Habitat Features Influencing Use of Farmstead Shelterbelts by the Eastern Cottontail (Sylvilagus floridanus)[1]

ABSTRACT: Use of five farmstead shelterbelts by the eastern cottontail (*Sylvilagus floridanus*) in southeastern Minnesota was investigated using live-trapping and quantification of habitat features surrounding trap stations. Logistic regression identified proximity and density of shrubby vegetation as primary determinants of trap use by rabbits in summer and autumn. Coniferous overstory vegetation and mowed grassy areas also were associated with trap use during these seasons.

INTRODUCTION

Farmstead shelterbelts are important wildlife habitats in the central United States (Popowski, 1976). This habitat type, consisting of multiple rows of trees and shrubs planted on windward sides of farm homes and buildings (Smith and Scholten, 1980), is used by the eastern cottontail (*Sylvilagus floridanus*) for food and shelter during winter (Podoll, 1979). Moreover, shelterbelts are preferred by rabbits over other farmland habitat types (*e.g.*, fence rows, roadsides, waste areas) in summer and autumn (Swihart, 1981). The suitability of a particular shelterbelt for rabbits may vary due to differences in vegetative composition or other factors (Podoll, 1979). Consequently, the objective of this study was to identify habitat correlates influencing use of farmstead shelterbelts by *S. floridanus* during summer and autumn. These findings will be valuable to landowners in intensively farmed regions by providing them with a quantitative basis for managing shelterbelts either to attract or to discourage use by eastern cottontails. A better understanding of shelterbelt use by this leporid is important, for less than 3% of the Great Plains is wooded, and farmstead shelterbelts comprise a substantial portion of this area (Griffith, 1976).

METHODS

This study was conducted at the Rosemount Agricultural Experiment Station, Dakota Co., Minnesota, from 12 July to 9 November 1979 and from 16 July to 31 October 1980. Five shelterbelts were chosen for study, ranging from 4-8 rows in width and established from 1946 to 1961. Sizes of shelterbelts varied from 0.37 to 1.01 ha. Trees and shrubs commonly planted in rows included Colorado blue spruce (*Picea pungens*), pine (*Pinus* spp.), eastern cottonwood (*Populus deltoides*), caragana (*Caragana arborescens*), tartarian honeysuckle (*Lonicera tatarica*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*) and box elder (*Acer negundo*). Woody understory vegetation included green ash saplings, tartarian honeysuckle, black raspberry (*Rubus occidentalis*), gooseberry (*Ribes* spp.) and red-berried elder (*Sambucus pubens*). Major herbaceous species were bluegrass (*Poa pratensis*) and goldenrod (*Solidago* spp.).

Traps ($n = 40$; Tomahawk Live Trap Co., 23 x 23 x 66 cm) were placed at 50-m intervals along a medial transect positioned parallel to the major axis of a shelterbelt. The location of the initial trap along a transect was selected randomly. Each trap was covered with heavy-duty roofing paper (Fitzsimmons, 1978); apples were used as bait. Weekly trapping sessions lasted 4 successive days, followed by 3 days during which traps were closed. Rabbits were marked with numbered ear tags and brightly colored discs (National Band and Tag Co.) at initial capture. Data recorded for individuals at each capture included weight, length of ear, hind foot and total body, sex, reproductive status and location of capture. Age of individuals was determined using a growth curve for Illinois rabbits (Lord, 1963).

Ten habitat features were measured at each trap station during July and August 1980 and were subsequently used in statistical analyses (Swihart, 1981). These variables were: (1) distance (m) to the nearest stump (STUMPDIS), (2) number of stumps (STUMPDEN), (3) percentage of coniferous overstory vegetation (CONIFER); (4) mean area (m^2) occupied by artificial cover sites such as abandoned sheds or junkpiles (ARTAREA); (5) percentage of shrubby vegetation (SHRUBCOV); (6) distance (m) to the nearest shrubby vegetation occurring at a density of > 10 stems/m^2 (SHRUBDIS); (7) density of shoulder-high woody vegetation (WOODVEG); (8) percentage of grassy vegetation (GRASS); (9) percentage of area subjected to cultivation (CULTAREA), and (10) percentage of area mowed more than twice per season (GRASS > 2). STUMPDEN and ARTAREA were measured within a 225-m^2 circle centered on a trap. CONIFER, SHRUBCOV, WOODVEG and GRASS were measured at 20 equally spaced intervals along 2 perpendicular 30-m^2 transects centered on a trap; CULTAREA and GRASS > 2 were

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measured using a 1.6-ha (4.0 acre) circle centered on traps and mapped on aerial photographs (Dueser and Shugart, 1978; Swihart, 1981).

Logistic regression (BASIC program LOGIT; Yang and Larntz, 1976) was used to assess the importance of the 10 variables in predicting differential use of trap stations by rabbits. Linear logistic response models analyze odds of success for a binary response variable given fixed levels for each explanatory variable (Fienberg, 1980). The logistic model may be expressed as

$$\log_e \left(\frac{p_i}{1-p_i}\right) = Y_i = \beta_o + \sum_{j=1}^{r} \beta_j z_{ij}, \quad i = 1, 2, \ldots, n$$

where Y represents the logarithmic odds of success for event i, p_i is the probability of success of the ith event, β_o is a constant, the quantities z_{ij} are values of the r explanatory variables for the ith event, and the quantities β_j represent coefficients for the j explanatory variables (Fienberg, 1980). After fitting the model, p_i is obtained by

$$p_i = \frac{e^{Y_i}}{1 + e^{Y_i}}$$

Conceptually, logistic regression is similar to ordinary least-squares regression, with the exception that the latter technique generates a value for a continuous response variable rather than an odds ratio for a dichotomous response variable. We believe that linear regression with probability of capture as the response variable would result in misleading and erroneous predictive equations due to differential trappability of individuals (Huber, 1962; Chapman and Trethewey, 1972). Consequently, logistic models were fitted using the 10 habitat features as explanatory variables and trap success/failure as the binary response variable. Data were analyzed for each year, before and after harvest of field crops adjacent to shelterbelts, and for adults, juveniles, males and females, giving eight analyses. A backward stepping procedure was used to eliminate explanatory variables from each model; variables with nonsignificant t-statistics ($p > 0.05$) were removed from the regression equations. After a model was selected, a test of goodness-of-fit was performed using the likelihood ratio statistic, G^2, where $p > 0.05$ was deemed an acceptable fit.

RESULTS

A total of 3876 trap nights resulted in 78 captures of 49 individuals. Rabbits were captured in 24 and 10 of the 40 total traps in 1979 and 1980, respectively. Captures occurred in 10 different traps prior to harvest and in 26 traps subsequent to harvest. Eleven traps captured adults, whereas 20, 22 and 19 traps captured juveniles, males and females, respectively.

Probability of a trap capturing a rabbit in 1979 was related directly to lower values of SHRUBDIS (Table 1). GRASS > 2 exhibited a positive association with capture success in 1980. Higher values of WOODVEG around a trap station increased the probability of capturing a rabbit at that station prior to harvest. Capture after crop harvest was inversely associated with SHRUBDIS and positively, though less significantly, related with CULTAREA ($t = 1.93$, $df = 37$, $0.05 < p < 0.10$). Probability of capturing an adult at a trap station increased with greater values for CONIFER and GRASS > 2. Juvenile capture rates displayed a significant inverse relationship with SHRUBDIS and a less significant positive association with WOODVEG ($t = 1.99$, $df = 37$, $0.05 < p < 0.10$). Probability of capturing a male rabbit increased with larger WOODVEG values, and CONIFER had a similar but less pronounced effect ($t = 1.95$, $df = 37$, $0.05 < p < 0.10$). None of the 10 variables explained a significant proportion of the variability between trap stations capturing females vs. those not capturing females.

DISCUSSION

Five of the eight regression models incorporated WOODVEG or SHRUBDIS (Table 1); these two variables measured the presence of shrublike vegetation around a trap station. High WOODVEG values characterized concentrations of tartarian honeysuckle, red-berried elder, caragana, Colorado blue spruce and/or young pines; SHRUBDIS typically reflected these species plus black raspberry and gooseberry. The importance of shrubby vegetation as escape cover for rabbits is well known (Linder and Hendrickson, 1956; Kabat and Thompson, 1963). In our study, trap stations located in areas of shelterbelts with dense stands of shrubby vegetation were more likely to be used by rabbits than those in less shrubby sites. For instance, 11 of 12 traps in a four-row shelterbelt captured rabbits; the only unsuccessful trap was located in a relatively open (low WOODVEG, high SHRUBDIS), unmowed sector of the shelterbelt.

The percentage of coniferous overstory vegetation affected trap use by adults and, to a lesser degree, trap use by males (Table 1). Large pines contributed the most to high CONIFER values at trap stations; yet large pines presumably afford little or no food and shelter. However, large CONIFER values may reflect indirectly some other feature important to rabbits in shelterbelts. For example, the relatively open canopy of pines and the lack of lower branches on older pines allow understory encroachment by important colonizing species such as black raspberry and red-berried elder. Many individual plants of these shrubby species may have been overlooked in sampling due to the arbitrary criterion of >10 stems/m^2 used for tabulating SHRUBDIS.

The relationship between extent of frequently mowed areas and rabbit use of trap stations was evident in 1980, but not in 1979 (Table 1). A dry spring and summer in 1980 presumably decreased both forage quality and forage quantity compared to 1979. Consequently, rabbits may have required larger tracts of frequently mowed areas (*e.g.*, lawns, roadsides) for feeding in 1980 relative to 1979, thereby accounting for the difference in importance of GRASS$>$2. Traps located proximal to feeding areas had an increased likelihood of success, perhaps because *Sylvilagus floridanus* prefers to feed in grassy areas close to woody escape cover (Korschgen, 1980).

Abundant woody vegetation (high WOODVEG, low SHRUBDIS) characterized successful trap stations both before and after harvest (Table 1). Furthermore, traps exhibited higher probabilities of success after harvest if they were surrounded by a relatively large expanse of cultivated land. These results concur with other studies. Anderson and Pelton (1976), for example, found that rabbits inhabiting fields during the growing season were displaced by harvesting operations; displaced individuals subsequently moved to nearby wooded sites.

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TABLE 1.—Logistic regression models predicting odds of trap success (response variable) in shelterbelts based on habitat features (explanatory variables) measured at each trap station and selected via backward elimination. A separate model was fitted for each year, before harvest, after harvest, and for adults, juveniles and males

Analysis	Model[1]	df	G^2
1979	$Y=$ 1.17 − 0.21 (SHRUBDIS)	38	45.2*
1980	$Y=$ −2.84 + 0.10 (GRASS>2)	38	41.8*
Preharvest	$Y=$ −3.92 + 0.11 (WOODVEG)	38	36.4*
Postharvest	$Y=$ 1.41 − 0.20 (SHRUBDIS)	38	43.4*
Adults	$Y=$ −4.23 + 0.07 (CONIFER) + 0.09 (GRASS>2)	36	34.2*
Juveniles	$Y=$ 1.19 − 0.41 (SHRUBDIS)	37	39.1*
Males	$Y=$ −3.32 + 0.17 (WOODVEG)	37	38.3*

[1] $Y = \log_e \left(\frac{p}{1-p}\right)$, where p represents the probability of trap success.

Solve for p by $p = \frac{e^Y}{1 + e^Y}$

*p>0.10

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