Large-scale expert validation of species distribution models

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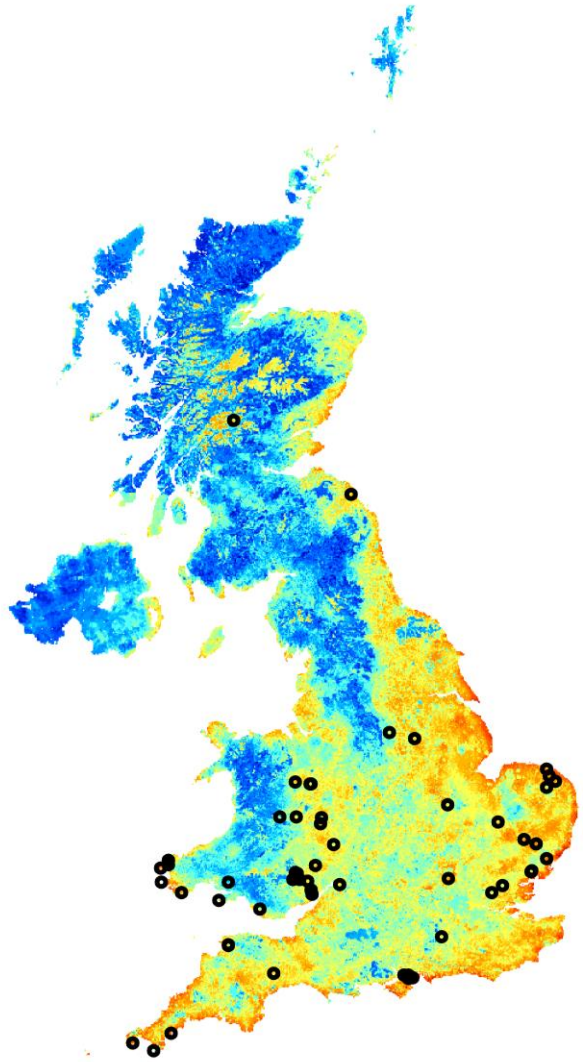
What is an SDM and how does it work?

- SDMs are models or algorithms that estimate species' environmental preferences
- They compare the environments at locations where species were recorded vs. where they were not
- Often used to estimate habitat suitability at regional and national levels



We fitted lots of SDMs

- Habitat suitability surfaces are incredibly useful
- So, we fitted models for >6k species
- Using occurrence data from recording schemes

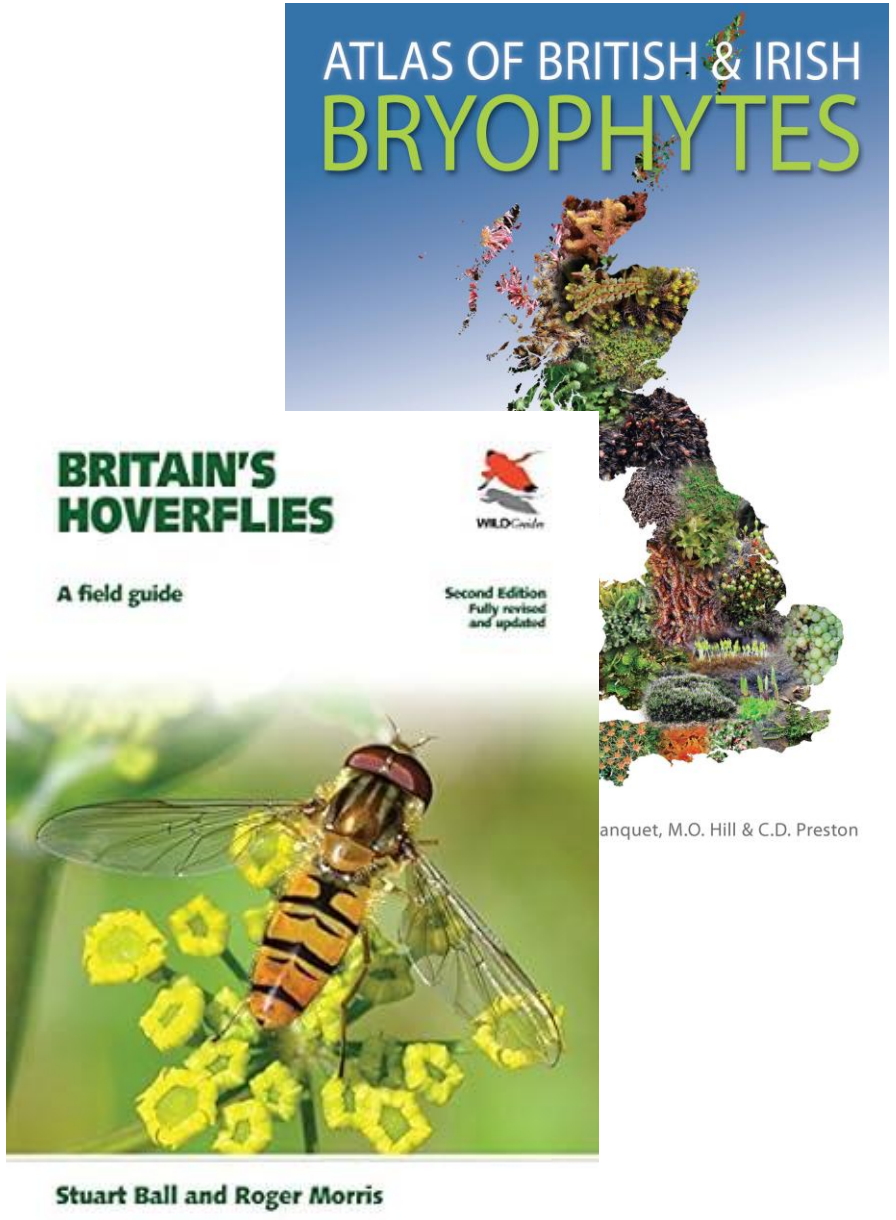
Taxon group	Number of species modelled
Birds	223
Vascular plants	1589
Bryophytes	782
Mammals	59
Invertebrates	2756
Lichens	1017
Herptiles	14
Total	**6440**

The challenge

- Observations reflect both species' distributions and where people went looking for them
- SDMs struggle to disentangle the two
- So, it's not clear whether the model is predicting habitat suitability or the types of environments that people go
- And the "fit" of the model to the data doesn't tell us much

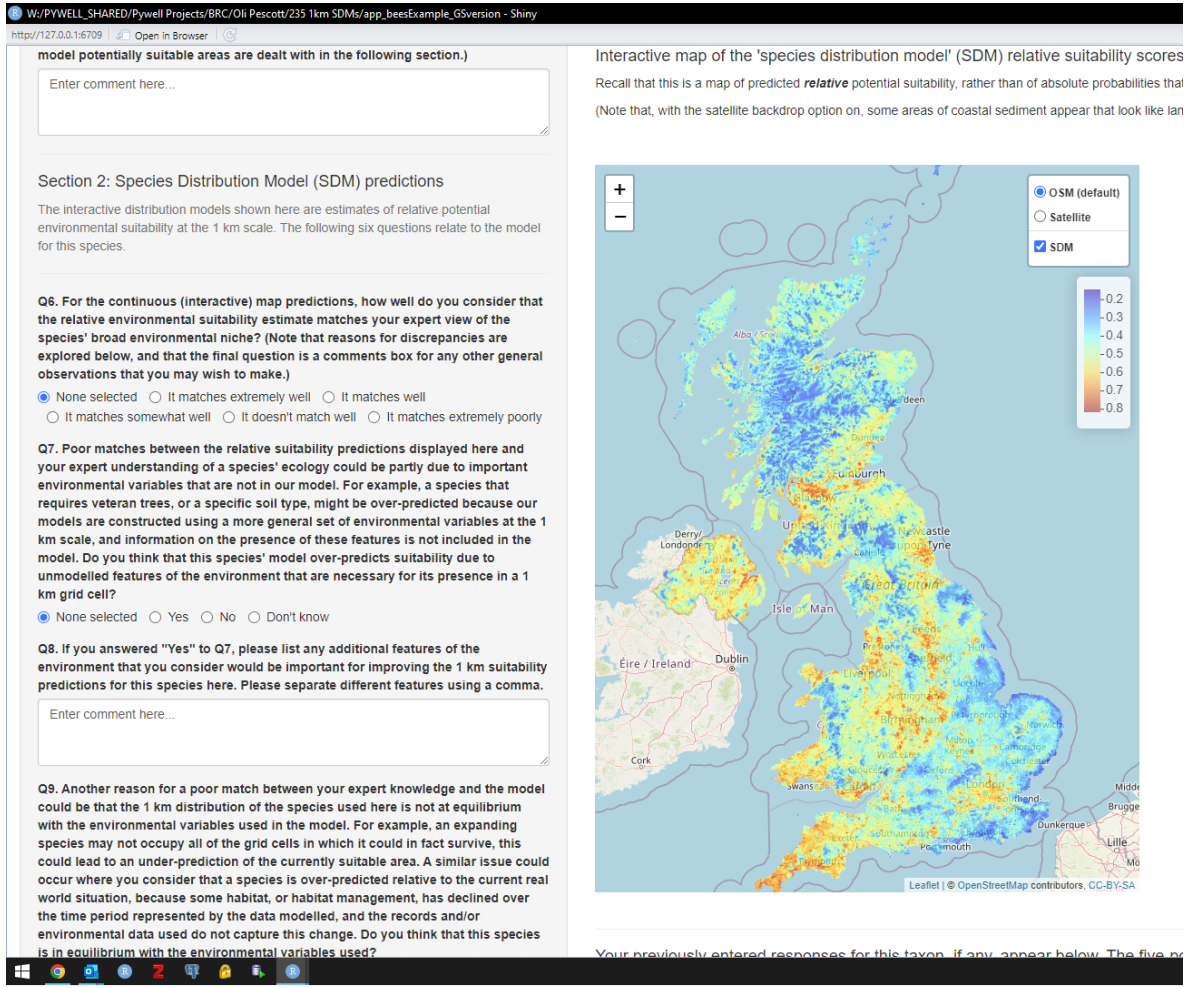
Enter taxon and dataset experts

- National curators of the data for their taxon group
- Written autecological papers, field guides and distribution atlases
- Can offer a different perspective on whether the models are predicting habitat suitability correctly



Expert feedback

- Experts assessed models via Oli's tailored R shiny apps
- Lot of questions about the data and the models
- Main one being how well the models captured the species' true environmental niches

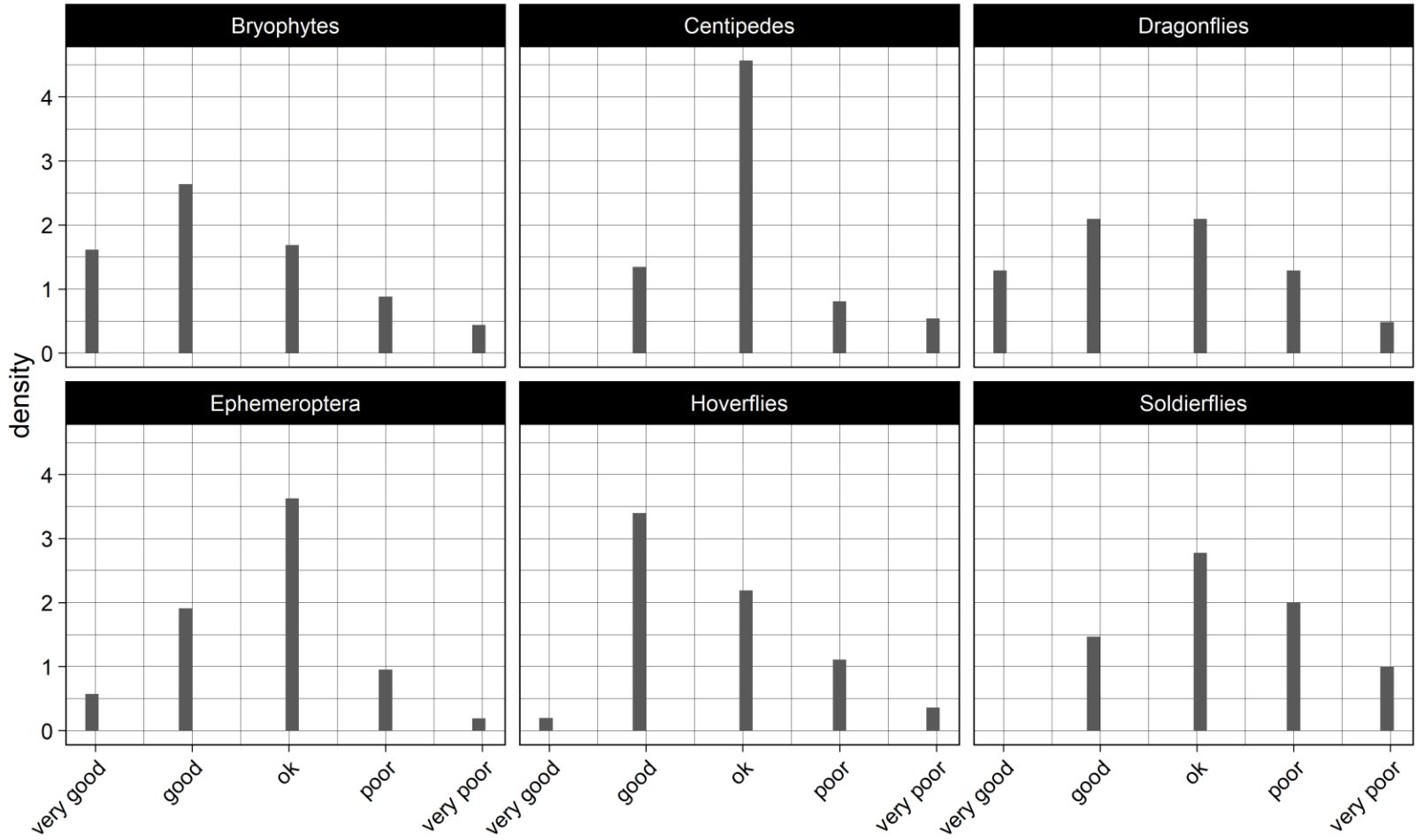


We got loads of responses

- Responses from 6 schemes (plus herps)
- We asked experts to rate 100 species (or all species if this was less than 100)
- In total >500 species assessed

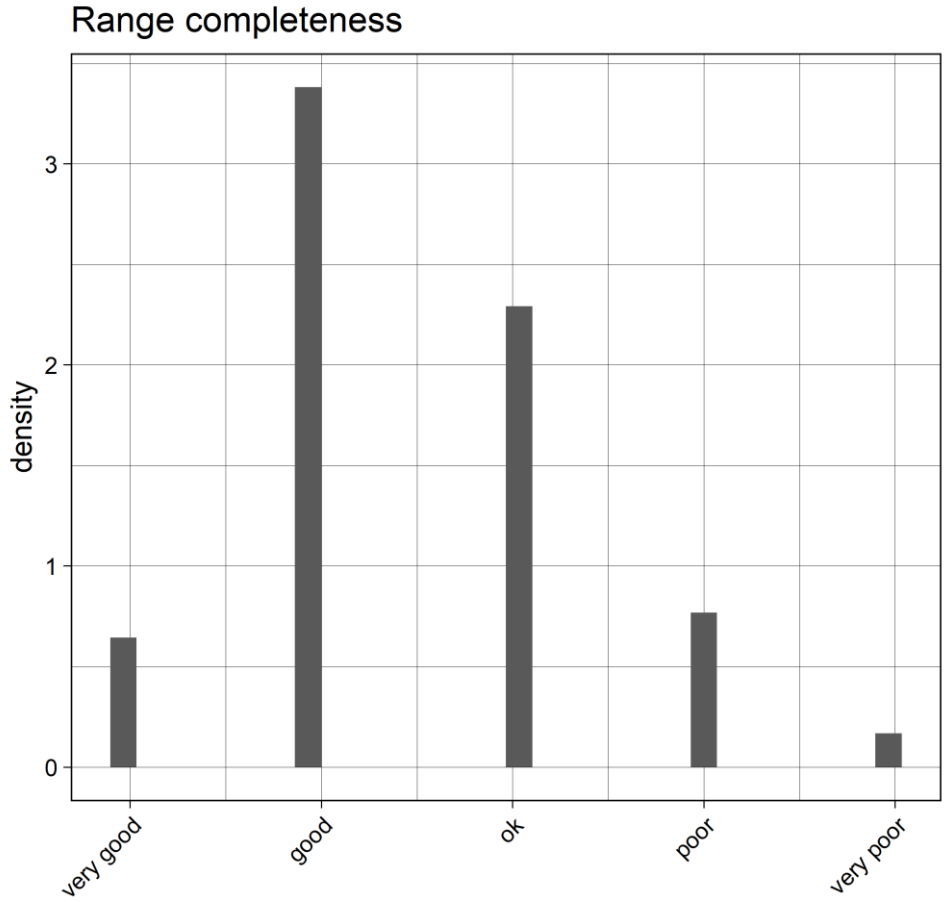
Taxonomic group	Number of species modelled	Number of species assessed	Expert initials	Recording scheme
Mosses, liverworts and hornworts (Bryophyta, Marchantiophyta, and Anthocerotophyta)	782	100	CDP	British Bryological Society (https://www.britishbryologicalsociety.org.uk/)
Centipedes (Chilopoda)	29	29	TB	British Myriapod and Isopod Group, Centipede Recording Scheme (https://www.bmig.org.uk/)
Dragonflies (Odonta)	46	46	PT	British Dragonfly Society Recording Scheme (https://british-dragonflies.org.uk/)
Hoverflies (Syrphidae)	226	226	RM	Dipterists Forum, Hoverfly Recording Scheme (http://hoverfly.uk/hrs/)
Mayflies (Ephemeroptera)	38	38	CM	Riverfly Recording Schemes: Ephemeroptera (http://www.ephemeroptera.org.uk/)
Soldierflies and allies (Lower Brachycera)	95	95	MH	Soldierflies and Allies Recording Scheme (http://soldierflies.brc.ac.uk/)
Total	1216	554	-	-

Are the models any good?



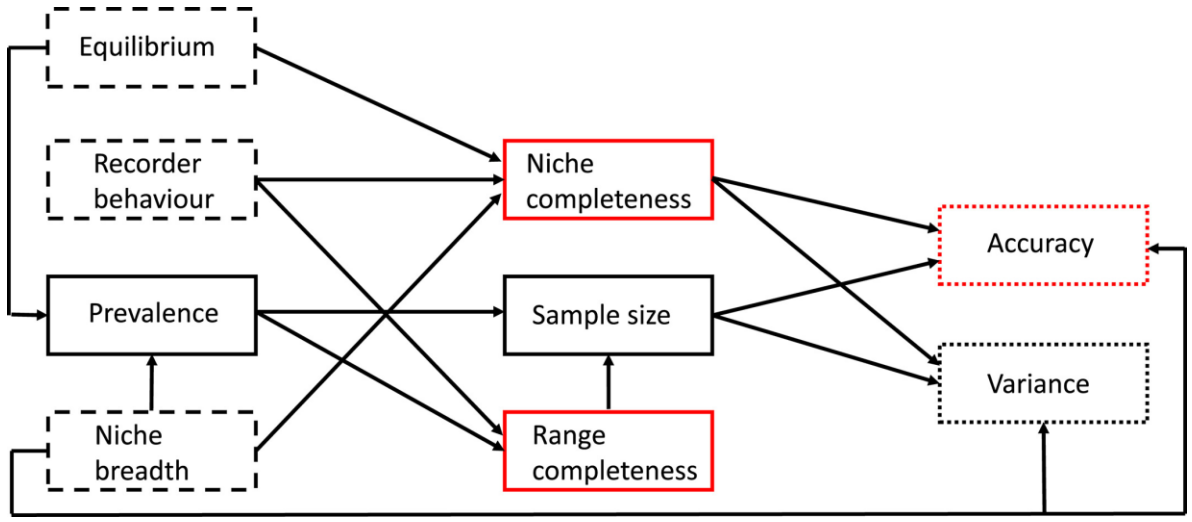
Some additional questions

- Do the records cover the species environmental niche and geographic range?
- Is the species at equilibrium with its environment?
- So, we had lots of info on the species, the data and model performance



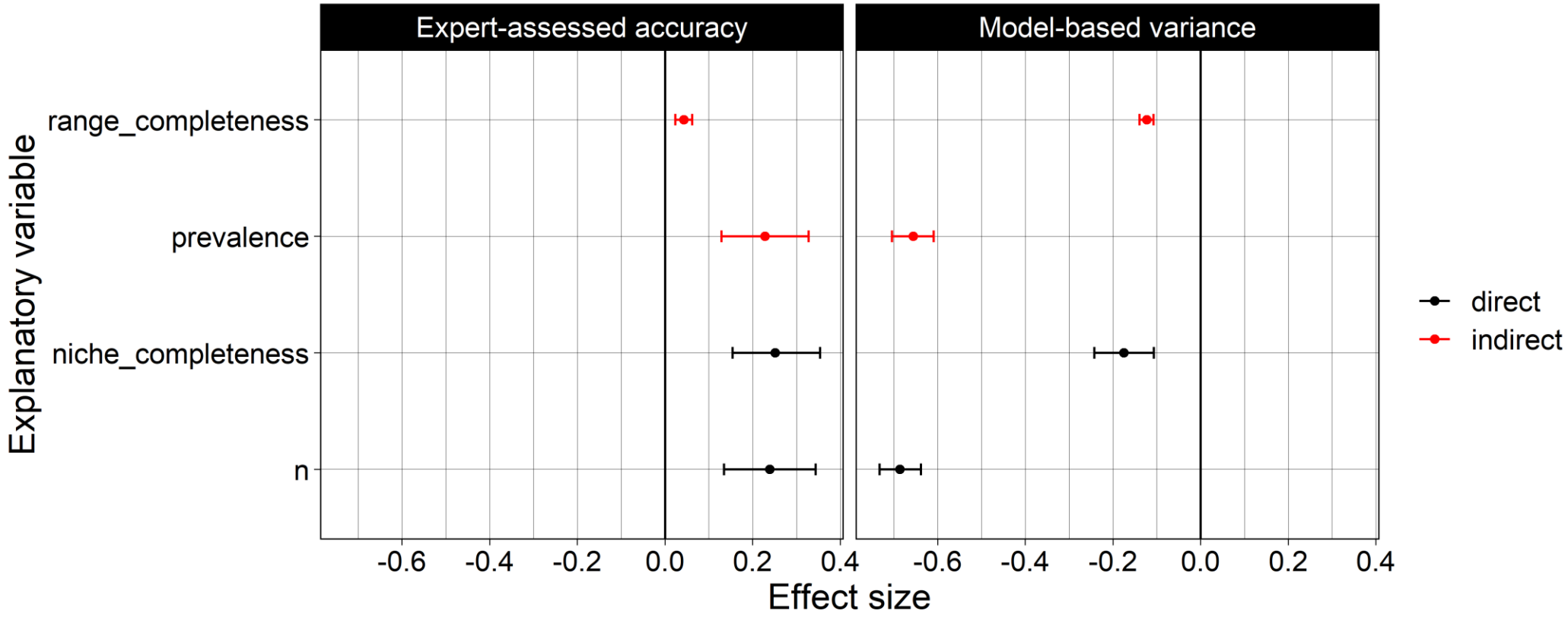
Causal inference about the drivers of model performance

- Came up with causal diagram depicting causes of accuracy and variance
- “Nodes” denote variables and “edges” denote effects
- Theorise, test, refine, repeat
- Final model analysed statistically



Boyd, R. J., Harvey, M., Roy, D., Barber, T., Haysom, K., & ... Pescott, O. L. (2023). Causal inference and large-scale expert validation shed light on the drivers of SDM accuracy and variance. *Diversity and Distributions*, 1–11. https://doi.org/10.1111/ddi.13698

Causal inference about the drivers of model accuracy



Summary

- Experts told us what the data could not: whether the models were any good at predicting habitat suitability
- They also provided info on the data and species
- The result was a quite unprecedented dataset
- And we used it to work out what makes a good (and bad) model

Thank you

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