Food-web structure and dynamics in the frontal zone of Kuroshio Extension

H. Saito, Y. Nishibe, K. Hidaka. T. Ichikawa, S. Kakehi, M. Nakamachi, Y. Okazaki (Fisheries Research Agency)

K. Takahashi, K. Furuya, K. Hamasaki, Y. Nishibe, Y. Tada (Univ. of Tokyo)

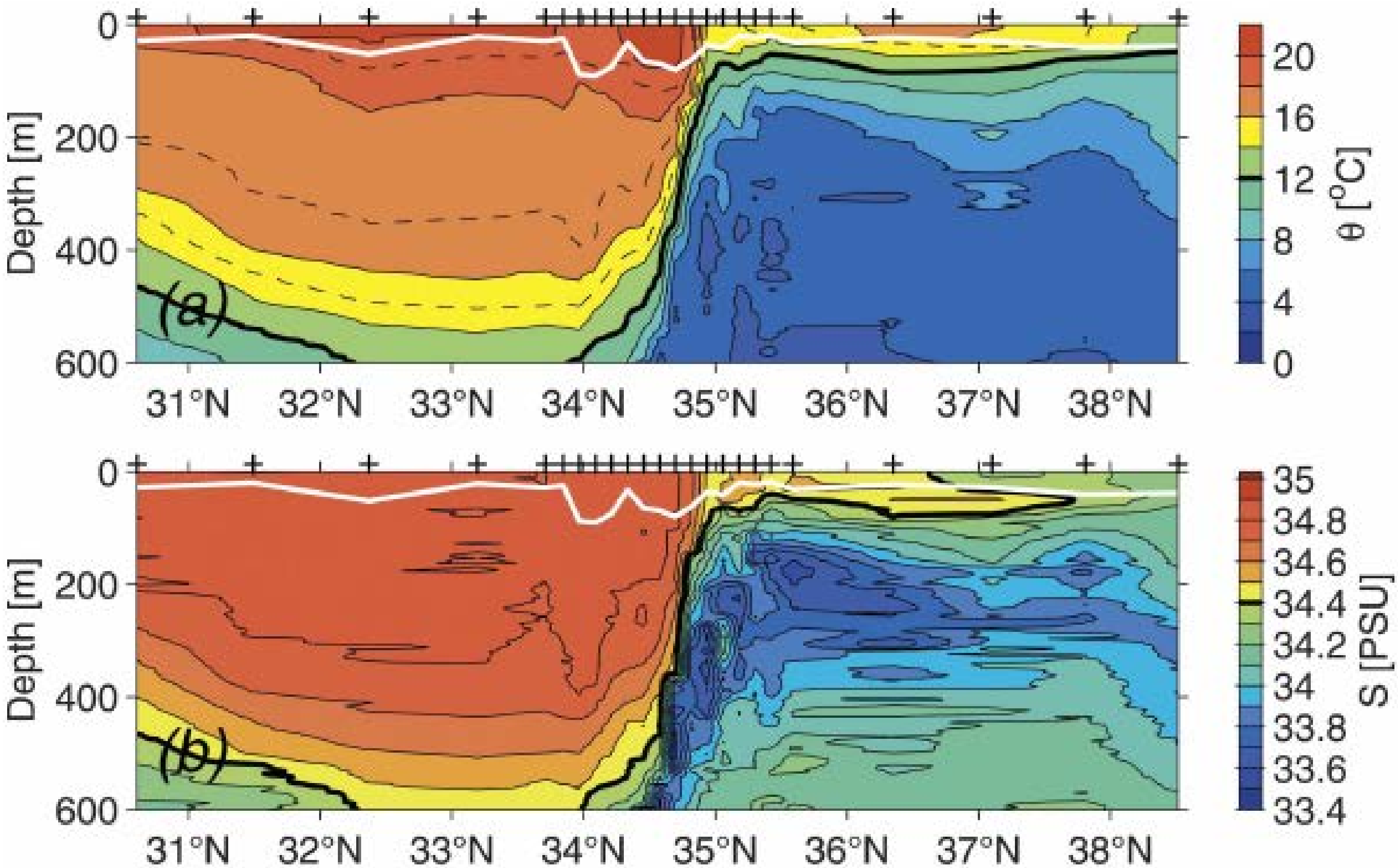
M. Ichinomiya (Pref. Univ. of Kumamoto)

POMAL

IMBER JAPAN

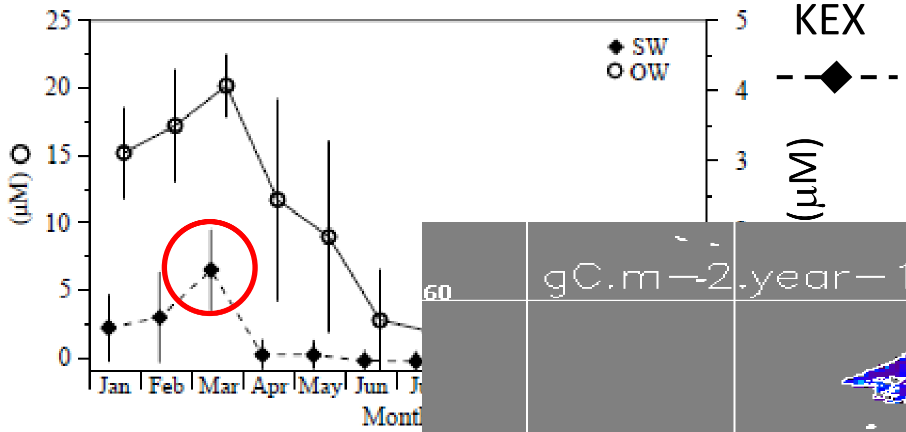
Japanese Integrated Marine Biogeochemistry and Ecosystem Research

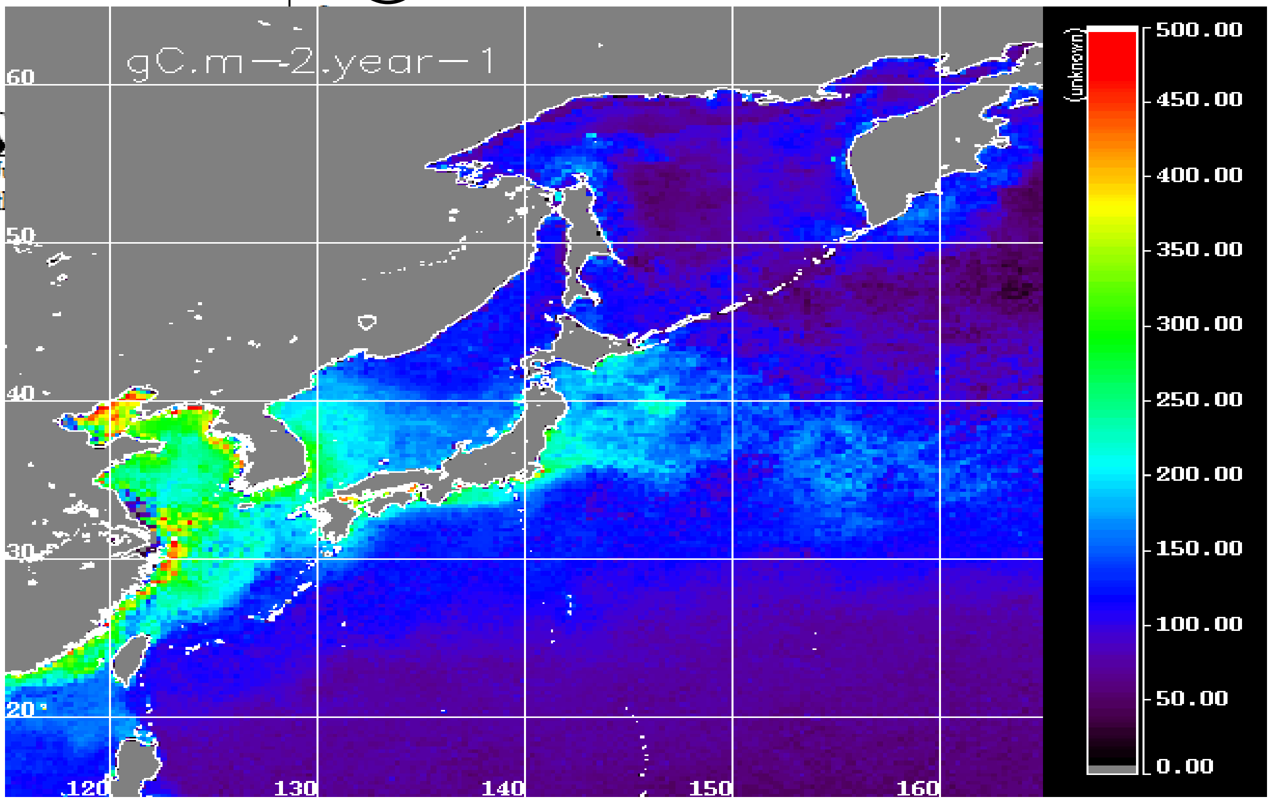
Kuroshio Extension



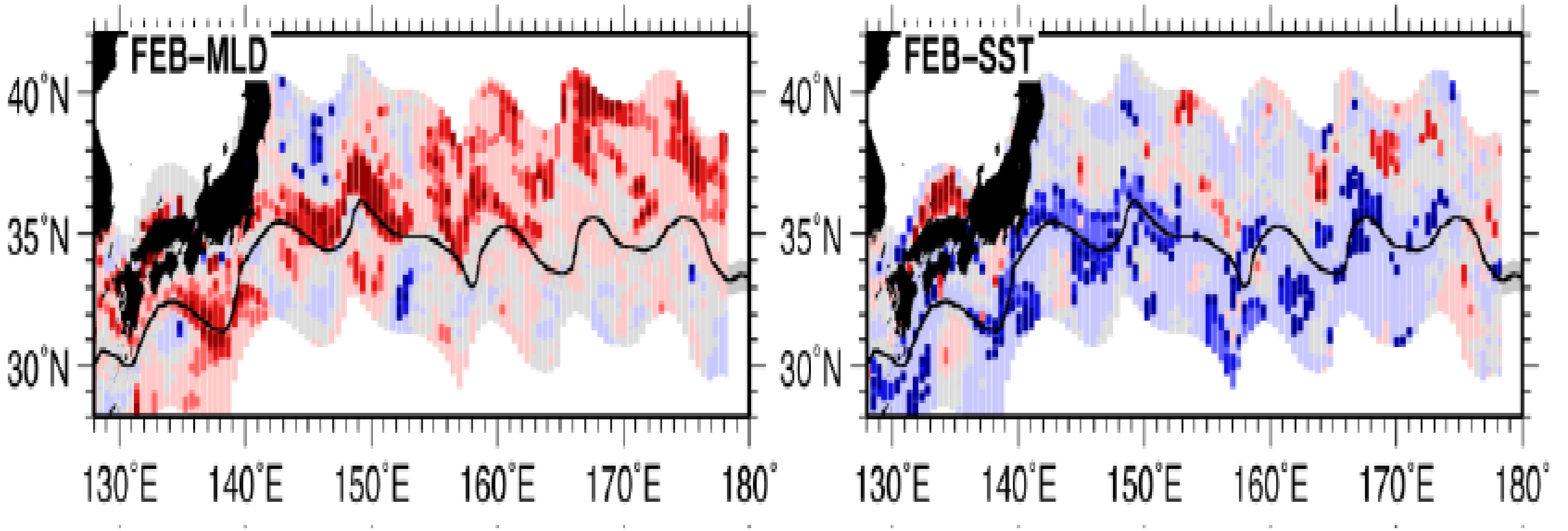
Qiu et al. 2006

Kuroshio Extension Region (KEX)





Significant correlation between sardine RPS (recruitment per spawner) and MLD or SST



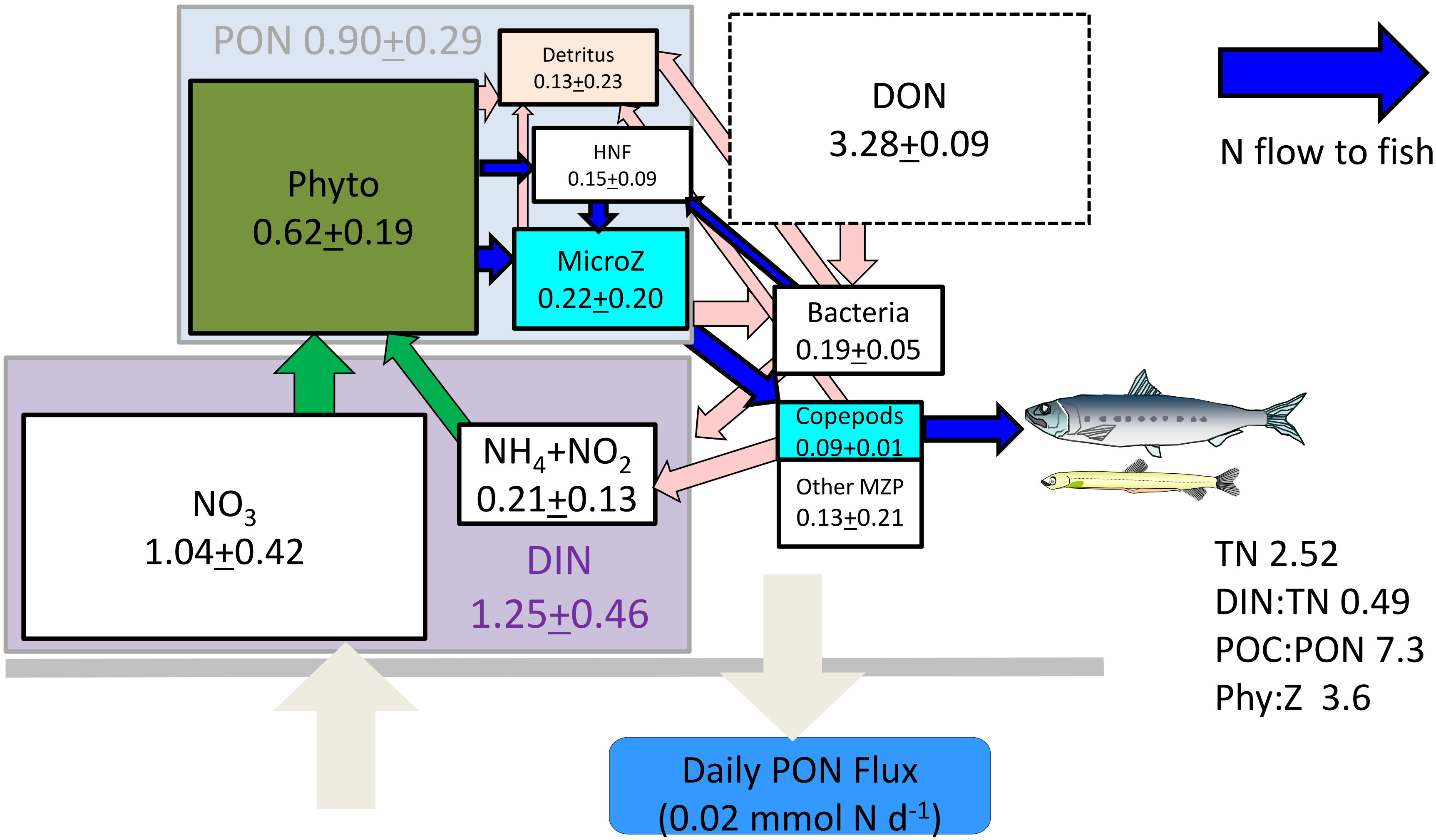
(Nishikawa, Yasuda & Itoh, FO, 2011)

In spite of the importance in the food-web dynamics at the frontal region of KEX especially considering the fish stock fluctuation, BGC, ecosystem components and their physiological characteristics have been seriously understudied.

In the SUPRFISH programme, we carried out comprehensive ecosystem study to understand the ecosystem components, structure and the control factors of food-web dynamics in the KEX ecosystem in spring.

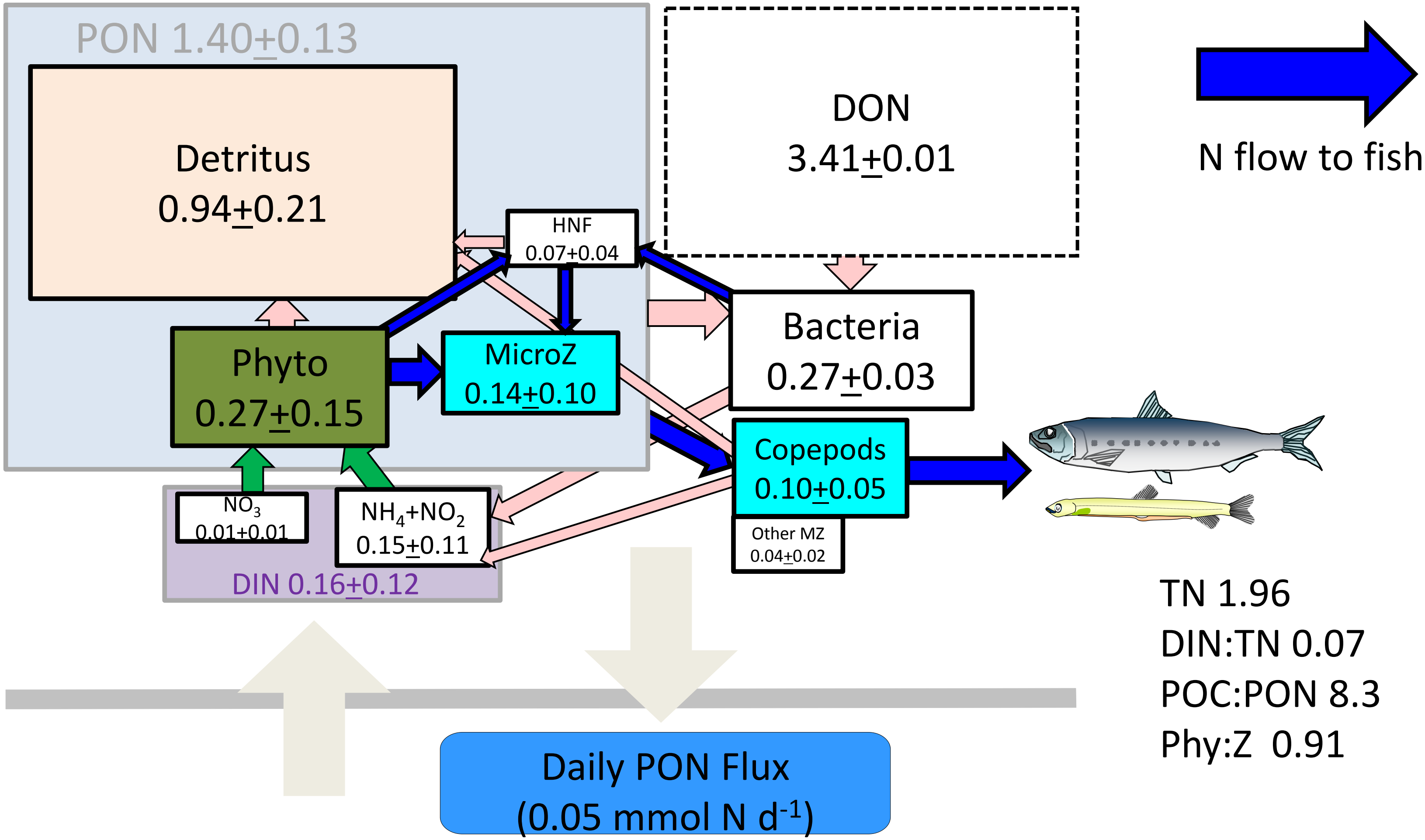
SUPRFISH is a part of POMAL project funded by AFFRC, Ministry of Agriculture, Forestry and Fisheries, Japan

N Inventory in KEX axis (April 10 m, mmol m^{-3})



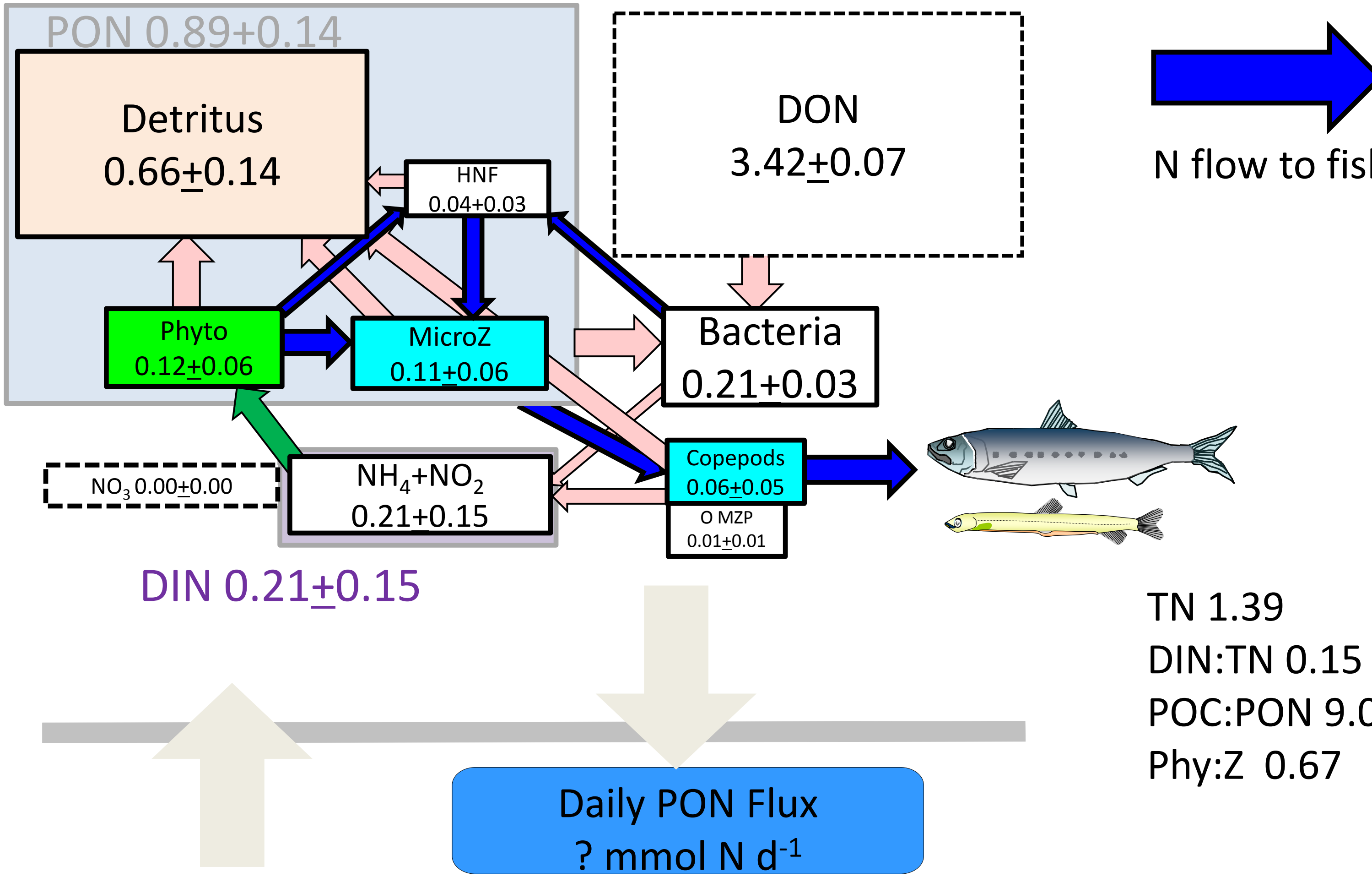
TN 2.52
DIN:TN 0.49
POC:PON 7.3
Phy:Z 3.6

N Inventory in KEX axis (May 10 m, mmol m^{-3})



TN 1.96
DIN:TN 0.07
POC:PON 8.3
Phy:Z 0.91

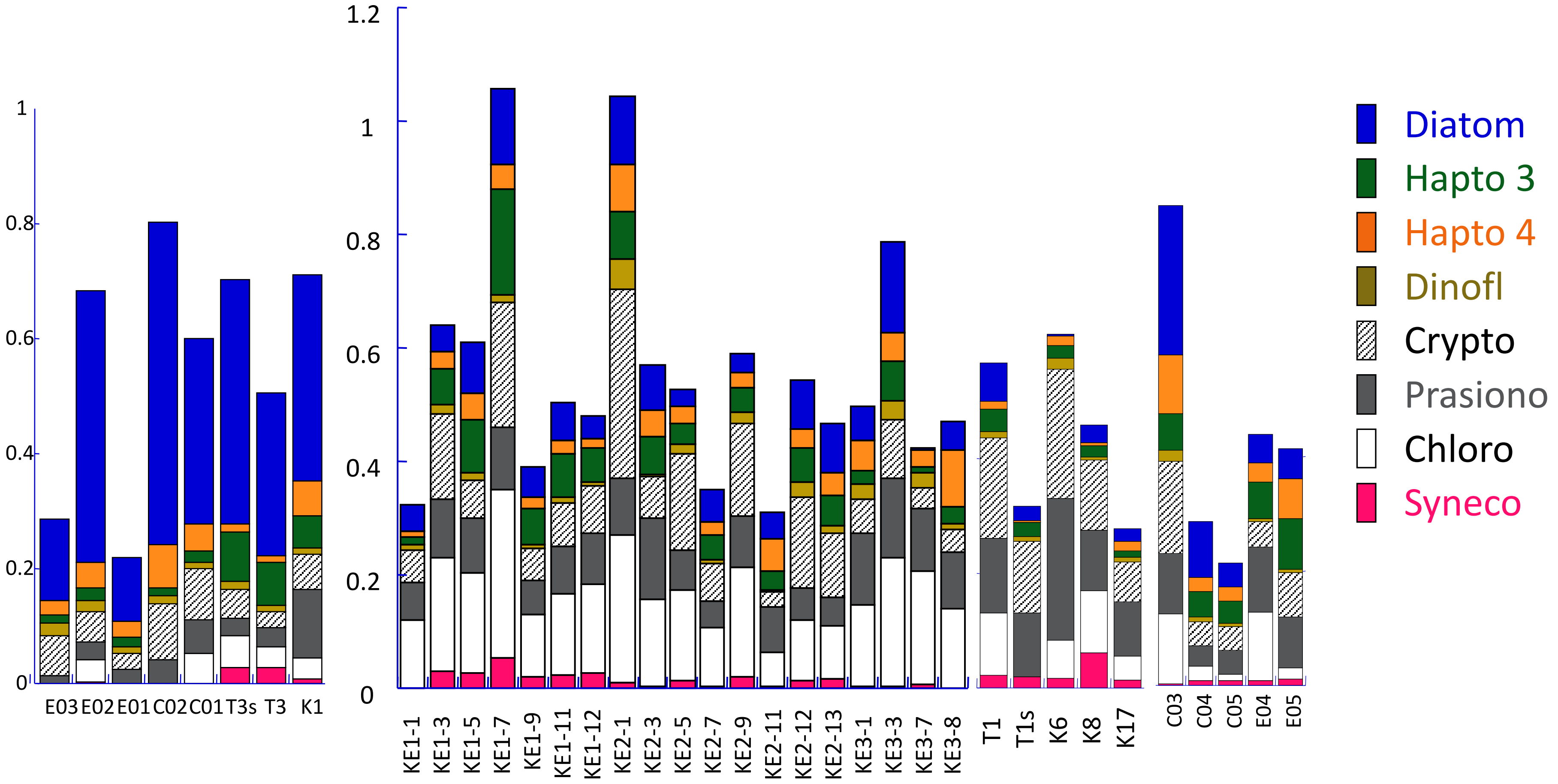
N Inventory South of KEX axis-May



TN 1.39
DIN:TN 0.15
POC:PON 9.0
Phy:Z 0.67

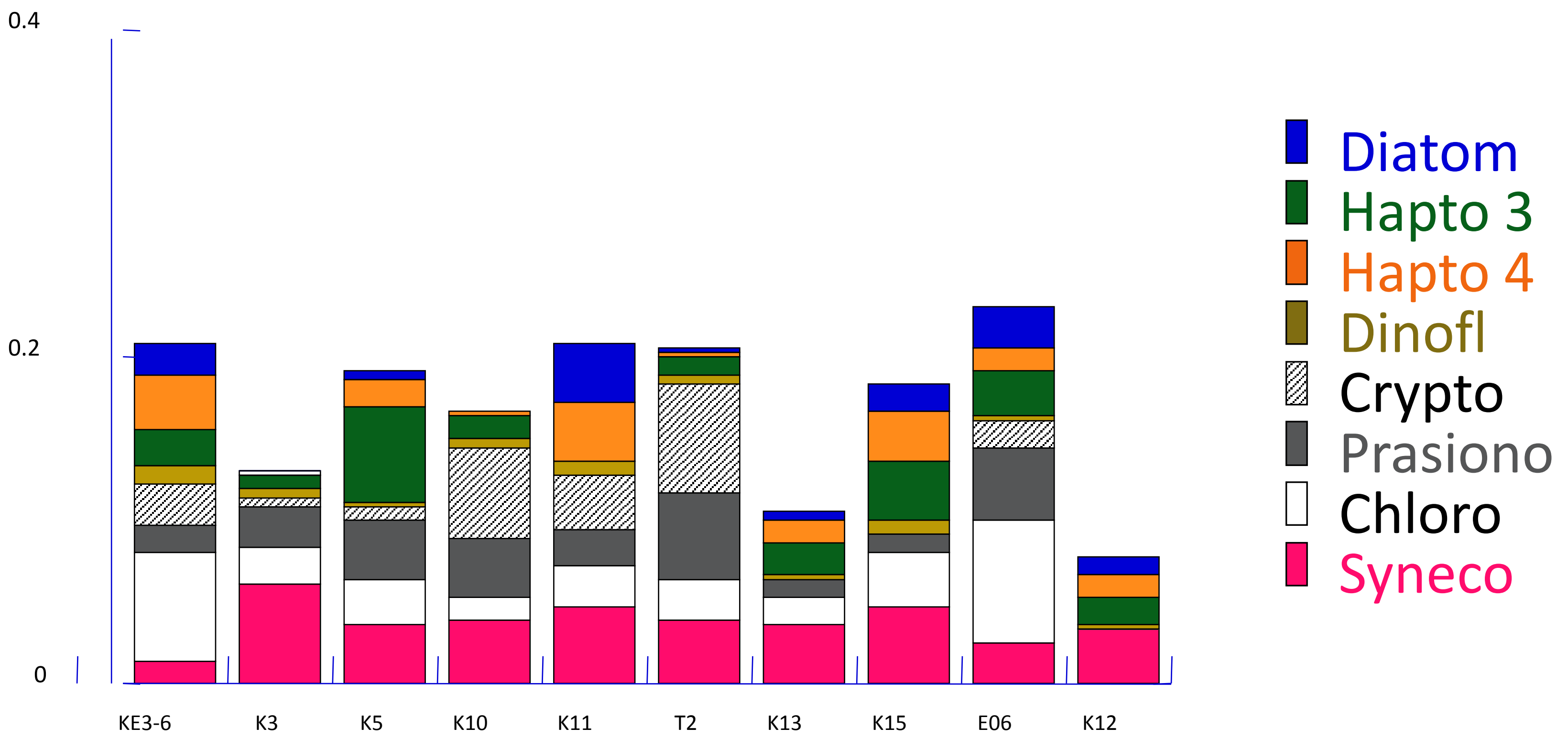
Phytoplankton community structure

Blooming period in the KEX and northern KEX



Phytoplankton community structure

South of KEX



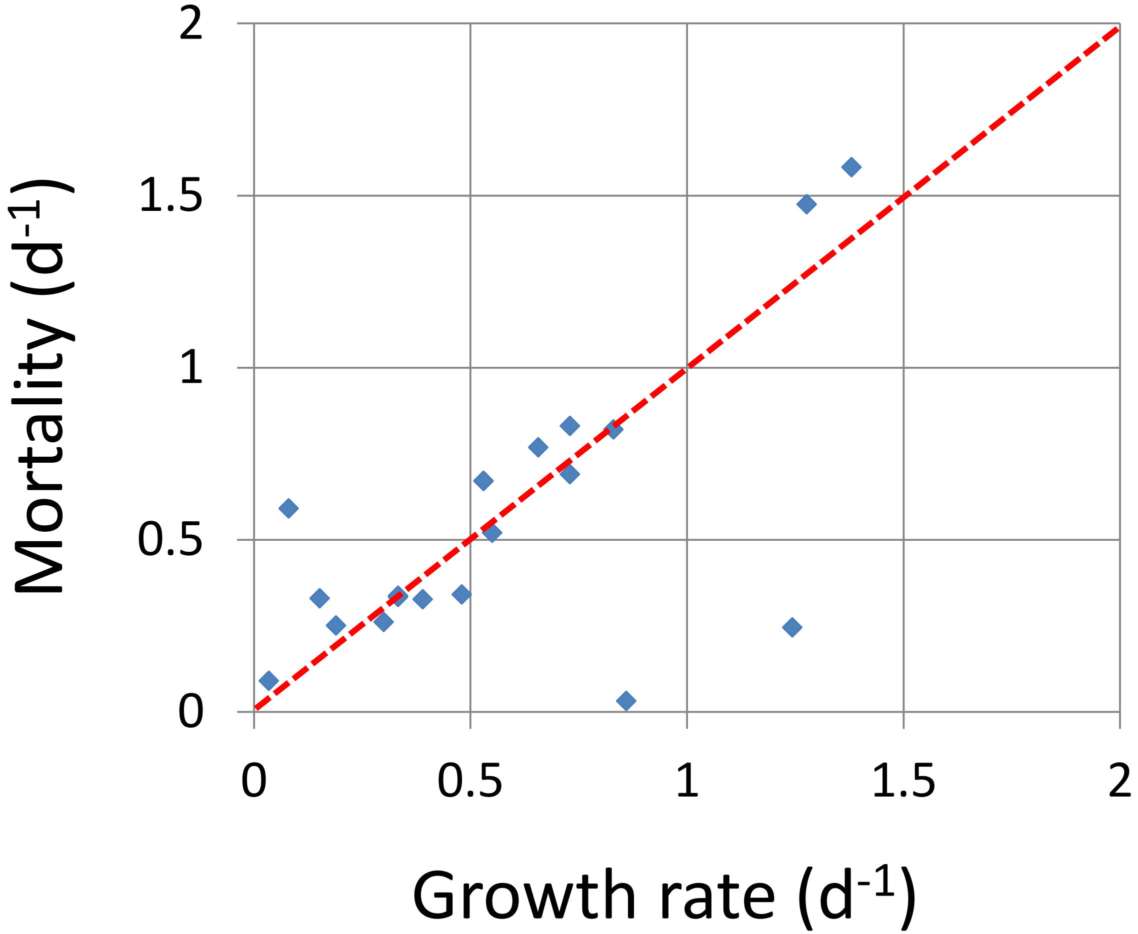
Primary production
Bacterial vs Phytoplankton ratio

>1 indicate lateral DOM flux from external region

Cruise	Station	**Bacterial production integrated ($mgC\ m^{-2}\ d^{-1}$)**	**Primary production integrated ($mgC\ m^{-2}\ d^{-1}$)**	**B:P production integrated**
WK0804	KE1-11	460	444	1.04
	KE1-12	789	356	2.22
	KE2-13	421	483	0.87
	KE3-7	170	146	1.17
WK0805	F1	152	234	0.65

Suggesting KEX ecosystem is partly supported by the 1er production of up stream region

Bacterial growth vs mortality

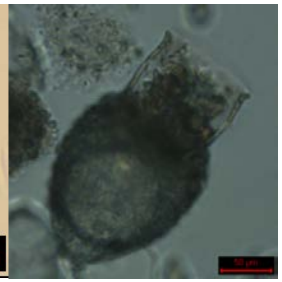


Mirozooplankton (10-200 µm)

Ciliates

Naked (NC)

Tintinnid



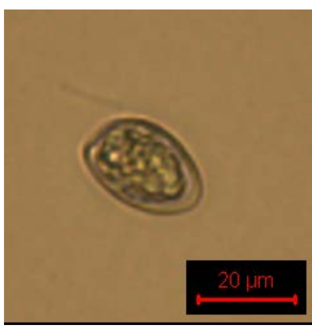
Crustacean nauplii

Others

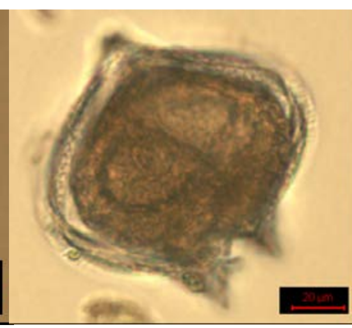
Radiolaria
Foraminifera

Dinoflagellates (autotrouph, mixotrouph, heterotrough)

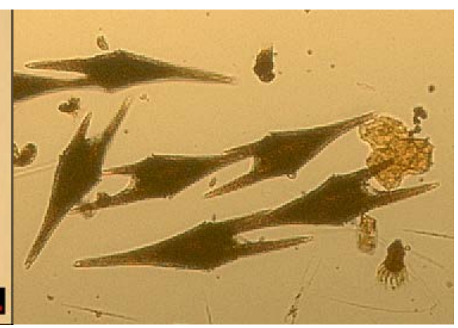
Thecate



10-20µm
Prorocentrum sp.

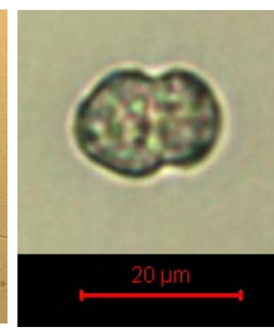


> 20µm
Protoperidinium

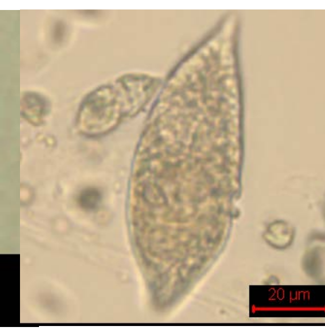


> 20µm
Ceratium

Athecate

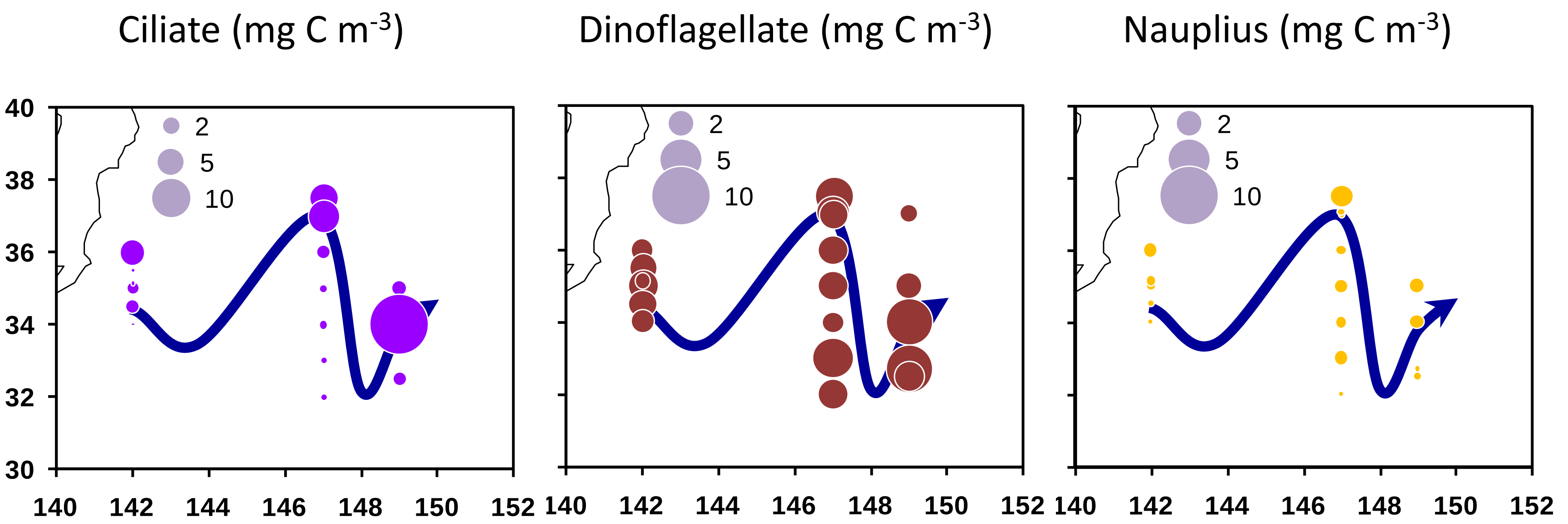


10-20µm
Gymnodinium



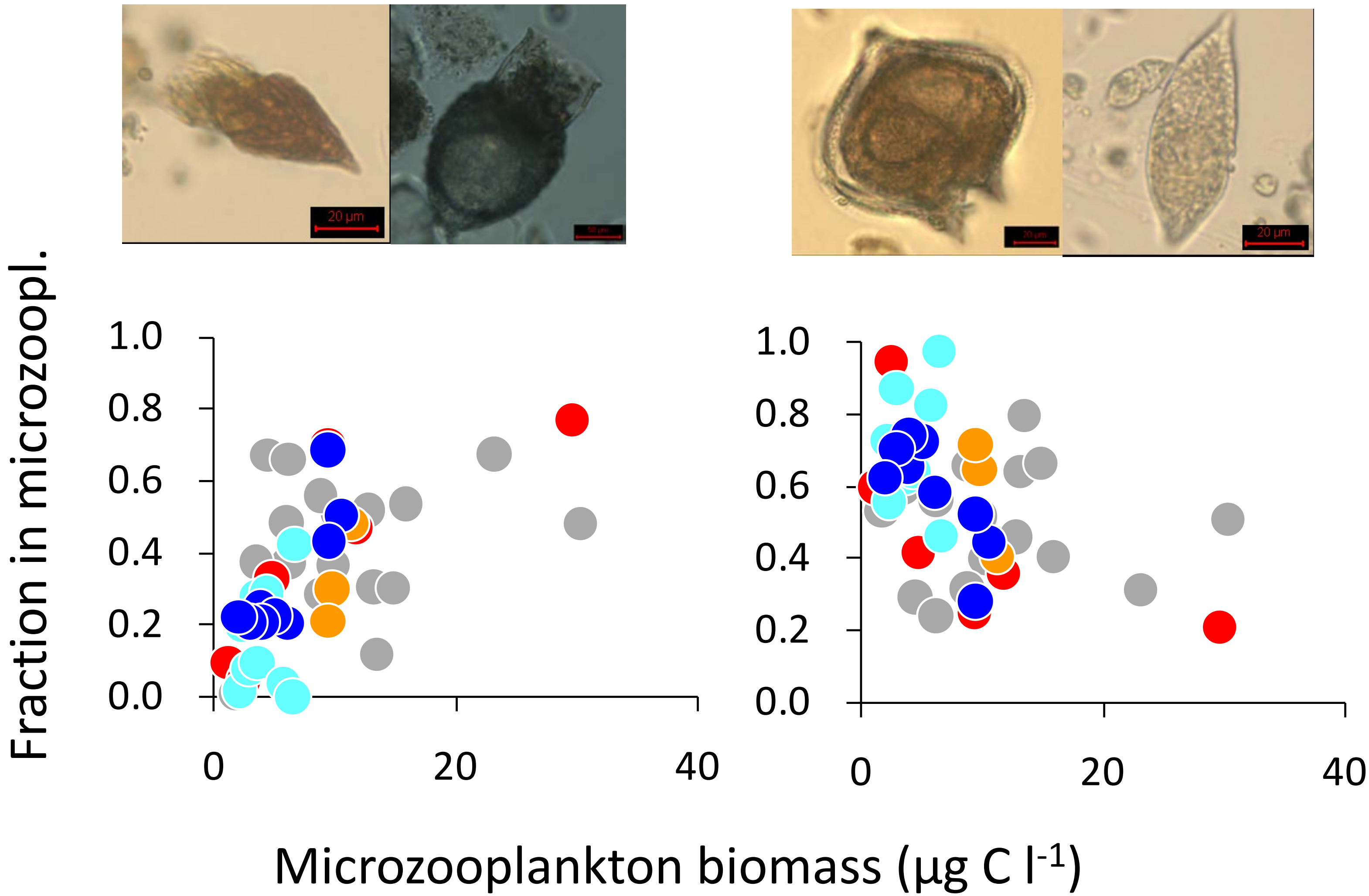
> 20µm
Gyrodinium
Gymnodinium

Microzooplankton (mg C m^{-3})



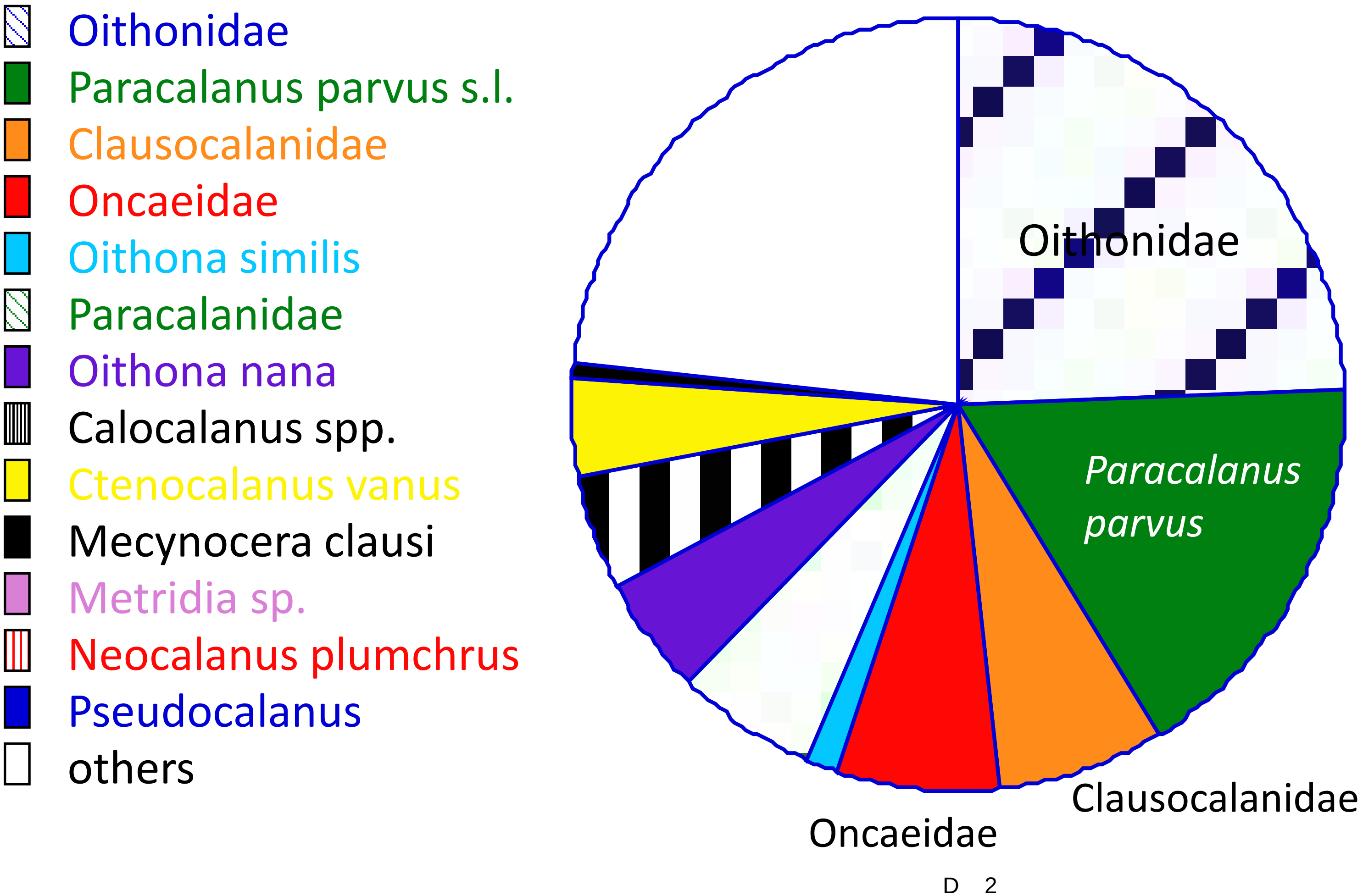
Ciliates

Dinoflagellates



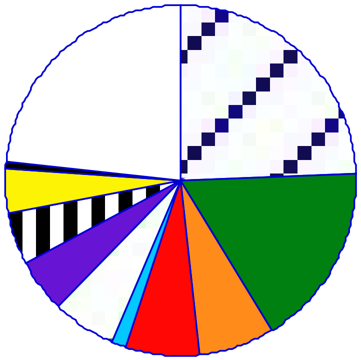
KEX Copepods Community

Grouping by means of Bray-Curtis index



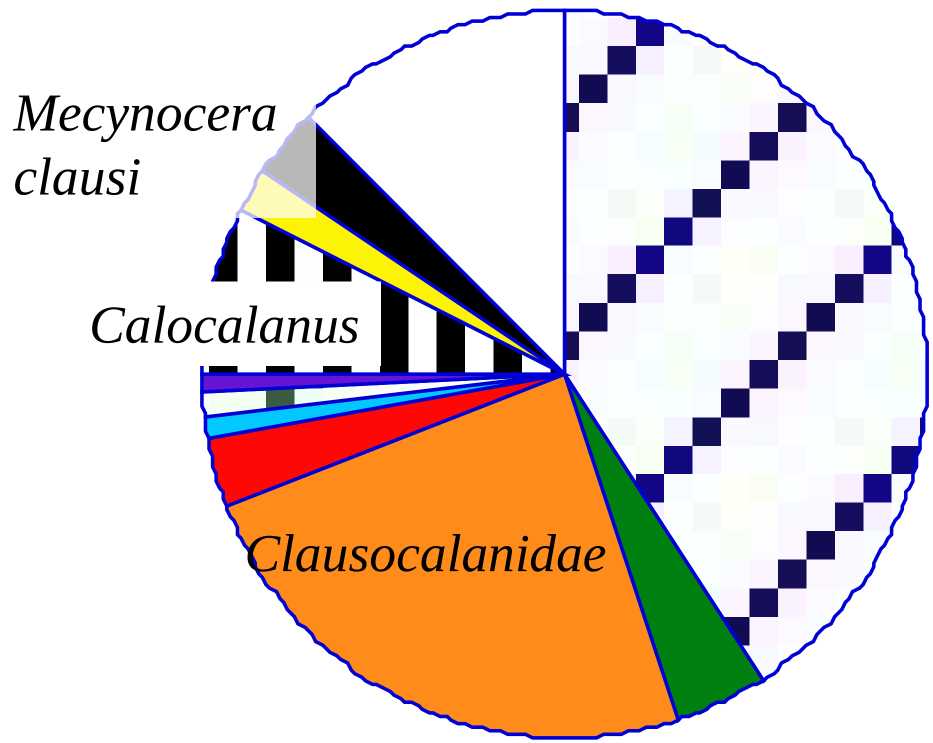
KEX Copepods Community

Grouping by means of Bray-Curtis index



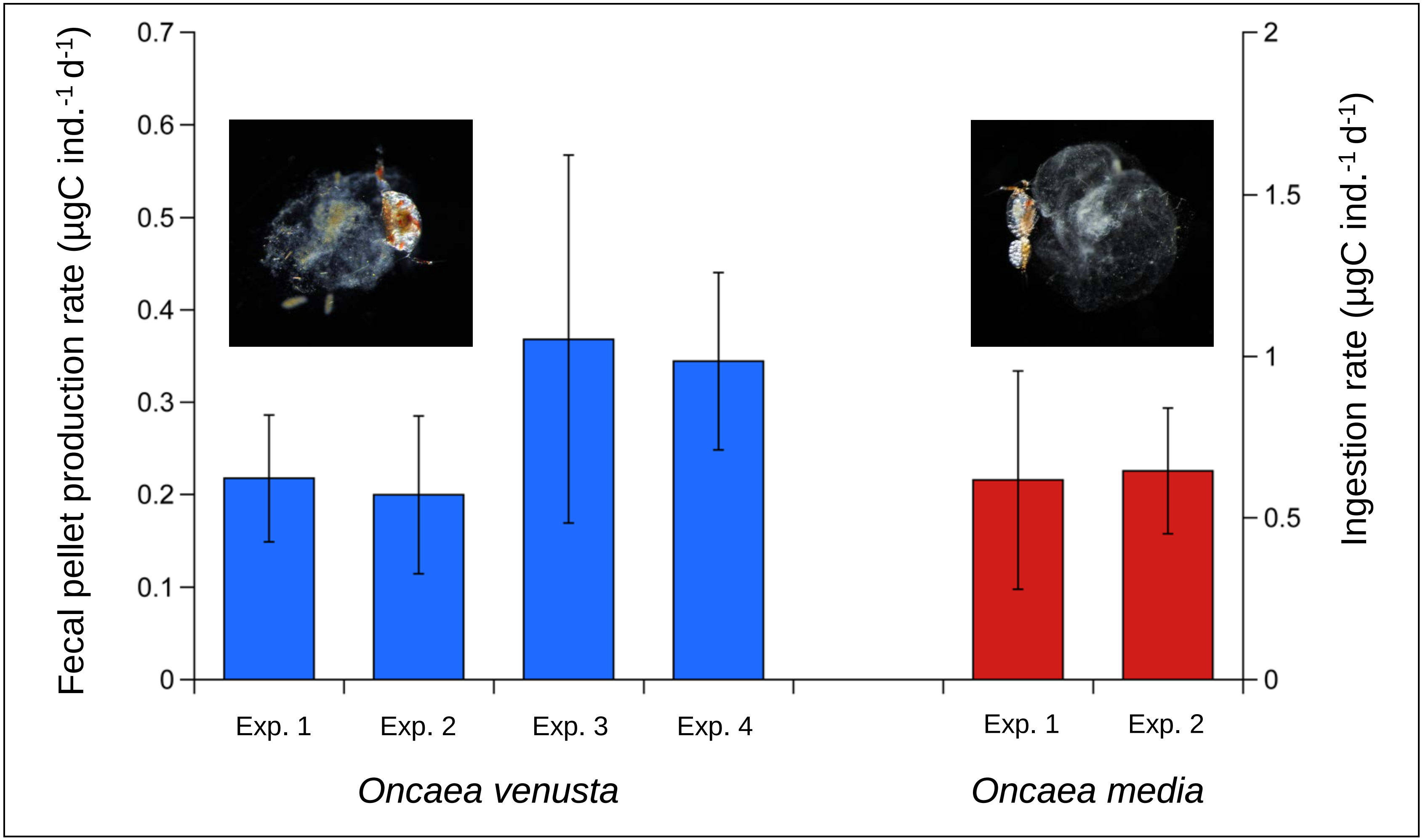
- Oithonidae
- Paracalanus parvus s.l.
- Clausocalanidae
- Oncaeidae
- Oithona similis
- Paracalanidae
- Oithona nana
- Calocalanus spp.
- Ctenocalanus vanus
- Mecynocera clausi
- Metridia sp.
- Neocalanus plumchrus
- Pseudocalanus
- others

After nutrient depletion

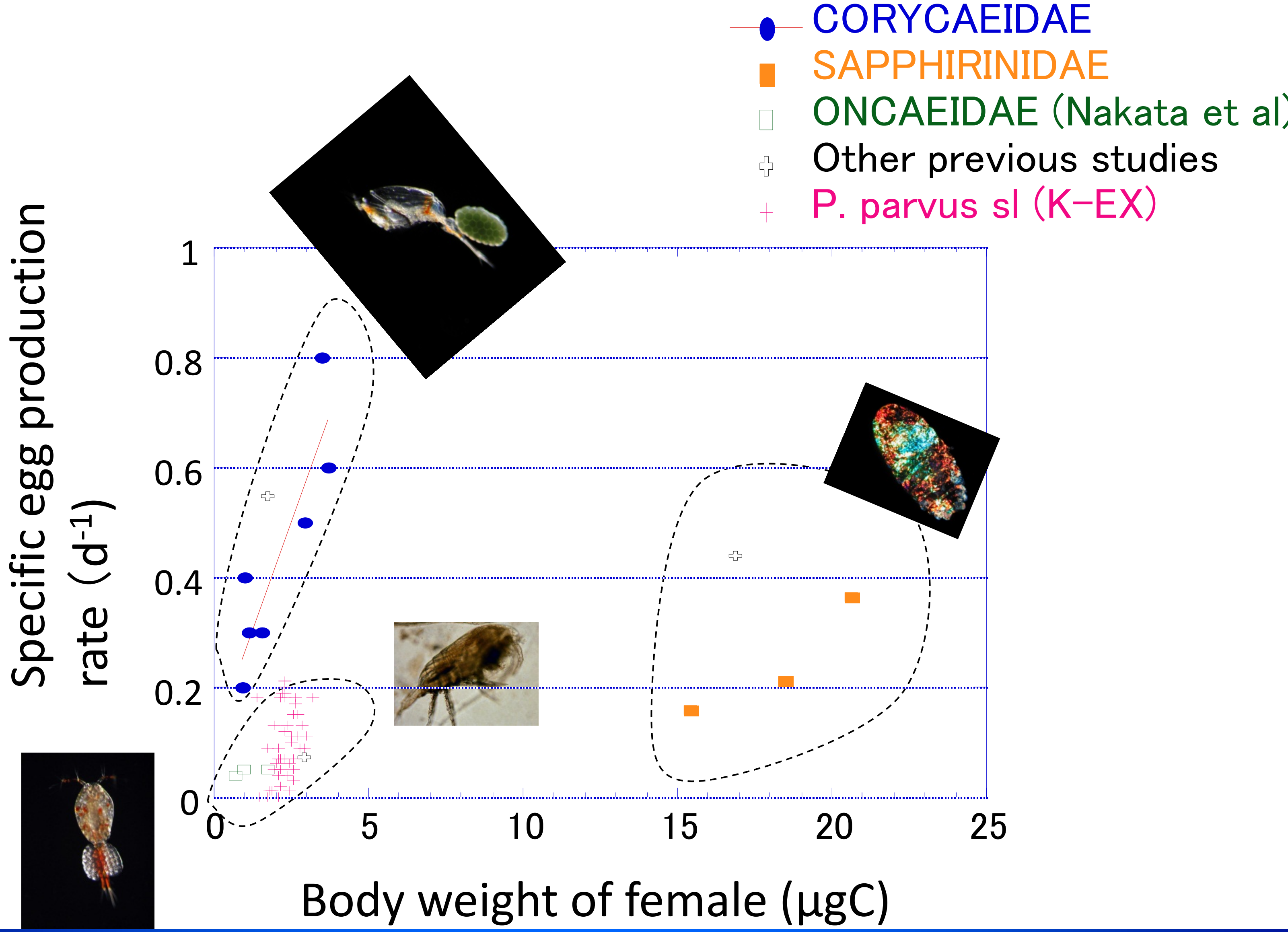


Oncaea venusta and *O. Media*

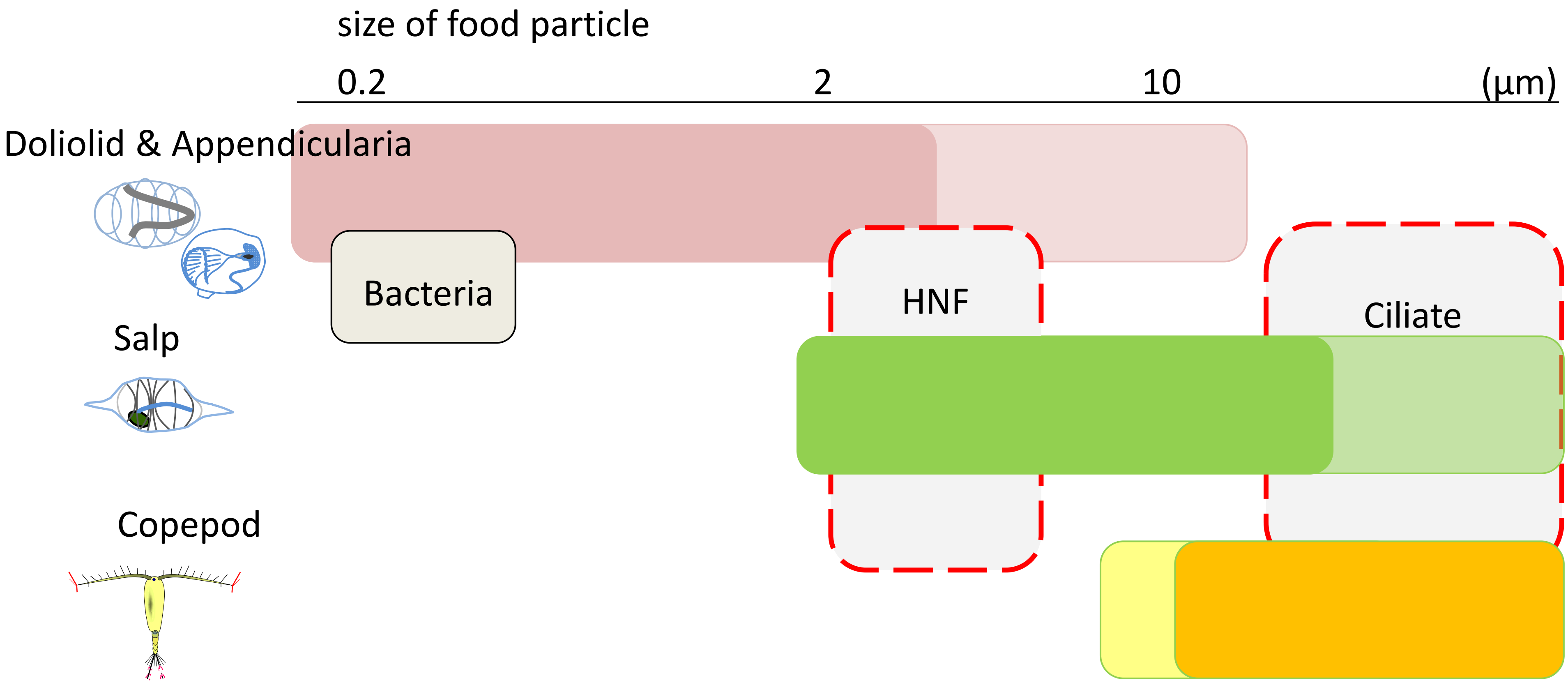
Faecal pellet production and ingestion rate on discarded appendicularian house



Weight specific egg production rate



Prey size of Tunicates & Copepod



Grazing pressure of appendicularians

Station	Ingestion	abundance	comm. ingestion	0-50m Chl. a	% ingestion
	(μg chl ind-1 d-1)	(inds. m-2)	(mg chl m-2 d-1)	(mg m-2)	
KE1-11	0.17	15208	2.62	37.09	7.1
KE1-12	0.15	20000	3.08	28.40	10.8
KE2-13	0.64	45440	29.30	30.83	95.0
KE3-7	0.17	79272	13.31	37.85	35.2
KE3-8	0.39	20275	7.86	37.61	20.9

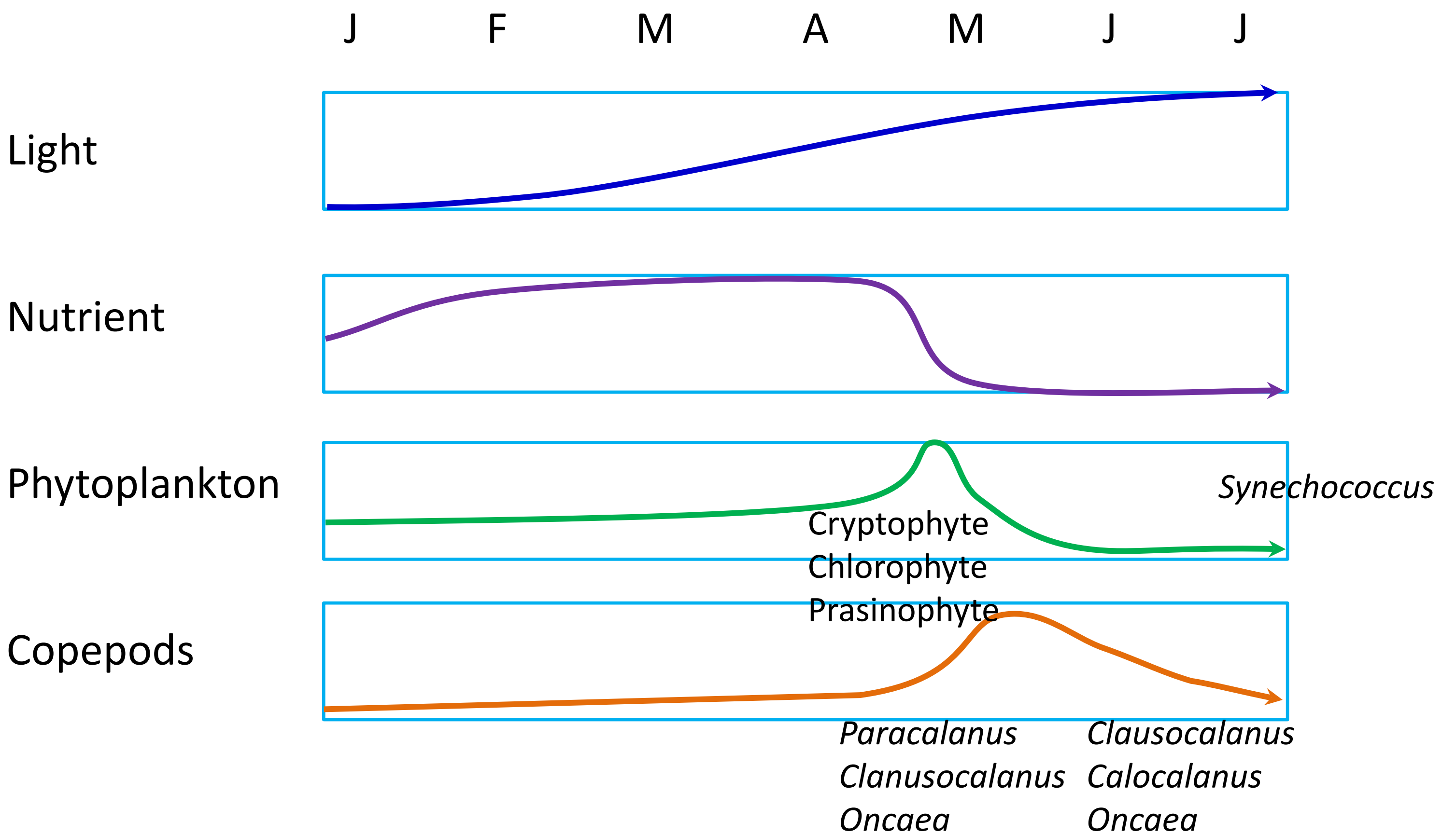
Ecological function of appendicularian

High grazing pressure on phytoplankton and the production of sticky houses indicate appendicularians role of repackaging and gathering small non-sinking particles which are not transported to fish through grazing food chain (*Paracalanus*).

Supporting the production of *Oncaea*, important prey for juvenile fish in the KEX.

Appendicularians transfer nano- picophytoplankton production to *Oncaea*. Increasing the ecological transfer efficiency of microbial production which are dominant in the KEX ecosystem.

Ecosystem succession in the KEX



Nut+
Nano+microphyto.
Hervivorous copepods

Nut-zero
Picophyto.
Detritivorous copepods
HNF

Bottom-up control of the ecosystem succession

Conclusion

- Chlorophyte, cryptophyte and prasiophyte are dominant phytoplankton at pre- and mid-bloom period. *Synechococcus* is dominant after nutrient depletion
- Bacterial biomass and production is equivalent to or higher than those of phytoplankton, partly dependent on the production out of KEX
- Ciliates and dinoflagellates are dominant components in microzooplankton. Ciliates increase with phytoplankton biomass but this tendency is not clear for dinoflagellates.
- Appendicularians play unique role of transferring nano- and pico-phytoplankton production and detritus to fish larvae through supplying discarded house to *Oncaea* spp.
- Detritivorous (*Oncaea*) and carnivorous (*Corycaeus, Sapphlina*) copepods are suggested to be important prey for larval/juvenile fish after the decrease of calanoid copepods (*Paracalanus, Clausocalanus, Calanus*).
- Various food-web processes support larval and juvenile fish production in the KEX