An Eco-Evolutionary Basis for Adaptation to Climate Change

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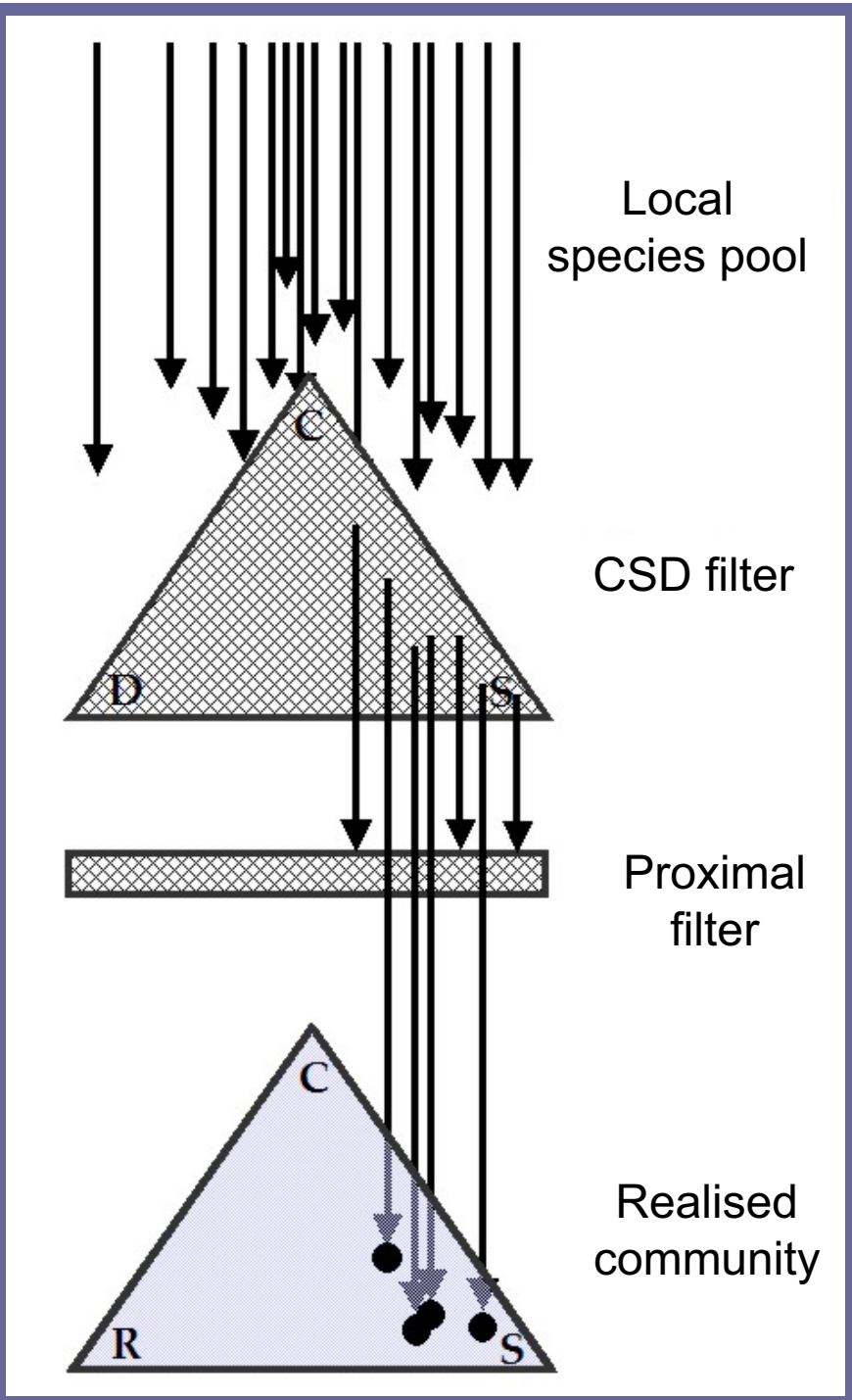
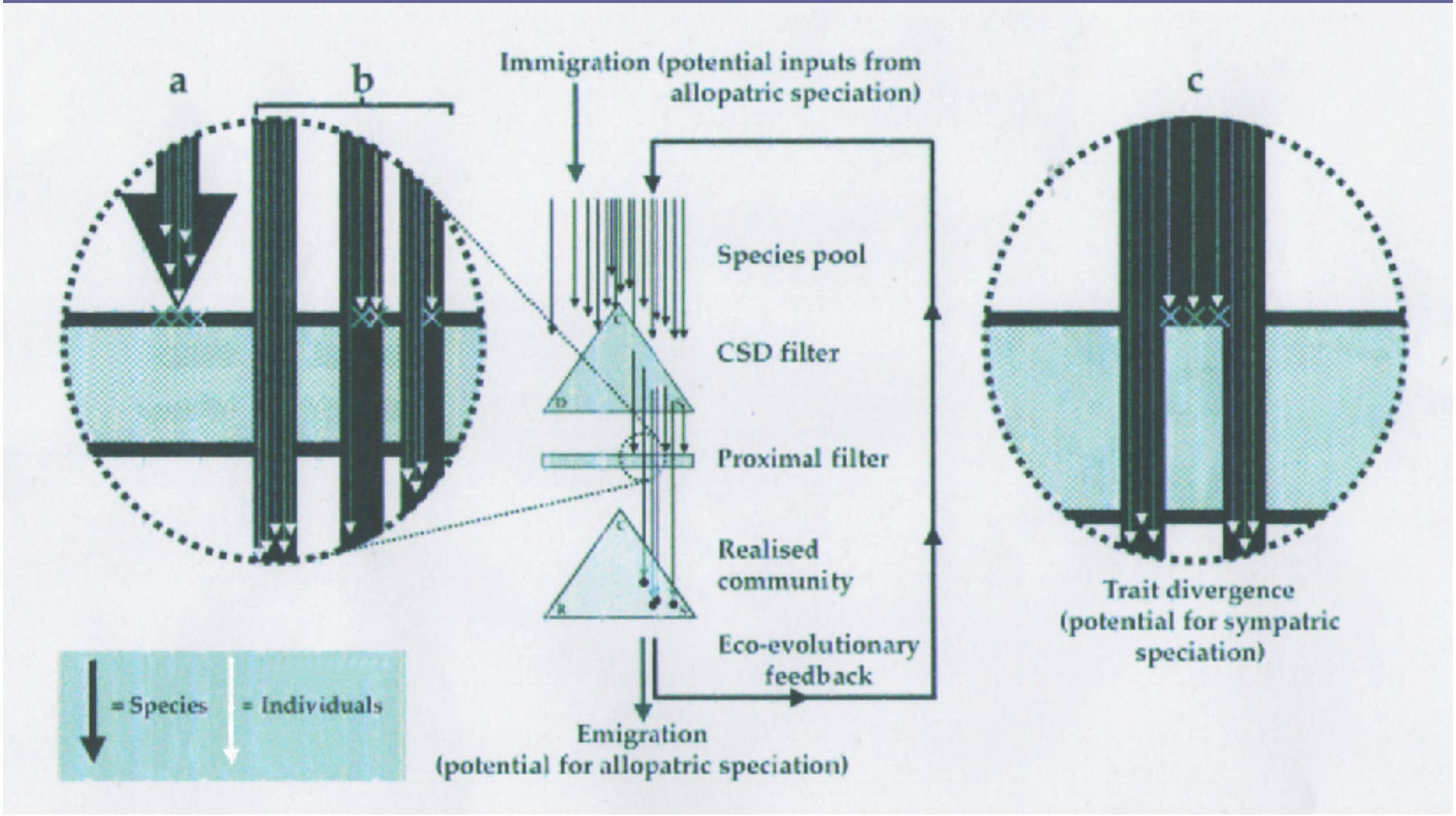
The twin-filter model of community and ecosystem assembly*

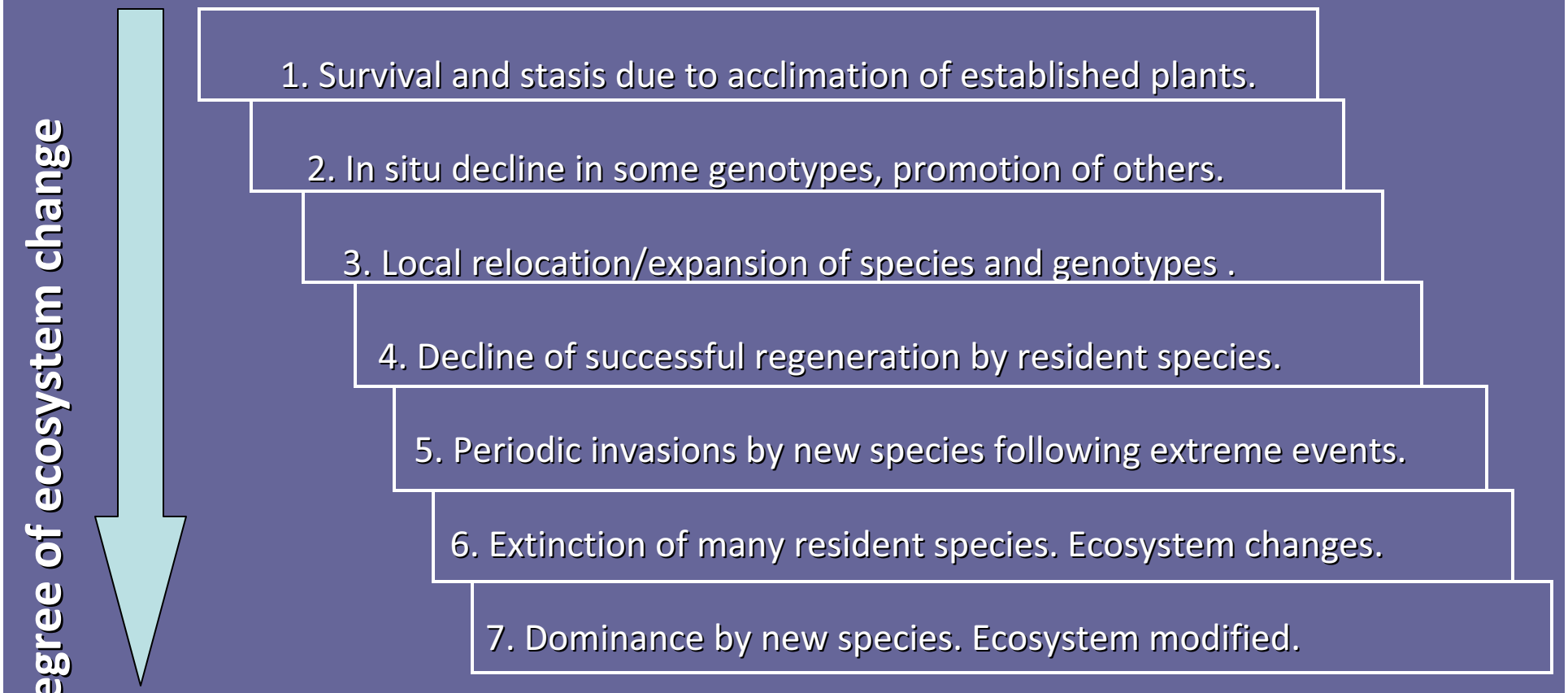


*Phil Grime and Simon Pierce (2011) *The Evolutionary strategies that shape ecosystems*. (in press)

Detail of the twin-filter model showing how ecological filters can act as evolutionary selection pressures



7 steps of vegetation response to climate change



Buxton Climate Change Study

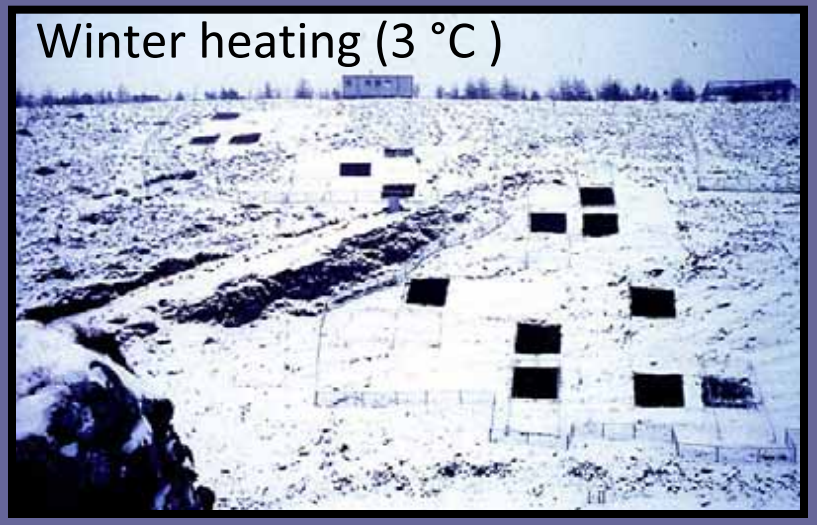
Est. 1993

Calcareous grassland

Annually grazed, production 350-400 g/m^2/yr

Buxton, England; 370 m a.s.l., 53 20’ N Lat

Long-term climate manipulations



+ Temp/water interactions

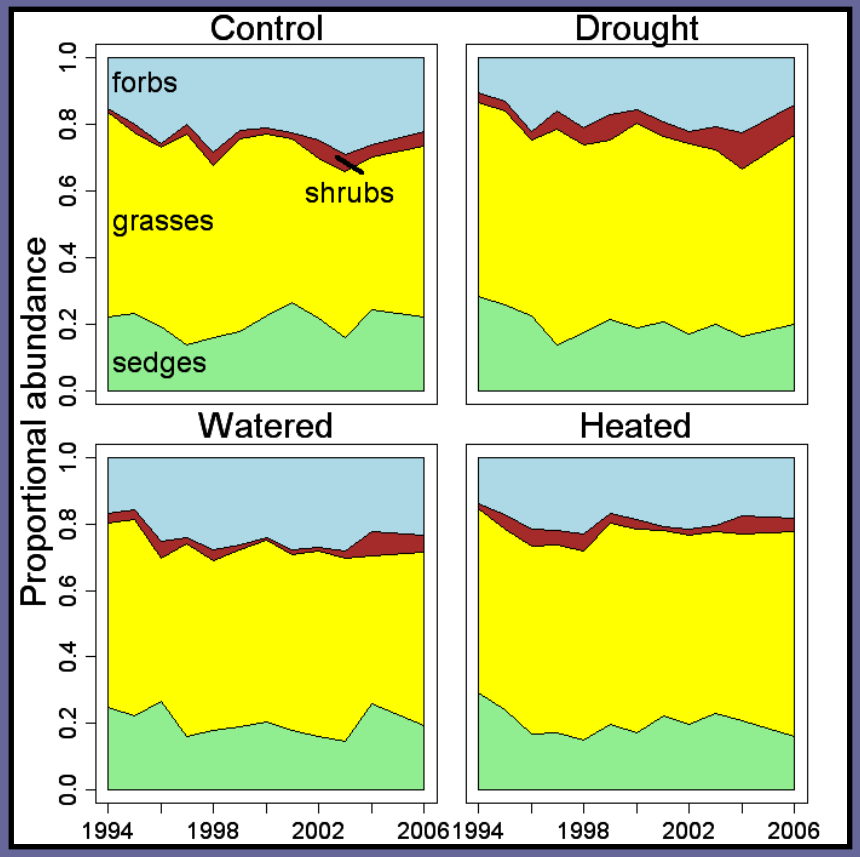
3x3 m plots, 5 replicates

Results after 5 years

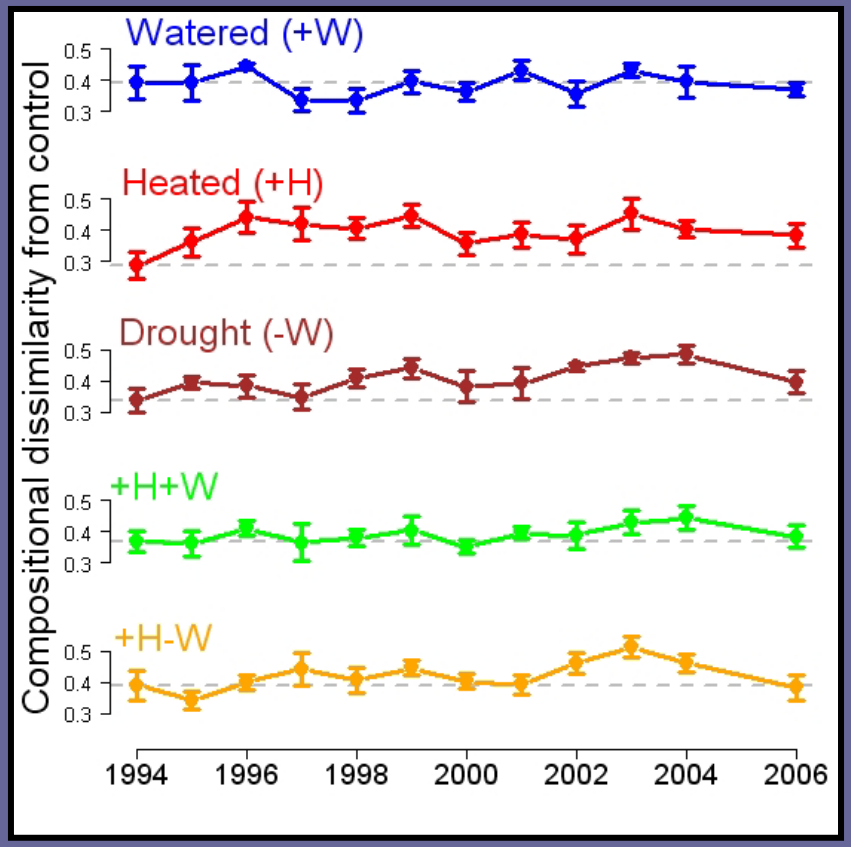
Grime *et al*. (2000)
Science 289:762-765.

No progressive change in composition after 13 years in 3x3 m plots

Grime et al. 2008 *PNAS*



Major life form groups unchanged



Species composition fairly stable

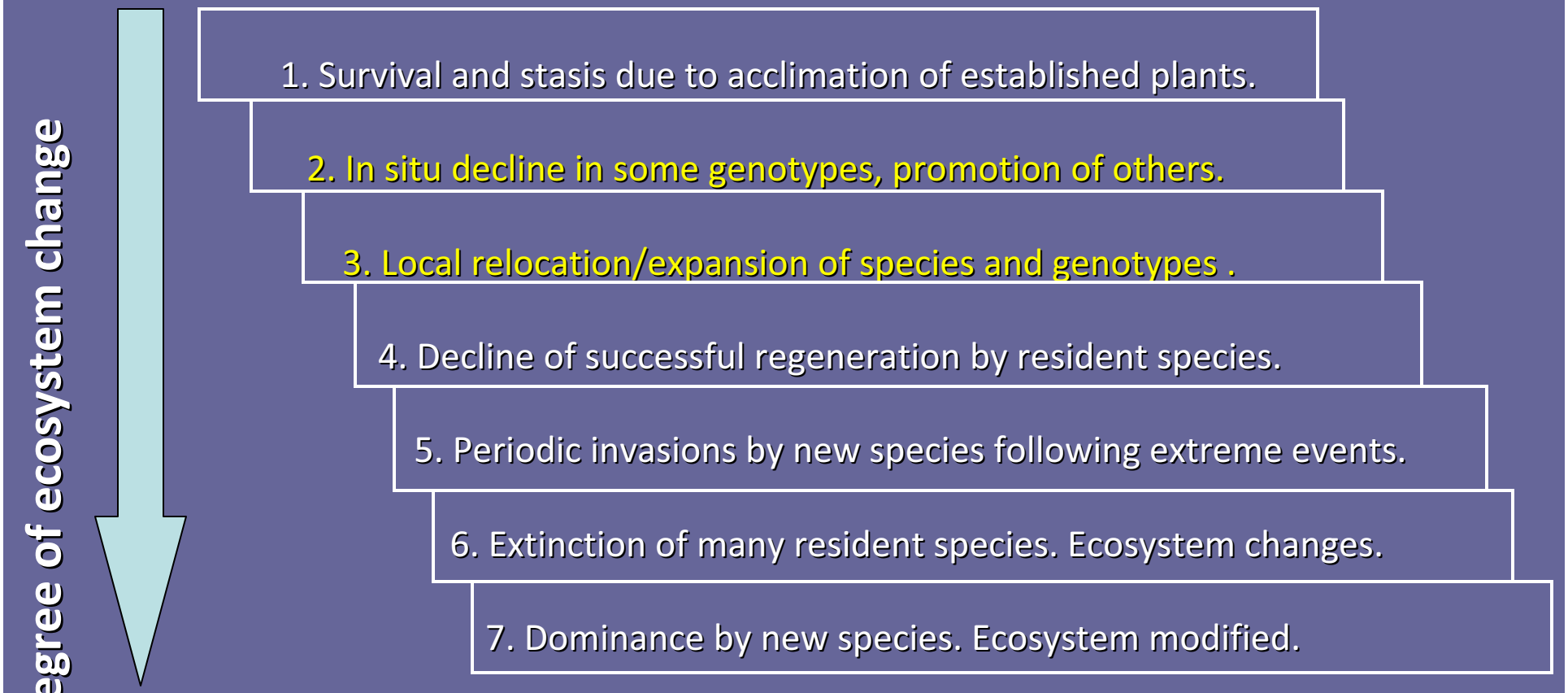
Why does this grassland resist climate forcing?

The search for genetic responses to the long-term manipulations of the Buxton climate

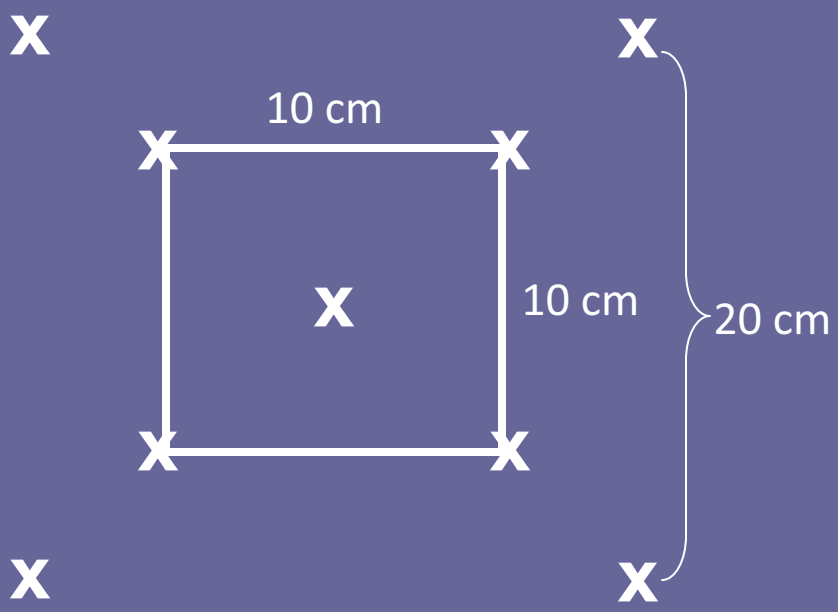
- *Plantago lanceolata, Festuca ovina, Potentilla erecta, Carex flacca, Carex panicea, Briza media, Sanguisorba minor.*

- Catherine Ravenscroft
- Raj Whitlock
- Sarah Buckland

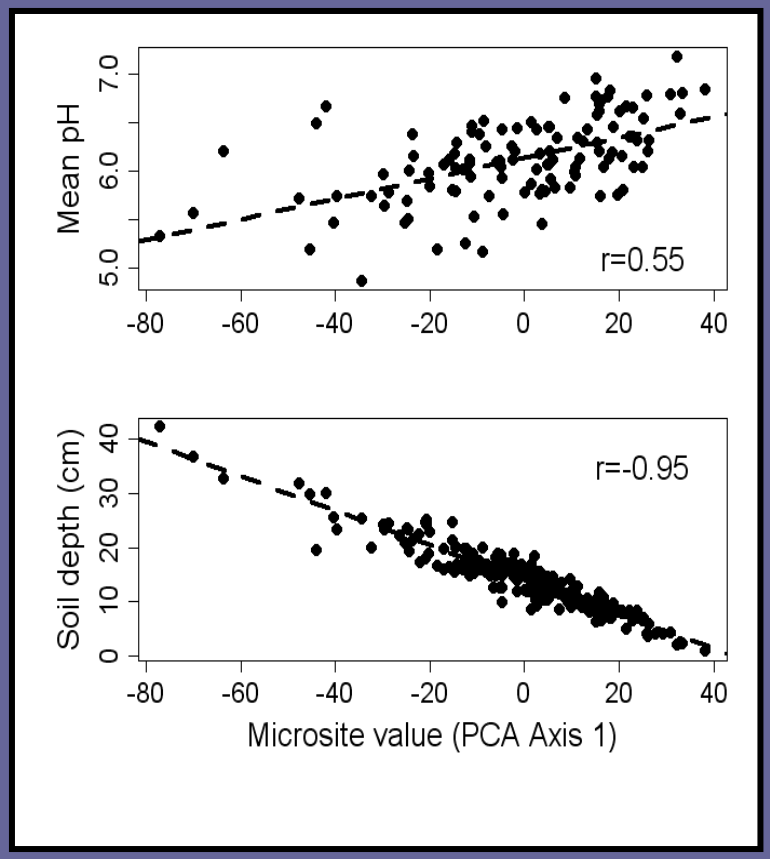
7 steps of vegetation response to climate change



Fine-scale (100 cm^2) vegetation and soil surveys (2008)

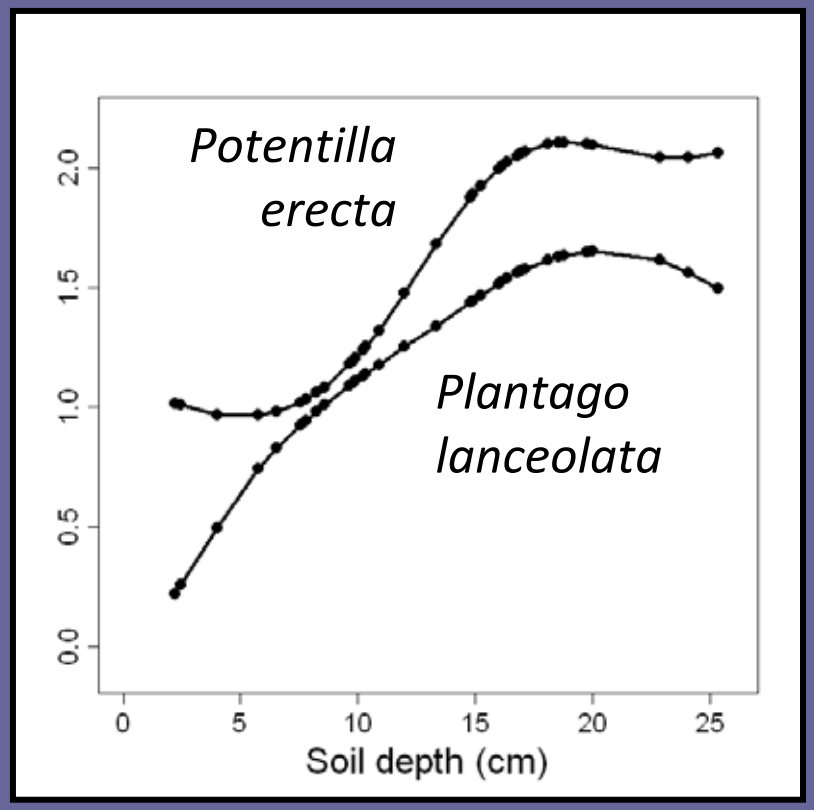


240 quadrats (8 per 3x3m plot)

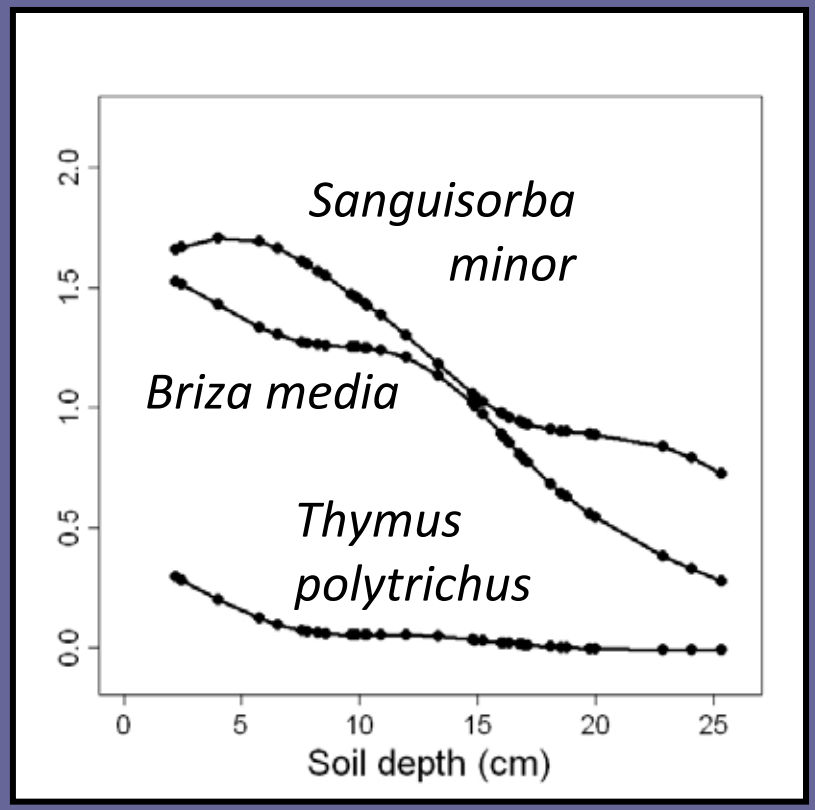


13 out of 25 species exhibited microsite responses in controls (*GLM P<0.05*)

Deep site specialists

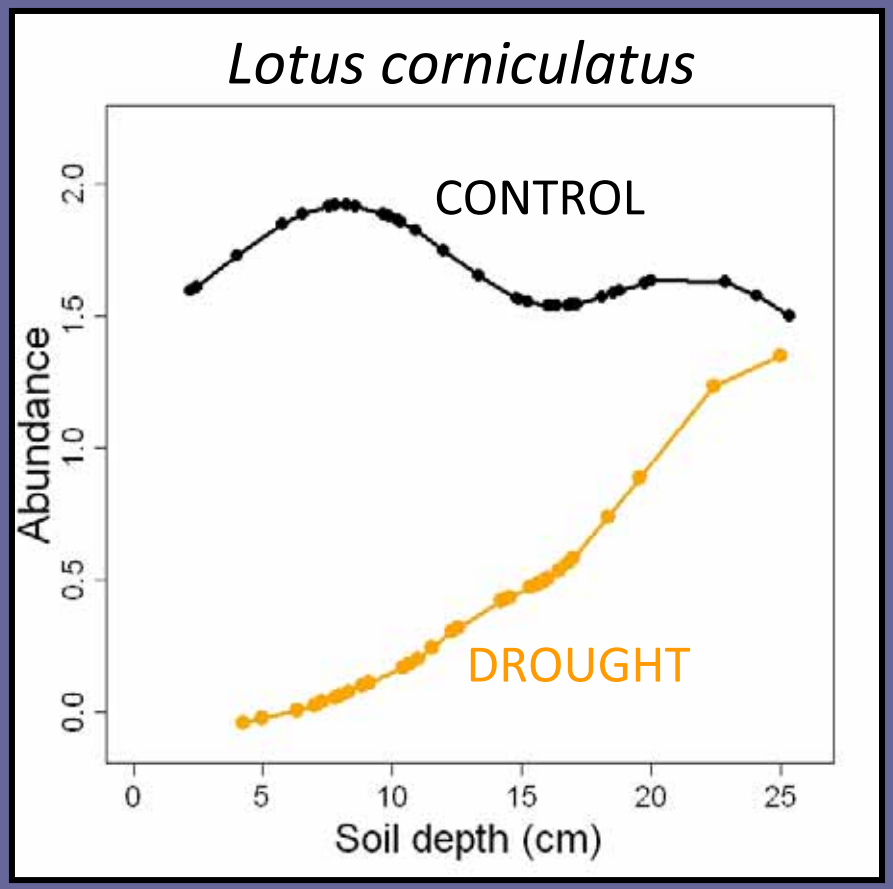


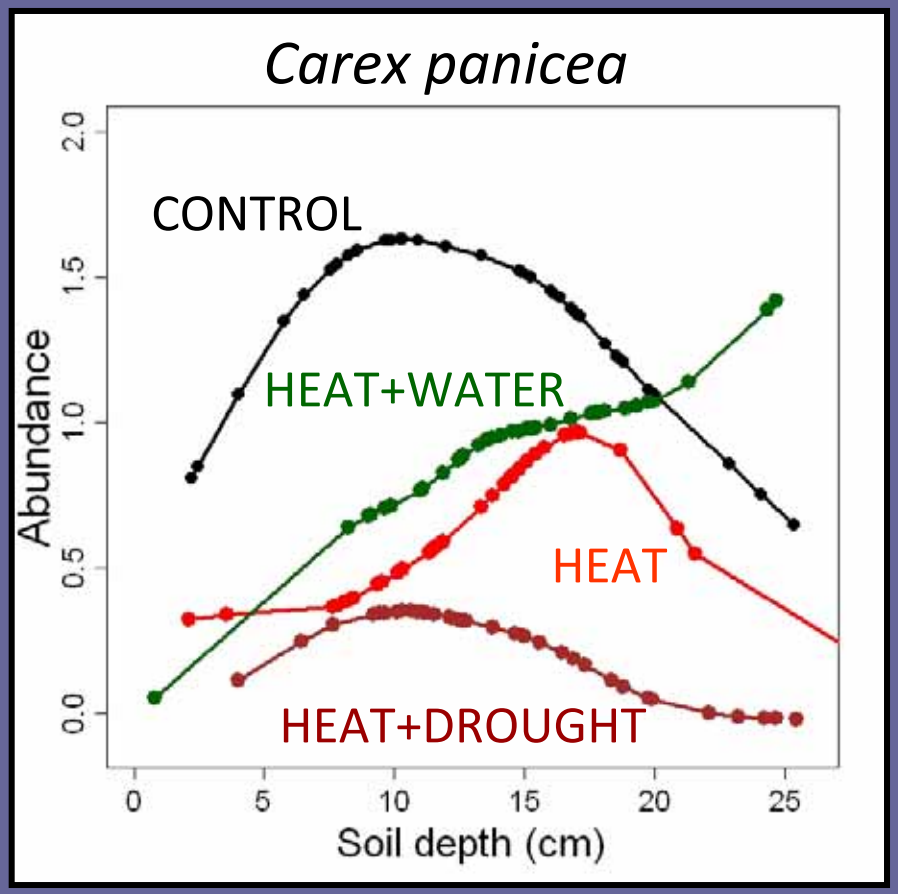
Shallow site specialists



Generalized Additive Models (GAM)

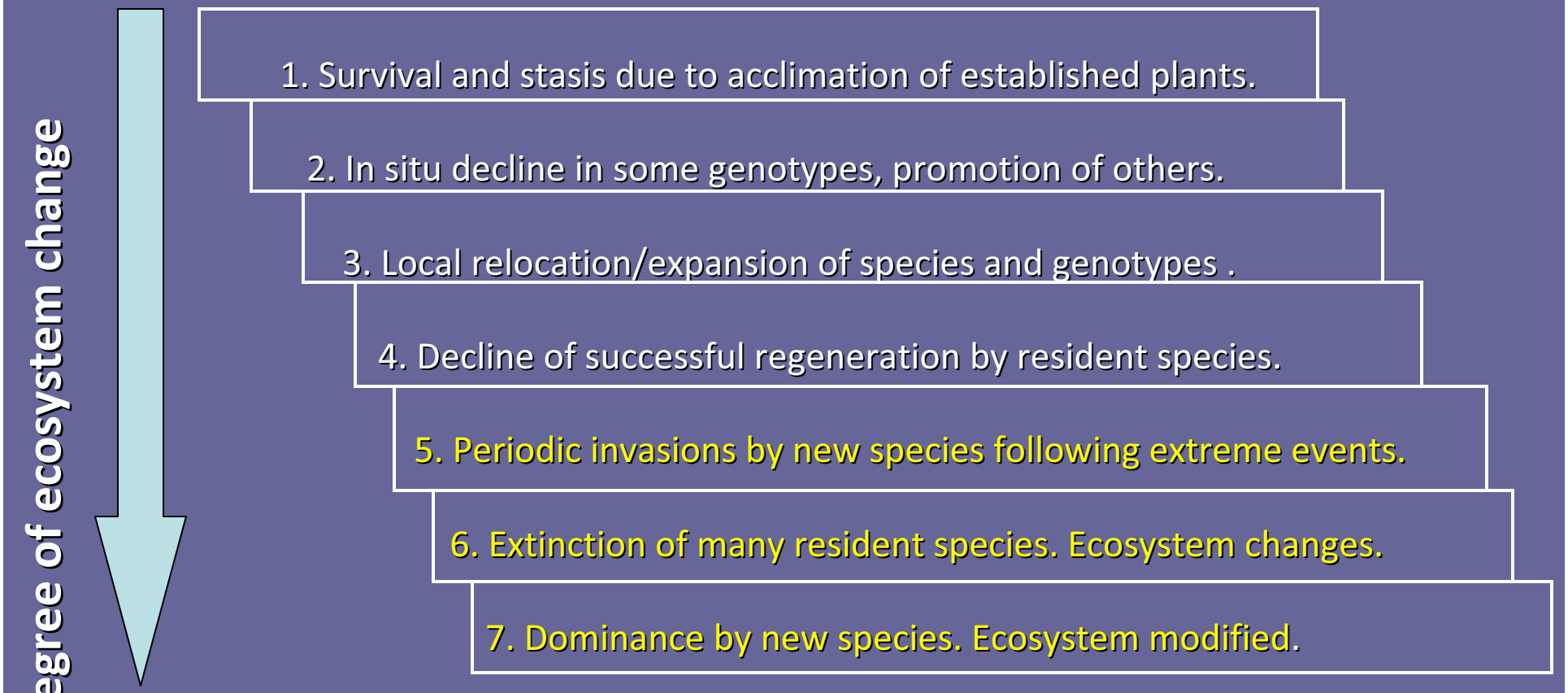
Microsite variation **prevented species loss** in response to climate change

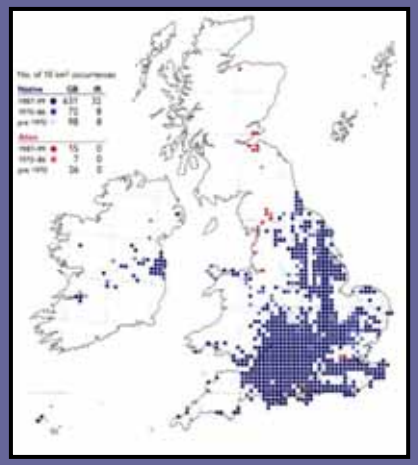


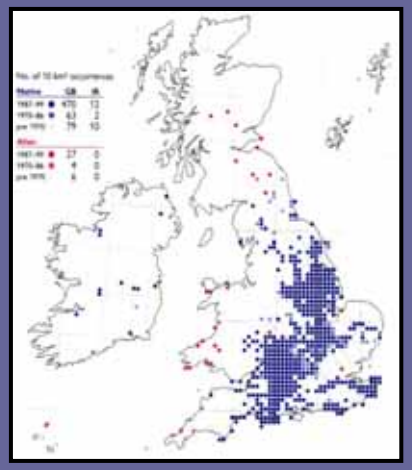


9 out of 25 species exhibited a microsite-treatment interaction (GLM $P<0.05$)

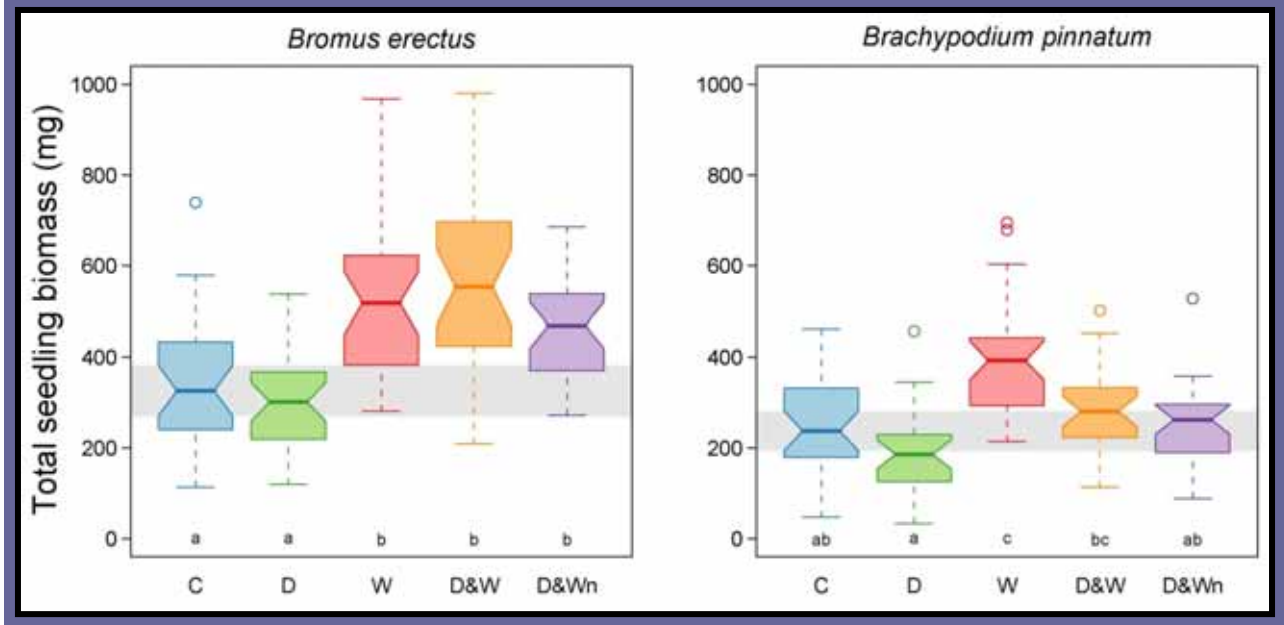
7 steps of vegetation response to climate change







B. Moser et al., (2011) Journal of Ecology (in press)



Heated

Heated

In progress

1. Microsite effects: what underlies climate-soil depth interactions? Role of competition?
2. Local adaptation: significant for how many species? Can adaptation 'outrun' migration?
3. Incipient invasions: seedlings can recruit, but will these species become dominant?
4. Ecosystem effects: do fine-scale shifts feedback to ecosystem processes?

Just starting: The seasonal warming experiment