Merriam Kangaroo Rat a Factor in Mesquite Propagation on Southern Arizona Range Lands

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MESQUITES (*Prosopis* spp.), shrubs or trees of little forage value, now occupy nearly 60 million acres of range land in Arizona, New Mexico, and Texas. A large part of this occupation is comparatively recent invasion which has resulted in progressively poorer ranges for domestic livestock grazing, because of accelerated erosion and decreased grass density (Fig. 1). Certain evidence collected on the Santa Rita Experimental Range indicates that the Merriam kangaroo rat (*Dipodomys merriami merriami* Mearns) is one of the important factors in the spread of this undesirable plant.

This study is a part of investigations being conducted by the Southwestern Forest and Range Experiment Station in cooperation with the University of Arizona Agricultural Experiment Station under RMA Project RM:b-4 for "Research on the basic ecology and physiology in control of undesirable range shrubs." Identification of the rodents was made by H. G. Reynolds and confirmed by comparison with verified study skins in collection of Dr. C. T. Vorhies, Economic Zoologist, University of Arizona, Tucson, Arizona.

The Santa Rita Experimental Range is located in southern Arizona about 30 miles south of Tucson. Natural vegetation varies from desert shrub, dominated by creosotebush and cactus at elevations of 3000 feet to semidesert grassland at 4000 feet characterized by numerous species of grama and three-awn grasses. Precipitation increases with elevation from approximately 12 inches at 3000 feet to 18 inches at 4000 feet. More than 90 percent of the forage production comes from perennial grasses whose main growing period coincides with summer rains of July, August, and September. Certain annuals mainly introduced Mediterranean species, mature as a result of winter rainfall, but these provide only a limited and undependable supply of forage.

Mesquite Invasion

The Santa Rita Experimental Range provides an excellent example of the mesquite invasion problem on southwestern grasslands. On the basis of present size and distribution of plants, it is apparent that velvet mesquite (*Prosopis juliflora* var. *velutina* (Woot.) (Sarg) was originally confined mainly to the bottoms and margins of main drainage channels. It now occurs in moderate to dense stands on uplands and mesas at intermediate elevations throughout the Santa Rita Experimental Range. Much of the spread and increase of mesquite has occurred during the past 40 to 50 years and is continuing. For example, recent remapping of certain sample areas on the Santa Rita Experimental Range showed that increases in mesquite ranging from 64 to 99 trees per acre have occurred during the past 16 years.

Although velvet mesquite furnishes some forage for livestock and has local value for posts and fuel, lands heavily invaded by this shrub are conceded to be greatly reduced in total economic pro-

ductivity. Most alarming is the effect of mesquite stands in decreasing the production of grass forage. Reduction in perennial grass yields due to presence of mesquite has been observed to be as much as two-thirds.

Velvet mesquite reproduces entirely by seed, but has no special seed devices for dissemination by wind or water. Some spread of mesquites occurs as a result of seed being carried downstream along arroyos, but distribution is believed largely dependent upon the animal factor.

Domestic animals are often cited as one of the most potent factors in the dispersal of seed. Mesquite seeds are borne

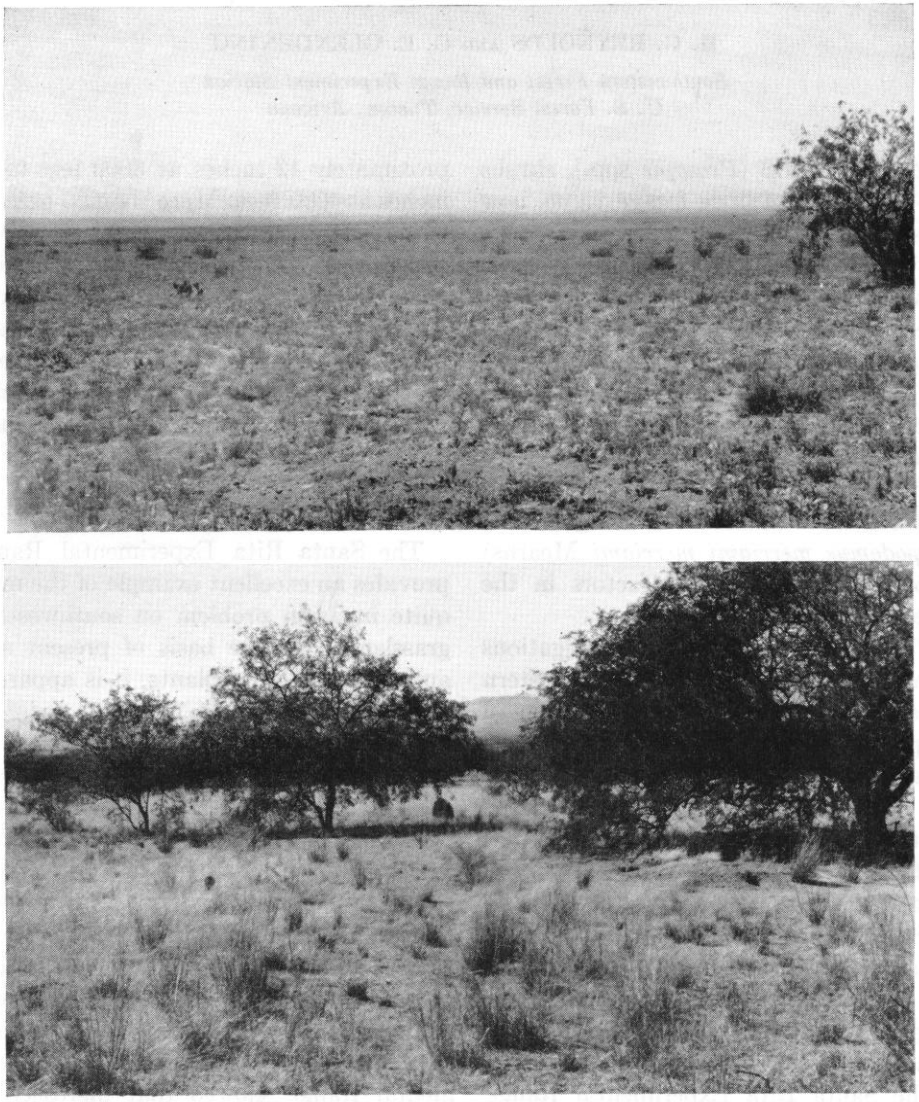

FIGURE 1. The top photograph shows an almost open stand of grass as it appeared in 1919 The photograph below, made of the same area in 1948, illustrates the marked increase in mesquite during the 29 years.

in fleshy pods which are eaten avidly by cows and horses. From 12 to 45 percent of these pass through the alimentary tract unharmed. These seeds are deposited in an environment that is favorable for germination and seedlings are commonly observed in this media. Once domestic livestock are introduced into a mesquite inhabited area, an important artificial agency is immediately brought into play for seed dissemination.

Merriam Rats Spread Mesquite Seed

Recent studies furnish strong evidence that the Merriam kangaroo rat is an important animal agency assisting in the spread of mesquite. The Merriam rat is a small nocturnal animal with a body weight of 40 to 50 grams. It is active throughout the year, and depends almost entirely upon seeds for food. Mesquite seeds are an important and preferred food item (Table 1). Beans of mesquite occurred in 1.0 to 27.0 percent of pouches examined monthly during a two-year period. Heaviest collecting of mesquite seeds by rats coincided with the seeding period in June and July.

Mesquite seeds are collected by rats from pods which have fallen to the ground. Some seeds are apparently tested for soundness by gnawing. Under laboratory conditions it has been found that nicking of seed coats increases the germination of sound seed from less than 6 percent to more than 90 percent. Thus, when seed coats are perforated by gnawing, germination of the seed may be greatly enhanced if the embryo is not harmed.

Many more seeds of mesquite are collected by kangaroo rats during the seeding period than are required for present or future use. Seeds not eaten at the time of collection are stored in small surface excavations for use during the inclement season. These caches are $\frac{1}{2}$ to $1\frac{1}{2}$ inches in depth and are located more or less at random throughout the home territory of a particular rat, often at some distance from the nearest tree. The Merriam kangaroo rat is the only animal on the study area which has been observed or reported to make such surface caches.

The finding of mesquite seeds and gravel together in cheek pouches during the late fall and winter seasons suggests that some caches are relocated and the seed used as food when other sources of seed are not available on the ground surface. Other caches, from which seeds are not recovered by these rodents, result in the planting of mesquite seed at a considerable distance from the parent plant.

TABLE 1

Percent of cheek pouches of Merriam kangaroo rats containing mesquite beans. The percentages are based upon 50 to 100 pouch examinations made monthly by H. G. Reynolds

MONTHS	PERCENT
January	6.0
February	12.0
March	2.8
April	3.2
May	2.9
June	10.4
July	27.4
August	4.8
September	1.2
October	2.0
November	1.0
December	2.1
Average	6.3

Rodent Seed Caches Produce Mesquite Seedlings

During July 1948 many unopened surface caches produced vigorous mesquite seedlings (Fig. 2). The caches which produced seedlings during the 1948 summer season were distinctly more numerous in clearings between trees than under tree crowns.

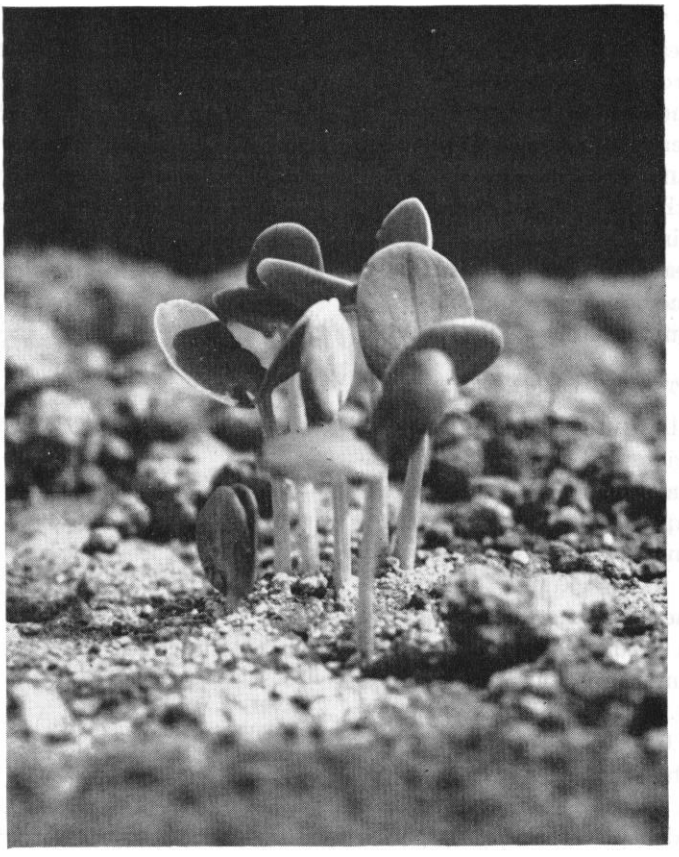

FIGURE 2. Vigorous mesquite seedlings about 10 days old sprouting from a Merriam kangaroo rat seed cache.

Of 913 mesquite seedlings observed under various environmental conditions during 1948, 63 percent were found singly or in groups of 2 and 3; while 27 percent of the total number occurred in clusters ranging from 4 to as many as 13 seedlings. Since pods of velvet mesquite tend to break into segments containing from 1 to 3 seeds each between the time of ripening and germination, it is probable that some instances of multiple emergence of seedlings are not associated with rodent activity. However, it seems highly improbable that clusters containing 4 to 13 seedlings should occur as a result of any

TABLE 2

Relation of Merriam kangaroo rats to mesquite seedlings and grass density under three levels of protection

RELATED FACTORS	DEGREE OF PROTECTION		
	Cattle and Rabbits Excluded	Cattle Excluded	No Protection
Mesquite seedlings per acre*	22	129	269
Merriam Rats per acre†	1.1	1.5	3.5
Density Perennial Grass (Percent)†	1.5	1.1	0.5

* Average of three stations.
† One station.

other disseminating process than the burial of seed by the kangaroo rat.

On study plots that were (1) open to cattle, rabbits, and rodents, (2) closed to cattle only, and (3) closed to cattle and rabbits, the number of mesquite seedlings varied directly with the numbers of kangaroo rats and inversely with the perennial grass density (Table 2). Where no protection was provided, density of perennial grasses was only one-third as great as where cattle and rabbits were excluded. On these plots, lower grass density, associated with greater grazing pressure was related directly to greater abundance (3 and 12 times, respectively) of rats and mesquite seedlings. No doubt, the activities of cattle and rabbits also favored the greater abundance of seedlings on the unprotected areas, but the fact that the number of seedlings per cluster was observed to be greatest on the unprotected areas where rat population was highest seems to indicate that these rodents play an important direct role.

Summary

Merriam kangaroo rats collect mesquite seeds as a preferred food item. Not all the harvested seed is consumed, and a large portion is buried in shallow caches. Mesquite seed stored in such caches, if not rediscovered by rats, germinates during favorable climatic years, resulting in the emergence of seedlings at some distance from the parent tree.

As mesquite increases, perennial grass decreases, and greater numbers of Merriam rats occupy the habitat. Hence, once the grass density on range lands is reduced so that the habitat is favorable for rats, and mesquite becomes established, the mesquite seeds may continue to be further spread by rats, as well as by livestock and other agencies. Consequently, on such areas any attempts to stop or retard the invasion of mesquite through a reduction in livestock should also consider control of the Merriam kangaroo rat.