

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?)*



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, mineralisable 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)

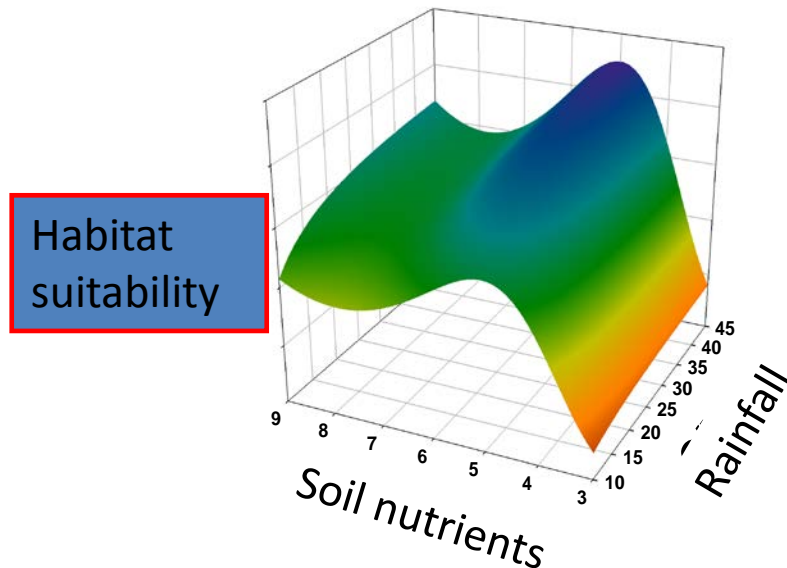


What is MultiMOVE?



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

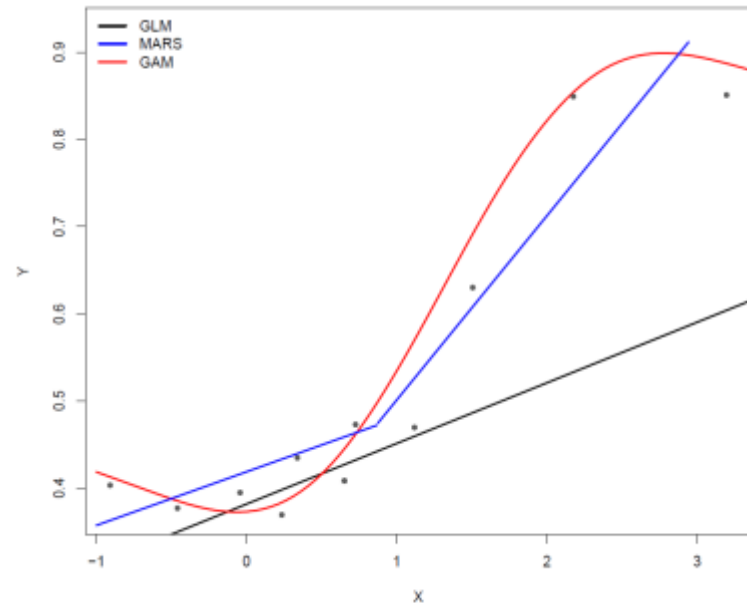
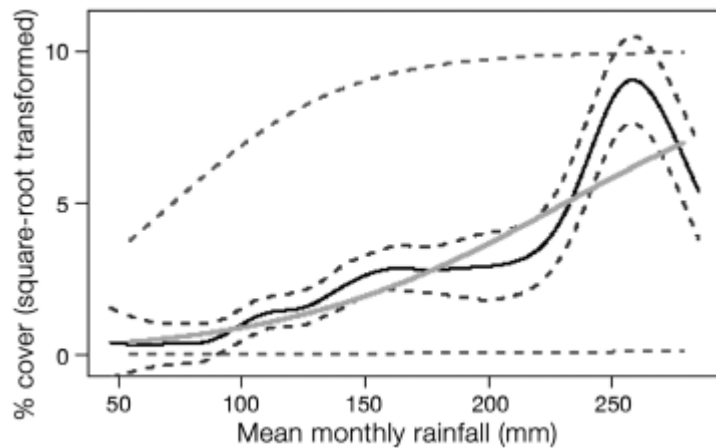
Round-leaved Sundew



- 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.

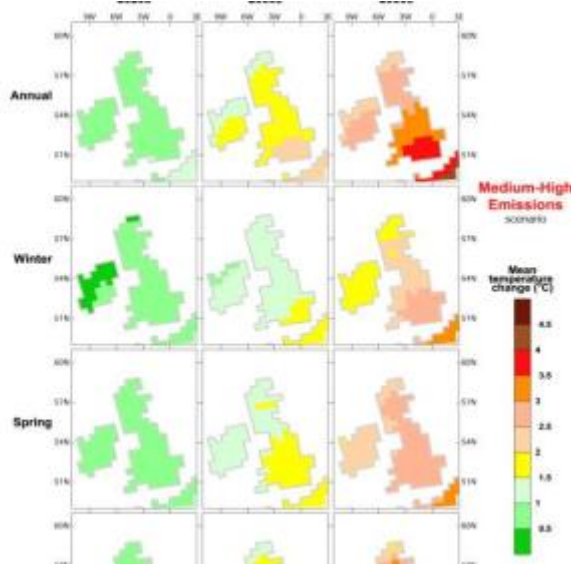
Ensemble modelling to better communicate uncertainty

- 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

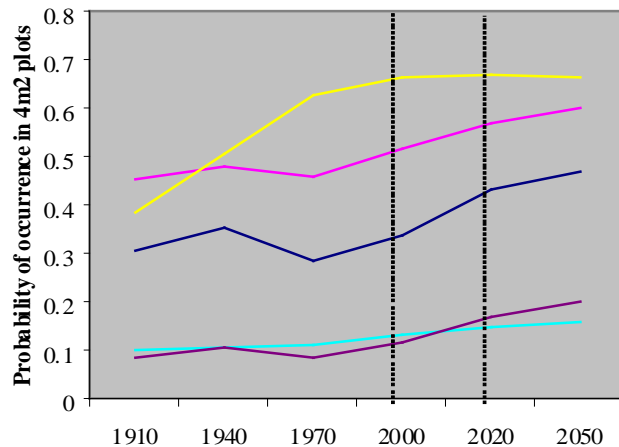
(see De Vries et al 2010. *Ecol. Applications* 20, 60-79)



Climate scenario

Niche model; MultiMOVE

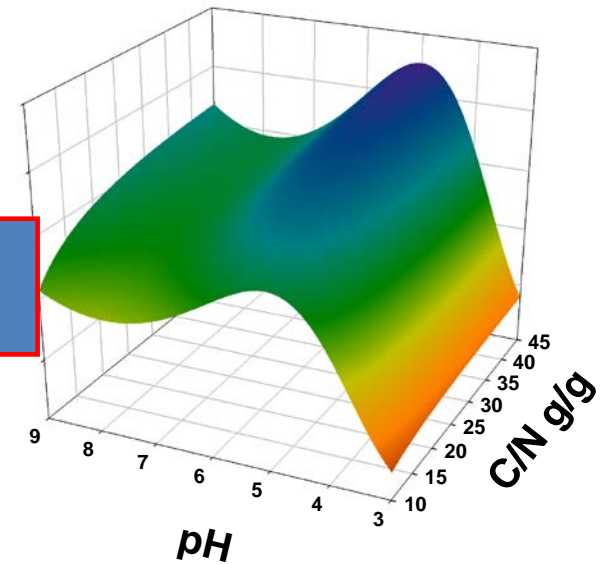
Predicted species change



- *Cirsiium palustre*
- *Holcus lanatus*
- *Juncus effusus*
- *Poa trivialis*
- *Ranunculus repens*

Habitat suitability

e.g. Round-leaved sundew



Implications for biodiversity and ecosystem function



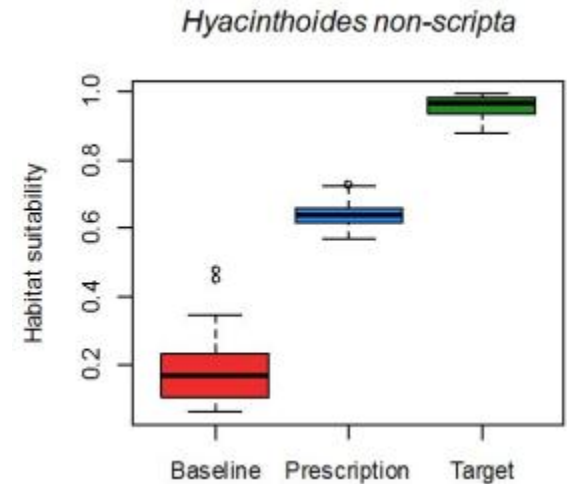
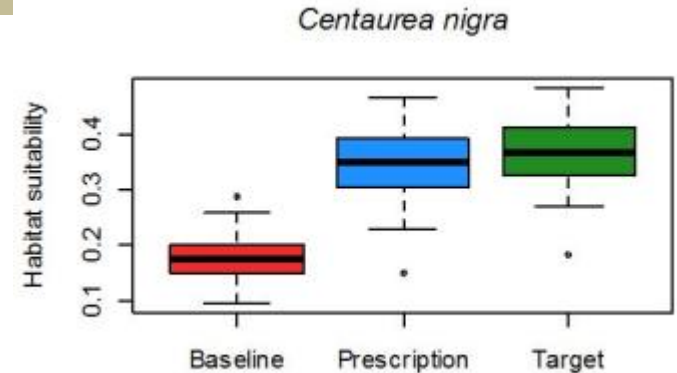
Model application: Simulation of the impacts of Glastir interventions

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

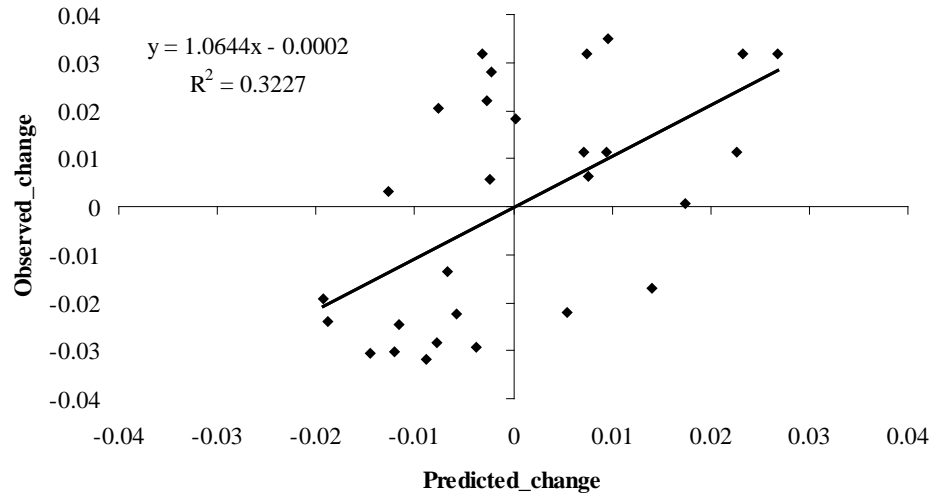
Woodland expansion (AWE 24). Scenario covers **23 years** of natural succession. Baseline habitat is **Improved Grassland** and target habitat is **Broadleaved Woodland**.

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.**



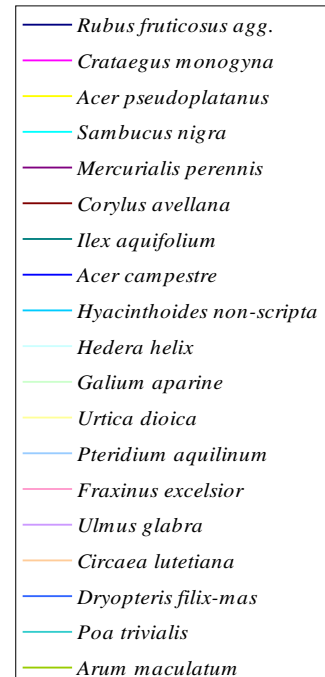
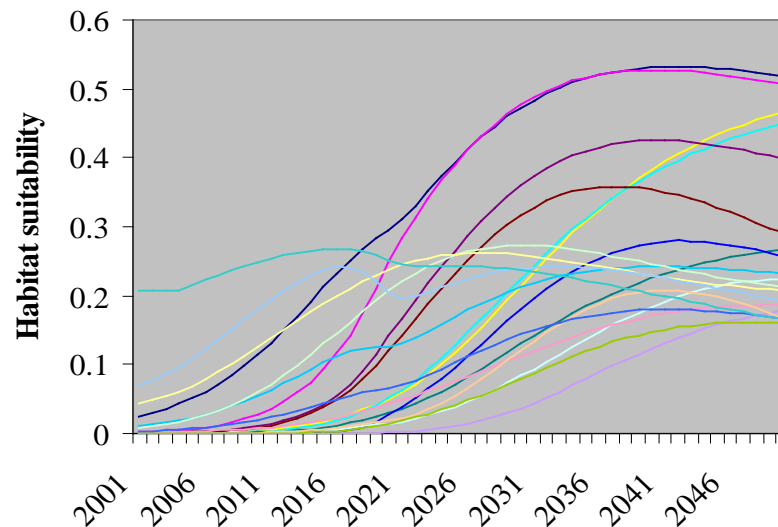
Has MultiMOVE been tested?



- 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)

Predicted increasers



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 |
|-------------------------------|-----------------|-------------------|
| <i>Plantago lanceolata</i> | 0.55 | 1.00 |
| <i>Lotus corniculatus</i> | 0.56 | 0.97 |
| <i>Festuca rubra</i> agg. | 0.47 | 0.95 |
| <i>Galium verum</i> | 0.63 | 0.94 |
| <i>Thymus polytrichus</i> | 0.54 | 0.83 |
| <i>Bromus arvensis</i> | 1.00 | 0.00 |
| <i>Anagallis minima</i> | 1.00 | 0.00 |
| <i>Dianthus deltoides</i> | 0.92 | 0.13 |
| <i>Potentilla neumanniana</i> | 0.92 | 0.00 |
| <i>Aceras anthropophorum</i> | 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

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 |
|-------------------------------|------|------|-------|-------------------------|
| <i>Plantago lanceolata</i> | 124 | 59 | 7744 | 0.55 |
| <i>Lotus corniculatus</i> | 118 | 65 | 5887 | 0.56 |
| <i>Festuca rubra</i> agg. | 113 | 70 | 11192 | 0.47 |
| <i>Galium verum</i> | 111 | 72 | 2881 | 0.63 |
| <i>Thymus polytrichus</i> | 83 | 100 | 3363 | 0.54 |
| <i>Bromus arvensis</i> | 1 | 182 | 0 | 1.00 |
| <i>Anagallis minima</i> | 1 | 182 | 0 | 1.00 |
| <i>Dianthus deltoides</i> | 3 | 180 | 3 | 0.92 |
| <i>Potentilla neumanniana</i> | 1 | 182 | 1 | 0.92 |
| <i>Aceras anthropophorum</i> | 1 | 182 | 2 | 0.87 |