Pteropod larvae exhibit shell dissolution and malformation in a high CO_2 ocean

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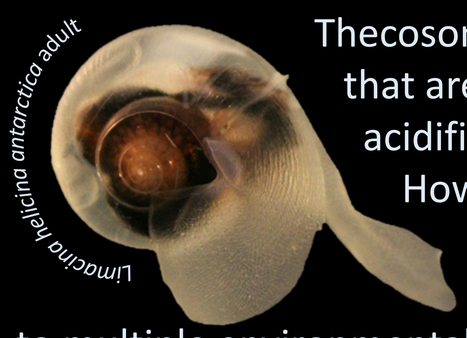
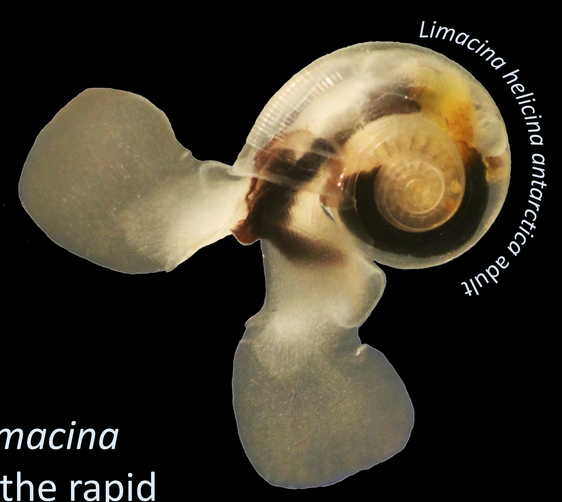
Introduction

Early developmental stages of marine calcifiers are thought to be particularly vulnerable to climate change.



Thecosome pteropods are planktonic gastropods that are often referred to as sentinels to ocean acidification due to their aragonite shells. However, the impact of ocean acidification on pteropods early life stages remains poorly understood and their response to multiple environmental stressors, such as ocean acidification and global warming is undetermined.

Pteropods can dominate zooplankton communities, are key components of polar pelagic food webs and act as important contributors to carbon and carbonate fluxes.



Aim

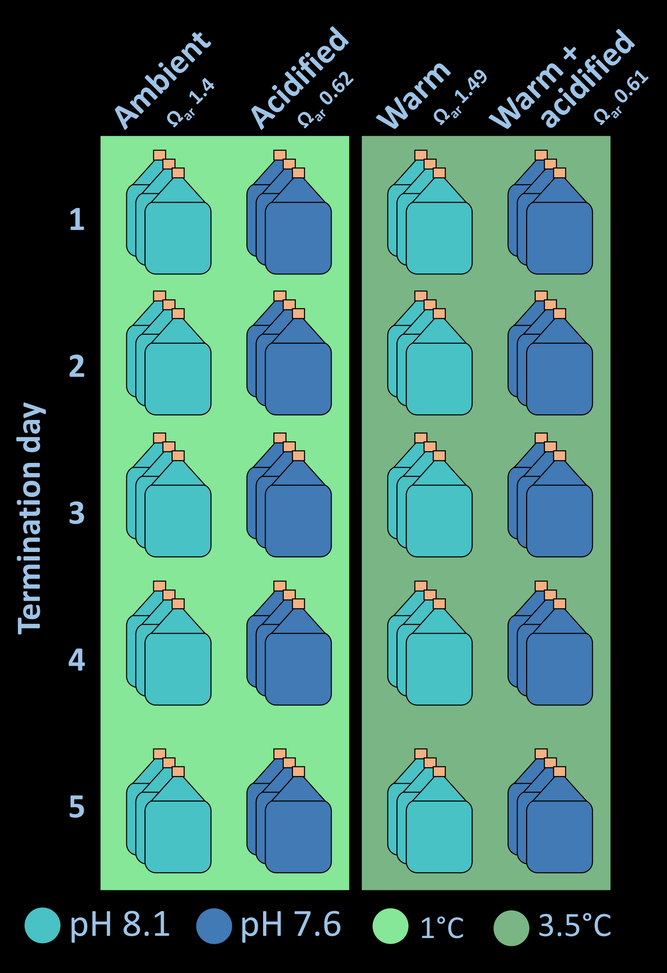
Here we investigate the response of *Limacina helicina antarctica* larvae over time to the rapid acidification and warming projected within the Southern Ocean.

Methods

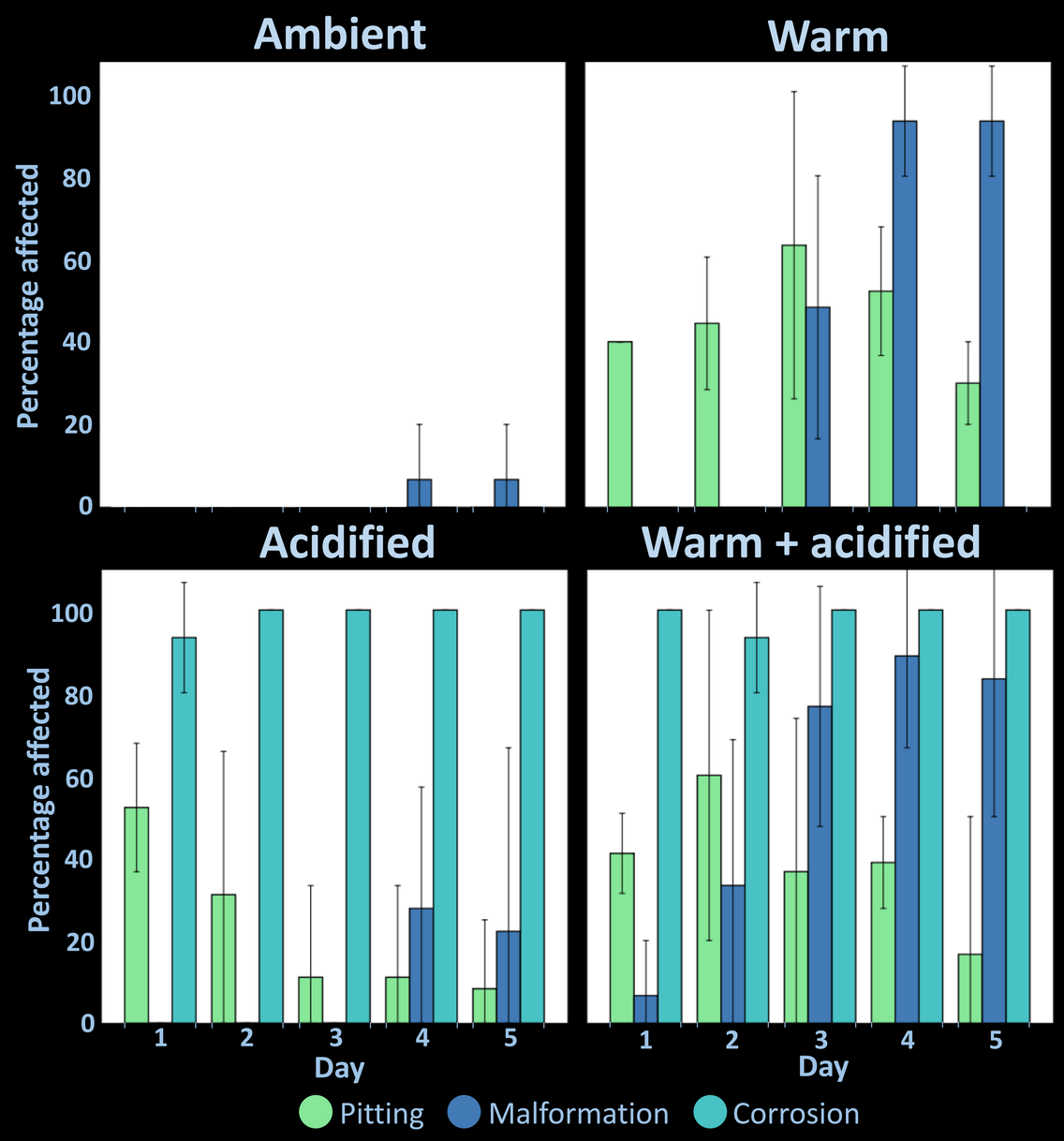
Adult *Limacina helicina antartica* were collected using a motion-compensated bongo net within the Scotia sea, Antarctica. Actively swimming individuals with no signs of damage and fully translucent shells were placed in ambient conditions where some spawned eggs.

Three sets of five larvae were placed in either ambient, warm, acidified and warm + acidified conditions (see opposite) and terminated daily for 5 days.

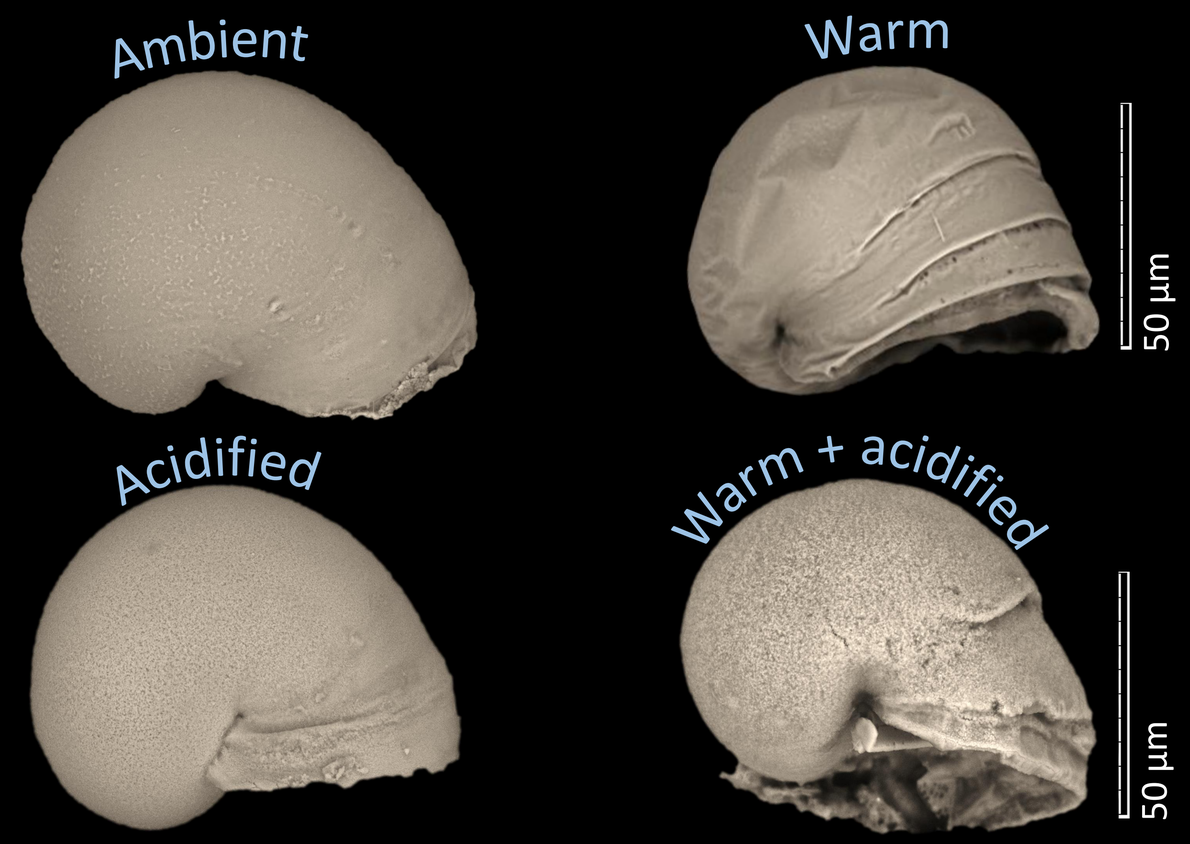
On termination, mortality rates were determined before preserving the larvae. Larval shells were examined under a variable pressure scanning electron microscope for signs of dissolution, pitting and malformation.



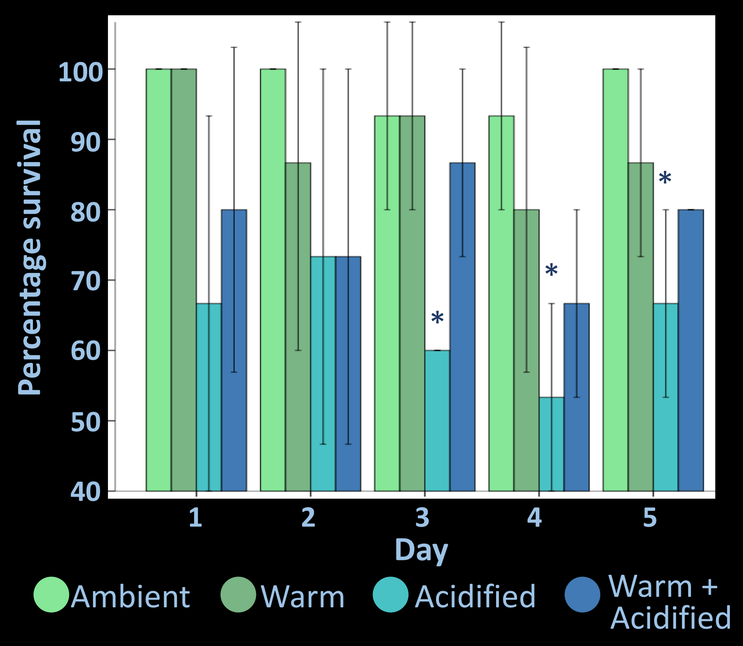
Larvae displayed shell corrosion and malformation



Corrosion was observed on ~99% and pitting on ~50% of larval shells within warm and warm + acidified conditions. Conversely within acidified conditions pitting reduced with exposure time. Shell malformation occurred after 3 and 4 days of exposure within warm and acidified conditions. In warm + acidified conditions malformation increased over time from 20% after one day of exposure to 80% after four days.



Mortality increased in acidified conditions



There was no difference in survival of larvae between ambient, warm and warm + acidified conditions over time.

However, after 3 days of exposure larvae in acidified conditions exhibited significantly higher mortality.

Conclusions

We demonstrate the larval *Limacina helicina antarctica* are susceptible to shell dissolution, even after short term exposure to acidified or warm acidified conditions.

Mortality increased after 3 days under acidified conditions alongside shell malformations within warm, acidified and warm + acidified conditions. This may allude to a physiological time point were larvae are particularly vulnerable to stressors.

These aspects could have severe implications on larval development and in turn impact the population dynamics of this keystone species.

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