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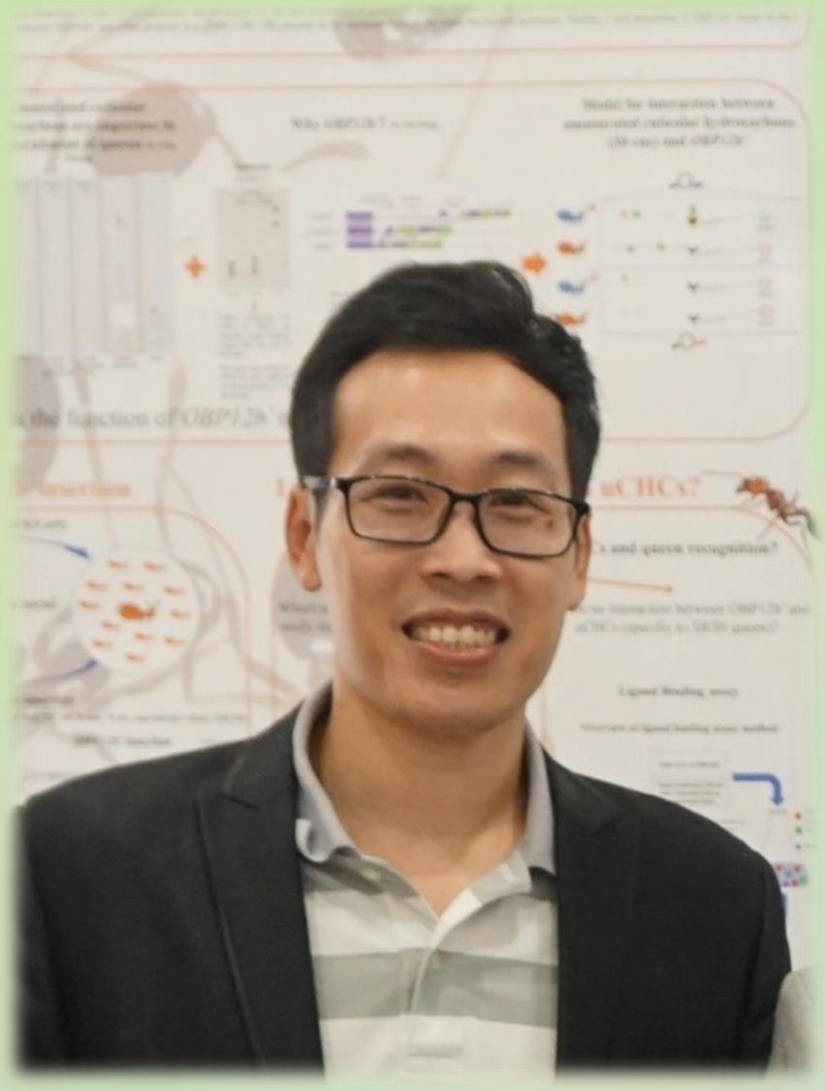
Terrestrial Biodiversity and Ecosystems

Understanding the Spatiotemporal Patterns of Bat Distributions in Vietnam Under Environment Changes for Conservation Planning



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[Doctoral Dissertation Defense Presentation]

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Abstract

Biodiversity loss is an environmental crisis that causes huge impacts on ecosystems and human well-being. Establishing protected areas is one of the most common tools to prevent biodiversity loss and maintain ecosystem integrity. However, many protected areas perform poorly due to not incorporating spatiotemporal information on biodiversity distributions under the changing environment into the design. In addition, many conservation efforts have limited effectiveness because planning is usually restricted by administrative boundaries, failing to capture species' across-boundary distributions and movement. These challenges are particularly serious for bats (Order Chiroptera) because of their wide distributions, sensitivity to environmental changes, and elusive nature. My study thus aims to use the bats in Vietnam as a case to demonstrate how the spatiotemporal information on species distributions under environmental changes can be obtained and used for guiding conservation planning. Specifically, I characterized bat species distributions and predicted their dynamics under projected climate and land-cover changes to (1) investigate the individual and interactive effects of the two major environmental changes on bats for guiding conservation strategies, (2) access the representativeness of the current protected area network for bats and prioritize areas for improvement, and (3) evaluate the importance of transboundary collaboration for prioritizing protected areas for bat conservation in the face of environmental changes.

In the first study of my dissertation, I predicted current and future distributions of 81 bat species in Vietnam under different CO_2 emission and environmental change scenarios using species distribution models. Evaluations of individual and interactive effects of climate and land-cover changes on the bats' range size and species richness patterns revealed that both threats individually would predominantly exert negative effects by the 2050s. Furthermore, simultaneous occurrences of these threats generally intensified the impacts by mitigating individual positive effects and/or enhancing negative effects. Because of significant interspecific and geographic variations in the direction and magnitude of these effects, our results underscore the importance of incorporating species-specific and spatial-explicit information on species distributions into conservation planning for bats.

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Since establishing protected areas is one of the most commonly used conservation approach, in the second study I used the information on species distribution to evaluate the representativeness of Vietnam's current protected area network for bats. I found that although the network is more representative for bats than random, it only covers, in average, 6.56% of the current distribution range of individual bat species. By integrating the species distribution information with the spatial prioritization analysis, I showed that the range coverage (or representativeness) of the protected area network can increase to 12.11% without increasing its size. While incorporating the predictions of future bat distributions into the prioritization process did not influence the current representativeness, it can significantly improve the representativeness under projected environmental changes. Finally, since all of the 81 bat species have their distribution ranges beyond Vietnam's boundary, in the third study I assessed whether the prioritization process implemented across Vietnam, Laos and Cambodia together (i.e., transboundary prioritization) can lead to higher representativeness of protected areas than the prioritization implemented within each of the countries independently (i.e., national prioritization). The results showed that the transboundary and national prioritization processes resulted in similar representativeness of protected areas under the current situation, transboundary prioritization had better performance under the changing environments, especially when the projected future distributions of bats were accounted for in the prioritization process. In summary, these studies show that climate and land-cover changes are likely to interactively cause profound negative impacts on bats. For effective conservation in the face of environmental changes, it is essential to incorporate the spatio-temporal information on bat distributions and cross-border collaboration into conservation planning. This study not only improves our understanding of the potential impacts of environmental changes on bat diversity, but also provides conservation suggestions for mitigating the impacts. The developed approaches, particularly the integration of spatiotemporal patterns of species distribution into prioritizing protected areas within and across borders, can have broader conservation applications for other taxa.