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Spatial Distribution Modelling of Prothonotary Warbler (Protonotaria citrea) on Breeding Grounds

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Introduction

Ecological niche modeling is used to predict a species' distribution in a geographic area based on abiotic and biotic variables. Understanding a species' range is important for conservation and restoration efforts. As anthropogenic forces may alter or deplete habitat, it is important to know the ecological requirements of a species to understand how and what habitat to protect. With the increasing threat of climate change and rising temperature and precipitation, the suitable habitat and the distribution for many species is expected to shift. Migratory species are particularly at risk of these changes as they require suitable habitat not only on their wintering and stopover grounds, but on their breeding grounds. Without suitable breeding grounds, reproductive success is guaranteed to decline for a species. Understanding how these changes affect the range and distribution of a species allows researchers and conservationist to better formulate effective species management plans

Objective and Hypothesis

The objective of this study is to determine the potential future suitable habitat ranges of the Prothonotary Warbler (*Protonotaria citrea*) under both conservative and high emission climate scenarios in it's temperate, breeding habitat.

It is predicted that suitable habitat for the Prothonotary Warbler will remain similar to it's current conditions under the conservative climate scenario and will decrease under the high emission climate scenario.

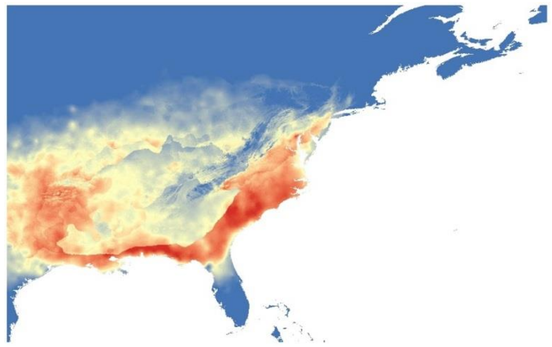

Fig. 1 Current distribution of Prothonotary Warblers Breeding Ground

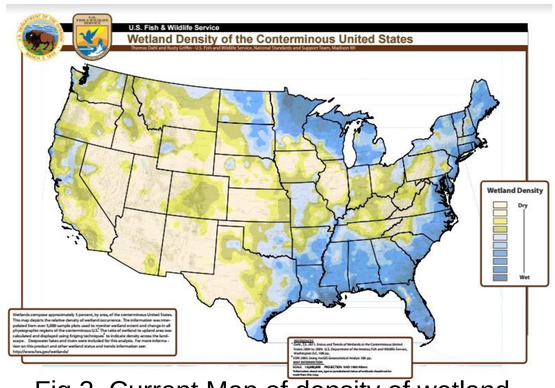

Fig 2. Current Map of density of wetland habitat across Unitded States

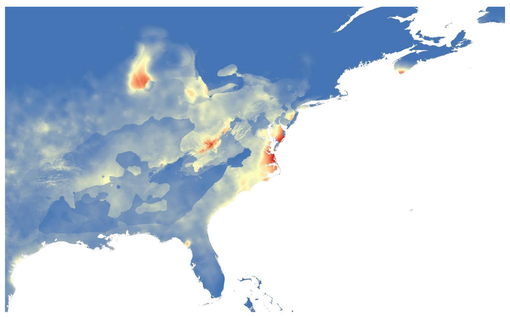

Fig. 3 Projected distributon under conservative estimates of climate change in the year 2050

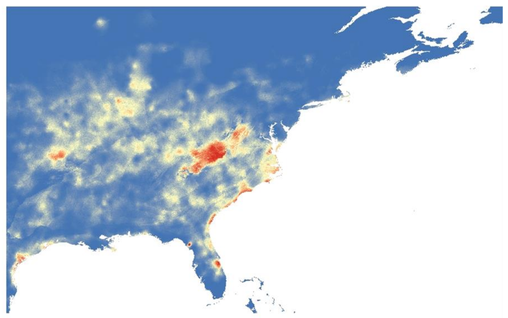

Fig. 5 Projected distributon under conservative estimates of climate change in the year 2070

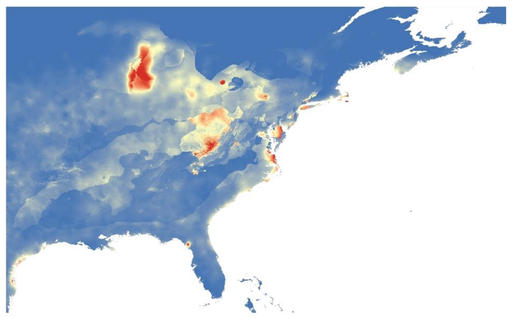

Fig. 4 Projected distributon under "status quo" estimates of climate change in the year 2050

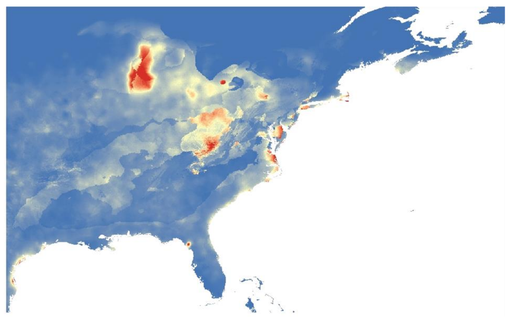

Fig. 6 Projected distributon under "status quo" estimates of climate change in the year 2070

Methods

Data for Prothonotary Warbler occurrence was collected from the Global Biodiversity Information Facility. The abiotic variables for modeling were accessed from WorldClim.org. Maxent, a program used to predict a species range, was used to run a spatial distribution model and to determine which abiotic variables contributed to the model the most. A subset of 19 bioclimatic variables was selected for the final model based on the results from the jackknife chart. This chart identifies which variables contribute the most to the model as well as which variables have the greatest effect if removed. The selected variables were then filtered by a correlation matrix in R to identify and remove highly correlated variables. The variables included in the final model were

- Minimum Temperature of the Coldest Month
- Maximum Temperature of the Warmest Month
- Mean Temperature of the Driest Month
- Precipitation of the Warmest Quarter
- Precipitation Seasonality
- Mean Temperature of the Wettest Quarter

A conservative and a more extreme emission scenario were used to project models for the future for 2050 and 2070. The Climate scenarios were collected from NASA's GISS ModelE from the Fifth Assessment IPCC report.

Acknowledgments

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- Guido Berguido and guides

Conclusions

The current distribution of the Prothonotary Warbler's potential breeding ground includes the eastern coast along the Atlantic Oceans, as far north as Northern Virginia as well as the Mississippi Alluvial Valley in the southern United States. The effects of climate change will cause a shift in the size of habitable breeding grounds and move them further north. The Prothonotary Warbler is a habitat specialist, primarily living in forested wetland habitat. The distribution shown in the niche model closely resembles the density of wetland habitat in the United States. While the shifting habitat meets temperature and precipitation requirements of the Prothonotary Warbler, much of the available habitat is not in already existing wetlands and is unlikely to be used by this species.

VCU Team Warbler

Rice Rivers Center VCU