Trap Biases in Surveying the Small Mammals of UNDERC

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ABSTRACT

This study investigates the efficiency of three trap types across several habitats. Trapping stations containing Sherman live traps, Museum Special snap traps, and 32-oz pitfalls were set up in six different habitats across the University of Notre Dame Environmental Research Center in northern Wisconsin and the Upper Peninsula of Michigan. Four replicates of each habitat were trapped for five nights. Captures per trapnight were calculated for each species by habitat and trap type. The resulting data showed that very few of the 14 captured species were caught in all three trap types. Sherman traps captured the widest variety of species (11) while pitfalls had the highest rate of success (6.8 percent). Masked shrews were significantly more likely to be caught in pitfalls than in either Shermans or Museum Specials. On the other hand, meadow jumping mice showed a marginally significant tendency towards Museum Specials over pitfalls while deer mice preferred Shermans over pitfalls. Deer mice were also the only species trapped arboreally with less than 2 percent of their total number trapped in trees. This data shows the importance of multiple trap type use. No trap captured all species present in the habitats studied and several species show marked preferences for different types of traps.
Key Words: trapnight, Sherman live trap, Museum Special snap trap, pitfall, arboreal, trap success

INTRODUCTION

Small mammal surveys can indicate the health of an ecosystem as well as provide information about possible sources of food for larger animals. When sampling small mammals, one could attempt to survey a population using tracks or scat as signs that a certain animal had been in the area recently. However, this method has quite a few shortcomings when attempting to obtain a quantitative count of species abundance in a given environment. Some areas are better suited for preserving signs while in other types it is very difficult to tell that an animal passed by even moments before (Wemmer et. al., 1996). Also, signs generally are useful only in establishing the presence or absence of a species. Surveying the population by trapping solves many of these problems. When trapped, animals can be identified, aged and sexed with accuracy. Then live individuals can be marked for later recapture and released while deceased individuals can be prepared as voucher specimens (Jones et. al., 1996). This enables the researcher to quantitatively determine the approximate number of individuals of a species across a wide variety of habitats (Slade et. al., 2000).

The researcher can also use trapping to establish the three-dimensional habitat use of small mammals. This can be done by placing traps at differing heights in trees and comparing how often a species is caught on the ground versus in an arboreal trap. It is important to look at vertical habitat use because similar species can coexist with each other by exploiting differing levels of vegetation in the same habitat range (Pruett et. al., 2002).

However, traps are not without bias. Certain traps are more likely to catch certain types of animals, based on the individual’s species, size, and behavior. For example, pitfalls catch smaller animals that navigate nonvisually. These creatures are less likely to see a trap or drift fence (if in place) and, therefore, do not avoid them like other, more visually-oriented species might (Williams and Braun, 1983). On the other hand, Museum Special snap traps capture species that are large enough to jump or climb out of a pitfall.

However, they are more likely to be affected by adverse weather than a pitfall, which makes them unsuitable for use year-round (Mengak and Guynn, 1987).

Until this study, no small mammal surveys had been conducted at the University of Notre Dame's Environmental Research Center (UNDERC). We attempted to determine the distribution of small mammal species across several different habitats and how trap types influenced the species caught in each of these habitats. It was realized that in order to achieve an accurate estimate of small mammal populations, we must examine how different trap types affect survey data from a range of habitats.

MATERIALS AND METHODS

Experimental Site

All trapping was conducted within the UNDERC property, a 7500 acre area located along the state line of Wisconsin and Michigan's Upper Peninsula (ca 46^{o}13' N, 89^{o}32' W). More than 16 percent of the property is open water found in 30 major lakes and bogs. UNDERC has an altitude of between 1640 to 1700 feet above sea level. It also contains three main streams, the longest of which is Tenderfoot Creek, which runs approximately three miles from its southern origin in Tenderfoot Lake to the northern border of the property. Trapping sites were spread out across the property, with four representative sites for each of the six habitat types surveyed (appendix 1). The habitats that were chosen to survey were riparian corridors, lakeshores, wetlands with open water, wetlands with no open water, upland hardwood forests, and bottomland mixed forests.

Trapping Procedures

In this study, trapping stations were established following guidelines from Francl et al (2002). Each of the habitats surveyed was sampled using 32-oz pitfalls, two sizes of snap traps (Museum Specials and Victor mouse traps), and Sherman live traps. These traps were set up in groups consisting of one pitfall, one Sherman, and one Museum Special. Museum Specials and Victor mouse traps generally were alternated between trapping stations. The Sherman trap and Museum Special were baited with a mix of oats and peanut butter. For wetlands with no open water and both forest habitat types, each replica consisted of 30 trap stations set up in grids with each station seven meters from any other. The majority of these grids were five by six stations, except in smaller areas where the grid was adjusted to conform to the size of the particular habitat. In the forested habitats, a small Museum Special snap trap was also attached to a tree branch to determine the vertical habitat use of the small mammals. In the riparian, lakeshore, and open water wetland habitats, trap stations were set up in transects following the edges of the water. Generally they were set up 15 stations on each side of the researcher's entry point.

Trapping was conducted on four occasions during June and July, 2003. Every week 30 trapping stations were placed in each of the six habitats, and every week new sites were chosen in order to sufficiently sample habitats across the property. The traps were set for five nights and checked every morning to collect any captured animals. Live animals were identified to species, weighed, sexed, classified as adult or juvenile, and then released. It was also noted whether or not males were scrotal and females were lactating. The animals that were dead upon arrival were collected and the date, habitat type, trap type, and species were noted. For each species of deceased specimens that were collected, several representative individuals were prepared as voucher specimens (Yates et. al., 1996).

Data Analysis

The data was pooled for each habitat and overall success per trap night was calculated by species for the three trap types. For each trap type, the total number of traps set was multiplied by the number of nights they were out to obtain the total trap nights. For each species, the number of individuals caught was divided by the total trap nights to obtain the captures per unit effort. An analysis of variance was run in SYSTAT to compare the trap success for each species, followed by a post-hoc Tukey's test to analyze which success rates were significantly different.

RESULTS

Over the course of the summer, 11,115 total trap nights were logged. Over the 24 sites trapped, 14 species were found in the three trap types analyzed (fig. 1).

Species	Abbreviation	Sherman	Museum Special	Pitfall	Total Captured
Sorex cinereus	SOCI	0.000285	0.004234	0.054596	214
Peromyscus maniculatus	PEMA	0.026211	0.028643	0.001114	211
Microtus pennsylvanicus	MIPE	0.005983	0.009963	0.004735	78
Zapus hudsonius	ZAHU	0.003134	0.008468	0	45
Clethrionomys gapperi	CLGA	0.002279	0.003487	0.001114	26
Tamias minimus	TAMI	0.003419	0.001993	0	20
Blarina brevicauda	BLBR	0.000285	0.001245	0.00195	13
Synaptomys cooperi	SYCO	0.000855	0.000249	0.002507	13
Tamiasciurus hudsonicus	TAHU	0.002564	0	0	9
Sorex arcticus	SOAR	0	0	0.001114	4
Sorex palustrus	SOPA	0	0	0.001114	4
Tamias striatus	TAST	0.000285	0.000498	0	3
Condylura cristata	COCR	0	0	0.001695	1
Mustela frenata	MUFR	0.000285	0	0	1
	Average Trap Success	0.045584	0.05878	0.068524	

Fig. 1. The species trapped listed in order of abundance. Listed are captures per trap night for each trap type by species and the average trap success for each of the trap types.

The two most commonly caught species were deer mice (*Peromyscus maniculatus*) and masked shrews (*Sorex cinereus*) while only one star-nosed mole (*Condylura cristata*) and one long-tailed weasel (*Mustela frenata*) were trapped over the course of the entire summer. Some of these species were not caught in all three traps types. Shermans caught the widest variety with 11 species, while both Museum specials and pitfalls caught nine species. Trap success for Sherman traps was 4.5 %, 5.9 % for Museum Specials, and 6.8 % for pitfalls. The average success rate was 5.7 percent across all traps.

After examining trap success by individual species for the three trap types through analysis of variance, it was found that masked shrews were the only species for which trap type made a highly significant difference ($F = 49.376$; $df = 2$; $P < 0.001$). A Tukey's post-hoc test revealed that masked shrews were much more likely to be caught by a pitfall than either a Museum Special or a Sherman. Further analysis of the trapping data showed marginally significant trends for deer mice, northern short-tailed shrews, and meadow jumping mice. Deer mice were more likely to be caught in a Sherman than a pitfall while northern short-tailed shrews were more likely to be in a pitfall than a Sherman. Meadow jumping mice were trapped more often in Museum Specials than in pitfalls. None of the other species trapped showed any significant preference towards a specific trap type.

The only species captured in traps placed in trees was the deer mouse. A total of four deer mice were all that was caught vertically in the seven sites that had a sufficient understory to look at three-dimensional habitat distribution. These four accounted for 1.9 percent of the total number of deer mice trapped.

DISCUSSION

Several species showed trends in the trap type most likely to catch an individual. For masked shrews, the species with the most pronounced trap 'preference', there are several factors that contribute to making the pitfall the most successful trap. Average body size is one such factor. Because it is a very small animal who weighs on average between 3.5 - 5.5 g (Kurta, 1995), a masked shrew can very easily fall into a 32-oz pitfall and be unable to climb back out. This small animal is also unlikely to weigh enough to set off a Sherman or Museum Special snap trap. Additionally, because masked shrews navigate primarily by non-visual senses, they are less likely to see and be lured in by baited traps (Francl et. al., 2002). It is logical to conclude that they are more likely to accidentally fall into a pitfall, especially if it is placed along a prominent runway. Other small species in the study area caught exclusively by pitfalls were the arctic shrew (*Sorex arcticus*) and the water shrew (*Sorex palustris*). Both of these species also navigate non-visually and have average body weights of 7-13 g and 10-18 g, respectively (Kurta, 1995), making them good candidates to be trapped in pitfalls. Another species that showed a tendency toward pitfall captures was the northern short-tailed shrew (*Blarina brevicauda*). While this shrew generally has a larger body weight, it may have been able to be caught in the pitfalls because it lacked strong jumping abilities. It is also possible the pitfalls trapped mainly juvenile northern short-tailed shrews which, due to their smaller body size, were unable to escape. The fact that pitfalls usually trap the juveniles of larger species was noticed for several additional species in this study as well as supported by the results from previous research (Francl et. al., 2002).

While pitfalls were successful in trapping many species in the study area, several species favored Museum Special snap traps or Sherman live traps. Deer mice showed a marginally significant preference for Sherman traps over pitfalls. As a larger species weighing on average between 12-24 g (Kurta, 1995), deer mice are too large to be easily trapped in pitfalls. They are the ideal weight, however, for both Sherman and Museum Special traps. Another species that showed a trend away from pitfalls was the meadow jumping mouse (*Zapus hudsonius*). With an average weight of about 12-28 g (Kurta, 1995), it would seem to be a good candidate for all three trap types. However, the meadow jumping mouse has developed a very good jumping ability that makes the pitfalls inefficient when trying to trap it. In this survey, not a single jumping mouse was caught in a pitfall. Similarly, larger species like the least chipmunk (*Tamias minimus*) and the eastern chipmunk (*Tamias striatus*) were never caught in pitfalls. The one species caught solely by Sherman traps is the red squirrel (*Tamiasciurus hudsonicus*). This large mammal has such a high average weight that it must contort itself in order to even fit in the Shermans (Drickamer et. al., 1993; Francl et. al., 2002). If it were to attempt to retrieve bait from a Museum Special trap, the large size of the red squirrel could probably enable it to escape with relative ease.

The small number of deer mice trapped vertically in the vegetation suggests that they were the only small mammal utilizing their habitat three-dimensionally. In past studies, deer mice have been trapped upwards of 48 percent of the time in arboreal habitats (Harny et. al., 1987). Research has also suggested that deer mice resort to vertical habitat use when competition with similar species makes finding ground forage more difficult (Pruett et. al., 2002). The low incidence of aboreally trapped deer mice in this study may be due to the fact that they lacked competitors and therefore spent more time in the prime forest floor habitats. No other species trapped in this study have been known to use aboreal habitats as they are primarily fossorial species that stay close to the ground. However, in order to statistically analyze the vertical distribution of all the small mammals in the study area, more data would have to be collected.

Southern red-backed voles (*Clethrionomys gapperi*), southern bog lemmings (*Synaptomys cooperi*) and meadow voles (*Microtus pennsylvanicus*) were all medium-sized species that were captured in all three trap types. However, they were the only species that were captured in all three trap types and still showed no significant preference. This may have been due to the large size discrepancy between adults and juveniles of these species. As they had such a large range of possible body weights, these species could fall in the optimal weight range for all three trap types.

In order to obtain a diverse survey of the small mammal population in the study site, all three trap types were necessary. Even with the overlap, each trap type caught a different proportion of all species. Therefore, the conclusion presented in prior research (Drickamer et. al., 1993; Francl et. al, 2002) that trapping is best conducted with a variety of trap types holds true across the habitats sampled in this survey.

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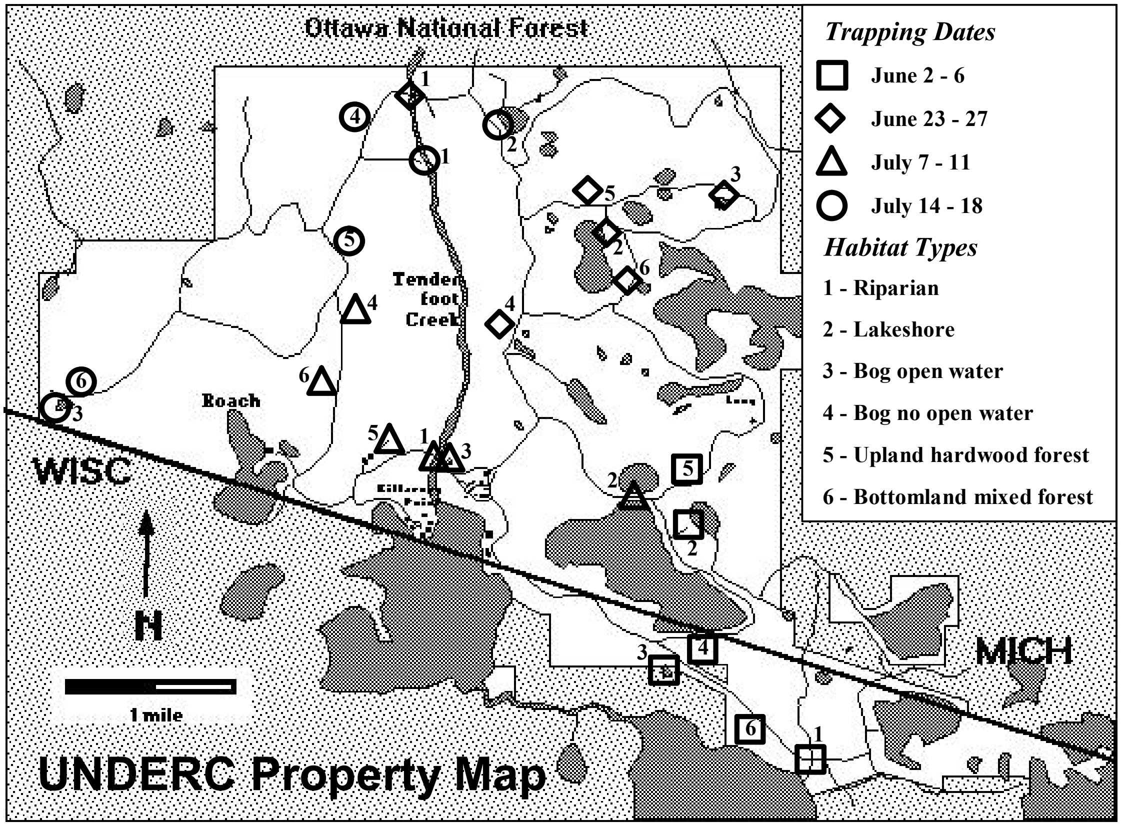
APPENDIX



Appendix 1. Basic map of the University of Notre Dame Environmental Research Center (UNDERC) showing property boundaries, major bodies of water and roadways. The trapping sites are grouped according to both the dates and the habitat type trapped.