Efficacy of a Multiple-Capture Live Trap for Small Mammals[1]

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ABSTRACT. **We compared the efficacy of Victor® Tin Cat® and Sherman live traps for capturing small mammals in northern hardwood and red pine (*Pinus resinosa*) stands in the north-central Upper Peninsula of Michigan during 2001. Overall mean capture rates (total captures/100 adjusted trap nights) by habitat were greater ($P \leq 0.030$) for Sherman traps than for Tin Cat traps. Capture rates remained lower for Tin Cat traps in northern hardwood ($P = 0.004$) but not red pine ($P = 0.936$) habitat after adjusting for species (sciurids) unable to enter them. Greater species diversity values were obtained using Sherman traps in both habitats. We conclude that in sampling arrays tested, Victor Tin Cat traps were less effective than Sherman traps for estimating small mammal abundance and diversity.**

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INTRODUCTION

Live traps are commonly used to estimate small mammal abundance and diversity (for example, Von Trebra and others 1998; Carey and Wilson 2001). Differential trapping success among types and sizes of small mammal live traps has been demonstrated (Slade and others 1993; O'Farrell and others 1994). Consequently, interpretation of results for a particular trap type can only be made with some knowledge of the trap's performance relative to other trap types.

Multiple-capture live traps have been used in several recent studies of small mammal ecology and distribution, with the commercial Victor Tin Cat trap (Woodstream Corp., Lititz, PA) used most commonly (for example, Bowman and others 2001a,b,c). One proposed benefit of using these traps is a reduction in the number of traps necessary to sample an area due to their multiple-capture capability. Tin Cat traps reset after each capture and can hold several small mammals simultaneously. The website for the manufacturer of the Tin Cat trap (www.woodstream.com) states these traps can hold up to 30 mice. Studies by Bowman and others (2001a,b,c) used arrays of five Tin Cats in a cross pattern spaced 35 m apart, which presumably sampled the same area as 25 Sherman traps set in a 5 x 5 grid with 10 m spacing, or a circle of about 50 m radius (J. Bowman, Ontario Ministry of Natural Resources, personal communication).

Another potential benefit of Tin Cat traps is the increased likelihood of multiple captures due to the presence of a small mammal in the trap. An animal in the trap may help other individuals overcome a neophobic response. Residual odors of conspecifics in traps has enhanced capture efficacy for several small mammals species (Rowe 1970; Drickamer 1984; Tobin and others 1994).

Despite its increasing use in ecological studies, the efficacy of the Victor Tin Cat has not been thoroughly tested against the more commonly used Sherman live trap (H. B. Sherman Traps Inc., Tallahassee, FL). Our objective was to compare small mammal capture rates and species composition between Victor Tin Cat and Sherman live traps in previously used trap arrays to determine the effectiveness of Tin Cat traps in estimating abundance and diversity of small mammals.

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MATERIALS AND METHODS

The study was conducted in the north-central Upper Peninsula of Michigan, on lands administered by Pictured Rocks National Lakeshore and Hiawatha National Forest. Trapping was conducted in two habitats: northern hardwoods with a dominant overstory of sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*), and a red pine (*Pinus resinosa*) plantation.

We used collapsible Sherman live traps (Model LFG) designed for single captures (Fig. 1). Sherman traps were 8.0 x 8.8 x 23.4 cm with one tapered 6.5 to 7.0 x 8.0 cm entrance. Victor® Tin Cat® live traps (Model 308) were 26.7 x 15.9 x 4.8 cm with a clear plastic lid and two 2.8 x 3.5-cm entrances. Tin Cat traps were designed for multiple captures.

The experimental design in each habitat was a randomized split-block with 6 replicates. Each block consisted of 25 Sherman traps and 5 Tin Cat traps. We placed Sherman traps in a 5 x 5 grid with 17.5-m spacing for an effective trapping area of about 7,650 m^2. We placed a Tin Cat trap in the center of each split and remaining traps 35 m from center in the cardinal directions; this array was designed to sample a 50-m radius around the center trap (effective trapping area of 7,850 m^2; Bowman and others 2001a,b,c). Blocks and splits within blocks were separated by >25 m; blocks were >25 m from habitat edge. All traps were placed in "most likely runway" positions, baited with rolled oats and peanut butter, and rebaited as necessary. Prebaiting was not conducted. Cotton was placed in traps to provide bedding. Traps were set initially during morning and checked 3 times each day for 4 days, resulting in 100 and 20 unadjusted trap nights/block for Sherman and Tin Cat traps, respectively. Individuals captured were identified to species and released at their respective capture sites. We followed animal care and use guidelines outlined by the American Society of Mammalogists (1987).

To standardize trapping effort, Sherman traps that were sprung were adjusted using 0.5 time intervals (that is, trap nights; Belant 1992; Beauvais and Buskirk 1999). Tin Cat traps allowed multiple captures and were not adjusted for unless disturbed or missing. We calculated mean number of captures/100 adjusted trap nights for each trap type in both habitats. We also calculated mean capture rates excluding sciurids (red squirrel [*Tamiasciurus hudsonicus*], eastern chipmunk [*T. striatus*], and least chipmunk [*Eutamius sciurus*]), as these species were too large to enter Tin Cat traps.

Because of unequal variances, we used Wilcoxon rank sum tests (Zar 1984) to compare mean rank scores of capture rates between trap types in each habitat using PROC NPAR1WAY (SAS Institute Inc. 1990). Means are reported with ± 1.0 standard error; statistical significance was established at $P < 0.050$.

We used Species Richness, Shannon-Weiner, and Simpson's indices to compare species diversity of small mammals captured with each trap type in each habitat (Colinvaux 1986; Kirkland 1990). Species Richness (S) is a measure of the number of species documented by capture. The Shannon-Weiner index (H') measures the probability of selecting the identity of an individual taken from the sample at random using the equation:

$$H' = -\Sigma\, p_i \ln p_i$$

Where p_i is the proportion of the total number of individuals in the ith species for i = 1 to n.; H' increases with species diversity. Simpson's index (l) is the probability that any two individuals selected at random will be the same species and uses the equation:

$$\lambda = \Sigma\, p_i^2$$

for i = 1 to n. Simpson's index is an inverse measure of diversity in that species diversity increases as λ decreases.

FIGURE 1. Victor® Tin Cat® (top) and Sherman (bottom) live traps used in efficacy trials, Upper Peninsula of Michigan, July 2001.

RESULTS

We captured 253 individuals in 1,440 unadjusted trap nights, 141 in northern hardwood and 112 in red pine. In the northern hardwood habitat, 139 were captured in Sherman traps and 2 were captured in Tin Cat traps. We captured 112 individuals in Sherman traps and 9 in Tin Cat traps in the red pine stand. Deer mice (*Peromyscus maniculatus*) and eastern chipmunks were the species most commonly captured in both habitats (Fig. 2).

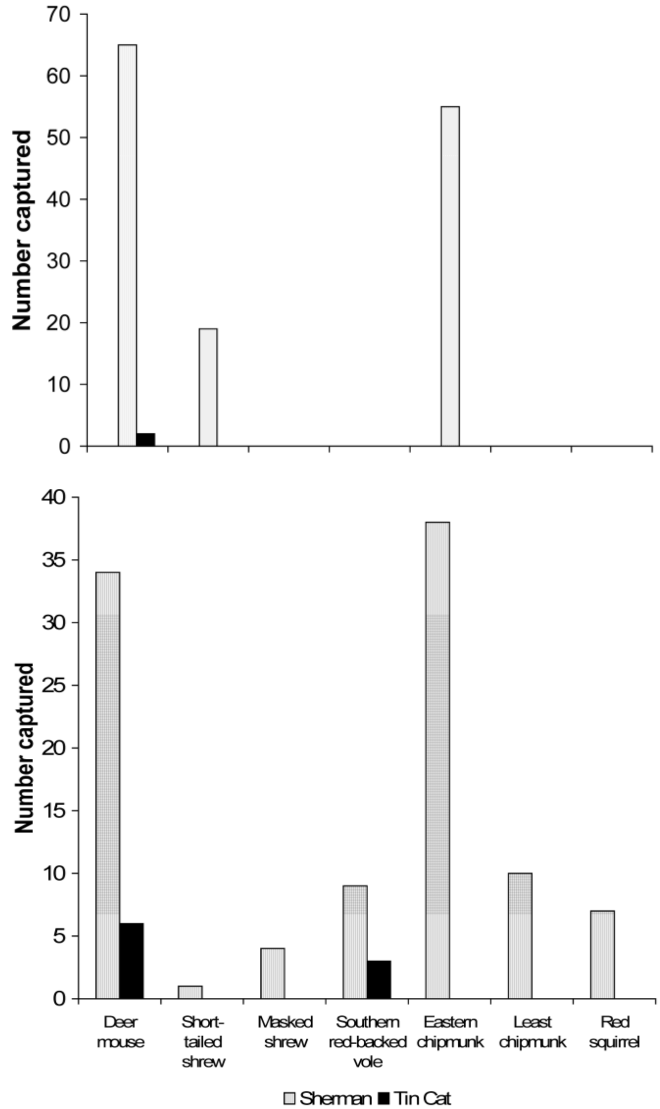

FIGURE 2. Small mammals captured using Sherman and Victor® Tin Cat® live traps in northern hardwood (top) and red pine stands (bottom), north-central Upper Peninsula of Michigan, July 2001.

Overall mean capture rates were greater for Sherman traps than for Tin Cat traps in northern hardwood (Z = 2.87, P = 0.004) and red pine habitats (Z = 2.16, P = 0.030; Table 1). After adjusting for sciurid captures, capture rates remained higher for Sherman traps in northern hardwoods (Z = 2.85 P = 0.004) but not in the red pine habitat (Z = 0.80, P = 0.936).

We captured 7 species overall, 3 in northern hardwood and 7 in red pine. In the northern hardwood habitat, 3 species were captured in Sherman traps and 1 species was captured using Tin Cat traps. We captured 7 species in Sherman traps and 2 species in Tin Cat traps in the red pine stand. Greater species diversity values were obtained using all 3 indices from Sherman traps in

Table 1

Small mammal capture rates (individuals/100 adjusted trap nights) using Sherman and Victor Tin Cat live traps, north-central Upper Peninsula of Michigan, July 2001.

	Sherman					
	With sciurids		Without sciurids		Tin Cats	
Habitat	x	SE	x	SE	x	SE
Northern hardwood	8.1	2.7	4.7	0.4	0.9	0.6
Red pine	6.0	0.9	2.8	0.8	2.5	0.9

both habitats (Table 2).

One multiple capture (2 deer mice) was recorded for Tin Cat traps; only individual captures were recorded for Sherman traps.

DISCUSSION

Overall capture rates and species diversity were lower with Tin Cat than with Sherman traps. Only 4% of total individuals and one-half of non-sciurid species were captured using Tin Cat traps. Although capture rates were similar between trap types in red pine habitat, few individuals were captured in Tin Cat traps. Thus, small differences in the number of individuals or species captured using Tin Cat traps could have a large effect on estimates of abundance and species diversity. Further, the small opening size of Tin Cat traps does not allow for capture of sciurids which are frequently important for assessing small mammal community abundance and diversity.

Olfaction is important in the social biology of small mammals (Stoddart 1974) and residual odors from small mammals in traps have been reported to enhance trapping efficacy (Drickamer 1984; Tobin and others 1994). The potential benefit of the presence of small mammals in Tin Cat traps as attractants to enhance capture rates through multiple captures was not observed in this study. Residual odor of small mammals captured was present in both trap types. Therefore, visual and olfactory cues were not advantages for using Tin Cat traps in our study.

Small mammal capture rates and trap efficacy vary markedly across studies. Location, season, and trap type, among other factors, influence capture rates (Wiener and Smith 1972; Williams and Braun 1983; Mengak and Guynn 1987). Indeed, multiple studies comparing identical trap types have reached different conclusions on capture effectiveness (Sealander and James 1958; Wiener and Smith 1972). Tin Cat and Sherman live traps have reportedly had similar capture rates in a previous study (J. Bowman, Ontario Ministry of Natural Resources, personal communication). In trap arrays and habitats we compared, however, we do not recommend Tin Cat over Sherman live traps. While three days of prebaiting prior to trapping was used previously (Bowman and others 2001a,b,c), we do not believe that prebaiting in our study would have changed the relative efficacy of the trap types. Although equipment costs and trapping effort were greater with Sherman traps, greater numbers of individuals and species captured using Sherman traps will likely result in improved estimates of small mammal abundance and diversity.

Table 2

Small mammal species diversity using Species Richness (S), Shannon-Weiner (H′), and Simpson's (λ) indices calculated from captures using Sherman and Victor Tin Cat live traps, north-central Upper Peninsula of Michigan, July 2001.

	Sherman								
	With sciurids			Without sciurids			Tin Cat		
Habitat	*S*	*H′*	λ	*S*	*H′*	λ	*S*	*H′*	λ
Northern hardwood	3	0.79	0.40	2	0.54	0.65	1	0	1.00
Red pine	7	1.54	0.27	4	0.84	0.55	2	0.61	0.56

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