Effects of Incorporating Genetic Differentiation in Species Distribution Models Under Climate Change

Anna Calderon

Matthew Lau

Harvard Forest

Abstract

**Environmental niche modeling will become increasingly important as rapid climate change may cause changes in geographical distribution of many species. Therefore, it will be vital to enhance the predictability of species distribution models to better gage species response to changing conditions**. However, most species distribution models do not consider intraspecific genetic variation. Including the genetic heterogeneity of a species into ENMs may result in a model that can more accurately predict current and future species distributions. We propose developing two conceptual models involving the use and exclusion of local adaptation and different amounts of plasticity on arbitrary populations projected thirty-four years into the future. Second, we will utilize environmental niche models to compare the differences in including and excluding local adaptation and plasticity. Finally, we propose an analogous model using real data on different species of Apheanogaster. First, we expect to find that when local adaptation and plasticity variables are included, the predictability of species distribution models will increase. Second, when local adaptation and plasticity is accounted for in ENMs, we expect to see a higher climatic suitability range as opposed to ENMs which do not consider adaptation and plasticity. Third, we expect to see that models incorporating high margin plasticity will exhibit the highest range of species distribution.

How should I end this paragraph?

Introduction

Finally, cluster things.

Species distribution models are tools used to spatially visualize and predict the presence of a species based on correlative variables such as geography and environmental variables. Recently, the idea of including genetic differentiation in ENMs has taken root. It is now widely accepted that a species’ ability to occupy a wide range of habitats largely depends on genetic modifications within populations optimized by natural selection (Antonovics 1971). Despite this recognized phenomenon, few studies have incorporated intraspecific genetic variation into their models. Studies have shown correlations between genetic differentiation within a species and geographical heterogeneity as a result of natural selection (Linhart and Grant, 1996).

It has been documented that including intraspecific genetic differentiation may help improve the predictability of ENMs under climate change. For example, Valladares et al. found that by accounting for dispersal limitations and population differentiation, conventional ENMs underestimated the changes in distributions under climate change. Other studies report that working with localized occurrence data increases the accuracy of ENMs (Marcer et al., 2016). Garzón et al., similarly found that including local adaptation and plasticity dampens the reduction in species range distribution under projected climate change conditions.