Predicting the ecological and societal impacts of species on the move with climate change in the UK

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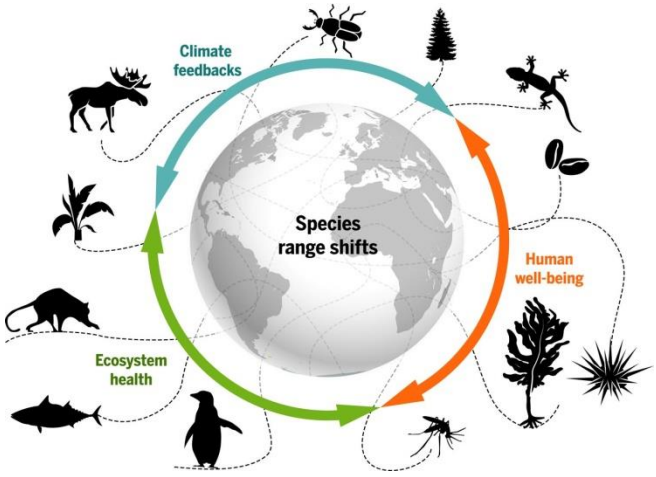

There is a growing recognition that the redistribution of species driven by a changing climate is creating profound challenges for societies and regional economies around the globe. As well as having serious consequences for economic development, livelihoods, food security, human health and culture, species' redistribution is testing the limit of our understanding of ecological systems, highlighting key knowledge gaps in our ability to predict biodiversity's response to global environmental change.

The global reshuffle of biodiversity distribution can be witnessed in countries like the UK, where a recent study found that at least 55 species have arrived in the country in the past decade, likely due to climate change; around 20% of these species are suspected to impact positively or negatively on recipient ecosystems, or nearby human communities. These numbers are expected to be a gross underestimate of the likely impacts of species movements on ecosystems and society, given (a) the likely underrepresentation of invertebrates in the dataset, and (b) the fact that it only focused on new arrivals, disregarding, for example, unusual blooms and mass abundances linked to climate change and known to negatively impact ecosystems and/or society.

Sadly, our current ability to predict which species are altering their distribution with climate change, and what the impacts of these redistributions may be, is limited. Interdisciplinary work is critically needed to enable the quick identification of species likely to be problematic (or beneficial) and locations likely to experience significant ecological and societal positive or negative impacts from biodiversity's redistribution under a changing climate; this information is key to identify, prioritize and then mitigate or prevent future risks. Certain geographic locations may indeed be more likely to experience a higher level of societal and/or ecological pressure with the arrival of new species (e.g. those near the coast or with higher human population densities). One might also hypothesize that specific traits are associated with larger redistributions (e.g. highly mobile species) or more damaging impacts (e.g. species that are vectors for disease).

This PhD project will combine unique datasets on UK climatic conditions, species ecology and distribution as well as landcover attributes with state-of-the-art quantitative approaches to understand and predict how the landscape, climate, and other factors such as individual traits speed or slow species' spread. Its outcome will provide the first comprehensive and spatially-explicit picture of how climate change may impact UK society through its impact on biodiversity in the near future, while exploring for the first time whether the ecological traits that make species likely to be good invaders are also the traits that make species likely to redistribute more

efficiently in response to climate change. The developed framework will provide a demonstration of how countries can enhance their ability to mitigate the consequences of a global redistribution of biodiversity underpinned by climate change.

Training opportunities:

The proposed project offers opportunity to learn modern techniques of remote sensing, programming and practical ecological modelling. The student will have access to formal training via Reading University, which offers a comprehensive programme of researcher development comprising over 90 different generic and professional skills training courses covering transferable and professional skills development including Master's level modules.

The supervisory team brings together complementary experience in climate change ecology, geography, biodiversity monitoring, satellite remote sensing analyses, statistical and predictive modelling, research-based solutions for improved management of change, and science to policy knowledge transfer. Together, they have ample experience with PhD student supervision, peer-reviewed publications (>600 peer-reviewed papers published between all of us), the production of impactful science, and the integration of science into management and policy. The supervisory team is experienced in the techniques required for this project, and will provide one- -to- -one training in any additional areas required, as well as providing the resources needed to attend specialist training courses externally.

Student profile:
This project would be suitable for students with strong quantitative and modelling skills, a good understanding of climate change ecology, and an interest in interdisciplinary approaches and the science to policy interface.

Funding particulars:
The Joint Nature Conservation Committee (JNCC) is a case partner on this proposal, insuring that the outcomes of this work inform future monitoring strategies and nature policies in the UK. The recruited PhD student will have the opportunity to spend time at JNCC and work closely with staff members to help translate research findings into practice.

References: (optional)

Pecl et al. (2017) *Science* https://science.sciencemag.org/content/355/6332/eaai9214
Pettorelli et al. (2019) *Journal of Applied Ecology* https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.13465