



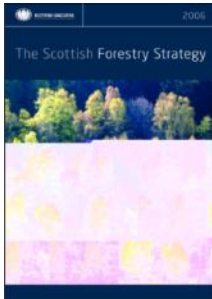
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Woodland regeneration: impacts on biodiversity and below ground processes.

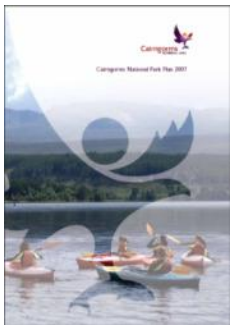
Ruth Mitchell

(and the work of many others)

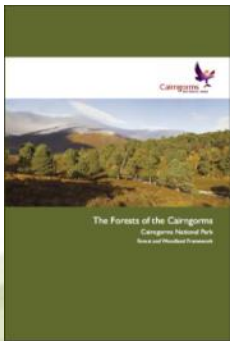
The importance of increasing tree cover



Scottish forest strategy: “increase woodland cover from 17.1 to 25% cover.”

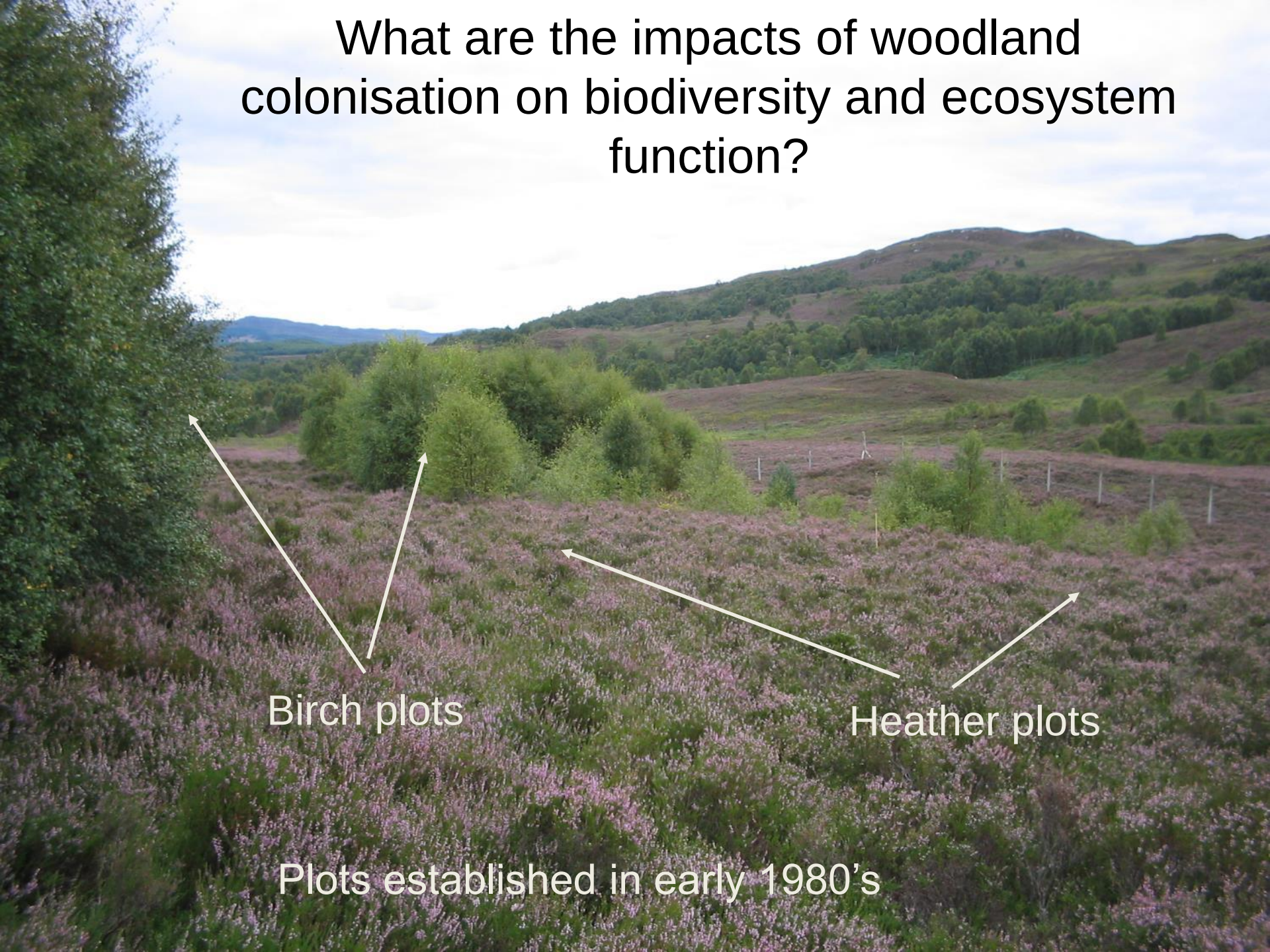


Cairngorm National Park Plan: “Enhance the condition of existing woodland cover and expand to develop habitat networks that complement the landscape character and other land-uses.”



Cairngorms National Park Forest and Woodland Framework: “Encourage full range of forest ecosystems from valley floor to natural altitudinal tree-line in targeted areas and the re-development of woodland types that have declined”

What are the impacts of woodland colonisation on biodiversity and ecosystem function?

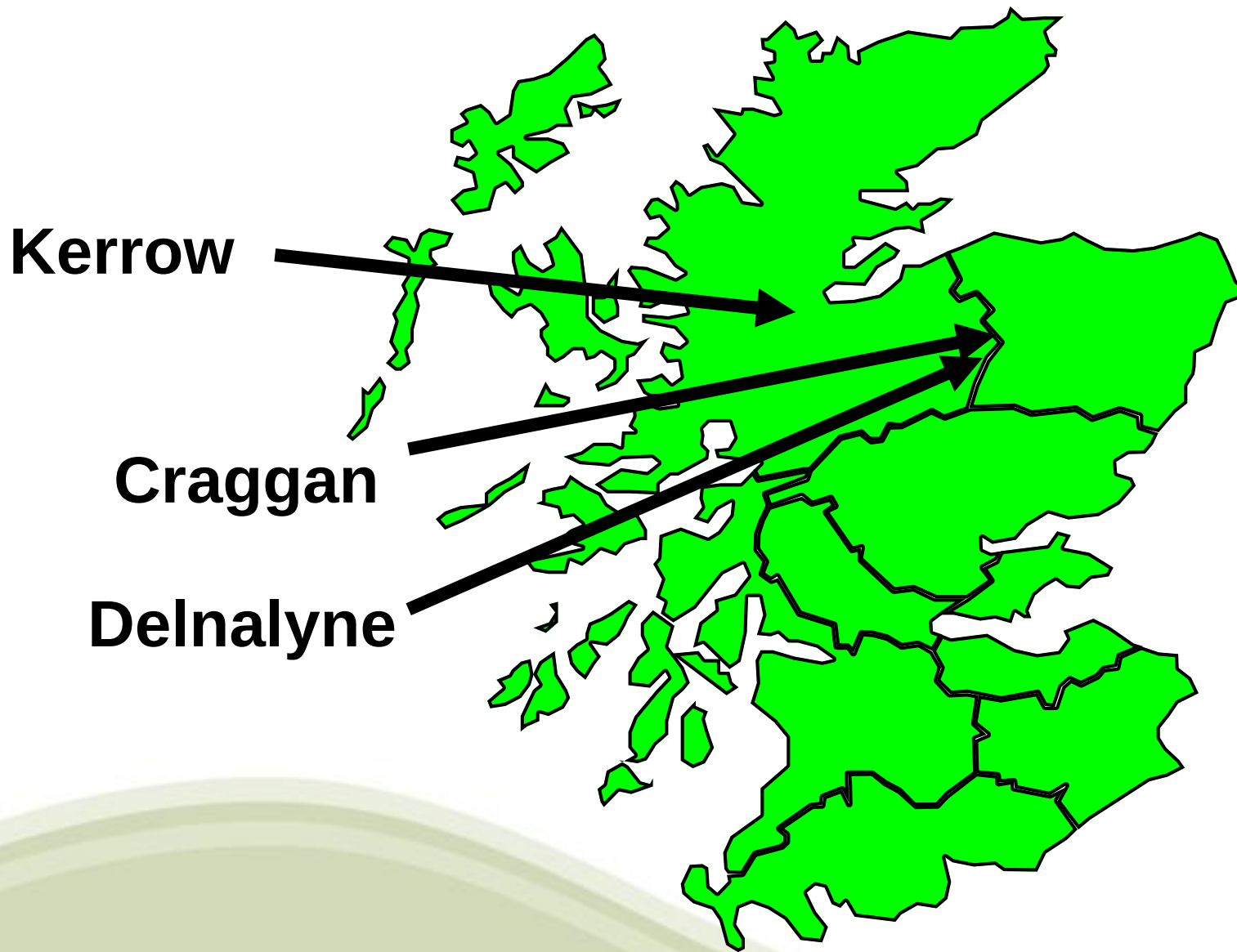


Birch plots

Heather plots

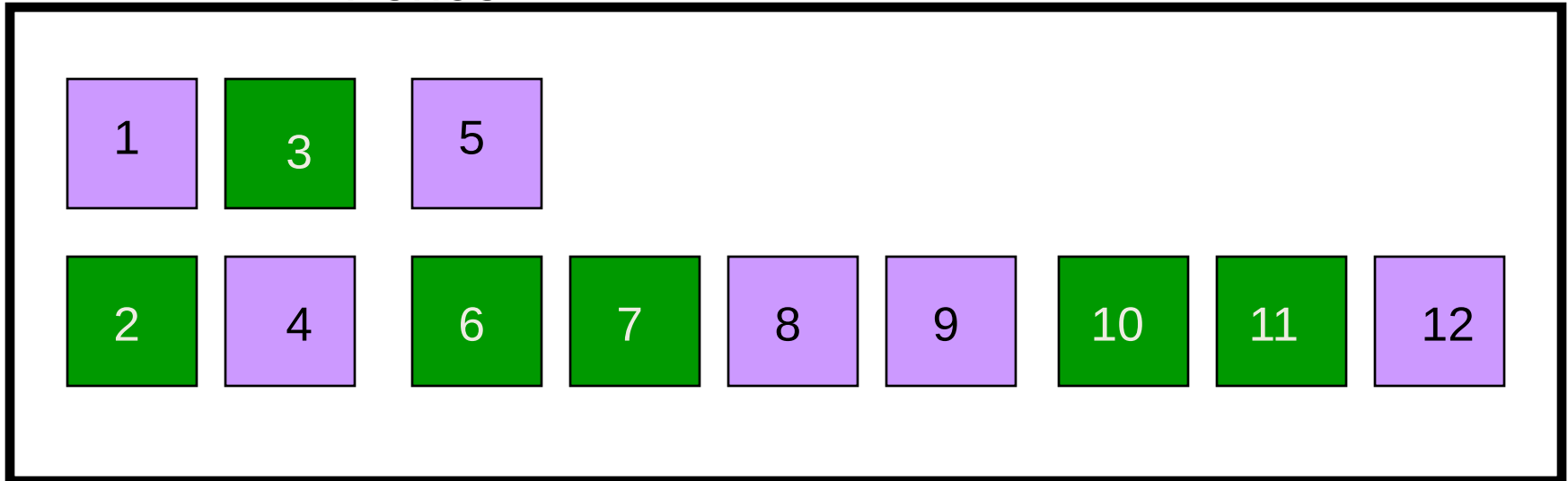
Plots established in early 1980's

Location of sites



Example of experimental site

Fence



Control heather plot

Planted birch plot

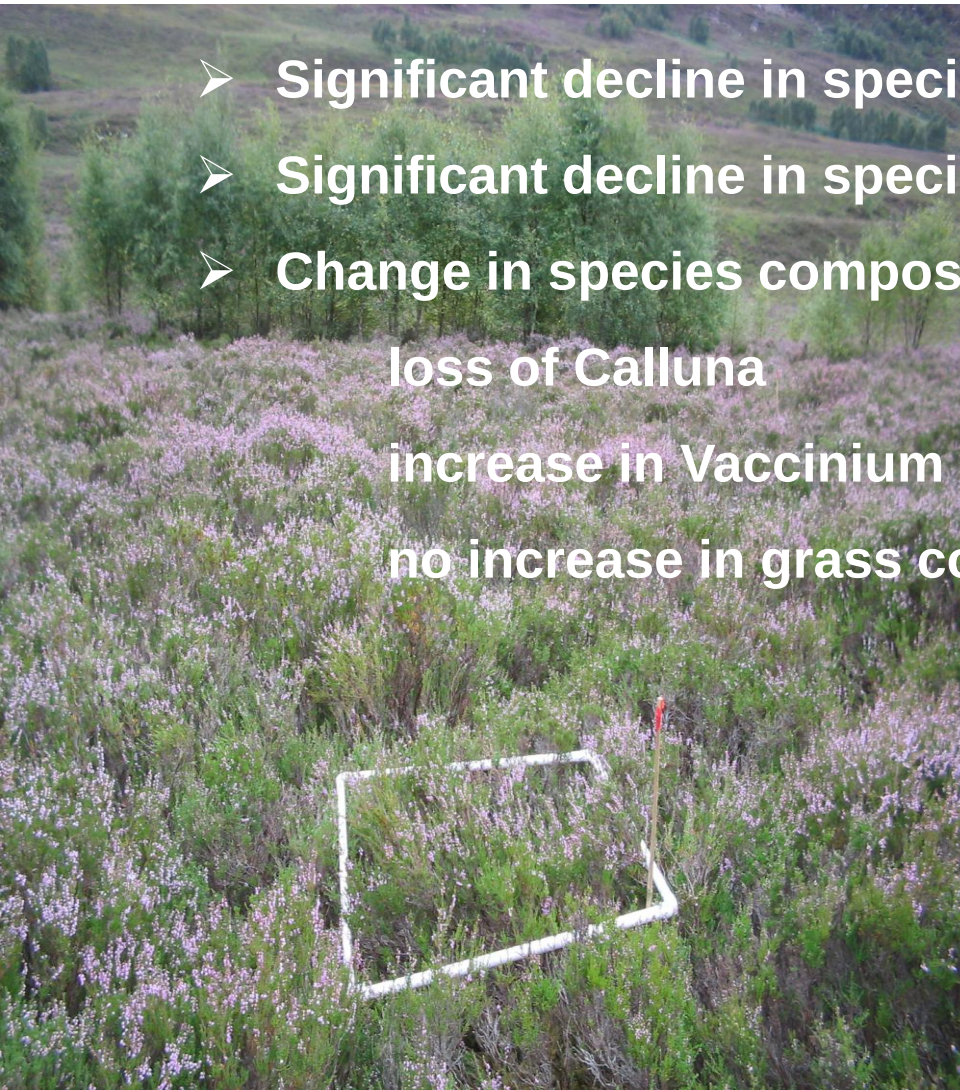
5 permanently marked quadrats in each plot

Effects of birch on:

- Above ground: Vegetation
- Soil chemistry
- Soil physical properties
- Below ground:– Mites, Enchytraeids, Collembolla, soil microbial community
- Ecosystem processes: decomposition, nitrogen mineralization
- Ecosystem services: carbon storage

Effect of birch on vegetation

- Significant decline in species number
- Significant decline in species richness
- Change in species composition:
 - loss of *Calluna*
 - increase in *Vaccinium* and mosses in birch plots
 - no increase in grass cover



Heather plot



Birch plot

Effect of birch on soil

Chemical properties

Significant increases in:

- phosphorus
- nitrogen mineralisation

Significant decrease in

- carbon
- Soil moisture



Effect of birch on soil

Physical properties

Significant increase in:

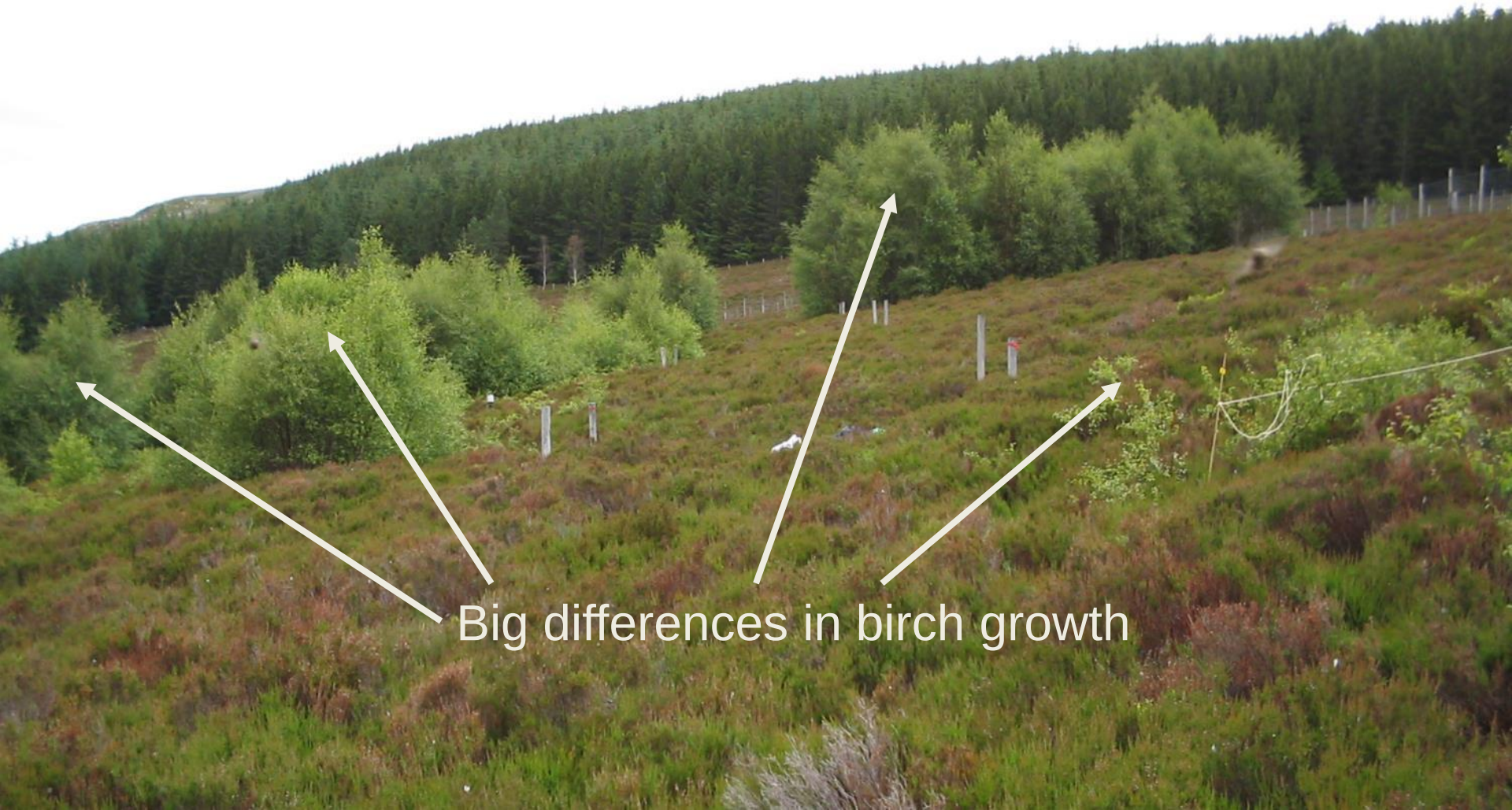
- bulk density

Significant decreases in:

- depth of organic layer

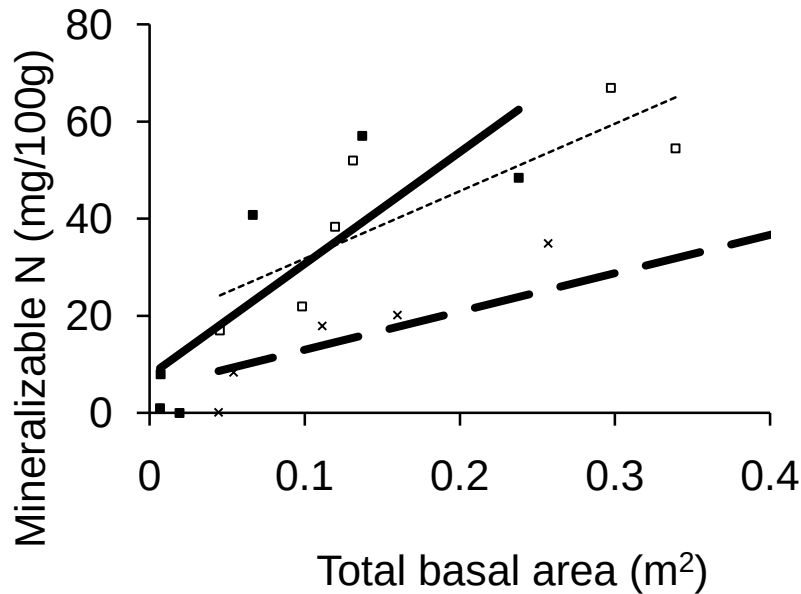


Are these changes driven by the trees?

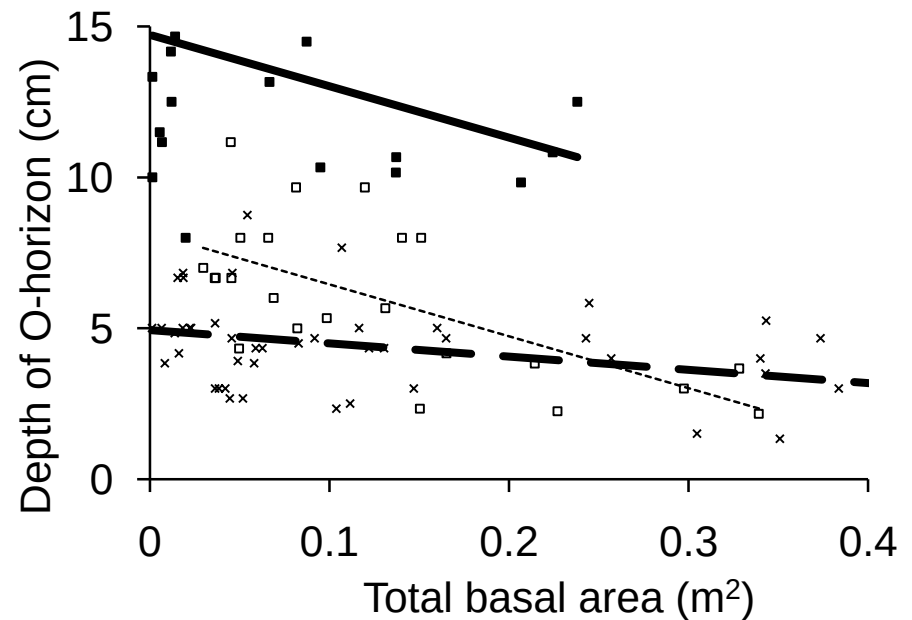


Big differences in birch growth

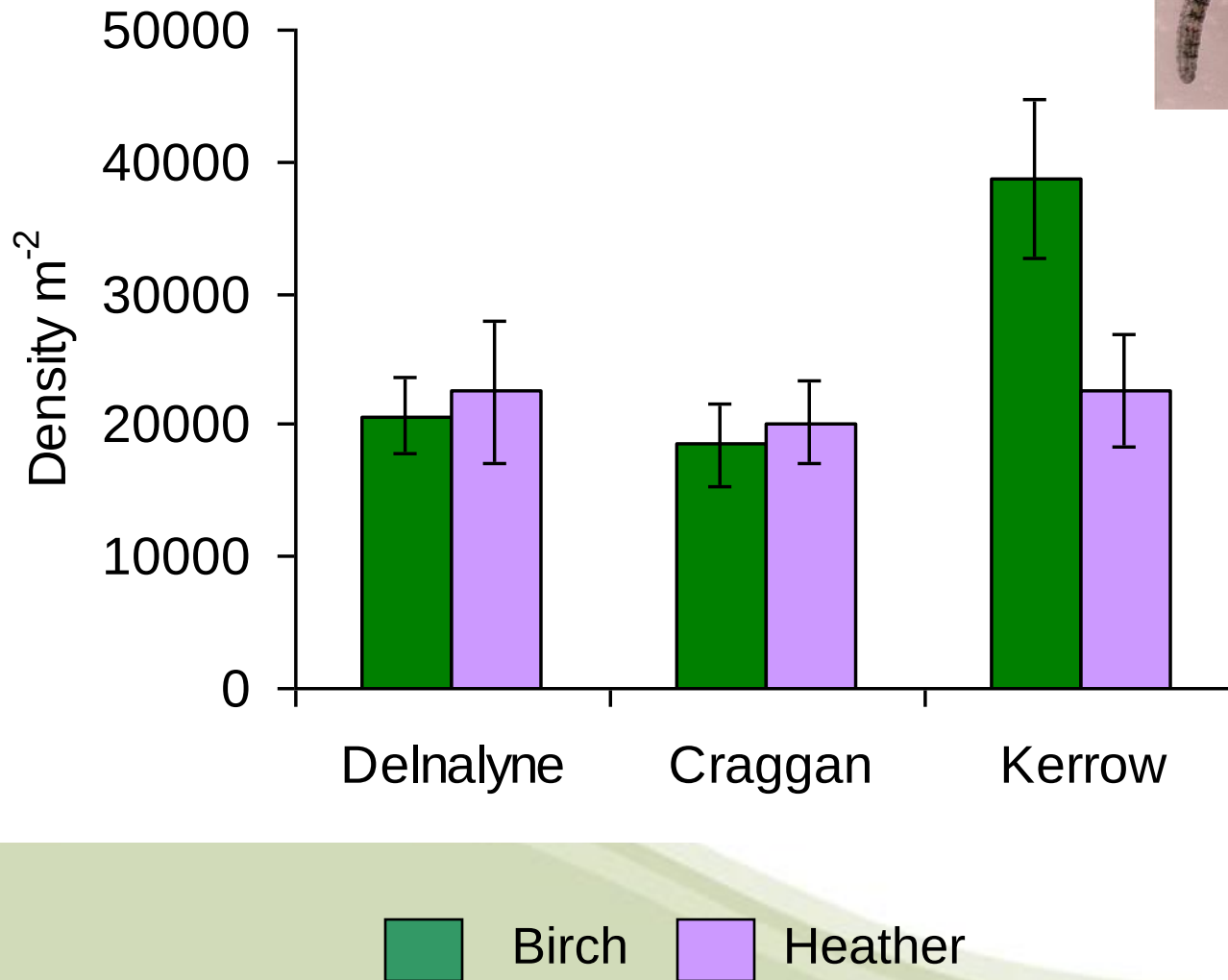
Are these changes driven by the trees?



--- Delnalyne
... Craggan
— Kerrow

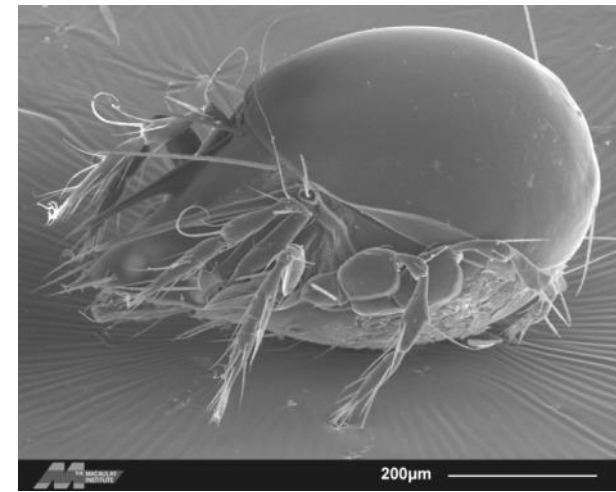
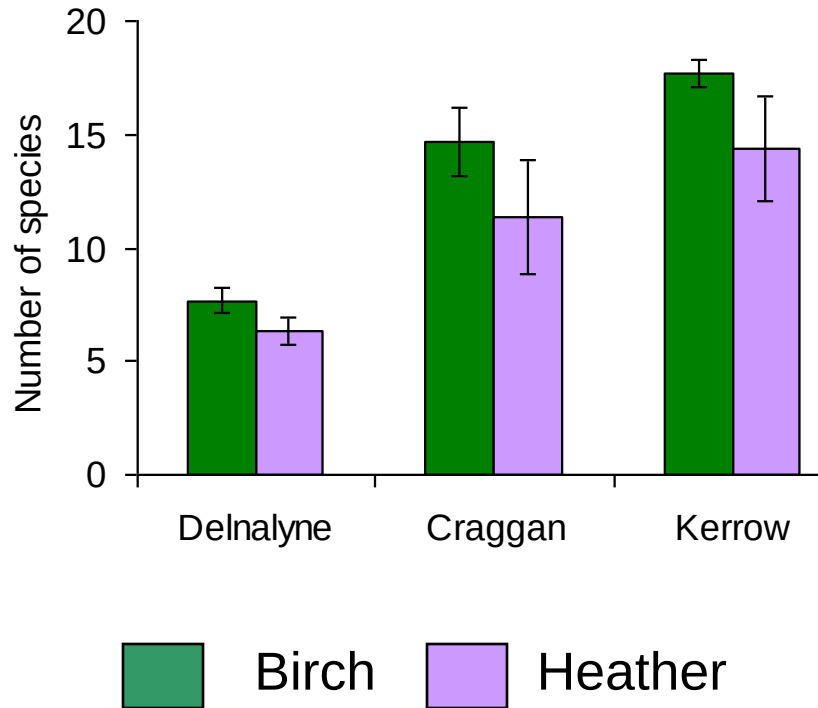


Enchytraeids

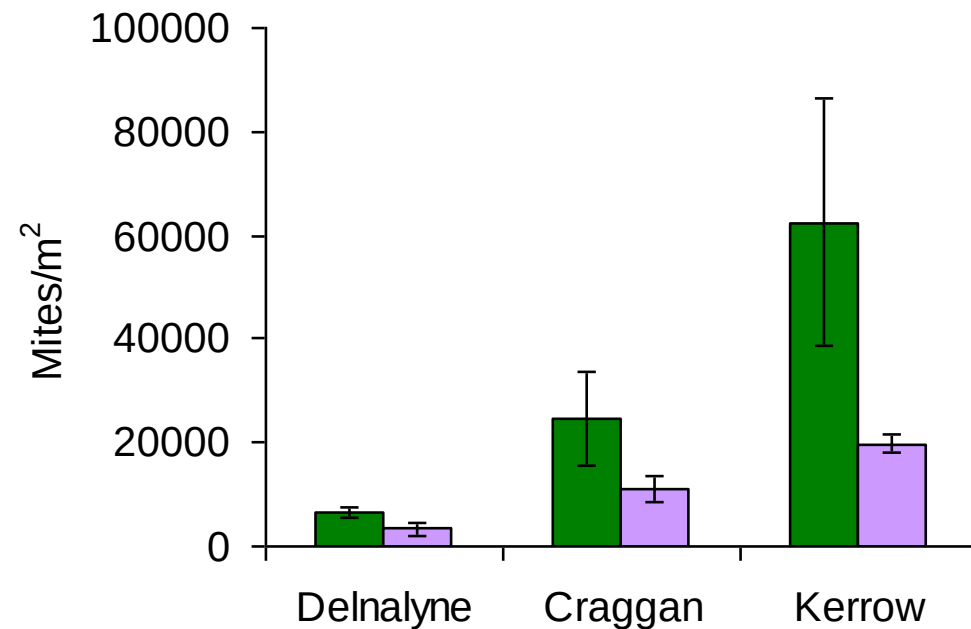


Mites

Oribatid mite species richness



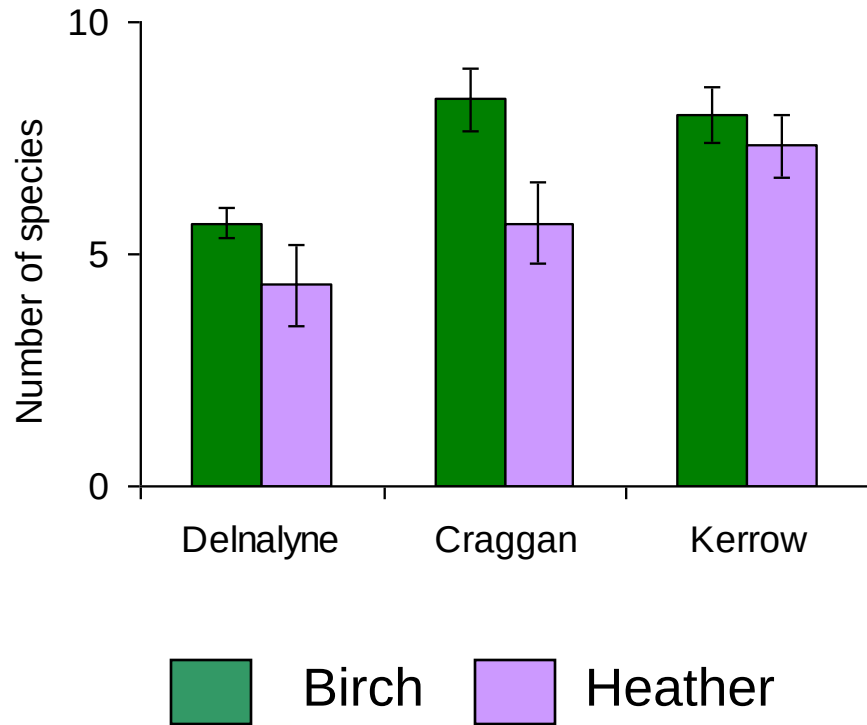
Oribatid mite abundance



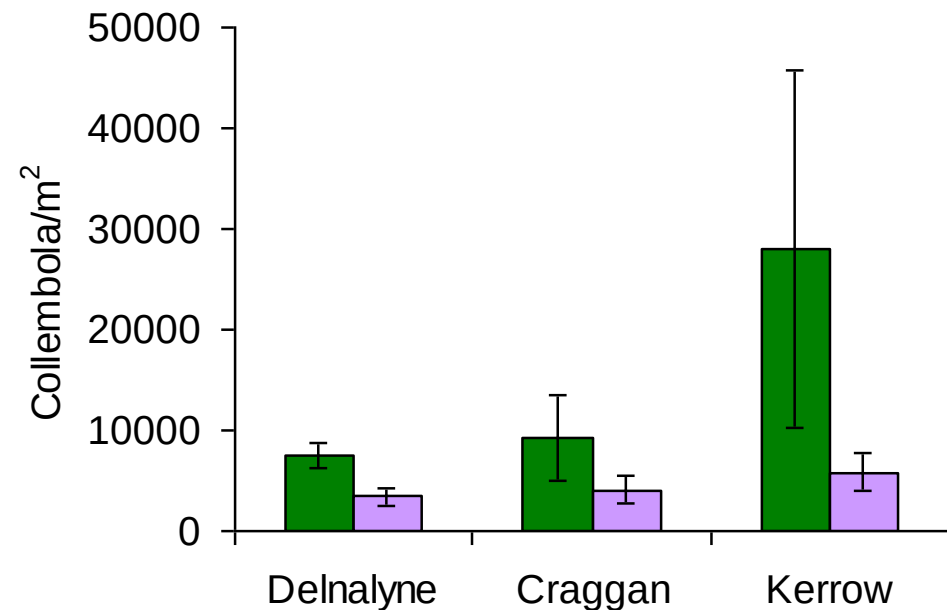
Similar results for
Mesostigmata and
Prostigmata mites

Collembola

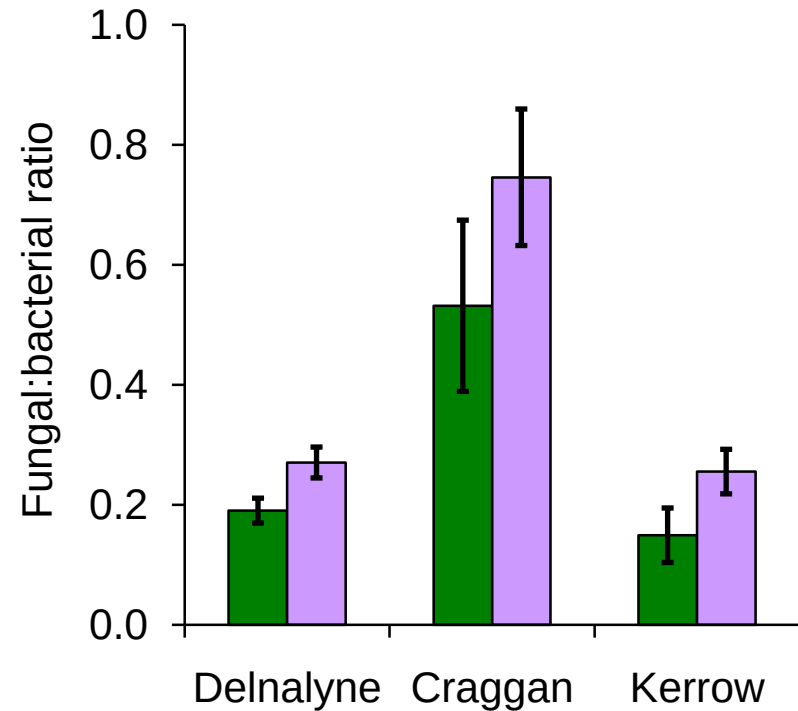
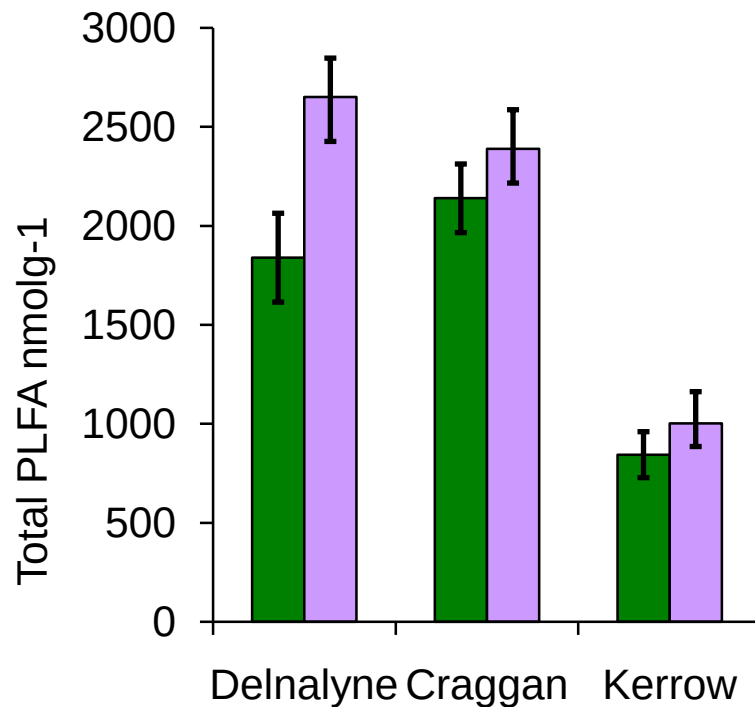
Collembola species richness



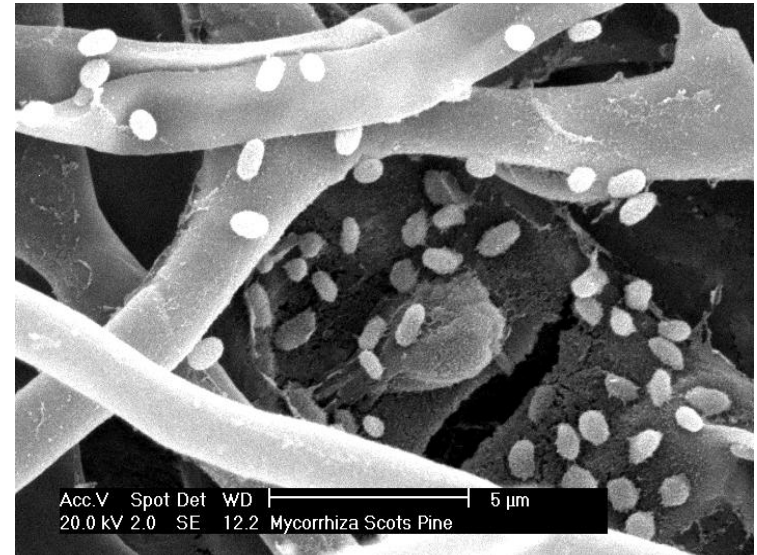
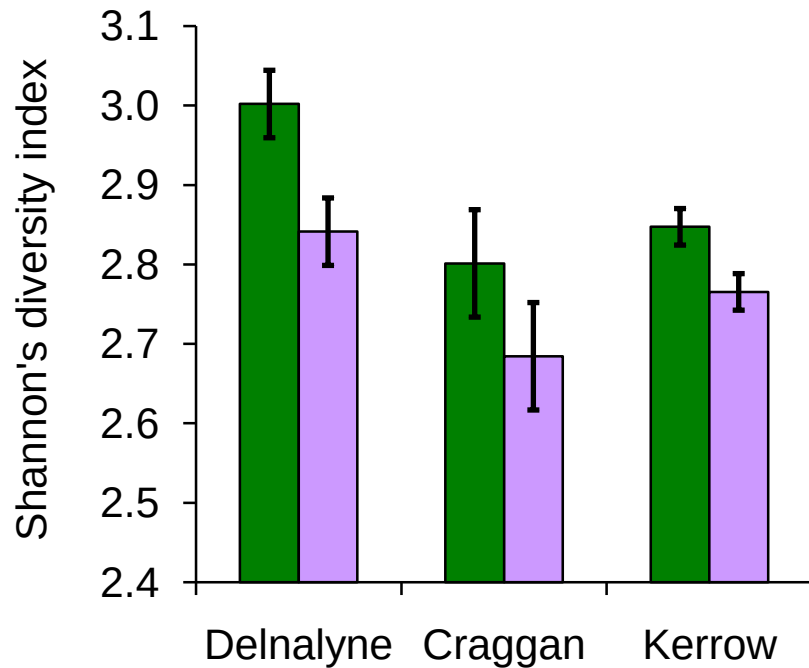
Collembola abundance



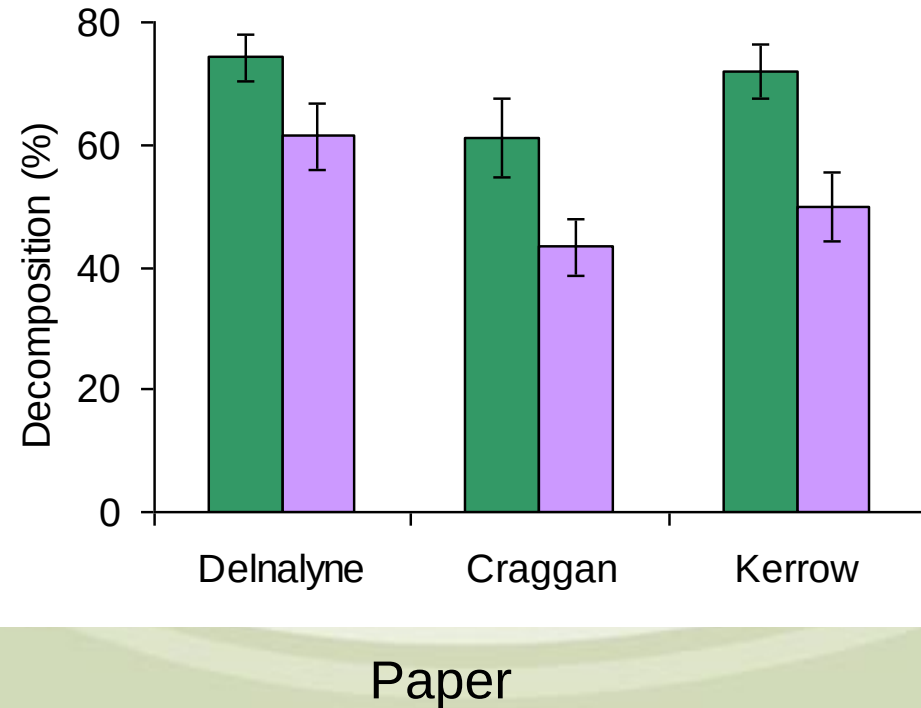
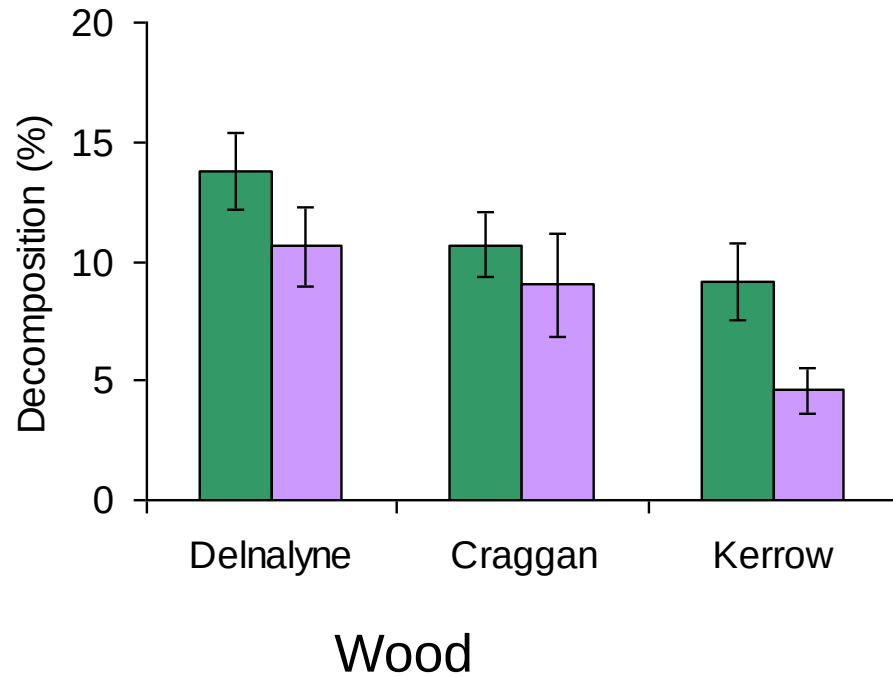
Soil Microbial Community - PLFAs



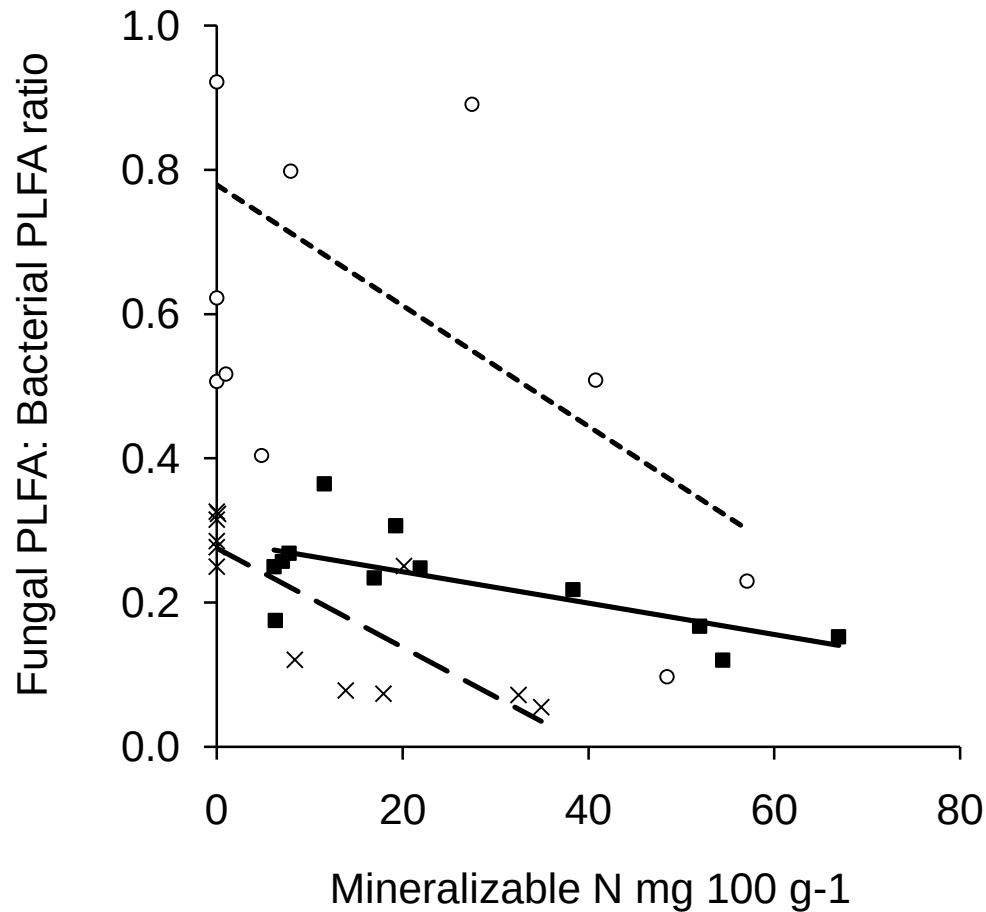
Soil Microbial Community - PLFAs



Ecosystem function: Decomposition

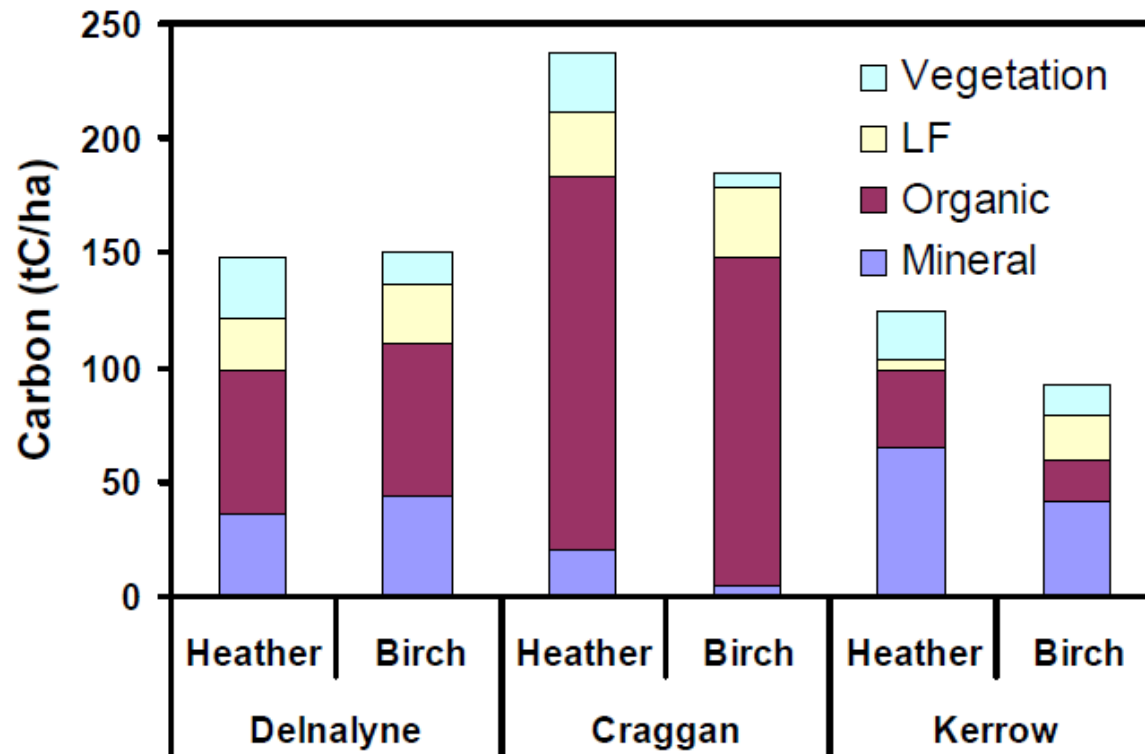


Ecosystem function: N mineralization



Change in microbial community related to change in function

Impacts on carbon storage?



Decline in carbon storage??

Carbon dynamics



Measurement of dissolved organic carbon (DOC):
DOC concentrations highest under planted pine



Measurement of CO₂ released from the soil:
Soil respiration is unaffected by planting



Measurement of root production and disappearance:
Maximum root production in summer, related to soil respiration and soil temperature



Recording the weather:
Relate changes to environmental changes

Carbon dynamics

Summary data on soil C fluxes ($\text{kg ha}^{-1} \text{ yr}^{-1}$)

Land Use	CO_2	DOC	Root C loss to soil
Heather	13965	10.66	14.61
Birch	12306	18.70	6.63
Pine	13324	44.02	16.40

Effect of tree planting on carbon budget?

Understanding the mechanisms



The role of the ground flora in driving changes:

Removal of early or late successional ground flora species.



The role of litter in driving changes:

Addition of extra litter to increase rate of change.

Interactions between grazing and tree colonisation?



Possible impacts on:

- Decomposition/nutrient cycling
- Ground flora interactions
- Ticks

Early days – only 8 years!

Conclusion

Birch colonisation drives changes in:

- Communities: above ground & below ground
- Soil: chemistry & physical properties
- Ecosystem processes: decomposition & N mineralisation
- Ecosystem services: carbon storage
 - Rate of change very slow
 - Mechanisms behind these changes still unclear
 - Interactions with grazing?



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Thank you

Rob Brooker, Colin Campbell, Clare Cameron, Steve Chapman, Lisa Cole, Lucy Gilbert, Richard Gwatkin, Alison Hester, Richard Hewison, Kenny Hood, Graham Osler, Robin Pakeman, Jasmine Ross, Louise Ross, Adam Vanbergan.

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