Ecosystem Status Report: Eastern Bering Sea 2023

Elizabeth Siddon

With contributions from:

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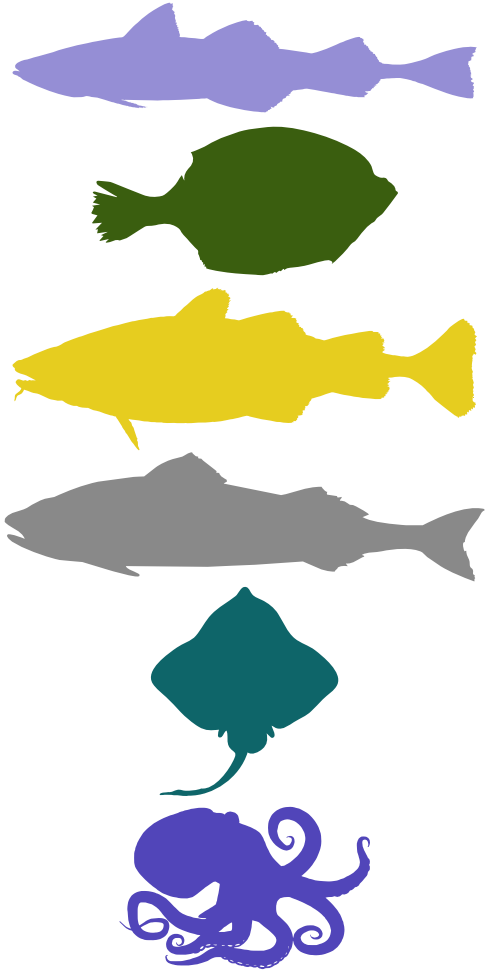
NOAA FISHERIES

Outline

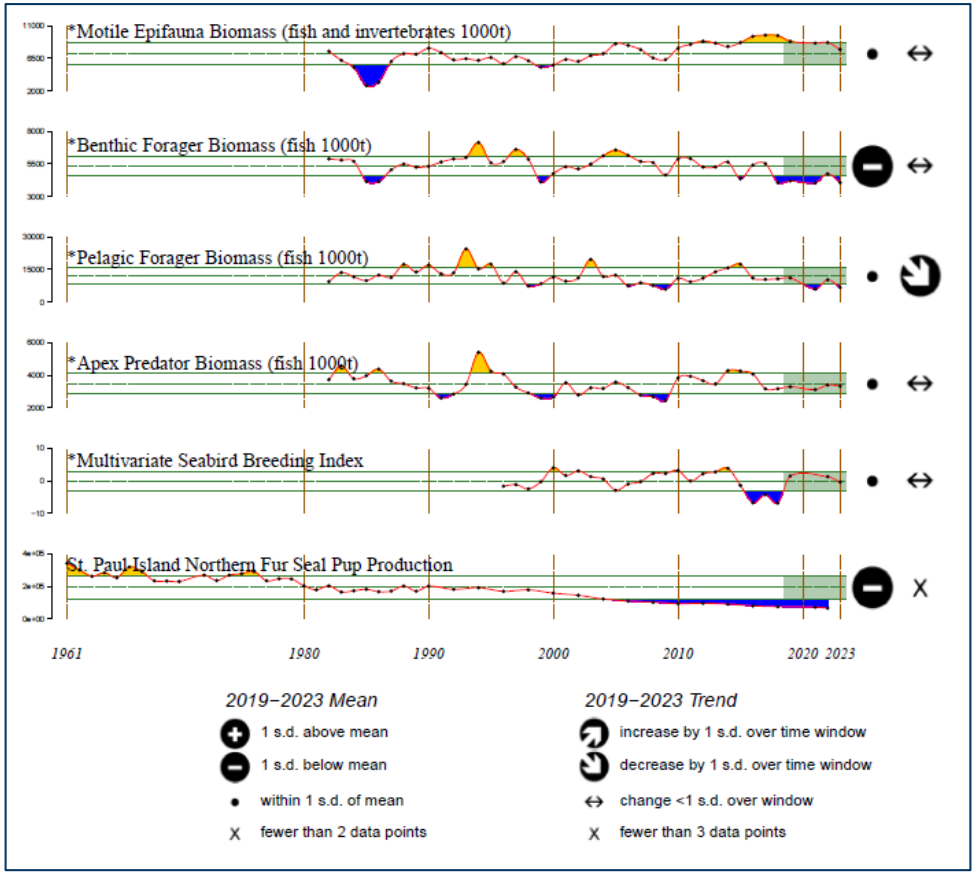
- Risk table scores
- Noteworthy Topic
- Ecosystem assessment
  - Southeastern Bering Sea
  - Northern Bering Sea

Ecosystem Considerations for Risk Tables



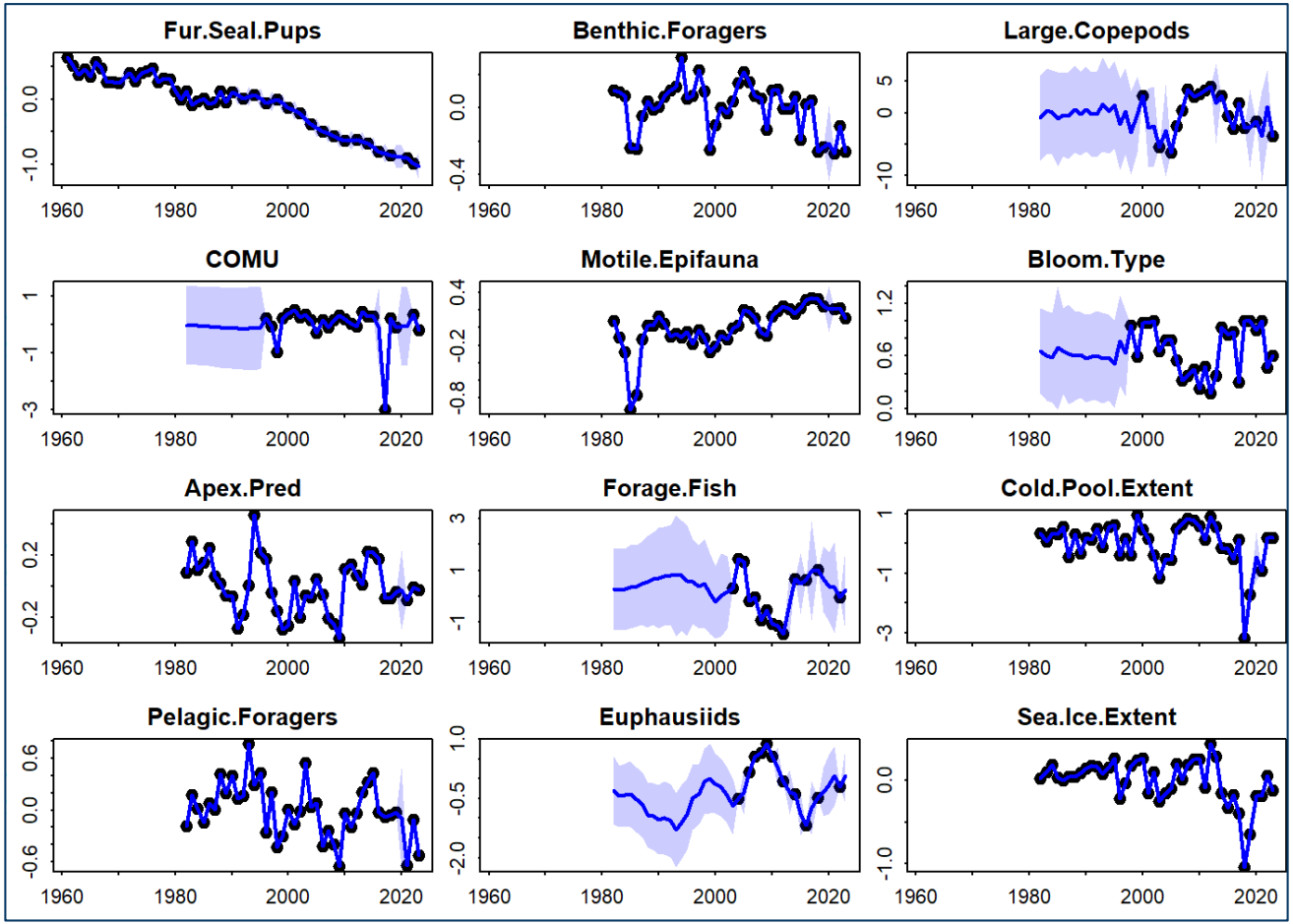
Pollock Level 2	Multiple indicators of primary and secondary productivity show adverse signals borne out in continued declining trends in juvenile and adult fish condition.
Yellowfin sole Level 2	Multiple indicators across the same trophic level are present in the consistent declines in fish condition for flatfishes. In addition, there are bottom-up concerns for prey availability.
Pacific cod Level 1 +ESP	ESR + ESP indicators together suggest no increased concern for the stock at this time.
Sablefish Level 1 +ESP	ESR + ESP indicators together suggest no increased concern for the stock at this time. *Note:* impact of juvenile sablefish in the EBS ecosystem remains unknown.
Skates Level 1	Proper evaluation of risk is difficult for a data-limited stock. However, available data suggests no increased concern for the stock at this time.
Octopus Level 1	Proper evaluation of risk is difficult for a data-limited stock. However, available data suggests no increased concern for the stock at this time.

Quantifying Linkages Among Report Card Indicators



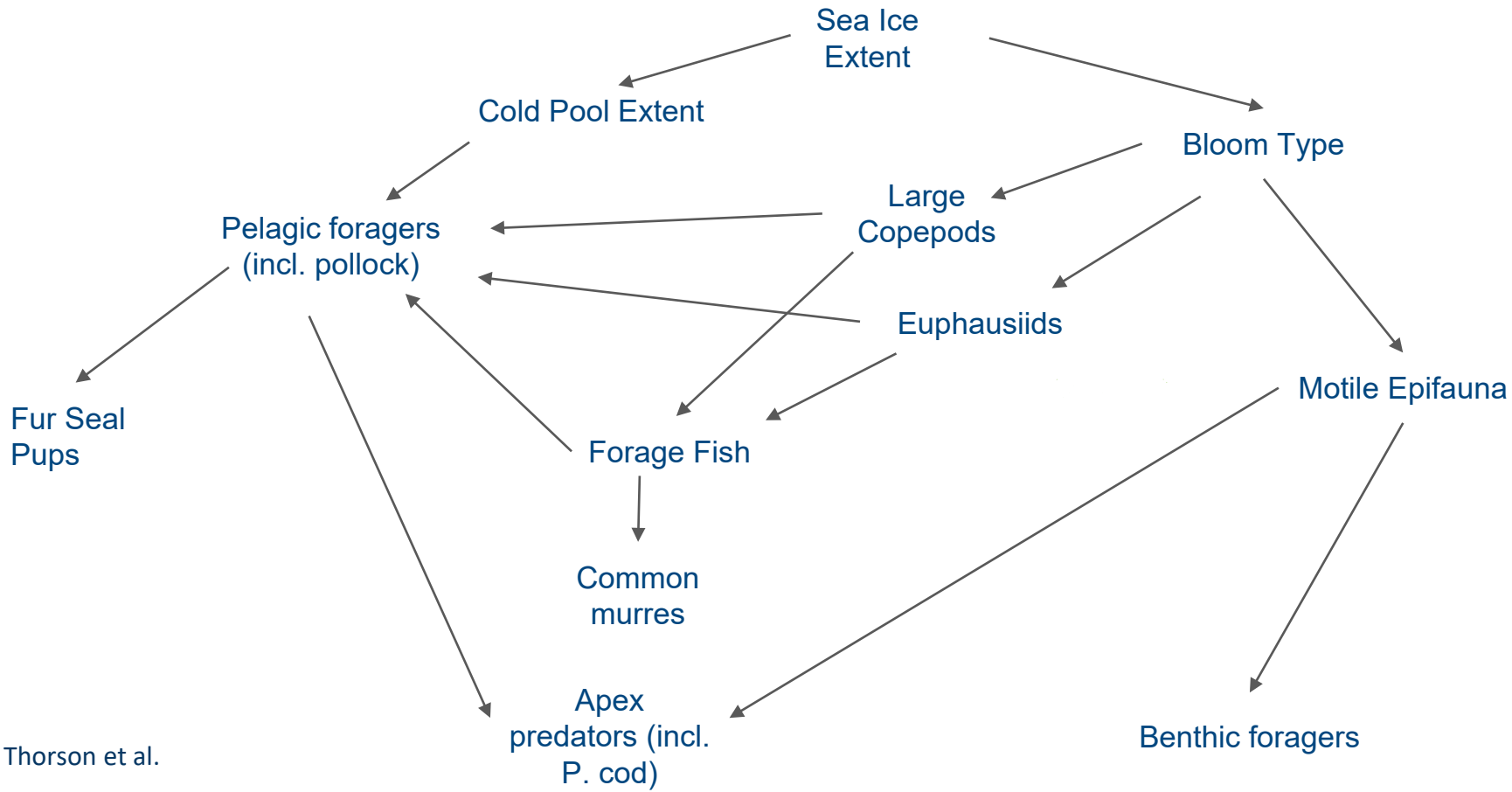
Thorson & Siddon with contributions from Barnett, Kimmel, Nielsen, Ressler, Rohan, Rustand, Thoman, Towell, Whitehouse, and Yasumiishi and methods development with Andrews and Large

Quantifying Linkages Among Report Card Indicators



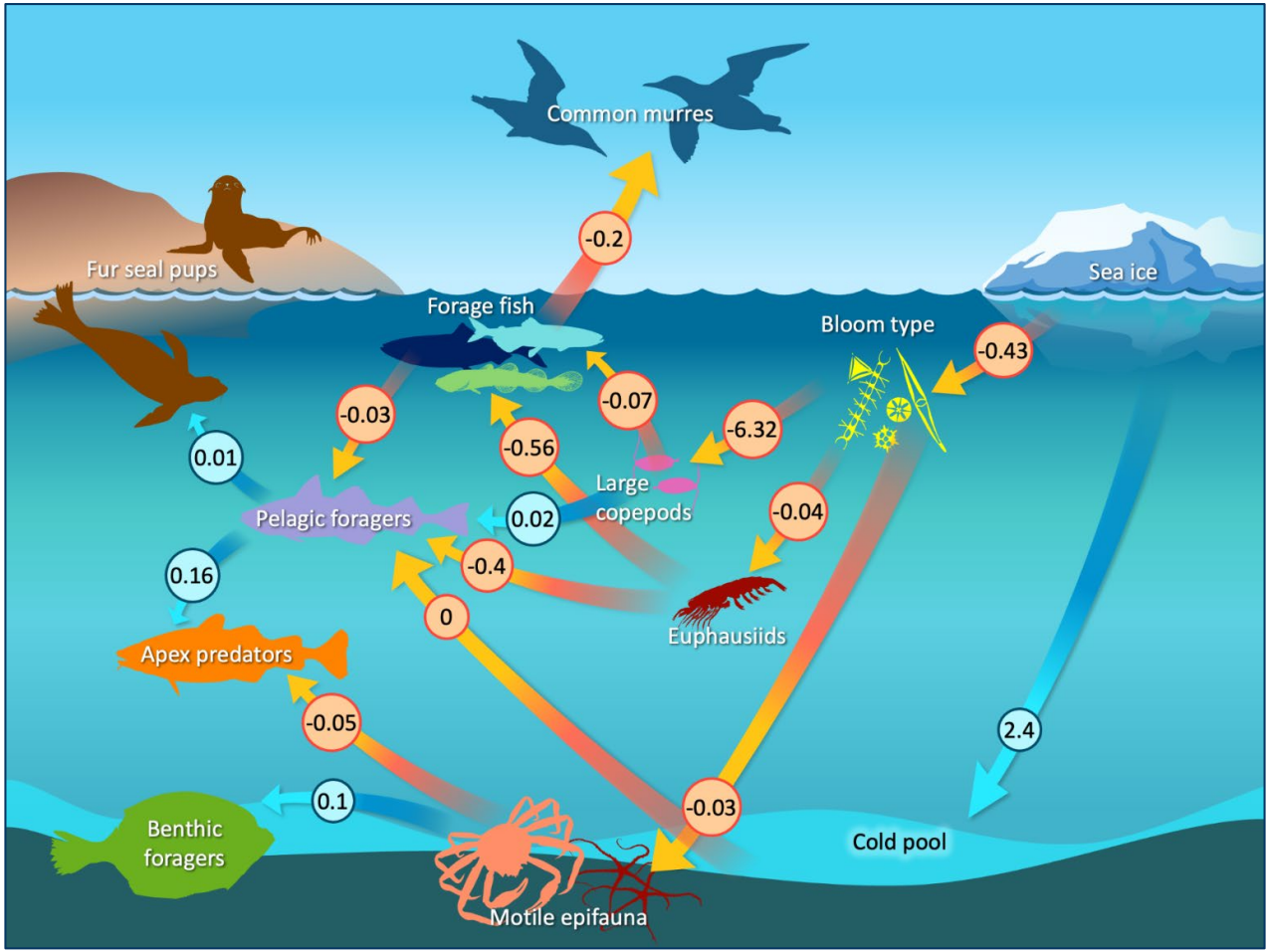
Thorson et al.

Quantifying Linkages Among Report Card Indicators



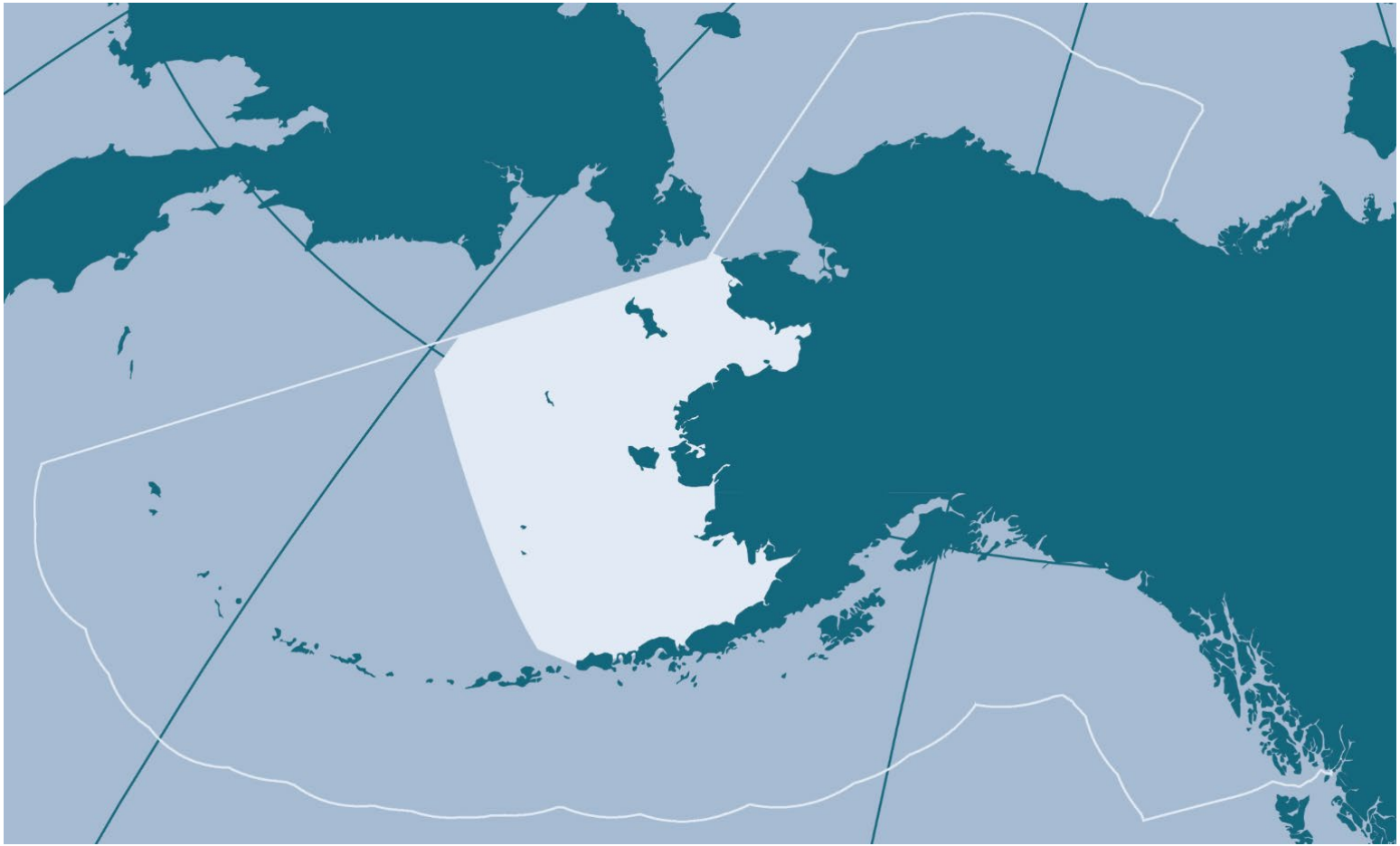
Thorson et al.

Quantifying Linkages Among Report Card Indicators

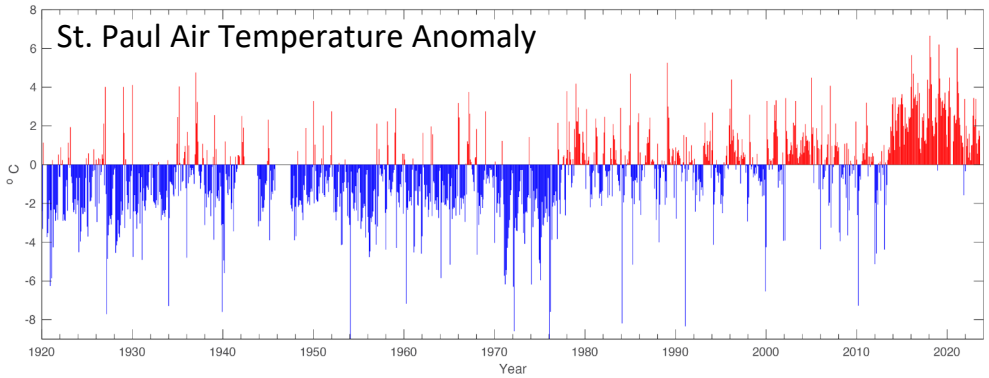


Thorson et al.

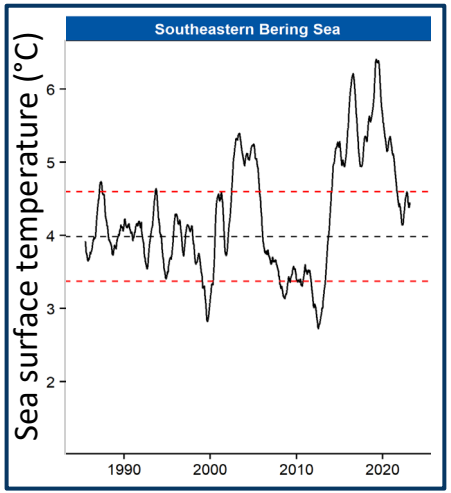
Ecosystem Assessment

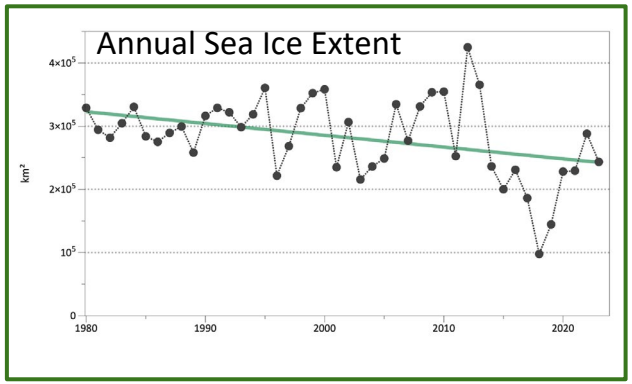


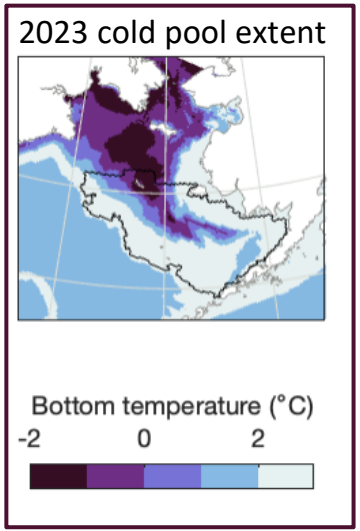
*The Bering Sea has **cooled** relative to the recent warm stanza (2014-2021), but largely **remains warmer** than average*



- Sea surface temperatures are within 1SD of the 30-year mean (1985-2014).
- Annual sea ice extent increased, but similar low ice years prior to 2010.
- Cold pool extent was average.

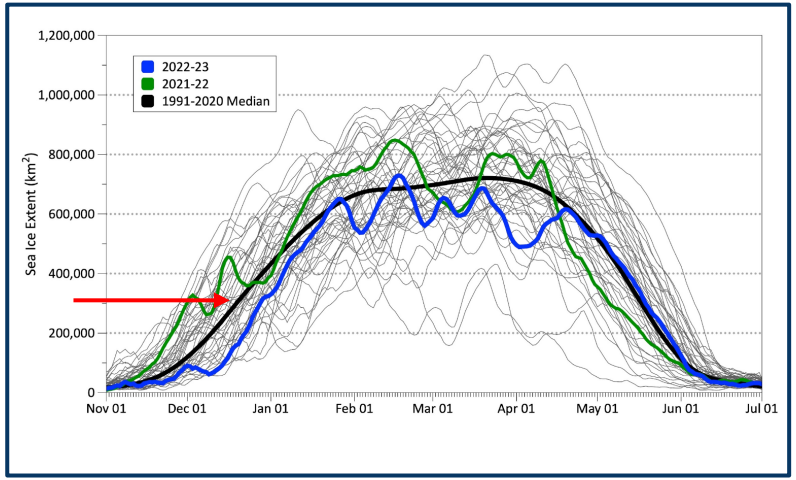


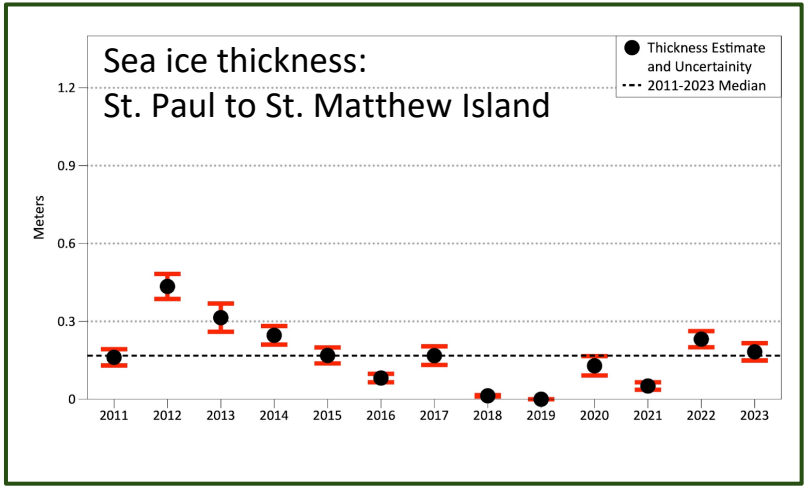


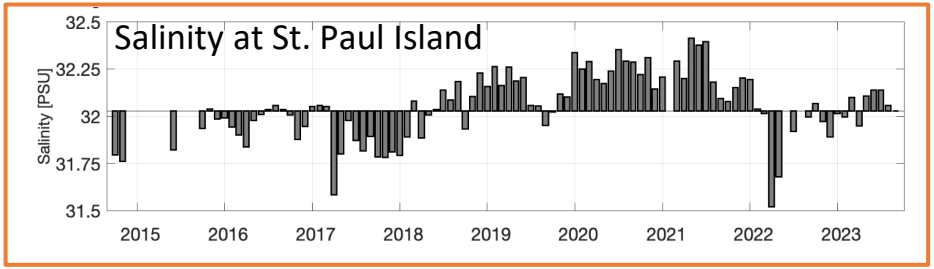


Overland & Wang, Lemagie & Callahan, Thoman, Kearney

Sea ice dynamics impact the vertical stratification of the water column, which impacts biological dynamics





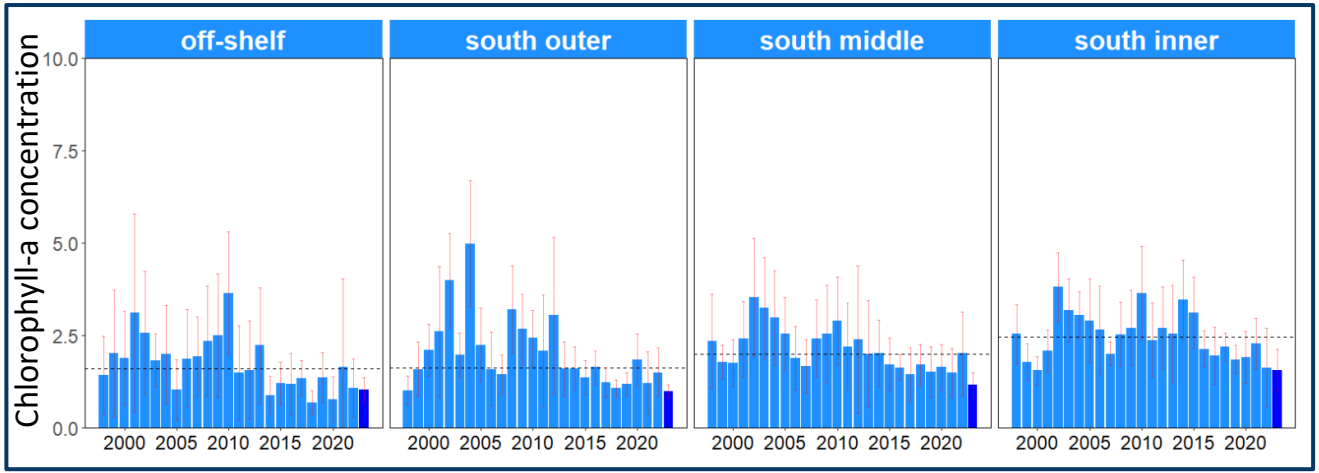


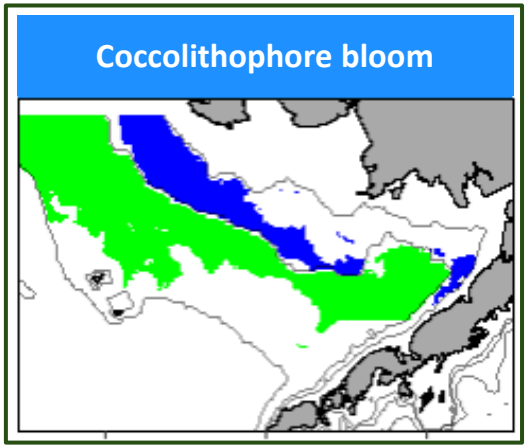
- Delayed freeze-up due to warm SSTs.
- Sea ice thickness at time series median (2011-2023).
- Salinity increased during the warm stanza (lack of freshwater input from sea ice melt), but that trend slowed since 2022.

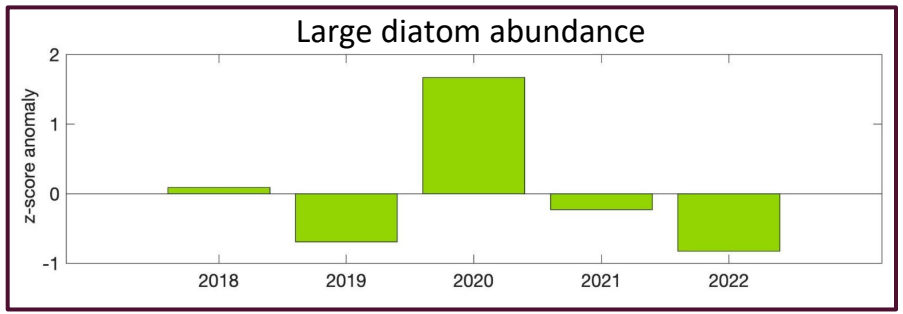
* Stratification index planned for 2024.

Thoman, Thoman, Divine et al.

Metrics indicate poor primary productivity over the southern shelf



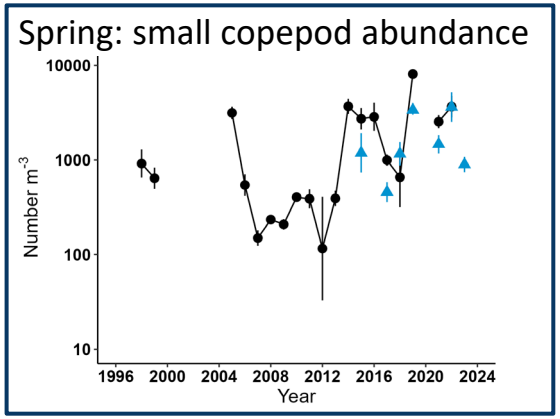




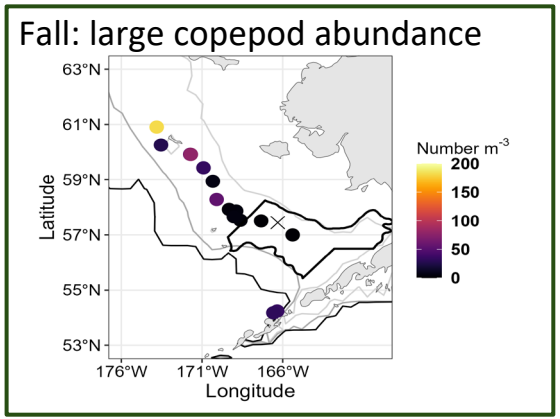
- Chlorophyll-a concentrations were among the lowest across sub-regions.
- Coccolithophore bloom was highest in the time series (1997–2023).
- Large diatoms from the continuous plankton recorder (CPR) show a declining trend 2020–2022.

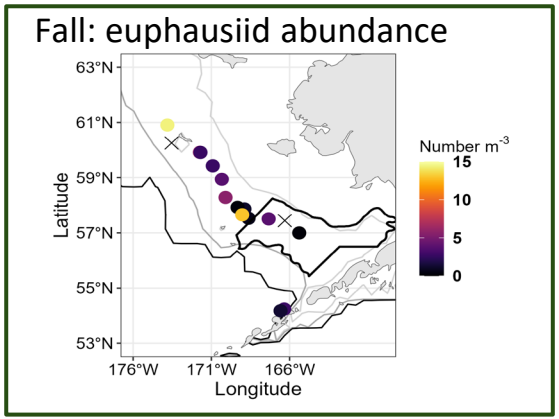
Nielsen et al., Nielsen & Eisner, Ostle & Batten

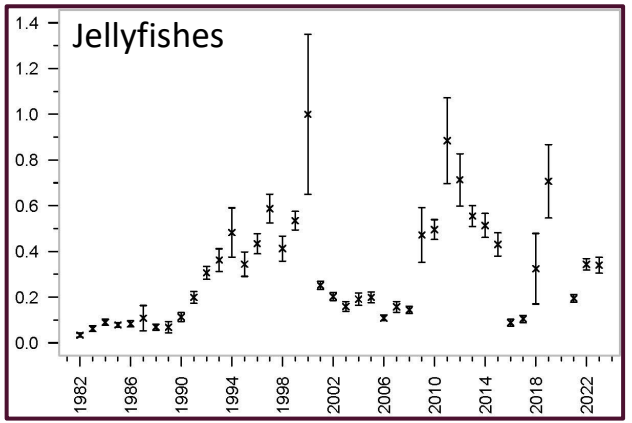
Secondary productivity was moderate to low over the southern shelf



- Spring: moderate abundance of small copepods; low abundance and low lipid content of large copepods and euphausiids.
- Fall: moderate abundance of small copepods continued; abundance of large copepods and euphausiids low, but increased south to north.
- Jellyfish abundance was average; competitors with plankton-feeders.

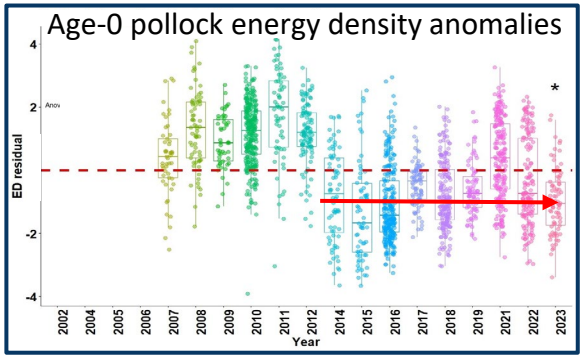


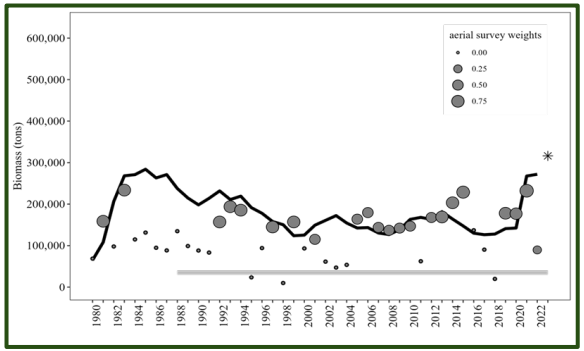




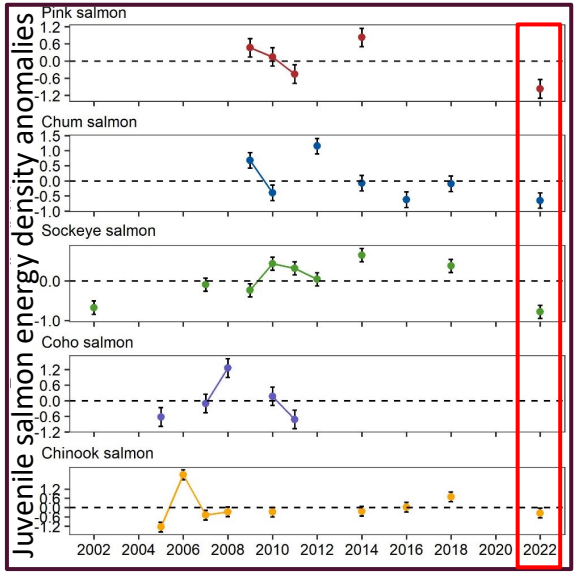
Kimmel et al.

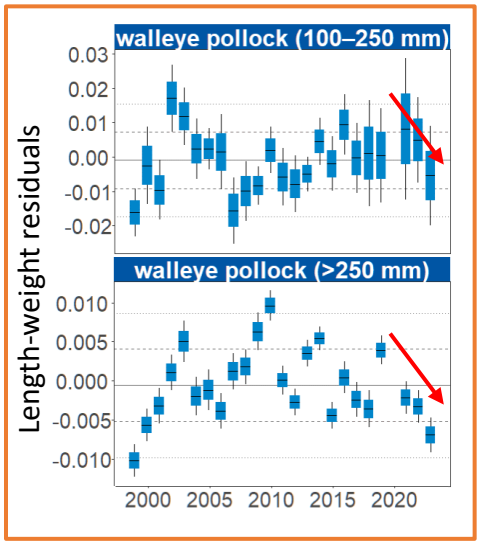
Integrated measures of pelagic productivity were mixed

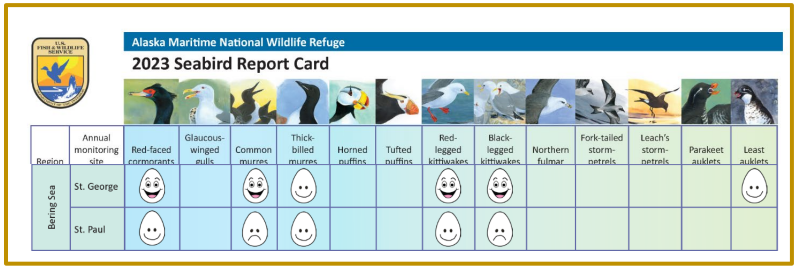




- Age-0 pollock condition remained low.
- 2022 juvenile salmon condition was low.
- Juvenile and adult pollock condition continued to decline.
- Togiak herring biomass high (strong 2016 & 2017 year classes).
- Bristol Bay sockeye biomass high since 2015 (not shown).
- Seabird reproductive success was mixed; higher on St. George Island than on St. Paul Island.

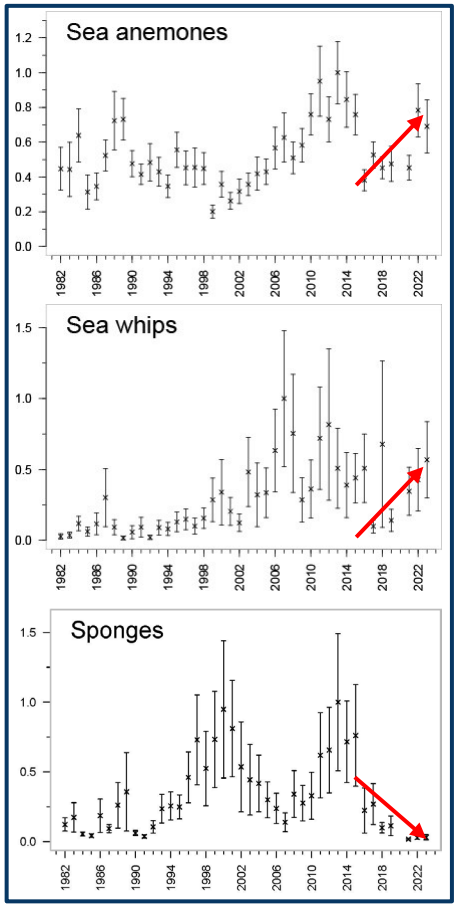


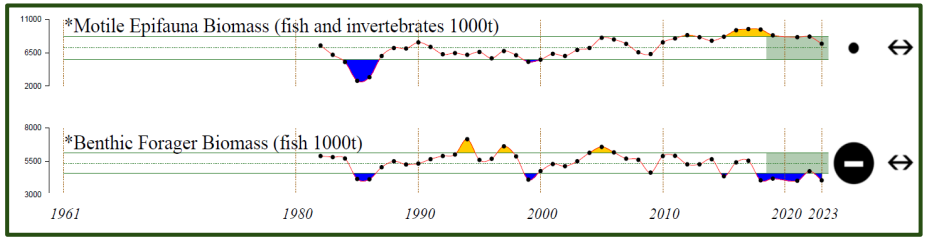


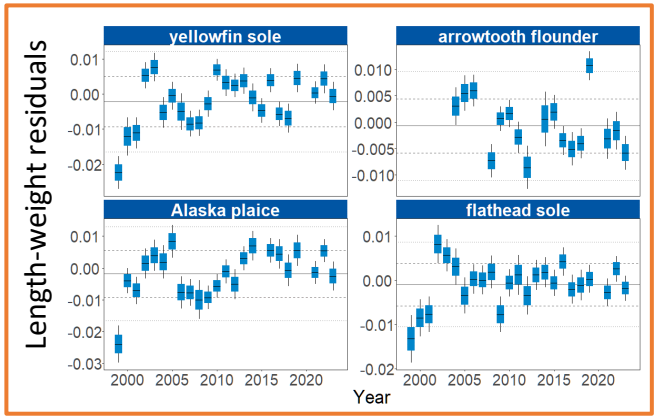


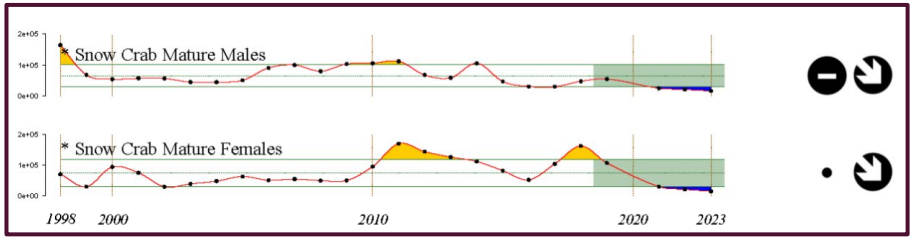
Page et al., Fergusson et al., Prohaska & Rohan, Joy et al., Divine et al.

Direct and indirect measures of benthic productivity were mixed, but largely showed declines





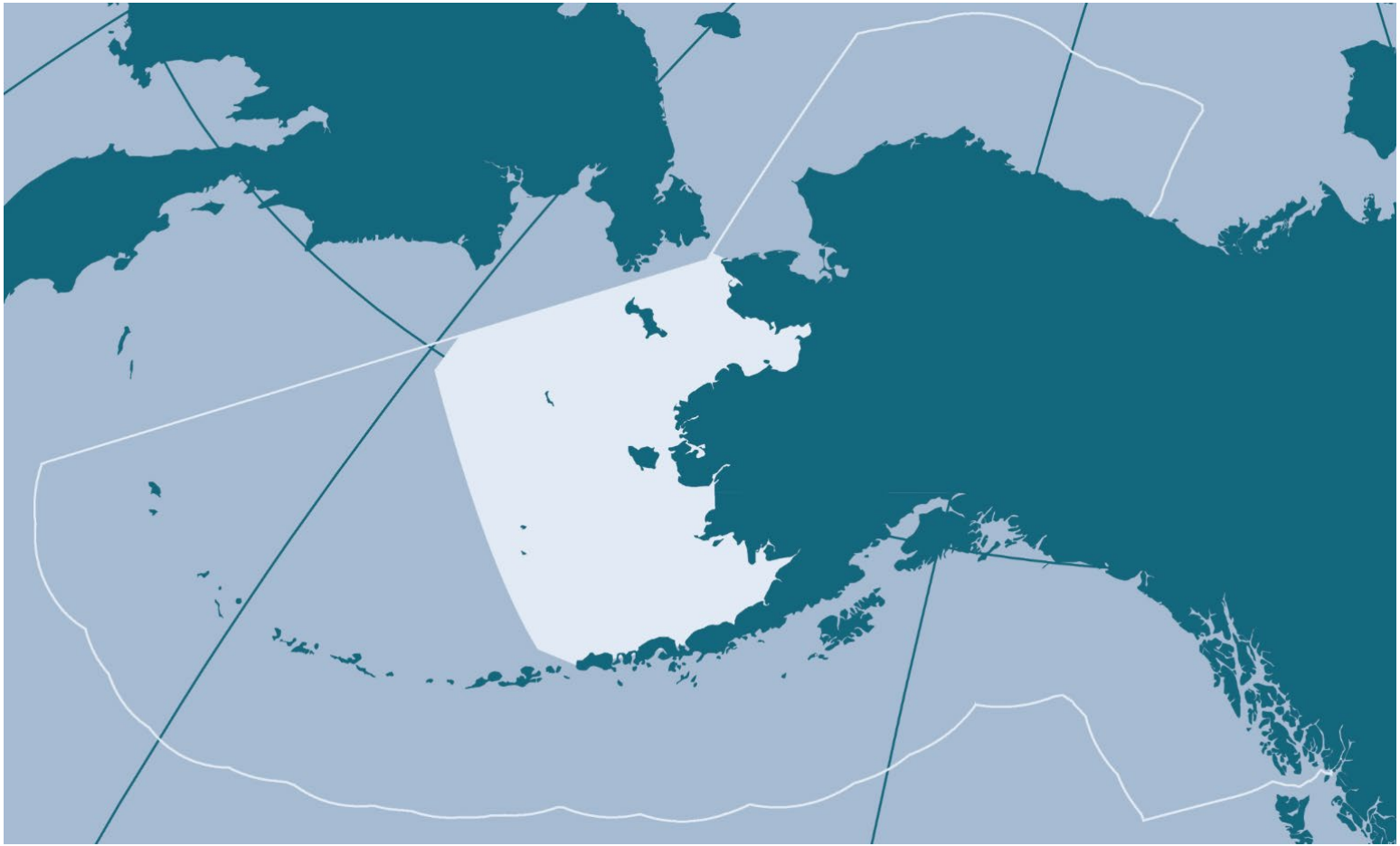




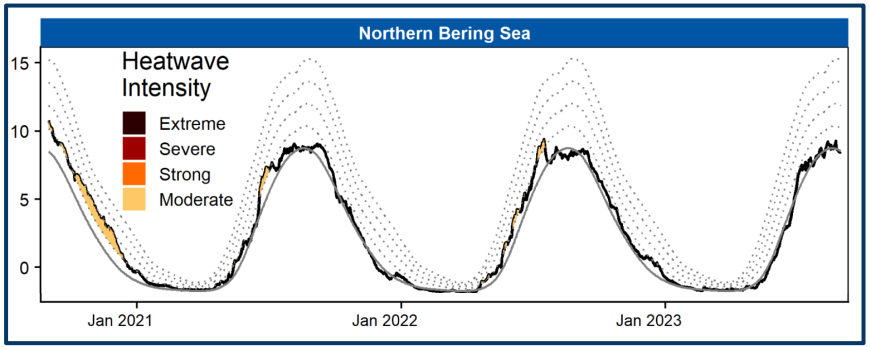
- Structural epifauna trends mixed.
- Motile epifauna declined since 2017, but above time series mean (1982–2023).
- Echinoderms have increased, crabs have decreased.
- Benthic foragers remain below the mean.
- Flatfishes may be experiencing prey limitations.
- Several crab stocks showed biomass declines in 2023.

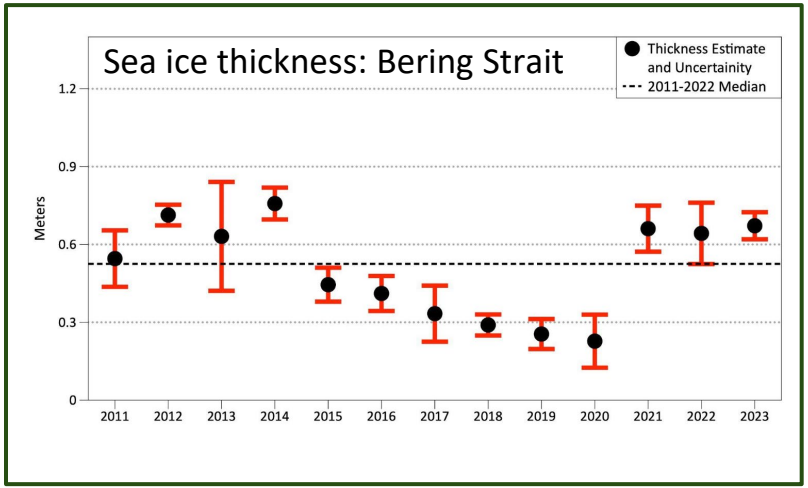
Buser, Whitehouse, Prohaska & Rohan, Richar

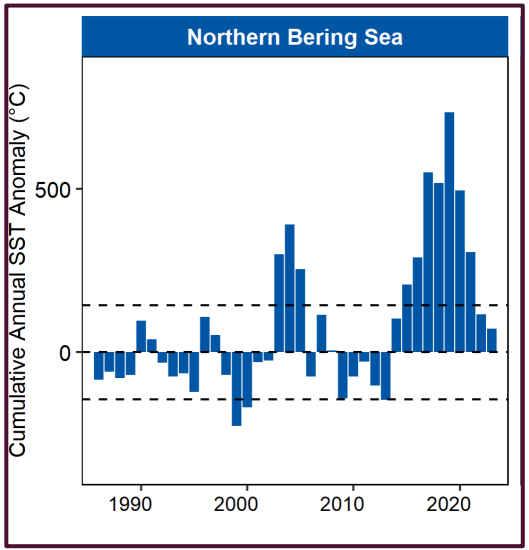
Ecosystem Assessment



Northern Bering Sea also transitioned to more average physical conditions since 2021; Biological response has differed from the southeastern shelf ecosystem



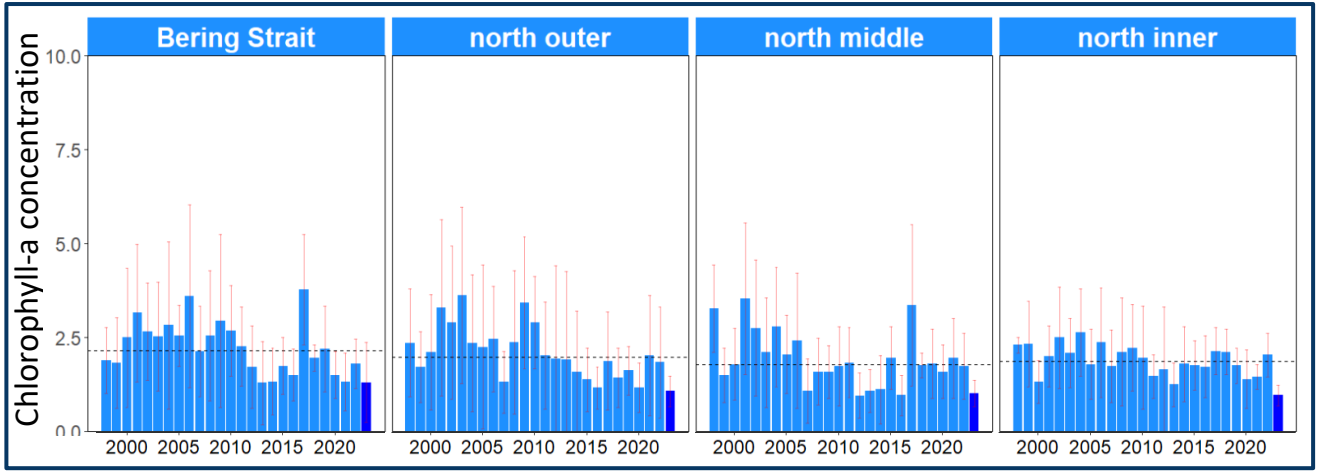


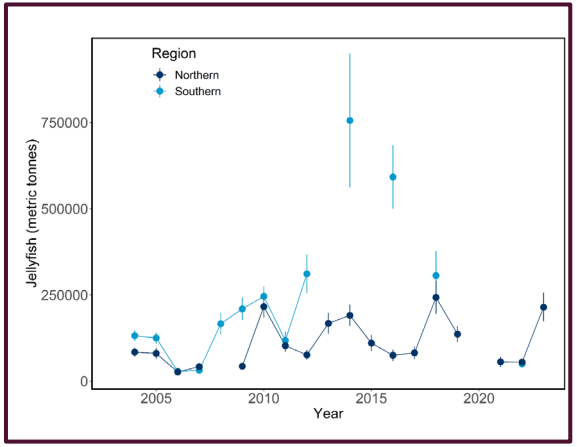


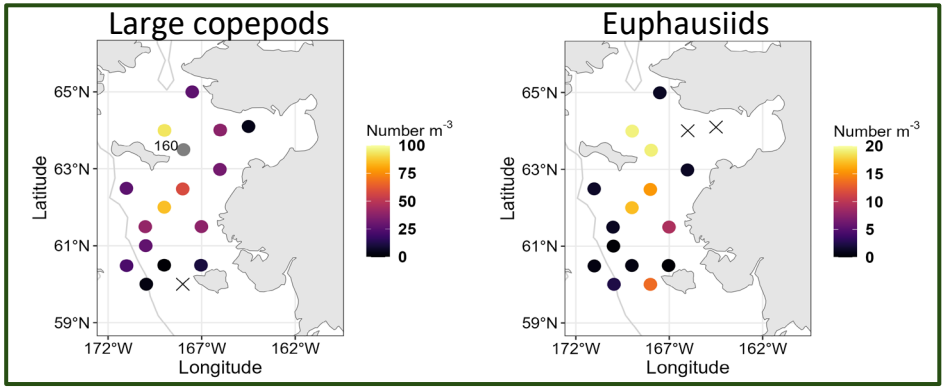
- No prolonged marine heatwaves since January 2021.
- Sea ice thickness above time series median (2011-2023) since 2021.
- SSTs within 1SD; organisms experienced reduced cumulative thermal exposure and metabolic demands.

Lemagie & Callahan, Thoman, Lemagie & Callahan

Primary productivity was low; Secondary productivity was higher, especially for euphausiids



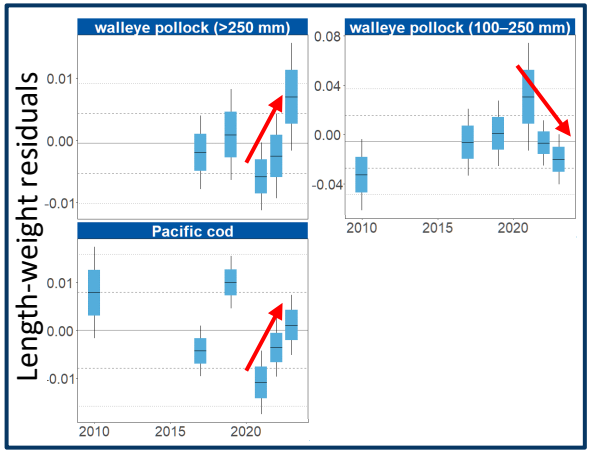


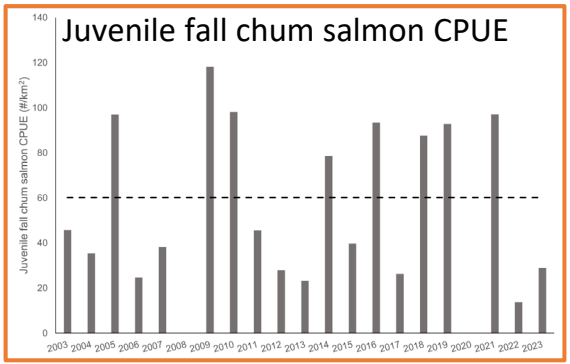


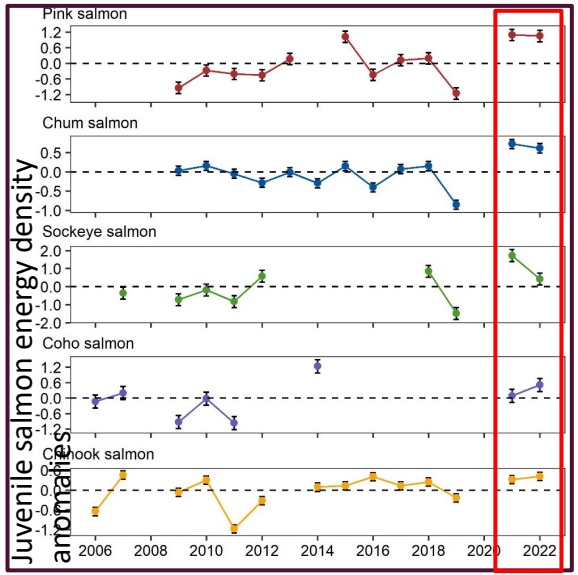
- Chlorophyll-a concentrations among the lowest across sub-regions.
- Hot spots of large copepods and euphausiids observed around St. Lawrence Island.
- Jellyfish, potential competitors for zooplankton prey, increased over the NBS shelf.

Nielsen et al., Kimmel et al., Yasumiishi et al.

Integrated measures of pelagic productivity were mixed



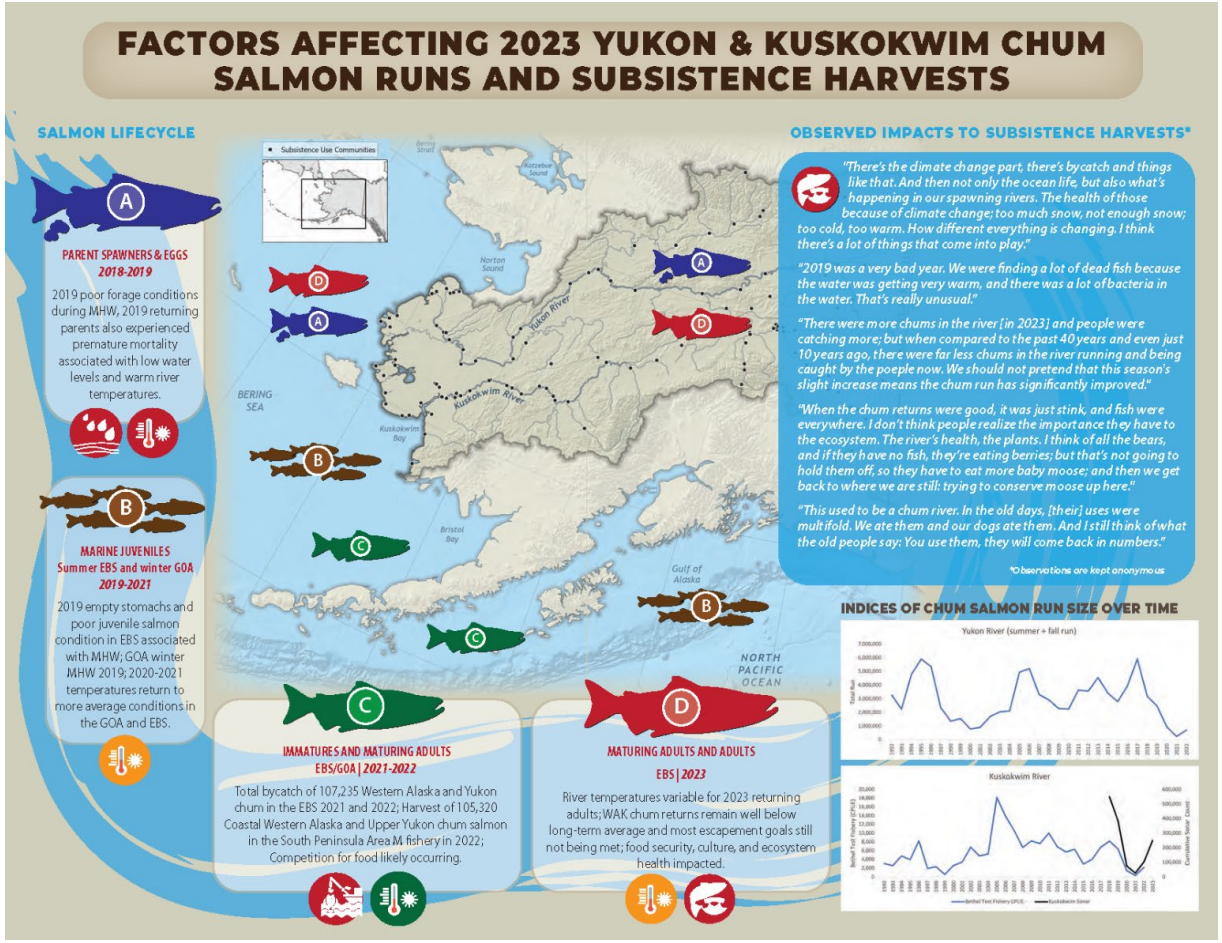




- Adult pollock condition highest in time series; juvenile pollock decreased since 2021.
- Pacific cod condition increased to average in 2023.
- Qualitative observations from St. Lawrence Island indicated that seabirds did well in 2023.
- In 2022, juvenile salmon condition was positive for all species in the NBS.
- Slight increases were observed in juvenile Chinook and chum salmon indices in 2023.

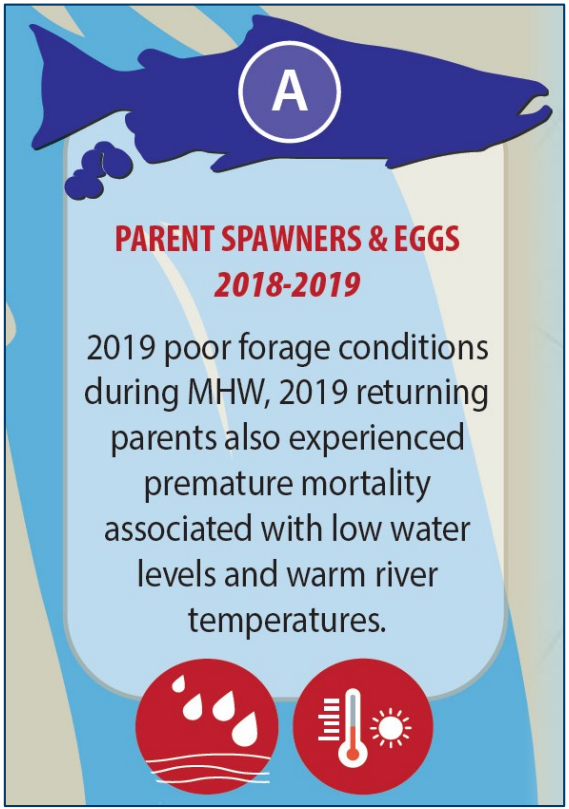
Prohaska & Rohan, Integrated Seabird Information, Fergusson et al., Murphy et al.

Factors affecting 2023 Yukon & Kuskokwim chum salmon runs and subsistence harvests



Contributors:
Whitworth, Vicente, Magel, Howard, von Biela, Williams, and Chambers

Factors affecting 2023 Yukon & Kuskokwim chum salmon runs and subsistence harvests



"2019 was a very bad year. We were finding a lot of dead fish because the water was getting very warm, and there was a lot of bacteria in the water. That's really unusual."

Kuskokwim River Inter-Tribal Fish Commission, 2023

Fisheries / Volume 47, Issue 4 / p. 157-168

Feature

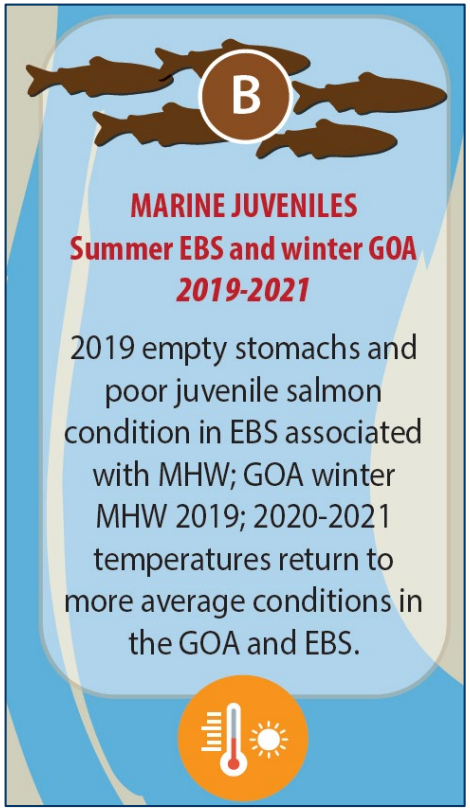
Premature Mortality Observations among Alaska's Pacific Salmon During Record Heat and Drought in 2019

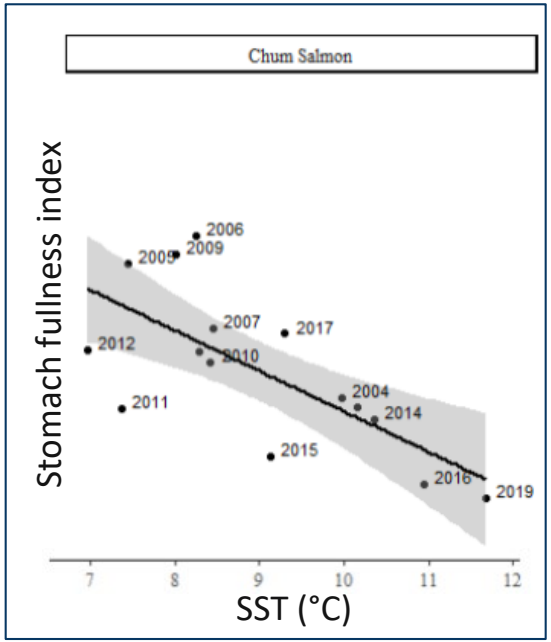
Vanessa R. von Biela ✉, Christopher J. Sergeant, Michael P. Carey, Zachary Liller, Charles Russell, Stephanie Quinn-Davidson, Peter S. Rand, Peter A.H. Westley, Christian E. Zimmerman

First published: 15 February 2022
https://doi.org/10.1002/fsh.10705

Ferriss and Zador, 2022; Siddon, 2022; Barbeaux et al., 2020; Piatt et al. 2020; Murphy et al., 2021; Suryan et al., 2021; von Biela et al., 2022

Factors affecting 2023 Yukon & Kuskokwim chum salmon runs and subsistence harvests



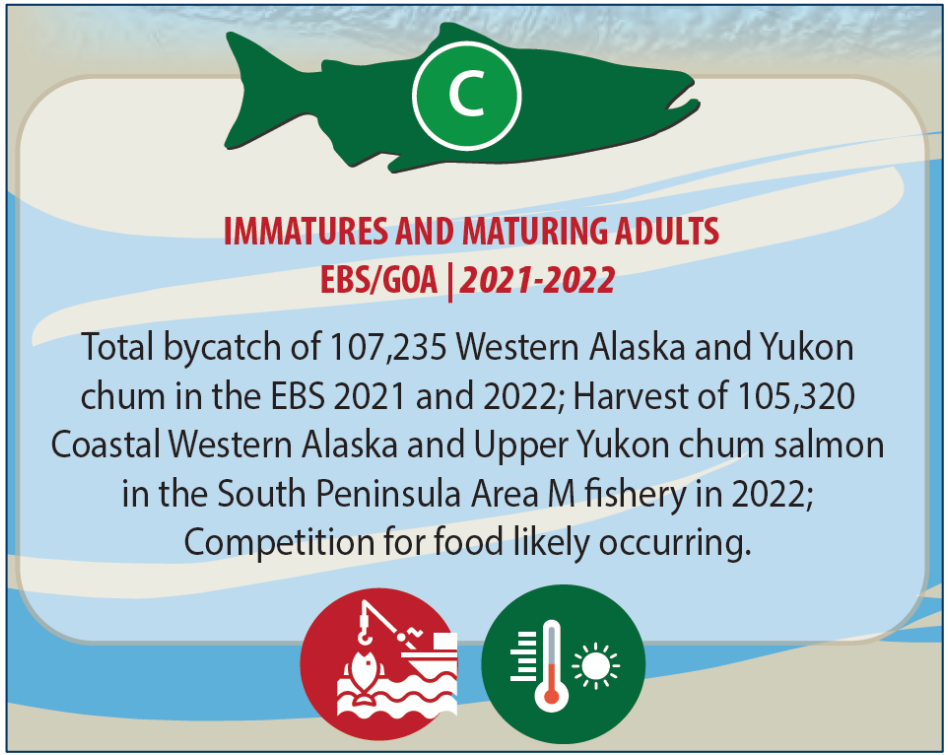


Siddon, 2022; Ferriss and Zador, 2022; Murphy et al., 2021; Burril et al., 2018

"There's the climate change part, there's bycatch and things like that. And then not only the ocean life, but also what's happening in our spawning rivers. The health of those because of climate change; too much snow, not enough snow; too cold, too warm. How different everything is changing. I think there's a lot of things that come into play."

Kuskokwim River Inter-Tribal Fish Commission, 2023

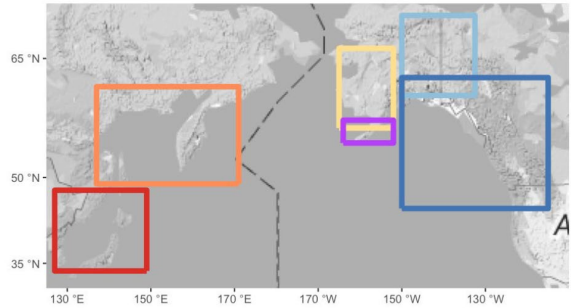
Factors affecting 2023 Yukon & Kuskokwim chum salmon runs and subsistence harvests



"This used to be a chum river. In the old days, [their] uses were multifold. We ate them and our dogs ate them. And I still think of what the old people say: You use them, they will come back in numbers."

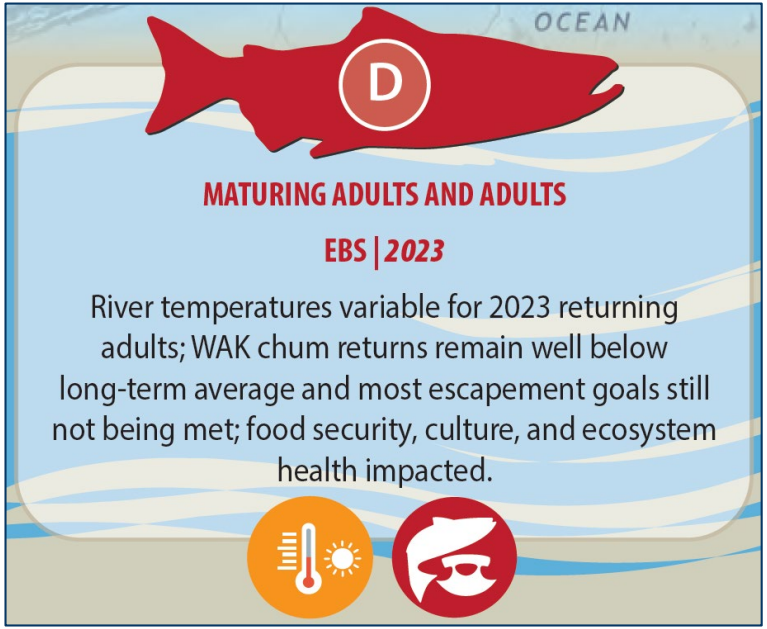
Kuskokwim River Inter-Tribal Fish Commission, 2023

Six regional baseline chum salmon populations

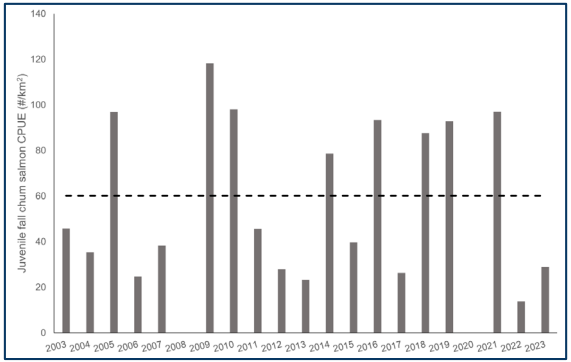


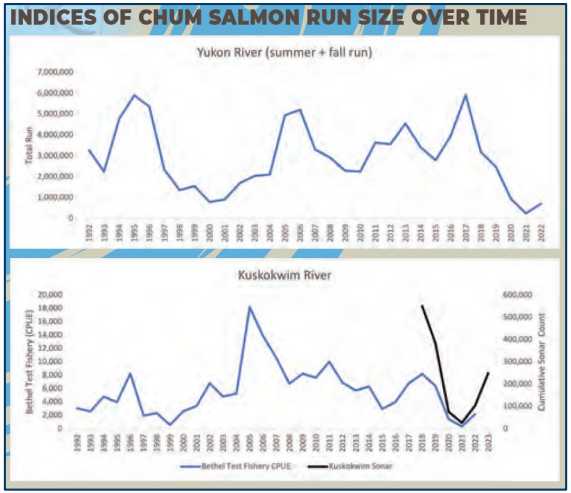
Dann and Foster, 2023; Haapala, 2023

Factors affecting 2023 Yukon & Kuskokwim chum salmon runs and subsistence harvests



Murphy et al., 2023

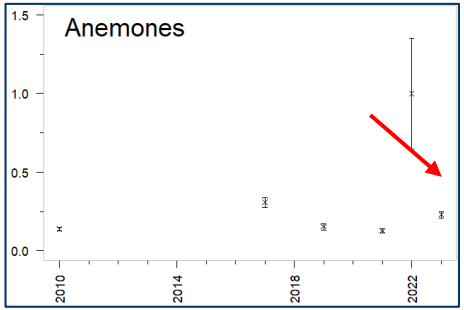


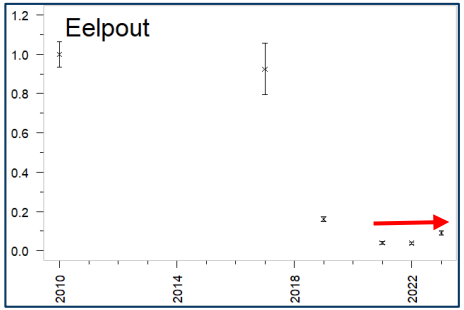


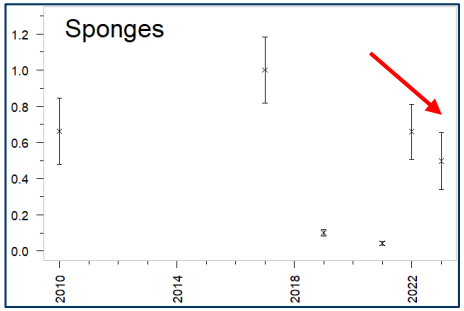
"There were more chums in the river [in 2023] and people were catching more; but when compared to the past 40 years and even just 10 years ago, there were far less chums in the river running and being caught by the people now. We should not pretend that this season's slight increase means the chum run has significantly improved."

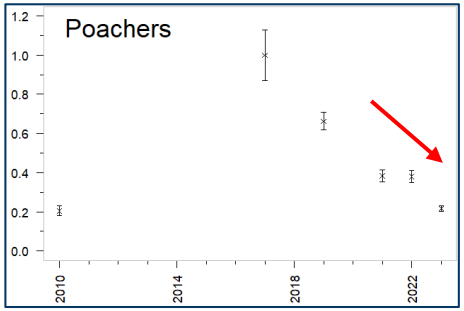
Kuskokwim River Inter-Tribal Fish Commission, 2023

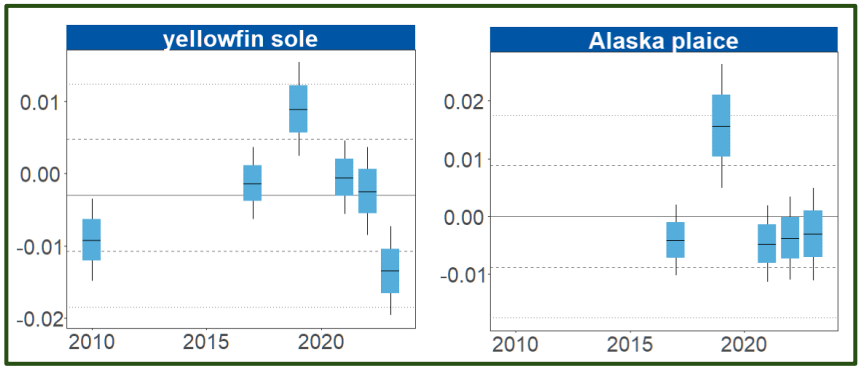
Direct and indirect measures of benthic productivity were mixed, but largely showed declines











- Anemone biomass low in 2023.
- Sponges more variable; biomass moderate in 2023.
- Continued low biomass of eelpouts in 2023.
- Continued declining trend in poachers since 2017.
- Yellowfin sole condition decreased to time series low in 2023.
- Alaska plaice condition remained just below the time series average.

Buser, Prohaska & Rohan

2023 Summary and *implications*

The Bering Sea has cooled relative to the recent warm stanza (2014-2021), but largely remains warmer than average

Cumulative thermal stress is lower; species distributions and predator/prey interactions impacted by cold pool extent

Southeastern Bering Sea: in an ecological transition

Metrics indicate poor primary productivity while secondary productivity was moderate to low

Potential bottom-up limitations throughout the food web

Integrated measures of pelagic productivity were mixed

Cumulative impacts of thermal exposure & prey limitations during extended warm phase;

Potential competitive pressure from large year classes (i.e., Togiak herring, Bristol Bay sockeye salmon)

Metrics of benthic productivity were mixed, but largely showed declines

Echinoderms (i.e., brittle stars) continue to do well; multiple crab stocks continue to show declines

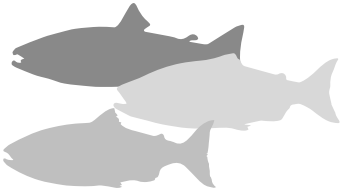
Northern Bering Sea: some signs of recovery in the pelagic system

Biological response has differed from the southeastern shelf ecosystem

Faster ecological response (recovery/resilience) to cooler conditions?

Primary productivity was low; secondary productivity was higher, especially for euphausiids

Improved bottom-up conditions relative to the southern shelf



Integrated measures of pelagic productivity were mixed

Some signs of recovery, though several salmon stocks still well below average

Measures of benthic productivity were mixed, but largely showed declines

Understanding drivers and impacts of changes in benthic community in the NBS remains limited