Effects of Timber Harvest on Avian Abundance and Diversity

by

McKenzie Brandon

Undergraduate honors thesis under the direction of

Dr. Kevin Ringelman

Department of Renewable Natural Resources

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Louisiana State University
& Agricultural and Mechanical College
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INTRODUCTION

Human consumption of natural resources has the potential to fundamentally alter habitats and the wildlife that rely on them. For example, unsustainable timber harvesting practices are the main cause of forest fragmentation and habitat destruction worldwide and can lead to species declines (Damette and Delacote 2011). In the United States, even sustainable timber harvest alters the plant community by resetting forest succession, which may potentially influence the wildlife community in that area (Dykstra et al. 1997). Timber harvest has the ability to decrease canopy closure, crown volume, and tree density, and increase total understory vegetative cover, grass cover, and foliage density (Dykstra et al. 1997). Wildlife responses to timber harvest, especially in birds, are often species specific: some species (shrub specialists) are adapted to early successional stages of stands and prefer these as breeding habitats (Perry and Thill 2013), while others can thrive only if mature forest fragments remain (Kahler and Anderson 2010).

Given this variation in avian habitat preferences, one method of timber harvest that may benefit the greatest diversity of avian species is group-selection harvest. This method involves cutting stands of trees in different years to maintain stands in various states of succession throughout the property. Thus, group-selection cutting practices have the potential to benefit early successional birds while retaining the mature-forest bird community. Not surprisingly, large cut site areas (>0.5 ha) result in the greatest diversity and abundance of early successional species (Moormand and Guynn 2011). However, it may be possible to provide habitat for the same early-successional species by creating smaller clusters of cut areas instead (Campbell et al. 2007, Moorman and Guynn 2011).

Changes in forest condition due to timber harvest alter the avian community in an area, but do not necessarily decrease the total number of species. In ponderosa pine (*Pinus ponderosa*) stands in the Black Hills National Forest in South Dakota and Wyoming, most stands had been harvested as of 1997, with only 12% of old growth remaining. Dykstra et al. (1997) discovered that although a few species disappeared from harvested sites, they were replaced by other species. That is, the species composition changed, but the number of species remained the same. These results parallel results of other studies on the effects of timber harvest on avian species (Franzreb and Ohmart 1978), and some studies have even found regenerating stands had higher bird abundance and species richness than mature stands (e.g., Duguid et al. 2016).

Louisiana bottomland hardwoods provide important habitat for resident species, occur within a major corridor for neotropical migrants (Barry et al. 1995), and have been subject to timber harvest for more than a century. Clearly, the effects of timber harvest on avian populations may be especially important in this region, but remain understudied. In this study, I evaluated the abundance and diversity of avian species on recently cut and uncut timber stands in Plaquemine, Louisiana.

MATERIALS AND METHODS

The project area (30°26’ N, 91°18’ W) is part of a timber harvest property owned and managed by A. Wilbert’s Sons, LLC located in Plaquemine, Louisiana. On this property, there are stands with trees cut in 2012, 2006, and 2000, and unharvested stands. My project focuses on stands cut in 2012 and unharvested stands because these groups have the most differentiated types of habitat. Unharvested stands served as the control and provided bottomland hardwood habitat with trees such as bald cypress (*Taxodium distichum*), sugarberry (*Celtis laevigata*), palmetto (*Sabal palmetto*), and maples (*Acer* spp.). Harvested stands served as the experimental group and were characterized by early successional species consisting mainly of woody vines, shrubs, and tall grasses.

In ArcGIS, I mapped out the project area and identified two sites, each with a harvested and unharvested stand. Sites were not majorly flooded, had both harvested and unharvested stands adjacent to each other, and were geographically separated by 350 m. Within each of the four stands, I randomly selected 3 points for observations (12 total observation points). Points were spaced at least 100 meters apart (to avoid double-counting birds), and at least 100 meters from the edge of the stand (to limit bias from edge effects) (Ralph et al. 1995). Points were then transferred to a GPS unit. Before the first date of sampling, I went to the property to scout the sites. Harvested stands were thick with dense, woody vegetation and briars. I used a machete to cut paths to the points in these stands. I flagged points with small strips of fluorescent tape so that they would be easier to find on future visits.

Observations began on September 20, 2016. All field observations were made with Madelyn McFarland (undergraduate, LSU-RNR) to maximize detection and accurate identification of bird species. We sampled on Tuesdays and Thursdays to ensure adequate temporal coverage while balancing logistical demands of ongoing classwork. We sampled one complete site (6 points, 3 each in harvested and unharvested stands) on Tuesdays and the other site on Thursdays. We alternated beginning in the unharvested stand and beginning in the harvested stand between visits. We did this to ensure that time of day did not affect our findings because avian activity significantly declines as the morning progresses (Lynch 1995). We started at dawn each day and continued for two and a half to three hours, depending on travel time to points. We remained at each point for eight minutes performing point counts. Initial species detections typically occur within the first five to ten minutes of being at a site, and the detection rate significantly drops after this point (Lynch 1995). There were 13 occasions where the observation window was shortened due to time constraints, which we controlled for statistically in our analysis (see below).

We identified birds visually and acoustically, but observations were predominantly made acoustically. To increase our efficiency and accuracy, we began taking audio recordings in the field to listen to later. During our second trip on September 29, we began using an iPhone 6 to record audio at each point. We combined observations from the recordings with observations made in the field, and compiled this data into an Excel spreadsheet. Over the course of two weeks, we identified the majority of the calls in forty-seven separate recordings, with the help of Dr. Kevin Ringelman and Cameron Rutt (Ph.D. candidate, LSU-RNR).

I conducted analyses in Excel and Program R during February and March of 2017. I quantified major avian guild differences between sites using summary statistics and graphical analyses to diagnose the effects of habitat on species composition. I used two-sample t-tests and multiple linear regression to test for significant differences in avian abundance and diversity at each of these sites. I used an alpha value of 0.05 to indicate significance of statistical tests. Data presented are means ± standard error unless otherwise noted.

RESULTS

Over a six-week period, I made observations on 9 sampling occasions. Overall, 410 individuals of 20 avian species were identified across 47 point counts (Table 1). I detected significantly more individuals in harvested plots (9.87±0.71) than in unharvested plots (6.67 ± 0.52) ($t = -3.32$, $p < 0.01$) (Fig. 1). I also detected significantly more species in harvested plots (6.70 ± 0.34) than in unharvested plots (5.15±0.37) ($t = -2.83$, $p < 0.01$) (Fig. 2). Most species were at least occasionally detected in both plots (Fig. 3), but Brown-headed Cowbirds and Ibis were only found in harvested sites, whereas Mourning Doves were only found in unharvested sites (Fig.3).

When broken down into plots (Fig. 4), harvested plots in Site 2 had the most individuals detected (119), but the least number of species (16). Carolina Wrens and Gray Catbirds were the most abundant species in these plots. Harvested plots in Site 1 had the highest number of species detected (19) and 108 individuals. Brown-headed Cowbirds and Gray Catbirds were the most abundant species in these plots. Unharvested plots in Site 1 had 92 individuals of 16 species, with Carolina Wrens being the most abundant species. Unharvested plots of Site 2 had 91 individuals of 18 species, with Carolina Wrens and Carolina Chickadees being the most abundant species.

I used linear regression to evaluate the effect of observation duration on species abundance and diversity I detected. I detected on average about 1 more individual per minute of observation (0.90±0.26) (p-value < 0.001) (Fig. 5) and about 0.5 more species per minute of observation (0.48±0.15) (p-value < 0.01) (Fig. 6). I was concerned the treatment effect described above may be biased by time restrictions on certain days. There were 10 counts restricted to 5 minutes: 2 replicates in unharvested site 1, 5 replicates in unharvested site 2, and 3 replicates in harvested site 2. There were 3 counts restricted to 3 minutes, all in unharvested site 2. To control for the effect of observation duration, I used multiple linear regression. The number of individuals detected increased with both observation duration ($p < 0.01$), and in harvested plots ($p < 0.01$). The number of species detected also increased with both observation duration ($p < 0.01$), and in harvested plots ($p = 0.02$). This indicates that even controlling for observation duration, the treatment effect remained significant.

Common Name	Scientific Name	Alpha Code	Harvested	Unharvested
American Crow	*Corvus brachyrhynchos*	AMCR	7	15
Blue Jay	*Cyanocitta cristata*	BLJA	24	17
Brown-headed Cowbird	*Molothrus ater*	BHCO	18	0
Carolina Chickadee	*Poecile carolinensis*	CACH	17	21
Carolina Wren	*Thryothorus ludovicianus*	CAWR	29	46
Dark Ibis	*Plegadis sp.*	IBIS	1	0
Downy Woodpecker	*Picoides pubescens*	DOWO	4	7
Eastern Phoebe	*Sayornis phoebe*	EAPH	10	4
Eastern Towhee	*Pipilo erythrophthalmus*	EATO	24	6
Gray Catbird	*Dumetella carolinensis*	GRCA	35	10
Orange-crowned Warbler	*Oreothlypis celata*	OCWA	7	4
Pileated Woodpecker	*Dryocopus pileatus*	PIWO	1	1
Mourning Dove	*Zenaida macroura*	MODO	0	1
Northern Cardinal	*Cardinalis cardinalis*	NOCA	2	9
Northern Flicker	*Colaptes auratus*	NOFL	12	11
Red-shouldered Hawk	*Buteo lineatus*	RSHA	20	12
Red-bellied Woodpecker	*Melanerpes carolinus*	RBWO	1	4
Tufted Titmouse	*Baeolophus bicolor*	TUTI	3	7
White-winged Dove	*Zenaida asiatica*	WWDO	3	3
White-eyed Vireo	*Vireo griseus*	WEVI	9	2

Table 1: Common name, scientific name, alpha code, and abundance of birds in harvested and unharvested sites.

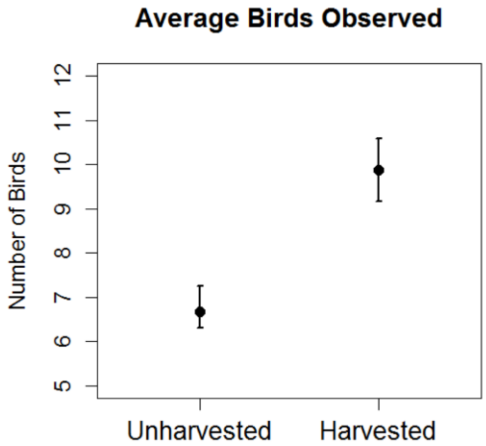

Figure 1. Individuals observed in harvested sites (9.87±0.71) and unharvested sites (6.67 ± 0.52) ($t = -3.32$, $p < 0.01$).

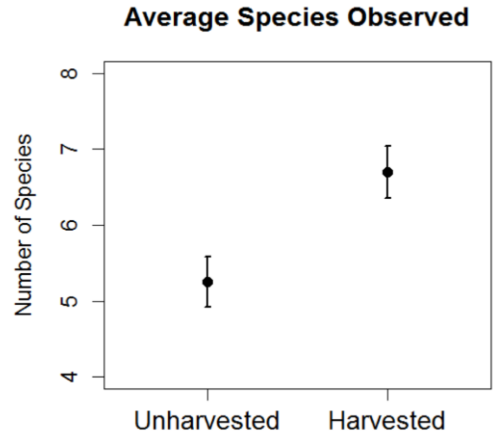

Figure 2. Species detected in harvested sites (6.70 ± 0.34) and unharvested sites (5.15±0.37) ($t = -2.83$, $p < 0.01$).

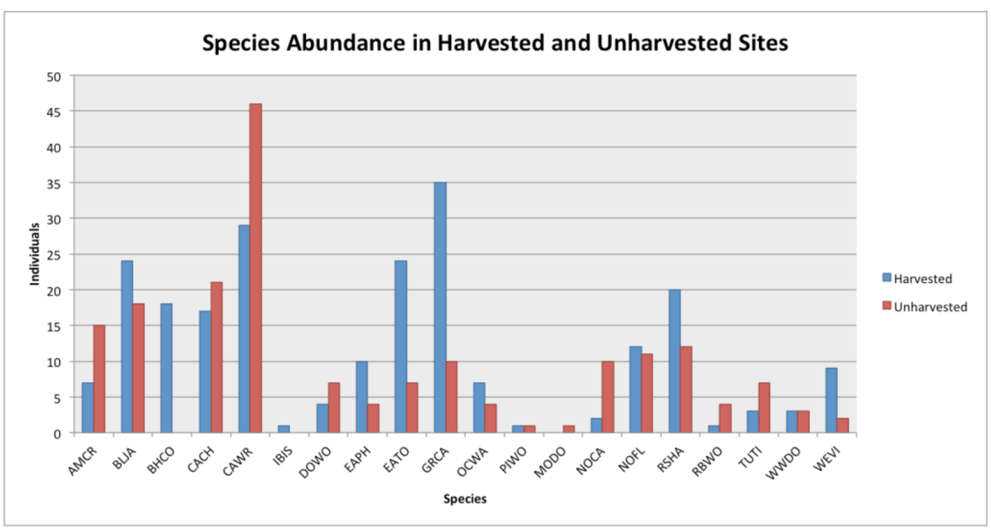

Figure 3. Total count of individuals per species observed in harvested and unharvested sites.

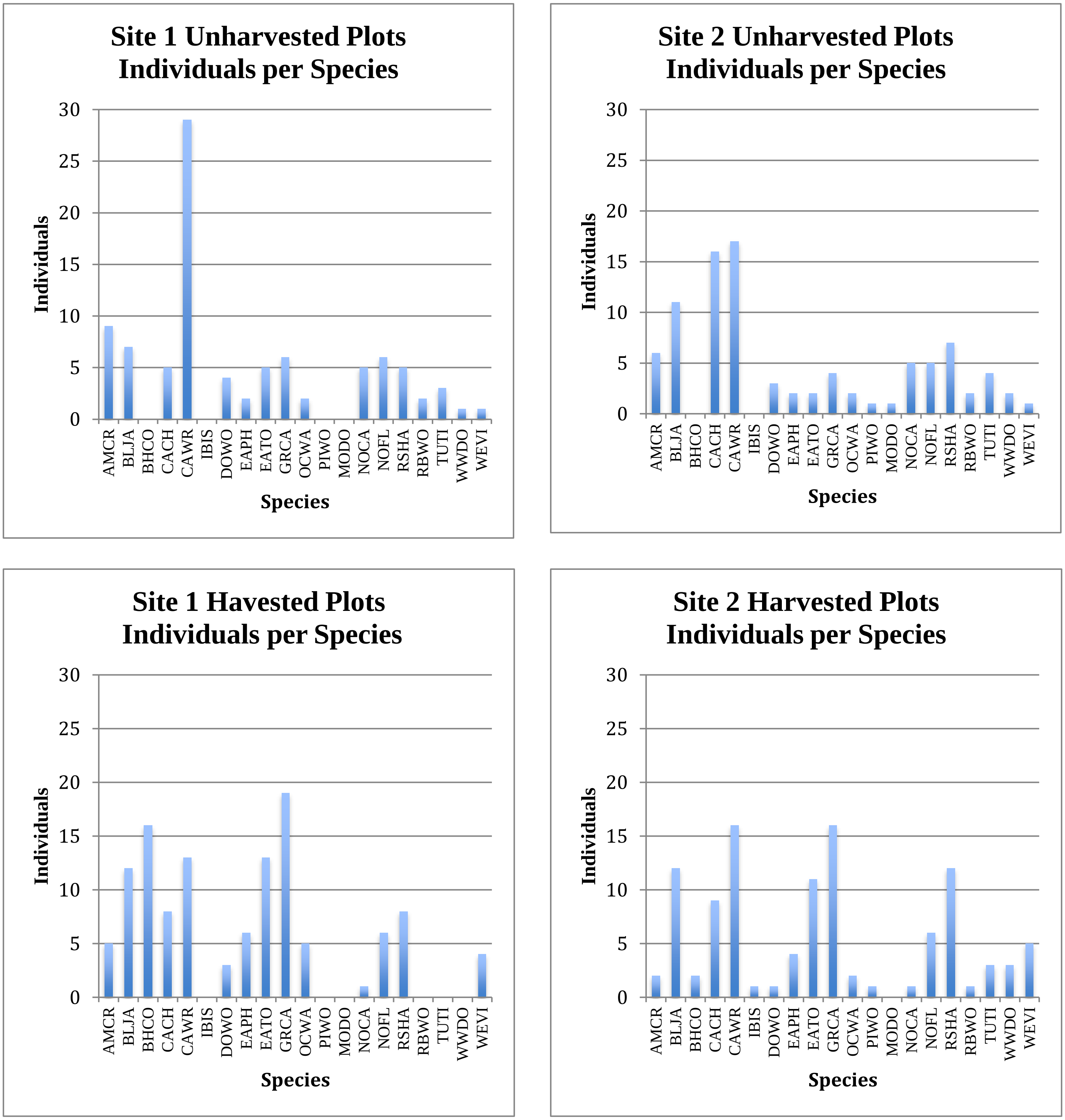

Figure 4. Individual bird amounts per species in harvested and unharvested sites. All three points in each plot were combined to provide total counts per plot.

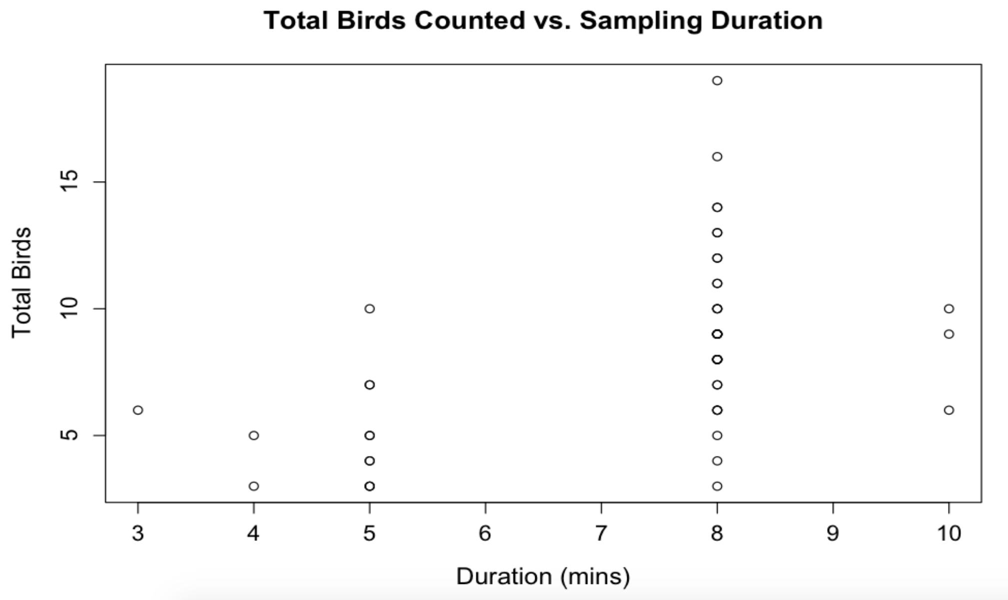

Figure 5. Duration of time spent at a site compared to number of individuals counted at the site. As duration increases by 1 minute, 0.90 ± 0.26 more individuals were counted.

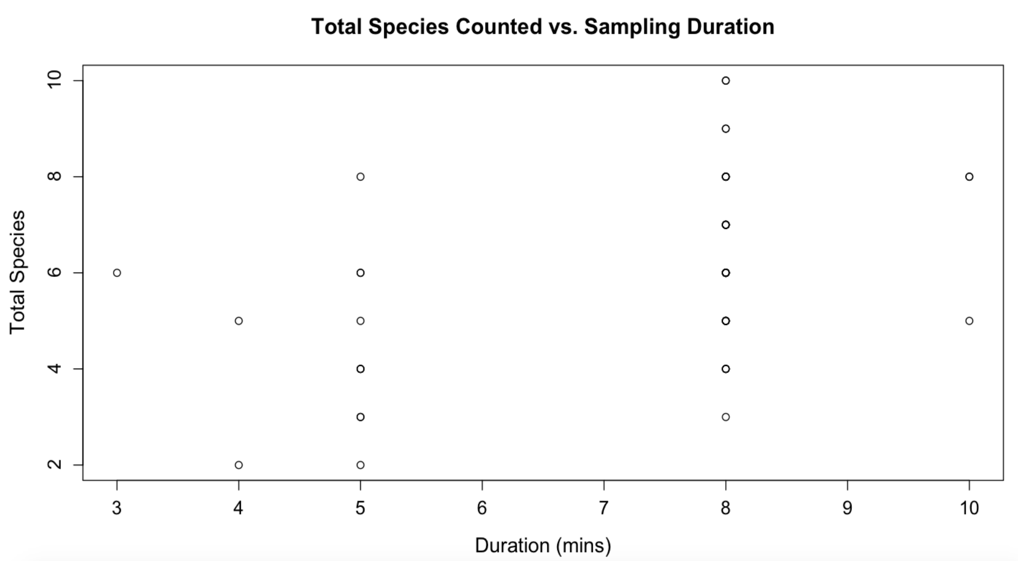

Figure 6. Duration of time spent at a site in minutes compared to number of species counted at the site. As duration increases by 1 minute, 0.48 ± 0.15 more species were counted.

DISCUSSION

My results show that harvested plots contained more birds and more species than unhavested plots. This parallels results in other systems such as New England forests where shelterwood timber harvest treatments are used. In those areas, more birds and species were found in regenerating stands than in mature stands (Duguid et al. 2016). My data show that, overall, Carolina Wrens are highly abundant across all sites. This coincides with data showing Carolina Wrens can live in bottomland forests and in brushy thicket areas and are common throughout their range (Cornell Lab of Ornithology 2016). Most species were detected in both harvested and unharvested sites. Brown-headed Cowbirds were only detected in harvested stands, concordant with previous data showing that these brood parasites prefer forest edges (Schweitzer et al. 1998). Eastern Towhees and Gray Catbirds were more common in harvested sites, suggesting these species specialize on edge habitat and are resilient to disturbance. Downy Woodpeckers and Tufted Titmice were mostly found in unharvested sites, suggesting that these species prefer late successional habitat.

My study contains observations made over the course of two months. Sallabanks et al. (2000) suggests that studies conducted on timber harvest effects on bird abundance should run for at least 3 years to gather enough (year-round) data to draw robust conclusions. Sallabanks et al. (2000) also suggest collecting pre- and post-harvest data on sites as well data on key habitat elements that may be responsible for any differences between harvested and unharvested sites, such as snag density and understory cover. Following these recommendations, there would be value in continuing this study with future interns for additional field seasons, perhaps during different times of the year. If the unharvested sites I studied are eventually harvested, my data on these sites can be used for pre-harvest data, and data taken afterwards can be used for post-harvest data. To build on the study, vegetation species composition should be documented in each site, as well as key habitat elements such as tree cavities, canopy density, and ground cover (Sallabanks et al. 2000).

In general, I found a greater species abundance and diversity in recently harvested timber stands. However, certain species seemed to prefer undisturbed, late-successional habitats, and so both habitats are necessary to support the full community of avian species. Given these results, I recommend continuing to practice group-selection harvest of timber to maintain a diversity of successional states on the property.

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