A HISTORY OF SQUIRREL BURROW GULLY FORMATION IN RELATION TO GRAZING

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During April and May, 1940, in the course of gathering material for an M.A. thesis, the writer had occasion to photograph two sites in southwestern Napa County, California, where ground squirrel burrows had incited gully formation. The thesis, together with the photographs, was subsequently published (Longhurst, 1940) and the process of gully formation with the relation to grazing described. Fifteen years later, in April, 1955, these two sites were again photographed. Since contrasting changes have taken place on the two sites, a brief description of them and their grazing history appears worth while.

More recently other workers have added further observations of gully formation from rodent burrowing to the literature. Crouch (1942) illustrated pocket gopher gullying, while Gunderson and Decker (1942) found that this process also occurs in Iowa, particularly with woodchuck burrows. Howard (1953) made additional observations in California, where he considered pocket gophers to be the chief burrowing rodents.

The two sites under study, which for convenience are designated as A and B, are located on the headwaters of Huichien Creek about one-fourth mile apart. Elevation for both is slightly over 200 feet. Precipitation in the form of rain averaged 24.61 inches for the 15-year period, as measured at the town of Napa, some five miles to the east. Carpenter and Cosby (1938) place the soils as Butte Stoney Loam on Site A and Coombs Gravelly Loam on Site B. Storie and Weir (1953) describe these soils as follows:

Butte—Podzolic upland soil from coarse-textured acid igneous rocks; moderately deep and perme-

Figure 1. **Left:** General view of Site A photographed on April 21, 1940, with location of burrow gully area indicated by arrow. **Right:** Close-up of burrow gully area in Site A in April, 1940.
Coombs—Noncalcic hrcmn valley and terrace soil from basic igneous alluvium with good drainage; has a natural grass vegetation. Cover on the two sites, which were in adjoining pastures, was predominantly annual grass and forbs with scattered oaks on the watersheds above. Both pastures were operated together from 1930 until 1939 with heavy seasonal sheep use. At that time the sheep were replaced with cattle, which also used the pasture seasonally during the winter and spring but at a more moderate stocking rate. In November, 1943, the pasture containing Site B was sold to a nearby dairy ranch, and, since then, has been exposed to extremely heavy yearlong cattle use by the dry stock from the dairy.

The important point is that during the fifteen year period between photos, Site A had moderate seasonal cattle use for the entire time, while Site B had 3 1/2 years of moderate seasonal cattle use and 11 1/2 years of very severe cattle use.

When first photographed in 1940, both sites were in approximately the same relative stage of erosion. Burrows of the Douglas ground squirrel (*Citellus beecheyi douglasii*) which ran with the slope had been enlarged to a diameter of two feet or more by subsurface waterflow during the rainy season. When the soil covering finally became too thin the tunnels collapsed, leaving the condition shown in Figure 1 and Figure 3 (left).

Figures 2 and 3 (right) show the two sites in 1955, 15 years later. On Site A, gullying had progressed to some extent, but the gullies were well grassed over and not actively enlarging. In contrast the gully at Site B had enlarged greatly both in depth and through headward erosion. (Note the eight-year-old boy standing in the hole.) As can be seen in Figure 3, in recent years the left hand channel has “pirated” the bulk of the overland flow and has been enlarging, while the original channel to the right has healed to some extent. The owner of the dairy had tried unsuccessfully to stem the erosion by piling old baling wire and brush in the gully.

The watershed behind Site B is slightly greater than behind Site A, but comparing the sites themselves, Site A had the steeper gradient. While these two sites were...
chosen for detailed comparison because of the photographic record available, a number of other gullies in the two pastures present the same general picture.

Although detailed records were not kept through the years, the impression gathered was that there were no major differences in squirrel numbers on the two areas. Apparently there was sufficient grazing on both areas to provide adequate squirrel habitat. The course of events suggests that rodent burrows are merely the precursors of gullies which are enlarged first by subsurface flow until they cave in, and secondarily by overland flow. It is primarily the overland water flow, as conditioned by existing ground cover and litter, which in turn are affected by grazing, that eventually determines the extent of erosion.

Since this process of water enlargement of rodent burrows, particularly those of the ground squirrel (*Citellus beecheyi*) and the pocket gopher (*Thomomys bottae*), is a widespread and common source of gully formation on the annual ranges of coastal California, there is added strength to the argument for moderate grazing.

**LITERATURE CITED**


Longhurst, W. M. 1940. The mammals of Napa County, California. Calif. Fish and Game 26:240-270.


**BOOK REVIEWS**

Edited by Donald W. Hedrick, Dept. of Animal Husbandry, Oregon State College, Corvallis, Oregon


This is indeed a remarkable little book containing 102 pages of agricultural information and philosophy. It deals with the past history, present position, and future needs of American agriculture. The catchy title, "Farmers at the Crossroads", is the first suggestion that this book is not purely a statistical treatise.

The short biographical sketch of the author's life in the forepart of the book is very good, for it puts the reader in the right frame of mind to understand what is to follow. No one having read this sketch could help but know that the opinions of the author would be written with the utmost honesty and sincerity, backed by a thorough knowledge of agriculture.

The glossary in the back, like the biography in the front, should be read before starting the book because it contains a thorough explanation of each term.

There are eleven chapters in "Farmers at the Crossroads", and each chapter deals with some phase of the agricultural situation. Each chapter is subdivided into several topics. I like this method of presentation because it is readable and keeps the ideas well defined.

No writer could cover this subject, or any subject of this kind, without a certain amount of statistical information. However, the author has kept figures to a minimum and the statistics that are used are interspersed with other material. This method of presentation makes the figures more readable and keeps them from becoming burdensome.

There are seven graphs to explain points of interest, and each has a very thorough explanation.

Mr. Benson gives a full history of the agricultural picture, including the effects of war economy, price supports, acreage quotas, and agricultural legislation that have contributed to our present problems. He defends his present stand on flexible price supports; yet his Great Plains program shows the willingness of The Department to offer assistance in times of emergency.

It is my opinion that the author places too much emphasis on price supports and their effect on the agricultural situation. He recognizes the importance of research, education, expanded markets, and adequate long term farm financing. I would like to have seen it made clearer that research, conservation, education, markets, and financial programs working properly would largely do away with the necessity of commodity supports of any kind.

Considerable mention is made of farmers losing their self reliance. We in agricultural circles know that this is just a trend and not an actuality. The thought has occurred to me that a person outside of agriculture reading this book (and it should be read by those kind of people) would picture the farmer as a dependent and unresourceful person.

Although "Farmers at the Crossroads" is a record of the hard facts that will influence this nation and the whole world, the reader will very likely remember it longer for the gems of...