INTERNATIONAL PACIFIC HALIBUT COMMISSION

Report on current and future Biological and Ecosystem Science Research activities

Agenda item: 4.1.1

IPHC-2026-SRB029-05

(J. Planas, C. Dykstra, A. Jasonowicz, C. Jones)

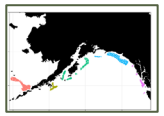
1. Migration and P

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

Inte intra c

Sadorus et al. (2021) *Fish*

Juvenile connectivity

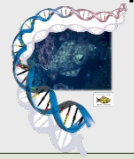
NMFS trawl survey data

Spatiotemporal model

Ontogenetic migration

Development and application of genomic

Genome sequence



Population structure analyses

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

OXFORD UNIVERSITY PRESS | Bioinformatics

***fst-gl*: Efficient and performance-oriented estimation of F_{ST} from genotype likelihoods**

Journal:	*Bioinformatics*
Manuscript ID	BIOINF-2026-2140
Manuscript type:	Applications Note
Date Submitted by the Author:	18-Jun-2026
Complete List of Authors:	Jasonowicz, Andrew; International Pacific Halibut Commission Planas, Josep; International Pacific Halibut Commission
Portal Keywords:	Algorithms, Bioinformatics, Genomics, Population genetics, SNPs

New bioinformatic method development

In Review in *Bioinformatics*

Stock composition: mixed stock analyses

Development of an epigenetic clock for aging Pacific halibut

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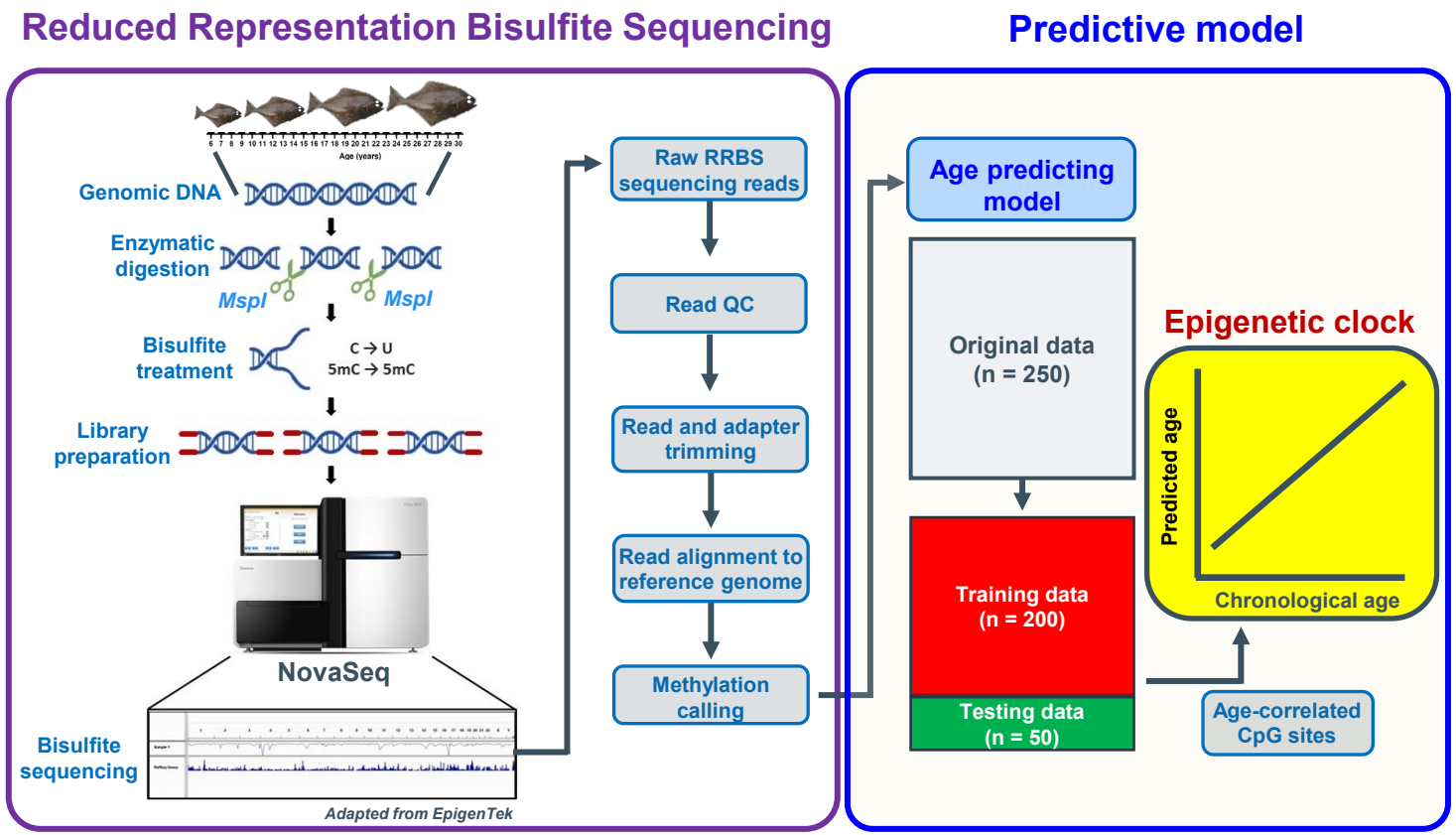
1. Migration and Population Dynamics

Development of an epigenetic clock for aging Pacific halibut

Sea Grant ALASKA
Project R/2024-05 (2025-2027)

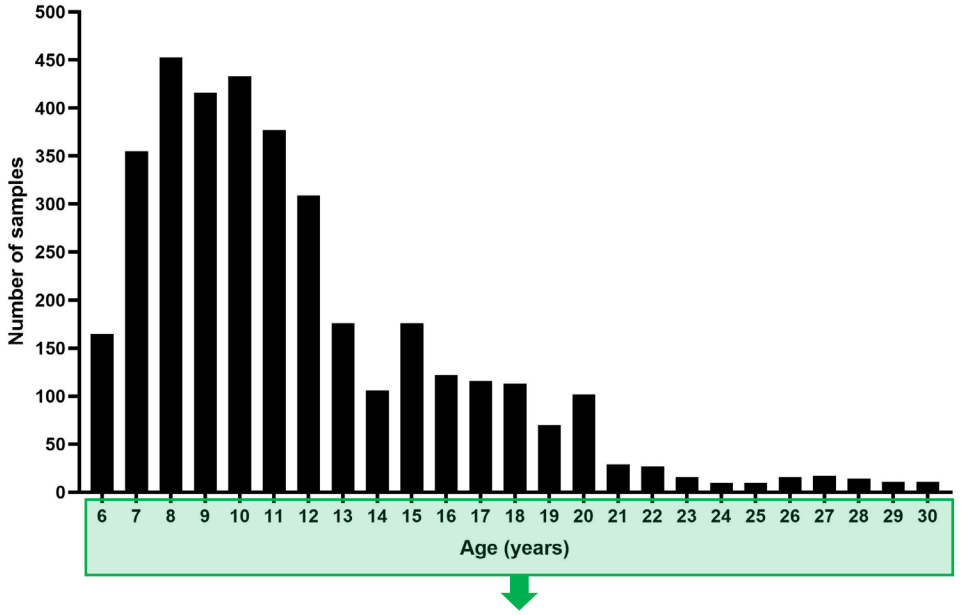
Project workflow



1. Migration and Population Dynamics

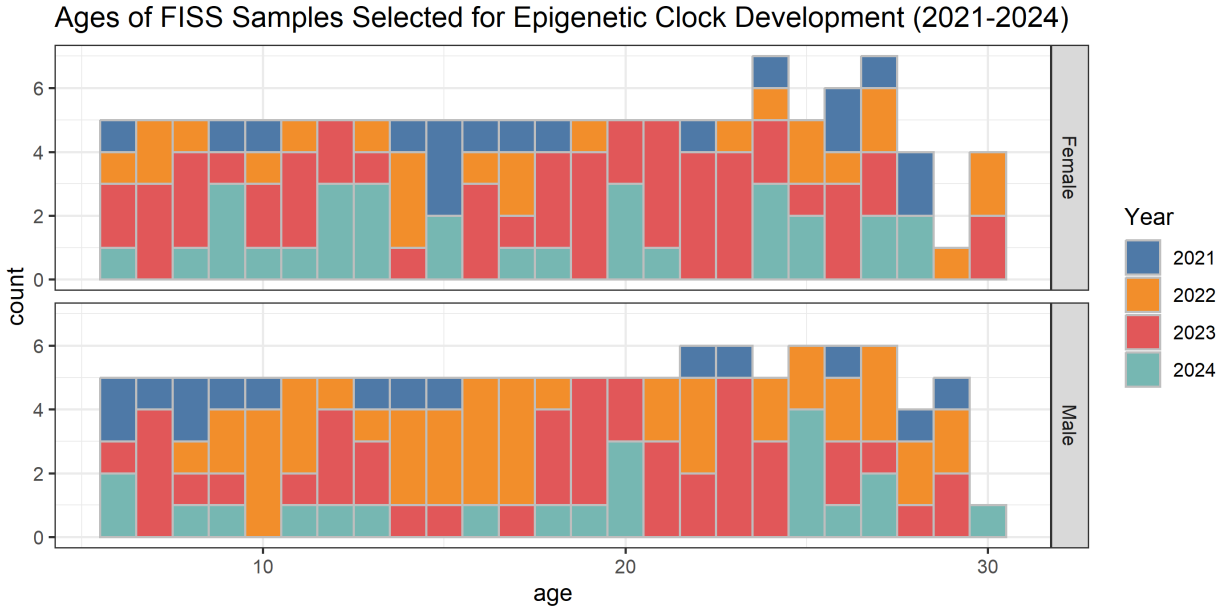
Development of an epigenetic clock for aging Pacific halibut

Genetic samples: aged fin clips



5♂ and 5♀/age from 6 to 30 years of age
N = 249 samples

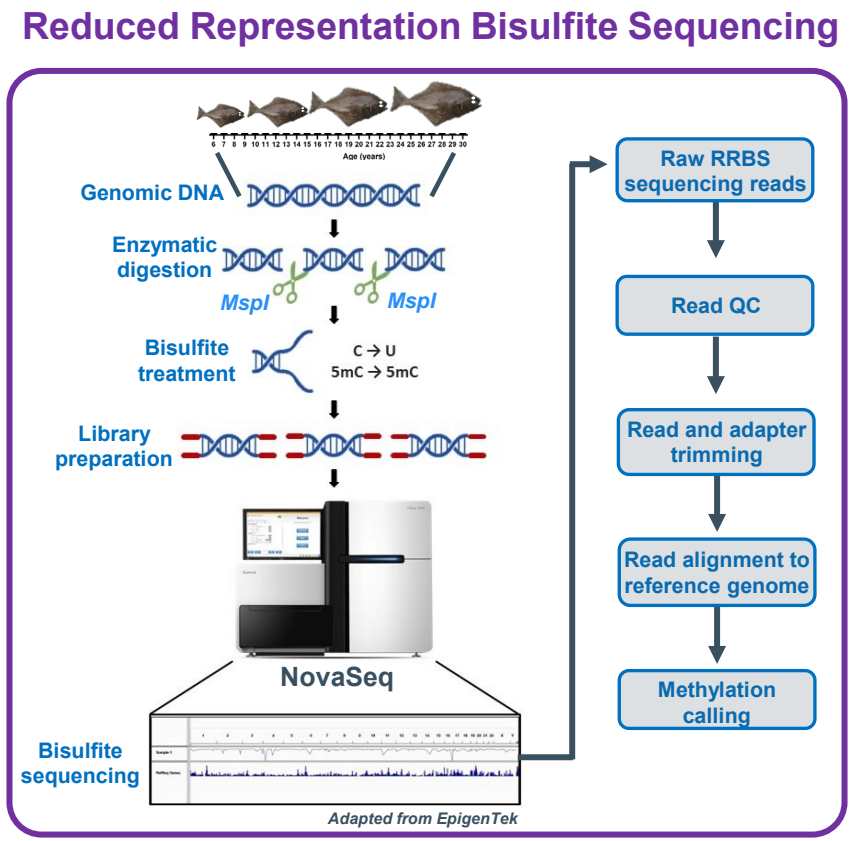
Year	2A	2B	2C	3A	3B	4A	4B	4D	Total
2021	1	12	12	3	0	3	1	0	32
2022	2	22	17	20	2	2	3	1	69
2023	16	32	25	14	10	0	0	0	97
2024	0	15	26	7	1	0	0	2	51
Total	**19**	**81**	**80**	**44**	**13**	**5**	**4**	**3**	**249**

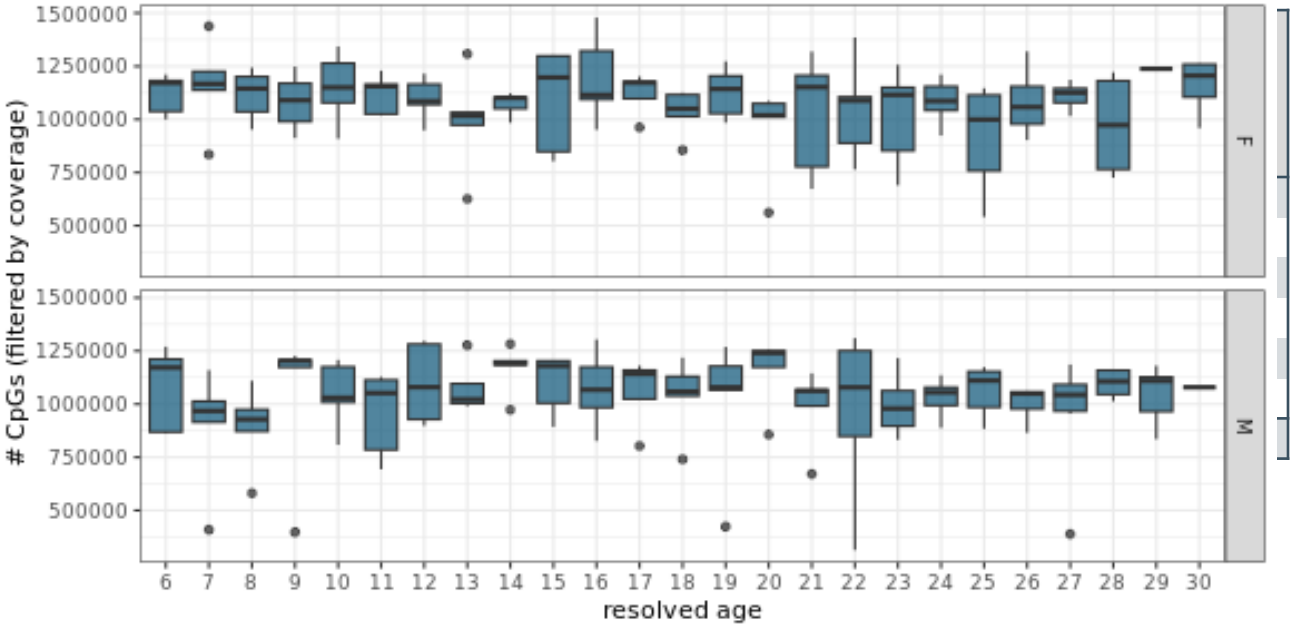


1. Migration and Population Dynamics

Development of an epigenetic clock for aging Pacific halibut

Sequencing results





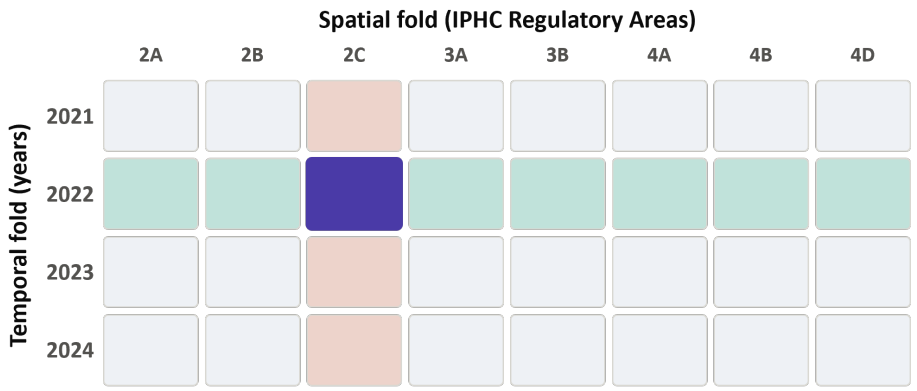
- After filtering reads with >10x: average 1,055,430 CpGs/sample
- **39,461** CpG sites common to all samples.
- Preprocessing filtering steps underway prior to modeling
- An elastic net model will be used to identify CpG sites most closely associated with age

1. Migration and Population Dynamics

Development of an epigenetic clock for aging Pacific halibut

Plans for *cross-validation* of the model:

1. In-sample cross-validation



- **Out-of-area: leave-one-area-out**
  (e.g. train model with all areas except 2C and test with 2C data)
- **Out-of-year: leave-one-year-out**
  (e.g. train model with all years except 2022 and test with 2022 data)
- **Area-year combination**
  (e.g. train model with all areas and years except 2C in 2022 and test model with data from 2C in 2022)

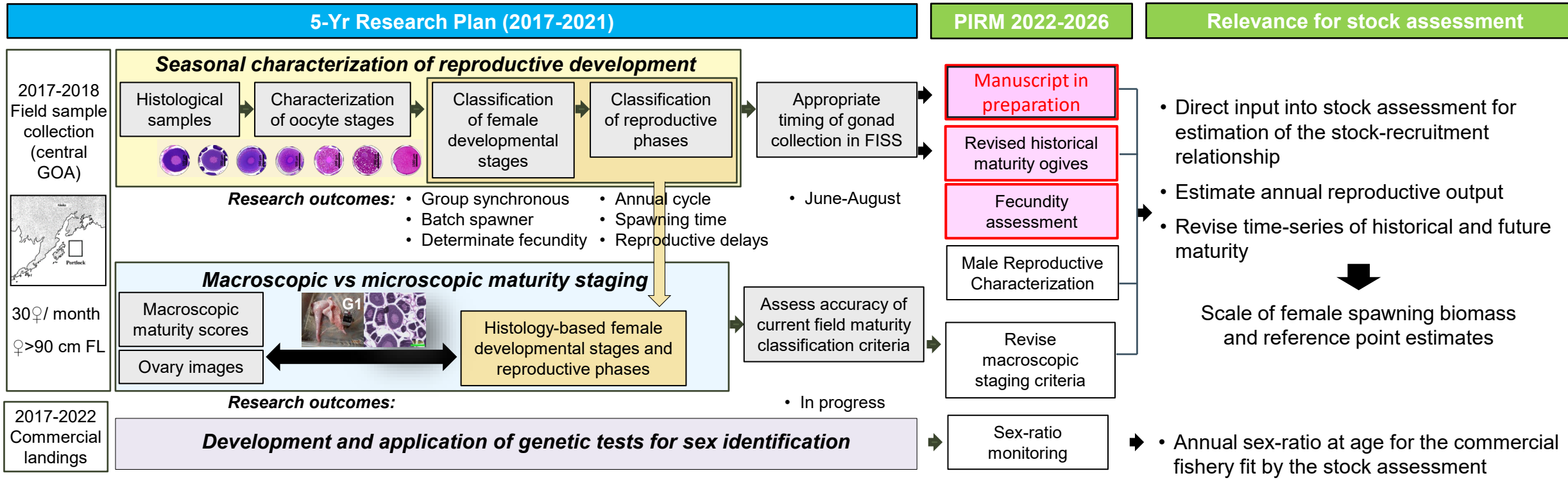
2. Out-of-sample cross-validation

Train model with data from 2021-2024 and test model with samples from 2017-2020

Year	2C	3A	3B	4A	4B	4C	4D	Total
2017	0	0	0	4	4	0	4	12
2018	1	3	2	0	5	0	1	12
2019	0	3	2	3	2	1	0	11
2020	3	4	4	0	0	0	0	11
Total	**4**	**10**	**8**	**7**	**11**	**1**	**5**	**46**

Number of samples processed	Average PCR duplication rate (%)	Average number of remaining reads/sample	Average of methylated control (%)	Average of unmethylated control (%)	Sum of deduplicated reads (reads remaining)
46	28.13	4,087,418	1.74	99.27	183,933,800

2. Reproduction

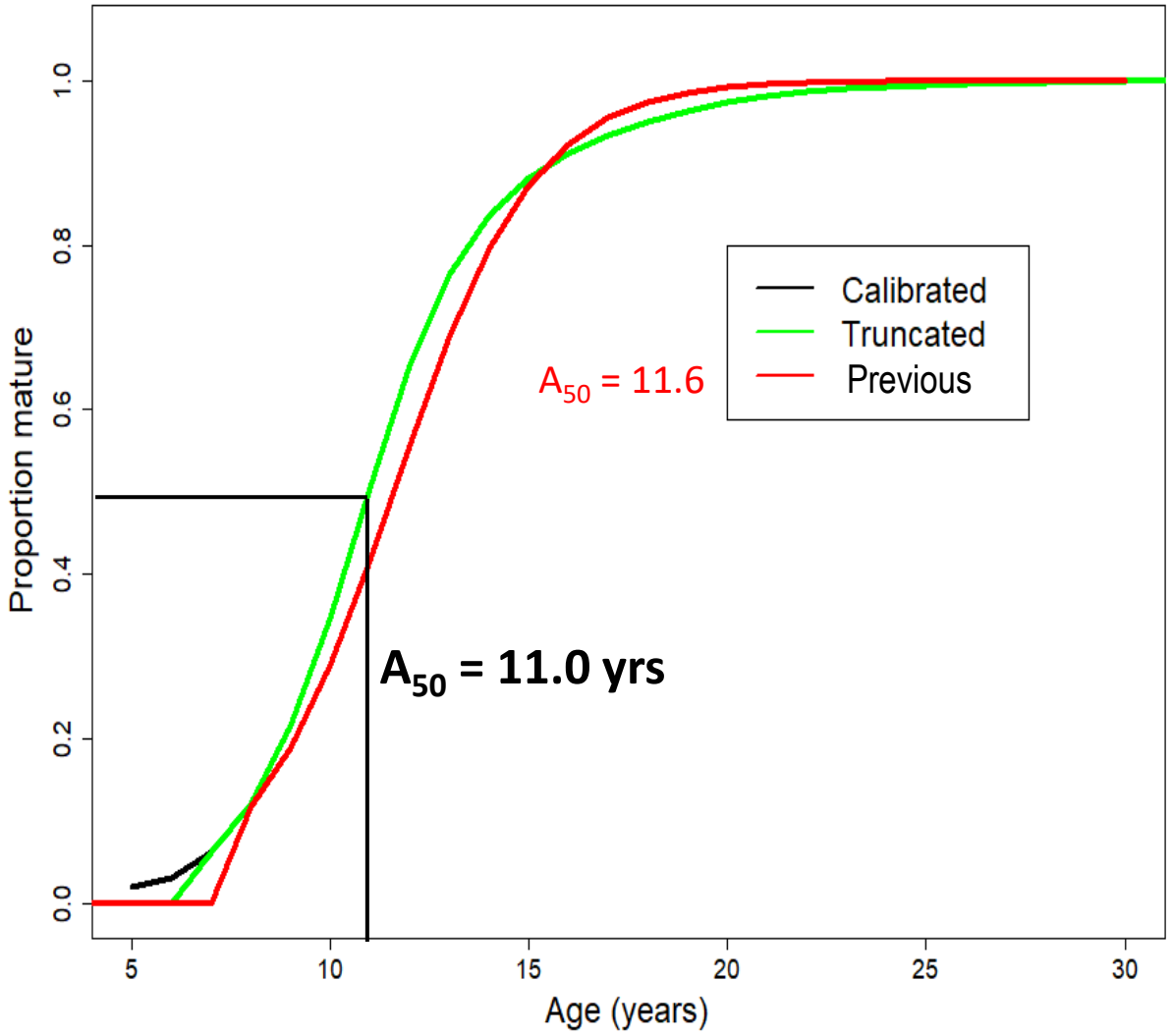


Publications: Fish et al. (2020) *J. Fish Biol.* ***97****: 1880–1885*
Fish et al. (2022) *Frontiers in Mar. Sci.* ***9****: 801759*
Simchick et al. (2024) *Gen. Comp. Endocrinol*. ***347****: 114425*

2. Reproduction

New coastwide maturity ogive

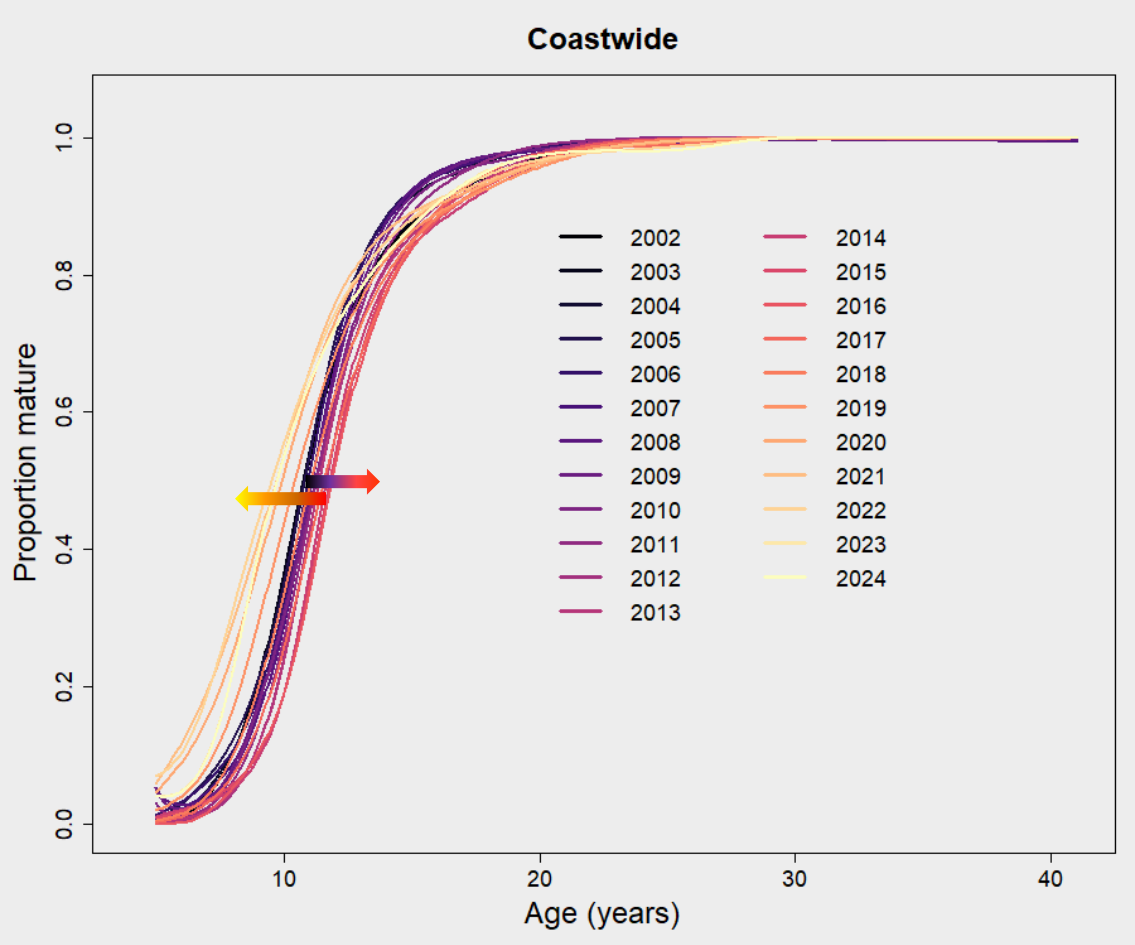
- A calibration between histological and visual maturity ogives with FISS-collected data from 2022-2024 was established.
- A **calibrated** coastwide maturity ogive was generated using visual maturity estimates from FISS (2002-2024)
- Maturity estimates from the average 2002-2024 calibrated coastwide ogive are shifted slightly to the left of **previous** assessment ogive (2002-2003)
- A_{50} is **0.6 yrs** lower
- Truncated to zero < Age 7
- **New coastwide maturity ogive used in the 2025 stock assessment**



2. Reproduction

Calibrated coastwide maturity ogives from 2002 to 2024

- GAM s(log(Age) * Region)
- Coastwide maturity ogive calculated from weighted regional ogives using average FISS space-time model abundance estimates from 2022-2024
- A calibration was developed between histological and visual maturity curves to estimate temporal patterns of age at maturity using the 2002-2024 time series of FISS visual maturity data
- Temporal shifts in maturity schedules are apparent

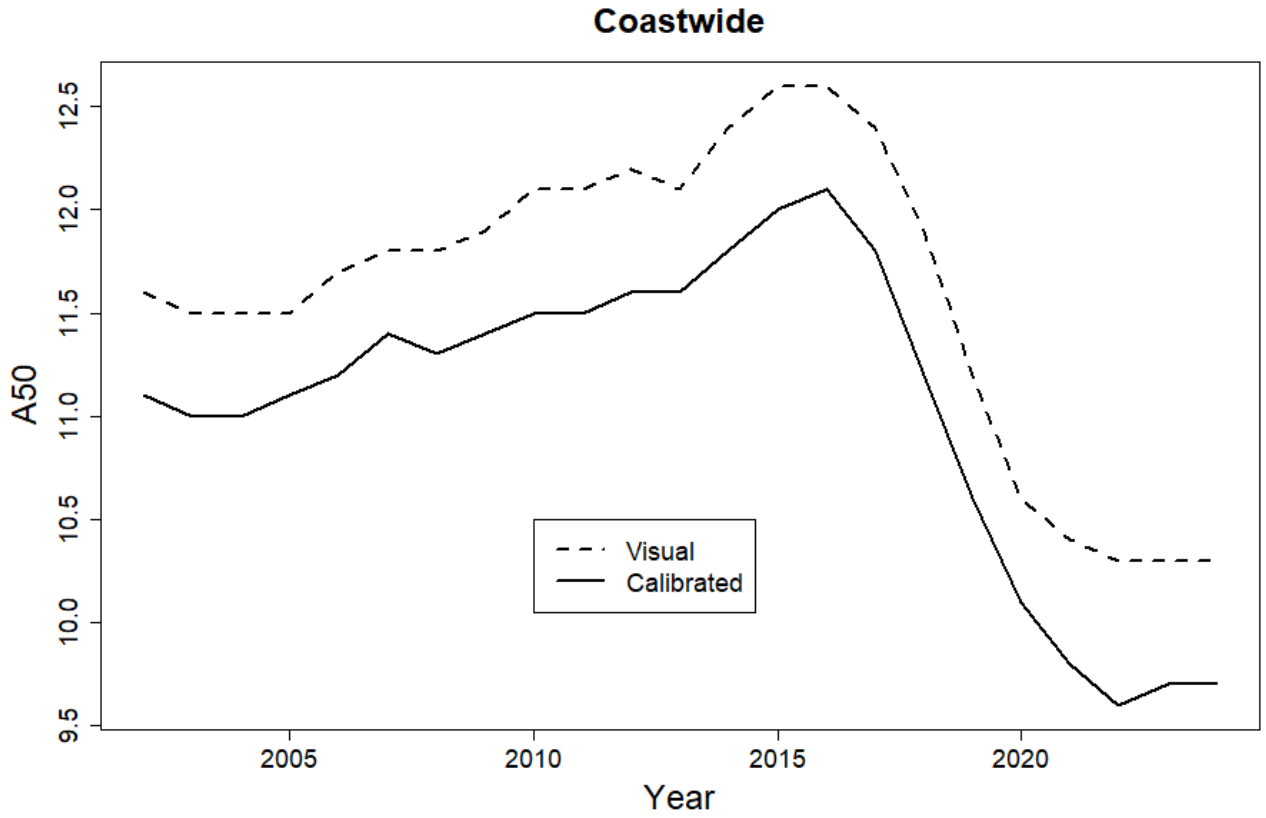


2. Reproduction

Historical coastwide maturity schedules

- 2002 - 2024
  - Raw visual data (dotted line)
  - Calibrated visual data using histology (solid line)

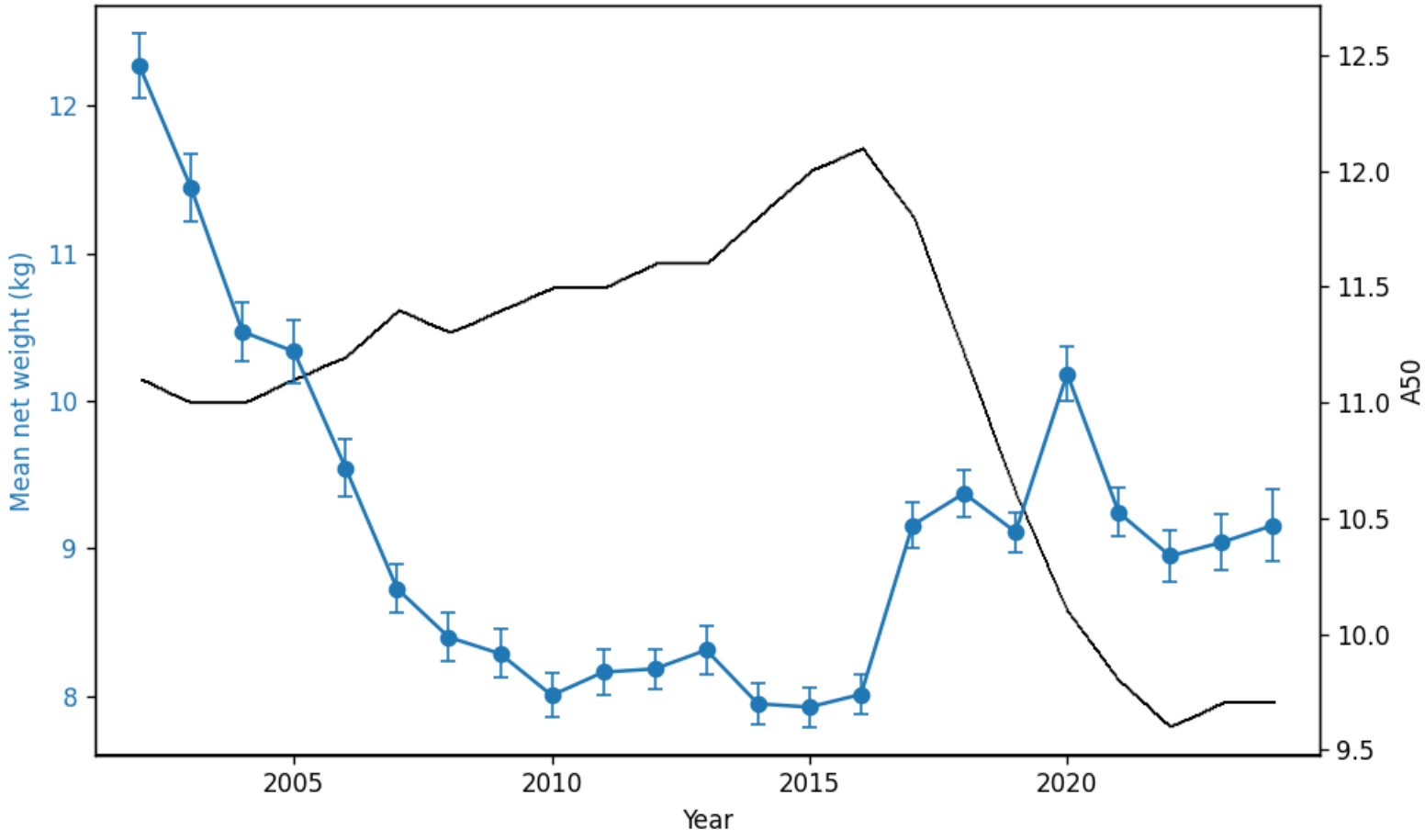
- Two temporal shifts
  - 2002 - 2016
  - 2017 - 2022



2. Reproduction

Potential drivers for changes in coastwide maturity-at-age

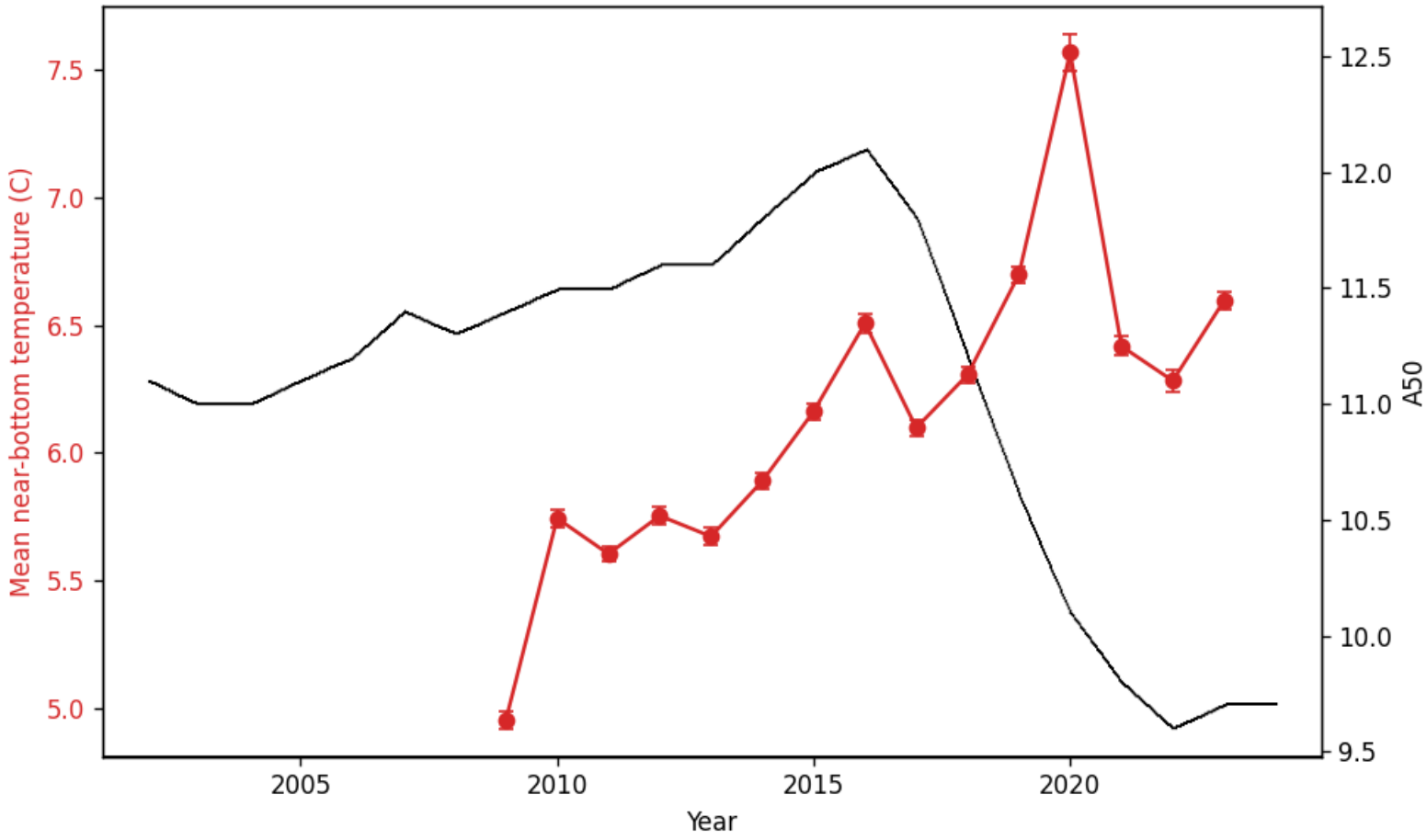
- Net weight
  - Dressed, head-on



2. Reproduction

Potential drivers for changes in coastwide maturity-at-age

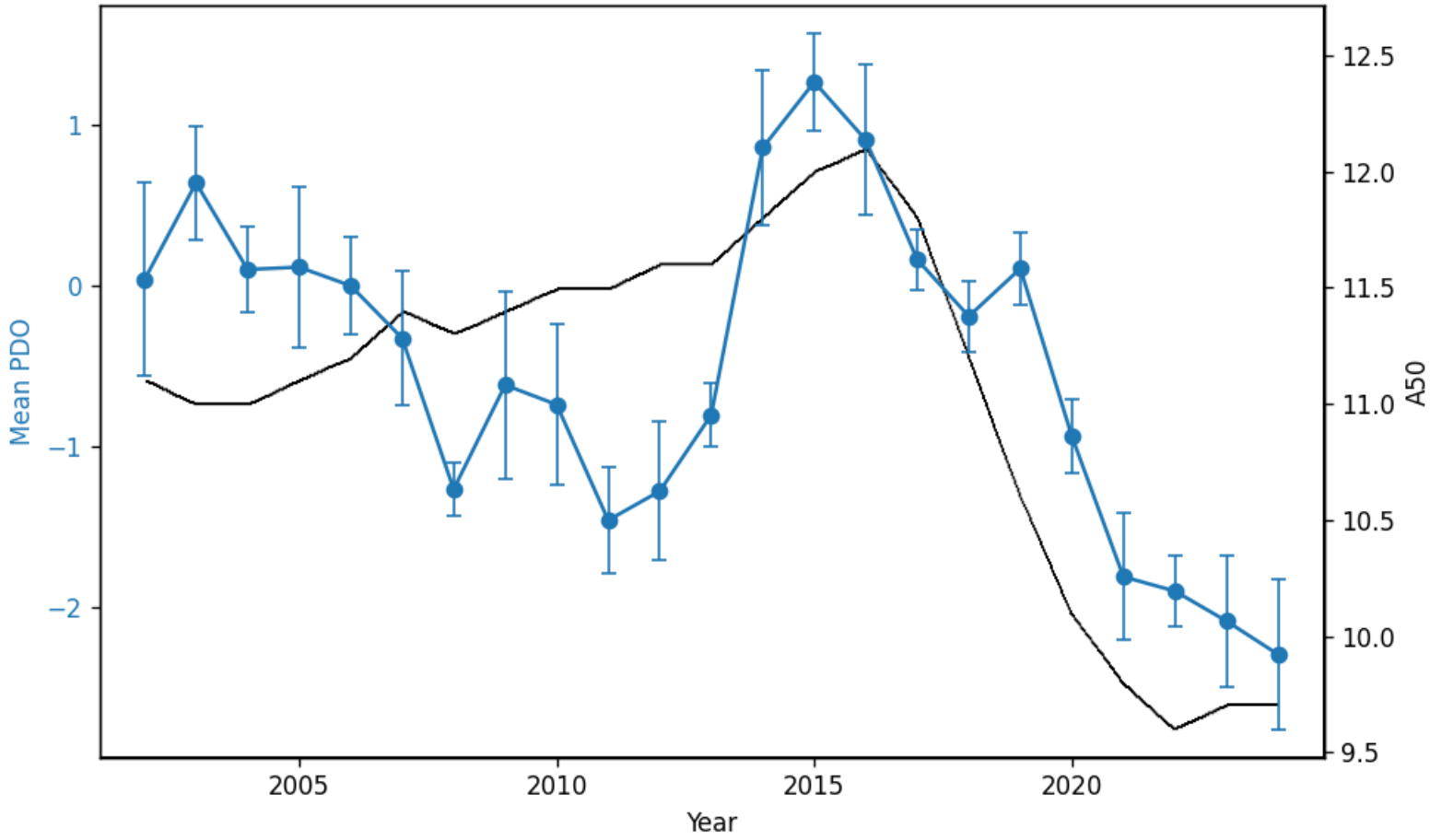
- Near-bottom temperature
  - FISS water-profiler data (2009-2023)



2. Reproduction

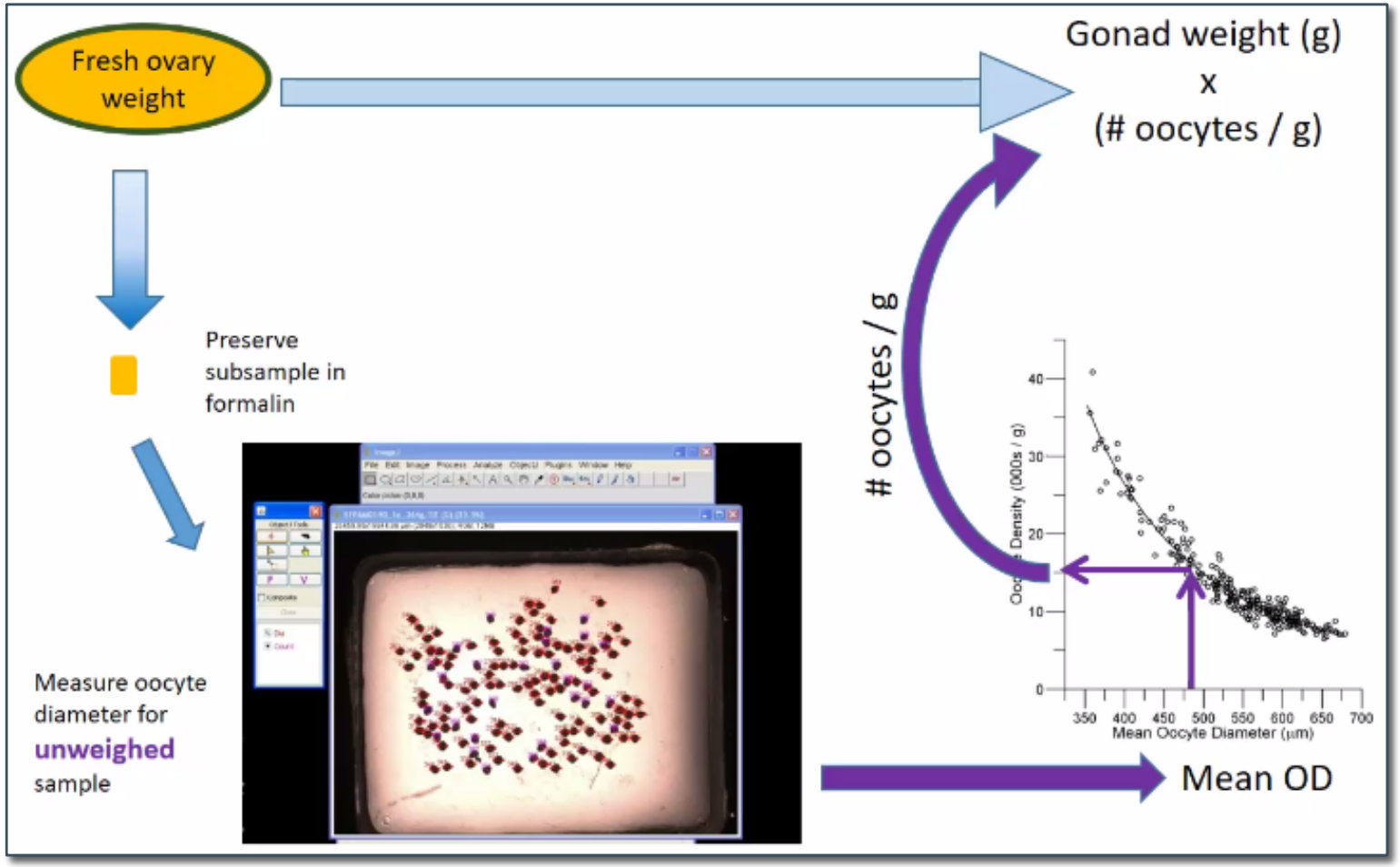
Potential drivers for changes in coastwide maturity-at-age

- Pacific Decadal Oscillation (PDO)



2. Reproduction

Fecundity estimation – Autodiametric method



Potential Annual Fecundity (PAF) (Total # oocytes)

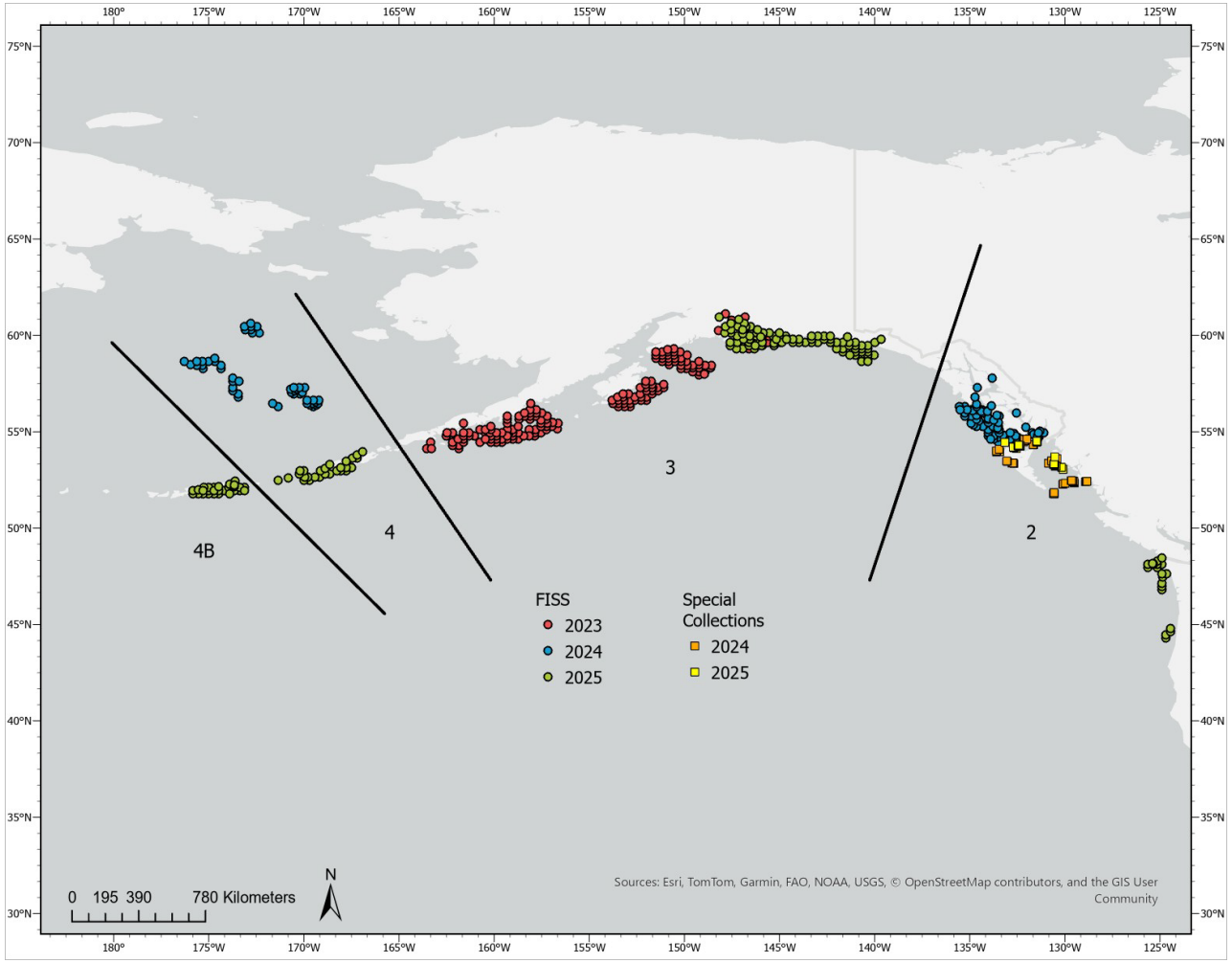
2. Reproduction

Fecundity estimation – Sample collection

- FISS
  - 2023: Region 3
  - 2024: Regions 2 and 4
  - 2025: All Regions
  - 2026: Regions 2, 3 and 4

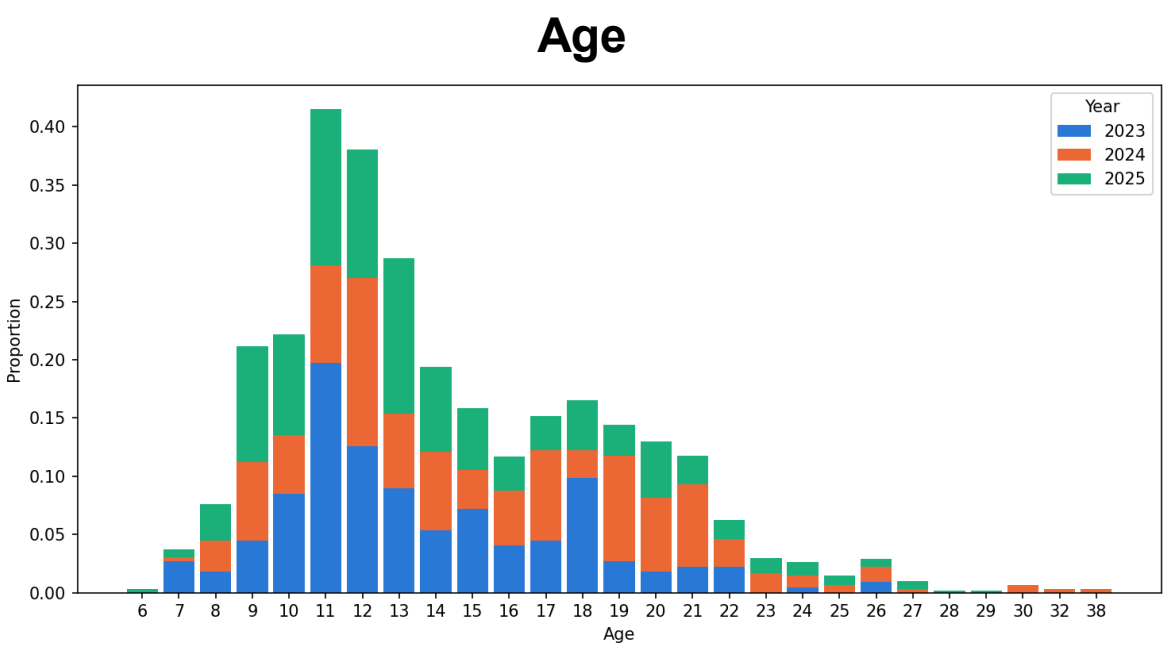
- Special Collections
  - 2024 and 2025: Region 2
  - 2026: Regions 2 and 3

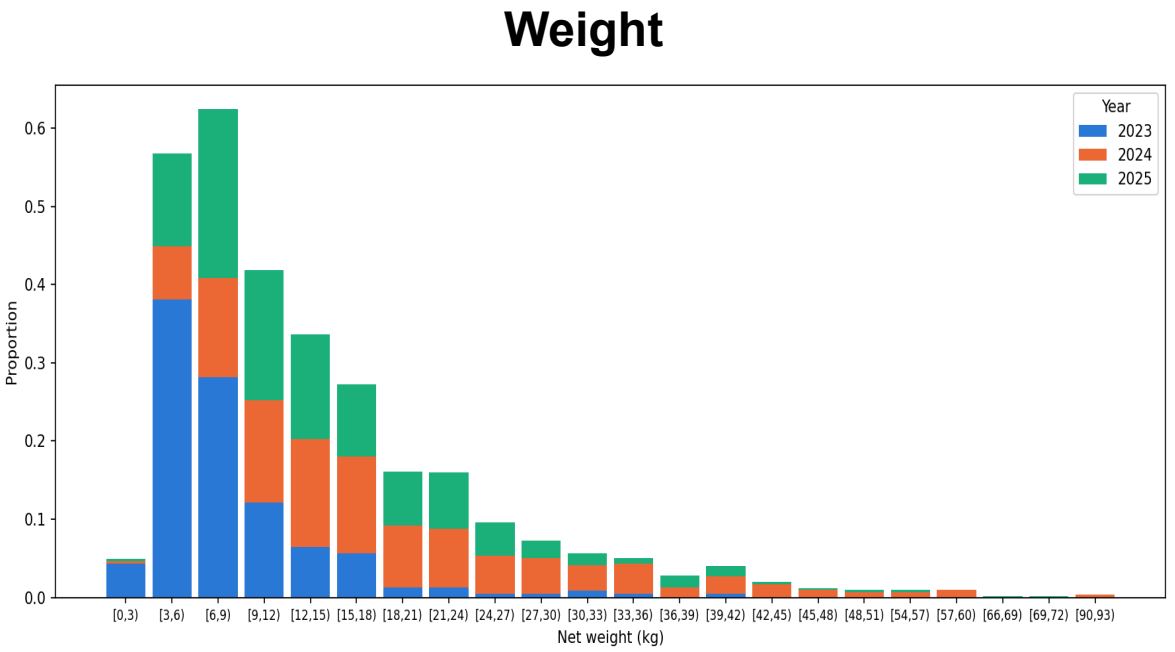
2023-2025: 1,154 G2 samples collected



2. Reproduction

Fecundity estimation – Age and weight distribution of mature samples



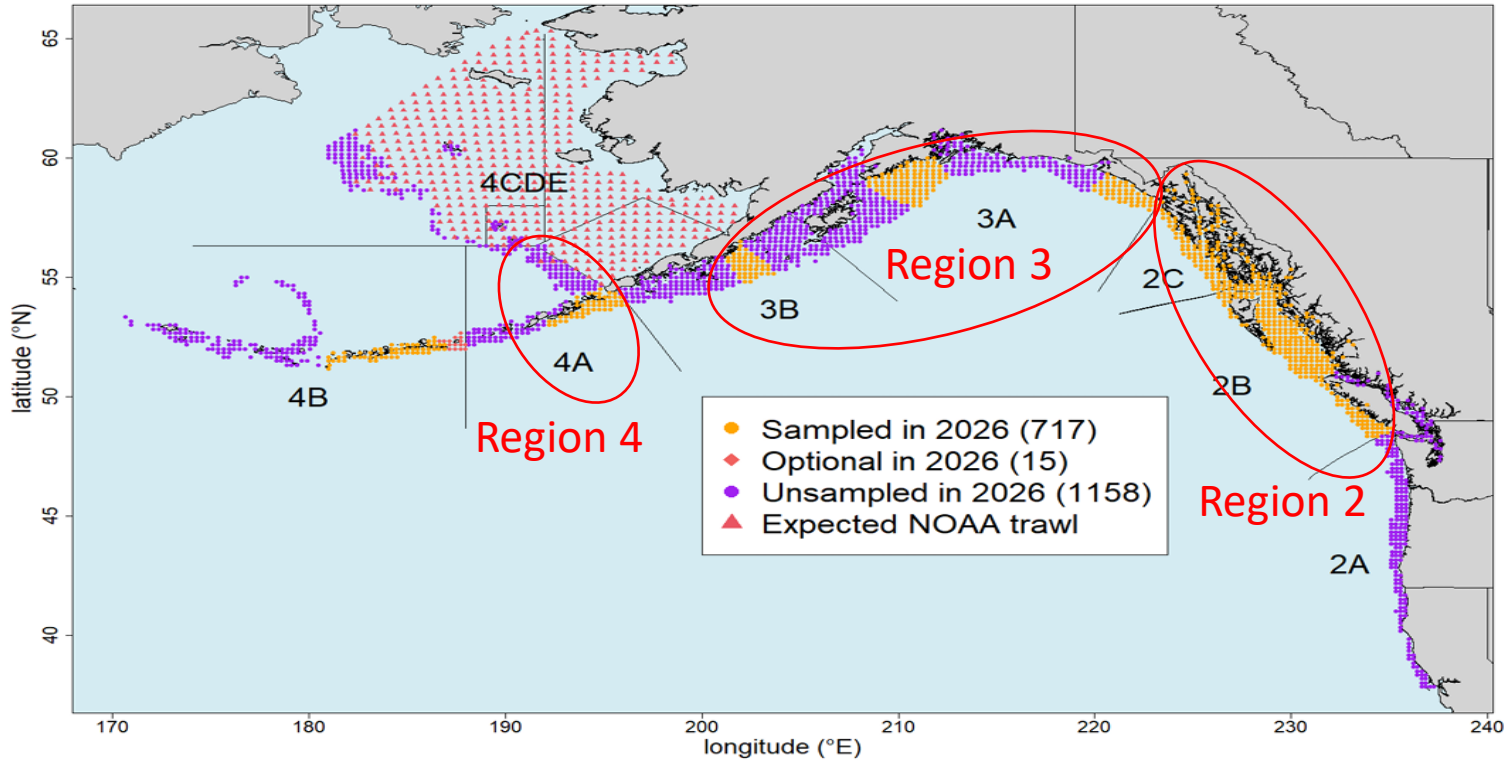


2. Reproduction

Maturity / Fecundity sampling – 2026 FISS

- Region 2
  - Histology: 277
  - Fecundity: 5
- Region 3
  - Histology: 479
  - Fecundity: 29
- Region 4
  - Histology: 427
  - Fecundity: 38

(as of 4 September 2026)



3. Growth

5-Yr Research Plan (2017-2021)

(2022-2026)

2016-2018 Age-0 summer collection (Kodiak)

Fish rearin at Hatfield Marine Science Center (Newport

Identification and validation of physiological growth markers

© 2025. Published by The Company of Biologists | Journal of Experimental Biology (2025) 228, jeb251013. doi:10.1242/jeb.251013

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RESEARCH ARTICLE

Mechanisms underlying thermally induced growth plasticity in juvenile Pacific halibut

Josep V. Planas[1,§], Andrew J. Jasonowicz[1], Anna Simeon[1,*], Crystal Simchick[1], Emma Timmins-Schiffman[2], Brook L. Nunn[2], Anita C. Kroska[3,‡], Nathan Wolf[3] and Thomas P. Hurst[4]

Research outcomes:
- Differentially-expressed genes
- Differentially-expressed proteins
- Validated growth markers

Environmental influences on growth patterns

Research outcomes:
- Effects of temperature on growth rates
- Temperature-specific molecular responses

Environmental influences on growth patterns

Dietary influences on growth patterns and physiological condition

Drivers of changes in size-at-age

External collaborators: Behavioral Ecology Program at AFSC-NOAA (Newport, OR), Alaska Pacific University, UW
External funding: NPRB Grant#1704 (Sept. 2017-Feb. 2020)
Publications: Planas et al. (2025)

4. Mortality and Survival Assessment

5-Yr Research Plan (2017-2021) | **PIRM 2022-2026** | **Relevance for stock assessment**

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

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

Research outcomes:
- Recreational DMR

Best handling practices in longline fishery

Best handling practices in recreational fishery

- Improved estimates of discard mortality
- Reduce potential bias in stock assessment results and management of mortality limits

Reduce unobserved mortality and its effect on stock 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* } Longline fishery
Dykstra et al. (2024) *Ocean & Coastal Management*. ***249****: 107018*.

Dykstra et al. In Preparation } Recreational fishery

Manuscript in preparation

5. Fishing technology

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

Relevance for stock assessment

Summer 2023 pilot test

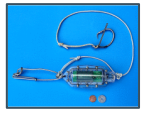
Investigate new methods for whale avoidance/deterrence to reduce whale depredation in the longline fishery

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*

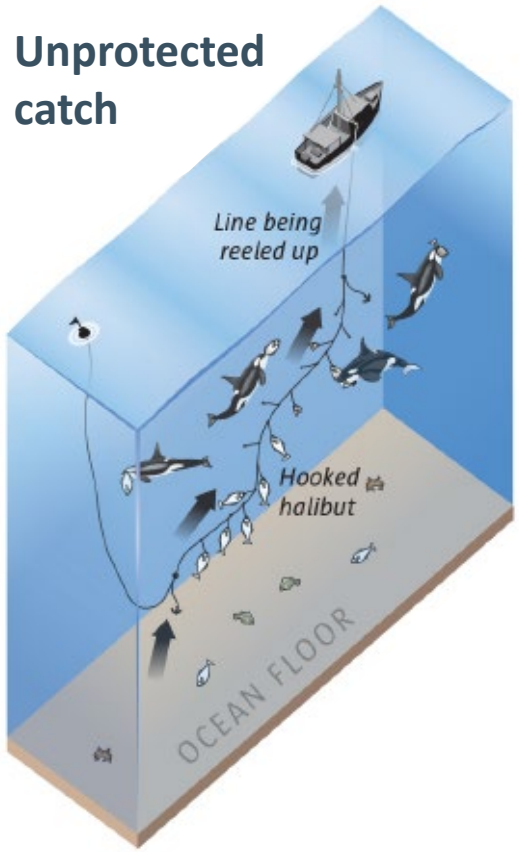
5. Fishing technology

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

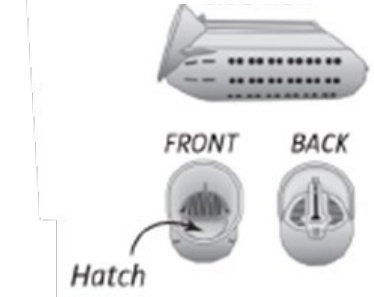
Reducing whale depredation by protecting longline catches

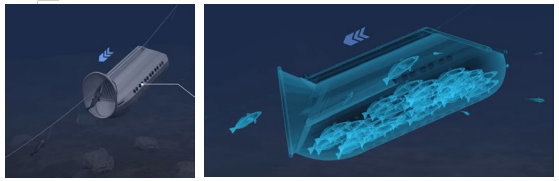
- Underwater Shuttle: Encapsulate fish at depth – protect enroute to the surface

Unprotected catch



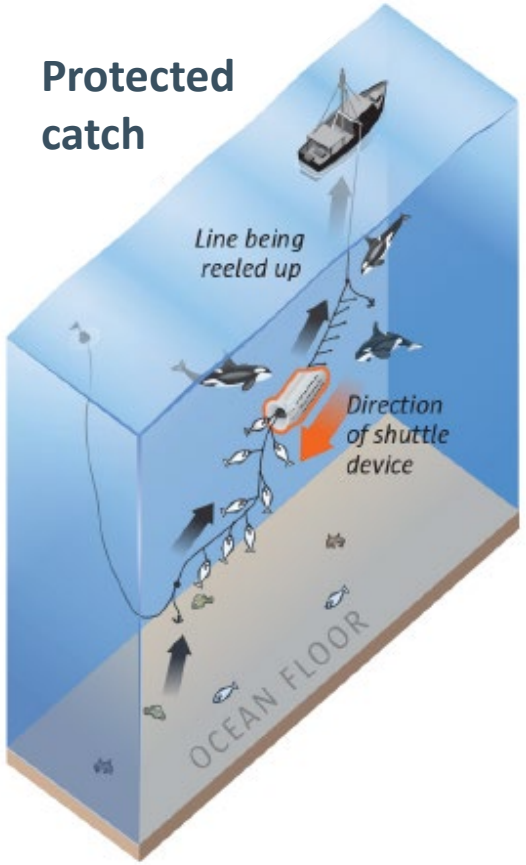
Underwater Shuttle





2.6 m x 0.8 m
100 kg empty

Protected catch



Emptying shuttle

Graphics by Mark Nowlin / The Seattle Times. Source materials: Alaska Sealife Center in Seward, NOAA, North Pacific Longline Association, Alaska Department of Fish and Game, Sago Solutions AS. Photos IPHC.

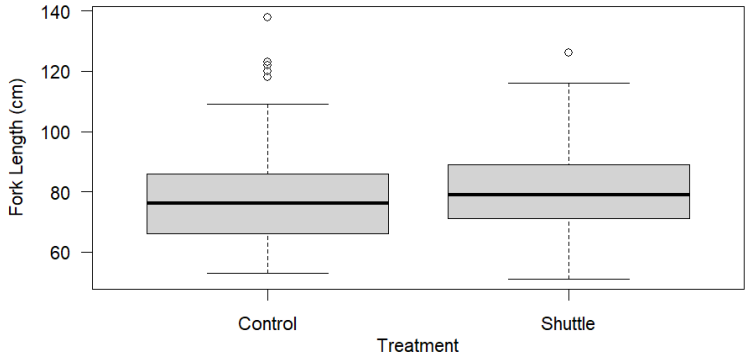
5. Fishing technology

Reducing whale depredation by protecting longline catches: preliminary results

- Retention trends in shuttle from analyzed video footage (11/15 sets)

Common Name	Encountered	Excluded	Entered and Escaped	Entered and Passed Through	Retained
Pacific halibut	**121**	**1 (0.8%)**	**0**	**9 (7.5%)**	**112 (93.3%)**
Sablefish	186	2 (1.1%)	54 (29.4%)	34 (18.5%)	96 (52.2%)
Pacific cod	124	3 (2.4%)	13 (10.7%)	6 (5.0%)	102 (84.3%)
Rockfish	19	7 (43.8%)	2 (16.7%)	1 (8.3%)	9 (75.0%)
Skate	18	3 (16.7%)	0	2 (13.3%)	13 (86.7%)

- Size of Pacific halibut retained



Conclusions

- Shuttle can be safely deployed and retrieved by vessels with a picking boom
- Shuttle has good retention in terms of numbers and size of Pacific halibut
- Continued interest from the fleet in this approach

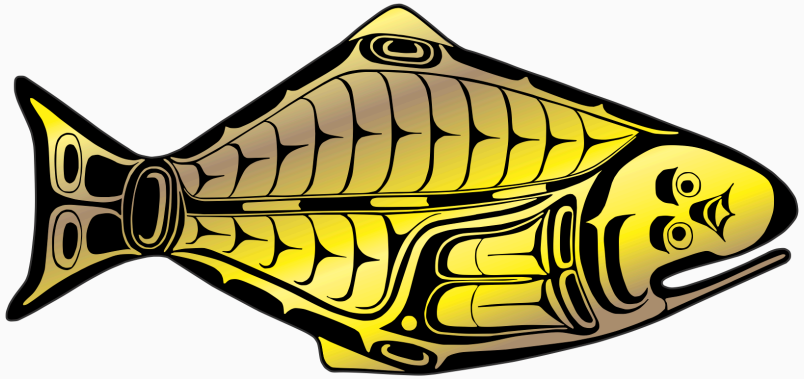
Summary of awarded research grants to IPHC

Project #	Grant agency	Project name	PI	Partners	IPHC Budget ($US)	Management implications	Grant period
1	Alaska Sea Grant	Development of a non-lethal genetic-based method for aging Pacific halibut (R/2024-05)	IPHC, Alaska Pacific U. (APU)	Alaska Fisheries Science Center-NOAA (Juneau)	$60,374	Stock structure	January 2025-January 2027
				Total awarded ($)	**$60,374**		

Research proposal submitted to the North Pacific Research Board (pending decision):

Summary Page
Proposal No: 5620
Proposal Title: Estimating fecundity in female Pacific halibut: development of an autodiametric method
Project Period: Start Date: Jan 2027, End Date: Dec 2027
Budget: **Total Funding Requested From NPRB:** $122,945.00 1. International Pacific Halibut Commission: $122,945.00 **Total Other Support:** $90,184.00 1. International Pacific Halibut Commission: $90,184.00
Research Categories: Fishes and Invertebrates

INTERNATIONAL PACIFIC



HALIBUT COMMISSION

https://www.iphc.int/