Overview of the zooplankton from viewpoint of food for fish resources in the western North Pacific

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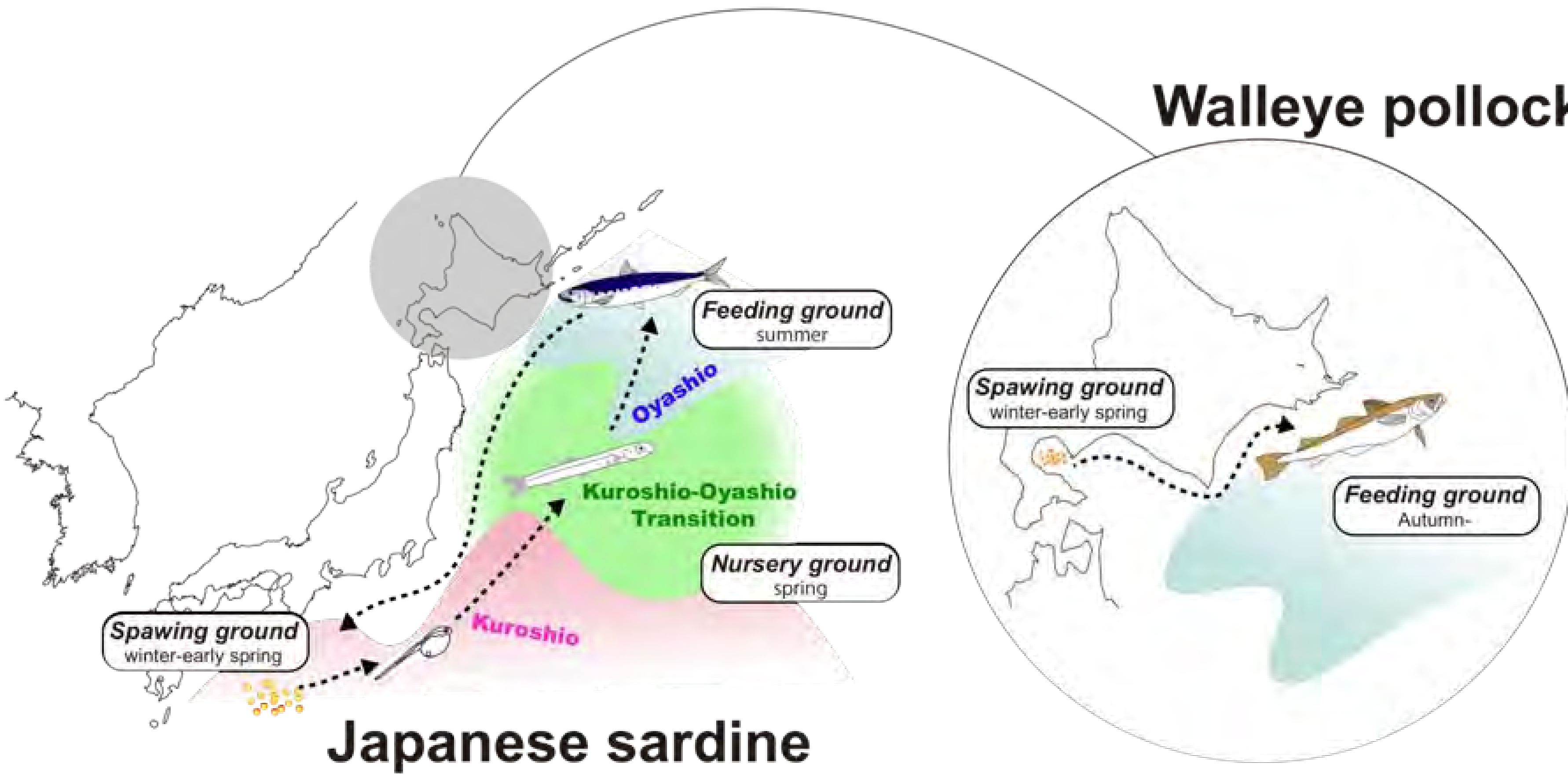


Important feeding ground for fish resources.

Hypothesis

Mortality in their early life stage is one of the cause of change in stock size of fish resource.

Possible causes of mortality

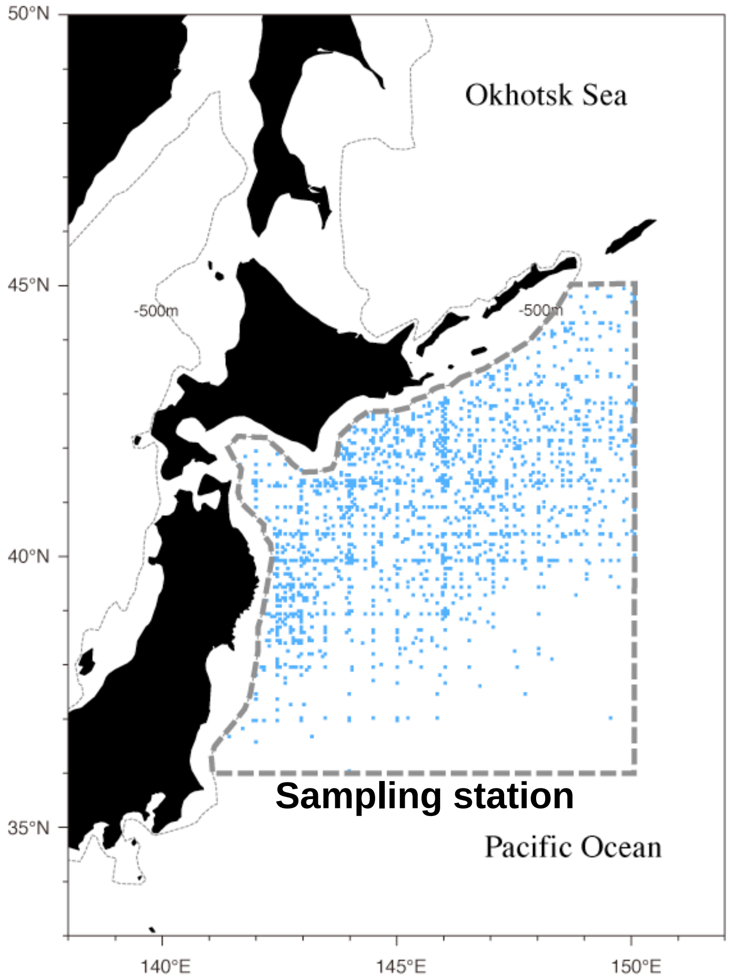
1. **Predation**

2. **Physiology**

3. **Food condition**

Oyashio and Transition

Data and Method



Samples: ODATE COLLCETION

Period: 1950-2008

Plankton net: Marutoku (1960-1990)
NORPAC (1990-2008)

Mesh & diameter: 0.33mm, 45cm (both nets)

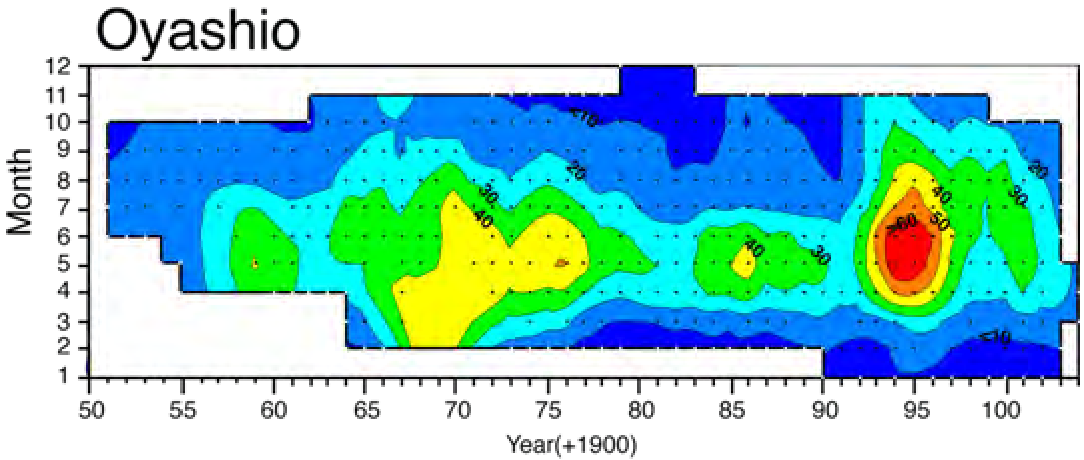
Sampling layer: 0-150m

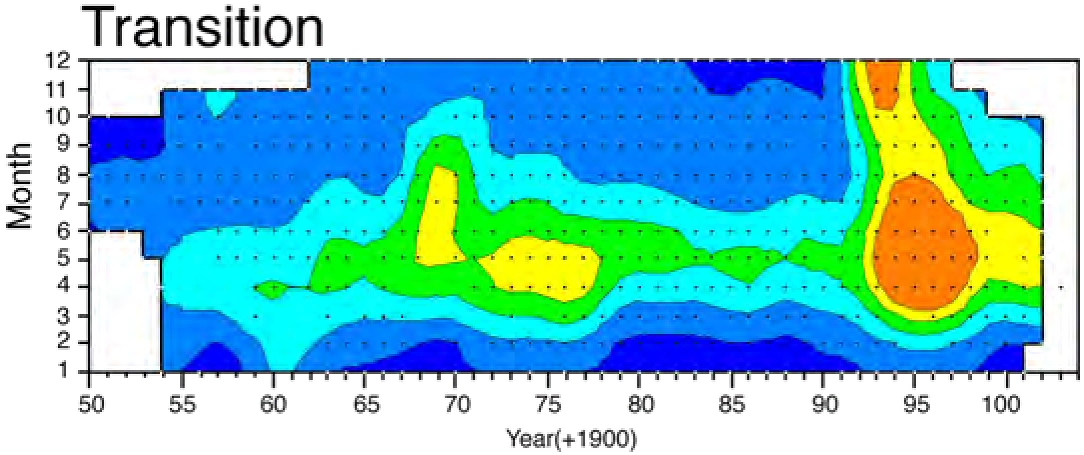
Definition of water mass:
Oyashio less than 5° C
Transition 5-15° C
at 100m depth

Analysis: Counting the individual number for the each species by microscope.

Oceanographic data:
WOD2001+A-line+ JODC
Temp・Sal・nutrients etc

Variation in mesozooplankton biomass





Zooplankton biomass represented similar pattern of decadal scale variation in both waters.

Groups of zooplankton community

Kidachi (1997)

A

Kuroshio-warm water species: carnivorous, omnivorous

Ctenocalanus vanus,Oithona spp., *Oncaea* spp., *Corycaeus* spp. etc

B

Dial migratory, herbivorous except with copepod

Euphausia spp., *Undeucaeta* spp., *Scottocalanus*, *Pleuromamma* spp. etc.

C

Coastal species: mainly herbivore

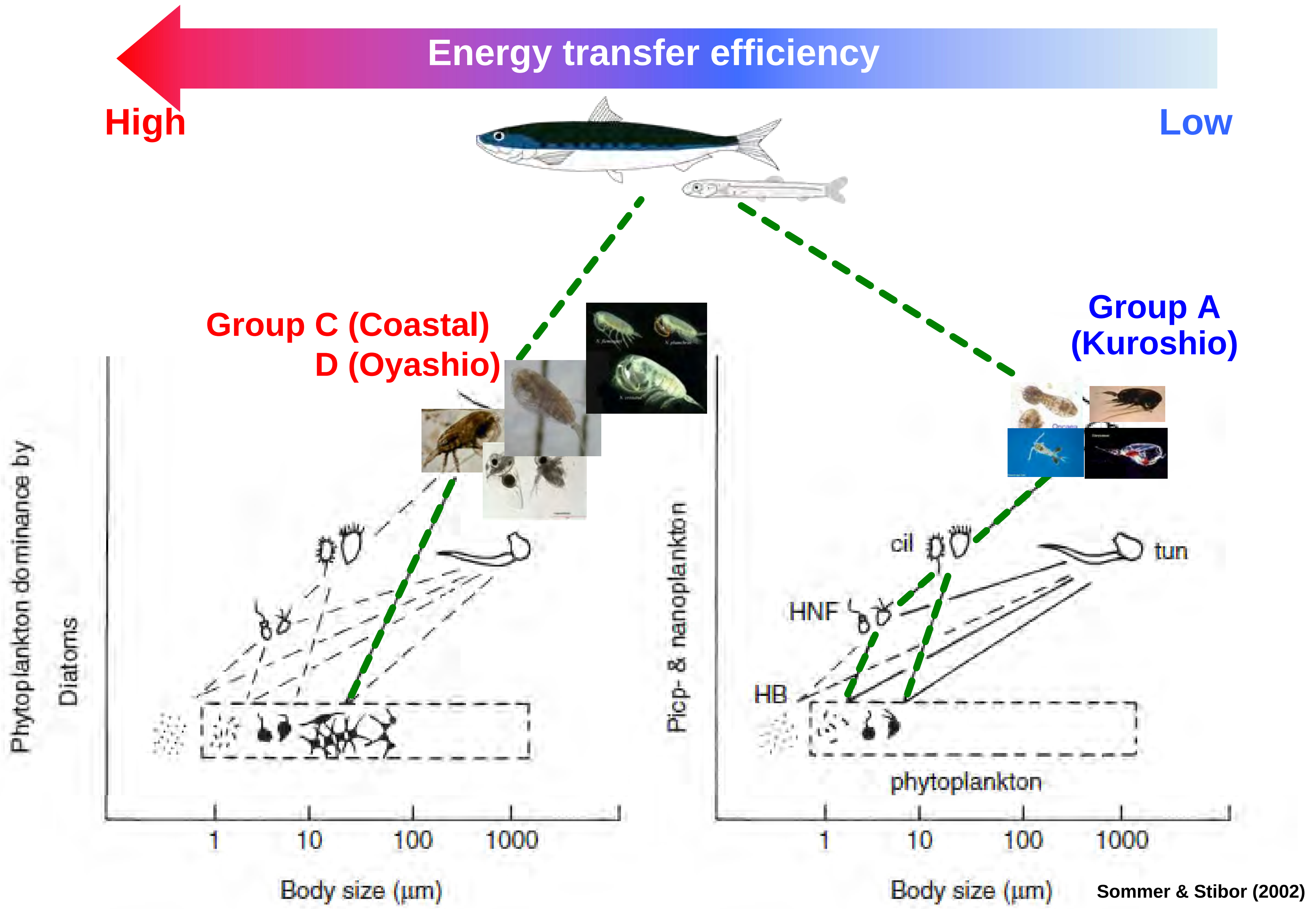
Paracalanus parvus, *Calanus sinicus*, *Acartia omorii*, etc.

D

Oyashio cold water species: mainly herbivore

Neocalanus spp., Eucalanus bungii, Mertidia pacifica, etc.

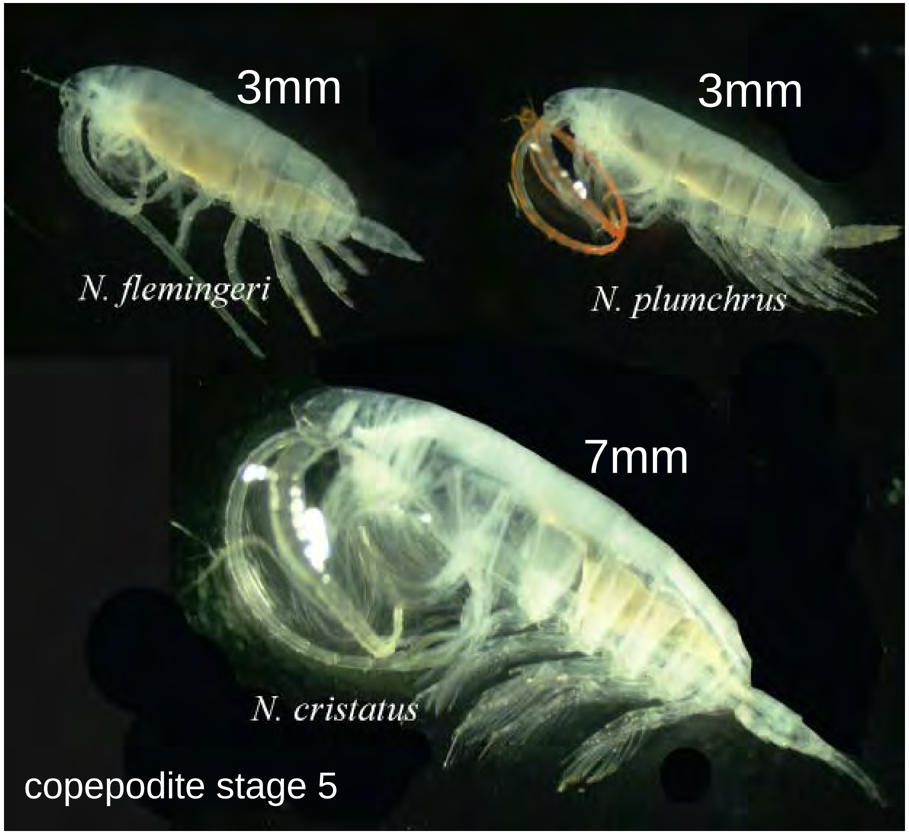
Effect of community change for fish



Sommer & Stibor (2002)

Oyashio cold water species

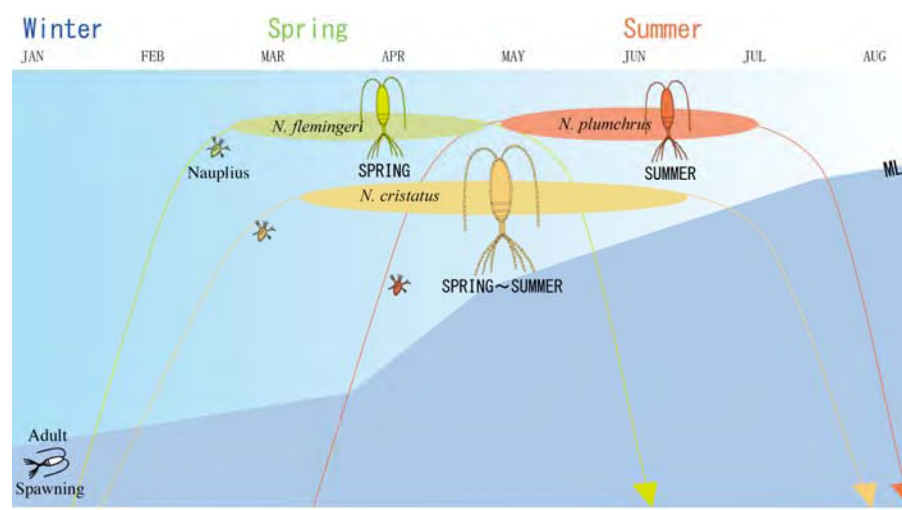
Neocalanus copepds



1 Dominant in biomass

2 Large body size

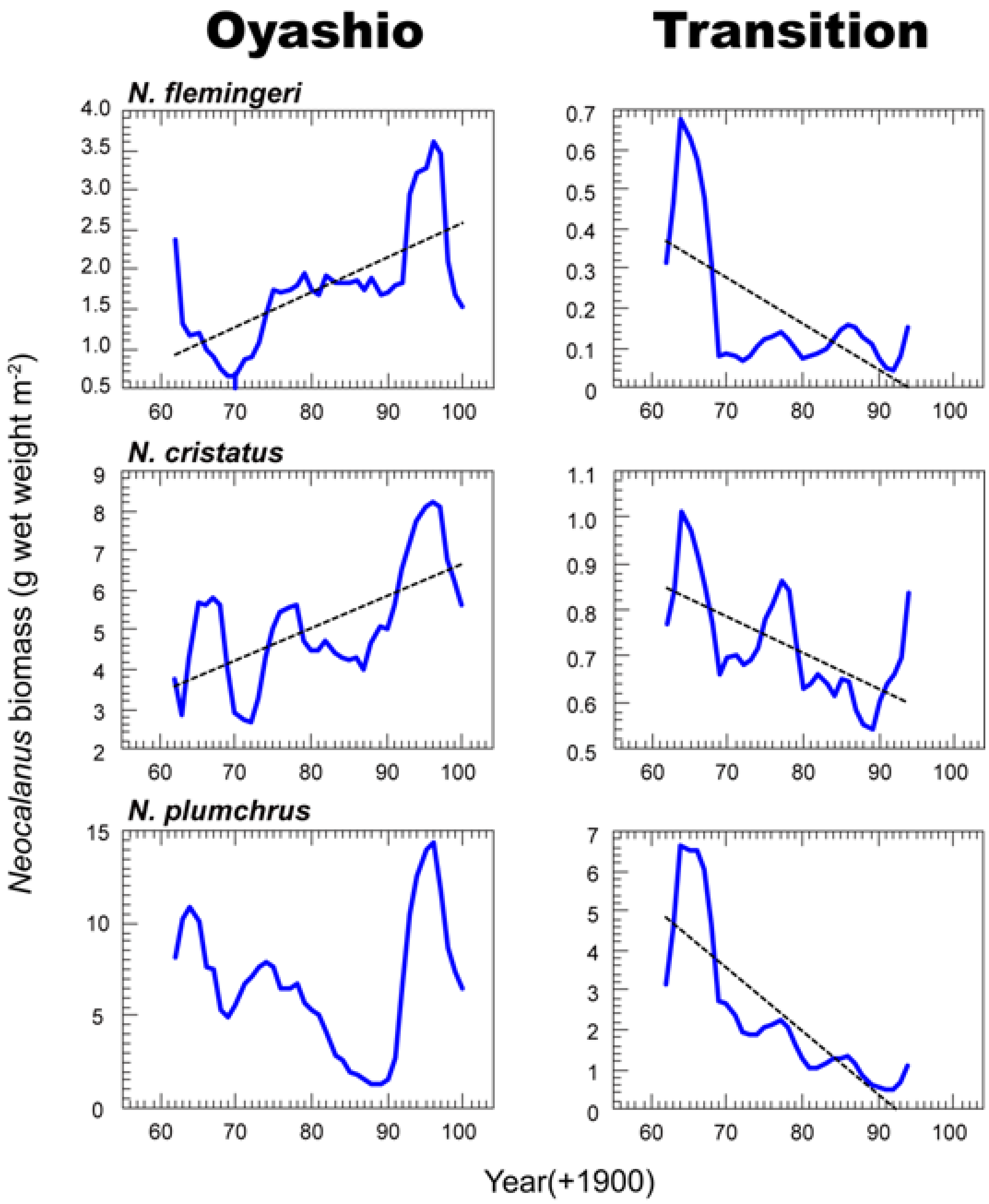
3 Strong Seasonality



Variation in *Neocalanus* (annual mean Apr-Sep)

N. flemingeri and *N. cristatus* had increase trend.

N. plumchrus significantly decrease in 1980s.



Three species had decrease trend.

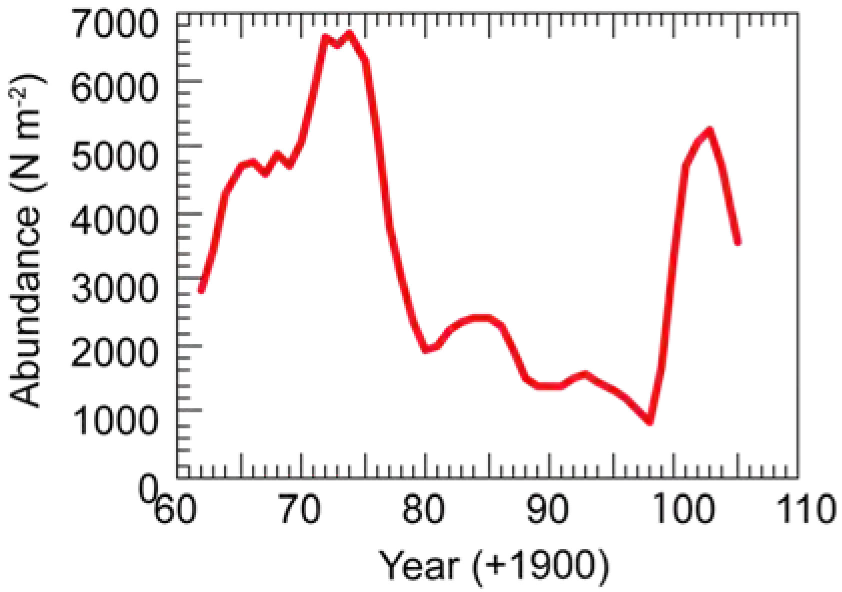
Kuroshio warm water species in May

Oithona similis

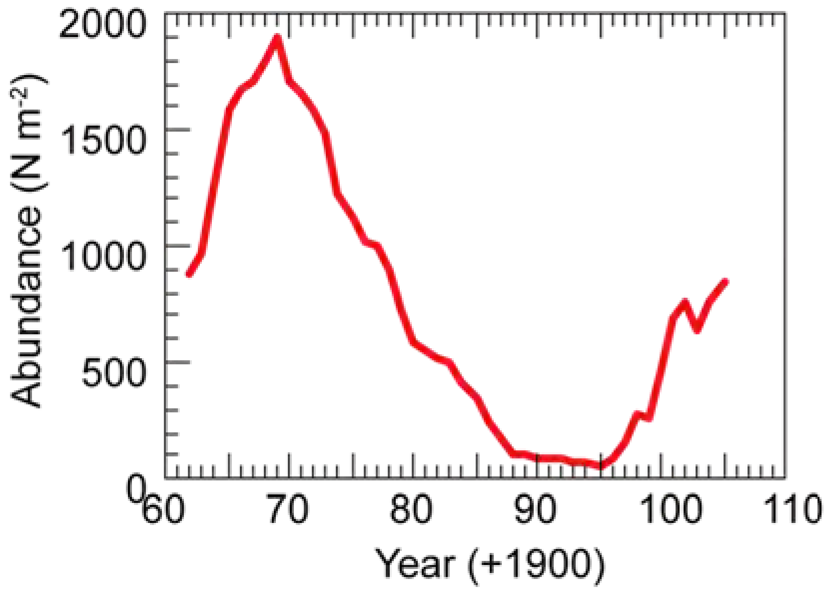
Body size is 0.7-1.0mm (adult)

Copepodite and nauplius may be important food for sardine larvae.

Oyashio



Transition



The abundance peaked around 1970 and decreased after mid 1970s. The abundance increased after late 1990s again.

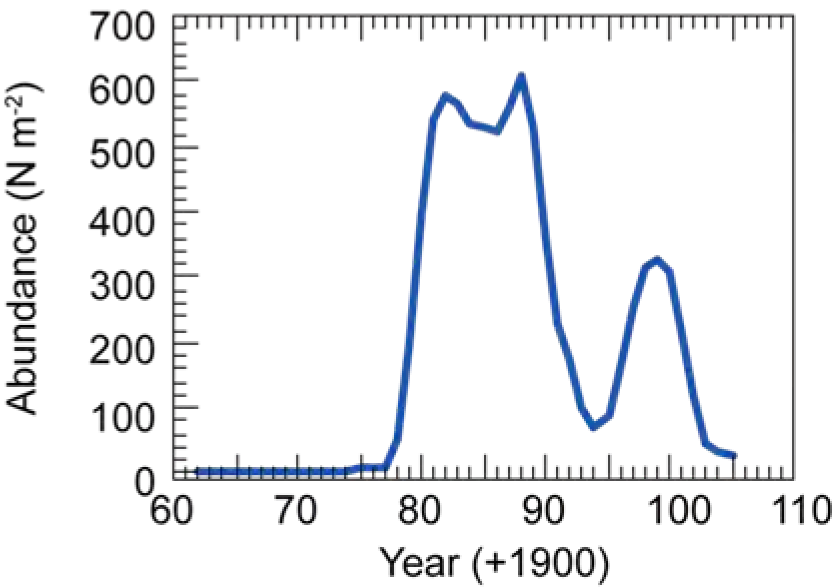
Coastal species in May

Acartia omorii

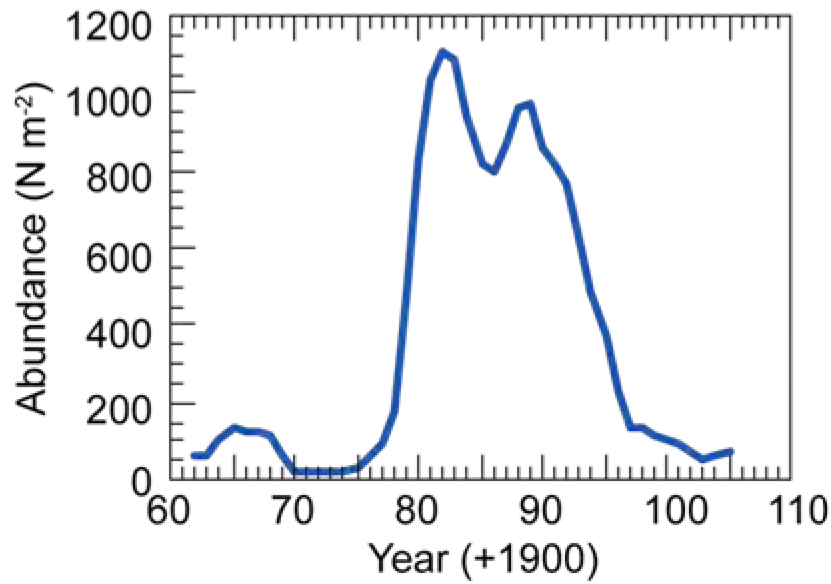
Body size is 1.0mm (adult)

Copepodite and nauplius may be important food for sardine larvae.

Oyashio



Transition

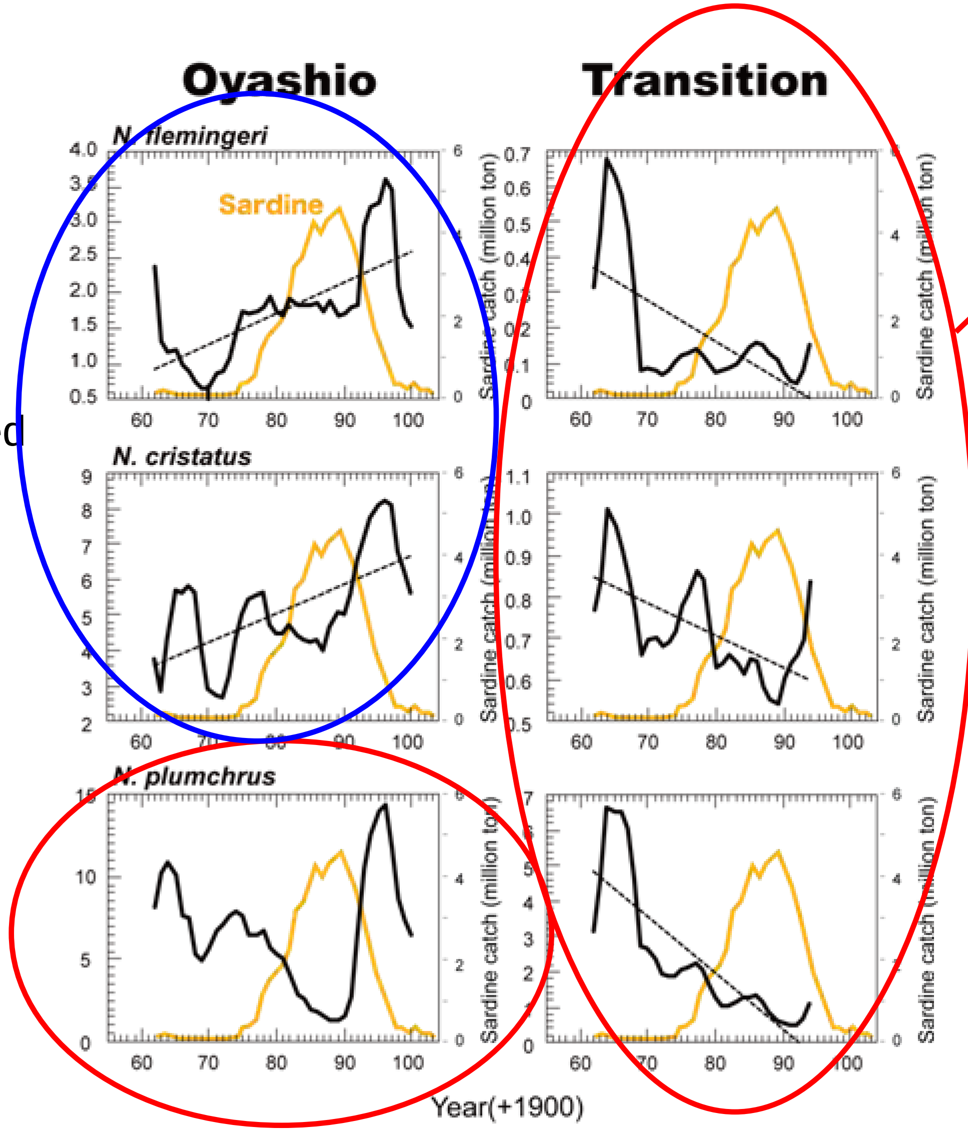


The abundance increased in late1970s and peaked in mid1980s.
The abundance decreased after mid 1990s again.

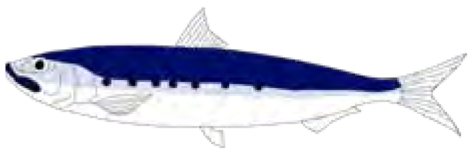
Relation between copepod and sardine stock

Neocalanus: Oyashio cold water species

Timing of increase in both species corresponded with sardine. However the high biomass continued after mid 1990s when decrease the sardine stock .



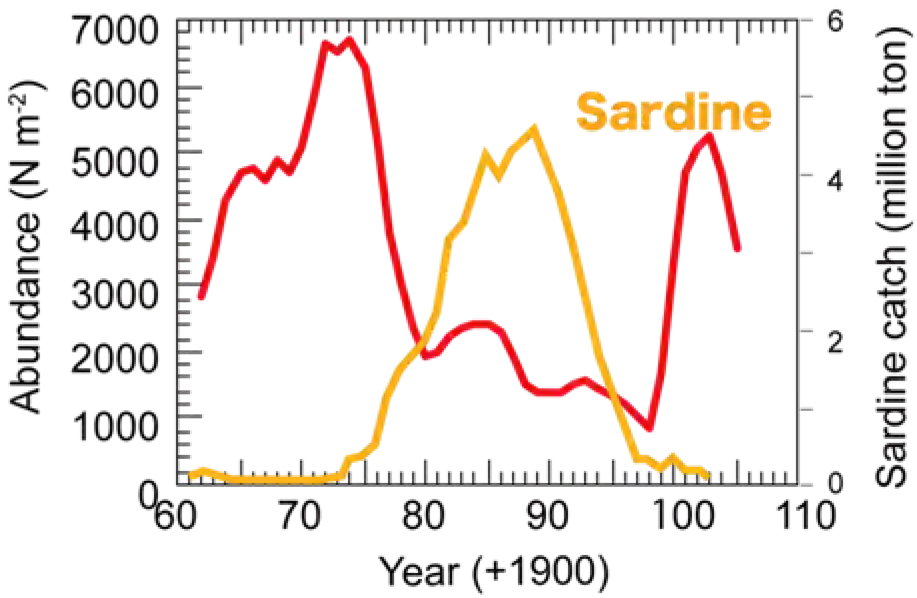
Neocalanus had inverse relationship with sardine.



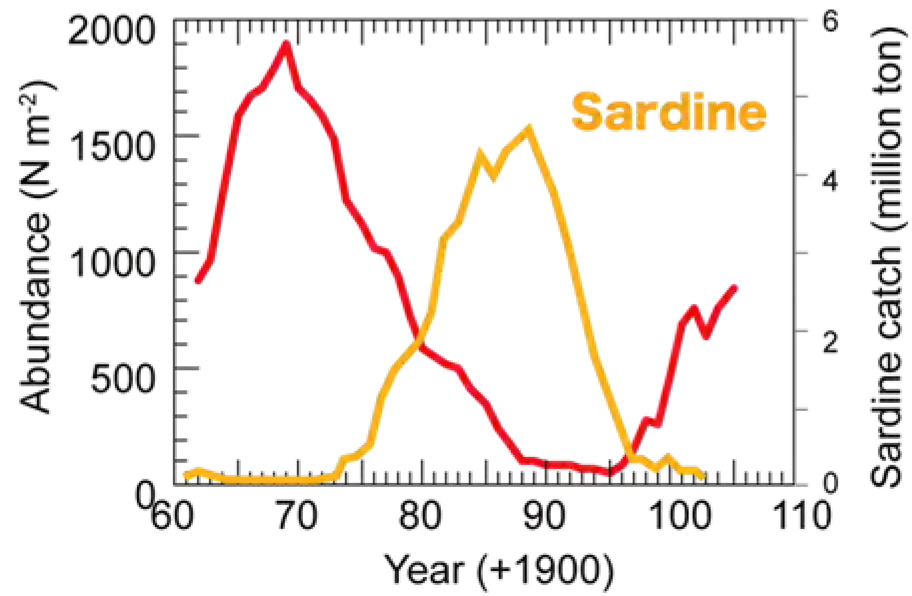
Relation between copepod and sardine stock

Kuroshio warm water species: *Oithona similis*

Oyashio



Transition

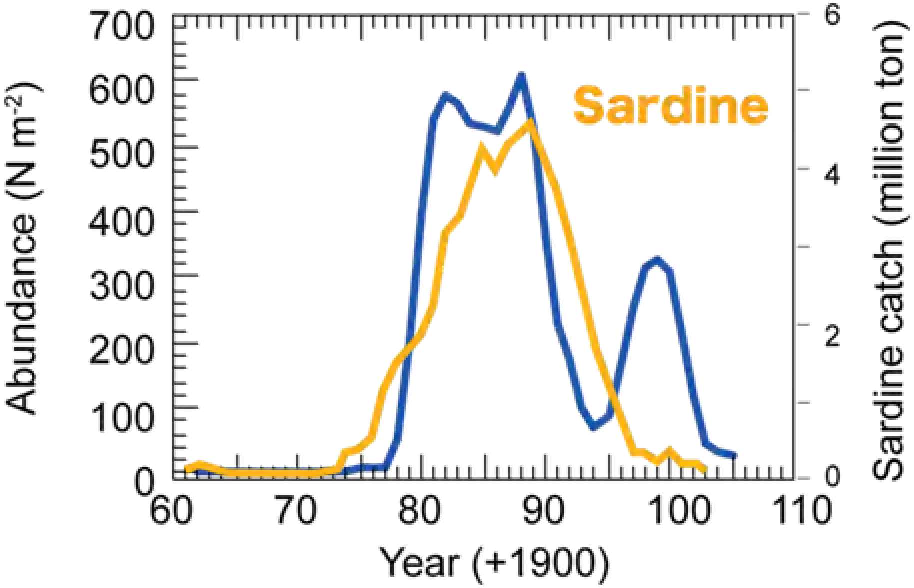


Abundance of *O. similis* represent inverse relation with sardine catch.

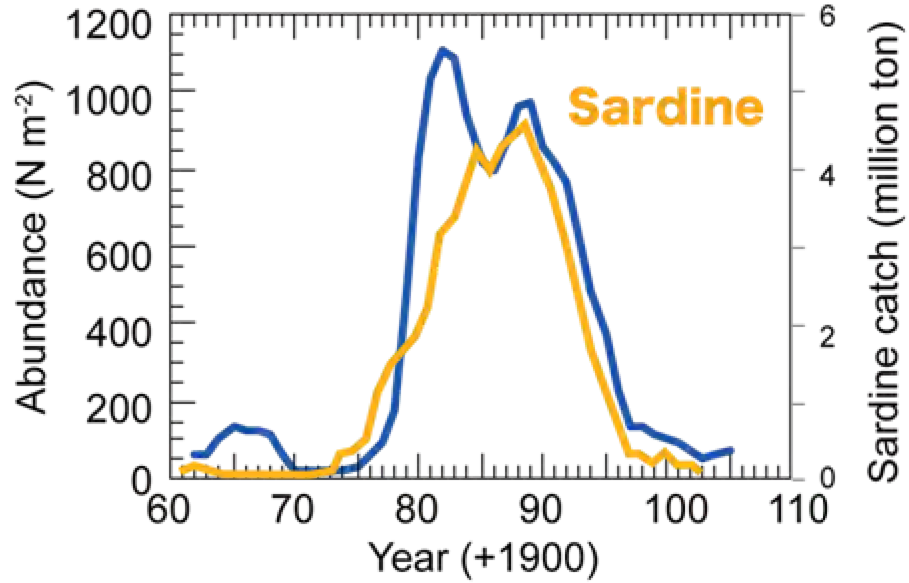
Relation between copepod and sardine stock

Coastal species: *Acartia omorii*

Oyashio

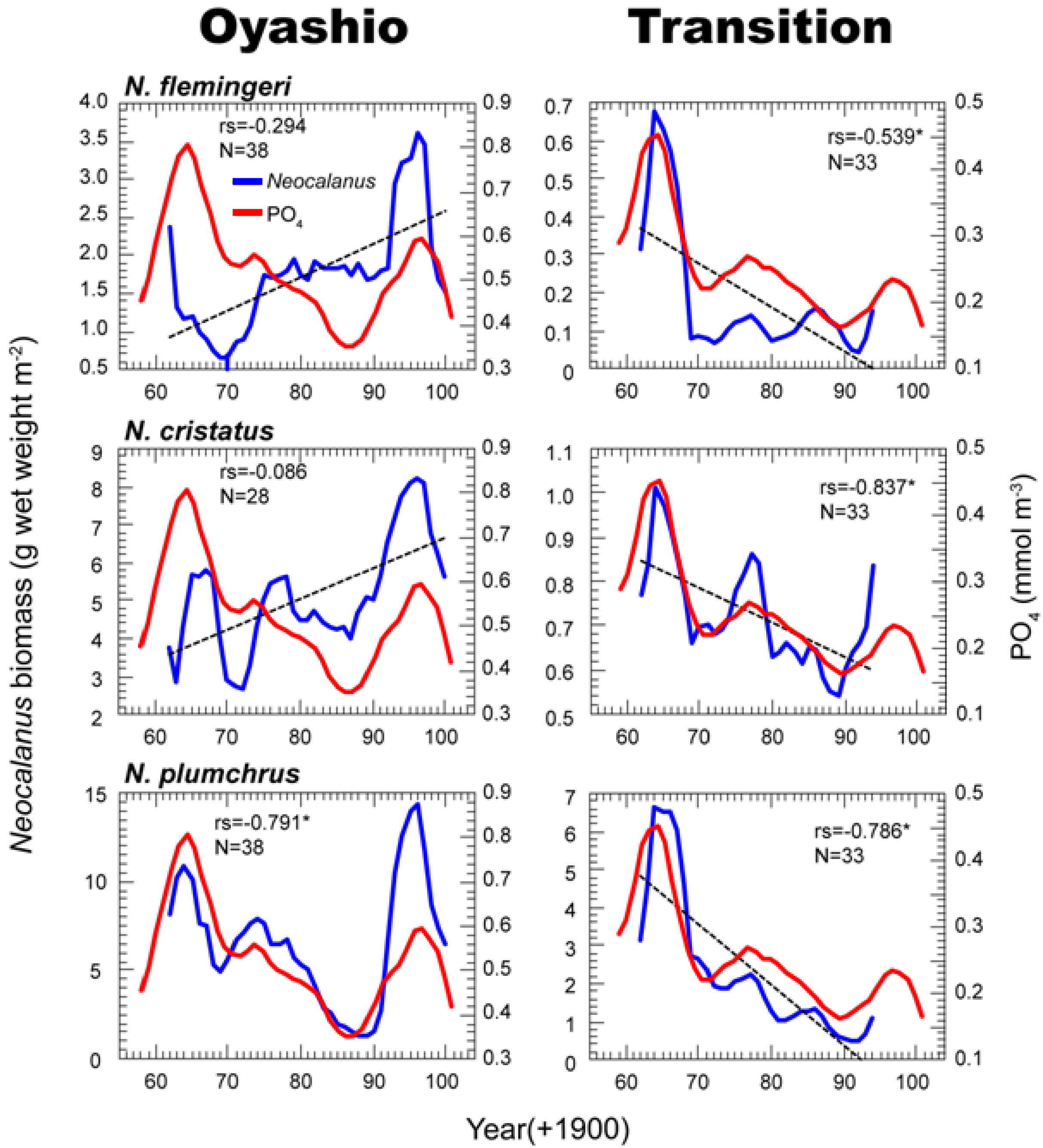


Transition

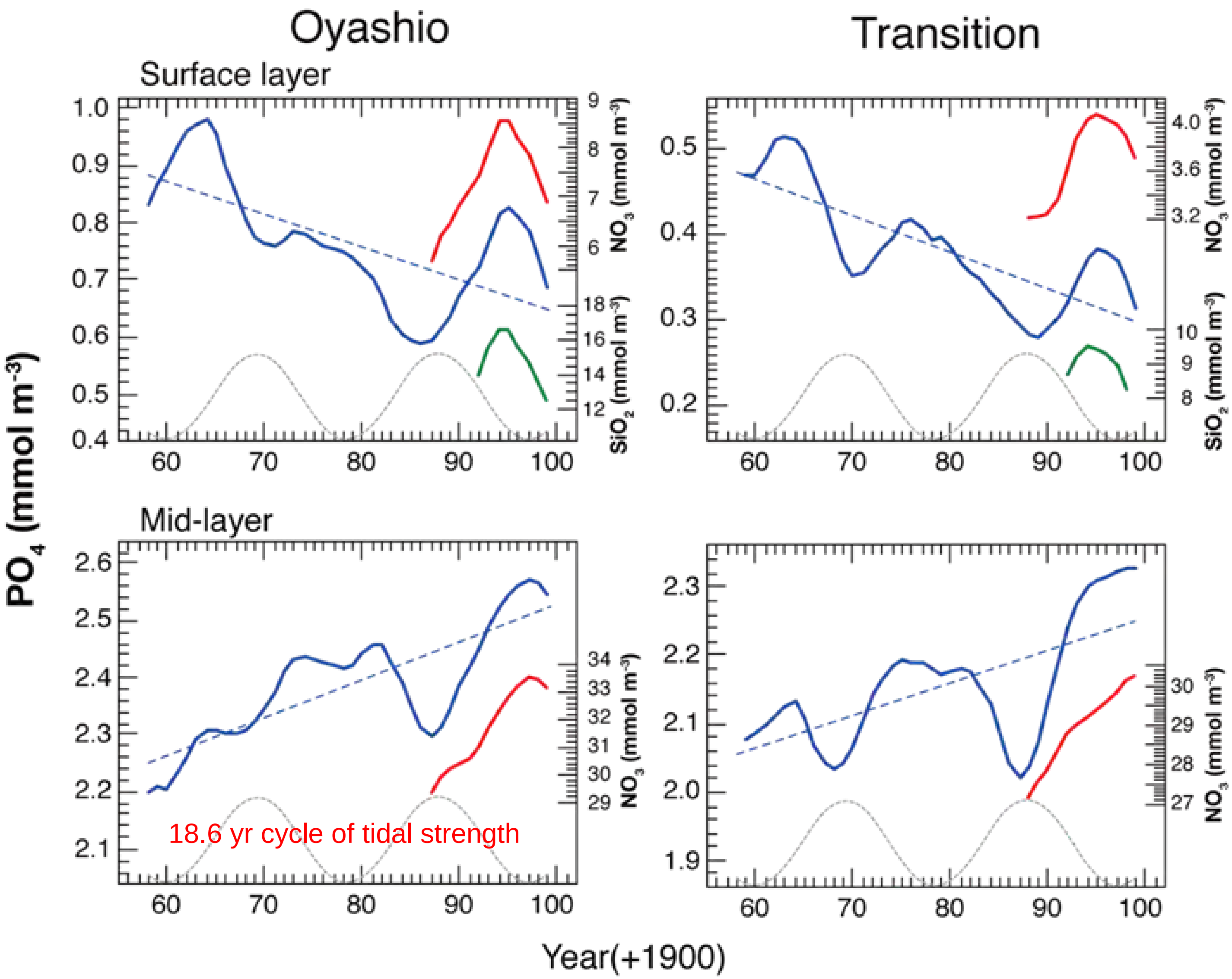


Abundance of *A. Omorii* represented similar pattern to sardine catch.

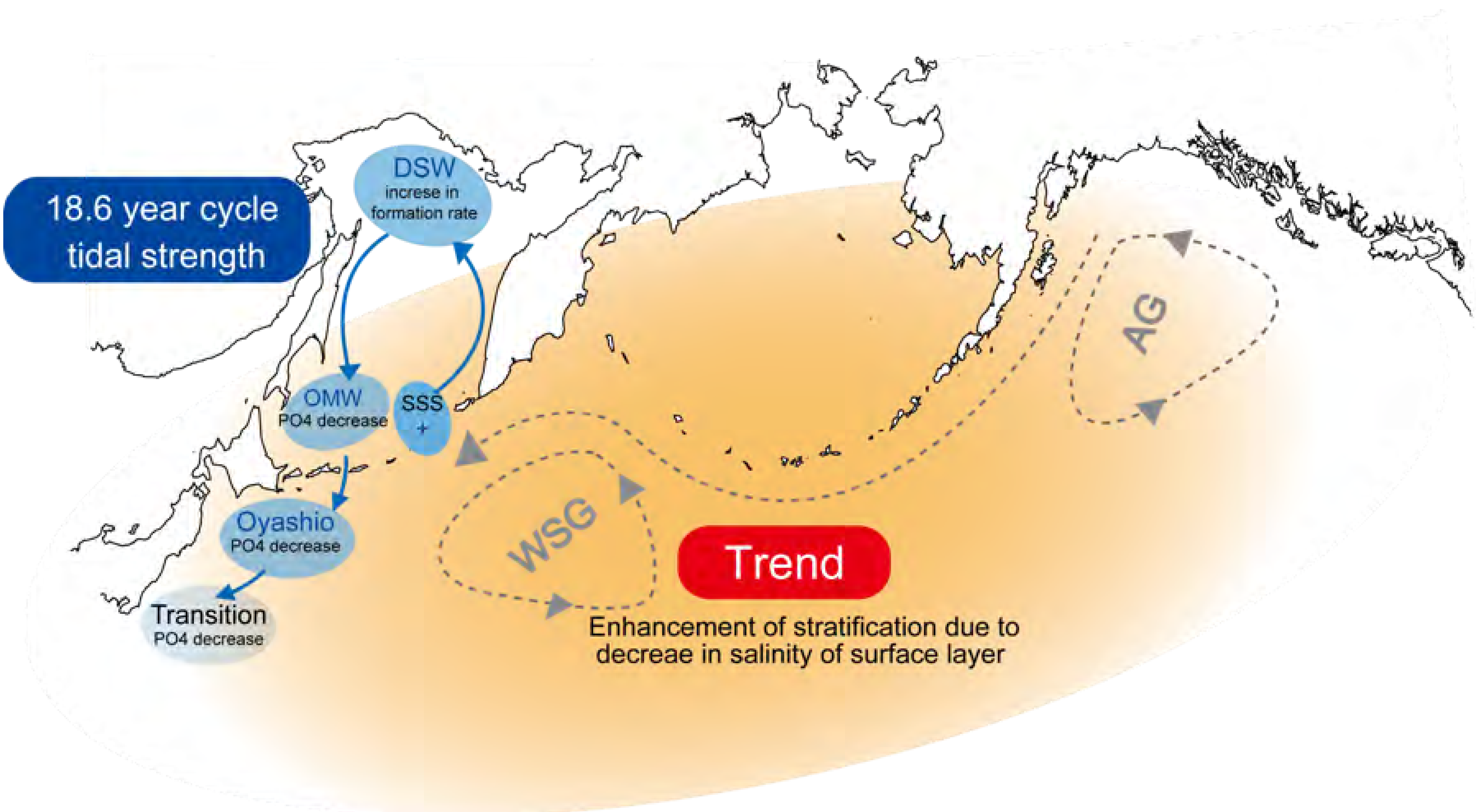
Mechanism of the copepod change



Possible mechanism of PO_4 change



Schematic view of mechanism of PO_4 change



Other possible mechanism: Regime Shift

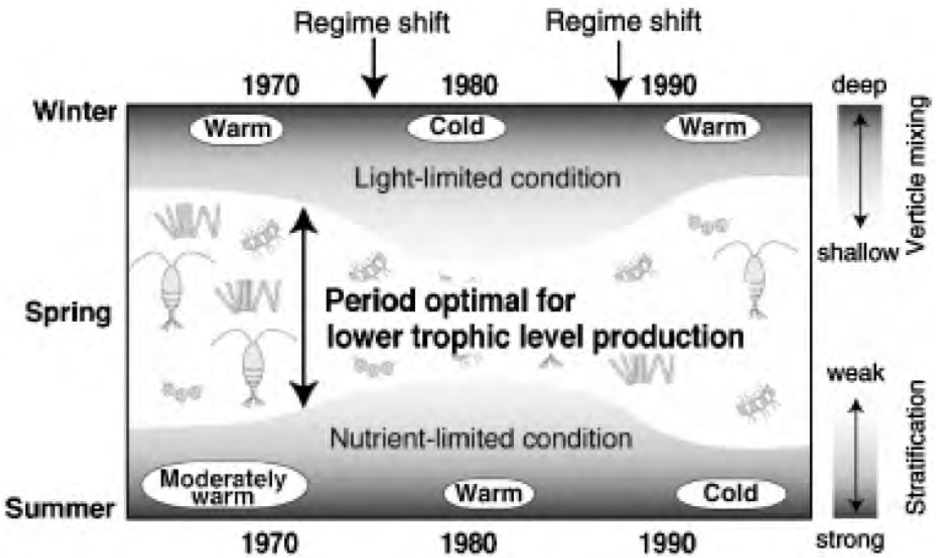
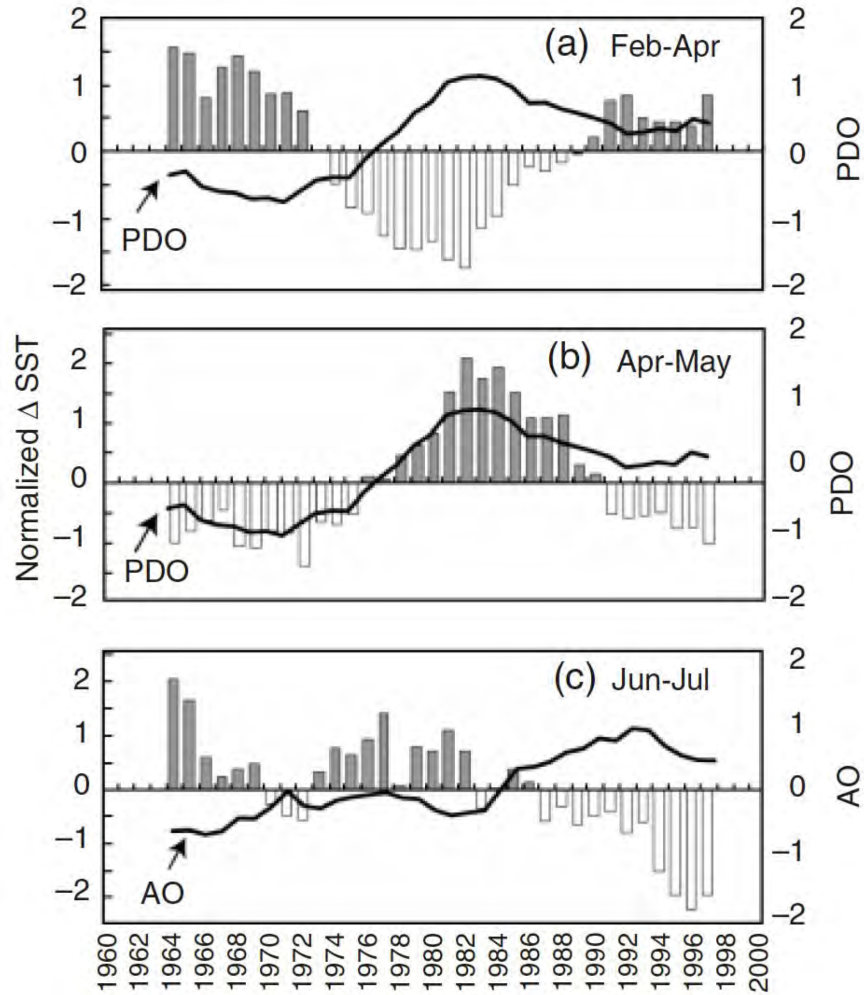


Fig. 10 Hypothetical diagram of mechanisms of decadal variation in the phenology of the lower trophic level in the western North Pacific (see text for details).



Chiba et al., (2006)

Zooplankton variation in Kuroshio

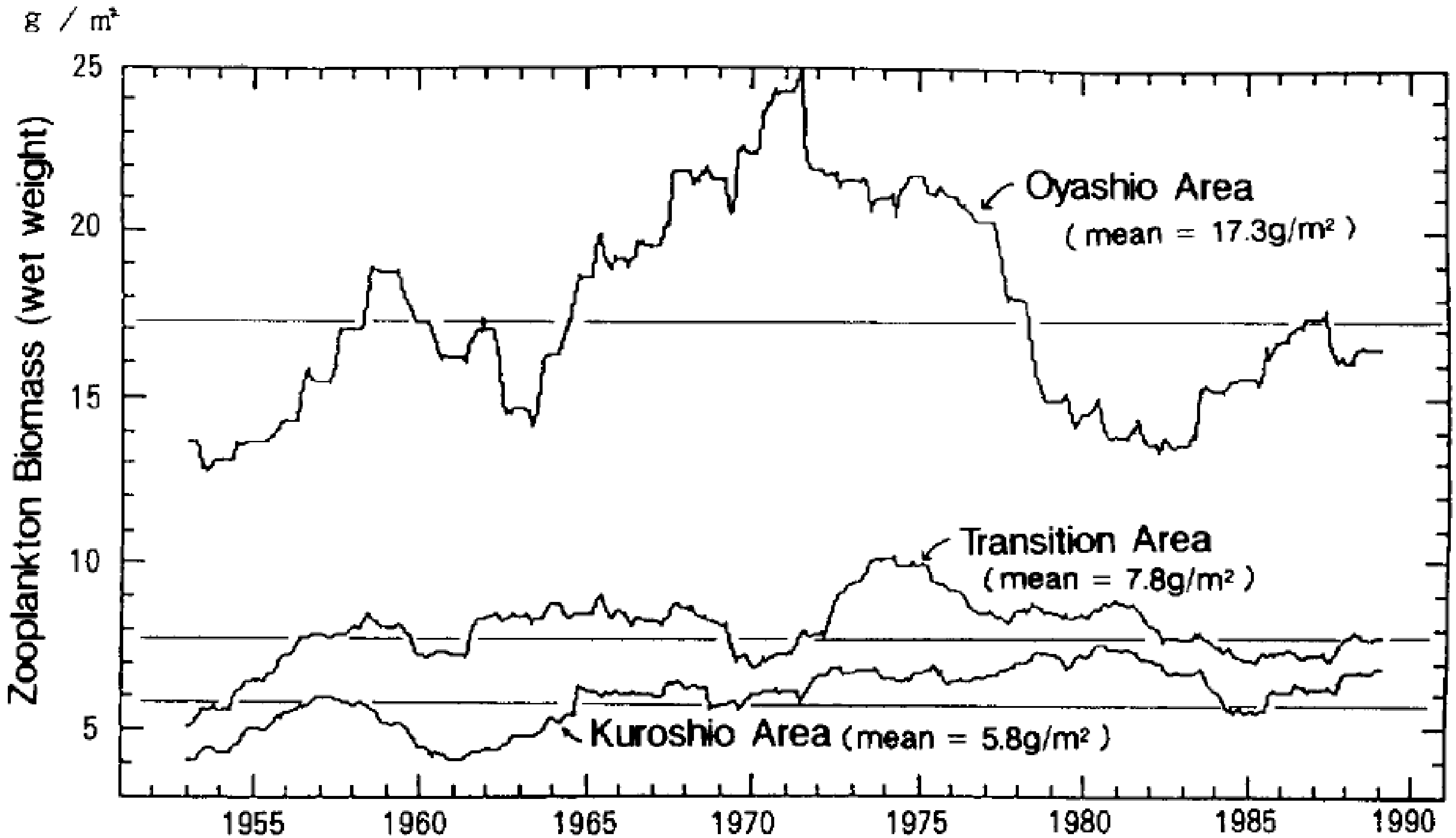
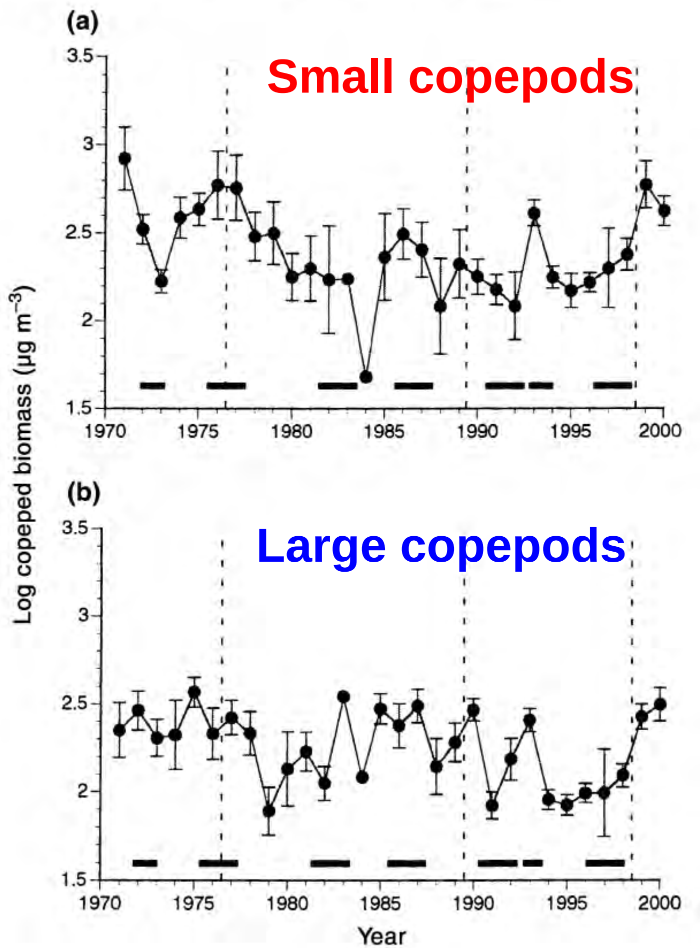


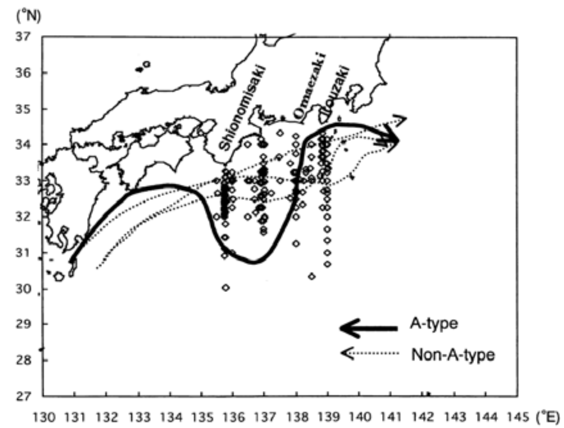
Fig. 12 Long term variability of zooplankton biomass indicated by 48 months running mean from 1951 to 1990. Horizontal lines in the figure show mean values of zooplankton biomass in each area.

Odate (1994)

Zooplankton variation in Kuroshio

Figure 3. Interannual variations in the log-transformed biomass of large (a) and small copepods (b) in the Kuroshio in winter from 1971 to 2000 with corresponding standard errors. Vertical dashed lines and solid bars in each figure denote the climatic regime shifts in 1976/77, 1989/90 and 1998/99, and the periods of El Niñ, respectively.





Biomass of small copepod represented slightly low value in 1980s. On the other hand, large copepod did not decrease in 1980s.

Nakata & Hidaka (2003)

Summary

1. Zooplankton biomass represented similar pattern between Oyashio and Transition waters. However the pattern of variation was different species level.

2. Variation of A. omorii represented similar pattern to the sardine stock. This suggest that the change of community structure relate to the variation in sardine stock. However, sardine stock already started to increase in 1972. In this year, abundance of A. omorii was still low.

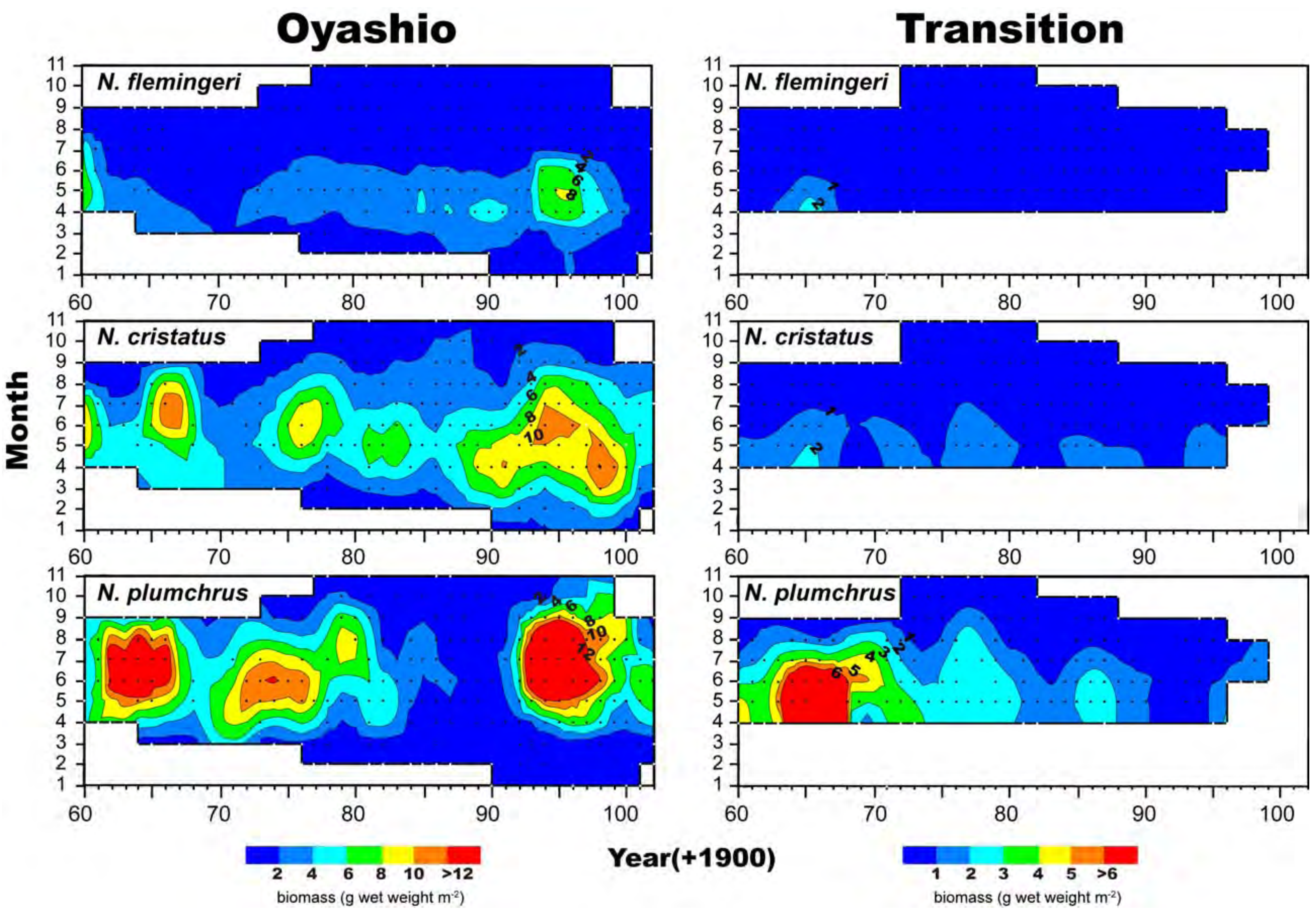
3. Variation in nutrients (PO_4) supply related to the decadal scale variation in Neocalanus biomass. However the cause of the other species is not clear.

4. In the Kuroshio, biomass of small copepod represented slightly low value in 1980s. On the other hand, large copepod did not decrease in 1980s.

Future problem

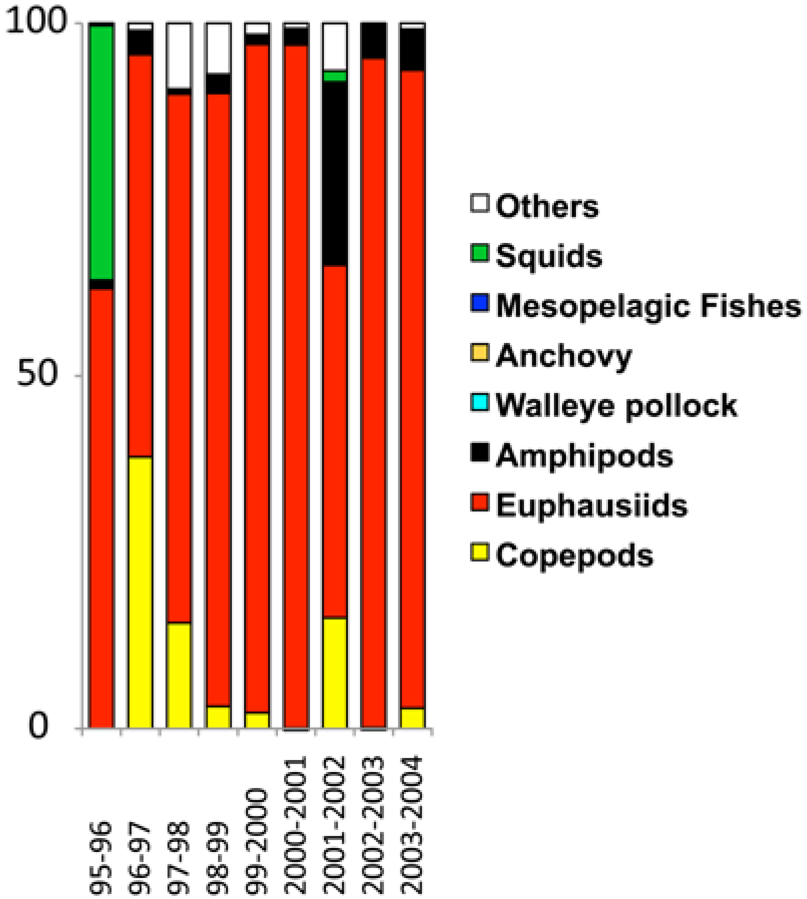
The information of the food items of fish is not enough. Therefore study of the food habit of fish resources is important.

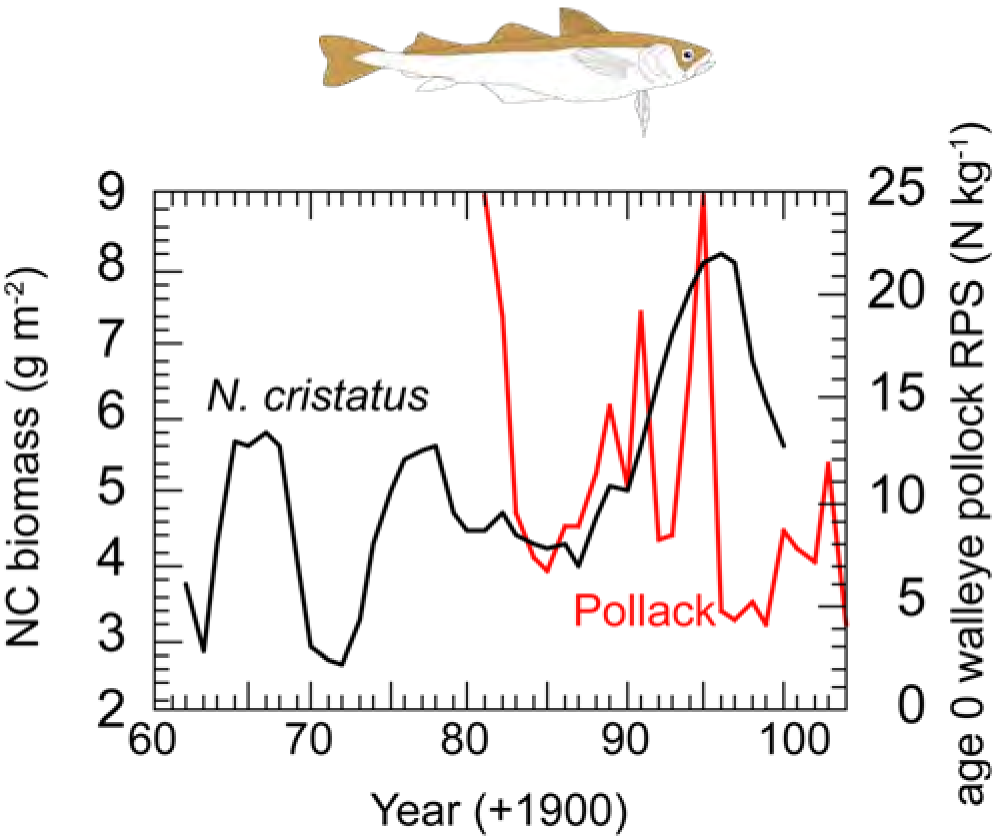
Variation in *Neocalanus*



Relation between copepod and walleye pollock RPS

Food composition (%) of age 0





Data from Dr. Yamamura.

N. cristatus is important food resources.

North Pacific

Process of ecosystem change