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# Investigating the effects of repeated cold exposures on the fertility of a winter-active parasitoid

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## Introduction

Climate change is causing warmer winters in temperate regions. This means some insects are increasingly **winter-active**, skipping diapause (Stelzer et al., 2010; Tougeron et al., 2017).

Sudden **cold events** in winter may severely affect persistence of insect populations through lethal and sublethal effects.

**Figure 1**: The stratospheric polar vortex, the weakening of which due to global warming, may cause sudden winter cold extremes.

The impact of cold on **fertility** is one such sublethal effect which may incur similar costs to the typically studied lethal limits (Walsh et al., 2019).

**Aim**: To investigate how a scenario of repeated cold exposures could impact the fertility of *Aphidius ervi,* a **beneficial insect** that performs a valuable agroecosystem pest control service.

## Methods

- One day old parasitoid mummies were isolated, placed in boiler tubes, and submerged in an alcohol bath for 2 hours for 3 consecutive days at set temperatures dependant on treatment group. Once treated they were left to emerge. The control group was untreated at 15°C.

Treatment groups

-10°C -5°C 0°C +5°C

- Emerged adults were frozen at -70°C and then dissected under a microscope in PBS to isolate the ovaries.
- Ovaries were burst and egg load and egg volume (as an average of the 20 eggs per specimen) determined.

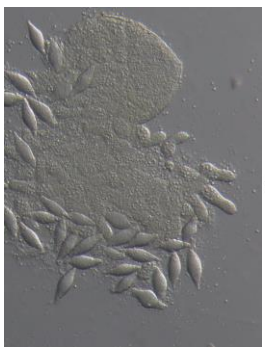

**Figure 2**: Burst *A. ervi* ovary with eggs spilling out

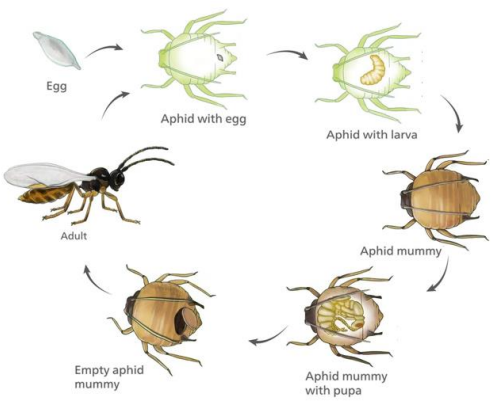


**Figure 3**: *A. ervi* life cycle

## Results so far

- Repeated cold exposure for 3 days during pupal development produced no significant effect on egg load ($p$ = 0.132, $f$ = 1.818) nor did it have a significant effect on egg volume ($p$ = 0.0984, $f$ = 2.018).
- Graph (figure 3), shows a trend that egg volume does seem to decrease with increasing severity of cold exposure. Pairwise post-hoc analysis indicates some values were close to significance ($Tukey_{control- -10}$: $p$ = 0.0636).

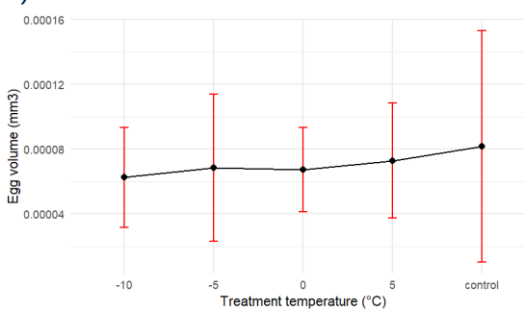


**Figure 4**: Effect of the temperature of cold exposure treatment on egg volume. Points= means, bars= SD.

- Power analysis indicated significance for egg volume can be achieved with an increase in n of 9 per group.

## Discussion

Currently the study suggests egg load and volume are not significantly affected by repeated cold exposures. However, there is a trend for egg volume being affected which may become apparent once dissections have been completed.

A previous study investigating prolonged heat exposure on egg load and egg volume found significance for both (Le Lann et al., 2011). But no studies have investigated parasitoid egg volume in relation to cold prior to this.

If the effect becomes significant, this could demonstrate plasticity in the egg size of a koinobiont parasitoid for the first time as a result of cold exposure.

The future direction of this study, should significance be achieved, will be to investigate the implications of egg size plasticity through examining progeny of treated specimens. Additionally, an investigation into the effects of cold exposure on male fertility will be carried out.

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**References:**

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Walsh, B.S. *et al.* (2019) *Trends in Ecology & Evolution*, 34(3), pp. 249–259.