
Spatial and temporal pattern of a pollinator-transmitted pathogen in a long-lived perennial, *Silene acaulis*

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ABSTRACT

Questions: Does the spatial structure or rate of spread of anther-smut disease differ among plots with low versus high density of the host *Silene acaulis* or low (<6%) versus high (25%) disease frequency? What is the demographic pattern of seedling recruitment and host mortality in *S. acaulis*? How do the temporal dynamics of anther-smut disease differ among hosts that vary in lifespan and population persistence?

Organisms: *Silene acaulis*, a long-lived alpine tundra perennial, and *Microbotryum violaceum*, a pollinator-transmitted fungus that causes anther-smut disease.

Field site and time: Plots ranged in elevation from 3658 m to 3964 m on Pennsylvania Mountain Field Station owned by Colorado State University, Park County, Colorado, USA. Six plots (6 × 10 m) were spatially mapped for 5–8 years and three of these plots were monitored for seedling recruitment and host mortality for 8 years.

Methods: The spatial structure of healthy, diseased and juvenile plants was monitored in natural plots that ranged in host density from 3 to 27 plants per square metre and from 5–25% in initial disease frequency. The spatial pattern of diseased plants was analysed using Moran's *I*, and a join-count method was used to analyse nearest-neighbour relationships of juveniles and healthy or diseased adults. Data on rate of disease spread and loss were monitored in all plots. Demographic data on seedling recruitment and host mortality, as well as spore dispersal patterns, were monitored in three of the six plots.

Results: Infections were stable regardless of host density or initial disease frequency; less than 1% of healthy individuals became infected and less than 1% diseased individuals lost infection over the 8-year study period. Diseased plants were significantly clustered at the scale of less than 1 m in five of six plots; Moran's *I*, a measure of spatial autocorrelation, ranged from 0.1 to 0.6. There was a trend for higher autocorrelation values in plots with lower host density. The number of new seedlings was consistently greater than either the number of deaths or new infections. The annual rate of disease spread in *S. acaulis* is lower than that reported for four other hosts of the same disease. Among-species comparisons suggest that the spatial clustering of diseased plants, rarity of vegetative infection of juveniles, short flowering time and high temporal stability of *S. acaulis* populations contribute to the relatively low rate of disease spread in *S. acaulis*.

Keywords: Caryophyllaceae, *Microbotryum violaceum*, plant–fungus interactions, *Silene acaulis*, spatial autocorrelation, *Ustilago violacea*.

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