

Ecosystem Status Report Gulf of Alaska 2020

Bridget Ferriss & Stephani Zador
GOA Groundfish Plan Team November, 2020



With contributions from:



PRINCE WILLIAM SOUND
SCIENCE CENTER



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Institute for Seabird
Conservation and
Research

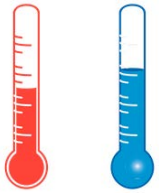


COASST

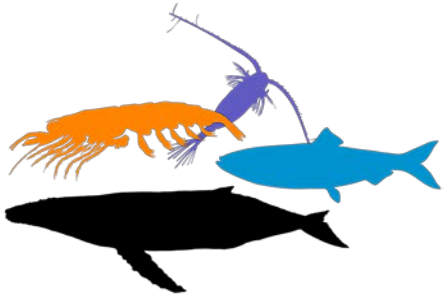


Thank you!

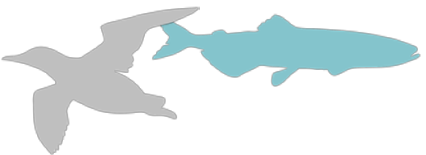
GOA 2020: Key Messages



1. Return to long-term mean surface temperatures after 2014-2016 and 2019 heatwave years



2. Average to positive trends in forage conditions & higher trophic level species (with exceptions)



3. Some species showing continued response to heatwave years

COVID-19 Related Ecosystem Data Loss in GOA (*limited*)



Data Collection

- Off-year for biennial NOAA surveys in GOA
- Other annual, regional NOAA surveys completed
- Existing partnerships continue to inform

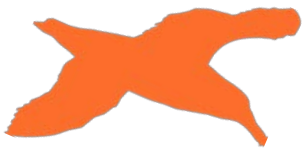
Data Loss

- Delayed analysis of 2019 data (lab access)
 - Zooplankton, larvae, ichthyofauna
- Cancelled/Reduced non-NOAA surveys
 - Seabird reproductive success (Alaska Maritime National Wildlife Refuge/USFWS)
 - Nearshore habitat sampling (National Parks Service)



Data Mitigation

- Seabird synthesis (COASST, USFWS, USGS, ISRC)



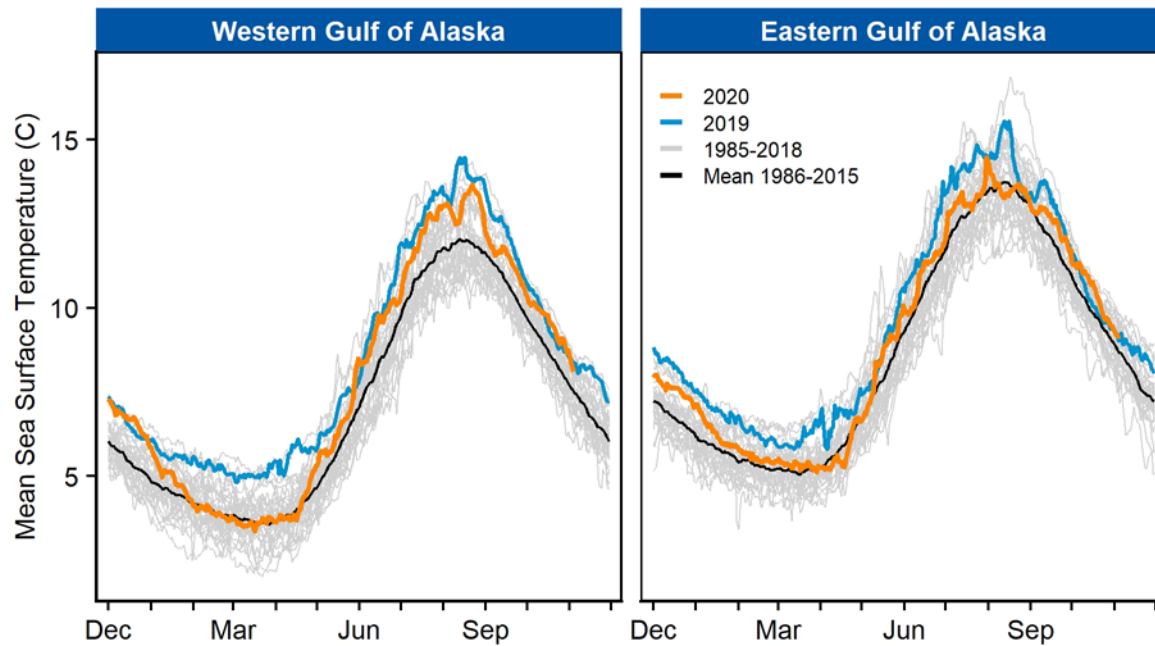
2020 OCEANOGRAPHY



Sea Surface Temperature & Marine Heatwaves

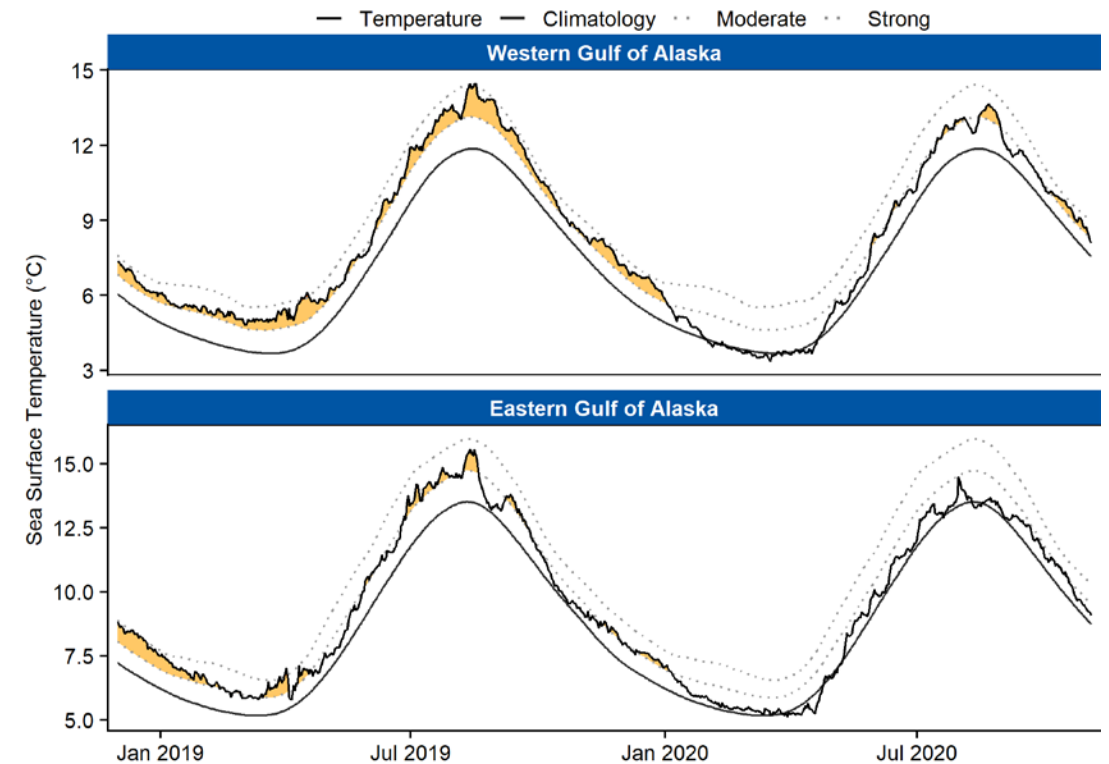
J. Watson

- 2020 GOA late winter temperatures cooled to the long-term mean through April
- WGOA then warmed above the mean, oscillating around the marine heatwave threshold, for much of summer and fall



- EGOA warmed in the fall

Return to more average thermal conditions at surface in general, with warmth in latter half of year



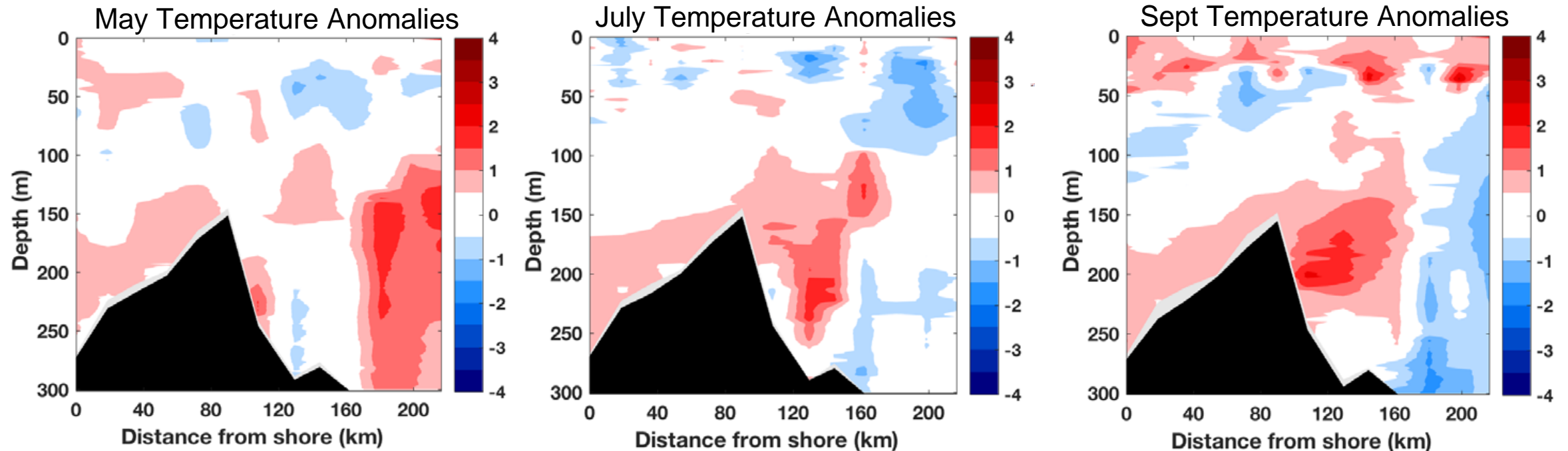
Ocean Temperature At Depth

S. Danielson, R. Hopcroft, R. Campbell

- Seward Line-cross shelf transect temperature anomaly profile

- Residual heat at depth (100m-250m) nearshore and at distance from shore

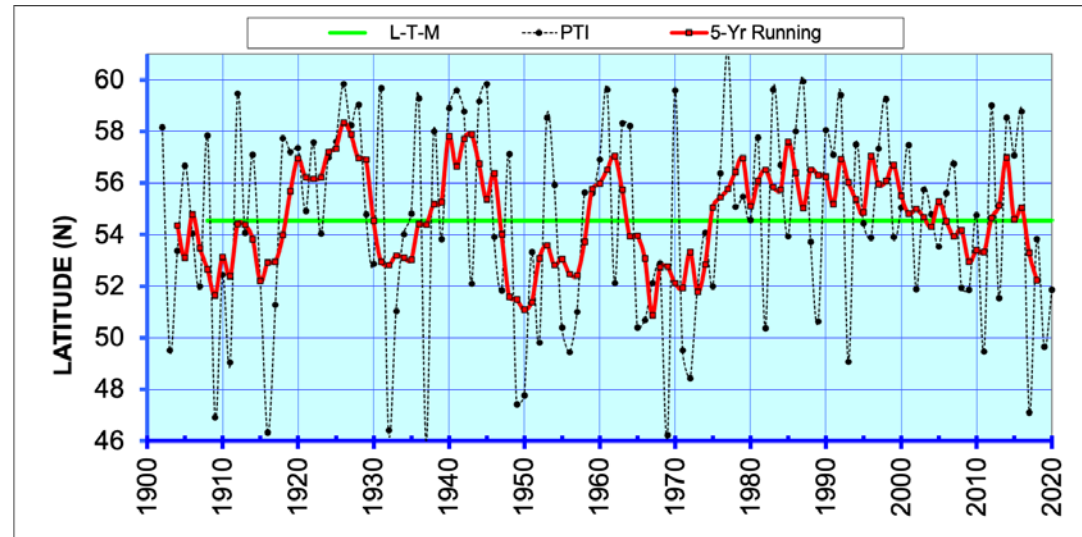
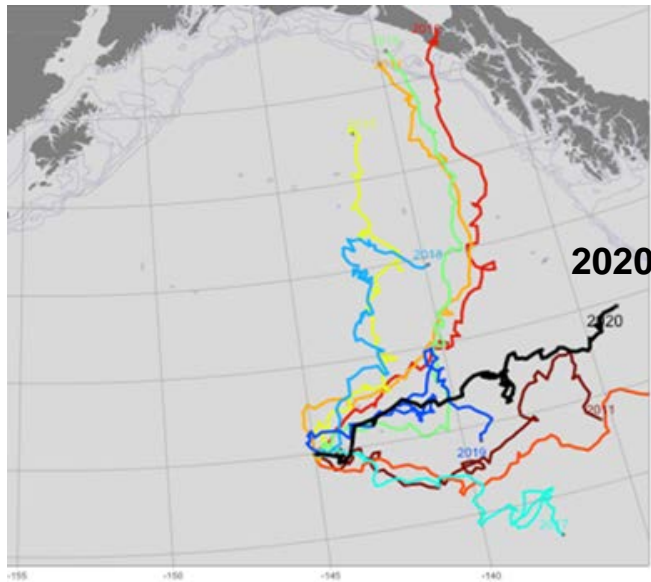
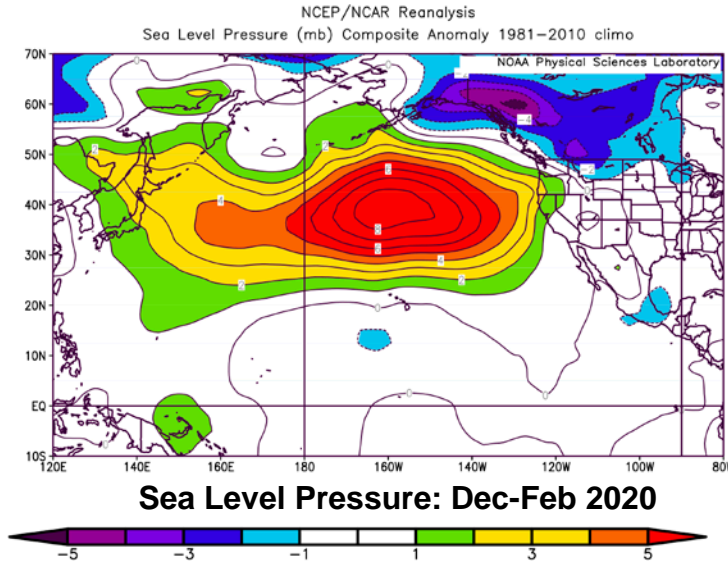
lagged effects of marine heatwaves?



Surface Transport

N. Bond, W. Stockhausen

- Eastward and southward transport across GOA (winter 2020)
- Upwelling–favorable westerly winds associated with the large high pressure system in winter 2019/20.
- 2020 Papa Trajectory Index extended further south and east than the long-term mean
- Similar years, included 2019, 2017, 2013, and 2011



Surface Transport: Shelikof Spring Wind

M. Wilson, L. Rogers

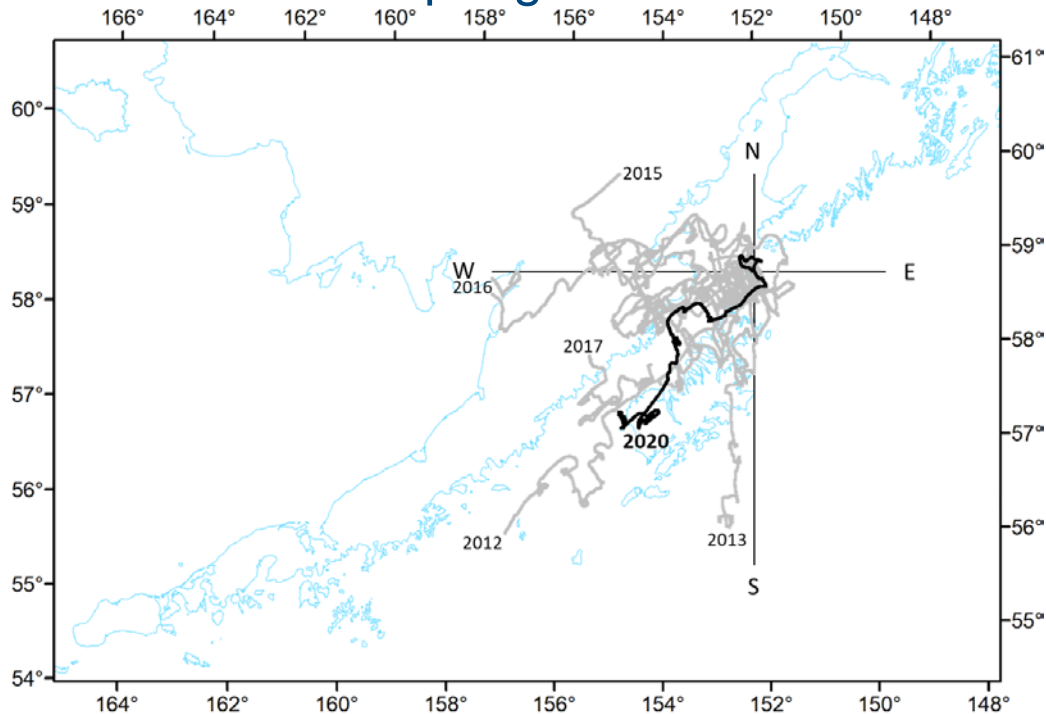


- Spring surface winds off NE Kodiak Archipelago indicating the direction of coastal flow

- Data:

- National Data Buoy Center (NDBC) at site AMAA2 (30min intervals, 2004-present)
- Model-based data from the National Centers for Environmental Prediction (NCEP) (monthly averages; 1948-2020)

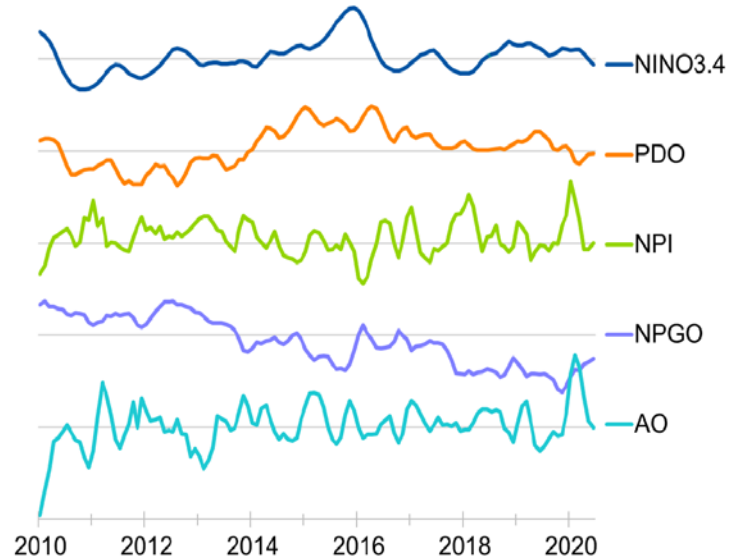
Shelikof Spring Wind Direction



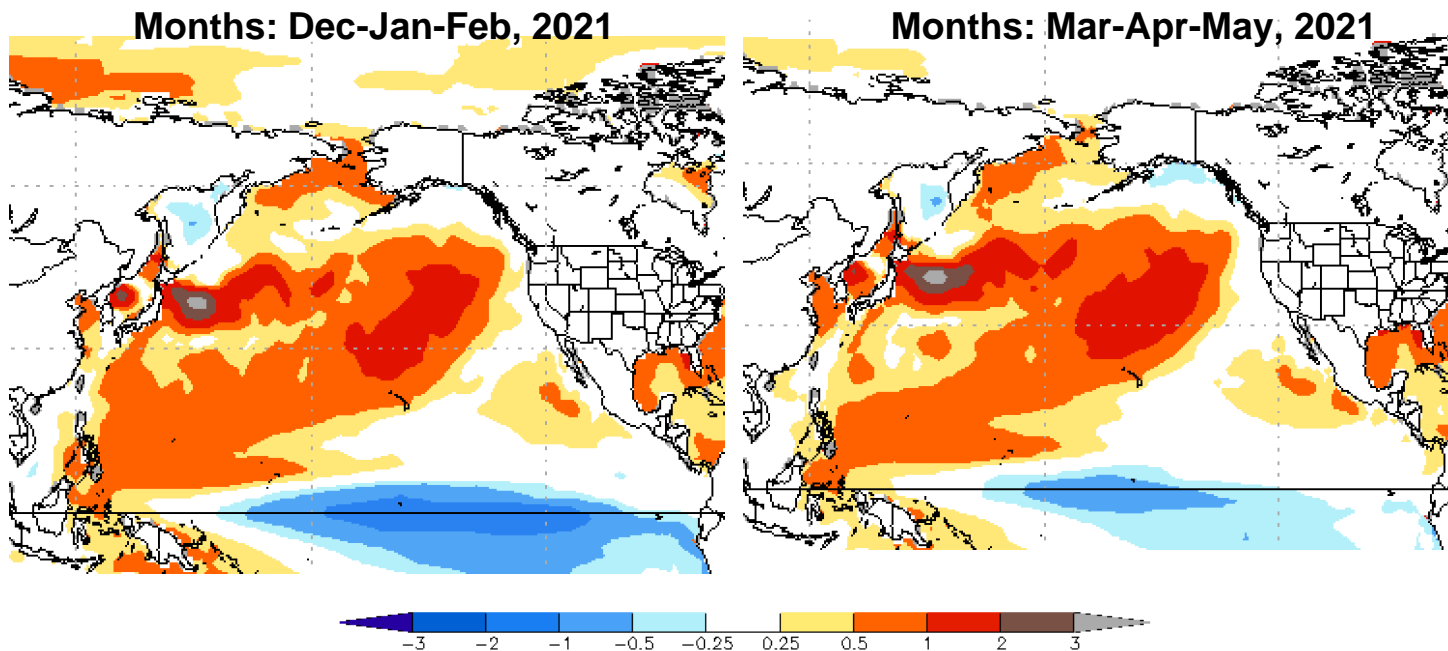
- 2020: Downwelling-favorable northeasterly spring winds (i.e., down Shelikof Strait)
- Predict good recruitment of 2020 pollock year class (correlation of southwest wind direction with estimates of age-1 pollock abundance)
 - Retention of larval and juvenile pollock in favorable habitat

2021 Climate & SST Predictions

N. Bond



- NMME models
- La Niña (winter)-uncertain strength of response in N. Pacific
- GOA coastal waters predicted to have near normal SST (Dec – Feb)
- And slightly cooler Mar-May
- Weaker Aleutian Low
- Positive SLP anomalies south of AK peninsula (similar to winter 2020 but weaker in amplitude)



2020 FORAGE CONDITIONS



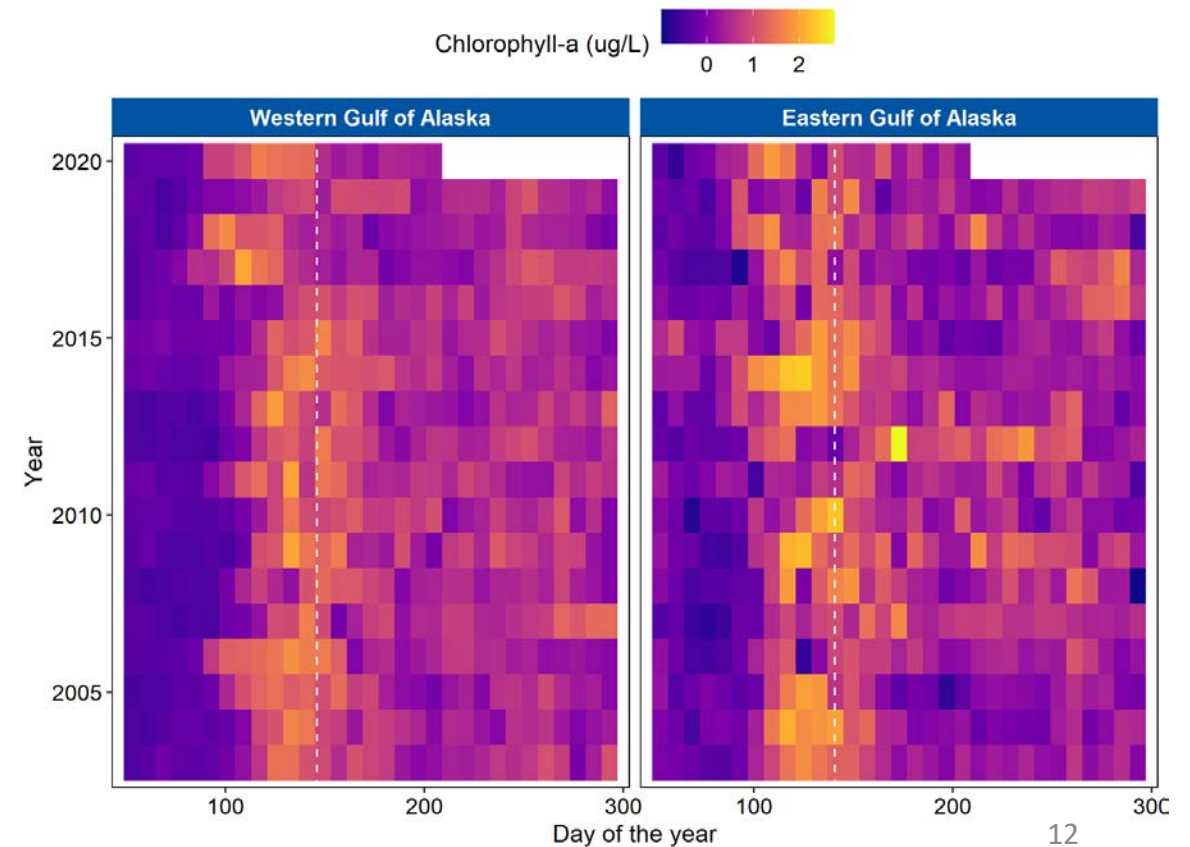
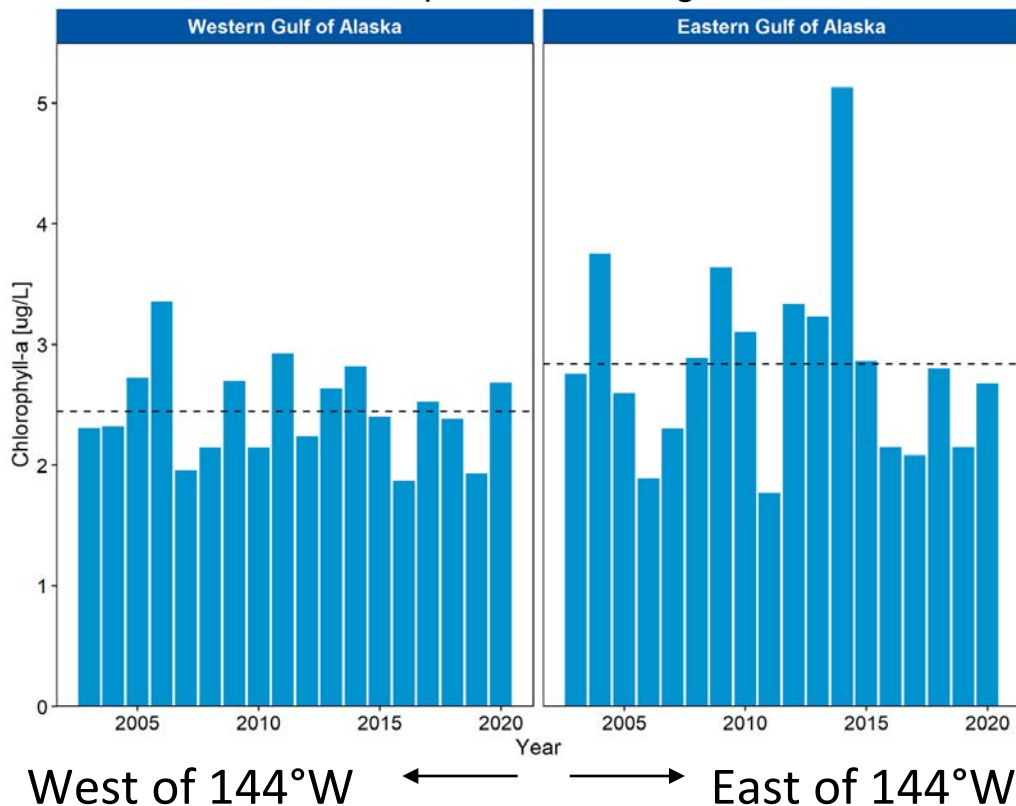
Chlorophyll-a

J. Watson, J. Gann, J. Nielsen

- **Average spring (April-June) chlorophyll-a concentrations** based on MODIS satellite 8 day composites
- Biomass slightly above (WGOA) and below (EGOA) the 2003-2020 mean
- Return to 'average' conditions relative to 2019

- Timing of the **spring bloom was substantially earlier** in 2020
- WGOA spring bloom peak around day 117-April 26 (2003-2020 mean day of 146-May 25)
- EGOA spring bloom peak around day 109-April 18 (2003-2020 mean day of 141-May 20).

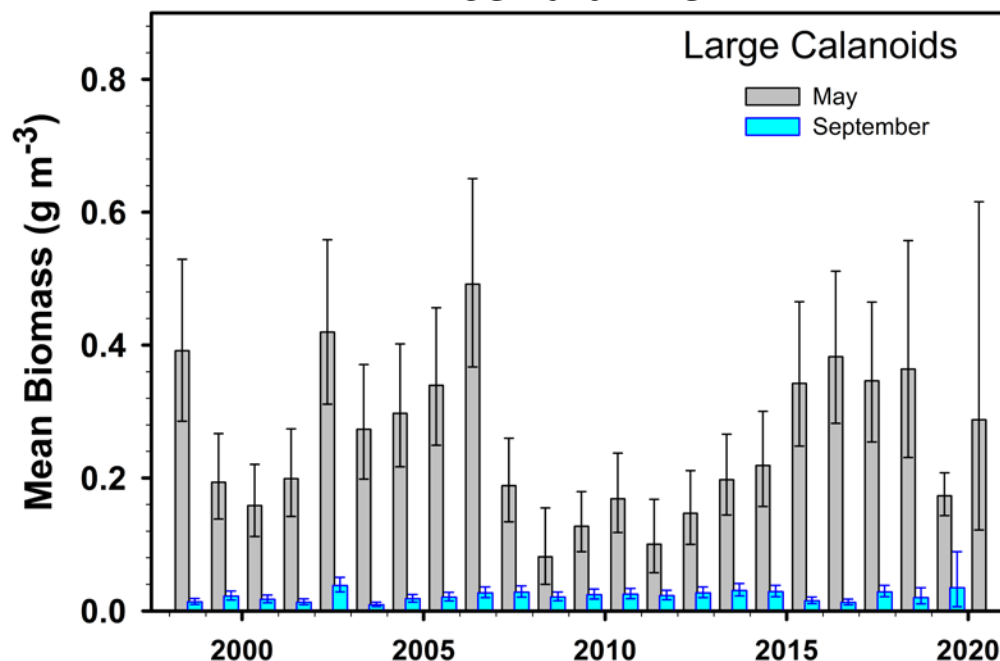
April-June Average



Copepods

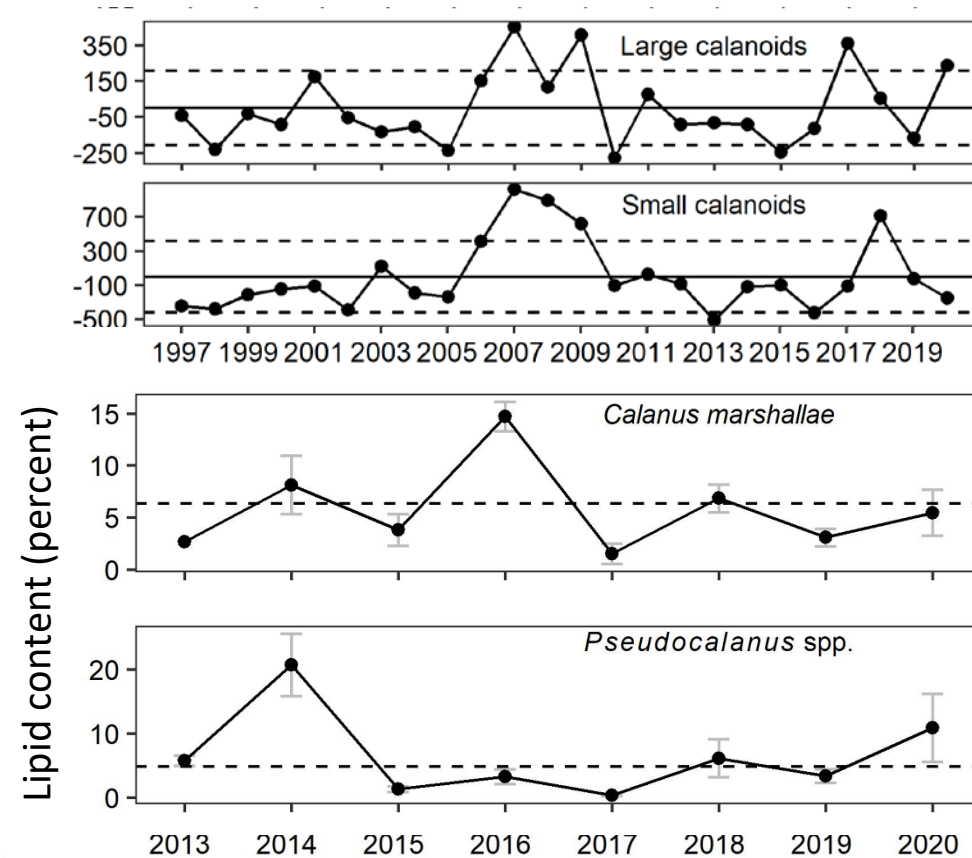
R. Hopcroft, Coyle, E. Ferguson

Seward Line



- Seward Line, large calanoid copepod biomass in May 2020 was at or slightly above average, higher than 2019.
- In Icy Strait, the 2020 total density was average (large calanoid copepods increased while small calanoid copepods decreased) and zooplankton lipid content increased to average (*Calanus marshallae*) and above average (*Pseudocalanus spp.*)

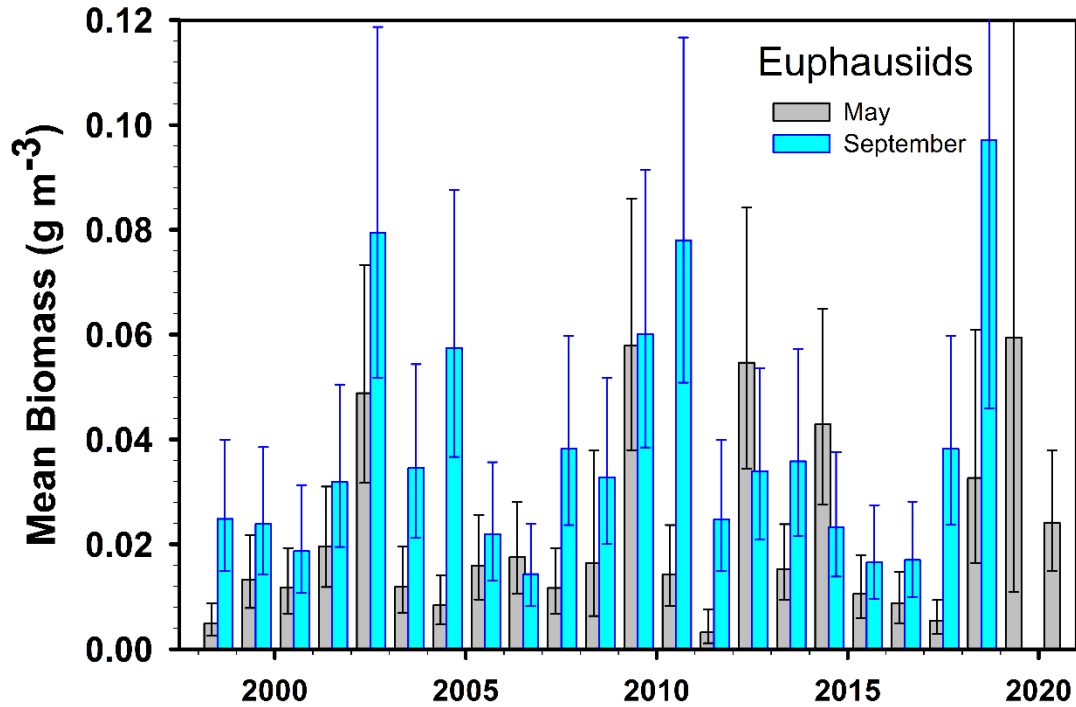
Icy Strait



Euphausiids

R. Hopcroft, Coyle, E. Fergusson, L. Rogers

Seward Line

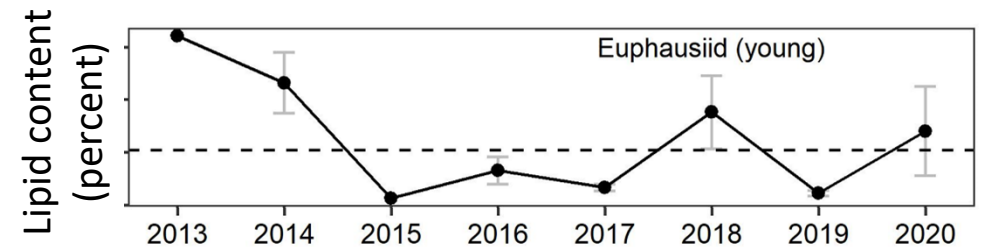


- Seward Line -Euphausiid biomass during May 2020 was slightly above average (lower than 2019); Sept 2019 & 2020 data not available
- In Icy Strait, euphausiid larvae density below average but percent lipid content increased

Density anomalies
(mean #/m³)

Icy Strait

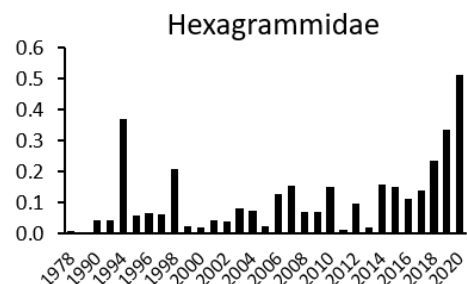
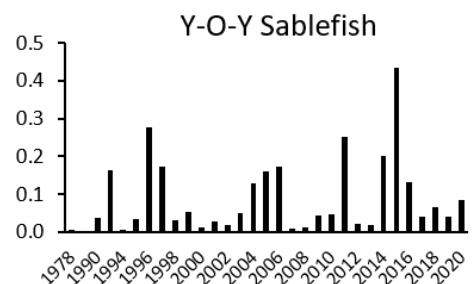
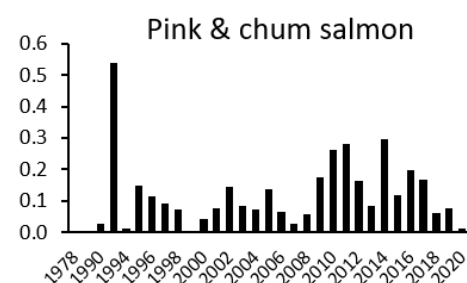
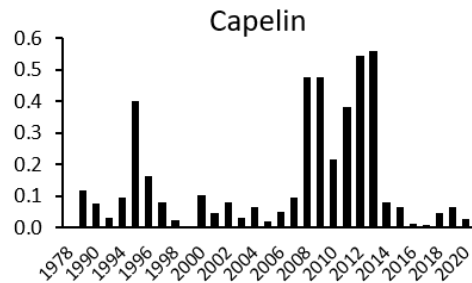
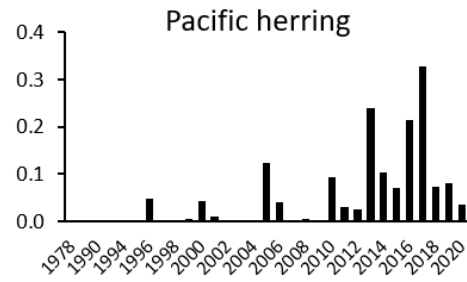
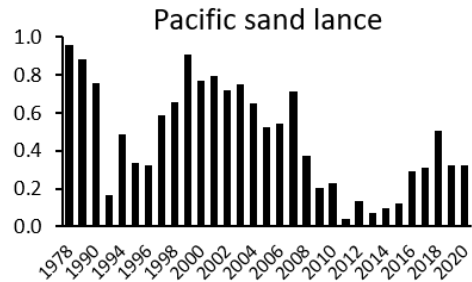
1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019



Forage Fish

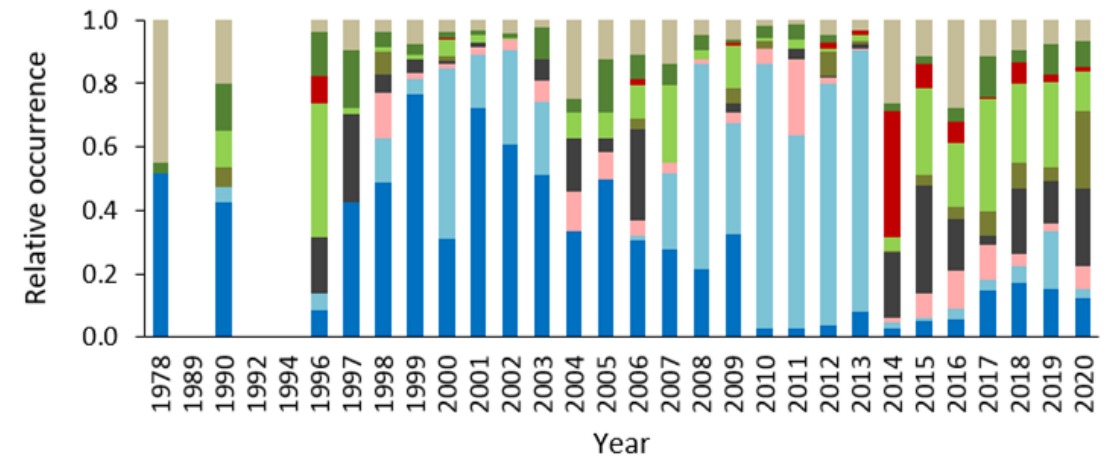
S. Hatch, M. Arimitsu, J. Piatt

Rhinoceros Auklet Chick Diet (Middleton Island) (diving)



- Prey species occurrence in the nestling diet of piscivorous seabirds on Middleton Island from 1978–2020
- Capelin remain scarce following 2014–2016 heatwave
- High hexagrammidae (mainly greenling, but also lingcod, Atka mackerel)
- Sand lance continues to be prominent (increased since 2014–2016 heatwave)

Kittiwake Chick Diet Jun-Aug (surface)



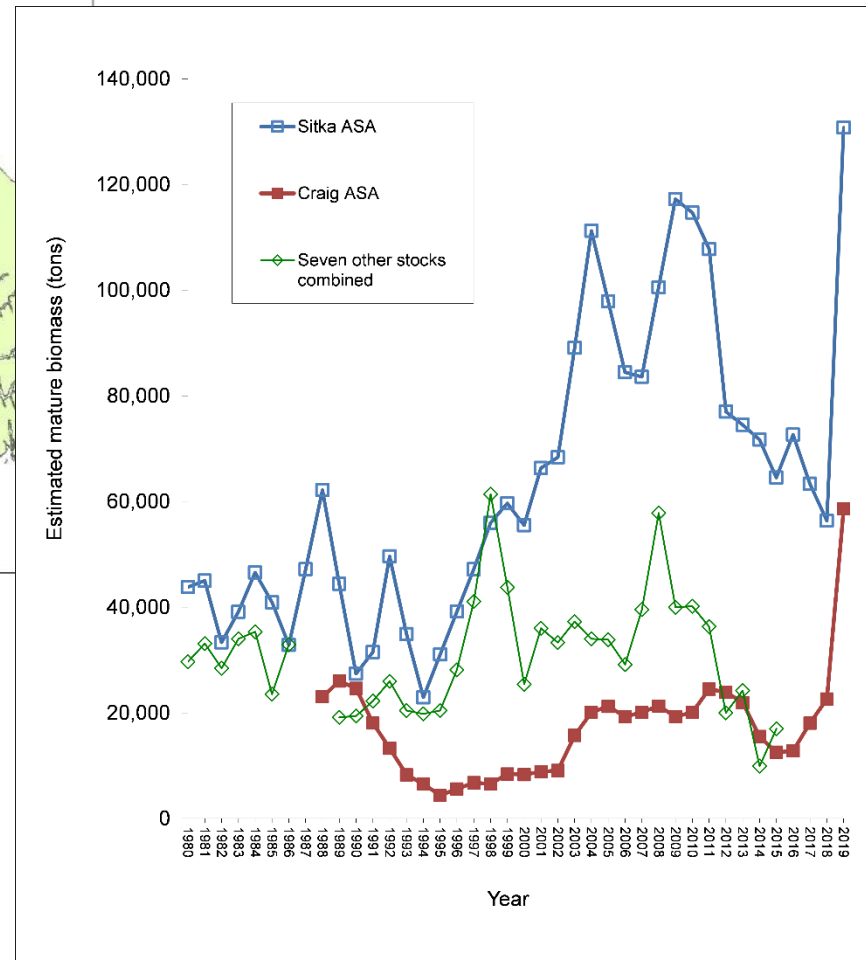
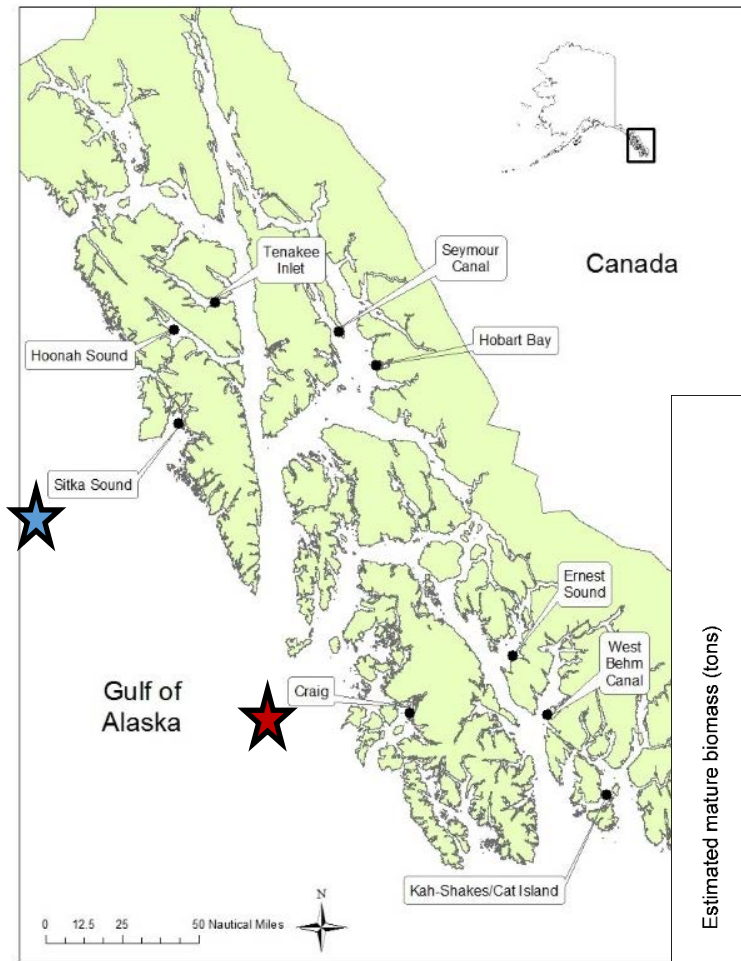
- Sand lance
- Capelin
- Salmon
- Sablefish
- Hexagrammidae
- Other fish
- Myctophids
- Invertebrates

Proportion of biomass

Year

Herring

Hebert, Dressel, Pagau, Trochta, Haught

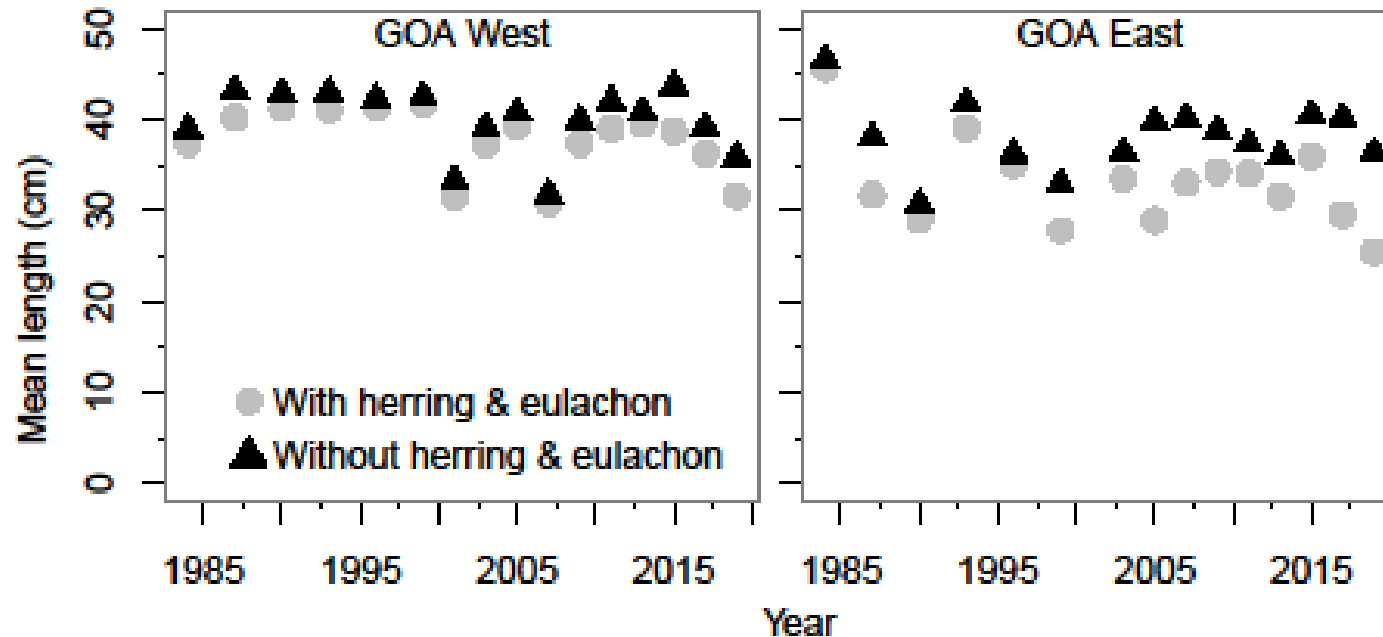


- SEAK: Increase in populations exposed to ocean influence (Sitka Sound & Craig): large recruitment event of age-3 herring observed in 2019 and preliminary 2020 data show age-4 herring for Sitka and Craig stocks were very high
- PWS: remains low but slight increase in 2019, 2020 – recruitment of large 2016 year class into spawning biomass

Increased age herring abundance in SEAK (but not PWS)

Mean Length of Groundfish Community

A. Whitehouse

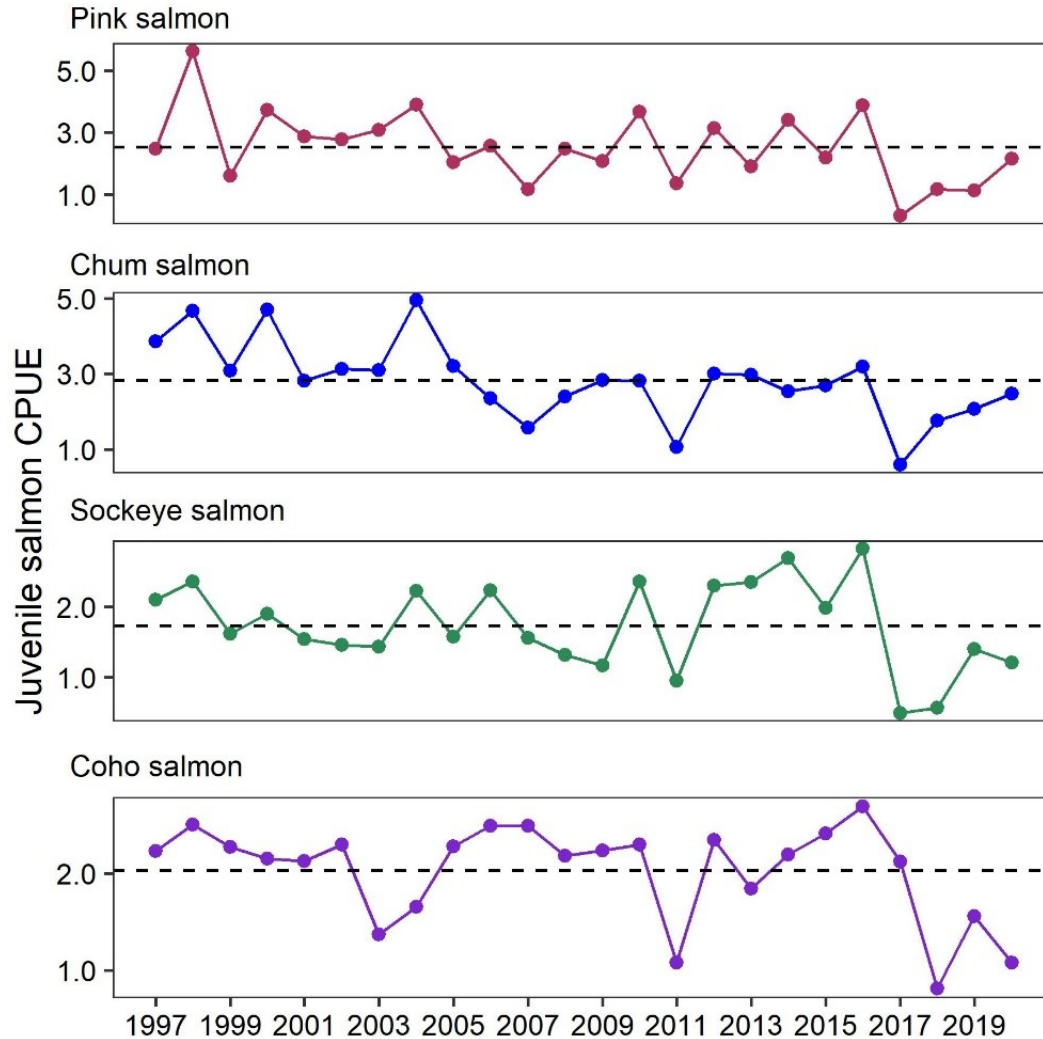


- Bottom trawl survey mean length of fish (species-specific mean lengths, weighted by biomass indices)
- Herring decreases mean length in EGOA (2017,2019)

Support for increased herring abundance in EGOA in 2017, 2019

Juvenile Salmon (Icy Strait)

M. Ferguson, J. Murphy, A. Gray



- Juvenile pink and chum increased to long-term average
- Juvenile sockeye and coho decreased from 2019
- 2017 was record low recruitment for all salmon
- Lengths were all approximately at 24 year average

2020 SALMON, MARINE MAMMALS, & SEABIRDS



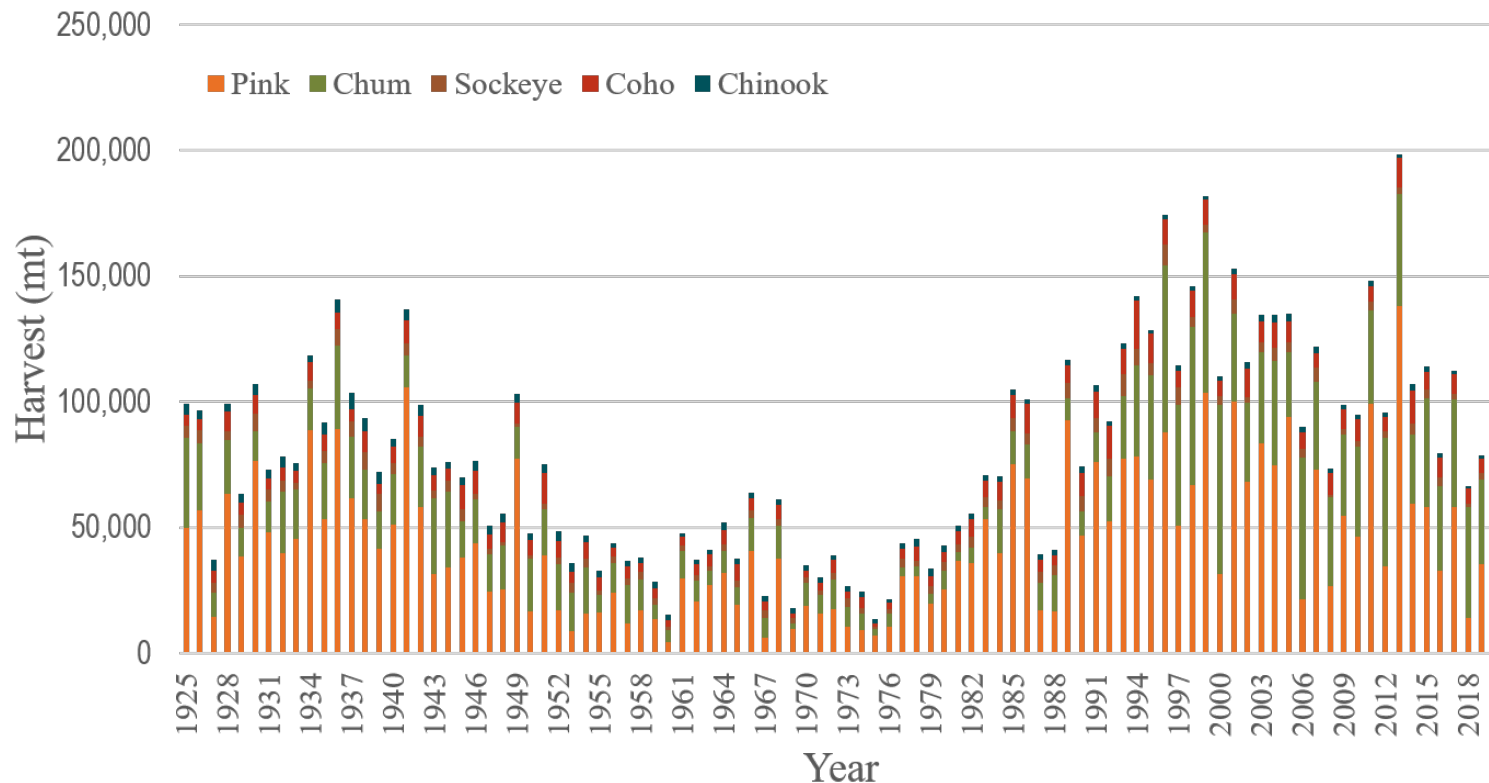
<https://www.nps.gov/glba/learn/nature/humpback-whales-in-glacier-bay.htm>

Low Salmon Catches in GOA & SE Alaska

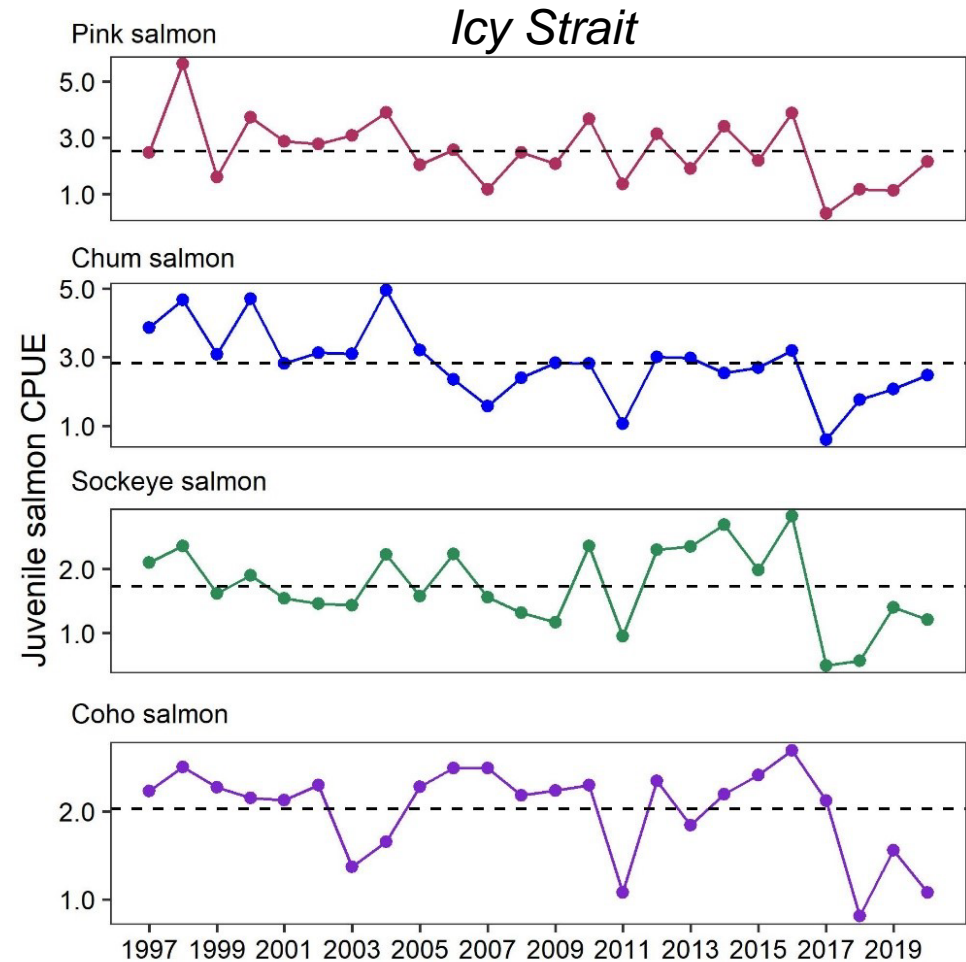
J. Murphy, R. Brenner

- GOA low commercial salmon catches (chum & sockeye)
- SEAK lowest since 1976 (pink, sockeye, chum)
- Increasing juvenile abundance since 2017 indicates harvests will increase in coming years although may still be below average

Social economic concerns in 2020



SE Alaska Commercial Salmon Harvest through Sept 22, 2020; ADFG



Humpback Whales

Gabriele, Neilson, Moran, Straley

- *Prince William Sound: #whales and encounter rate remain low (below pre-MHW levels)*

*Reduced herring?
Change distribution?*

Prince William Sound Humpback Whales

| Month/year | Counts of whales | Counts of calves | Nautical miles surveyed | Encounter rate Whale/NM |
|------------|------------------|------------------|-------------------------|-------------------------|
| Sep-08 | 71 | 17 | 412 | 0.17 |
| Oct-11 | 62 | 2 | 441 | 0.14 |
| Sep-12 | 81 | 5 | 444 | 0.18 |
| Sep-13 | 113 | 6 | 355 | 0.32 |
| Sep-14 | 181 | 1 | 427 | 0.42 |
| Sep-17 | 12 | 0 | 543 | 0.02 |
| Sep-18 | 17 | 1 | 541 | 0.03 |
| Sep-19 | 35 | 0 | 573 | 0.06 |
| Sep-20 | 14 | 2 | 331 | 0.04 |

- *Glacier Bay: Increased #calves to pre-MHW levels(12 calves documented in June-Aug); calf survival also increased*

Increased herring?

Glacier Bay & Icy Strait Humpback Whales

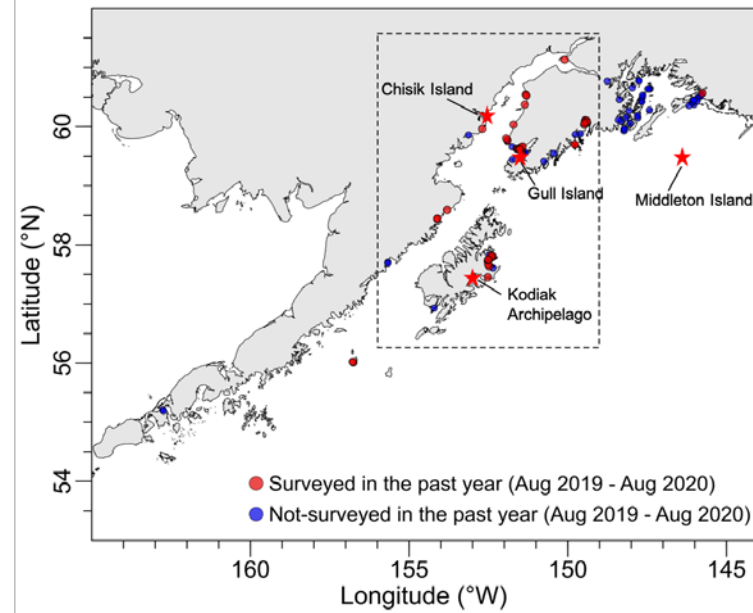
Seabird Synthesis

Hatch (Inst. for Seabird Res. & Cons.)







Jones, Lindsey, Burgess (COASST)

Corcoran (USFWS)


Arimitsu, Piatt, Marsteller, Schoen (USGS)




Surface-feeding

| Black-legged kittiwake | |
|---|---|
|  | <ul style="list-style-type: none"> • Some colonies newly abandoned • Breeding timing average |
|  | <ul style="list-style-type: none"> • Reproductive success fair to good |
|  | <ul style="list-style-type: none"> • No unusual mortality detected |
| Common murre, tufted puffin, pelagic cormorant, rhinoceros auklet | |
|  | <ul style="list-style-type: none"> • Low murre colony counts • Earlier breeding by cormorants |
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|  | <ul style="list-style-type: none"> • No unusual mortality detected |

Diving

 Colony attendance & timing of breeding







 Reproductive performance

 Mortality index

Primarily Fish eating

- Missing USFWS Alaska Maritime National Wildlife Refuge Seabird surveys (COVID-19)
- Colony attendance remains low in some populations
- Reproductive success fair to good for fish-eating birds (surface and diving) (where they showed up)
- No large scale mortality events

Surface-feeding

| Black-legged kittiwake | |
|---|--|
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Primarily Fish eating

Diving

- (Kodiak Archipelago) continued **trend of abandonment** of colonies (2 additional colonies)
- (Middleton Island & Kodiak Arch.) **timing of breeding average**

- (Kodiak Arch.) appeared to have **variable reproductive success**
- (Middleton Isl.) **strong reproductive success**, following poor breeding beginning in 2014

- Tufted puffin (Kodiak Arch.) The **timing of breeding was not unusual**
- Pelagic cormorants (Middleton Isl.) **timing of breeding was earlier** than recent years, continuing a 6-year trend of gradual advancement of breeding
- Common murres (Cook Inlet) continues a **declining population trend** in nesting colonies

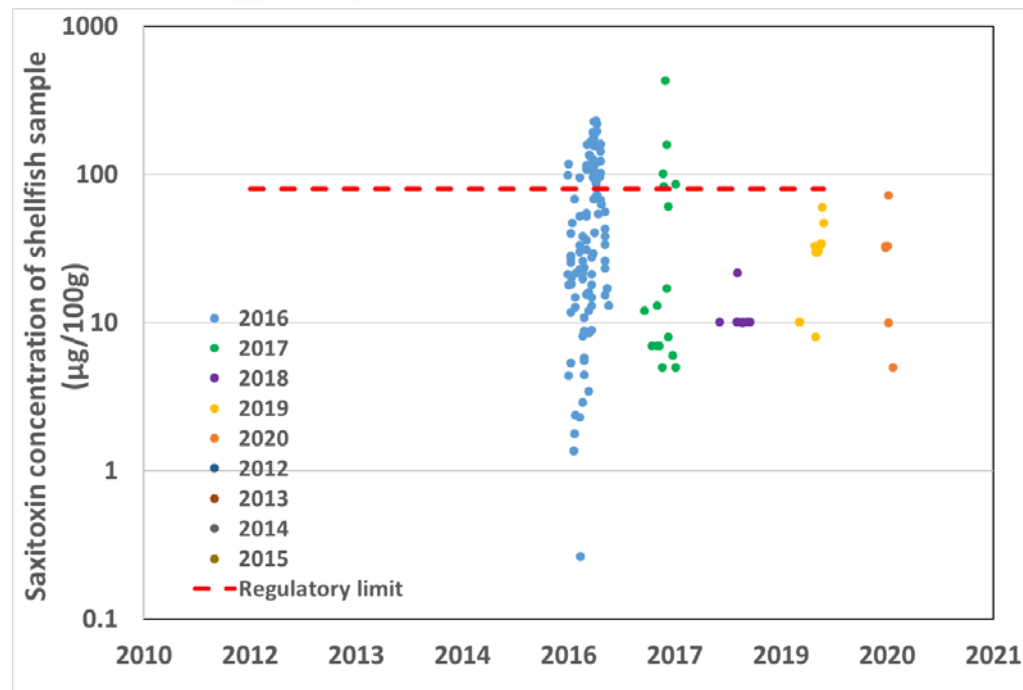
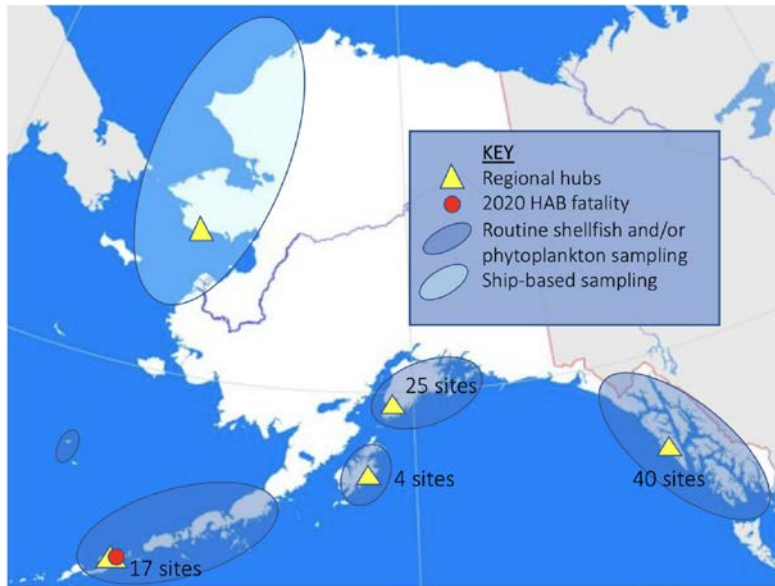
- Tufted puffins (Kodiak Arch.) appeared to have **fair to good breeding performance**, “with nests hatching and many birds sighted flying around the colony with bills full of fish to feed chicks”
- Rhinoceros auklets/pelagic cormorants (Middleton Isl.) had their **highest breeding success** since 2008/at least 2002
- Common murres (Cook Inl.) **produced chicks** for the first time (Chisik Isl.) and second time (Gull Isl.) following total breeding failure related to the 2014 marine heatwave

Mixed trends in seabird recovery from marine heatwaves; Spatial variation; Suggest increase in availability of forage fish in WGOA

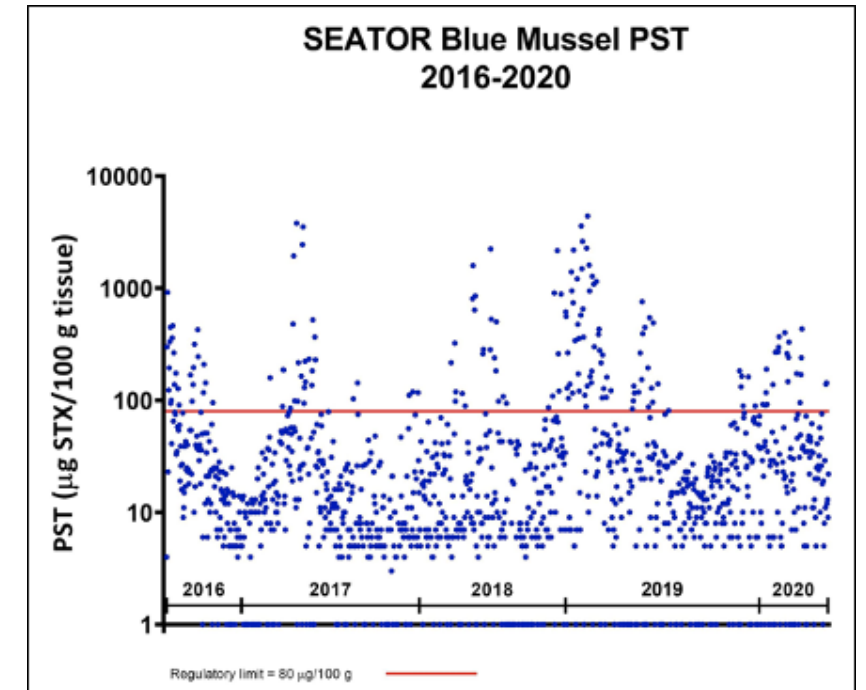
Harmful Algal Blooms

Alaska Harmful Algal Bloom Network (AHAB)

- 29 Sampling partners
- Shellfish and phytoplankton monitoring showed a consistent presence of harmful algal blooms (HABs) in 2020
- Bivalve shellfish from areas that are well known for having PSP levels above the regulatory limit, including Southeast Alaska and Kodiak, continued to test above the regulatory limit



Kachemak Bay; Data collected by Kachemak Bay National Estuarine Research Reserve and NOAA Kasitsna Bay Lab.



SEAK and Kodiak communities. Data provided by SEATOR

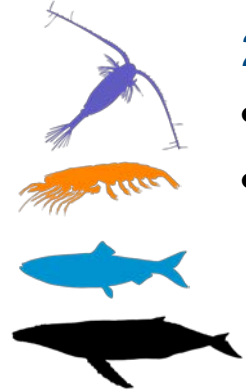
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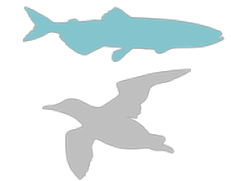
- Near-long term average SST winter & spring; warm summer (WGOA) and fall (WGOA & EGOA); predicted La Niña 2021 — *improved spawning conditions in spring (relative to 2019) and predicted end of elevated SST in winter 2021*

2. Positive trends in forage conditions & higher trophic level species (with exceptions)



- Average to increased zooplankton (increased large copepods)
- Mixed forage fish trends *limited data: some forage fish moderate to incr., (e.g., some herring, sandlance, juv. Salmon; seabird breeding success) — *improving prey base for planktivorous & piscivorous groundfish, some seabirds (e.g., Middleton Island) & humpback whales (Glacier Bay/Icy Strait)*

3. Some species showing continued response to heatwave years



- Residual warmth at depth (Seward Line) — *potential implications for early survival of groundfish that use these habitats for spawning (e.g., Pacific cod)*
- Mixed forage fish trends *limited data: some key species still low (e.g., capelin, some herring) —
- Some groundfish, seabird, whale populations still low — *some seabirds show colony abandonment, low population (e.g., murre), and Prince William Sound humpback whales*