

# Ecosystem Status Report: Eastern Bering Sea 2022

C4 ES ESF  
December 2022

Elizabeth Siddon



BERING SEA FISHERMEN'S ASSOCIATION



KUSKOKWIM RIVER INTER-TRIBAL FISH COMMISSION



NORTH PACIFIC FISHERY MANAGEMENT COUNCIL

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NOAA FISHERIES

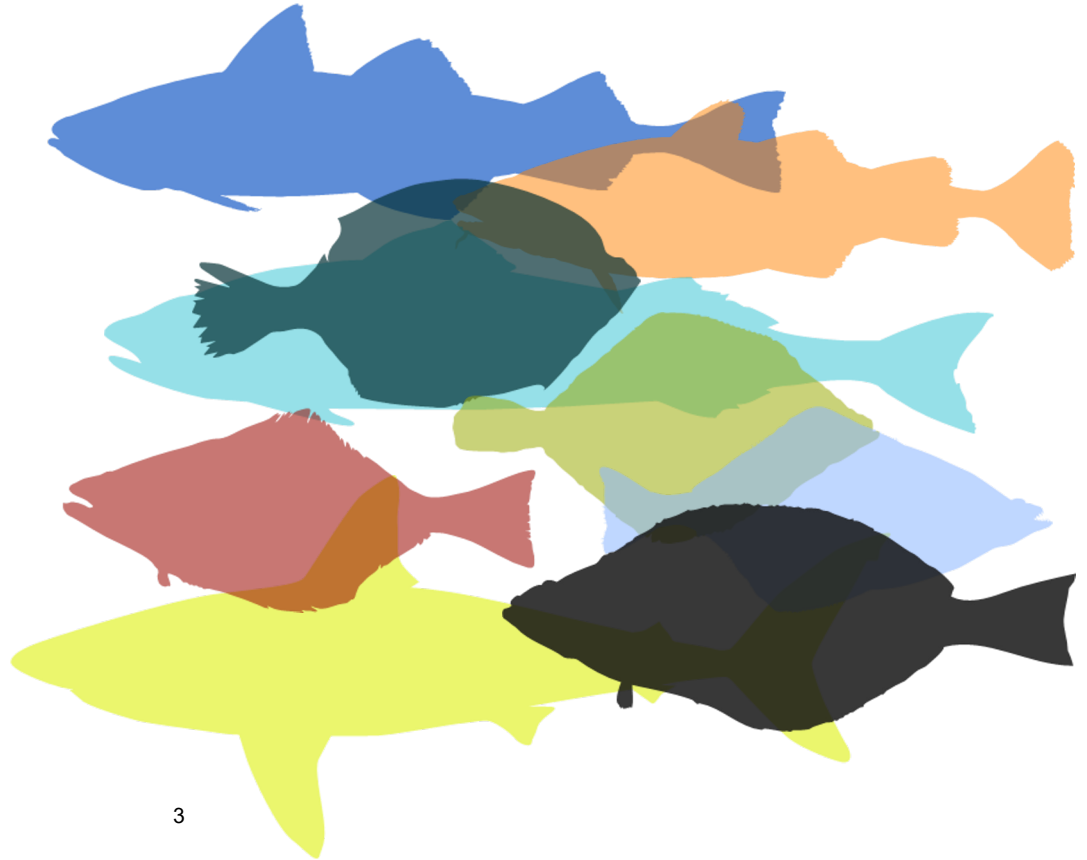


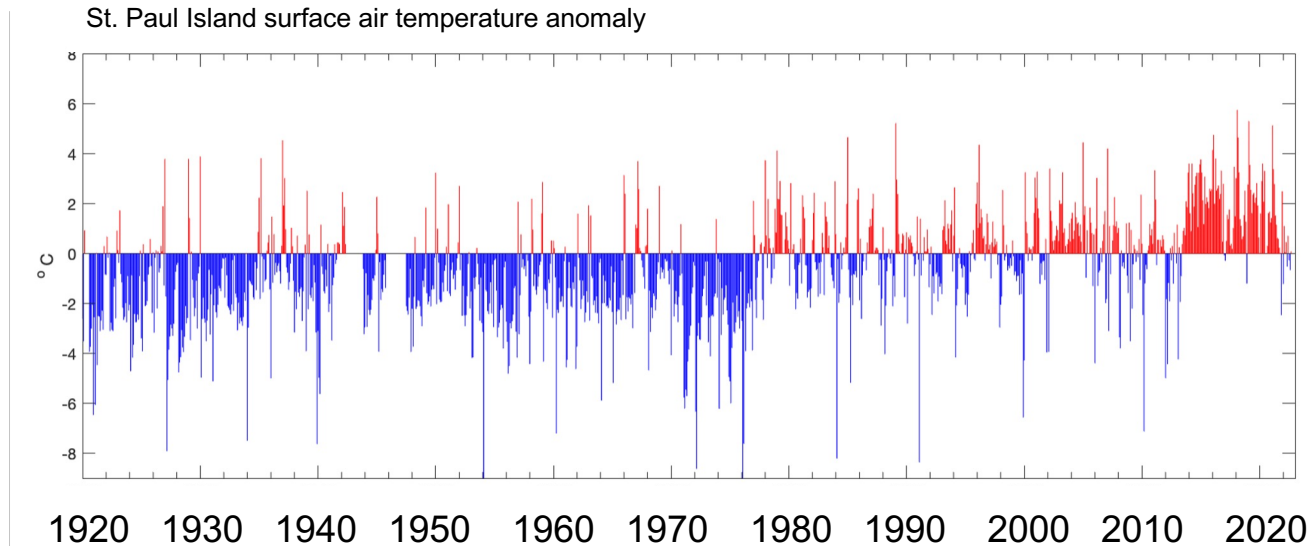
- BLUF: 2022 Risk Table scores for Ecosystem/Environmental concerns
- Review of the recent warm stanza
- Current conditions: 2022

## Level 1

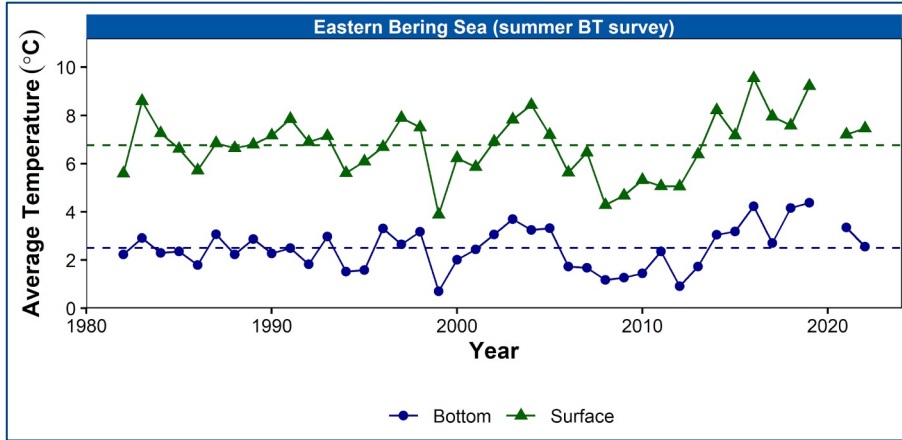
*No apparent environmental/  
ecosystem concerns*

- EBS pollock
- EBS Pacific cod
- Yellowfin sole
- Sablefish (statewide)
- Northern rock sole
- Arrowtooth flounder
- Kamchatka flounder
- Greenland turbot
- Sharks (statewide)



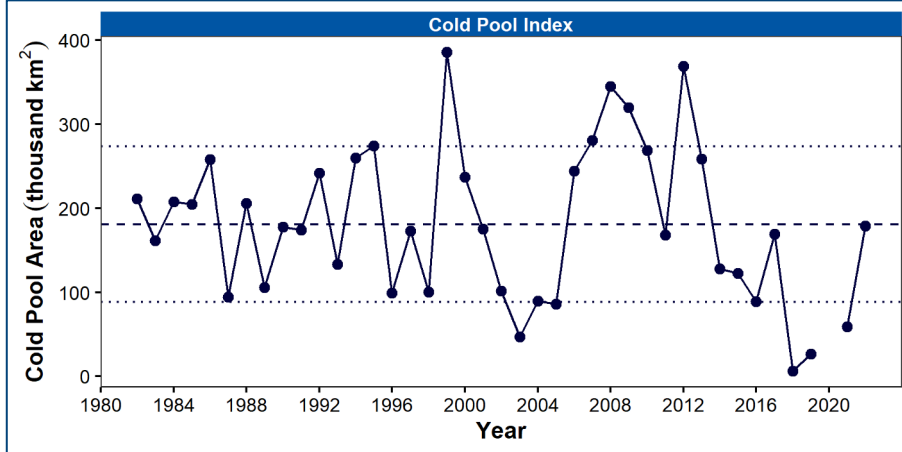


- In ~2014, the EBS entered a warm phase of unprecedented duration
- Ecosystem responses can be:
  - Immediate
  - Lagged
  - Cumulative
- Impacts of the recent warm stanza to groundfish and crab stocks
- The past year has seen a relaxation to more average thermal conditions



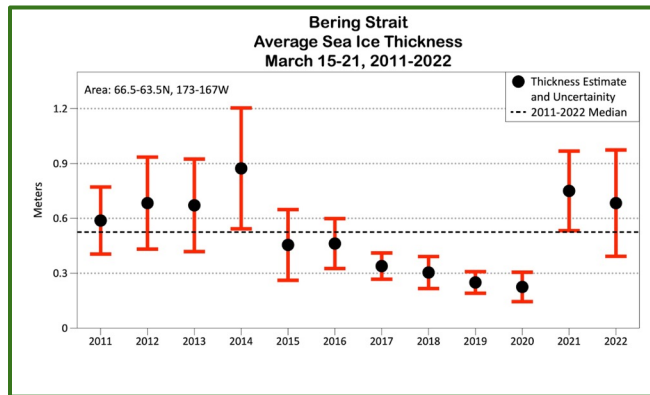
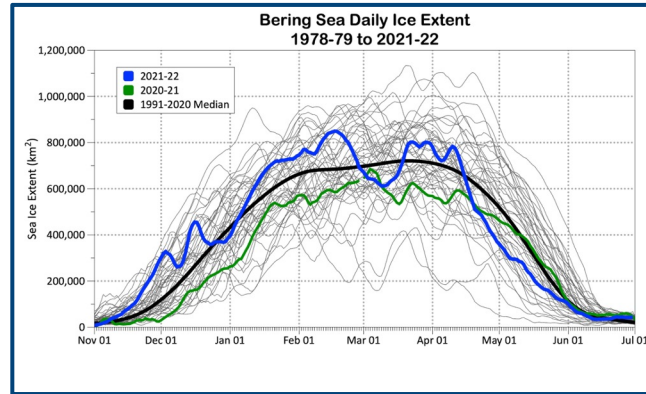
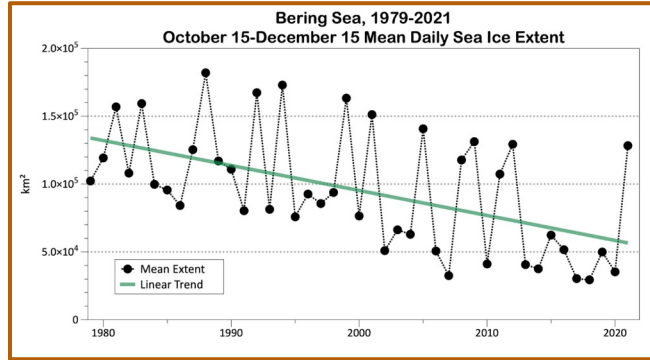
### Immediate ecosystem responses

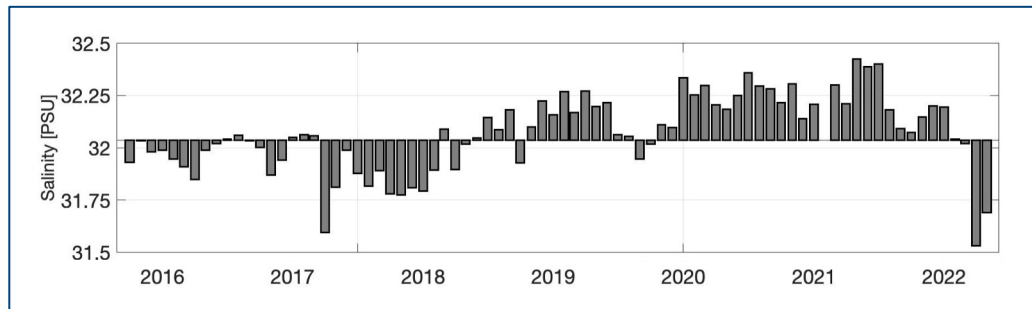
- Surface and bottom temperatures
  - above the time series average beginning in 2014
  
- Cold pool extent
  - below the time series average beginning in 2014
  - 2018, 2019, and 2021 were the lowest cold pool extents in the time series



Cumulative ecosystem responses

- Residual warmth resulted in delayed sea-ice formation
- Delayed freeze-up led to shortened ice seasons that in turn had impacts on ice thickness
- Thinner sea ice resulted in earlier ice retreat, further truncating the ice season and perpetuating the residual warmth into the following year



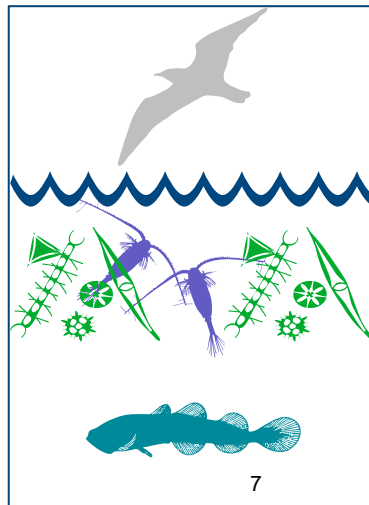


### Sea-ice growth

- Salt is extruded
- Increased salinity

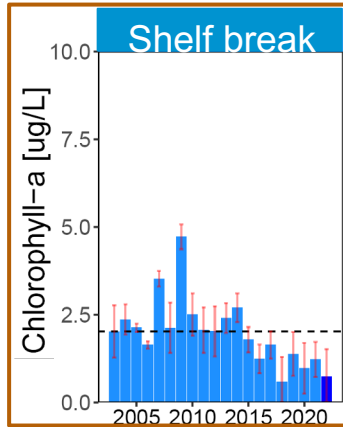
### Sea-ice melts

- Freshwater
- Decreased salinity



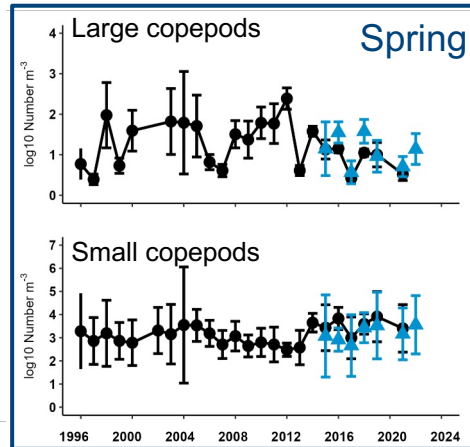
### Impacts to groundfish and crab

- Loss of sea ice may have contributed to an increase in salinity at the Pribilof Islands
- Sea ice “conveyor belt”
- Changes in the salinity structure can impact the vertical stratification and vertical mixing of primary and secondary productivity



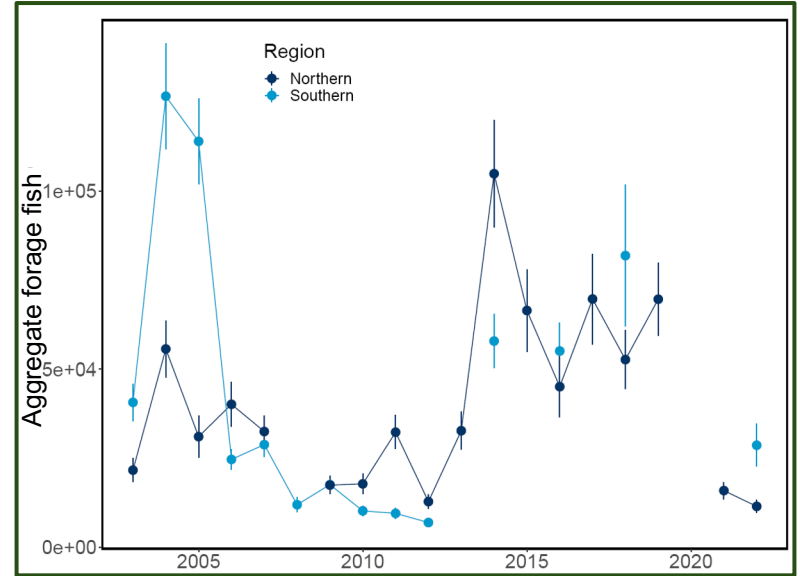
Primary productivity

- Decrease in chl-a at the shelf break since 2014
- Suggests potential limitations at the base of the food web



Secondary productivity

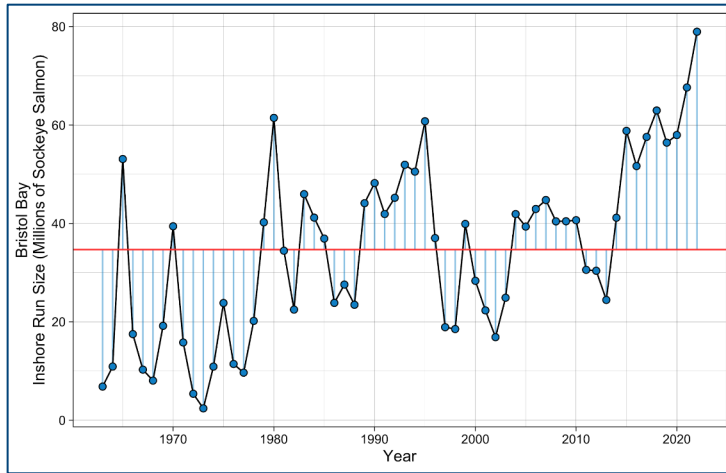
- Decrease in large copepods; increase in small copepods
- Suggests favorable prey conditions for early life stages of pollock



Forage Fish

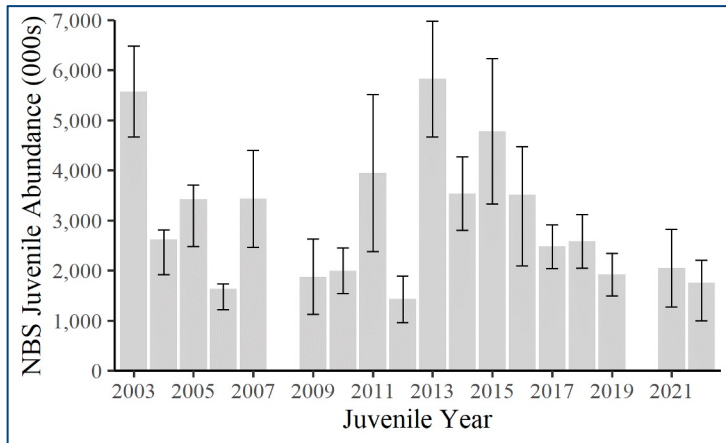
- Increased biomass of forage fish (EBS + NBS) during the warm stanza
- Suggests improved summer foraging conditions, especially for surface-feeding organisms like piscivorous seabirds



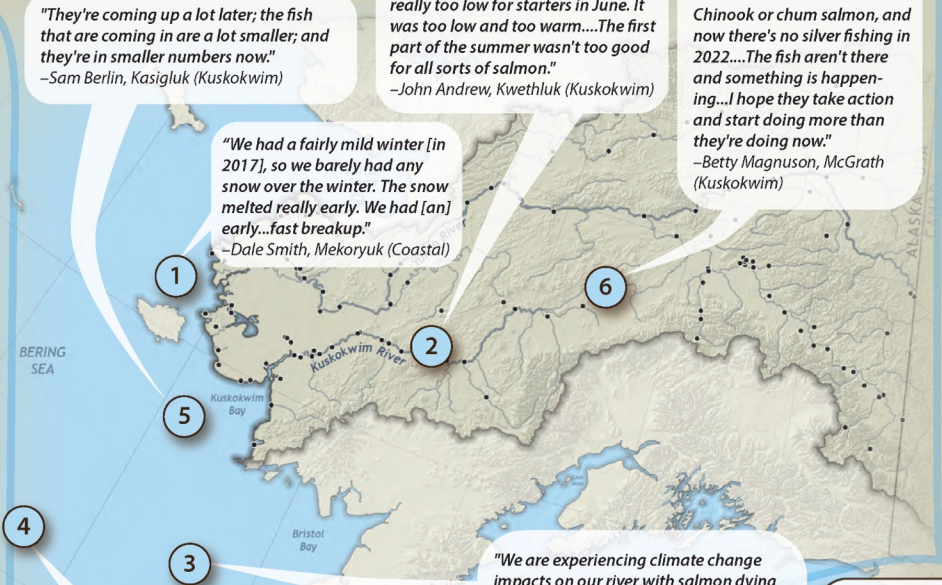


### Contrasting salmon responses

- Bristol Bay sockeye salmon returns showed a large increase during the recent warm stanza
  - 2015-2022 returns all >50 million salmon
  - 2022 run was the largest since 1963
  - *Suggests favorable ocean conditions for juveniles since summers of 2012 & 2013 and winters 2012/2013 and 2013/2014*
- Juvenile Chinook salmon in the northern Bering Sea have shown declines since ~2013
- Adult runs (e.g., Chinook, chum, and coho) throughout the AYK region have experienced unprecedented failures in recent years
  - *Suggests the dynamic life histories within salmon species are impacted by freshwater and marine habitat conditions*



# FACTORS AFFECTING 2022 KUSKOKWIM AND YUKON CHINOOK SALMON RUNS AND SUBSISTENCE HARVESTS



**1**






**PARENT SPAWNERS & EGGS**  
2016 & 2017

Marine heatwave conditions prior to run, stressful river temperatures, decreased body size.

**2**








**FRY**  
2017 & 2018

Low summer water levels, continued warm river conditions.

**3**

**MARINE JUVENILES**  
2019

Large marine heatwave, empty stomachs, weakened condition.

"They're coming up a lot later; the fish that are coming in are a lot smaller; and they're in smaller numbers now."  
—Sam Berlin, Kasigluk (Kuskokwim)

"The [2017 summer] water level was really too low for starters in June. It was too low and too warm...The first part of the summer wasn't too good for all sorts of salmon."  
—John Andrew, Kwethluk (Kuskokwim)

"We had a fairly mild winter [in 2017], so we barely had any snow over the winter. The snow melted really early. We had [an] early...fast breakup."  
—Dale Smith, Mekoryuk (Coastal)

"I'm really saddened and devastated for our Tribal families upriver who haven't had a chance to catch Chinook or chum salmon, and now there's no silver fishing in 2022...The fish aren't there and something is happening...I hope they take action and start doing more than they're doing now."  
—Betty Magnuson, McGrath (Kuskokwim)

"We are experiencing climate change impacts on our river with salmon dying [in 2019], and also warming and other things happening in the high seas where they go out and then before they return."  
—Mike Williams Sr., Akiak (Kuskokwim)

"I think [the causes of salmon declines] are a combination of climate and bycatch: Irresponsible or unsustainable fishing in the oceans coupled with climate change."  
—Anonymous (Kuskokwim)

"[In 2019] the weather was 80 degrees, [and] when you put your hand in the river, the river was warm. [It was the] first time I ever heard [of] fish floating down the river."  
—James Landlord, Mountain Village (Yukon)

**6**





**ADULT RUNS**  
2022

Amounts necessary for subsistence not met since 2010, directed fisheries remain closed, high occurrence of Ichthyophonus.

**5**








**MATURING ADULTS**  
2022

Marine temperatures decreased from marine heatwave conditions.


**4**

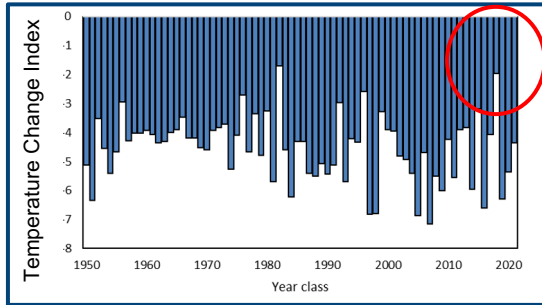
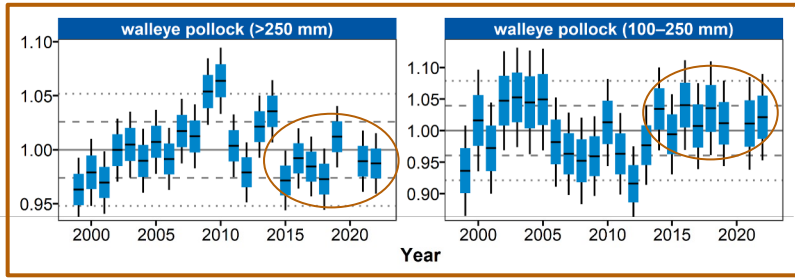




**IMMATURES**  
2019-2021

~28,300 Western Alaska Chinook salmon caught as bycatch 2019-2020, 2021 bycatch estimates N/A.

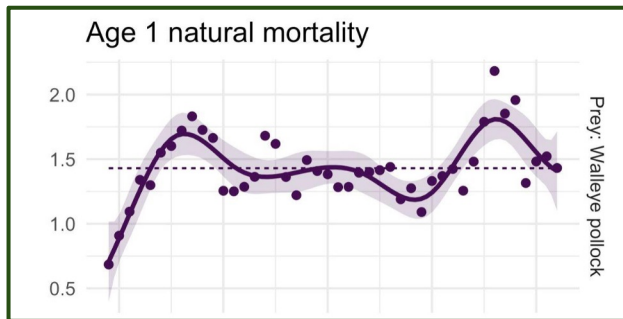
**+** = positive effect  
**-** = negative effect





### The 2018 year class of pollock

- Fish condition indicates prey availability, growth, general health, and habitat
  - Below-average condition of adult pollock
  - Above-average condition of juvenile pollock
  
- Bottom-up drivers of recruitment success
  - Cool summer SSTs in 2018 (age-0); warmer spring SSTs in 2019 (age-1)
  - Age-0 diets in 2018 had a large proportion of euphausiids, mitigate lower large copepod abundances
  
- Top-down drivers of predation pressure
  - CEATTLE model shows declines in predation mortality due to declines in total predator biomass
  - Reduced cold pool extent, adult pollock moved into the NBS, reduced predation pressure on the 2018 year class





- The warm stanza contained a pulse event of near-absence of sea ice, and subsequent absence of cold pool, in the winters of 2017/2018 and 2018/2019
- Shifts in the distribution of groundfish and crab stocks have been documented
- Examples of stocks that are “winners” and “losers”, although the exact mechanisms are not fully understood at this time

- “Winners”

- 2014-2019 year classes of sablefish
- Bristol Bay sockeye salmon returns since 2015
- 2017 year class of Togiak herring
- 2018 year class of pollock

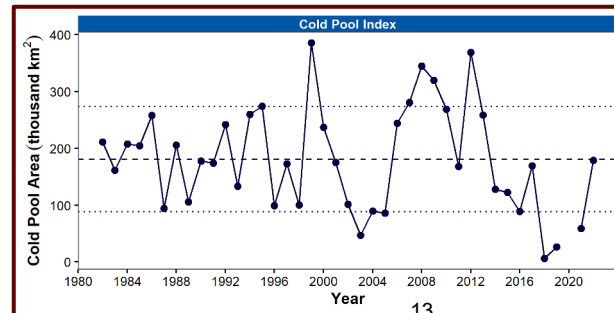
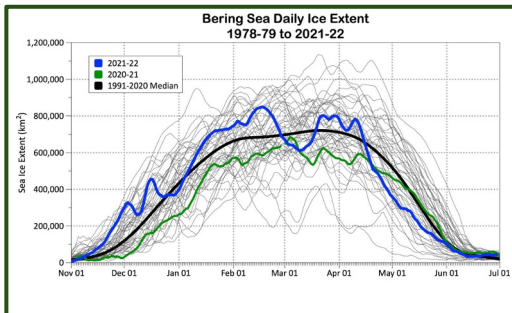
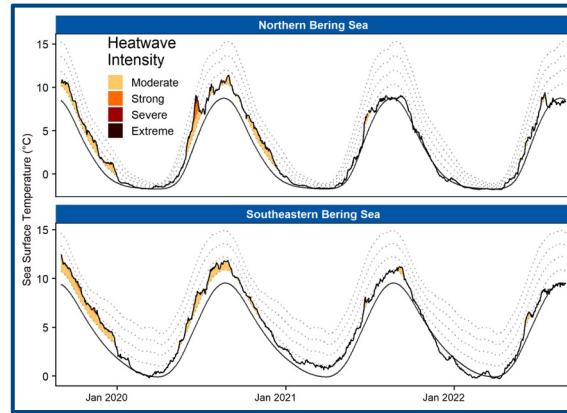
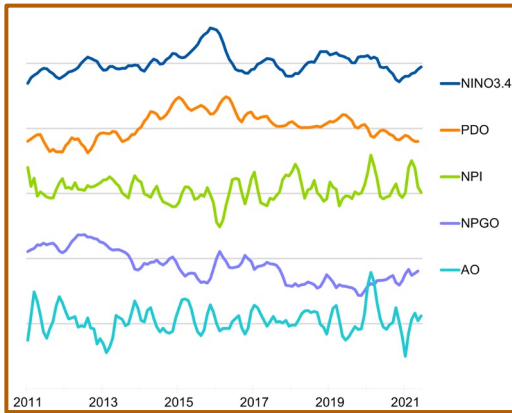
- “Losers”

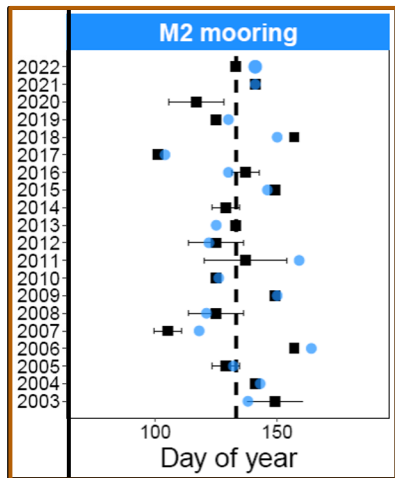
- Several crab stocks (notably snow crab and Bristol Bay red king crab)
- Multiple Western Alaska Chinook, chum, and coho salmon runs.

## Oceanographic conditions

Indications that the warm phase has ended:

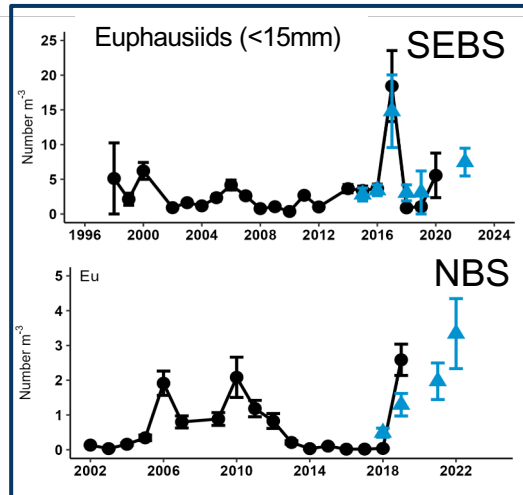
- The combined states of 3 climate indices (NPI, AO, La Niña)
- 3<sup>rd</sup> year of La Niña predicted in 2023
- Marine heatwaves have been infrequent and brief
- Sea-ice extent was generally above average during winter 2021-2022
- 2022 cold pool was near average





Primary productivity

- 2022 spring bloom timing was similar to the long-term average
- 2022 coccolithophore index was among the highest ever observed



Secondary productivity

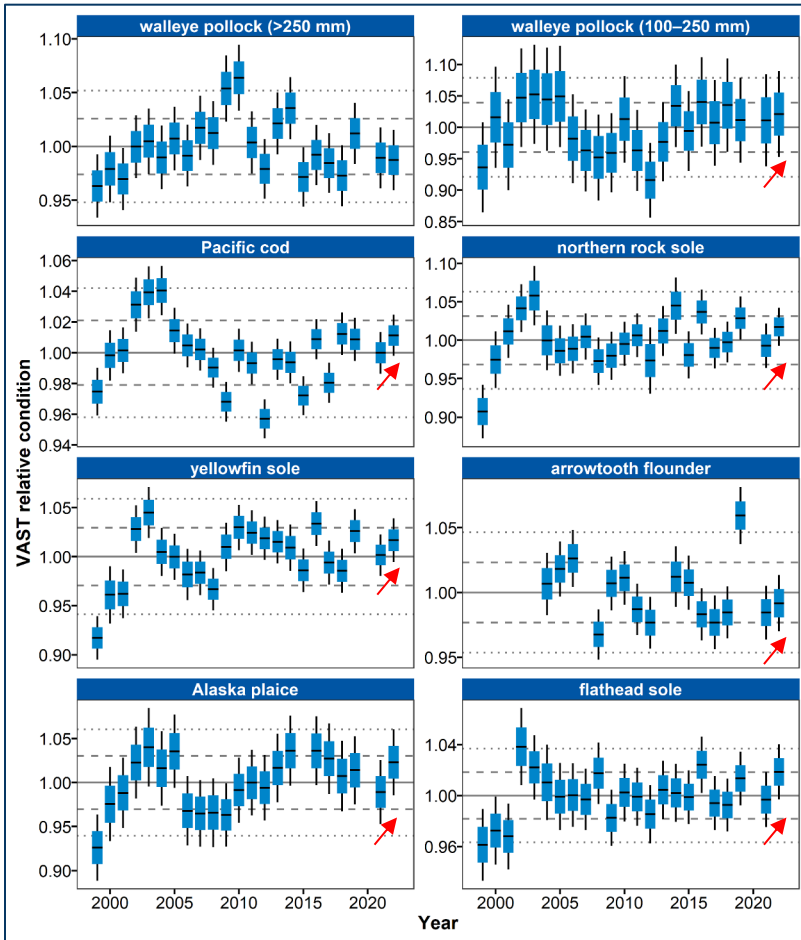
- Late summer: few large and small copepods; increased euphausiids (SEBS + NBS), suggesting widespread abundance

Alaska Maritime National Wildlife Refuge  
2022 Seabird Report Card

Region	Annual monitoring site	Red-faced cormorants	Glaucous-winged gulls	Common murre	Thick-billed murre	Horned puffin	Tufted puffin	Red-legged kittiwake	Black-legged kittiwake
Chukchi Sea	Cape Lisburne								
Bering Sea	St. George	☺		☺	☹			☺	☺
	St. Paul	☺		☺	☹			☺	☺

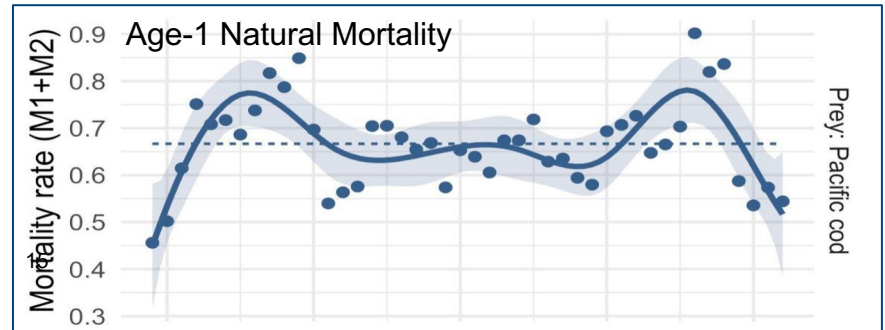
Seabirds

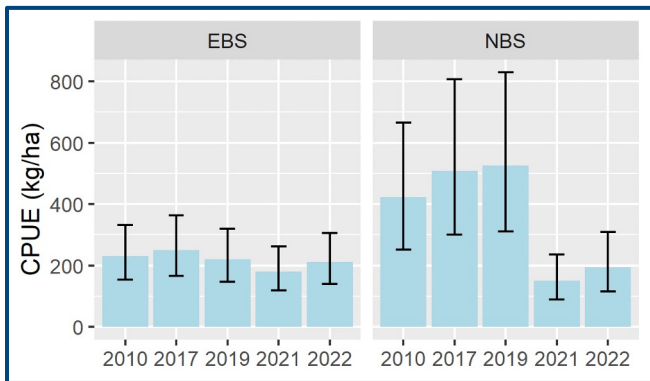
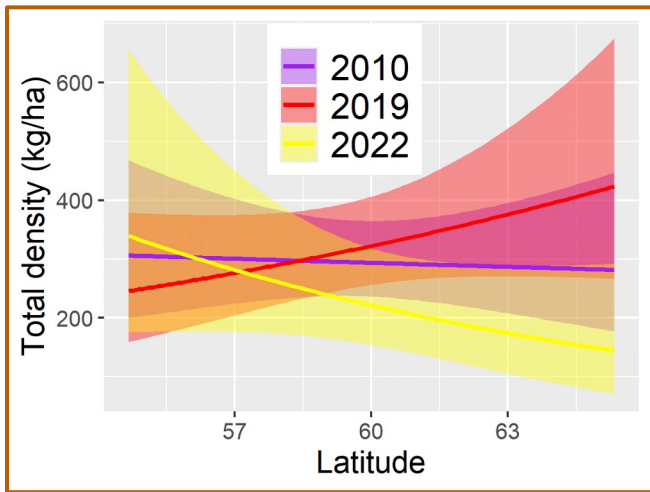
- Reproductive success tracked prey availability
- Pribilof Islands (SEBS)
  - Reproductive success was high (except TBMU)
  - Abundance was low
- St. Lawrence Island (NBS)
  - Planktivorous seabirds did well
  - Piscivorous species had reproductive failures
- No indications of a major die-off event (COASST)



### Groundfish Condition

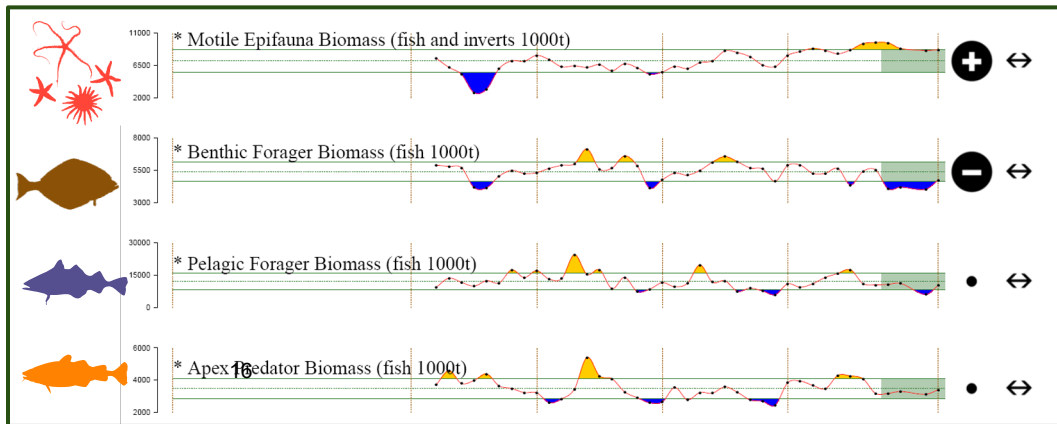
- Cooler conditions should coincide with better groundfish condition, based on metabolic demands
- Groundfish condition improved from 2021 to 2022 for fish over the southern shelf (except adult pollock); trends were more variable over the northern shelf
- CEATTLE multispecies model indicates improved conditions for juvenile groundfish survival through 2022 via predation release



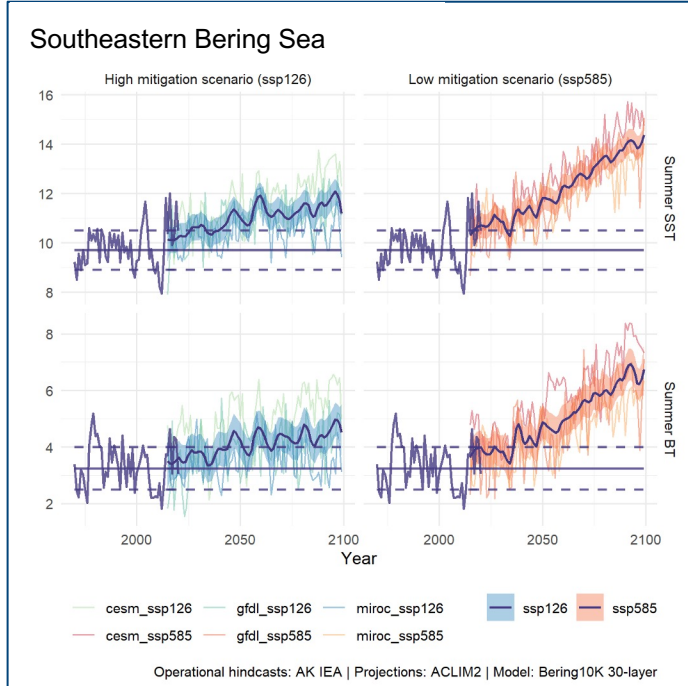


### Groundfish community responses

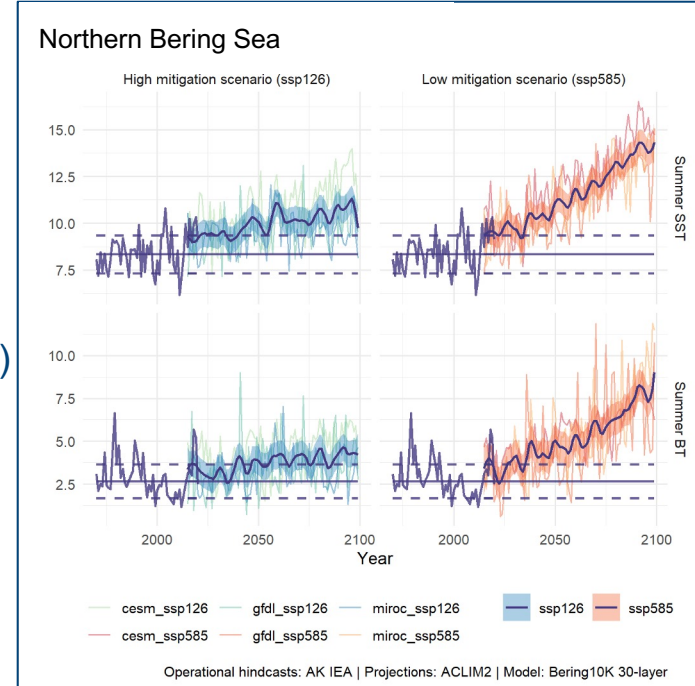
- The groundfish community shifted north between 2010 and 2019, then south in 2021 as conditions cooled, and into slightly deeper waters in 2022
- Drop in CPUE in the NBS in 2021 and 2022 may indicate
  - Migration out of the survey area
  - Carrying capacity exceeded during the very warm years
- Guilds provide trends for ecologically relevant groupings for SEBS, though individual stock dynamics fluctuate between SEBS and NBS







## Sea surface (SST) and bottom temperature (BT) projections



- “High mitigation scenarios” predict a future Bering Sea that is slightly warmer but relatively similar to contemporary conditions
- “Low mitigation scenarios” predict warming that drives the modeled Bering Sea system to conditions well beyond those observed to date



Sea-ice extent was above average during winter 2021-2022; the 2022 cold pool extent was near average  
*Indicates a return to more average thermal conditions and potential end of the extended warm phase*



Monitoring of emerging stressors: Ocean Acidification (OA), Harmful Algal Blooms (HABs)  
*Impacts to groundfish and crab are active areas of research*



Primary productivity average; large coccolithophore bloom; late-summer lower abundance of small and large copepods, but relatively higher abundance of euphausiids  
*Spatial and temporal trends in bottom-up trophic pathways varied over the shelf*



Seabird reproductive success was exceptional at the Pribilof Islands, but was mixed at St. Lawrence Island  
*Indicates local availability of zooplankton and forage fish over the southern shelf, but limited forage fish availability in the northern Bering Sea*



Groundfish condition improved from 2021 to 2022 (except adult pollock); CEATTLE multispecies model indicates improved conditions for juvenile groundfish survival through 2022 via predation release  
*Indicates sufficient prey availability under cooler thermal conditions (i.e., reduced metabolic demands)*



Groundfish community indicators (e.g., guilds) based on data collected from the standard bottom trawl survey  
*Individual stock dynamics continue to fluctuate between the southern and northern shelves (i.e., Pacific cod)*



# Additional Information Available

C4 BS ESR  
December 2022

**Aleutian Islands:** [Full GPT presentation](#) (@1:26:35), [AI In Brief](#), [AI full report](#)

**Eastern Bering Sea:** [Full GPT presentation](#) (@28:15), [EBS In Brief](#), [EBS full report](#)

**Gulf of Alaska:** [Full GPT presentation](#) (@33:17), [GOA In Brief](#), [GOA full report](#)

Ecosystem Status Reports through 2021 are available [here](#):

