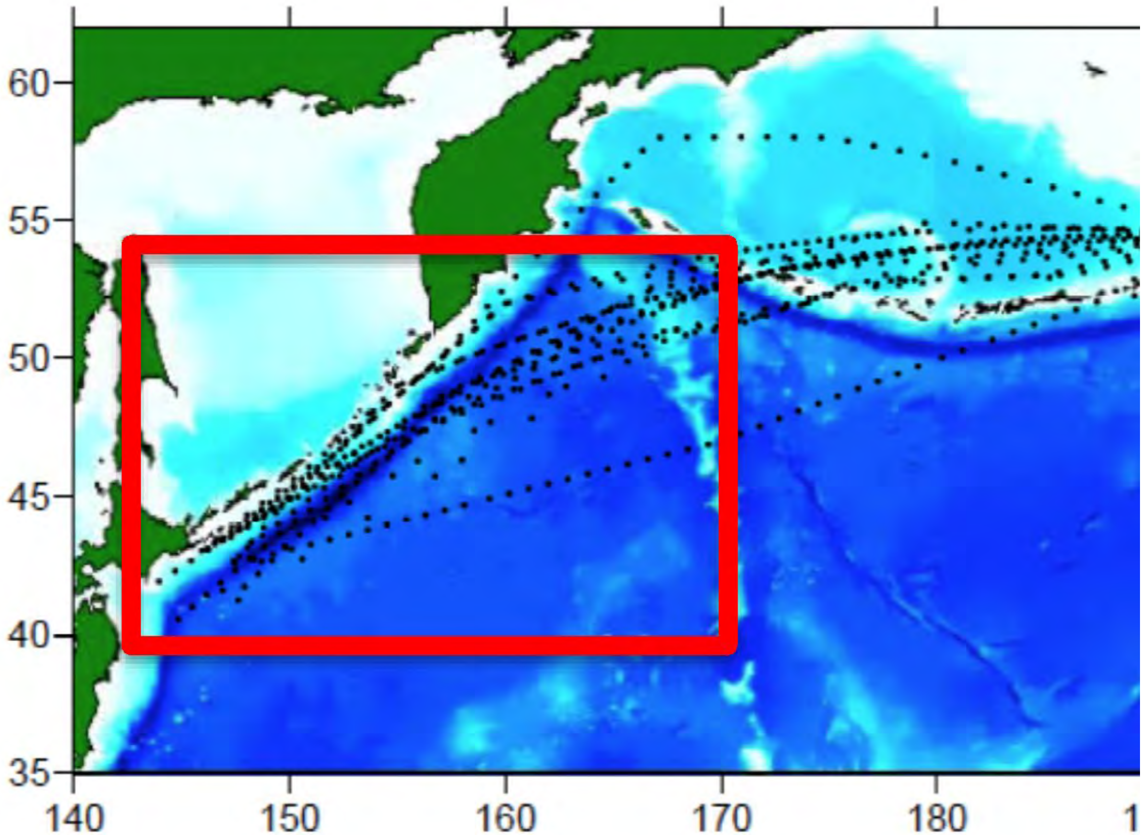
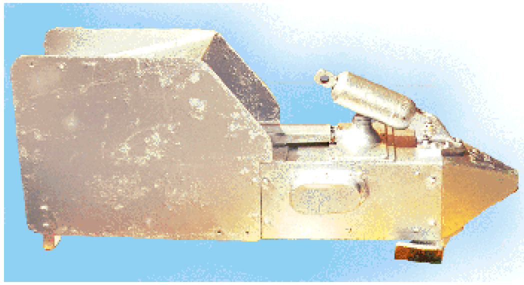
2019 PICES Annual Meeting
CPR WS, Oct 18th, 2019

Japanese Contribution to North Pacific CPR Survey





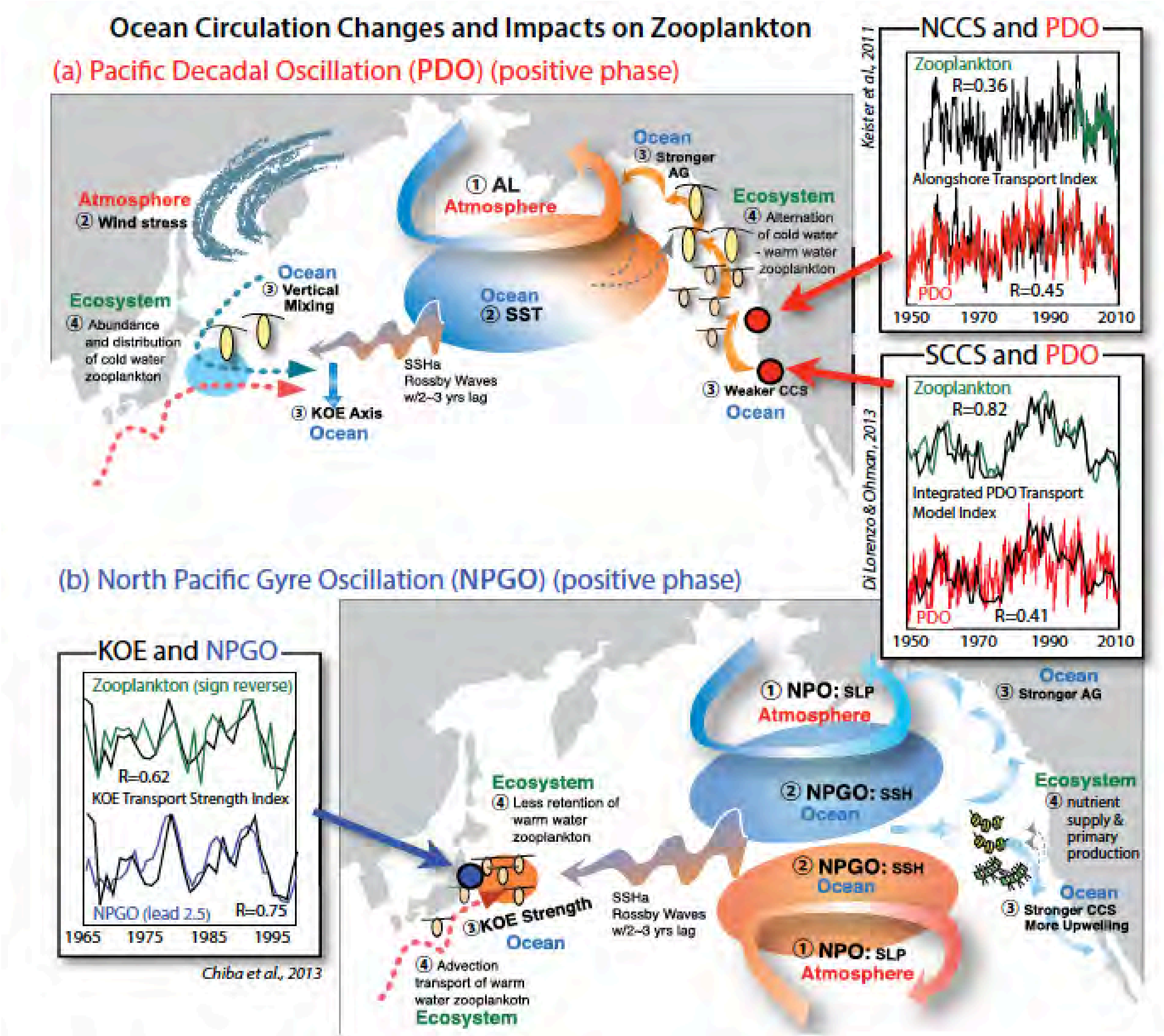
- Joined in 2009
- VJ line (west of 170E)
- Oyashio region & WNP subarctic gyre
- sample analized for 2000 - 2016

GACS
GLOBAL ALLIANCE OF CONTINUOUS PLANKTON RECORDER SURVEYS

Sanae Chiba
JAMSTEC

JAMSTEC
CONTINUOUS PLANKTON RECORDER SURVEY
SAHFOS
FRA
Fisheries Research Agency

ENP – WNP Comparison of Long-term LTL Ecosystem Change



(Di Lorenzo et al., 2013)

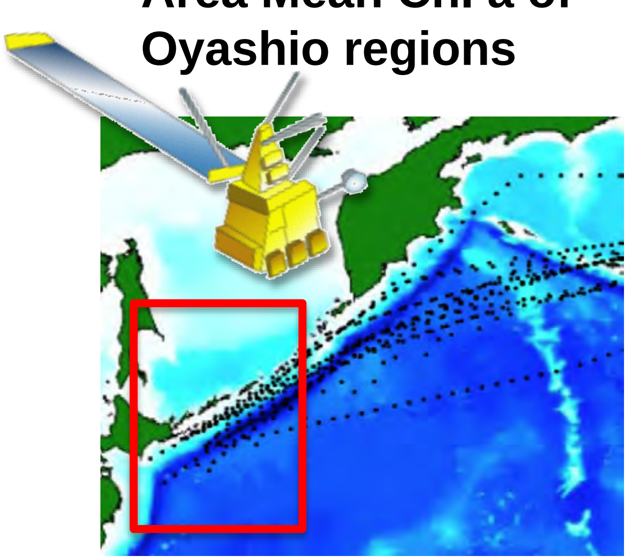
OUTCOMES

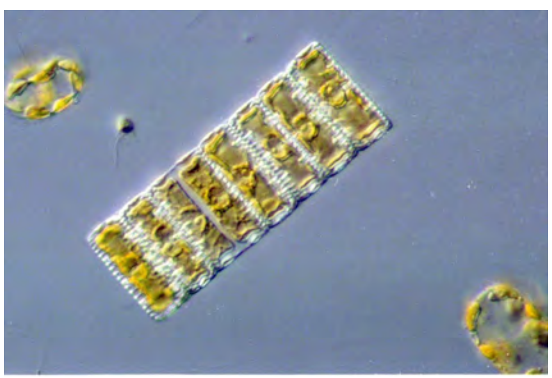
1.
Phytoplankton phenolgy and composition change & PDO
(Chiba et al., GRL 2012)

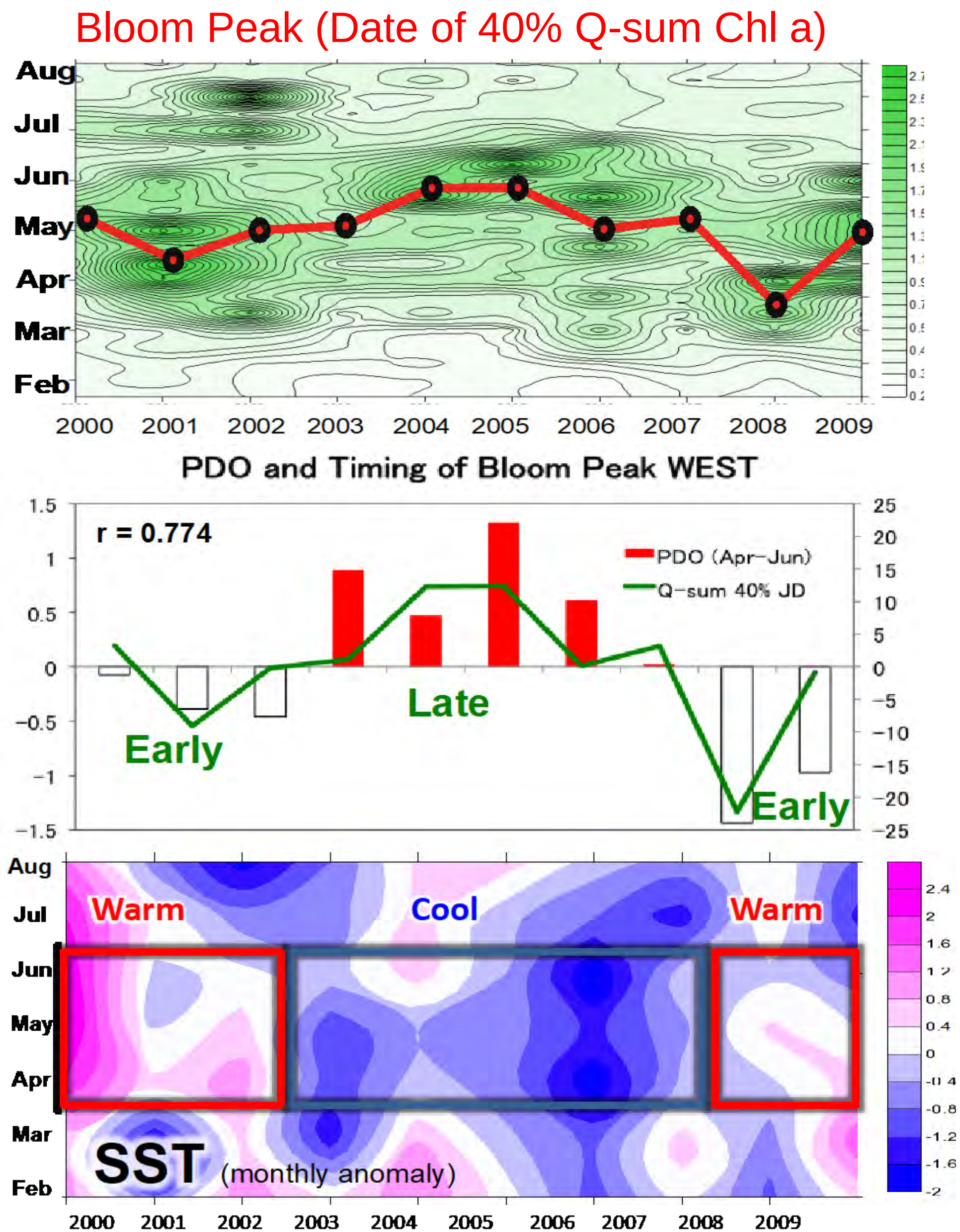
2.
East-West comparison of Zooplankton community changes (Chiba et al. 2015)

Phytoplankton Phenology and PDO (Satellite Obs)

Area Mean Chl a of Oyashio regions





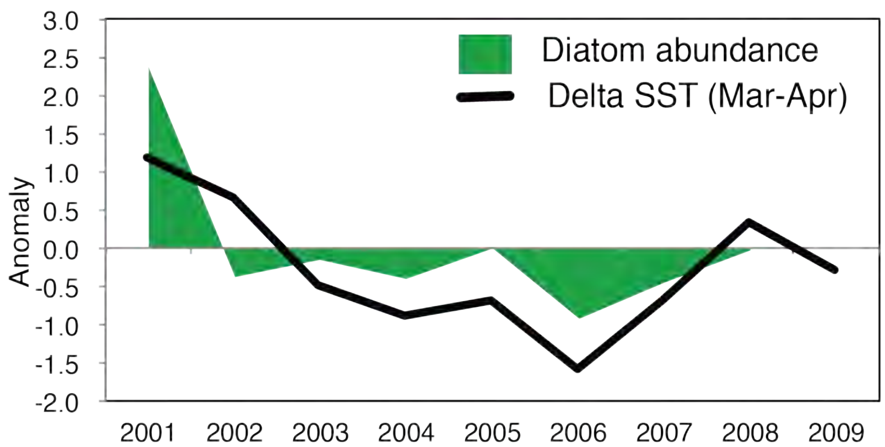


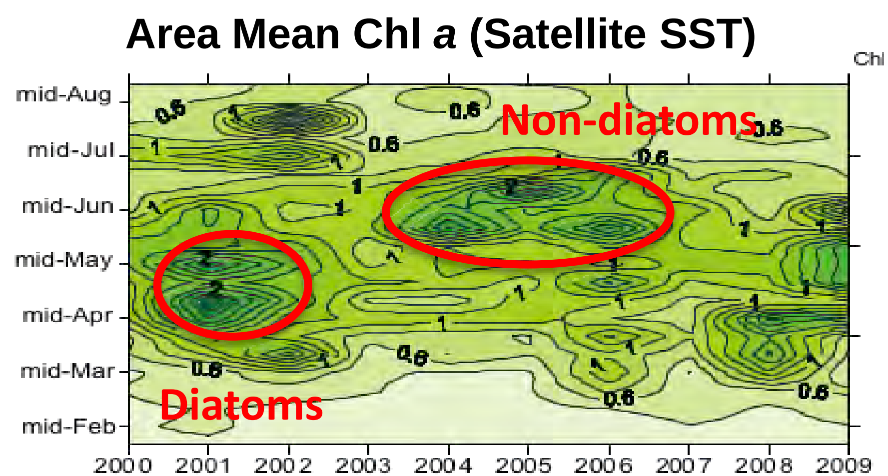
(Chiba et al. 2012, GRL)

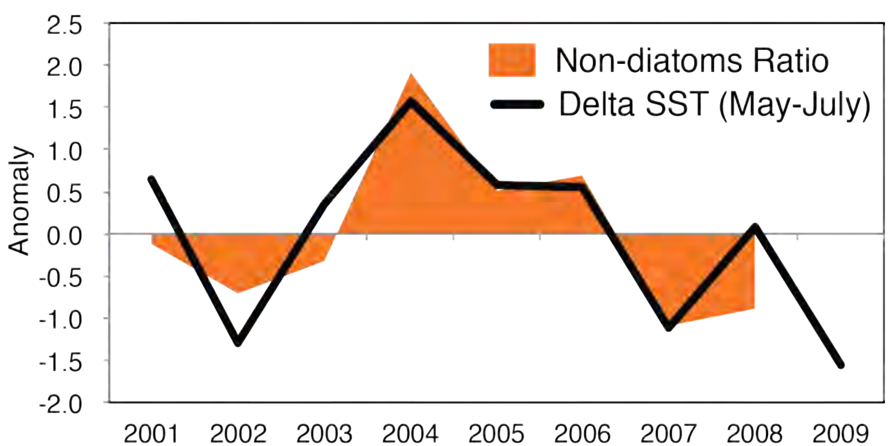
Change in Phytoplankton Community (CPR)

PP community changed responding to extent of seasonal warming (and ML shoaling) rather than SST value at a time

Rapid warming (and quick stratification) in early spring benefits Diatoms and that in summer benefits Dinoflagellates







IMPLICATION

To better predict phytoplankton response to future climate change, not only change in interannual/ seasonal C-W cycle, but change in seasonal ML process must be understand

OUTCOMES

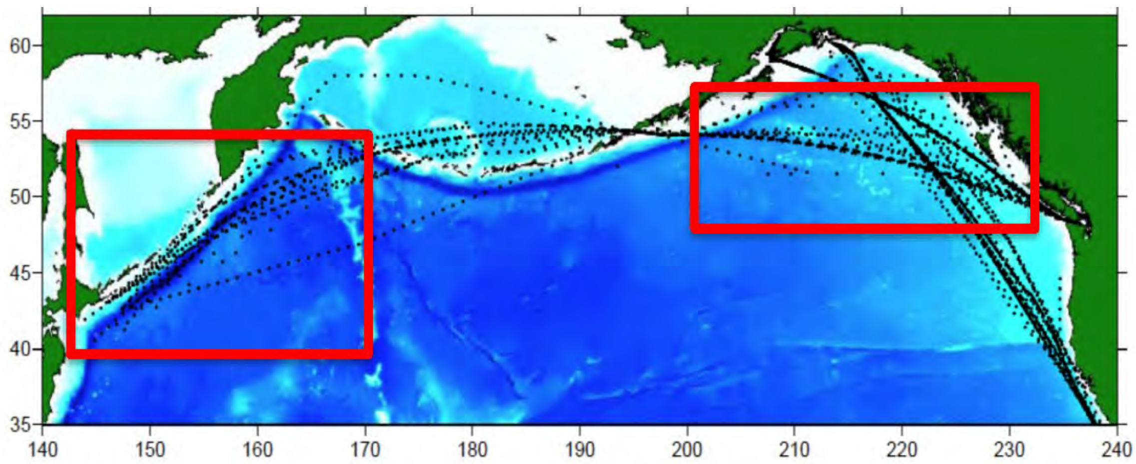
1.

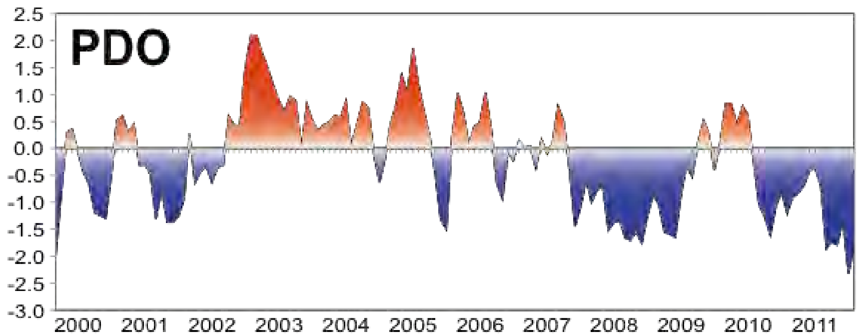
Phytoplankton phenolgy and composition change & PDO
(Chiba et al., GRL 2012)

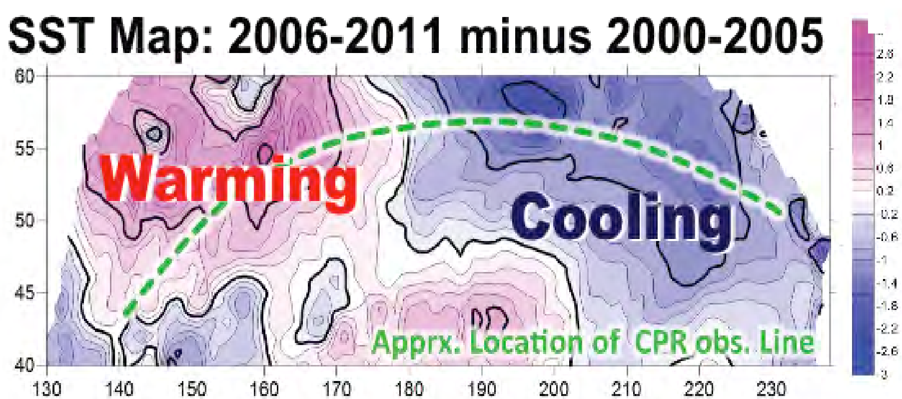
2.

East-West comparison of Zooplankton community changes (Chiba et al. 2015)

East-West Comparison of Zooplankton Community Changes

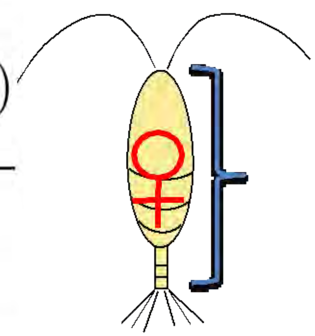






Copepod Community Size (CCS)

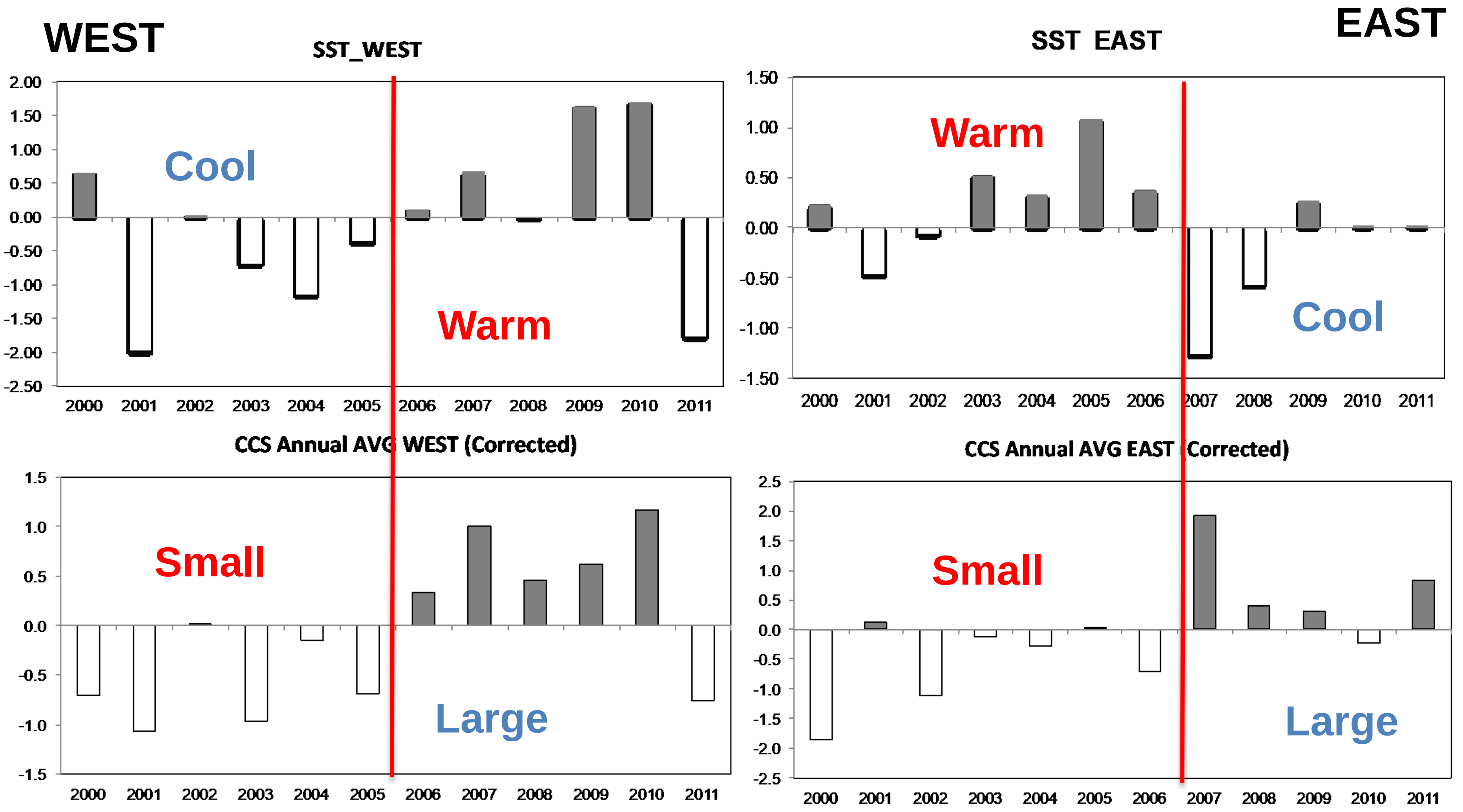
$$\overline{S} = \frac{\sum_{i=1}^{N} (L_i \times X_i)}{\sum_{i=1}^{N} X_i}$$



For each sample, multiply total length (L) of each species i (adult female) by its abundance (X_i), sum over all species (N), and divide by total abundance.

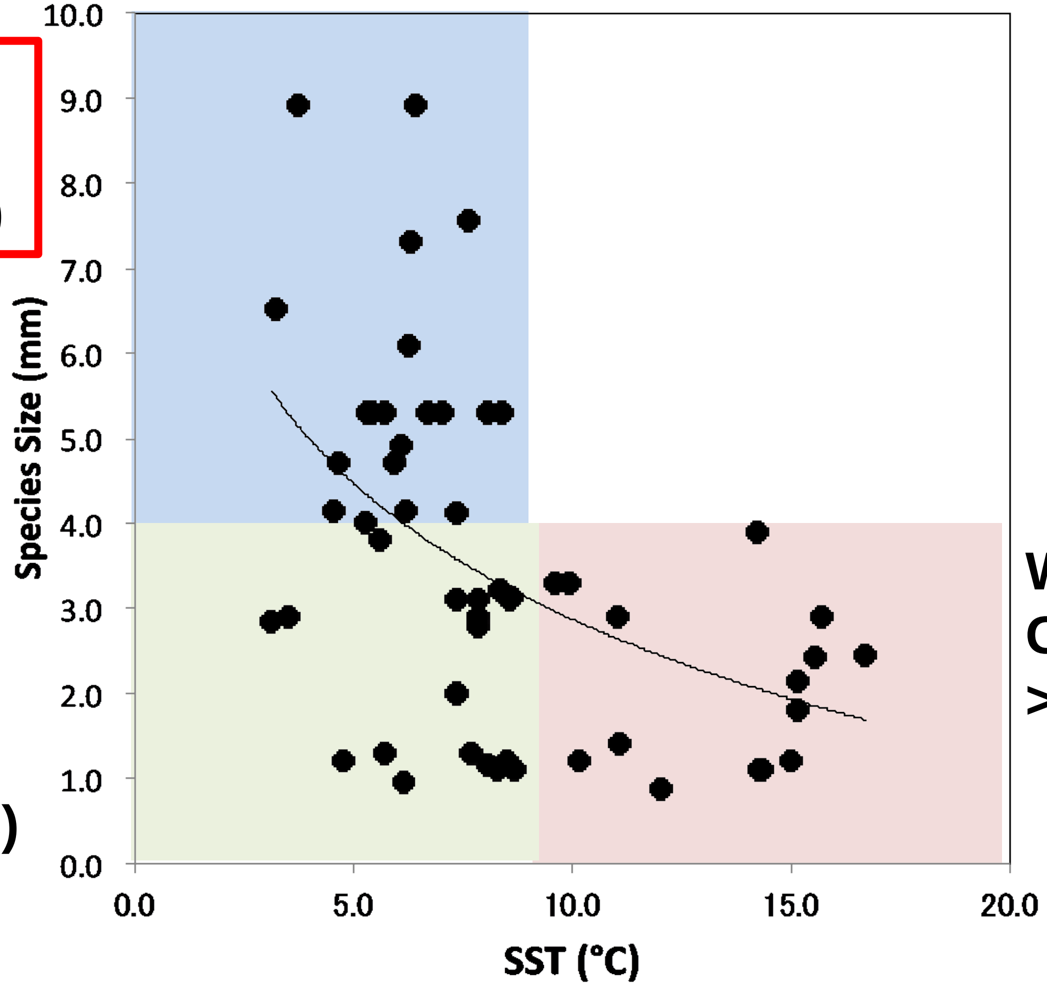
East-West Comparison of Zooplankton Community Changes

Time Series CCS & SST (Annual AVG)



East-West Comparison of Zooplankton Community Changes

AVG SST of Occurrence and Size of 54 copepod spp/taxa



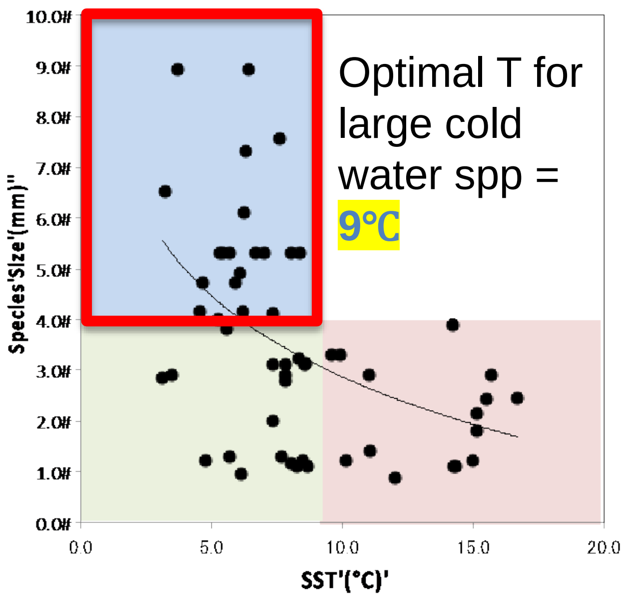
Large Cold Water Group (>4mm, <9° C)

Warm Water Group (<4mm, >9° C)

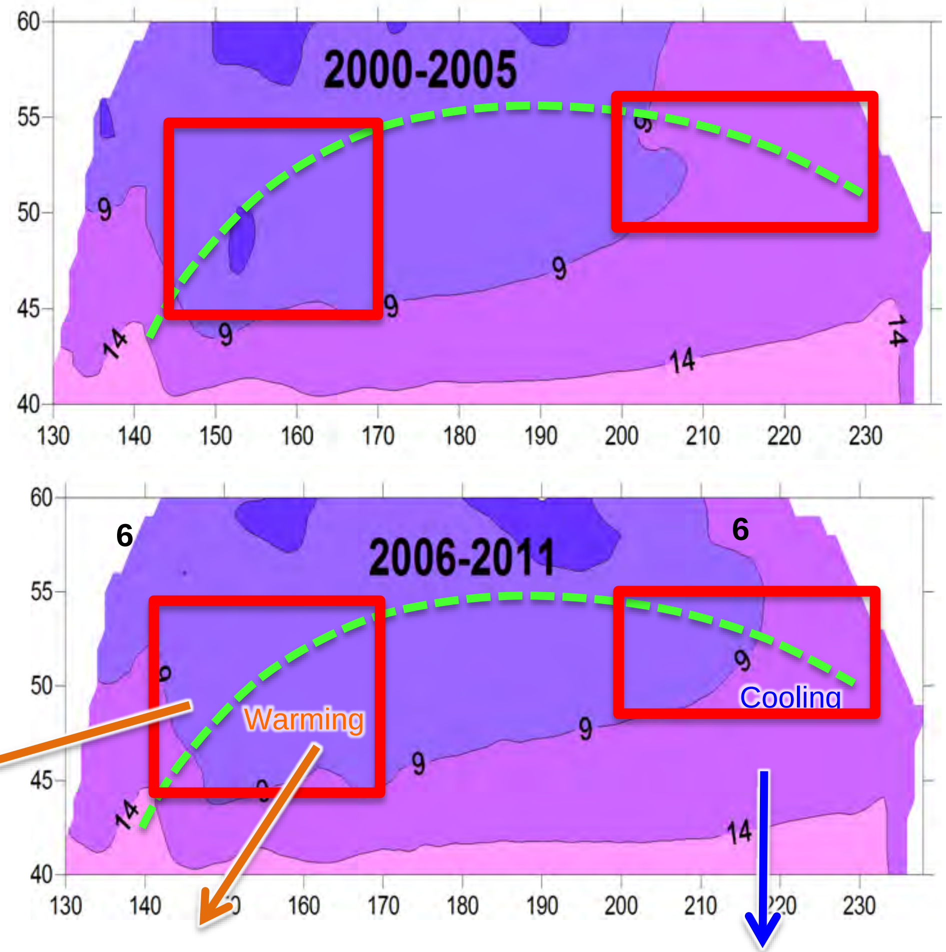
Small Cold Water Group (<4mm, <9° C)

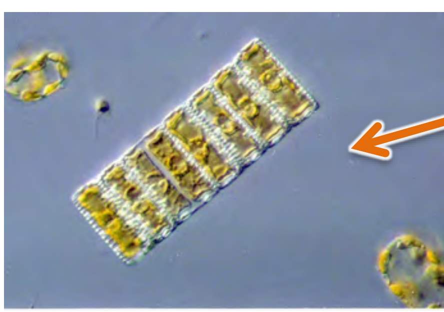
East-West Comparison of Zooplankton Community Changes

AVG SST of Occurrence and
Size of 54 copepod spp/taxa



Chante in the 9℃ isotherm before and after 2006



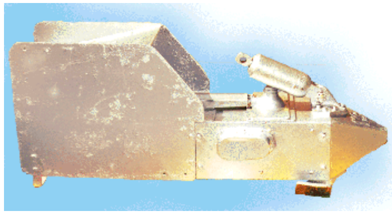


More spring phytoplankton

9° C boundary location not changed

9° C boundary shifted eastward

Warming occurred within the optimal SST envelope for large cold water copepod species in WEST



What I like about CPR ….

Standardized and streamlined protocol for

- observation
- sample analysis
- data processing
- report to policy

14 LIFE BELOW WATER

TARGET 14·1

REDUCE MARINE POLLUTION

Adding values on CPR survey

Monitoring Ocean Acidification Impacts on ecosystem

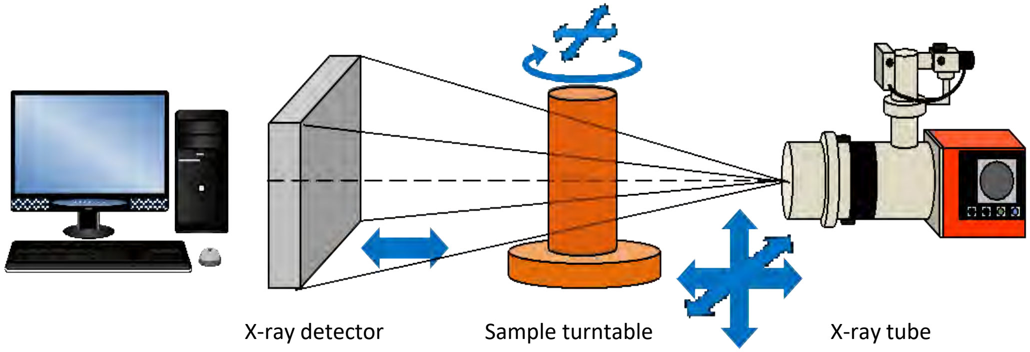
Monitoring of Marine microplankton pollution

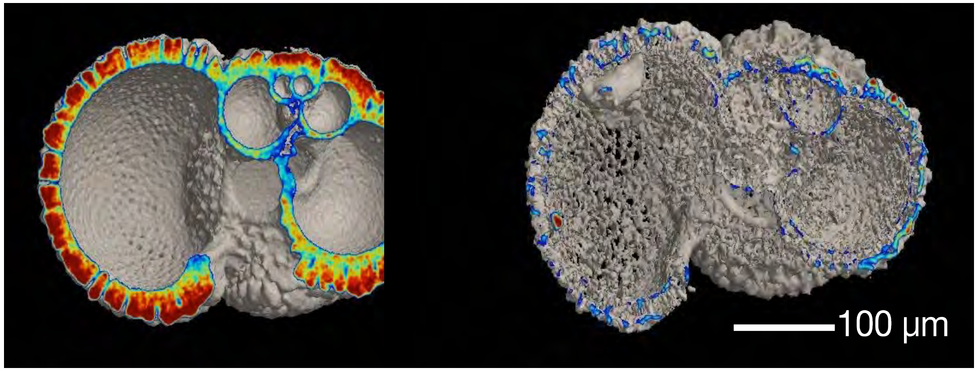
10

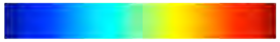
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

OA Impact Study

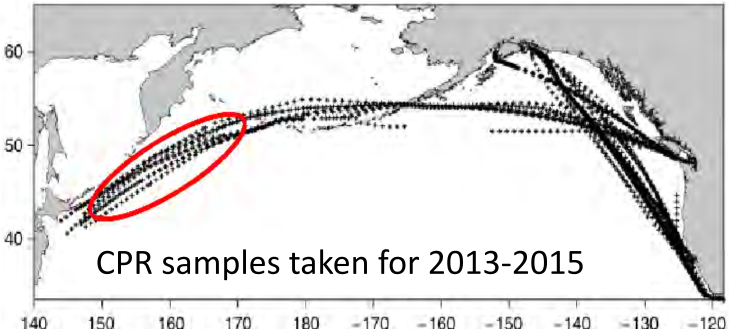
Looking inside: Microfocus X-ray CT (MXCT)







Images of foraminiferan shells obtained by using microfocus X ray computer tomography



pH and calcite saturation in seawater (Wakita et al., 2013)

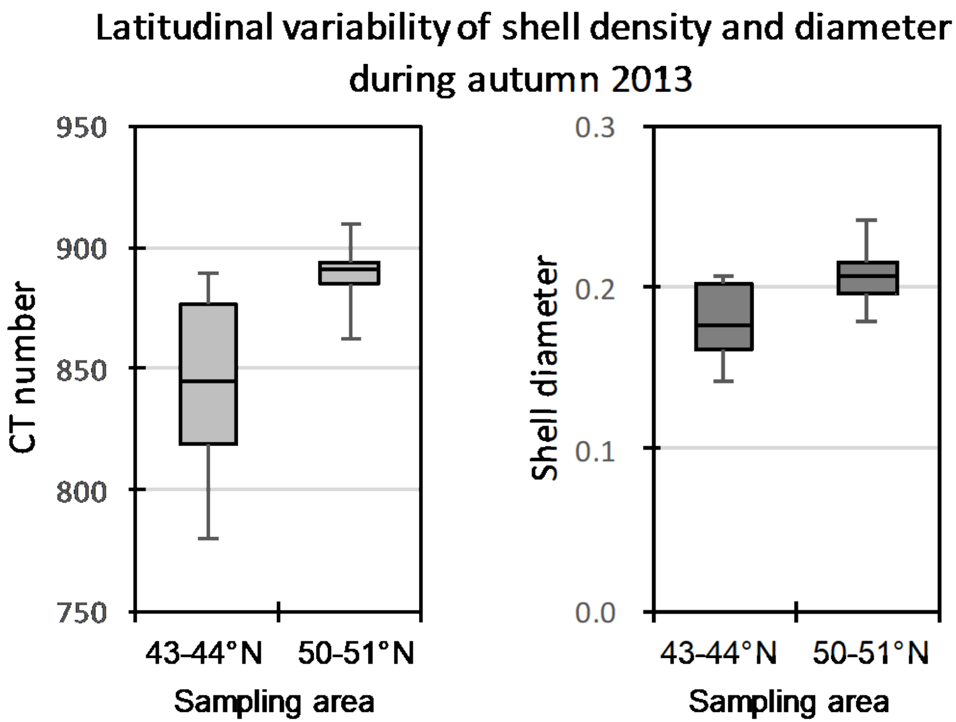
Surface: decreasing at the rate of -0.001 yr^{-1}
200-300m: -0.005 yr^{-1}

The highest rate in the Pacific!

Calcite saturation horizon: shoaling at 2.9 m yr^{-1}

OA Impact

Seasonal and Spatial variation and CT value (Shell density)



Preliminary results;

1) Shell densities in 50-51°N were higher than those in 43-44°N
2) Variability of the shell density was large in 43-44°N
3) Shell sizes in 50-51°N were larger than those in 43-44°N

… in progress

✓ collecting additional data in the study area and from different year/season

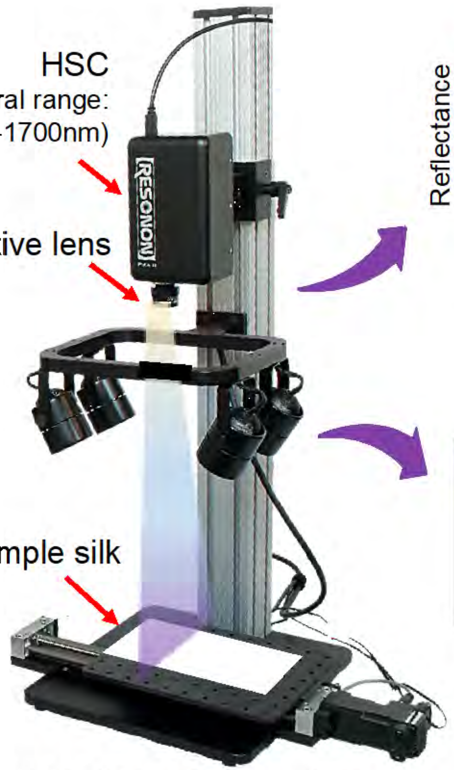
✓ investigating environmental properties which affect the variability

Microplastic Monitoring

HSC
(infrared spectral range: 900-1700nm)

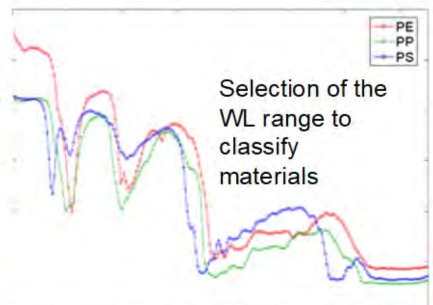
Objective lens

CPR sample silk



Hyperspectral imaging system (example: RESONON Inc. Pika320)

① data collection of material (PE, PP, PS) specific spectral signals of CPR microplastics



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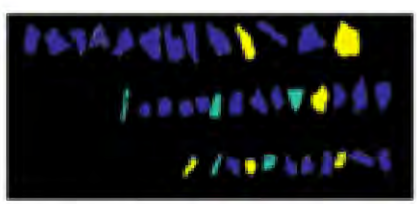
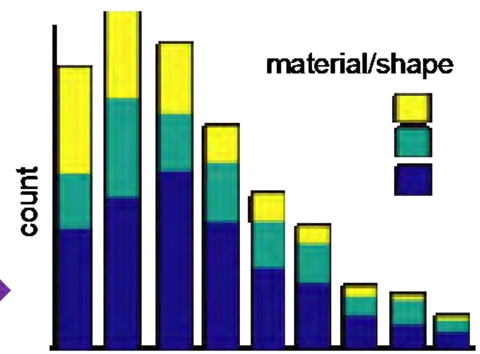


② algorism to classify materials, and visualization (by artificial coloring on HSC images)

Machine learning

③ development of automated analyzing system



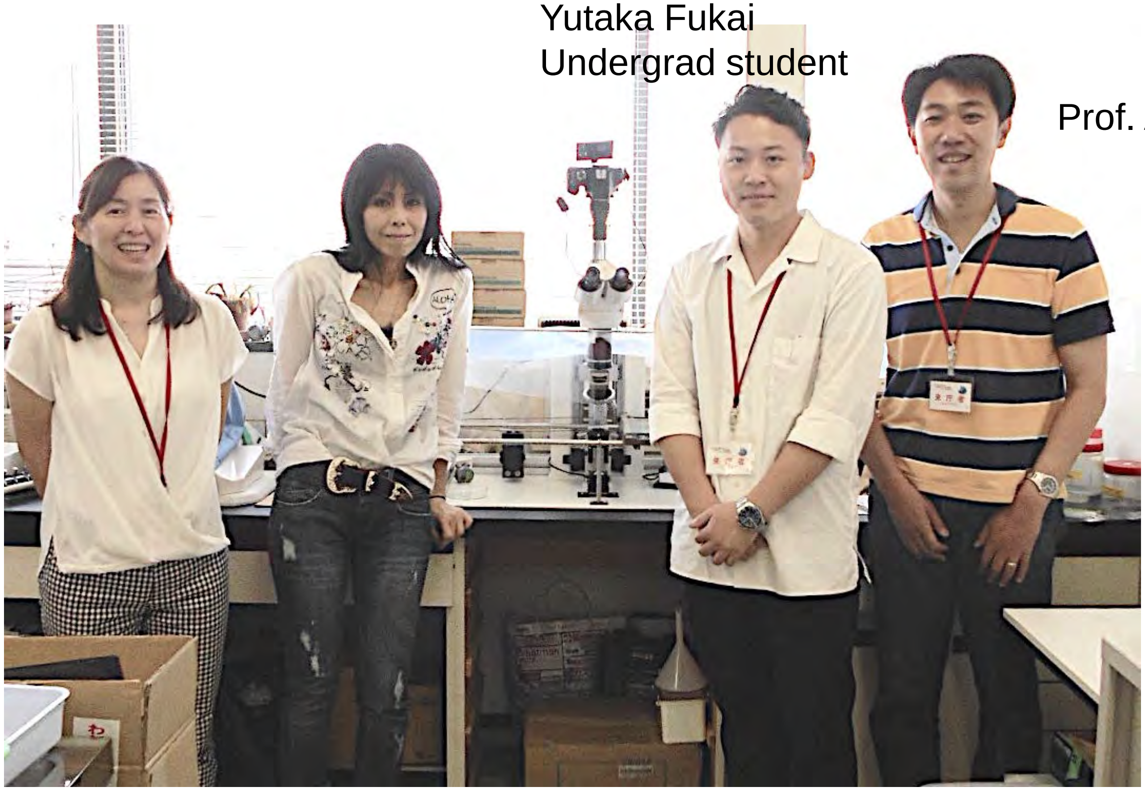
Since 2019 and beyond….

Make Continuous Plankton Recorder Survey CONTINUOUS…

Hokkaido University
Plankton laboratory

Yutaka Fukai
Undergrad student

Prof. Atsushi Yamaguchi



BIO Poster: 13923

Seasonal abundance, population structure, and diel changes in abundance of five large dominant copepods evaluated by CPR samples collected in the western subarctic Pacific

Yutaka Fukai, Sanae Chiba, Sonia Batten, Yuka Sasaki, Hiroya Sugisaki and Atsushi Yamaguchi

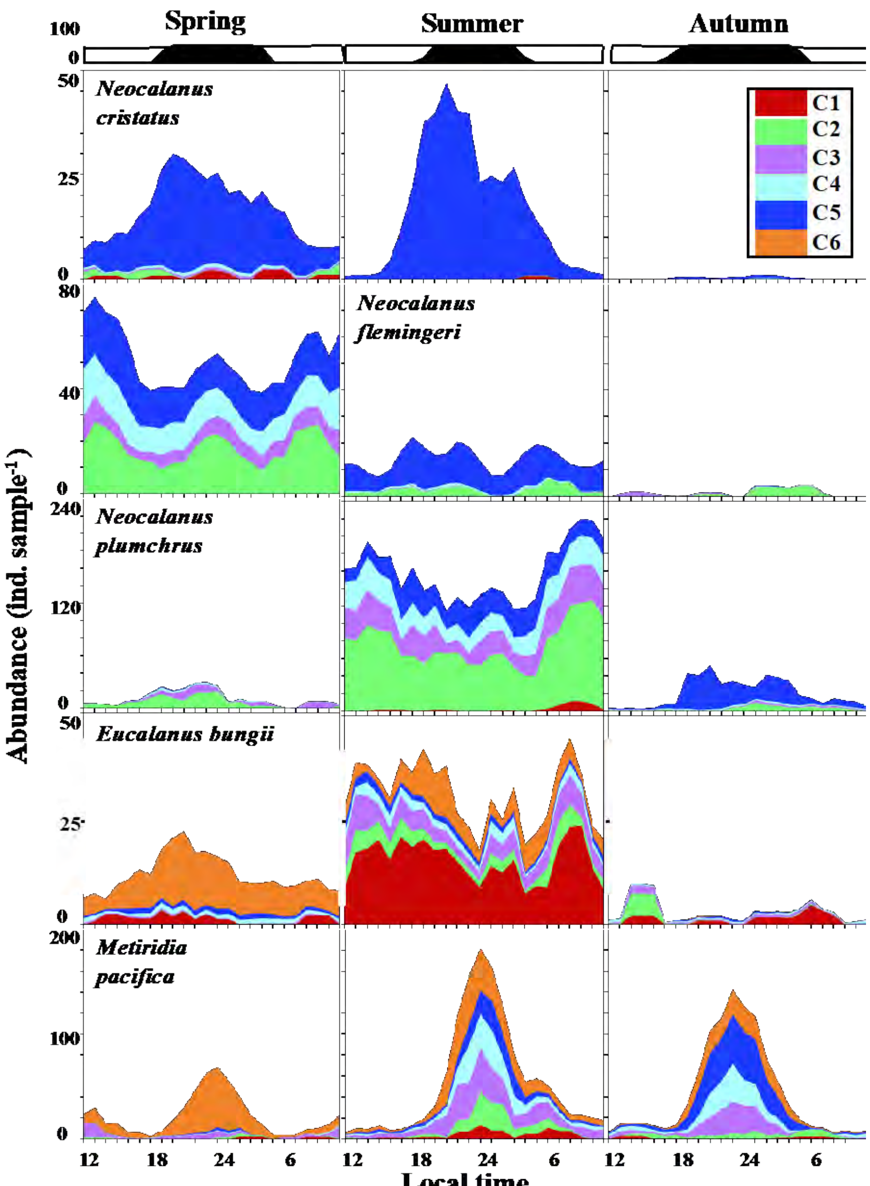
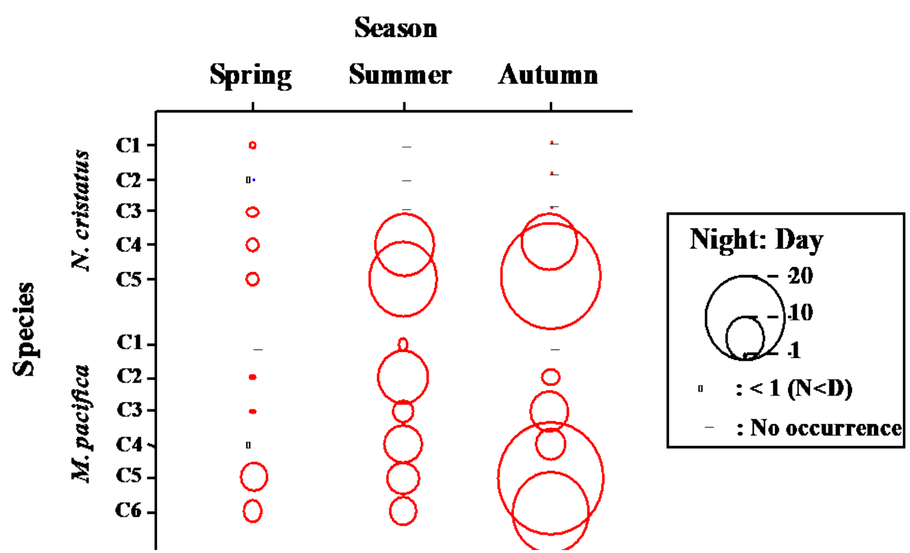


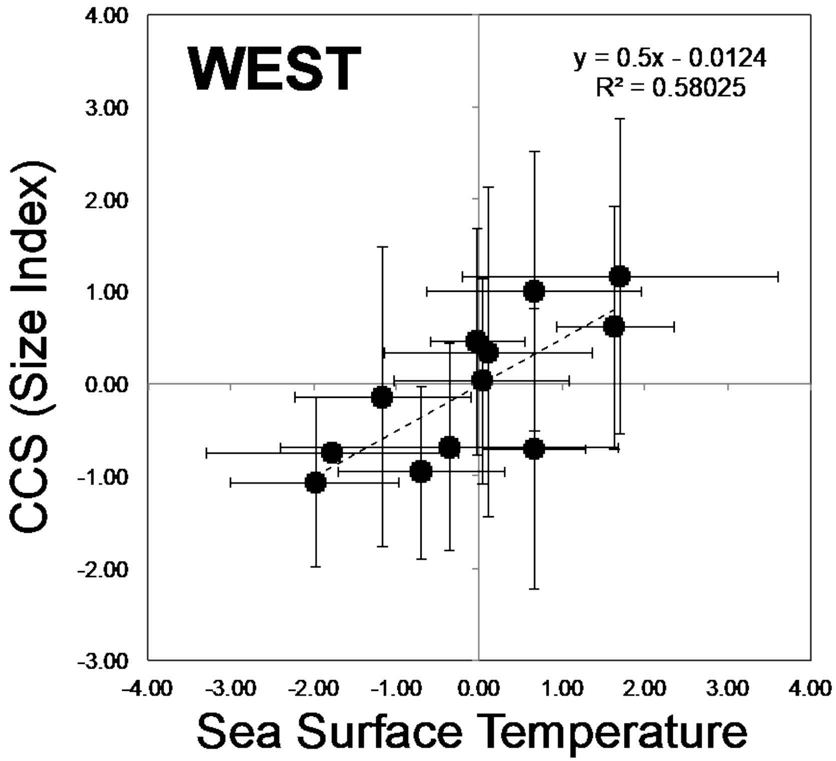
Fig. 2. Mean seasonal abundance of each copepodid stage of *Neocalanus cristatus*, *N. flemingeri*, *N. plumchrus*, *Eucalanus bungii*, and *Metridia pacifica* along with the local time. Panels are separated with season (spring [left], summer [middle], and autumn [right]). For the proportion of day (open) and night (solid in each season), see top panels.

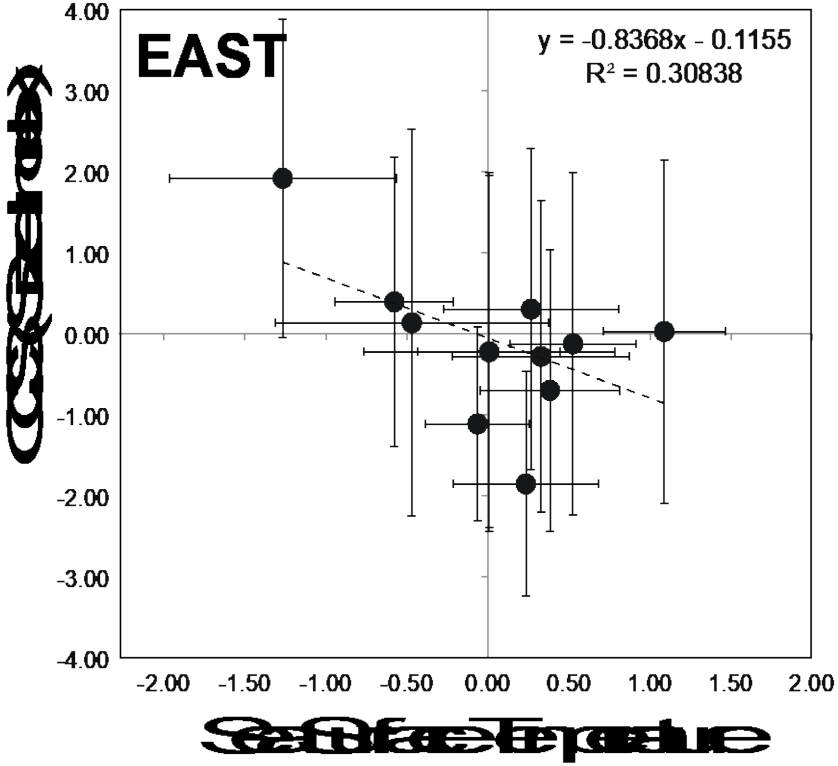


ave the Sea”

RESULTS

CCS & SST (Annual AVG)





***WEST**: Inconsistent to the conventional theory: larger (smaller) in cooler (warmer) condition*

DISCUSSION

PDO-NPGO system

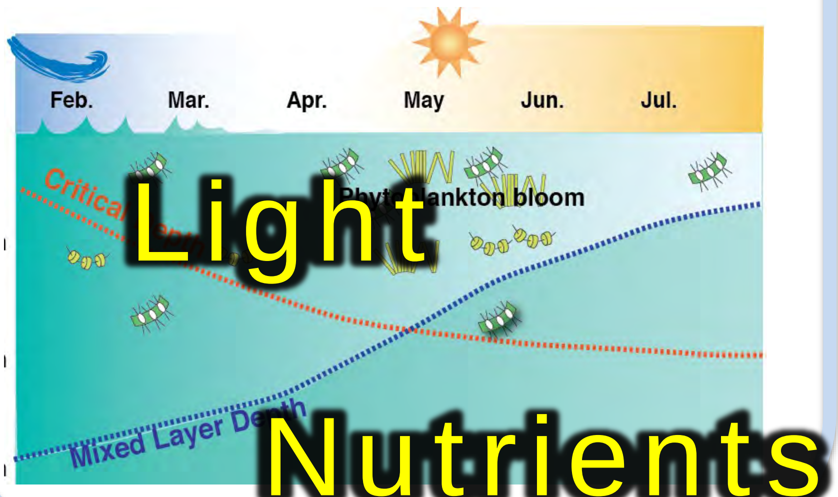
Mechanisms which drive cool-warm condition and plankton community variability differ bw/ East and West

WEST — **Wind Stress**

EAST — **Ocean Circulation**

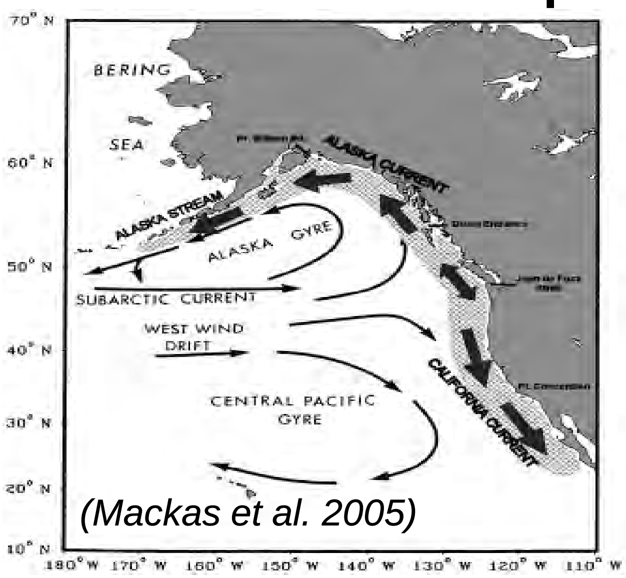
Seasonal Mixed Layer – Bottom-up Process

Within the SST-Envelope…



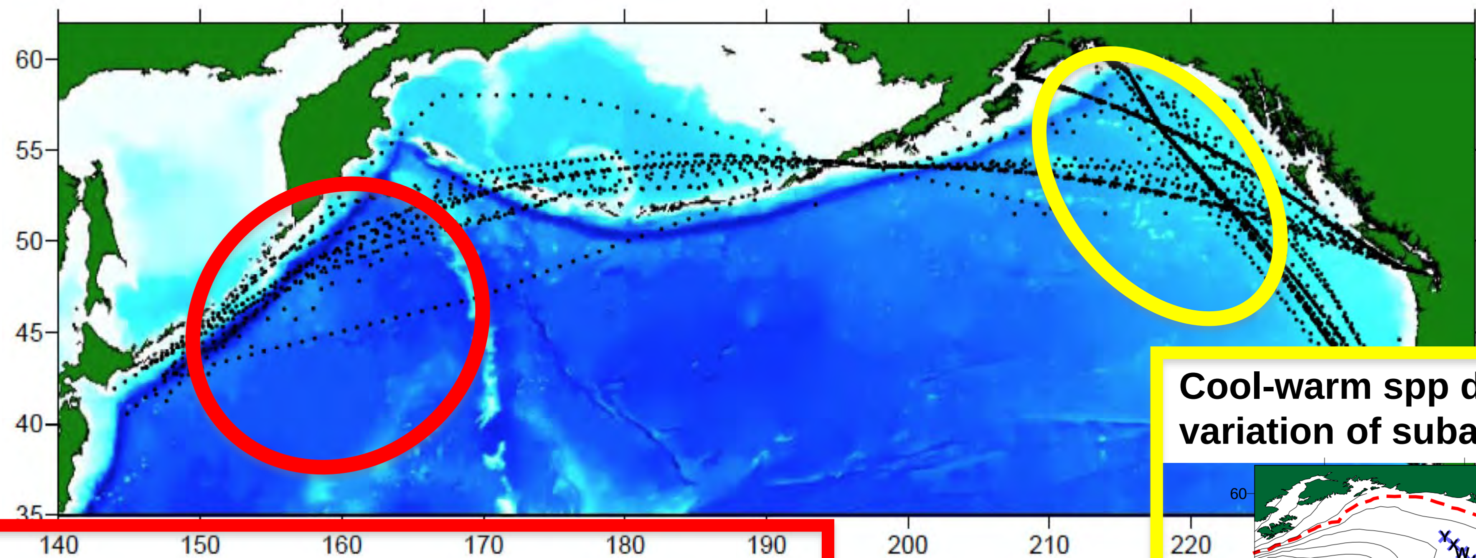
Advenction Transport by Current Dynamics

Out of the SST-Envelope…

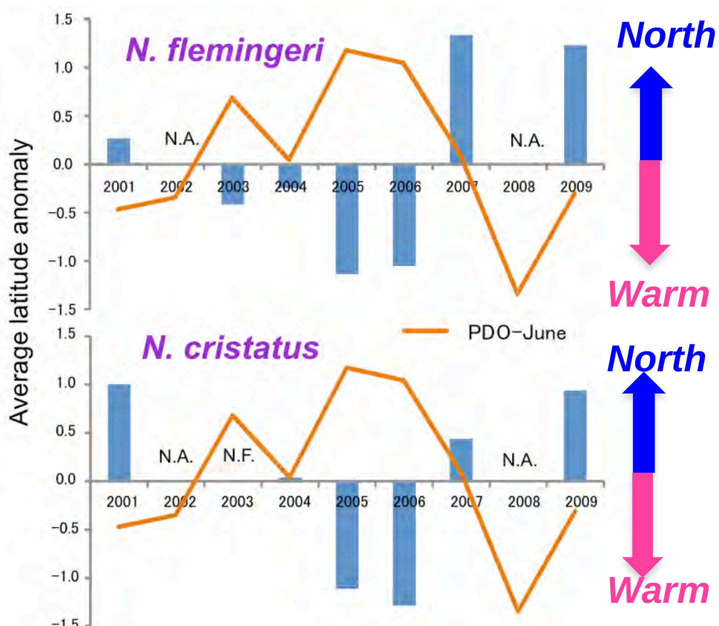


(Mackas et al. 2005)

Biogeographical shift of zooplankton and PDO

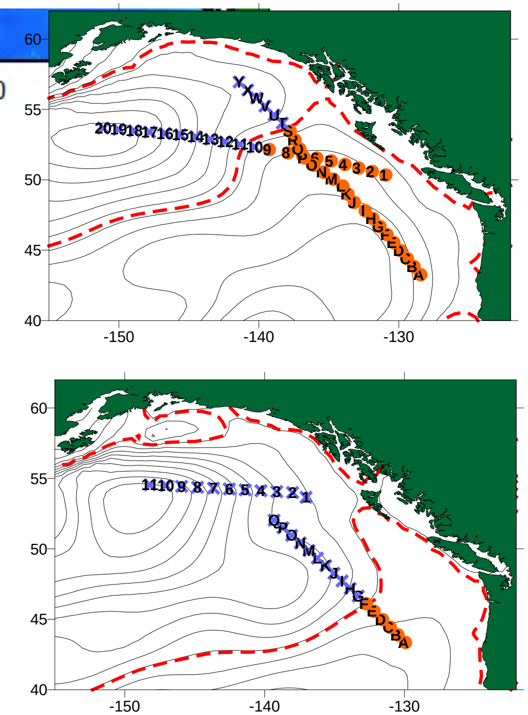


PDO & Latitudinal Shift of *Neocalanus spp.*



Yoshiki et al.
not published

Cool-warm spp distribution and variation of subarctic boundary



Batten, S.D. and Freeland, H.J. (2007). Fisheries Oceanography, 16, 536-646.

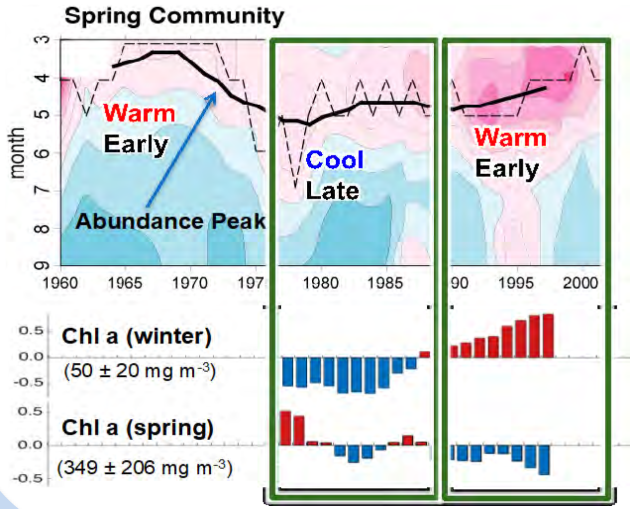
DISCUSSION

East-West Discrepancy on Cool-Warm cycle & Copepod Size - Other Studies -

WEST

Warm & Larger

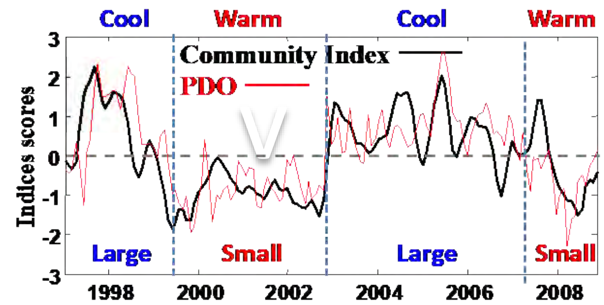
Warming could positively affect on growth/production of cold-water species, e.g. by good-match with phytoplankton seasonality ***(Chiba et al., 2006 & 2008)***.

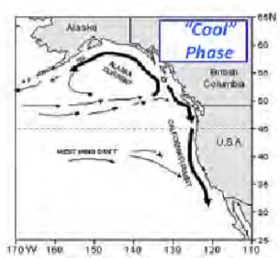


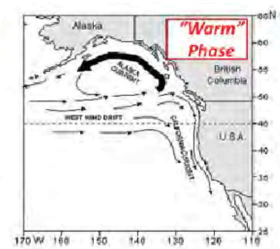
EAST

Warm & Smaller

Regional warming and increase of warm-water (small) species could be induced by northward advection transport driven by the oceanic currents dynamics ***(Kiester et al., 2011).***







SST – PDO related Pattern

SST Map (2006-2011 avg – 2000-2005 avg, normalized)