Lipid biomarkers and stable isotopes reveal disconnect between feeding dynamics of mesopelagic zooplankton and a spring diatom bloom in the Scotia Sea

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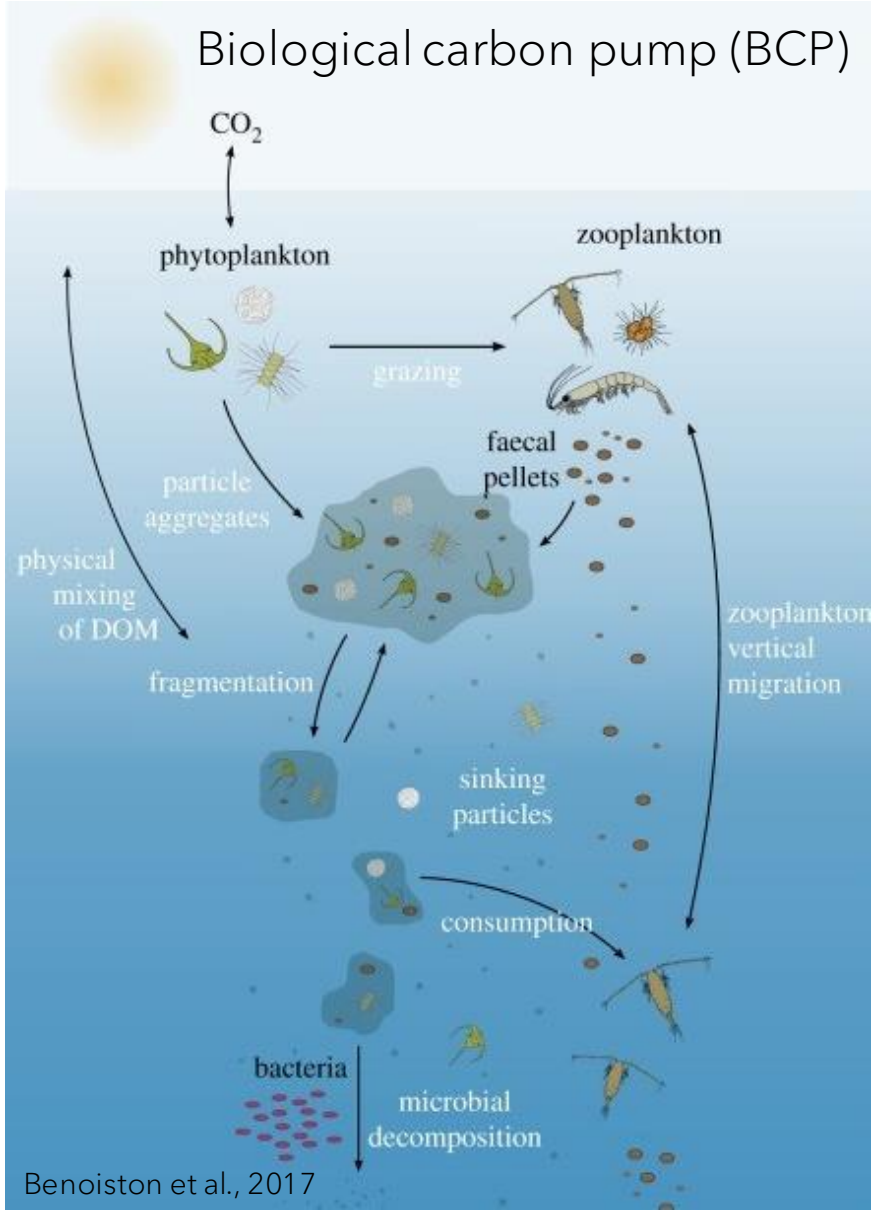
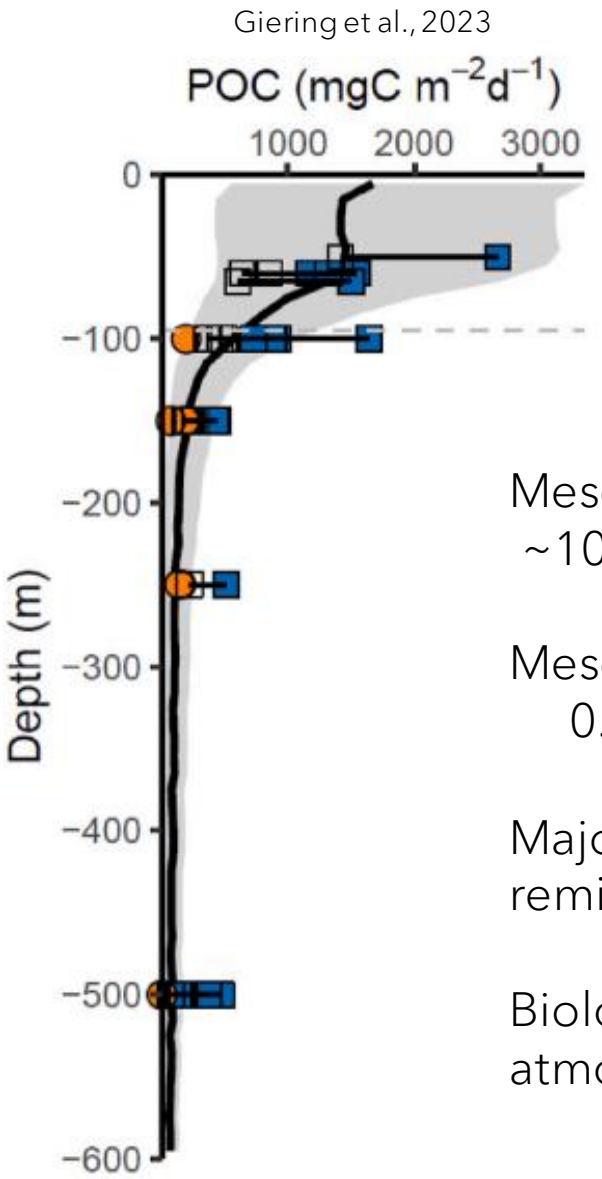
Images: Dan Mayor, Instagram @oceanplankton

Why study zooplankton in the mesopelagic?





Mesopelagic zone
~100 – 1000 m

Mesozooplankton size range
0.2 – 20 mm

Majority of particulate organic carbon (POC) remineralised within the upper mesopelagic

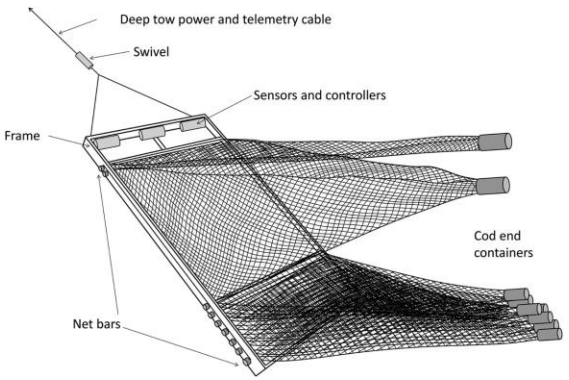
Biological carbon pump estimated to lower atmospheric CO_2 levels by up to 200 ppm

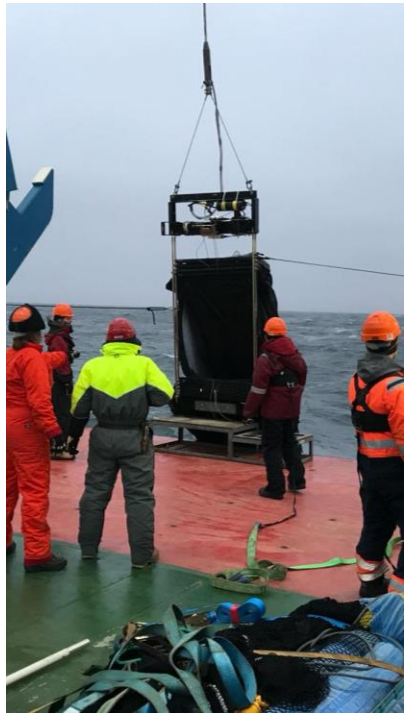
Study site

COMICS programme funded by NERC.

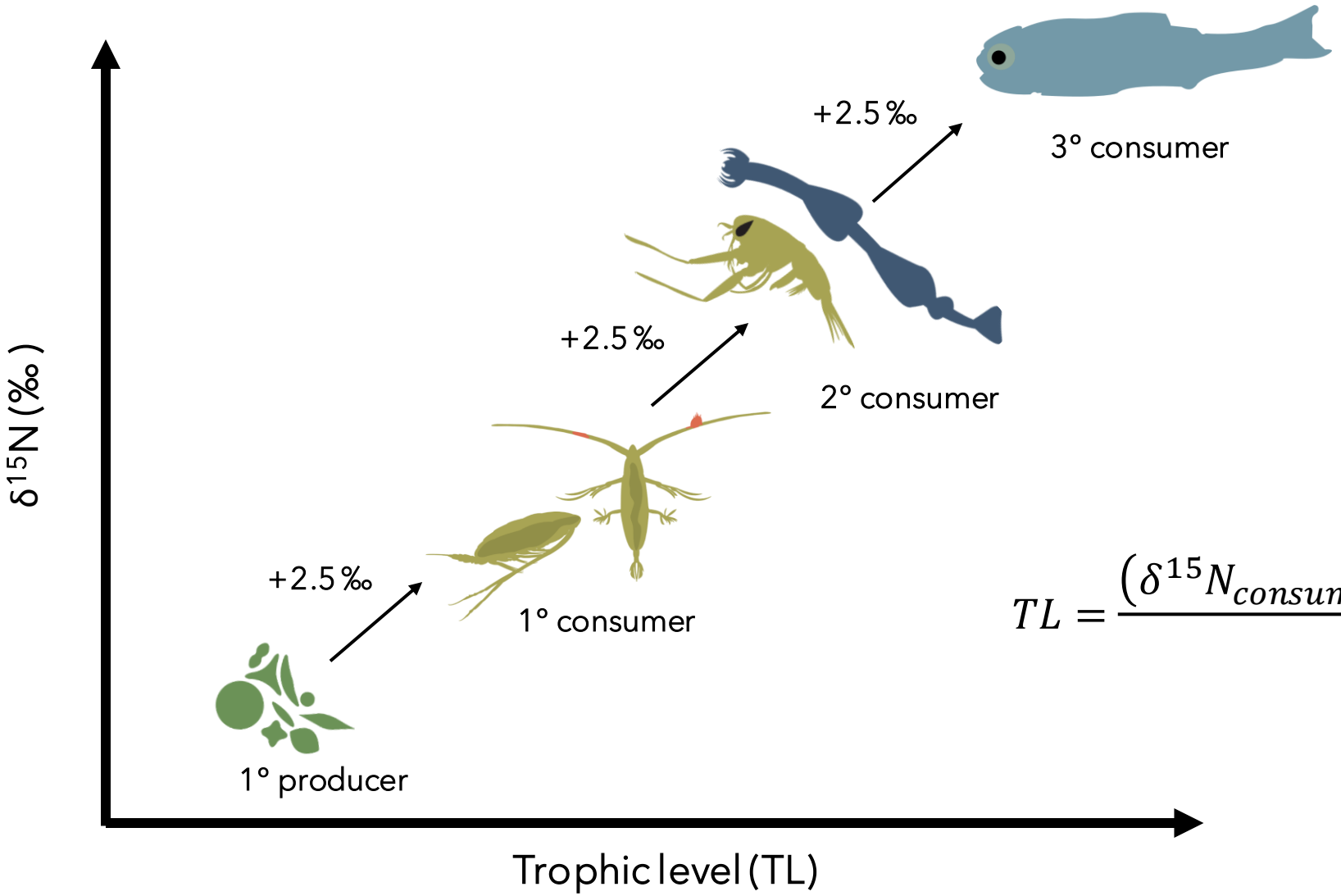
Research cruise DY086 (12th Nov. – 19th Dec. 2017).

3 visits to the P3 sampling site:
P3A, P3B, P3C



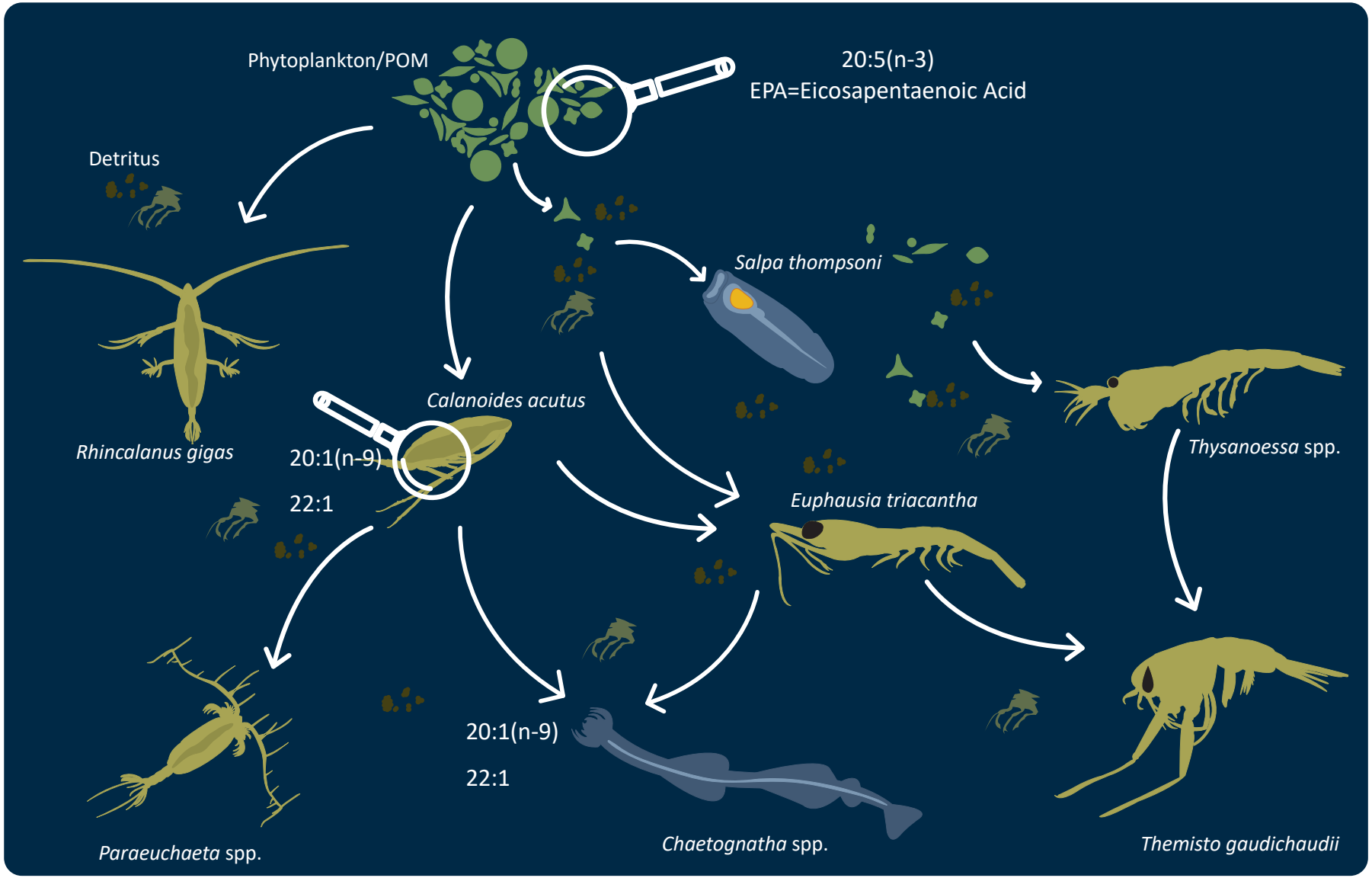


Nitrogen stable isotope analysis



$$TL = \frac{\left(\delta^{15}N_{consumer} - \delta^{15}N_{primary\ consumer}\right)}{2.5} + 2$$

Lipid biomarkers



Some important fatty acids:

20:5(n-3) **EPA** – diatoms

22:6(n-3) **DHA** – dinoflagellates

20:1(n-9) & **22:1(n-11)** herbivorous calanoid biomarker

18:1(n-9) – general zooplankton/animal biomarker

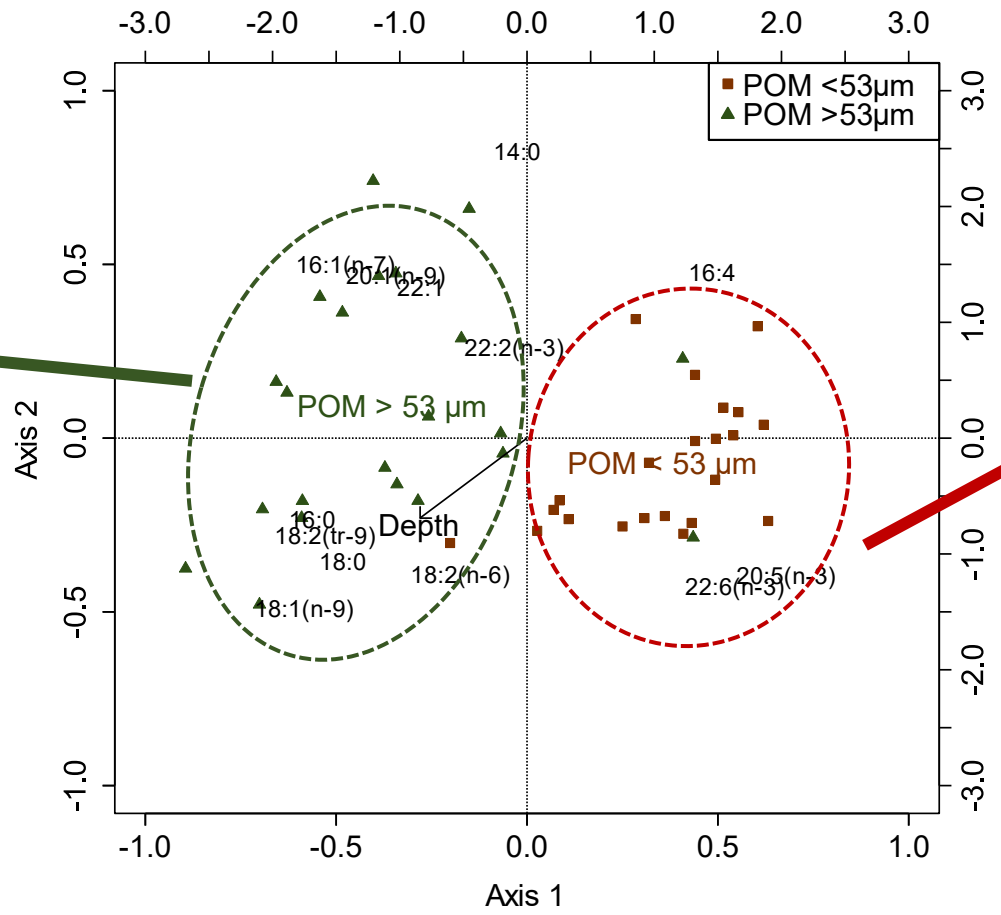
Particulate organic matter (POM)

Station P3 was characterised by a phytoplankton bloom dominated by large diatoms, with live, intact diatoms at depths within and below the epipelagic zone.

Zooplankton fatty acid biomarkers

20:1(n-9) & **22:1(n-11)** herbivorous calanoid biomarker

18:1(n-9) – general zooplankton/animal biomarker



Diatom and dinoflagellate fatty acid biomarkers

20:5(n-3) **EPA** – diatoms

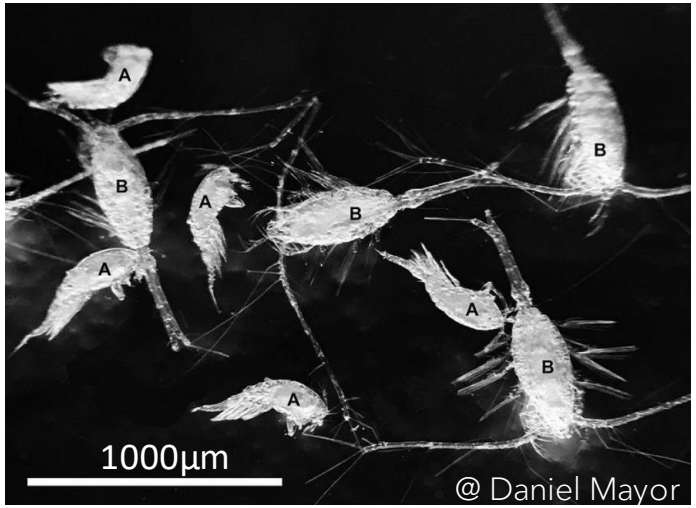
22:6(n-3) **DHA** – dinoflagellates

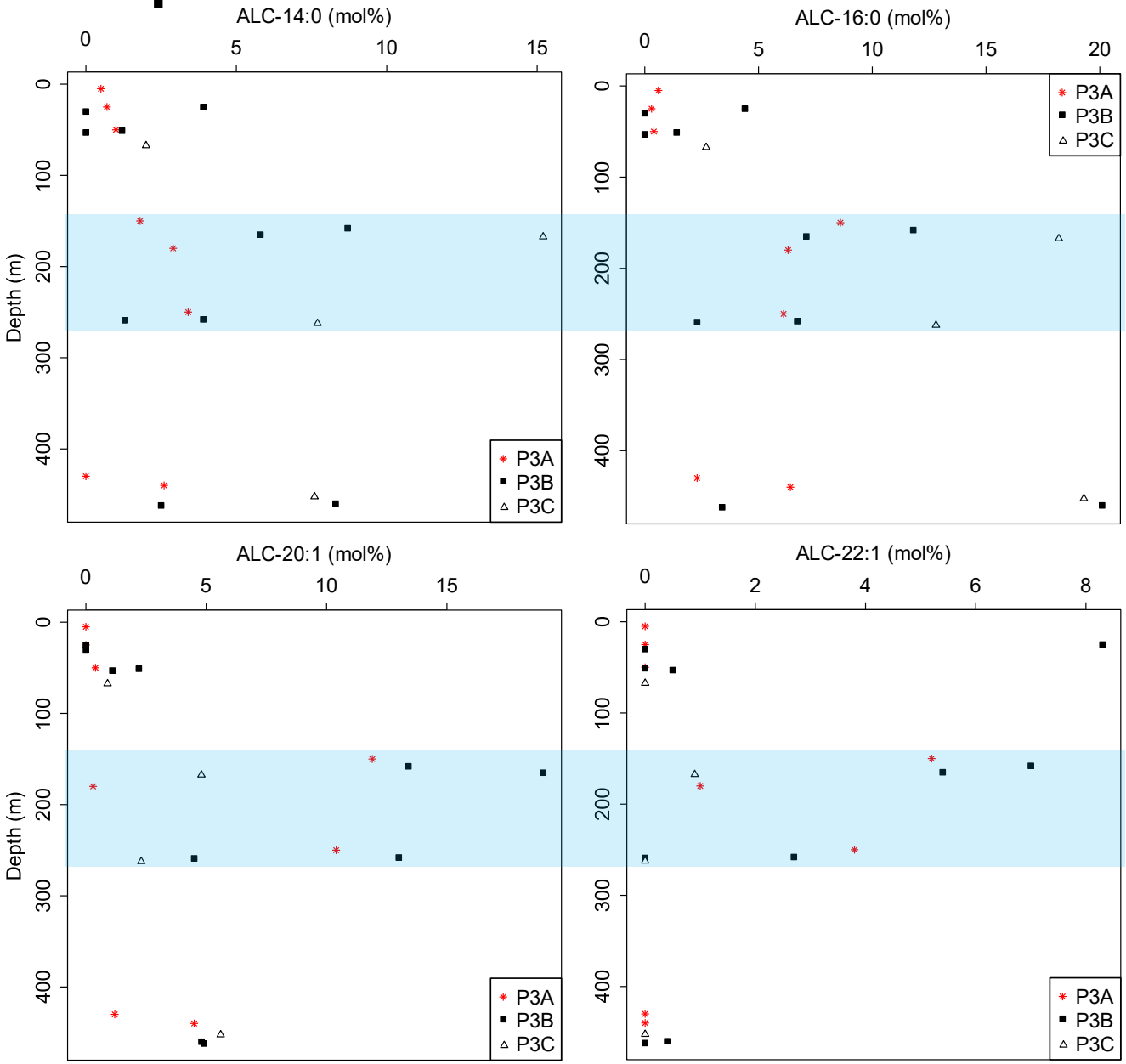
Analysis of POM > 53 µm

Fatty alcohols as indicators of zooplankton not POM.

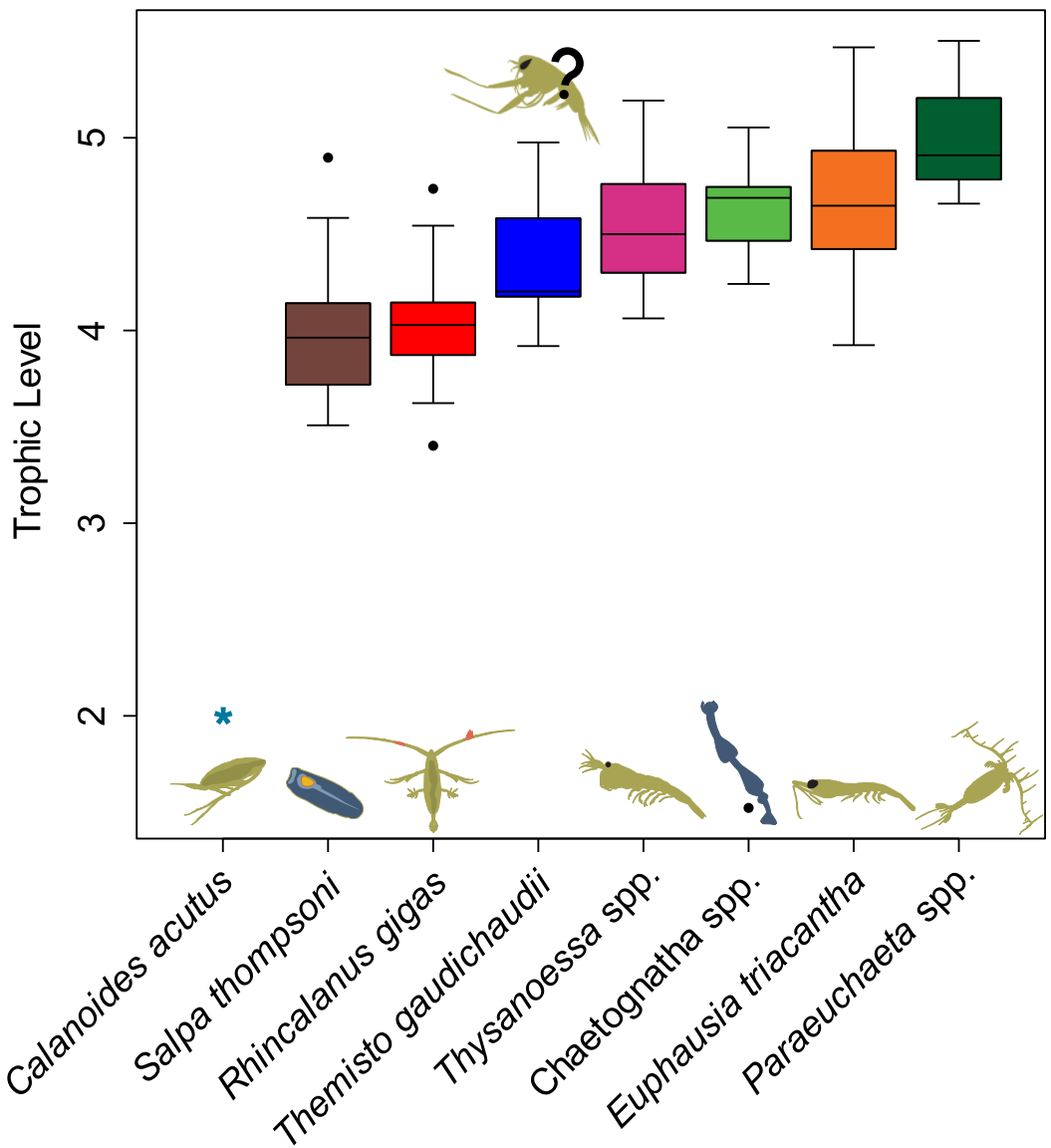
Higher abundance of fatty alcohols between ~150 – 250 m.

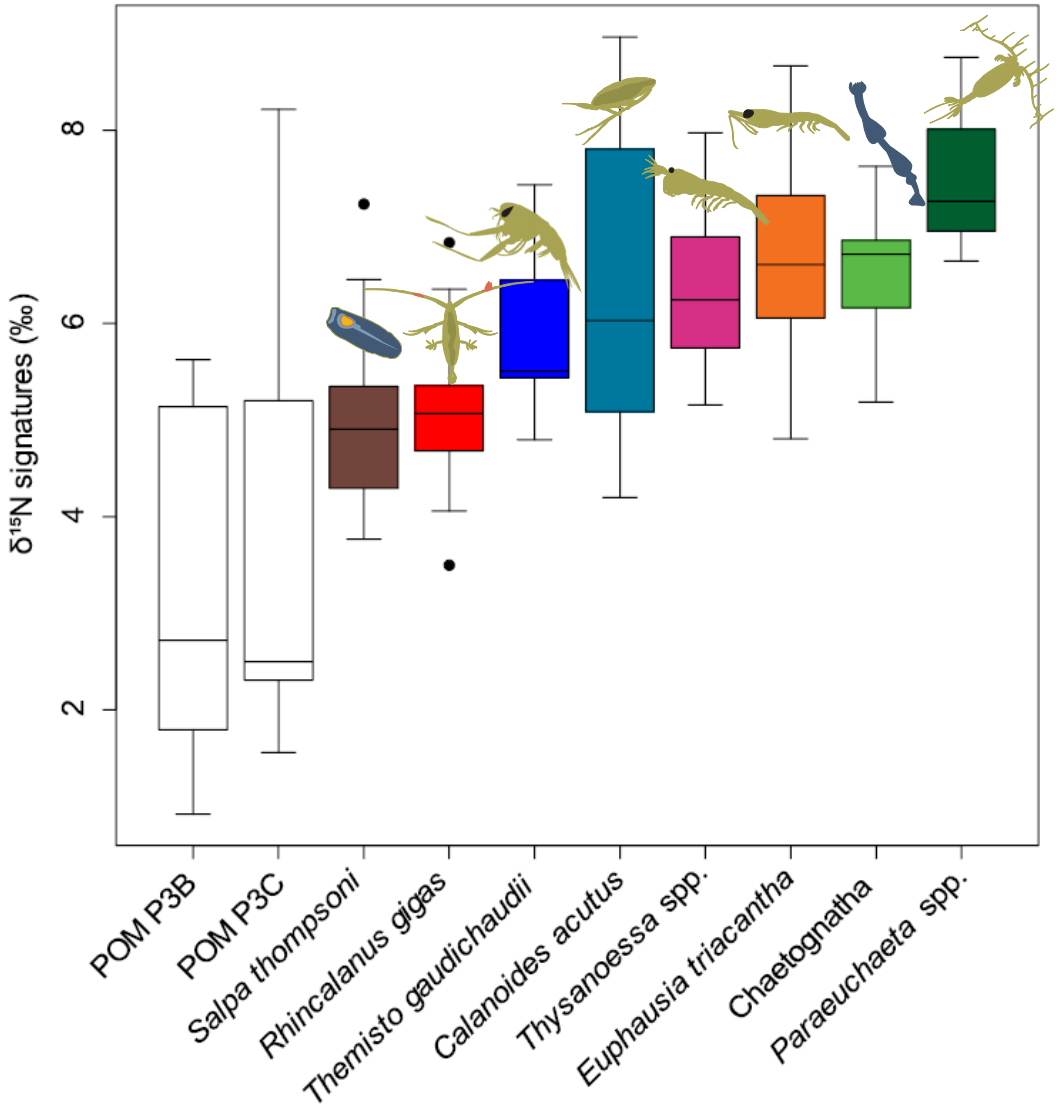
Presence of small particle-associated copepod (e.g. *Oncaeidae* (A) and *Oithonidae* (B)) at the boundary of the epi- to mesopelagic?



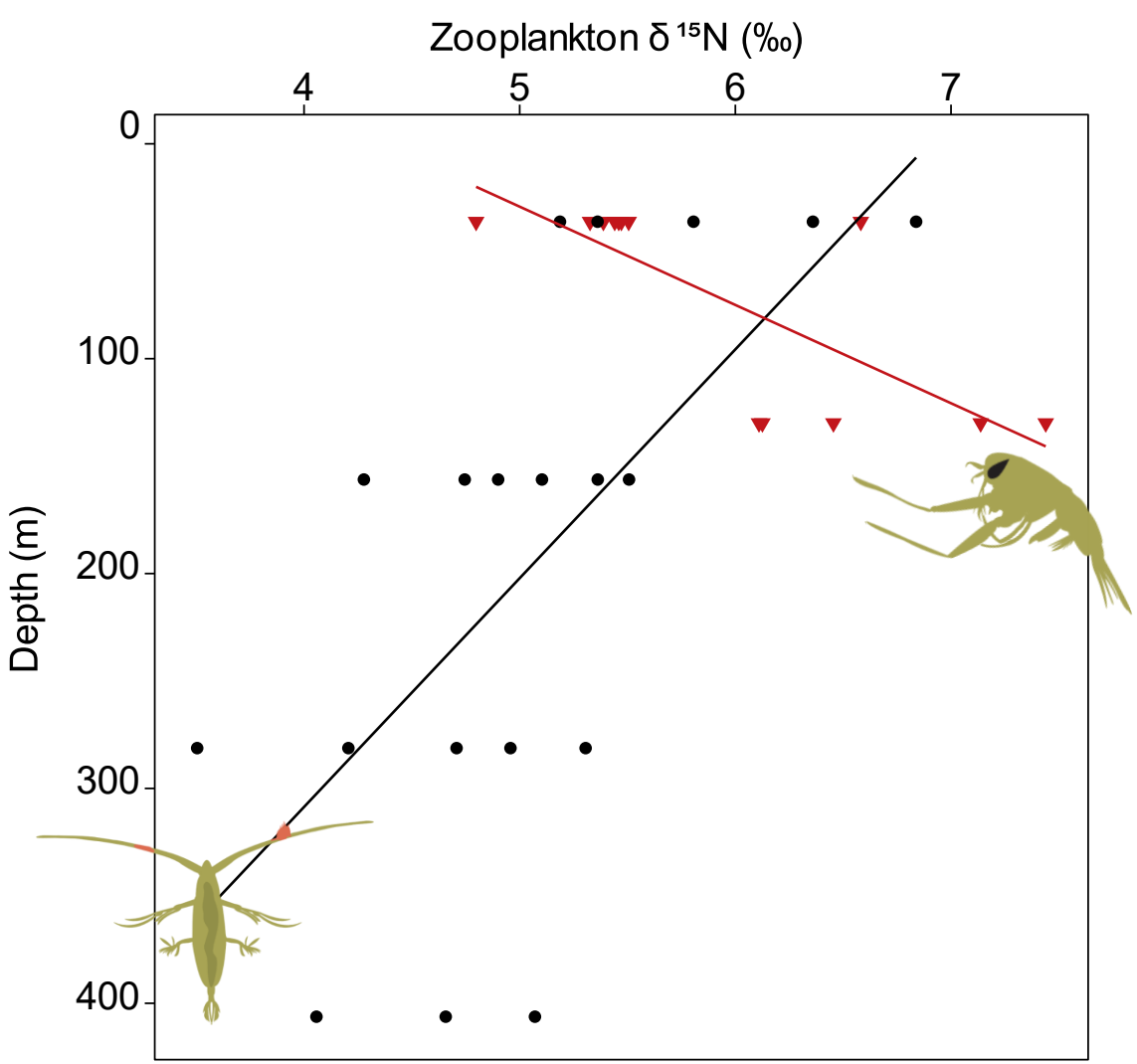


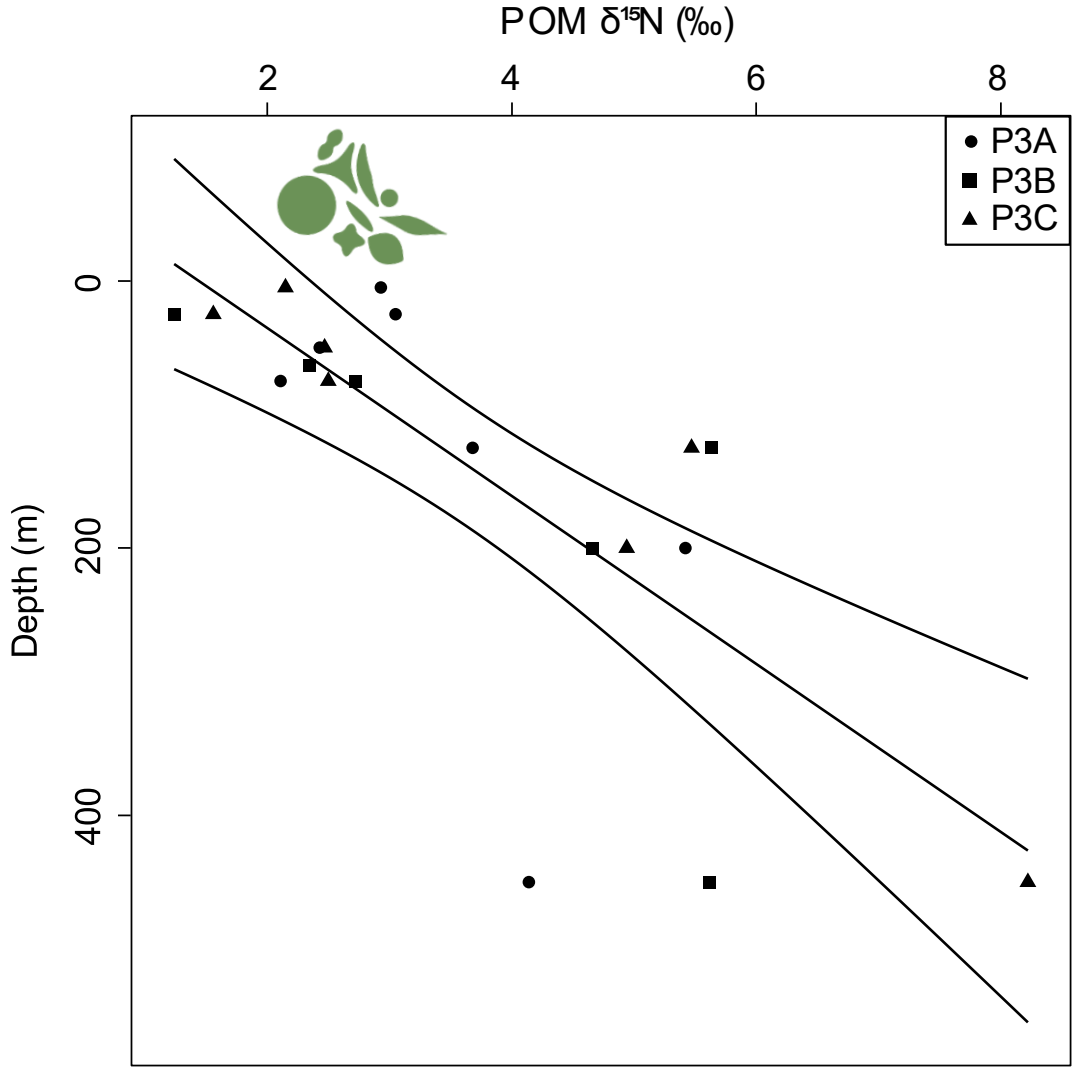
Stable isotope analysis





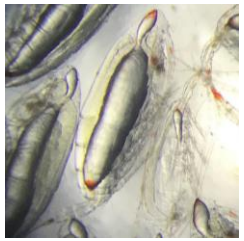
Stable isotope analysis





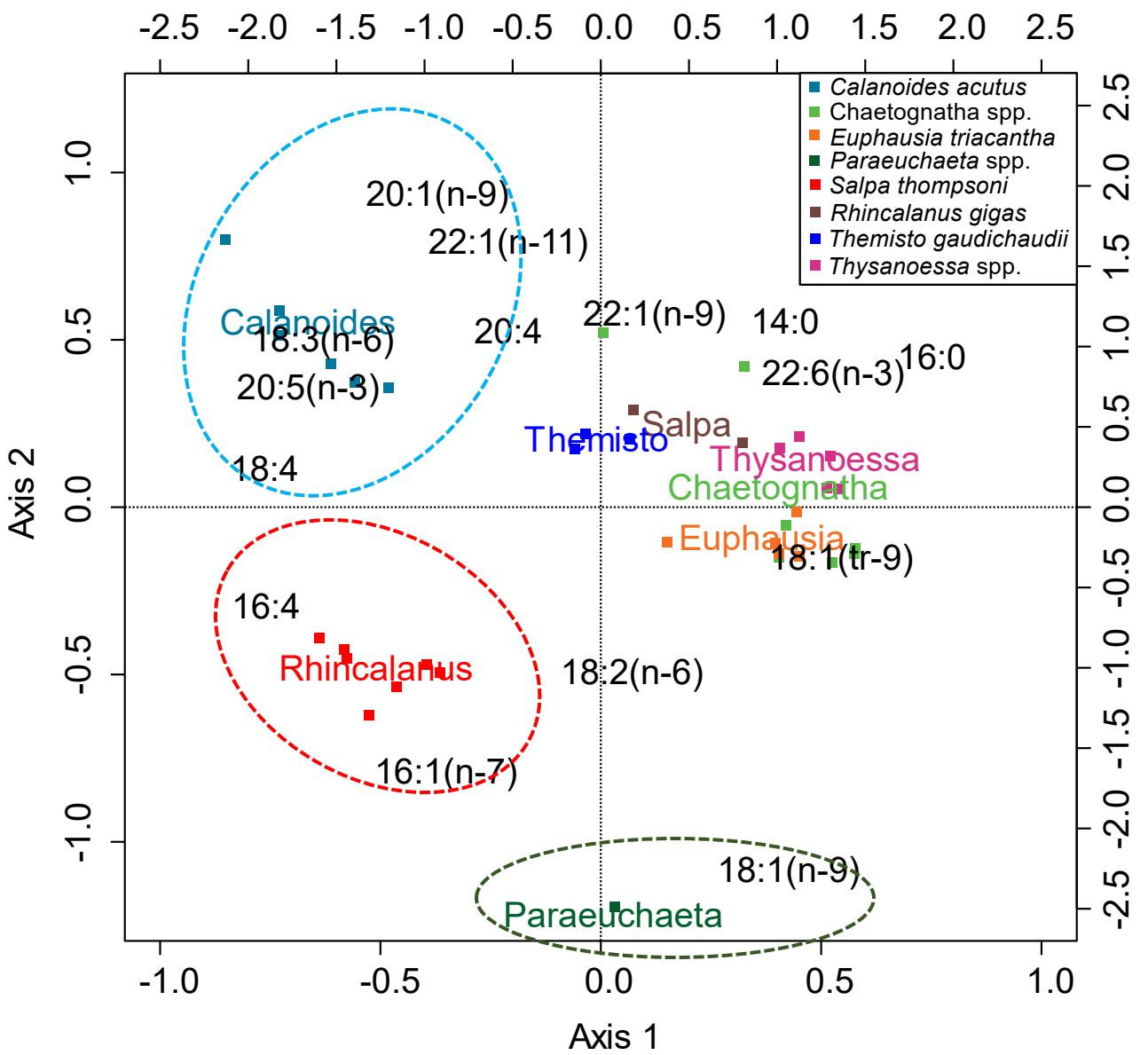
Fatty acid analysis of zooplankton

C. acutus – herbivorous ; diapausing
Large lipid stores (~50% of dry weight)
Diatom markers ~29%

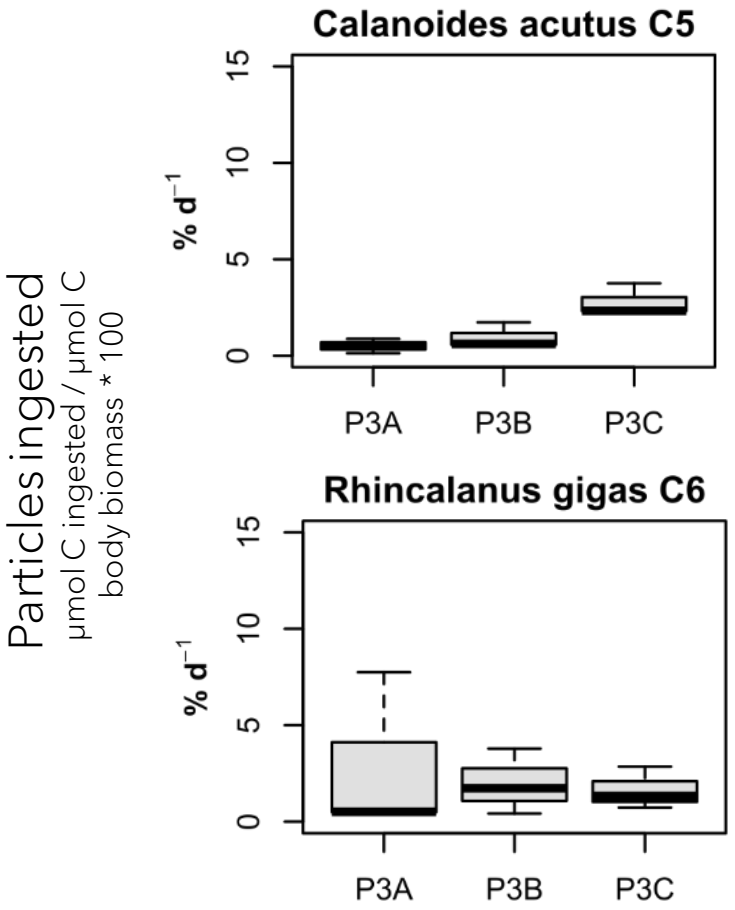


R. gigas – herbivorous ; diapausing
Large lipid stores (~40% dry weight)
Diatom markers ~40%

Paraeuchaeta – carnivorous ; non-diapausing



Importance of considering physiology



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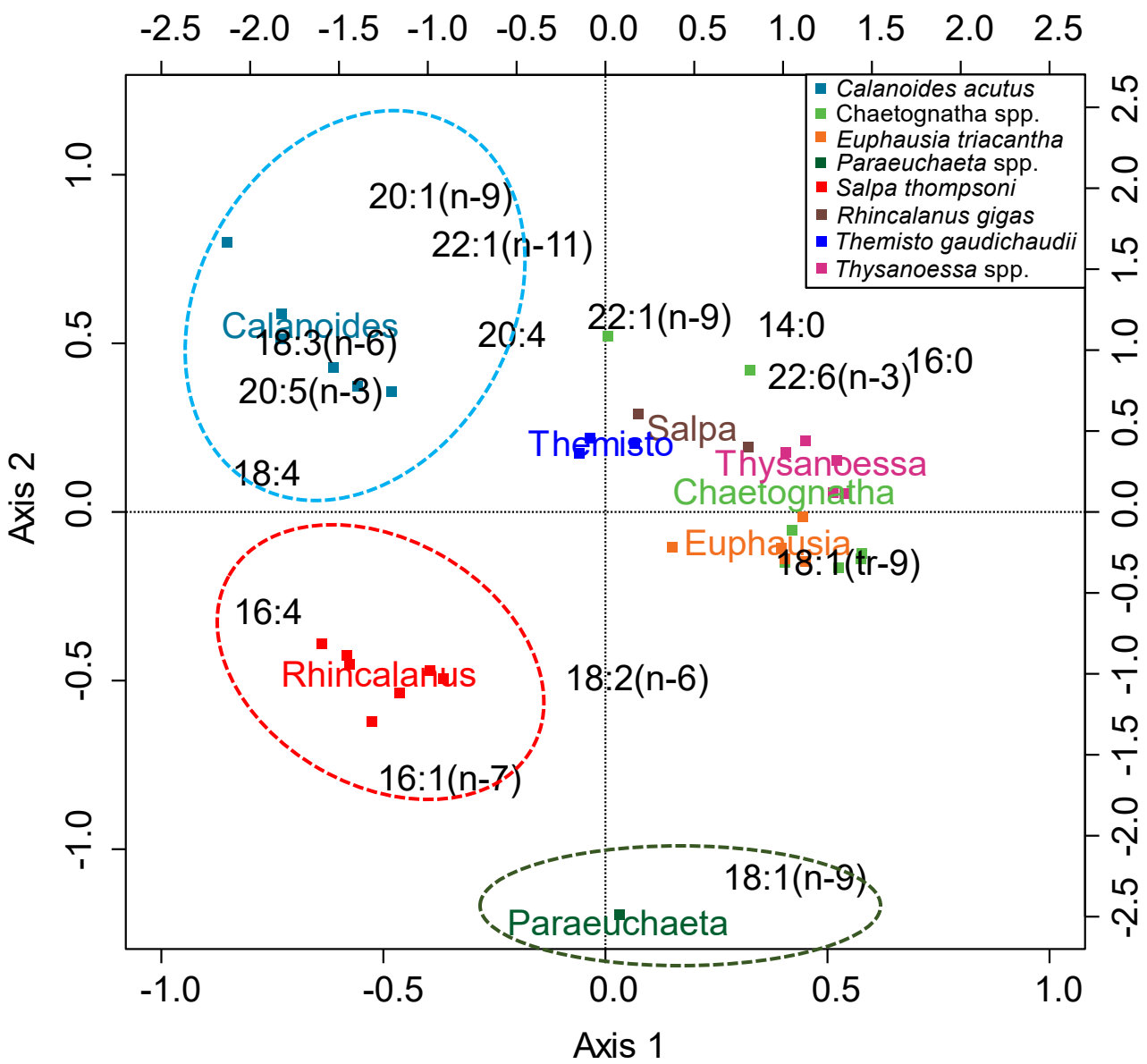
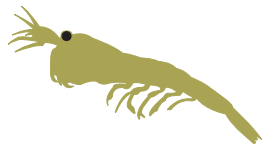
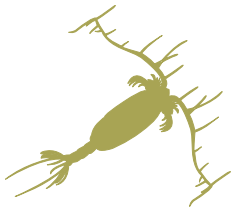
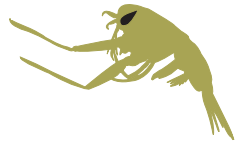


Conclusion

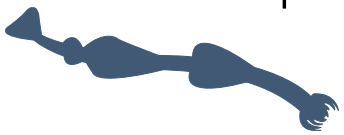


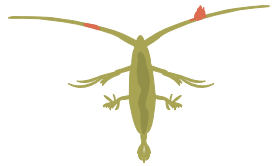
The lipid and stable isotope data highlight the importance of considering zooplankton physiology when investigating trophic ecology and tracing carbon cycling.

→ Extent to which herbivorous/diapausing species do or do not interact with the spring bloom.

→ The decoupling between feeding dynamics of the zooplankton and the spring diatom bloom will influence the quality/quantity of organic matter leaving the upper mesopelagic.

→ Presence of particle-associated copepods at the boundary of epi- to mesopelagic may have an important role in the attenuation of POM.





Thank you

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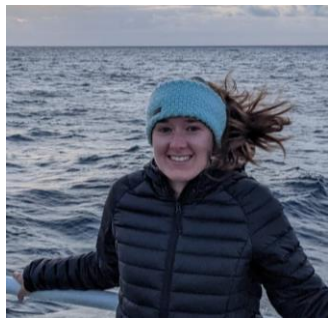

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