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INTERPRETING MOUNTAIN MEADOW RANGE CONDITION BY OBSERVING TREND AND STAGE OF PLANT SUCCESSION

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Importance of Meadow Forage

Mountain meadows in Washington and Oregon potentially are capable of producing 10 to 15 times more forage per acre than the average timbered summer range that is predominant in these States. The forage that is produced on meadows ordinarily stays lush and green throughout the summer grazing period in contrast to the timbered summer range forage which usually begins to dry in August. Range forage in a cured state usually is low in protein, in calcium and phosphorus, and in vitamins, and is incapable of producing rapid weight gains in livestock. Although mountain meadow acreage is but one or two per cent of the total summer range in Washington and Oregon, it is capable of pro-

ducing an important amount of summer forage that is critically needed to produce prime beef and lamb.

Mountain meadow forage is so attractive to grazing animals that, if preventive measures are not taken, the meadows usually support more than their share of the grazing load. As a consequence, range depletion has occurred that in many instances has reduced meadow grazing capacities to or below the level of the timbered range. This forage production loss sometimes goes unnoticed because of the small areas that are involved. In other cases, the importance of the feed loss is apparent and steps are taken to correct the grazing management so that the production of meadow forage may be increased. The situation with respect

to mountain meadow range is a generally lowered production with some meadows improving and others losing in productiveness. Those responsible for the management of summer range in Washington and Oregon should uniformly recognize the importance of meadow forage and should be able to judge the condition and trend of the vegetation in order that proper and timely adjustments in handling the meadows may be made.

On the hypothesis that knowledge of plant succession and retrogression affords a practical means of judging meadow condition, the Pacific Northwest Forest and Range Experiment Station has studied the vegetation of 31 meadows in eastern Oregon. Based on careful range inspections that took such factors as soil erosion, plant vigor and plant density into consideration, these meadows were classified with respect to range condition in four groups: excellent, good, fair, and poor. The average density and composition of range plant species was obtained for meadows in each grouping in order to establish significant indicators of meadow condition and of trends from one condition to another.

The term, plant succession, is not used in the discussion that follows to describe the hydroseres of meadow development, but rather to delineate vegetation stages from or toward the mesophytic community of grasses and sedges that dominate on meadows in good range condition. For practical purposes this community is termed the climax stage, and the vegetation on badly depleted meadows the first weed stage. The succession that will be discussed takes place under mesophytic or xeric conditions and is entirely man-caused.

Earmarks of Meadow Condition

The vegetation of the four meadows that were classified as excellent was found to cover 70 per cent of the ground surface and to consist largely

¹ Common and scientific names of range plant species referred to are listed at the end of this article.

of perennial grasses, chief of which was tufted hairgrass. Tufted hairgrass¹ made up nearly $\frac{3}{4}$ of the total vegetation. Grasslike plants, most important of which was Nebraska sedge, represented about 15 per cent of the vegetation. Perennial weeds made up about 10 per cent; annual grasses and weeds, thinly scattered in the stand, accounted for the remainder of the plant cover. The chief characteristics determined of meadows in excellent condition were, therefore, a vegetation of high density consisting mainly of tufted hairgrass, a noticeable quantity of Nebraska sedge, few weeds of any kind, and virtually no annuals.

On the eight meadows in good condition, vegetation covered half of the ground surface. The composition was about equally divided between perennial grasses and showy perennial weeds. Grasslike species made up about 15 per cent of the vegetation. Tufted hairgrass still was the dominant grass, but thin bentgrass was a close second on meadows in good condition. Ovalhead sedge was about as noticeable as Nebraska sedge in the grasslike group and both tended to be surpassed by Baltic rush. Of the perennial weeds, western aster and Columbia groundsel were usually most abundant although American bistort and other showy weeds sometimes dominated the landscape.

The vegetation on the 13 meadows in fair condition covered about $\frac{1}{3}$ of the ground surface and was comprised largely of perennial weeds which made up $\frac{2}{3}$ of the vegetation. Only $\frac{1}{4}$ of the vegetation was perennial grasses. Grasslike species were not prominent and the density of annual weeds and grasses was found to be low. Tufted hairgrass on meadows in fair condition was less than $\frac{1}{4}$ of the grass cover, being surpassed by Kentucky bluegrass and equalled by red fescue and thin bentgrass. Nebraska sedge usually was absent, being replaced largely by ovalhead sedge. Columbia groundsel, western yarrow, cinquefoil, western aster, and common dandelion were the most

abundant perennial weeds.

The six poor condition meadows supported a vegetation that covered only 10 per cent of the ground surface. Annual weeds, principally Douglas knotweed and tarweed, made up 40 to 50 per cent of the cover. Annual and perennial weeds together made up about $\frac{3}{4}$ of the entire vegetation. Annual grasses were two or three times more abundant than perennial grasses. Tufted hairgrass had largely disappeared from the meadows in poor condition, the most abundant perennial grass being slender hairgrass which is practically worthless for forage or for arresting soil erosion. The most abundant perennial weeds were common dandelion, cinquefoil, and western yarrow.

Grazing capacity estimates based on surveys of the individual meadows, with forage values established by careful sheep grazing trials, show that the meadows in excellent condition can support 10.5 sheep months of use per acre on the average. Similar values determined for meadows in good, fair, and poor condition were 6, 3.9, and 0.7 sheep months per acre respectively. Thus, lowering the range condition by one class results in a loss of about 30 per cent of the grazing capacity. Tufted hairgrass forage produced four-fifths of the grazing capacity on meadows in excellent condition.

Summarizing the vegetation characteristics of the meadows in different condition classes, it is apparent that the four groups fall into rather definite plant succession stages. The best condition answers the definition of the climax stage being dominated with a single species, tufted hairgrass. The good condition, with about equal division between perennial grasses and weeds, is typical of the mixed grass-and-weed stage. The fair condition in which perennial weeds are about three times as abundant as perennial grasses is corollary to the second weed stage. The poor condition, wherein annual weeds constitute more than one-half the vegetation and weeds as a class make up $\frac{3}{4}$ of the plant cover, is illustrative of the

first weed stage. The rapid decrease in grazing values signifies the validity of the range condition classification. The guides to determine relative meadow condition can therefore be based on the plant succession stage, most outstanding earmarks of which are the density of vegetation, the proportion of weeds to grasses, the abundance of tufted hairgrass, and the presence or absence of annual weeds.

Identification of Trend in Meadow Condition

The trend in condition of meadow range is associated with the dynamic phases of plant succession and retrogression. Accordingly if one is familiar with the characteristics of plant succession stages on meadows, it is but a step further to determine approximately the trend or direction of the succession. On the meadow examined that were in the lower stages and which definitely were improving or deteriorating in range condition, observations were made that can serve to guide such a determination. The most significant of these observations are as follows:

(1) When dealing with meadows that are in near-climax condition, the places to watch for deterioration are the drier, better drained spots. Here the tufted hairgrass will be thinning and low in vigor if the meadow condition is retrogressing, and species such as thin bentgrass, Kentucky bluegrass, red fescue, western aster, ovalhead sedge and other secondary species will be in a thrifty condition and spreading. On the other hand if the meadow vegetation is improving, the tufted hairgrass on these sites although thin in stand will be comprised of young, vigorous plants that obviously are making a go of it in competition with the species already mentioned.

(2) If the meadow is in the mixed grass-and-weed stage, a sign of deterioration is the absence or sparseness of tufted hairgrass on the drier sites and a thinning of this species on the more moist situations. Mountain brome, slender wheatgrass, ovalhead sedge,

and weeds such as Columbia groundsel, western yarrow, western aster, and cinquefoil will be common and abundant on the dry sites. Kentucky bluegrass, red fescue, and thin bentgrass will also be spreading on the relatively moist areas. There is a tendency for meadows deteriorating from the mixed grass-and-weed stage to take on a decidedly patchy appearance due to the colonization of dry patches by weeds which flower brilliantly. A sign of betterment in meadows that are in the mixed grass-and-weed stage is a thick, healthy stand of tufted hairgrass in the moist locations, with a scattering stand of young hairgrass plants on the moderately dry sites. Another good sign is the thickening of Kentucky bluegrass, thin bentgrass, and red fescue in patches of perennial weeds on dry situations.

(3) Signs of deterioration from the second weed stage are the occurrence of thrifty tufted hairgrass only in very wet places, the bulk of the meadow covered with weeds such as western yarrow growing in a clumped, turflike form and common dandelion growing with a prostrate rosette habit. Another sign of deterioration is oniongrass growing in a semidecumbent form on the drier sites. The absence of perennial grass seedlings and the presence in great abundance of annual weeds even on moist spots are indicators of retrogression. Signs of improvement are young, thrifty tufted hairgrass plants spreading on the drier sites, and invading areas dominated by red fescue, Kentucky bluegrass, and thin bentgrass. Another sign of improvement is the invasion of perennial weed colonies by Kentucky bluegrass, thin bentgrass, and red fescue.

(4) Signs of meadow improvement from the first weed stage are young tufted hairgrass plants becoming established in wet places; Kentucky blue-

grass, red fescue, and thin bentgrass spreading noticeably in patches of annual and perennial weeds on moist ground; and young littleflower penstemon, Columbia groundsel, cinquefoil, western yarrow, and other perennial weeds becoming established on the driest sites in competition with annual weeds such as knotweed and tarweed.

The foregoing observations that have correlated plant succession and retrogression principles with the condition and trend of condition of meadow range do not constitute a mechanical rule of thumb for range administrators to apply blindly. They do indicate, however, that dependable guides are available if such things as the pattern of plant succession on meadows, the vegetation of the climax formation, the indicator species in the various stages of succession, and the significance of the various stages to grazing values are understood. If these guides are followed, better results will be obtained from range management in this region.

COMMON AND SCIENTIFIC NAMES

- American bistort: *Polygonum bistortoides* Pursh.
 Baltic rush: *Juncus balticus* Willd.
 Cinquefoil: *Potentilla* spp. L.
 Columbia groundsel: *Senecio columbianus* Greene.
 Common dandelion: *Taraxacum officinale* L.
 Douglas knotweed: *Polygonum douglasii* Greene.
 Kentucky bluegrass: *Poa pratensis* L.
 Littleflower penstemon: *Penstemon procerus* Dougl.
 Mountain brome: *Bromus carinatus* H. & A.
 Nebraska sedge: *Carex nebraskensis* Dew.
 Oniongrass: *Melica* spp. L.
 Ovalhead sedge: *Carex festivella* Mack.
 Red fescue: *Festuca rubra* L.
 Slender hairgrass: *Deschampsia elongata* (Hook.) Munro.
 Slender wheatgrass: *Agropyron trachycaulum* (Schwein) Hitchc.
 Tarweed: *Madia* spp. Molina.
 Thin bentgrass: *Agrostis diegoensis* Vas.
 Tufted hairgrass: *Deschampsia caespitosa* (L.) Beauv.
 Western aster: *Aster occidentalis* Nutt.
 Western yarrow: *Achillea lanulosa* Nutt.