



**NOAA
FISHERIES**

**Alaska Fisheries
Science Center**

2018 Recruitment Processes Alliance (RPA) surveys: Gulf of Alaska, Eastern 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 19, 2018

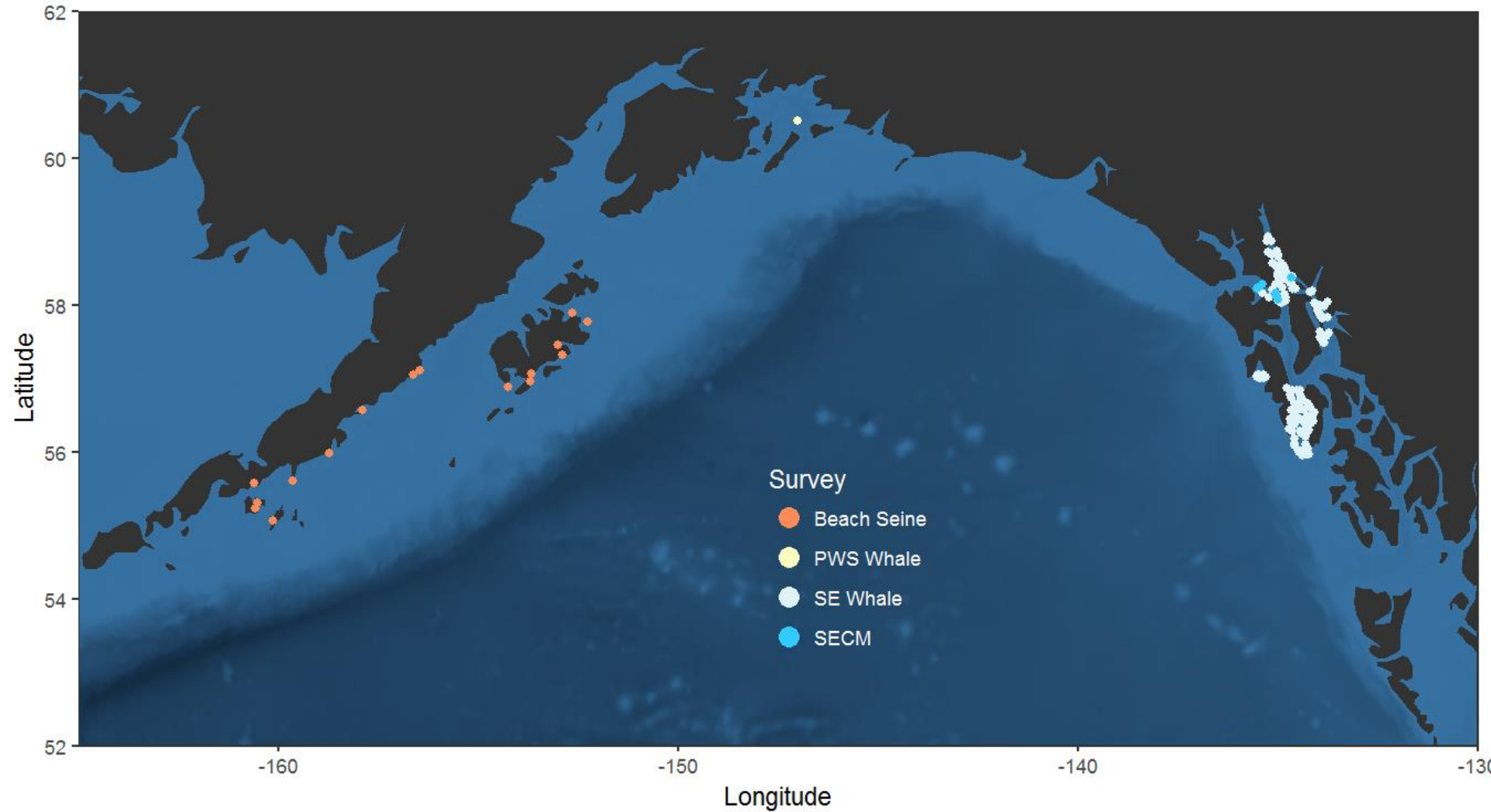
Goal & Objectives

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

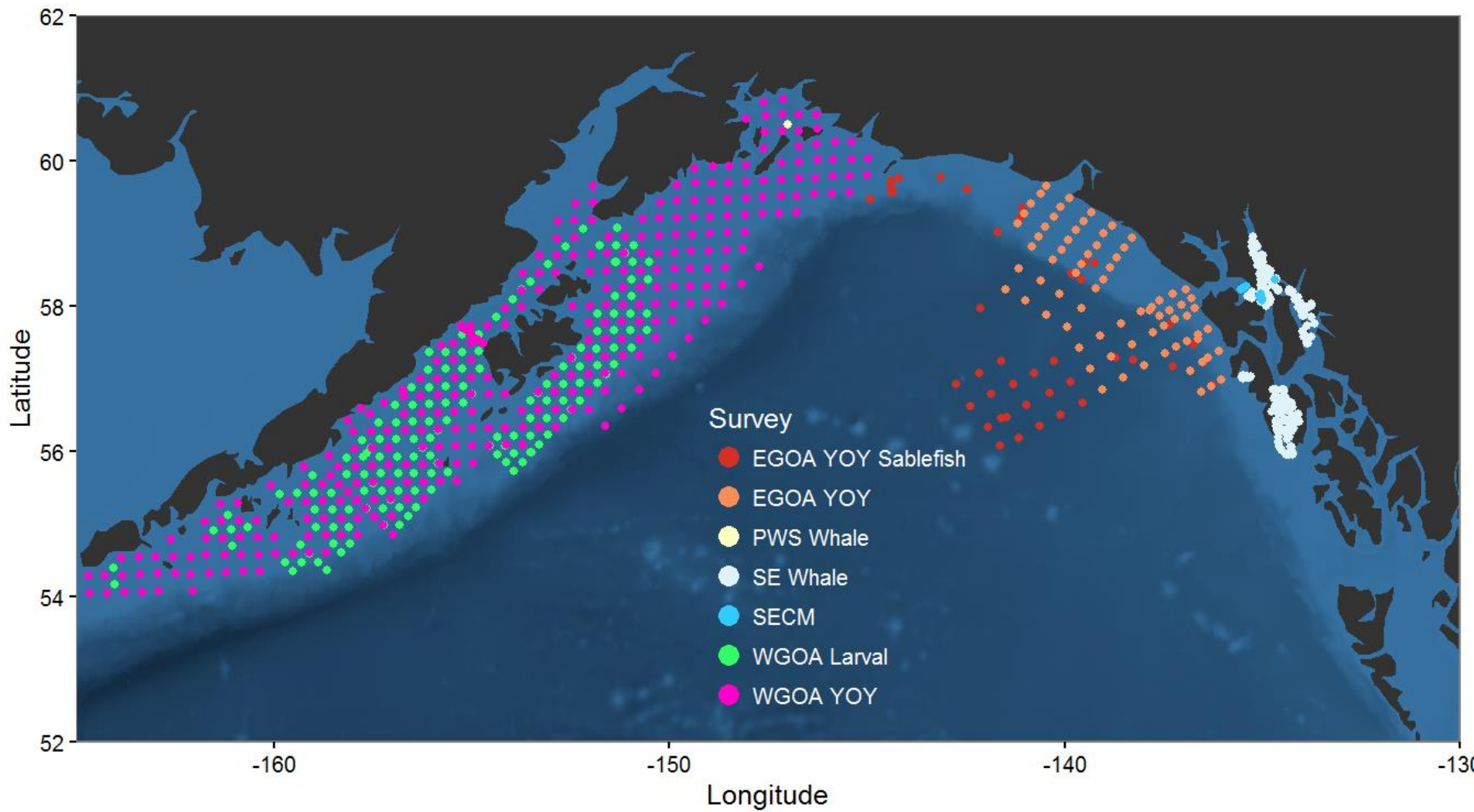
Objectives today:

1. Let you know when & where we collect information on physical and biological oceanography, zooplankton, jellyfish, and fish.
2. Present observations from 2018 surveys.
3. Provide basis for ongoing dialogue on which data/indicators are useful for stock assessments, ESRs, ESPs.

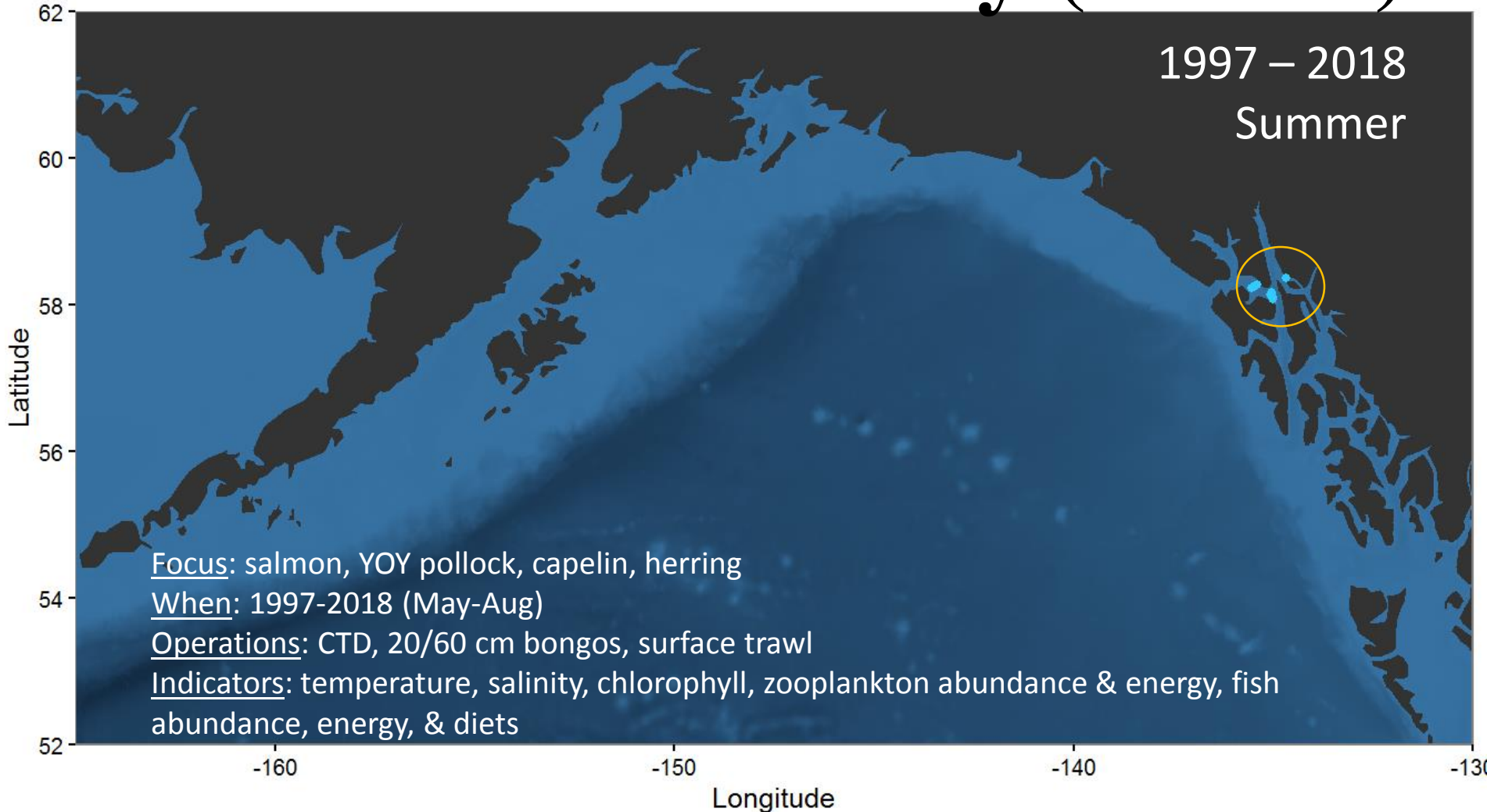
2018 GOA Ecosystem Surveys



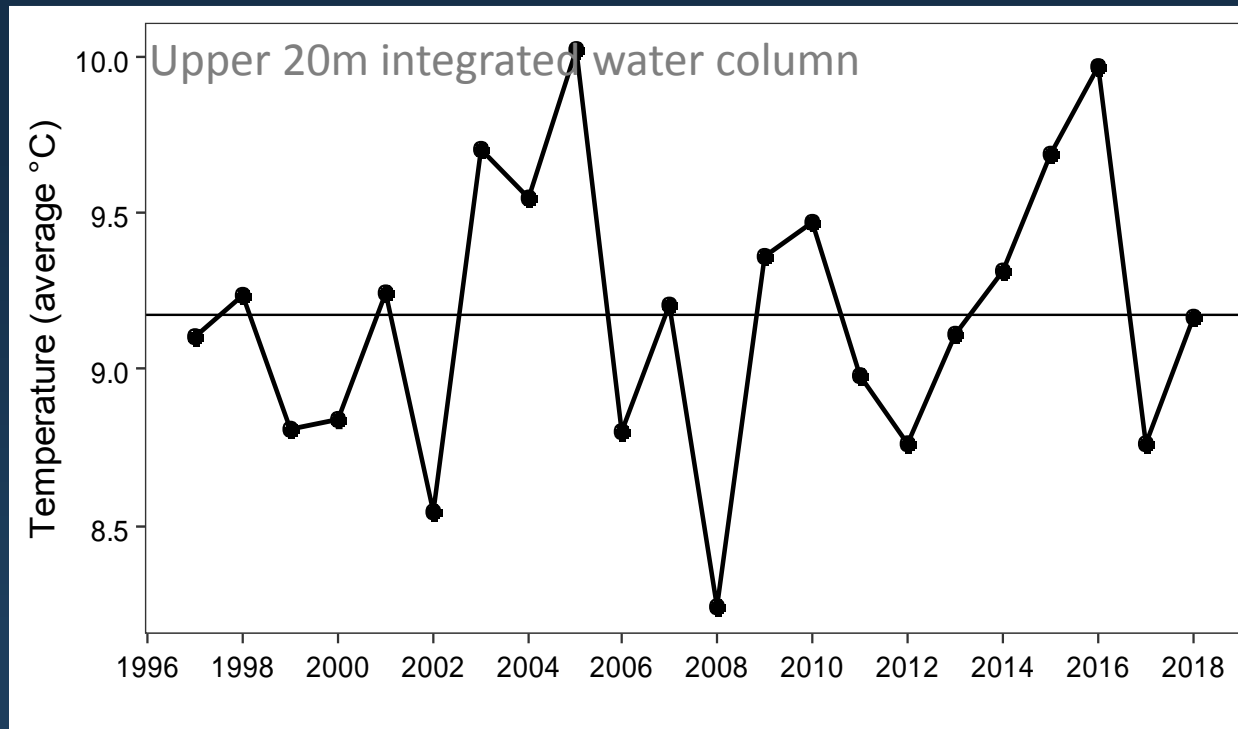
2017



EGOA inshore survey (SECM)



Icy Strait Temperature Index

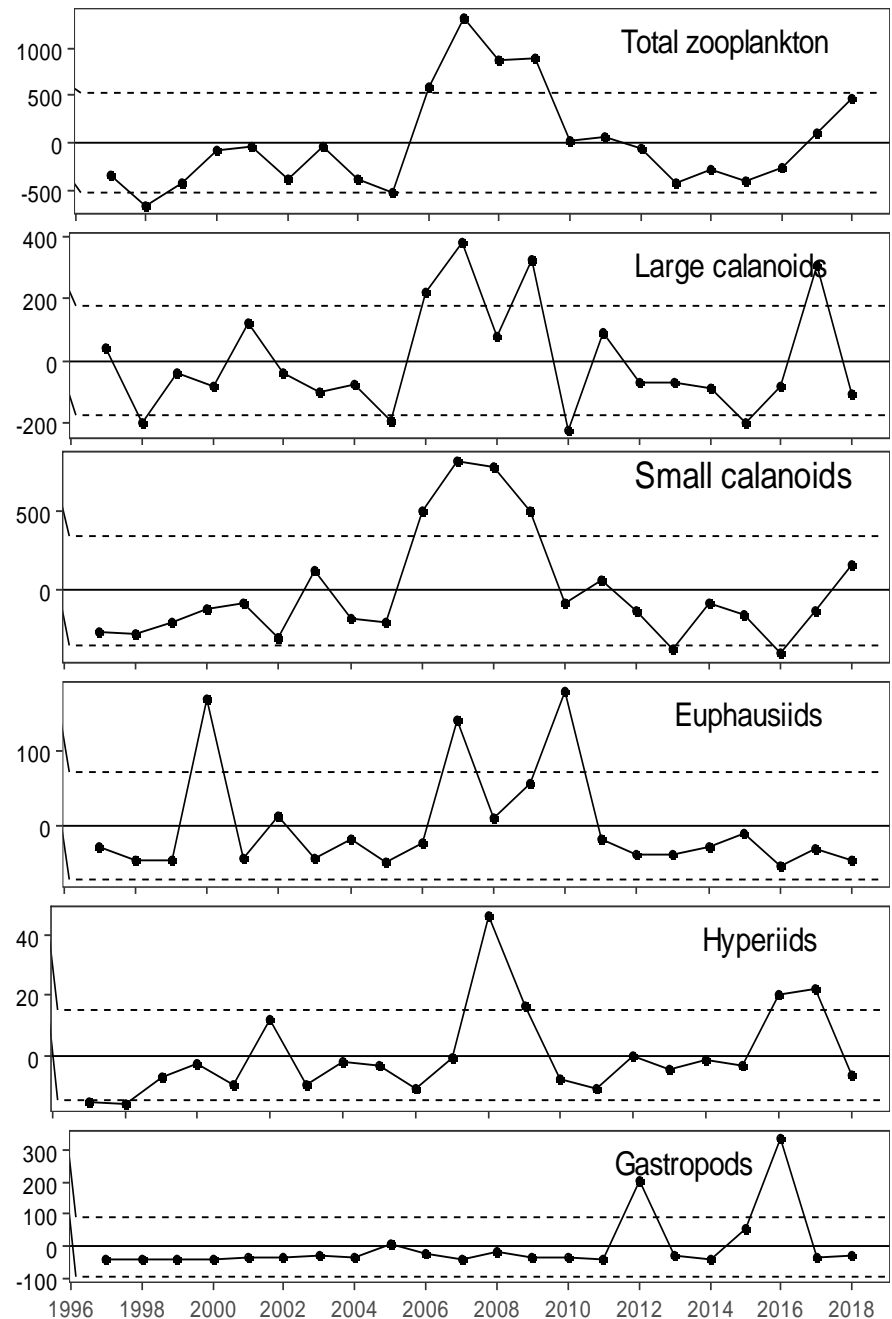


Summer temperatures were average in 2018.

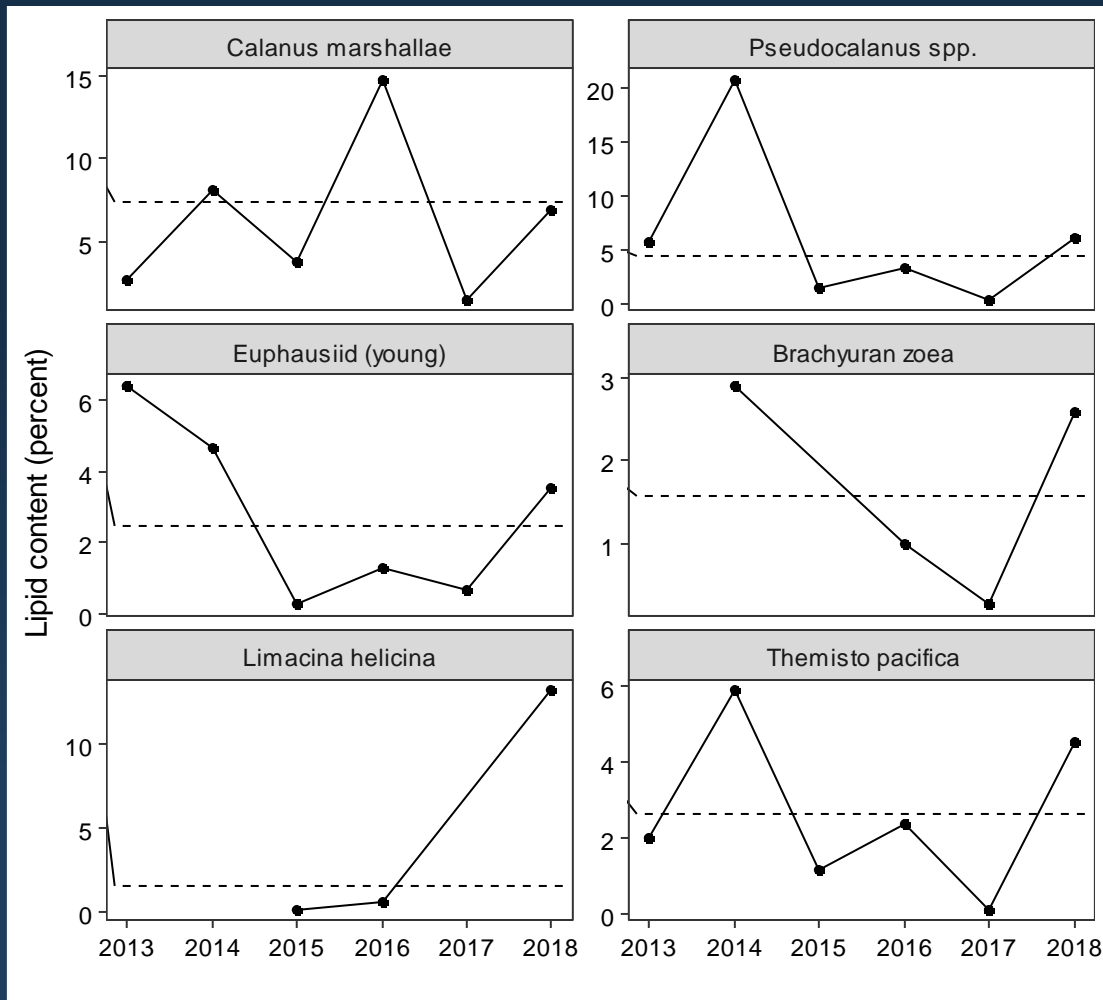
Zooplankton

- High zooplankton density driven by small calanoid copepods.
- All other taxa below average.

Density anomaly (average #/m³)

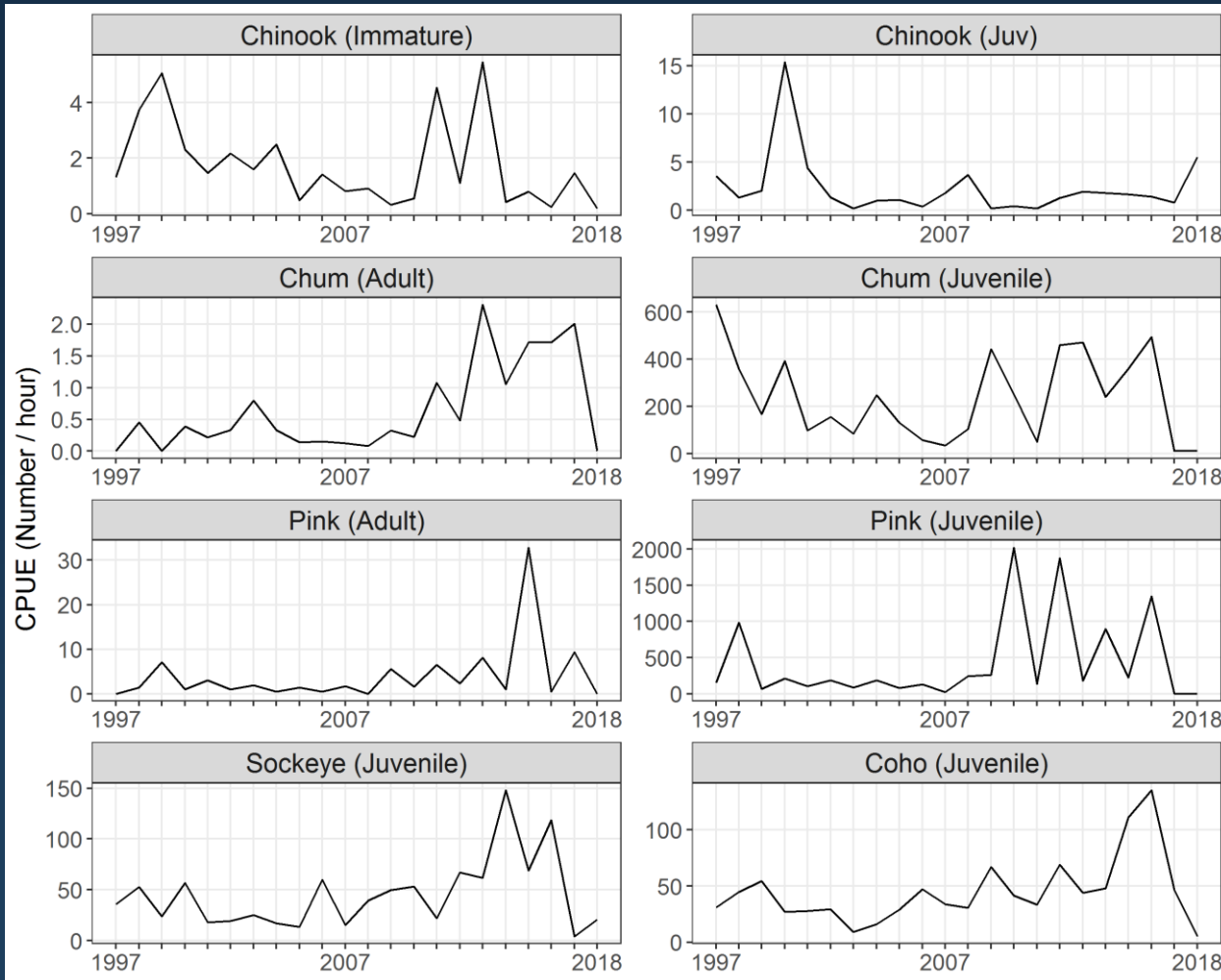


Zooplankton lipid content



- Increase in lipid content from 2017.
- Improved nutritional quality of prey for larval and juvenile fish.

Salmon CPUE



Very low catches of juvenile salmon

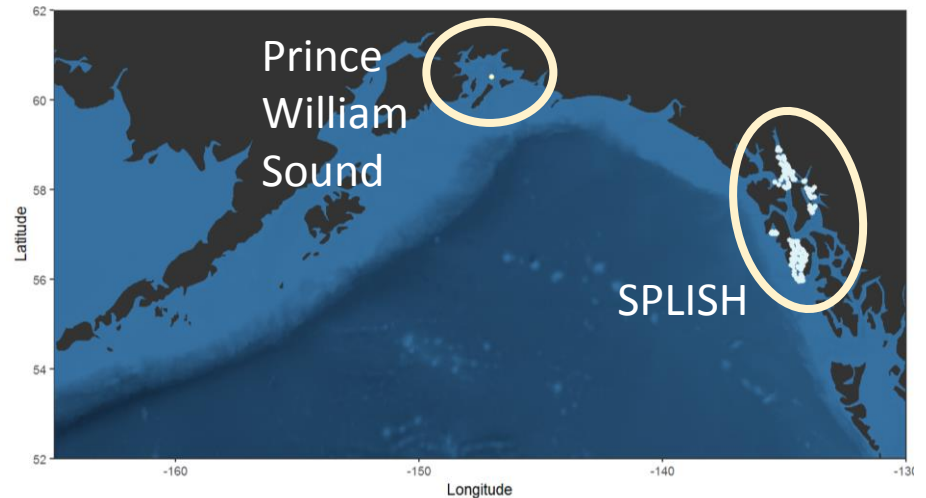
Very few outmigrating pinks

Suggests poor freshwater survival and/or shifted outmigration timing.



Gulf of Alaska

2 Whale Surveys



Contact : Ron Heintz, John Moran

Survey of Population Level Indices for Southeast Alaska Humpback (SPLISH)

Whale surveys – SPLISH, PWS

Humpback whales

- Improved body condition in 2018 relative to 2017.
- Increased abundance, but still low.
- Still no calves observed in 2018.
- Incorporating drones into surveys in 2019 for condition.





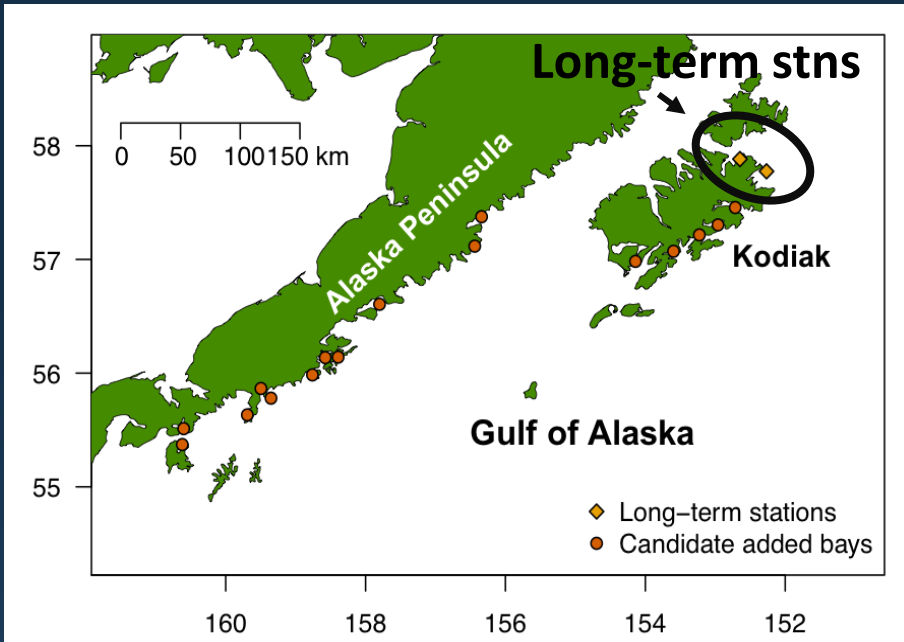
Western Gulf of Alaska

Beach Seine Survey

2006-2018

Contact : Ben Laurel

2018 beach seine survey



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

When:

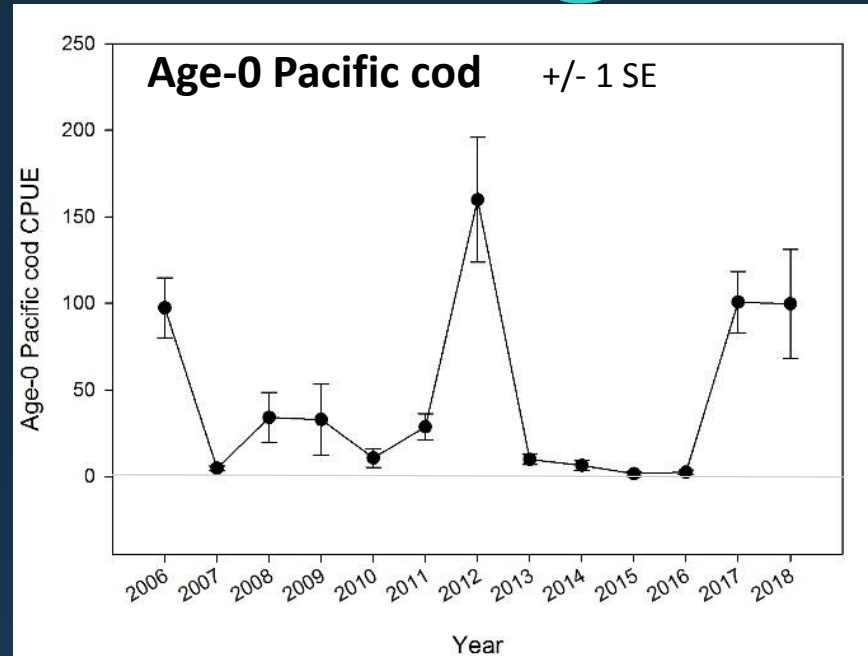
Kodiak: July/Aug (4 surveys, 16 sites across 2 bays) 2006-2018

Expanded WGOA: July/Aug (1-2 surveys, 83 sites across 14 bays) 2018

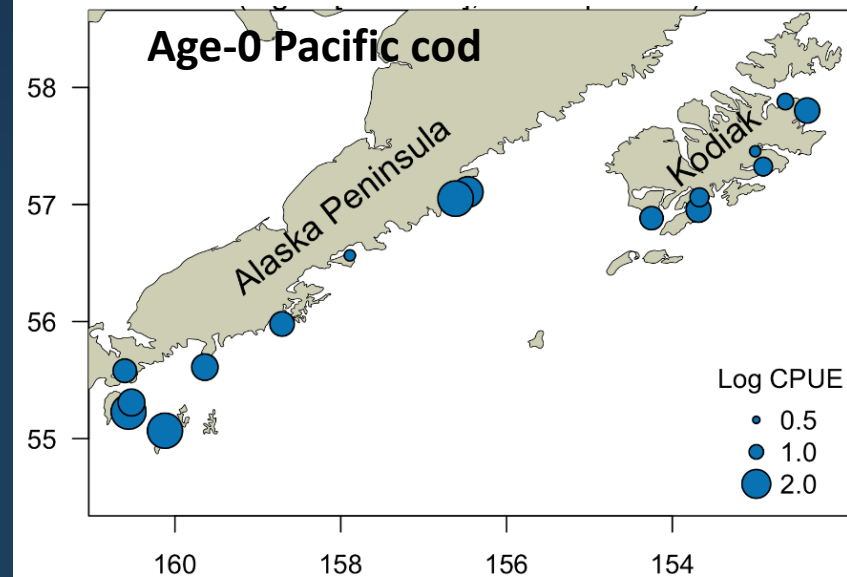
Operations: Beach seine, YSI, Baited cameras (Kodiak only)

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

Age-0 Pacific cod



- High catches of Age-0 Pacific cod suggest abundant 2018 year class.
- Catches high along Alaska Peninsula, and increased to the west.
- Age-1 cod (2017 YC) were abundant in baited camera survey. No older cod.

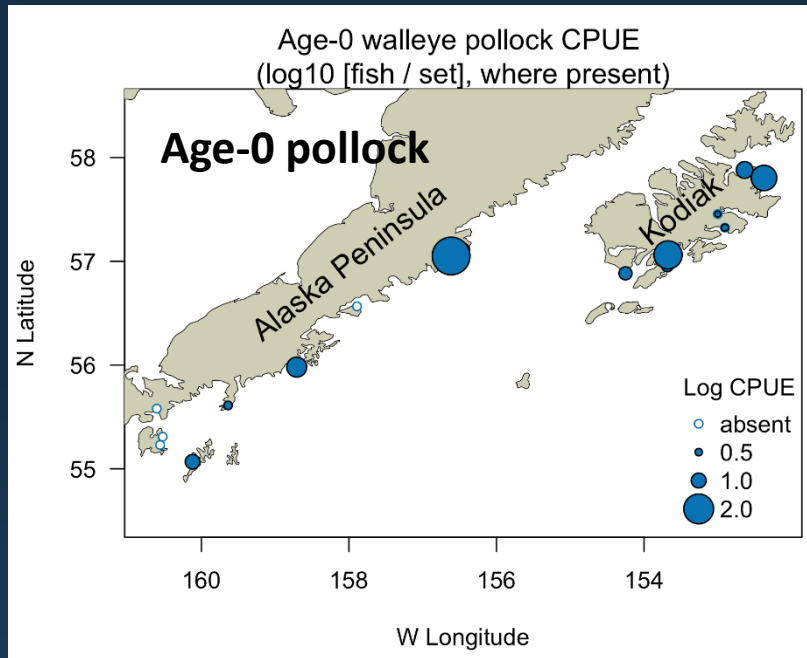


Baited cameras captured abundant age-1 cod



Contact: Ben Laurel

2018 beach seine survey



Age-0 pollock also abundant.

2019-2021: Focus on Pacific cod pre-settlement (spawning/larval production), settlement (summer growth), and overwinter processes. (AFSC Regional Work Plan)

Contact: Ben Laurel
(RACE-Newport)

Gulf of Alaska summary

Recovery from the Blob

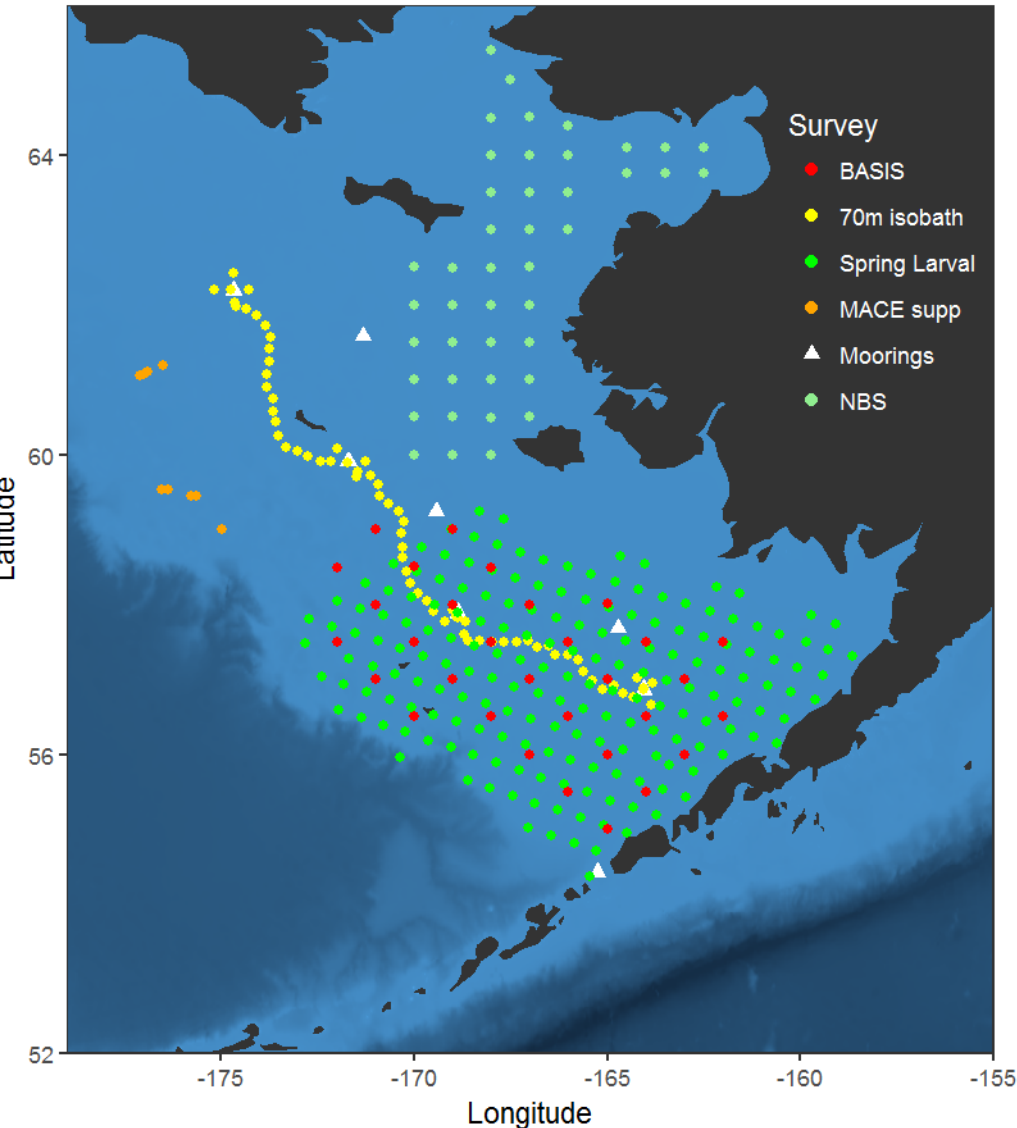
EGOA

- Average temperatures.
- Abundant small calanoid copepods, few large calanoid copepods.
- Average to high lipid content of zooplankton.
- Low juvenile salmon abundance.
- Whale condition improving.

WGGOA

- Age-0 P cod and pollock present in high numbers. Age-1 P cod continue to be abundant, suggesting potential for strong 2017 and 2018 year classes following the Blob.

2018 Bering Sea Ecosystem Surveys



Moorings and 70m Isobath

Latitudinal picture of lower trophics and processes on middle shelf in spring and autumn

Spring Larval Survey

Spatially-extensive sampling of zooplankton and fish early life stages.

BASIS

Ecology of YOY gadids, salmon, forage fishes and their prey in late summer.

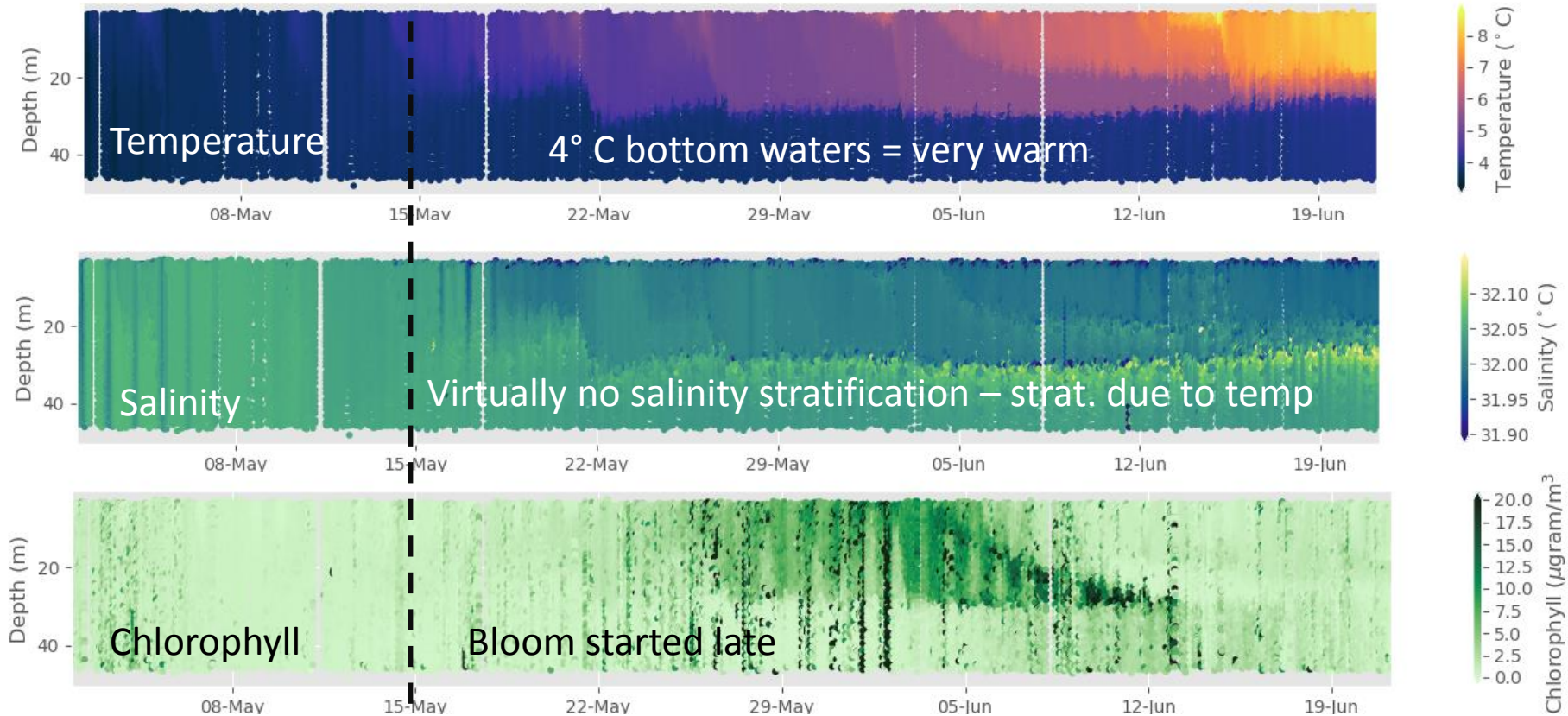
Northern Bering Sea Survey

Ecology of YOY gadids, salmon, herring, capelin and lower trophic levels.

MACE Leg 3 supplemental sampling

Zooplankton and YOY gadids on outer shelf.

Warm in the EBS (M2 prawler)



08-May

29-May

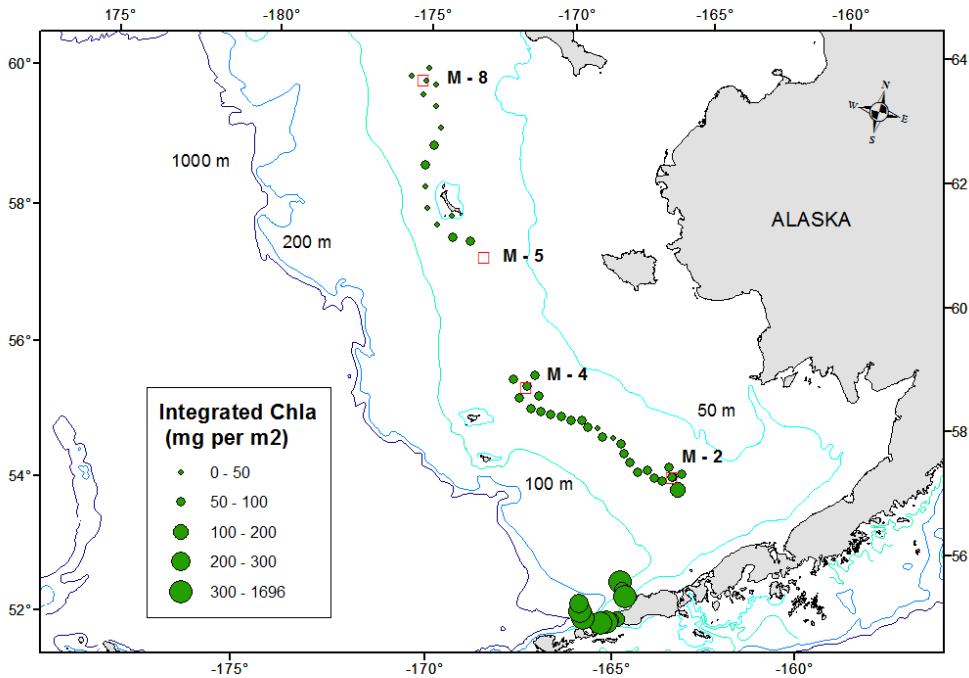
19-Jun

Strong wind mixing

↓ Stratification begins ~15 May, a few weeks later than typical for no ice years

Spring bloom was late

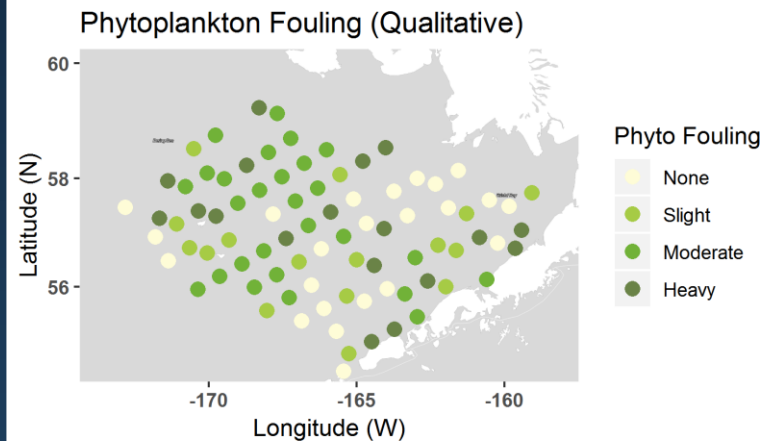
Chlorophyll a , 2-10 May (Spring Mooring Survey)



Integrated chla consistently low N & S except Unimak (likely GOA-derived).

Contact: Janet Duffy-Anderson

14 May – 1 June (Spring Larval Survey)



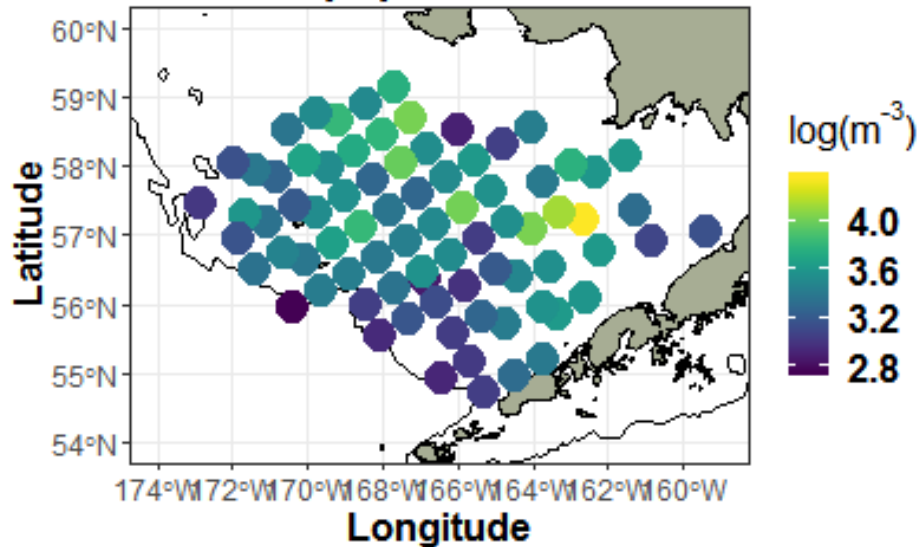
Bloom underway by late May.

Rapid Zooplankton Assessment (RZA)

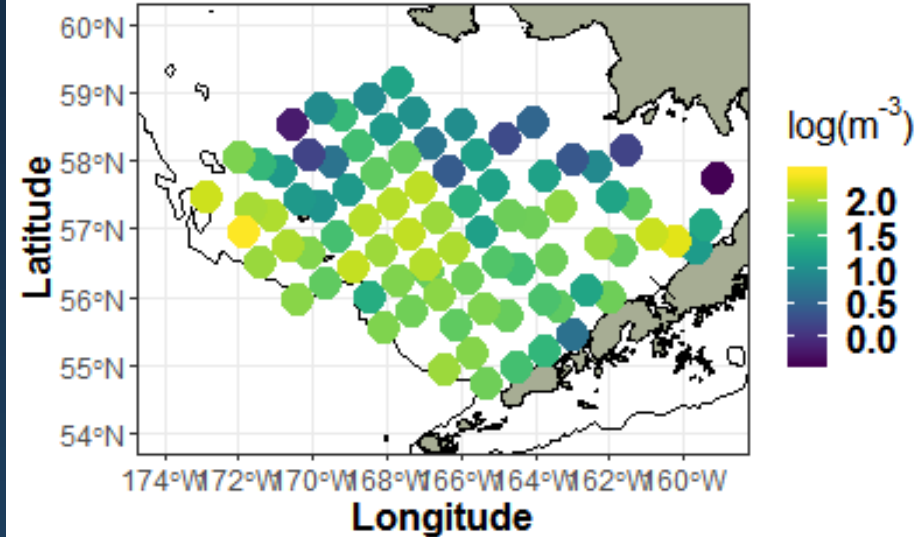
Larval survey

Spring (14 May to 1 Jun 2018)

Small Copepods

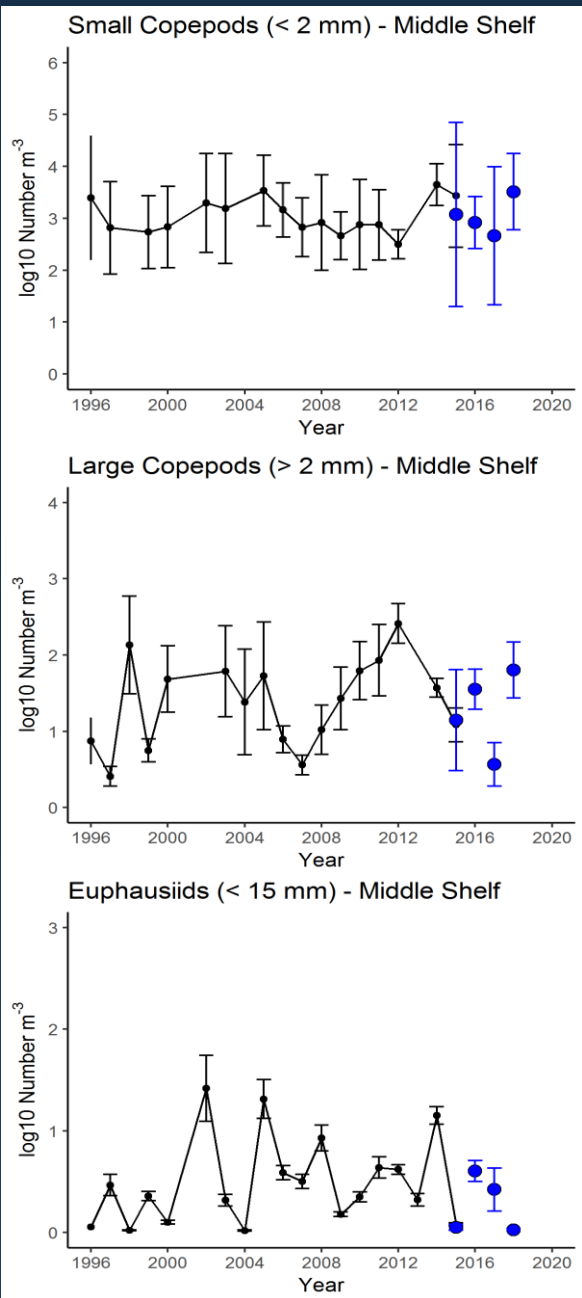


Large Copepods

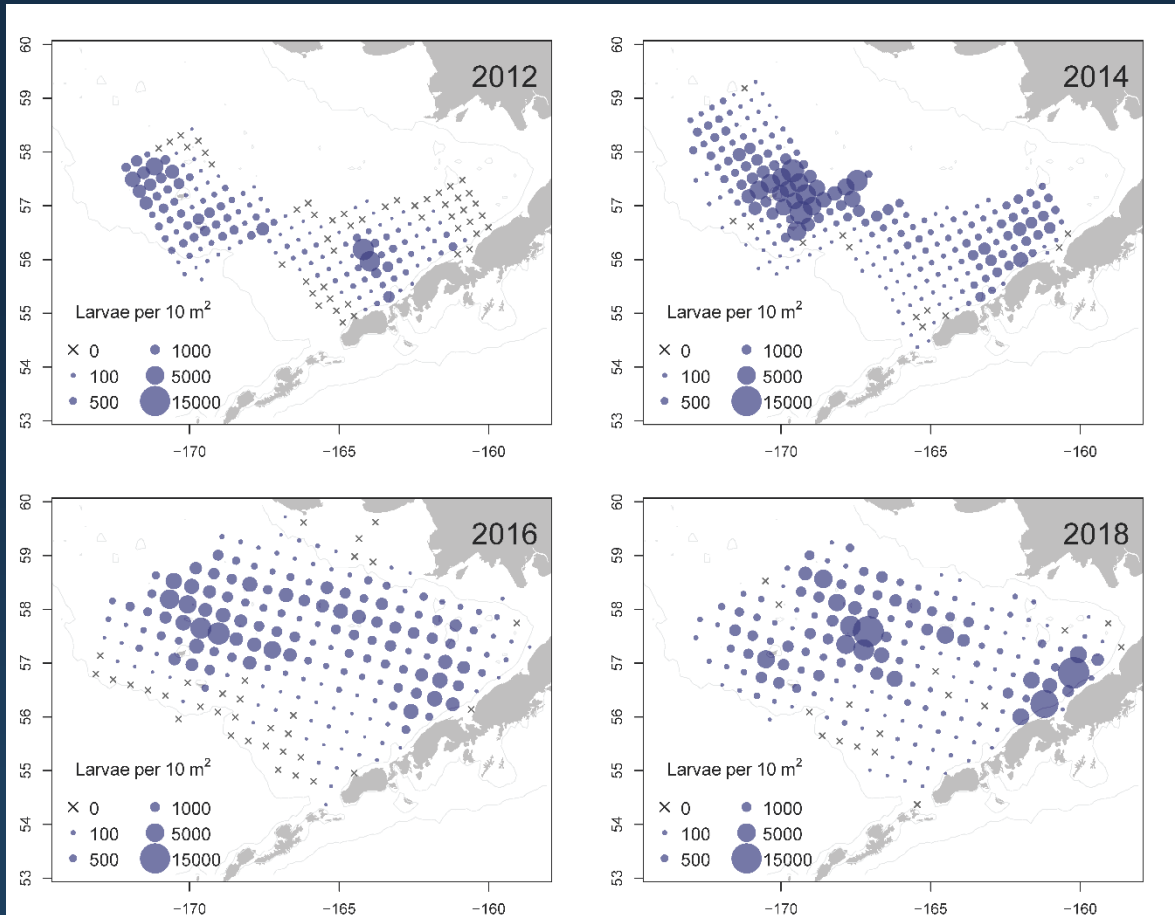


Rapid Zooplankton Assessment (RZA) - Spring

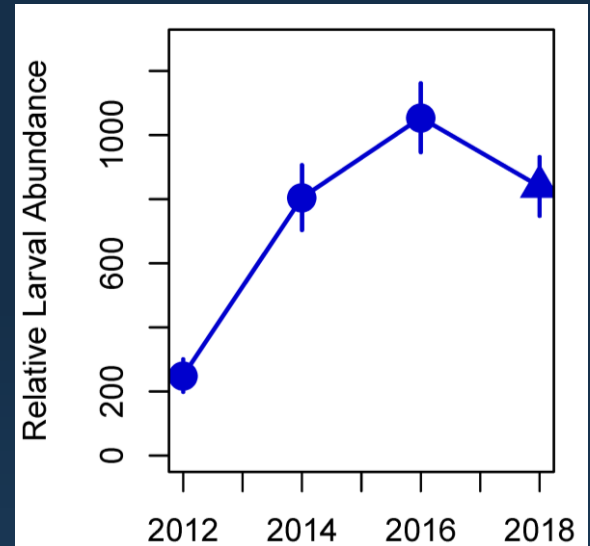
- Small copepod abundances high in spring, as expected during a warm year
 - Predict high abundances of small copepods throughout the year.
- Large copepod abundances were around average in spring, as expected in a warm year
 - Predict low abundance in fall (Kimmel et al. 2017)
- Small euphausiid numbers were very low in spring, similar to 2015



Larval walleye pollock abundance



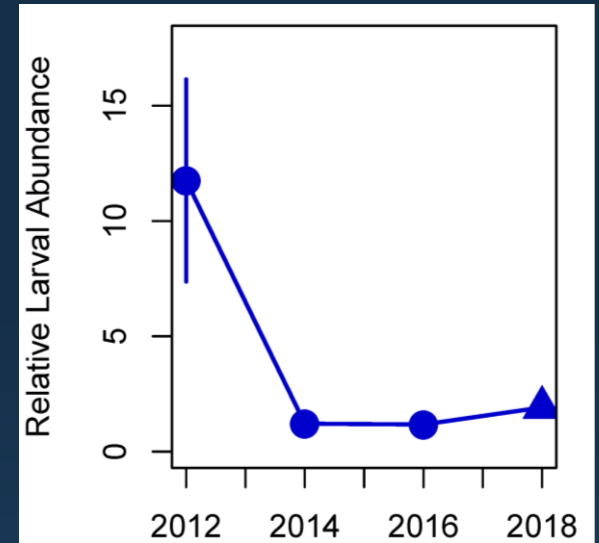
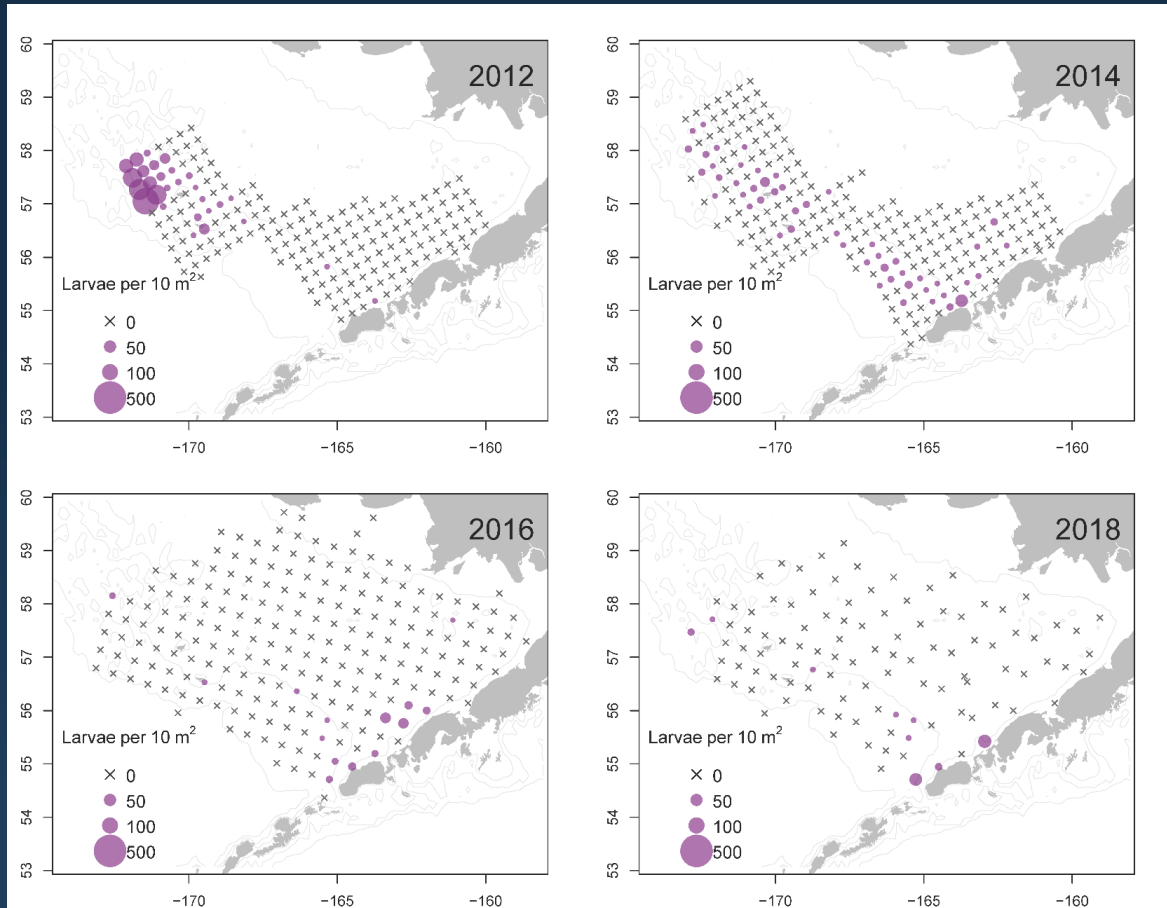
2012 – 2016: Laboratory-verified data. 2018: On-board rapid assessment



Larval pollock appeared in good condition: no indication of starvation

Next: look at larval size for indication of phenology

Larval Pacific cod abundance



Few larval cod in 2018,
concentrated near
Unimak

2012 – 2016: Laboratory-verified data. 2018: On-board rapid assessment

Contact : Janet Duffy-Anderson, Lauren Rogers

Southeast Bering Sea Summary

Warm year conditions in the SEBS

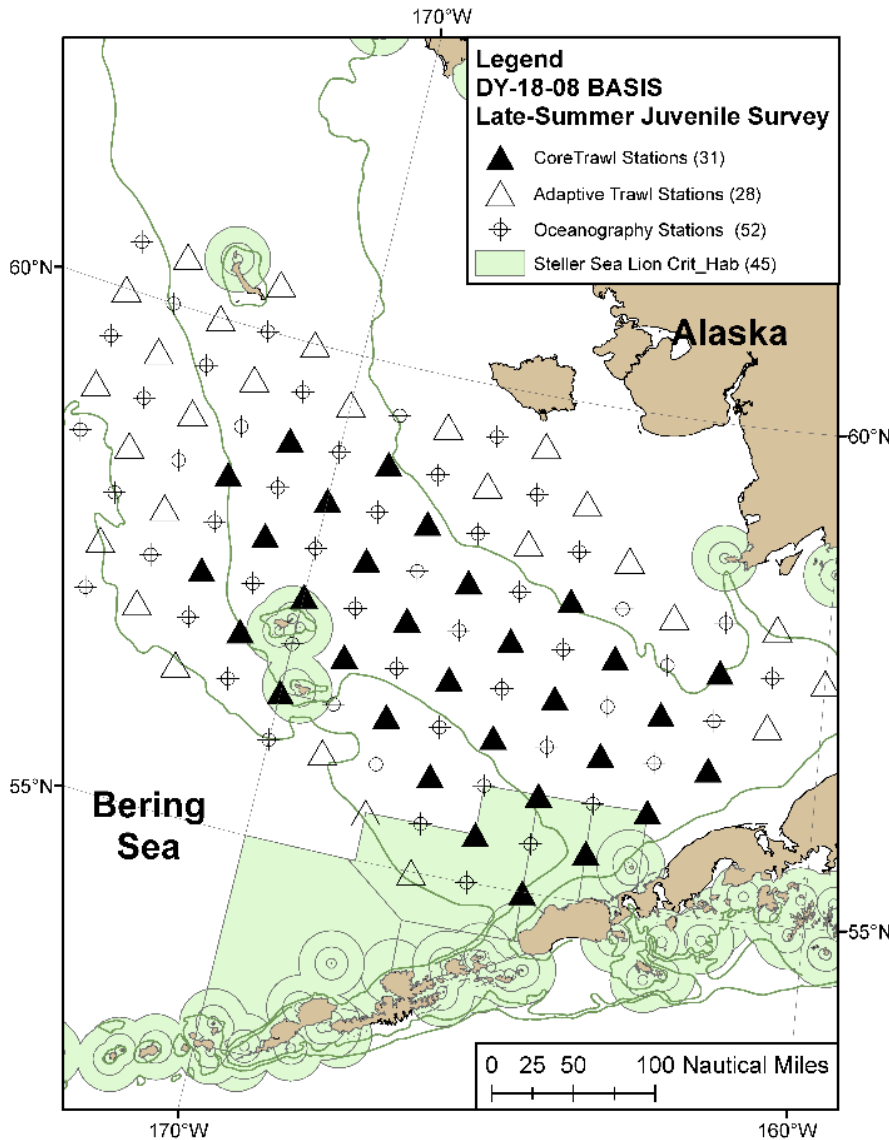
- Warm bottom temperatures, late stratification, and late spring bloom.
- Despite late bloom, large and small zooplankton relatively abundant, as expected in warm spring.
- Expectation is that large copepods will be less abundant in fall.
- Larval pollock widespread and abundant. Few larval cod.

BASIS survey delayed, so no info yet on fall zoops, age-0 pollock, energy density, etc.

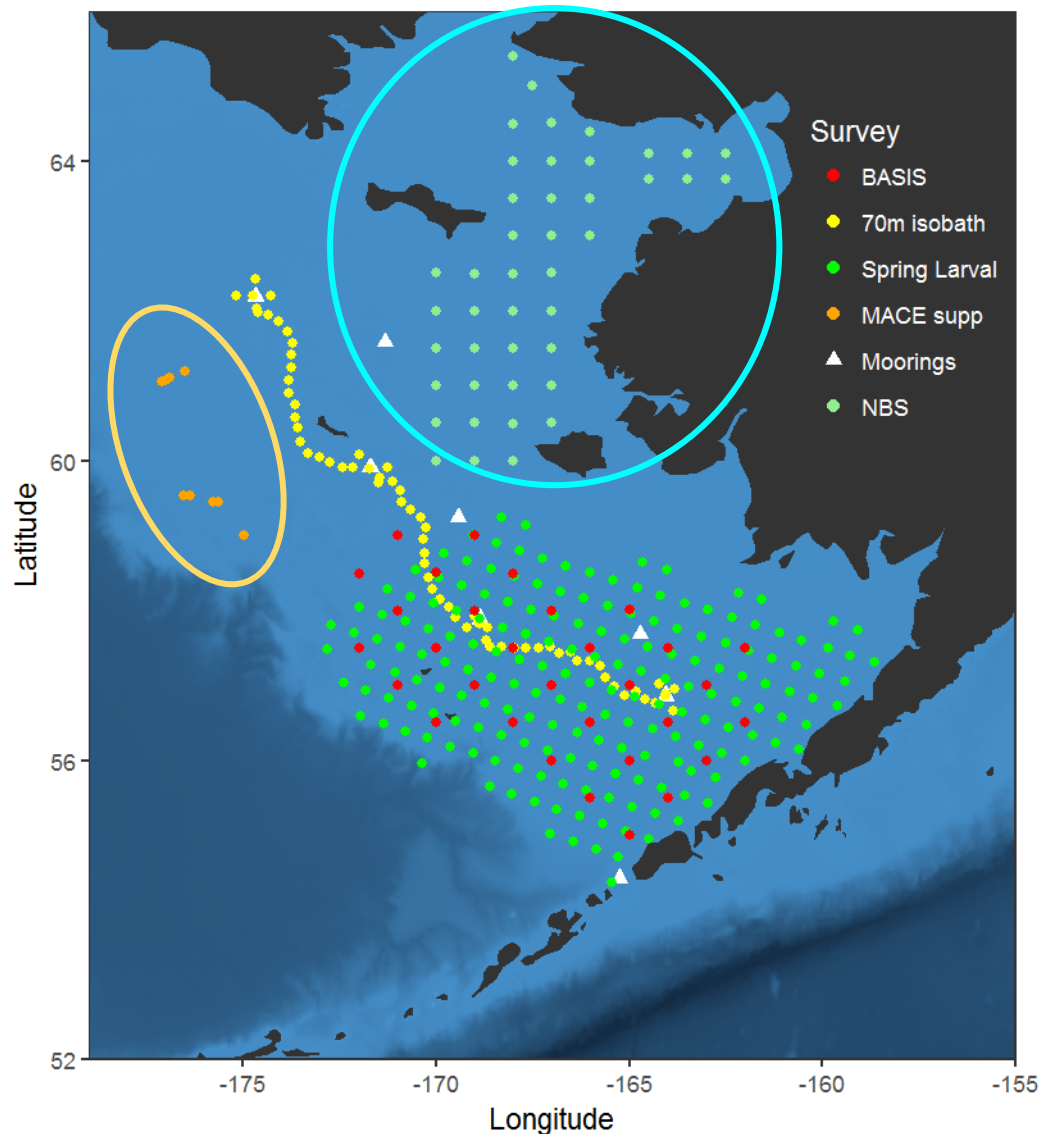
BASIS

2018 survey will be late and short due to Dyson issues.

Reduced days at sea: plan to sample ~26 core stations in middle domain



2018 Northern Bering Sea Surveys



Moorings and 70m Isobath

Latitudinal picture of lower trophics and processes on middle shelf in spring and autumn

Spring Larval Survey

Spatially-extensive sampling of zooplankton and fish early life stages.

BASIS

Ecology of YOY gadids, salmon, forage fishes and their prey in late summer.

Northern Bering Sea Survey

Ecology of YOY gadids, salmon, herring, capelin and lower trophic levels.

MACE Leg 3 supplemental sampling

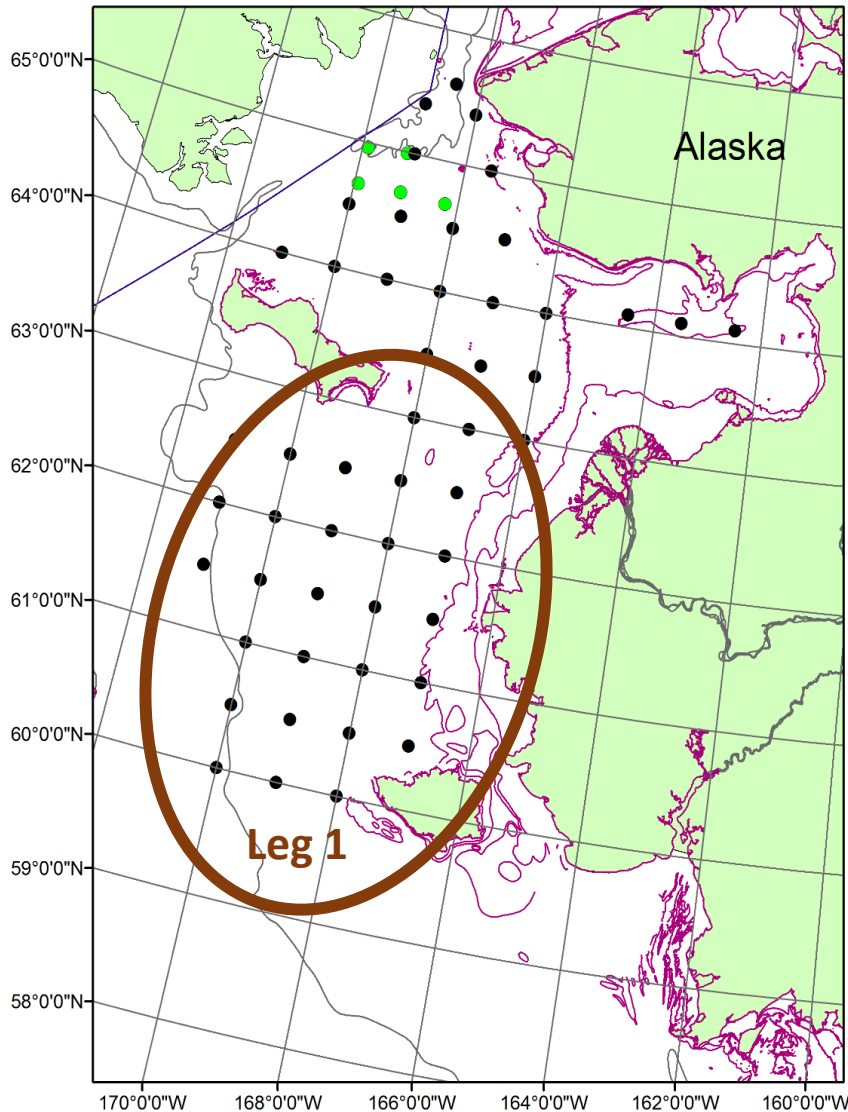
Zooplankton and YOY gadids on outer shelf.

Northern Bering Sea Survey

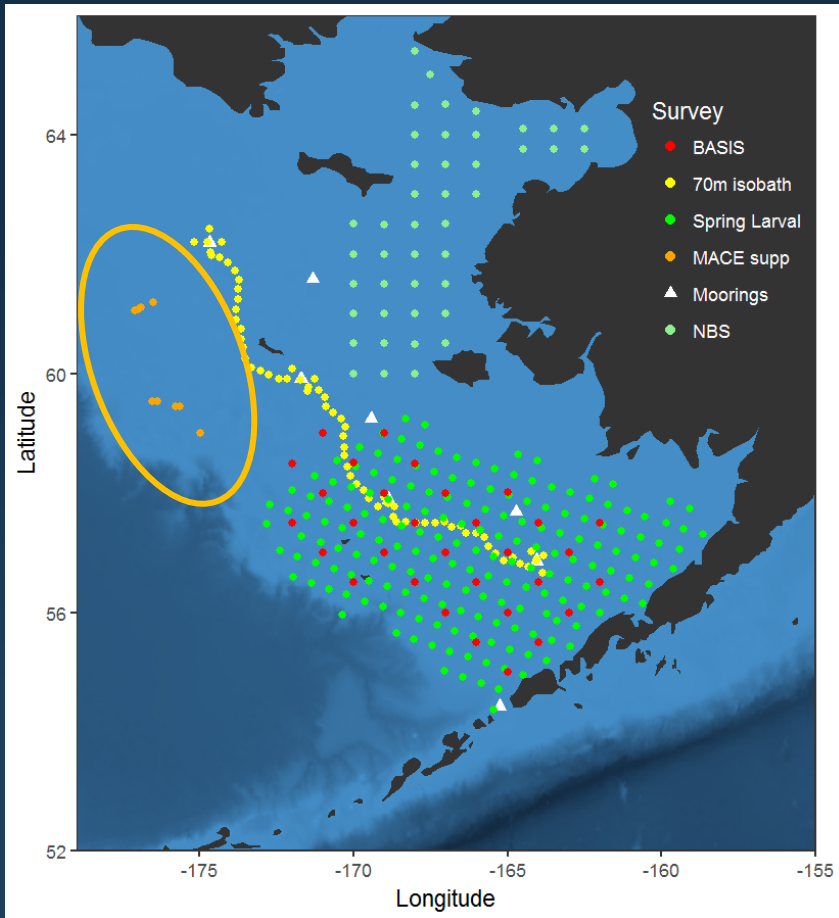
Aug/Sep 2003-2018

Leg 1:

- Pacific herring = dominant fish catch
- Adult walleye pollock present in low numbers within surface waters at least as far N as St Lawrence.
- Age 0 walleye pollock were more abundant along the 60N transect and at stations further offshore
- Juvenile chum, pink, coho, Chinook, and sockeye salmon
- Coldest bottom temp was 2.9 °C
- SST from 9.2 to 11.6 °C, warmest temps nearshore



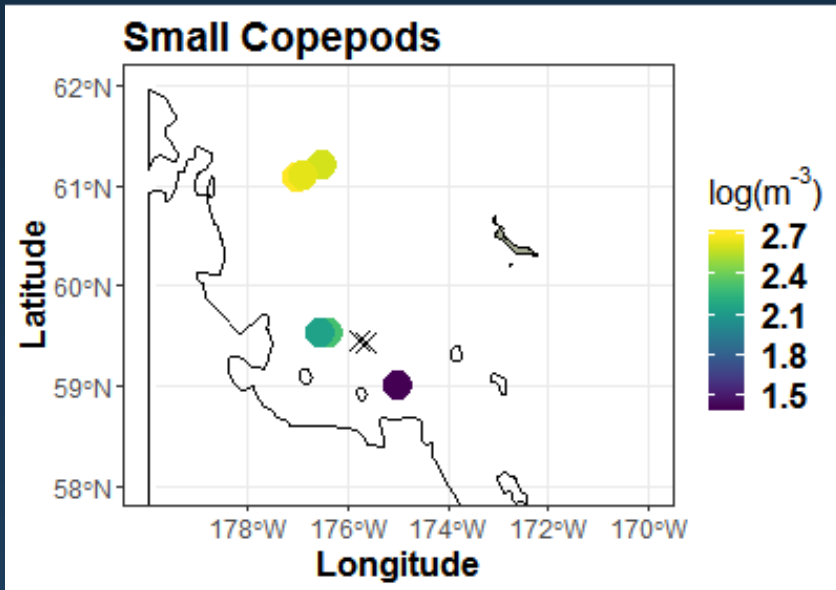
MACE Leg 3 – Supplemental sampling 16-19 August



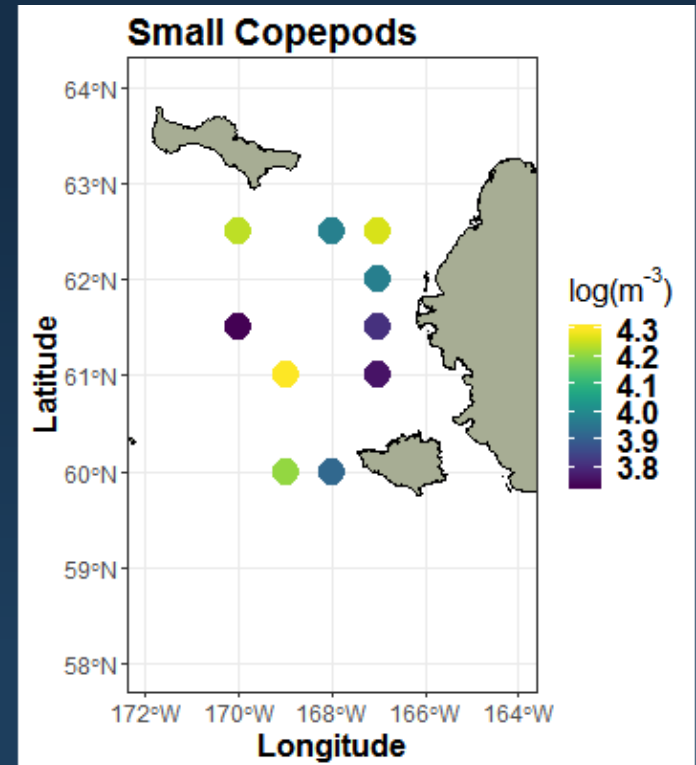
- Age-0 pollock relatively abundant (CPUE: 21 – 230 pollock per 1000m³), similar to BASIS 2016 catches.
- Many smaller age-0 pollock (20 – 35 mm)

Rapid Zooplankton Assessment (RZA)

MACE survey
16-20 August



Northern Bering Sea Survey
28 August to 8 September 2018

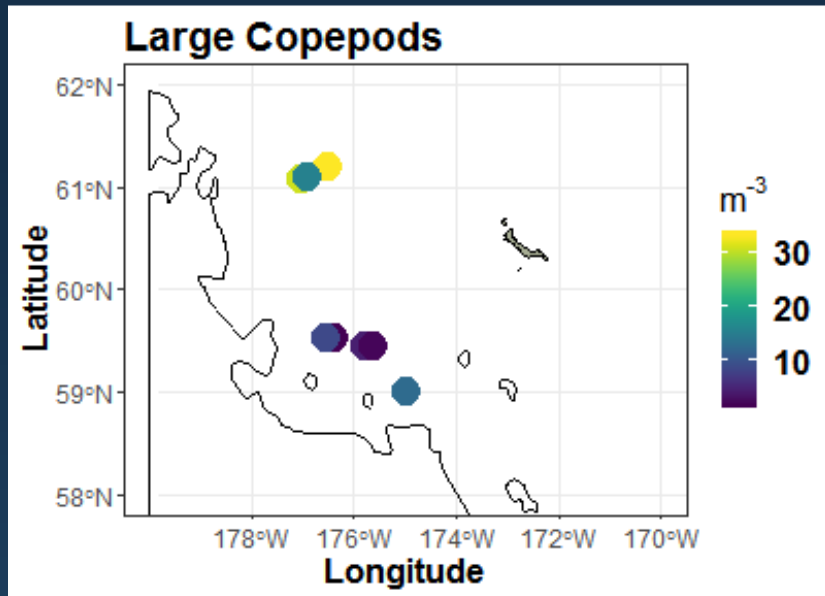


Small copepods were less abundant on outer shelf, relatively abundant in NBS survey.

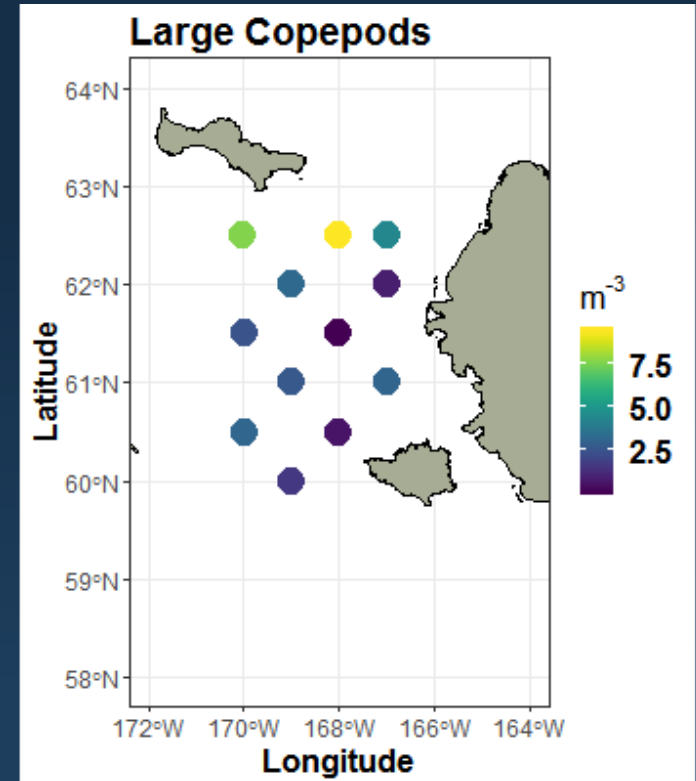
Contact: David Kimmel

Rapid Zooplankton Assessment (RZA)

MACE survey
16-20 August



Northern Bering Sea Survey
28 August to 8 September 2018



Large copepods numbers were very low in the Northern Bering Sea
(Note change from log scale.)

Contact: David Kimmel

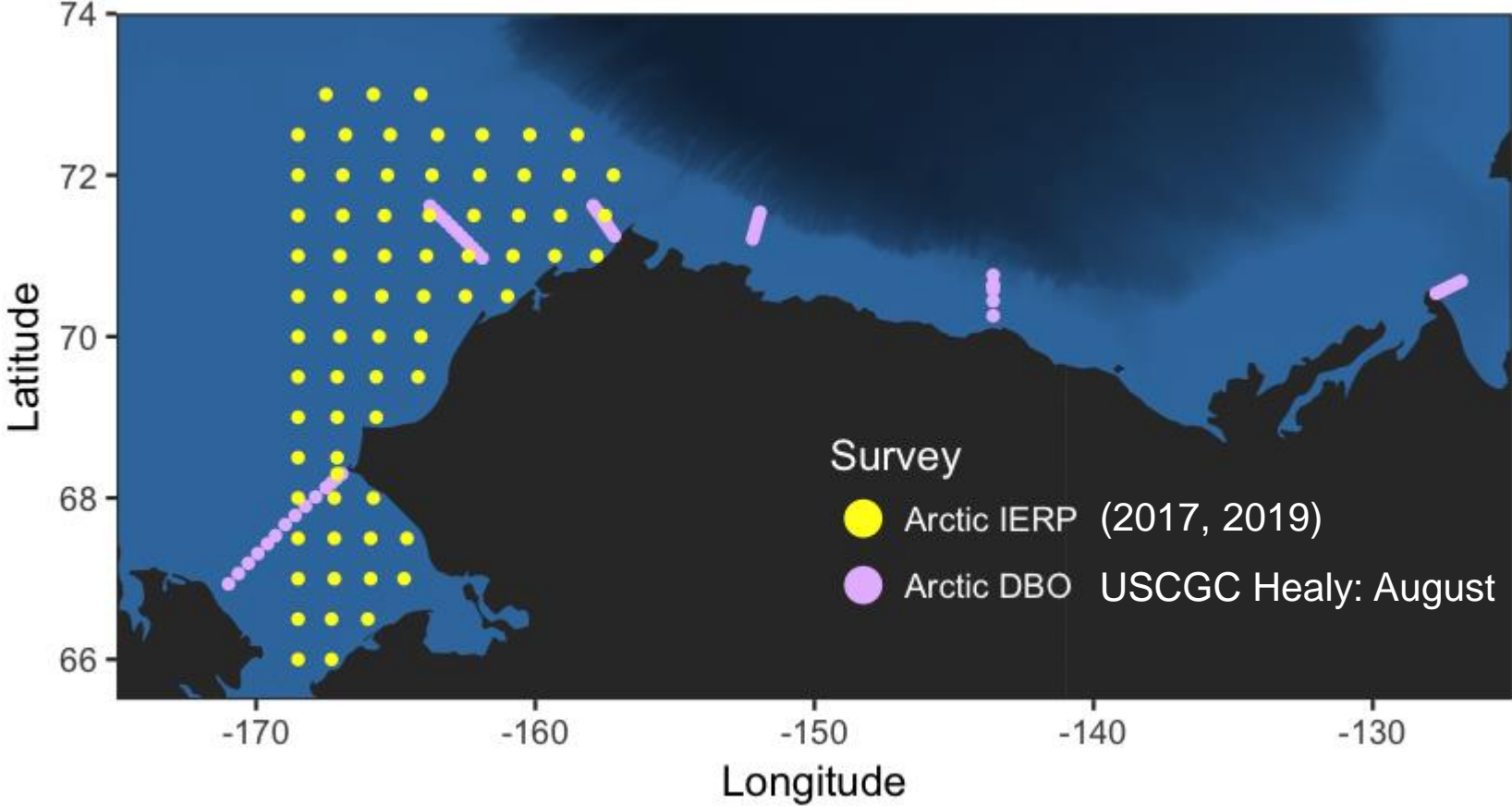
Northern Bering Sea summary

Preliminary observations of extreme warm year

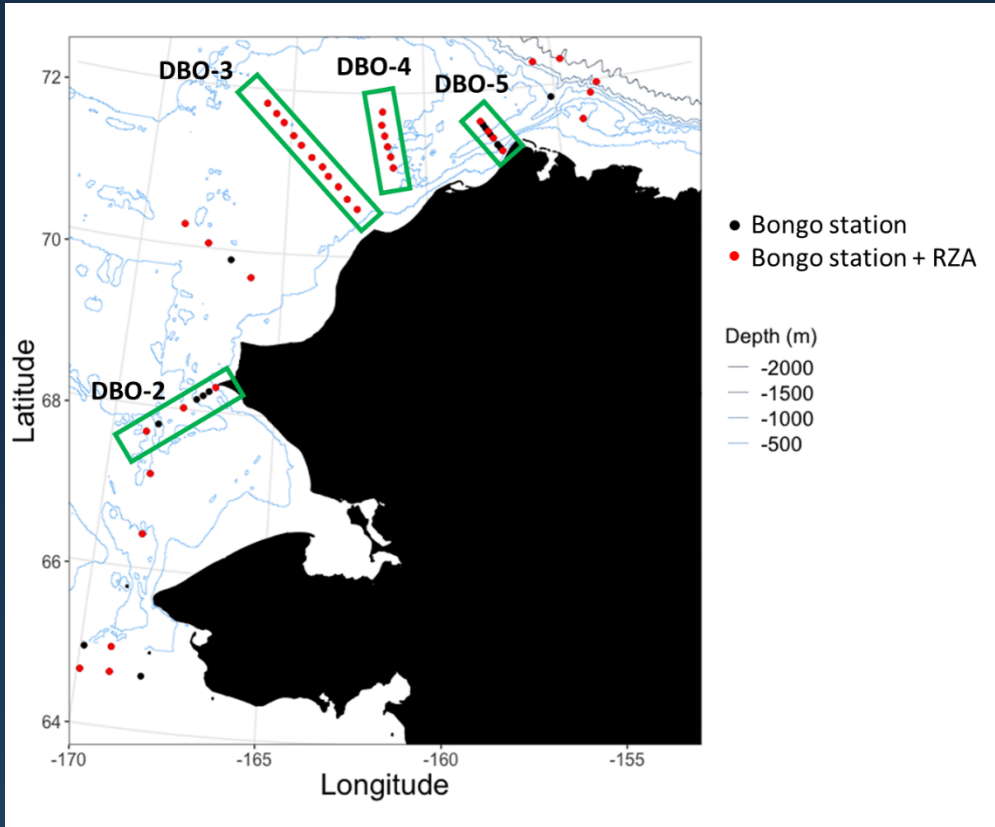
- Very warm, no cold pool
- Abundant small copepods
- Very few large copepods
- Plentiful herring, chum, pink salmon
- Adult pollock at least to 63 °N.
- Age-0 pollock present on outer shelf, into NBS survey area (and Arctic).

Will have a more complete picture when surveys are complete and samples are processed.

2018 Arctic Ecosystem Surveys



2018 High Arctic – Distributed Biological Observatory



August 2018

CTDs

Integrated Chla

Zooplankton samples – on board
rapid analyses

Larval fish



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



Acknowledgements

Ellen Yasumiishi (EGOA), John Moran & Ron Heintz (Whale surveys), Elizabeth Siddon (EBS), Alex Andrews (BASIS), Jordan Watson & Emily Fergusson (SECM), Ed Farley, Kristin Cieciel & Libby Logerwell (NBS), Janet Duffy-Anderson (EBS, NBS, Arctic), David Kimmel & Colleen Harpold (RZA), Ben Laurel & Mike Litzow (WGOA Beach Seine)

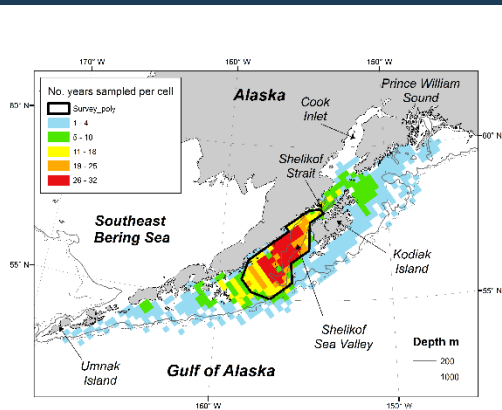
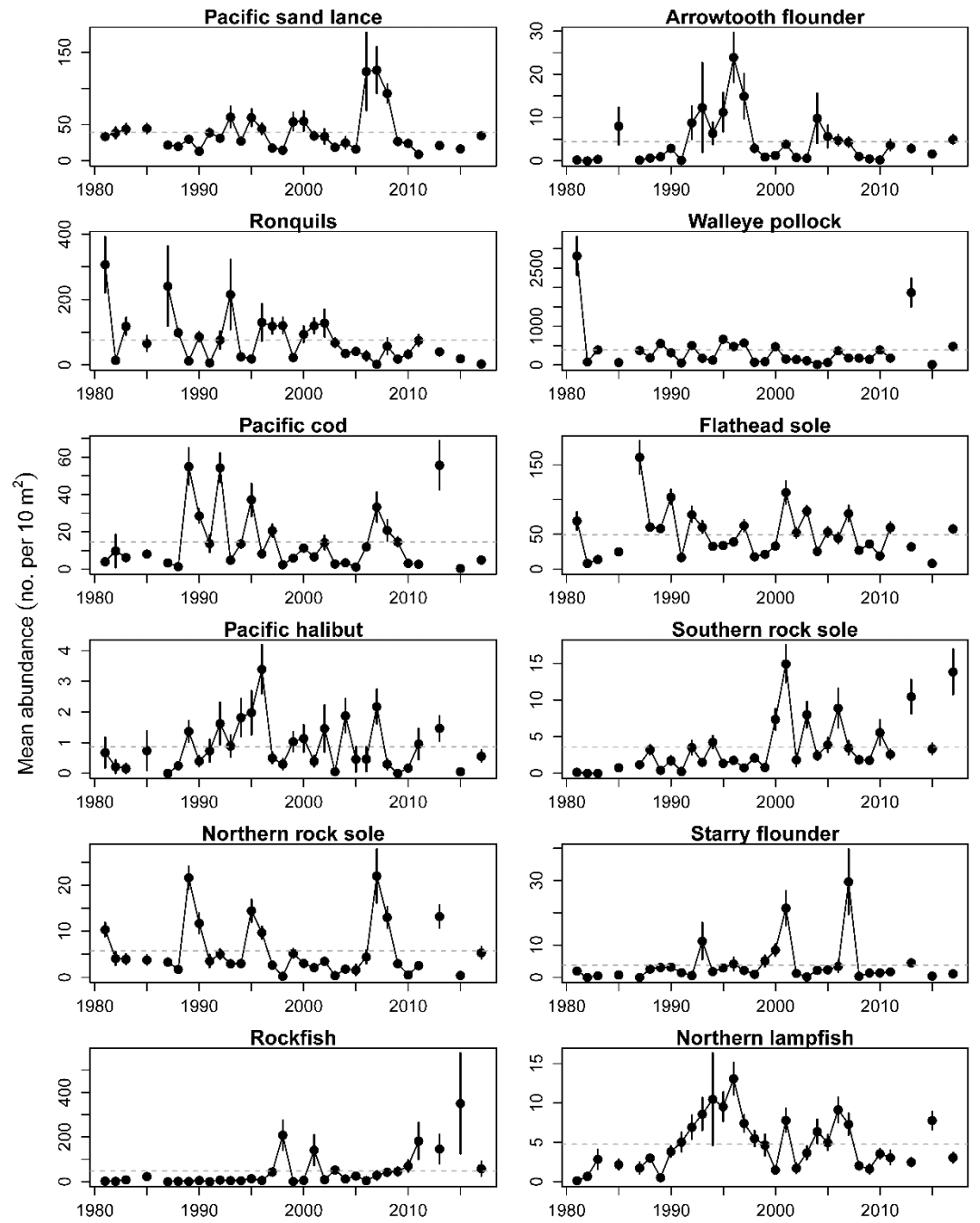
Extra slides

Larval fish abundance (1981-2017)

Pollock: above average

Cod: below average, but >2015

Rockfish (mostly POP): decline from recent high abundance



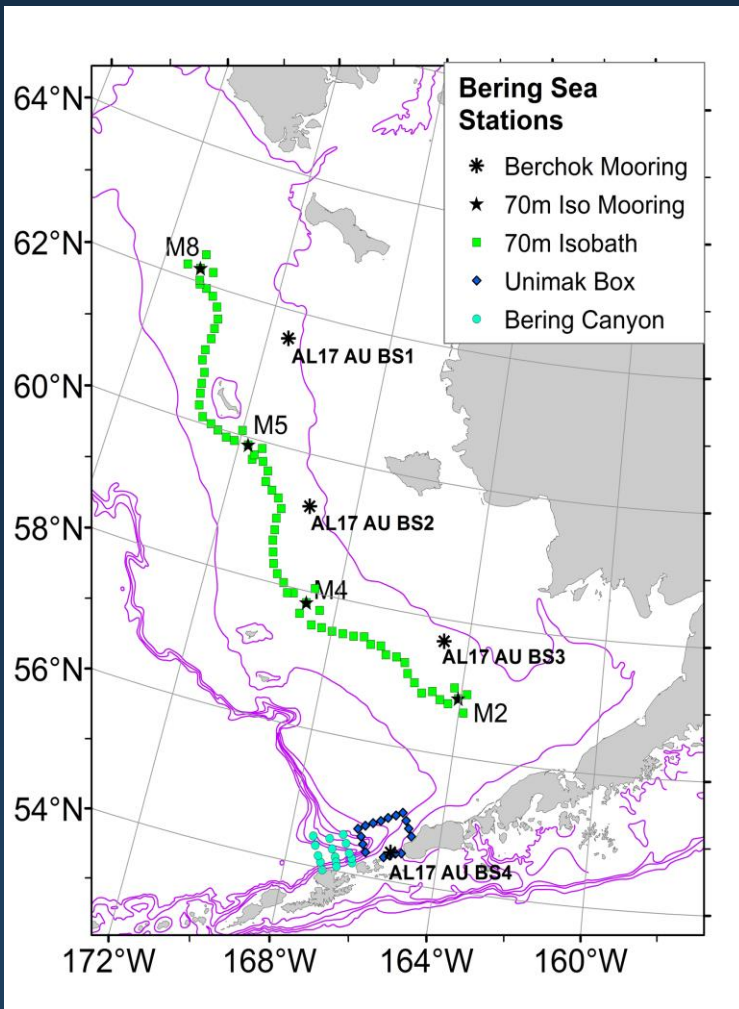
Moorings and 70m isobath

Latitudinal picture of lower trophics
and processes on middle shelf

When: April 22 – May 10 and Sept 21 – Oct 7

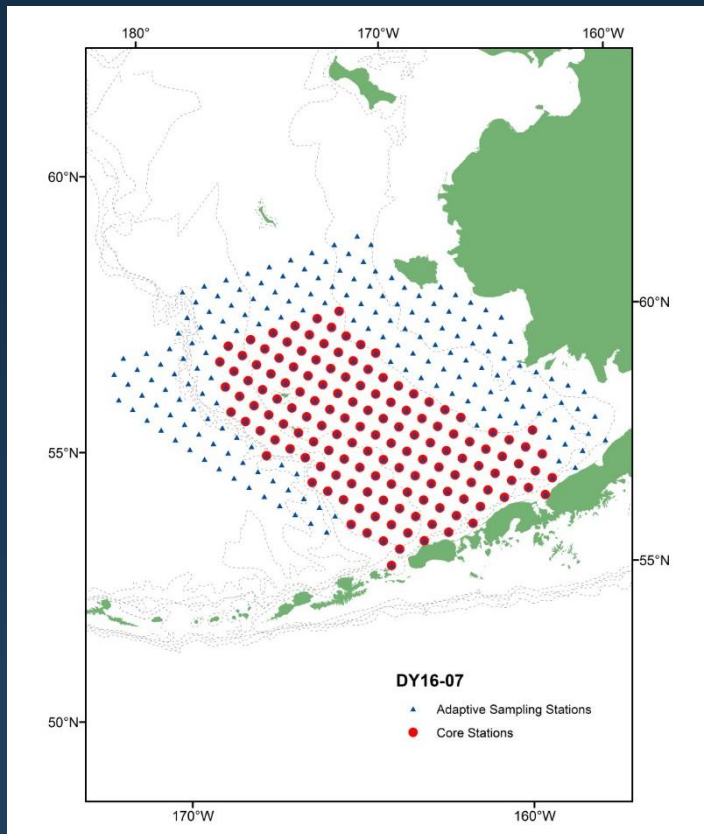
Operations: Surface, subsurface moorings and
instrumentation (incl Prawler), CTDs, Bongos

Indicators: Integrated chl a ; Zooplankton species
distribution, abundance, stage; on board rapid
zooplankton assessment (RZA); T, S, O $_2$, etc



Spring Larval Survey

Spatially-extensive sampling of zooplankton and larval fishes in spring.



Focus: Larval fishes (esp pollock), zooplankton

When: May/June 2003-2011, 2012-2018 (even yrs)

Operations: Bongo nets, CTDs, CalVET

Indicators: Larval fish & zooplankton species abundance, distribution, size, condition

Products: Rapid Zooplankton Assessment (RZA), Rapid Larval Fish Assessment (5 spp)

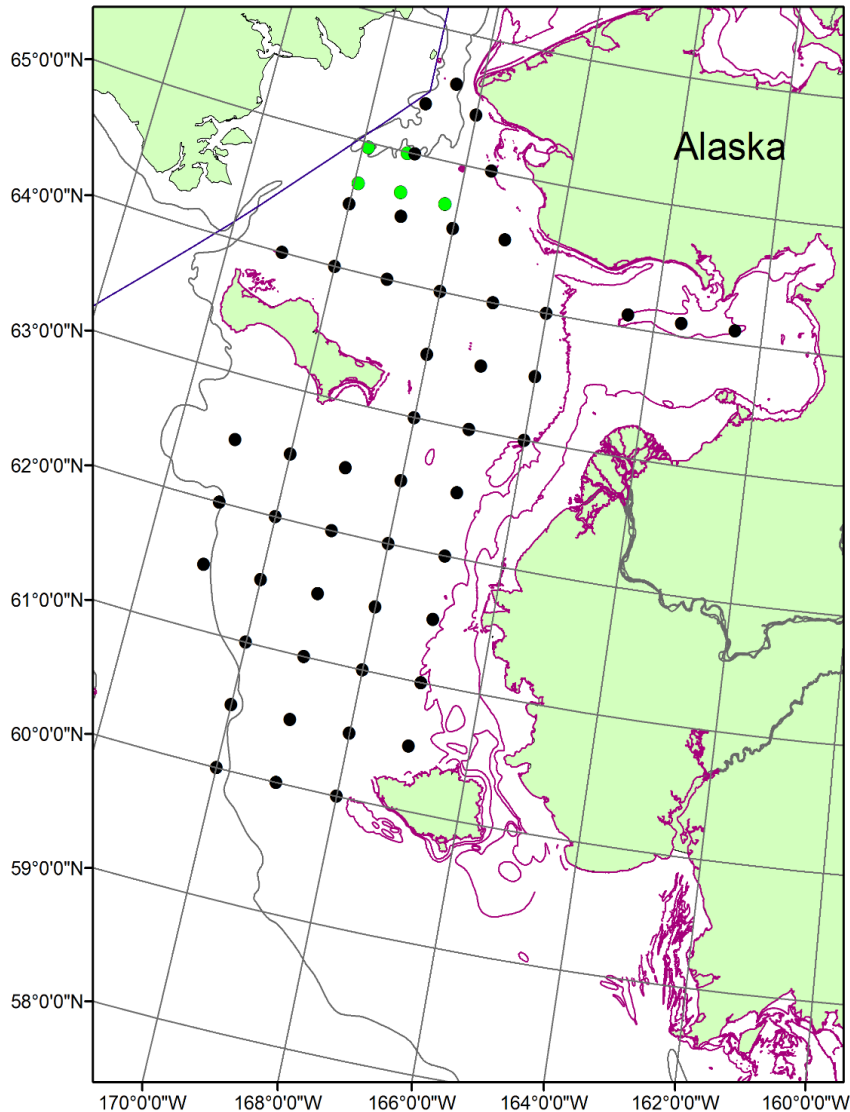
Northern Bering Sea Survey

Focus: YOY gadids, juv salmon, herring, capelin

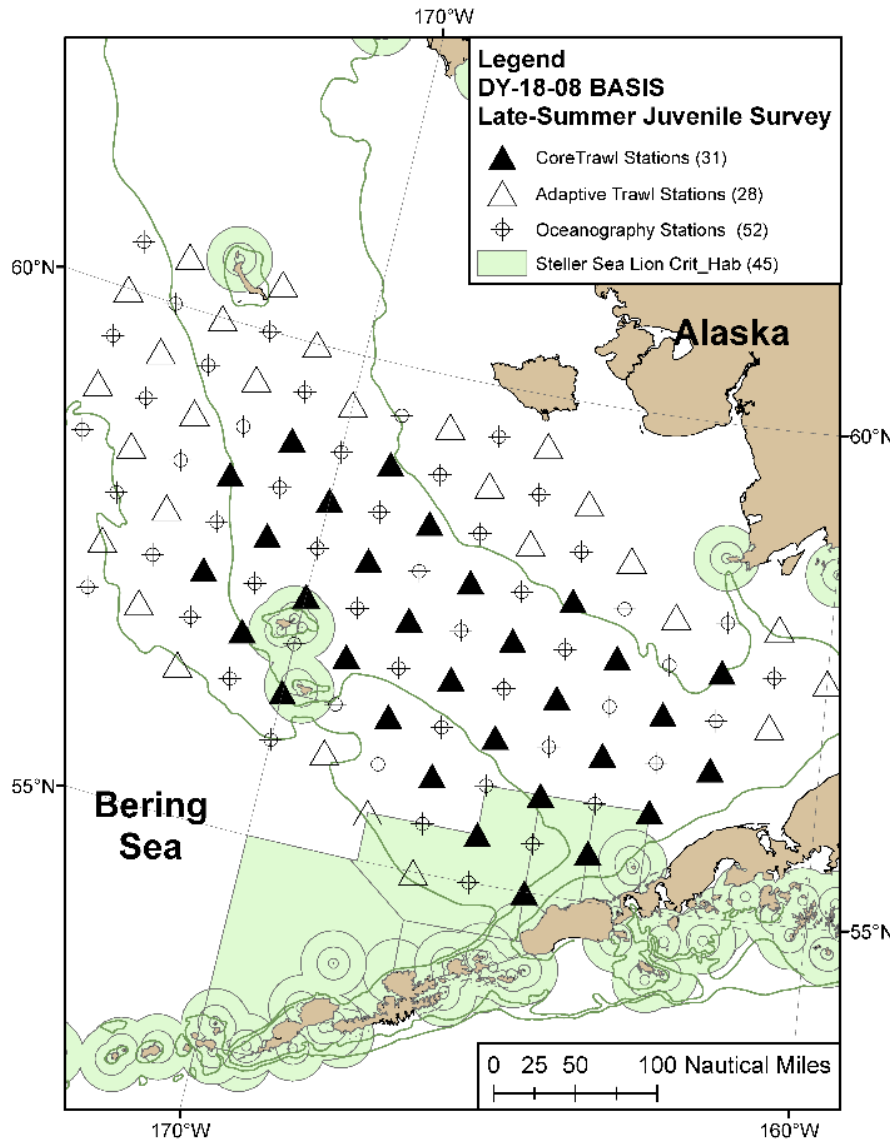
When: Aug/Sep 2003-2018

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



BASIS



Focus: YOY pollock, YOY Pcod, juv salmon, herring, capelin

When: Aug/Sep 2003-2018 (not 2013, 2017)

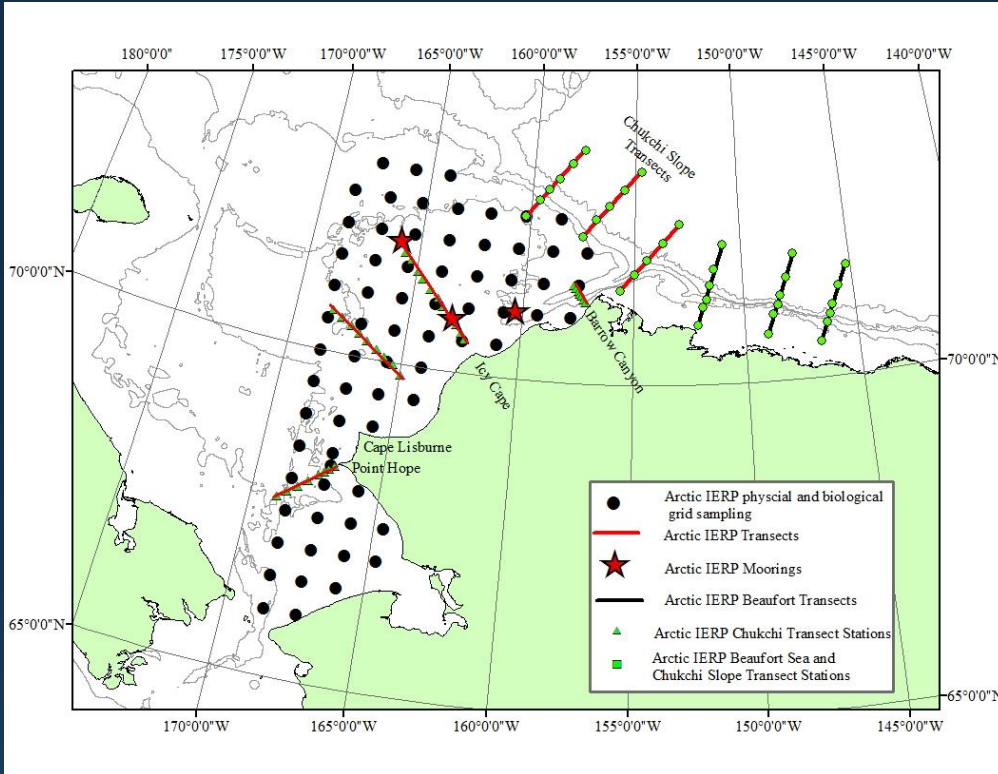
Operations: CTD, 20/60 bongos, surface trawl, oblique trawl, acoustics

Indicators: Chla, zooplankton, abundance & distribution of jellyfish, forage fish, juv salmon, juv groundfish, diets, temperature, salinity, oxygen, pollock recruitment predictors (x4)

2018 survey will be late and short due to Dyson issues.

Reduced days at sea: plan to sample ~26 core stations in middle domain

High Arctic - Arctic IERP



Loss of sea ice and continued warming of sea temperatures during summer in the Chukchi Sea will restructure the food web.

Physical
Oceanography



Zooplankton



Fish



On board
Fish Diet



Laboratory
Analyses

