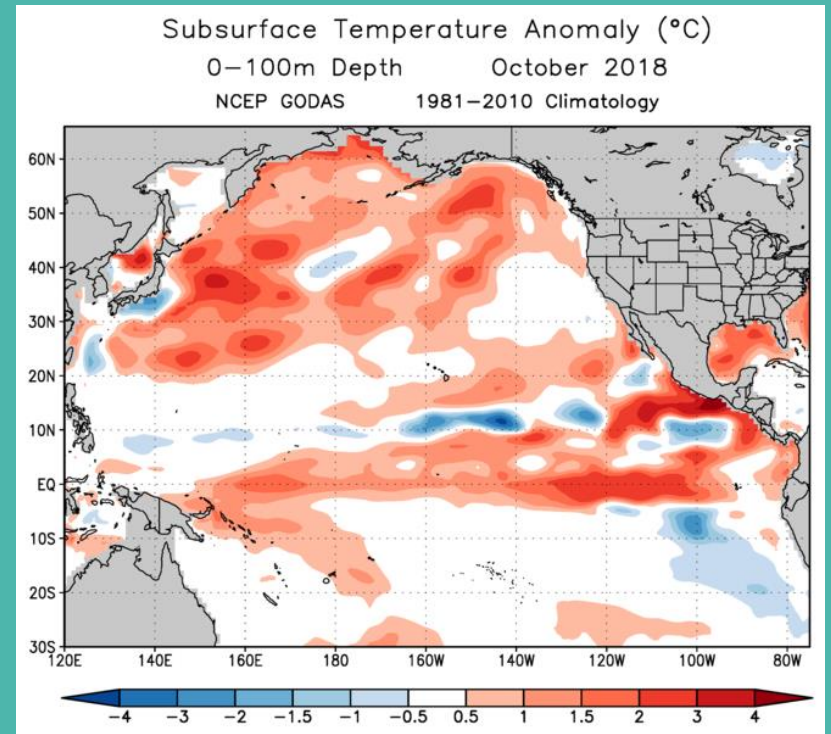


# Gulf of Alaska 2018

## Ecosystem Status Report



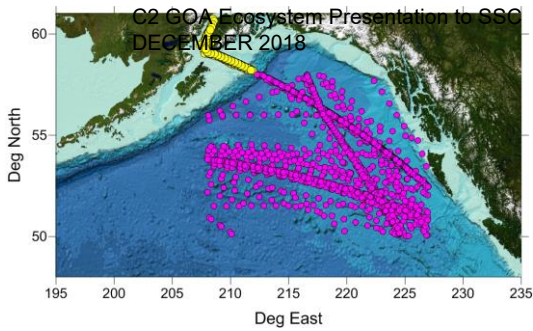
Stephani Zador and Ellen Yasumiishi  
Alaska Fisheries Science Center  
SSC  
December 3, 2018

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# Complete Recap of 2017

# Complete recap of 2017

1. Temperatures moderated relative to heatwave years 2014–2016; Blob dissipated
2. Reduced transport in the Alaska Current and low eddy activity
3. Abundant, but small, zooplankton taxa and few euphausiids in WGOA; few zooplankton in EGOA

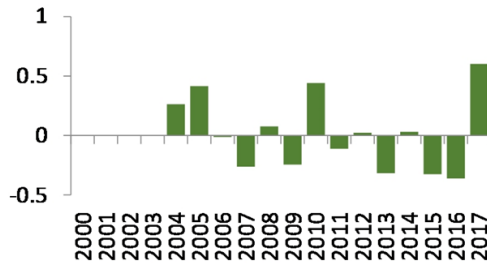


# 2017 Zooplankton

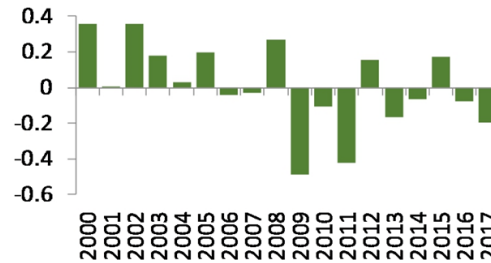
Batten, Hopcroft, Ressler, Fergusson

Alaskan Shelf

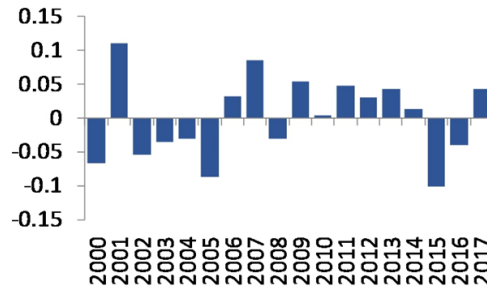
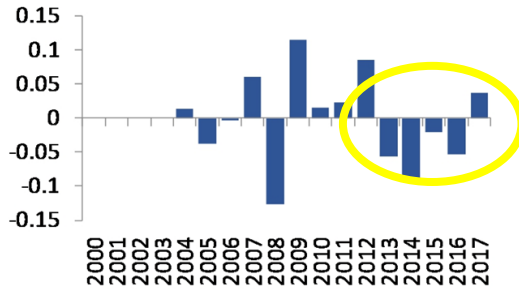
Large  
Diatom  
Abundance  
Anomaly



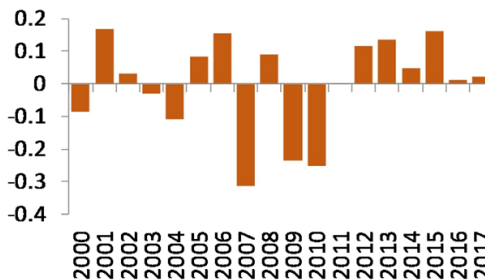
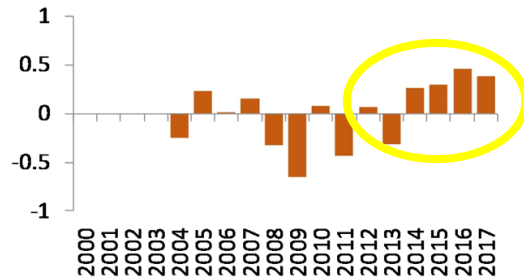
Oceanic NE Pacific



Copepod  
Community  
Size  
Anomaly



Mesozoo-  
plankton  
Biomass  
Anomaly

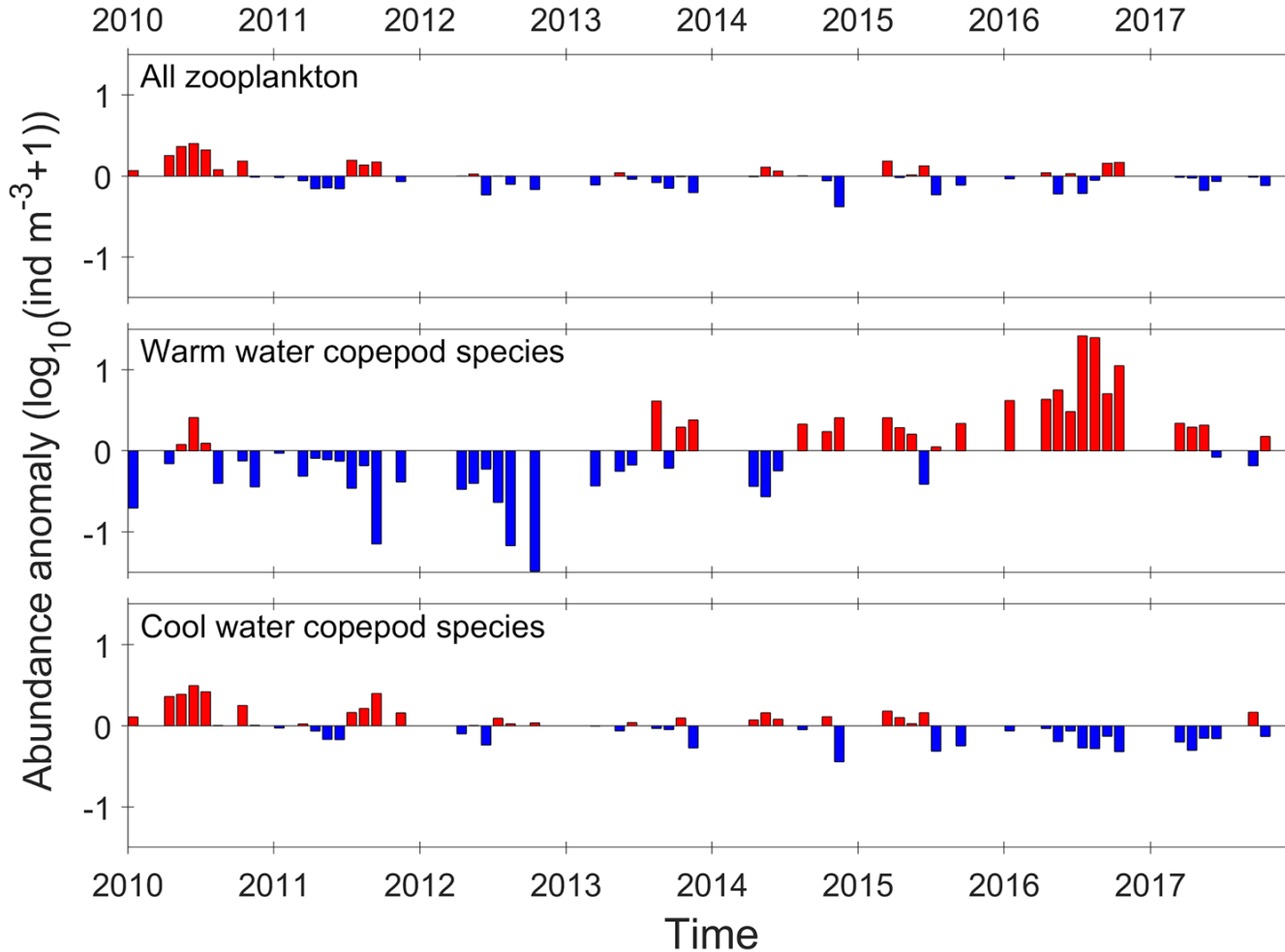


- Continuous Plankton Recorder
- Copepods small during heatwave
- Switched to larger in 2017
- Mesozooplankton biomass high
- Seward Line copepods abundant, but euphausiids low
- Euphausiids also low in acoustic survey
- Lipid content low Icy Strait

# 2017 Zooplankton

Campbell et al

## Prince William Sound



- PWS typically lags the GOA by ~1 year

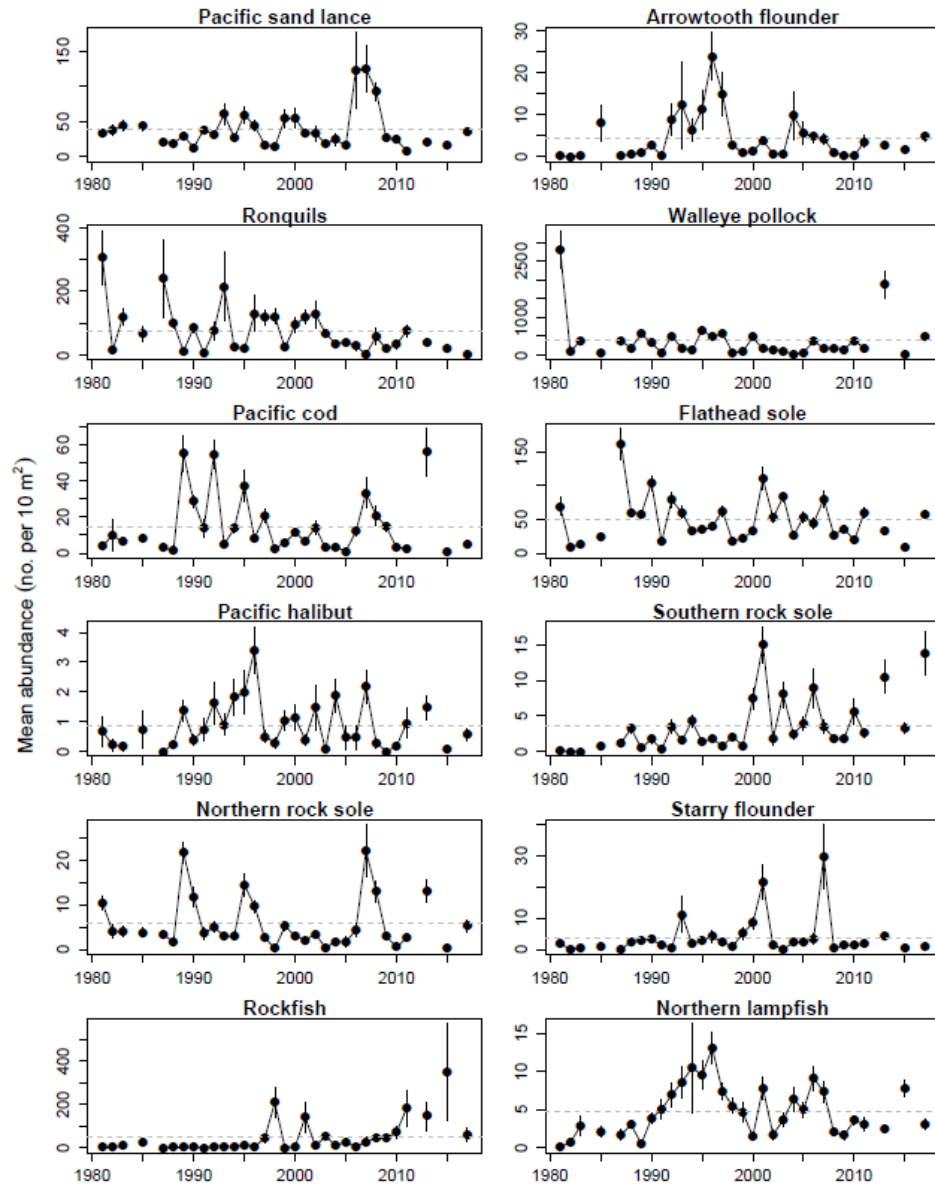
# Complete recap of 2017

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3. Abundant, but small, zooplankton taxa and few euphausiids in WGOA; few zooplankton in EGOA
4. Few cod larvae, but above-average abundance of pollock larvae. Wide distribution, unlike in 2013. Late summer age-0 pollock abundant around Shelikof and Kodiak.

# 2017 Larval and age-0 groundfish

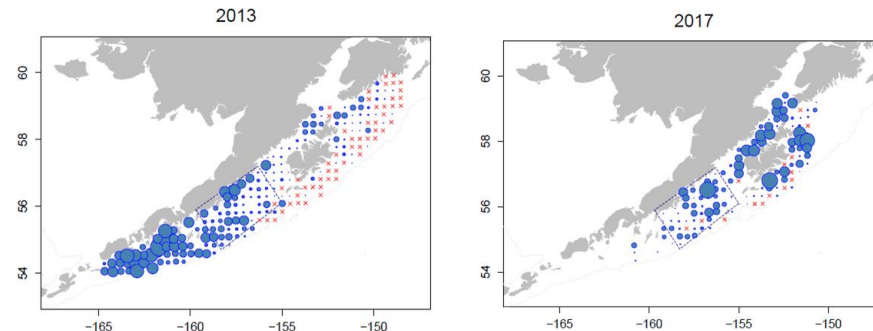
EcoFOCI, EMA, RECA

## Larvae



- Mostly average abundance during larval surveys except few cod
- Positive signs for 2017 pollock
  - Above average larval densities
  - Widely distributed age-0s
  - Energy density high EGOA
  - Seen again as age-1s during winter Shelikof surveys

## Age-0 pollock



# Complete recap of 2017

1. Temperatures moderated relative to heatwave years 2014–2016; Blob dissipated
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4. Few cod larvae, but above-average abundance of pollock larvae. Wide distribution, unlike in 2013. Late summer age-0 pollock abundant around Shelikof and Kodiak.
5. All groundfish but cod had poor body condition. Record low for arrowtooth (apex) and northern rockfish (pelagic)
6. Salmon marine survival low
7. Seabirds and marine mammals poor reproduction overall
8. Seabird bycatch up but other non-target catch low (jellyfish, inverts)



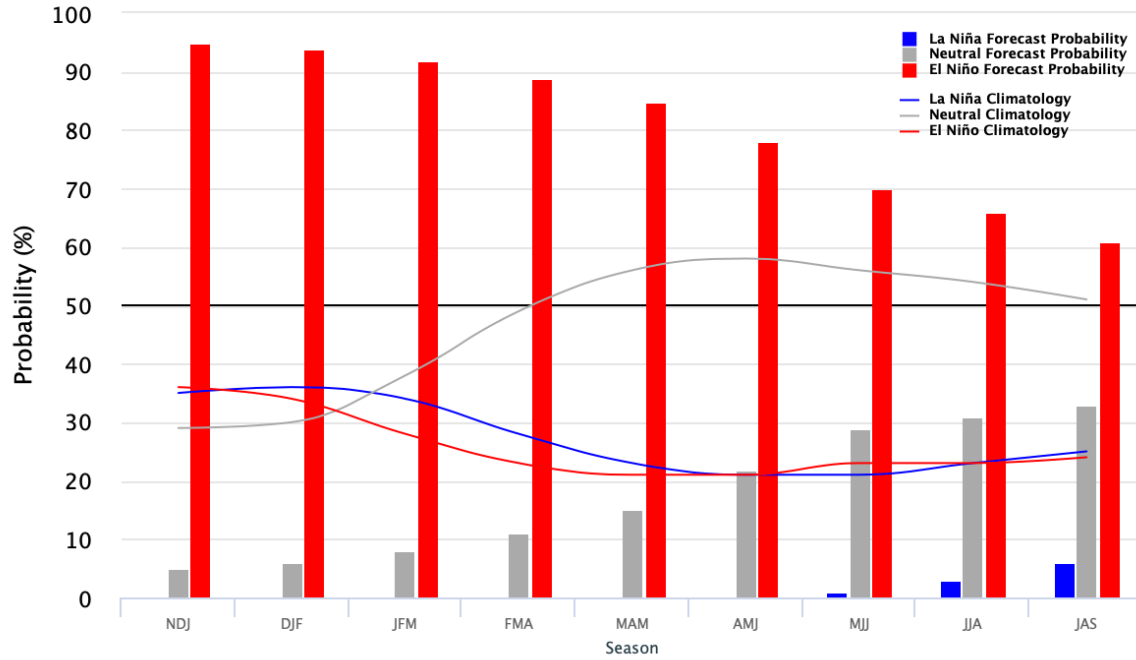
# Current Conditions Western GOA

West of Cape Suckling 144°W

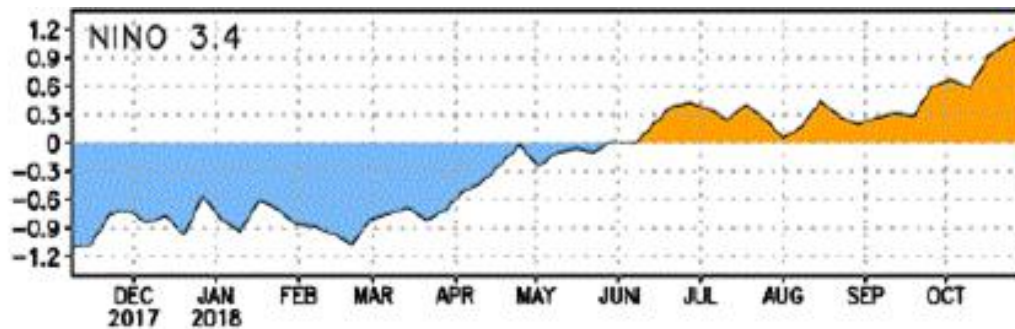
# 2018 climate

Mid-November 2018 IRI/CPC Model-Based Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly  
Neutral ENSO:  $-0.5^{\circ}\text{C}$  to  $0.5^{\circ}\text{C}$

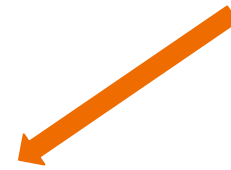
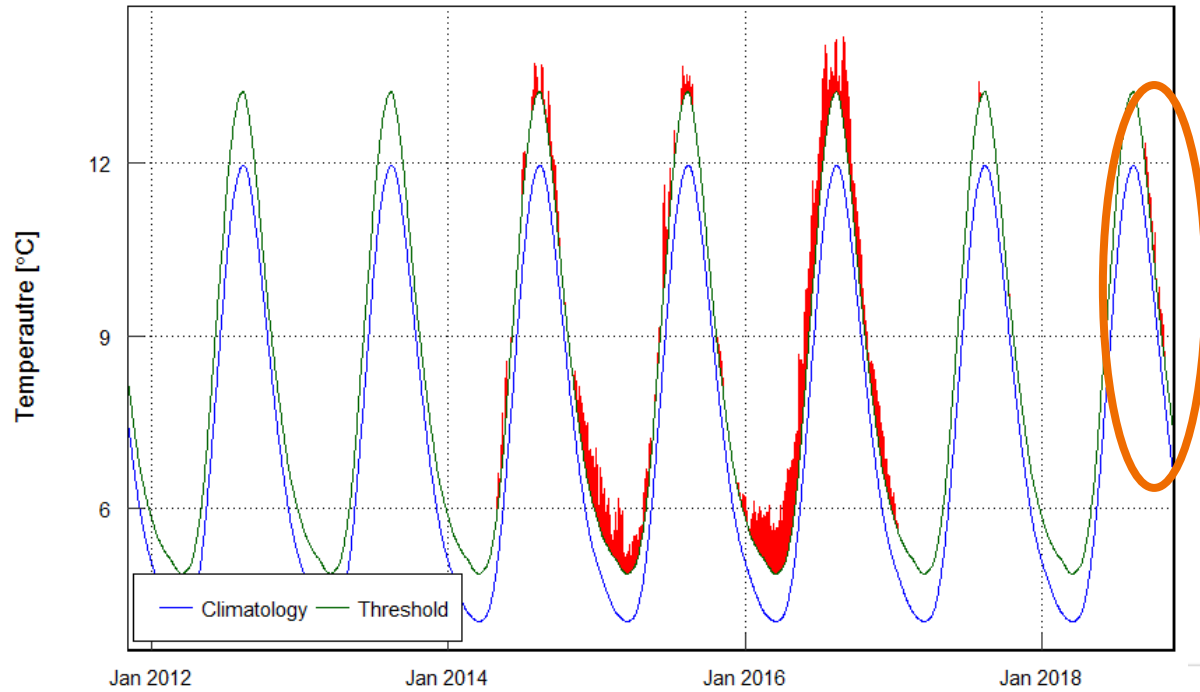


- El Niño this winter
- PDO remains neutral



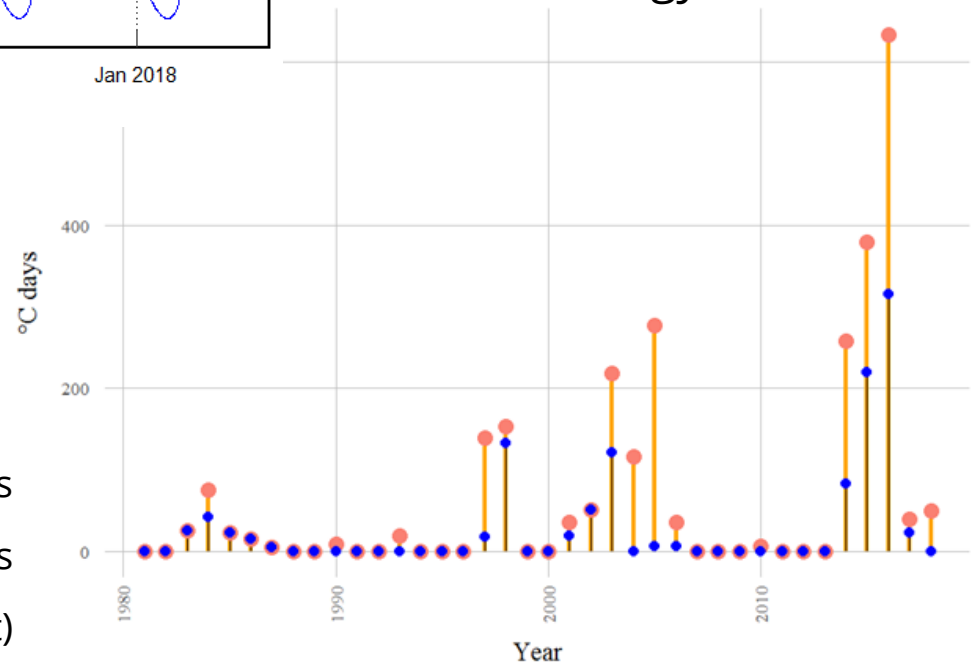
# Another heatwave!

Barbeaux



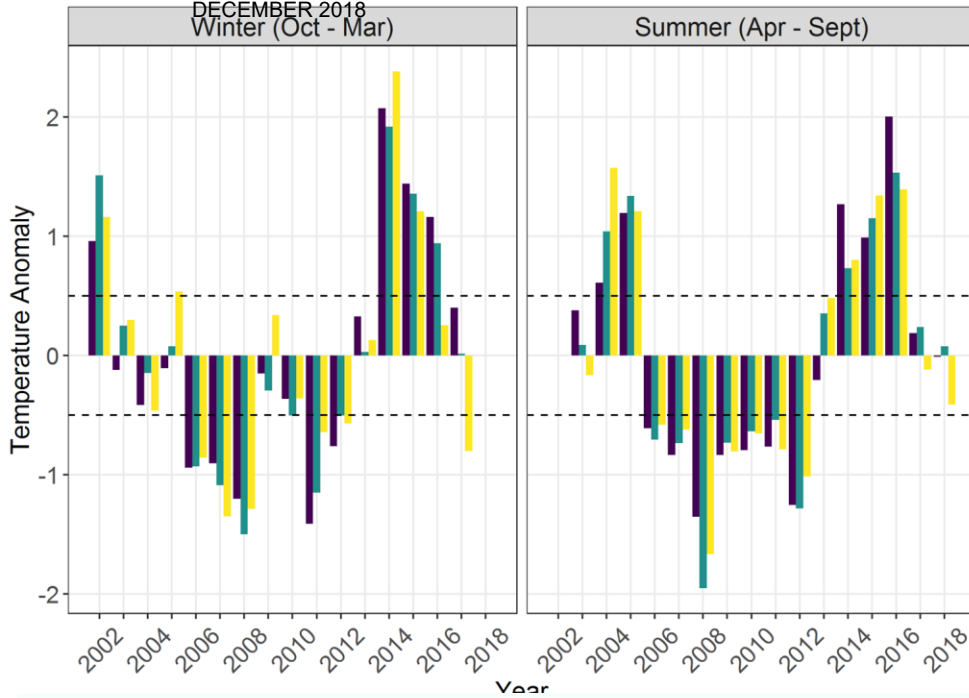
- The GOA is currently in a heatwave (as of 25 Nov 2018)
- Red is above 90% of climatology

Red dots: **annual** cumulative degree days  
Blue dots: cumulative **winter** degree days  
(as of 21 Oct)



DECEMBER 2018  
Winter (Oct - Mar)

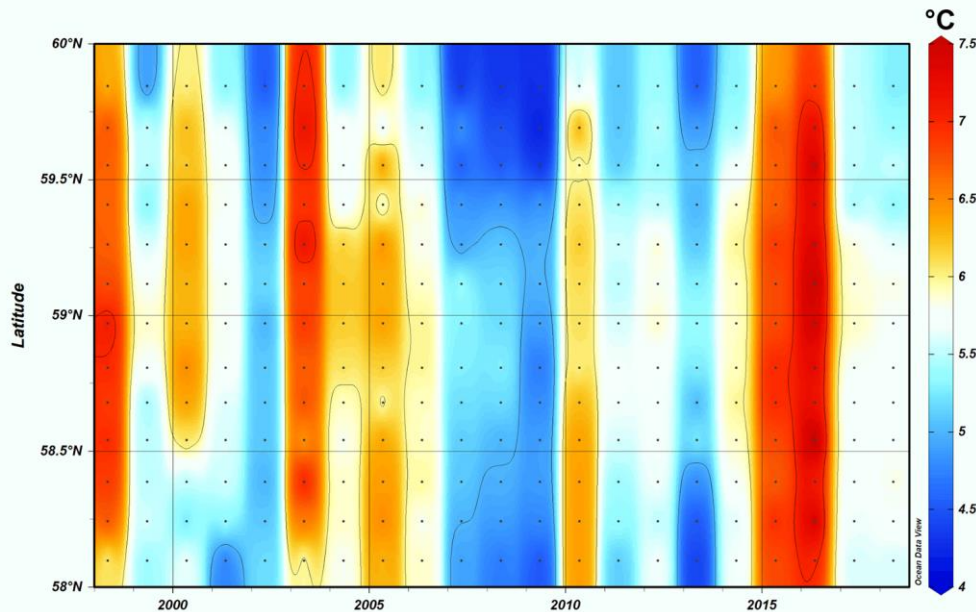
Summer (Apr - Sept)



# 2018 oceanography

Watson, Danielson and Hopcroft

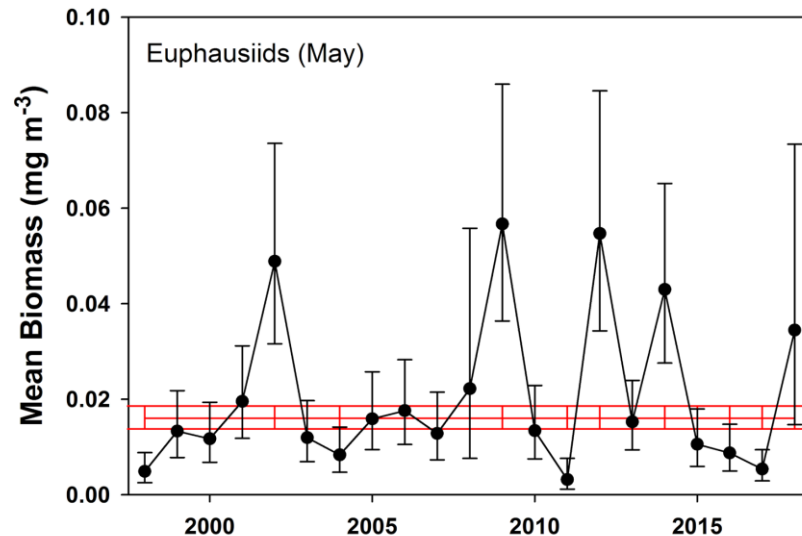
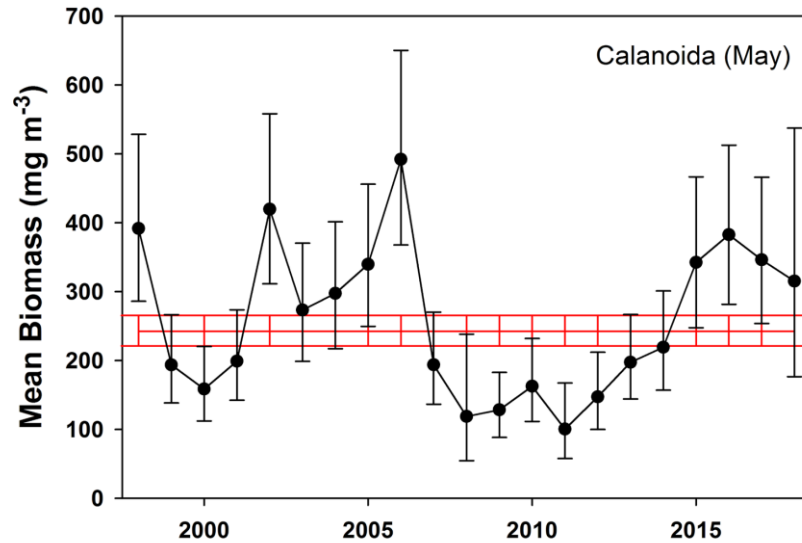
Satellite-derived sea surface temperature



May temperature averaged over top 100m depth at the Seward Line

# 2018 zooplankton

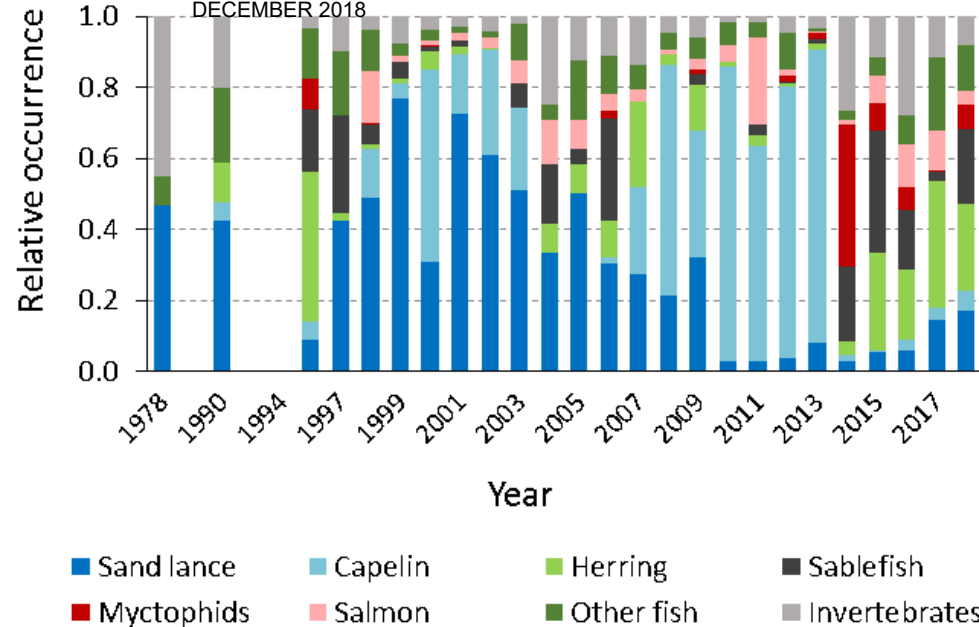
Hopcroft and Coyle



- Seward Line sampling during May
- 0.5 mm mesh
- Averaged over top 100m
- Copepods remained abundant in 2018
- Euphausiids increased in 2018

# Kittiwake June-August

C2 GOA Ecosystem Presentation to SSC  
DECEMBER 2018

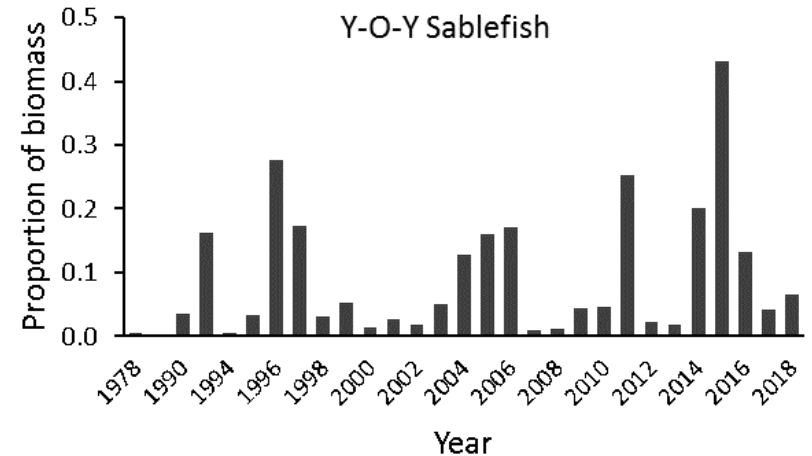
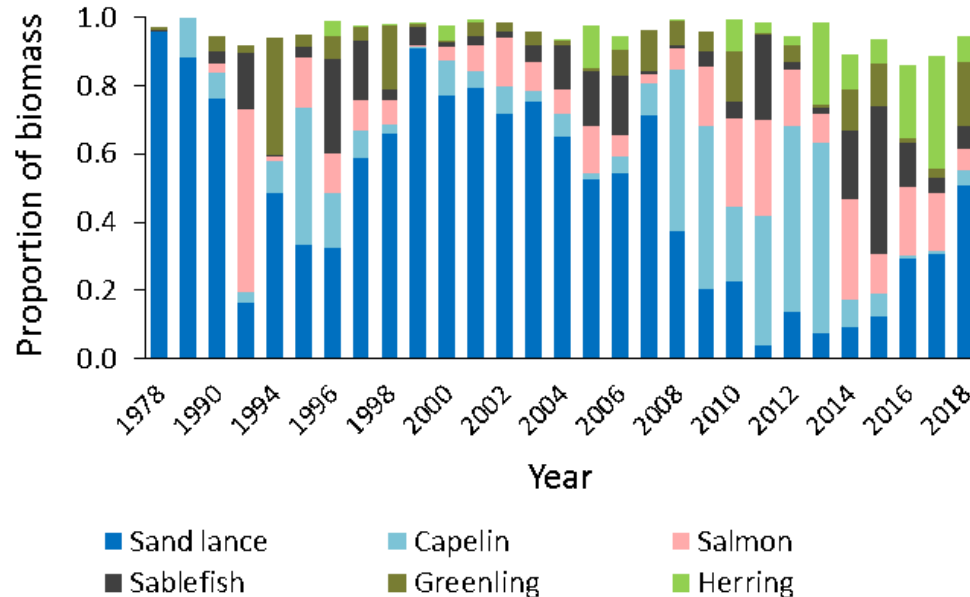


# 2018 forage fish

Hatch et al, Pegau et al

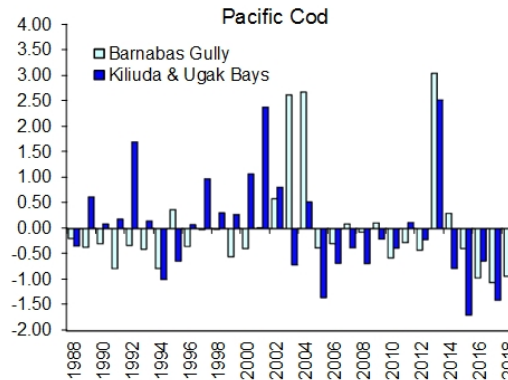
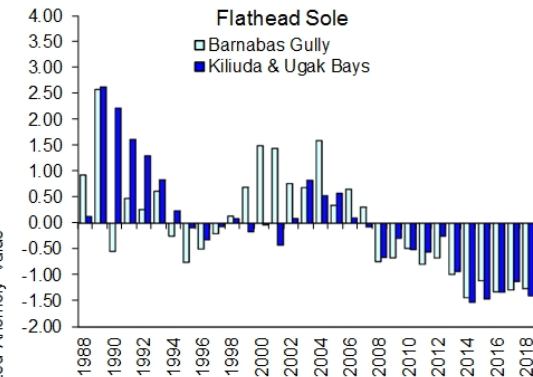
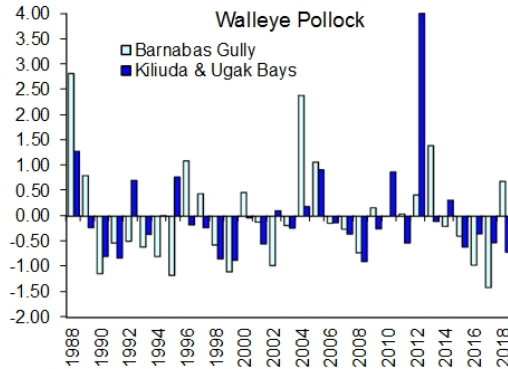
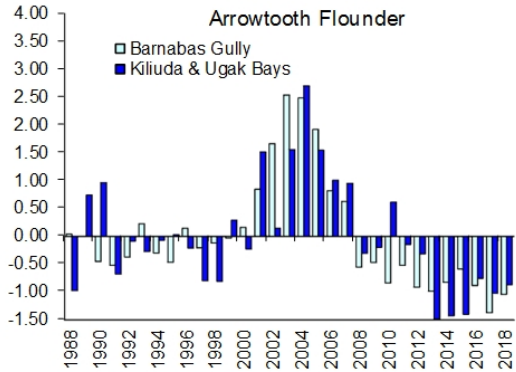
- Sampled from seabirds provisioning chicks at Middleton Island
- Time series also available for herring, salmon
- Lots of age-0 pollock (B. Laurel pers. comm.)
- PWS herring mile-days of milt continued decline to lowest on record

## RHAU chick diet

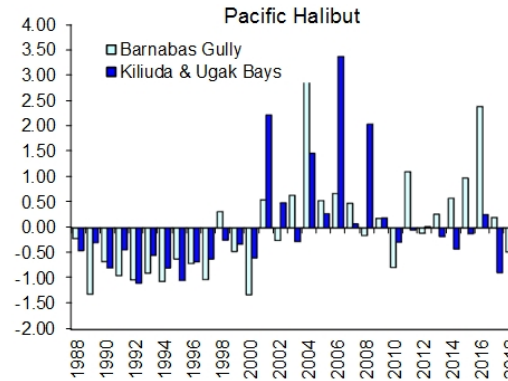
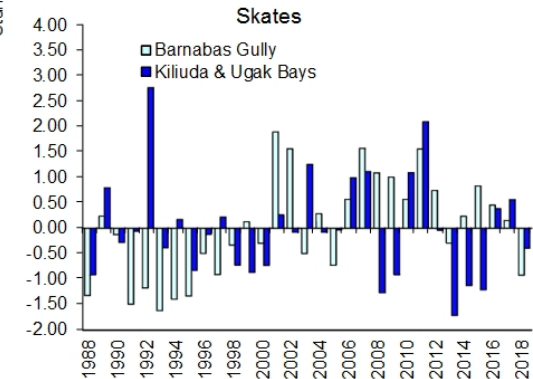


# 2018 groundfish

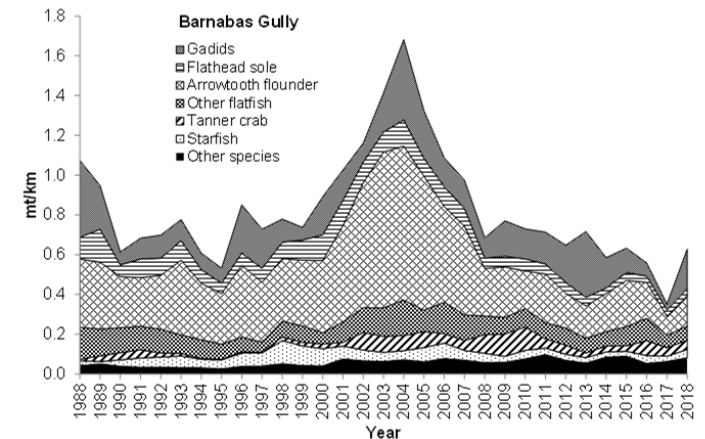
Worton



Standardized Anomaly Value



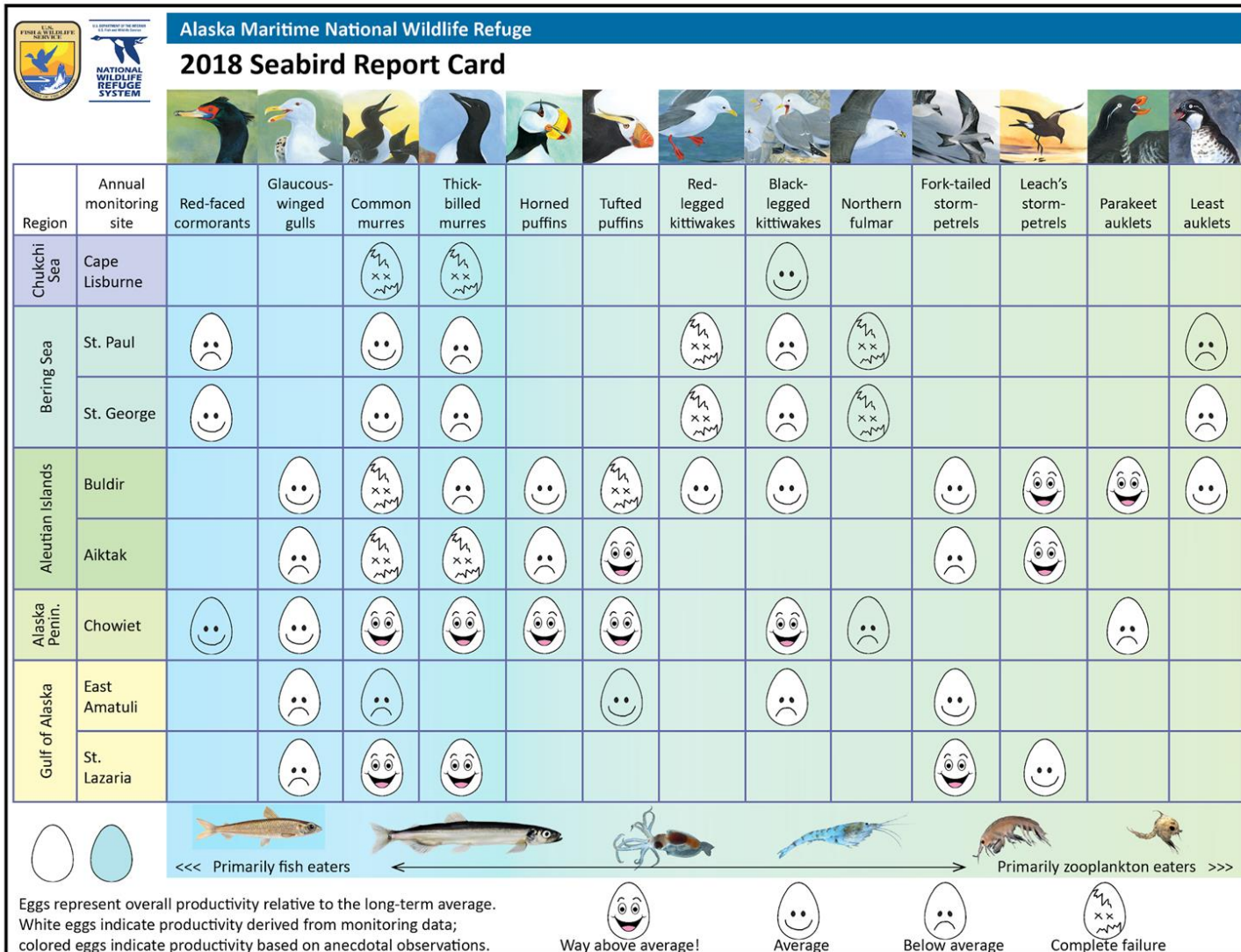
- Large mesh
- Catches remain below the long term mean for ATF, pollock (inshore), flathead sole, cod, skates, halibut
- Overall catch increased from 2017 due to pollock and ATF





# 2018 seabirds

Renner et al



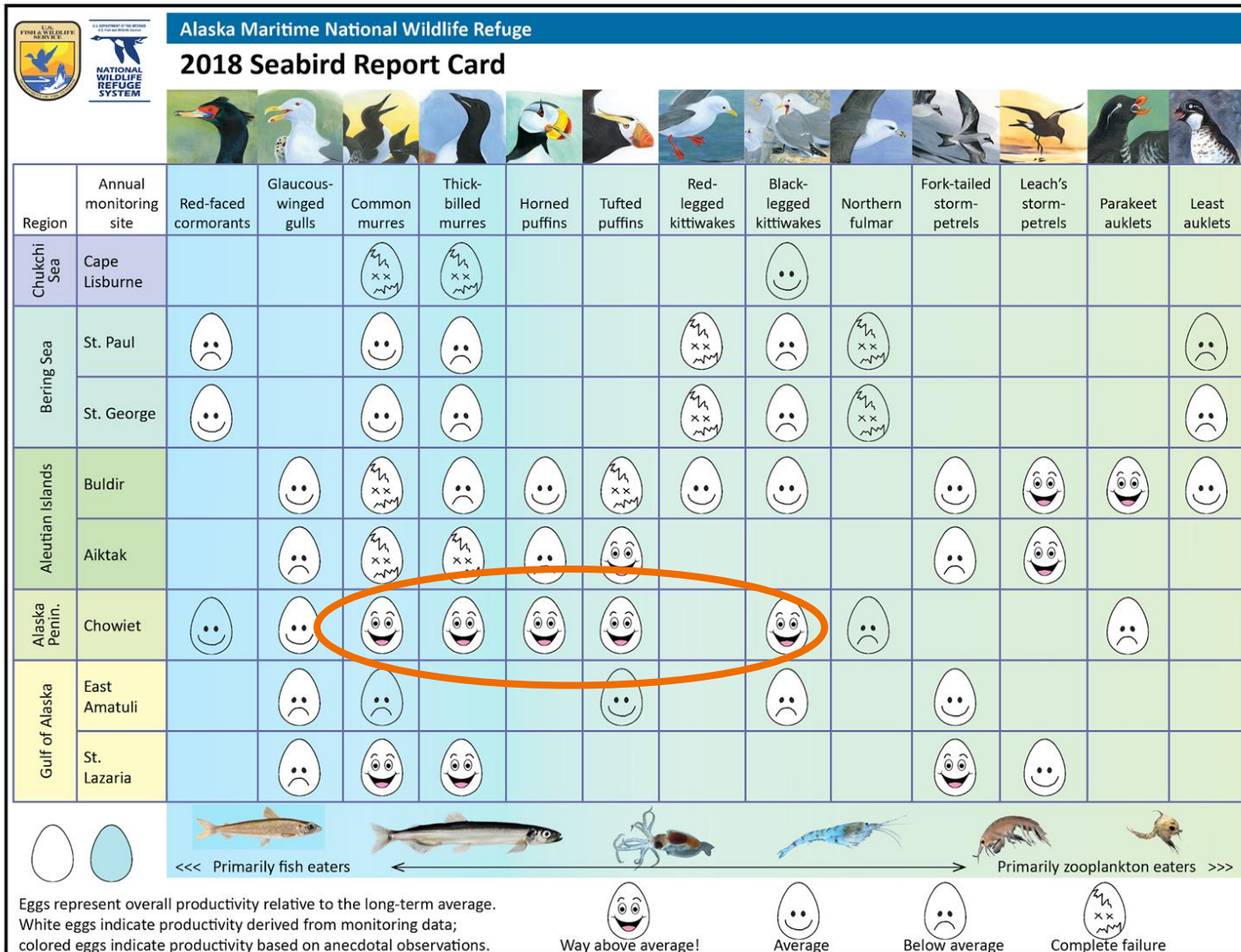
Few murrens at cliffs, but those there did well reproductively

In general, piscivorous birds didn't do well during the heatwave, but planktivorous birds did well (except Chowiet this year)



# 2018 seabirds

Renner et al

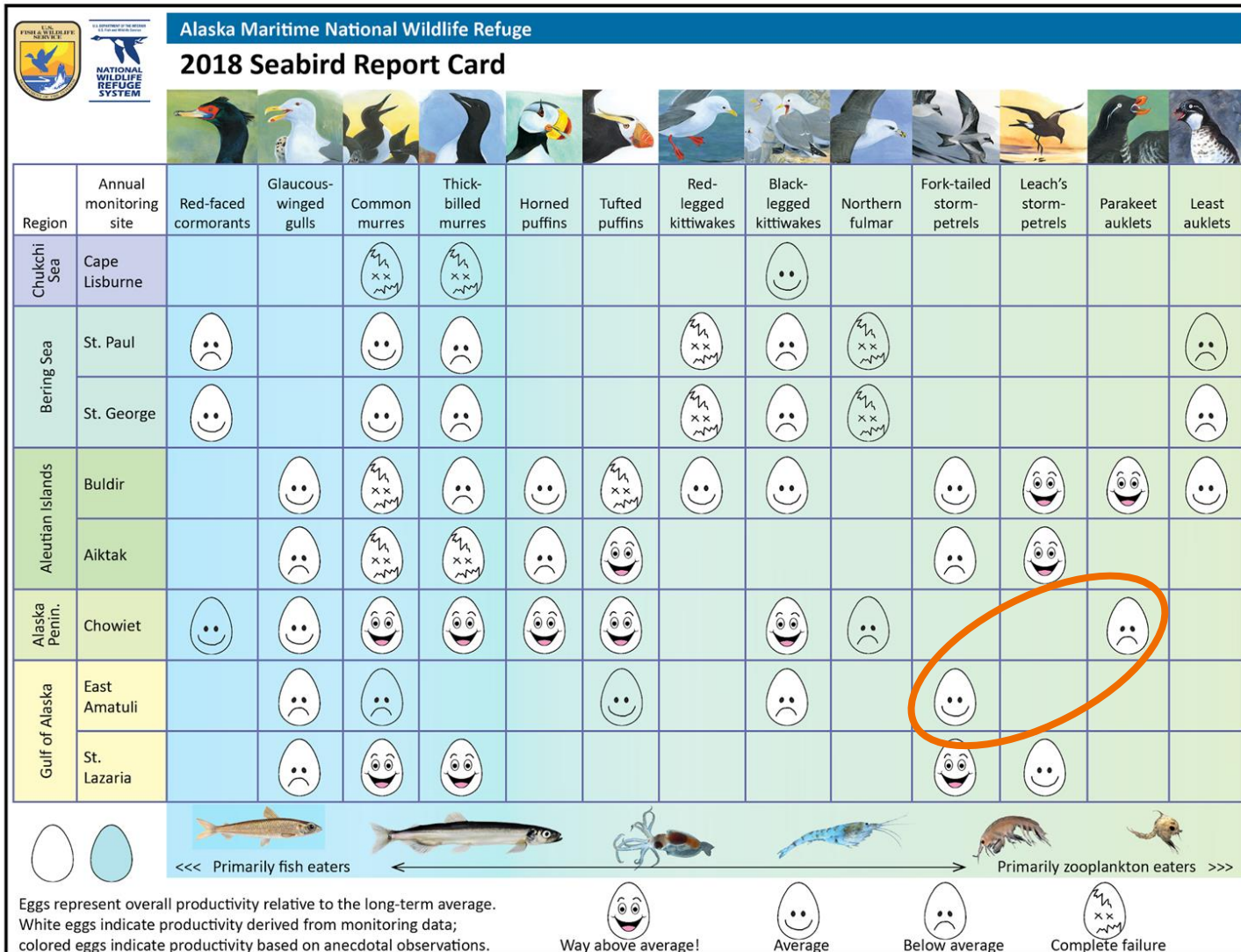


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Renner et al



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# 2018 humpback whales

Moran and Straley

## Fall survey of humpback whales in Prince William Sound

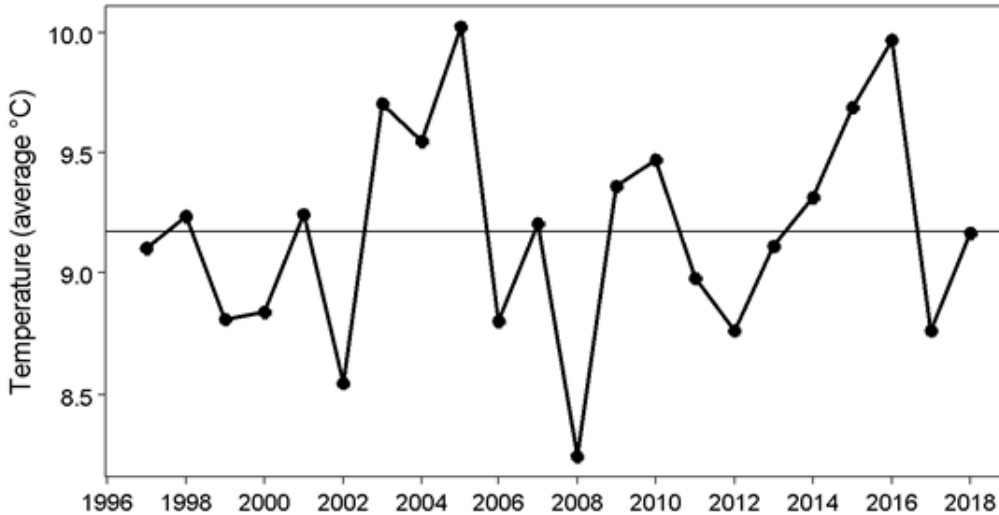
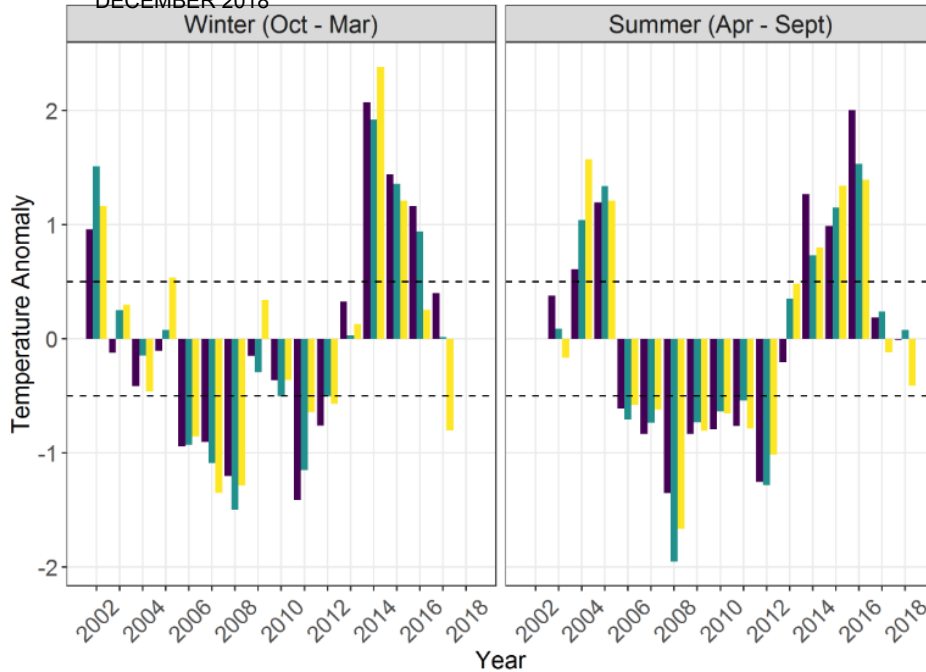
Month/year	Counts of whales	Nautical miles surveyed	Encounter rate Whale/NM
Sep 2007*	24	370	0.06
Sep 2008	71	412	0.17
Oct 2011	62	441	0.14
Sep 2012	81	444	0.18
Sep 2013	113	355	0.32
Sep 2014	181	427	0.42
Sep 2017	12	543	0.02
Sep 2018	17	541	0.03

\* didn't survey hotspot at Montague Entrance

- Some with poor body condition in 2018 but lesser extent than in 2016-2017
- PWS whale decline mirrors herring decline



# Current Conditions Eastern GOA



# 2018 oceanography

Watson, Fergusson

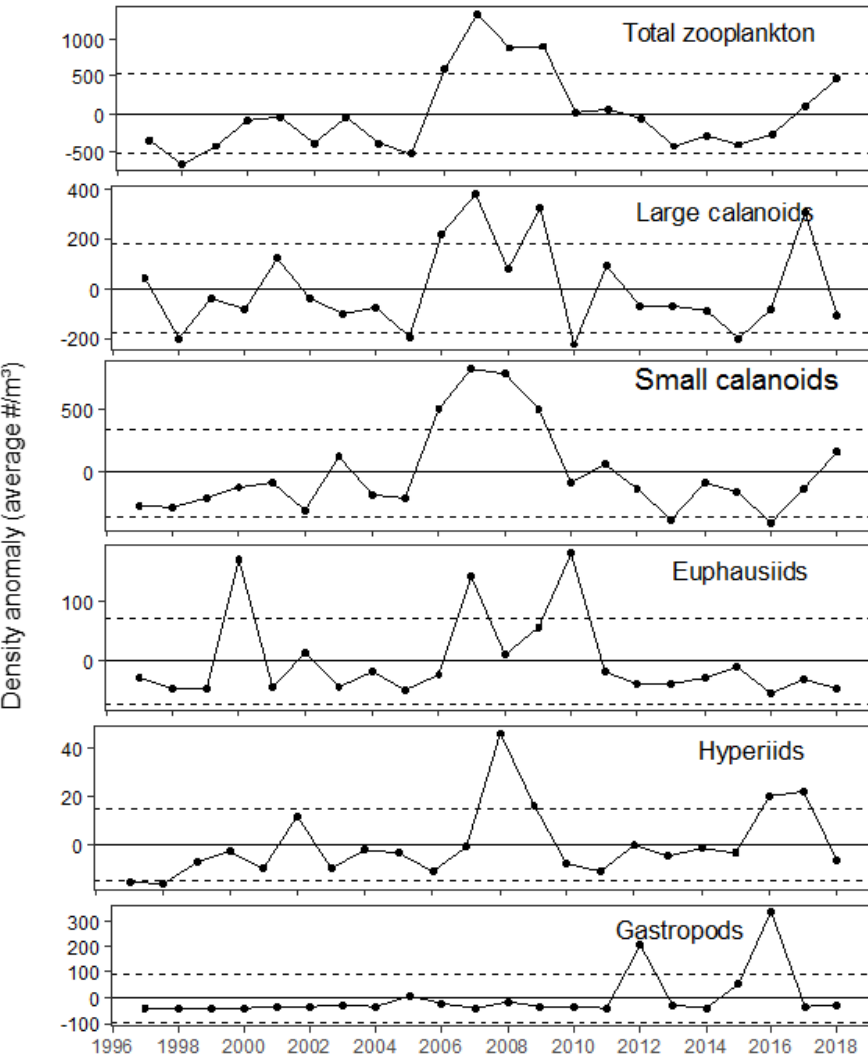
- Satellite derived data indicate cooler winter & spring sea temperatures in the EGOA.
- Icy Strait 20-m integrated SST (May-Aug.) was average (9.2 °C) for the 22 year time series.



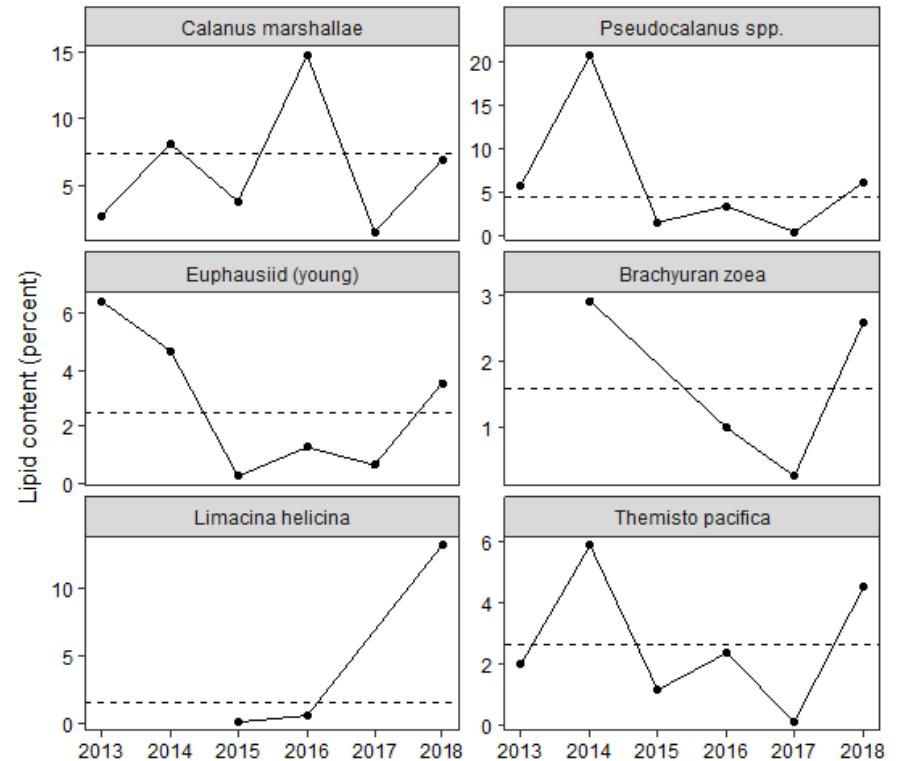
# Icy Strait 1997–2018

# 2018 zooplankton

Fergusson, Fugate

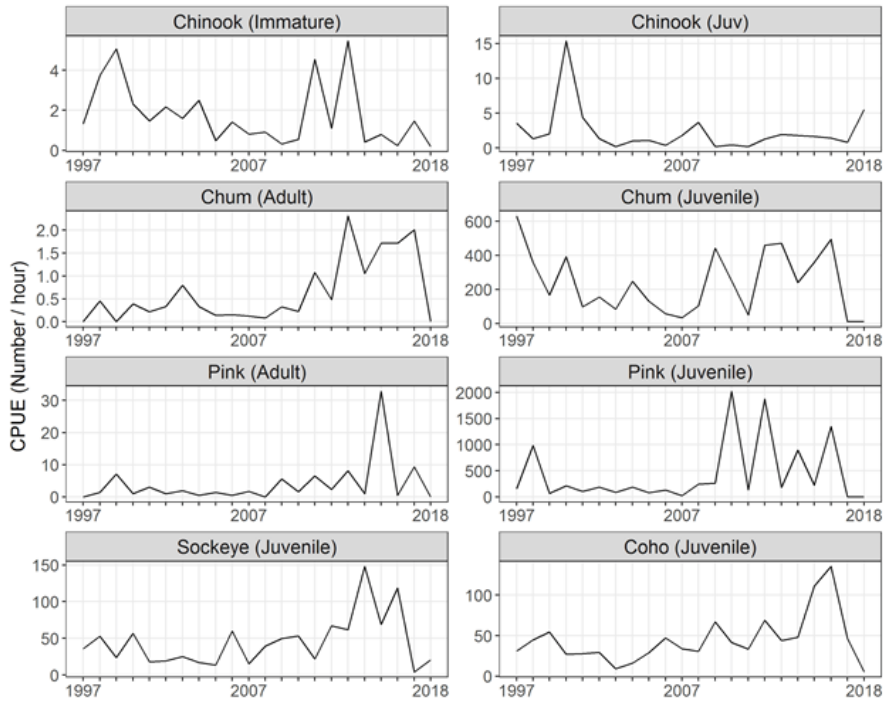


- Increase in zooplankton densities, but
- Decrease in large copepods
- Increase in lipid content (small sample sizes)

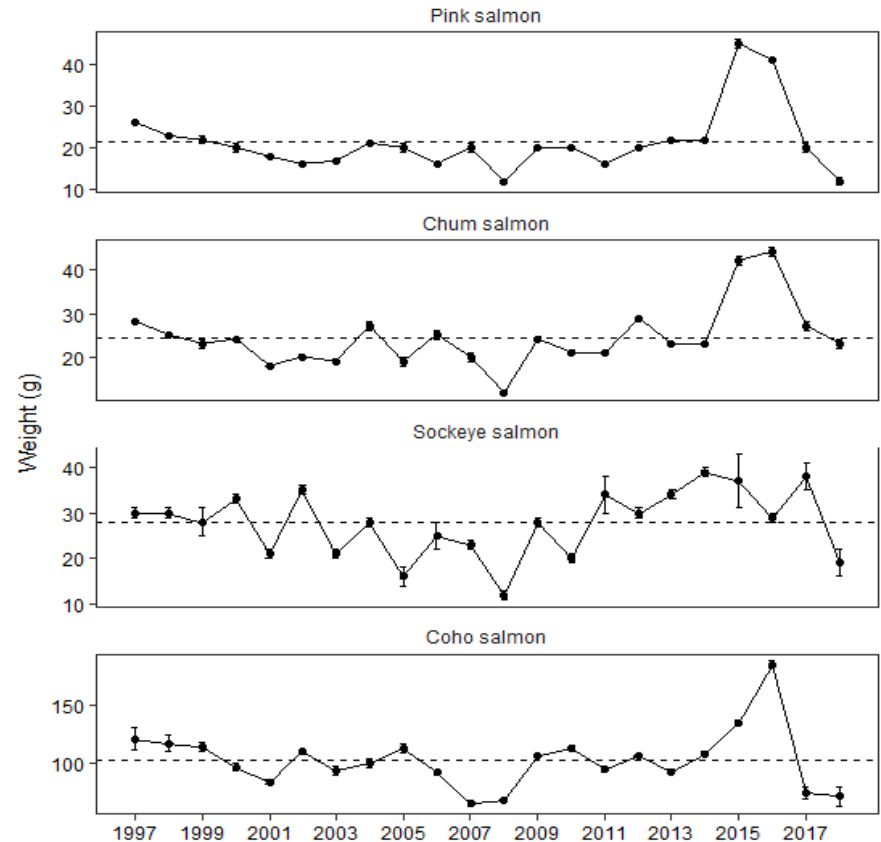


- Icy Strait, 1997–2018
- Low CPUE of juvenile salmon sampled at sea
- Small juveniles in length and weight

## CPUE



## Weight

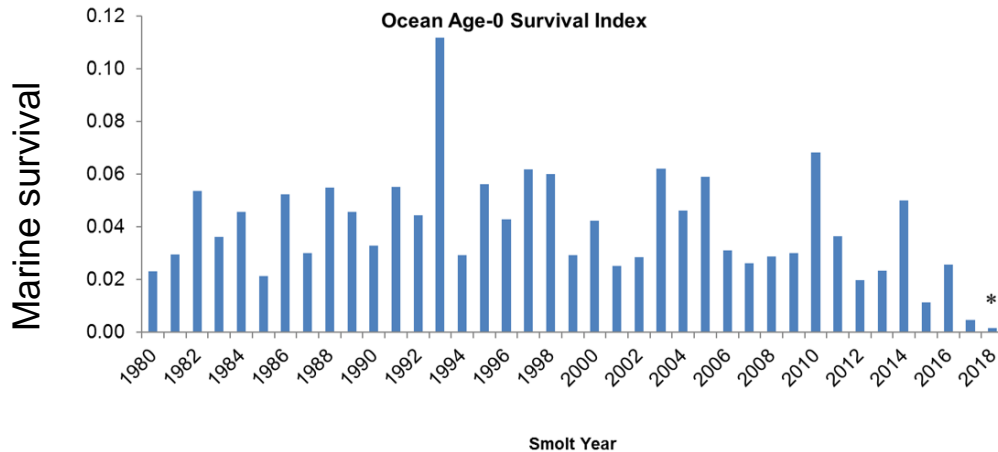


- Auke Creek weir, 1980–2018; Icy Strait
- Low marine survival of coho (piscivores) and pink (planktivores) salmon, 2017 & 2018 out migrants
- Record low returns of adult pink salmon in 2018

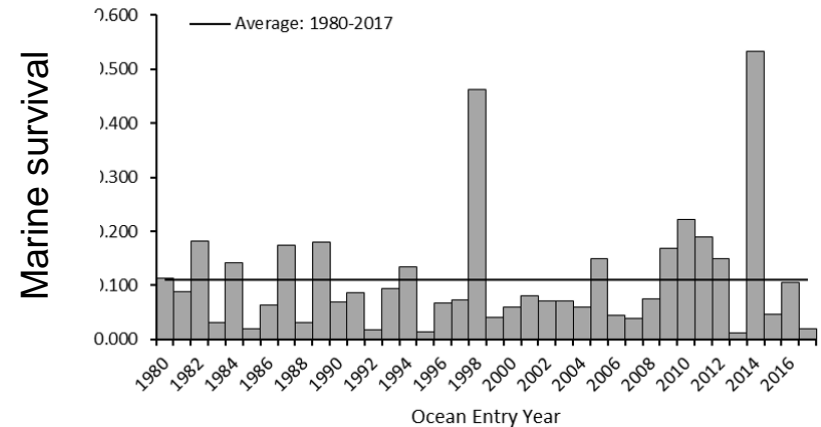
# 2018 salmon

Vulstek, Russell, Yasumiishi

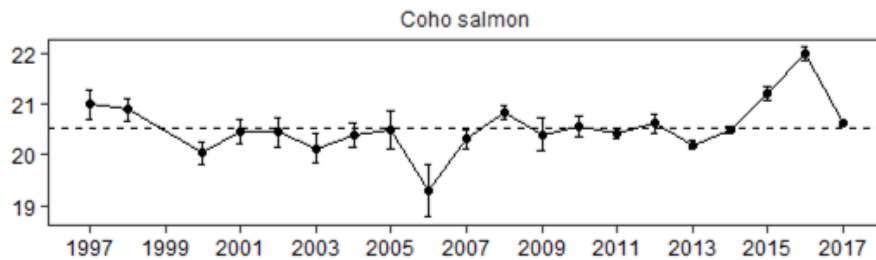
### Coho salmon (jacks)



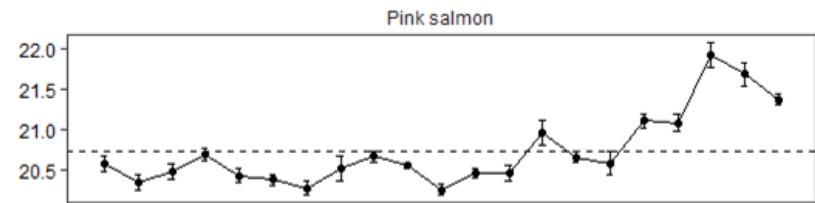
### Pink salmon



### Energy density (kj/g)



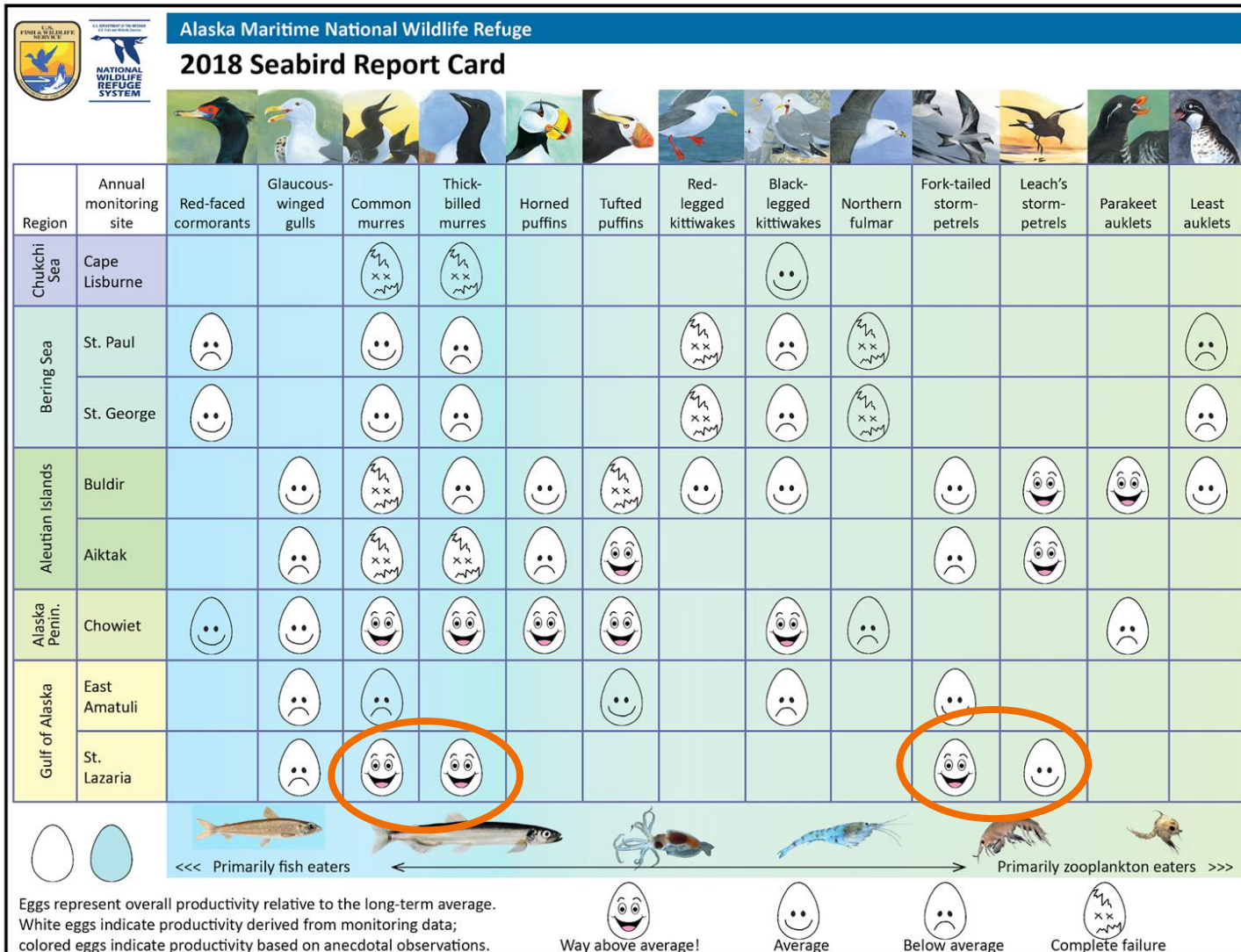
### Energy density





# 2018 seabirds

Renner et al



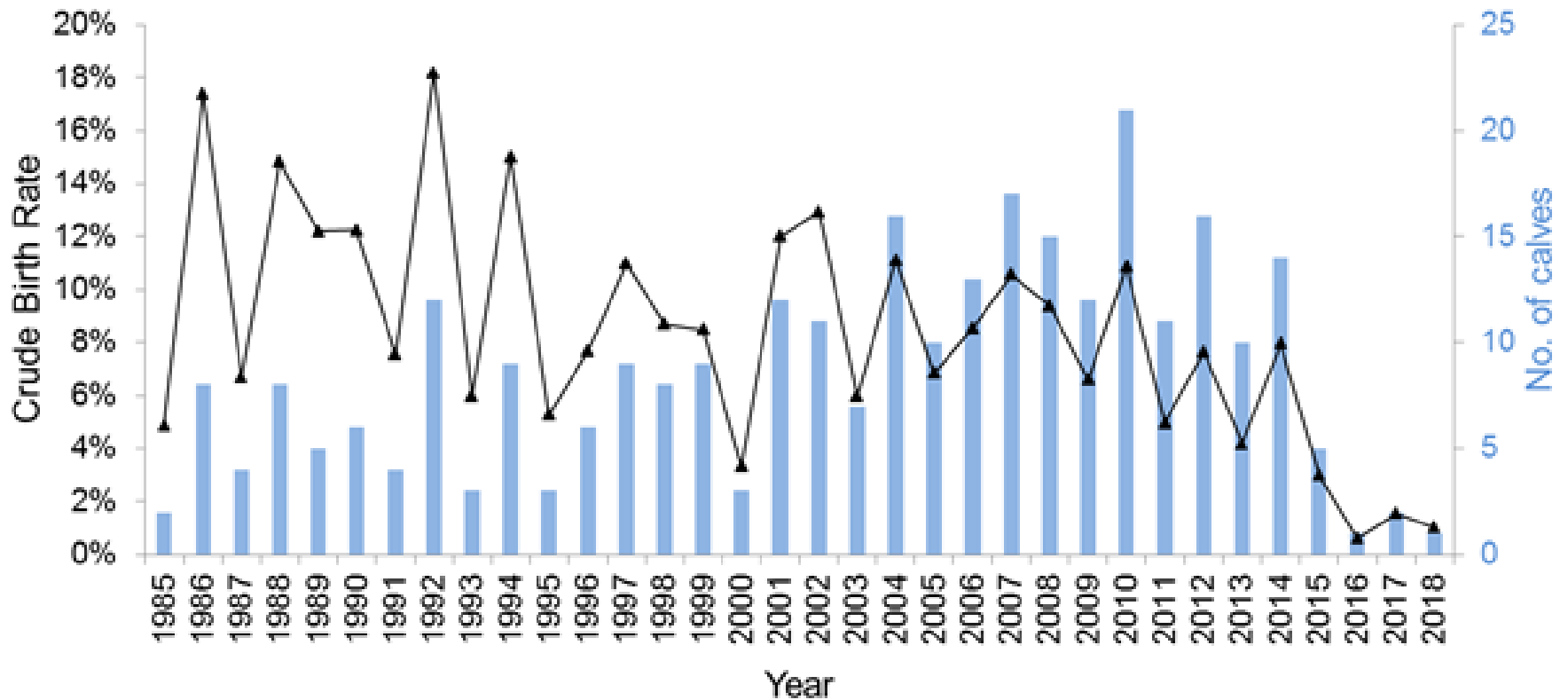
Piscivorous and planktivorous seabirds did well at St Lazaria (Sitka)

- Low crude birth rate (1/99)
- Low calf #
- Improved adult body condition

# 2018 marine mammals

Gabriele, Neilson, Moran

Humpback whales in Glacier Bay, northern southeast Alaska



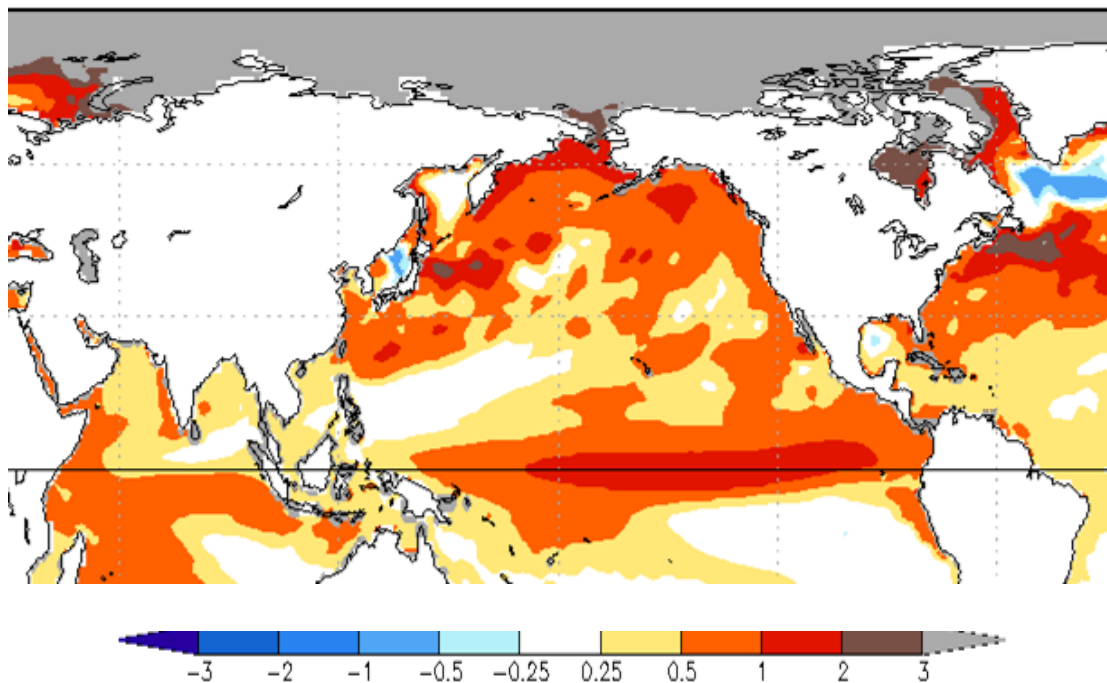
# Predictions and Forecasts

# 2019 Sea Surface Temperature Forecasts

Bond

## Feb-Apr 2019

NMME Forecast of SST Anom IC=201811 for Lead 3 2019FMA



- 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).

# Summary

2018

- The GOA is currently in a heatwave (25 Nov 2018)
  - Warm SST forecasted across North Pacific (Feb-Mar-Apr 2019)
  - In general, during the 2014–2016 heatwave, copepods were small but abundant in WGOA, but forage fish were absent
  - In 2018, mixed zooplankton signals in the western GOA, but good forage fish signals
  - Seabirds and marine mammals continue to show lagged negative effects of the heatwave
-

# Contributors

Mayumi Arimitsu, Steve Barbeaux, Sonia Batten, James Bodkin, Nick Bond, Rob Campbell, Heather Coletti, Ken Coyle, Seth Danielson, Thomas Dean, Alison Deary, Sherri Dressel, Brie Drummond, Anne Marie Eich, Emily Fergusson, Benjamin Fissel, Shannon Fitzgerald, Corey Fugate, Chris Gabriele, Tom Gelatt, Bradley P. Harris, Scott Hatch, Stormy Haught, Kyle Hebert, Ron Heintz, Paul K. Hershberger, Russ Hopcroft, Katrin Iken, Tayler Jarvis, Stephen Kasperski, Arthur Kettle, Brenda Konar, Carol Ladd, Geoffrey Lang, Anna Lavoie, Jean Lee, Daniel Lew, Mandy Lindeberg, Caitlin McKinstry, Kathryn Miers, Jennifer Mondragon, Daniel Monson, John Moran, Franz Mueter, Janet Neilson, John Olson, W. Scott Pegau, John Piatt, Heather Renner, Lauren Rogers, Nora Rojek, Joshua R. Russell, Sioned E. Sitkiewicz, T. Scott Smeltz, Kim Sparks, William Stockhausen, Janice Straley, Rob Suryan, Kathryn Sweeney, Marysia Szymkowiak, John Trochta, Scott Vulstek, Jordan Watson, Sarah R. Webster, George A. Whitehouse, Sarah Wise, Nathan Wolf, Carrie Worton, Ellen Yasumiishi, and Stephani Zador

Thank you!