



INTERNATIONAL PACIFIC



HALIBUT COMMISSION

Biological and Ecosystem Science Research Update

Agenda Item 7.3

IPHC-2019-IM095-13

Outline



INTERNATIONAL PACIFIC



HALIBUT COMMISSION



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



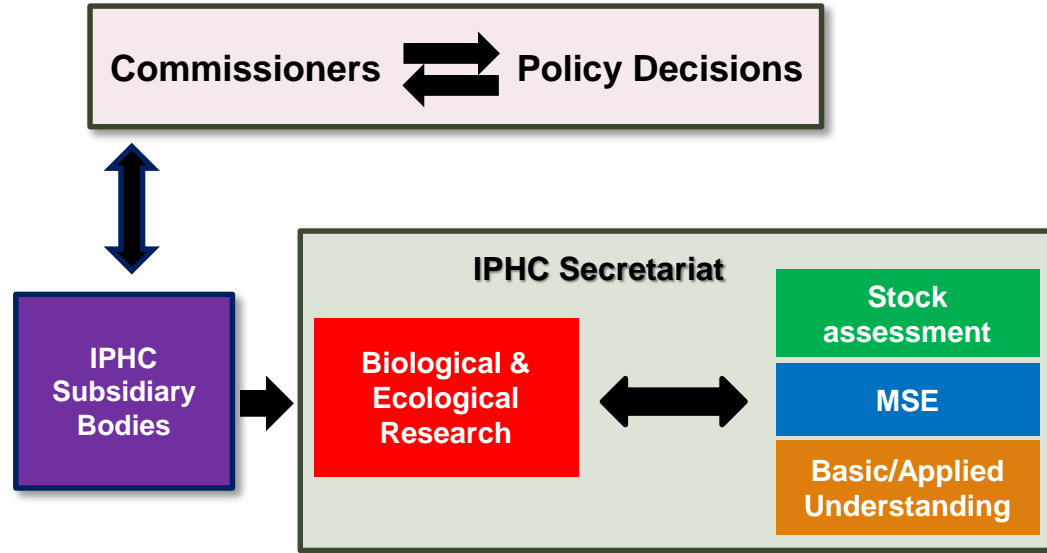
Five-year research plan and management implications

5-Year Biological and Ecosystem Science Research Plan

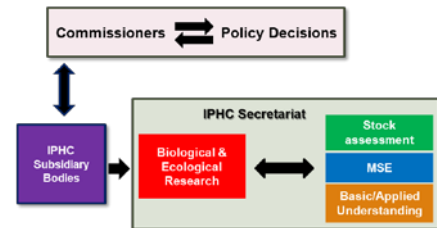
<i>Primary Research Areas</i>
Migration
Reproduction
Growth
DMRs and discard survival
Genetics and genomics



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

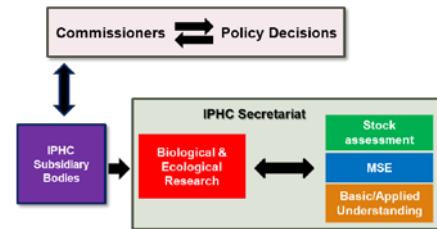
Relevance for stock assessment
Geographical selectivity
Stock distribution
Spawning biomass scale and trend Stock productivity Recruitment variability
Temporal and spatial variation in growth Yield calculations Effects of ecosystem conditions Effects of fishing
Scale and trend in mortality
Scale and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



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	Spawning biomass scale and trend Stock productivity	Sex ratio Maturity schedule fecundity
Growth			Weight-at-age
Discard Survival			Changes in weight-at-age Discard mortality estimates and uncertainty in discard mortality estimates
Genetics and Genomics	Sequencing of the Pacific halibut genome	Management units	Information for structural choices

Sex ratio of commercial landings	Spawning biomass scale and trend INPUT: Sex ratio at age
	Operating Model INPUT: Sex ratio at age



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 Sample collection	Data analysis	Data synthesis
	Adult and juvenile migration	Tagging Data analysis	Tagging	Data synthesis SA MSE	Tagging Data analysis	Data synthesis SA MSE
						Data synthesis



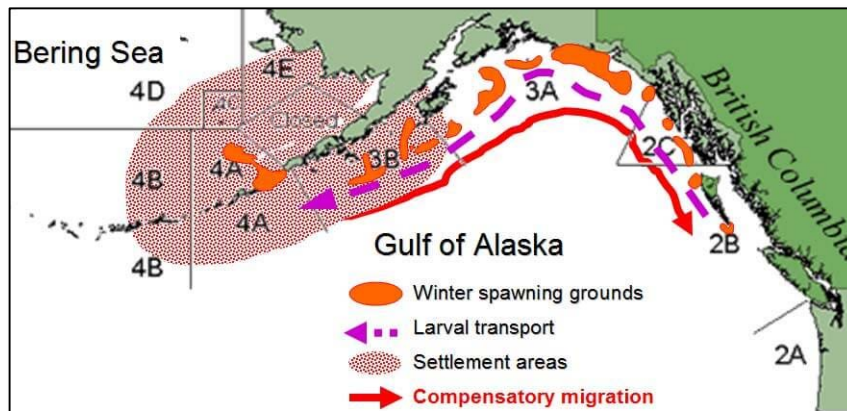
Progress on ongoing research projects

1. Migration and distribution

Projects:

1. Larval and early juvenile dispersal

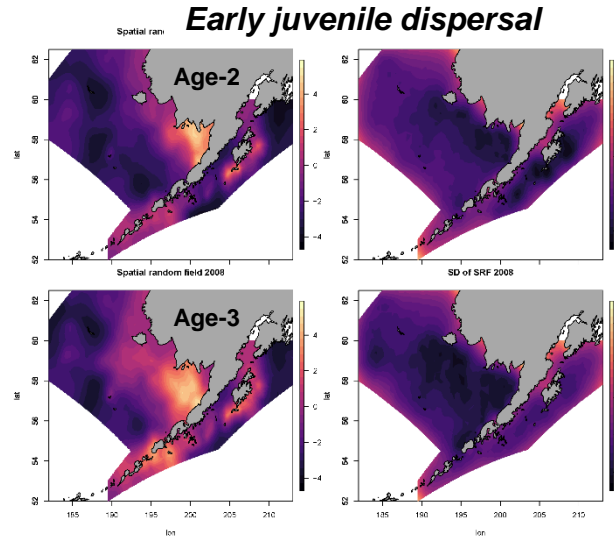
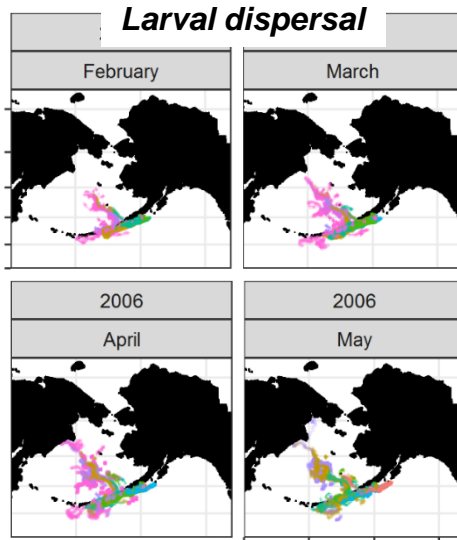
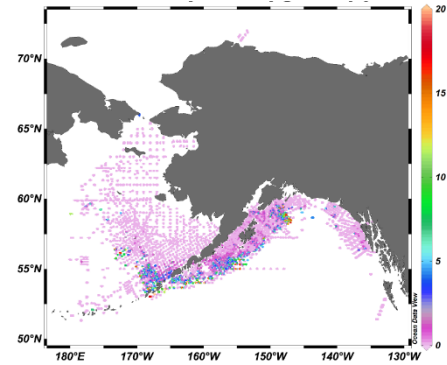
2. Late juvenile and adult migration



1. Migration and Distribution

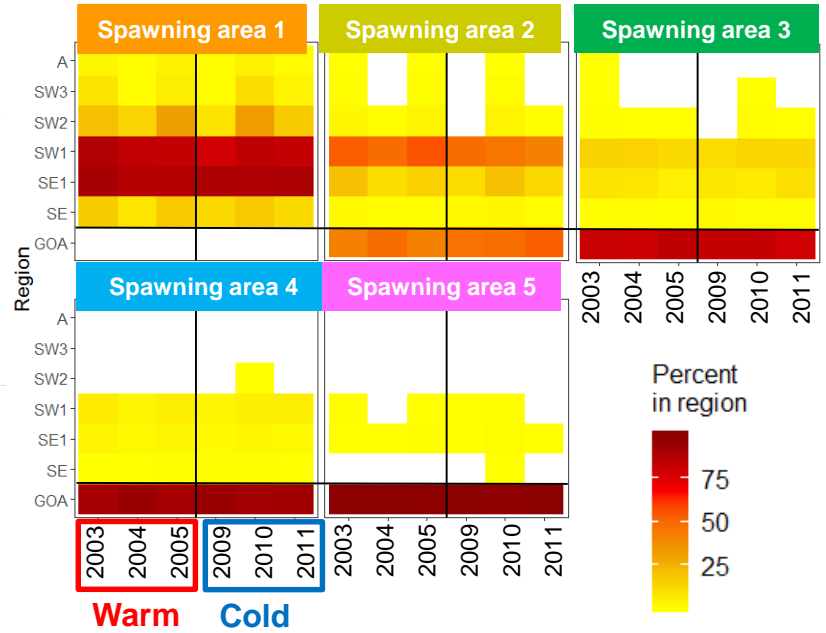
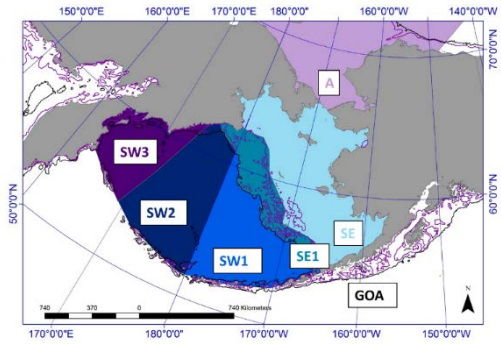
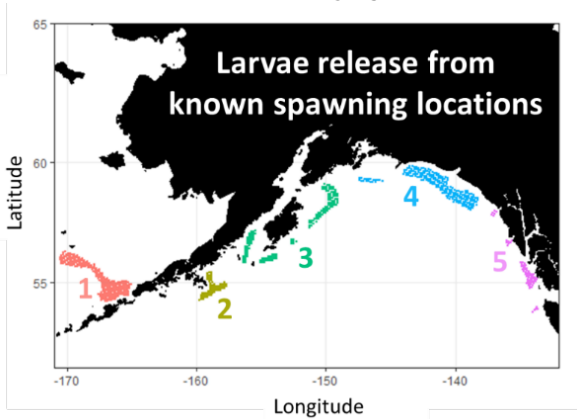
1. Larval and early juvenile dispersal

- Contribution of spawning grounds to settlement grounds
- Connectivity of ocean basins
- Environmental effects on larval distribution
- Collaboration with NOAA/EcoFOCI 
- Dispersal of young fish post-settlement



1. Migration and Distribution

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



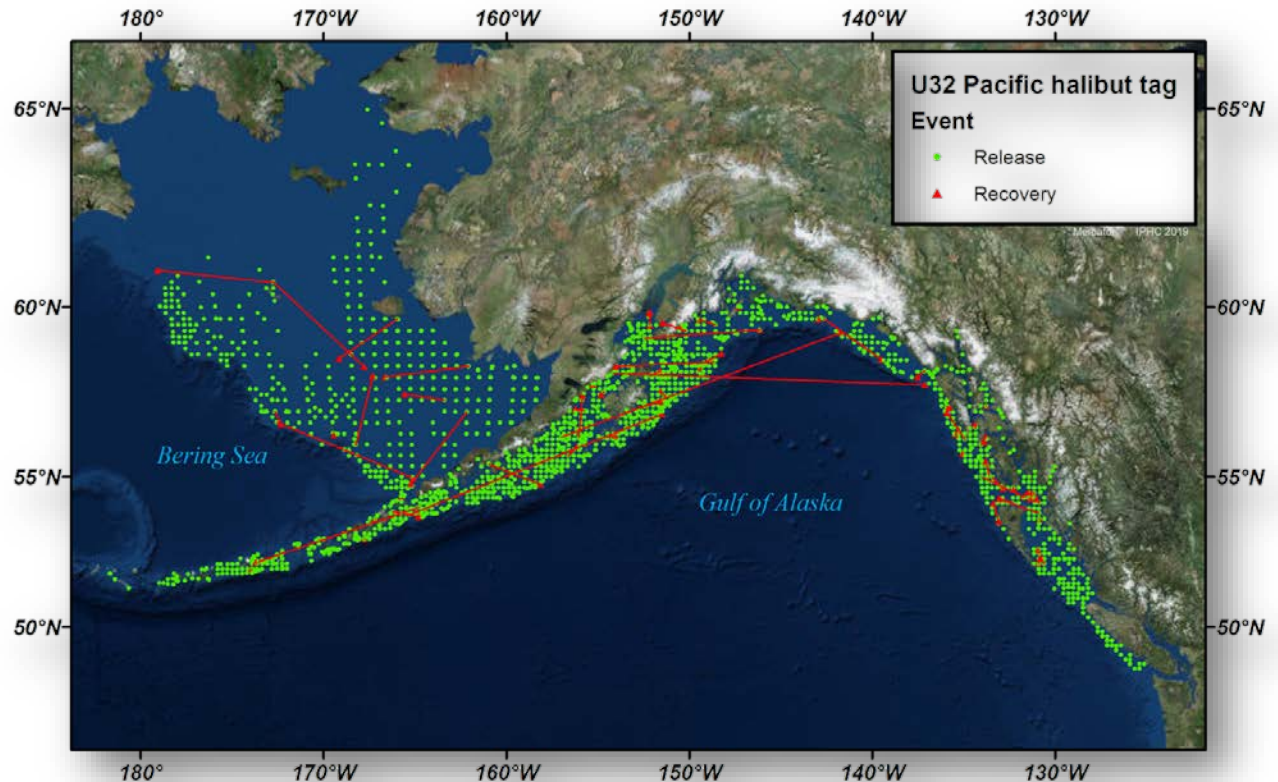
1. Migration and Distribution

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



Since 2015:

- 10,770 U32 fish wire tagged in FISS and NMFS Trawl Survey
- 110 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 eastern Bering Sea shelf:

- Collaboration with Norton Sound Economic Development Corporation (NSEDC) and UAF to tag U32 and O32 Pacific halibut ($n = \sim 56$) with pop-up satellite (PAT) tags in Norton Sound and St. Lawrence Island

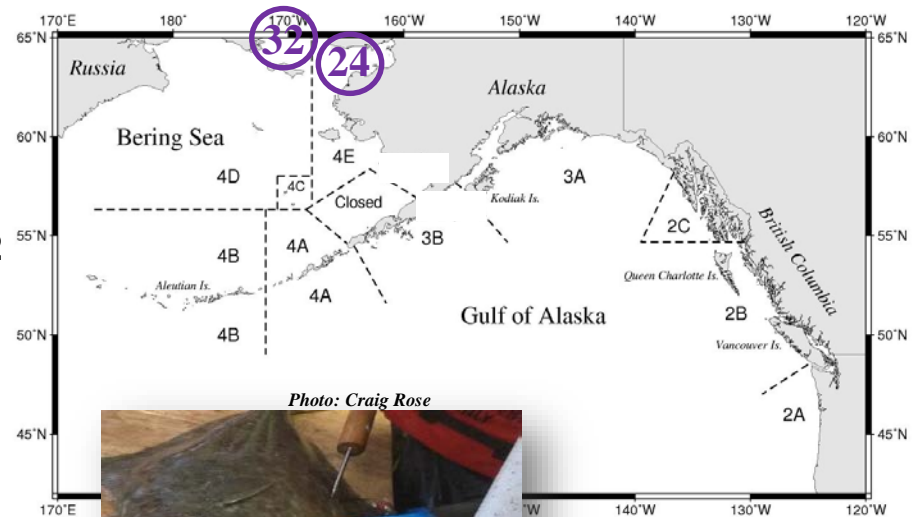


Photo: Craig Rose



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***

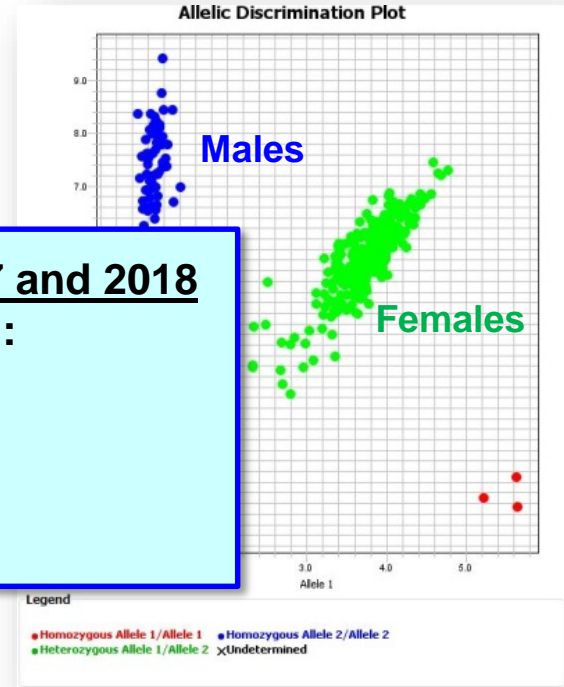
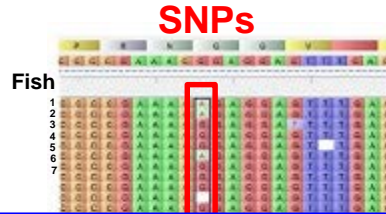
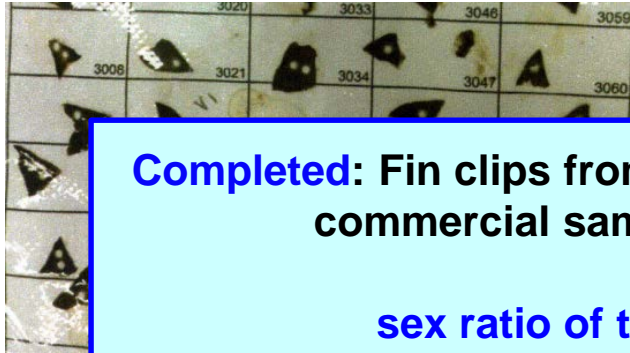


2. Reproduction

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



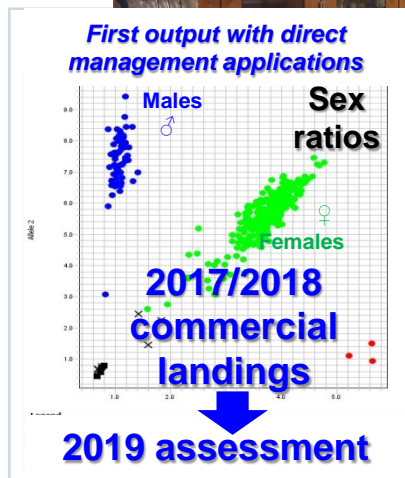
Biological laboratory at IPHC: established in 2018



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

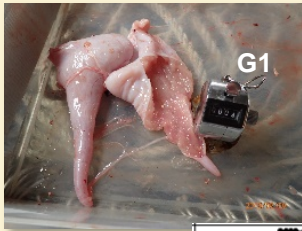


2. Reproduction

2. Full characterization of the annual reproductive cycle

Objective: Revise maturity estimates for female Pacific halibut

Macroscopic maturity staging (visual assessment)

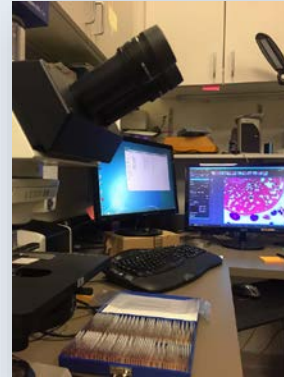


Maturity Stage

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

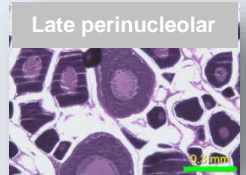
vs

Microscopic maturity staging (histological assessment)

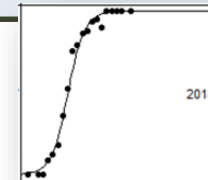
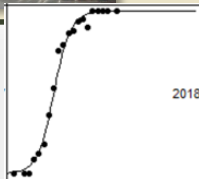


Ovarian histology

↓
Oocyte stage
classification



↓
Maturity staging

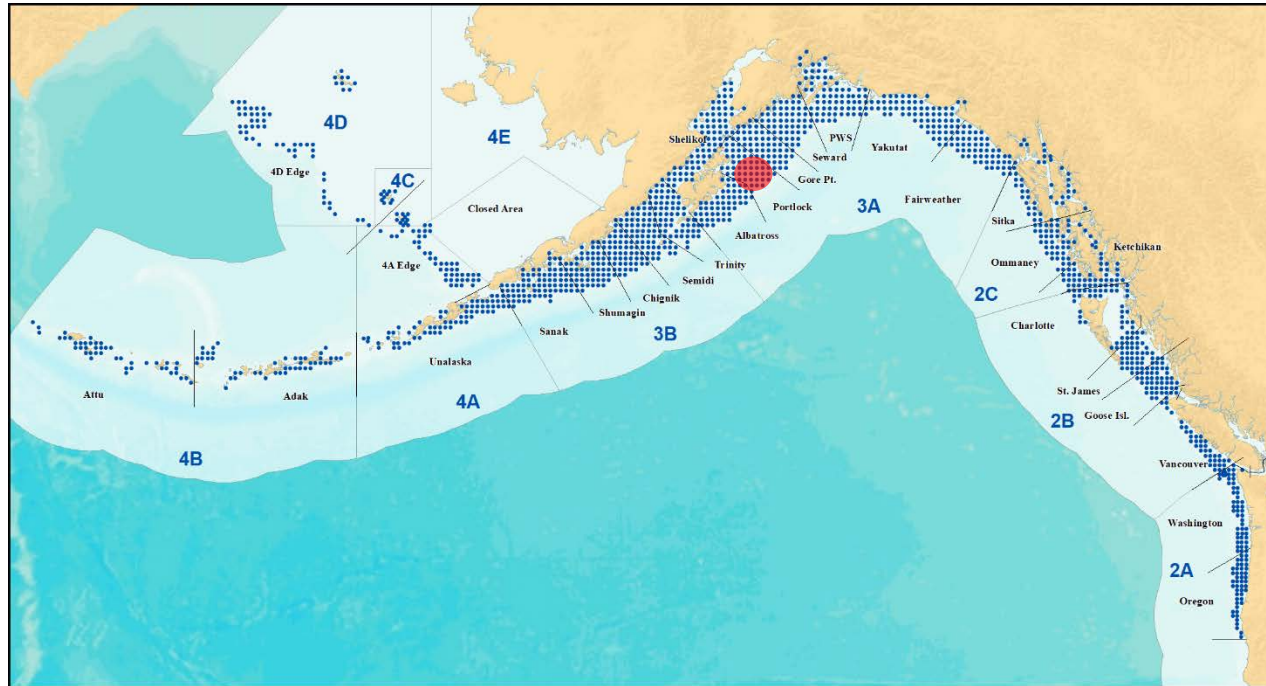


- Maturity ogives
- Maturity estimates



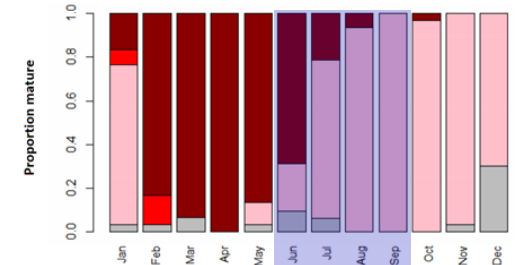
2. Reproduction

Female maturity information available from one region: Portlock

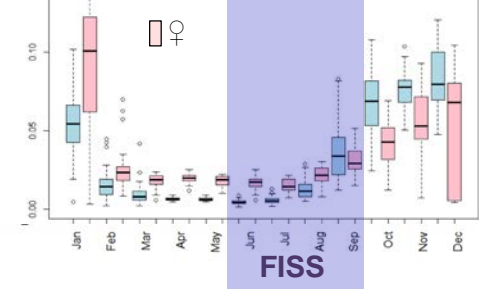


- Full annual collection (2018)

Macroscopic maturity staging (♀)



Gonadosomatic index

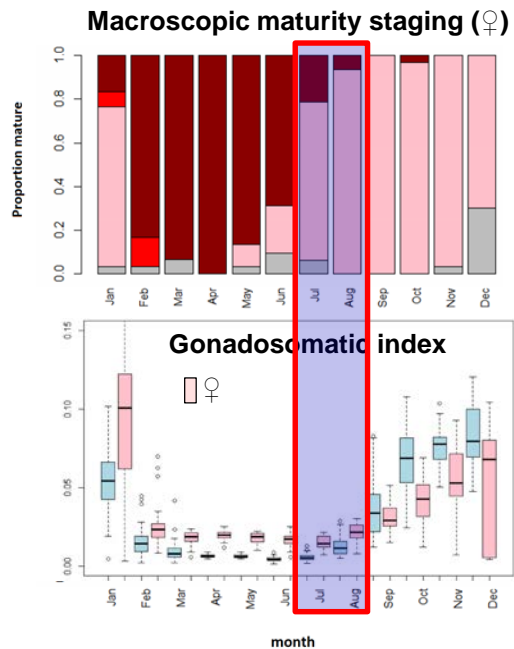
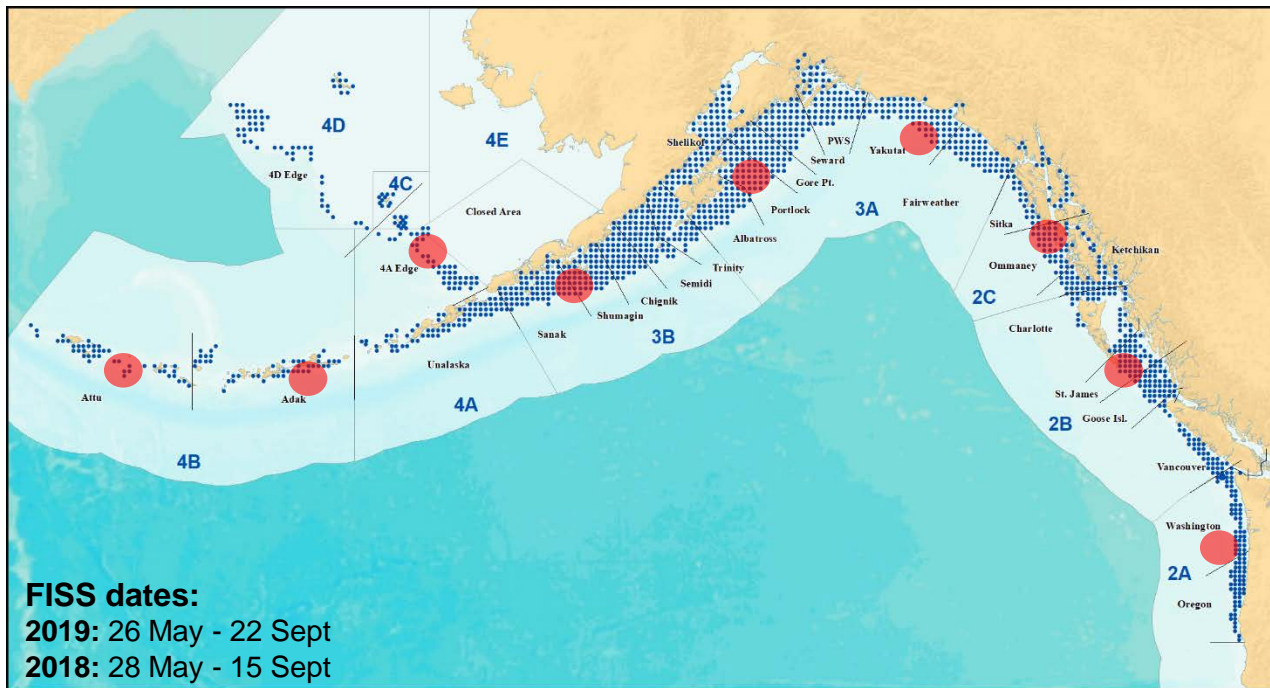


- Interannual collection
June 2017, 2018, 2019



2. Reproduction

Proposed research: Spatial analysis of maturity



- July-August collection in FISS



3. Discard mortality rates and survival assessment

Projects:

1. Improve DMR estimations in the directed longline fishery



NOAA FISHERIES

Saltonstall – Kennedy Grant NA17NMF4270240



2. Estimate DMRs in the guided recreational fishery



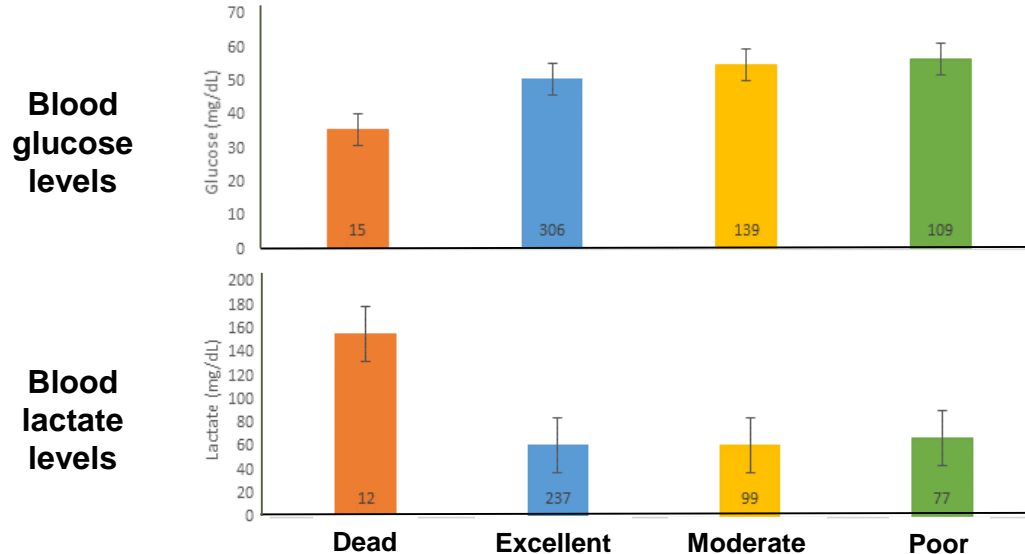
NFWF National Fish and Wildlife Foundation



3. 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



3. 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



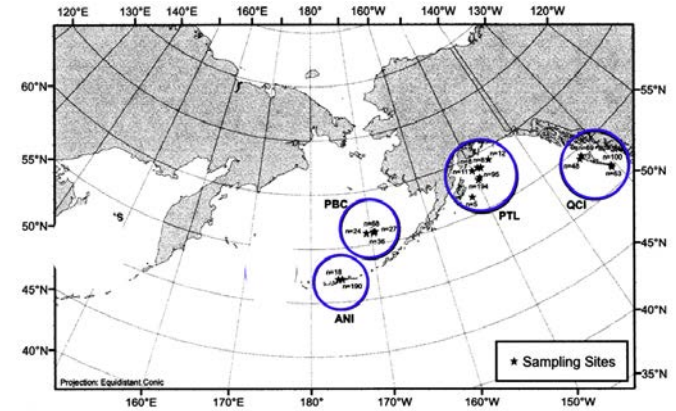
Tagging with sPATs



4. Genetics and Genomics

Projects:

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

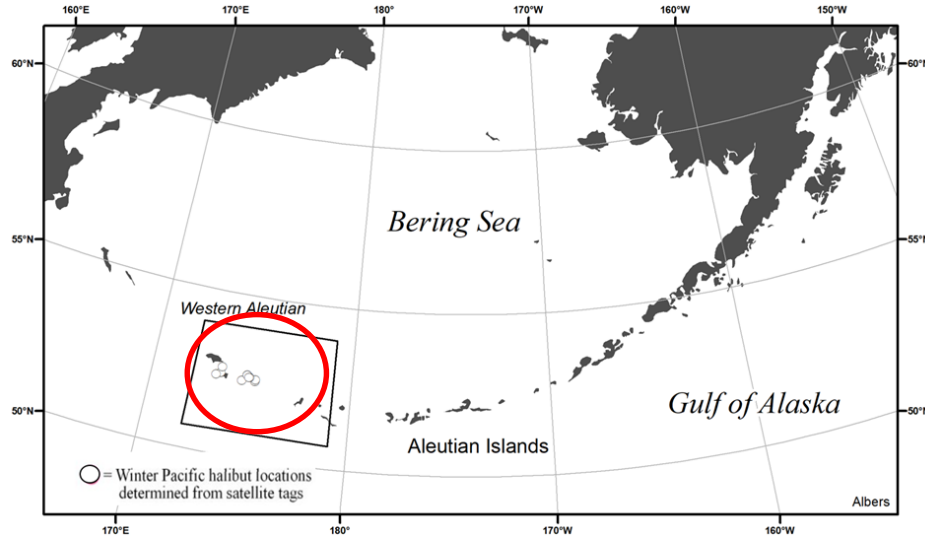


**New research position:
Genetics
Mr. Andy Jasonowicz
1 yr- contract
8/26/2019-8/25/2020**



4. Genetics and Genomics

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



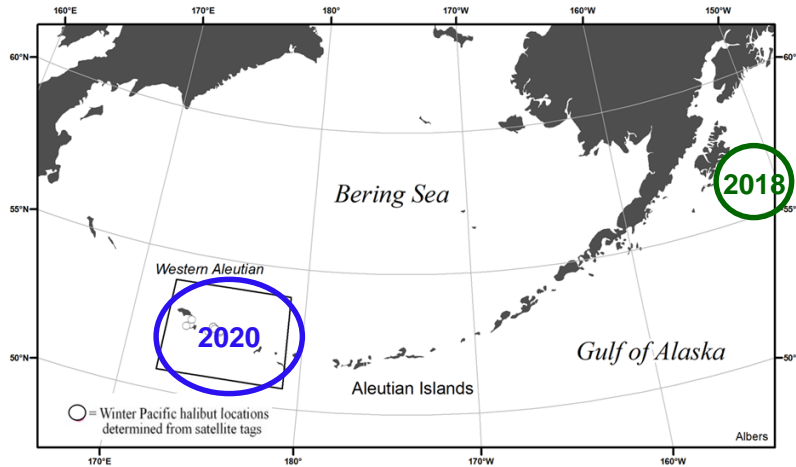
Aim: Investigate potential genetic differences between Eastern and Western Aleutian Islands

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

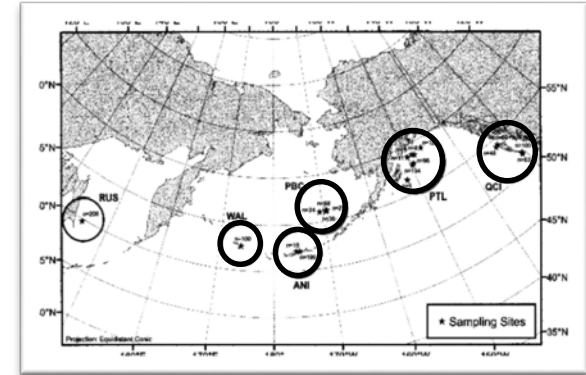


4. Genetics and Genomics

- Genetic structure of the Pacific halibut population:
 1. Identification of spawning groups
 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)
Old samples (early 2000s)



Outline



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- Five-year research plan and management implications
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- **Externally-funded collaborative research**

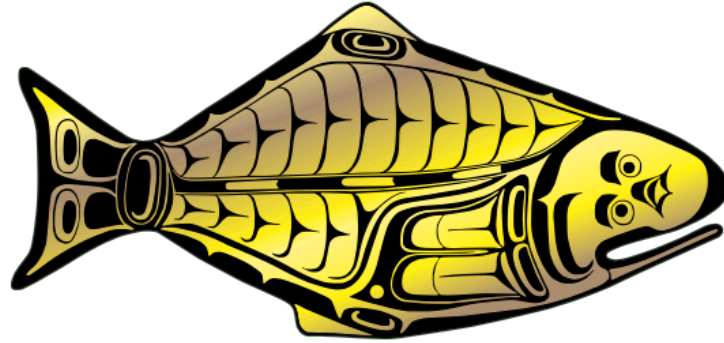


Externally-funded collaborative research

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



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