Life-long *in situ* exposure to ocean acidification reduces heterotrophy in the stony coral *Galaxea fascicularis*

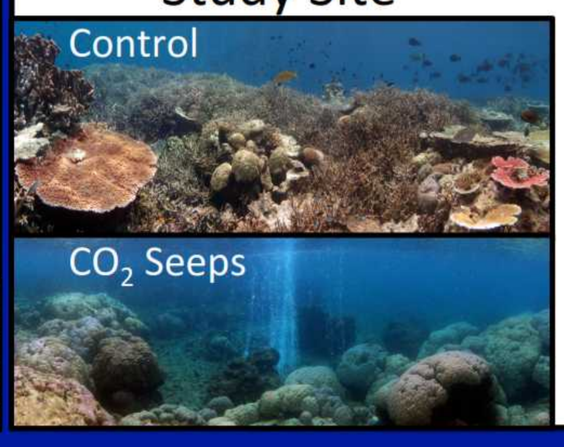
Joy Smith[1,2](JZ.Smith@aims.gov.au), Julia Strahl[1], Sam Noonan[1], Gertraud Schmidt[2], Claudio Richter[2], Katharina Fabricius[1]
[1]Australian Institute of Marine Science, Townsville, Queensland, 4810, Australia, [2]Alfred Wegener Institute, Bremerhaven, 27568, Germany

Study Objective

Corals must consume zooplankton to get essential nutrients (N, P, trace elements). Increased heterotrophy can also mitigate against the effects of ocean acidification (OA) for some coral species. Here, we determine the effects of OA on heterotrophy for *Galaxea fascicularis* that have lived their entire lives at CO_2 seeps.

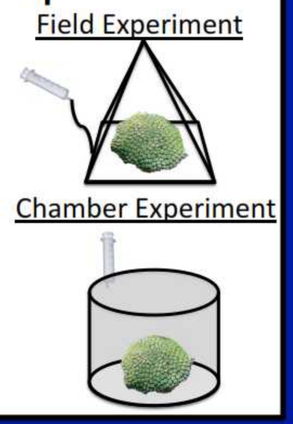
Methods

Study Site



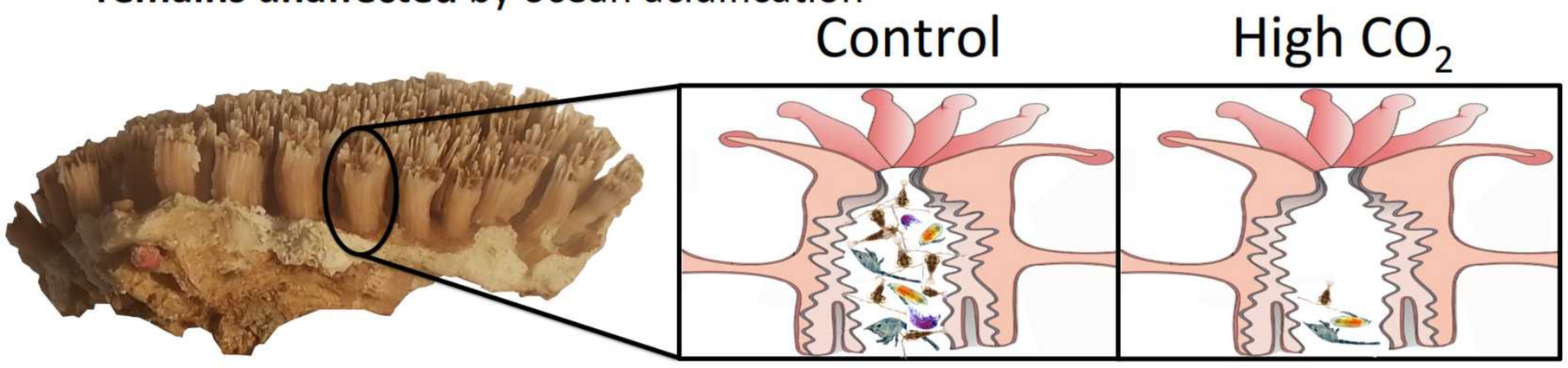
Experimental Set-up

Corals were fed a known quantity of zooplankton for 1 hr at high CO_2 (~1000 µatm) and control seawater (~380 µatm) in field and laboratory experiments over two expeditions and their gut contents were analyzed.

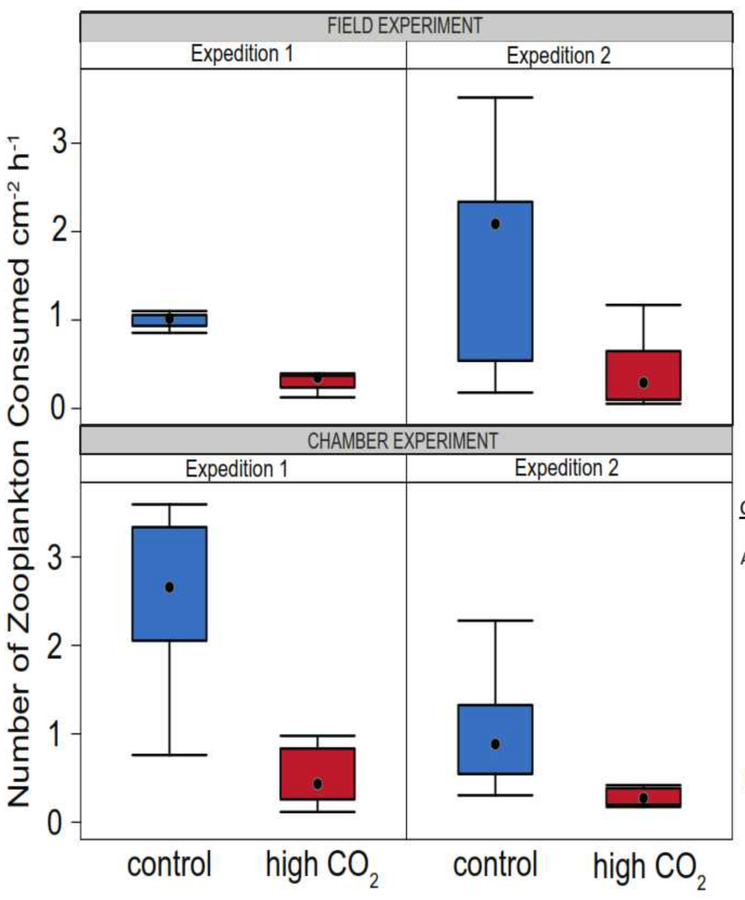


Do corals consume zooplankton differently under high CO_2?

YES! Corals **eat less** zooplankton, but the **types of zooplankton they consume remains unaffected** by ocean acidification

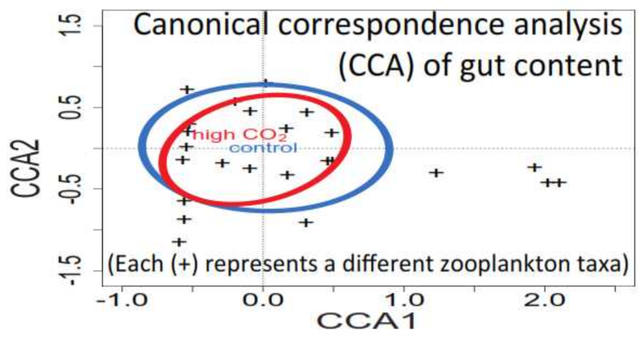


PROOF: 1.) Reduced feeding rates

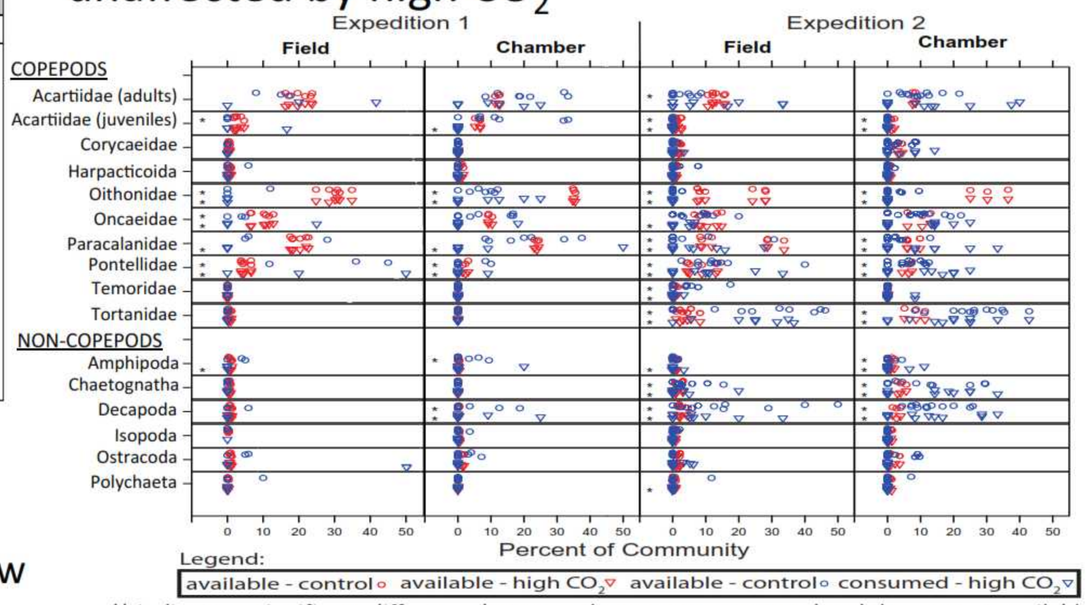


Two methods (field and chamber experiments) over two expeditions show reduced heterotrophy under high CO_2

2.) Similar composition of zooplankton taxa consumed under high CO_2



3.) *Galaxea fascicularis* consume certain zooplankton taxa, but this selectivity was unaffected by high CO_2



(* indicates a significant difference between the percent consumed and the percent available in the water column (t-tests, p-value < 0.05))

Why is heterotrophy reduced?

No difference in feeding effort (polyp expansion) across CO_2 levels

parameter:	χ^2	p-value	comment
CO_2 (high CO_2 (~1000 µatm) vs. control (~380 µatm))	3.4	0.33	No difference in polyp expansion across CO_2 level
Methods (Field vs. Chamber)	20.6	<0.05	Corals in field more expanded than chamber experiment
Expeditions (Expedition 1 vs. Expedition 2)	9.8	<0.05	Corals in Expedition 2 more expanded than Expedition 1

No difference in corallite size across CO_2 levels

(1-way ANOVA: $F_{(1,62)}$=2.7, p-value=0.11)

Reduced heterotrophy not caused by CO_2-impairment of neurotransmitters

Addition of gabazine did NOT improve feeding rates (1-way ANOVA: $F_{(2,22)}$=0.51, p-value=0.48)

Other possible reasons for reduced feeding:

- Reduced demand for zooplankton-derived energy due to enhanced photosynthesis
- Physiological stress
- Reduced particle retention
- Reduced nematocyst functioning

Implications for Corals

Reduced heterotrophy will have important implications for the health and resilience of corals. As ocean acidification will increasingly become unfavorable for many coral species, their ability to react will become imperative to their survival.

Acknowledgements
The authors for would like to thank the crew of the M/V Chertan for field support, and Meliha Bademci and Johanna Arndt for laboratory assistance. This project is funded in part by the Great Barrier Reef Foundation's Resilient Coral Reefs Successfully Adapting to Climate Change research and development program. Additionally, this project has been co-funded through BIOACID and a MARES grant. MARES is a joint Doctorate program selected under Erasmus Mundus coordinated by Ghent University (FPA 2011-0016). Check www.mares-eu.org for extra information. Photo credits for reef photos: Sam Noonan