Ecology of a Southern Illinois Bluegrass-Broomsedge Pasture

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Many acres of unfertile land abandoned or neglected as a result of previous unwise land use policies are found in southern Illinois. These abandoned or neglected rolling upland fields are quickly clothed by a vegetation predominantly of wiregrass *(Aristida oligantha)* and broomsedge *(Andropogon virginicus)* with broomsedge almost always dominating by a large measure.

Few studies have been made of the forage production by different types of vegetation and its consumption by stock, particularly in pastures adjudged to be in poor condition. For a given vegetational type these facts must be obtained before any phase of improvement is sought. A detailed knowledge of the plants and their response to varied conditions is of vital importance in proper management of pastures.

Pasture Condition and Use

The 80-acre pasture used in this study is located 5 miles south of Carbondale, Illinois. The topography is that of rolling upland. Hills of 20 to 40 feet in height are separated by ravines. The ravines are wet at times, and a few of them are continuously wet as there are at least two springs which produce seepage water. One pond is located in the southeast corner of the pasture, and the entire south end of the pasture is coursed by a stream from the overflow of the pond and the springs. The occurrence of water in the south end of the pasture has resulted in heavier grazing there.

Grazing began in this pasture several years ago when it was converted from a golf course. In the beginning the pasture was largely of Kentucky bluegrass *(Poa pratensis)*. With the reduction of bluegrass by heavy use and mid-summer drought, broomsedge entered and became established in considerable amount. In recent years the pasture has been mowed twice a year in an effort to control weeds and broomsedge. The broomsedge has not diminished notice-

ably under this treatment. The present rate of stocking has varied but little over the past three years. Usually the pasture is stocked with from 24 to 28 animals of which five or six are calves. The grazing period has varied from 6½ to 7 months.

Vegetation Sampling

The vegetation of the entire pasture was sampled by means of numerous well-distributed square-foot plots. A transect through the pasture was made in such a way that the sampling area included all types of topography. Sampling for percentage composition was by a stratified random method along the transect line at intervals of 20 paces. Fifty samples were taken in June and 50 in July. The July samples were taken between those obtained earlier. The apparatus and method was that employed by Voigt and Weaver (1951).

Basal area was estimated as the percent of ground covered by vegetation at a height of 1.5 inches. It was found to average 25.6 percent for the pasture as a whole. In estimating percentage composition the total vegetation regardless of amount was considered as 100 percent. The percent of each species was based upon the part of the total basal area that each furnished. A percent composition thus based upon basal area was not recorded if it furnished less than 5 percent. This was occasioned by certain minor forbs or sedges which were considered to be ecologically of small importance.

Kentucky bluegrass existed as a type in only small and scattered areas, although it made up 36 percent of the vegetation (Table 1). The largest part of the pasture was a mixture of bluegrass and broomsedge. Other areas where broomsedge or bluegrass gave way to other types were the hillsides or hilltops where wiregrass or low weedy annual herbs replaced them. Broomsedge made up 28 percent of the vegetation and nearly always had a small amount of Kentucky bluegrass with it.

Sampling for Yield and Consumption

Many methods for determining consumption of forage by range animals are available and have been described by Heady (1949). The cage or portable exclosure method was used in this study because it combines both yield and consumption and gives a month-to-month picture of pasture trends. Monthly yields and consumption may be obtained by species or other component by selective clipping. The cage method has been used elsewhere with satisfactory results (Joint committee, 1943; Klingman *et al.*, 1943; and Darland and Weaver, 1945).

Five exclosures were spaced in the south side of the pasture in the bluegrass-broomsedge type. Each exclosure covered a 29-square-foot area. The exclosures were spaced 100 to 125 yards apart.

By subtracting air-dry weight of the vegetation clipped from the five grazed control areas from that clipped from the five exclosed areas, the average monthly consumption could be ascertained. Yield of the first month was calculated to be the air dry forage under the exclosure after a month of protection from grazing. Selective clipping of bluegrass, broomsedge, and forbs was employed. Each of these components was bagged separately for each control and exclosed area. Thus monthly and total seasonal yields and consumption were available by components (Table 2).

The Broomsedge Community

Broomsedge is typically a community unto itself, but it may often occur in mixtures with small amounts of other grasses. The most frequent companion grasses in this area are Kentucky bluegrass, and on poorer sites, the wiregrasses.

Well established and undisturbed broomsedge will tend to lose its vigor in a few years as the amount of debris developed in the bunches exerts the unfavorable reactions of crowding and shading the new growth. The tall and persistent dead stalks and leaves, however, react in the same manner on other

Table 1. Percentage composition of the vegetation in the experimental bluegrass-broomsedge pasture as determined from 100 one-square-foot samples.*

Species	Composition
	Percent
Grasses & Grass-like Plants	
Redtop *(Agrostis alba)*	0.1
Wiregrass *(Aristida oligantha)*	3.2
Broomsedge *(Andropogon virginicus)*	28.1
Lovegrass *(Eragrostis pectinacea)*	3.1
Six-weeks fescue *(Festuca octoflora)*	1.0
Rush *(Juncus* spp.)	3.8
Kentucky bluegrass *(Poa pratensis)*	36.4
Panic grass *(Panicum* spp.)	0.8
Beadgrass *(Paspalum circulare)*	1.2
Total	77.7
Forbs	
Ragweed *(Ambrosia bidentata)*	2.5
Daisy *(Chrysanthemum leucanthemum)*	1.4
Buttonweed *(Diodia teres)*	6.4
Lespedeza *(Lespedeza stipulacea)*	9.5
Yellow oxalis *(Oxalis stricta)*	0.1
Bracted plaintain *(Plantago aristata)*	1.1
Sorrel *(Rumex acetosella)*	1.3
Total	22.3
Grand total	100.0

* Average basal area of vegetation on the sample plots was 25.6 percent.

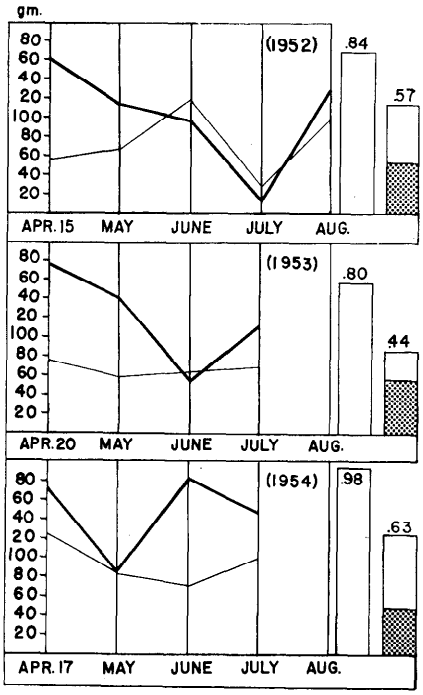

FIGURE 1. Monthly yields (heavy line) and consumption (lighter line) in a bluegrass-broomsedge pasture during the summer months of 1952, 1953, and 1954. Bar graphs at right show total yield and consumption each year in tons per acre. Proportion of broomsedge consumed is the patterned fraction of the consumption bar.

species, with the result that an older community of broomsedge will characteristically appear half dead. Thus, even though it reacts adversely to itself, the type is maintained for several years. Infrequent burns seem advantageous to broomsedge, as they clear the bunch of debris and stimulate growth from the periphery of the bunch. The center of the bunch having deteriorated through crowding and shading manifests a ring of new growth. As the new growth from the ring thickens the same reactions destroying the centers of the old bunch cause a breaking of the ring. Thus several nuclei for bunch development may result. Where these young bunches or edges of older bunches are grazed, the shallowly rooted young offshoots may be pulled from the ground. Broomsedge begins growth in late spring and makes its best growth in late June or July. It is tolerant of rather droughty conditions.

In good vigorous condition broomsedge will form bunches which average 8-10 inches in diameter. The interspace in such a stand is 12-15 inches. Broomsedge is a vigorous competitor on moderately acid soils of low fertility. It may be a subsere dominant for several years. Its height at maturity is 30 to 40 or more inches. The bunches average 80 flowers stalks in an old stand, and the stems may have 12-13 internodes. There may be as many as 50 racemes per stalk and 8-12 spikelets per raceme, thus it is seen that its reproductive potential is great. The rate of germination has been found to be around 20 percent. In the broomsedge type, broomsedge will often compose 60 percent or more of the community and yield as much as 2 tons of air-dry forage at the end of the growing season. The basal area of this type is about 14 percent.

Yields and Consumption

The production and consumption lines (Figure 1) are farther apart in mid-summer and late summer, and heavier grazing is indicated in the spring and again in the fall. Ths is in accordance with the findings of Fulleman and Burlison (1939), and Weaver and Darland (1945) who show a good correlation of yields, consumption, changes in palatability, and temperature and rainfall.

During the summer of 1952 when severe drought conditions prevailed, the utilization of broomsedge was good. This was apparently due to a lack of other available forage and to larger quantities being necessarily consumed by the animals because of a decreasing crude protein content with the age of the plant. According to the data of Morrison (1937) forage containing less than 12 percent crude protein is only 56 percent digested. Crude protein analysis of broomsedge was made by the Kjeldahl method (nitrogen times 6.25). These analyses showed a level of about 9 percent crude nitrogen in May, which declined steadily to about 3 percent in late fall. A high of 8.66 in young broomsedge and a high of 7.53 in the blooming stage was found in Texas by Frapps and Fudge (1940). Their mean figures for broomsedge in young and blooming stage were 6.59 and 5.0 respectively. The minimum requirement for mature cows has been set at 9 percent by Morrison (1937).

Yields and Consumption—1952

Production in the pasture was fairly high in spring and showed a steady decline to June, then dropped abruptly between June and July to rise sharply between July and August. The production decline is correlated with the decline of the cool-season bluegrass during the warmer and drier weather of this period and the relatively poor growth of the warm-season broomsedge during this drought year. The sharp rise in production at the end of the season was due to the increased bulk of flower stalks and inflorescences (Figure 1). Broomsedge usually begins to flower by mid-July.

The somewhat low consumption figure in the spring is explainable in terms of greater availability and abundance of more palatable grasses, especially bluegrass. The exclosures for measuring yields and consumption were all placed in the bluegrass-broomsedge type. With the decline of bluegrass in warm weather the increased grazing pressure is reflected in a rise in the consumption of broomsedge during June (Table 2). By July total production and consumption were almost the same. Increased production in the fall was due mostly to the flowering phase of broomsedge. The accompanying increase of consumption was due to increased use of the broomsedge, particularly the upper inflorescence,

probably due to a higher protein content there. This "topping" of the plants in flower has been observed in other grass species. Bluegrass did not resume growth until later in the fall. Total production in the pasture from mid-April to mid-September was 0.84 tons per acre. The total amount consumed was 0.57 tons per acre. Broomsedge made up 52 percent of the total yield and 50 percent of the total amount consumed (Table 2).

Table 2. Summary of yields and consumption of vegetation by three components (bluegrass, broomsedge, and forbs) on the experimental pasture during the summers of 1952, 1953, and 1954. Figures are averages of grams of air-dry material from 5 portable exclosures and their grazed controls. Figures in parenthesis give tons per acre.

	April May	May June	June July	July Aug.	Aug. Sept.	Percent Total Prod.	Percent Total Cons.
1952							
Bluegrass							
Yield	124.4	19.5	.....	.....	36.0	35.6 (.30)	
Cons.	55.8	21.9	19.6	.....	28.0		33.6 (.19)
Broomsedge							
Yield	32.0	67.5	80.0	2.8	82.2	52.4 (.42)	
Cons.	4.0	36.2	66.3	16.9	62.0		49.6 (.28)
Forbs							
Yield	8.0	28.9	7.5	9.1	7.0	12.0 (.12)	
Cons.	.....	8.2	34.8	12.5	7.4		16.8 (.10)
						100.0 (.84)	100.0 (.57)
1953							
Bluegrass							
Yield	110.8	10.2	1.8	.....		25.4 (.20)	
Cons.	55.7	4.7	4.3	6.4			26.7 (.12)
Broomsedge							
Yield	49.6	89.1	52.3	68.0		53.4 (.43)	
Cons.	10.6	42.0	51.3	40.5			54.3 (.24)
Forbs							
Yield	17.7	41.7	.....	43.5		21.2 (.17)	
Cons.	9.6	11.6	7.0	22.3			19.0 (.08)
						100.0 (.80)	100.0 (.44)
1954							
Bluegrass							
Yield	114.1	35.2	43.9	45.2		40.2 (.40)	
Cons.	75.0	46.6	7.8	15.3			38.1 (.24)
Broomsedge							
Yield	39.7	42.1	103.3	53.2		40.2 (.39)	
Cons.	28.5	37.1	50.0	30.4			38.4 (.24)
Forbs							
Yield	21.7	8.9	36.8	49.5		19.7 (.19)	
Cons.	20.6	1.1	13.7	53.2			23.5 (.15)
						100.0 (.98)	100.0 (.63)

Yields and Consumption—1953

The year 1953 was a more severe drought year than the preceeding year, and it was considered necessary to plan a continuation of the study through the third year in order to compare broomsedge utilization during drought and normal climatic years. The climate during the spring of 1953 was much the same as the year before, with heavy rain during March and April. In the period of June to October the total rainfall was about one-half normal. Production and consumption figures during the early months were nearly parallel to those of the year before (Figure 1). In May the production was slightly less than the year before with consumption about the same. Both production and consumption steadily declined to the end of the summer.

More bluegrass was consumed than produced during May and July. The residues of previous months thus accounted for the greater consumption than production during any one month. Broomsedge made up more than twice as much as any other component in May with consumption of this species being 78 percent of all forage produced during this month (Table 2). The total yield of the pasture during the four-month period (mid-April, mid-August) was 0.80 tons per acre. Bluegrass made up 25 percent, broomsedge 53 percent and herbs 21 percent of the production, respectively. Consumption amounted to 0.44 tons per acre, and 54 percent of all forage eaten was broomsedge (Table 2).

Yields and Consumption—1954

The effects on the vegetation of the return of more normal climatic conditions in 1954 were readily observed. The early and more normal production of bluegrass was noted, and the continued good growth of this species into July was in marked contrast with the previous two years. During this year there was never a point where consumption exceeded production. Only in mid-May did consumption nearly equal production (Figure 1). The bulk of the bluegrass had been eaten before heavy growth of the warm-season broomsedge began. More normal conditions are also reflected in greater production and increased consumption. The increased consumption was due to increased production of the highly palatable lespedeza and bluegrass.

Total yield for the year was 0.98 tons per acre, of which about 40 percent was broomsedge and 40 percent bluegrass. The nearly

equal production of the two grasses was closely paralleled by consumption. Of the 0.63 tons per acre consumed, 38.1 percent was bluegrass and 38.4 was broomsedge (Table 2). This pasture seems to be in an especially favorable ecological situation, since the two leading species of grasses produce the bulk of the forage, and they compliment each other as to seasonal growth. This would be an ideal situation if each grass were equally palatable and nutritious. However, the high fiber content and generally low crude protein of broomsedge indicate that this species should be replaced for a better economic return. Where the land is too steep for proper renovation, the broomsedge-bluegrass type of pasture might be kept. Gains by steers on the broomsedge type of the Atlantic Coastal Plains are reported to be 90 pounds during the months of April and May (Campbell and Biswell, 1945).

On lands within a watershed area broomsedge provides excellent cover against erosion, and, if mowed or burned to reduce old growth, two or three months of satisfactory grazing could be had.

Summary

In an 80-acre southern Illinois pasture dominated by Kentucky bluegrass and broomsedge, yield and consumption studies were carried out during the summer months of 1952, 1953, and 1954. Yields and consumption were measured for three components (bluegrass, broomsedge, and forbs) using the portable exclosure (cage) method and selective clipping.

The year 1952 was a drought year. Total production was 0.84 tons per acre, and consumption was 0.57 tons per acre, of which 50 percent was broomsedge.

Another drought year followed. Production and consumption figures during the early months were similar to the year before. Later both production and consumption steadily declined to the end of the season. Total yield was 0.80 tons per acre. Bluegrass made up 25 percent, broomsedge 53 percent, and forbs 21 percent of the production. Consumption was 0.44 tons per acre, and 54 percent of all forage consumed was broomsedge.

More normal climatic conditions prevailed during 1954. Total yield for the year was 0.98 tons per acre, of which about 40 percent was broomsedge and 40 percent was bluegrass. The consumption was 0.63 tons per acre, of which bluegrass was 38.1 percent and 38.4 percent was broomsedge.

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Photo Contest Reminder

The Society plans to continue the popular photo contest held during the annual meeting. For the Thirteenth Annual Meeting of the Society, to be held at Portland, Oregon, February 2-5, 1960, categories will remain unchanged. Prizes will be awarded. Detailed contest rules will be available in the next issue of the Journal.

Frank W. Stanton
Chairman, Sub-Committee
Photo Contests & Displays