Do fungi and bacteria respond similar across a steep local pH gradient?

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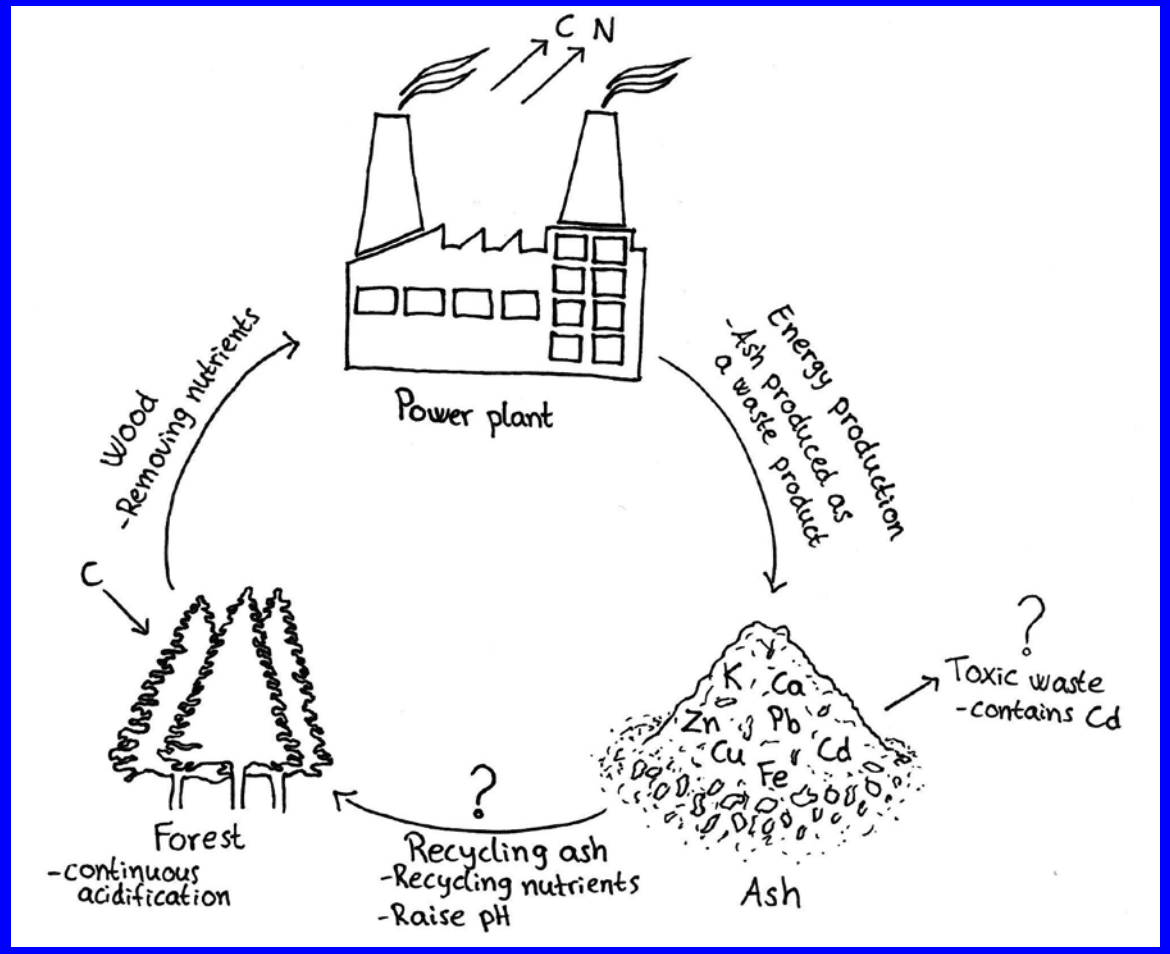
AIMs of study

1. Do fungi and bacteria respond similar across a steep local pH gradient?

2. How resistant are microbial communities? Can we smash the microbial community by applying extreme dosages of wood ash?

Why wood ash



- Wood ash returned to forest floor mitigates nutrients lost from repeated harvests
- The project ASHBACK investigated potential ecosystem-level and eco-toxicological problems when returning wood ash

Plots and experimental setup

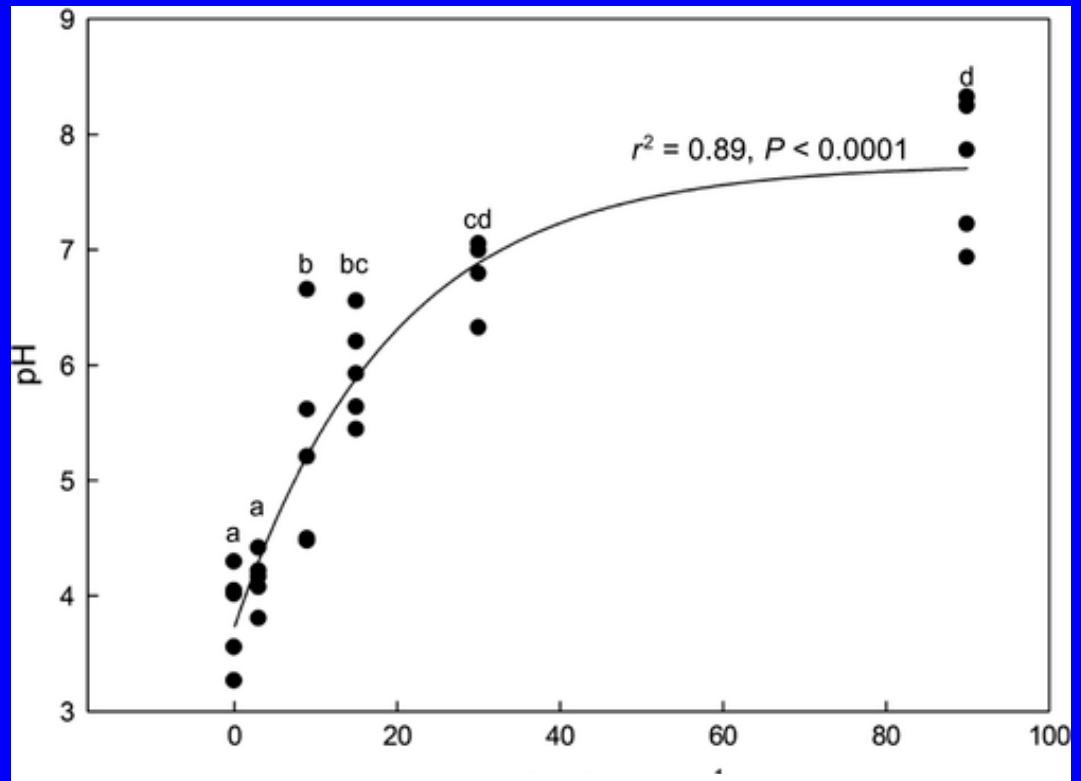
Experimental site:
Norway spruce plantation in NW Jutland (Denmark)

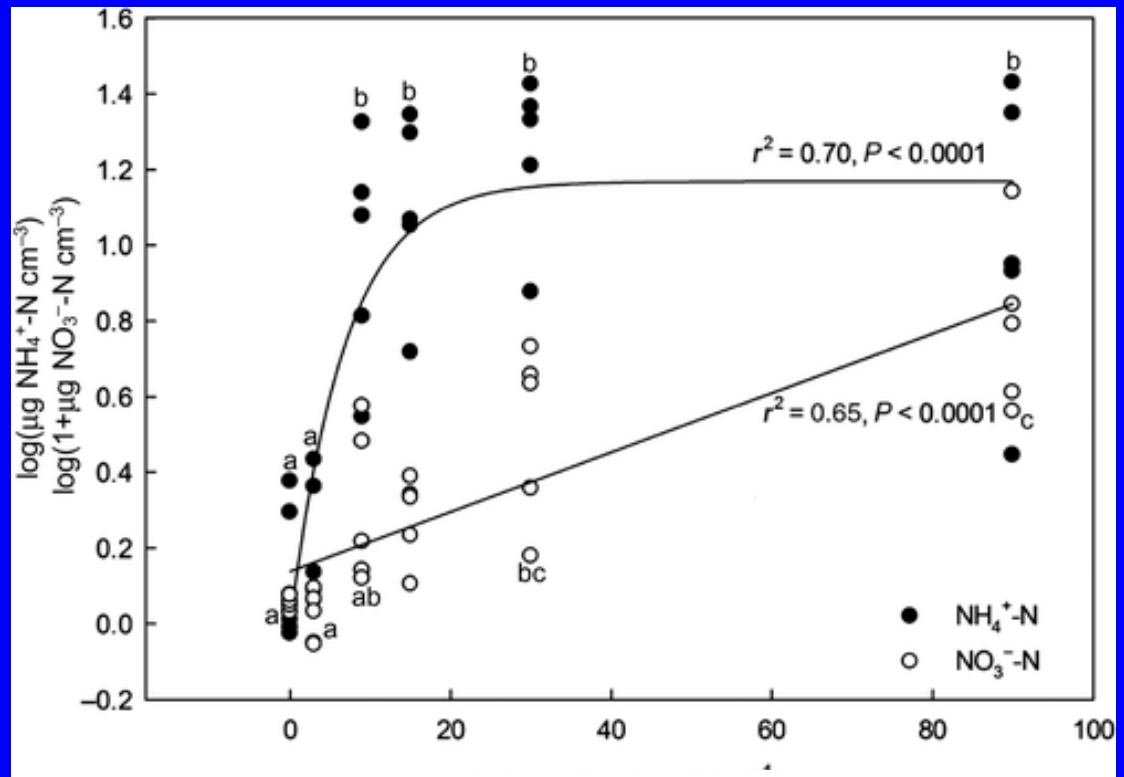
Wood ash applied as follows:
0 – 3 – 9 – 15 – 30 – 90 t ha-1 onto 2 x 2 m

Sampling and Methods – 2 years after application

- Soil samples were taken to 5 cm depth (organic – top mineral A-horizon)
- pH and mineral N was measured in water extracts
- DNA was extracted and fungi and bacteria amplicon sequenced (meta-barcoded)

pH and mineral N responded strongly to ash

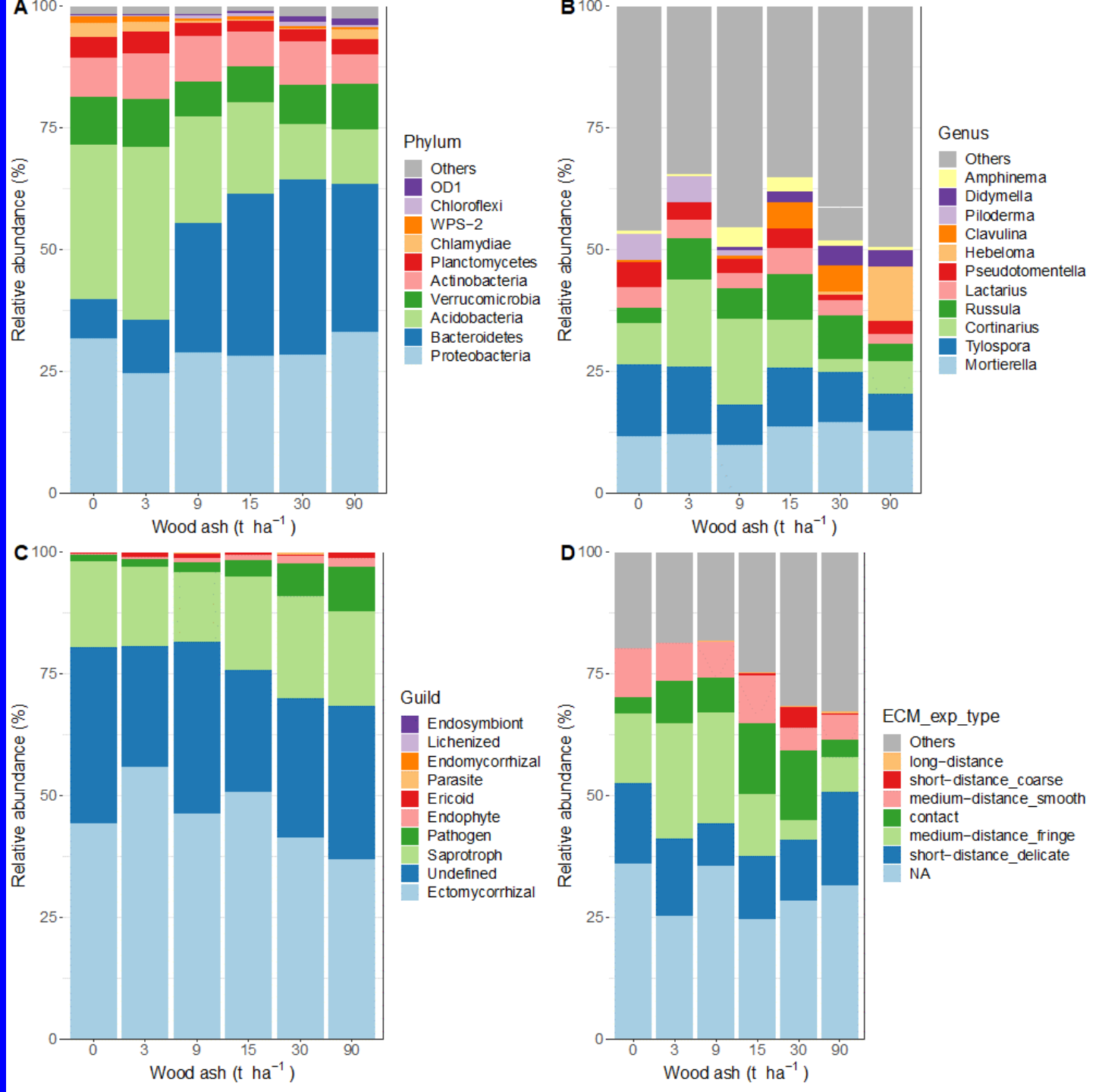


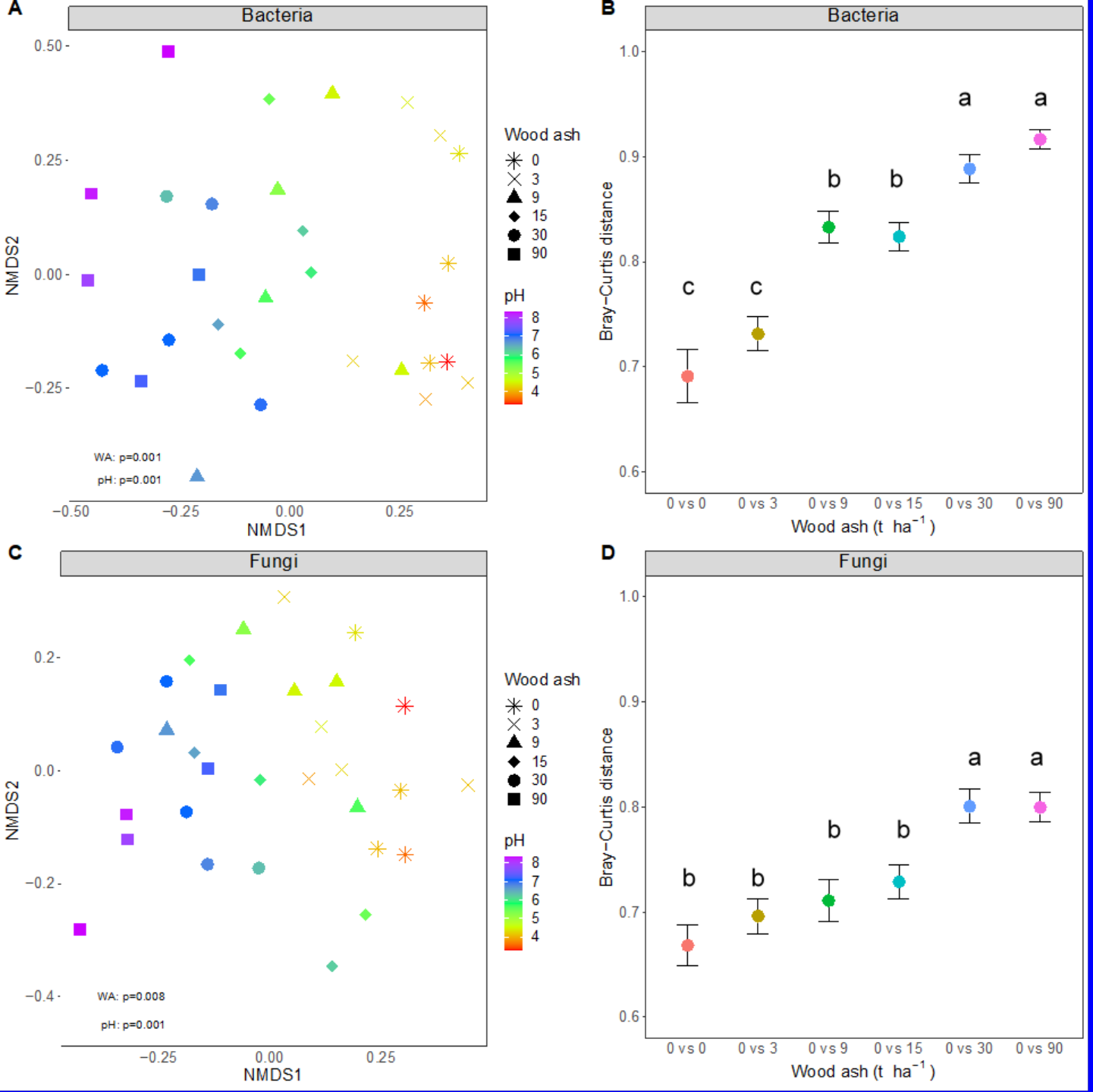


(Vestergård et al. 2017, GCB BIOENERGY)

Community compositions and functional groups

- Changes in both taxonomic (A & B) as well as functional groups of fungi (C) and ectomycorrhizal exploration types (D)
- Diversity are maintained and even increased for fungi (not shown)!





Communities changed directionally with increasing wood ash dosage (pH)

- Gradual changes of both bacteria and fungi (A & C)
- Fungal community was more resistant to changes than bacteria (B & D)

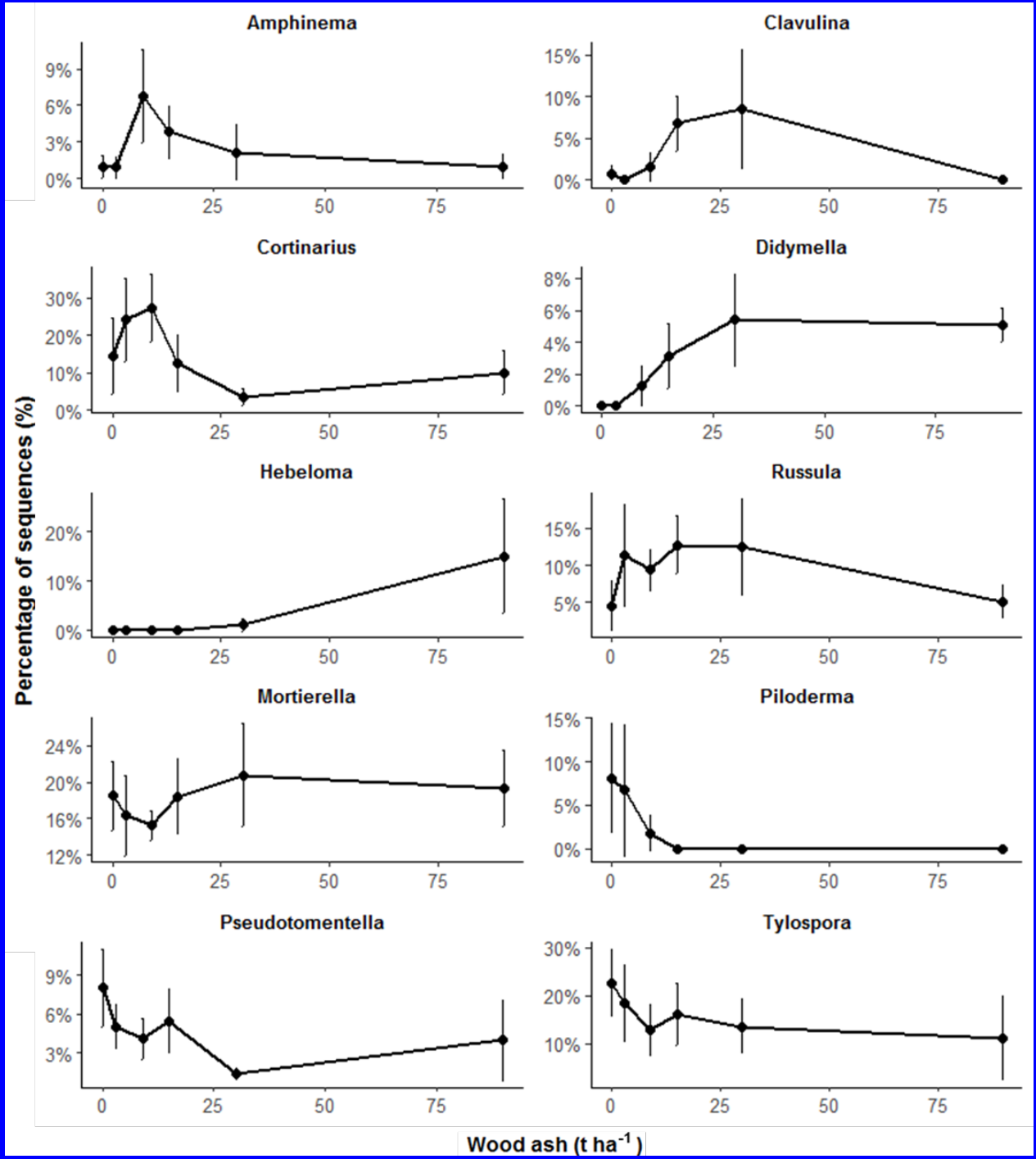
Drivers of community changes

Table 2. Results of *envfit* analyses. The *envfit* analysis test for significant correlation of environmental parameters to the NMDS projections of community dissimilarities between samples (Bray-Curtis) and it test all parameters separately.

Explanatory variable	Bacterial communities	Fungal communities
Wood ash (t ha^{-1})	0.73***	0.52***
pH	0.88***	0.86***
NH_4 (µg cm^{-3})	0.51***	0.29*
NO_3 (µg cm^{-3})	0.47***	0.34**

Values are R^2-values.
Asterisks refer to significance level (* is 0.01<p<0.05, ** is 0.001<p<0.01, *** is p<0.001)

pH explains the NDMS best followed by wood ash and N

Conclusion

1. Both communities responded gradually to wood ash but bacteria steeper/more than fungi
2. pH explained the community changes better than wood ash dosage
3. The microbial system stayed intact and diverse despite the extreme dosages applied