

Soil microbiology and ecosystem function in chemically restored lowland heath



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Background – *Calluna* heath

- **86 % of Dorset heath lost between 1835 & 1980**
- **~8,000 ha remaining, about 13 % of remaining lowland heath**
- **But it is fragmented**
- **UK Biodiversity action plan priority**
- **Difficult to restore on improved farmland due to legacy of high pH and nutrient levels**

Design of trial

- **Trial established in 1999 on two NT farms**
- **2 chemical treatments & soil stripping**
- **Ferrous ammonium sulphate – didn't work!**
- **Elemental sulphur applied at 3.6 t ha⁻¹ did!**
- **Successful removal of competitive mesotrophic grasses achieved**
- **Heath like vegetation community restored after addition of propagules**

Site location



The Isle of
Purbeck between
Wareham and
Corfe.

Experimental Area



Restored heath!



However

- **Available Nutrient levels relatively high**
- **Ericoid mycorrhizal fungi colonisation of *Calluna* low (Diaz et al., 2008)**
- **No O horizon**
- **Soil pH rising (3.0 – 4.4)**
- **By 2009, 6 plots had reverted to grassland or were dominated by *Juncus effusus***
- **What is the future of the other 4 plots?**

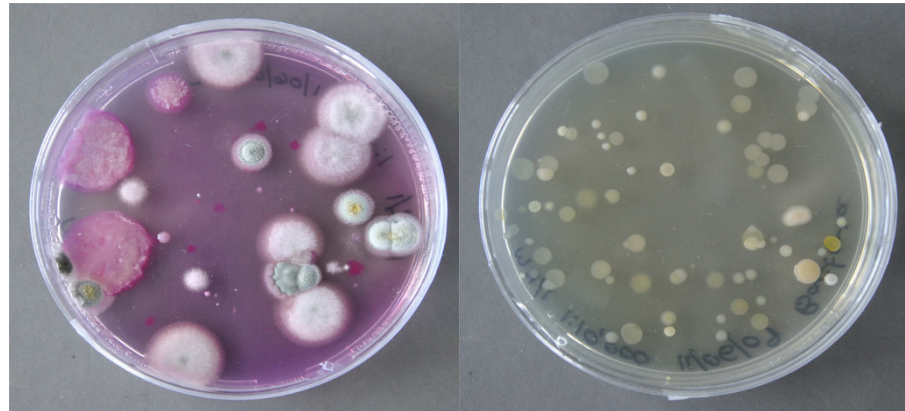
Possible factors for success

- **Lowering soil pH should drive changes in the microbial community**
- **Could this result in the restoration of a key ecosystem function – slow decomposition of plant litter?**
- **Thus decreasing nutrient mobilisation**
- **‘locking’ nutrients in a developing O horizon**
- **Giving time for re-podzolisation to take effect?**

Research questions

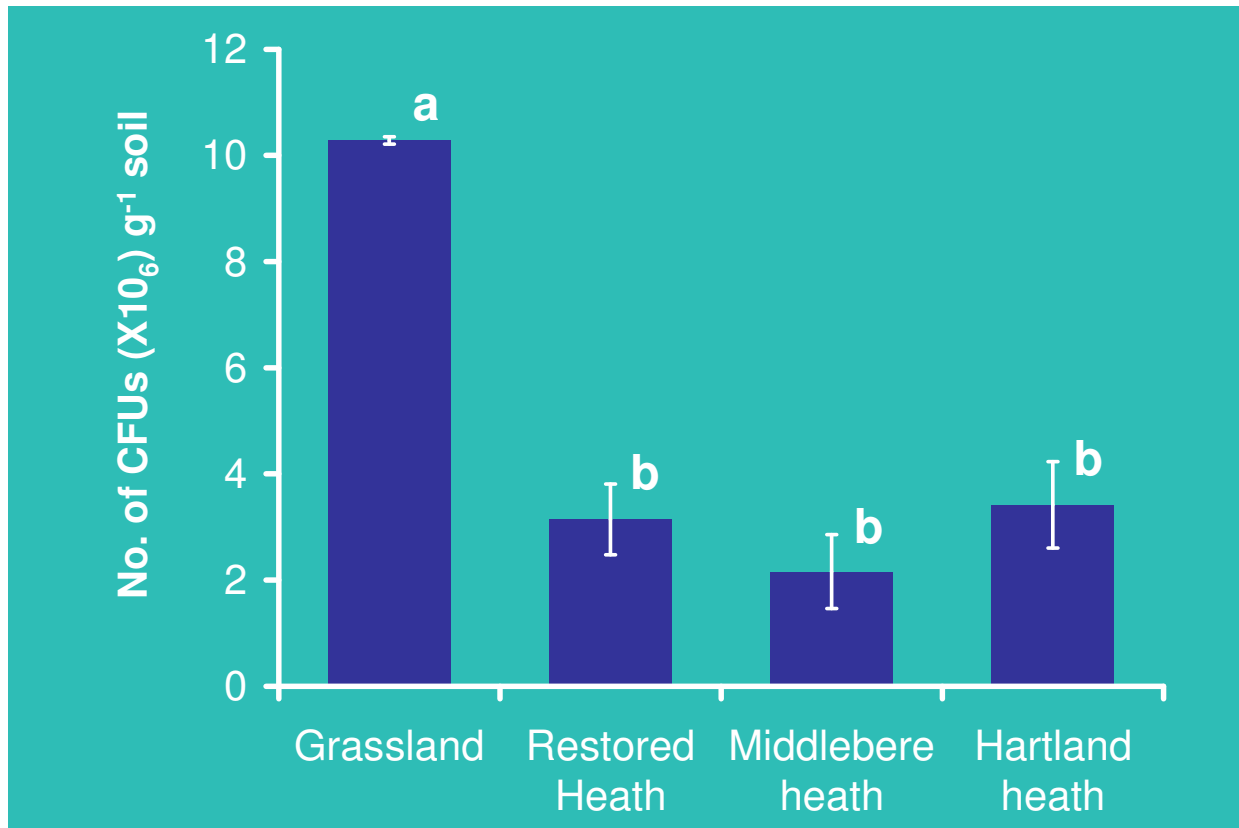
- **Has elemental sulphur amendment driven change in the microbial community?**
- **Has this in turn reduced microbial activity?**
- **And therefore litter decomposition rates?**

Quantifying microorganisms



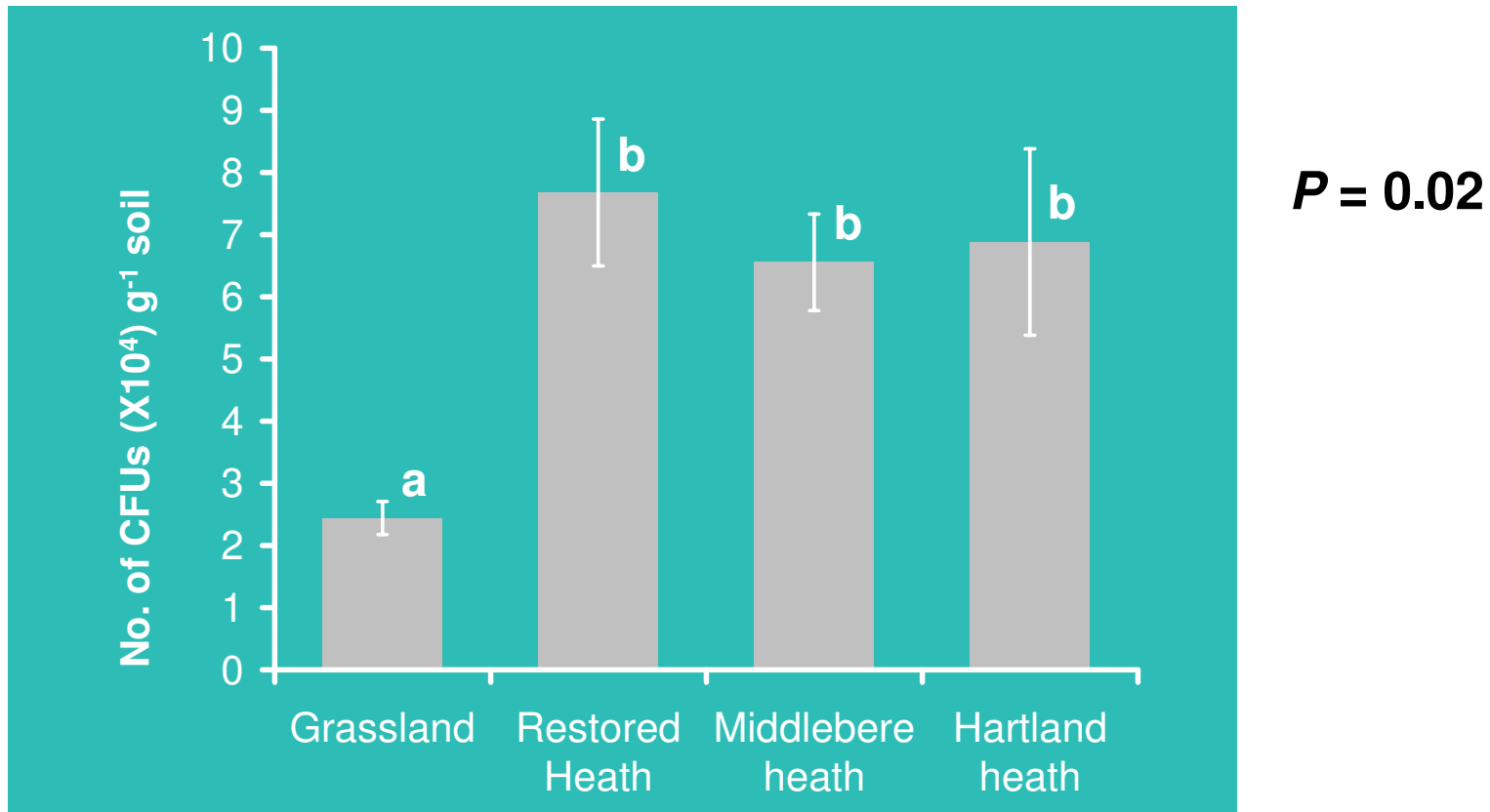
- The number of colony forming units (CFUs) of bacteria and fungi were determined by a selective viable count procedure.
- Many components of the soil microbial community will not be cultured!

Results – Bacterial CFUs



$P = 0.001$

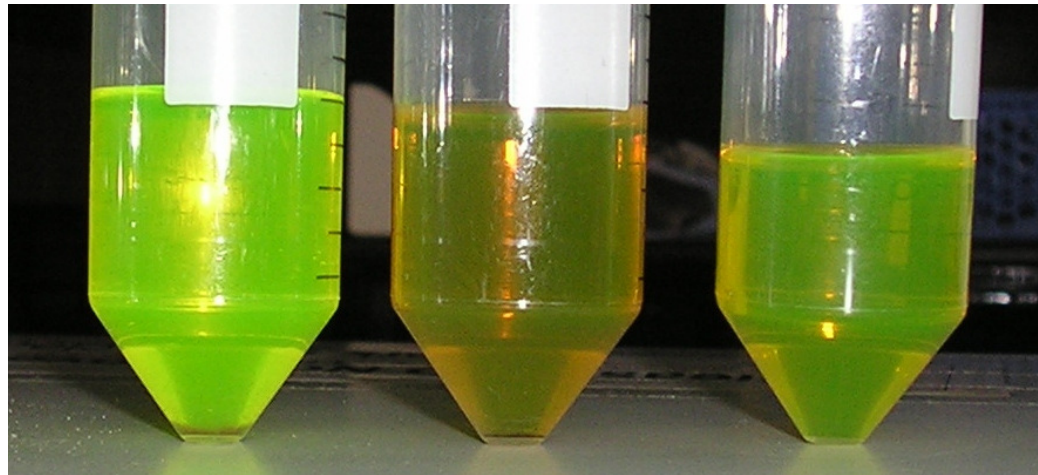
Results – Fungal CFUs



Potential drivers of change

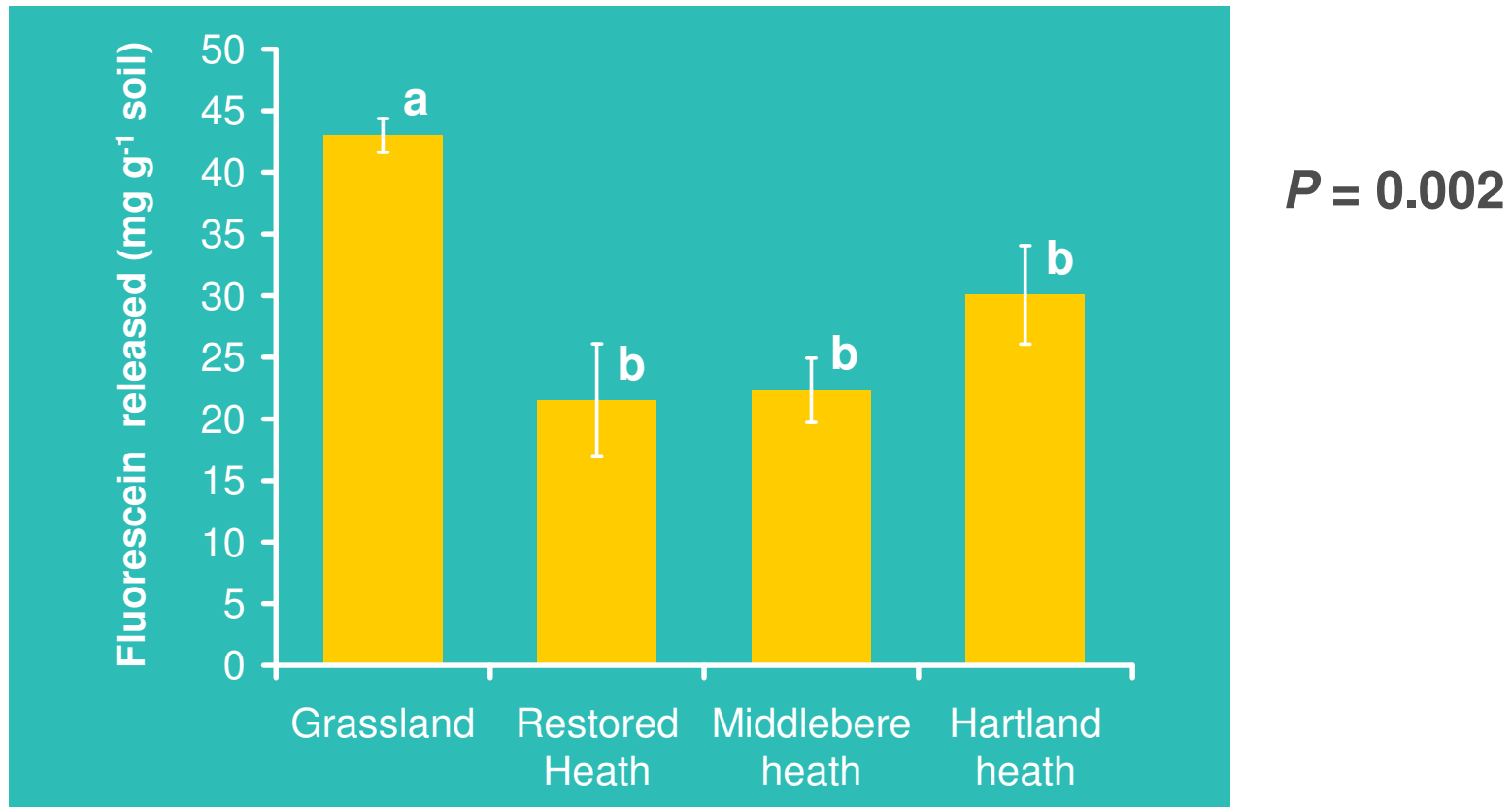
	Fungi	pH	Al	Moist.	C:N
Bacteria	-0.65**	0.78**	-0.48	-0.26	-0.61*
Fungi		-0.57*	0.09	0.13	0.32
pH	-0.57*		-0.34	-0.14	-0.49
Al	0.09	-0.034		0.52	0.79**
Moist	0.13	-0.14	0.52		0.77**

Microbial activity



- Hydrolytic enzymes convert colourless Fluorescein diacetate into fluorescein
- Enzymes include lipases, esterases, proteases
- Which are involved in decomposition
- FDA hydrolysis correlates with measures of microbial biomass

Results – FDA assay

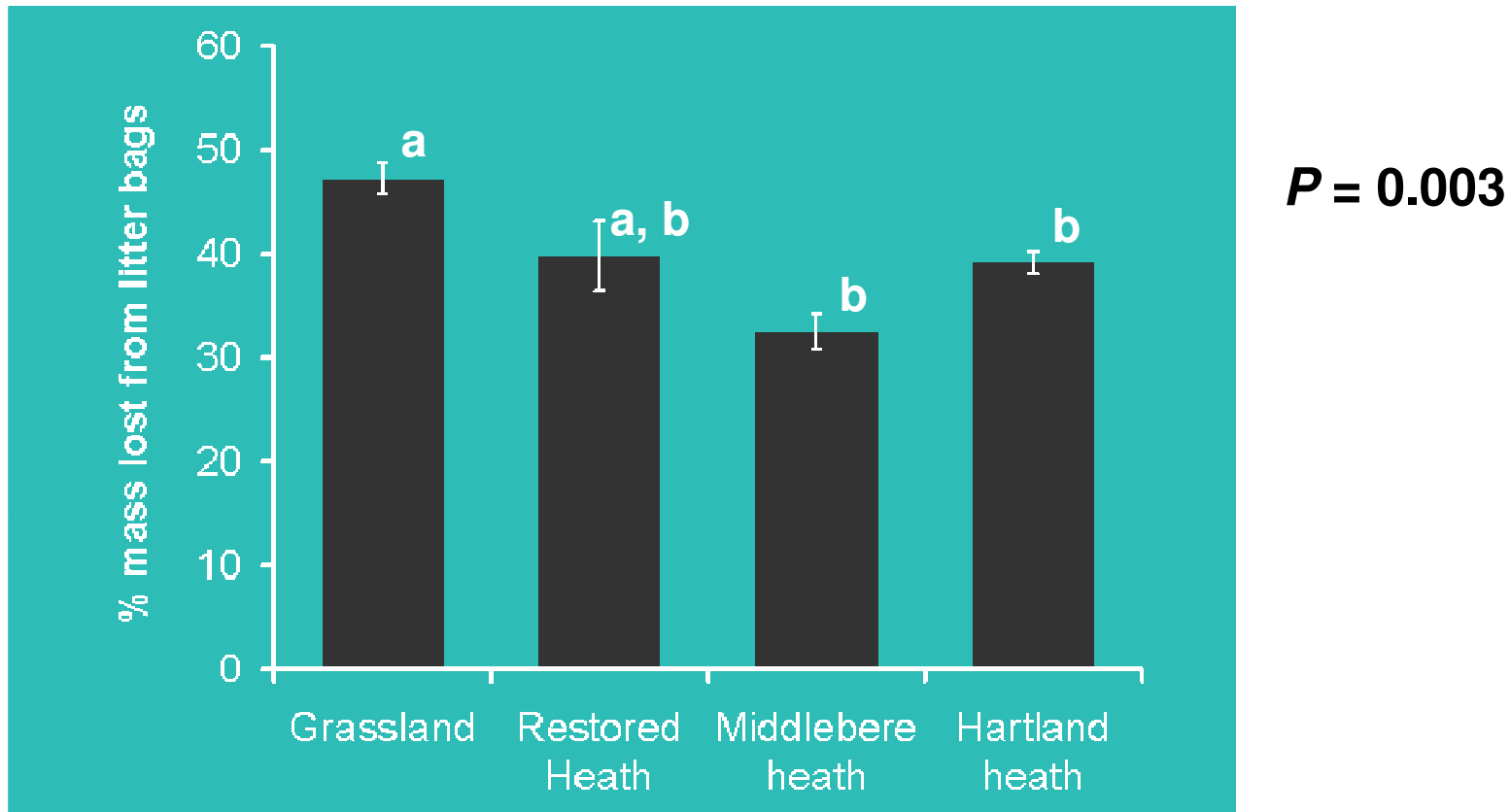


Litter decomposition



- Barley straw in 100 μm mesh litter bags
- Buried for 1 year (from 2008)
- Measure of decomposition by microorganisms AND protozoa & nematodes

Results – Litter bags



Summary

Elemental sulphur appears to:

- **Result in a restoration of some aspects of soil microbiology and microbial activity**
- **Thereby impacting on litter decomposition**
- **At least partially restoring a key ecosystem function of slow litter decomposition**
- **Which should translate into a reduction in the competitive advantage of *Molinia* and other grasses over *Calluna***
- **But is this enough for *Calluna* to survive?**

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