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Effects of Rodents on Germination of Desert Annuals

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EFFECTS OF RODENTS ON GERMINATION OF DESERT ANNUALS

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ABSTRACT

Several Desert Biome studies, and studies outside the Biome, have indicated the effect rodents have on desert plants in terms of predation and consumption. This study was undertaken at the Silverbell site (Tucson Basin) to determine how the activities of rodents might enhance germination and survival of desert annuals, particularly the caching activities of the rodents. In addition, further efforts are being made to determine the microhabitat distribution of the seed resource, and identify the areas and microhabitats from which the rodents gather their seeds. Finally, several seed germination parameters, such as scarification and leaching, will be observed for their effect on annual plant germination. The work described was not begun until late 1974, and therefore is incomplete at this time.

INTRODUCTION

It is known from rodent studies in areas other than deserts that rodent seed predators can affect the germination of seeds and distribution of seedlings by their seed-gathering activities (Abbott and Quink 1970; Smith and Follmer 1972). To determine what, if any, effect desert rodents have on the germination of desert annuals, rodent surface caches are being caged to keep seedling predators from getting to the seedlings, and the number of seedlings germinating from the experimental (cache) cages and control cages will be compared. In addition, several parameters of germination are being observed to determine their effect on seedling success.

A major gap in the data from many areas is the distribution of the resources available to the consumers. Hundreds of small soil samples are being periodically taken at the Silverbell site to find out in which microhabitats the seeds are distributed, and their degree of clumping; a factor apparently important in their use (Franz et al. 1973).

In conjunction with this effort and with the studies being done by Dr. James Brown for the Desert Biome, sampling will also take place in experimental areas where 1) ants are absent, 2) rodents are absent, 3) ants and rodents are absent and 4) control areas. Soil analyzed for seeds from these areas should indicate the effect of these predators on the distribution and abundance of the seed resource.

It is obvious that some seeds escape predation because during "good" years there are incredible numbers of annuals germinating across the desert. Therefore, in association with determining where the seeds are distributed, studies will be completed to determine from which microhabitat the rodents gather their seeds, thereby identifying where seeds remain for other seed predators (e.g., ants) and for subsequent germination.

OBJECTIVES

1. To observe, locate and mark surface rodent caches and to determine the possible effects of caching on seed germination.
2. To determine several parameters of desert annual seed germination (e.g., effects of scarification, leaching).
3. To determine the microhabitat into which seeds are dispersed. Using ant and rodent exclosures from another Desert Biome study (Dr. James H. Brown), seed accumulation in the absence of seed predators will also be determined.
4. To determine from which microhabitat(s) rodents gather their seeds.

METHODS

Close observation of the desert floor indicates that there are numerous areas which have been "worked" by foraging rodents. These worked areas represent either previously stored seed reserves which are being revisited or areas in which the rodent has determined to have seeds available. In a large, open area near the Silverbell site, 25 of these "worked" areas were covered with plastic baskets approximately 125 mm square and 110 mm high. Next to each caged cache, a cage was placed over an undisturbed area, producing 25 pairs of experimental and control cages. The numbers of seedlings germinating under the experimental and control cages are being counted and recorded (DSCODE A3URC01).

Work has not begun on the attempts to determine the effects of scarification on seed germination, although the equipment has been purchased. Selected seeds (those which are abundant) will be experimentally germinated, without treatment, to ascertain a percent germination. Other seeds of the same species will then be experimentally treated, including tumbling in a gem tumbler to simulate scarification and leaching in water for various lengths of time. Subsequent germination tests will provide data on the effect of these experimental regimes.

Two major efforts are being made to determine the distribution and degree of clumping of desert seeds. One involves taking many soil samples at different times of the year and analyzing them for seed content. In this way the distribution, accumulation and/or depletion of the seed reserve can be followed. The circular samples are approximately 39 mm across and 20 mm deep. Fifty samples are taken at each permanent site and either 25 or 50 taken at various alternate sites. There are five permanent sites which are sampled during each sampling period; one in the low, flat area of the old 1970 site, and one each in the experimental areas on the current validation site which are 1) without ants, 2) without rodents, 3) without ants and rodents and 4) control. The various alternate sites include areas of obvious heavy foraging activity, under bushes of various sizes, and on the leeward and windward sides of

obstructions (e.g., branches on the ground, rocks). These areas are thought to be appropriate sites for seed accumulation. Over 1,000 soil samples have been taken so far (A3URC02, A3URC04).

The second effort to determine seed distribution involved placing fifty-seven 30-cc plastic medicine cups in the ground so that the lips of the cups are even with the surface. Detritus, soil and seeds accumulate in these cups, and the seeds will be extracted, identified and counted. Twenty-five of the cups are placed out in the open in a line running NW-SE. Cups are also placed on the NW, NE, SE and SW sides of eight *Larrea tridentata* bushes, for a total of 32 cups under bushes. The cups are placed at different directions to determine the effect of prevailing winds on seed accumulation (A3URC03).

To determine from which microhabitat the rodents gather their seeds, advantage is being taken of the fact that small heteromyid rodents go into torpor at low ambient temperatures when the food ration is low (Brown and Bartholomew 1969). Individuals of *Perognathus amplus* from the Silverbell area are being placed at 8-9 C and given various seed distributions and clumpings. The experiments are run for four days, with the amount of time being spent in torpor being an indication of the relative accessibility of the seeds. Animals are given 2 g of seeds a day (more than the minimum daily requirement) for the four days of the experiment to simulate a steady-state system, and are presented regimes of randomly scattered seeds, one 2-g clump and four 0.5-g clumps at depths of 1 cm, 2 cm and surface, as well as a contol with an ad lib portion of seeds available.

RESULTS

Relatively few data have accumulated from this study for several reasons. Field studies were not begun until September 1974. The task of separating the seeds from the soils is enormous and will begin in 1975 when funds become available for student help. A total of over 2,000 soil samples and the contents of 350 medicine cups will be analyzed (A3URC03).

The field study which shows initial tangible results is the caged cache study (A3URC01). The first time the cages were checked after being installed (October 1974) there were 104 seedlings in the experimental (cache) cages and 49 in the controls. When rechecked in December 1974, there were 194 seedlings in the experimental cages and 90 in the controls. This tends to indicate that the specific foraging areas are rich in seeds and/or provide an enhanced germination site for seedlings.

The laboratory rodent-foraging experiments were delayed as recent, unpublished information indicates a seasonal variability in the likelihood of entering torpor, making it difficult to rely on torpor in seasons other than late winter. For finer resolution of the relative torpor data, it is desirable to use the period of highest likelihood of torpor.

DISCUSSION

This is an on-going study, with much of the data being accumulated in the subsequent year of field work. However, two points should be made. From earlier studies (Franz et al. 1973) it appears that the rodents are taking their seeds from clumped sources. This study is an effort to locate seed accumulations and ascertain their degree of clumping. Also, it appears that rodents, through their caching activities, may have an enhancing effect on the germination of seedlings.

EXPECTATIONS

In 1975, experiments will be concluded which indicate the effect of scarification and leaching on seed germination. Experiments will also be continued through at least two more germination seasons in 1975 to follow the potential enhancement of germination by rodent caching activity. Soil samples will continue to be taken and analyzed for seed content, as will the contents of the medicine cups experiments. The use of the experimental plots to check seed accumulation in the absence of predators will be a valuable addition to the seed distribution portion of the study. At least four observation periods will be added to the three in 1974. The laboratory experiments to determine foraging microhabitats of rodents will be refined where needed (e.g., perhaps using intermediate depths of 0.5 cm and 1.5 cm). In addition, the foraging experiments will be expanded to include the activities of ants in an effort to pin down where seeds occur in the desert, from which microhabitat the seed predators get their seeds and where seeds remain for potential germination.

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