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IPHC 5-year Biological and Ecosystem Science Research Plan (2017-21): update

Agenda Item 6.1 IPHC-2021-AM097-10

SEAR

Five-year research program and management implications (2017-2021)

5-Year Biological and Ecosystem Science Research Plan

Primary Research Areas	Main Objectives	Management implications
Migration	Improve understanding of migration throughout all life stages (larval, juvenile, adult feeding and reproductive migrations)	Stock distribution, regional management
Reproduction	Information on sex ratios of commercial landings and improved maturity estimates	Female stock spawning biomass
Growth	Improve understanding of factors responsible for changes in size-at-age and development of tools for monitoring growth and physiological condition	Biomass estimates
DMRs and discard survival	Improve estimates of DMRs in the directed longline and guided recreational fisheries	Discard mortality estimates
Genetics and genomics	Improve understanding of the genetic structure of the population and create genomic tools (genome)	Stock distribution, local adaptation

Next 5-Year Research Plan (2021-26) in development



1. Migration and Distribution

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SARank	Relevance for MSE	MSE Rank
Migration	Larval and juvenile connectivity and early life history studies	Improved understanding of larval and juvenile distribution	Improve estimates of productivity	3. Biological input	Improve parametization of the Operating Model	1. Biological parameterization and validation of movement estimates

- Key findings:
 - Aleutian Islands constrain connectivity, but large island passes act as conduits between the GOA and Bering Sea
 - Degree of inter-basin larval connectivity is influenced by spawning location
 - Large degree of within-basin connectivity
 - Demersal stage fish in the Bering Sea migrate outward from Bristol Bay and reach Unimak Pass by age-4, widely dispersed by age-6





Sadorus et al. 2021. Fisheries Oceanography. (In Press).



	% larvae reaching BS						
	Warm Cold						
Year	2005	2009					
SR 1	100	100					
SR 2	58.1	52.7					
SR 3	15.2	17.2					
SR 4	8.2	4.5					
SR 5	0.6	0.08					



2. Reproduction

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	
	Histological maturity assessment	Updated maturity schedule				
	Examination of potential skip spawning	Incidence of skip spawning	Scale biomass and			
Reproduction	Fecundity assessment	Fecundity-at-age and -size information	reference point estimates	1. Biological input	Improve simulation of spawning biomass in the Operating Model	
	Examination of accuracy of current field macroscopic maturity classification	Revised field maturity classification				
	Sex ratio of current commercial landings	Sex ratio-at-age	Scale biomass and fishing intensity	1. Assessment data collection and processing		



2. Reproduction

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	Histological maturity assessment	Histological maturity assessment Updated maturity schedule					
	Examination of potential skip spawning	Incidence of skip spawning	Scale biomass and				
Reproduction	Fecundity assessment	Fecundity-at-age and -size information	reference point estimates	1. Biological input	Improve simulation of spawning biomass in the Operating Model		
	Examination of accuracy of current field macroscopic maturity	Revised field maturity classification					
			Reproductive cycle				
	Alaska	Goi	adal growth Maturation		ning		
	Sept Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug 2017 2018 30 °/30 °		G1	Late perinucleolar	2018		



2. Reproduction

Re	search area	Re	esearch activities		Research outcomes		Research outcomes Relevance for assessment		SA Rank	Releva	nce for MSE
		Histologi	cal maturity assessm	ent L	Update	ed maturity schedu	le				
		Exam	ination of potential skip spawning	' Ir	ncider	nce of skip spawnir	ng				
Re	Growth phaseI(acronym)gPrimaryGGrowthG(PG)G	Developmental stage (acronym) One nucleolus (PGon)	Description Pho Oocytes are small, angular, and compact with a single large nucleolus. Cytoplasm stains dark purple.	to F	Fecun	ndity-at-age and -siz information	ze	Scale biomass and reference point estimates	1. Biological input	Improve spawnin the Ope	simulation of g biomass in erating Model
]	Perinucleolar (PGpn)	Oocytes are larger and rounder than PGon and nuclei develop and flatten around the nucleus.		F /	Microscopic mat	turi	ity staging: based on h	istological oocyte stage	es	T T
		Cortical alveolar (PGca)	First cortical alveoli appear as white stain in the periphery of the oocyte.			50.75- 50.50- SGe SGe	EA S	ARLY So, SGfg Ge SGe LATE S	Gfg SGfg SGfg SGfg	Alpo SGe	
	Secondary I Growth ((SG)	Early (SGe)	Yolk globules first appear at the periphery, stain pink, and fill inwards occupying up to 1/3 of the cytoplasm.			B 0.25-		SGe SGe		Pawning	-
		Late	Yolk globules transition from only the periphery of the			March April		May June July August Sep	itember October November December Jan	nuary February	
	(OM)	imary Secondary Growth 60 1000 (OMgm) Periovulatory (OMpa)	Maturation 1600 3000 With large yolk globules. Nucleus no longer visible and the yolk globules coalesce into		Prosocition mature						Maturity Stage immature maturing ripe resting
		(Омро)	a central yolk mass. Oocyte is still within the follicle wall.		L	March April	N	flay June July August Sept	tember October November December Jar	uary February	



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3. Growth

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	MSE Rank
Growth	Identification and application of markers for growth pattern evaluation Environmental influences on growth patterns	Identification and application of markers for growth pattern evaluation Environmental influences on growth patterns	Scale stock productivity and reference point		Improve simulation of variability and allow for scenarios investigating	3. Biological parameterization and validation for growth
	Dietary influences on growth patterns and physiological condition	Dietary influences on growth patterns and physiological condition	estimates		climate change	projections





IPHC

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	MSE Rank
Mortality and survival assessment	Discard mortality rate estimate: longline fishery Discard mortality rate estimate: recreational fishery Best handling practices: longline fishery	Experimentally-derived DMR Guidelines for reducing discard mortality	Improve estimates of unobserved mortality	2. Fishery yield	Improve estimates of stock productivity	1. Fishery parameterization 2. Fishery parameterization
	Best handling practices: recreational fishery	Guidelines for reducing discard mortality		3. Fishery yield		

<u>Directed longline fishery</u>







DMR Best predictors of mortality Best practices



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Mortality and survival assessment	Discard mortality rate estimate: longline fishery Discard mortality rate estimate: recreational fishery Best handling practices: longline	Experimentally-derived DMR Guidelines for reducing	Improve estimates of unobserved mortality	2. Fishery yield	Improve estimates of stock productivity	1. Fishery parameterization 2. Fishery parameterization
	Best handling practices: recreational fishery	Guidelines for reducing discard mortality		3. Fishery yield		

<u>Directed longline fishery</u>

NOAA FISHERIES Saltonstall – Kennedy Grant NA17NMF4270240 (2017-2020)





Electronic Monitoring





Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	MSE Rank
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	fishery	discard mortality		3. Fishery yield		

Guided recreational fishery () NFWF National Fish and Wildlife Foundation



- 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





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Guided recreational fishery

NFWF National Fish and Wildlife Foundation





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Survey: Dock-side interviews (n=51 Sitka (n=16), Juneau (n=8) - Homer (n=12), Seward (n=15)

- Hook types: 75% Circle Hooks 25% Jigs (J-hook)
- Hook removal: 54% reverse hook 40% twist with gaff
- Fish Handling upon release:
 - Body and tail supported (65%)
 - **Operculum (10%**
 - Tail only (10%)



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- Assessment of mortality of discarded fish 4.

2021 **Field Experiment**



5. Genetics and Genomics

Completed sequence of the Pacific halibut genome

- Size: 594 million base pairs
- 24 chromosomes
- 27,422 genes
- 91 X coverage



NIH U.S. National Library of Medicine	NCBI National Center for Biotechnology Information										
Hint: For a larger view of the graphical panel, dick on the blue ≪ to hide the left sidebar, or press the '[' key.											
Genome Data Viewer											
Hippoglossus stenolepis (Pacific halibut)	Assembly: IPHC_HISten_1.0 (GCF_013339905.1) • Chr 23 (NC_048949.1) •										
Search assembly Q glycoprotein hormone subunit alpha Examples ►	K NC_048949.1: 10,057,926 - 10,061,402										
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https://www.ncbi.nlm.nih.gov/assembly/GCA_013339905.1



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Important for:

- Genomic analyses of population dynamics: stock structure and spatial connectivity.
- Identifying potential local and/or environmental adaptations.
- Provide genetic basis for life-history traits (e.g. growth, maturity, migratory behavior, etc.).





5. Genetics and Genomics

Research area	Research activities	Research outcomes	Relevance for stock assessment (SA)	SA Rank	Relevance for MSE	MSE Rank
Genetics and genomics	Population structure	Stock structure of IPHC Regulatory Area 4B relative to the rest of the Convention Area	Altered structure of future stock assessments	2. Biological input	Improve parametization	 Biological parameterization and validation of movement estimates. Biological parameterization and validation of recruitment distribution
	Distribution	Assignment of individuals to source populations and assessment of distribution changes		3. Biological input	of the Operating Model	

1. Study of the genetic stock structure



2. Study of the genetic variability of juveniles from GOA and BS



NMFS Trawl Survey samples

Externally-funded collaborative research

Project #	Grant agency	Project name	PI	Partners	IPHC Budget (\$US)	Management implications	Grant period
1	Saltonstall-Kennedy NOAA	Improving discard mortality rate estimates in the Pacific halibut by integrating handling practices, physiological condition and post- release survival (<i>Award No. NA17NMF4270240</i>)	IPHC	Alaska Pacific University	\$286,121	Discard estimates	September 2017 – August 2020
2	North Pacific Research Board	Somatic growth processes in the Pacific halibut (<i>Hippoglossus stenolepis</i>) and their response to temperature, density and stress manipulation effects (<i>NPRB Award No. 1704</i>)	IPHC	AFSC-NOAA-Newport, OR	\$131,891	Changes in biomass/size- at-age	September 2017 – February 2020
3	National Fish and Wildlife Foundation	Discard mortality rate characterization in the Pacific halibut recreational fishery (<i>NFWF Award No. 61484)</i>	IPHC	UA Fairbanks, APU, Grey Light Fisheries, Alaska Charter Association	\$98,901	Discard estimates	April 2019 - June 2021
Total awarded (\$) \$516,913							





Recommendation

That the Commission:

• **NOTE** paper IPHC-2021-AM097-10 which outlines progress on the IPHC's 5-year Biological and Ecosystem Science Research Plan (2017-21).



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