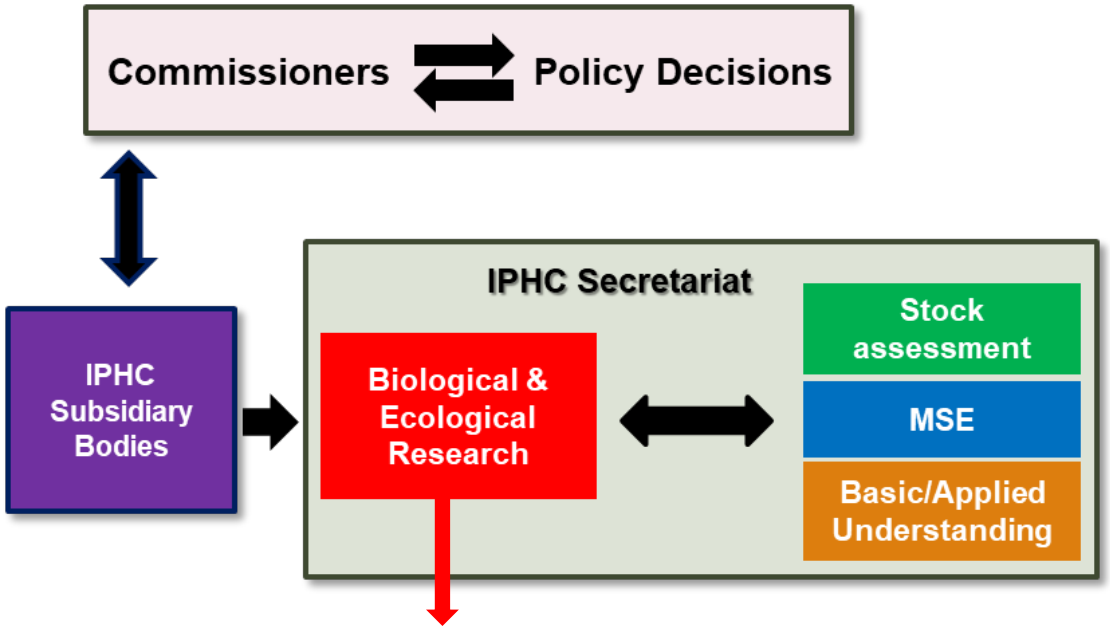
INTERNATIONAL PACIFIC HALIBUT COMMISSION

Report on current and future biological and ecosystem science activities

Agenda item: 9.1

IPHC-2024-IM100-15
(J. Planas)

Biological and Ecosystem Science Research

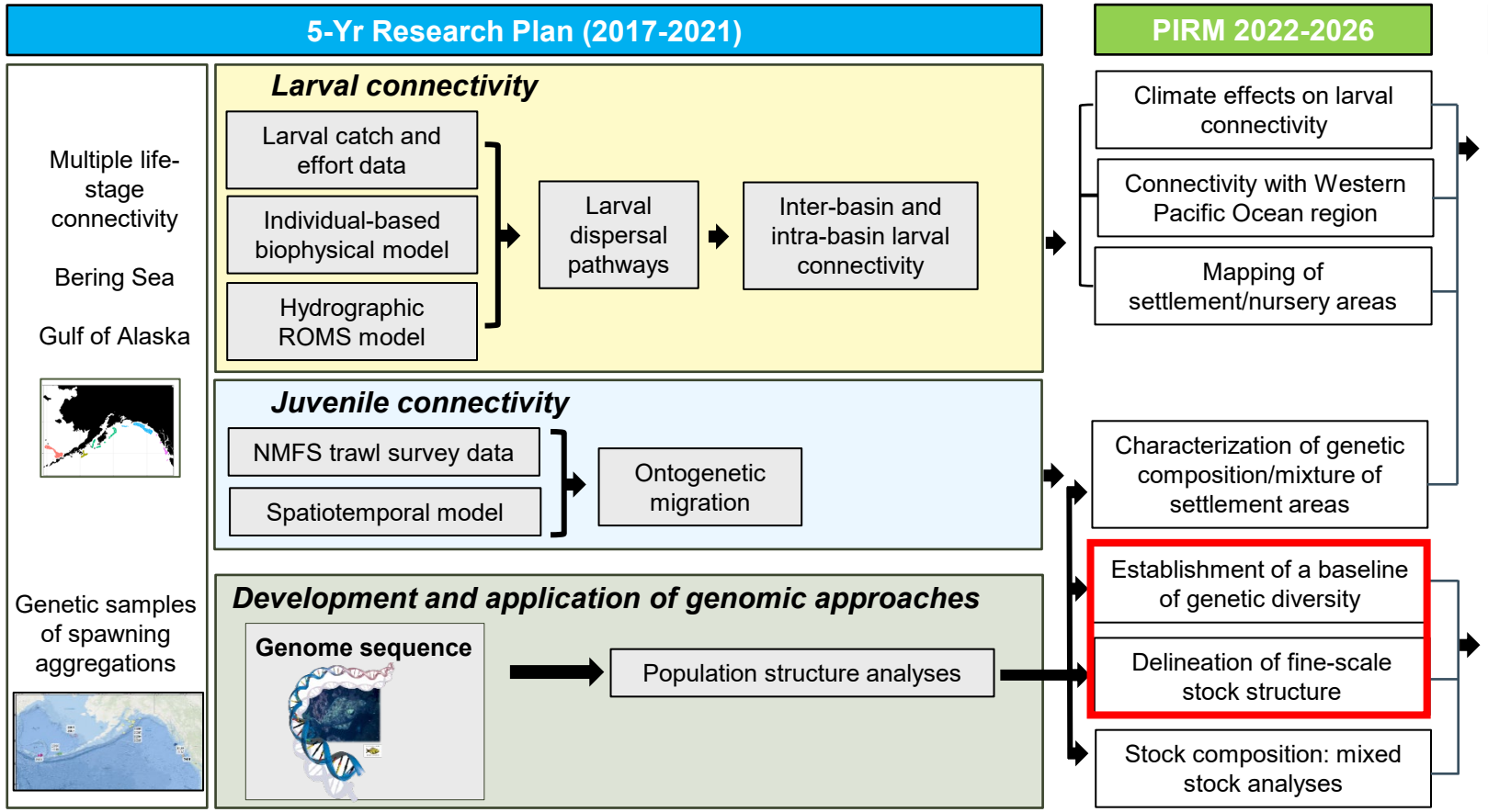


5 Yr –Program of Integrated Research and Monitoring (2022-2026)

Research Areas:

- Migration and Population Dynamics
- Reproduction
- Growth
- Mortality and Survival Assessment
- Fishing Technology

1. Migration and Population Dynamics



Publications:

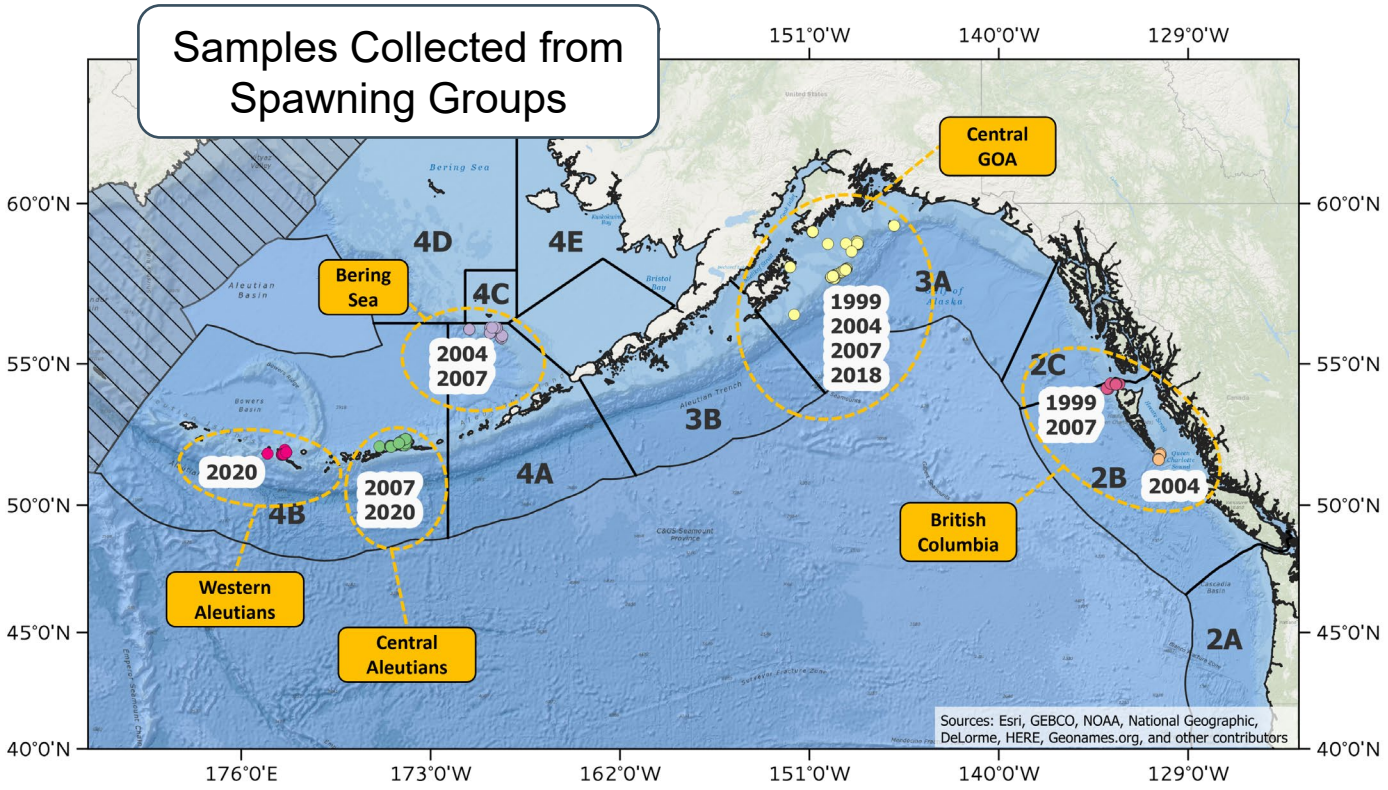
Sadorus et al. (2021) *Fisheries Oceanography* ***30****: 174*

Jasonowicz et al. (2022) *Molecular Ecology Resources* ***22****: 2685*

1. Migration and Population Dynamics

Population Genomics

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



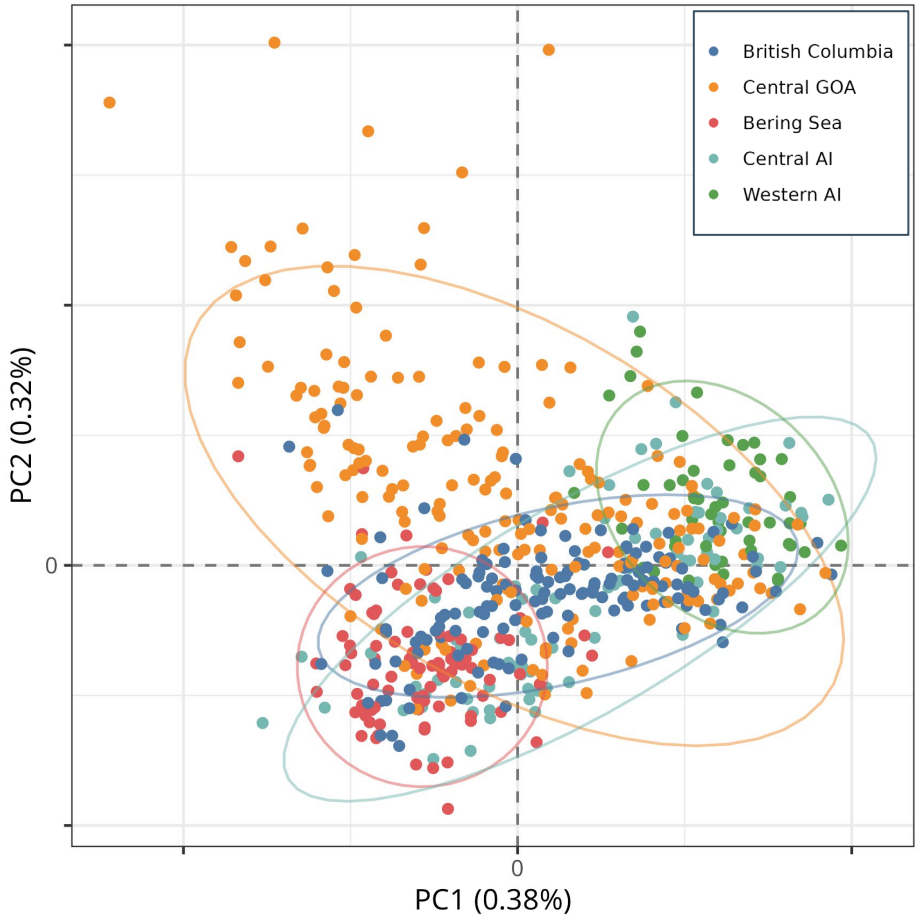
NPRB Project 2110 (2022-2024)

- **L**ow-**c**overage **w**hole-**g**enome **r**esequencing (lcWGR).
- Allows for screening genomic variation at very high resolution.
- Establish Genetic Baseline.
- Identify potential local and/or environmental adaptations.

- **570 individuals (~ 50/collection)**
- **3 sequencing runs - Illumina NovaSeq S4**
- **~ 10.3 million autosomal SNPs**
- **~ 4.8 million SNPs (minor allele frequency ≥ 0.05)**

1. Migration and Population Dynamics

Population Structure



- Principal components analysis (PCA) – one single cluster and considerable overlap among geographic collections.
- Unsupervised clustering – no evidence of discrete groups.
- Assignment testing - Can we assign individuals back to the population they were sampled from?
  - Assignment accuracy was validated using cross-validation (training/test split):

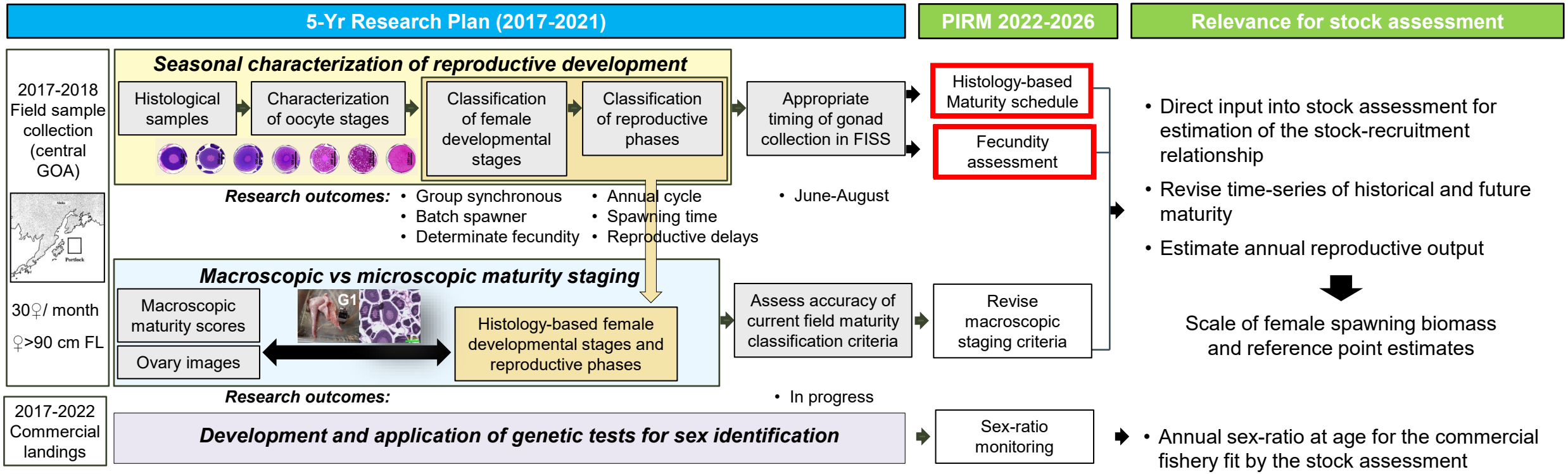
34.7 % assignment accuracy

1. Migration and Population Dynamics

Conclusions:

- No discrete genetic groups of Pacific halibut were identified within IPHC Convention Waters using high resolution genomics techniques.
- Lack of evidence for genetic structure. Likely due to considerable geneflow among geographic areas since Pacific halibut are capable of long-distance movements throughout their life history.
- Limited ability to assign individuals back to the location in which they were sampled.
- There results are consistent with current IPHC stock assessment practices: modeled as a single coastwide stock.

2. Reproduction

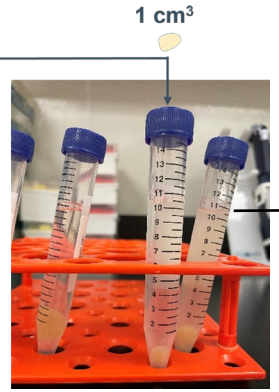


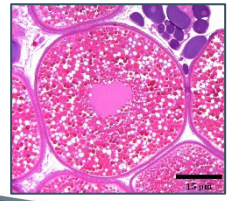
Publications:

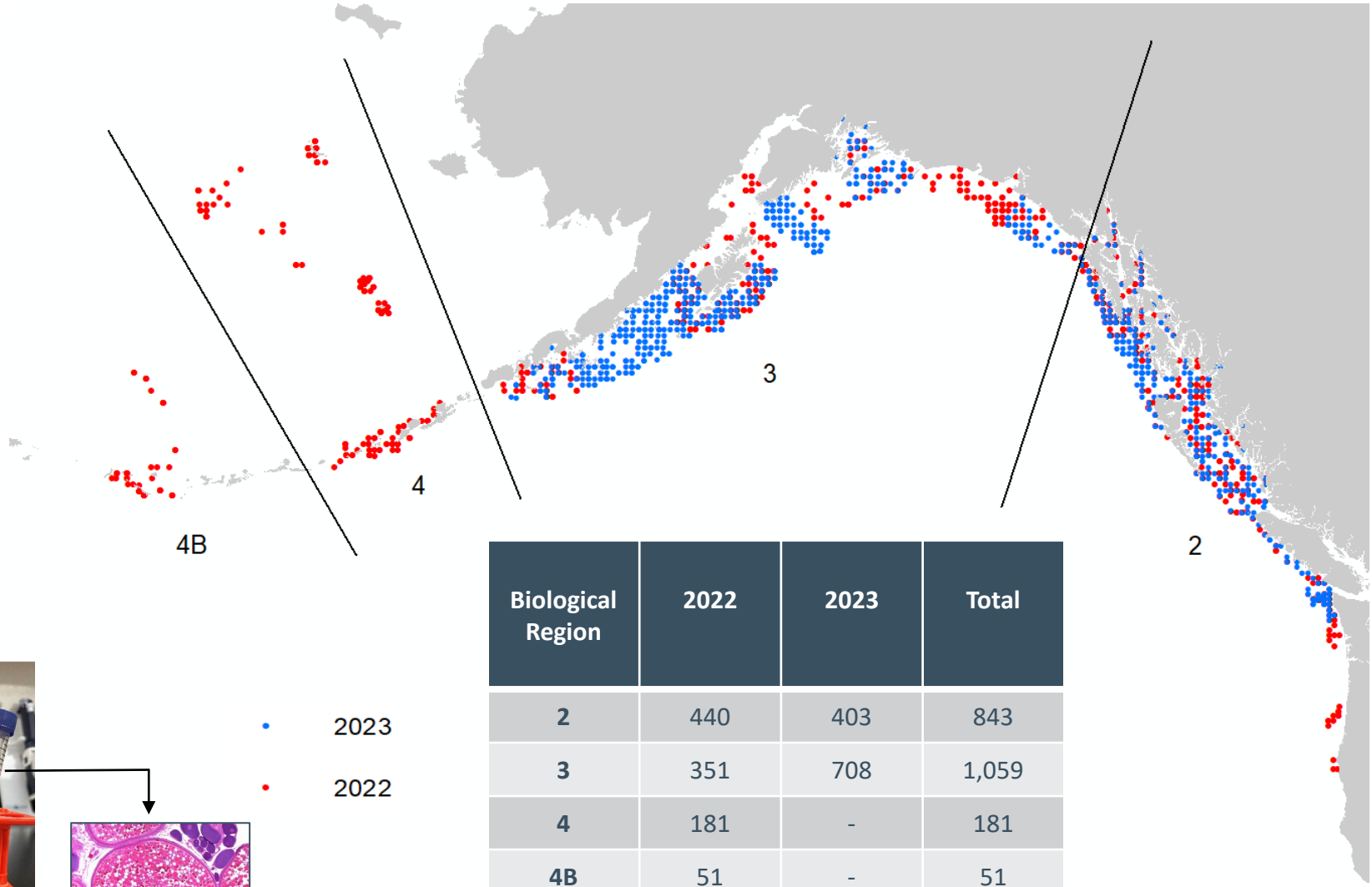
Fish et al. (2020) *Journal of Fish Biology* **97**: 1880–1885
Fish et al. (2022) *Frontiers in Marine Science* **9**: 801759
Simchick et al. (2024) *General Comparative Endocrinology* **347**: 114425

2. Reproduction

2022/2023 FISS Sample Collection for Histological Maturity Assessment



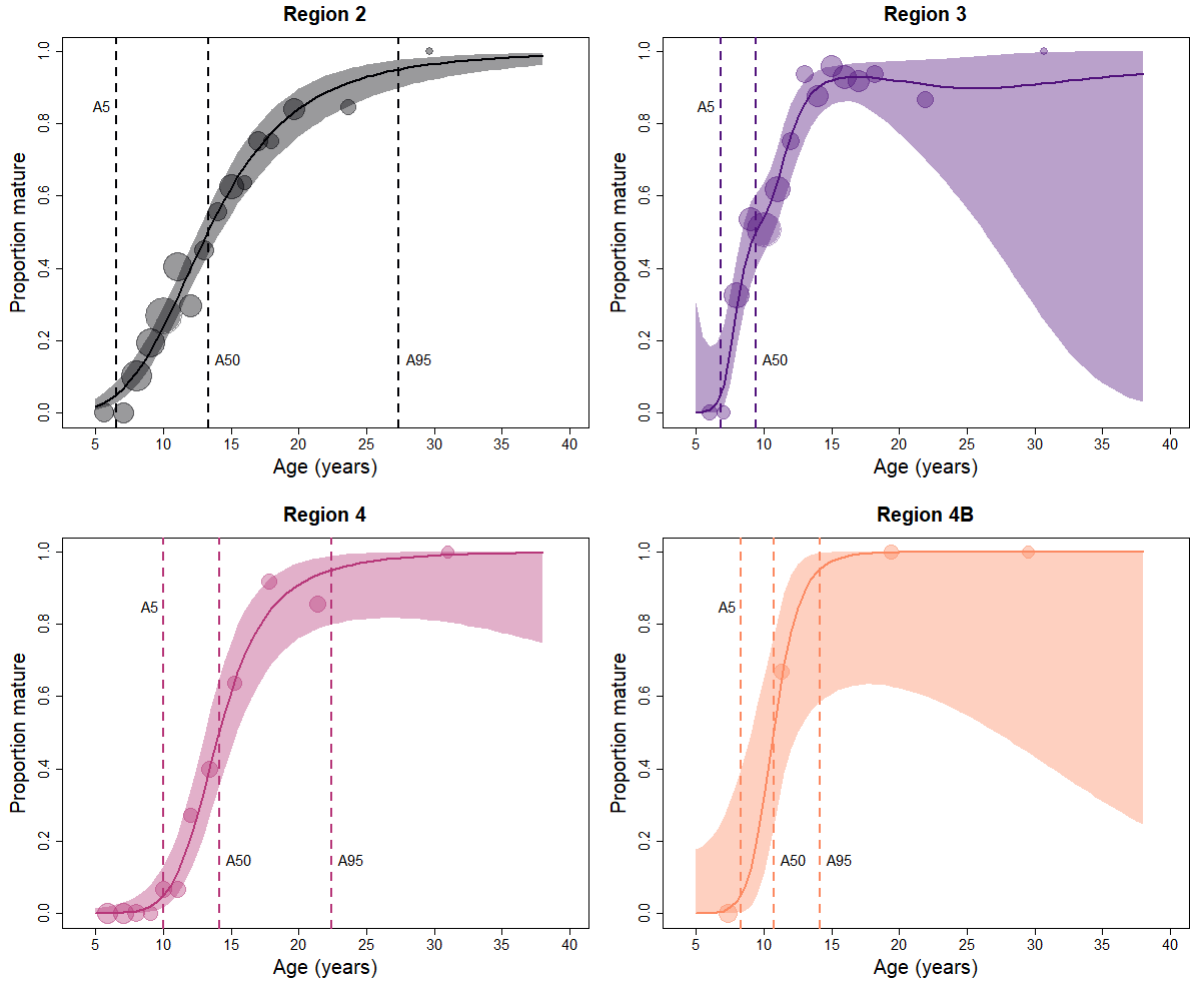




Biological Region	2022	2023	Total
2	440	403	843
3	351	708	1,059
4	181	-	181
4B	51	-	51
Total	1023	1,111	2,134

2. Reproduction

2022 Ogives by Biological Region (2, 3, 4, 4B)

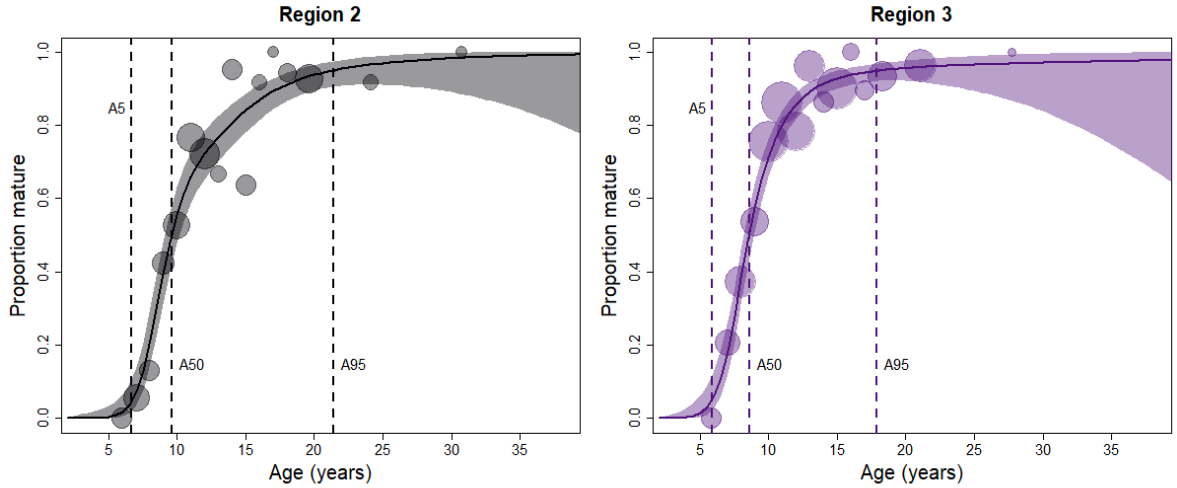


- Curve steepness: 2 < 3/4 < 4B
- Higher proportion of mature females at younger ages in 4B.
- May indicate potential regional differences in maturity schedules.

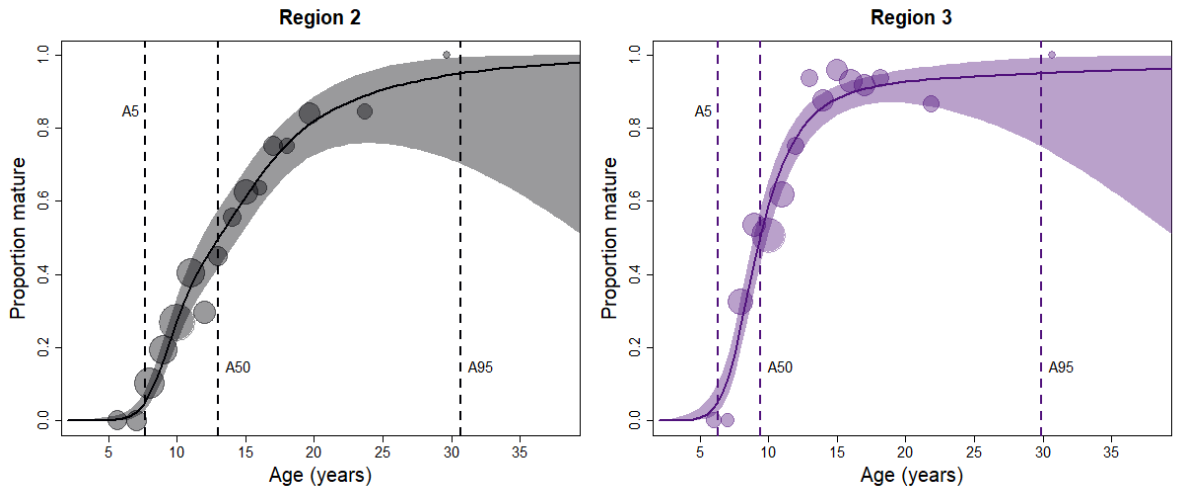
2. Reproduction

2023 Ogives by Biological region (BR2 and BR3)

2023



2022 (revised)

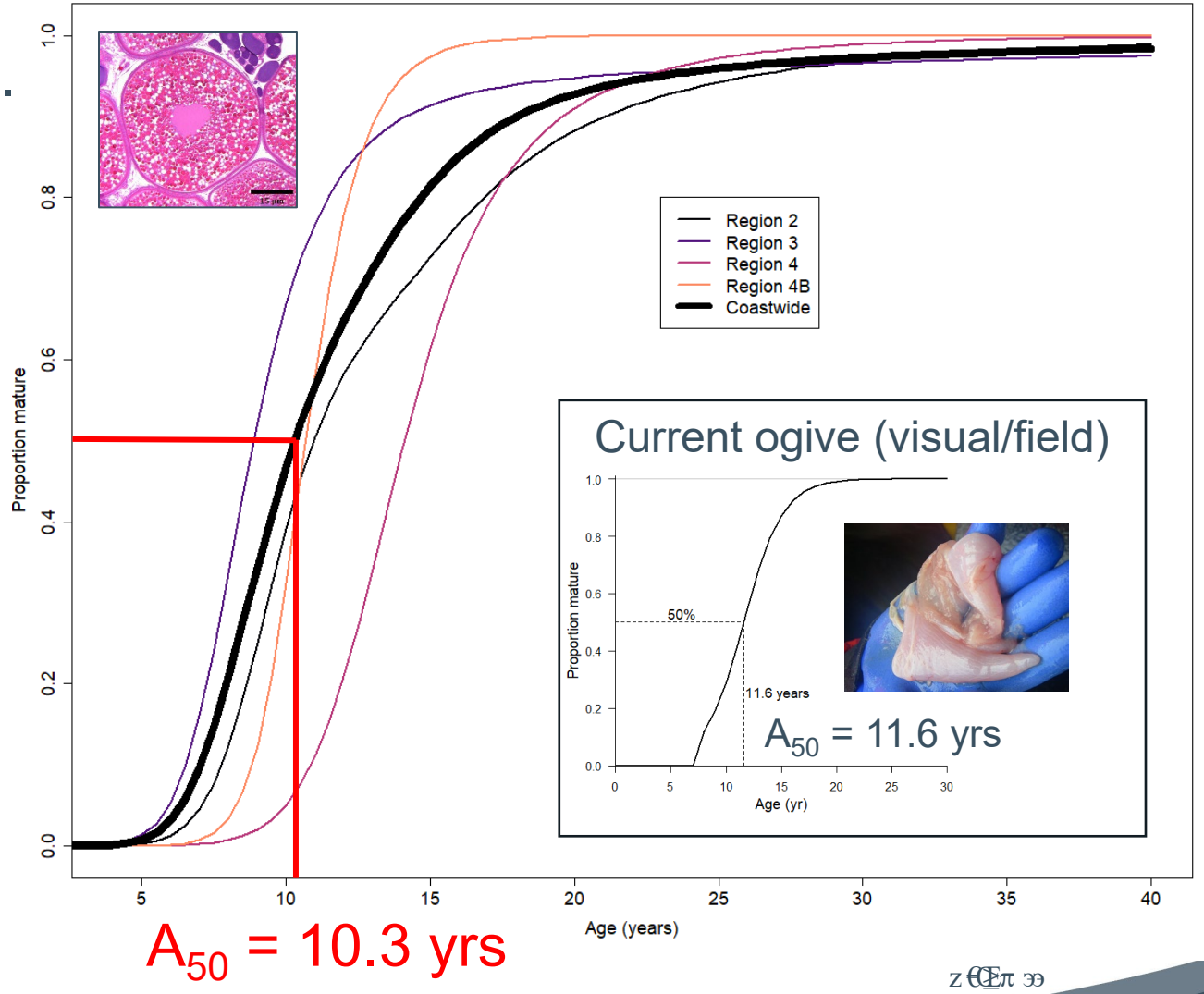


Includes year effect (2 years of data)

2. Reproduction

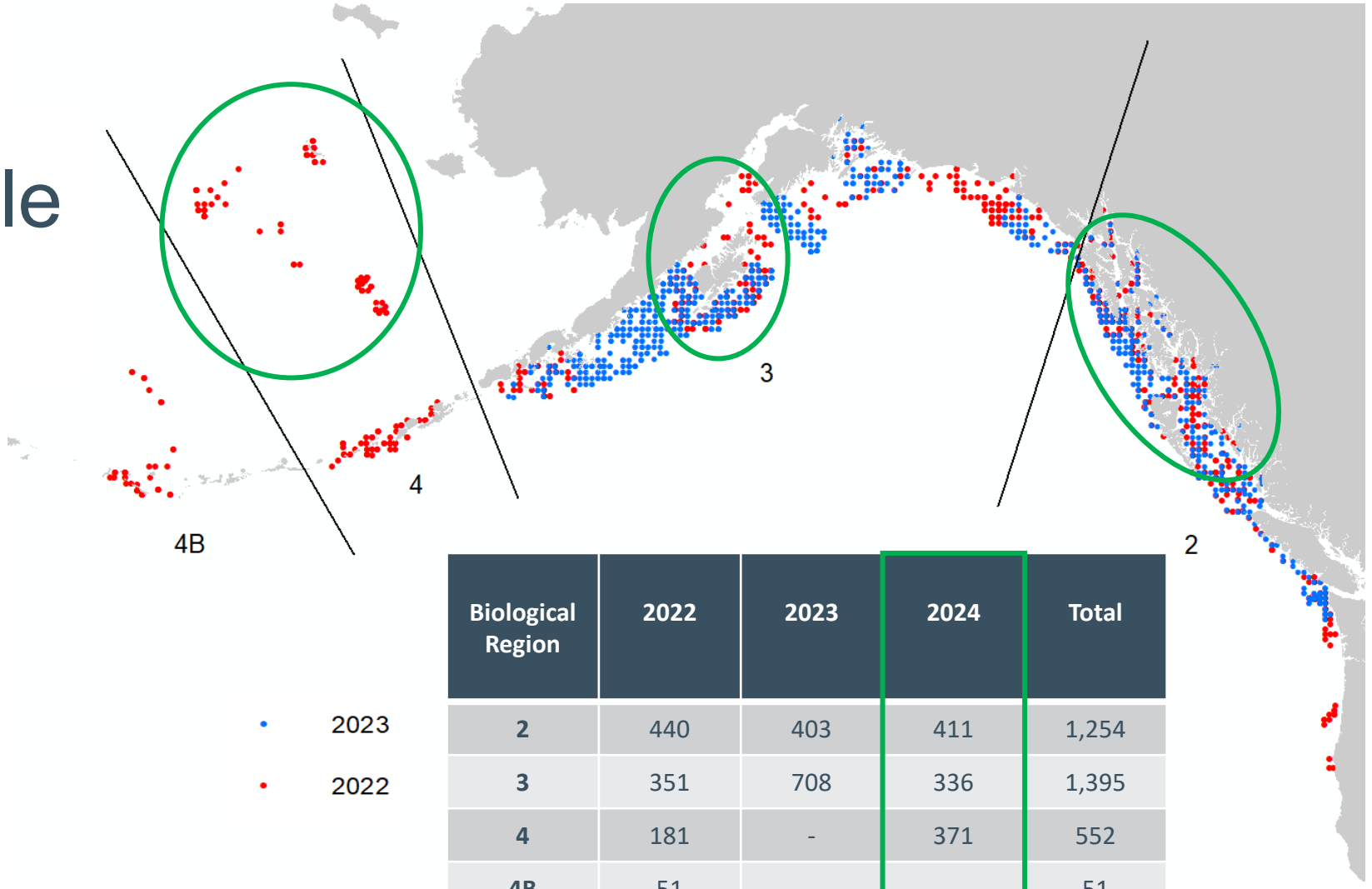
Coastwide Ogive from Histological Maturity Assessment

- 2022/2023 data pooled by region.
- Coastwide ogive calculated from weighted regional ogives using FISS space-time model abundance estimates.
- Coastwide ogive falls between Biological Regions 2 and 3.



2. Reproduction

2024 FISS Sample Collection



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

Conclusions:

- Spatial differences among Biological Regions for maturity-at-age.
- Earlier oocyte development from West (BR4B) to East (BR2).
- Coastwide ogive: lower A50 than visual (field) maturity-at-age.
- Next steps: process 2024 maturity samples for use in 2025 full stock assessment.

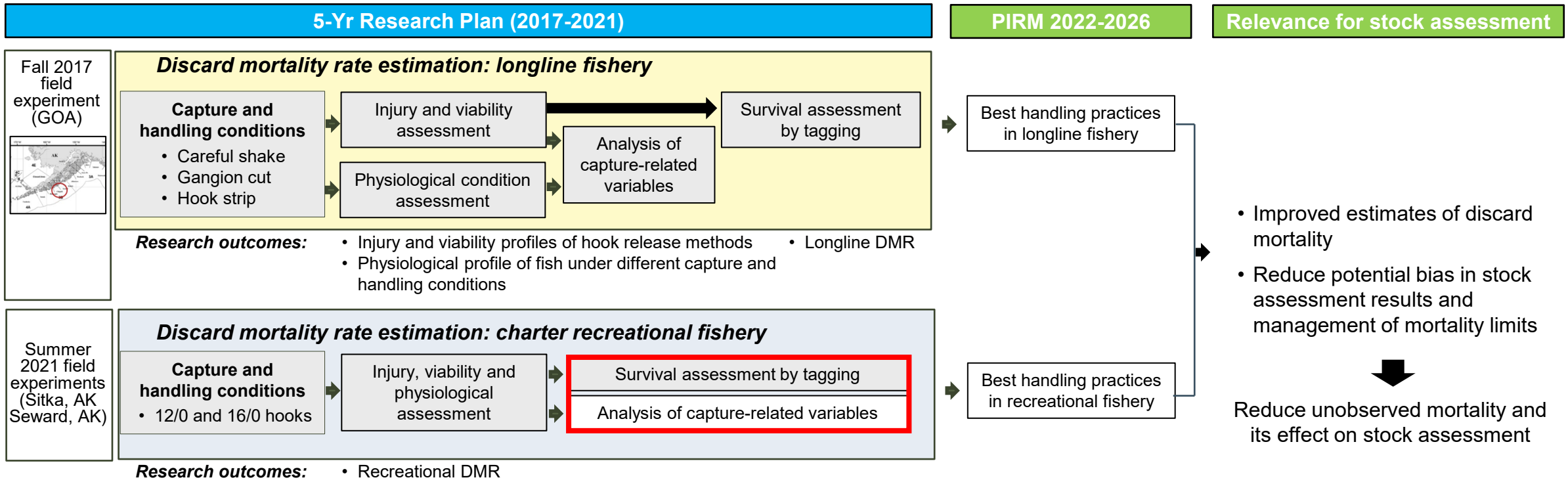
2. Reproduction

Fecundity estimations

- Summer ovarian samples collected in 2023 and 2024 FISS.
- Additional ovarian samples for fecundity collected in the Fall of 2024 (Charlotte and St. James charter regions; IPHC Reg. Area 2B):
  - ✓ 273 samples (85 – 200+ cm in fork length)

- Ovarian samples will be used initially for the development of the method to estimate fecundity in Pacific halibut, followed by actual fecundity estimations by size and by age.

3. Mortality and Survival Assessment



External funding: Saltonstall-Kennedy NOAA (2017-2020); NFWF (2019-2021); NPRB#2009 (2021-2022)

Publications:

Kroska et al. (2021) *Conservation Physiology* ***9****: coab001*

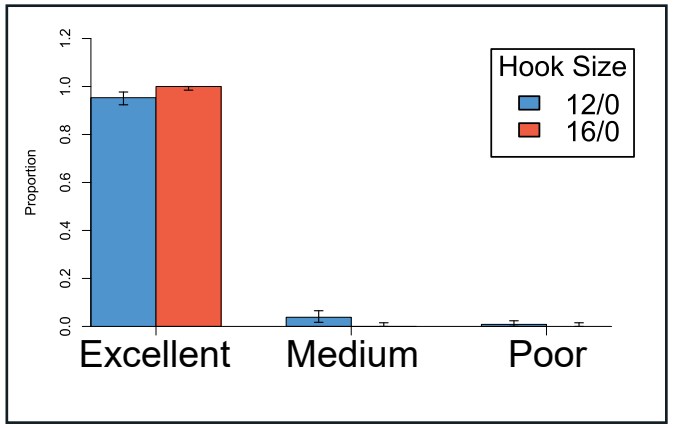
Loher et al. (2022) *North American Journal of Fisheries Management* ***42****: 37-49*

Dykstra et al. (2024) *Ocean & Coastal Management* ***249****: 107018*.

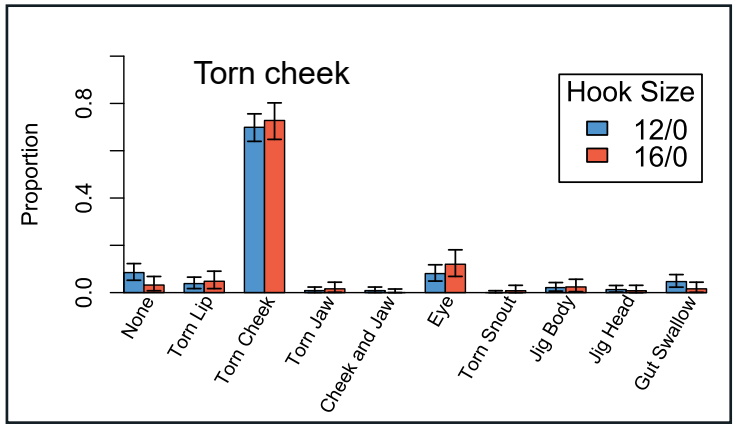
3. Mortality and Survival Assessment

Characterization of capture and handling practices on survival of recreational discards

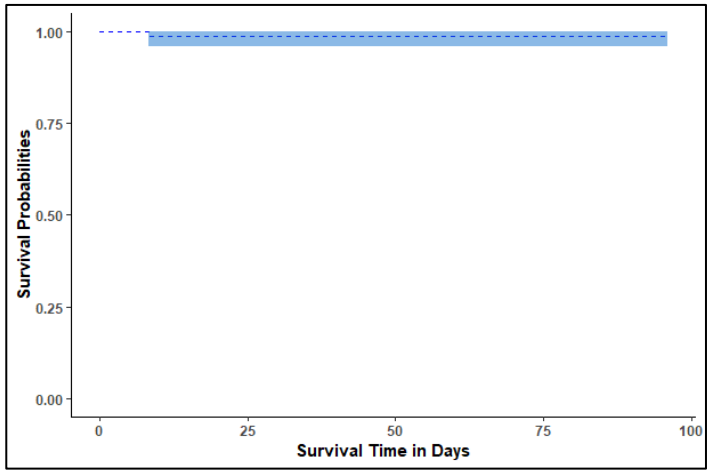
Viability by hook size



Injury types by hook size



Survival probabilities (sPAT tagging)



- Discard mortality rate estimate: **1.35%** (95% CI of 0.00-3.95% for fish in **Excellent** viability)

4. Fishing technology

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

Relevance for stock assessment

Summer 2023 pilot test

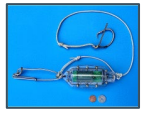
Investigate new methods for whale avoidance/deterrence to reduce whale depredation in the longline fishery

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: BREP NOAA NA21NMF4720534 (2021-2023), NA23NMF4720414 (2023-2025)

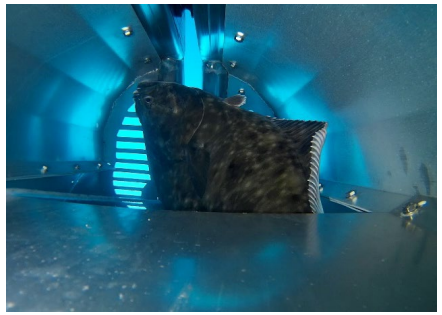
Publications:
Lomeli et al. (2021) *Fisheries Research* ***233***: *105737*
Lomeli et al. (2023) *Ocean & Coastal Management* ***241***: *106664*

4. Fishing technology

NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Bycatch Reduction Engineering Program
(BREP) NA21NMF4720534

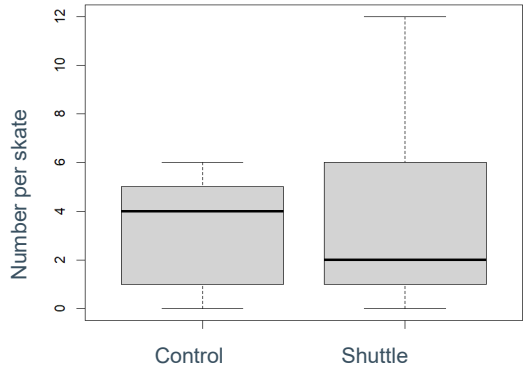
Reducing whale depredation by protecting longline catches

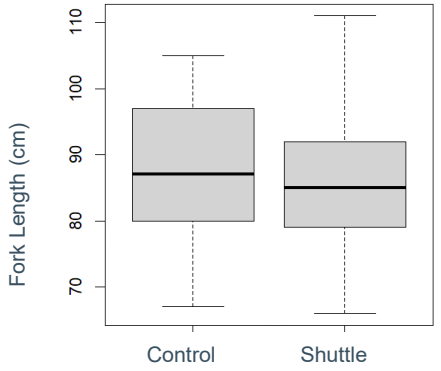
Shuttle system

Results:

- Shuttle can be safely utilized on small vessels.
- Similar catch rates to standard gear.
- Comparable size categories of fish entrained.



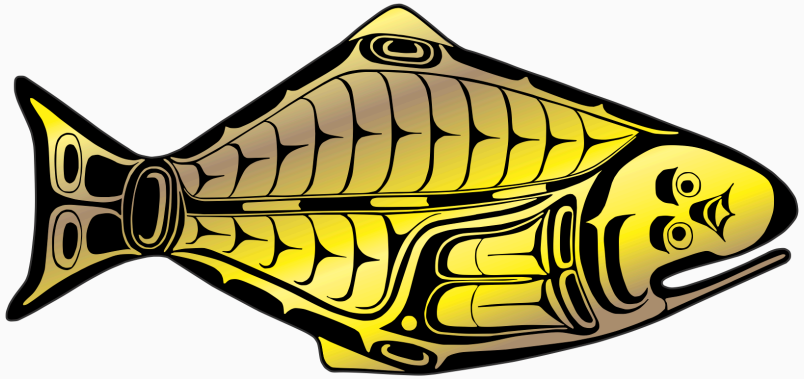


Next phase: Full scale testing of shuttle system to minimize whale depredation in longline fisheries (BREP NA23NMF4720414)

Summary of current competitive research grants awarded to IPHC

Project #	Grant agency	Project name	PI	Partners	IPHC Budget ($US)	Management implications	Grant period
1	Bycatch Reduction Engineering Program-NOAA	Full scale testing of devices to minimize whale depredation in longline fisheries (NOAA Award Number NA23NMF4720414)	IPHC	Alaska Fisheries Science Center-NOAA (Seattle)	$199,870	Mortality estimations due to whale depredation	November 2023 – April 2026
2	Alaska Sea Grant	Development of a non-lethal genetic-based method for aging Pacific halibut (R/2024-05)	IPHC, Alaska Pacific U.	Alaska Fisheries Science Center-NOAA (Juneau)	$60,374	Stock structure	January 2025 - December 2026
Total awarded ($)					**$260,244**		

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

https://www.iphc.int/