MultiMOVE: Pre-bundled niche models for British plant species

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GMEP Glastir Monitoring and Evaluation Programme

Why: Niche Modelling?

Because: We need to predict potential vegetation change to understand the following:

- *Biodiversity outcomes expected from Glastir*
- *Effects of land-use and other agri-environment interventions*
- *Effects of changing atmospheric deposition*
- *Climate change*

AND

- *Interactions (eg. does projected climate change make a species more or less sensitive to Nitrogen deposition? Can land management mitigate the effects of climate change?)*



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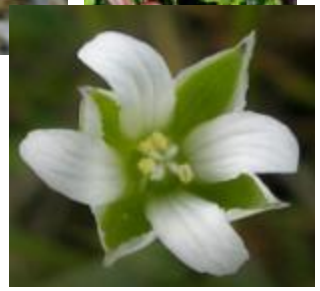
How? By quantifying the niche of a plant

Key axes that define where a plant lives:

- **Shade/disturbance**
  - Measured by cover-weighted canopy height (Ash, Bird's-foot Trefoil)

Substrate fertility and pH

- Measured by %C, %N, mineraliseable N, soil pH (Crowberry, Nettle, Carline Thistle)



Soil wetness

- Measured by volumetric soil moisture (Sphagnum, Upright Chickweed)

Climate

- Long-term annual averages 1961-'90; min Jan, max July, annual precpn (Marsh Hawksbeard, Downy Willow)

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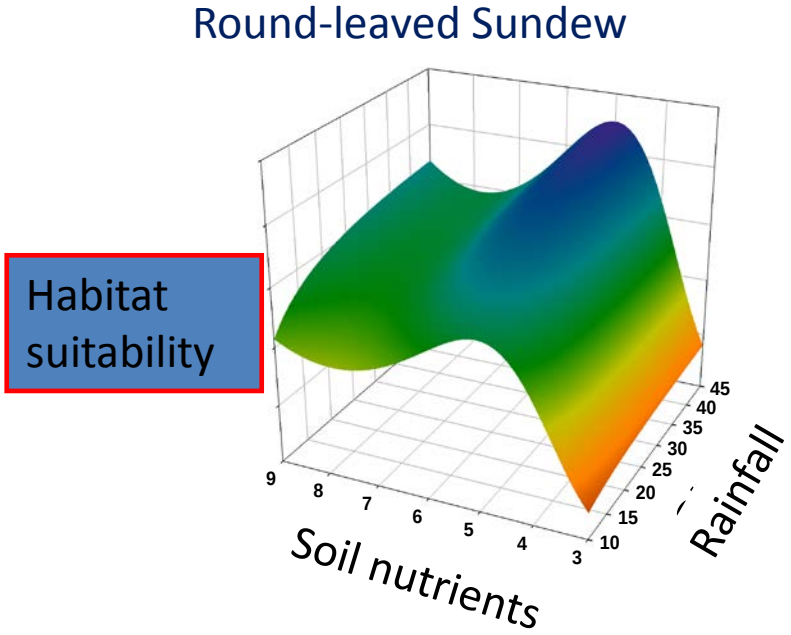
What is MultiMOVE?

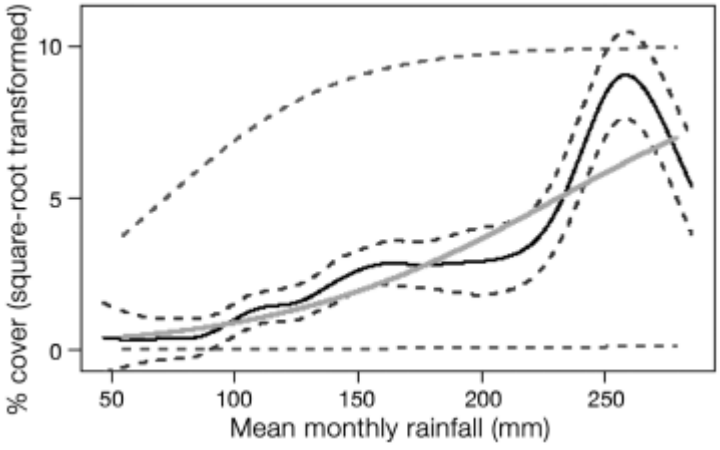
- MultiMOVE integrates multiple gradients and responses.....
- For example Sundew is more vulnerable in drier parts of Britain

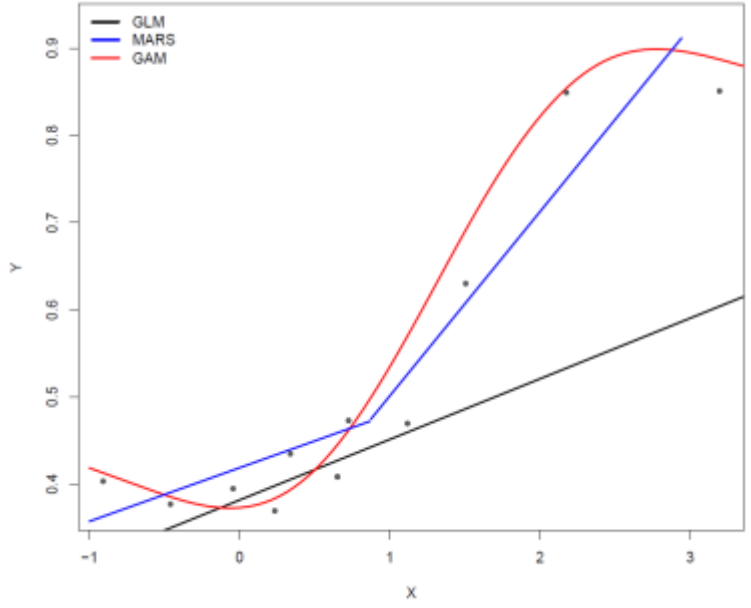


- The models are built from very large presence / absence datasets (Countryside Survey, NVC, GB Woodland Survey, Key Habitats survey)
- They cover 97% of CSM indicators, most nectar plants, ecosystem dominants and many less common species
- All models have been compiled into a user friendly R package with functions to easily extract, map and plot model output.

Ensemble modelling to better communicate uncertainty

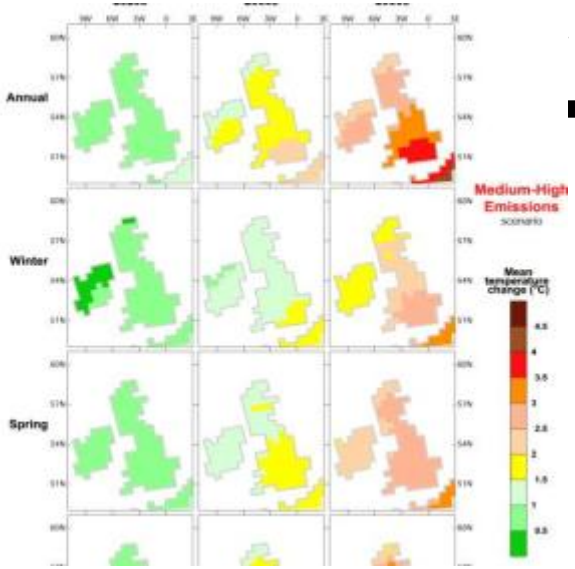
- MultiMOVE comprises three statistical modelling techniques
  - GLMs, GAMs and MARS.
- More models generate a more robust ‘consensus’ and help to quantify the uncertainty in the model projections.
- Three further techniques are being added this Summer; Neural Networks, Random Forests, Plateau models (developed by BiOSS)





Model application: Linking dynamic and niche models to predict effects of climate, pollution and management on plant biodiversity

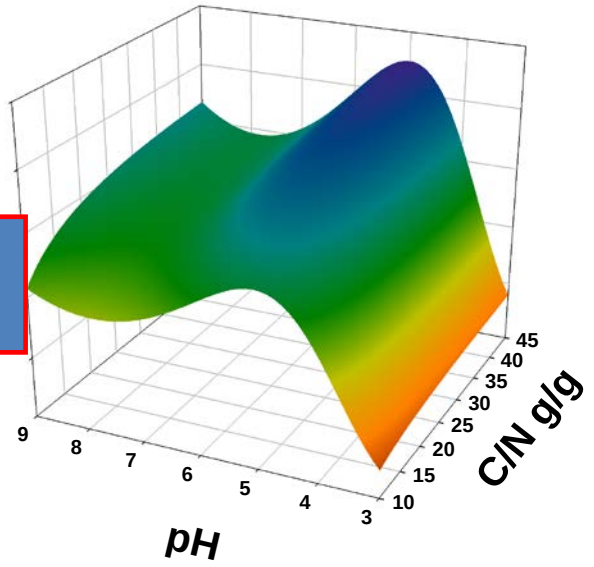
(see De Vries et al 2010. *Ecol. Applications* 20, 60-79)



Climate scenario

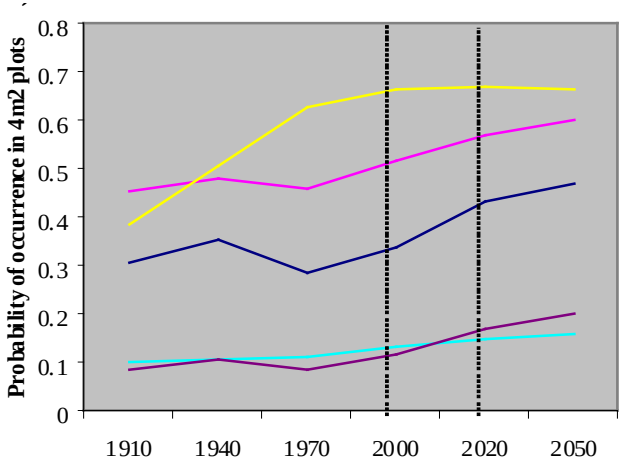
Niche model; MultiMOVE

e.g. Round-leaved sundew



Habitat suitability

Predicted species change

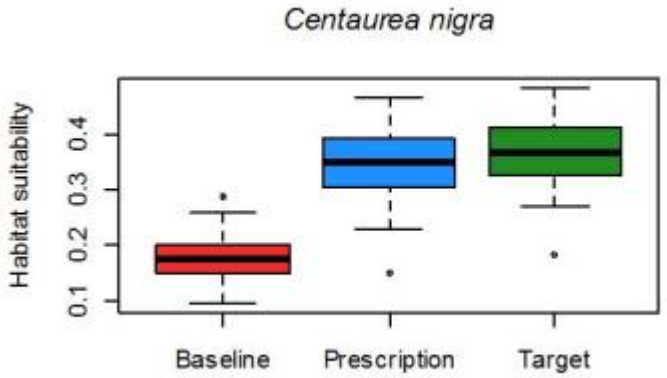


Cirsium palustre
Holcus lanatus
Juncus effusus
Poa trivialis
Ranunculus repens

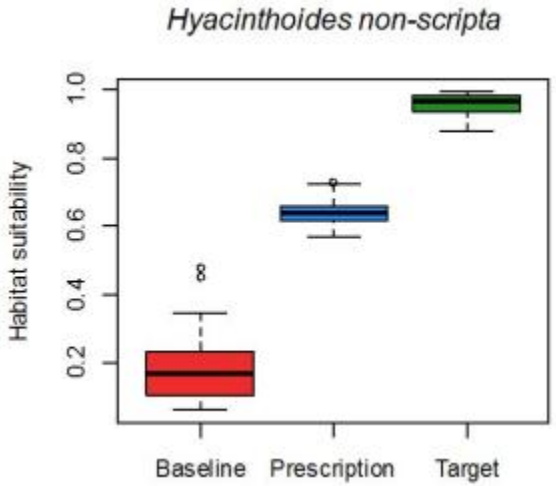
Implications for biodiversity and ecosystem function

Model application: Simulation of the impacts of Glastir interventions

Low input grassland (AWE/Advanced 15). No fertiliser for 12 years on **Improved Grassland** (baseline habitat). Target habitat is considered to be **Neutral Grassland**.



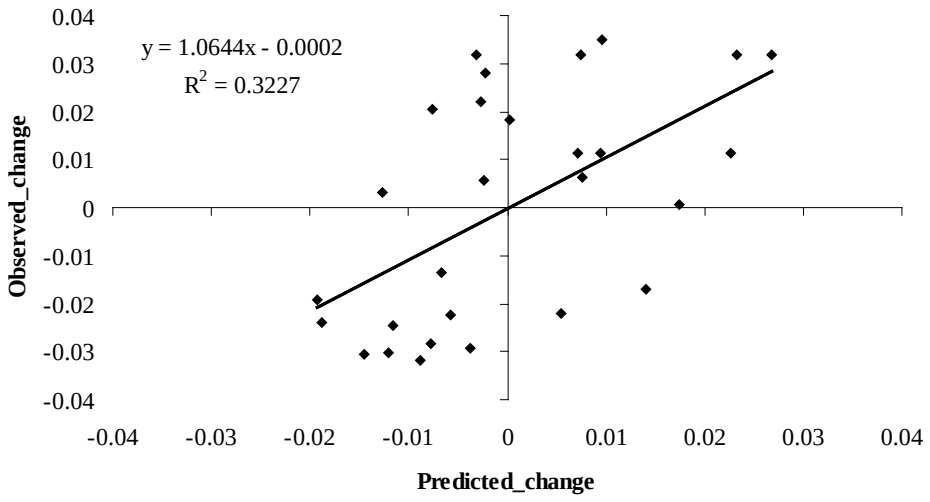
Woodland expansion (AWE 24). Scenario covers 23 years of natural succession. Baseline habitat is **Improved Grassland** and target habitat is **Broadleaved Woodland**.



Key messages from year 1 GMEP simulations:

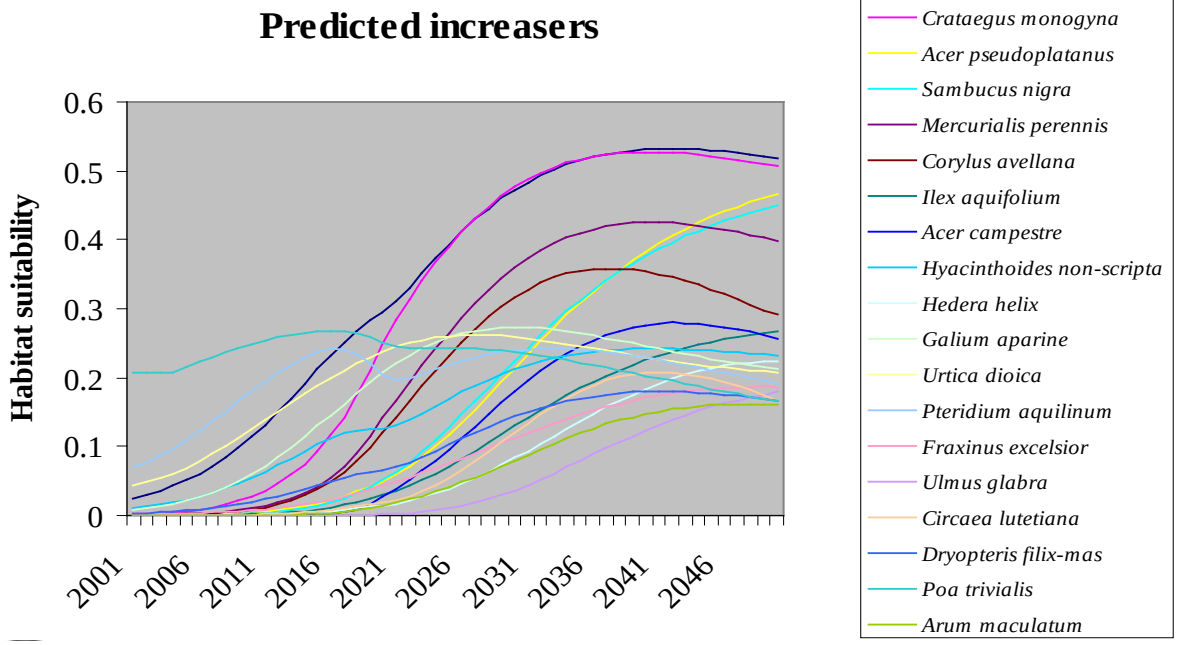
- **Of the 40 projections run for common species, 30 (75%) were consistent with the expected impact of Glastir.**
- **But, ecological impacts take time: 10 years for Bracken control, 12 years for low input grassland and 23 years for succession in response to Woodland expansion and Streamside planted buffer strips.**

Has MultiMOVE been tested?



- Projections positively associated with observed change at Moorhouse blanket bog ECN site, Cumbria 1971-2001

- Predicting vegetation change from arable to woodland from 2000 to 2050 at Park Grass control plots at Rothamsted.
- 65% match to the target community (NVC)



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Modelling rare species

The example of Purple Milk Vetch:

- We quantify species' associations with the rare species.
- Rare species + associated species data is the limiting factor.
- In the last 3 years data has become available for 30 Threatened Plant species surveyed by the Botanical Society of the British Isles.

Associates	Rare companions	Common companions
Plantago lanceolata	0.55	1.00
Lotus corniculatus	0.56	0.97
Festuca rubra agg.	0.47	0.95
Galium verum	0.63	0.94
Thymus polytrichus	0.54	0.83
Bromus arvensis	1.00	0.00
Anagallis minima	1.00	0.00
Dianthus deltoides	0.92	0.13
Potentilla neumanniana	0.92	0.00
Aceras anthropophorum	0.87	0.00

Next steps for GMEP

- Application to Glastir GMEP 1km squares and plots in year 2.
- Key task: Further development of realistic timescales and targets for plant species change due to Glastir interventions using published evidence-base and MultiMOVE.
- More work on defining target vegetation types and analysing timescales for expected ecological response.

Other work

- Better integration with the other models presented today.

Thank you

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Modelling rare species

The example of Purple Milk Vetch:

- We quantify species' associations with the rare species.
- Survey data is the limiting factor.
- We can define indicators for the 30 Threatened Plant species surveyed by the Botanical Society of the British Isles. In the last 3 years.

Associates	RpCp	RpCa	RaCp	Companion species index
Plantago lanceolata	124	59	7744	0.55
Lotus corniculatus	118	65	5887	0.56
Festuca rubra agg.	113	70	11192	0.47
Galium verum	111	72	2881	0.63
Thymus polytrichus	83	100	3363	0.54
Bromus arvensis	1	182	0	1.00
Anagallis minima	1	182	0	1.00
Dianthus deltoides	3	180	3	0.92
Potentilla neumanniana	1	182	1	0.92
Aceras anthropophorum	1	182	2	0.87