

Biodiversity in the 2016 to 2022 Strategic Research Programme

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Skuce, Alistair McVittie, Ali Karley, Katherine Preedy, Adrian
Newton, Antonia Eastwood and many others



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SEFARI 

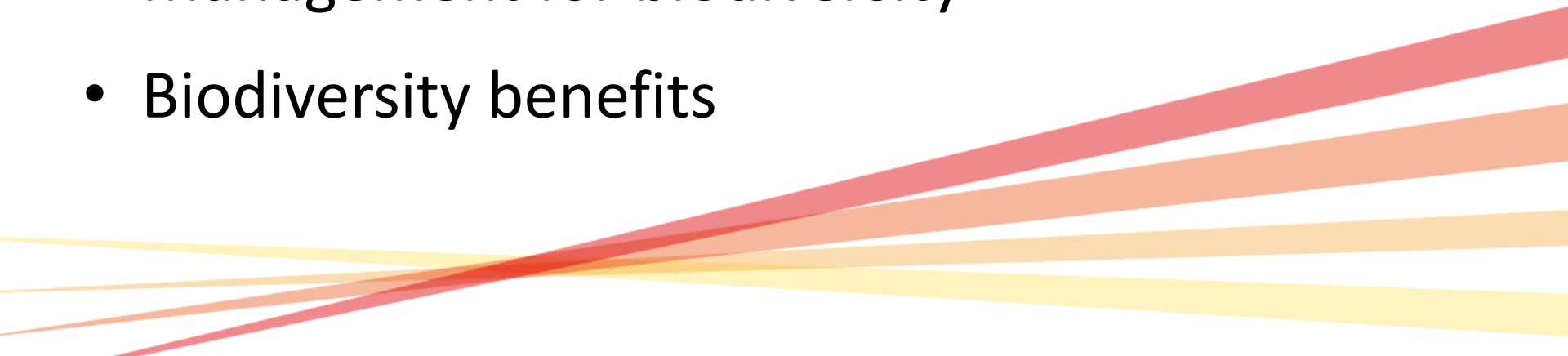
The SEFARI logo icon consists of a central green plant-like shape surrounded by several white, radiating lines of varying lengths, resembling a sunburst or a stylized flower.

Biodiversity



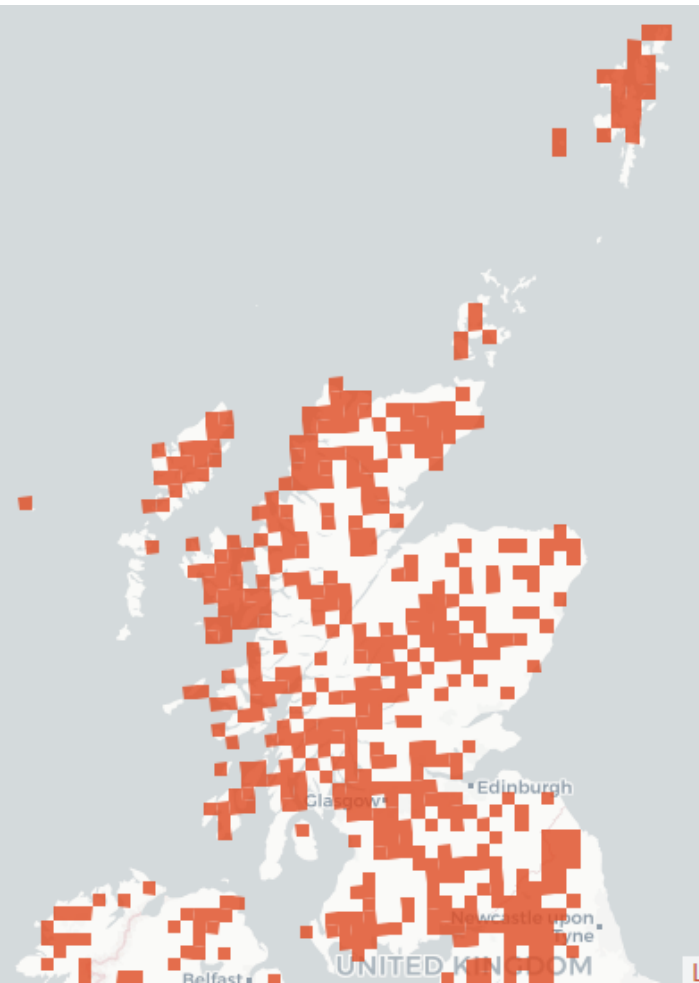
I'll try and cover the multi-faceted work in five areas

- Trends in biodiversity
- Invasive species, pests and diseases
- Species conservation
- Management for biodiversity
- Biodiversity benefits



Trends – using bryophytes as indicators

- We can link occurrence records with habitat preferences



Sphagnum magellanicum

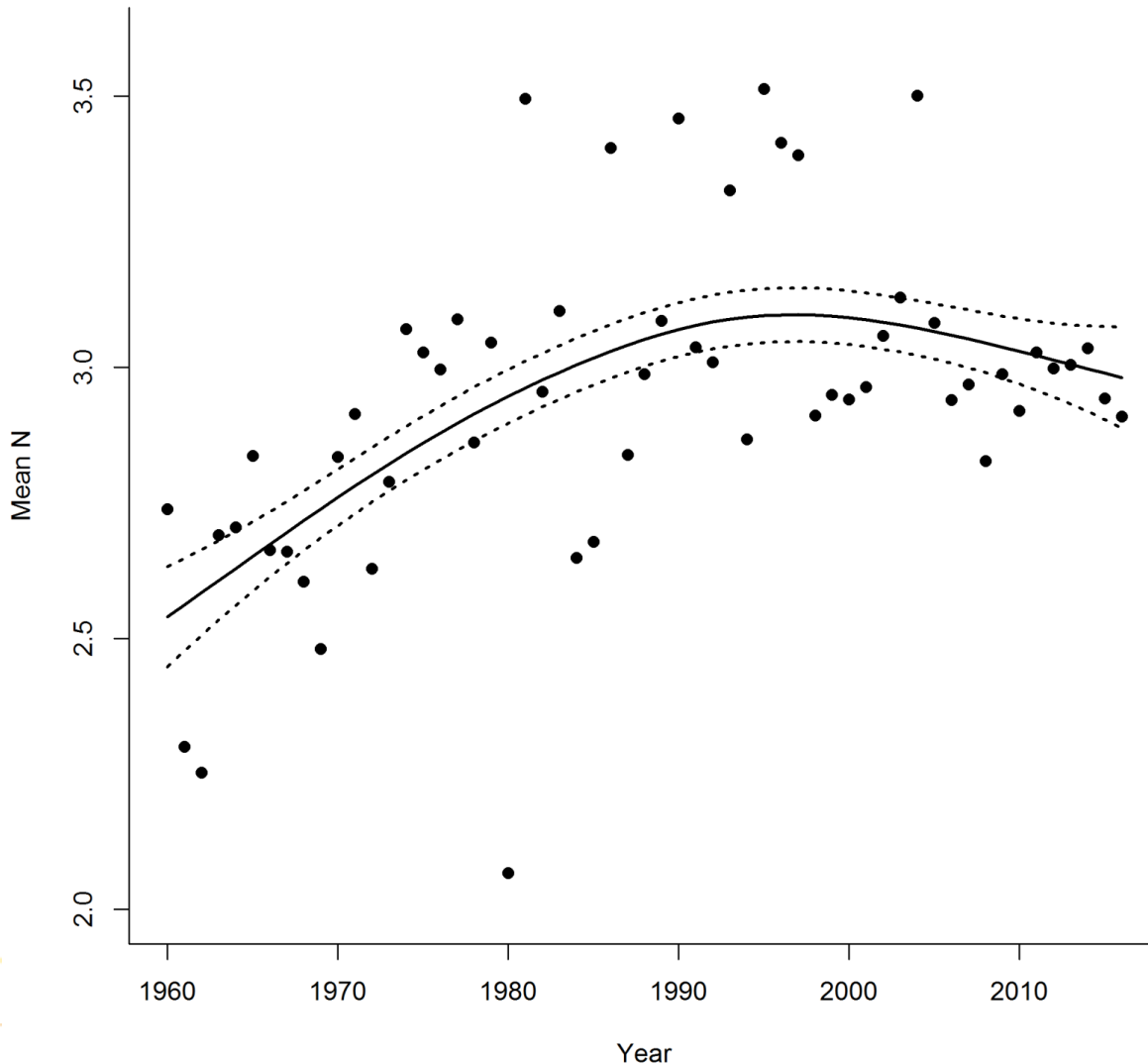
January Temperature	2.9
July Temperature	13.4
Precipitation	1418
Light*	8
Moisture	8
Reaction	1
Nitrogen	1

*Ellenberg indicators ranging from 1 (low) to 9 (high)

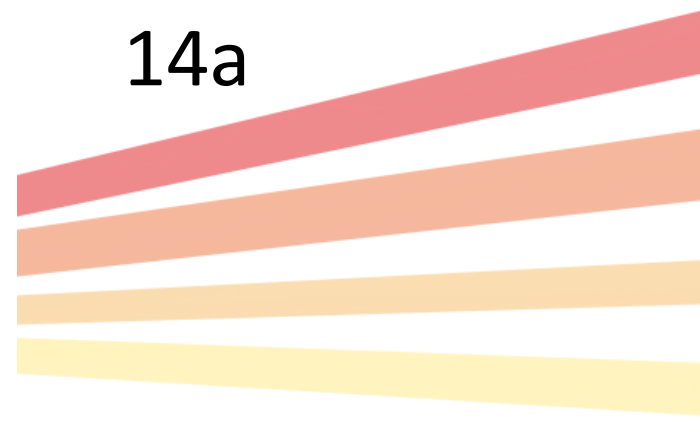
Trends – using bryophytes as indicators



- Nitrogen



- SEWeb
Ecosystem
Health
Indicator
14a



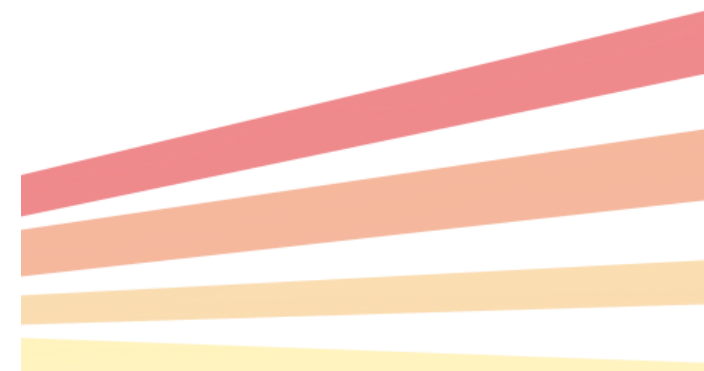
Trends – using bryophytes as indicators



- July Temperature



- SEWeb
Ecosystem
Health
Indicator 14b



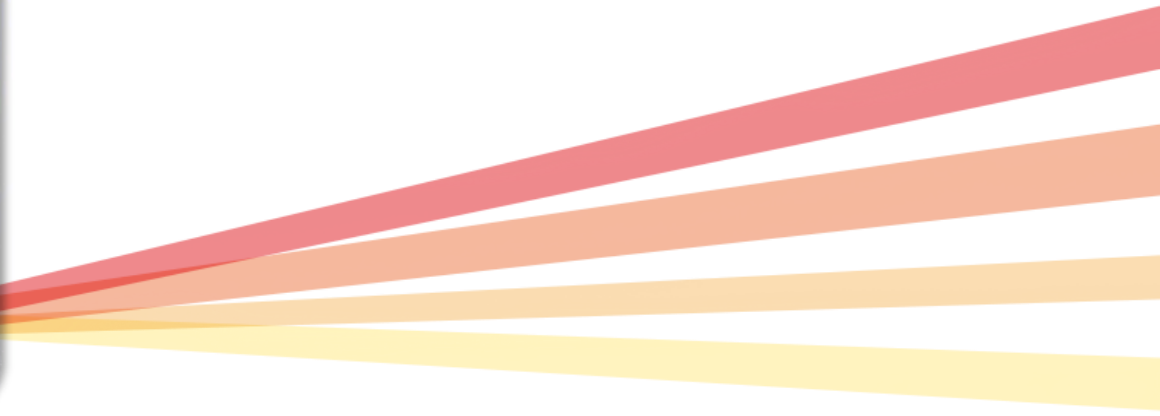
Contact: robin.pakeman@hutton.ac.uk

Pests & pathogens - pathogenic

Phytophthora species



- c. 200 species of damaging plant pathogens
- 26 species on UK Pest Risk Register
- Detection and identification challenging
- New detection system using DNA barcoding of environmental DNA (eDNA) samples



Pests & pathogens - pathogenic

Phytophthora species

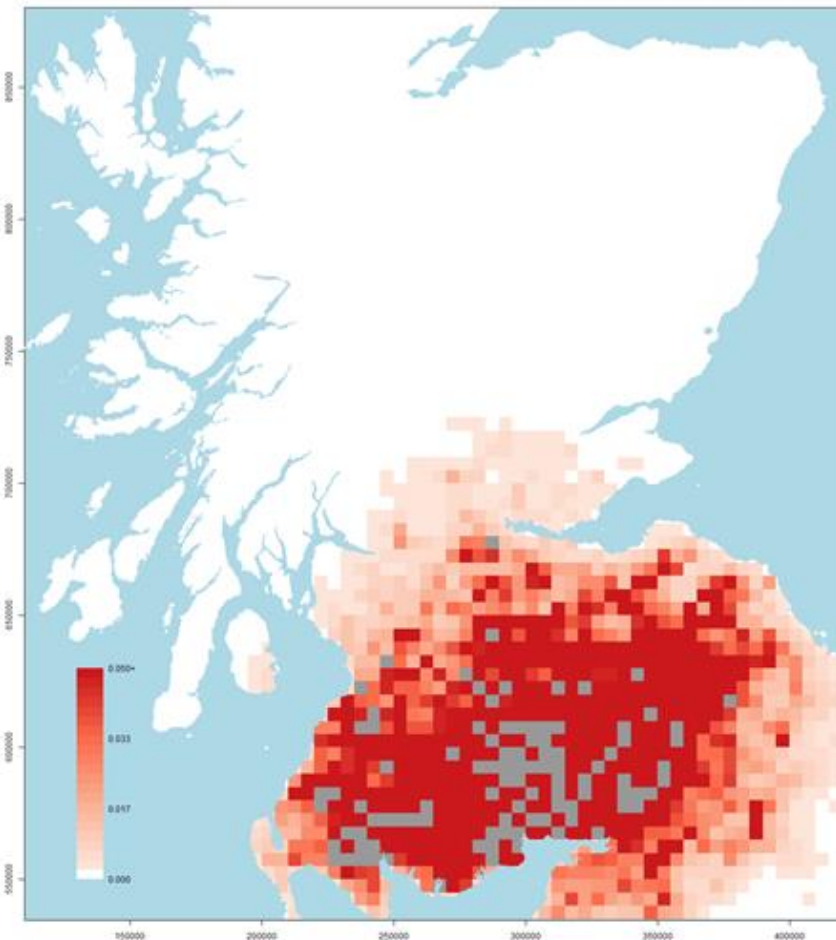


- 10^8 DNA barcode reads processed
- 39 known species of *Phytophthora* in Invergowrie Burn water
- Multiple unknown taxa
- eDNA metabarcoding provides a powerful approach for tracking pathogen populations

Pests & pathogens – can we predict spread?



- Can we predict spread in heterogenous landscapes?

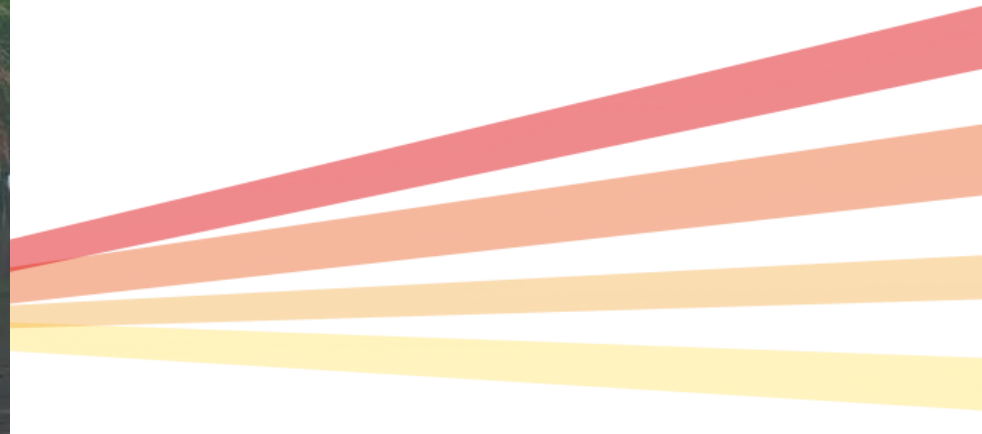


- Data driven software tool
- Predicted spread of *Dendroctonus micans* – a commercially important pest of spruce
- Also, working on Emerald Ash Borer in the USA

Contact: Stephen Catterall, stephen@bioss.ac.uk

Disease and conservation

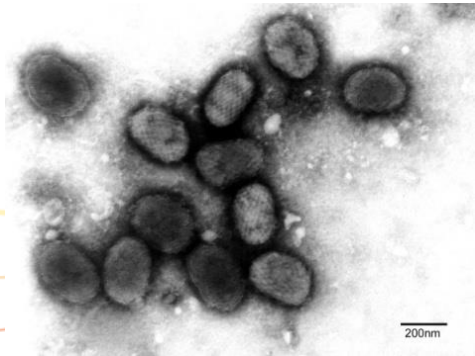
- Grey squirrels carry Squirrelpox virus (SQPV) which is lethal for reds
- Modelling suggests SQPV carrying greys oust reds c. 26 times quicker than if not carrying the virus



Disease and conservation



- SEFARI scientists monitoring greys have test 850 squirrels. Very few had the virus in contrast to England (c. 80 %)
- Suggests misunderstanding of virus biology or that targeted control by the Saving Scotland's Red Squirrel project has made a difference to virus spread



Conservation – alpine blue sow-thistle

- Less than 100 alpine blue sow-thistle plants remained in the UK
- Stuck on small, isolated cliff ledges for many generations -> escape grazing
- Poor genetic health (low genetic diversity and high inbreeding)
- Fail to reproduce in the wild



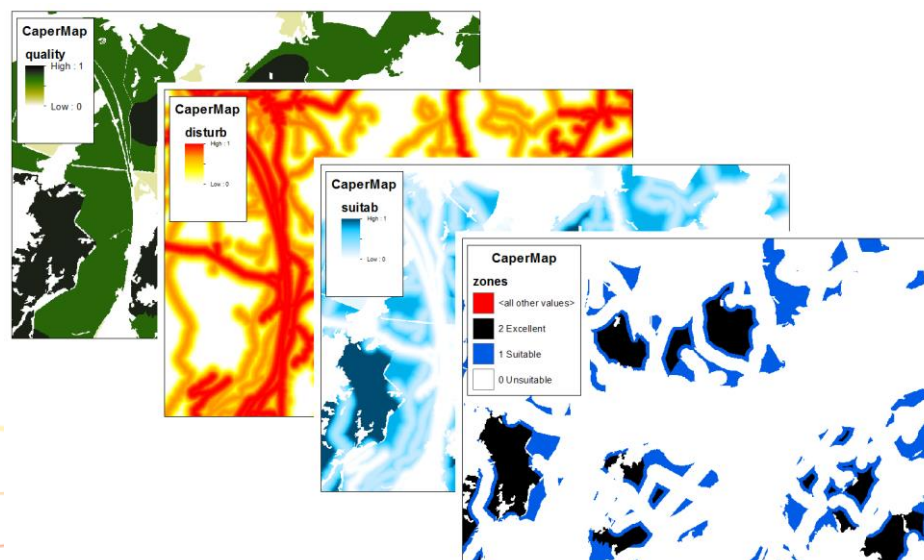
Conservation – alpine blue sow-thistle



Conservation - Capercaillie



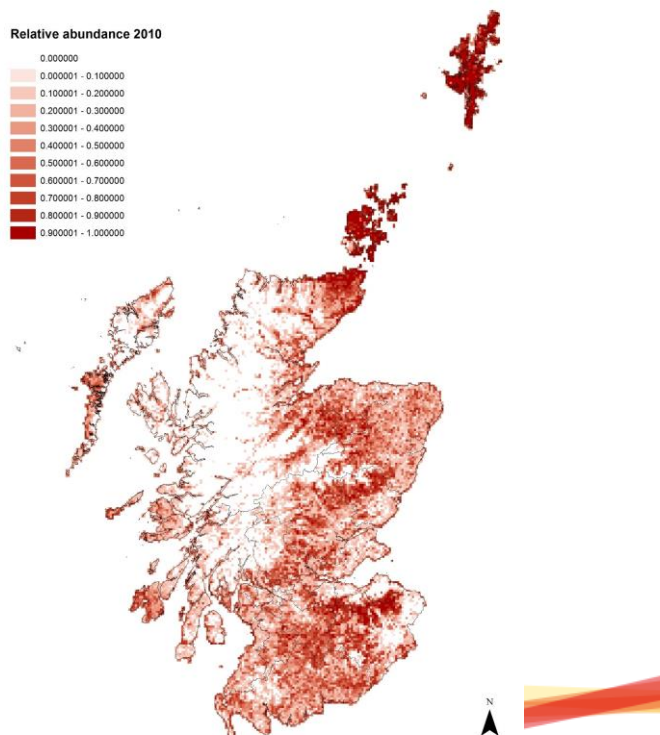
- Development of CaperMap
- Participatory Geographic Information System
- Communication and engagement tool to promote capercaillie conservation
- Assess different scenarios/opinions



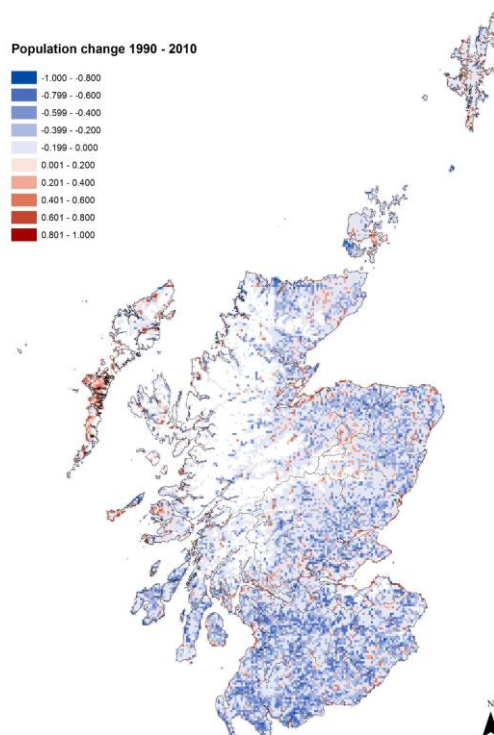
Conservation - Waders

- Wading bird populations in decline – need landscape level, collaborative action. Priority areas identified

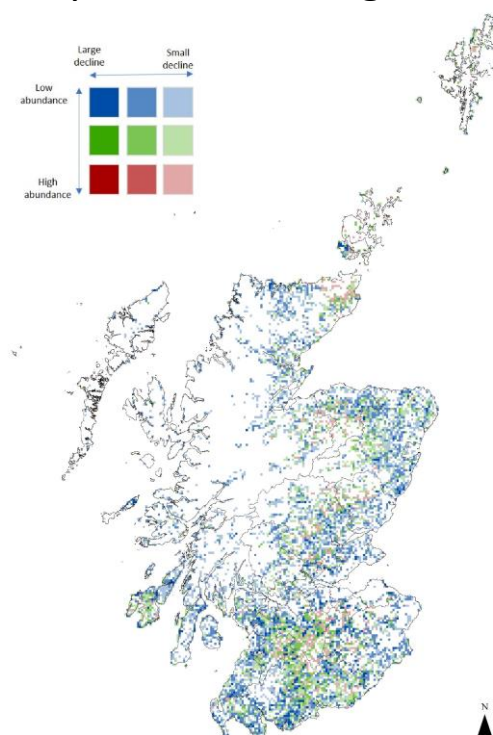
Relative abundance



Population change

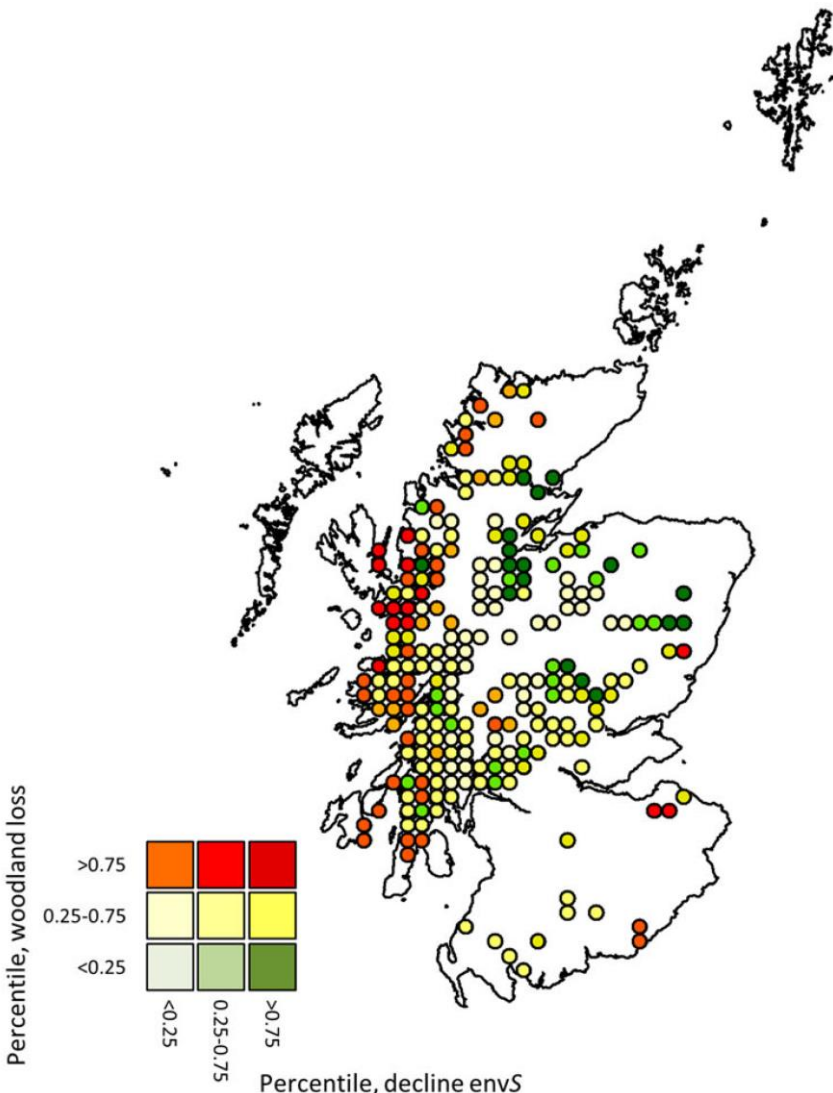


Population cooling



Conservation – epiphytic lichens

- Climate change risk for woodland lichens



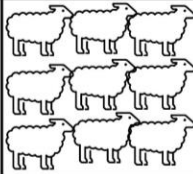
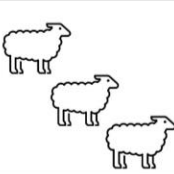
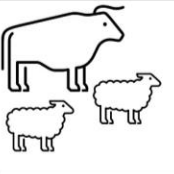
- Shrinking climate space (decline in environmental suitability envS) is exacerbated by woodland loss
- Need to increase area of native woodland - FGS

Management – upland biodiversity



- Glen Finglas experiment looking at how management of grazing can have cascading effects through ecosystems
- Four treatments
 - i. High (nine sheep per plot = $2.7 \text{ sheep ha}^{-1}$)
 - ii. Continued (three sheep per plot = $0.9 \text{ sheep ha}^{-1}$)
 - iii. Mixed (cattle and sheep = $0.9 \text{ sheep ha}^{-1}$)
 - iv. None

Management of upland biodiversity

				No grazing
Plants				
Diversity	High	Low	Mod	Low
Stability	High	Mod	High	Low
Heterogeneity	Low	Mod	Low	High
Herbivores				
Plant bug abundance	Low	Mod	Mod	High
Plant bug diversity	High	Low	Mod	High
Moth abundance	Low	High	Mod	High
Moth diversity	Low	Mod	Mod	High
Vole abundance	Low	Mod	Mod	High
Predators				
Spider abundance	Low	Mod	Mod	High
Spider diversity	Low	Mod	Mod	High
Beetle abundance	High	High	Mod	Low
Beetle diversity	High	High	Mod	Low
Fox activity	Low	Mod	Mod	High
Meadow pipit numbers	High	Mod	High	Low
Bird diversity	Low	Low	Low	High

Management – trade-offs between conservation and animal health



- Some management prescriptions promote wetland grazing, but concern about fluke risk
- Investigation of
 - i. Wader scrapes
 - ii. Natterjack toad habitat



Management – trade-offs between conservation and animal health



- Both options have relatively low fluke risk (low/no faecal eggs, few snail hosts)
- No apparent trade-off, but requires ongoing risk assessment and monitoring



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Management – biodiversity net gain



Case studies on Biodiversity Net Gain demonstrated that this can be achieved through trading-up habitat types or condition based on common metrics



Net gain was more difficult to achieve when considering a broader range of ecosystem services including ES values. This is largely due to loss of habitat extent



Loss of productive land to development may be offset in biodiversity terms, but there could be natural capital implications

Benefits – crop diversity

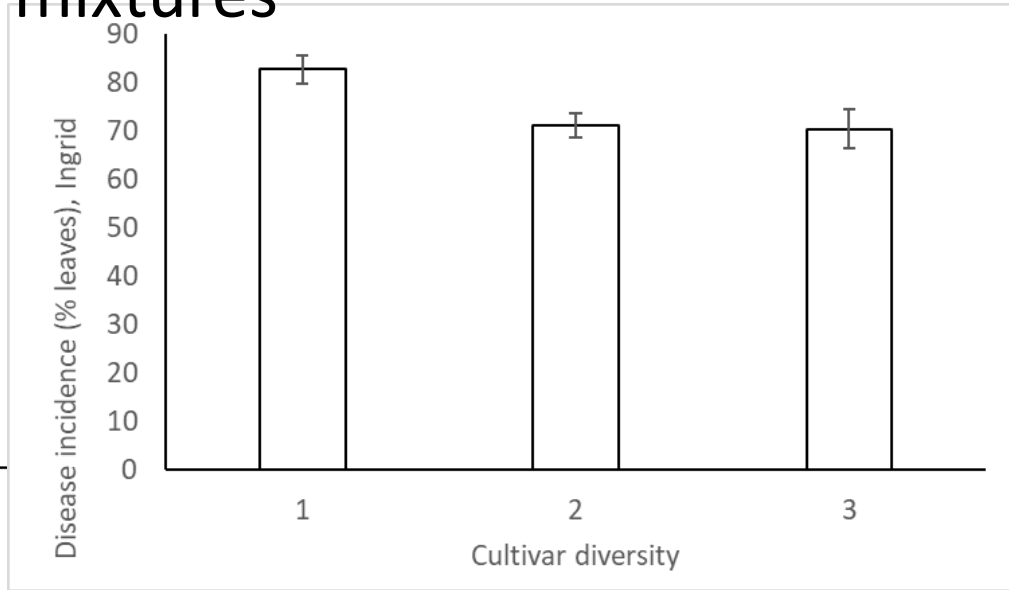
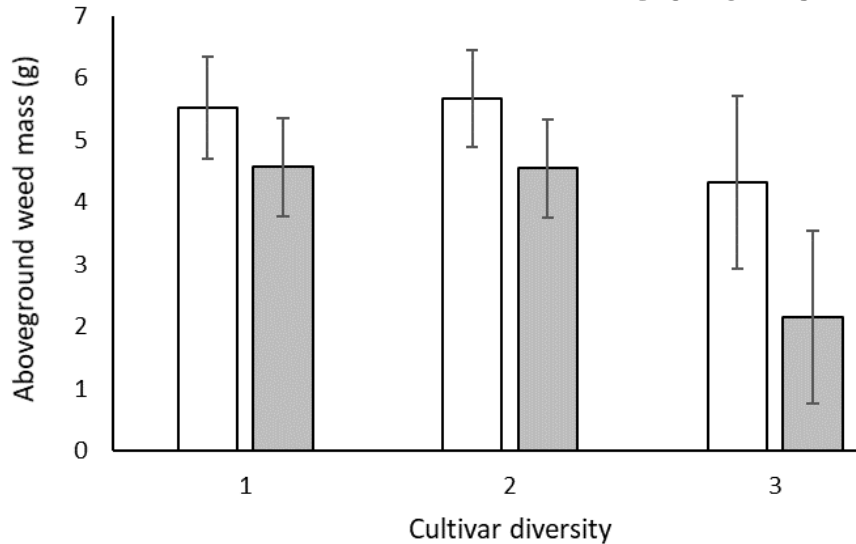


- Can we use ecological knowledge of the benefits of biodiversity to develop sustainable agricultural systems?
- Approach – manipulate crop diversity, either in terms of cultivar or species mixtures

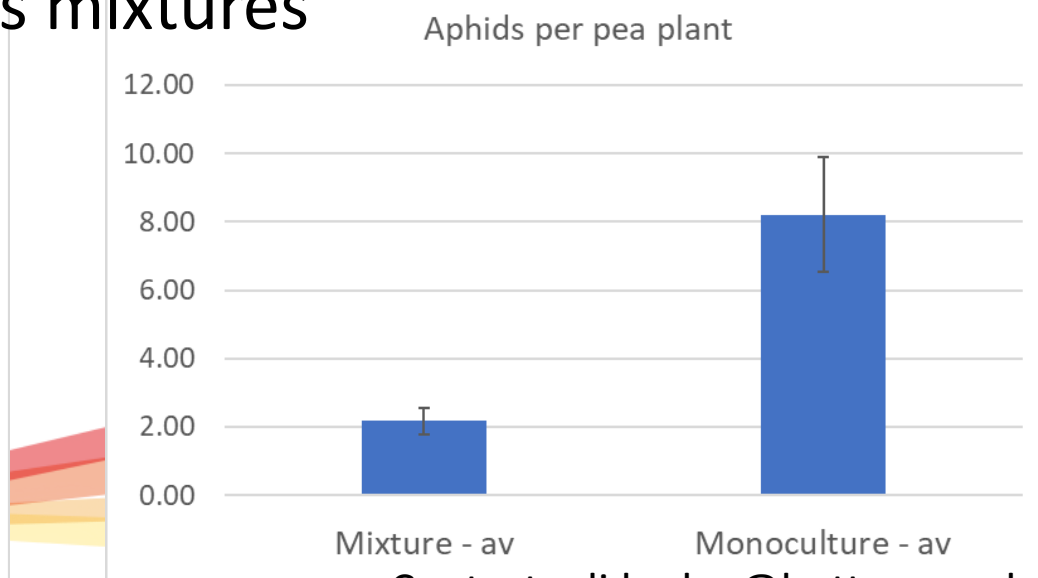
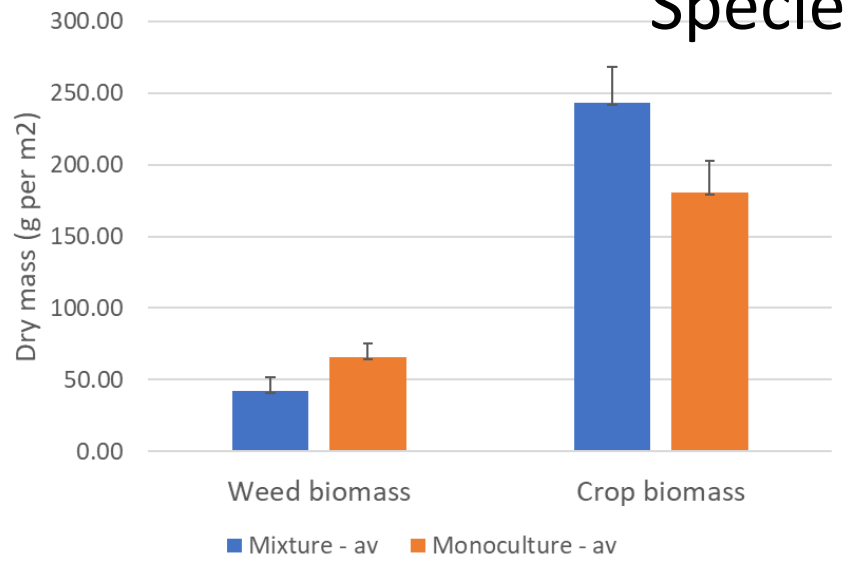


Benefits – crop diversity

Cultivar mixtures



Species mixtures



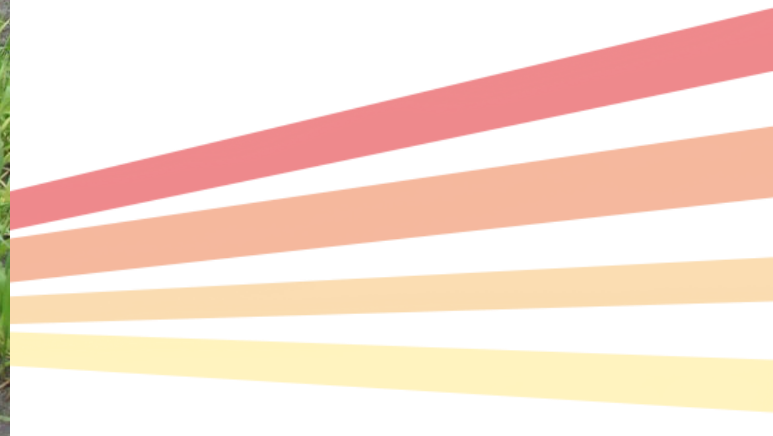
Benefits – utilising genetic diversity



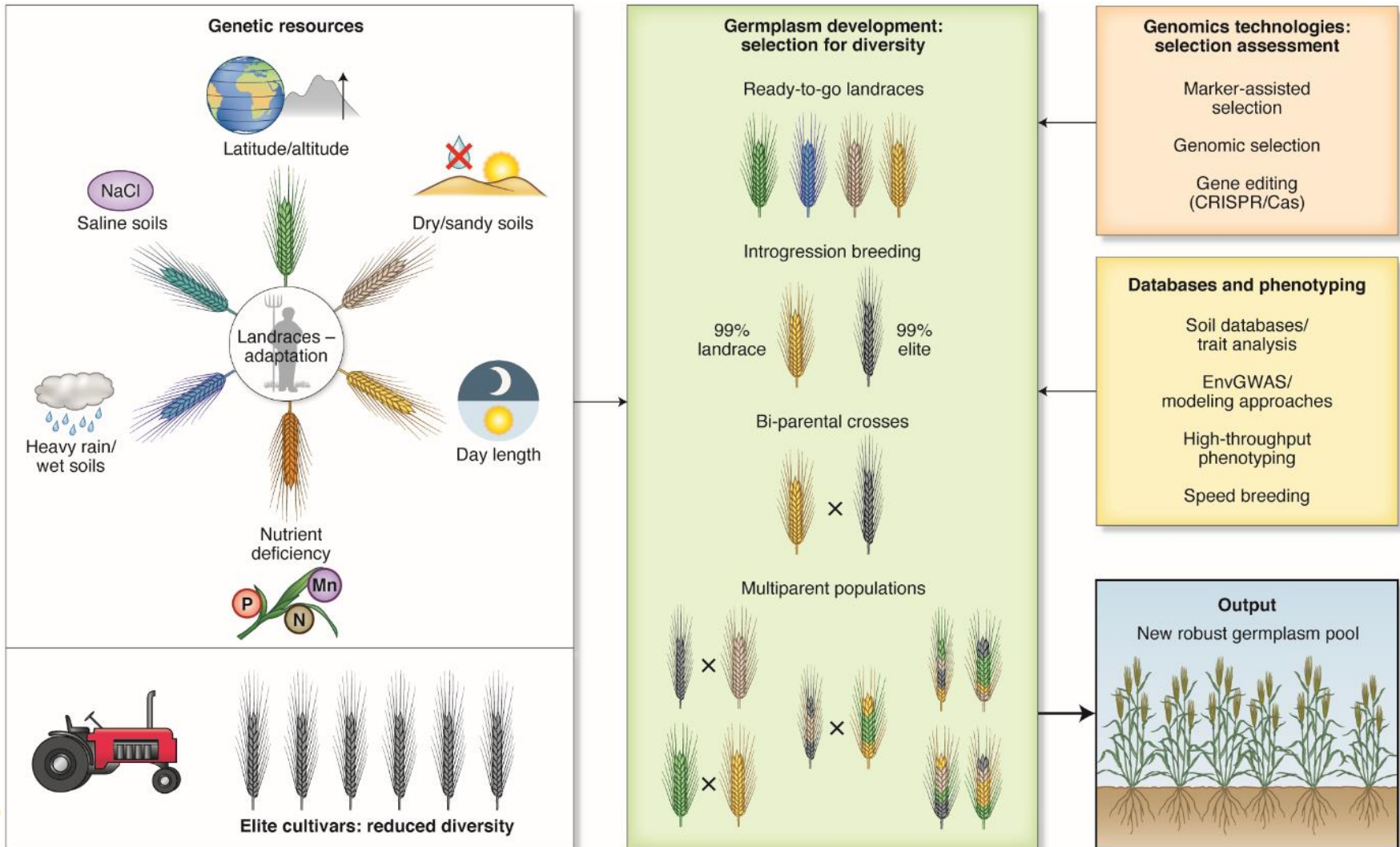
- Bere barley – Scotland's landrace
- Selection to grow on marginal soils
- Unprecedented manganese efficiency on high pH soils (machair)

Bere North Ronaldsay

KWS Irina



Benefits – utilising genetic diversity



Benefits – engagement with nature



- Using Participatory Video with young people changed initial negative views on greenspace
- Fostered connection and empathy with nature
- Boosted confidence and self esteem
- Changed behaviours e.g. littering, using greenspaces for relaxing during exams
- Participatory video could be a transformative engagement tool

Benefits – engagement with nature



- “It was the deer that really opened up my eyes... if I litter right now the deer can eat the plastic and that would cause it to die and that’s not right. They have... they have feelings, they have many things. What we feel, they feel as well. If we feel pain, they feel pain.”

- <https://vimeo.com/678138988>
- Password – nature



Thank you

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