

# Microzooplankton in the food web of the coastal Gulf of Alaska

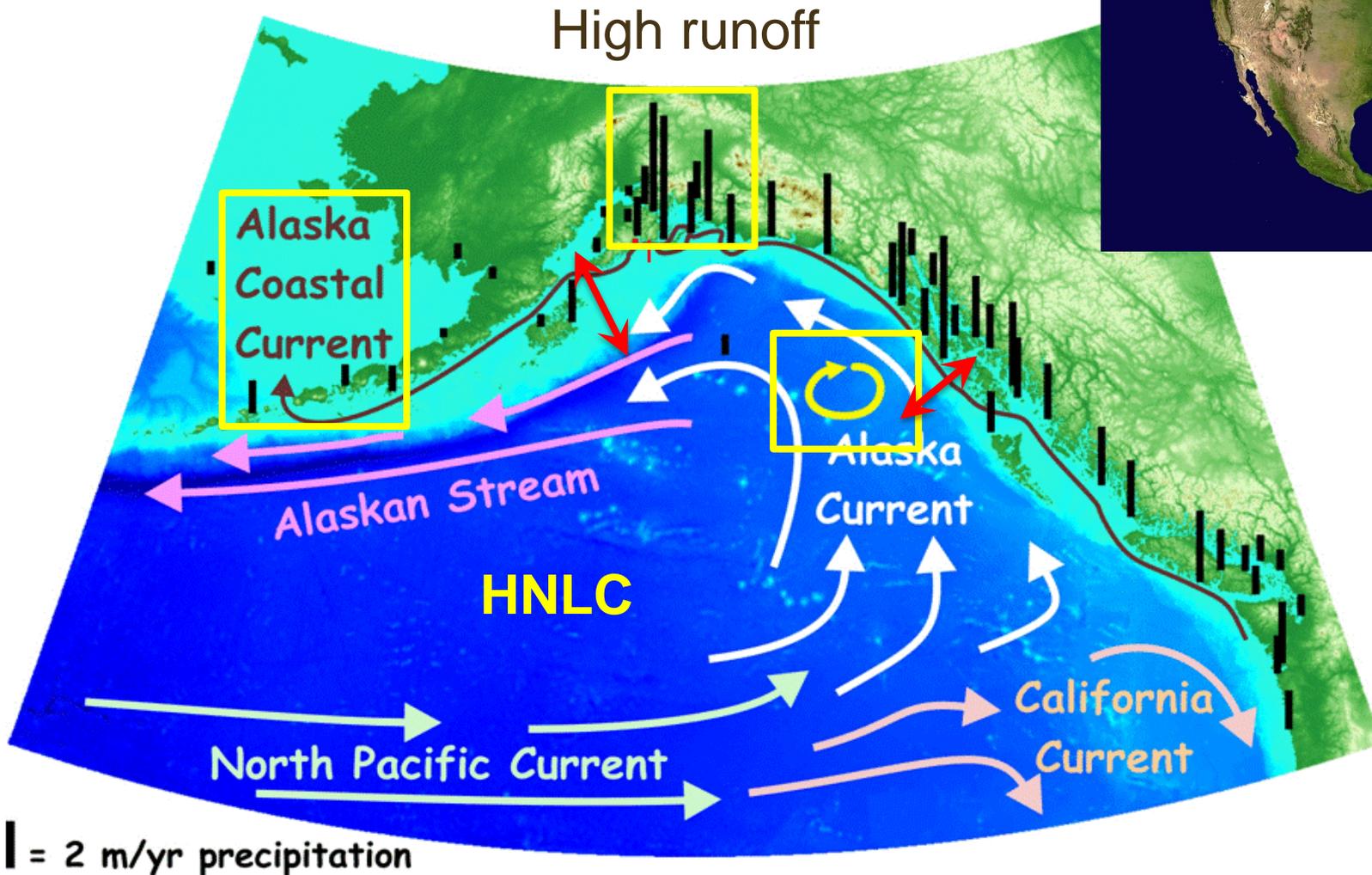
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University of Alaska Fairbanks



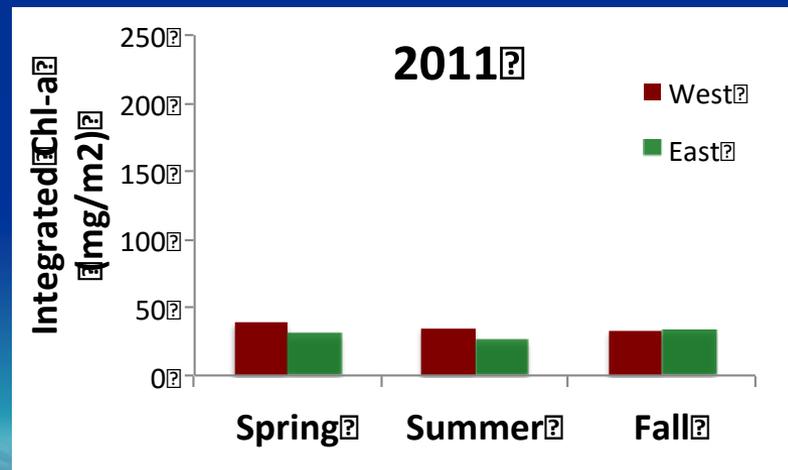
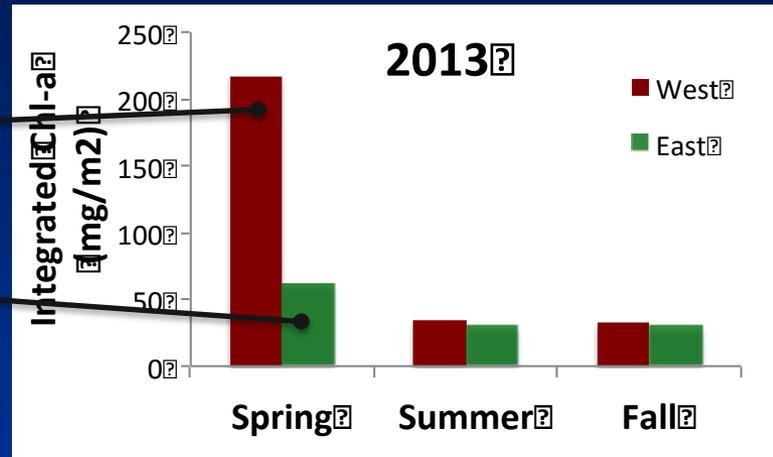
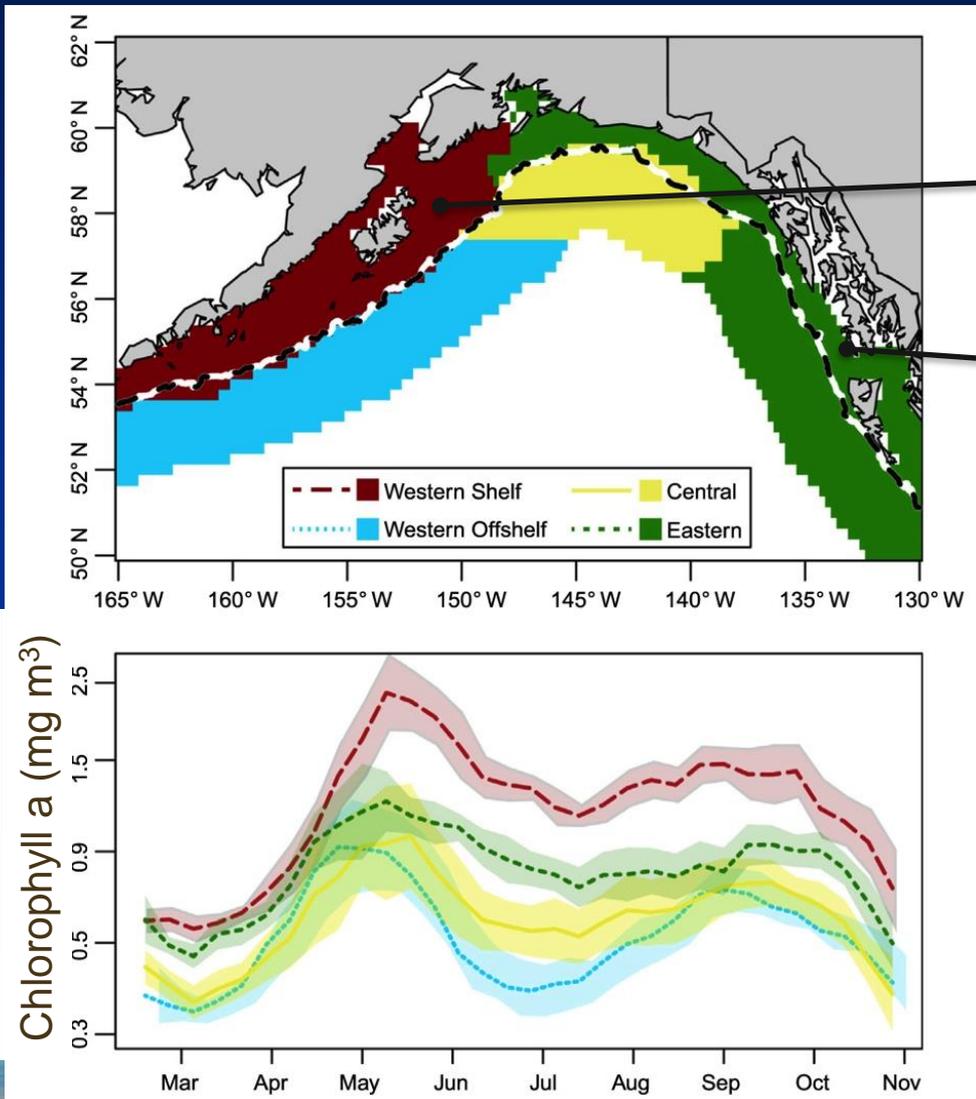
# The setting: dynamic

## Cross-shelf exchange





# Strong seasonality: phytoplankton

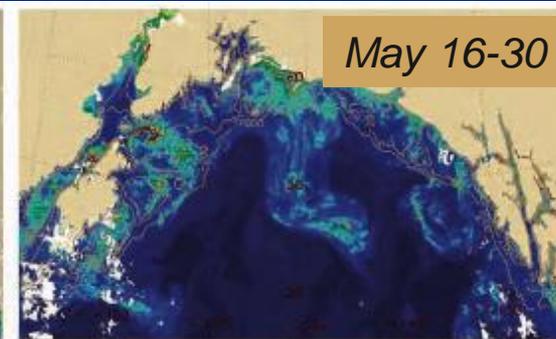
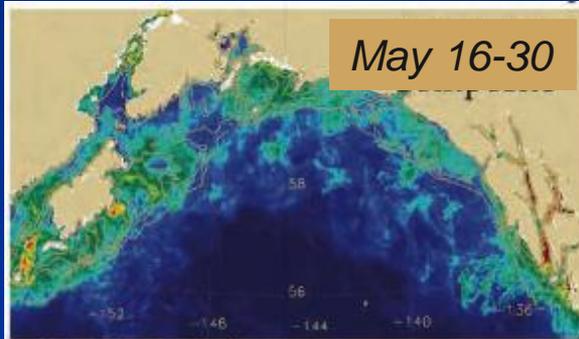
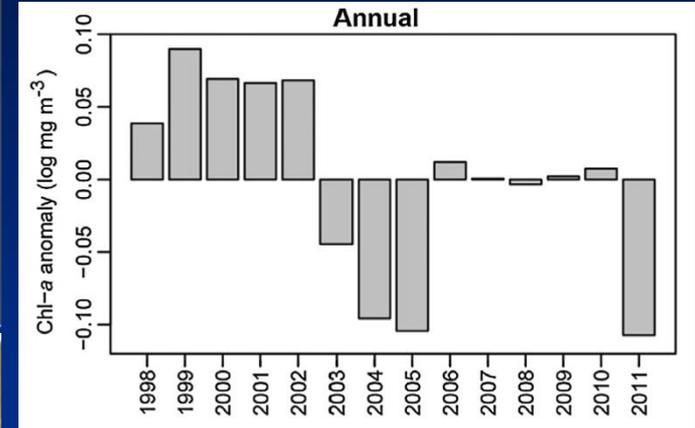
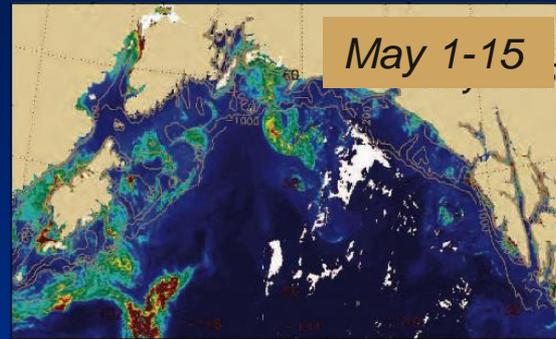
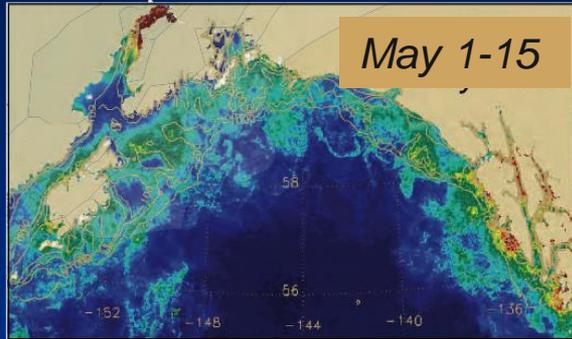


# Interannual variability: phytoplankton

Long-term average

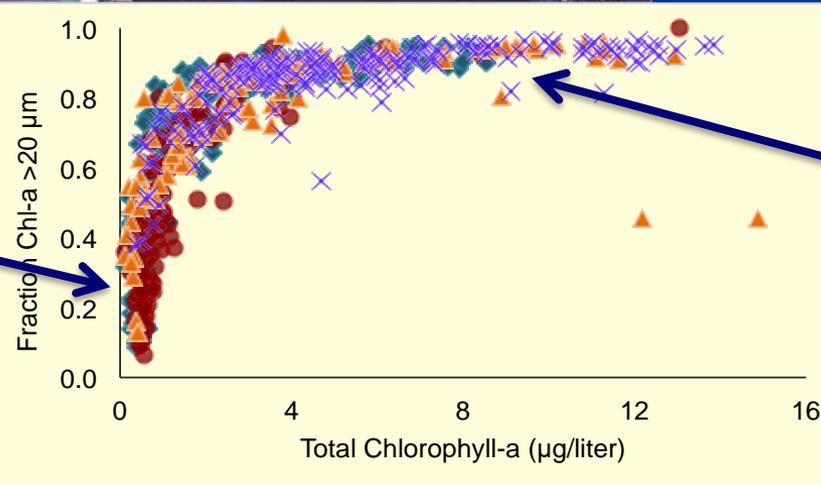
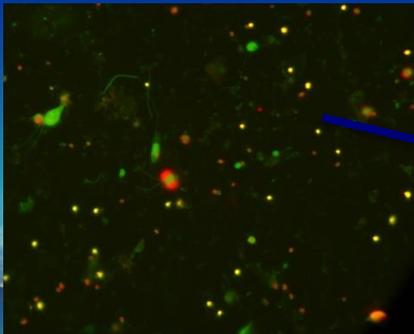
2011

Chlorophyll anomalies



2011 spring bloom very low  
Large cells (diatoms) sparse

Low-chl water:



High-chl water:

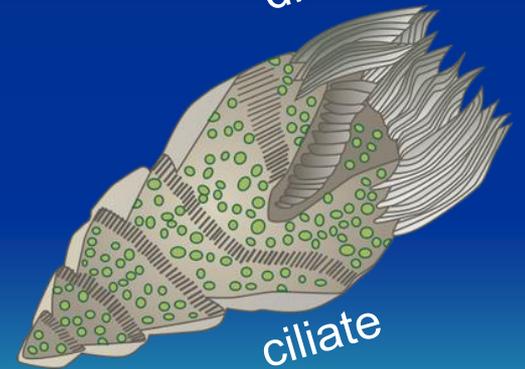


# Questions of our study:

- How does the environment affect the microzooplankton community?
- How might temporal and spatial contrasts in microzooplankton influence the food web?



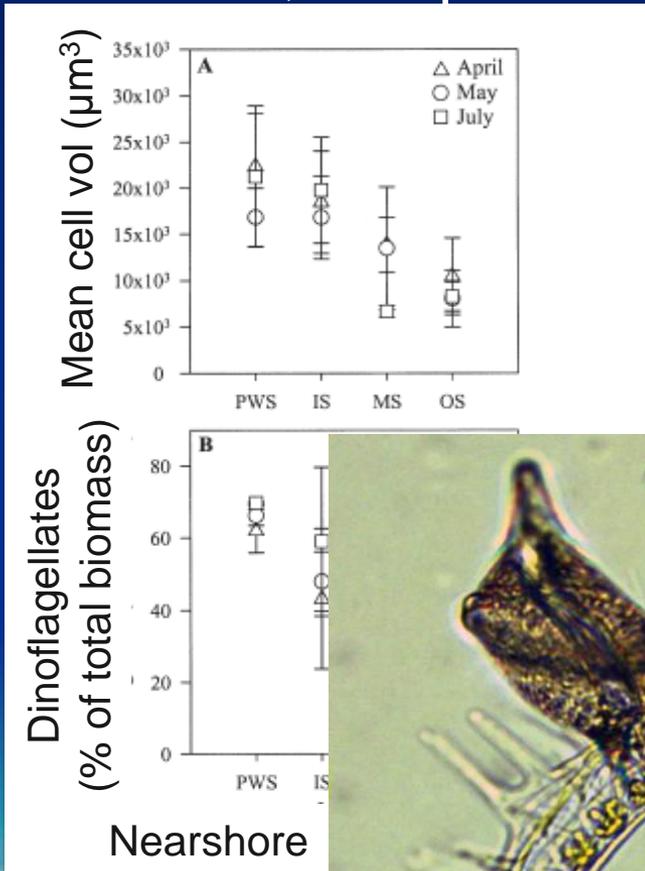
dinoflagellate



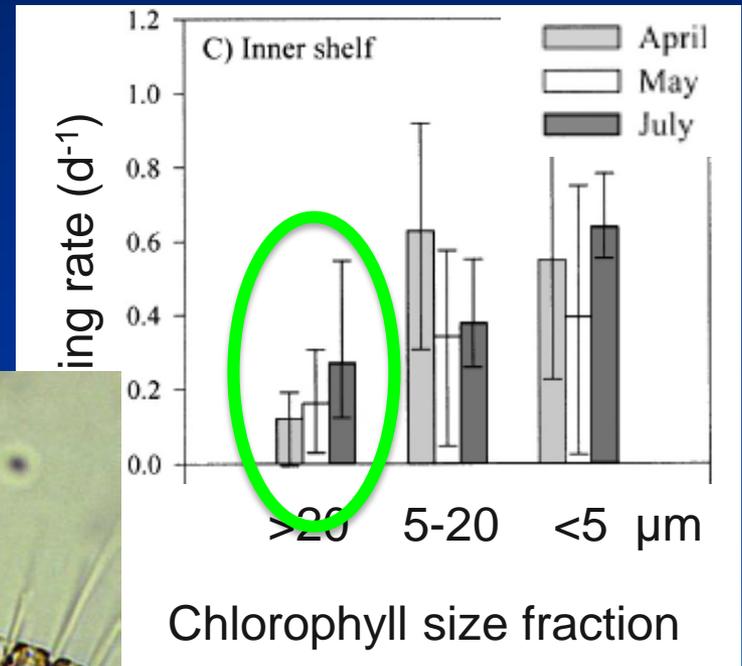
ciliate

# What we know about CGOA microzoo:

1. Cross-shelf gradient in biomass, composition



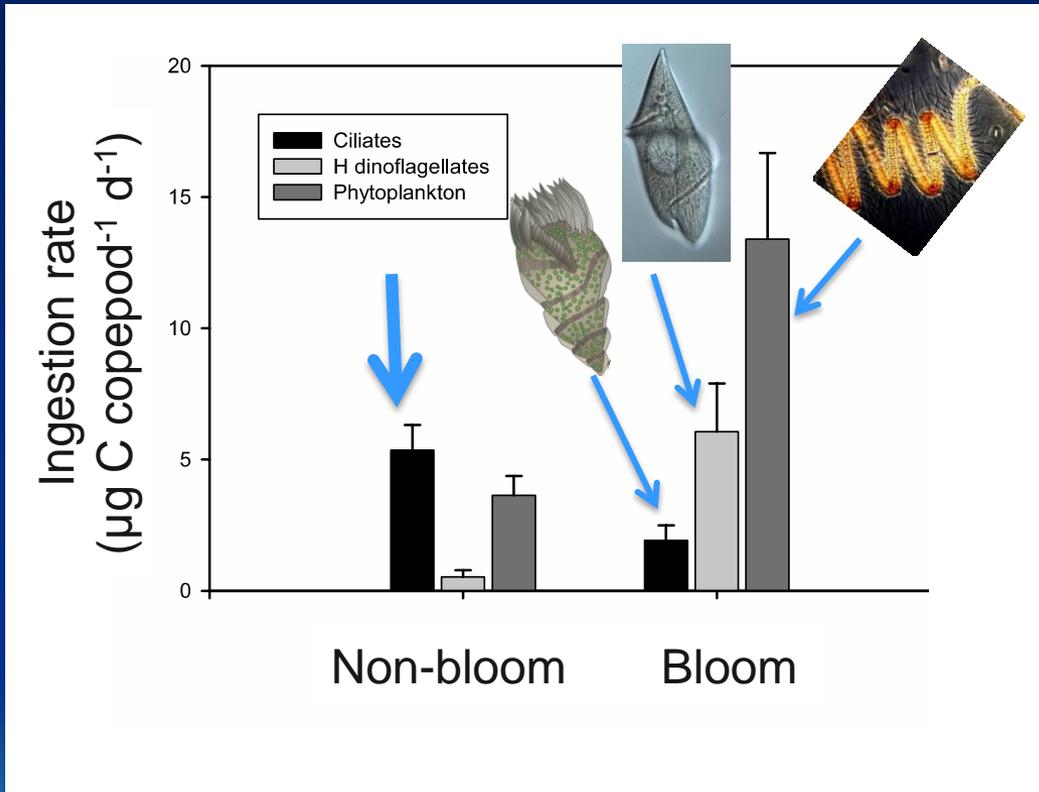
2. Moderate – high grazing rates common



including microzoo grazing on diatoms

# What we know about CGOA microzoo:

## 3. Prey for dominant mesozooplankton species



*Neocalanus cristatus*

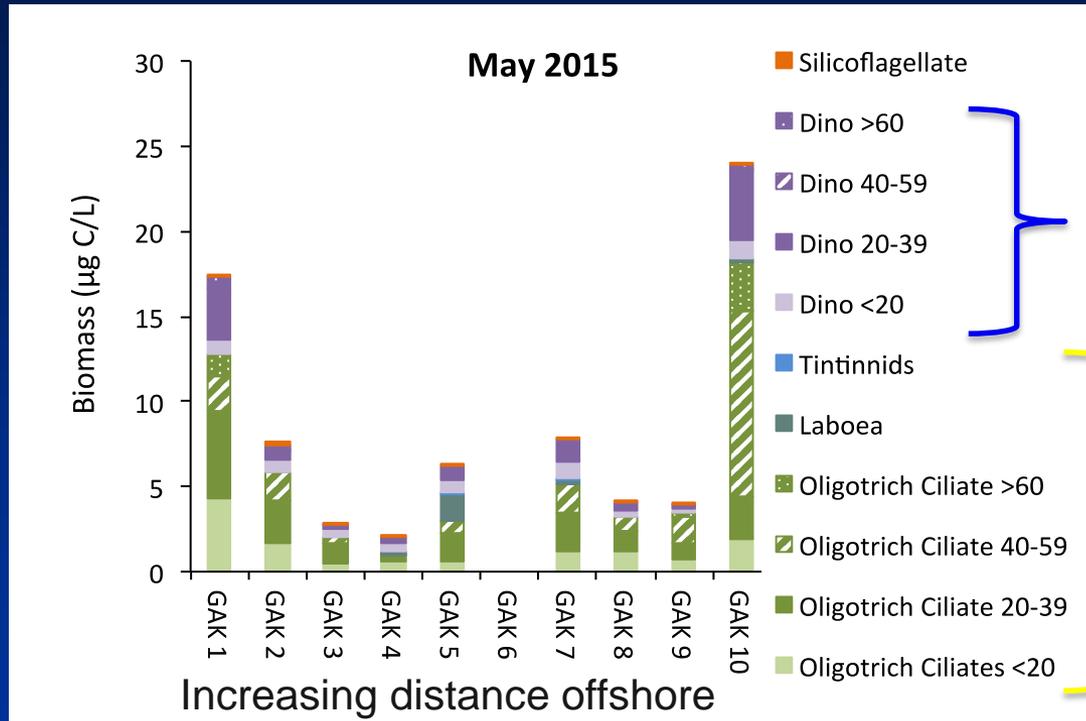
Also:

*Pseudocalanus* spp.

*Calanus marshallae*

(Napp et al. unpub.)

# How are microzoo assessed?



## Dinoflagellates

*Gymnodinium*  
*Gyrodinium*  
*Ceratium*  
*Polykrikos*  
*Protooperidinium*  
*Amphidinium*  
*Dinophysis*  
 misc (by shape)

## Ciliates

*Laboea*  
*Tontonia*  
*Strombidiniopsis*  
*Strobilidium*  
*Strombidium* (var)  
*Mesodinium*  
 tintinnids (by genus)  
 misc (by shape)

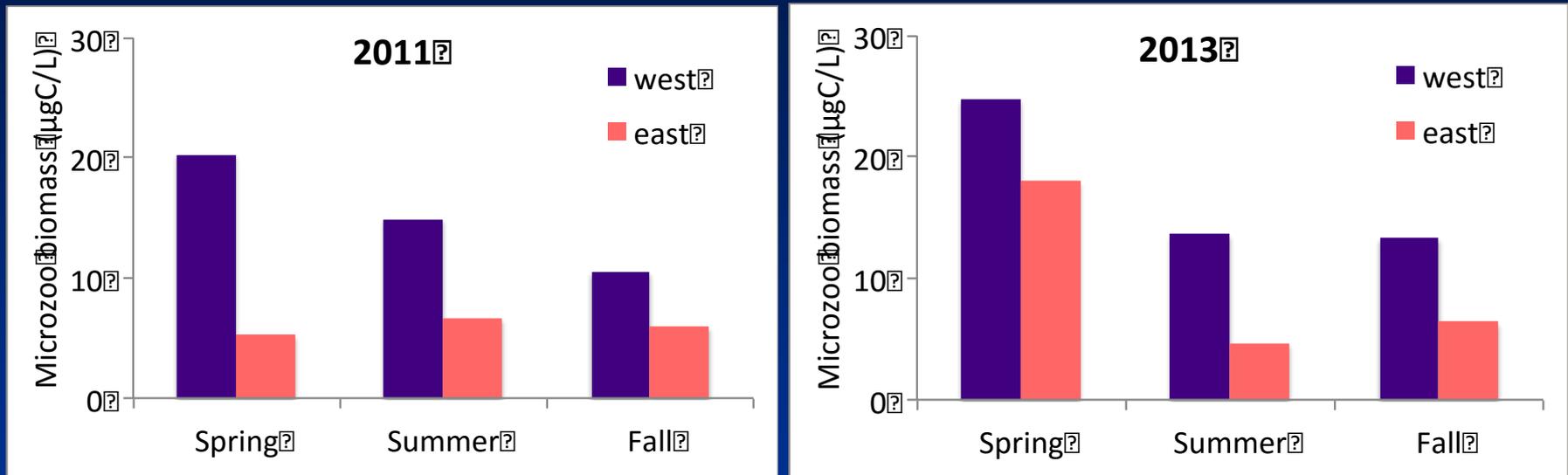
Taxonomic detail level:

Readily identifiable species/genera

Otherwise, broad size and taxonomic category (functional groups)

All cells sized, converted to C biomass from volume using empirical factors

# New data: Seasonal cycles in microzoo



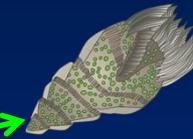
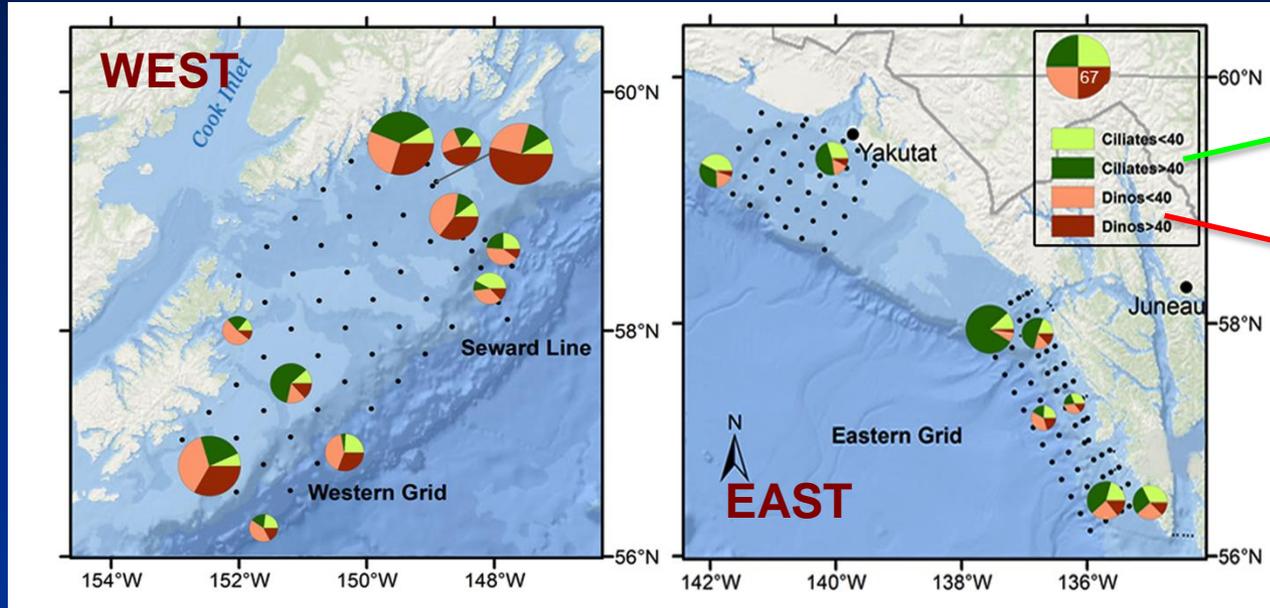
Median values from 10 m samples (n = 6-16)

- Biomass 2-3x higher in spring
- West higher than east
- Absence of spring phyto bloom seen in 2011 microzoo

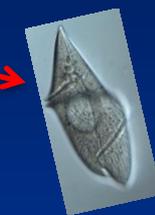
Strom et al. 2016

# Contrasts in microzoo community composition

Spring 2013

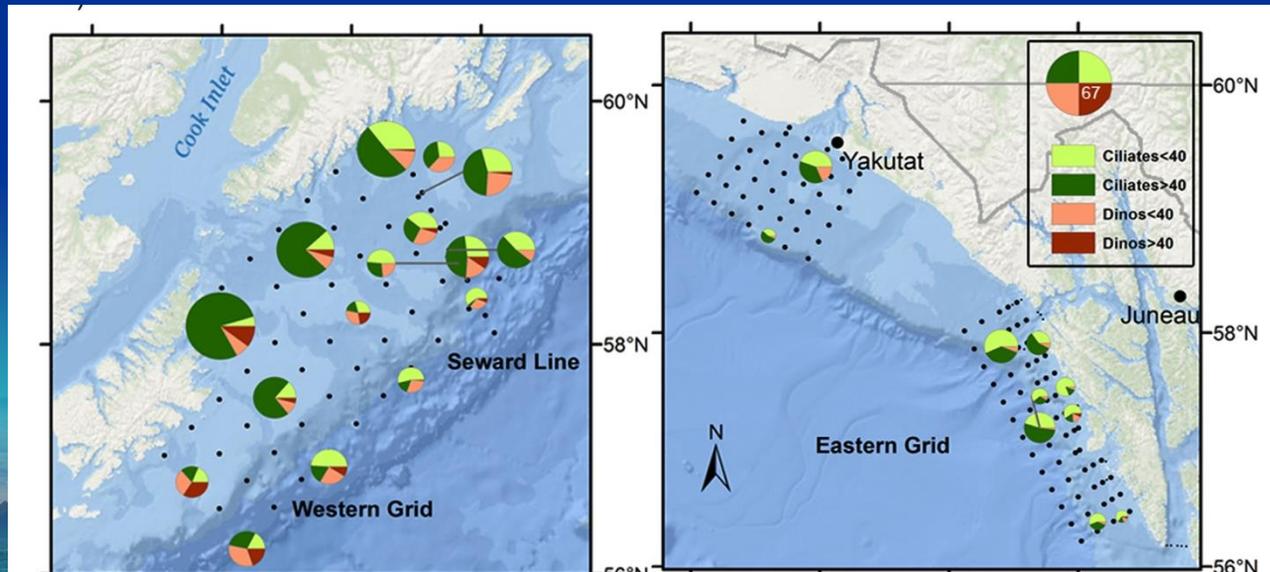


ciliates



darker = larger

dinos

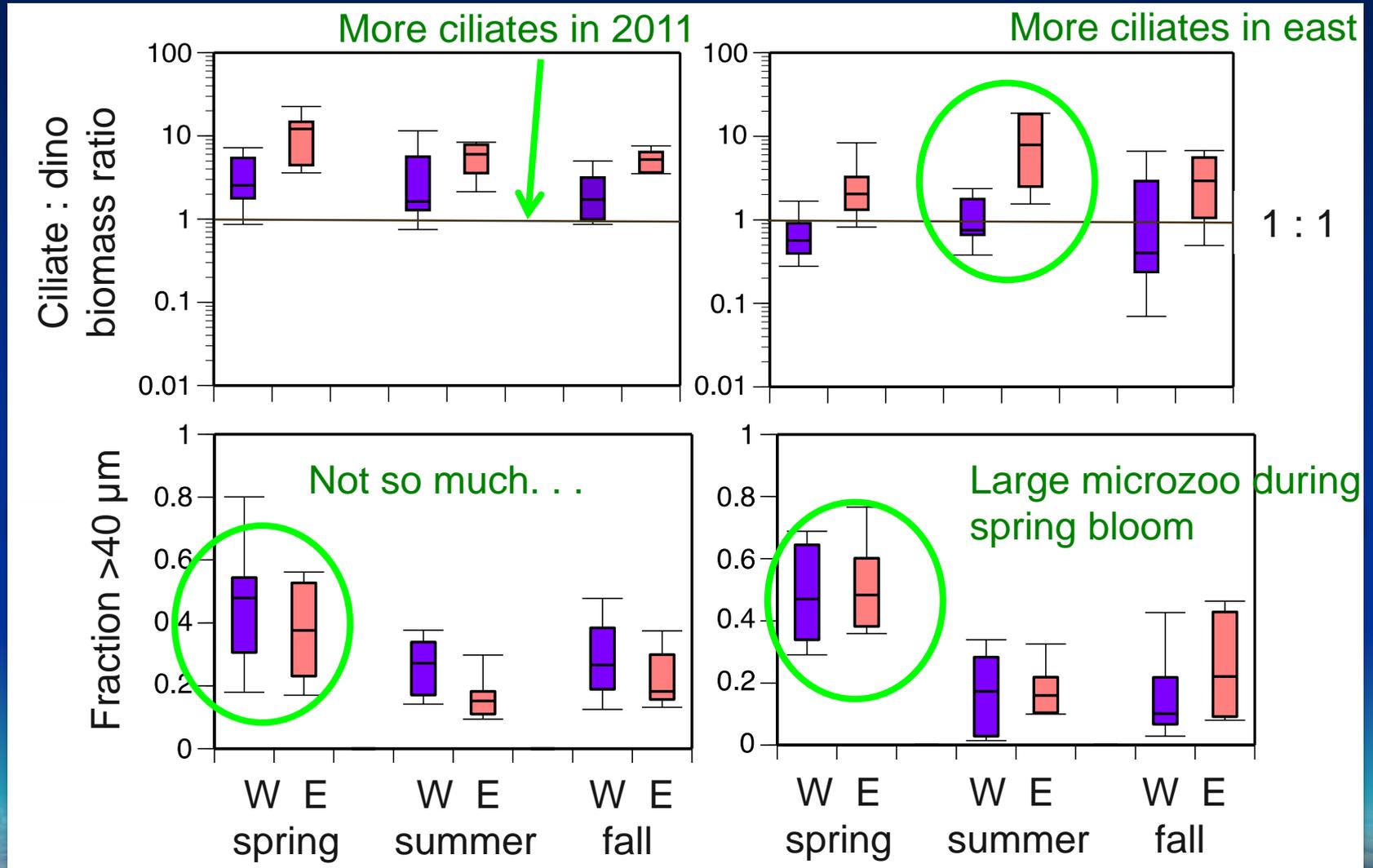


Spring 2011

# Contrasts in microzoo community composition

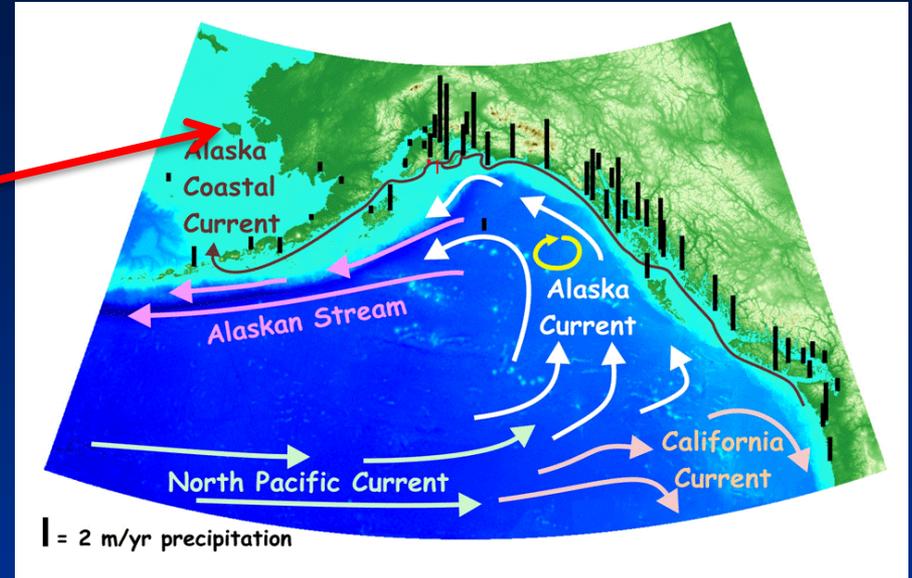
2011

2013



# That is more ciliates than we expected

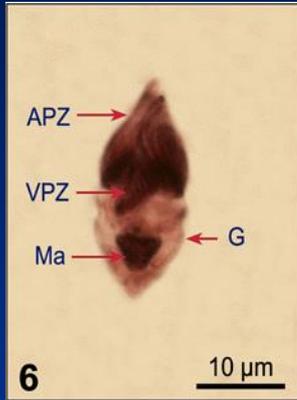
Bering Sea:



Year	Season	Avg % Dinos	Reference
1992	spring	48 - 54	Howell-Kübler et al. 1996
1999	summer	~50	Olson & Strom 2002
2004	summer	~70	Strom & Fredrickson 2008
2008-10	spring	65 - 75	Sherr et al. 2013
2008-10	summer	64	Stoecker et al. 2014

From Stoecker et al. 2014

# Why so many ciliates?



*Strombidium dalum*

SMALL forms can be abundant

Low production times/places  
Feed on <5 µm prey efficiently



*Laboea strobila*

LARGE forms often most of biomass

Low production times/places  
Feed on 5-15 µm prey

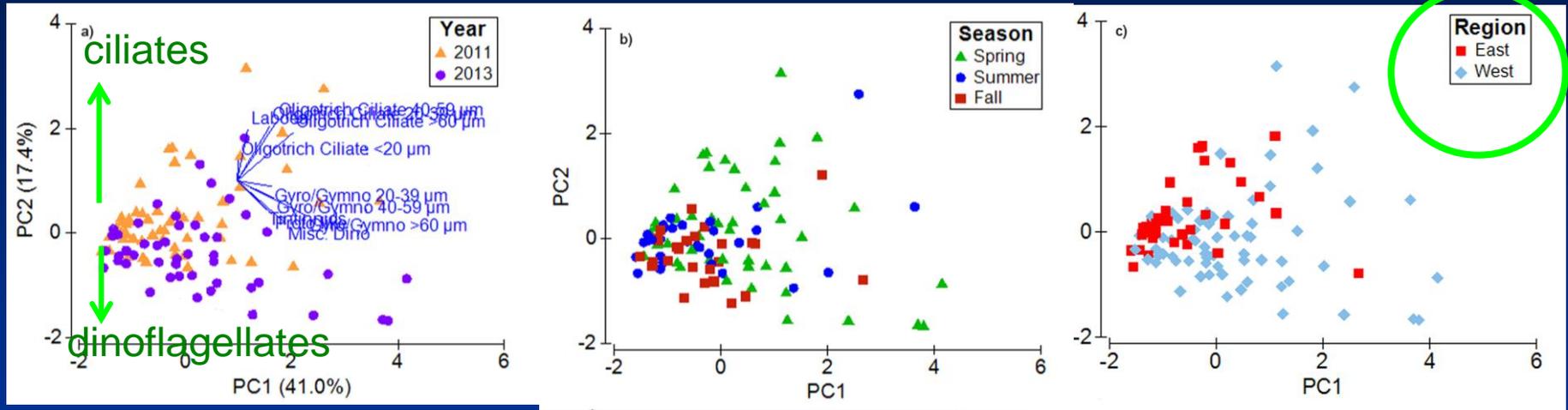
Many species RETAIN CHLOROPLASTS  
(mixotrophs) – Stoecker et al. 2014

Adaptation to variable environment



*Strombidium rassoulzadegani*

# Drivers of microzoo community composition



Biomass →

PC1 related most strongly to largest ciliates and dinoflagellates

PC1 positively correlated with chlorophyll (but not T, S, nutrients)

Strom et al. 2016

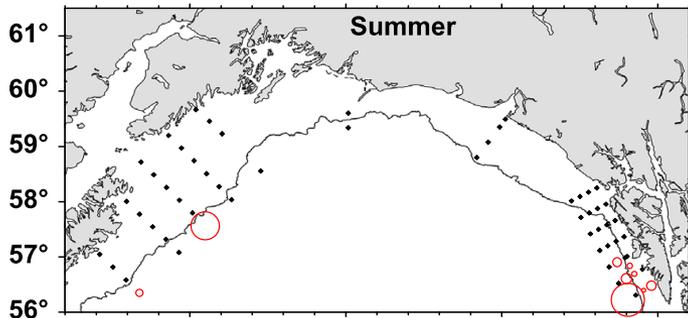
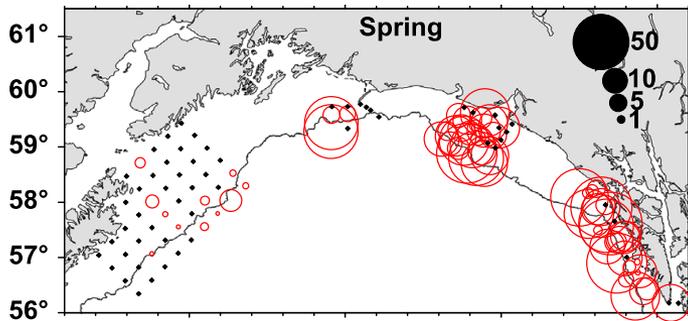
# Relationship to mesozooplankton (top down)



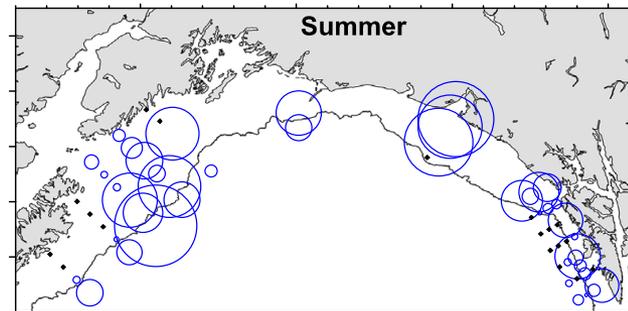
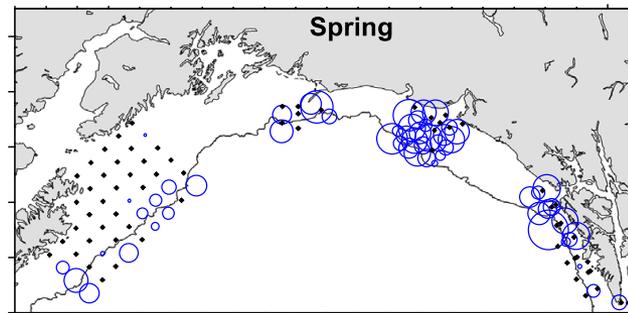
## SALPS

Unusually abundant in 2011

### *Salpa aspera*



### *Cyclosalpa bakeri*



MAX CLEARANCE  
(% water column d<sup>-1</sup>)

20

1

5

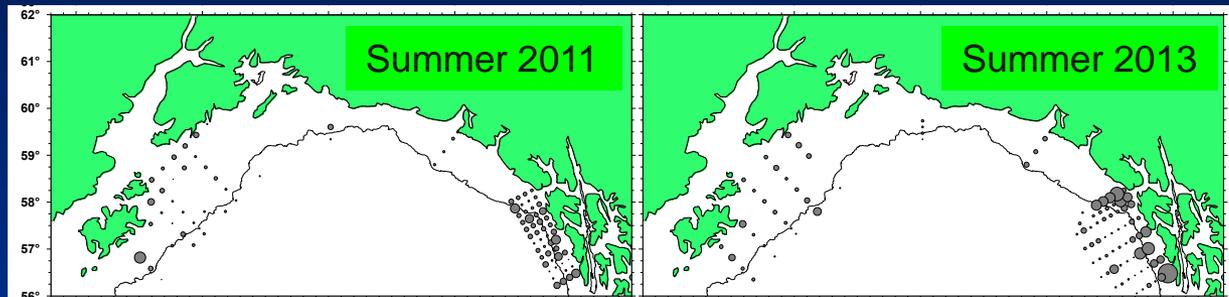
1

Li et al. 2016

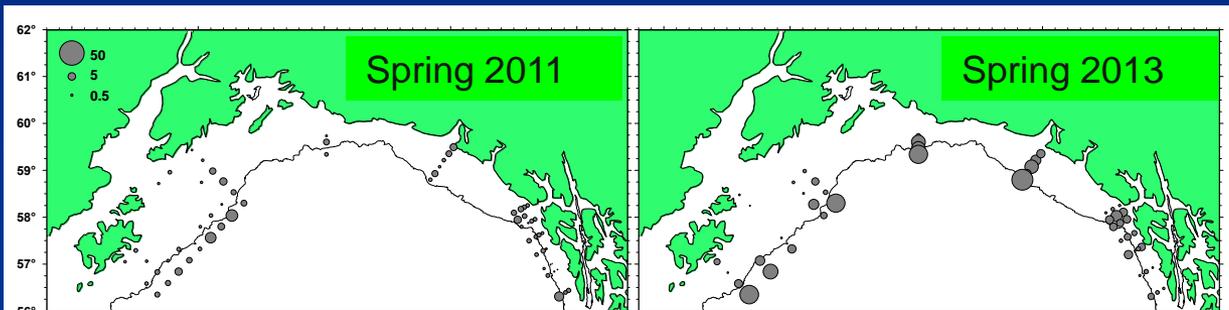
Image credits: L. Madin ([www.who.edu](http://www.who.edu)); D. Wrobel ([jellieszone.com](http://jellieszone.com))

# Relationship to mesozooplankton (top down)

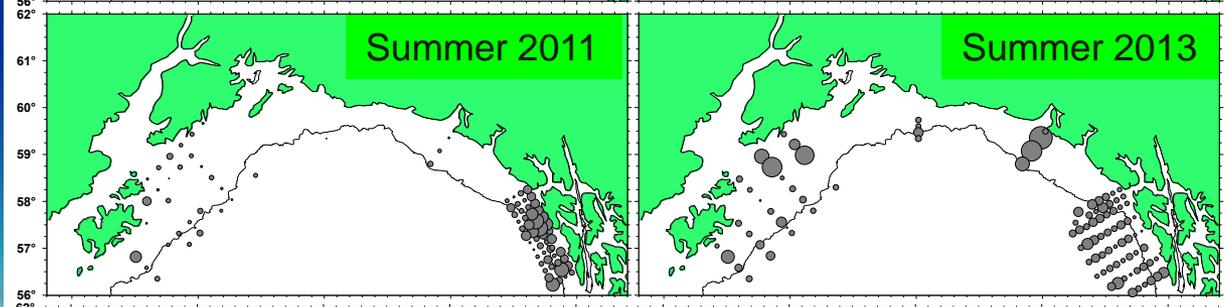
*Neocalanus* spp. (spring dominant) similar between regions and years



*Calanus marshallae*  
higher in east



Euphausiids usually  
higher in east



Narrow shelf in east =  
MORE OCEANIC =  
large-bodied zoop =  
larger prey

# Conclusions

- Microzooplankton in the CGOA show seasonal, regional and interannual variation that reflects the underlying production regime
- Ciliates made up a large proportion of the community, especially in lower production seasons and locations
- Large ciliates likely a key functional group in the ecosystem due to chloroplast retention (mixotrophic life style) and importance as prey
- Predation by mesozooplankton likely affects microzoo abundance and community composition

**Thank you very much – Tusen takk!**