Small mammal populations in clearcuts of various ages in south central Montana
by Martin Lyle Heath

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Zoology
Montana State University

Abstract:
Four clearcuts of various ages, located in a subalpine fir (Abies lasiocarpa) forest in south central Montana, were live-trapped to determine the species composition and density of small mammals in the area. An adjoining forest site was concurrently trapped in the same manner, to serve as a control. Each site was trapped for eight days (1600 trap nights) during the months of June to September, 1972. The animals, captured were in a ratio of 48% Peromysaus maniculatus, 21% Clethrionomys gapperi, 16% Sorex cinereus. and Sovex Vagrans, and 15% a mixture of six other species. The spatial and temporal distribution of the first three groups was examined using a linear correlation model, with the significance level set at P=0.10. Results showed a number of significant correlations between age of clearcut and the number, of various animals captured in the clearcut or the adjoining forest. P. manioulatus was shown to decrease in number, as the clearcuts aged, while J. gappevi increased and Sovex sp. remained at a relatively constant level. Species diversity decreased in the forest adjoining a clearcut as the clearcut aged.. Significant correlations were also found between the distance from the clearcut-forest interface that a trap was placed and the number and species of. animals captured. .

P. ¦ manioulatus was found to increase, in number as sampling progressed into: the clearcut, and to decrease as sampling entered the forest. C,, gappevi showed the opposite, trend, increasing in the forest and decreasing in the, clearcut; Sovex sp. showed slight increases in number as trap sites were moved deeper into the forest. Other population trends tested were found to be statistically nonsignificant.

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Date February 8, 1973

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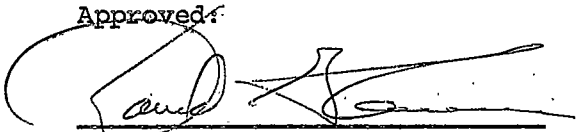

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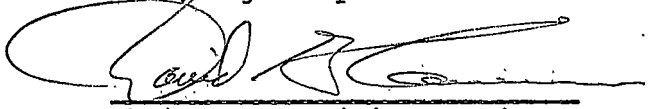

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ABSTRACT

Four clearcuts of various ages, located in a subalpine fir *(Abies lasiocarpa)* forest in south central Montana, were live-trapped to determine the species composition and density of small mammals in the area. An adjoining forest site was concurrently trapped in the same manner, to serve as a control. Each site was trapped for eight days (1600 trap nights) during the months of June to September, 1972. The animals captured were in a ratio of 48% *Peromyscus maniculatus*, 21% *Clethrionomys gapperi*, 16% *Sorex cinereus* and *Sorex vagrans*, and 15% a mixture of six other species. The spatial and temporal distribution of the first three groups was examined using a linear correlation model, with the significance level set at P=0.10. Results showed a number of significant correlations between age of clearcut and the number of various animals captured in the clearcut or the adjoining forest. *P. maniculatus* was shown to decrease in number as the clearcuts aged, while *C. gapperi* increased and *Sorex* sp. remained at a relatively constant level. Species diversity decreased in the forest adjoining a clearcut as the clearcut aged. Significant correlations were also found between the distance from the clearcut-forest interface that a trap was placed and the number and species of animals captured. *P. maniculatus* was found to increase in number as sampling progressed into the clearcut, and to decrease as sampling entered the forest. *C. gapperi* showed the opposite trend, increasing in the forest and decreasing in the clearcut. *Sorex* sp. showed slight increases in number as trap sites were moved deeper into the forest. Other population trends tested were found to be statistically non-significant.

INTRODUCTION

Communities of small mammals in Rocky Mountain forest clearcuts have been studied from two viewpoints. Silviculturists have examined the influence of rodent and insectivore population changes upon reforestation rates. Moore (1942) reported that shrews *(Sorex* sp.*)* selectively ate large conifer seeds, thus giving small-seeded conifer species such as lodgepole pine *(Pinus contorta)* an advantage. Radvanyi (1970) found 3 to 35% of white spruce *(Picea glauca)* seeds destroyed by *Peromyscus* sp. and 2 to 10% destroyed by *Sorex cinereus*. Studying a western Oregon clearcut, Gashwiler (1967) reported that birds and mammals consumed 63% of the tree seed.

Mammalian ecologists have studied the ways changes in the vegetation on clearcuts are reflected in changes of the small mammal community (Trowsdell, 1954; Tevis, 1956; Gashwiler, 1970).

A typical field design for studying small mammal population changes on clearcuts involves trapping a forest site before and after clearcutting. The site is then periodically sampled as the vegetation undergoes temporal changes.

There are two disadvantages to this experimental design. First, the vegetational changes on a coniferous clearcut cover a long time span. Basile and Jensen (1971) found that on lodgepole pine clearcuts, seral herbaceous plants prosper for twenty years before they are stifled by the growth of pine. Few researchers have the ten to twenty years

necessary to sample a single clearcut as it passes through the early stages of vegetative succession. Second, in sampling a single clearcut annually, most investigators fail to compensate for the normal annual fluctuations in rodent populations (see Terman, 1966 for a complete analysis of these trends). Because of their magnitude and aperiodicity, these fluctuations can distort or obscure any succession-dependent trends in population data for a number of years.

An alternative to sampling a single clearcut as it passes through successive vegetational stages is to sample clearcuts of various ages during a single year, thus possibly minimizing the confounding effects of annual population fluctuations. This is the approach used in the present study. The confounding factors of such a method include all of the ecological factors that can affect multiple sites differentially: slope, altitude, aspect, soil conditions and history of treatment.

The influences of these variables upon the data were minimized for this study in two ways. First, sites of various ages were selected such that slope, altitude, aspect and treatment were as comparable as possible for all sites. Second, for each clearcut sampled, a plot was also sampled in a mature timber stand that immediately adjoined the clearcut and had similar features. Therefore, if it is assumed that each clearcut and the adjacent forest were co-inhabited by a single pre-clearcut small mammal community, and if progressive changes

can be shown in those communities in the sampled clearcuts but are not found in the control sites, temporal changes in the clearcuts would logically be considered a major cause of the change.

Although the main objective of this project was the assessment of small mammal population changes in relation to the aging of a series of coniferous clearcuts, several subordinate hypotheses were also tested:

1) There are no significant changes in species diversity of small mammals as clearcuts undergo successional changes.
2) There are no significant differences between the numbers of animals captured or species diversity of the small mammal community within a clearcut and that of the adjoining forest.
3) There is no significant edge effect with respect to the clearcut-forest interface.

DESCRIPTION OF AREA

Four clearcut areas, 4, 6, 8, and 10 years old were selected for study. These were located in the Gallatin Mountain Range, approximately 15 miles southwest of Bozeman, Montana (see Figure 1). All were located in mid-slope of northeast-facing slopes in the Little Bear Creek and Big Bear Creek drainages, northwestward flowing tributaries of the West Gallatin River. The physical characteristics of the sites are given in the following table.

Table 1. Physical Characteristics of Experimental Clearcut Sites.

Date of cut	1962	1964	1966	1968
Age of cut when trapped	10 years	8 years	6 years	4 years
Size of cut (ha.)	10.5	3.3	14.9	15.7
Slope (%)	2-5%	8-12%	6-9%	3-7%
Aspect	60° ENE	60° ENE	55° ENE	50° NE
Altitude (meters)	2120	2100	2080	2040
Location	NE¼ S16 R5E T4S	NE¼ S16 R5E T4S	NE¼ S8 R5E T4S	SW¼ S10 R5E T4S

In this area mature forest of northeast-facing slopes at approximately 2000 meters elevation is similar to the *Abies lasiocarpa-Vaccinium scoparium* habitat type of Daubenmire and Daubenmire (1968). The Daubenmire study was developed for forests of eastern Washington

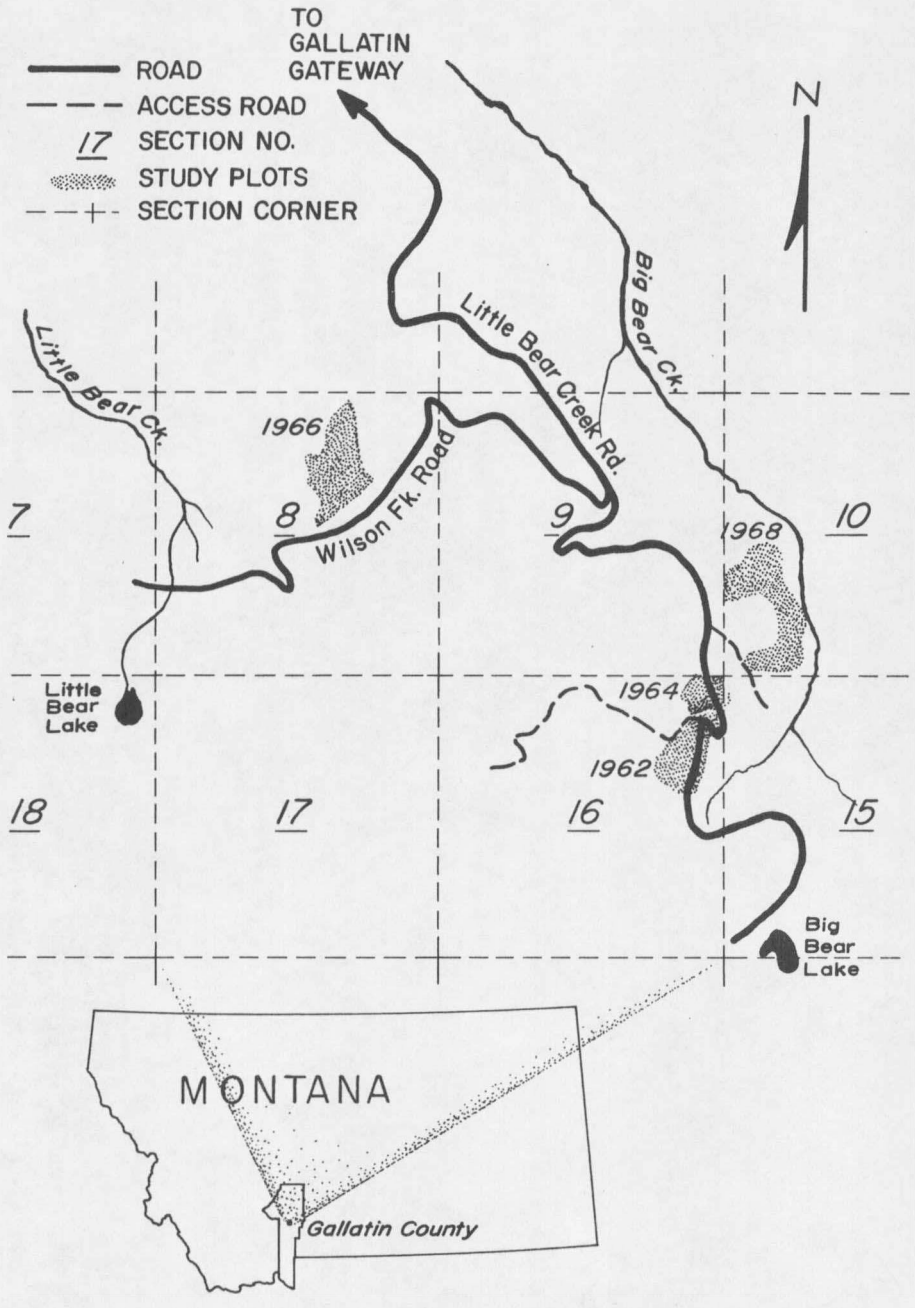

Figure 1. Map of Study Area. Garnet Mountain Quadrangle, Montana.

and northern Idaho. The Bear Creek study area is closely similar to the *A. lasiocarpa-V. scoparium* habitat type of Pfister *et al.* (1972). The latter work contains detailed lists of the composition of understory vegetation found in the seral stages of each habitat type. Although Pfister's work describes coniferous forests of the western slope of the Rocky Mountains, a different climatic region than the present study, the proximity of the two study regions should allow considerable predictive value to be placed on Pfister's data. A complete analysis of central and eastern Montana forest habitat types is presently being developed (Pfister, personal communication).

In the areas sampled, varying quantities of Douglas fir *(Pseudotsuga menziesii)* and lodgepole pine were found. Following disturbance, especially fire, a seral stand of commercially valuable lodgepole pine usually replaces the fir. Therefore, clearcuts are usually burned following logging to favor the pine. The study areas were all clearcut during the summer, with slash piled and burned the following fall. Each clearcut was bordered for at least 200 meters by a stand of "undisturbed" mature timber.

METHODS

At each clearcut site, 200 permanent trapping points, spaced five meters apart, were set up in a ten by twenty rectangular array. The long axis of the rectangle paralleled the aspect of the clearcut, while the short axis lay along the clearcut-forest interface, such that adjoining ten by ten trap grids covering 0.25 hectare were located in the clearcut and adjacent timber.

Trapping was conducted at each site for two or three successive days during each of three periods (early, middle and late summer). Sites were sampled at random within each period. Clearcut sites and their adjoining control sites were always trapped simultaneously. Dates of trapping are given in Table 6 of the Appendix.

A large Sherman live trap, baited with rolled oats and peanut butter, and supplied with cotton waste as bedding, was placed at each trapping point. Traps were sometimes placed on logs or stumps. Traps were checked within two hours of sunrise each morning and captured animals were marked by toe-clipping and released. Sex, age class and reproductive condition of the animals, and vegetational surroundings of the trap were noted for each capture. Pelage color and size were used to classify animals as adult or juvenile. Sub-adults were treated as juveniles. Evident scrotal testes were the criterion used to classify adult males as sexually active. Adult females were classified as pregnant (externally palpable embryos), lactating

(visible mammae), or nongravid. Nomenclature of mammals follows Hall and Kelson (1959). Eight days of trap data (1600 trap nights) from each site were used in analyses. Trapping took place from June 22 to September 16, 1972.

DATA

Two hundred and thirty animals, comprising ten species, were captured 329 times. The animals caught were deer mice *(Peromyscus maniculatus)*; masked and vagrant shrews *(Sorex cinereus* and *Sorex vagrans)*; montane voles *(Microtus montanus)*; western jumping mice *(Zapus princeps)*; boreal red-backed mice *(Clethrionomys gapperi)*; short-tailed weasels *(Mustela erminea)*; northern pocket gophers *(Thomomys talpoides)*; yellow pine chipmunks *(Eutamias amoenus)* and a single house mouse *(Mus musculus)*. Red squirrels *(Tamiasciurus hudsonicus)* and pikas *(Ochotona princeps)* were seen near all experimental sites but were not captured. The numbers of each species captured on each clearcut and its adjoining control during 1600 trap days are shown in Table 2. Animals captured repeatedly were counted only once in analyses except in the spatial distribution calculations.

Several *Sorex* were identified in the laboratory as both *Sorex cinereus* and *Sorex vagrans* based on skull characteristics but, because the two species could not be readily distinguished in the field, all *Sorex* captured were listed as *Sorex* sp. *Microtus* were classified as *Microtus montanus* on the basis of dental characteristics as given by Hall and Kelson (1959).

Table 2. Numbers of Animals Caught, by Species. The Data for each Clearcut are Pooled for all Trap Days.

Species	Age of Cut (Years) 4 F†	4 C†	6 F	6 C	8 F	8 C	10 F	10 C	Total F	Total C
deer mice *Peromyscus maniculatus*	8	27	9	24	7	18	7	10	31	79
red-backed mice *Clethrionomys gapperi*	3	2	3	4	6	10	15	5	27	21
shrew *Sorex* sp.	3	5	4	8	1	7	2	7	10	27
voles *Microtus montanus*	4	2	0	6	0	0	0	0	4	8
chipmunk *Eutamias amoenus*	4	1	1	2	0	2	0	2	5	7
jumping mice *Zapus princeps*	0	3	0	1	0	1	0	0	0	5
weasel *Mustela erminea*	1	0	0	2	0	0	0	0	1	2
pocket gopher *Thomomys talpoides*	1	0	0	1	0	0	0	0	1	1
house mouse *Mus musculus*	0	0	0	1	0	0	0	0	0	1

†F = Trap Data for Forest.
†C = Trap Data for Clearcut.

Total capture data for *P. maniculatus*, *C. gapperi*, and *Sorex* sp. are shown in Table 7 of the Appendix. Only those species comprising fifteen percent or more of the total summer catch are included in statistical calculations unless otherwise stated. Statistical analyses were tested at a level of significance of P=0.10.

Statistically significant trends in species composition proportions were observed for *P. maniculatus* and *C. gapperi*. Changes in species proportions for the four sites are graphed in Figure 2.