

Geographical variation of community structure of bacillariophyceae (diatom) in the western North Pacific Ocean

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Background

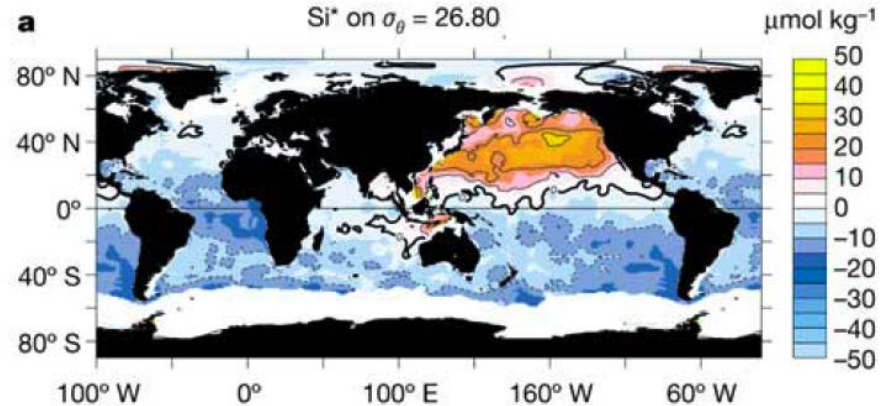
Features of oceanography in the west. North Pacific.

Complex and diverse environment



- Subtropical and subarctic waters exist in narrow latitude band.
- Various scale eddies are formed.
- There is some marginal seas.

High nutrient supply



Sarmiento et al., (2004) Nature

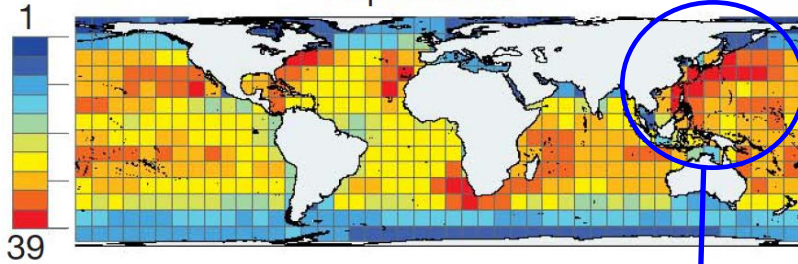
- Terminal area of Deep circulation
- Up ward intrusion to upper layer (ridge domain)
- Supply of amount of nutrient to NPIW

Plankton ecosystem is deeply related to the environment. So it is expect to the complex and diverse plankton ecosystem is formed in the western North pacific.

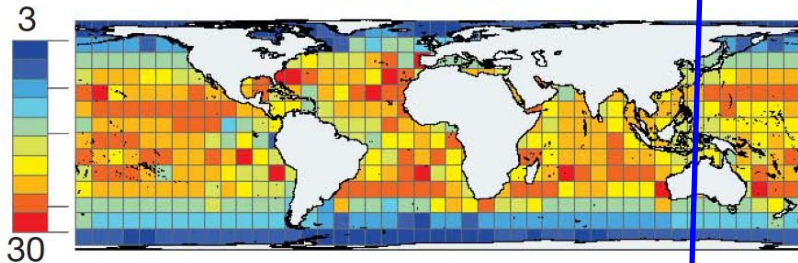
Feature of biodiversity in the Western North Pacific

Biodiversity

Euphausiids

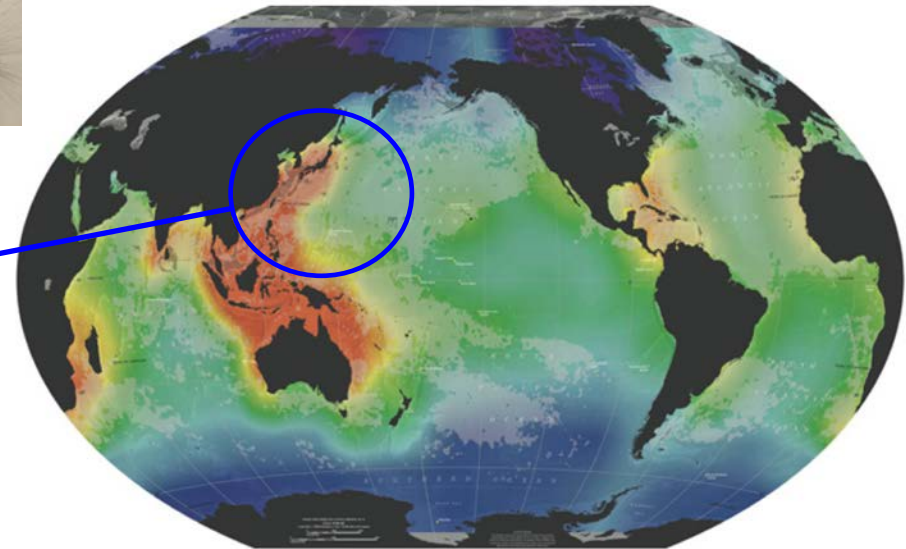


Foraminifera



Tittensor et al., (2010), Nature

Census of Marine Life

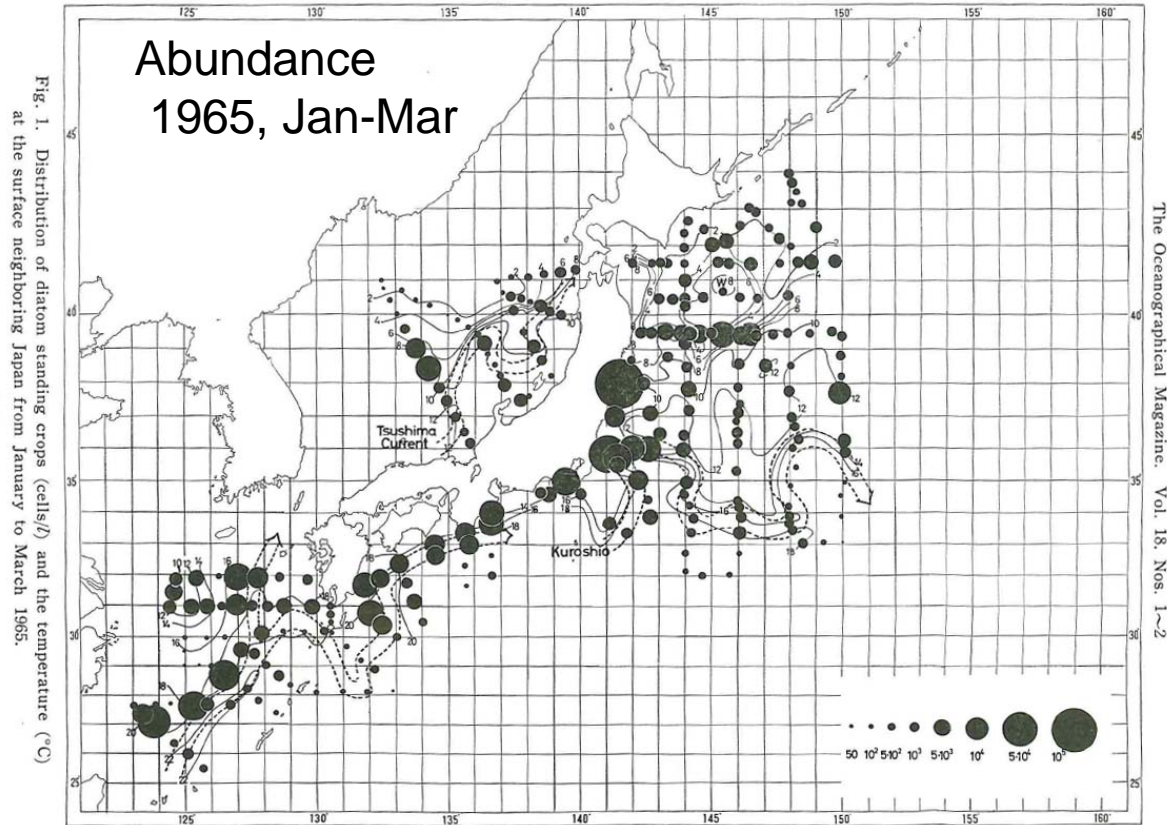


* High biodiversity area

Diatom has not well studied.

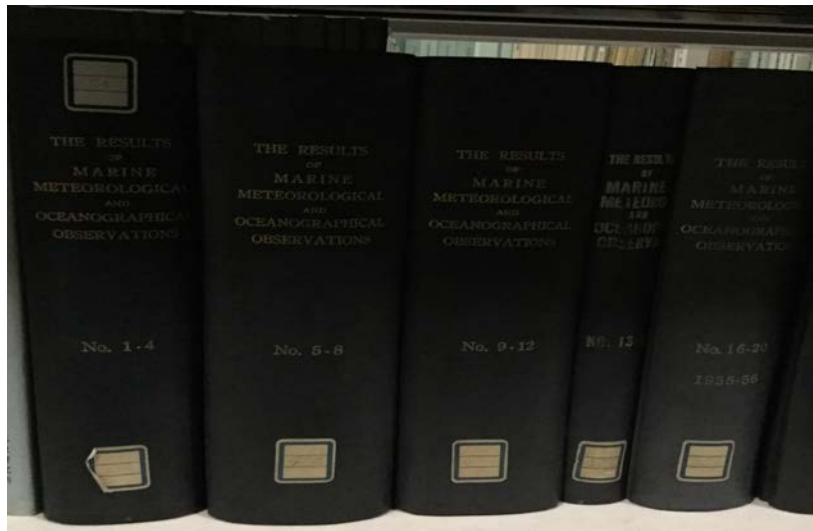
Past Study

Analysis of diatom data by CSK (cooperative study of Kuroshio)



Geographical distribution of diatom abundance was reported by JMA. However, community structure of the diatom has not been studied. So we analyzed the community structure of diatom by using the multivariate analysis.

Data



- Observation of JMA
- We digitized book data.
- Species level abundance
- Period 1949-1992
- Collected at surface (0m)
- Data number is 18032.

↓ raw data

Checking and modified correct species name by WoRMS website



- 271 species appeared.

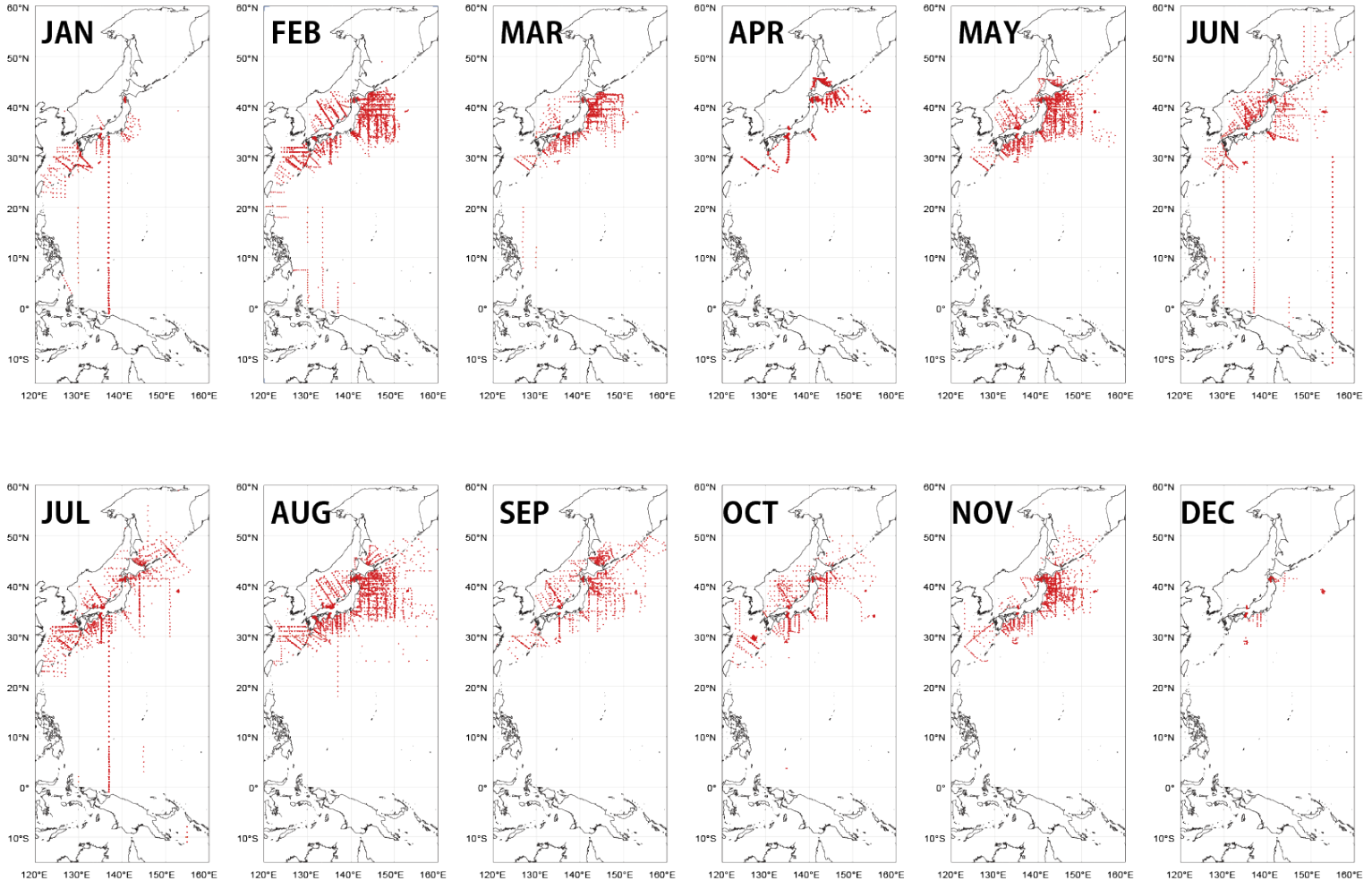
Data were transformed to Darwin Core format.



OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM



Data collecting location for each month

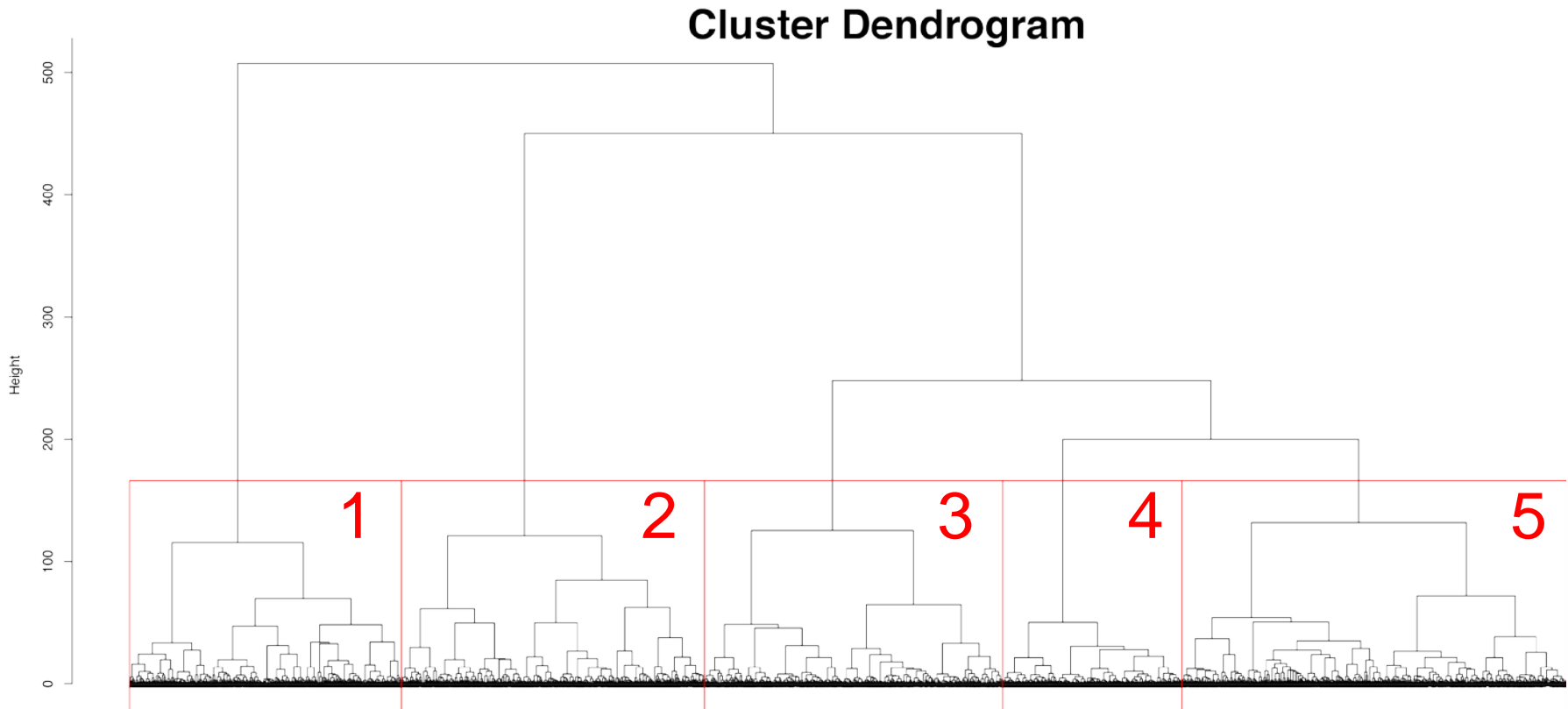


Classification of community structure by cluster analysis

Method

- Species level abundance data for each station (data 18032)
- Logarithm transformed
- Similarity index: Bray-Curtis
- Clustering method: Ward

We classified 5 groups.



Determination of cluster groups for the each grid

We determined the cluster groups by grid
(1 × 1, lat. Long.) and month.

Determination methods is as follows:

Data number is 1 in the grid:

We did not used the grid.

Data number 2:

If all data is grouped same group, we decided the group.





The group were different among 2, we did not used the grid.

Data number 3 and more than 3:

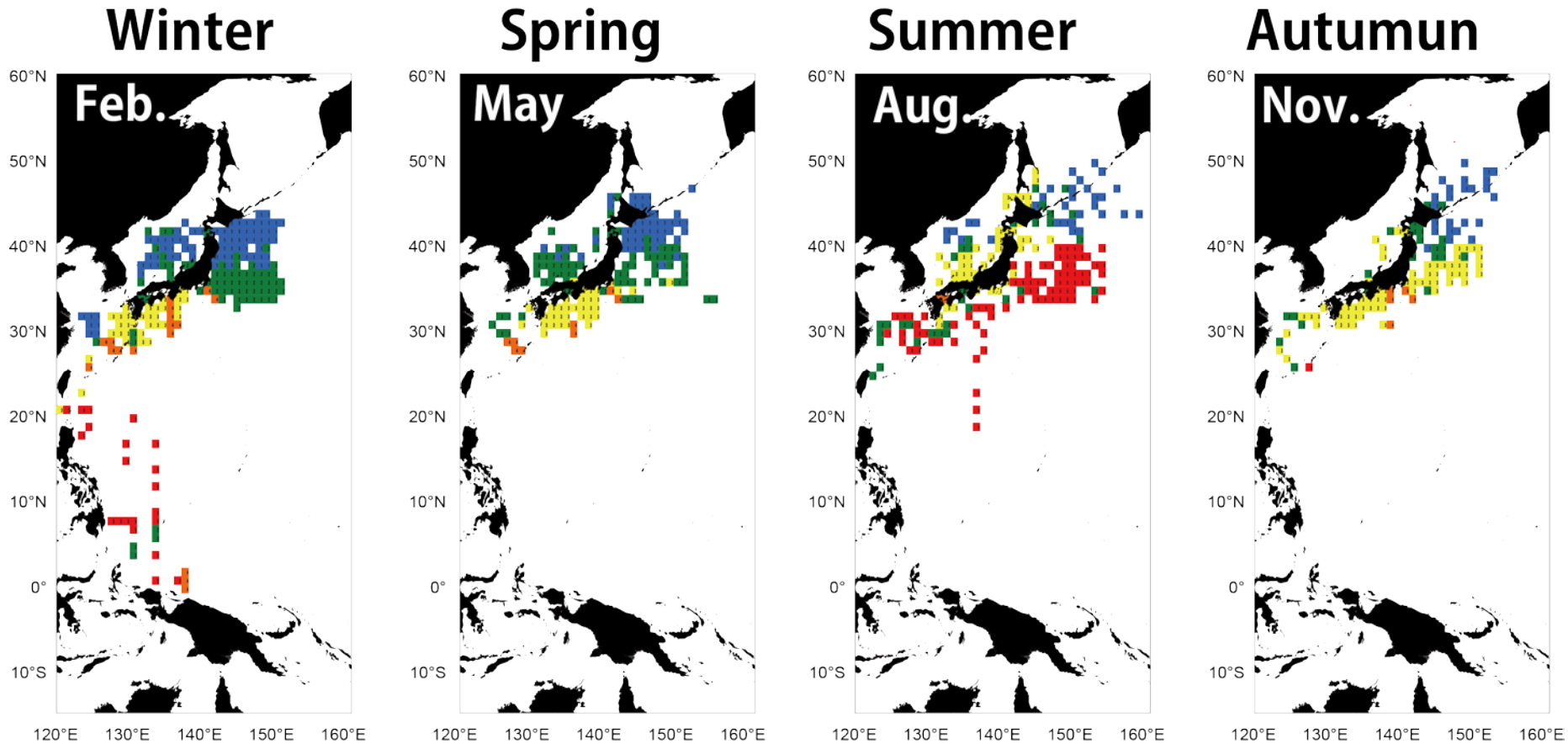
We decided the group more than 50% occupied. If there is no more than 50% specific group, we did not used the grid.

Finally, we selected 10993 data for analysis.

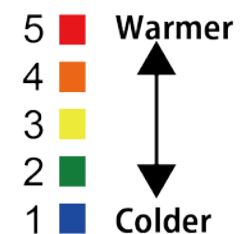
Geographical variation of 5 groups for each month

- Groups 1  to 5  distributed from north (cool) to south (warm).
- Group 1  mainly appeared north of 40N throughout year.
- Group 3  mainly appeared in the coastal area of Japan.

Geographical variation of 5 groups for each seasons



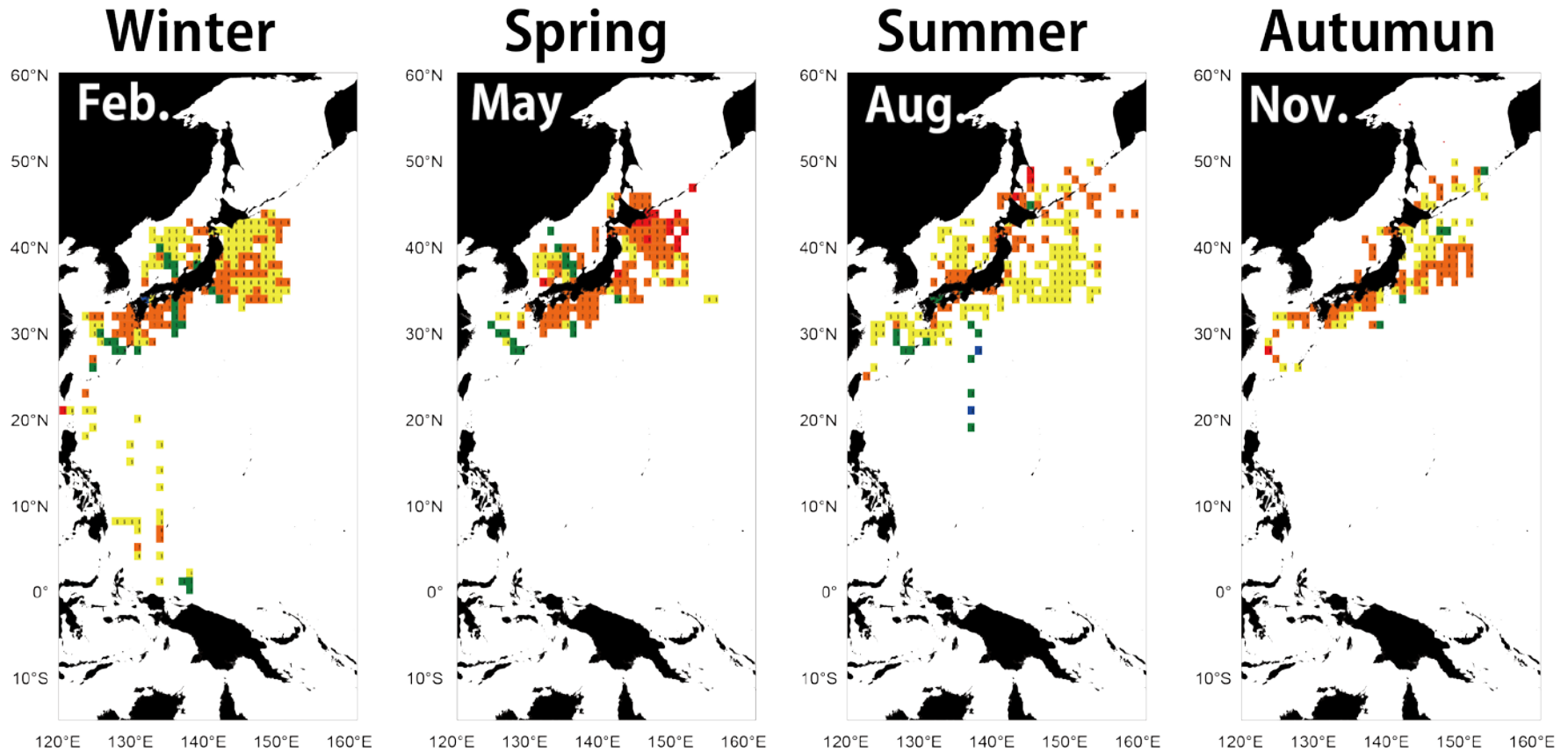
- Group 1 (blue) mainly appeared north of 40°N throughout year.
- Distribution of warmer groups (2 (green) - 5 (red)) represented north ward shift from spring to summer.



Geographical variation abundance of diatom for each month

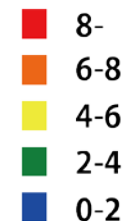
- Abundance is low in the subtropical and tropical area throughout year.
- High Abundance appear in the southern coastal area of Japan in Feb.
- Abundance increase from March to May in the Oyashio region.

Abundance of diatom for each Season



- High Abundance appear in the southern coastal area of Japan in four seasons except with summer.
- Abundance increase in spring in the Oyashio region.
- Abundance decreased during summer in the almost waters.

Abundancen (log N m⁻³)

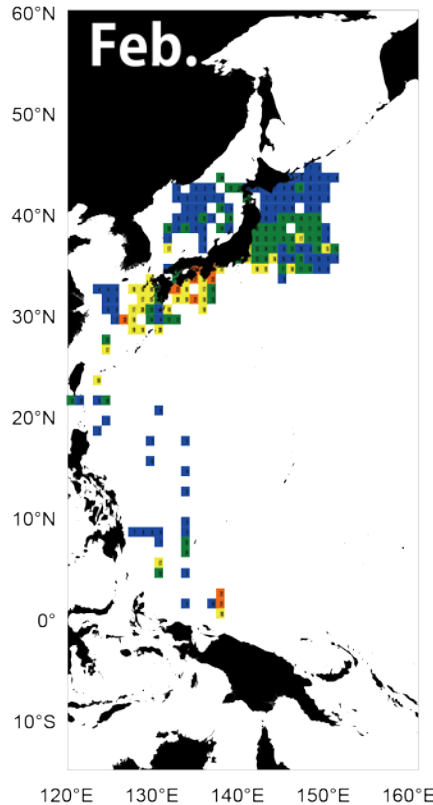


Species No. (biodiversity) for each month

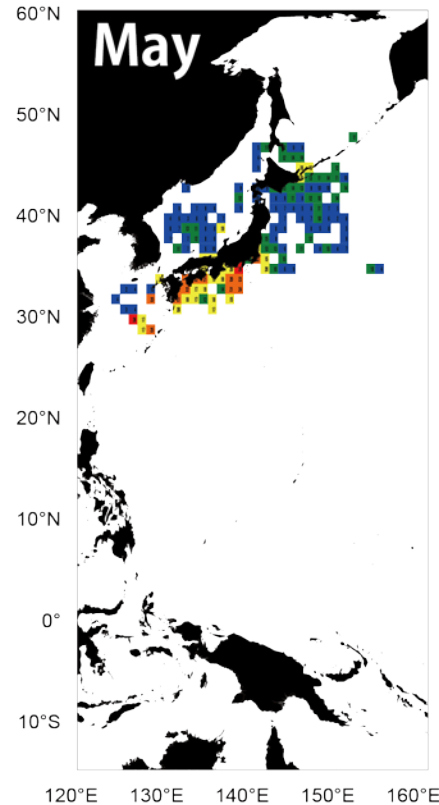
- Species No. is relatively low in the Oyashio waters throughout year.
- High species number appear in the southern coastal area of Japan throughout year except with summer.
- Species No. decreased in summer around Japan.
- Species No. increased from Oct. around Japan.

Species No. (biodiversity) for each season

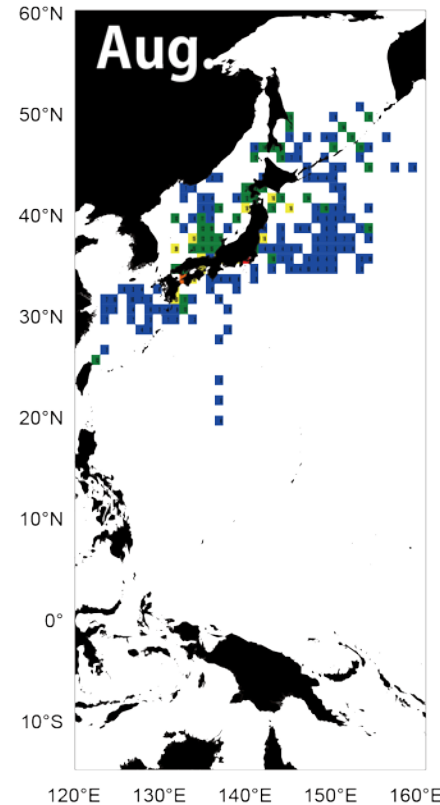
Winter



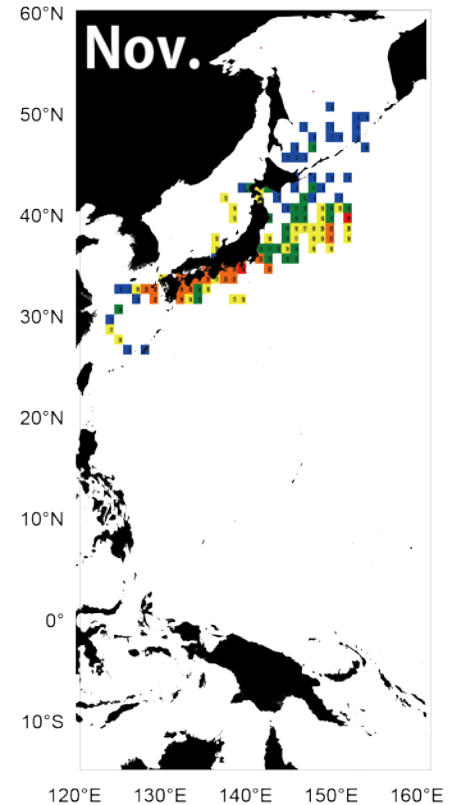
Spring



Summer

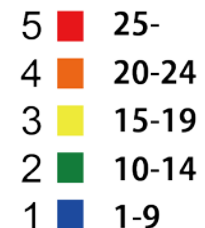


Autumun



- Species No. is relatively low in the Oyashio waters throughout year.
- High species number appear in the southern coastal area of Japan throughout year except with summer.
- Species No. decreased in summer around Japan.
- Species No. increased in autumn around Japan.

Average species No.



Top 5 species for each cluster groups

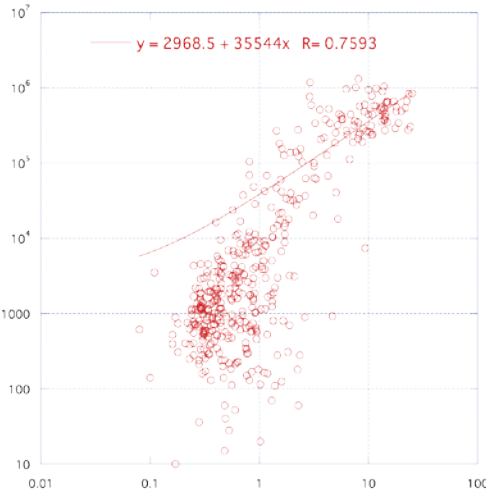
Cluster 1 (Colder)		Cluster 2		Cluster 3	
	%		%		%
1 <i>Chaetoceros debilis</i>	32	1 <i>Skeletonema costatum</i>	48	1 <i>Skeletonema costatum</i>	22
2 <i>Thalassiosira nordenskioldii</i>	23	2 <i>Chaetoceros compressus</i>	11	2 <i>Chaetoceros compressus</i>	13
3 <i>Chaetoceros socialis</i>	15	3 <i>Eucampia zodiacus</i>	5	3 <i>Cerataulina pelagica</i>	8
4 <i>Fragilariopsis oceanica</i>	11	4 <i>Chaetoceros debilis</i>	4	4 <i>Leptocylindrus minimus</i>	7
5 <i>Chaetoceros compressus</i>	5	5 <i>Pseudo-nitzschia seriata</i>	4	5 <i>Chaetoceros socialis</i>	5
Total N (cell N L-1)	138991	Total N (cell N L-1)	31870	Total N (cell N L-1)	49665

Cluster 4		Cluster 5 (Warmer)	
	%		%
1 <i>Pseudo-nitzschia delicatissima</i>	18	1 <i>Skeletonema costatum</i>	40
2 <i>Eucampia zodiacus</i>	9	2 <i>Rhizosolenia calcar-avis</i>	11
3 <i>Guinardia striata</i>	7	3 <i>Climacodium biconcavum</i>	6
4 <i>Skeletonema costatum</i>	7	4 <i>Rhizosolenia styliformis</i>	6
5 <i>Leptocylindrus mediterraneus</i>	5	5 <i>Leptocylindrus mediterraneus</i>	4
Total N (cell N L-1)	28	Total N (cell N L-1)	73

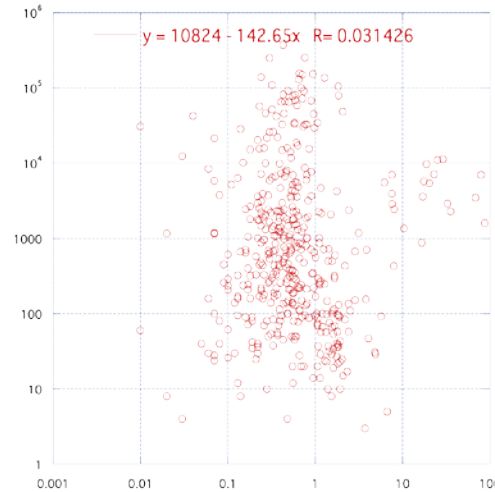
- *Chaetoceros debilis* is important for northern areas, on the other hand *Skeletonema costatum* is important for southern Areas.
- Abundance of diatom is highest in group1 and lowest in group 4. More than 4000 times higher in group 1 than group 4.

Abundance and Chl-a relationship for each group

Cluster 1



Cluster 2



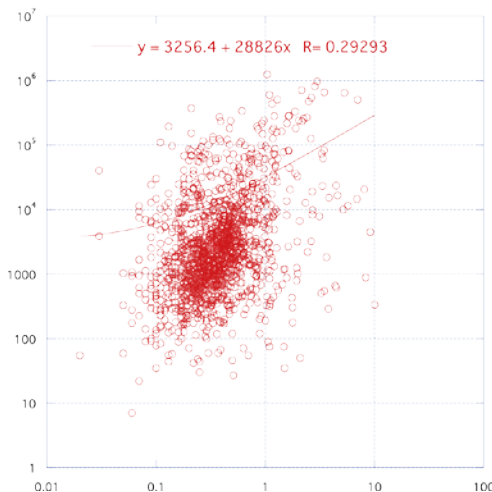
• Diatom abundance represented high correlation coefficient for group 1.

This suggest that the diatom is important in the phytoplankton community in this area.

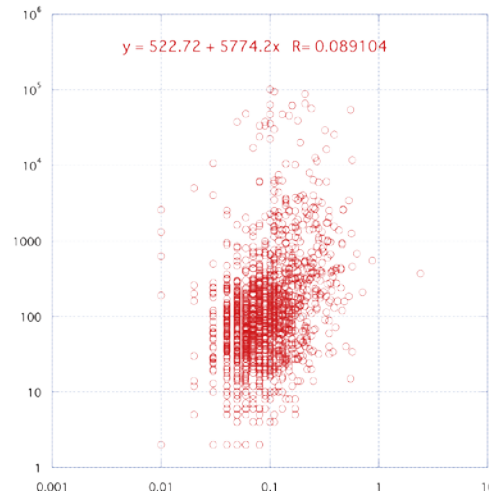
• Diatom abundance did not have significant correlation coefficient for group 2 and 5.

This suggest that the diatom is not important in the phytoplankton community in this area.

Cluster 4



Cluster 5



Chl (µg/l)

Summary

- 1 We classified 5 groups of diatom community.
- 2 Groups 1 to 5 distributed from north (cool) to south (warm).
- 3 Group 1 mainly distributed north of 40° N.
- 4 Distribution of warmer groups of 2-5 represented north ward shift from spring to summer.
- 5 Abundance of diatom is highest in group1 and lowest in group 4.
- 6 Group 1 abundance represented high correlation coefficient with Chl-a. On the other hand abundance of group 2 and 4 did not represented significant relationship.
- 7 Next step, we will try to clarify the mechanism of the geographical variation of community structure of diatom by using environmental data.