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Live-trapping vs. snap-trapping of deer mice: a comparison of methods

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In this study I compared live-trapping and snap-trapping as means to assess abundance and population trends of deer mice *Peromyscus maniculatus* (Wagner, 1845) in the southern Yukon. I also investigated the presence of "trap-shy" individuals which may invalidate the central assumption of mark-recapture and enumeration methods. Live-trapping was very efficient for this population of deer mice. Snap-trapping the two previously live-trapped populations showed that 11% and 12% of the individuals were not tagged. These untagged individuals could be either "trap-shy" or new recruits. Both snap-trapping and live-trapping provided similar estimates of population size and trend. However, the sex and age structure revealed by each method were very different. An important incidental result was that both minimum number alive and Jolly-Seber estimates were very similar.

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Introduction

Many studies on populations of small mammals have used either live-trapping or snap-trapping to estimate population density. In general, live-trapping has been used to gather detailed demographic information and population trends. In contrast, snap-trapping has been used to carry out broad surveys of distribution and abundance of small mammals. Snap-trapping has also been used to gather information on long-term trends in population abundance (Montgomery 1987). Few studies however, have compared both methods in the same location and time.

In live-trapping studies the enumeration method has been preferred because many of the assumptions of mark and recapture methods are not fulfilled in natural populations (Hilborn *et al*. 1976). From a number of papers that examined *Peromyscus* populations, Montgomery (1987) found that only 8% utilized capture-mark-recapture methods whereas 61% used minimum number alive to estimate abundance. Recently, probabilistic models of population estimation, such as Jolly-Seber, have been strongly recommended for small mammal studies since they are less biased than enumeration techniques (Nichols and Pollock 1983, Montgomery 1987). Enumeration estimates, in turn, are inappropriate for interspecific comparisons because different species have different capture probabilities (Nichols 1986). However, Boonstra (1985) found that both Jolly-Seber and the total enumeration techniques provided similar values for population size of *Microtus pennsylvanicus*. Krebs *et al*. (1986) concluded that

enumeration methods may remain useful when populations are low and recaptures infrequent.

The central assumption of the enumeration method is that all resident individuals are trapped. In turn, mark-recapture methods assume equal catchability among individuals. Two kinds of animals may render these assumptions untenable: individuals that never enter traps and individuals that become "trap-shy" after being caught. To fulfill these assumptions, many researchers using enumeration rely on intensive prebaiting and trapping. In mark-recapture studies there are several methods to assess heterogeneity in capture probability (Montgomery 1987). However, these are only concerned with the second kind of individuals, those that become trap-shy after being trapped.

The purpose of this study was twofold: First, to investigate the presence of trap-shy individuals which may invalidate a central assumption of mark-recapture and enumeration methods. Second, to compare live-trapping and snap-trapping to assess population density and trends.

Study area and methods

The study was carried out in boreal forest at the south corner of Kluane Lake, Yukon Territory, Canada (61°N, 138°W), from May to September 1983. The forest was dominated by white spruce *Picea glauca*. Balsam poplar *Populus balsamifera* and trembling aspen (*P. tremuloides*) occurred in small patches. The common species in the understory were soapberry (*Sheperdia canadensis*), willow (*Salix glauca*), licorice root (*Hedysarum borealis*) and bearberry (*Arctostaphylos rubra, A. uva-ursi*).

To investigate the presence of trap-shy individuals, two live-trapping grids (A and B) were trapped from May to September. Each grid contained 42 Longworth live-traps, spaced at 10 m intervals in a 6×7 pattern (0.42 ha). Traps were prebaited with whole oats for 5 days and then set for two nights at least every second week. All captured individuals of deer mouse *Peromyscus maniculatus* (Wagner, 1845) were ear-tagged with fingerling fish tags. The live-trapping program ended on September 11th, 1983. Population estimates were obtained by both enumeration (MNA) and Jolly-Seber (J-S) techniques to be compared with numbers collected from snap-trapping. On September 13th, two days following completion of live-trapping each live-trap was replaced by two Museum Special snap-traps. These 84 snap-traps were baited with peanut butter and set also for two consecutive nights.

To compare live-trapping and snap-trapping as indices of population size and trends, two snap-trapping grids (X and Y) were also sampled from May to September. Each grid had 49 stations with two Museum Special snap-traps per station. The stations were spaced at 10 m intervals. The size of each grid was 0.49 ha. Grids were located between 500 and 1000 m apart from live-trapping grids. No tagged individuals were caught in snap-trapping grids. Traps were baited with peanut butter and set for three nights every 10 days. Grids X and Y were compared with two live trapping grids (B and G). Grid A was not used here because it was an experimental grid (Galindo and Krebs 1987).

Results

During the final live-trapping session (September 11th), 21 individuals were caught and released on grid A. Two days later, in the snap-trapping session, all of these individuals were caught, as well as six additional individuals. Three of latter were living on grid A but had skipped the last live-trapping session, two had been ear-tagged on

nearby grids, and only one had not been caught before. Thus, 24 (89%) of 27 snap-trapped individuals, could be considered live-trapped residents whereas 3 (11%) were caught for the first time in this grid during the snap-trapping session (Fig.1).

On grid B, 15 individuals were caught and released during the last live-trapping session (September 11th). Two days later, 14 animals were caught with snap-traps. Of these 14, 12 were residents, and two were untagged. One of the 12 residents had not been captured during the last six live-trapping sessions. Of the 3 residents not caught by snap-traps, one was snap-trapped on grid A, approximately 100 m away, and the others were never caught. From a total of 17 individuals caught in either session, 2 (12%) were untagged (Fig. 1).

Minimum number alive (MNA) and Jolly-Seber (J-S) estimates were very similar throughout the season on both grids (Fig. 1).

Overall, both snap-trapping and live-trapping showed a similar trend in population density (Fig. 2). During May and June, few individuals were caught (from 2 to 8) in any given session. The snap-trapping grids showed a decline during late June and early July. In contrast, numbers on the live-trapping grids increased at this time. During July to September, an increase in numbers was documented by both methods (from 2 to 21). Numbers declined slightly towards the end of the study (Fig. 2).

The number of individuals caught per session by each method (live-trapping and snap-trapping) was very similar. During May and June, the highest number of individuals caught by live-trapping was 18 and by snap-trapping was 21. Using dates when both methods were used, I found a positive correlation (Spearman rank correlation $r = 0.65$, $n = 22$, $p < 0.001$) between their values. When the population was removed by snap-trapping, immigration to the area was very rapid (Fig. 2).

Discussion

If live-trapping is effective at catching all resident individuals in the population, or if there is no heterogeneity in capture probability then an alternative trapping method should catch the same individuals that were caught in live-traps. In contrast, if live-trapping is not effective, then the alternative trapping method should reveal untagged individuals or individuals that were caught at some earlier point but avoided live-traps thereafter. Very few studies have confirmed the efficiency of live-trapping (Stickel 1946), whereas others have shown that there are components of the population that do not enter live-traps (Boonstra and Krebs 1978, Beacham and Krebs 1980, Boonstra and Rodd 1984). It is possible that some animals might avoid both kinds of traps.

The results of this study indicate that 11 and 12% of the population was not accounted for by the live-trapping methods. These untagged individuals were trapped by the alternative (snap-trapping) method. These animals could either live in the area but were not caught by live-traps or could be new recruits. In fact, the removal of resident individuals during the first night could have attracted new immigrants to the

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NUMBER OF INDIVIDUALS

GRID A


```
30
25
20
15
10
5
0
      MAY        JUN        JUL        AUG        SEP
```

— JOLLY-SEBER   — M.N.A.

NUMBER OF INDIVIDUALS

GRID B


```
20
15
10
5
0
    MAY        JUN        JUL        AUG        SEP
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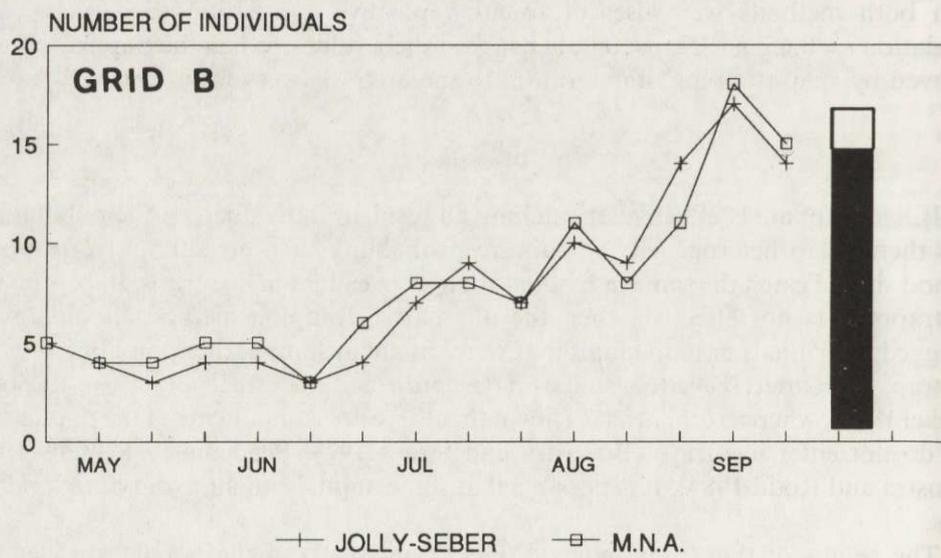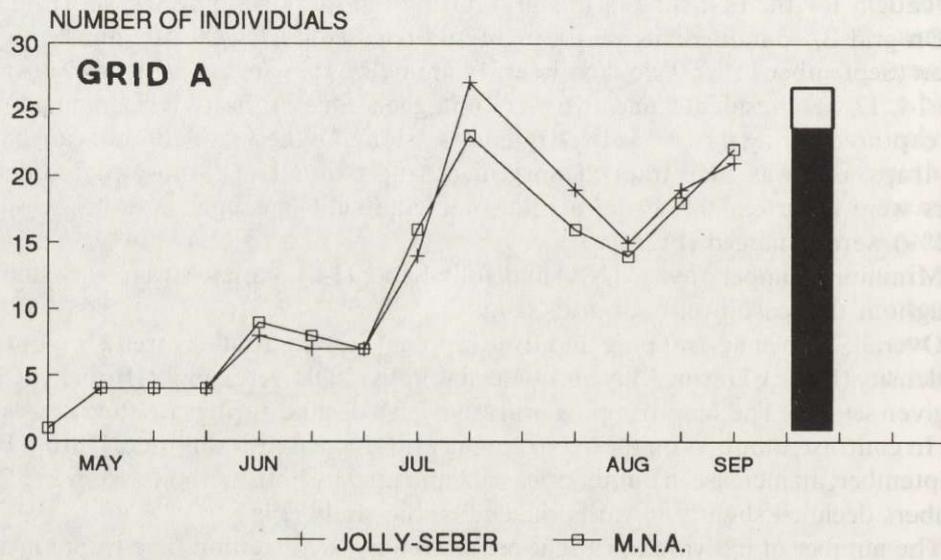
— JOLLY-SEBER   — M.N.A.

Fig. 1. Density trends shown by the enumeration method (MNA) and by the Jolly-Seber method (J-S). Bars show the number of individuals caught by snap-trapping. Tagged animals are indicated by hatching.

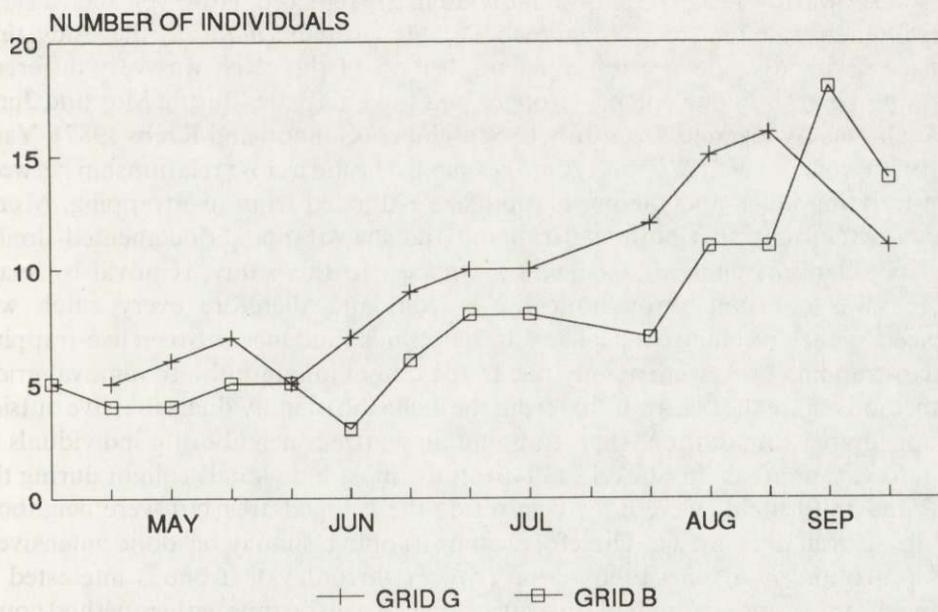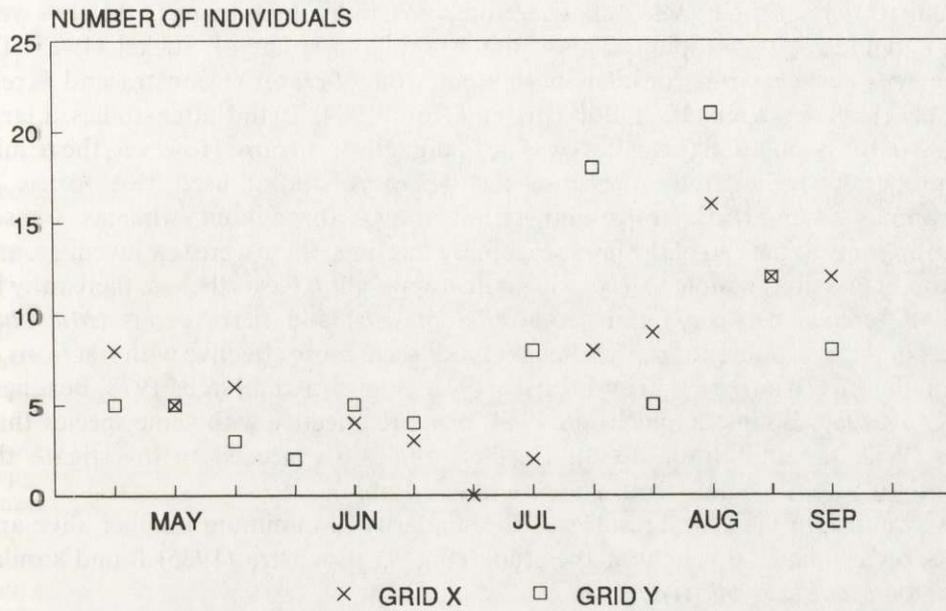NUMBER OF INDIVIDUALS

NUMBER OF INDIVIDUALS

Fig. 2. Comparison of number of individuals caught on snap-trapping grids (X, Y) versus minimum number alive (MNA) on live-trapping grids (G, B).

area. Only one individual was likely "trap-shy". But even this, could have emigrated and return after 6 trapping sessions. Therefore, most individuals living in the area were being caught by live-trapping. This result is similar to that of Stickel (1946) for *Peromyscus leucopus*, but contrasts with studies on *Microtus* (Boonstra and Krebs 1978, Beacham and Krebs 1980, Boonstra and Rodd 1984). In the latter studies, a large fraction of the population (juveniles) was not caught by live-traps. However, the results are not strictly comparable, because the *Microtus* studies used two forms of live-trapping (Longworth traps and pitfall traps), throughout whereas I used snap-traps only at the end of the field season. By this time, there were few juveniles, and therefore it was not possible to assess juvenile trappability. Nevertheless, there may be a real difference between omnivorous (*Peromyscus*) and herbivorous (*Microtus*) rodents in their response to traps. Some methods seem more effective with fractions of the populations (Andrzejewski and Rajska 1972, Boonstra and Krebs 1978, Beacham and Krebs 1980, Boonstra and Rodd 1984) or more effective with some species than others (Williams and Braun 1983). Further studies are needed to investigate the response of juvenile omnivorous rodents to live-traps.

An important incidental result was the similarity of minimum number alive and Jolly-Seber estimates throughout the study (Fig. 1). Boonstra (1985) found similar results for *Microtus pennsylvanicus*.

The abundances and population trends shown by both snap-trapping and live-trapping were very similar. Since snap-trapping sessions took place every 10 days, this result shows how rapidly removed individuals are replaced. However, such a rapid dispersal tendency might be particular to *Peromyscus maniculatus* at the study time and place. Evidently, the sex and age composition of the catch was very different. Snap-trapping grids documented a stronger bias towards males during May and June, and caught mostly juveniles from July to September (Galindo and Krebs 1987). Yang *et al.* (1970) working with *Microtus ochrogaster* also found a close relationship between a snap-trapping index and the population size estimated from live-trapping. Montgomery (1987) found that both live-trapping and snap-trapping documented similar annual population trends of *Apodemus sylvaticus*. In this study, removal by snap-trapping was constant throughout the season, and therefore every catch was influenced by the preceding catch. The differences in abundance between live-trapping and snap-trapping grids were mainly due to the rate of immigration to removal grids. Both methods share the bias resulting from the inclusion of individuals that live outside the trapped area. In addition, snap-trapping may attract neighboring individuals to move into vacant areas. In Stickel's (1946) study, most individuals caught during the second and third nights were not living inside the trapped area but were neighbors living in surrounding areas. Therefore, snap-trapping should be done intensively (many traps) and in a short time period (two or three days). If one is interested in knowing the number of individuals in a given area, at a given time, either method could be satisfactory. For large scale surveys of rodent populations at one time, the snap-trap grid might require less effort.

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