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HABITAT USE AND FOOD SELECTION OF SMALL MAMMALS NEAR A SAGEBRUSH/CRESTED WHEATGRASS INTERFACE IN SOUTHEASTERN IDAHO

David K. Koehler¹ and Stanley H. Anderson²

ABSTRACT.—Habitat use and food selection data were collected for deer mice (*Peromyscus maniculatus*), montane voles (*Microtus montanus*), Ord's kangaroo rats (*Dipodomys ordii*), and Townsend's ground squirrels (*Spermophilus townsendii*) near a sagebrush (*Artemisia tridentata*)/crested wheatgrass (*Agropyron cristatum*) interface in southeastern Idaho. Significantly more captures occurred in the native sagebrush habitat than in areas planted in crested wheatgrass or in disturbed sites. Crested wheatgrass, a prolific seed producer, still accounted for over 30% of the total captures. Montane voles and Townsend's ground squirrels (during periods of aboveground activity) used the crested wheatgrass habitat throughout the summer, while deer mice and Ord's kangaroo rats exhibited heavy use after seed set.

Key words: small mammals, food selection, habitat selection, deer mice, montane vole, Ord's kangaroo rat, Townsend's ground squirrel.

Research has been conducted on various aspects of the ecology of wildlife residing on and adjacent to the Subsurface Disposal Area (SDA) and one other low-level radioactive waste disposal site on the Idaho National Engineering Laboratory (INEL) in southeastern Idaho. Small mammals were the most frequently occurring wildlife (Arthur and Markham 1983), and densities on the SDA were considerably higher than in adjacent native vegetation types (Groves 1981). Crested wheatgrass planted on the SDA for soil stabilization and hydrologic benefits may provide food for small mammals. A prolific seed producer, it provides a readily available seed source for granivorous rodents in this cold-desert system (Arthur et al. 1986).

In other regions where crested wheatgrass has been planted for livestock grazing use, relative densities and species diversities of small mammals (Reynolds 1980, Reynolds and Trost 1980) were reduced. However, studies conducted on the INEL have shown that crested wheatgrass seedings are used by small mammals as food sources. Filipovich (1983) reported that deer mice (*Peromyscus maniculatus*), the most abundant rodent on these disposal areas, shifted to heavy use of grass seed when crested wheatgrass went to seed. Reynolds and Arthur (1983) told of a radio-marked deer mouse that would traverse a

linear distance of approximately 250 m each evening from native sagebrush vegetation to the border of the SDA. This animal would then spend the night foraging near the SDA boundary before returning to its burrow at dawn.

This study was undertaken to evaluate the habitat use and food selection of small mammals near a sagebrush/crested wheatgrass interface on INEL. Efforts were concentrated on the four most abundant species of small mammals on the SDA, deer mice, montane voles, Ord's kangaroo rats, and Townsend's ground squirrels.

METHODS

The INEL is a nuclear energy research facility under the jurisdiction of the U.S. Department of Energy. It occupies approximately 231,000 ha of sagebrush desert on the upper Snake River Plain in southeastern Idaho. Average minimum and maximum daily temperatures in summer and winter range from 10 to 30 C, and -16 to -3 C, respectively. Average annual precipitation is approximately 22 cm (Clawson et al. 1989).

The SDA, a 36-ha portion of the Radioactive Waste Management Complex, has been used for the interment of solid, low-level radioactive waste since 1952. Mixed activation,

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fission, and transuranic radioactive wastes have been disposed at the SDA through use of shallow burial techniques.

Vegetation on the SDA and its perimeter consists primarily of a seeded stand of crested wheatgrass. The native vegetation surrounding the SDA is a predominantly big sagebrush/bluebunch wheatgrass (*A. spicatum*) steppe (McBride et al. 1978). Additionally, several disturbed and unseeded areas are found around the periphery of the SDA. These areas typically support a sparse cover of Russian thistle, cheatgrass (*Bromus tectorum*), and green rabbitbrush (*Chrysothamnus viscidiflorus*) (Arthur 1982).

HABITAT USE.—A 6.24-ha (240 × 260-m) live-trapping grid was established on and adjacent to the SDA to examine habitat use patterns. One hundred eighty-two trapping stations were spaced at 20-m intervals on the 13 × 14 grid. Each trapping station consisted of two Sherman live traps baited with a mixture of rolled oats and whole wheat and containing nonabsorbent cotton for bedding.

Each trap station in the live-trapping grid was placed into one of three habitat type categories: native sagebrush/bluebunch wheatgrass steppe; crested wheatgrass; or recently disturbed but unseeded sites consisting of a sparse cover of Russian thistle, cheatgrass, and green rabbitbrush. Categorization was based on visual observation of the vegetative community in which the trap station occurred. Sixty-five (36%), 63 (35%), and 54 (30%) of the 182 trapping stations occurred in native sagebrush vegetation, crested wheatgrass, and disturbed sites, respectively.

Habitat use data were collected in June, July, and August 1984. Each trapping session consisted of seven consecutive nights of trapping during which traps were set prior to sunset and then checked twice nightly. Animals were carried halfway to the next trapping station prior to release to minimize the tendency to immediately reenter known traps (Price et al. 1984). Measures of habitat use were expressed in terms of total captures, captures per 100 trap nights, and percentage of captures occurring in each of the three habitat types.

Chi-square goodness-of-fit tests, including Yates' correction for continuity (Zar 1974), were used to test for differences between numbers of total captures observed versus

expected in each of the three habitat types. Expected values were determined for each species by multiplying the total captures for that species by the percentage of the trap grid occupied by the particular habitat type. Results of the chi-square tests indicated whether habitat selection occurred or if use was determined by availability. Testing for significance was conducted at the $P < .05$ and $P < .01$ levels.

FOOD HABITS.—Diet composition and seasonal use of crested wheatgrass as a food for deer mice, montane voles, Ord's kangaroo rats, and Townsend's ground squirrels collected near a sagebrush/crested wheatgrass interface were evaluated. Four separate trapping periods were conducted during the year to correspond with different phenological stages of crested wheatgrass. These included June (vegetation lush and green), July (onset of desiccation), August (vegetation severely desiccated and seed set), and January and early March (vegetation dormant with winter conditions prevalent).

Two separate grids were trapped for food habit analysis of small mammals captured near a sagebrush/crested wheatgrass interface. The first grid consisted of two lines of traps in a 25 × 100-m configuration. Trap lines were oriented parallel to and 50 and 75 m from the sagebrush/crested wheatgrass interface in the native sagebrush habitat type. Because montane voles and Ord's kangaroo rats exhibited a high degree of fidelity to the crested wheatgrass and were not captured, the trapping scheme was modified. The second configuration consisted of a 75 × 350-m trap grid established perpendicular to the sagebrush/crested wheatgrass interface so that it overlapped both vegetation types. The grid began 100 m inside the crested wheatgrass and extended 250 m into the sagebrush. Trap stations were spaced at 25-m intervals. This modification also allowed documentation of movements across the sagebrush/crested wheatgrass interface.

Trapping procedures were identical for both grids as follows. Each trapping station consisted of two traps, one Museum Special snap trap and one Sherman live trap. Snap traps were baited with peanut butter while the live traps were either unbaited or baited with a small amount of whole wheat. The traps remained set continuously during trapping

TABLE 1. Total captures of small mammals in each of three habitat types on and adjacent to the SDA, June–August 1984. Significance of chi-square tests between observed versus expected numbers is shown. Captures per 100 trap nights in parentheses.

Habitat type and species	June	July	August	Total
CRESTED WHEATGRASS				
<i>Dipodomys ordii</i>	107 (6.1)	43 (2.4)	40 (2.3)	190** (3.6)
<i>Microtus montanus</i>	62** (3.5)	41** (2.3)	25** (1.4)	128** (2.4)
<i>Peromyscus maniculatus</i>	219** (12.4)	237** (13.4)	339** (19.2)	795** (15.0)
TOTAL	388* (22.0)	321 (18.1)	404* (22.9)	1113** (21.0)
DISTURBED SITES				
<i>Dipodomys ordii</i>	127** (8.4)	45** (3.0)	48** (3.2)	220** (4.9)
<i>Microtus montanus</i>	16 (1.1)	8 (0.5)	3 (0.2)	27** (0.6)
<i>Peromyscus maniculatus</i>	271 (17.9)	264 (17.5)	329 (21.8)	864 (19.0)
TOTAL	414 (27.4)	317 (21.0)	380 (25.2)	1111 (24.5)
NATIVE SAGEBRUSH				
<i>Dipodomys ordii</i>	25** (1.4)	7** (0.4)	7** (0.4)	39** (0.7)
<i>Microtus montanus</i>	5** (0.3)	0** (0.0)	2** (0.1)	7** (0.1)
<i>Peromyscus maniculatus</i>	436** (24.0)	358** (19.7)	498** (27.4)	1292** (23.7)
TOTAL	466 (25.7)	365 (20.1)	507 (27.9)	1338 (24.5)
TOTAL CAPTURES				
<i>Dipodomys ordii</i>	259 (5.1)	95 (1.9)	95 (1.9)	449 (2.9)
<i>Microtus montanus</i>	83 (1.6)	49 (1.0)	30 (0.6)	162 (1.0)
<i>Peromyscus maniculatus</i>	926 (18.2)	859 (16.9)	1166 (22.9)	2951 (19.3)
TOTAL	1268 (24.9)	1003 (19.8)	1291 (25.4)	3562 (23.2)

* $P < .05$.

** $P < .01$.

sessions and were checked at least each morning and evening. Rodents captured in live traps were immediately sacrificed by cervical dislocation.

Diet composition was determined by micro-histological analysis of stomach contents. All analyses were conducted by the Composition Analysis Laboratory at Colorado State University (Sparks and Malechek 1968). Identification of plant and arthropod fragments was made by comparison of microscopic characteristics with reference specimens collected on the INEL. Unidentified species were classified by genus, family, or order. Stomach content composition was reported as the percent relative density (number of points where each item occurred relative to the total number of points in that sample) of plant or arthropod fragments identified in the sample.

RESULTS

Habitat Use

A total of 3898 captures of seven species of small mammals in 15,288 trap nights occurred during the summer of 1984. The four species of primary concern accounted for 3562 (91%) (Table 1). Deer mice were the most fre-

quently captured species, accounting for 76% of the total. During the project, 747 deer mice, 106 montane voles, and 95 Ord's kangaroo rats were captured and used in habitat evaluation analyses. Only two Townsend's ground squirrels were caught because of their diurnal activity patterns.

Most animals (1138 or 38%) were caught in the native sagebrush habitat. The fewest captures (1111 or 31%) occurred in disturbed sites, while 1113 (31%) were made in crested wheatgrass (Table 1). Chi-square tests confirmed that the native sagebrush habitat type was used significantly ($P < .01$) more than disturbed sites or crested wheatgrass.

When captures per 100 trap nights were considered (Table 1), the results were different. Again, the highest relative density of small mammals, 28.2 individuals per 100 trap nights, was observed in sagebrush vegetation type. But the amount of use observed in the disturbed sites and crested wheatgrass habitat types was reversed. Disturbed sites accounted for 25.7 captures per 100 trap nights, while the crested wheatgrass had 22.5 captures per 100 trap nights.

Although crested wheatgrass had the lowest relative density of small mammals of any of

the habitat types, all three types received considerable use. Several species of small mammals used this habitat type heavily throughout the summer or seasonally.

Montane voles exhibited a significant ($P < .01$) selection for the crested wheatgrass habitat type and against both disturbed sites and native sagebrush habitat types. Seventy-nine percent of all captures of montane voles occurred in crested wheatgrass and 17% in disturbed sites. Thus, 96% of the montane vole captures occurred in habitat types created by waste management operations.

Ord's kangaroo rats used both disturbed sites and crested wheatgrass significantly ($P < .01$) more and native sagebrush significantly ($P < .01$) less than would be expected. Over 42% of all captures of kangaroo rats occurred in the crested wheatgrass habitat, while 49% of the captures occurred in disturbed sites. So, as with montane voles, a large percentage of all captures (91%) of kangaroo rats was recorded in habitat types resulting from alteration of the native sagebrush vegetation type.

Deer mice used the sagebrush habitat significantly ($P < .01$) more than the disturbed and crested wheatgrass habitats. Nearly 44% of all captures of deer mice occurred in sagebrush, while disturbed sites and crested wheatgrass accounted for 29% and 27%, respectively. However, use of crested wheatgrass increased as the summer progressed, and by August more captures occurred in crested wheatgrass than in disturbed sites (Table 1).

Food Habits

Although an attempt was made to collect at least 10 individuals of each of the four small mammal species during each trapping session, it was not always possible because some animals were trap shy and some were found to have empty stomachs. There was a high degree of similarity in the food habits of animals collected from both trap grids. Therefore, data were pooled to evaluate food habits of small mammals collected near a sagebrush/crested wheatgrass interface.

DEER MICE.—Stomach contents of 72 deer mice were analyzed from August 1983 through June 1985. Crested wheatgrass appeared to be relatively unimportant as a food item except during periods after the grass had gone to seed. Lepidoptera larvae ranked as

the most important item in diets of deer mice collected in June and constituted 71% of the fragments identified in the samples. Small amounts of crested wheatgrass were present in the samples collected in July. However, it ranked as the eighth most frequently consumed food item and composed less than 1% of the diet. Gramineae seed was the most important food item in July, making up 66% of the diet of deer mice.

There was a pronounced shift to the use of crested wheatgrass by deer mice in August. In this month, crested wheatgrass was found in 22 of the 29 (76%) animals collected; thus, it ranked as the most important food item. Coleoptera adults and Orthoptera ranked second and third, comprising 19 and 10%, respectively.

Ten deer mice were collected in January and 10 in March. Unidentified seed was the most important food item, comprising 96% of the food in these animals. Crested wheatgrass was not identified in any of these samples.

MONTANE VOLES.—Stomach contents of 20 voles were evaluated. Crested wheatgrass was the major food item for montane voles throughout the summer. Samples from all voles collected in June, July, and August contained crested wheatgrass.

ORD'S KANGAROO RATS.—Food habits of 25 kangaroo rats were evaluated. Eight animals were collected in June 1985, 5 in July 1984, and 12 in August 1983 and 1984. Four of the 8 (50%) kangaroo rats collected in June had been feeding on crested wheatgrass; thus, crested wheatgrass was the fourth most important food item. The three items that were eaten in higher percentages were pollen (33%), unidentified arthropods (18%), and plant parts from the family Compositae (16%).

In July all five animals collected had eaten crested wheatgrass. At this time crested wheatgrass ranked as the most important food item, making up 82% of the diet of these animals. Twelve animals were collected in August, and again crested wheatgrass was identified in every sample. It accounted for 91% of the diet in animals this month.

TOWNSEND'S GROUND SQUIRRELS.—Seasonal activity of the Townsend's ground squirrel appeared to be closely correlated to the availability of crested wheatgrass in its lush state. Eighty percent (8 of 10) of the ground squirrels trapped in June had used crested

wheatgrass as a food source. Only one ground squirrel was trapped in July. Stomach contents of this individual consisted of only two items: crested wheatgrass (9%) and gramineae seed (91%).

DISCUSSION

Analysis of habitat use and food habits of small mammals around the SDA indicated that the crested wheatgrass habitat type was frequently utilized. Resident animals used crested wheatgrass as a food item, and seeds appeared to attract transients. The percentages of total captures of small mammals occurring in each of the three habitat types were as follows: native sagebrush vegetation (37%), disturbed and unseeded sites (33%), and crested wheatgrass (30%) (Table 1). These results were similar to those of Reynolds (1980) but were opposite those reported by Groves (1981), who found that crested wheatgrass received the most use followed by disturbed sites and then native sagebrush vegetation. Groves (1981) captured higher numbers of small mammals in the crested wheatgrass than in the other two habitat types. However, montane voles were at a high point in their population cycle at the time the earlier study was conducted, which probably accounts for the differences in results. Our results indicated that although crested wheatgrass had the lowest density of small mammals of any of the habitat types, it received considerable use. Several species of small mammals used this habitat type heavily either throughout the summer or seasonally.

Groves (1981) also reported that the densities he found in both the crested wheatgrass and native sagebrush habitat types were considerably higher than had been reported in the literature for similar vegetation types in other areas. This may have been due to the diversity of the area with three distinctive habitat types and the large amount of "edge," all in a rather confined area.

Montane voles were more dependent upon the crested wheatgrass habitat type than any other species captured during the study. Results of all small mammal studies conducted on the INEL have indicated montane voles were restricted almost exclusively to crested wheatgrass communities (Allred 1973, Reynolds 1980, Filipovich 1983, Groves

and Keller 1983). Voles are typically herbivorous, but little has been reported on specific food habits for this species. Food habit analysis conducted during this study showed crested wheatgrass to be the dominant food item for montane voles on the INEL. All 19 animals captured during the summer months had crested wheatgrass in their stomachs.

Use of crested wheatgrass by kangaroo rats was substantial. This would be expected since kangaroo rats are heteromyids, and crested wheatgrass is such a prolific seed producer. Groves (1981) hypothesized that the enhanced seed supply provided by crested wheatgrass may have accounted for the high number of kangaroo rat captures in this habitat type. Most studies of the food habits of Ord's kangaroo rat have found that this animal is primarily herbivorous/granivorous, eating large amounts of seeds along with the succulent leaves of grasses, forbs, and shrubs, and with arthropods being infrequently consumed (Johnson 1961, Flake 1973, Best and Hoditschek 1982, Koehler 1988). Food habits of kangaroo rats captured near the sagebrush/crested wheatgrass interface we studied fit these broad guidelines. Crested wheatgrass was eaten throughout the summer, but its importance increased as the summer progressed. Crested wheatgrass made up 82% of the food intake in July and 91% in August. This shift to heavy use of crested wheatgrass corresponded to the time of seed set by this grass.

Deer mice are omnivorous, their food habits generally reflecting the local availability of food items (Johnson 1961). Other studies involving food habits of deer mice in southern and southeastern Idaho have found that these rodents rely heavily on arthropods, especially Coleoptera adults and Lepidoptera larvae (Halford 1981) in spring and early summer, followed by a shift to plant material in July and August (Johnson 1961, Filipovich 1983). Our results are consistent with these findings. Crested wheatgrass varied seasonally in importance as a food item. It was relatively unimportant in June, when deer mice consumed various arthropods, and was heavily used later in the summer. The shift to crested wheatgrass in July and August corresponded to the time of summer when the grass set seed.

Food habit studies on Townsend's ground squirrels have reported that these animals

feed mostly on succulent green vegetation (Alcorn 1940, Johnson 1961), especially grasses (Johnson 1977, Smith and Johnson 1985). Both Scheffer (1941) and Johnson (1977) noted that the aboveground activity of Townsend's ground squirrels was highly correlated to the presence of succulent green vegetation. This was also noticed around the SDA. Ground squirrels were present and active early in the spring until about July, when the crested wheatgrass started to desiccate. At this time the animals would go into torpor until the following spring. Johnson (1977) reported that the primary food item of Townsend's ground squirrels on the Hanford Reservation in eastern Washington was Sandberg bluegrass (*Poa sandbergii*); in southern Idaho, cheatgrass provided most of the forage consumed (Smith and Johnson 1985). In both cases the primary food eaten by Townsend's ground squirrels was also the primary grass species on the study area. Crested wheatgrass was the most heavily used food item by ground squirrels around the SDA, making up the bulk of the diets of the ground squirrels analyzed. It was also common to observe ground squirrels feeding on crested wheatgrass, and freshly cut stems were often found in active burrow entrances.

The presence of crested wheatgrass affected small mammal community structure around the SDA by influencing which species were present and their relative densities. Montane voles, Ord's kangaroo rats, and Townsend's ground squirrels exhibit early colonization characteristics after a disturbance. These species, which are either absent or uncommon in the predominant native vegetative types, now compose a large portion of the small mammal community in the SDA environs. Other species, such as deer mice, have adapted to certain components of the introduced vegetation type, specifically the use of crested wheatgrass as a food source.

Although the crested wheatgrass habitat type was used less than either of the other two habitat types, more than 30% of the total captures of small mammals occurred there. Deer mice, Ord's kangaroo rats, and Townsend's ground squirrels used the crested wheatgrass habitat heavily seasonally. Montane voles used the habitat throughout the summer. The use of crested wheatgrass as a food source appeared to be a key element in attracting

small mammals to this habitat type. Crested wheatgrass does influence the type of small mammal community and the densities of these animals. Thus, this unnatural community has an impact on the total diversity of wildlife in the area.

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