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Plant Communities of the Loess Bluffs of Northwestern Iowa

JACK L. CARTER¹

Abstract. Three typical plant communities on the west-facing slopes of the loess bluffs of northwestern Iowa were studied. Quadrat sampling was conducted in August of 1957, and June and September of 1958. Thirty quadrat samples were made at each station in August, 1957, and in June and September of 1958. Species were classified according to their relative frequencies per quadrat into rare, infrequent, frequent, and common and assigned a rating of 1, 2, 3, or 4, respectively. A total of 164 species of vascular plants were collected and identified by 270 quadrat samples in the three communities. Twenty-one species were found to be common to these three communities, while twenty species were considered frequent in occurrence.

As one enters Iowa from the west (at any point other than northern Sioux and Lyon Counties in the northwest corner) the most outstanding geological formations are the vast deposits of grayish or pale buff colored, calcareous silty material known as loess. This particularly rugged belt, five to ten miles wide, occurs just east of the Missouri River valley in Monona, Woodbury, and Plymouth counties and continues southward along the Missouri River across western Iowa.

Associated with these high loess bluffs are plant communities of a far more western environment than one expects to find in Iowa. This study is concerned with three typical loess bluff communities: T 83N, R 44W, in the Turin, Iowa area in Monona County; T 89N, R 44W, in the Stone State Park area in Woodbury County; and Sec's. 29, 30, and 32, T 91N, R 48W, in the Joy Creek area in Plymouth County. Even though only three typical communities are considered in this report, similar areas with similar floras exist at many locations along what might be called "the western slopes of Iowa."

INSCRIPTION OF THE AREAS

The areas considered in the investigation are typical west-facing slopes formed by thick layers of wind-blown loess. Although the area is thought to have been glaciated three times (1) the most outstanding features of the topography are these rugged bluffs with relief of over 10 feet in places. Within these areas many road-cuts expose 30 feet of loess and where the loess is thick, it is commonly calcareous. Many exposures contain calcareous concretions and snail shells.

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Loess is a complex silty material which is quite retentive of moisture and which stands in vertical cuts. Erosion does occur to some extent in loess, but very slowly, and only in the case of considerable washing.

There is considerable grazing in the areas surrounding these bluffs, but the steep incline sometimes reaches 85° and 90° from the horizontal and does limit the accessibility of the west-facing slopes to cattle. The east-facing slopes are generally much more gradual, permitting them to be extensively grazed in some areas. All of the areas considered in this study were relatively undisturbed during the growing seasons of 1956 through 1959.

The climate of Monona, Woodbury, and Plymouth counties (2) is essentially that of mid-continental United States, tending toward a western dryness. The direction of the prevailing winds is from the northwest. However, during the normal growing season these winds are usually from the south and the southwest. Wind velocity is, in general, highest in the northwest section of the state; thus evaporation is proportionately high.

The winters are often long and severe with temperatures often reaching -15° to -20° F. During July, extremes of 98° to 102° F. are often recorded at the weather stations in that area.

The growing season, or the number of days between the last spring minimum of 32° F. and the first autumn minimum temperature of 32° F., ranges between 149 and 153 days.

Precipitation is also a definite limiting factor in the vascular flora of the loess bluffs of northwestern Iowa. The normal annual precipitation per year averages 26.0 inches in this area, while the state average is 31.6 inches.

QUADRAT SAMPLING

Throughout the growing season of 1956 these communities were floristically studied, the specimens identified, and checklists prepared for each area. In August of 1957, and June and September of 1958, the author, with the assistance of students from Northwestern College, Orange City, Iowa, conducted quadrat sampling studies of these areas.

Thirty quadrat samples were made at each station in August, 1957, and in June and September, 1958. The quadrats were distributed in three horizontal rows of ten each approximately 12 feet apart on the west-facing slope of each bluff. One row was within 6 to 8 ft. of the top of the bluff, one row was placed half way down the west-facing slope, and the bottom row was approximately 20 ft. from the base of the bluff. By placing the lower row of the quadrats some distance from the base of the bluff it was possible to eliminate heavily grazed areas and thus

get a more realistic picture of the species occurring on the west-facing slopes.

Much barren soil made it possible to record all the species occurring in each one-meter quadrat. The greatest number of species occurring in a single one-meter quadrat was nine at the Joy Creek Bluffs, while the average number of species recorded was 6.2 per quadrat.

The nomenclature, in general, follows that employed in either *Gray's Manual of Botany*, 8th Edition (3) or the *New Britton and Brown Illustrated Flora* (4). Introduced and adventive species are indicated by an asterisk before the binomial.

In establishing the relative frequencies for the species collected and identified in the quadrat sampling the following rating scale was used.

- 1—Rare —Species collected only once or twice in a single community.
 2—Infrequent—Species collected in one community or more and recorded in 1 to 10 percent of the quadrats sampled.
 3—Frequent —Species collected in two or three communities and recorded in 10 to 25 percent of the quadrats sampled.
 4—Common —Species collected in all three communities, and observed and recorded in 25 to 56 percent of the quadrats sampled.

Scientific Names	Relative Frequencies		
	Stone State Park	Joy Creek Bluffs	Turin, Monona County
<i>Achillea millefolium</i> L.	2	2	3
<i>Agoseris cuspidata</i> (Pursh) Raf.	1	3	3
<i>Allium canadense</i> L.			2
* <i>Amaranthus graecizans</i> L.			1
<i>Ambrosia artemisiifolia</i> L.	1		
<i>Ambrosia psilostachya</i> DC.	1	1	
<i>Amorpha canescens</i> Pursh	4	4	3
<i>Andropogon gerardi</i> Vitman.	4	3	4
<i>Andropogon scoparius</i> Michx.	4	4	4
<i>Anemone cylindrica</i> Gray	2		2
<i>Anemone patens</i> L.	1	3	1
<i>Antennaria neglecta</i> Greene		1	2
<i>Arabis canadensis</i> L.	2	1	
<i>Aristida longiseta</i> Steud.		2	
<i>Aristida oligantha</i> Michx.			2
<i>Artemisia dracunculus</i> L.		1	
<i>Artemisia ludoviciana</i> Nutt.	3	3	
<i>Asclepias auriculata</i> (Engelm.) Holz			1
<i>Asclepias tuberosa</i> L.		2	
<i>Asclepias verticillata</i> L.	4	4	4
<i>Asclepias viridiflora</i> Raf.	3	4	4
<i>Aster ericoides</i> L.	2	2	1
<i>Aster laevis</i> L.	3	1	1
<i>Aster oblongifolius</i> Nutt.	2	2	2
<i>Aster sericeus</i> Vent.	3	3	3
<i>Astragalus crassicaerpus</i> Nutt.	4	4	4
<i>Astragalus lotiflorus</i> Hook.	4	4	4
<i>Astragalus missouriensis</i> Nutt.	4	4	4
<i>Bouteloua curtipendula</i> (Michx.) Torr.	4	4	4
<i>Bouteloua gracilis</i> (HBK.) Lag.	2	4	4
* <i>Brassica kaber</i> (DC.) L.C. Wheelr.	1		

* <i>Bromus japonicus</i> Thumb.	2		
<i>Cacalia tuberosa</i> Nutt.			1
<i>Calamovilfa longifolia</i> (Hook.) Scribn.	3		2
* <i>Cannabis sativa</i> L.	1		
<i>Carex brevior</i> (Dew.) Mack.	3	2	2
<i>C. eburnea</i> Boott	1		
<i>Carex gravida</i> Bailey		2	
<i>Carex pensylvanica</i> Lam.		2	3
<i>Carex saximontana</i> Mackenz.	1		
<i>Castilleja sessiliflora</i> Pursh	1	1	2
<i>Ceanothus ovatus</i> Desf.	3	2	2
<i>Cenchrus pauciflorus</i> Benth.		2	
* <i>Chenopodium album</i> L.	2	2	2
<i>Cirsium flodmani</i> (Rydb.) Arthur	1	2	3
<i>Comandra umbellata</i> (L.) Nutt.		2	1
<i>Convolvulus sepium</i> L.		1	
<i>Conyza canadensis</i> (L.) Cron.			2
<i>Crotalaria sagittalis</i> L.	1		
<i>Croton monanthogynus</i> Michx.			1
<i>Dalea enneandra</i> Nutt.	3	3	2
<i>Delphinium virescens</i> Nutt.	3	4	3
<i>Dyssodia papposa</i> (Vent.) Hitchc.		2	
* <i>Echinochloa crusgalli</i> (L.) Beauv.	2		
<i>Echinacea pallida</i> Nutt.	1	2	2
<i>Elymus canadensis</i> L.	3	3	3
<i>Equisetum laevigatum</i> A. Br.	2	2	2
<i>Eragrostis cilianensis</i> (All.) Link	2	2	
<i>Eragrostis spectabilis</i> (Pursh) Steud.			1
<i>Eupatorium altissimum</i> L.			1
<i>Euphorbia corollata</i> L.			1
<i>Euphorbia dentata</i> Michx.	2	2	2
* <i>Euphorbia falcata</i> L.			1
<i>Euphorbia glyptosperma</i> Engelm.	2	3	2
<i>Euphorbia heterophylla</i> L.	1		
<i>Euphorbia maculata</i> L.		2	
<i>Euphorbia marginata</i> Pursh	4	4	3
<i>Euphorbia supina</i> Raf.		1	
<i>Fragaria virginiana</i> Duchesne	1		
<i>Gaura coccinea</i> Pursh	1	2	1
<i>Gentiana puberula</i> Michx.	1	1	
<i>Gerardia aspera</i> Dougl.		1	
<i>Glycyrrhiza lepidota</i> (Nutt.) Pursh	1		
<i>Haplopappus spinulosus</i> (Pursh DC.)	3	3	4
<i>Hedeoma hispida</i> Pursh	2	2	3
* <i>Helianthus annuus</i> L.			1
<i>Helianthus laetiflorus</i> Pers.	2	2	1
<i>Heliopsis helianthoides</i> (L.) Sweet		1	
<i>Heuchera richardsonii</i> R. Br.			1
<i>Houstonia nigricans</i> (Lam.) Fern.			3
<i>Isanthus brachiatus</i> (L.) BSP.	1	1	
<i>Koeleria cristata</i> (L.) Pers.	3	3	2
<i>Kuhnia eupatorioides</i> L.			1
<i>Lactuca ludoviciana</i> (Nutt.) Riddell	1		1
<i>Lactuca pulchella</i> (Pursh) DC.	1	2	1
<i>Lappula echinata</i> Gilib.	4	4	4
<i>Lappula redowskii</i> (Hornem.) Greene	2		1
<i>Lespedeza capitata</i> Michx.			1
<i>Liatris punctata</i> Hook.	1		2
<i>Linum rigidum</i> Pursh	4	4	4
<i>Linum sulcatum</i> Riddell		1	
<i>Lithospermum canescens</i> (Michx.) Lehm.	2	2	1
<i>Lithosperm incisum</i> Lehm.	4	3	4
<i>Lygodesmia juncea</i> (Pursh) D. Don	4	4	3

* <i>Medicago lupulina</i> L.	2		3
* <i>Melilotus alba</i> Desr.	2	1	1
<i>Mentzelia decapetala</i> (Pursh) Urban & Gilg.	1	2	
<i>Mirabilis hirsuta</i> (Pursh.) MacM.		1	
<i>Monarda fistulosa</i> L.		2	1
<i>Muhlenbergia cuspidata</i> (Torr.) Rydb.	3	3	3
<i>Muhlenbergia frondosa</i> (Poir.) Fern.	1		
* <i>Nepeta cataria</i> L.			1
<i>Oenothera biennis</i> L.	1		
<i>Oenothera serrulata</i> Nutt.	3	3	3
<i>Onosmodium occidentale</i> Mack.			2
<i>Oxalis stricta</i> L.			1
<i>Oxalis violacea</i> L.	1	2	1
<i>Oxytropis lambertii</i> Pursh	2	2	3
<i>Panicum scribnerianum</i> Nash	3	3	4
<i>Panicum virgatum</i> L.	1	2	1
<i>Panicum wilcoxianum</i> Vasey			1
<i>Penstemon albidus</i> Nutt.		3	
<i>Penstemon grandiflorus</i> Nutt.	3	3	3
<i>Petalostemum candidum</i> (Willd.) Michx.		2	1
<i>Petalostemum multiflorum</i> Nutt.		1	
<i>Petalostemum occidentale</i> (Gray) Fern.	3	3	4
<i>Petalostemum purpureum</i> (Vent.) Rydb.	4	4	4
<i>Phlox pilosa</i> L.	1	1	1
<i>Physalis longifolia</i> Nutt.		1	
<i>Physalis virginiana</i> Mill.			1
<i>Plantago purshii</i> R. & S.	1	2	1
<i>Polanisia graveolens</i> Raf.			1
<i>Polygala verticillata</i> L.		1	1
* <i>Polygonum convolvulus</i> L.	1		2
* <i>Polygonum persicaria</i> L.			1
<i>Polygonum ramosissimum</i> Michx.	1		
<i>Potentilla arguta</i> Pursh		2	
<i>Psoralea argophylla</i> Pursh		1	1
<i>Psoralea esculenta</i> Pursh	2	2	2
<i>Ratibida columnifera</i> (Nutt.) Wooten & Stardl.	1	1	
<i>Ratibida pinnata</i> (Vent.) Barnh.	2		
<i>Rhus glabra</i> L.	2	2	
<i>Rosa suffulta</i> Greene			1
<i>Salix humilis</i> Marsh	2	1	1
* <i>Salsola kali</i> L.	3	4	3
* <i>Salvia reflexa</i> Hornem.	3	2	2
<i>Schedonnardus paniculatus</i> (Nutt.) Trel.	1		
<i>Scrophularia lanceolata</i> Pursh		1	1
<i>Senecio plattensis</i> Nutt.	1	2	2
* <i>Setaria italica</i> (L.) Beauv.		1	
* <i>Shepherdia argentea</i> Nutt.	1		
<i>Silphium laciniatum</i> L.	1		
<i>Sistrinchium campestre</i> Bickn.	3	3	2
* <i>Solanum rostratum</i> Dunal.	1	3	1
<i>Solidago altissima</i> L.	1	1	
<i>Solidago gigantea</i> Ait.			2
<i>Solidago missouriensis</i> Nutt.	4	1	2
<i>Solidago nemoralis</i> Ait.		1	
<i>Solidago rigida</i> L.	1		
<i>Solidago speciosa</i> Nutt.		1	
<i>Sorghastrum nutans</i> (L.) Nash	1	1	
<i>Spartina pectinata</i> Link			1
<i>Spaeralcea coccinea</i> (Pursh) Rydb.		2	
<i>Sporobolus asper</i> (Michx.) K.	2		
<i>Sporobolus crytandrus</i> (Torr.) Gray	3	4	3
<i>Stipa spartea</i> Trin.	2		1
<i>Strophostyles leiosperma</i> (T.&G.) Piper	1		1

<i>Tradescantia bracteata</i> Small	2	
<i>Verbena bracteata</i> Lag. & Rodr.	3	1
<i>Verbena stricta</i> Vent.	2	
<i>Vicia americana</i> Muhl.	1	1
<i>Viola pedatifida</i> G. Don.	2	2
<i>Yucca glauca</i> Nutt.	3	3

SUMMARY

A total of 164 species of vascular plants were collected and identified by 270 quadrat samples in three plant communities on the loess bluffs of northwestern Iowa. From this study the common species occurring in these communities, or those receiving a total rating of 10, 11, or 12, at three stations include the following:

<i>Amorpha canescens</i> Pursh	<i>Linum rigidum</i> Pursh
<i>Andropogon gerardi</i> Vitman	<i>Lithospermum incisum</i> Lehm.
<i>Andropogon scoparius</i> Michx.	<i>Lygodesmia juncea</i> (Pursh) D.
<i>Asclepias verticillata</i> L.	Don
<i>Asclepias viridiflora</i> Raf.	<i>Panicum scribnerianum</i> Nash
<i>Astragalus crassicaarpus</i> Nutt.	<i>Petalostemum occidentale</i> (Gray)
<i>Astragalus lotiflorus</i> Hook.	Fern.
<i>Bouteloua curtipendula</i> (Michx.)	<i>Petalostemum purpureum</i> (Vent.)
Torr.	Rydb.
<i>Bouteloua gracilis</i> (HBK.) Lag.	<i>Salsola kali</i> L.
<i>Euphorbia marginata</i> Pursh	<i>Setaria viridis</i> (L.) Beauv.
<i>Haplopappus spinulosus</i> (Pursh)	<i>Sporobolus cryptandrus</i> (Torr.)
DC.	Gray
<i>Lappula echinata</i> Gilib.	

Other species which might be considered frequent to these communities, and receiving a total rating of 7, 8, or 9 at the three stations include the following:

<i>Achillea millefolium</i> L.	<i>Koeleria cristata</i> (L.) Pers.
<i>Agoseris cuspidata</i> (Pursh) Raf.	<i>Mullenbergia cuspidata</i> (Torr.)
<i>Aster sericeus</i> Vent.	Rydb.
<i>Astragalus missouriensis</i> Nutt.	<i>Oenothera serrulata</i> Nutt.
<i>Carex brevior</i> (Dew.) Mack.	<i>Oxytropis lambertii</i> Pursh
<i>Ceanothus ovatus</i> Desf.	<i>Penstemon grandiflorus</i> Nutt.
<i>Dalea emeandra</i> Nutt.	<i>Salvia reflexa</i> Hornem.
<i>Delphinium virescens</i> Nutt.	<i>Sisyrinchium campestre</i> Bickn.
<i>Elymus canadensis</i> L.	<i>Solidago missouriensis</i> Nutt.
<i>Euphorbia glyptosperma</i> Engelm.	<i>Yucca glauca</i> Nutt.
<i>Hedeoma hispida</i> Pursh	

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