Ecosystem Status Report: Eastern Bering Sea 2022

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NOAA FISHERIES

Outline

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

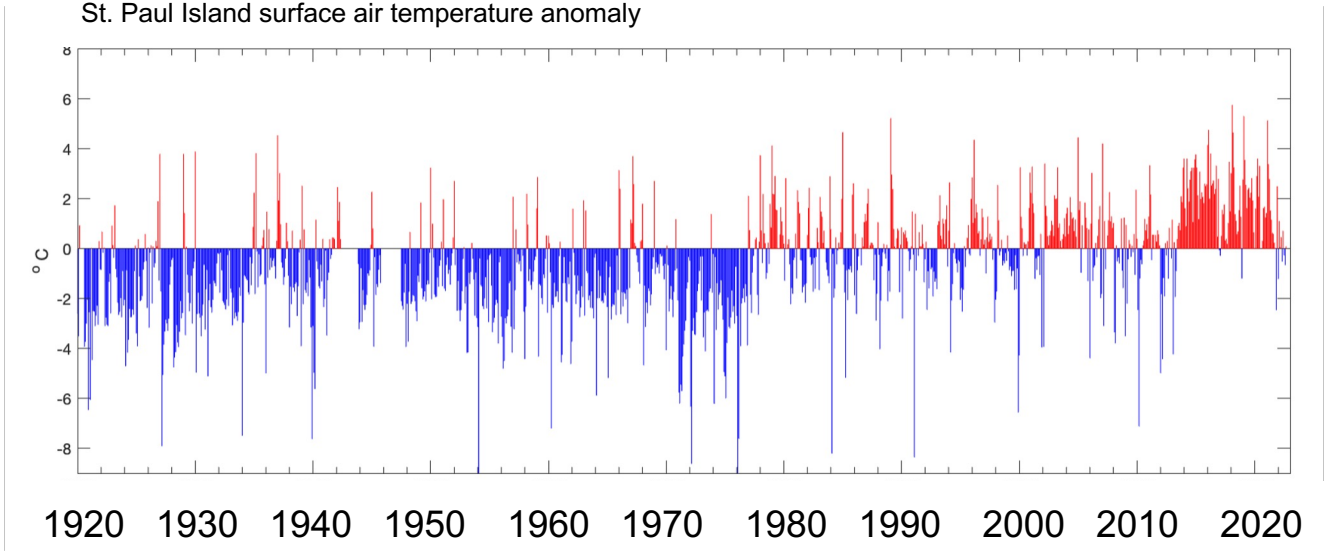
2022 Risk Table scores for Ecosystem/Environmental concerns

Level 1

No apparent environmental/ ecosystem concerns

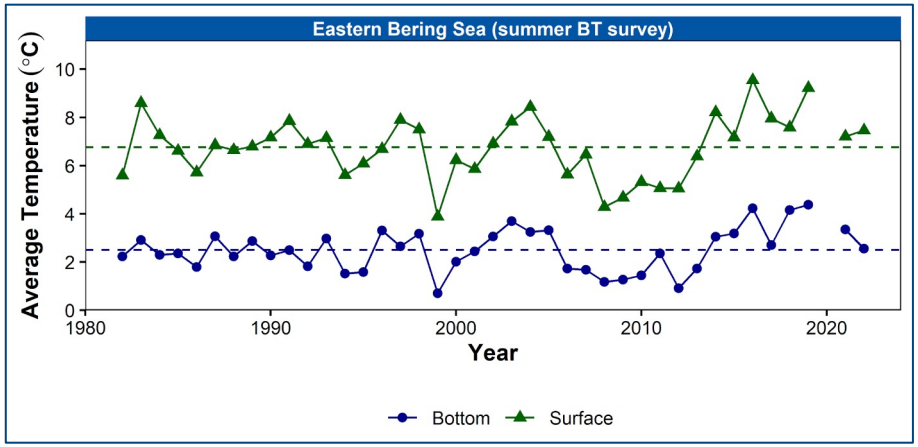
- EBS pollock
- EBS Pacific cod
- Yellowfin sole
- Sablefish (statewide)
- Northern rock sole
- Arrowtooth flounder
- Kamchatka flounder
- Greenland turbot
- Sharks (statewide)

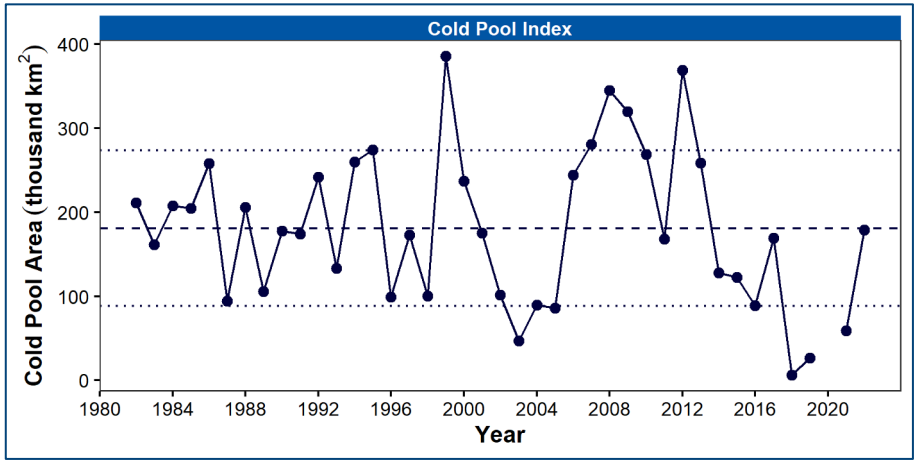
Review of the recent warm stanza



- 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

Oceanographic response



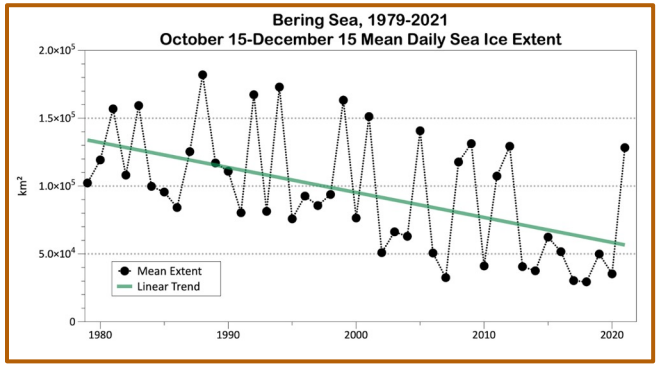


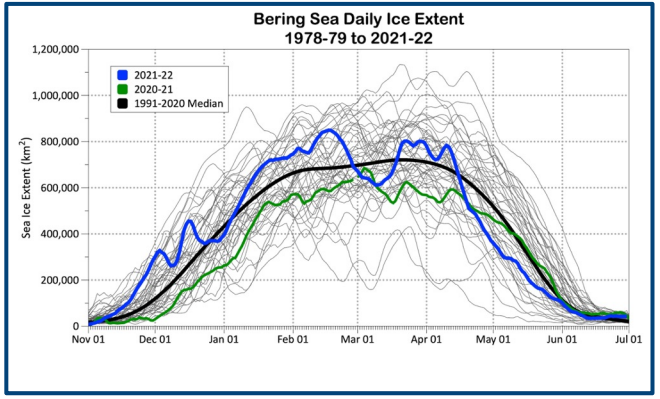
Immediate ecosystem responses

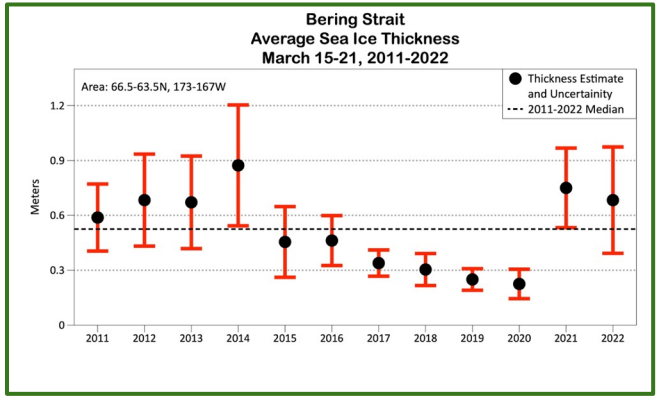
- Surface and bottom temperatures
  - above the time series average beginning in 2014

- 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

Oceanographic response

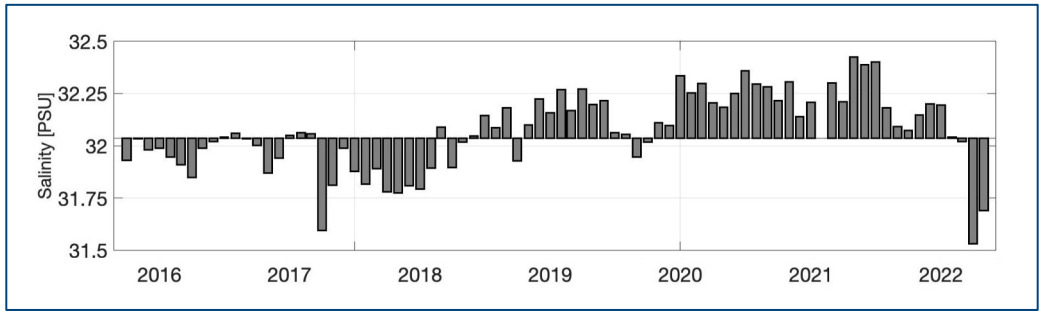






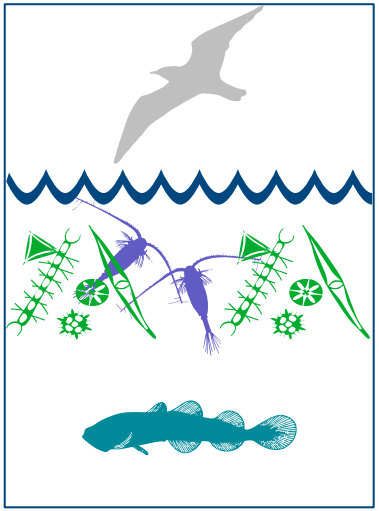
Cumulative ecosystem responses

- 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

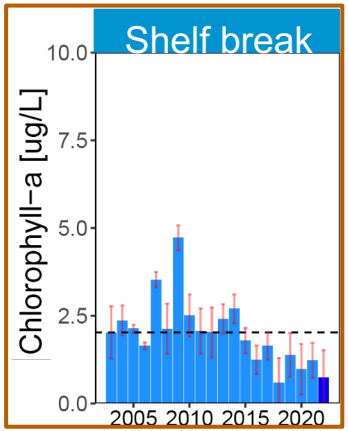


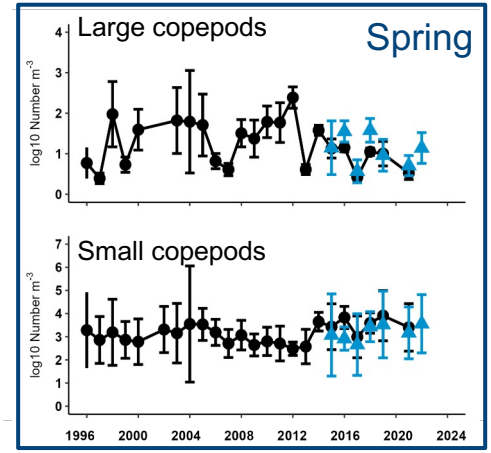
Impacts to groundfish and crab

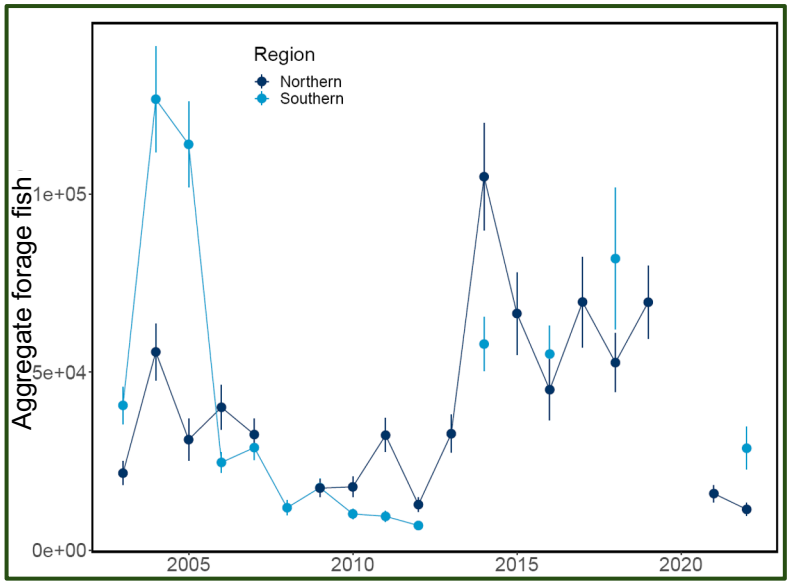
- Loss of sea ice may have contributed to an increase in salinity at the Pribilof Islands
- Sea ice “conveyor belt”
- Changes in the salinity structure can impact the vertical stratification and vertical mixing of primary and secondary productivity

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

Biological response







Primary productivity

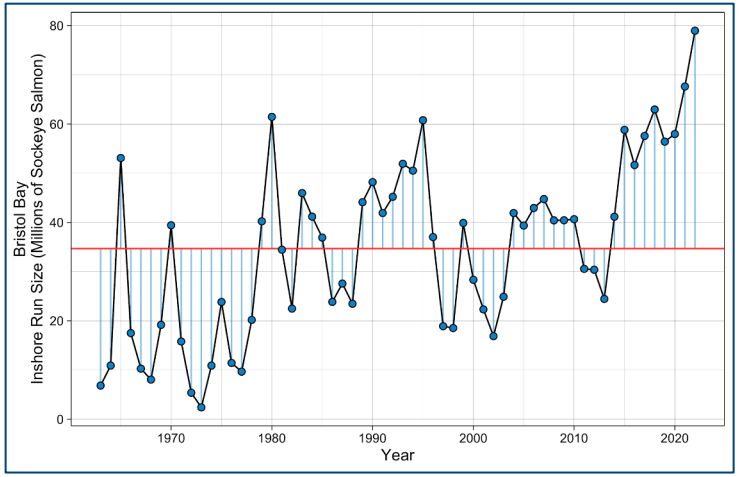
Decrease in chl-a at the shelf break since 2014
- Suggests potential limitations at the base of the food web

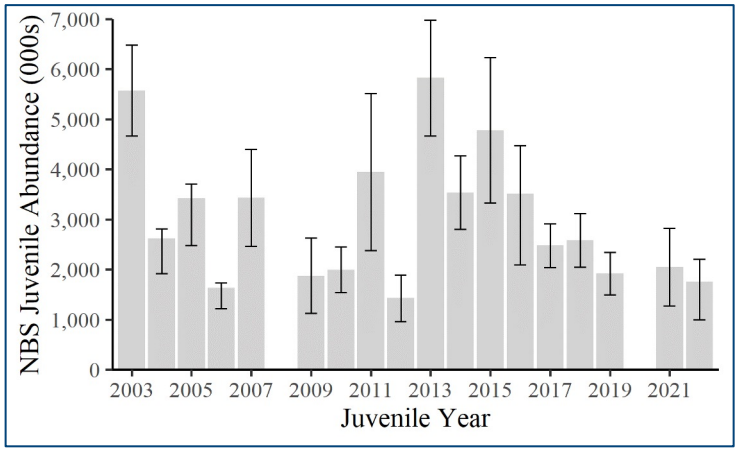
Secondary productivity

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

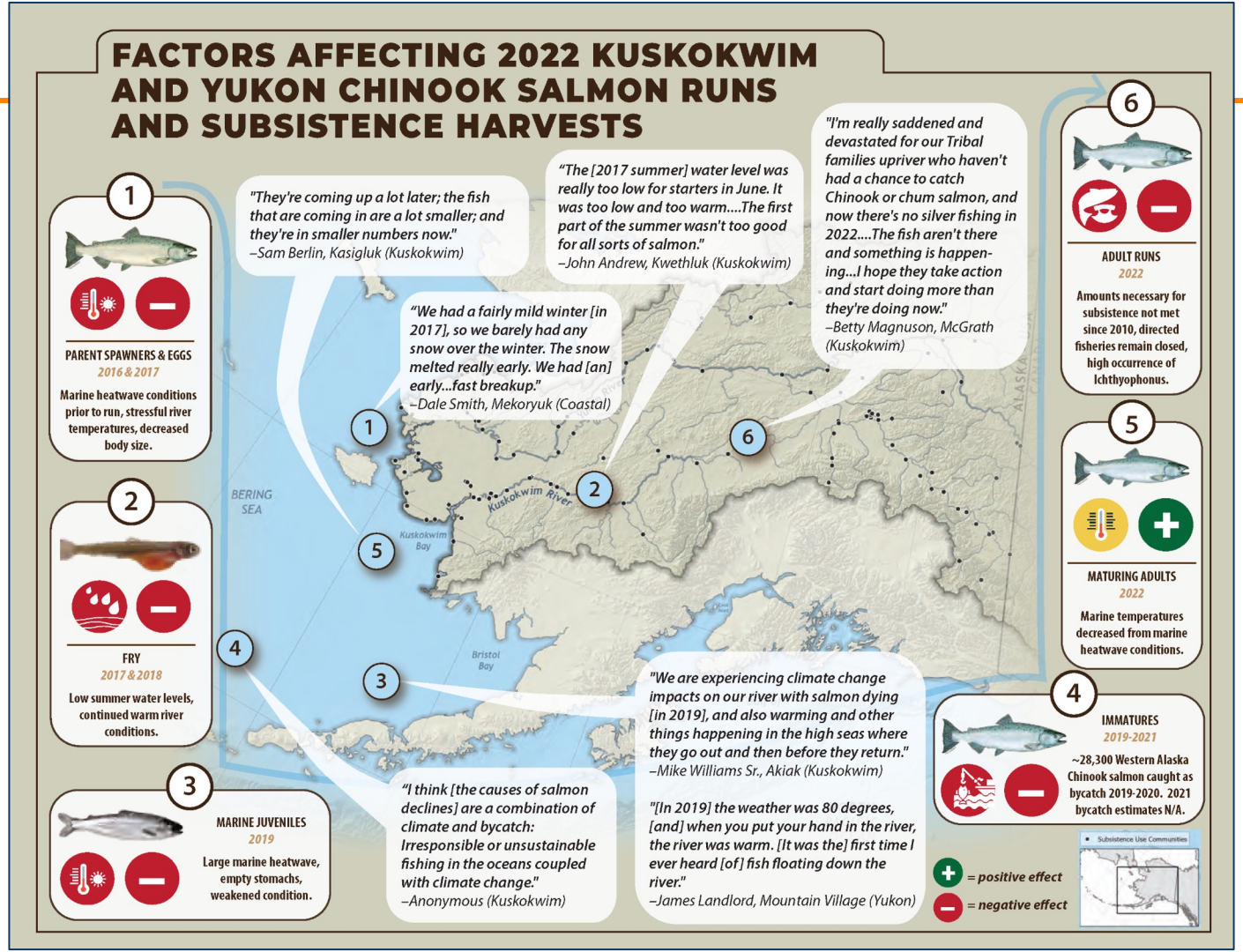




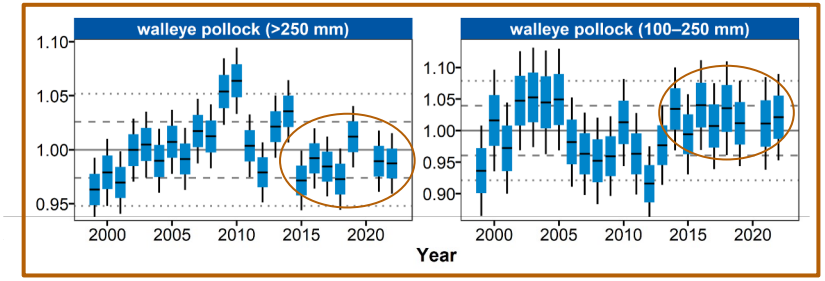
Contrasting salmon responses

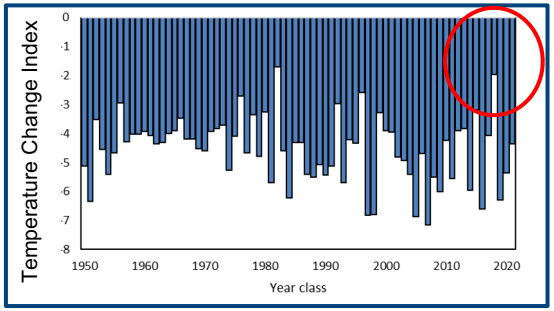
- Bristol Bay sockeye salmon returns showed a large increase during the recent warm stanza
  - 2015-2022 returns all >50 million salmon
  - 2022 run was the largest since 1963
  - *Suggests favorable ocean conditions for juveniles since summers of 2012 & 2013 and winters 2012/2013 and 2013/2014*

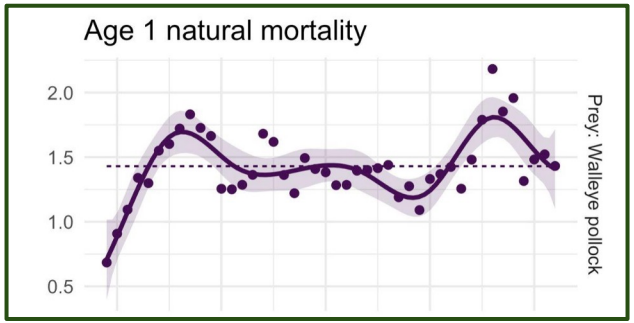
- Juvenile Chinook salmon in the northern Bering Sea have shown declines since ~2013
- Adult runs (e.g., Chinook, chum, and coho) throughout the AYK region have experienced unprecedented failures in recent years
  - *Suggests the dynamic life histories within salmon species are impacted by freshwater and marine habitat conditions*



[2022 Kuskokwim River Salmon Situation Report]







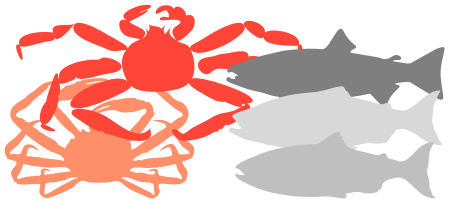
The 2018 year class of pollock

- 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

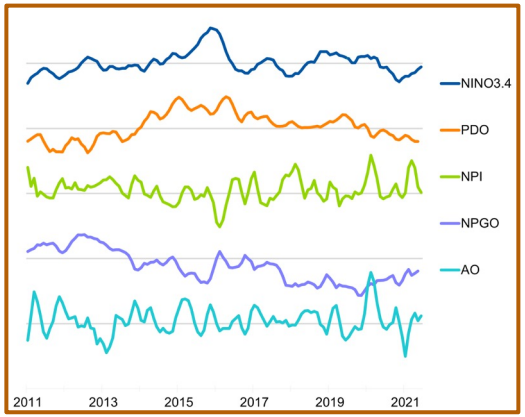
Summary of the recent warm stanza

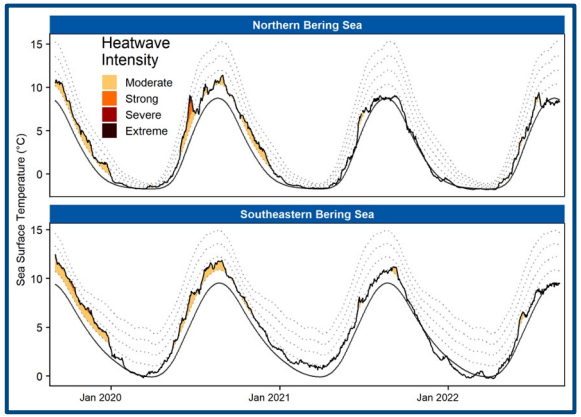
- The warm stanza contained a pulse event of near-absence of sea ice, and subsequent absence of cold pool, in the winters of 2017/2018 and 2018/2019
- Shifts in the distribution of groundfish and crab stocks have been documented
- Examples of stocks that are “winners” and “losers”, although the exact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

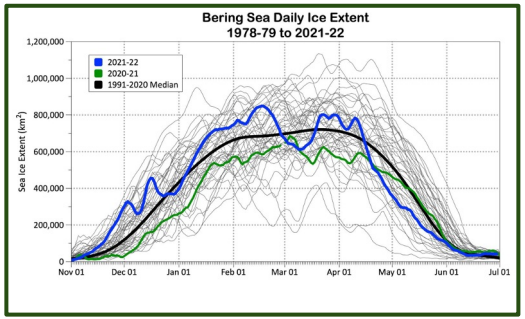
- “Winners”
  - 2014-2019 year classes of sablefish
  - Bristol Bay sockeye salmon returns since 2015
  - 2017 year class of Togiak herring
  - 2018 year class of pollock

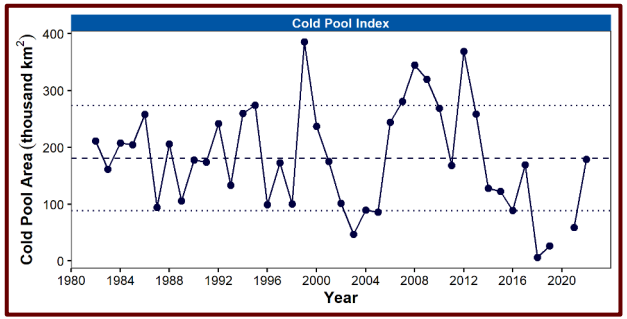


- “Losers”
  - Several crab stocks (notably snow crab and Bristol Bay red king crab)
  - Multiple Western Alaska Chinook, chum, and coho salmon runs.







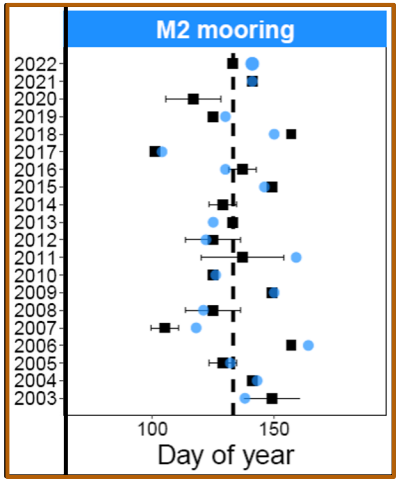


Oceanographic conditions

Indications that the warm phase has ended:

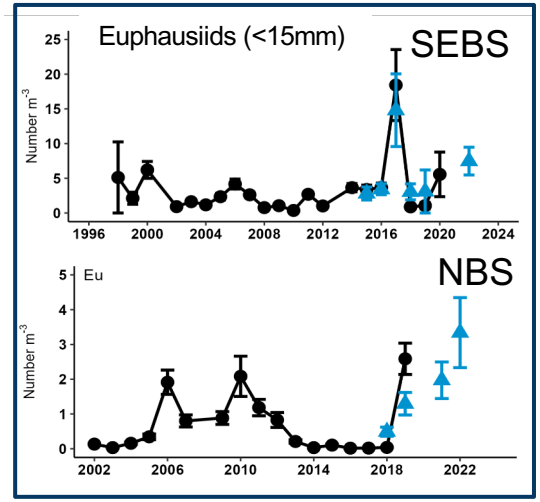
- The combined states of 3 climate indices (NPI, AO, La Niña)
- 3rd year of La Niña predicted in 2023
- Marine heatwaves have been infrequent and brief
- Sea-ice extent was generally above average during winter 2021-2022
- 2022 cold pool was near average

Nielsen et al., Kimmel et al., Integrated Seabird Information — Current Conditions: 2022



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

Seabirds

Reproductive success tracked prey availability

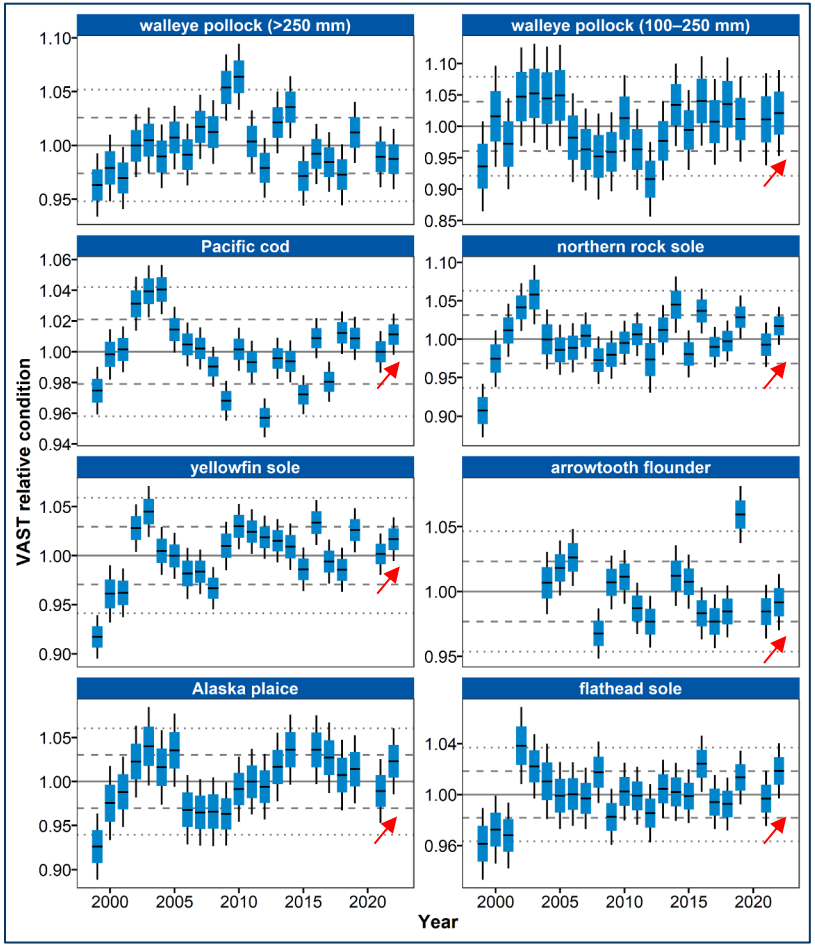
Pribilof Islands (SEBS)

- Reproductive success was high (except TBMU)
- Abundance was low

St. Lawrence Island (NBS)

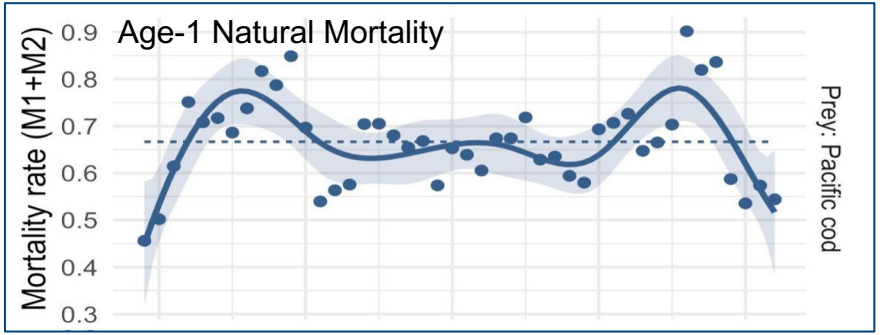
- Planktivorous seabirds did well
- Piscivorous species had reproductive failures

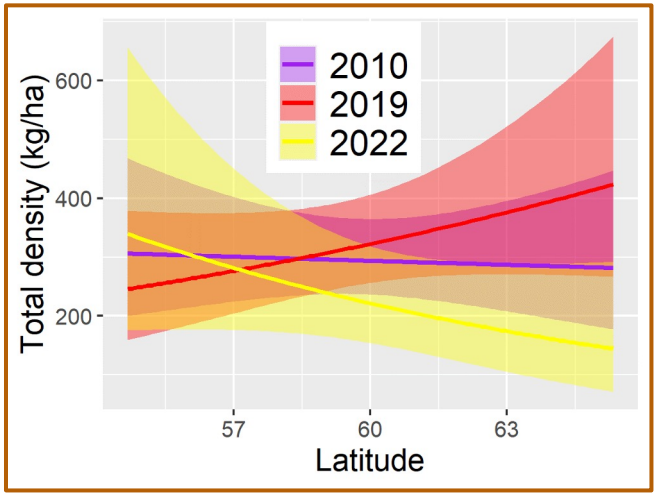
No indications of a major die-off event (COASST)

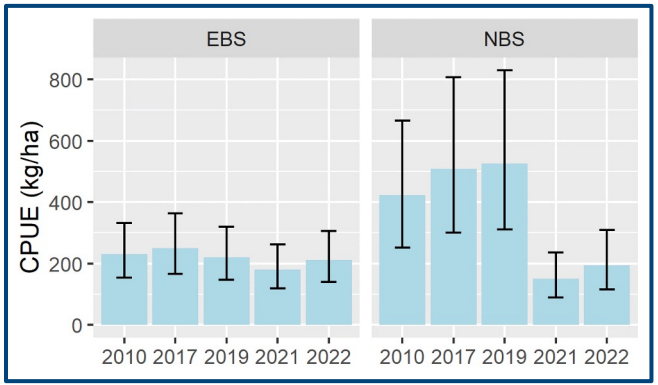


Groundfish Condition

- 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

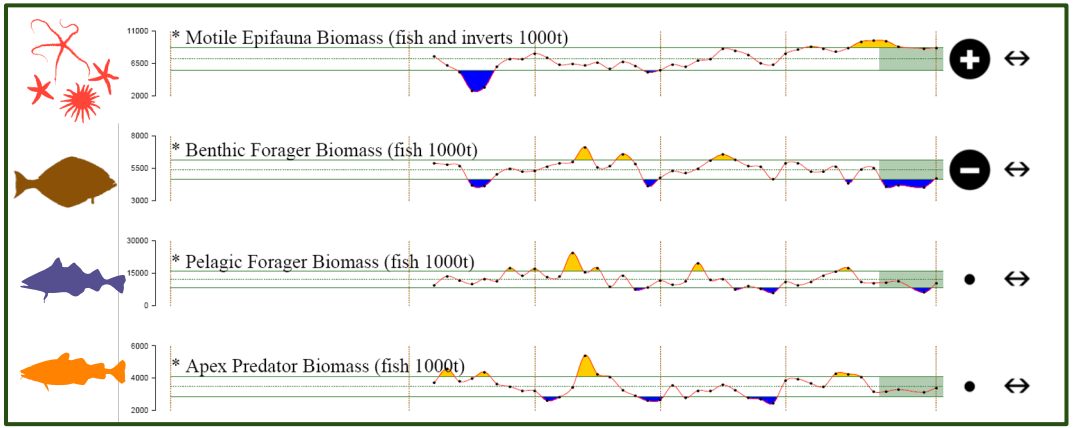


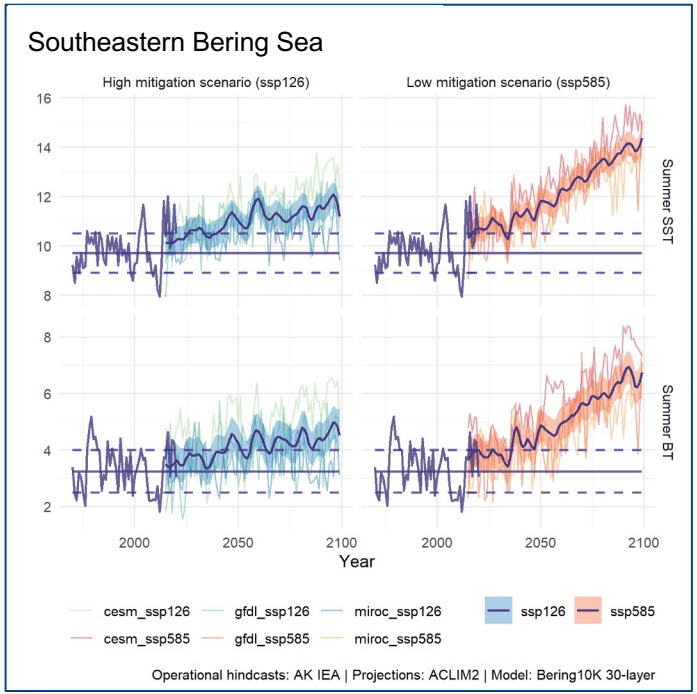




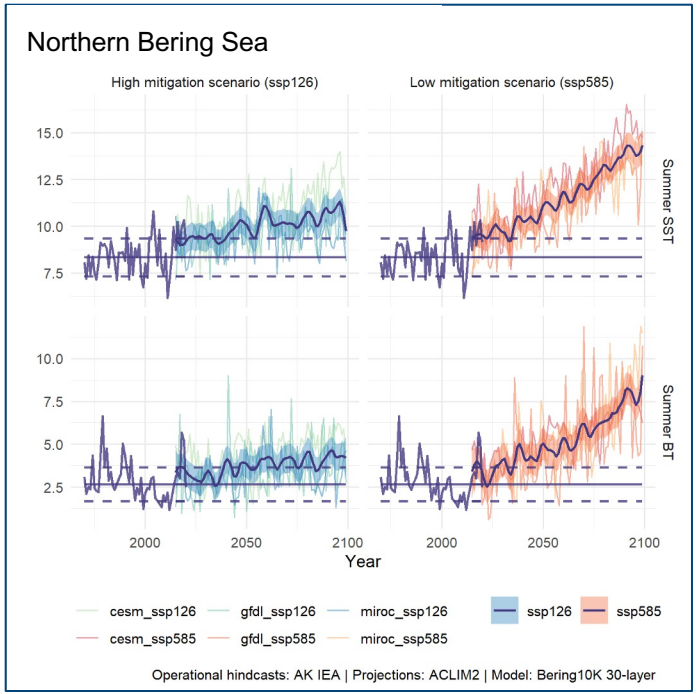
Groundfish community responses

- 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

2022 Summary and *implications*

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

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: