Zooming In to See the Bigger Picture: How *Daphnia* Gut Morphology Varies with Population, Parasitism, and Salt

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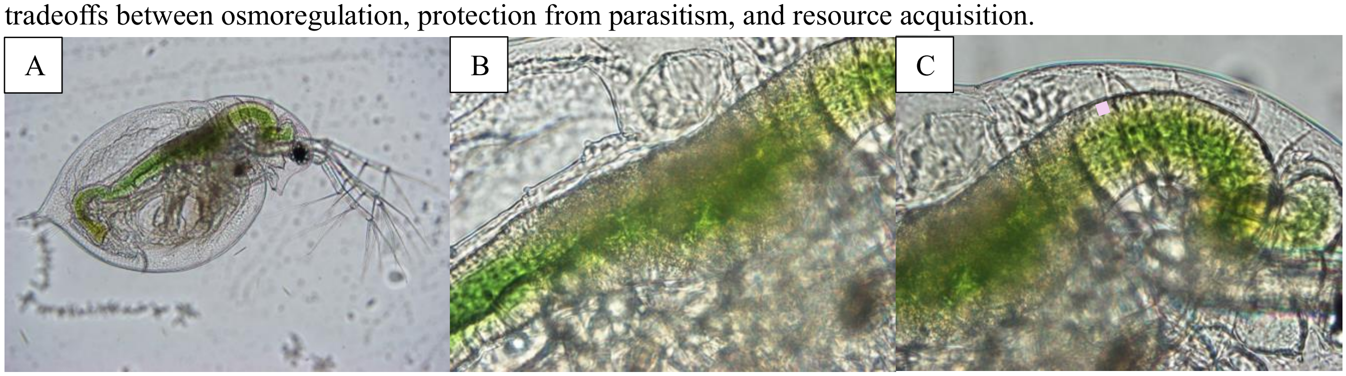
The biggest ideas of ecology, questions from toxicity limits to the dynamics of parasitic interactions, can be answered by studying one of the smallest organisms: the *Daphnia ambigua*. These *Daphnia* are planktonic crustaceans found in freshwater ecosystems where they serve as vital food for fish and important consumers of algae, contributing to a stable food web and maintaining water quality. The Rogalski Lab collects its *Daphnia* from local Sewall Pond, where *Daphnia* experience fluctuations in salinity between seasons and infection from a recently discovered gut parasite. By growing *Daphnia* collected from Sewall Pond, the Rogalski Lab has model organisms for experiments concerning toxicity and parasitism.

Throughout most of their season, *Daphnia* reproduce asexually, birthing genetic clones of themselves. At the end of their season however, *Daphnia* enter diapause, reproducing sexually—amplifying genetic diversity—and leaving behind a resting egg bank that gives the next season's population a distinct set of genotypes. The genetic diversity between *Daphnia* populations of different seasons and the genetic similarity of *Daphnia* populations of the same season allow the Rogalski Lab to examine questions of adaptation and evolution as each season the *Daphnia* battle different stresses.

I spent the summer examining the gut parasite discovered last year. The gut parasite was collected at two different periods during the same season, one point where the salinity of Sewall Pond was relatively normal (the G-strain parasite) and one point where the salinity was elevated (the Gx-strain parasite). *Daphnia* populations were also collected from these same time points, creating a G and a Gx population. While these two populations have not been genotyped, the lab has treated them as genetically distinct populations given the possibility of adaptation to salt stress between collection periods. My goal for the summer was to understand how the gut morphology of different *Daphnia* populations responded to combinations of gut parasitism and salinity stress. *Daphnia* guts tend to be thicker to aid food assimilation, which provides energy for reproduction. Their guts also aid in regulating internal salt balance and are impacted by exposure to some parasites.

My set-up tested four clones (G12, G16, Gx39, and Gx40) in six conditions of varying parasitic and salinity stress: control water + no parasite, control water + G-strain parasite, control water + Gx-strain parasite, high-salt water + no parasite, high-salt water + G-strain parasite, and high-salt water + Gx-strain parasite. *Daphnia* were imaged throughout the trial to measure gut wall thickness and determine infection status for replicates in each treatment.

My preliminary results suggest the average gut width depended on the treatment and the clonal lineage. Overall, the gut wall tended to be thinner in the high-salt treatment. The G12 clone had a thicker gut in the low-salt, parasite-free treatment, suggesting parasitism may also affect gut thickness, but this depends on genetic context. Likewise, gut thickness was only reduced for the G16 clone in the parasite treatment, indicating a lack of response to salinity. My results suggest the stress of gut parasitism and salt toxicity interfere with food absorption by altering gut thickness. Future research may examine how adaptation to salt stress, parasitism, or both in combination, may involve gut morphology and tradeoffs between osmoregulation, protection from parasitism, and resource acquisition.



Infected Gx40 clone from control water + Gx-strain parasite treatment: (A) fully body, 10X, (B) visible patches of spores in the midgut, (C) upper gut, where gut thickness was measured as width of the epithelium (marked by pink line).

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