

Distance Modeling of Avian Species in Lilley Cornett Woods, Kentucky

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Introduction

In ecology, most scientists aim to develop research projects that will answer a wide array of questions and examine multiple relationships within an ecosystem. This is especially important in underfunded areas, and those in which field and/or lab work is particularly time-consuming. In the field of ornithology, distance modeling is a common method of study, and is preferred for its ability to cheaply, quickly, and effectively study multiple species of birds and their relationships to dozens of environmental characteristics.



Figure 1. A Black-and-White Warbler (*Mniotilta varia*), one of over forty bird species found in LCW during the study period.

Distance modeling is used to predict the density of a species at the site in which it was studied. The predictions are based upon the importance of environmental characteristics in density for that species. In doing this we not only create estimates of density and relative influence of the environment, but we also obtain a data set which is widely applicable. This form of analysis can be expanded to make estimates over large areas of habitat, to monitor changes in population and habitat quality over time, and to examine responses to

disturbance. For these reasons, distance modeling plays a valuable role in informing conservation and management decisions.

Methods

Study Site

Lilley Cornett Woods (LCW), located in southeast Kentucky, is a mixed mesophytic forest spanning more than 550 acres. Nearly half of this area is considered old-growth forest, meaning it has been unaltered by humans for approximately 150 years or more. It is divided into three main areas, and within these areas are 135 plots established by Dr. William H. Martin in 1971. For this study, 34 sites within the Big Everidge and Shop Hollow areas were examined.

Data Collection

Point counts were conducted at each of the study plots during June of 2017. Because of the relatively small size of LCW compared to other study areas, distance between sites was reduced to a minimum of 100m. Each site was visited once within thirty minutes before and three hours after sunrise. Each count was split into fifteen 1-minute intervals. Every bird seen or heard within 150m was recorded. Distances of individuals were rounded to the nearest multiple of five.

Covariate data were gathered using Geographic Information Systems (GIS), and relative tree volume data were collected during previous projects.

Data Analysis

All analyses were performed using the software programs R and RStudio, using the packages 'unmarked', 'rmarkdown', and 'AICcmodavg'.



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Distance sampling was used to model density. Individuals detected more than 50m away were not included in the analyses. In instances of model instability, any models returning non-alphanumeric values or a Hessian error were removed.

Results

Responses to Disturbance

Density variation surrounding disturbed areas was heterogeneous, with about the same number of species tending towards disturbed areas as those avoiding them. Blue-headed Vireos were found in much higher densities near roads, whereas Tufted Titmice avoided roads.

A similar variety of responses to disturbance was seen in distance to trail, with Hooded Warblers preferring areas away from trail (**Fig 2**) and Red-eyed Vireos congregating in areas close to the trail (**Fig 3**).

Hooded Warbler

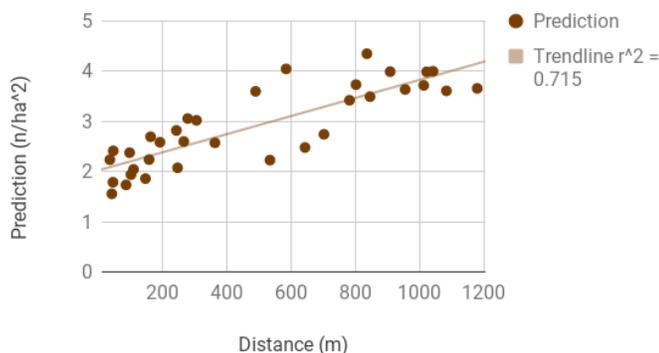


Figure 2. Hooded Warbler response to distance to trail.

Red-eyed Vireo

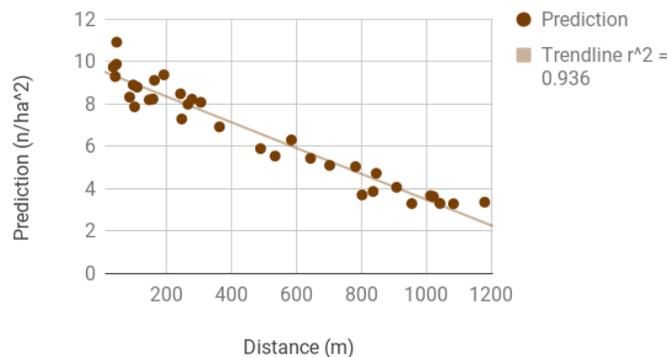


Figure 3. Red-eyed Vireo response to distance to trail.

Importance of Eastern Hemlock

As seen in responses to disturbance, the importance of Eastern Hemlock varied greatly. Species such as the Black-throated Green Warbler, Hooded Warbler, and Acadian Flycatcher were more dense in areas without hemlock, whereas species such as the Red-eyed Vireo and the Blue-headed Vireo were more dense in areas with hemlocks.

Conclusions

The varied responses speak to the importance of forest heterogeneity and complexity; in one area of natural forest there may be species with completely different habitat preferences, able to cohabitate due to the complexity and variety of the ecosystem. It is clear that the loss of even one species may change the dynamics of the forest, and therefore every effort should be made to preserve the forest biodiversity.

References

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