ECOSYSTEM CONSIDERATIONS

For Eastern Bering Sea Crab

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NPFMC Crab Plan Team
September 10, 2018

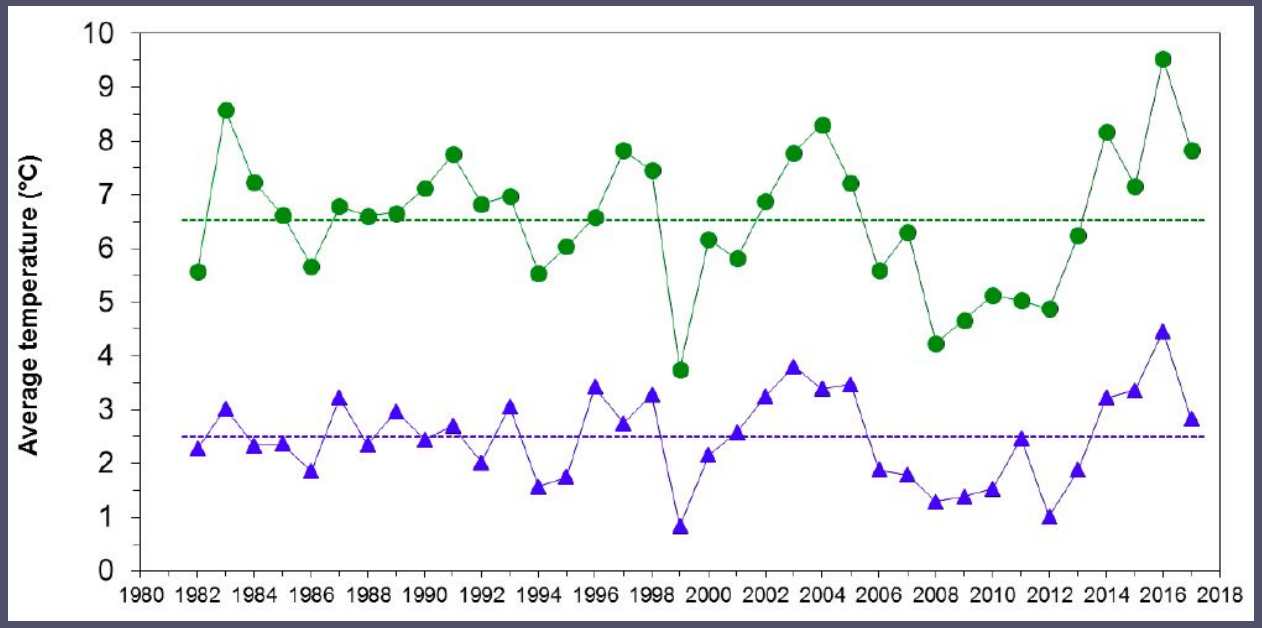
Outline

1. 2017 crab-relevant biological information (review)
2. 2018 climate and oceanography
3. 2019 sea surface temperature forecasts

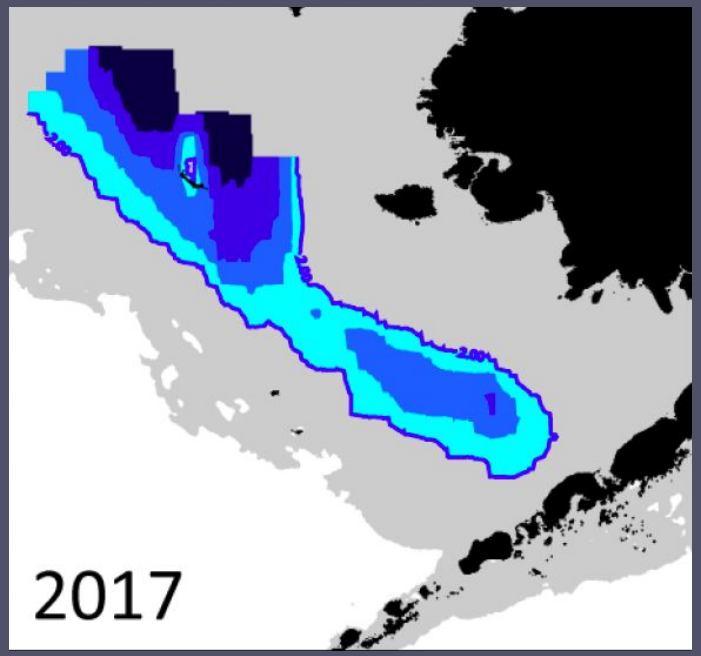
2017 Biological observations

2017 EBS climate

Lauth, Overland et al.

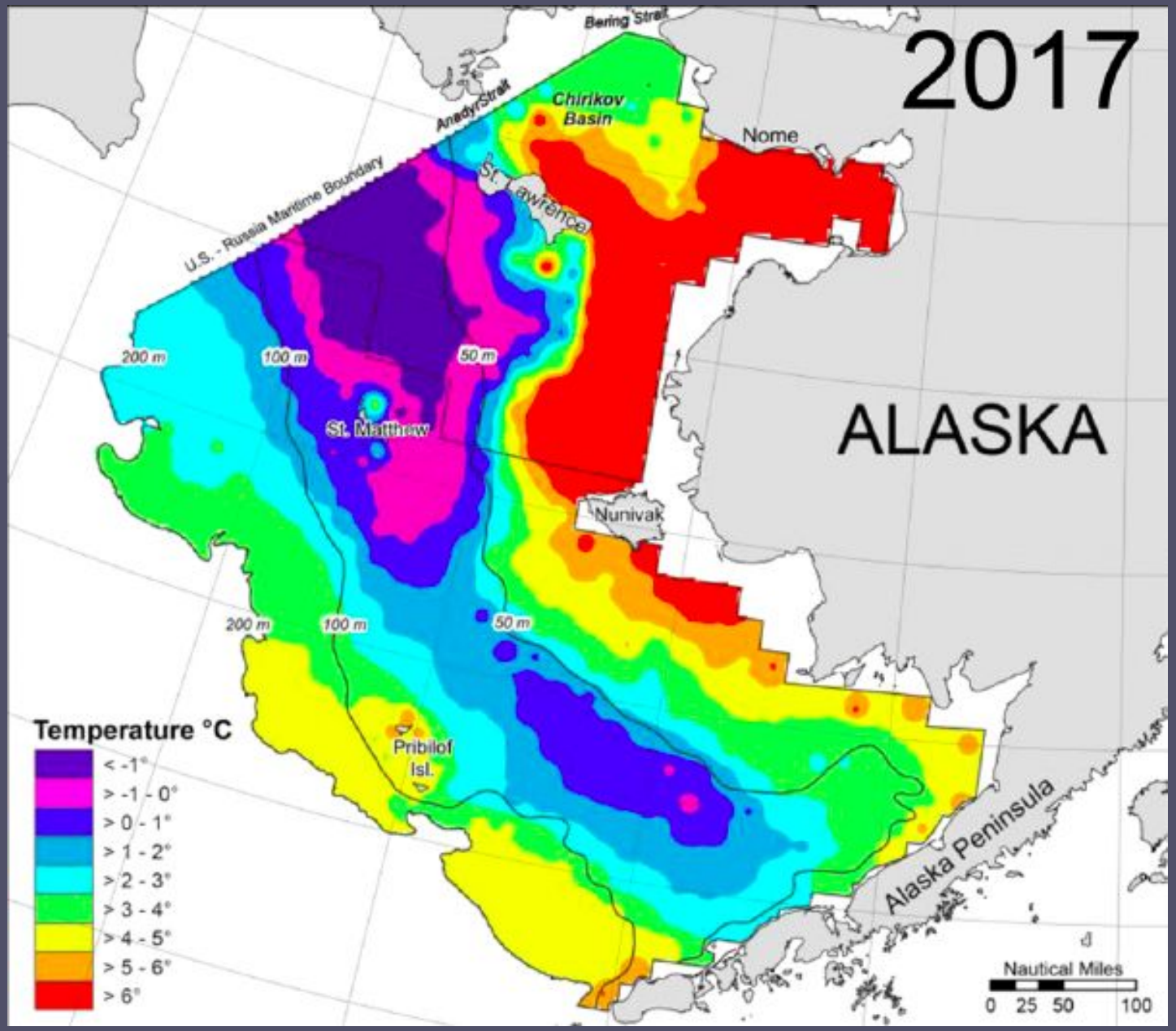


- Residual heat maintained above-average water temperatures (surface and bottom).
- Sea ice extended over much of the southern shelf.
- Larger, although narrow, cold pool.



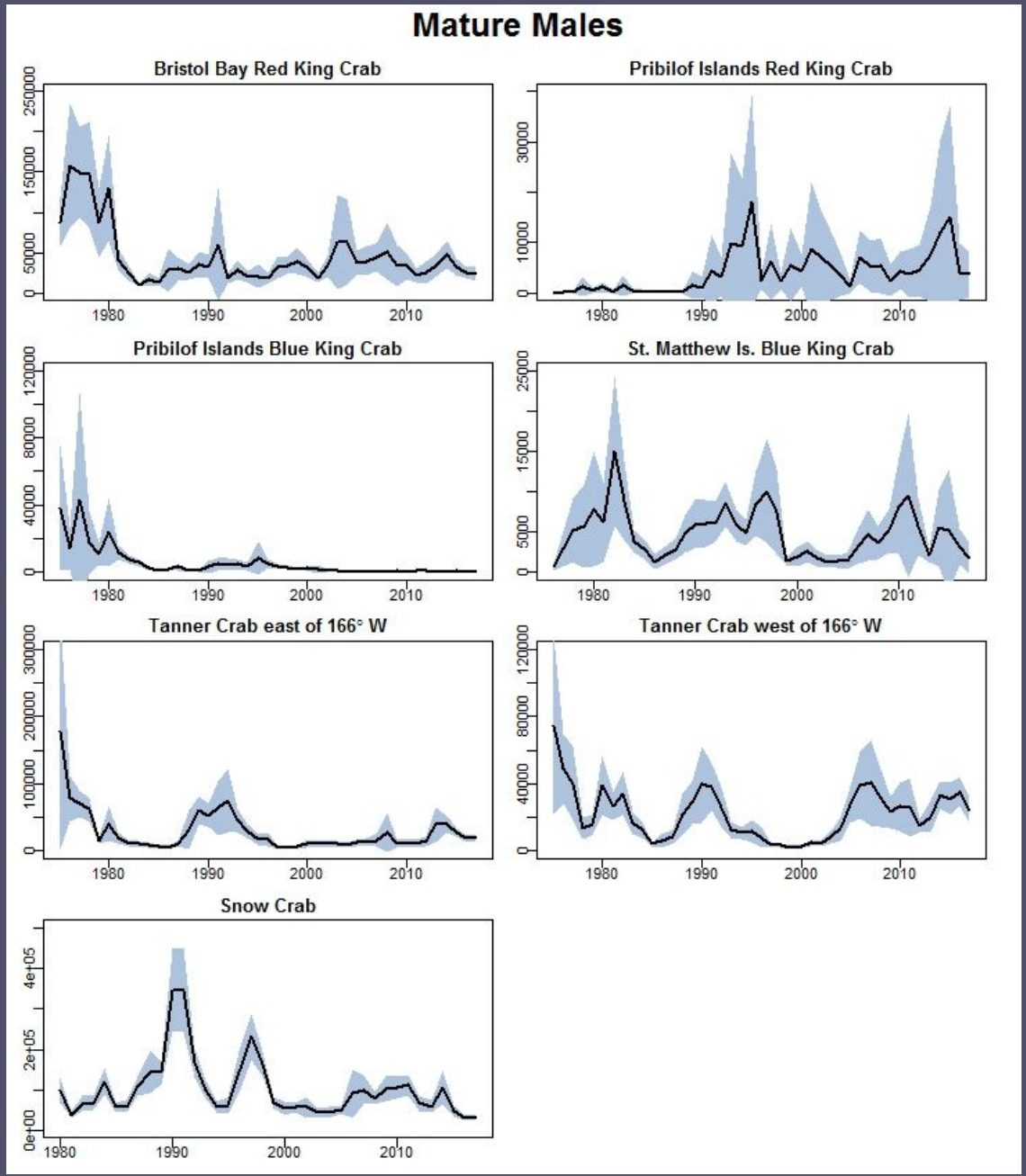
EBS climate

Lauth



Commercial crab biomass

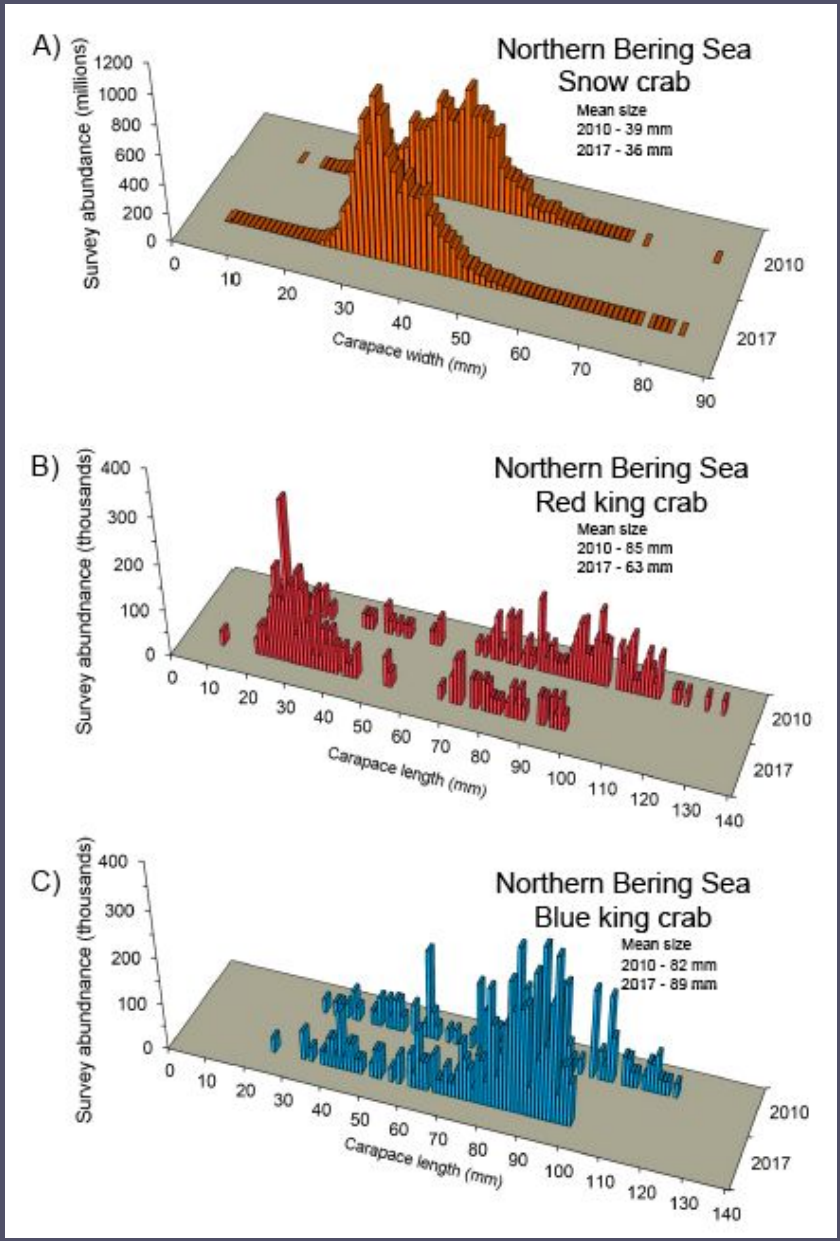
Foy et al.



- Biomass trends are highly variable; trends were negative in 2017.
- Interannual variability of benthic predators.
- Seasonal variability of pelagic prey resources (larval stages of crab).

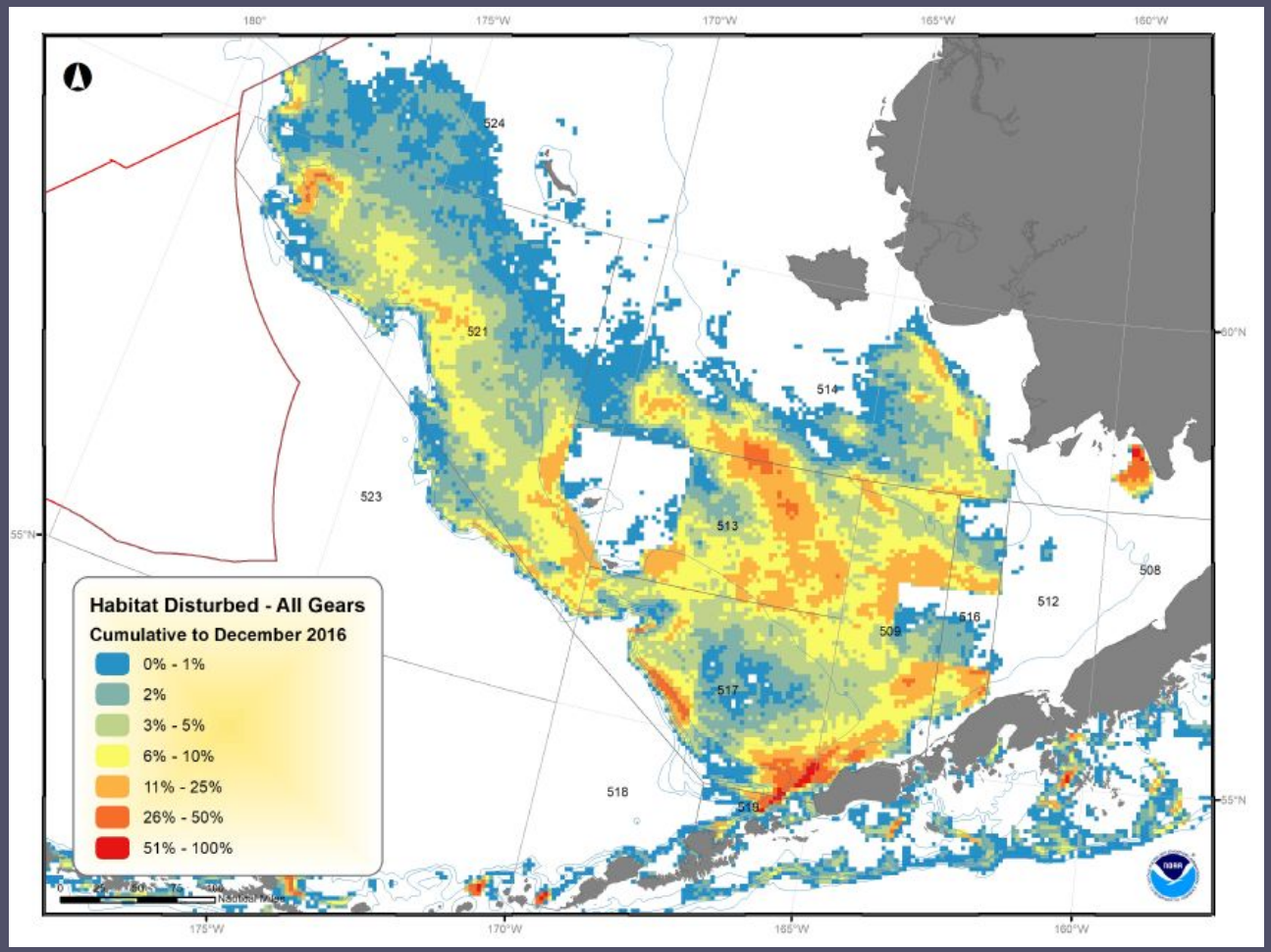
2017 NBS survey
Lauth

- Snow crab and RKC abundance increased. Biomass for both crabs decreased because of lower mean sizes.
- Snow crab were concentrated along the 50 m isobath and the southwest corner of St. Lawrence Island in the same location where Pacific cod were abundant.
- BKC increased abundance and biomass while the mean size decreased.

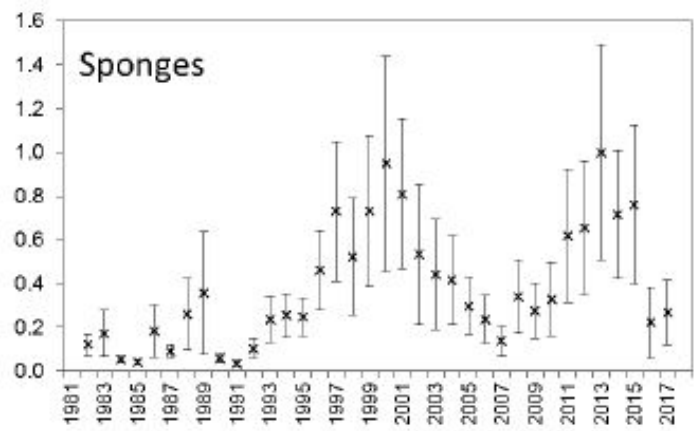


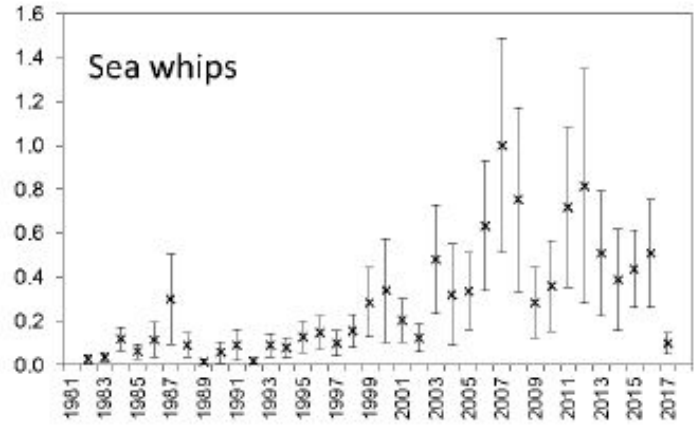
(2016) Fishing impacts

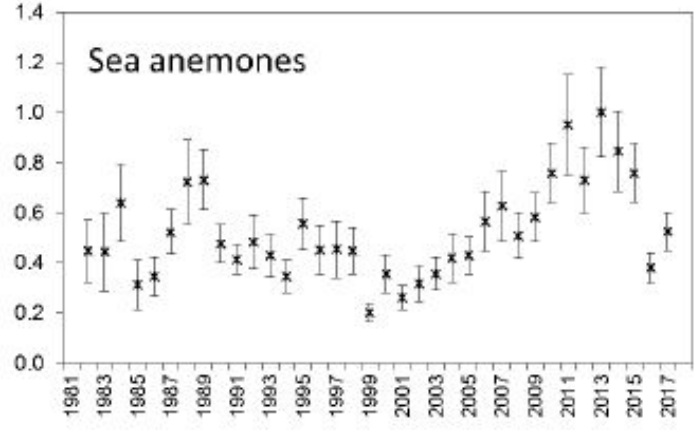
Olson



- Based on Fishing Effects model
- Effects are cumulative
- All gear types
- Considers impacts and recovery







Structural epifauna

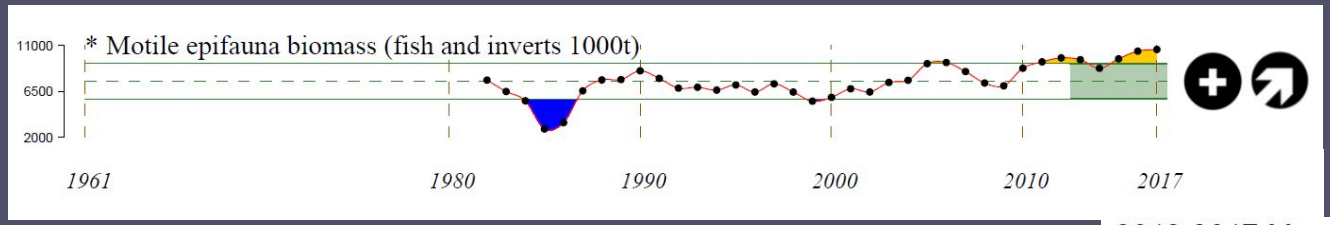
Lauth and Hoff

- Sponges and sea anemones similar to 2016, but lower than recent 7 years.

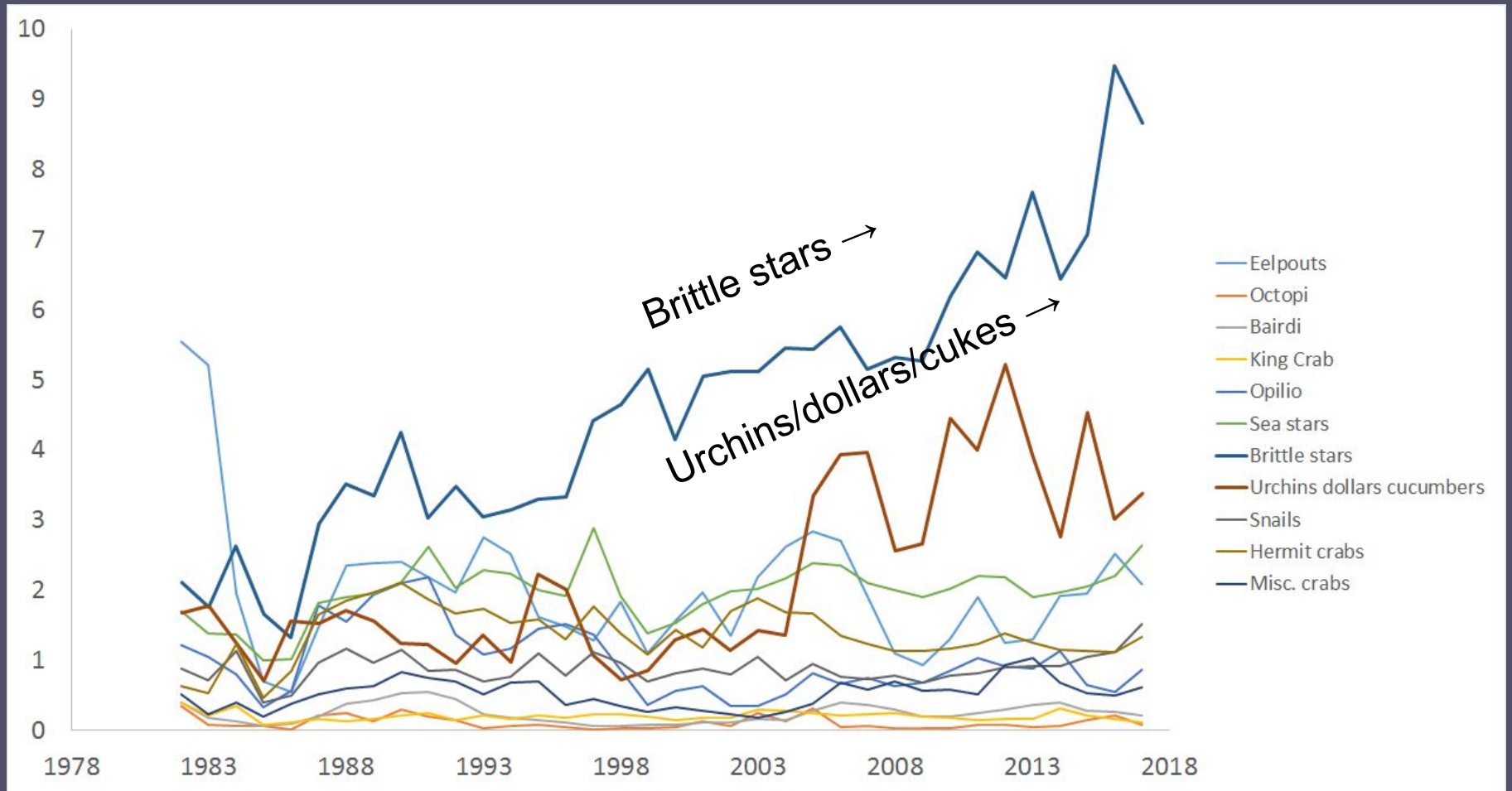
- Sea whips decreased significantly from 2016.

- Indicator of seafloor habitat condition.

Motile epifauna

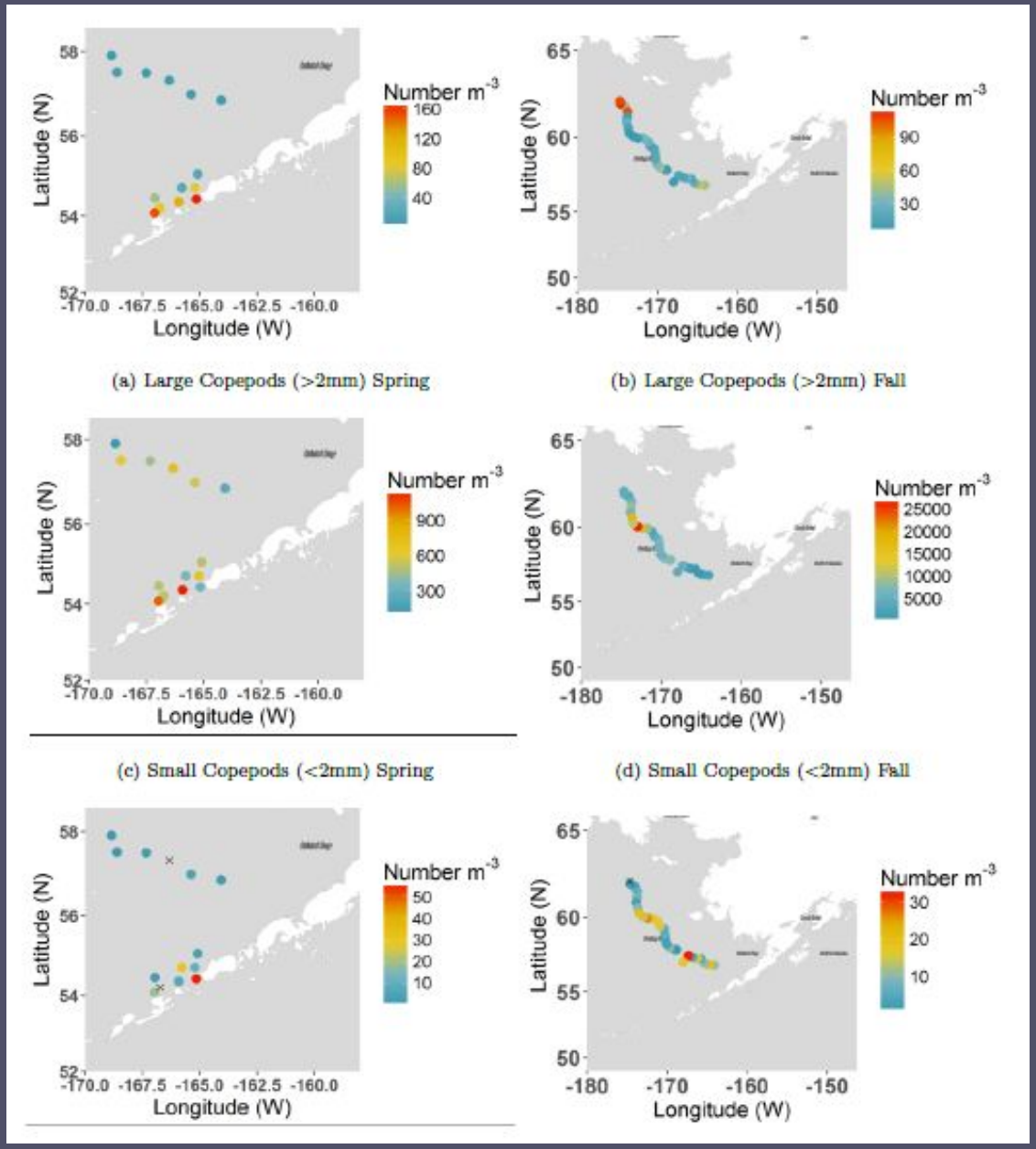


2013-2017 Mean		2013-2017 Trend	
⊕	1 s.d. above mean	↗	increase by 1 s.d. over time window
⊖	1 s.d. below mean	↘	decrease by 1 s.d. over time window
•	within 1 s.d. of mean	↔	change <1 s.d. over window
X	fewer than 2 data points	X	fewer than 3 data points



Zooplankton

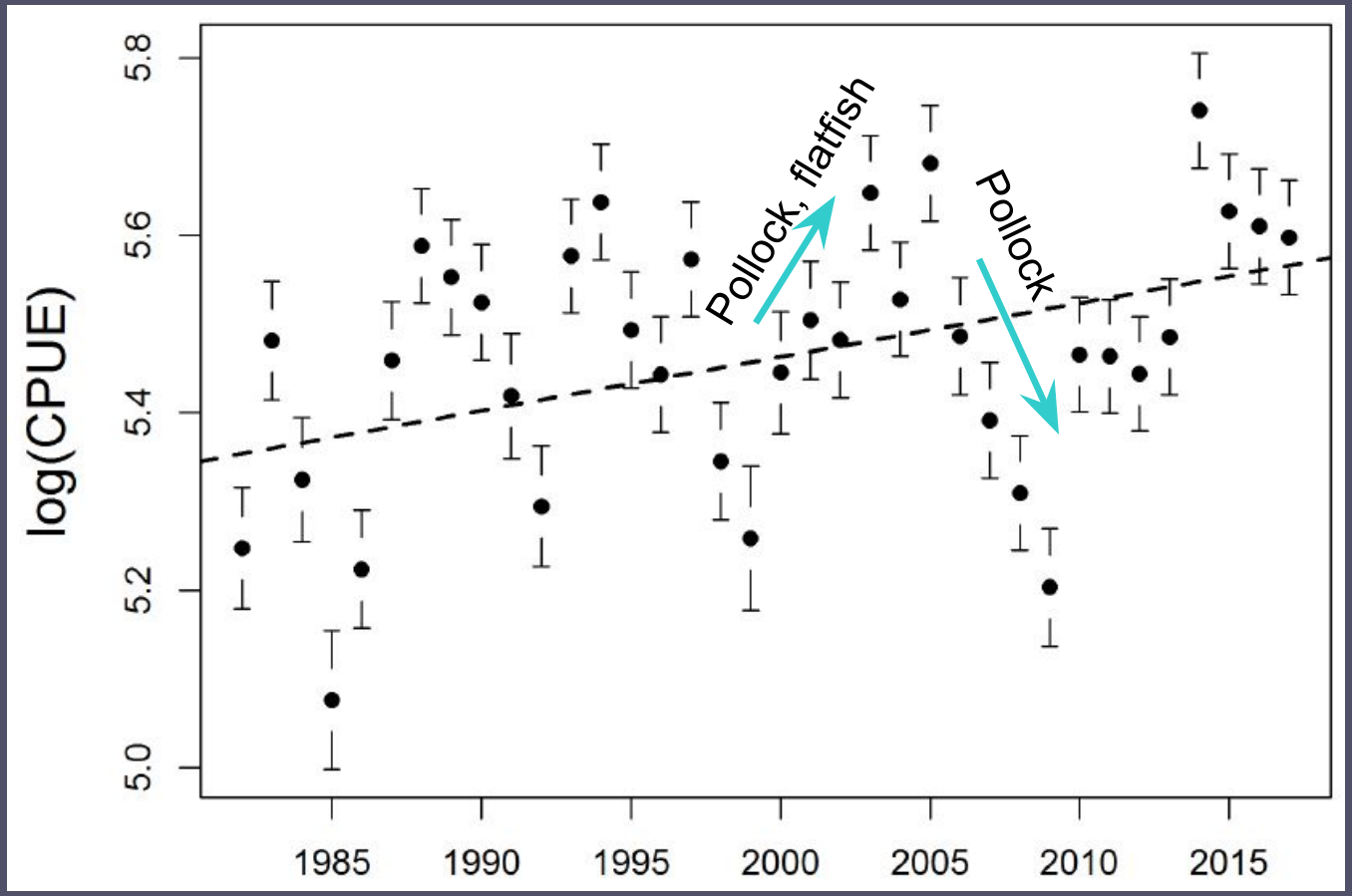
Harpold & Kimmel



- Large copepod abundance low and decreased from spring → fall
- Small copepods more prevalent and increased spring → fall
- Copepod abundances were below 2016
- Euphausiid abundance low; comparable to 2016
- Increased productivity in the north, especially near St. Matthews Island

Aggregated CPUE of fish and invertebrates in bottom trawl surveys

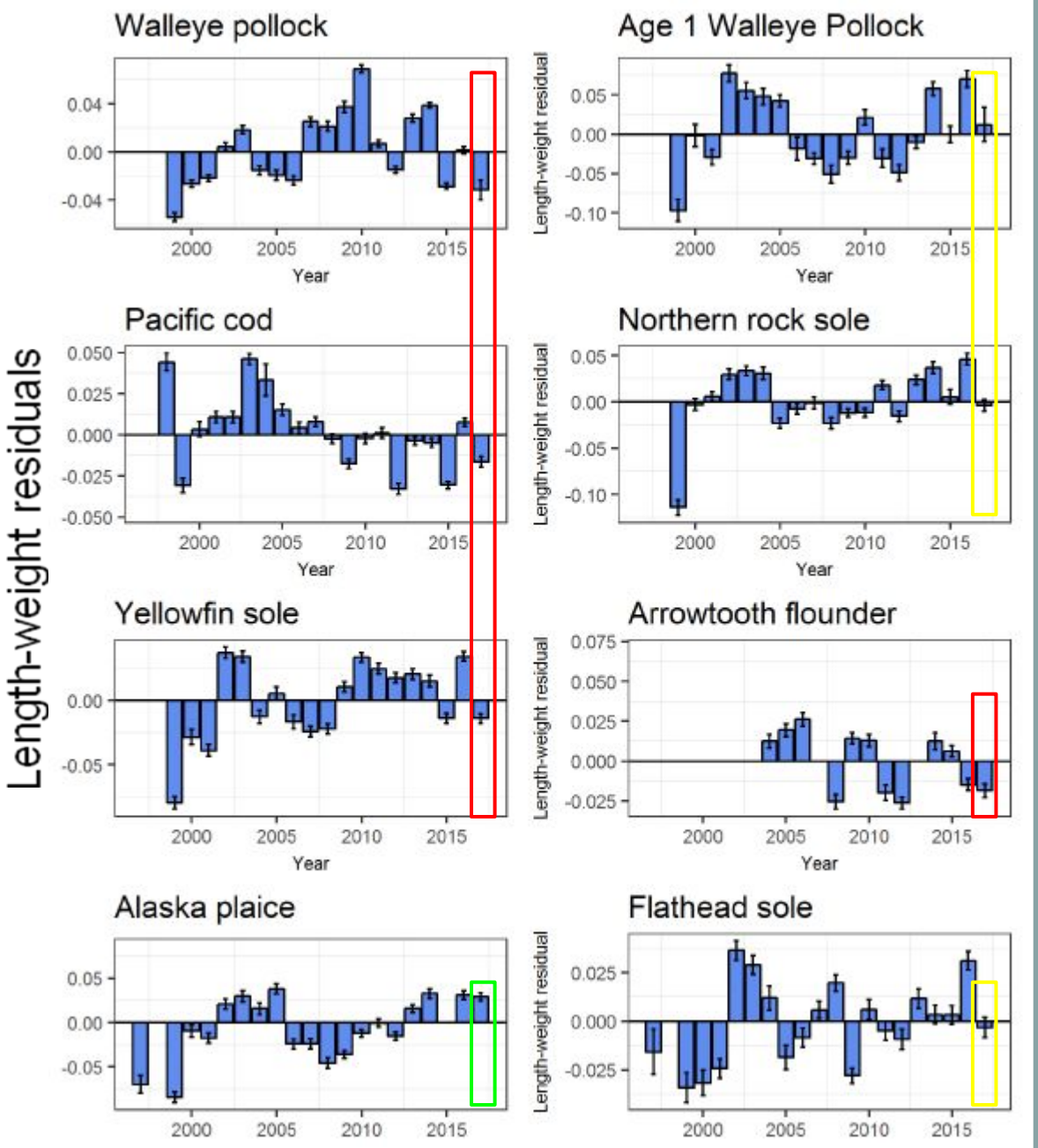
Mueter



- CPUE has remained stable since 2015.
- Fluctuations over time largely due to pollock.
- Decrease in early 2000s was a concern, but has increased due to strong year classes of pollock.

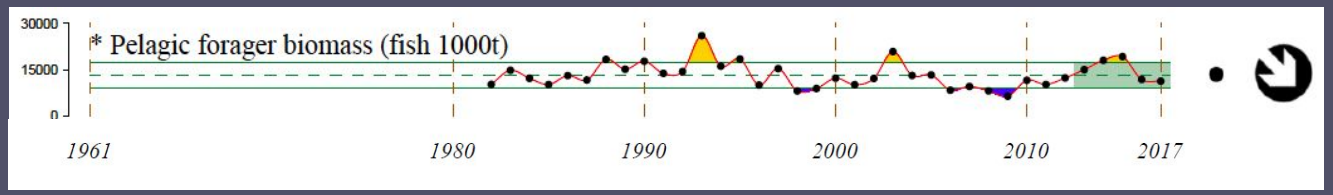
Groundfish Condition

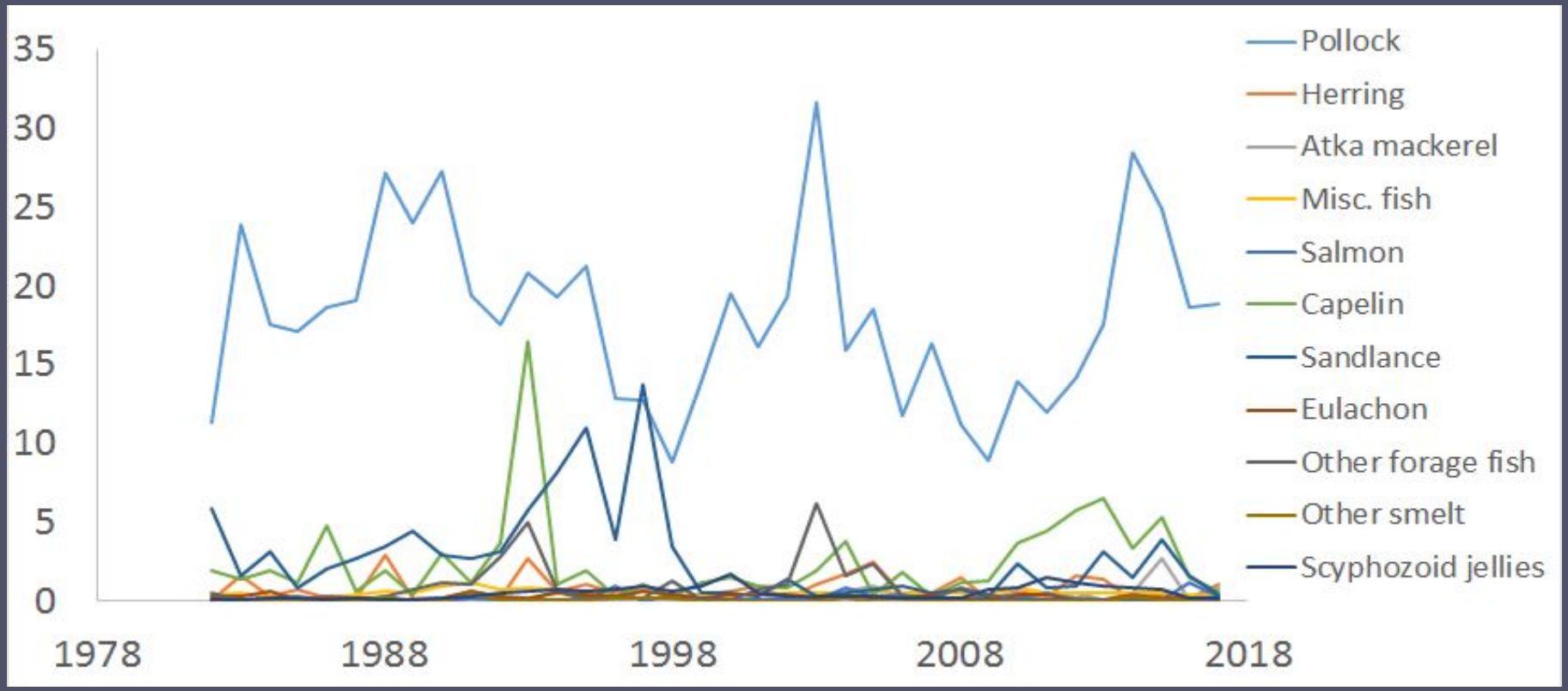
Boldt et al.



- Reduced condition for all species from 2016 → 2017 is a potential cause for concern.
- Poor condition may be a leading indicator of poor overwinter survival.

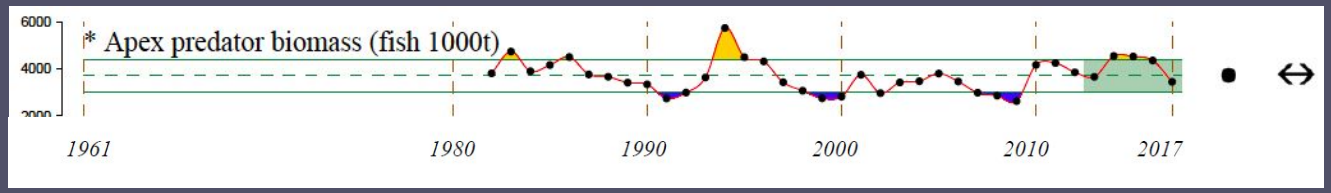
Pelagic foragers

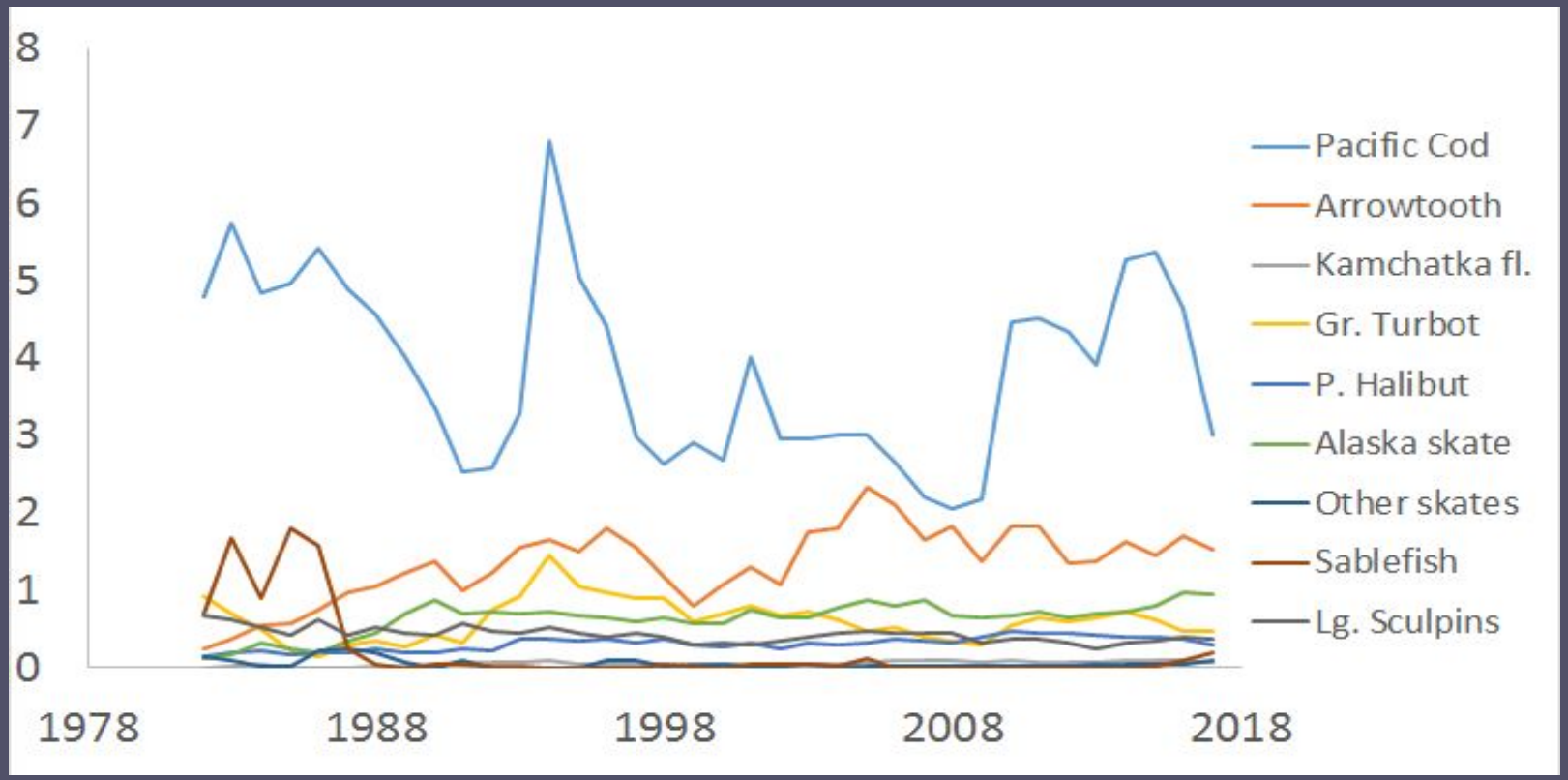




- Biomass of pelagic foragers at long-term mean.
- An increase in Pacific herring was offset by a decrease in Capelin.

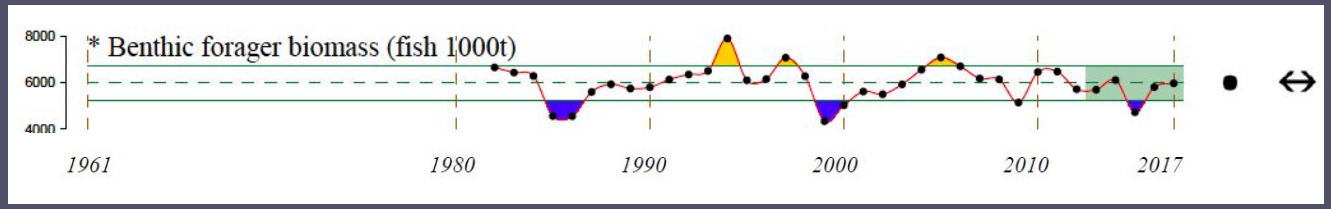
Apex fish

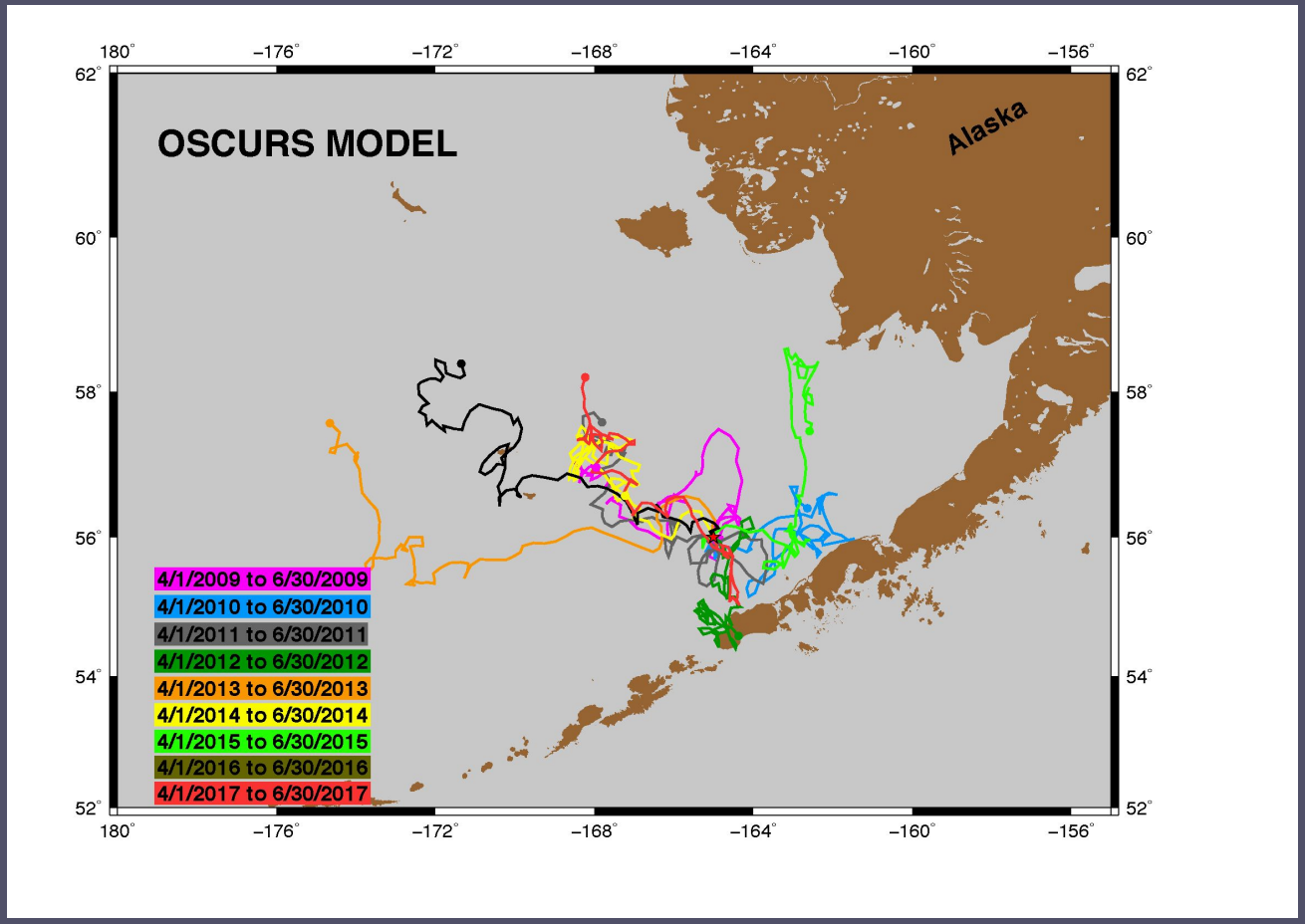




- Apex predators declined.
- 35% reduction in Pacific cod.
- 11% reduction in Arrowtooth flounder.

Benthic foragers

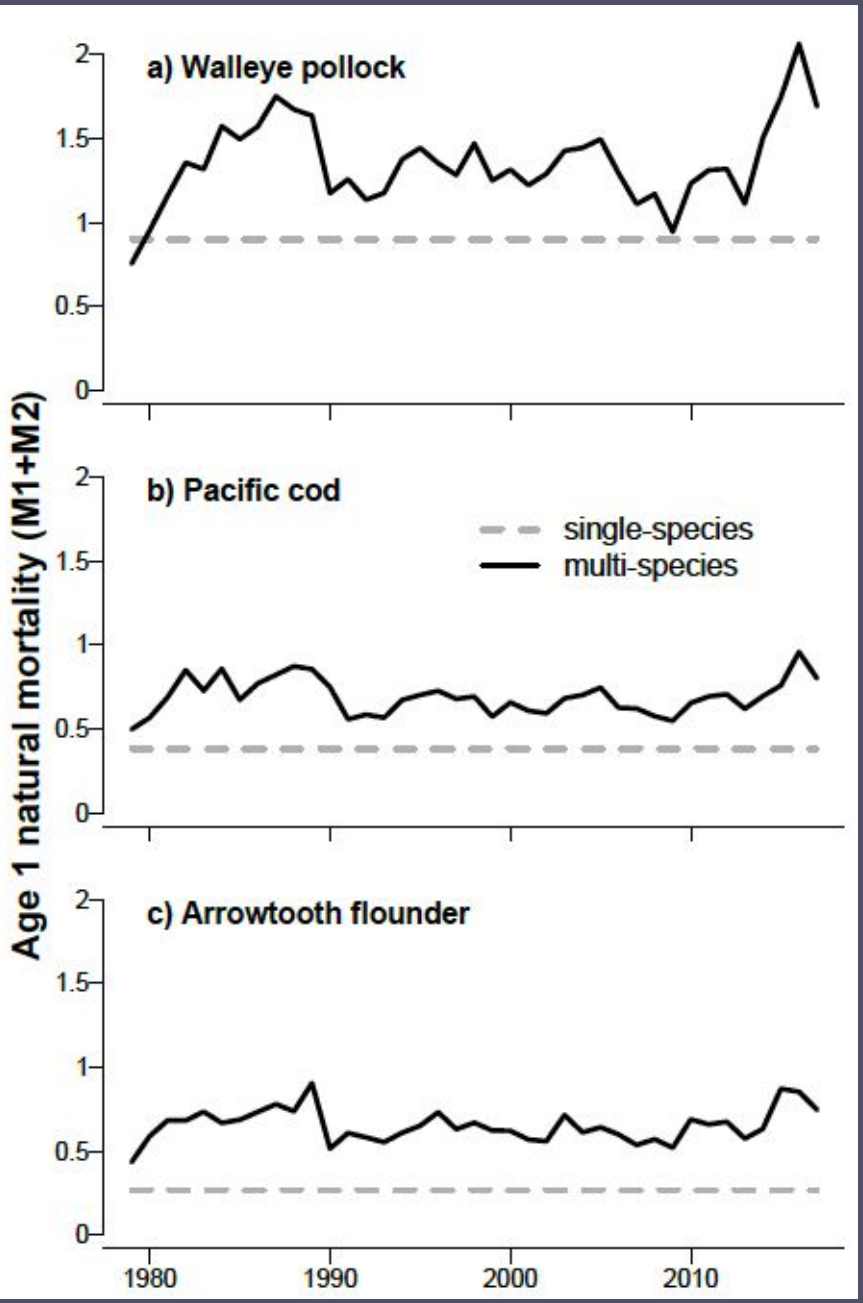




- More consistent with below-average recruitment years.
- Dip in 2015 due to NRS, which continues to decline.
- Return to average due to increase in “misc flatfish” and FHS.

Natural Mortality (CEATTLE)

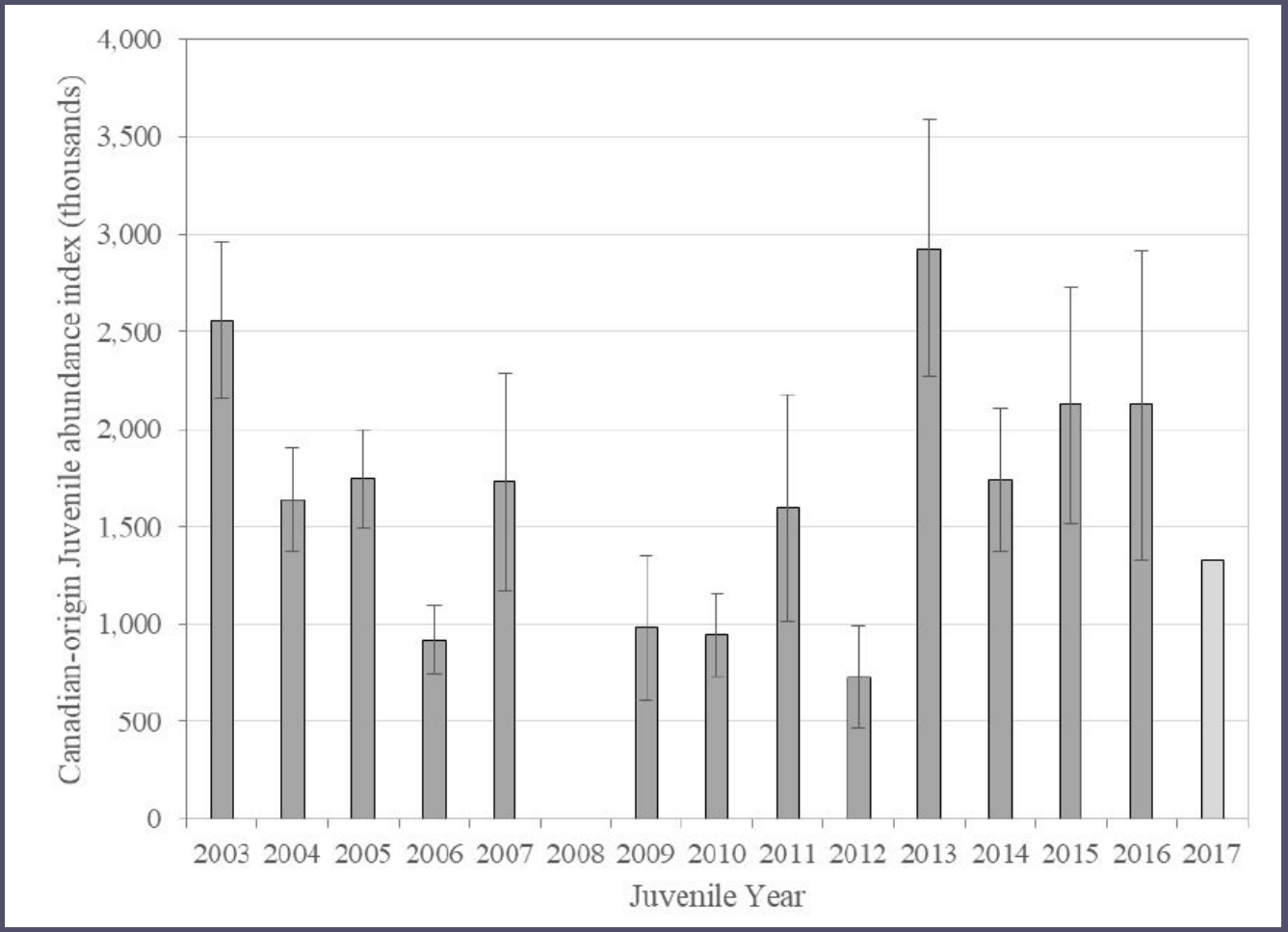
Holsman et al.



- Estimated age-1 natural mortality for pollock, Pacific cod, and ATF peaked and 2016, but remained at elevated levels in 2017.
- The peak in mortality in 2016 reflects maturation of the 2012 year class of pollock.
- Elevated natural mortality levels may reflect higher metabolic (and energetic) demand of predators under warm conditions.

Juvenile Chinook salmon

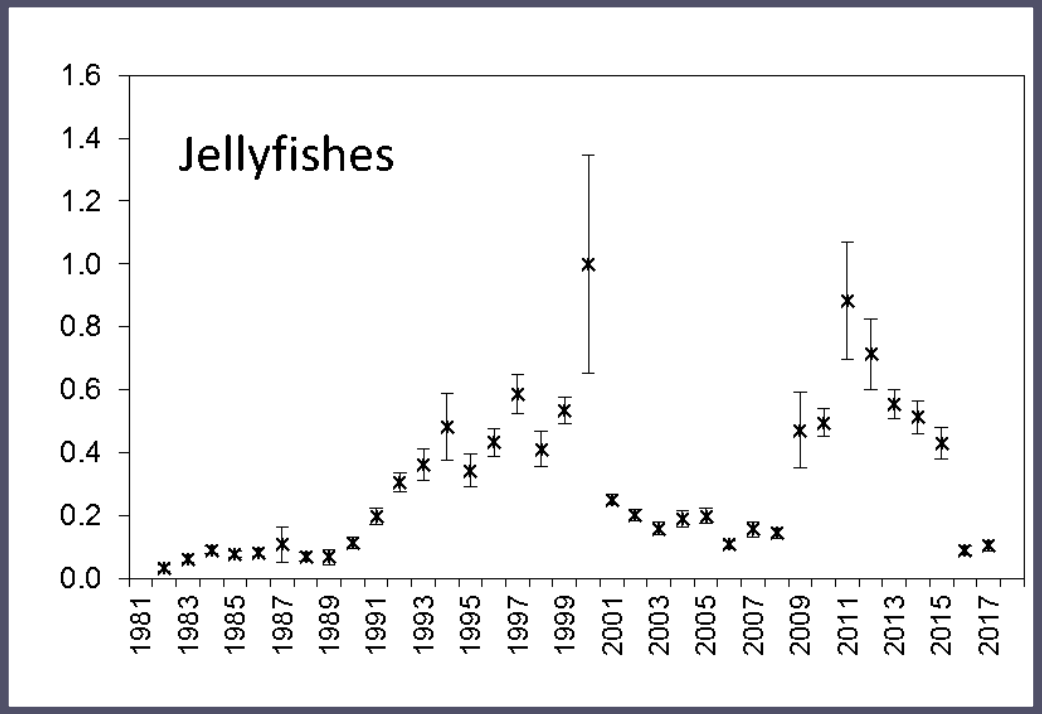
Murphy and Howard



- Juvenile Chinook abundance has important implications for abundance-based bycatch caps.
- Low juvenile abundance increases the probability of reduced bycatch caps 3 to 4 years in the future.

Jellyfish

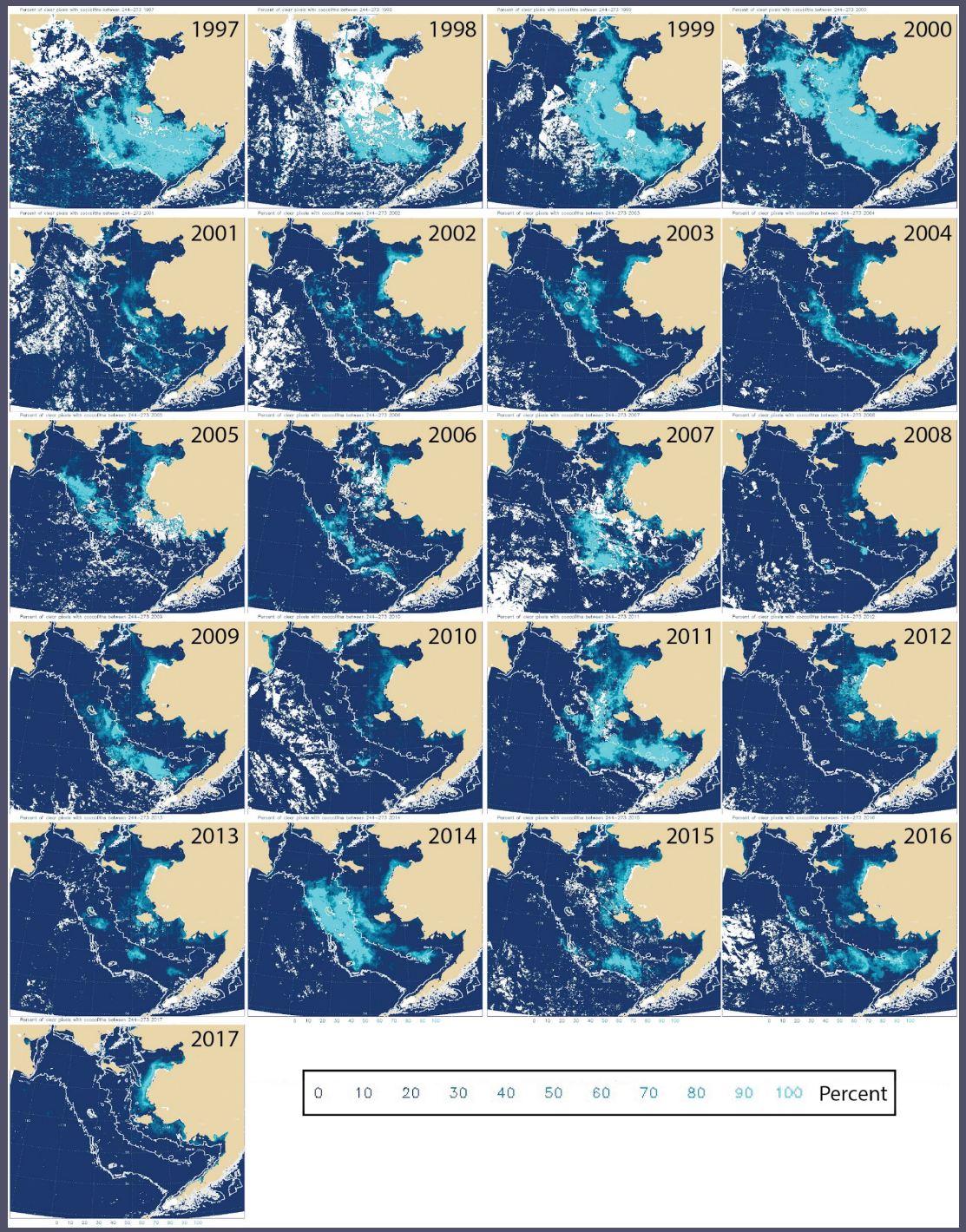
Lauth and Hoff



- 2017 was among the lowest relative abundance since 1989.
- End of recent bloom (2009-2015)?
- Large blooms can have predatory impact on juvenile and forage fishes.

Coccolithophores

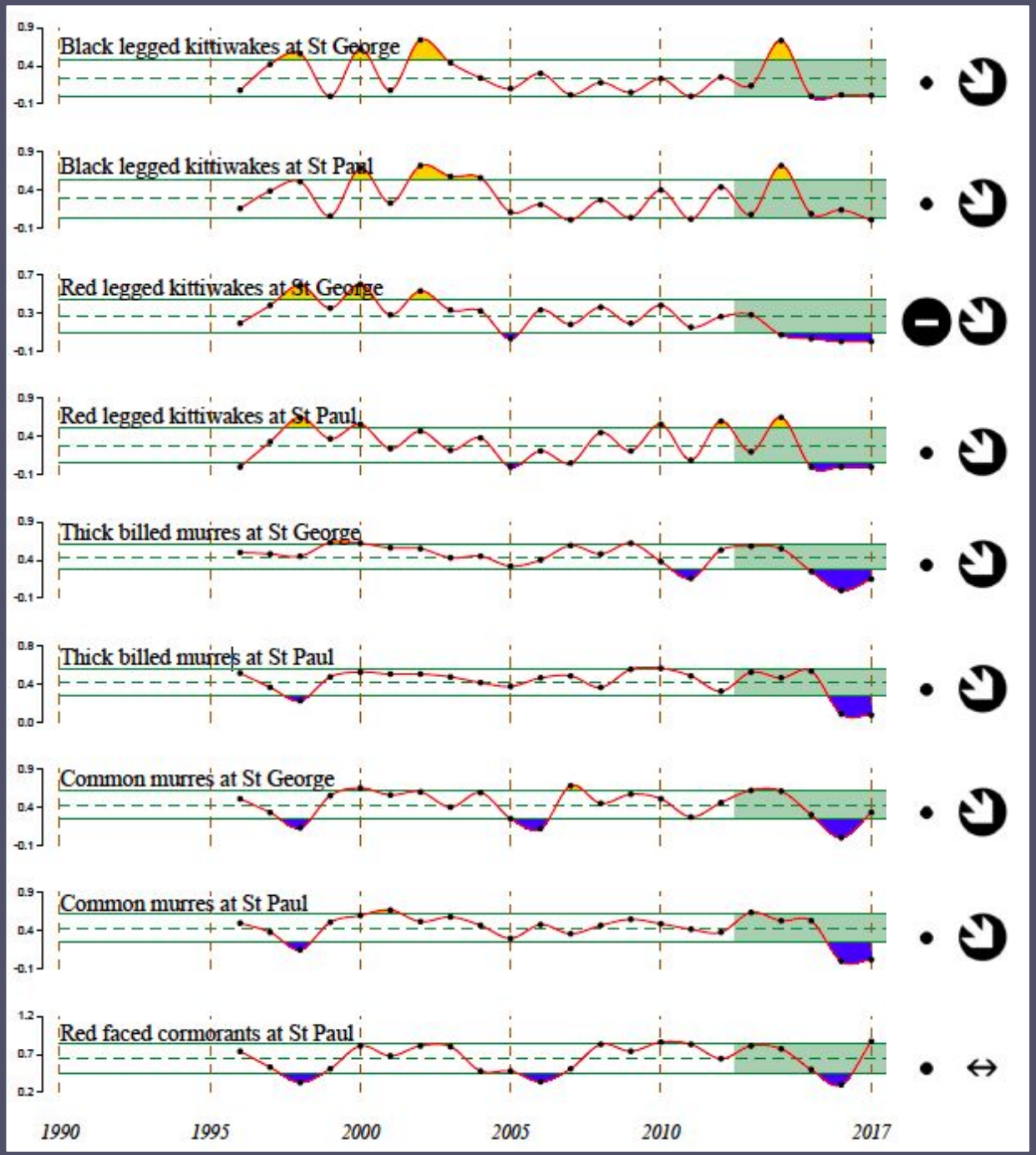
Ladd and Eisner



- Typically peak in September.
- Related to strong stratification.
- Negative impacts on visual foragers.
- smaller coccolithophores result in longer food chains.
- 2017 was the lowest index of the record.
- weak stratification?

Seabird reproductive success

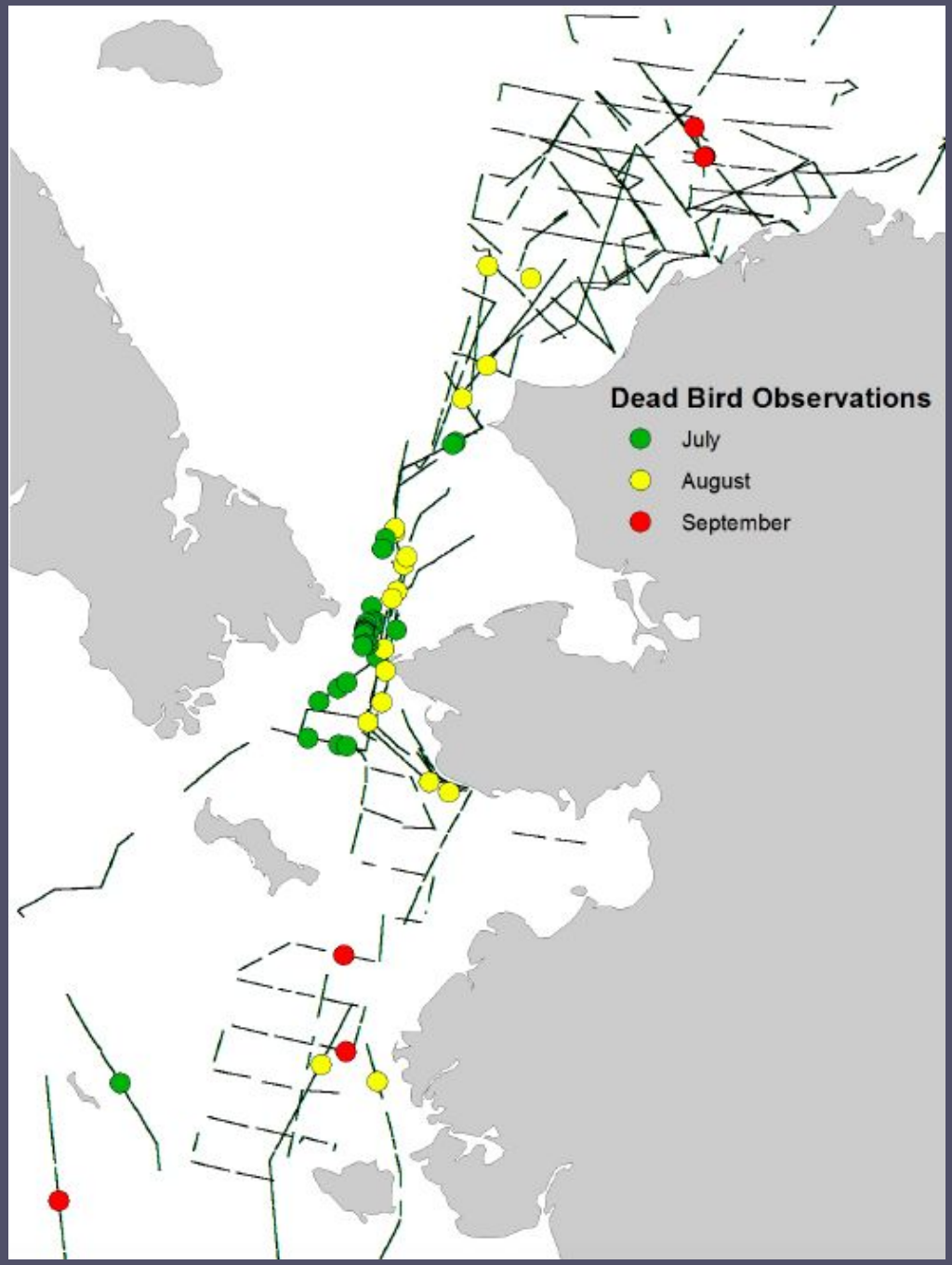
Renner & Romano



- Cliff-nesting, primarily fish-eating species.
- Overall poor reproductive success in 2017.
- Exception was nearshore-feeding red-faced cormorant.

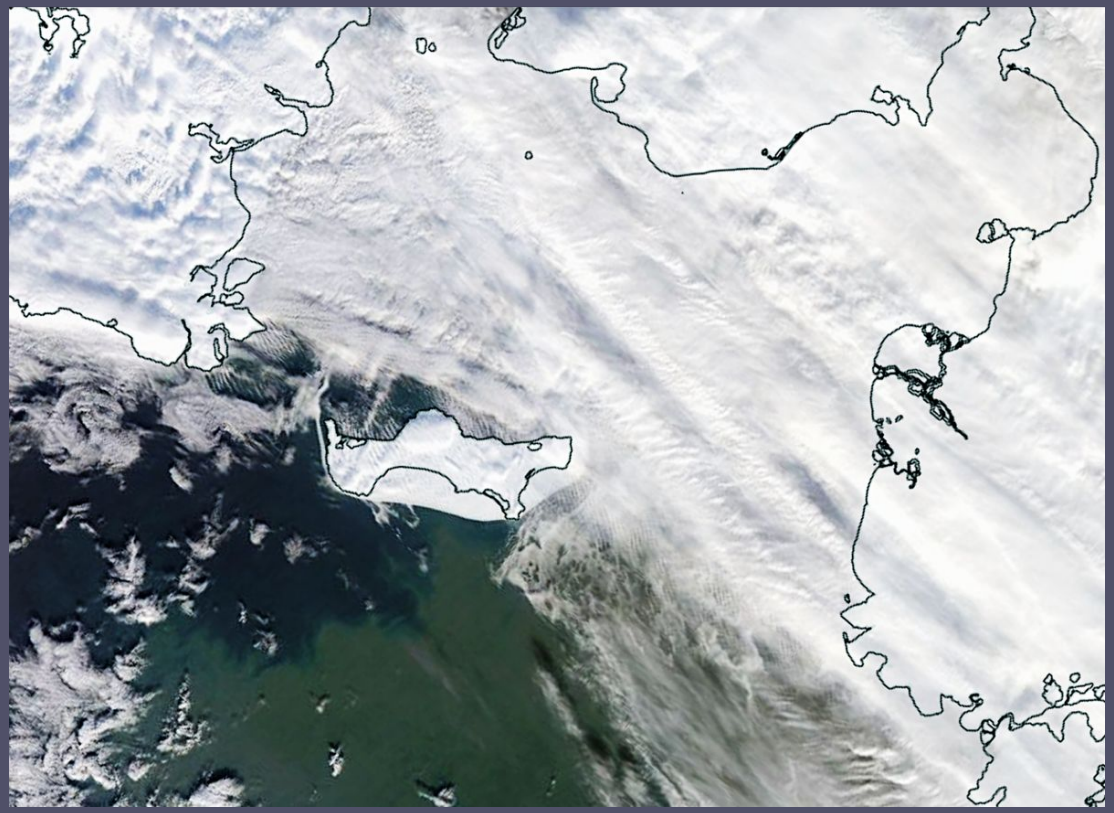
Dead and Dying Seabirds

Kuletz et al.



Species found included:

- Northern fulmars
- Short-tailed shearwaters
- Murres
- Kittiwakes
- Puns
- Auklets



2018 Climate and Oceanography

Current North Pacific Climate Highlights

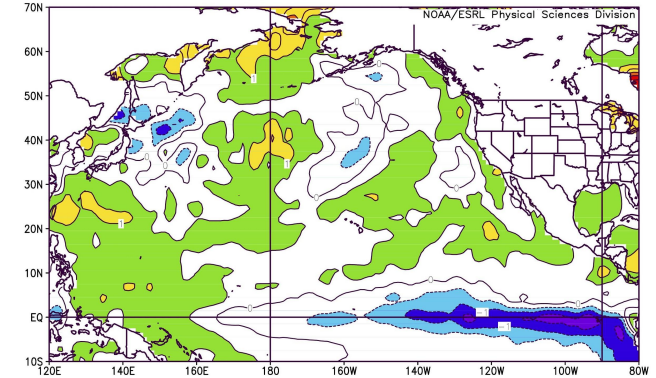
Bond

- 2017-2018 was similar to 2016-2017. Both winters featured La Niña and weaker than normal Aleutian lows.
- SST anomalies in 2017-2018 tended to be positive, with increasing positive anomalies in the Bering Sea.
- PDO was slightly positive with a decline to near zero in summer 2018.
- ~70% chance of a weak-moderate El Niño for winter 2018-2019.

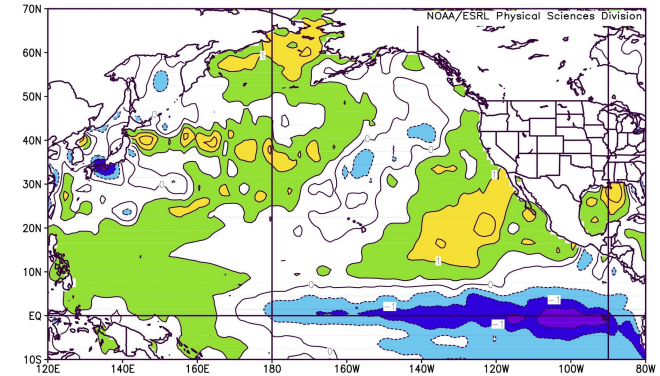
Sea Surface Temperature Anomalies

Bond

Warmer than normal across most of the N Pac



Autumn 2017

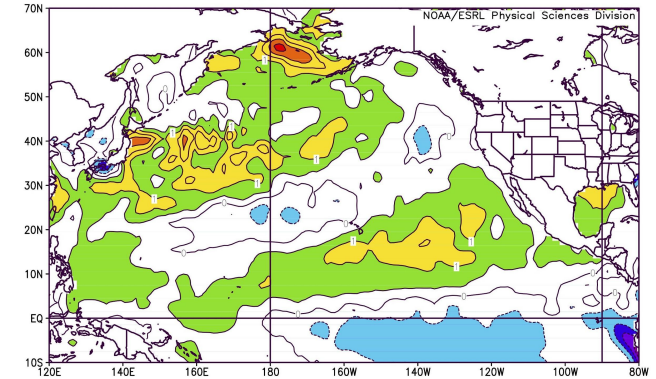


Winter 2017/18

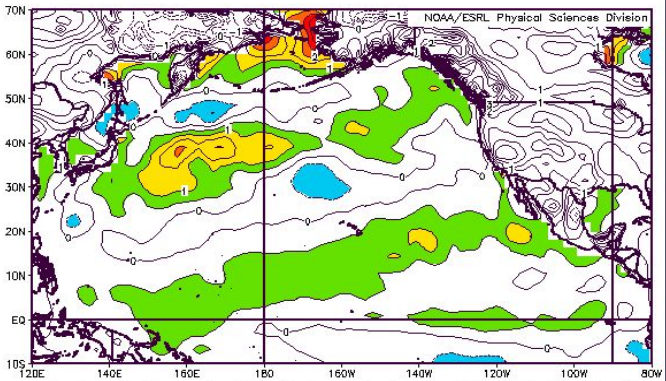
Weak to moderate La Niña conditions

Warm relative to seasonal norm in EBS

End of La Niña

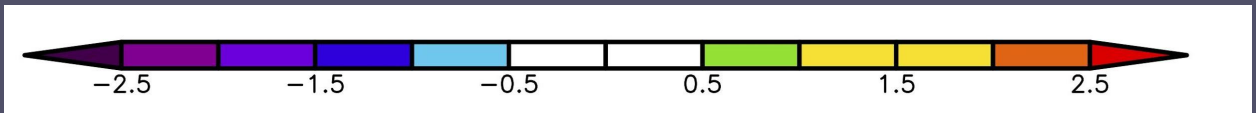


Spring 2018



Summer 2018

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

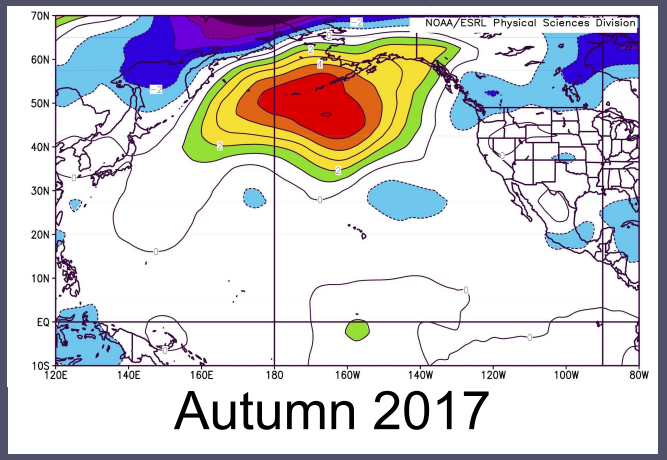


From NOAA's Optimum Interpolation SST analysis

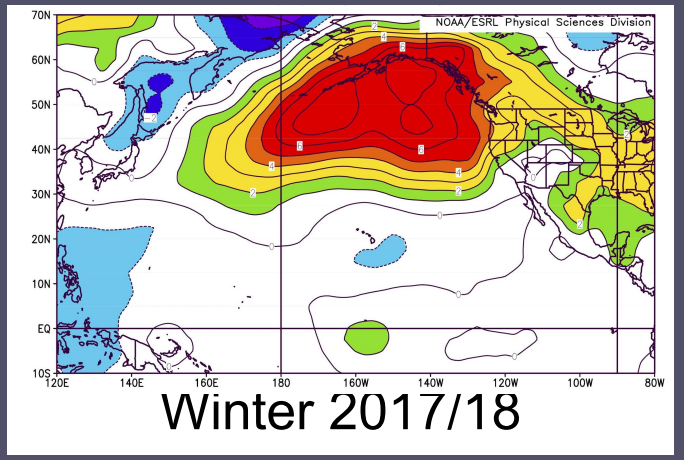
Sea Level Pressure Anomalies

Bond

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



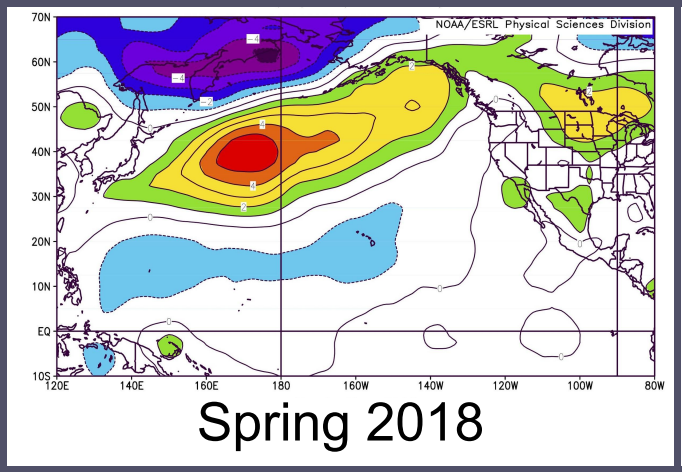
Autumn 2017



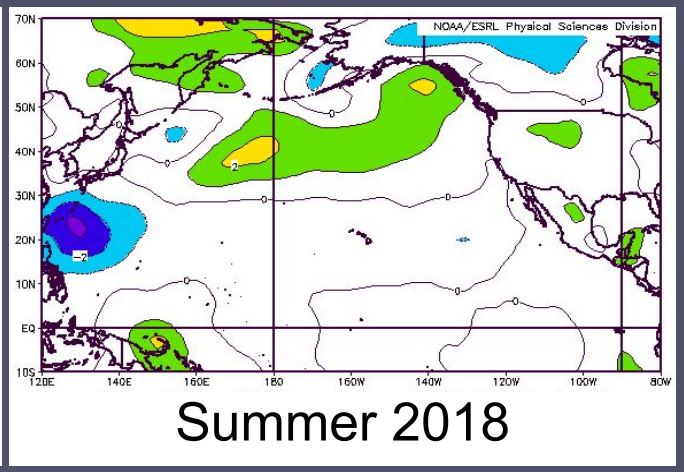
Winter 2017/18

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

Warm, SW flow anomalies across the Bering Sea. Upwelling-favorable winds in coastal GOA.

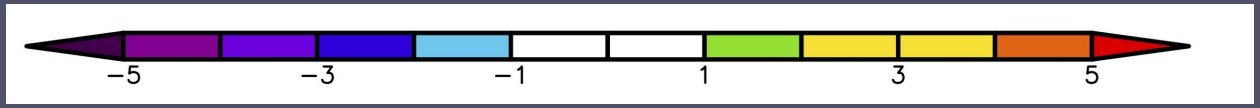


Spring 2018



Summer 2018

Weak anomalies; typical for Summer. Lower pressure from NW Canada into Bering Sea.

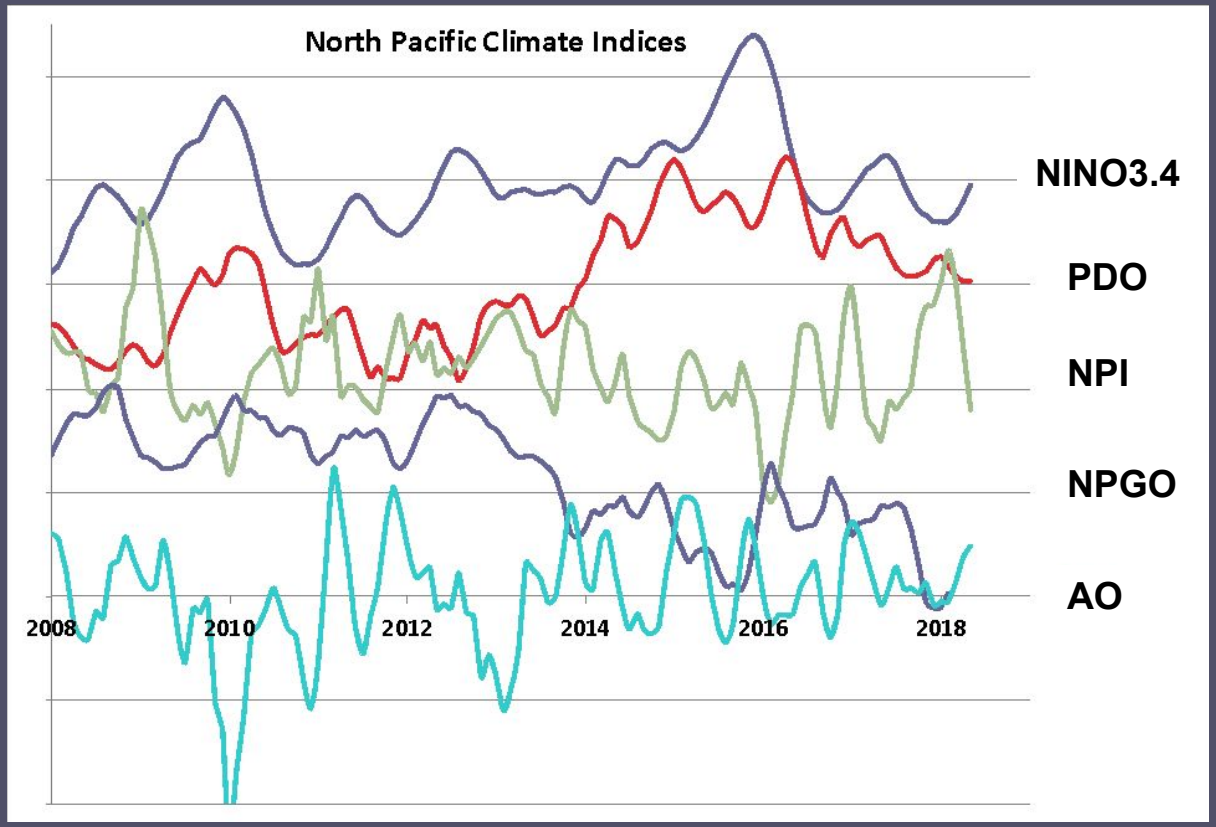


From the NCEP/NCAR Reanalysis project

Climate Indices

Bond

The North Pacific atmosphere-ocean climate system was mostly on the warm side during 2017-18.



Second fall/winter with negative NINO3.4; weak to moderate La Niña event.

Positive PDO that began in 2014 ended in 2017. Consistent with remote effects of ENSO and transition from El Niño (2015-16) to La Niña.

NPI strongly positive early 2018. Common with La Niña, but magnitude greater than expected.

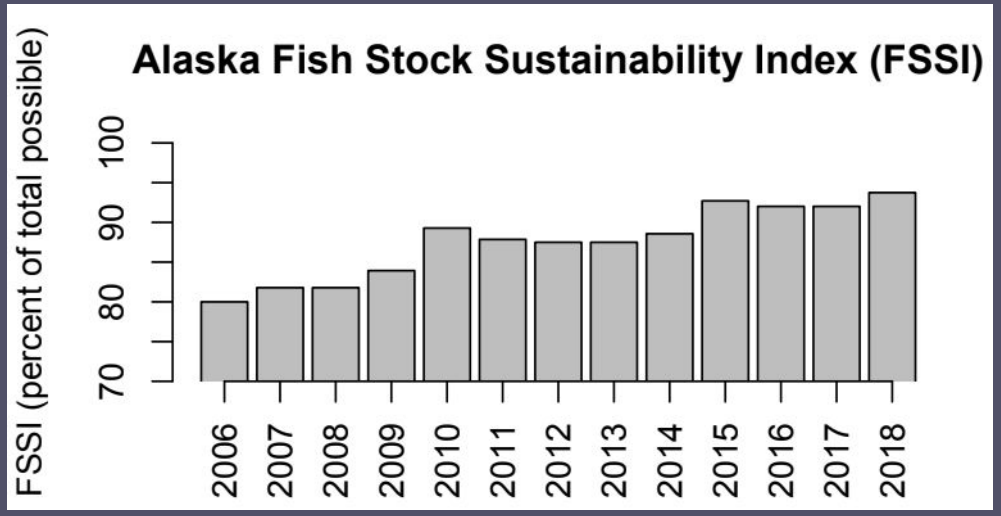
NPGO negative 2017 to 2018 (Feb); declining since 2012.

AO near-neutral in 2017; transition to positive in spring/summer 2018 resulting in low pressure in the Arctic.

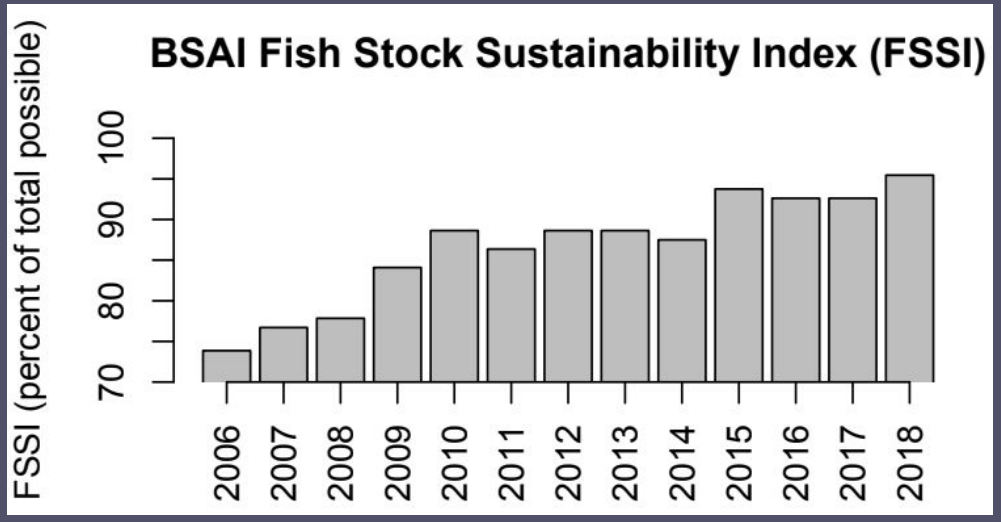
2018 Fish Stock Sustainability Index

Whitehouse

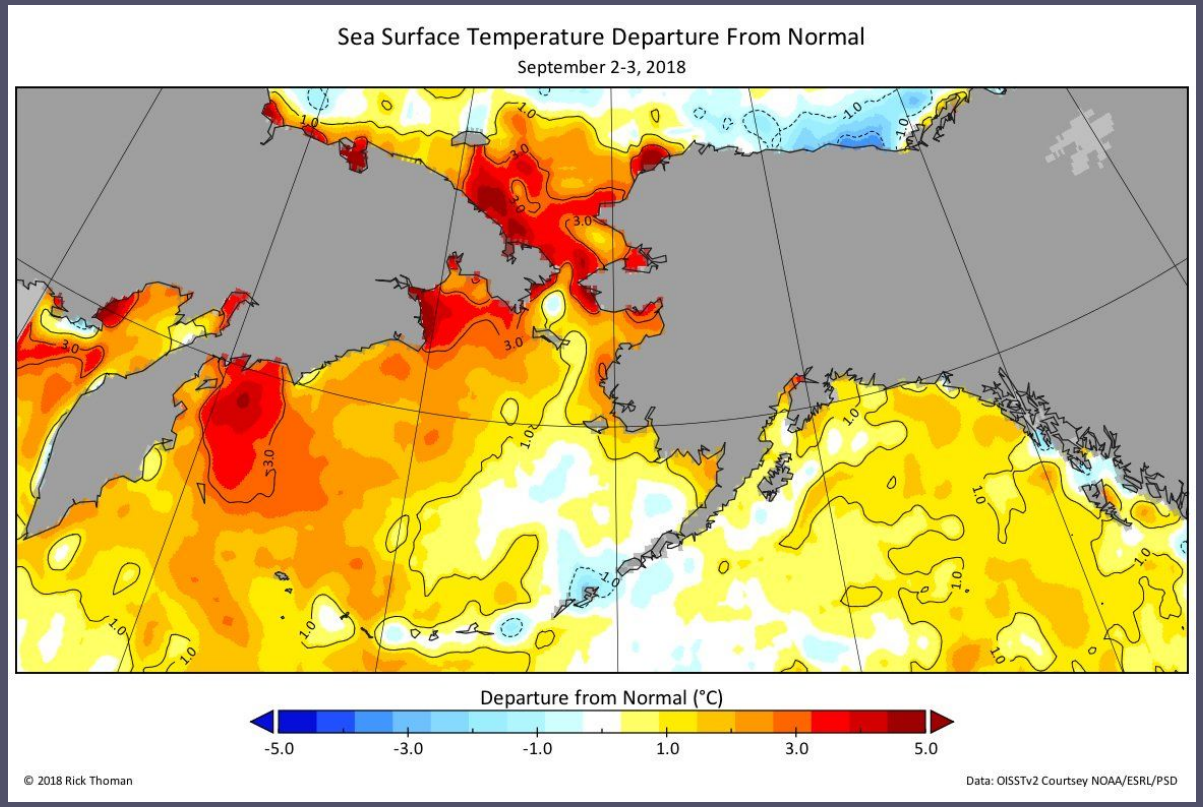
Performance measure for sustainability of stocks selected for importance to commercial and recreational fishing



- Alaska FSSI is 135 out of 144, or 93.75%
- 2018 increased 2.5 points due to ↑ scores for two king crab stocks and ↓ score for snow crab in EBS.



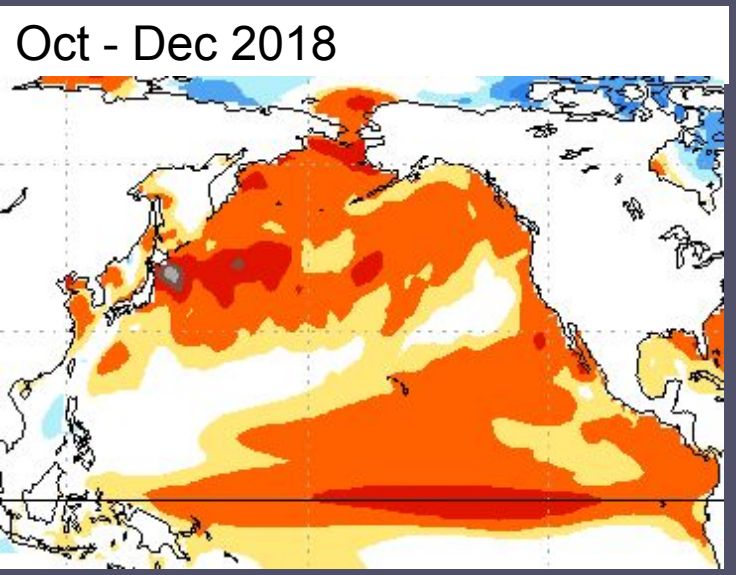
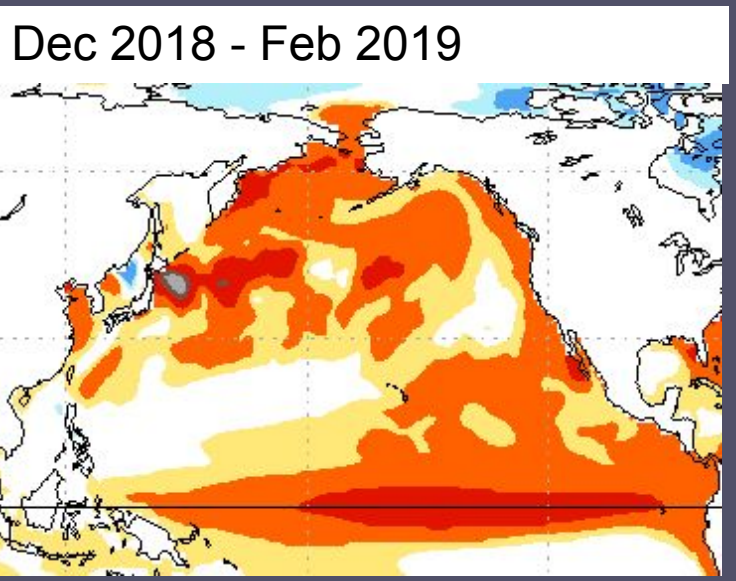
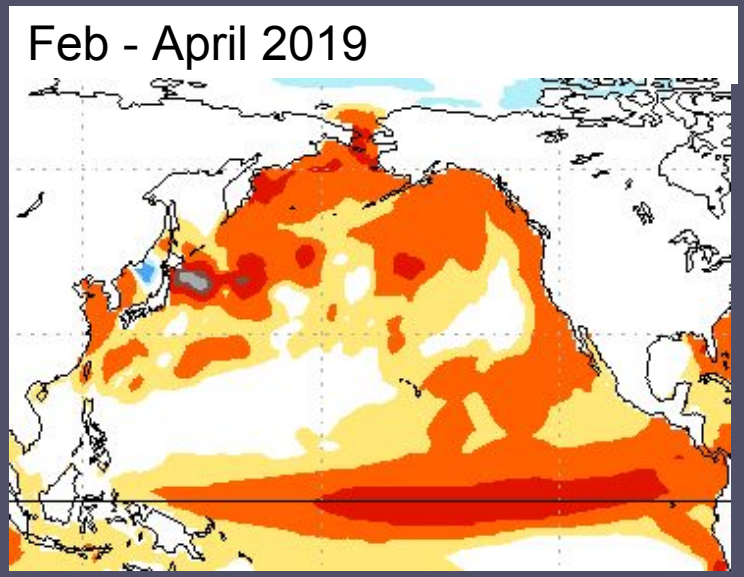
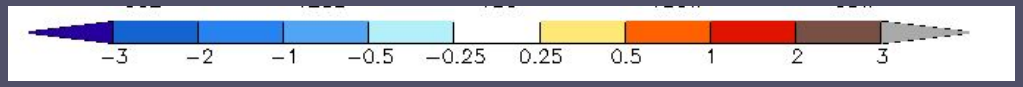
- BSAI score is 84 out of 88, or 95.45%.
- No BSAI groundfish stock or stock complex subject to overfishing, considered to be overfished, or approaching an overfished condition.
- Pribilof Islands blue king crab is overfished, but not subject to overfishing.



2019 Sea Surface Temperature Forecasts

SST Projections from the National Multi-Model Ensemble

Bond



- Warm conditions across N. Pacific through Dec
- Positive anomalies greatest (>1˚C) in NBS
- Fall → winter 70% chance of El Niño
- Aleutian low deeper than normal in late winter of 2018/19 = warm weather for Alaska enhanced by warm waters.
- PDO may be ill-suited for characterizing the state of the N Pacific in early 2019.