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Repopulation and Food Habits of *Peromyscus maniculatus* on a Burned Sagebrush Desert in Southeastern Idaho

Abstract

During October 1975 and May 1976, small mammals were trapped on burned, control, and burned-soil accumulation areas of sagebrush desert following a fire in September 1974. Although six species of rodents were trapped on the study areas, deer mice (*Peromyscus maniculatus*) constituted 87 percent of the total sample. The kangaroo rat (*Dipodomys ordii*) was the only species which was more abundant in the burned areas than in the control areas. Number of deer mice per trap night, an index of relative density, increased from 0.00 and 0.005 in 1975 to 0.01 and 0.03 in 1976 in the burned and burned-soil accumulation areas, respectively. The control areas had trap-night indices for deer mice of 0.05 in 1975 and 0.08 in 1976. The diets of deer mice in May 1976 from burned and control areas indicated an intense and similar reliance on a few food items but were statistically different ($P < 0.05$). Insects provided over 90 percent of the diet. Vegetation differences between the burned and control areas were not reflected in the spring diet. Studies on seasonal food habits are needed to explain the effects of fire on small mammal repopulation of a desert ecosystem.

Introduction

During September 1974, a fire destroyed all the above-ground vegetation on 300 ha at the Idaho National Engineering Laboratory (INEL) Site, Butte County, in southeastern Idaho (Fraley *et al.*, 1976). The area contained big sagebrush-bluebunch wheatgrass (*Artemisia tridentata-Agropyron spicatum*) and big sagebrush-squirreltail grass (*A. tridentata- Sitanion hystrix*) vegetation types prior to the burn. The species composition and densities of the rodent populations prior to the burn were not known.

Much literature is available on the effects of forest and grass fires on rodent populations (Krefting and Ahlgren, 1974; Cook, 1959; Tester, 1965). However, information is limited on the effects of fire on rodent populations in a desert shrub community (Chew *et al.*, 1958). There is also a paucity of information on the effects of fire on rodent food sources and, subsequently, on rodent repopulation of a burned area. Therefore, a study was conducted to judge the effects of fire in a desert sagebrush community on rodent food habits.

Study Area

The study was conducted on the INEL Site which covers an area of 2315 km^2 and is located on the cool desert shrub biome along the western edge of the upper Snake River Plain. The topography is flat to rolling, with an average elevation of 1470 m. Annual precipitation averages 18-20 cm and temperatures range from –42 to 39°C, with an annual average of 6°C. Vegetation is dominated by desert shrubs, primarily big sagebrush (Harness and West, 1973).

One study site was located on the burned area, and another was established on an adjacent unburned area which served as a control. Vegetation on the control area consisted of *Artemisia tridentata-Agropyron spicatum* and *A. tridentata-S. hystrix* vegetation types. Other important species on the control area were thickspike wheatgrass (*Agropyron dasystachyum*), textile onion (*Allium textile*), goosefoot (*Chenopodium* sp.), few-flowered eriastrum (*Eriastrum sparsiflorum*), and Hood's phlox (*Phlox hoodii*) (Fraley *et al.*, 1976). Vegetation in the burned area during 1975 consisted primarily of bluebunch wheatgrass, few-flowered eriastrum, Hood's phlox, perennial mustard (*Schoenocrambe linifolia*), and western stickseed (*Lapulla redowskii*) (Fraley *et al.*, 1976). During 1976, tumbleweed (*Salsola kali*) and halogeton (*Halogeton glomeratus*) increased in importance. During 1975, the biomass estimates for both areas were similar. In 1976, the non-sage biomass was significantly greater ($P < 0.05$) in the burned area than in the control area and was attributable to an increase in annuals, particularly tumbleweed and halogeton (Fraley, 1978). Big sagebrush did not occur on the burned site in 1975 and 1976. There appeared to be no difference in vegetation diversity between the burned and control areas in 1976. More bare ground was present in the burned area (84 vs. 75 percent) than in the control area (51 vs. 59 percent) in 1975 and 1976, respectively (Fraley, 1978).

Methods

Two 400 m transects were located in the burned area and two in the control area (Fraley *et al.*, 1976). One transect was also established in an area of soil accumulation adjacent to the burned area. The soil accumulation area was also burned, but woody parts of vegetation remained. This site acted as a wind break where wind-blown soil from the burn area accumulated. Twenty permanent stations were located on each burn and control transect at 20 m intervals. Thirty temporary stations were placed on the soil accumulation area at 20 m intervals.

Traps were set during October 1975 and May 1976 on the burn area, control area, and soil accumulation area. Two Museum Special snap traps and one McGill rat trap were placed at each station and baited with a peanut butter-oatmeal mixture. One trap was placed on the center of the transect and the other traps were placed 1.5 m each side of the center line. Traps were set for three consecutive nights in 1975 and five consecutive nights in 1976 for a total of 990 and 1650 trap nights, respectively. Traps were prebaited for three consecutive nights before trapping.

Deer mice (*Peromyscus maniculatus*) gastrointestinal (GI) tracts were sent to Colorado State University Composition Analysis Laboratory for analysis of food content. Data were recorded on sex, age (adult or subadult), and weight, and were categorized by capture location (burned or control). Sex was determined during dissection and age was determined by body weight (mice less than 15 g were assumed to be subadult). One hundred twenty-nine deer mice GI tracts from the control area and 65 deer mice GI tracts from the burned and soil accumulation areas were analyzed. All samples were from the 1976 trapping period. Mice from the soil accumulation areas were categorized as burned area samples because vegetation patterns in both areas were similar and increased the sample of burned area rodents for food habits analyses. Stomach samples from each of six categories (control area male, control area female, and control area subadult, and burned area male, burned area female, and burned area subadult) were combined, and five slides were made for each category. Fields on microscope slides were viewed under a binocular microscope at 100x for identifiable food fragments. Forty fields were examined per slide, and the percent relative density of food fragments was recorded. Plant fragments were quantified as described by Sparks and Malecheck (1968). The percentage of classified food fragments approximated the percentage relative dry weights of food categories in the diet (Dearden *et al.*, 1975).

Percent similarity between diets was calculated using Kulcyznski's coefficient of community (Oosting, 1956) for food items comprising $\geqq 2$ percent of the diet. A Chi-square contingency table was used to determine differences in diets between burn area and control area deer mice (Snedecor and Cochran, 1972). A diversity index was also calculated for diets of burned and control area rodents using the Shannon-Weiner formula (Collier *et al.*, 1973). Level of significance was established as $P < 0.05$ for all analyses.

Results and Discussion

A total of 288 rodents representing six species (deer mouse, least chipmunk [*Eutamias minimus*], kangaroo rat [*Dipodomys ordii*], western harvest mouse [*Reithrodontomys megalotis*], northern grasshopper mouse [*Onychomys leucogastor*], and Townsend's ground-squirrel [*Spermophilus townsendi*]) was captured during the two trapping periods (Table 1). The only rodents trapped in 1975 from the burned area were two kangaroo rats. During 1976, 26 rodents were trapped on the burned area. Eleven rodents were trapped in 1975 in the burned-soil accumulation area compared to 82 in 1976 (Table 1). Although only 13 kangaroo rats were captured both years, all were trapped on the burned sites. Apparently, removal of the brush species by fire and the accumulation of soil on some burned sites provided favorable habitat for kangaroo rats. Least chipmunks, western harvest mice, northern grasshopper mice and Townsend's ground-squirrels were captured too infrequently (Table 1) to enable comparisons between study areas. Generally, the numbers of each species trapped in all study areas increased in 1976 compared to 1975. This increase reflected the additional trap nights in 1976.

TABLE 1. Number of all rodents trapped from burn, control, and soil accumulation areas on the Idaho National Enginering Laboratory Site during October 1975 and May 1976 and the number of **Peromyscus maniculatus** captured per trap night.

	Number captured											
	Peromyscus maniculatus		Eutamias minimus		Dipodomys ordii		Reithrodontomys megalotis		Onychomys leucogaster		Spermophilus townsendi	
Location	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976	1975	1976
Burn	0 (0.00)[a]	22 (0.01)	0	0	2	3	0	1	0	0	0	0
Control	47 (0.05)	134 (0.08)	5	5	0	0	0	1	0	2	0	1
Soil Accumulation	5 (0.005)	43 (0.03)	3	1	1	7	0	5	0	0	0	0
Totals	52	199	8	6	3	10	0	7	0	2	0	1

[a]( ) = number per trap night.

The majority (87 percent) of rodents captured during both years were deer mice. Deer mice were most abundant in the control area followed by the soil accumulation and burned areas (Table 1). Indices of deer mice densities (number per trap night) increased in all study areas in 1976 over 1975. The greatest increase in deer mice density occurred in the soil accumulation areas (Table 1).

No deer mice were trapped on the burned area during October 1975, but in May 1976, 22 were captured. During the respective years 1975 and 1976, 47 and 134 deer mice were captured on the control areas. Cook (1959) found that *P. maniculatus* populations attained higher densities in brush areas than in open grasslands, areas which may correspond to the control and burned areas in this study. Five deer mice were captured in 1975 and 43 in 1976 on the soil accumulation area.

Food habits data for deer mice indicated a heavy reliance on insects (Table 2). Deer mice are omnivorous and consume a variety of plant and animal foods, with their diet reflecting local availability of foods at various seasons (Martin *et al.*, 1961). All food habit determinations were made on deer mice captured in late May, a period when insects were probably most abundant. Insects probably were the most available food source during the entire study period.

TABLE 2. Percent relative density ($\overline{X}\pm SD$) of the food categories found in the gastrointestinal tracts of **Peromyscus maniculatus** from control and burned areas on the Idaho National Engineering Laboratory Site, May 1976.

	Control ($\overline{X}$+SD)				Burn ($\overline{X}$+SD)			
	Male (50)[a]	Female (44)	Juvenile (35)	Total Population (129)	Male (29)	Female (29)	Juvenile (7)	Total Population (65)
Lepidoptera Larvae	71 ± 6	49 ± 3	73 ± 9	64 ± 13	31 ± 7	23 ± 9	57 ± 5	37 ± 16
Coleoptera adult	20 ± 3	45 ± 3	10 ± 2	25 ± 15	60 ± 8	65 ± 6	36 ± 8	54 ± 15
Araneida	2 ± 1	3 ± 2	3 ± 2	3 ± 2	1 ± 1	0.5 ± 0.7	0.3 ± 0.7	1 ± 1
Formicidae	2 ± 2	0	9 ± 3	4 ± 4	0	0	0	0
Feather	2 ± 2	2 ± 2	0	1 ± 2	0	0	0	0
Orthoptera	0.4 ± 0.5	0.2 ± 0.5	0.8 ± 0.7	0.5 ± 0.6	0	0	0	0
Plants	0	1 ± 1	4 ± 3	1 ± 2	8 ± 3	11 ± 4	6 ± 5	8 ± 4
Seeds	0	0	0.7 ± 0.6	0.2 ± 0.5	0	0	0	0

[a]( ) = number of deer mouse stomachs combined for microscopic analysis.

Coleoptera adults and Lepidoptera larvae accounted for over 90 percent of the diet of deer mice from both the burned and control areas (Table 2). The Shannon-Weiner diversity indices were 1.38 and 1.32 for diets of deer mice captured in control and burned areas, respectively. These low diversity indices indicate that deer mice from both the burned and control areas depended upon a small number of food items. No significant difference (paired t-test) was found in the diversity indices of burned versus control area rodents. Kulcyznski's coefficient of community indicated a 66 percent similarity in the diets of burn and control rodents. Although this figure represents a high percentage overlap, the diets of deer mice from the burned and control areas were statistically different ($P < 0.05$). The diet of control area deer mice contained about half the amount of Coleoptera adults and nearly twice the amount of Lepidoptera larvae as the burned area rodents (Table 2). Comparisons of the two major food items in the diet indicated significant differences ($P < 0.05$) between burn and control deer mice. The abundance of Coleoptera adult and Lepidoptera larvae on the study areas was not measured. Thus, the reason for the differences in occurrence of the two items in the gastrointestinal tract is unclear. Perhaps the vegetation cover and species differences between the two areas (Fraley, 1978) was a factor affecting the density of the two groups of insects and consequently the diets of the deer mice. *Formicidae* and *Orthoptera* availability was also likely a function of the vegetation composition of burned and control areas. Ants (*Formicidae*) and crickets or grasshopers (*Orthoptera*) did not occur in the diets of burned area deer mice, but comprised respectively 4 and 5 percent of the relative density of control deer mice diets (Table 2).

The occurrence of plants in the diet of both control and burned area deer mice was less than 10 percent, although deer mice collected from the burned site consumed significantly ($P < 0.05$) more plant material than control deer mice (Table 2). This finding may reflect a lack of new growth during 1976 of sagebrush and grasses on the study areas (Fraley, 1978): *Artemisia spp.* represented over 90 percent of the plants consumed by deer mice from both areas. These results, then, are contrary to vegetation data collected in 1976, which indicated *Artemisia spp.* occurred only on the control grids (Fraley, 1978). Since deer mice have home ranges from 0.1 to over 1.2 ha (Lechleitner, 1969), perhaps mice inhabiting the burned area fed in adjacent areas containing sagebrush.

Since the degree of movement by deer mice between control and burned areas was not studied, one cannot conclude that deer mice from the burned area did not forage in the adjacent control areas. Statistical analyses of food habits, however, indicate that deer mice from the burned and control areas are different populations with respect to diet. The differences in vegetative composition in the burned and control areas were not reflected in deer mice diets. Still, vegetative composition could account for the availability of insects and as a consequence have an indirect effect on the food habits of deer mice from the burned and control areas. Further food habits data on a seasonal basis would enable better evaluation of the use of food habits to help explain the effects of fire on small mammal densities. Combining seasonal, long-term food habits data with vegetation analysis and rodent trapping should enable investigators to estimate the relationships of plant succession and rodent repopulation in desert ecosystems following fires. In a slow recovery area, information of this type is useful to allow man to predict the adverse impacts of a disturbance such as fire.

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