Estimating Seasonal Avian Diversity in an Urban Wetland in Columbus, Ohio

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ABSTRACT

Biodiversity can be a useful measure of overall health of an ecosystem. Despite seasonal changes in avian communities, diversity is often measured only during the breeding season. Monitoring avian species over seasonal variations has the potential to expand our understanding of the ways in which habitats can be utilized by a variety of species. In a 52-acre urban wetland, avian species were captured using mist netting over a period of three years. This method allowed for sampling of secretive species that standard audio-visual surveys often fail to detect. Plumage characteristics were used in identifying species. We calculated diversity using Shannon's index and standardized effort using net hours to compare diversity among seasons. Using capture effort, we also estimated relative abundance of species and analyzed the effect of temperature on diversity. This study provides a measure of diversity for the site during under-sampled times of the year when communities tend to shift in composition.

INTRODUCTION

Biodiversity has been used as a measure of habitat quality in a number of habitats, including urban wetlands[1-3]. Calculating diversity indices during different seasons has the potential to inform management decisions. In avian ecology, however, the focus of diversity sampling occurs during the breeding season. In contrast, non-breeding seasons are often under-sampled. In order to better understand the seasonal variation, data collection occurred during October through March. Avian species were captured using mist-netting, which can aid in accounting for secretive and recaptured species. It was hypothesized that weather would have an effect on diversity indices with a prediction that lower temperatures, higher wind speeds, and more precipitation would result in a lower diversity index.

STUDY AREA

The Wilma H. Schiermeier Olentangy Wetland Research Park (ORWRP) is a 52-acre urban wetland located in Columbus, Ohio (Fig. 1). It contains two experimental wetlands, bottomland hardwood forests, and is located directly adjacent to the Olentangy River. The research park is a part of the School of Environment and Natural Resources within the Ohio State University. The study area is surrounded by urban development, including a bike path through the park. This unique study site allows researchers to capture trends in avian diversity in a setting with apparent anthropogenic influences.

Figure 1. Avian diversity data was collected at the Wilma H. Schiermeier Olentangy River Wetland Research Park located in Columbus, Ohio from August 2015 through December 2017.

METHODS

Mist nets were set up in the ORWRP at set locations shortly before sunrise (Fig. 2 and 3). Nets were checked at 30-minute intervals and captured species were brought back to the banding station located on site[4]. Each bird was identified to species, sexed, and aged using the Identification Guide to North American Birds[5] (Fig. 4). Birds were banded with aluminum bands from the USGS Bird Banding Lab. This allowed captured species to be identified to an individual level and aided in determining recapture status.

Figure 2. Setting up a 12-meter mist net at the ORWRP.

All species were recorded along with the number of hours the nets were open. Net hours were calculated by summing the total number of hours each net was open. Seasons were categorized into mid-migration (October), late-migration (November), and winter (December-March). Shannon's diversity index (H; $H = \sum_{i=1}^{s} p_i \ln(p_i)$), equitability (EH; $EH = H/\ln S$), and abundance were calculated for each

season and standardized by net hours[6,7]. This allowed comparison among seasons despite variation in sampling time.

Linear regressions were used to assess correlation to average temperatures, wind speed, and total precipitation with mid-late seasonal diversity and evenness. The winter season was not assessed due to ongoing data collection. Statistical software, R, was used to run linear regressions and perform t-test analysis of diversity and evenness using a statistical significance value of $p = 0.05$ [8].

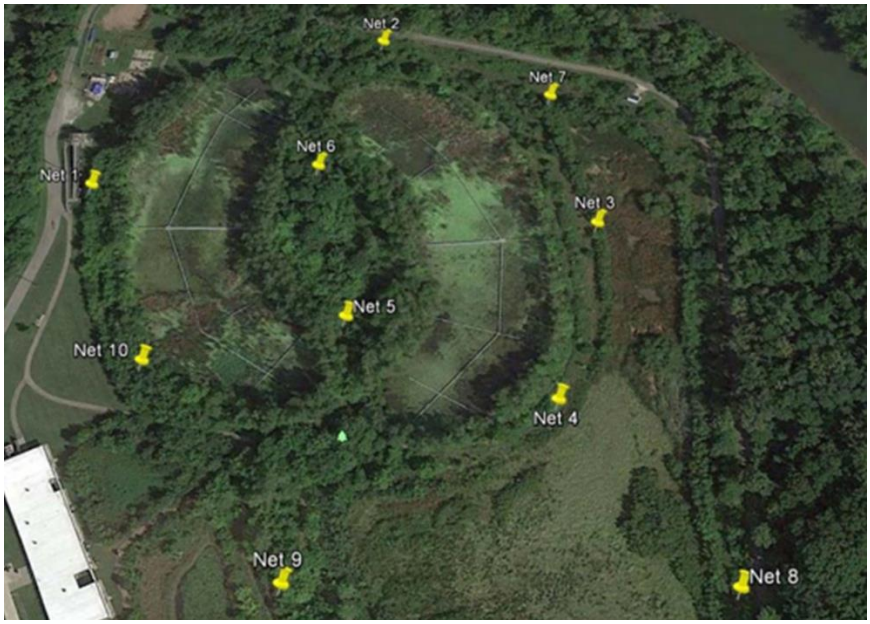


Figure 3. Mist net locations at the Wilma H. Schiermeier Olentangy River Wetland Research Park in Columbus, Ohio.

RESULTS

Diversity was highest during mid-migration, but had a lower evenness value. Late-migration and winter diversity indices and evenness estimates were similar (Table 1).

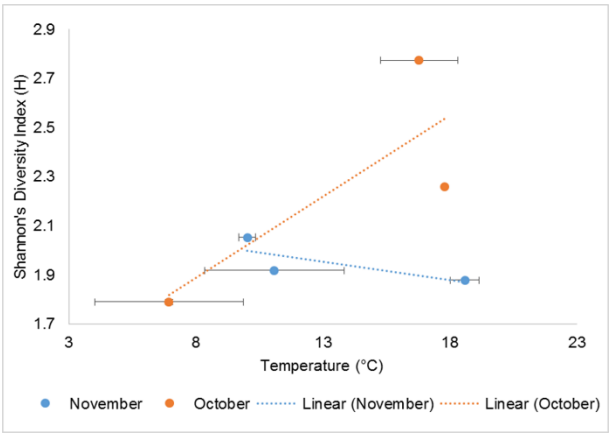
Shannon's diversity index for October and November showed a positive and negative relationship to temperature, respectively, with no significance ($R2=0.65$, $p=0.40$; $R2=0.57$, $p=0.46$; Fig. 3A).

Shannon's equitability estimates for October and November showed a positive relationship to temperature ($R2=0.77$, $p=0.32$; $R2=0.14$, 0.75; Fig. 3B).

Table 1. Shannon's diversity indices[a] and Shannon's equitability estimates[b] were calculated for mid-migration (October 2015-2017), late-migration (November 2015-2017), and winter (December-March 2015-2016) at ORWRP.

Season	H[a]	EH[b]
Mid-migration	2.60	0.77
Late-migration	2.15	0.80
Winter	2.21	0.80

A]



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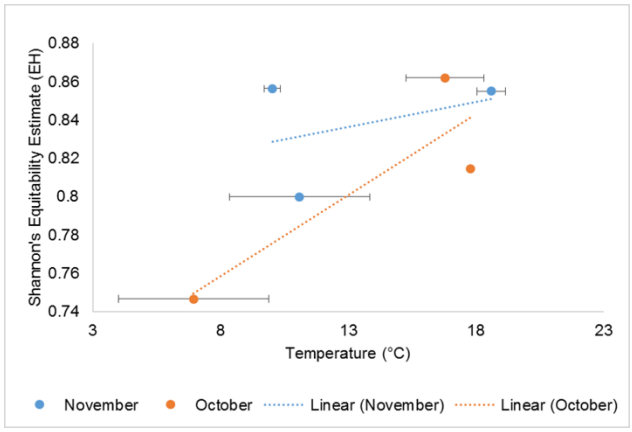

Figure 4. Shannon's diversity index (H) showed a positive correlation to temperature in October (r=0.81; p=0.40) and a negative correlation to temperature in November (r=-0.75; p=0.46) but there was no significant difference found [A]. Shannon's equitability estimate (EH) showed a positive correlation in both October (r=0.88; p=0.32) and November (r=0.38; p=0.75) [B].

Changes in community assemblages and abundances can be seen in Fig 4 with the five most abundant species per season. Migrants such as the White-throated Sparrow and Carolina Chickadee show an increase from mid-late migration.

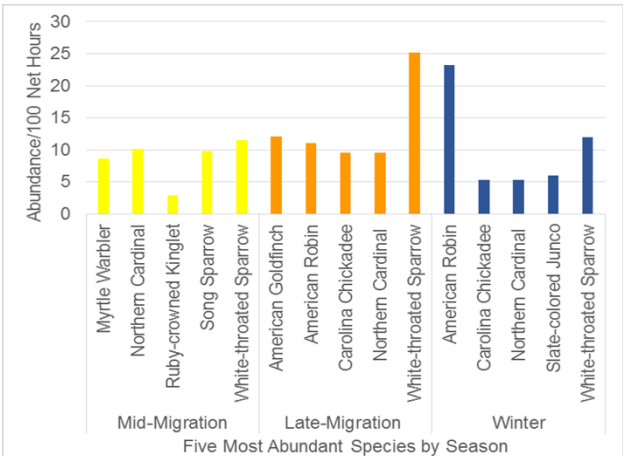

Figure 4. The five most abundant species per 100 net hours in each season at the ORWRP in Columbus, Ohio

DISCUSSION

While there was no significant relationship between diversity and temperature, evidence indicates that diversity may increase during days with increased temperature. This trend could be due to lower activity during more extreme weather conditions and thus decreased mist-netting. Decreases in bird detection in relation to adverse weather conditions have been documented and discussed before[9]. The lower diversity value during the mid-migration and winter seasons was due to a lower species richness value and not a lower estimated abundance. The abundance estimates were higher during these seasons compared to the October season. This suggests that the ORWRP provides sufficient overwintering habitat for winter resident species (Fig. 5).

The findings in this study are preliminary with a limited sample size. Continued data collection could provide further information for managers at the ORWRP. Future directions for this study include the incorporation of point count surveys on sampling days to capture species that are not often captured with mist nets. Comparing the diversity indices with the breeding season would show a holistic view of changing communities and should be included in future analysis.

Figure 5. Overwintering species such as the Blue Jay (*Cyanocitta cristata*) and Brown Creeper (*Certhia americana*) were captured at the ORWRP, 2015-2017.

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