Using a Species Distribution Model to assess how Climate Change will affect the Amphispiza Quinquestriata

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CISA Student Showcase

Introduction and Objectives

The Five-Striped Sparrow (*Amphispiza Quinquestriata)* is traditionally found in Mexico favoring dry canyon slopes and rocky hillsides. The first recorded sighting in the state of Arizona was in the early 1970's and sightings have increased annually since then. In Arizona they are typically seen in the southern region of the state, primarily in the Coronado National Forest boarding Mexico. Currently there is little information published about this species, therefore my primary objective is to assess how their range will be impacted by climate change in the next 60-80 years. To do this, I am using a species distribution model and different bioclimatic variables to predict the changes to their current habitat and any future habitat loss or expansion.

Methods

Data Collection/Preparation: Occurrence data was collected from GBIF, bioclimatic data was collected from WorldClim, and elevation data was collected from Earthenv. The initial step of "cleaning" the occurrence data is important for reducing spatial aggregation, removing duplicate occurrences, NA's, while also adding in pseudo absence and background data. Once the data has been "cleaned", 80% of the data will be used for model testing while the remaining 20% will be used in the final prediction model.

Variable Selection: The function *VarSel* from the *SDMTune* package in R was used to remove highly correlated variables to reduce any potential analysis bias.

Modeling: Once the highly correlated variables were removed, the remaining selected variables were then used in model evaluations and predictions. The first model produced was used for training purposes to ensure correct accuracy. Then the remaining data (testing data), was used to create a raster object with predictions from a fitted *maxtent* model. Lastly, the AUC and TSS scores were calculated.

Climate Change Simulations: The same selected variables were then used (both current and future) in four different climate change scenarios, SSP126, SSP245, SSP370, SSP585.

Results

The models resulted in an AUC score of 0.951 and a TSS score of 0.787. The AUC score ranges from 0 to 1 and is used to evaluate the performance in classification models. TSS scores range from -1 to 1 and represent the performance of a species distribution model.

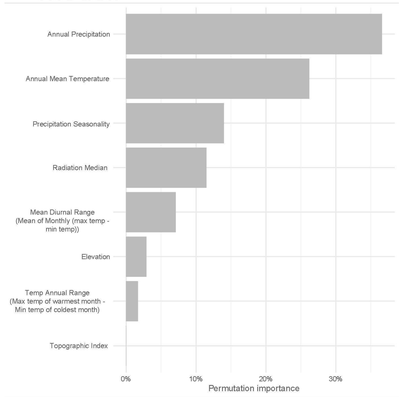

Figure 1. Represents the variable importance produced from the *VarSel* function in the *SDMTune* package in R.

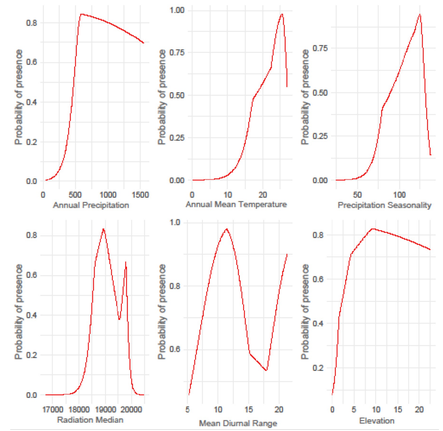

Figure 2. Represents the species probability of presence based on the selected variables. This was produced from the *var.maxent* function in R.

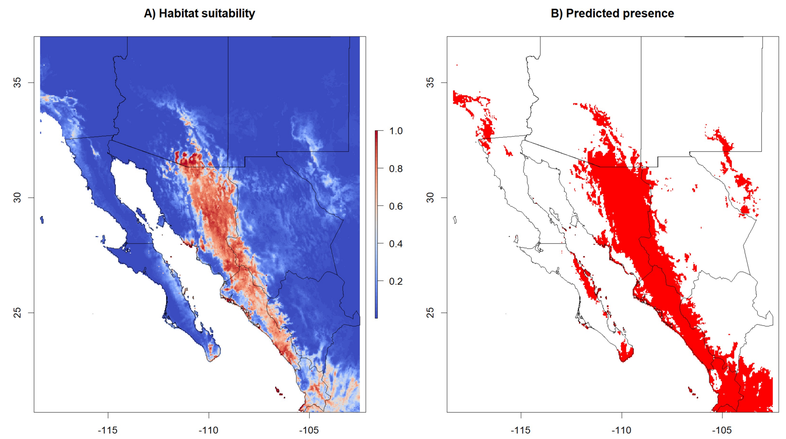

Figure 3. Represents the combined habitat suitability map and the predicted presence.

Results

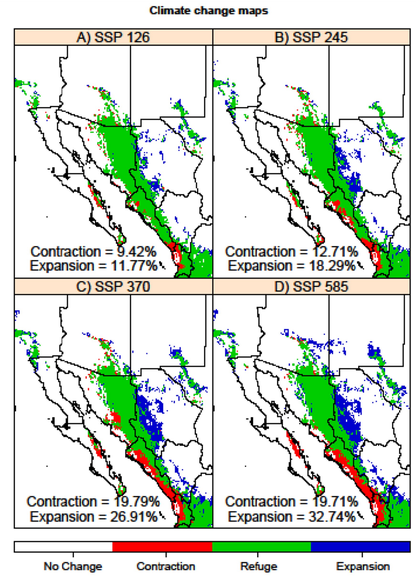

Figure 4. Displays the final climate change simulation results. Ranging from the most optimistic model (SSP126) to least (SSP585).

Conclusions

In conclusion, the Five-Striped Sparrow (*Amphispiza Quinquestriata)* is primarily influenced by the annual precipitation, annual mean temperature, and precipitation seasonality. When looking at the final climate change simulation results, not only is the species predicted to continue their expansion north into Arizona reaching the Superstition Mountains. They are predicted to experience habitat loss on the coast of Mexico resulting in expansion eastward as far as the Sacramento Mountains in New Mexico.

Literature Cited & Acknowledgements

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Sergio Vignali [aut, cre] (). (2022, August 25). *SDMtune: Vignettes/basic-use.rmd*. R Package Documentation. Retrieved November 11, 2022, from https://rdrr.io/cran/SDMtune/f/vignettes/basic-use.Rmd

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