

The Effect of Firewood Removal on Breeding Bird Populations in a Northern Oak Forest¹

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Abstract.--Breeding bird populations and snags were examined in relation to a controlled firewood removal in a northern oak forest in Michigan. Snag densities were significantly decreased by the firewood removal, but a complete reduction did not occur due to new snag generation and the presence of certain snags unsuitable as firewood. Cavity-nesting bird species were not decreased by the firewood removal due in part to the utilization of live trees or dead portions of live trees as nest sites. Snags did provide important foraging sites, but their loss did not cause identifiable decreases in the use of the study areas in this investigation.

INTRODUCTION

Past reductions in fossil fuels have led to a greater use of alternate energy sources. Wood, as a home heating fuel, continues to increase in popularity. For example, the number of firewood cutting permits issued by the White Cloud Ranger District of the Manistee National Forest has risen 414% between 1978 and 1982. Increasing demand for firewood poses a potential threat to the wildlife that utilize snags for food or cover. Many species of birds have been shown to use snags for numerous purposes including nesting, roosting, perching, and storing food (Thomas et. al. 1979, Miller and Miller 1980). The role of snags as nesting and foraging sites for the cavity-nesting bird species has been the subject of a number of recent studies (Conner et. al. 1975, Scott 1978, Conner 1980, Mannon, Meslow, and Wright 1980). Nest sites are generally considered a primary limiting factor in determining densities of these species. This study examined the impact of firewood removal on breeding bird populations and

habitat, especially snag densities and characteristics, within a northern oak forest in Michigan.

SITE DESCRIPTION

Six, 15 ha rectangular study plots were established within the White Cloud Ranger District of the Huron-Manistee National Forest, 12 km west of Big Rapids, Michigan. Plot boundaries were designated to make all plots as uniform in stand characteristics as possible. The distance between plots ranged from 200 m to over 1 km. Stands, consisting mainly of mature red oak (Quercus rubra) and white oak (Q. alba) along with smaller percentages of red maple (Acer rubrum), black oak (Q. velutina), and big-toothed aspen (Populus grandidentata), covered the study area. Midstory vegetation was comprised of witchhazel (Hamamelis virginiana), serviceberry (Amelanchier spp.), and sassafras (Sassafras varifolium).

Extensive vegetative sampling was conducted on each plot to quantify characteristics such as stem densities and vegetative cover. The absolute density of woody species >5 cm d.b.h. averaged 528 ± 73 per ha, with a mean basal area of 25.5 ± 3.5 m² per ha. Importance values based on relative density, relative frequency, and relative dominance averaged 102 ± 3.4 for white oak, 84.7 ± 10.5 for red oak, 57.8 ± 10.7 for red maple, 28.9 ± 4.1 for black oak, and 13.8 ± 4.9 for big-toothed aspen. The % vegetation cover measured in three height strata (<1 m, 1-7 m, >7 m) was used to calculate foliage height diversity (McArthur and McArthur 1961) which averaged 0.87 ± 0.02 . The average age of the stands was 65 years.

¹Paper presented at the Snag Habitat Management Symposium. (Northern Arizona University, Flagstaff, June 7-9, 1983).

²Journal Article No. 10859 from the Michigan Agricultural Experiment Station.

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METHODS

Three of the 6 study plots were randomly selected for treatment while the other three served as controls. In this study, treatment consisted of the removal of all dead standing or dead and down wood as per National Forest Service policy regarding firewood removal. In September 1981, the center 8 ha of each treatment plot was cleared of all firewood. A small number of the more rotten snags were considered unsuitable as firewood and were not removed to simulate conditions found on areas open to the public for firewood cutting. The uncut 50 m border zone served as a buffer and made it possible to examine any changes in bird distributions such as possible clumping of territories around the treatment area.

Breeding bird population densities were determined by the spot-mapping method following I.B.C.C. recommendations (1970). Birds were censused once before firewood removal in the breeding season of 1981 and once again following treatment during the 1982 season. At least 8 surveys were made of each plot each year between 10 May and 23 June. Census takers and their routes over the plots were regularly varied to control observer bias and compensate for changes in bird detectability with time of day. Following the censusing each morning, cavity-nesting birds were located and followed to determine active nest sites.

A survey of all snags >18 cm d.b.h. was conducted both years to determine snag densities and characteristics. Each snag in this size class was examined and the features of tree species, d.b.h., height, % bark cover, top condition, and number of branches were recorded. The presence of woodpecker foraging evidence and cavities was also noted.

These features were used to categorize snags into five different stages. These stages ranged from snags with 100% bark cover, intact top, and many branches to snags with 0-5% bark cover, broken tops and no branches (Fig. 1).

The density of snags in the 5-18 cm d.b.h. size class was determined by a random sampling method using 50 m x 50 m quadrats. Physical characteristics of snags in this size class were not recorded. Bird population parameters and snag densities were tested for significant differences by the use of t-tests.

RESULTS

A total of 915 snags >18 cm d.b.h. were surveyed in 1981 at a mean density of $10.2 \pm .89$ snags per ha. The density of snags in the 5-18 cm d.b.h. size class averaged 45.4 ± 5.9 per ha. The average d.b.h. of the snags in the larger size class was 24.6 ± 0.64 cm and ranged up to 50 cm. Woodpecker foraging evidence appeared on $44.6 \pm 2.1\%$ of the larger snags and more specifically on $74.5 \pm 2.8\%$ of the aspen snags. Only $8.8 \pm 1.9\%$ of the snags examined in 1981 held cavities. None of the above factors were significantly different between controls and treatments in 1981, prior to firewood removal.

The majority of the snags present on the study area in 1981 were in the early stages of snag succession (Fig. 2) based on the categorization scheme presented earlier. Few snags characterized by stage 5 were present. The % of snags with foraging evidence or cavities, however, was greater in the later stages (Fig. 3).

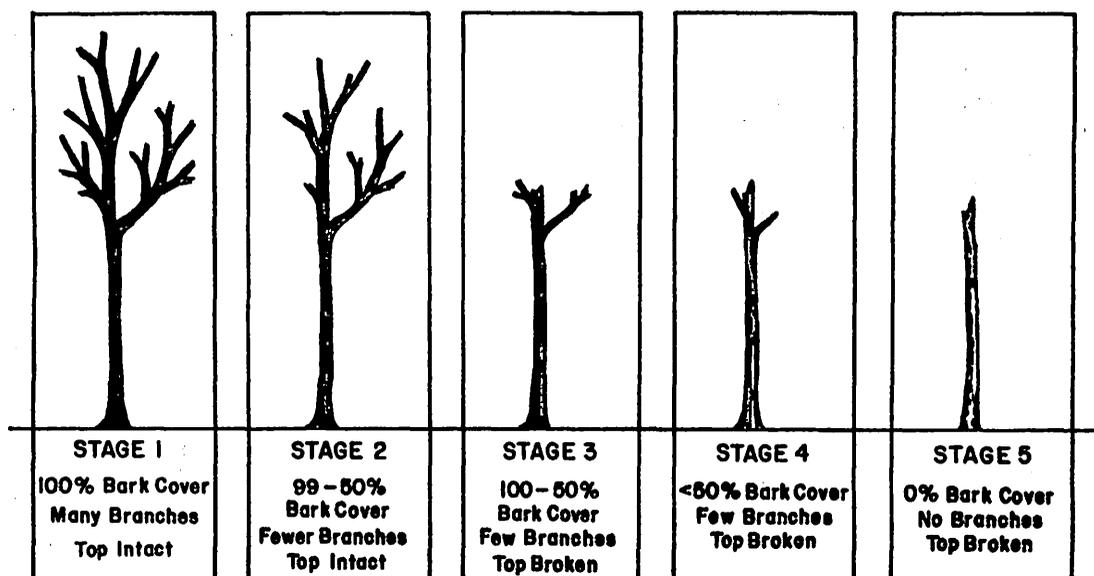


Figure 1. Description of the stages of snag decay based on physical characteristics of bark cover, top condition, and number of branches.

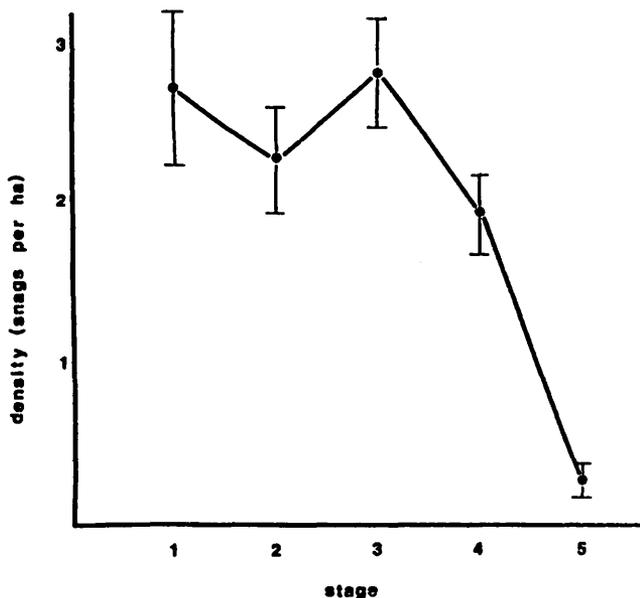


Figure 2.--Mean densities and standard errors of snags (>18 cm d.b.h.) by stage in 1981 in northern oak stands in Michigan.

Densities of snags (>18 cm d.b.h.) on treatment plots decreased significantly following firewood removal (Fig. 4). Snag densities over the entire treatment plot were reduced an average of $34.7 \pm 6.7\%$ while densities specifically within the treatment zone were decreased an average of $69.1 \pm 3.4\%$. Snags (5-18 cm d.b.h.) were also significantly decreased by firewood removal to $35 \pm 7.8\%$ of their original density of the entire plot. Total reductions in snag numbers were not achieved due to the generation of new snags and the presence of a small number of snags that were unsuitable as firewood.

The aspect of snag generation was evident on control plots as well. All control plots showed a net increase in snag (>18 cm d.b.h.) densities with the exception of plot 5, where the net change in density was -0.37% due to the occurrence of some uncontrolled, non-project related firewood cutting. The average % change in snag densities on the other 2 control plots was $18.75 \pm 4.15\%$. Based on data collected on the two undisturbed control plots, live trees were becoming snags at a mean rate of 2.1 ± 0.6 per ha.

Fifteen species of breeding birds were included in the census of 1981 and 1982 (Table 1). The eastern wood pewee was the most abundant species followed by the red-eyed vireo. Six species of cavity-nesting birds were observed, but only three, the hairy woodpecker, the white-breasted nuthatch, and the great-crested flycatcher were found on all plots both years. Cavity-nesters made up 14.9% and 12.5% of the total population in 1981 and 1982, respectively. Prior to firewood removal, breeding bird populations averaged 189.5 ± 5.5 individuals per 40 ha and were not significantly different between control and treatment plots (Table 2). Following the treatment, bird populations on control plots were significantly

greater ($P < 0.10$) than those on treatment plots. These differences were due mainly to greater numbers of scarlet tanagers and ovenbirds. Densities of cavity-nesting birds on treatment plots were not significantly different from control plots either before or after firewood removal. Bird species richness and diversity were not affected by the treatment.

Nest sites of all cavity-nesting birds were not successfully located, but at least one nest site was located for each cavity-nesting species with the exception of the great-crested flycatcher (Table 3). Most nests found were those of the hairy woodpecker and the white-breasted nuthatch. The low number of nest sites located for the downy woodpecker, black-capped chickadee, and red-headed woodpecker corresponded to the infrequent occurrence of these species on the study plots. Oaks were selected the most frequently by all cavity-nesting species except for the hairy woodpecker which more often selected aspen. Eighty-six % of all nests were located in live trees or dead portions of live trees and only 14% of the nests were located in snags.

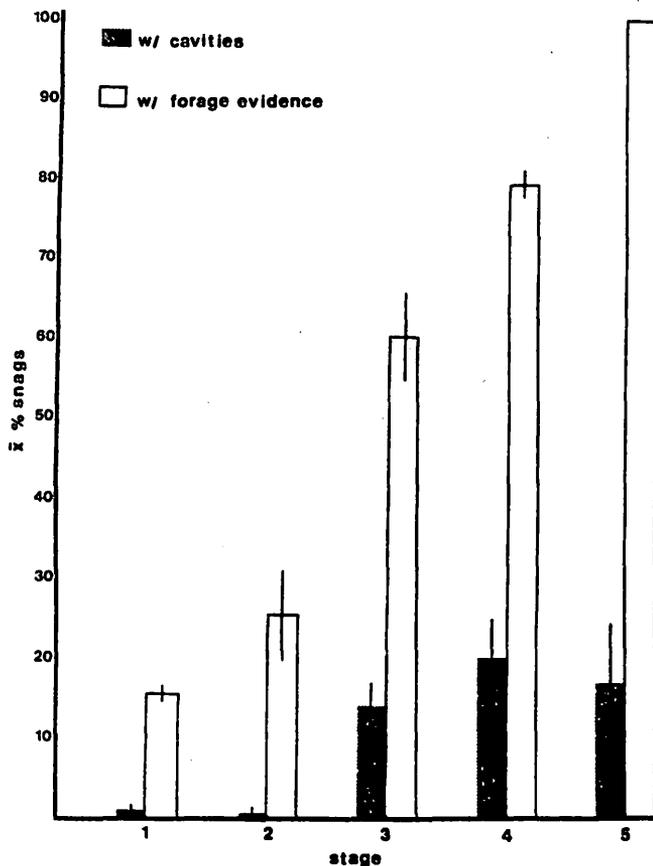
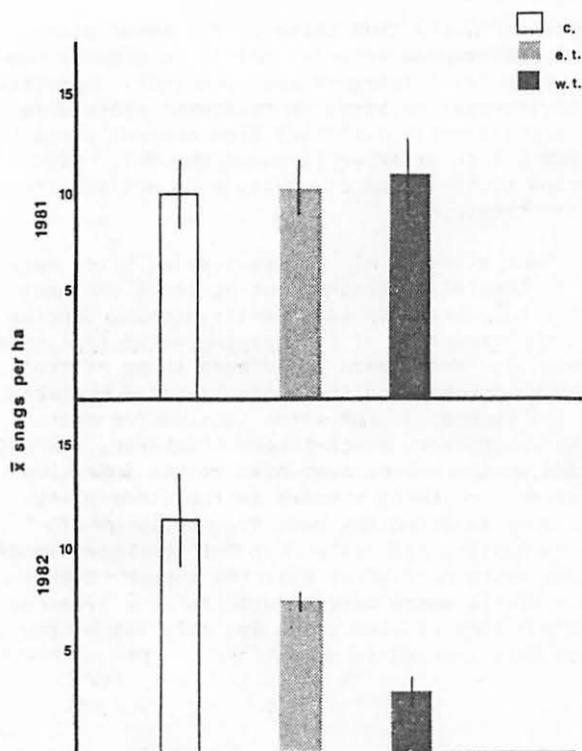


Figure 3.--Mean and standard error of snags (>18 cm d.b.h.) with foraging evidence and cavities in 1981 in oak stands in Michigan.

DISCUSSION



*significantly different ($P < 0.02$) from controls.

Figure 4.--Mean snag (>18 cm d.b.h.) densities and standard errors for control plots (c.), entire treatment plots (e.t.), and within the treatment area (w.t.) before and after firewood removal in oak stands in Michigan.

Results of the bird census and snag survey conducted in 1981 confirmed that control and treatment plots did not differ in terms of snag densities or bird populations prior to firewood removal. Vegetative sampling completed during the study period also showed no major differences in the plant community, so that the only significant difference in bird habitat between control and treatment plots in 1982 was the decrease in snag densities resulting from the firewood cutting. The significantly ($P < 0.10$) lower density of breeding birds on the treatment plots in 1982 is difficult to relate to the reduction in numbers of snags because the species accounting for most of the difference were not cavity-nesters.

The absence of an expected decrease in cavity-nesting bird species may have been due to several factors. First, most of the cavity-nesting birds inhabiting the study plots preferred to nest in live trees or dead portions of live trees. The preference for live trees exhibited by the hairy woodpecker and the white-breasted nuthatch has been noted by other authors (Kilhorn 1968, Lawrence 1966). The use of live aspen by hairy woodpeckers follows with the observations of Lawrence (1966) but is in contrast to those of Conner (1976). The lack of data collected for the great-crested flycatcher made it impossible to determine whether it was more often selecting cavities in live trees or snags, but regardless, detections of this species did not decrease after firewood removal. Secondly, snag densities present on the study plots before treatment were considerably above levels recommended by Evans and Conner (1979) for woodpecker species typical of this vegetation type, so that significant reductions in snag numbers may have still left enough remaining snags to support the populations. The average snag

Table 1.--Average numbers of breeding birds by species before and after firewood removal on 15 ha study plots in northern oak stands in Michigan.

Common name (Scientific name)	1981		1982	
	Control $\bar{X} \pm S.E.$	Treatment $\bar{X} \pm S.E.$	Control $\bar{X} \pm S.E.$	Treatment $\bar{X} \pm S.E.$
Red-headed woodpecker (<i>Melanerpes erythrocephalus</i>)	0.67±0.67	0.67±0.67	-	-
Hairy woodpecker (<i>Picoides villosus</i>)	3.3±0.67	2±0	2±0	2±0
Downy woodpecker (<i>Picoides pubescens</i>)	-	-	0.67±0.67	-
Great-crested flycatcher (<i>Myiarchus crinitus</i>)	2.6±0.67	2.6±0.67	2±0	2.6±0.67
Eastern wood pewee (<i>Contopus virens</i>)	18.7±0.67	18.7±1.7	16.7±2.9	16.7±1.3
Blue jay (<i>Cyanocitta cristata</i>)	1.3±0.67	4.6±0.67	6.7±0.67	4.6±1.3
Common crow (<i>Corvus brachyrhynchos</i>)	-	-	-	0.67±0.67
Black-capped chickadee (<i>Parus atricapillus</i>)	-	1.3±1.3	2±1.1	0.67±0.67
White-breasted nuthatch (<i>Sitta carolinensis</i>)	4±0	4±1.1	4±0	4±1.1
American robin (<i>Turdus migratorius</i>)	0.67±0.67	0.67±0.67	1.3±0.67	-
Yellow-throated vireo (<i>Vireo flavifrons</i>)	-	-	0.67±0.67	1.3±0.67
Red-eyed vireo (<i>Vireo olivaceus</i>)	15.3±0.67	10.7±2.4	16.7±1.3	14.6±1.3
Ovenbird (<i>Seiurus aurocapillus</i>)	9.3±1.8	10.7±1.8	12±1.1	8.7±3.3
Scarlet tanager (<i>Piranga olivacea</i>)	6.7±1.3	8±2.3	12±1.1	6.7±1.8
Rose-breasted grosbeak (<i>Pheucticus ludovicianus</i>)	8.7±1.8	8.7±1.8	10±2	11.3±1.8

Table 2.--Breeding bird community characteristics before and after firewood removal on study plots in northern oak stands in Michigan.

	1981		1982	
	Treatment $\bar{X} \pm S.E.$	Control $\bar{X} \pm S.E.$	Treatment $\bar{X} \pm S.E.$	Control $\bar{X} \pm S.E.$
Bird density (40 ha)	194 \pm 4.6	189 \pm 6.3	196 \pm 9.4*	230 \pm 8.6*
C.N.B. density (40 ha)	28 \pm 1.8	29 \pm 1.8	25 \pm 4.7	28 \pm 3.5
Species richness	10 \pm 0.6	9.7 \pm 0.3	10 \pm 0.0	10.7 \pm 0.9
Species diversity ¹	2.04 \pm 0.06	2.00 \pm 0.05	2.07 \pm 0.11	2.07 \pm 0.08

*significantly different (P<0.10)

¹) calculated by the Shannon Weaver Index

d.b.h. was also within the ranges used by woodpeckers with the exception of the pileated woodpecker (*Drycopus pileatus*), although this species was observed foraging on the plots occasionally.

The near total absence of the downy woodpecker may have been due to the high percentage of snags in the early stages of snag succession, which may have been too "hard" for this species to excavate (Conner 1978). The higher percentage of older snags having cavities points to the increasing value of a snag as it ages. Since firewood cutters normally prefer the harder snags in an early stage of snag decay, the impact of the removal on some species may become more pronounced with time when no new snags will be left to age.

The importance of snags as foraging sites was evident by the high number exhibiting signs of use. Aspen species, in particular, appeared important in this regard. Due to the poor quality of aspen as firewood, it is usually less often selected by firewood cutters, and was often the species of snag not cut in this study due to its rapid decay. However, as the stands investigated age, aspen will become less frequent due to successional change, and other species of snags, such as oaks, will become more important as foraging sites. Again, the high % of foraging evidence on snags in the later stages of decay may mean that the effect of firewood removal may become greater with time.

Table 3.--Condition of nest trees used by the cavity-nesting bird species in northern oak stands in Michigan.

	Live tree	Dead portion of live tree	Dead tree
Hairy woodpecker	4	0	0
White-breasted nuthatch	6	0	1
Downy woodpecker	0	1	0
Black-capped chickadee	1	0	0
Red-headed woodpecker	0	0	1

The generation of new snags was clearly evident on the control plots and is a factor which may reduce the impact of firewood removal. Although the trees that died and became snags between 1981 and 1982 were probably not very suitable for cavity-nesting species and also provided poor foraging sites, their value to cavity-nesters will increase in time if they are not removed by additional firewood cutting. However, it would take approximately four to five years for snag generation to produce recommended numbers of snags (Evans and Conner 1979) and many more years before these snags decayed to the preferred stages.

A final consideration in the results of the study related to the dimensions of the study plots. Although a 15 ha study plot size approached the limit of managability of the project, large numbers of cavity-nesters important in showing statistically significant changes did not occur in the study plots due to the large territory size of most cavity-nesting species.

MANAGEMENT IMPLICATIONS

Results of this study suggest that small areas within this vegetation type could be harvested for firewood without significant reductions in cavity-nesting bird populations due to the extensive use of live trees or dead portions of live trees for nesting by these species. This does not mean that the loss of snags over large areas would not decrease bird numbers, but that blocks up to 8 ha in size may be intensively harvested over a short time span. Cavity-nesting species in other vegetation types may show a different response if they are more dependent on snags, as has been suggested by other authors, than the species observed in this study. However, even in northern oak forests, continual harvesting of newly formed snags may be detrimental because eventually no snags in the later stages of decay will be present.

The importance of aspens as foraging sites as well as nesting sites in both live and dead trees indicates that at least small percentages of this or other "soft" species should be encouraged in forest stands. Timber harvesting and timber stand improvement practices might be modified to include such considerations.

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