1953

Prairie flora on the Missouri River bluffs of western Iowa

John Barstow Morrill Jr.
Iowa State College

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PRAIRIE FLORA ON THE MISSOURI RIVER BLUFFS
OF WESTERN IOWA

by

John Barstow Morrill, Jr.

A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
MASTER OF SCIENCE

Major Subject: Systematic Botany

Signatures have been redacted for privacy

Iowa State College
1953
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INRODUCTION

In western Iowa, from Sioux City south to Hamburg, the Missouri River flood plain is bordered by a series of abrupt loess bluffs. Because of the wide variability in exposure, because of the characteristic wind-deposited loess and because of the accessibility to river migration routes, the bluffs possess a diverse, albeit characteristic flora. Investigations of localized or specialized ecological niches frequently yield not only floristic data but insight into historical development and migration movements of both individual species and floristic units. For instance, McLaughlin (1932) in his study of the sand barren flora of northwest Wisconsin was able to show possible migrational routes of the Atlantic coastal plain flora into Wisconsin.

Although certain aspects of the bluff flora have previously been described (Pammel, 1902; Shimek, 1909; Conard, 1952), no inclusive botanical survey of the area has been made. The present study, undertaken to fill such a need, is designed not only to provide a reasonably complete floristic survey of the bluff flora, but also to consider the components of the flora from an ecological and geographical standpoint.
PHYSICAL CONSIDERATIONS

Topography

The loess bluffs bounding the flood plain of the Missouri River form the western limits of the loess hill area in Iowa. The topography of this area is predominantly hilly. Between the hills are many stream valleys with nearly level flood plains that compose nearly all the level land of the area. The major streams flow in a southwest direction through canal-like channels toward the Missouri River. Characteristic of the area are the apparent lack of system in the divides, the winding roads, and the vertical walls of road cuts and stream channels.

The dominant features of the loess hills are the bluffs that rise 60 to 200 feet above the Missouri River flood plain. These bluffs may extend eastward for a mile from the river valley but the distance is usually less than a quarter of a mile. The west faces have a 40 to 100 per cent slope. The back slopes are less precipitous than those facing the valley. Many of the bluffs exhibit patches of bare, vertical loess and are marked by "cat steps," i.e., small shelves formed by slippage of the water-soaked loess along joint planes (Kay, 1943; Shimek, 1938). On many of the pastured slopes these steps have been accentuated by the treading of cattle.

Loess

According to Simonson, Riecken and Smith (1952), most of the loess in the area apparently came from the Missouri River flood plain during
the time of the Iowan glacier. Sediments carried down by floods from the melting glacier were deposited in the flood plain. When cold weather in the fall stopped the melting, the waters receded and left the flood plain as a dry mud flat with no vegetation. Fall and winter winds then picked up the silt and deposited it as loess over the rolling glacial drift plain. Where the courser materials were dropped at the edge of the flood plain, the thickest deposit of loess developed. Over much of the area the loess formed dune-like piles where the material accumulated on the leeward slopes and crests. At the same time the windward slopes became steeper.

In composition, the loess is fine-textured, homogeneous, free of pebbles, and massive or obscurely stratified. It consists mainly of silt with little clay and traces of fine sand. Quartz is the predominating mineral. In places carbonate minerals may be abundant, as evidenced by nodules and tubules of calcium carbonate. In road cuts these nodules often appear in one layer. Scattered through the loess in pockets are fossil shells of terrestrial snails. Little organic matter, however, is preserved in the loess. Because of its porous nature, the loess oxidizes readily and loses water rapidly. It is tan or yellow in color and tends to fracture vertically and horizontally.

Soils

The soils of the loess hill area belong to the Monona-Ida-Hamburg association (Simonson, Riecken and Smith, 1952). The soil of the steep bluffs bordering the Missouri River flood plain is a Lithosol called the
Hamburg series (Knox silt loam in earlier reports). Because of its narrow limits this series is usually not shown on small scale maps. The series is characterized by the steep slopes on which it occurs, the lack of a distinct A horizon, and a calcareous C horizon directly at the surface.

Climate

The climate of Iowa is typically midcontinental, temperate winters alternating with periods of prolonged high temperatures during the summer. In the western counties, less affected by the cooling influence of the Great Lakes and exposed to hot southwesterly winds from May to September, the summer extremes are accentuated. Average temperatures, precipitation and length of growing season for Fremont and Woodbury counties (southern and northern limits of the loess bluffs, respectively) are given in Table 1. It will be noted that the north-south climatic variations within the bluff area are slight, Sioux City (Woodbury County) averaging slightly colder in the winter and having seven inches less annual precipitation.

Shimek (1909, 1911) investigated the temperature, rate of evaporation, and the velocity and direction of the wind on the bluffs at Missouri Valley, Council Bluffs, and Omaha. He found that the greatest evaporation occurred on the slopes and ridges exposed to the diurnal western and southwesterly winds, and that the rate of evaporation was higher at Council Bluffs than at Omaha because it was exposed to the southwesterly winds sweeping across the flood plain. Daily temperatures usually increased
until early afternoon but the evaporation rate and wind velocity were subject to irregular fluctuations. The fluctuations, however, were correlative. Shimak concluded that evaporation was most rapid from surfaces exposed to the prevailing summer winds and "two o'clock" sun which produced the maximum temperature and minimum humidity of the air.

In general, the more xeric conditions on the bluffs are to be found on the exposed southwest surfaces. This situation may be modified locally by barriers such as ridges or trees. On the eastern and southeastern slopes the vegetation, subjected to less extreme conditions, is more mesophytic but may revert to a xerophytic type wherever a break in the bluffs allows the prevailing summer winds to pass over the east slopes. On many of the bluffs the upper leeward slopes are devoid of trees because the wind in passing over the sharp summits produces eddy currents. The lower limits of the eddy currents are marked by a change from the short grasses, *Andropogon scoparius* and *Bouteloua curtipendula*, to the taller grasses, especially *Andropogon gerardi*. 
Table 1. Comparison of the climate at Thurman, Fremont County and Sioux City, Woodbury County (Reed, 1941)

<table>
<thead>
<tr>
<th></th>
<th>Thurman</th>
<th>Sioux City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average July temperature</td>
<td>77.2°F.</td>
<td>75.9°F.</td>
</tr>
<tr>
<td>Average January temperature</td>
<td>23.5°F.</td>
<td>19.5°F.</td>
</tr>
<tr>
<td>Annual precipitation</td>
<td>32.7 inches</td>
<td>25.6 inches</td>
</tr>
<tr>
<td>Average growing season</td>
<td>162 days</td>
<td>165 days</td>
</tr>
</tbody>
</table>
REVIEW OF LITERATURE

An early record of the plants occurring on the bluffs in western Iowa was left by Bradbury, an English naturalist who traveled in America from 1809 to 1811. In describing his voyage up the Missouri River, Bradbury (1819) told of collecting plants on the bluffs on the east side of the river opposite the mouth of the Papillion River. In order to reach these bluffs he had to wade a shallow lake known today as Folsom Lake. At the end of the account of his voyage is "A catalogue of some of the more rare or valuable plants discovered in the neighborhood of St. Louis and on the Missouri." Included in the catalogue are several of the plants collected on the Iowa bluffs.

Intending to publish a full list of his collections, Bradbury found on returning to England that part of his plant collection had been submitted to Pursh who had described several of the new species in the appendix of his Flora Americae Septentrionalis (1814). Pursh, although never having been west of the Mississippi, became the first botanical author to describe plants collected along the Missouri.

James (1823) spoke of finding Oxytropis lambertii, the great flowering pentstemon, leafless prenanthes, and yellow euchromea in 1819 on the bluffs six miles south of the mouth of the Platte River. According to Shimek (1915) the "pentstemon" was probably Penstemon grandiflorus, the "leafless prenanthes" was Lygodesmia juncea, and the "yellow euchromia" was Castilleja sessiliflora.
Little was written, from a botanical viewpoint, on the bluffs until the early 1900's. Hitchcock (1889) presented a brief account of the occurrence of *Linum rigidum* Pursh and *Stipa comata* Trin. on the bluffs at Sioux City. Pammel (1895, 1902) prepared an annotated list of the plants occurring in western Iowa and discussed possible modes and direction of migration of certain species. In his annotated list of plants collected on two trips through southwestern Iowa, Fitzpatrick (1899) enumerated several species that occurred on the loess hills in Fremont County. Boot (1914) recorded the blooming periods of prairie and forest floras in St. Clair Township, Monona County. Many of the species treated in his paper occur on the Missouri River bluffs.

The most comprehensive study of the plants on the bluffs was by Shimek (1909) who tabulated the dry prairie plants and the stations at which they were found on the flood plain and adjoining bluffs. Shimek (1899, 1909), as well as Pammel (1902), concluded from climatological studies that the westerly and southwesterly summer winds had the greatest effect in preventing the forest's encroachment on the exposed slopes.

The loess bluffs extend into Atchison and Holt Counties in northwest Missouri. In his study of the mound flora of Atchison County, Bush (1895) presented an annotated list of characteristic species and delineated the bluff topography. Palmer and Steyermark (1935), describing the plant regions of Missouri, enumerated the typical representatives of the loess bluffs of Atchison and Holt Counties.
METHODS OF PROCEDURE

Field Studies

Field investigations were limited to the prairie flora of the loess part of the bluffs. The lower slopes, where unwooded, had been converted into cultivated fields or pastures, both of which had many weedy species. Although the steeper (loess) slopes were often grazed, some of the native vegetation remained even on the heavily grazed bluff tops and upper slopes. Fences usually marked the boundary between the gentle lower slopes and upper loess slopes.

Sixteen field stations were established on the bluffs between Sioux City and Hamburg (Map 1). The stations were chosen with the following factors in mind: the steepness of the bluff, the extent to which it was covered by prairie and the exposure of the west and southwest faces. Several of the sites that showed promise in the spring became pastures later in the season.

The field collections were begun on May 2, 1952. It was not until June 16, however, that all the stations were established. From this date until October 4, 1952, each station was visited every two weeks.

The following are the locations of the field stations:

Station 1. Woodbury Co., Sioux City Twp. In the vicinity of Chief War Eagle Monument north of Riverside Park, Sioux City.

Station 2. Woodbury Co., Woodbury Twp., Sec. 29, N.W. ¼ and Sec. 30, N.E. ¼. Bluff and rolling prairie northeast of Sergeant's Bluff.
Station 3. Woodbury Co., West Fork Twp., Sec. 31. Above a gravel pit adjacent to Iowa Highway #141, 4 miles northwest of Holly Springs.

Station 4. Monona Co., Grant Twp., Sec. 19, S.E. ¼. West of Grant Center.


Station 6. Harrison Co., Little Sioux Twp., Sec. 8, S.W. ¼. Northeast of Little Sioux by County Trunk D.

Station 7. Harrison Co., Raglan Twp., Sec. 21, S.E. ¼. Adjacent to Iowa Highway #183.


Station 11. Pottawattamie Co., Lake Twp., Sec. 11, N.E. ¼. Adjacent to the Chicago and North Western Railroad north of Council Bluffs.


Station 15. Fremont Co., Sidney Twp., Sec. 24, S.E. ¼. South of Possum Creek by Iowa County Trunk K.

Herbarium Studies

Studies in the Iowa State College Herbarium were carried out in order to record previous collections from the bluffs and to determine the geographical distribution of certain western and southern species. Distributional data and collection records were also obtained from the University of Iowa Herbarium.

Maps

The location of the 16 field stations is shown on Map 1. In Maps 2 to 9, the geographical distributions of eight species are indicated by cross-hatched areas. These maps were prepared from information from monographs and floristic lists, as well as from data obtained in the course of herbarium studies. Maps 10 to 39, prepared from data obtained from herbarium sheet labels, denote the distribution of certain species in Iowa. In these maps, black dots represent each recorded locality. Circles have been placed in the center of those counties for which no specific location record exists.
Map 1. Locations of the 16 field stations along the loess bluffs.
ANALYSIS OF LOESS BLUFF FLORA

Description of Field Stations

The 16 field stations are listed and described below.

Station 1. The lower part of the steep south slope is dominated by *Molilodus albus* and *Rhus glabra*. In proceeding upward, these dominants are replaced first by *Andropogon gerardi* and then *Andropogon scoparius*. On the summit are short grasses and weed species that are succeeded by *Stipa spartea* on the gentle back slope. The back slope is basin-shaped, prairied and devoid of trees.

Station 2. This site consists mainly of rolling upland prairie with the more xerophytic species located on the denuded summits. Although the area is grazed, the native grasses are still dominant. The north and east slopes are covered with *Stipa spartea*. On the more exposed slopes *Andropogon scoparius* and *Bouteloua curtipendula* are frequent. Over the lower north slopes and in depressions are stands of *Rhus glabra* and *Symphoricarpos occidentalis* that spread upward into the prairie. On the west and south bluff faces, disturbed by quarrying operations, native prairie exists only near the summit.

Station 3. The south face of this bluff (Figure 1) has a 45°-60° slope and is covered with bunches of *Andropogon scoparius* and *Yucca glauca*. On the summit and north slope *A. scoparius* and *Bouteloua curtipendula* are replaced by *A. gerardi*.

Station 4. This bluff (Figure 2) is neither high nor abrupt. Glacial till is exposed on the lower three-fourths of the west slope.
Figure 1. View of south slope of station 3 above gravel pit by Iowa Highway # 141.

Figure 2. View of the west slope of station 4.
The characteristic prairie vegetation occurs on the east slope which is exposed to southwest winds and protected by fences.

Station 5. Extending in a north-south direction, this bluff (Figure 3) has several cuts that expose the southeast slopes to the southwestern winds. The lower west slope has a border of *Fraxinus americanus* above which *Rhus glabra*, *Symphoricarpus orbiculatus* and *Andropogon gerardi* spread into the upland prairie. *Yucca glauca* is quite prominent on the southeastern slopes as well as the west slopes. Near the summit, the slopes in the lee of the wind support *Andropogon scoparius* and *Bouteloua curtipendula*, which are replaced by *A. gerardi* as the effective eddy current range of the wind is passed.

Station 6. In Shimek's report (1908) this bluff is called Murray Hill. The face of the bluff rises at nearly a 60° angle above County Trunk D. The bluff summit is over two hundred feet above the valley floor. On the steep west face only *Yucca glauca*, bunches of *Andropogon scoparius* and *Muhlenbergia cuspidata* and a few scattered forbs are present. A fence bounding the ridge at the top limits the extent of the east pastured slopes that are both closely grazed and mowed (Figure 4). The south and southeast slopes are overgrazed and badly eroded.

Station 7. Prairie grasses occur on the east slope which is exposed to southwestern winds. On the lower east slope the prairie is succeeded by *Rhus glabra*, *Cornus asperifolia* and *Fraxinus pennsylvanica*.

Station 8. The lower west slope of this bluff (Figure 5) is composed of *Crataegus* sp., *Fraxinus* sp., and *Morus* sp. Beneath the trees
Figure 3. View looking north toward station 5.

Figure 4. View of the summit of station 6 showing the fence separating the east and west slopes.
are *Symphoricarpos orbiculatus*, *Rhus glabra*, *Cornus asperifolia*, and many weeds. Beyond the edge of the woods is a band of *R. glabra* that persists on the west face to the summit. The bluff is heavily pastured, the west face cut by paths. *Andropogon scoparius* is prominent only on steep slopes (45° or more). The summit and east slope where exposed to the south and southwest wind are dominated by *A. scoparius* and *Bouteloua curtipendula*. Wherever a shallow depression offers shelter these grasses are invaded by *R. glabra*. *Quercus macrocarpa* and *Fraxinus pennsylvanica* comprise the border of the open woods on the east slope.

Station 9. Disturbed by overgrazing, this bluff’s physiognomy is characterized by *Verbena stricta*, *Aristida oligantha*, and *Plantago purshii*. Sparse tufts of grass occur on the pronounced cat steps of the west slope. The prairie persists only on the steep northwest and upper west slopes.

Station 10. On the lower part of the undisturbed west slope is a thicket of *Fraxinus pennsylvanica*. Above this is a band of *Andropogon gerardi*, *Rhus glabra* and *Symphoricarpos occidentalis*. *A. gerardi* is replaced by *A. scoparius* as soon as the shelter-belt effect of the *F. pennsylvanica* is passed. *A. scoparius* and *Bouteloua curtipendula* dominate the upper west slope. At the summit a fence separates the ungrazed western slope from the grazed summit and east slope where *R. glabra* and weed species are the primary invaders. The pastured area is bordered on the east slope by *Quercus macrocarpa* and *F. pennsylvanica*.

Station 11. The steep west slope (Figure 6) has patches of bare loess on which *Rhus glabra*, *Rosa arkansana* var. *suffulta* and *Melilotus*
Figure 5. West pastured slope of station 8 with prominent cat steps.

Figure 6. View looking south along the west face of station 11.
officinalis are prominent. The remainder of the slope is populated by Andropogon scoparius, Bouteloua curtipendula and Muhlenbergia cuspidata. On the summit and east slope is a run-down pasture bordered by Symphoricarpus orbiculatus and Quercus macrocarpa.

Station 12. The west slope of the bluff (Figures 7 and 8) rises above a cultivated field. The gullies and northwest slopes are populated by Fraxinus pennsylvanica. Andropogon scoparius, Bouteloua curtipendula and scattered Rhus glabra cover most of the west slope. The summit is a narrow ridge never more than ten feet wide. The east slope is characterized, to the base, by A. scoparius and B. curtipendula. Although the area is pastured, the weed species are not prominent except along the lower slopes and the bare loess of the ridge top.

Station 13. This bluff (Figure 9) is probably the one described on Shimek's labels as "Bluffs east of Pacific Junction." The south end of the west facing bluff exposes a cut through 60 feet of loess and glacial till. A group of Juniperus virginiana occurs among the prairie grasses on the upper west slopes and summit, and east slope exhibits the remnants of an orchard. The west slope is pastured and weedy, with the native prairie persisting only near the summit.

Station 14. The loess part of the bluff (Figure 10) is abrupt but not high. Although the area is pastured, bunch-forming grasses and Yucca glauca occur on the steeper west slopes. The main grass of the east slopes is Andropogon gerardi which is replaced by A. scoparius and Bouteloua curtipendula near the summit. The bordering woods are limited to the lower slopes.
Figure 7. View of north and west slopes of station 12 from the flood plain.

Figure 8. West slope of station 12 rising above weedy pasture.
Figure 9. View looking north from flood plain toward station 13.

Figure 10. West slope of station 14 rising above pasture.
Station 15. At this station the bluffs (Figure 11) rise above a weedy pasture. While the lower west slopes are weedy and eroded, the upper slopes are dominated by Andropogon scoparius and Bouteloua curtipendula. Again at the summit the weed species are prominent on the bare loess. Woods are present on the east slope to the summit where Quercus macrocarpa, Corylus americana and Ulmus rubra border the prairie. On the west slope the woods are confined to the gullies (Figure 12).

Station 16. This is the only station that shows no signs of pasturing. The bluff (Figure 13) rises nearly 200 feet above the flood plain. The undisturbed prairie on the west slope has the usual zones of vegetation. At the bottom of the slope is a Fraxinus pennsylvanica thicket. Andropogon gerardi occupies the lower level of the slope and A. scoparius the upper level. On the summit A. scoparius and Bouteloua curtipendula are the dominants. To the east these grasses are bordered by Quercus macrocarpa, Corylus americana and Cornus asperifolia. Because the grasses have formed extensive mats to the exclusion of other species, the number of species collected at this station is small.

Plant Communities

According to Oosting (1948), a community is an aggregation of living organisms that have mutual relationships between themselves and to their environment. The plant communities described in this paper are characterized on the basis of their general appearance (i.e., predominant species) and habitat. Each community is named according to the most prominent
Figure 11. West slope of station 15.

Figure 12. View of west slope of station 15 showing gullies occupied by trees.
Figure 13. View of the west slope of station 16.
species or pair of species in it. These species, however, may or may not dominate the community.

**Andropogon gerardi community**

This community usually occurred on the edges of the woods on the lower west slopes, upper east slopes, and in sheltered gullies. It was predominantly characterized by *Andropogon gerardi*, *Rhus glabra* and *Symphoricarpus orbiculatus*, shrubby invaders of the prairie, and *Amorpha canescens* were also relatively common.

- **Checklist of prevalent species.**
- *Amorpha canescens*
- *Aster azureus*
- *Aster cordiflorus*
- *Aster laevis*
- *Cacalia tuberosa*
- *Elymus canadensis*
- *Eupatorium altissimum*
- *Lithospermum canescens*
- *Rhus glabra*
- *Salix humilis*
- *Silphium laciniatum*
- *Sisyrinchium campestre*
- *Solidago canadensis*
- *Solidago speciosa*, var. *angustata*
- *Sorghastrum nutans*
- *Symphoricarpus occidentalis*
- *Symphoricarpus orbiculatus*

**Andropogon scoparius-Bouteloua curtipendula community**

Occurring on the upper slopes and summits this community was characterized by *A. scoparius* and *Bouteloua curtipendula* which often formed dense mats. Where grazing had taken place *B. curtipendula* was the more prominent of the two.
Checklist of prevalent species.

Agoseris cuspidata
Andropogon scoparius
Anemone cylindrica
Anemone patens, var. wolfgangiana
Aster oblongifolius
Aster sericeus
Astragalus crassicarpus
Bouteloua curtipendula
Calamovilfa longifolia
Castilleja sessiliflora
Comandra richardiana
Delphinium virescens
Gaura parviflora
Gerardia aspera
Haplopappus spinulosus
Houstonia nigricans
Liatris punctata
Liatris aspera
Linum rigidum
Linum sulcatum
Lithospermum incisum
Oxytropis lambertii
Petalostemon candidum
Petalostemon purpureum
Psoralea esculenta
Senecio plattensis

Andropogon scoparius-Yucca glauca community

On the steep unsheltered slopes exposed to the arid west and south-west winds the sod-mat type of grass growth was replaced by the development of bunches. While the two dominant bunch formers were A. scoparius and Muhlenbergia cuspidata, the latter was inconspicuous. Weaver and Fitzpatrick (1934) found that on the steep loess hill slopes, A. scoparius often comprised 90 per cent of the vegetative cover.

Checklist of prevalent species.

Andropogon scoparius
Aster ericoides
Sporobolus cryptandrus-Lygodesmia juncea community

This community was characteristic of bare vertical loess. Most of the members were perennials with long roots.

The following were usually the first plants to populate exposed vertical loess:

Astragalus lotiflorus
Gaura coccinea
Houstonia nigricans
Lygodesmia juncea
Melilotus albus
Melilotus officinalis
Psorales argophylla
Rosa arkansana var. suffulta
Sphaerulcea coccinea
Sporobolus cryptandrus

Verbena stricta community

Where the grass cover had been disturbed by overgrazing on the lower west and upper east slopes and summits, weed species were abundant and often formed the dominant aspect of the vegetation.
Checklist of prevalent species.

Ambrosia artemisiifolia
Cirsium discolor
Erigeron canadensis
Euphorbia marginata
Grindelia squarrosa
Helianthus annuus
Helianthus laetiflorus var. rigidus
Setaria viridis
Solanum rostratum
Solidago rigida
Verbascum thapsus
Vernonia baldwinii

Trees and Shrubs Bordering the Prairie

The common trees and shrubs immediately bordering the prairies are as follows:

Cornus asperifolia
Corylus americanus
Fraxinus americana
Fraxinus pennsylvanica
Gleditsia triacanthos
Populus deltoides
Quercus macrocarpa
Quercus muehlenbergii
Rhus glabra
Symphoricarpos occidentalis
Symphoricarpos orbiculatus
Ulmus americana
Ulmus rubra

While all the above listed species were present in the southern counties, Quercus rubra, Quercus muehlenbergii, and Gleditsia triacanthos were not found in the immediate area of the prairie above Mills County. Rhus glabra was common on the prairied slopes and often present even in the Andropogon scoparius-Yucca glauca community. Mingled with R. glabra, but not advancing as far into the prairie were Symphoricarpos orbiculatus
and Symphoricarpos occidentalis. Quercus macrocarpa usually occurred along the ridges on the upper eastern slope and was scattered over the western slopes; Fraxinus pennsylvanica and Cornus asperifolia were ordinarily associated, forming a border at the base of the steep west slopes and in the gullies.

Floristic Composition of the Prairie Flora

Prairie element

The prairie species found on the bluffs may be divided roughly into the two subgroups characterized in the following paragraphs.

The plants enumerated below are wide ranging from New England and Atlantic Seaboard States, west to central North Dakota and eastern Colorado, and south to Texas and Louisiana.

Andropogon gerardi
Andropogon scoparius
Anemone cylindrica
Antennaria neglecta
Asclepias viridiflora
Aster ericoides
Aster laevis
Aster oblongifolius
Astragalus canadensis
Bouteloua curtipendula
Carex festucacea
Cassia fasciculata
Chenopodium leptophyllum
Comandra richardsoniana
Elymus canadensis
Eupatorium altissimum
Euphorbia corollata
Festuca octoflora
Hedeoma hispida
Koeleria cristata
Linum sulcatum
Lithospermum canescens
Muhlenbergia racemosa
Oxalis violacea
Panicum oligosanthes var. scribnerianum
Panicum virgatum
Polygala verticillata
Rosa arkansana var. suffulta
Salix humilis
Senecio plattensis
Solidago canadensis
Solidago nemoralis
Solidago rigida
Sorghastrum nutans
Sporobolus asper
Sporobolus cryptandrus
Stipa spartea
Symphoricarpos occidentalis
Symphoricarpos orbiculatus

In the second group the species are distributed in the Mississippi River and Missouri River drainage basins from the Prairie Peninsula of Illinois, Indiana, Ohio and Michigan west across the Great Plains to southern Saskatchewan and the foothills of the Rockies, southwest to Mexico and Texas, and south to Mississippi and Louisiana.

Agoseris cuspidata
Amorpha canescens
Anemone patens var. wolfgangiana
Antennaria campestris
Asclepias viridiflora var. lanceolata
Aster missouriensis
Aster sericeus
Bouteloua gracilis
Bouteloua hirsuta
Cacalia tuberosa
Castilleja sessiliflora
Ceanothus ovatus forma pubescens
Coreopsis palmata
Delphinium virensens
Gerardia aspera
Holianthus laetiflorus var. rigidus
Kuhnia eupatorioides var. corymbulosa
Liatris aspera
Lithospermum incisum
Muhlenbergia cuspidata
Petalostemum candidum
Western element

These species are limited to the area between the Rockies and the Upper Mississippi River. They range from the intermontane prairies of the Rockies east across the central plains to the Minnesota and Upper Mississippi River valleys and along the loess bluffs of western Iowa and Missouri south to New Mexico and Texas. Some of them extend into Iowa on the bluffs and the northwest corner of the state. Others, abundant in the sand hill region of central and western Nebraska, extend eastward only along the bluffs of the Platte and Missouri rivers. Further details are given in the distributional maps for eight of the species in the following list:

Agropyron desertorum
Asclepias viridiflora var. linearis
Astragalus lotiflorus
Astragalus missouriensis
Astragalus striatus
Cleome serrulata
Dalea enneandra
Gauro coccinea (Map 2)
Haplopappus spinulosus (Map 3)
Liatris punctata
Linum rigidum (Map 4)
Lomatium foeniculaceum
Lygodesmia juncea (Map 5)
Mentzelia decapetala (Map 6)
Mirabilis linearis
Oxytropis lambertii
Penstemon albidos
Penstemon graciilis
Penstemon grandiflorus (Map 7)
Petalostemum multiflorum
Petalostemum occidentale
Psoralea esculenta
Sphaeralcea coccinea (Map 8)
Stipa comata
Yucca glauca (Map 9)

The following species, originating on the Great Plains, have spread eastward through Iowa and are infrequently recorded in the states of the Prairie Peninsula on dry roadides, along railroads and in waste places:

Artemisia ludoviciana
Astragalus crassicarpus
Calamovilfa longifolia
Callirhoe involucrata
Dalea alopecuroides
Dyssodia papposa
Echinacea angustifolia
Euphorbia marginata
Gaura parviflora
Grindelia squarrosa
Helianthus annuus
Helianthus petiolaris
Oenothera serrulata
Panicum wilcoxianum
Plantago purshii
Polanisia trachysperma
Salvia reflexa
Solanum rostratum
Vicia americana var. angustifolia

Ruderals

These plants are usually found on disturbed ground along roadides, in pastures and cultivated fields. Wherever they occur at the expense of more desirable species they are usually considered as weeds. This cosmopolitan group includes species from different parts of the United
States as well as those naturalized from Europe and Asia.

Amaranthus retroflexus  
Ambrosia artemisiifolia  
Aristida oligantha  
Aster ericoides  
Bromus tectorum  
Cannabis sativa  
Cenchrus pauciflorus  
Chenopodium album  
Datura stramonium  
Erigeron canadensis  
Erigeron ramosus  
Euphorbia dentata  
Euphorbia heterophylla  
Euphorbia maculata  
Euphorbia serpyllifolia  
Helianthus annuus  
Hordeum jubatum  
Lepidium densiflorum  
Lespedeza stipulacea  
Melilotus albus  
Melilotus officinalis  
Nepeta cataria  
Oenothera biennis  
Panicum capillare  
Salsola kali var. temuifolia  
Setaria viridis  
Sida spinosa  
Solidago canadensis  
Solidago rigida  
Teucrium canadense  
Verbascum thapsus  
Verbena hastata  
Verbena stricta  
Vernonia baldwini  

Southeastern element

The species listed below are of southeastern affinities. Only one species, *Houstonia nigricans*, is abundant in Iowa. It is recorded from the southwestern counties and Missouri River bluffs.

Croton capitatus  
Croton monanthogynous
Houstonia nigricans
Schrankia uncinata

Supplementary list of rare species

The following list includes those species for which there are few or no records from Iowa. In general they are western in origin.

Three species -- *Agropyron desertorum*, *Lomatium foeniculaceum* and *Thymelaea passerina* -- have not previously been reported from Iowa.

*L. foeniculaceum*, native to the Great Plains, has been recorded as far east as eastern Nebraska and Kansas. *A. desertorum*, introduced from Russia, has been planted in the northern Great Plains area (Hitchcock, 1950). *T. passerina* is native to central and southern Europe. This species is not included in the plant manuals of the United States. To the author's knowledge this is the first report of the species for the United States.

*Agropyron desertorum*
*Astragalus missouriensis*
*Astragalus striatus*
*Callirhoe involucrata*
*Cleome serrulata*
*Croton capitatus*
*Croton monanthogynus*
*Helianthus petiolaris*
*Lomatium foeniculaceum*
*Mirabilis linearis*
*Petalostemum multiflorum*
*Penstemon albidos*
*Penstemon gracilis*
*Schrankia uncinata*
*Sida spinosa*
*Stipa comata*
*Thymelaea passerina*
DISCUSSION

The ecological factors that permit species of the Great Plains to exist on the bluffs have been discussed by Pammel (1902), Shimek (1909), and Conard (1952). Shimek's data (1909) suggest that the porous soil and exposure to the arid southwest winds have allowed the more xerophytic western species to become established on the bluffs. There is, however, little information dealing with the migration of the western species to the bluffs.

The distributional maps of some of these plants may offer a key to certain eastward migration routes of the Great Plains flora. In general, the extensions into the prairie region have been along the Missouri, North Platte, Sioux, and Minnesota river valleys. The outlying tongues along these rivers are probably migratory tracts that provide a series of xeric habitats where the endemic species of the region reach their ecological limits. Only the more xerophytic species perpetuate themselves. In these specific and usually limited areas the western migrating species are able to compete successfully with the native species. The principal continuous area in Iowa offering suitable habitats for western species is the loess bluffs bordering the Missouri River flood plain. Some western species do occur on well-drained knolls in the northwest corner of the state as well as in dumps, pastures and along railroad beds. Possibly they are unable to spread farther into the region because the distance between favorable habitats is greater than their effective disseminating range. Whether the migratory tracts are
active or passive is beyond the scope of this study. However, much of the topography of these putative migratory tracts has been modified by cultivation and grazing; hence, the likelihood of further migration may be rather limited.

While apparently migrating into Iowa from the west and northwest along the Missouri River, several of these species probably originated in the southwest. Hall (1928) designates Mexico as the center of distribution of the genus *Haplopappus*. The aborescent ancestors of *Mentzelia decapetala* (Darlington, 1934) and *Sphaeralcea coccinea* (Kearney, 1942) also originated in Mexico. The greatest number of species of the genus *Yucca* occur in the southwestern part of the United States. According to Adams (1905) this southwestern flora has spread northward along either side of the Rockies and to the southeast occupying the relatively dry situations in the moist regions.

In explaining the history of *Penstemon grandiflorus*, Pennell (1935) has suggested the following: a southern distribution from Texas to Kansas during the Wisconsin stage of the Pleistocene epoch, a more recent northern extension on sandy outwashes along the Missouri, Sioux, and Upper Mississippi rivers, and extensions north from these areas to the head of the Red River and into central Minnesota. Other western species could have followed this pattern.
ANNOTATED LIST

The following information is provided for each plant enumerated.

(1) The scientific name.

(2) Ecological preference and the community in which it most commonly occurred. This information is not provided for those species recorded only from previous herbarium collections.

(3) The author's collections cited by station numbers.

(4) Other collections. Each county appears alphabetically, followed by collection locality or localities (in some cases not indicated on herbarium label). Specimens are identified by the collectors' surnames in parenthesis. The specimens are in the Iowa State College Herbarium unless IA follows the surname in which case the specimens are those from the State University of Iowa Herbarium.

The families are arranged according to the system of Engler and Prantl. The genera within each family and the species within the genera are alphabetical.
EQUISETACEAE

_Equisetum hyemale_ L., var. _intermedium_ A. A. Eat.

West slopes near summits. _Andropogon scoparius-Bouteloua curtipendula_ community.

Author's collections: 2, 6, 13, 14, 15.

Other collections. Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA). Monona: Grant Center (Shimek IA).

PINACEAE

_Juniperus virginiana_ L.

On prairied west slopes near summit. _Andropogon scoparius-Bouteloua curtipendula_ community.

Author's collections: 13, 15.

GRAMINEAE

_Agroecron desertorum_ (L.) Gaertn. Map 10

Northwest slope. _Andropogon scoparius-Bouteloua curtipendula_ community.

Author's collections: 2

_Agroecron smithii_ Rydb.

Northwest slope. _Andropogon gerardi_ community.

Author's collections: 9

Other collections. Monona: Grant Center (Shimek IA). Pottawattamie: Council Bluffs (Shimek IA).

_Agroesia hiealis_ (Walt.) B.S.P.

Summit in pasture.

Other collections. Monona: Grant Center (Shimek IA).

_Andropogon gerardi_ Vitman

Lower west slopes and east slopes. Scattered on summits and upper west slopes. _Andropogon gerardi_ community.

Author's collections: 1, 7, 12, 15, 16.
Other collections. Fremont: Hamburg (Shimek IA). Harrison: Missouri Valley (Shimek); Murray Hill (Shimek IA). Monona: Turin (Pammel, Shimek IA). Pottawattamie: Council Bluffs (Shimek). Woodbury: Sergeant's Bluff (Shimek IA); Sioux City (Pammel, Wakefield).

**Andropogon scoparius** Michx.
The dominant grass of west slopes and summits, except in badly disturbed areas. *Andropogon scoparius-Yucca glauca* and *Andropogon scoparius-Bouteloua curtipendula* communities.

Author's collections: 1, 2, 3, 7, 8, 9, 14, 16.


**Aristida oligantha** Michx.
Run-down pastures on summits. *Aristida oligantha-Plantago purshii* community.

Author's collections: 2, 5, 6, 7, 8, 9, 11, 12, 13, 15.

Other collections. Pottawattamie: Council Bluffs (Pammel).

**Bouteloua curtipendula** (Michx.) Torr.
Slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 3, 4, 5, 7, 8, 9, 10, 11, 14, 15, 16.


**Bouteloua gracilis** (H.B.K.) Lag.
Summits by paths. *Aristida oligantha-Plantago purshii* community.

Author's collections: 5, 8, 15.

Other collections. Fremont: Hamburg (Shimek). Monona: Turin (Shimek).

**Bouteloua hirsuta** Lag.
Summits by paths. *Aristida oligantha-Plantago purshii* community.

Author's collections: 14, 16.
Other collections. Fremont: Hamburg (Shimek). Monona: Turin (Shimek IA).

*Bromus inermis* Leyss.

Other collections. Harrison: Missouri Valley (Shimek IA).

*Bromus japonicus* Thumb.

Lower west slope. *Verbena stricta* community.

Author's collections: 9.

*Bromus tectorum* L.

Pastured slopes. *Verbena stricta* community.

Author's collections: 13.

Other collections. Pottawattamie: Council Bluffs (Shimek).

*Calamovilfa longifolia* (Hook.) Scribn. Map 11.

On edge of summits at top of west slopes.

Author's collections: 1, 2, 3, 6, 7, 8.


*Cenchurus pauciflorus* Benth.

Bare loess in run-down pastures on summits and slopes. *Aristida oligantha-Plantago purshii* community.

Author's collections: 4, 5, 12, 13.


*Dactylis glomerata* L.

Introduced in Paper’s Field on loess ridge.

Other collections. Harrison: Missouri Valley (Shimek IA).

*Digitaria sanguinalis* (L.) Scop.

Bare loess of run-down pasture on summit. *Aristida oligantha-Plantago purshii* community.

Author's collections: 4.

Other collections. Harrison: Missouri Valley (Shimek).
Echinochloa pungens (Poir.) Rydb.
Bare loess in disturbed area on summit. Verbena stricta community.

Author's collections: 14.

Other collections. Harrison: Missouri Valley (Pammel, Shimek).

Elymus canadensis L.
West slopes. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 2, 6, 7, 9, 11, 12, 13, 15, 16.


Elymus riparius Wiegand
West slope near summit. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1.

Eragrostis spectabilis (Pursh) Steud.
Summits. Aristida oligantha-Plantago purshii community.

Author's collections: 1, 2, 4, 7, 12.

Other collections. Fremont: Hamburg (Shimek); Waubonsie State Park (Hayden, Pohl). Pottawattamie: Council Bluffs (Shimek).

Festuca octoflora Walt.
Summits. Aristida oligantha-Plantago purshii community.

Author's collections: 13, 15.

Other collections. Woodbury: T. 86 N., R. 47 W., Sec. 30 (Pohl).

Hordeum jubatum L.
Pastured slopes. A weedy species.

Author's collections: 3, 7, 10, 12.

Other collections. Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA).

Hordeum pusillum Nutt.
In a pasture on lower west slope.

Author's collections: 13.

Other collections. Pottawattamie: Council Bluffs (Shimek).
Koeleria cristata (L.) Pers.
Upper slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 2, 8, 10, 11.

Other collections. Harrison: Missouri Valley (Pammel, Shimek); Murray Hill (Shimek). Monona: Grant Center (Shimek); Turin (Shimek). Pottawattamie: Council Bluffs (Shimek IA).

Muhlenbergia cuspidata (Nutt.) Rydb.
West slopes. Andropogon scoparius-Yucca glauca community. It is a bunch forming grass.

Author's collections: 1, 2, 4, 6, 7, 8, 9, 10, 11, 13, 16.


Muhlenbergia racemosa (Michx.) B.S.P.
West slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 6, 10, 11, 12, 16.


Panicum capillare L.
Summits and slopes. A weed species common in every community.

Author's collections: 2, 3, 4, 5, 8, 11.

Other collections. Fremont: Hamburg (Shimek IA). Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA).

Panicum oligosanthes Schultes, var. scribnerianum (Nash) Fern.
Upper slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 6, 7, 8, 15.

**Panicum virgatum** L.  
Summit. *Verbena stricta* community.  
Author's collections: 11.  
Other collections. Fremont: Hamburg (Shimek IA).

**Panicum wilcoxianum** Vasey.  
Upper west slopes. *Andropogon scoparius-Bouteloua curtipendula* community.  
Author's collections: 1.  

**Paspalum ciliatifolium** Michx.  
Run-down pasture on summit.  
Author's collections: 8, 9.  
Other collections. Fremont: Waubonsie State Park (Shimek IA).

**Poa compressa** L.  
East slope at summit. *Andropogon scoparius-Bouteloua curtipendula* community.  
Author's collections: 1.  
Other collections. Pottawattamie: Council Bluffs (Shimek).

**Poa pratensis** L.  
Upper slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.  
Author's collections: 2.  

**Setaria glauca** (L.) Beauv.  
Run-down pastures on summits. *Aristida oligantha-Plantago purshii* community.  
Author's collections: 14.  
Other collections. Fremont: Hamburg (Shimek). Harrison: Missouri Valley (Shimek IA).
Setaria viridis (L.) Beauv.
Run-down pastures on summits. *Aristida oligantha-Plantago purshii* community.

Author's collections: 4, 5, 9, 11, 12, 13, 14.

Other collections. Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA). Pottawattamie: Council Bluffs (Shimek).

**Sorghastrum nutans** (L.) Nash
Gullies and slopes on edge of woods. *Andropogon gerardi* community.

Author's collections: 5, 8, 14, 16.

Other collections. Fremont: Hamburg (Shimek). Woodbury: Sioux City (Pammel).

*Sphenopholis obtusata* (Michx.) Scribn.
Lower west slopes on edge of open woods.

Author's collections: 4, 12.

**Sporobolus asper** (Michx.) Kunth
Upper west slope and summit. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 13.

Other collections. Woodbury: Sioux City (Pammel).

**Sporobolus cryptandrus** (Torr.) Gray
A pioneer on bare vertical loess of west slopes.

Author's collections: 1, 3, 4, 5, 6, 7, 8, 9, 12, 13, 15.


**Stipa comata** Trin.

Other collections. Woodbury: Sioux City (Hitchcock).

**Stipa spartea** Trin.
Upper slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community. This species may dominate the community on the back slopes and rolling land behind the bluff summits.

Author's collections: 1, 4, 6, 8, 10, 11.
Other collections. Harrison: Missouri Valley (Shimek IA); Murrey Hill (Shimek). Monona: Grant Center (Shimek); Turin (Shimek IA). Pottawattamie: Council Bluffs (Pammel). Woodbury: Sioux City (Hayden).

*Stipa viridula* Trin.
Pasture on west slope. *Verbena stricta* community.

Author’s collections: 9.

**Cyperaceae**

*C. Carex blanda* Dew.

Author’s collections: 12.

*C. Carex festucacea* Willd.
Upper slopes and summits. *Andropogon scoparius–Bouteloua curtipendula* community.

Author’s collections: 2, 3, 8, 10, 13, 15.

Other collections. Harrison: Missouri Valley (Shimek). Monona: Turin (Shimek).

**Liliaceae**

*C. Asparagus officinalis* L.
Lower slopes. *Andropogon gerardi* community.

Author’s collections: 10, 11.

Other collections. Harrison: Missouri Valley (Shimek). Pottawattamie: Council Bluffs (Shimek).

*S. Smilacina stellata* (L.) Desf.

Other collections. Monona: Grant Center (Shimek).

*C. Yucca glauca* Nutt.
West and east slopes exposed to the southwest winds. *Andropogon scoparius–Yucca glauca* community.

Author’s collections: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16.

IRIDACEAE

Sieyrinchium campestre Bickn.
Upper slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 4, 5, 7, 8, 9, 10, 11, 12, 14, 15.


SALICACEAE

Populus deltoides Marsh.
Isolated plants on west slopes and in gullies.

Author's collections: 6, 15.

Salix humilis Marsh.
Northwest and east slopes. Andropogon gerardi community.

Author's collections: 16.


Salix interior Rowlee


CORYLACEAE

Corylus americana Walt.
Edge of woods bordering prairie on upper east slopes and summits.

Author's collections: 14, 15, 16.
Other collections. Fremont: Babbitt Place, 10 miles west of Sidney (Pammel). Harrison: Missouri Valley (Clark, Shimek).

**FAGACEAE**

*Quercus macrocarpa* Michx.

Bordering prairie and often scattered on prairied west slopes.

Author's collections: 14, 15, 16.


*Quercus muehlenbergii* Engelm.

Bordering prairie on summits. Not found north of Mills County.

Other collections. Fremont: Hamburg (Pammel); Babbitt Place, 10 miles west of Sidney (Hayden); Waubonsie State Park (Hayden). Mills: Glenwood (Pammel); Rawles Twp., Sec. 36 (Hayden).

**ULMACEAE**

*Ulmus rubra* Muhl.

Edge of woods bordering prairie on summits.

Author's collections: 15.


**CANNABINACEAE**

*Cannabis sativa* L.

Pastured slopes and summits. * Verbena stricta* community.

Author's collections: 3, 5, 9, 13.

**SANTALACEAE**

*Comandra richardsiana* Fern.

Summits and upper east slopes. *Andropogon scoparius*–*Bouteloua curtipendula* community.
Author's collections: 2, 4, 5, 6, 10, 15, 16.


_Comandra umbellata_ (L.) Nutt.
Summits and upper east slopes. _Andropogon scoparius–Bouteloua curtipendula_ community.

Other collections. Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek). Monona: Turin (Goodman, Shimek).

**POLYGONACEAE**

_Polygonum convolvulus_ L.
Loess ridge.

Other collections. Monona: Turin (Shimek IA).

_Polygonum pennsylvanicum_ L.
Pastured east slope. _Verbena stricta_ community.

Author's collections: 12.

_Polygonum remotissimum_ Michx.
Loess ridges. _Verbena stricta_ community.

Author's collections: 8, 10.

Other collections. Fremont: Hamburg (Shimek IA). Harrison: Missouri Valley (Pemmel); Murray Hill (Shimek IA); Woodbury: Sioux City (Pemmel).

_Polygonum scandens_ L.
Summit of bluff. _Verbena stricta_ community.

Author's collections: 14.

_Rumex crispus_ L.
Top of ridge.

Other collections. Harrison: Missouri Valley (Shimek IA).

**CHENOPODIACEAE**

_Chenopodium album_ L.
Slopes and summits, pastures. Verbena stricta community.

Author's collections: 7, 10, 11.

Other collections. Harrison: Murray Hill (Shimek).

Chenopodium leptophyllum Nutt.

Paths on summits. Aristida oligantha-Plantago purshii community.

Author's collections: 3, 11.

Kochia scoparia (L.) Schrad.
Pastured slopes. Verbena stricta community.

Author's collections: 4, 5, 6.

Salsola kali L., var. tenuifolia Tausch.
Weedy pastures on summits. Verbena stricta community.

Author's collections: 1, 2, 3, 4, 6, 12, 14.


AMARANTHACEAE

Amaranthus graecizans L.

Other collections. Harrison: Missouri Valley (Shimek IA). Woodbury: Sioux City (Pammel).

Amaranthus retroflexus L.
Pastured summits. Verbena stricta community.

Author's collections: 14.

Other collections. Harrison: Missouri Valley (Shimek IA).

NYCTAGINACEAE

Mirabilis linearis (Pursh) Heimeral

Other collections. Woodbury: Sioux City (Pammel).
**RANUNCULACEAE**

**Anemone canadensis L.**
Loess on detached ridge south of Grant Center.

Other collections. Monona: Grant Center (Shimek IA).

**Anemone cylindrica Gray**
East slopes and summits. *Andropogon scoparius*–*Bouteloua curtipendula* community.

Author's collections: 2, 4, 5, 8.

Other collections. Harrison: Missouri Valley (Shimek). Mills: bluffs east of Pacific Junction (Shimek). Monona: Grant Center (Shimek); Kennebec Twp., Sec. 7 (Hayden). Pottawattamie: Council Bluffs (Shimek). Woodbury: Sergeant's Bluff (Shimek).

**Anemone patens L., var. wolfgangiana (Bea.s.) Koch**
Northwest and east slopes. *Andropogon scoparius*–*Bouteloua curtipendula* community.

Author's collections: 2, 4, 5, 6, 10.

Other collections. Monona: Grant Center (Shimek).

**Anemone virginiana L.**
East slope. *Andropogon gerardi* community.

Author's collections: 1, 11.

**Clematis virginiana L.**
Upper east slopes on edge of woods. *Andropogon gerardi* community.

Author's collections: 6.

Other collections. Woodbury: Sergeant's Bluff (Shimek).

**Delphinium virescens Nutt.**
Single plants scattered on slopes and summits. *Andropogon scoparius–Bouteloua curtipendula* and *Andropogon scoparius–Yucca glauca* communities.

Author's collections: 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

Ranunculus abortivus L.

Other collections. Fremont: Hamburg (Shimek IA).

CAPPARIDACEAE

Cleome serrulata Pursh

Rare on the bluffs.

Other collections. Fremont: Hamburg (Hitchcock IA). Monona: Turin (Pammel). Woodbury: Sergeant's Bluff (Shimek); Sioux City (Campbell, Pammel).

Polanisia trachysperma T. & G.

Rare loess on west slopes. Andropogon scoparius-Yucca glauca community.

Author's collections: 1, 5, 6.

CRUCIFERAE

Arabia hirsuta (L.) Scop.

East slope at summit. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 4, 6.

Capsella Bursa-pastoris (L.) Medic.

Other collections. Pottawattamie: Council Bluffs (Shimek).

Descurainia pinnata (Walt.) Britt. var. brachycarpa (Richars.) Fern.


Draba reptans (Lam.) Fern., var. micrantha (Nutt.) Fern.

Rare loess on summit. Aristide oligantha-Plantago purshii community.

Author's collections: 2.

Lepidium densiflorum Schrad.

Pastured summits. Verbena stricta community.

Author's collections: 8, 11, 13.

Lepidium draba L.

Other collections. Woodbury: Sergeant's Bluff (Pemmel).

Rorippa sinuata (Nutt.) Hitchc.

West slope. Andropogon scoparius–Bouteloua curtipendula community.

Author's collections: 3, 5, 12.

Sisymbrium altissimum L.

Other collections. Monona: Turin (Shimek).

SAXIFRAGACEAE

Heuchera richardsonii R. Br., var. grayana Rosend., Butt. & Lak.

North slopes. Andropogon gerardi community.

Author's collections: 9, 10.

Other collections. Monona: Kennebec Twp., Sec. 18 (Hayden); Turin (Goodman, Shimek, Weber).

ROSACEAE

Fragaria virginiana Duchesne

Lower slopes. Andropogon gerardi community.

Author's collections: 3, 12, 15.

Geum canadense Jacq.

Upper east slope. Andropogon gerardi community.

Author's collections: 3, 5.

Potentilla canadensis L.

Other collections. Harrison: Missouri Valley (Shimek IA).

Potentilla norvegica L.

Pasture on summit. Verbena stricta community.

Author's collections: 3, 4.
Rosa arkansana Porter, var. suffulta (Greene) Cockerell
West slopes and summits, often on bare vertical loess. Andropogon scoparius-Yucca glauca community.

Author's collections: 4, 6, 8, 10, 11, 15, 16.

Other collections. Fremont: Hamburg (Shimek IA). Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA). Monona: Grant Center (Shimek); Turin (Shimek IA). Pottawattamie: Council Bluffs (Shimek).

Rubus occidentalis L.

Other collections. Harrison: Missouri Valley (Pammel, Shimek).

LEGUMINOSAE

Amorpha canescens Pursh.
Undisturbed prairie on lower west and upper east slopes. Andropogon gerardi community.

Author's collections: 1, 2, 6, 7, 8, 11, 13, 15, 16.


Astragalus canadensis L.
Sheltered slopes on edge of woods. Andropogon gerardi community. Uncommon on the bluffs.

Author's collections: 1, 2, 14.

Other collections. Woodbury: Sergeant's Bluff (Isely).

Astragalus crassicarpus Nutt.
Upper west slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 4, 6, 8, 10, 11, 12, 16.


Astragalus lotiflorus Hook.
Bare loess on steep west slopes and summits. Andropogon scoparius-Yucca glauca community.

Map 15
Author's collections: 1, 2, 3, 5, 7, 8, 9, 10, 11, 13, 14, 15.

Other collections. Fremont: (Anderson); Hamburg (Ash, Pammel, Shimek). Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA). Monona: Grant Center (Shimek IA); Turin (Goodman). Pottawattamie: Council Bluffs (Goodman, Shimek). Woodbury: Sioux City (Shimek); bluffs southeast of Sioux City (Fox IA).

**Astragalus missouriensis** Nutt.  
Map 16.

Other collections. Woodbury: 15 miles southeast of Sioux City (Fox IA).

**Astragalus striatus** Nutt.  
Loess hill.

Other collections. Harrison: Missouri Valley (Shimek IA).

**Cassia fasiculata** Michx.  
Common on flood plain and lower west slopes, advancing to summits along cow paths in run-down pastures.

Author's collections: 2, 6, 7, 9, 15, 16.

Other collections. Fremont: Washington Twp., Sec. 29 (Hayden); Hamburg (Shimek). Woodbury: Sioux City (Pammel, Shimek).

**Crotalaria sagittalis** L.  
Prairie on bluffs.

Other collections. Woodbury: Sergeant's Bluff (Shimek).

**Dalea alopecuroides** Willd.  

**Dalea enneandra** Nutt.  
West slopes and summits. *Andropogon scoparius-Yucca glauca* community.

Author's collections: 1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

Other collections. Fremont: (Anderson); Waubonsie State Park (Hayden); Hamburg (Fitzpatrick, Pammel, Shimek). Harrison: Missouri Valley (Shimek). Mills: Lyons Twp., Sec. 36 (Hayden); Glenwood (Pammel). Pottawattamie: Lewis Twp., Sec. 7 (Hayden); Council Bluffs (Shimek). Woodbury: Sergeant's Bluff (Isely); Sioux City (Hayden, Pammel, Shimek).
Desmanthus illinoensis (Michx.) MacM.
Frequent on flood plain. Only one plant found on a bluff summit.

Author's collections: 16.

Other collections. Fremont: Hamburg (Shimek IA).

Desmodium canescens (L.) DC.
One plant found on summit of bluff among Andropogon gerardi.

Author's collections: 16.

Lespedeza capitata Michx.
Scattered on undisturbed slopes. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 3, 8, 11, 14, 15, 16.

Other collections. Fremont: Washington Twp., Sec. 29 (Hayden); Hamburg (Pammel, Shimek IA). Monona: Grant Center (Shimek IA). Pottawattanie: Council Bluffs (Shimek IA). Woodbury: Sergeant's Bluff (Shimek IA).

Lespedeza stipulacea Maxim.
Pioneer plant on bare loess of run-down pastures on summits. Introduced and naturalized in this country from eastern Asia.

Author's collections: 13, 14.

Lespedeza virginica (L.) Britt.
Summit. Andropogon scoparius-Bouteloua curtipendula community in opening in woods.

Author's collections: Fremont: Waubonsie State Park.

Medicago lupulina L.
 Bare loess at summit. Dyssodia papposa-Plantago purshii community.

Author's collections: 4, 5, 8, 14, 15.

Other collections. Monona: Turin (Shimek IA).

Medicago sativa L.
Cow path in run-down pasture on west slope.

Author's collections: 10.

Other collections. Harrison: Missouri Valley (Shimek IA).
Meli10tus albus Desr.
Pastures on west slopes and summits. *Andropogon scoparius-Yucca glauca* community. A pioneer on bare loess.

Author's collections: 1, 8, 10, 13.


Meli10tus officinalis (L.) Lam.
Pastures on west slopes and summits. *Andropogon scoparius-Yucca glauca* community. A pioneer on bare loess.

Author's collections: 1, 3, 5, 6, 7, 8, 9, 10, 11, 13, 14, 16.


Oxytropis lamberti Pursh
Upper west slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 3, 4, 6, 7, 8, 9, 10, 11, 12, 15.


Petalostemum candidum (Willd.) Michx.
In scattered groups on slopes and summits. Less common than *P. purpureum. Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 6, 7, 9, 10, 15, 14, 15.


Petalostemum multiflorum Nutt.
Other collections. Woodbury: bluffs southeast of Sioux City (Fox IA).

Petalostemum occidentale (Gray) Fern.
Rare on the bluffs.
Author's collections: 2, 3, 4, 5, 7, 8.

Other collections. Monona: Turin (Pammel). Woodbury: Sioux City (Pammel); bluffs southeast of Sioux City (Fox IA).

Petalostemum purpureum (Vent.) Rydb.
West slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 16.


Psoralea argophylla Pursh
In groups on upper slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 16.


Psoralea esculenta Pursh
Single plants on west slopes at summits. Andropogon scoparius-Bouteloua curtipendula community. In July the stems break off near the ground and the seeds are scattered as the plant is blown about (Weaver and Fitzpatrick, 1934).

Author's collections: 1, 2, 4, 5, 6, 7, 8, 9, 12.

Other collections. Harrison: Missouri Valley (Shimek); Murray Hill (Shimek IA). Monona: Turin (Goodman, Shimek IA, Weber). Pottawattamie: Council Bluffs (Shimek). Woodbury: 15 miles south of Sioux City (Goodman); Stone State Park (Hayden).

Schrankia nuttallii (DC.) Standl.
West slopes. Andropogon scoparius-Bouteloua curtipendula community. Limited to the loess area of western Iowa.

Author's collections: 13.

Strophostyles helvolu (L.) Ell.
Loess ridge.

Other collections: Fremont: Hamburg (Shimek IA).

Strophostyles leiopserma (T. & G.) Piper
West slopes. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 8, 9, 10, 11, 13, 15, 16.


Trifolium pratense L.
Loess ridge.

Other collections. Harrison: Missouri Valley (Shimek IA).

Trifolium repens L.
Ridge southwest of Grant Center.

Other collections. Monona: Grant Center (Shimek IA).

Vicia americana Muhl.

Other collections. Monona: Grant Center (Shimek IA). Pottawattamie: Council Bluffs (Shimek IA).

Vicia americana Muhl., var. angustifolia Nees.
West slopes. Andropogon scoparius-Yucca glauca community.

Author's collections: 1, 5, 7, 9, 10, 15.

Other collections. Harrison: Missouri Valley (Fox, Shimek). Pottawattamie: Council Bluffs (Shimek IA).

OXALIDACEAE

Oxalis stricta L.
Pastures on summits. Aristida oligantha-Plantago purshii community.

Author's collections: 1.

Map 18. Oxytropis lambertii
Map 19. Petalostemon multiflorum
Map 20. Petalostemon occidentale
Map 21. Peoraea esculenta
Map 22. Schrankia mutellin
Map 23. Linum rigidum
Map 24. Croton capitatus
Map 25. Croton nonanthogynus
**Oxalis violacea L.**

Lower west slopes. *Andropogon gerardi* community.

Author's collections: 1, 3, 6, 13, 15.


**LINACEAE**

*Linum rigidum* Pursh

West slopes and summits. *Andropogon scoparius-Bouteloua curtispendula* and *Andropogon scoparius-Yucca glauca* communities.

Author's collections: 2, 3, 4, 5, 6, 7, 8, 10, 14.

Other collections. Monona: Turin (Goodman, Jurley, Weber). Woodbury: (Oleson); Sioux City (Shimek IA).

*Linum sulcatum* Riddell

Scattered on slopes and summits. *Andropogon scoparius-Bouteloua curtispendula* community. Blooms later than *L. rigidum*.

Author's collections: 1, 4, 5, 8, 10, 15, 16.

Other collections. Monona: Grant Center (Shimek IA). Woodbury: Sioux City (Hitchcock IA).

**POLYGALACEAE**

*Polygala verticillata* L.

Bare loess on summits and slopes. *Andropogon scoparius-Bouteloua curtispendula* and *Aristida oligantha-Plantago purshii* communities.

Author's collections: 1, 4, 7, 8, 10, 15.

Other collections. Harrison: Missouri Valley (Shimek IA). Woodbury: Sioux City (Fammel).

**EUPHORBIACEAE**

*Croton capitatus* Michx.

Path on bluff summit. *Aristida oligantha-Plantago purshii* community. Rare.

Author's collections: 14.
Croton monanthogynus Michx.
Paths on west slopes and summit. Aristida oligantha-Plantago purshii community. Rare.

Author's collections: 5.
Other collections. Monona: (D. F. Balloun).

Euphorbia corollata L.
Upper east slopes. Andropogon gerardi community.

Author's collections: 12, 13, 14, 15, 16.
Other collections. Woodbury: Sioux City (Pammel).

Euphorbia dentata Michx.
Slopes and summits. Verbena stricta community.

Author's collections: 1, 3, 10, 12, 14.

Euphorbia esula L.
Lower west slopes in disturbed area. Verbena stricta community.

Author's collections: 2, 3.

Euphorbia glyptosperma Englem.
West slopes. Andropogon scoparius-Yucca glauca community.

Author's collections: 6.

Euphorbia heterophylla L.
Scattered on west slopes. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 4, 5, 6, 7, 13.
Other collections. Woodbury: Sioux City (Pammel, Taylor).

Euphorbia marginata Pursh
Pastured slopes and summits. Verbena stricta community.

Author's collections: 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.
Other collections. Harrison: Missouri Valley (Pammel). Woodbury: Sioux City (Campbell, Hayden, Pammel).
**Euphorbia maculata L.**

Bare loess on summits. *Aristida oligantha-Plantago purshii* community.

Author's collections: 1, 10, 11, 12.

Other collections. Monona: Turin (Shimek).

**Euphorbia serpyllifolia Pers.**

Bare loess on pastured summits. *Aristida oligantha-Plantago purshii* community.

Author's collections: 3, 6, 9, 10, 11, 12, 13, 14, 15.

Other collections. Fremont: Hamburg (Shimek). Harrison: Murray Hill (Shimek).

**Euphorbia supina Rof.**

Pastured summits. *Aristida oligantha-Plantago purshii* community.

Author's collections: 1, 11.

Other collections. Harrison: Missouri Valley (Pammel).

**ANACARDIACEAE**

**Rhus glabra L.**

Edge of woods advancing over prairie, especially in disturbed areas.

Author's collections: 2, 4, 8, 10, 11, 13, 15.


**CELASTRACEAE**

**Celastrus scandens L.**

Edge of woods at summits and in sheltered gullies.

RHAMNACEAE

Ceanothus ovatus Desf. forma pubescens (S. Wats.) Soper
Undisturbed slopes and summits. Andropogon gerardi community.

Author's collections: 3, 5, 6, 7, 8, 10, 12, 15, 16.


MALVACEAE

Callirhoe involucrata T. & G.
Weedy pasture on summit. Aristida oligantha-Plantago purshii community.

Author's collections: 11.

Sida spinosa L.
Prairie steppe on loess ridge.

Other collections. Fremont: Hamburg (Shimek IA).

Sphaeralcea coccinea (Pursh) Rydb. Map 26
A pioneer species on bare vertical loess. Muhlenbergia cuspidata-Lygodemia juncea community. Distribution in Iowa restricted to the loess bluffs.

Author's collections: 12.

Other collections. Harrison: Murray Hill (Shimek); Missouri Valley (Shimek).

VIOLACEAE

Viola pedatifida Don.
Summits and upper east slopes. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 2, 5, 12.

LOASACEAE

*Mentzelia decapetala* (Pursh) Urban & Gilg.  
West slopes. *Andropogon scoparius-Yucca glauca* community. Infrequent.

Author's collections: 7, 8.

Other collections. Harrison: Missouri Valley (Hughes). Woodbury: Sioux City (Hayden, Pammel, Taylor).

THYMELAEACEAE

*Thymelaea passerina* (L.) Coss. & Germ.  
Bare vertical loess. This species is new to Iowa. It was determined by Dr. Richard W. Pohl.

Author's collections: 12.

ONAGRACEAE

*Gaura coccinea* Pursh  
West slopes. *Andropogon scoparius-Yucca glauca* community. A pioneer on bare vertical loess. Restricted to the western tier of counties in Iowa.

Author's collections: 2, 3, 4, 6, 7, 9, 10, 11, 14, 15.

Other collections. Monona: Grant Center (Shimek IA); Turin (Goodman, Pammel, Shimek, Weber). Pottawattamie: Council Bluffs (Shimek IA).

*Gaura parviflora* Dougl.  
Summits and upper slopes. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 4, 5, 6, 8, 9, 15.


*Oenothera biennis* L.  
Scattered on slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 2, 4, 5, 7, 8, 9, 10, 12, 13, 15.
Oenothera laciniata Hill
Prairie on ridge of bluff. Rare.

Author's collections: 13.

Other collections. Pottawattamie: Council Bluffs (Shimek).

Oenothera serrulata Nutt.
West slopes and summits. Andropogon scoparius-Yucca glauca and Sporobolus cryptandrus-Lygodesmia juncea communities.

Author's collections: 1, 3, 4, 5, 11, 12, 13, 14, 16.

Other collections. Fremont: Hamburg (Shimek). Monona: Turin (Shimek).

UMBELLIFERAE

Lomatium foeniculaceum (Nutt.) C. & R. Map 31
Pasture on lower west slope. This is the first record of this species in Iowa. It has been reported as far east as northeast Kansas and southeast Nebraska.

Author's collections: 15.

CORNACEAE

Cornus asperifolia Michx.
Edge of woods bordering prairie.

Author's collections: 14, 15, 16.


APOCYNACEAE

Apocynum cannabinum L.
In gully. Andropogon gerardii community.

Author's collections: 7.
ASCLEPIADACEAE

Asclepias tuberosa L.
East slope. Andropogon gerardi community. Rare on the bluffs.
Author's collections: 14.

Asclepias verticillata L.
Slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.
Author's collections: 3, 7, 10, 11, 13, 14, 15.

Other collections. Fremont: Hamburg (Shimek). Monona: Turin (Pammel). Woodbury: Sergeant's Bluff (Shimek); Sioux City (Pammel).

Asclepias viridiflora Raf.
Undisturbed upper west slopes and summits. Andropogon scoparius-
Bouteloua curtipendula community.
Author's collections: 5, 6, 7, 10, 15.

Other collections. Mills: bluffs east of Pacific Junction (Shimek IA).

Asclepias viridiflora Raf., var. lanceolata (Ives) Torr.
Undisturbed upper west slopes and summits. Andropogon scoparius-
Bouteloua curtipendula community.
Author's collections: 3, 4, 7, 9, 10, 15, 16.

Other collections. Harrison: Murray Hill (Shimek). Monona: Turin (Shimek).

Asclepias viridiflora Raf., var. linearis (Gray) Fern. Map 32
Undisturbed upper west slopes and summits. Andropogon scoparius-
Bouteloua curtipendula community.
Author's collections: 1, 5, 10, 12, 16.

Other collections. Mills: bluffs east of Pacific Junction (Shimek). Monona: Grant Center (Shimek).

CONVOLVULACEAE

Convolvulus sepium L.
Other collections. Monona: Grant Center (Shimek).
POLEMONIACEAE

Phlox pilosa L.
Northeast slope. Andropogon gerardi community.

Author's collections: 10.

Other collections. Harrison: Murray Hill (Shimek).

BORAGINACEAE

Cynoglossum officinale L.
Run-down pasture on summit. Verbena stricta community.

Author's collections: 6, 14.


Lappula redowskii (Nornem.) Greene, var. occidentalis (Wats.) Rydb.
Summits and lower slopes. Aristida oligantha-Plantago purshii community.

Author's collections: 7, 11.

Other collections. Monona: Grant center (Shimek IA); Turin (Weber).

Lithospermum canescens (Michx.) Lehm
Sheltered slopes. Andropogon gerardi community.

Author's collections: 1, 2, 4, 5, 7, 10, 12, 15, 16.

Other collections. Fremont: Hamburg (Shimek). Harrison: Missouri Valley (Shimek IA). Monona: Grant Center (Shimek); Turin (Goodman). Pottawattamie: 6 miles south of Council Bluffs (Goodman).

Lithospermum incisum Lehm
Upper slopes and summits. Andropogon scoparius-Bouteloua curtipendula community. This species blooms earlier than L. canescens.

Author's collections: 1, 2, 5, 9, 11, 12.


Onosmodium occidentale Mackenz.
Occasional on pastured west slopes. Verbena stricta community.
Author's collections: 14.


VERBENACEAE

Verbena bracteata Lag. & Rodr.
Run-down pastures on summits. Aristida oligantha-Plantago purshii community.

Author's collections: 7, 8, 10.

Other collections. Monona: Grant Center (Shimek IA); Turin (Shimek).

Verbena stricta Vent.
Run-down pastures on slopes and summits. Verbena stricta community. This species is an excellent indicator of disturbed area. Two stems characteristically arise from a tap root.

Author's collections: 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15.


Verbena stricta Vent., forms albiflora Wadmond
Rare in run-down pastures on slopes and summits. Verbena stricta community.

Author's collections: 2, 6, 9.

LABIATAE

Hedeoma hispida Pursh
Slopes and summits. Aristida oligantha-Plantago purshii community.

Author's collections: 2, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16.


Nepeta cataria L.
Disturbed summits. Verbena stricta community.
Author's collections: 4, 14, 16.

Other collections. Monona: Turin (Shimek IA).

Salvia reflexa Hornem.
Pastured slopes and summits. Aristida oligantha-Plantago purshii community.

Author's collections: 3, 4, 8, 11, 13, 14.


Teucrium canadense L.
Pastured slopes and summits. Verbena stricta community.

Author's collections: 8, 10, 11, 13, 14, 15.

Other collections. Fremont: Hamburg (Pammel, Shimek).

Solanaceae

Datura stramonium L.
Bare loess of paths on west slopes. Verbena stricta community.

Author's collections: 12, 13.

Physalis heterophylla Nees.
Paths on west slopes. Verbena stricta community.

Author's collections: 13, 15.

Physalis longifolia Nutt.
Pastured summits. Verbena stricta community.

Author's collections: 13.

Physalis virginiana Mill.
Pastured summits. Verbena stricta community.

Author's collections: 15.

Solanum rostratum Dunal
Bare loess in run-down pastures on slopes and summits. Verbena stricta community.

Author's collections: 3, 4, 6, 9, 11.
Other collections. Woodbury: Sioux City (Shimek).

SCROPHULARIACEAE

Castilleja sessiliflora Pursh.
Bluff summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 2, 9, 10, 12, 15, 16.
Other collections. Fremont: Hamburg (Shimek). Harrison: Missouri Valley (Shimek). Monona: Grant Center (Shimek); Turin (Goodman). Pottawattamie: Council Bluffs (Shimek). Woodbury: 15 miles south of Sioux City (Goodman).

Gerardia aspera Dougl.
Upper west slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 14, 15, 16.

Penstemon albidus Nutt.
Rare in Iowa.

Other collections. Woodbury: 15 miles south of Sioux City (Weber).

Penstemon gracilis Nutt.
Rare in Iowa.

Other collections. Harrison: Missouri Valley (Shimek).

Penstemon grandiflorus Nutt.
West slopes and summits. Andropogon scoparius-Bouteloua curtipendula and Andropogon scoparius-Yucca glauca communities.

Author's collections: 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16.
Other collections. Harrison: Missouri Valley (Shimek); Murray Hill (Shimek). Mills: bluffs east of Pacific Junction (Shimek IA).
Monona: Grant Center (Shimek); Kennebec Twp., Sec. 18 (Hayden); Turin (Goodman, Shimek). Pottawattamie: Council Bluffs (Goodman, Hayden, Shimek). Woodbury: Sioux City (Pammel).

Scrophularia lanceolata Pursh.
Loess ridge.

Other collections. Monona: Turin (Shimek IA).

Verbascum thapsus L.
Introduced weed in run-down pastures on lower west slopes and upper east slopes. Verbena stricta community.

Author's collections: 13, 14.

Other collections. Fremont: Hamburg (Shimek).

PLANTAGINACEAE

Plantago aristata Michx.
Summits. Aristida oligantha-Plantago purshii community. Rare on the bluffs.

Author's collections: 10.

Other collections. Fremont: Waubonsie State Park (Shimek).

Plantago lanceolata L.

Other collections. Harrison: Missouri Valley (Shimek).

Plantago purshii R. & S.
Rare loess of paths on summits. Aristida oligantha-Plantago purshii community.

Author's collections: 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16.


Plantago rugelii Dene.

Other collections. Harrison: Missouri Valley (Shimek).
Map 34. Penstemon gracilis

Map 35. Penstemon grandiflorus

Map 36. Houstonia nigricans

Map 37. Haplopappus spinulosus

Map 38. Liatris punctata

Map 39. Lygodemis juncea
RUBIACEAE

*Houstonia nigricans* (Lam.) Fern.
Slopes and summits. *Andropogon scoparius-Yucca glauca* community.

Author's collections: 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16.


CAPRIFOLIACEAE

*Symphoricarpos occidentalis* Hook.
At edges of woods. *Andropogon gerardi* community.

Author's collections: 3, 4, 5, 6, 8, 14.


*Symphoricarpos orbiculatus* Moench.
At edges of woods. *Andropogon gerardi* community.

Author's collections: 1, 7, 8, 10, 11, 13, 14, 16.


COMPOSITAE

*Achillea millefolium* L.
North prairie slope. Associated with *Stipa spartea*. Rare on the bluffs.

Author's collections: 1.

*Agoseris cuspidata* (Pursh) Raf.
Summits of bluffs. *Aristida oligantha-Plantago purshii* community.

Author's collections: 1, 2, 4, 6, 7, 12.
Ambrosia artemisiifolia L.
Abundant in run-down pastures or gentle slopes and summits. Aristida oligantha-Plantago purshii community. It often forms extensive societies.

Author's collections: 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 16.

Ambrosia psilostachya DC., var. coronopifolia (T. & G.) Farw.

Other collections. Monona: Turin (Shimek). Woodbury: Sergeant's Bluff (Shimek IA).

Antennaria campestris Rydb.
Summit.

Other collections. Monona: Turin (Shimek).

Antennaria neglecta Greene
Summits and upper east slopes. Aristida oligantha-Plantago purshii community.

Author's collections: 2, 3, 4, 6, 7, 9, 10, 12, 14, 15.

Antennaria neodioica Greene
Summit.

Other collections. Monona: Turin (Weber).

Antennaria plantaginifolia Hook.

Other collections. Monona: Turin (Goodman).

Artemisia glauca Pall.

Other collections. Woodbury: Sioux City (Pammel).

Artemisia ludoviciana Nutt.
Summits. Andropogon scoparius-Poletoua curtipendula community.
Author's collections: 1, 2, 4, 11, 12, 14.

Other collections. Harrison: Missouri Valley (Pammel, Shimek IA); Murray Hill (Shimek IA); bluffs east of Little Sioux (Shimek). Woodbury: Sergeant's Bluff (Shimek IA); Sioux City (Pammel).

**Aster azureus Linde**
East and lower west slopes near borders of woods. *Andropogon gerardi* community.

Author's collections: 12, 13, 14, 15, 16.

Other collections. Pottawattamie: Council Bluffs (Shimek).

**Aster cordifolius L.**
On edge of woods. *Andropogon gerardi* community.

Author's collections: 10, 11, 15, 16.

**Aster ericoides L.**
West slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* and *Andropogon scoparius-Yucca glauca* communities.

Author's collections: 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16.

Other collections. Fremont: Hamburg (Shimek IA). Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA). Mills: Rawles Twp., Sec. 31 (Hayden). Woodbury: Sioux City (Bakke).

**Aster laevis L.**
Upper east slopes and summits at edge of woods. *Andropogon gerardi* community.

Author's collections: 5, 7, 8, 9, 10, 11, 12, 14, 15, 16.

Other collections. Fremont: Washington Twp., Sec. 29 (Hayden); Hamburg (Shimek). Harrison: Missouri Valley (Shimek). Monona: Grant Center (Shimek). Woodbury: Sioux City (Bakke, Pammel).

**Aster oblongifolius Nutt.**
Upper west slopes. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

Other collections. Fremont: Hamburg (Shimek); Washington Twp., Sec. 29 (Hayden). Harrison: Missouri Valley (Shimek); Murray Hill
Aster sagittifolius Wedemeyer, var. drummondii (Lindl.) Shimmers
Edge of woods on summits.

Other collections. Fremont: Hamburg (Shimek IA); Washington Twp., Sec. 29 (Hayden); Hamburg (Pammel). Pottawattamie: Lewis Twp., Sec. 7 (Hayden).

Aster sericeus Vent.
Slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 2, 3, 4, 5, 7, 8, 10, 12, 14, 15.

Other collections. Fremont: Waubonsie State Park (Shimek IA). Harrison: Missouri Valley (Shimek IA); Murray Hill (Shimek IA). Monona: Turin (Pammel, Shimek). Pottawattamie: Council Bluffs (Shimek). Woodbury: Sergeant's Bluff (Shimek); Sioux City (Pammel).

Cacalia tuberosa Nutt.
Upper east slopes. Andropogon gerardi community.

Author's collections: 1, 8, 9, 10, 11, 14.


Cirsium flodmanni (Rydb.) Arthur
Pastures on summits. Verbena stricta community.

Author's collections: 2, 3, 4, 6, 9.

Other collections. Fremont: Hamburg (Pammel). Monona: Grant Center (Shimek). Woodbury: Sergeant's Bluff (Shimek IA); Sioux City (Pammel, Shimek).

Cirsium altissimum (L.) Spreng.
Pastures on summits. Verbena stricta community.

Author's collections: 4, 10, 14.

Cirsium discolor (Muhl.) Spreng.
Run-down pastures at summits and upper east slopes. Verbena stricta community.

Author's collections: 3, 6.

Coreopsis palmata Nutt.
Upper slopes. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 12, 14.

Dyssodia papposa (Vent.) Hitchc.
Bare loess in run-down pastures on summits. Aristida oligantha-Plantago purshii community.

Author's collections: 3, 6, 7, 10, 11, 14, 15.


Echinacea angustifolia DC.
Slopes and summits. Andropogon scoparius-Bouteloua curtipendula community.

Author's collections: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

Other collections. Monona: Turin (Shimek). Pottawattamie: Council Bluffs (Shimek). Woodbury: Sergeant's Bluff (Shimek); Sioux City (Hayden).

Erigeron canadensis L.
Lower west slopes and summits. Verbena stricta community.

Author's collections: 1, 3, 5, 6, 8, 9, 10, 11, 12.


Erigeron philadelphicus L.
Loess ridge.

Other collections. Monona: Grant Center (Shimek).

Erigeron strigosus Muhl.
Disturbed areas on summits and scattered on slopes. Andropogon scoparius-Bouteloua curtipendula community.
Author's collections: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16.

Other collections. Harrison: Murray Hill (Shimek).

**Eupatorium altissimum L.**

Lower slopes. *Andropogon gerardi* community.

Author's collections: 5, 6, 11, 12, 14, 16.

Other collections. Fremont: Washington Twp., Sec. 29 (Hayden). Pottawattamie: Lewis Twp., Sec. 7 (Hayden).

**Eupatorium rugosum Hautt.**

Edge of woods on east slope. *Andropogon gerardi* community.

Author's collections: 16.

**Grindelia squarrosa (Pursh) Dunal**

Run-down pastures on upper slopes and summits. *Verbena stricta* community.

Author's collections: 10, 11, 12.


**Haplopappus spinulosus** (Pursh) DC. Map 37

Bare loess on summits and upper west slopes. *Andropogon scoparius-Yucca glauca* community.

Author's collections: 1, 2, 3, 6, 7, 8, 12, 13, 14.


**Haplopappus spinulosus** (Pursh) DC., var. *glaberrimus* (Rydb.) Blake

Other collections. Harrison: Missouri Valley (Pammel).

**Helianthus annus L.**

Disturbed loess slopes and summits. *Andropogon scoparius-Yucca glauca* community. It may form extensive societies on bare loess.

Author's collections: 1, 2, 3, 4, 5, 6, 8, 9, 11, 13, 14, 15, 16.
Other collections. Harrison: Missouri Valley (Pammel, Shimek). Monona: Turin (Pammel); Grant Center (Shimek).

**Helianthus laetiflorus** Pers., var. rigidus (Cass.) Fern.
Slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community. Spreads by rhizomes, often forming colonies on open ground.

Author's collections: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16.


**Helianthus maximilliani** Schrad.
Run-down pasture on summit. *Verbena stricta* community.

Author's collections: 2.

Other collections. Woodbury: Sioux City (Pammel).

**Helianthus petiolaris** Nutt.
Pastures on summits. *Aristida oligantha-Plantago purshii* community.

Author's collections: 2.

Other collections. Harrison: Missouri Valley (Shimek).

**Helianthus strumosus** L.
Edge of woods on east slopes. *Andropogon gerardi* community.

Author's collections: 11.

**Heliopsis helianthoides** (L.) Sweet, var. scabra (Dunal) Fern.
East slope.

Author's collections: 1.

Other collections. Fremont: Hamburg (Shimek).

**Iva xanthifolia** Nutt.
East slope near summit in weedy pasture.

Author's collections: 1, 13.

Other collections. Fremont: Hamburg (Wright); Thurman (Pammel). Monona: Grant Center (Shimek). Woodbury: Sioux City (Campbell).
Kuhnia eunatoroides L., var. corymbulosa T. & G.
Slopes and summits. *Andropogon scoparius-Bouteloua curtipendula*
community.

Author's collections: 1, 2, 4, 5, 6, 7, 10, 12, 13, 15, 16.

Other collections. Fremont: Hamburg (Shimek). Harrison: Missouri
Valley (Shimek). Mills: bluffs east of Pacific Junction (Shimek).
Monona: Grant Center (Shimek). Pottawattamie: Council Bluffs
(Shimek). Woodbury: Sergeant's Bluff (Shimek); Sioux City (Pammel).

*Lactuca pulchella* (Pursh) DC.
Scattered on upper slopes. *Andropogon scoparius-Bouteloua curtipendula*
community.

Author's collections: 1, 2, 3, 4, 7, 10, 11.

Other collections. Monona: Turin (Pammel). Woodbury: Sioux City
(Pammel).

*Lactuca ludoviciana* (Nutt.) Riddell
Pastured slopes. *Verbena stricta* community.

Author's collections: 3, 5, 10, 11.

*Lactuca scariola* L.

Other collections. Woodbury: Sioux City (Shimek).

*Liatris aspera* Michx.
Upper east slopes and summits. *Andropogon scoparius-Bouteloua
curtipendula* community.

Author's collections: 1, 2, 5, 8, 11, 15.

*Liatris punctata* Hook.
West and southwest slopes and summits. *Andropogon scoparius-Bouteloua
curtipendula* and *Andropogon scoparius-Yucca glauca* community.

Author's collections: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,
15, 16.

Other collections. Fremont: Washington Twp., Sec. 29 (Hayden);
Hamburg (Shimek). Harrison: Missouri Valley (Pammel, Shimek).
Monona: Turin (Pammel, Shimek). Pottawattamie: Lewis Twp., Sec. 7
(Hayden); Council Bluffs (Shimek). Woodbury: Sioux City (Hayden,
Pammel).
Lygodemia juncea D. Don
Slopes and summits. *Andropogon scoparius-Yucca glauca* community.

Author's collections: 1, 2, 4, 5, 6, 7, 9, 10, 12, 13, 14, 15, 16.


Prenanthes aspersa Michx.
Scattered on lower west slopes and summits. *Andropogon gerardi* community.

Author's collections: 2, 3, 4, 8, 11, 14.

Other collections. Woodbury: Sioux City (Pammel).

Ratibida columnifera (Nutt.) Wooton & Standl.
West slopes. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 2, 3, 11, 13.


Senecio plattensis Nutt.
Upper east slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 2, 4, 6, 7, 10.


Silphium integrifolium Michx.
East slopes and lower west slopes. *Andropogon gerardi* community.

Author's collections: 12, 13.

Other collections. Fremont: Hamburg (Shimek); Thurman (Pammel).

Silphium laciniatum L.
Upper east slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 1, 2, 3, 7.

Other collections. Monona: Grant Center (Shimek).
Solidago canadensis L.
East slopes and gullies on west slopes. *Andropogon gerardi* community.

Author's collections: 2, 3, 8, 11, 12.

Other collections. Fremont: Hamburg (Pammel, Shimek). Harrison: Murray Hill (Shimek). Monona: Grant Center (Shimek). Woodbury: Sergeant's Bluff (Shimek); Sioux City (Pammel).

Solidago missouriensis Nutt.
West slopes and summits. *Andropogon scoparius-Yucca glauca* community.

Author's collections: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.

Other collections. Fremont: Hamburg (Shimek). Harrison: Missouri Valley (Shimek). Monona: Grant Center (Shimek); Turin (Pammel). Pottawattamie: Council Bluffs (Shimek). Woodbury: Sioux City (Pammel).

Solidago nemoralis Ait.
Slopes and summits. *Andropogon scoparius-Bouteloua curtipendula* community.

Author's collections: 3, 4, 5, 9, 10, 11, 14, 15, 16.


Solidago rigida L.
Upper slopes and summits. *Verbena stricta* community.

Author's collections: 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15.


Solidago speciosa Nutt., var. angustata T. & G.
Sheltered slopes and summits. *Andropogon gerardi* community.

Author's collections: 2, 5, 11, 12, 15, 16.

Taraxacum officinale Weber

Other collections. Monona: Turin (Shimek).

Tragopogon porrifolius L.

Other collections. Pottawattamie: Council Bluffs (Shimek).

Vernonia baldwinii Torr.

Pastured slopes and summits where forest is invading. Verbena stricta community.

Author's collections: 10, 12, 13, 14, 15, 16.

Other collections. Fremont: Hamburg (Pammel, Shimek); Washington Twp., Sec. 29 (Hayden). Harrison: Missouri Valley (Shimek).

Vernonia missurica Raf.

Loess ridge.

Other collections. Pottawattamie: Council Bluffs (Shimek IA).

Xanthium varianum Greene

In path on pastured slope. Aristida oligantha-Plantago purshii community.

Author's collections: 13.
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