

THE RELATIVE IMPORTANCE OF THREE SPECIFIC CLIMATIC FACTORS ON NORTH AMERICAN BREEDING BIRD SPECIES RICHNESS

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ABSTRACT:

Understanding of the relationships between bird species and environment facilitates protecting avian biodiversity and maintaining nature sustaining. However, the effects of many climatic factors on bird richness have not been fully grasped. To fill this gap, this study investigated the relationships between the richness of three typical North American breeding bird species and three climatic factors at the monthly scale. Based on the North American Breeding Bird Survey (BBS) data during 1967-2014, the relationships between the numbers of Carolina wren, Cerulean warbler, and Red-bellied woodpecker and the three climatic factors of precipitation, vapor pressure, and potential evapotranspiration were examined using the method of Pearson linear regression analysis. The results indicated that the three climatic factors have correlations with the richness of the breeding bird species but in different modes, e.g., strong correlations for the non-migratory species but weak correlations for the migratory species.

1. INTRODUCTION

Understanding of the interactions between various bird species and their environments is increasingly highlighted (e.g., Sauer et al., 1994; Link and Sauer, 1998; Bled et al., 2013; Goetz et al., 2014), especially in the context of global change. The relevant studies have been conducted in many fields concerning avian ecology, since the scientific inferences facilitate enhancing many studies and managements, e.g., guiding more effective policy-making for biodiversity conservation (Bellard et al., 2012).

The relative importance of different environmental variables in predicting bird species richness has been long investigated (e.g., Cueto and Casenave, 1999; Seoane et al., 2004; Coops et al., 2009; Hansen et al., 2011; Fitterer et al., 2012). Now, progress in remote sensing and ecological modelling can support a timely and robust analysis of more complicated ecological variables, such as 3D habitat structures that underlie large-scale patterns of breeding bird species richness (e.g., Bled et al., 2013; Goetz et al., 2014). However, the effects of the hydrology-typed climatic factors like precipitation, evapotranspiration and vapor pressure on bird species richness have not been fully examined.

In addition, the previous studies focusing on the interactions of bird species richness and environmental factors were generally conducted at the annual scales (Scott et al., 1994; Florent et al., 2013). This temporal scale cannot characterize the changes of the richness of different bird species along seasons. Thereby, the mechanisms underlying the influence and response between bird species richness and climatic factors at finer temporal scales have been unclear yet, particularly at the continental scales.

To address these gaps, this study investigated the relationships between the richness of different bird species and the values of different hydrology-typed climatic factors, which were compiled at the monthly scales both. The optimal relationship determined

for each bird species can reveal the dependence of that species to the related climatic factor.

2. MATERIALS AND METHODS

2.1 Study Area

The study area was located in the North American continent, briefly in U.S.A. as shown in Figure 1. The mainland of U.S.A. features a huge diversity of bird species and varying climate. Stretching from the East Coast to the eastern North Dakota, further down to Kansas, is the continental-humid climate that features four distinctive seasons and a large amount of annual precipitation, with places like New York City reaching about 50 inches on average. Starting at the southern border of the continental-humid climate zone to the Gulf of Mexico shows a subtropical climate. This region has the wettest cities in the contiguous U.S.A. with annual precipitation reaching about 67 inches in Mobile, Alabama. Stretching from the borders of the continental humid and subtropical climates and going west to the Cascades Sierra Nevada, south to the tip of Durango, north to the border with tundra climate, the steppe/desert climate is the driest climate in the U.S.A. In consequence, so many kinds of climates may relate to different modes of bird distributions.

2.2 Data of Bird Observation

We used the data of bird observation from the North American Breeding Bird Survey (BBS), which started in 1966 for the purpose of characterizing North American avian population changes. Bird observations were annually deployed at the peak of the nesting season (June in common) along 4100 randomly selected routes through the U.S.A. and Canada, but not all routes were available every year (www.pwrc.usgs.gov/bbs). The participants being skilled in avian identification collected

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