

Biodiversity and the resilience of nature's benefits to people: a case study on agricultural areas in South Africa

Jessica J. Williams^{1*}, Vivienne P. Groner^{1,2*}, Henry Ferguson-Gow^{1*}, Fiona Spooner³, David Shen^{1,4}, Caswell Munyaji⁵, Tafadzwanashe Mabhaudhi^{5,6}, Rob Slotow^{1,5}, & Richard G. Pearson¹



Introduction

- Land-use and climate change are leading to shifts in animal communities within South Africa
- These shifts can result in declines in ecosystem functioning and reduce the benefits that nature provides for people
- To ensure the continuation of these benefits, we need to understand their resilience – i.e., how capable is a system of sustaining a desired ecosystem service (e.g., pollination) in the face of disturbance?
- One major question, and key to future agricultural production, is how resilient are ecosystem services to shifts in animal communities?
- As part of an ongoing study within the Sustainable and Healthy Food Systems programme⁺, we investigated the resilience of pollination and natural biological pest control to future environmental changes in South Africa



Focal study system: communal farming areas around Durban, South Africa

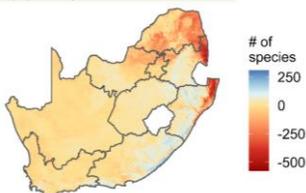
Methods

- Species distribution models – we predicted **climatically suitable areas** for ~1,700 animals (vertebrates and invertebrates) under current and future (RCP 4.5) climates
- We modelled the impacts of **land-use type** and **intensity** on habitat suitability under a shared socioeconomic pathway (SSP2)
- We produced a **risk assessment approach**:
 - Each species was given a score based on the risk the species' loss posed to pollination or pest control
 - Species' scores were summed for each community (1x1km), to get a proxy for the community's contribution towards pollination or pest control
 - Changes in community scores across time were used to assess the resilience of communities to provide pollination or pest control

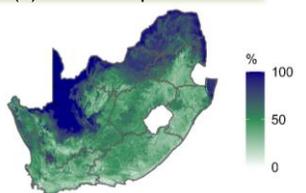
Results

- Under SSP245, in 2080, the models predicted large changes in community composition (a, b, c) compared to present day.
- From the change in community score, we estimated the resilience of pollination and pest control under this future scenario (d, e).
- Our results suggest that the resilience of pollination and pest control may be particularly low in areas of Limpopo, the Northern Cape, and along the eastern edge of KwaZulu-Natal

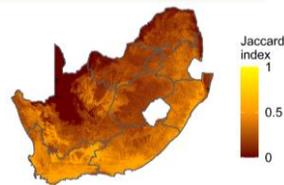
(a) Δ species richness



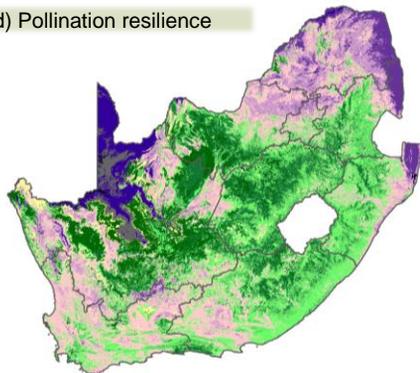
(b) Local extirpation



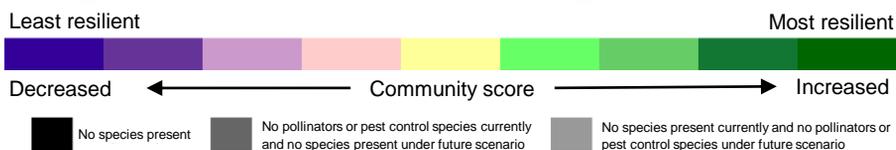
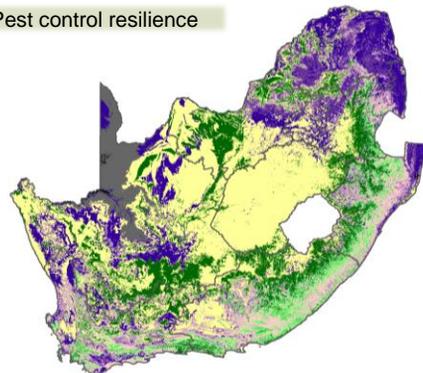
(c) Species turnover



(d) Pollination resilience



(e) Pest control resilience



Conclusions

- The resilience of pollination and pest control to shifts in animal communities has potential to differ greatly across South Africa
- Areas with low resilience resulted from (1) declines in community size (number of species) and (2) loss of key pollinator or pest control species with no animals moving into the community filling these roles (decrease in community score despite increase in community size)
- Preserving nature's benefits to people remains a big challenge. Understanding how resilient ecosystem services are and highlighting areas at risk of ecosystem service shortfall is crucial if we are to work towards ensuring global food security under future environmental change



jessica.williams.16@ucl.ac.uk
@jjwilliams924

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Author affiliations: ¹University College London, ²Imperial College London, ³Our World In Data at the Global Change Data Lab, ⁴Yale University, ⁵University of KwaZulu-Natal, ⁶International Water Management Institute. *Joint first authors
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