INTERNATIONAL PACIFIC HALIBUT COMMISSION

Report on current and future Biological and Ecosystem Science Research activities

Agenda item: 9.1

IPHC-2025-IM101-14

(J. Planas)

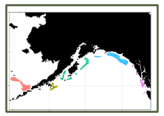
1. Migration and Population Dynamics

5-Yr Research Plan (2017-2021)

Multiple life-stage connectivity

Bering Sea

Gulf of Alaska



Genetic samples of spawning aggregations

Larval connectivity

- Larval catch and effort data
- Individual-based biophysical model
- Hydrographic ROMS model

→ Larval dispersal pathways → Inter-basin and intra-basin larval connectivity

Sadorus et al. (2021) *Fish. Oceanog.* ***30****: 174*

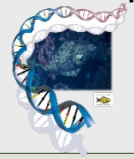
Juvenile connectivity

- NMFS trawl survey data
- Spatiotemporal model

→ Ontogenetic migration

Development and application of genomic approaches

Genome sequence



→ Population structure analyses

Jasonowicz et al. (2022) *Mol. Ecol. Res.* ***22****: 2685*

PIRM 2022-2026

- Climate effects on larval connectivity
- Connectivity with Western Pacific Ocean region
- Mapping of settlement/nursery areas
- Characterization of genetic composition/mixture of settlement areas
- Establishment of a baseline of genetic diversity
- Delineation of fine-scale stock structure
- Stock composition: mixed stock analyses

Relevance for stock assessment

- Generate potential recruitment covariates
- Define management targets for minimum spawning biomass by Biological Region

→ Improved estimates of productivity

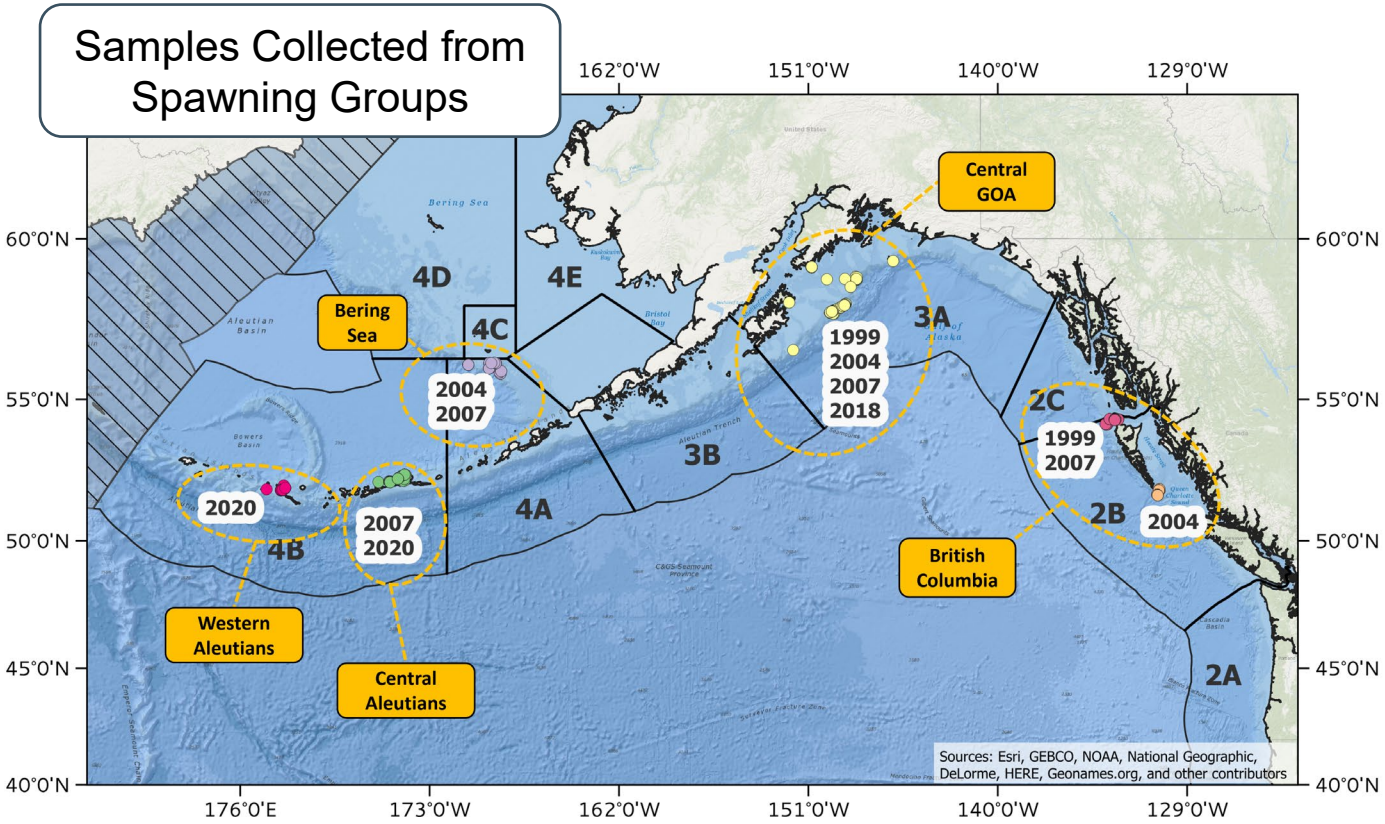
- Determine the need for separate assessments for certain components of the stock

→ Potential revision of structure of future stock assessments

1. Migration and Population Dynamics

Population Genomics

Objective: Resolve the genetic structure of the Pacific halibut stock in IPHC Convention Waters



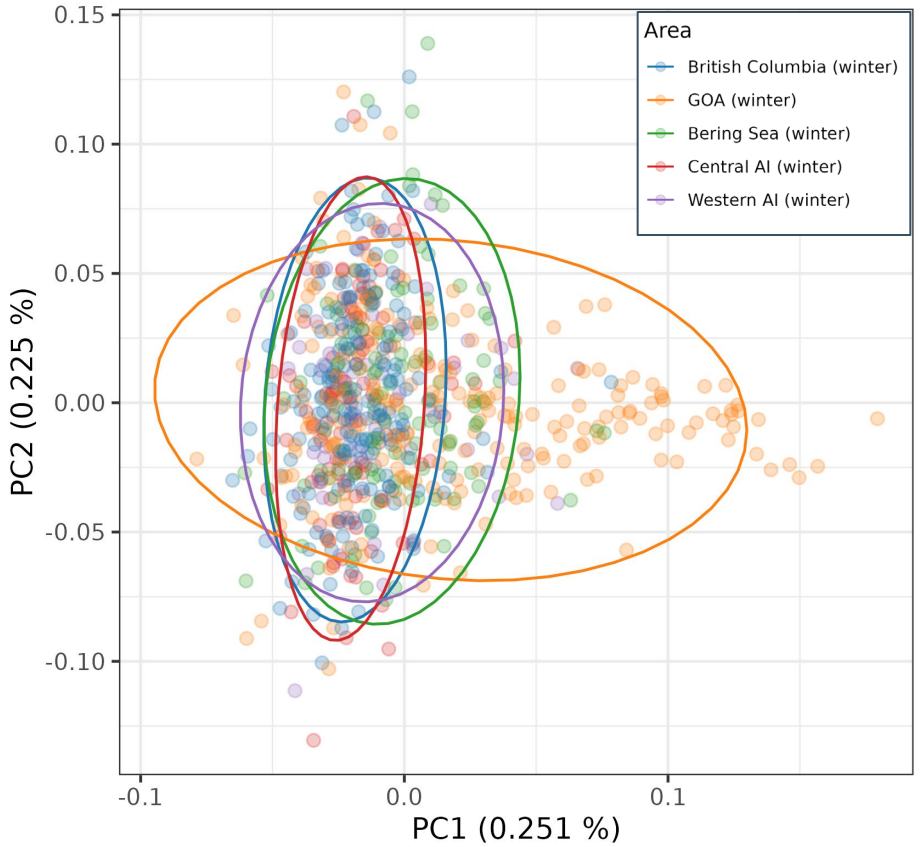
NPRB Project 2110 (2022-2024)

- Low-coverage whole-genome resequencing (lcWGR)
- Allows for screening genomic variation at very high resolution
- Added 185 winter- collected samples to the dataset

- **731 individuals (~60/collection)**
- **4 sequencing runs - Illumina NovaSeq**
- **~ 3.7 million autosomal SNPs (minor allele frequency ≥ 0.05)**

1. Migration and Population Dynamics

Population Structure

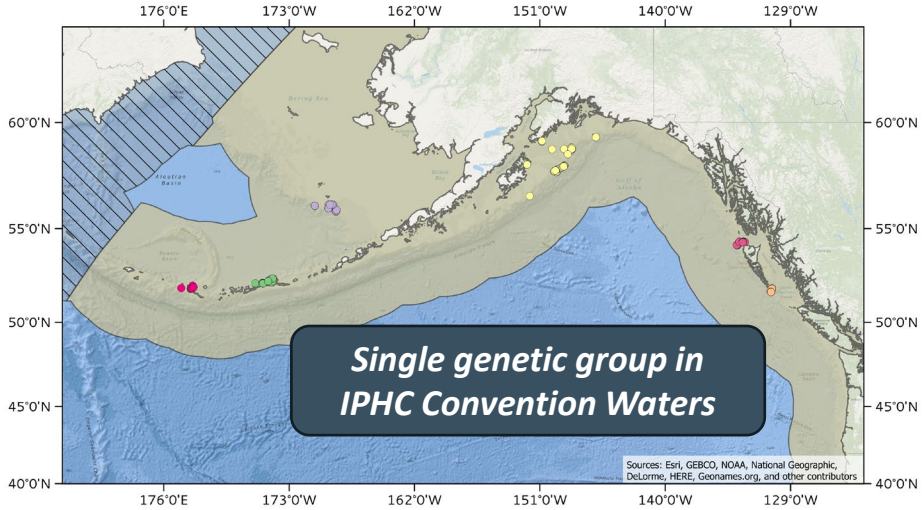


- Principal components analysis (PCA)
  - *No discrete genetic groups detected*
- Ur ence of discrete groups

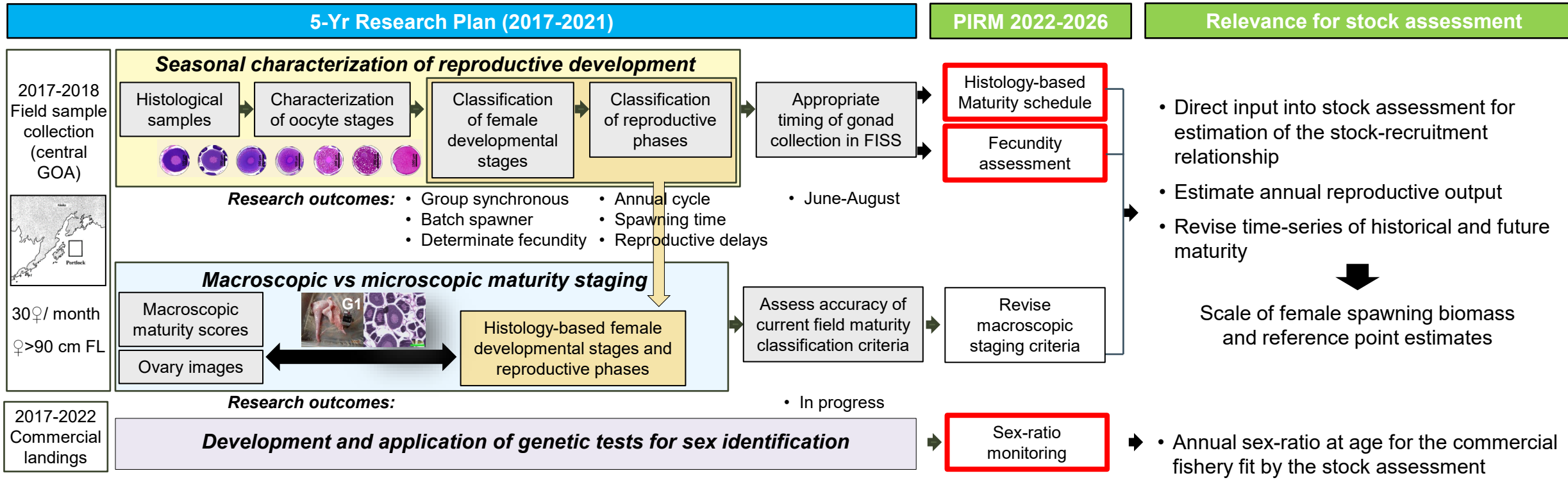
1. Migration and Population Dynamics

Conclusions

- We have improved the quality of our dataset by increasing and balancing sample sizes among the geographic areas studied.
- Even with a high-resolution genomic method we cannot identify discrete genetic groups among the population.
- There is a low probability of accurately assigning individuals back to the location in which they were sampled.
- These results support the concept of a single genetic group in IPHC Convention Waters and are consistent with current IPHC assessment practices: modeled as a single coastwide stock.



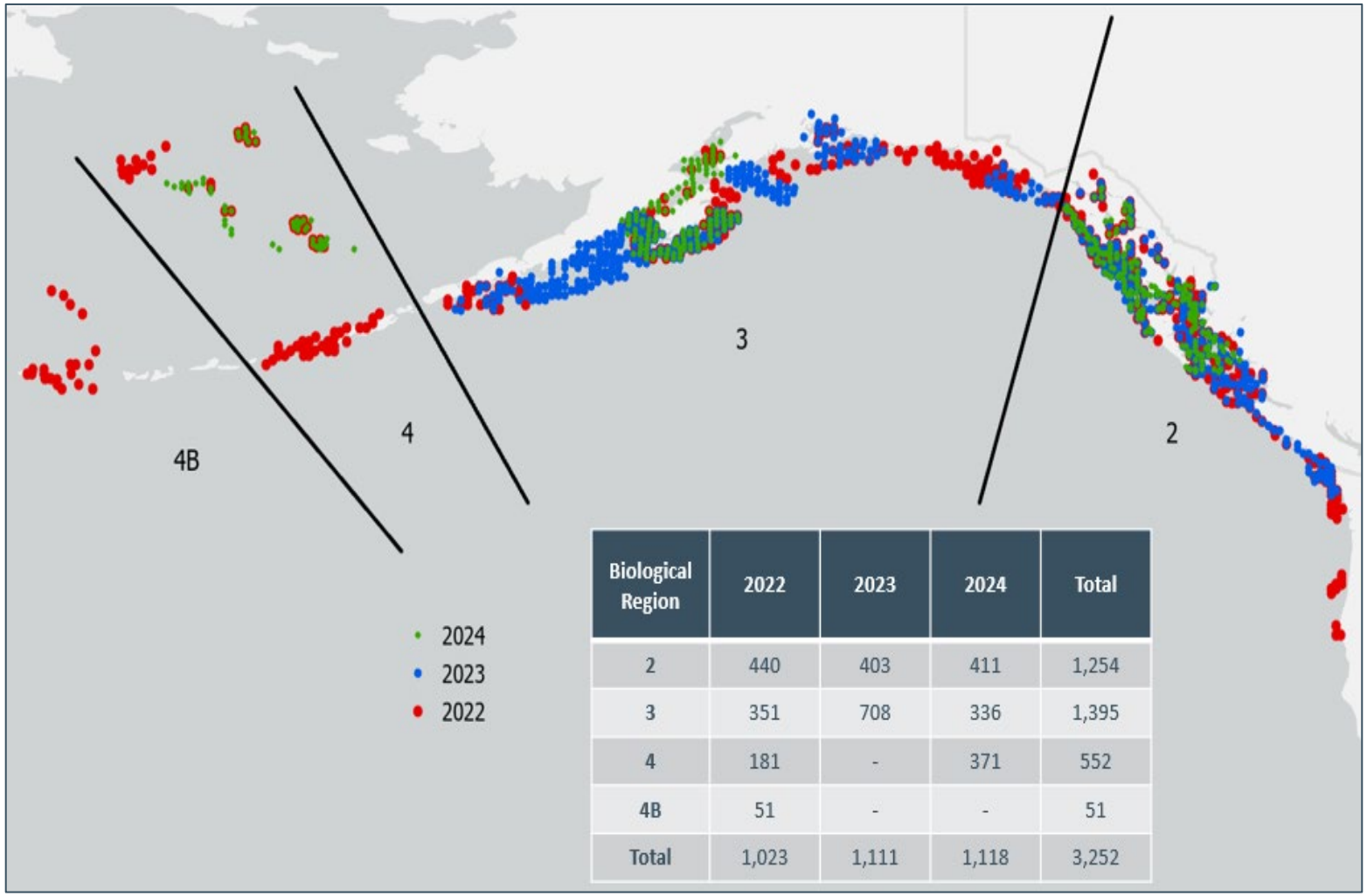
2. Reproduction



Publications: Fish et al. (2020) *J. Fish Biol.* ***97****: 1880–1885*
Fish et al. (2022) *Frontiers in Mar. Sci.* ***9****: 801759*
Simchick et al. (2024) *Gen. Comp. Endocrinol*. ***347****: 114425*

2. Reproduction

2022-2024 FISS
Sample Collections for
Histological Assessment



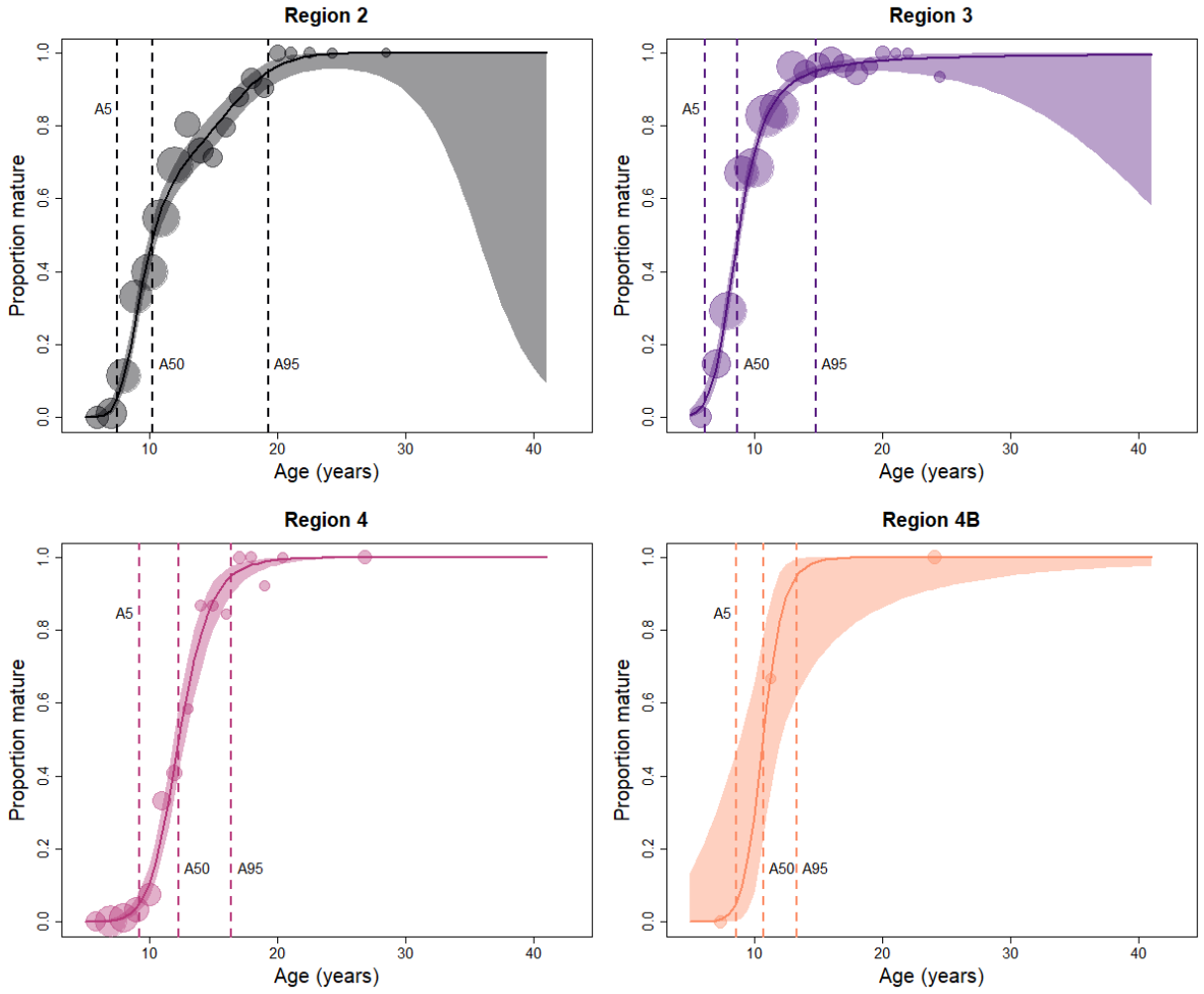
Biological Region	2022	2023	2024	Total
2	440	403	411	1,254
3	351	708	336	1,395
4	181	-	371	552
4B	51	-	-	51
Total	1,023	1,111	1,118	3,252

2. Reproduction

Histology-based ogives by biological region (2022-2024 combined)

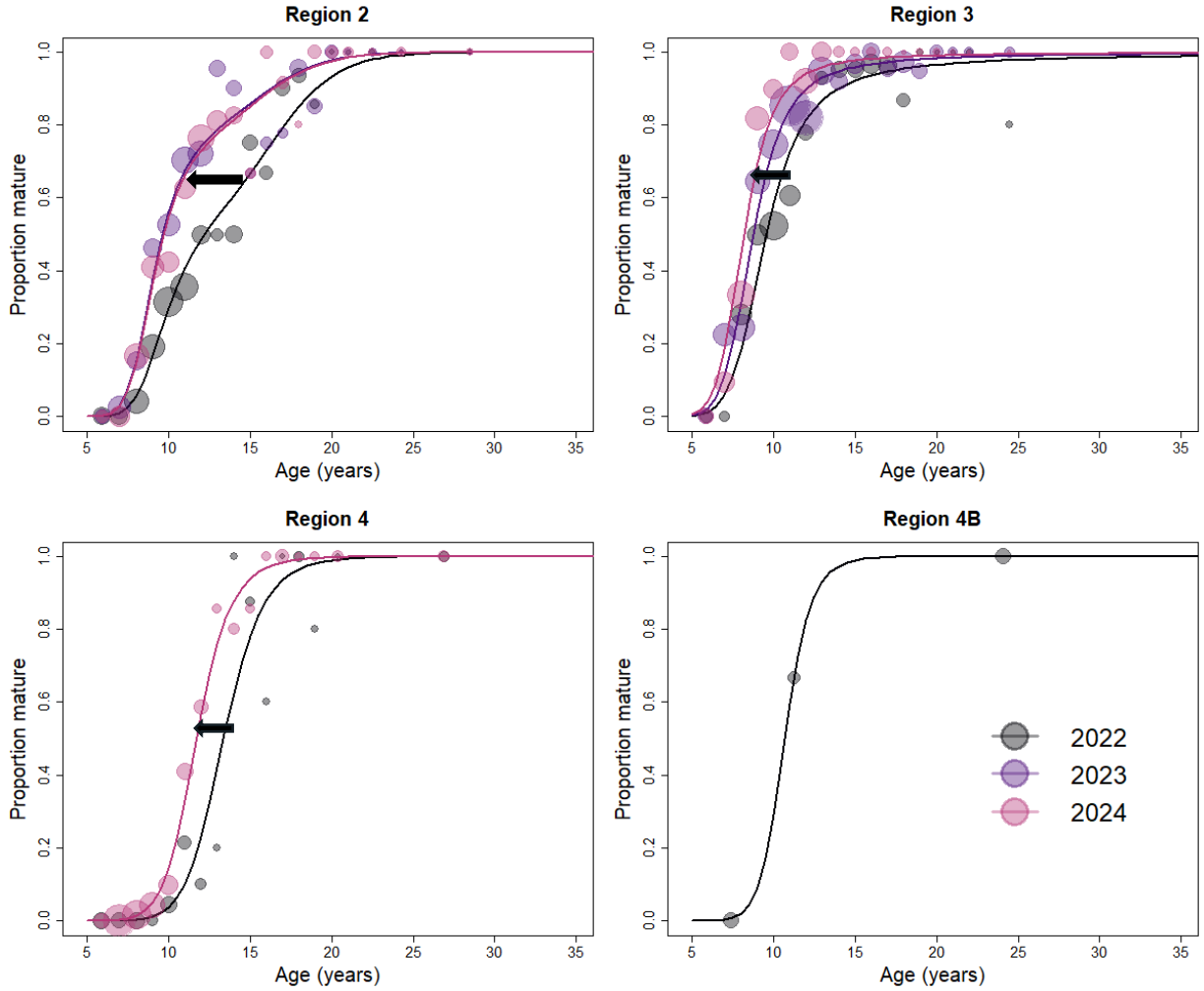
N = 3,252 females

Generalized Additive Model:
s(log(Age) * Region)



2. Reproduction

Histology-based ogives by biological region and year: 2022-2024



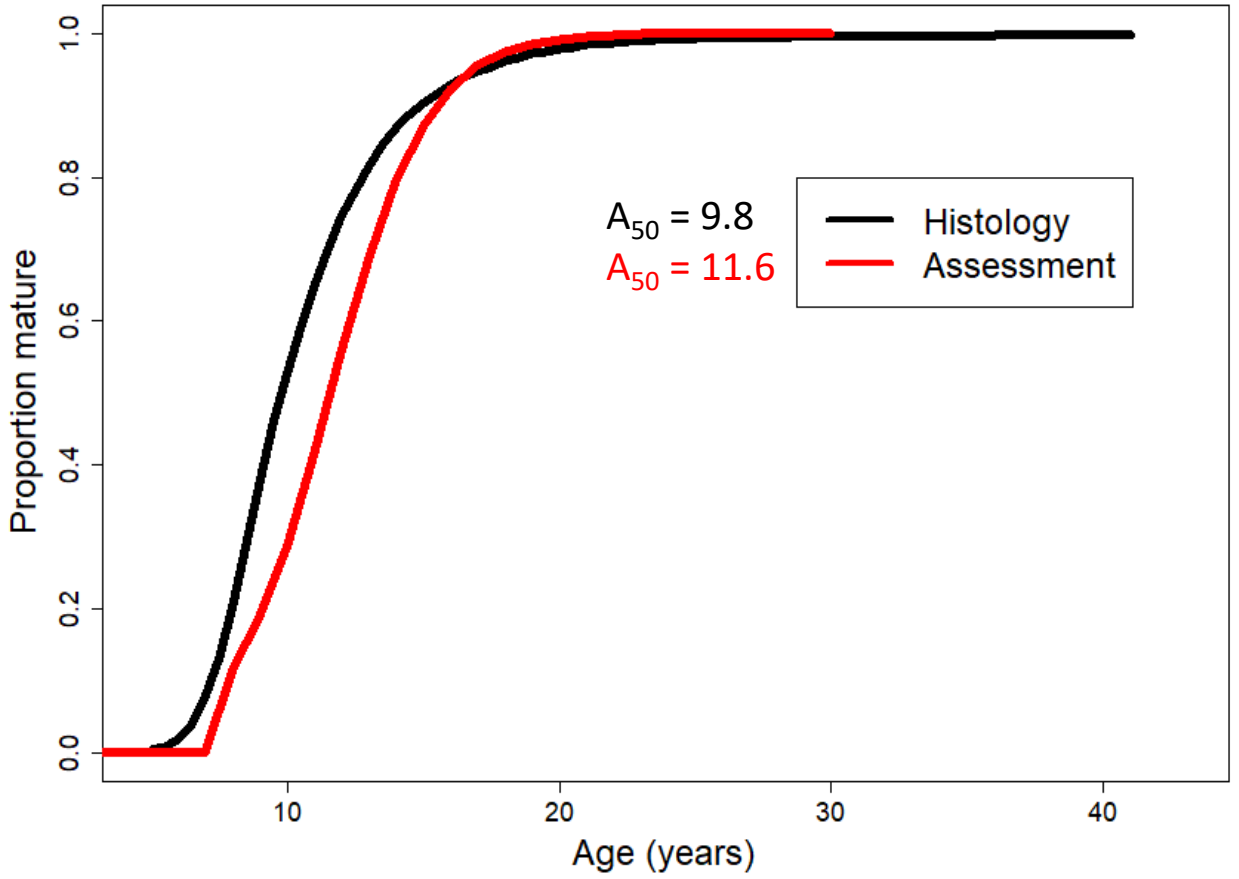
2. Reproduction

Histology-based coastwide maturity ogive

GAM s(log(Age) * Region)

Coastwide maturity ogive calculated from weighted regional ogives using average FISS space-time model abundance estimates from 2022-2024

New maturity ogive shows earlier age at maturity than currently used estimates



2. Reproduction

Fecundity assessment

- Collection of fecundity samples from large females (> 90 cm)

Year	Region	Platform	# of Samples (mature)
2023	3	FISS	297
2024	2	FISS	90
2024	4	FISS	76
2025	All	FISS	TBD
2024	2	Fall	273
2025	2	Late summer	254

- Sample processing to begin late Fall 2025 / Winter 2026

2. Reproduction

Conclusions

- Histology-based maturity estimates:
  - Region 3 shows higher proportion of mature females at younger ages than other regions
  - Regional maturity ogives have shifted to the left from 2022-2024

- Fecundity estimates:
  - Samples collected in 2023, 2024 and 2025
  - Question: Is female Pacific halibut fecundity proportional to body weight?

3. Fishing technology

5-Yr Program of Integrated Research and Monitoring (2022-2026)

Relevance for stock assessment

Summer 2023 pilot test

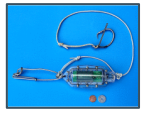
Investigate new methods for whale avoidance/deterrence to reduce whale depredation in the longline fishery

International Workshop on Protecting Fishery Catches from Whale Depredation → Catch protection device selection and production:
- Shuttle
- Slinky pot-Shroud

→ Pilot testing → Catch protection device refinement and improvement → Field testing in presence of whales:
- Killer whales (orcas)
- Sperm whales

Research outcomes:
- New tools for fishery avoidance and/or deterrence
- Improved estimation of depredation mortality

Collaboration with PSMFC



Investigate behavioral and physiological responses to fishing gear to reduce bycatch

Use of artificial illumination to reduce bycatch → Method refinement and improvement

Circle hook modifications to reduce rockfish bycatch → Method refinement and improvement

Research outcomes:
- New methods for reducing bycatch
- Improved estimation of bycatch mortality

- Increasing available yield for directed fishery.
- Reduce potential bias and uncertainty in the stock assessment.

↓

Improve mortality accounting

External funding: Bycatch Reduction Engineering Program NOAA NA21NMF4720534 (2021-2023), NA23NMF4720414 (2023-2025)

Publications: Lomeli et al. (2021) *Fisheries Research* ***233****: 105737*

Lomeli et al. (2023) *Ocean & Coastal Management* ***241****: 106664*

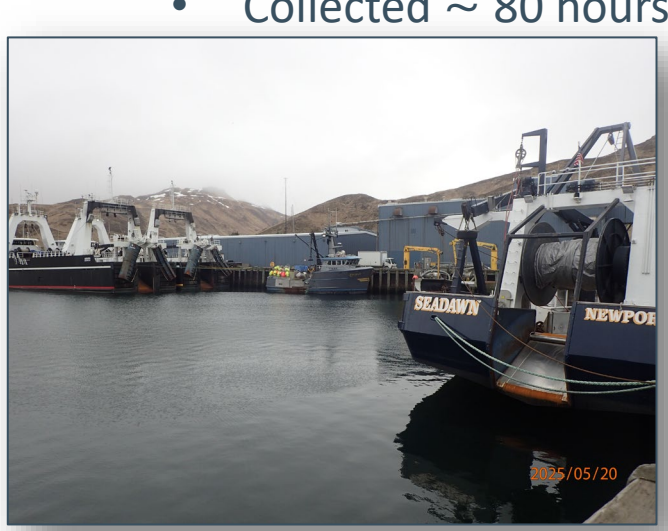
3. Fishing technology

NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Bycatch Reduction Engineering Program
(BREP) NA23NMF4720414

Reducing whale depredation by protecting longline catches

Second phase: Testing shuttle in the presence of depredators

- Objective: Further refine and characterize performance of the shuttle device in the presence of toothed whales in IPHC Regulatory Area 4A.
- Field study took place from 21-28 May 2025 from Dutch Harbor, AK on the F/V Oracle.
- 18 sets: 15 sets with shuttle and control catch paired comparisons (8 sets in the presence of orcas).
- Collected ~ 80 hours of underwater footage. Catch data under analysis.



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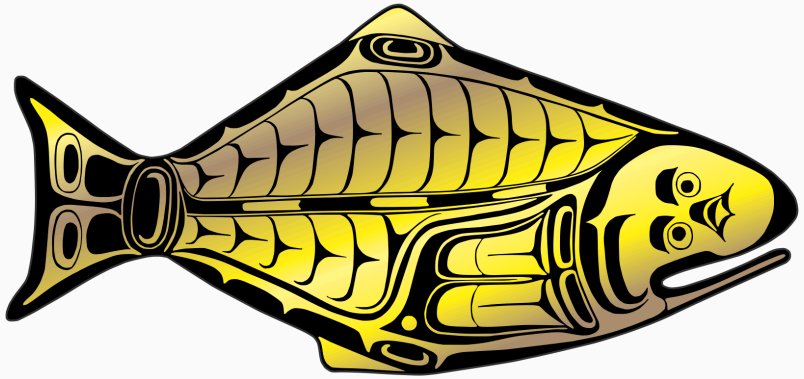

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https://www.iphc.int/