

# 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 rodent.

The two sites under study, which for convenience are designated as A and B, are located on the headwaters of Huichica 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-

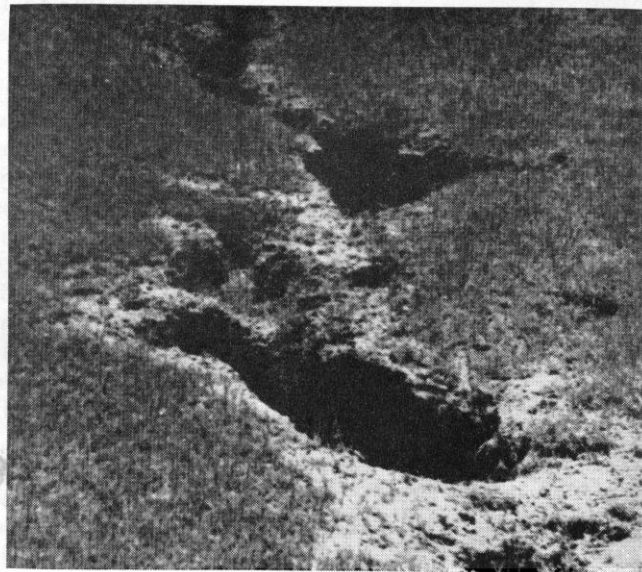
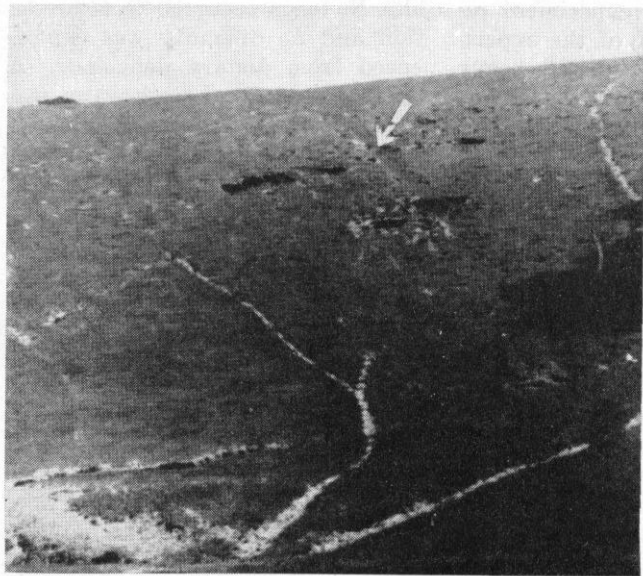


FIGURE 1. *Left*: General view of Site A photographed on April 21, 1940, with location of burrow gully area indicated by arrow. *Right*: Close-up of burrow gully area in Site A in April, 1940.

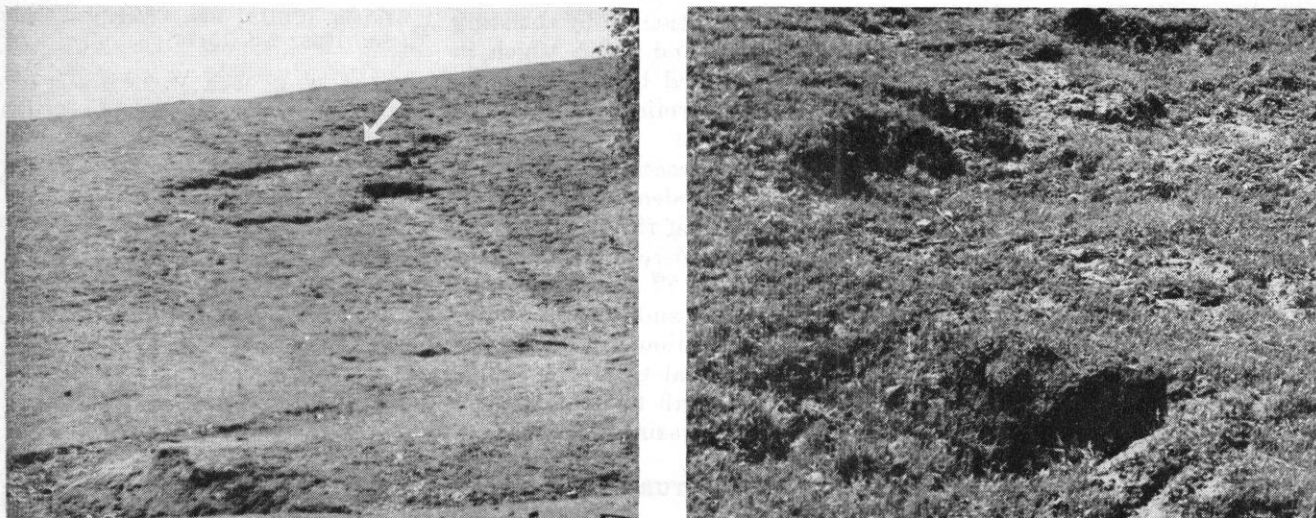


FIGURE 2. *Left*: General view of Site A on April 23, 1955, 15 years after the first photographs. *Right*: Close-up of burrow gully area in 1955. Compare with Figure 1.

able with a natural vegetation of woodland or timber.

Coombs—Noncalceic brown 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  $3\frac{1}{2}$  years of moderate seasonal cattle use and  $11\frac{1}{2}$  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

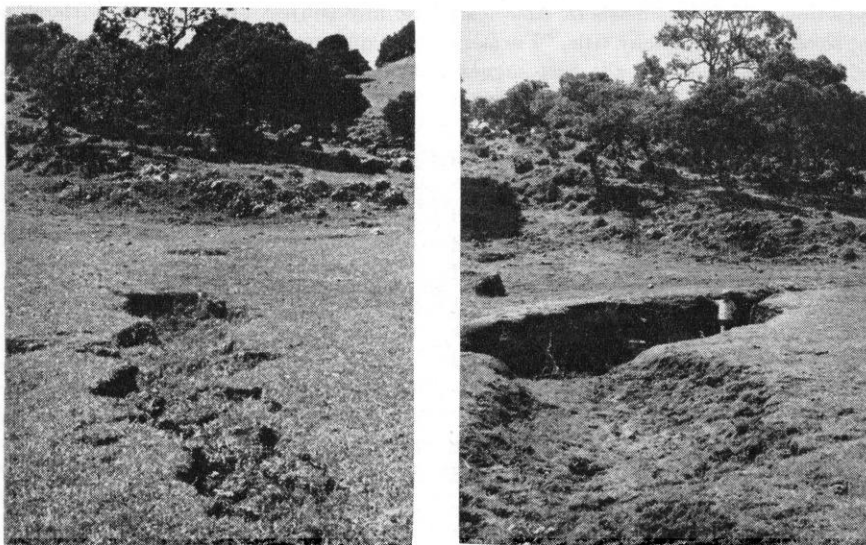


FIGURE 3. *Left*: General view of Site B on May 5, 1940. *Right*: Gully on Site B 15 years later. Photographed on April 23, 1955.

## TECHNICAL NOTES

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.

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