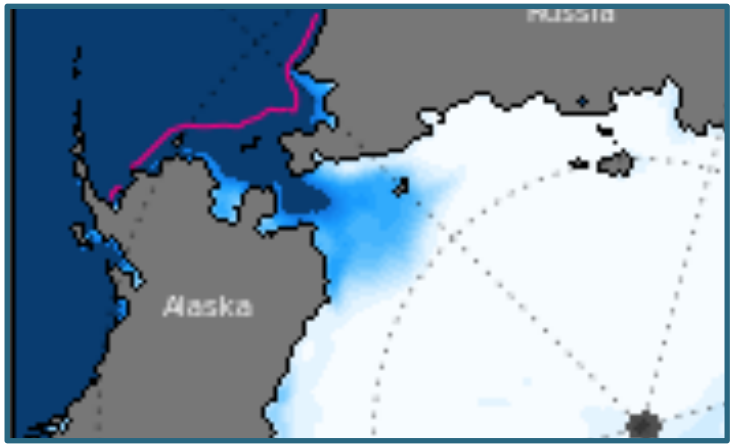
Ecosystem stress test: What an ice-free winter might mean for the eastern Bering Sea

Elizabeth C. Siddon, Janet Duffy-Anderson, Phyllis Stabeno, Alex Andrews, Kristen Cieciel, Ed Farley, David Kimmel, Jesse Lamb, Bob Lauth, Steve Porter, and Lauren Rogers

November 1, 2018

Unprecedented lack of sea ice: what caused it?

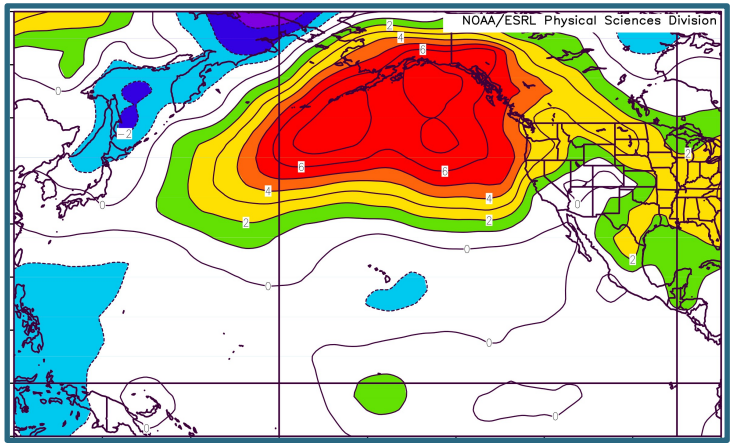
Residual heat in the system



National Snow & Ice Data Center

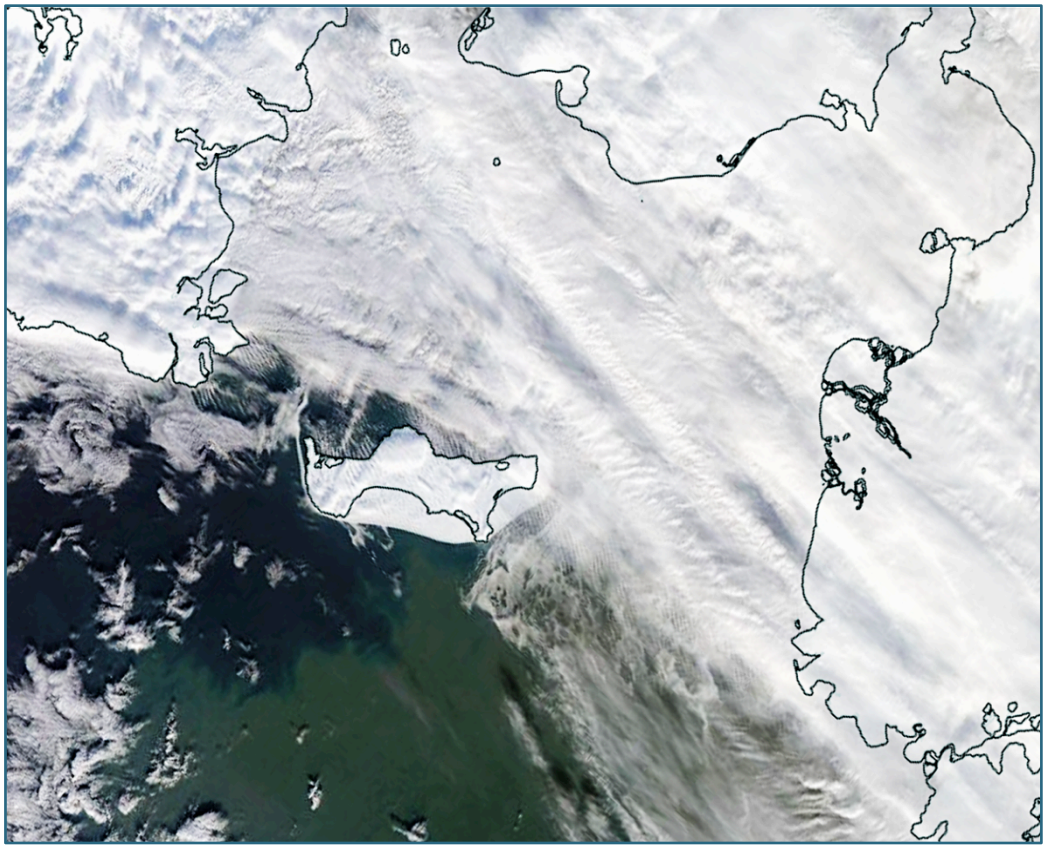
Persistent high pressure system

Anomalous winds from the south



Nick Bond

Consequences of no sea ice



No freshwater lens after ice melt.

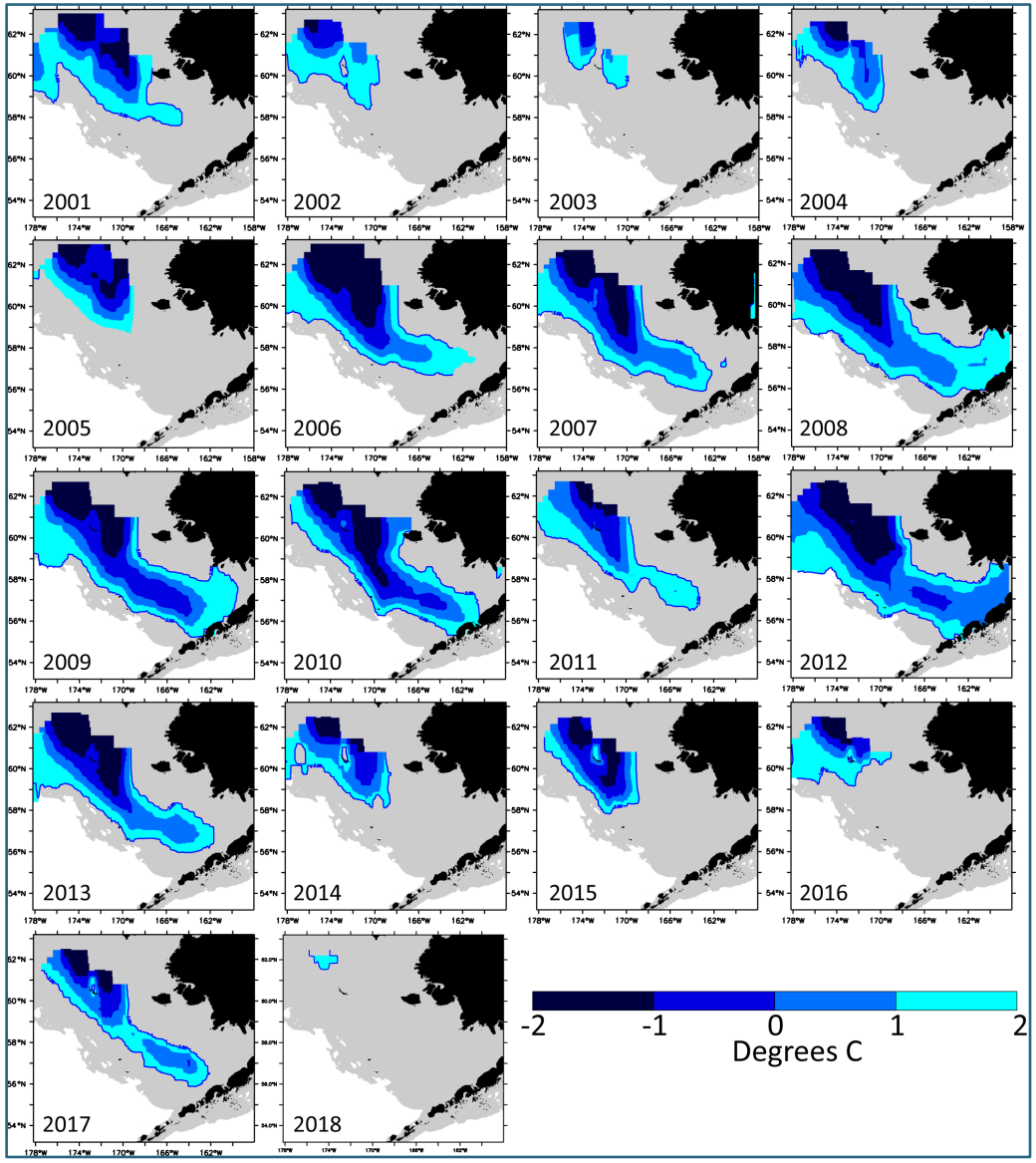
No salinity stratification.

Well-mixed water column.

Water column will cool more rapidly.

No cold pool.

Cold pool dynamics



Low ice years = ‘warm’

High ice years = ‘cold’

2002-2005 = warm stanza

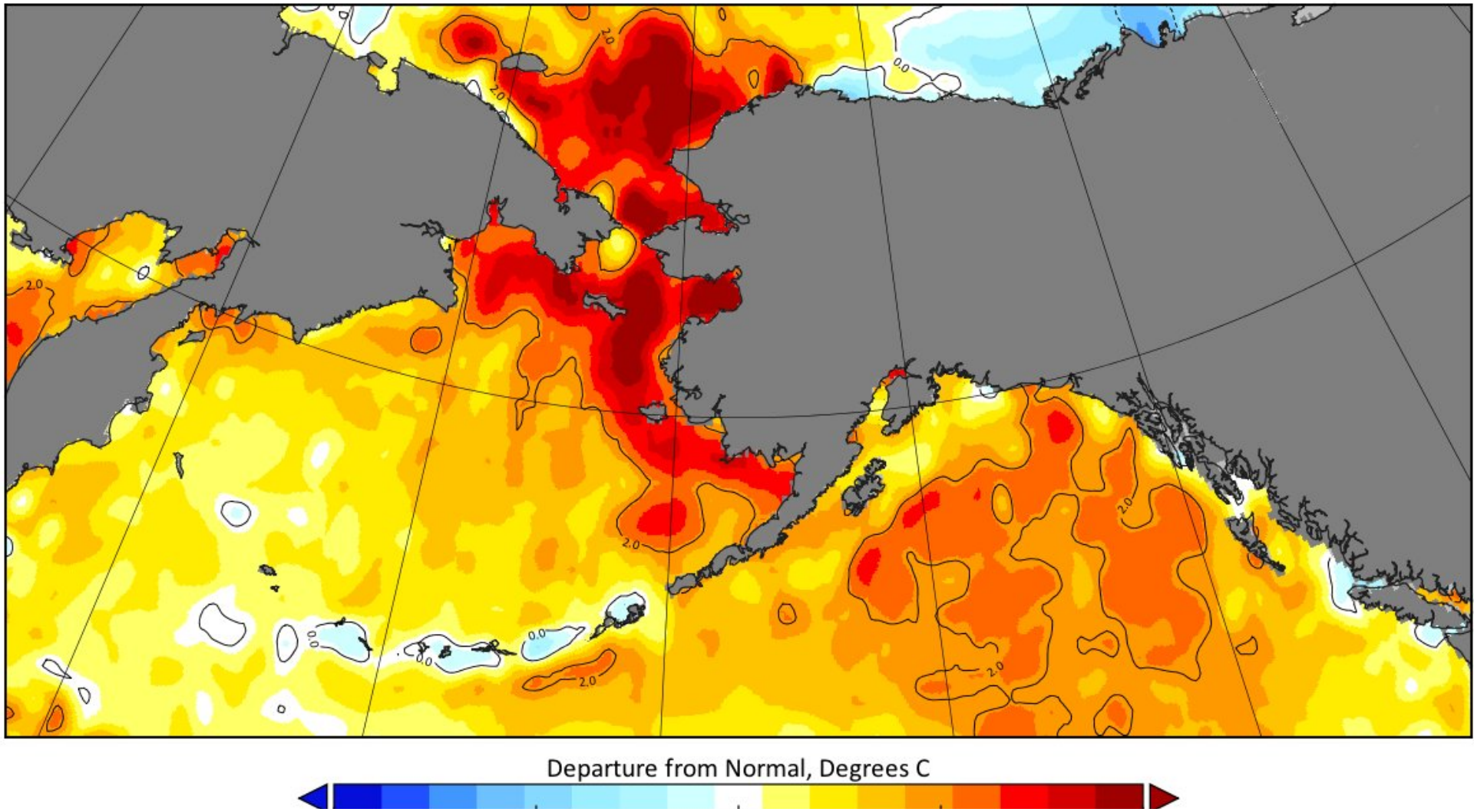
2007-2012 = cold stanza

2014-2016 = warm stanza

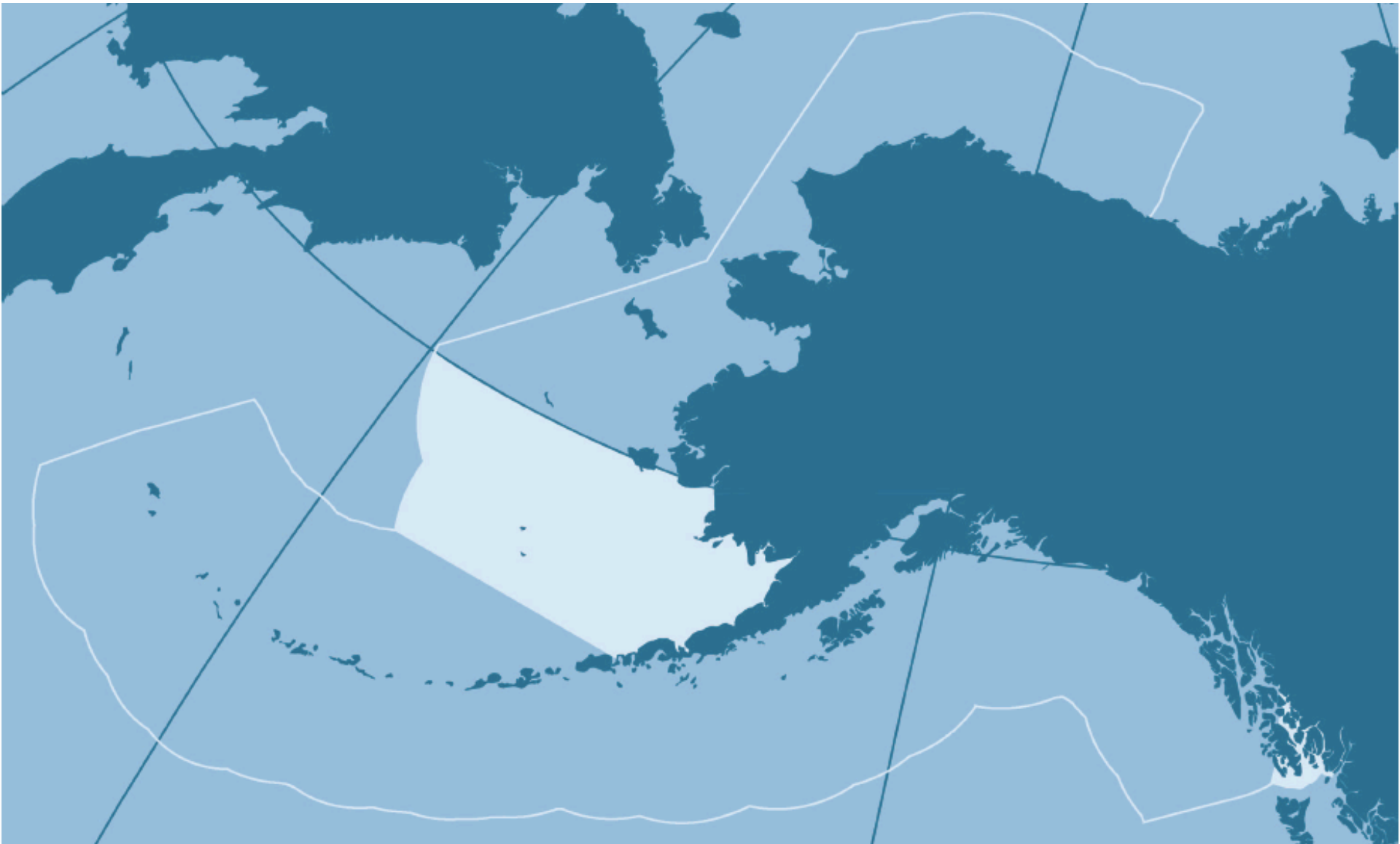
2017 = narrow, but extensive

2018 = cold pool ‘droplet’

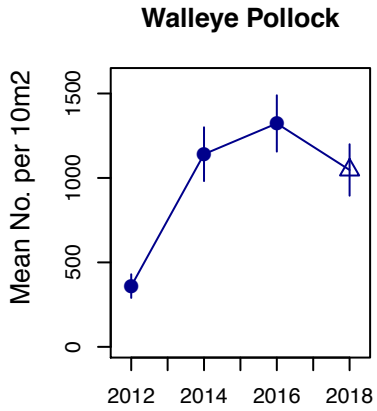
How did the ecosystem respond?

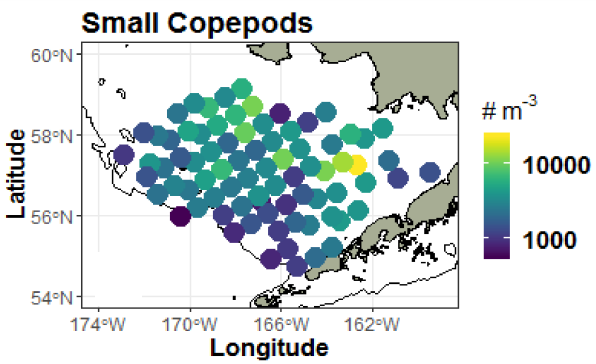


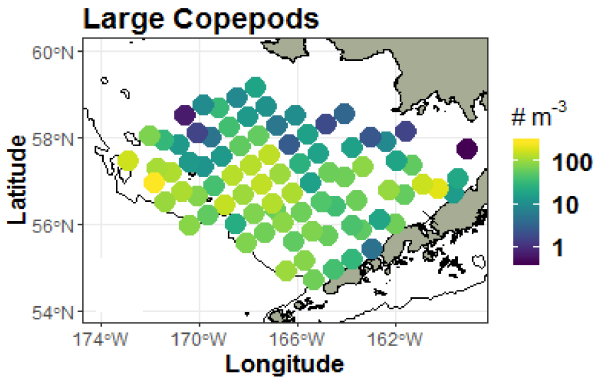
Southeastern Bering Sea

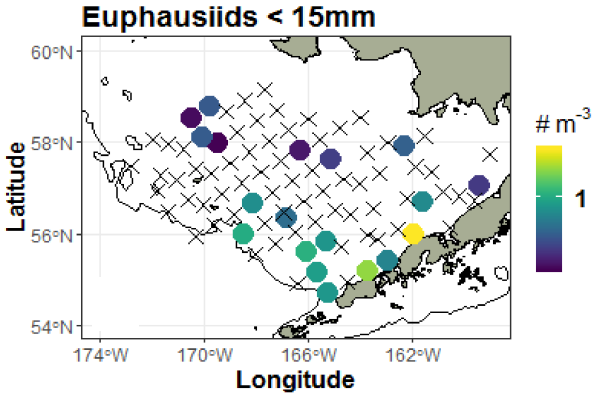


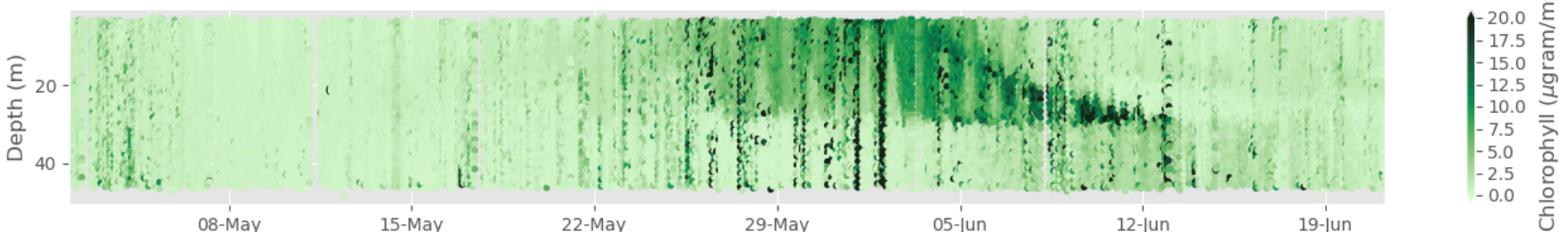
Southeastern Bering Sea





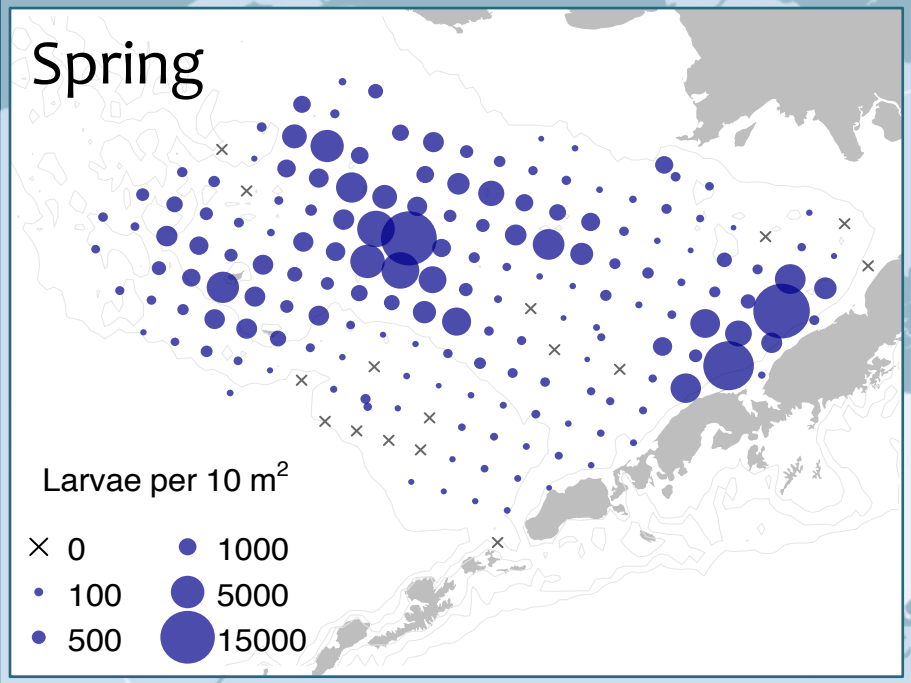


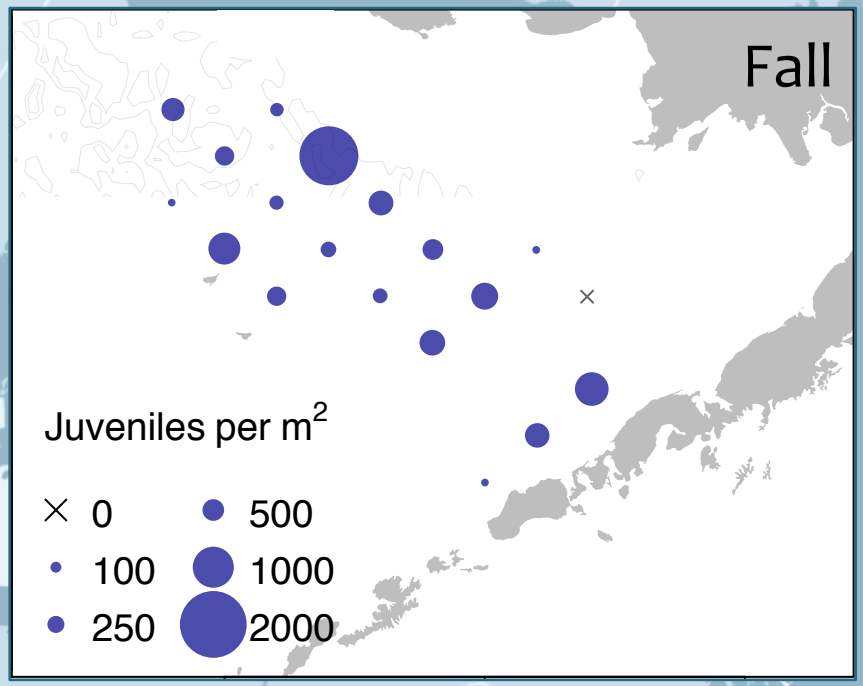




Southeastern Bering Sea

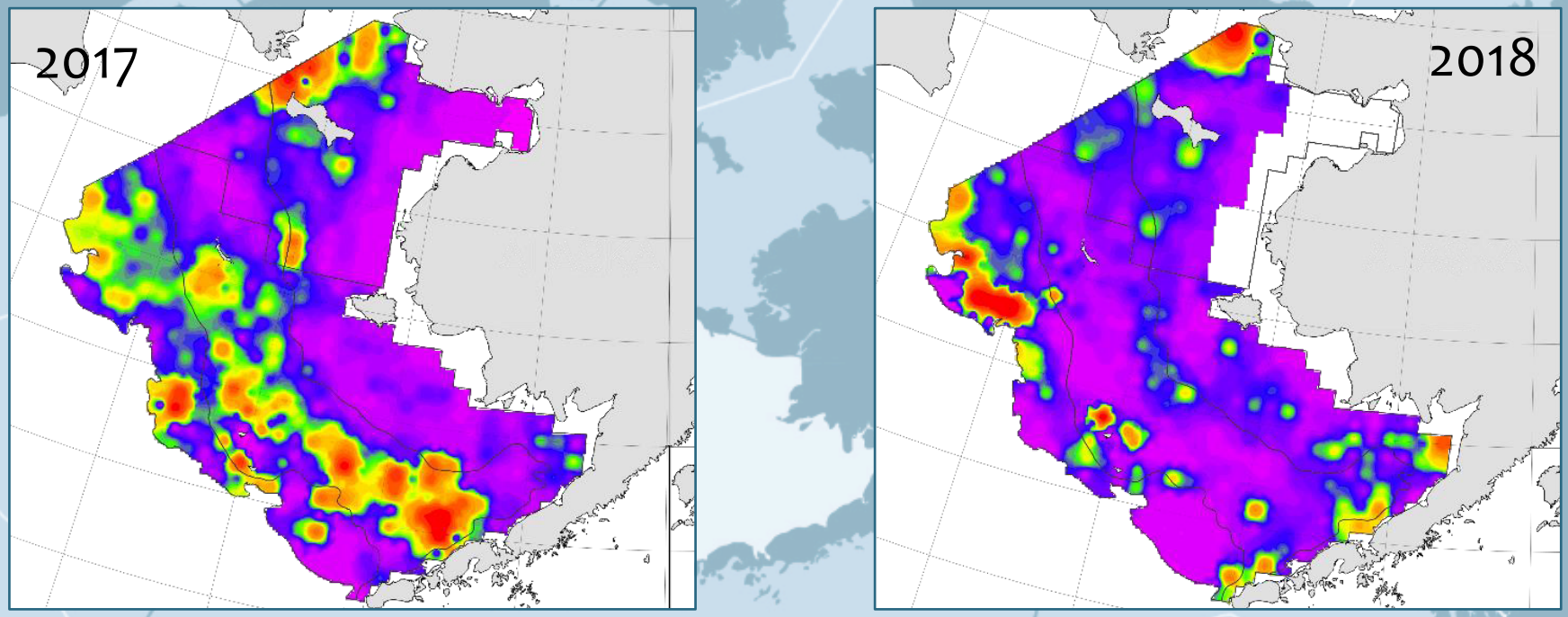
Walleye pollock





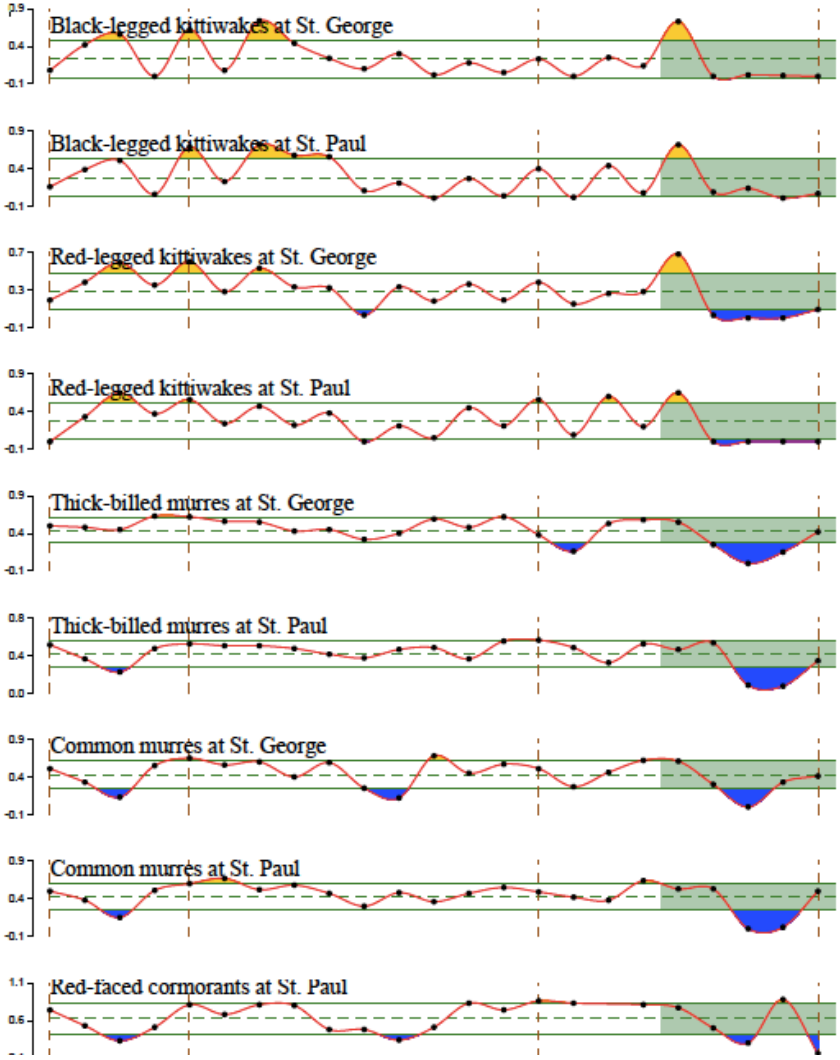
Southeastern Bering Sea

Walleye pollock (adults)



Southeastern Bering Sea

Alaska Maritime National Wildlife Refuge



SUMMARY

No cold pool over the southeastern shelf.

Reduced stratification.

Weak, delayed bloom.

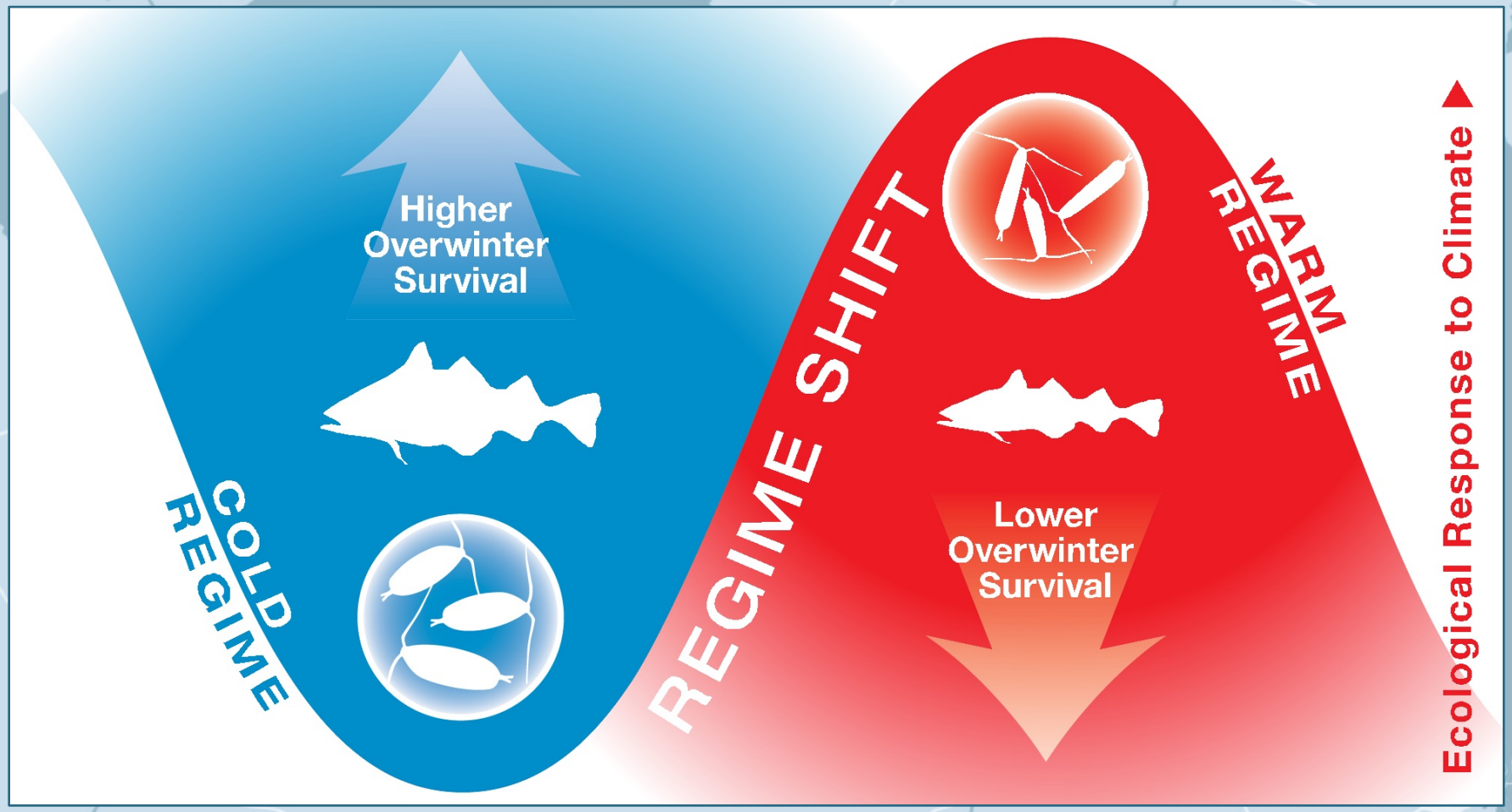
Low abundance and quality of zooplankton.

Larval fish production high.

Adult pollock biomass decreased from 2017.

Poor reproductive success for seabirds at Pribilof Islands.

Southeastern Bering Sea



IMPLICATIONS

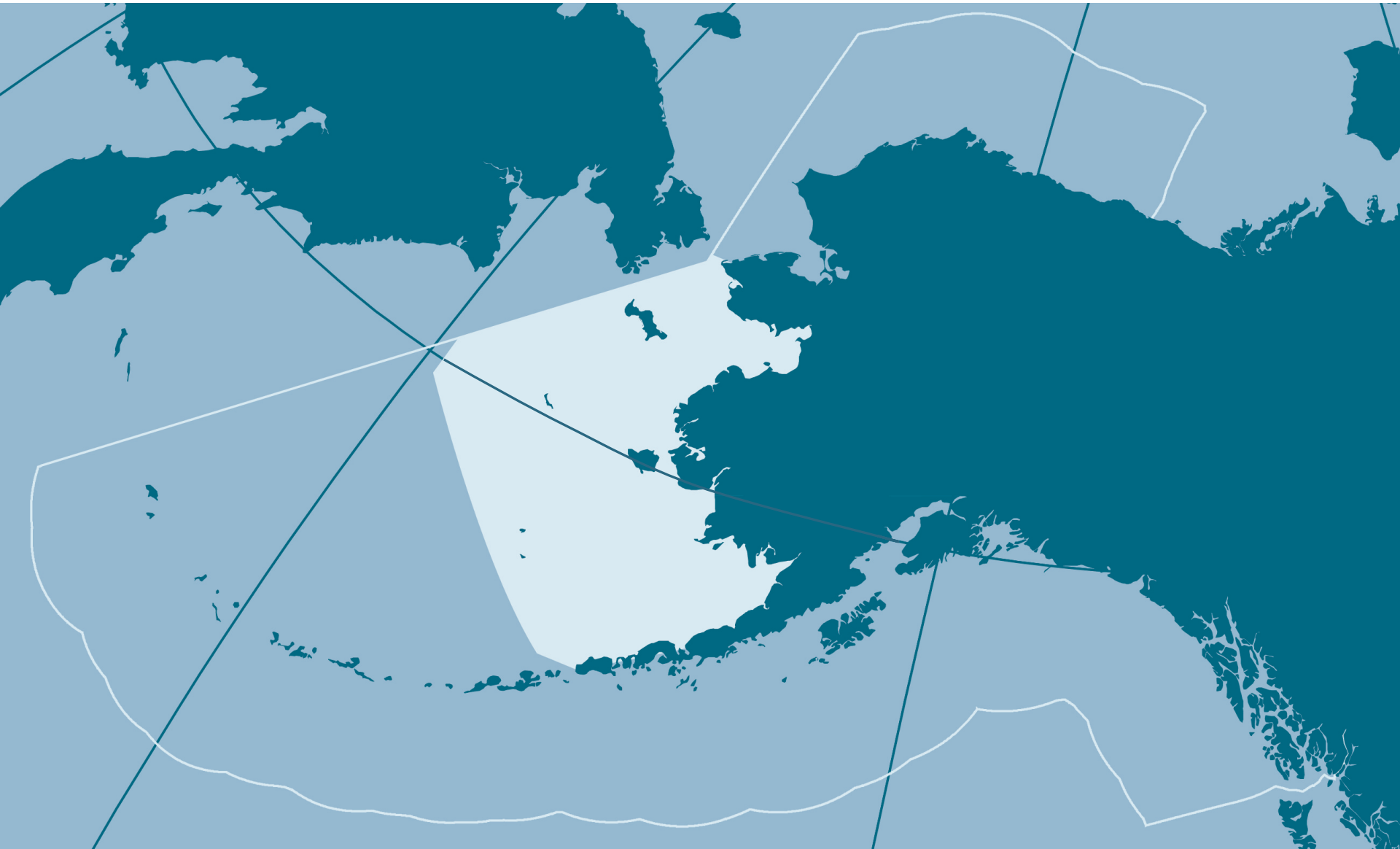
Juvenile pollock condition and survivorship are predicted to be below average due to poor prey resources.

Continued warm conditions are predicted for summer 2019.

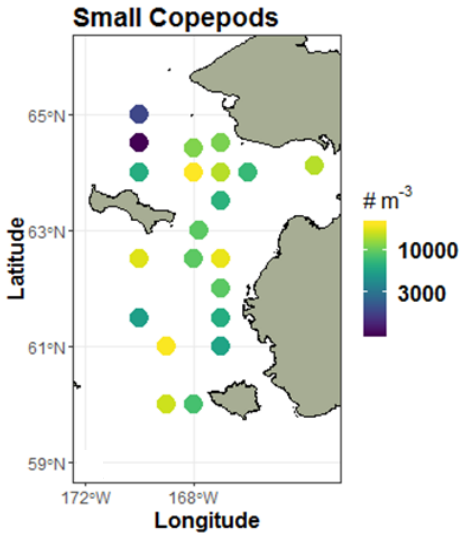
Cumulative effects of poor recruitment success could impact fishable biomass in coming years.

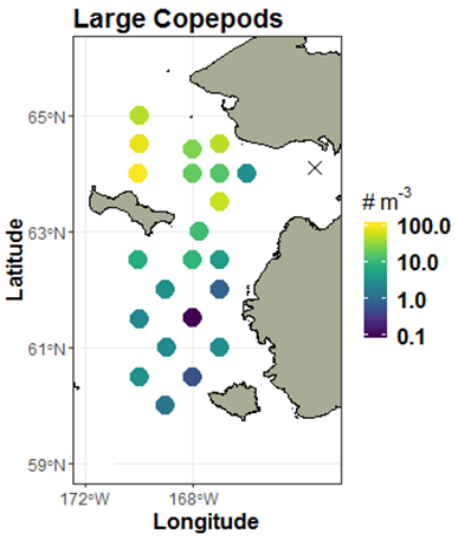
Cumulative impacts of poor seabird reproductive success remains a concern.

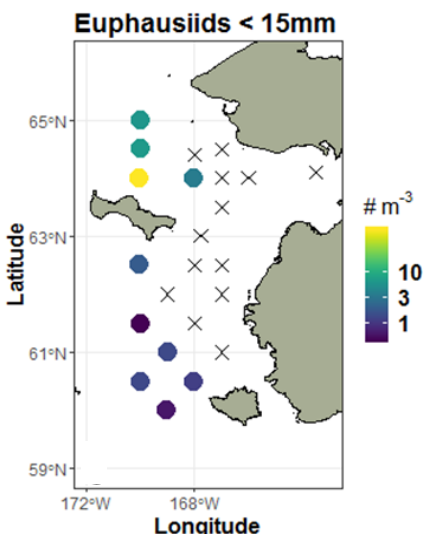
Northern Bering Sea

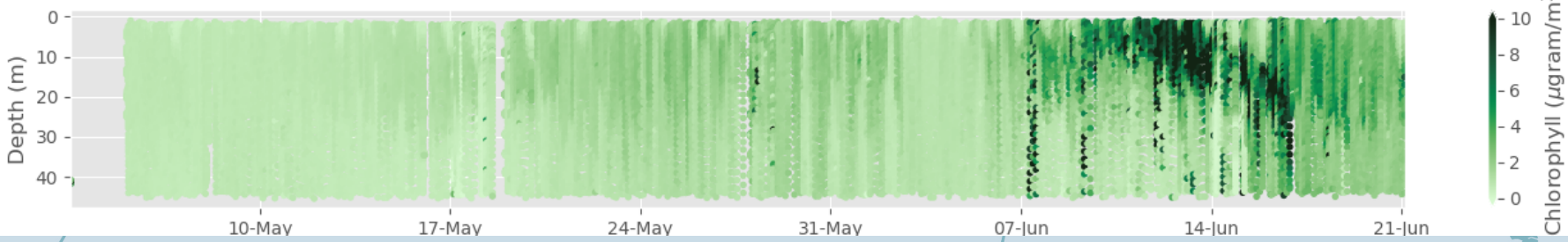


Northern Bering Sea

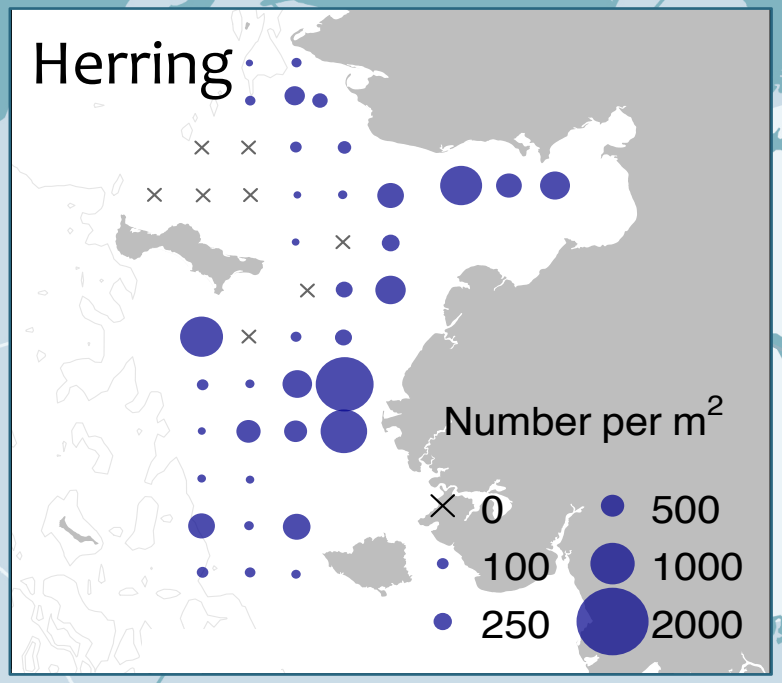


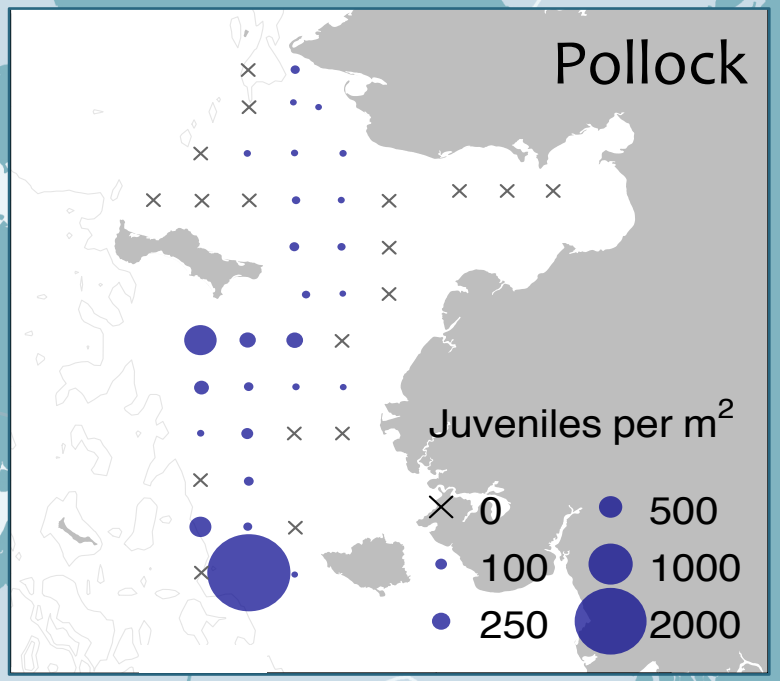






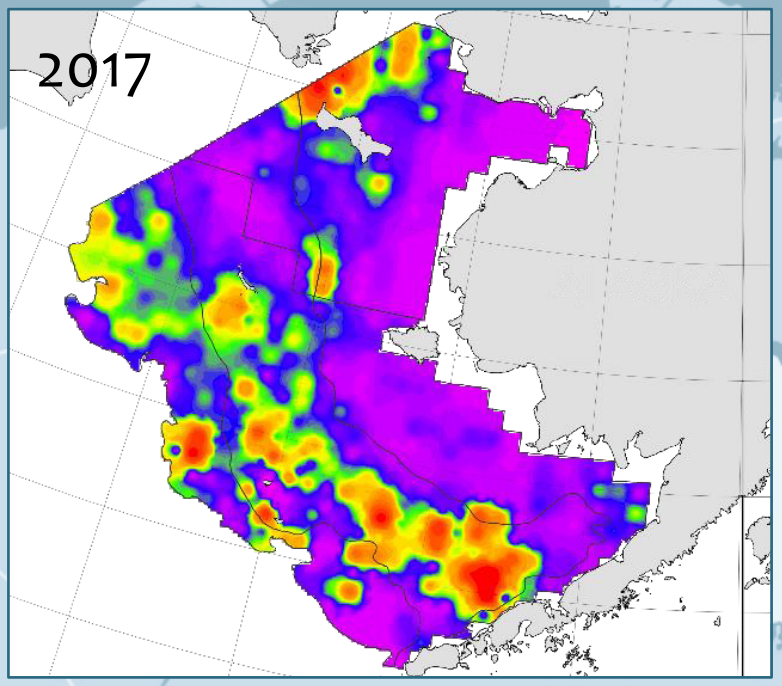
Northern Bering Sea

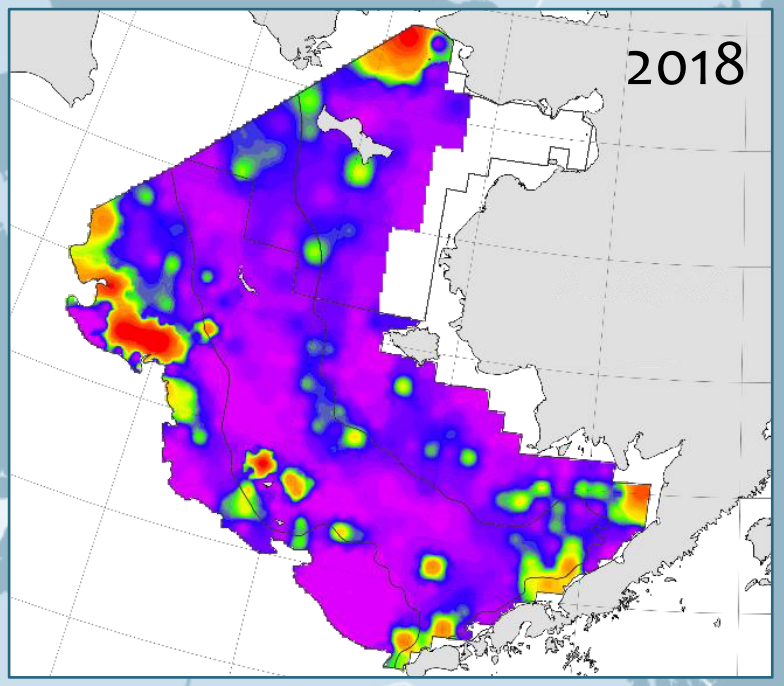




Northern Bering Sea

Walleye pollock (adults)





Northern Bering Sea

Seabird breeding success observations 2018 – Alaska Maritime NWR

Colony	Murres	Kittiwakes	Cormorants	Auklets	Notes
Cape Lisburne	☹	?	?	Not present	Kittiwakes either failed or late (sitting tight)
Cape Thompson	😐	😐	Few noted	Not present	no chicks observed, only 1 egg
Cape Lewis	😐	😐	?	Not present	
Puffin/ Chamisso	☹	?	?	Not present	Murres observed attending cliffs on Puffin, not Chamisso Poor weather, brief look only
Sledge	☹	☹	🙂	Not present	8% of kittiwakes had chicks
Bluff	☹	☹	🙂	Not present	10% of kittiwakes had chicks
St. Matthew	?	?	?	?	Red-legged kittiwakes breeding for first time
Nunivak	😐	😐	?	Not present	Poor weather, brief look only
St. Paul	☹	😐	🙂	☹	Murres initiated very late
St. George	☹	😐	🙂	☹	Murres initiated very late

😐 Zero production ☹ Low production 🙂 Average to above average

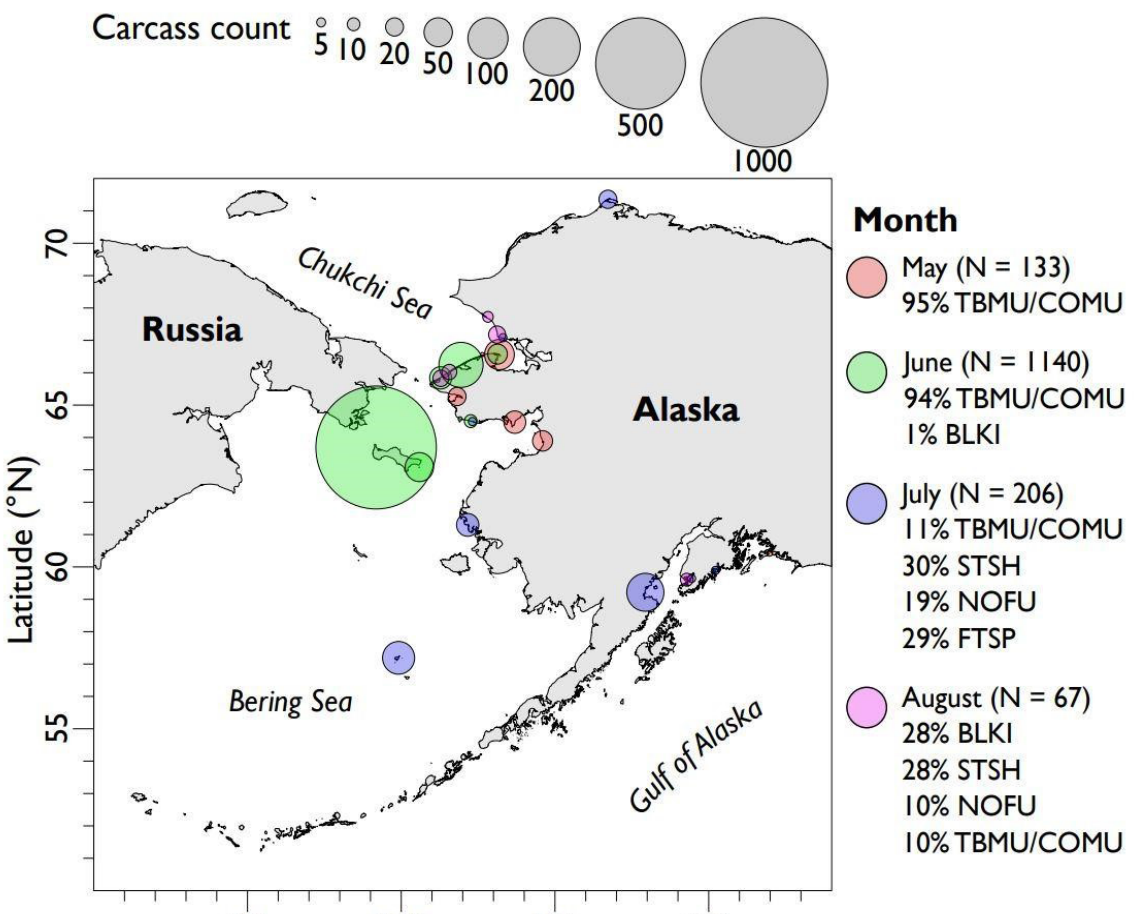
Northern Bering Sea

Seabird breeding success observations 2018 – Alaska Maritime NWR

Colony	Murres	Kittiwakes	Cormorants	Auklets	Notes
Cape Lisburne		?	?	Not present	Kittiwakes either failed or late (sitting tight)
Cape Thompson			Few noted	Not present	no chicks observed, only 1 egg
Cape Lewis			?	Not present	
Puffin/ Chamisso		?	?	Not present	Murres observed attending cliffs on Puffin, not Chamisso Poor weather, brief look only
Sledge				Not present	8% of kittiwakes had chicks
Bluff				Not present	10% of kittiwakes had chicks
St. Matthew	?	?	?	?	Red-legged kittiwakes breeding for first time
Nunivak			?	Not present	Poor weather, brief look only
St. Paul					Murres initiated very late
St. George					Murres initiated very late

Zero production Low production Average to above average

Northern Bering Sea



Contributing Partners:

Sea Grant Alaska

KAWERAK, INC.

COASST

USGS science for a changing world

NATIONAL PARK SERVICE

NOAA

SUMMARY

Lack of sea ice (unprecedented).

Weak stratification.

Well-mixed water column.

Zooplankton abundance increased with latitude, but overall low.

Large copepods dominated by *Eucalanus bungii* (not lipid-rich).

Juvenile forage fish abundance low.

Adult pollock biomass decreased from 2017.

Seabird reproductive failures and die-off event (unprecedented).

IMPLICATIONS

Did fish overwinter in the northern Bering Sea last winter (2017/18)?

- If so, what impact did they have on prey resources?
- Did their presence shift the food web balance?

Ecosystem indicators suggest poor productivity and lack of a sufficient prey base.

Will fish overwinter in the northern Bering Sea this winter (2018/19)?

CONCLUSIONS

Distributions are shifting northward.

Connectivity between southeastern and northern Bering Sea.

Can populations simply move north?

- Spawning locations? Spawning success?
- Carrying capacity?
- Mechanistic linkages hold?

Expanded surveys for stock assessments and ecosystem assessments.