Seed Dispersal in Relation to Rodent Activities in Seral Big Sagebrush Communities[1]

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Highlight

Heteromyid rodents play an active role in the dispersal of caryopses and seeds of herbaceous species in degraded big sagebrush communities. Collections of caryopses of downy brome, deposited in caches, influence the dynamics of the grass population and the diet of animals on range sites in winter. Seeds and caryopses of alien weeds and exotic wheatgrasses were recovered more frequently from the pouches of rodents than seeds of native species.

Our purpose was to investigate the food habits of the kangaroo rat (*Dipodomys* spp.) and the Great Basin pocket mouse (*Perognathus parvus*) in relation to seed dispersal in degraded big sagebrush communities.

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Methods and Materials

We conducted the investigation at Medell Flat and Hallelujah Junction, located 47 and 37 km north of Reno, Nevada, respectively. Both locations support seral plant communities on big sagebrush sites.

The Medell Flat site is situated on a broad alluvial fan at 1370 m elevation. The soils are Mollic Haplargids derived from decomposing granite (Evans et al., 1967). A domestic livestock and jackrabbit (*Lepus californicus*) exclosure of 12.5 ha in area was constructed on the area in 1963 after the site was burned in a wildfire. Within the exclosure, the vegetation is dominated by the alien annuals, downy brome (*Bromus tectorum* L.), and tumble mustard (*Sisybrium altissimum* L.). The native perennial grasses, squirreltail (*Sitanion hystrix* (Nutt.) J. G. Smith), and Indian ricegrass (*Oryzopsis hymenoides* (R. & S.) Ricker) have became reestablished in the exclosure and, in portions of the area, they are suppressing the alien annuals. The exotic perennial wheatgrasses, intermediate wheatgrass (*Agropyron intermedium* (Host.) Beauv., cultivar Amur), and crested wheatgrass (*A. desertorum* (Fisch.) Schult., cultivar standard), have been introduced to portions of the exclosure.

The vegetation surrounding the exclosure is dominated by low rabbitbrush (*Chrysothamnus viscidiflorus* (Hook.) Nutt.) with a downy brome understory.

The Hallelujah Junction site is located at 1400 m elevation on an alluvial terrace. The soil is a Typic Arguistoll of higher potential than the Medell Flat location (Eckert and Evans, 1967). Approximately 10 ha were mechanically cleared of big sagebrush in 1958. The present plant community within the exclosure is similar in composition and dominance to that found at Medell Flat. An additional alien wheatgrass, pubescent wheatgrass (*A. trichophorum* (Link) Richt., cultivar Topar), has been established at Hallelujah Junction. The vegetation surrounding the exclosure is a dense stand of mature big sagebrush with an annual dominated understory.

Estimated annual precipitation (June to July) is 200 to 250 mm.

Trapping of rodents was keyed to the reproductive phenology of the vegetation. We began trapping in August when downy brome caryopses matured and continued until November when low rabbitbrush

Table 1. Plant material recovered from rodent pouches expressed as a percentage of the total number of animals trapped in each genera.[a]

Material recovered	Kangaroo rats	Pocket mice
Native species		
Low rabbitbrush achenes	1.6	3.5
Gilia sp. seeds	2.8	7.2
Squirreltail caryopses	2.8	
Asclepias sp. seeds	1.4	
Hieracium sp. seeds	1.4	
Total	10.0	10.7
Alien annuals		
Downy brome caryopses	87.3	46.4
Tumble mustard seeds	2.8	7.1
Total	90.1	53.5
Alien perennials		
Crested wheatgrass	5.6	50.0
Intermediate wheatgrass	7.0	42.8
Pubescent wheatgrass	2.8	
Total	15.4	92.8

[a] Rodents often possessed more than one plant species at a time in their pouches resulting in a total percent possession greater than 100.

achenes matured. We employed 50 large snap trap traps set in 5 lines.

Both genera of rodents are members of the family Heteromyidae which possess cheek pouches. The pouch contents of each rodent was separated and identified to species.

The density of rodent food caches was obtained by locating 25 plots of 1 m^2 along three lines in the exclosure. Carotene levels of downy brome seedlings growing in rodent caches was determined.

Results

Rodents Trapped

Three species of kangaroo rat were caught at Medell Flat; *Dipodomys merriami merrami* Mearns, *D. panamintinus leucognys* Grinnell, and *D. ordii columbianus* Merriam. The latter two species were also caught at Hallelujah Junction. A total of 40 male and 31 female kangaroo rats were examined. The same species of pocket mouse (*Peragnathus parvus*) was caught at both locations, with the subspecies *P. parvus olivaceous* Merriam trapped at Medell Flat and *P. parvus mollipilosus* Cones caught at Hallelujah Junction. A total of 16 males and 12 females were trapped.

Table 2. Number and weight (g) of grass caryopses recovered from rodents.

Major grass species	Kangaroo rats		Pocket mice	
	Number	Weight	Number	Weight
Downy brome	1537	3.5	205	0.5
Intermediate wheatgrass	755	4.0	119	0.6
Crested wheatgrass	79	0.2	312	0.8

Plant Material Recovered

In terms of animal possession, seeds of the alien weeds and forage grasses provided the major portion of the cheek pouch content of the rodents (Table 1).

Some green plant material was recovered from the pouches of both kangaroo rats and pocket mice, but it was present in cheek pouches of only 3% of the rodents trapped. Downy brome caryopses were the most frequent material recovered from pouches of the kangaroo rats. The pouches of the pocket mice also often contained downy brome caryopses, but caryopses of the exotic forage species were much more frequently recovered. Seed and caryopses of native species were recovered less frequently in both types of rodents. Squirreltail was at least as abundant in the communities as the exotic perennial wheatgrasses and low rabbitbrush was the dominant species in portions of the trapping areas of both Medell Flat and Hallelujah Junction. Both of these native species were recovered from a relatively small number of rodents.

The pouches of the kangaroo rats contained twice as many downy brome as intermediate wheatgrass caryopses (Table 2). However, the greater weight per caryopsis resulted in a larger weight of intermediate wheatgrass being recovered. The pocket mouse pouches yielded more caryopses of crested than intermediate wheatgrass. Intermediate wheatgrass culms are cut at ground level by the pocket mice and the mature caryopses removed from the inflorescence. Pocket mice are capable of destroying up to 50% of a wheat crop by systematically cutting the culms down and removing the seeds (Scheffer, 1938). Crested wheatgrass culms are not cut. The crested wheatgrass caryopses recovered from the rodents were either gathered off the ground or removed from the inflorescence without cutting the culm.

Undoubtedly, the rodents were handling a larger volume of caryopses than the data indicates. It is characteristic of heteromyid rodents to empty their pouches before taking an attractive bait (Mauer, 1967). We found bait in 36% of the pouches of the pocket mice and 11% of the kangaroo rats.

Both genera of rodents were active in the collection and transport of downy brome caryopses from maturity until germination occurred with the first fall rain. After the downy brome caryopses had dehisced from the inflorescence, the rodents continued to seek out the caryopses in the litter and on the soil surface. Apparently, the rodents rob grass caryopses from harvester ant (*Pogonomyrmex occidentalis* Cresson) accumulations. The finding of caryopses in pouches with the "groated" appearance of ant work, evidence of rodents digging in ant nests and the finding of ant bait (dodecachlorooctahydro-1,3,4 metheno-2H-cyclobuta (cd) pentalene (Mirex)) in pouches indicates the rodents at least occasionally rob the ant nests.

The rodents began digging food caches as soon as the downy brome caryopses matured. The caches were small pits approximately 5 cm deep and 3 cm in diam, and concentrated in sandy soil areas, within a short radius of the burrow. The habit of preparing this type of food cache is characteristic of both the kangaroo rat (Hawbecker, 1940; Reynolds, 1958) and the pocket mouse (Goldman, 1911; Scheffer, 1938). In late fall, the mean density of the caches was 5.76 per m^2. Approximately 3 caches/m^2 contained downy brome plants. The caches with plants contained an average of 65 downy brome plants and 155 ungerminated caryopses. Many of the caches without plants appeared to be empty of downy brome caryopses. Either the contents of the caches had already been consumed or the rodents failed to fill them after they were dug. Caryopses of crested and intermediate wheatgrasses were not found in the caches.

The downy brome caryopses in the caches were the first to germinate. The depressed topography of the caches provides an excellent "safe site" for germination (Harper et al., 1965). As soon as germination occurred, the rodents began eating the green coleoptiles of the downy brome plants. Downy brome caryopses contain less than 0.004 mg/g of carotene (Savage et al., 1969). We determined the carotene of downy brome plants growing in rodent caches to be 0.04 mg/g.

Discussion

The heteromyids, presumably along with deer mice (*Peromyscus* spp.) and other associated rodents, play a very active role in the dispersal of propogules of herbaceous species in degraded big sagebrush communities. In the plant communities investigated, the caryopses of downy brome and intermediate and crested wheatgrasses undoubtedly play an important role in the diet of these rodents. The activities of the rodents in collecting, transporting, and caching downy brome caryopses tend to place the caryopses in optimum situations for germination i.e. covered with soil or litter in depressed micro-relief (Evans and Young, 1970). Feeding trials with chukar partridges whose diet is largely dependent on downy brome caryopses have shown that the conversion of dry caryopses to more digestible seedlings may be a critical point in the diet of overwintering populations (Savage et al., 1969). In southern Nevada the reproduction of kangaroo rats is dependent on fall germination of annual species (Beatley, 1969). Downy brome plants that establish in the fall tend to produce more caryopses and mature earlier than plants establishing in the spring (Finnerty and Klingman, 1962). Normally there are so many more downy brome caryopses produced than are necessary to establish the population (Young et al., 1969), it is doubtful if the caryopses consumed by the rodents reduce the weed population.

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