

# 2019 EASTERN BERING SEA ECOSYSTEM STATUS REPORT

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ALASKA FISHERIES SCIENCE CENTER

BSAI Groundfish Plan Team

November 12, 2019

# WITH CONTRIBUTIONS FROM:

*Thank you!*

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# OUTLINE

- Sea ice 2017/2018
- Full recap of 2018
- Sea ice 2018/2019...similarities and differences
- 2019 conditions
- Ecosystem responses reflective of:
  - 2018 conditions
  - 2019 conditions
  - cumulative impacts of the 'double whammy'

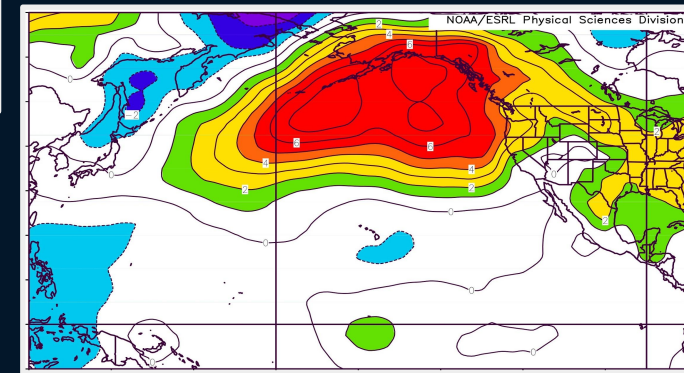
# 2017/2018 unprecedented lack of sea ice - what caused it?

Bond, Stabeno

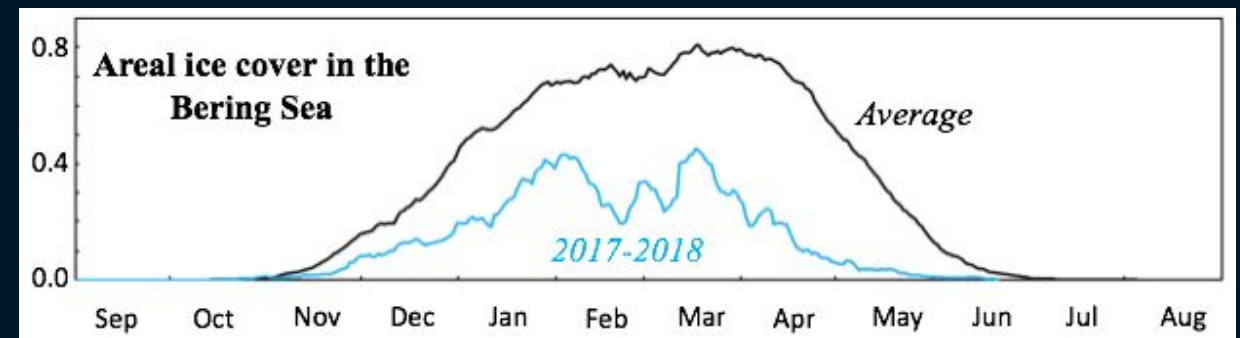
1) Residual heat in the system



2) Persistent high pressure system



3) Anomalous winds from the south



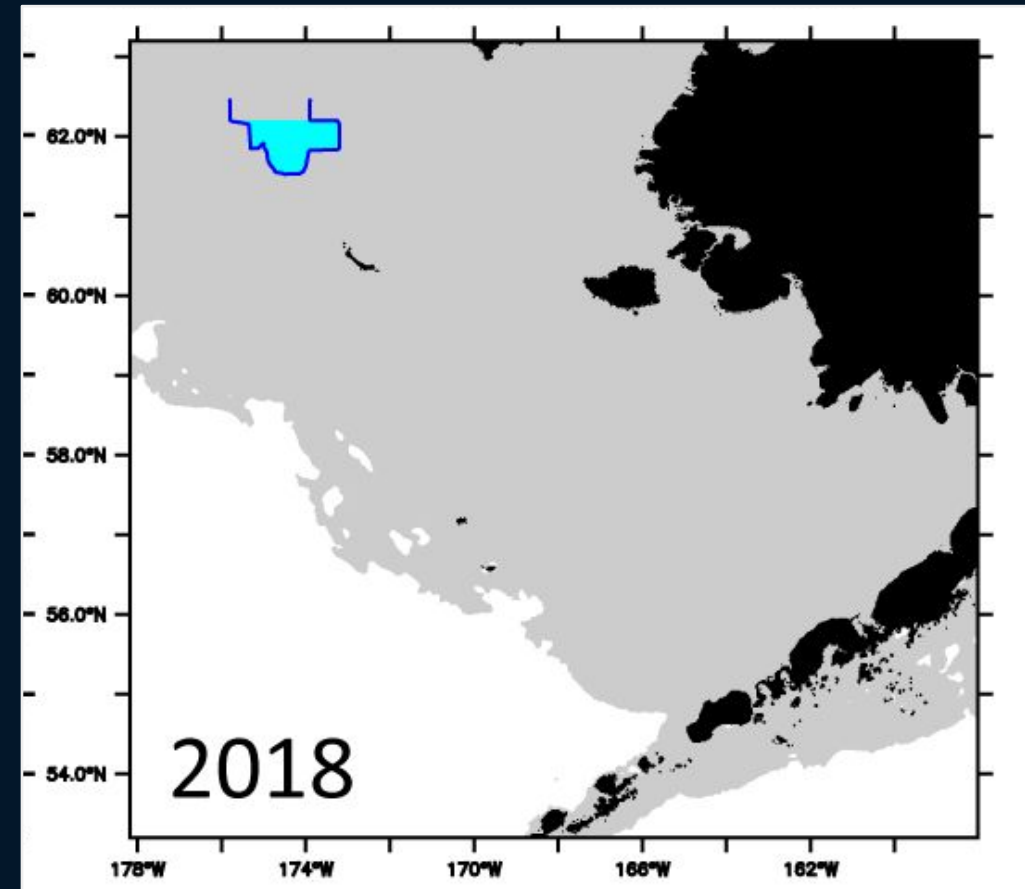


# RECAP OF 2018 a tale of two regions

Ladd

## Southeastern Bering Sea

No cold pool.



# RECAP OF 2018 a tale of two regions

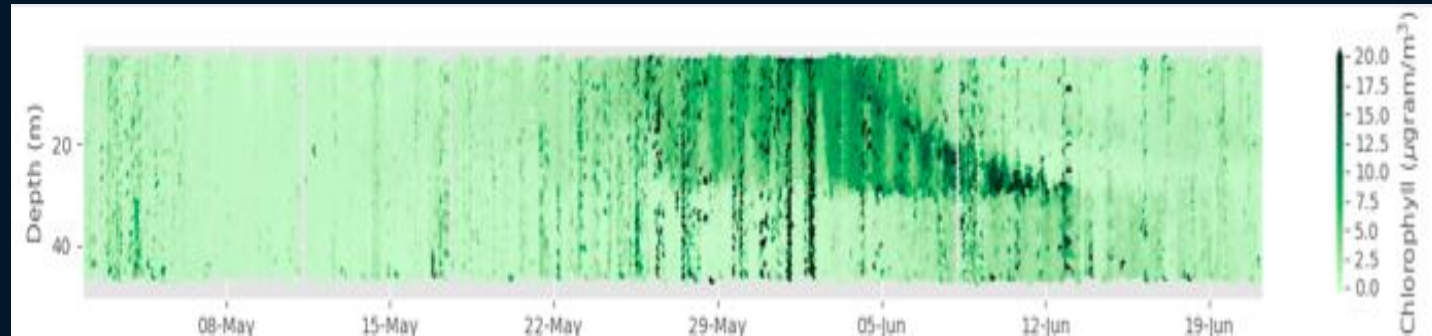
Stabeno

## Southeastern Bering Sea

No cold pool.

Reduced stratification (no salinity component).

Weak, delayed bloom.



# RECAP OF 2018 a tale of two regions

Recruitment Processes  
Alliance (RPA)

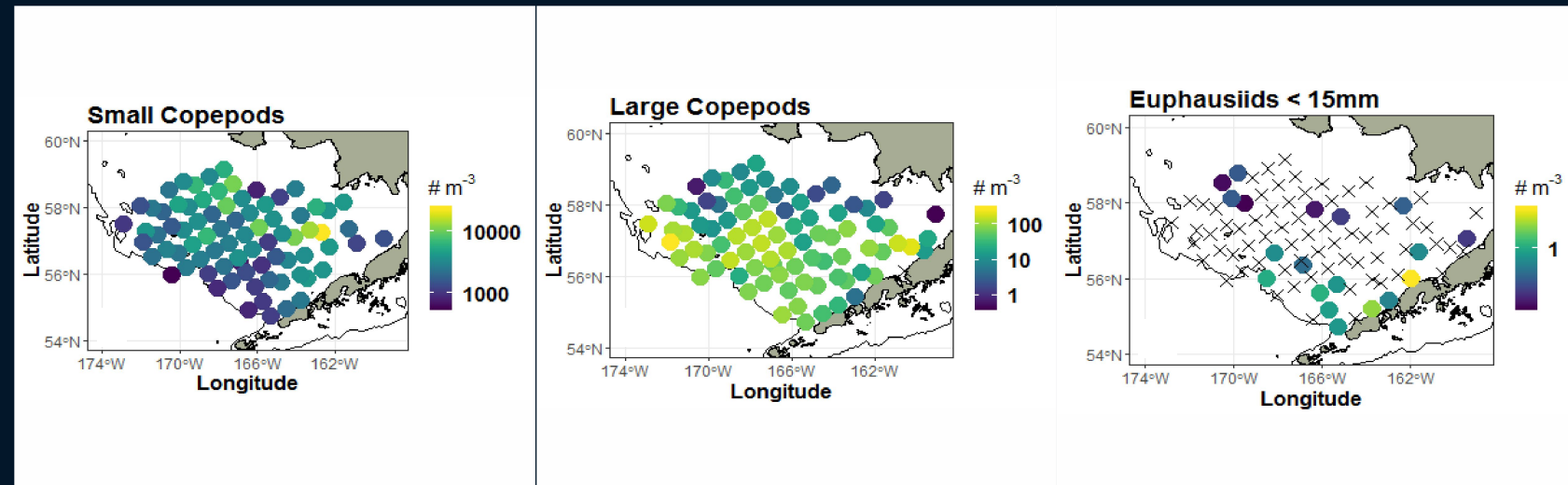
## Southeastern Bering Sea

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Low abundance/quality of  
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# RECAP OF 2018 a tale of two regions

RPA, Rooper

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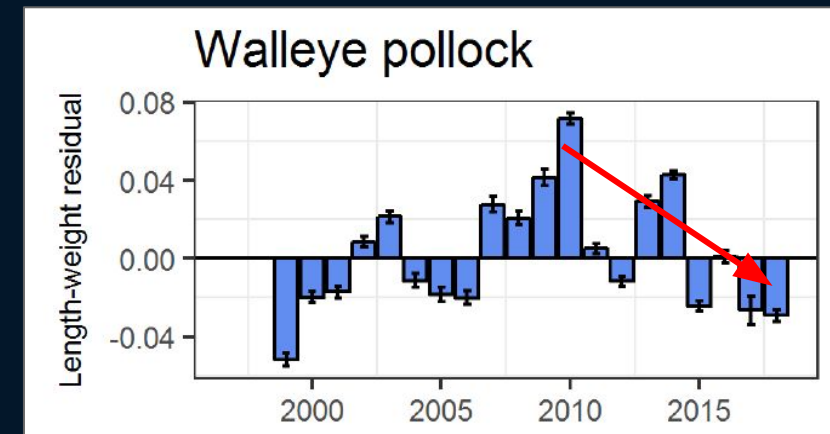
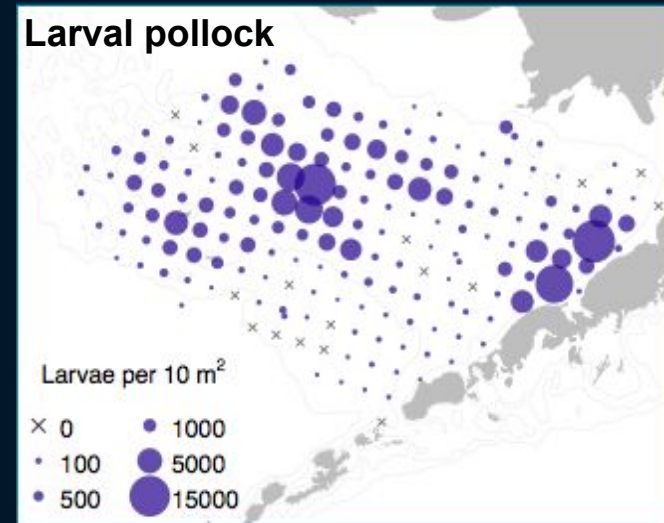
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Reduced stratification.

Weak, delayed bloom.

Low abundance/quality of zooplankton.

Larval fish production high; adult condition continued decreasing trend.



# RECAP OF 2018 a tale of two regions

Alaska Maritime  
National Wildlife Refuge

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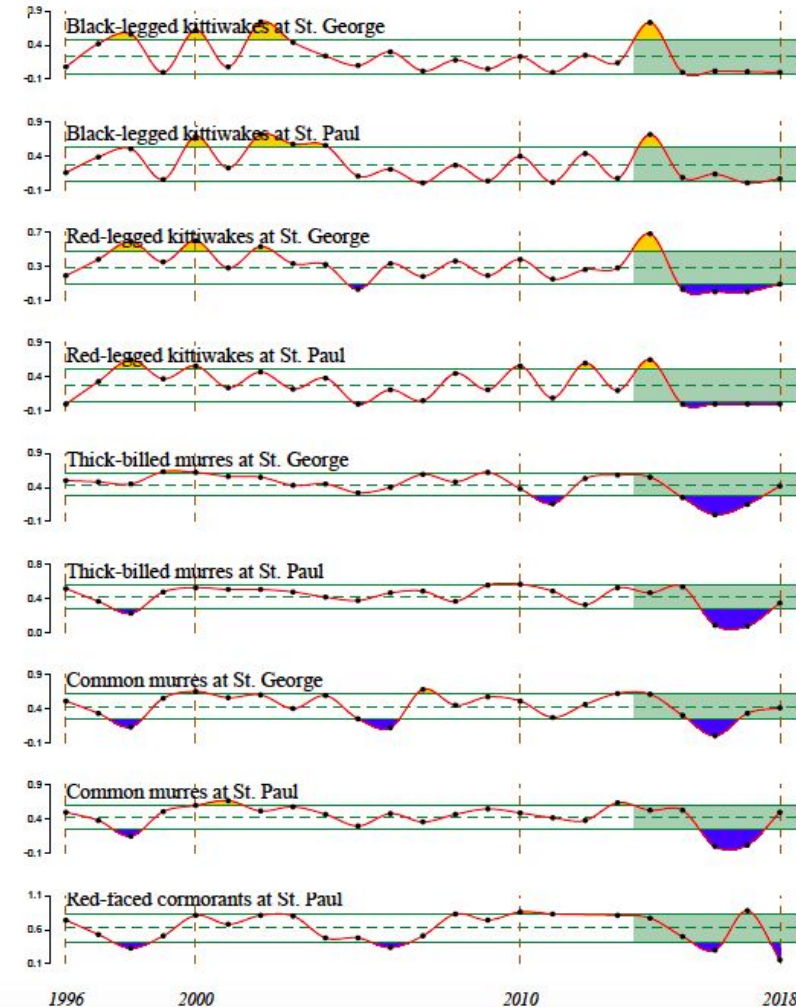
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Larval fish production high; adult condition continued decreasing trend.

Poor reproductive success for seabirds at the Pribilof Islands.





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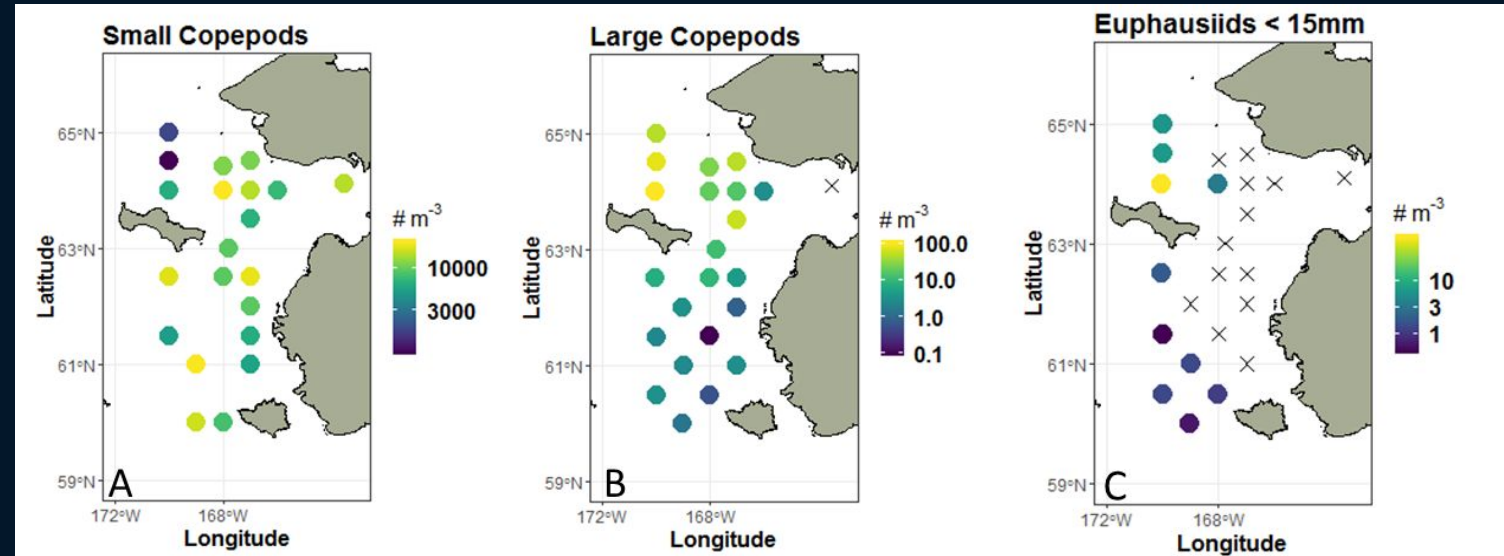
RPA

## Northern Bering Sea

Lack of sea ice; no ice algae to seed productivity.

Weak stratification.

Zooplankton abundance low; large copepods *Eucalanus bungii*.



# RECAP OF 2018 a tale of two regions

RPA

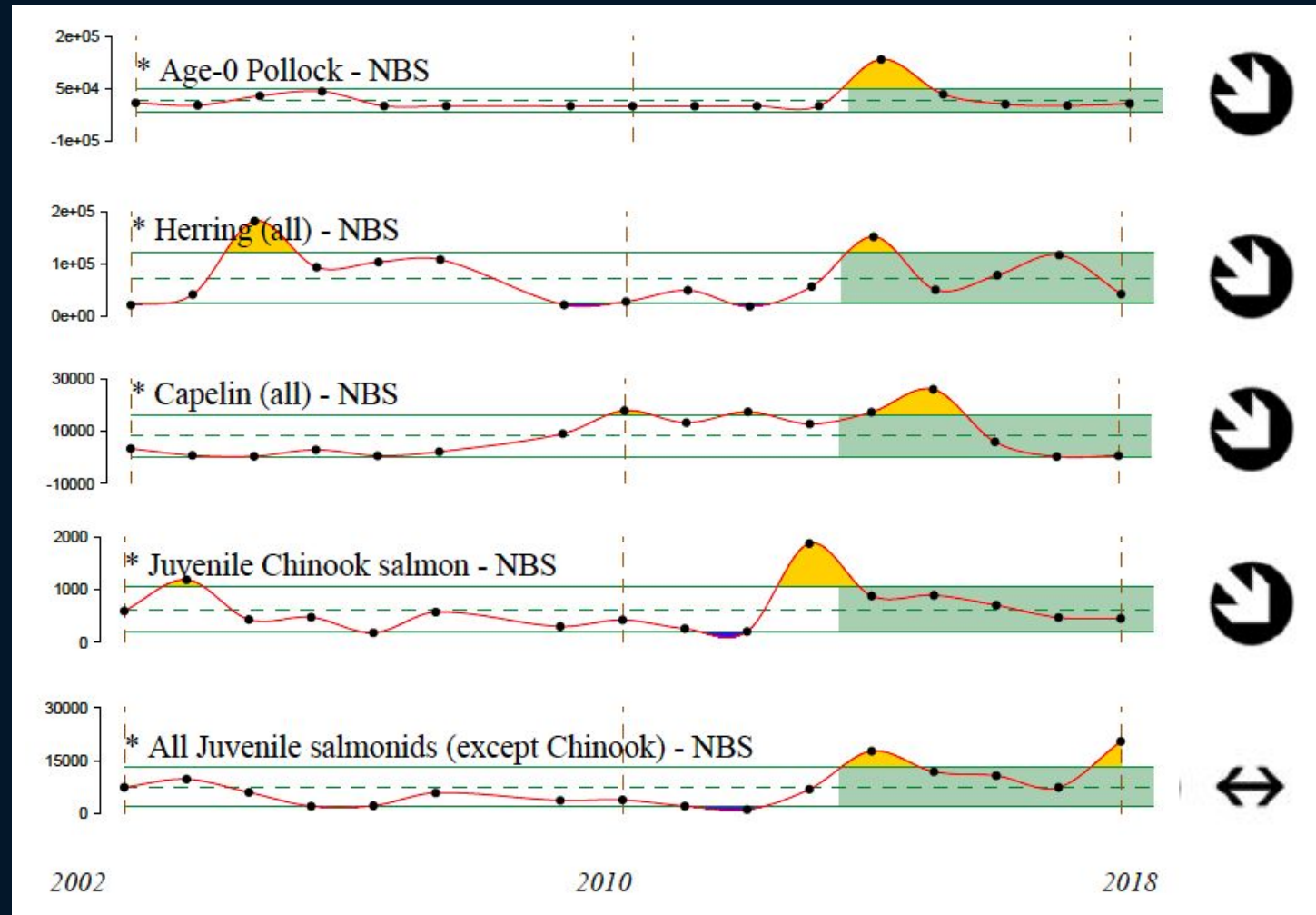
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Lauth

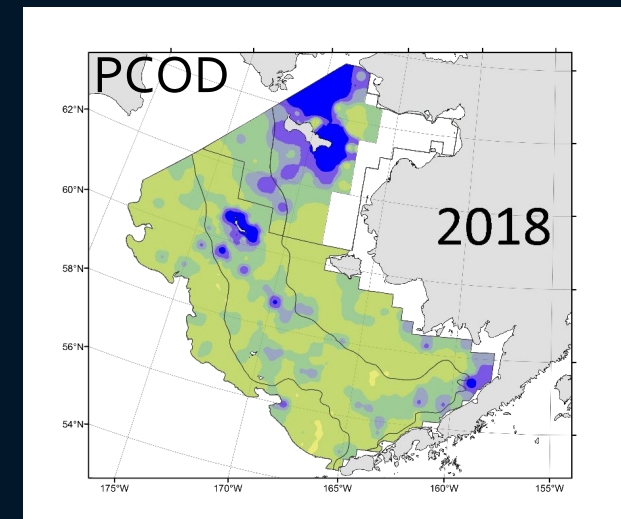
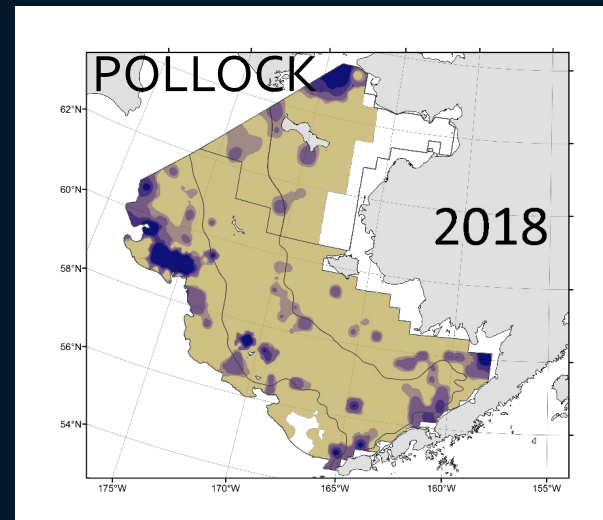
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# RECAP OF 2018 a tale of two regions

COASST and  
regional partners

## Northern Bering Sea

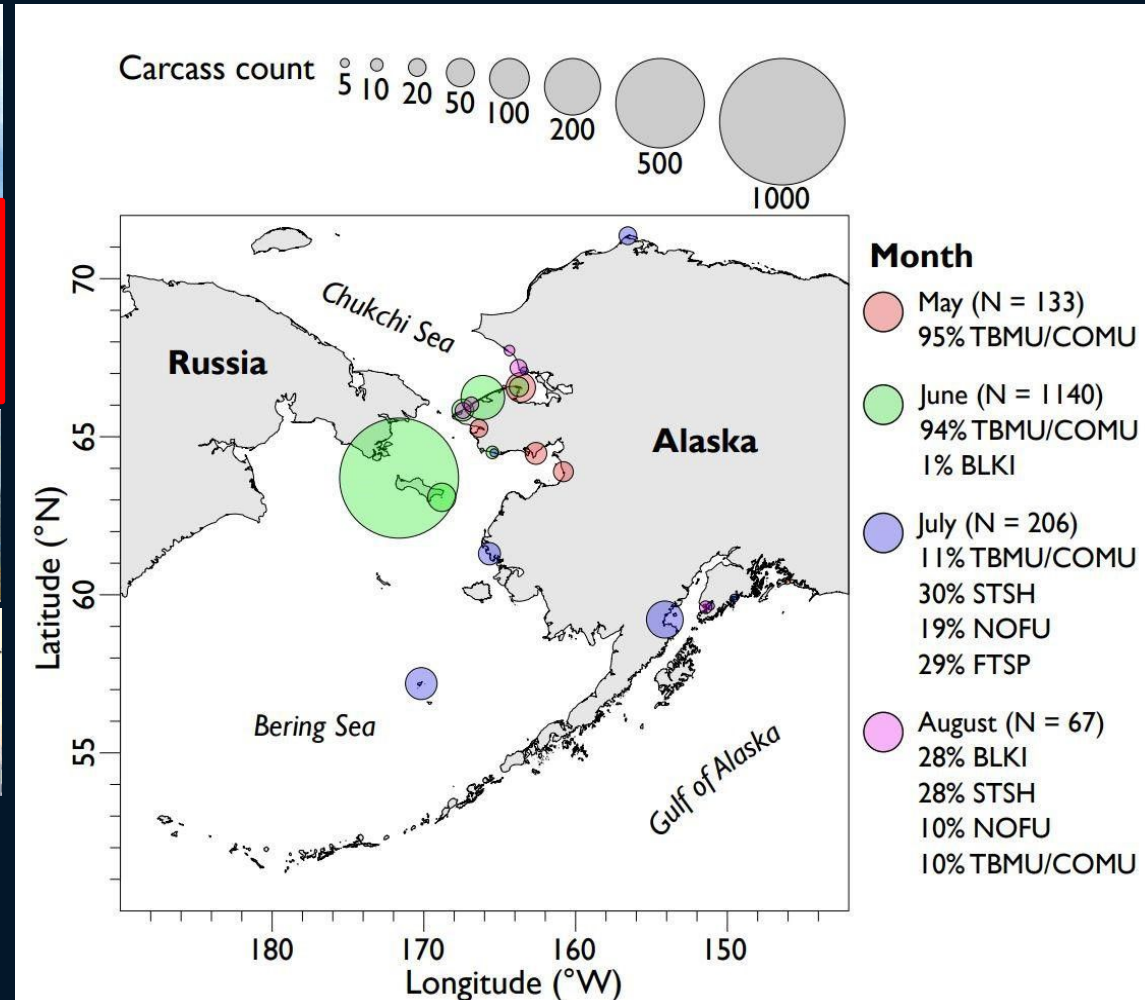
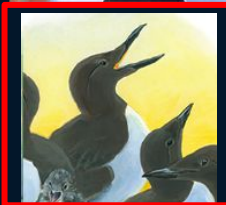
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Boveng

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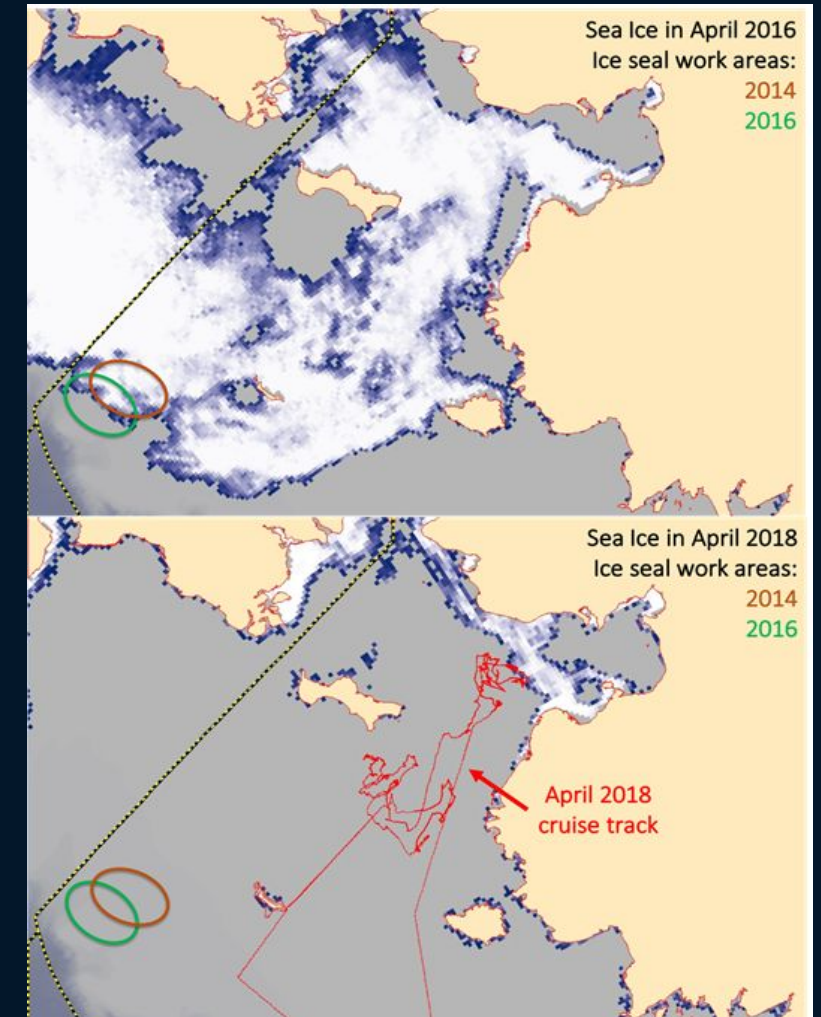
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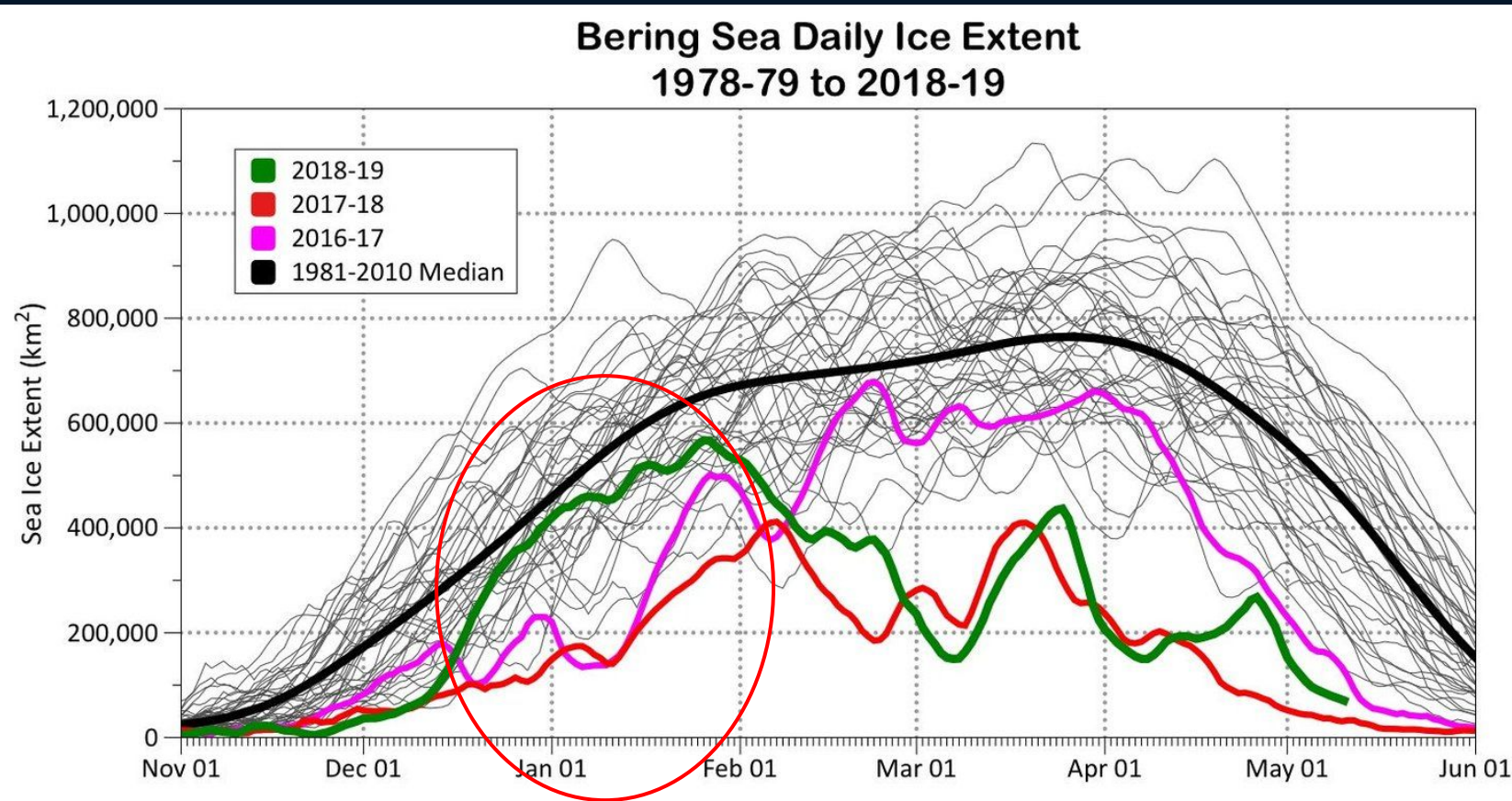
Ice seal distribution shifted.





# 2018/2019 'unprecedented again' lack of sea ice - similarities and differences

Thoman

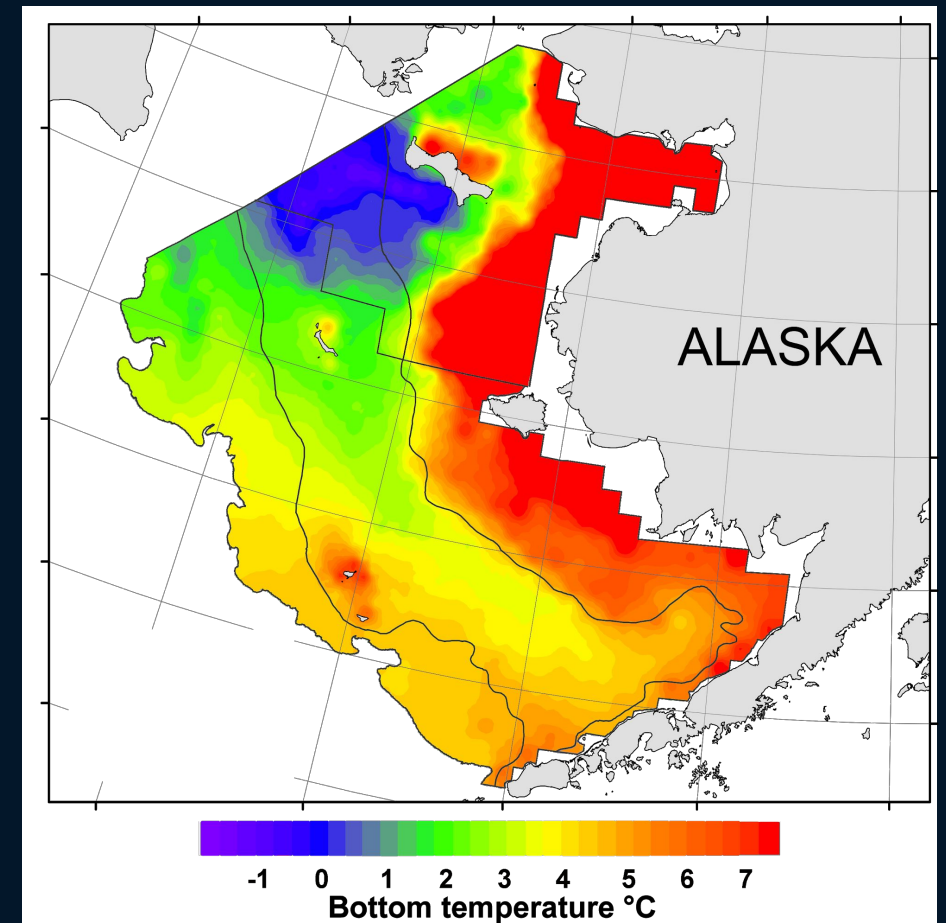
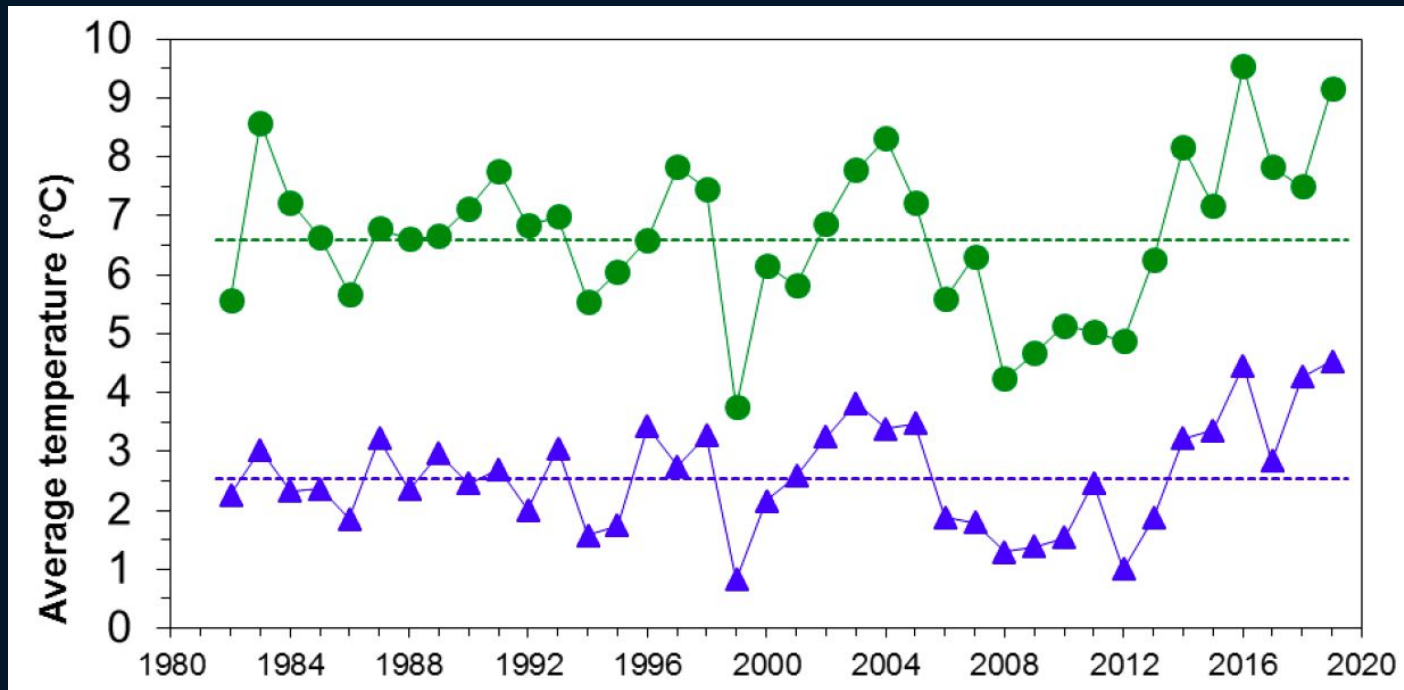


- Double whammy
- Early ice mid-Dec through Jan
- Warm winds in February
- What impact did early ice have on the ecosystem?



# 2018/2019 'unprecedented again' lack of sea ice - similarities and differences

Britt

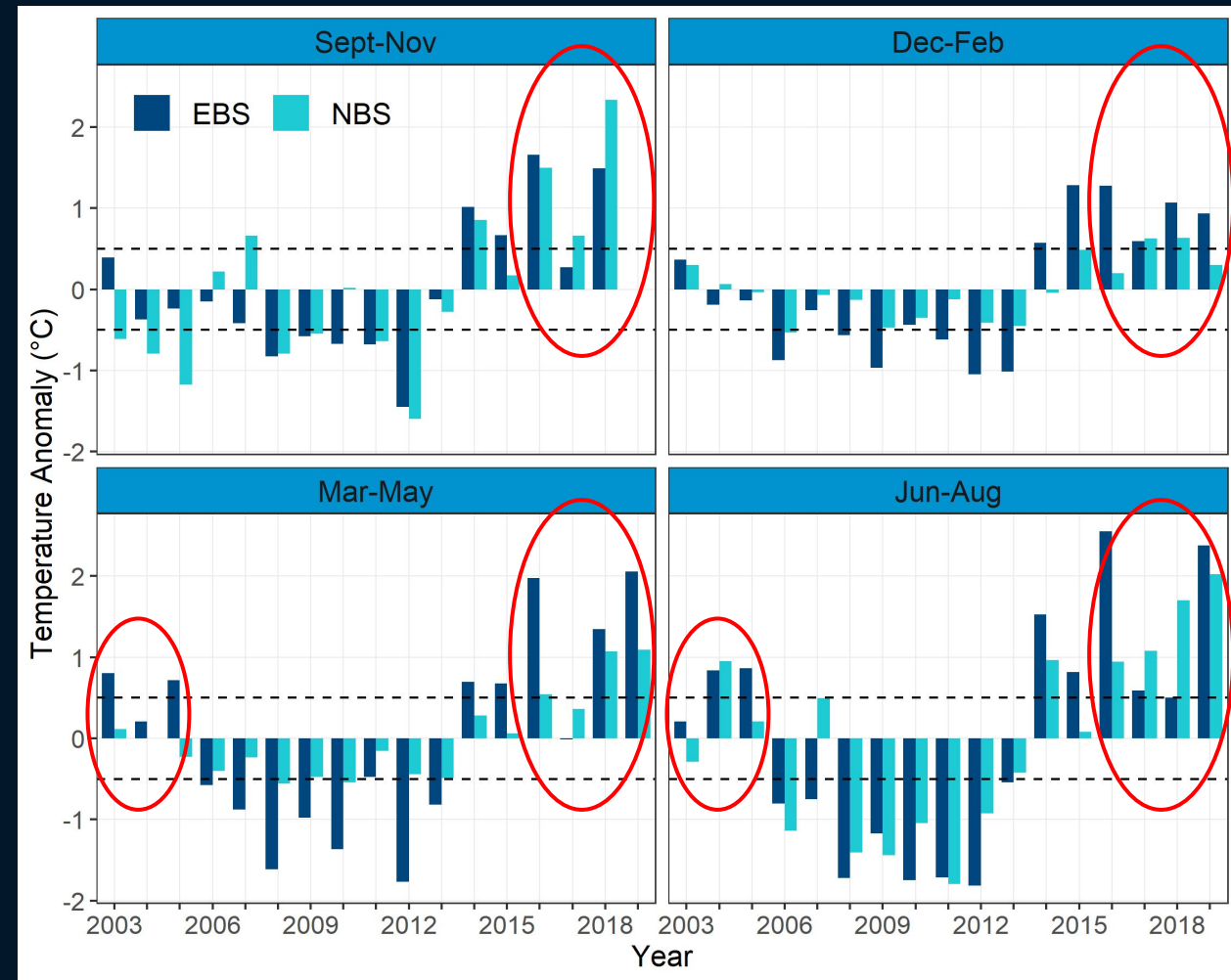


# 2018/2019 'unprecedented again' lack of sea ice - similarities and differences

Watson

## Satellite-derived SST

- Warm stanza in early 2000s driven by conditions in Mar-May and Jun-Aug.
- In recent years, warmth has persisted throughout the year.
- Endless summer?

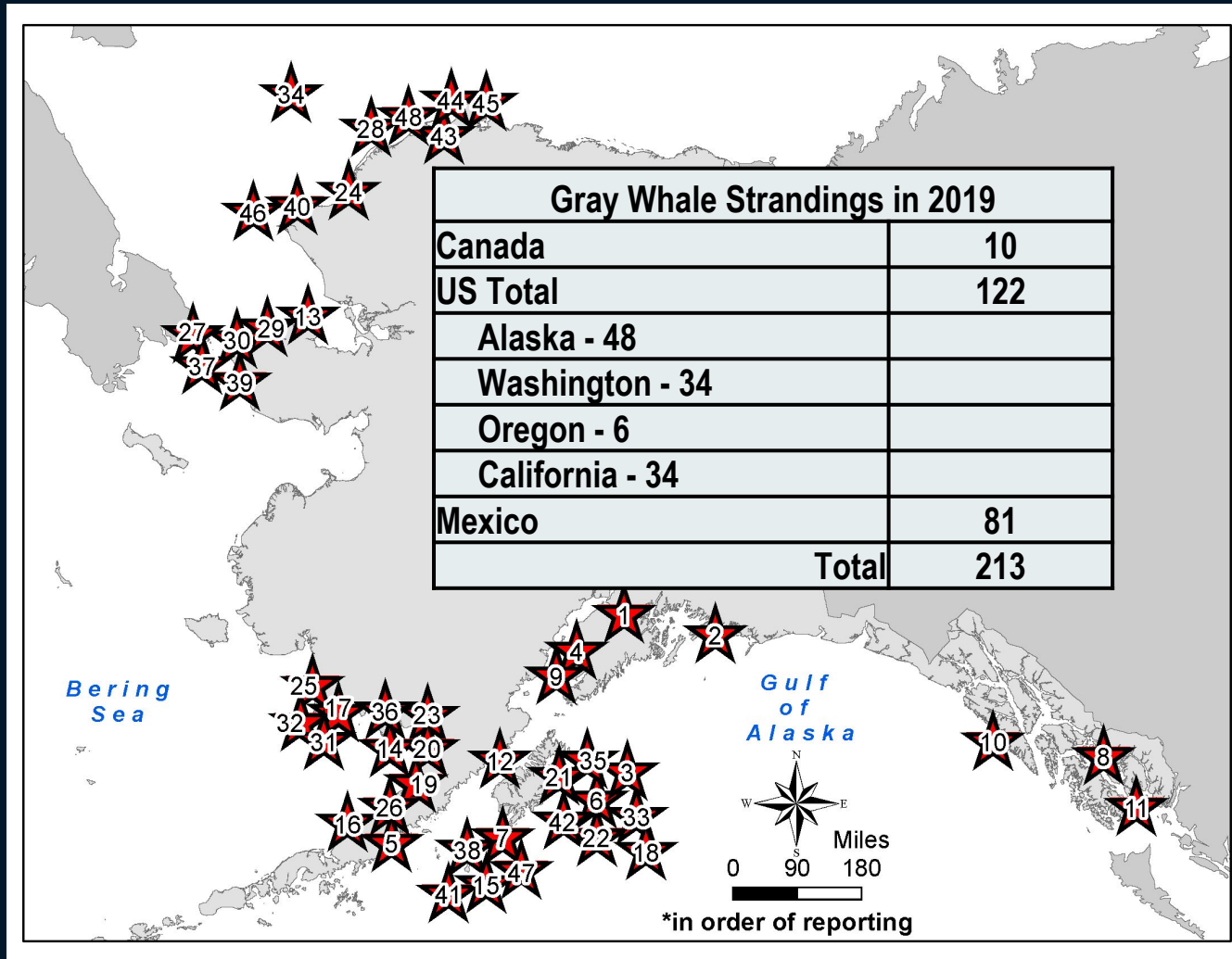




# REFLECTIVE OF 2018

Savage

## Gray whale Unusual Mortality Event



# REFLECTIVE OF 2018

Savage

## Gray whale Unusual Mortality Event

Preliminary necropsy results show evidence of emaciation.

Annual migration of up to 20,000 km.

- Summer and fall in the Bering and Chukchi seas feeding.
- Feed on amphipods, mysids, crab larvae.
- Overwinter (mating, calving) along the west coast of southern Baja California Peninsula.





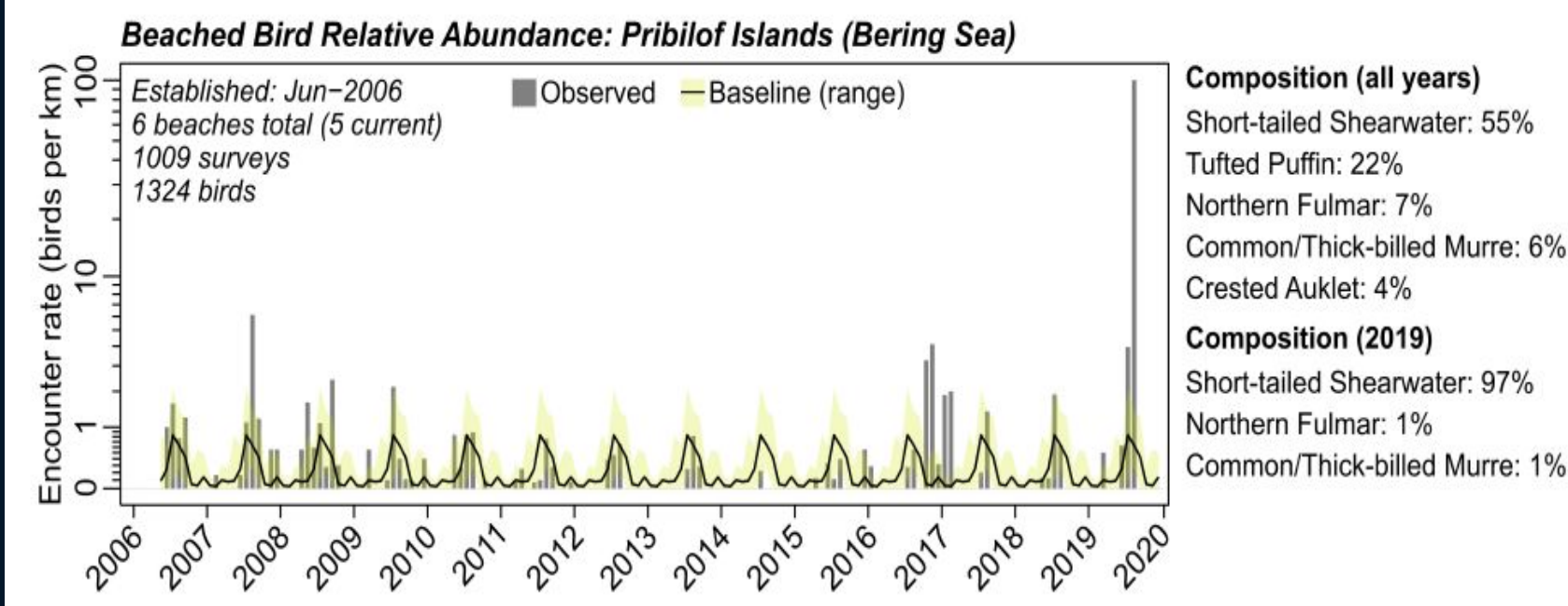
# REFLECTIVE OF 2018

COASST  
USFWS  
AMNWR and  
regional partners

## Short-tailed shearwater die-off event

### PRIBILOF ISLANDS

- Long term trends of seabird die-offs.
- COASST beach surveys.
- Standard methods since 2006.





## REFLECTIVE OF 2018

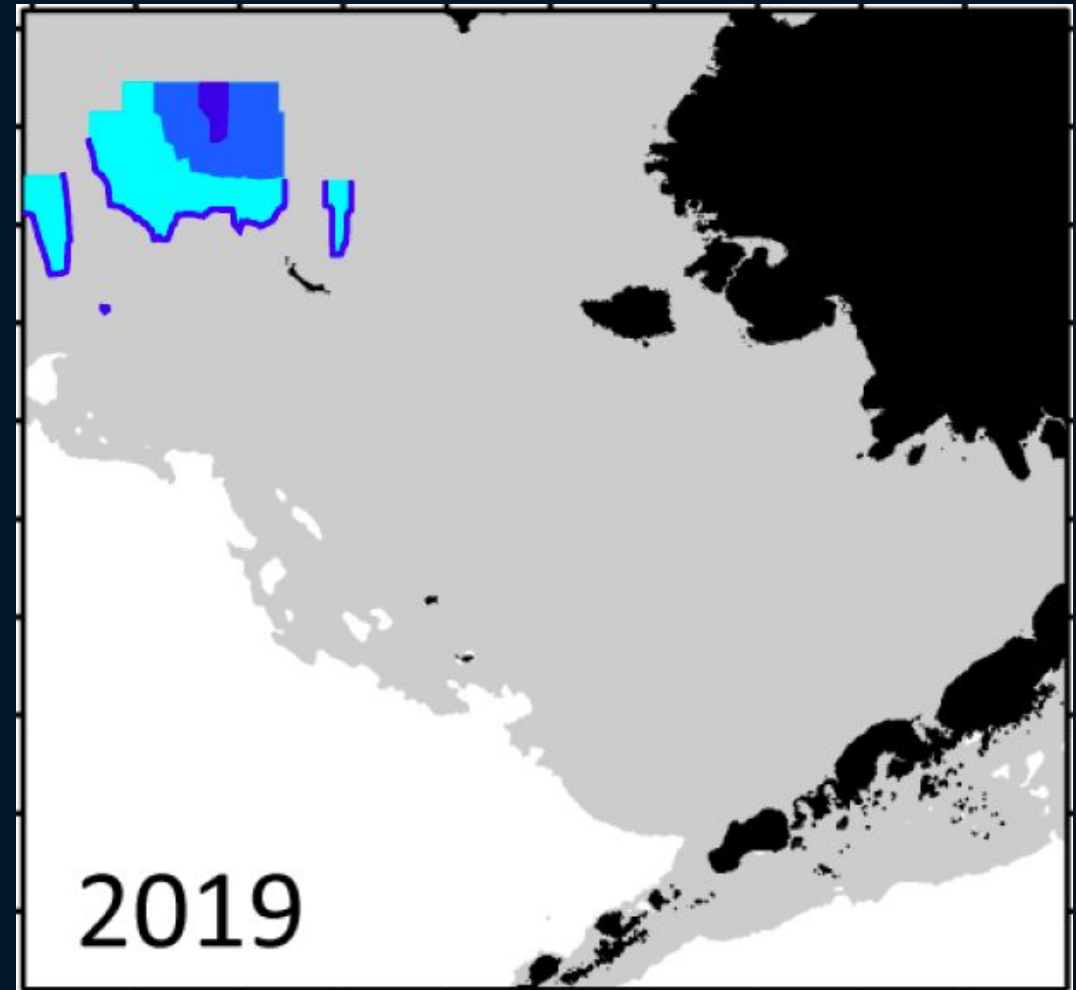


- Both species feed in the Bering Sea during summer:
  - gray whales are benthic feeders (e.g., amphipods)
  - shearwaters are planktivorous (e.g., euphausiids)
- Both species embark on long migrations to the southern hemisphere for breeding during the austral summer.
- The 2019 mortality events may reflect:
  - (i) 2018 feeding conditions in the Bering Sea,
  - (ii) conditions experienced during the breeding season in the southern hemisphere, or
  - (iii) lack of available prey to complete the migration to the Bering Sea in 2019.

# REFLECTIVE OF 2019

Ladd

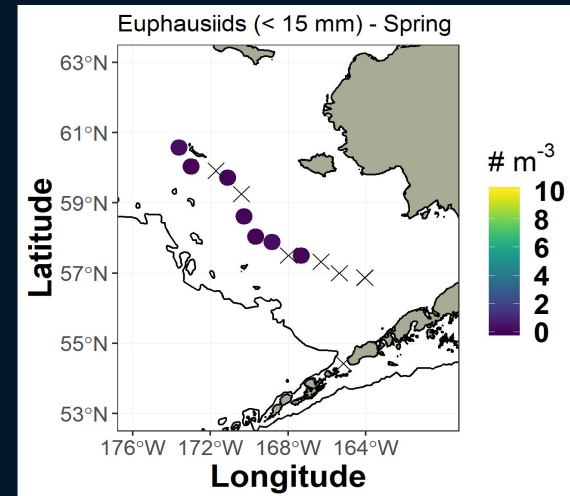
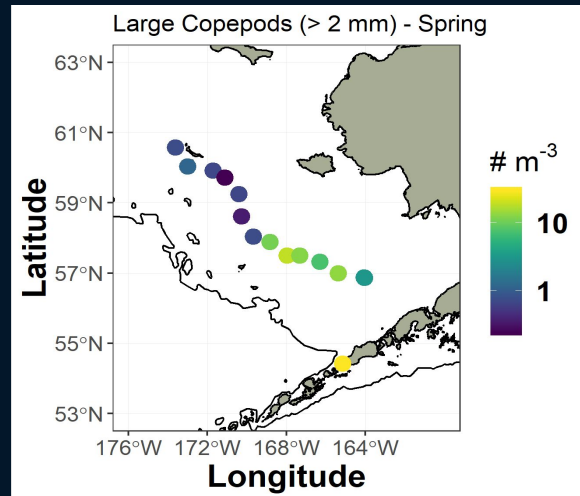
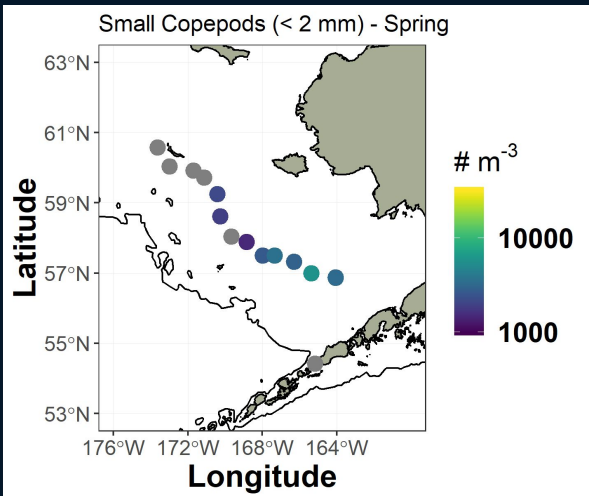
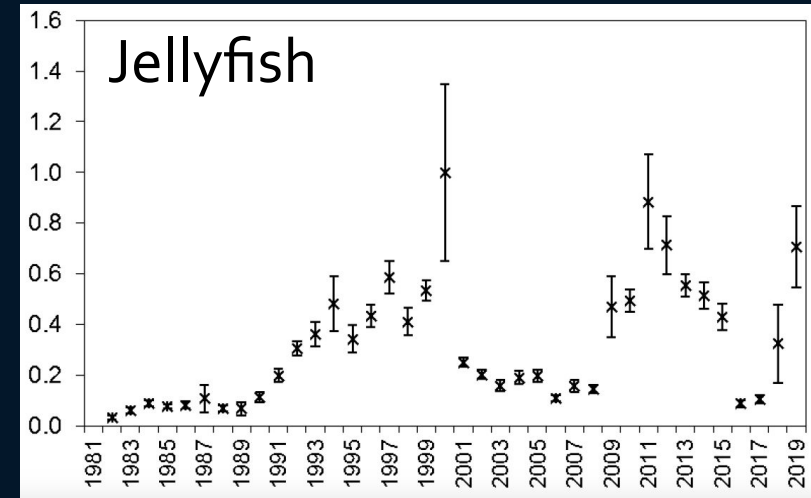
- Spring bloom occurred earlier (~9 days) than the long-term average.



# REFLECTIVE OF 2019

Britt, RPA

- Spring bloom occurred earlier (~9 days) than the long-term average.
- Zooplankton composition was dominated by small copepods.
- Jellyfish abundance increased.

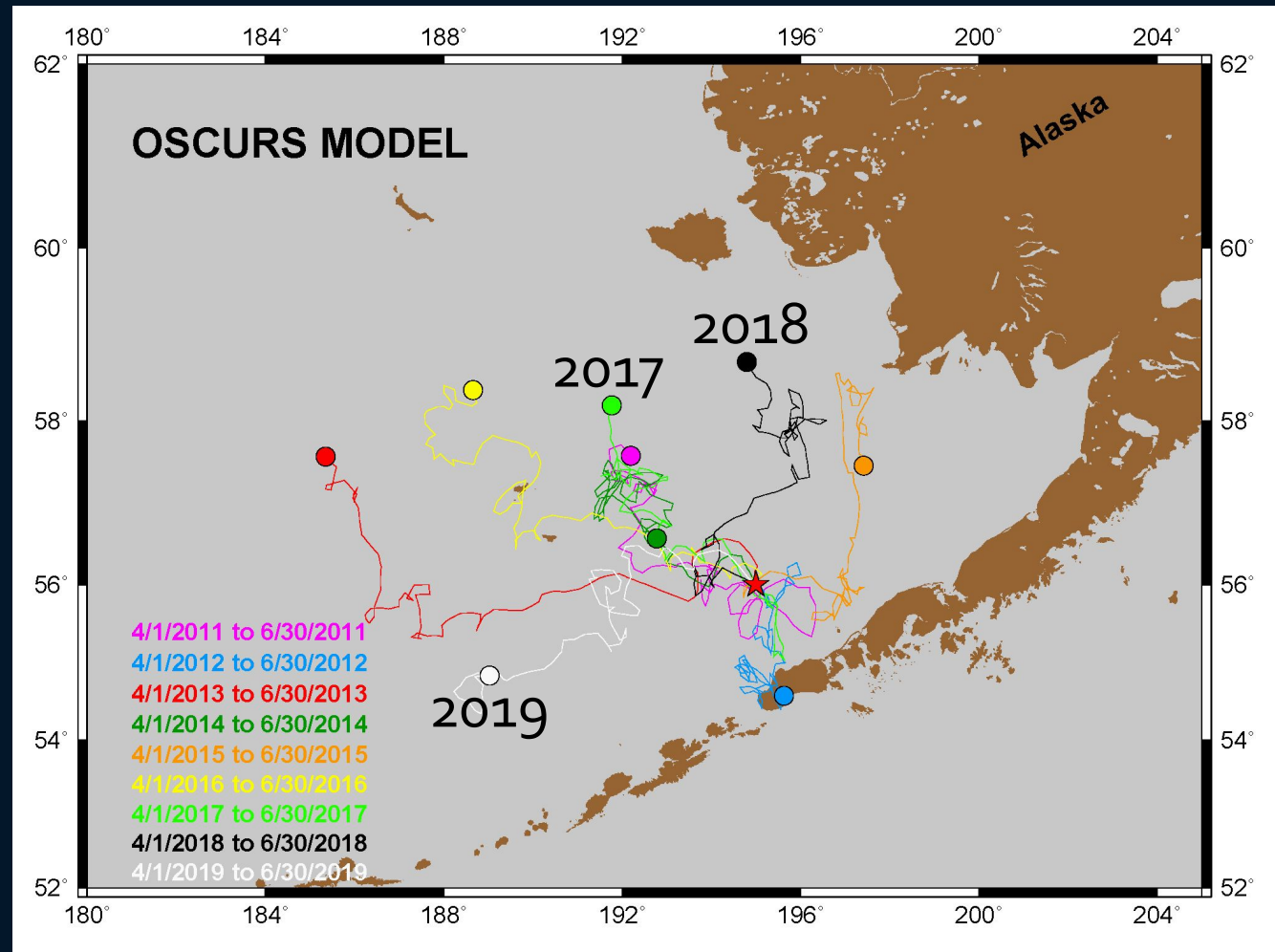


# REFLECTIVE OF 2019

Wilderbuer

## Wind forcing for winter-spawning flatfish

- The 2017 drift pattern was mixed.
- The 2018 drift was favorable with northward/onshore winds.
- The 2019 drift pattern appears unfavorable with westerly winds.





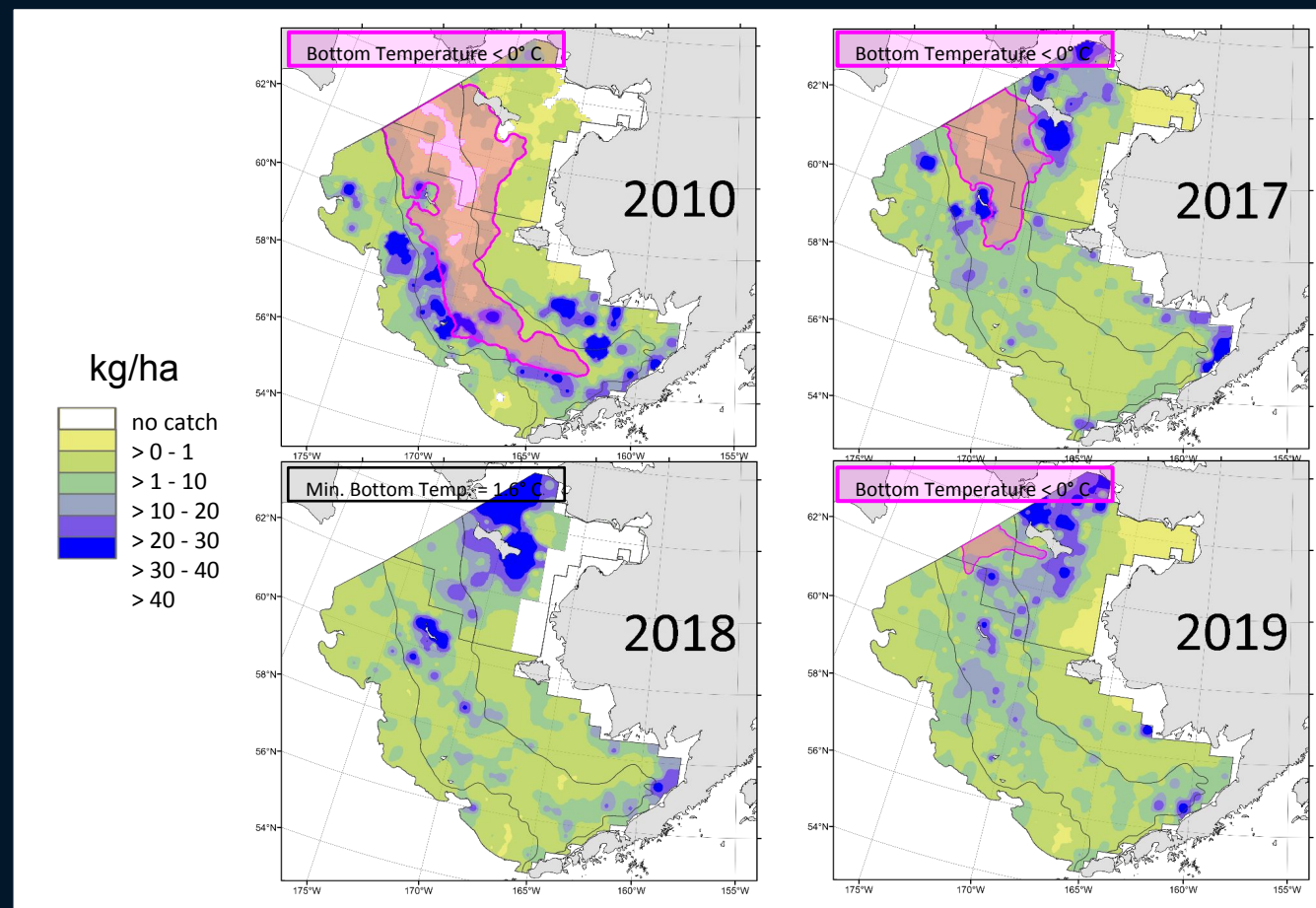
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Britt

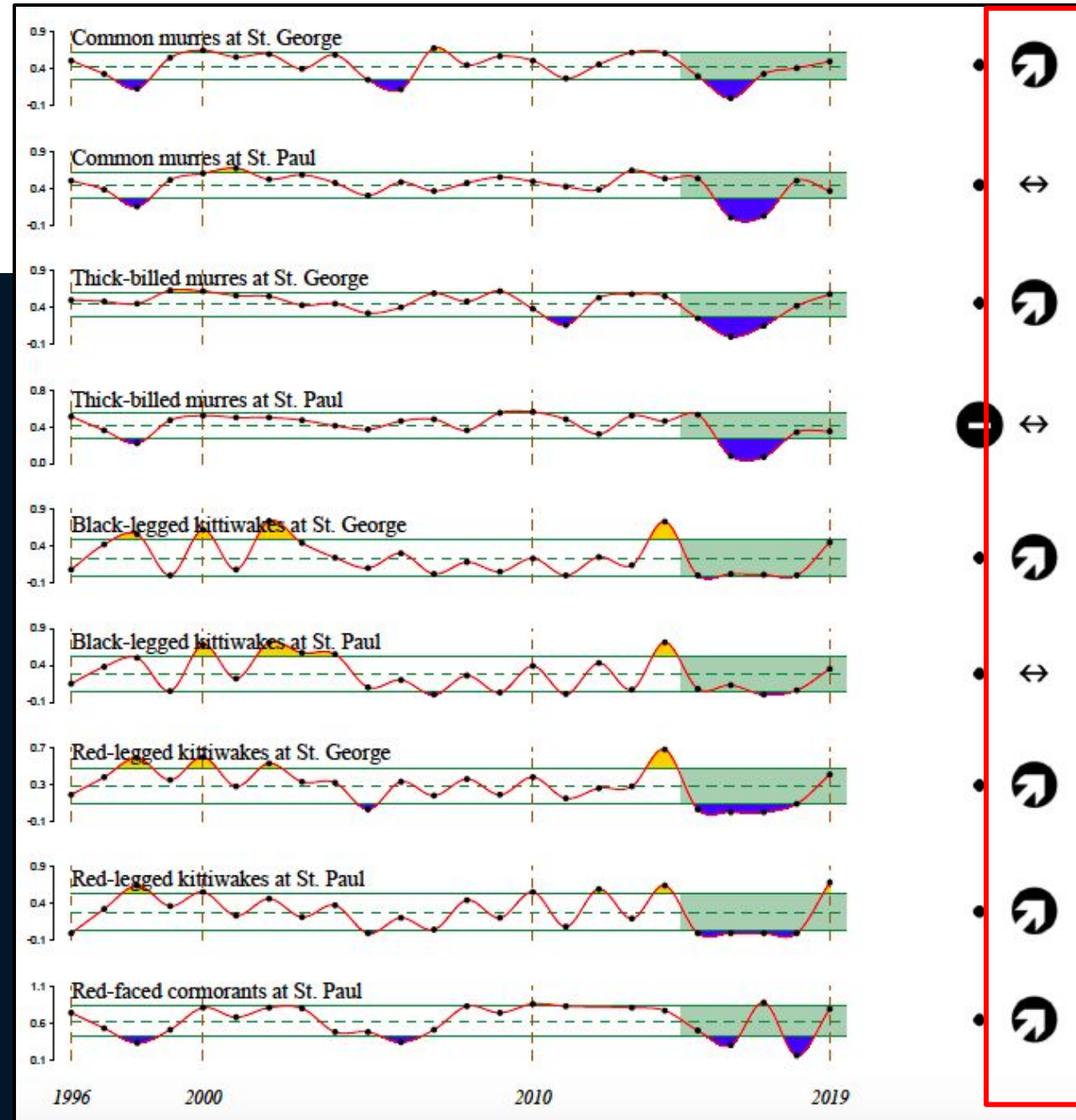
## Pacific cod

- Northern Bering Sea
  - Biomass +30% from 2017.
  - Abundance +52%.
  - Fish appeared healthy.
- Southeastern Bering Sea
  - Biomass +2% from 2018.
  - Below the long-term mean.
  - Abundance +112%.
  - Indicates recruitment of age-1 fish.
  - Moved out of warm inner domain?
  - Westerly winds?



# REFLECTIVE OF 2019

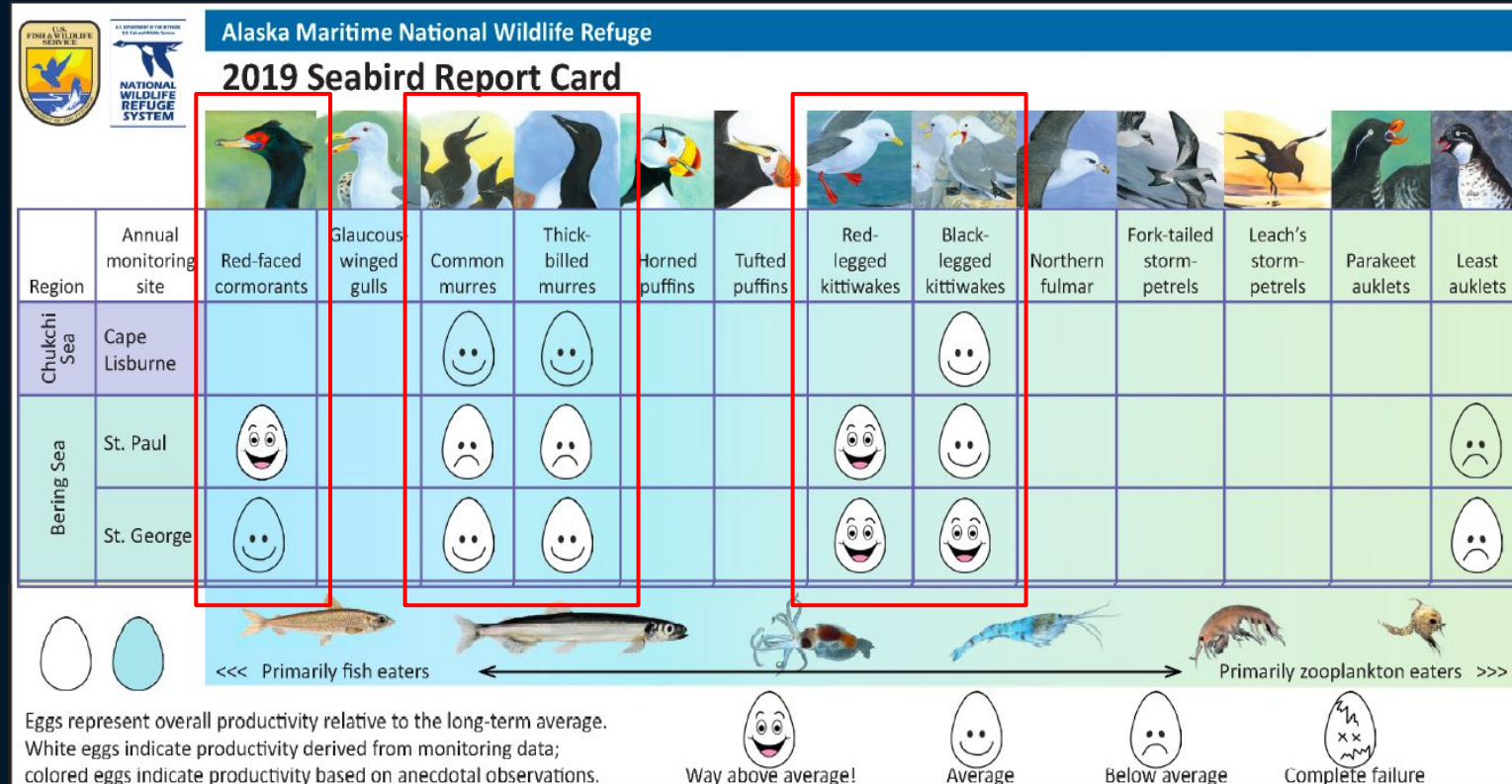
- Spring bloom occurred earlier (~9 days) than the long-term average.
- Zooplankton composition was dominated by small copepods.
- Jellyfish abundance increased.
- Seabird reproductive success at the Pribilof Islands.



# REFLECTIVE OF 2019

Alaska Maritime  
National Wildlife Refuge

Successful breeding events occurred for fish-eating species (murrelets at St. George and red-faced cormorants at both islands) and plankton-eating species (both species of kittiwakes at both islands).



# REFLECTIVE OF 2019



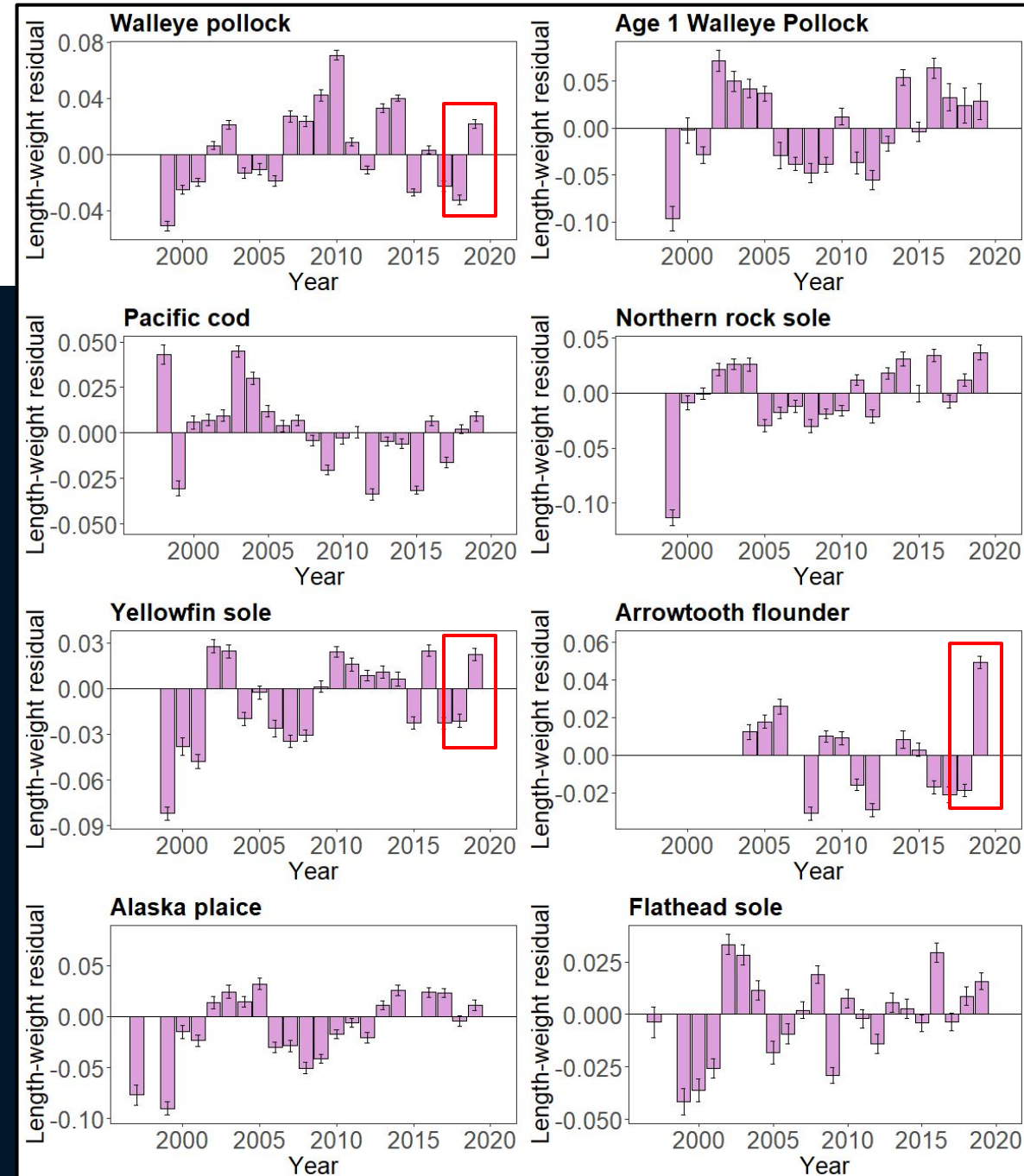
- Seabirds may have been successful at finding lipid-rich copepods and euphausiids, even though abundances were low;
- Competition for available prey may have been reduced as a result of shearwater mortalities and/or poor recruitment events for fish species;
- Colonies at the Pribilof Islands may have benefited from northward shifts in fish populations;
- Below-average coccolithophore bloom index for 2019.





# REFLECTIVE OF CUMULATIVE IMPACTS

- Groundfish condition increased in 2019 relative to 2018.
- Condition was positive for all species shown.
- Large increases were seen for adult pollock, Yellowfin sole, and Arrowtooth flounder.
  - possible shift to benthic-dominated system?



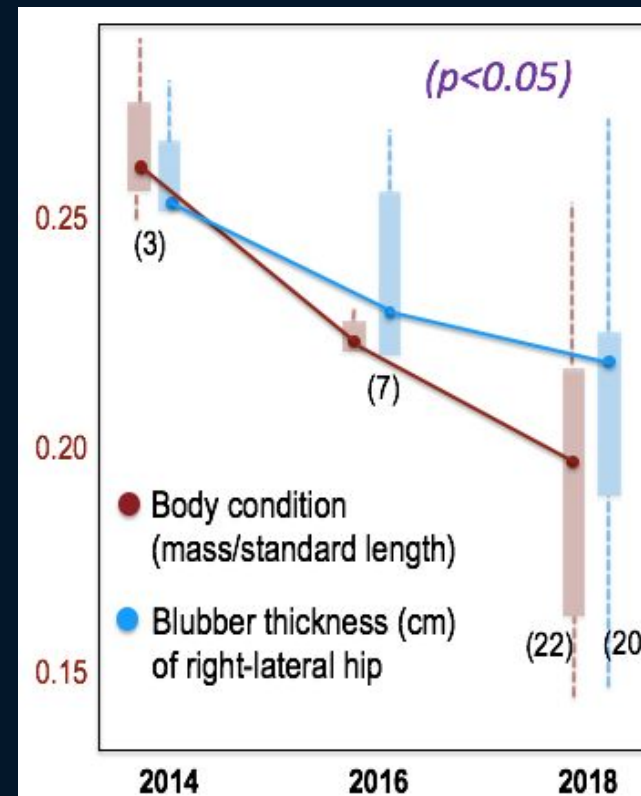


# REFLECTIVE OF CUMULATIVE IMPACTS

Boveng

## Ice seal Unusual Mortality Event

- Between 2018 and 2019, 282 ice seal carcasses (mostly young) were reported from the Bering and Chukchi seas.
- Mortalities and decline in pup condition consistent with lack of sea ice for pupping and nursing.
- Competition for prey from groundfish.
- Starvation attributed.



- Linear regression on effect of year
- Accounted for sex & date
- Small sample sizes
- Both independent measures, showed a significant negative trend

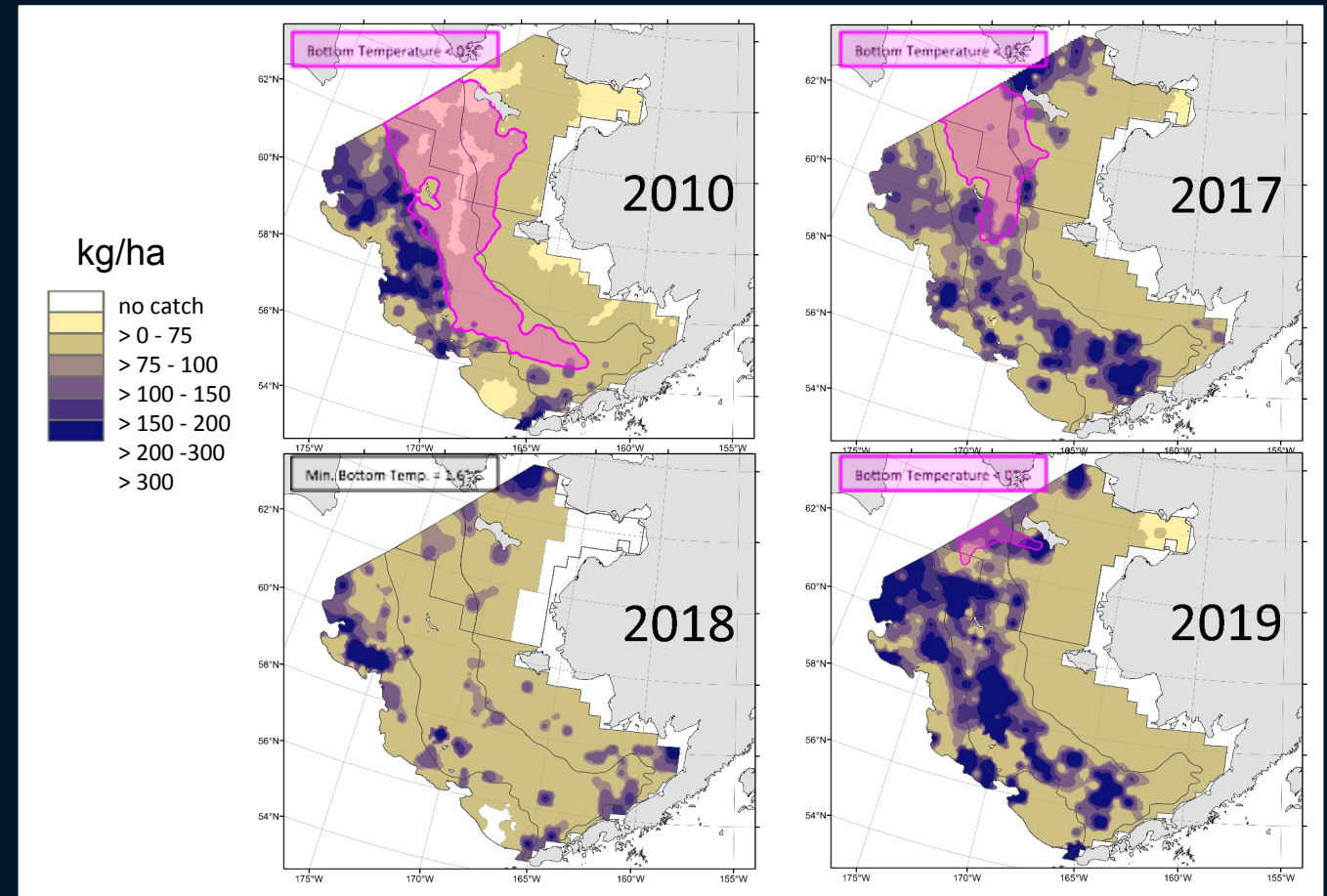
# REFLECTIVE OF CUMULATIVE IMPACTS



Britt

## Walleye pollock

- Northern Bering Sea
  - Biomass -11% from 2017.
  - Abundance +59%.
  - Indicates successful recruitment.
- Southeastern Bering Sea
  - Biomass +75% from 2018.
  - Just above the long-term mean.
  - Abundance +53%.
  - Indicates movement of adult fish into the region.



# REFLECTIVE OF CUMULATIVE IMPACTS



RPA

## Walleye pollock recruitment forecasts for the 2018 year class

- Temperature change index
  - Above average recruitment
  - cool summer conditions as age-0 followed by warm spring as age-1 fish.
- Surface silicic acid
  - Below average recruitment
  - Silicate concentrations high, but fish weights were below average.
- Diet energy density
  - Below average recruitment
  - Note: euphausiids comprised >50% of age-0 diet.
- Age-0 energy density
  - Below average recruitment

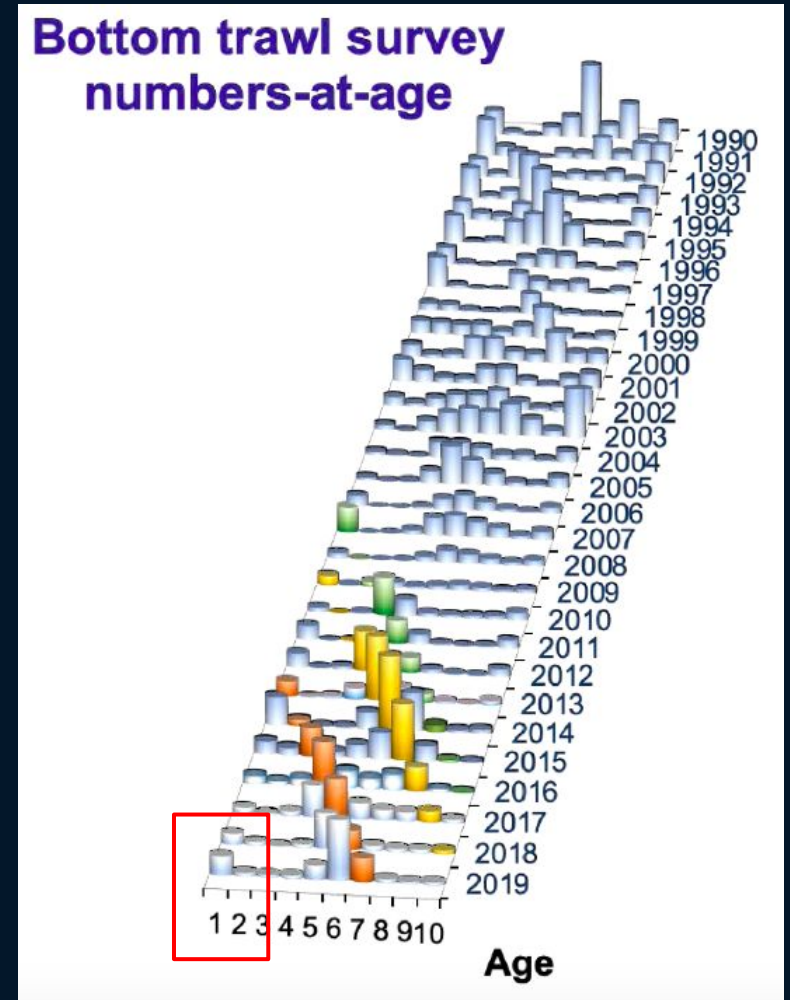
# REFLECTIVE OF CUMULATIVE IMPACTS



Ianelli

## And yet....

- Anomalous February winds increased on-shelf flow and upwelling conditions. Upwelling of productivity during winter may have subsidized energy transfer.
- Reduced cannibalism because recent years' recruitment has been low.
- Age-1 natural mortality estimate was at the long-term mean (CEATTLE) demonstrating reduced predation of the 2018 year class.



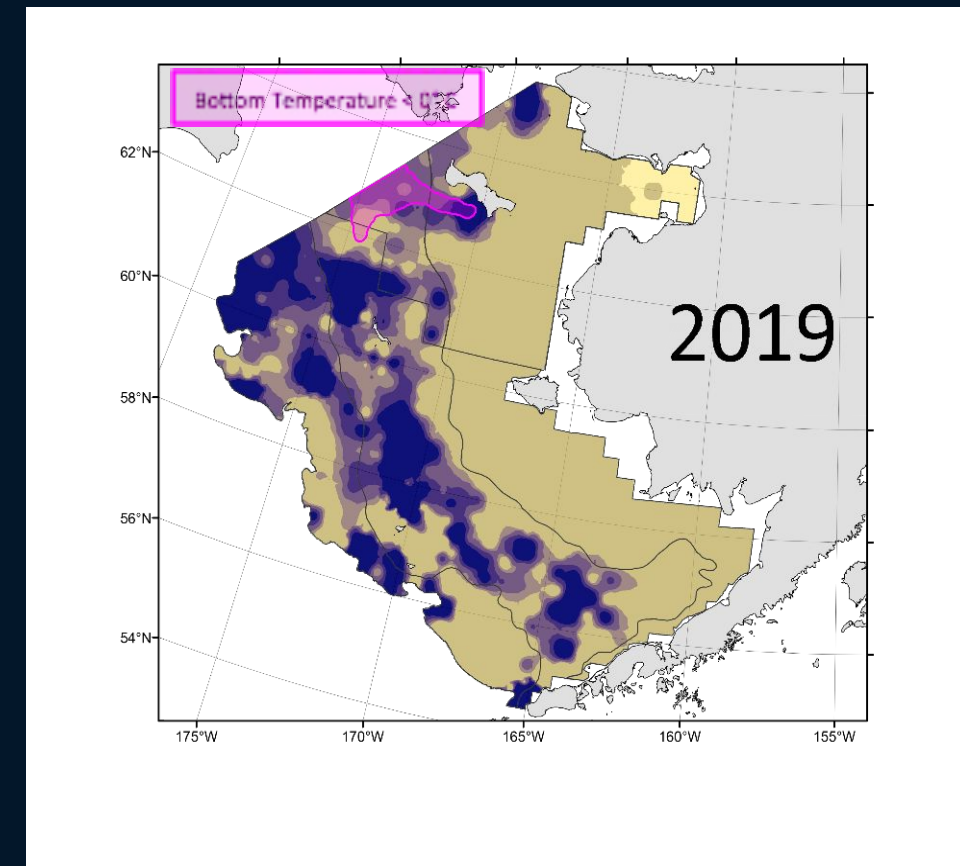
# REFLECTIVE OF CUMULATIVE IMPACTS



Britt

## But...

- 75% increase in biomass from 2018 to 2019.
- Indicates adult fish moved into the region.
- Therefore, the 2019 year class may experience increased predation pressure from cannibalism.



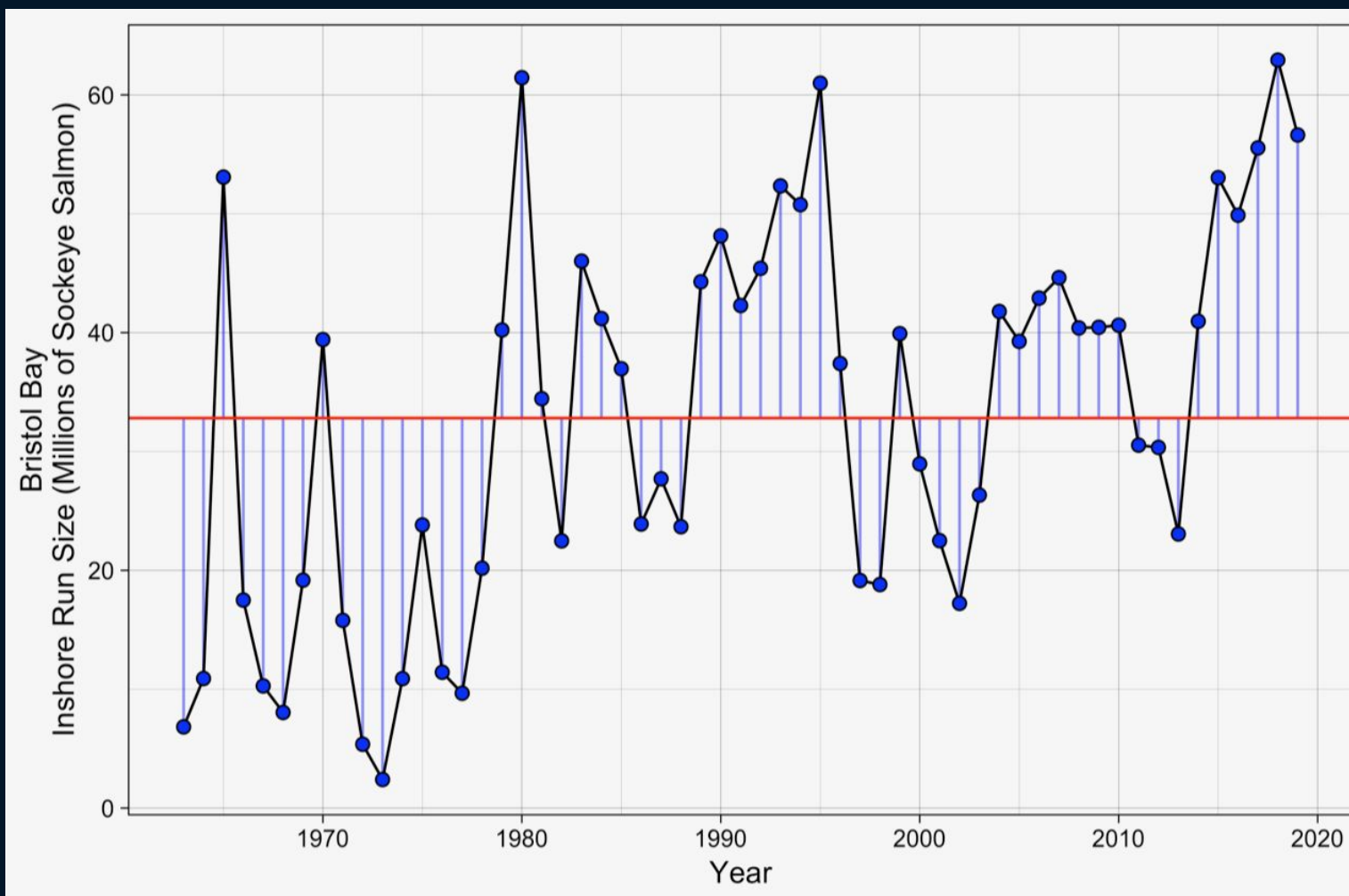


# OTHER INDICATORS

Cunningham

## Bristol Bay sockeye salmon

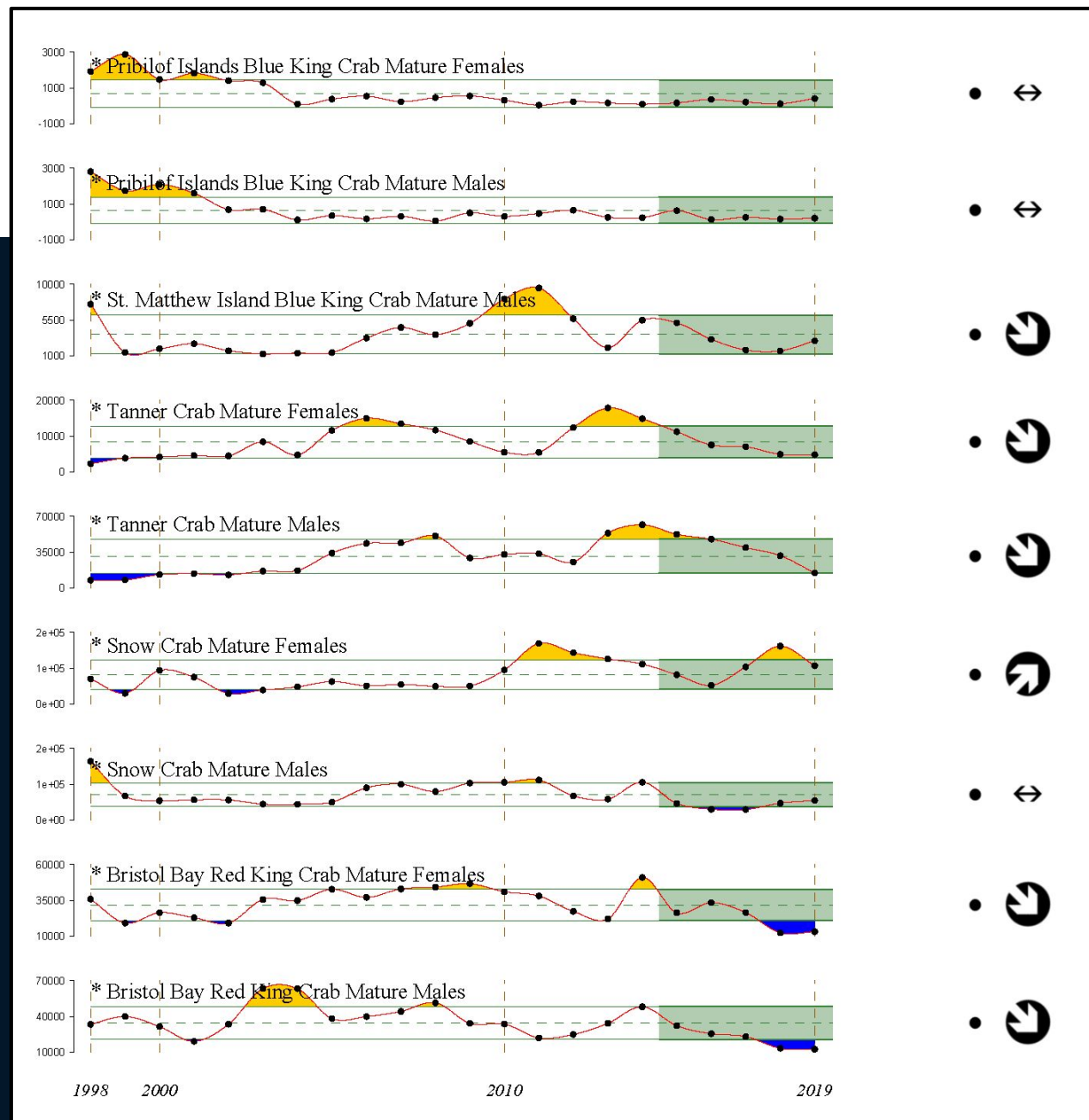
- 2019 inshore run was 56.6 million
- 4th largest since 1963
- Fish experienced positive conditions at ocean entry in the summers of 2016 and 2017, and winters of 2016/2017 and 2017/2018.



# OTHER INDICATORS

## Commercial crab biomass

- Pribilof Islands and St. Matthew Island BKC remain below long-term means.
- Tanner crab below long-term mean.
- Female snow crab above long-term mean, but declined from 2018; males below long-term mean.
- Bristol Bay RKC remain well below long-term mean.



# IMPLICATIONS



2<sup>nd</sup> winter of low sea ice in NBS; unprecedented warm inner domain. Impacts to fish distribution (juveniles and adults).



Zooplankton prey base dominated by small, lipid-poor copepods; low abundances of large copepods and euphausiids. Impacts to carrying capacity throughout the system.



Pollock increase represents movement of adult fish into SEBS; 2018 year class appears strong; PCod biomass continues to increase in the NBS. Groundfish condition increased from 2018.



Seabird die-off (mainly short-tailed shearwaters) attributed to starvation. Concerns about food security in NBS. Seabirds at colonies did better than expected.

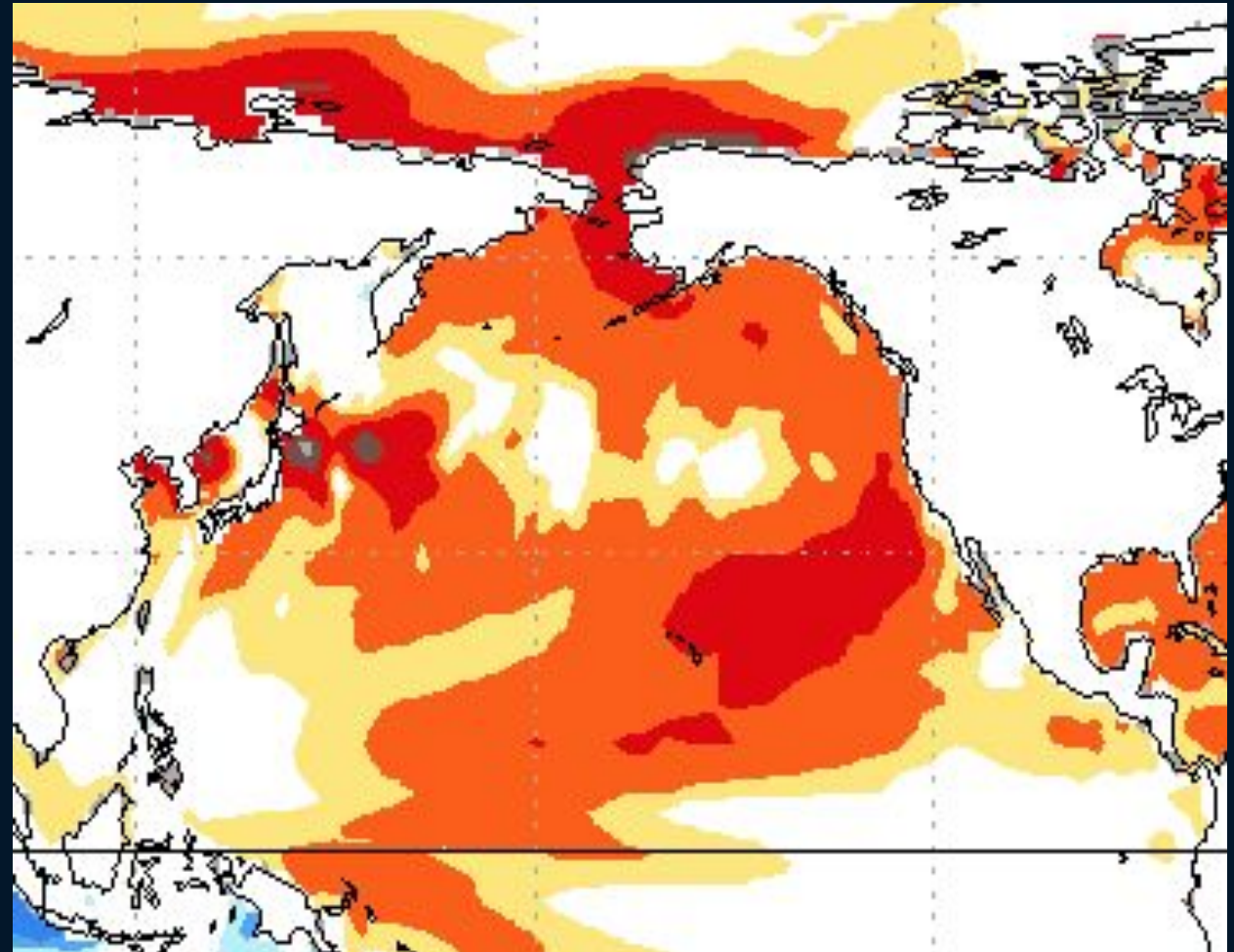


Gray whale UME; ice seal UME. Indicates impacts of changes in food web structure and carrying capacity of the NBS.

# FORECASTS AND PREDICTIONS

## National Multi-Model Ensemble

- Continued warmth in the North Pacific and eastern Bering Sea into 2020.
- Worth noting the 2018 forecasts also predicted warmth, but the northern Bering Sea was actually substantially warmer than forecast.



# POLLOCK AND PACIFIC COD recruitment timeseries

