



The Effects of Environmental Cues on Production of Dormant Eggs in an Exotic Zooplankton

Camille Gilley, Melissa Pompilius, and Dr. Robert Fischer
 MTSU CBAS Department of Biology

MIDDLE TENNESSEE STATE UNIVERSITY

Background

PROBLEM: Nonindigenous Invasive Species (NIS) can dramatically alter aquatic ecosystems.

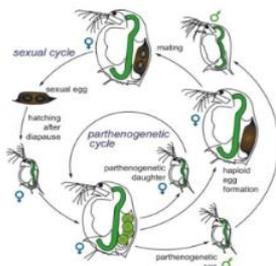
- Although most vertebrate NIS and their impacts in this region have been well documented, less is known about the potential impacts of invertebrate species.

One such species is *Daphnia lumholtzi*, an aquatic invertebrate zooplankton that was introduced to a Texas reservoir in the 1980s, and has since spread rapidly to a broad range of aquatic habitats throughout the US.



QUESTION: What characteristics allow an exotic species to colonize a new environment?

- Possible attributes: short generation time, fertilized female able to colonize alone, polyphagous, and able to function in a wide range of physical conditions.



Previous studies have shown that *Daphnia lumholtzi* may have filled an empty thermal niche above the native's optimal temperature.

Females are able to reproduce asexually but can also reproduce sexually by producing environmentally-resistant Dormant Eggs (DE's) that can be later fertilized by males.

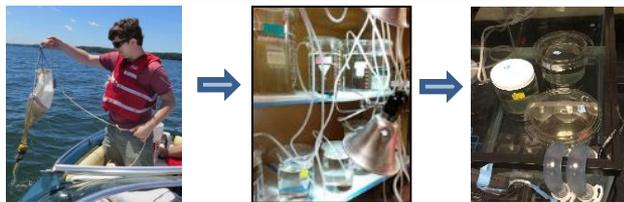
References

Ehrlich, P.R. "Which Animal Will Invade?" *Springer*. Springer New York, 01 Jan. 1986. Web.
 Engel K, Tollrian R. Competitive ability, thermal tolerance and invasion success in exotic *Daphnia lumholtzi*. 2011;34(1):92-97.6
 Sarma1, S. S. S., S. Nandini, and R. D. Gulati. "Life History Strategies of Cladocerans: Comparisons of Tropical and Temperate Taxa." *Developments in Hydrobiology Aquatic Biodiversity II* (2005): 315-33. Web.

Purpose and Objectives

Despite their ability to parthenogenetically reproduce, *Daphnia lumholtzi* is believed to use environmental cues to induce a population of sexually reproducing females to produce DE's and then males to fertilize those eggs. While it isn't clear which environmental cues induce male and DE production, some studies suggest that multiple cues may be required, including changes in temperatures, population density, and water quality. In this study, we investigated the effects of combined environmental cues on male and DE production in *D. lumholtzi* by varying the initial population density coupled with changes in temperature to simulate cooling seasons (22°C-16°C) or warming seasons (23°C-30°C).

Materials and Methods



Zooplankton were collected from field sites by sampling the water column with a plankton net.

Individual females were isolated from field samples to establish isofemale (clonal) lineages in the laboratory.

Samples from the lab were placed within 1 L aquaria.

Number of Daphnia Within Each 1 L Aquaria

17C	5	7	10
23C	5	7	10
29C	5	7	10

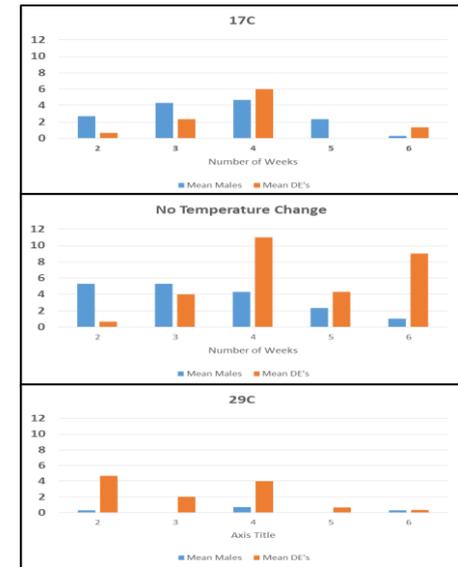
- 9 total 1 L aquaria: 3 aquaria with a low density number (5) of *Daphnia*, 3 with a medium density number (7), and 3 with a high density number (10).
- 3 aquaria with varying densities were placed in each temperature range: 16C-18C, 22C-24C, and 28C-30C.



- All aquaria were acclimated for 1 week prior to experiment initiation.
- Once acclimated, each aquaria was cleaned on a weekly basis and monitored for DE's, males, and changes in population density.
- 5 total changes were made throughout this ongoing experiment.

Results

- Two-tail t-tests were run on all variables. Significance determined at the $P < 0.05$ level.
- Significant differences (< 0.05) were found for male production in the high density aquaria comparing 16C vs 30C and 22C vs 30C., but no differences were found at low or medium densities at any temperature.
- No significant difference in DE production was observed at any density or temperature.



- Significant male production was observed at 17C and 22C but not at 30C.

Discussion

- The data collected shows that at warming temperatures of 28C-30C, *Daphnia lumholtzi* reproduce asexually because population density increased over time while DE and male production stays low. However, cooling temperatures of 16C-18C show mainly sexual reproduction at play based on the higher numbers of DE's and males produced.
- These observed trends could possibly be attributed to the tropical origins of *Daphnia*: the environmental cue of cooling seasons may trigger environmentally-resistant DE's.
- Next, we will repeat this experiment with a similar design while controlling population densities.