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Do anole species respond differentially to climate change? The climatic niche and habitat changes of Cuban anoles under future scenarios of climate change

 # climate change # adaptation # endemic species

DATES
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COUNTRY
Cuba

STUDENT
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EDUCATION LEVEL
Master

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Context

The genus *Anolis* (anole lizards) is the most diverse amniote genus of the planet, with more than 430 recognized species. In the context of climate change, it was suggested that global warming does not represent a big threat to survival in anoles, when compared with the effects of habitat loss and invasive species. However, they are affected by the thermal and biophysical environments where they live. Even though their climatic niche has been well studied, how climate change will influence anoles biology, population dynamics and distribution remain understudied. Some authors employed Species Distribution Models (SDMs) to predict distributional shifts induced by climate change for Puerto Rican and Cuban anoles respectively, where suitable habitats for the majority of the species is predicted to severely decrease. Widespread species can occupy diverse habitats with different local environmental conditions. Because the geographical range and physiological tolerances of a species are intimately linked, it is expected that widespread species face higher climatic variation along their distributions, being more tolerant to high temperatures and extreme weather conditions, and consequently having the ability to conserve their current geographical ranges under climate change scenarios.

Objectives

The main objective of this work is to study the relationship between the climatic variation experienced by restricted and widespread *Anolis* lizards from different ecomorphs along their distributional ranges, as proxy for species climatic tolerances, and the distributional shifts induced by climate change, which could give an idea on how anoles could face climate change, and which species or group of species should receive more conservation efforts. Several questions will be assessed:

- Should we expect that widely distributed anoles occupy habitats with higher climatic variation than species with restricted distribution?
- If so, will widely distributed anoles lose a lower percentage of their current distributional range under future scenarios of climate change, and consequently be less affected by this than restricted species?

Methods

For this study we selected 12 endemic anoles from Cuba that belong to four different ecomorphs.

Climatic variation

We used the climatic variation experienced by a species along its distributional range as proxy for species tolerances to risky weather conditions induced by climate change. In order to characterize the climatic niche, seven bioclimatic variables from the WorldClim database related with natural history of these species were selected, and their values from each locality were extracted. For each variable, we calculated descriptive values for both species and ecomorph levels. Coefficient of variation and Ranges were taken as measures of variability to assess the climatic variation in the distributional range of each species, where higher values of these measures indicate higher climatic variation.

Niche modeling

Niche modeling was achieved using both Niche Analyst and MaxEnt algorithm. Niche Analyst provides a representation of the Hutchinsonian duality of the niche through visualizations of the interaction of the environmental niche and the geographical space inside an ellipsoid. MaxEnt relates environmental data with species occurrence records to visualize the suitability of a location according to its environmental features. The result of the combination of current and future models provided a new model with areas of stability, expansion, reduction and unsuitable areas.

Statistics

Multivariate linear models were fitted to evaluate the relationship between the observed climatic variation and the current distribution of the species, as well as between the predicted habitat loss for each scenario and the current distribution of species. PERMANOVAs were done to assess the differences in bioclimatic variables among species, ecomorphs and future scenarios. Principal component analysis (PCA) was performed to visualize the multivariate data and PERMANOVA results.

About the research team

Anaisa Cajigas Gandia started her master studies on September 2019 at the Université de Bourgogne Franche-Comté (Dijon, France) as part of the Behavioural Ecology and Wildlife Management (BEWM) program. Her master project is co-supervised by Dr. Roberto Alonso Bosch (University of Havana, Cuba), Dr. Carlos Mancina (Institute of Ecology and Systematics, Cuba) and Dr. Anthony Herrel (National Museum of Natural History of Paris, France).

Before starting her master program, Anaisa obtained her Bachelor degree at the Faculty of Biology, University of Havana, Cuba, where she received the Scientific Merit Award for her relevant academic and research trajectory. After graduation, she joined the Institute of Ecology and Systematics as member of the Division of Zoology, where she currently works. She collaborates in her research with the Cuban Society of Zoology. She also benefits from the assistance of her colleagues, Sergio del Castillo, Claudia Vega and Annabelle Vidal, for modeling and statistical analyses.