Small Mammal Distributions Relative to Corridor Edges Within Intensively Managed Southern Pine Plantations

Nicole L. Constantine, *Memorial High School, Eau Claire, WI 54701;* **Tyler A. Campbell,** *USDA Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center, Texas Field Station, Texas A&M University-Kingsville, Kingsville, TX 78363;* **William M. Baughman,** *MeadWestvaco Corporation, Forest Resources Division, Summerville, SC 29484;* **Timothy B. Harrington,** *USDA Forest Service, Pacific Northwest Research Station, Olympia, WA 98512;* **Brian R. Chapman,** *College of Arts and Sciences, Sam Houston State University, Huntsville, TX 77341; and* **Karl V. Miller,** *Daniel B. Warnell School of Forest Resources, University of Georgia, Athens, GA 30602.*

ABSTRACT: *We characterized small mammal communities in three loblolly pine (*Pinus taeda*) stands in the Lower Coastal Plain of South Carolina during June 1998–Aug. 2000 to investigate influence of corridor edges on small mammal distribution. We live-trapped small mammals in three regenerating stands following clearcutting. Harvested stands were bisected by 100-m-wide, 20–23-year-old pine corridors. During 47,040 trap nights, we recorded 907 captures of 661 individual small mammals. Species captured included southern short-tailed shrews (*Blarina carolinensis*), cotton mice (*Peromyscus gossypinus*), cotton rats (*Sigmodon hispidus*), eastern harvest mice (*Reithrodontomys humulis*), marsh rice rats (*Oryzomys palustris*), and golden mice (*Ochrotomys nuttalli*). We did not observe an edge effect (i.e., preference or avoidance) in small mammal captures at the corridor edge. Rodent captures were greatest in harvested stands, declined near the edge of mature pine corridors, and were lowest within corridors. Shrew captures were generally greatest in mature pine corridors and least in the interior of harvested stands. Retention of mature pine corridors of only 100 m may maintain some small mammals (i.e., shrews) that would not occur if stands were completely harvested. South. J. Appl. For. 29(3):148–151.*

Key Words: Corridor, ecosystem-based forestry, intensive management, loblolly pine, pine plantation, *Pinus taeda*, rodents, shrews, small mammals, South Carolina.

In the southeastern United States, the forest products industry typically uses short-rotation, even-aged silvicultural systems to manage pine (*Pinus* spp.) plantations. However, ecological, environmental, and societal concerns have increased emphasis on incorporating multiple resource management goals (e.g., soil erosion, water quality, timber, wildlife). As a signatory of the Sustainable Forestry Initiative (SFI) (American Forest and Paper Association 2002), the MeadWestvaco Corporation (MWC) (Stamford, CT) is committed to forest biodiversity. Recently MWC developed a strategy known as "ecosystem-based forestry" to increase heterogeneity of wildlife habitat. This program involves overlap of a mosaic of later successional habitats on a landscape dominated by various successional stages of pine plantations. These habitats include streamside management zones, special habitat zones, and where these features do not exist, 100-m-wide corridors of mature (>20 year old) pines retained to maintain forest habitat connectivity. These corridors may provide residual habitat for small mammal species associated with closed-canopy forests (e.g., shrews), whereas adjacent harvested stands may provide habitat for other species [e.g., cotton mouse (*Peromyscus gossypinus*), cotton rat (*Sigmodon hispidus*)].

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Retaining corridors in intensively managed forest landscapes contributes to landscape heterogeneity and creates ecotones between harvested areas and forested corridors potentially affecting small mammal communities (Constantine et al. 2004). Although the edge-effect concept remains a basic ecological principle, increases in edge habitat may not benefit all wildlife species (Noss 1983, Yahner 1988). Therefore, additional research is needed to examine the influence of edge on wildlife species in different ecosystems. Because the natural history, population dynamics, and community interactions of small mammals are well documented, they have the potential to serve as a model to assess ecological questions (Barrett and Peles 1999).

Studies examining small mammals and edge effects have been conducted in agricultural and prairie landscapes (Heske 1995, Pasitschniak-Arts and Messier 1998). The few studies that have examined small mammal distributions relative to forest edges have either only examined response of a single species (Mills 1995, Kingston and Morris 2000) or have reported conflicting results (Yates et al. 1997, Menzel et al. 1999). Our study provides information on small mammal distributions relative to corridor edges in a heterogeneous, intensively managed pine ecosystem. Our objectives were to characterize small mammal communities at the corridor edge and identify relationships between small mammal captures and distance from the corridor edge.

Methods

Our study was conducted in three loblolly pine (*Pinus taeda*) stands (16–20 ha) in the Lower Coastal Plain of Charleston and Colleton counties, South Carolina. The 20- to 23-year-old stands were located in the MeadWestvaco South Region on the Jericho and O'Bryan Units. Experimental stands were flat with slopes $<2\%$ and elevations ranging from 20 to 30 m above mean sea level. Soils were poorly drained with a neutral pH and high levels of phosphorus. Stands were productive with a site index of 24.4 m for loblolly pine at base age 25 years. All three stands were sheared, root raked, and bedded when established, but no additional management practices (other than harvest, see below) were subsequently applied. Mean tree density for all stands before harvest was 673 trees/ha, and the mean dbh was 27.9 cm. Overstory of experimental stands consisted of a canopy of loblolly pine with a mixture of sweetgum (*Liquidambar styraciflua*) and red maple (*Acer rubrum*) in the midstory. Understory was dominated by wild grape (*Vitis* spp.), greenbrier (*Smilax* spp.), poison ivy (*Toxicodendron radicans*), and Virginia creeper (*Parthenocissus quinquefolia*).

Stands were harvested in May 1998 using clearcutting with retention of mature (20–23-year-old) pine corridors. Corridors were 100 m wide, bisected the harvested stands, were approximately 425 m in length, were approximately 180 m from adjacent stands, and were connected with other mature forest stands.

From June 1998 to Aug. 2000, we collected small mammals by live-trapping in the three harvested stands with corridors. Within each stand, we established eight parallel live-trapping transects every 14.3 m perpendicular to and centered on corridors (Figure 1). Each transect was comprised of 14 trapping stations (i.e., trap columns that corresponded to distance from edge) at 14.3-m intervals. Sampling methodology followed Constantine et al. (2004). We placed a Sherman live-trap baited with commercial pellets (Flint River Mill, Bainbridge, GA) at each station and set each trap for five consecutive nights during each of the 27 months. On capture, we uniquely marked animals with numbered Monel #1 ear tags (National Band and Tag, Newport, KY), recorded standard morphological measurements, and determined gender. We released all animals at their capture locations. Immediately prior to setting traps, we made adjustments to live-traps to minimize sprung-but-empty sets. Consequently, these rarely occurred. All small mammal protocols were approved by the University of Georgia's Institutional Animal Care and Use Committee (Permit No. A3437-01).

We recorded total captures of rodents and shrews for each trap column, which provided a measure of the distance from edge, during each month. We combined monthly data into summer (June–Aug.), fall (Sept.–Nov.), winter (Dec.–Feb.), and spring (Mar.–May) seasons during each year. Because edge effect may be a function of season (Pasitschniak-Arts and Messier 1998), we conducted preliminary analyses of capture data across seasons. We did not observe seasonal differences; therefore, we pooled data across all trapping periods and calculated mean captures by species for each trap column. We only incorporated unique small mammal captures (i.e., did not include recaptures) in our analyses, which we quantified as mean captures/100 trap nights. We used polynomial regression to evaluate relationships between number of small mammal captures and distance from corridor edge (Neter et al. 1989). We selected this approach because we estimated, a priori, that given our sampling design small mammal distributions relative to edges would be polynomial rather than linear. We used the quadratic model to test statistical significance at

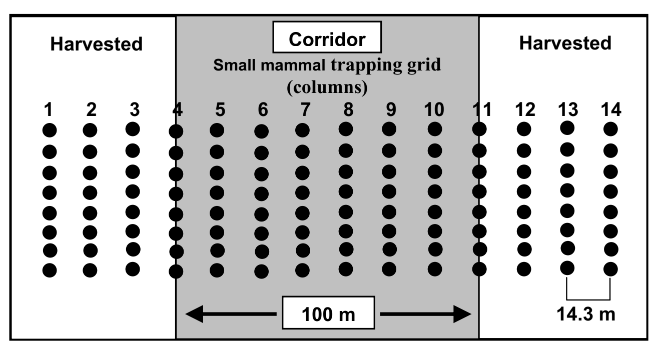

Figure 1. Trapping grid layout within harvested stands (n = 3) containing 100-m-wide corridors in intensively managed pine stands of the Lower Coastal Plain, 1998–2000. The numbers correspond to live-trap stations on transects (n = 8), with trap locations indicated with a black circle. Each of the 14 trap stations is 14.3 m apart and represents a trap column (i.e., distance from corridor edge). Trap columns 4 and 11 were at the edge between the corridor (i.e., forest) and recently harvested stands.

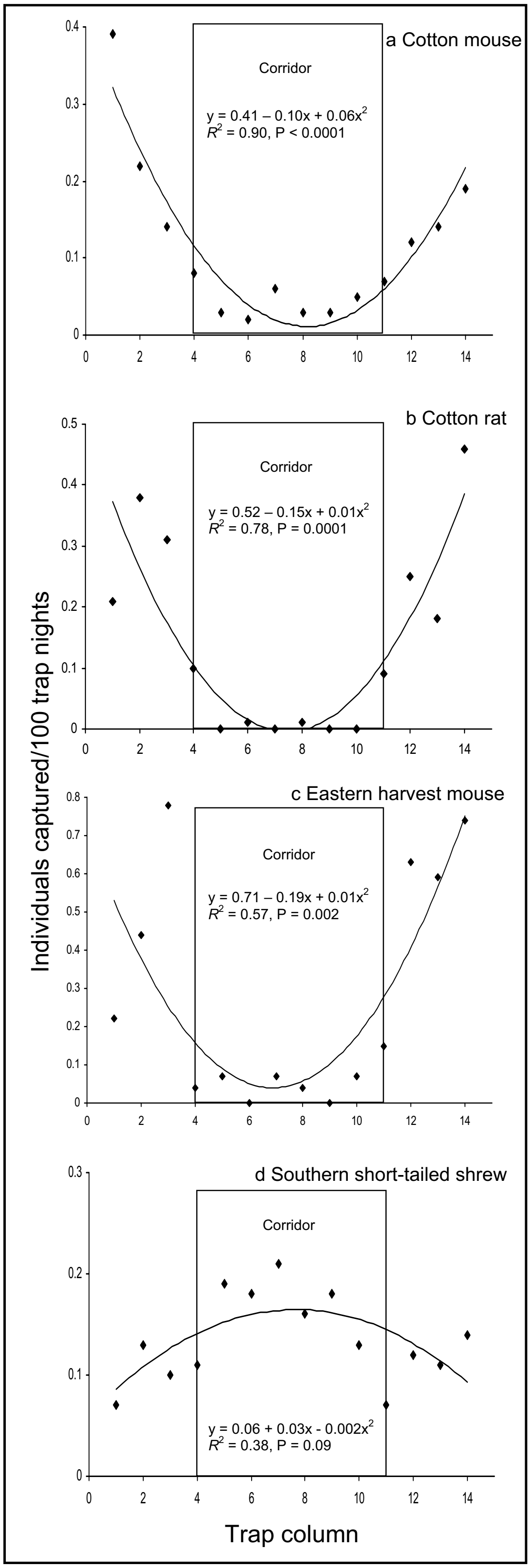

Figure 2. Mean number of individuals of 4 small mammal species/100 trap nights (TN) by trap column (i.e., distance from edge) in three harvested stands with high-contrast edge in the Lower Coastal Plain of South Carolina, 1998–2000: (a) cotton mouse, (b) cotton rat, (c) Eastern harvest mouse, (d) Southern short-tailed shrew.

$\alpha = 0.05$, with quality of fit determined by plotting residuals versus predicted values. Given configuration of the sampling across mature pine corridors into adjacent harvested stands, we predicted a quadratic relationship.

Results

We recorded 907 captures of 661 small mammals during 45,360 trap nights. We captured 135 individual southern short-tailed shrews (*Blarina carolinensis*), 127 individual cotton mice (*Peromyscus gossypinus*), 199 individual cotton rats (*Sigmodon hispidus*), 96 individual eastern harvest mice (*Reithrodontomys humulis*), 3 individual marsh rice rats (*Oryzomys palustris*), and 1 golden mouse (*Ochrotomys nuttalli*).

In harvested stands with corridors, capture rates of cotton mice, cotton rats, and eastern harvest mice capture rates were influenced by trap locations (Figure 2, a–c). Capture rates of these species were greatest in the interior of harvested stands, gradually declined toward the edge, and were very low within the mature pine corridor. No distinct edge preference or avoidance was evident. The spatial distribution of southern short-tailed shrews displayed a distinct distribution pattern in harvested stands with corridors (Figure 2d). Shrew captures were not significantly influenced by trap location, although more ($n = 76$) were capture within corridors than outside corridors ($n = 46$).

Cotton mice and cotton rats were the most commonly captured small mammal species at the corridor edge. However, marsh rice rats, eastern harvest mice, and southern short-tailed shrews were also captured in edge habitats. None of these species were unique to the corridor edge. Southern short-tailed shrews, cotton mice, eastern harvest mice, and cotton rats were captured in all habitat types (i.e., harvested stand, edge, and corridor). The single golden mouse was captured in a mature pine corridor, and marsh rice rats were only captured in the harvested stands.

Discussion

Forest management practices, such as clearcutting and corridor retention, alter the size and shape of stands and ultimately change the amount of edge (Hunter 1990). Whereas others have demonstrated a pronounced edge effect with regard to small mammal abundance in different systems (Rosenberg and Raphael 1986, Sekgororoane and Dilworth 1995, Bayne and Hobson 1998), we found small mammal captures were more closely tied to specific habitat types and did not demonstrate discrete peaks at the corridor edge (see Hansson 1994, Kingston and Morris 2000, Bowman et al. 2001).

Small mammals did not exhibit distinct species-specific patterns in distribution relative to the corridor edge. The three most frequently captured rodents (i.e., cotton mice, cotton rats, and eastern harvest mice) displayed similar patterns in their spatial relationship to the corridor. Total rodent captures significantly peaked in harvested stands, and total shrew captures peaked, but not significantly, within mature pine corridors. Because shrews were captured in greatest numbers within the corridor, it appears mature pine corridors may maintain some small mammals that may otherwise have been reduced if stands were completely harvested. However, our results were inconclusive in this regard (i.e., lack of significance), and further study is warranted.

Similar to Sekgororoane and Dilworth (1995), we did not find small mammals avoiding the corridor edge. Our failure to detect edge effects may be a function of the relatively young age (i.e., 0–2 years) of the three harvested stands. Sekgororoane and Dilworth (1995) did not observe edge effects for small mammals in young (i.e., 0–5 years) spruce-pine forests in Canada, but observed edge effects in older cuts (i.e., 6–10 years).

Unlike Menzel et al. (1999), we did not find peaks in small mammals at the corridor edge. Our data show that although certain species are associated with a particular habitat type, they make use of the corridor edge, as reported by others (Kirkland et al. 1985, Hansson 1994, Sekgororoane and Dilworth 1995). Cotton rats and cotton mice, species associated with recently regenerating stands (Bayne and Hobson 1998), were captured in greatest numbers in the harvested stands; whereas the only golden mouse, a species associated with forested areas (Linzey and Packard 1977), was captured in mature pine corridors. Unlike Mengak and Tipton (1978), we did not observe edge specialists, such as eastern harvest mice (Lidicker and Koening 1996), confined to areas that incorporated a recently harvested stand-mature forest ecotone.

Although small mammals were not found in greater numbers at the forest edge, retention of mature pine corridors (of only 100 m) may maintain some small mammals (i.e., shrews) that would not occur if stands were completely harvested. We suggest forest managers consider retaining mature pine corridors through harvested stands in intensively managed landscapes of the Lower Coastal Plain if management goals include maximizing forest wildlife diversity.

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