Project information

Keywords
copepod, reproduction, mortality
Project title
WP2-OA-4: Transgenerational effects of OA in arctic copepods
Year
2017
Project leader
Claudia Halsband
Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)
69.67°N 18.79°E
Participants

Dr Peter Thor (NPI)

Kristine Hopland-Sperre (APN)

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International collaborators

Dr Iris Hendriks (IMEDEA-UIB, Spain)

Flagship
Ocean Acidification
Funding Source

Flagship Ocean Acidification

Summary of Results

The study aimed to investigate the effect of high pCO2/low pH (forecasted for the year 2300) on the small arctic calanoid copepod *Acartia longiremis*, sampled in the fjords outside of Tromsø. The species fulfils several requirements for such a study, including a short life cycle (≥ 1 generation per year), locally high abundance, broadcast spawning strategy (separate eggs from females). Caveats include relatively low egg production rates and low hatching success under laboratory conditions, rendering a continuous copepod culture challenging

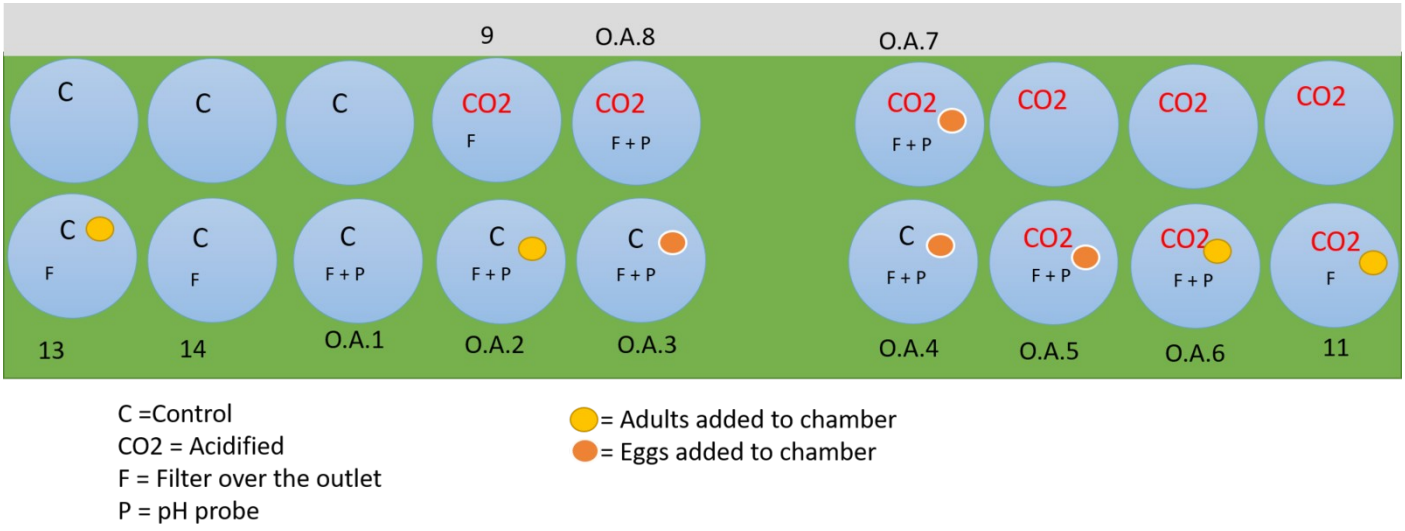

Fig. 1: Experimental set up of OA tanks for mortality estimates of *A. longiremis*.

The experimental set up included 8 tanks (15 L) arranged randomly in an aquarium room (Fig. 1). Ideally, the experiment should have run for several months to determine long-term effects in a multigenerational study over 2-3 generations. As this proofed difficult both in the previous year and this year, shorter term experiments were conducted in addition, focusing on life history and fitness traits of *A. longiremis* with a view to design suitable new OA experiments with this species. Egg production rates and hatching success of *A. longiremis* in varying feeding and handling treatments were conducted in bottle incubations (500 mL volume) on a plankton wheel at

ambient pH (Fig. 2). The evolution of pH in bottles was also measured over 8 days.

Fig.2: Bottle incubations on a plankton wheel

Both adult Acartia (> 1000 individuals per tank) and eggs (> 1000 per tank) collected from field-caught individuals were incubated in the tanks and fed with *Tetraselmis* sp. (10000 cells per mL) in a flow-through system with a flow of approximately 10 L per hour. The copepods were incubated for 2 months from 14th July to 14th August, but only few individuals survived without significant production of new offspring, and only very few nauplii were observed in tanks that started with eggs. No copepodites or adults were found in these tanks to produce a second generation. Copepods in tanks without flow survived better, and best survival rates were obtained in bottle incubations (statistical analysis in progress).

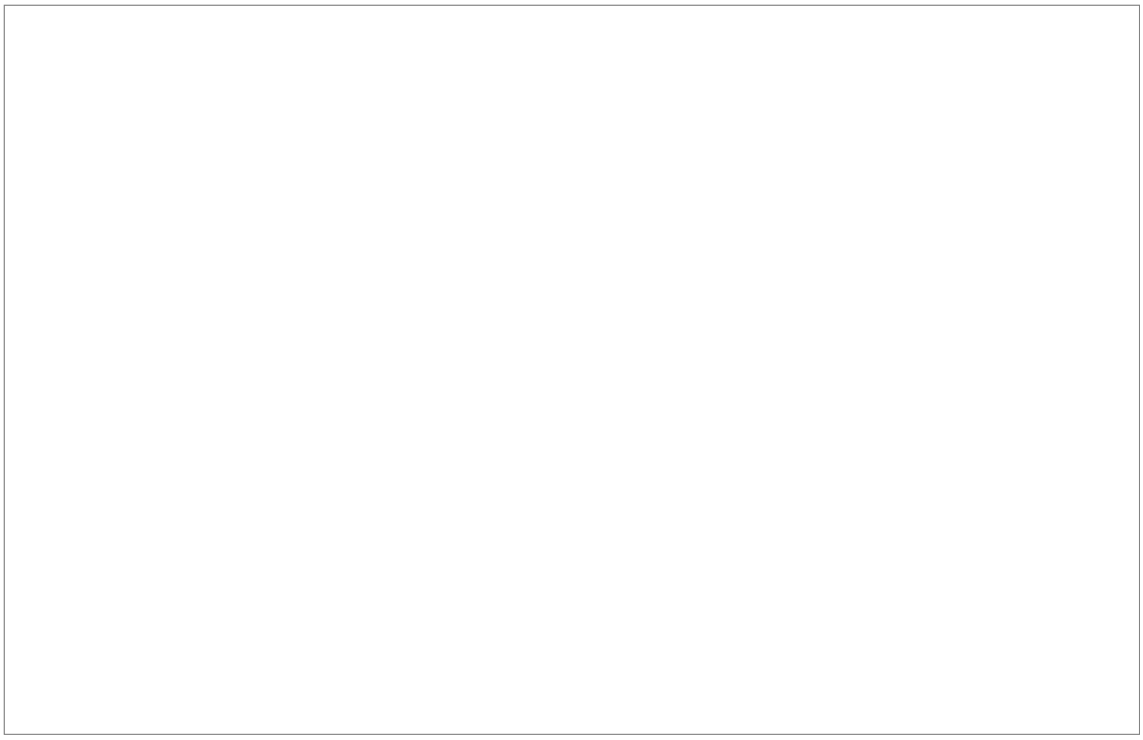

Fig. 3: Seasonal development of in situ gg production rates of *A. longiremis*.

Egg production rates in freshly caught animals were highest in June (Fig. 3), when the highest proportion of females was ready to spawn daily and clutch sizes reached maxima of 10-12 eggs per female and day. Egg production rates were lower in May, July and August. June is thus the best time of year to collect A. longiremis from the field, both for incubation of actively reproducing females and for collection of eggs. Egg production rates were relatively stable over 72h, but a high proportion of females does not spawn at all, keeping average rates low. Handling stress decreased survival in bottles. Copepods transferred to new media monthly survived longer, than those transferred at higher frequencies (from daily to bi-weekly). The pH remained stable over 72h in bottles, and started increasing by approximately 0.8 between day 3 and 8. Experiments in bottles thus require water changes every 72h or less to keep a consistent pH (Fig. 4).

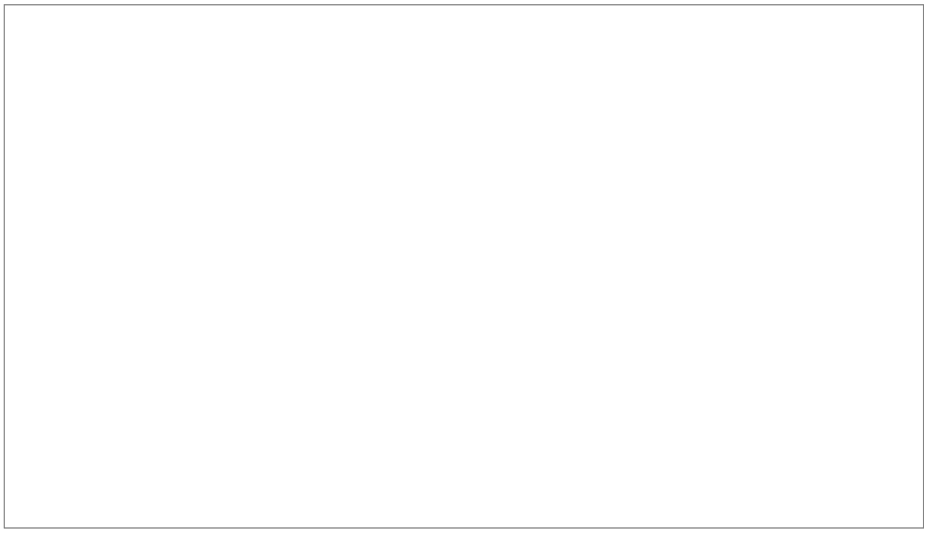

Fig. 4: Gradual increase of experimentally low pH in incubation bottles submersed in seawater for 8 days on a plankton wheel, in comparison with the control (at ambient pH).

Master and PhD-students involved in the project

NA

For the Management

The project provides information about the practical challenges of experimental OA studies on arctic zooplankton. Recommendations for future studies are provided.

Published Results/Planned Publications

NA

Communicated Results

NA

Interdisciplinary Cooperation

NA

Budget in accordance to results

The funding has been used for salaries, consumables and bench fees at the Kraknes station according to the original budget.

Could results from the project be subject for any commercial utilization

No

Conclusions

Experiments mimicking the effects of ocean acidification on arctic zooplankton species are challenging. High mortality rates in rearing experiments with both *Calanus glacialis* and *Acartia longiremis* have so far prevented meaningful long-term incubations over multiple generations to investigate OA effects on whole organism physiology and fitness endpoints such as reproductive output and offspring survival. This hampers our prediction capabilities at population level and thus estimates of OA impacts on ecosystem services. New approaches are needed to overcome culturing challenges and new methods at the molecular level may be more suitable to assess potential negative impacts of OA on non-calcifiers. For example, transcriptomics and DNA-based investigations may point to the physiological processes that may be altered or impaired by OA and can help to resolve these questions in the future.