INTERNATIONAL PACIFIC

HALIBUT COMMISSION

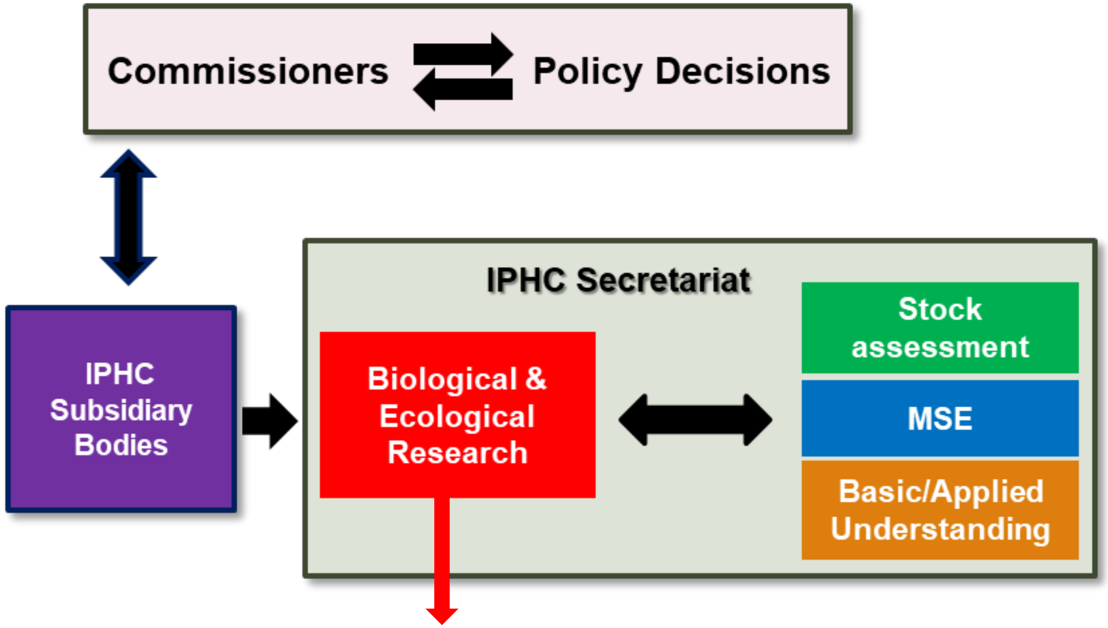
Report on current and future Biological and Ecosystem Science Research activities

Agenda item: 4.1.3

IPHC-2024-SRB024-09

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

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

Top research priorities for stock assessment

SA Rank	Research outcomes	Relevance for stock assessment	Specific analysis input	Research Area	Research activities
1. Biological input	Updated maturity schedule	Scale biomass and reference point estimates	Will be included in the stock assessment, replacing the current schedule last updated in 2006	**Reproduction**	Histological maturity assessment
	Incidence of skip spawning		Will be used to adjust the asymptote of the maturity schedule, if/when a time-series is available this will be used as a direct input to the stock assessment		Examination of potential skip spawning
	Fecundity-at-age and -size information		Will be used to move from spawning biomass to egg-output as the metric of reproductive capability in the stock assessment and management reference points		Fecundity assessment
	Revised field maturity classification		Revised time-series of historical (and future) maturity for input to the stock assessment		Examination of accuracy of current field macroscopic maturity classification
2. Biological input	Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area	Altered structure of future stock assessments	If 4B is found to be functionally isolated, a separate assessment may be constructed for that IPHC Regulatory Area	**Migration and population dynamics**	Population structure
3. Biological input	Assignment of individuals to source populations and assessment of distribution changes	Improve estimates of productivity	Will be used to define management targets for minimum spawning biomass by Biological Region		Distribution
	Improved understanding of larval and juvenile distribution		Will be used to generate potential recruitment covariates and to inform minimum spawning biomass targets by Biological Region		Larval and juvenile connectivity studies
1. Assessment data collection and processing	Sex ratio-at-age	Scale biomass and fishing intensity	Annual sex-ratio at age for the commercial fishery fit by the stock assessment	**Reproduction**	Sex ratio of current commercial landings
	Historical sex ratio-at-age		Annual sex-ratio at age for the commercial fishery fit by the stock assessment		Historical sex ratios based on archived otolith DNA analyses
2. Assessment data collection and processing	New tools for fishery avoidance/deterence; improved estimation of depredation mortality	Improve mortality accounting	May reduce depredation mortality, thereby increasing available yield for directed fisheries. May also be included as another explicit source of mortality in the stock assessment and mortality limit setting process depending on the estimated magnitude	**Fishing technology**	Whale depredation accounting and tools for avoidance
1. Fishery yield	Physiological and behavioral responses to fishing gear	Reduce incidental mortality	May increase yield available to directed fisheries	**Fishing technology**	Biological interactions with fishing gear
2. Fishery yield	Guidelines for reducing discard mortality	Improve estimates of unobserved mortality	May reduce discard mortality, thereby increasing available yield for directed fisheries	**Mortality and survival assessment**	Best handling practices: recreational fishery

Top research priorities for MSE

MSE Rank	Research outcomes	Relevance for MSE	Research Area	Research activities
1. Biological parameterization and validation of movement estimates	Improved understanding of larval and juvenile distribution	Improve parametization of the Operating Model	**Migration and population dynamics**	Larval and juvenile connectivity studies
	Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area			Population structure
2. Biological parameterization and validation of recruitment variability and distribution	Assignment of individuals to source populations and assessment of distribution changes	Improve simulation of recruitment variability and parametization of recruitment distribution in the Operating Model		Distribution
	Establishment of temporal and spatial maturity and spawning patterns	Improve simulation of recruitment variability and parametization of recruitment distribution in the Operating Model	**Reproduction**	Recruitment strength and variability
3. Biological parameterization and validation for growth projections	Identification and application of markers for growth pattern evaluation	Improve simulation of variability and allow for scenarios investigating climate change	**Growth**	Evaluation of somatic growth variation as a driver for changes in size-at-age
	Environmental influences on growth patterns			
	Dietary influences on growth patterns and physiological condition			
1. Fishery parameterization	Experimentally-derived DMRs	Improve estimates of stock productivity	**Mortality and survival assessment**	Discard mortality rate estimate: recreational fishery

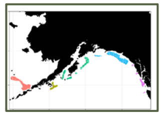
1. Migration and Population Dynamics

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*

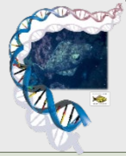
Juvenile connectivity

- 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

Brief Background & Introduction

Results

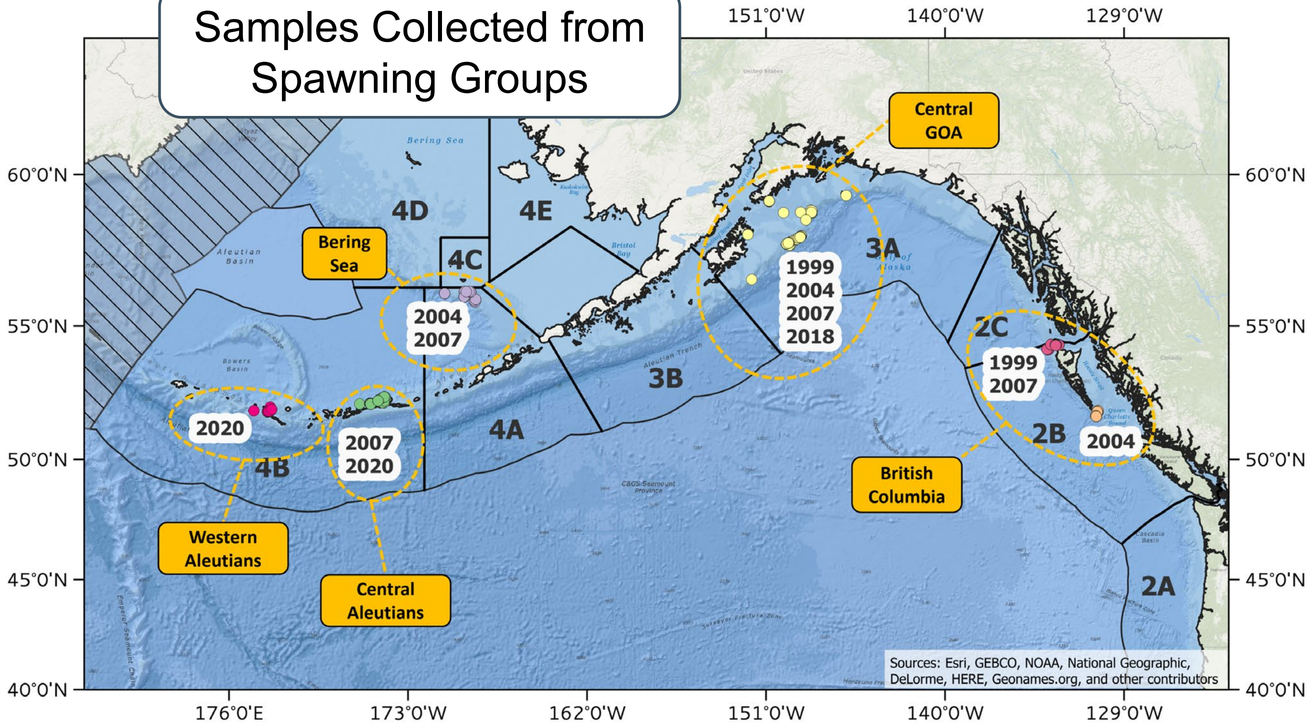
- PCA & K-means clustering
- Admixture – Unsupervised clustering (model based)
- Assignment Testing – Supervised method - Can we use a subset of SNPs to identify source populations of individuals?

1. Migration and Population Dynamics

Population Genomics

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

Samples Collected from Spawning Groups



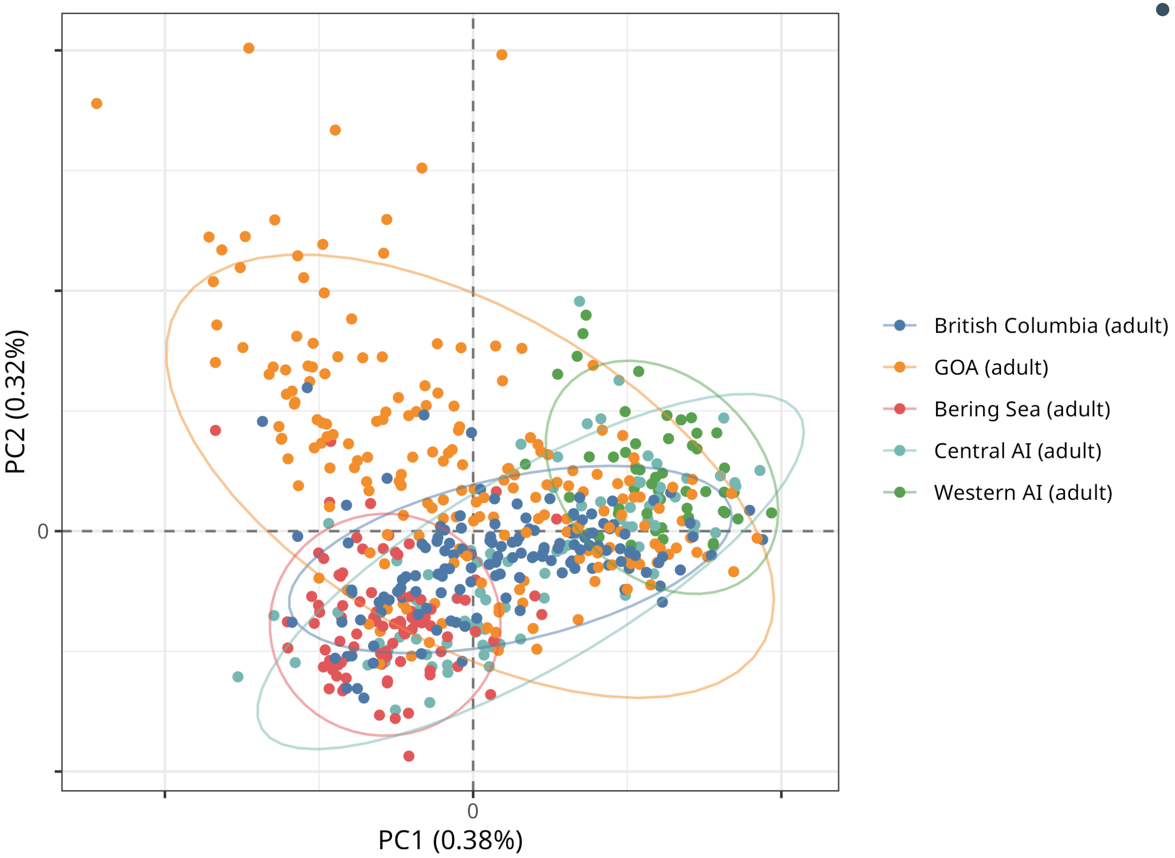
NPRB Project 2110 (2022-2024)

- **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**
- **Mean coverage - 3.5x**
- **10,371,343 autosomal SNPs**
- **4,793,014 (minor allele frequency ≥ 0.05)**

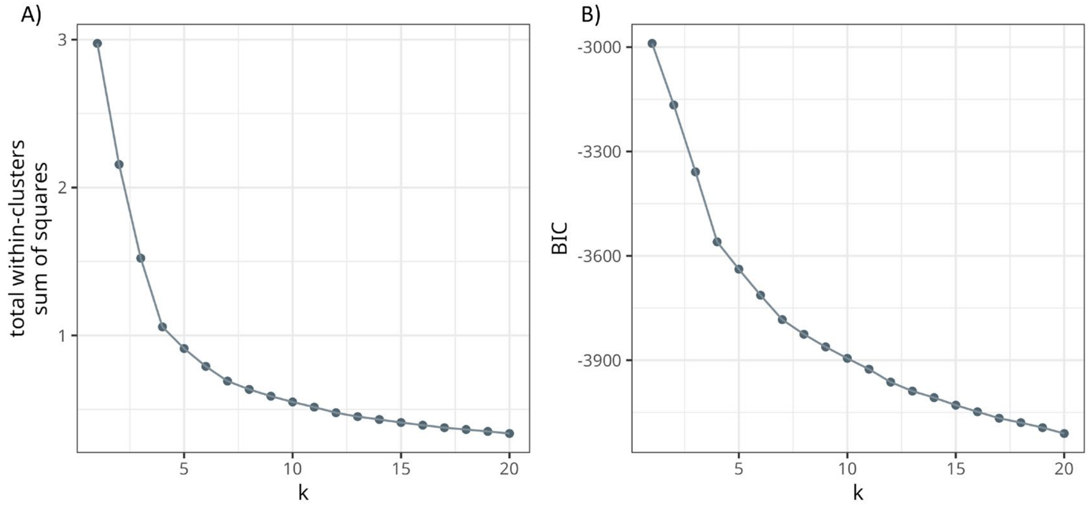
1. Migration and Population Dynamics

Population Structure



- Principal components analysis (PCA)
  - Estimate covariance matrix from genotype likelihoods (*PCAngsd)*
    - 4,793,014 autosomal SNPs
      - Allele frequency ≥ 0.05
  - Eigendecomposition (*R*)
  - K-means clustering (*R*)

K-means clustering (top 3 PCs)



1. Migration and Population Dynamics

SRB023–Req.05 (para. 52) The SRB REQUESTED that admixture analyses and assignment testing be conducted and reported at SRB024, including estimates of assignment accuracy.

Admixture Analysis (*NGSAdmix*)

- Unsupervised model-based clustering (assumes HWE within clusters & SNPs are in linkage equilibrium)
  - Partition individuals into a pre-defined number of discrete populations (K)
  - Estimates allele frequencies for each cluster (F)
  - ***Estimates membership probabilities for each individual (Q) to each cluster***

Assignment Testing (*WGSassign*)

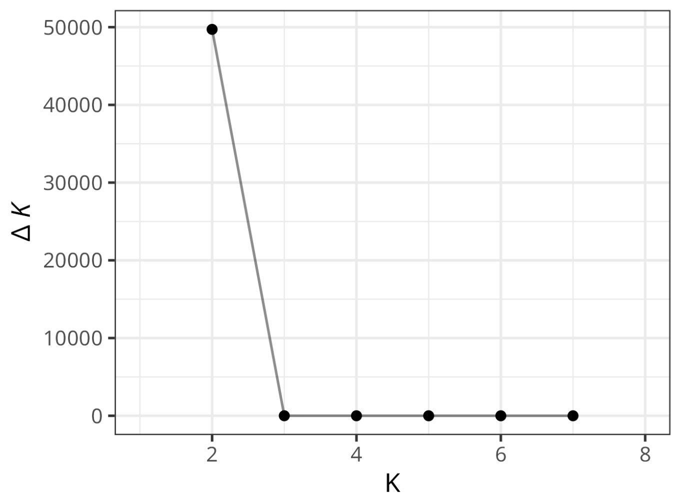
- Supervised method (pre-defined populations)
- What is the likelihood that an individual's genotype originates from a set of (pre-defined) reference populations?

1. Migration and Population Dynamics

Admixture Analysis - *NGSAdmix*

- Ran model for K=2 to K=8 (5 replicates for each K)
- Required assignment probability of ≥ 0.8 to a single cluster for assignment.
- ΔK– to evaluate support for best K (Evanno at al. 2005)

Evanno, G., Regnaut, S., and Goudet, J. 2005. Detecting the number of clusters of individuals using the software structure: a simulation study. Mol. Ecol. **14**(8): 2611–2620. doi:10.1111/j.1365-294X.2005.02553.x.



1. Migration and Population Dynamics

Assignment Testing - *WGSassign*

- Reference populations defined by geographic area
- Simple Training Holdout procedure
- Recommended approach by Anderson 2010 when selecting SNPs based on allele frequency
- Referred to as the "gold standard" by Anderson 2010 and Waples 2010

Anderson, E.C. 2010. Assessing the power of informative subsets of loci for population assignment: Standard methods are upwardly biased. Mol. Ecol. Resour. **10**(4): 701–710

Waples, R.S. 2010. High-grading bias: Subtle problems with assessing power of selected subsets of loci for population assignment. Mol. Ecol. **19**(13): 2599–2601.

Dataset (50:50 split)

Training Set

SNP Selection

- Pairwise F_{ST} among collection areas
- Top 1,000 SNPs per comparison
- At least 10 Kbp apart
- Remove any duplicates (8,497 SNPs)

Define reference populations/reporting groups

- Estimate allele frequencies

Validation Set

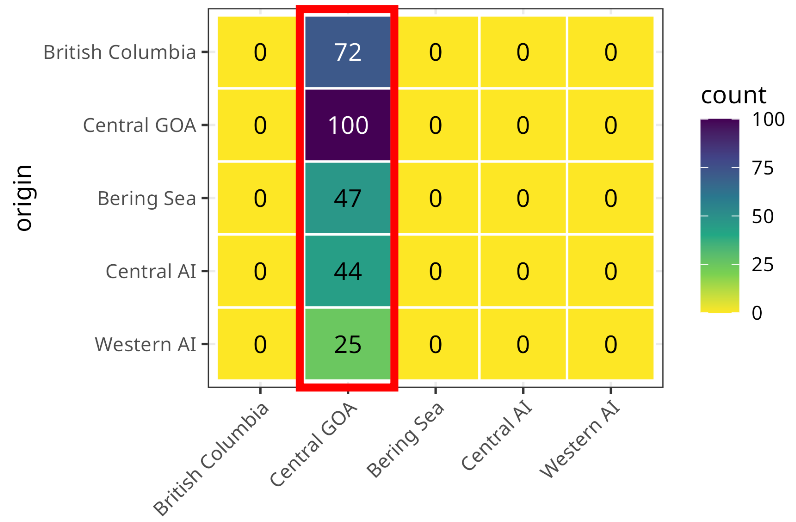
Assignment testing

- Assign individuals back to the reference populations
- Evaluate assignment accuracy with a set of “new” samples.

1. Migration and Population Dynamics

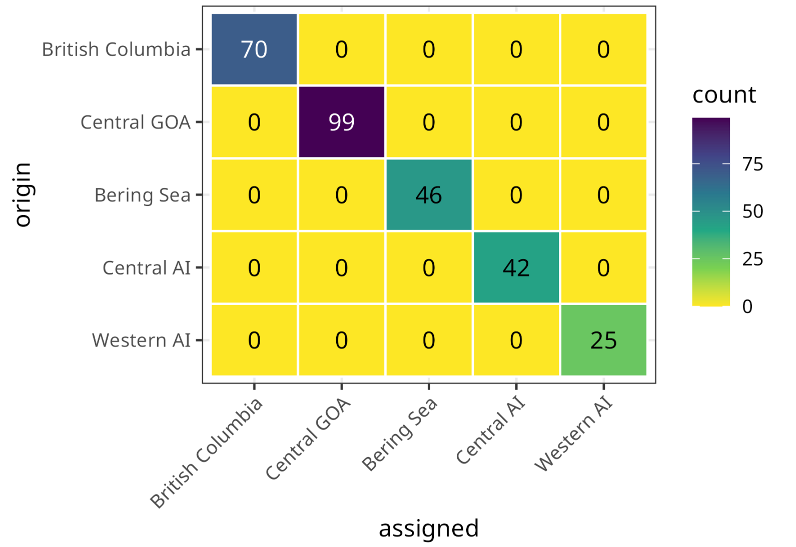
Assignment rates of the validation set

- 34.7 % assignment accuracy
- All samples assign back to Gulf of Alaska with > 95% probability



Self assignment rates of the training set

- Leave-one-out cross-validation
- Self assignment accuracy = 100%



1. Migration and Population Dynamics

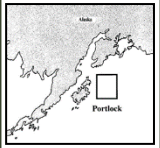
Conclusions

- Unsupervised clustering methods failed to identify discrete genetic groups of Pacific halibut.
- Limited ability to assign individuals back to the location in which they were sampled.
- Considerable geneflow – lack of structure.
    - Tagging data – 11% of Pacific halibut are recovered in a different IPHC Regulatory Area than they are released (Carpi et al. 2021).
    - Large amounts of larval exchange between Gulf of Alaska and the Bering Sea (Sadorus et al. 2021).
- Results are consistent with current assessment practices (modeled as a single coastwide stock).

2. Reproduction

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

2017-2018 Field sample collection (central GOA)



30♀/ month

♀>90 cm FL

Seasonal characterization of reproductive development

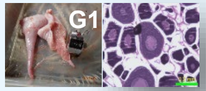
Histological samples → Characterization of oocyte stages → Classification of female developmental stages → Classification of reproductive phases → Appropriate timing of gonad collection in FISS → Histology-based Maturity schedule; Fecundity assessment

Research outcomes:
- Group synchronous
- Batch spawner
- Determinate fecundity
- Annual cycle
- Spawning time
- Reproductive delays
- June-August

Macroscopic vs microscopic maturity staging

Macroscopic maturity scores

Ovary images



Histology-based female developmental stages and reproductive phases → Assess accuracy of current field maturity classification criteria → Revise macroscopic staging criteria

Research outcomes:
- In progress

2017-2022 Commercial landings

Development and application of genetic tests for sex identification → Sex-ratio monitoring

- Direct input into stock assessment for estimation of the stock-recruitment relationship
- Estimate annual reproductive output
- Revise time-series of historical and future maturity

Scale of female spawning biomass and reference point estimates

- Annual sex-ratio at age for the commercial fishery fit by the stock assessment

Reduce uncertainty in stock size and fishing intensity

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

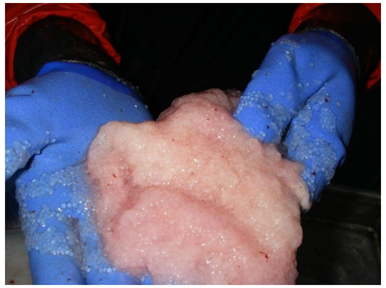
Female Maturity: visual assessment (macroscopic)

- Current maturity estimates
- Fishery-Independent Setline Survey (FISS)

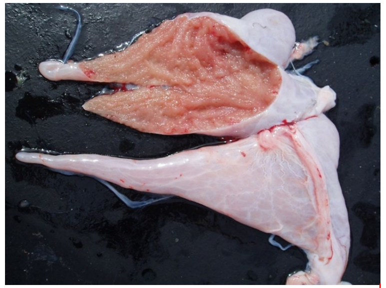
Immature (1)

Mature (2)

Spawning (3)

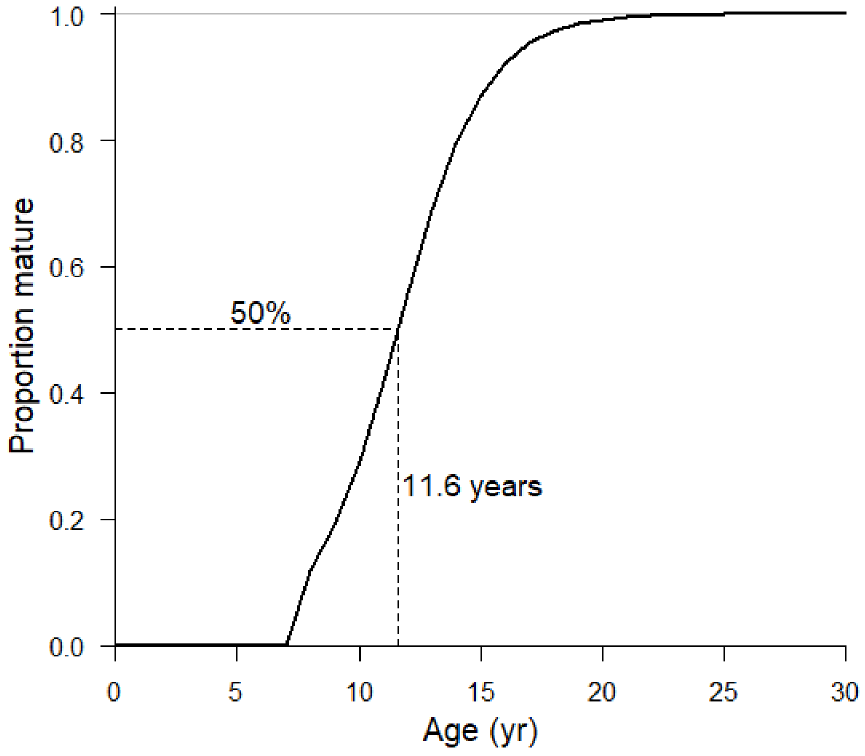


Resting (4)



Immature

Mature



2. Reproduction

Histological (microscopic) maturity assessment

Immature

Female oocyte stages

Mature

Growth phase (acronym)	Developmental stage (acronym)	Description	Photo	Sample size	Oocyte diameters (μm) Mean ± SD	Range (min - max)
Primary Growth (PG)	One nucleolus (PGon)	Oocytes are small, angular, and compact with a single large nucleolus. Cytoplasm granules stain dark purple.		51	116 ±89	36 - 381
	Perinucleolar (PGpn)	Oocytes are larger and rounder than PGon Nuclei develop and flatten around the nucleus. Cytoplasm granules stain light purple.		55	235 ± 92	103 - 479
	Cortical alveolar (CA)	First cortical alveoli appear as white stain in the periphery of the oocyte.		237	445 ± 80	195 - 664
Secondary Growth (SG)	Primary vitellogenesis (Vtg1)	Yolk globules first appear at the periphery, stain pink, and fill inwards occupying up to 1/3 of the cytoplasm.		663	544 ± 69	362 - 750
	Secondary vitellogenesis (Vtg2)	Yolk globules transition from only the periphery of the ooplasm and fill inwards to the nucleus.		341	686 ± 91	465 - 910
	Tertiary vitellogenesis (Vtg3)	Yolk globules completely fill the ooplasm to the central nucleus and coalesce into larger yolk globules.		500	1171 ± 216	706 - 1644
Oocyte Maturation (OM)	Germinal vesicle migration (GVM)	The nucleus begins to migrate through a cytoplasm fully filled with large yolk globules.		302	1271 ± 257	811 - 1769
	Periovulatory (PO)	Nucleus no longer visible and the yolk globules coalesce into a central yolk mass. Oocyte is still within the follicle wall.		54	2037 ± 270	1600 - 2811
	Postovulatory follicle (POF)	Collapsed empty follicle wall remaining after a periovulatory oocyte is expelled.				

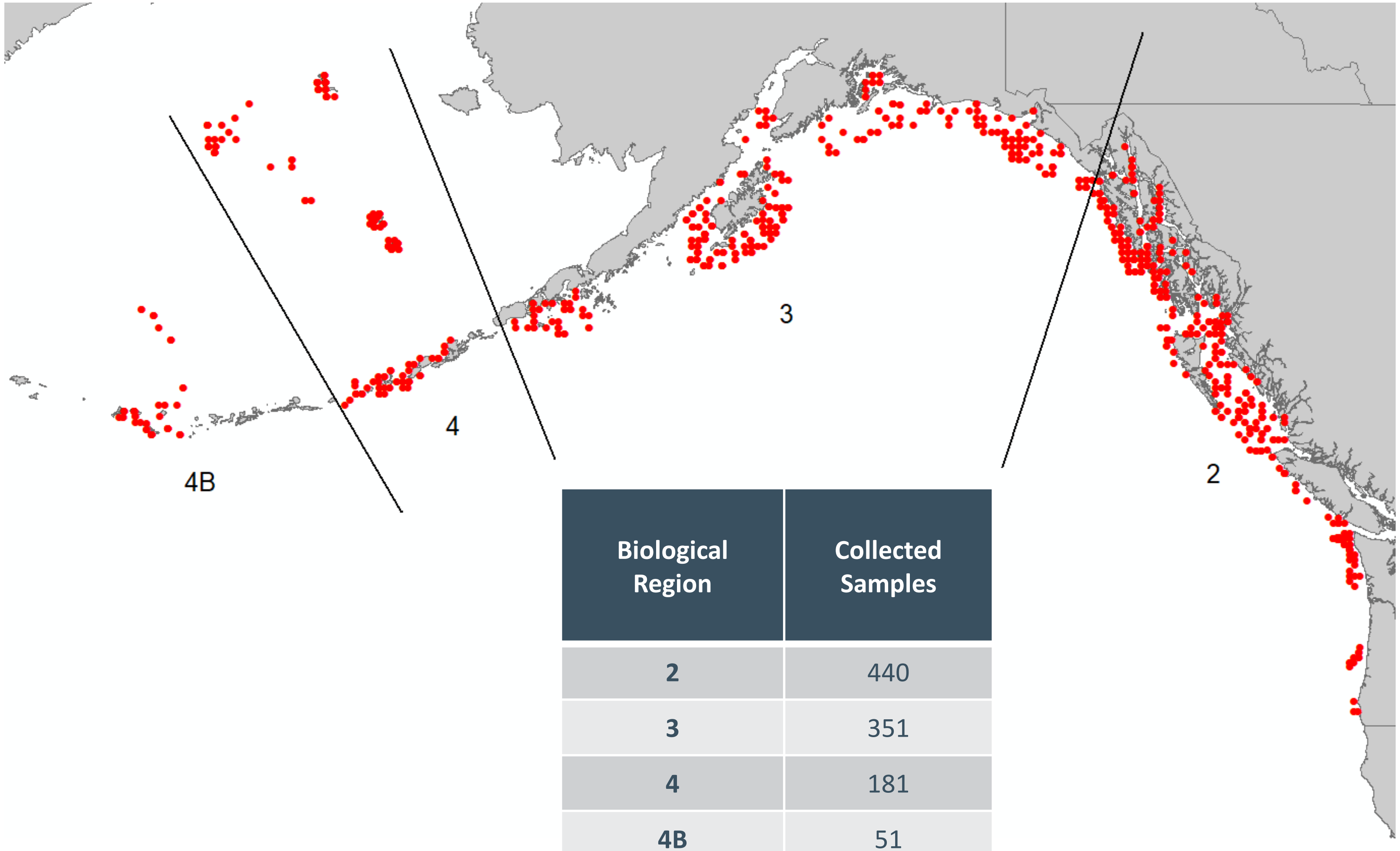
Pacific halibut oocyte histology

Females are assigned to a developmental stage based on the most advanced oocyte stage present

Fish et al. (2020) *J Fish Biol.* **97**:1880-1885

2. Reproduction

2022 FISS Ovary Sample Collection for Histological Assessment

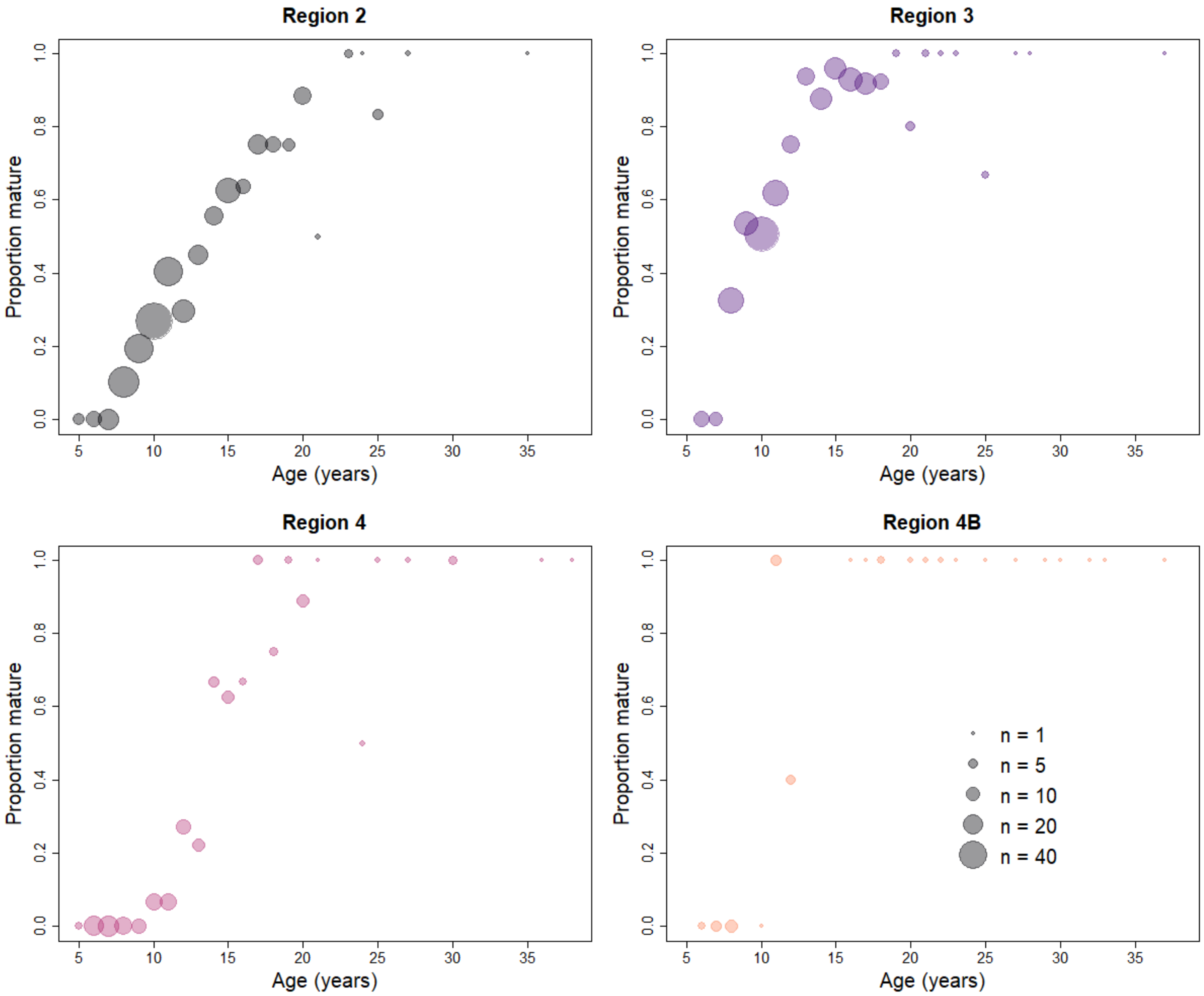


Biological Region	Collected Samples
2	440
3	351
4	181
4B	51
Total	1023

2. Reproduction

Histological maturity assessment

- Raw data by Biological Region
- Each bubble represents an age



International Pacific Halibut Commission

2. Reproduction

Maturity Model Comparisons

- Models with age and region
  - Logistic GLM: logit(P(mature)) ~ age*Region
  - Logistic GLM: logit(P(mature)) ~ log(age)*Region
  - Logistic GAM: logit(P(mature)) ~ s(log(age), by Region)
- Models with age for each region (single region models)
  - Logistic GLM with estimated breakpoint
  - Logistic GLM with breakpoint at A50

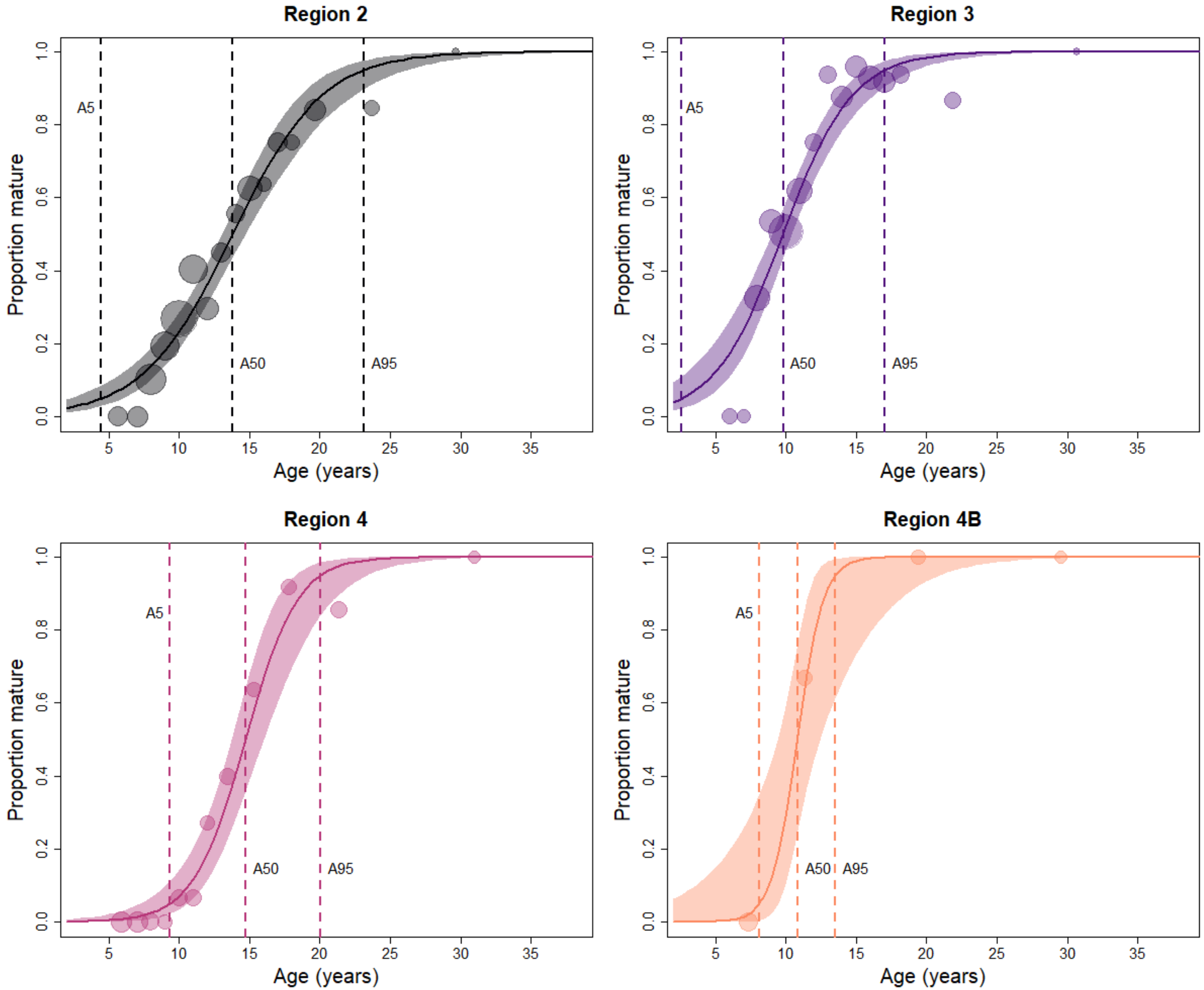
	Model	AIC
Age	Age	995.99
	Age * Region	894.24
	sqrt(Age) * Region	882.67
	log(Age) * Region	874.06
Length	Length	1038.99
	Length * Region	944.53
	log(Length) * Region	940.03
Weight	Weight	1082.99
	Weight * Region	983.65
	log(Weight) * Region	956.41

2. Reproduction

GLM, age*Region

AIC = 894.2

Data binned for plotting



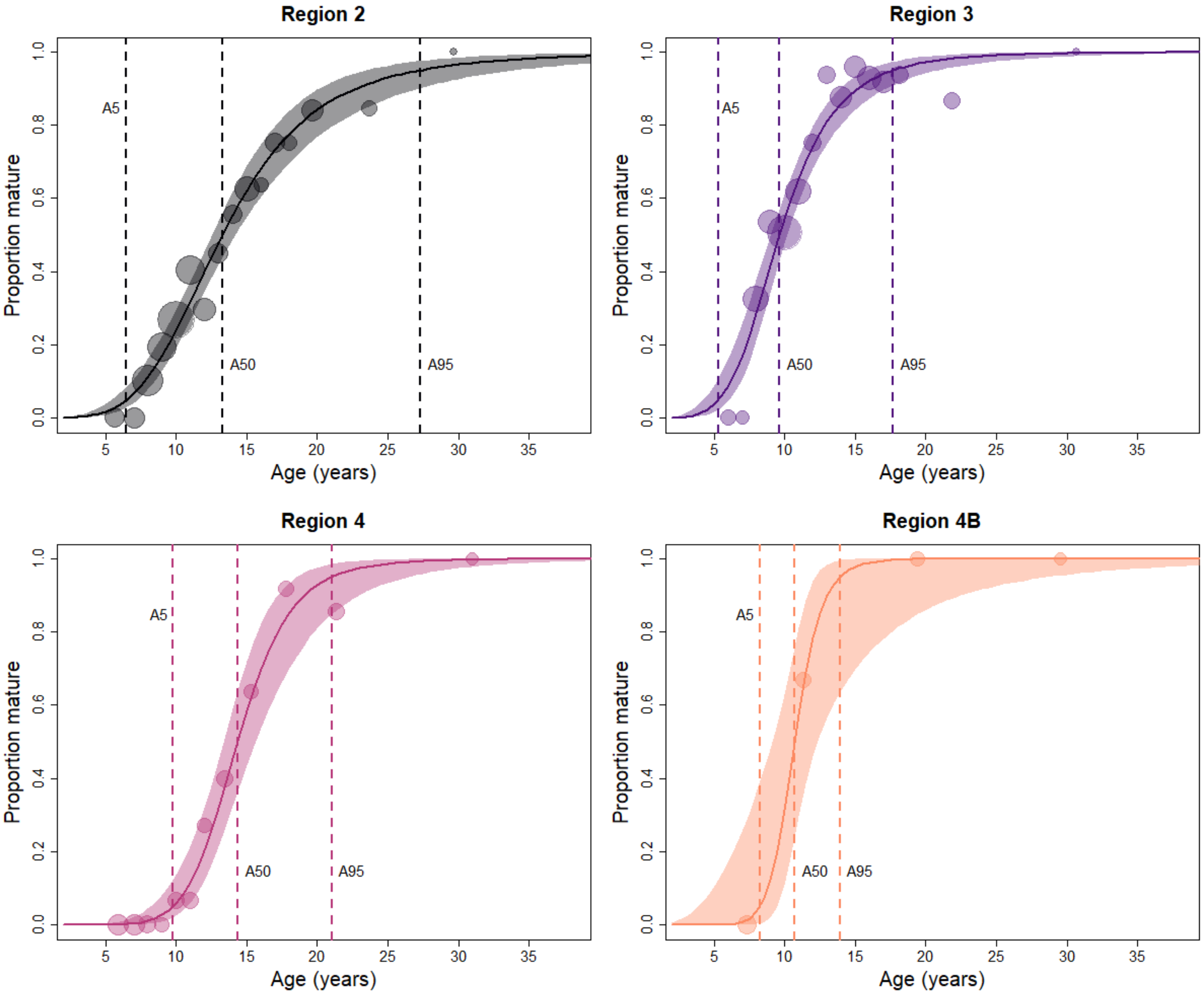
International Pacific Halibut Commission

2. Reproduction

GLM, log(age)*Region

AIC = 874.1

log() transform improves fit



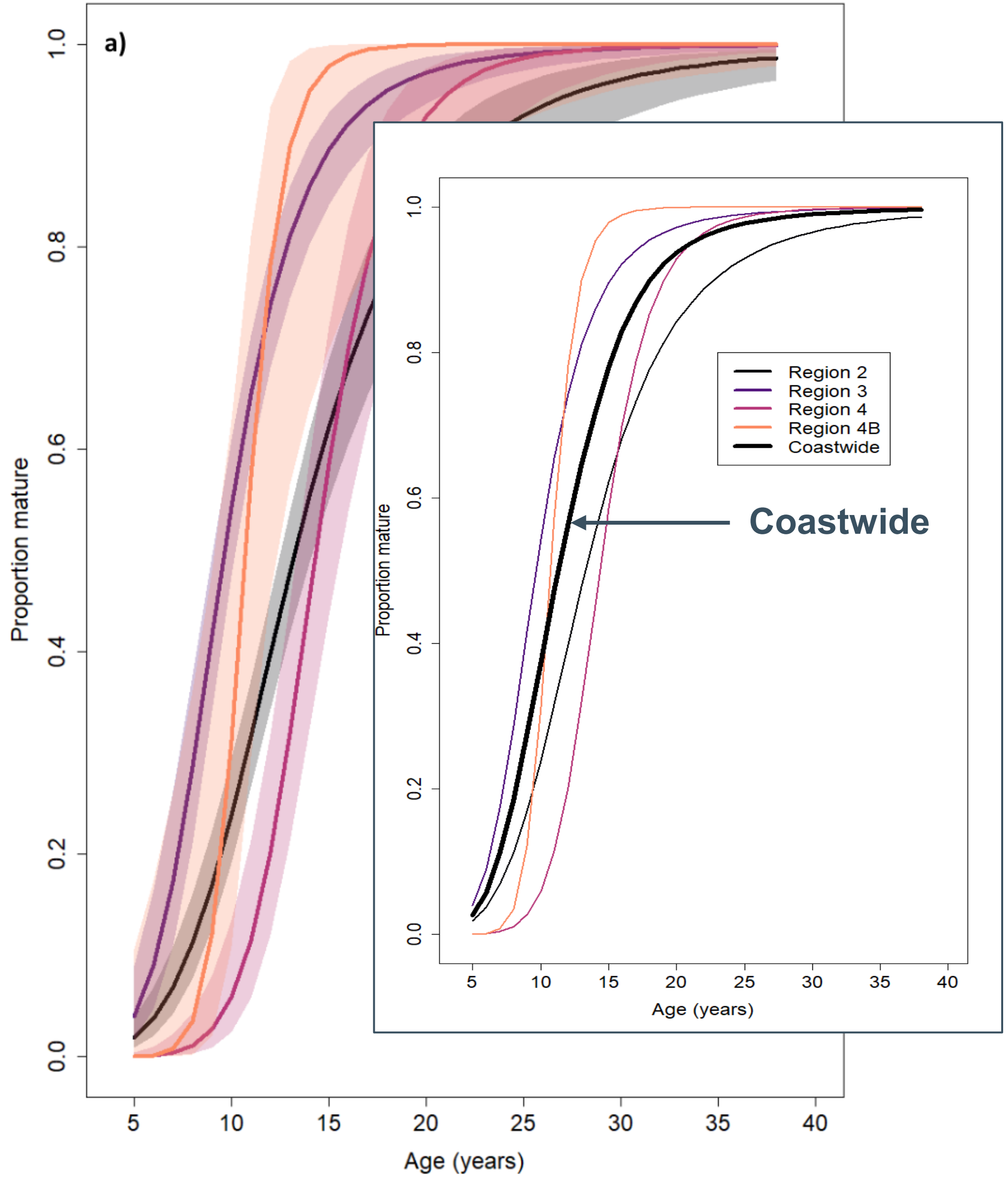
2. Reproduction

GLM, log(age)*Region

- Coastwide ogive calculated from weighted regional ogives using FISS space-time model NPUE

- Coastwide ogive falls between Biological Regions 2 and 3

- A_{50} = 11.3 yrs



2. Reproduction

Maturity Model Comparisons

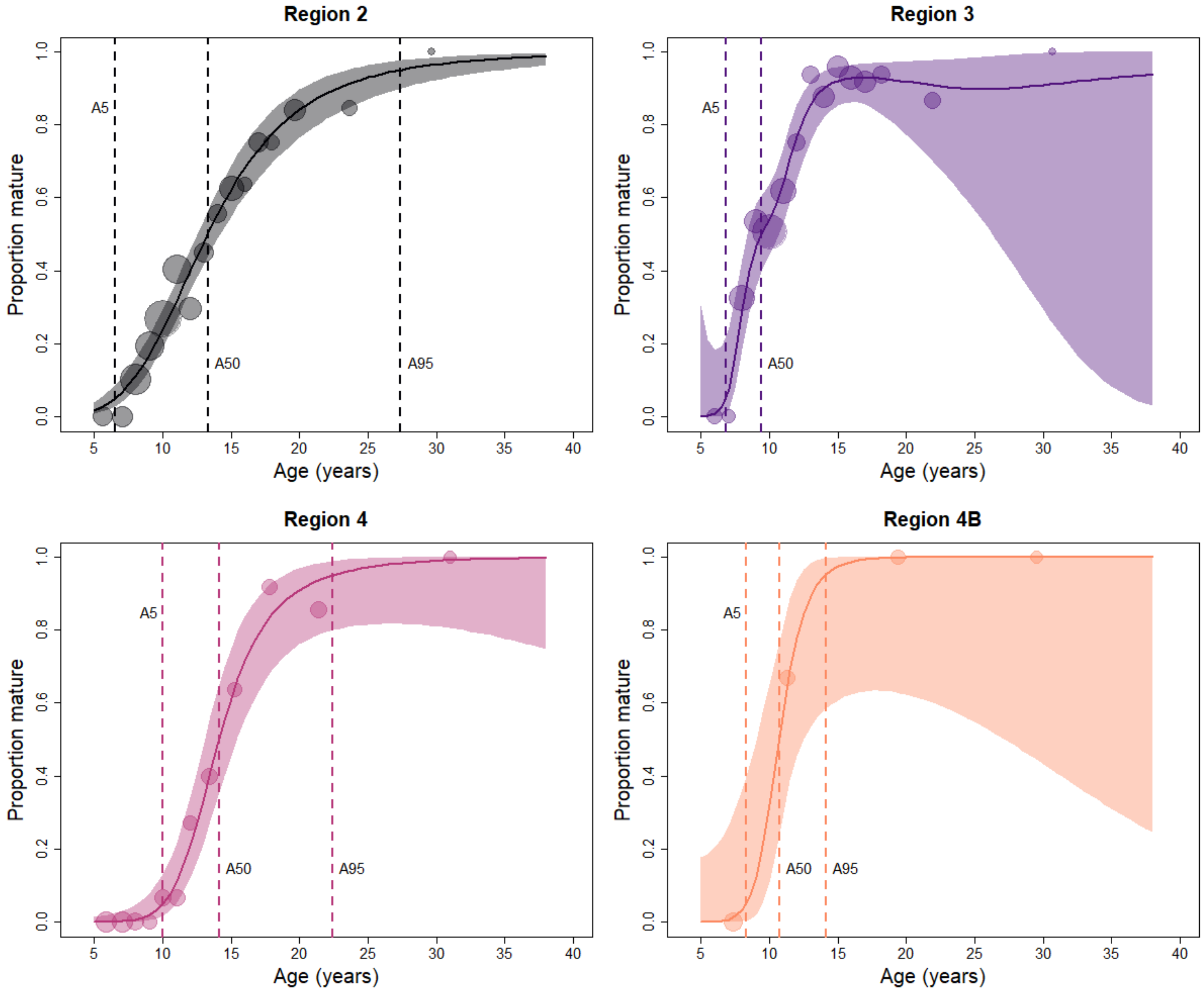
- Models with age and region
  - Logistic GLM: logit(P(mature)) ~ age*Region
  - Logistic GLM: logit(P(mature)) ~ log(age)*Region
  - Logistic GAM: logit(P(mature)) ~ s(log(age), by Region)
- Models with age for each region (single region models)
  - Logistic GLM with estimated breakpoint
  - Logistic GLM with breakpoint at A50

2. Reproduction

GAM,
s(log(age) by Region)

AIC = 869.4

k = 14

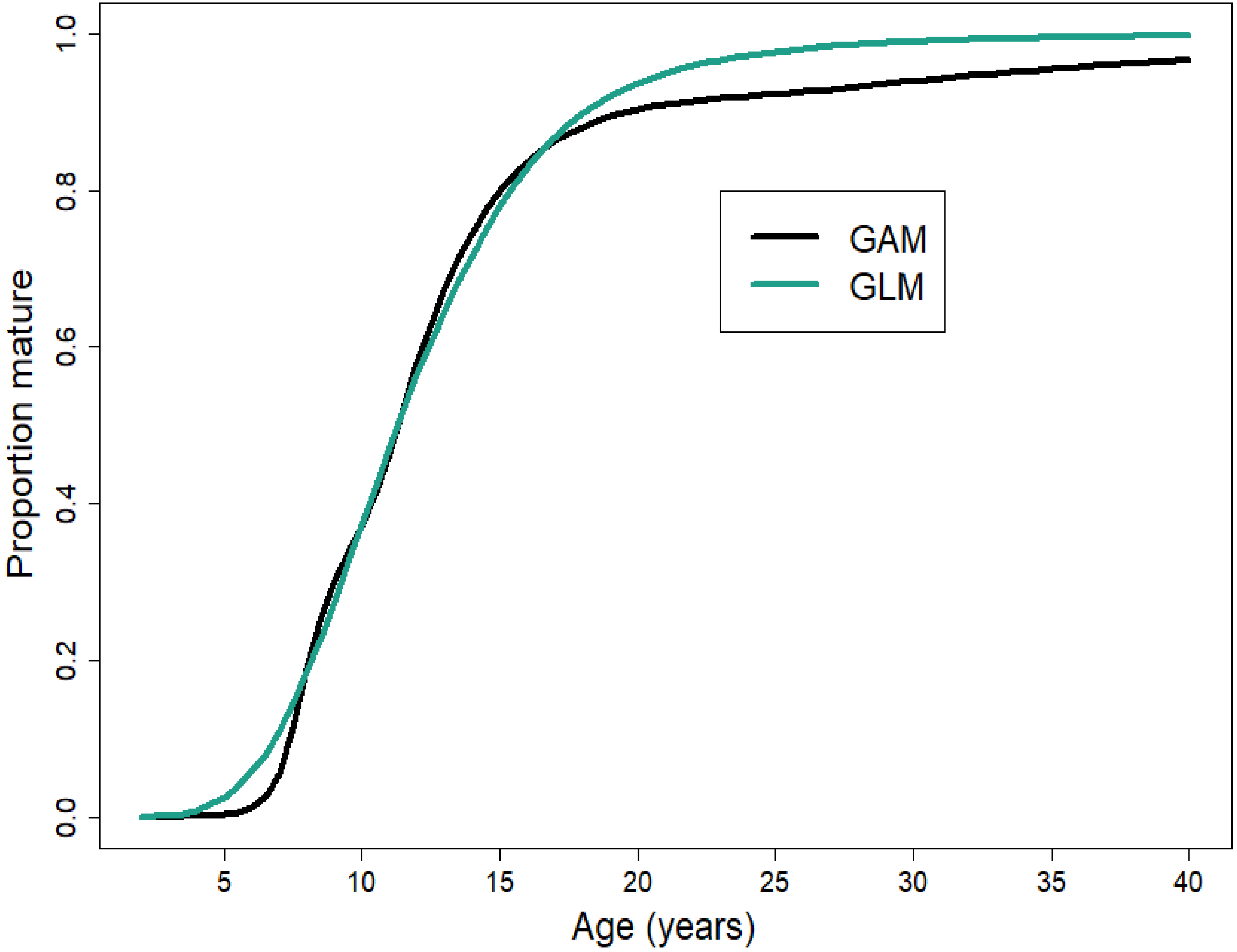


2. Reproduction

Coastwide Ogives

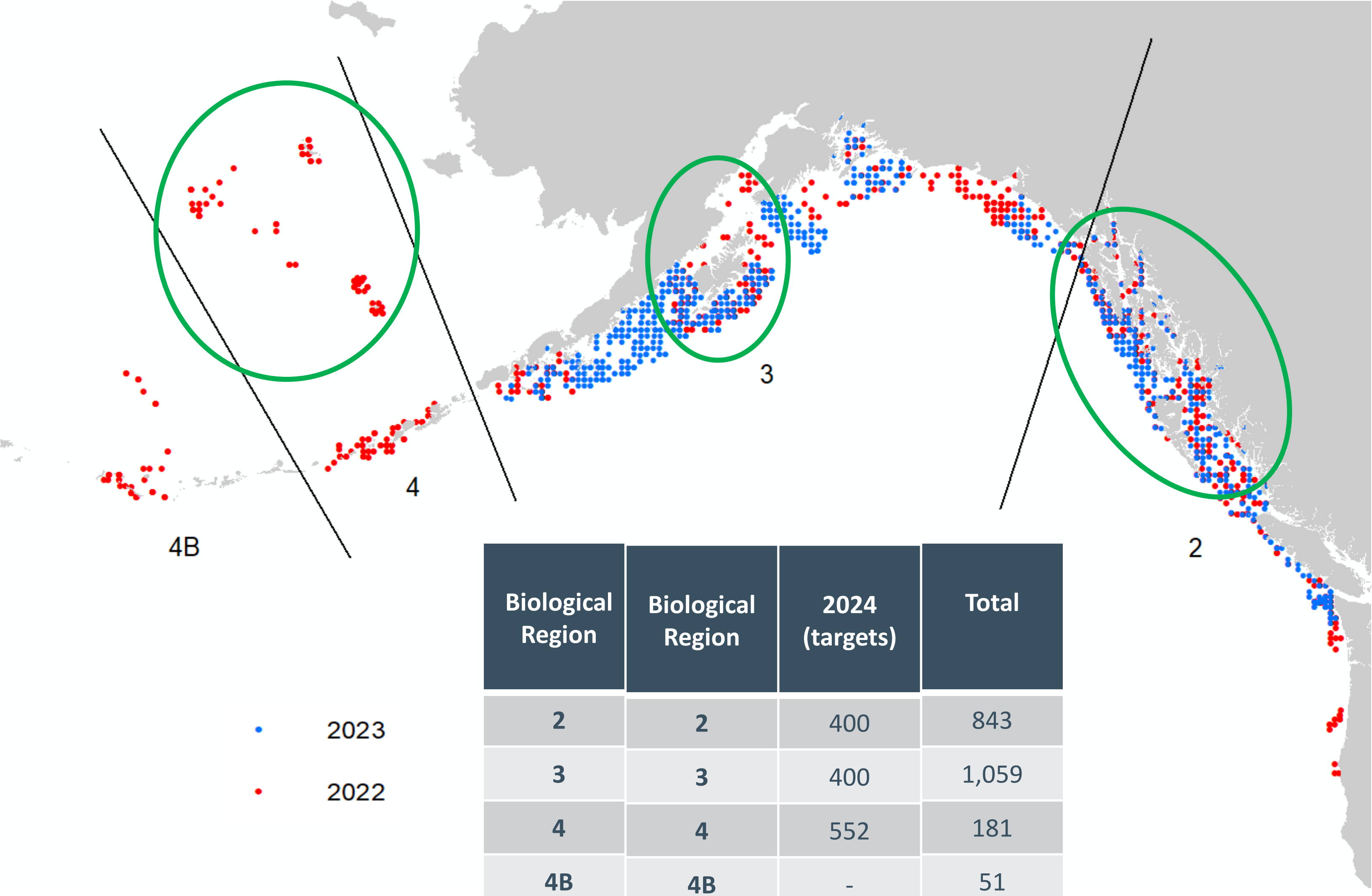
- GLM vs GAM

- GAM shows a steeper rise at younger ages and lower proportion mature for older individuals



2. Reproduction

2024 FISS Sample Collection



Biological Region	Biological Region	2024 (targets)	Total
2	2	400	843
3	3	400	1,059
4	4	552	181
4B	4B	-	51
Total	Total	1,352	2,134

2. Reproduction

Conclusions

- General modeling approach
  - log(age) transformation
  - GAM best fit model
  - Other suggestions?
- Coastwide ogive
  - Weighted regional ogives using FISS space-time model NPUE
  - GAM for combining regions to generate coastwide model?
- 2023 data currently being processed

3. 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

Best handling practices in longline fishery

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 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

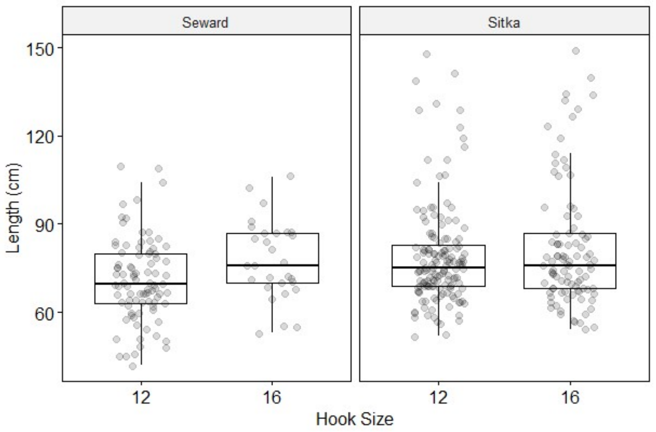
External funding: Saltonstall-Kennedy NOAA (2017-2020); NFWF (2019-2021); NPRB#2009 (2021-2022)

Publications: Kroska et al. (2021) *Conservation Physiology* ***9****: coab001*
Loher et al. (2022) *North American Journal of Fisheries Management* ***42****: 37-49*
Dykstra et al. (2024) *Ocean & Coastal Management*. ***249****: 107018.*

3. Mortality and Survival Assessment

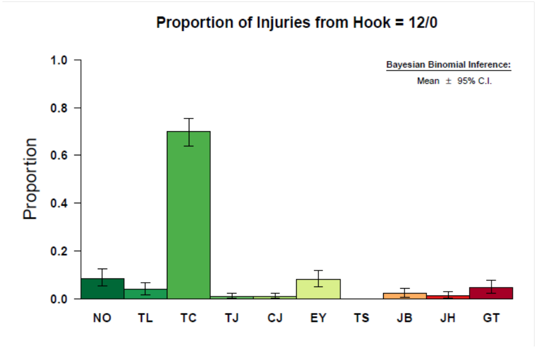
Characterization of discards in the charter recreational fishery

Effect of Hook Size on Fish Length

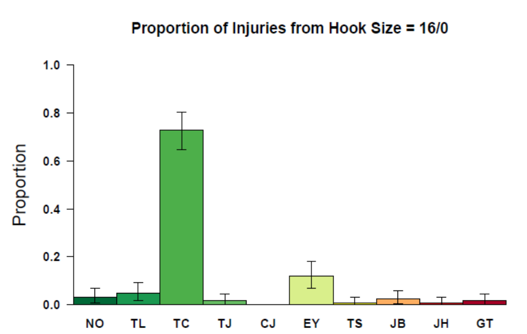


Injuries by Hook Size and Recovery Status

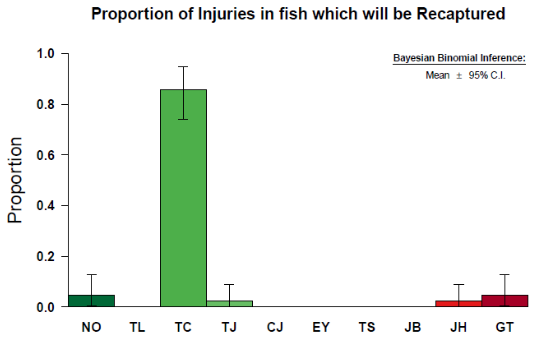
None
Torn Lip
Torn Cheek
Torn Jaw
Cheek and Jaw
Eye
Torn Snout
Jig Body
Jig Head
Gut Hook



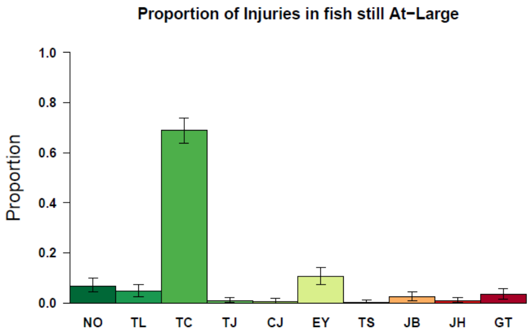
A) 12/0 Hook



B) 16/0 Hook



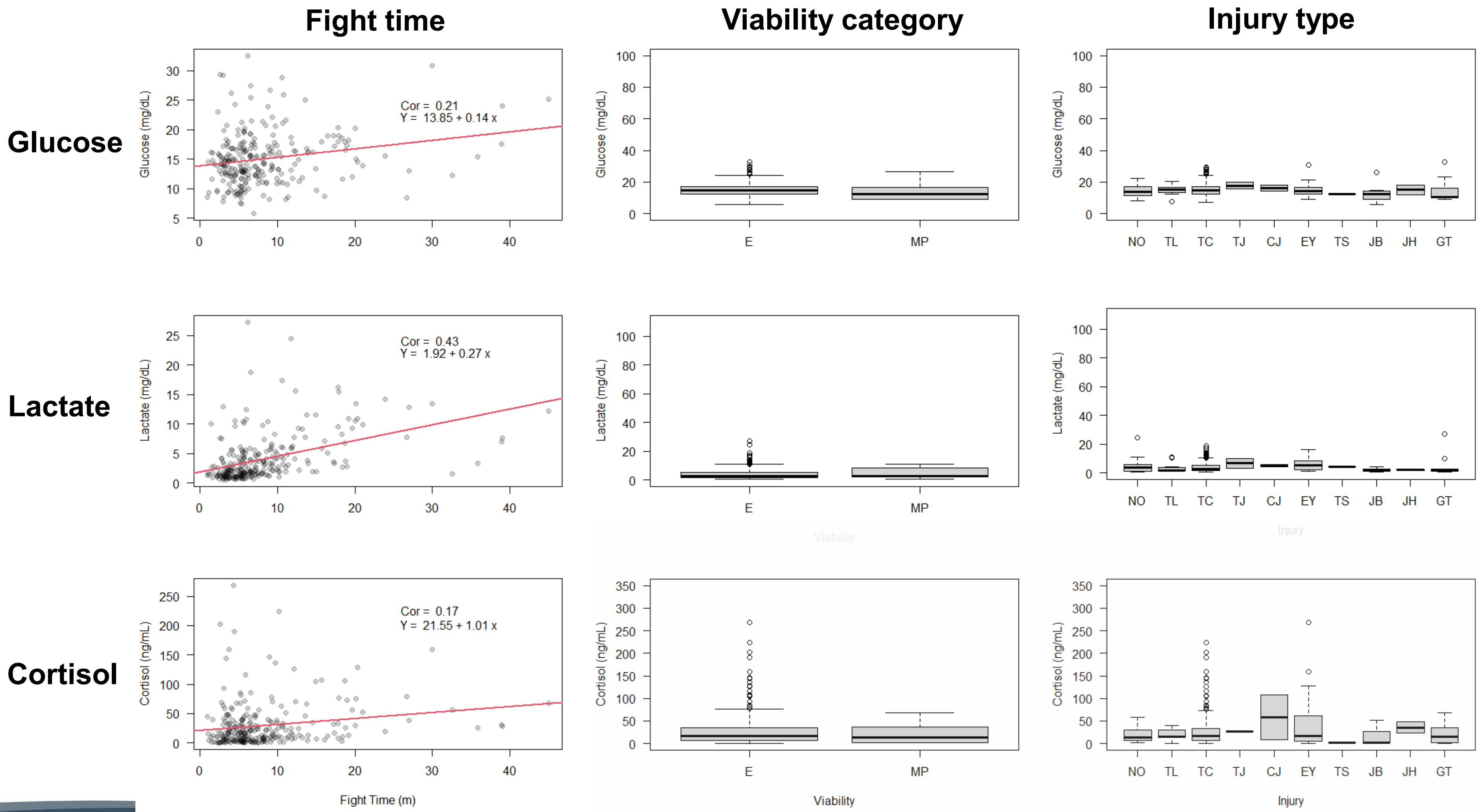
C) Recaptured



D) At - Large

3. Mortality and Survival Assessment

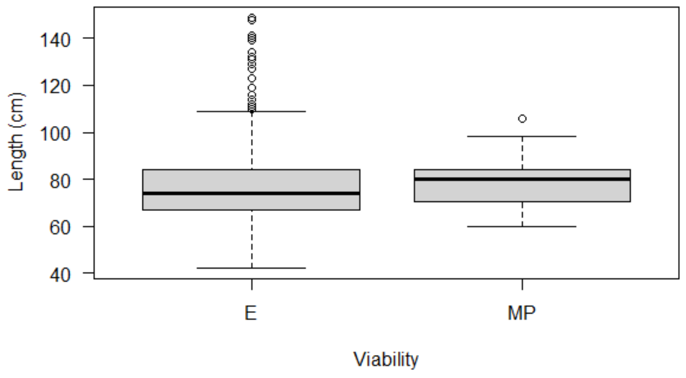
Characterization of discards: stress indicators in the blood



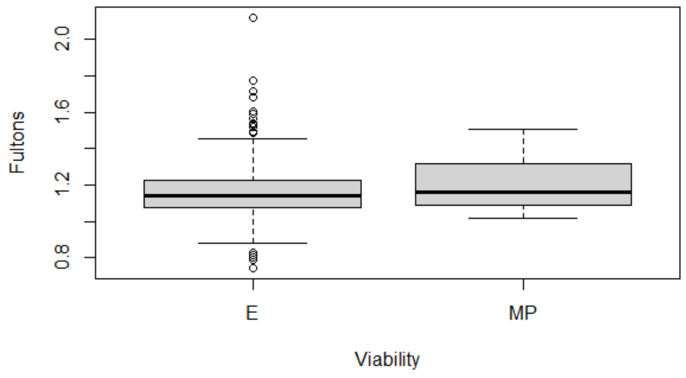
3. Mortality and Survival Assessment

Characterization of discards: size and condition by viability

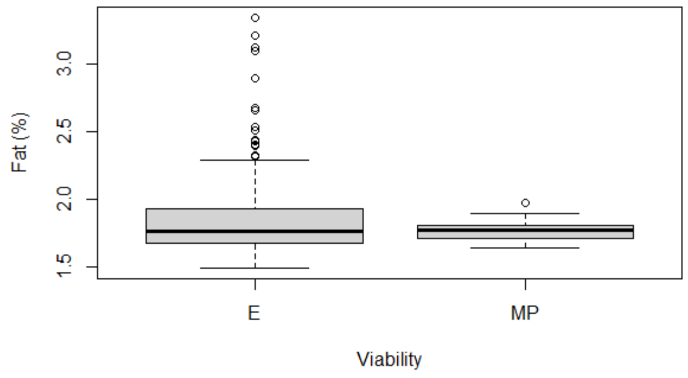
Fish Length



Fulton's K



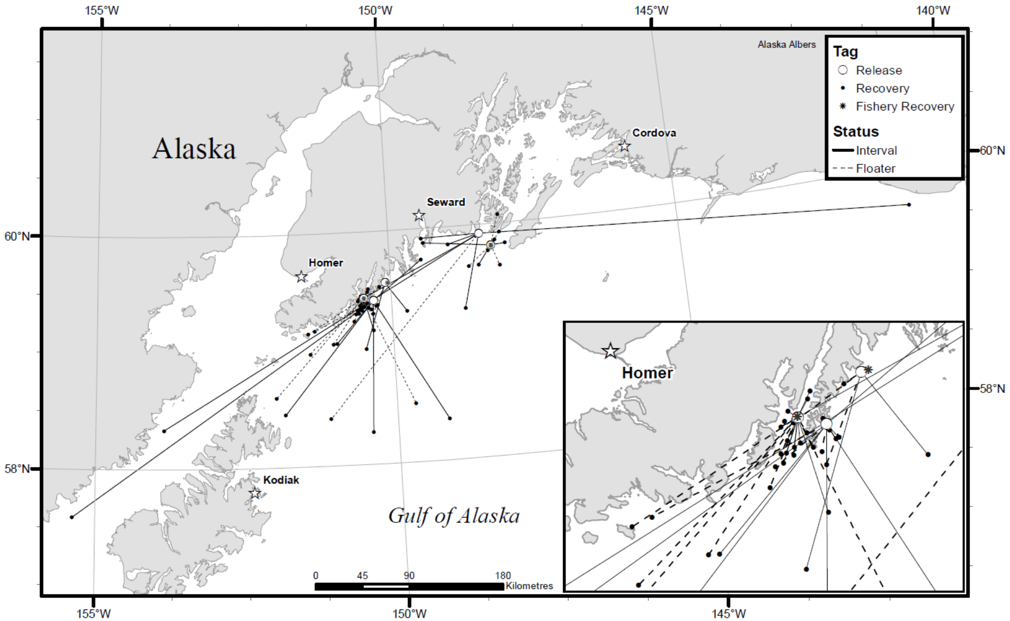
Fat (%)



3. Mortality and Survival Assessment

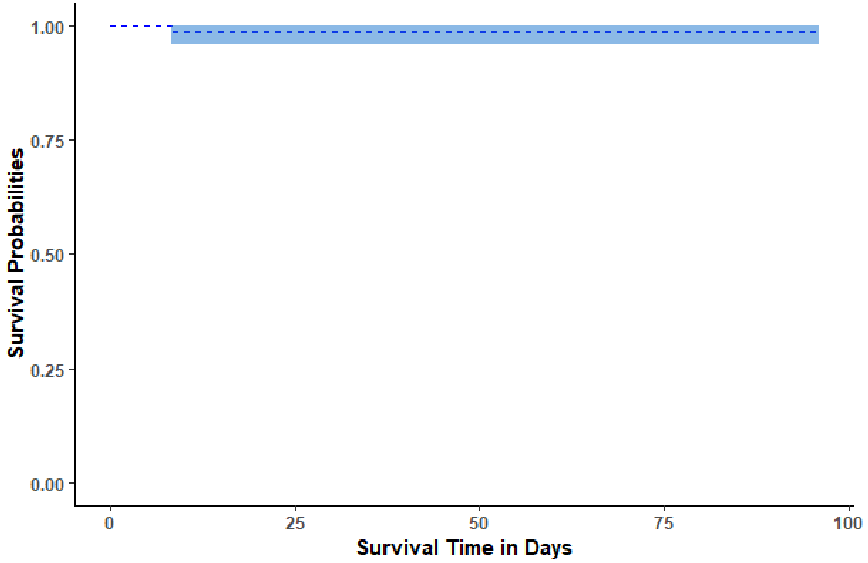
Characterization of discards: sPAT tagging

Behavior of sPAT taged fish (E viability, n = 76)



Status	Sex	Count	Distance Traveled			Days at Liberty		
			Average	Min	Max	Average	Min	Max
Premature Release	F	18	39.35	0.1	227.77	46.06	8.25	69.08
Premature Release	M	12	26.3	0.21	74.51	36.23	3.58	76.83
Full Duration	F	21	66.6	0.45	415.6	96	96	96
Full Duration	M	25	21.4	0.51	139	96	96	96

Survival probabilities



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

3. Mortality and Survival Assessment

Characterization of discards in the charter recreational fishery

Conclusions

- Different hook sizes did not have different size selectivity in this study.
- The majority of injuries (~75%) were a simple torn cheek.
- Blood stress indicators increased with fight time but were not significantly different between viability or injury classifications.
- Fish size, fitness, and fat levels were similar across viability classifications.
- Estimated discard mortality estimates are very low (1.35%) for fish of Excellent viability in the charter recreational fishery.

4. Fishing technology

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

Summer 2023 pilot test

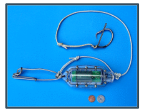
Investigate new methods for whale avoidance/deterrence to reduce whale depredation in the longline fishery

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

Relevance for stock assessment

- 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*

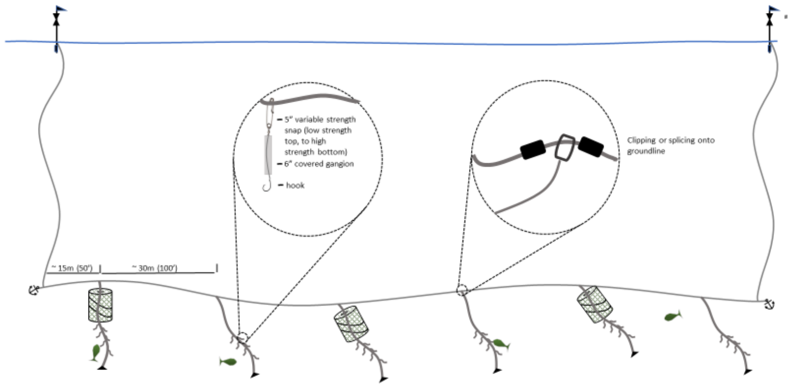
Lomeli et al. (2023) *Ocean & Coastal Management* 2***41****: 106664*

4. Fishing technology

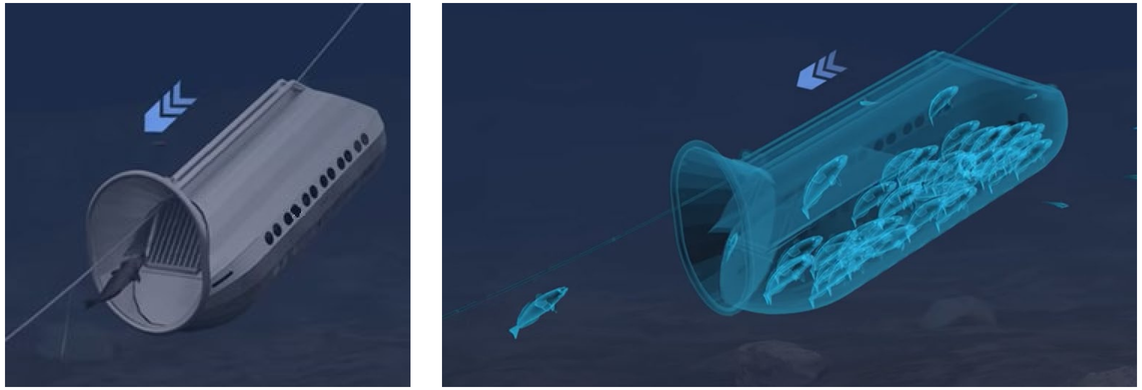
Bycatch Reduction Engineering Program
(BREP) NA21NMF4720534

Reducing whale depredation by protecting longline catches

Devices selected for testing:



Branch lines with shrouds



Shuttle

Field testing of catch protection devices - 2023

Tested selected devices for:

- Deployment and retrieval logistics.
- Determine optimal configurations (weighting, attachments).
- Investigate basic performance characteristics (species/sizes).

4. Fishing technology

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

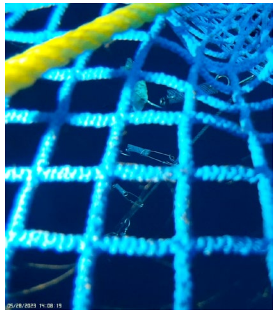
Reducing whale depredation by protecting longline catches

Shrouds

Planning required for general deployment, retrieval, safety

- Adjusted from 3 shrouds + 3 control branches to 2+2 with a blank in the middle
- Reduced hook spacing on branch line from 4 to 2 feet.





Results:

- Variable strength snaps allowed hooks to cluster.
- Shrouds generally slid down to cover the hooks but commonly with some snarling.
- Low catch rates in final configuration – affected by small effective fishing footprint, and lots of hagfish.
- Basic concept works – many logistical issues to sort out before scaling up to fishery level.

4. Fishing technology

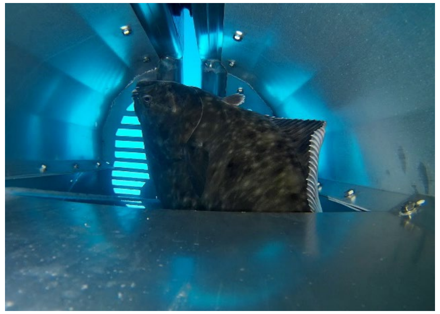
NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Bycatch Reduction Engineering Program
(BREP) NA21NMF4720534

Reducing whale depredation by protecting longline catches

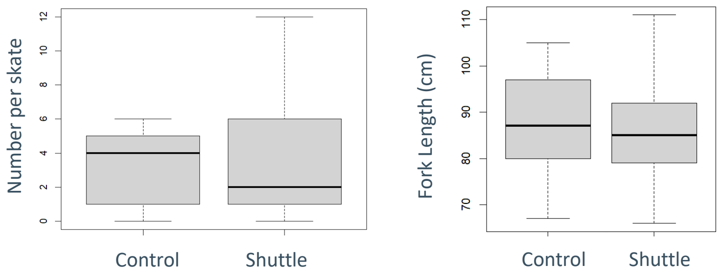
Shuttle

- Attach the device in-line during hauling event (1:30 min once technique established)
- Blank section of gear required to ensure unit is near bottom before encountering fish – avoid moving them into the water column

Results:

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



Pacific Halibut Metrics - Shuttle

4. Fishing technology

Bycatch Reduction Engineering Program (BREP) NA23NMF4720414

Reducing whale depredation by protecting longline catches

Next phase: Testing shuttle in the presence of depredators

Secured funding from NOAA BREP 2023 NA23NMF4720414

- Permit and vessel selection permitting:
- 10 days of fishing in presence of Orcas / Sperm whales.
- Further refinements (attachment protocols, gangion/hook strength).
- Catch rate comparisons with and without shuttle device.
- Catch composition details (size ranges, species, catch volume).

- Actively seeking vessels interested / available for the project.

Summary of awarded research grants to IPHC current in 2024

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	$199,870	Mortality estimations due to whale depredation	November 2023 – April 2025
2	Alaska Sea Grant (pending award)	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)	$60,374	Stock structure	February 2024-January 2026
				Total awarded ($)	**$260,244**		

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https://www.iphc.int/