The influence of parasitism and salinity stress on *Daphnia ambigua* fitness

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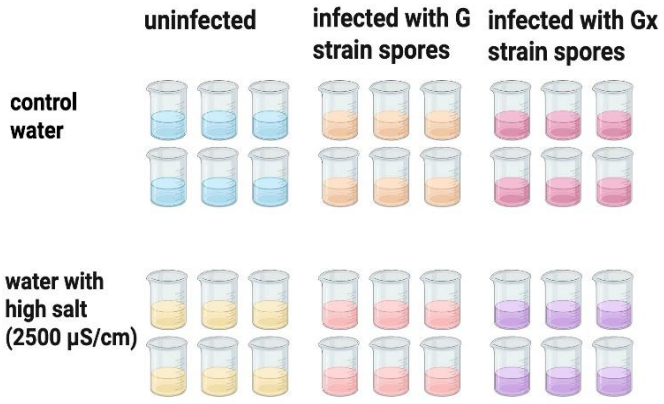
The ecological relationship between symbionts and their hosts exists on a continuum. Parasitism, in which parasites benefit at cost to their hosts, commensalism, in which consequences for hosts are neutral, and mutualism, in which both organisms derive a net benefit, are not fixed categories for host and parasite but rather shift depending on genetic and environmental factors (Dziuba et al., 2024). The purpose of my study was to investigate this relationship using the Rogalski lab's model organism *Daphnia ambigua* which are small planktonic crustaceans commonly inhabiting ponds and lakes. Local field populations of *Daphnia* have recently been afflicted by epidemics of a previously unknown, intracellular, spore-forming parasite. Preliminary lab and field studies have shown this parasite reduces *Daphnia* reproduction, but impacts may depend on the host's history of exposure. Previous research in the Rogalski lab shows that *Daphnia* are impacted by salt pollution, but populations can adapt to this stress. Building on this knowledge, I designed an experiment to examine how *Daphnia* respond to the combined pressures of parasitism and salt stress. How do these stressors interact, and does evolutionary history affect the outcome?

Adult *Daphnia* were placed in beakers of filtered pond water assigned to one of six experimental conditions. Salt content was either natural (670 µS/cm) or elevated to 2500 µS/cm. Beakers were either left uninfected or supplied with spores isolated from two different *Daphnia* strains labeled G and Gx (see Figure 1). *Daphnia* tested in this experiment also belonged to the G and Gx strains harvested in 2024. This reciprocal transplant design allowed for insight into *Daphnia* response when exposed to both familiar and unfamiliar spores. The spores were introduced three days before salt stress was introduced, to allow for infection to take hold and to avoid compromising spore virulence by placing spores directly into salty water. *Daphnia* were fed, water-changed, and monitored regularly for fifteen days following the introduction of salty conditions, after which the experiment was terminated. Fitness was measured by two standard markers of reproduction: total offspring produced during the trial, and survival time (days elapsed from start of experiment to recorded death).



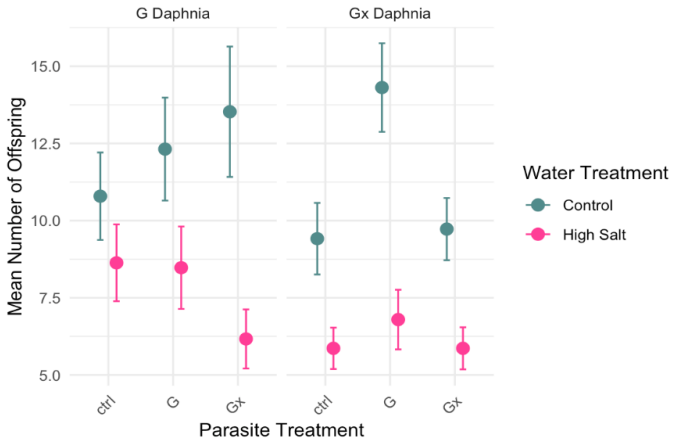


Fig. 1. *Method Both G and Gx* Daphnia *strains received treatments.*
Fig. 2. *Daphnia reproduction under different treatments.*

Surprisingly, *Daphnia* produced a greater number of offspring when populations were exposed to spores from the unfamiliar strain as compared to control and native-spore treatments. In contrast, native-spore treatments did not seem to impact their fitness. While these findings could be interpreted as evidence of mutualism, abundant reproduction could also be a stress response rather than a marker of improved fitness. However, unfamiliar spores did not boost reproduction in the high salt treatments, suggesting that salt stress is extreme enough to negate parasite-induced responses. Future studies will include assessing the direct impact of salt on spore infectivity, measuring stress-induced changes in gut thickness, and documenting fluctuations in virulence over different seasons in the field.

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References

Dziuba, M., McIntire, K., Seto, K., & Rogalski, M. (2024). Phylogeny, morphology, virulence, ecology, and host range of *Ordospora pajunii* (Ordosporidae), a microsporidian symbiont of *Daphnia* spp. *American Society for Microbiology, 15*(6), e00582-24. https://doi.org/10.1128/mbio.00582-24