

Utilization of Grasslands in the Flint Hills of Kansas¹

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THE Flint Hills of Kansas constitute one of the last large segments of true prairie in the United States. They cross Kansas between the 96th and 97th meridians, narrowing abruptly to the north and ending before the Nebraska boundary is reached. To the westward there occurs a gradual transition to mixed prairie and to the east lies a diversified farming area once covered by true prairie but now largely broken, except for the rougher portions. Toward the south, however, the eastern side of the Flint Hills is bounded by sandstone hills with similar terrain and with a vegetative cover of true prairie and in sandy places savanna. On their southern end the Flint Hills join the Osage range lands of Oklahoma, a region of similar grasslands.

As the name Flint Hills suggests, this is a hilly region with the cherty, limestone beds strongly dissected by erosion that is still somewhat active in spite of the rather good grass cover. The ridges tend to be narrow and the side slopes steep. The soils are shallow in terms of cultivation but the limestone of the slopes is broken, thus allowing good penetration of moisture and of plant roots. The ridgetops often have shallow soils over dense clay and with less favorable moisture relations. The soils generally are rocky, often with cherty materials at the surface, and thus only

limited areas can be brought under cultivation. Cultivation is limited to the small valleys and to certain gently sloping uplands. The terrain and soil conditions have been described by Fly (1946).

Native vegetation is the only agricultural crop that these rough lands are capable of supporting. Should it be destroyed, the productive capacity of the land would be lost until such time as the vegetation could be restored. On rough, rocky lands such as most of these, revegetation by any means other than natural succession may be so costly as to be impractical, and may even be impossible. It is therefore imperative that utilization practices be compatible with the ecological and physiological needs of the vegetation. Aldous (1935) and Anderson (1940) have discussed pasture practices for this area.

HISTORICAL

The Flint Hills have been used intensively for grazing since the early 1880's when southwestern cattlemen discovered that animals could be fattened to market conditions on them in a single summer season. There developed a grazing system in which the grasslands are leased by cattlemen of the Southwest and cattle are shipped to the area at or near the beginning of spring growth of the vegetation. This leasing for summer grazing has set the pattern for grazing management throughout the Flint Hills.

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The Flint Hills rapidly came under fence after their use by southwestern cattle began and, therefore, have practically no history of intensive use as open range. For this reason they were not subjected to the abuses inherent in the uncontrolled use which began on the mixed prairie of Kansas with the coming of the railroads in the mid 1860's.

The cattle shipped to the Flint Hills in the early days were all mature animals, many of them 4- or 5-year-olds, or even older. As the demand for smaller animals has developed, there has been a shift to younger cattle. Some aged cattle are still pastured there, but the most common age is 2 years and a few groups of yearlings are to be found among the transient animals.

IMPORTANCE OF THE AREA

The agricultural and economic importance of the Flint Hills bluestem grazing lands has been emphasized by the reports of the Kansas State Board of Agriculture (1950 and 1951b) which show that, in addition to approximately one-half million head of local beef cattle, an average of nearly 300,000 head are shipped each spring from the ranges of the Southwest to fatten on the summer-growing bluestems. Pastures for these so-called transient animals are leased by the cattlemen on a "per head" basis, the leases stipulating acreage allowances, grazing dates, and other conditions of management agreed upon at the time the leases are drawn in late winter or early spring.

The southwestern cattle reach the Flint Hills in the late spring, usually late April, but sometimes earlier or later than this. They are considered to be in transit to market, stopping enroute to fatten. They are then moved to market when the owner deems them to be ready for sale, the better ones attaining this

condition by late July or August. Shipment continues well into the fall.

Livestock gains are high on good or excellent Flint Hills pasture. Weight gains of 200 to 300 pounds per head are not uncommon for 2-year-old steers, while thin, mature animals may gain up to 350 pounds or more in a grazing season.

The Flint Hills are traditionally a cattle country, very few livestock of other classes occurring there. Cattle lend themselves to undisturbed grazing in large pastures. Here they are visited at regular intervals by riders who check on the condition of the cattle and the grass, and who tend the fences and the watering and salting facilities. The land owner, or his agent who arranges for the lease and distributes the cattle, is responsible for the care of the animals and is required to deliver them at the close of the grazing period or to furnish evidence of their death in the event of loss. Practically all leases stipulate the grazing fee and the acreage allowance per head of stock. Recently a few contracts have been written in which the grazing fee is determined by the amount of gain made by the animals.

Local cattle are managed on the bluestem pastures in much the same manner as the transient animals. Some land owners purchase animals for summer grazing in preference to leasing their pastures. Cattle often are purchased in the fall and wintered in lots or in farm fields. Where sufficient tillable land is available for the production of winter feeds, breeding herds are found. They, too, are generally turned onto native grass at about the same time as transient cattle, but the practice of wintering them on bluestem is now being tried in some sections. The dried grass is extremely low in protein and may be so leached as to contain little in the way of minerals, but when fed a supplement

of oilseed cake the animals wintered on it may be expected to maintain their body weights or, in favorable seasons, gain 50 or 75 pounds during the winter.

UTILIZATION BY GRAZING ANIMALS

The management of grazing on range pastures generally is concerned with obtaining the maximum degree of utilization that is compatible with efficient livestock production and with maintenance of the forage resource. In the Flint Hills, on the contrary, the major objective has been to obtain rapid steer gains during the early part of the growing season. To this end annual spring burning and early stocking have been practiced since the 1880's, when these grasslands first came into extensive use.

That so much of the Flint Hills range land has been maintained in a relatively good condition is due in part to the leasing arrangements. To bring about rapid livestock gains at a time of year when the major forage species are just beginning to grow rapidly, the cattlemen have demanded adequate acreage allowances. This, together with the fact that many animals attain market condition during midsummer and are then removed for sale, has left these pastures understocked in the last half of the growing period, thus, a large volume of growth and relatively adequate carbohydrate food reserves have been allowed to accumulate each season. This has tended to compensate for the depleting effects of early stocking and annual spring burning, but some degree of deterioration has occurred even under this system. Pastures grazed the full season without reduction in stocking load, and especially the smaller ones that nearly always are stocked heavily, have suffered moderate to severe depletion.

ECOLOGICAL STRUCTURE

The Vegetation

The vegetation of the Flint Hills is that of true prairie, the two bluestems being the most abundant species. Anderson (1951) reported that little bluestem (*Andropogon scoparius*) made up 24 percent and big bluestem (*A. gerardi*) 18 percent of the vegetation of experimental pastures in typical Flint Hills range near Manhattan, Kansas. Other species of major importance in this study were indiangrass (*Sorghastrum nutans*) and sideoats grama (*Bouteloua curtipendula*) each 8 percent, blue grama (*Bouteloua gracilis*) and hairy grama (*B. hirsuta*) taken together 6 percent, buffalograss (*Buchloe dactyloides*) nearly 5 percent, and the introduced Kentucky bluegrass (*Poa pratensis*) 8 percent of the population. Perennial grasses made up 84 percent of the vegetation of these pastures, sedges and rushes (*Carex* and *Juncus* species) 6 percent, annual grasses less than 2 percent, perennial forbs a little more than 5 percent, annual forbs 2 percent, and shrubs only 0.3 percent.

Cover

Bluestem vegetation of the Flint Hills provides a full vegetative cover. The undisturbed or only moderately grazed canopy of living tops, or of frosted top growth in winter, gives complete coverage of the soil and full protection against accelerated erosion. Runoff losses are minimized by this protective mantle of grass tops, as are moisture losses by evaporation from the soil surface. Basal cover, on the other hand, is quite sparse in good bluestem vegetation. Anderson (1951) found the area occupied by basal portions of plants to be only 21 percent of the soil surface. This sparse basal cover is typical of bluestem grasslands in

excellent range condition, and any decline in range condition due to excessive grazing will result in at least a temporary increase in percentage basal cover as certain species increase and others invade. Increasing perennial grasses include Kentucky bluegrass, buffalograss, the gramas, certain dropseeds (*Sporobolus* species), the rosette forming panicums (*Panicum* species) and others.

Herbage Production

Climax prairie vegetation in the Flint Hills contains very little non-palatable plant growth. The yield generally is high and all of the tops are accessible and more or less readily available to grazing. Yields of 2000 to 3000 pounds of dry matter per acre per season are not uncommon under excellent range condition, and yields upward of 1000 pounds are the rule rather than the exception. Assuming that at least half of the forage can safely be removed by grazing and that an average of 20 pounds of dry matter per day would be sufficient for the average grazing animal, it will be seen that production will vary from nearly 1 to about $2\frac{1}{2}$ animal-unit-months of grazing per acre. This is in agreement with the acreage allowances in Flint Hills commercial pastures, although they are seldom stocked at the heavier of these rates. The Kansas State Board of Agriculture (1951a) reported that 1951 acreage guarantees for a 6-month grazing season ranged from 3.5 to 6.5 for steers and cows and 2.5 to 4.5 for young cattle, although fattening animals often are marketed before the end of the 6 months.

Climatic Reactions

The Flint Hills lie in the 30-36 inch rainfall belt in an area of relatively mild temperatures. Forest generally has been

excluded except in postclimax sites, although during favorable periods there does occur some extension of forest onto the uplands.

Deep penetration of rainfall allows deep-rooted prairie species to dominate on all but the driest upland sites. There reduced infiltration and water loss by runoff and evaporation bring about preclimax conditions favoring the shorter grasses. These often become the major species on such sites even under moderate grazing.

It has been said that the true prairie would have been forest except for such factors as frequent fires and occasional periods of extreme drought. These have been natural factors of the environment however, and the Flint Hills can therefore be considered to exhibit a true grassland climate. As Borchert (1950) has pointed out, "The prairie has had a climate more like that of the steppe than the eastern forests during most winters and the summers of major drought years. But during most summers the climate is more like that of the eastern forest."

Prior to 1934 there had, in fact, occurred some extension of forest vegetation from its postclimax position along streams and draws out onto the true prairie uplands of the Flint Hills. Its destruction during the drought of the mid 1930's was striking evidence of the influence of climate on the character of the vegetation.

Major Influents

The major influents superimposed upon the bluestem vegetation by man are grazing and frequent burning. Both have long been major factors influencing vegetative population and trends. Prior to settlement, the grazing was by wild herds and the burning by the uncon-

trolled fires set by Indians or by natural causes. At present the grazing is principally by cattle and the burning by the more or less controlled fires employed in the management of the pastures.

ECOLOGICAL SUCCESSION

Ecological succession is profoundly affected by grazing. Close forage removal results in retrogression as evidenced by rapid decrease of certain major grass species typified by the bluestems and by such forbs as perennial sunflowers and legumes. At the same time other grasses such as the gramas and certain dropseeds, and numerous forbs and shrubs such as ironweed (*Veronia*), verbena (*Verbena*), ragweed (*Ambrosia*), coralberry (*Symphoricarpos*), and sumac (*Rhus*) become more abundant. Invasion, principally by annual grasses and forbs at first and later by perennials, also occurs.

Succession Induced by Grazing

Succession following depletion, if encouraged by carefully controlled grazing, may advance rapidly toward climax in pastures where the retrogression has not been too great. The prairie dominants recover rapidly under protection and spread by vegetative means as well as by natural reseeding to reoccupy the ground lost by depletion. Seedlings of the major species compete successfully, establishing themselves in stands either of increasers or of invaders.

Succession following severe depletion is slowed to the extent that the dominant forage species have been eliminated. If a pasture has been so depleted that little or no seed is available for natural revegetation, the restoration of the bluestems must depend on outside sources of seed. Fortunately, relatively little of the region has been plowed but remains in natural vegetation, so the source of seed is as near as the nearest pasture or

fence row. However, pastures so severely depleted as this are likely to be so weedy and brushy that reestablishment of the bluestem vegetation would be seriously delayed even if seed were available. In this event, weed eradication measures are needed.

This extreme situation exists in very few Flint Hills pastures, so restoration is mostly a matter of encouraging natural succession. Only a few small farm pastures or parts of pastures near farmsteads or near watering facilities have become so depleted as to require reseeding. This is indeed fortunate because the steep terrain and rocky soils may preclude seedbed preparation and seeding.

Succession Induced by Cultivation

The problem of ecological succession induced by cultivation is of limited importance in the Flint Hills. The areas now in cultivation have mostly been rather carefully selected and, for the most part, are kept in the crop rotation. If such lands are sown to pasture, smooth brome (*Bromus inermis*) or other rotation pasture crops generally are used. Thus, relatively little "go back" land exists except in a few places where tillage during the early days of settlement was sometimes unwisely attempted on shallow uplands. These old fields soon were abandoned and were returned to the pastures, but their outlines still remain, emphasized by the plants that occupy them. Such old fields are now characterized by thin stands of native grass and an abundance of summer annuals such as prairie threeawn (*Aristida oligantha*), or often by seeded stands of Korean lespedeza (*Lespedeza stipulacea*). Soil depletion and erosion losses both have played a part in creating an environment unfavorable to the rapid reestablishment of the dominant prairie forage species. Furthermore, succession has been hindered by the fact that the

"go back" areas have not received protection, but have simply been thrown into the large pastures.

Succession Induced by Fire

Fire plays an important role in the management of Flint Hills pastures. Most leased pastures are lightly stocked in the latter months of the growing season, leaving a large accumulation of tops which remain on the land over winter. Pasture leases commonly contain clauses requiring its removal by burning prior to the beginning of the new grazing season. Since it is difficult to control the spread of fire and also because the commercial grazing management tends to set the pattern for the entire region, annual spring burning is widely practiced throughout the Flint Hills. Cattlemen maintain that the purpose of the burning is to prevent patchy grazing, but another factor is the increased rate of spring growth that occurs for a time on pastures burned early in the spring. Aldous (1934) showed that burned pasture plots outyielded unburned ones for a few weeks in the spring, but that the unburned ones rapidly overtook them during the summer months and greatly exceeded them in total growth for the season. It is important for transient cattle to fatten as rapidly and as early as possible, however, and the additional early-season growth afforded by early burning helps hasten these southwestern cattle to market.

The overall effect of pasture burning is to reduce total forage yields. The chief factor responsible for this is the reduction in soil moisture resulting from long spring exposure to runoff and from surface evaporation during the period between the date of burning and the beginning of growth of the summer growing prairie dominants. Needless to

say, this effect is more pronounced in dry summers than in favorable ones.

Burning influences ecological succession. First, it removes all old growth, exposing the new growth to earlier use by animals. Thus, close grazing is encouraged, and should it be continued, depletion is hastened, not so much by the burning as by the abusive grazing. Secondly, burning may cause population changes even where grazing is not involved. Aldous (1934) showed that early spring burning caused an increase in density and favored the finer stemmed species such as little bluestem and prairie dropseed, while burning as late as possible before spring growth started caused a decrease in density and induced a trend toward the taller, coarser species such as big bluestem, indianguass, and switchgrass (*Panicum virgatum*).

A study of the experiments by Aldous will reveal the reason for the population shift brought about by early burning. Species like little bluestem and prairie dropseed (*Sporobolus heterolepis*) are the natural dominants of relatively dry sites in the prairie. Early burning brought about reductions in soil moisture, thus making the environment less favorable for the larger species that are naturally more abundant in sites of favorable moisture conditions. The reason for the shift to taller, coarser species following annual late burnings is not clear.

THE FUTURE

The future of the Flint Hills as an agricultural region depends upon maintenance of the forage resource, the native vegetation, in a vigorous and productive state and upon wise and efficient utilization of this forage by grazing animals. Abusive grazing can destroy the vegetation and leave the land exposed to the ravages of erosion. Fortunately, the land owners realize this. They are interested in

maintenance of the pastures and those who understand the needs of the forage species practice moderate grazing.

There is little opportunity to increase the cultivated acreage for the production of the supplemental forage crops because of the rough, rocky nature of the soils, so the bulk of the forage must continue to come from native vegetation. Tillage is not reducing the natural grassland acreage of the Flint Hills materially, so this is not to be considered a vanishing grassland. The grazing may not always be too carefully regulated, but acreage allowances generally are sufficient, after the pattern set by the commercial grazing, so abusive grazing is not reducing the grassland acreage.

There is little likelihood, on the other hand, that the acreage of native grasses can be increased to any great degree. Most of the land now tilled will remain in cultivation for the production of feeds and forages to supplement the native pastures. Actually, there is too little tillable land to support completely balanced livestock husbandry. Only fields depleted by abusive farming practices will be returned to permanent pasture and only part of this will be sown to native grasses because cool-season crops such as smooth brome can be grown to extend the grazing season. Returning land to native pasture usually consists merely of extending the pasture fence to include the abandoned field in the hope that natural reseeding will take place. Some few depleted fields probably will be reseeded to bluestem mixtures, however.

Since continued productivity of these range pastures is dependent chiefly upon management of the grazing, it is imperative that correct practices be understood and applied to these grasslands. To this end an adequate grazing research pro-

gram is a major requirement, and it must be accompanied by an active and enlightened extension program to carry the results of research to those who manage the grazing.

Because range condition is judged in terms of the vegetation that might be expected to occur naturally, the need for the preservation of undisturbed or primitive areas is emphasized for the maintenance of bluestem grasslands in their climax condition or as near to it as possible. These would be important supplements to grassland research and would serve as living museums for generations to come.

SUMMARY

The Flint Hills bluestem prairie is not in great danger of destruction. The fact that it generally has not shown severe decline in condition is evidence that grazing has not been extremely abusive. This cannot be attributed entirely to good management based on full understanding of the growth requirements of the vegetation, but rather to the fortuitous circumstance that pasture leasing has been dominated by cattlemen of the Southwest. They have demanded an ample acreage allowance to permit quick fattening of the transient cattle and have begun removing finished animals in midseason, thus leaving the pastures lightly stocked during the latter part of the growing season. This has permitted the storage of sufficient organic reserves to maintain these pastures in relatively good condition in spite of annual burning and early stocking.

So long as the present grazing system is continued, the Flint Hills can be expected to remain in good condition. It seems imperative that maintenance should be based on a sounder foundation than this, however, and a knowledge of the ecological and physiological require-

ments of the forage grasses is therefore essential for every grassland manager.

LITERATURE CITED

- ALDOUS, A. E. 1934. Effect of burning on Kansas bluestem pastures. *Kans. Agr. Expt. Sta. Tech. Bul.* 38. 65 pp.
- . 1935. Management of Kansas permanent pastures. *Kans. Agr. Expt. Sta. Bul.* 272. 44 pp.
- ANDERSON, K. L. 1940. Deferred grazing of bluestem pastures. *Kans. Agr. Expt. Sta. Bul.* 291. 27 pp.
- . 1951. The effects of grazing management and site conditions on Flint Hills bluestem pastures in Kansas. Unpublished thesis.
- BORCHERT, J. E. 1950. The climate of the central North American grassland. *Ann. Assoc. Amer. Geog.* 60: 1-39.
- FLY, C. L. 1946. Natural agricultural resource areas of Kansas. *Kans. State Bd. Agr. Rpt.* 65, No. 271: 126-195.
- Kansas State Board of Agriculture. 1950. Cattle on pastures in the Blue Stem (Flint Hills) and Osage sections of Kansas and Oklahoma, June 1, 1950. *Kans. State Bd. Agr. and U. S. Dept. Agr. Bur. Agr. Econ. Rpt.* June 14, 1950. (Mimeographed)
- . 1951a. Osage-Blue Stem (Flint Hills) pasture report, April 1, 1951. *Kans. State Bd. Agr. Rpt. and U. S. Dept. Agr. Bur. Agr. Econ.*, April 11, 1951. (Mimeographed).
- . 1951b. Cattle on pastures in the Blue Stem (Flint Hills) and Osage sections of Kansas and Oklahoma, June 1, 1951. *Kans. State Bd. Agr. and U. S. Dept. Agr. Bur. Agr. Econ. Rpt.* June 13, 1951. (Mimeographed).

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Members who wish to present papers at the annual meeting in Omaha, Nebraska in January, 1954 are invited to offer them now. This is in accordance with Article V, Section 6 of the Bylaws (See March 1951 Journal, Vol. 4: 134).

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