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# **The Flora and Sandhills Prairie Communities of Arapaho Prairie, Arthur County, Nebraska**

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Lincoln, Nebraska 68588

## **INTRODUCTION**

The Arapaho Prairie is a 526-hectare (two-section) tract of upland Sandhills prairie located approximately nine miles southwest of the town of Arthur in Arthur Co., Nebraska (Sec. 31, 32 T18N R39W). The Prairie is at the extreme southwest edge of the 52,000-km<sup>2</sup> Nebraska Sandhills (see Kaul 1975) and is floristically and ecologically typical of the slightly drier, western part of this vegetation type. Sandhills prairie which stretches across much of north central Nebraska is a unique type of "mixed" grassland (Pool 1914, Rydberg 1931, Tolstead 1942, Weaver 1965) created by impact of the dry, continental climate on the extensive sand dunes. It is dominated by both characteristic tallgrass prairie species and characteristic shortgrass prairie species in a distinctive combination.

Arapaho Prairie was purchased by The Nature Conservancy in January, 1977. Cattle were immediately removed, and the prairie is now being managed by the School of Life Sciences, University of Nebraska-Lincoln for teaching and ecological research. Arapaho Prairie is currently one of the largest, ungrazed tracts of Sandhills prairie available for intensive scientific study.

This paper, which contains an annotated list of the vascular flora of Arapaho Prairie and a brief description of its plant communities, is one of a series of papers describing the biology and ecology of this typical Sandhills prairie (Ballinger et al. 1979, Jones and Droge 1980). Partial species lists and community descriptions have been published for Sandhills prairie (Rydberg 1895, Pool 1914, Tolstead 1942) but the names are antiquated and virtually unreadable. In addition, much of the previous published information (Weaver 1965, Burzlaff 1962) is not site specific. An available, complete listing of plant species is important for an intensively used research natural area. Such a new, annotated species list, generated from intensive plant collection at the site during the past several years, is provided in this paper.

## **SITE DESCRIPTION**

Important place names and land-use history of Arapaho Prairie are shown in Fig. 1. Land-use history was reconstructed based on local landmarks, topographic

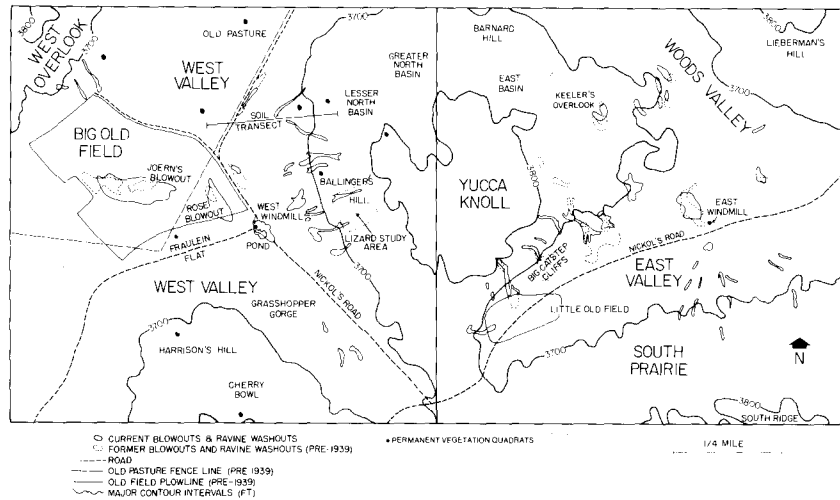


Figure 1. Land use history and place names of Arapaho Prairie, Arthur Co., Ne. Old field and fenceline information based on aerial photographs beginning 1939.

maps and historic aerial photographs from the Conservation and Survey Division of the University of Nebraska and the USDA Soil Conservation Service. Some “frivolous” place names are included to identify both permanent and temporary study and sampling areas. A permanently marked grid system is planned for the entire Prairie. Permanently marked plant and animal study sites used for long-term sampling are also shown (Fig. 1).

Two very old, abandoned fields have been located; they make up 5.2 ha. on section 32 and 27 ha. on Section 31 (Fig. 1). From deed records and interviews with prior owners we have determined that the Little Old Field on Section 32 was abandoned between 1918 and 1926, shortly after the original section homestead was patented in 1918. The Big Old Field on Section 31 was abandoned before 1937, some time during the Great Drought. Given the fairly accurate age determination of these old fields, we have initiated studies of succession. As irrigated agriculture spreads, there is acute risk of agricultural abuse followed by abandonment of these easily eroded sand dunes. Arapaho Prairie itself provides evidence for this concern: a large blowout complex of 4.0 ha. is still active in the valley floor in the center of the Big Old Field. This blowout apparently originated when the old field was abandoned in 1931-1937 (Lawson et al. 1071). Continuous grazing disturbance since that period has not allowed ecological succession to restabilize the area. Since the removal of all domestic grazing in 1977, the blow-out appears to be gradually stabilizing. Information on successional processes and mechanisms in Sandhills prairie is badly needed.

Arapaho Prairie has moderate topographic relief with elevations from 1110 m (3640 ft) in the lowest interdunal basins to 1180 m (3860 ft) on the ridge tops (Fig 1 and 3). The Prairie includes portions of four different dune slopes of varying exposure, two major interdunal valley systems, and one large triangular dune complex. This major dune, approximately 1 mile in length, is in the northern portion of Sections 31 and 32 and includes slope exposures to the north, southwest and southeast. In addition, this dune is capped by an excellent example of a stabilized sequence of "blowout" depressions beginning at low elevations on the north flank of the dune and progressing toward the crest of the dune in a SSE direction (see topographic intervals of Fig. 3). A similar sequence of stabilizing blowouts occurs on the north flanks of the southern dunes of Section 31 and 32 proceeding off of the property to the SSE. The dates of stabilization of erosion cycles on these dunes are currently under debate for the Nebraska Sandhills (Ahlbrandt and Fryberger 1980).

The soils mapped in Fig. 2 are chiefly Valentine fine sand on the upper slopes with Doger and Dunday loamy fine sands in the interdunal valleys. The gradation between the coarse sands of the dune crests and the fine soils of the valley bottoms create a complex topographic/edaphic gradient in plant water relations and community composition which will be reported in detail elsewhere (Harrison, Barnes, and Heinisch, unpublished).

Annual rainfall is approximately 40 cm, of which 80% falls between April and September. A recording rain gauge and weather station has been installed at the site to characterize macro- and micro-climate.

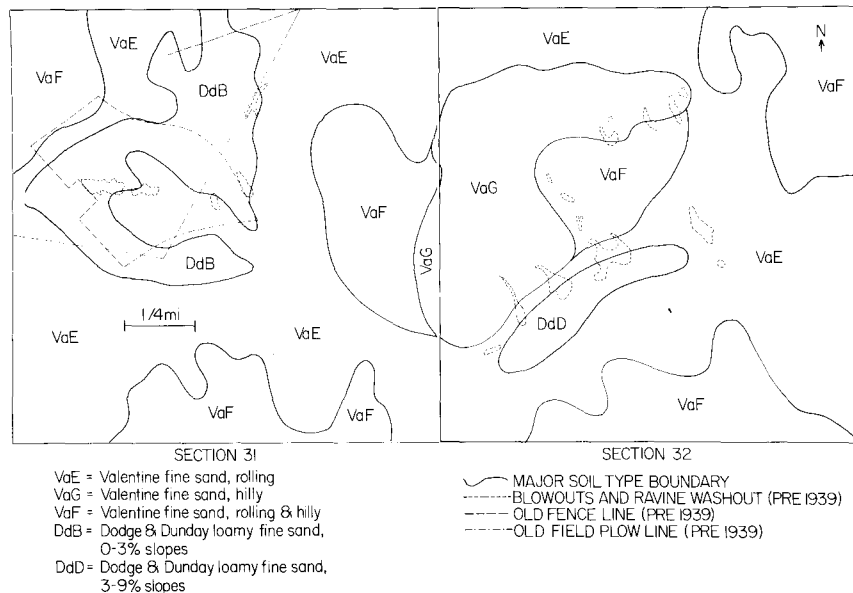


Figure 2. Soil map of Arapaho Prairie, Arthur Co., Nebraska (redrawn from USDA Soil Conservation Service, 1977).

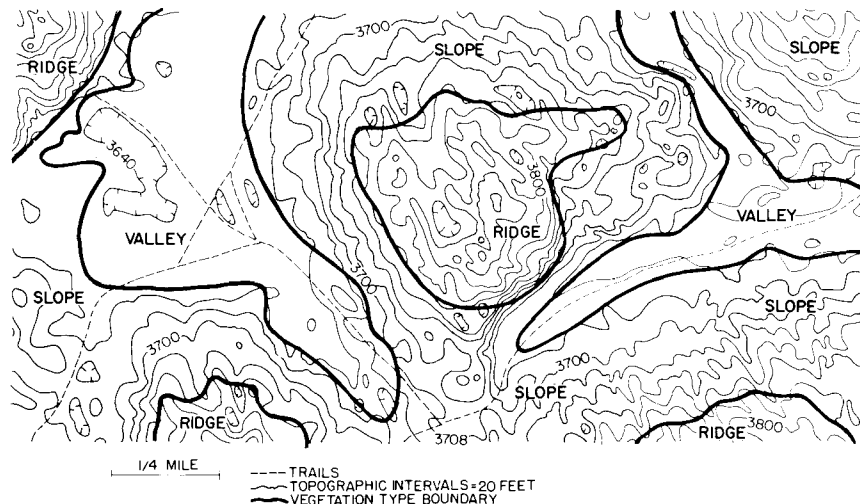


Figure 3. Vegetation map of Arapaho Prairie, Arthur Co., Nebraska. (T18N, R39W, sect. 31, 32). The dominants of the communities indicated are as follows: Valley (lowest flattest areas): *Calamovilfa longifolia* (27% cover), *Stipa comata* (26%), and *Bouteloua gracilis* (18%); Slope community (gentle slopes, 3-17%): *Bouteloua gracilis* (27%), *Calamovilfa longifolia* (22%), and *Bouteloua hirsuta* (13%); Ridge Community (steepest slopes, 17-60%) *Bouteloua hirsuta* (20%), *Calamovilfa longifolia* (13%), and *Andropogon scoparius* (10%). Percentage cover by species was measured in 1979 from 60 m<sup>2</sup> systematically located quadrats in representative stands at each site (Harrison, Barnes, Heinisch, unpub.).

There is no natural permanent surface water or wet meadow habitat present on the Prairie. Two long-established windmills provide runoff pools which support small areas (approximately 500m<sup>2</sup> for common aquatic plants, and provide water for regional animals. Aquatic plants are found in the stock tanks themselves (e.g., *Potamogeton pectinatus*). The windmill on Section 32 was broken in 1976-79 and the aquatic plant community there perished. Aquatic plants found in 1977 at the Section 31 windmill site are given at the end of Table 1. The runoff pools by the Sec. 31 windmill have not been stable over the period of the study. Hydrophytic species were virtually eliminated in 1978 and 1979 but expanded in 1980. For example, *Heteranthera limosa*, an aquatic annual, was collected in 1977, absent in 1978-9, and reappeared in 1980, while *Sagittaria* sp. has not been seen since 1977.

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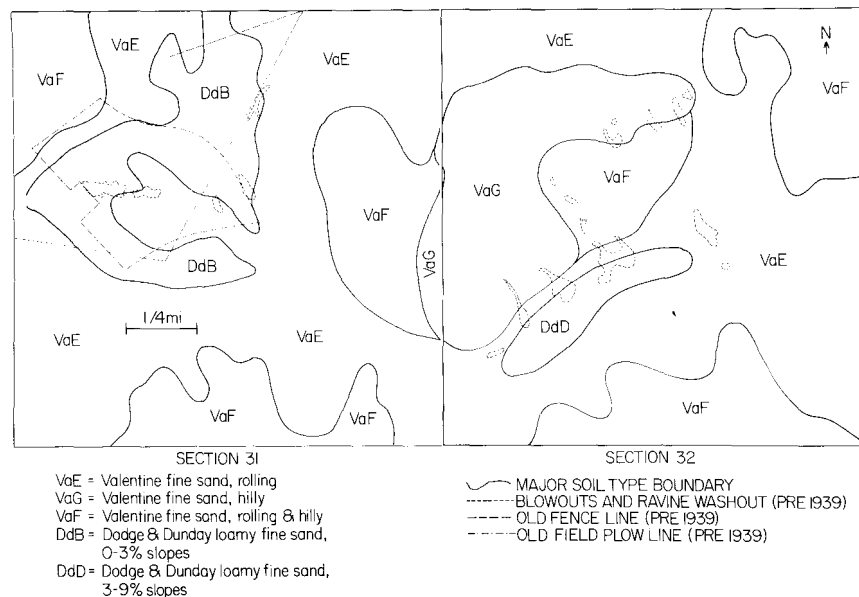


Figure 2. Soil map of Arapaho Prairie, Arthur Co., Nebraska (redrawn from USDA Soil Conservation Service, 1977).

Table 1. Annotated list of vascular plants of Arapaho Prairie, Arthur Co., Nebraska.

Key to annotations:

Before name: \* county record; \*\* range extension

After name:

Habitat	Frequency	Flowering time
valley	(refers to distribution	(anthesis in
slope	in a designated habitat)	average years)
ridge	rare = rare	sp = through
		May
blowouts = blowouts, washouts	occ = occasional	su = June-
		July
disturb = disturbed areas	com = common	f = Aug.-
		Sept.
moist = moist bottoms	loc com = locally common	
	abund = abundant	
	loc abund = locally abundant	
		intro = introduced weed

Nomenclature according to Van Bruggen (1976) and Barkley (1977).

## A. Dry Prairie

### PTEROPHYTA

#### Equisetaceae

- \* *Equisetum laevigatum* A. Br. — valley, slope, ridge; occ; sp & su

### SPERMATOPHYTA

#### (Monocotyledoneae)

#### Commelinaceae

- Commelina erecta* L. — slope; occ to loc com; su & f
- Tradescantia occidentalis* (Britt.) Smyth. — valley, slope; com; su

#### Cyperaceae

- \* *Carex eleocharis* Bailey — moist; rare to loc com; sp
- \* *C. heliophila* Mack. — valley, slope, ridge; abund; sp
- C. praegracilis* W. Boott. — moist; rare to loc com; sp
- Cyperus schweinitzii* Torr. — valley, slope, ridge; com; su

#### Liliaceae

- \* *Allium textile* A. Nels. & MacBr. — slope; abund; sp
- \* *Yucca glauca* Nutt. — slope, ridge; com to loc abund; su

#### Poaceae/Graminae

- Agropyron pectiniforme* Roem. & Schult. — moist, valley; rare; sp; intro
- \* *A. repens* (L.) Beauv. — valley, slope, blowouts; occ to loc com; su; intro
- A. smithii* Rydb. — valley; com; sp
- Andropogon hallii* Hack. — slope, ridge; com; f
- \* *A. scoparius* Michx. — slope, ridge; com; f
- \* *Aristida longiseta* Steud. — valley; occ; su
- \* *Bouteloua gracilis* (H.B.K.) Griffiths — valley; slope, ridge; occ to loc com; f
- \* *B. hirsuta* Lag. — valley, slope, ridge; abund; f
- \* *Bromus inermis* Leyss. — valley; occ; sp; intro
- B. japonicus* Thunb. — disturb; loc abund; sp; intro

- \* *B. racemosus* L. — disturb; loc com; sp; intro
- B. tectorum* L. — valley, disturb; loc com; sp; intro
- Calamovilfa longifolia* (Hook.) Scribn. — valley, slope, ridge; abund; su
- \* *Cenchrus longispinus* (Hack.) Fern. — blowouts, disturb; loc abund; f
- Distichlis spicata* (L.) Greene. — valley; rare; f
- Echinochloa muricata* (Beauv.) Fern. — blowouts, disturb, moist; rare; su; intro
- Eragrostis cilianensis* (All.) E. Mosher — valley, disturb, occ; su; intro
- E. trichodes* (Nutt) Wood — ridge; loc abund; f
- Festuca octoflora* Walt. — disturb, valley, slope; com to loc abund; sp & su; intro
- Hordeum jubatum* L. — disturb, valley; occ to loc com; su
- \* *H. pusillum* Nutt. — valley; rare; sp
- Koeleria pyramidata* (Lam.) Beauv. (= *K. cristata*) — valley, slope, ridge; abund; sp
- \* *Muhlenbergia pungens* Thurb. — disturb, blowouts; com; f
- Munroa squarrosa* (Nutt) Torr. — disturb, blowouts; loc abund; su
- \* *Panicum capillare* L. — valley, disturb; occ; su
- P. oligosanthes* Schult, var. *scribnerianum* (Nash.) Fern. — valley, slope, ridge; occ; f
- P. virgatum* L. — valley; occ; su
- \* *P. wilcoxianum* Vasey — slope; occ; su
- Paspalum setaceum* Michx. var. *stramineum* (Nash) D. Banks — valley, moist, disturb; rare; f
- \*\* *Poa interior* Rydb. — valley; occ; su
- Redfieldia flexuosa* (Thurb.) Vasey — blowouts; loc com; f
- \* *Sorghastrum avenaceum* (Michx.) Nash. (= *S. nutans*) — ridge; loc abund; f
- \* *Sporobolus cryptandrus* (Torr.) A. Gray — valley, slope, ridge; com to loc abund; su
- Stipa comata* Trin. & Rupr. — valley, slope, ridge; com to loc abund; su
- \* *Triplasis purpurea* (Walt.) Chapm. — ridge, blowouts, disturb; rare; f

## SPERMATOPHYTES

### (Dicotyledoneae)

#### Amaranthaceae

- Amaranthus arenicola* I.M. Johnst. — disturb; occ to loc com; su

- \* *A. retroflexus* L. — disturb; occ to loc com; su; intro
- \* *Froelichia floridana* (Nutt.) Moq. — disturb, valley, slope; occ to loc com; f

#### Anacardiaceae

- \* *Toxicodendron rydbergii* (Small ex Rydb) Greene — disturb, ridge, blowout; occ to loc abund; sp

#### Apocynaceae

- \* *Apocynum sibericum* Jacq. — valley, slope, blowout; occ to loc com; su

#### Asclepidaceae

- Asclepias arenaria* Torr. — slope, ridge; com; su
- \* *A. lanuginosa* Nutt. — slope, ridge; rare to loc com; su
- \* *A. pumila* (A. Gray) Vail — valley, slope; rare to loc com; su
- \* *A. stenophylla* Gray — valley, slope, ridge; rare; su
- \* *A. viridiflora* Raf. — slope; com; su

#### Asteraceae/Compositae

- \*\* *Agoseris glauca* (Pursh) D. Dietr. — valley; com; sp
- \* *Ambrosia artemisiifolia* L. — blowout, disturb; occ; f
- \* *A. psilostachya* D.C. — valley, slope, ridge, disturb, blowout; abund; f
- \* *Antennaria parviflora* Nutt. — slope, ridge; com to loc abund; sp
- \* *A. plantaginifolia* (L.) Rich. — slope, ridge; com to loc abund; sp
- \* *Artemisia campestris* L. — valley, slope, ridge; abund; f
- \* *A. ludoviciana* Nutt. — valley, slope; com to loc abund; f
- Aster ericoides* L. — valley; loc com; f
- \* *A. oblongifolius* Nutt. — valley; occ; sp
- \* *Chrysopsis villosa* (Pursh) Nutt. — slope, ridge; occ; su
- \* *Cirsium canescens* Nutt. — valley, slope, disturb; com; su
- \* *C. flodmani* (Rydb.) Arthur — valley, disturb; occ; f
- \* *C. undulatum* (Nutt.) Spreng. — valley, slope, ridge; com; su
- \* *Conyza canadensis* (L.) Cronq. — disturb; com to loc abund; f
- Erigeron bellidiastrum* Nutt. — slope, ridge; occ; su
- \* *Grindelia squarrosa* (Pursh) Dunal. — valley; occ; f
- Haplopappus spinulosus* (Pursh) D.C. — ridge; com; su & f



- Helianthus petiolaris* Nutt. — disturb; abund; su & f
- \* *H. rigidus* (Cass.) Desf. — valley, slope, ridge; abund; f
- \* *Hymenopappus filifolius* Hook. — slope, ridge; occ; su
- \* *H. tenuifolius* Pursh. — valley, slope; occ to loc abund; su
- \* *Iva xanthifolia* Matt. — disturb, blowout; rare to loc com; f
- \* *Kuhnia eupatorioides* L. — slope, ridge; occ; su
- Lactuca oblongifolia* Nutt. (= *pulchella*) — valley, slope; occ; su
- \* *L. serriola* L. — disturb, valley; rare; su; intro
- Liatris glabrata* Rydb. — valley, slope; loc com; f
- \* *L. punctata* Hook. — slope, ridge; com; su & f
- Lygodesmia juncea* (Pursh) D. Don — slope, ridge; com; su
- L. rostrata* A. Gray — disturb, blowouts; rare; f
- Machaeranthera linearis* Greene — valley, slope; occ; f
- Ratibida columnifera* (Nutt.) Woot & Standl. — valley, slope, ridge; com; su & f
- \* *Senecio plattensis* Nutt. — valley, slope; com; sp
- S. riddellii* T. & G. — valley, slope, ridge; com; f
- \* *Solidago missouriensis* Nutt. — valley, slope; com; f
- \* *S. mollis* Bartl. — valley; occ; f
- \* *S. nemoralis* Ait. — ridge; occ; f
- \* *Taraxacum officinale* Weber — moist, valley; rare; sp; intro
- Thelesperma megapotamicum* (Spreng.) O. Ktze. — valley, slope; rare; su
- \* *Townsendia exscapa* (Rich.) Porter — slope, ridge; com; sp
- \* *Tragopogon dubius* Scop. — valley; occ; su; intro
- \* *Xanthium strumarium* L. — disturb; occ to loc abund; f
- Boraginaceae**
- \* *Cryptantha celosioides* (Eastw.) Payson — slope; occ to loc com; su
- \* *C. minima* Rydb. — disturb, valley, slope; occ; su
- \* *Lappula redowskii* (Hornem.) Greene — disturb, valley; com to loc abund; sp
- Lithospermum carolinense* (Walt.) Mac-Mill. — slope; com; sp
- \* *L. incisum* Lehm. — valley, slope; com; sp
- Brassicaceae/Cruciferae**
- \* *Erysimum asperum* (Nutt.) DC. — valley, slope; abund; sp
- \* *Lepidium densiflorum* Schrad. — valley, slope; com; sp
- \* *Lesquerella ludoviciana* (Nutt.) Wats. — valley, slope, ridge; com; sp
- \* *Sisymbrium altissimum* L. — blowout, disturb; occ; sp
- Cactaceae**
- \* *Coryphantha vivipara* (Nutt.) B & R — valley, slope, ridge; occ; su
- \* *Opuntia fragilis* (Nutt.) Haw. — slope, ridge; abund; su
- \* *O. macrorhiza* Engelm (= *O. humifusa*, *compressa*) — valley, slope, ridge; com; su
- Capparidaceae**
- Cleome serrulata* Pursh. — valley, disturb; com to loc abund; f
- \* *Cristatella jamesii* T. & G. — disturb; rare to loc abund; su & f
- Chenopodiaceae**
- \* *Chenopodium album* L. — disturb; com; su & f
- \* *C. dessicatum* A. Nels. — blowouts, disturb; loc com; su & f
- C. subglabrum* (Wats.) A. Nels. — blowouts, disturb; occ; su
- Cycloloma atriplicifolium* (Spreng.) Coult. — disturb; com; f
- Kochia scoparia* (L.) Schrad. — disturb; occ to loc com; f; intro
- \* *Salsola collina* Pall. — disturb, blowout; f; intro
- \* *S. iberica* Sennes & Pau (= *S. kali*) — disturb; loc abund; f; intro
- Convolvulaceae**
- \* *Cuscuta coryli* Engelm. — valley, disturb; occ to loc com; su
- Evolvulus nuttallianus* R. & S. — valley; rare to occ; su
- \* *Ipomoea leptophylla* Torr. — ridge; occ to loc com; su & f
- Euphorbiaceae**
- Croton texensis* (Klotzsch) Muell. — disturb, blowouts, valley, slope; com; su & f
- \* *Euphorbia geyeri* Engelm. — disturb, valley, ridge; occ to loc com; su & f
- \* *E. missurica* Raf. — disturb, valley, ridge; occ to loc com; su & f

# Fabaceae/Leguminosae

- Amorpha canescens* Pursh. — valley, slope; com; su
- \* *Astragalus ceramicus* Sheld. var. *filifolius* (Gran) Herm. — ridge; occ; su
- \* *A. crassicaupus* Nutt. var. *crassicaupus* — valley, slope; com; sp
- \* *A. lotiflorus* Hook. — valley; occ; sp
- Glycyrrhiza lepidota* Pursh. — valley, slope; com; f
- \* *Lathyrus polymorphus* Nutt. — slope, ridge; com to loc abund; sp
- \* *Melilotus albus* Desr. — moist; rare; su; intro
- \* *M. officinalis* (L.) Lam. — disturb, moist, blowouts; occ to loc abund; su; intro
- \* *Oxytropis lambertii* Pursh. — valley, slope, ridge; occ to loc com; sp
- \* *Petalostemon candidum* (Willd.) Michx. — valley, slope, blowouts; occ; su
- \* *P. purpureum* (Vent.) Rydb. — valley, slope; com; su
- \* *P. villosum* Nutt. — slope, ridge, blowouts; com; f
- Psoralea digitata* Nutt. — slope, ridge; occ; su
- \* *P. esculenta* Pursh. — slope, ridge; occ; sp
- \* *P. lanceolata* Pursh. — slope, ridge; occ; sp, su
- \* *P. linearifolia* T. & G. — slope, blowout, disturb; loc com; su
- \* *P. tenuiflora* Pursh. — slope, ridge; com; su

# Hydrophyllaceae

- \* *Ellisia nyctelea* L. — disturb, valley; occ to loc com; sp

# Lamiaceae

- Monarda pectinata* Nutt. — slope, ridge; com; su

# Linaceae

- \* *Linum rigidum* Pursh. — slope, ridge; com; su
- \* *L. sulcatum* Riddell — slope, ridge; occ; su

# Loasaceae

- Mentzelia nuda* (Pursh) T. & G. — valley, slope; com; f

# Malvaceae

- Sphaeralcea coccinea* (Pursh) Rydb. — valley; loc com; su

# Nyctaginaceae

- Mirabilis birsuta* (Pursh) MacMill. — valley; rare; su
- \* *M. linearis* (Pursh) Hiemerl. — valley, slope, ridge; occ; su

# Onagraceae

- Calylophus serrulatus* (Nutt.) Raven — slope, blowouts; occ to loc com; su
- \* *Gaura coccinea* Pursh. — valley; occ; su
- \* *Oenothera nuttallii* Sweet. — disturb, blowouts; loc com; su
- O. rhombipetala* Nutt. — valley, slope, blowouts; occ; su

# Papaveraceae

- Argemone polyanthemosa* (Fedde) G. Ownbey — disturb, valley; com to loc abund; su

# Plantaginaceae

- Plantago patagonica* Jacq. — valley, slope, ridge, disturb; abund; su

# Polemoniaceae

- \* *Ipomopsis longiflora* (Torr.) G. Don — slope; com; late f
- \* *Phlox andicola* Nutt. — valley, slope, blowouts; occ to loc com; sp

# Polygonaceae

- Eriogonum annuum* Nutt. — valley; occ; su
- \* *Polygonum arenastrum* Jord. ex Bor. — moist, disturb; occ to loc com; sp/su/f
- P. lapathifolium* L. — moist; occ; su
- \* *P. pennsylvanicum* L. — moist, disturb; occ; su
- \* *P. ramosissimum* Michx. — valley, slope; occ; su
- \* *Rumex venosus* Pursh. — valley, disturb, blowouts; occ to loc com; sp

# Portulacaceae

- \* *Talinum parviflorum* Nutt. — valley; rare; sp

# Ranunculaceae

- \* *Delphinium virescens* Nutt. — valley, slope; occ to loc com; su

# Rosaceae

- \* *Potentilla pensylvanica* L. — valley; rare; su
- Prunus besseyi* Bailey — slope, ridge; occ to com; sp

- \* *P. virginiana* L. — ridge; occ to loc abund; sp
- \* *Rosa arkansana* Porter — slope, ridge, blowouts; com to loc abund; su & f
- \* *R. woodsii* Lindl. — valley; rare to loc com; su
- Salicaceae**
- \* *Populus deltoides* Marsh. — moist, blowouts; rare; sp
- Salix exigua* Nutt. ssp. *interior* (Rowlee) Cronq. — moist, blowouts; loc com; sp
- S. petiolaris* Sm. — blowouts; rare to loc com; sp
- \* *S. rigida* Muhl. — blowouts; rare to loc com; sp
- Scrophulariaceae**
- \* *Penstemon albidus* Nutt. — valley, slope; com; su
- \* *P. angustifolius* Pursh. — slope, ridge; com; sp (Color variable, usually blue, sometimes white)
- Solanaceae**
- \* *Physalis bедераefolia* Gray — slope; occ; su
- P. virginiana* Mill. spp. *hispida* Waterfall — valley, slope; occ; su
- \* *Solanum americanum* Mill. — blowouts; rare; su
- \* *S. triflorum* Nutt. — valley, moist; rare to loc com; su
- Verbenaceae**
- Verbena bracteata* Lag. & Rodr. — valley, disturb; occ to loc com; su & f; intro
- B. Aquatics (and wet)**
- (Monocotyledonae)**
- Alismaceae**
- Sagittaria* sp. — moist; rare to loc com; f
- Cyperaceae**
- Carex brevior* (Dew.) Mack. — moist; rare to loc com; su
- Eleocharis macrostachya* Britt. — moist; abund; sp
- \* *E. smallii* Britt. — moist; rare to loc abund; su
- Scirpus americanus* Pers. — moist; rare to loc com; su
- S. validus* Vahl. — moist; rare to loc com; su
- Juncaceae**
- \* *Juncus nodosus* L. — moist; rare; su
- \* *J. tenuis* Willd. — moist; rare to loc com; su
- Lemnaceae**
- \* *Lemna minor* L. — moist; rare to loc abund
- Spirodela polyrbiza* (L.) Schleid. — moist; loc abund
- Pontederiaceae**
- \* *Heteranthera limosa* (Sw.) Willd. — moist; rare to loc com; su
- Potamogetonaceae**
- Potamogeton pectinatus* L. — moist, (in stock tank); rare; su
- Typhaceae**
- Typha* sp. — moist; rare; su
- (Dicotyledonae)**
- Asteraceae**
- Bidens* sp. — moist; loc com; f
- Added in proof:**
- Anacardaceae**
- Rhus aromatica* Ait. var. *trilobata* (Nutt.) Gray — ridge; rare; sp

The same general pattern is seen in the forbs. Groups characteristic of tallgrass prairies and of shortgrass prairies are present. *Psoralea* spp., *Solidago* spp., and *Asclepias* spp. are genera well developed in eastern mesic prairies. *Artemisia campestris*, *Cycloloma atriplicifolium*, *Opuntia* spp., *Heliasthus petiolaris*, and *Yucca glauca* are chiefly western and xeric. *Ipomoea leptophylla*, *Cristatella jamesii*, *Oenothera rhombipetala*, and *Croton texensis* appear to be sand specialists.

The vegetation map (Fig. 3) of Arapaho Prairie based on topography, field survey and quantitative quadrat data for the major species (Data to be published elsewhere), illustrates the interrelationships between topography, soil type and the plant composition. Three specific plant communities are recognized for Arapaho Prairie. These are labeled *Valley*, *Slope*, and *Ridge* and are characteristic of valley bottoms, gradually sloping hillsides, and steep ridges (but not their flat tops), respectively. These plant communities correspond to the "dry valley," "rolling," and "choppy" range sites of the range management/Soil Conservation Service literature (Burzlaff 1962, USDA 1971). We have chosen to name the Arapaho Prairie vegetation types based on site-specific topography and dominant plant species, rather than the generalized hypothetical "climax" vegetation that a formal range site designation implies.

The "Valley" community is dominated by the grasses *Calamovilfa longifolia* (prairie sandreed), *Stipa comata* (needle-and-thread), and *Bouteloua gracilis* (blue gramma) (27, 26, and 18% canopy coverage respectively, Harrison, Barnes and Heinisch, unpub.). Characteristic subdominant species found in quantitative quadrat sampling include the sedges *Carex heliophila* and *C. eleocharis*, *Agropyron smithii* (western wheatgrass), and *Sporobolus cryptandrus* (sand dropseed). Common forbs measured in the valley sites include *Psoralea tenuiflora* (slimflower scurfpea), *Ratibida columnifera* (prairie coneflower), *Sphaeralcea coccinea* (scarlet globemallow), and *Croton texensis* (croton). An interesting suite of species tends to occur only in the valley bottom sites and may be used as "indicator species" for this topographic/edaphic site (Table 2).

The "Slope" vegetation includes hillsides of approximately 10 to 40% slope of all aspects. It is dominated by the grasses *Bouteloua gracilis*, *Calamovilfa longifolia*, and *Bouteloua hirsuta* (hairy gramma) (27, 22, and 13% cover, respectively). The decrease in relative importance of *Stipa comata* on these sloping sites as well as the increase in importance of the *Bouteloua* spp. is notable, probably due to the more drought tolerant nature of the *Bouteloua* spp. in the coarser sandy upland soils, and moderate infiltration of precipitation in the coarser slope soils. Characteristic subdominant species include *Koeleria pyramidata* (June grass), *Stipa comata*, *Andropogon hallii* (sand bluestem), and *Panicum virgatum* (switchgrass). Major forbs include *Carex* spp. (sedges), *Opuntia fragilis* (prickly pear cactus), and *Trandescantia occidentalis* (spiderwort).

There are definite effects of slope aspect on plant composition that we have not chosen to quantify, in part because Sandhills prairie lacks well-developed north-facing slopes due to the prehistoric deposition direction of the major dune masses. There are major southwest- and southeast-facing steep slopes along the major northern dune complex (Ballinger Hill and Catstep Cliff, Fig. 1), and these generally south-facing slopes tend to have quantitative differences in species composition, as

Table 2. Indicator species which tend to be found almost exclusively on either the "Valley" or "Ridge" topographic/vegetation sites of Arapaho Prairie.

VALLEY (Bottoms and Margins)	RIDGE (Upper, Steep Slopes)
<i>Agropyron smithii</i>	<i>Amorpha canescens</i>
<i>Aristida longiseta</i>	<i>Andropogon scoparius</i>
<i>Astragalus lotiflorus</i>	<i>Astragalus ceramicus</i> var. <i>filifolius</i>
<i>Carex eleocharis</i>	<i>Bouteloua hirsuta</i>
<i>Carex praegracilis</i>	<i>Haplopappus spinulosus</i>
<i>Erysimum asperum</i>	<i>Helianthus rigidus</i>
<i>Hordeum jubatum</i>	<i>Petalostemon villosus</i>
<i>Mirabilis hirsuta</i>	<i>Redfieldia flexuosa</i>
<i>Monarda pectinata</i>	<i>Solidago nemoralis</i>
<i>Physalis virginiana</i> ssp. <i>hispida</i>	<i>Sorghastrum avenaceum</i>
<i>Poa interior</i>	<i>Yucca glauca</i>
<i>Potentilla pensylvanica</i>	
<i>Solanum triflorum</i>	
<i>Solidago mollis</i>	

influenced by slope, exposure, and sand texture. The floristic composition of these steeper slopes is quite similar to the "Ridge" community to be described below.

The "Ridge" vegetation is dominated by *Bouteloua hirsuta*, *Calamovilfa longifolia*, and *Andropogon scoparius* (little bluestem), comprising 20, 13, and 10% canopy cover, respectively. The decrease in total plant cover on these steep coarse sands with the increase in shallowly rooting *B. hirsuta* and deeply rooting *A. scoparius* is especially marked. The lack of *B. gracilis* on these steeper slopes is notable. We are currently examining the site preference characteristics of the two *Bouteloua* species along this topographic/edaphic gradient. Subdominant species of the Ridge sites include *Stipa comata*, *Helianthus rigidus*, *Koeleria pyramidata*, *Andropogon hallii*, *Sorghastrum avenaceum*, and *Panicum virgatum* in decreasing order of importance. Major forbs include *Carex heliophila*, *Ambrosia psilostachya*, *Opuntia fragilis*, *Artemisia ludoviciana*, and *O. macrorrhiza*, in decreasing order of frequency. Major shrubs are *Yucca glauca*, *Amorpha canescens*, *Rosa arkansana*, and *Prunus besseyi*. *Prunus virginiana* is restricted to this community type and is found only in two very large patches, probably clones, on top of Harrison's Hill. The unique group of species which are found only in the Ridge community on open, steep sandy ridges and exposed areas are given in Table 2. This interesting suite has a diversity of morphological adaptations but most species tend to be very deeply rooting from rhizomes (e.g., *Sorghastrum*, *Helianthus rigidus*, *Petalostemon villosus*), tap roots (e.g., *Haplopappus*, *Amorpha*, *Yucca*), crowns or bunches (*Solidago*, *Andropogon scoparius*). Deep rooting is especially important because the coarse unstable sand has low water holding capacity; moderate amounts of precipitation infiltrate rapidly and are stored deep within the coarse-textured sandy profile. Deep, vigorous root systems are therefore a requisite for successful occupation of the steep, open ridgetop sites.

The tallgrass prairie species *Sorghastrum avenaceum* is especially noteworthy in this regard. It is conspicuously absent in all Valley sites and probably could not have been totally eliminated from these lowland sites by moderate grazing pressure alone as has been suggested by local range scientists. On the other hand, it is locally abundant on certain "Ridge" type sites either high or low on the dunes. These peculiar "microsites" are steep, open, generally eroding places which are probably blown free of snow in the winter. *Sorghastrum* always co-occurs with *Panicum virgatum*, *Helianthus rigidus*, and *Solidago nemoralis* on the same open, unstable sites either high on the dune crests, lower on the dune flanks, or on the edges of older, stabilizing blowouts.

Many "Ridge" species may be restricted to these sites by intensive interference competition from other species which occupy lower elevation sites with finer soil texture and greater water holding capacity. Experiments are currently underway to test this hypothesis.

Blowout communities produced by local wind erosion of the dune tops or ridges occur on Arapaho Prairie (e.g., Cherry Bowl and Keeler's Overlook, Fig. 1) but are not discussed here because they have been richly described by Rydberg (1895), Pool (1914), Weaver (1965), and others. *Redfieldia flexuosa*, *Muhlenbergia pungens*, and *Calamovilfa longifolia* are characteristic perennial grasses of moving sand in this community. Sandwash communities, characterized by a diversity of annual native species, have also been recognized (Pool 1914) and occur on Arapaho Prairie. The native annuals *Helianthus petiolaris*, *Croton texensis*, *Euphorbia missurica*, and *E. geyeri* are common both in blowouts and sandwashes. Other, less frequently encountered native species (e.g., *Froelichia floridana*, *Cristatella jamesii*, *Salsola collina*, *Munroa squarrosa*, and *Triplasis purpurea*) also occupy these blowout and sandwash sites.

Low-lying disturbed areas generally are colonized by the blowout and sandwash species, but also by introduced weeds such as *Melilotus* spp., *Bromus tectorum*, *Salsola iberica*, *Amaranthus retroflexus*, *Festuca octoflora*, and *Conyza canadensis*.

We invite research on Arapaho Prairie. Contact Director, Cedar Point Biological Station, School of Life Sciences, Univ. Nebraska, Lincoln, Ne. 68588.

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