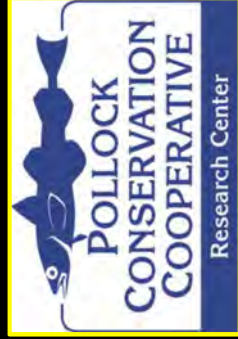


# Ecological interactions among key groundfish species in the Gulf of Alaska



Dr. Anne Beaudreau (PI) Cheryll Barnes, PhDc



Lorenzo Ciannelli,  
Oregon State



Martin Dorn,  
AFSC



Kirsten Holsman,  
AFSC



Mary Hunsicker,  
NWFSC



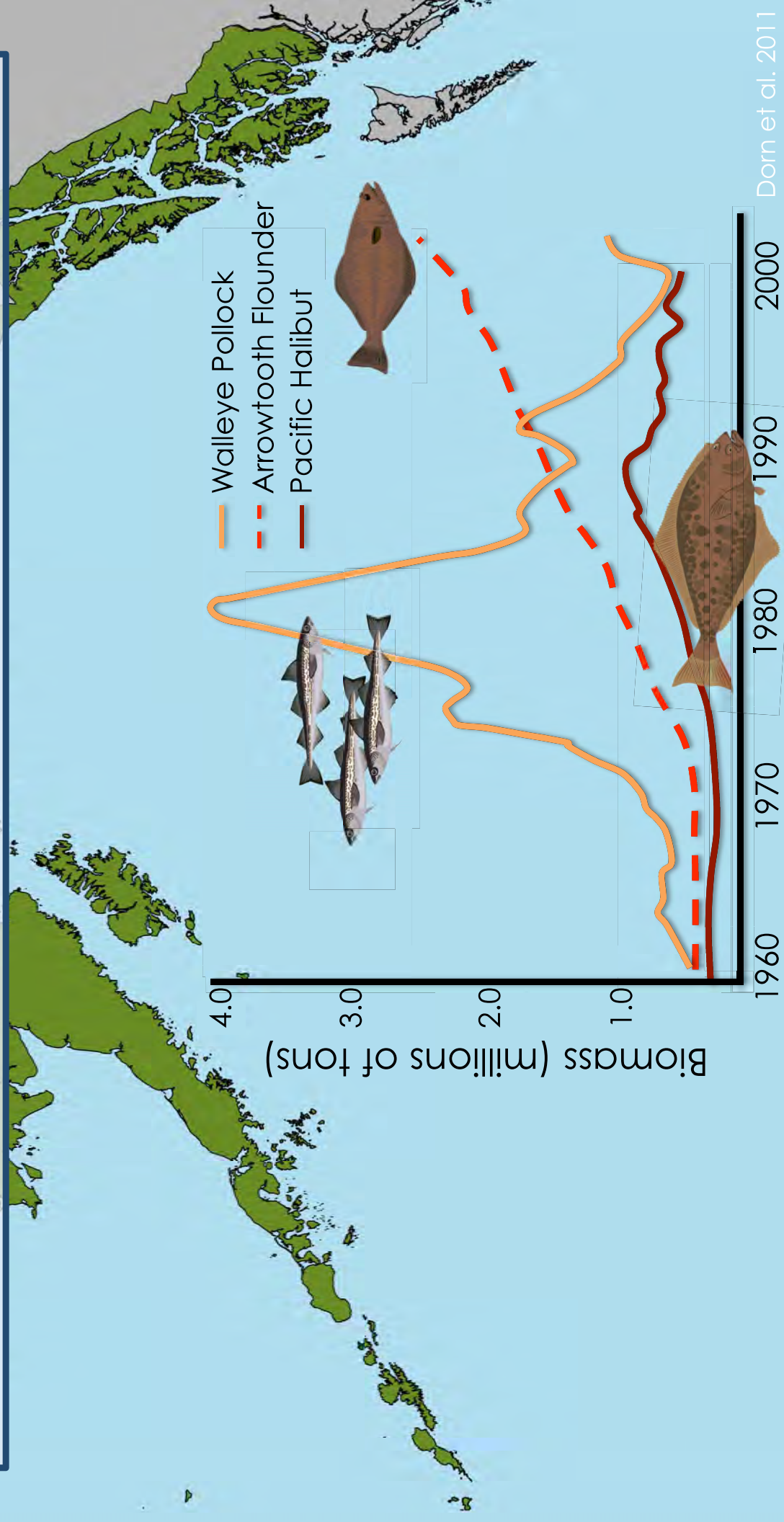
Terry Quinn,  
UAF



Richard Yamada,  
AK Charter Assoc.

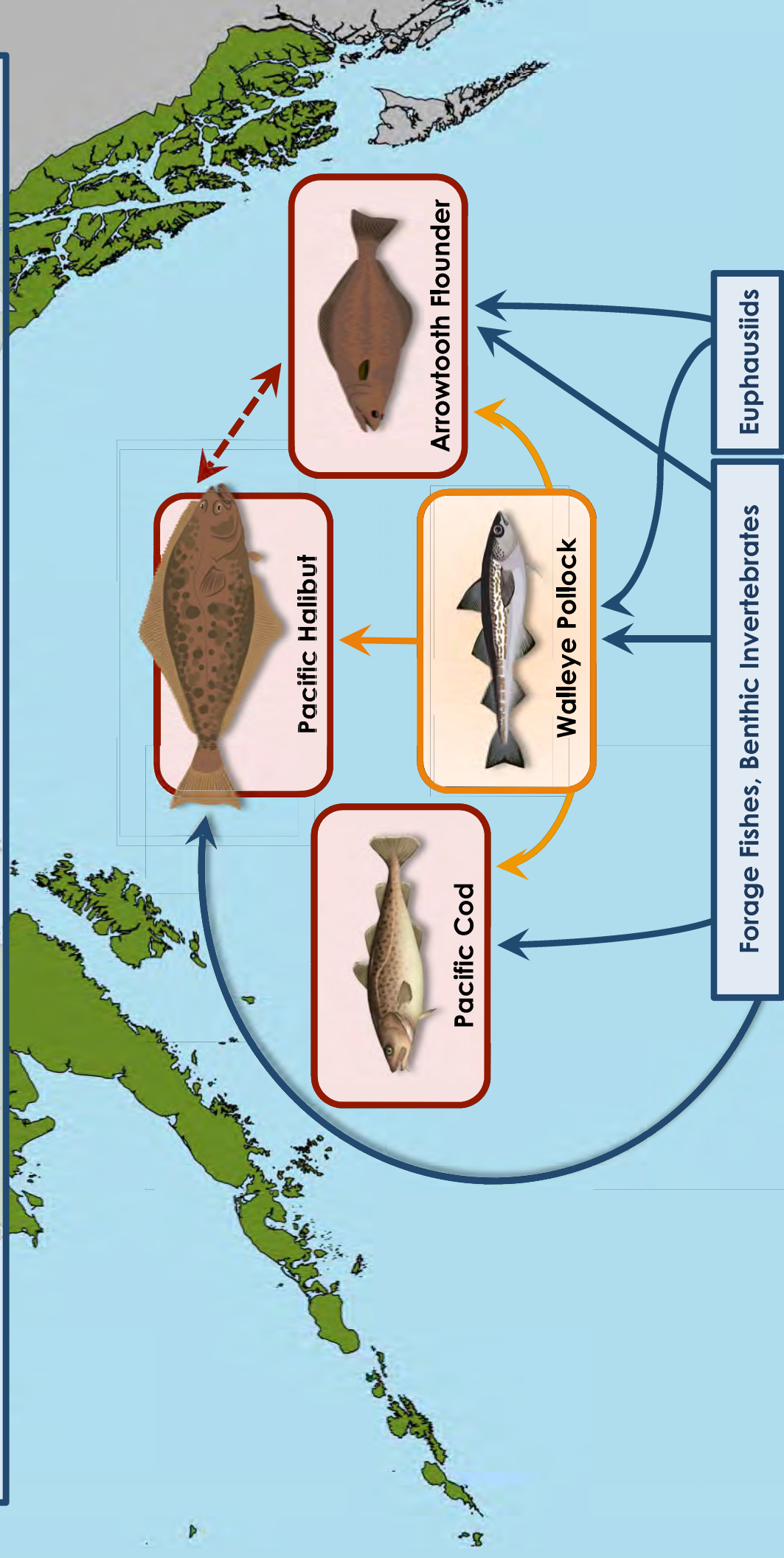
# PCCRC-funded Projects

Ecological interactions among key groundfish species in the Gulf of Alaska



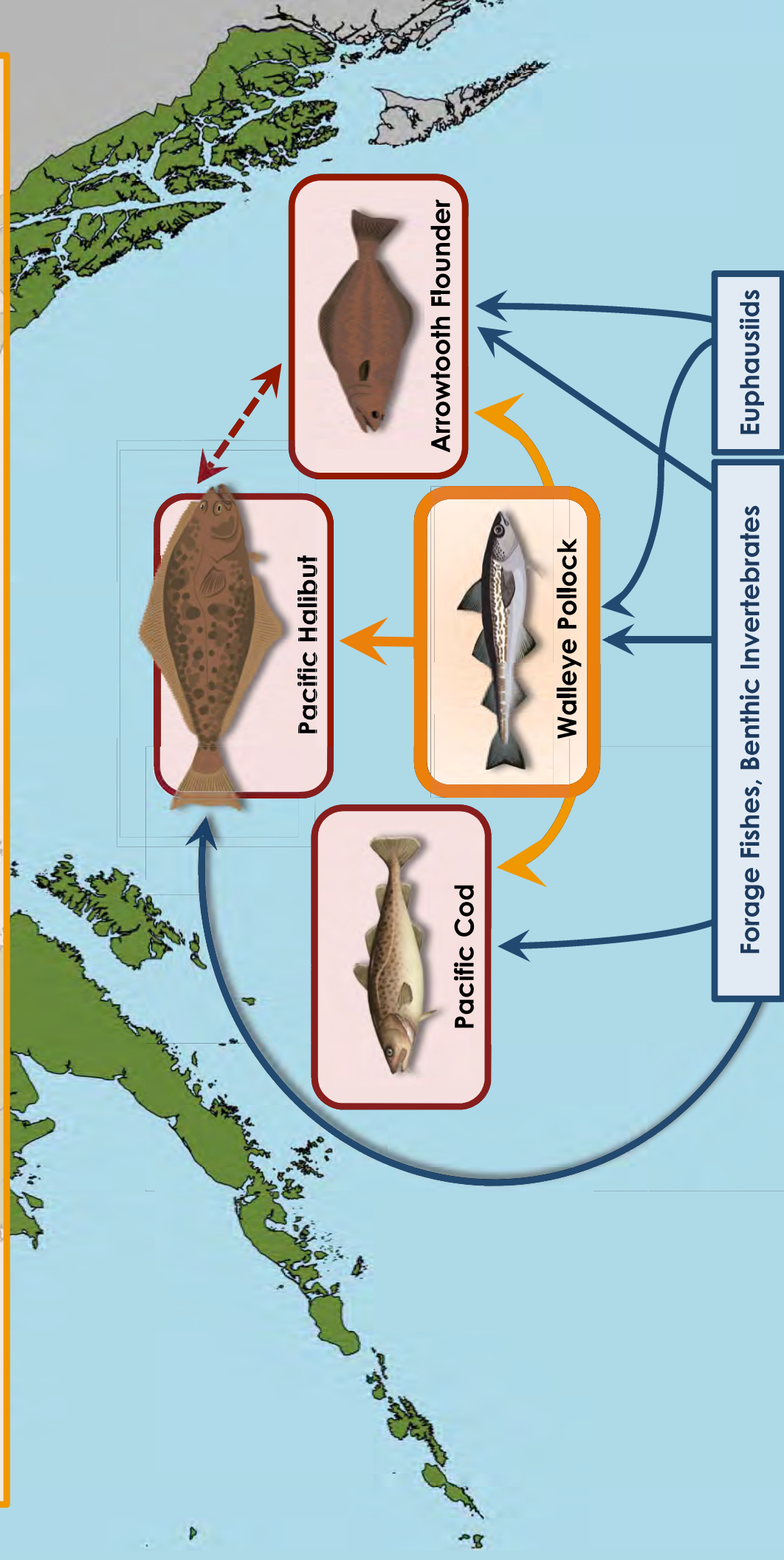
# PCCRC-funded Projects

Ecological interactions among key groundfish species in the Gulf of Alaska



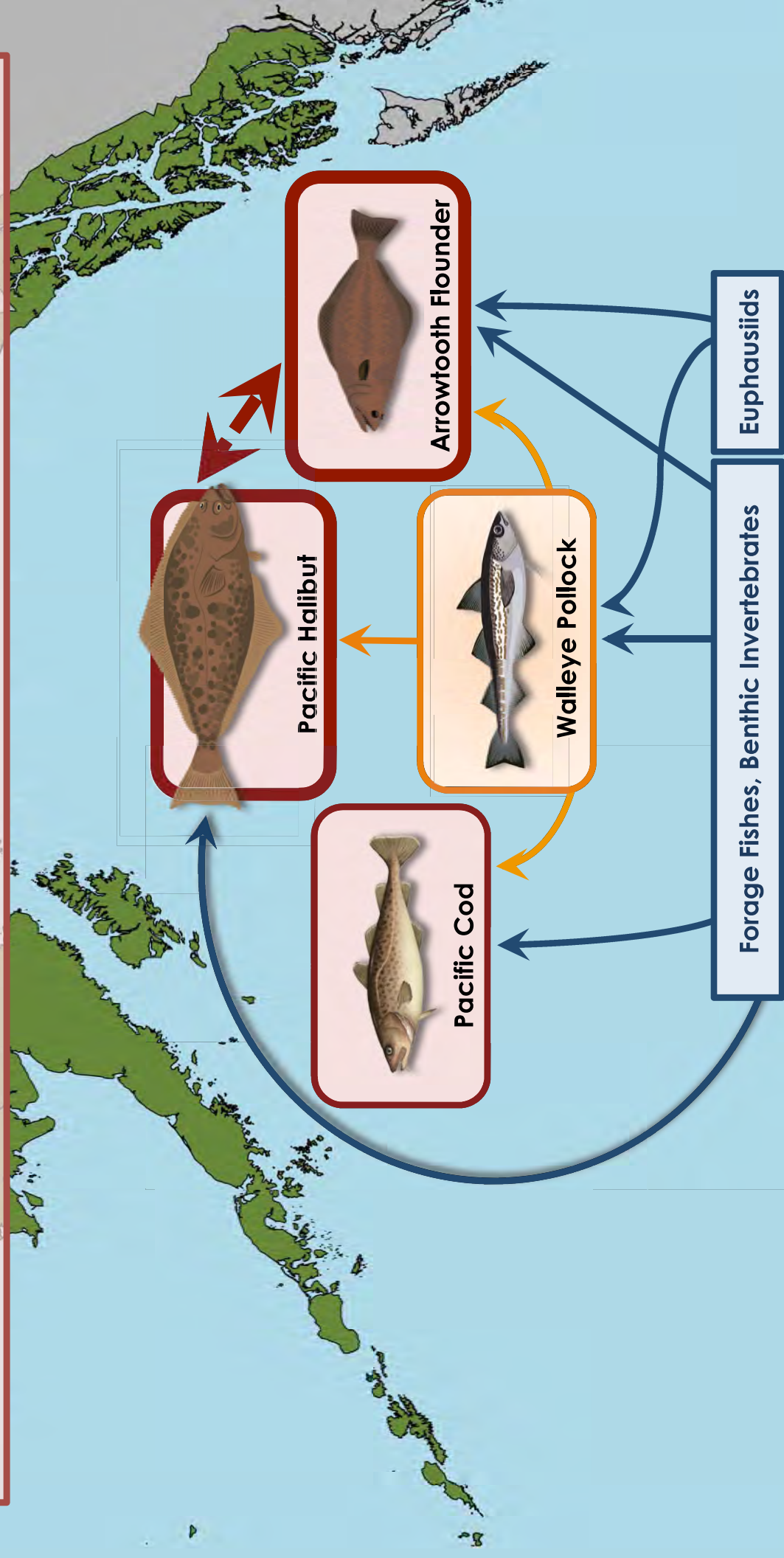
# PCCRC-funded Projects

Ch 1. Calculating an index of predation to augment the stock assessment for Gulf of Alaska pollock



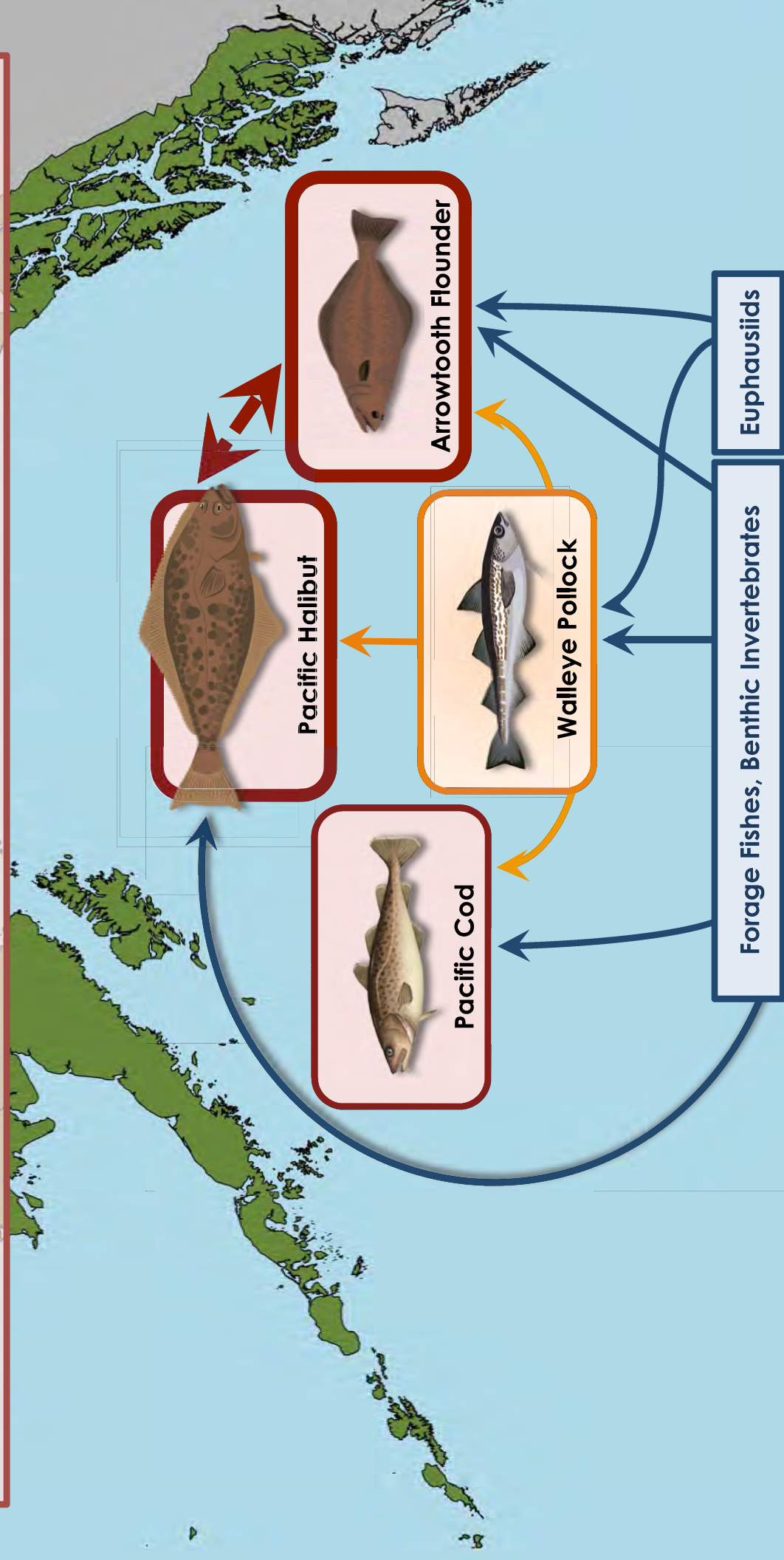
# PCCRC-funded Projects

Ch 2. Assessing the potential for competition between Pacific Halibut and Arrowtooth in the GOA



# PCCRC-funded Projects

## Ch 3. Quantifying distributions and diet compositions of Pacific Halibut and Arrowtooth in SE Alaska



# Benefits of this Research

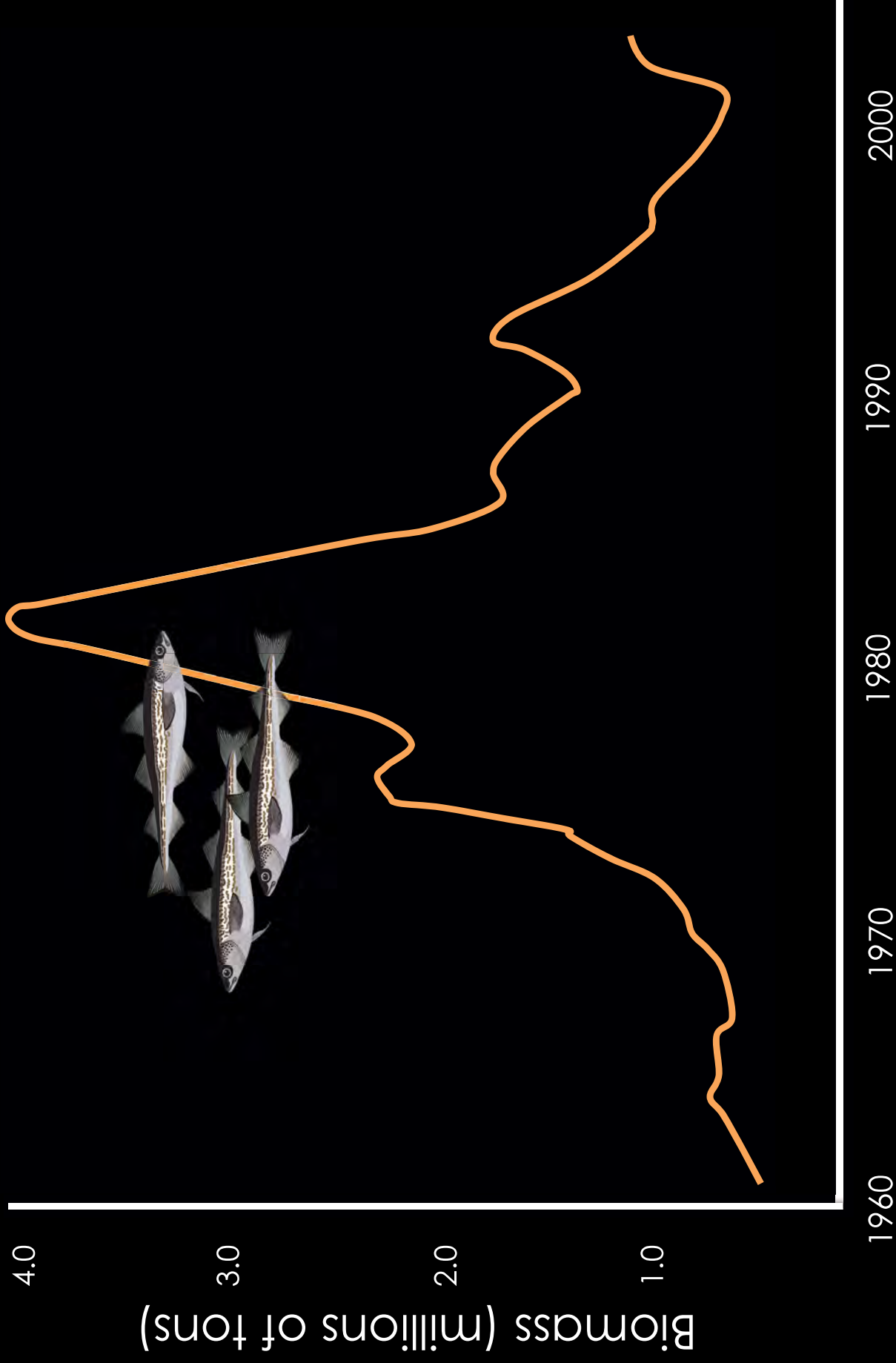
---

- better understand (a)biotic effects on the distributions and abundances of commercially valuable species
- increased collaboration among scientists, managers, and members of industry
- improved accounting of predator-prey relationships in stock assessments and fishery management plans



# 2017 in Review

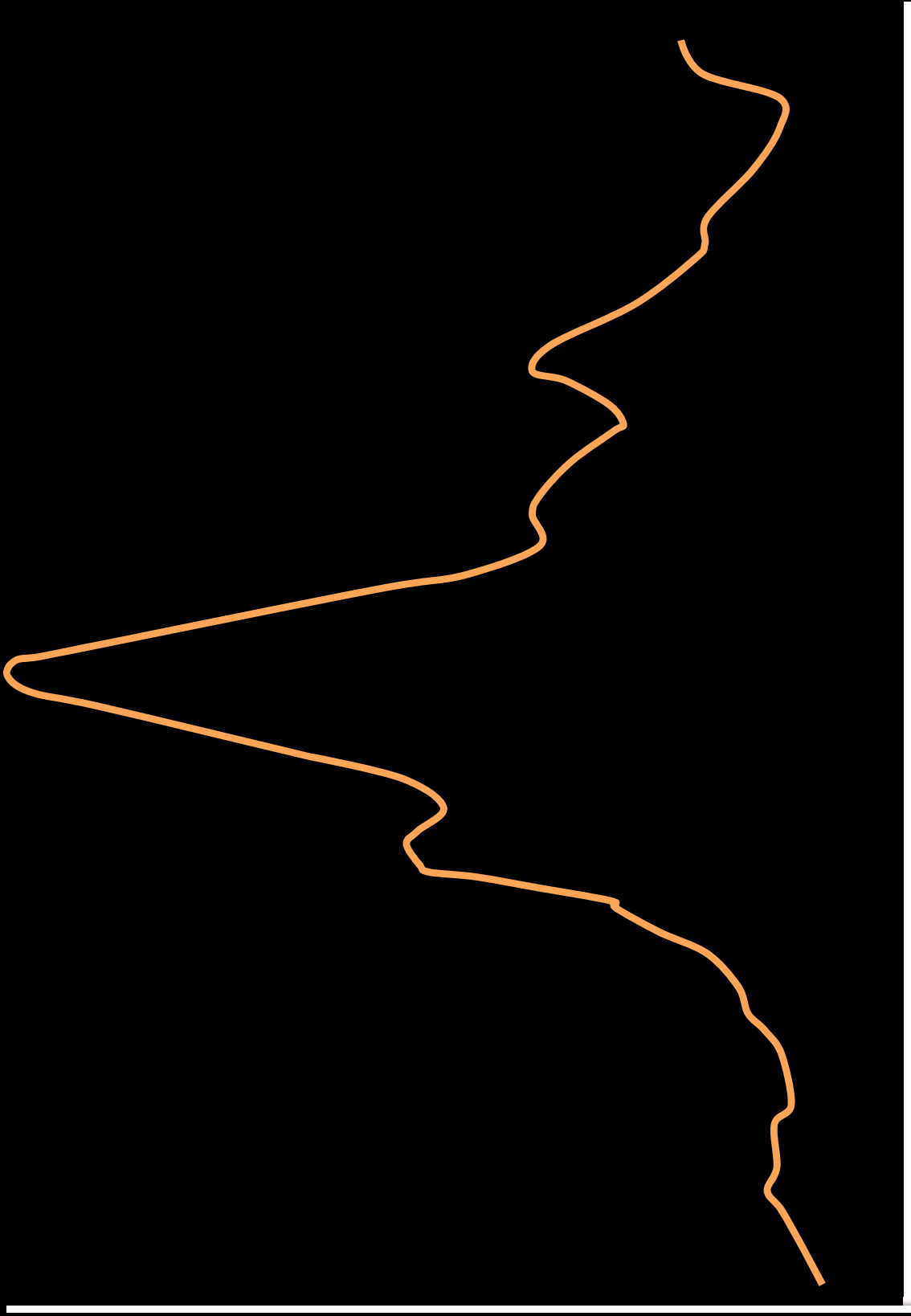
---





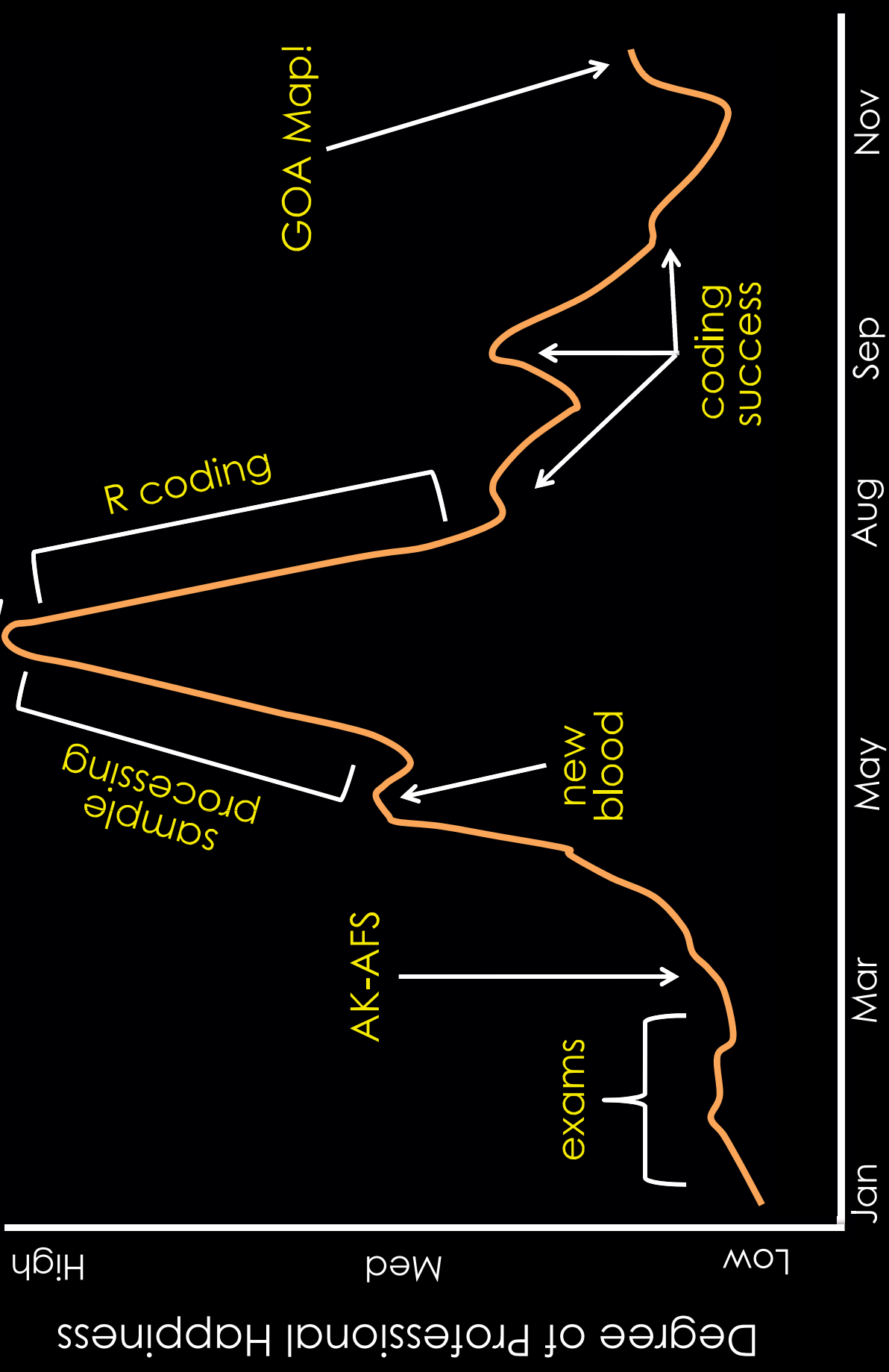
# 2017 in Review

---



# 2017 in Review

data collection complete;  
AFSC bottom trawl survey



Alaska Fisheries  
Science Center, NOAA

Gulf of Alaska  
bottom trawl survey

Leg 4, Jul 19 to Aug 6  
Seward to Ketchikan



**2017 Ocean Explorer Otolith Collections**

GOA Survey

**Species**

Species	Sampling Plan
Pacific Halibut	~All (Tag, Qty)
Pollock	Random 5 when 10-500 pollock; 10 if > 500. If juveniles <25 cm dominate in any catch, only collect otoliths from 2 of the < 25 fish and allocate the remainder of the sample to larger fish.
P. Cod	Random 5 when 10-300 Pcod; 10 if > 300
Arrowtooth Flounder	Random 2 when >=2 ATF
Flathead sole	Random 3 when 10-100 FHS; 5 if > 100
Dover sole	Random 5 when 10-100 Dover; 10 if > 100
Rex sole	Random 3 when >=10 Rex
SST	Random 4 when >= 10 SST
Atka mackerel	4/cm/sex/region
Sablefish	Stations<200m up to 20 random sablefish
Rougheye rockfish	1/cm/sex/haul
Blackspotted rockfish	1/cm/sex/haul
Northern rockfish	1/cm/sex/haul; none in EGOA
Shortraker rockfish	1/cm/sex/haul
Sharpchin rockfish	4/cm/sex/haul
Redstripe rockfish	4/cm/sex/haul
Dusky rockfish	3/cm/sex/haul
POP	1/cm/sex/every other positive POP haul

Complete Nomenclature Code List - 43 and 44 Series Fish - 10/10/2007

Code	Species
01	Atlantic salmon
02	Atlantic salmon
03	Atlantic salmon
04	Atlantic salmon
05	Atlantic salmon
06	Atlantic salmon
07	Atlantic salmon
08	Atlantic salmon
09	Atlantic salmon
10	Atlantic salmon
11	Atlantic salmon
12	Atlantic salmon
13	Atlantic salmon
14	Atlantic salmon
15	Atlantic salmon
16	Atlantic salmon
17	Atlantic salmon
18	Atlantic salmon
19	Atlantic salmon
20	Atlantic salmon
21	Atlantic salmon
22	Atlantic salmon
23	Atlantic salmon
24	Atlantic salmon
25	Atlantic salmon
26	Atlantic salmon
27	Atlantic salmon
28	Atlantic salmon
29	Atlantic salmon
30	Atlantic salmon
31	Atlantic salmon
32	Atlantic salmon
33	Atlantic salmon
34	Atlantic salmon
35	Atlantic salmon
36	Atlantic salmon
37	Atlantic salmon
38	Atlantic salmon
39	Atlantic salmon
40	Atlantic salmon
41	Atlantic salmon
42	Atlantic salmon
43	Atlantic salmon
44	Atlantic salmon
45	Atlantic salmon
46	Atlantic salmon
47	Atlantic salmon
48	Atlantic salmon
49	Atlantic salmon
50	Atlantic salmon
51	Atlantic salmon
52	Atlantic salmon
53	Atlantic salmon
54	Atlantic salmon
55	Atlantic salmon
56	Atlantic salmon
57	Atlantic salmon
58	Atlantic salmon
59	Atlantic salmon
60	Atlantic salmon
61	Atlantic salmon
62	Atlantic salmon
63	Atlantic salmon
64	Atlantic salmon
65	Atlantic salmon
66	Atlantic salmon
67	Atlantic salmon
68	Atlantic salmon
69	Atlantic salmon
70	Atlantic salmon
71	Atlantic salmon
72	Atlantic salmon
73	Atlantic salmon
74	Atlantic salmon
75	Atlantic salmon
76	Atlantic salmon
77	Atlantic salmon
78	Atlantic salmon
79	Atlantic salmon
80	Atlantic salmon
81	Atlantic salmon
82	Atlantic salmon
83	Atlantic salmon
84	Atlantic salmon
85	Atlantic salmon
86	Atlantic salmon
87	Atlantic salmon
88	Atlantic salmon
89	Atlantic salmon
90	Atlantic salmon
91	Atlantic salmon
92	Atlantic salmon
93	Atlantic salmon
94	Atlantic salmon
95	Atlantic salmon
96	Atlantic salmon
97	Atlantic salmon
98	Atlantic salmon
99	Atlantic salmon
00	Atlantic salmon









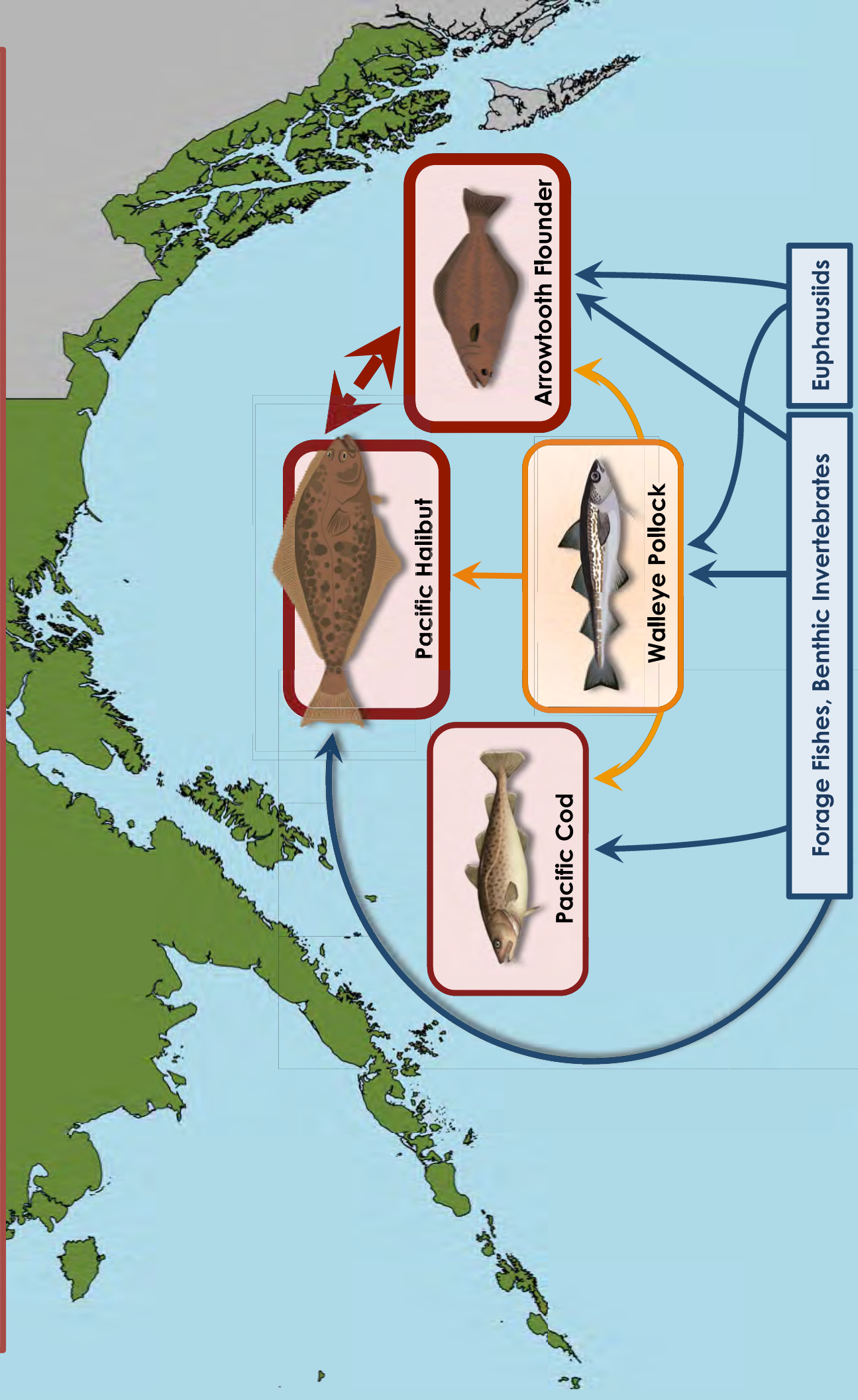








## Ch 2. Assessing the potential for competition between Pacific Halibut and Arrowtooth in the GOA



## Ch 2. Assessing the potential for competition between Pacific Halibut and Arrowtooth Flounder in the GOA

### RACE division

~ Resource Assessment and  
Conservation Engineering

1990 – 2017

### REEM group

~ Resource Ecology and  
Ecosystem Modeling

1990 – 2013

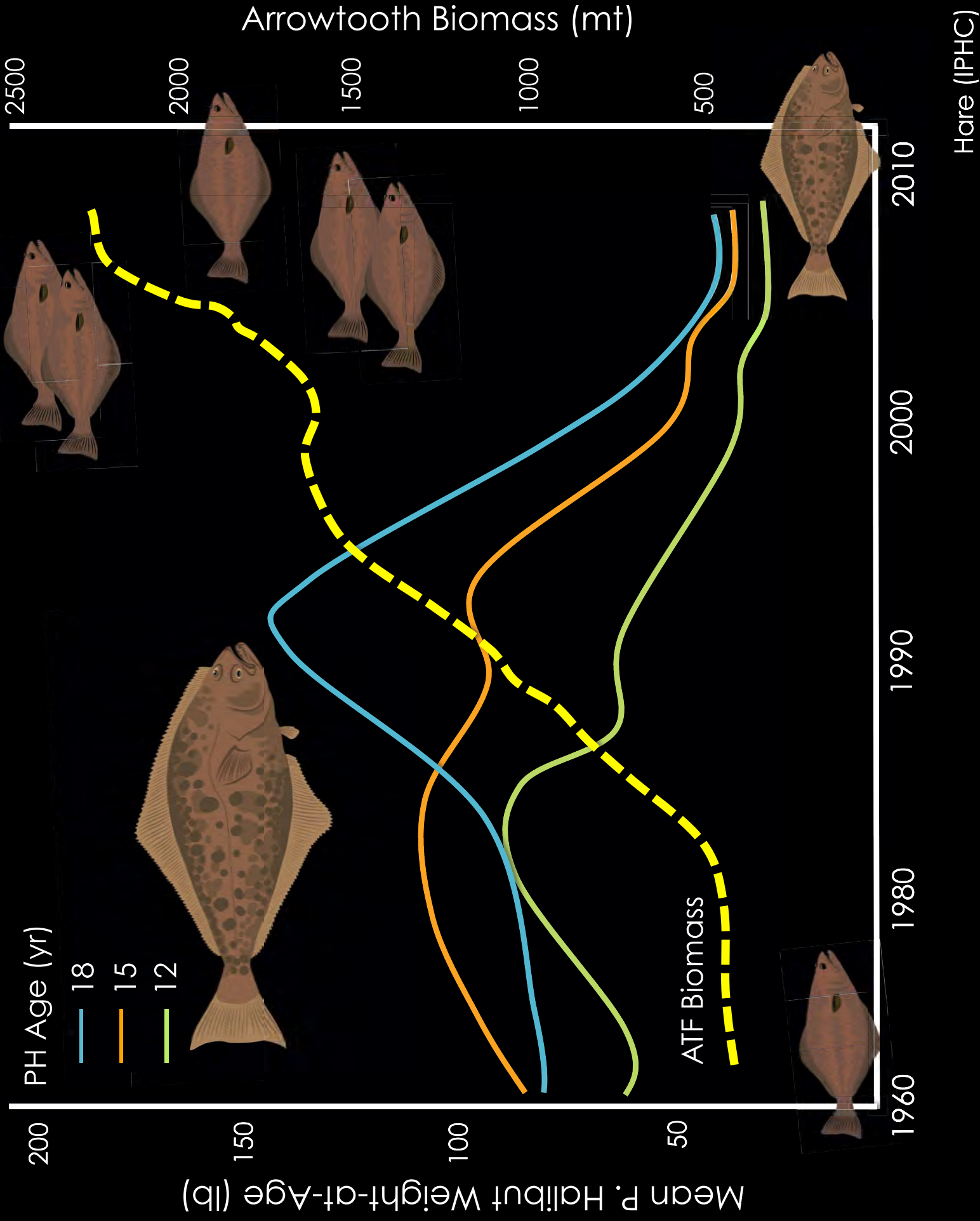
PH: 111,590 (4,504 stomachs)

ATF: 1,696,911 (7,068 stomachs)



# NOAA FISHERIES

# Ch 2: Competition between PH and ATF



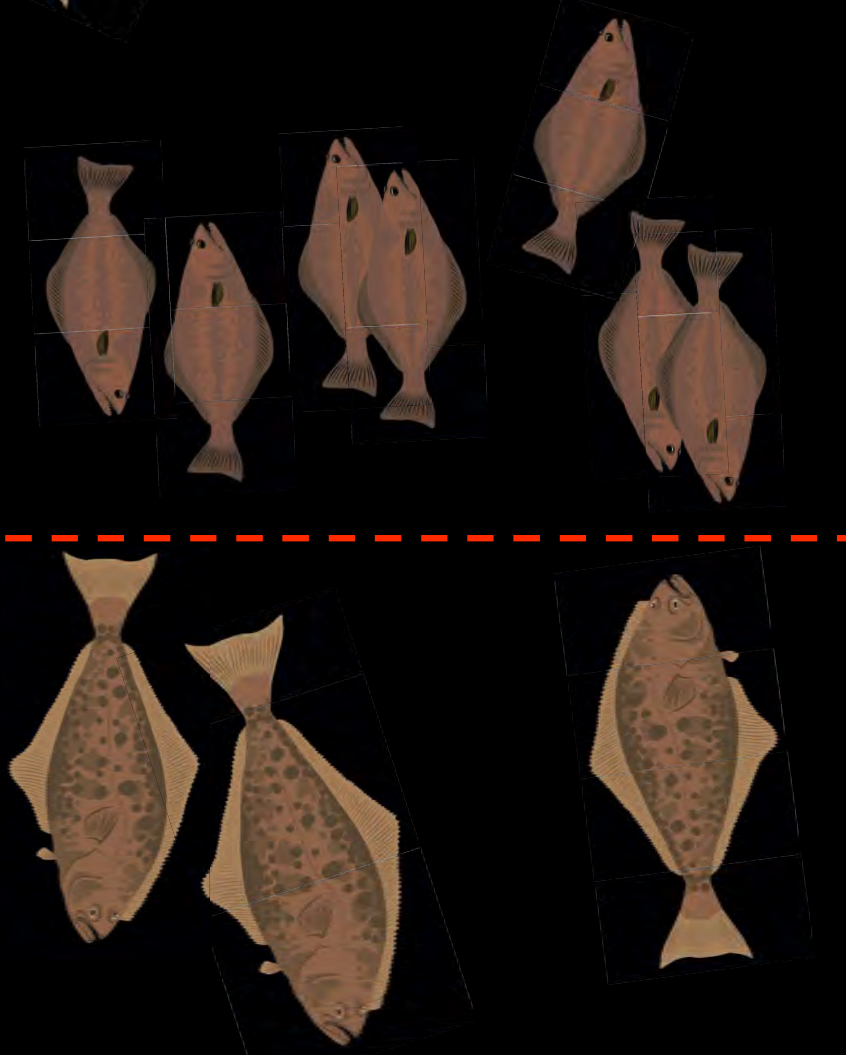
Hare (IPHC)

Are Pacific Halibut and Arrowtooth Flounder  
competing for prey and/or space?

# Are Pacific Halibut and Arrowtooth Flounder competing for prey and/or space?

## Resource Partitioning

Spatial Overlap



Dietary Overlap

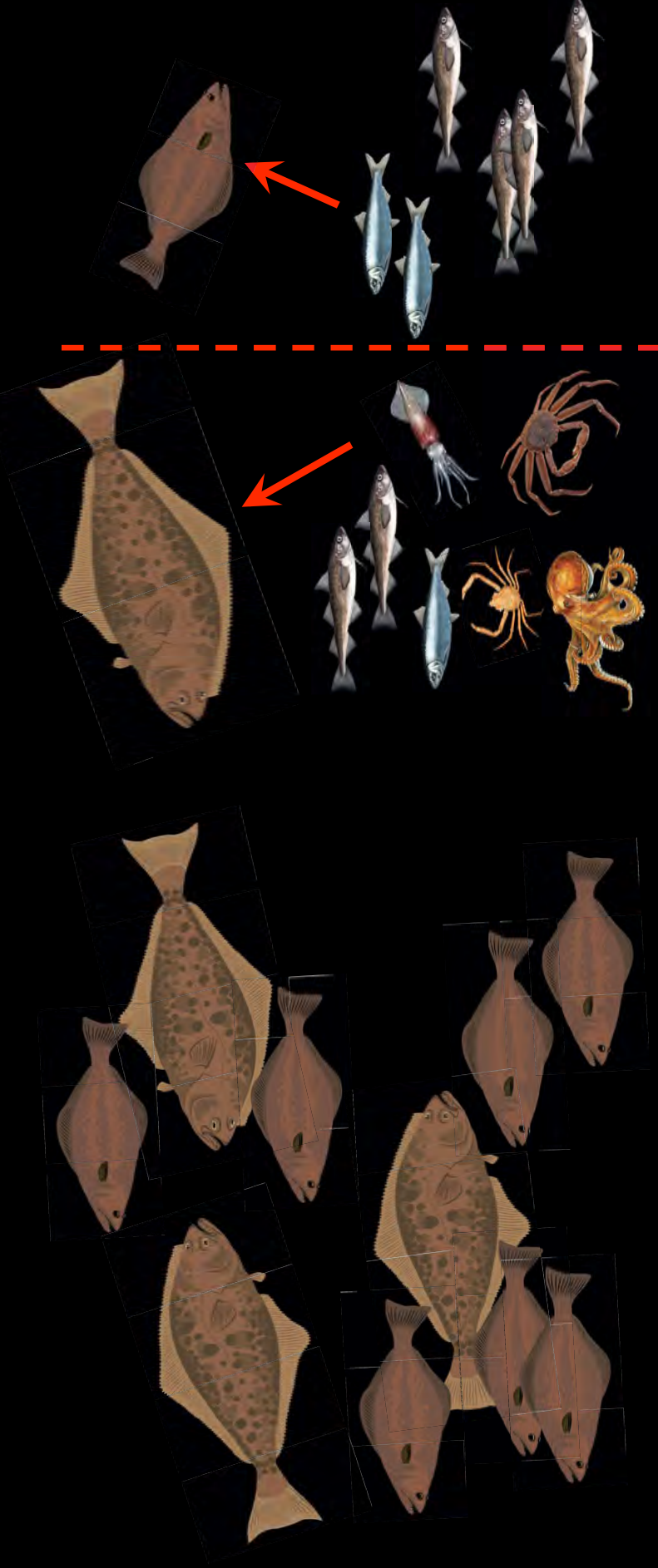


# Are Pacific Halibut and Arrowtooth Flounder competing for prey and/or space?

## Resource Partitioning

Spatial Overlap

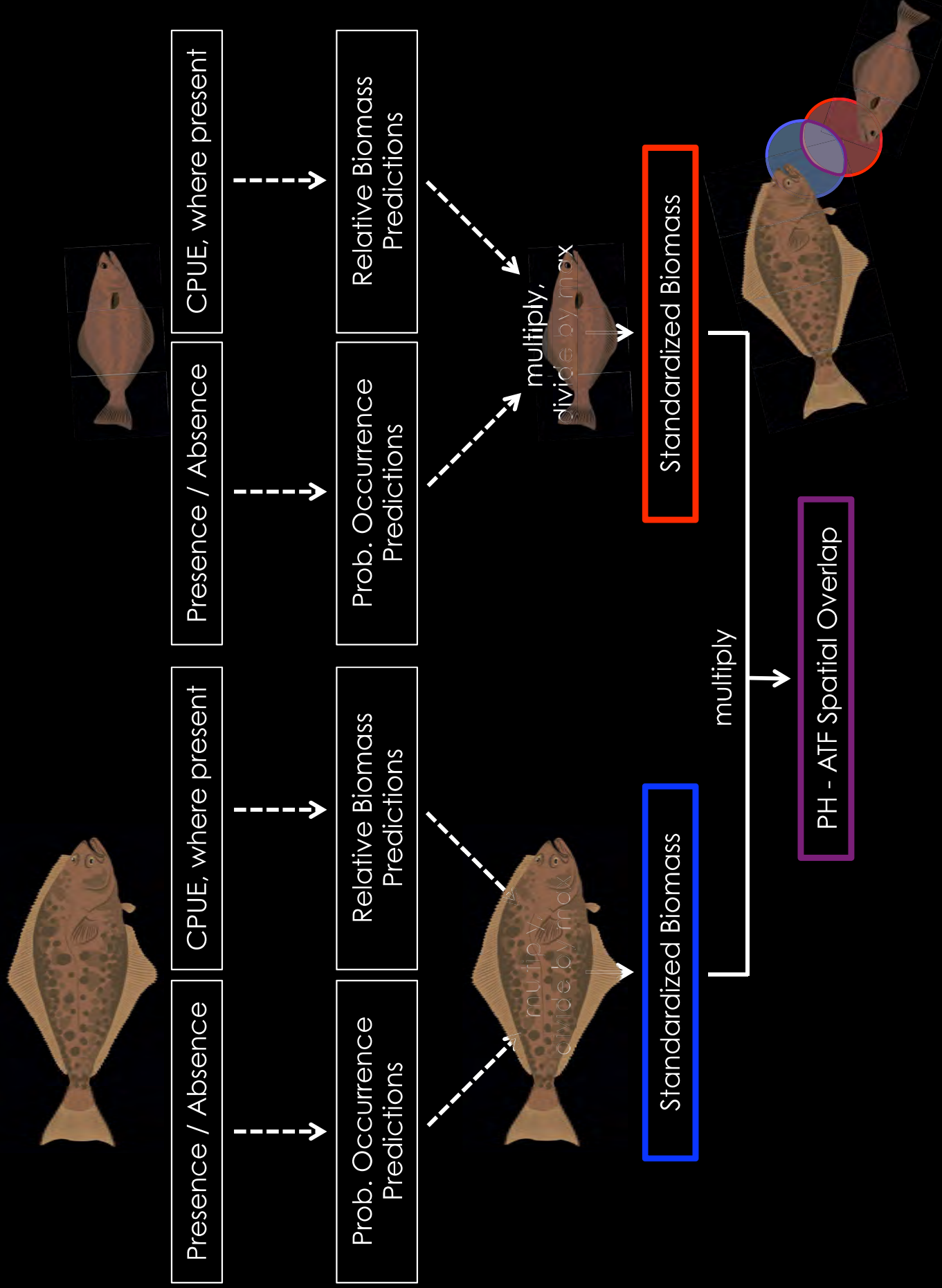
Dietary Overlap





# Analytical Framework: Spatial Overlap

generalized additive mixed models (GAMMs)



# Analytical Framework: Spatial Overlap

generalized additive mixed models (GAMMs)



Presence / Absence

CPUE, where present

Presence / Absence

CPUE, where present



Prob. Occurrence Predictions

Relative Biomass Predictions

Prob. Occurrence Predictions

Relative Biomass Predictions

multiply, divide by max

multiply, divide by max

multiply, divide by max

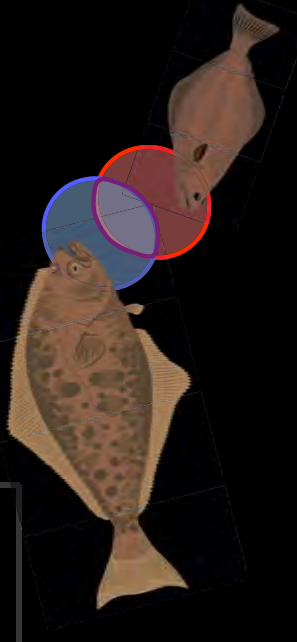
multiply, divide by max



Standardized Biomass

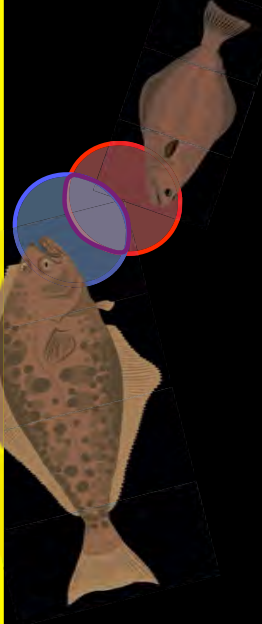
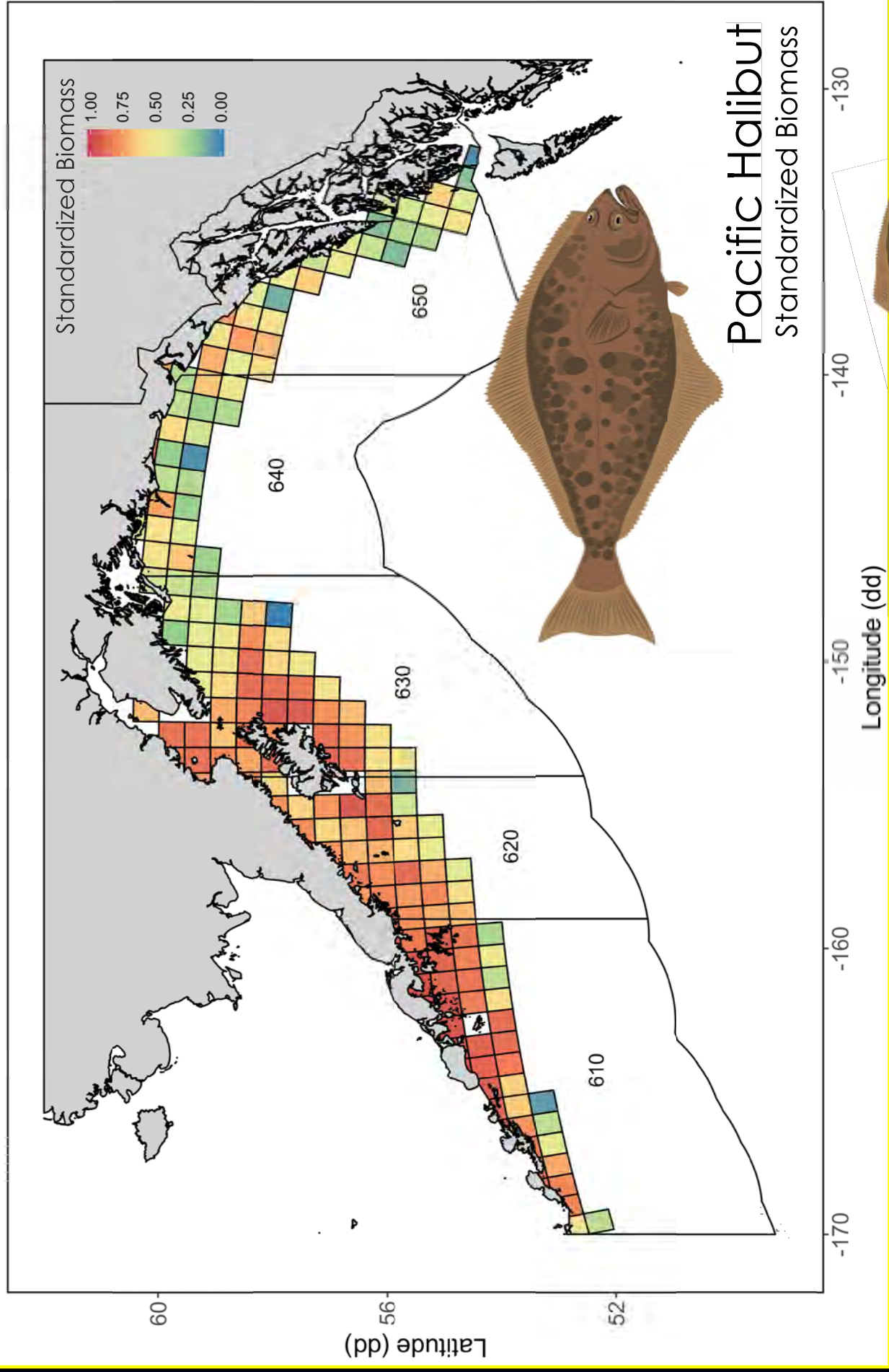
Standardized Biomass

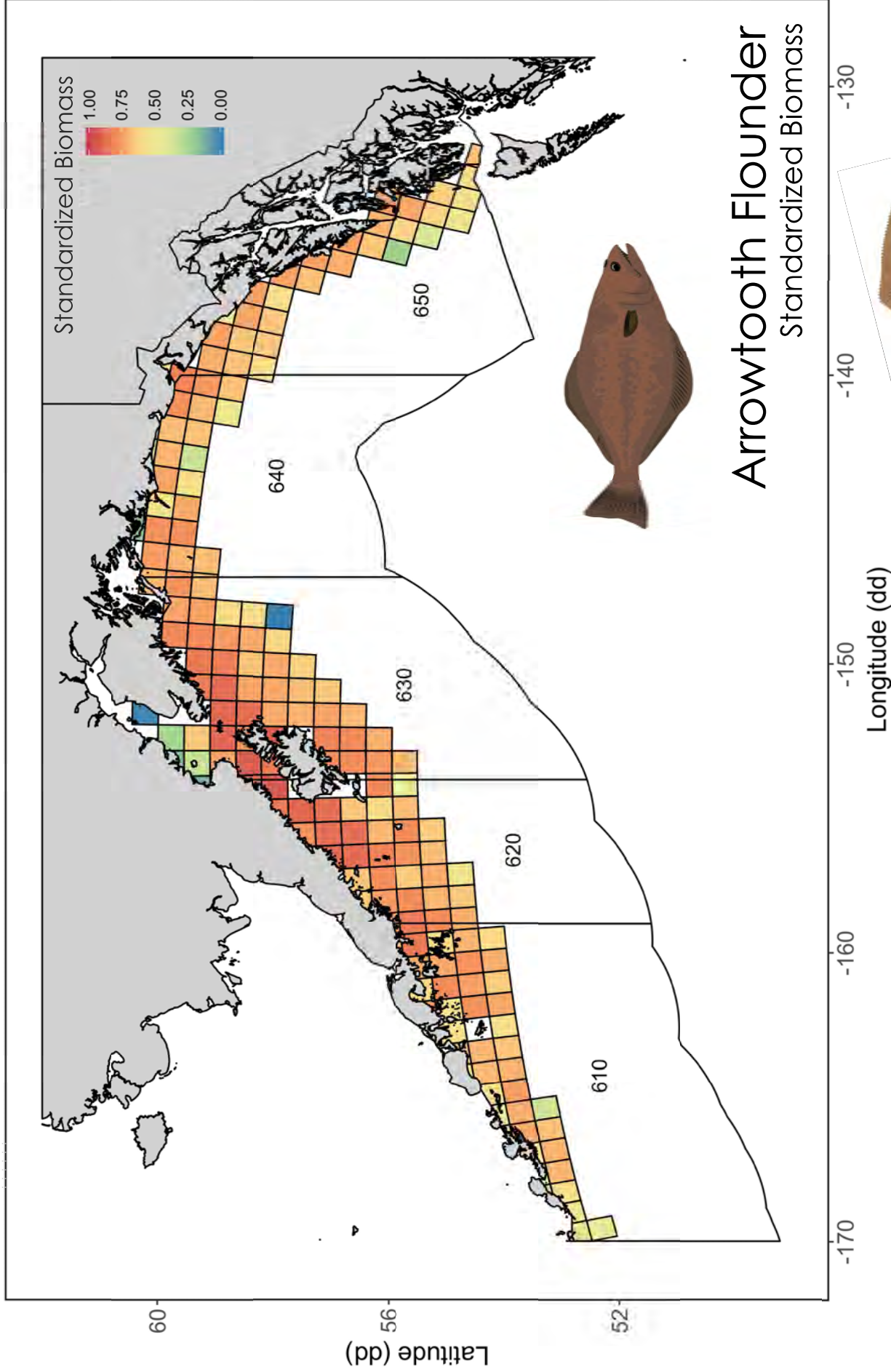
multiply



PH - ATF Spatial Overlap

# Ch 2: Competition between PH and ATF



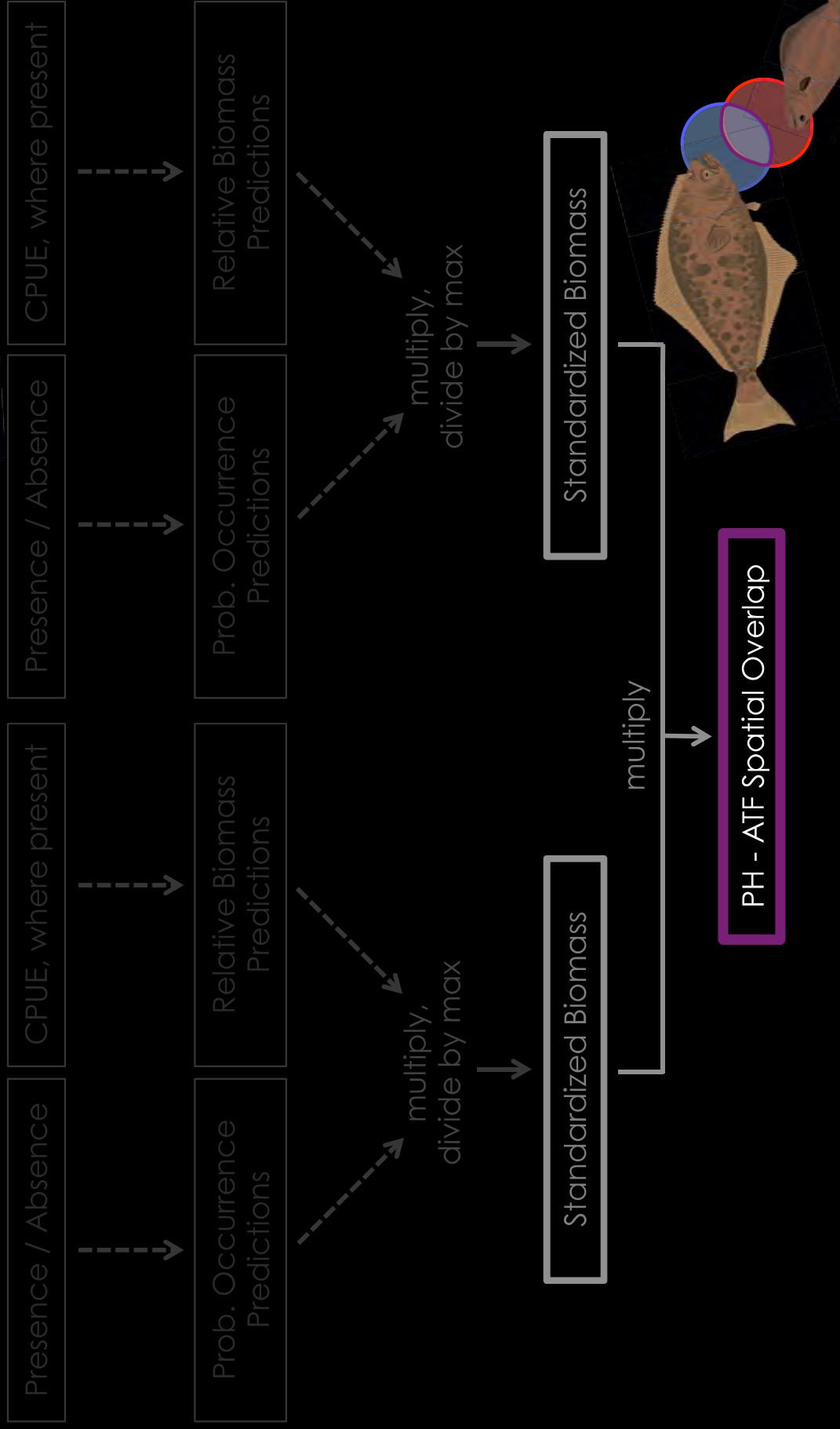


Arrowtooth Flounder  
Standardized Biomass

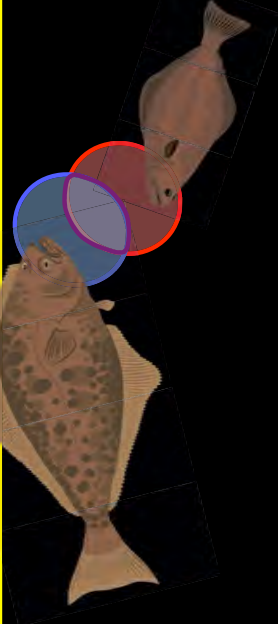
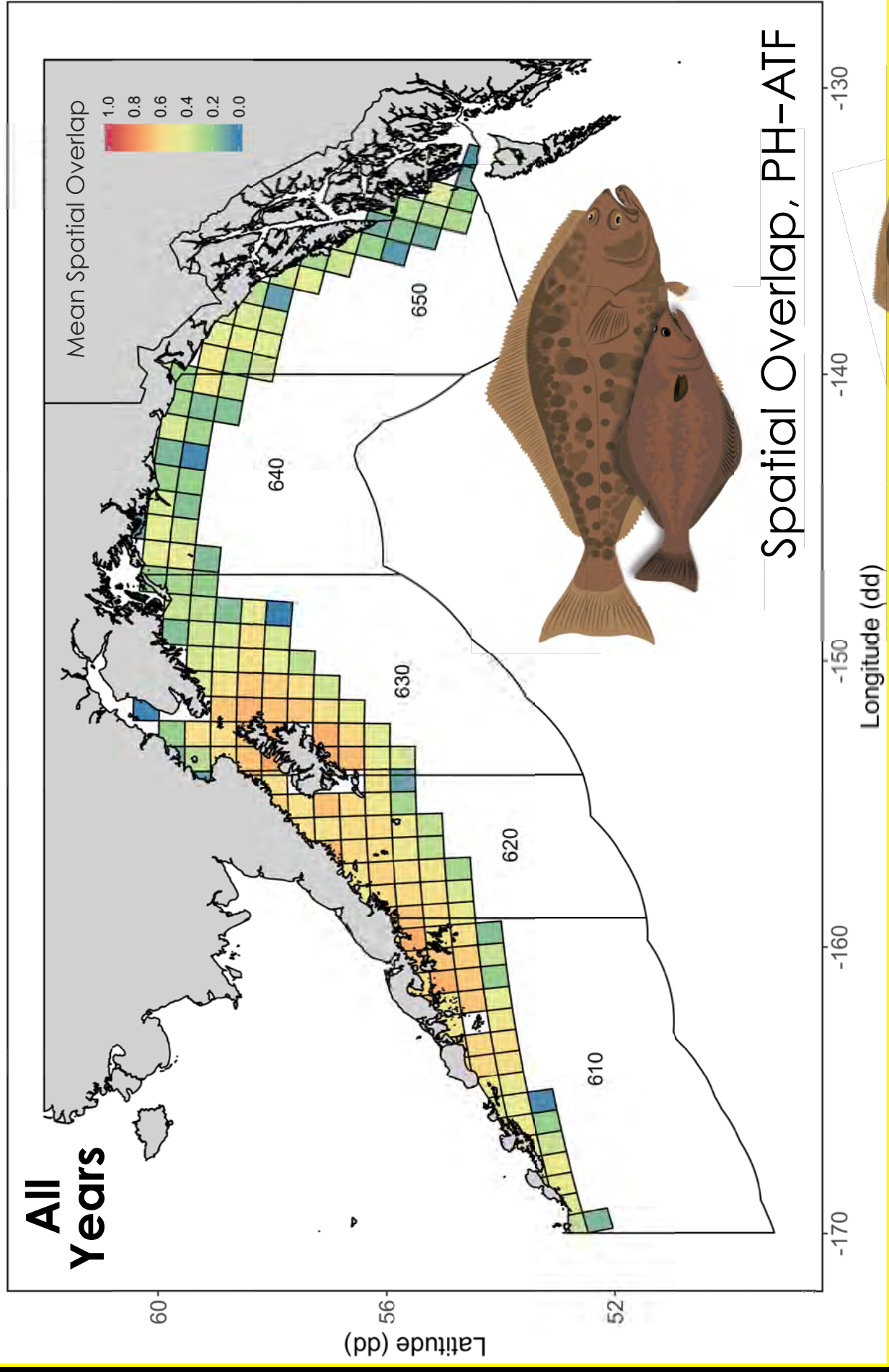


# Analytical Framework: Spatial Overlap

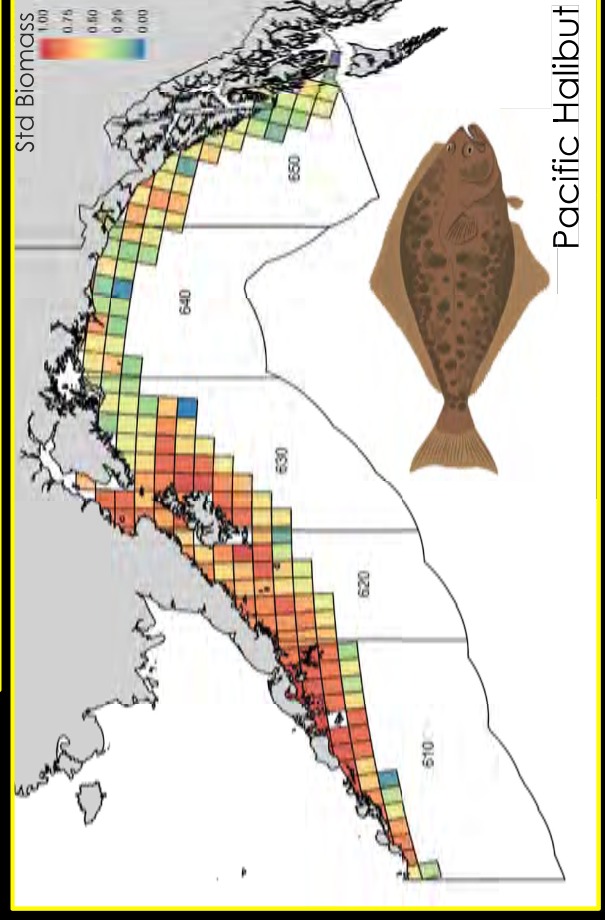
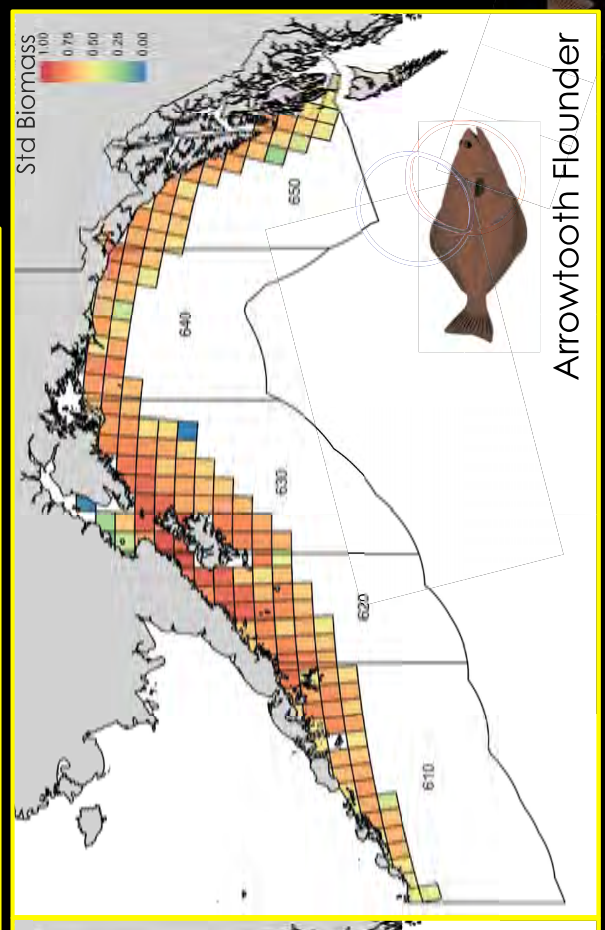
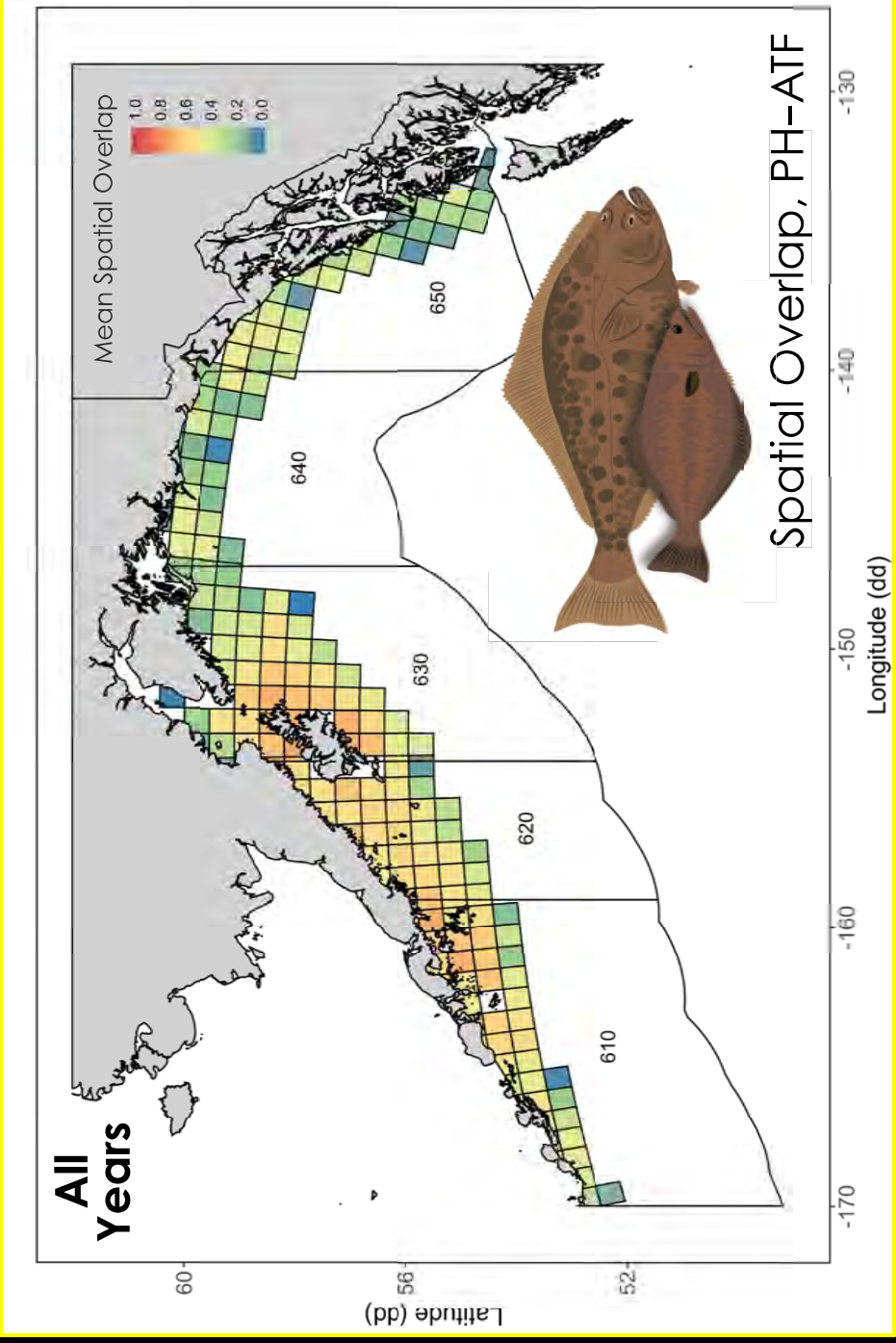
generalized additive mixed models (GAMMs)



# Ch 2: Competition between PH and ATF

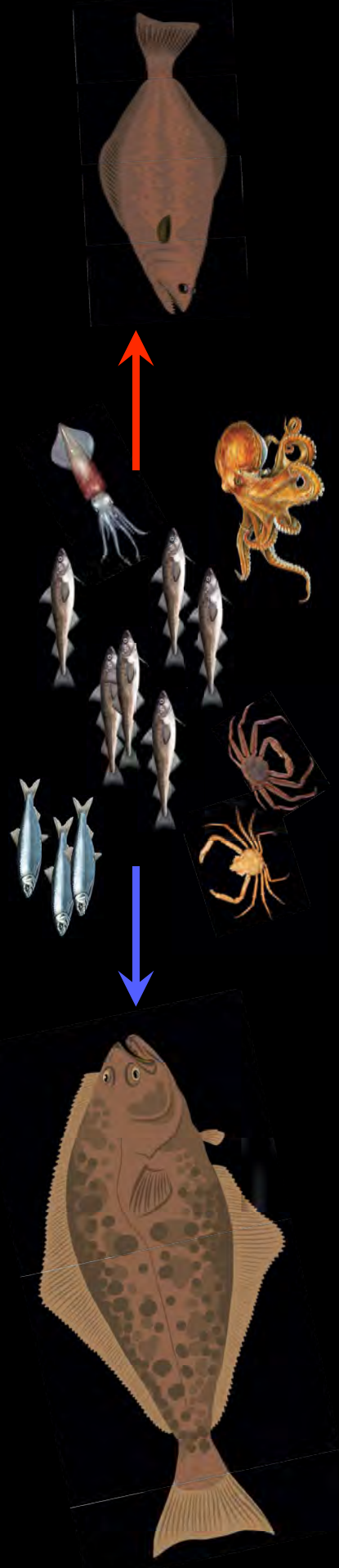


# Ch 2: Competition between PH and ATF



# Analytical Framework: Dietary Overlap

Schoener's Index (1968)



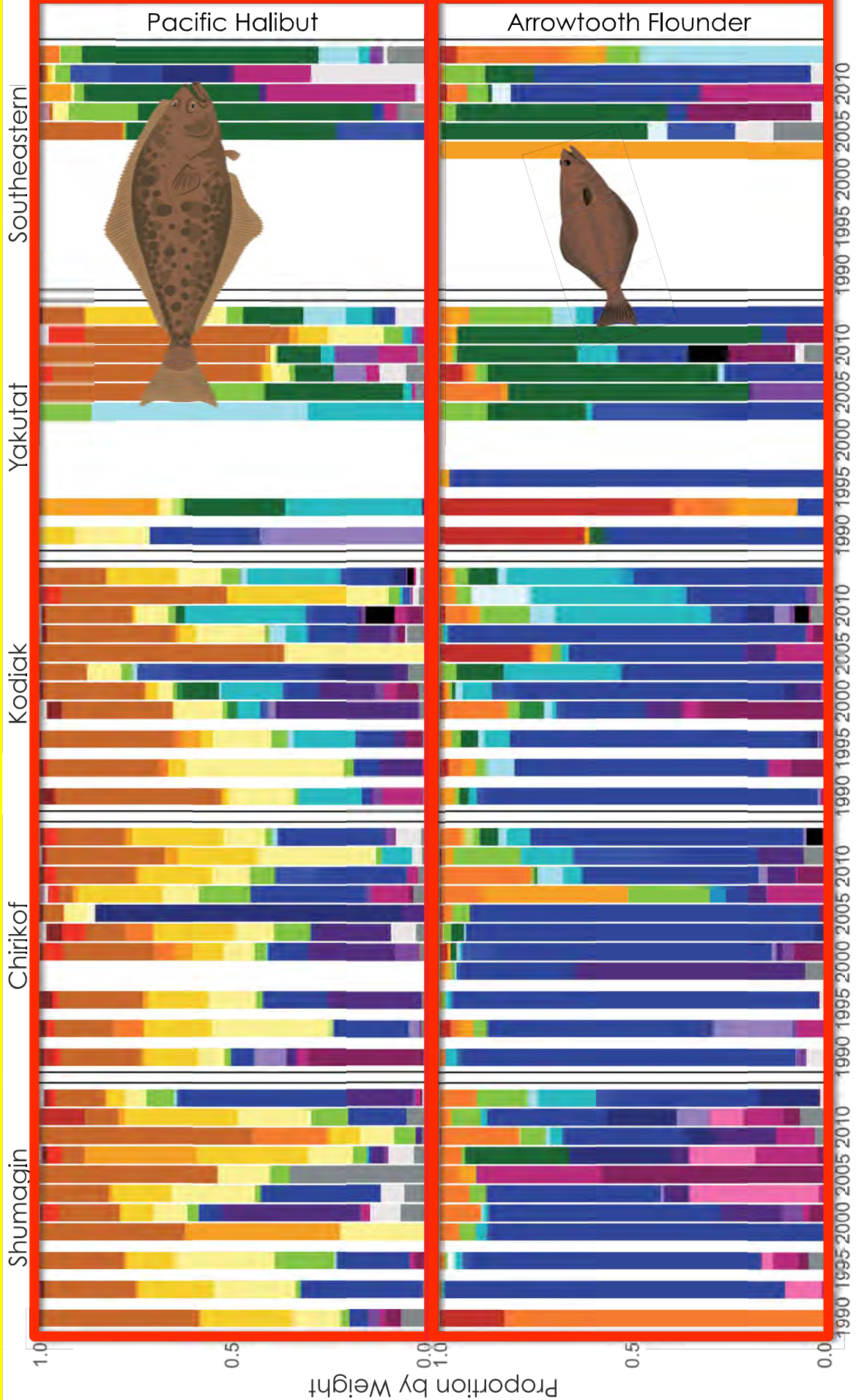
$$\text{Dietary Overlap (D)} = 1 - 0.5 \left( \sum | \text{prop}_{\text{PH}} - \text{prop}_{\text{ATF}} | \right)$$

prop: proportion of prey taxa  $i$  (by weight)

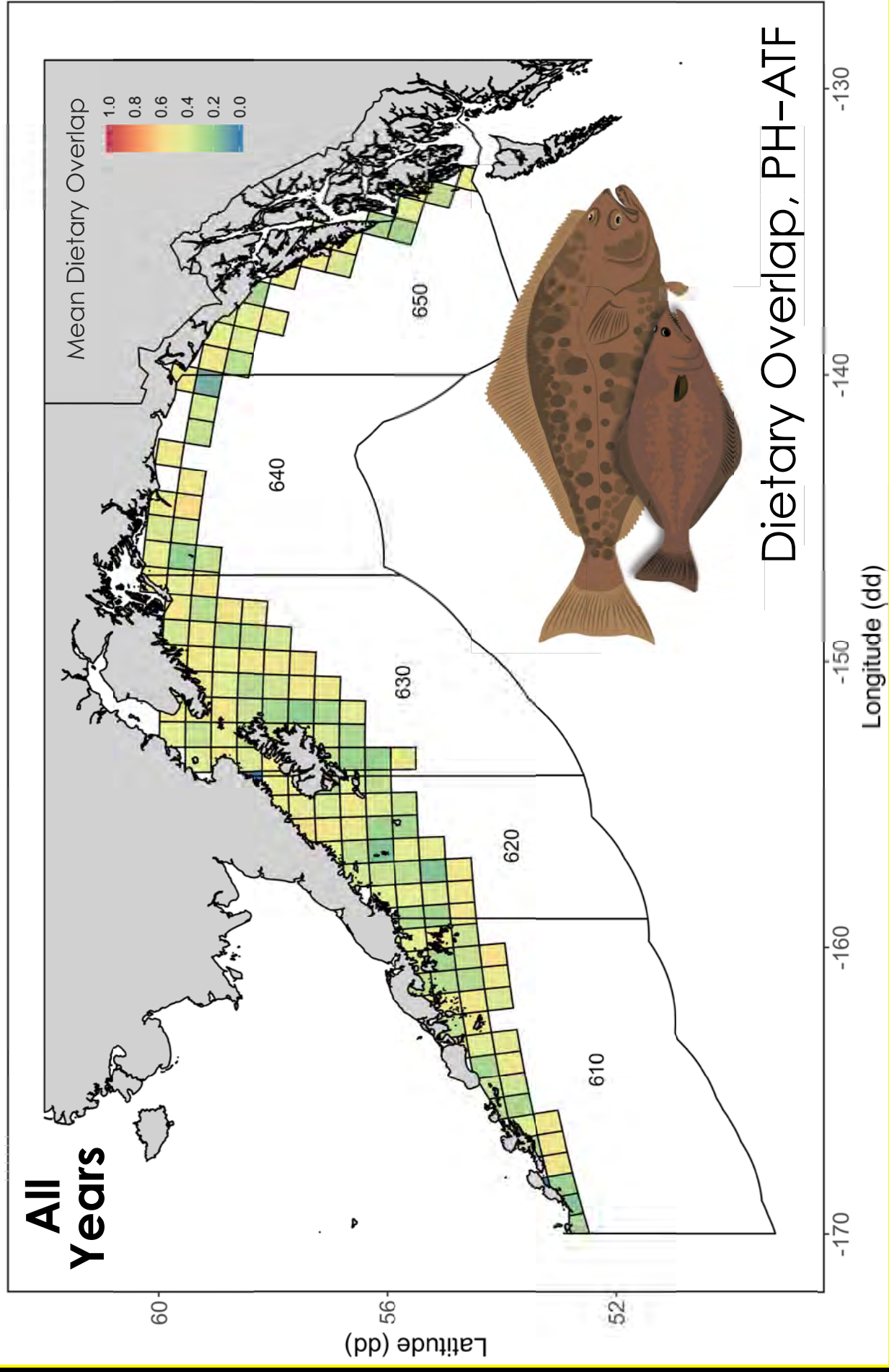
D	Degree of Overlap
0.0	none
0.5	moderate
1.0	total



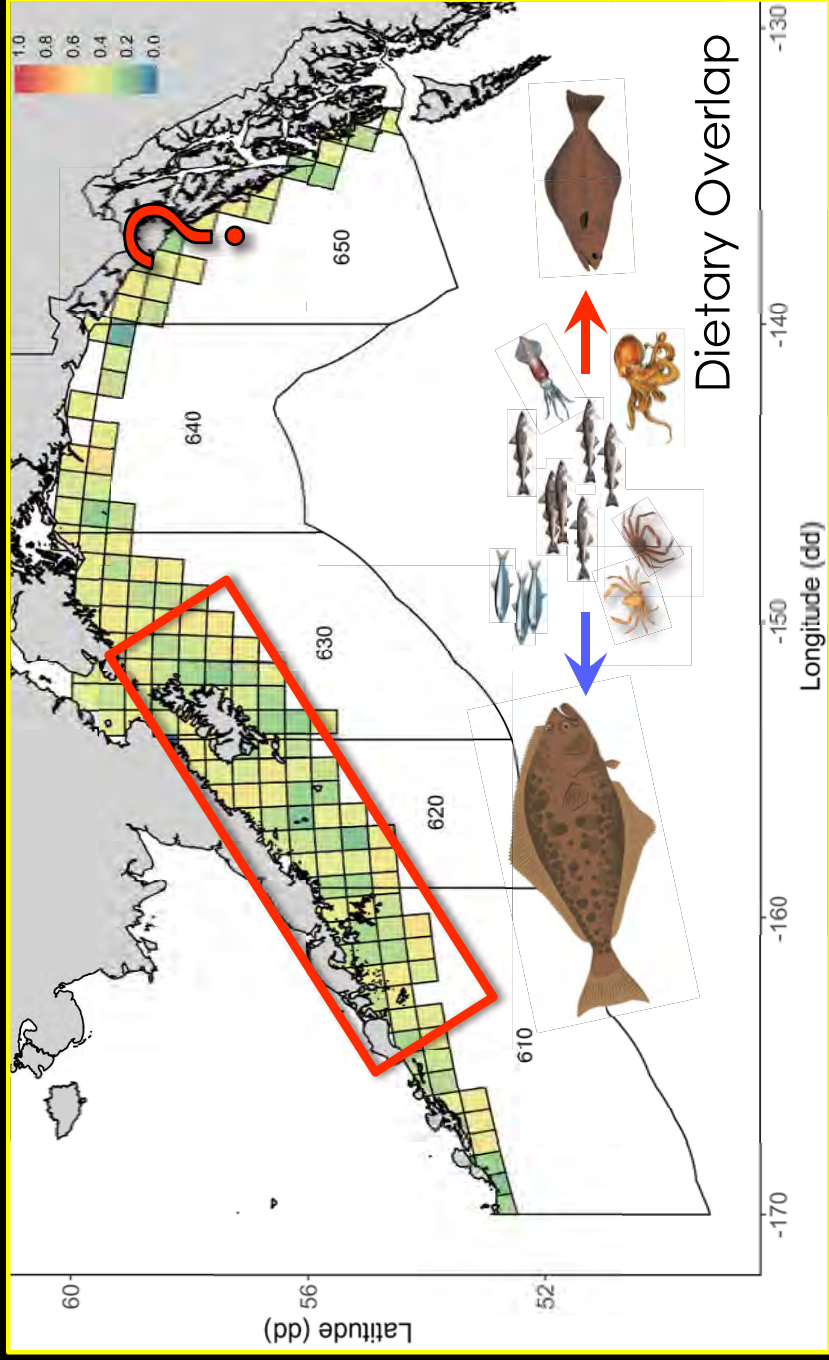
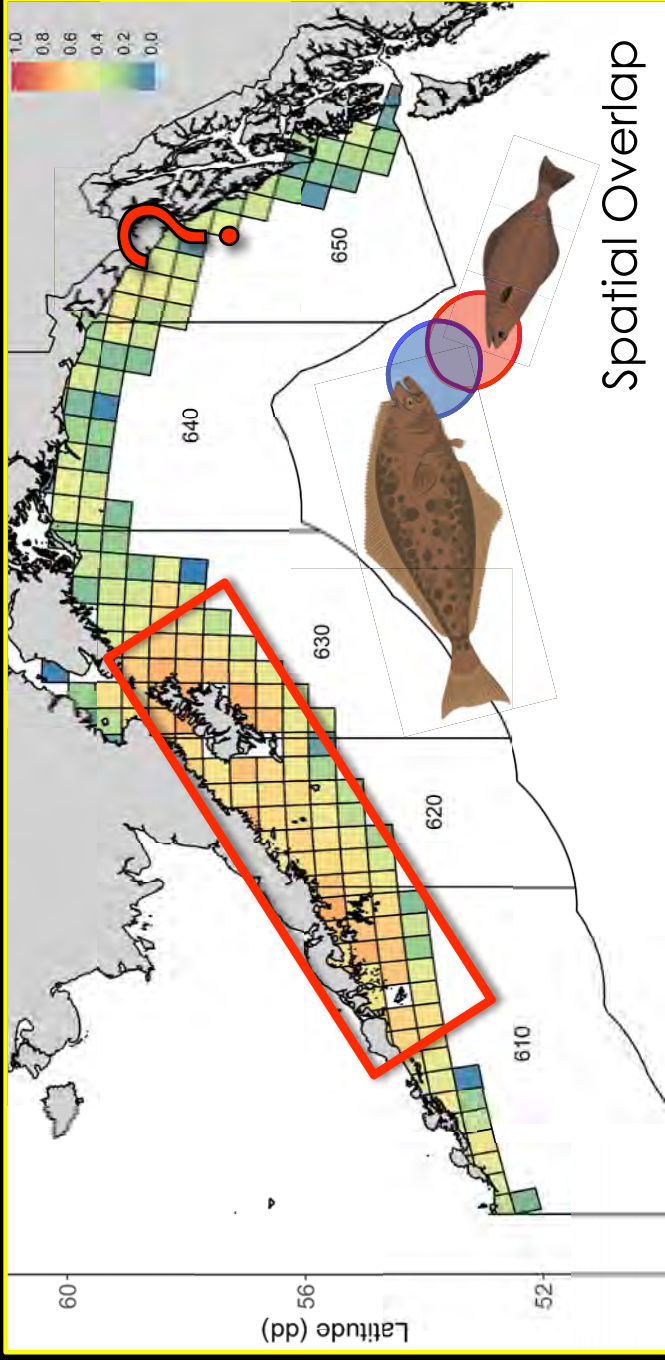
# Ch 2: Competition between PH and ATF



# Ch 2: Competition between PH and ATF



# Ch 2: Competition between PH and ATF



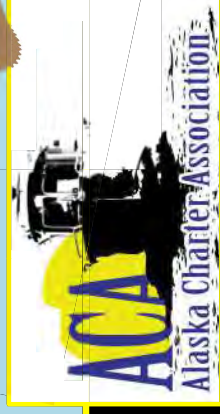
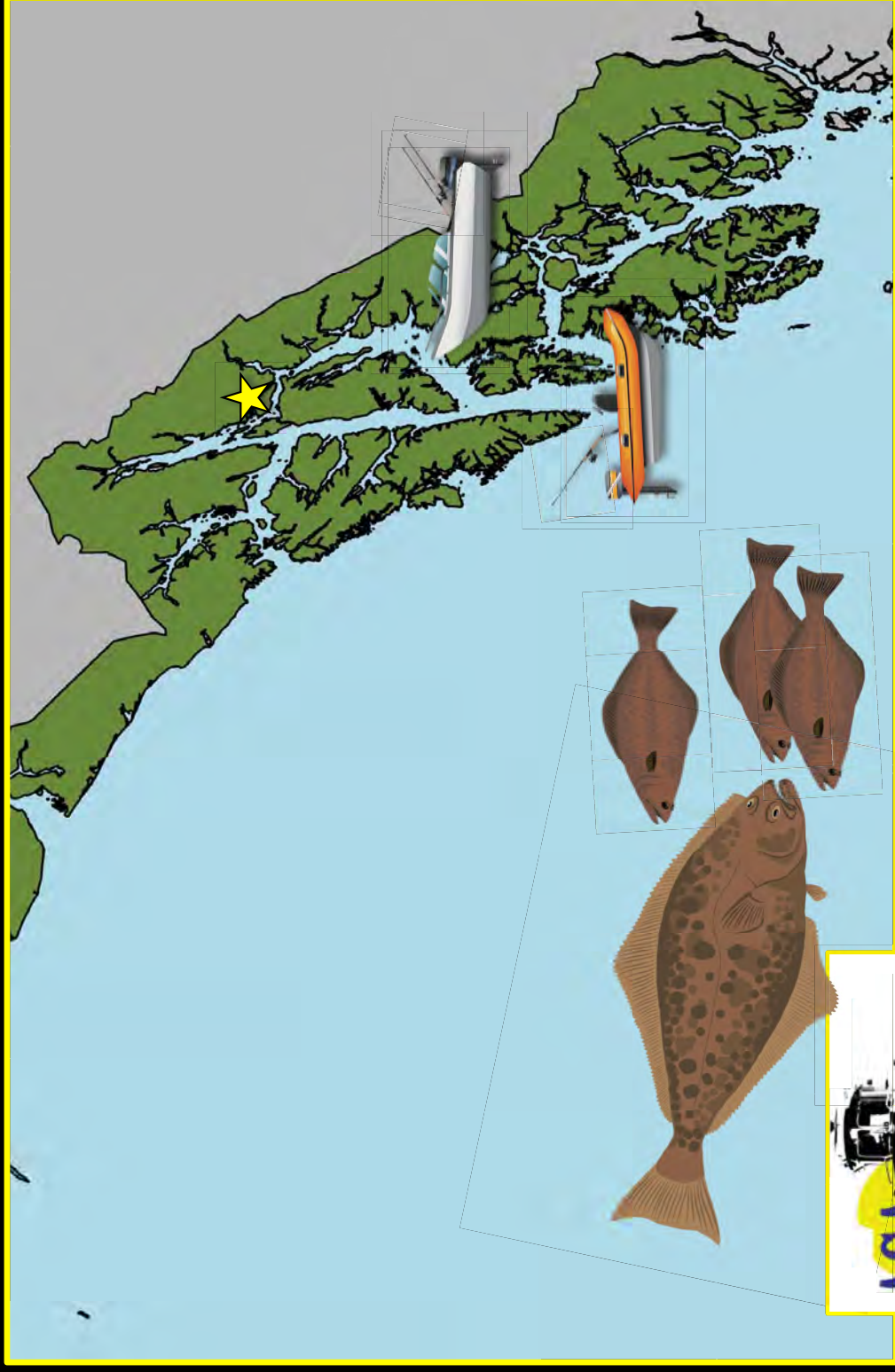
# Ch 3. Quantifying densities and diet compositions of Pacific Halibut and Arrowtooth Flounder in Southeast AK

Recreational  
Anglers, SEAK

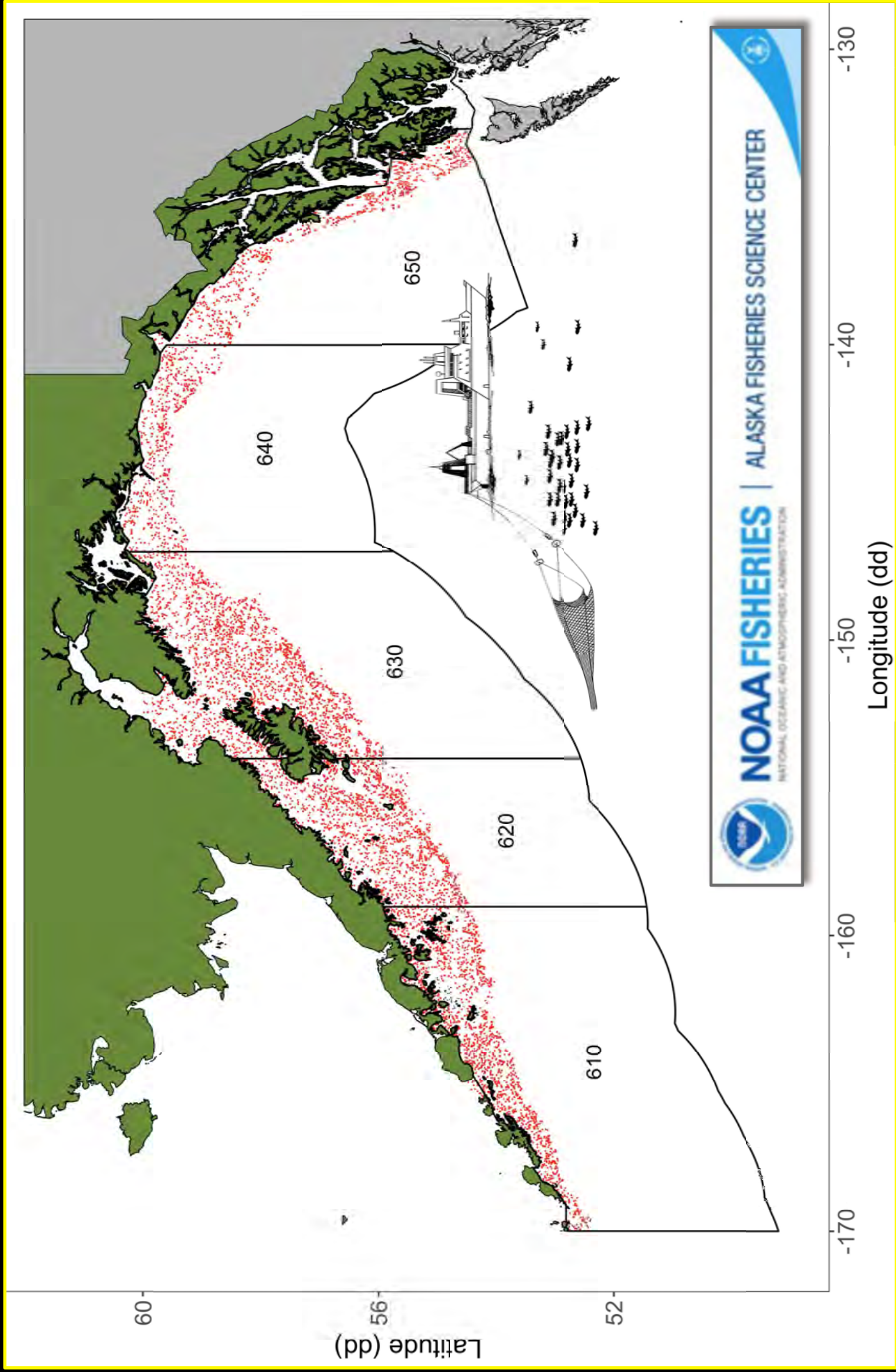
- guided
- unguided

2015 and 2016

- ~ Shelter Lodge
- ~ Anchor Point Lodge

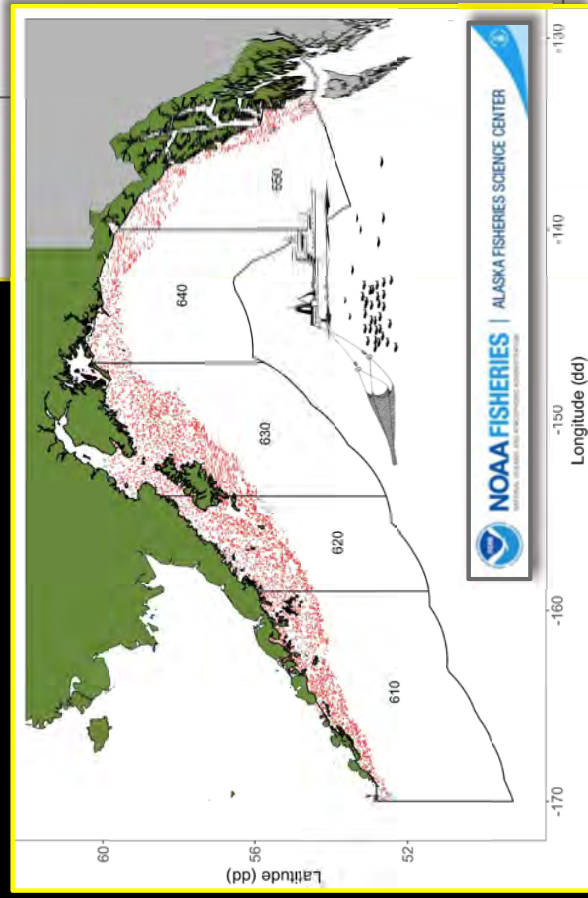
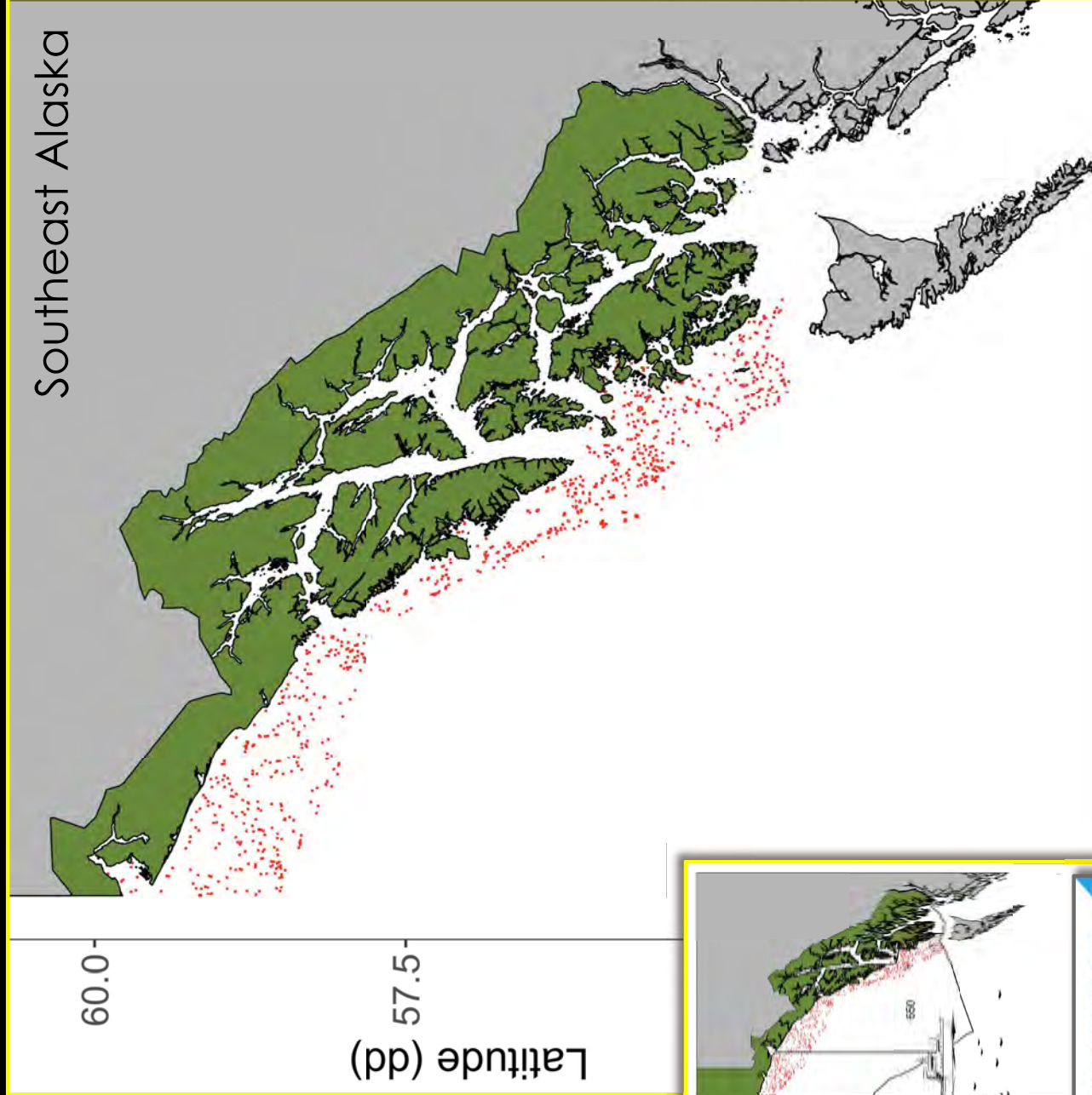


# Ch 2: PH and ATF in Gulf of Alaska

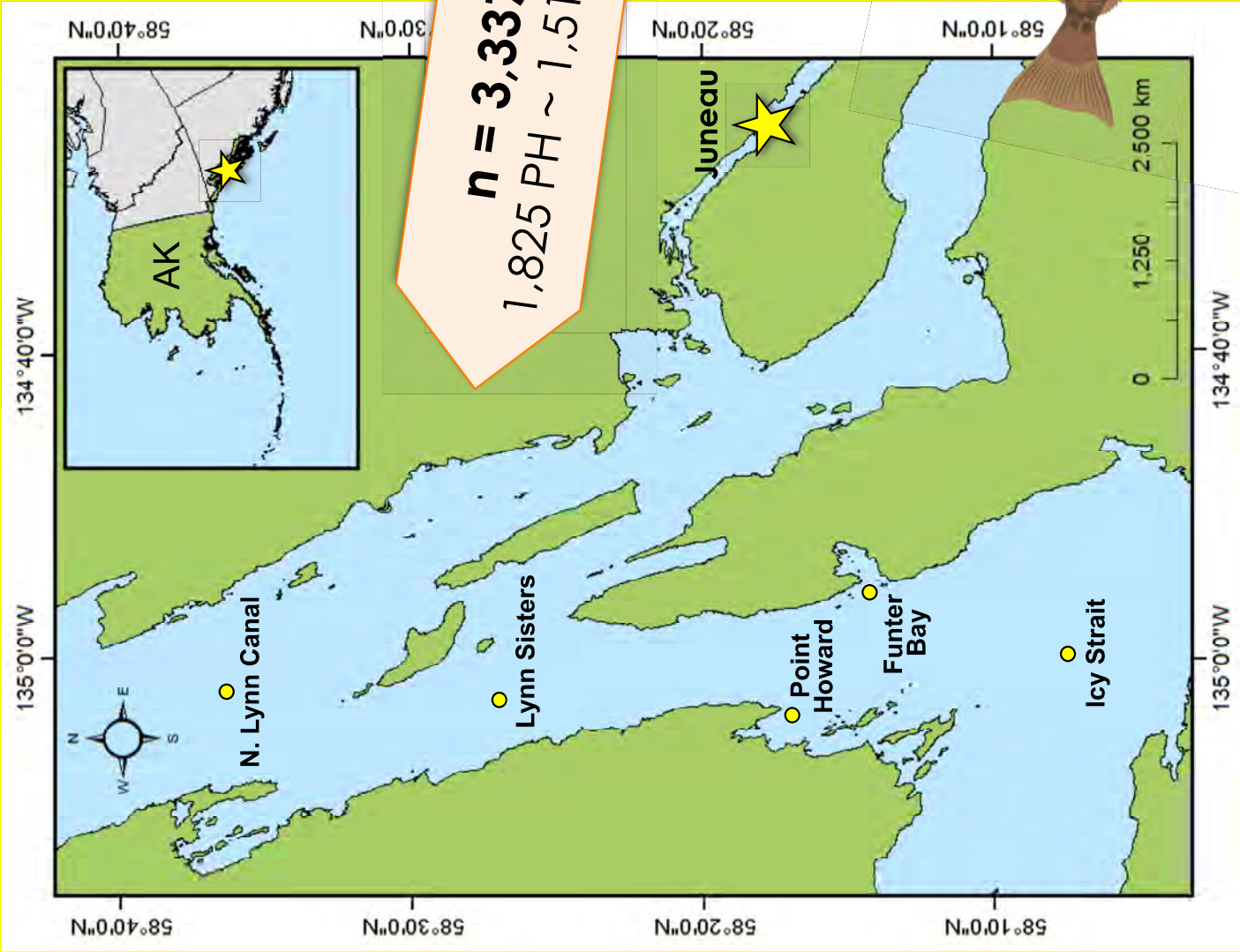


# Ch 3: PH and ATF in Southeast Alaska

Southeast Alaska



# Ch 3: PH and ATF in Southeast Alaska



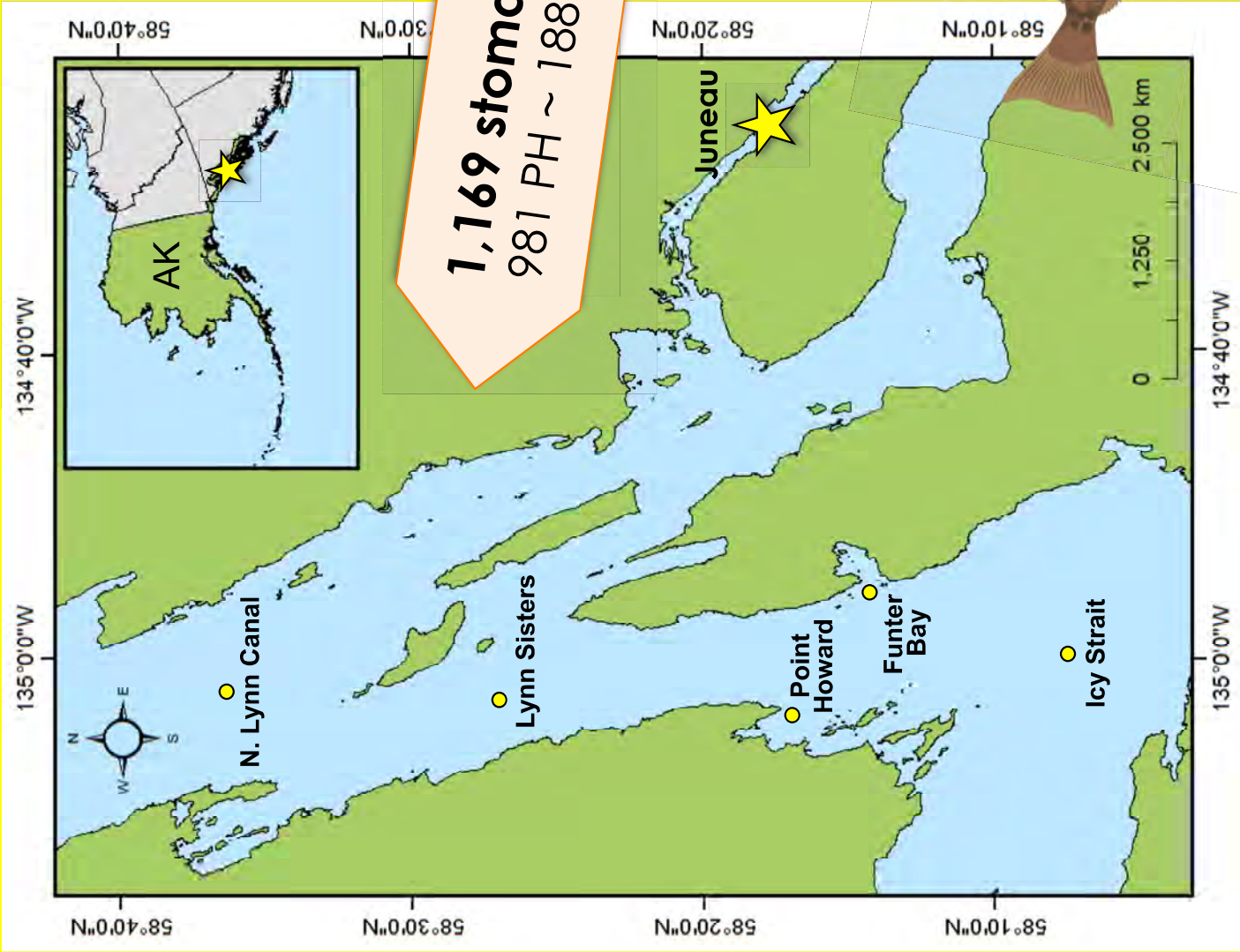
**n = 3,337**  
**1,825 PH ~ 1,512 ATF**



Kelsey Cruz



# Ch 3: PH and ATF in Southeast Alaska



**1,169 stomachs**  
981 PH ~ 188 ATF

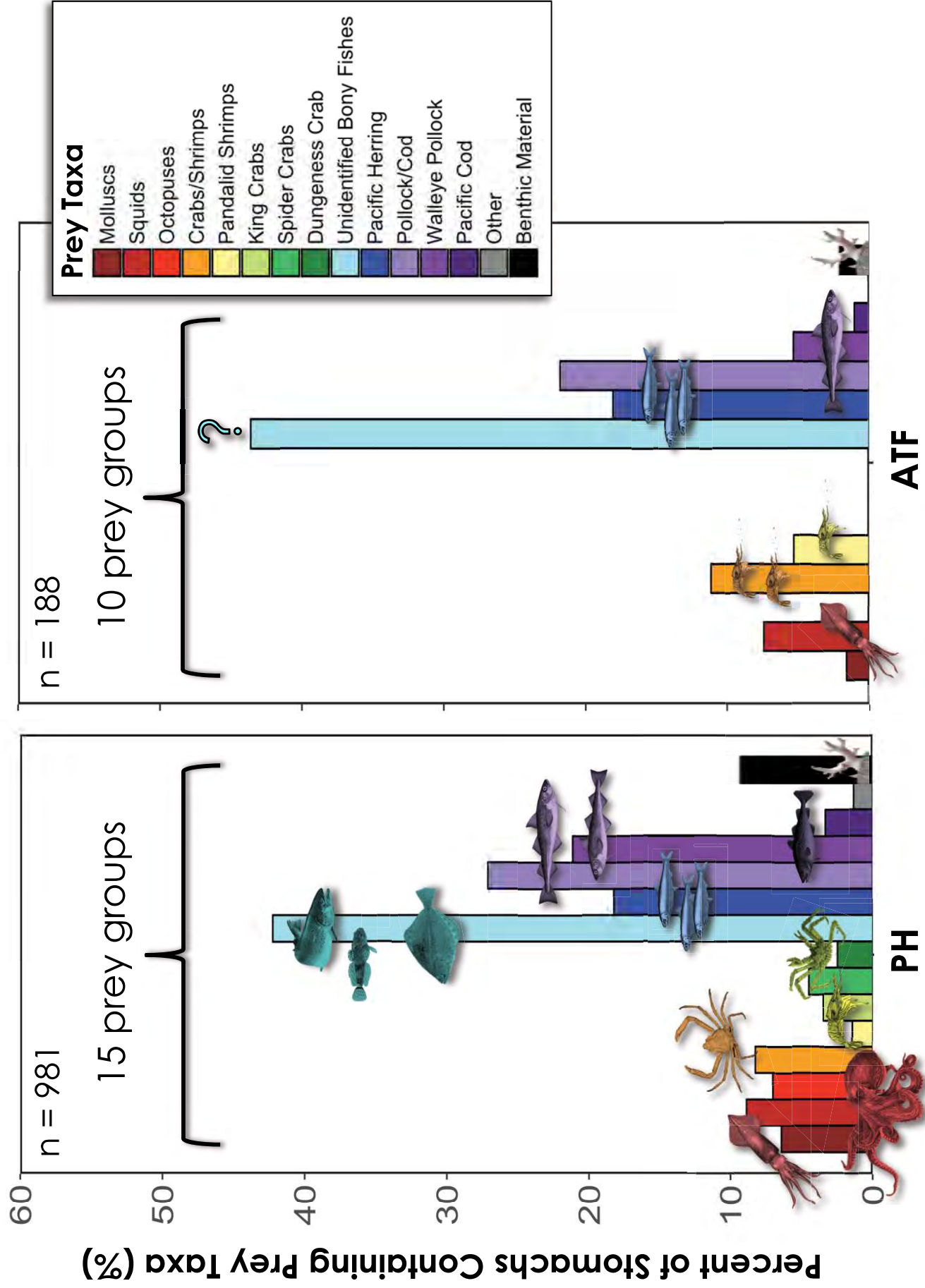


Kelsey Cruz

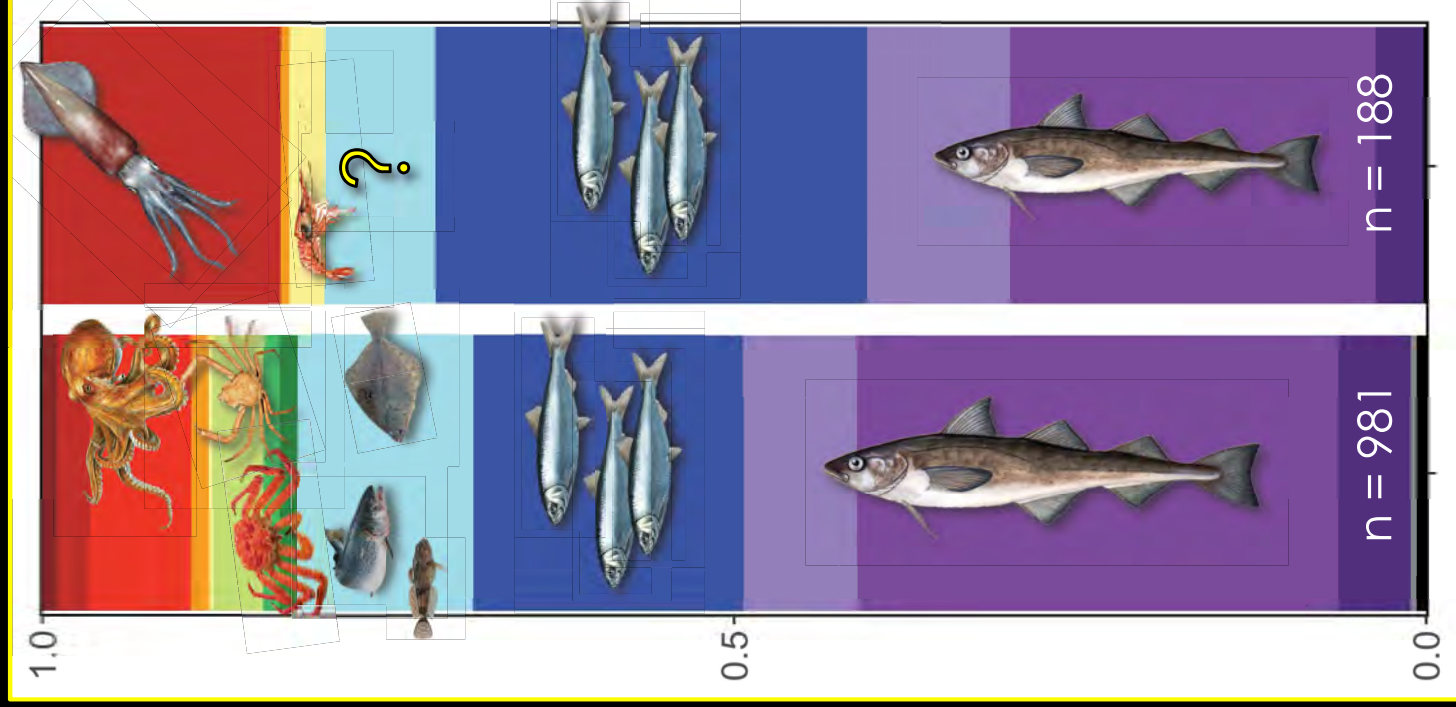
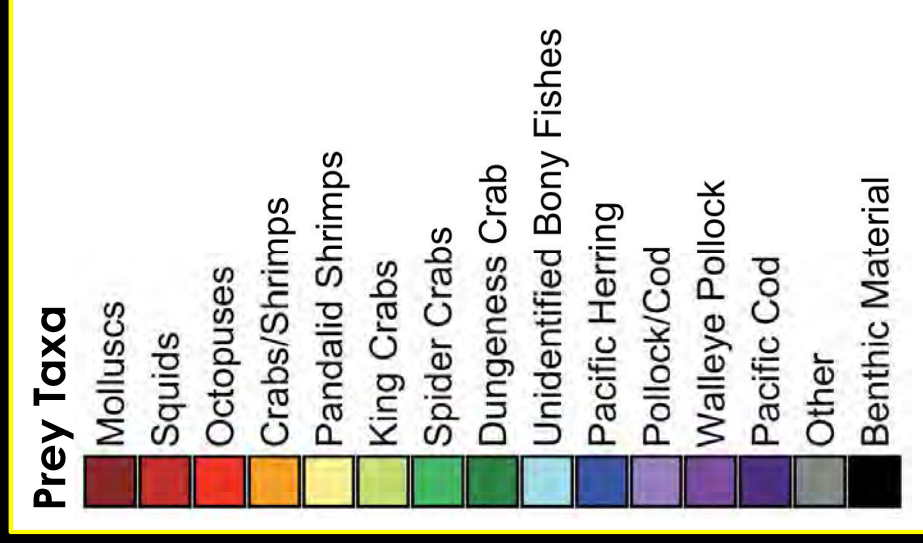




# Frequency of Occurrence

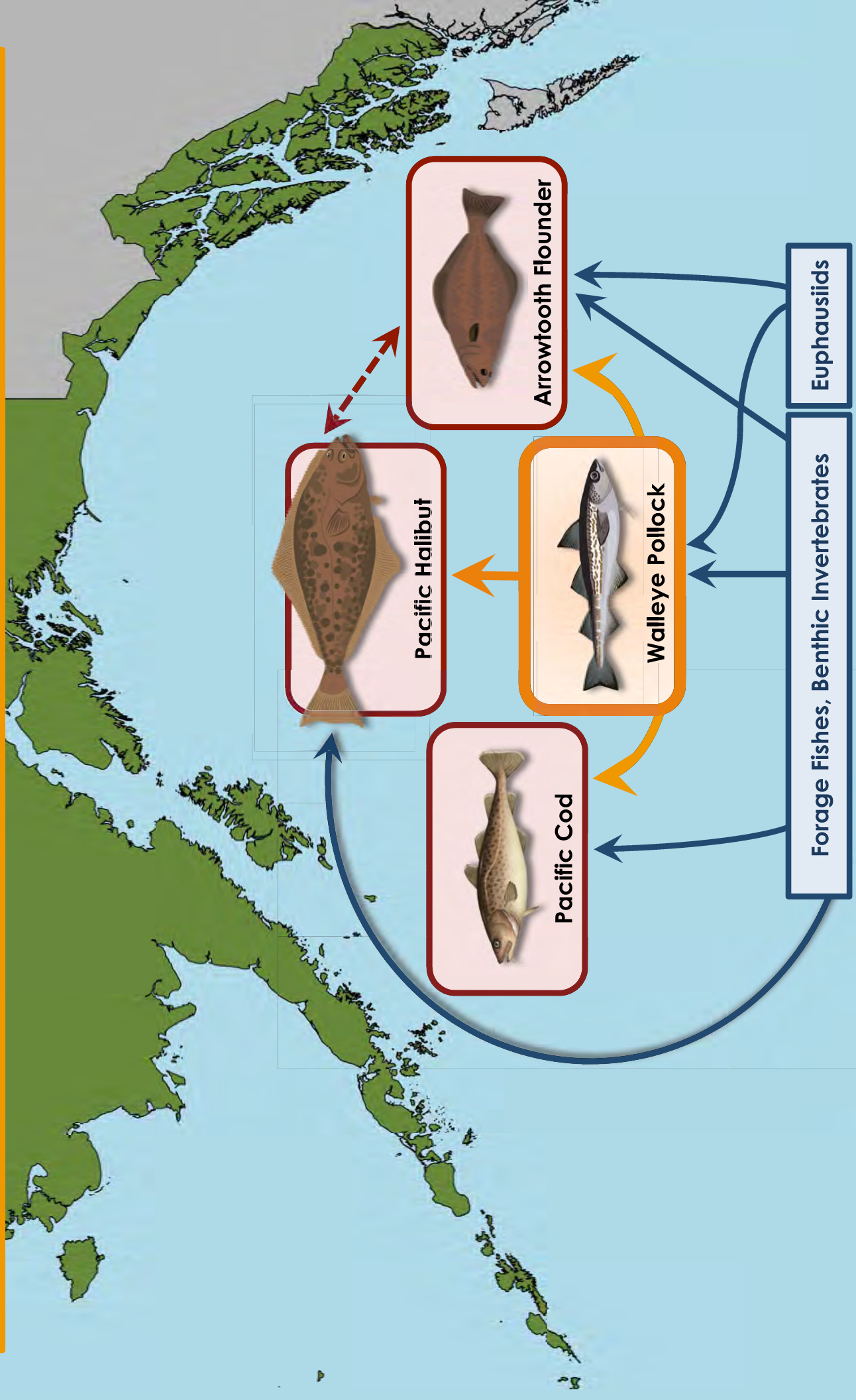


all predator sizes



PH ATF

# Ch 1. Calculating an index of predation to augment the stock assessment for Gulf of Alaska pollock



# Ch 1. Calculating an index of predation to improve the stock assessment for Walleye Pollock in the GOA

- conducted exploratory analyses on pollock distributions and abundances
- developed analytical framework for meeting project objectives

	2015	2016	2017	2018	2019
coursework					
comprehensive exams					
field sampling					
laboratory processing					
data management and analyses				Ch 1	
Manuscripts					
Ch 2: PH/ATF competition (data)					
Ch 1: Pollock predation				Ch 1	
Ch 3: PH/ATF resource use (field)					
defend and graduate					



collaborating with **Martin Dorn**

Lead Stock Assessment Scientist, GOA pollock

- develop framework for incorporating predation index into stock assessment

# Acknowledgments

## Co-Authors

Anne Beaudreau  
Richard Yamada

## Committee Members

Lorenzo Ciannelli  
Martin Dorn  
Kirstin Holsman  
Mary Hunsicker  
Terry Quinn

## Field & Lab Interns

Madison Bargas  
Katie Brown  
Helena Delgado-Nordmann  
Amanda Gile  
Georgina Hunt  
Zach Johanson  
Aiden Kamber  
Sawyer Link  
Harmony Wayner

## Shelter Lodge

Ben Huntley  
Brandon Rux  
Ikaika Vivas  
Jon Wilson  
Kenji Yamada

## Anchor Point Lodge

Dean Murayama  
Darryl Chow  
Edmond Coccagna  
Ken Fukada  
Jason Helyer  
Wayne Nasu

## Artwork

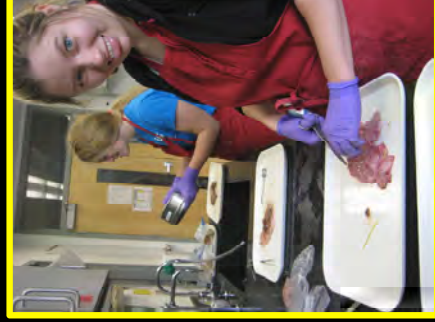
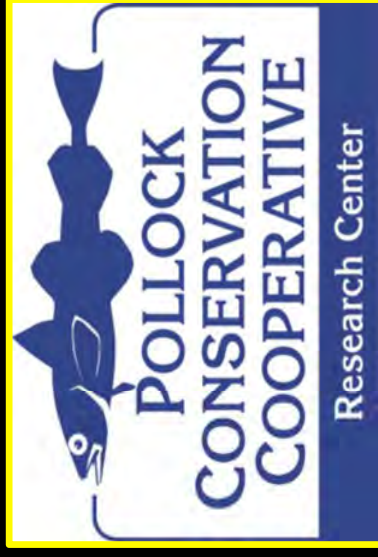
Nick Ingram

## UAF

Coastal Fish. Ecol. Lab  
Franz Muefer

Tiago Campello  
Maggie Chan  
Dan Michrowski  
Julie Nielsen  
Jordan Watson

## Funding Provided By:



Cheryl L. Barnes, PhD Student  
University of Alaska Fairbanks  
cheryl.barnes@alaska.edu



Shelter Lodge

