Zooplankton feeding provides essential energy to key physiological processes in the cold water coral *Desmophyllum dianthus*

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State of the art

- Cold water corals (CWC) run deep sea reef ecosystem functioning
- Limited knowledge on CWC ecophysiology and feeding ecology
- Recent studies suggest zooplankton as preferred food source

Aims

- Quantify key physiological process rates in the CWC *D. dianthus*
- Investigate metabolic significance of feeding on zooplankton
- Budget the allocation of zooplankton-derived organic carbon

Methods

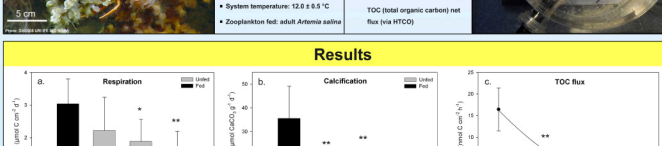
Desmophyllum dianthus

- Cosmopolitan cold-water species
- Depth distribution: 8 – 2,460 m
- Solitary polyps; height: 5 – 10 cm
- Efficient capture of large range of zooplankton size classes
- Sampling location: Mediterranean Sea (South off Malta)
- Maintained in flow-through aquarium systems (sub-surface seawater)
- System temperature: 12.0 ± 0.5 °C
- Zooplankton fed: adult *Artemia salina*

Physiological measurements

- Incubation of fed and unfed corals:
  - Fed: Monitored ingestion of 4 adult *Artemia salina* d^{-1}
  - Unfed: Maintained in pre-filtered (50 µm) fresh seawater (1 – 3 wk)
- Closed cell incubation: 6 h at 12.0 °C
- Parameters measured:
  - Respiration (via electrodes)
  - Calcification (via total alkalinity)
  - TOC (total organic carbon) net flux (via HTCO)

Results



Mean rates (± SD) of respiration (a), calcification (b) and net total organic carbon (TOC) flux (c) for zooplankton-fed and unfed *Desmophyllum dianthus* specimens (n = 10). Significantly higher rates for all measured parameters found in zooplankton-fed specimens; respiration (One-way ANOVA, df=3, F=5.325), calcification (Kruskal-Wallis, df=3, H=17.886), TOC flux (Kruskal-Wallis, df=3, H=18.060), significance levels at p<0.05 (*) and p<0.01 (**) for all comparisons.

Zooplankton feeding significantly supports respiration, calcification and total organic carbon release in *D. dianthus*

Compared to symbiotic tropical species: Respiration and calcification up to 80 and 90% lower; TOC flux in lower range

Summary

- Zooplankton feeding fuels CWC key physiological processes
- Absence of zooplankton leads to a significant decline in coral respiration, calcification and net organic carbon release
- Zooplankton may cover up to 3-fold of respiratory demand
- Respiration-derived energy may strongly influence calcification

Conclusions

These findings highlight zooplankton as an essential nutritional source for *D. dianthus*, with further implications for the role of CWC in controlling deep sea reef ecosystem functioning by constructing habitats for a high associated biodiversity, and by fuelling biogeochemical cycles via the release of organic matter.

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