Carolyn Hull Sieg and **Daniel W. Uresk,** USDA Rocky Mountain Forest and Range Experiment Station
South Dakota School of Mines Campus, Rapid City, South Dakota 57701

and

Richard M. Hansen, Range Science Department
Colorado State University, Fort Collins, Colorado 80523

Seasonal Diets of Deer Mice on Bentonite Mine Spoils and Sagebrush Grasslands in Southeastern Montana

Abstract

Deer mice captured on bentonite mine spoils and sagebrush grasslands consumed mainly arthropods and seeds. Arthropod consumption was negatively correlated with availability and positively correlated with precipitation, indicating that deer mice apparently do not seek arthropods as a source of moisture. However, forb consumption was positively correlated with availability and negatively correlated with precipitation, indicating that deer mice eat forbs when available, but in increased amounts during periods of drought. Deer mice selected for specific types of arthropods and plants, but their selectivity may be partly an expression of the habitat.

Introduction

Deer mice (*Peromyscus maniculatus*) are common inhabitants of mine spoil environments (Verts 1957, Wetzel 1958, Sly 1976, Hansen and Warnock 1978, Hingtgen and Clark 1984), although little is known about their ecology in these habitats. Deer mice have been reported to be opportunistic, omnivorous animals, consuming a variety of foods depending on the habitat and season (Jameson 1952, Williams 1959, Flake 1973). Arthropods, seeds, and forbs are important in diets of deer mice, and these rodents have been reported to cause problems on seeded areas by consuming seeds of planted species (Everett *et al.* 1978). Seasonal differences in their diet have been largely attributed to changes in the availability of food resources (Johnson 1961, Whitaker 1966). However, few authors have presented data on food availability. This paper characterizes seasonal food habits of deer mice on bentonite mine spoils and unmined sagebrush grasslands, relates food selection to availability, and discusses potential impacts of deer mouse granivory and herbivory on revegetation efforts.

Study Area and Methods

This study was conducted in southeastern Montana, approximately 9 km west of the town of Alzada in southeastern Carter County. Elevations range from 1000 to 1100 m. The area receives an average of 37 cm of precipitation annually (National Oceanic and Atmospheric Administration 1976). Nearly 50 percent (18 cm) of the precipitation occurs between May and July. In 1979 and 1980, 26 and 35 cm of precipitation were received, respectively. Precipitation was lower than normal during most seasons of the study (Figure 1). The mean temperature is 7.8 C, ranging from an average of −6.4 C in January to 22.6 C in July (National Oceanic and Atmospheric Administration 1976).

Unmined sagebrush-grasslands are dominated by big sagebrush (*Artemisia tridentata*) with an understory of western wheatgrass (*Agropyron smithii*), and green needlegrass (*Stipa viridula*). Buffalograss (*Buchloe dactyloides*) and lichen (*Parmelia chlorochrae*) are other common species in the area. Rillscale (*Atriplex suckleyi*) is the most common plant on the bentonite mine spoils, regardless of the age or reclamation treatment. Western wheatgrass and crested wheatgrass (*Agropyron cristatum*) contribute slightly to the vegetal cover on the spoils; several other plants, including bromegrasses (*Bromus* spp.), foxtail barley (*Hordeum jubatum*), and lichen, are present as minor components of the plant cover on the mine spoils.

Twelve 60-x 60-m (0.36 ha) study sites were established: two on gently undulating unmined sagebrush grasslands, and 10 on bentonite mine spoils. The bentonite spoils ranged in age from

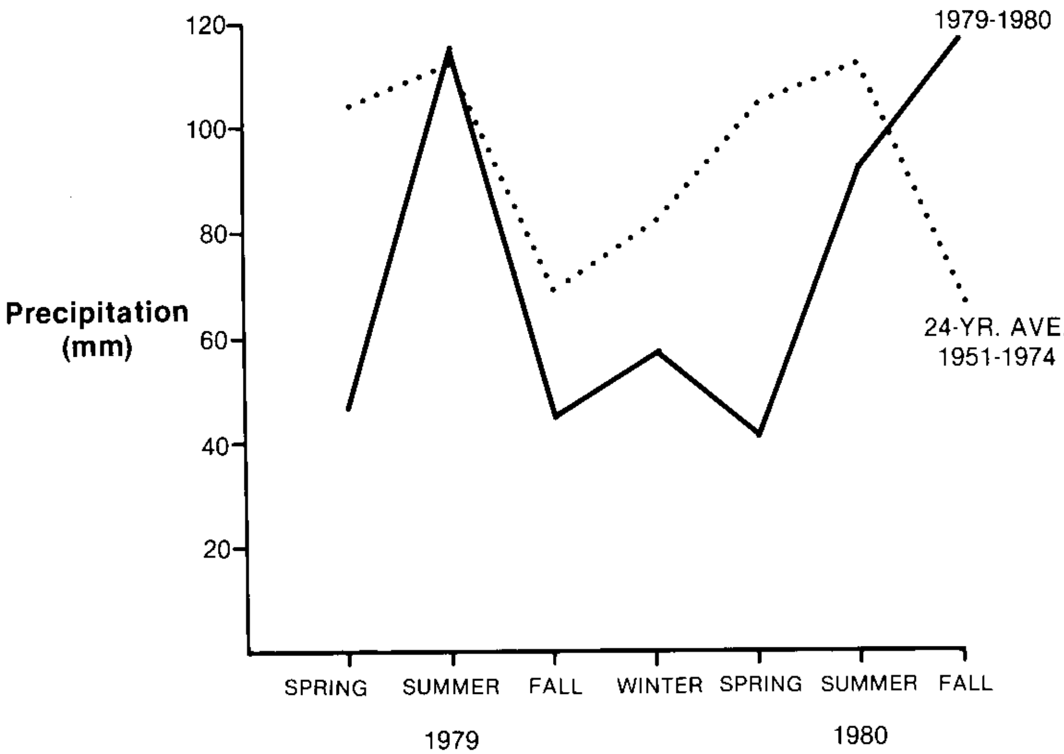

Figure 1. Total seasonal precipitation in 1979 and 1980 compared with average precipitation between 1951 and 1974, near Alzada, Montana.

1 to 28 years. Each bentonite pit and associated spoil pile cover less than 5 ha. Old bentonite spoils (12 to 28 years old) are steep and generally barren. More recent spoil piles have been recontoured, covered with a thin layer of topsoil, and seeded with a mixture of wheatgrasses (*Agropyron* spp.) and yellow sweetclover (*Melilotus officinalis*). However, excessive levels of salinity and sodium, severe soil compaction, and low precipitation often preclude the establishment of vegetation (Sieg *et al.* 1983).

Dietary Analysis

Fecal pellets were collected from deer mice captured in Sherman live traps. Thirty-six traps were arranged in a grid pattern with 10-m spacing on each site. After one night of pre-baiting, the traps were set for three consecutive nights every three weeks from May through October in 1979 and 1980. Rolled oats mixed with peanut butter was used as bait.

Fecal samples were collected from first-time captured animals, placed in paper envelopes and dried. The pellets were combined for each site and trap session, then divided into two equal samples. Invertebrates were identified by examining 40 fields per sample in a petri dish at 40 power magnification; then, one slide was made from each sample and 40 fields per slide were examined at 100 power magnification for identification and quantification of plant species (Sparks and Malecheck 1968). Frequency of occurrence data were converted to percent relative density (Fracker and Brischle 1944). Plant and arthropod samples were collected in the field and used as reference specimens.

Food Availability

The availability of foods was determined by sampling macroarthropod populations, plant aboveground biomass, and plant canopy cover on each study site. Availability of arthropods was measured by the proportion of a particular arthropod group in the total capture. The relative abundance of ground-dwelling macroarthropods was estimated using 15-x 15-cm metal pitfall traps. Twelve cans were buried flush with the soil surface in a grid pattern with 15-m spacing on each site. The pitfall traps were opened every three weeks for three consecutive nights. The macroarthropods were collected, classified to order and family, and counted daily. Although this technique may underestimate less mobile arthropods and larvae (Thomas and Sleeper 1977), adequate results have been obtained for most species captured on this study area (Gist and Crossley 1973, Baars 1979).

Availability of forage was assumed to be equivalent to the proportion of a particular food plant in the aboveground biomass. Aboveground biomass was estimated each year at the peak of production (late July) by harvesting plants at ground level in 10 randomly located 20-x 50-cm quadrats on each of three permanent line transects on each site. Plant species were separated in the field, oven-dried in the laboratory at 60 C for 48 hours, and weighed.

Plant canopy cover was assumed to be a reflection of forb availability throughout the growing season. Plant canopy cover of forbs was estimated in 50 quadrats (20 x 50 cm) placed at 1-m intervals along permanent line transects (Daubenmire 1959). Three transects, each 50 m in length, were sampled on each site. Canopy cover was visually estimated as falling into one of seven cover classes: 0 = less than 1 percent cover, 1 = 1-5 percent, 2 = 5-25 percent, 3 = 25-50 percent, 4 = 50-75 percent, 5 = 75-95 percent, and 6 = 95-100 percent cover. Sampling was conducted three times a year, in late spring, midsummer, and late summer.

Statistical Analysis

One- and two-way (incorporating both years) analysis of variance and Tukey's multiple comparison procedure (Kleinbaum and Kupper 1978) were used to compare diets and food availability among sites and seasons. Spearman's rank order correlation coefficient and chi-square contingency tables (Steele and Torrie 1980) were used to compare dietary composition between years. Kendall's coefficient of concordance (Kendall 1970) was used to compare rank order of foods among site types.

Relative percentages of food items in the diets were compared to relative abundance in the field by chi-square analysis. Preference indices for arthropods were calculated by dividing the relative composition (based on relative density) of specific groups in the animal matter portion of the diet by the relative abundance of these arthropods in the field. Preference indices for plants were calculated by dividing the relative composition (based on relative density) of specific plants in the vegetal portion of the diet by the relative weight of these plants in the aboveground biomass (Krueger 1972).

Relationships between arthropods and forbs in the spring, summer, and fall diets in each year (dependent variables), and seasonal precipitation, forb cover, and arthropod availability (independent variables) were evaluated by all-possible regression analysis (Dixon 1983). The summer diet of the deer mice (dependent variable) was compared with total aboveground biomass (independent variable) for each year.

Results

Dietary Analysis

Arthropods and seeds were the major foods of deer mice captured during the study. Arthropods made up 52 percent and 75 percent of the diets in 1979 and 1980, respectively; seeds averaged 35 percent and 9 percent (Table 1). The most common arthropods in the diet were Hymenoptera (22 percent) and adult Coleoptera (15 percent and 18 percent). Rillscale seeds were commonly consumed in 1979, comprising 33 percent of the diet. American vetch (*Vicia americana*) was the most common forb eaten (2 percent and 7 percent). Grasses and shrubs made up a small portion of the diet in both years. Fungi (*Endogennae*) and algae were present in the feces in both years.

The rank order of food items was significantly correlated among site types ($W = 0.78$, $P < 0.005$), indicating that deer mice ate foods in the same relative proportions on the various sites. However, the rank order of food items in the diet was not significantly correlated for the two years ($r_S = 0.17$, $P > 0.10$), which indicated that the

TABLE 1. Major foods of deer mice (*Peromyscus maniculatus*) on bentonite mine spoils and sagebrush-grass rangelands near Alzada, Montana (N = 192).

Food Item	% Relative Density 1979 ($\bar{x}$ ± SE)[1]	1980 ($\bar{x}$ ± SE)[1]
Arthropods		
Araneida	0.2 ± 0.1	2.7 ± 1.6
Coleoptera adult	17.5 ± 2.3	15.4 ± 2.7
Coleoptera larvae	1.3 ± 0.5	2.4 ± 0.8
Diptera	0	9.8 ± 1.8
Hymenoptera	22.2 ± 2.3	22.4 ± 3.7
Lepidoptera	0.4 ± 0.1	7.5 ± 2.1
Orthoptera	0.1 ± 0.05	8.2 ± 2.0
Unknown adult	2.3 ± 0.7	2.6 ± 1.5
Unknown larvae	8.1 ± 1.0	3.6 ± 1.1
Total	(52.1 ± 3.1)	(75.0 ± 2.8)
Seeds		
Atriplex suckleyi	32.9 ± 2.5	2.6 ± 0.3
Chenopodium spp.	0.01 ± 0.01	1.0 ± 0.2
Plantago sp.	0	2.2 ± 0.6
Unknown seeds	1.2 ± 0.4	3.2 ± 0.2
Other seeds	0.4 ± 0.1	0.1 ± 0.1
Total	(34.5 ± 2.8)	(9.1 ± 0.5)
Grasses		
Bromus spp.	0.8 ± 0.1	0.3 ± 0.1
Other grasses	1.3 ± 0.4	0.4 ± 0.1
Total	(2.1 ± 0.3)	(0.7 ± 0.1)
Forbs		
Atriplex suckleyi	1.3 ± 0.3	0.8 ± 0.2
Vicia americana	2.0 ± 0.3	6.8 ± 1.8
Other forbs	0.8 ± 0.2	3.4 ± 0.5
Total	(4.1 ± 0.3)	(11.0 ± 0.6)
Shrubs		
Artemisia tridentata	1.9 ± 0.02	1.9 ± 0.1
Other shrubs	0.7 ± 0.1	0.1 ± 0.1
Total	(2.6 ± 0.3)	(2.0 ± 0.2)
Algae	1.4 ± 0.8	0.9 ± 0.4
Fungi (*Endogennae*)	2.9 ± 0.9	1.6 ± 0.7

[1]Mean ± standard error.

deer mice did not eat foods in the same relative proportions during the two years. The dietary shift ($P < 0.001$) between years included a decrease in seed consumption and an increase in invertebrates eaten in 1980 (Table 1). Rillscale seeds decreased from 33 percent of the diet in 1979 to 3 percent in 1980. Diptera arthropods were present in the deer mouse diet (10 percent) only in 1980.

Seasonal trends in arthropod consumption were similar in both years, with peak consumption occurring in the summer (June and July) (Figure 2). Fewest arthropods were consumed in spring. However, seasonal trends for seed consumption differed ($P < 0.05$) between years. Seed consumption was highest in the spring of 1979, and lowest in summer (Figure 3). Seed consumption increased during the 1980 study period, with the peak consumption occurring in the fall. Grasses and shrubs were consumed in small amounts in all seasons.

Food Availability

Macroarthropods. A total of 1187 macroarthropods were captured in 1979, while numbers decreased ($P < 0.01$) to 530 in 1980. Peak captures occurred in the spring of 1979 (April and May), and in the summer of 1980 (June and July) (Figure 2). The rank order of common macroarthropods was significantly correlated among sites ($W = 0.81$, $P < 0.005$), indicating that various arthropods were available in the same relative amounts on the twelve sites.

Ground beetles and other Coleoptera, crickets (Orthoptera), and ants and wasps (Hymenoptera) were the most commonly captured macroarthropods on the study area, followed by wolf spiders (Araneida) and mites (Acarina). Daddy-longlegs (Opiliones), millipedes (Diplopoda), and true bugs (Hemiptera) each contributed less than 5 percent to the total capture. Scorpions (Scorpionida) and butterflies and moths (Lepidoptera) were captured in low numbers. The relative abundance of the arthropod types captured on the study area differed significantly ($P < 0.001$) from the percentage of these arthropods in the diet of the deer mice. Dipterans and Lepidopterans were preferred arthropods only in 1980; Hymenopterans were slightly preferred foods in both years (Table 2).

Plants. In 1979, aboveground biomass averaged 215 kg/ha; in 1980 the average production decreased ($P < 0.05$) to 121 kg/ha on the twelve study sites. Important plant species on the study area, in terms of percent relative weight, were rillscale, wheatgrasses, lichen, buffalograss, and green needlegrass (Table 3). The relative composition of prominent plant species differed significantly ($P < 0.05$) from the relative density of these plants in the diets of deer mice captured on the study area. Rillscale and lichen had the highest preference indices in 1979; American

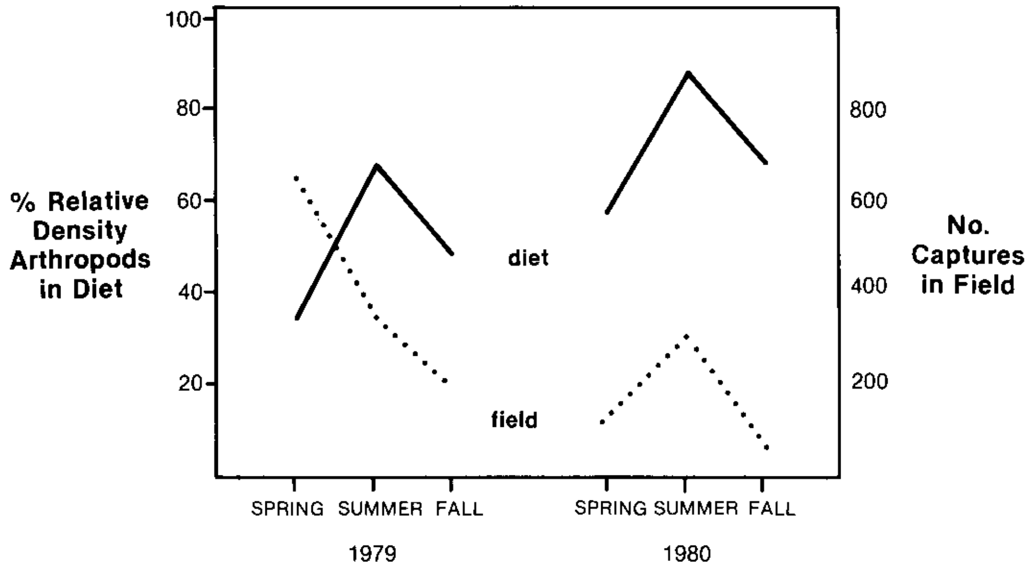

Figure 2. Relative amounts of arthropods in deer mouse diets compared with seasonal arthropod captures on bentonite mine spoils and sagebrush grasslands near Alzada, Montana in 1979 and 1980.

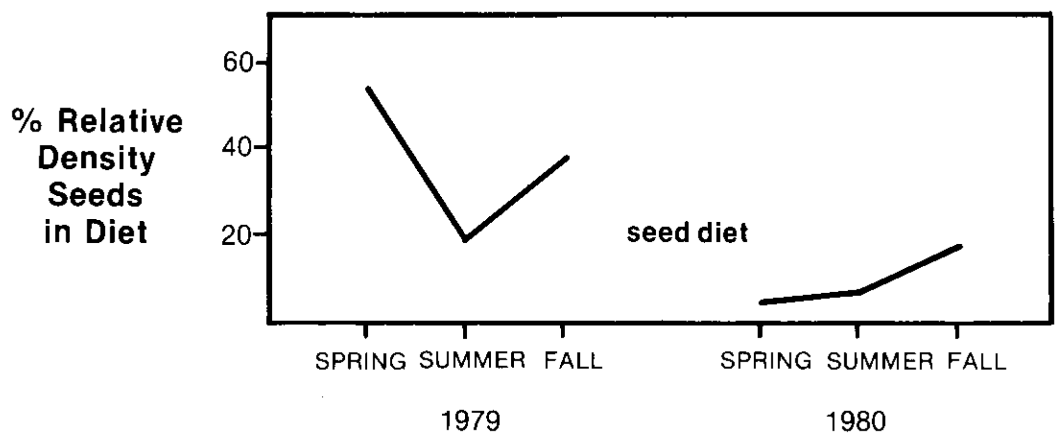

Figure 3. Relative amounts of seeds in deer mouse diets on bentonite mine spoils and sagebrush grasslands near Alzada, Montana in 1979 and 1890.

vetch and rillscale were the most preferred species in 1980. Wheatgrasses and buffalograss were among the least preferred plants in both years (Table 3).

Plant canopy cover of forbs averaged less than 10 percent during all seasons of the two-year study. Forb cover peaked in the fall of 1979, and in the summer of 1980 (Figure 4).

Discussion

Arthropods, seeds, and forbs are common components of deer mouse diets, although their relative proportions vary regionally. The high proportion of arthropods in this study is consistent with several studies (*i.e.*, Dusek and McCann 1975, Halford 1981, Hingtgen and Clark 1984), although species composition varies from some

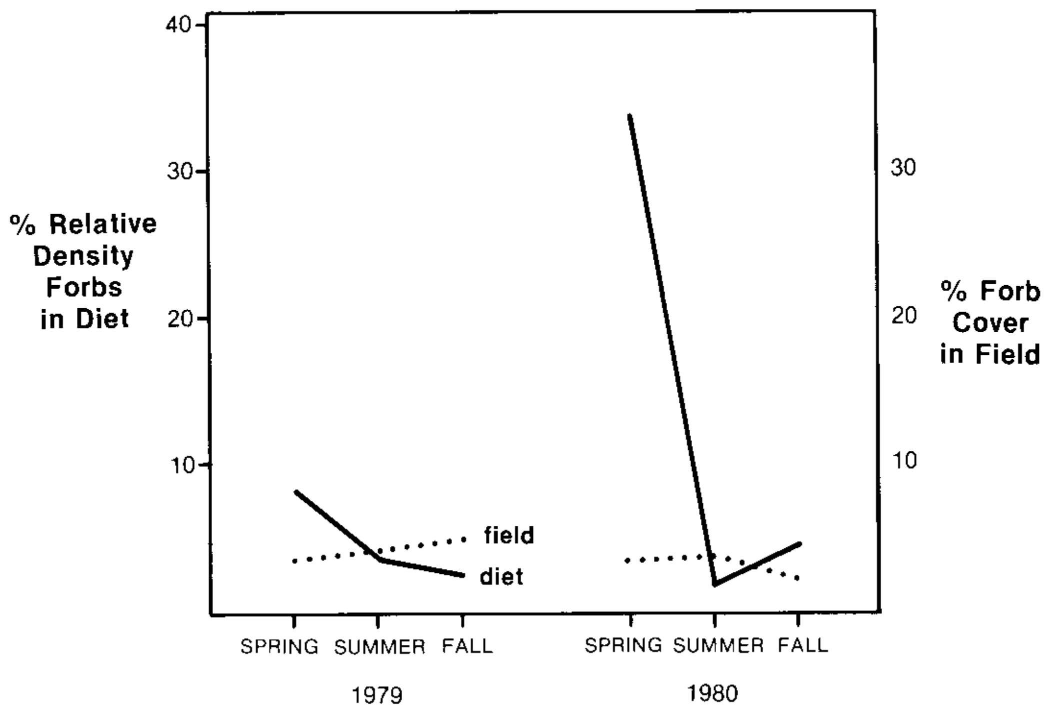

Figure 4. Relative amounts of forbs in deer mouse diets compared with average seasonal forb cover on bentonite mine spoils and sagebrush grasslands near Alzada, Montana in 1979 and 1980.

TABLE 2. Percent relative composition and deer mouse preference indices for arthropods captured on bentonite mine spoils and sagebrush-grasslands near Alzada, Montana, in 1979 and 1980.

	1979		1980	
Group	% of Capture	Preference Index	% of Capture	Preference Index
Coleoptera	29.1	0.6	30.2	0.6
Orthoptera	19.9	0.1	38.7	0.2
Hymenoptera	20.4	1.1	12.6	1.8
Araneida	14.7	0.1	9.4	0.3
Acarina	6.0	0	2.3	0
Opiliones	3.4	0	2.6	0
Diplopoda	4.0	0	0.8	0
Lepidoptera	0.8	0.4	1.3	5.7
Hemiptera	1.3	0	0.9	0.4
Diptera	0	0	0.1	9.8
Unknown	0	-	1.1	-

TABLE 3. Percent relative weight in aboveground biomass and deer mouse preference indices for plants on bentonite mine spoils and sagebrush-grasslands near Alzada, Montana, in 1979 and 1980.

Plant	1979 % by Weight	1979 Preference Index	1980 % by Weight	1980 Preference Index
Atriplex suckleyi	25.8	22.1	42.1	10.4
Agropyron spp.	28.3	0.1	22.8	0.1
Parmelia chlorochrae	7.4	5.7	9.3	3.2
Stipa viridula	8.2	0	2.5	0
Buchloe dactyloides	3.4	0	7.2	0
Bromus spp.	3.2	4.8	1.5	7.4
Vicia americana	0.8	3.9	0.4	22.3

studies. Lepidopterans (Flake 1973) and Orthopterans (Dusek and McCann 1975) were more important food sources in other studies than Coleopterans and Hymenopterans. Deer mice are known for their granivorous food habits, and have been blamed for consuming planted seeds (*i.e.*, Everett *et al.* 1978). However, a preference for *Atriplex* seeds has not previously been reported. Big saltbush (*A. lentiformis*) and fourwing saltbush (*A. canescens*) were among least preferred plants offered to deer mice by Everett *et al.* (1978). Forbs are generally minor components in deer mouse diets, but may comprise the majority of the diet in some habitats (Goodwin and Hungerford 1979). American vetch has not previously been reported as a preferred food item, although sainfoin (*Onobrychis viciaefolia*), also a legume, was a preferred food of deer mice on seeded coal spoils in Wyoming (Hingtgen and Clark 1984).

Yearly and seasonal variations in the deer mouse diet are commonly reported, and are generally attributed to changes in availability of the food resources (Whitaker 1966). However, in this study, arthropod consumption was higher in 1980 than in 1979, in spite of substantial declines in macroarthropod captures in 1980. Further, arthropod consumption was negatively correlated ($r = -0.28$, $p = 0.014$) with arthropod availability, indicating that the mice did not necessarily consume arthropods in relation to their availability. Arthropod consumption was positively correlated with precipitation ($r = 0.49$, $p = 0.0001$), supporting recent conclusions of Meserve (1976) and Haufler and Nagy (1983), that deer mice apparently do not seek arthropods as a source of moisture. Possibly, because of the higher caloric content of arthropods (5.8 kcal/g), compared to seeds (4.4 kcal/g) and green vegetation (4.1 kcal/g) (French *et al.* 1976), deer mice sought out arthropods to meet minimal nutritional requirements, particularly when plant materials were less available.

The increase in forb consumption from 1979 to 1980 may be attributed to dry conditions, especially during the spring of 1980. Forb consumption was positively correlated ($r = 0.43$, $p = 0.001$) with total forb canopy cover, but negatively correlated with precipitation ($r = -0.40$, $P = 0.001$), indicating that deer mice consumed forbs when available, but in increased amounts during periods of drought. Other authors have suggested the importance of green vegetation as a source of moisture (Jones *et al.* 1983), and the potential role of green vegetation in the diet on the reproductive capacity of some small mammals (Reichmann and Van De Graff 1975).

Seed consumption declined from 1979 to 1980, and at least for rillscale seeds, was likely related to availability. During drought periods, rillscale was short in stature and produced fewer seeds. Flake (1973) reported that deer mice depended on seeds in times of insect scarcity, but in this study, the greatest use of seeds was in the spring of 1979, when insects were highly available.

Deer mice have been reported to be very opportunistic feeders, readily consuming new foods (Johnson 1961), and reflecting the availability of various foods in their diets. However, if deer mice in this study were totally opportunistic, they should have selected foods in proportion to the availability of the food items. To the contrary, the deer mice appeared to show some dietary selectivity, as indicated by high preference indices for some uncommon plants (*i.e.*, bromegrasses and American vetch) and lower indices for some common plants (*i.e.*, wheatgrasses). Deer mice on our study area also appeared to exhibit some selectivity in regards to arthropods. Crickets (Orthopterans) were highly available, yet were apparently not preferred food items, based on low preference indices. Availability of Lepidopterans and Dipterans is more difficult to measure with the use of pit traps, but assuming their capture rates are a relative approximation of availability, deer mice in our study showed some preference for these arthropods, at least in 1980. Limited food resources in 1980 provided a good test of the "opportunistic hypothesis," and high preference indices in that year suggest that deer mice actively searched out some foods, and therefore may not be totally opportunistic in their feeding behavior.

It is unlikely that deer mice pose a serious threat to revegetation success on bentonite mine spoils. Deer mice in this area relied heavily on arthropods, and to a lesser extent on plant materials. Wheatgrasses are a major component of seed mixtures used in this area, and deer mice showed low preference for these grasses, although wheatgrasses were important in the total plant biomass on the study area. The most significant negative impact on revegetation efforts may be on some native legumes, such as American vetch, which was highly preferred by deer mice in our study. Hingtgen and Clark (1984) concluded that deer mice on Wyoming coal spoils negatively affected the establishment of sainfoin.

Conversely, deer mice may be beneficial to the establishment of some plants on bentonite mine spoils, and may help control some undesirable plants. Rothwell and Holt (1978) proposed that deer mice on recent mine spoils are important as vectors of vesicular-arbuscular mycorrhizal fungi. The presence of mycorrhizae in the feces of deer mice captured on bentonite mine spoils was an indication of the role these animals play in the dispersal of endophytes essential to the growth and development of many plants. Further, the high preference for bromegrasses is an indication that deer mice may help curb the invasion of undesirable bromegrasses on the mine spoils.

Perhaps deer mice should be called "selective opportunists." On this study area, deer mice readily exploited new food resources on the bentonite mine spoils, but did not always consume foods in the same relative proportion to availability. Nutritional needs, including water requirements, may influence the dietary habits of these small mammals, possibly causing them to seek out forbs during periods of drought. Future research comparing the dietary habits of deer mice with the availability of various food resources may show that deer mice are more selective in their feeding behavior than previously reported, but the expression of selectivity may be determined in part by the habitat.

Acknowledgments

The authors thank Lynn Alexander, Colorado State University, for help with field work, the owners of the Wyotana Ranch for their cooperation in this study, and NL Industries Baroid Division, and International Minerals and Chemical Corporation for permission to use their land. Darrell Ueckert, Jerran Flinders, and Lee Rogers provided helpful suggestions for revising an earlier draft of this manuscript.

Literature Cited

Baars, M. A. 1979. Catches in pitfall traps in relation to mean densities of carabid beetles. Oecologia 41:25-46.

Daubenmire, R. 1959. A canopy-coverage method of vegetation analysis. Northw. Sci. 33:43-64.

Dixon, W. J. 1983. BMDP Statistical Software. University of California Press, Berkeley.

Dusek, G. L., and S. McCann. 1975. Bull Mountains Coal Field Study. Progress Report. Montana Dept. Game and Fish.

Everett, R. L., R. Meeuwig, and R. Stevens. 1978. Deer mouse preference for seed of commonly planted species, indigenous weed seed, and sacrifice foods. J. Range Manage. 31:70-73.

Flake, L. P. 1973. Food habits of four species of rodents on a shortgrass prairie in Colorado. J. Mammal. 54:636-647.

Fracker, S. B., and J. A. Brischle. 1944. Measuring the local distribution of *Ribes*. Ecology 25:283-303.

French, N. R., W. E. Grant, W. Grodzinski, and D. M. Swift. 1976. Small mammal energetics in grassland ecosystems. Ecological Monographs 46:201-220.

Gist, C. S., and D. A. Crossley. 1973. A method for quantifying pit-fall trapping. Env. Ent. 3:951-952.

Goodwin, John G., Jr., and C. Roger Hungerford. 1979. Rodent population densities and food habits in Arizona ponderosa pine forests. USDA For. Serv. Res. Pap. RM-214, Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colorado.

Halford, D. K. 1981. Repopulation and food habits of *Peromyscus maniculatus* on a burned sagebrush desert in southeastern Idaho. Northw. Sci. 55:34-49.

Hansen, L. P., and J. E. Warnock. 1978. Response of two species of *Peromyscus* to vegetational succession on land strip-mined for coal. Am. Midl. Nat. 100:416-423.

Haufler, J. B., and J. G. Nagy. 1983. Summer food habits of a small mammal community in the pinyon-juniper ecosystem. Great Basin Nat. 44:145-150.

Hingtgen, T. M., and W. R. Clark. 1984. Impact of small mammals on the vegetation of reclaimed land in the Northern Great Plains. J. Range Manage. 37:438-441.

Jameson, E. W., Jr. 1952. Food of deer mice, *Peromyscus maniculatus,* in the northern Sierra Nevada, California. J. Mammal. 33:50-60.

Johnson, D. R. 1961. The food habits of rodents on rangelands of southern Idaho. Ecology 42:407-410.

Jones, J. K., Jr., D. M. Armstrong, R. S. Hoffmann, and C. Jones. 1983. Mammals of the Northern Great Plains. University of Nebraska Press, Lincoln.

Kendall, M. G. 1970. Rank Correlation Methods. 4th edition. Hafner Press, New York.

Kleinbaum, D. G., and L. L. Kupper. 1978. Applied regression analysis and other multivariable methods. Duxburg Press. North Scituate, Massachusetts.

Krueger, W. C. 1972. Evaluating animal forage preference. J. Range Manage. 35:471-475.

Meserve, P. L. 1976. Food relationships of a rodent fauna in a California coastal sage scrub community. J. Mammal. 57:300-319.

National Oceanic and Atmospheric Administration. 1976. Climate of Colony, Wyoming. Climatography of the United States No. 20. Ashville, North Carolina.

Reichman, O. J., and K. M. Van De Graff. 1975. Association between ingestion of green vegetation and desert rodent reproduction. J. Mammal 56:503-506.

Rothwell, F. M., and C. Holt. 1978. Vesicular-arbuscular mycorrhizae established with *Glomus fasciculatus* spores isolated from the feces of cricetine mice. USDA For. Serv. Res. Note NE-259, Northeastern For. Exp. Sta., Berea, Kentucky.

Sieg, C. H., D. W. Uresk, and R. M. Hansen. 1983. Plant-soil relationships on bentonite mine spoils and sagebrush-grassland in the northern High Plains. J. Range Manage. 36:289-294.

Sly, G. R. 1976. Small mammal succession on strip-mined land in Vigo County, Indiana. Am. Midl. Nat. 95:257-267.

Sparks, D. R., and J. C. Malecheck. 1968. Estimating percentage dry weight in diets using a microscope technique. J. Range Manage. 21:264-265.

Steele, R. G., and J. H. Torrie. 1980. Principles and Procedures of Statistics. 2nd Ed. McGraw-Hill Book Co., Inc. New York.

Thomas, B., Jr., and E. L. Sleeper. 1977. The use of pitfall traps for estimating the abundance of arthropods, with special reference to the Tenebrionidae (Coleoptera). Ann. Ent. Soc. Amer. 70:242-248.

Verts, B. J. 1957. The population and distribution of two species of *Peromyscus* on some Illinois strip-mined land. J. Mammal. 38:53-59.

Wetzel, R. M. 1958. Mammalian succession on mid-western floodplains. Ecology 39:262-271.

Whitaker, J. O. 1966. Food of *Mus musculus, Peromyscus maniculatus bairdi,* and *Peromyscus leucopus* in Vigo County, Indiana. J. Mammal. 47:473-486.

Williams, O. 1959. Food habits of the deer mouse. J. Mammal. 40:415-419.

Received 13 May 1985
Accepted for publication 14 June 1985