

2019 EASTERN BERING SEA ECOSYSTEM STATUS REPORT

Elizabeth Siddon & Stephani Zador
Alaska Fisheries Science Center

North Pacific Fishery Management Council

December 2019

WITH CONTRIBUTIONS FROM:

Thank you!

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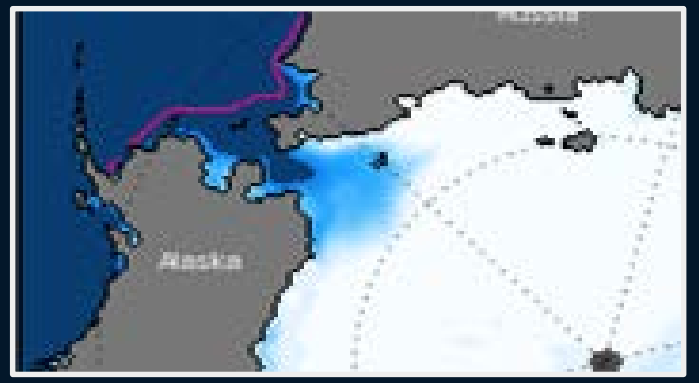
OUTLINE

- 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

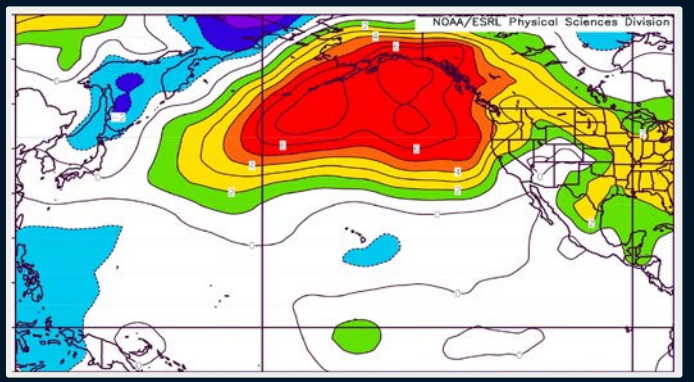
2017/2018 unprecedented lack of sea ice - what caused it?

Bond, Stabeno

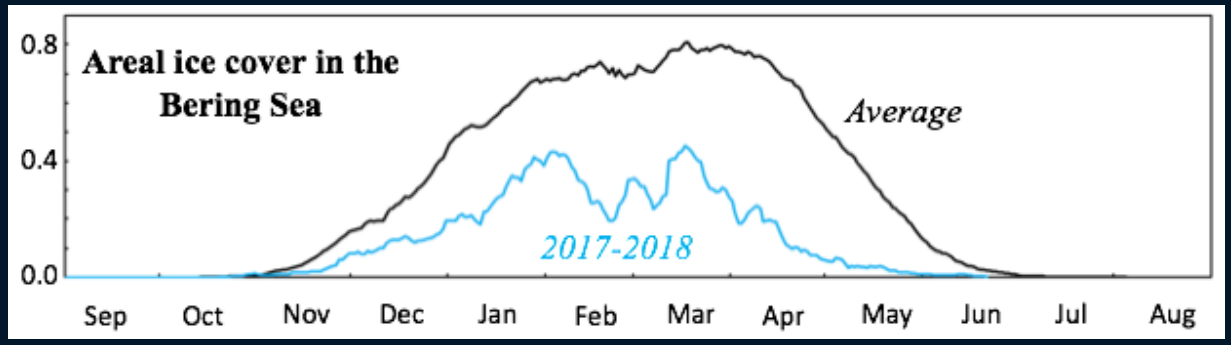
1) Residual heat in the system



2) Persistent high pressure system



3) Anomalous winds from the south

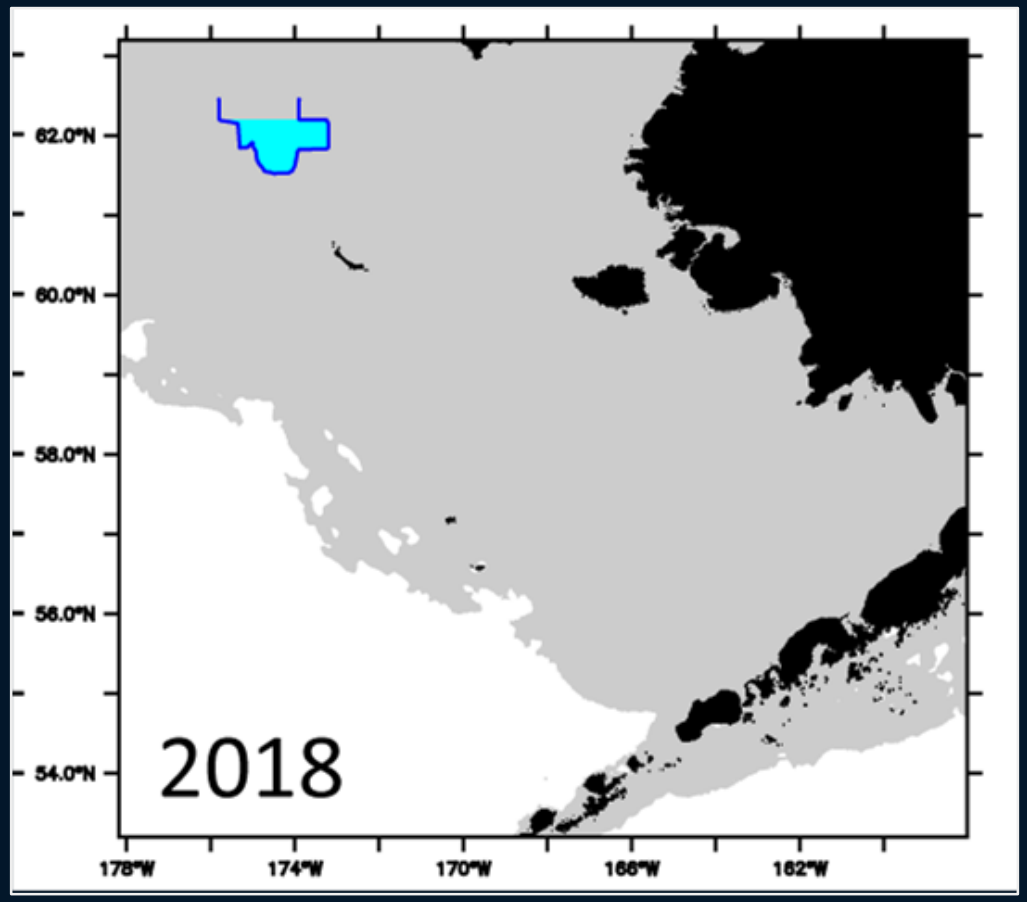


RECAP OF 2018
a tale of two regions

Ladd

Southeastern Bering Sea

No cold pool.



RECAP OF 2018
a tale of two regions

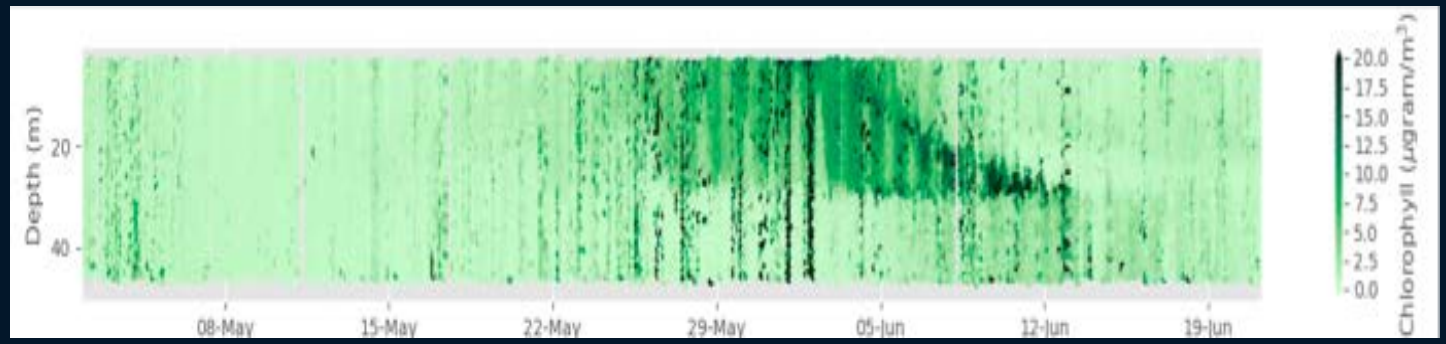
Stabeno

Southeastern Bering Sea

No cold pool.

Reduced stratification (no salinity component).

Delayed bloom.



RECAP OF 2018
a tale of two regions

Recruitment Processes Alliance (RPA)

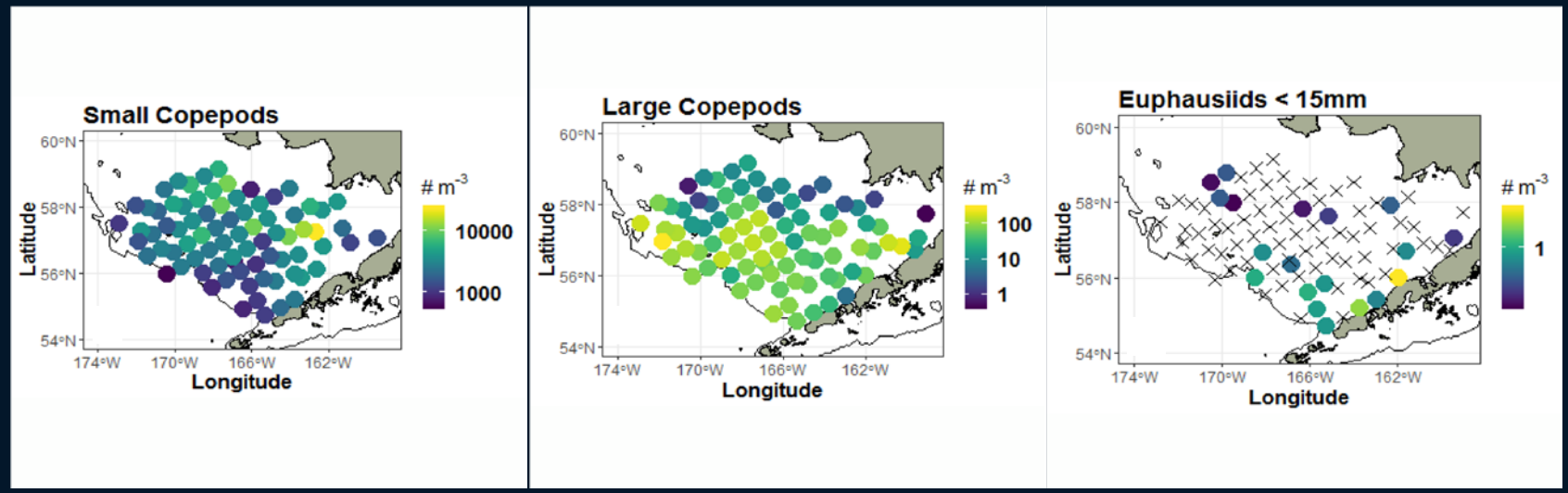
Southeastern Bering Sea

No cold pool.

Reduced stratification.

Delayed bloom.

Low abundance/quality of zooplankton.



RECAP OF 2018
a tale of two regions

RPA, Rooper

Southeastern Bering Sea

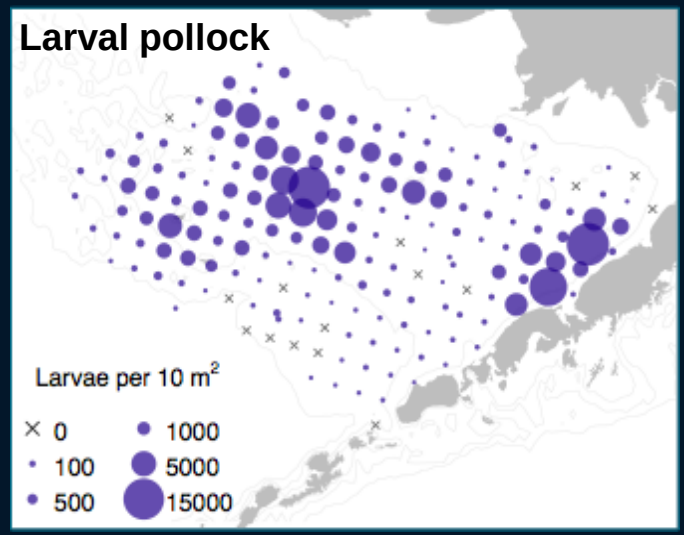
No cold pool.

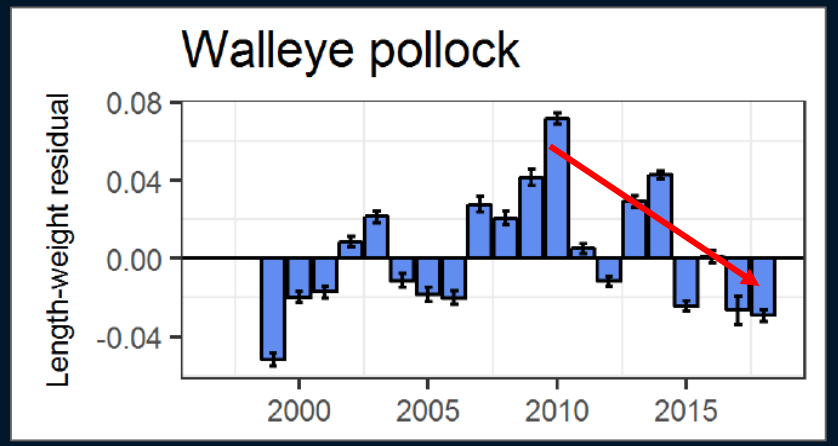
Reduced stratification.

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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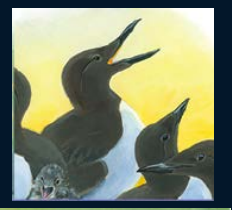
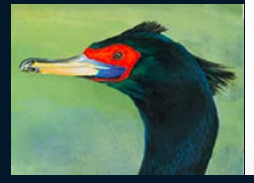
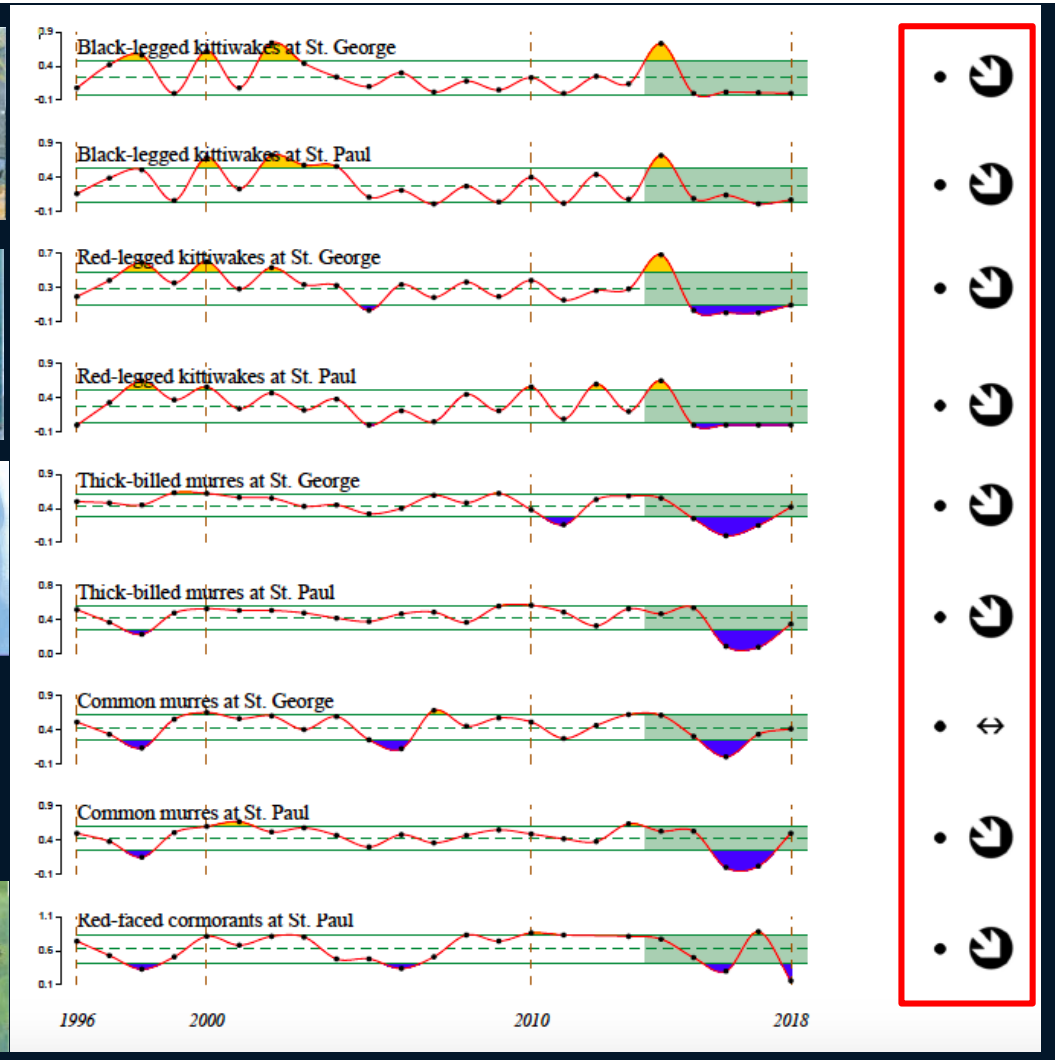
Poor reproductive success for seabirds at the Pribilof Islands.







RECAP OF 2018
a tale of two regions

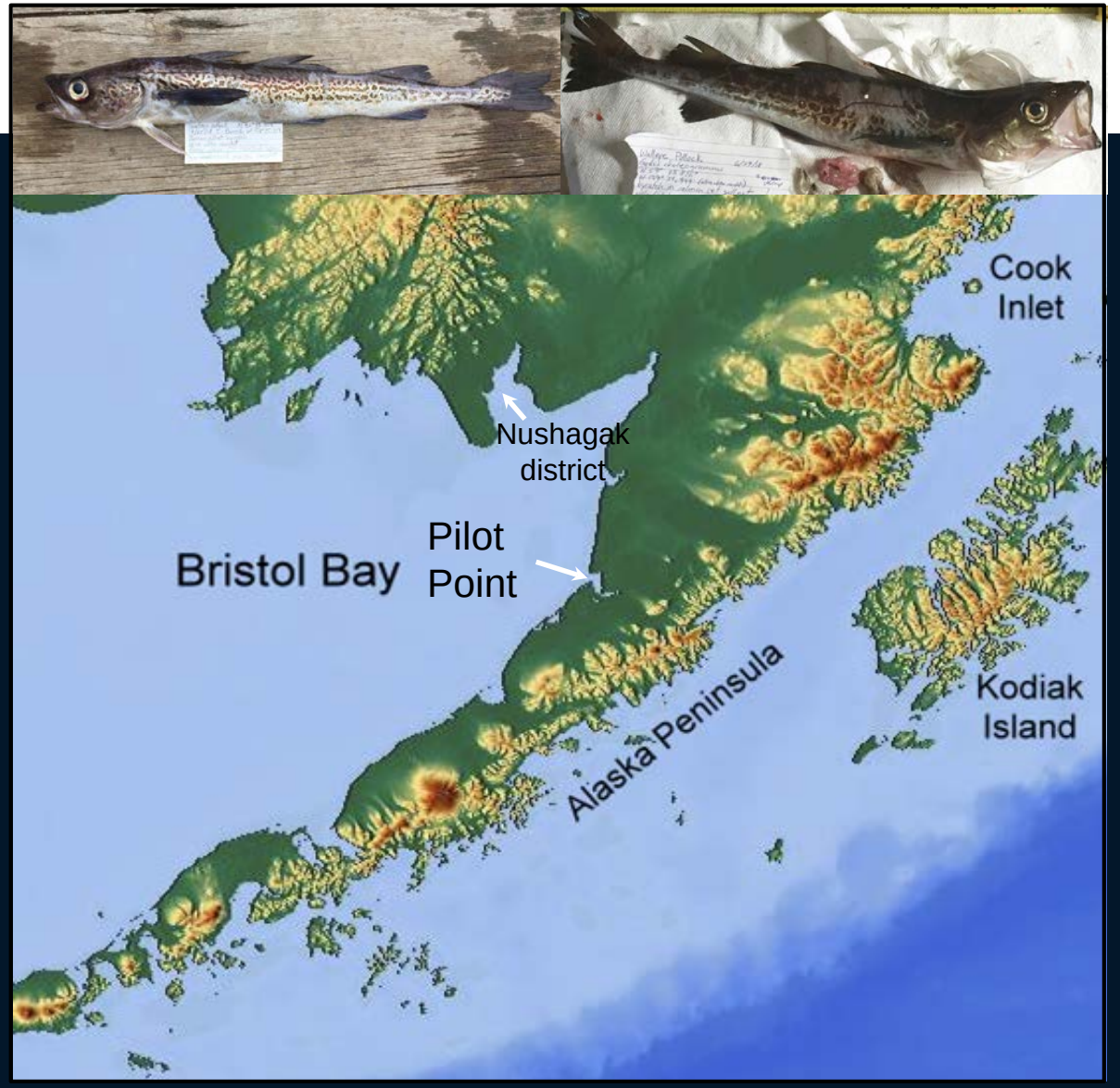
Subsistence and commercial fishers, AFSC, and NWFSC

2018 Hot Topics update

Adult pollock washed ashore in Bristol Bay in high numbers and demonstrated unusual behaviors in 2018.

Fish diets were "pretty typical" for the inner domain. Samples contained "low, but detectable levels of PSP" therefore toxins could have played a role in the unusual behaviors.

Comparison samples were collected during BASIS 2018. Diets contained euphausiids and age-0 gadids, typical for the middle domain. Samples also contained low levels of PSP; likely "background" levels and not high enough to cause mortality in fish.



RECAP OF 2018
a tale of two regions

Ecosystem Conservation Office
Aleut Community of St. Paul Island

2018 Hot Topics update

The rat was found dead on June 30, 2019 after 10-months of intensive effort by the 'strike team'.

RECAP OF 2018
a tale of two regions

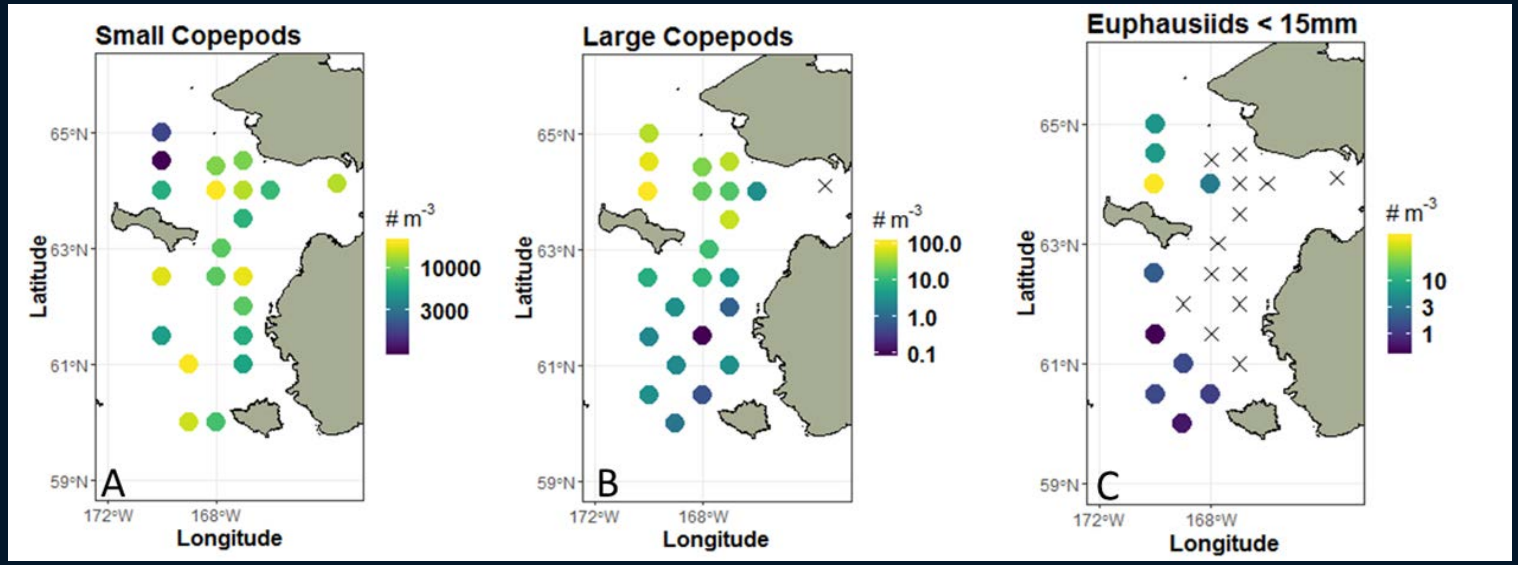
RPA

Northern Bering Sea

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

Weak stratification.

Zooplankton abundance low; large copepods *Eucalanus bungii.*



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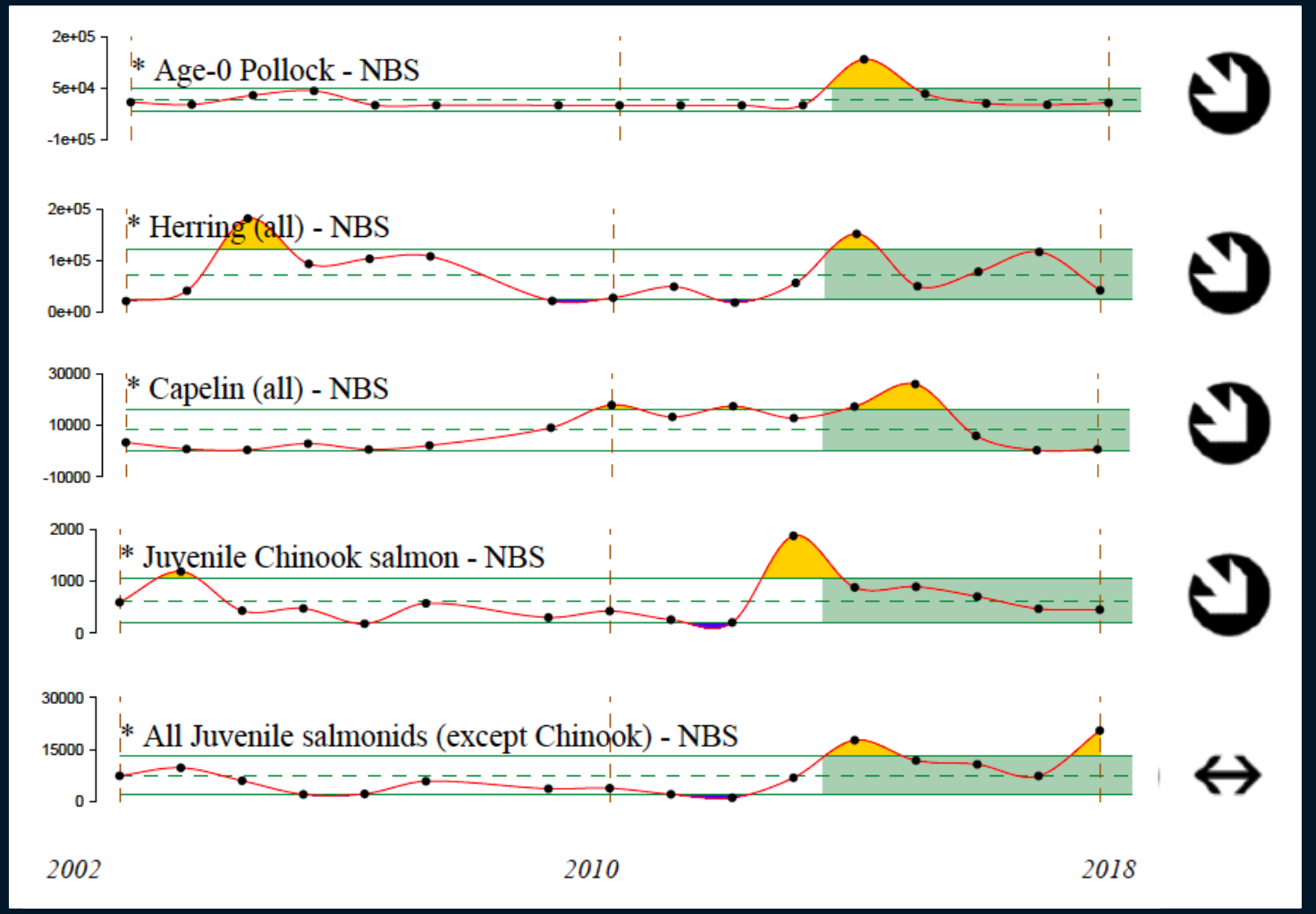

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Lauth

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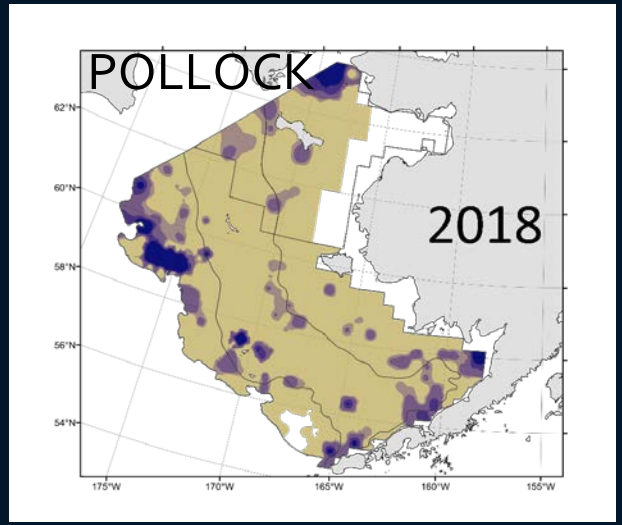
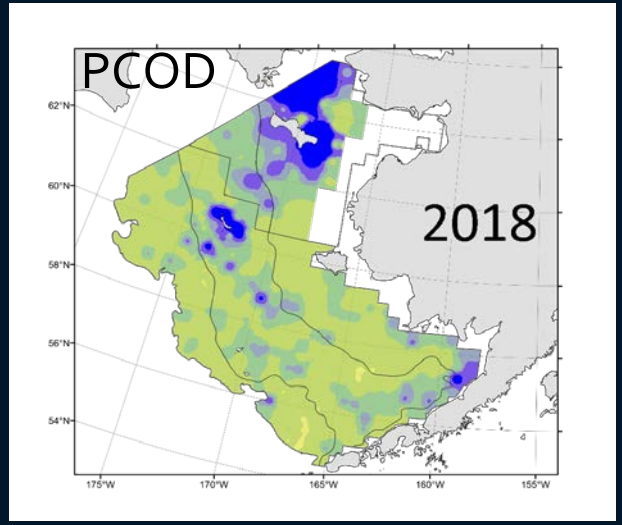
Juvenile forage fish abundances low; adult groundfish biomass persisted.





RECAP OF 2018
a tale of two regions

COASST and
regional partners

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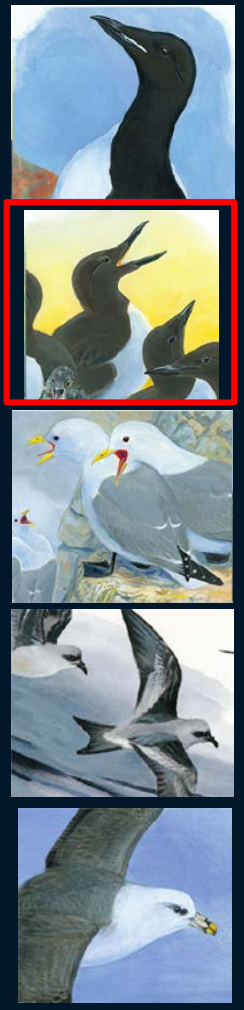
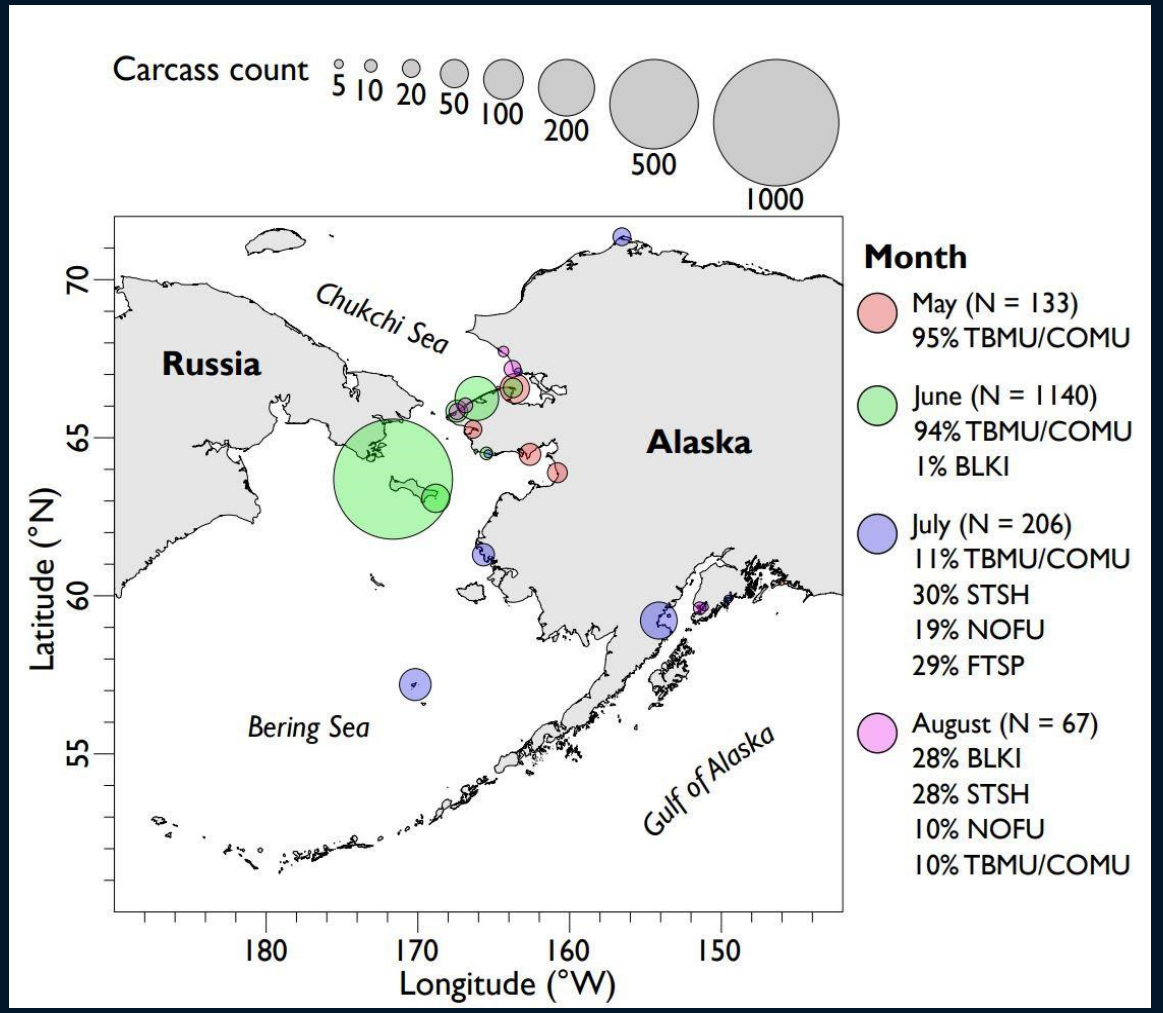
Seabird die-off event.





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Boveng

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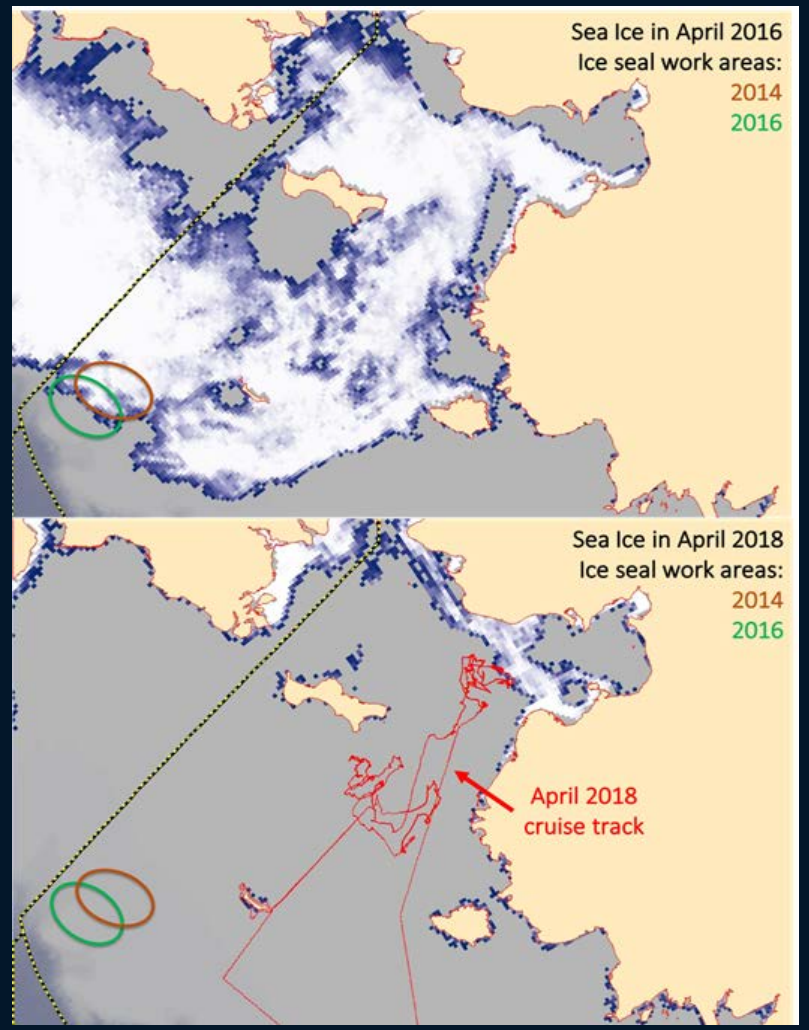
Seabird die-off event.

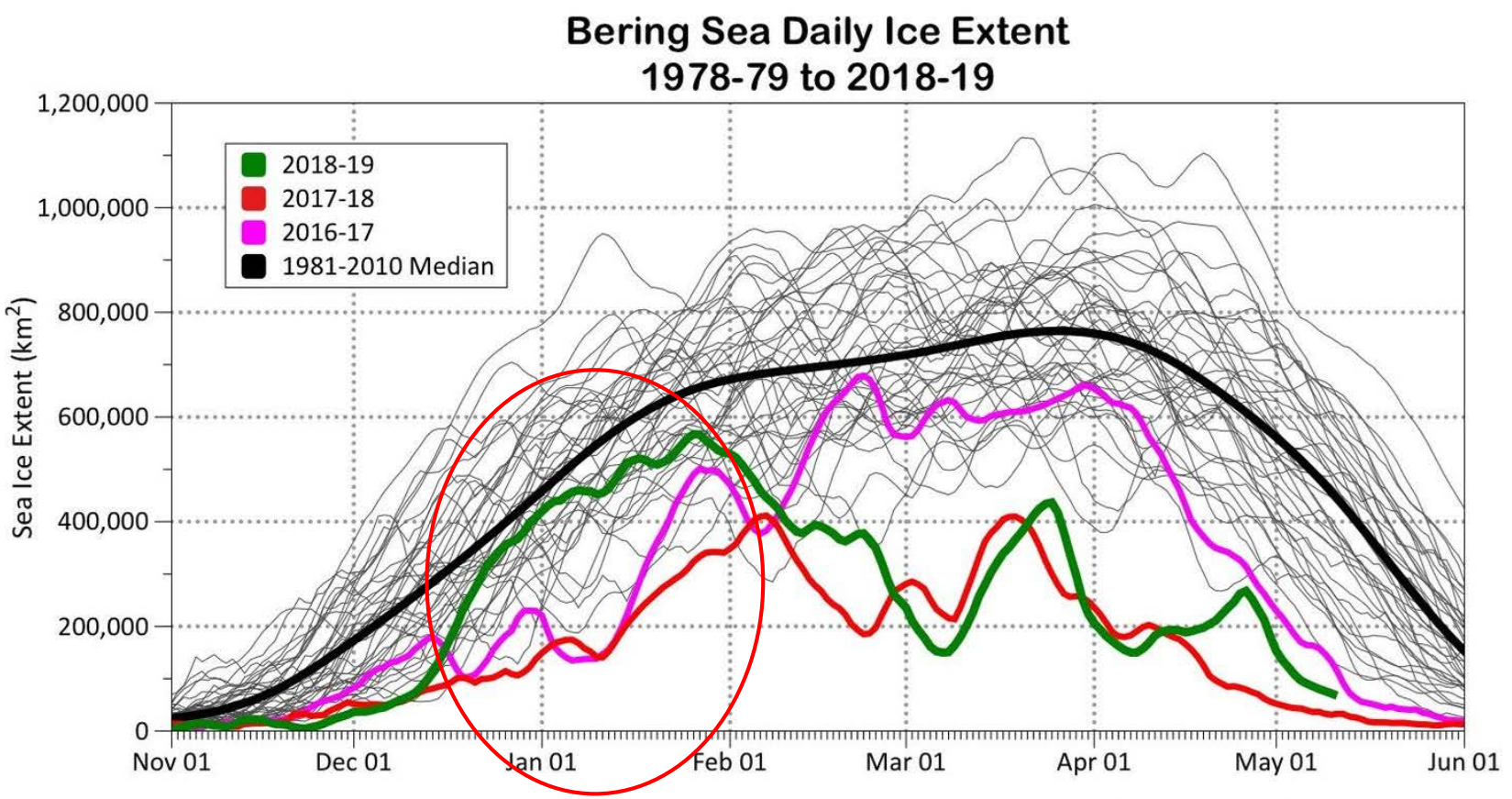
Ice seal distribution shifted.



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

PEEC

Thoman



ACCAP Alaska Center for Climate Assessment and Policy
A NOAA RISA TEAM

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

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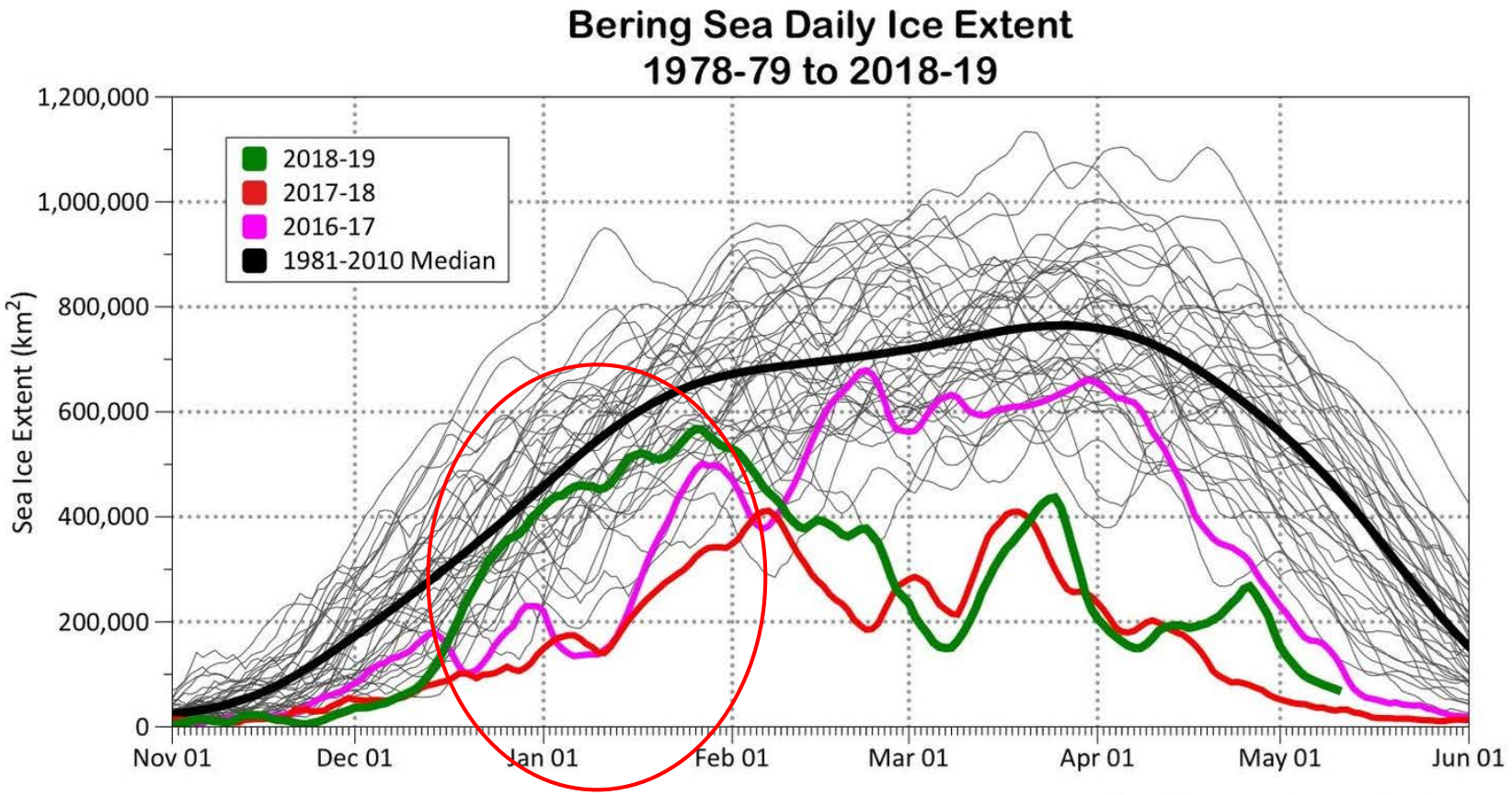

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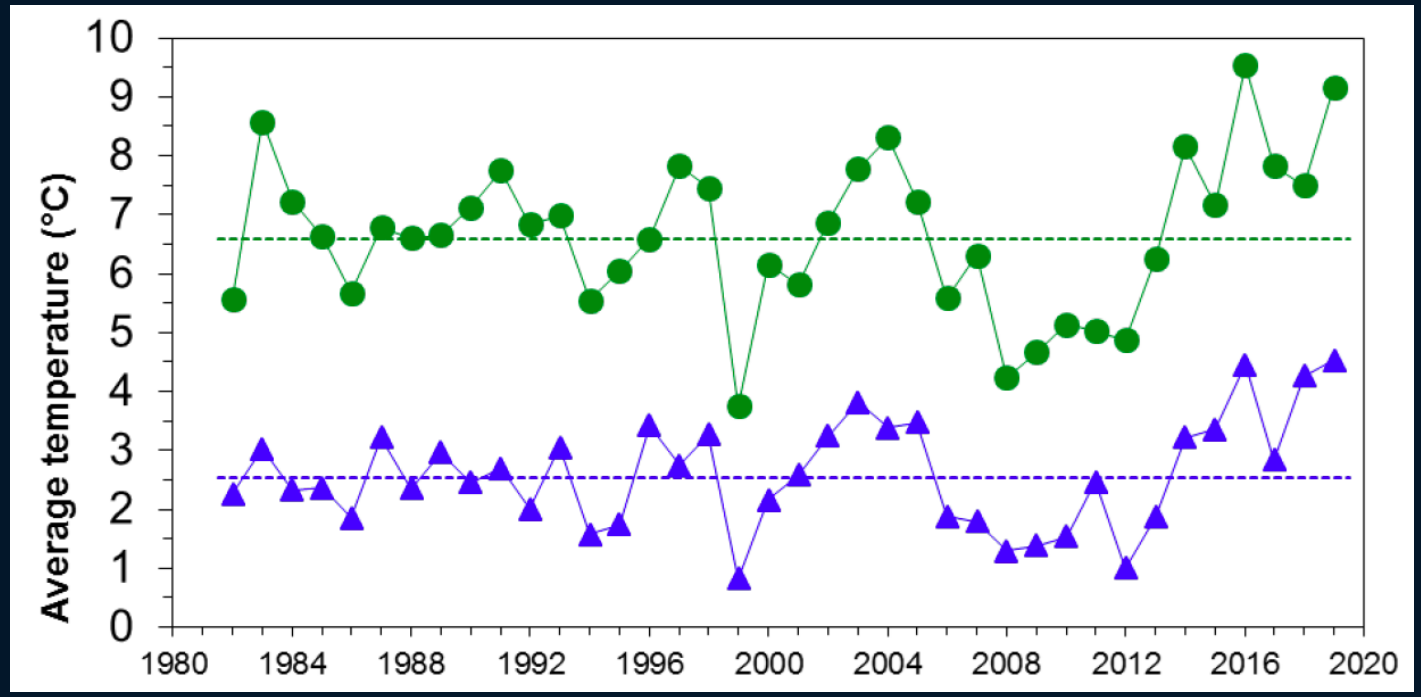
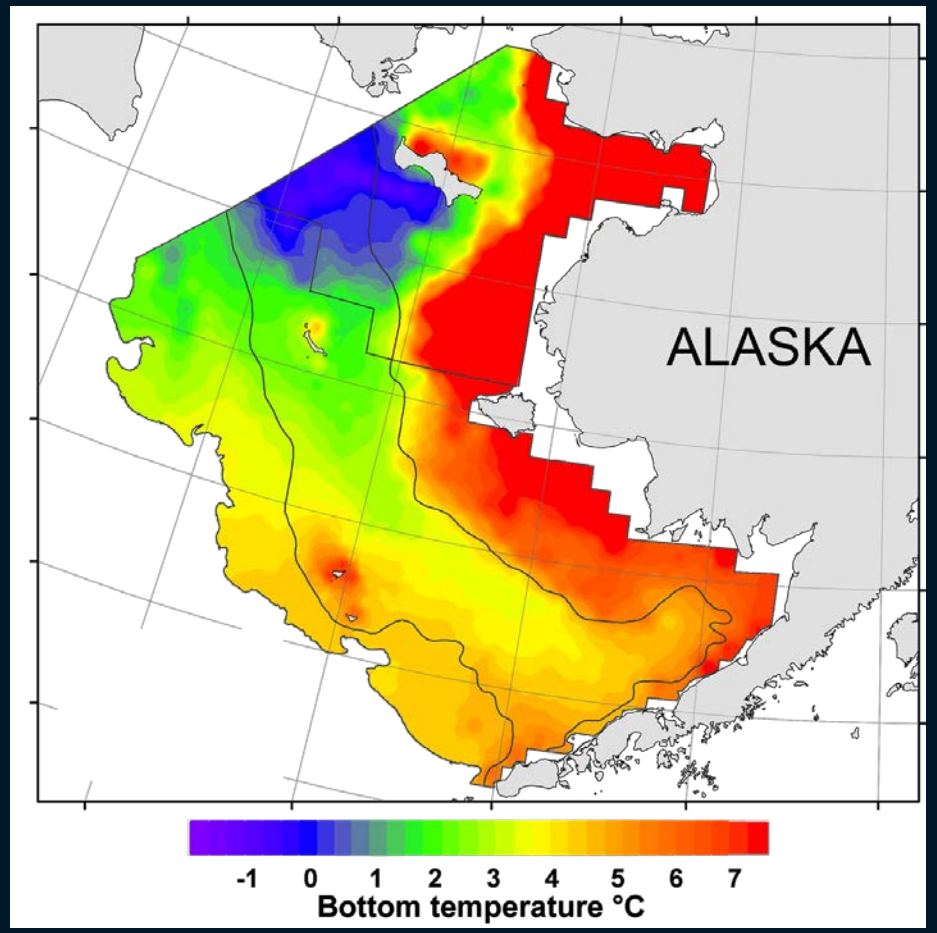
- Warm winds in February
- 'Double whammy'
- What impact did early ice have on the ecosystem?

"We call it El Niño"
Ferdinand Sharp
Manokotak, AK

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

Britt



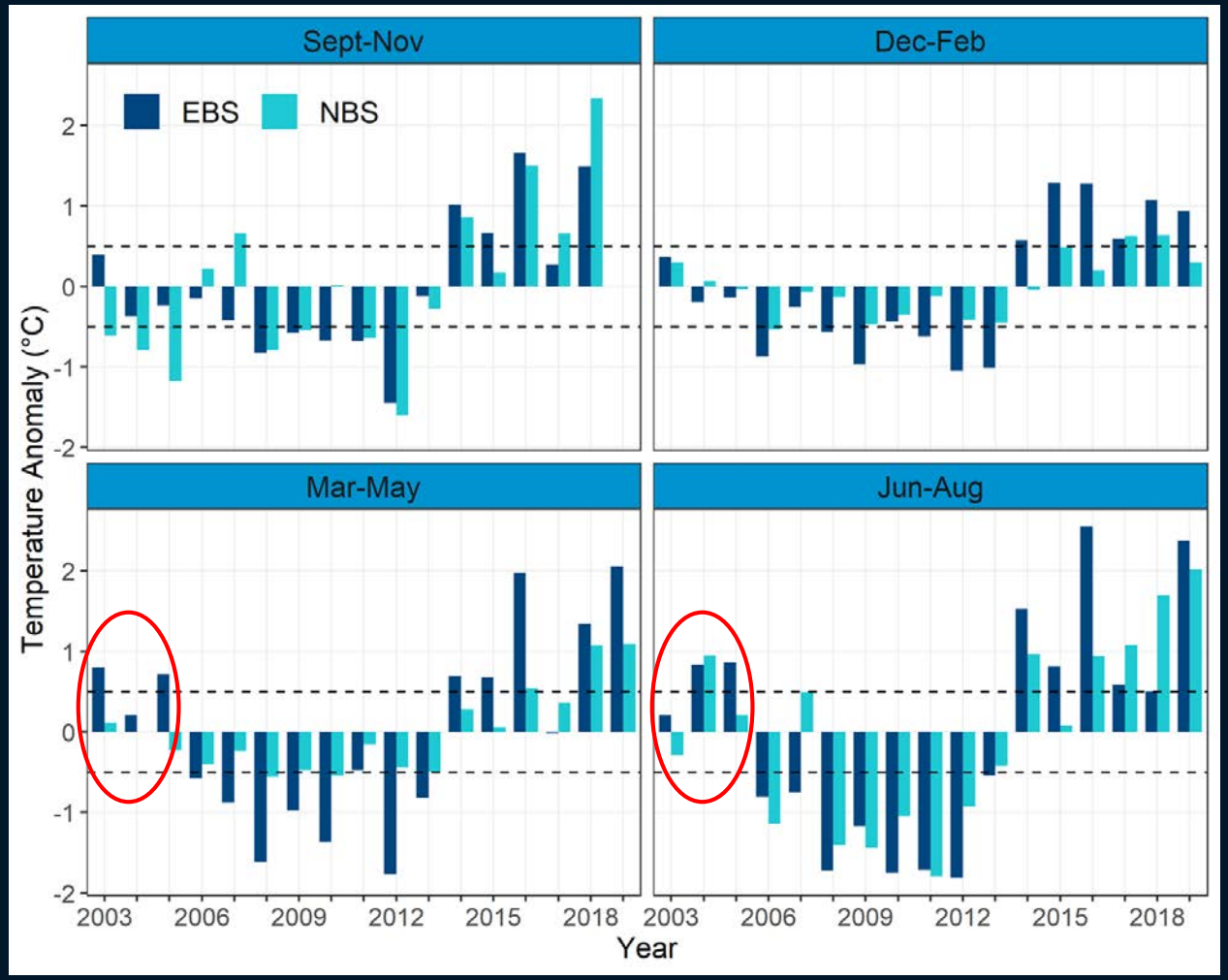


2018/2019 'unprecedented again' lack of sea ice - similarities and differences

Watson

Satellite-derived SST

- Warm stanza in 2003-2005 driven by conditions in Mar-May and Jun-Aug.
- In recent years, warmth has persisted throughout the year.
- Endless summer?



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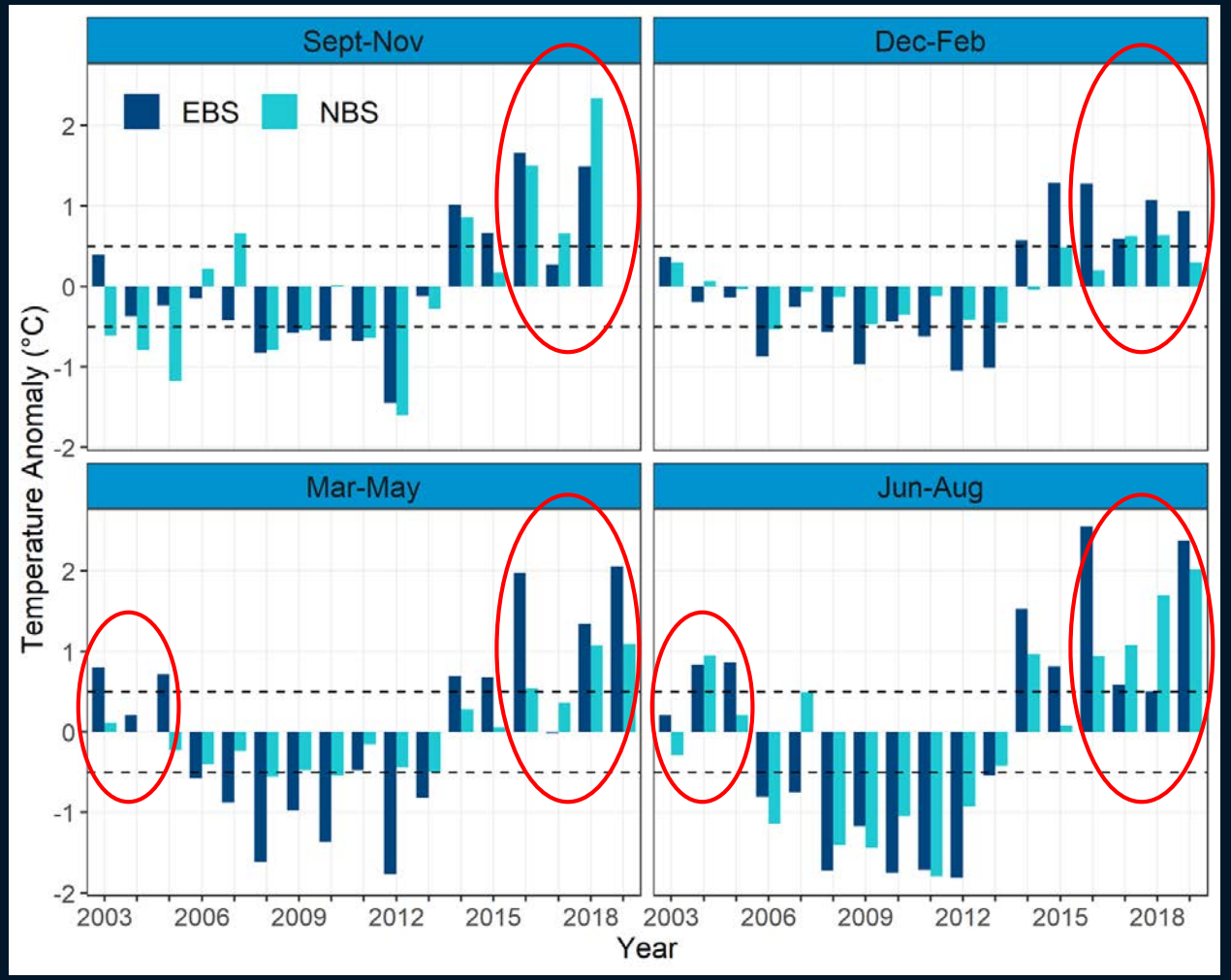
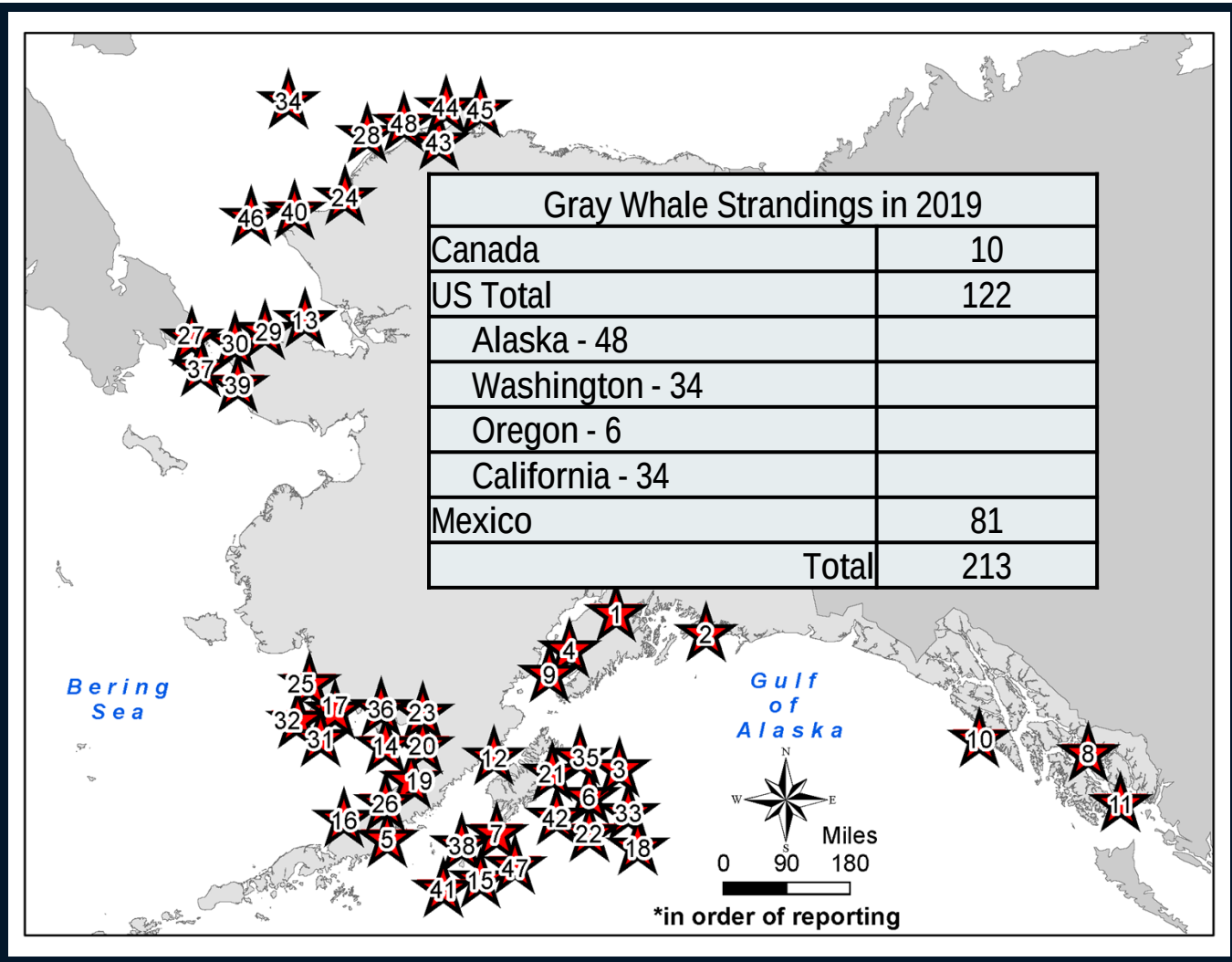


REFLECTIVE OF 2018

PEEC

Savage

Gray whale
Unusual Mortality Event



REFLECTIVE OF 2018

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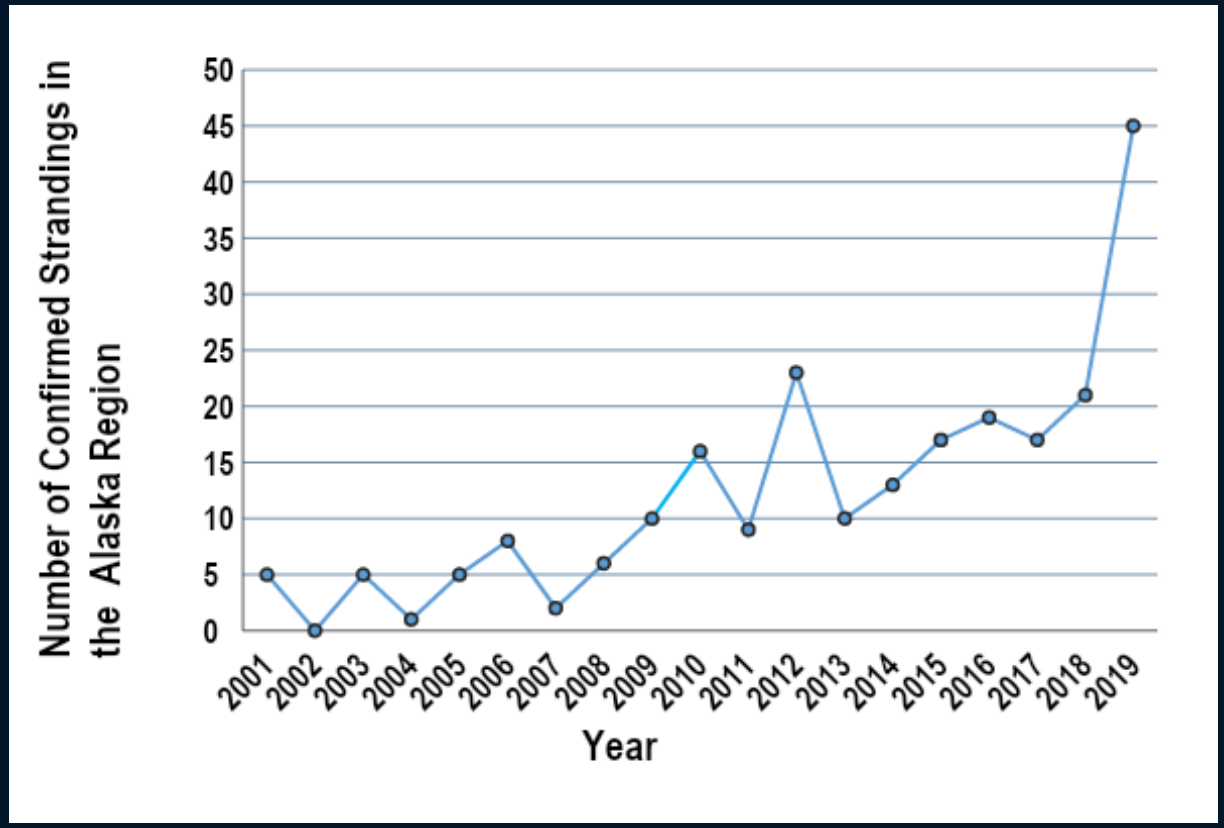
Savage

Gray whale
Unusual Mortality Event

Preliminary necropsy results show evidence of emaciation.



REFLECTIVE OF 2018

PEEC

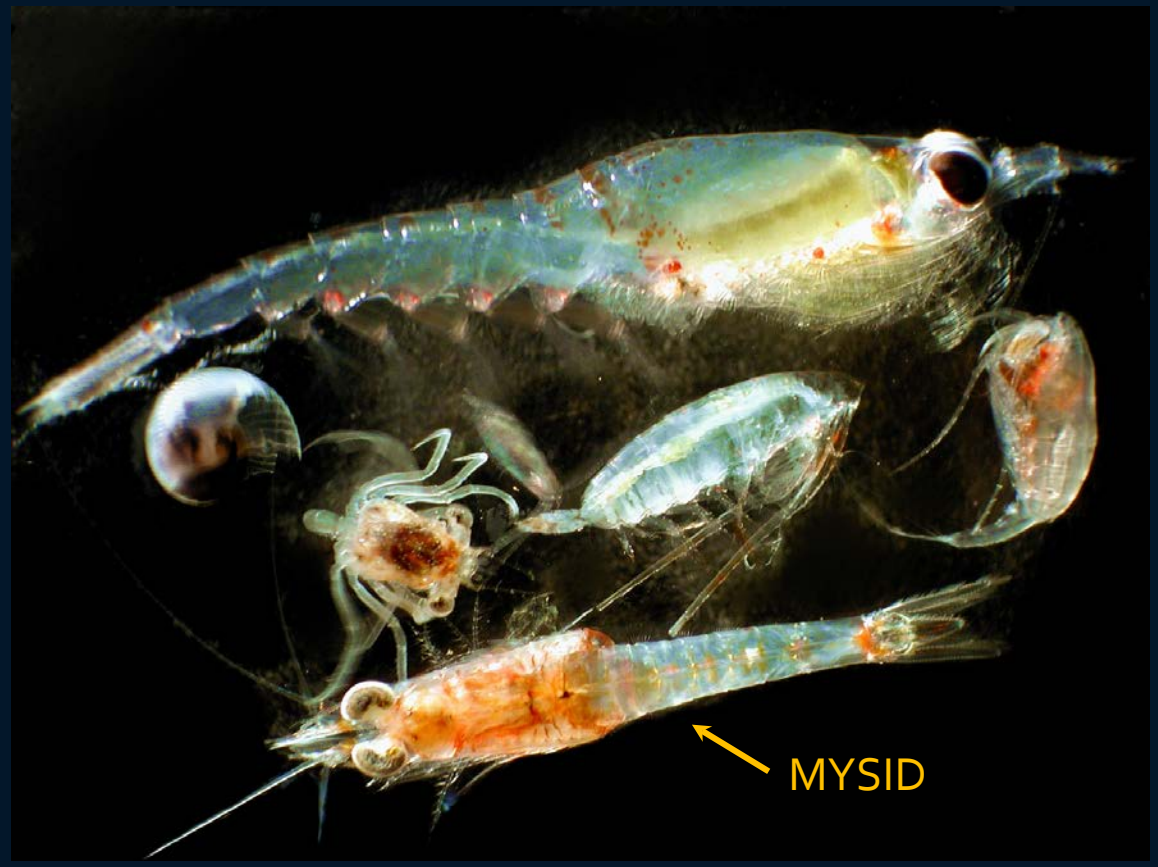
Savage

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.



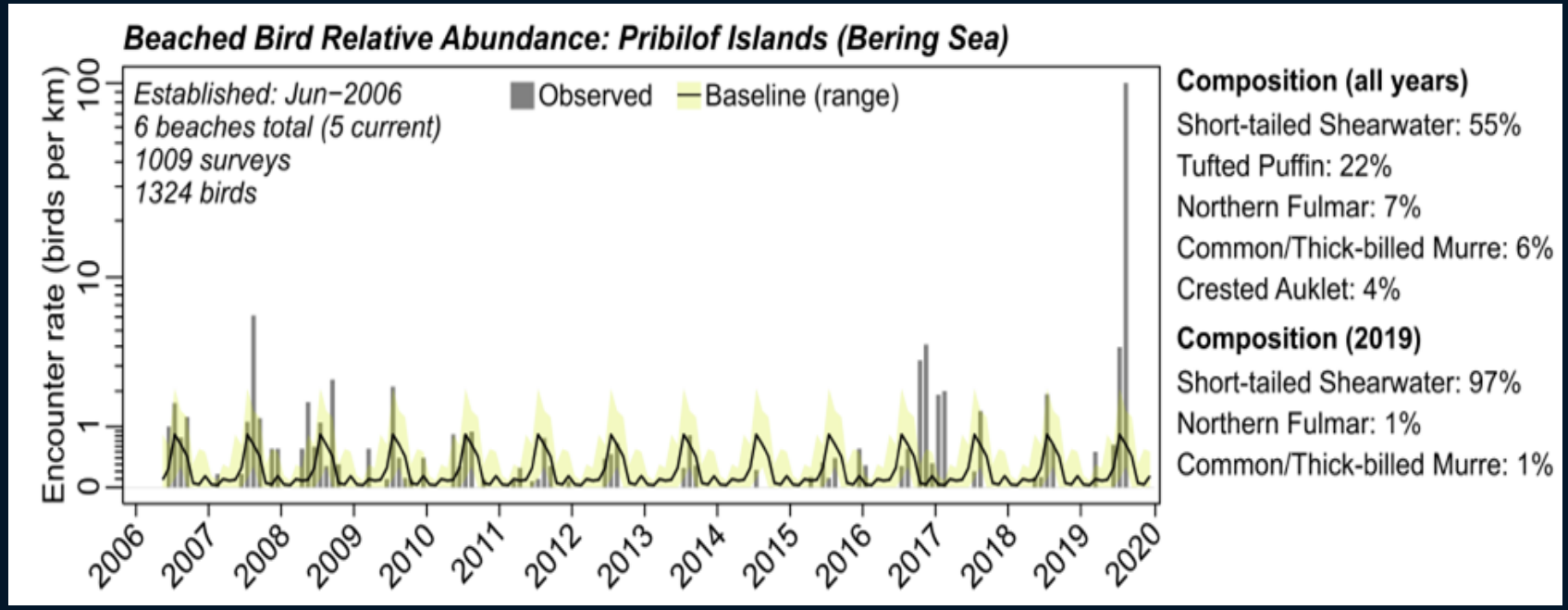
REFLECTIVE OF 2018

COASST
USFWS
AMNWR and
regional partners

Short-tailed shearwater die-off event

<u>PRIBILOF ISLANDS</u>

- 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,

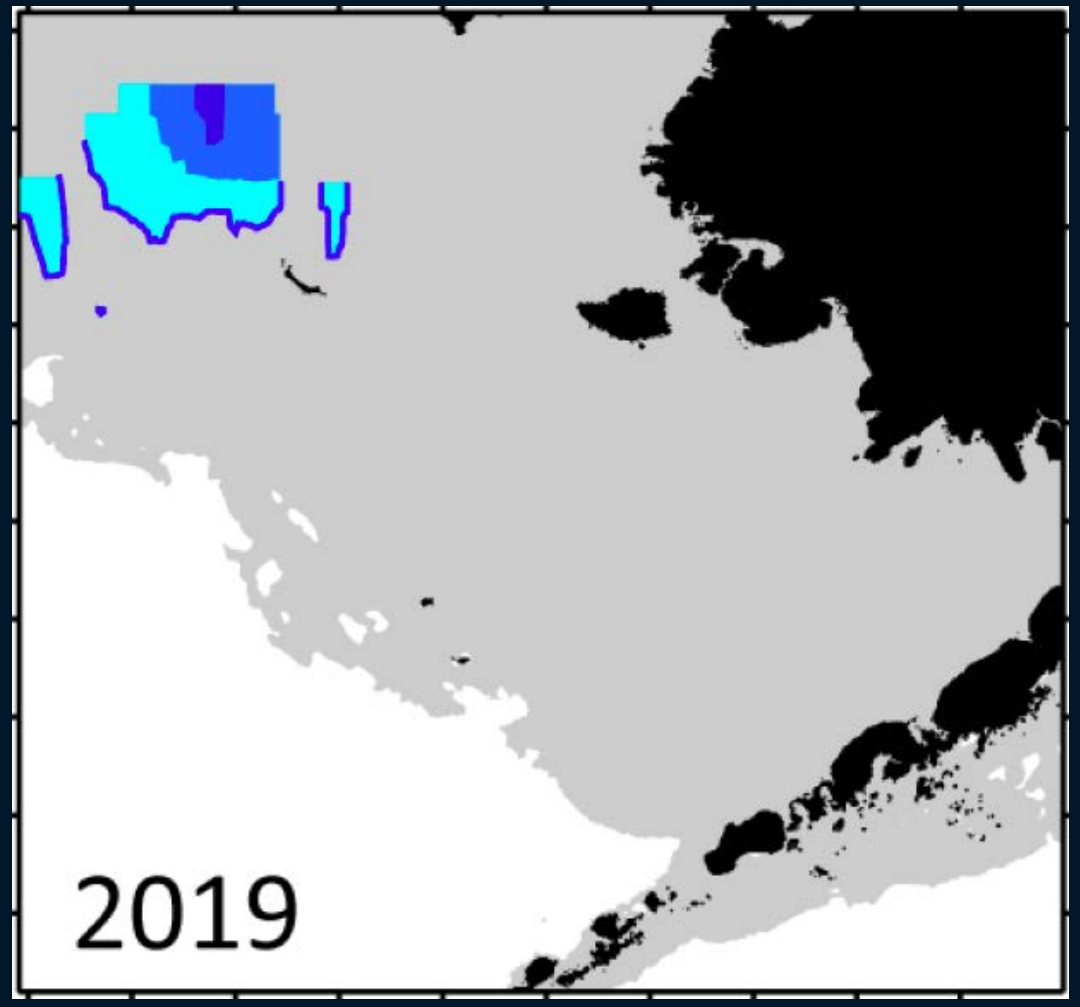
  (ii) conditions experienced during the breeding season in the southern hemisphere, or

  (iii) lack of available prey to complete the migration to the Bering Sea in 2019.

REFLECTIVE OF 2019

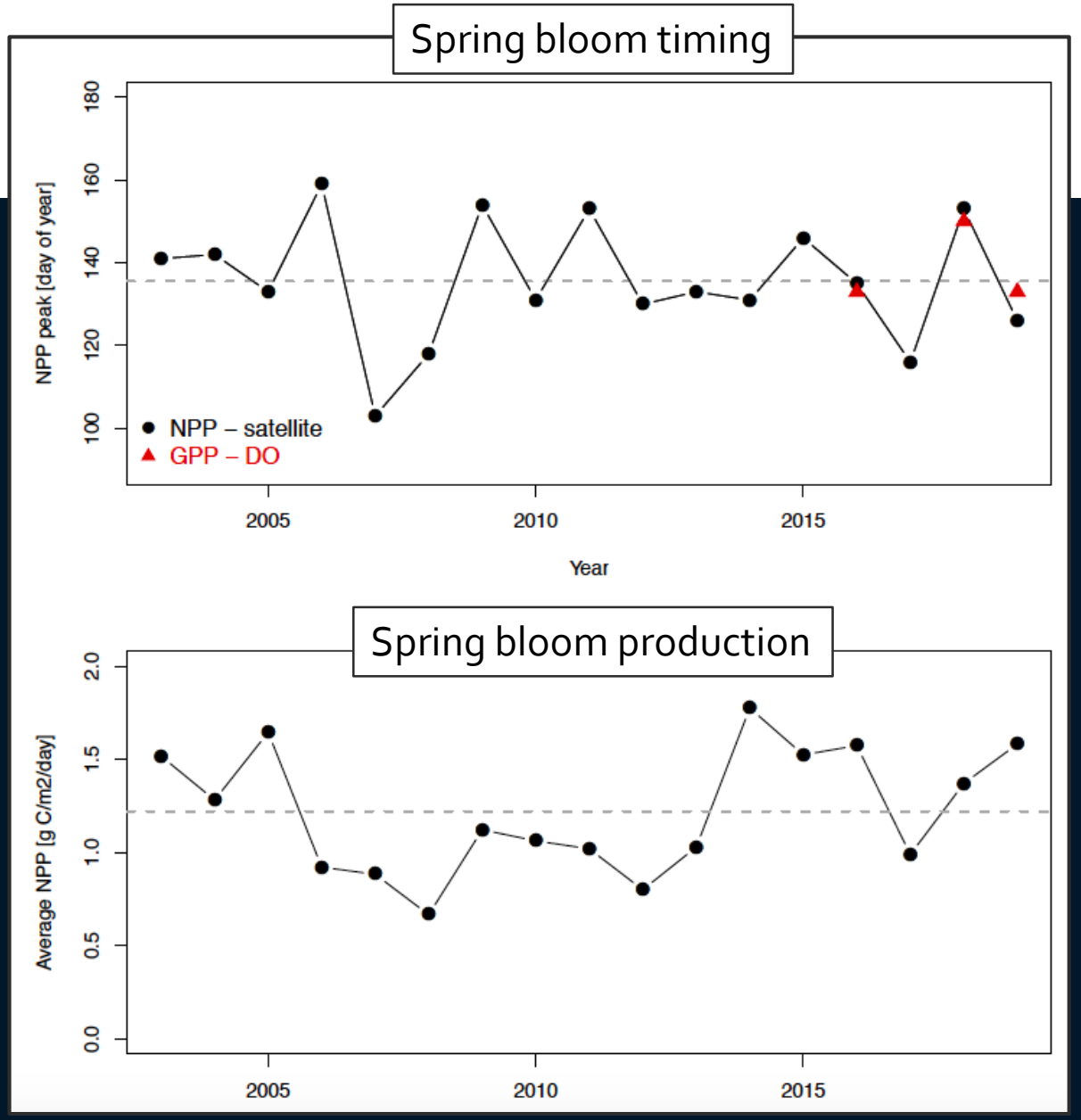
Ladd

- Small cold pool over the northern shelf.



REFLECTIVE OF 2019

- Small cold pool over the northern shelf.
- Spring bloom earlier than long-term average.

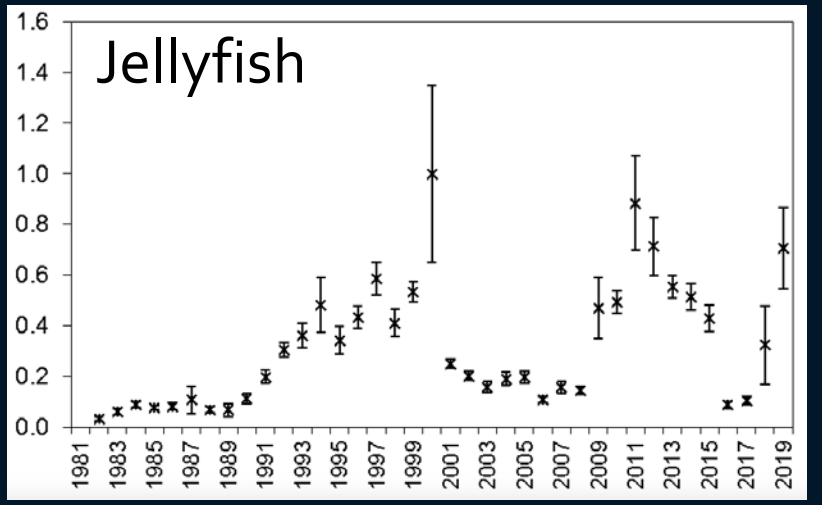


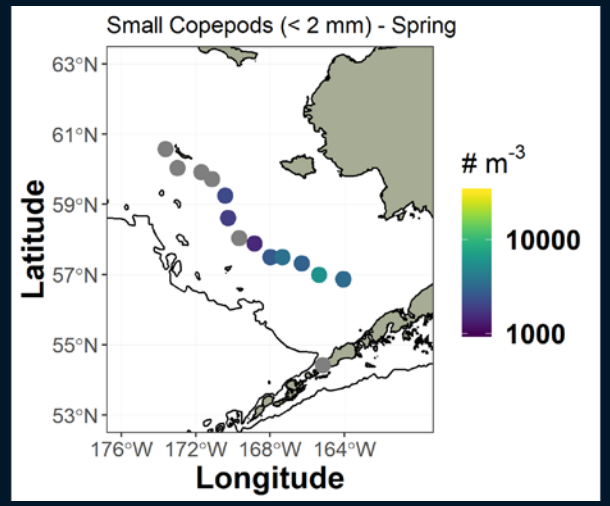
Nielsen

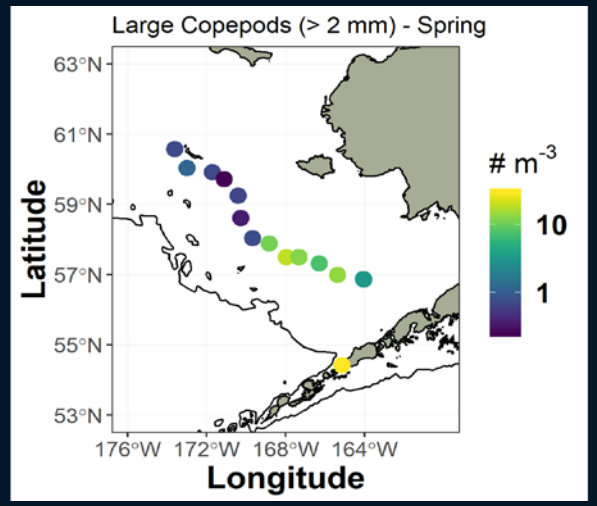
REFLECTIVE OF 2019

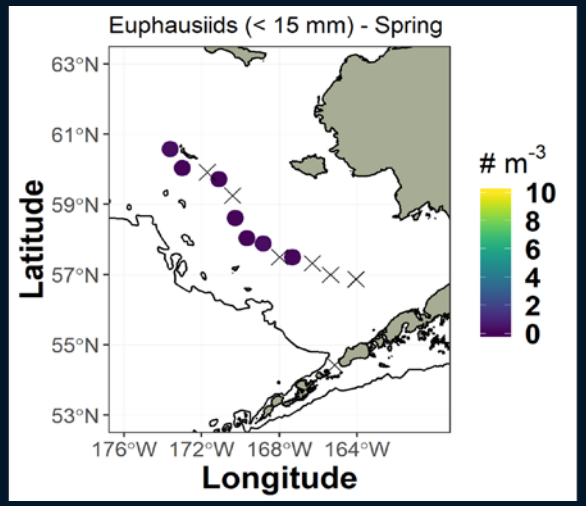
Britt, RPA

- Small cold pool over the northern shelf.
- Spring bloom earlier than long-term average.
- Zooplankton dominated by small copepods.
- Jellyfish abundance increased.









REFLECTIVE OF 2019

Wilderbuer

- Small cold pool over the northern shelf.
- Spring bloom earlier than long-term average.
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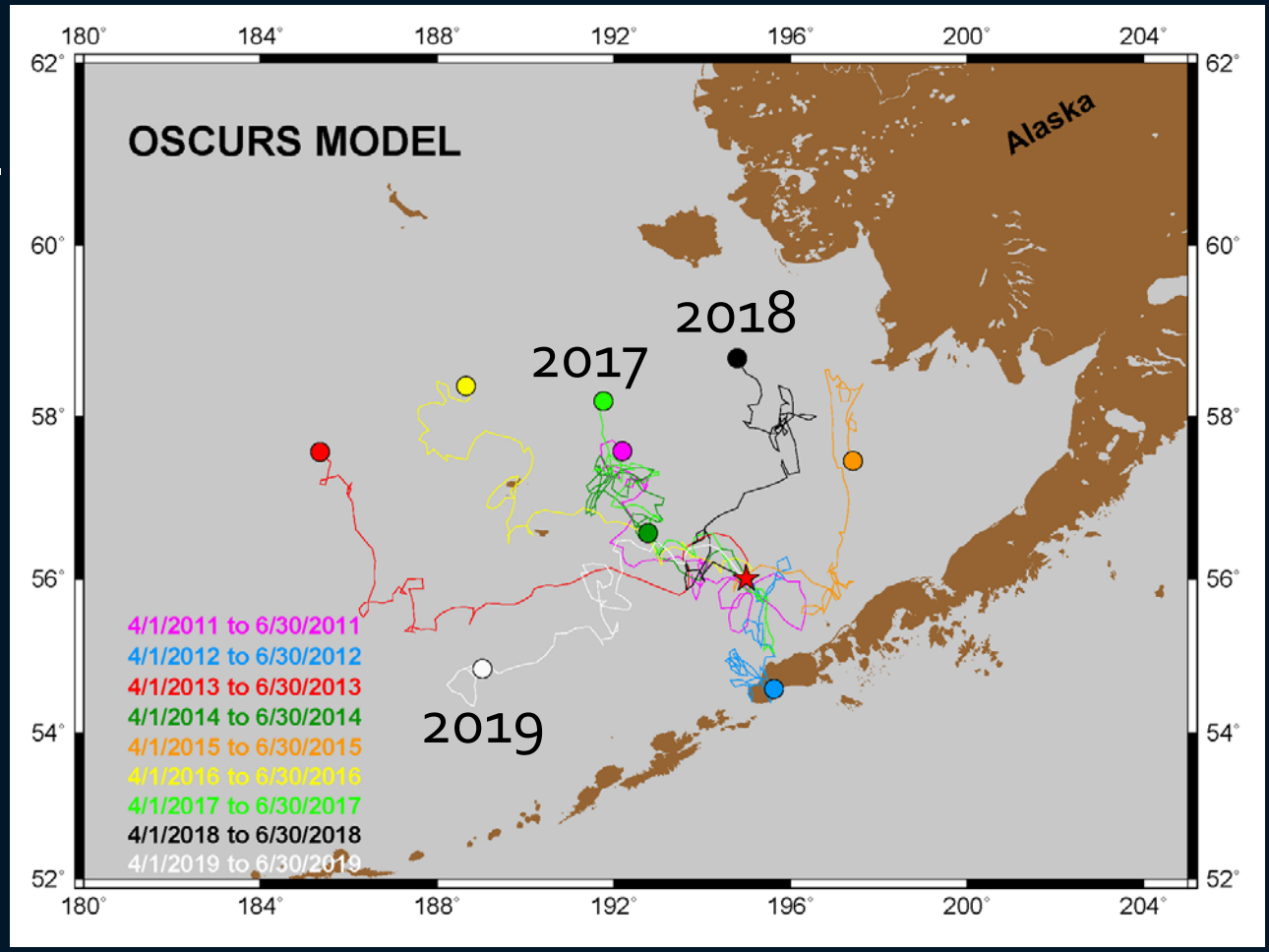
- Jellyfish abundance increased.
- The 2019 drift pattern appears unfavorable with westerly winds.

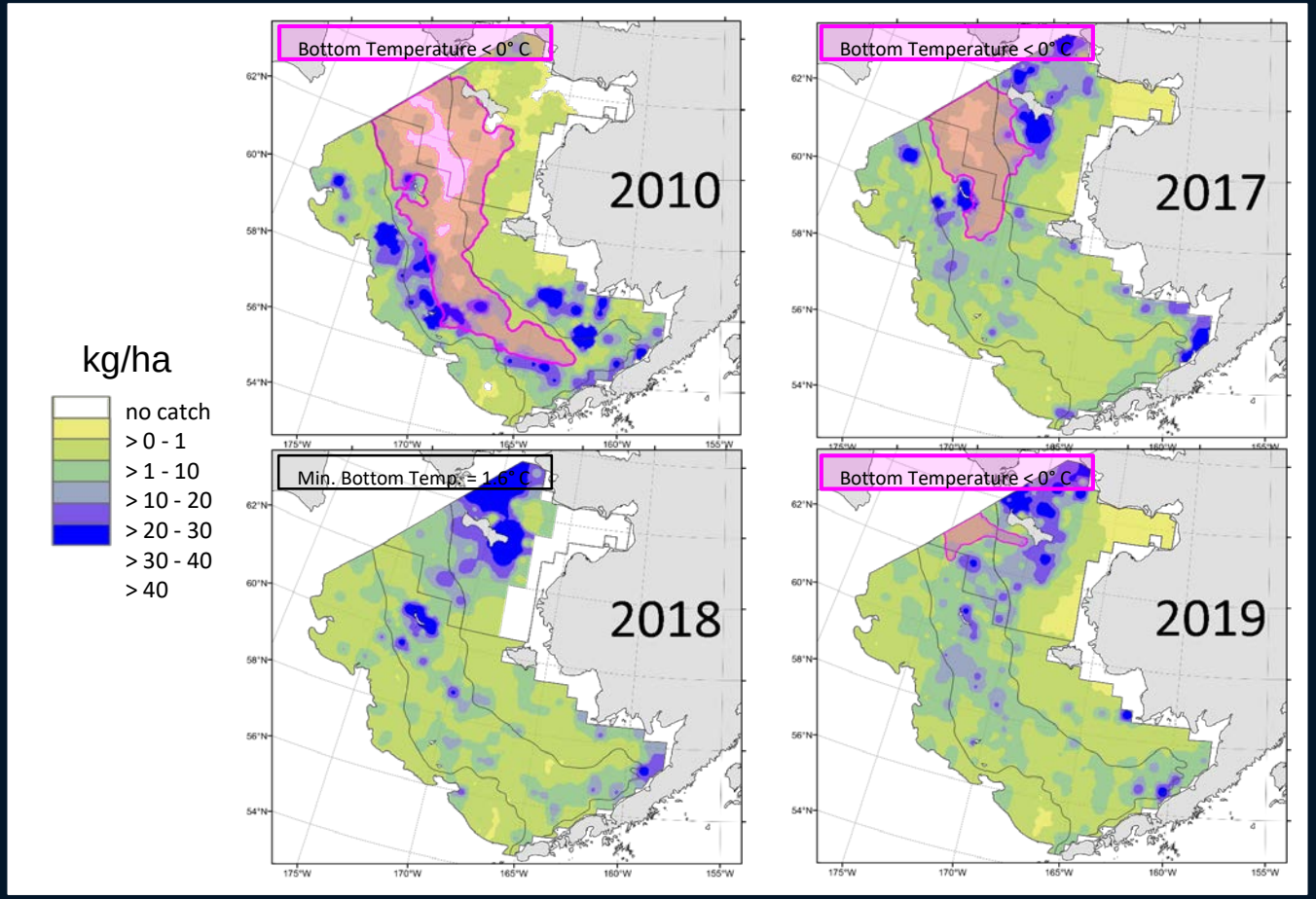


REFLECTIVE OF 2019

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?



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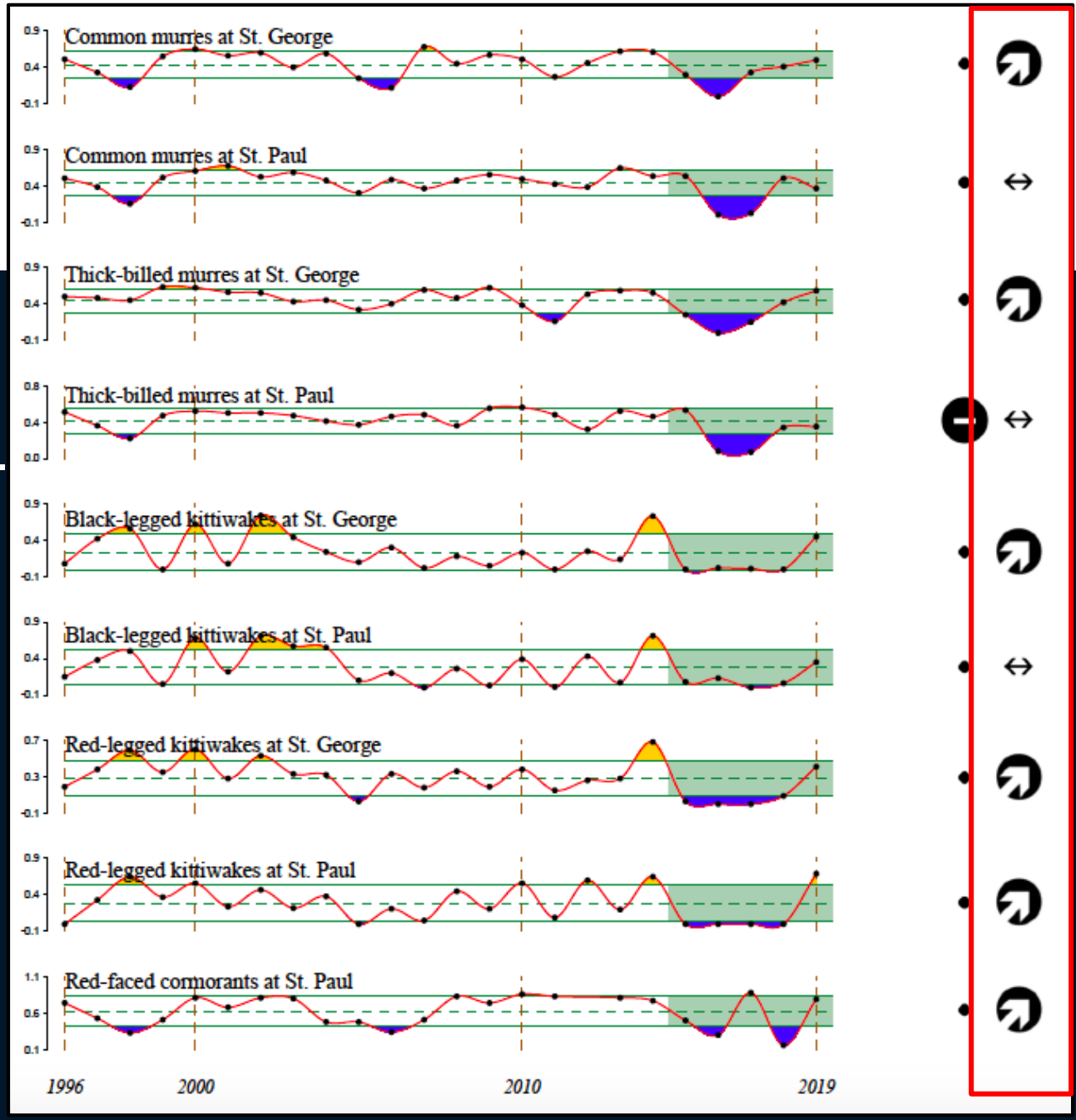
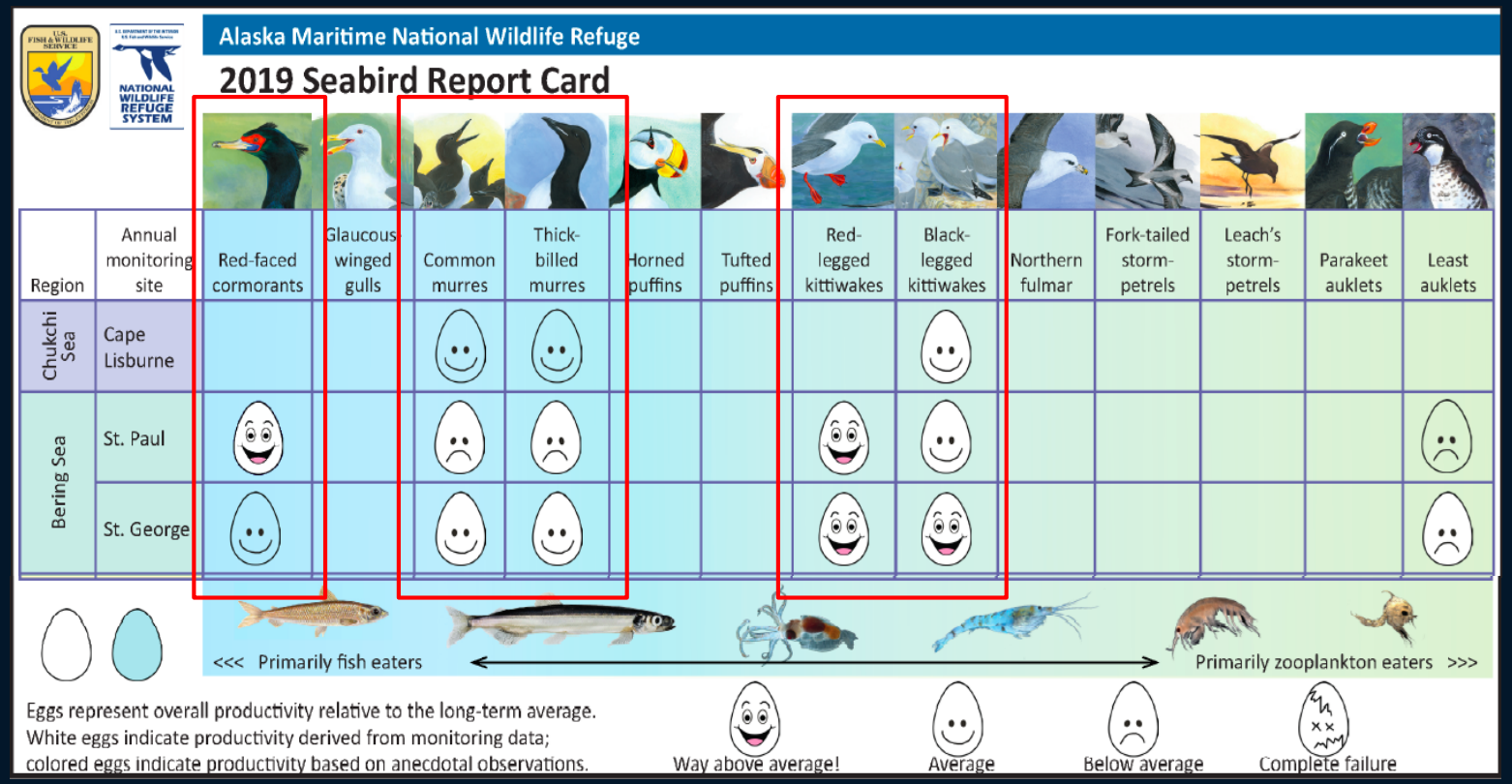
Alaska Maritime
National Wildlife Refuge



REFLECTIVE OF 2019

Alaska Maritime
National Wildlife Refuge

Successful breeding events occurred for fish-eating species (murres 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.

Integrated Seabird Information

In this year's Eastern Bering Sea Ecosystem Status Report, information was collected from a number of sources to derive regional seabird summaries in the southeastern and northern Bering Sea. The synthesized information provides an overview of environmental impacts on seabirds which are indicative of ecosystem productivity.

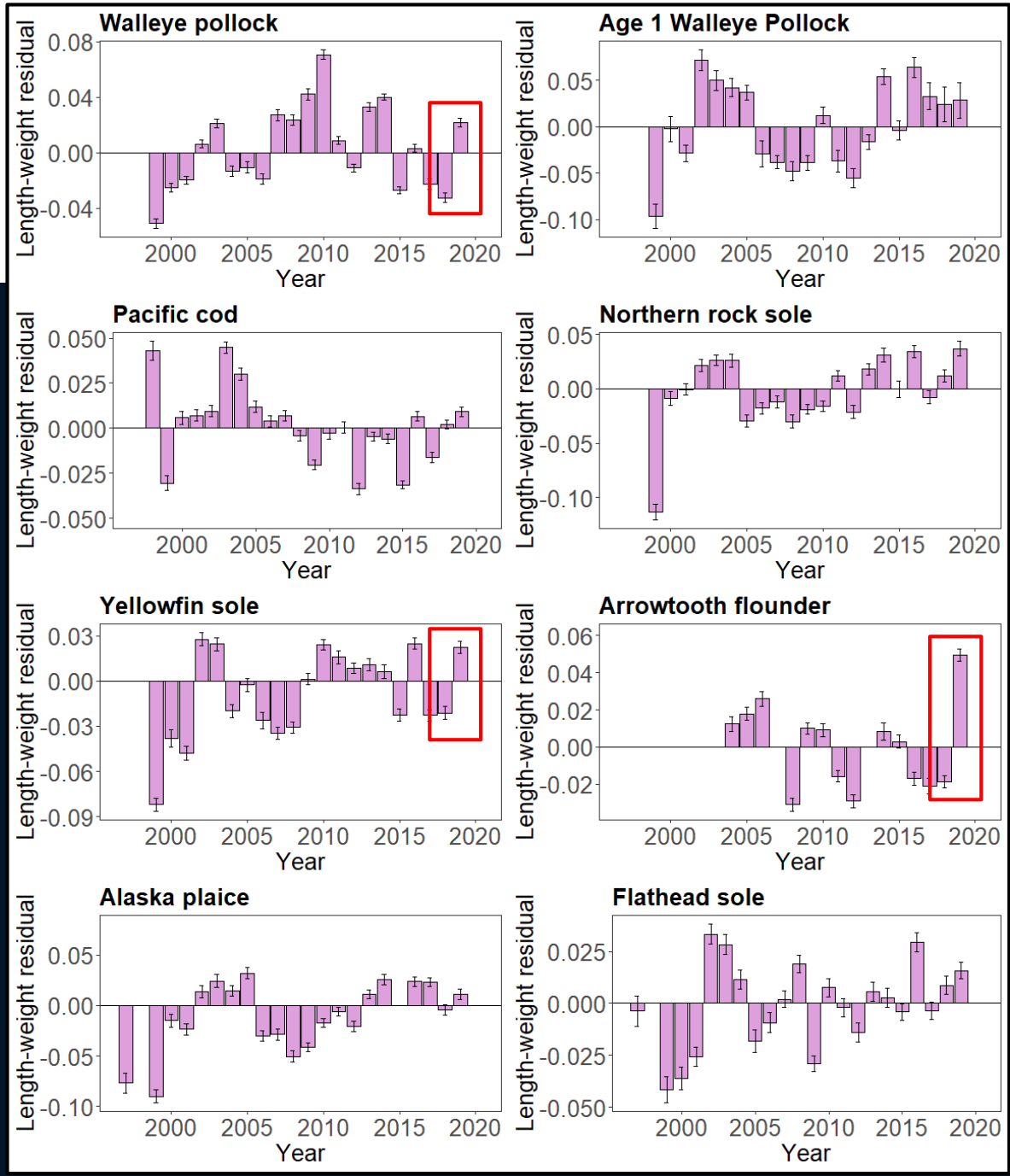
Aleut Community of St. Paul Island Ecosystem Conservation Office

and community members!

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?

Laman



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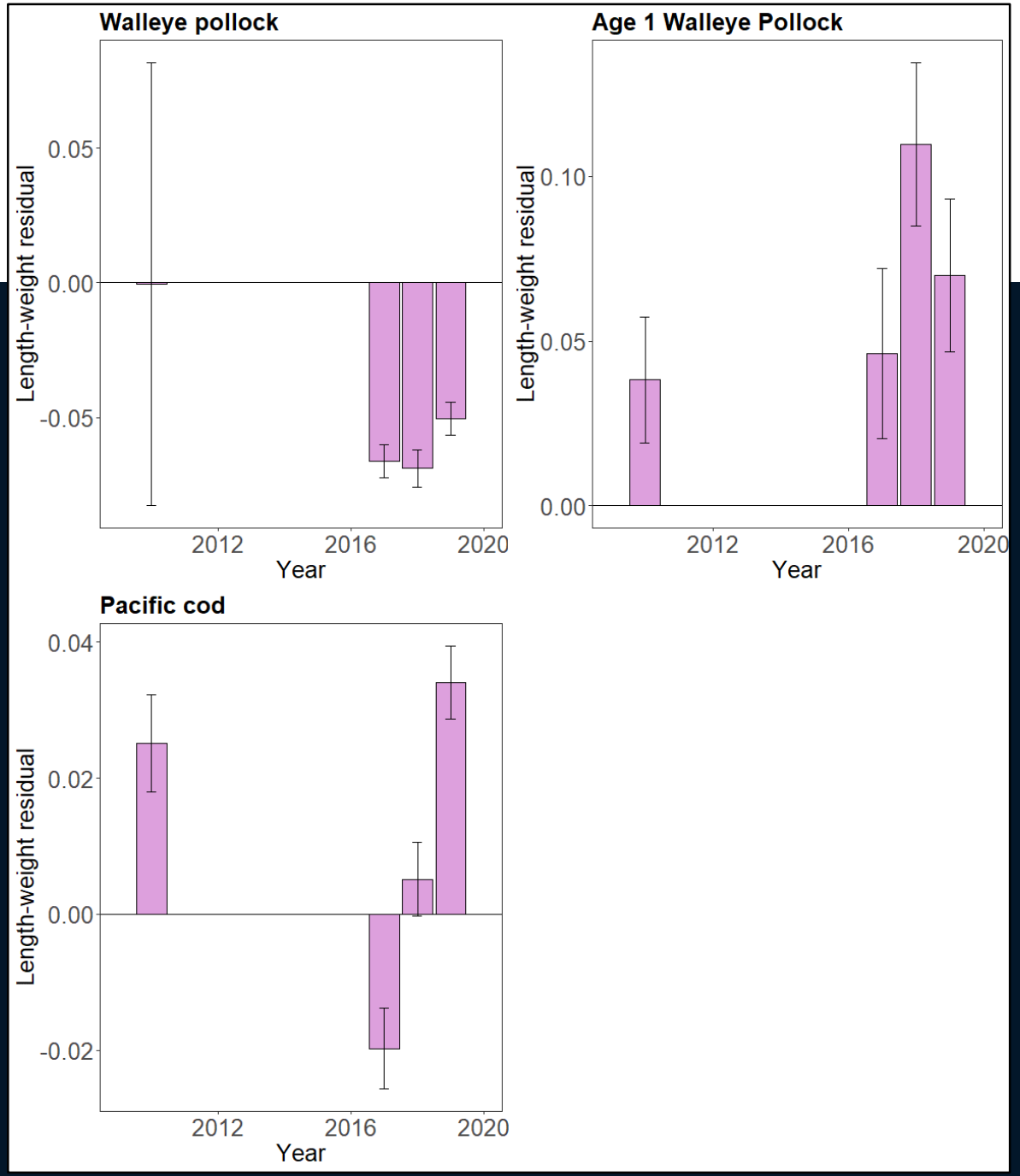
- Condition was positive for all species shown.
- Large increases were seen for adult pollock, Yellowfin sole, and Arrowtooth flounder.
  - possible shift to benthic-dominated system?

Laman

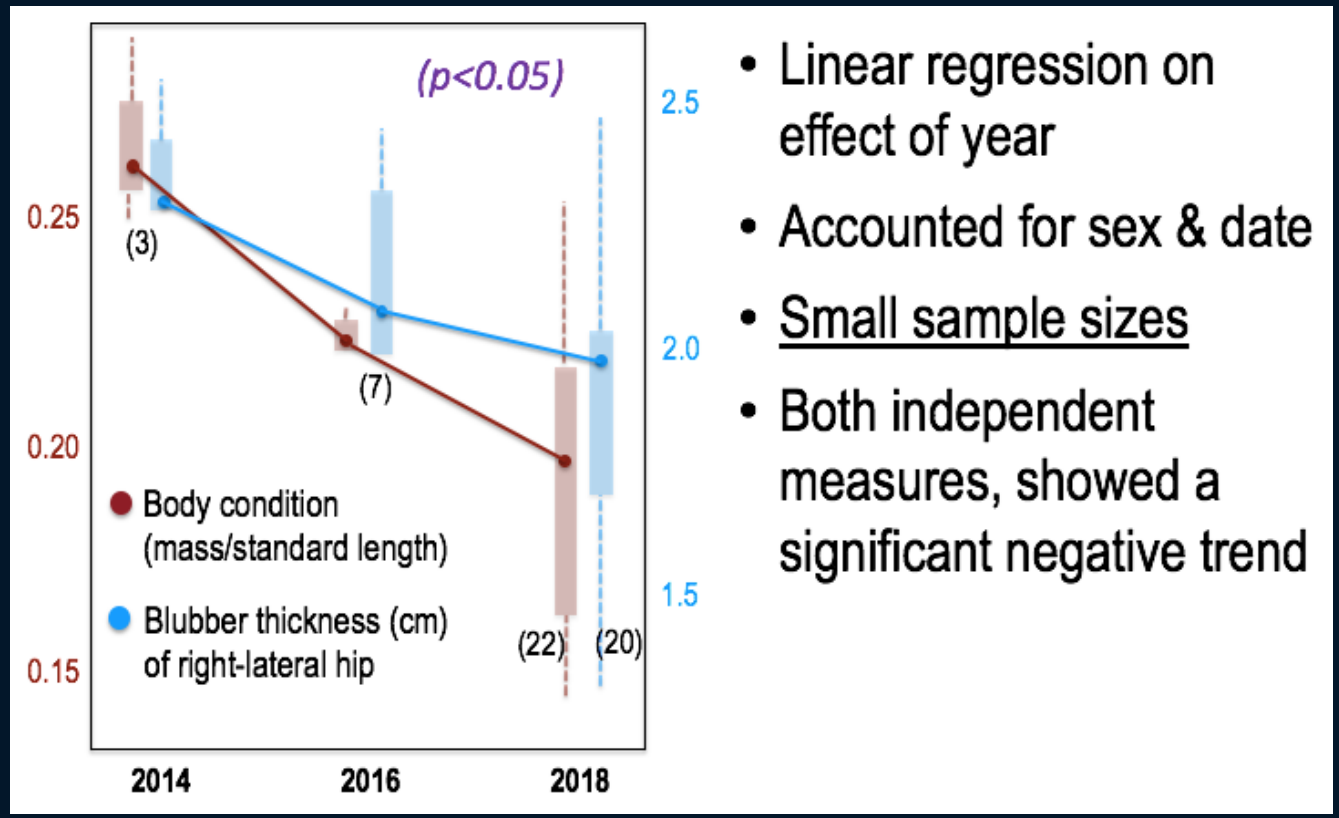


REFLECTIVE OF CUMULATIVE IMPACTS

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.



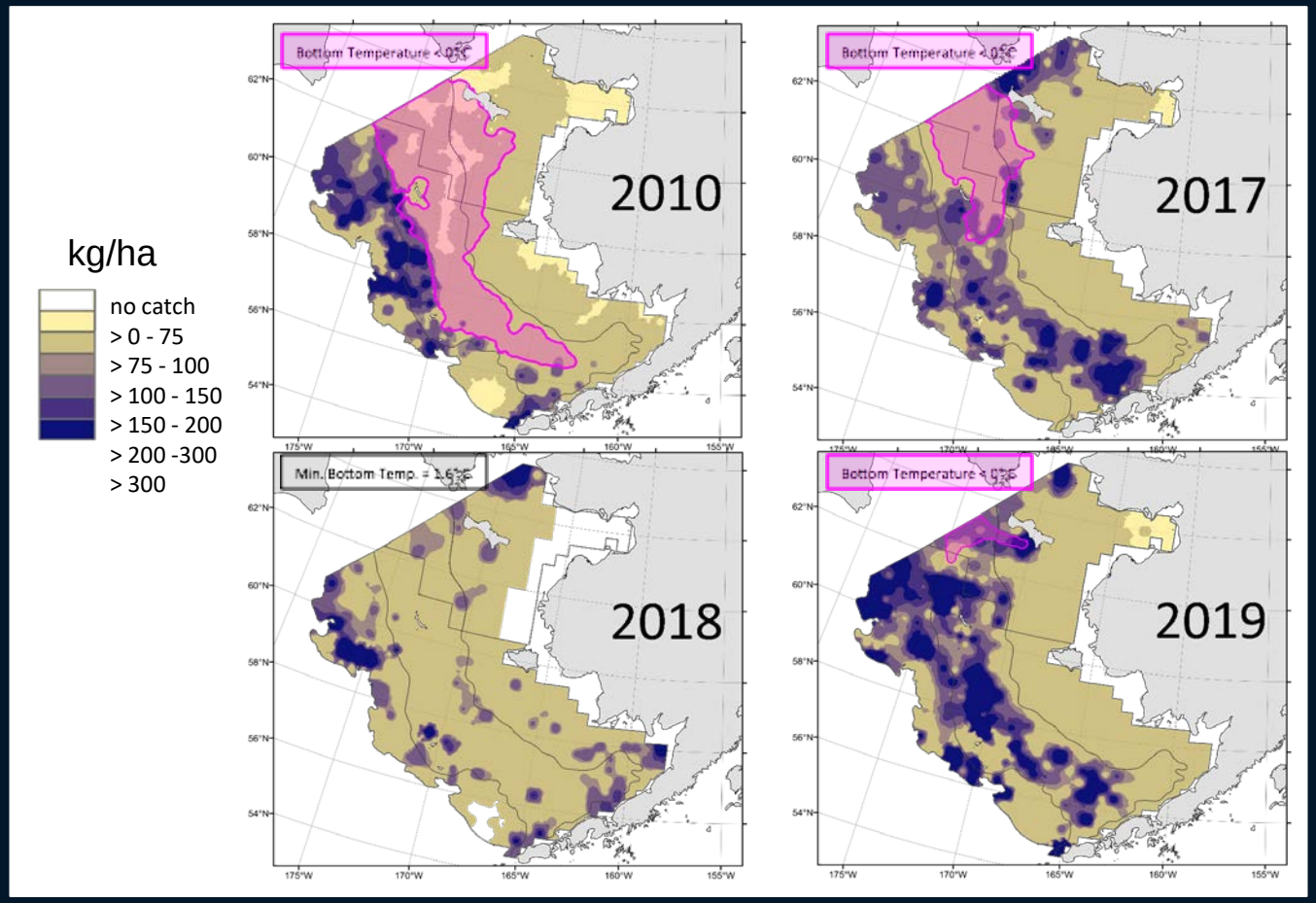
REFLECTIVE OF CUMULATIVE IMPACTS

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

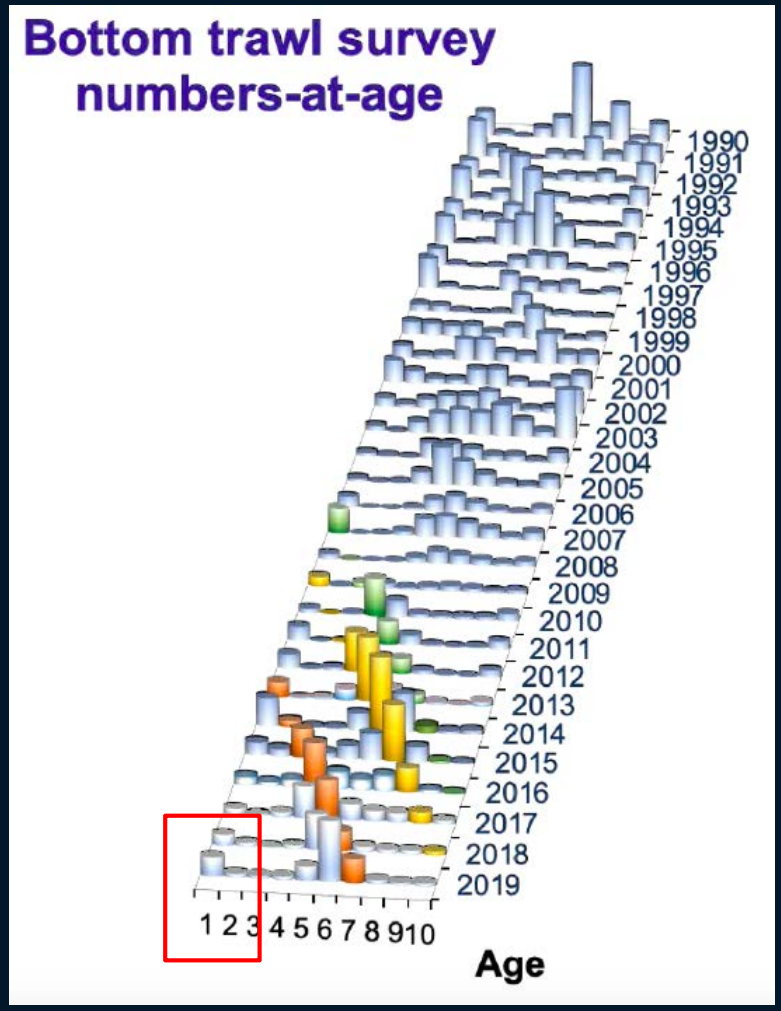
- Temperature change index
  - Above average recruitment
  - cool summer conditions as age-0 followed by warm spring as age-1 fish.
- Surface silicic acid
  - Below average recruitment
  - Silicate concentrations high, but fish weights were below average.
- Diet energy density
  - Below average recruitment
  - 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.

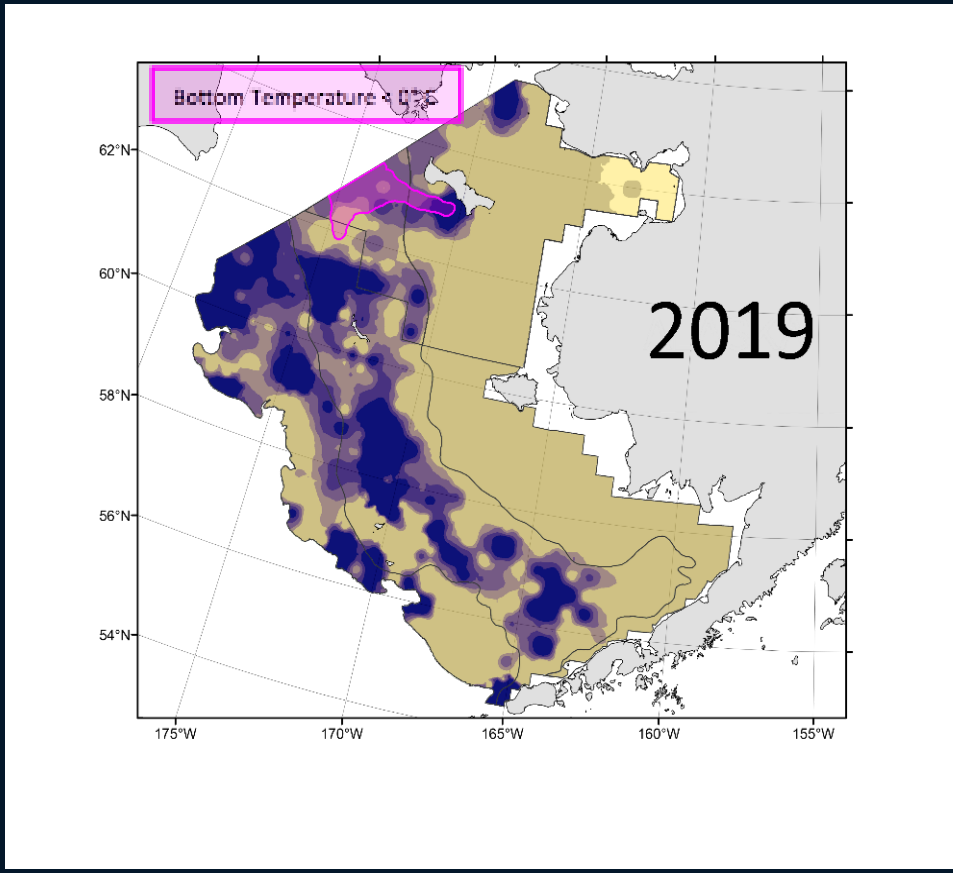


REFLECTIVE OF CUMULATIVE IMPACTS

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.

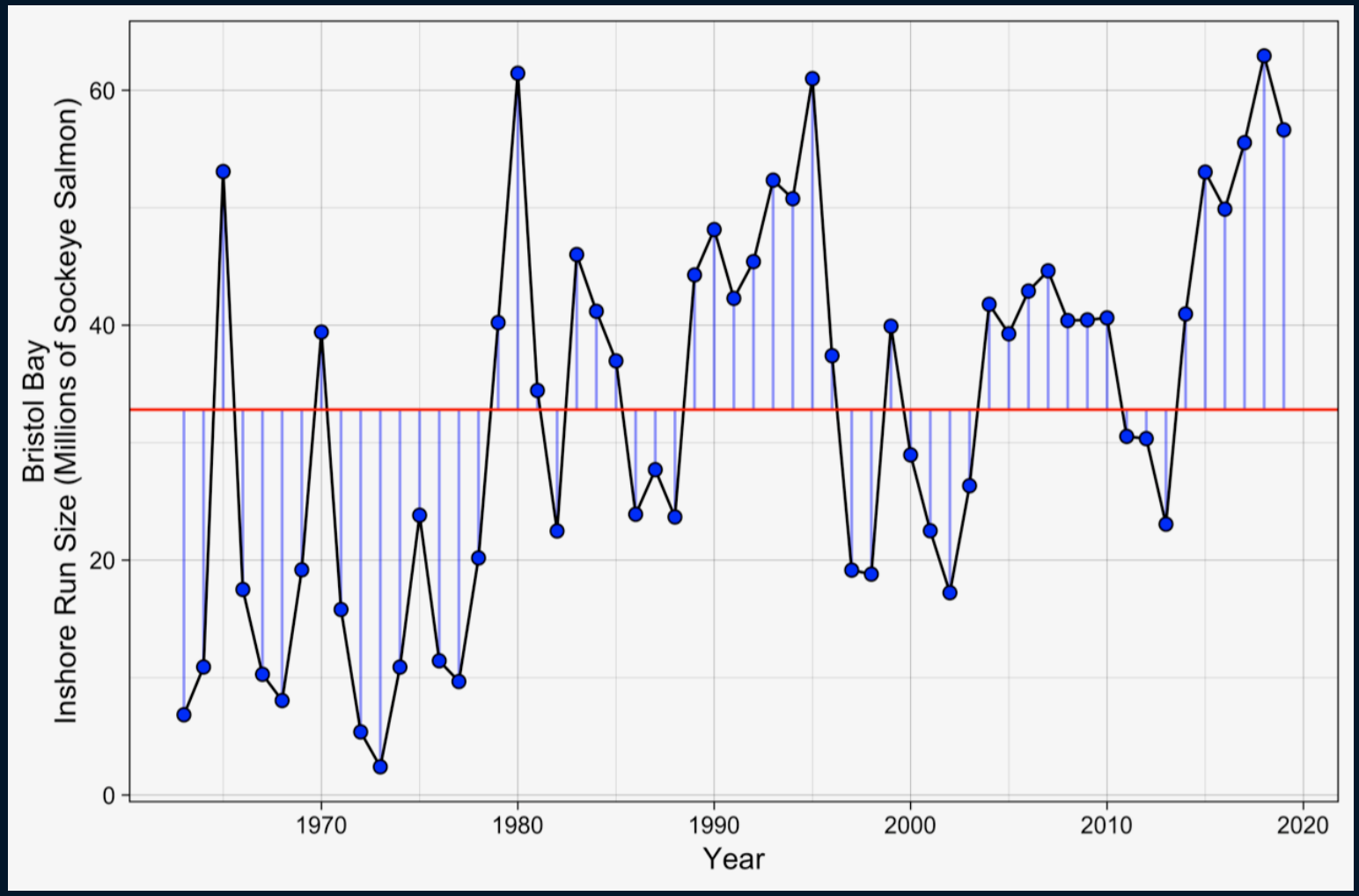


OTHER INDICATORS

Cunningham

Bristol Bay sockeye salmon

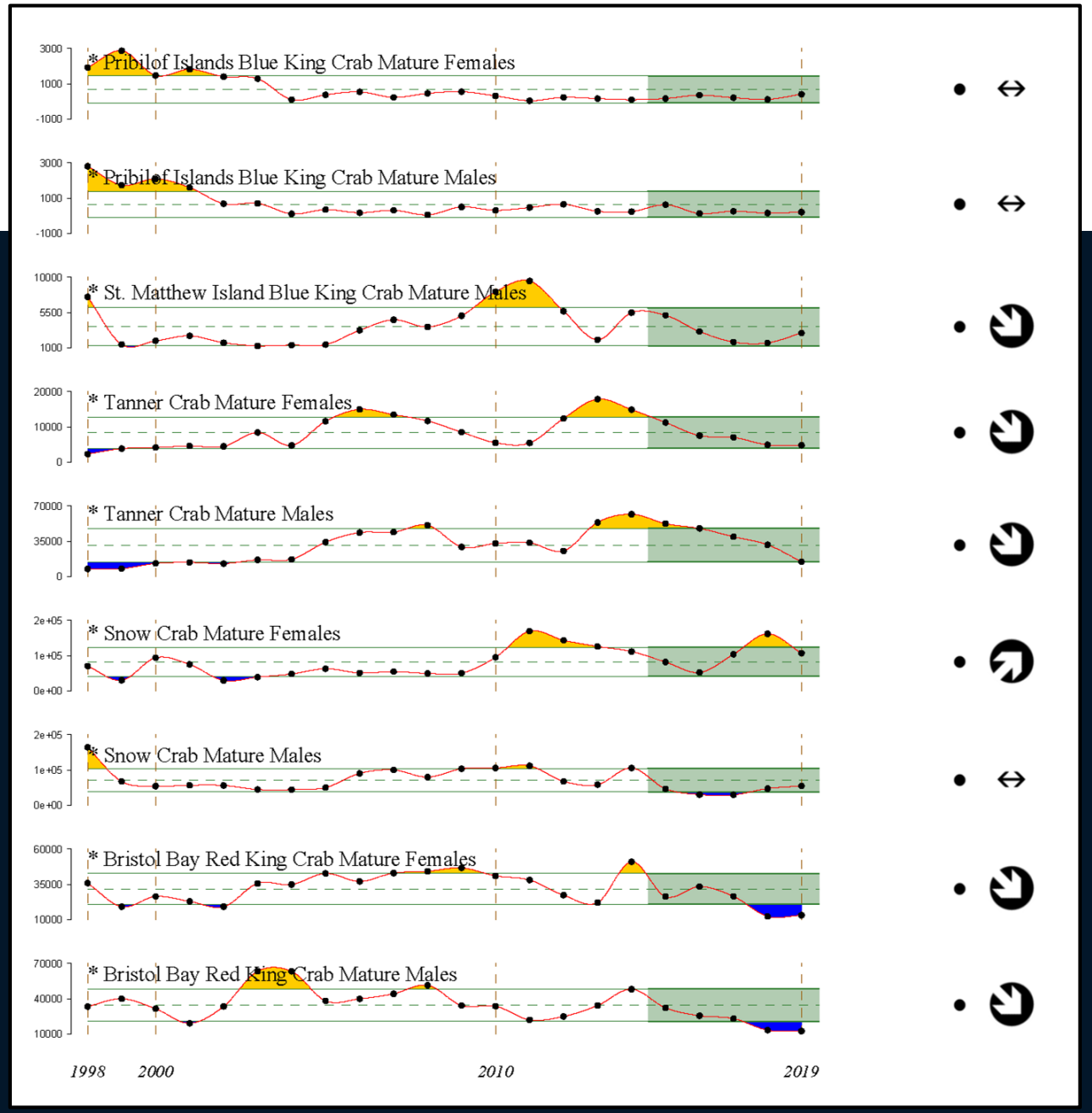
- 2019 inshore run was 56.6 million
- 4th largest since 1963
- Fish experienced positive conditions at ocean entry in the summers of 2016 and 2017, and winters of 2016/2017 and 2017/2018.



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.



Richar

SUMMARY & *IMPLICATIONS*

2nd 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. *Indicates positive groundfish responses to ecosystem conditions.*

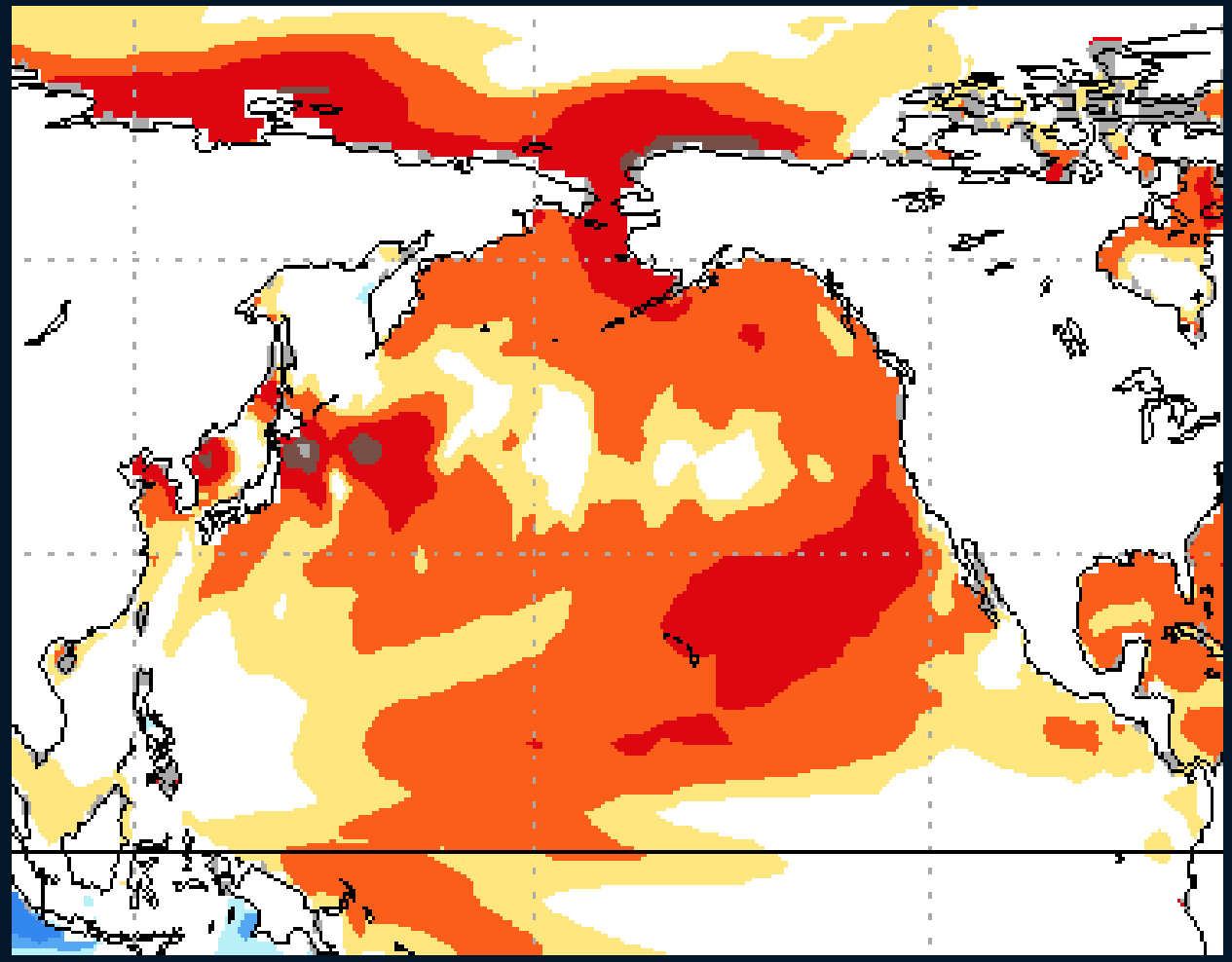
Seabird die-off (mainly short-tailed shearwaters) attributed to starvation. Concerns about food security in NBS. Seabirds at colonies did better than expected.
Indicates mixed responses by seabirds.

Gray whale and ice seal Unusual Mortality Events (UMEs).
Indicates impacts of changes in food web structure and carrying capacity of the NBS.

FORECAST

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.



Bond