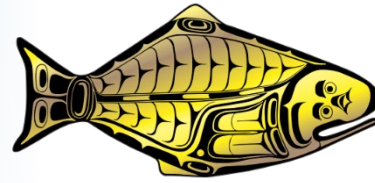


INTERNATIONAL PACIFIC



HALIBUT COMMISSION

Report on current and future biological and ecosystem science research activities

Agenda Item 7

IPHC-2022-SRB020-08

(J. Planas)



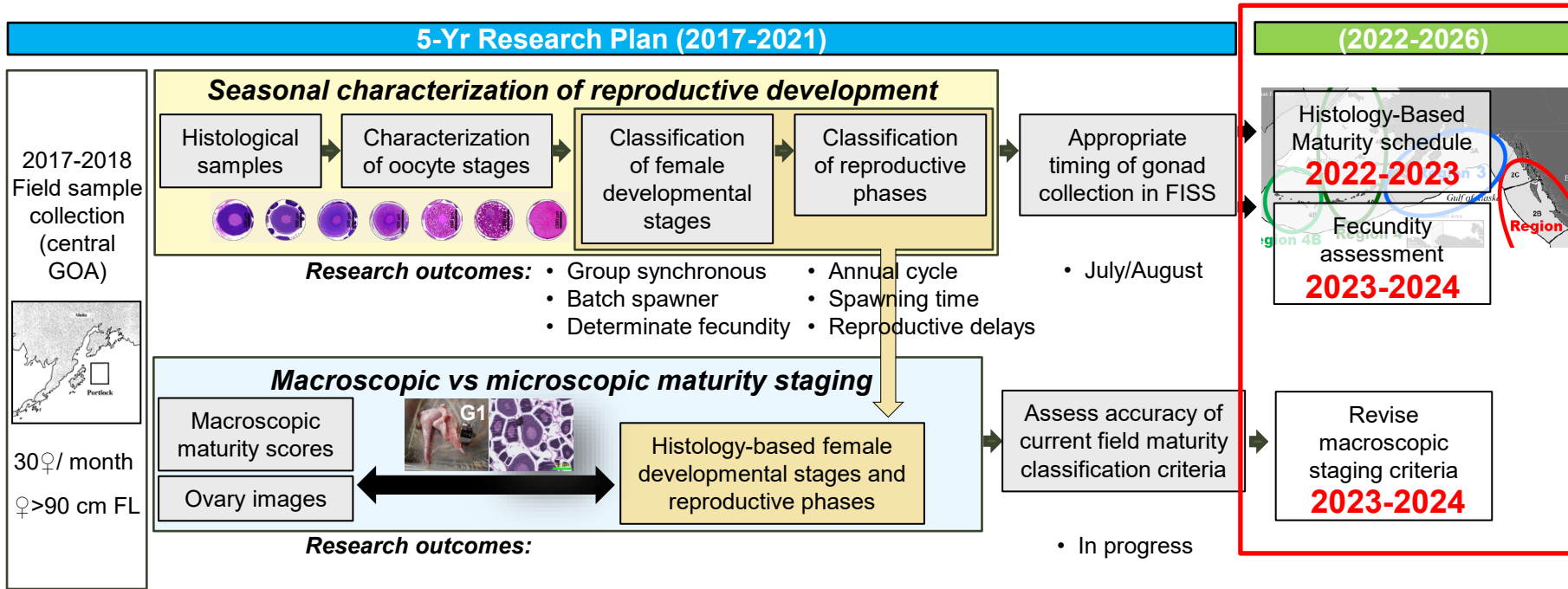
Outline

Progress in key research areas:

1. Reproduction
2. Discard mortality rates: guided recreational fishery
3. Catch protection strategies against whale depredation
4. Population genomics



1. Reproduction



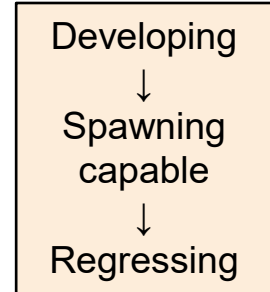
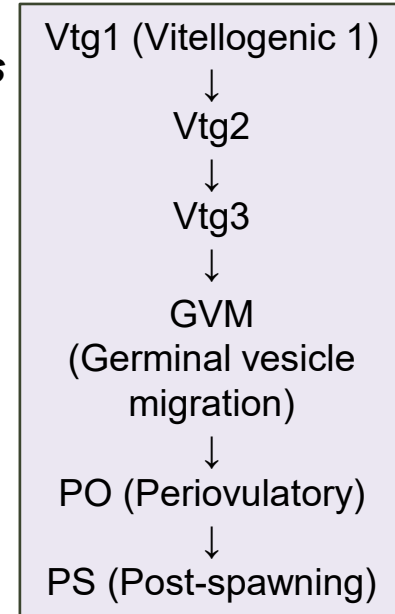
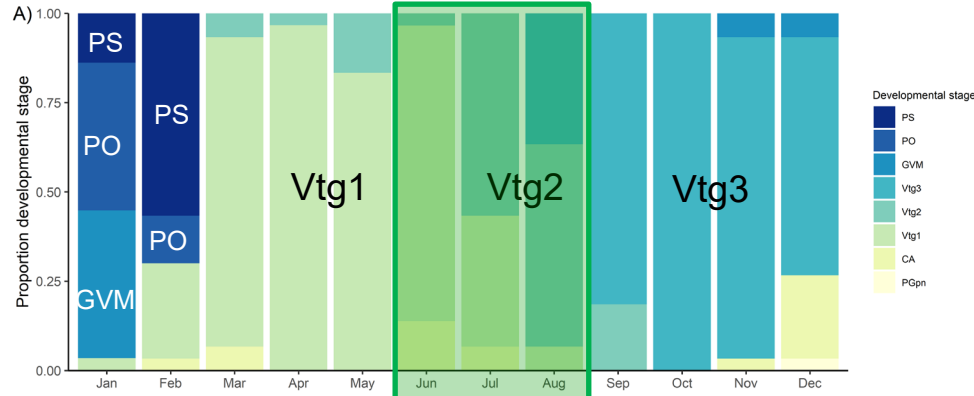
Publications: Fish et al. (2020) [Journal of Fish Biology](#) **97**: 1880–1885
 Fish et al. (2022) [Frontiers in Marine Science](#) **9**: 801759



1. Reproduction

Microscopic maturity staging: based on histological oocyte stages

Female developmental stages

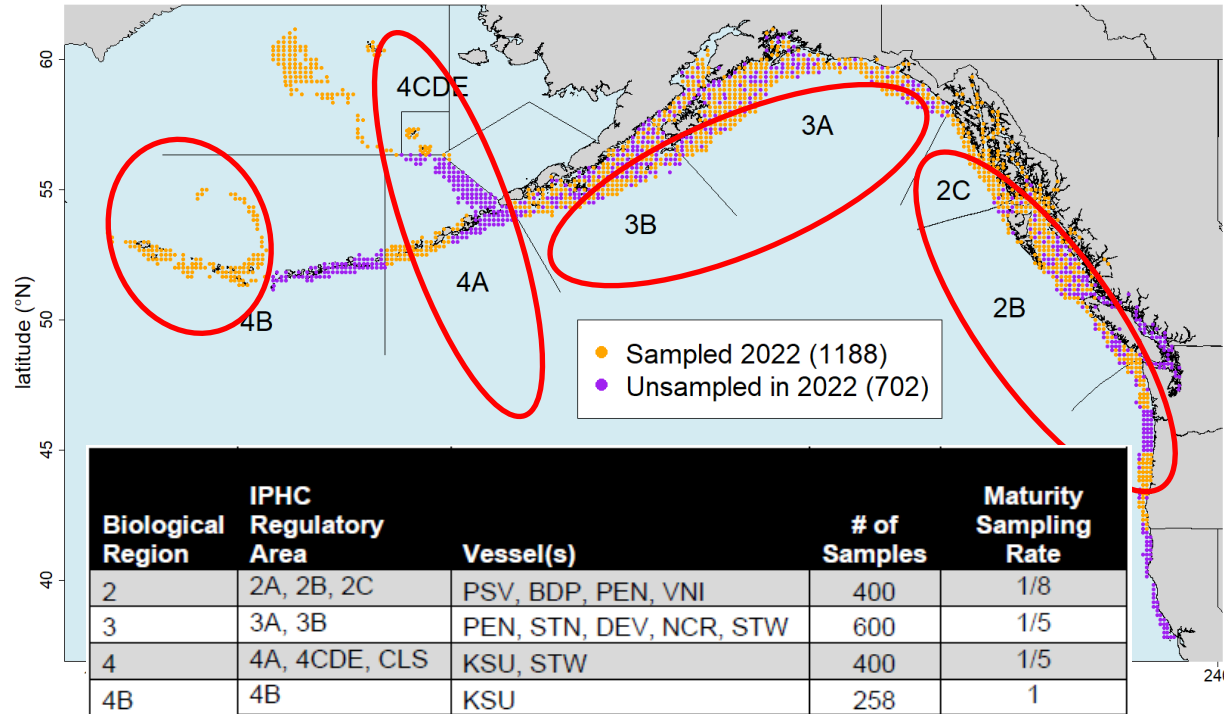


Fish et al. (2022) *Front. Mar. Sci.* 9:801759

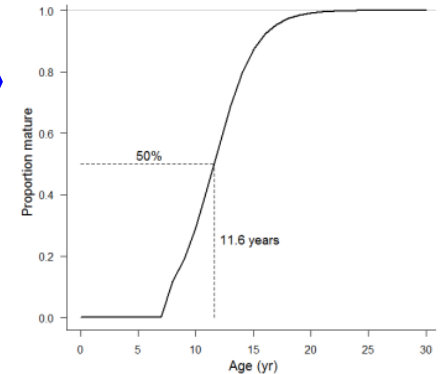


1. Reproduction

FISS 2022: ovarian sample collection for histology-based maturity



- Revise maturity estimates per biological region by histological staging



1. Reproduction

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE
Reproduction	Histological maturity assessment	Updated maturity schedule	Scale biomass and reference point estimates	1. Biological input	Improve simulation of spawning biomass in the Operating Model
	Examination of potential skip spawning	Incidence of skip spawning			
	Fecundity assessment	Fecundity-at-age and -size information			
<p>SRB019–Req.06 (para. 46) The SRB NOTED that the IPHC Secretariat is finalising a proposed sampling design for the collection of ovaries in the 2023 FISS, for providing precise estimates of fecundity and REQUESTED for SRB020 in June 2022, more detail on the considerations taken to ensure the sampling maximises the opportunity to address the objectives.</p>					
	landings	catch-at-age	intensity	collection and processing	



1. Reproduction

FISS 2023: ovarian sample collection for fecundity estimations

Method: Auto-Diametric Fecundity Estimation

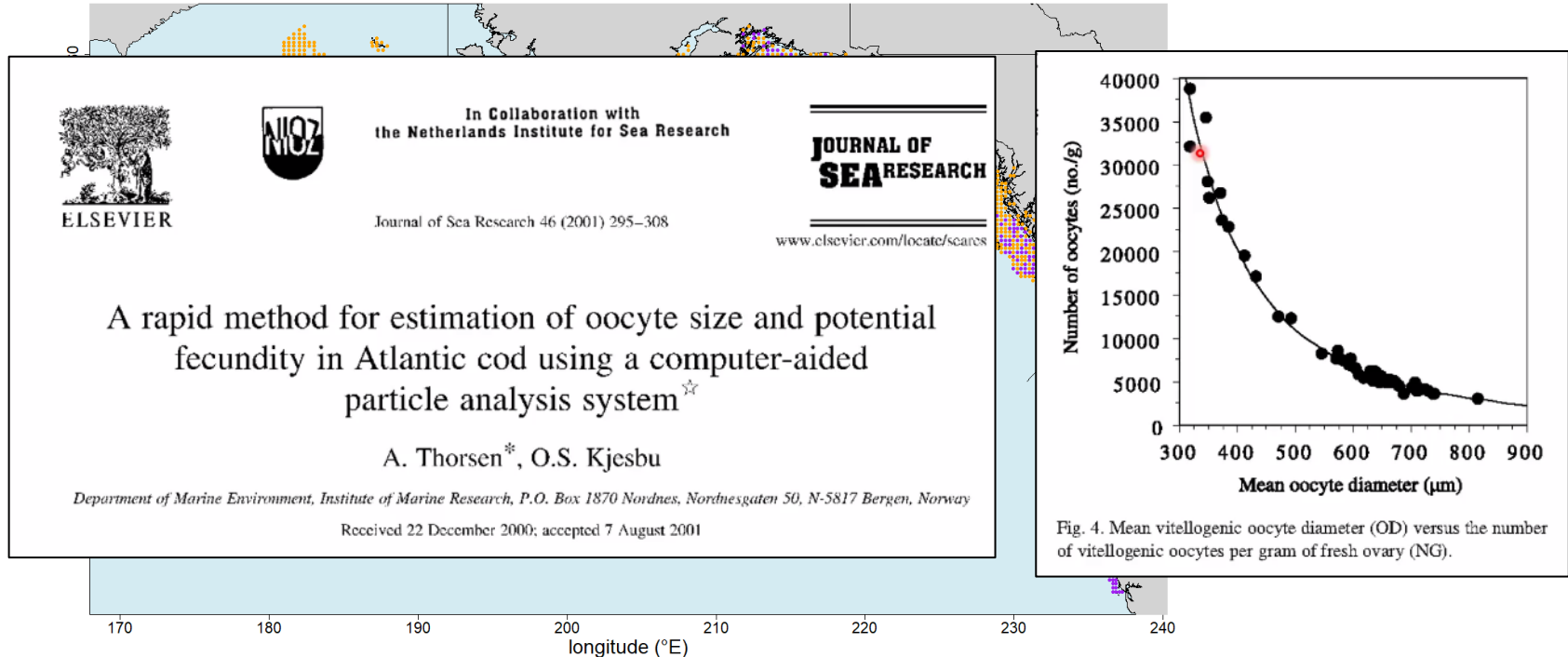
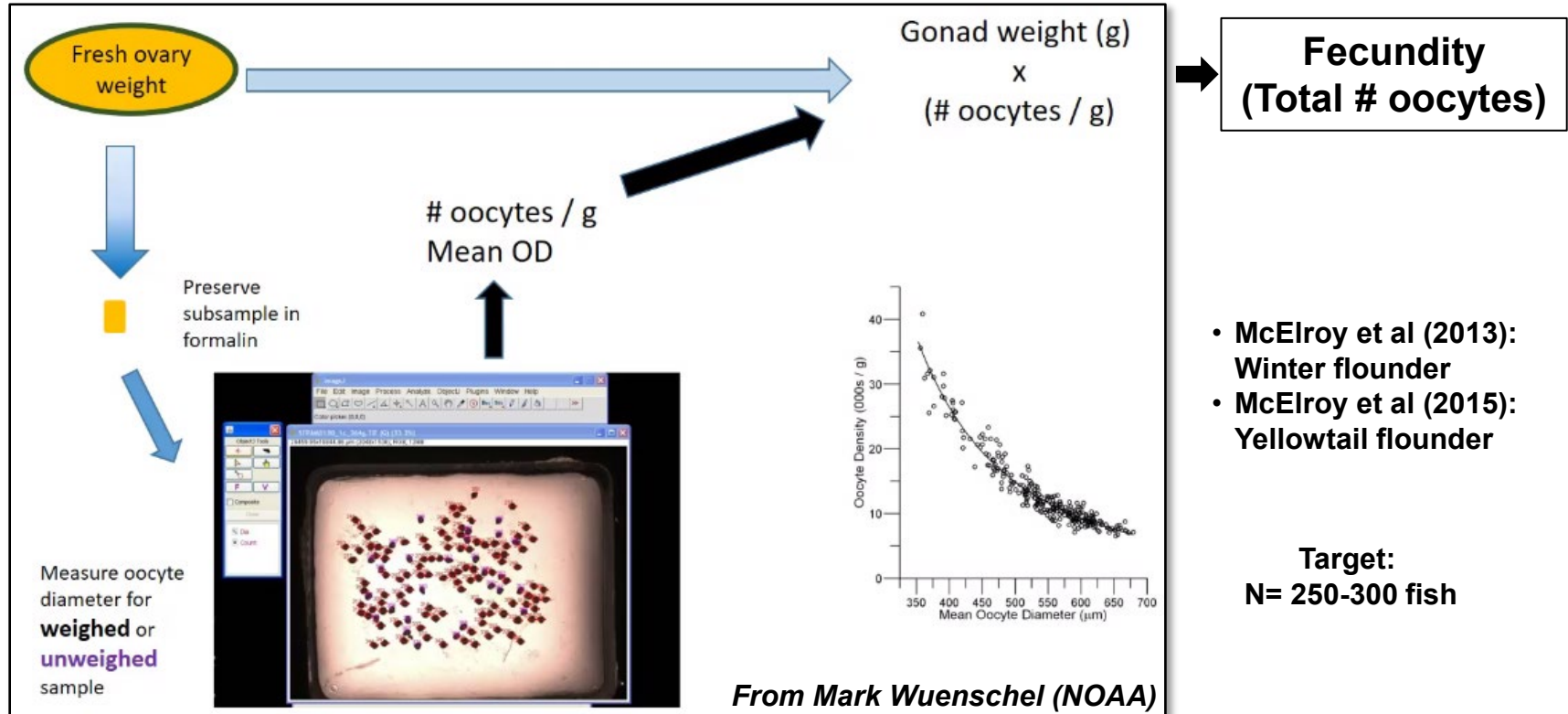


Fig. 4. Mean vitellogenic oocyte diameter (OD) versus the number of vitellogenic oocytes per gram of fresh ovary (NG).



1. Reproduction

Method: Auto-Diametric Fecundity Estimation



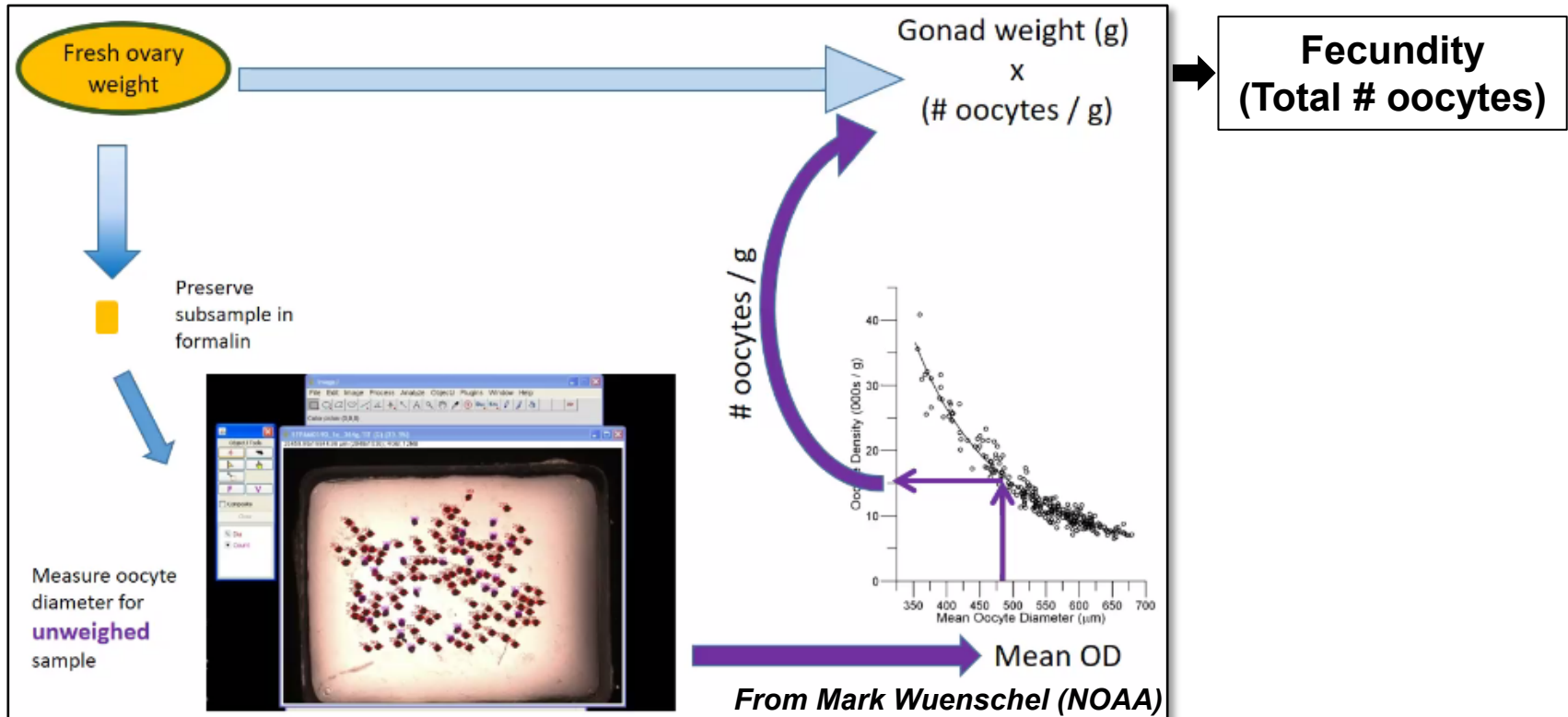
- McElroy et al (2013): Winter flounder
- McElroy et al (2015): Yellowtail flounder

Target:
N= 250-300 fish



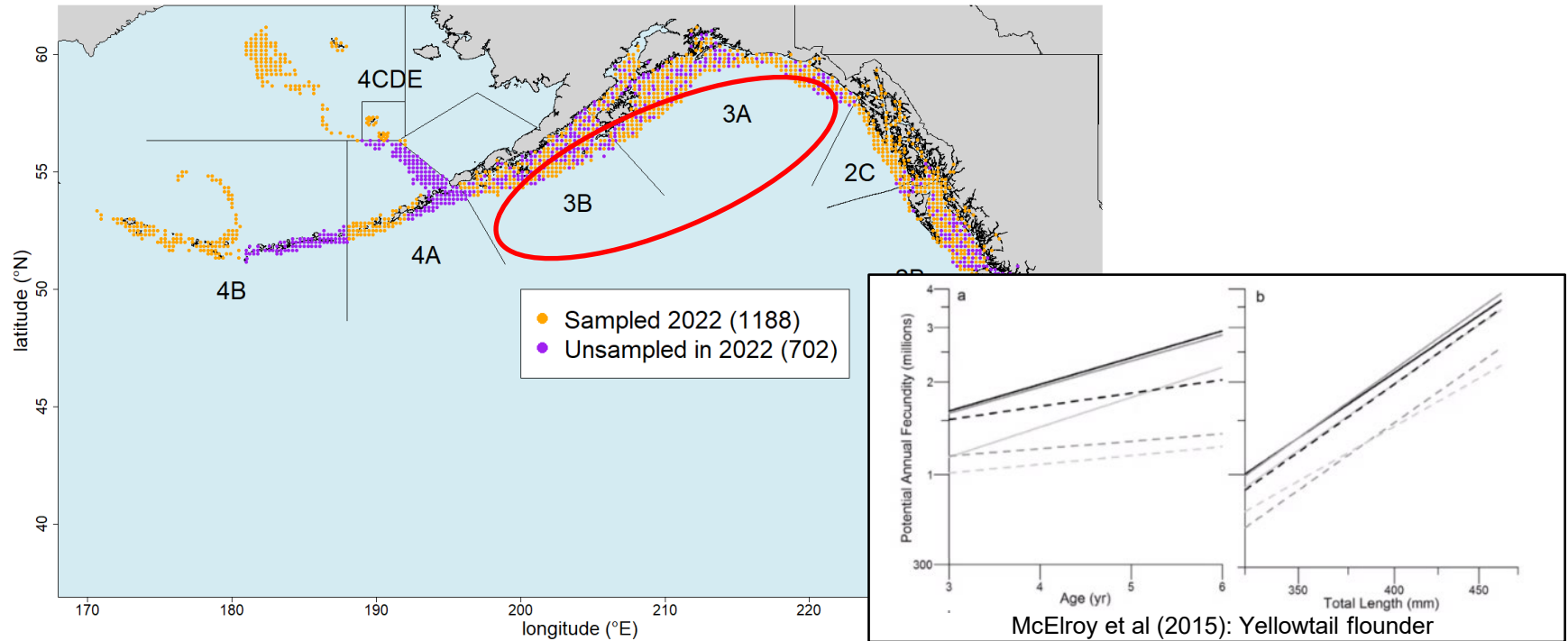
1. Reproduction

Method: Auto-Diametric Fecundity Estimation



1. Reproduction

FISS 2023: ovarian sample collection for fecundity estimations



2. Mortality and Survival Assessment

5-Yr Research Plan (2017-2021)

(2022-2026)

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

Best handling practices
in longline fishery

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: guided 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

Best handling practices
in recreational fishery

Research outcomes:

- In progress

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



2. DMRs: guided recreational fishery

- Guided recreational fishery



NFWF National Fish and Wildlife Foundation



UNIVERSITY OF ALASKA FAIRBANKS



NPRB Grant No. 2009



1. Collect information on hook types and sizes and handling practices

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

- Two gear sizes: 12/0 and 16/0 hooks
- Observations and samples: hooking time, time on deck, weight, length, hook injury type and picture, viability, fat content, fish temperature, blood sample, fin clip, tag.

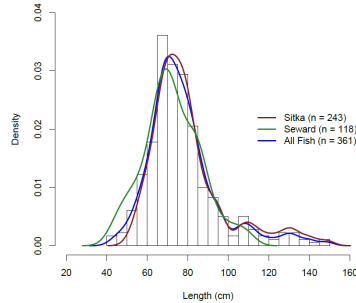
- **Sitka, AK** – 243 fish sampled, and wire tagged
 - 52 – 149 cm ($\bar{x} = 80.1 \pm 19.0$ cm), 1.5 – 49.8 kg ($\bar{x} = 7.4 \pm 7.5$ kg)
- **Seward, AK** – 118 fish sampled (80 sPAT tags, 38 wire tags)
 - 42 – 110 cm ($\bar{x} = 72.5 \pm 14.1$ cm), 0.6 – 17 kg ($\bar{x} = 5.0 \pm 3.3$ kg)



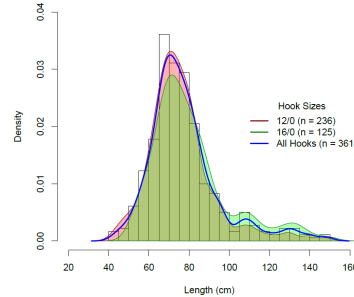
2. DMRs: guided recreational fishery



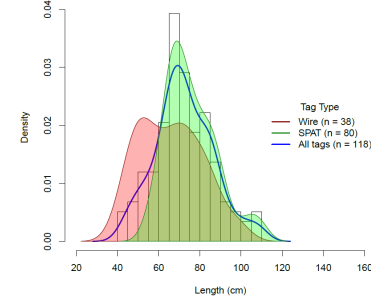
Gear types and catch size composition



A) Length distributions by port

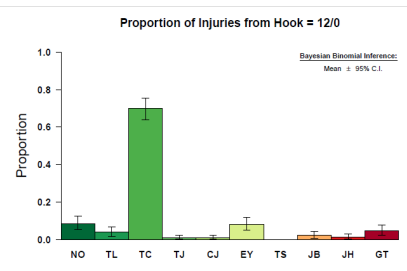


B) Length distributions by hook size

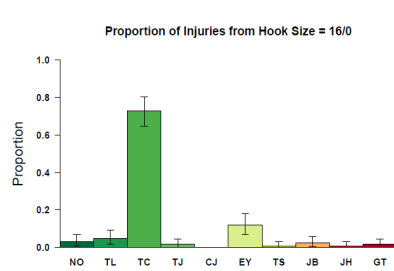


C) Length distributions by tag type (Seward)

Injury Profiles



A) Injuries – 12/0



B) Injuries – 16/0

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



2. DMRs: guided recreational fishery

Preliminary results: Quantify and Characterize Survival

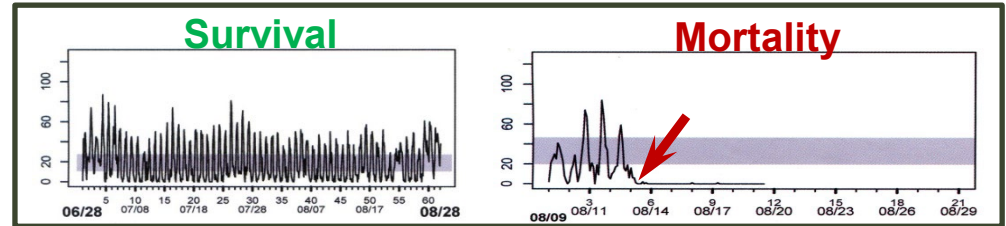


- Tags
 - Wire = 281 (243 Sitka, 38 Seward) – 27 recovered to date
 - sPAT = 80 (Seward) – 76 provided functional data
 - 7 fishery recoveries, 21 premature release, 48 full duration
 - 3.42% (0.00 – 8.04 CI) / 2.04% (0.00-5.92 CI)



A) Wire Tag

B) sPAT Tag



C) Typical acceleration patterns for fish that survive and fish that die



2. DMRs: guided recreational fishery



Preliminary summary

- First time for determination of Pacific halibut discard mortality within the recreational fleet
- Charter recreational vessels represent good platforms for research
- Hook size does not appear to have a marked difference in size of catch
- Different hook sizes have similar injury profiles
- Torn cheek being the predominant injury
- Physiological parameters still being developed/analyzed
- Preliminary tagging results show low mortality, consistent with current discard mortality estimates



3. Catch Protection – Depredation

1st International Workshop on Protecting Fishery Catches from Whale Depredation:

- Virtual workshop - 74 participants from 6 countries
- 3 presentations on different strategies for protecting the catch from longlines:

- Shuttles – Sago Solutions (NO),
- Shrouds – INFREMER, IRD, MARBEC, (FR)
- Slinky Pots – Fish Tech Inc. (US)

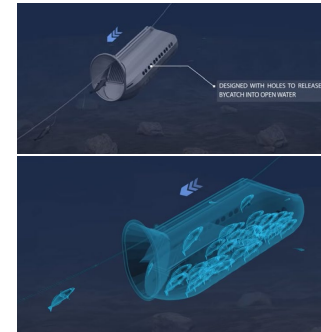


- Cover the catch – shroud/cachalotera or via shuttle
- Small size for smaller vessels (slinky pots don't require reconfiguration or large stowage concerns)
- Branchlines to break gear into smaller manageable subunits
- Short gangions to keep catch near a mainline /reduce fouling/keep within the reach of the shroud
- Minimize fiddling with release mechanisms or repacking of shrouds

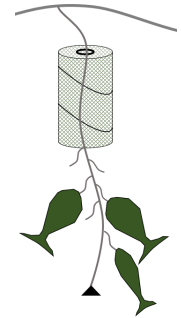
3. Catch Protection – Depredation

Pilot Phase:

- Late Summer, early fall. Preferably on an open deck vessel
- Central Gulf of Alaska (3A) – variety of fish size and decent catch rates
- Test two different models
 - i. Reduced size Sago Extreme shuttle with modified entry (A)
 - ii. Open end slinky pots over easy slip snap gear on branchlines (B)
- Testing
 - i. Deployment / Retrieval logistics
 - ii. Optimal configurations (weighting, attachments)
 - iii. Basic performance (species/sizes)

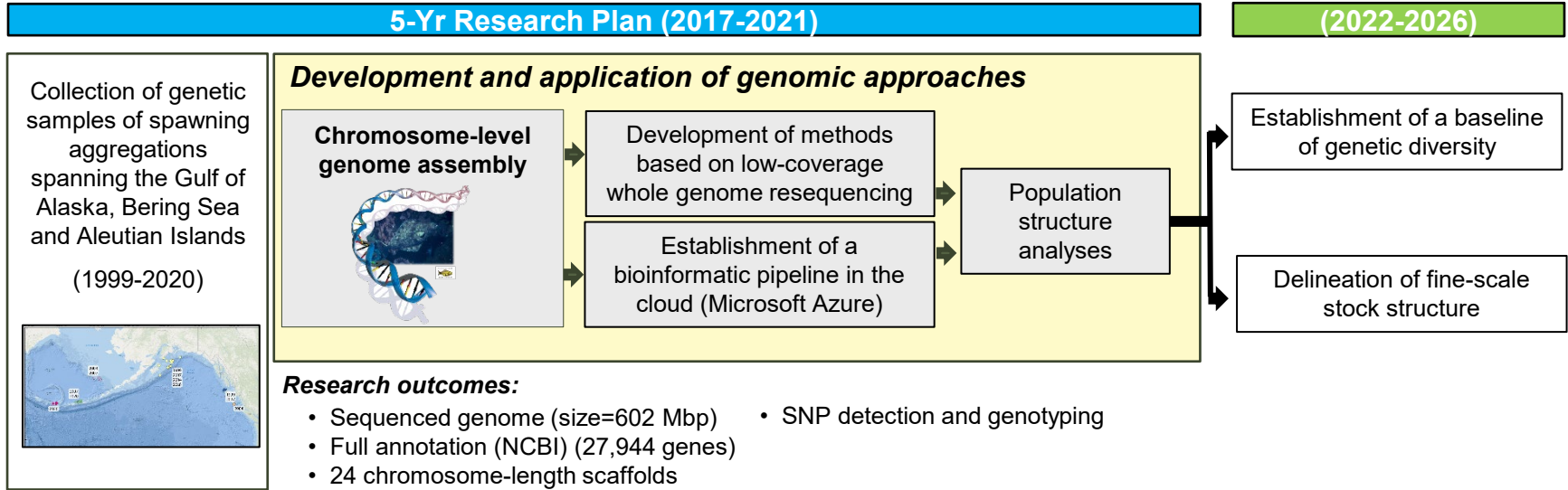


A) Sago shuttle



B) Slinky shroud

4. Population genomics



External Funding: NPRB#2110 (2021-2024)

Publications: Jasonowicz et al. (2022) [Molecular Ecology Resources](#) (In Press)



4. Population genomics

Sequence read alignment workflow for lcWGR

Remove adapters
and low quality
bases

Trimmomatic

Align raw reads
to genome

Minimap2

Filter low quality
alignments

Samtools

Remove PCR
duplicates

Picard

Clip overlapping
read pairs

Bamutil

Indel realignment

GATK

*Analysis Ready
Alignments*

Genotype Likelihood
estimation

- *angsd*
 - samtools model
 - p-value $\leq 1e-6$
 - base quality ≥ 20
 - individuals ≥ 402
 - MAF ≥ 0.01

10,415,578 SNPs

PCA

- *PCangsd*
 - only autosomal SNPs
 - MAF ≥ 0.05

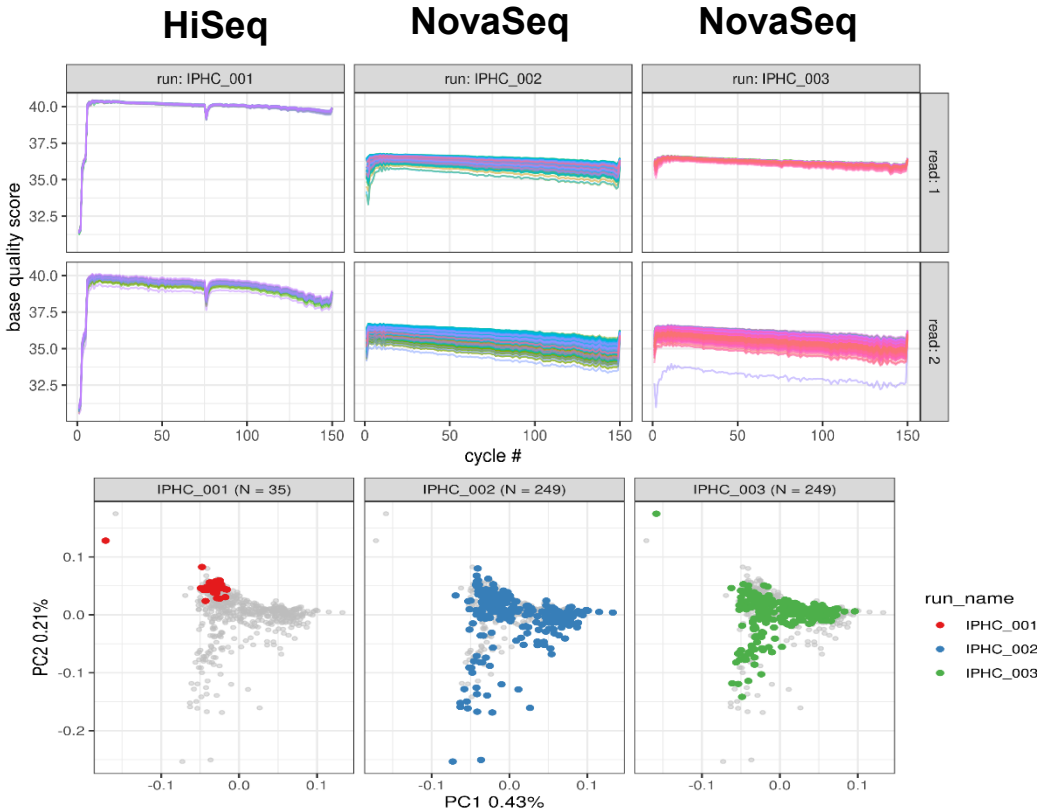
4,235,107 SNPs

- Address potential quality differences in the raw data
- Increased stringency of read trimming – sliding window
- Check for systematic differences among runs – PCA



4. Population genomics

Comparison of Sequencing Runs



- Difference in base quality scores between the sequencing platforms is the result of different sequencing chemistries.
- Re-sequence IPHC_001 (n=36) on the final NovaSeq run.
- Incorporate additional steps from Lou & Therkildsen 2021 to mitigate possible batch effects.
- Version 2 of the reference genome will require re-processing of all samples.

Lou, R. N., and N. O. Therkildsen. 2021. Batch effects in population genomic studies with low-coverage whole genome sequencing data: Causes, detection and mitigation. *Molecular Ecology Resources* (July):1–15.



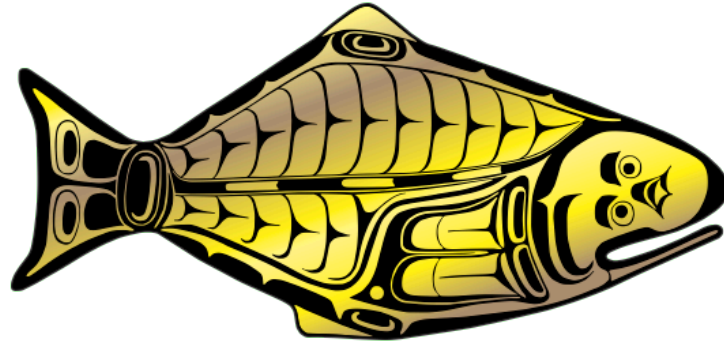
Recommendation

That the SRB:

- **NOTE** paper IPHC-2022-SRB020-08 which outlines progress on the IPHC's 5-year Biological and Ecosystem Science Research Plan (2017-21).



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