Carbon budgets of Scotia Sea mesopelagic zooplankton and micronekton communities during austral spring

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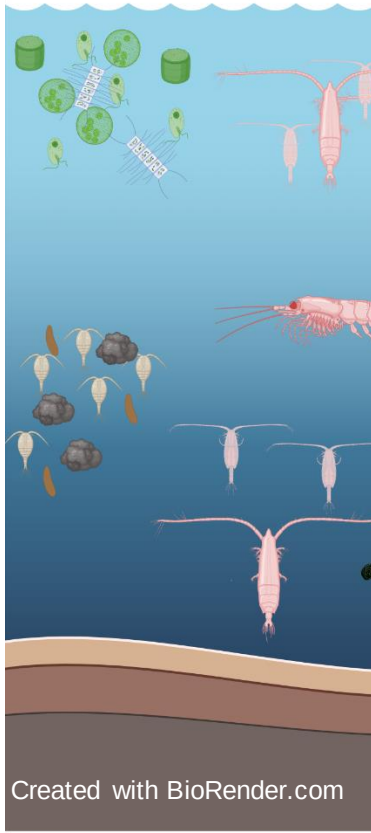
COMICS

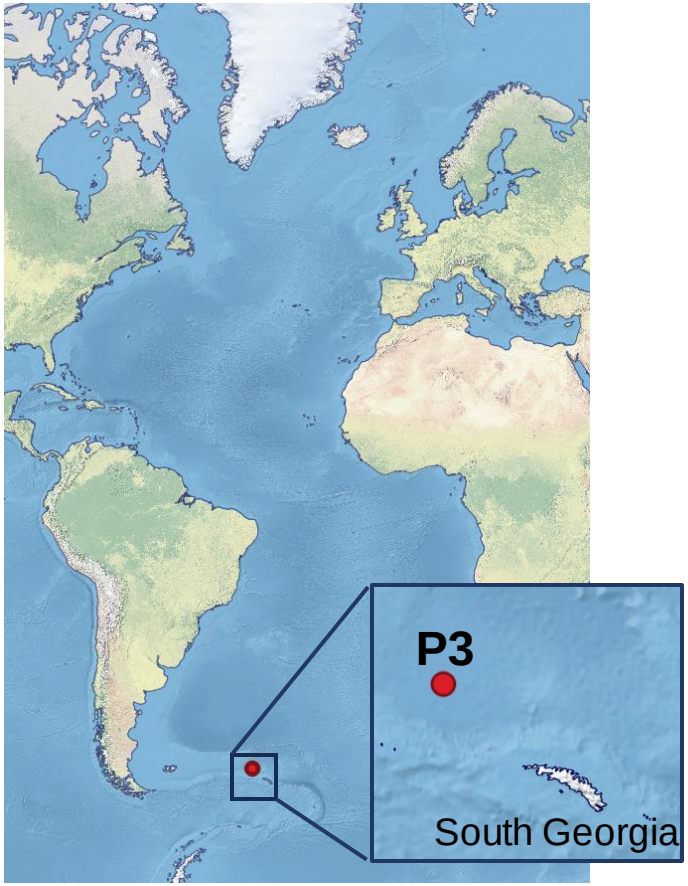
- Controls over Ocean Mesopelagic Interior Carbon Storage programme (COMICS) https://comics.ac.uk/

  - Deliver new insights into the processes influencing carbon cycling in the mesopelagic zone (Sanders et al., 2016).

- Deep Sea Research Part II: Topical Studies in Oceanography: 105296. https://doi.org/10.1016/j.dsr2.2023.105296

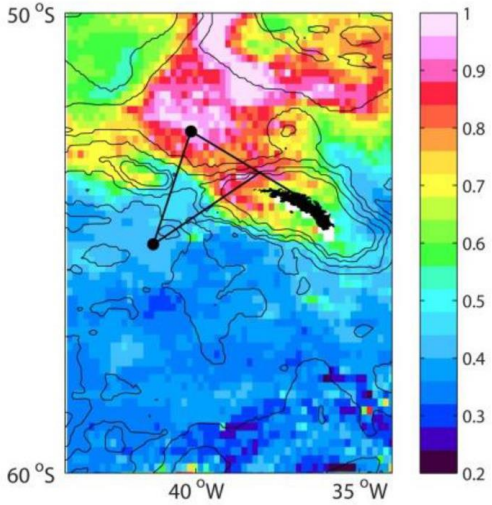


Scotia Sea – Station P3



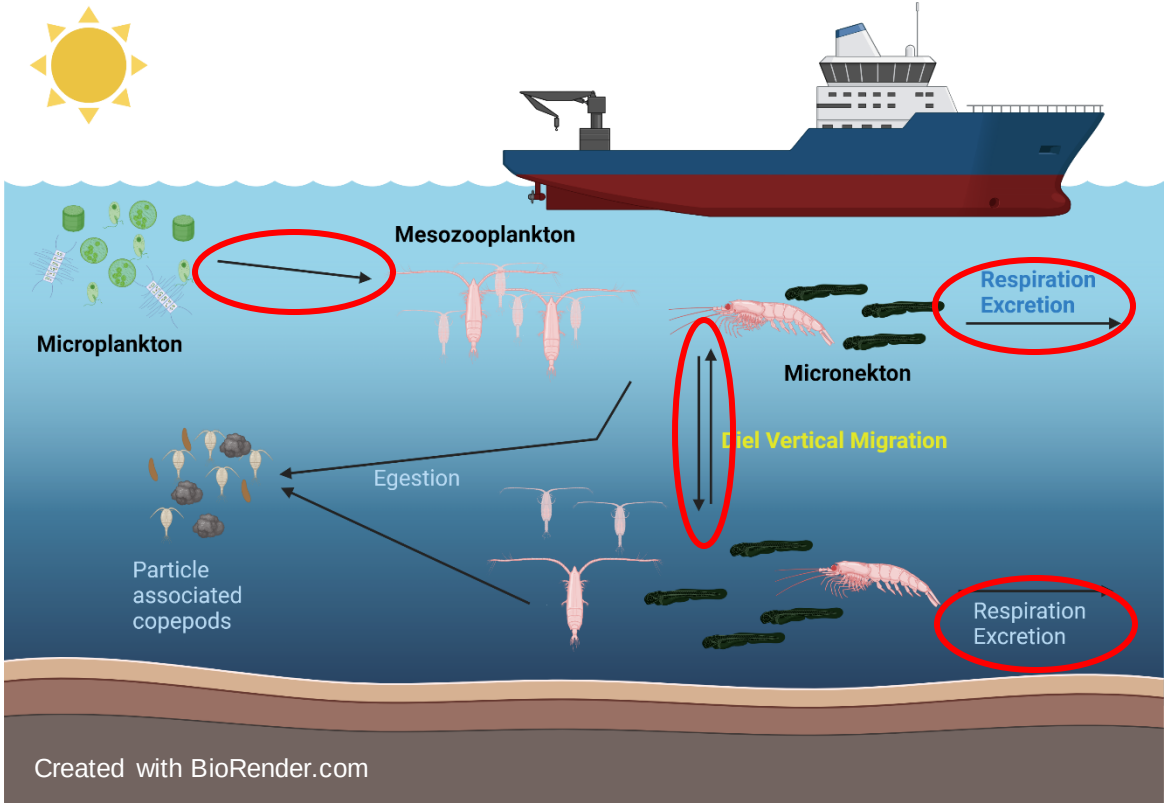
- Iron-fertilised hotspot
- Extensive phytoplankton bloom
- High zooplankton & nekton biomass
- High levels of C export
- Long-term mooring observatory

(https://www.bas.ac.uk/project/scoobies/)



Climatological satellite-derived primary production (gCm^{-2}) in December. From Sanders et al. (2016). Frontiers in Marine Science 3 (136)

Objectives



Generate carbon budgets of the mesopelagic zooplankton and micronekton communities in the Scotia Sea

Ingestion ≥ Respiration + Excretion

Quantify:

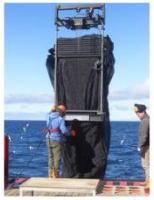
- Vertical distribution & movements of zooplankton & micronekton
- Feeding & metabolic requirements

Methods - Net sampling

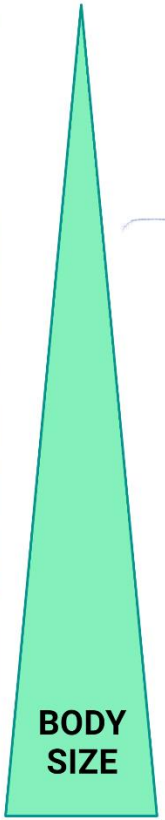
Bongo 100µm

Mammoth, 300µm

MOCNESS, 330µm



RMT25, 4mm



- Surface to 500m
- Day/night samples
- Biomass & species composition
- Metabolic rates
- Lipid content

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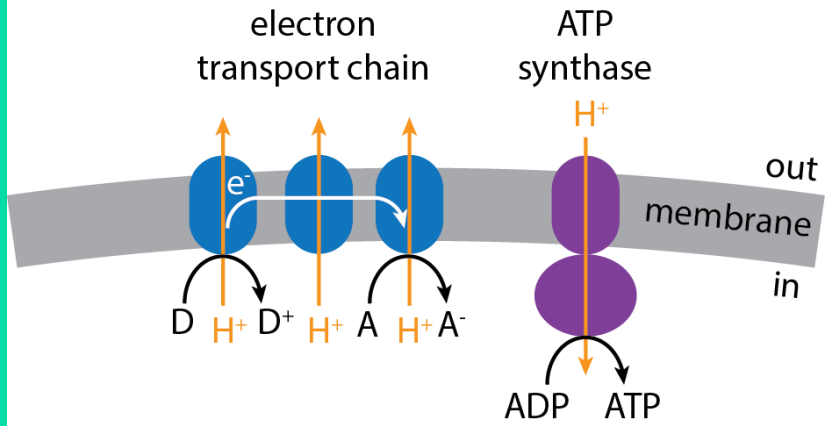
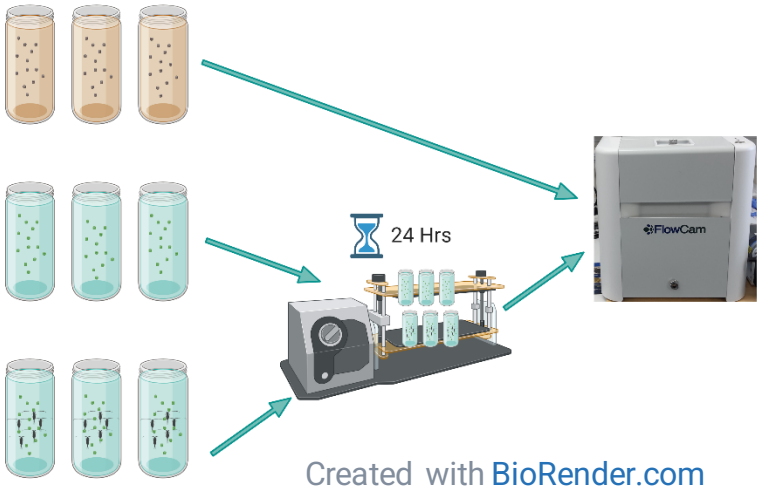
Methods - Metabolic rates

Respiration - Electron Transfer System (ETS) activity (RQ = 0.9)
- Allometric estimates

Ingestion - Particle Removal Incubations
- Published daily rations





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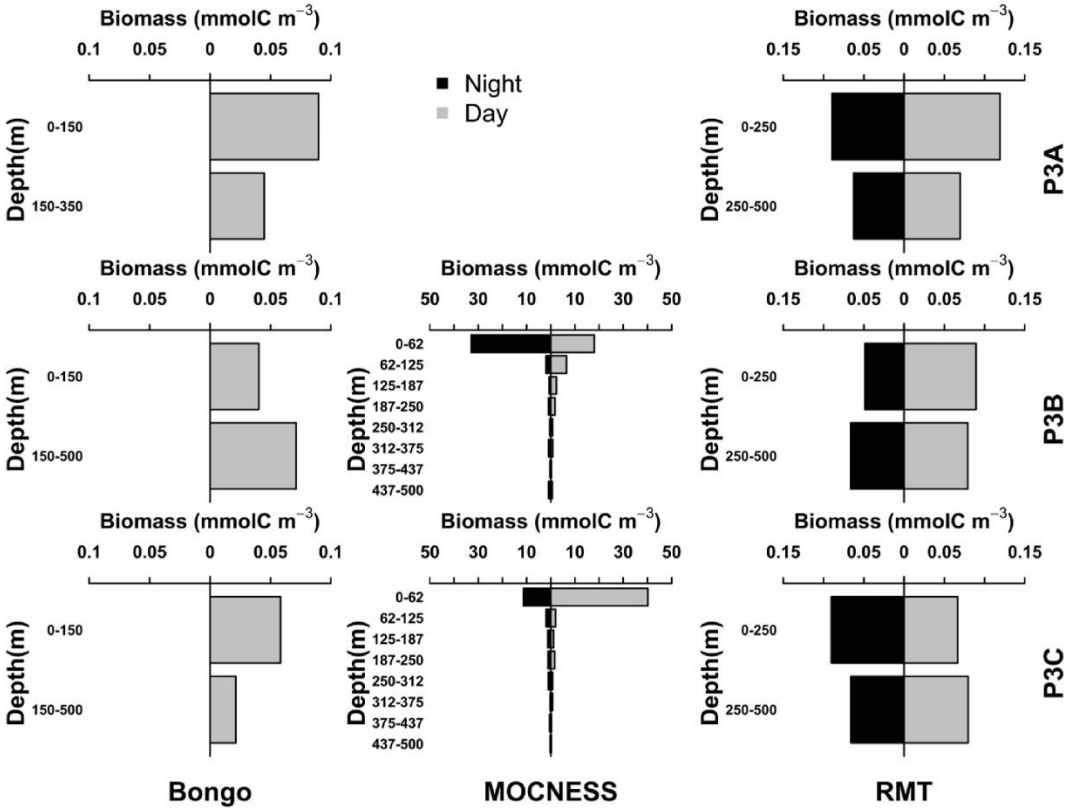
Results - Biomass



Note different scales on x-axes

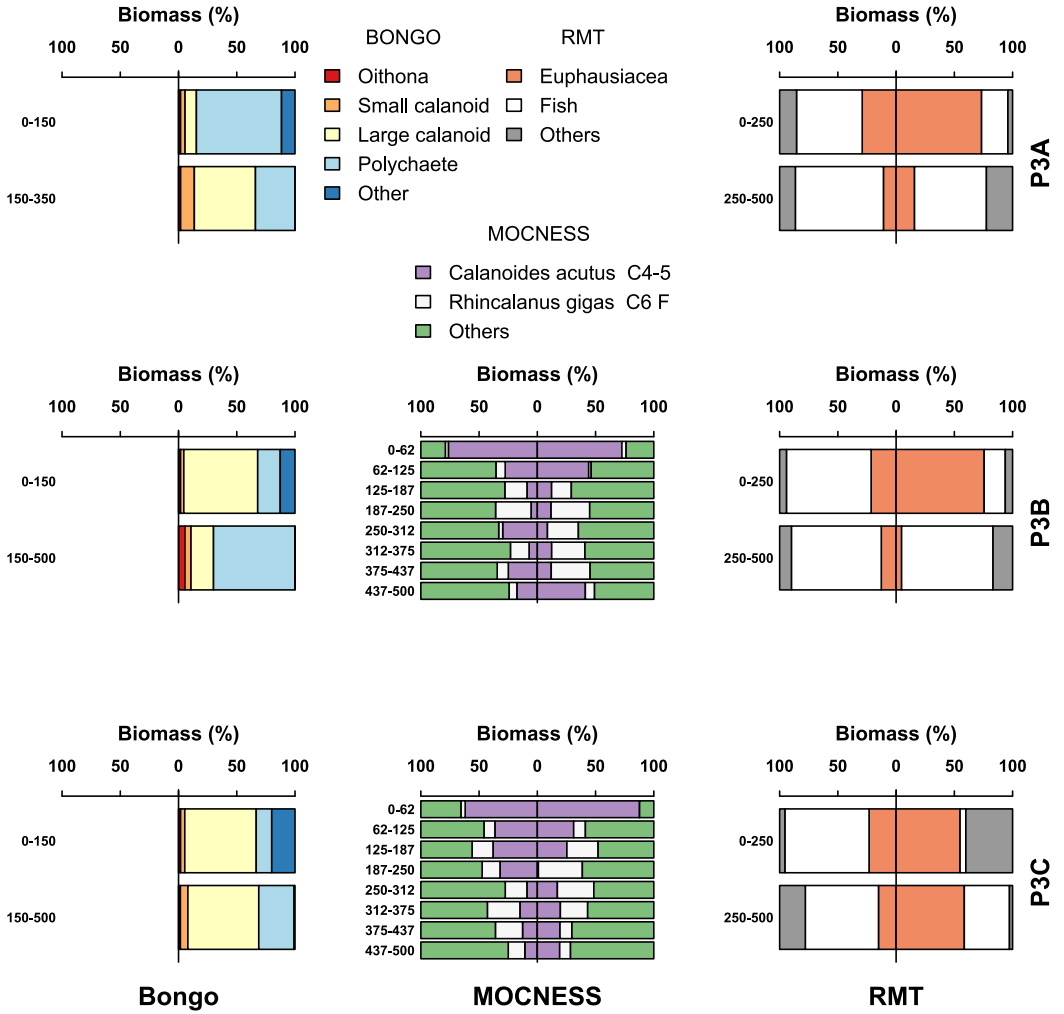
Biomass dominated by >330μm mesozooplankton

Community composition

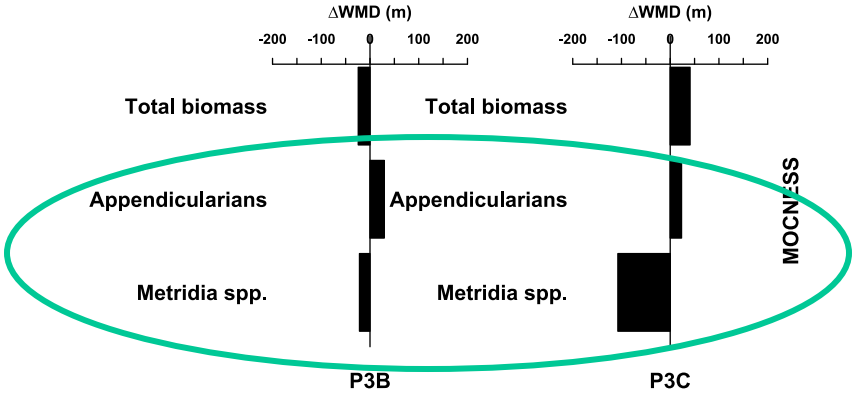
Bongo – Calanoid copepods & pelagic polychaetes

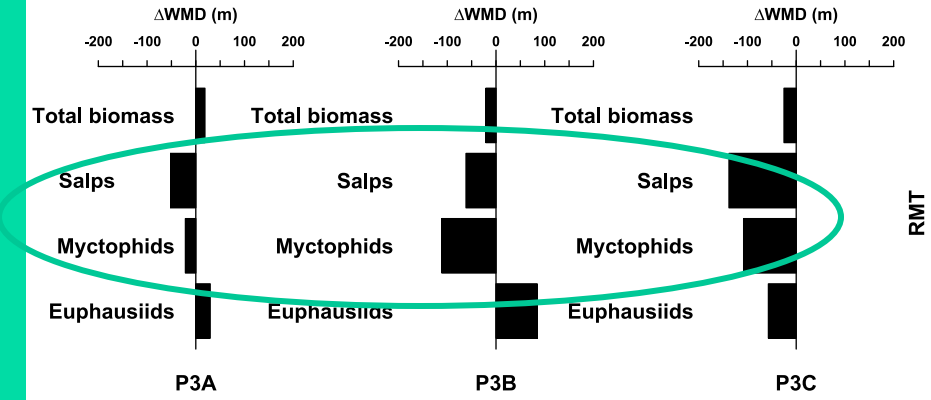
MOCNESS – Large lipid storing copepods (***Calanoides acutus*** & ***Rhincalanus gigas***)

RMT – mesopelagic fish & euphausiids



Diel Vertical Migration





$\Delta WMD = WMD_{night} - WMD_{day}$

(Negative ΔWMD = deeper during day)

Little evidence of synchronised DVM

Little consistency in DVM behaviour of taxa

Specific Respiration & Ingestion

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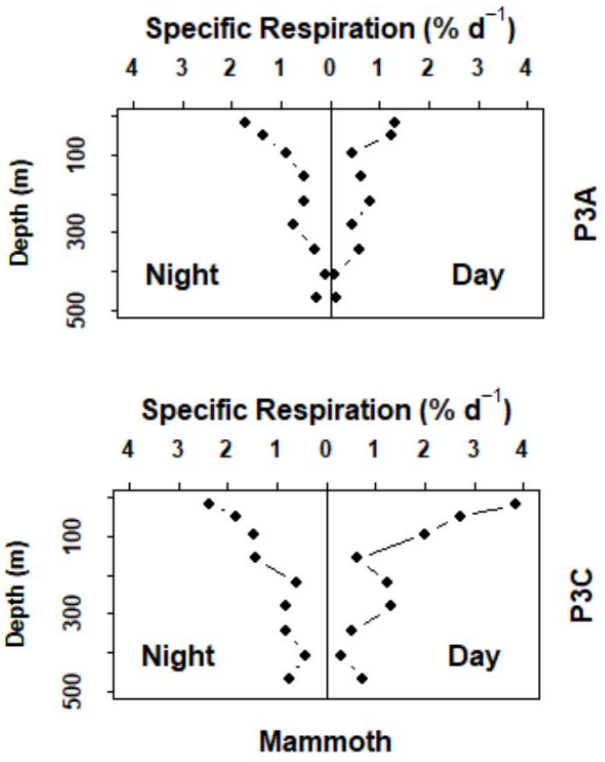
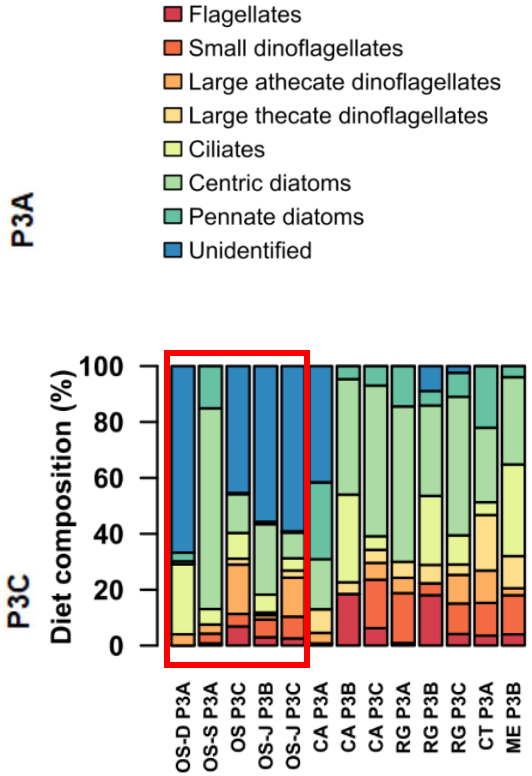
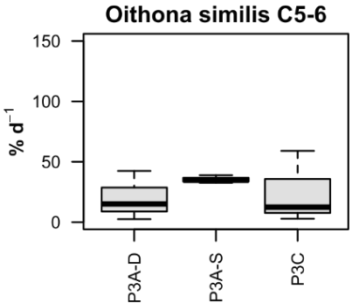
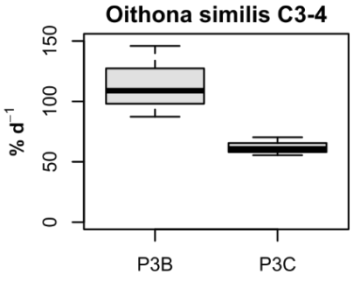
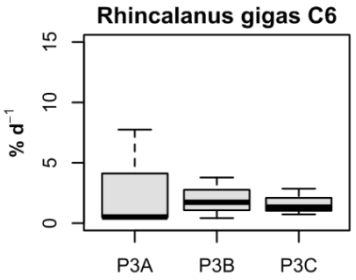
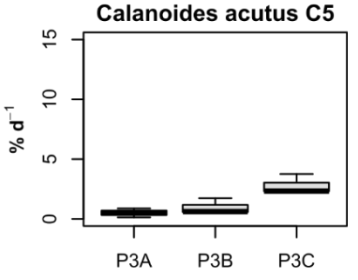




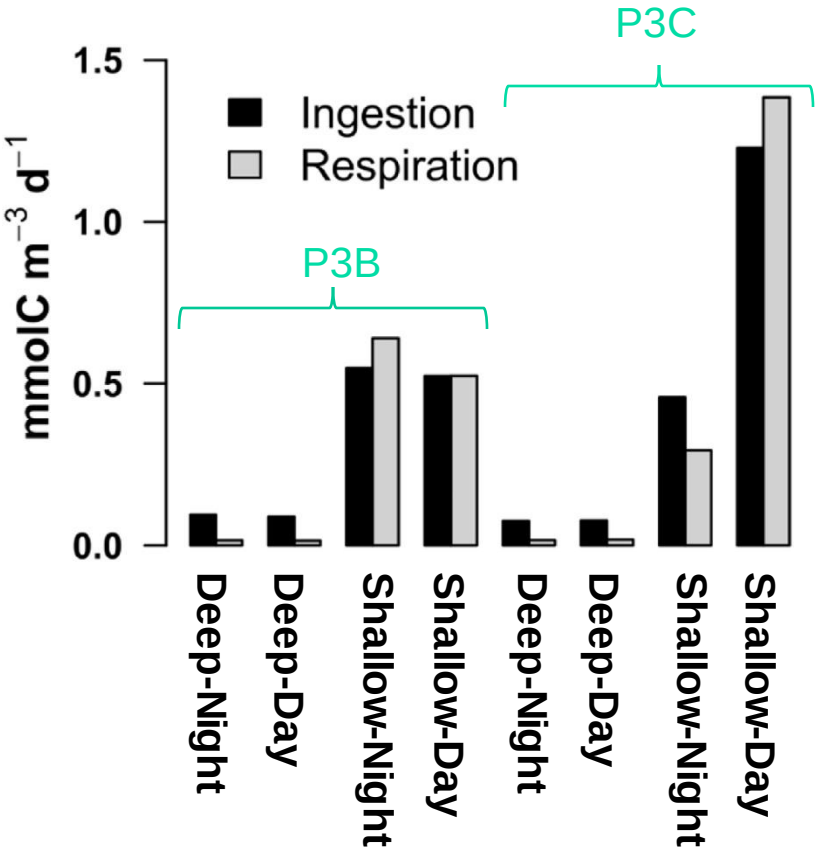








Carbon budgets



RQ = 0.9

Ingestion > Respiration @ depth

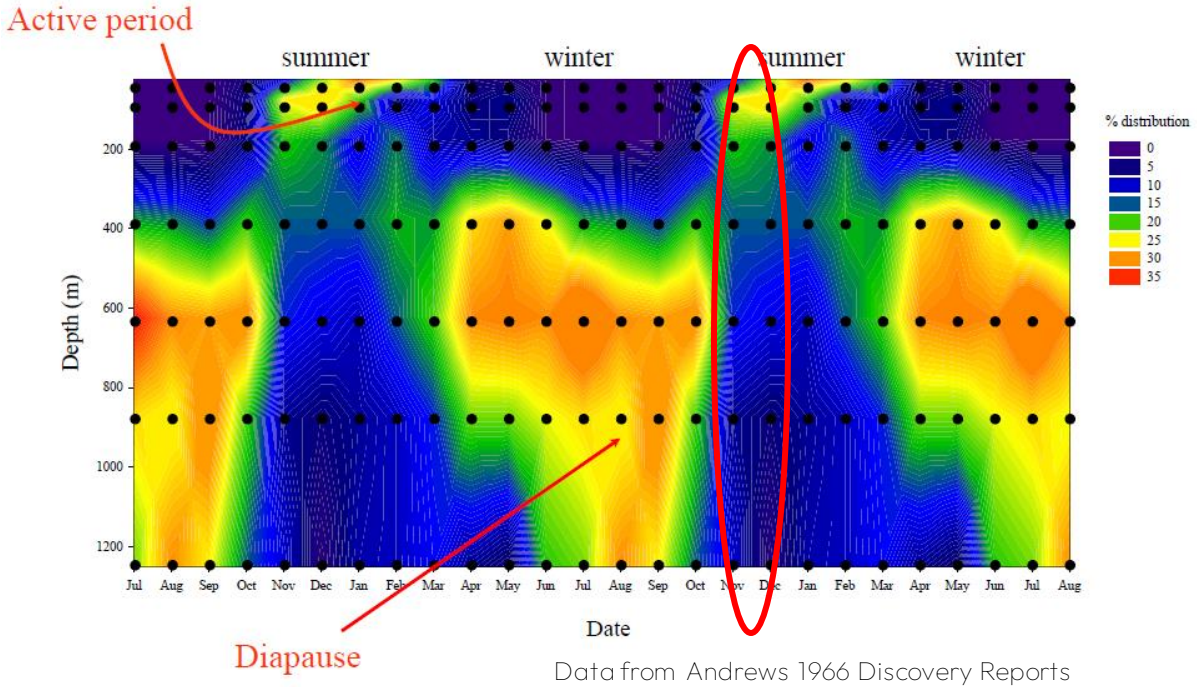
BUT

Ingestion ≤ Respiration @ surface

Lipid content

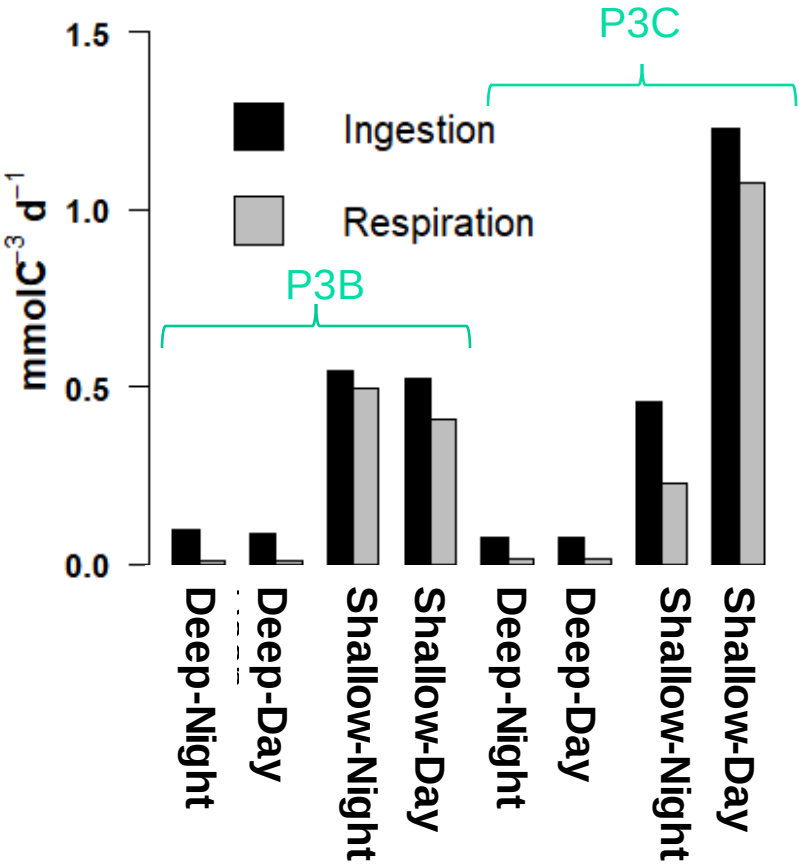
Calanoides acutus: 924.1 ± 233.9 to 785.1 ± 232.5 mg lipid g^{-1} OC

Rhincalanus gigas: 798.1 ± 138.0 to 500.1 ± 51.3 mg lipid g^{-1} OC



Data from Andrews 1966 Discovery Reports

Carbon budgets RQ = 0.7



RQ = 0.7 = lipid catabolism

Ingestion > Respiration

BUT

Would need absorption efficiencies > 90%

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Conclusions

Synchronised DVM should not be assumed

Need to understand the physiology of animals

Stored lipids represent carbon ingested during the previous growing season

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Acknowledgements

- The crew and participants of cruise DY086
- May Gomez, Ted Packard and Ico Martinez (EOMAR), Santiago Hernández León, Laia Armengol, and Ione Medina Suarez (IOCAG)
- Brian Dickie (University of Southampton)
- Natural Environment Research Council funded Large Grant, COMICS (NE/M020762/1; NE/M020835/1).