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EFFECTS OF VEGETATIVE FACTORS ON THE WINTER DISTRIBUTION OF THE COLOR PHASES OF THE EASTERN SCREECH OWL, *OTUS ASIO*, IN CENTRAL PENNSYLVANIA

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ABSTRACT

The Eastern screech owl, *Otus asio*, exhibits two color phases, the rufous (red) phase, and the gray phase. Previous studies have shown that the rufous phase exhibits a higher metabolic rate, leading to the consumption of more prey and the expenditure of more energy. Certain vegetative factors can lead to variations in prey habitat, possibly influencing placement of screech owl territories. The goal of this research was to determine if there were any vegetative differences between red and gray phase screech owl territories. We examined six vegetative factors including tree density, basal area, basal area of large seeded trees (oaks, hickories, walnuts), density of snags, percent canopy cover, and percent ground cover. We hypothesized that the rufous phase would have a preference in winter toward forests with higher tree density, higher basal areas of all trees and large-seeded trees only, greater snag density, higher percent canopy cover, and higher percent ground cover. We found no significant differences in any of these six factors between rufous and gray phase owl territories: tree density (t = -1.67, df = 8, P = 0.134), basal area (t = -0.82, df = 11, P = 0.430), basal area of large seeded trees (t = -0.29, df = 9, P = 0.777), snag density (t = -1.35, df = 7, P = 0.218), canopy cover (t = 1.73, df = 10, P = 0.114), and ground cover (t = 0.34, df = 17, P = 0.736). These results suggest that vegetative cover is not a determining factor in screech owl territory preference.

Keywords: eastern screech owl, habitat selection, Otus asio, *metabolism, vegetation.*

INTRODUCTION

The Eastern screech owl is a wide-ranging species, found East of the Rocky Mountains to the Atlantic, and from the Canadian boreal forest, south to Mexico. It exhibits two color morphs, rufous (red) and gray. The rufous morph typically lives in the south, while the gray morph inhabits the north, but both phases can be found in central Pennsylvania (The Birdhouse Network, 2001). The rufous color phase has been shown in previous studies to have a higher metabolic rate than its gray counterpart, which will give the gray an advantage over the rufous when prey is limited (Burggren and Roberts, 1991). Due to its low metabolic rate, the rufous phase may eat more prey in order to obtain sufficient energy for growth, maintenance, movement, and reproduction. This is a problem for the rufous phase, especially in winter, because endothermic animals must produce at least as much body heat as they lose (Hekstra, 1973).

For these reasons, we hypothesized that the rufous phase should inhabit forests with vegetative factors that increase its ability to catch prey, and result in the expenditure of less energy. Since a forest with higher densities of trees has less open areas and thus would accumulate less snow, we hypothesized that the rufous phase would have a preference in winter towards higher density forests. This is because the Eastern screech owl is a visual hunter and needs to see their prey to capture it (Johnsgard, 1988). This is unlike other species of owls that can capture prey under total darkness by sound cues alone, even diving into the snow to capture prey (Johnsgard, 1988). We also hypothesized that the Eastern screech owl would prefer forest with higher basal areas in winter, since they are susceptible to predation. Studies show that rufous owls need more sheltered roosting sites than the gray owls because of its contrasting color to its surroundings. For this reason, larger trees should allow for them to stay hidden from visually oriented predators such as hawks, mammals, and other owls (Baker and Bibby, 1987). Our third hypothesis was that the rufous owls should have a preference for inhabiting forests with an increased basal area of large seeded trees, such as oaks, hickories, and walnut. This is due to the importance of these tree species to the diets of small mammals and birds upon which the Eastern screech owl feeds. Studies show that acorns alone are a significant food item for more than 150 species of birds and mammals. They typically make up at least 25% of the diets of both gray squirrels and white-footed mice, which are both primary prey species of the Eastern screech owl (Line, 1999). Another study conducted in Eastern Tennessee found that many more small mammals were found in mature oak-hickory forest than in nearby smaller seeded pine forests (Dueser and Shugart, 1978).

Our fourth hypothesis stated that the rufous phase should inhabit areas with a greater density of snags or dead trees due to the amount of energy they save. Nesting in cavities of dead trees may reduce the owls' metabolic demands, because such shelters may reduce heat loss. This would be especially advantageous to the rufous owls because of their higher metabolic rate (Carey and Marsh, 1981; Heinrich, 1993). Our fifth hypothesis stated that the rufous phase should prefer forests with high canopy cover, favoring more foraging rodent prey. Rodents are more likely to forage on moonlit nights if there is sufficient shading from the canopy (Bowers, 1988).

Our final hypothesis was that the rufous owl should inhabit areas with more ground cover, which also favors more rodent prey. Fruits, seeds, and nuts produced by plants found in dense ground cover provide abundant food for small birds and mammals, which attain high densities in forest with these characteristics (Baranski, 1975). Higher small mammal densities make it easier for rufous owls to catch prey, thus reducing their energy expenditure during the cold winter months.

This study is a continuation of work done by Olsen and Mooney (2001), who located the territories used in this research. Our research was designed to gain more knowledge of the vegetative preferences of the Eastern screech owl color phases, which was also the subject of their research. This knowledge can then be used in formulating timbering methods that preserve suitable habitat for conserving the color phases of this bird

METHODS

During April 2001, we sampled sixteen predetermined Eastern screech owl territories in Huntingdon County, Pennsylvania. Eight plots were inhabited by the rufous color phase, and eight others were inhabited by the gray phase (Table 1).

Three samples were taken within each of these sixteen territories. The first sample was determined by marking off 35 meters from the boundary of each territory. The second two were chosen by using a random number generator from 1 to 8 which corresponded to the headings of a compass (i.e , 1=north, 2=Northeast, 3=East, etc.). Once two numbers were generated we marked off 35 meters in the corresponding direction, which designated the center of each sample area. This was done to ensure that the territories would be adequately sampled in a random way, but not go beyond the areas where particular owl phases were recorded.

At each sample plot we estimated six vegetative factors: tree density, tree basal area, basal area of large seeded trees, density of snags, percent canopy cover, and percent ground cover. The first four factors were measured by marking off a 15-m radius circle, with a tape measure, around the center of each plot. Each tree in the circle was counted, identified by species, and measured for DBH (diameter at breast height [1.64 m] = the circumference/3.14), and any snags in the circle were recorded. Only trees with a DBH of 7.62 cm (3 in) or greater were recorded. We calculated the basal area of each large-seeded tree (oaks, hickories, and walnuts) so that it could be used to formulate the total basal area of large seeded trees per sample plot

Table 1: General descriptions of the screech owl territories within six locales in Huntingdon County, Pennsylvania. Trap lines that were operated on the same night are paired (e.g., 1a, 1b). Based on Olsen and Mooney (2001).

General Locale	Town	Territory	Rufous	Gray	Description
Patrick's Lodge	Petersburg	Spillway	√		Primarily evergreen, with scattered deciduous, bordered by small stream and pond, lowland
Patrick's Lodge	Petersburg	Fire Ring		√	Exclusively mixed deciduous, no significant top soil, instead mostly boulders, elevated hillock
Patrick's Lodge	Petersburg	Patrick's Lodge	√		Mixed deciduous and evergreens, alongside very small pond formed by dammed stream
Fouse's Crossing	Entriken	Wetlands		√	Primarily deciduous with mixed evergreens, slightly higher peninsula amidst lowland wetlands.
Trolley Grade	Huntingdon	Predator	√		Mixed deciduous and evergreens, stream lowlands
Petersburg Pike	Oneida	Power Lines		√	Exclusive deciduous, immature forest, bordered by power line cut
Trolley Grade	Huntingdon	Stream	√		Mixed deciduous and evergreens, stream lowlands
Petersburg Pike	Oneida	Deer Path		√	Primarily deciduous with scattered evergreens, alongside small clearing
Raystown Spillway	Juniata Valley	House	√		Primarily deciduous with scattered evergreens, melt-water stream-bed, nearly adjacent to Raystown Branch of the Juniata River
Raystown Spillway	Juniata Valley	Dam		√	Primarily deciduous with scattered evergreens, extremely steep slope on both sides of stream.
Raystown Spillway	Juniata Valley	Squirrel	√		Primarily deciduous with scattered evergreens, nearly adjacent to Raystown Branch of the Juniata River
Raystown Spillway	Juniata Valley	Logging Road		√	Primarily deciduous with scattered evergreens, slope on both sides of stream.
Fouse's Crossing	Entriken	James Creek	√		An evergreen stand clearly divided from a deciduous stand by a ~20m wide swath of swampy lowlands
Raystown Field Station	Entriken	RFS		√	Mixed deciduous and evergreens, exposed ridge top
Patrick's Lodge	Petersburg	Gravel Pit	√		Primarily evergreen with scattered deciduous, small melt-water stream
Fouse's Crossing	Entriken	Suburbia		√	Primarily evergreens with mixed deciduous, steep incline

The final two vegetative factors, canopy cover and groundcover, were measured by taking two 10-m transect lines. The first transect line was extended from the center by randomly sampling numbers as before, and measured out 10 m from the center in the direction of the corresponding compass heading. The second transect line was set at a right angle to the first. We randomly sampled numbers, 1-4 designated that it should go to the right of the first transect line, while numbers 5-8 designated that it should go to the left of the first transect line. The percent canopy cover was estimated using an ocular tube with cross hairs. Starting from the end of the 10 meter transect line we looked upward toward the sky at a 45° angle, noting whether the crosshairs were covered by any vegetation. If so, this was recorded as being canopy, if not it was considered open. This was done a total of 20 times at each sample plot (10 per transect line) at each 1-m interval. Percent groundcover was also determined by using an ocular tube and the same techniques and transect lines as done for percent canopy cover. The only difference is that we looked down at a 45° angle and recorded ground cover as being any type of herbaceous plants, small woody saplings, large rocks/rock piles, and fallen logs or debris. We did not count leaf litter, or bare soil as ground cover since they do not provide any food value or much protection from predators.

Mean values of each six vegetative factors were calculated for each of the 48 sample sites (16 territories with 3 sample sites each). The basal areas were converted to meters per sample site. Each sample site consisted of an area of 706.86 m^2. Means for all six vegetative factors were then calculated for each of the 8 rufous phase territories (24 sample sites) and 8 gray phase territories (24 sample sites). After testing for normality and equal variances, a two sample t-test was done comparing each vegetative factor separately between rufous and gray owl territories. A P-value ≤ 0.05 was used to determine whether data were significant.

RESULTS

None of the six vegetative factors differed significantly between rufous and gray phase territories. (tree density: $t = -1.67$, df = 8, $P = 0.134$; basal area: $t = -0.82$, df = 11, $P = 0.430$; basal area of large seeded trees: $t = -0.29$, df = 9, $P = 0.777$; snag density: $t = -1.35$, df = 7, $P = 0.218$; canopy cover: $t = 1.73$, df = 10, $P = 0.114$; and ground cover: $t = 0.34$, df = 17, $P = 0.736$) (Figs. 1 & 2).

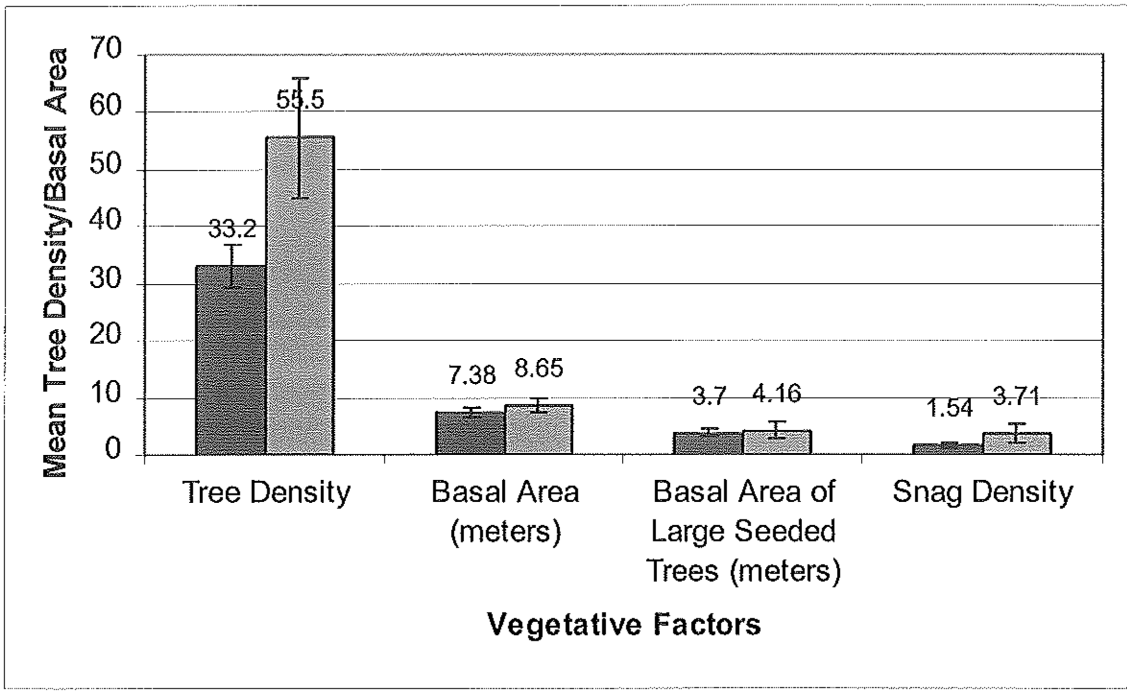

Figure 1. Means (±SE) of various vegetative factors, comparing 8 gray phase and 8 rufous phase screech owl territories in Huntingdon County, Pennsylvania.

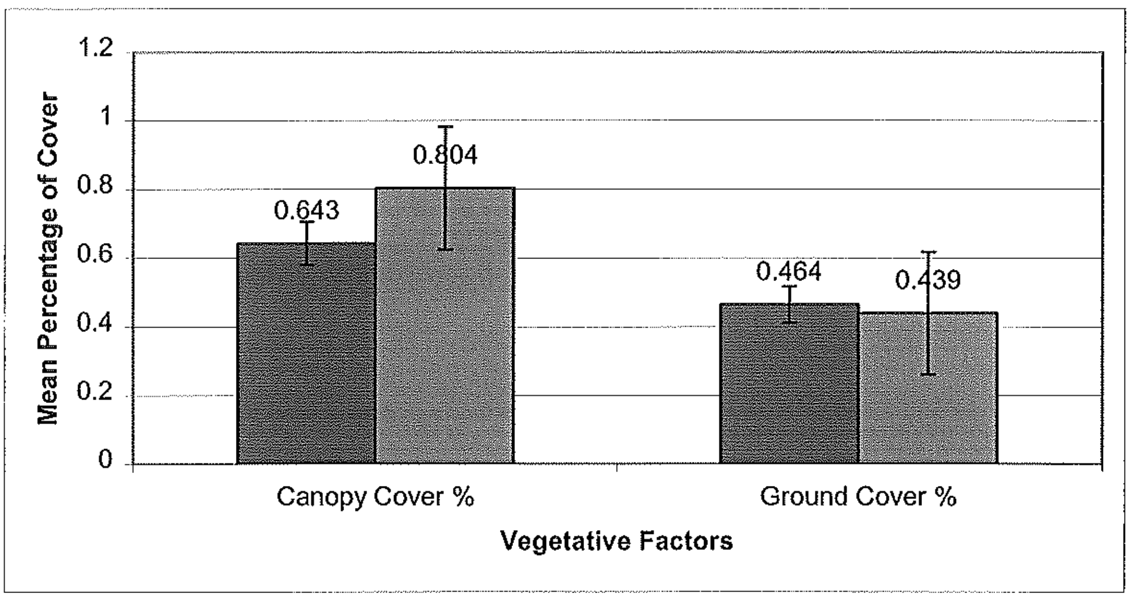

Figure 2. Mean (±SE) percent canopy cover and ground cover, comparing 8 gray phase and 8 rufous phase screech owl territories in Huntingdon County, Pennsylvania.

DISCUSSION

None of the six vegetative factors that we tested differed significantly between rufous and gray phase Eastern screech owl territories. These results suggest that the two color phases do not have significant differences in preference for forest habitat, at least during mild winters with minimal snow cover such as the one that occurred during this study. Despite their higher metabolic rate, the rufous phase may have been able to use similar forest habitat as that of the gray phase because prey were readily accessible (due to lack of snow cover) and heat loss was minimal (due to mild temperatures). In addition, some of the vegetative factors we examined may have had conflicting effects on prey accessibility. For example, increased groundcover may not only favor more small mammals, but also limit the ability of the Eastern screech owl to catch these prey.

Another factor possibly affecting our data is that the territories of the rufous and gray phase owls differ. This is important since the rufous may inhabit larger areas, and thus not need as high prey densities, which we hypothesized were related to some of our vegetative factors, such as ground cover.

Further studies should be done to see if the results of our study would be the same during harsher winters. In addition, it may be worthwhile to directly estimate seed densities on the forest floor, which may affect the abundance of the owls' prey. This is especially important in the case of large seeded trees since some species of oaks only produce acorns every two years, and the abundance of such seeds can greatly vary from year to year. Another possible avenue of study would be to compare possible differences between deciduous and coniferous forests. This may be more useful than sampling canopy cover, since coniferous forests would let in much less light than a deciduous forest, as well as possibly supply the screech owl with increased cover from predators.

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