# Comparative study of the life histories of *Eucalanidae* copepods in the subtropical and subarctic Pacific

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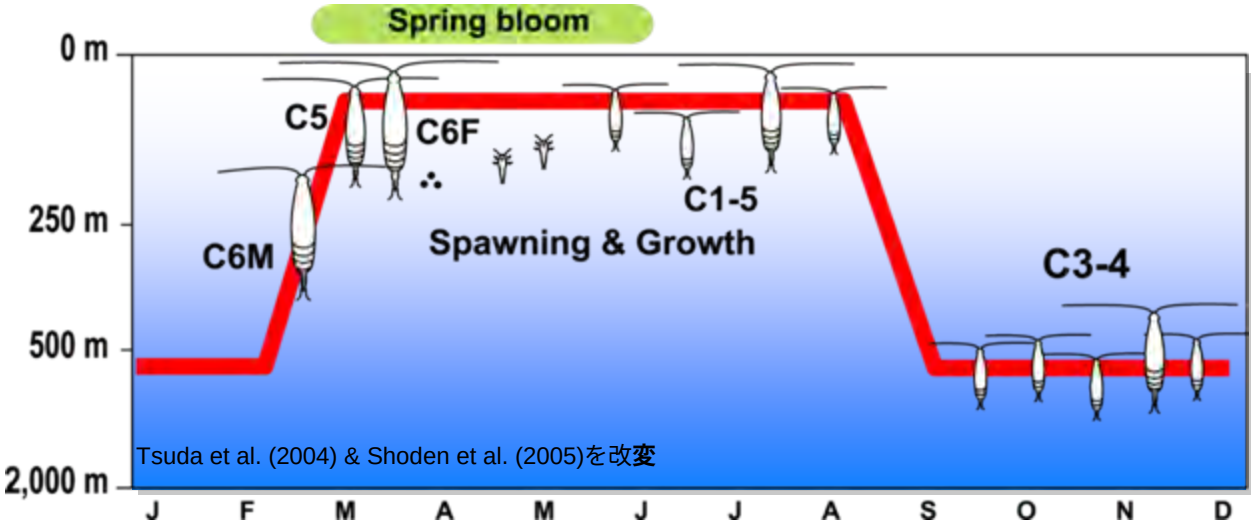
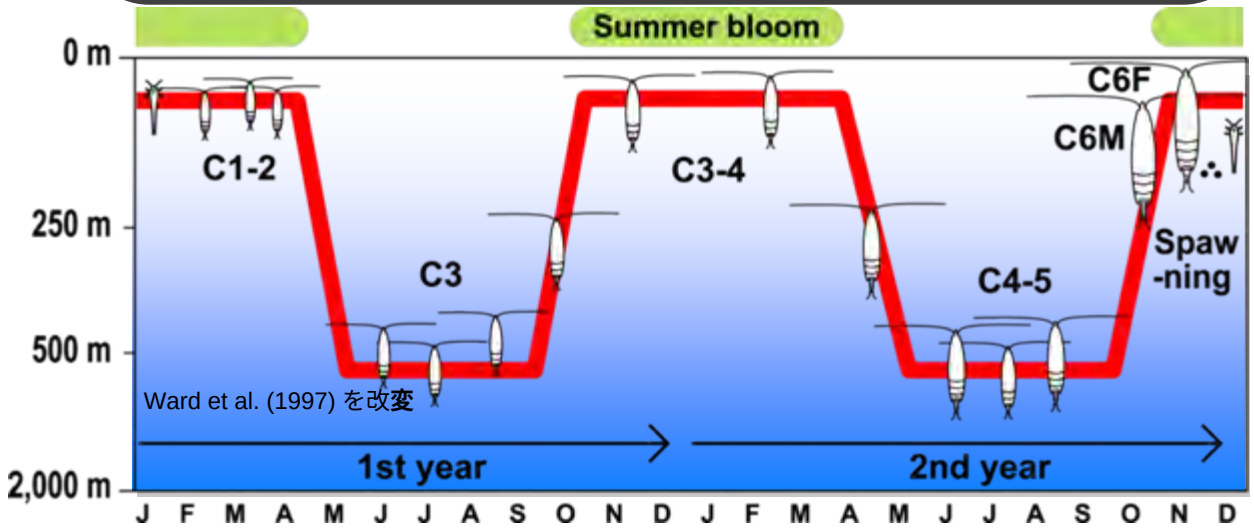
# Life cycle and seasonal OVM of cold water Eucalanidae

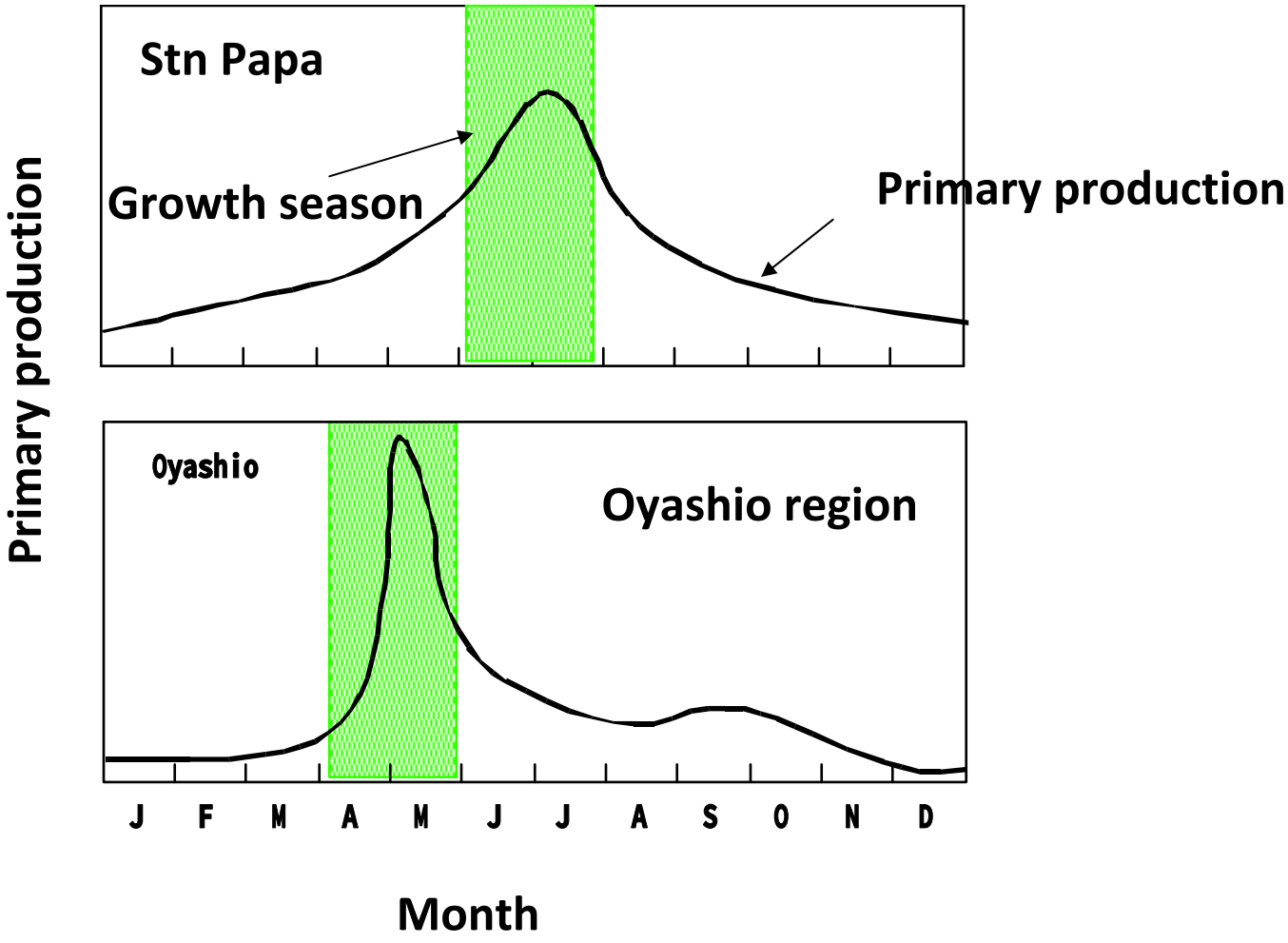



**Seasoanl OVM is a nessesary strategy to survive**



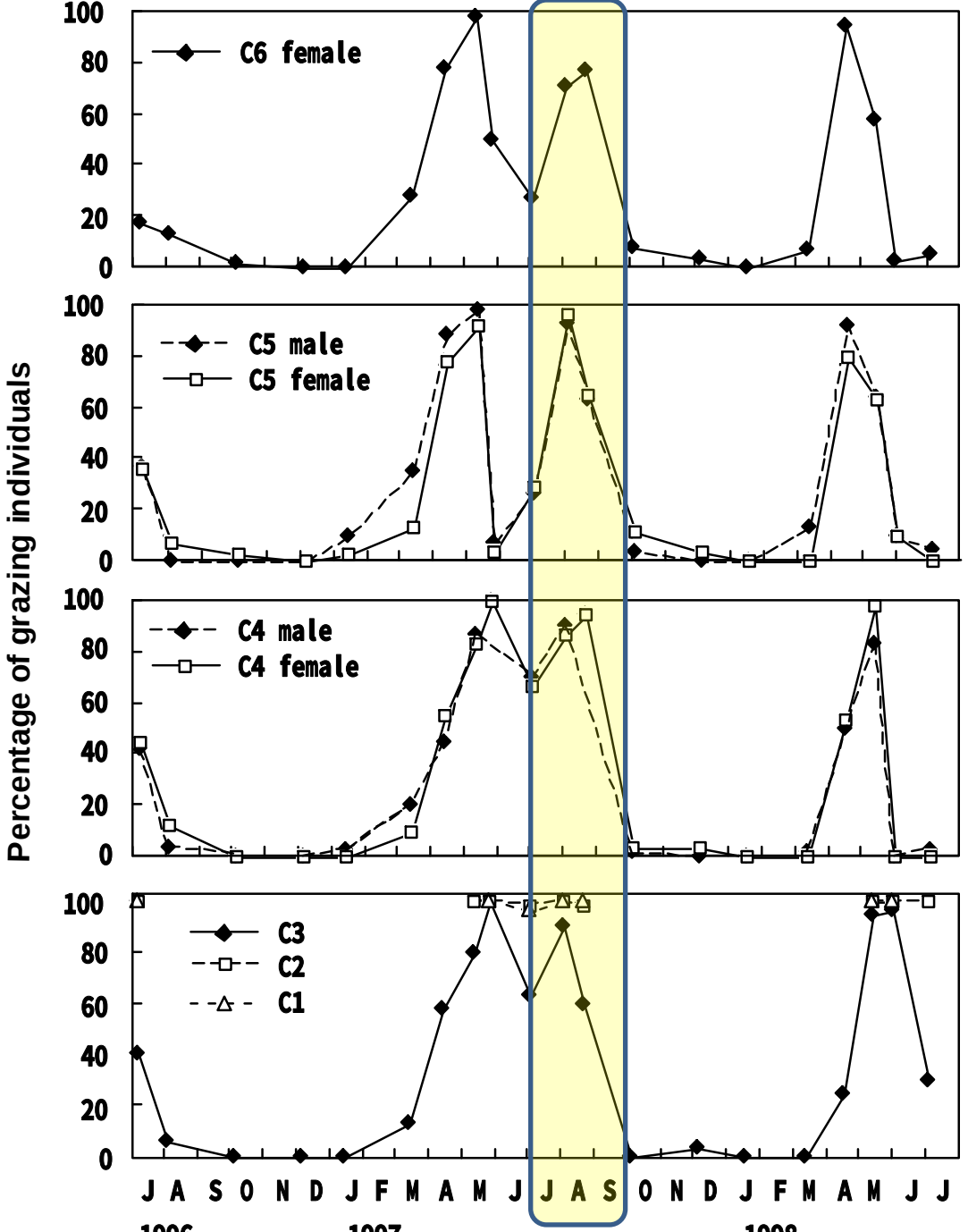


# Primary production and growth season of *Eucalanus bungii*



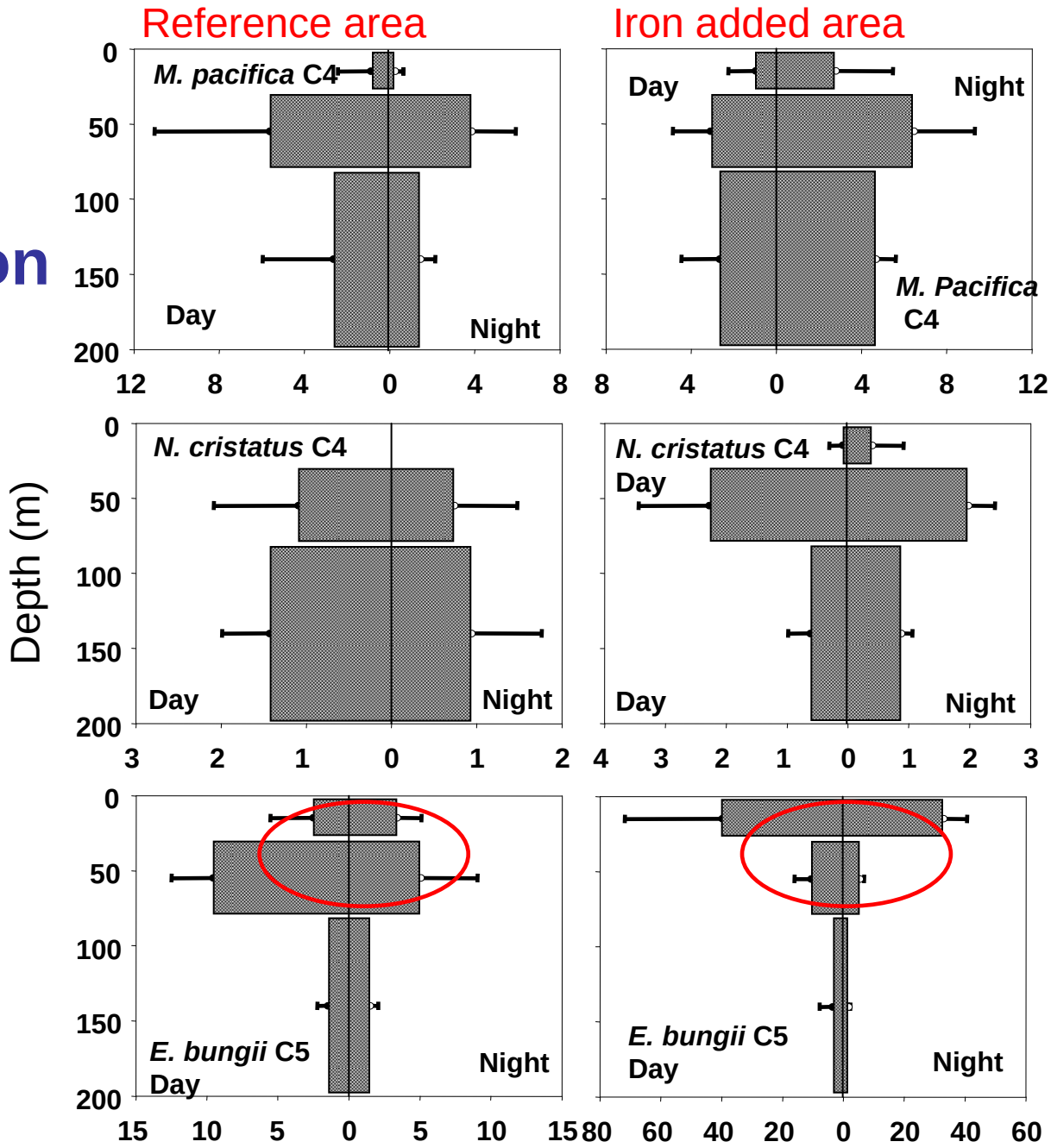

Tsuda et al 2005

Percentage of individuals *Eucalanus bungii* In Oyashio area



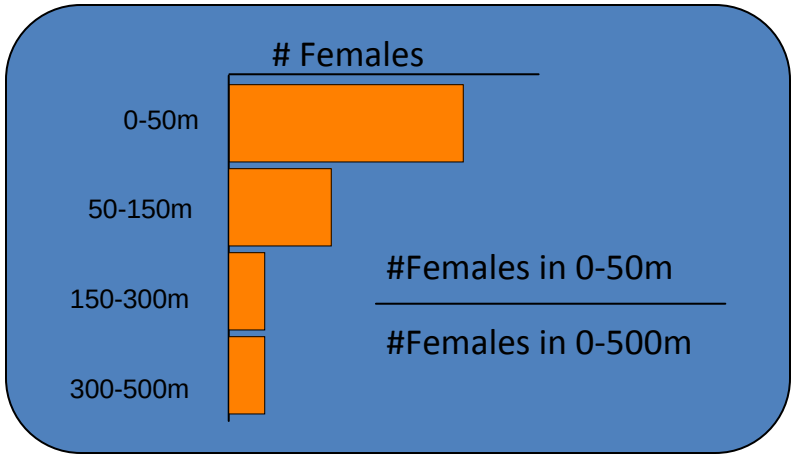

Tsuda et al 2005

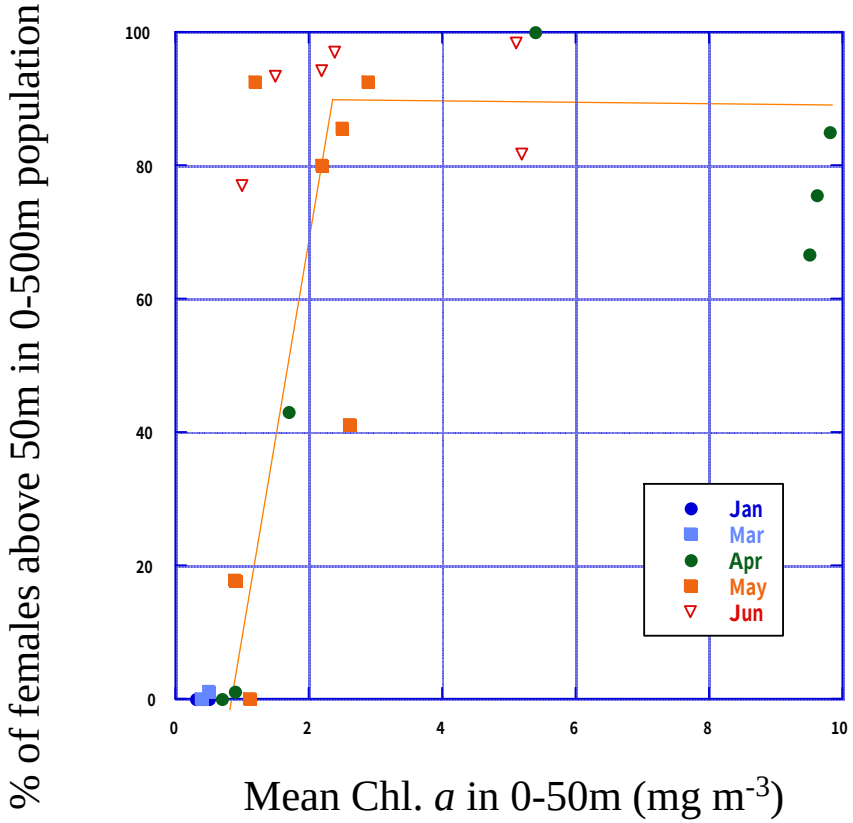
# Averaged vertical distribution




Tsuda et al 2005

# Surface emergence and Chlorophyll concentration



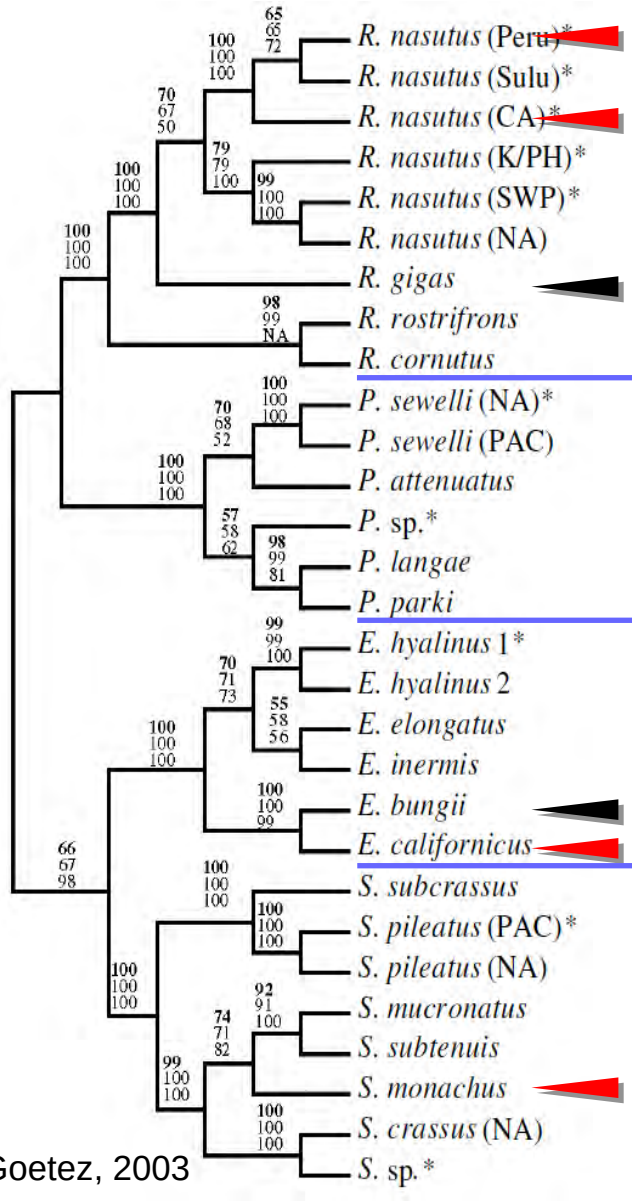




Takahashi unpublished

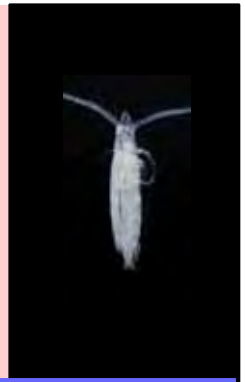
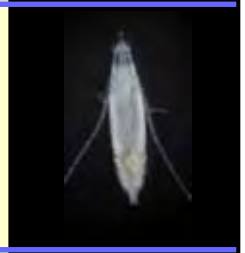
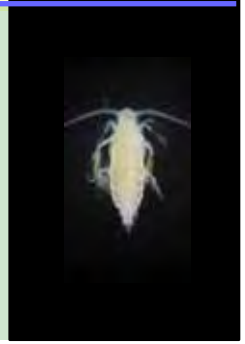
# Summary of subarctic *Eucalanus*

- Seasonal OVM with surface spawning
- Reproduction during the local production maximum
- Plastic behaviors and life cycles

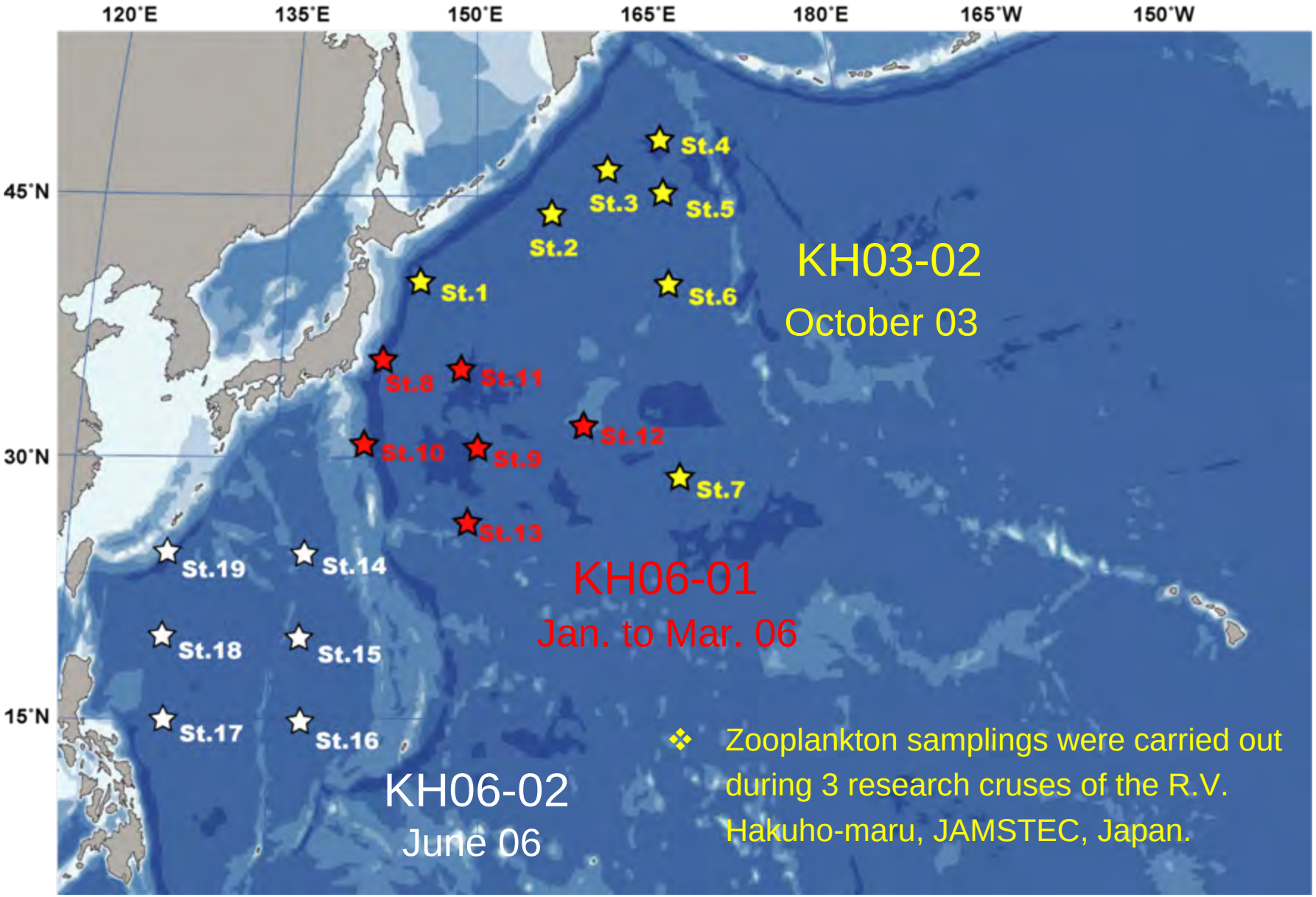
# Phylogeny of Eucalanidae




Goetez, 2003

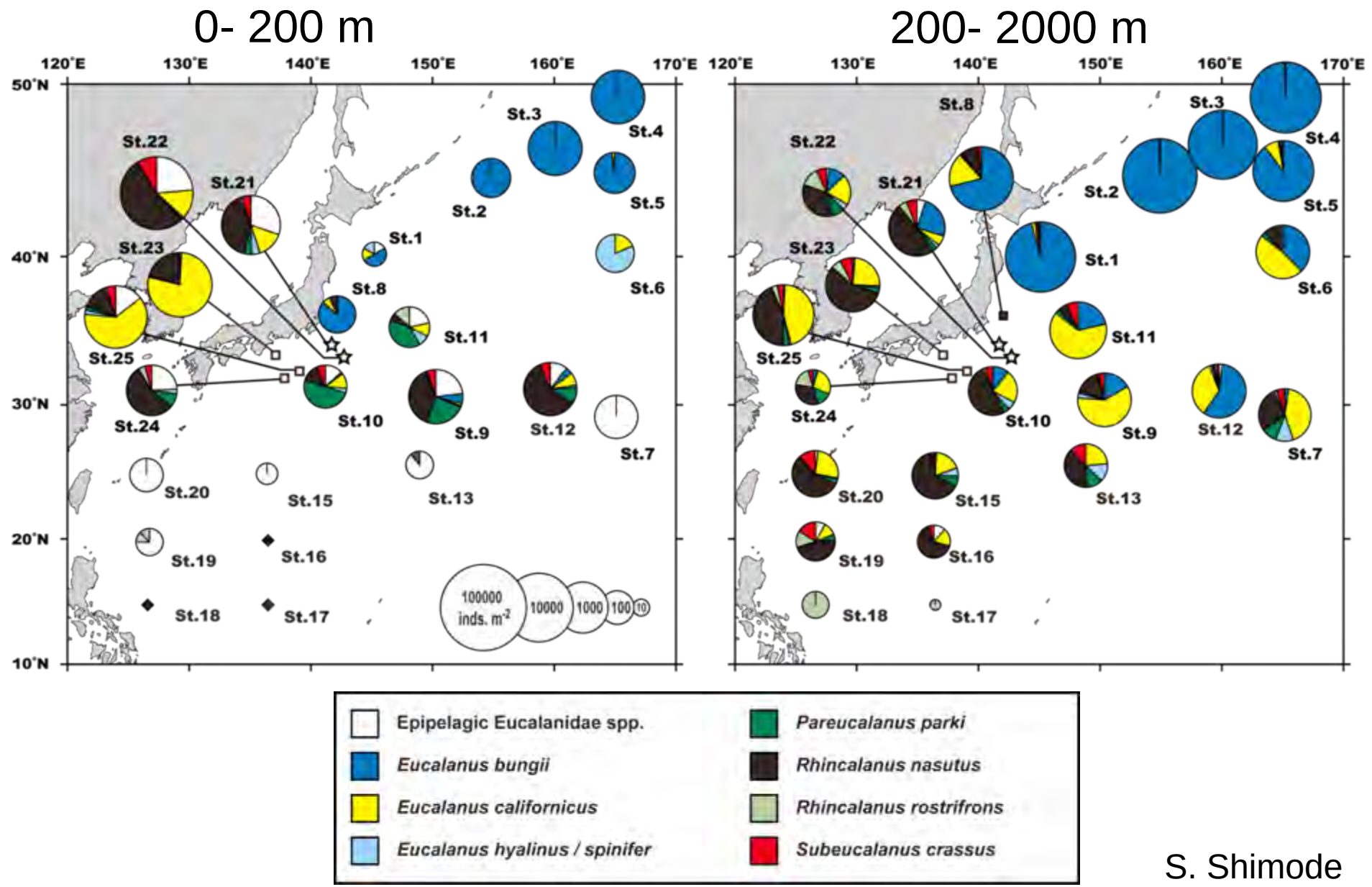
| Genus | Distribution | |
|---|---|---|
| *Rhincalanus* | **Oceanic**<br>**Tropical to polar** |  |
| *Pareucalanus* | **Oceanic**<br>**Middle latitude** |  |
| *Eucalanus* | **Oceanic**<br>**Subtropical to subarctic** |  |
| *Subeucalanus* | **Coastal to Oceanic**<br>**Tropic to subtropical** |  |

# Sampling stations



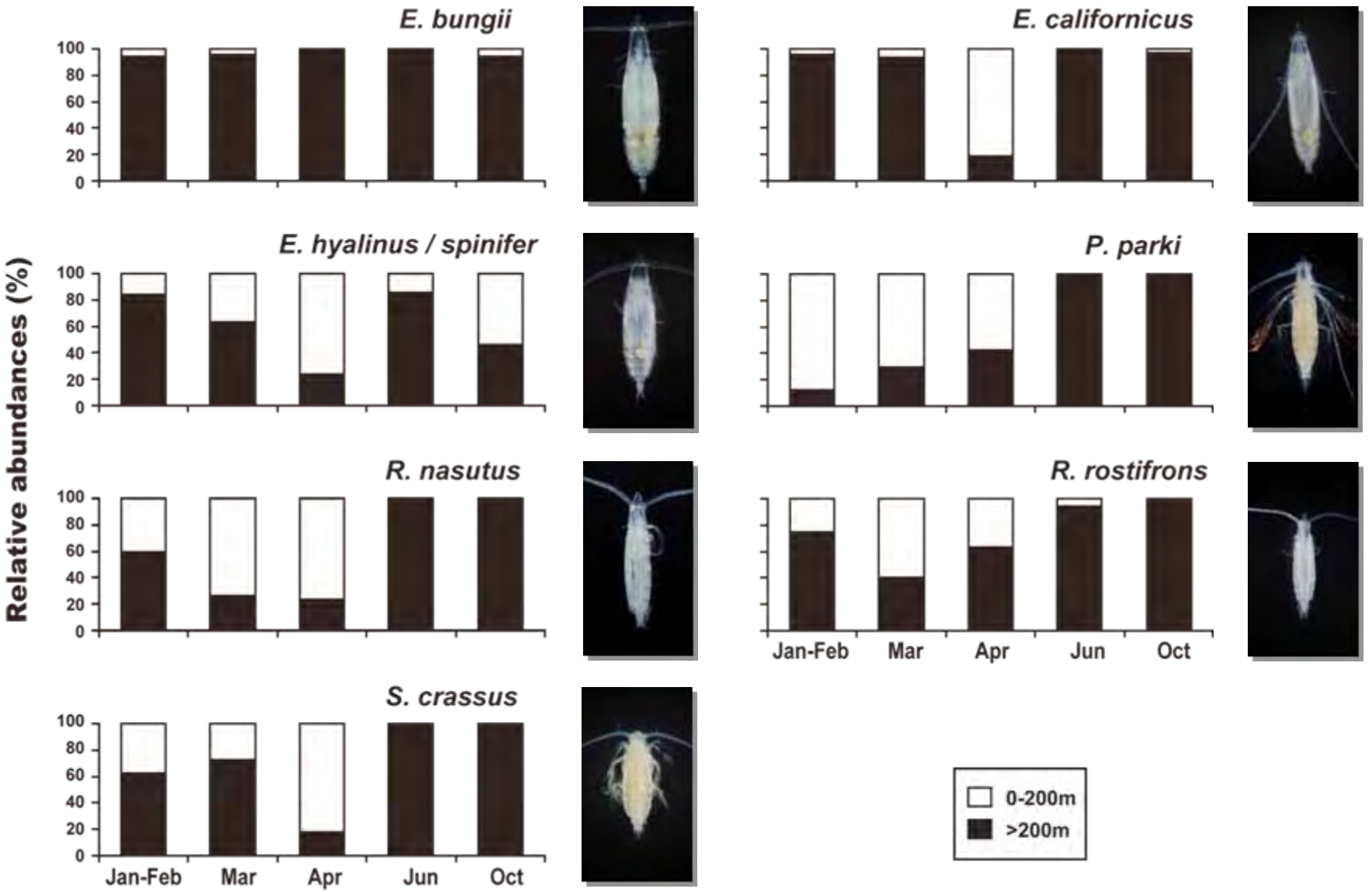

- Zooplankton samplings were carried out during 3 research cruses of the R.V. Hakuho-maru, JAMSTEC, Japan.

# Geographical distribution of Eucalanidae



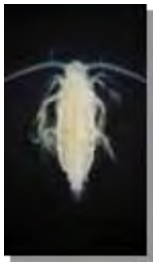

S. Shimode

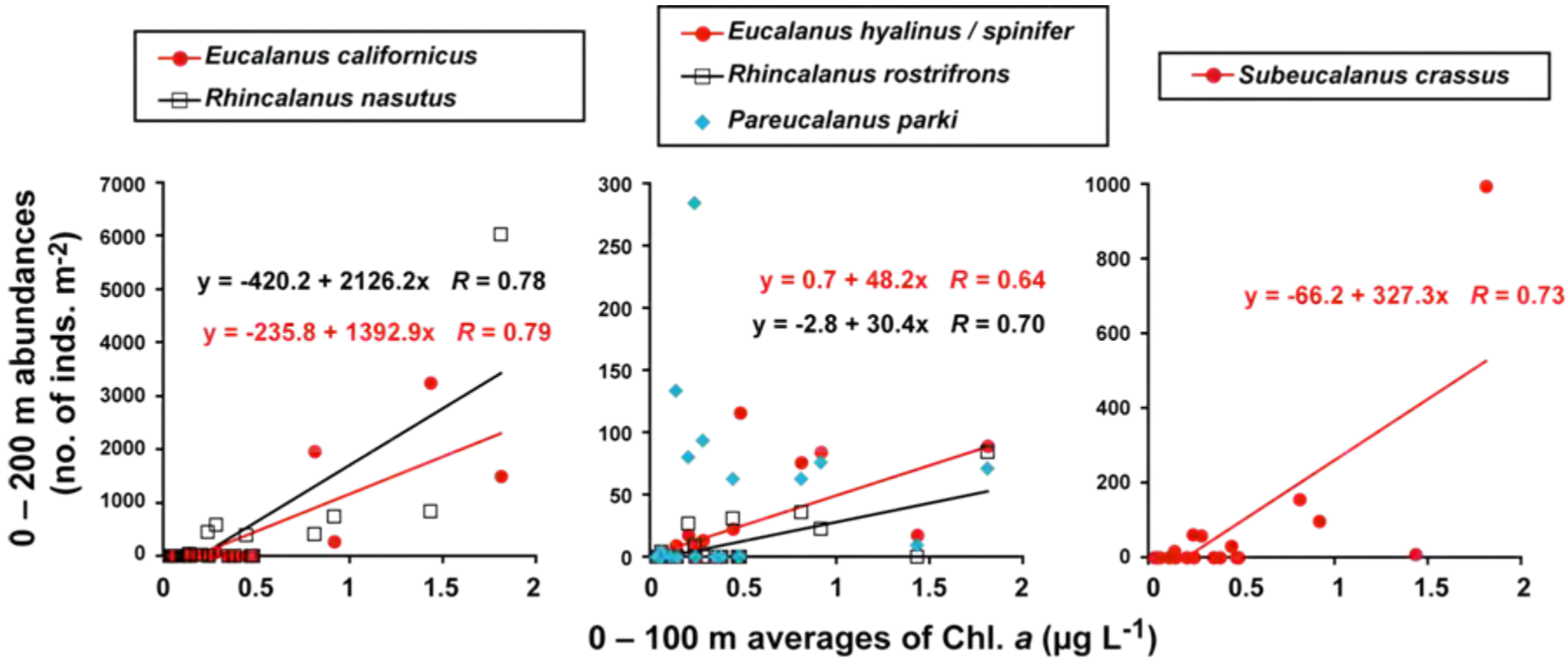
# Seasonal occurrence Eucalanidae copepods




S. Shimode

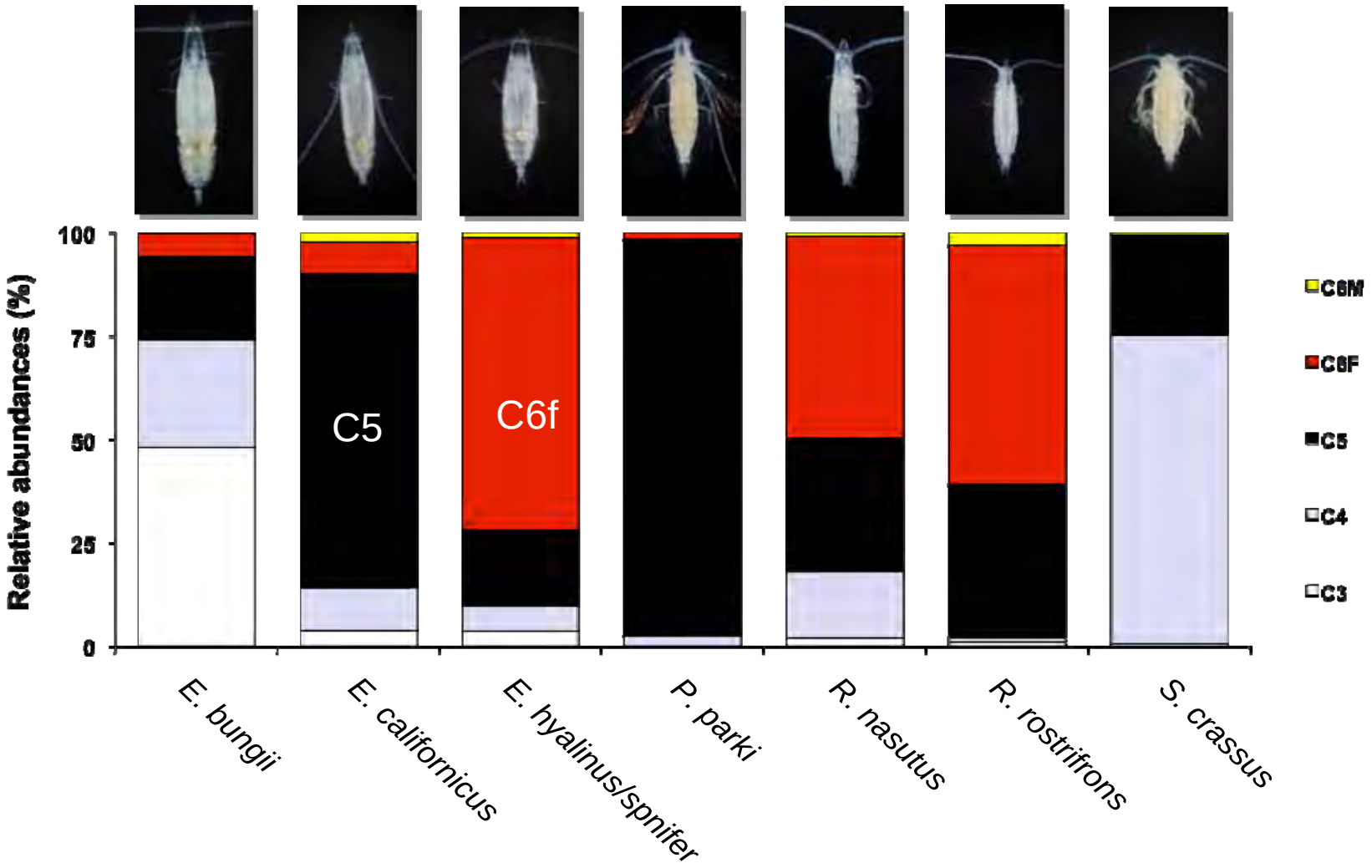
# Surface occurrence and chlorophyll-a concentration



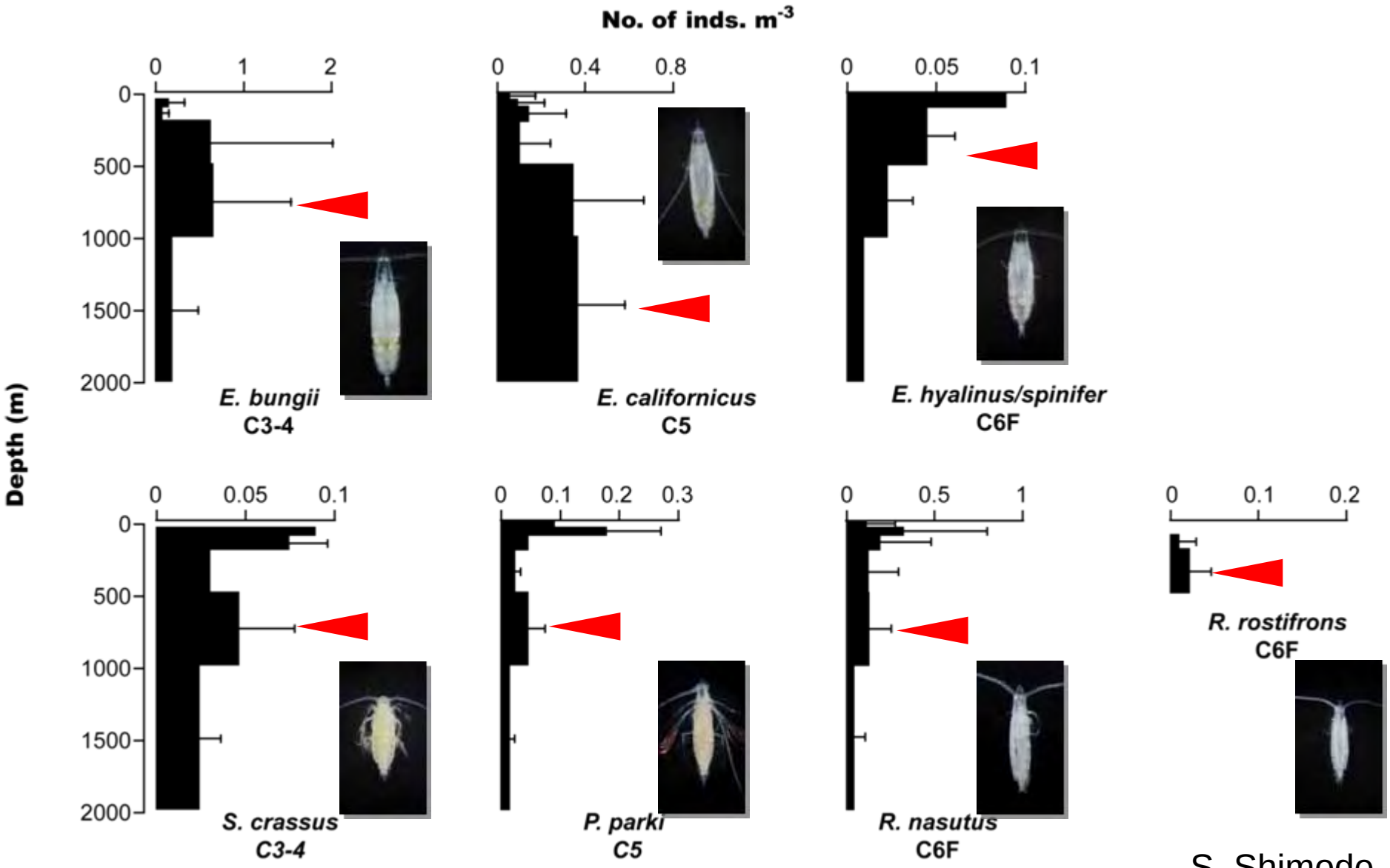



S. Shimode

# Overwintering stages

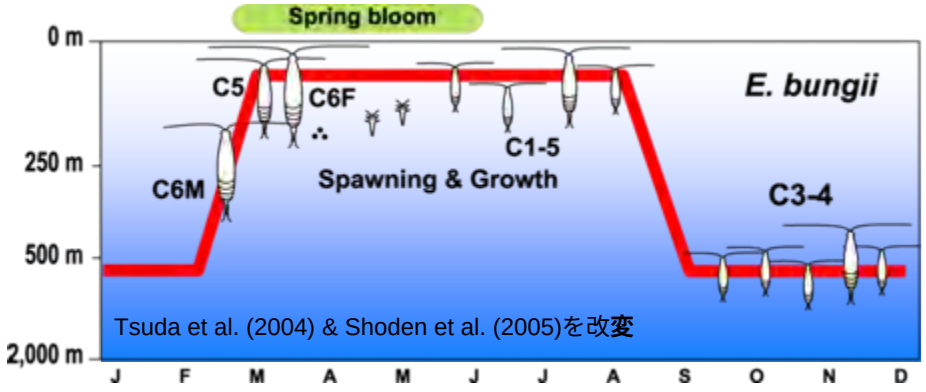


# Overwintering depth (example of cruise KH-06-01)

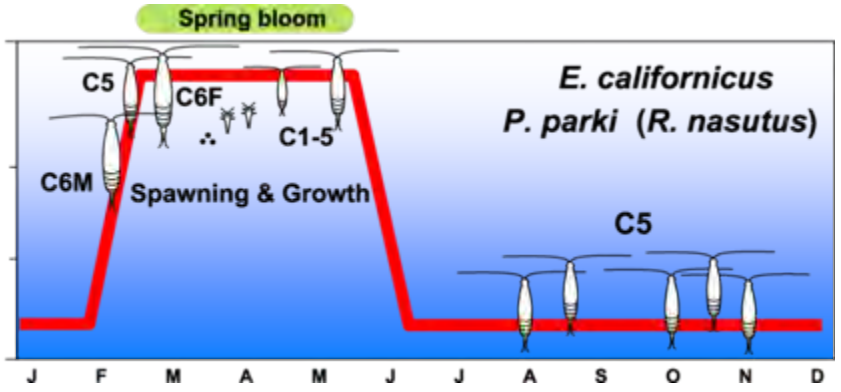



S. Shimode

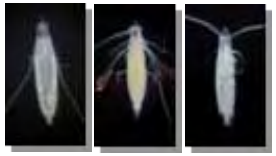
# Life cycles and OVM patterns of Eucalanidae in the Pacific

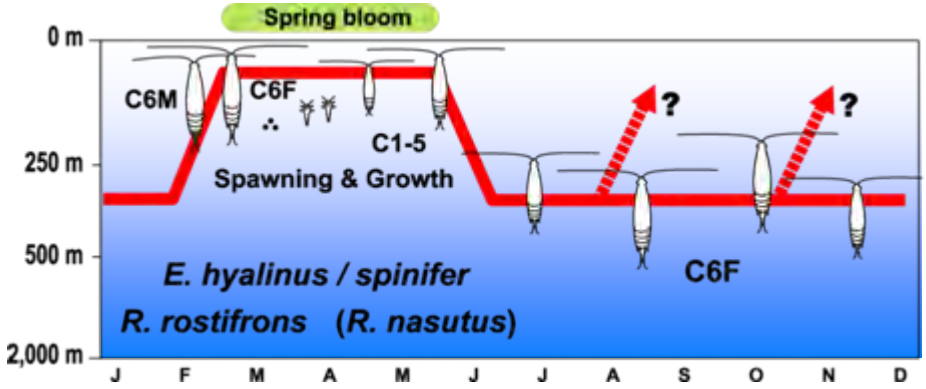



**Subarctic: Dormacy at 200-500m as C3-C6**

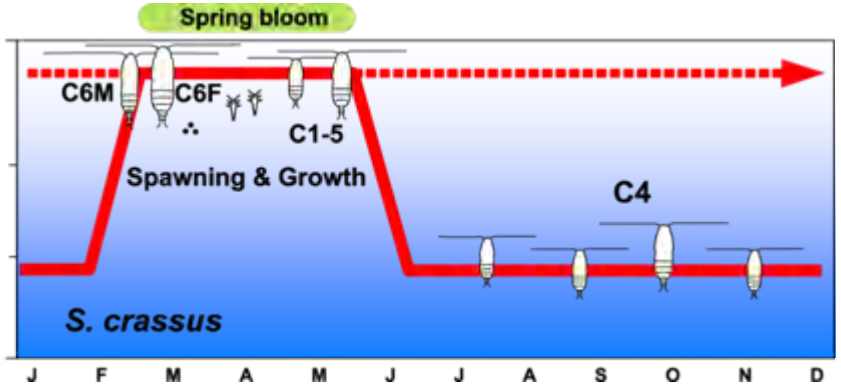



**Middle latitude: Dormancy at > 500 m as C5**

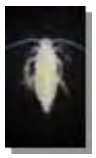





**Subtropical: Dormancy at 200-500 m as C6 female**

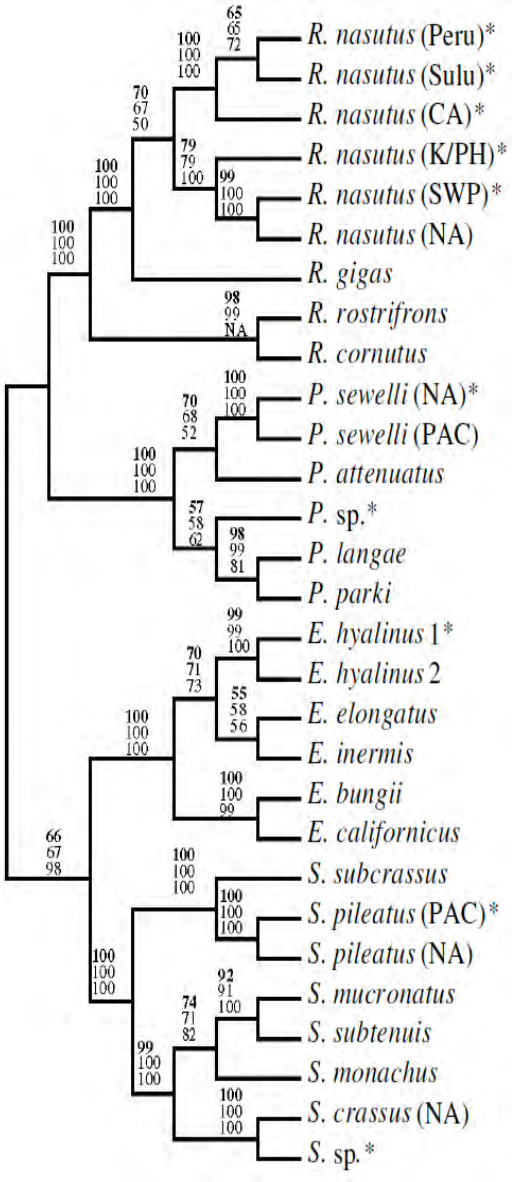


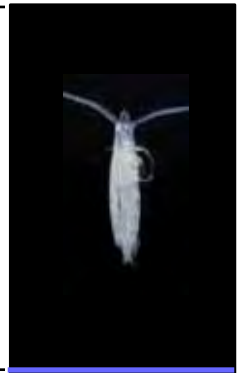
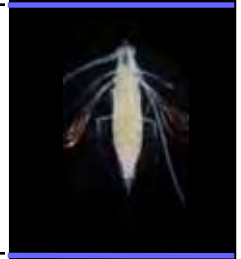
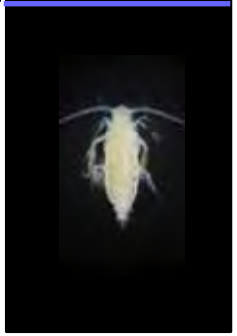

**Coastal: A part of population stays at mesopelagic layer**



# Phylogeny and estimated life cycle patterns in Eucalanidae

Goetez, 2003



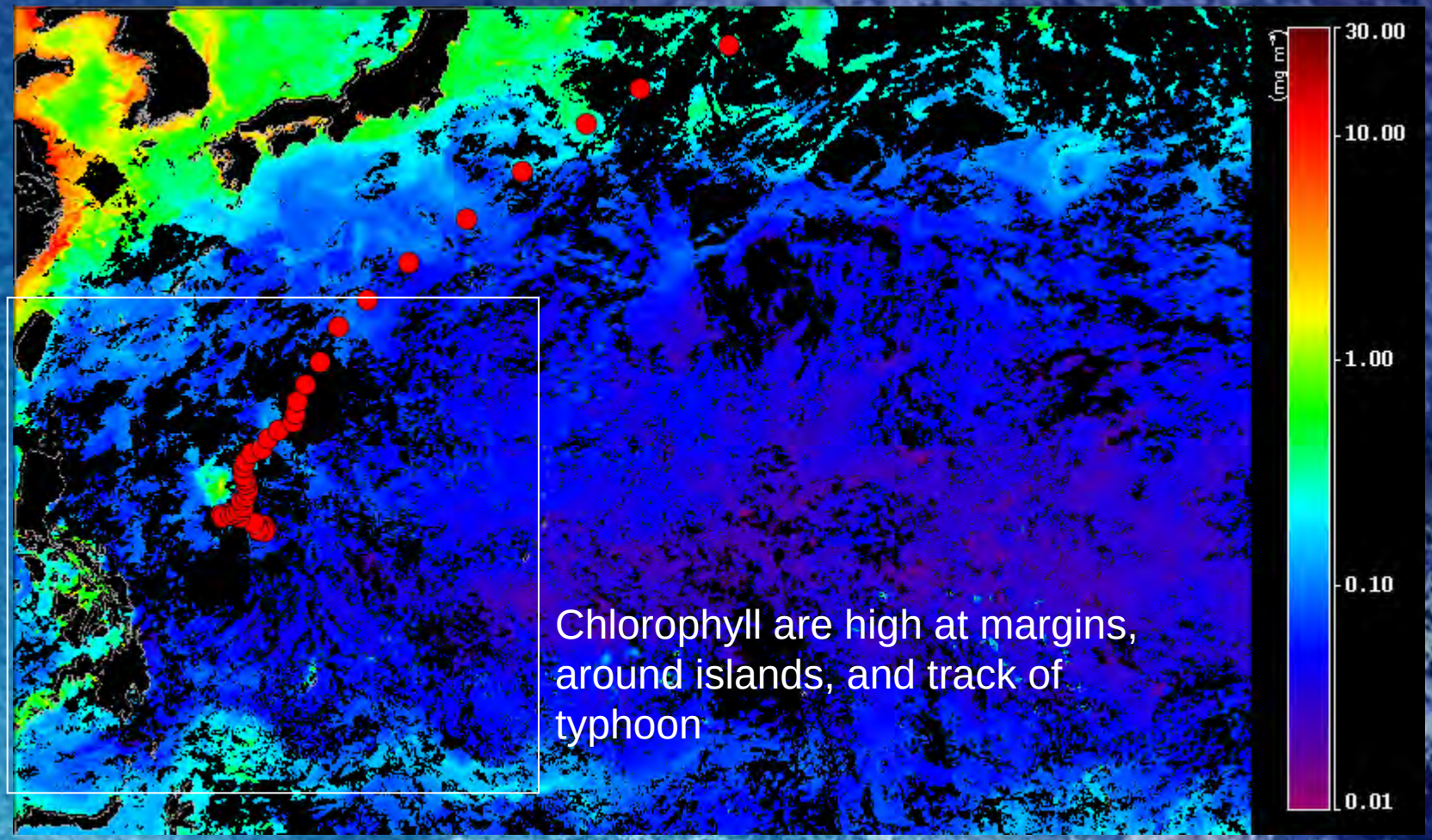

| OVM | Size | Genus | OVM | OVM type | |
|---|---|---|---|---|---|
| OVM | M / L / S | ***Rhincalanus*** | **Seasonal OVM** | **Subarctic<br>Middle lat.<br>Subtropical** |  |
| Epi | | ***Pareucalanus*** | **Seasonal OVM<br>Epipelagic** | **Middle lat.** |  |
| | | ***Eucalanus*** | **Seasonal OVM** | **Subarctic<br>Middle lat.<br>Subtropical** |  |
| | | ***Subeucalanus*** | **Seasonal OVM<br>Epipelagic** | **Middle lat.<br>Coastal** |  |

# Why Eucalanidae copepods have OVM?

- Subtropical and tropical Pacific are characterized by less seasonality at low phytoplankton standing stock.
- Large copepods are not adaptive for continuous reproduction at low food availability.
- But, there are spatially and temporally unpredictable high primary production.
- Surface occurrence and early copepodites were mainly observed in ocean margins during winter to spring

M. Toratani

# Chlorophyll distribution in Oct. 2003 and typhoon




Chlorophyll are high at margins, around islands, and track of typhoon

SeaWiFS 8 days composite image

# Conclusion

- Many Eucalanidae copepods have OVM as life cycle strategy, in spite of subtropical and tropical species.
- Dormant stages and depth varied by species.
- OVM in subtropical and tropical species are considered to evolved to utilize the unpredictable primary production.
- OVM facilitate the adaptation to the intensive seasonality in polar regions.