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Summer Research Summary
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How do salt-sensitive and salt-tolerant genotypes respond across a broad salinity gradient?

Daphnia, also known as "water fleas," are small planktonic crustaceans commonly found in freshwater environments. They play an important role in maintaining ecosystem balance by serving as prey for larger aquatic animals like fish and insects, and by feeding on tiny particles such as algae. By consuming algae, Daphnia help keep the water clearer and cleaner, which is why they are often called filter feeders (Ebert, 2022). In recent years, salinity levels in many freshwater ecosystems have started to fluctuate and increase. These changes are largely driven by human activities and natural environmental factors. Rising salinity negatively affects biodiversity and threatens the survival of freshwater species. Some organisms are now undergoing natural selection, where only those that can tolerate the changing conditions continue to survive and reproduce (Hintz & Relyea, 2019).

Previous research in the Rogalski lab has shown that elevated salinity can reduce Daphnia fitness, including their survival, growth, and reproduction. However, the effects of *low* salinity levels are not well understood. (Rogalski et al, 2024) This study aimed to investigate how Daphnia with varying salt tolerances respond to both low- and high-salinity environments. We measured fitness in terms of survival, growth, and reproduction.

We tested two Daphnia populations collected from different years. One group, collected in 2021 when the lake had lower salinity, was more salt-sensitive. The other group, from 2022, was more salt-tolerant, collected after lake salinity had increased. Although both groups share the same genotype, natural selection likely caused a shift from mostly salt-sensitive individuals in 2021 to more salt-tolerant ones in 2022 as environmental conditions changed. To evaluate their fitness, both groups were exposed to 15 different salinity levels, ranging from 100 $\mu\text{S}/\text{cm}$ to 4000 $\mu\text{S}/\text{cm}$. All salinity treatments were conducted under the same controlled conditions. We recorded survival, growth, and reproduction for each group at every salinity level.

Fitness responses differed across the salinity gradient, with no consistent trend observed. At the highest salinity level (4000 $\mu\text{S}/\text{cm}$), neither group survived. At the lowest level (100 $\mu\text{S}/\text{cm}$), both populations exhibited similar survival rates and were able to grow and reproduce. Interestingly, mid-range salinity levels (approximately 800 to 1600 $\mu\text{S}/\text{cm}$) supported relatively higher growth and reproduction in both groups compared to extreme conditions. Although the data did not reveal significant differences, likely due to outliers and the small number of replicates, the results still provide useful insights for future research. It may be helpful to test additional salinity levels, especially in the 800–1200 $\mu\text{S}/\text{cm}$ range, to better capture subtle trends and reduce the influence of outliers. Each salinity condition in this experiment included only two to three replicates, which may have limited the ability to detect consistent patterns. Increasing the number of replicates in future experiments would help clarify whether the observed differences reflect true population-level effects or random variation among individuals.

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Rogalski, M. A., Baker, E. S., Benadon, C. M., Tatgenhorst, C., & Nichols, B. R. (2024). Lake water chemistry and local adaptation shape NaCl toxicity in *Daphnia ambigua*. *Evolutionary Applications*, 17(3). <https://doi.org/10.1111/eva.13668>

