The Influence of Position on Clone Growth: Spatial Dynamics in a Simulated Bracken - Grass Mosaic

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"VegeTate" is a relatively simple mass-based spatial simulation model of vegetation dynamics, which can be parameterized from growth observations on monocultures and can simulate potentially unlimited numbers of intermixed species and genotypes [2]. Growth and competition within cells in a grid are calculated from a system of partial differential equations related to the logistic growth equation [4, 1]. It is being developed through application to bracken - grass mosaics for two reasons:

- Invasion of bracken (*Pteridum aquilinum*) into pasture is a globally important problem in agriculture and conservation [5].
- Bracken - grass mosaics are also useful model systems for studying general principles of spatial dynamics in vegetation [2, 3].

When collateral impacts of animals grazing grass, e.g. trampling, were included, VegeTate generated persistent bracken - grass mosaics for a wide range of parameterizations [2]. Locally high densities of bracken discouraged grazing, shifting the balance of competition in favour of bracken. In simulations generating mosaics there were large contrasts in the amount of growth achieved from each initial cell [3]. Bracken from many initial cells became extinct, while total bracken mass at the end of the simulation was dominated by a small number of clones. Such spatial dynamics could amplify and accelerate processes of natural selection and genetic drift.

During the expansion of patches of bracken, the relationship between position and opportunity to grow can become systematic and predictable.

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Thus there may be natural selection for spreading strategies that increase the probability that clones will occupy positions with high growth potential. The centres of large bracken patches have limited opportunities for growth, so weak selection for traits adapted to the centres of patches may partly explain the tendency for dieback to occur at the centres of large patches dominated by a single plant species.

Environmental factors modify the relative advantage of different positions. For example, without grazing, clones at the outer margins of a spreading patch of bracken achieve the highest relative growth rates. However, with grazing, clones at the fringes of patches, where bracken density is low and grazing intensity is high, may be driven towards extinction and replaced by clones spreading from where bracken is denser, closer to the centre of patches. Thus traits related to vegetative spread may become linked to traits related to responses to the environment.

References

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