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Direct and indirect effects of snail herbivory on *Spirodela polyrhiza* in a two-year outdoor experiment

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Predicting the outcome of species interactions in complex communities requires separating the direct effects that organisms have on each other from those that function indirectly through their influence on other community members and the environment. We performed a two-year outdoor experiment with 14 mesocosms containing the giant duckweed, *Spirodela polyrhiza*, in the presence or absence of its aquatic snail herbivore, *Lymnaea stagnalis*. We analyzed the snail effects on the aquatic community and the evolutionary consequences for the duckweed. The direct and indirect effects of snails turned out to be often antagonistic. In the first year, snail herbivory reduced the duckweed abundance by direct grazing but also promoted duckweed growth indirectly by reducing algae competition and increasing phosphate availability, thereby shifting plant traits and genotype frequencies. In the second year, the ponds experienced an algae bloom and strong phosphate depletion which abolished and reversed various effects and trait-fitness associations observed in the previous year. Over the two years, the direct effects were observed to be stronger but fluctuating, while the indirect effects were weaker but more consistent. The results highlight the need for multiple season experiments with complex communities to understand the forces in species interactions that drive evolution.

Corresponding author email

shuqing.xu@uni-mainz.de

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References

Sara Nouere, Martin Schäfer, Antonino Malacrinò, Martin Lohr, Christoph Vorburger, Shuqing Xu (2025) Contrasting and fluctuating selection from direct and indirect herbivory drives transient plant evolution. Authorea (Preprint) DOI: 10.22541/au.176219502.28259701/v1

Primary author(s) : SCHÄFER, Martin (Institute of Organismic and Molecular Evolution (iomE), Johannes Gutenberg University Mainz)

Co-author(s) : NOUERE, Sara (Institute of Organismic and Molecular Evolution (iomE), Johannes Gutenberg University Mainz); MALACRINO, Antonino (Department of Biological Sciences, Clemson University, USA); LOHR, Martin (Institute for Molecular Physiology, Johannes Gutenberg University Mainz); VORBURGER, Christoph (Department of Aquatic Ecology, Swiss Federal Institute of Aquatic Science and Technology (EAWAG)); XU, Shuqing (Institute of Organismic and Molecular Evolution (iomE), Johannes Gutenberg University Mainz)

Presenter(s) : SCHÄFER, Martin (Institute of Organismic and Molecular Evolution (iomE), Johannes Gutenberg University Mainz)

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