Assessing Capture Success of Small Mammals Due to Trap Orientation in Field–Forest Edge Habitat

DANIEL M. WOLCOTT,[1, 2] MADISON R. ACKERMAN,[1] and MICHAEL L. KENNEDY[1]

[1]Ecological Research Center, The University of Memphis, Memphis, Tennessee 38152 USA
[2]Corresponding author: dmw5@txstate.edu

Wolcott, Daniel M., Madison R. Ackerman, and Michael L. Kennedy. 2014. Assessing capture success of small mammals due to trap orientation in field–forest edge habitat. Canadian Field-Naturalist 128(2): 191–194.

The prediction that trap orientation would not affect the likelihood of capturing small-nonvolant mammals in field–forest edge habitat was tested during late May and early June 2010 at 3 locations in western Tennessee. Traps were placed in pairs along transects in edge habitats with the orientation of one trap facing outward, toward the field, and the other oriented inward, toward the forest. Results reflected no differential capture success due to trap orientation among ages, sexes, species, or locations. This finding should facilitate the inventorying and monitoring of small mammals in an abundant and potentially species-rich habitat type found in many terrestrial regions.

Key Words: capture success; edge habitat; Sherman live trap; small mammal monitoring; trap success; trap susceptibility; trap orientation

Introduction

Adjoining field and forest habitats (field–forest edge) are common throughout many ecoregions. Generally, variety and abundance of life are thought to be greatest in and about edges (Smith and Smith 2012). However, the intensity, or even presence, of edge effects has been questioned by many recent studies (reviewed in Murcia 1995). Although field–forest edges are sites with the potential for high biodiversity, the increase in such sites due to habitat fragmentation raises the risk of deleterious effects on resident communities (Groom *et al.* 2006).

Field–forest edges are interesting sites for studying aspects of biodiversity and sustainability of small mammal populations. Murcia (1995) and Fagan *et al.* (1999) noted the need for investigations in edge habitats. Many studies of natural history traits require live capture and examination of individual animals. Choosing an effective, unbiased trapping method is important for collecting reliable information on populations of small mammals (Risch and Brady (1996). Wilson *et al.* (1996) described procedures for measuring and monitoring biological diversity; however, they did not discuss orientation of live traps in detail. At this time, the significance of trap orientation to capture success in field-forest edge habitats is unknown.

The transition zone between field and forest habitats often contains thick vegetation, which may be easier to access from the field side. When sampling for small mammals with live traps in many field–forest edges, investigators must decide whether to place the traps with opening toward the field or the forest. Given that visibility and accessibility are greater from the field side, traps are usually approached from this direction to reduce the time and effort needed to check and rebait them. The extra effort required to access a trap opening that faces the forest is worthwhile if capture success is enhanced but not if it is decreased or insignificant. Therefore, the purpose of our investigation was to test the prediction that trap orientation (opening of the trap facing the field or the forest) has no effect on the likelihood of capturing small, non-volant mammals (hereafter, small mammals) in field–forest edge habitat.

Study Area

The study was conducted at three locations in western Tennessee: Ames Plantation, Meeman Biological Station, and Shelby Farms Park (hereafter, Ames, Meeman, and Shelby Farms, respectively). Ames was located in Fayette and Hardeman counties (35°6.9'N, 89°12.7'W); Meeman (35°21.7'N, 90°1.1'W) and Shelby Farms (35°8.4'N, 89°50.2'W) were in Shelby County. All locations represented sites with numerous anthropogenic field–forest edge habitats. At Ames, fields were either currently used for agriculture or were early successional habitat. Forests consisted mainly of mature bottomland hardwoods with some upland hardwood forests (Baldwin *et al.* 2005). At Meeman, fields consisted of maintained areas with some early successional habitat, and forests comprised mature upland and bottomland hardwood forests (Carver *et al.* 2011). Shelby Farms was the study area with the greatest anthropogenic influence. Fields there were created by current agricultural practices or were maintained areas or road edges, and forests comprised upland and bottomland hardwood forests (Wolcott *et al.* 2012). Habitats examined in our investigation represented a mosaic of field–forest edge types in both rural and urban locations.

Methods

Trapping

Our trapping protocol consisted of transect-sampling using Sherman live traps (7.5 cm × 9.0 cm × 23.0 cm; H. B. Sherman Traps, Inc., Tallahassee, Florida) following the method of Jones *et al.* (1996). During late May and early June 2010, traps were placed along 54 transects in pairs with one trap facing the forest and the other oriented toward the field. Each transect included 30–40 total traps with pairs of traps spaced approximately 5 m apart. Trap placement was fully randomized throughout the study with an even number of transects having the field-facing trap on the left-hand side and other transects having the field-facing trap on the right side. All traps were placed with the door mechanism free from obstructions to ensure efficient operation. Traps were baited with rolled oats and checked daily.

We conducted sampling for 1–3 nights along each transect. Number of trap-nights (i.e., one trap set for one night) was used as a metric to maintain equal comparisons between the two trap orientations. Species, age, and sex of captured animals were determined. Animals were temporarily marked on the ventral surface (lightly) with a black or blue sharpie marker (Sanford LP, Oak Brook, Illinois) and released at the site of capture. We followed the guidelines for the use of wild mammals in research suggested by the American Society of Mammalogists (Sikes *et al.* 2011) and the Institutional Animal Care and Use Committee of the University of Memphis approved our methods (IACUC Protocol 0673).

Analysis

Logistic regression was used to assess capture success based on trap orientation. The dependent variable was categorized as binary: capture success of a field-facing trap was coded as 0, and capture success of a forest-facing trap was coded as 1. The predictor variables for sex, age, location, and species were coded as dummy variables (see Sokal and Rohlf 2012). Ages were categorized as juvenile, sub-adult, or adult (see Martin *et al.* 2002). Reference categories were adult for age, female for sex, Ames for location, and House Mouse (*Mus musculus*) for species. Logistic regressions considered possible demographic factors (sex, age, and species) as well as locale, which could account for differences in capture success due to trap orientation. The goodness-of-fit for each logistic regression was assessed using a likelihood ratio test (Sokal and Rohlf 2012). All statistical tests were performed in R version 3.0.2 (R Foundation for Statistical Computing, Vienna, Austria, 2012).

Results

Sampling effort (orientation of traps equally divided) was 10216 trap-nights: Ames 1596, Meeman 2280, Shelby Farms 6340. In total, 408 individual small mammals (191 males, 217 females) were captured a total of 480 times (230 males, 250 females): captures at each location were Ames 147 (65 males, 82 females); Meeman 75 (38 males, 37 females); Shelby Farms 258 (127 males, 131 females). A total of six species were captured. The White-footed Mouse (*Peromyscus leucopus*) was captured most often (n = 324; 157 males, 167 females) followed by the Hispid Cotton Rat (*Sigmodon hispidus*; n = 80; 33 males, 47 females), the Woodland Vole (*Microtus pinetorum*; n = 40; 19 males, 21 females), the North American Deermouse (*Peromyscus maniculatus*; n = 23; 13 males, 10 females), the House Mouse (n = 9; 6 males, 3 females), and the Marsh Oryzomys (*Oryzomys palustris*; n = 4; 2 males, 2 females).

Likelihood ratio tests conducted for each model showed that neither demographic factors nor location significantly increased the likelihood of capture success in a particular orientation: sex L = 0.441, df = 1, P = 0.507; age L = 1.016, df = 1, P = 0.602; species L = 3.602, df = 1, P = 0.608; location L = 0.362, df = 1, P = 0.835).

Discussion

Our results support the prediction that trap orientation does not affect the capture success of small mammals in relation to age, sex, species, or location in field–forest edge habitat. Rana (1986) and Norton (1987) showed that small mammals do not use areas randomly and that well-placed traps will enhance capture success. Capture success for this group of mammals is also influenced by several factors other than placement (see Wilson *et al.* 1996). For example, sampling may vary among habitat (e.g., Feldhamer *et al.* 1993; Schnell *et al.* 2008). Capture rates are also known to be different for males and females (Davis and Emlen 1956). Males often have larger home ranges than females and, thus, greater exposure to traps. Because of this, males are often captured more frequently than females resulting in sex biases in trapped samples (Buskirk and Lindstedt 1989; Poindexter *et al.* 2013). Our findings suggest that a sex bias is not present in the successful capture of individuals at a particular orientation.

Differential capture among species may be related to population density, with the most abundant species generally being captured in greatest numbers (see Nichols 1986; Hopkins and Kennedy 2004). As in our investigation, LaMountain (2007) reported that the White-footed Mouse was abundant in edge and forest habitats and the Hispid Cotton Rat was abundant in field habitat in western Tennessee. Other studies have recorded high densities of White-footed Mouse in edge (e.g., Adler and Wilson 1987; Manson *et al.* 1999) and forest sites (e.g., Yahner 1992; Wolf and Batzli 2002). Foster and Gaines (1991) and Brady and Slade (2001) noted an abundance of Hispid Cotton Rat in field habitats. In our study, we were able to capture species that are abundant in each of these habitat types. Our findings demonstrate that there was no significant difference in captures between the two trap orientations due to species.

Other factors are known to influence the capture of small mammals. For example, trap type (Sealander and James 1958; Hansson and Hoffmeyer 1973), type of bait (Churchfield 1990), moonlight (Price *et al.* 1984), chemical odours (Chabreck *et al.* 1986, Heske 1987), fire (Christian 1977; Gates and Tanner 1988), and weather (Gentry *et al.* 1966; Doucet and Bider 1974). In addition, Barnett and Dutton (1995) noted the importance of trap position, spacing, quantity, and duration in the capture of small mammals. Because orientation of the trap could be a consideration in several of these untested factors, additional investigations of trap orientation in relation to trapping methods could provide new insight into procedures for studying small mammals in various habitats.

Overall, we found no difference in capture success due to trap orientation in field–forest edges in relation to age, sex, species, or location. It appears that the orientation of a trap in field–forest edge habitat makes little difference in the capture of small mammals. Given this finding, we note that orienting trap openings toward the field will likely minimize the trapping effort associated with checking and rebaiting traps. This information should be useful in future studies relating to the challenging tasks of surveying and monitoring populations of small mammals.

Acknowledgements

We thank the personnel of the Ames Plantation, Meeman Biological Station, and Shelby Farms Park for permission to work on lands under their control. We also thank A. Christopher Grow, as well as students from the University of Memphis field techniques course, who assisted in various aspects of the fieldwork associated with our investigation.

Literature Cited

Adler, G. H., and **M. L. Wilson.** 1987. Demography of a habitat generalist, the white-footed mouse, in a heterogeneous environment. Ecology 68: 1785–1796.

Baldwin, R. A., A. E. Houston, M. L. Kennedy, and **P. S. Liu.** 2005. Predicting raccoon, *Procyon lotor*, occurrence through the use of microhabitat variables. Canadian Field-Naturalist 119: 225–231.

Barnett, A., and **J. Dutton.** 1995. Expedition field techniques: small mammals (excluding bats). Geographic Outdoors, Royal Geographic Society with IBG, London.

Brady, M. J., and **N. A. Slade.** 2001. Diversity of a grassland rodent community at varying temporal scales: the role of ecologically dominant species. Journal of Mammalogy 82: 974–983.

Buskirk, S. W., and **S. L. Lindstedt.** 1989. Sex biases in trapped samples of Mustelidae. Journal of Mammalogy 70: 88–97.

Carver, B. D., M. L. Kennedy, A. E. Houston, and **S. B. Franklin.** 2011. Assessment of temporal partitioning in foraging patterns of syntopic Virginia opossums and raccoons. Journal of Mammalogy 92: 134–139.

Chabreck, R. H., B. U. Constantin, and **R. B. Hamilton.** 1986. Use of chemical ant repellents during small mammal trapping. Southwestern Naturalist 31: 109–110.

Christian, D. P. 1977. Effects of fire on small mammal populations in a desert grassland. Journal of Mammalogy 58: 423–427.

Churchfield, S. 1990. The natural history of shrews. Cornell University Press, Ithaca, New York.

Davis, D. E., and **J. T. Emlen.** 1956. Differential trapability of rats according to size and sex. Journal of Wildlife Management 20: 326–327.

Doucet, G. J., and **J. R. Bider.** 1974. The effects of weather on the activity of the masked shrew. Journal of Mammalogy 55: 348–363.

Fagan, W. H., R. S. Cantrell, and **C. Cosner.** 1999. How habitat edges change species interactions. American Midland Naturalist 153: 165–182.

Feldhamer, G. A., R. S. Klann, A. S. Gerard, and **A. C. Driskell.** 1993. Habitat partitioning, body size, and timing of parturition in pygmy shrews and associated sorcids. Journal of Mammalogy 74: 403–411.

Foster, J., and **M. S. Gaines.** 1991. The effects of a successional habitat mosaic on a small mammal community. Ecology 72: 1358–1373.

Gates, C. A., and **G. W. Tanner.** 1988. Effects of prescribed burning on herbaceous vegetation and pocket gophers (*Geomys pinetis*) in a sandhill community. Florida Scientist 51: 129–139.

Gentry, J. B., F. B. Golley, and **J. T. McGinnis.** 1966. Effect of weather on captures of small mammals. American Midland Naturalist 75: 526–530.

Groom, M. J., G. K. Meffe, and **C. R. Carroll.** 2006. Principles of conservation biology, Third edition. Sinauer Associates, Inc., Sunderland, Massachusetts.

Hansson, L., and **I. Hoffmeyer.** 1973. Snap and live trap efficiency for small mammals. Oikos 24: 477–478.

Heske, E. J. 1987. Responses of a population of California voles, *Microtus californicus*, to odor-baited traps. Journal of Mammalogy 14: 9–12.

Hopkins, H. L., and **M. L. Kennedy.** 2004. An assessment of indices of relative and absolute abundance for monitoring populations of small mammals. Wildlife Society Bulletin 32: 1289–1296.

Jones, C., W. J. McShea, M. J. Conroy, and **T. H. Kunz.** 1996. Capturing mammals, Pages 115–155 *in* Measuring and monitoring biological diversity: standard methods for mammals *Edited by* D. E. Wilson, F. R. Cole, J. D. Nichols, R. Rudran, and M. S. Foster. Smithsonian Institution Press, Washington, D.C.

LaMountain, H. L. 2007. Biodiversity of small mammals in anthropogenic-edge habitats: is there an edge effect? M.S. thesis, The University of Memphis, Memphis, Tennessee, USA.

Manson, R. H., R. S. Ostfeld, and **C. D. Canham.** 1999. Responses of a small mammal community to heterogeneity along forest-old-field edges. Landscape Ecology 14: 355–367.

Martin, E. R., R. H. Pine, and **A. F. DeBlase.** 2002. A manual of mammalogy with keys to families of the world. McGraw-Hill, New York, New York.

Murcia, C. 1995. Edge effects in fragmented forests: implications for conservation. Trends in Ecology and Evolution 10: 58–62.

Nichols, J. D. 1986. On the use of enumeration estimators for interspecific comparisons with comments on a 'trappability' estimator. Journal of Mammalogy 67: 590–593.

Norton, T. W. 1987. The effects of trap placement on trapping success of *Rattus lutreolus velutinus* (Thomas) (Muridae: Rodentia) in north-east Tasmania. Australian Wildlife Research 14: 305–310.

Poindexter, C. J., G. D. Schnell, C. Sánchez-Hernández, M. L. Romero-Almaraz, M. L. Kennedy, T. L. Best, C. Wooten, and **J. L. Waits.** 2013. Demographic features and habitat preferences of *Osgoodomys banderanus* (Osgood's deermouse) in Colima, Mexico. Southwestern Naturalist 58: 8–19.

Price, M. V., N. M. Waser, and **T. A. Bass.** 1984. Effects of moonlight on microhabitat use by desert rodents. Journal of Mammalogy 65: 353–356.

Rana, B. D. 1986. Effect of trap placement on trapping success of small mammals. Saugetierkundliche Mitteilungen 32: 261–264.

Risch, T. S., and **M. J. Brady.** 1996. Trap height and capture success of arboreal small mammals: evidence from southern flying squirrels (*Glaucomys volans*). American Midland Naturalist 136: 346–352.

Schnell, G. D., M. L. Kennedy, C. Sanchez-Hernandez, M. L. Romero-Almaraz, B. D. N. Estevez, J. A. Guerrero, T. L. Best, M. C. Wooten, and **R. D. Owen.** 2008. Habitat preference of the endemic Tawny Deermouse (*Peromyscus perfulvus*), a species of conservation concern. Southwestern Naturalist 55: 9–20.

Sealander, J. A., and **D. James.** 1958. Relative efficiency of different small mammal traps. Journal of Mammalogy 39: 215–223.

Sikes, R. S., W. L. Gannon, and the Animal Care and Use Committee of the American Society of Mammalogists. 2011. Guidelines of the American Society of Mammalogists for the use of wild mammals in research. Journal of Mammalogy 92: 235–253.

Smith, T. M., and R. L. Smith. 2012. Elements of Ecology. Eighth edition. Benjamin Cummings, Boston, Massachusetts.

Sokal, R. R., and **F. J. Rohlf.** 2012. Biometry. Fourth edition. W. H. Freeman and Company, New York, New York.

Wilson, D. E., F. R. Cole, J. D. Nichols, R. Rudran, and **M. S. Foster.** 1996. Measuring and monitoring biological diversity: standard methods for mammals. Smithsonian Institution Press, Washington, D.C.

Wolcott, D. M., A. C. Grow, A. E. Houston, C. A. Goudie, E. Ozdenerol, B. D. Carver, L. R. Miller, B. A. Simco, and **M. L. Kennedy.** 2012. Checklist of medium and large mammals at Shelby farms park, Memphis, Tennessee. Journal of the Tennessee Academy of Sciences 87: 99–104.

Wolf, M., and **G. O. Batzli.** 2002. Effects of forest edge on populations of white-footed mice *Peromyscus leucopus*. Ecography 25: 193–199.

Yahner, R. H. 1992. Dynamics of a small mammal community in a fragmented forest. American Midland Naturalist 127: 381–391.

Received 7 November 2013
Accepted 3 January 2014