

A preliminary ecosystem assessment of the Northern Bering Sea

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OUTLINE

1. Why didn't the NBS freeze up last winter/spring?
2. How has the ecosystem responded?
3. Groundfish in the NBS
4. Implications for the future

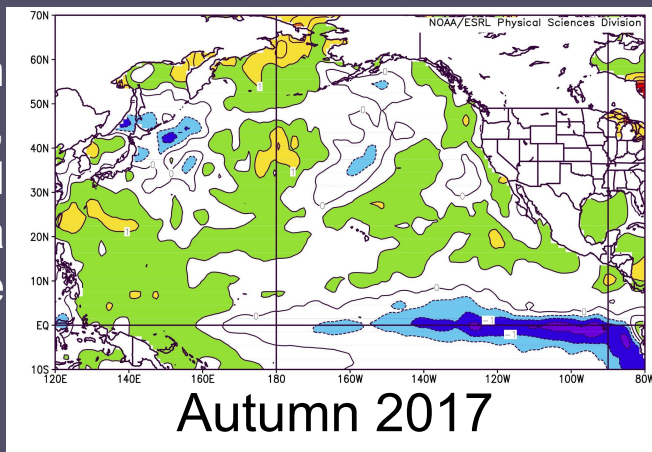
Why didn't the NBS freeze up last winter/spring?



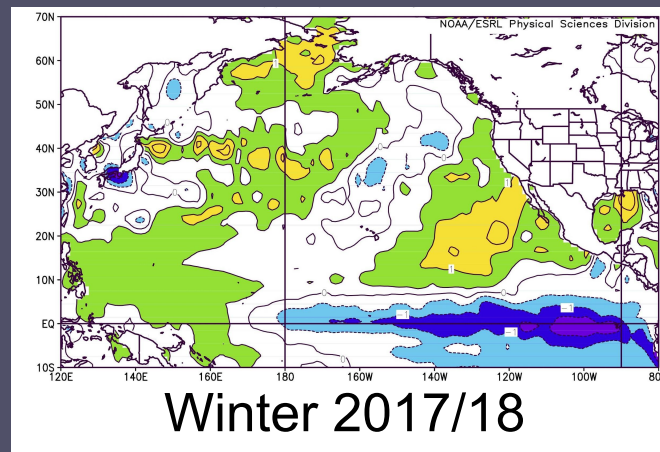
Sea Surface Temperature Anomalies

Bond

Warmer than normal, delayed onset of sea ice

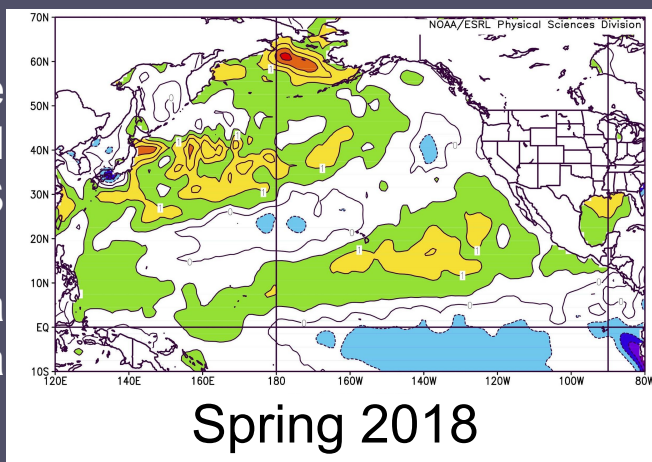


Weak to moderate La Niña conditions

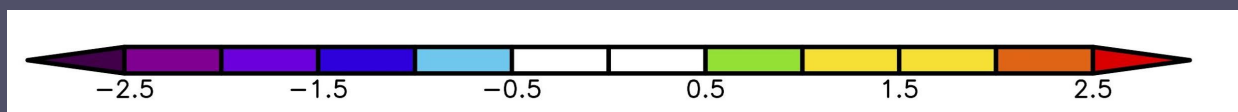
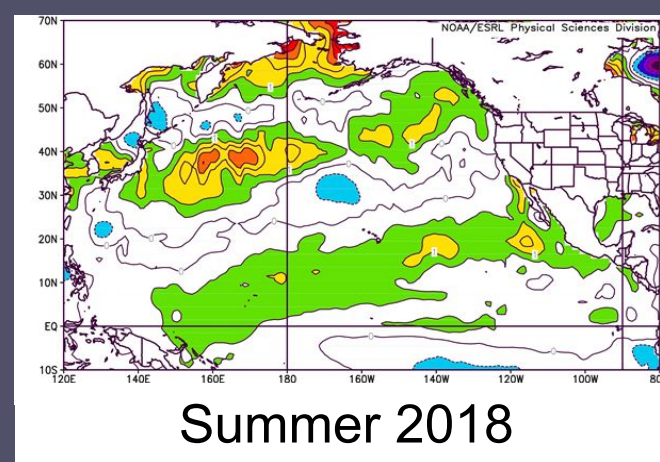


Warm relative to seasonal norm in EBS

End of La Niña



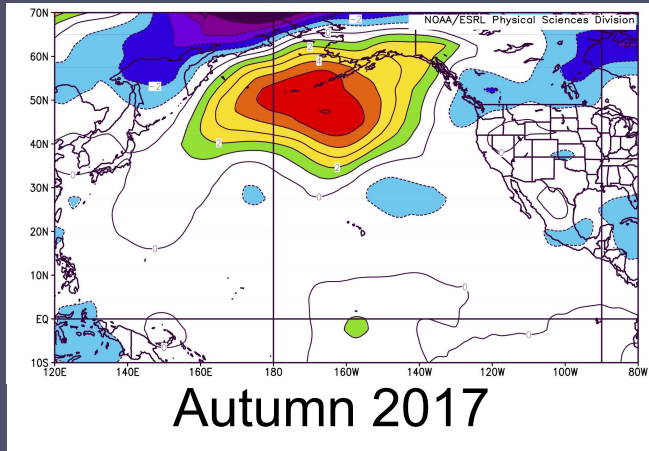
Particularly strong anomalies (> 2°C) developed near Bering Strait.



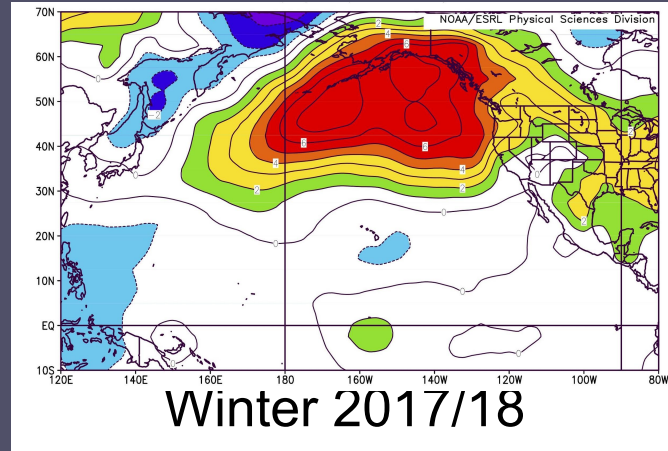
Sea Level Pressure Anomalies

Bond

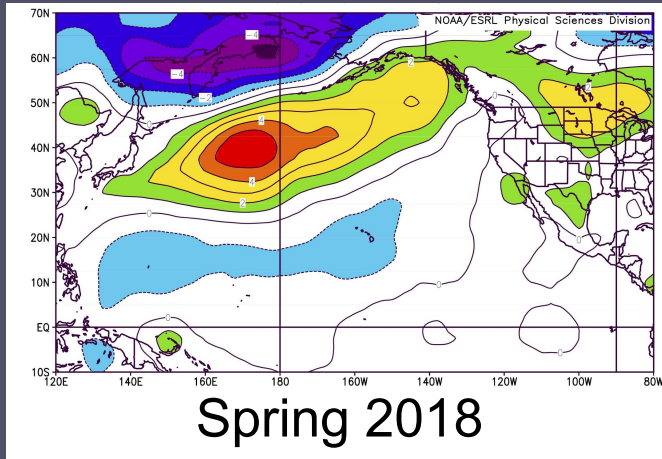
Enhanced storminess along east coast of Asia. Suppressed storminess from AI to GOA.



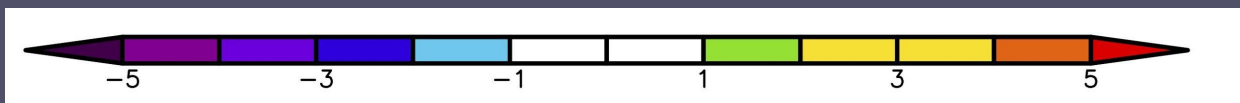
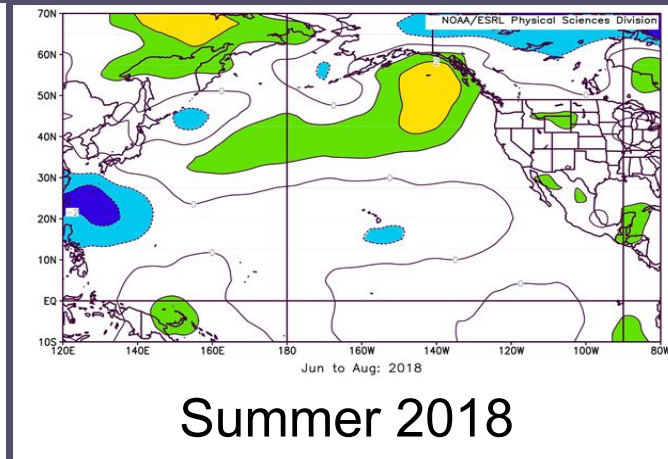
Expansion of Fall pattern. Strong wind anomalies from SW across the Bering Sea.



Warm, SW flow anomalies across the Bering Sea.



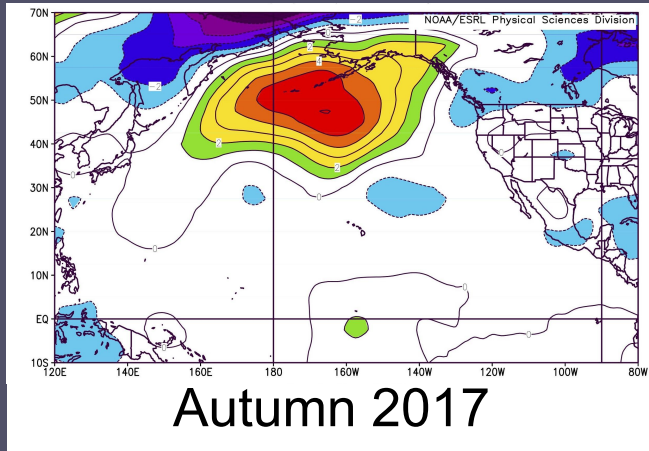
Weak anomalies; typical for Summer.



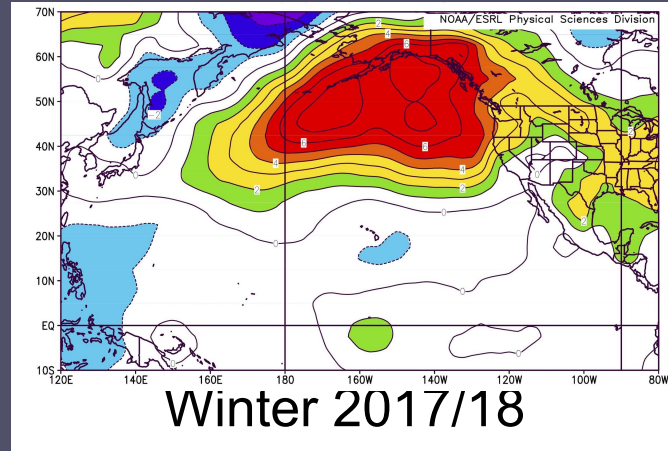
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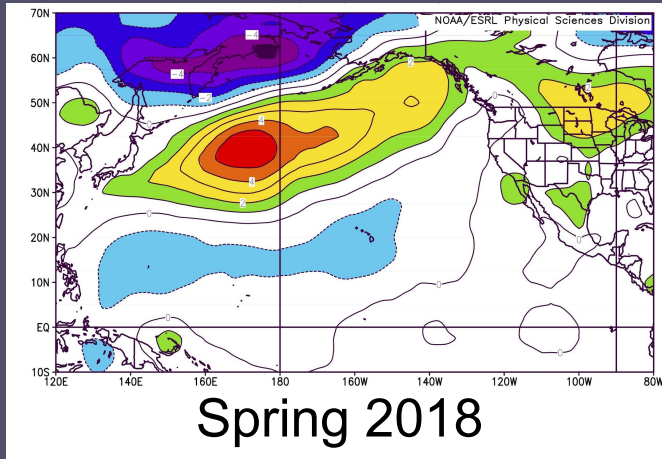
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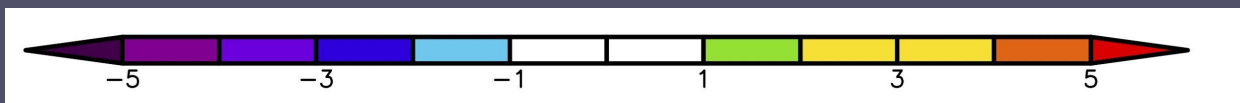
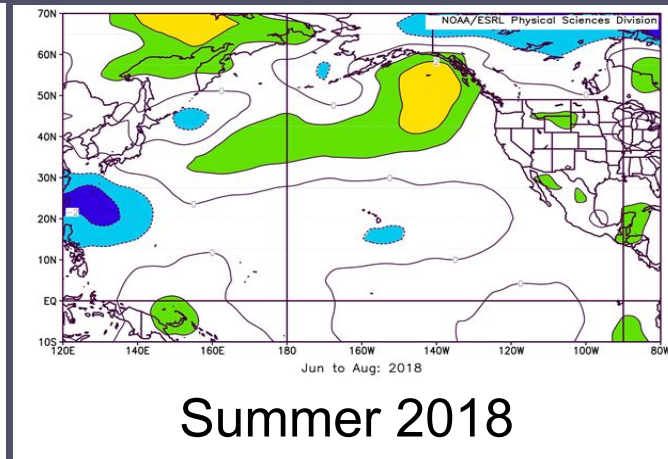
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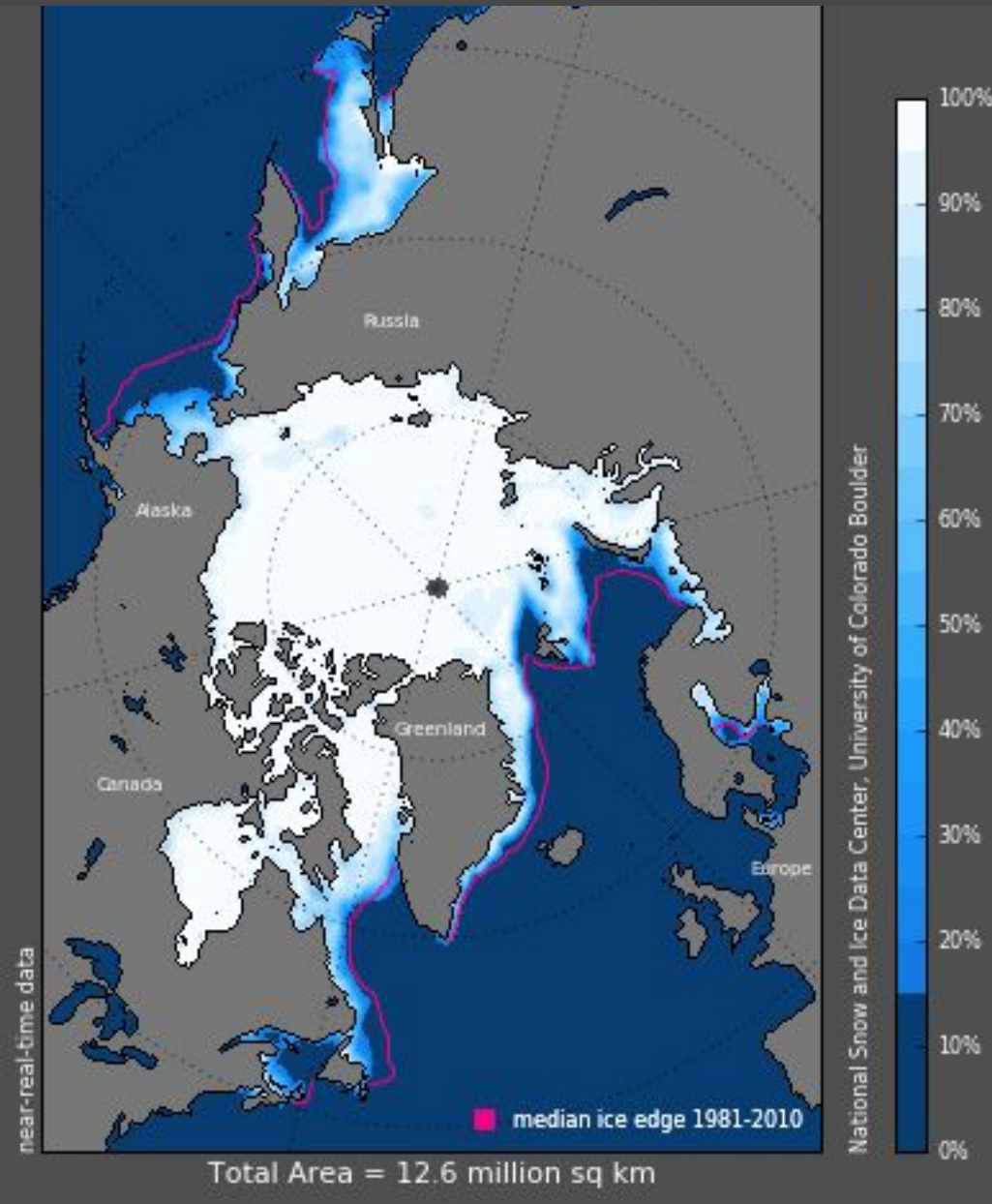


Weak anomalies; typical for Summer.



Sea Ice Concentration Mar 2018

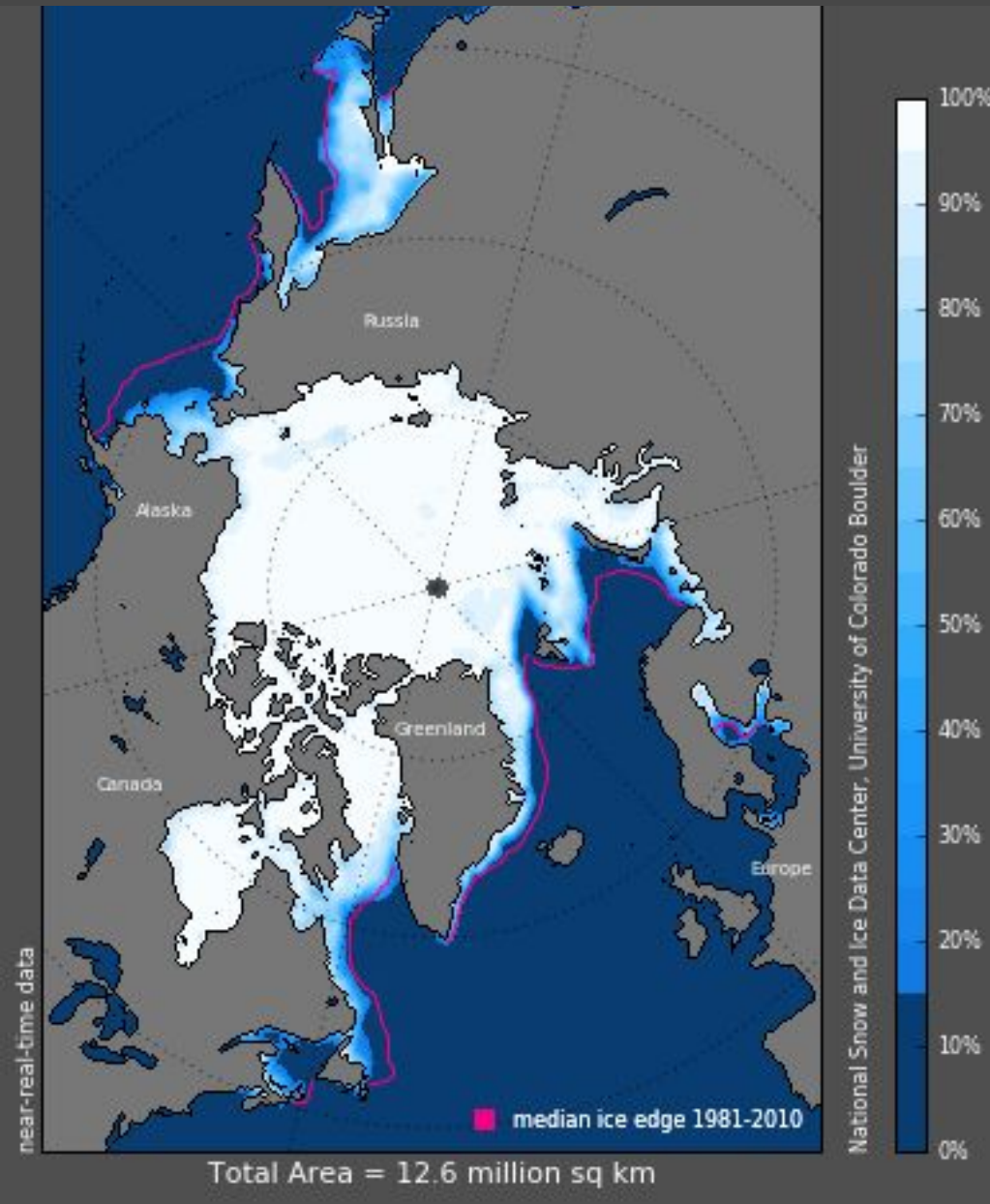
Sea Ice Concentration
National Snow and Ice Data Center



Even at its maximum extent, sea ice concentration was low.

Sea Ice Concentration Mar 2018

Sea Ice Concentration
National Snow and Ice Data Center



Even at its maximum extent, sea ice concentration was low.

Unprecedented pattern.



Sea Ice Concentration Mar 2018

Sea Ice Concentration National Snow and Ice Data Center

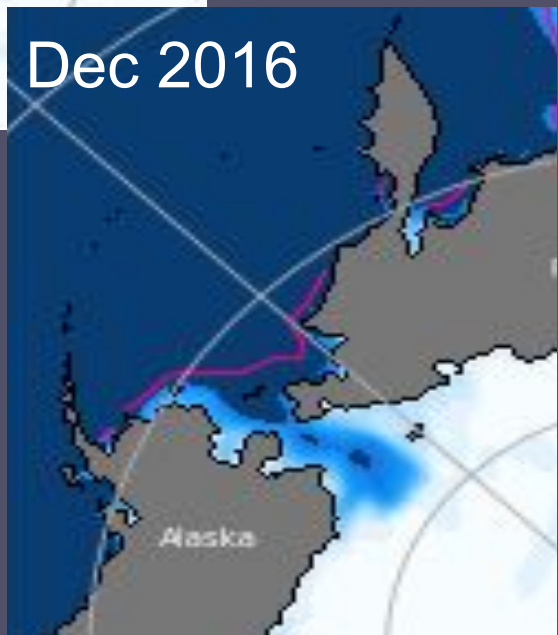
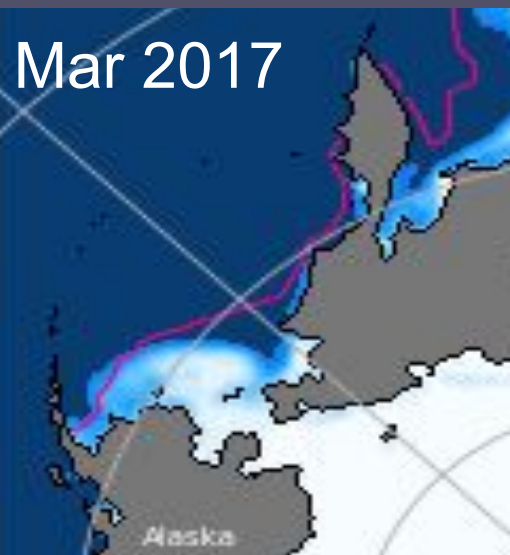
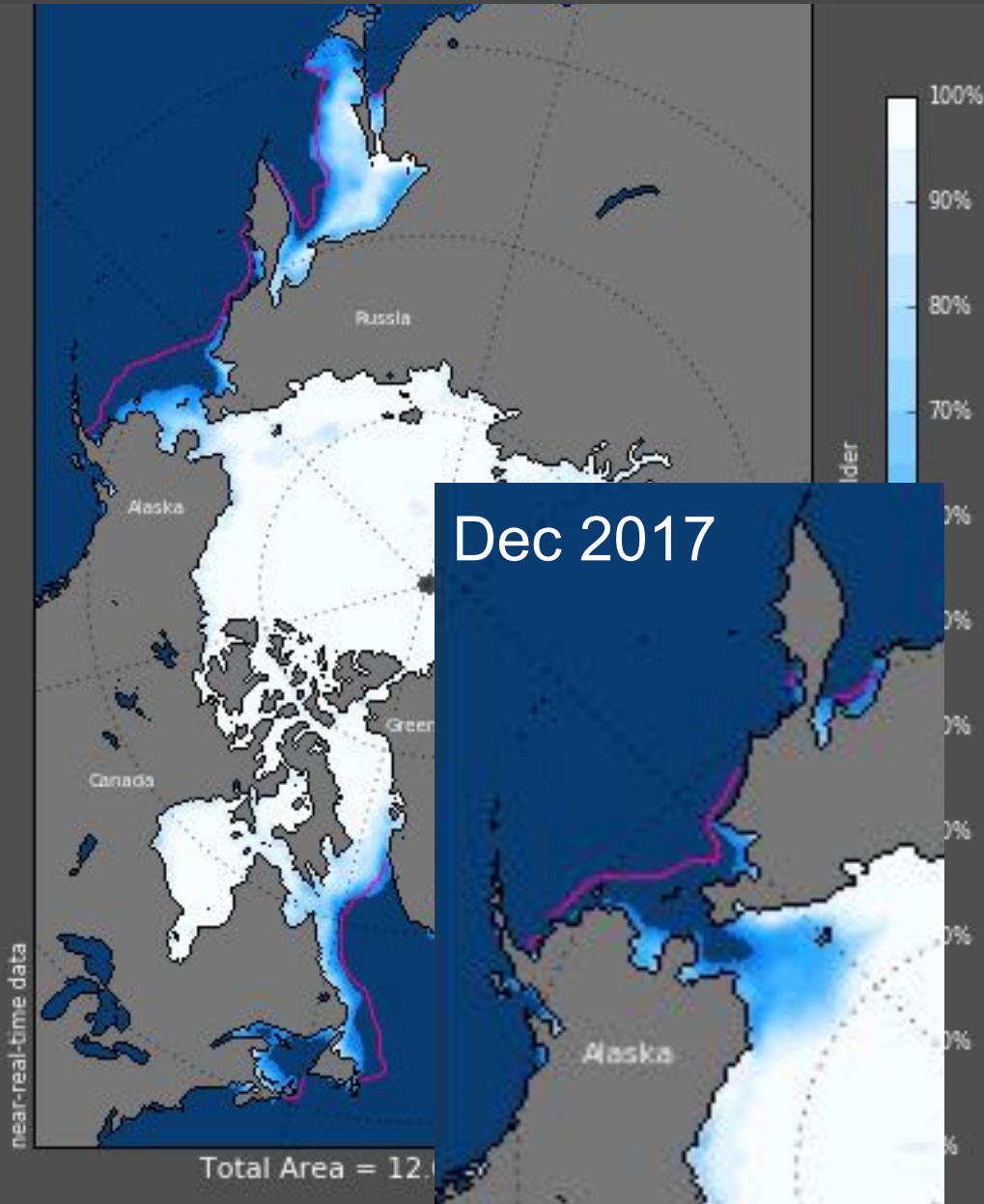


The Chukchi was late to freeze up due to residual heat.

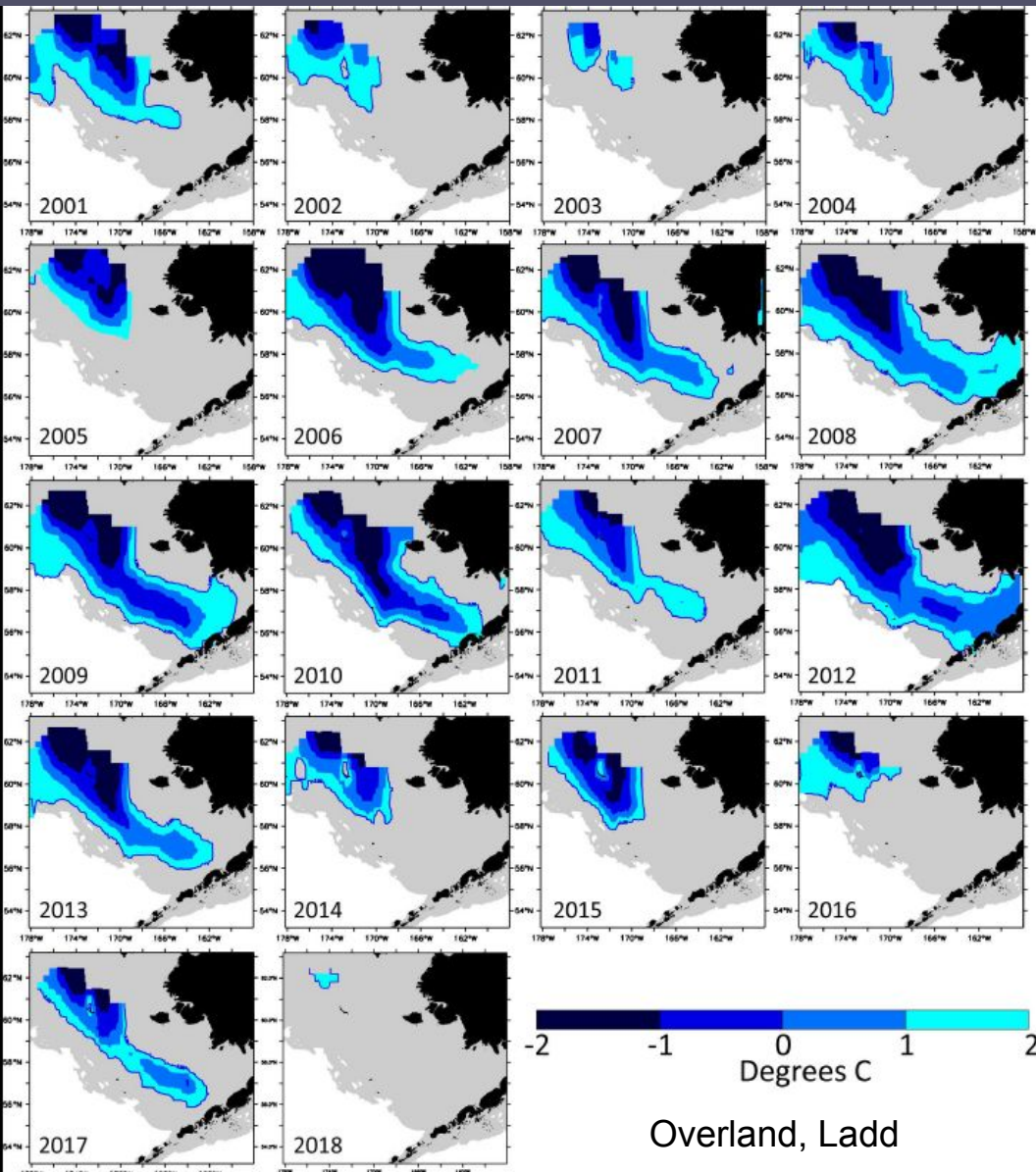
Open water in December.

Sea Ice Concentration Mar 2018

Sea Ice Concentration National Snow and Ice Data Center



Some consequences of no ice



No freshwater lens after sea ice melt.

Leads to no salinity stratification.

Water column well mixed.

No warm water “refuge” at bottom.

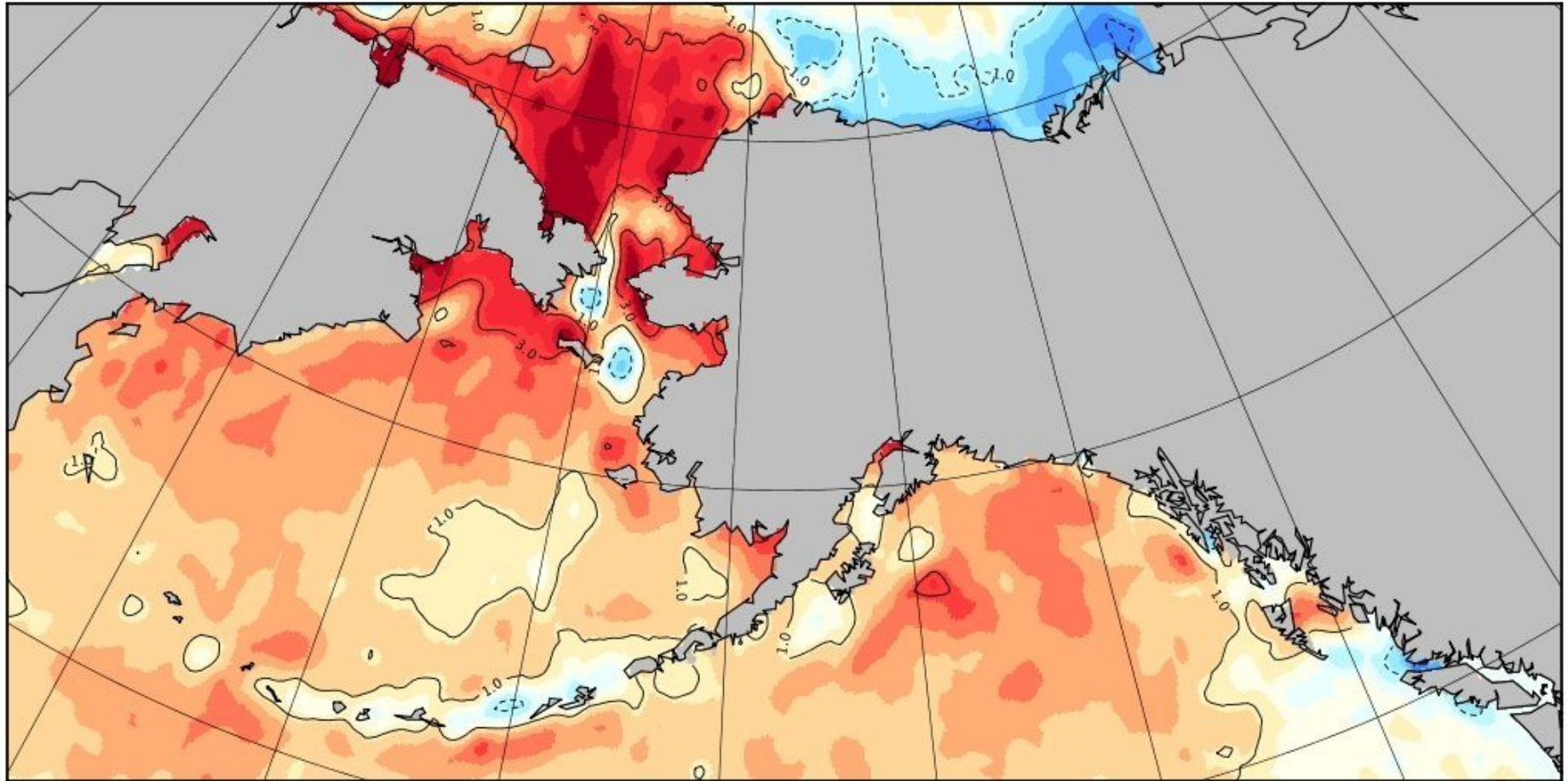
Water column will cool more rapidly.

No cold pool on SEBS shelf.

Where we are now(ish)

Sea Surface Temperature Departure from Normal

September 23-24, 2018



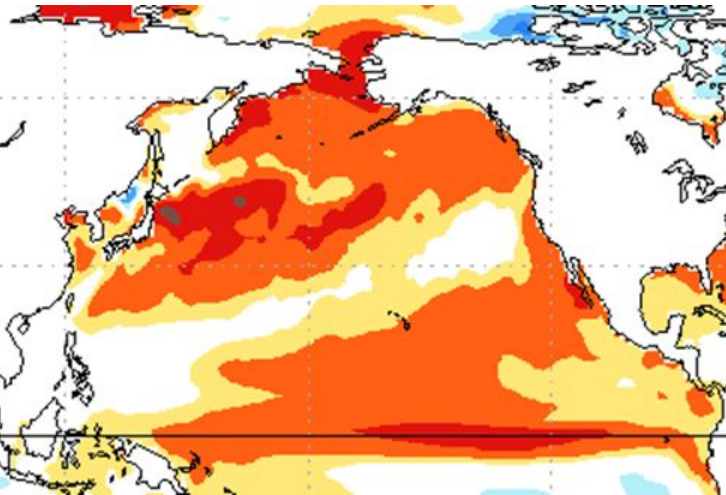
Departure from Normal (°C)



2019 Sea Surface Temperature Forecasts

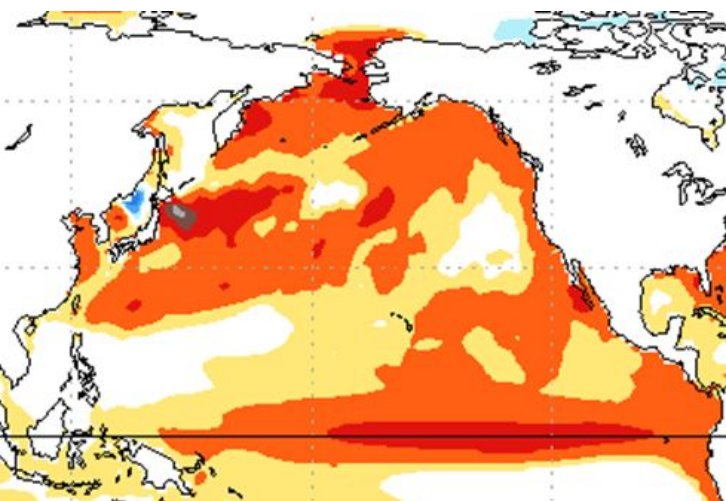
Bond

Oct - Dec 2018

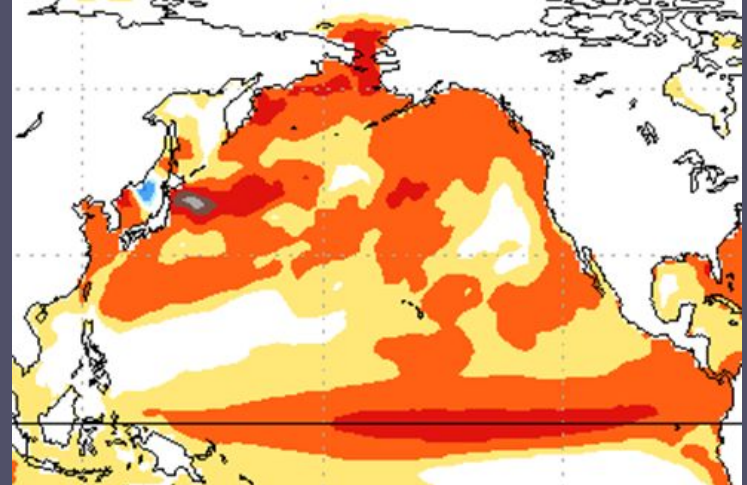


- Warm conditions across N. Pacific through December.
- Positive anomalies ($>1^{\circ}\text{C}$) greatest in NBS.
- 70% chance of El Niño.
- Aleutian low deeper than normal in late winter of 2018/19 = warm weather for Alaska enhanced by warm waters.
- No typical PDO pattern in N Pacific in early 2019 (warm everywhere).

Dec 2018 - Feb 2019



Feb - April 2019

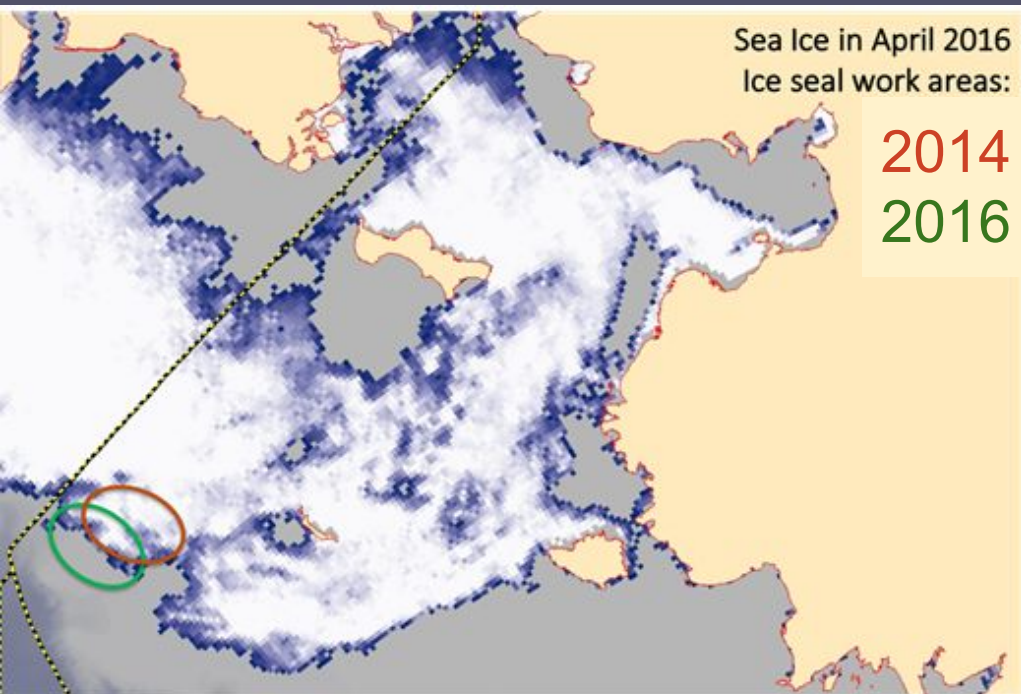


-3 -2 -1 -0.5 -0.25 0.25 0.5 1 2 3

How has the ecosystem responded?

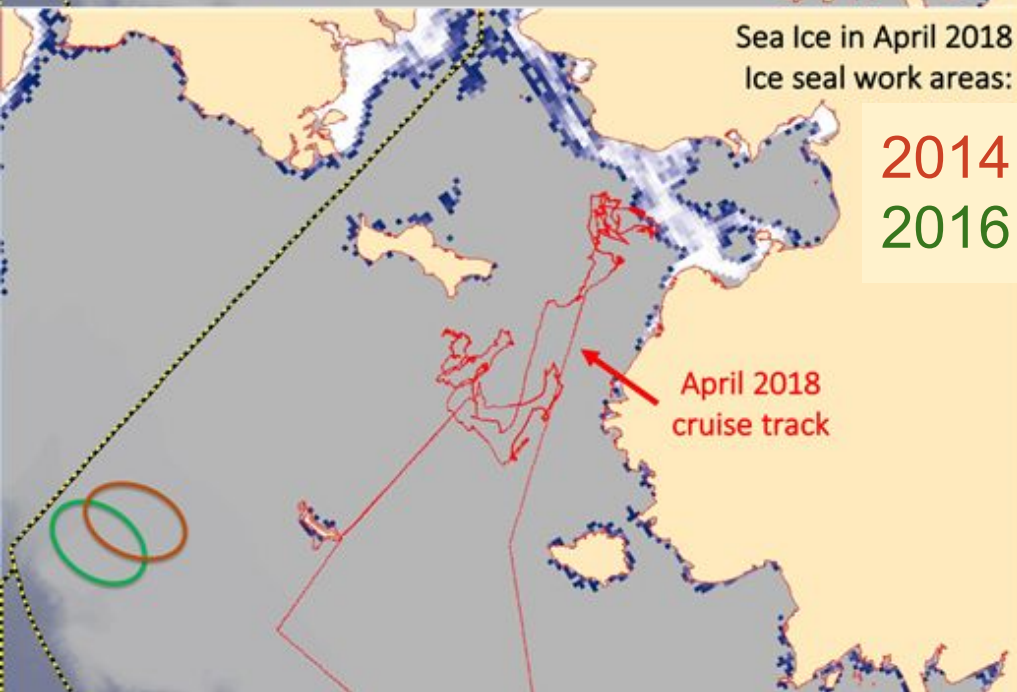
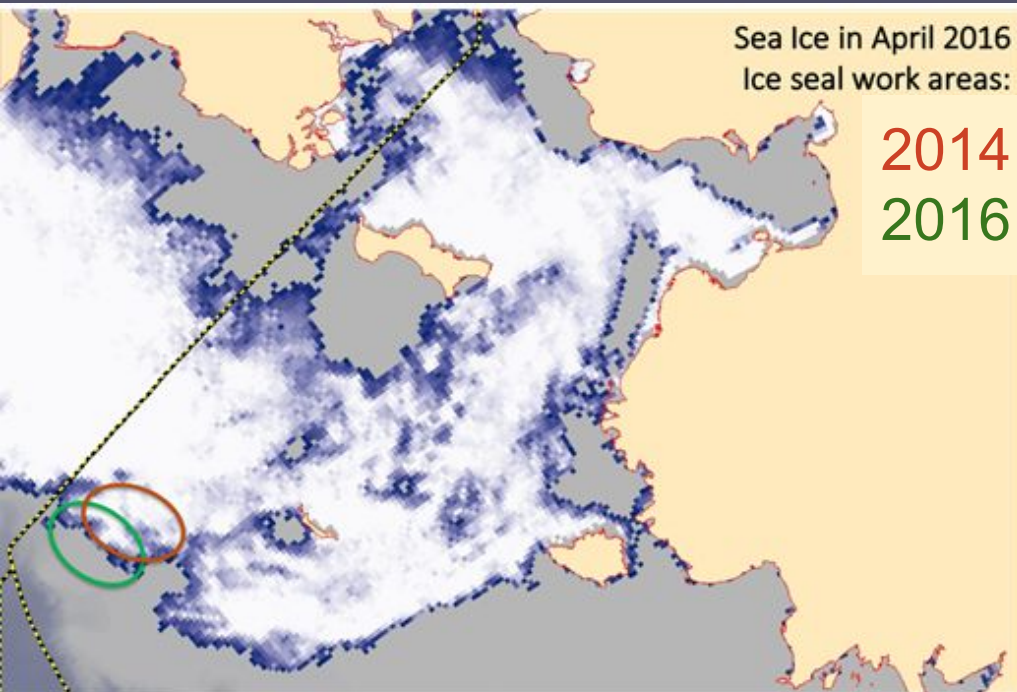
Marine Mammals

Boveng, Sheffield



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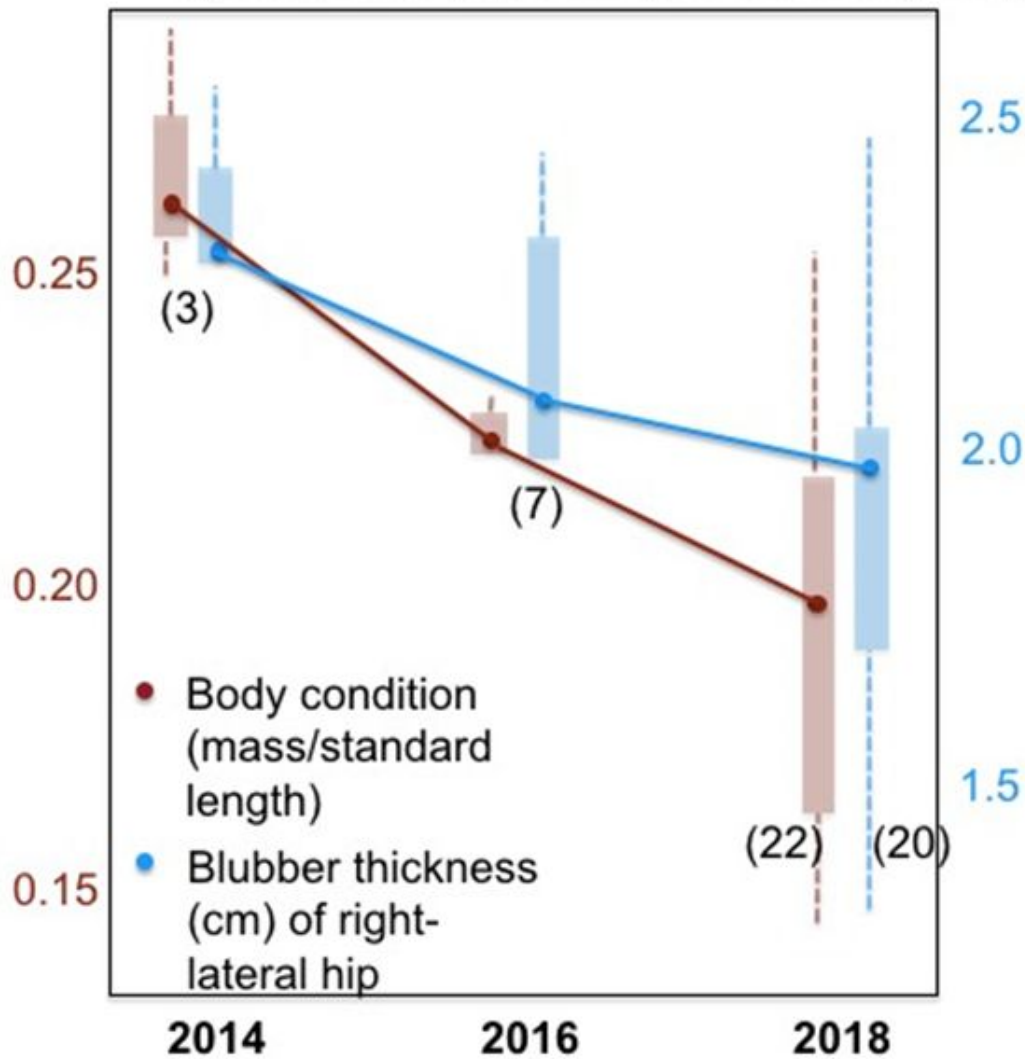
Ice seals scarce.

Pupping areas on ice were displaced north.

Seal strandings reported at Wales and St Lawrence.

In July, exceptionally large numbers of humpbacks north of St. Lawrence.

Spotted seal pups in April and early-May



Preliminary data *suggest* spotted seal pups had poor body condition relative to earlier years.

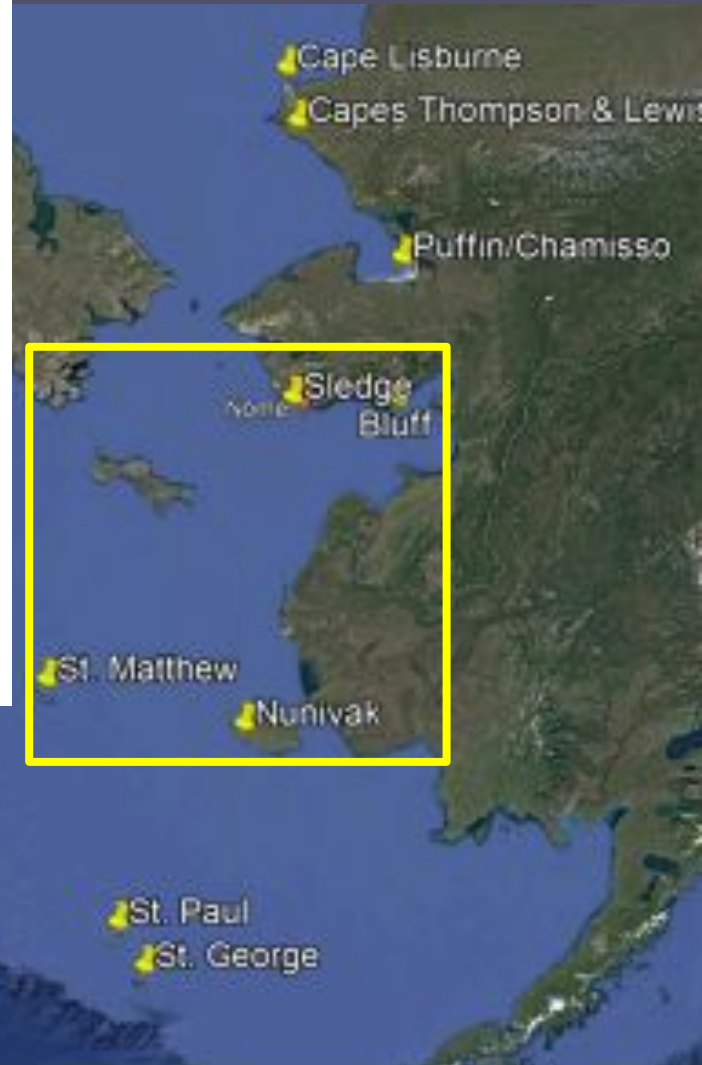
Poor seabird reproduction at colonies

Renner (USFWS), Sheffield

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

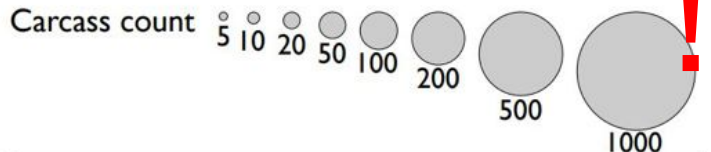
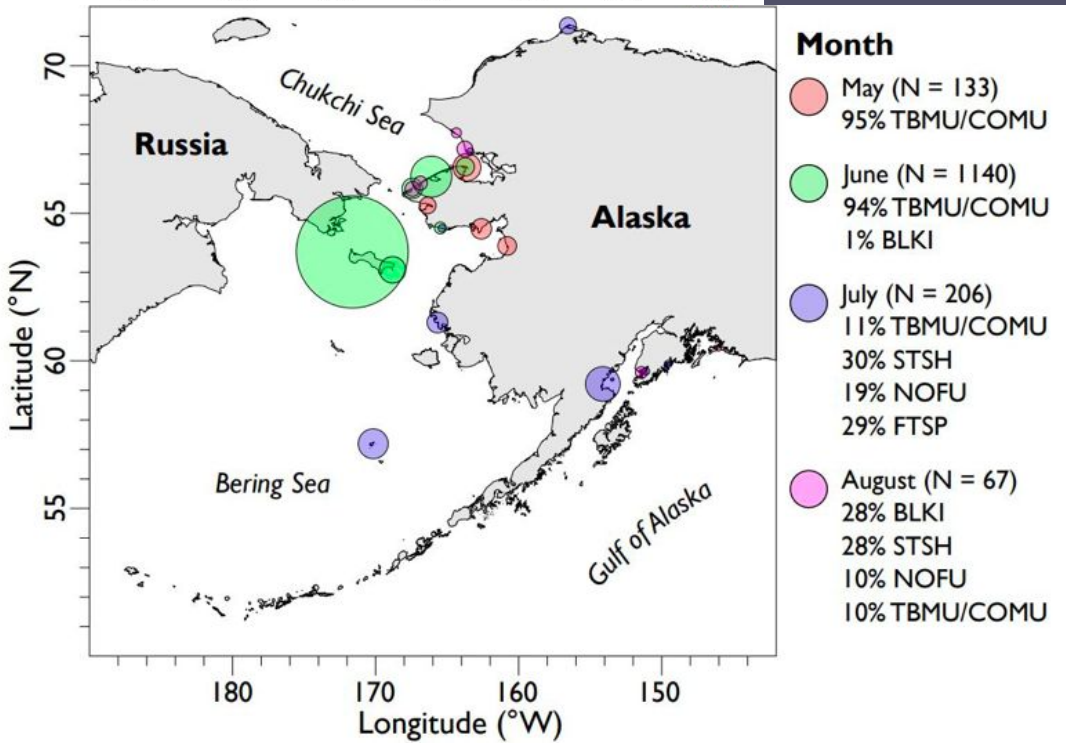
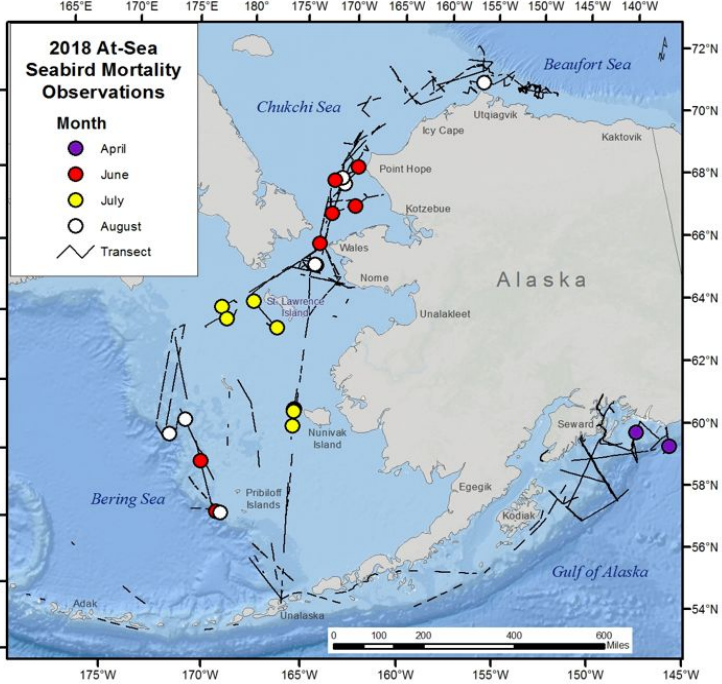


Exceptional murre breeding failure noted by communities and biologists.

Dead seabirds at sea and on the coast

Kuletz, Labunski, Kaler (USFWS)
 Parrish, Jones, Burgess (COASST)
 Sheffield (UA-Nome)
 Ahmasuk (Kawerak, Inc.)
 Schoen (USGS)

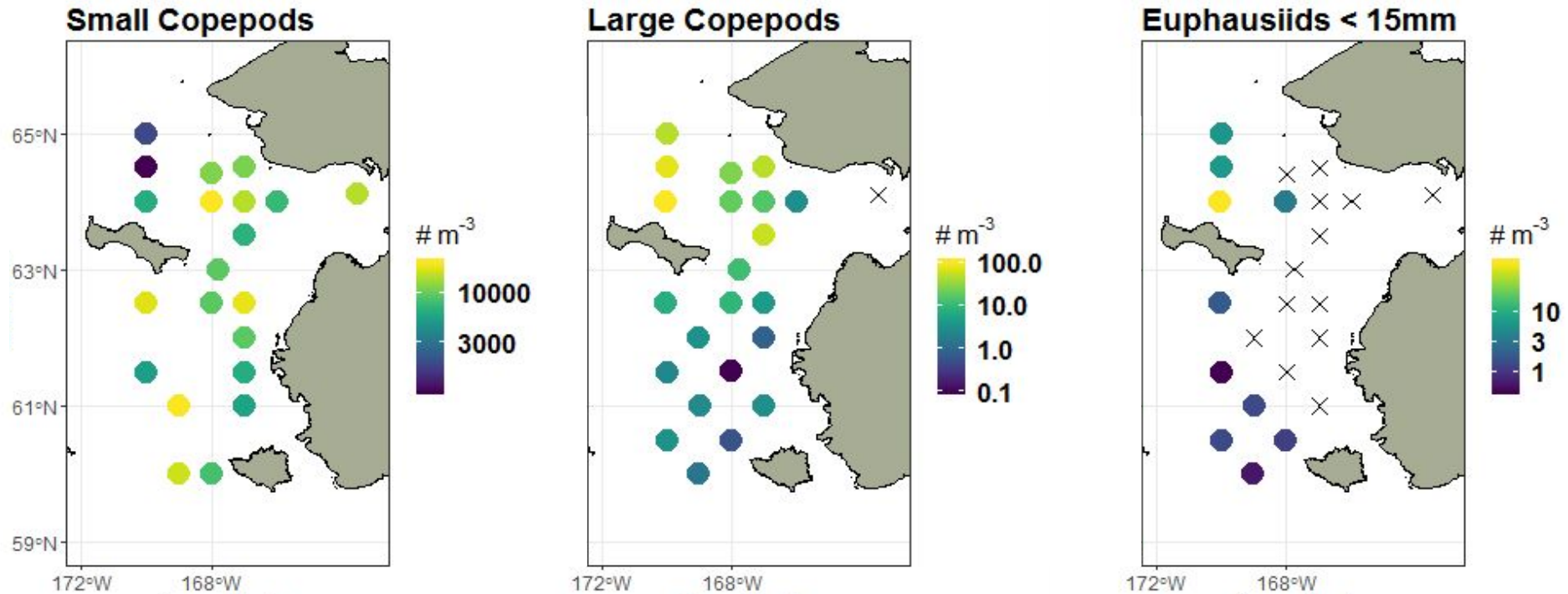
- Widespread die-offs; unprecedented at some locations.
- Starvation only identified cause of death (to date).
- Die-offs due to lack of food or unfavorable foraging conditions.



Rapid Zooplankton Assessment

2018 NBS

Logerwell, Lamb, Ferm



First year of RZA on NBS surface trawl survey (no historical context).

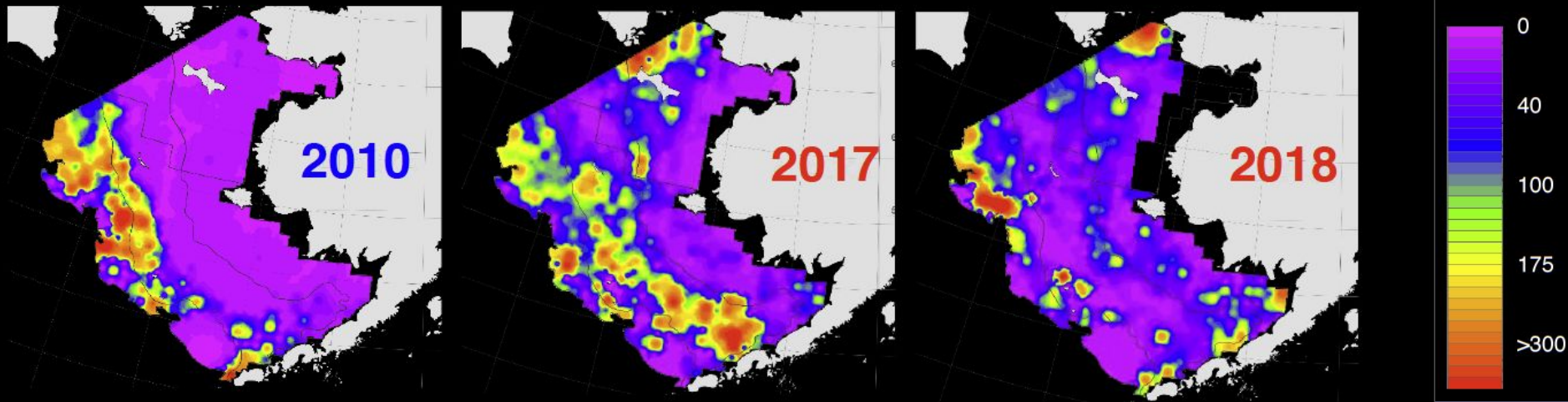
Small copepods prevalent in NBS, except at NW stations.

Large copepods and euphausiids increased from south to north, but were low overall.

Large copepods were mostly *Eucalanus bungii*; large, but NOT lipid-rich.

Groundfish in the NBS

Walleye pollock distribution

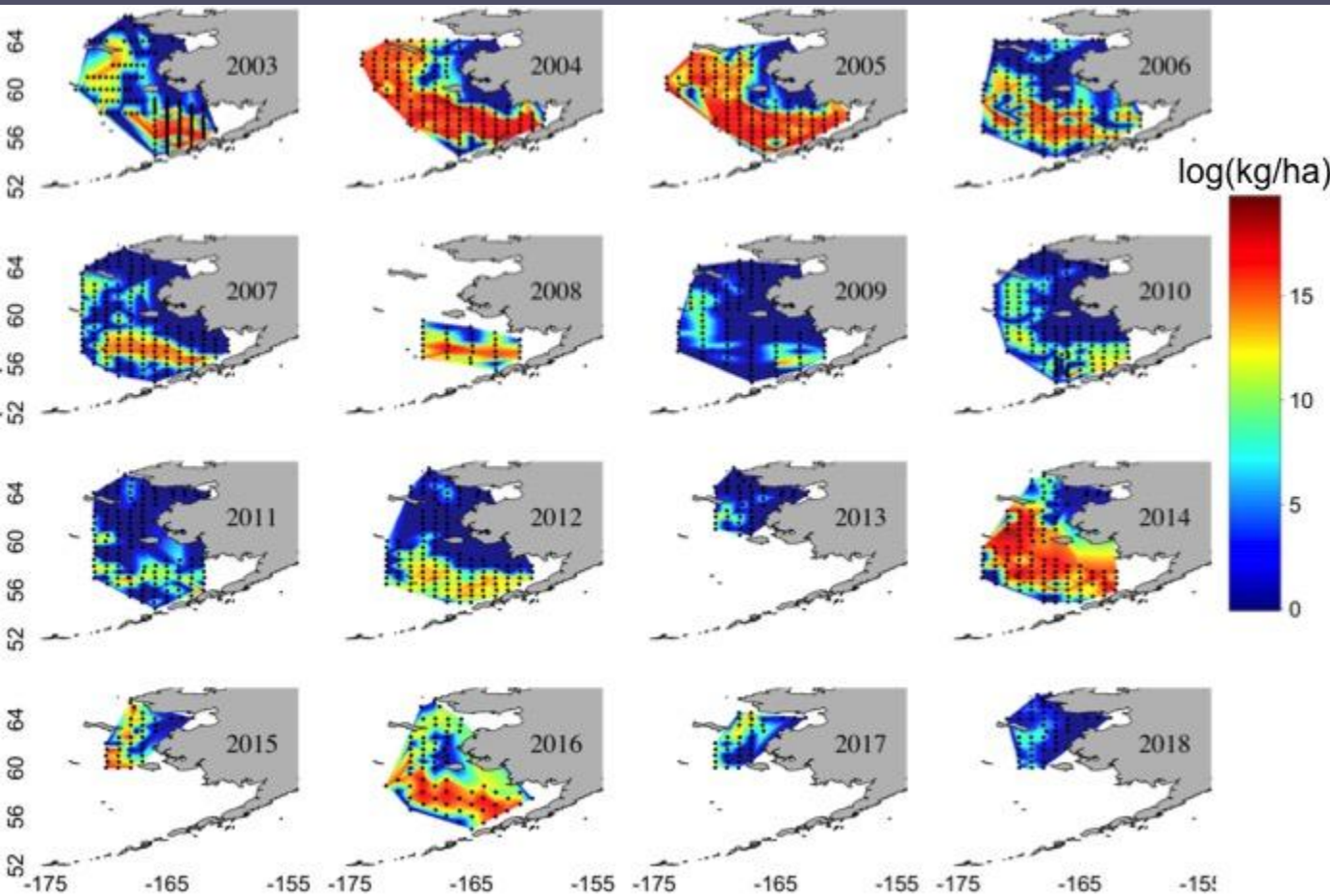


Abundance increased, but biomass decreased in NBS.

Groundfish

Farley, Cieciel, Murphy (NBS)

Andrews, Siddon (SEBS)



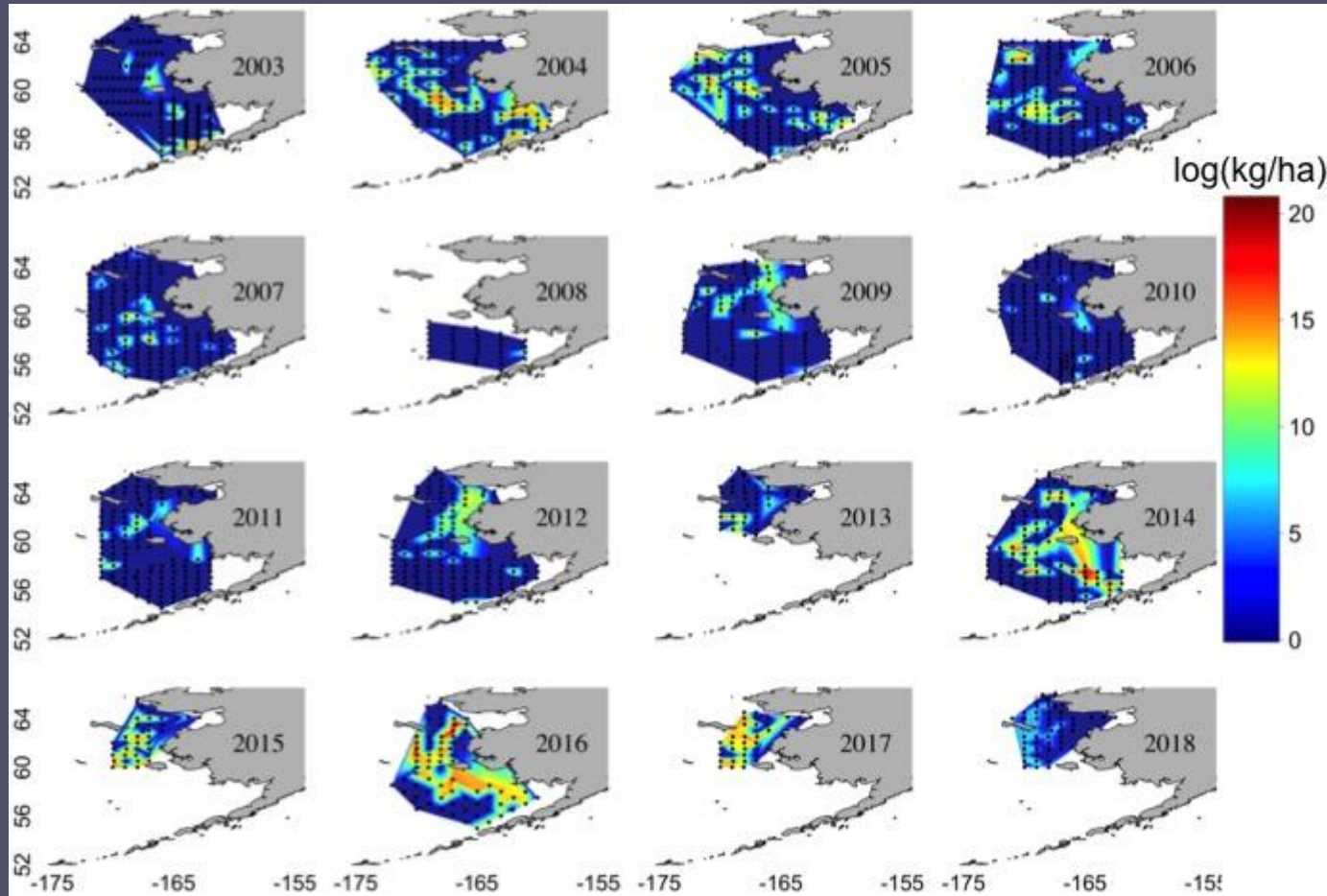
Age-0 pollock in NBS not unusual, especially in warm years.

Biomass decreased from 2017 to 2018.

Groundfish

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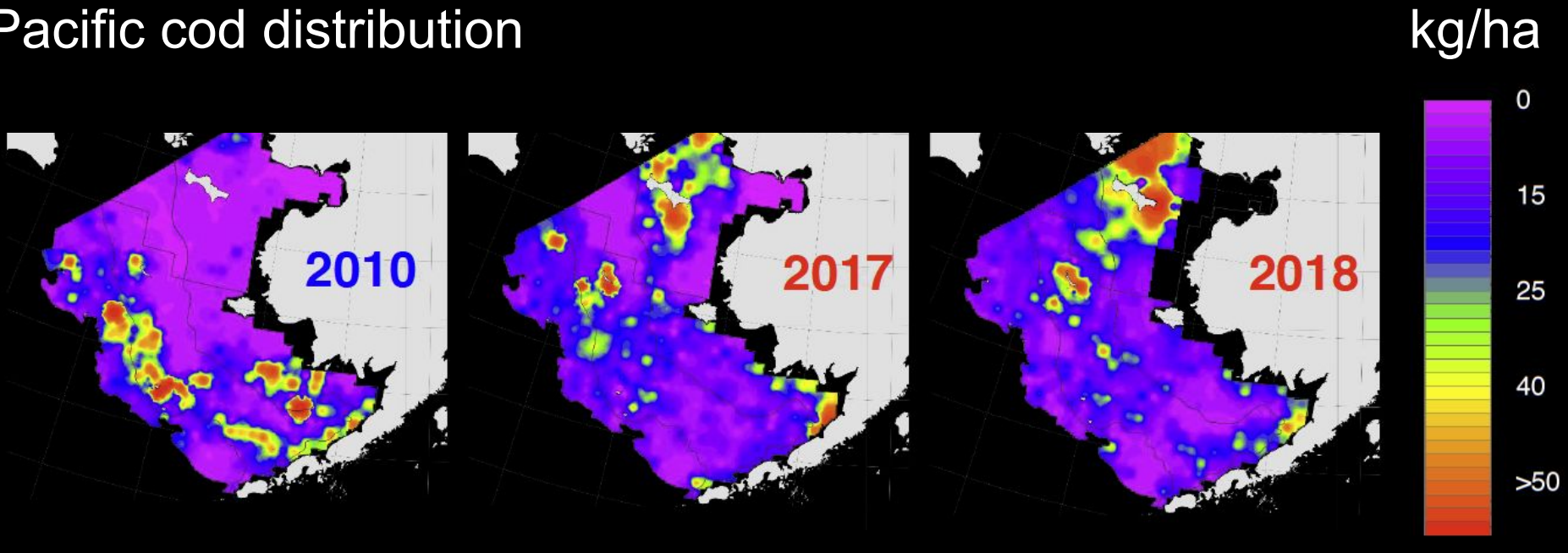
Andrews, Siddon (SEBS)



Age-1+ pollock in NBS not unusual, especially in warm years.

Biomass decreased from 2017 to 2018.

Pacific cod distribution

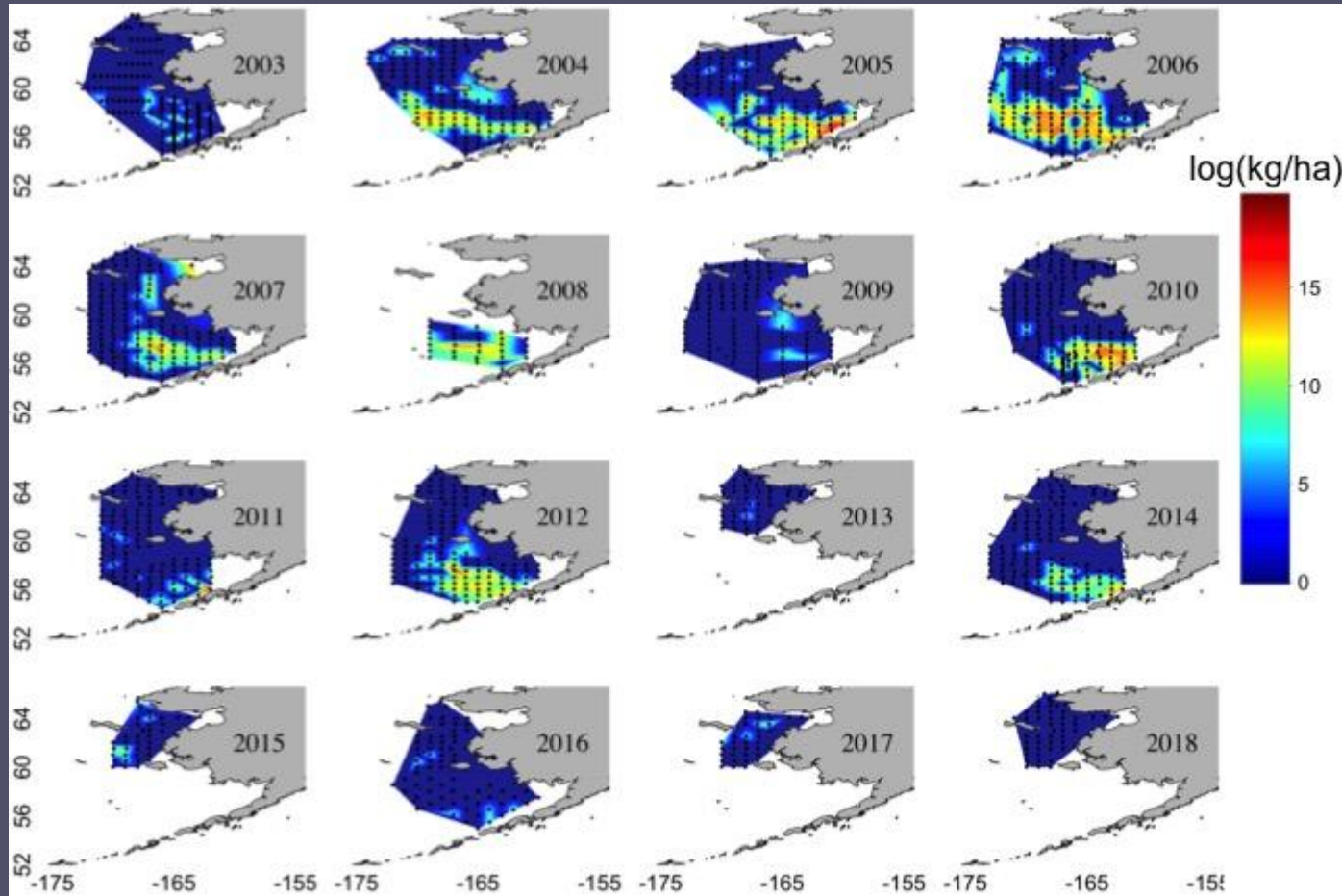


Abundance and biomass increased from 2017 to 2018 in NBS.

Groundfish

Farley, Cieciel, Murphy (NBS)

Andrews, Siddon (SEBS)



Age-0 P. cod biomass in NBS typically low.

Years of higher biomass in SEBS do not correspond to warm/cold years.

Preliminary observations of groundfish diets from BT survey:

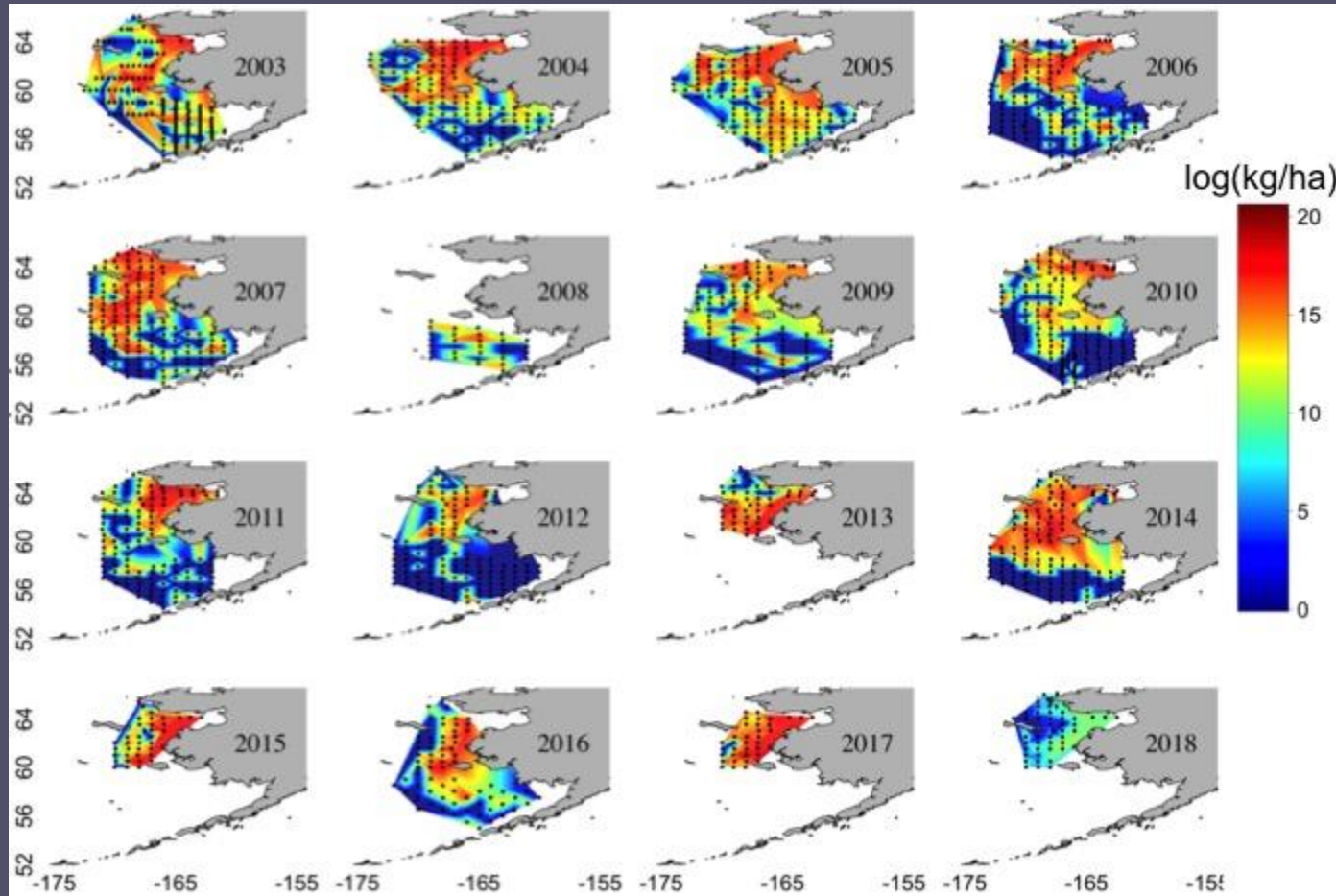


- Pollock
 - Ate mostly non-pandalid shrimps and polychaetes.
 - Similar to diets in inner domain and Bristol Bay.
- Cod
 - Ate mostly *Opilio*; polychaetes at limited stations.
 - Not unusual compared to other years.

Groundfish

Farley, Cieciel, Murphy (NBS)

Andrews, Siddon (SEBS)



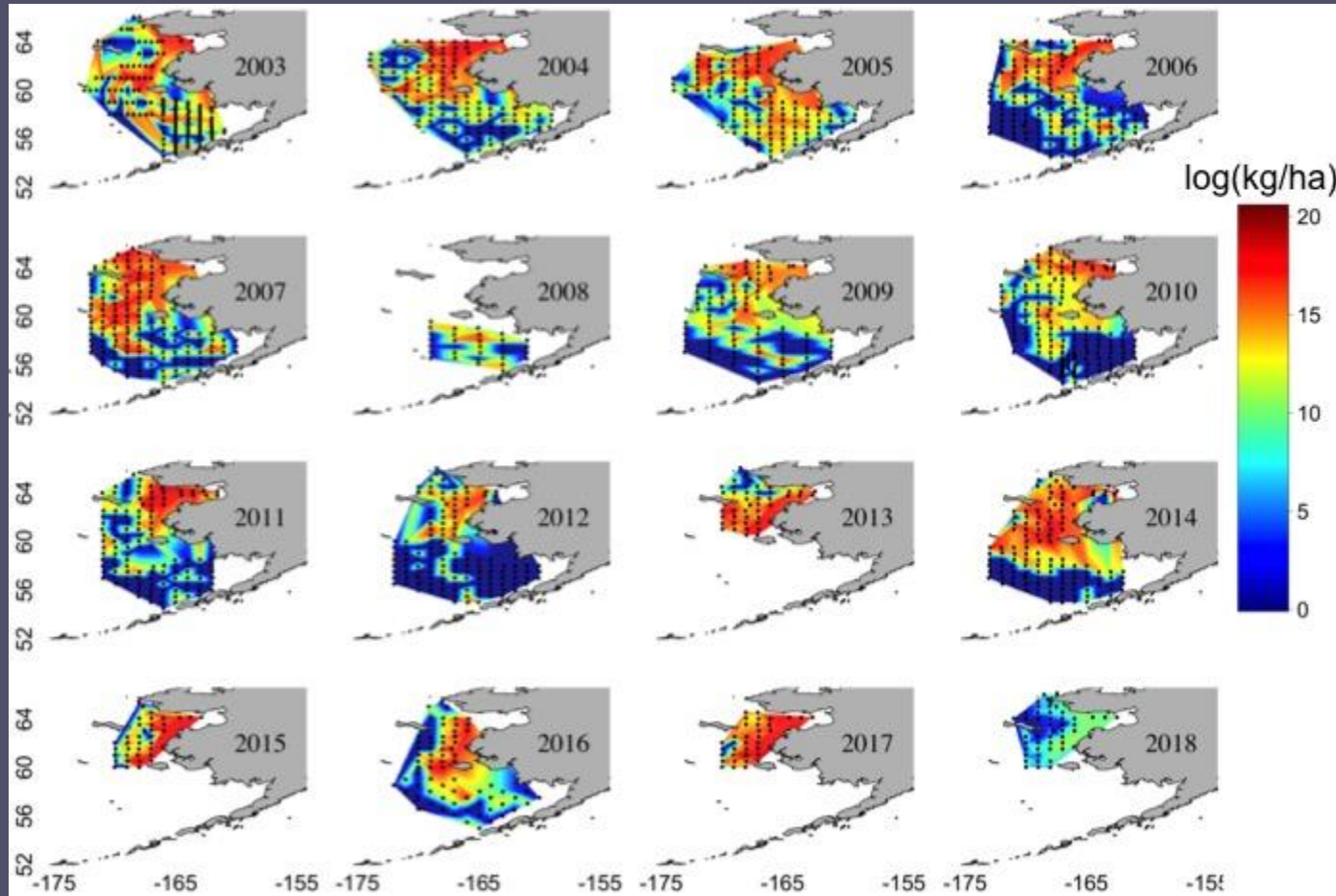
Herring biomass consistently high in NBS.

2018 biomass lowest of the time series for NBS.

Groundfish

Farley, Cieciel, Murphy (NBS)

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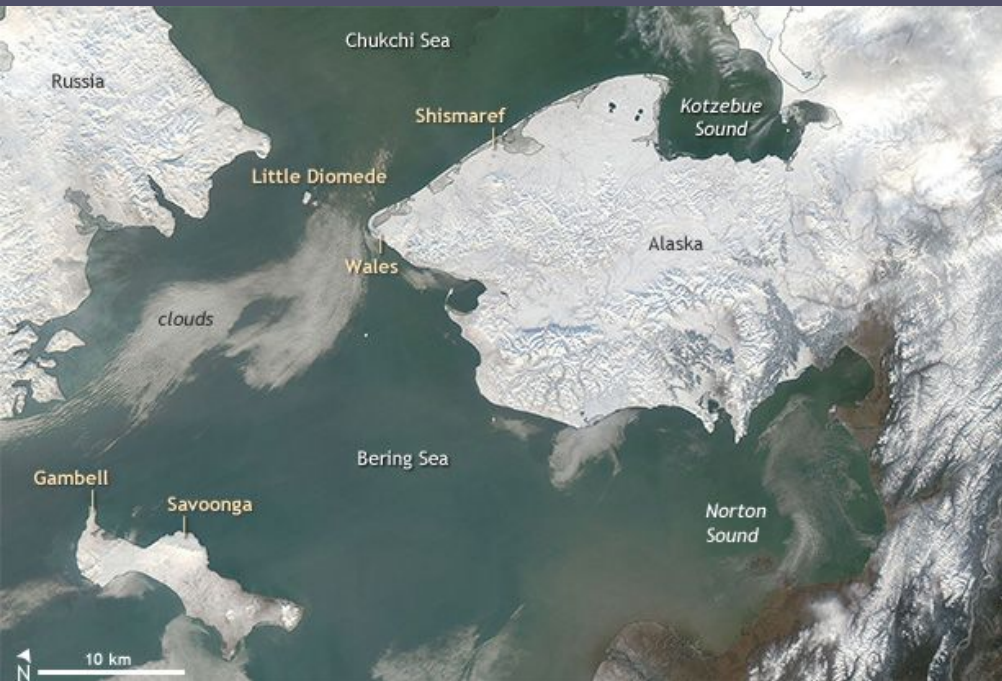


Implications for the future

Implications

Environment

- A similar lack of freeze up in the NBS is unlikely.
- Although a low ice year (ice to St Matthews) is possible.
- Cooling of the water column likely to be quick due to lack of salinity stratification.



Groundfish

- Swim south before freeze up, or
- Stay
 - Trapped?
 - Sufficient prey?
 - New balance for food web?



Summary and Preliminary Conclusions

1. The little to no sea ice last winter was unprecedented
2. A combination of residual heat and very unusual weather led to the unexpected lack of freeze up
3. Adult and juvenile pollock and cod were present in the NBS (again)
4. It is unknown whether they remained in the north last winter
5. Birds in the NBS ecosystem had exceptional breeding failures and unprecedented die-offs
6. Marine mammals had unusual distributions, die-offs, and poor body condition
7. Ecosystem status suggests poor productivity and lack of sufficient prey base in 2018

A full assessment of the NBS ecosystem will be presented in December