Identifying ‘faithful neighbours’ of rare plants in Britain; an application of the TPP dataset

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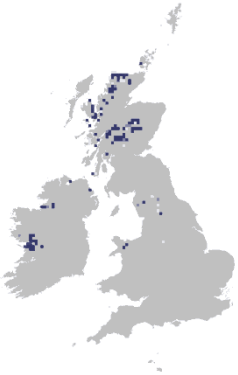
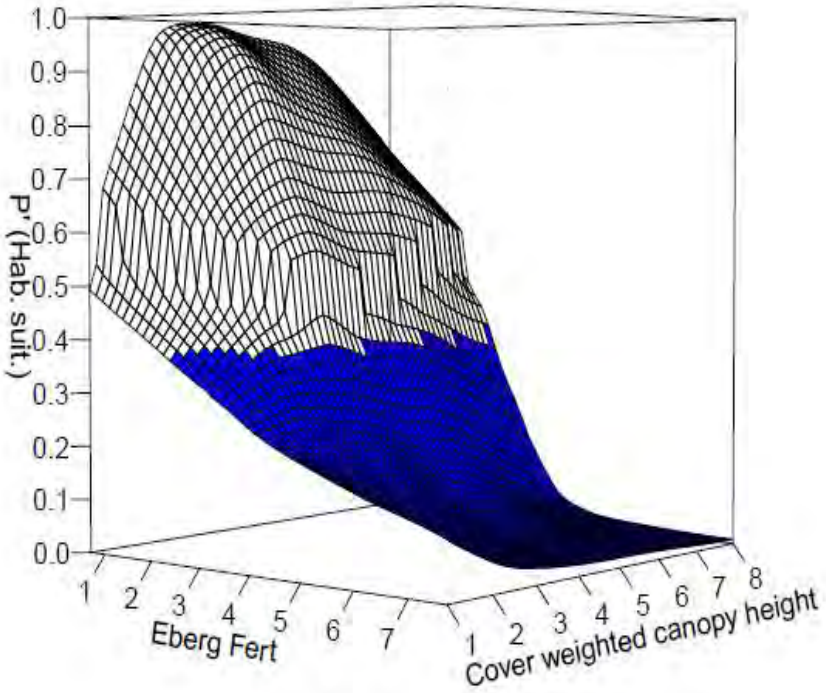
Upper Teesdale… recent trends:

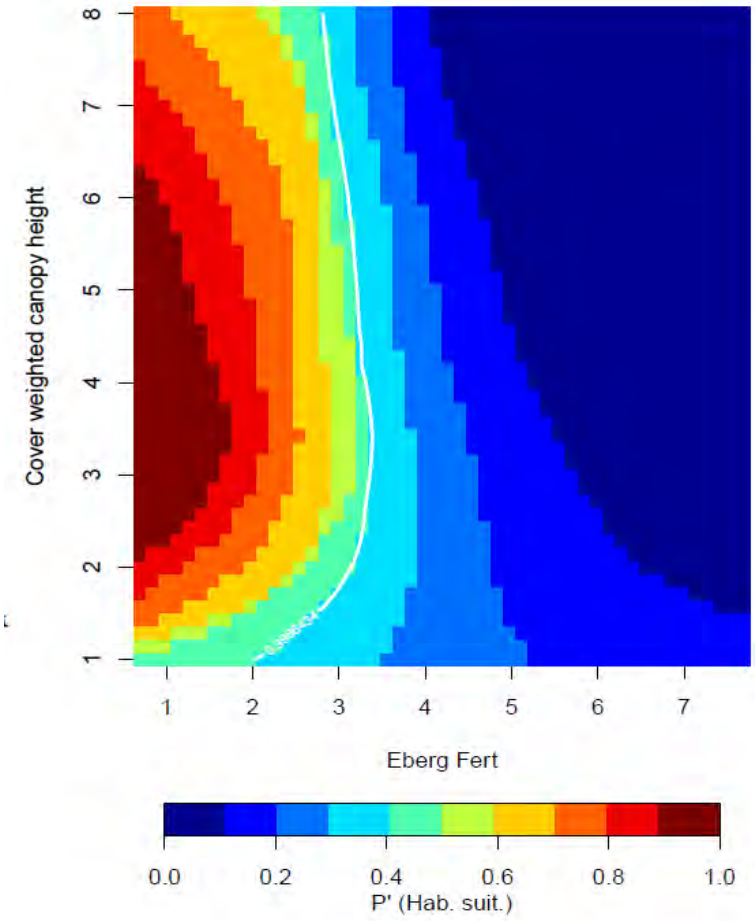
- Warmer winters..
- More rabbits…
- More disturbance…
- More weedy generalists



We know a lot about common species habitat preferences…

- Here we quantify the response of *Calluna vulgaris* to vegetation height and soil fertility

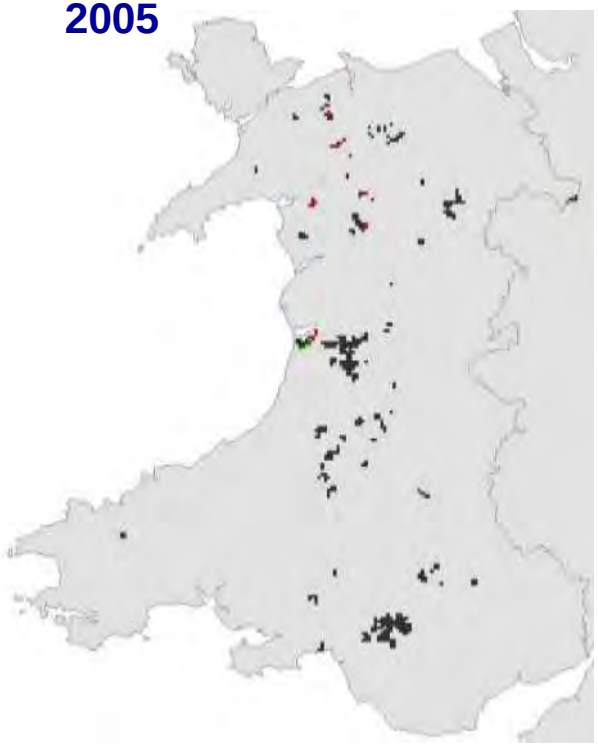




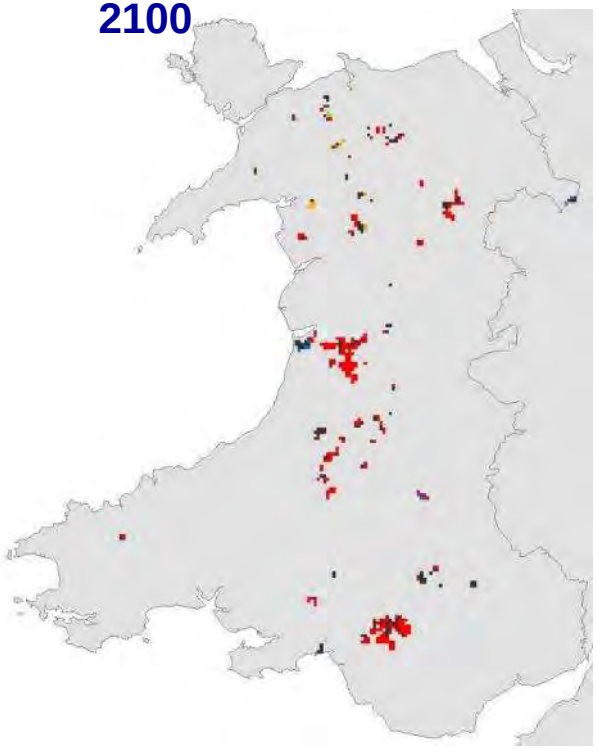
We can then try to model the impact of global change drivers

Habitat suitability scores for *Calluna vulgaris* in the bog habitat in Wales

2005



2100



The driver in this instance is the impact of N deposition on soil Carbon:Nitrogen ratio.

Conditions are expected to be less favourable in 2100.

.. We can do this because we have lots of data for common species.

Rare species are more of a problem:

- Data are less readily available.
- Populations are easily overlooked.
- Populations are small and therefore vulnerable.

But, If we could determine which sets of more common species tend to grow with a rare species we could address conservation and survey problems such as;

- Early-warning monitoring of a possible reduction in the suitability of conditions for extant rare plant populations by reference to changes in the presence of neighbouring plant species.

- Evidence to support assessment of the suitability of sites for re-introduction of the rare species.

- Locating new or pre-existing populations based on identifying floristically appropriate vegetation patches in a wider area of search.

Modelling rare species in terms of their association with common species

- The Threatened Plants Project (TPP) provides a fantastic new resource!
- Quadrat data from TPP allows us to quantify which common species grow with rare plants

TP	Count	TP	Count	TP	Count
Astragalus danicus	80	*Gentianella campestris*	131	*Oenanthe fistulosa*	106
Blysmus compressus	80	*Groenlandia densa*	40	*Ophrys insectifera*	43
Carex ericetorum	45	*Gnaphalium sylvaticum*	53	*Polystichum lonchitis*	43
Cephalanthera longifolia	56	*Herminium monorchis*	11	*Pyrola media*	52
Crepis mollis	44	*Hordeum marinum*	30	*Scleranthus annuus*	68
Campanula patula	17	*Juniperus communis*	59	*Sium latifolium*	86
Chrysanthemum segetum	99	*Meum athamanticum*	67	*Stellaria palustris*	43
Coeloglossum viride	94	*Melampyrum cristatum*	11	*Sibbaldia procumbens*	37
Dianthus deltoides	44	*Monotropa hypopitys*	56	*Viola lactea*	57
Fallopia dumetorum	10	*Melittis melissophyllum*	70	*Vicia orobus*	81

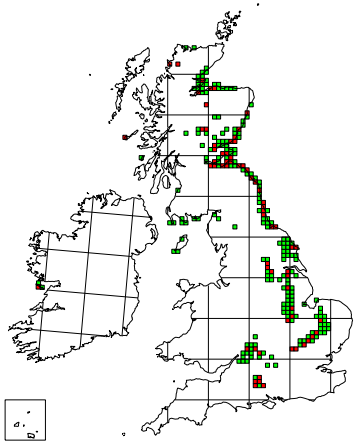
Rare species data

- Revisited sites where species previously recorded
- 2X2 m quadrats centred on the rare species
- At least 1 quadrat per site
- Initial analysis of 6 species and their associates

Wider GB survey data

Dataset	Reference	Date recorded	Geographical scope	Source	Number of quadrats
National Vegetation Classification	Rodwell (1997) et seq.	1965-1980	Great Britain	I.M. Strachan (JNCC)	31266
Countryside Survey 2000	Smart et al. (2003)	1998/1999	Great Britain	CEH	7221
Key Habitats survey	Hornung et al. (1996)	1995	Great Britain	CEH	548
The 'Bunce' Woodland Survey	Kirby et al. (2005)	1971	Great Britain	CEH	1648

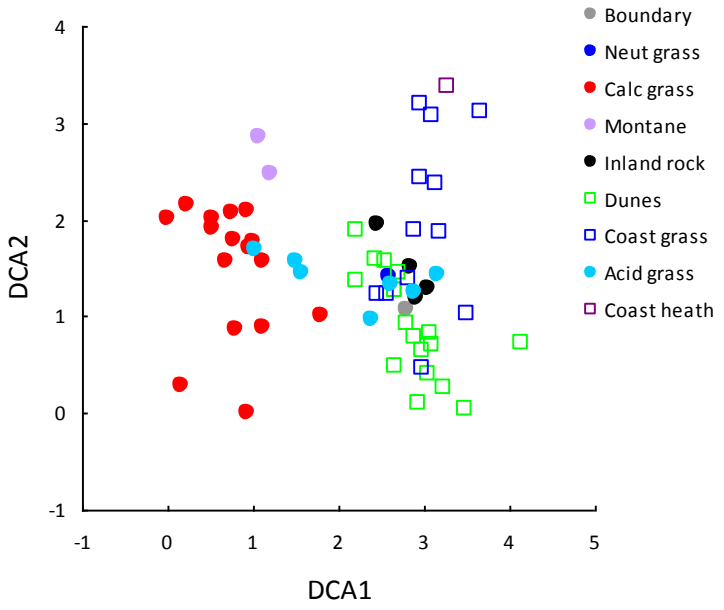
Astragalus danicus



Most common associates in 2008 survey

Species	%	Species	%
Lotus corniculatus	59	*Bromopsis erecta*	15
Plantago lanceolata	58	*Plantago coronopus*	15
Galium verum	54	*Carex flacca*	14
Festuca rubra	46	*Helianthemum numm.*	14
Thymus polytrichus	31	*Luzula campestris*	14
Armeria maritima	28	*Anthoxanthum odoratum*	13
Koeleria macrantha	26	*Anthyllis vulneraria*	13
Achillea millefolium	25	*Arrhenatherum elatius*	13
Trifolium repens	24	*Centaurea nigra*	13
Cerastium fontanum	20	*Dactylis glomerata*	13
Festuca ovina	20	*Hypochaeris radicata*	13
Linum catharticum	19	*Ranunculus bulbosus*	13
Briza media	18	*Campanula rotundifolia*	11
Taraxacum officinale	18	*Carex arenaria*	11
Agrostis capillaris	16	*Holcus lanatus*	11
Senecio jacobaea	16	*Pilosella officinarum*	11
Brachypodium pinnat.	15	*Sanguisorba minor*	11

We rely on sampling intensity to describe associations in different habitats

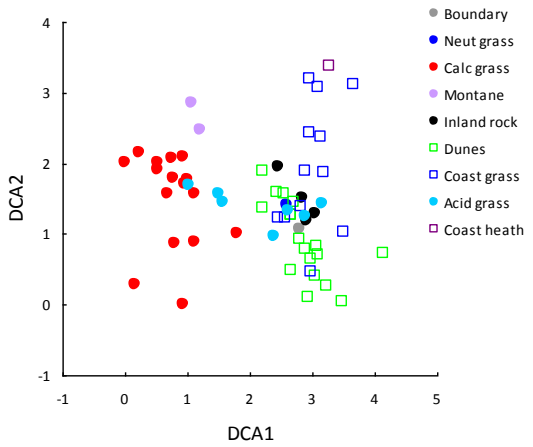


Analytical issues:

- A very common species could grow with rarity all the time but be very common without the rarity

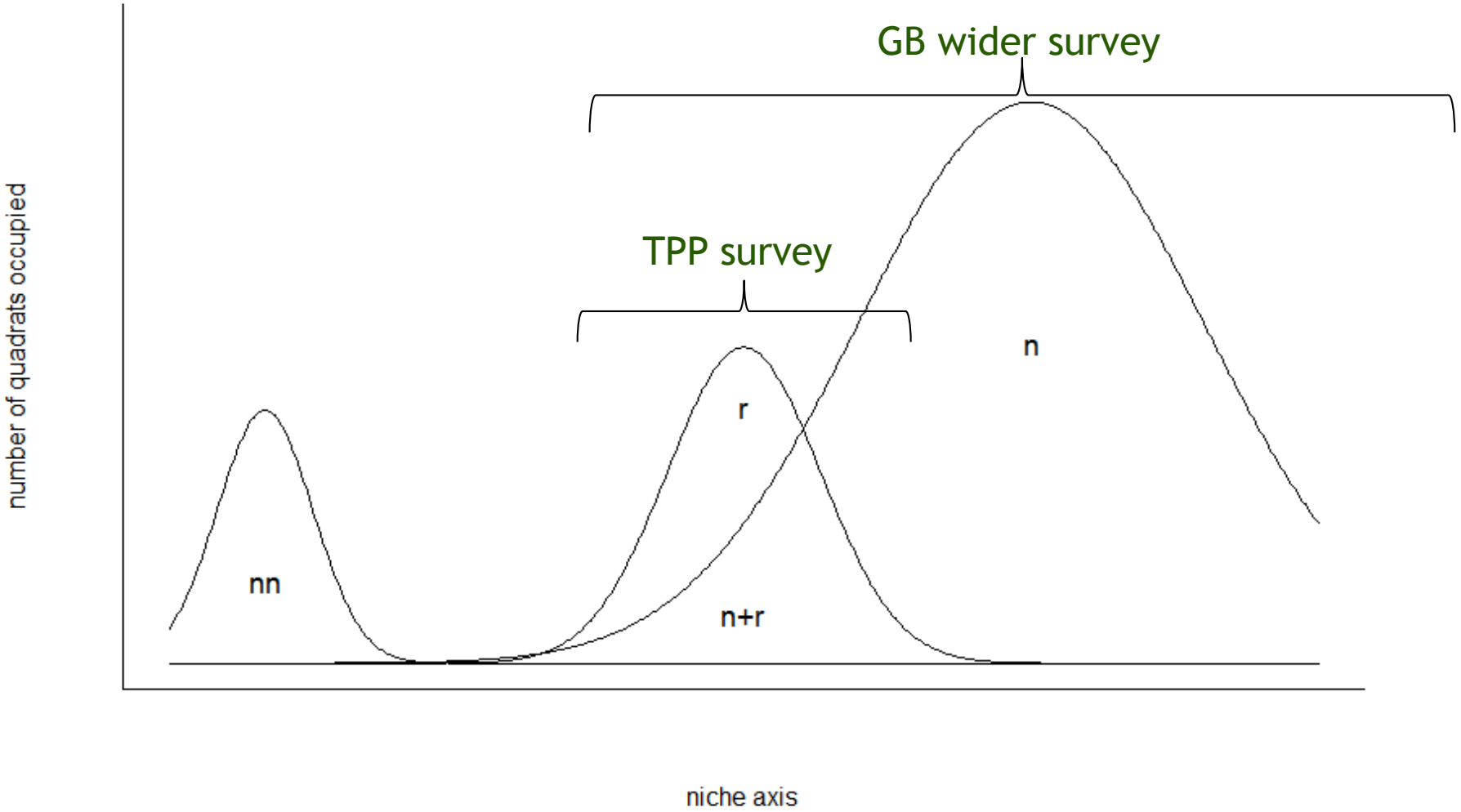
- Multivariate methods don't necessarily help
  - Because we would have to combine and interpret axes
  - Because we want to select a subset of indicators suited to less expert botanists
  - Because we want indicator A to be independent of bias in indicator B

- Further options:
  - Bayes Theorem
  - Likelihood ratios from clinical testing



Restricting the sampling domain:

- We want to condition on probability of finding the rare species (r) within the wider niche space of the neighbour (n)
- Define a set of quadrats from the wider survey data that contained any of the neighbours (n) of the rare species (r)
- Exclude non-neighbours (nn)



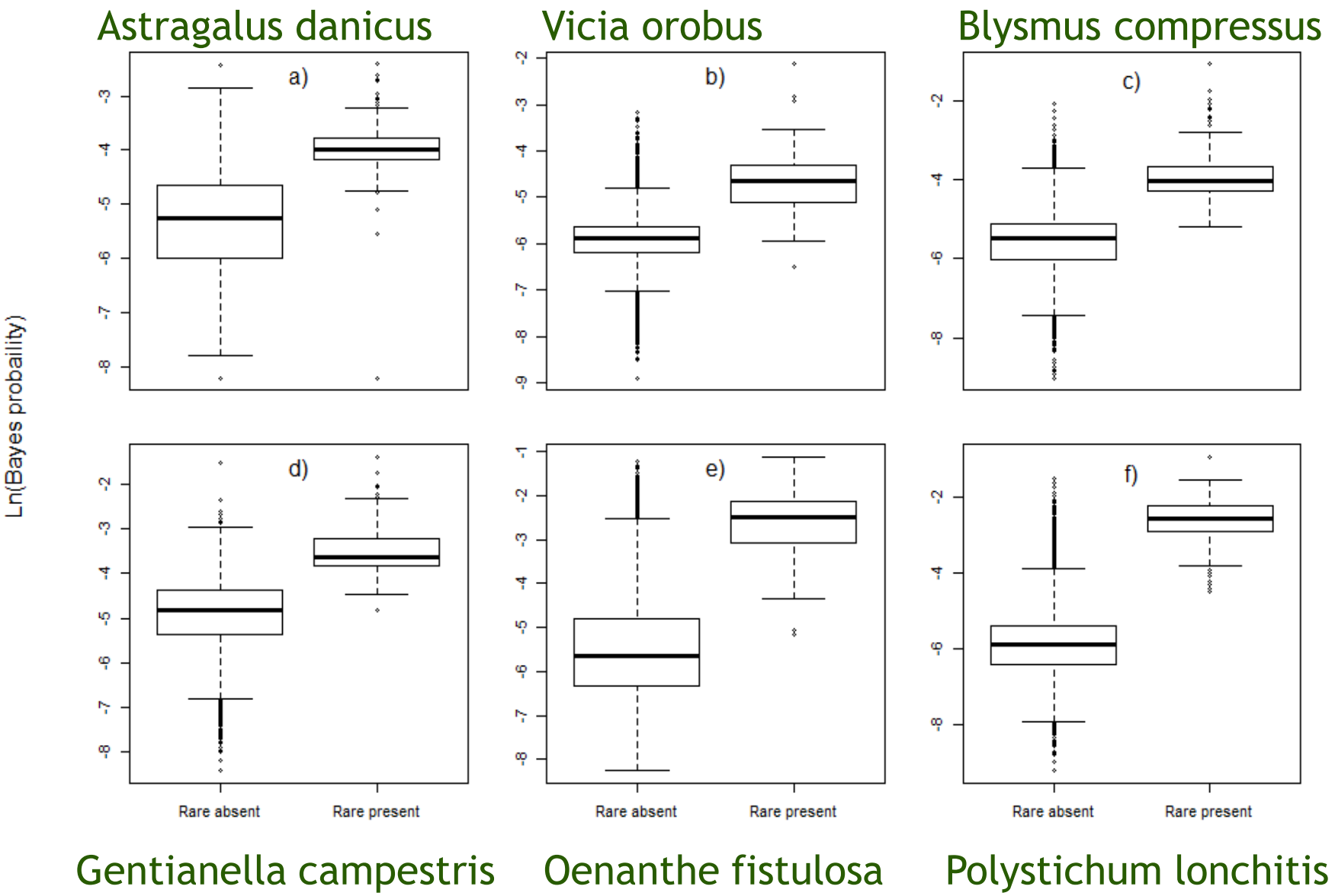
Application of Bayes Theorem:

- We want to know the probability of the rare species occurring given a neighbour species.
- Example:

- We combined the contextual GB data and the TPP data to define the probability that a rare (r) species will be present when a neighbour (n) species is present, as follows;

$$P(r|n) = \frac{P(n|r) * P(r)}{(P(n|r) * P(r)) + (P(n|r') * P(r'))}$$

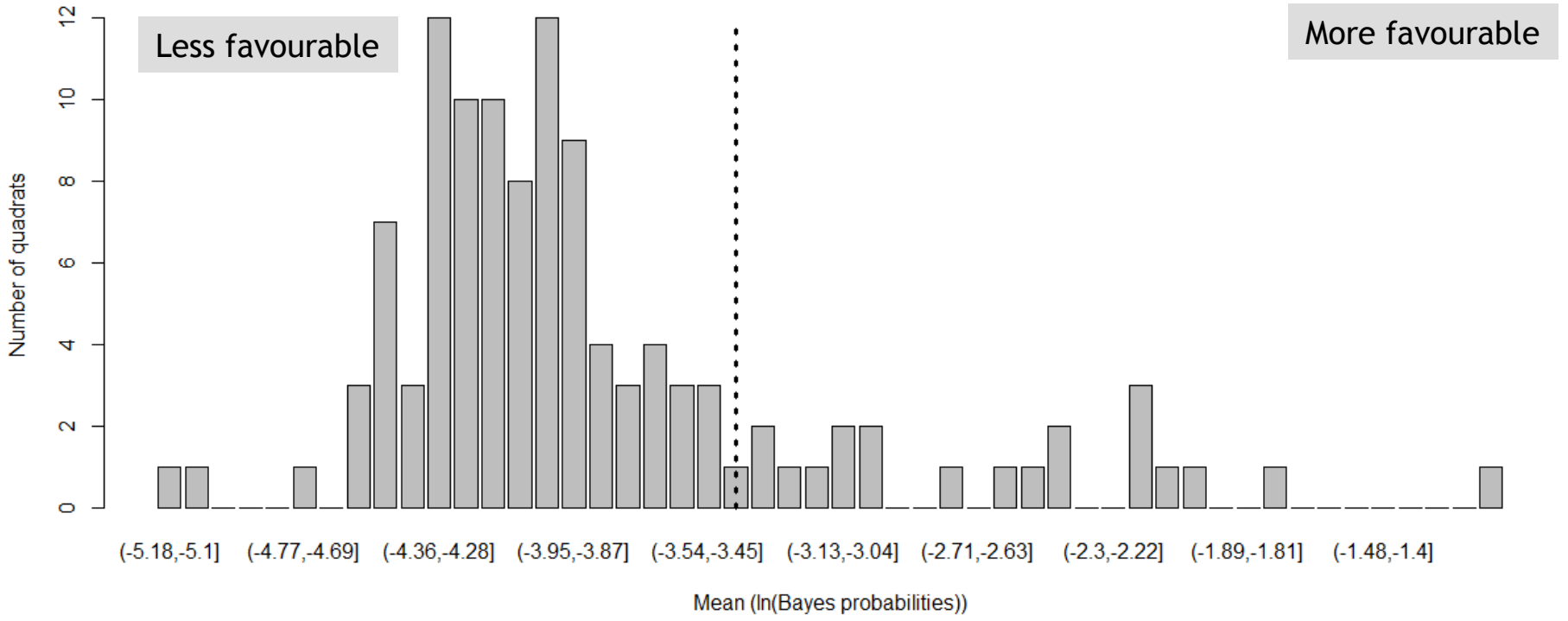
Results: ln(Bayes probabilities) for 6 rare species:



Blysmus compressus on the Orton to Appleby road in Cumbria:

- Growing with *Potentilla anserina*, *Elytrigia repens*, *Agrostis stolonifera*, *Polygonum aviculare*, *Matricaria discoidea*, *Holcus lanatus*

Results: How typical is the new quadrat as a location for *Blysmus*?



- Neighbours do not suggest atypical conditions although species richness was unusually low (mean = 24 per quadrat in TPP dataset)

Conclusions:

- Approach could be extended to other TPP species.
- Because each neighbor is treated individually the method lends itself to campaigns involving volunteers of varying experience.
- This also means that the influence of biased recording in the TPP and GB datasets is minimized.

Thank you for listening. Ideas and suggestions welcome.
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