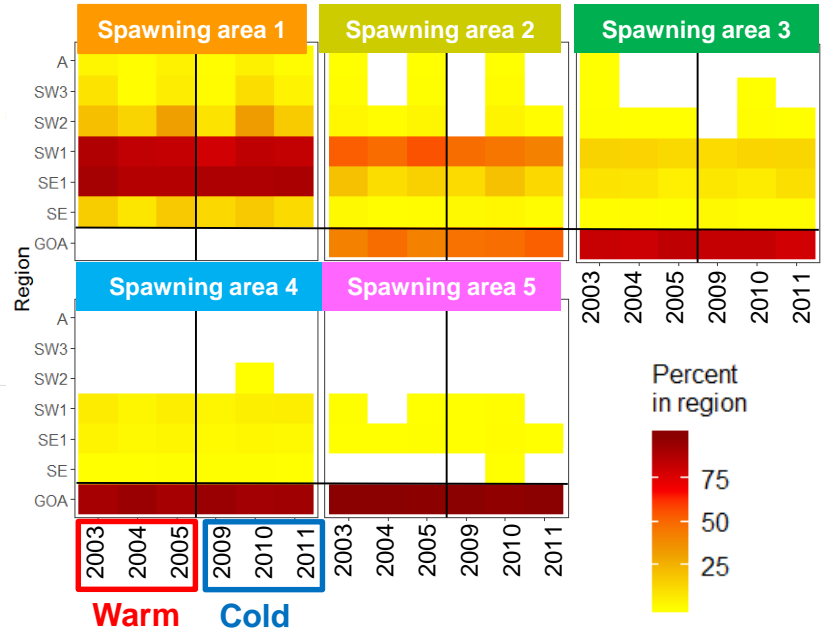
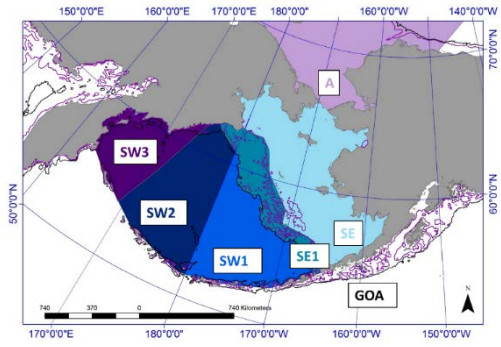
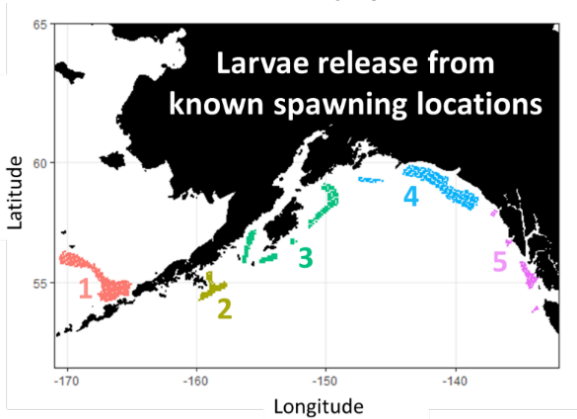
- Contribution of spawning grounds to settlement grounds
- Connectivity of ocean basins
- Environmental effects on larval distribution
- Collaboration with NOAA/EcoFOCI  **NOAA FISHERIES**  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
- Dispersal of young fish post-settlement





# 1. Migration and Distribution

## 1. Larval and early juvenile dispersal: connectivity between GOA and BS



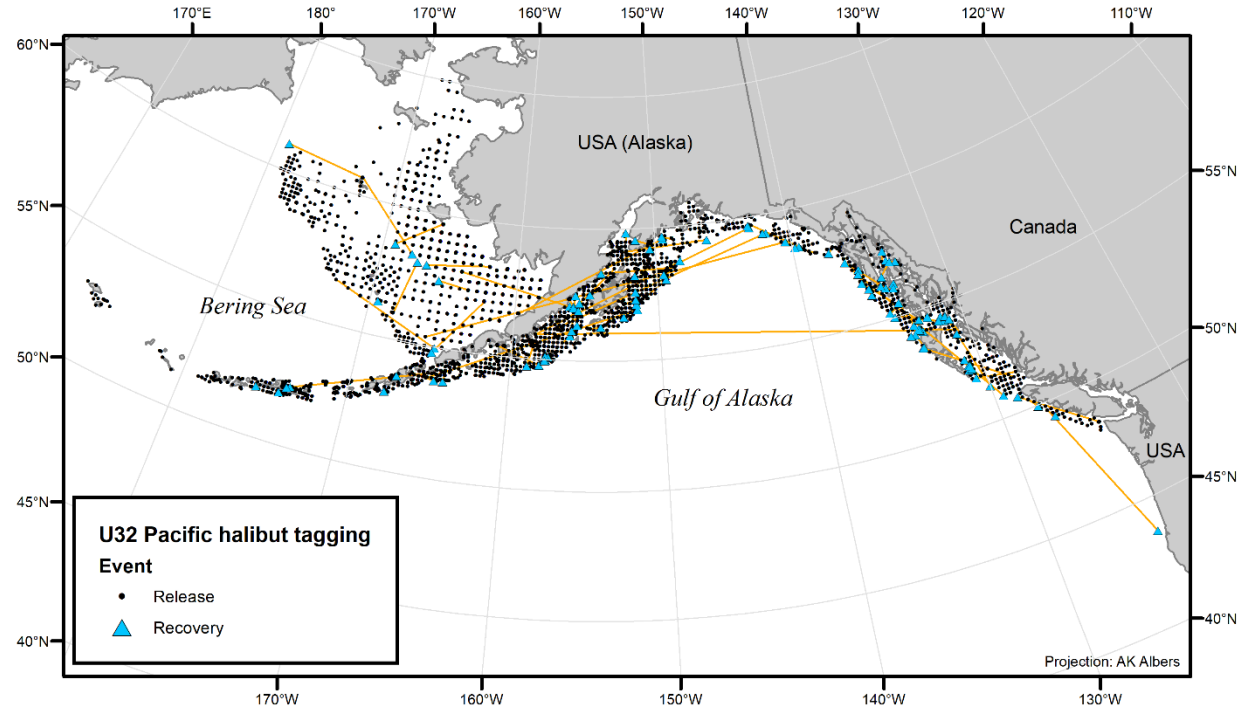
# 1. Migration and Distribution

## 2. Late juvenile and adult dispersal: wire tagging of U32 fish



Since 2015:

- **10,791** U32 fish wire tagged in FISS and NMFS Trawl Survey
- **132** recoveries



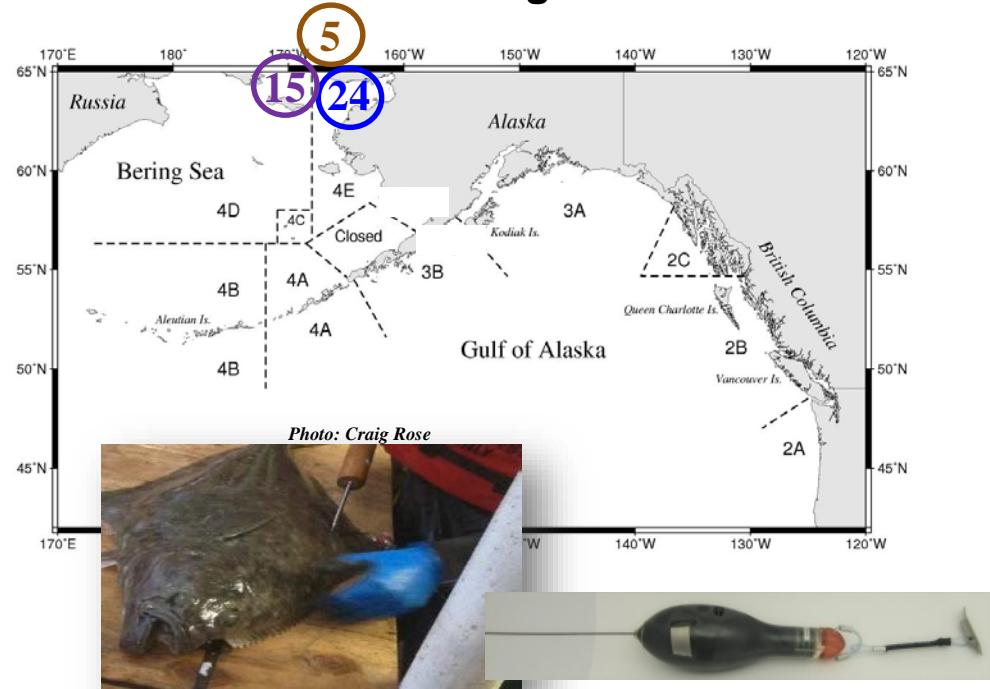
# 1. Migration and Distribution

## 2. Late juvenile and adult dispersal: electronic tagging of U32 and O32 fish

- In 2019 efforts were focused on the northeast Bering Sea shelf:

- Collaboration with Norton Sound Economic Development Corporation (NSEDC) and UAF to tag Pacific halibut (n = 44) with pop-up satellite (PAT) tags in the northeast Bering Sea

- St. Lawrence
- Norton Sound
- NMFS Northern Bering Sea Trawl Survey



# 1. Migration and Distribution

## East-West North Pacific connectivity: developing international collaborations



W2: **FIS** Workshop  
Integrating biological research, fisheries science and management of Pacific halibut and other widely distributed fish species across the North Pacific in the face of climate and environmental variability

Co-sponsors: [IPHC](#)

Duration:

1 day

Convenors:

Josep Planas, *corresponding*

(International Pacific Halibut Commission - IPHC)

Gordon Kruse

(University of Alaska Fairbanks, USA)

Chris Rooper (DFO, Canada)

Roman Novikov

(Kamchatka Research Institute of Fisheries and Oceanography, Russia)

Naoki Tojo

(Hokkaido University, Japan)

Invited Speakers:

[Janet Duffy-Anderson](#) (NOAA, USA)

[Mark Lomeli](#) (PSMFC, USA)

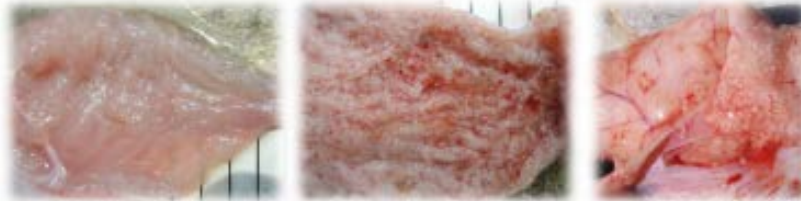
[David Wilson](#) (IPHC)



# 2. Reproduction

## Projects:

- 1. Sex ratio of the commercial landings***
- 2. Full characterization of the annual reproductive cycle to improve current estimates of maturity***

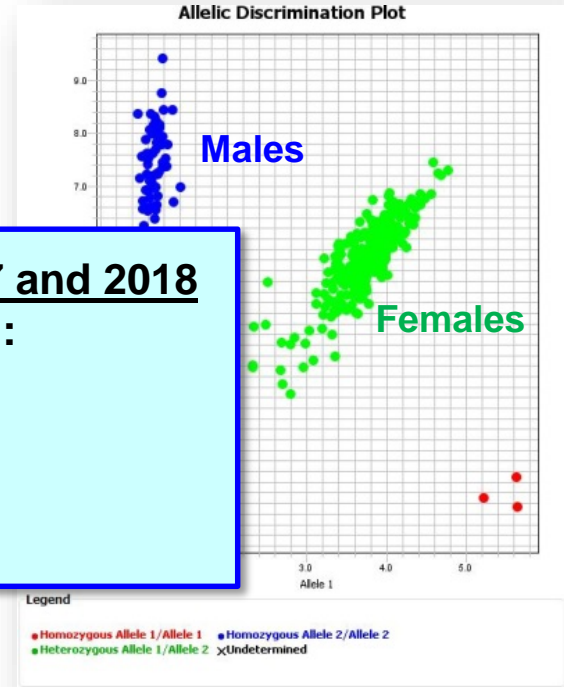
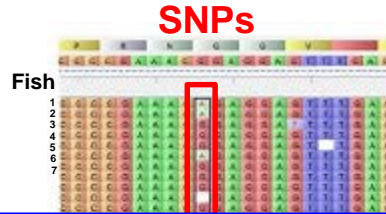
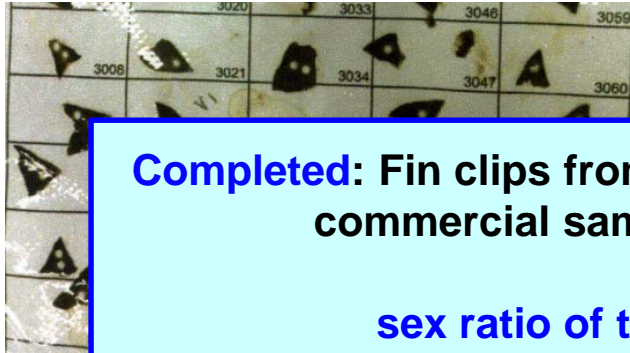


# 2. Reproduction

## 1. Identification of sex in the commercial landings

To generate sex-ratio data for use in assessment and policy analysis

Application of genetic techniques (SNPs)



**Completed:** Fin clips from entire set of aged 2017 and 2018 commercial samples (>10,000 fish/year) :

↓

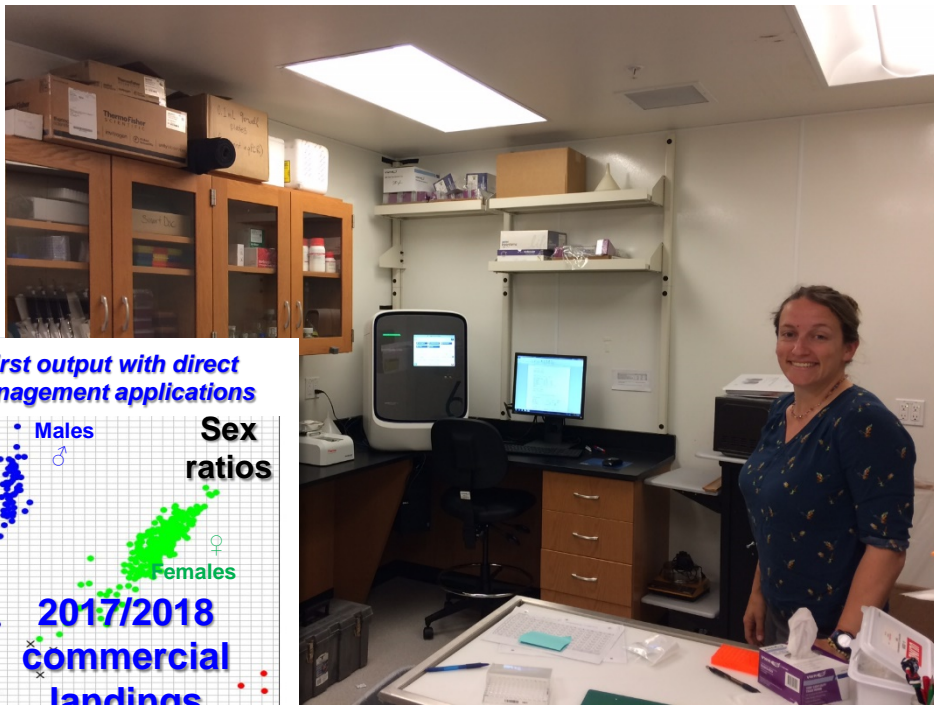
**sex ratio of the commercial fishery**

↓

**2019 FINAL STOCK ASSESSMENT**



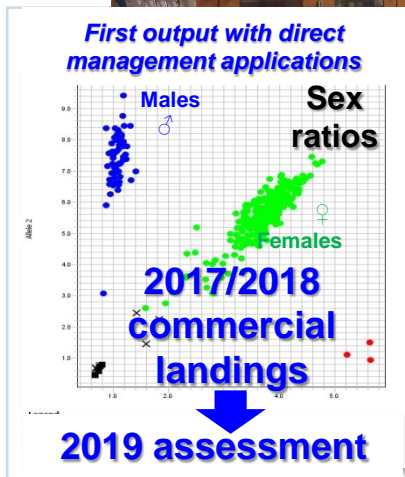
# Biological laboratory at IPHC: established in 2018



- Laboratory technician: *Ms. Anna Simeon*
  - Full time; 04/2018 - 03/2020
  - Salary co-financed by NPRB

- Current lab capabilities:

- Nucleic acid extraction and quantification } Sex ratios/ genetics/ migration
- Genotyping }
- Gene expression → Growth/reproduction
- Blood metabolite and hormone determinations } Discard survival/ reproduction
- Staff and student training }



- Alaska Pacific University MSc Student: Ms. Teresa Fish
- 2019 IPHC Intern: Ms. Kennedy Bolstad
- High school Senior Project: Mr. David King

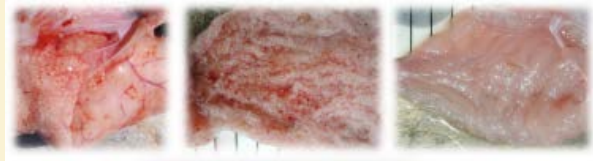


# 2. Reproduction

## 2. Full characterization of the annual reproductive cycle

**Objective:** Revise maturity estimates for female Pacific halibut

### Macroscopic maturity staging (visual assessment)

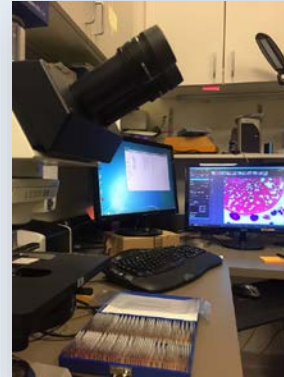


#### Maturity Stage

- 1  immature
- 2  maturing
- 3  ripe
- 4  resting

vs

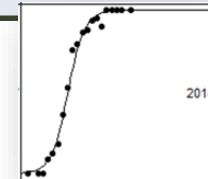
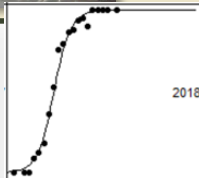
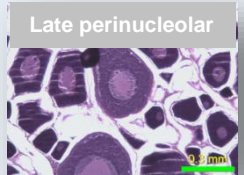
### Microscopic maturity staging (histological assessment)



#### Ovarian histology

↓  
Oocyte stage  
classification

↓  
Maturity staging



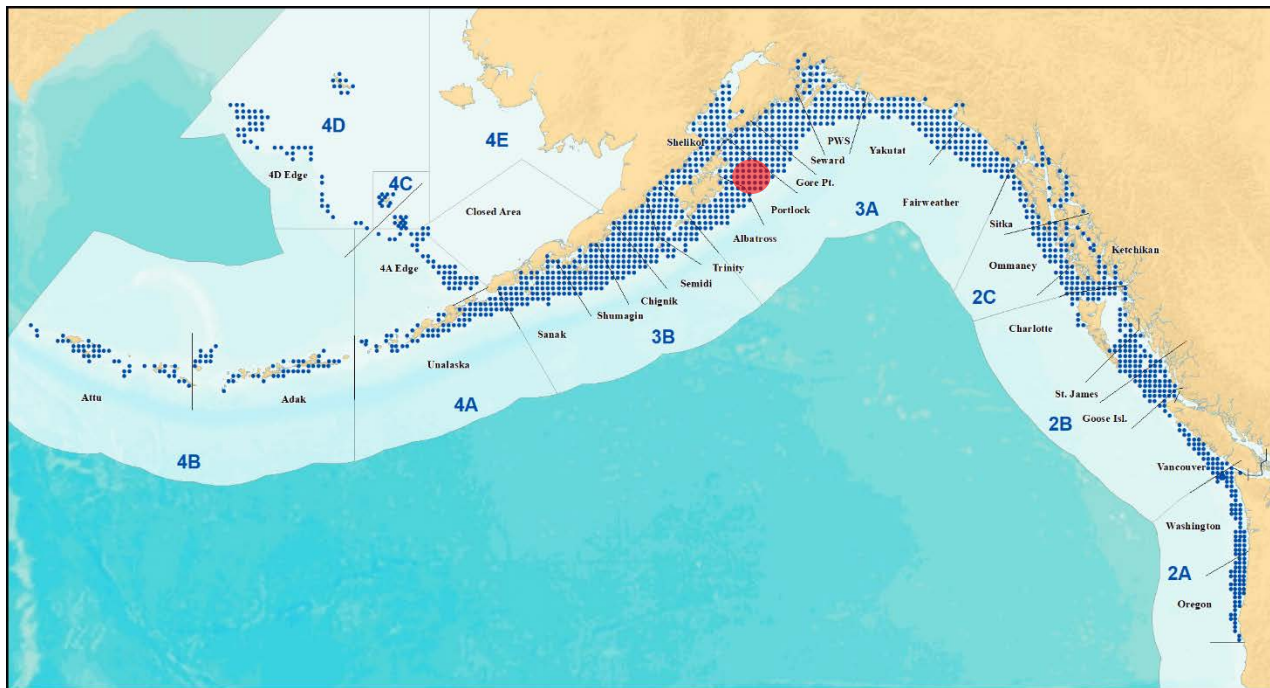
- Maturity ogives
- Maturity estimates





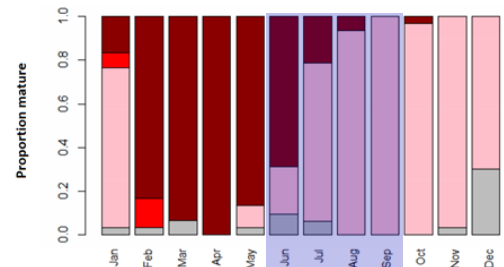
# 2. Reproduction

## Female maturity information available from one region: Portlock

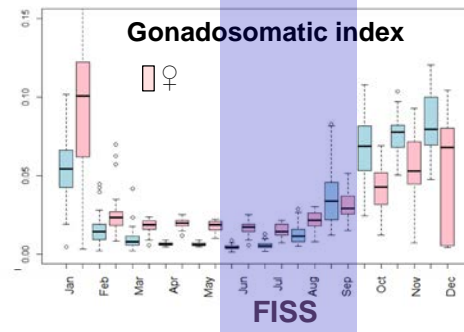


- Full annual collection (2018)

### Macroscopic maturity staging (♀)



### Gonadosomatic index

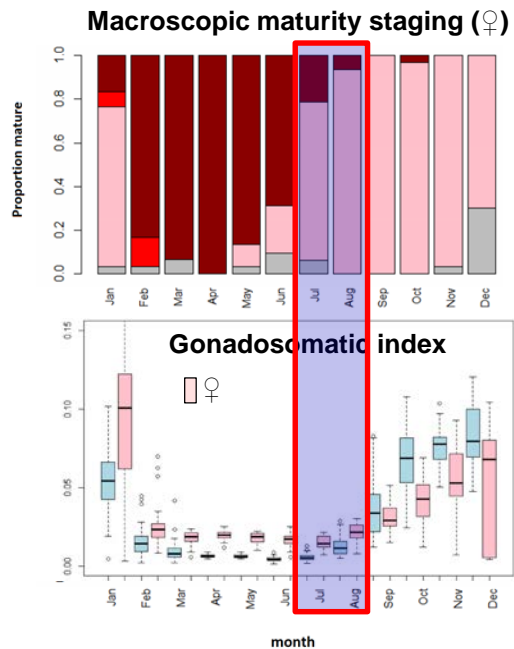
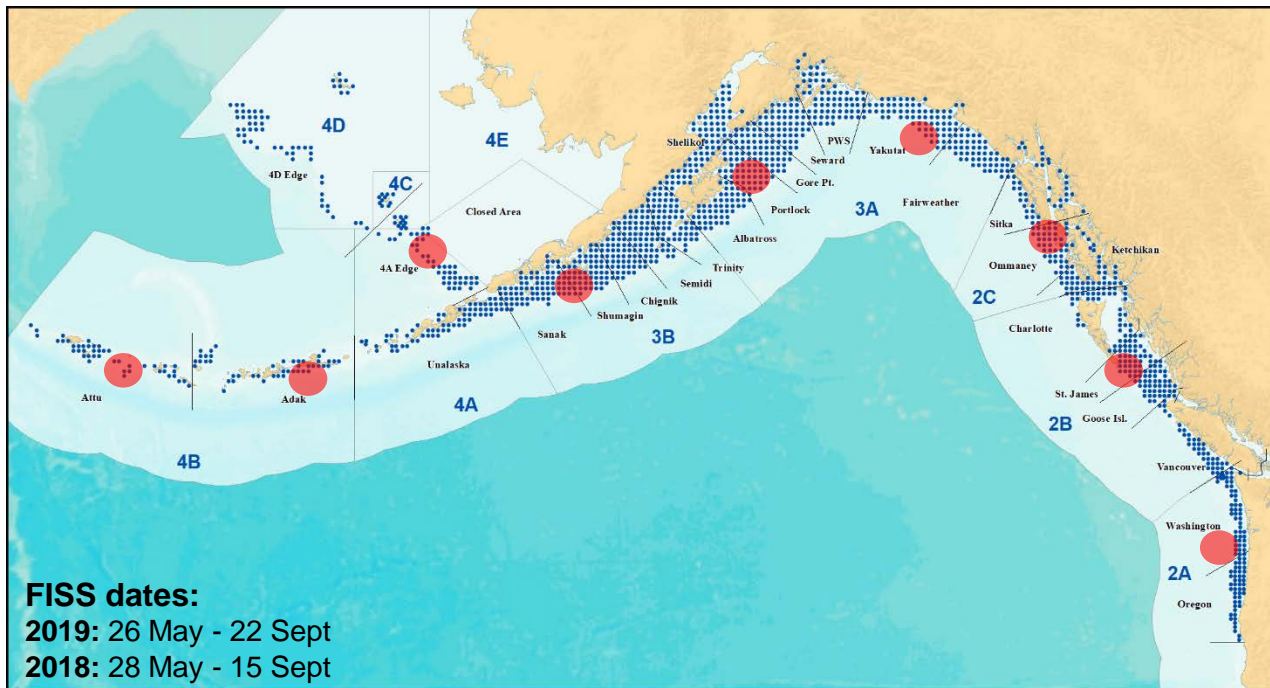


- Interannual collection  
June 2017, 2018, 2019



# 2. Reproduction

## Proposed research: Spatial analysis of maturity



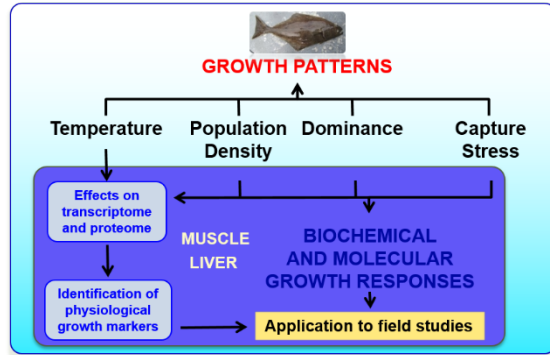
- July-August collection in FISS



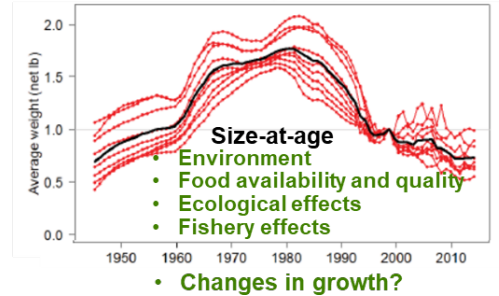
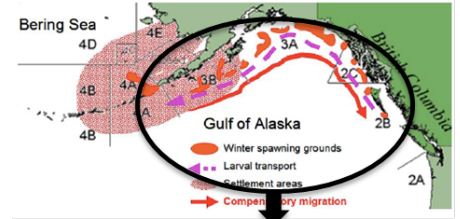
# 3. Growth

## Projects:

- 1. Identification and validation of physiological markers for growth**
- 2. Evaluation of growth patterns in the Pacific halibut population and possible effects of environmental variability**



NPRB Grant 1704  
(2017-2020)



Dr. Thomas Hurst



# 4. Discard mortality rates and survival assessment

Projects:

*Provide direct estimations of DMRs in:*

*1. The directed longline fishery*



*2. The guided recreational fishery*



# 4. DMRs and survival assessment

## 1. Directed longline fishery: A. Relationship between *handling practices* and *injury levels* and *physiological condition* of released Pacific halibut

- Assessed *injuries* associated with release techniques (careful shake, gangion cut, hook stripping).



- *Physiological condition* of released fish

- Condition factor indices

- Blood stress

- Fat content

- *Capture conditions*

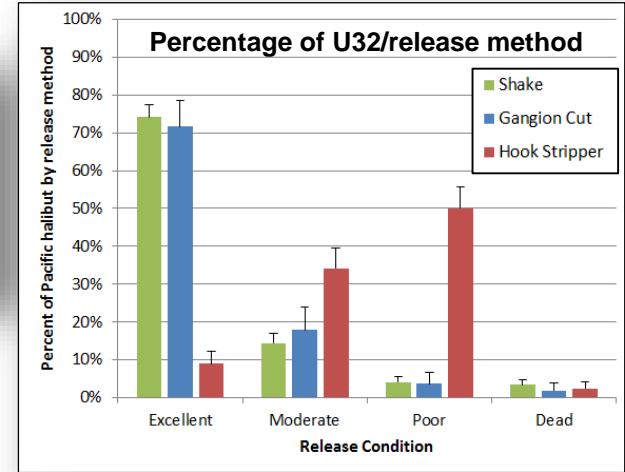
- Time



- Water temperature loggers



- Fish temperature



### Stress indicators:

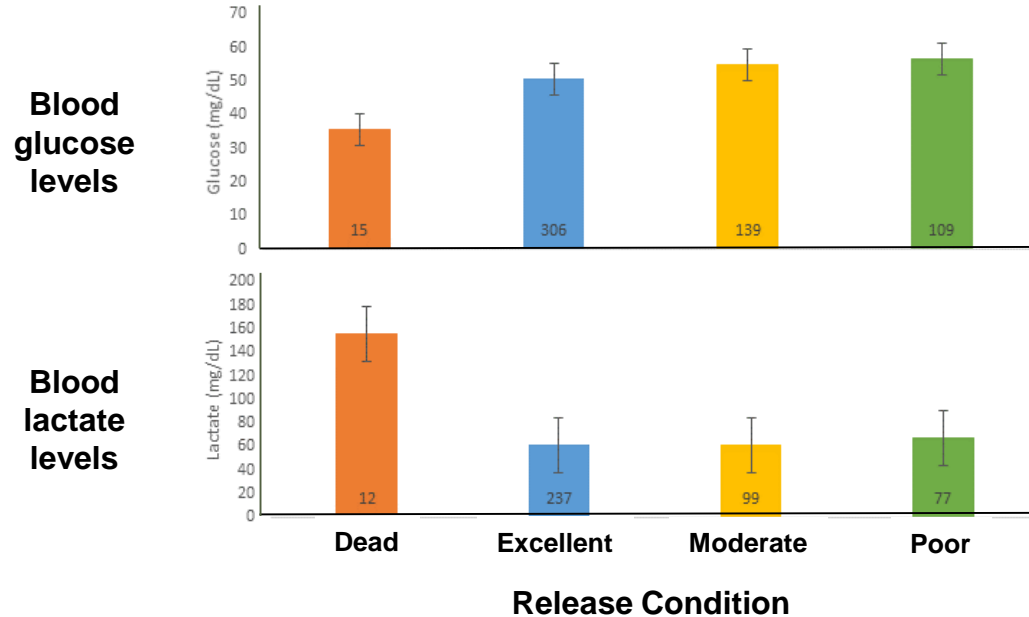
- ✓ Glucose
- ✓ Lactate
- ✓ Cortisol



# 4. DMRs and survival assessment

## 1. Directed longline fishery: A. Relationship between *handling practices* and *injury levels* and *physiological condition* of discarded Pacific halibut

- *Physiological condition* of discarded fish: Stress indicators by release condition



Physiological predictors of survival



# 4. DMRs and survival assessment

## 2. Guided recreational fishery: Estimation of DMRs

- Project initiated in 2019

### Objectives:

2019

1. Collect information on hook types and sizes and handling practices: **Completed**

2020

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



Sport charter



Captured Pacific halibut



Hook injury assessment



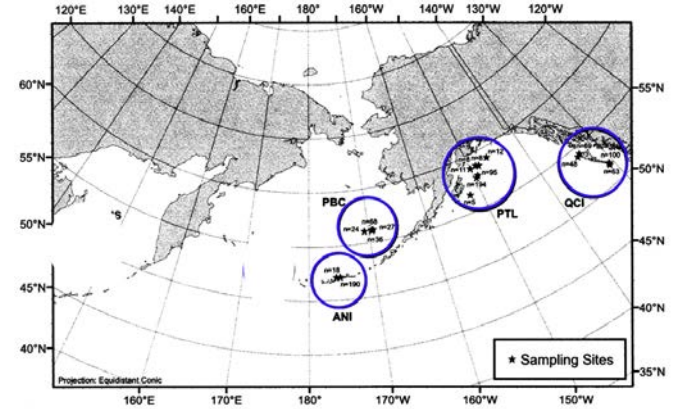
Tagging with sPATs



# 5. Genetics and Genomics

## Projects:

1. *Genetic structure of the Pacific halibut population and distribution*
2. *Genome sequencing*



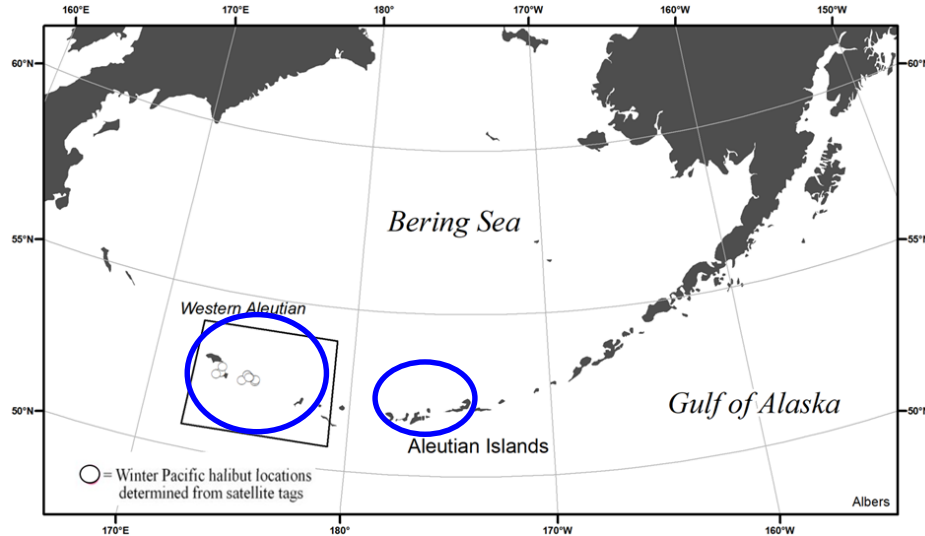
**New research position:  
Genetics  
Mr. Andy Jasonowicz  
1 yr- contract  
8/26/2019-8/25/2020**





# 5. Genetics and Genomics

- **Genetic structure of the Pacific halibut population:**
  1. **Reg. Area 4B Structure: – Eastern vs Western Aleutian Islands**



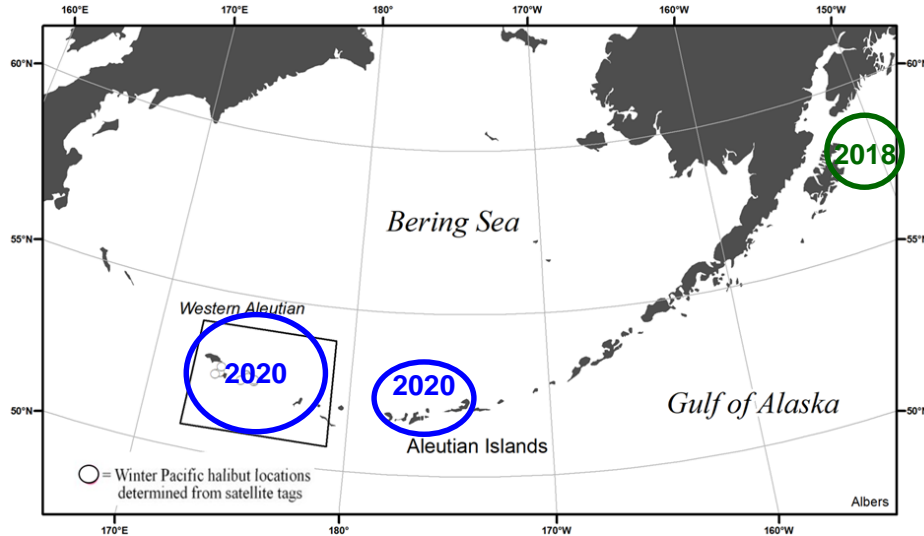
**Aim: Investigate potential genetic differences between Central and Western Aleutian Islands**

1. **Collect winter genetic samples (winter 2020)**
2. **Conduct genetic analyses**

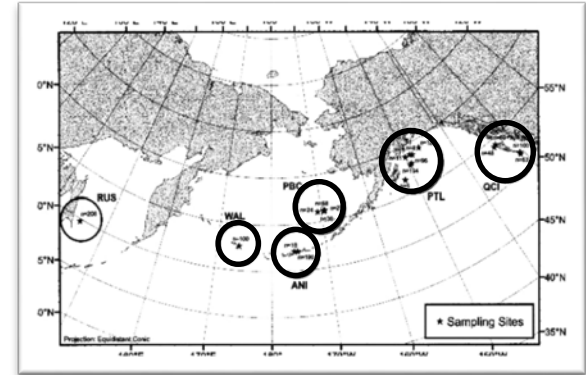


# 5. Genetics and Genomics

- Genetic structure of the Pacific halibut population:
  2. Identification of potential genetic signatures of origin (baseline signals)



**Aim:** Establish genetic baselines from known spawning groups to conduct assignment studies and determine the genetic population structure coastwide



**Aim:** Revised population structure

**Genetic analyses using:**

New samples (2018, 2020)

Previous samples (early 2000s)



# Outline



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- Five-year research plan and management implications
- Progress on ongoing research projects
- **Externally-funded collaborative research**



# Externally-funded collaborative research

Project #	Grant agency	Project name	PI	Partners	IPHC Budget (\$US)	Management implications	Grant period
1	Saltonstall-Kennedy NOAA	<b>Improving discard mortality rate estimates in the Pacific halibut by integrating handling practices, physiological condition and post-release survival</b> (Award No. NA17NMF4270240)	IPHC	Alaska Pacific University	\$286,121	Discard estimates	September 2017 – August 2020
2	North Pacific Research Board	<b>Somatic growth processes in the Pacific halibut (<i>Hippoglossus stenolepis</i>) and their response to temperature, density and stress manipulation effects</b> (NPRB Award No. 1704)	IPHC	AFSC-NOAA-Newport, OR	\$131,891	Changes in biomass/size-at-age	September 2017 – February 2020
3	Bycatch Reduction Engineering Program - NOAA	<b>Adapting towed array hydrophones to support information sharing networks to reduce interactions between sperm whales and longline gear in Alaska</b>	ALFA	IPHC, University of Alaska Southeast, AFSC-NOAA	-	Whale Depredation	September 2018 – August 2019
4	Bycatch Reduction Engineering Program - NOAA	<b>Use of LEDs to reduce Pacific halibut catches before trawl entrapment</b>	PSMFC	IPHC, NMFS	\$1,750	Bycatch reduction	September 2018 – August 2019
5	National Fish and Wildlife Foundation	<b>Discard mortality rate characterization in the Pacific halibut recreational fishery</b> (NFWF Award No. 61484)	IPHC	UA Fairbanks, APU, Grey Light Fisheries, Alaska Charter Association	\$98,901	Discard estimates	2019-2020
<b>Total awarded (\$)</b>					<b>\$518,663</b>		



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