Biomass Allocation of Range Expanding Grassland Species

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Climate change affects the range and diversity of species

Rising temperatures may drive lowland plants into alpine ecosystems, potentially disrupting native biodiversity and ecosystem function [1].

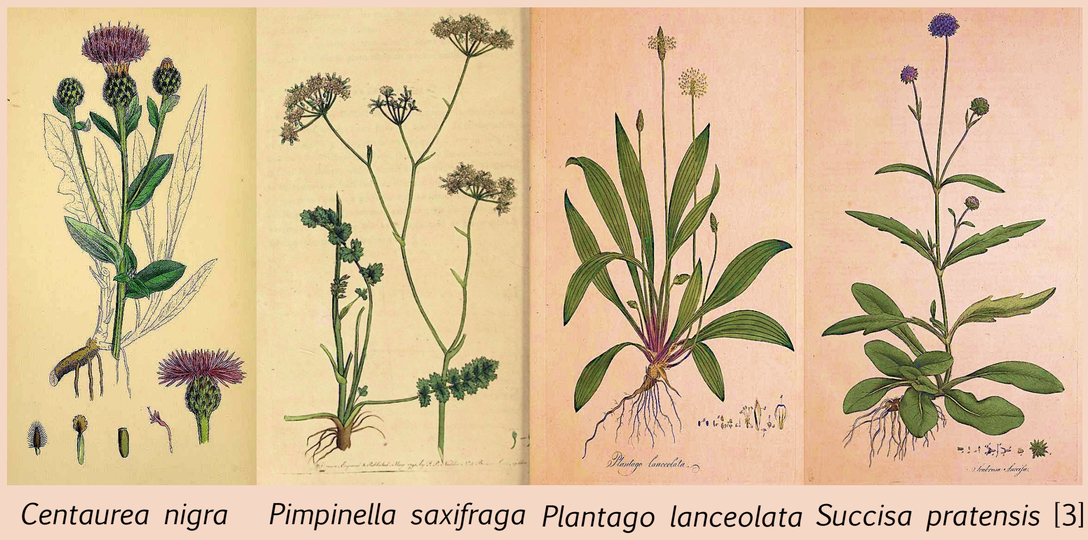
To adapt, plants can alter biomass allocation among different parts [2].

This study examines how four low-elevation grassland species adjust biomass allocation when grown within and outside their native range under varied temperature and vegetation conditions, providing insight into potential adaptive strategies shaping future alpine ecosystems..

H1, Competition: In competition-free plots, translocated plants will allocate more to flowers and stems for reproduction and structure; in resident vegetation, more will go to leaves to compete for light.

H2, Temperature: In warmed plots, translocated plants will show allocation patterns similar to those at their native warmer range.

Study species



Centaurea nigra *Pimpinella saxifraga* *Plantago lanceolata* *Succisa pratensis* [3]

Figure: Biomass allocation in percentage of total mass by species, site, and treatment

Methods

Upslope transplantation field experiment.

Study area: Two montane grassland sites near Voss, Norway, with a 400 m elevation difference representing ~2°C warming due to climate change.

- High Site (Helgaset, 730 m): South-facing, semi-calcareous wet grassland; 10 treatment blocks in fenced areas avoiding obstacles.
- Low Site (Gråsida, 315 m): Similar habitat; 10 treatment blocks in a single fenced area.

Plot Design: 1x1 m plots with focal species in randomized coordinate grids.

Treatments: Warming w/OTC (open top chambers) vs. ambient, and with vs. without competition.

Biomass Collection: Plants harvested in late August, cut 1 cm above ground level, put in bags labeled w/ species, site, plot and coordinate. Biomass stored in -20 °C freezer until processing in lab.

Lab Processing: Separating plants into stems, leaves, and flowers, drying them at 65°C for >3 days, and weighing the dry mass.

Did warming, competition, or elevation affect the mass allocation?

Mass allocation differed significantly between high- and low-elevation sites, though **treatments showed no statistically significant effect**. Outside their native range, without competition, plants allocated more to stems and reproductive parts, while competitive conditions led to greater leaf biomass investment (**H1 supported**). Temperature had less influence, with no clear mass allocation trend linked to warming (**H2 not supported**). High interspecific variation limited the ability to assess combined treatment effects across species.

Further research

This project is part of the **RangeX** research group, which examines multiple traits of focal species and native vegetation. Given the limited treatment effects on mass allocation, **other traits and below-ground mass** may offer **stronger insights into treatment impacts** and help predict the effects of range-expanding species on native alpine ecosystems.

BIO299: poster 17

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References:
[1]: Chen, I.-C., Hill, J. K., Ohlemüller, R., Roy, D. B., & Thomas, C. D. (2011). Rapid Range Shifts of Species Associated with High Levels of Climate Warming. *Science*, *333*(6045), 1024–1026. https://doi.org/10.1126/science.1206432
[2]: Zhou, T., Du, W., Wang, J., Zhang, L., Gao, J., Shi, N., Wang, L., Wu, Y., & Tian, B. (2023). Divergent responses of plant functional traits and biomass allocation to slope aspects in four perennial herbs of the alpine meadow ecosystem. *Frontiers in Plant Science*, *14*. https://doi.org/10.3389/fpls.2023.1092821
[3]: Illustrations from: http://www.plantillustrations.org/