A Comparison of Snap Traps for Evaluating Small Mammal Populations

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Abstract: We compared rat, mouse, and museum special snap traps to determine if differences existed in capture efficiency of small mammals and whether type of trap affected indices of richness, evenness, and diversity. Small mammals were trapped in 57 streamside study areas in 1990 to 1995 in the Ouachita Mountains, Arkansas. Efficiency of mouse traps was equal to or greater than that of museum special traps in capturing all small mammal species. Rat traps were most efficient for capturing the 2 largest small mammal species recorded, the eastern wood rat (*Neotoma floridana*) and the cotton rat (*Sigmodon hispidus*). We found no difference among the types of traps in their susceptibility to being inadvertently sprung by extrinsic factors such as rain. Mean species richness, evenness, and diversity did not differ among trap types. A combination of mouse and rat traps increased species richness and diversity over mouse traps alone. A combination of mouse, rat, and museum special traps did not greatly increase any community measure relative to the mouse and rat trap combination. We conclude that use of museum special traps for sampling small mammals is unnecessary unless the objective is to acquire museum specimens.

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Researchers and land managers frequently trap small mammals to evaluate relationships between land use practices and small mammal population levels and species diversity. Selecting the type of trap to use depends not only on study objectives, but also on cost and efficiency of traps. Many types of small mammal traps are available and studies suggest some traps are more efficient at capturing certain mammal species (Smith et al., 1971, Wiener and Smith 1972, Innes and Bendell 1988).

Small mammal kill traps, or snap traps, are a commonly used and inexpensive type of trap. Comparisons among types of snap traps suggest museum special traps may capture higher numbers of individuals than rat or mouse traps (Smith et al. 1971, Wiener and Smith 1972, Pendleton and Davison 1982); however, no study has compared the 3 types of snap traps concurrently. Because museum special traps are designed specifically for capturing museum specimens and must be purchased through specialized suppliers, these traps can cost many times more than rat or mouse traps.

Diversity indices, including Shannon's (Shannon and Weaver 1949), are commonly used to compare small mammal communities; however, few have investigated whether type of snap trap affects these indices. Pendleton and Davison (1982) compared diversity indices among rat traps, museum special traps, and Sherman live traps, and found higher diversity measures associated with museum special traps; however, their data were not statistically tested. Our objective was to compare the capture efficiency of mouse, rat, and museum special traps and to determine how selected diversity measures are affected by these types of traps.

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Methods

The study was conducted in streamside management zones (SMZs) and other riparian areas on Weyerhaeuser Company and USDA Forest Service lands in the Ouachita Mountains near Hot Springs, Arkansas. SMZs are forest strips left along permanent and intermittent streams after timber harvest in adjacent stands and are often surrounded by pine plantations. In this study, SMZs consisted of natural, second-growth hardwood and pine forest and ranged from 6 to 246 m in width. Pine plantations adjacent to SMZs and streams varied from approximately 2 to 20 years in age.

We had 57 study areas which were sampled in groups of 19 for 2 consecutive years. Three groups of study areas were sampled between 1990 and 1995. Groups were comprised of 15 SMZs of varying width, 3 areas centered on streams in pine plantations with no SMZ present, and 1 area located in a continuous forest stand (i.e., an area centered on a stream in a late-rotation forest stand not surrounded by pine plantation). Each group was trapped for 10 days in February. Traps were placed at stations on both sides of streams and in adjacent pine plantations. Continuous forest areas and SMZs ≥60 m wide contained 54 trap stations, whereas SMZs <60 m wide and areas centered in pine plantations contained 36 trap stations. Trap stations were 10 to 40 m apart. At each trap station we set 1 Victor® mouse trap, 1 Victor® rat trap, and 1 Woodstream® museum special trap. Traps were generally <2 m apart and were placed beside down wood and other natural runs where possible. Traps were baited with a combination of rolled oats, peanut butter, and vegetable oil.

The 2 years of data for each area were combined for analysis. Similarity in species captured by trap type was calculated using Sorensen's Index (SI) = 200C/(A + B), where A = number of species captured in trap type A, B = number of species captured in trap type B, and C = number of species shared by the 2 types of traps (Mueller-Dombois and Ellenberg 1974). SI can range from 0% (i.e., no species in common) to 100% (i.e., identical species composition).

To adjust for unequal trapping effort among study areas, capture rates are expressed as the number of small mammals captured/100 available trap nights. Capture rates by species and trap type were calculated for each of the 57 study areas. Mean capture rates by species and trap type were nonnormal and were compared using nonparametric analysis of variance (ANOVA) and Duncan's Multiple Range Test on ranks (SAS Inst. 1988) at the 0.10 level of significance.

Because extrinsic factors such as rain or falling leaves can trip traps and eliminate their ability to capture small mammals, empty sprung traps were excluded from the capture rate calculations. The percentage of traps that were sprung was calculated for each area for the 2-year trapping period. We calculated the mean percent of traps that were sprung by trap type and compared these means using parametric ANOVA on arcsine transformed data at the 0.05 level.

The total number of individuals caught and capture rate were determined for each area by trap type with all species combined. Species richness, evenness, and diversity were determined for each area by trap type. Means for each variable were calculated from the 57 sample areas. Species richness was defined as the number of different species caught in an area for the 2-year trapping period. Some individuals of the genus *Peromyscus* could not be accurately identified to species. Because qualified mammalogists conflicted in their identification of certain individuals to species, we decided to categorize these individuals into a *Peromyscus* spp. group. The *Peromyscus* spp. group was not included in the calculation of richness, evenness, and diversity measures. Species diversity was determined for each area using the Shannon Index (Shannon and Weaver 1949). We used Pielou's J (Pielou 1969) to index evenness of small mammal communities. These data were normally distributed, they were compared using parametric one-way ANOVAs and Duncan's multiple range tests at the 0.05 level of significance.

Mean capture rate, species richness, evenness, and diversity were calculated for rat and mouse traps combined, and for rat, mouse, and museum special traps combined. We compared the percent change in means for these 2 combinations.

Results

A total of 2,054 small mammals was captured on 122,276 trap nights, adjusted for empty sprung traps. Twelve species and 1 genus (*Peromyscus*) were identified

(Table 1). The mouse trap was most efficient at capturing animals of low body mass, including the least shrew (*Cryptotis parva*) and short-tailed shrew (*Blarina carolinensis*). Although museum special traps captured the greatest total number of golden mice (*Ochrotomys nuttalli*) and *Peromyscus* spp., museum special capture rates were not greater for these 2 taxa (Table 2). The SI of species composition was 80% between rat and mouse traps, 80% between rat and museum special traps, and 83% between mouse and museum special traps. The eastern woodrat and the cotton rat, the 2 largest species captured, were caught exclusively in rat traps.

The mean percent (± SE) of empty sprung traps was 14.7 (± 1.1) for mouse traps, 15.1 (± 1.1) for museum special traps, and 13.3 (± 1.0) for rat traps. The percent of empty sprung traps did not differ among types of traps ($F = 0.83$; df = 2, 168; $P = 0.4385$).

Capture rates varied among type of traps for some species (Table 2). The eastern woodrat was the only species whose capture rate was greatest in rat traps. Although cotton rats were caught exclusively in rat traps, only 2 were captured, resulting in no significant difference in capture rate. Mouse traps had greater capture rates than rat traps for the short-tailed shrew, golden mouse, and pine vole (*Microtus pinetorum*). Capture rates for museum specials and mouse traps did not differ ($P > 0.10$) for any species except short-tailed shrews.

For all species combined, museum specials and mouse traps did not differ ($P > 0.05$) in mean total number of individuals/area captured or in capture rate (Table 3). Museum special and mouse traps captured more small mammals and had higher

Table 1. Size range and total captures by type of trap of small mammals collected in 57 streamside study areas in the Ouachita Mountains, Arkansas, 1990 to 1995.

Taxon	Size range (g)[a]	Trap type: Mouse (40,609)[b]	Trap type: Museum special (40,358)	Trap type: Rat (41,309)
Least shrew (*Cryptotis parva*)	4–8	6	0	1
Short-tailed shrew (*Blarina carolinensis*)	5–11	335	190	91
Fulvous harvest mouse (*Reithrodontomys fulvescens*)	7–18	67	67	51
Golden mouse (*Ochrotomys nuttalli*)	12–31	257	310	207
Deer mouse (*Peromyscus maniculatus*)	16–26	9	8	8
White-footed mouse (*Peromyscus leucopus*)	13–36	47	47	39
Texas mouse (*Peromyscus attwateri*)	19–41	9	7	9
Peromyscus spp.	13–51	33	43	19
Cotton mouse (*Peromyscus gossypinus*)	20–51	23	36	36
Pine vole (*Microtus pinetorum*)	21–56	28	21	11
Marsh rice rat (*Oryzomys palustris*)	31–78	0	1	1
Hispid cotton rat (*Sigmodon hispidus*)	52–211	0	0	2
Eastern woodrat (*Neotoma floridana*)	147–428	0	0	27

[a]From Sealander and Heidt (1990).
[b]Total adjusted trap nights.

Table 2. Mean capture rate/100 trap nights (±SE) by species and type of trap for small mammals collected from 57 streamside study areas in the Ouachita Mountains, Arkansas, 1990 to 1995.

	Trap type		
Taxon	Mouse	Museum special	Rat
Least shrew (*Cryptotis parva*)	0.017A[a] ± 0.014	0.000A ± 0.000	0.003A ± 0.003
Short-tailed shrew (*Blarina carolinensis*)	0.839A ± 0.082	0.486B ± 0.061	0.226C ± 0.037
Fulvous harvest mouse (*Reithrodontomys fulvescens*)	0.183A ± 0.064	0.186A ± 0.061	0.136A ± 0.058
Golden mouse (*Ochrotomys nuttalli*)	0.663A ± 0.078	0.778AB ± 0.091	0.502B ± 0.058
Deer mouse (*Peromyscus maniculatus*)	0.018A ± 0.009	0.020A ± 0.009	0.017A ± 0.010
White-footed mouse (*Peromyscus leucopus*)	0.120A ± 0.036	0.105A ± 0.029	0.086A ± 0.028
Texas mouse (*Peromyscus attwateri*)	0.017A ± 0.010	0.014A ± 0.006	0.017A ± 0.009
Cotton mouse (*Peromyscus gossypinus*)	0.055A ± 0.016	0.086A ± 0.022	0.082A ± 0.024
Peromyscus spp.	0.074A ± 0.023	0.092A ± 0.030	0.038A ± 0.012
Pine vole (*Microtus pinetorum*)	0.070A ± 0.022	0.056AB ± 0.022	0.028B ± 0.016
Marsh rice rat (*Oryzomys palustris*)	0.000A ± 0.000	0.002A ± 0.002	0.002A ± 0.002
Hispid cotton rat (*Sigmodon hispidus*)	0.000A ± 0.000	0.000A ± 0.000	0.006A ± 0.006
Eastern woodrat (*Neotoma floridana*)	0.000A ± 0.000	0.000A ± 0.000	0.072B ± 0.016

[a]Within rows, means followed by the same letter are not different ($P < 0.10$).

Table 3. Mean total captures/area, species richness, evenness, and diversity (± SE) by trap type collected from 57 streamside study areas in the Ouachita Mountains, Arkansas, 1990 to 1995.

	Trap type		
Variable	Mouse	Museum special	Rat
Total captures/area	13.84A[a] ± 1.05	12.07A ± 1.09	8.49B ± 0.87
Capture rate/100 trap nights	1.95A ± 0.14	1.71A ± 0.15	1.17B ± 0.11
Species richness	3.09A ± 0.17	3.07A ± 0.18	2.91A ± 0.20
Evenness	0.83A ± 0.02	0.83A ± 0.02	0.87A ± 0.02
Diversity	0.86A ± 0.05	0.87A ± 0.05	0.81A ± 0.06

[a]Within rows, means followed by the same letter are not different ($P < 0.05$).

capture rates than rat traps. Indices of species richness, evenness, and diversity did not differ among type of trap (richness: $F = 0.28$; df = 2, 168; $P = 0.756$; evenness: $F = 1.91$; df = 2, 151; $P = 0.152$; diversity: $F = 0.36$; df = 2, 167; $P = 0.695$).

A combination of rat and mouse traps increased species richness and diversity over mouse traps alone (Table 4); however, the lower capture success of rat traps

Table 4. Comparison of mean capture rate, richness, evenness, and diversity followed by percent change in mean for mouse traps alone, a combination of mouse and rat traps, and a combination of mouse, rat and museum special traps collected from 57 streamside study areas in the Ouachita Mountains, Arkansas, 1990 to 1995.

		Mouse and rat		Mouse, rat, and museum special	
Variable	Mouse	Mean	% Change[a]	Mean	% Change[b]
Capture rate/100 trap nights	1.95	1.56	−20.0	1.61	3.2
Species richness	3.09	3.88	25.6	4.35	12.1
Evenness	0.83	0.81	−2.4	0.76	−6.2
Diversity	0.86	1.02	18.6	1.05	2.9

[a]Percent change compared to mouse traps alone.
[b]Percent change compared to a combination of mouse and rat traps.

resulted in a lower capture rate. A combination of all 3 types of trap did not greatly increase species richness or diversity over a combination of rat and mouse traps.

Discussion

Mouse traps were equal to or more efficient than museum special traps in capturing small and intermediate-sized small mammals. Rat traps captured the largest small mammal species most efficiently. A research study suggesting that museum special traps are more efficient than mouse traps (Smith et al. 1971) was not supported by our findings; however, our results support Pendleton and Davison's (1982) finding that museum special traps are more efficient than rat traps for all but the largest small-mammal species. We also found that no type of trap was more susceptible to being inadvertently sprung from rain or other factors.

Because no species of small mammal was caught exclusively in museum special traps, the use of museum specials did not increase species richness. Furthermore, capture rates in museum specials were not greater than capture rates in mouse traps. Unless voucher specimens are required, our results suggest that a combination of less expensive rat and mouse traps can be used to obtain representative samples of small mammals. Because richness, evenness, and diversity measures were not affected by individual trap types, our data suggest that any 1 of the 3 trap types could be used to estimate these parameters; however, because the larger mammal species were captured exclusively in rat traps, richness, diversity, and total number of species captured can be increased by using a combination of rat and mouse traps. Only modest increases in richness and diversity would be expected if museum specials are used in conjunction with rat and mouse traps.

Literature Cited

Innes, D. G. L. and J. F. Bendell. 1988. Sampling of small mammals by different types of traps in northern Ontario, Canada. Acta Theriologica 33:443–450.

Mueller-Dombois, D. and E. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, New York, N.Y. 547pp.

Pendleton, G. W. and R. P. Davison. 1982. Relative efficiency of three small-mammal traps in prairie wetlands. Prairie Nat. 14:9–12.

Pielou, E. C. 1969. An introduction to mathematical ecology. John Wiley and Sons, New York, N.Y. 286pp.

SAS Institute, Inc. 1988. SAS/STAT user's guide, version 6.03 edition. SAS Inst., Inc., Cary, N.C. 1028pp.

Sealander, J. A. and G. A. Heidt. 1990. Arkansas mammals: their history, classification, and distribution. Univ. Ark. Press, Fayetteville. 308pp.

Shannon, C. E. and W. Weaver. 1949. The mathematical theory of communication. Univ. Ill. Press, Urbana. 177pp.

Smith, G. C., D. W. Kaufman, R. M. Jones, J. B. Gentry, and M. H. Smith. 1971. The relative effectiveness of two types of snap traps. Acta Theriologica 16:284–288.

Wiener, J. G. and M. H. Smith. 1972. Relative efficiencies of four small mammal traps. J. Mammal. 53:868–873.