Exploring terrestrial invertebrate redistribution in the UK

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Introduction

One of the most rapid impacts of climate change is the resulting movement of species to track their optimal habitat conditions[1]. With such species movements key to species survival[2] and resulting in wide reaching ecological and socio-economic consequences[3], investigation in this area is paramount. This poster provides insight into terrestrial species redistribution in the UK as well as a trait-based investigation with the case study of British Odonata.

Study Aim: Explore terrestrial invertebrate redistribution in the UK and unveil links between distribution change and climate change.

Hypotheses:

H1: Distribution change will be correlated with climatic change.

H2: Traits associated with fast life-history and ecological generalisation will be positively correlated with distance shifted by species.

H3: Body size and range size will be good indicators of species range-shift abilities.

Methodology

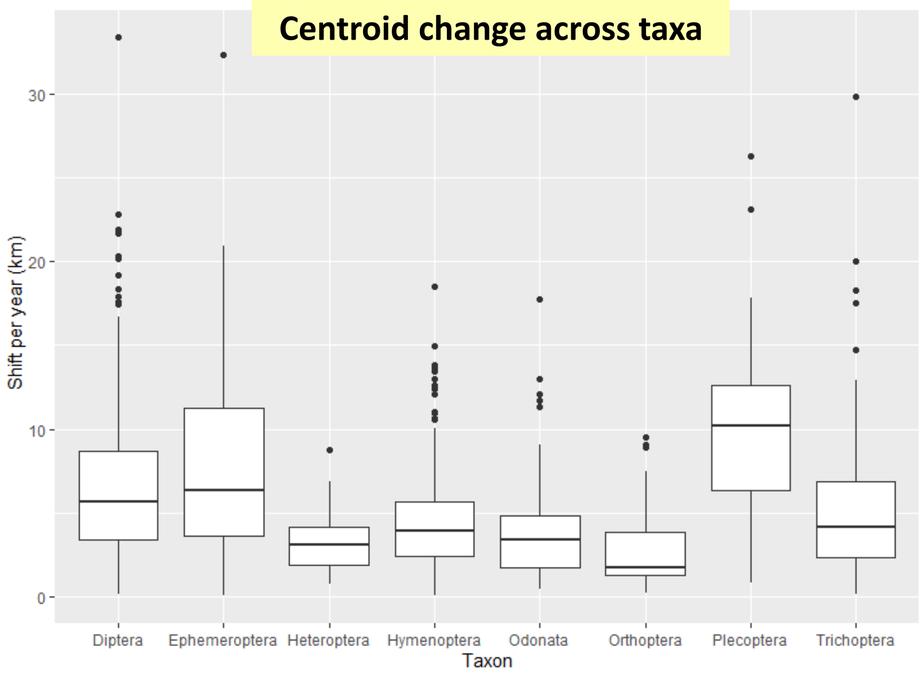
Distribution shift: Species geographical distribution centre was determined during two periods. Change in longitude and latitude was extracted as well as distance and direction shifted by species.

Climate change: Analysis of HadUK-Grid climate variables[4].

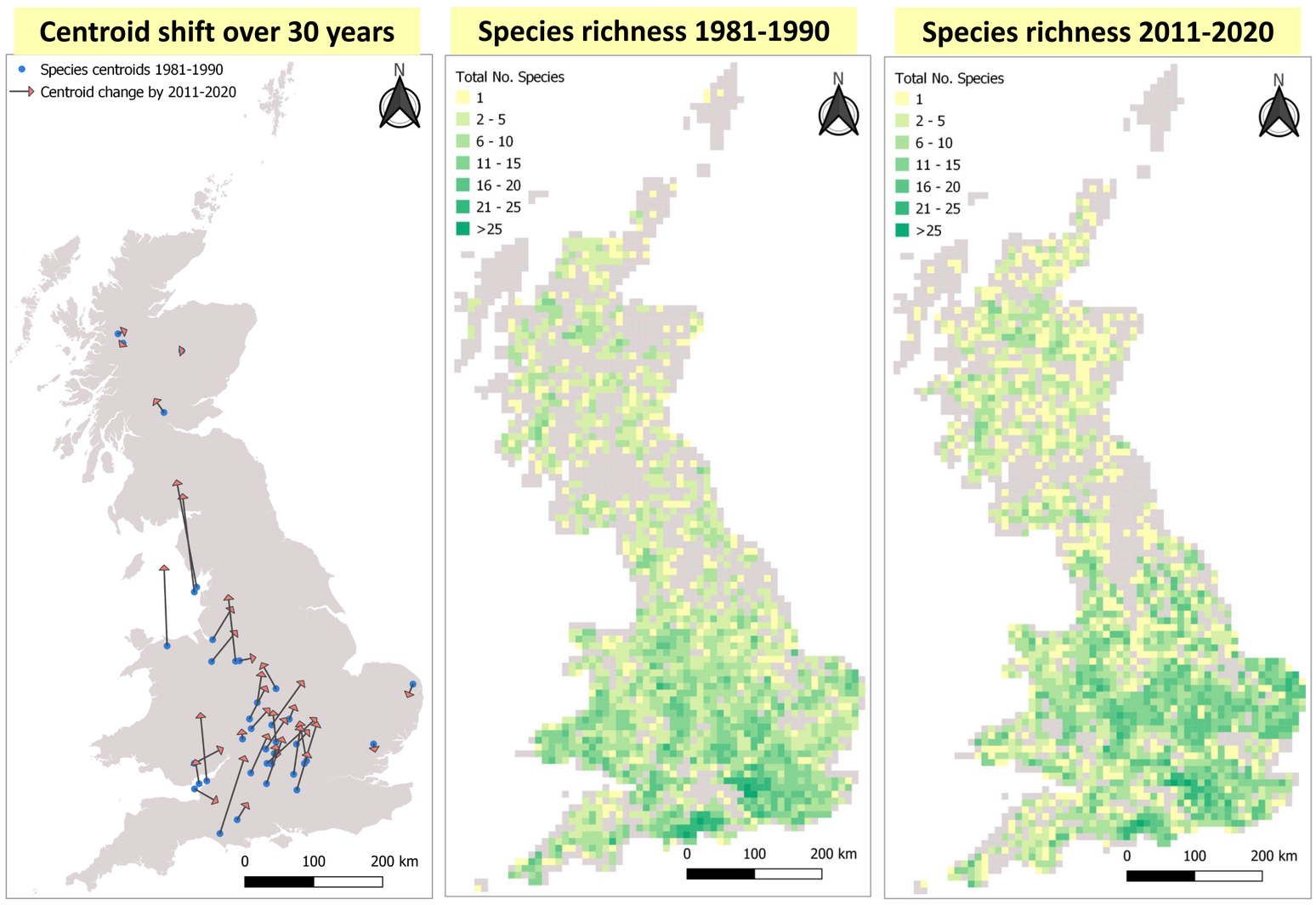
Traits: Species trait information was extracted from literature[5] including length, habitat, and number of generations.

(1) Invertebrate Centroid Shifts

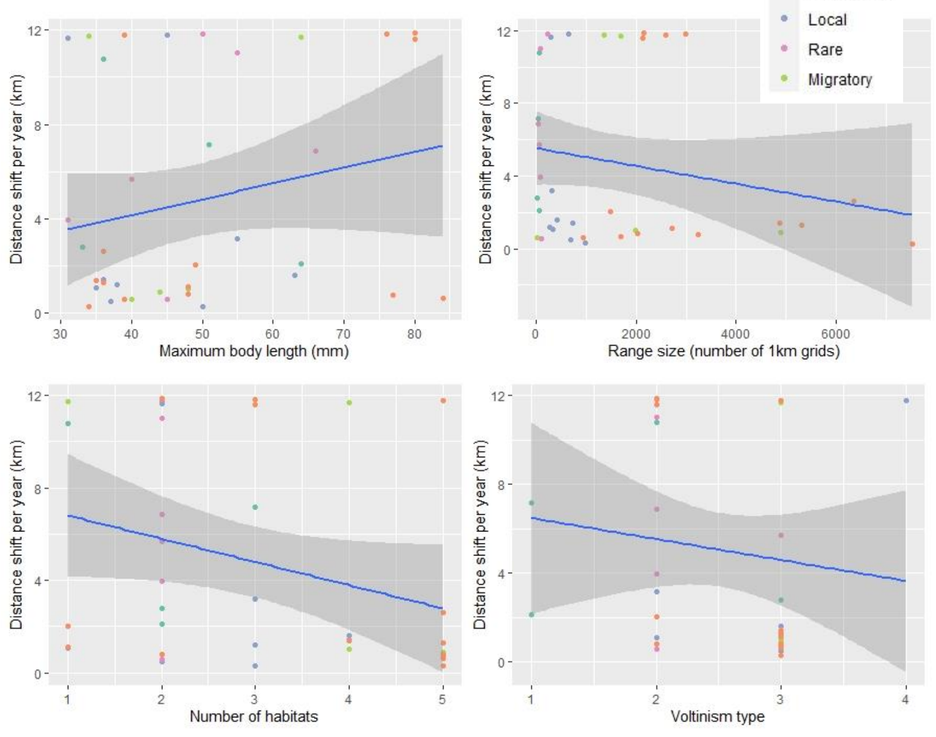
	Number of Species	Shift per year (km)	Mean direction (degrees)
Diptera	443	7.15	29.58 (NE)
Ephemeroptera	43	7.00	233.78 (SW)
Heteroptera	38	4.07	10.01 (N)
Hymenoptera	246	5.33	34.13 (NE)
Odonata	41	4.90	42.14 (NE)
Orthoptera	37	2.80	76.38 (E)
Plecoptera	27	11.28	350.47 (N)
Trichoptera	148	4.28	116.33 (SE)



(2) Odonata distribution change



(3) Influence of species traits



Key Findings

(1) Different taxonomic groups have shifted at different rates and in different directions over the past three decades. Mean shifts range from 2.8km/year (E) for Orthoptera to 11.3km/year (N) for Plecoptera.

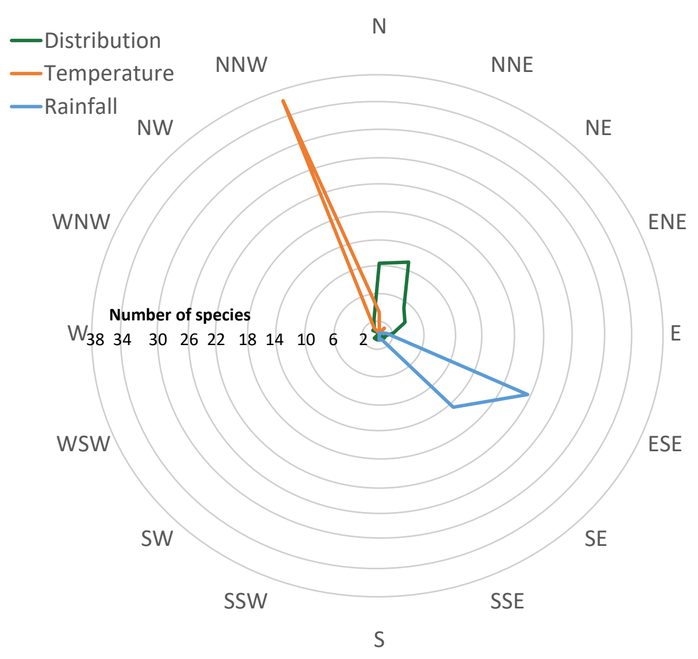
(2) Many Odonates have shifted in a northeast direction with species richness increasing in the North and Scotland.

(3) Variability in the distance shifted by species supports previous findings of individualistic responses to climate change, however, none of the species traits investigated were found to be statistically significant in determining species' range-shift ability and distance shifted.

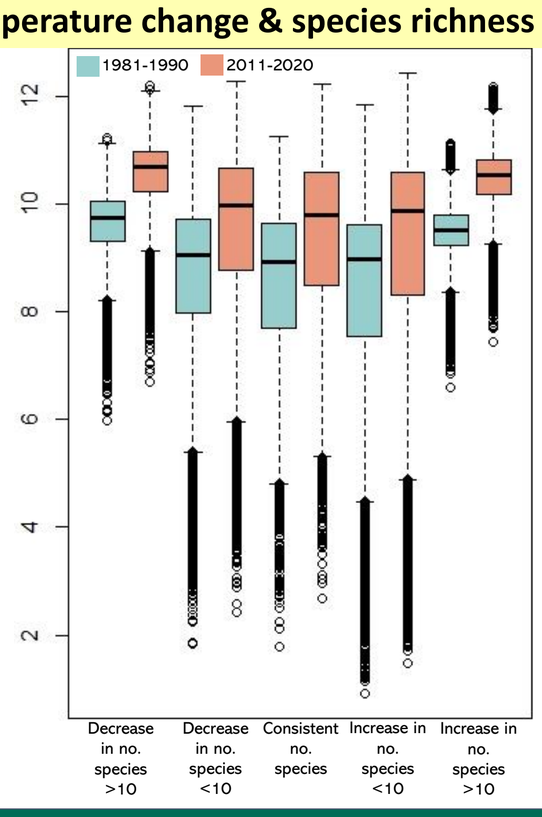
(4) Regression analysis indicated that the change in mean temperature and total precipitation climatic variables were significant predictors of latitude change between periods (R^2 = 35.6, F(9.7,2)=4.85, $p < 0.001$). Climatic change was not a significant predictor of change in longitude or direction of shift.

(4) Influence of climate change

Directional change in distribution & climate



Temperature change & species richness



References: 1. Scheffers, B. R., Meester, L. D., Bridge, T. C. I., Hoffmann, A. A., Pandolfi, J. M., Corlett, R. T., Butchart, S. H. M., Pearce-Kelly, P., Kovaes, K. M., Dudgeon, D., Pacifici, M., Rondinini, C., Foden, W. B., Martin, T. G., Mora, C., Bickford, D. & Watson, J. E. M. (2016). The broad footprint of climate change from genes to biomes to people. *Science, 543*(6313), 719-730; **2.** Mason, S. C., Palmer, G., Fox, R., Gillings, S., Hill, J. K., Thomas, C. D. & Oliver, T. H. (2015). Geographical range margins of many taxonomic groups continue to shift polewards. *Biological Journal of the Linnean Society, 115*, 586-597; **3.** Wallingford, P. D., Morelli, T. L., Allen, J. M., Beaury, E. M., Blumenthal, D. M., Bradley, B. A., Dukes, J. S., Early, R., Fusco, E. J., Goldberg, D. E., Ibáñez, I., Laginhas, B. B., Vilá, M. & Sorte, C. J. B. (2020). Adjusting the lens of invasion biology to focus on the impacts of climate-driven range shifts. *Nature Climate Change, 10*, 398-405; **4.** Powney, G. D.,Brooks, S. J., Barwell, L. J., Bowles, P., Fitt, R. N. L., Pavitt, A., Spriggs, N. J. B. (2014), Morphological and geographical traits of the British Odonata. *Biodiversity data journal, e1041*; **5.** Met Office; Hollis, D.; McCarthy, M.; Kendon, M.; Legg, T.; Simpson, I. (2018): HadUK-Grid gridded and regional average climate observations for the UK. Centre for Environmental Data Analysis.