PICES 13th Annual Meeting

Decadal scale variation of copepod community structure in the Oyashio based on the Odate Collection

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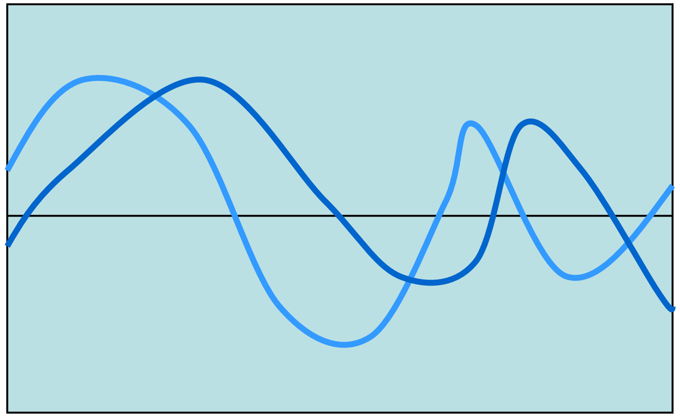
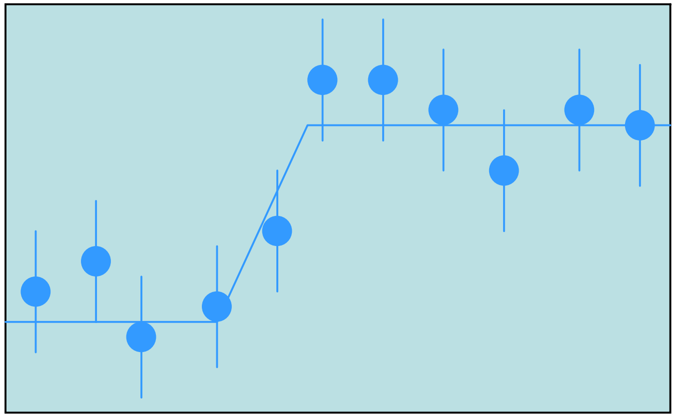
Introduction

Oscillation

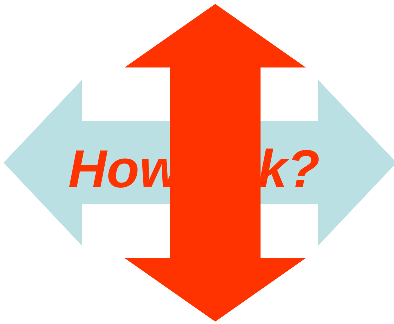


Regime shift



correlations

Climate



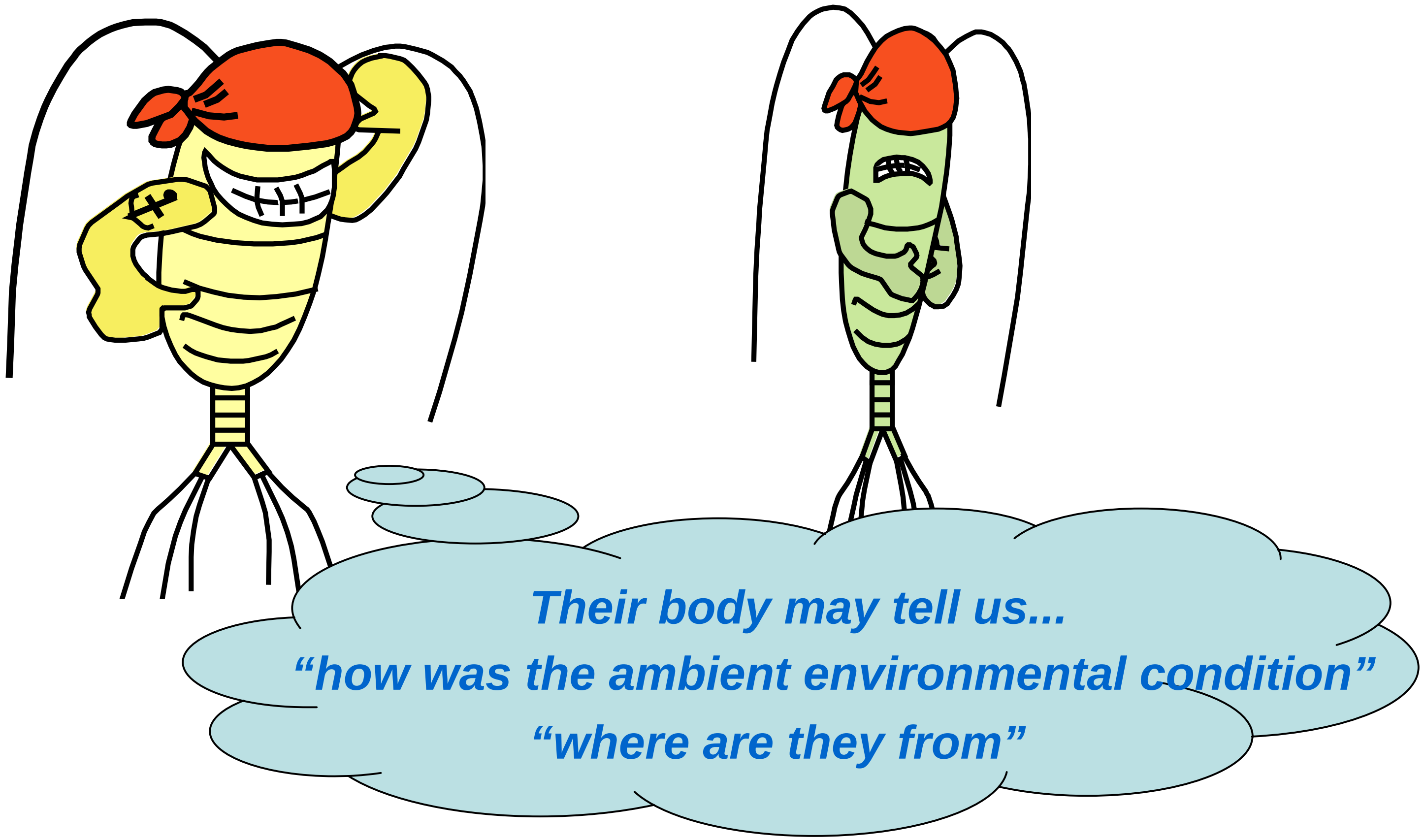
Ecosystem

mechanisms

Introduction

Advantage of Detailed Zooplankton Analysis for Climate-Ecosystem Change Studies

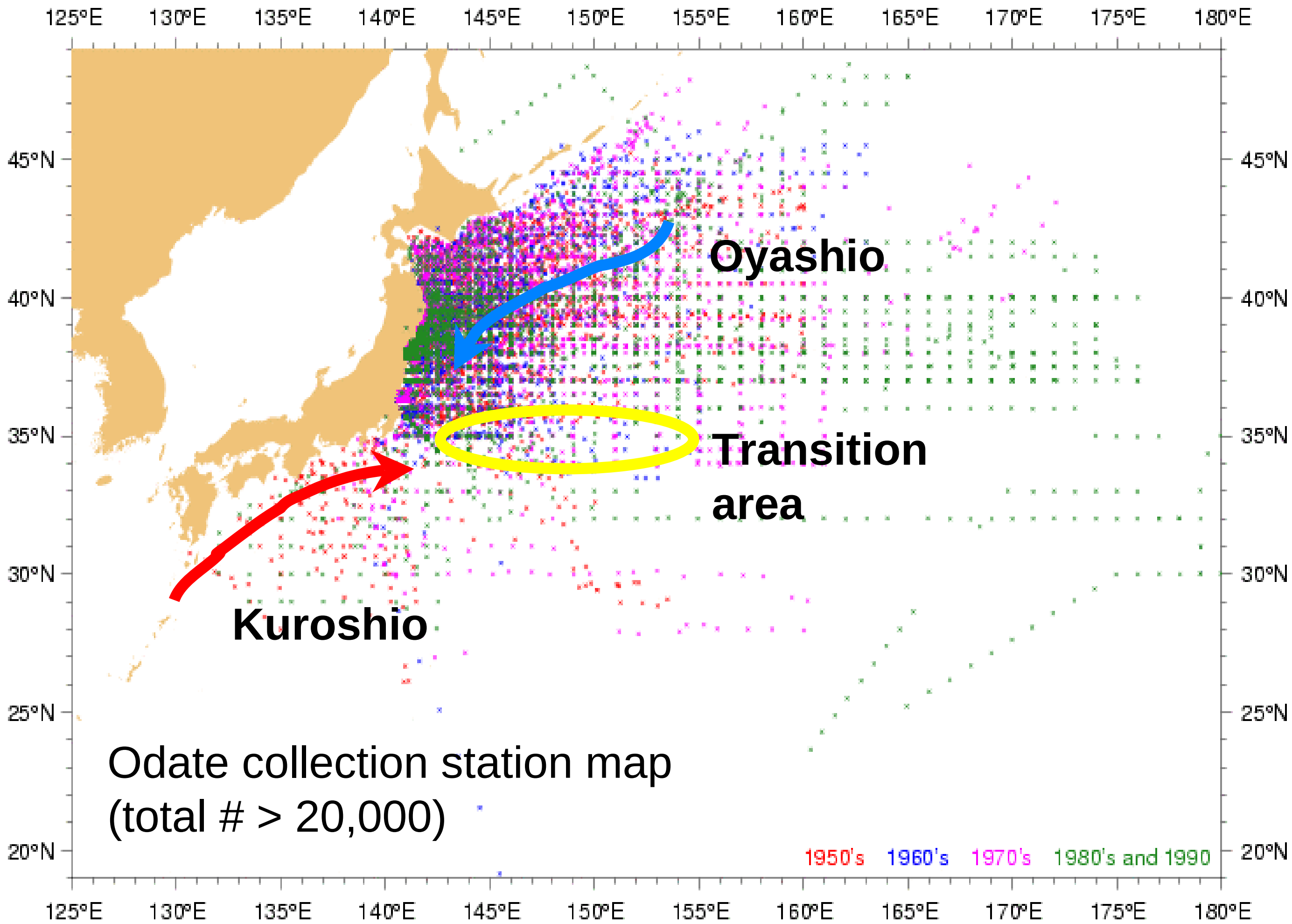
- Their community structure and biological states preserve a state of past events



- There are some historical zooplankton collections waiting to be analyzed

Odate Collection

Zooplankton samples taken in water adjacent to Japan 1950s - present



Wet weight data were analyzed by Odate (1994) and archived by Tohoku Fisheries Research Institute.

To elucidate mechanisms of basin scale, multi-decadal change in marine ecosystems

Process study on long-term variation of lower trophic level ecosystem in the western North Pacific

The ODATE project

2003-2005 (6?) FY

Funded by the Japanese Ministry of Environment

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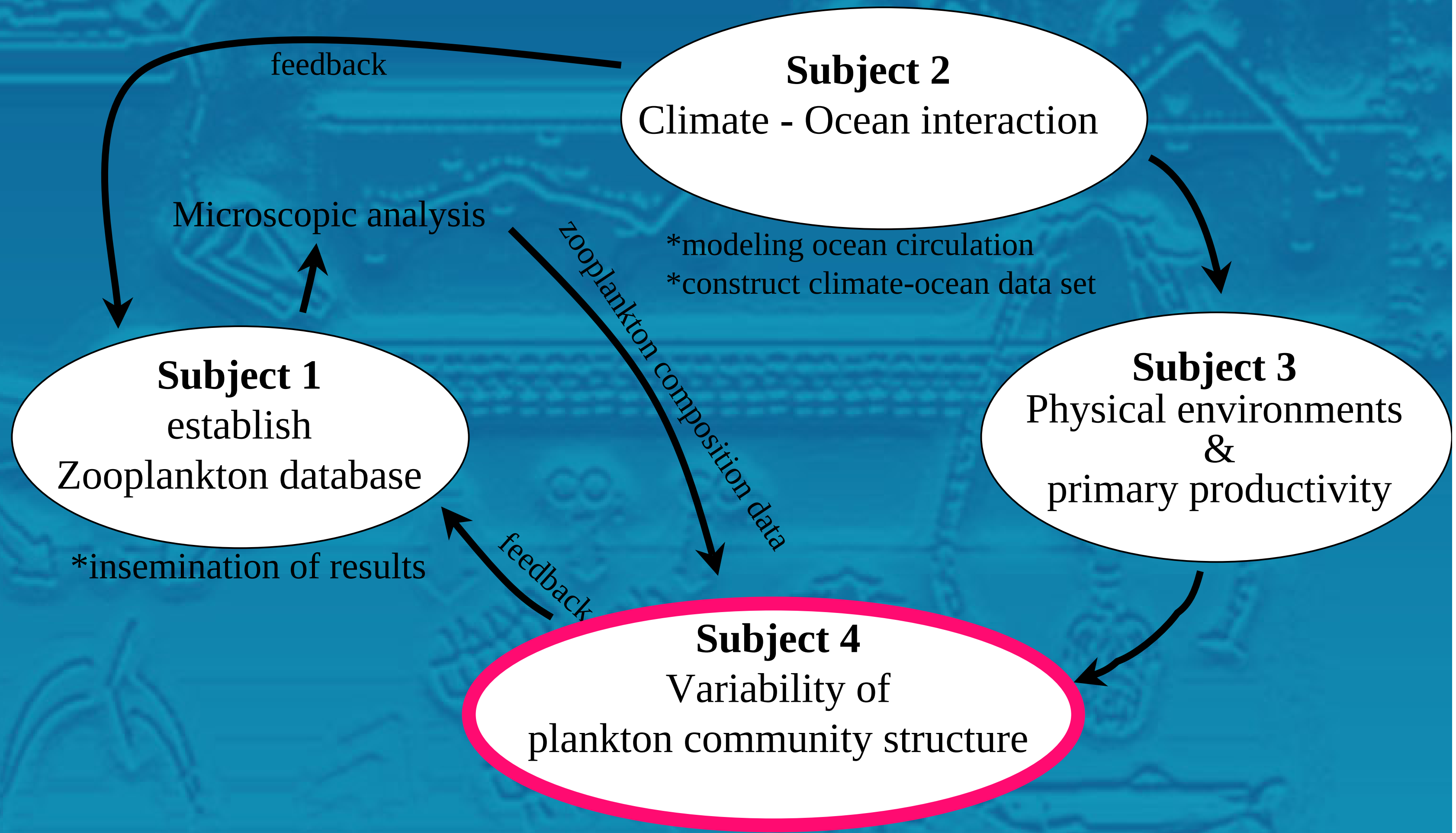
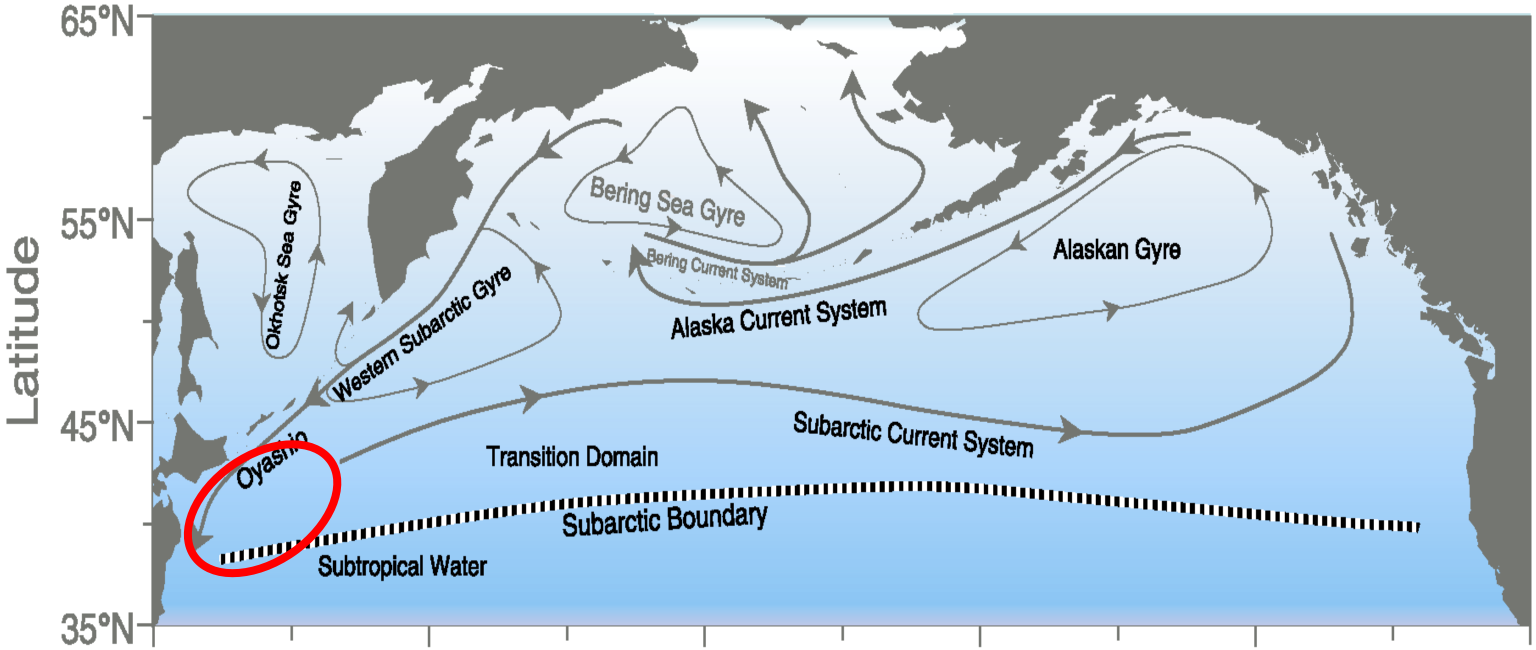
Components of the Odate Project

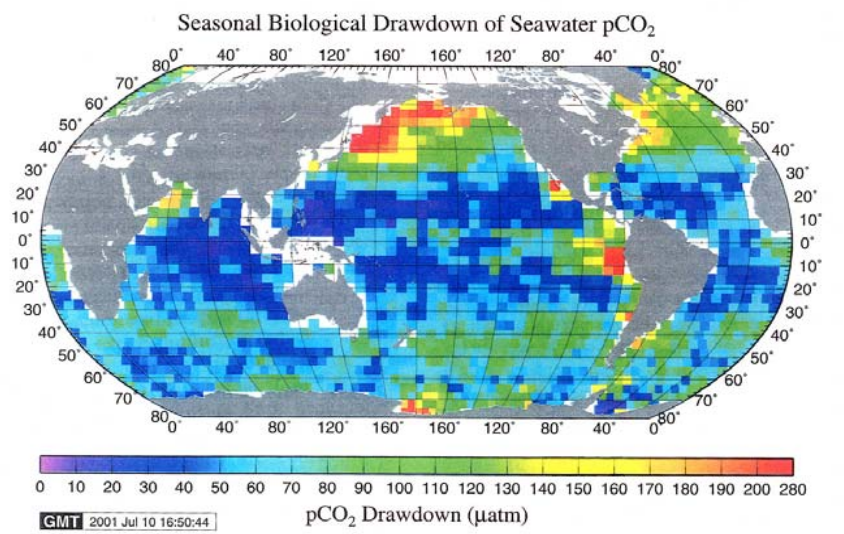


1. Copepods community analysis
2. Quantitative and phenological changes of Target species
3. $\delta^{15}N$ analysis of target species for basin scale comparison

2003-2004FY Target: Oyashio Domain



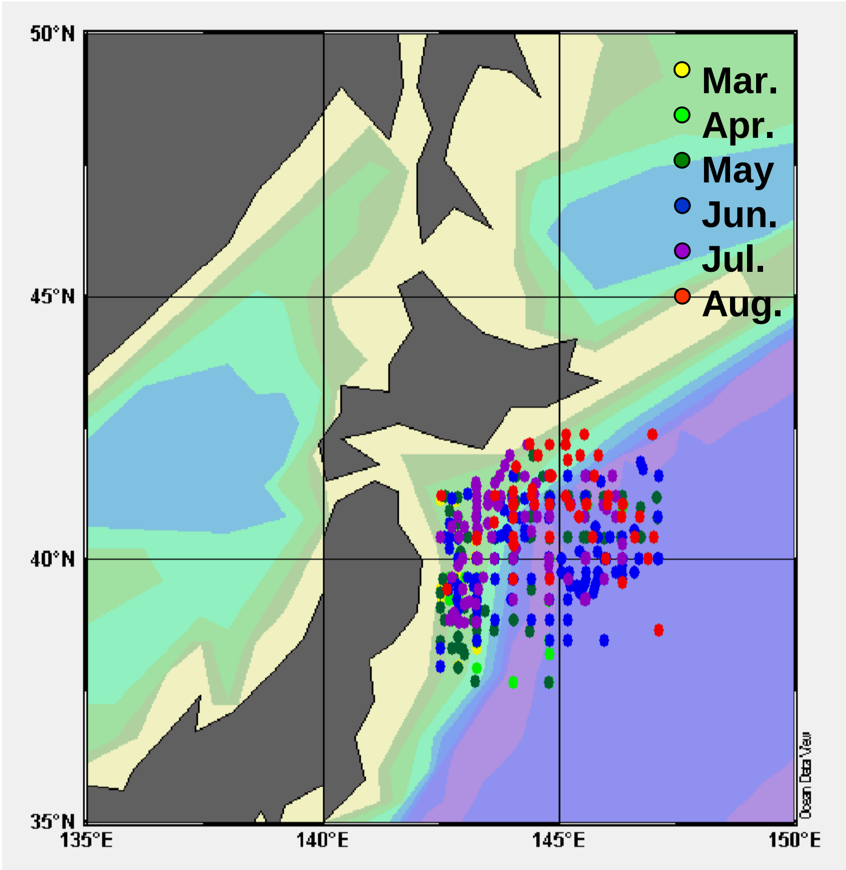
- Criteria for Oyashio
  T< 5C at 100m depth
- Extensive spring bloom
- Efficient BCP function



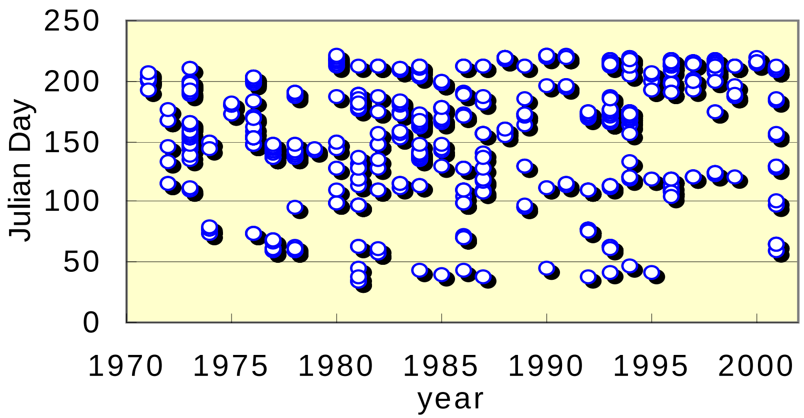
$(\Delta pCO_2)_{bio} = (pCO_2 \text{ at } T_{mean})_{max} - (pCO_2 \text{ at } T_{mean})_{min}$

(Takahashi et al. 2002, DSR II, 49)

Selection of Data

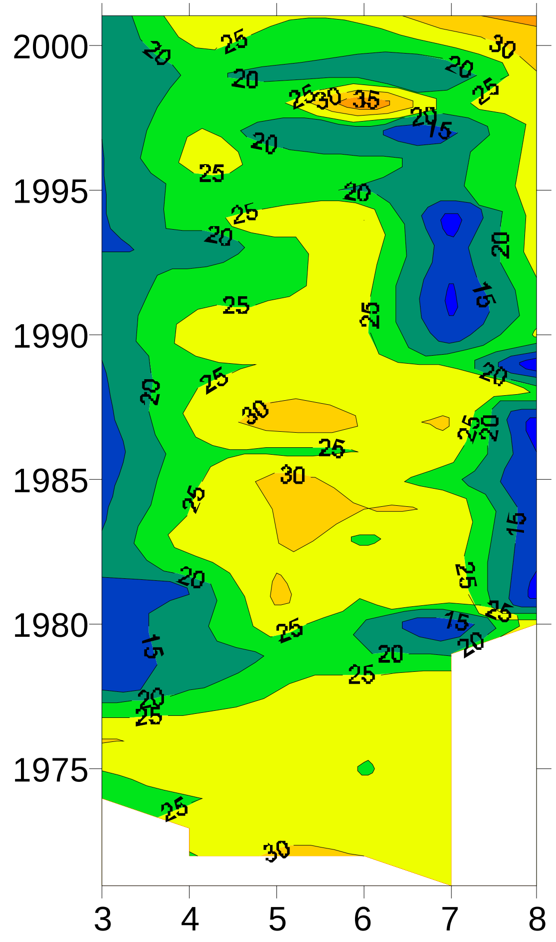


Temporal distibution of Data

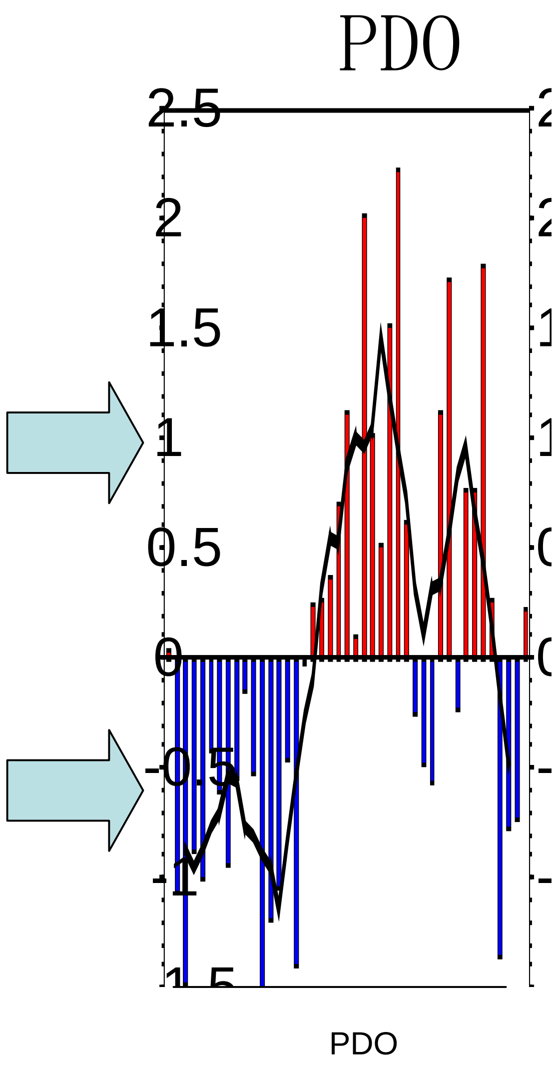


- Target area
  37-43N, 142-147E
  Bottom depth > 500 m
- Year/Season
  1972-2001
  March – August
  (of Feb-Dec from 1960s)
- Number of samples analyzed: 578 (of >1300)
- Number of copepod species observed: 120
- Monthly mean abundance for each year for each species

Regime Shift & Oyashio Copepods



Time series of total copepods abundance [log (inds.m^{-3} + 1)]
March-August, 1972-2001



1998 regime sift?

Spring production: small

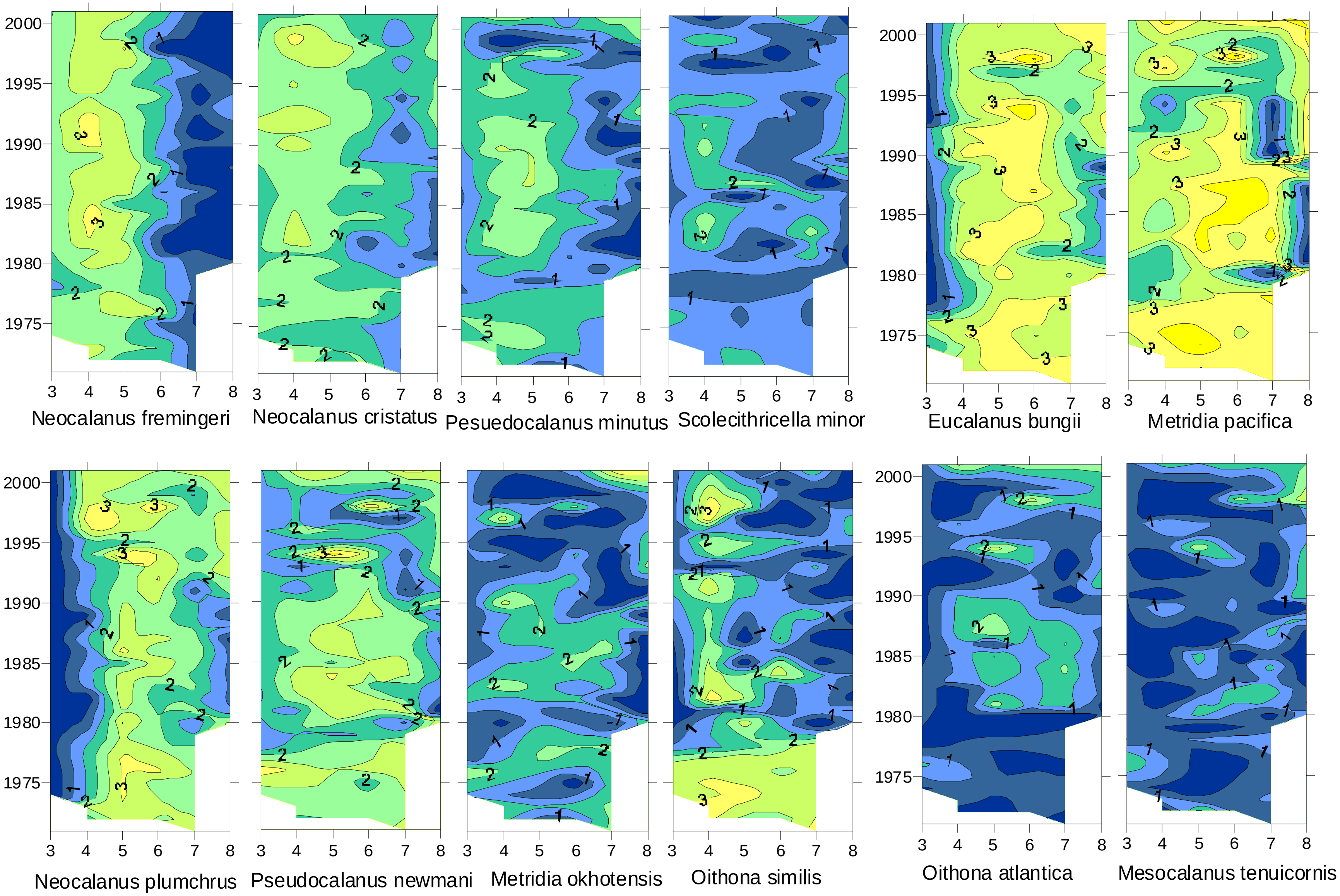
1988/89 regime sift

productive season: short

1976/77 regime sift

productive season: elongated

Time series of abundance of dominant copepod species [inds. 1000 m^{-3})]



Community Analysis: Methods

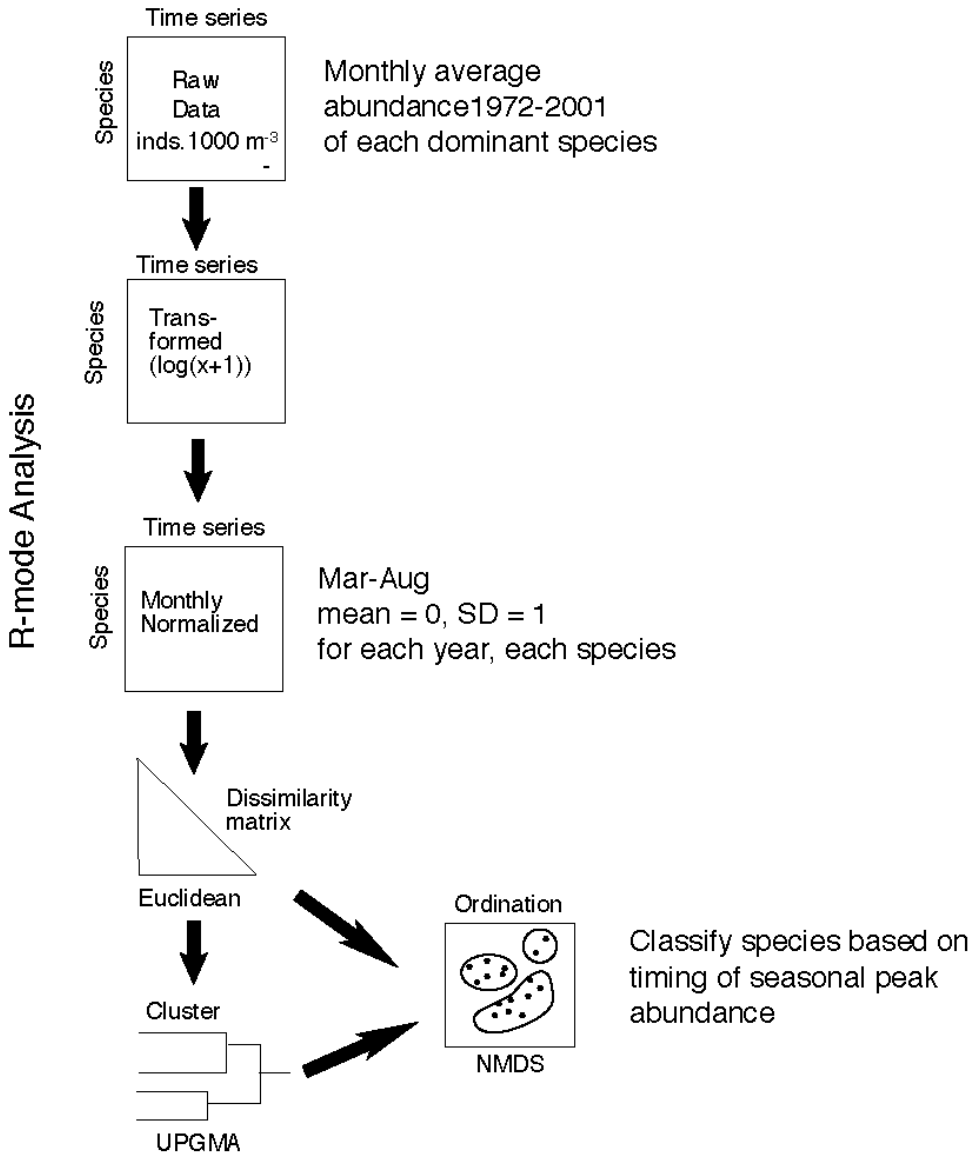
Dominant species list

> 1% abundance at any month

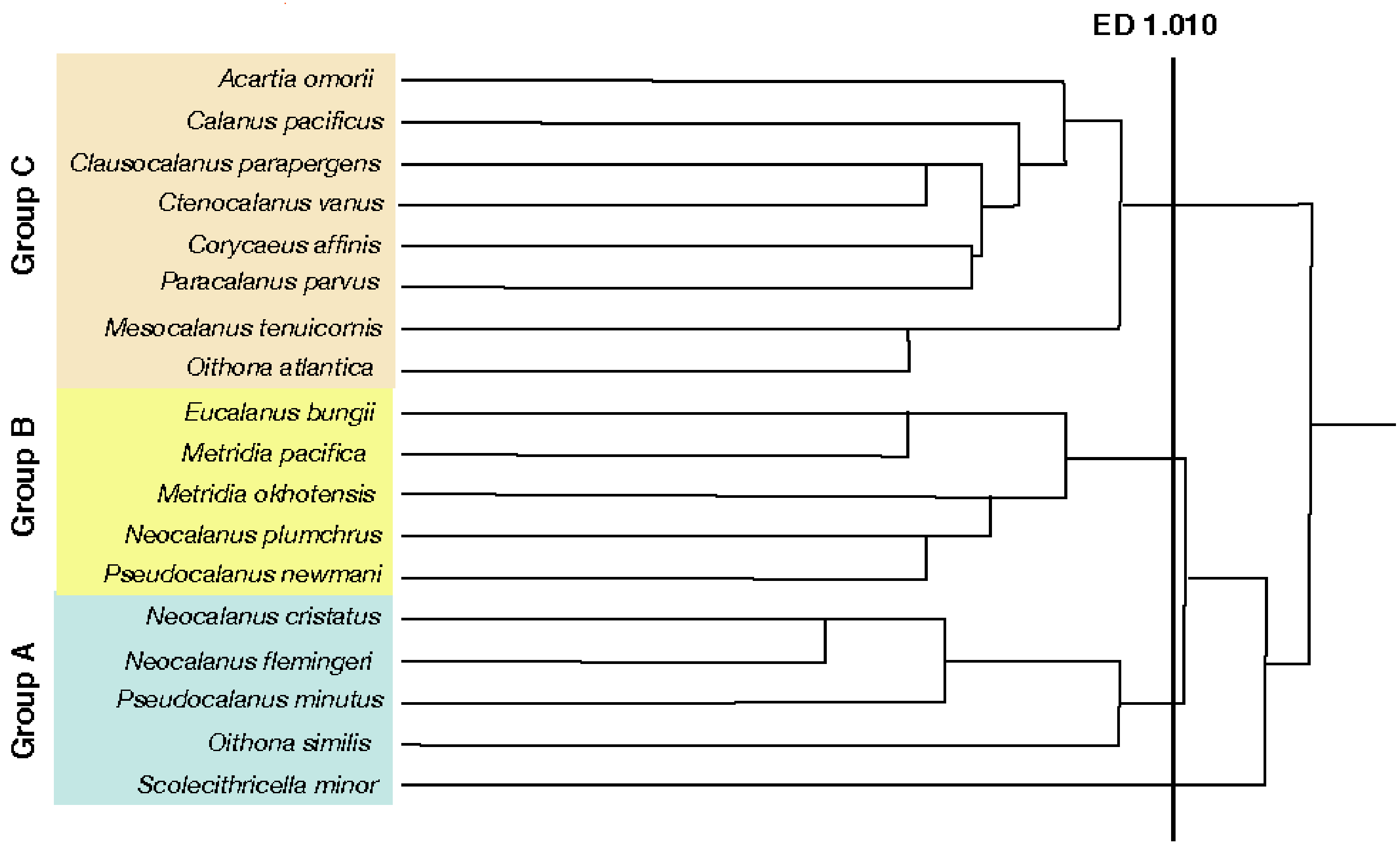
species
Acartia omorii
Calanus pacificus s.l.
Clausocalanus parapergens
Corycaeus affinis
Ctenocalanus vanus
Eucalanus bungii
Mesocalanus tenuicornis
Metridia okhotensis
Metridia pacifica
Neocalanus cristatus
Neocalanus flemingeri
Neocalanus plumchrus
Oithona atlantica
Oithona similis
Paracalanus parvus
Pseudocalanus minutus
Pseudocalanus newmani
Scolecithricella minor

Abundance correction for DVM influence was made

Community classification

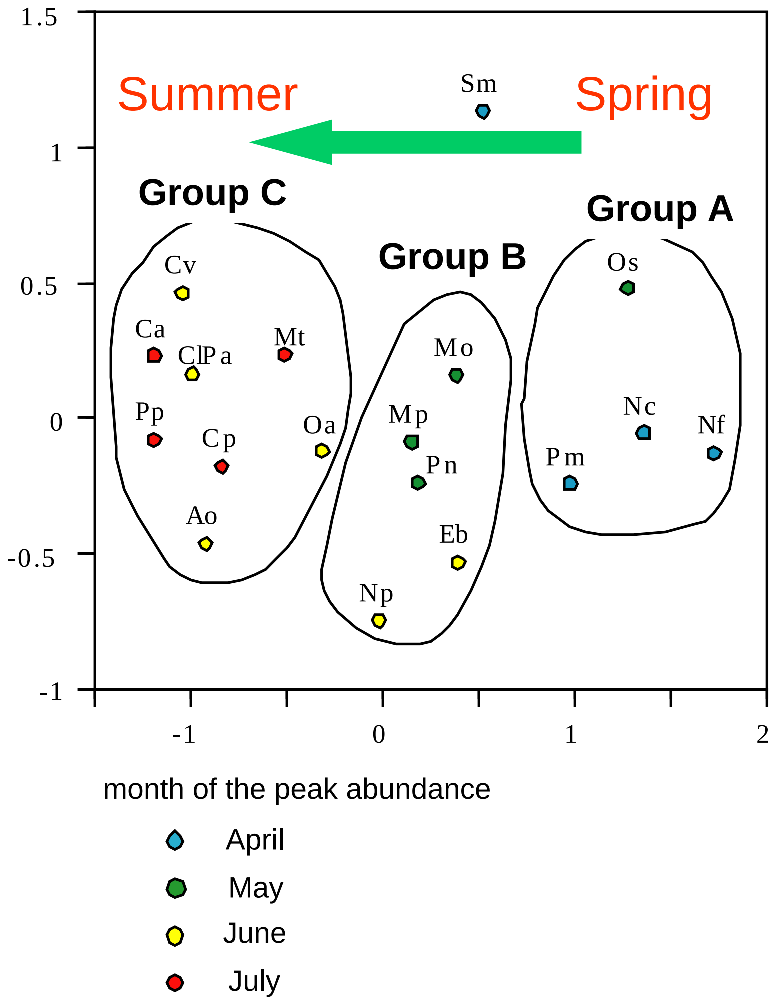


Community Analysis: Results



Cluster Dendrogram

Community Analysis: Results



NMDS ordination plot of copepods cluster groups.

Group	spp. code	species
Group A		
	Pm	*Pseudocalanus minutus*
	Nc	*Neocalanus cristatus*
	Nf	*Neocalanus flemingeri*
	Os	*Oithona similis*
Group B		
	Eb	*Eucalanus bungii*
	Mo	*Metridia okhotensis*
	Mp	*Metridia pacifica*
	Pn	*Pseudocalanus newmani*
	Np	*Neocalanus plumchrus*
Group C		
	Cp	*Calanus pacificus* s.l.
	Mt	*Mesocalanus tenuicornis*
	Oa	*Oithona atlantica*
	Pp	*Paracalanus parvus*
	ClPa	*Clausocalanus parapergens*
	Ca	*Corycaeus affinis*
	Cv	*Ctenocalanus vanus*
	Ao	*Acartia omorii*
Outlier		
	Sm	*Scolecithricella minor*

Species list for each cluster group

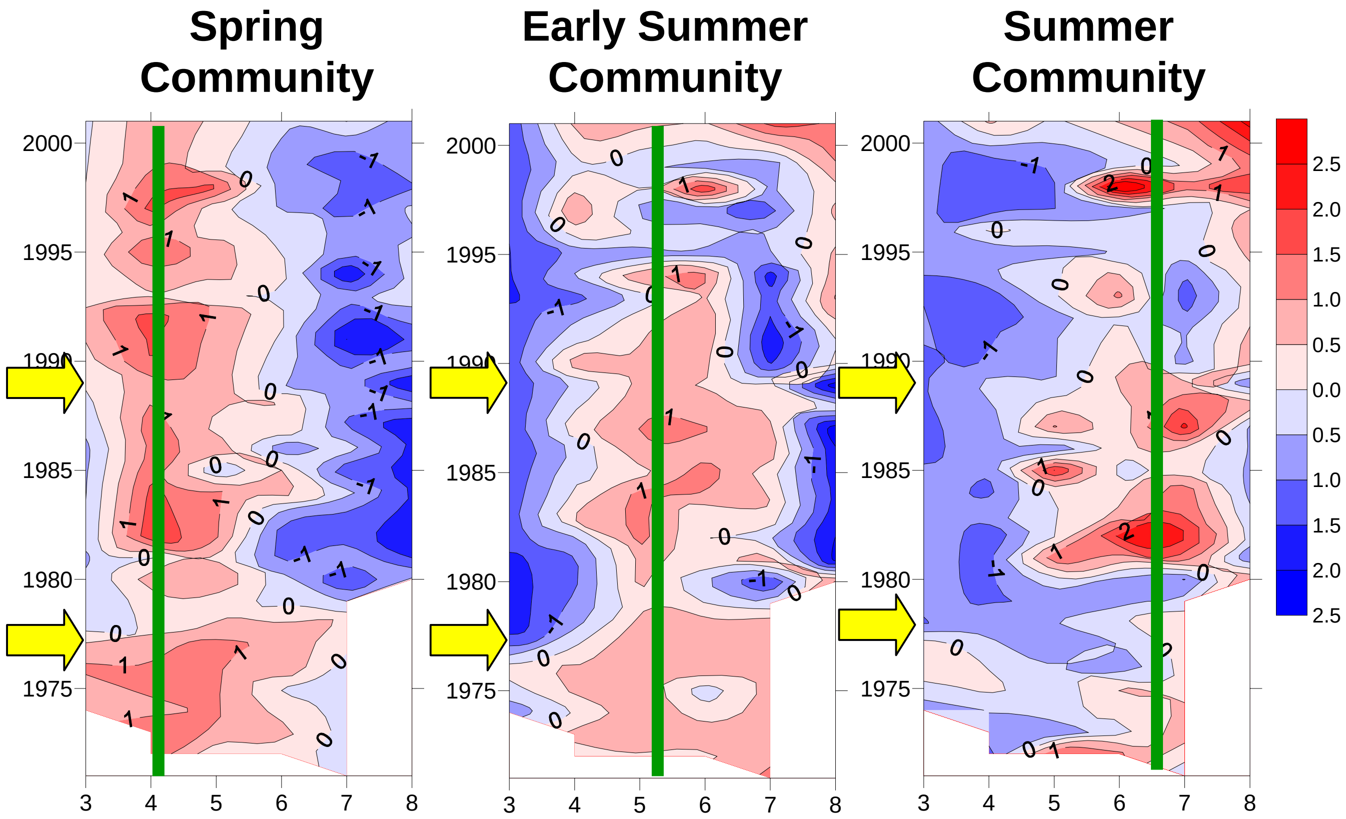
Subarctic species

Temperate species

widely distributed species

by Chihara & Murano (1994)

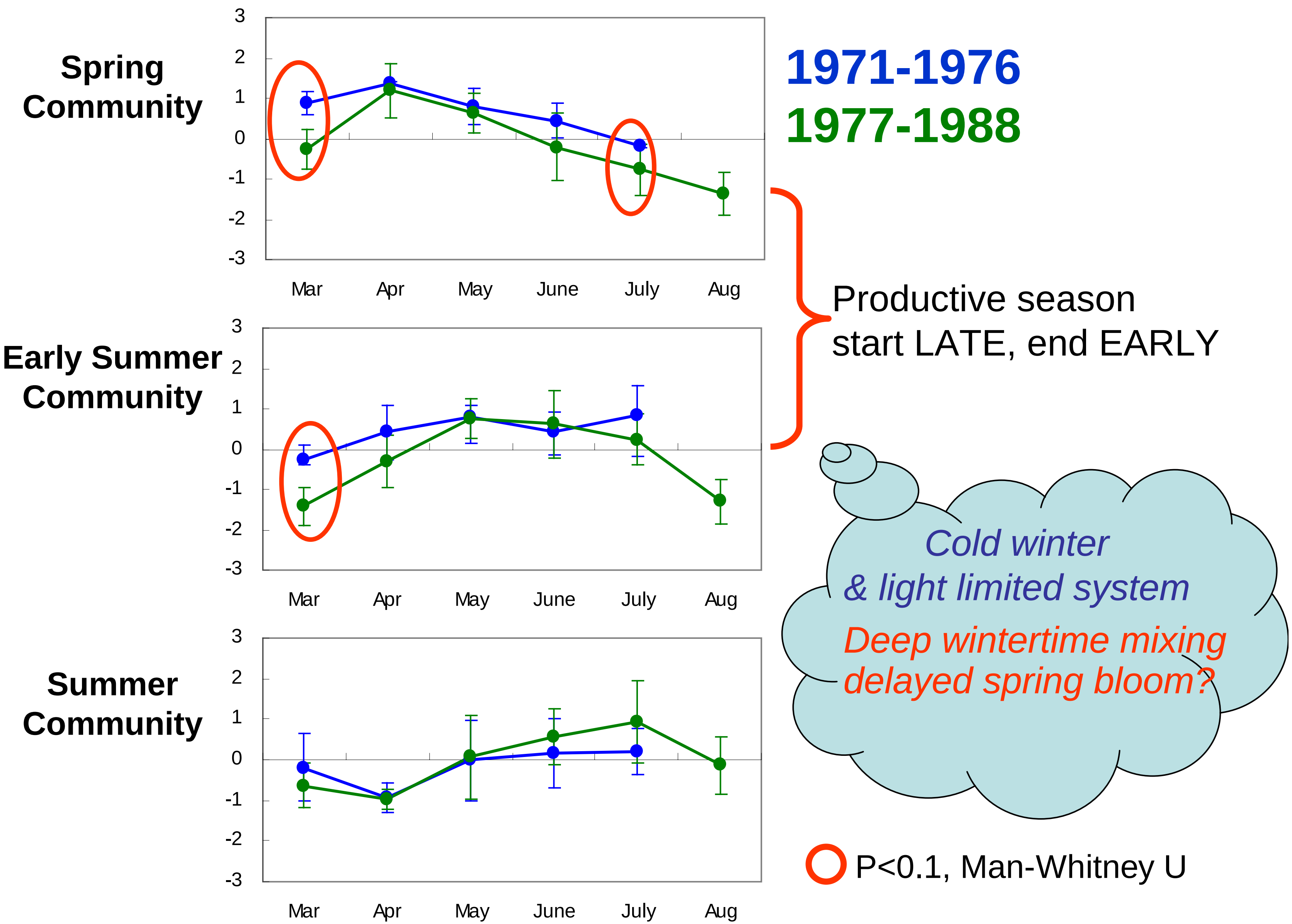
Community Analysis: Results



Time series of normalized anomaly of average copepods abundance [log(inds m^{-3})] for each cluster group (average = 0, SD = 1)

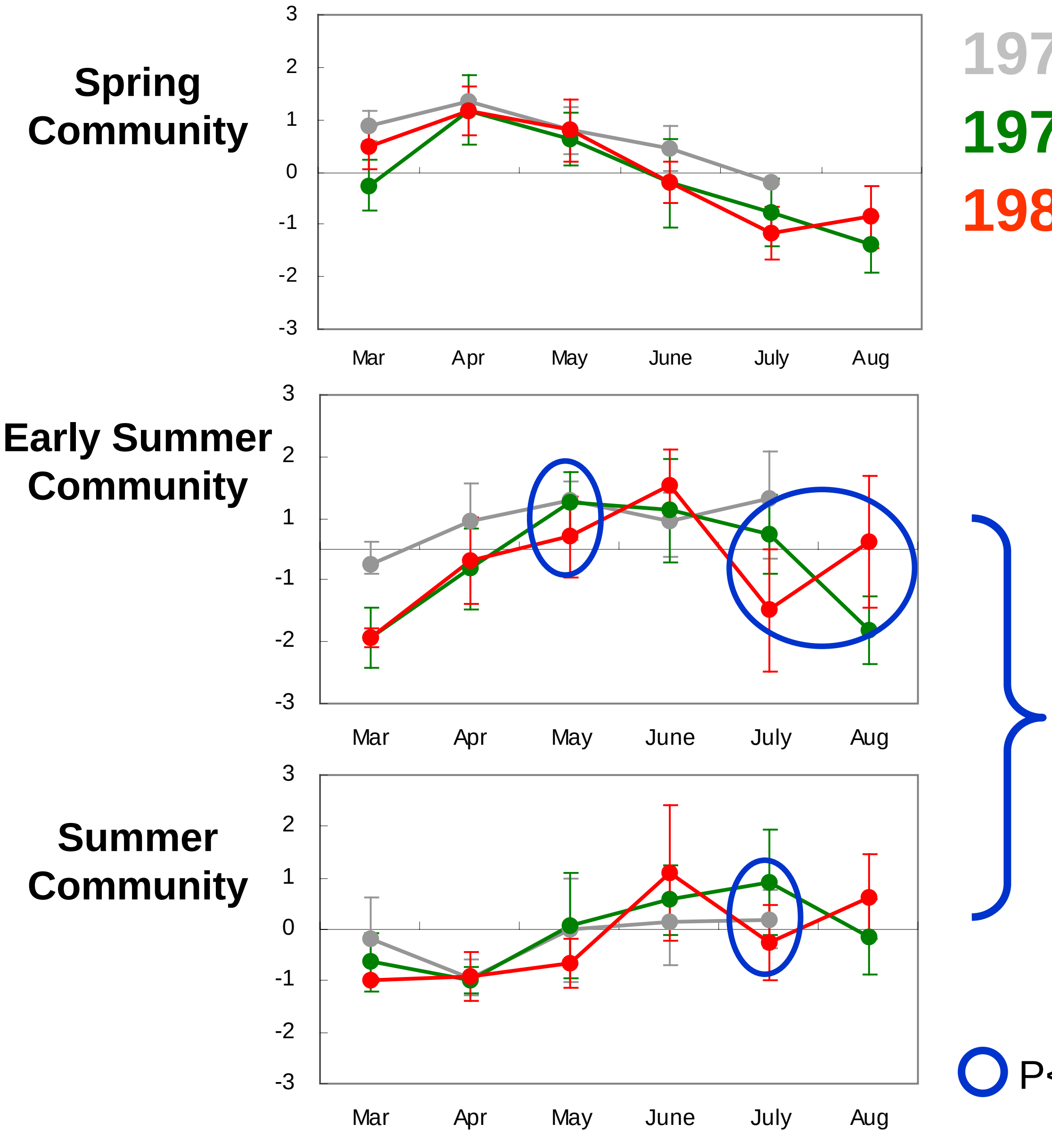
Timing of peak abundance

Mean monthly abundance of community groups



Community Analysis: Results

Mean monthly abundance of community groups



1971-1976
1977-1988
1989-1999

Spring abundance: small

Sporadic abundance increase in summer

P<0.1, Man-Whitney U

Summary

- Copepods community in the Oyashio varied in decadal scale, both in abundance and phonology. Regime shifts related?

- But..community structure differed between the early 1970s and 1990s.
  - Variation was “one-way” (not oscillation)

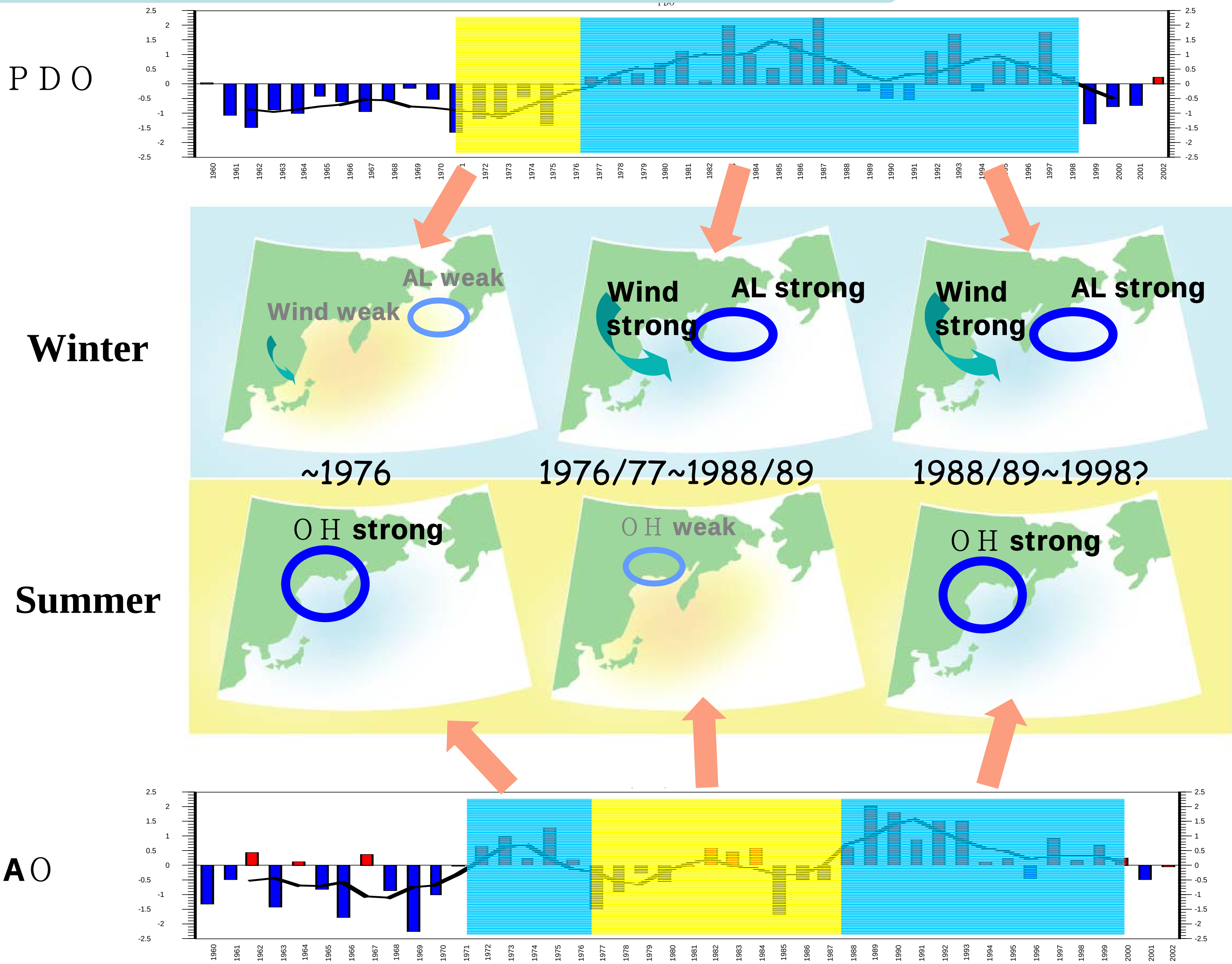
- Decadal scale variation pattern differed among the 3 seasonal communities.
  - Changes in the late 1970s were obvious only in the Spring Community and Early Summer Community: delayed and short productive season.
  - Changes in the late 1980s - early 1990s) were obvious only in the Early Summer Community and Summer Community: low spring production, sporadic abundance increase in summer

- Environmental variation
  from Winter to Spring was responsible for the changes in the late 1970s
  Spring to Summer the late 1980s

Different mechanisms work for decadal scale variation of the lower trophic levels in Winter and Summer


To be continued

Decadal scale variation: winter vs. summer



７．　補足資料

仮説

冬の十年スケール変動と夏の十年スケール変動をもたらす気候変化
とそれに伴うメカニズムは異なるものである

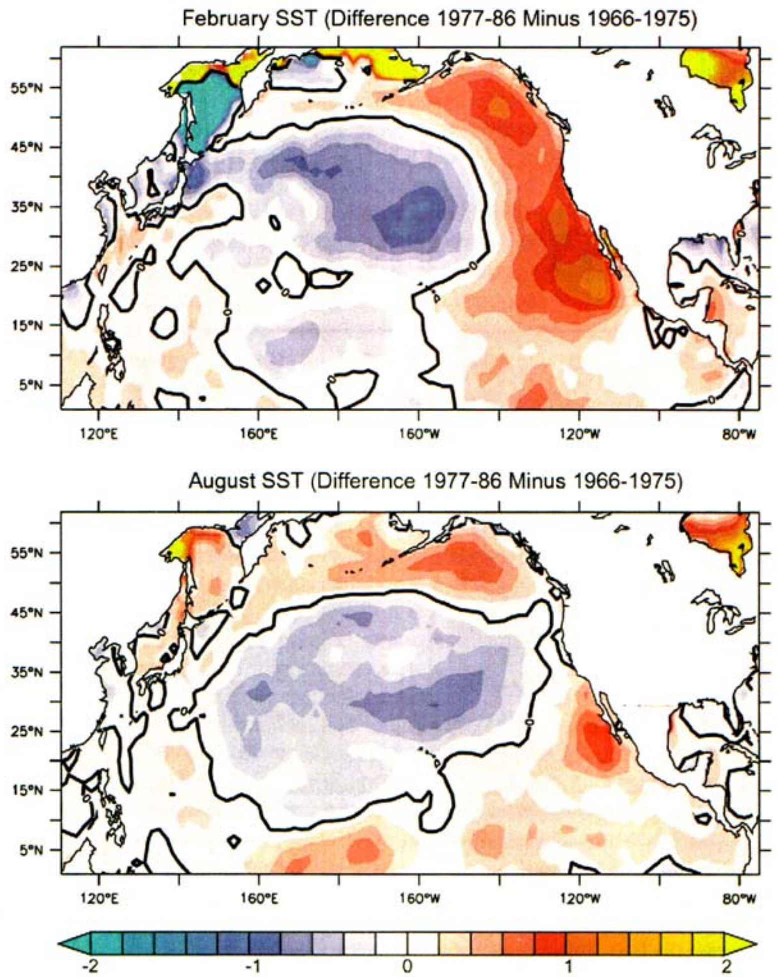
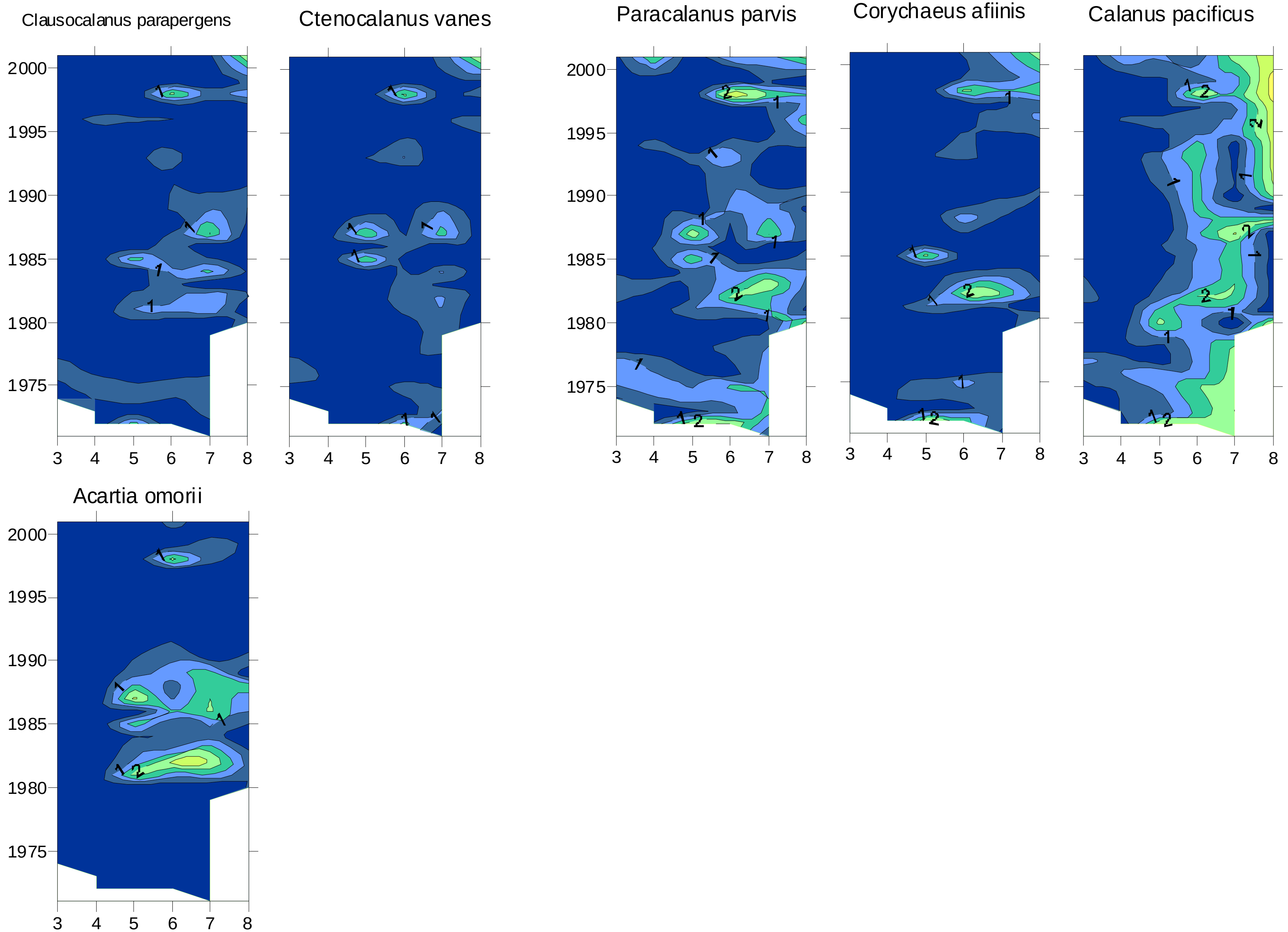


Fig. 2. February (top) and August (bottom) SST differences between 1977–86 and 1966–75. Large positive changes (warmer water in more recent regime are red; cooler water is blue) are widespread along the west coast during winter and summer, with largest differences during winter. (Figure courtesy of Franklin Schwing.)

(Batcheder & Powell, 2000, Prog. Oceanog. 53: 105-114)

Time series of abundance of dominant copepod species [inds. 1000 m^{-3})]



Variation in timing of peak abundance for each cluster group

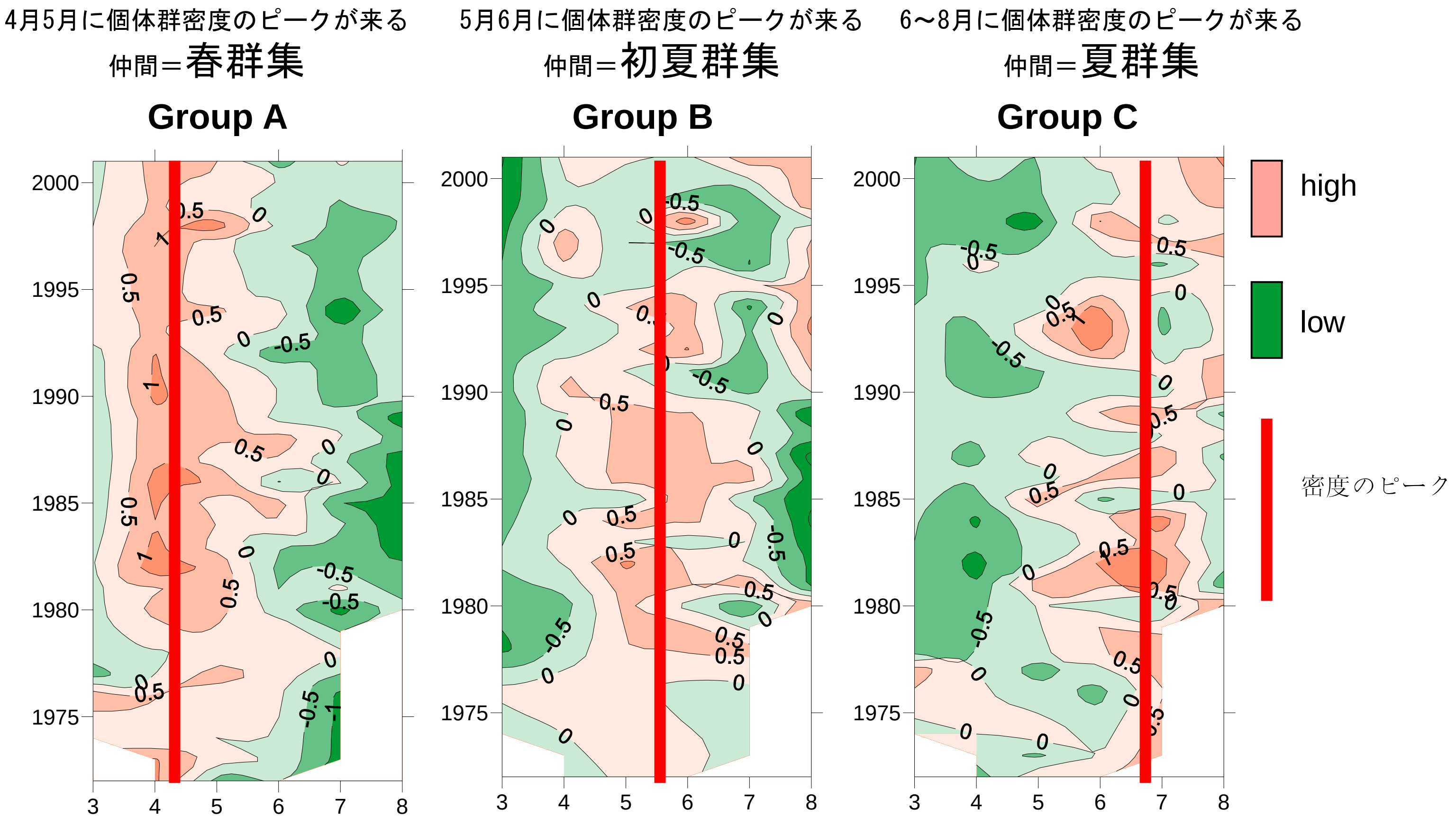


Fig. 10　各カイアシ類群集の月毎に正規化したLog平均密度, 年ごとに3–8月の平均＝０標準偏差が１とした）の時系列（オレンジが正偏差、緑が負偏差）

注）<u>30年間の生物量のピーク時期のずれのみを示している。</u>