Ecosystem Status Report Gulf of Alaska 2020

Bridget Ferriss & Stephani Zador

With contributions from:

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Thank you!

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

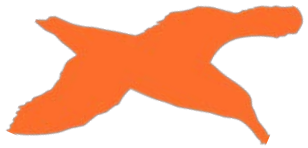
Data Collection

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

Data Loss

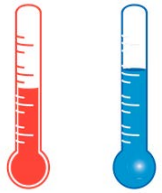
- Delayed analysis of 2019 data (lab access)
  - Zooplankton, larvae, ichthyofauna
- Cancelled/Reduced non-NOAA surveys
  - Seabird reproductive success (Alaska Maritime National Wildlife Refuge/USFWS)
  - Nearshore habitat sampling (National Parks Service)

Data Mitigation

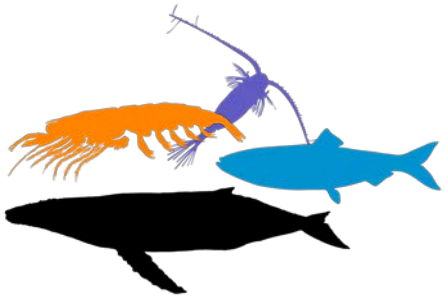


- Seabird synthesis (COASST, USFWS, USGS, ISRC)

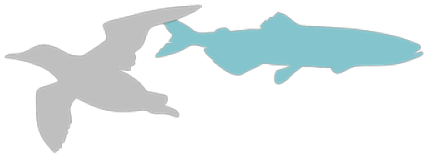
GOA **2020**: Key Messages



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

Risk Tables: Environmental/ Ecosystem Considerations

Level 1

(No apparent environmental/ ecosystem concerns)

- Walleye pollock
- Pacific cod
- Dusky rockfish
- GOA northern rockfish
- Pacific ocean perch
- GOA thornyhead complex
- GOA shark complex

Level 2

(Some indicators showing adverse signals relevant to the stock but the pattern is not consistent across all indicators.)

- Sablefish (statewide)

2020 Gulf of Alaska

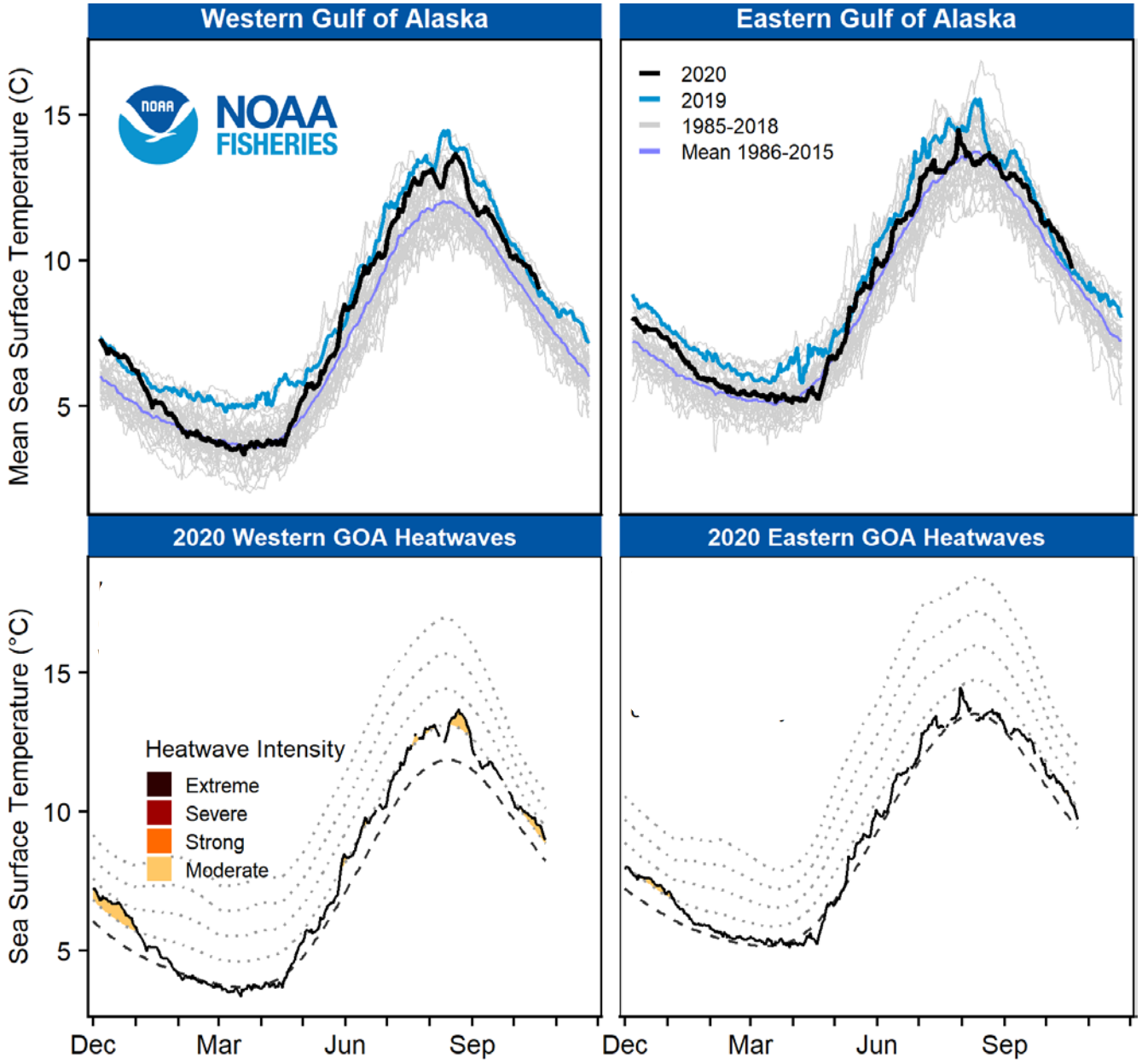
1. OCEANOGRAPHY

2. FORAGE CONDITIONS

3. SALMON, MARINE MAMMALS, & SEABIRDS

Sea Surface Temperature & Marine Heatwaves

J. Watson



- 2020 GOA late winter temperatures cooled to the long-term mean (1985-2015) 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

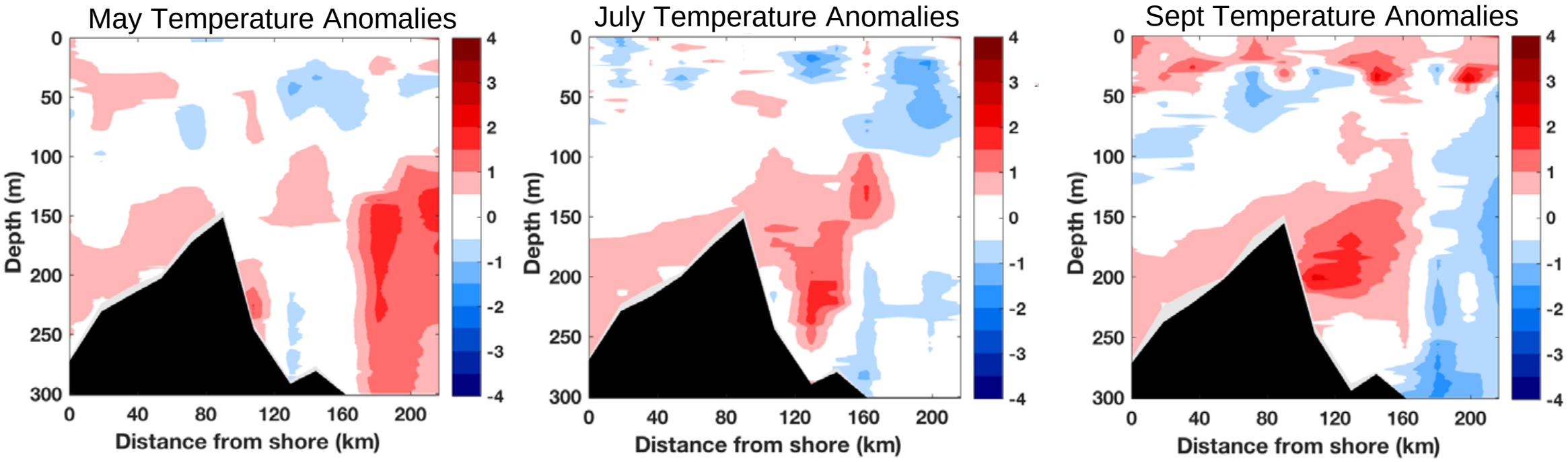
Return to more average thermal conditions at surface in general, with warmth in latter half of year

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

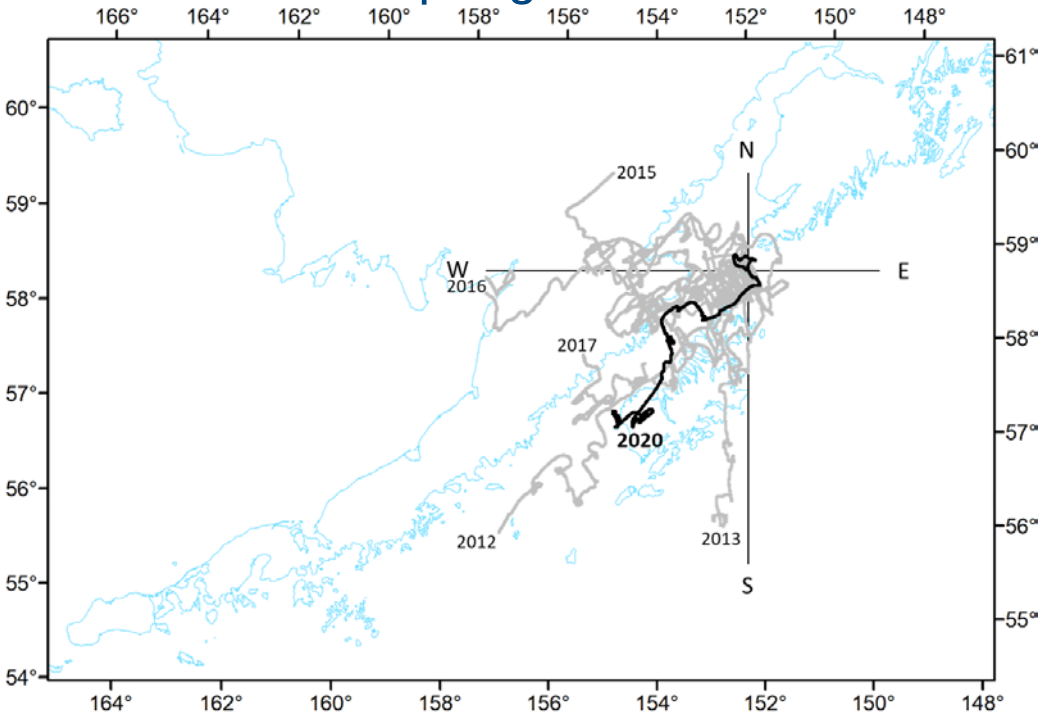
lagged effects of marine heatwaves?



Surface Transport: Shelikof Spring Wind

M. Wilson, L. Rogers

Shelikof Spring Wind Direction



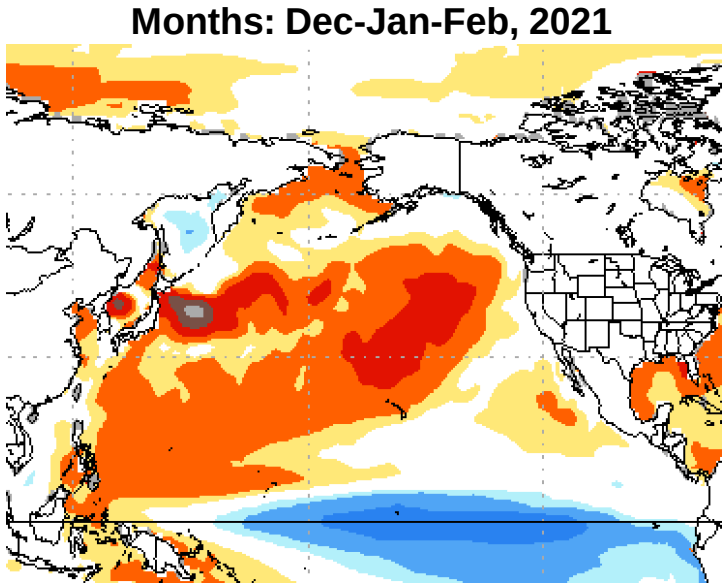
- Spring surface winds off NE Kodiak Archipelago indicating the direction of coastal flow

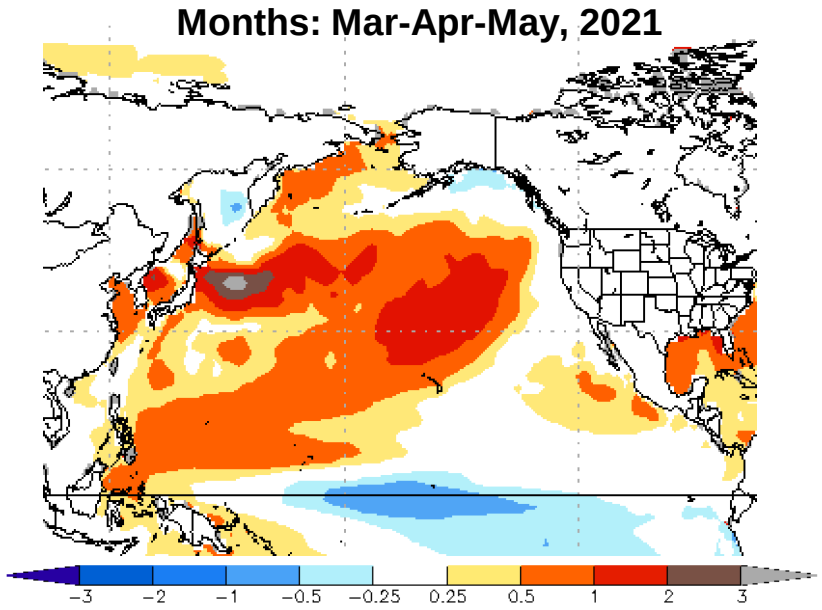
- Data:
  - National Data Buoy Center (NDBC) at site AMAA2 (30min intervals, 2004-present)
  - Model-based data from the National Centers for Environmental Prediction (NCEP) (monthly averages;1948-2020)

- 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





- National Multi-Model Ensemble (NMME)
- 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 Gulf of Alaska

https://gulfwatchalaska.org/monitoring/pelagic-ecosystem/forage-fish-2/

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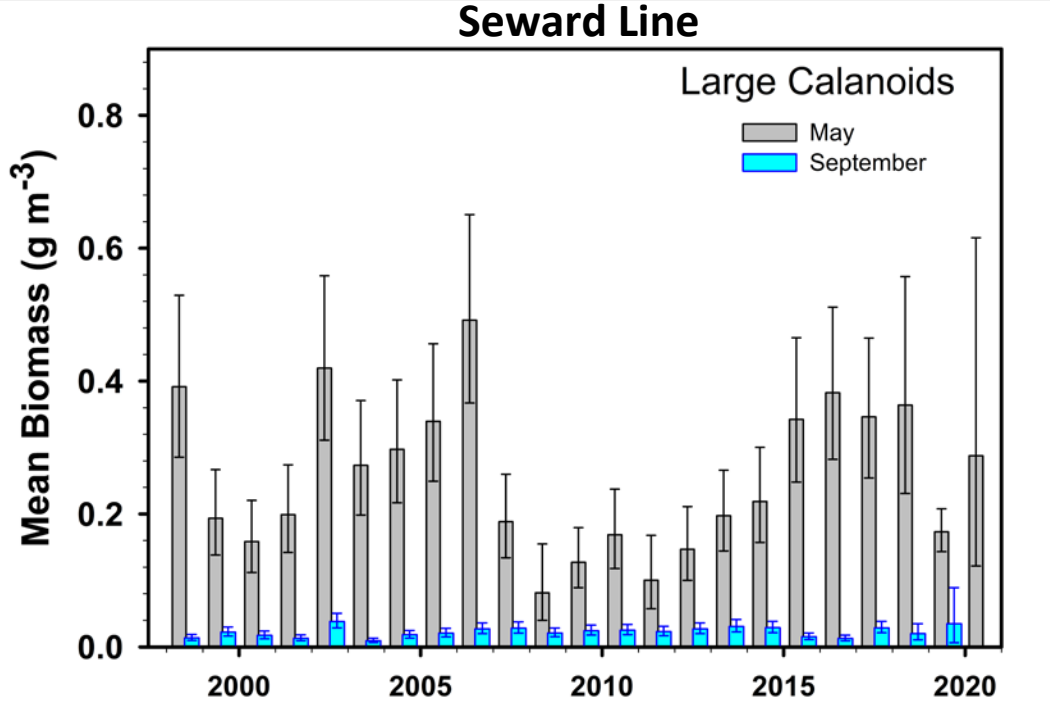
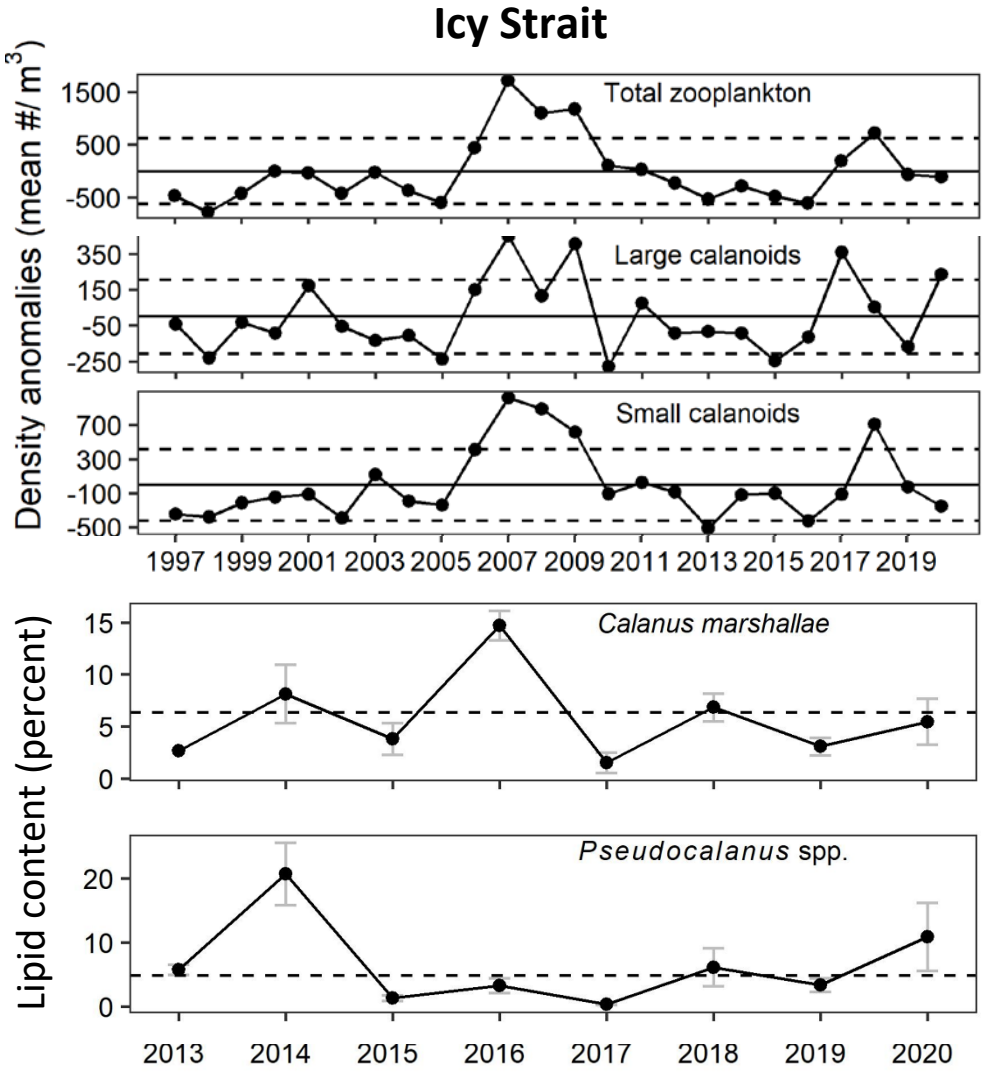
Copepods

R. Hopcroft, Coyle, E. Ferguson



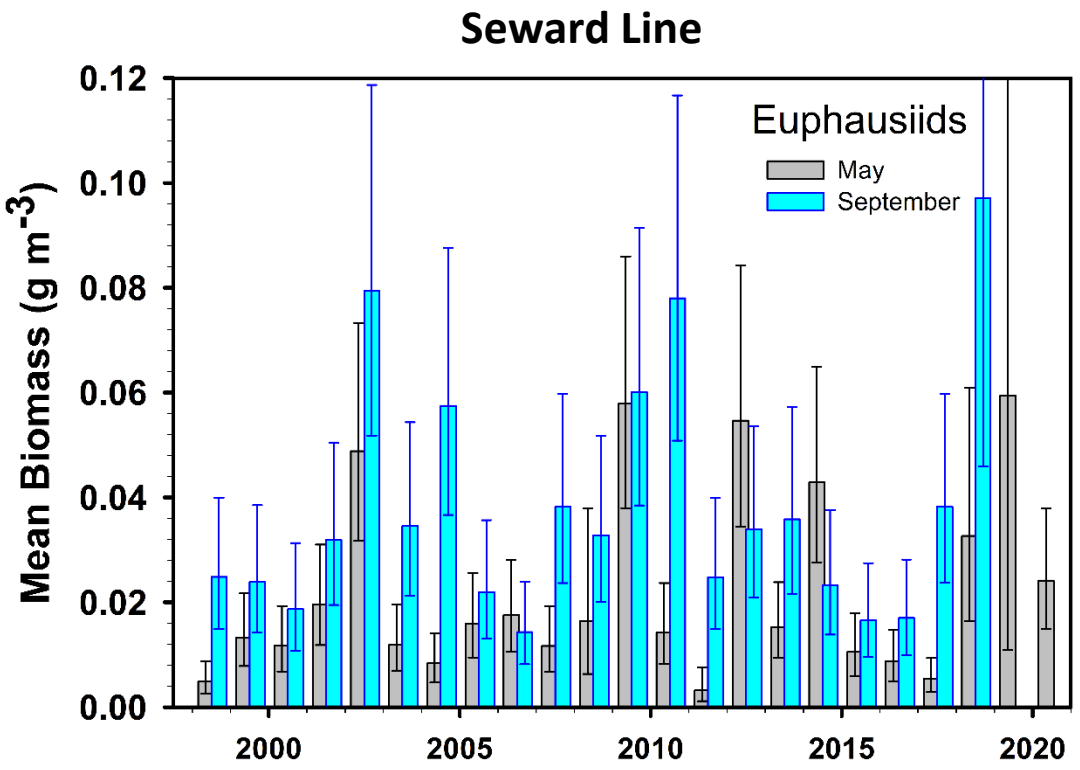


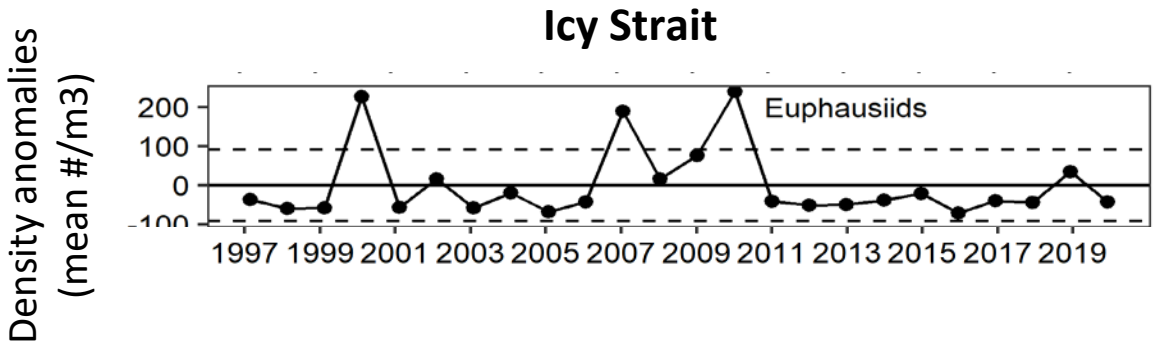
- Seward Line, large calanoid copepod biomass in May 2020 was at or slightly above average, higher than 2019.

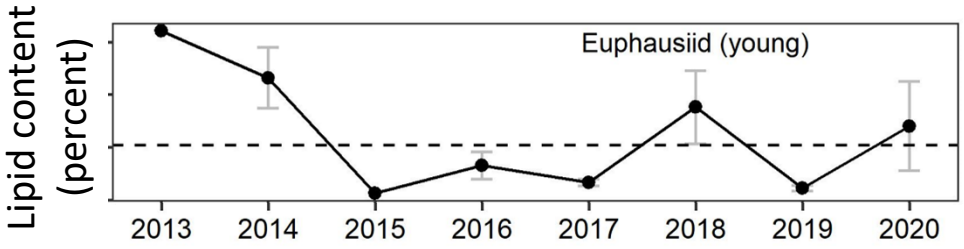
- In Icy Strait, the 2020 total density was average (large calanoid copepods increased while small calanoid copepods decreased) and zooplankton lipid content increased to average (*Calanus marshallae*) and above average (*Pseudocalanus spp.*)

Euphausiids

R. Hopcroft, Coyle, E. Fergusson



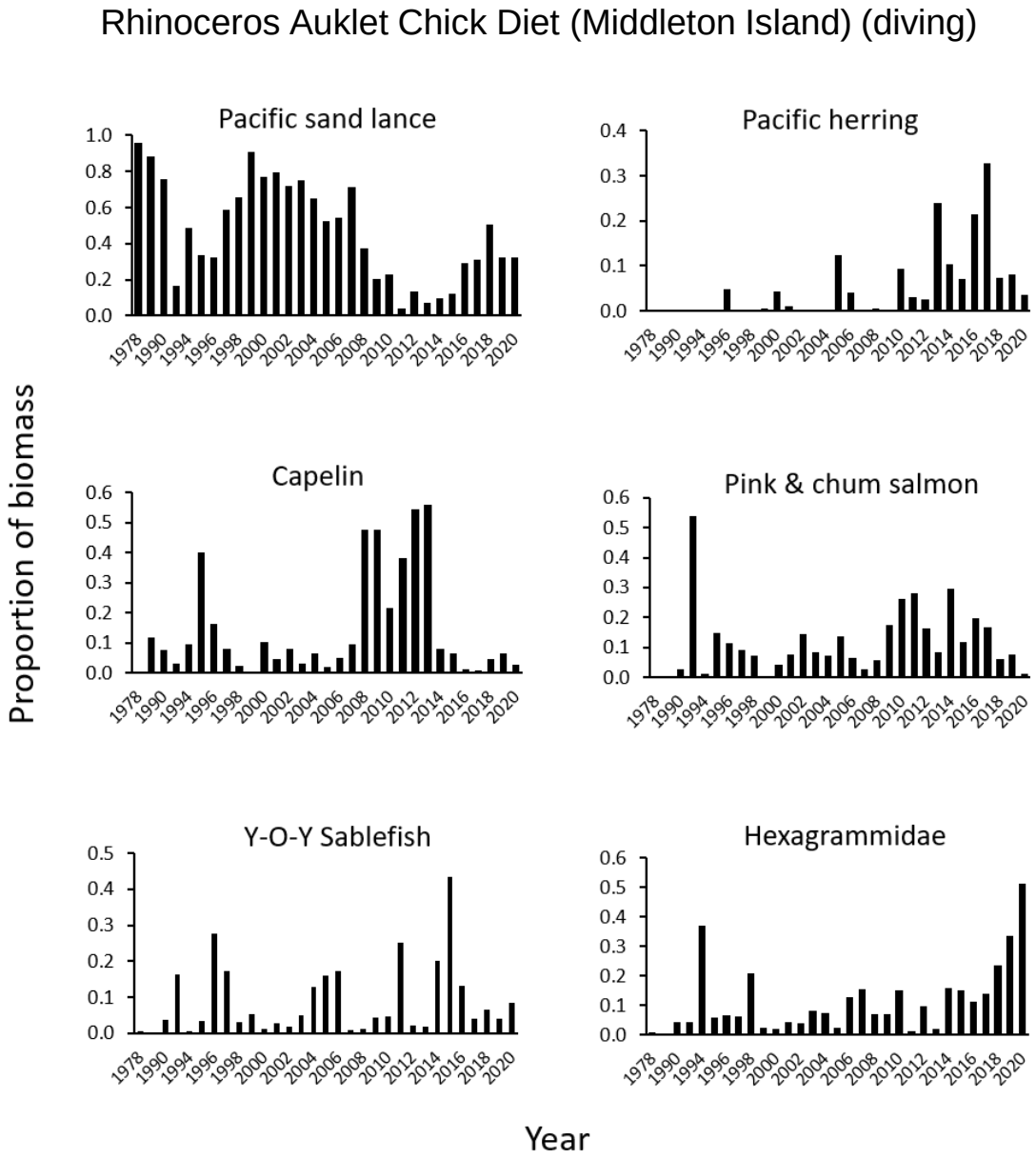




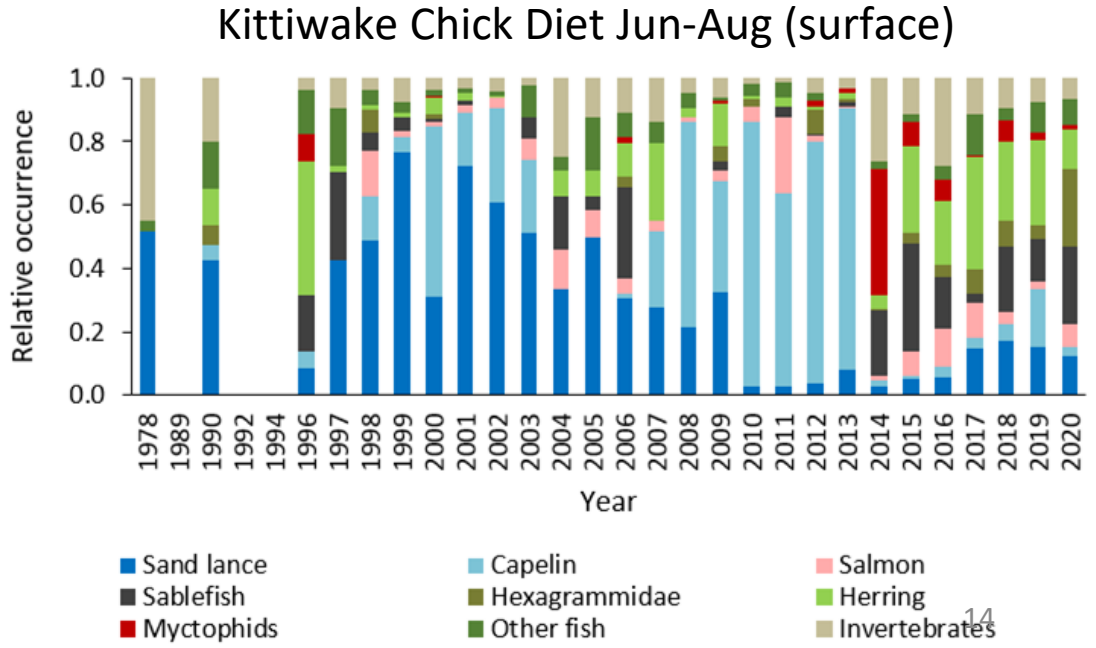
- Seward Line -Euphausiid biomass during May 2020 was slightly above average (lower than 2019); Sept 2019 & 2020 data not available
- In Icy Strait, euphausiid larvae density below average but percent lipid content increased

Forage Fish

S. Hatch, M. Arimitsu, J. Piatt

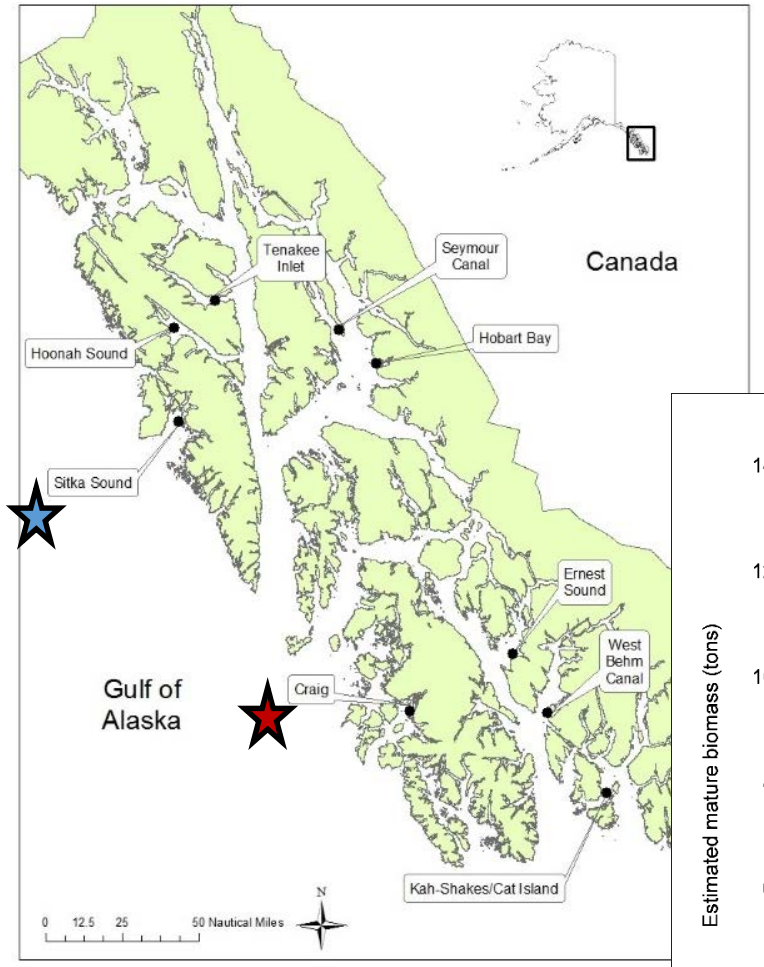


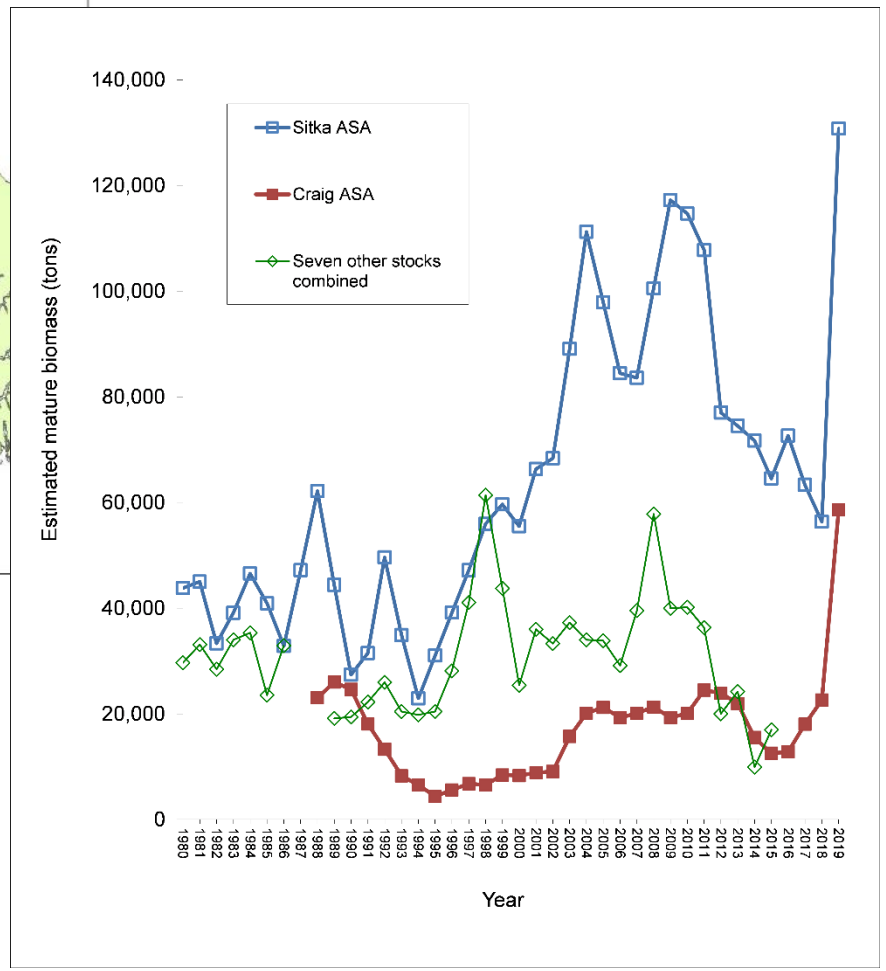
- Prey species occurrence in the diet of piscivorous seabirds on Middleton Island from 1978–2020
- Sand lance continues to be prominent (increased since 2014–2016 heatwave)
- Capelin remain scarce following 2014–2016 heatwave
- High hexagrammidae (mainly greenling, but also lingcod, Atka mackerel)



Herring

Hebert, Dressel, Pagau, Trochta, Haught



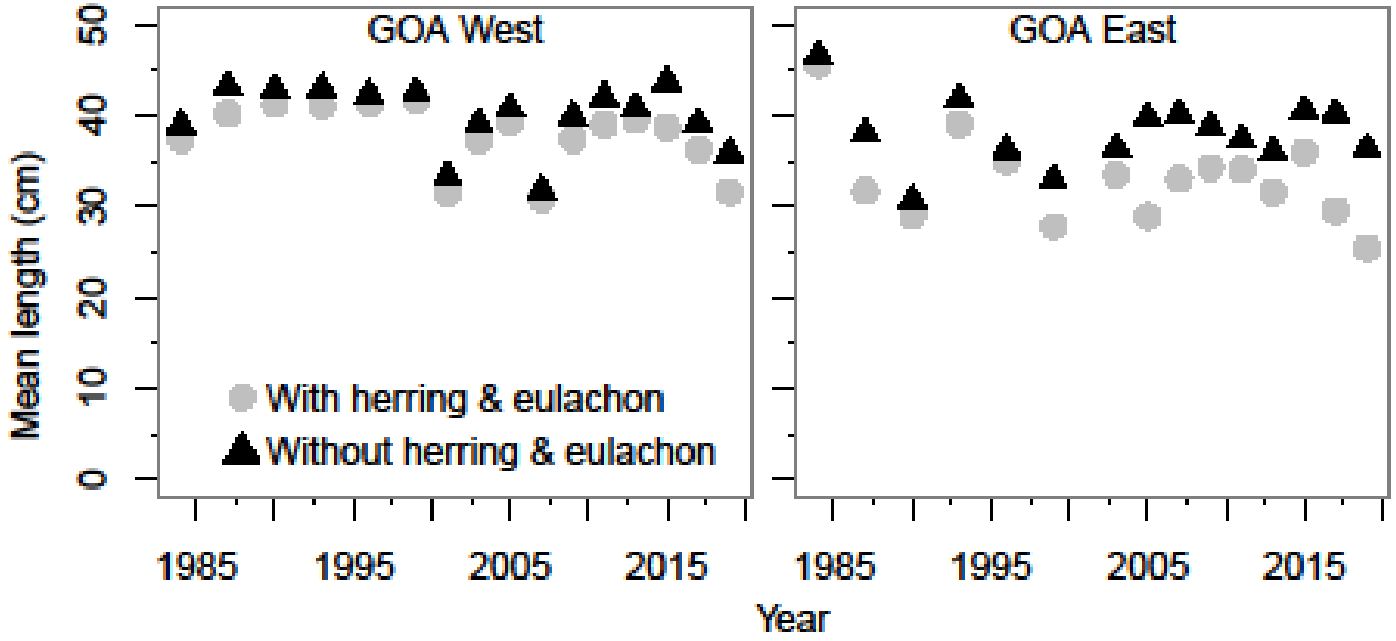


- SEAK: Increase in populations exposed to ocean influence (Sitka Sound & Craig): large recruitment event of age-3 herring observed in 2019 and preliminary 2020 data show age-4 herring for Sitka and Craig stocks were very high
- PWS: remains low but slight increase in 2019, 2020 – recruitment of large 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 icreased herring abundance in EGOA in 2017, 2019

2020 Gulf of Alaska


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

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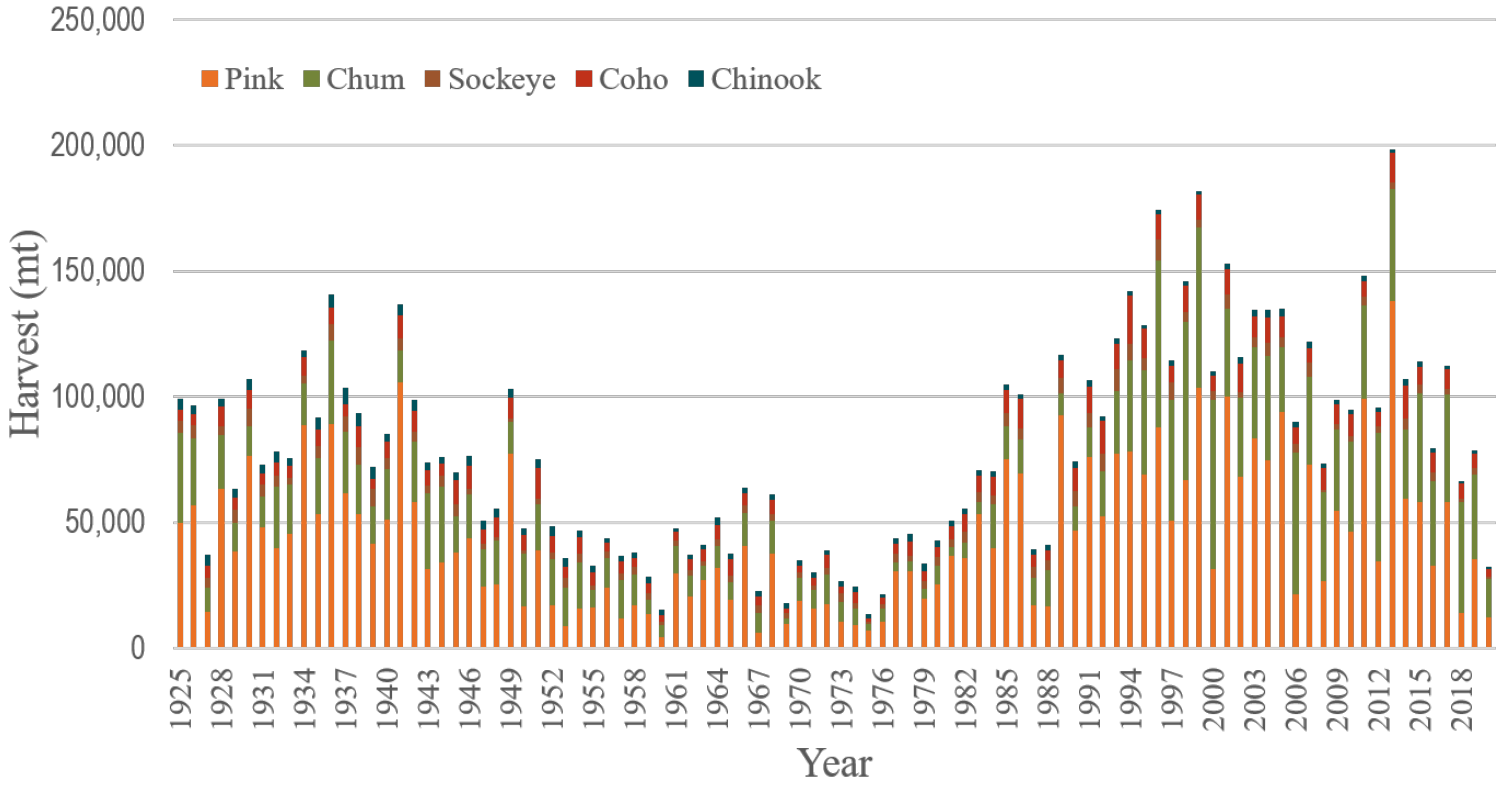
3. SALMON, MARINE MAMMALS, & SEABIRDS

Low Salmon Catches in GOA & SE Alaska

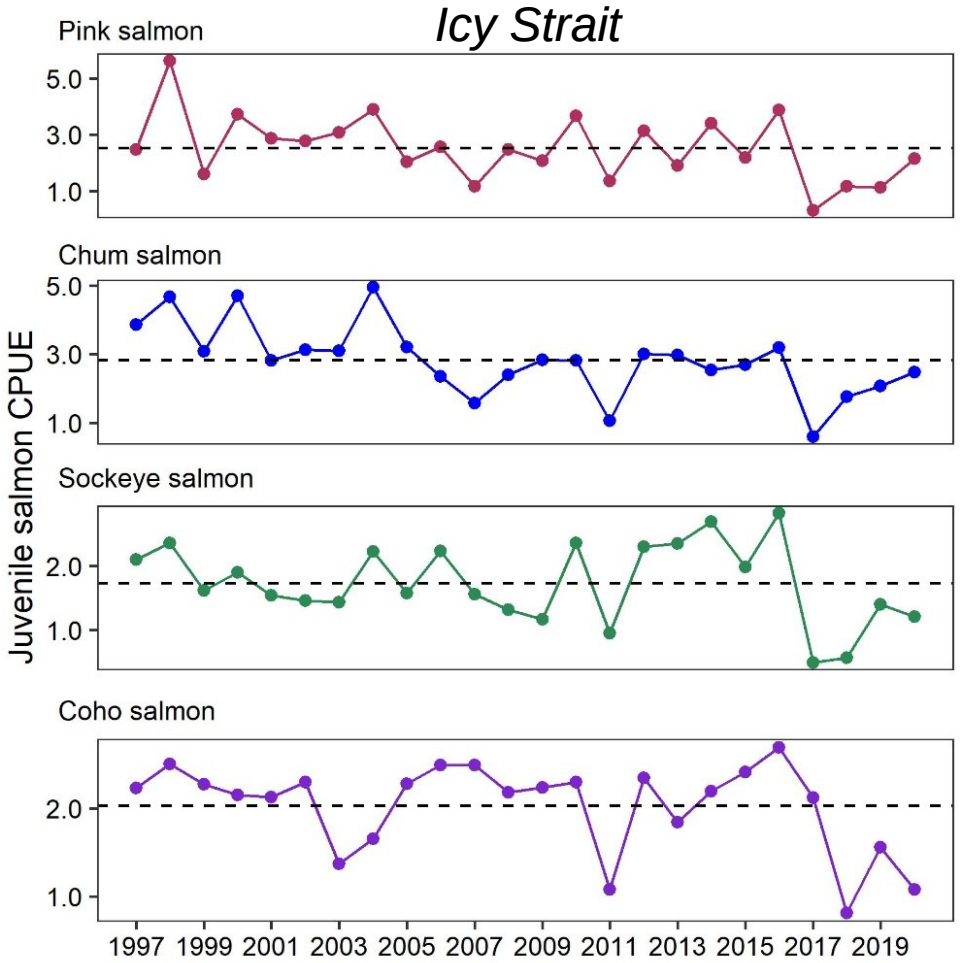
J. Murphy, R. Brenner

- 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?

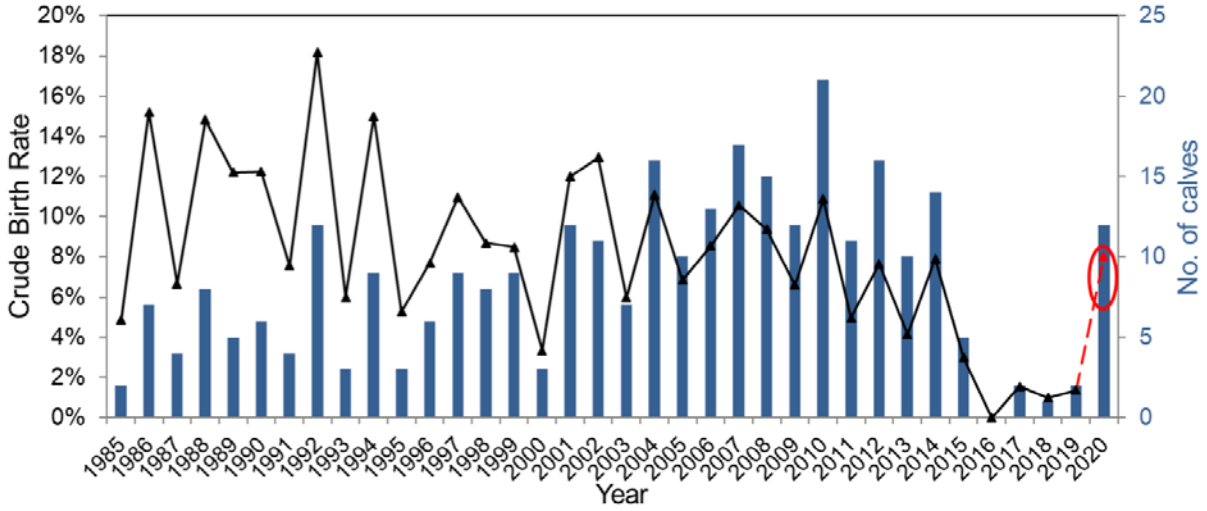
- *Glacier Bay*: **Increased #calves to pre-MHW levels**(12 calves documented in June-Aug); calf survival also increased

Increased herring?

Prince William Sound Humpback Whales

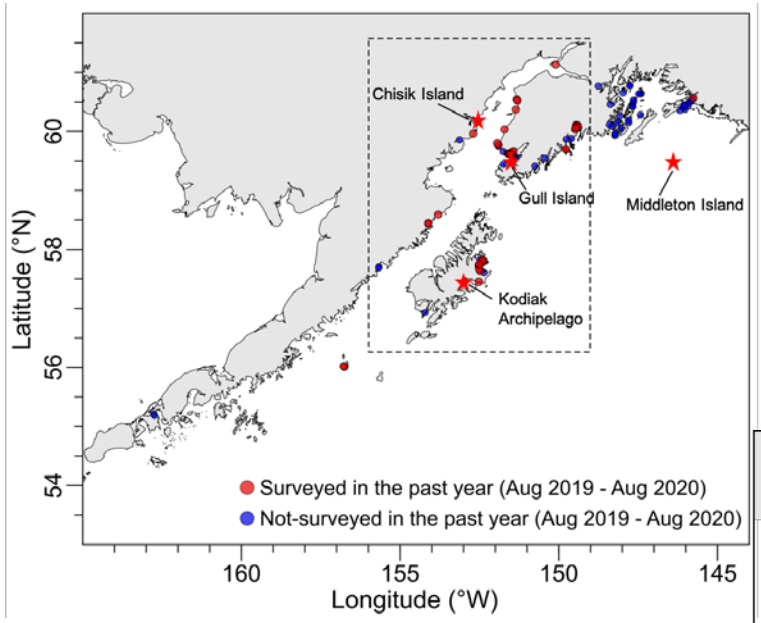
Month/year	Counts of whales	Counts of calves	Nautical miles surveyed	Encounter rate Whale/NM
Sep-08	71	17	412	0.17
Oct-11	62	2	441	0.14
Sep-12	81	5	444	0.18
Sep-13	113	6	355	0.32
Sep-14	181	1	427	0.42
Sep-17	12	0	543	0.02
Sep-18	17	1	541	0.03
Sep-19	35	0	573	0.06
Sep-20	14	2	331	0.04

Glacier Bay & 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

- Some colonies newly abandoned
- Breeding timing average
- Reproductive success fair to good
- No unusual mortality detected

Common murre, tufted puffin, pelagic cormorant, rhinoceros auklet

- Low murre colony counts
- Earlier breeding by cormorants
- Reproductive success fair to good
- No unusual mortality detected

Diving

Primarily Fish eating

Colony attendance & timing of breeding

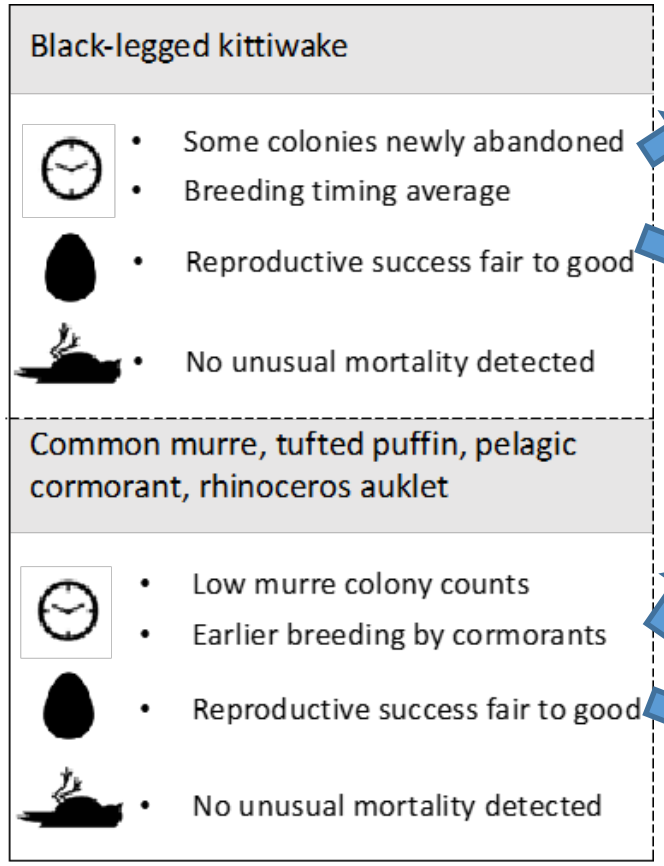
Reproductive performance

Mortality index

- 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

Mixed trends in seabird recovery from marine heatwaves: Population decline reflects lack of recovery from MHW, Reproductive success suggests increase in availability of forage fish in WGOA in 2020

**Figure & compilation by Gemma Carroll*



Surface-feeding

Diving

Primarily Fish eating

- (Kodiak Archipelago) **Trend of abandonment** of colonies (2 additional colonies)
- (Middleton Island & Kodiak Arch.) Breeding **timing** was **average**

- (Kodiak Arch.) **Variable reproductive success**
- (Middleton Isl.) **Strong reproductive success**, following poor breeding beginning in 2014

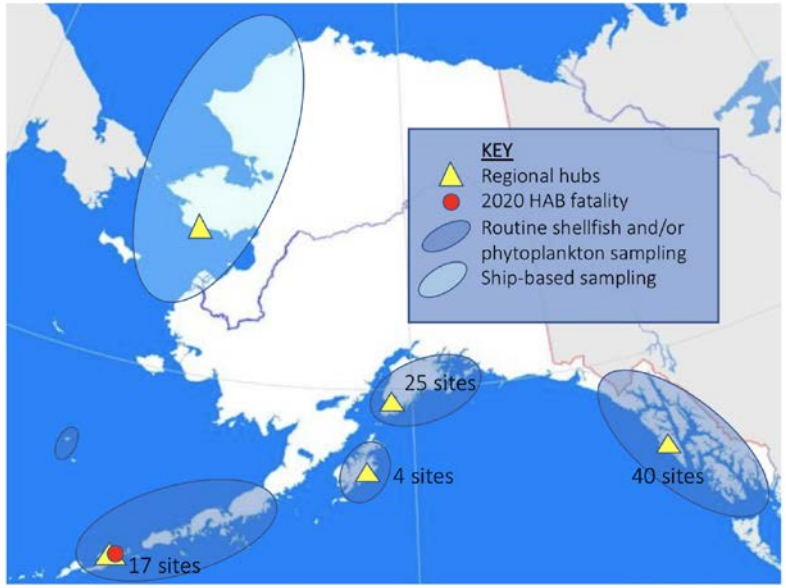
- Tufted puffin (Kodiak Arch.) Breeding **timing was not unusual**
- Pelagic cormorants (Middleton Isl.) Breeding **timing was earlier**
- Common murres (Cook Inlet) **Declining population trend** in nesting colonies

- Tufted puffins (Kodiak Arch.) **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.) **Highest breeding success** since 2008/at least 2002
- Common murres (Cook Inl.) **Produced chicks** for the 1st (Chisik Isl.) and 2nd time (Gull Isl.) since 2014 marine heatwave

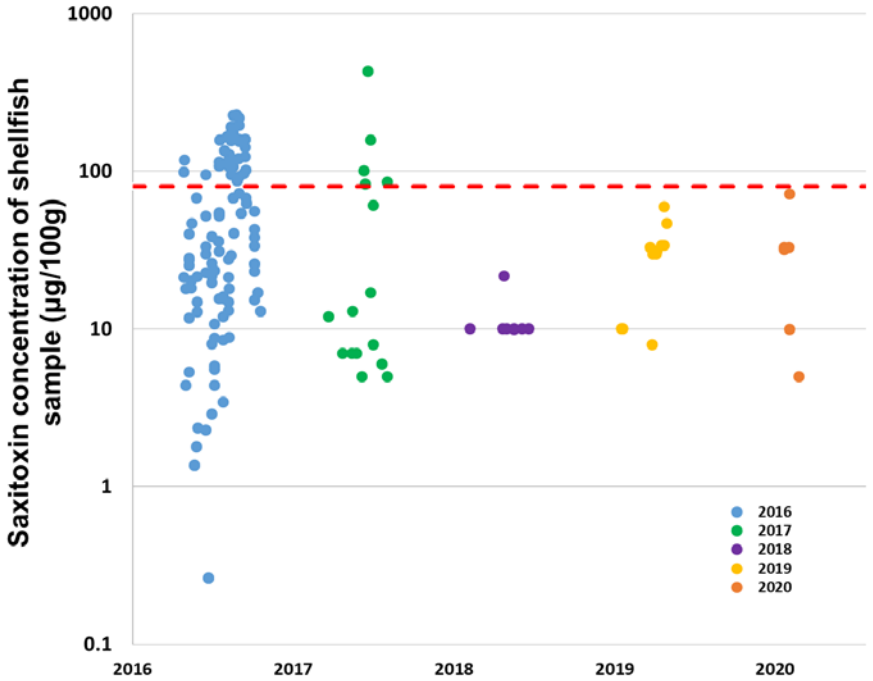
Mixed trends in seabird recovery from marine heatwaves: Population decline reflects lack of recovery from MHW, Reproductive success suggests increase in availability of forage fish in WGOA in 2020

Harmful Algal Blooms

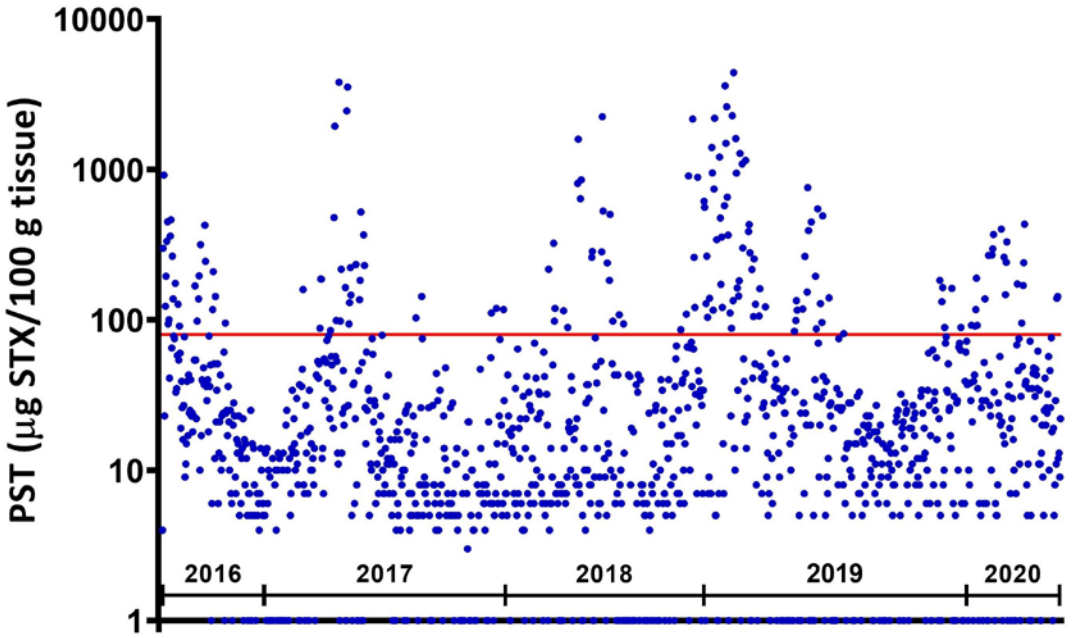
Alaska Harmful Algal Bloom Network (AHAB)



- 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.

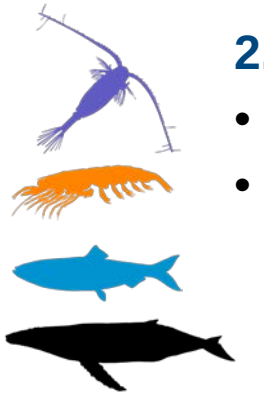


SEAK and Kodiak communities. Data provided by SEATOR

GOA **2020**: Key Messages

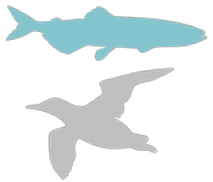
1. Return to long-term mean surface temperature after 2014-2016 and 2019 heatwave years

- 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 groundfish, seabird, whale populations still low — *some seabirds show colony abandonment, low population (e.g., murres), and Prince William Sound humpback whales*

2020 Gulf of Alaska Ecosystem Status Report:

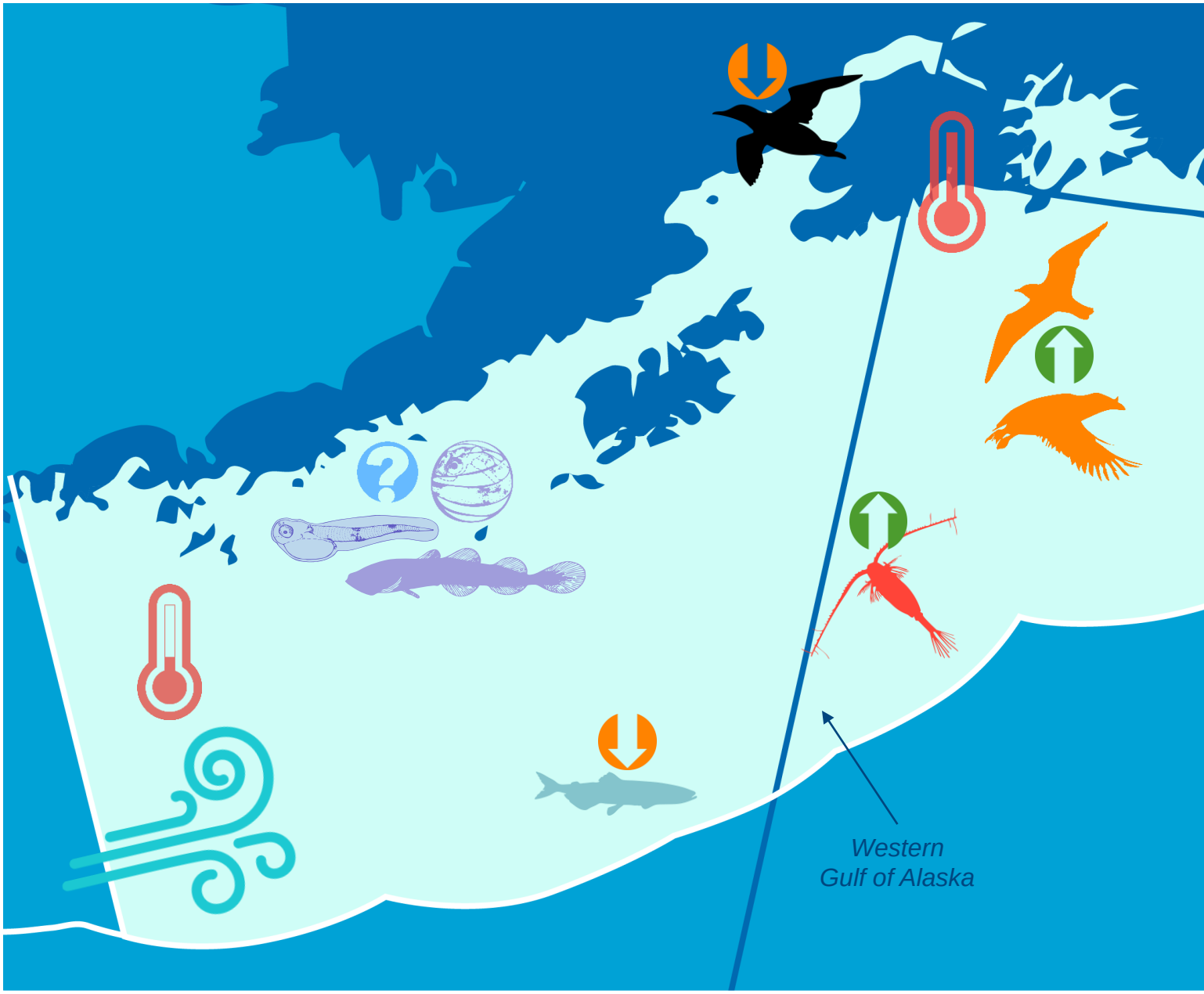
IN BRIEF

Overview

Conditions in the Gulf of Alaska were close to average in 2020.
Key observations include:

- Sea surface temperatures returned to the long-term mean after 2014-2016 and 2019 heatwave years, with a warm summer and fall.
- Forage conditions were average or improved over past years. This may have contributed to the increased reproductive success of some seabird and humpback whale populations.
- Some species continue to be affected by past marine heatwaves and elevated ocean temperatures.

NOAA FISHERIES
Alaska Fisheries Science Center



Sea Surface Temperatures About Average in 2020

This year, sea surface temperatures returned to the long-term mean after 2014-2016 and 2019 heatwave years, with a warm summer and fall.

Last year's (2019) marine heatwave persisted throughout the year and ended December, 2019. **Sea surface temperatures** then cooled to near-long term averages in the winter and spring of 2020. This was followed by warmer temperatures in the summer in the western Gulf of Alaska), and in the fall in the western and eastern Gulf of Alaska .

Western Gulf of Alaska temperatures fluctuated around the marine heatwave threshold (above the 90th percentile for five consecutive days) in the summer. Heatwave conditions have persisted from September through present (November 2020). Sea surface temperatures during winter and spring of 2021 are predicted to be average or cooler than average, with the arrival of **La Niña**. The average temperatures in the first half of the year provided improved later winter/spring conditions for groundfish who spawn on the continental shelf (e.g., Pacific cod, **walleye pollock**, and northern rock sole), relative to 2019. We expect the current heatwave conditions will have a reduced impact on the Gulf of Alaska groundfish community because of the late onset and predicted cooling in 2021.

Increased Food Availability in 2020

Forage conditions were average or improved over past years. This may have contributed to the increased reproductive success of some seabird and humpback whale populations. Specifically, seabird breeding success on Middleton Island, Kodiak, and Cook Inlet (e.g., fish-eating surface feeders: **black-legged kittiwakes** and **rhinoceros auklets**) and for the Glacier Bay/Icy Strait humpback whale population suggest improved forage fish availability and abundance in 2020. However, some key prey species such as **capelin** are still at low abundance.

Forage conditions (availability of high fat content zooplankton and forage fish) for groundfish and higher trophic level species were generally average or above average in 2020. Zooplankton biomass (abundance by weight) was above the long-term average. An increase in **large calanoid copepod** biomass was observed around the Seward Line and Icy Strait. At the same time, there was a decrease in the biomass of **smaller copepods** and about average biomass of **euphausiids** around Icy Strait. However in the inside waters of the Strait, euphausiid biomass was lower than previous years.

Limited data on forage fish suggest improving forage conditions, since the 2014-2016 marine heatwave years, for piscivorous groundfish, some fish-eating seabirds (e.g., black-legged kittiwakes and rhinoceros auklets on Middleton Island) and **humpback whales** (Glacier Bay/Icy Strait). Abundance of mature (age 3+) **Pacific herring** increased in 2019 to highest levels in the time series in Sitka Sound (since 1980) and Craig (since 1988). Other regions across the Gulf of Alaska (including Prince William Sound) also saw increased abundance, although overall herring stock sizes remain low. Preliminary 2020 data show similar elevated herring abundance.

Juvenile salmon in Southeast Alaska continue to increase from low abundance levels in 2017. However, **juvenile sockeye** and **coho** decreased from 2019 levels.

Previous Marine Heatwaves Continue to Impact Some Species

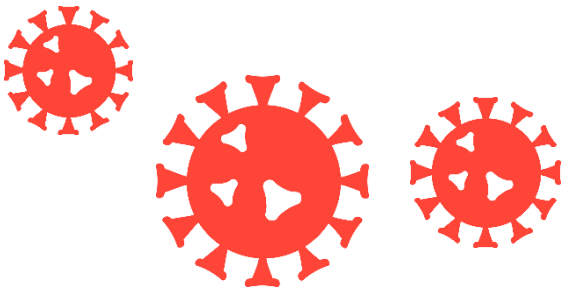
Effects of the 2014-2016 and the 2019 marine heatwave years are still evident in the Gulf of Alaska.

Deeper shelf waters (100-200m), observed from nearshore to offshore of Seward, still have elevated temperatures. This has potential implications for the early survival of groundfish that use these habitats for spawning (e.g., Pacific cod).

While some forage fish conditions have been improving, others, such as capelin, have remained at low levels since the 2014-2016 heatwave.

Seabird and whale populations continue to be affected by previous warm years. This includes the decreasing common murre population counts in Cook Inlet, abandoned nesting colonies of black-legged kittiwakes around Kodiak, and low numbers of humpback whales observed in Prince William Sound.

Hot Topics



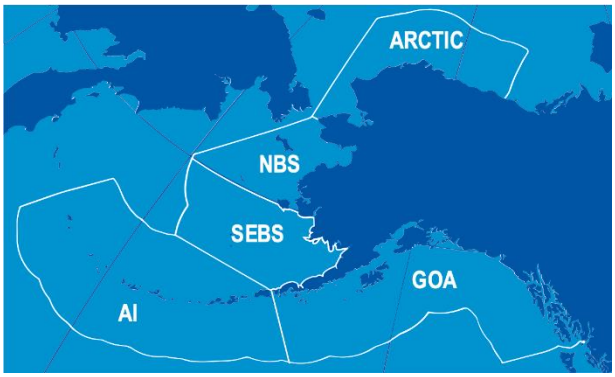
COVID-19: Fishing and harvesting businesses in Alaska were considered 'essential businesses' under 2020 COVID regulations. They proceeded, at a substantial cost, while striving to maintain a safe working environment for their employees and minimize spread to local community residents. Impacts on harvesting and processing businesses included a reduction in transportation options, limited ability to switch crews throughout the fishing seasons, and market shifts (e.g., from food service to shelf stable products).

Low Commercial Salmon Catch in Gulf of Alaska: In 2020, commercial salmon catches were the lowest in Gulf of Alaska since 1985 and the lowest in Southeast Alaska since 1976 (driven by pink, sockeye, and chum salmon). These low adult returns in Southeast Alaska reflect low early marine survival of juvenile salmon observed in 2017-2019. They pose a social economic concern for 2020.

Management Uses

Ecosystem information was formally considered in seven full, and one partial, stock assessments for Gulf of Alaska groundfish stocks in 2020.

The remainder of this section will be completed following the December 2020 North Pacific Fishery Council Meeting.



Reference: Ferriss, B.E. and S. Zador 2020. Ecosystem Status Report for the Gulf of Alaska, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, AK 99501.

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More information on these and other topics can be found on the Ecosystem Status Report website.

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