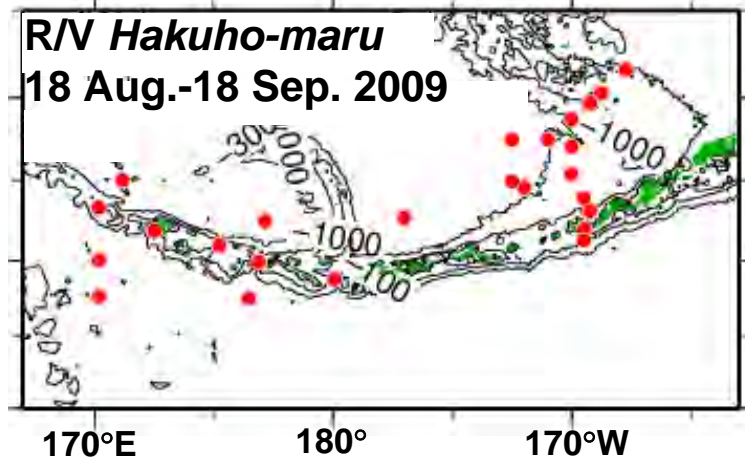
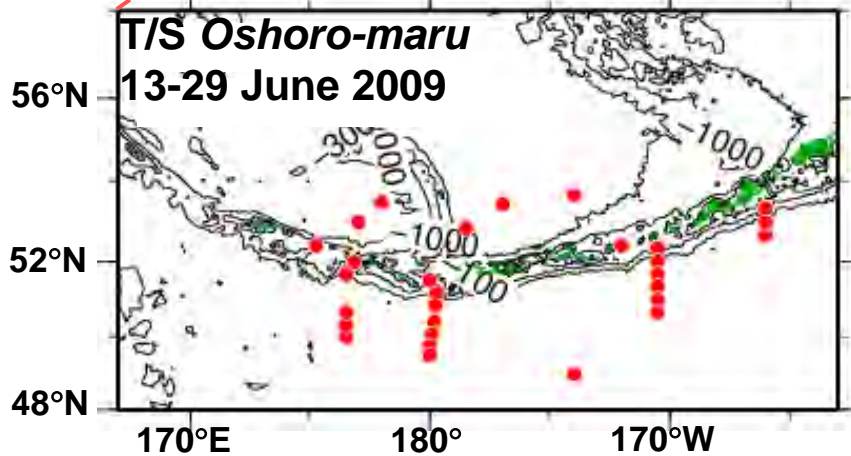
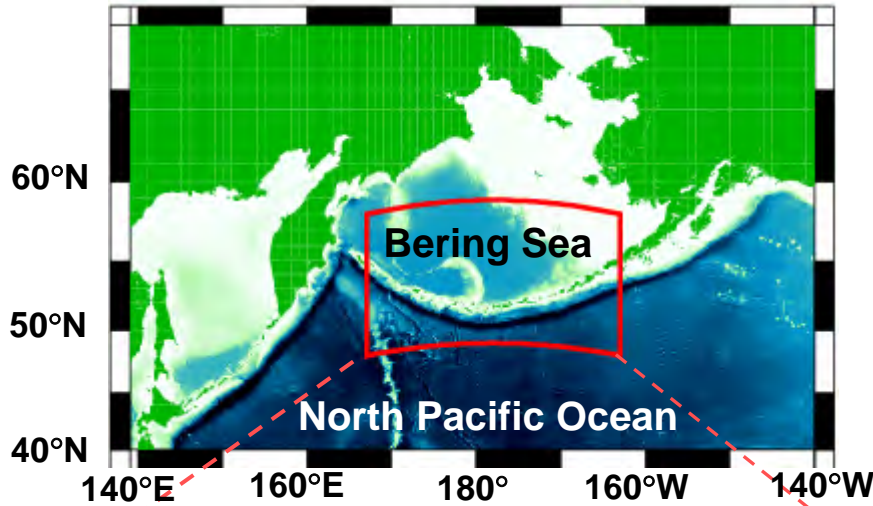


# Temporal and spatial changes in zooplankton community around the Aleutian Islands during the summer of 2009



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# 1. Introduction

## Water around the Aleutian Islands

Highly productive, index of climate change

### Specialized physical oceanography

Change in flow mass of Alaskan Stream Impact ?

Anticyclonic eddies

Vertical mixing by tides and turbulent



Abundance & horizontal  
distribution of zooplankton

### Past studies on zooplankton

Large sized-mesh plankton net

Count with taxonomic group & genus

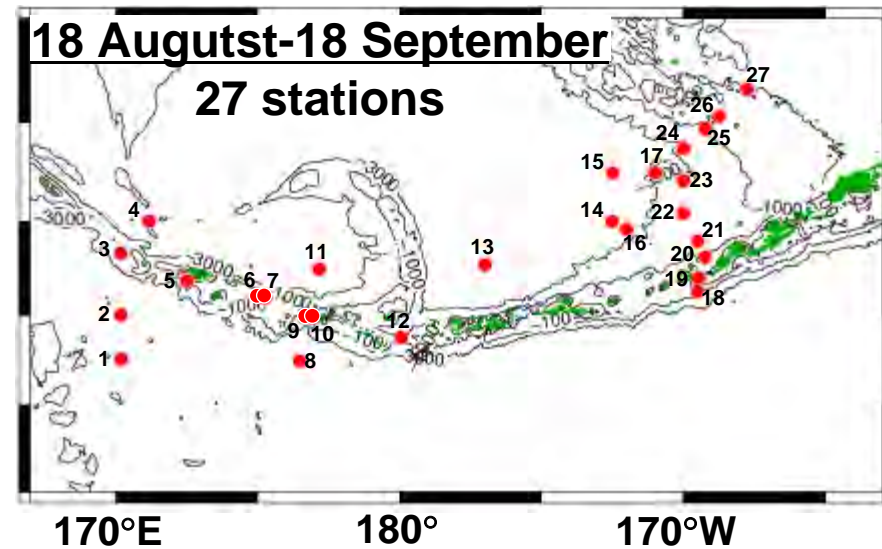
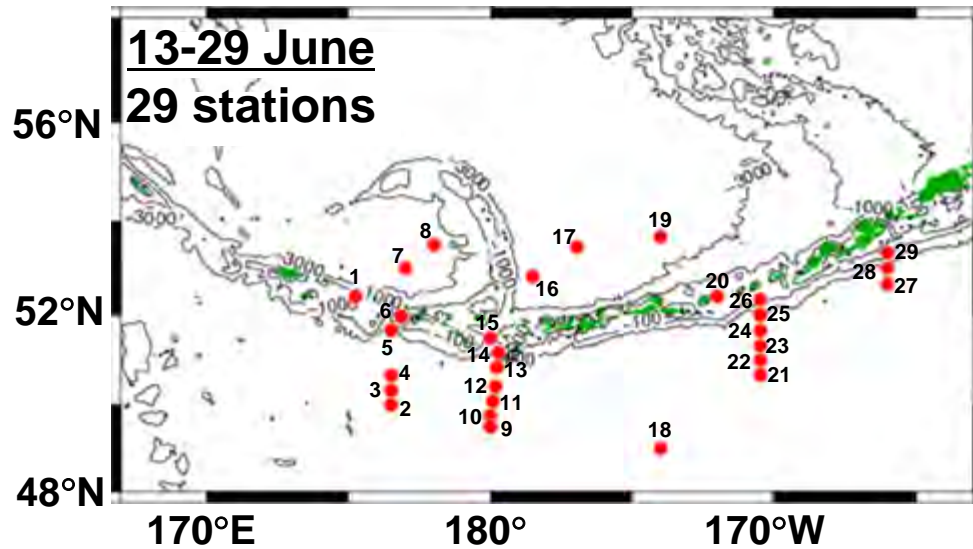
### This study

Small sized-mesh net plankton net

Count down to species & stage level

**Purpose: Analyze spatial and temporal changes of zooplankton  
community around the Aleutian Islands during the summer of 2009**

## 2. Methods



### Field study

- 100  $\mu\text{m}$  mesh sized plankton net
- 0-150 m or bottom-10 m vertical haul
- CTD: temperature, salinity, fluorescence

### Zooplankton sample analysis

- Zooplankton: Count by taxonomic group
- Calanoid copepods: Count by species and copepodid stage



NORPAC net

### Data analysis (Q-mode analysis)

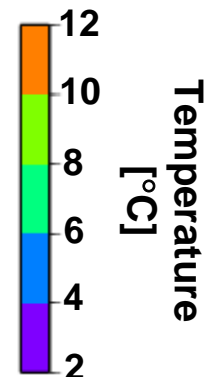
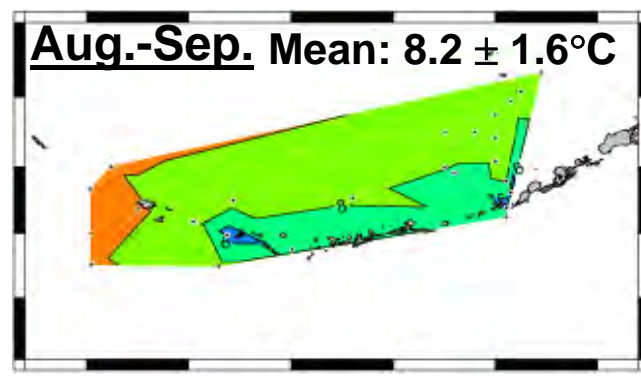
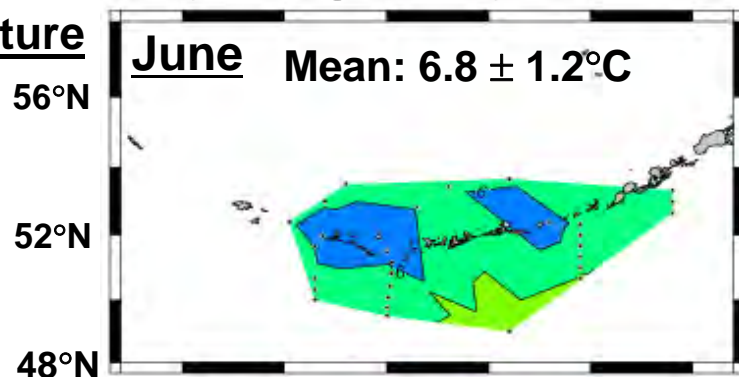
- Cluster analysis based on the abundance of each taxon and copepod species

→ group sampling stations

- Identify characterized taxonomic group and species (one-way ANOVA, Fisher's PLSD)

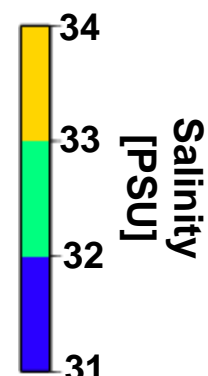
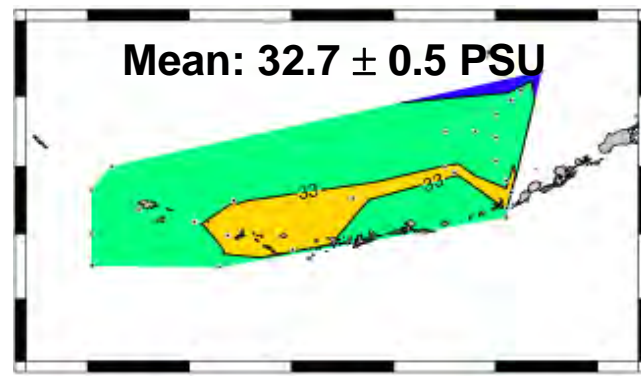
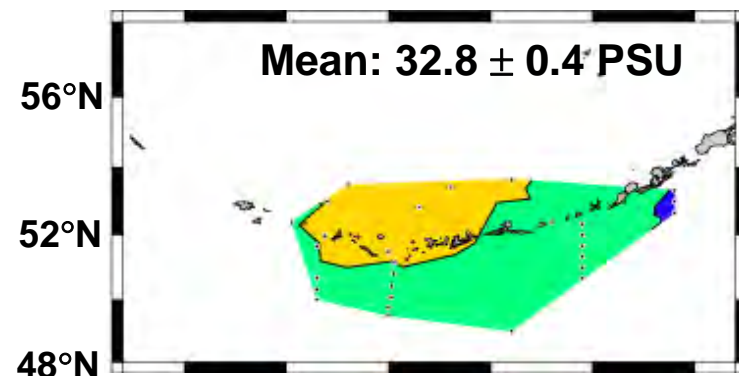
### 3. Results: Hydrography

#### Temperature



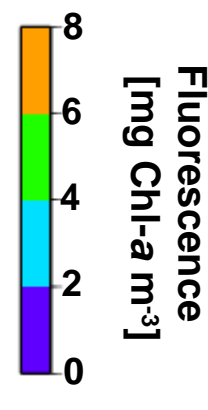
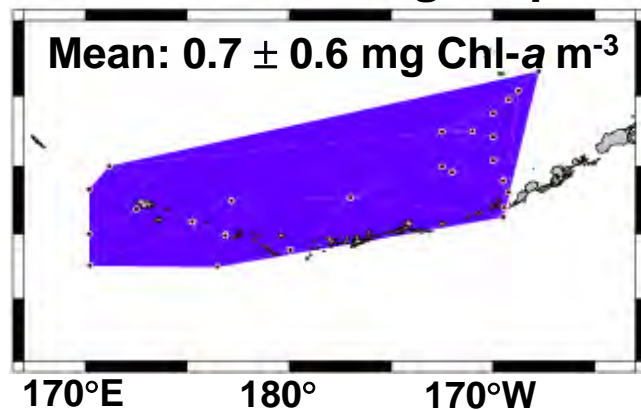
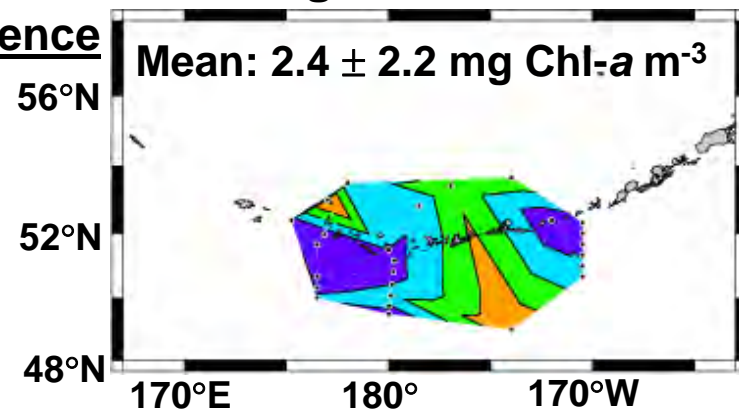
Significantly higher in Aug.-Sep. ( $p < 0.05$ ,  $U$ -test)

#### Salinity



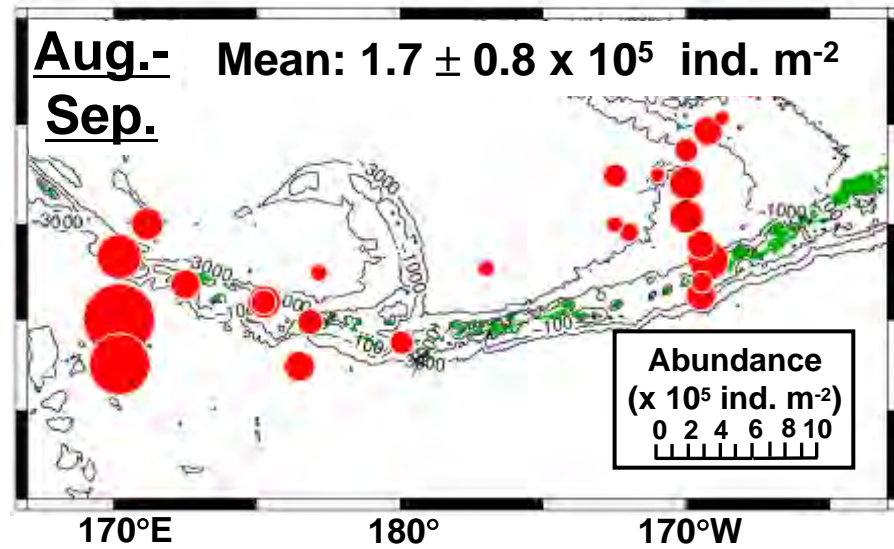
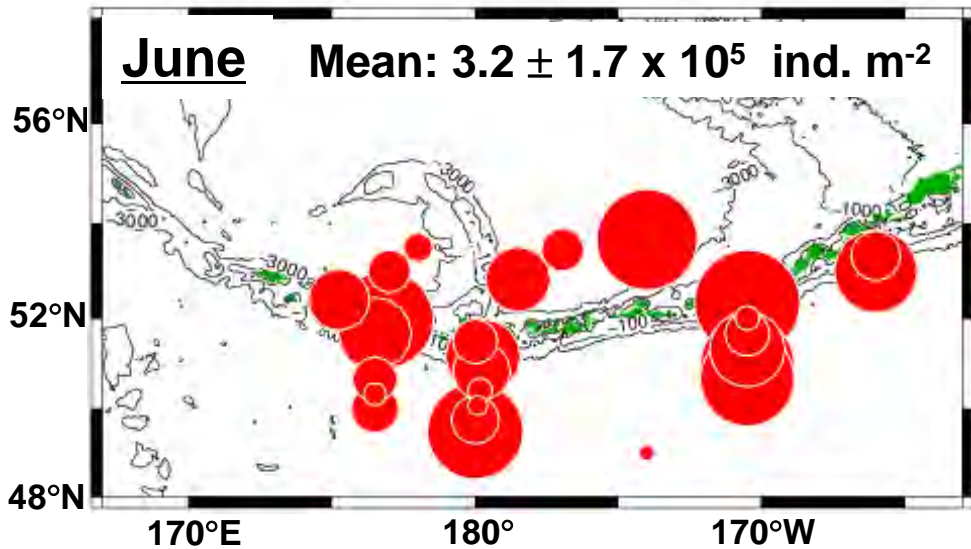
No significant difference between June & Aug.-Sep.

#### Fluorescence

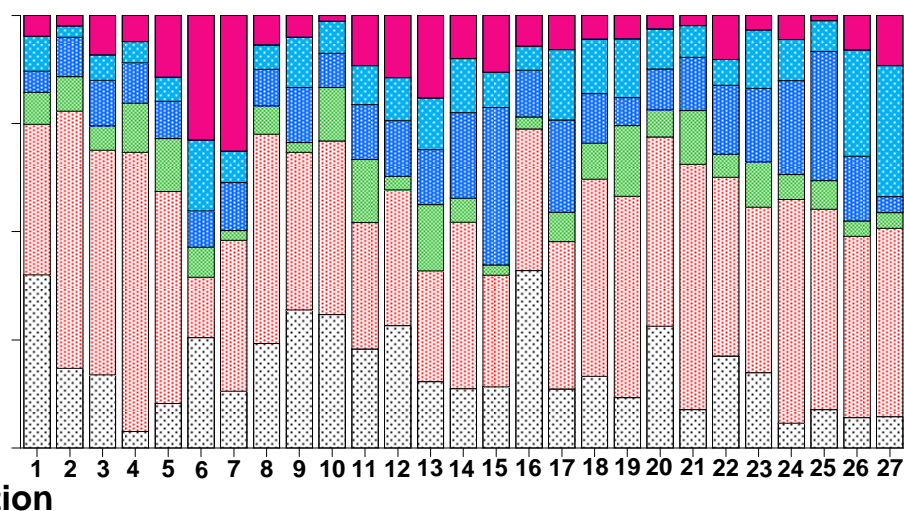
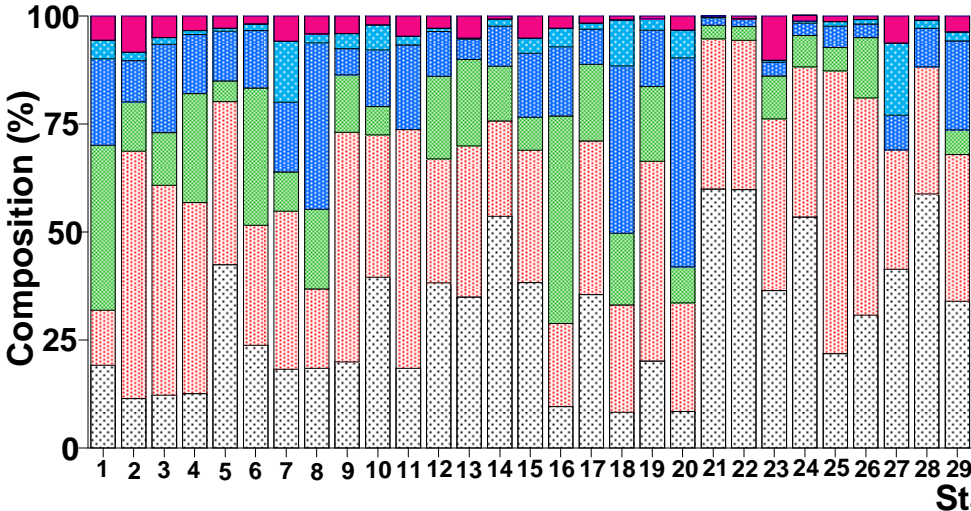


Significantly higher in June ( $p < 0.05$ ,  $U$ -test)

# 4. Zooplankton abundance and taxonomic composition



Abundance: Significantly greater in June than in Aug.-Sep. ( $p < 0.05$ , *U*-test)



Copepodid nauplii  
  Cyclopid copepods  
  Poecilostomatoid copepods  
  Large calanoid copepods  
  Other copepods  
  Other zooplankton taxonomic group

Nauplii was abundant in June: cyclopid copepods was abundant in August-September.

# 5. Results: Zooplankton taxa and species list

Calanoid copepods: 16 genera and 24 species

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Amphipoda

*Pleuromanmma abdominalis*

Appendicularia

*Pleuromanmma scutullata*

Cephalopoda

*Pseudocalanus minus*

Chaetognatha

*Pseudocalanus minutus*

Copepoda

*Pseudocalanus moultoni*

Calanoida

*Pseudocalanus newmani*

*Acartia longiremis*

*Racovitzanus antarcticus*

*Aetideopsis rostrata*

*Scolecithricella minor*

*Calanus marshallae*

*Scolecithricella ovata*

*Calanus pacificus*

Calanoida nauplii

*Candacia columbiae*

Cyclopoida

*Eucalanus bungii*

Harpacticoida

*Gaetanus simplex*

Poecilostomatoida

*Gaidius variabilis*

Decapoda

*Heterorhabdus tanneri*

Euphausiacea

*Metridia pacifica*

Euthecosomata

*Microcalanus pygmaeus*

Foraminiferida

*Neocalanus cristatus*

Hydrozoa

*Neocalanus flemingeri*

Ostracoda

*Neocalanus plumchrus*

Polychaeta

*Paraeuchaeta elongata*

Pteropoda

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● Coastal, ● Deep sea species

Cluster analysis based on these abundance data

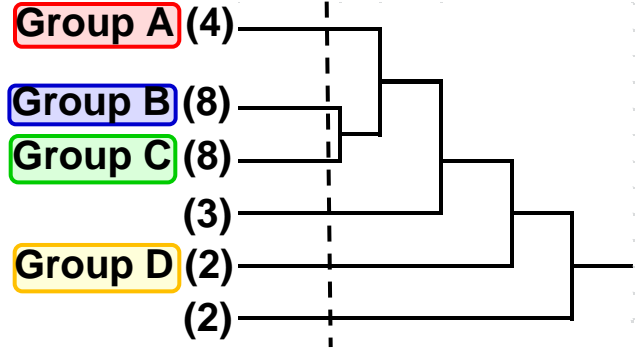
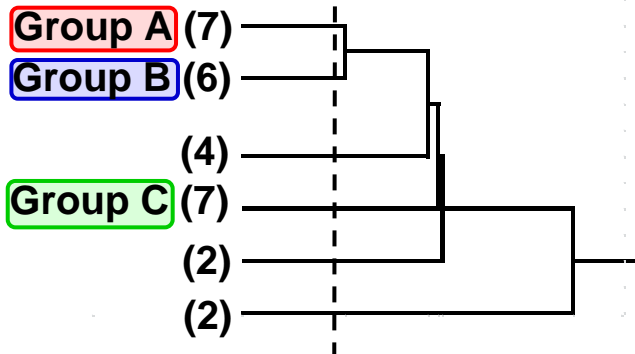
# 6. Cluster analysis on zooplankton community

June

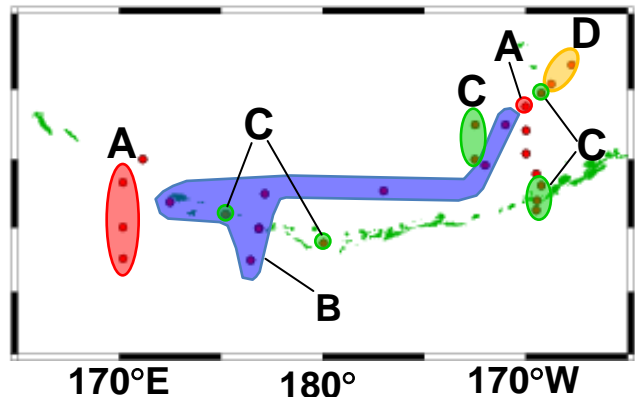
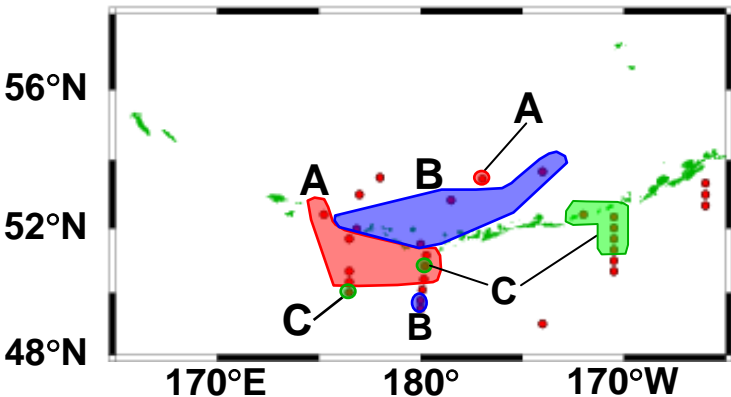
Aug.-Sep.

15%

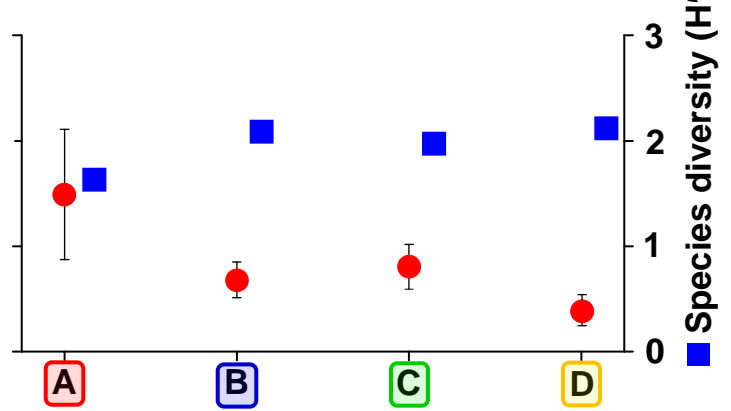
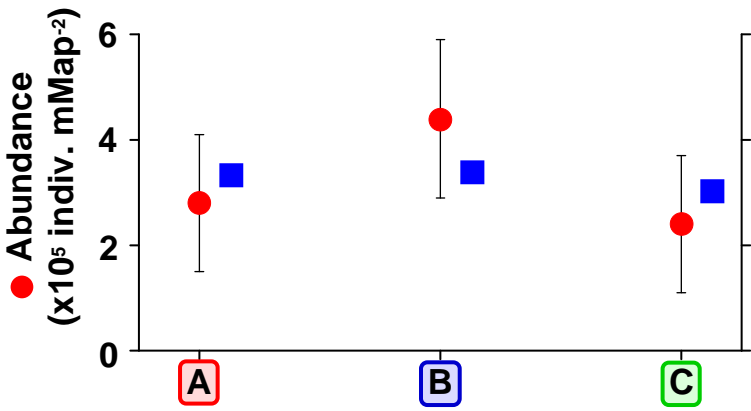
17%



June: 3 groups  
 Aug.-Sep.: 4 groups were identified

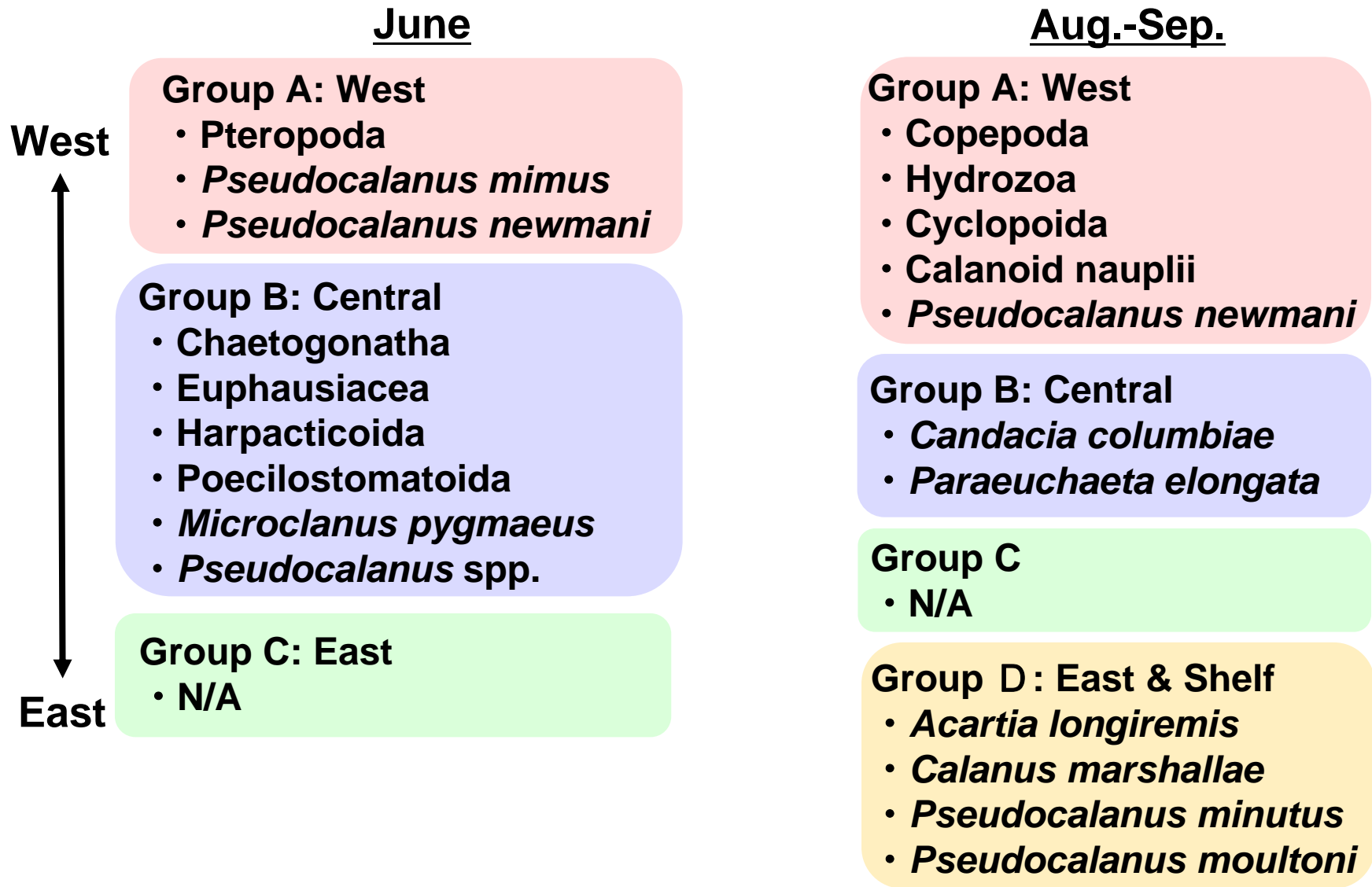


Each group distributed in western, central, eastern regions



Abundance was greater in June.  
 Diversity was higher in Aug.-Sep.

## 7. Characterized taxonomic group and species (one-way ANOVA, Fisher's PLSD)

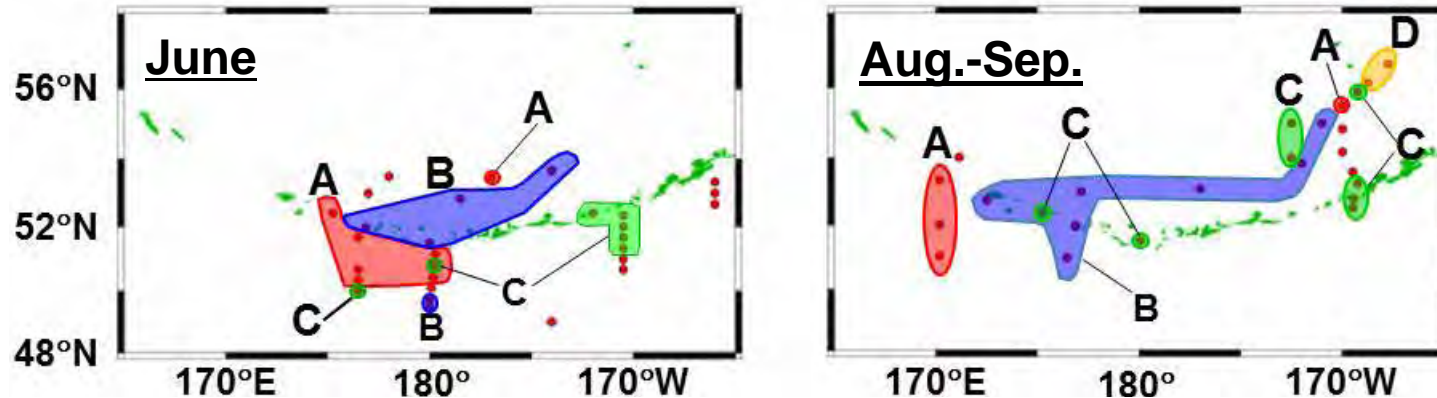


In central region, both coastal and deep sea species were identified as characterized species



## 8. Discussion: Spatial change in zooplankton community

Zooplankton community was divided to three: west, central & east.



Characterized calanoid copepods varied with region

### Central

Coastal *Pseudocalanus* & deep sea *P. elongata*

→ *P. elongata* directly preys on *Pseudocalanus*

### East & Shelf

Coastal species *Acartia longiremis* breeds resting eggs.

→ Relatively shallow depth is suitable for the reproductive strategy.

*Calanus marshallae* completes the life history in coastal region.

*Paraeuchaeta elongata* C6F



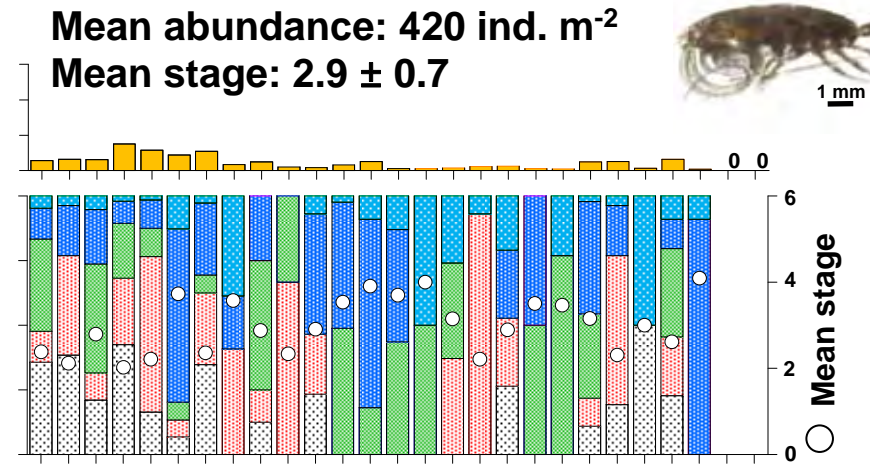
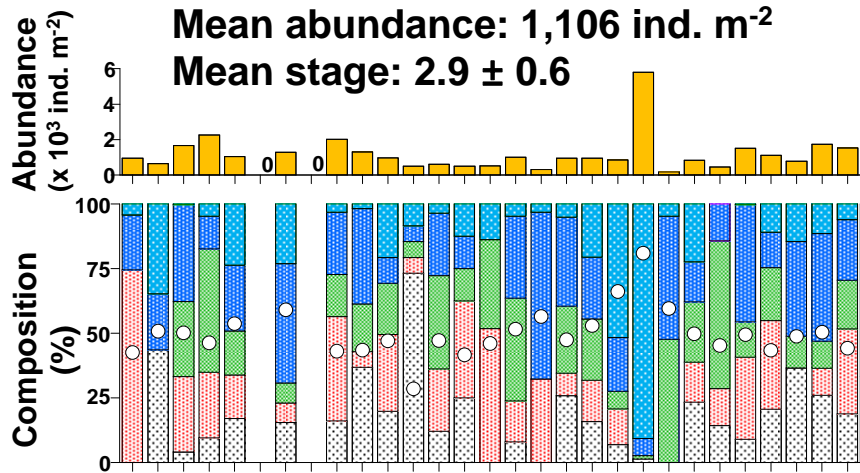
*Pseudocalanus moultoni* C6F



Spatial distribution depends on environments which their life history can complete

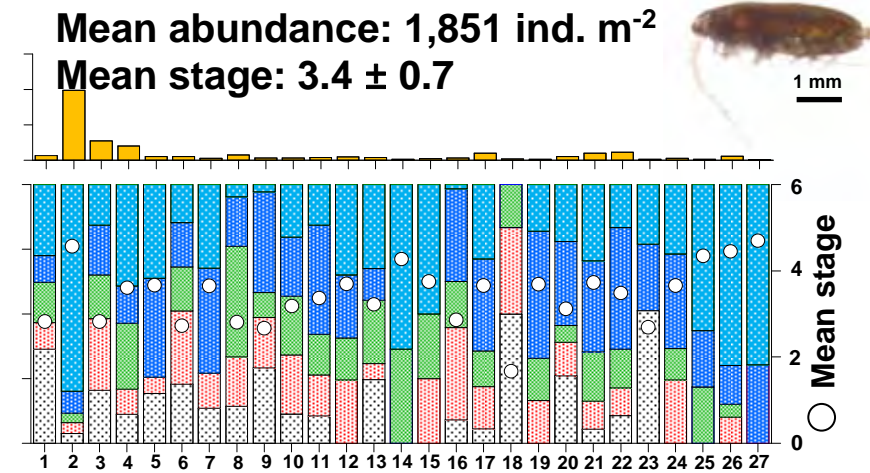
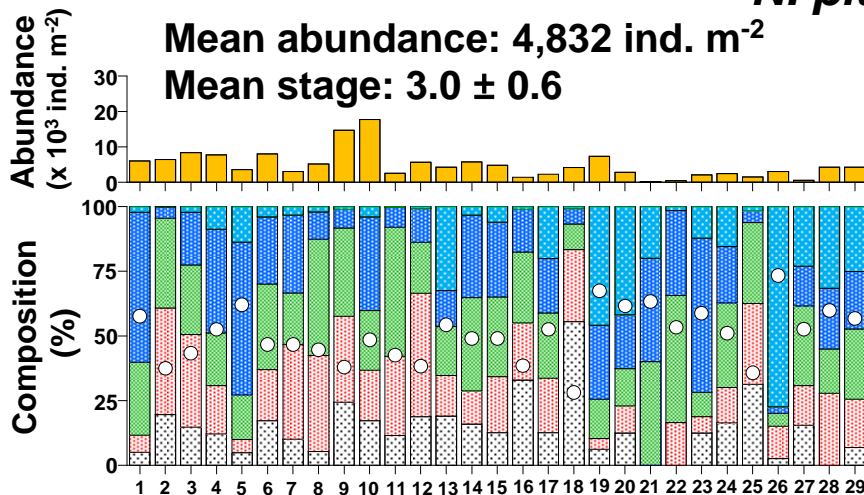
# 9. Abundance and stage structure of large calanoid copepods-1

June *Neocalanus cristatus* Aug.-Sep.



**Abundance significantly decreased but stage composition did not change.**

*N. plumchrus*



C1
  C2
  C3
  C4
  C5

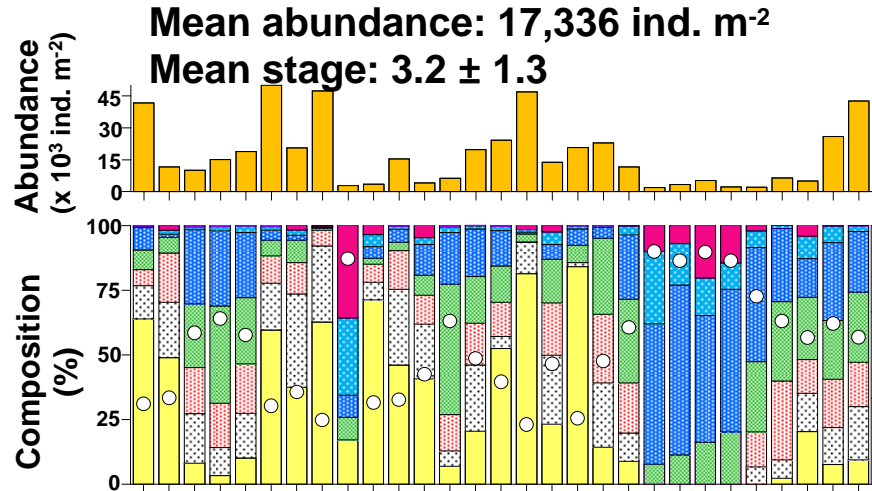
**Abundance significantly decreased; mean stage significantly advanced.**

# 10. Abundance and stage structure of large calanoid copepods-2

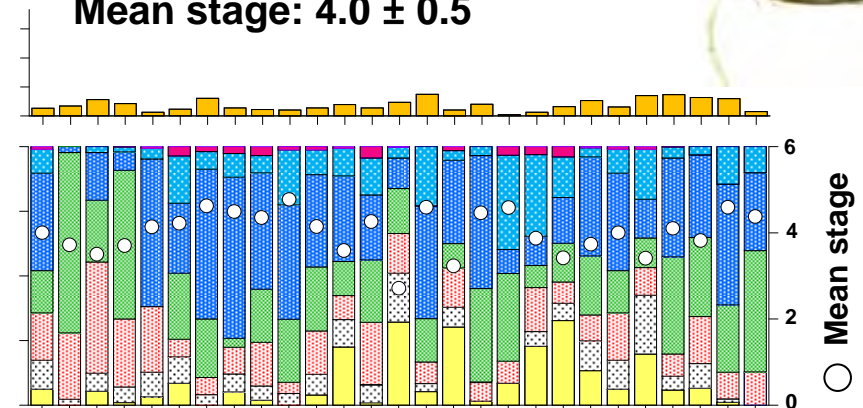
**June**

*Eucalanus bungii*

**Aug.-Sep.**

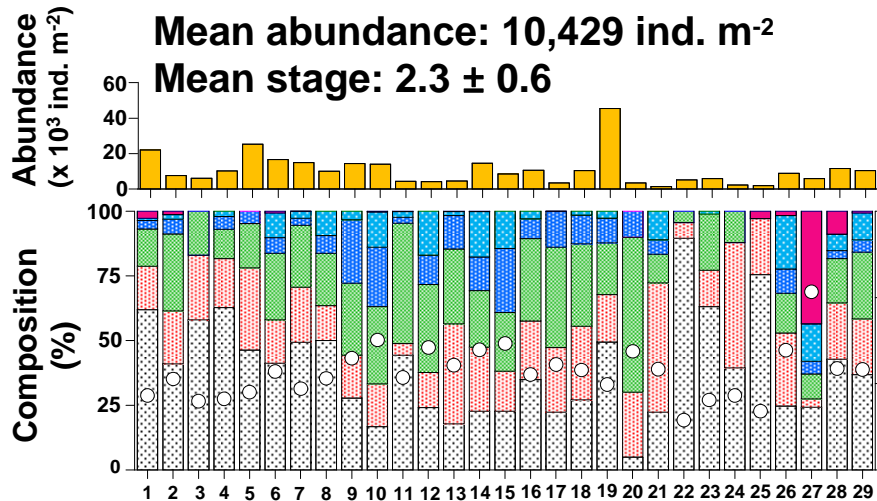


Mean abundance: 5,660 ind. m<sup>-2</sup>  
Mean stage: 4.0 ± 0.5

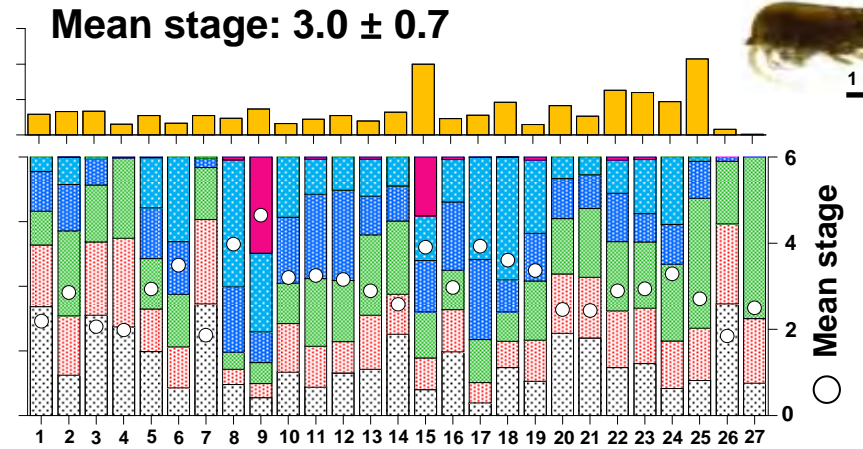


Abundance significantly decreased; mean stage increased.

*Metridia pacifica*



Mean abundance: 13,686 ind. m<sup>-2</sup>  
Mean stage: 3.0 ± 0.7



Legend: N (Yellow), C1 (Dotted), C2 (Red), C3 (Green), C4 (Blue), C5 (Light Blue), C6 (Pink)

Abundance did not decrease; late stages were abundant in Aug.-Sep.

# 11. Discussion of temporal change & Summary

June: Abundance was higher; Nauplii were abundant

- Magnitude of reproduction depends on phytoplankton abundance  
→ Massive reproduction may occur throughout the region

Aug.-Sep.: Abundance was less than in June

- Nauplii and large copepod abundances decreased

Large copepods from June to August-September

Abundance

Decrease: *Neocalanus* & *E. bungii* → 1-year life history

No change: *M. pacifica* → Multiple generations per year

Stage

Advance: *E. bungii* & *N. plumchrus* → Growth of cohort

*M. pacifica* → reflect of phytoplankton abundance

No change: *N. cristatus* → Reproduction through a year

*Neocalanus cristatus* C5



*Metridia pacifica* C6F



- Summary**
- Zooplankton community could be divided to west, central & east
  - Stage structure advanced from June through August-September