

# Ecosystem Status Report 2019

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Ellen Yasumiishi  
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North Pacific Fisheries  
Management Council  
December, 2019



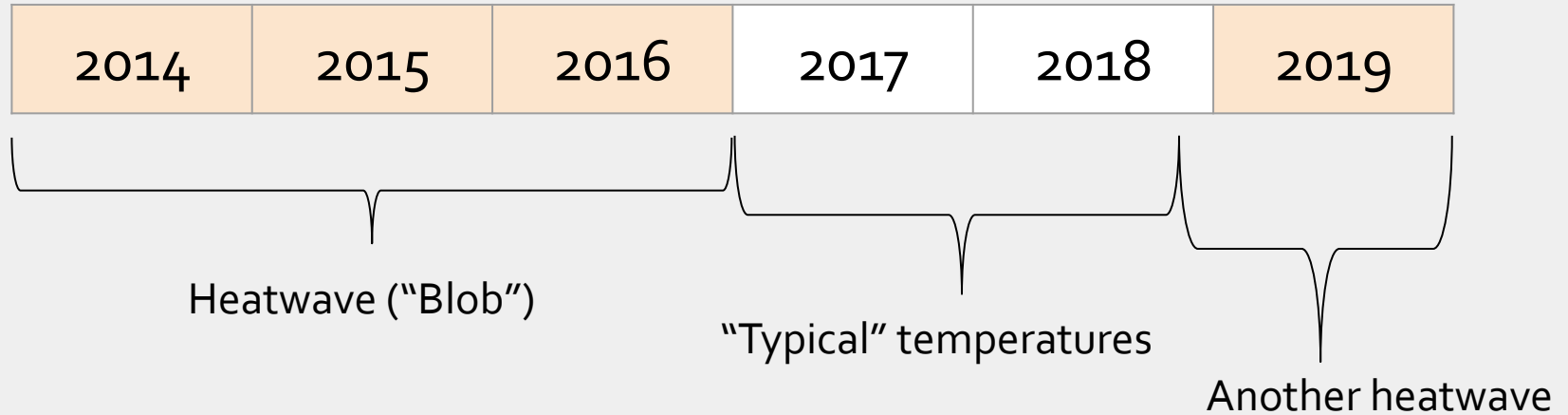
Gulf of Alaska

## With contributions from:

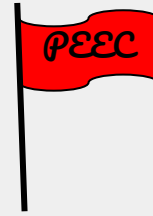
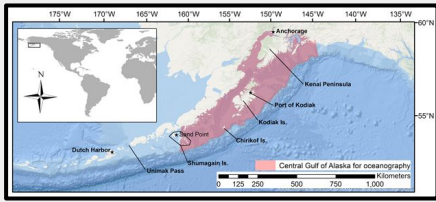
Mayumi Arimitsu, Brenda Ballachey, Sonia Batten, James Bodkin, Nick Bond, Rob Campbell, Heather Coletti, Dan Cooper, Kenneth O. Coyle, Seth Danielson, Alison Deary, Thomas Dean, Annette Dougherty, Sherri Dressel, Anne Marie Eich, John Eiler, Daniel Esler, Emily Fergusson, Benjamin Fissel, Shannon Fitzgerald, Christine Gabriele, Sarah Gaichas, Jeanette Gann, Andrew Gray, Chuck M. Guthrie III, Colleen Harpold, Bradley P. Harris, Scott Hatch, Stormy Haught, Kyle Hebert, Paul K. Hershberger, Russell Hopcroft, Katrin Iken, Steven Kasperski, Arthur Kettle, Kim Kloecker, Brenda Konar, Joseph Krieger, Anita Kroska, Carol Ladd, Ned Laman, Jesse Lamb, Geoffrey M. Lang, Jean Lee, Mandy Lindeberg, Alexa L. Marinelli, Maxwell Marsh, Caitlin McKinstry, Daniel Monson, John Moran, James Murphy, Janet Neilson, Hanhvan T. Nguyen, Jens Nielsen, John Olson, Wayne Palsson, Melanie Paquin, W. Scott Pegau, John F. Piatt, Steven Porter, Patrick Ressler, Melissa Rhodes-Reese, Brian Robinson, Lauren Rogers, Matthew Rogers, Nora Rojek, Joshua Russell, Kate Savage, Sioned E. Sitkiewicz, T. Scott Smeltz, Kim Sparks, Janice Straley, William Stockhausen, Robert Suryan, John Trochta, Scott Vulstek, Charlie Waters, Jordan Watson, Ben Weitzman, George A. Whitehouse, Matthew Wilson, Sarah P. Wise, Nathan Wolf, Carrie Worton, Ellen Yasumiishi, and Stephani Zador

*Thank you*

# Recent history of the Gulf of Alaska

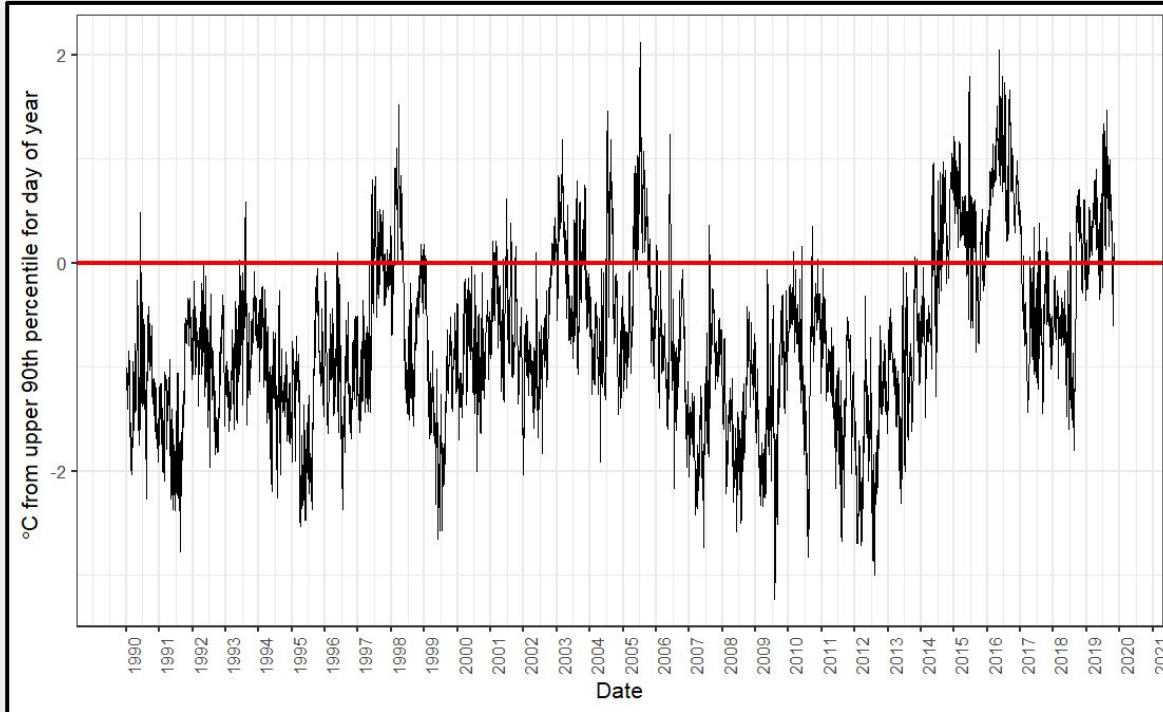


1. Where did we see signs of responsiveness to cooler conditions vs. lagged effects of the 2014–2016 heatwave?
2. What are the responses to the current heatwave? Are they similar or different to those from the 2014–2016 heatwave?



# Western GOA heatwave

S. Barbeaux



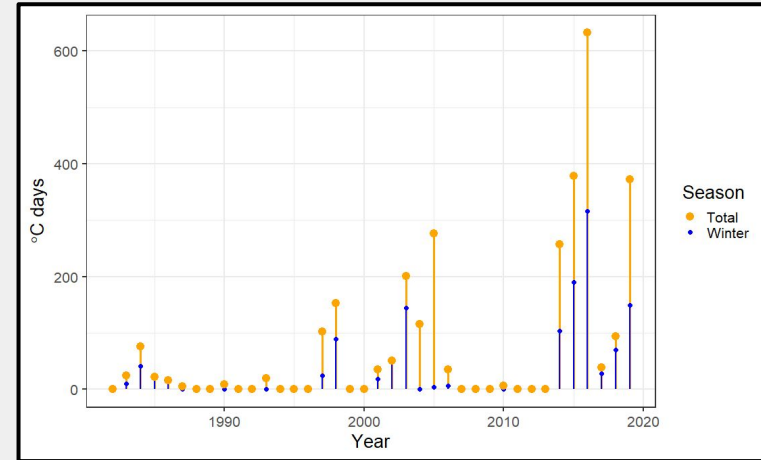
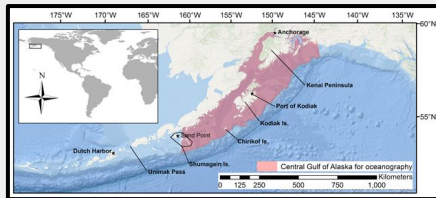
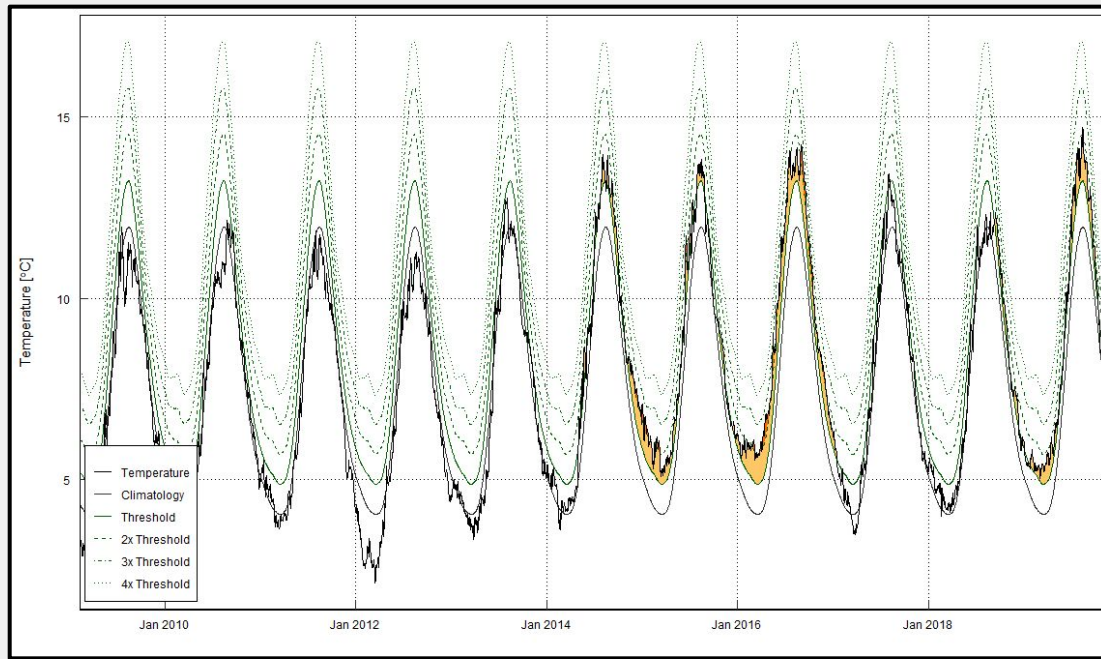
- Cumulative 5-d exceeding 90% threshold (A. Hobday)
- Standardized to remove seasonal signal



# Western GOA heatwave

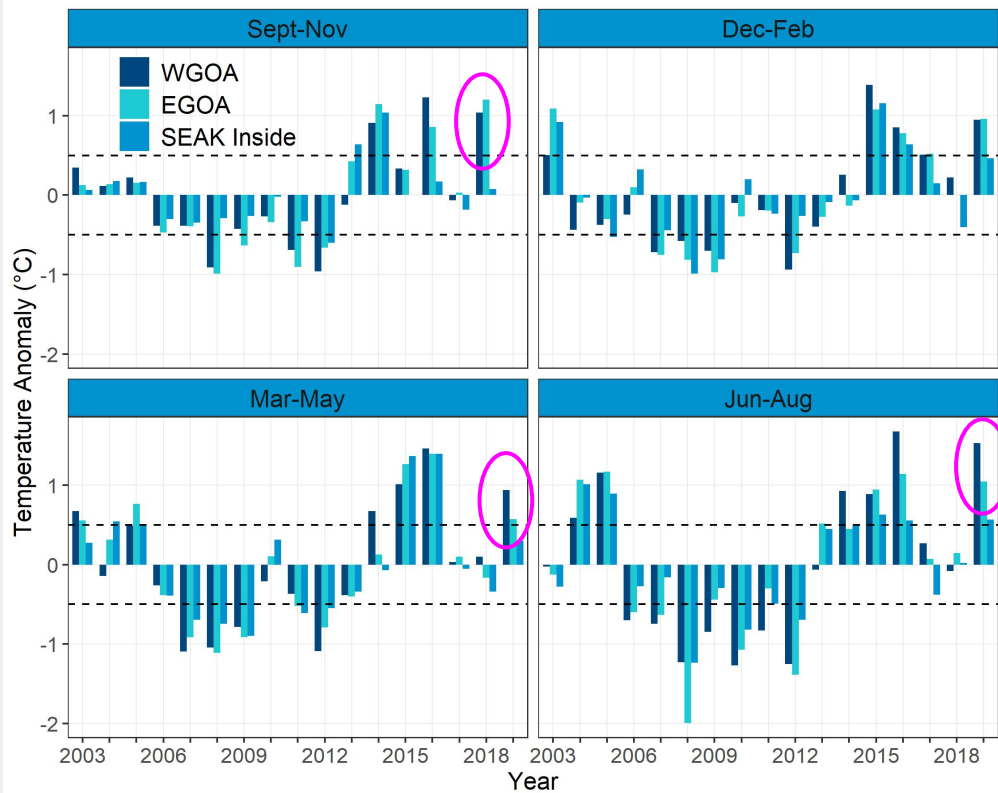
S. Barbeaux

- 2019 similar to 2015 overall,
- But proportionally more heat in summer
- *Timing of heatwave may have different impacts on biota*

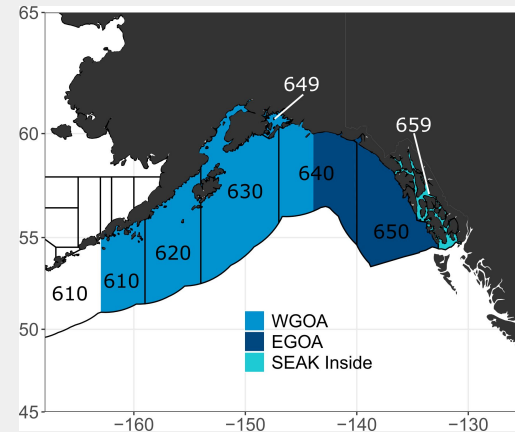


# Satellite-derived Sea Surface Temperature Anomalies

J. Watson

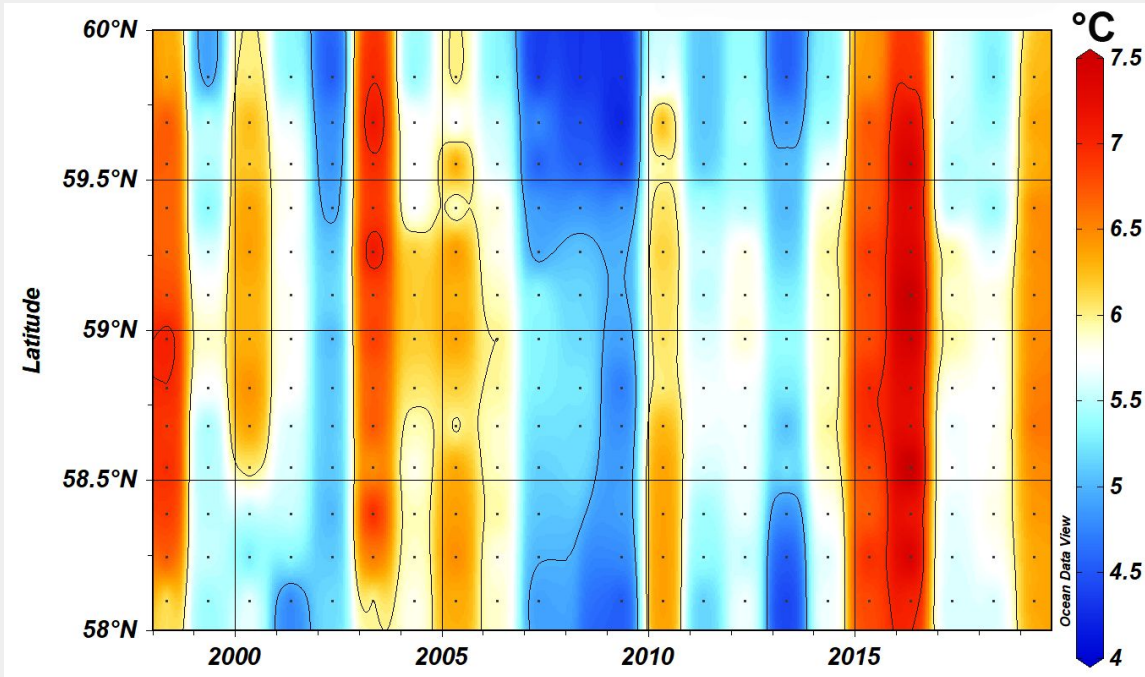
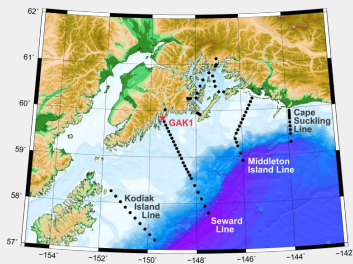


- Current heatwave started fall 2018 in both E/W GOA
- Eastern GOA during spring/summer 2019 not as warm as western GOA



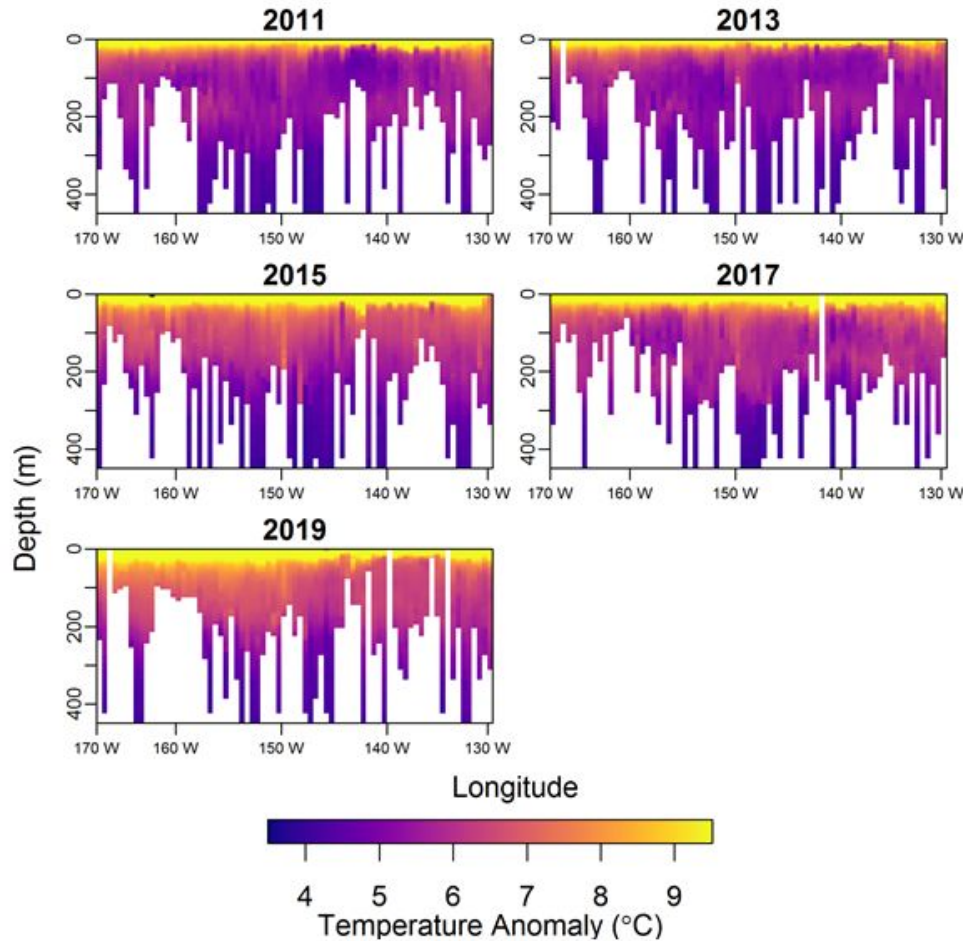
# Spring (May) Seward Line Temperature Profile

Danielson and Hopcroft

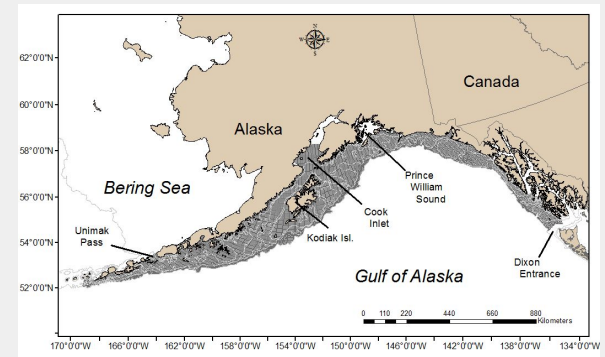


- Integrated over top 100 m
- May 2019 not as warm as during 2015
- *Timing of heatwave may have different impacts on biota*

# Bottom Trawl Survey Temperature Profile N. Laman



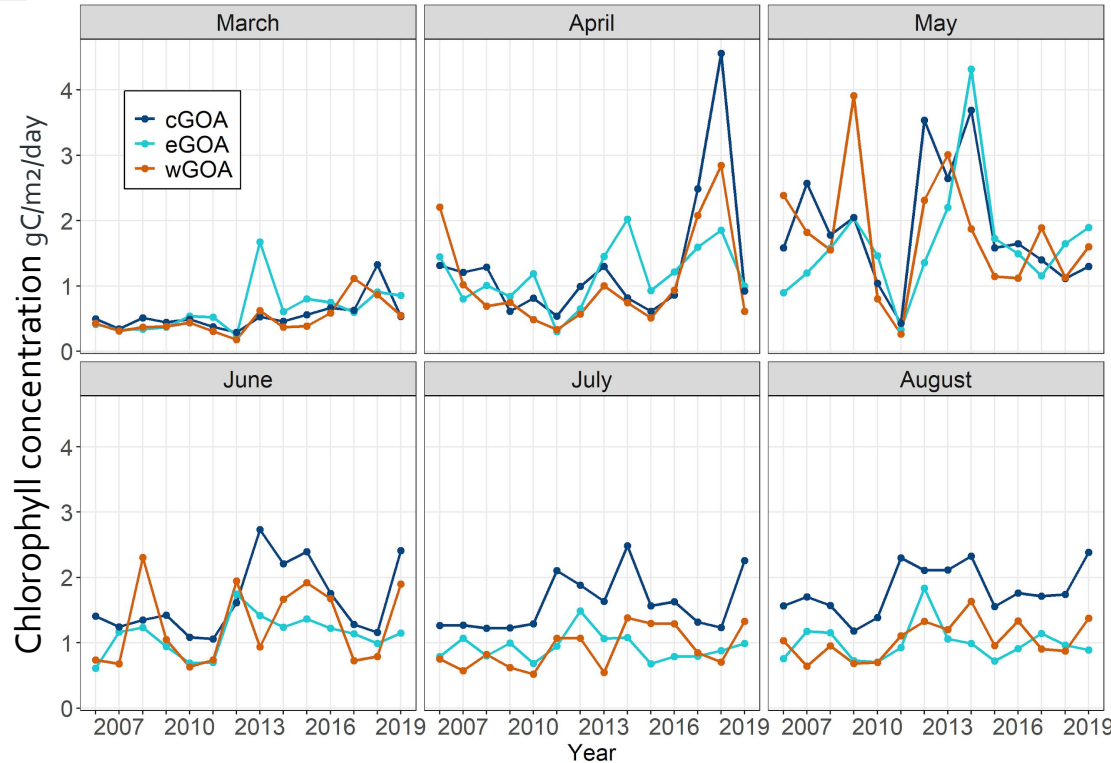
- Warm water to depth
- Especially in west, where warmer than in 2015



# Satellite-derived Chlorophyll *a* Trends

Gann, Watson

## Regional time-series per month

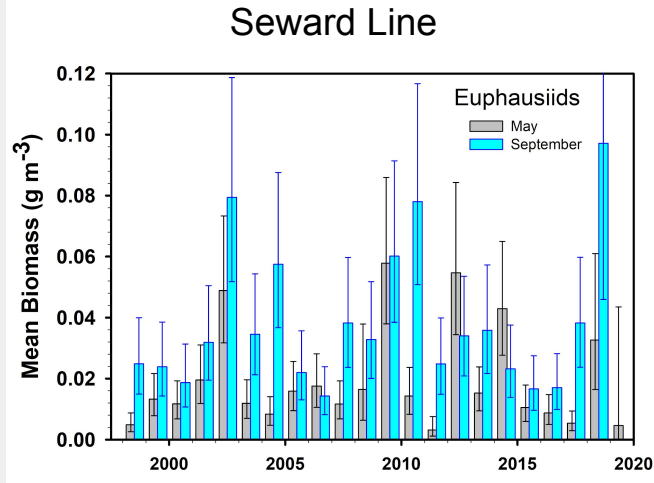


- Chlorophyll *a* is a proxy for phytoplankton biomass
- 2018
  - early, high biomass
- 2019
  - late bloom did not show up until June (WGOA)
  - low early season biomass
- *May impact zooplankton and larval fish predators depending on time and location*

# Euphausiids

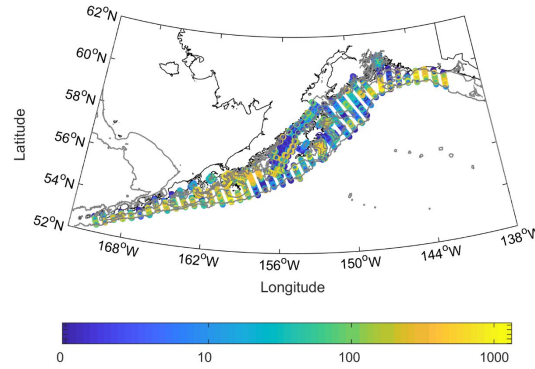
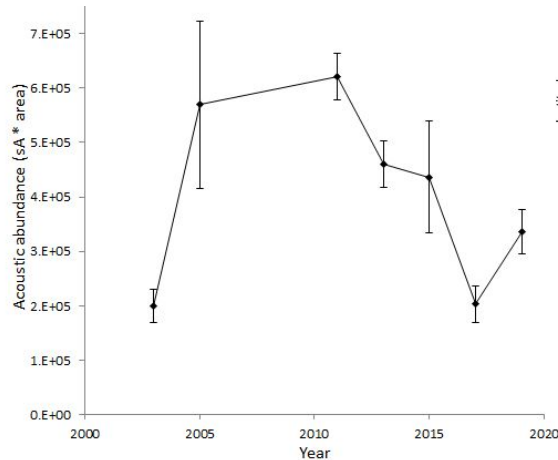
Hopcroft, Coyle, Ressler, Drummond

Take-home:  
Moderate-to-low  
overall

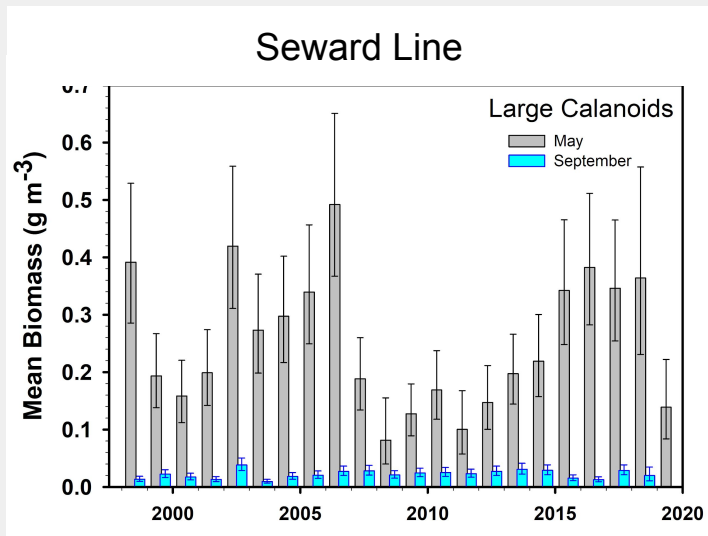


- Low biomass on the Seward Line during spring (but very high fall 2018; *good for 2018 yc pollock?*)
- Moderate-low biomass in acoustic survey
- Average parakeet auklet reproduction at Chowiet (diet primarily euphausiids)
- Below-average storm-petrel reproduction at the Barrens (diet is euph/amphipod mix)
- Average/above-average storm-petrel reproduction at St Lazaria (diet is euph/amphipod mix)

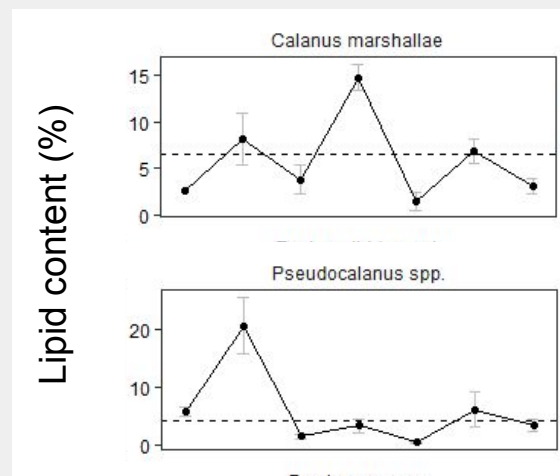
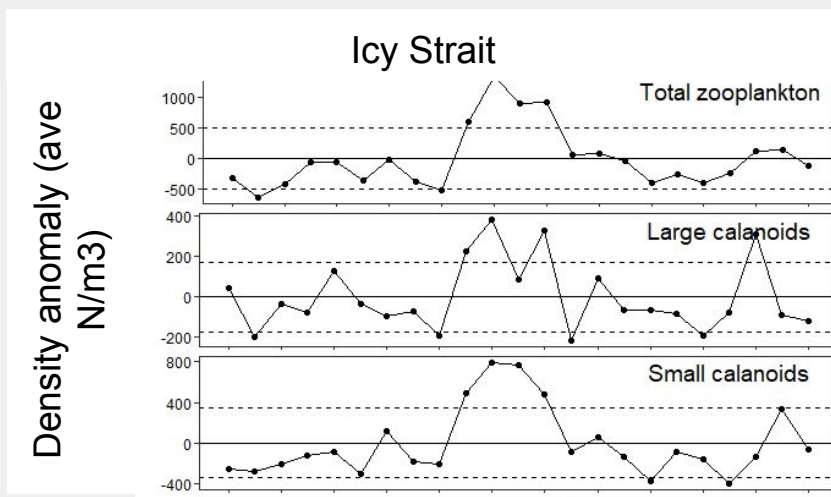
### Acoustic Survey







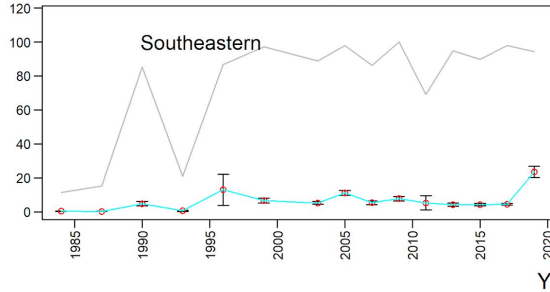
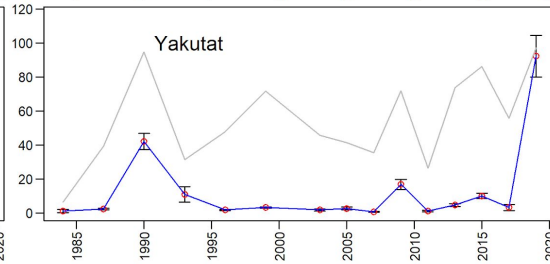
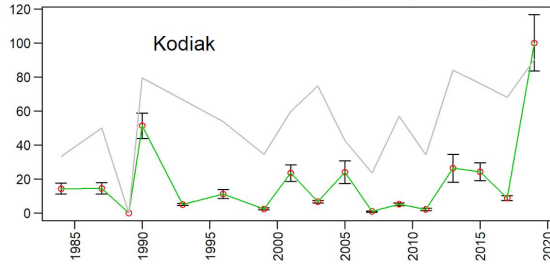
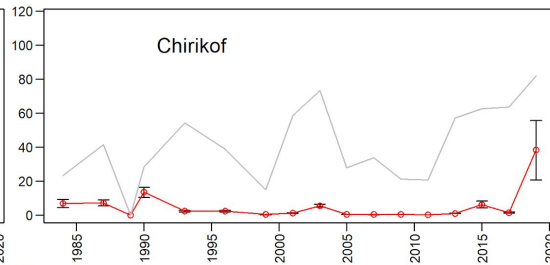
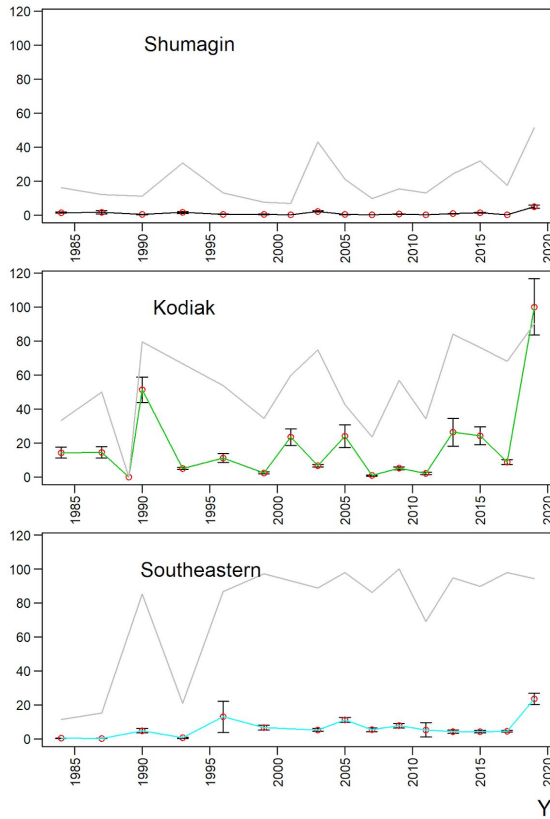
- Low biomass on the Seward Line during spring (May)
- Icy Strait—low densities and lipid content



# Jellyfish

W. Palsson

Jellyfish Relative CPUE



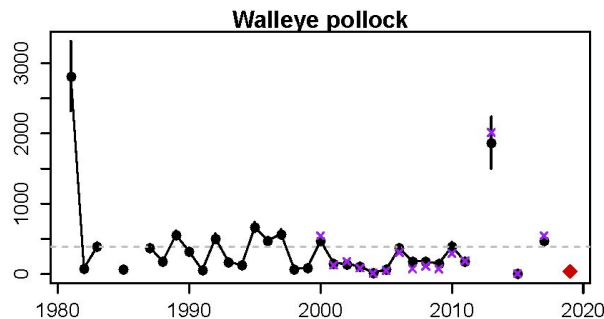
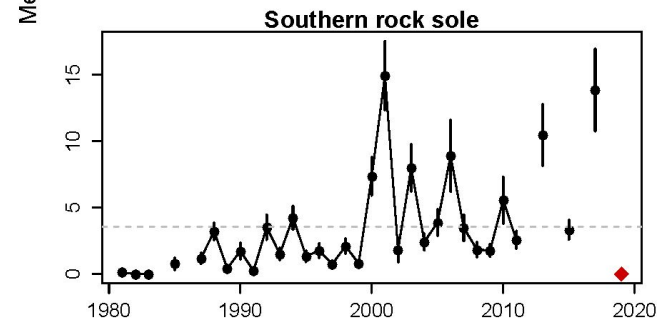
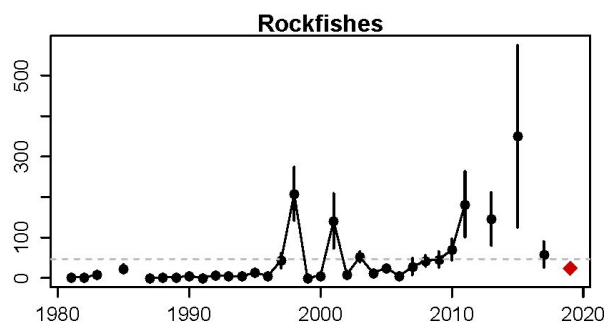
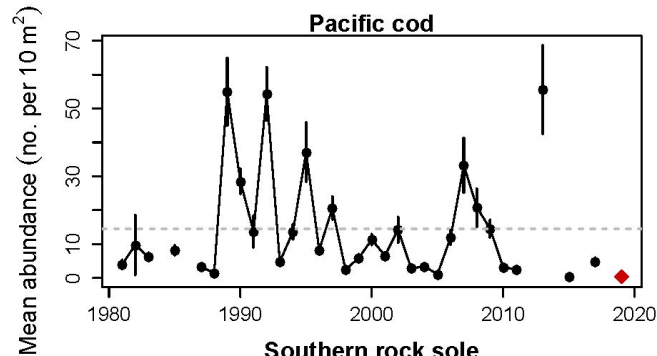
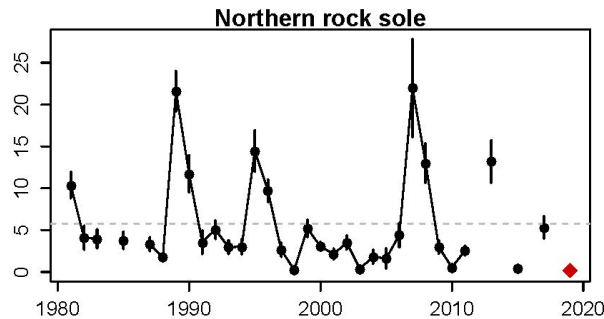
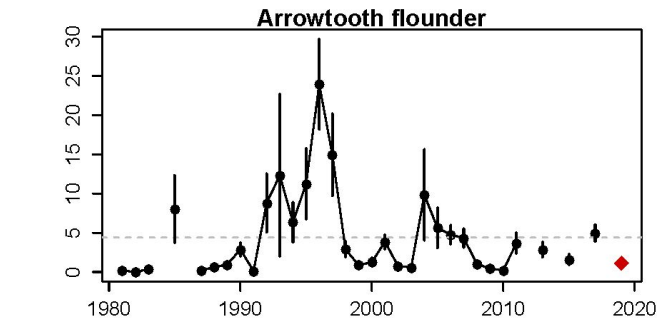
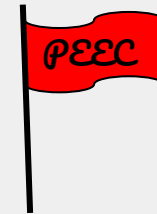
Year



- Record abundances caught during BT survey
- Across all regions
- Mostly *Chrysaora melanaster*
- Feed on zooplankton and small fish
- Significant additional predation pressure on prey?

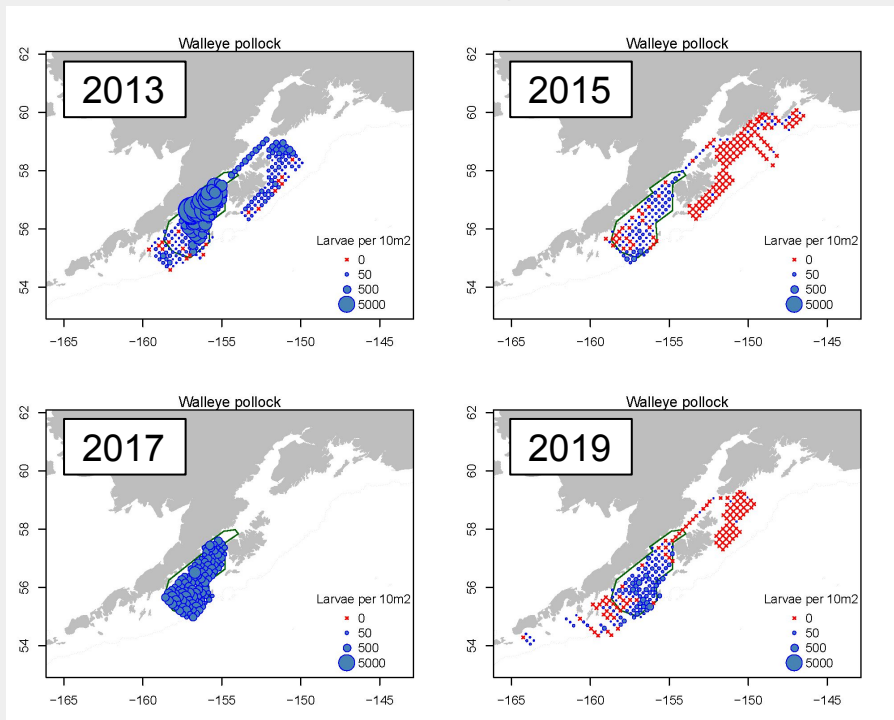


# GOA Larval Fish Survey Duffy-Anderson



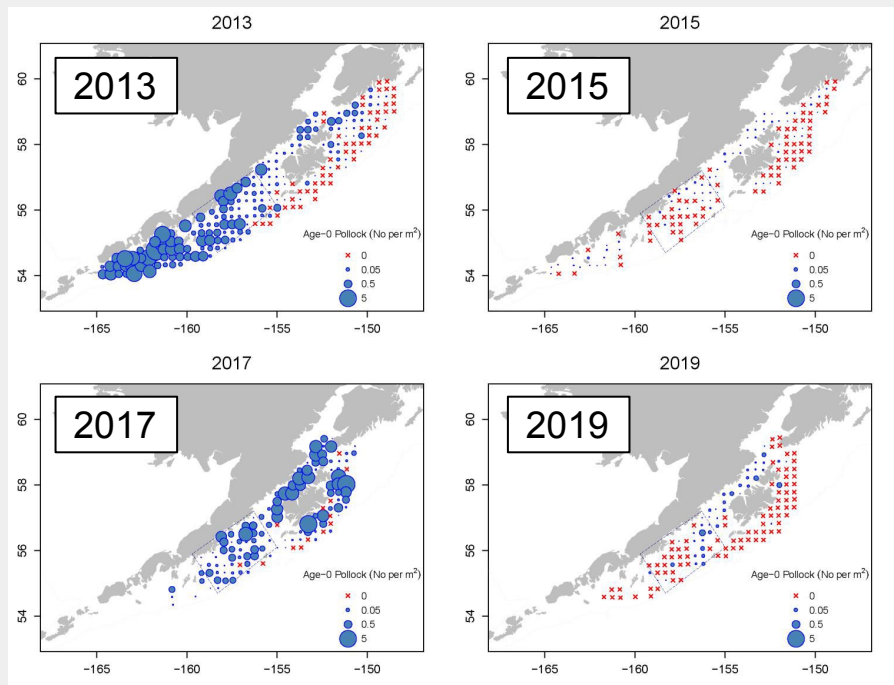
- Few larval fish in spring (response to current heatwave?)
- 3<sup>rd</sup> lowest pollock catch
- 2<sup>nd</sup> lowest Pacific cod catch
- Few rockfish (*different from last heatwave*)

# Spring



# 2019 pollock year class Duffy-Anderson

# Summer

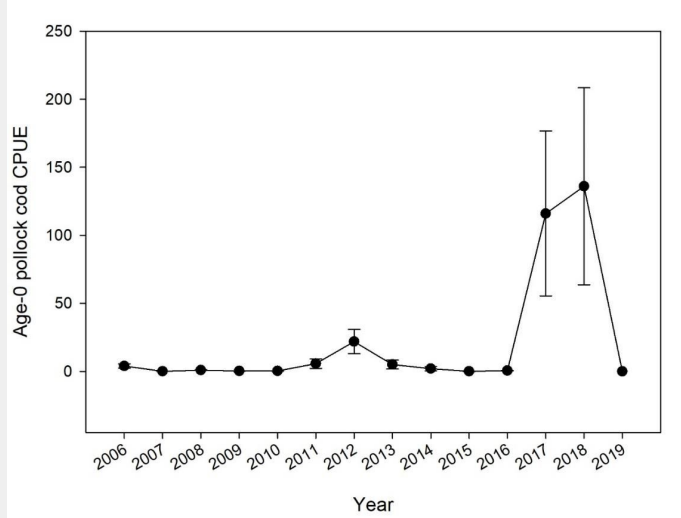


- *Does distribution in late summer influence recruitment success?*

# Summer

## 2019 pollock year class Laurel, Duffy-Anderson

Kodiak beach seines

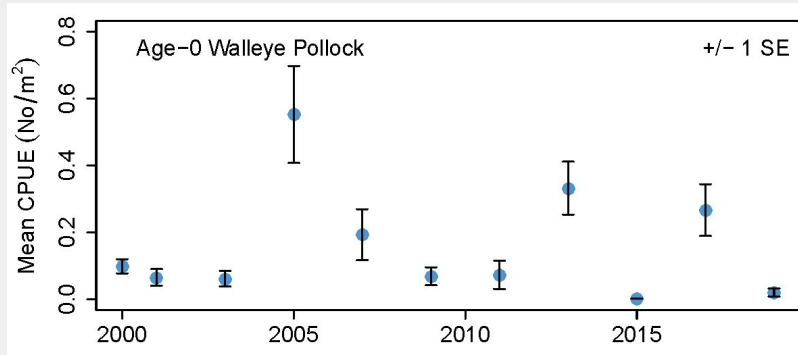


- Beach seines and surface trawls saw few 2019 pollock
- Only indicator that showed substantial age-0 pollock was from seabirds:

- Puffins at Aiktak (Unimak Pass) fed chicks ~50% age-0 pollock
- Whereas at Chowiet (Semidis) 2% pollock, 86% squid



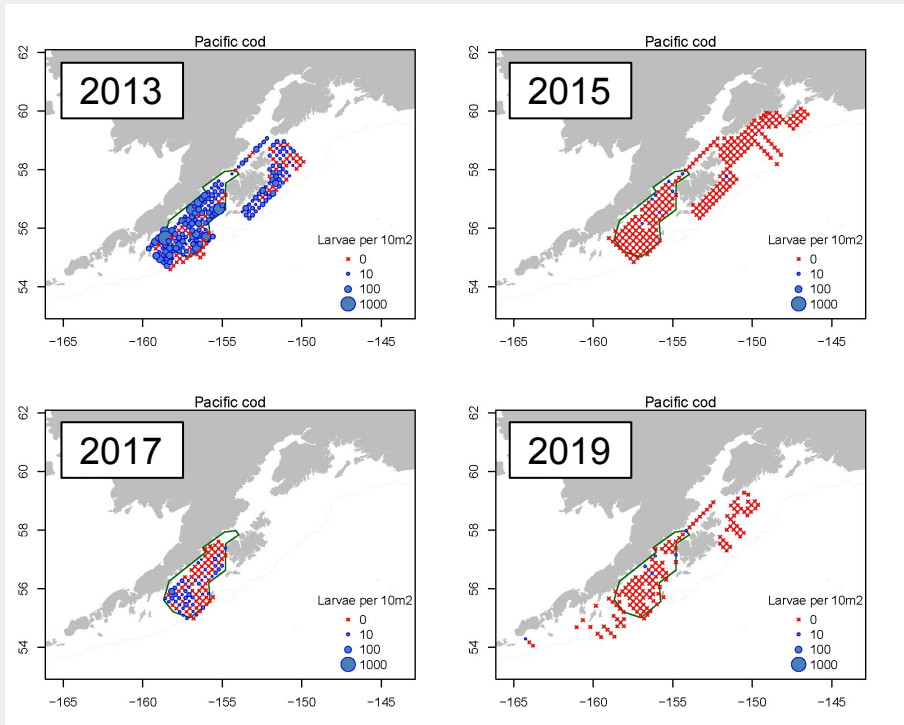
Surface trawl



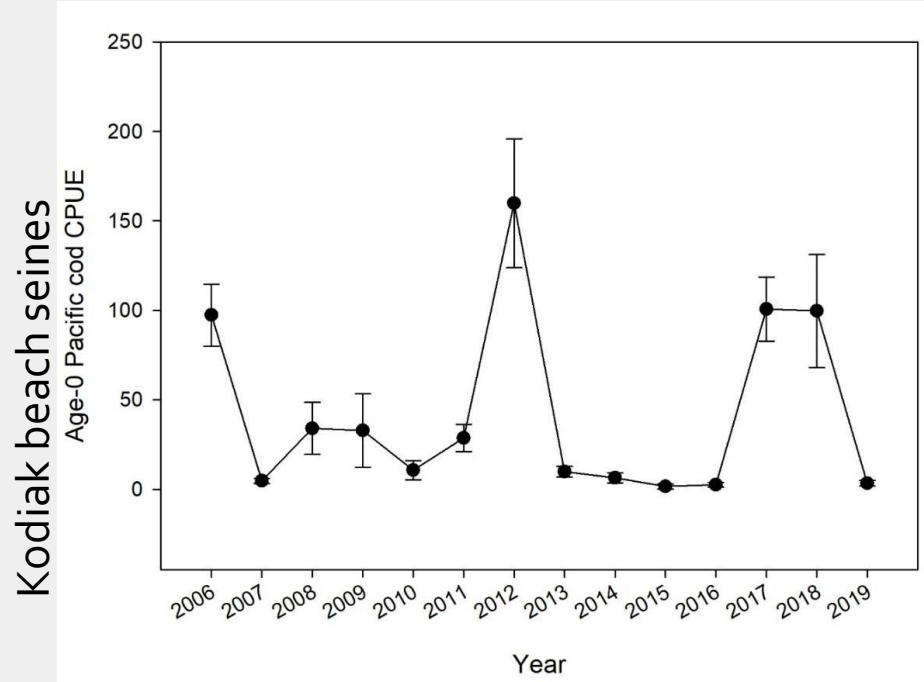
# 2019 Pacific cod year class

Duffy-Anderson, Laurel

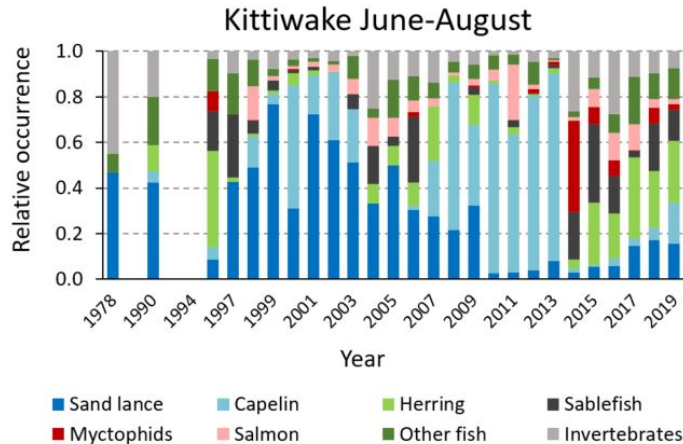
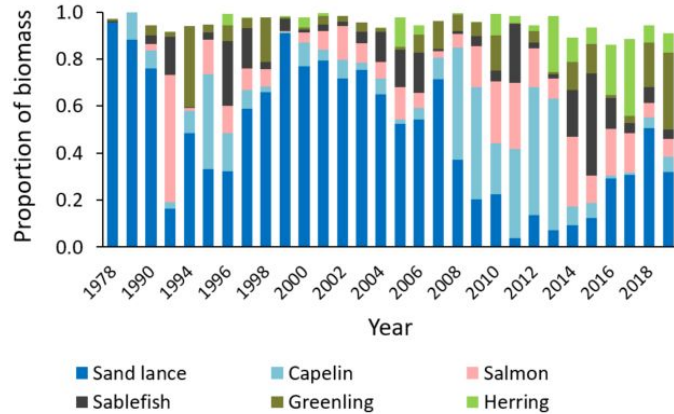
## Spring



## Summer



## Rhinoceros auklet chick diet

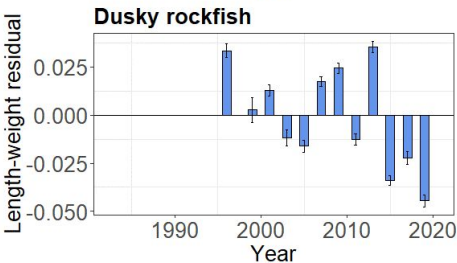
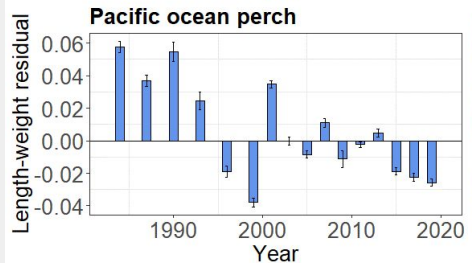
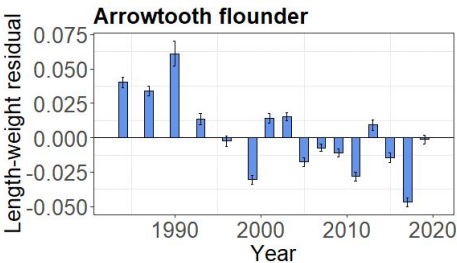
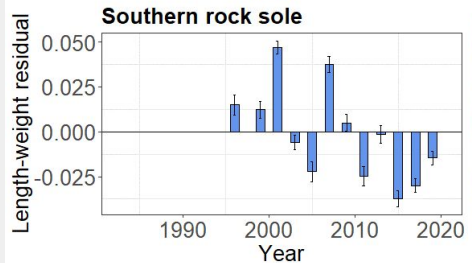
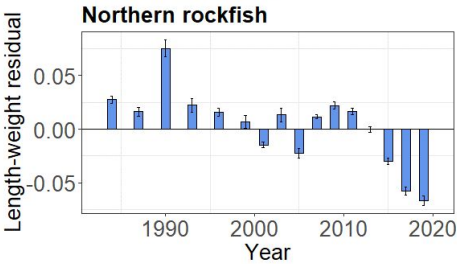
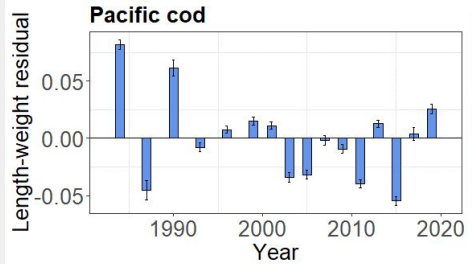
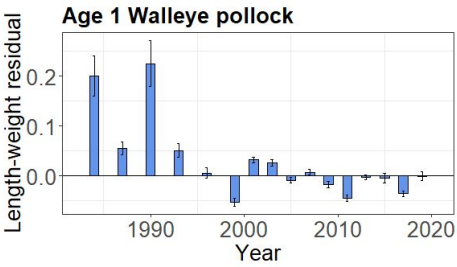
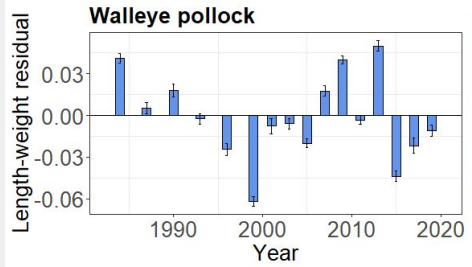


## Other forage fish Hatch

- Chick diets at Middleton Island
- Sand lance more abundant in 2019 than during 14–16 heatwave
- Capelin remain scarce following 14–16 heatwave (*lagged impact*)
- GPS-tracked birds foraged nearshore
- Diverse diets
- *Limited "typical" offshore forage fish prey?*

# Groundfish Condition

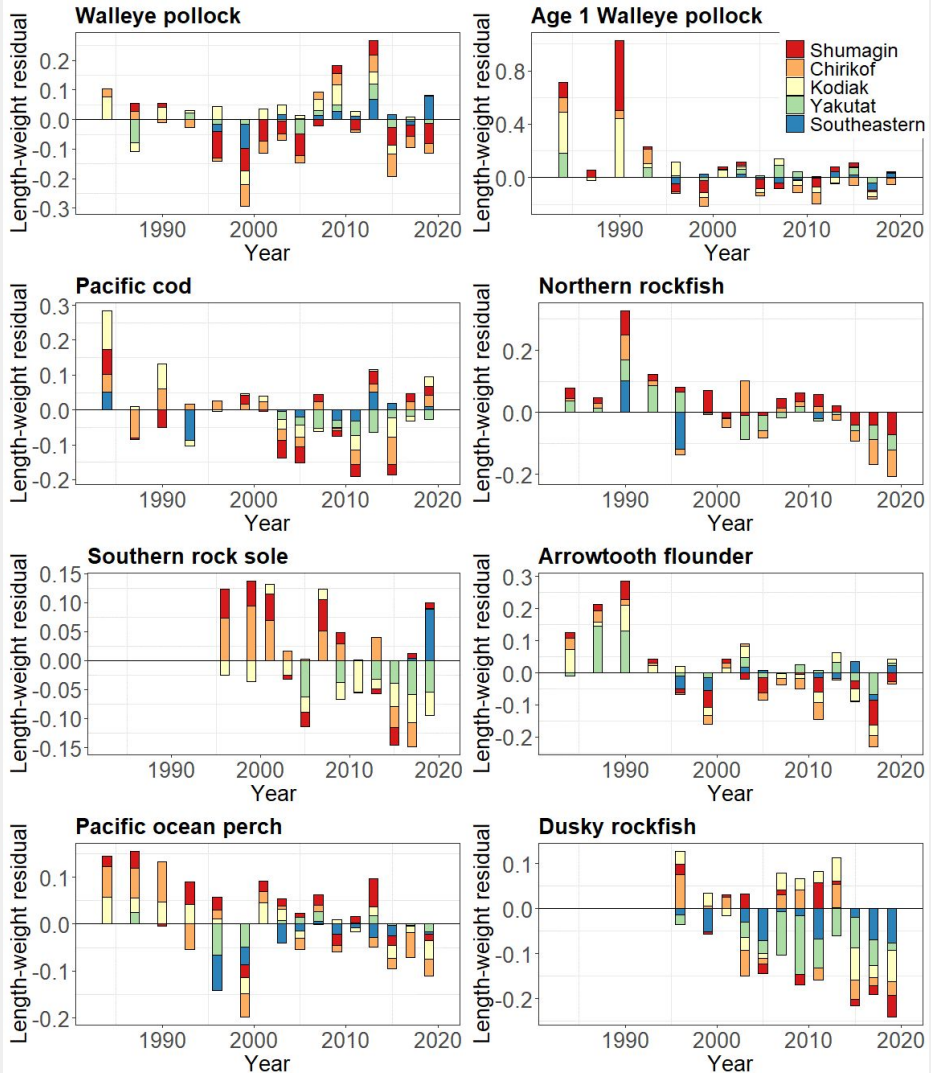
N. Laman



- Length-weight residuals
- Integrates fish's feeding experience in the ecosystem
- All but cod at or below average
- Indicates feeding conditions not supportive of optimal growth
- *Current impact: increased metabolic rates due to heatwave*

# Groundfish Condition

N. Laman

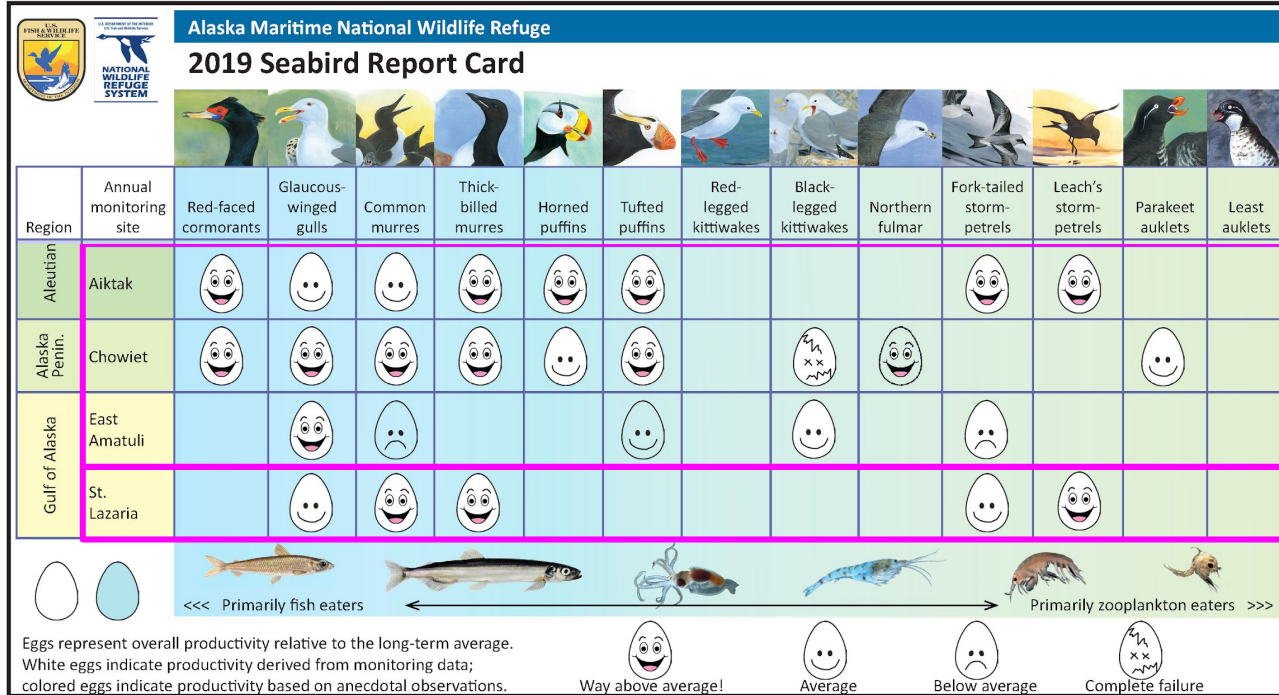


- Pollock in better condition in EGOA
- Not consistent across years, so likely not survey timing (fish put on weight over the summer)
- *Lagged impact of 14-16 heatwave is many fewer cod (and arrowtooth flounder) in the system*
- *Less predation pressure on forage fish?*



# Seabirds

## B. Drummond



WGOA

EGOA

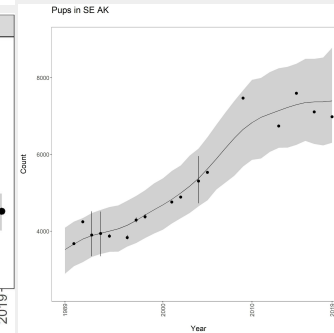
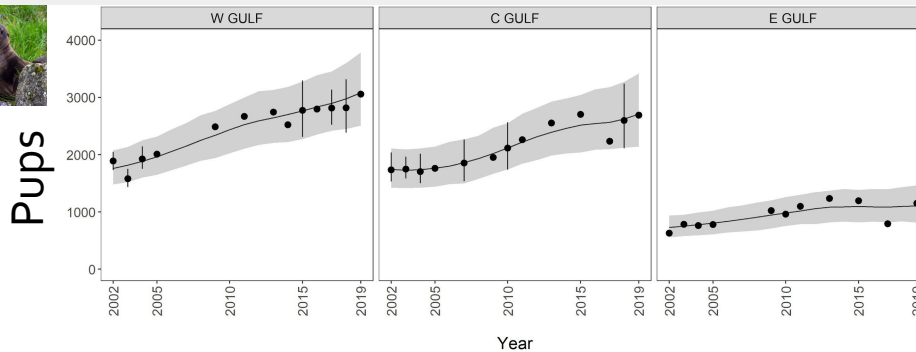
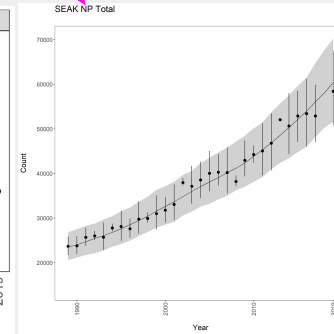
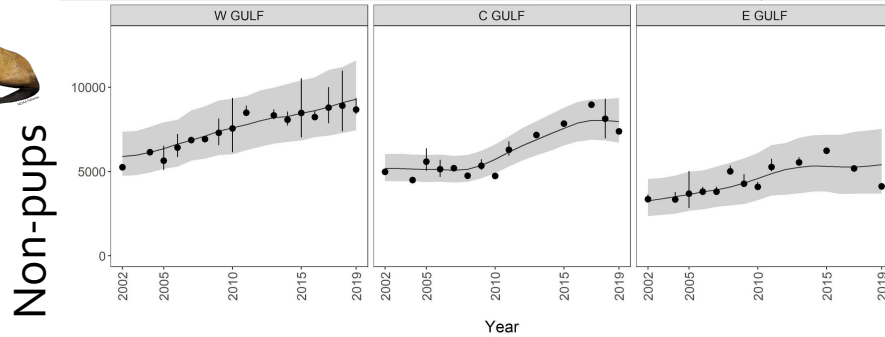
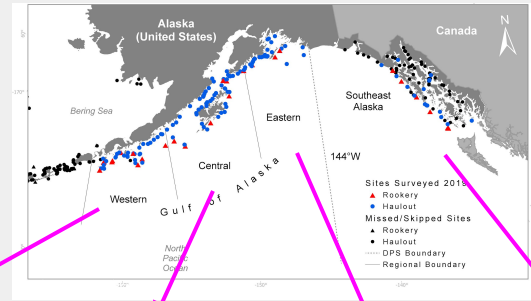
- Diving birds fed chicks with diverse prey (not "typical" forage fish sp)
- Evidence of feeding more nearshore
- Kittiwakes at Chowiet/Semedis abandoned chicks (no age-o pollock?)



# Steller Sea Lions

## K. Sweeney

\*Received too late to include in the ESR

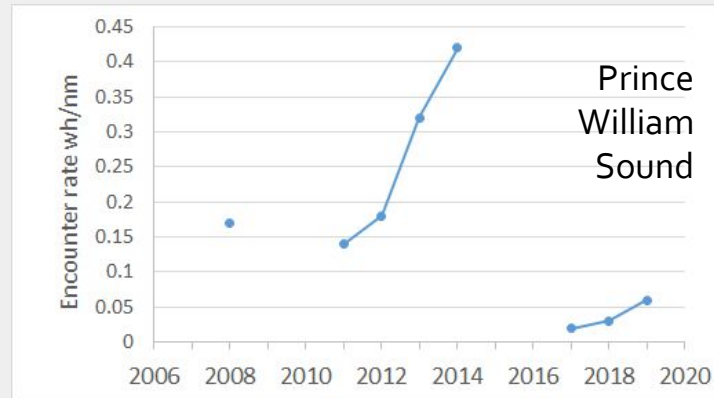
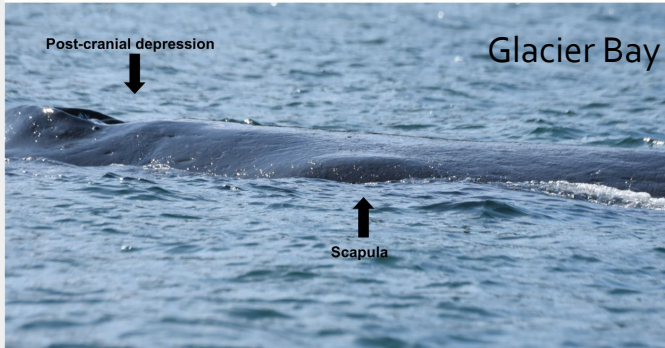
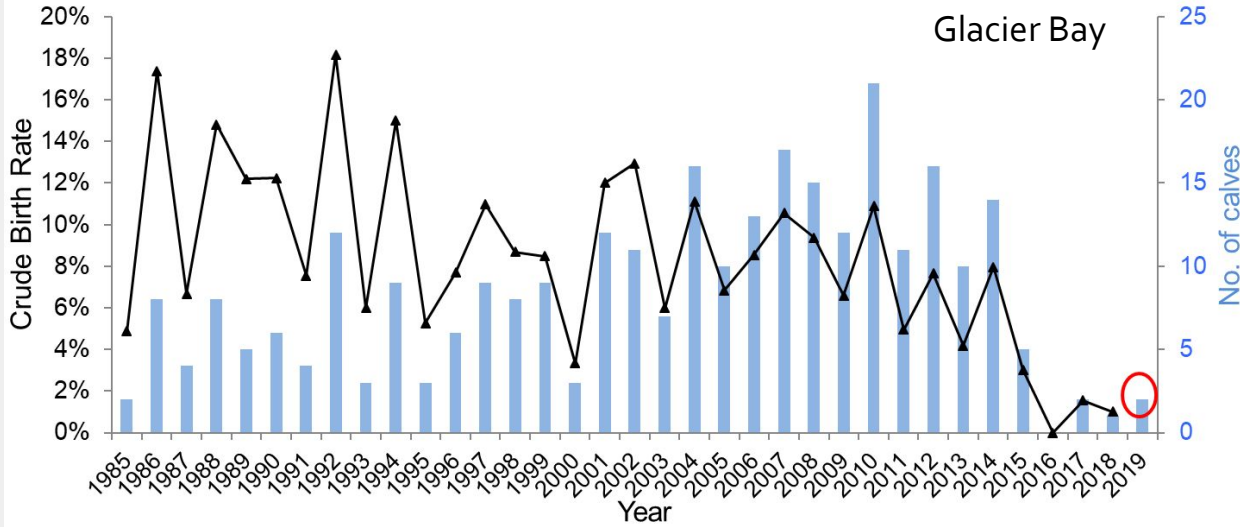


- Modelled counts of adults/juveniles (non-pups) and pups
- WGOA: declines in non-pups but increases in pups
- EGOA: increases in non-pups but declines in pups
- *Mixed signs of lagged impacts?*

# Humpback Whales

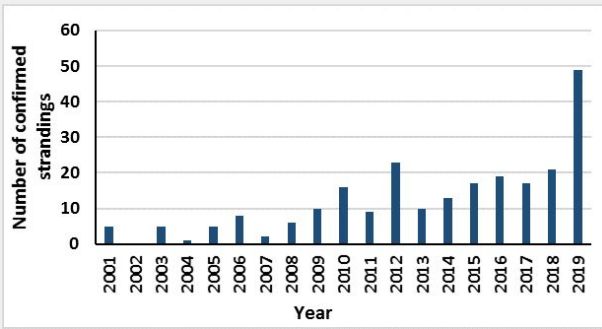
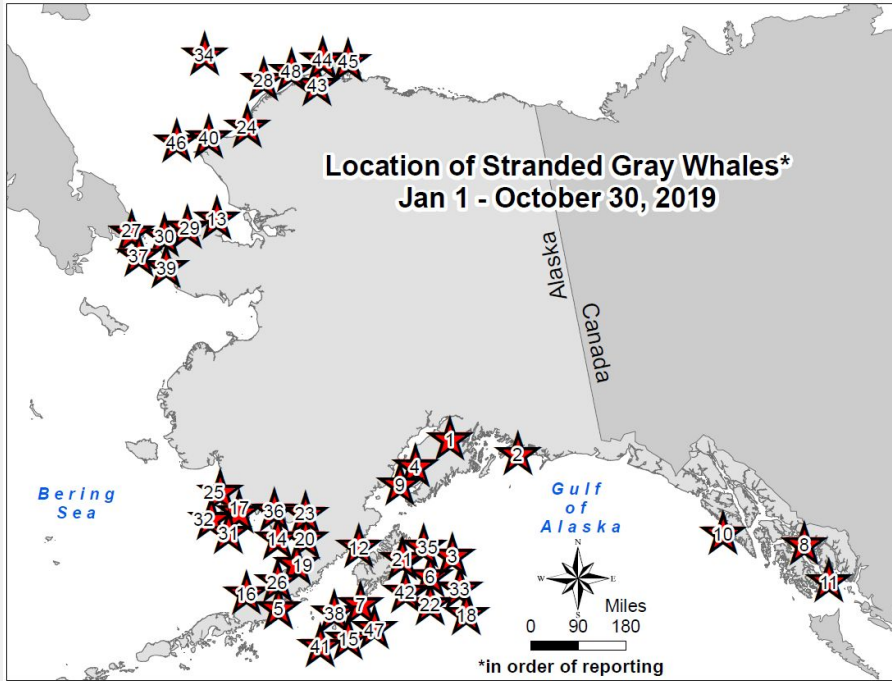
C. Gabriele, J. Moran

- *Lagged impacts of 14-16 heatwave*
- Minor improvements, still poor body condition in GLBA
- Feeding on euphausiids (not herring) in PWS



# Notable: Gray whale UME

K. Savage



Gray Whale Strandings in 2019	
Canada	10
US Total	122
Alaska - 48	
Washington - 34	
Oregon - 6	
California - 34	
Mexico	81
<b>Total</b>	<b>213</b>



# Notable: Gray whale UME

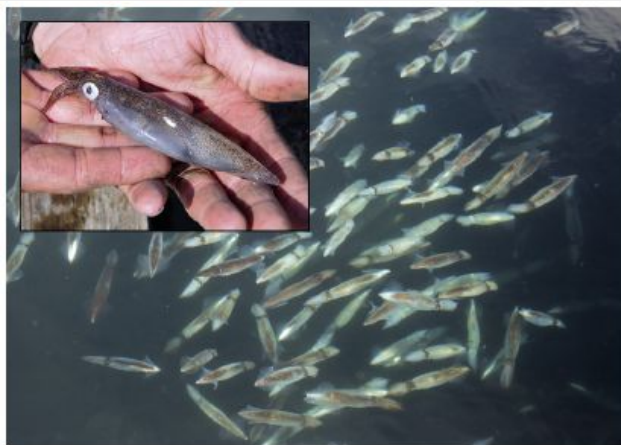
## K. Savage

- Preliminary necropsy results show evidence of emaciation.
- Annual migration of up to 20,000 km.
  - Summer and fall in the Bering and Chukchi Seas feeding on amphipods, mysids, crab larvae.
  - Overwinter (mating, calving) along the west coast of southern Baja California Peninsula.
- *Mortality likely linked to changes in Bering/Chukchi, not GOA*



# Notable: Market Squid Spawning in the GOA

Eiler, Marinelli, Jorgenson

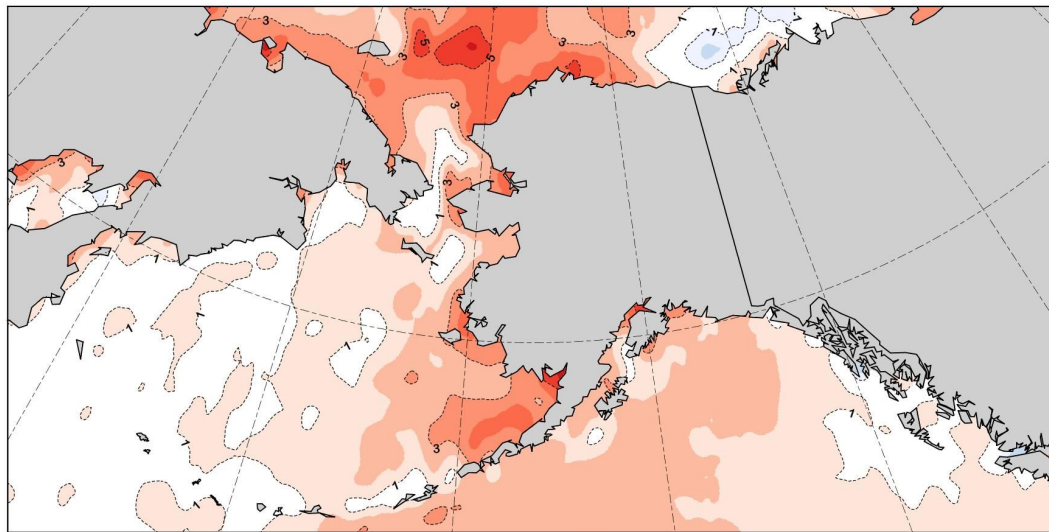


- Market squid *Doryteuthis opalescens*
- Range from Baja to SEAK, most in Baja to central CA
- Thought too cold for spawning north of BC
- Spawning on nets at Little Port Walter: 2015, 2016, 2018, and 2019
- Spawning on crab pots in Kodiak: 2016–2018
- Documented in seabird chick diets
- *Range expansion a result of increased temps?*

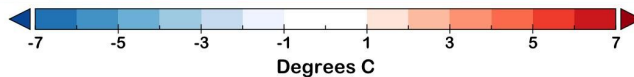


## Sea Surface Temperature Departure from Normal

August 30-September 5, 2019



Graphic by @AlaskaWx



Rick Thoman

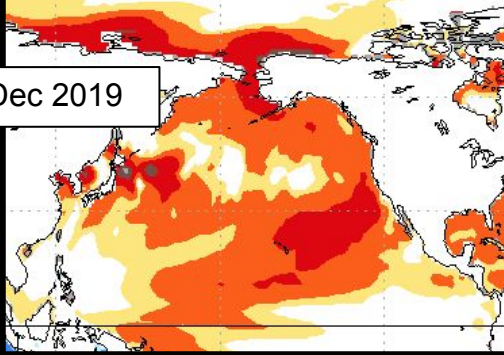
OISSTv2 courtesy of NOAA/PSD/ESRL

# 2020 Sea Surface Temperature Forecasts

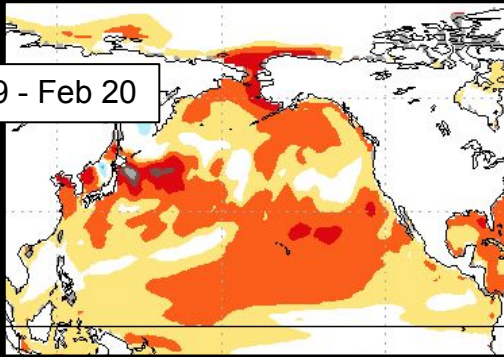
# SST Projections from the National Multi-Model Ensemble

N. Bond

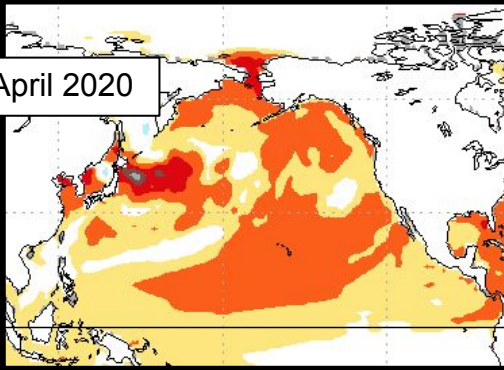
Oct - Dec 2019



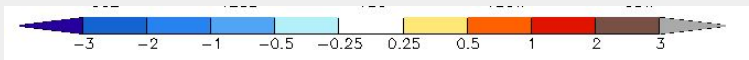
Dec 19 - Feb 20



Feb - April 2020



- Projected continuation of warmth but reduced magnitude
- Previous projections were warm, but not warm enough
- Warmest north of Kuroshio Extension
- Neutral ENSO projected



# Summary *and Implications*



Warm temperatures through 2019, similar to the 2014-2016 heat wave.

*Increased metabolic rates of groundfish? Poor lower trophic productivity?*



Delayed/small phytoplankton bloom; moderate-low zooplankton abundance.

*Mismatched timing and low prey abundance for planktivorous predators?*

Weak 2019 year class for pollock and Pacific cod; other forage fish not abundant. *Low prey abundance for piscivorous predators?*



Groundfish condition below average. *Prey limitations/increased metabolic demands?*

Seabirds at colonies did well, foraged more nearshore; saxitoxin linked to localized tern die-off. *Enough alternative prey for chicks? Fewer groundfish competitors?*



Few humpback adults and calves. Some declines in Steller sea lions. *Minor improvement but still lagged impacts from previous heatwave?*



