# RANGE PRESERVATION AND ITS RELATION TO EROSION CONTROL ON WESTERN GRAZING LANDS. BULLETIN NO. 675, JUNE 25, 1918

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UNITED STATES DEPARTMENT OF AGRICULTURE

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Contribution from the Forest Service
HENRY S. GRAVES, Forester

Washington, D. C. ▼ June 25, 1918

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## PURPOSE OF THE STUDY.

The aim of this bulletin is to show the relation between range preservation and erosion and its control on grazing lands in the West. It is true, perhaps, that topography, climate, and soil are the primary factors in determining erosion; but, on the lands under discussion, the combination of these factors with the vegetative cover is such that erosion is slight where the natural conditions have not been disturbed and may be made serious by any influence which upsets the balance established by nature. Grazing may become such a disturbing influence by changing or destroying the vegetative cover. Numerous instances are on record where serious erosion was unknown until the ground cover was largely destroyed. On the other hand, in localities where the destroyed vegetation has been reestablished, a few typical cases of which are pointed out in the body of the report, serious erosion has been stopped.

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The data in the bulletin were obtained, for the most part, on the high summer range of the Manti National Forest in central Utah, where the conditions influencing erosion are similar to those prevailing on many of the mountain ranges in Utah, Wyoming, Idaho, Nevada, Arizona, and New Mexico, and to some extent in other western States.

To complete the study will require a number of years, but the data already available on the decrease in the productivity of the soil resulting from erosion, the increase in the difficulty of revegetating the lands as erosion and soil depletion advance, and the influence of range preservation in preventing destructive erosion are of so much importance that their publication, together with the accompanying recommendations, should stimulate closer observation on the part of those in charge of the range lands throughout the West and bring about improvements in the management of these lands, which, in view of the needs of the Nation, should not be deferred.

## DAMAGE CAUSED BY EROSION.

Every drop of rain that falls on more or less exposed soil has the power of removing soil particles, and with them the soluble salts essential to plant growth. Where the vegetative cover on a watershed has been largely destroyed the washing off of the surface soil may remove infinitely more decomposed vegetable matter and soluble plant food in a single season—indeed during one violent storm—than would be deposited by the decay of the vegetation in years. More than this, the resulting erosion, with its rush of water and débris, frequently ruins the lands where the débris is deposited and puts out of commission roads, trails, power plants, and other improvements. In many localities loss of property from this source has been appalling.

The greatest damage from erosion on range lands occurs where the areas have been badly overgrazed and the ground cover destroyed or seriously impaired. Before the ranges had been overstocked and the ground cover impaired, erratic run-off and erosion were practically unknown. After the breaking up of the vegetative cover in the early nineties, however, many streams originally of steady year-long flow and teeming with trout became treacherous channels with intermittent flow through which the water from rainstorms was plunged, or rose and fell according to the size and frequency of the storms and carried so much sediment in the water that fish and similar life could not exist. (Pl. I, fig. 1.)

The damage is not confined merely to the decrease in the forage yield on the range lands eroded and to the silting over of adjoining agricultural land to which the torrential floods carried the débris;

the efficiency of the watershed in maintaining a permanent flow of irrigation water is greatly decreased.

The importance of preserving the upper few inches of soil on the high ranges, and with it the vegetative cover, in order to regulate the stream flow, to maintain indefinitely the forage crop for grazing, and incidentally to prevent destructive erosion, is not always fully appreciated by the stockman and farmer. This is more especially true in localities where there is not an ample supply of irrigation water.

In the belief that more water would find its way into the irrigation canals if the vegetative cover were appreciably thinned out, there has been a tendency in some localities toward destructive grazing. For instance, several sheep owners have expressed a desire to be permitted to graze Ephraim Canyon so closely as to pack the soil firmly and to decrease appreciably the present density of that vegetation. They believed that a large amount of the water that is returned to the air in the form of evaporation from the vegetation, as well as that held by the rich surface soil, would, by thinning out the ground cover, be made available for irrigation. While it is true that if a given canyon were grazed destructively more water would undoubtedly rush down the water channels, and as a result a greater acreage of farm land could possibly be irrigated in early spring, there would be less water for subsequent irrigation at a time when the crops were seriously in need of it. With the destruction of the vegetative cover not even the lands most advantageously situated would have the benefit of a continuous stream flow for subsequent waterings during the season when even a light irrigation might result in the production of at least an average crop. In addition an enormous acreage of choice farm land would be destroyed by sedimentation, to say nothing of the high cost of upkeep of the irrigation ditches themselves.

Most farmers and live-stock growers adjoining the National Forests who are dependent upon the watersheds within the Forests for their irrigation water are likewise dependent upon the cool summer ranges for the maintenance of their stock. To graze any portion of the range destructively defeats the necessary economic balance between the range and live stock, on the one hand, and the farm land and farm crops, on the other. Much of the agricultural land adjoining the National Forests is so remote from railroads as to make the live-stock industry a necessity in the economic harvesting and marketing of the farm crops. And aside from the loss of various public and private improvements as a result of torrential floods and sediment deposits, there would remain only a small amount of forage, mostly inferior, on the watershed after three or four seasons of

excessively heavy grazing. The farmer-stockman can not afford to do without this feed. The temporarily larger profits that might be derived from overgrazing would soon be offset by the somewhat more moderate but continued profits accrued from a stable stock industry in which the lands are grazed on the basis of a sustained yield.

If instead of grazing merely one canyon beyond its carrying capacity the entire forest unit, and, indeed, all forest land of irregular topography throughout the West were likewise grazed, untold injury to farm land and other property from destructive erosion and floods would result, a sustained stream flow would no longer exist on the watersheds, and there would be neither a normal supply of water for the irrigation of the adjoining farm lands nor of forage for the live stock on the extensive forest ranges. Without these productive elevated range lands upon which to summer the stock, homes on many farms could no longer be maintained; and it would not be long before the lands would revert to the original wild state.

Within the boundaries of the Manti National Forest of Utah there is a belt of approximately 47,000 acres of land along the east side of the divide which is badly depleted as a result of overgrazing and erosion, making necessary a regulation protecting the areas from grazing part of the year. Along the west side of the divide there is a similar belt of about the same acreage where erosion is also causing damage. These belts are practically timberless, and are of value chiefly as watersheds, from which stream flow for irrigation is supplied, and for the grazing resources which they afford. That these and similar eroded lands would originally support a cow or the equivalent in sheep on from one-third to one-fifth the acreage required at the present time is evidence of the enormous loss annually to the live-stock industry alone. The soil and plant foods on these already relatively unproductive lands continue to be carried away by the run-off following each storm; and the destruction, where well advanced, is sure to continue until preventive measures are fully established.

Typical instances of the damage caused by erratic run-off and erosion are well worth citing. On July 28, 1912, a rainstorm occurred at the head of Ephraim Canyon, on the Manti National Forest, within a belt of 2 miles and between elevations of 9,000 and 10,500 feet. There was no rain in the valley or on the mountain below, approximately, 8,000 feet. The storm of 0.41 of an inch of rain fell intermittently, but at no time with special violence, for a period of two hours. A flood of sufficient force developed to reach to the city of Ephraim, 10 miles below, covering the streets and some farm land, and filling the basements of buildings with mud and débris. Laden with silt, logs, vegetable matter, and, during the

most violent period, with rocks containing as much as 30 cubic feet of material, the flood destroyed wagon roads, trails, and water ditches.

Another typical example of flood and erosion occurred on July 30, 1912, when a flow of torrential violence originated at the head of Becks Canyon. A rain, amounting to 0.55 of an inch, the greater part of which fell within an hour, started at 11 a. m., and at 11.45 a. m. a flood was pouring out of a small side canyon which drains into Becks Canyon from an area of less than 1,500 acres, at an elevation of about 10,000 feet. This area is virtually treeless and is fan-shaped, the main drainage channel originating at the head of a steep canyon which drops into Becks Canyon at the rate of about 1,000 feet in less than a mile. The soil is of a clay-loam type, and, considering the area as a whole, is of fair depth, there being but little outcrop. The slopes are moderately gentle, and because of this fact the area had not been included in the adjacent one which was protected from grazing until late in the season. An examination after the flood showed that the soil had been very densely packed by grazing previous to the storm. The whole of this small watershed was well marked with gullies. The flood was not observed until it reached the mouth of the side canyon. Here it presented a front approximately 8 feet wide and 1½ feet high. The water was so infiltrated with sediment that it did not run but rolled over and over, picking up small rock and gravel. The flow increased to a front of from 10 to 25 feet wide and from 6 to 8 feet high. The velocity and force of the rolling mass down the steep slope were appalling. The main flow lasted approximately one hour, varying in volume as had the rain 30 minutes previous. Owing to the enormous deposits of débris, the course at the mouth of the channel changed three times. As the stream changed its course from one side to another enormous quantities of material were deposited only to be carried away later. At one time approximately 5,000 cubic feet of the bank was torn out in a few minutes as the old bed filled up with material from above. All these tons of soil, vegetable matter, and other material were carried down by the rushing water in less than two hours after the rain began to fall.

In addition to the direct loss of personal property, damage to the range itself in the way of decreased forage production and soil depletion has a most vital effect on a community. Such loss is seldom fully appreciated until the stockmen must, of necessity, limit the number of animals grazed on the lands. Following the action of a few destructive floods, the productivity of the grazing lands may be so decreased that only the more inferior drought-resistant plants will thrive. Where the farm lands, upon which supplemental winter feed is grown, are remote from shipping points, as is true of much