NOAA FISHERIES

Alaska Fisheries Science Center

2019 Recruitment Processes Alliance (RPA) surveys: Gulf of Alaska, Bering Sea, Arctic

RPA (+): Ecosystems and Fisheries-Oceanography Coordinated Investigations (EcoFOCI), Ecosystem Monitoring and Assessment (EMA), Recruitment Energetics & Coastal Assessment (RECA), *plus* Fisheries Behavioral Ecology (FBE)

Presenter: Lauren Rogers

Ellen Yasumiishi

September 17, 2019

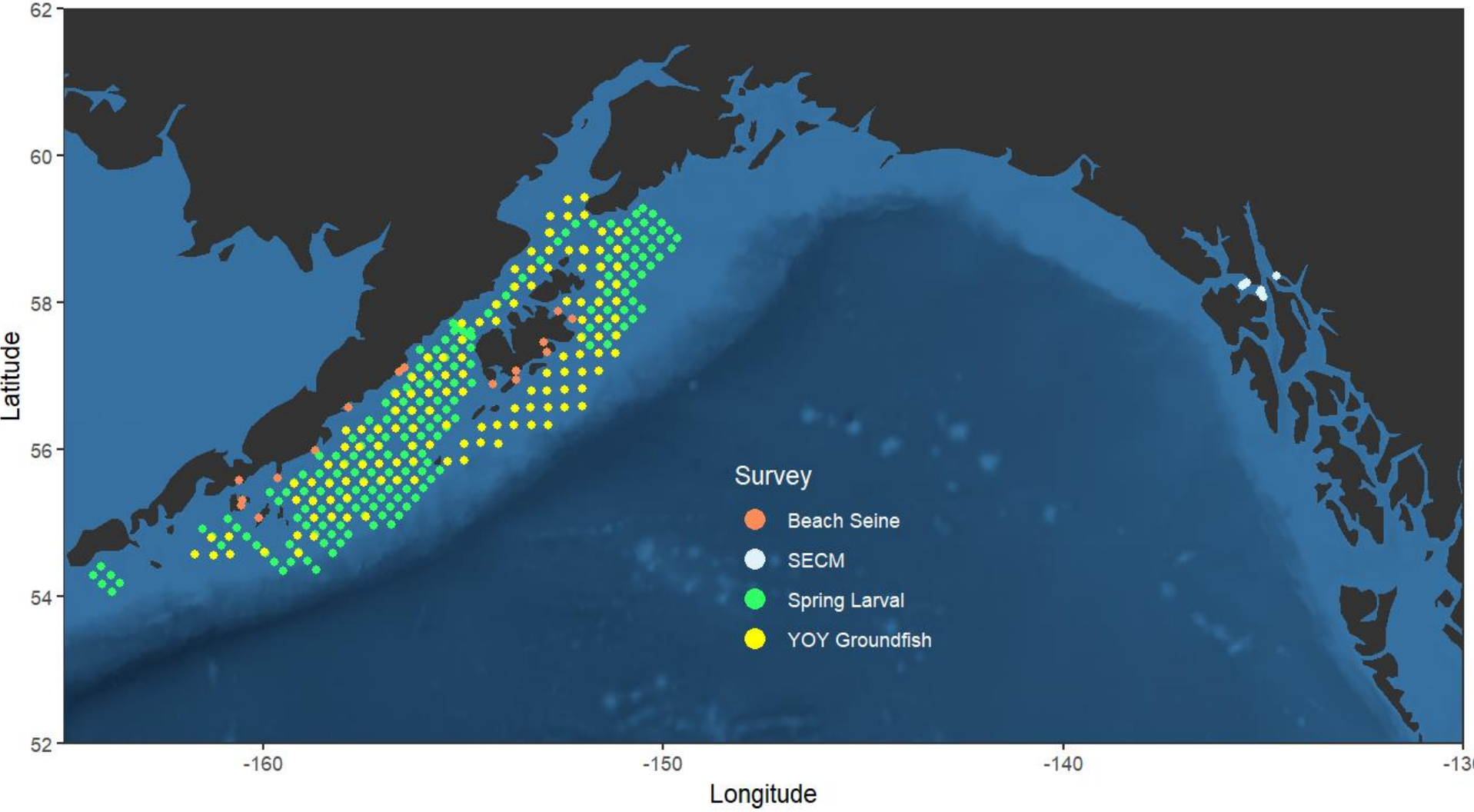
Goal & Objectives

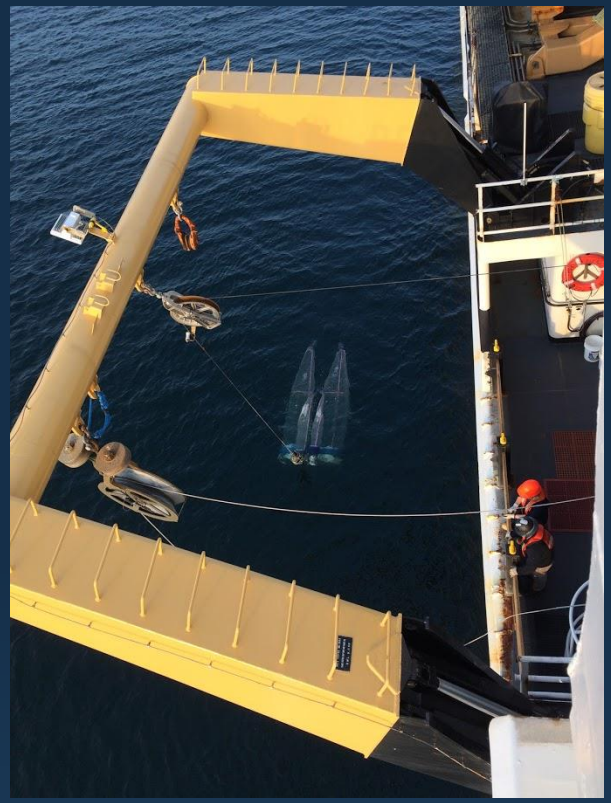
Goal: To provide current information on ecosystem conditions and recruitment processes.

Objectives:

1. Present observations from 2019 surveys.
2. Let you know when & where we collect information on physical and biological oceanography, zooplankton, jellyfish, and fish.
3. Provide basis for ongoing dialogue on which data/indicators are useful for stock assessments, ESRs, ESPs.
4. Update on targeted efforts to integrate recruitment models and indicators into stock assessments.

2019 GOA Ecosystem Surveys





Western Gulf of Alaska

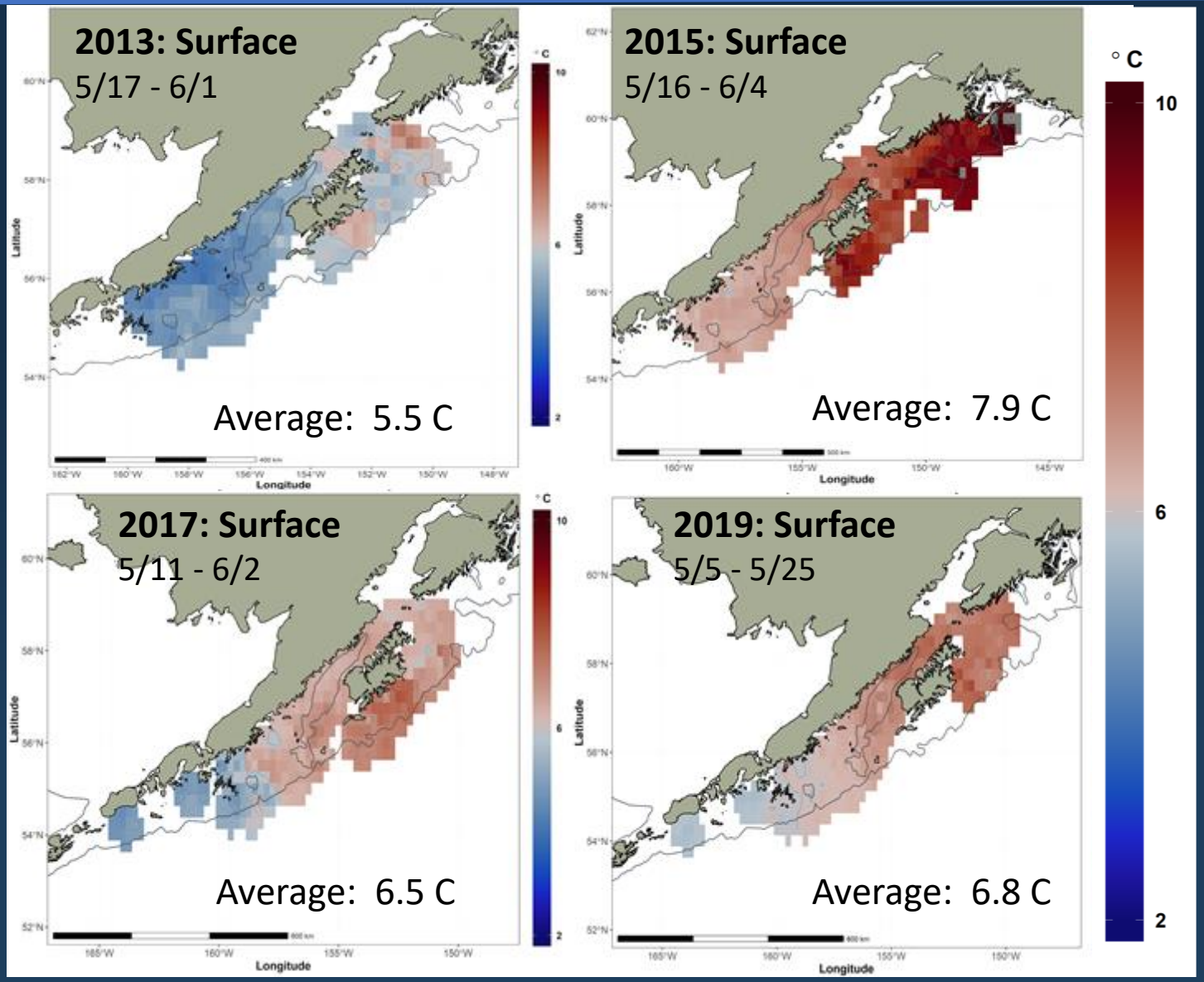
Spring Larval Survey

May 2019

Bongo w/ FastCAT

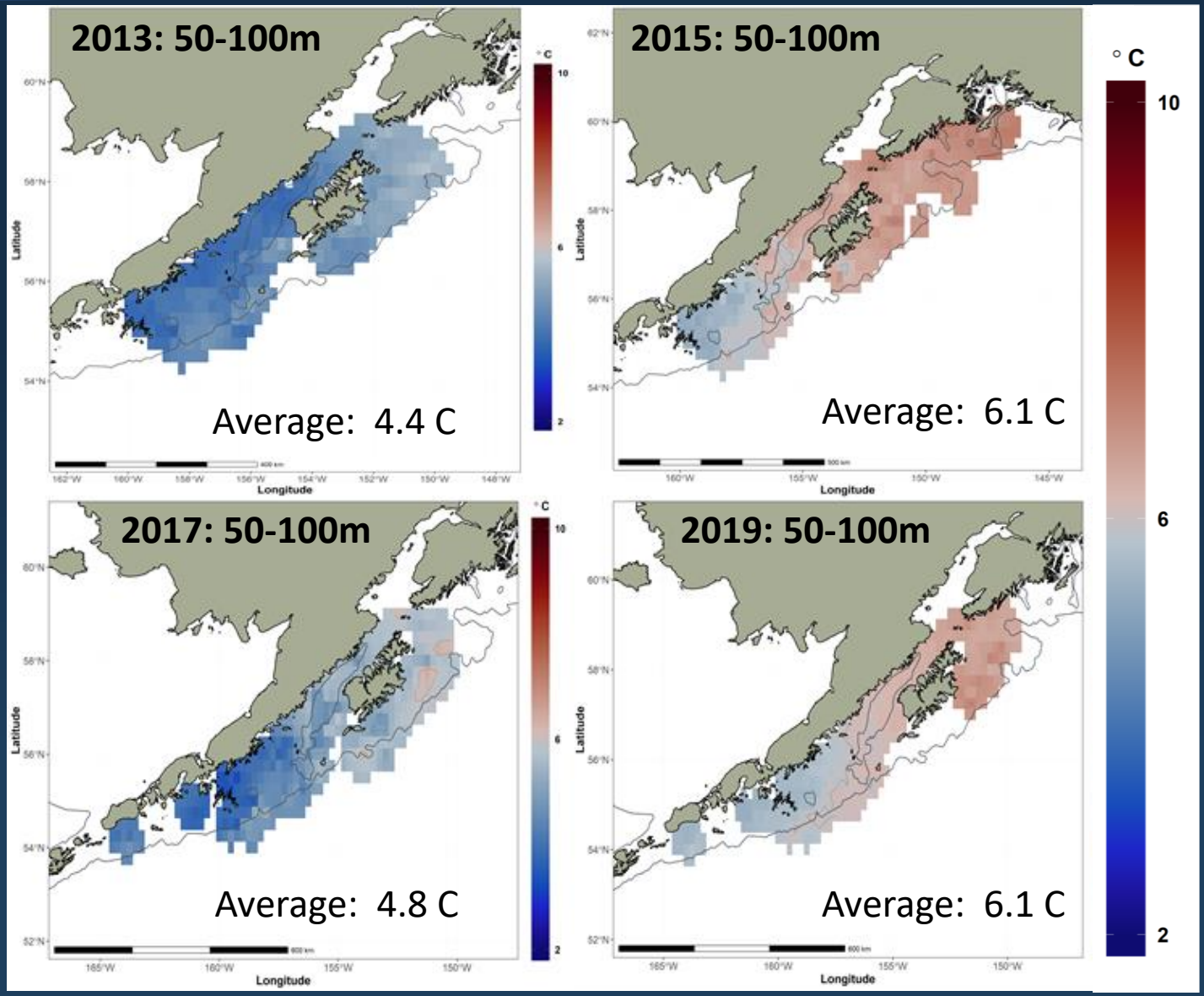
Contact: Janet Duffy-Anderson

Spring (May) Surface Temperature (0-10 m)



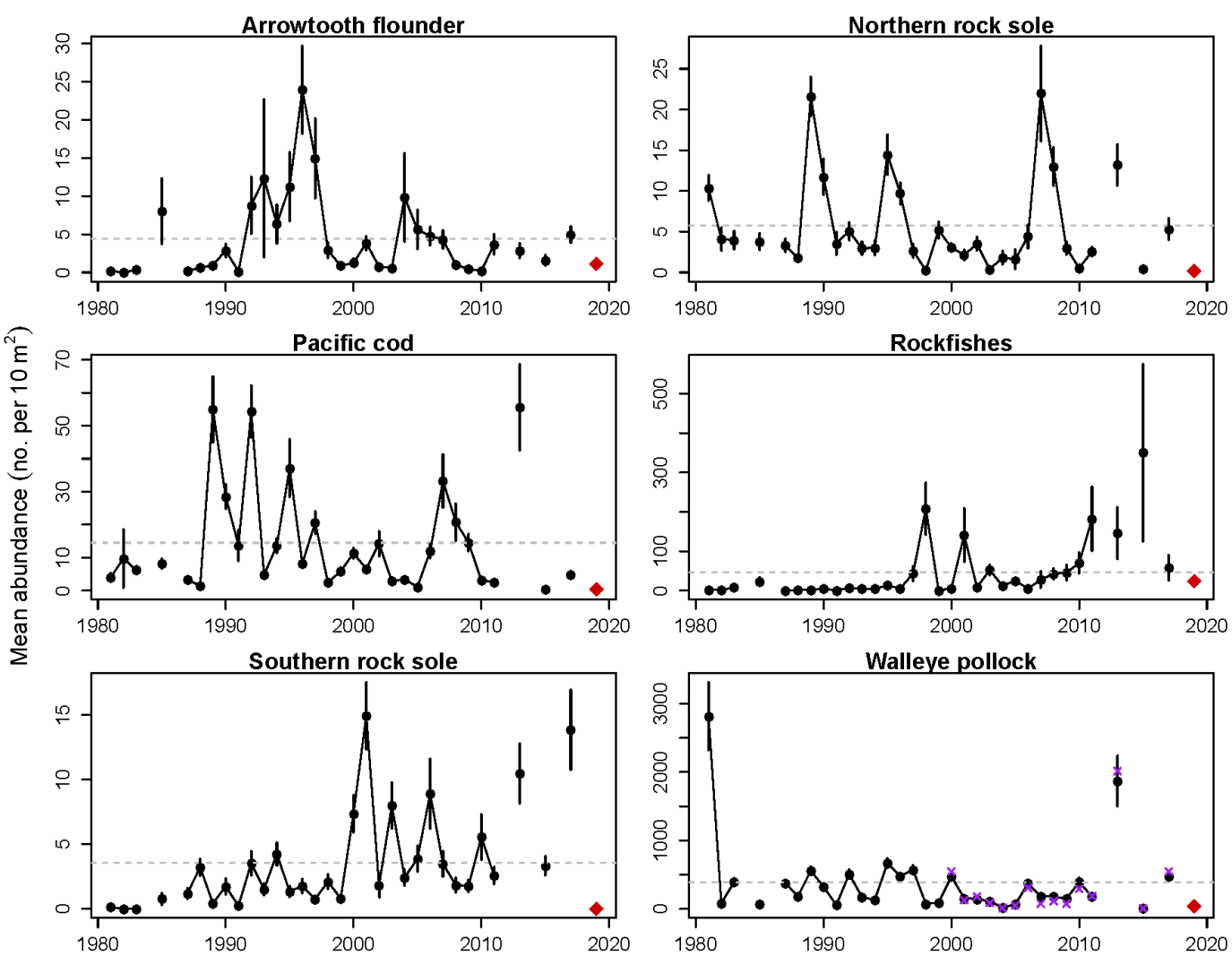
SST:
2019 similar to 2017 but warmer in Shelikof Strait

Spring (May) Temperature at depth (50-100m)



Near bottom temperature (50-100m); 2019 similar to 2015

Spring Larval Fish Abundance (Rapid Larval Assessment)



Take home

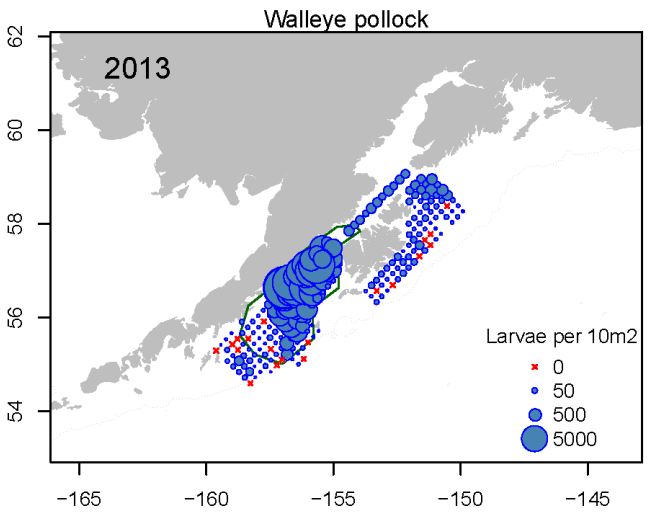
Few larval fish in Spring 2019.

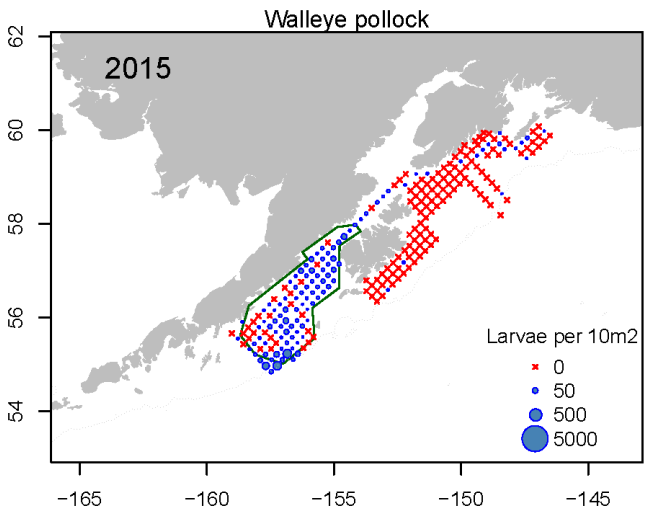
Second lowest Pcod catch.

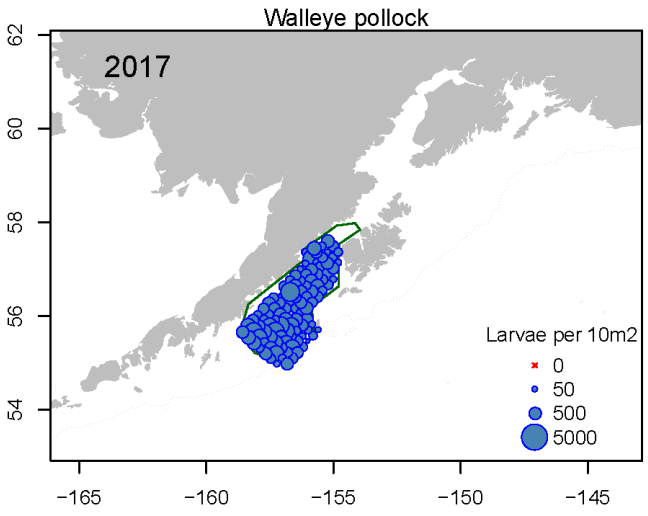
Third-lowest pollock catch.

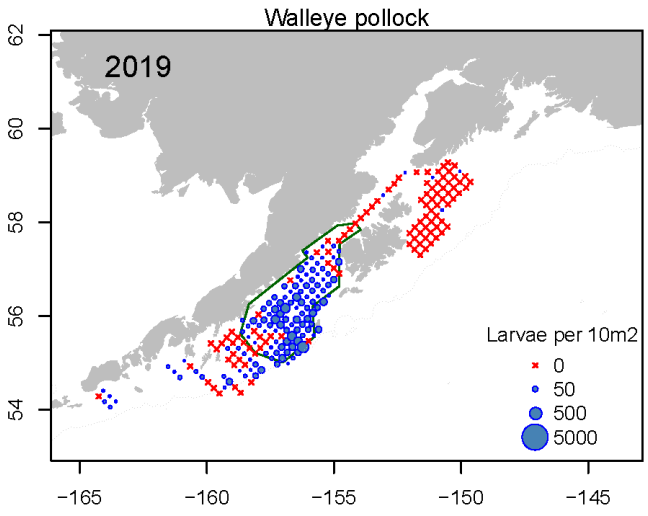
Contact: Janet Duffy-Anderson, Lauren Rogers

Spring - Walleye Pollock larvae







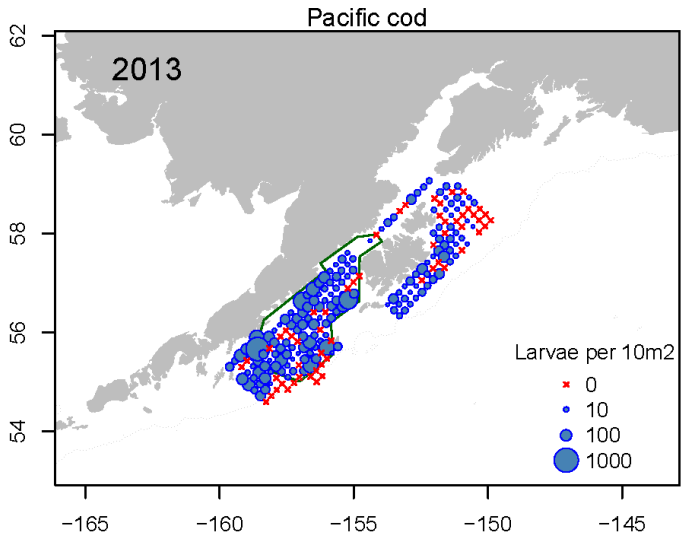


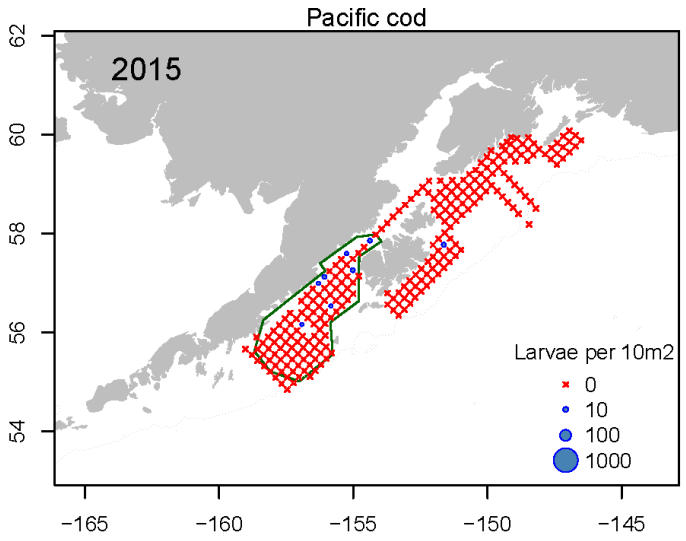
Take home

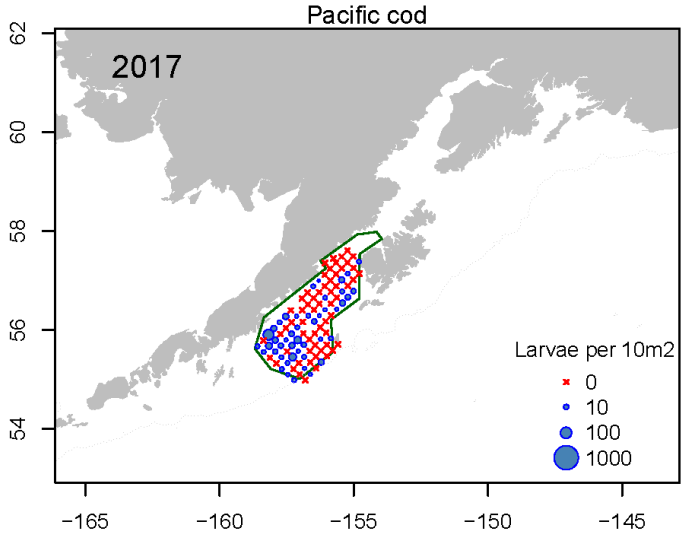
Very low abundance.

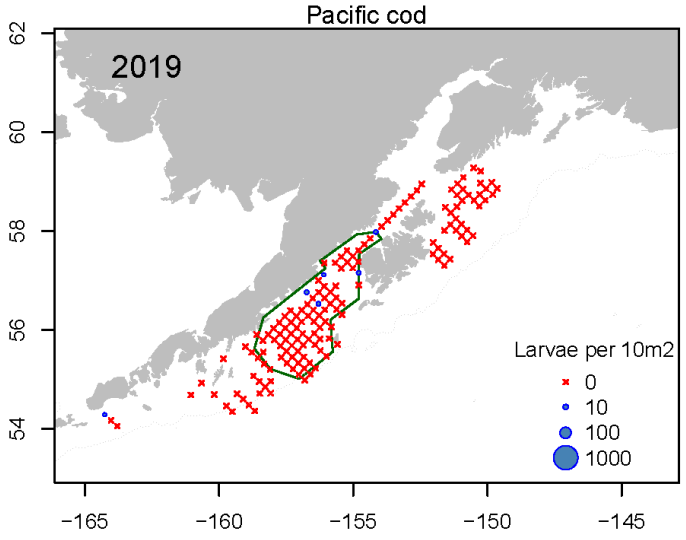
Distribution similar to 2015.

Spring - Pacific cod larvae





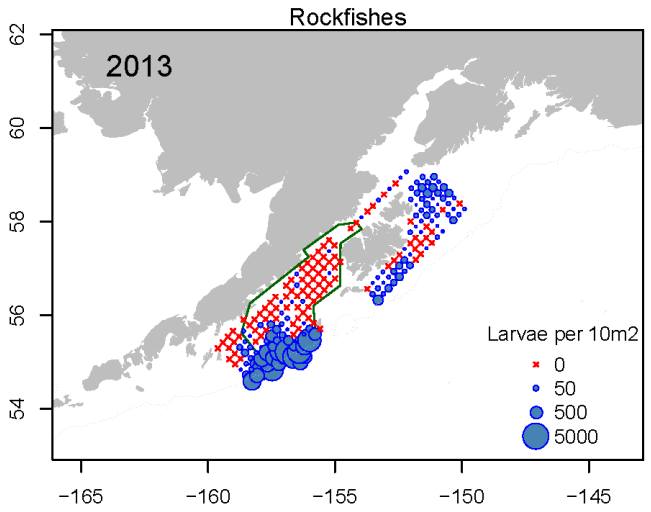


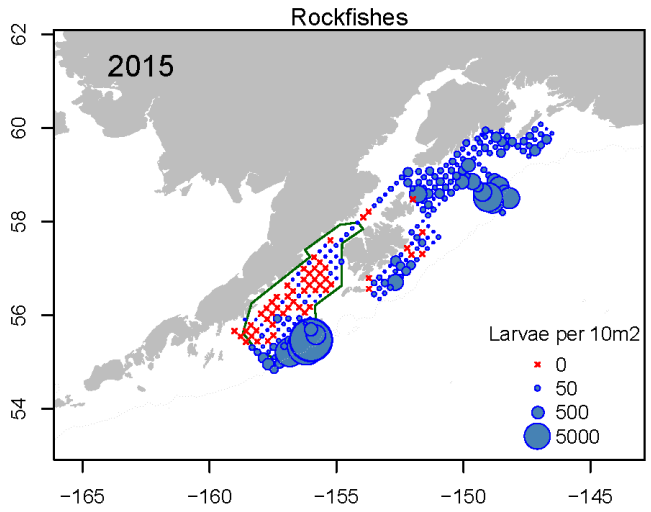


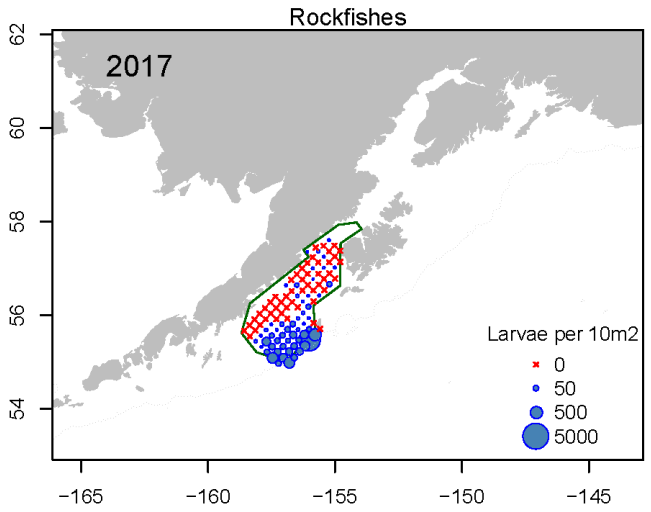
Take home

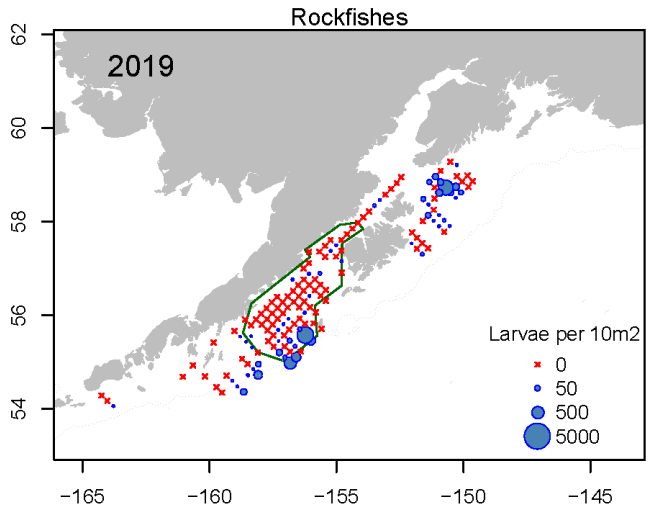
Almost no Pacific cod in 2019

Spring - Rockfishes spp. larvae





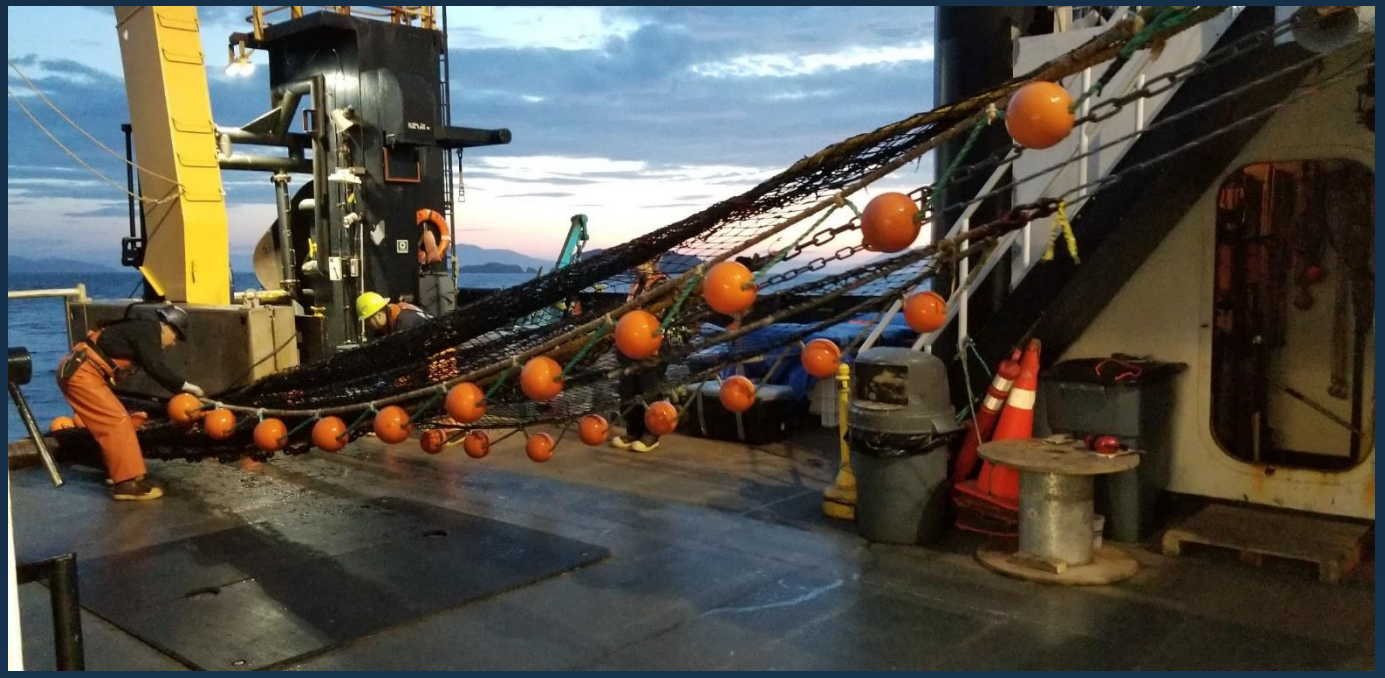




Take home

Low catches in 2019, unlike 2015.

Habitat on periphery of sampling grid.



Western Gulf of Alaska

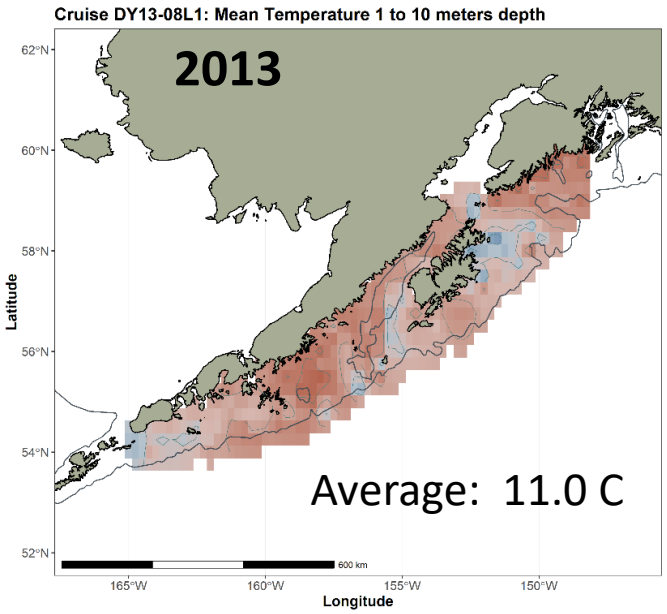
Late summer YOY groundfish and ecosystem survey

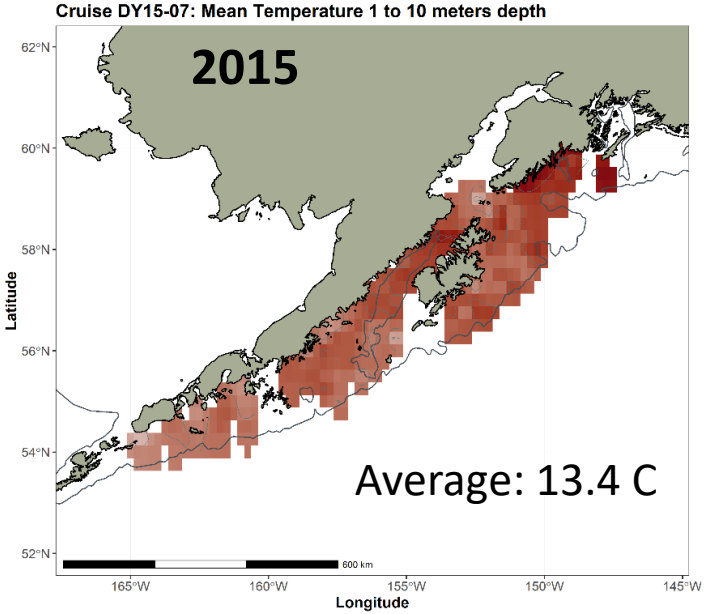
August – September 2019

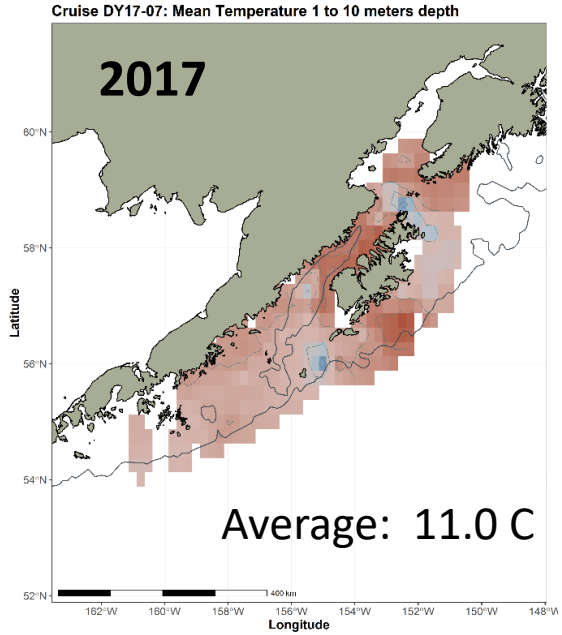
Bongo w/ FastCAT, Midwater trawl

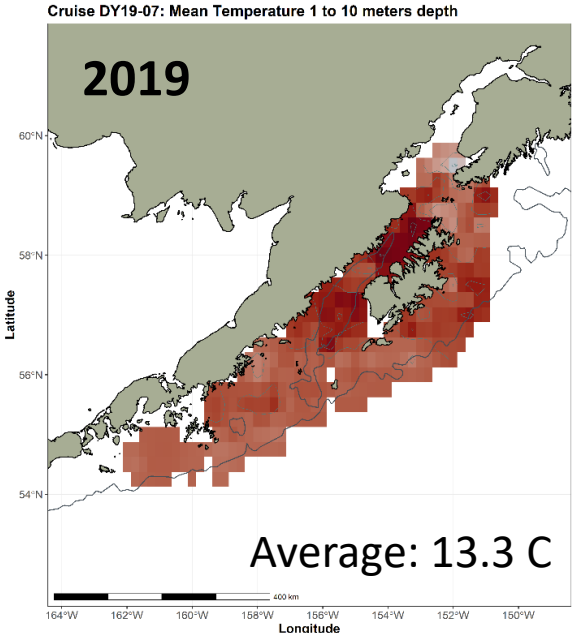
Contact: Janet Duffy-Anderson

Late Summer (Aug – Sept) Surface temperature

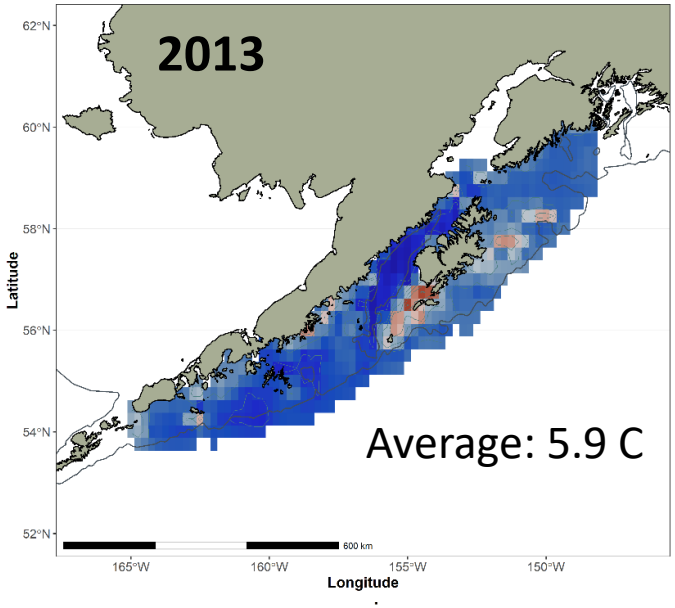


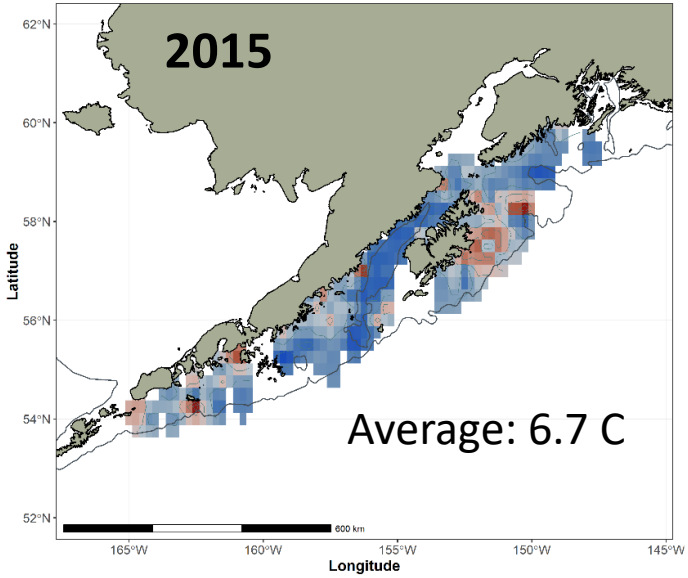


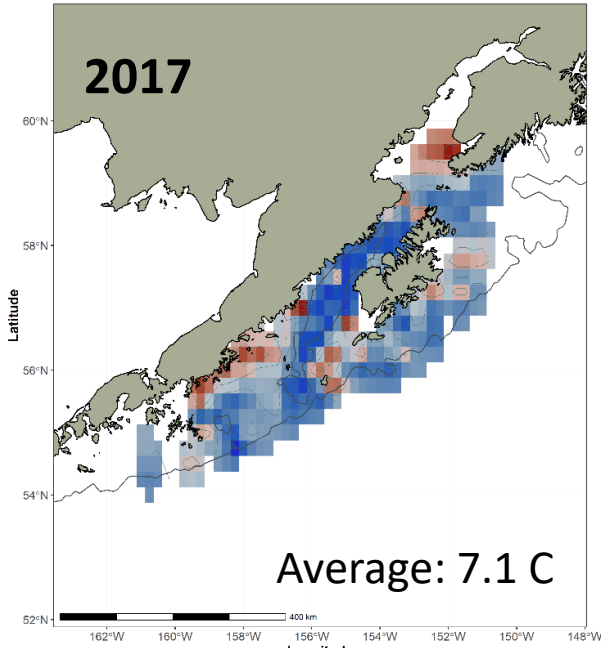


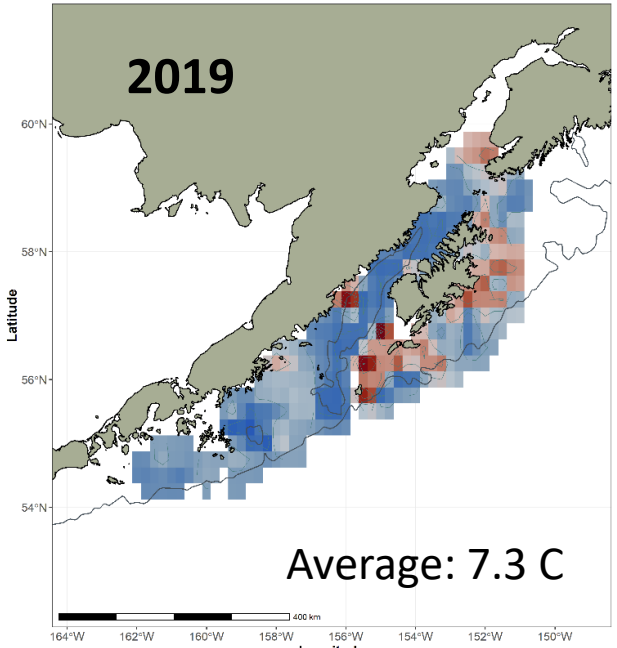


Late Summer (Aug – Sept) Bottom temp (at 200m or bottom)

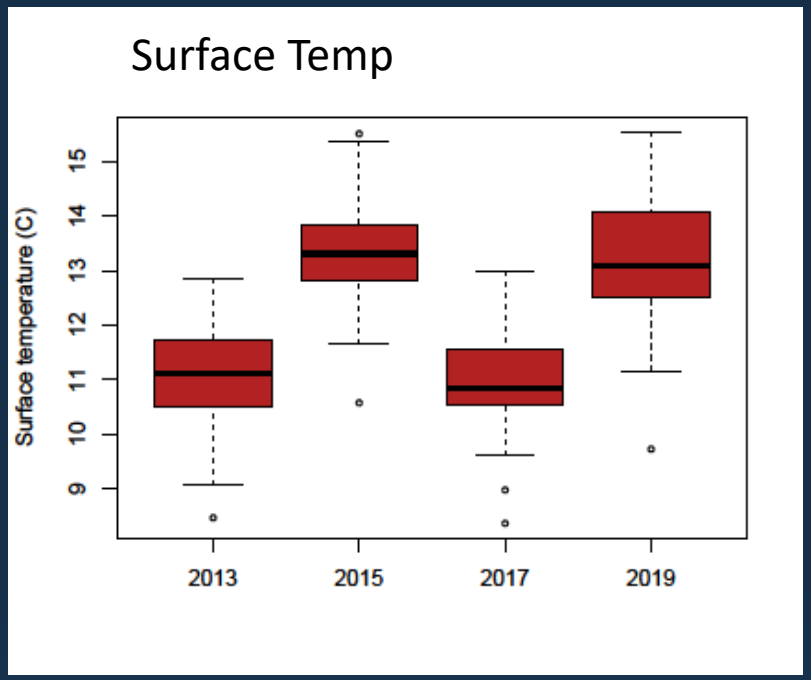


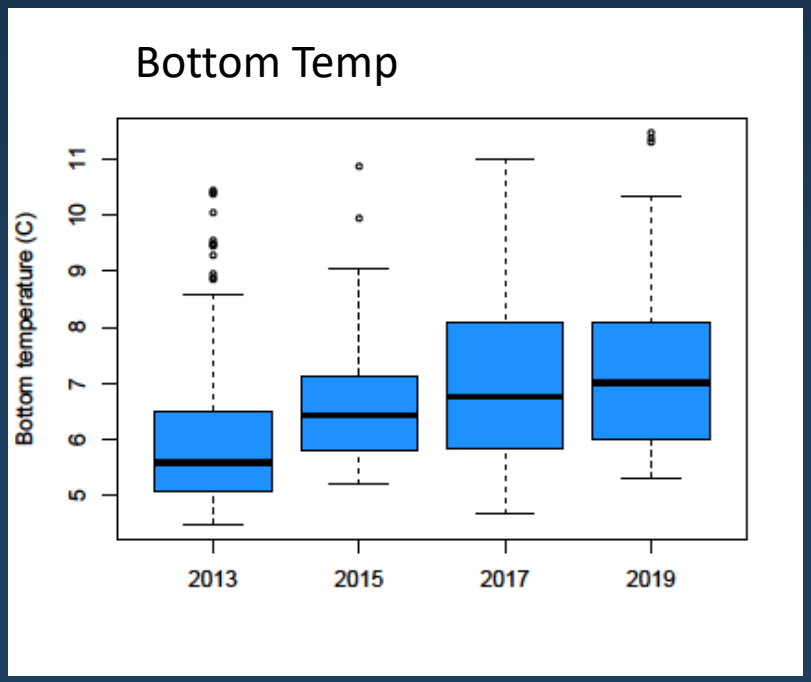


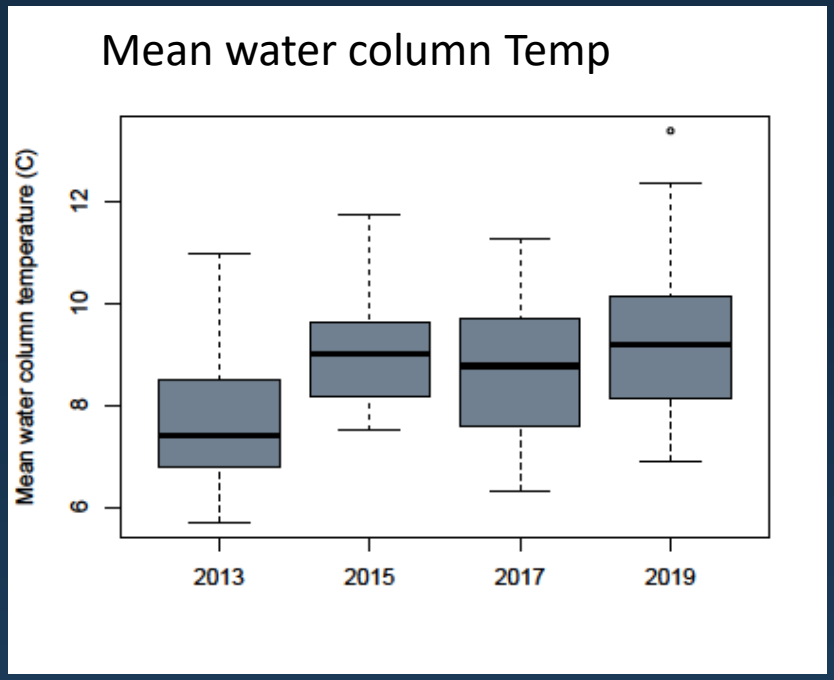




W GOA August-September water temperature

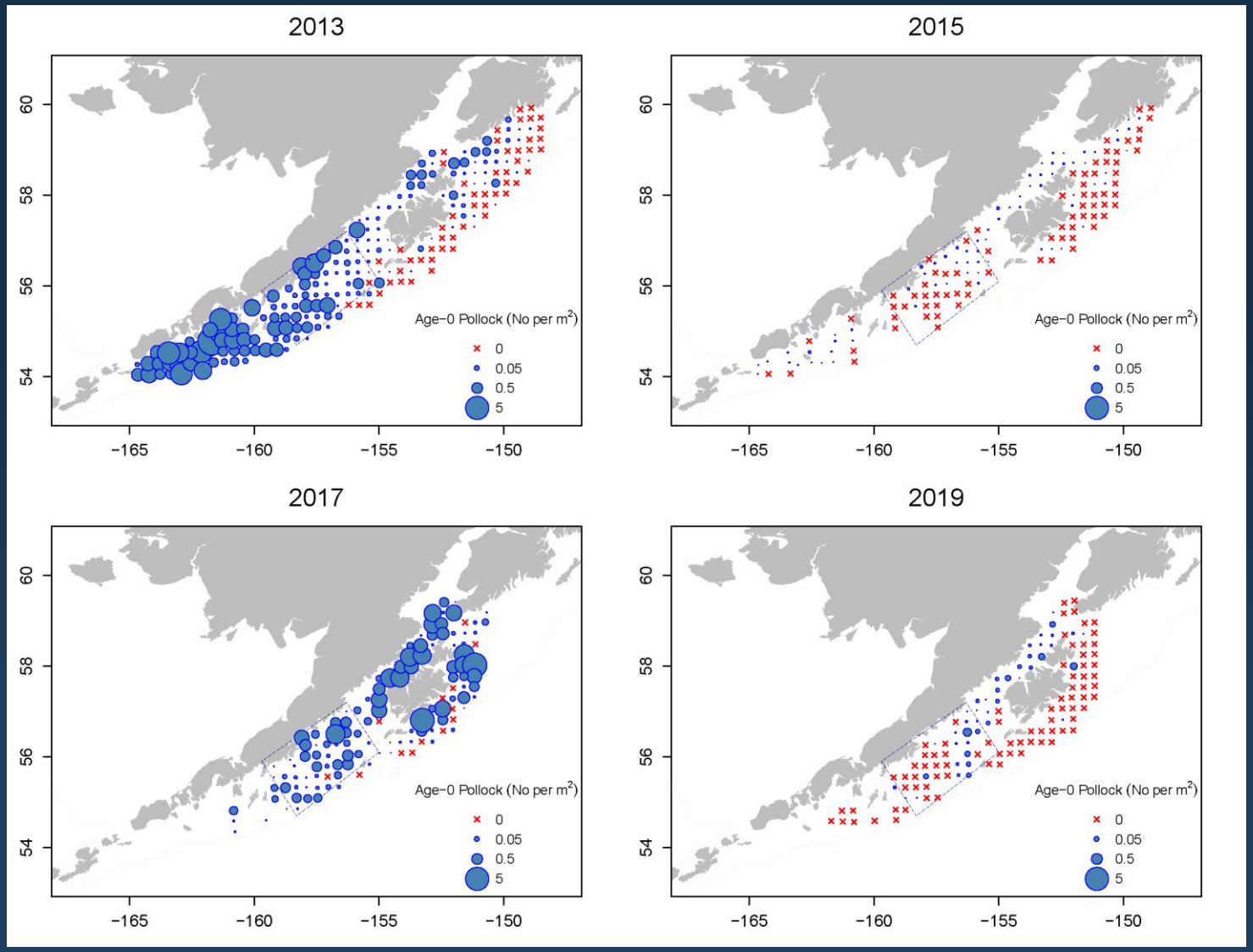






- In 2019, W GOA was warm throughout water column.
- 2019 warmer than 2015 on average.
- Few areas on shelf with <6 degree water.

Late summer Age-0 (YOY) Pollock



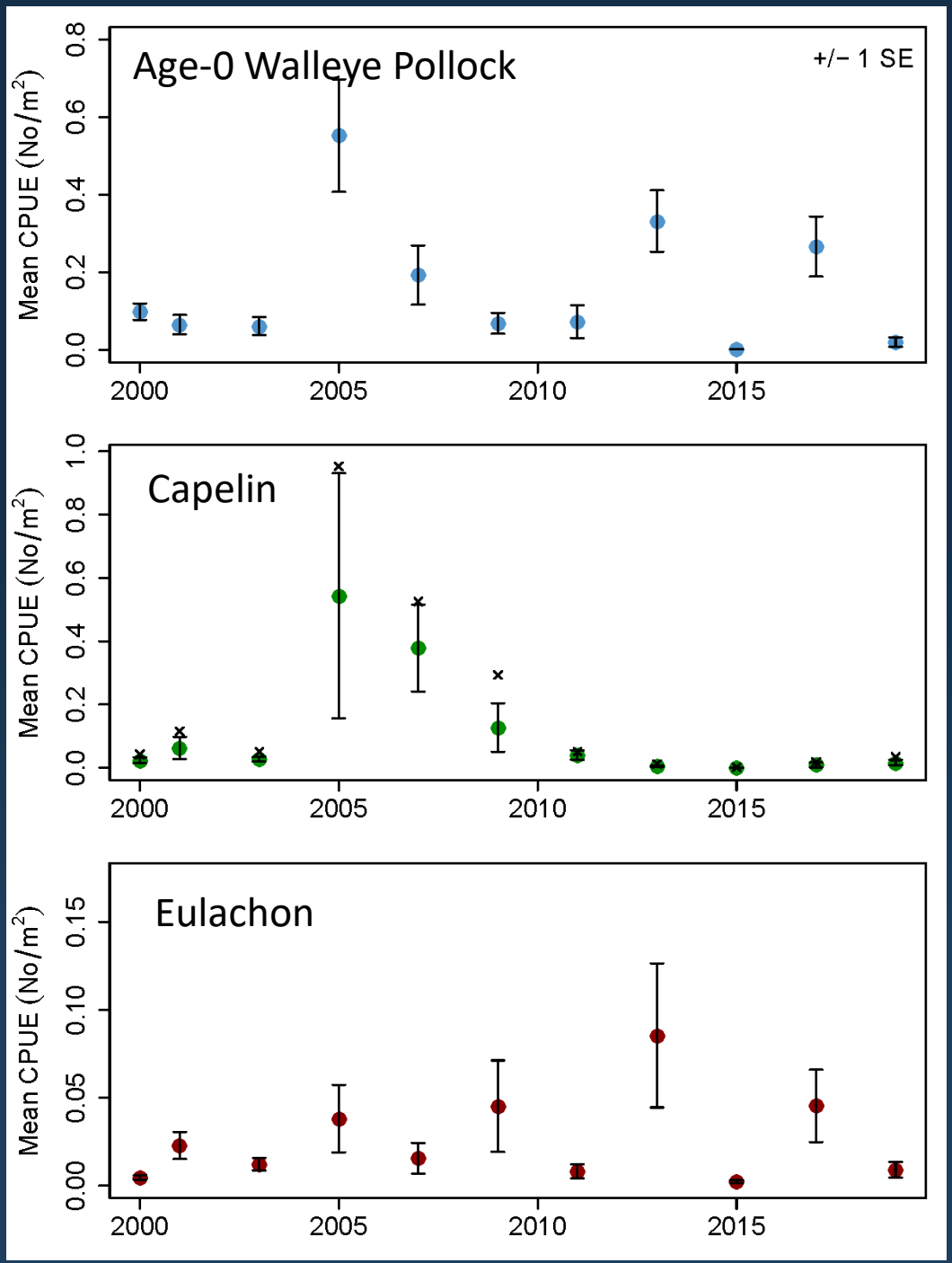
Take home

Few YOY pollock in late summer.

Concentrated in Shelikof.

Likely to be a weak 2019 year class.

Contact: Janet Duffy-Anderson, Lauren Rogers

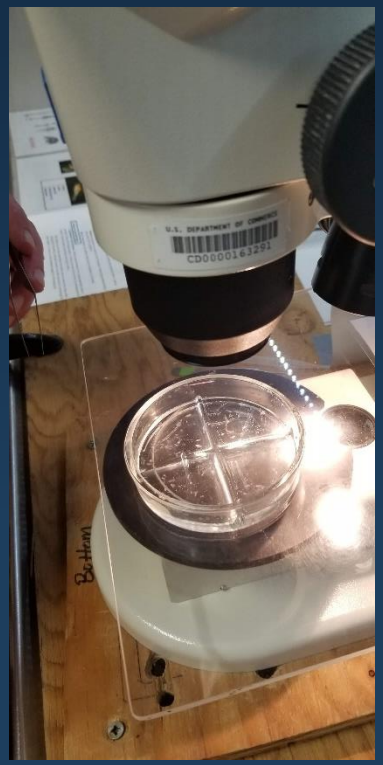


Late summer Fish CPUE

- Low catches of YOY pollock (2nd lowest on record)
- Low catches of capelin and eulachon.
- LOTS of jellies (esp. Chrysaora and Aquorea), and more than average salmonids.
- Low forage for piscivorous predators?

Western GOA
Rapid Zooplankton Assessment

- Spring AND Summer

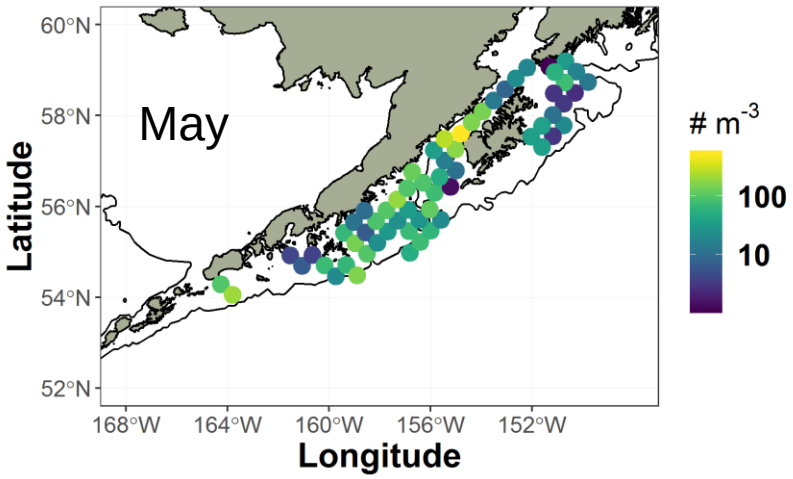


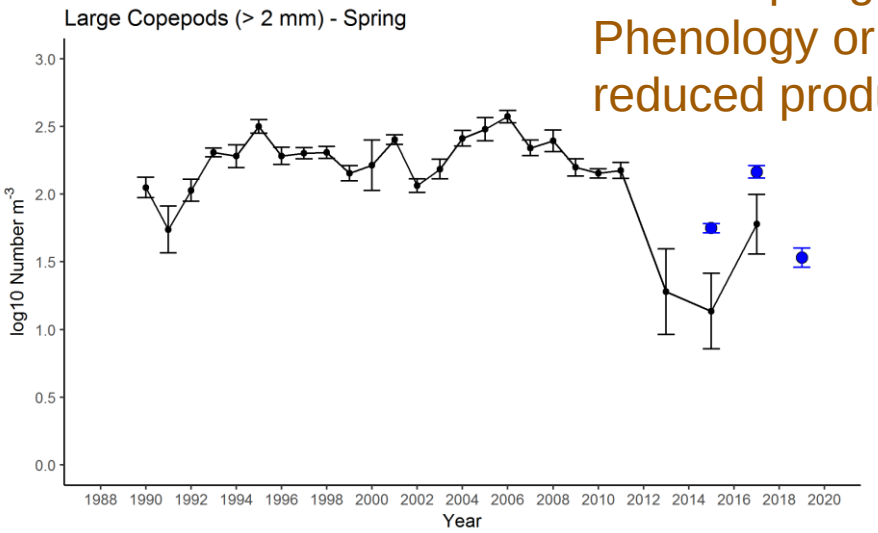
Contact D. Kimmel

Gulf of Alaska – Spring, Summer

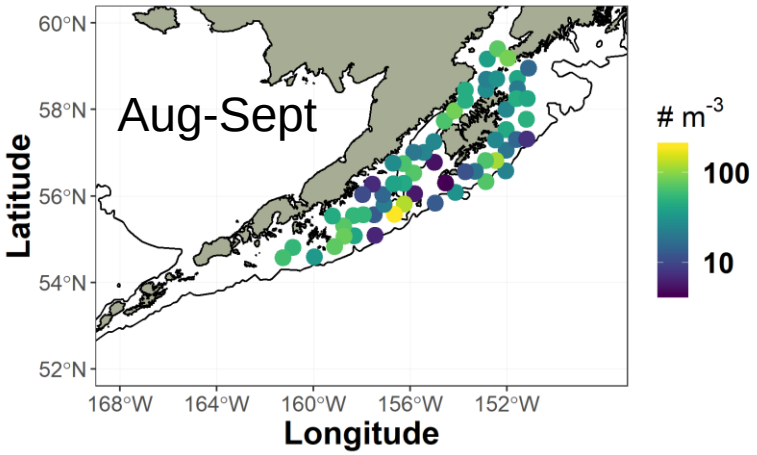
Zooplankton

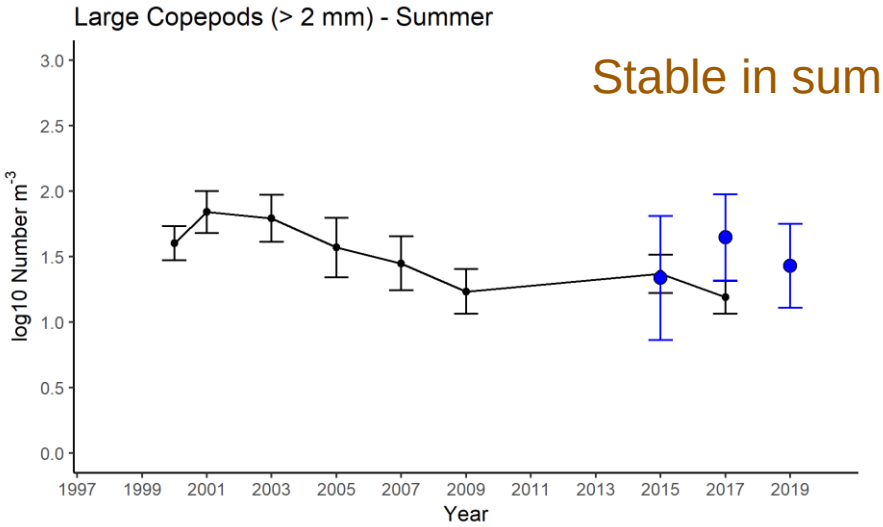
Large Copepods





Low in spring: Phenology or reduced production





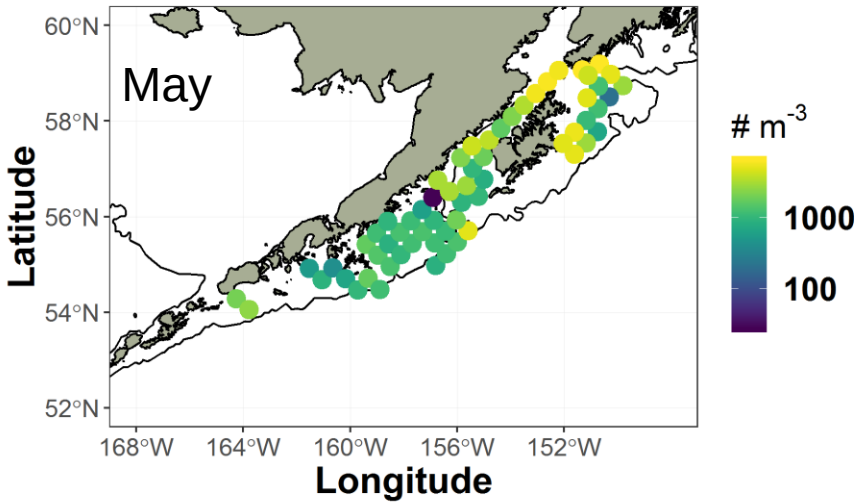
Stable in summer

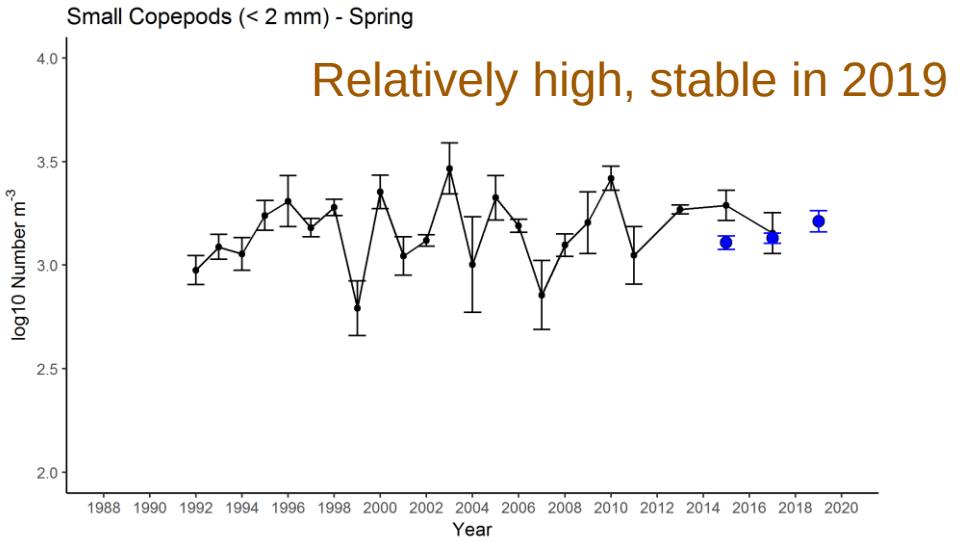
RZA by Lamb, Harpold, Rogers, Paquin (AFSC); CS: Dougherty, Wilson, Porter (AFSC); Plots by Kimmel (AFSC)

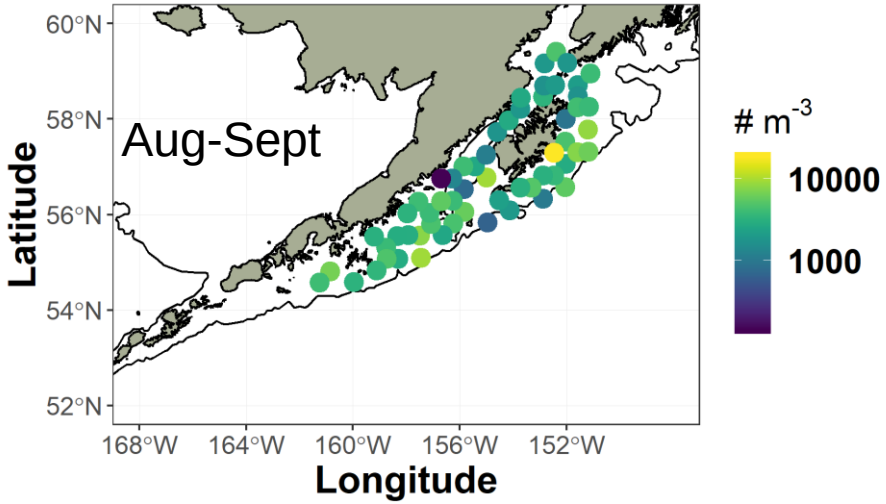
Gulf of Alaska – Spring, Summer

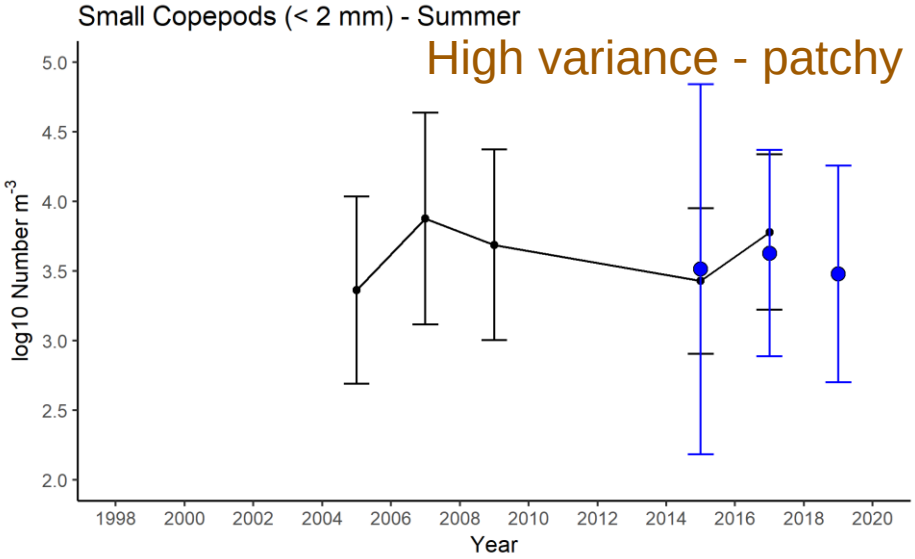
Zooplankton

Small Copepods







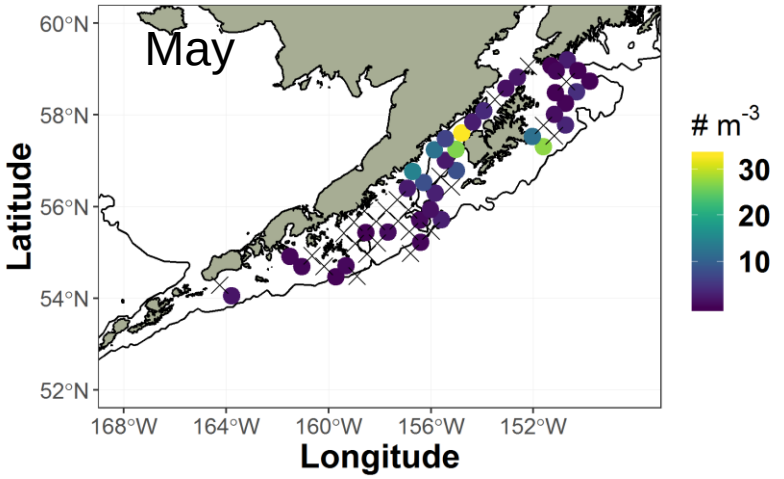


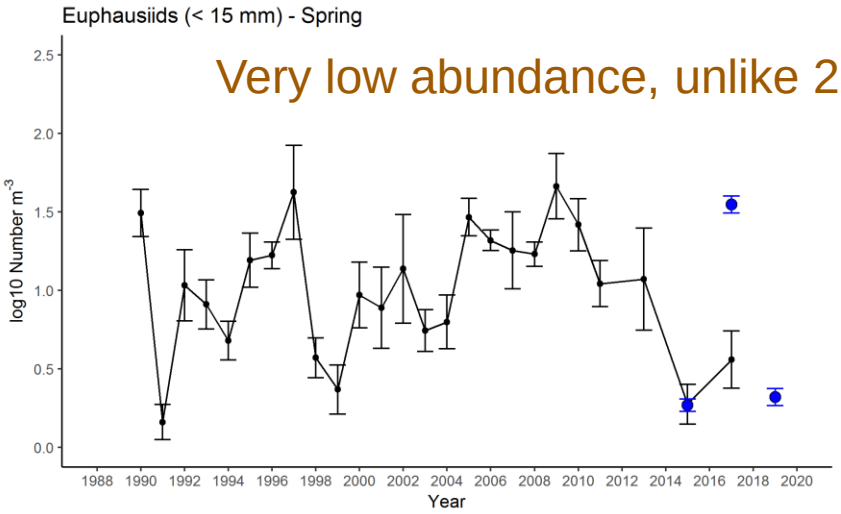
RZA by Lamb, Harpold, Rogers, Paquin (AFSC); CS: Dougherty, Wilson, Porter (AFSC); Plots by Kimmel (AFSC)

Gulf of Alaska – Spring, Summer

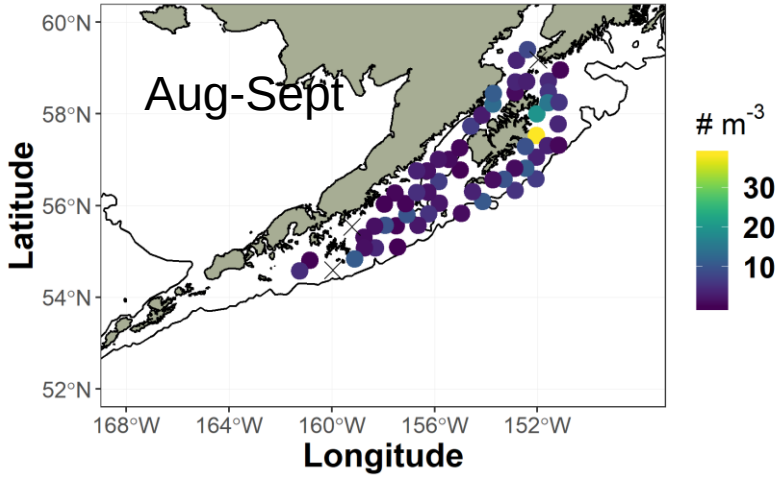
Zooplankton

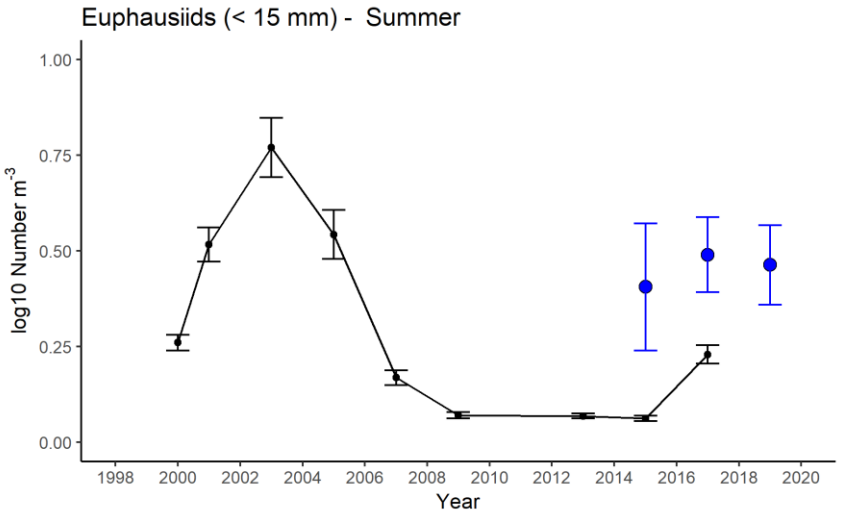
Small Euphausiids (<15mm)





Very low abundance, unlike 2017.





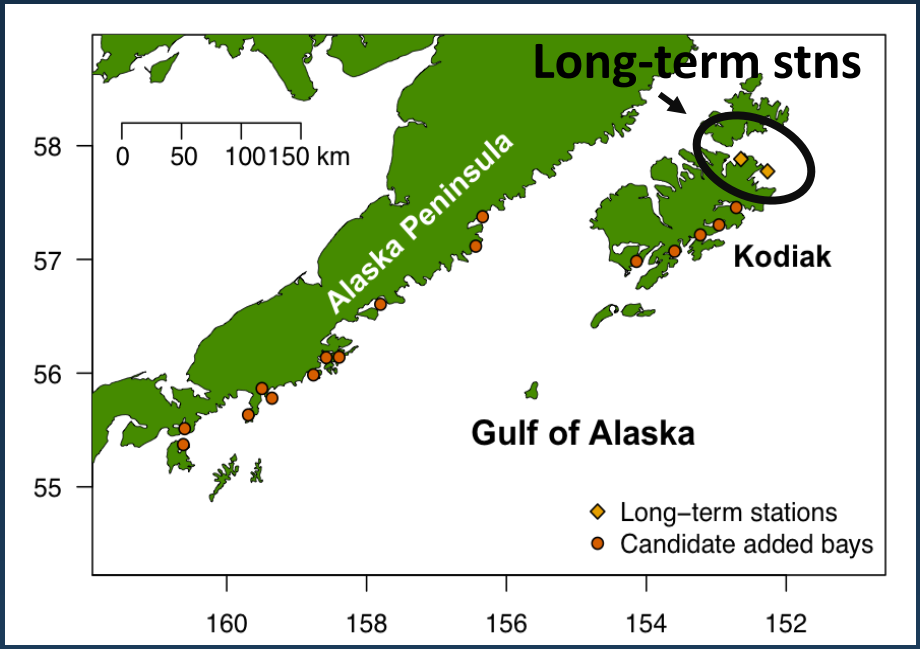
RZA by Lamb, Harpold, Rogers, Paquin (AFSC); CS: Dougherty, Wilson, Porter (AFSC); Plots by Kimmel (AFSC)

Western Gulf of Alaska

Beach Seine Survey
2006-2019

Contact : Ben Laurel

2019 beach seine survey



Focus: YOY gadids (Pacific cod, saffron cod, pollock)

When:

Kodiak: July/Aug (4 surveys, 16 sites across 2 bays) 2006-2019

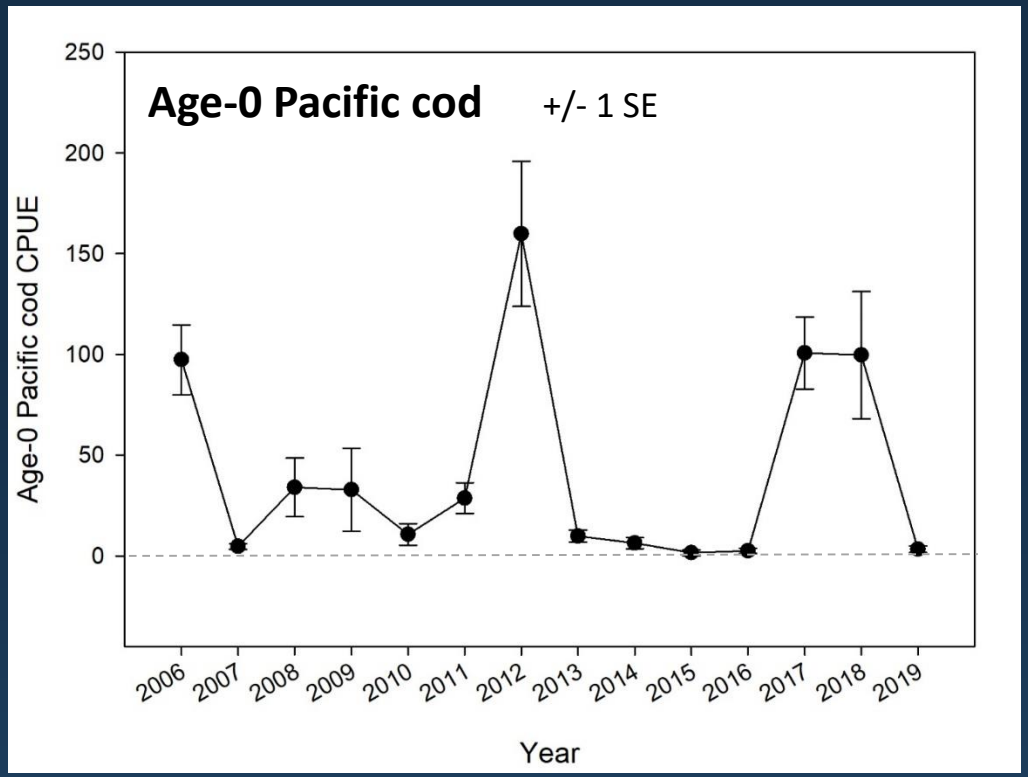
Expanded WGOA: July/Aug (72 sites across 13 bays) 2018-2019

Operations: Beach seine, YSI, baited cameras

Indicators: abundance & size, genetics, diets, temperature, salinity, oxygen

Contact : Ben Laurel, Mike Litzow

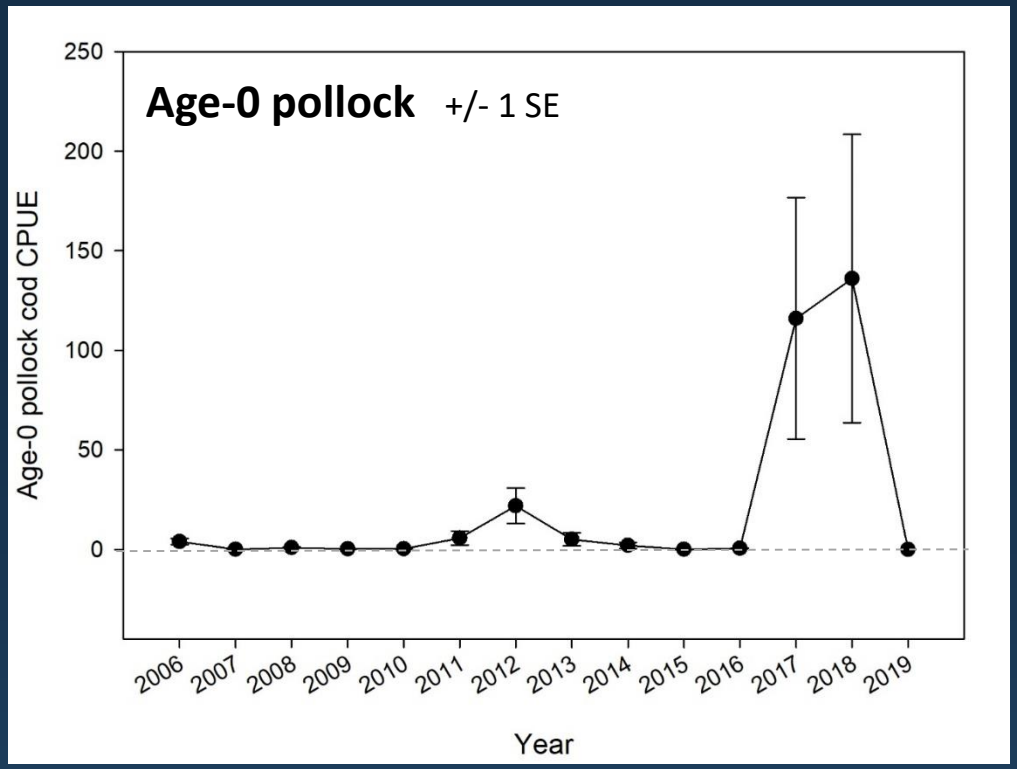
Age-0 Pacific cod



- Near absence of Age-0 Pacific cod in beach seine catches near Kodiak
- 3rd lowest catch, after 2015, 2016
- 2018 year class?

Contact: Ben Laurel

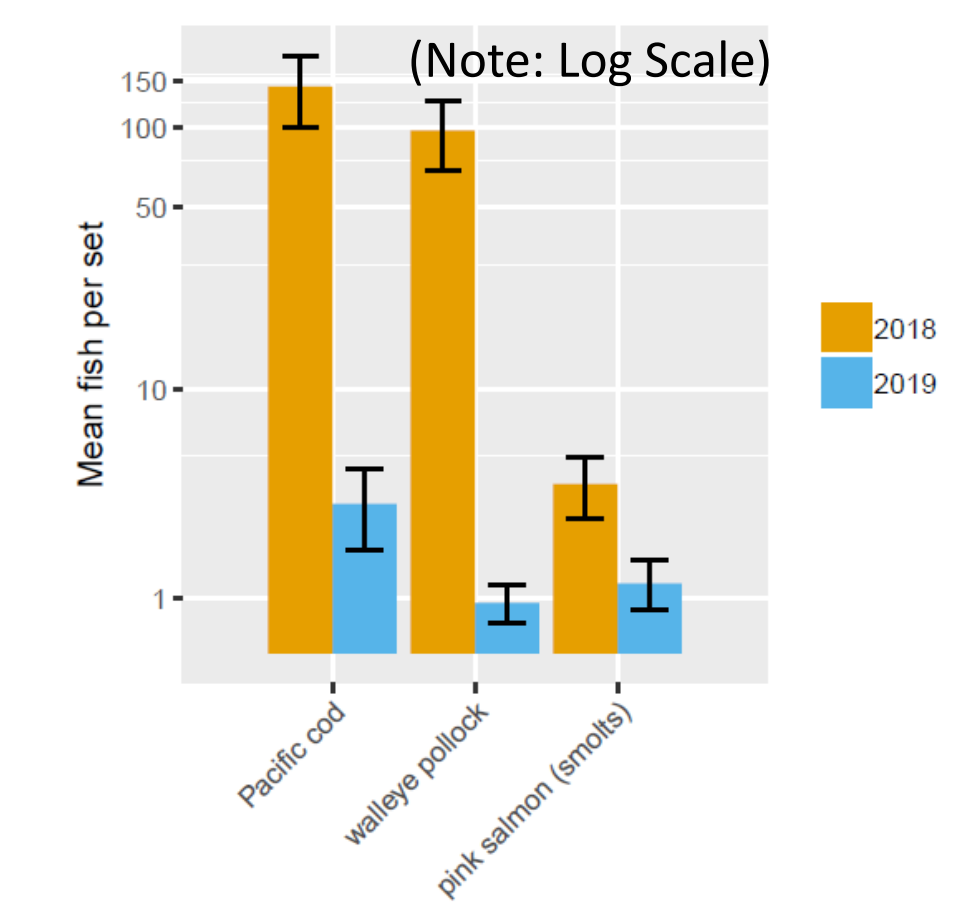
Age-0 pollock

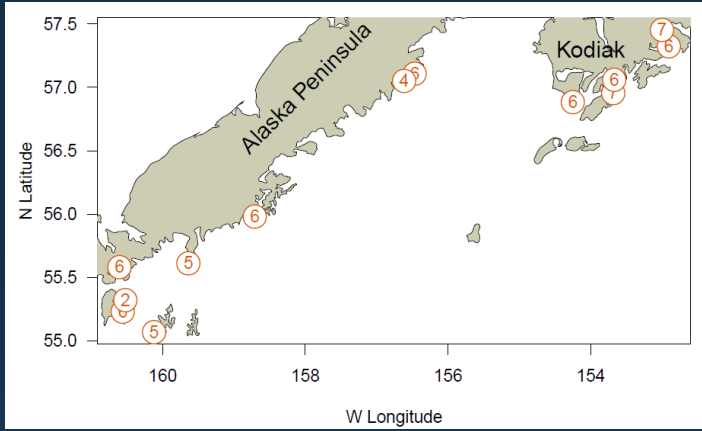


- Survey captures strong year-classes of pollock.
- In 2019, total absence of Age-0 pollock in beach seine catches near Kodiak.

Contact: Ben Laurel

Expanded WGOA beach seine survey





Consistently low catches of age-0 P cod and pollock throughout W. gulf.

Cooperative Research project

Contact: Mike Litzow

W Gulf of Alaska summary

Return of the Blob?

WGOA

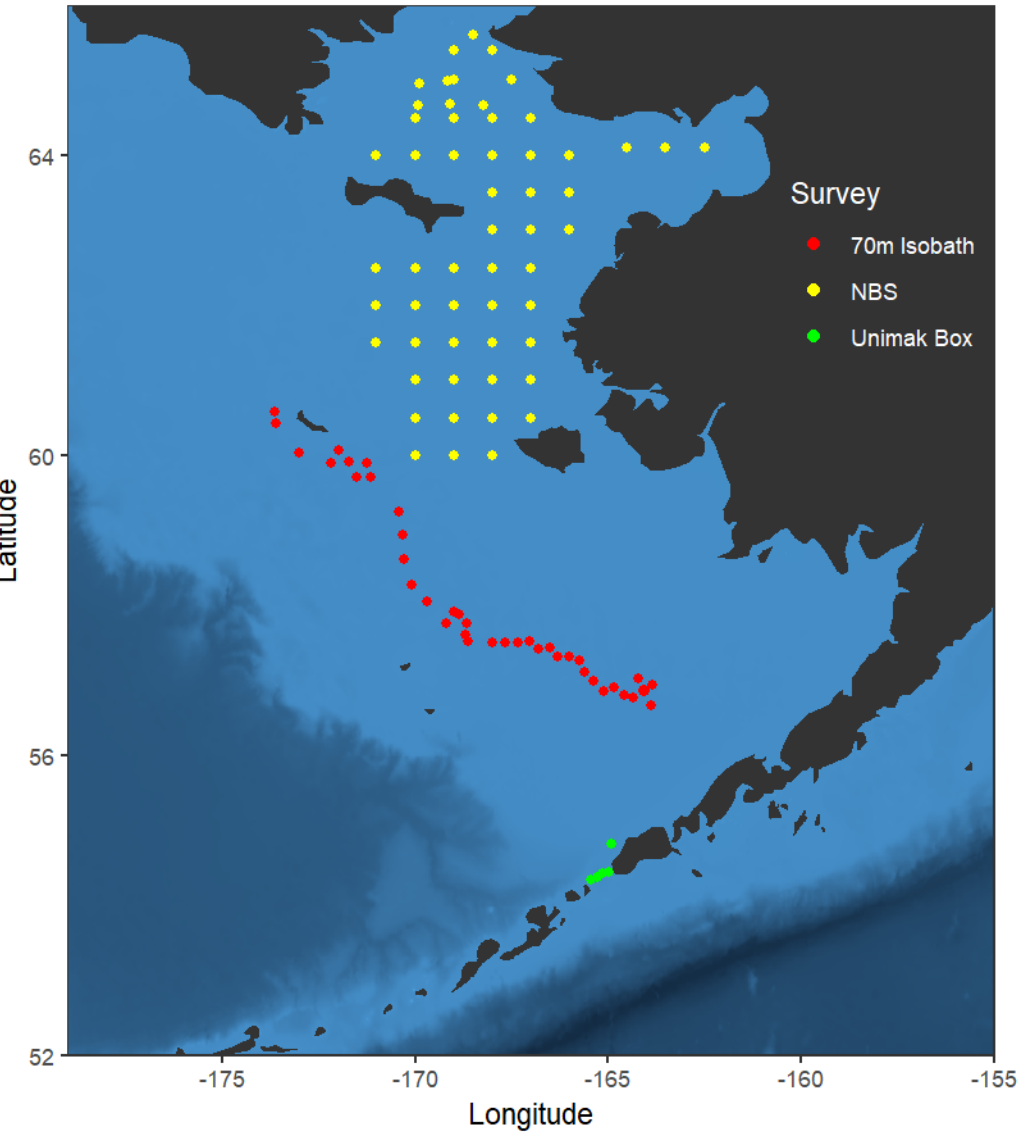
- Warm throughout water column, similar to Blob.
- Fewer large copepods in spring, average in summer.
- Few young euphausids in spring and summer (similar to 2015)
- Low larval fish abundance
- Few YOY pollock or Pacific cod in late summer.

Implications

→ Poor recruitment outlook for selected spp.

→ High temperatures (metabolic demands) and low production/availability of prey (small fishes, euphausiids) doesn't bode well for predators.

2019 Bering Sea Ecosystem Surveys



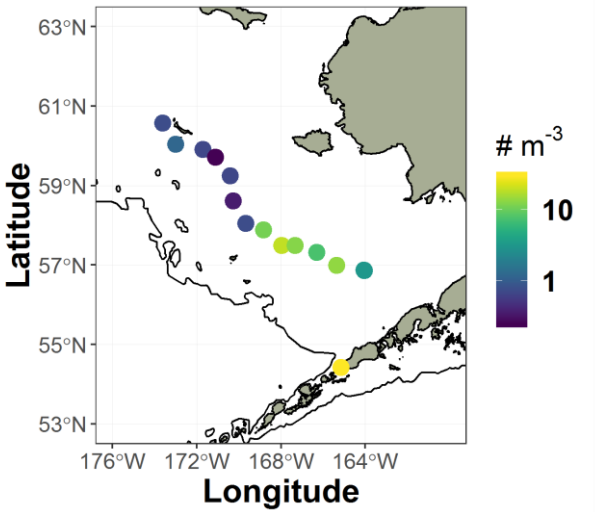
Moorings and 70m Isobath
Latitudinal picture of lower trophics and processes on middle shelf in spring and autumn (includes Unimak Box)

Northern Bering Sea Survey
Ecology of YOY gadids, salmon, herring, capelin and lower trophic levels.

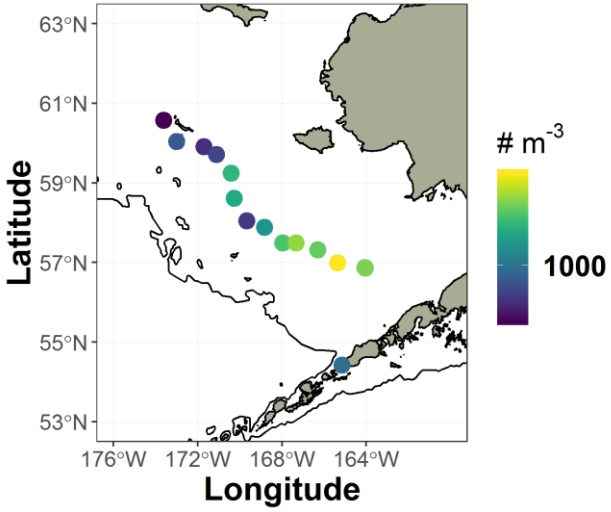
Bering Sea – Spring 70 m isobath

Zooplankton

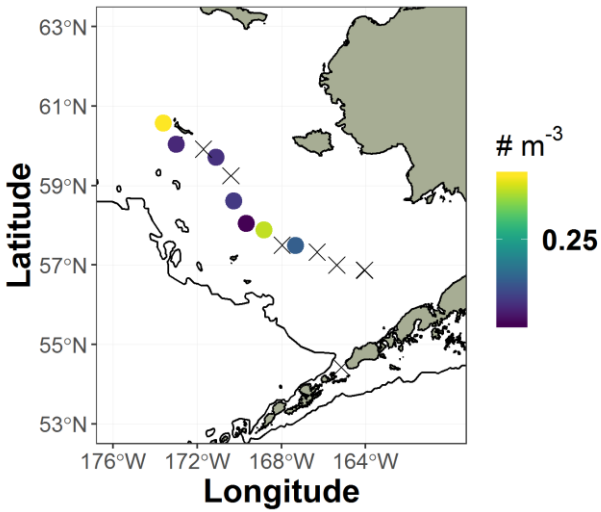
Large copepods > 2 mm



Small copepods < 2 mm

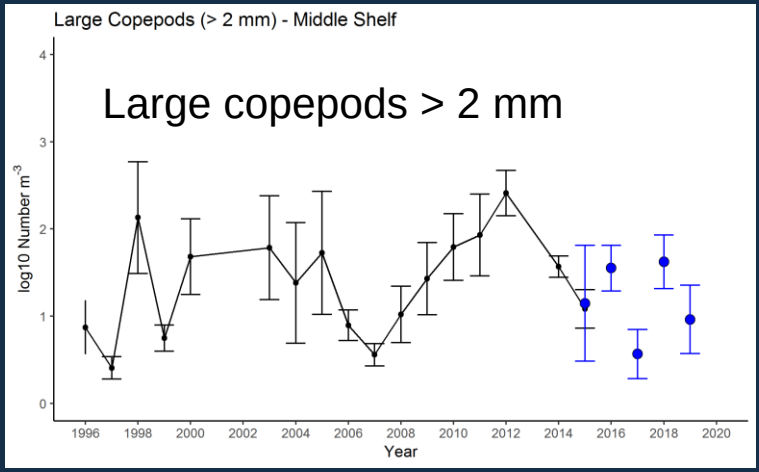


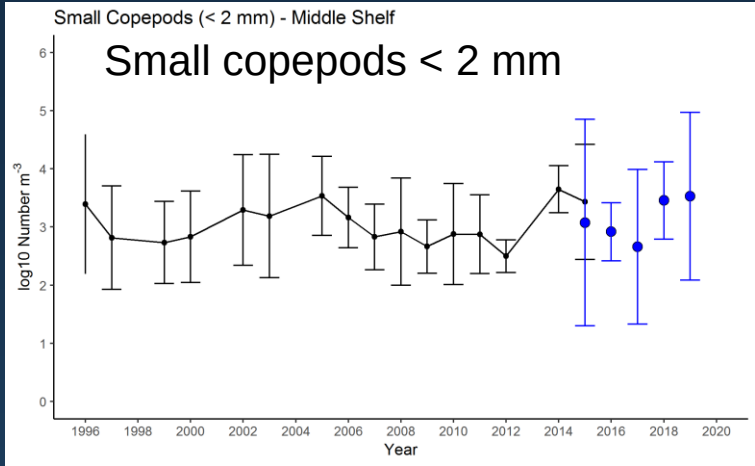
Euphausiids < 15 mm

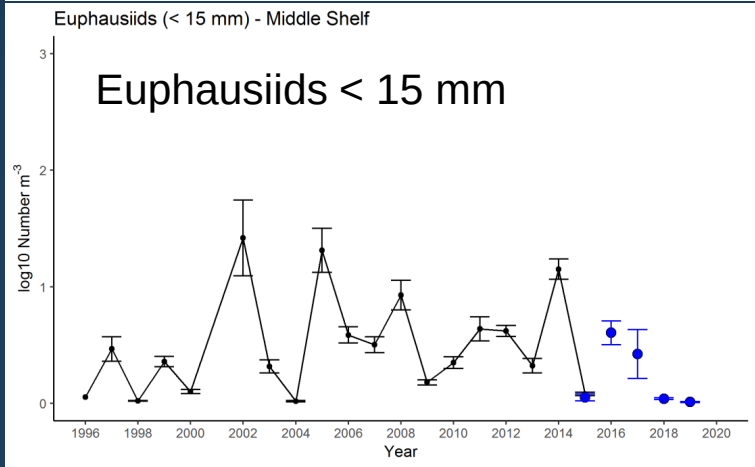


North/South gradient in copepod abundance.

RZA by Paquin, Rogers (AFSC); CS: Proctor (PMEL); Plots by Kimmel (AFSC)



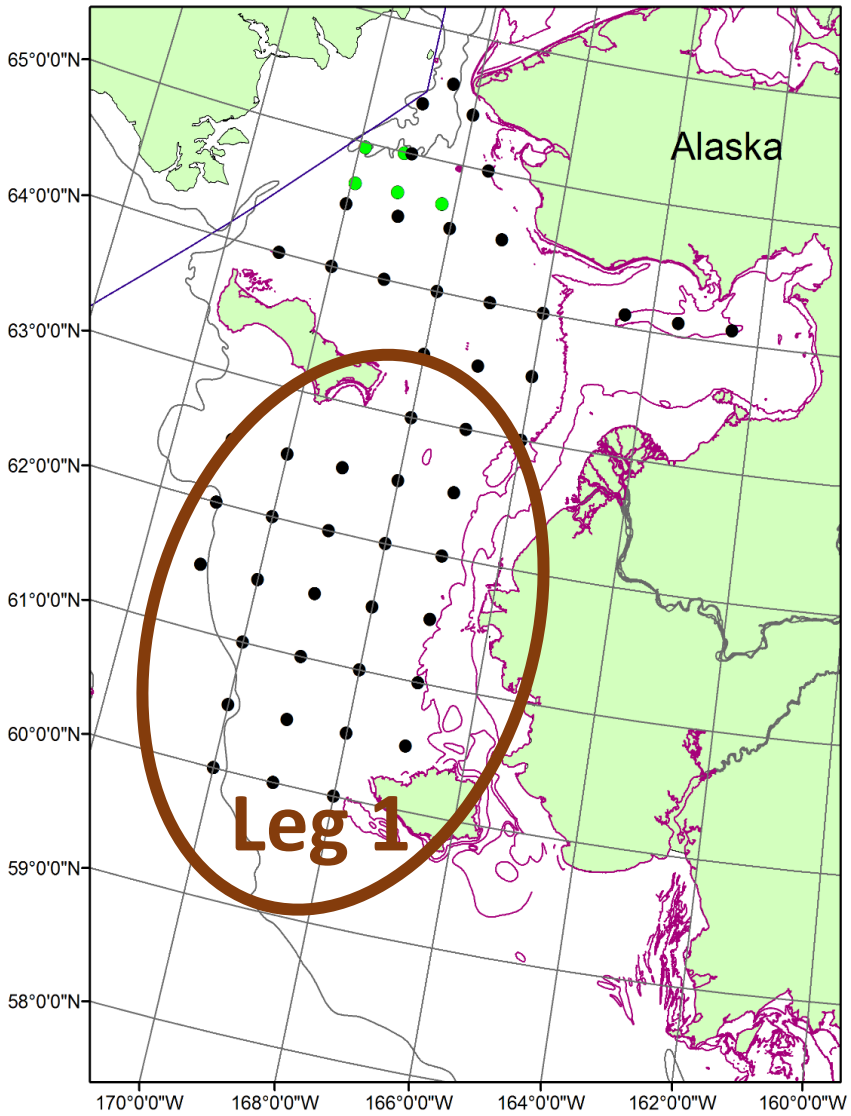




Rapid Zooplankton Assessment Spring 70m isobath

- Large copepod abundances were moderately low in spring
- Small copepod abundances high in spring, as expected during a warm year
  - Warm temperatures speed up development, favor smaller copepod species w/ multiple generations
- Small euphausiid numbers were very low in spring, similar to 2015, 2018

Contact: David Kimmel



Northern Bering Sea Survey

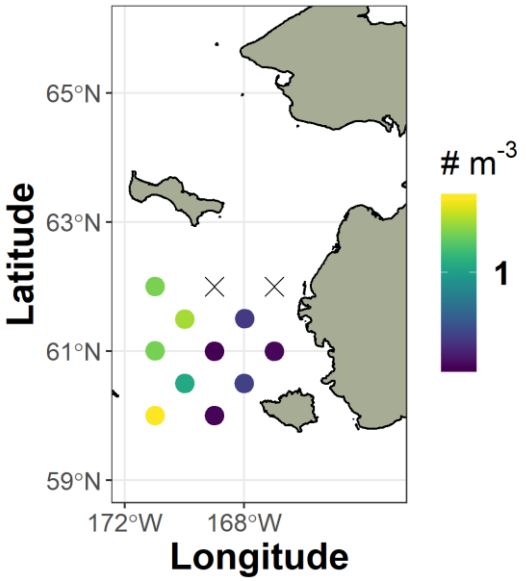
Aug/Sep 2002-2019

Leg 1 complete, Leg 2 underway

SST ranged 8 – 13 °C (likely warmest since survey started in 2002)

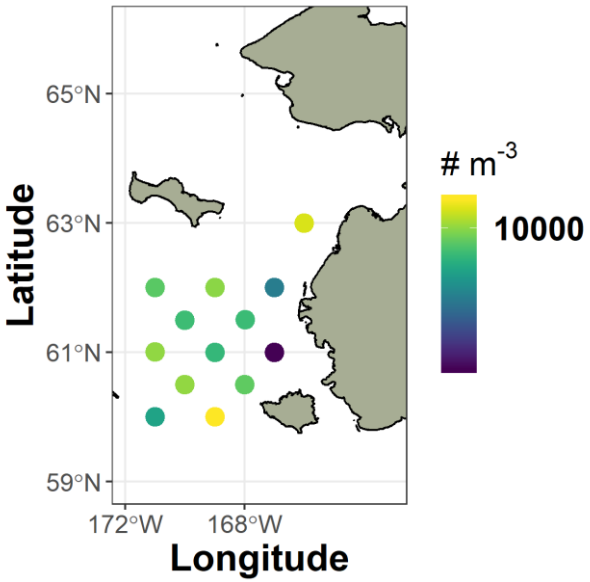
Contact: Jim Murphy

Large copepods > 2 mm



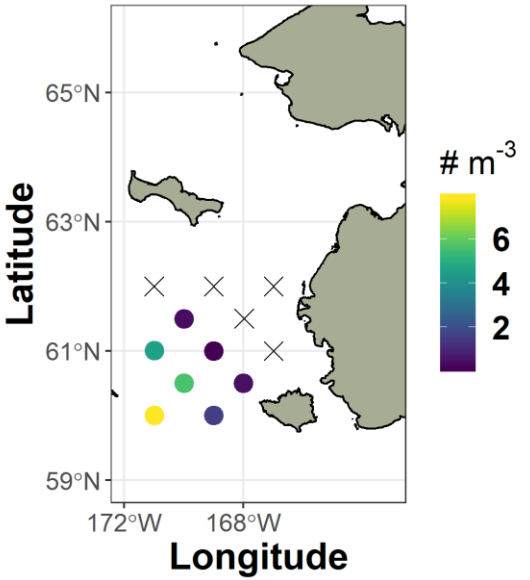
VERY low!

Small copepod < 2 mm



Relatively high

Euphausiids < 15 mm



Relatively low

Similar to late-summer warm year pattern in the SE Bering Sea.

RZA by Sewall, Waters, Nicholls (ABL); CS: Murphy (ABL); Plots by Sewall, Waters (ABL)

Northern Bering Sea - Leg 1
Upper trophic observations

- Lower than expected catches of age-0 pollock given a warm year.
- No age-0 saffron cod (usually catch 1000s).
- Lots of herring.
- No capelin (not unusual in a warm year).
- Low catches of juvenile Chinook salmon.
- Very high catches of juvenile pink and sockeye salmon
- Few auklets, puffins, murres, and shearwaters compared to 2018.

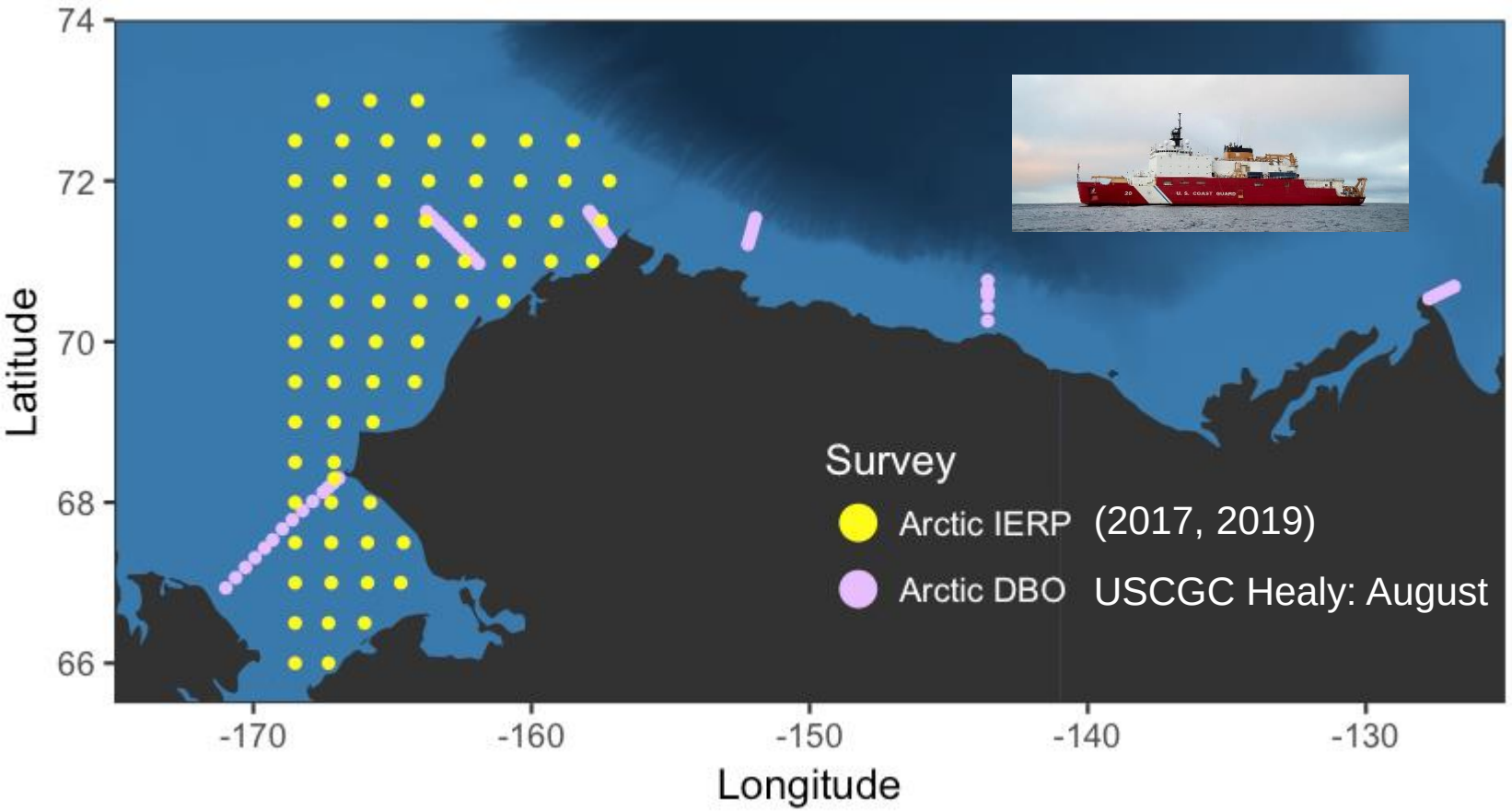
Contact: Jim Murphy

Southeast/Northern Bering Sea Summary

Continued warm conditions in the SEBS and NBS

- "Typical" warm year conditions in the SEBS
  - Zoop community dominated by small copepods.
  - No surveys for larval or YOY fishes.
  - Will know more from moorings, primary production data, etc
- Warm conditions in the NBS, with some anomalies…
  - Northerly distribution of pinks and sockeye
  - Absence of saffron cod
  - Few juvenile Chinook salmon
- Few large zooplankton in late summer in NBS – provisioning for overwintering groundfish?

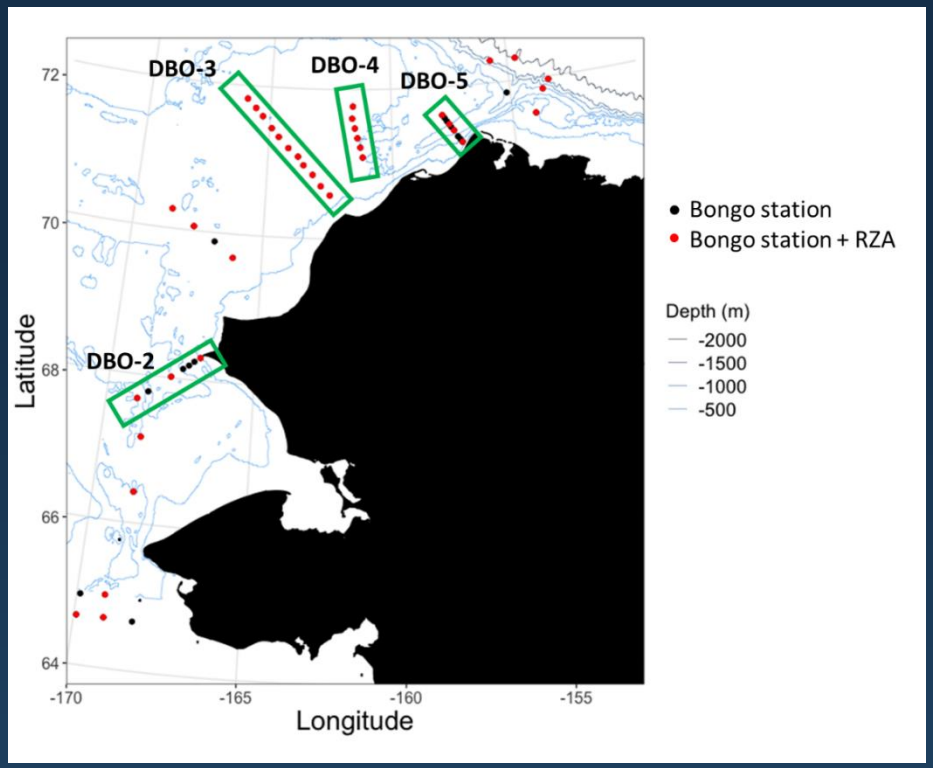
2019 Arctic Ecosystem Surveys



2019 Arctic

Distributed Biological Observatory

August 2019



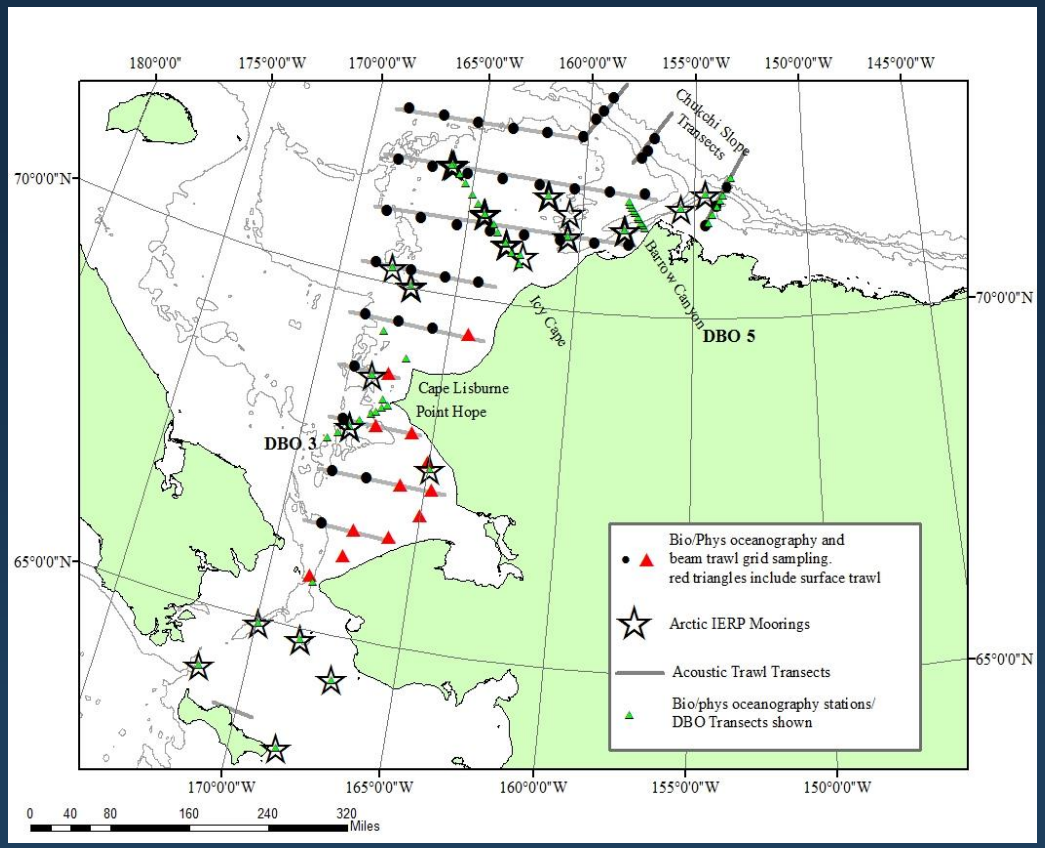
- Retraction of sea ice edge to 80N in August
- Open water for the entirety of the Chukchi shelf (US)
- HAB hotspots at 3 locations
- Very few large copepods or krill.
- No fish larvae in the bongo nets.

Contact: Janet Duffy-Anderson, Libby Logerwell

2019 Arctic

IERP

August - October 2019



- SST: 5.3 °C to 10.9 °C.
- Bottom Temp: -1.6 °C to 7.7 °C.
- **Zooplankton abundances very low, incl. large and small copepods (fewer than 2017).**
- Age-0 Arctic cod dominant fish in midwater trawls, fewer than 2017.
- **Large numbers of age 0 walleye Pollock (mean length 61 mm) caught on the 70.25N transect (farther north than previous)**
- **Two adult walleye Pollock were caught in the midwater at 70.25N 168.5W.**

Contact: Ed Farley, Libby Logerwell

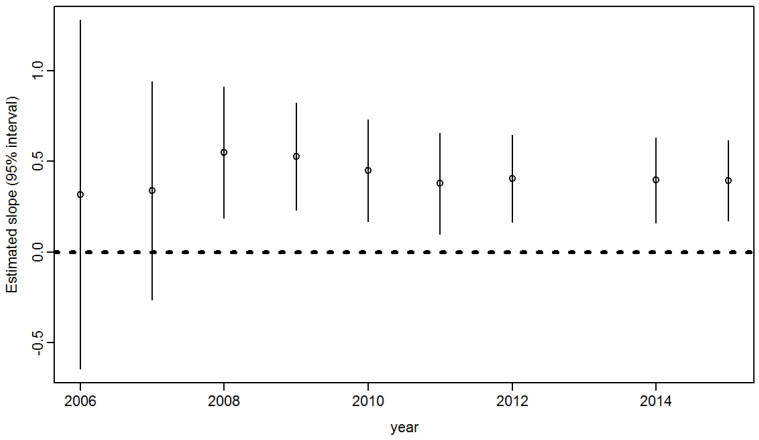
Additional data will be available

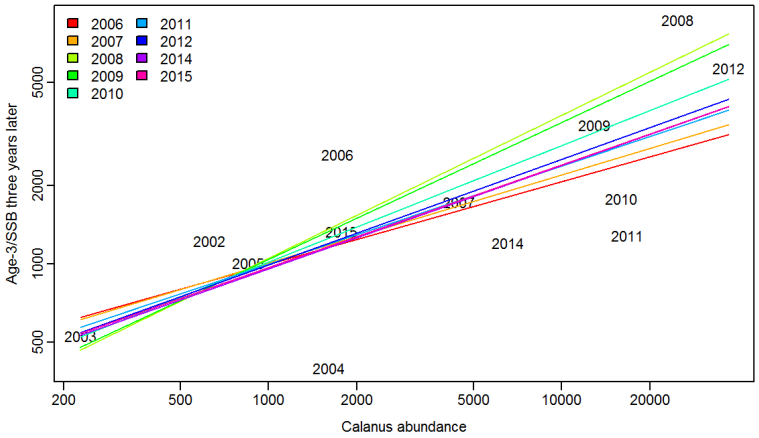
- Detailed zooplankton taxonomy
- Fish catch, distribution, size
- Fish diets, condition, energetics
- Zooplankton lipids
- Detailed larval fish taxonomy, body size
- Oceanography

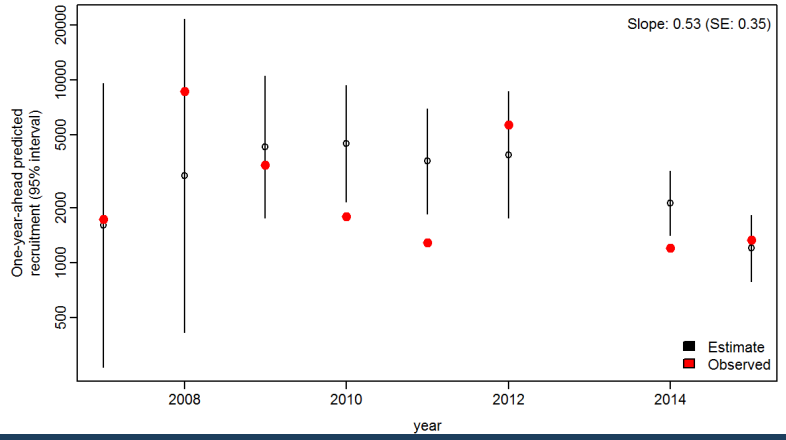
Recruitment models and linking to stock assessment

- EBS large copepod index → BS Pollock
- Pacific cod spawning habitat index → GOA P cod
- Recruitment forecast → BS Northern Rock Sole
- Indicator suite → GOA Pollock ESP

Calanus index and EBS Pollock recruitment.







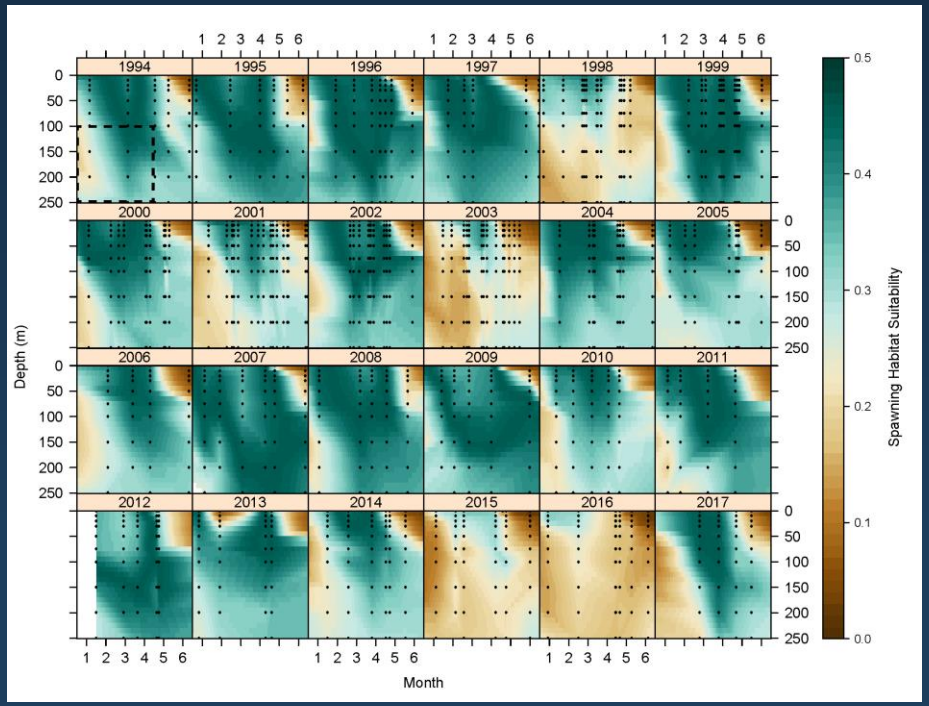
Abundance of large copepods in the EBS provides indicator of pollock recruitment.

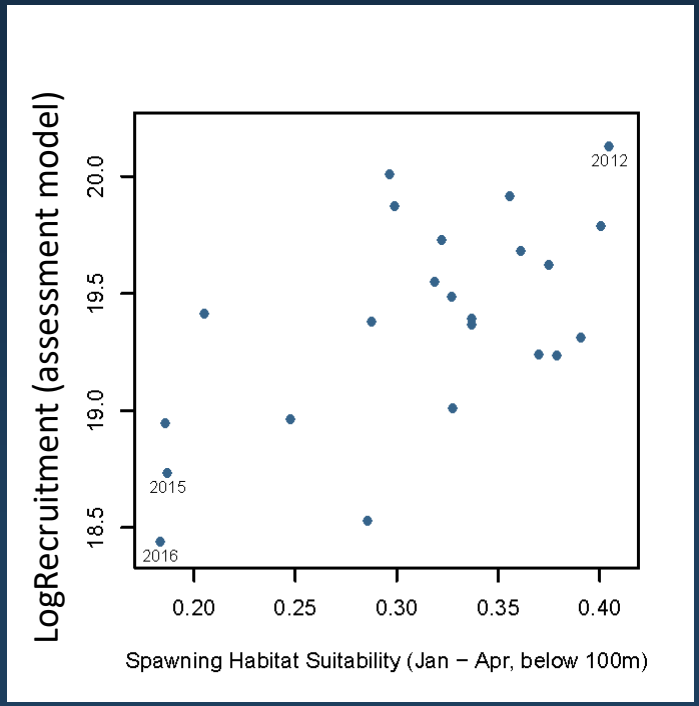
Ongoing skill-testing for possible inclusion in stock assessment.

Contact: Lisa Eisner, Ellen Yasumiishi, Jim Thorson

Spawning habitat index for GOA Pacific cod

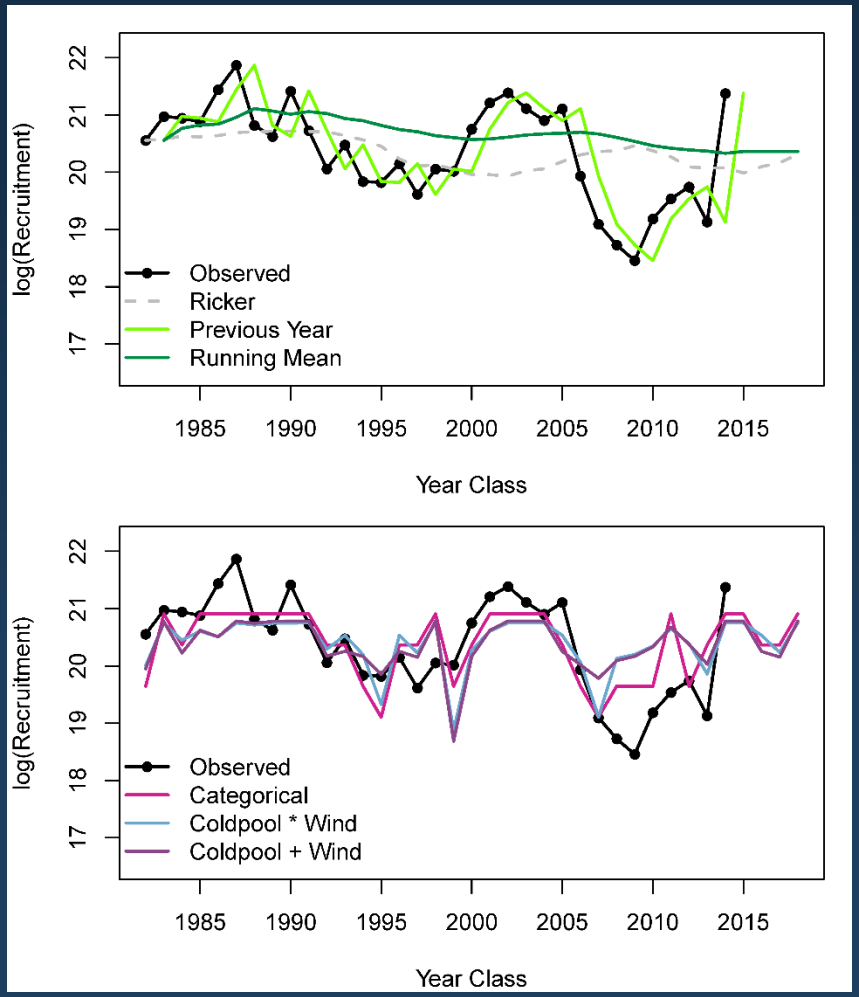
Warm waters limit success of GOA Pacific cod eggs.
Mechanistic link between thermal conditions and recruitment.





Contact: Lauren Rogers, Ben Laurel

Northern rock sole recruitment forecast



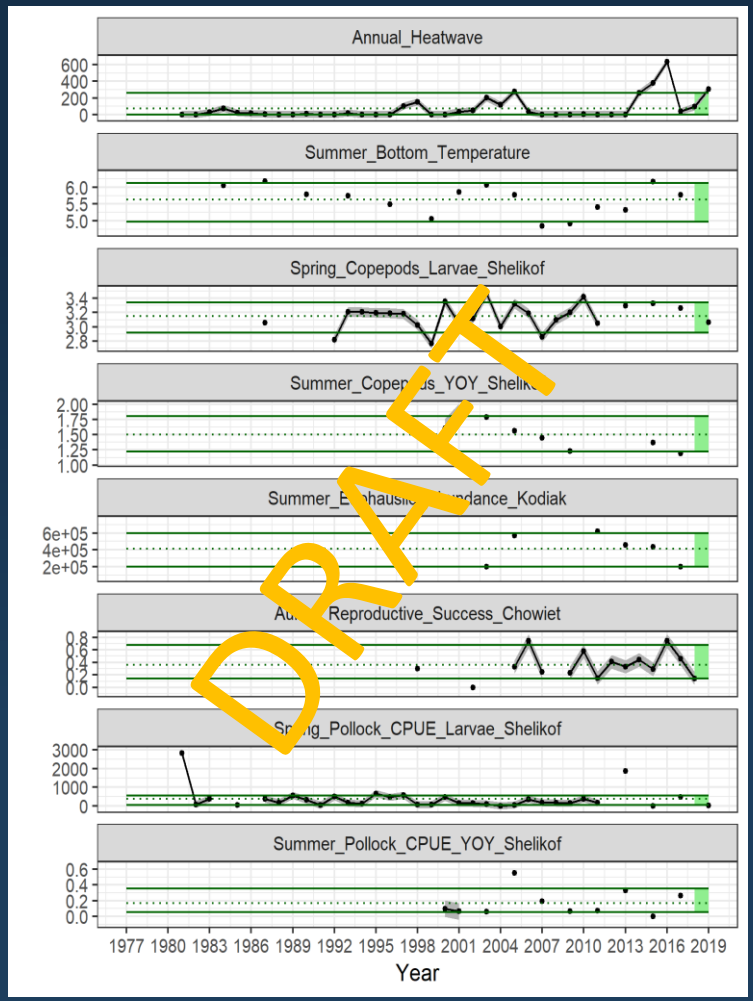
Strong recruitment in years with onshore wind-driven transport + nursery areas outside cold pool

Appendix to the assessment.

Contact: Lauren Rogers, Dan Cooper, Tom Wilderbuer

GOA Pollock ESP

- Suite of indicators
- Qualitative → Quantitative assessment



Contact: Kalei Shotwell, Martin Dorn, Alison Deary, Lauren Rogers, Ben Fissel

Acknowledgements

Ellen Yasumiishi, Elizabeth Siddon, Jim Murphy (NBS), Ed Farley (Arctic), Janet Duffy-Anderson (EBS, Arctic), David Kimmel & Colleen Harpold (RZA), Alison Deary and Annette Dougherty (RLA), Ben Laurel & Mike Litzow (WGOA Beach Seine), Matt Wilson and Steve Porter (WGOA YOY)

Everyone who helped in the field (too many to list)

Extra slides

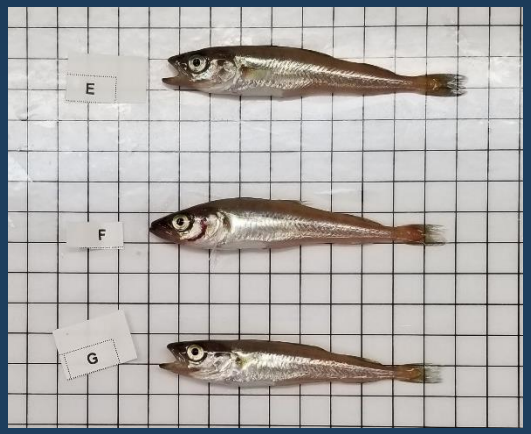
Additional WGOA sampling Aug/Sept 2019

HABs – Zooplankton, Fish (Lefebvre)

Sablefish traps (Strasburger, Moss)

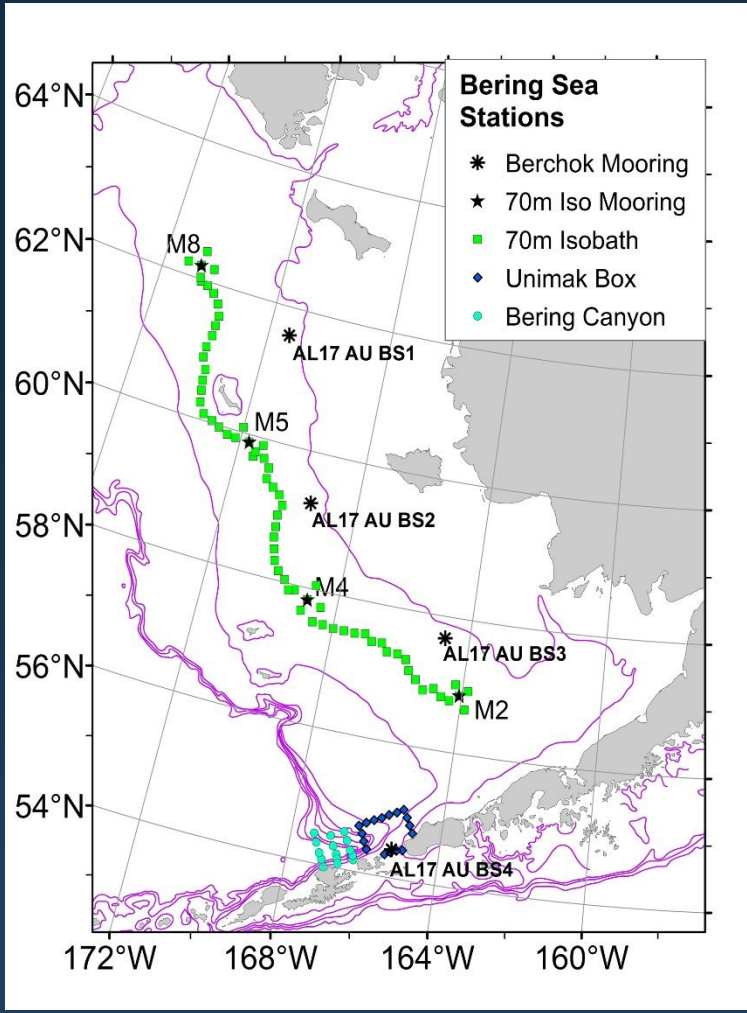
YOY pollock body condition (lipids, morphometrics) (Deary, Rogers, Miller, etc)

Diets



Contact: Janet Duffy-Andersen

Moorings and 70m isobath



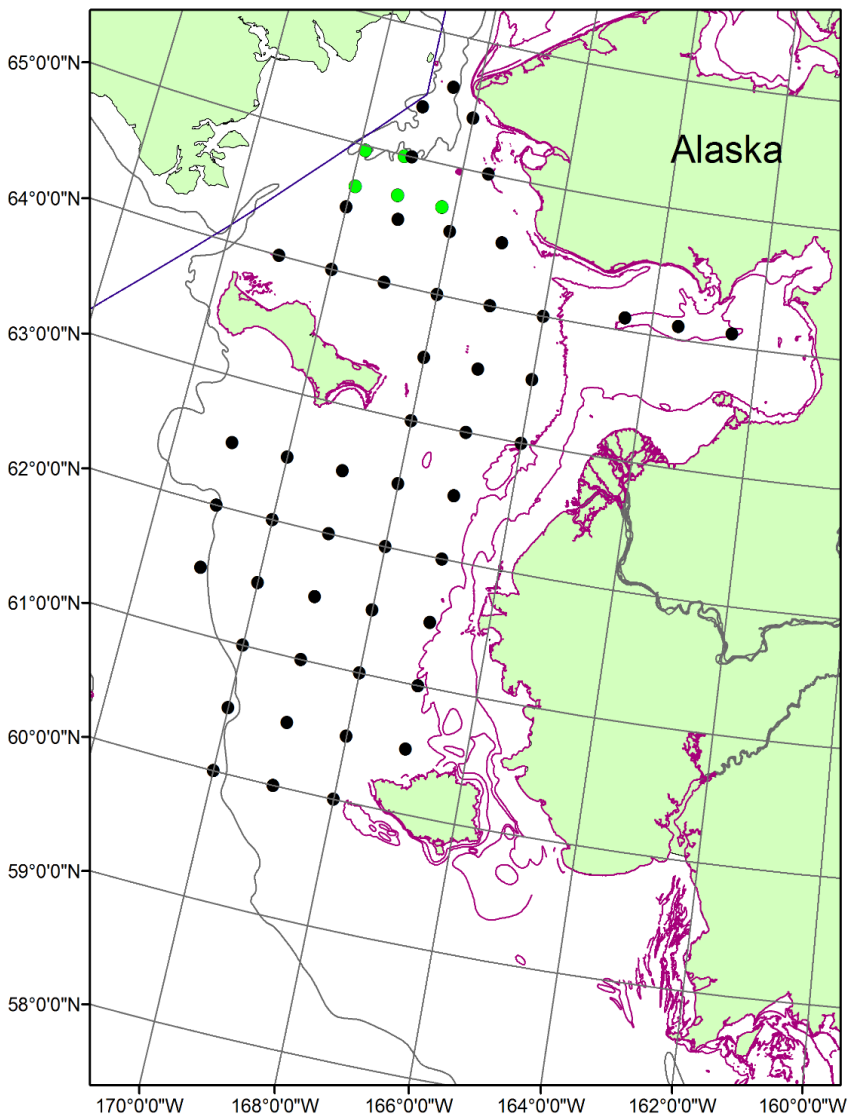
Latitudinal picture of lower trophics and processes on middle shelf

When: Late April and late Sept.

Operations: Surface, subsurface moorings and instrumentation (incl Prawler), CTDs, Bongos

Indicators: Integrated chl*a*; Zooplankton species distribution, abundance, stage; on board rapid zooplankton assessment (RZA); T, S, O2, etc

Contact : Janet Duffy-Anderson



Northern Bering Sea Survey

Focus: YOY gadids, juv salmon, herring, capelin

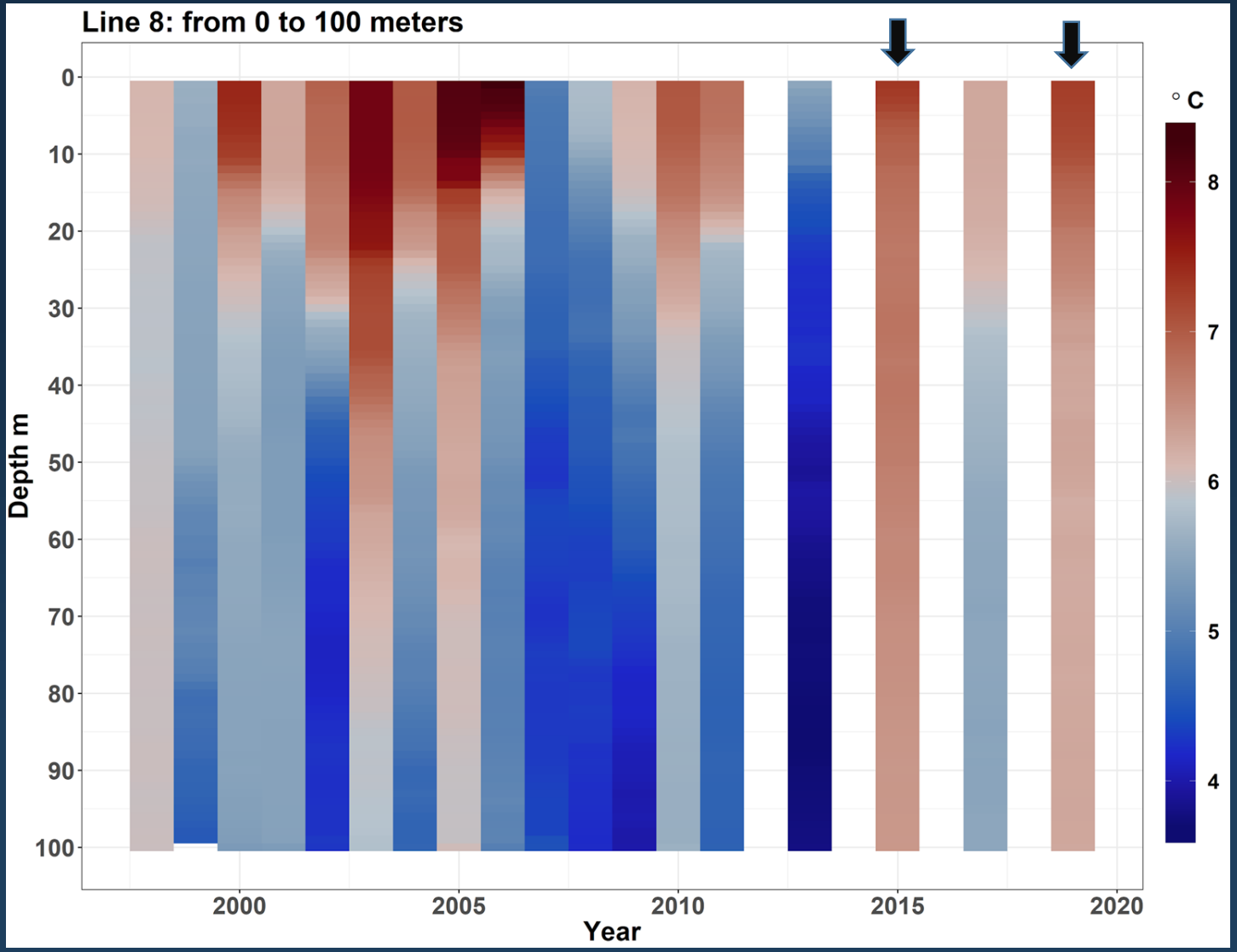
When: Aug/Sep 2003-2019

Operations: CTD, 20/60 bongos, surface trawl

Indicators: zooplankton; abundance, distribution, diet, fitness of yoy groundfish, forage fish and western Alaska juvenile salmon, temperature, salinity, chla, nutrients, Yukon River Chinook salmon forecast

Contact: Ed Farley

Line 8 Water Column Temperature

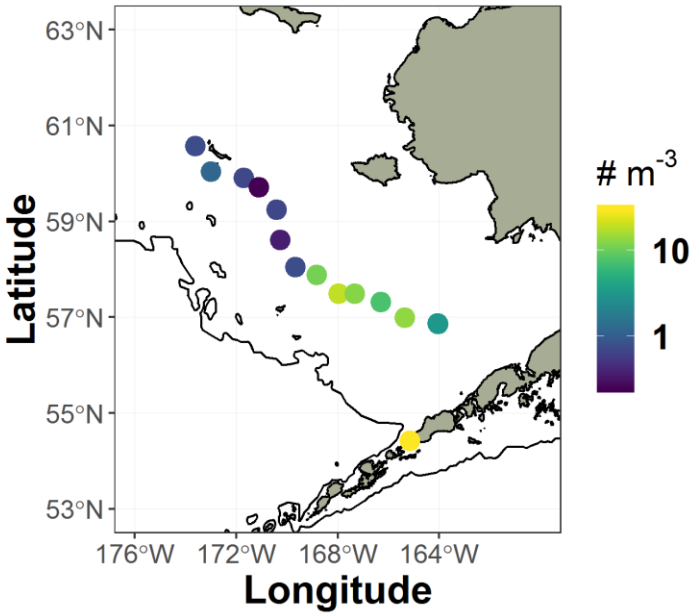


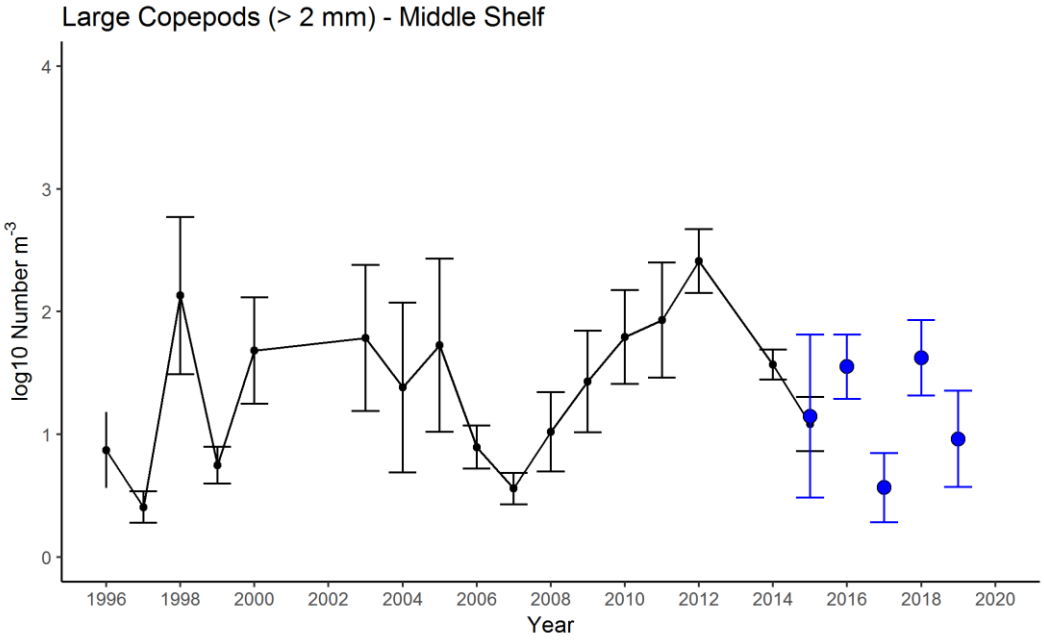
Take Home: Throughout water column, 2019 similar to 2015

Bering Sea – Spring 70 m isobath

Zooplankton
Large copepods

Large copepods > 2 mm





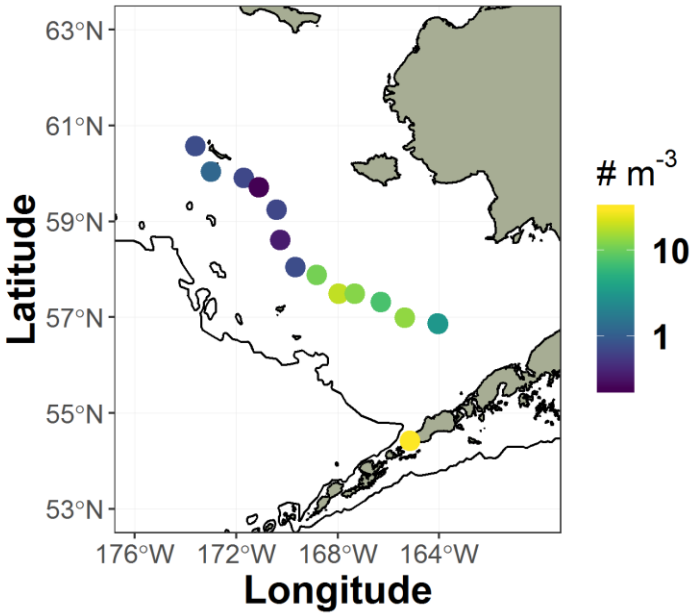
North/South gradient.
Overall, numbers were lower than in 2018, but not historically low.

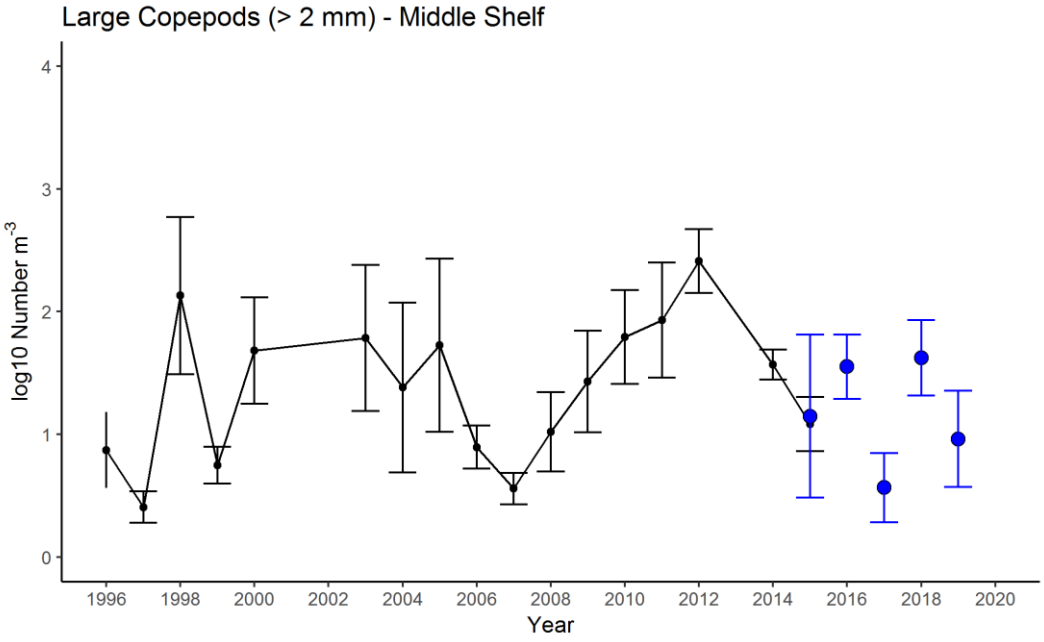
RZA by Paquin, Rogers (AFSC); CS: Proctor (PMEL); Plots by Kimmel (AFSC)

Bering Sea – Spring 70 m isobath

Zooplankton
Large copepods

Large copepods > 2 mm





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Overall, numbers were lower than in 2018, but not historically low.

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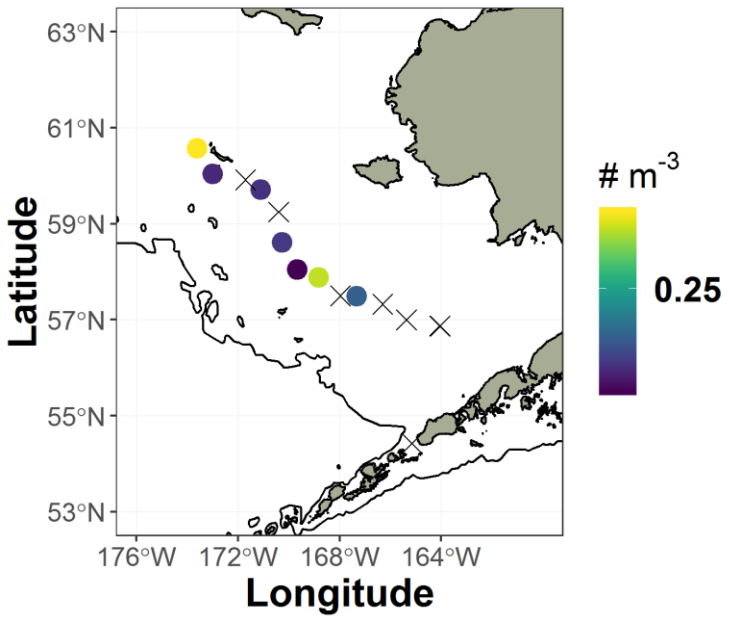
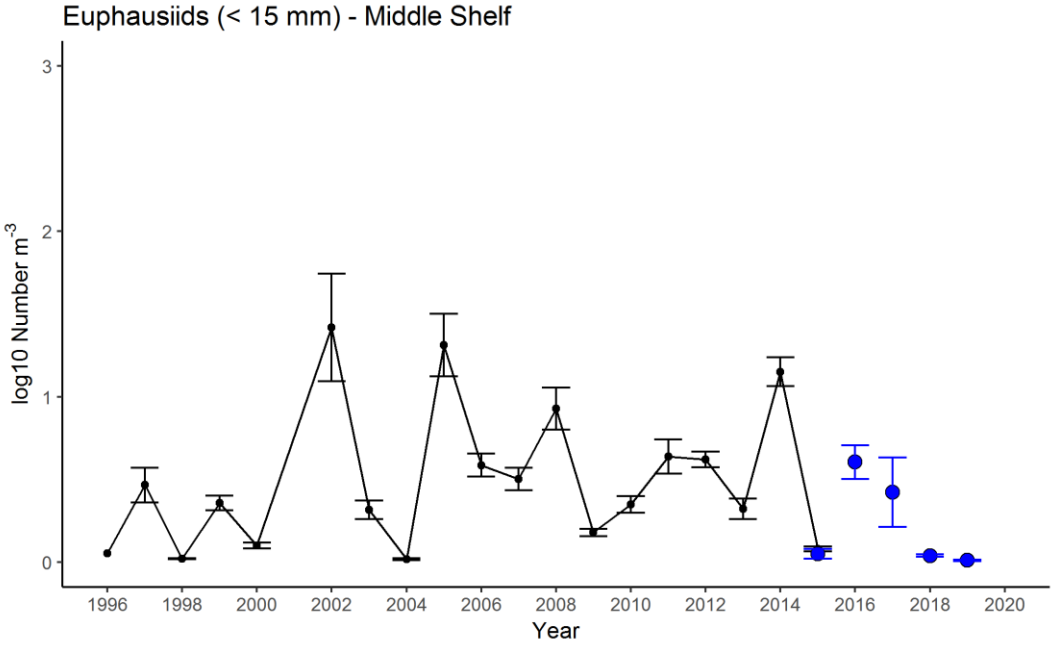
Bering Sea – Spring 70 m isobath

Zooplankton
Euphausiids

Euphausiids < 15 mm

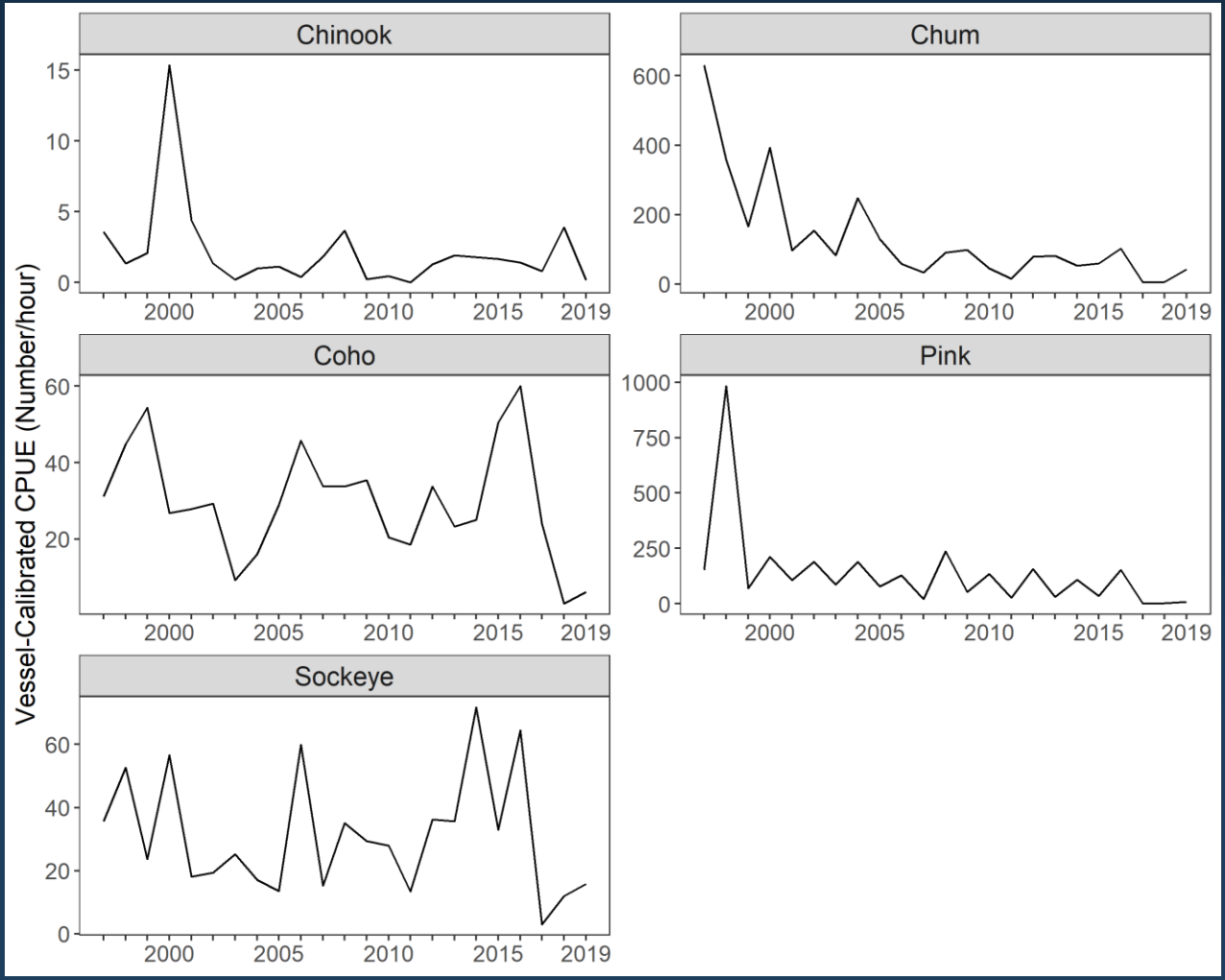




Small euphausiid numbers very low, but not unprecedented. Similar to 2015, 2018.

RZA by Paquin, Rogers (AFSC); CS: Proctor (PMEL); Plots by Kimmel (AFSC)

Salmon CPUE



Low catches of juvenile salmon

Contact : Andrew Gray / Jordan Watson / Emily Fergusson