VEGETATION-SOIL RELATIONSHIPS IN HILL PRAIRIES

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While much of the original prairie of Illinois has been converted to cropland, many small relict hill prairies persist on steep, usually south-facing slopes high above the Illinois and Mississippi Rivers. The similarity and persistence of these grassland stands make their study interesting and informative. Other than Evers' (1952) extensive floristic study of many of these prairies and the work of Kilburn and Ford (1962), little has been done to analyze vegetational and environmental features of these unique types of vegetation. This study reports soil-vegetation relations on six of these prairies located on the Principia College Campus, Sec. 20 T6N R11W, Jersey County, Elsah, Illinois. The nomenclature follows Fernald (1950).

Material and Methods

Vegetational information was recorded from plots 10 m by 10 m. In these square plots some 10 m^2 quadrats were established in a regular pattern (Warren, 1962), and frequency and coverage (Oosting, 1953) data were taken from them. One plot was established in approximately the center of each of the six prairies. The prairies covered less than one-half acre, and most were separated by small forested ravines. All were within a single section above the Mississippi River bluffs.

In each plot the slope percentages, the vertical drop per 100 feet horizontally, were averaged from two readings with meter stick and level. Six soil samples were collected in each plot, two each at the one, two and three foot levels, and were analyzed by the Bouyoucos Method.

Results

Slope averages varied from 17.3% to 56.3%, with an average of 32.8% (Table 1). Soil analyses are given in Table 2. All soils were extremely sandy and low in clay content. The averages for sand at all levels varied from 78.8% to 85%. It can be seen that the sand percentage decreases with depth in all cases, while the silt percentage increases. No trend is evident with the small amounts of clay present.

Table 1.—Percent Slope Measurements.

Prairie	*Top*	*Middle*	*Bottom*	*Average*
Amelanchier	13	32	37	27.3
Black Widow	57	65	47	56.3
Cone Flower	21	30	37	29.3
Sumac	9	10	33	17.3
Osage Bluff (right)	34	30	45	36.3
Osage Bluff (left)	17	50	33	33.3

TABLE 2. Soil Texture Percents in Hill Prairies at Depths of one, two and three Feet.

Prairie	Sand				Silt				Clay			
	1	2	3	Avg.	1	2	3	Avg.	1	2	3	Avg.
Amelanchier	89.8	84.8	82.6	85.7	9.0	12.7	15.0	12.2	1.3	2.5	2.4	2.1
Black Widow	85.3	81.5	80.1	82.3	13.4	17.2	18.2	16.3	1.4	1.4	1.8	1.5
Cone Flower	82.2	79.9	80.9	81.0	15.9	18.8	17.6	17.4	2.0	1.4	1.6	1.7
Sumac	83.9	78.8	73.8	78.8	14.9	20.7	25.4	20.3	1.3	.6	.8	.9
Osage Bluff (right)	85.3	86.3	83.4	85.0	14.1	13.2	16.2	14.5	1.6	.5	.5	.9
Osage Bluff (left)	85.8	83.8	81.8	83.8	14.1	15.9	17.7	15.9	.2	.4	.6	.3

TABLE 3.—Coverage Percents for Predominant Hill Prairie Plants and Bare Soil at Each Locality.

	Prairies						
Plant	*Amelanch.*	*Black W.*	*Cone Fl.*	*Sumac*	*Osage-R*	*Osage-L*	*Avg.*
Andropogon scoparious	62.0	43.5	54.0	45.0	52.0	40.5	49.5
Bouteloua curtipendula	0.0	12.5	1.0	20.2	9.5	16.1	9.9
Panicum oligosanthes	0.9	0.1	2.6	1.0	0.6	0.5	0.9
Lespedeza capitata	1.0	2.0	4.6	2.9	1.5	3.6	2.6
Lespedeza intermedia	0.0	1.2	0.5	0.9	4.5	5.2	2.0
Oxalis violacea	0.0	0.0	0.8	0.2	0.2	0.1	0.2
Houstonia nigricans	3.5	0.7	1.0	1.3	3.3	3.9	2.3
Erigeron strigosus	0.0	0.0	0.2	0.0	4.2	3.3	1.3
Senecio plattensis	0.0	5.6	0.3	6.3	0.0	0.0	2.0
Scutellaria parvula	0.8	0.6	0.2	0.0	0.4	0.9	0.5
Penstemon pallidus	1.6	0.3	2.1	3.8	0.9	0.2	1.5
Ruellia humilis	0.7	0.3	00.2	0.0	0.8	0.1	0.4
Other species	4.4	6.8	15.0	17.2	14.7	15.4	12.3
Bare soil	20.1	20.5	12.0	1.2	3.3	6.2	10.5

TABLE 4. Frequency Distribution Percentages for Predominant Hill Prairie Plants. Figures for each prairie based on ten m^2 quadrats.

	Prairies						
Plant	*Amelanch.*	*Black W.*	*Cone Fl.*	*Sumac*	*Osage-R*	*Osage-L*	*Avg.*
Andropogon scoparius	100	100	100	100	100	100	100
Bouteloua curtipendula	0	50	10	80	100	100	57
Panicum oligosanthes	40	30	50	20	30	10	30
Lespedeza capitata	100	50	100	100	80	60	82
Lespedeza intermedia	0	60	30	60	80	80	52
Oxalis violacea	10	20	70	10	70	40	37
Houstonia nigricans	100	90	90	40	90	90	83
Erigeron strigosus	0	0	20	0	90	70	30
Senecio plattensis	0	90	20	80	0	0	32
Scutellaria parvula	40	40	30	0	30	20	27
Penstemon pallidus	50	30	60	40	40	10	38
Ruellia humilis	40	30	20	0	50	10	25

The vegetational data (Tables 3 and 4) show that little bluestem (*Andropogon scoparius*) clearly dominates all prairies with coverage values ranging from 40.5% to 62%, and frequency values of 100% in all cases. No other plant has coverage and frequency values approaching these figures, although side oats grama (*Bouteloua curtipendula*) has one hundred percent frequencies in half the plots and coverage values of more than 9% in four of the plots. In the other two plots *Bouteloua* is rare. Frequency values exceeding forty percent were found in all plots for both *Lespedeza capitata* and *Houstonia nigricans*. Values for the other plants are less consistent than these.

Discussion

The data reveal that, on these steep, south-facing slopes with a very sandy soil, the assemblage of prairie plants and dominance of *A. scoparius* resembles the xeric prairies of Curtis (1959). Many typically more mesic prairie species were recorded, including *Andropogon gerardi* and *Sorghastrum nutans*, but their occurrence was not consistent. All species sampled are recorded by Evers (1955).

The high sand content of these soils apparently favors the persistence of prairie species. Coupled with high temperatures and prevailing winds on these south-facing and river-facing slopes, the environment favors prairie vegetation even though oak-hickory forest covers all undisturbed upland and north-slope habitats in the area.

Despite the dry and somewhat hostile environment, trees and shrubs do invade the prairies from the forested draws or ravines which dissect the slopes. These plants build up a forest environment of leaf mulch and forest ground cover, and spreading branches. The forest extends into the prairie in two ways: by establishment of seedling plants in this forest environment and by root sprouts (*e.g. Rhus glabra* and *Cornus drummondi*). The end result is a gradual overwhelming of the prairie vegetation and loss of the prairie species. This indicates that, in the absence of fire, the prairie is subclimax and the successional climax consists of forest or woodland vegetation.

Summary

Sampling of six small hill prairies overlooking the Mississippi River in Jersey County, Illinois, shows that the general aspect of each is south-facing, the slope average is 30%, and the soil is very sandy. The vegetation is strongly dominated by little bluestem, although several other prairie forbs and grasses frequently occur there.

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