

The Potential Habitat Fragmentation Caused by White-Tailed Deer (*Odocoileus virginianus*) and its Impact on Nest Predation

Benjamin Heys and Robert Keys
Cornerstone University, Grand Rapids, MI

Abstract

Migratory songbird populations have been declining. Habitat loss and fragmentation are two possible reasons for the declines. This study proposes the heavily used trails of white-tailed deer may be a potential cause of habitat fragmentation. The purpose of this study was to determine whether fragmentation caused by heavily-used deer trails has an impact on nest predation. We hypothesized that nests located closer to well-traveled deer trails would be depredated more often than those a greater distance from the trail. Two types of artificial bird nests simulating the black and white warbler and ruffed grouse were placed at different distances from heavily used deer trails. The nests which were farther from the deer trails were depredated more often than the nests closer to the trails. Warbler nests were depredated more often than grouse nests. Deer trails closer to edges had higher depredation rates than trails farther from edges. The results suggest that predators may be using deer trails to access the interior of a forest to prey upon bird nests.

Introduction

Migratory songbirds are in great danger. Their populations have been declining dramatically over the past forty years (Terborgh, 1992; Wilcove, 1985; Zanette and Jenkins, 2000; Linder and Bollinger, 1995). Terborgh (1992) states that only half as many waves of migratory birds were seen on radar over the Louisiana coast in the 1980's as compared to the 1960's. The main cause for these declines is thought to be the destruction of habitat. As habitat is disturbed, the breeding success of birds often declines due to nest predation. Many studies have found that increased habitat fragmentation increased nest predation (Wilcove, 1985; Yahner and Piergallini, 1998; Robinson, Thompson, Donovan, Whitehead, & Faaborg, 1995; Linder and Bollinger, 1995). Other studies indicate that increased fragmentation had no effect on nest predation or that it even decreased nest predation (Zanette and Jenkins, 2000). The discrepancies in the results of these experiments could be due to different experimental designs, different areas surrounding the fragments (i.e. - forest or agriculture), different definitions of fragmentation, or

different egg preferences by predators (Keyser, 2002; Robinson et al., 1995). Also, up to the present time, researchers have used different methods of measuring fragmentation. Fahrig (2003) says that many researchers consider fragmentation as “(a) reduction in habitat amount, (b) increase in the number of habitat patches, (c) decrease in sizes of habitat patches, and (d) increase in isolation of patches” (p. 489). He says that researchers have not been consistent in their measurements of fragmentation because they may define it in different ways. Some only define it in terms of one of the above aspects while others define it in terms of a combination of them. This may be another reason why contradictory results are found between many fragmentation studies. But overall, most sources seem to indicate that increased fragmentation increases nest predation.

When a habitat is fragmented it creates more edge. Keyser (2002) defines edges as, “Transitional zones from one habitat type to another” (p. 186). In these transitional zones, the plant and animal life changes from one habitat to another in proportion to the distance from the edge. In general, the research indicates that nests closer to an edge get depredated more often than nests farther away (Keyser, 2002; Linder and Bollinger, 1995). Keyser (2002) and Wilcove (1985) found that forests surrounded by agricultural and residential developments have higher depredation rates than forests surrounded by other forests.

All of the previous studies focus on fragmentation caused by humans. However, this study focuses on the potential of yet another type of habitat fragmentation. In a landscape saturated with well-traveled deer trails, could these heavily used trails potentially be another source of fragmentation?

Heavy deer trails cut a uniform forest into many smaller patches. Though deer trails are relatively small (compared to roads), they allow predators easier access to the interior of a forest

where they may not have had access before. In this way, deer trails fulfill Fahrig's (2003) definition of breaking the forest into patches. Some research has shown that heavy deer populations can change the composition and physical structure of a habitat by foraging and by making such well-traveled trails (Cote, 2005). The purpose of this study was to determine whether fragmentation caused by heavily-used deer trails has an impact on nest predation. We hypothesize that nests located closer to well-traveled deer trails would be depredated more often than those a greater distance from the trail.

Methods

This study was conducted at the Pierce Cedar Creek Institute in Baltimore Township, Barry County, Michigan (N42°32.220'/W85°17.830'). The Pierce Cedar Creek property is split in half by Cloverdale Road, a gravel surfaced township roadway. Hiking trails occur on both sides of the roadway and were used for access to habitat areas containing high frequency deer trails. Three days each were spent scouting the woodland areas on both sides of this roadway for the most heavily used deer trails. The GPS coordinates of each deer trail potentially usable in this study was mapped on a Garmin Map 76C GPS unit. Five trails on each side of the roadway were selected based on how heavy they were, how many deer tracks were seen, the length of the trail, and the potential for nest placement. Five infrared-triggered Cuddeback cameras were placed on the each of the five selected trails for one week. These ten potential study sites were monitored to determine if they were actually being used by deer, and also to observe what potential predators were in the area. Based on the pictures taken and on the factors mentioned above, five major deer trails were selected to be used in this experiment.

Two types of artificial ground nests were constructed for the study. Ground nests were used because many migrational birds are ground nesters (Wilcove, 1985). Open-cup nests were

constructed to simulate a black and white warbler nest, and ground nests were created to simulate the nesting conditions of the ruffed grouse (Harrison, 1975). The warbler nest was constructed using wooden wreaths wrapped with native grapevine. Dead leaves were then placed inside of the wreaths to form a cup shape. The inside diameter of the nest was 4.5 cm and the outside diameter was 8.0 cm. Grouse nests were constructed by using a hand shovel to dish out a cup-shaped indentation in the ground measuring about 11 cm in diameter. The nest was then lined with dead leaves. Latex gloves were worn while making the nests, and the warbler nests were sprayed with Silver XP scent removal spray to remove any human odors from the store where they were purchased. Clay eggs 13mm by 17mm were constructed with non-toxic Sculpy clay and painted to mimic the eggs of the black and white warbler (Keyser, 2002). After the paint had dried, the eggs were sprayed with scent removal spray. Quail eggs (24mm by 29mm) were purchased from a game farm and were used in the grouse nests. Two different nests were used for a number of reasons. One was the size of the eggs. Predation attempts by small predators can be monitored more easily using clay eggs because many smaller predators, like mice and chipmunks, are not able to eat quail eggs due to the large size of the egg and the shell is too thick for teeth or claw penetration (Keyser, 2002). The second reason was that quail eggs are natural, which helped add a realistic sense to the experiment. And third, it allowed for a comparison of different depredation rates between the two nests.

Each of the five deer trails had a total of 12 artificial nests (6 warbler, 6 grouse). The nests were placed at 1m, 5m, and 10m from the deer trail (Keyser, 2002). At whichever distance an individual nest was from the study trail, it was at least that distance from any other deer trail.

Four of the nests were at 1m, four were at 5m, and four were at 10m (Figure 1).

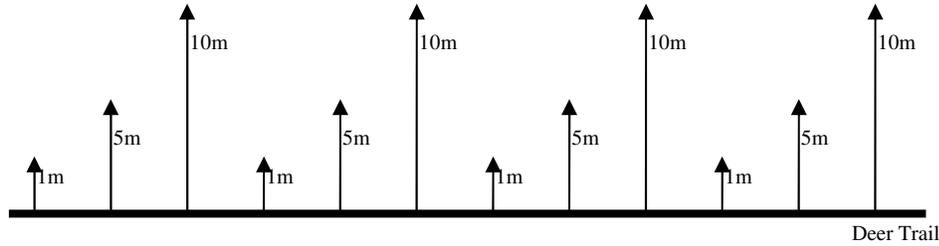


Figure 1. Artificial nest placement.

The nests were not placed in any specific sequence, but rather were arranged as to how they could be set up on each individual trail. All of the nests were spaced at least 12m from another nest. The nests were placed at the base of trees, and sticks were placed over the nests for cover (Wilcove, 1985). Yellow tape was wrapped around the trees to indicate where each nest was. The ends of the tape were cut off so they did not blow in the wind to help minimize the risk of predators realizing that eggs were below marked trees. Three clay eggs were placed in each of the warbler nests and three quail eggs were placed in each of the grouse nests. They were checked every third day for a total of ten check days. A nest was considered depredated if at least one egg was missing, removed from the nest, or had teeth marks. Damaged or broken eggs were replaced each time the nests were checked.

A control group was also established, consisting of 12 semi-randomly placed nests (6 warbler, 6 grouse). One warbler nest and one grouse nest were always placed near each other to compare their depredation rates. The control nests were placed at least 10m from any deer trail, though an effort was made to increase this as much as possible beyond the 10m distance. Rubber gloves and rubber knee-boots were worn throughout the experiment to minimize human scent. Silver XP scent elimination spray was also sprayed over pants and boots before every nest check.

Throughout the experiment, one infrared-triggered camera was placed on one nest on each of the five deer trails. The cameras were placed on specific nests on each trail, and they

were repositioned on a new nest approximately once a week. The cameras were set up within three meters from the nest so that any predators could be observed eating the eggs from the study nests. This set up allowed us to get an idea of what predators were in the area and potentially preying on study nests.

Results

Overall, 80.3% of the warbler nests and 62.0% of the grouse nests in the experimental group were depredated during this experiment. Only 52.0% of the warbler nests and 46.0% of the grouse nests were depredated in the control group. There were a total of 60 nests in the experimental group which were checked 10 times, and there were 12 nests in the control group which were checked 9 times. There was no significant difference in the depredation rates of nests when comparing those at 1m compared to 5m, at 1m compared to 10m, or at 5m compared to 10m for either warbler or grouse nests (Chi-Square: $p > .10$). There was a significant difference between the depredation rates of all of the nest distances in the experimental group when compared to the control group (Chi-Square: $p < .10$). In other words, the nests in the experimental group were depredated significantly more often than those in the control group. It was also found that warbler nests as a whole were depredated more often than grouse nests (Chi-Square: $p < .10$).

Edge effects were also taken into account. As the distance from a forest edge increased, the number of depredations per nest did not increase or decrease ($r = -.09088$). There was a significant difference between the average trail distance from an edge and the depredation rate ($r = -0.79151$). As the distance from an edge increased, the depredation rate decreased.

Anecdotal evidence collected by the cameras monitoring the nests throughout the experiment captured images of 179 raccoons, 39 fox squirrels, 2 gray squirrels, 10 opossums, 3

chipmunks, and 2 mice. To conclude that every single one of these animals was preying on the nests is difficult, but many of the pictures do show the animals in the nest or eating eggs.

Discussion

The depredation rates in this experiment were not representative of the depredation rates of real bird nests (Wilcove, 1985). Birds have capabilities of camouflaging and protecting nests which could not be mimicked in this experiment. Even so, the depredation rates from artificial nests are useful in determining if the depredation rates change as distance increases from deer trails.

Within the experimental group, the depredation rate did not change as distance increased. This may be due to using such short distances (10m was the farthest distance) from the deer trails. However at this site 10m was the furthest distance possible because of the heavy concentration of deer trails at Pierce Cedar Creek Institute. In their study of edge effects, Linder and Bollinger (1995) found that there was a significant difference in depredation rates between nests 20m from an edge as compared to nests 200m away. Though their study focused on edge effects, their longer range of distances suggests that 10m may not have been far enough to find a significant difference between depredation rates at the distances used in this experiment.

Our experimental nests were depredated more often than our control nests. When considering only the experimental group, the hypothesis does not appear to be supported. However, when comparing the experimental nests with the control nests, the hypothesis is supported. The nests which were farther from a deer trail were depredated less often.

Artificial warbler nests were depredated significantly more often than artificial grouse nests. This could be due to a number of reasons. First, warbler eggs are smaller, and there are a greater number of predators which could prey upon them, while many small predators may not

be able to prey upon grouse eggs (Keyser, 2002). Second, the warbler eggs were made out of clay which has natural salts and minerals. Even with the precautions used to remove scent, predators may have been more easily attracted to these eggs as the scent elimination spray would not have been able to eliminate the scents from the salts or minerals. Third, the warbler nests were composed of wreaths bought at a store. Even though the wreaths were composed of wood, native grapevine, and native leaves, they could have had a scent to them that was detectable to predators. Again, even though scent-elimination spray was used, the possibility for scent detection by predators was still possible. All of these factors probably played a role as to why artificial warbler nests were depredated more often than artificial grouse nests. However, even given these potential reasons for greater depredation on the artificial warbler nests, it must be noted that the warbler nests in the experimental group were preyed on significantly more than those in the control group.

There was no significant relationship between the distance an individual nest was from an edge and the number of times the nest was depredated. This may be related to predator home ranges and habits. A predator may walk in the same place habitually. If a nest is near where they walk, then the predator may remember that nest and prey upon it every day. However, if a predator was at the outer edge of their home range and was just passing through an area and found a nest, it probably would not continue to go back to it.

As the distance that a deer trail was from an edge decreased, the depredation rate increased. This agreed with Keyser (2002) and Linder and Bollinger (1995). Some researchers have found that edge can affect depredation up to 200m or more from the edge (Linder and Bollinger, 1995; Robinson et.al., 1995). Forests surrounded by agricultural and residential developments have higher predation rates than forests surrounded by other forests (Wilcove,

1985; Keyser, 2002). Given these definitions, most of the Pierce Cedar Creek Institute's wooded property can be considered edge habitat because much of it is closer than 200m from an edge. Also, the forests are surrounded by fields (agriculture). This information combined with the number of heavily used deer trails indicates that ground nesting birds may have a difficult time nesting at Pierce Cedar Creek Institute as compared to birds on a larger, less fragmented habitat.

Recommendations From the Study

A number of ideas could be used to try to help the migrational birds at Pierce Cedar Creek Institute. Given the results of this study we recommend that a population study on ground nesting or migrational birds could take place. Other studies could focus on the nesting success of these birds. If it was found that a high level of nest depredation was occurring, then population studies of both deer and predators would be helpful. If deer were found to be overpopulated for what the land could sustain, then the current deer management program could be reevaluated to increase the number of deer taken yearly on the site. The idea behind this is that if there were fewer heavily used deer trails, then predators may not be able to access the interior of the forest to find eggs. The most helpful thing that could be done would be to determine population estimates for predators in the area. If the populations of predators associated with nest depredation were too high, then management programs could be established to lower their populations to increase the survival rates amongst migratory ground nesting species.

Acknowledgements

The authors would like to acknowledge and thank the Willard and Jessie Pierce Foundation and the Pierce Cedar Creek Institute for their generous financial and institutional support of this research. We would also thank Cornerstone University for their financial assistance in the purchase of equipment for this study.

References

- Cote, S.D. (2005). Extirpation of a large black bear population by introduced white-tailed deer. *Conservation Biology*, 19(5), 1668-1671.
- Fahrig, Lenore (2003). Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution, and Systematics*, 34(1), 487-515.
- Harrison, H.H. (1975). *A Field Guide to the Birds' Nests: United States east of the Mississippi River*. Boston: Houghton Mifflin Co.
- Keyser, A.J. (2002). Nest predation in fragmented forests: landscape matrix by distance from edge interactions. *Wilson Bulletin*, 114(2), 186-192. Retrieved January 3, 2006, from Expanded Academic ASAP database.
- Linder, E.T., & Bollinger, E.K. (1995). Depredation of artificial ovenbird nests in a forest patch. *Wilson Bulletin*, 107(1), 169-175. Retrieved January 3, 2006 from Expanded Academic ASAP database.
- Robinson, S.K., Thompson, F.R., Donovan, T.M., Whitehead, D.R., & Faaborg, J. (1995). Regional forest fragmentation and the nesting success of migratory birds. *Science*, 267(5206), 1987-1991. Retrieved January 3, 2006, from Expanded Academic ASAP database.
- Terborgh, J. (1992). Why American songbirds are vanishing. *Scientific American*, 266(5), 98-105.
- Wilcove, D.S. (1985). Nest predation in forest tracts and the decline of migratory songbirds. *Ecology*, 66(4), 1211-1214.

Yahner, R.H., & Piergallini, N.H. (1998). Effects of microsite selection on predation of artificial ground nests. *Wilson Bulletin*, 110(3), 439-441. Retrieved January 3, 2006, from Expanded Academic ASAP database.

Zanette, L., & Jenkins B. (2000). Nesting success and nest predators in forest fragments: a study using real and artificial nests. *The Auk*, 117(2), 445-454. Retrieved January 3, 2006, from http://publish.uwo.ca/~lzanette/Web_papers/Auk.pdf