that the wisest among us must be prompted to speak out and teach the uninformed about range management; that we are about the management of a kind of land with multiple uses and that these lands offer manageable resource values to mankind in perpetuity. We sincerely hope that it is not too late.

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Mice and Management on the Mount Haggin Wildlife Management Area

Richard J. Douglass and Michael R. Frisina

The abundance of small mammals can be a sensitive measure of success or failure of livestock grazing programs on Western rangelands. The abundance and variety of rodents can serve as an indicator of general health of the vegetative resource.

The Montana Department of Fish, Wildlife and Parks undertook a project to examine the effects of a planned grazing system on various types of wildlife (elk, Frisina 1992; sandhill cranes, Frisina and Canfield 1986) on the Mount Haggin Wildlife Management Area (Fig. 1). The study reported here includes small mammals (Fig. 2) and associated predators.

Rodents form a major portion of the prey base for raptors (Phelan and Robertson 1978, Hamerstrom 1979, Simmons et al. 1986) and thus are the major focus of research reported in this article. This portion of the study examines how the grazing system affects the potential supply of mice as prey.

Livestock Grazing System

The Mount Haggin grazing system is a three-pasture system incorporating approximately 18,000 acres.

The three pastures are similar in size, approximately equal in livestock grazing capacity, and are fenced from each other. Fencing allows control of livestock but permits access by free-roaming wildlife. Cattle graze the pastures from June 15th through October 15th each year. The grazing level is set at 4,000 AUM's annually. Under the system each pasture receives one of three grazing treatments annually. The treatments are:

A Treatment: Available to livestock throughout the grazing season; grazing by livestock primarily during the growing season; rangeland is also available to free-ranging wildlife.

B Treatment: Grazing by livestock *after seed-ripe;* range land is also available to free-ranging wildlife.

C Treatment: Rested, available for wildlife use only. Rested from livestock grazing.

Each pasture receives one treatment annually and all three of the treatments during a three-year time period. Two-thirds of lands in the system are grazed during a single *grazing* season, but only one-third is grazed during a single *growing* season. Following cattle grazing of a pasture during the growing season (A Treatment), the pasture is rested from livestock grazing for two consecutive growing seasons by following the A Treatment with B and C Treatments, respectively. B Treatment pastures are not grazed until the end of the growing season, when plants have produced viable seeds. This approach enables plants to maintain maximum vigor and food storage, which promotes rapid post-grazing recovery. Grazing rotation thus allows for the maintenance of healthy,

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Fig. 1. *Cattle grazing on Mt. Haggin Wildlife Management Area.*

diverse, and vigorous rangeland vegetation. Desired livestock distribution within pastures is maintained with frequent herding by horsemen.

Methods

To determine grazing system effect on raptors biweekly or monthly mouse biomass loss (total weight of mice lost between trapping period expressed in ounces/acre/week or month) from each pasture was calculated. The assumption is that mouse biomass loss represents actual consumption by raptors.

Fig. 2. *Small mammals are an important consideration on Mt. Haggin Wildlife Management Area.*

To calculate mouse biomass loss, mouse population density was determined on a 5.4 acre livetrapping grid within each pasture plus a grid located in an ungrazed pasture. Population density estimates were made using the minimum number known to be alive (MNA) (Chitty and Phipps 1966) during each biweekly or monthly three-day trapping period. This method attempts to account for every individual on the grid rather than estimating total population size. This accounting also detects when mice disappear between trapping periods, in turn allowing determination of total mouse biomass loss between trapping periods. The field methods are similar to those of Krebs (1966) and involved trapping for three days biweekly or monthly using 100 traps per grid in each pasture. Parameters measured for animals captured were species, sex and weight. Mice were released at the capture site after processing.

In 1985 and 1986 trapping occurred biweekly from mid-May through mid-August. In 1987 trapping was conducted monthly from May through August.

Results

A major problem with attempting to determine impacts of grazing on mouse populations is that mouse population dynamics are extremely variable and the causes of this variability are not well understood (Krebs and Myers 1974). Natural variability can potentially confound attempts to detect impacts (Douglass 1989).

The population densities of deer mice and montane

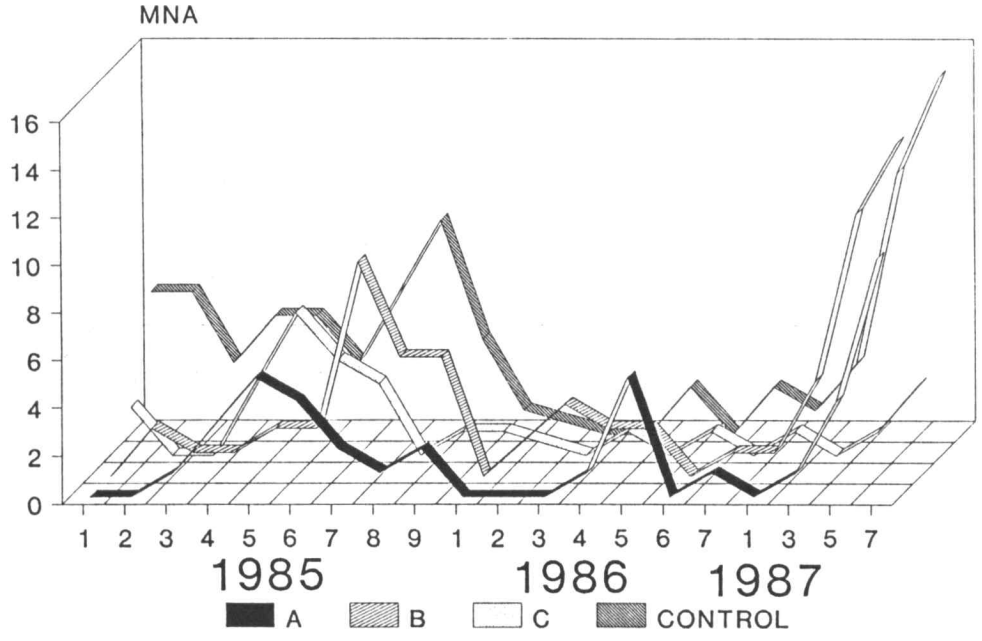

Fig. 3. *Numbers of small rodents on four trapping grids on the Mount Haggin Wildlife Management Area during summer months from 1985 through 1987.*

voles on all treatments was quite variable during the three years which encompassed one complete rotation of the grazing system (Fig. 3). The population densities were very low in 1985, lower still in 1986, then increased by 1987 to almost twice what they were at the beinning of the study. Despite this variability, effects of the grazing system were noted.

Population parameters are compared among treatments as well as with the control. The control is outside the grazing system and represents what happens in the absence of any domestic livestock grazing.

Figures 4 and 5 show how montane vole and deer mouse population dynamics were effected by the grazing system. Data represent averages for one full grazing rotation. Control data are from the single grid that was not grazed during this study.

These responses to grazing are consistent with previous research. Hestbeck (1987) reviewed literature concerning cover, predation and population density of voles. Generally as cover (grass and litter) is reduced voles become vulnerable to predation and densities remain low. Compared to the non-grazed condition and to meet

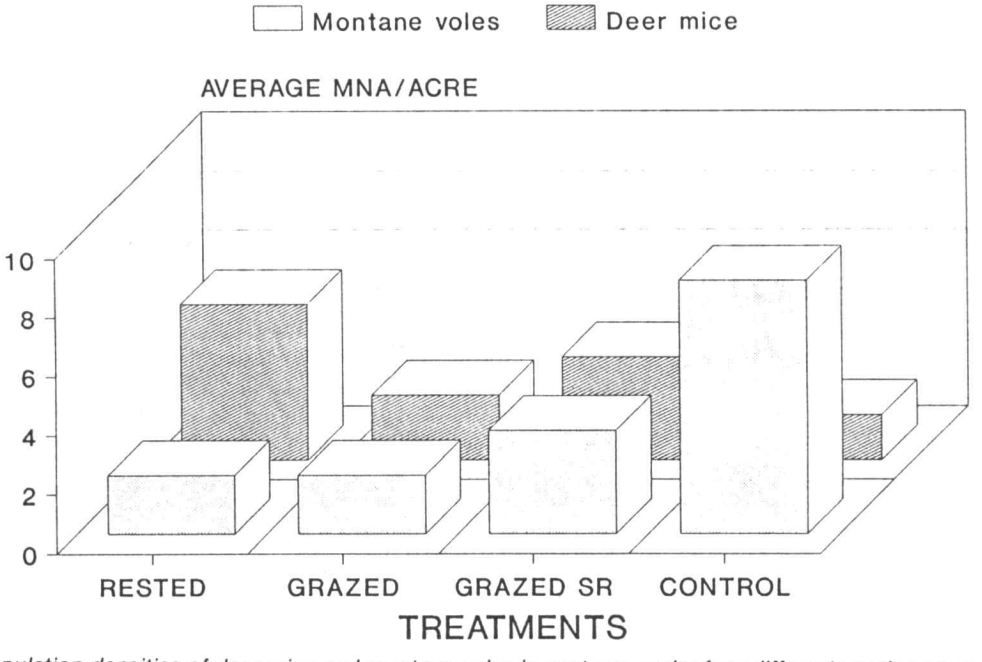

Fig. 4. *Average population densities of deer mice and montane voles in pastures under four different grazing treatments on the Mount Haggin Wildlife Management Area from 1985 through 1987.*

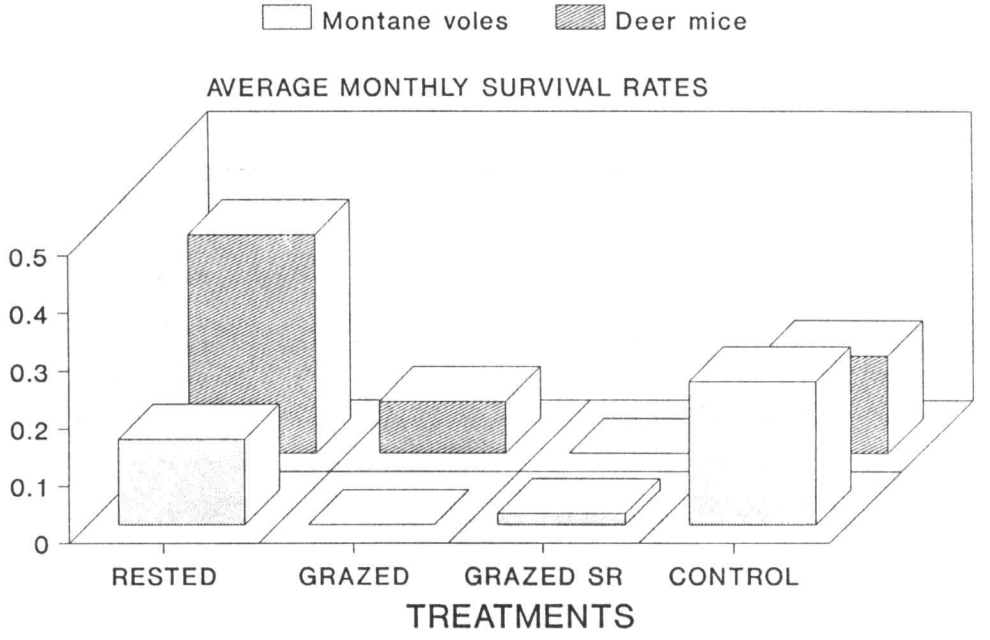

Fig. 5. *Average survival rates of deer mice and montane voles in pastures under four different grazing treatments on the Mount Haggin Wildlife Management Area from 1985 through 1987.*

habitat requirements of elk the grazing system tends to reduce standing litter and periodically reduce grass height and litter accumulation. This has the effect of lowering montane vole densities, presumably through predation. This will also probably inhibit extreme population fluctuations demonstrated by voles in areas of dense litter accumulation (Birney et al. 1976), However, deer mouse populations tend to be higher in areas with lower grass and litter cover (Robey et al. 1987 and Adler 1986).

Because we are interested in raptors, the important question is how does this decrease in one species of prey and increase in another affect prey base. Figure 6 shows the average mouse biomass loss per three-month sampling season of all mice lost from grids in all grazing treatments. The biomass of mice available to raptors in the grazing system is somewhat smaller than that available in the ungrazed control. Obviously if there are more animals in a population, there should be more available

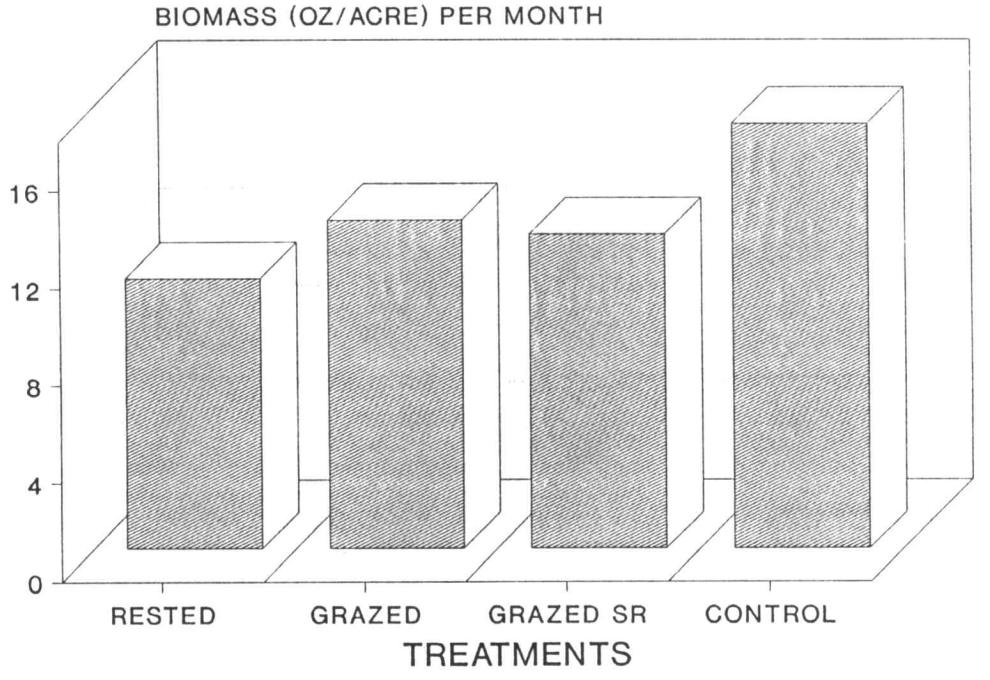

Fig. 6. *Average biomass of small rodents disappearing each month from pastures under four different grazing treatments on the Mount Haggin Wildlife Management Area from 1985 through 1987.*

for predation which is partially why the control produces a larger biomass of prey.

There is possibly a more complex interaction among density and factors such as survival and recruitment that produce densities. For example the rested treatment has the highest populations of montane voles and deer mice in the grazing system (Fig. 3) but produces the smallest biomass of mice available for raptors (Fig. 6). This apparent "lack of production" is the result of higher survival rates for both species in rested pastures (Figures 4 and 5). For raptors, before and after seedripe grazing is preferable to resting the pasture because grazing makes mice more vulnerable to raptors. Over time the resting process allows mouse populations to recover and produce more prey during the grazing periods than would be produced under continuous grazing.

An important factor to remember is both the grazing system and the control area are recovering from decades of intensive continuous domestic livestock grazing. The effects of the grazing system on predator-prey relationships must be viewed in light of the entire system being in a recovery process.

Management Implications

1. The Montana Department Fish Wildlife and Parks is meeting its primary goal of using the grazing system to help provide high quality habitat for elk while at the same time providing habitat to maintain substantial prey base for hawks and owls as watchable nongame wildlife.

2. A carefully designed grazing system that is maintaining the soils and vegetation will provide for substantially larger and more diverse small mammal populations than present under continuous season long grazing.

3. The grazing system on the Mount Haggin Wildlife Management Area may over time actually produce more prey than the control. The rotation of cattle through the pasture maintains a constantly renewed litter base within the grazing system. This litter base, although less than produced in the control, may contribute to a more stable mouse population in the system. By eliminating the extreme population fluctuations associated with heavy accumulations of litter (Birney et al. 1976). We may produce more mice over the long term with a more stable population.

4. The attractant of predatory birds to grazed pastures for feeding (on more vulnerable rodents) may be used as a tool for making these birds readily available as watchable wildlife.

5. Future research should also be directd at understanding the dynamics of ground squirrel populations since they are a very abundant prey base on this Wildlife Management Area.

6. This grazing system is located on a typical high mountain western livestock summer range. Grazing systems like the one at Mt. Haggin provide a practical solution in areas where multiple values must be accommodated.

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