# The potential impact of nanoplastic on Antarctic krill embryonic development in current and future acidified conditions of the Southern Ocean

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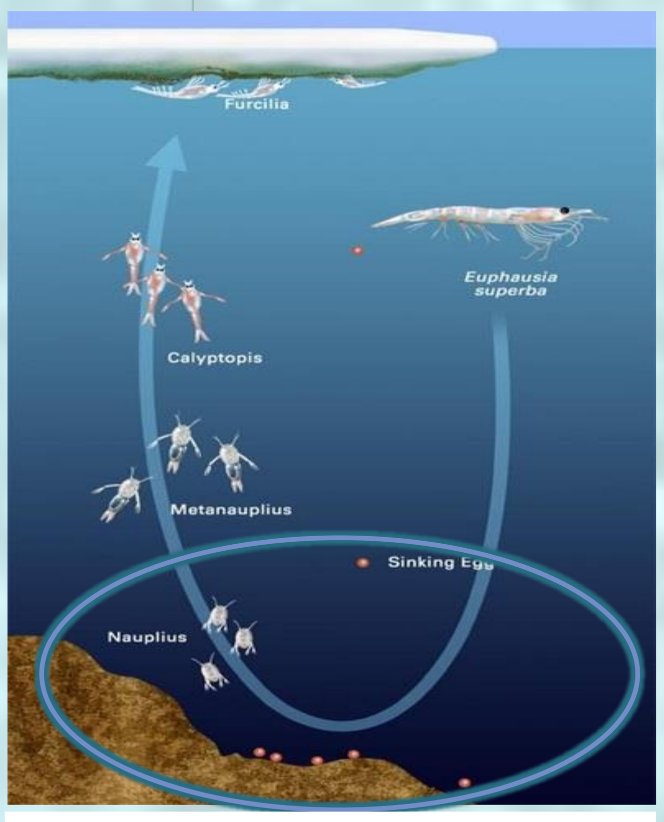



Fig 1. Antarctic krill lifecycle (Carr, 2014)

## Introduction

Antarctic krill *(Euphausia superba)* are amongst the most important and abundant filter-feeding metazoans in the Southern Ocean. The negative effects of rapid warming[1,2] and ocean acidification[3,4] have been acknowledged for the species. Less explored is the impact of increasing plastic pollution which the Southern Ocean has failed to avoid. Antarctic krill might be of increased risk of exposure to plastic particulates due to the ability of sea-ice to act as a sink for plastic particulates coupled with krill's reliance on sea-ice (Fig 1; Fig 2). The potential multi-stressor effects of plastic particulates coupled with the climate stressors intensified in the polar regions are also unexplored, yet the lifecycle of krill (Fig 1) exposes them to large changes in carbonate chemistry that will be further exacerbated in future conditions. Here, we present the progress of our ongoing investigation into the single and combined effects of nanoplastic and ocean acidification on the embryonic development of Antarctic krill.

## Hypotheses

- Nanoplastic will deleteriously impact the embryonic development of *E. superba.*
- The synergistic impact of nanoplastic and ocean acidification will increase detrimental consequences on embryonic development.

## Incubation

Organisms were collected in the Atlantic sector of the Southern Ocean.

Embryos (N~680) from a single female were incubated at 0.5 °C in a multiwell plate with treatments of 0.16 µm spherical, aminated (NP-$NH_2$), yellow-green fluorescent polystyrene nanoparticles at a final concentration of 2.5 µg/ml; in acidified conditions (pH 7.7); or with the combined treatment of nanoplastic and acidified water**.** Three multiwells contained 0.22 µm filtered seawater as a control. All treatments were carried out in triplicate.

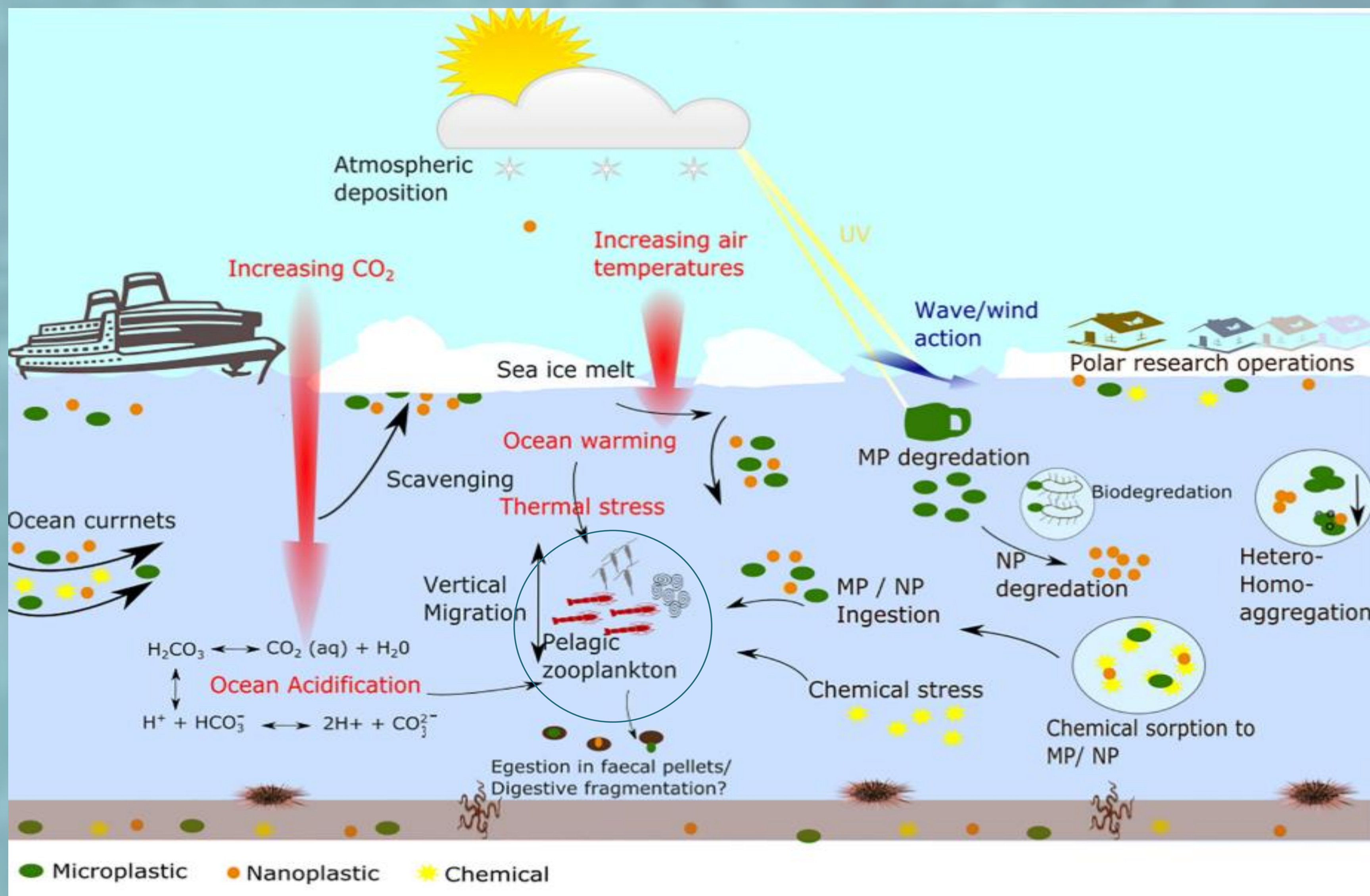


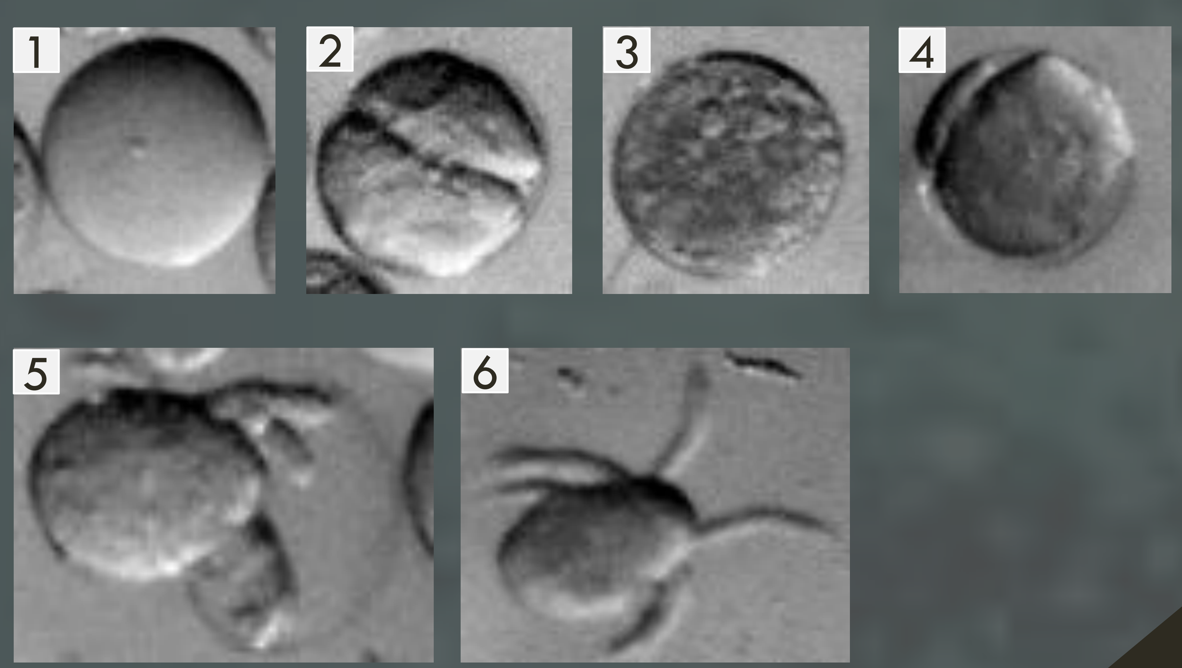

Fig 2. Potential pathways and fates of micro- and nano-plastics in the polar regions. Potential interactions with other anthropogenic chemical and climate stressors, and interactions with pelagic filter-feeding communities including Antarctic krill (Rowlands et al., 2020).

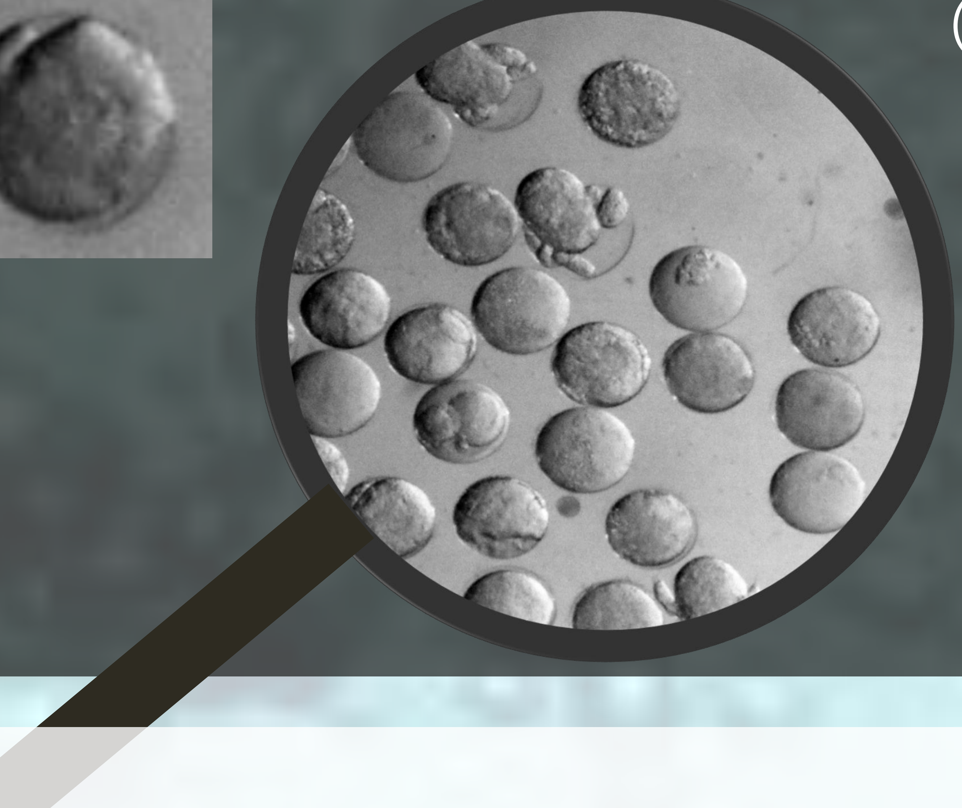
## Analyses

Embryonic development

Classified at the incubation end point as :

1. no development, 2. two-cell, 3. multi-cell, 4. limb bud, 5. entrapped nauplii, 6. hatched nauplii.



Nanoplastic quantification

Surfaces of a subset of embryos were imaged via scanning electron microscope (SEM) to determine absence/presence of nanoplastic adhered to the outer embryo surfaces (Fig 3). The residual of digested krill eggs will also be imaged via SEM to determine whether nanoplastic is able to penetrate the chorion (membrane).

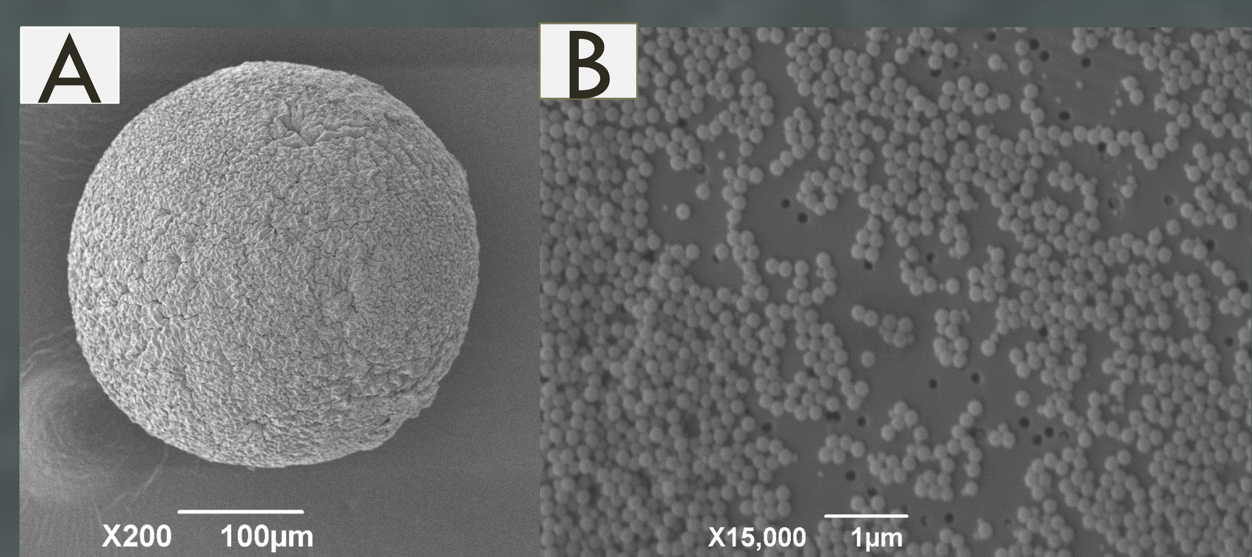



Fig 3. SEM images (A) Entire krill egg (B) Polystyrene nanoparticles (0.16um) used in incubations.

## Summary

Results from this multi-stressor nanoplastic/ocean acidification incubation will enhance our understanding of the potential impact of plastic pollution on Antarctic krill, at critical yet potentially most vulnerable embryonic life stages, in their current and predicted future environment. This is acknowledged to be a critical future research direction since addressing the toxicology of plastic particulates in singularity will fail to mimic future multi-stress conditions.

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