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Mike J. King

Olivet Nazarene University, mjking@olivet.edu

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**Foraging behavior of red-headed woodpeckers in endangered
black oak savanna habitat**

*A research paper submitted to the Ebert Pence and Fanny Boyce Undergraduate Summer
Research Experience Selection Committee*

December 17, 2018

Student: Mike J. King

Mentor: Derek W. Rosenberger, PhD.

Abstract

The objective of this study was to determine the role of black oak savanna habitat on red-headed woodpecker (*Melanerpes erythrocephalus*) foraging behavior. Through the development of a foraging ethogram, the recording of foraging behavior times, and the collection of habitat data we were able to assess if any patterns existed between foraging and black oak savanna habitat. Comparison of our data in black oak savannas to that of others in woodland suggests that foraging behavior may differ between habitat types. Tree species did appear to impact the proportion of certain foraging behaviors, however further study is needed to more fully determine the effect of tree species and habitat on foraging behavior. This work is the first to quantify the foraging behaviors of this threatened bird in the critically endangered black oak savanna habitat and thus serves as a first step in investigating this community dynamic.

Introduction

The red-headed woodpecker (*Melanerpes erythrocephalus* L.) is a declining species distributed across eastern North America. Found mainly on open savanna habitat, this woodpecker is thought to obtain some of its food by hawking, or preying on insects in the air, in addition to stereotypical pecking behavior (Beal 1911, Conner et. al 1994). It is also one of only 4 woodpecker species known to cache food, such as acorns, fruit, corn, and even live insects for consumption during winter months (Kilham 1958, Beal 1911).

Once one of the most abundant woodpecker species in eastern North America, the red-headed woodpecker has experienced a 75% decline since 1966 (Rodewald et al. 2016). This

rapid decline has placed the red-headed woodpecker under the “Near-Threatened” category on the IUCN Red list (2017) and is thought to be linked to the loss of their main habitat, oak savanna. Oak savanna is an area covered by herbaceous plants and a primarily oak tree canopy of between 10 and 50% (Wilcox et. al 2005). This habitat is thought to have once covered 11 to 13 million hectares of the Midwest. During the 1900’s, 99.8% of oak savannas were cut down or lost due to removal of standard thinning practices such as burning (Wilcox et. al 2005, Nuzzo 1985).

With the support of the Pence-Boyce Grant in 2017 and the Olivet Nazarene University Honors Program, Kimberly Zralka and Dr. Derek Rosenberger found that savanna habitat had a significant effect on red-headed woodpecker abundance, and that oak species also may have an effect. Winter surveys suggested that savanna habitat and oaks no longer affected woodpecker abundance in winter, suggesting oak savanna is particularly important in the summer months. However, it remains unclear what black oak savannas provide to red-headed woodpeckers that other habitats do not.

Due to the unique feeding habits of this particular species, we hypothesize that there is a relationship between oak habitat selection and food availability, particularly insect prey. Thus, in this study, our objective is first to identify red-headed woodpecker territories, as free distribution theory suggests that territories will be located in optimal habitat. Within identified territories, our second objective is to quantify red-headed woodpecker foraging behavior to determine if summer foraging behavior is affected by tree species.

Methods

In order to determine optimal areas to perform our study on red-headed woodpecker foraging behavior, we mapped out territories of individual woodpeckers using the method described by Wakely (1987). Briefly, this method includes walking transect lines in a grid across the length of the preserve, noting on a satellite map as precisely as possible the locations where birds are seen. We then marked territories based on groups of woodpecker sightings, bordered by points that the woodpeckers were seen engaging in territorial displays with other red-headed woodpeckers. The territories were located at Pembroke Dune and Savanna in Kankakee county, Illinois (41°04'27.0"N 87°38'26.8"W). Research permits were applied for and approved by the Nature Conservancy and Illinois State Nature Preserves Department. Five surveys were conducted over the course of the month of June, 2018, recording every red-headed woodpecker we were able to locate by sight or sound.

In order to quantify time spent exhibiting different types of foraging behavior, the territories were observed 3-4 times weekly. Woodpeckers were located by visual observation as the researcher walked through the area. Each woodpecker seen was observed for a 5-minute-long observation period when possible. Observing each individual as a sample unit provided us with the opportunity to determine which species of tree the woodpecker chooses to forage on the most. While observing the individual red-headed woodpeckers, we recorded the amount of time they spent engaging in each of the following six foraging behaviors: peer and poke, peck, excavate, hawk, vegetation, cache, and ground forage (Table 1). The tree species each bird foraged on was recorded to determine if tree species affected preferred foraging behavior.

Table 1. Ethogram based on (Conner et al 1994) used to record woodpecker foraging behaviors.

Behavior	Description
Peer and Poke	The bird moves across the surface of a tree, picking food from the bark without penetrating the wood.
Peck	The bird drills into the tree in search of burrowing insects.
Excavate	The bird pulls material from a hole in a tree, eating food found inside.
Hawk	The bird flies through the air to catch prey on the wing.
Vegetation	The bird eats berries or other plant foods from a tree or bush.
Cache	The bird stores food items in a crevice, hole, or other concealed area within a tree.
Ground Forage	The bird lands on the ground to find food.

Results

Red-headed woodpeckers were observed for a total of 7,921 seconds, and spent 2,431 of those seconds engaging in foraging behavior. Of the 2,431 seconds spent foraging, just over 75% of their time was spent engaging in the Peer and Poke and Hawking methods. The birds were not observed scaling bark from trees, and very little time was observed foraging on the ground (Fig 1).

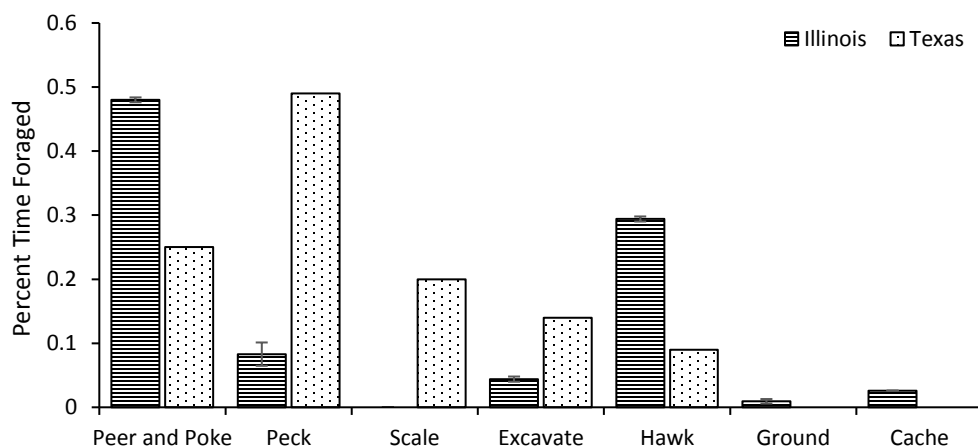


Fig. 1. Proportion of time spent engaging in specific foraging behaviors by red-headed woodpeckers in Illinois and Texas. Texas comparison taken from Conner et al (1994).

A total of seven territories were mapped out over the course of the summer (Fig. 2). These territories included 1-5 birds depending on if the bird was solitary, sharing a territory with a mate, or raising offspring. On average, there were 0.55 breeding pairs per hectare.



Fig 2: Red-headed woodpecker territories (Shaded areas) and territory size at Pembroke Savanna in Kankakee County Illinois, June 2018.

Red-headed woodpeckers were observed foraging on black oak, red oak, white oak, and unidentified snags. The woodpeckers foraged on black oak most often (Fig 3).

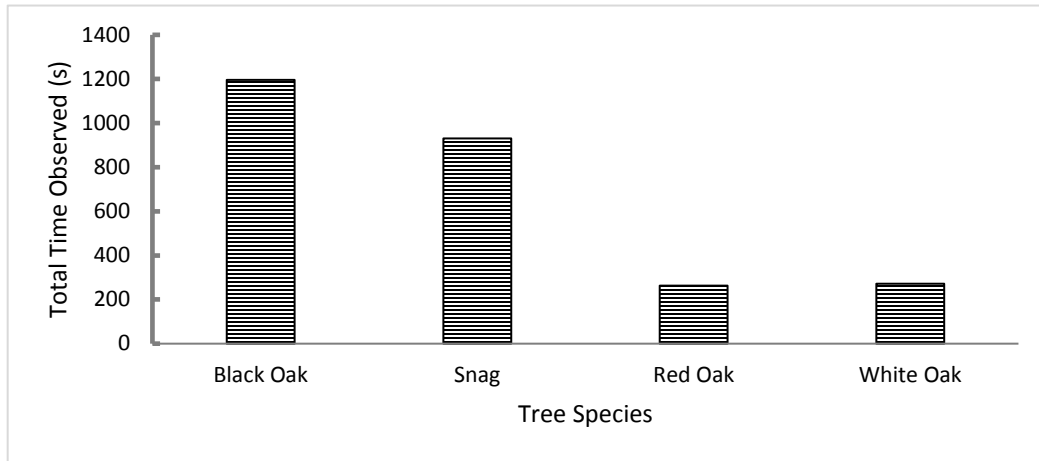


Fig 3: Oak species foraged upon shown against total time spent foraging on each species.

We found differences in foraging behavior exhibited across each tree species foraged upon. The most commonly utilized foraging behavior was peer and poke on all species. Hawking was also utilized often on every species except for snags. Pecking was utilized more on red oak than on the other oak species (Fig. 4).

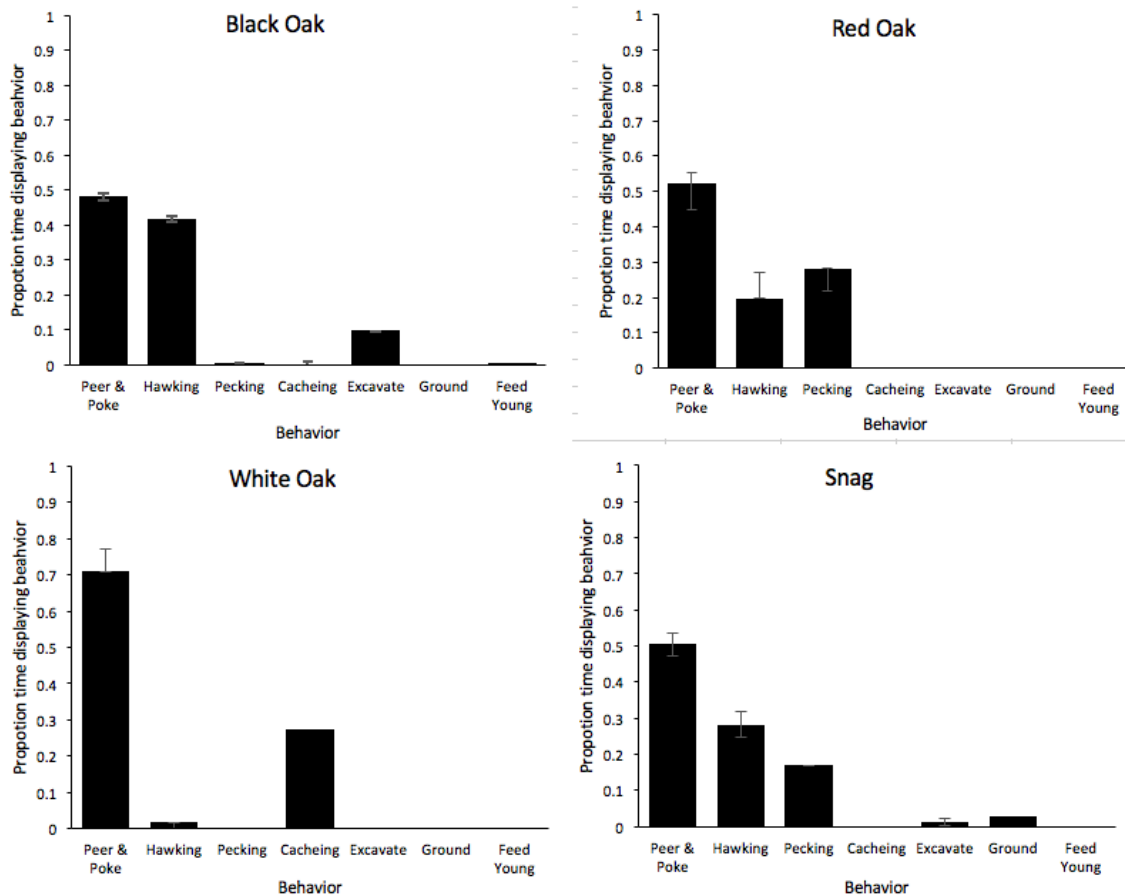


Fig 4: Oak species foraged upon shown against percent of the time spent foraging with each foraging behavior (n=2,431 seconds).

Discussion

Our study is the first to quantify foraging behaviors and tree use of the threatened red-headed woodpecker in critically endangered black oak savanna. We found that red-headed woodpeckers do indeed utilize black oak savanna, with the seven territories mapped in this study being entirely within savanna habitat. This is supported by the work done by Zralka and Rosenberger in 2017 (unpublished data) which showed the importance of red oak group savanna habitat to the population of red-headed woodpeckers in an area.

The most utilized foraging behavior in our study was peer and poke, which was also high in other studies (Conner et al 1994; Williams 1975). However, in comparison to previous work in woodlands (Conner et al 1994; Williams 1975), we observed a much greater amount of time spent hawking (Fig. 1). Conner et al (1994) observed much less hawking behavior in a bottomland hardwood forest in Texas than was observed in our study (Fig. 1), and it is possible that habitat difference is the defining variable between the two observations. Red-headed woodpeckers may hawk more than peck in savanna than woodland due to less abundant boring insects. Trees are not suppressed in a savanna as they may be in a woodland. This would improve tree health in a savanna and make trees less susceptible to boring insects. This study may be best received as a model of red-headed woodpecker foraging behavior specifically in black oak savanna. This can serve as a comparison of the bird's foraging behavior across different habitats and geographic locations.

Hawking behavior was utilized more on black oak than other tree types such as white oaks (Fig 4). More work studying the foraging behaviors on white oak would be beneficial in order to better understand the importance of black oak over other species in relation to the hawking behavior. Zralka and Rosenberger 2017 (unpublished data) showed the importance of red oak group trees (of which black oak belongs) in patch occupancy. More work showing the amount of time spent hawking near white oaks could help show the reason red oak group trees are important to red-headed woodpecker abundance. In the future, Olivet researchers will assess the differences between summer and winter foraging behaviors in black oak savanna. This will serve to provide valuable information regarding the importance of black oak savanna to the populations of red-headed woodpeckers that stay in Illinois savannas year-round. Other opportunities for future studies include the comparison of foraging behavior across all habitats occupied by red-headed woodpeckers, determining hawking utilization in correlation to canopy cover, and assessing boring insect abundance in relativity to tree population density.

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