Condition and Grazing Capacity of Wet Meadows on the East Slope of the Sierra Nevada Mountains

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DURING the years 1946, 1947, 1948 and 1949 a range survey was made on that portion of the Sierra Nevada Mountains included in the Toiyabe National Forest. Roughly, this includes the east slope of the Sierra Nevada Mountains from Beckwith Pass north of Reno, Nevada to Conway Summit south of Bridgeport, California. The topography is generally rough with steep slopes and deep canyons. The bulk of the soils is derived from granitic rock, although there are local areas where they developed from parent rock of volcanic origin. The valleys east of the range have an average elevation of 5,000 feet, and the mountains rise abruptly to an elevation of 9,000 to 10,000 feet in a horizontal distance of only a few miles. Average annual precipitation varies from 8 to 12 inches near the valley floor to 50 to 60 inches at some of the higher elevations. Most of this comes as snow during the winter months. Summers are dry, with considerable wind and infrequent storms.

These mountains were originally covered with forest. This varied from pinon pine (*Pinus monophylla*) at the lower elevations, through Jeffrey pine (*Pinus jeffreyi*) and lodgepole pine (*Pinus contorta*) at the middle elevations, to fir (*Abies sp.*) on the higher slopes. Wet meadows occurred along the streams.

Most of the forest was logged, beginning about 1870, and used for lumber and fuel in the mining camps from Virginia City to Bodie. Even the pinon pine was cut for fuel in many places. After logging it was burned, sometimes repeatedly, and heavily grazed. The original forested area now has some good stands of second growth timber, large areas of manzanita (*Arctostaphylos spp.*), snowbush (*Ceanothus velutinus*), some sagebrush (*Artemisia tridentata*), and aspen types (*Populus tremuloides*) that invaded the cut-over areas. These latter types were probably present in the original vegetation, but on a much smaller area than they now occupy. Most of the forage is still produced on wet meadows.

After examining a number of meadows at the beginning of the survey, it was decided to classify them according to conditon, and if possible, determine the grazing capacity for each condition class. Using as guides the criteria developed by Ellison and Croft in Utah (1944) and Reid and Pickford in Oregon and Washington (1946), tentative condition classes were set up. These were based upon the density of the plant cover, the floristic composition, the amount and dispersion of litter, and the presence, absence or degree of accelerated erosion. During the seasons of 1946 and 1947, 206 meadows were classified according to these criteria. Of these, 48 were classed as excellent, 71 as good, 44 as fair, 32 as poor and 11 as very poor, or depleted. A large proportion of those classed as excellent were cultivated and irrigated meadows. There were relatively few natural, wild meadows that rated excellent, but many of them rated good. At the end of each of these years some

small changes were made in the requirements for each condition class. During the years 1948 and 1949 approximately the same number of meadows were classified as during the previous 2 years, but no further changes were made in the requirements.

Grazing capacity studies were started in 1946 by keeping actual use records and checking utilization on nine meadow pastures that had been classified by the range survey crew. Seven of these were between 5,500 and 6,000 feet elevation, and two were between 7,500 and 8,000 feet elevation. Only three of these, one at the higher and two at the lower elevations, were natural, wet meadows. The others were subject to various systems of irrigation. The irrigated meadows had a much higher grazing capacity than the natural, wet meadows, some as high as 230 percent. This is because natural meadows are usually cold and waterlogged in the spring and tend to become dry in the fall, whereas the irrigated meadows can be kept at nearly optimum growing condition as far as water is concerned. However, the grazing capacity varied so widely with the care used in irrigating that these meadows were not included in the table of grazing capacities.

The two natural, wet meadows at the lower elevations were both classed as excellent. One contained 26 acres and the other 16 acres. They had a grazing capacity of 3.4 cow months per acre, based on moderate utilization.

The natural, wet meadow at the higher elevation contained 146 acres and was classed as good. It had a grazing capacity of 1.6 cow months per acre, based on the same degree of utilization. Checks were made on these pastures for the next 3 years. In 1948 a pasture was constructed at an elevation between 8,500 and 9,000 feet containing 152 acres of good meadow. This was moderately grazed and had a grazing capacity of 1.1 cow months per acre.

TABLE 1

Grazing capacity in cow months per acre for the different condition classes of meadow at various elevations

CONDITION CLASS	AVERAGE FORAGE ACRE FACTOR	ELEVATION IN HUNDREDS OF FEET						
		55–60	60–65	65–70	70–75	75–80	80–85	85–90
		Cow Months Per Acre						
Excellent	.323	3.4	3.1	2.9	2.7	2.5	1.9	1.7
Good	.206	2.2	2.0	1.9	1.8	1.6	1.2	1.1
Fair	.144	1.5	1.4	1.3	1.2	1.1	.8	.7
Poor	.080	.84	.78	.73	.68	.63	.47	.42

The lower grazing capacities at higher elevations appear to be due to shorter growing seasons and lower temperatures which result in a smaller volume of forage being produced. Truly alpine meadows with dwarf species were not included in this study but would probably show a still smaller grazing capacity.

The average forage acre factors were determined from the 206 meadows covered by the range survey in 1946 and 1947 and used, along with the grazing capacity figures obtained from the four natural, wet meadow pastures, to build a table of grazing capacities for the four major condition classes at 500-foot elevation intervals. These are shown in Table 1. Grazing capacity figures

shown for condition classes and elevations not tested were arrived at by interpolation. No figures were obtained for the depleted class because these meadows usually require complete rest or other special treatment. The capacities shown in this table must be regarded as approximations only. The few tests made can be used as rough guides for stocking meadows in this area, and, as such, proved very useful.

The figures in Table 1 were used, along with a forage acre requirement for the other types (timber, sagebrush, aspen, etc.), to check the grazing capacity of 38 cattle allotments included in the area covered by the range survey. Some allotments were checked 3 consecutive years, some 2 years and some only 1 year. This check was made by comparing the calculated grazing capacity for the allotment with the current utilization of forage under the present rate of stocking. There was a high proportion of meadow forage on most of the allotments. The estimated capacities checked very well, using these figures, with our concept of proper utilization of meadows. They were considered properly utilized when 60 to 70 percent by weight of the forage produced, by the species listed under palatable plants, had been taken by livestock.

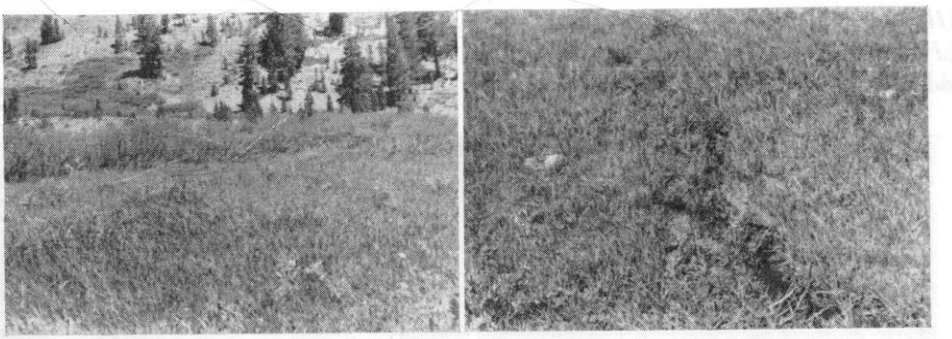
The condition classes established for meadows in this area are as follows:

Excellent Condition

Density—0.7 or more.

Composition—Palatable grasses and weeds must make up at least 70 percent of the plant cover (Fig. 1A). These should include all species of sedge (*Carex spp.*), bluegrass (*Poa spp.*), bentgrass (*Agrostis*), tufted hairgrass (*Deschampsia caespitosa*), timothy (*Phleum pratense*), mannagrass (*Glyceria striata*), velvetgrass (*Holcus lanatus*), orchardgrass (*Dactylis glomerata*), sweet anise (*Osmorhiza occidentalis*), and all species of clover (*Trifolium spp.*) found in these meadows. Mat muhly (*Muhlenbergia squarrosa*) and pull-up muhly (*Muhlenbergia filiformis*) should be confined to meadow edges and should make up no more than 5 percent of the composition. Sweet anise occurs only under dense willow patches.

Litter and Soil—Normally over 75 percent of the ground is covered with litter, but this may be lower if the meadow was heavily utilized the previous year. There must be a well developed layer of humus and unbroken



A B

Fig. 1. Meadow in excellent condition. A. General aspect, more than 0.7 density, with some willows present. B. Vegetated drainage channel with no visible erosion.

sod, with no visible erosion resulting from conditions on the meadow (Fig. 1B).

Good Condition

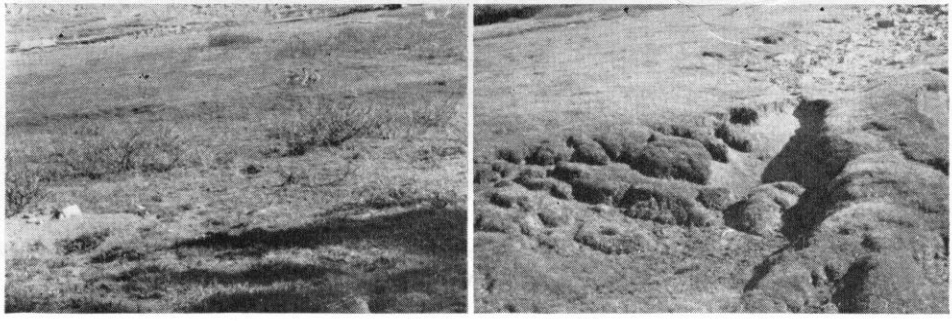
Density—0.5 or more.

Composition—Palatable grasses and weeds must make up at least 45 percent of the plant cover. Where the proportion of these falls below 60 percent the difference must be made up with less palatable, perennial grasses such as meadow barley (*Hordeum nodosum*), muhly, and rush (*Juncus spp.*). No forbs may be considered except clover or sweet anise

Fair Condition

Density—0.4 or more.

Composition—Palatable grasses and weeds make up at least 35 percent of the plant cover. Where the proportion of these falls below 45 percent the difference must be made up with less palatable, perennial grasses such as meadow barley, muhly and rush. Meadows in this condition are less dense than those in good condition and have a greater variety of unpalatable weeds. These include those listed under good condition and



A B

Fig. 2. Meadow in poor condition. A. General aspect, density 0.25 to 0.35. Willows show effects of continuous heavy browsing. B. Meadow edge; broken sod and bare ground.

when it is confined to areas under willow patches. These meadows are similar to those in excellent condition except that they are less dense and have more unpalatable or less desirable species such as rush, meadow barley, buttercup (*Ranunculus*), dandelion (*Taraxacum officinale*, cinquefoil (*Potentilla*), yarrow (*Achillea lanulosa*) and bistort (*Polygonum bistortoides*).

Litter and Soil—Normally over 60 percent of the ground is covered with litter, but this may vary with the previous year's utilization. There is a well developed layer of humus and unbroken sod, with no visible erosion resulting from conditions on the meadow.

others such as penstemon (*Penstemon*), falsehellebore (*Veratrum californicum*), aster (*Aster*), iris (*Iris missouriensis*), paintbrush (*Castilleja*) and monkeyflower (*Mimulus*). They may also have considerable rush, meadow barley and muhly.

Litter and Soil—Normally about 45 percent of the ground is covered with litter, but this may vary with last year's utilization. Sod may be broken with small, bare areas showing. The edges of some stream banks may be bare. Visible erosion is confined to movement of soil from bare areas to sod areas during storms. There must be no well developed rills or erosion pavement or gullies resulting from conditions on the meadow.

The only soil loss will be very light wind erosion from small, bare areas, or light water erosion around meadow edges during storms.

Poor Condition

Density—0.25 or more.

Composition—Palatable grasses and weeds must make up at least 25 percent of the plant cover (Fig. 2A). Where the proportion of these falls below 35 percent the difference must be made up with less palatable, perennial grasses such as meadow barley, muhly and rush. These meadows usually have a large proportion of meadow barley, rush or willow (*Salix spp.*) with many unpalatable weeds such as iris, buttercup, lupine (*Lupinus*), aster and penstemon.

Litter and Soil—The litter is usually sparse and poorly dispersed. The sod is patchy and broken. Regular drainage channels are scoured and have bare edges (Fig. 2B). There are patches of exposed soil with some erosion by wind and water, but no gullies due to conditions on the meadow.

Very Poor or Depleted Condition

Density—Less than 0.25.

Composition—Less than 25 percent of the plant cover is made up of palatable grasses and weeds. These meadows have a high proportion of willows or rush, with many unpalatable weeds of the same species listed under poor condition, together with numerous annuals.

Litter and Soil—The litter is sparse or nonexistent if the meadow is being grazed. The sod is broken with large, bare areas. Erosion pavement may be present or forming, and loss of soil is shown by topsoil remnants or pedestalled plants. There is heavy sheet erosion or well developed rills or gullies.

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FOOD

The future not just of America but of mankind is, Eisenhower feels, jeopardized by hunger. Two-thirds of the world's total population is underfed. At least a billion people never get enough to eat. If improvements in agriculture can help relieve the economic pressures which in turn produce political conflicts, the chances of war are lessened. . . . "Nothing is more important to the future of the United States than helping to feed the world's hungry people. Food means peace and freedom. Starvation is the weapon of communism."

John Gunther *in* McCalls, May 1950