Tree Species, State of Decay, and Orientation in Relation to Woodpecker Cavity Nesting

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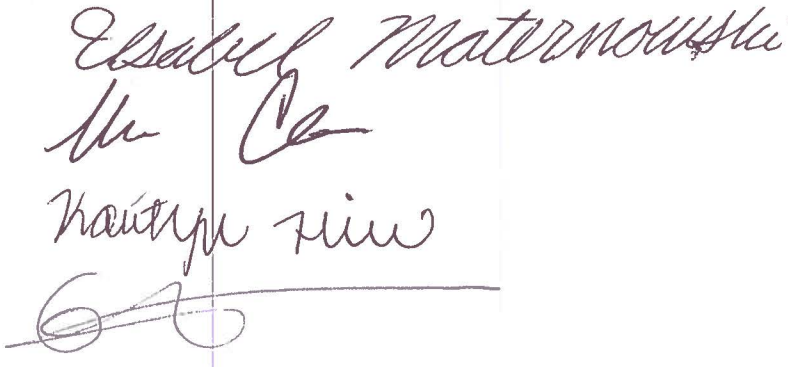
Abstract: Many bird species construct nests to protect and incubate their eggs. Woodpeckers construct their nests in tree cavities they excavate themselves, and therefore can control what type of tree they are nesting in and where the entrance is oriented. Unhealthy trees of softer wood may be easier to excavate than healthy hardwood, and sunlight may assist parents in keeping their young at a stable incubation temperature. Based on historical accounts at the University of Michigan Biological Station and current observations, we hypothesized that woodpeckers favor dead or dying aspen trees, and their morning activity indicates that eastward facing holes would be the most favorable for sun exposure. We searched several northern Michigan forests for woodpecker nesting cavities and recorded the tree's state of decay and direction. Through our observations, we determined that woodpeckers favor dead aspen trees, but there was no discernable preference for cavity direction. This data can inform future studies about the reproductive behavior of northern Michigan woodpeckers.



Introduction

One of the most recognizable characteristics of the reproduction of birds is their nests. Nests come in a variety of forms, but most serve to protect the fragile eggs and provide a place for incubation and rearing of offspring (Baicich and Harrison 1997). Since both hatchlings and eggs make easy targets for predators, the chicks often spend a significant period of time in the nest (Baicich and Harrison 1997). Commonly, nests are cup-shaped and placed in trees, but nests may come in a variety of forms.

Some birds nest at the center of trees or in other wooden structures such as telephone poles. These cavity nesters are able to hide their eggs and hatchlings from the view of predators since the only evidence of their presence is a small hole (Baicich and Harrison 1997). This enclosed space also enhances incubation since the cavity traps the warmth created by the parent and protects the offspring from harsh weather (Baicich and Harrison 1997). The direction the hole faces determines how much sunlight is able to enter the nest, and those that face eastward would receive the most direct sunlight in the morning when the birds are most active (Smith 2016). The most well known cavity nesters are woodpeckers as they create their own holes.

Cavity excavation varies depending on the woodpecker species, but often are gourd-shaped with a small opening for the parent and a large cavity reaching down into the tree where the eggs are laid (Baicich and Harrison 1997). After hatching, the chicks stay at the bottom of the nest, until they are able to climb to the opening to be fed by a parent (Baicich and Harrison 1997). Making such a large cavity requires significant effort on the part of the parents, who often construct a new nest each breeding season (Baicich and Harrison 1997). Therefore, many woodpeckers favor dead or rotting wood that is softer and easier to excavate, but not so soft that the tree is at risk of falling. A fungal infection of the tree may also assist woodpeckers in

excavation, since the fungus softens the heartwood while leaving the outer parts of the tree resistant to falling (Conner et al. 1976).

The majority of woodpeckers found in northern Michigan seem to favor aspen trees (*Populus sp.*); aspens are not as prone to falling over as other tree species as they decay (Blanc and Martin 2012). Of the six species of woodpeckers at the University of Michigan Biological Station (UMBS), half prefer to make their nests in dead wood: Downy Woodpecker (*Picoides pubescens*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), and Pileated Woodpecker (*Hylatomus pileatus*), while the remaining woodpeckers prefer live wood: Hairy Woodpecker (*Leuconotopicus villosus*), Northern Flicker (*Colaptes auratus*), and Yellow-bellied Sapsucker (*Sphyrapicus varius*) (Baicich and Harrison 1997). Based on historical accounts at the station (Pettingill 1974) and current observations, we hypothesized that woodpeckers favor dead or dying aspen trees, and their morning activity indicates their preference for eastward facing holes.

Methods & Materials

1. Study Area & Date

In order to better understand the behaviors of woodpeckers found near UMBS, we measured a variety of factors that could explain their nesting preferences. The variables that we have studied include tree circumference, species, decay, cavity orientation, and height of nest. We conducted our study from May 26th to June 6th 2018 on the UMBS property in Cheboygan County, as well as Mackinac, Chippewa, Luce, and Bay Counties located in Northern Michigan. The primary forest composition at UMBS is early successional with red pine (*Pinus resinosa*), white pine (*Pinus strobus*), quaking aspen (*Populus tremuloides*), white birch (*Betula papyrifera*), northern red oak (*Quercus rubra*) and sugar maple (*Acer saccharum*)

(Pettingill 1974). We examined nest cavities on the UMBS Grapevine trail, the Pine Point trail, Reese's Bog, the Gorge, and other sites in Northern Michigan, including areas in the Upper Peninsula. We searched for nest cavities from 8am to 11am when woodpeckers are most active (Smith 2016). We visited the UMBS property around Grapevine Trail four times (May 26th, May 30th, June 2nd, June 6th), and all other sites were visited only once during our research period.

2. Measurements

When a potentially active cavity was found, we marked the tree with tape so it could be revisited. We then quantified the circumference of the tree using a 50m measuring tape and the height of the cavity using the height by using a digital rangefinder. We also determined the Cardinal or Primary InterCardinal direction of the cavity opening using a compass. We identified the tree species and ranked the tree's degree of decay using a 1-5 scale adapted from Backhouse and Lousier (1991).

Table 1. Standards of ranking the degree of decay in trees

Stage of Decay	Description
1	Tree is living and healthy
2	Some branches are dead, but rest of tree is healthy
3	Most branches are dead, tree may be infected but is still alive
4	Tree is dead but still standing, structurally sound and retains many branches
5	Tree is dead and not structurally sound, most of it may be missing and in danger of falling

In addition, at each cavity we determined the most prevalent surrounding trees. We looked at each tree within a two meter radius of the cavity and determined averages based on these counts. During our excursions, we observed numerous Yellow-bellied Sapsuckers and attempted to follow them to their nests by listening and watching their movements. Otherwise, cavities were located by sight only. Generally, trails were the main way we were able to move through the forests, though occasionally we ventured deeper to investigate potential nest trees. We found a number of trees that had clearly been utilized as a source of food but had no sign of a nesting cavity. Because our data was collected as frequencies, we employed a Chi-Squared Goodness of Fit test and our nominal alpha value was set *a priori* at $\alpha=0.05$.

Results

1. Description of Cavities

Overall, we found seventeen cavities and confirmed three to be active. The first active cavity was found near Tahquamenon Falls in a Douglas fir satellite tower and belonged to a Pileated Woodpecker pair. The second was a Yellow-bellied Sapsucker nest found in an a quaking aspen on Grapevine trail on the UMBS campus. Finally, the third was a Red-bellied Woodpecker nest found in a quaking aspen in the UMBS parking lot. Of the seventeen cavities found, eleven were in aspen trees, two were in hemlock and white pine, and one cavity was found in both an oak and a Douglas fir satellite pole. For the Primary InterCardinal directions (Fig. 2), no cavities were found to be facing North, two were North-East, four were East, three were South-West, two were South, one was South-West, four were West, and one was North-West. In addition, one cavity was determined to be a 1 on our decay scale, and the 2, 3, and 5 categories contained two trees each. Ten trees fell into the 4 category.

We found that the most common trees surrounding cavities were maples at 33%. We were surprised to find that even in areas where there were trees of a variety of species, we still found the most cavities in aspens. The second most common tree was the beech tree at 20%, Aspen following at 18.4%, and white pine at 17%. The remaining species - Oak and Birch - each made up less than 15% of the surrounding trees.

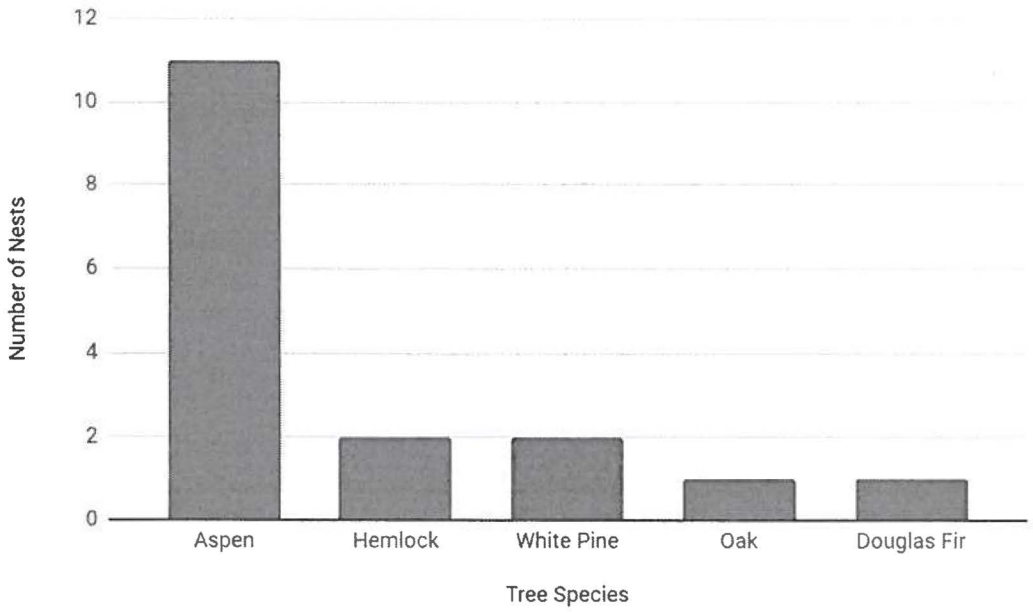


Figure 1. Number of nests and tree species

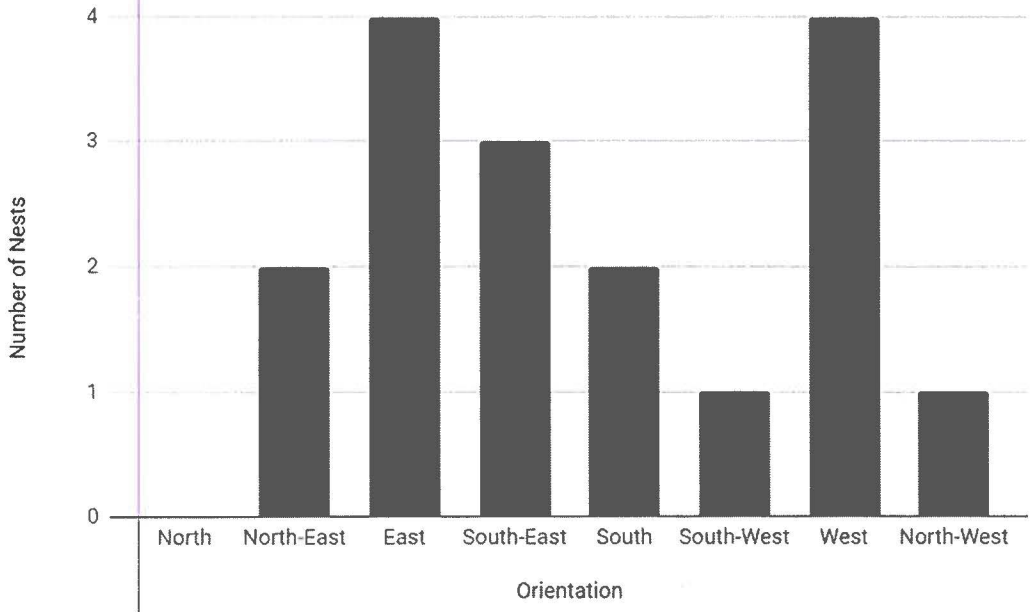
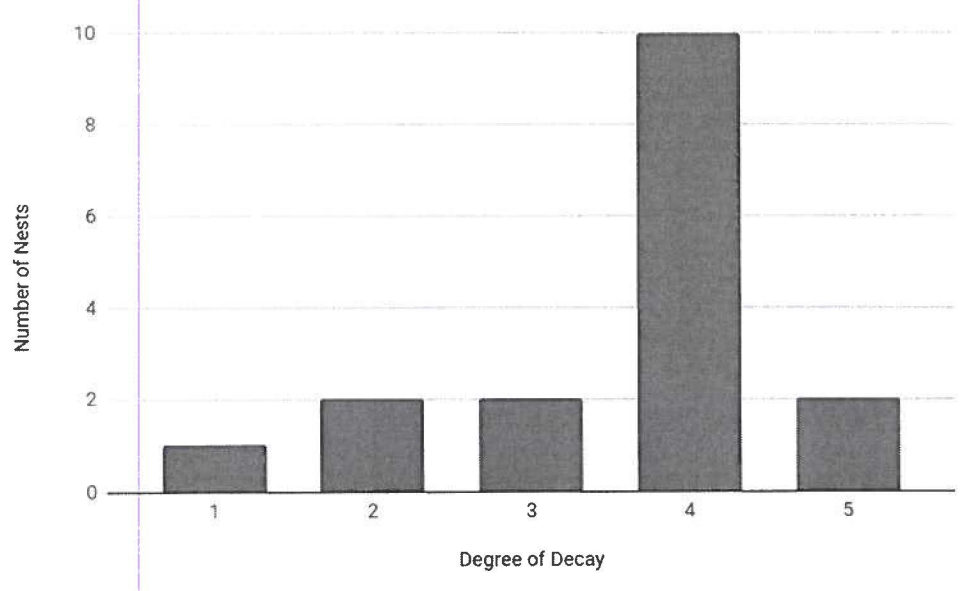


Figure 2. Number of nests and orientation



Stage of Decay	Description
1	Living & healthy
2	Some dead branches
3	Most dead branches
4	Tree is dead but upright
5	Tree has fallen

Figure 3. State of decay of nesting trees

2. Data analysis

Based on our data, there was a significant difference in tree species selected for cavity excavation, with aspens being favored over the other tree species observed (χ^2_4=21.529, p=0.0002). Similarly, our data showed woodpeckers had a significant preference for dead trees that were still standing, with ten of seventeen cavities found in category 4 trees (χ^2_4=16.235, p=0.0027). Unfortunately, we could not determine a significant preference for Eastward facing cavities (χ^2_7=7, p=0.42888).

Discussion

1. State of Decay

Based upon our research and observations, we observed the majority of cavities were found in dead and dying trees (4 to 5 on the decay scale) as we predicted. We believe that woodpeckers favor trees that are structurally sound but are soft and easy to excavate. A healthy tree likely contains harder heartwood (Conner et al. 1976). By boring into a tree that is already dead, or into a dead part of a living tree, the bird can save energy that could be better utilized foraging for food or finding a mate (Conner et al. 1976). According to Conner et al. (1976), many woodpeckers favor trees with a fungal infection. However, none of the trees that we observed were visibly infected.

2. Tree Species

Our results also supported that aspens would be the most popular cavity nesting trees. This is a result of a number of factors including tree strength, availability, and succession level of the forest. Out of the seventeen cavities we found, eleven were in aspens compared to two or less cavities in all other trees species. Compared to other woodpecker species, Yellow-bellied Sapsuckers seem to have specific requirement for young forest, and especially prefer to nest in

aspens (Walters et al., 2002). From our data and accounts from the literature, we speculated that cavity nesting birds might have chosen aspen trees because they are abundant in young forests of Northern Michigan, and Yellow-bellied Sapsuckers prefer them. Aspens have relatively soft wood compared to other tree species when living, and therefore are easier to excavate (Blanc and Martin 2012). In addition, aspens will not fall as easily once dead resulting in more stable nesting environments (Blanc and Martin 2012).

3. Cavity Orientation

The orientation of nest cavities is not generally well described, but we predicted woodpecker cavities would face east to obtain warmth from the sunrise. However, according to our data, it seems that the majority of woodpeckers in northern Michigan do not have a specific preference in the orientation of their nest opening. Perhaps the high density of the trees does not allow sunlight to significantly penetrate the canopy to warm the nest. Therefore, we found no trend in cavity orientation.

4. Limitations

Our searching range was limited to established trails so that cavities could be revisited easily. Because of this, we were not able to study trees in dense woods. Perhaps the lower accessibility to a wide range of woods resulted in the lower sample size (n=17). Compared to other researchers, our time to collect data was extremely short. We had only four weeks to conduct our experiment during our stay at the UMBS while others spend years collecting data. Even though we often heard the songs of Yellow-bellied Sapsuckers, Hairy Woodpeckers, and Red-headed Woodpeckers, we rarely succeeded in seeing them. In one day, we saw three Yellow-bellied Sapsuckers at Grapevine Trail, but we were only able to track one bird to its nest. We also did not have a precise way to determine whether the nest was active or not. Some of the

nests that we found were likely occupied in years past. For example, the cavities at the gorge and the bog were both previous Black-capped Chickadee nests. Therefore, there is a risk that the data that we collected might not represent the most recent trend of nesting behaviors.

5. Conclusion

Overall, our research could assist with future conservation efforts for cavity nesters. Our data shows that aspen trees are the prefered tree for woodpecker nest building. Aspen trees are among first succession species and only live between forty and one hundred fifty years (Schaetz). The age of a forest can determine the species of trees present, affecting the number of dead or dying aspen trees available to breeding woodpeckers. Our data could be used to inform future research into woodpecker preferences in Northern Michigan and the overall age and composition of the forests they inhabit.

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Appendix

Cavity #	Location	Height (m)	Circumference (m)	Tree Species	Degree of Decay	Estimated # of Cavities	Orientation	Birds Seen Nesting
1	GrapeVine Trail	12.6	1	Aspen	4/5	12	East	
2	GrapeVine Trail	1.6	1.75	Hemlock	1/5	6	West	
3	GrapeVine Trail	13.1	1.7	White Pine	4/5	12	East	
4	GrapeVine Trail	10.4	0.9	Aspen	2/5	5	East	
5	GrapeVine Trail	3.4	0.8	Aspen	4/5	3	South-West	
6	GrapeVine Trail	5.6	1	Aspen	4/5	5	East	
7	GrapeVine Trail	4.8	1	Oak	2/5	1	South	
8	GrapeVine Trail	19	1.45	Aspen	3/5	1	North-West	Yellow-bellied Sapsucker
9	Eastern UP	8.6	1.25	Aspen	4/5	1	South-East	
10	Eastern UP	9	1.7	Aspen	4/5	1	South-East	
11	Eastern UP	15.4	1.8	Aspen	4/5	1	South-East	
12	UMBS parking lot	13.7	1	Aspen	4/5	5	North-East	Red-headed Woodpecker
13	Pine Point	2.1	1	Aspen	3/5	7	West	
14	Reese's Bog	0.85	0.7	Hemlock	5/5	1	North-East	
15	Gorge	1.8	0.8	Aspen	4/5	1	South	
16	Tahquamenon	9.1	1	Douglas Fir (telephone pole)	5/5	1	West	Pileated Woodpecker
17	Pine Point	5	2	White Pine	4/5	4	West	