A PRELIMINARY BOTANICAL INVESTIGATION OF WRITING-ON-STONE PROVINCIAL PARK IN SOUTHERN ALBERTA

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INTRODUCTION

Writing-on-Stone Provincial Park is located in southern Alberta in Township 1, Range 13, West of the 4th Meridian. It is approximately five miles north of the International Boundary and covers all of section 35 and parts of section 36, straddling the Milk River. The park has an area of approximately one and one-quarter square miles, consisting mainly of the sandstone cliff formations of the Milk River Valley and mixed-grass prairie (Fig. 1). It lies well within the semi-arid region of the mixed grasslands and Brown Soil Zone of the Canadian Midwest. The climate is continental with extremes in temperature and precipitation. Trees and shrubs are mainly found along the river bank and streams, and in sheltered locations. The generally steep slopes and high insolation limit the flora to relatively few species. A Cordilleran element might be expected in the park, due to the proximity of the Rocky Mountains, the Cypress Hills, and the Sweet-Grass Hills in northern Montana.

I carried on field work in the park during parts of June and July, 1964 and again in August 1965 and July 1967, during which time 202 species of vascular plants were collected. Areas subject to relatively frequent or extensive disturbance, caused by human activity, or by flooding due to beaver dams, were studied only superficially. The present study describes the existing vascular flora of the park, which, to the best of the writer's knowledge, has not previously received detailed investigation. A few small collections have been made in recent years by Dr. B. Boivin, Department of Agriculture, Ottawa, and by Mr. J. J. Sexsmith, Research Station, Lethbridge (personal communication).

ACKNOWLEDGEMENTS

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STUDY AREA

Geology and Topography

In general, the topography of southern Alberta, including Writing-on-Stone, is undulating to rolling with deep, eroded river valleys and elevations up to 3500 feet. The upland prairie of the park area has been deeply eroded by the Milk River and transformed into a broad, relatively flat valley with numerous tributary coulees, in which the waters flow southward to join the Missouri River System.

A conspicuous feature of the park is the exposed sandstone formation known as the Milk River Formation of Mesozoic age. This formation is

Fig. 1 — Southeast view of Writing-on-Stone Provincial Park, taken from collecting locality #5, showing the sandstone formations, the Milk River, and the alluvial flat. Shrubs along the river banks are mainly *Salix sp.*, while grasses in the foreground belong to the *Stipa-Bouteloua-Agropyron* association.

sharply divided into lower and upper layers which are readily seen on the sculptured cliffs. The upper zone is argillaceous sandstone and sandy shale with noticeable interbedded lenticular sandstone, while the lower zone is mainly sandstone composed of shaly sandstone and sandy shale in the lowest part (Russell, 1937). These castellate sandstones do not occur outside the immediate neighborhood of the Park because they are somewhat older than the familiar Upper Cretaceous Bearpaw and Belly River formations and although of Upper Cretaceous age have been exposed by surface erosion of the Sweet Grass arch. This arch dips north carrying the sandstones beneath surface away from the Milk River.

The surface soils of the region which are represented in Writing-on-Stone Park have been formed from glacial till derived from native sandstones and shales and form part of the Brown Soil Zone. In the park the surface soils are mainly sandy loam on the upland prairie, while alluvial clays, gravel and sand are found in the river valley. Soil erosion is evident along steep banks of coulees and in areas known as "Badlands." Erosion is fairly rapid and moisture penetration slight, producing highly unfavorable conditions for the development of either a plant cover or normal soil profile.

Climate

The following notes of the regional climate of the area in which Writing-on-Stone Park is situated, have been abstracted from Clarke *et al.* (1943), Hargrave (1949), Peters (1955), Thomas (1963), and Campbell *et al.* (1962). The climate of the mixed-grass region of southern Alberta is continental in character with low precipitation and great extremes in temperature. The following values are given for the Range Experiment Farm at Manyberries, approximately 53 miles east of the park: mean annual precipitation over a 32-year period 12.0 inches; mean annual temperature for the same period of time 40.3°F. The mean annual evaporation during this period was 30.6 inches. West of the park, the meteorological station at

Kippenville lists a mean annual precipitation over a 21-year period of 13.13 inches.

The amount of precipitation varies widely from year to year, ranging from 7.62 inches to 18.06 inches. The prevailing winds are northwesterly, and in winter dry, warm chinooks are experienced. Frequent high winds are recorded through most of the year. Due to great variation in the topography of the park, local variations in the general climatic pattern might be expected.

PLANT COMMUNITIES

Since little is known of the vascular flora and the ecology of the park, a brief consideration of the more important plant communities and their relevant ecology is of value.

The vascular flora of the area of which the park is an integral part, conforms in part to the mixed-grass association of Coupland (1961) and Campbell *et al.* (1962). The communities described here are based upon Coupland's interpretation of climax and seral stages. In areas of varied relief several scattered climatic-climax and preseral communities occur. Pronounced steepness of slope acts as an arresting factor, preventing the presere from developing into a climatic-climax by preventing soil accumulation and the consequent establishment of a ground cover.

Preseral communities were also observed on recently exposed areas such as mudbanks and on periodically inundated riverflats. They were also noted in areas of human activity. A youthful invading vegetation was often seen in these areas, but due to the instability of the environment, this has been prevented from developing into climatic-climax communities. Ecotones were often obscure due to interdigitation of habitats as a result of contrasting soil conditions. Sharp community boundaries occurred where great contrast existed in topography, moisture availability, and degree of human interference.

The mixed-grass prairie comprises several plant communities, each distinguished by one or more grasses commonly associated with certain soil characteristics. Communities on the periodically inundated river flat and "Beaver meadows" were not studied in detail due to lack of time. Some communities were characteristic of the landscape, while others were a minor element. The following more important types are described in this paper.

Stipa-Agropyron-Koeleria association — well developed soils of intermediate texture on upland prairie

Stipa-Bouteloua-Agropyron association—loam and sandy-loam soils of the drier upland prairie

Agropyron consociation — alluvial soils

Stipa-Agropyron-Koeleria Association (Fig. 2)

The most abundant grass in this community type is *Stipa comata.* Other important grasses in order of declining abundance are: *Agropyron smithii, Agropyron cristatum, Koeleria cristata,* and *Carex filifolia.* Principal herbs are *Artemesia frigida,* and the prostrate shrub *Rosa arkansana.* The dwarf club-moss *Selaginella densa* is often a monodominant.

Considerable variation in composition of the mixed-grass association results from frequent topographical and soil differences. On areas of eroded soil *Agropyron smithii* is the dominant species. *Stipa spartea* var. *curtiseta, Stipa viridula,* and *Agropyron trachycaulum* characterize the deeper soils with more favourable moisture conditions.

Constant erosional forces in the "Badlands" prevented formation of a closed ground cover, and an extremely sparse vegetation evolved. Xerics such as *Gutierrezia sarothrae* and *Hymenoxys richardsonii* are characteristic. The prostrate shrub *Juniperus horizontalis* is also commonly found. *Opuntia polyacantha* and *Sphaeralcea coccinea* are often characteristic monodominants in the community, where native ground cover has been severely damaged.

Fig. 2 — Westerly view of Writing-on-Stone Provincial Park, taken from collecting locality #4, towards Lookout Butte. In the foreground a *Stipa-Agropyron-Koeleria* association on the upland prairie.

Stipa-Bouteloua-Agropyron Association

This association differs from the preceding by a close affinity to the more xeric loam and sandy-loam areas of the upland prairie and open slopes. The characterstic dominant is *Bouteloua gracilis* with such co-dominants as *Stipa comata* and *Agropyron smithii*. Lesser components of the association are *Koeleria cristata* and *Carex filifolia*. Characteristic associations are such grasses as *Calamovilfa longifolia Muhlenbergia cuspidata*, *Agropyron cristatum*, and the following herbs in decreasing order of abundance, *Artemisia frigida*, *Antennaria nitida*, *Antennaria parvifolia*, and *Astragalus pectinatus*. Common shrubs of open slopes are *Juniperus horizontalis* and *Artemisia cana*.

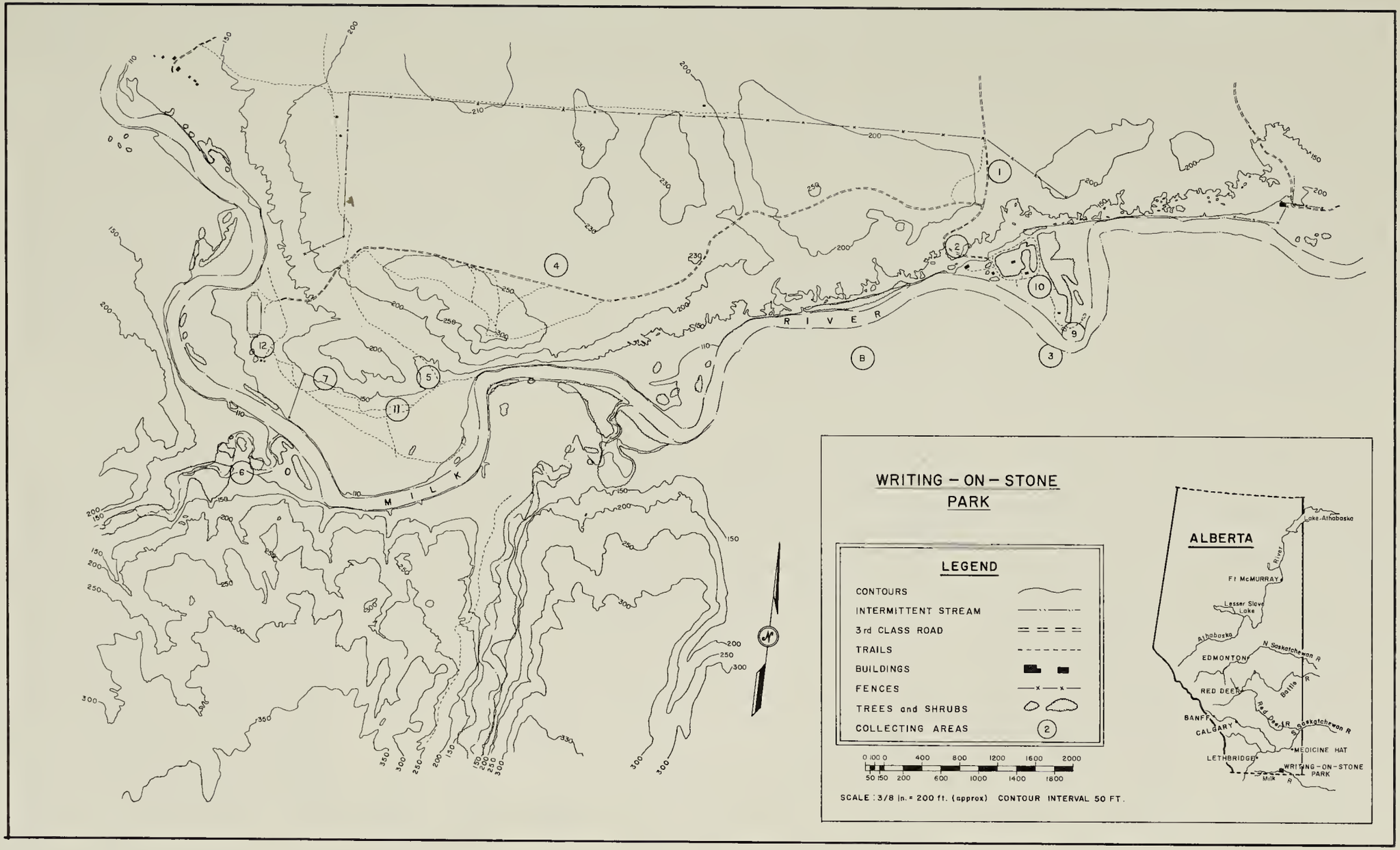
Agropyron Consociation

Agropyron smithii and *Agropyron trachycaulum* are the dominants of the consociation, occurring chiefly on the river flat. The drier areas here tend to be dominated by *Agropyron smithii*, while areas of higher soil moisture content support *Agropyron trachycaulum* as the characteristic species.

Minor community types are noticed on the periodically inundated river flats and stream banks. *Calamagrostis inexpansa* tends to be the dominant, while lesser components of the community are *Elymus canadensis*, *Poa compressa*, and *Sphenopholis obtusata*. Soils of high moisture content support a principal vegetation cover of *Eleocharis palustris*, *Scirpus americanus*, *Juncus balticus*, and *Juncus nodosus*, with such herbs as *Mentha arvensis* and *Glycyrrhiza lepidota*. Shrubs such as *Symphoricarpos occidentalis*, *Salix interior*, and *Salix amygdaloides* occur along coulee bottoms and on river and stream banks. Trees are uncommon but for *Populus sargentii*, which is found locally on low alluvial areas and along river banks.

EFFECT OF HUMAN ACTIVITIES ON THE FLORA OF THE PARK

The following notes on the history of the park have been abstracted from Campbell (1959), Dewdney (1964), and Bryant *et al.* (1964). The earliest inhabitants of the area in which the


WRITING – ON – STONE PARK
LEGEND
CONTOURS
INTERMITTENT STREAM
3rd CLASS ROAD
TRAILS
BUILDINGS
FENCES
TREES and SHRUBS
COLLECTING AREAS
0 100 0 400 800 1200 1600 2000
50 150 200 600 1000 1400 1800
SCALE : 3/8 In. = 200 ft. (approx) CONTOUR INTERVAL 50 FT.
ALBERTA
Lake Athabaska
Ft McMURRAY
Lesser Slave Lake
Athabaska R
N Saskatchewan R
EDMONTON
RED DEER
Battle R
Red Deer R
S Saskatchewan R
BANFF
CALGARY
MEDICINE HAT
LETHBRIDGE
WRITING-ON-STONE PARK
Milk R
RIVER
MILK

park is situated were Indian tribes. The first record of European man in the area was in 1855, when James Doty visited the site and saw the pictographs on the cliffs. A detachment of the Northwest Mounted Police maintained a post from 1887 to 1918 at what is now known as Police Coulee.

The area became a provincial park on August 31, 1935, but it was not until 1952 that development of tourist facilities, roads, etc., began. Writing-on-Stone Park, which was officially opened in 1957, is not a major tourist attraction, but is widely used by local residents as a recreation area.

As a result of human activities, several plant species have been introduced to the park. At campsites and on disturbed areas for example, such plants as *Agropyron cristatum, Bromus inermis, Nepeta cataria, Trifolium repens, Plantago major, Lactuca serriola,* etc., are commonly found.

Most aliens are confined to such man-made habitats, but some seem to have become naturalised and are spreading e.g. *Polygonum convolvulus, Rumex fennicus, Chenopodium album, Salsola kali* var. *tenuifolia, Sisymbrium altissimum, Medicago sativa, Melilotus* spp., *Cirsium arvense, Tragopogon dubius,* etc.

A few indigenous species such as *Thermopsis rhombifolia, Sphaeralcea coccinea, Orthocarpus luteus, Artemisia frigida,* and *Helianthus petiolaris,* are also spread by human influence and are often conspicuous along roadsides.

ANNOTATED CATALOGUE OF THE VASCULAR FLORA

The following catalogue contains taxa of vascular plants collected by the writer. Additional specimens collected by Dr. Boivin and Mr. Sexsmith are indicated. One taxon, *Parietaria pensylvanica,* unreported by Moss (1959), is assumed to be a new entity in the flora of Alberta.

Three taxa, *Heuchera flabellifolia, Delphinium nuttallianum* and *Solidago missouriensis var. extraria* are believed to be a Cordilleran element in the park. These species were collected at elevations over 3400 feet and have been observed by the writer in similar habitats at low elevations in the mountains of southwestern Alberta.

The nomenclature is after Moss (1959) except where synonyms are cited. Except as otherwise stated all specimens have been collected and identified by the writer. Critical specimens have been examined or identified by Dr. B. Boivin. Specimens have been deposited in the herbaria of the Canadian Department of Agriculture, Plant Research Institute, Ottawa (DAO), the University of Calgary, Calgary, Alberta (UC), and that of the writer. All of the writer's collections reported here, with the exception of localities 3 and 8 (Fig. 3) were made within the boundaries of the park. The collection numbers cited are those of the writer.

COLLECTING LOCALITIES

Mixed-grass prairie and dry slopes

1. Mixed grasslands and upper slopes in the vicinity of the northeast entrance to the park.
2. Eroded areas among the sandstone formations along the main road leading into the park.
3. Dry north-facing slopes south of the Milk River outside the Park boundary.
4. Mixed grasslands of the upland prairie.
5. Roadsides and exposed south-facing slopes.

Alluvial flat and stream banks

6. Lower slopes of sheltered ravine south of the Milk River near Stony Coulee.
7. Lower slopes north of the Milk River.
8. Alluvial flat south of the Milk River outside the park boundary.
9. River bank south of the main campsite.

Disturbed habitats

10. Waste areas and cultivated grounds of the main campsite.
11. Disturbed roadsides.
12. Disturbed areas near the sports grounds.

LIST OF SPECIES

EQUISETACEAE

Equisetum arvense L. Common on moist alluvial flat, 2760 (DAO).

Equisetum laevigatum A. Br. Locally on river bank and alluvial flat, 2730 (DAO).

SELAGINELLACEAE

Selanginella densa Rydb. Subdominant species common on dry eroded areas on prairie, 2150 (UC). Also found on dry upper slopes, 2795 (DAO).

POLYPODIACEAE

Cystopteris fragilis (L.) Bernh. Locally common in thickets at base of cliff on dry slope, 3277 (UC).

PINACEAE

Juniperus communis L. var. *depressa* Pursh Common semi-prostrate shrub of dry slopes, 2670 (DAO).

Juniperus horizontalis Moench Common on dry slopes, 2671 (DAO). Also common on dry sandstone ledges, 2174 (UC).

GRAMINEAE

Agropyron cristatum (L.) Gaertn. Common on dry upland prairie, 2778 (DAO).

Agropyron smithii Rydb. Common on dry prairie and slopes, 2782 (DAO). Also common on dry alluvial flat, 2797 (DAO).

Agropyron trachycaulum (Link) Malte Common on sheltered slope and damp upland prairie, 2803 (DAO). Also common on low alluvial flat, 3501.

Agrostis alba L. Uncommon in damp places along river, 2798 (DAO). Also locally on moist alluvial flat, 2801 (DAO).

Bouteloua gracilis (HBK). Lag. Common on dry upland prairie, 2780 (DAO).

Bromus inermis Leyss. Introduced weed of cultivated areas, 2775 (DAO).

Bromus tectorum L. Locally abundant on dry slope near main road, 2187 (DAO, UC).

Calamagrostis inexpansa A. Gray Common along river bank and low alluvial flat, 2781 (DAO).

Calamovilfa longifolia (Hook.) Scribn. Locally common on sandy areas on upland prairie, 2776 (DAO). Uncommon on slopes, 2802 (DAO). Locally on alluvial flat, 2810 (DAO).

Elymus canadensis L. Locally on river bank, 2809 (DAO). Locally on alluvial flat, 2774 (DAO).

Elymus cinereus Scribn. & Merr. (*E. piperi* Bowden) Locally on river bank, 2796 (DAO).

Hordeum jubatum L. Locally abundant on alluvial flat, 2777 (DAO).

Koeleria cristata (L.) Pers. Common on dry sandy prairie, 2185 (DAO, UC). Also common on dry slopes, 2783 (DAO). Common on grasslands on alluvial flat, 2784 (DAO).

Muhlenbergia cuspidata (Torr.) Rydb. Common on dry slopes, 2800 (DAO).

Oryzopsis hymenoides (R. & S.) Ricker Locally common on dry slopes, 2779 (DAO). Local in dry sandy grasslands, 2188 (DAO, UC).

Poa compressa L. Locally in damp grasslands on alluvial flat, 2799 (DAO). Other species of *Poa* may have been overlooked.

Spartina gracilis Trin. (Collected by Sexsmith, June 17, 1962).

Sphenopholis obtusata (Michx.) Sribn. Locally in damp grasslands on alluvial flat, 2781 A (DAO).

Sporobolis cryptandrus (Torr.) A. Gray (Collected by Sexsmith, July 13, 1941).

Stipa comata Trin. & Rupr. Very common on dry upland prairie, 2838 (DAO).

Stipa spartea Trin. var. *curtiseta* Hitchc. Very common on dry upland prairie, 2189.

Stipa viridula Trin. Common in dry prairie grasslands, 2186 (DAO).

CYPERACEAE

Carex filifolia Nutt. Common on dry upland prairie and slopes, 2182 (UC).

Carex lanuginosa Michx. (*C. lasiocarpa* Ehrh. var. *latifolia* (Bock) Gleason) Locally common on river banks, 2808 (DAO).

Eleocharis palustris (L.) R. & S. Common on river banks, 2811 (DAO).

Scirpus americanus Pers. Common on river bank, 2804 (DAO).

JUNCACEAE

Juncus balticus Willd. var. *littoralis* Engelm. Common on river bank, 2805 (DAO).

Juncus nodosus L. Common on moist alluvial flat, 2806 (DAO).

LILIACEAE

Allium cernuum Roth Locally on open slopes, 2677 (DAO).

Disporum trachycarpum (S. Wats.) B. & H. Locally common in thickets at base of cliff on dry slope, 3273 (UC).

Fritillaria pudica (Pursh) Spreng. Local at base of open slope, 3713.

Smilacina stellata (L.) Desf. Local among thickets on alluvial flat, 2737 (DAO).

Zygadenus gramineus Rydb. Common on grassy slopes, 3233 (UC).

IRIDACEAE

Sisyrinchium montanum Greene Local on low alluvial flat, 2785 (DAO).

SALICACEAE

Populus sargentii Dode Common tree along river bank and on low alluvial flats, 2182 (UC).

Salix amygdaloides Anderss. Common shrub along river bank and streams, 2190 (DAO, UC).

Salix interior Rowlee var. *pedicellata* (Anderss.) Ball Common along streams in coulees, 2743 (DAO). Also common along river bank, 2744 (DAO).

Salix lutea Nutt. Locally in wet places on alluvial flat, 2191 (UC).

BETULACEAE

Betula occidentalis Hook. Locally common on alluvial flat, 2159 (DAO, UC).

URTICACEAE

Parietaria pensylvanica Muhl. (Collected by Boivin, 12271, June 27, 1958).

Urtica dioica L. var. *procera* (Muhl.) Wedd. (*U. gracilis* Ait.) Common in thickets on alluvial flat, 2674 (DAO).

SANTALACEAE

Commandra pallida A. DC. Common on upland prairie, 2703 (DAO).

POLYGONACEAE

Eriogonum cernuum Nutt. (Collected by J. H. Hudson, August 27, 1959).

Eriogonum flavum Nutt. Common on dry exposed areas on slopes, 2170 (UC). Also common on open areas on upland prairie, 2757 (DAO).

Polygonum aviculare L. Common along roadsides, 2791 (DAO).

Polygonum convolvulus L. Introduced and common species of cultivated and waste areas, 2679 (DAO).

Polygonum ramosissimum Michx. Common on sandy soil along roadsides, 2769 (DAO).

Rumex fennicus Murb. Introduced and well established species of low areas on alluvial flat, 2684 (DAO).

Rumex maritimus L. var. *fueginus* (Phil.) Dusen Common along river bank, 2708 (DAO).

Rumex venosus Pursh Common on dry sandy slopes, 2160. (DAO, UC), 2682 (DAO).

CHENOPODIACEAE

Chenopodium album L. Common weed along roadsides and in disturbed areas, 2715 (DAO).

Chenopodium fremontii S. Wats. (Collected by Boivin, 12272, June 27, 1958).

Eurotia lanata (Pursh) Moq. Common on heavy soils in eroded areas, 2650 (DAO).

Salsola kali L. var. *tenuifolia* Tausch. Very common introduced weed of dry disturbed areas on upland prairie, 2719 (DAO).

Sarcobatus vermiculatus (Hook.) Torr. Locally common shrub on alluvial flat, 2653 (DAO).

AMARANTHACEAE

Amaranthus retroflexus L. Common weed of waste places, 2654 (DAO).

NYCTAGINACEAE

Mirabilis hirsuta (Pursh) MacM. var. *linearis* (Pursh) Boivin Locally on dry slopes, 2767 (DAO). (Det.-Boivin, 1966).

CARYOPHYLLACEAE

Arenaria lateriflora L. Locally in thickets at base of cliff on dry slope, 3275 (UC).

Cerastium arvense L. Common on gravelly prairie and dry slopes, 3276 (UC).

Lychnis pudica Boivin (*L. drummondii* (Hook.) S. Wats.) Uncommon on dry slopes, 2710 (DAO). (Det.-Boivin, 1967).

Paronychia sessiliflora Nutt. Common on dry gravelly slopes and ledges, 2686 (DAO).

Silene menziesii Hook. Locally common among shrubs on alluvial flat, 2178 (DAO, UC). Also locally common on river bank, 2741 (DAO).

RANUNCULACEAE

Anemone multifida Poir. Common in sheltered locations on slopes, 2752 (DAO).

Anemone multifida Poir. var. *hudsoniana* DC. Locally common in sheltered locations on grassy slope, 3264 (UC).

Clematis ligusticifolia Nutt. Common vine in coulees and sheltered places on alluvial flat, 2735 (DAO).

Delphinium nuttallianum Pritz. Local but uncommon at margin of thickets on prairie grassland, 3259 (UC).

Ranunculus cymbalaria Pursh Common on wet river bank and alluvial flat, 2713 (DAO).

Thalictrum venulosum Trel. Locally common among thickets on alluvial flat, 2695 (DAO).

CAPPARIDACEAE

Cleome serrulata Pursh Locally common on dry sandy soil, 2678 (DAO).

CRUCIFEREAE

Descurainia pinnata (Walt.) Britt. var. *brachycarpa* (Richards.) Fern. (Collected by Boivin, 12277, June 27, 1958).

Descurainia sophia (L.) Webb (Collected by Boivin, 12275, June 27, 1958).

Erysimum inconspicuum (S. Wats.) MacM. Locally on dry slopes, 2161 (DAO, UC).

Lepidium densiflorum Schrad. (Collected by Boivin, 12282, June 27, 1958).

Lesquerella alpina (Nutt.) S. Wats. var. *spathulata* (Rydb.) Payson Common on dry prairie, 2165 (DAO, UC). Also common on dry slopes, 2180 (DAO, UC).

Lesquerella arenosa (Richards.) Rydb. (Collected by Sexsmith, July 13, 1941).

Rorippa islandica (Oeder) Borbas Locally common on moist river bank and alluvial flat, 2765 (DAO).

Sisymbrium altissimum L. Introduced and well established weed along roadsides, 2657 (DAO).

SAXIFRAGACEAE

Heuchera flabellifolia Rydb. Locally common on rocky ledge on dry slope, 3274.

Ribes aureum Pursh Locally common at base of slopes, 2156 (DAO, UC). Common on river bank, 2656 (DAO). Also locally common on alluvial flat, 2787.

ROSACEAE

Amelanchier alnifolia Nutt. Locally along river bank, 2747 (DAO).

Chamaerhodos erecta (L.) Bunge ssp. *nuttalli* (Pickering) Hulten Common on dry gravelly slopes and sandstone ledges, 2768 (DAO).

Geum triflorum Pursh Common on upland prairie, 2185 (DAO).

Potentilla anserina L. Common on low meadow on alluvial flat, 2720 (DAO).

Potentilla effusa Dougl. Locally common on grassy slope, 2162 (DAO, UC).

Potentilla hippiana Lehm. Locally common on dry upland prairie, 2793 (DAO).

Potentilla pensylvanica L. Common on dry upland prairie, 2792 (DAO).

Prunus virginiana L. Common small tree of sheltered locations on slopes, 2696 (DAO).

Rosa acicularis Lindl. Common in sheltered locations on slopes, 2166 (UC).

Rosa arkansana Porter Common on dry slopes and prairie, 2659 (DAO).

Rosa woodsii Lindl. Common on upland prairie and slopes, 2702 (DAO).

LEGUMINOSAE

Astragalus aboriginum Richards. var. *glabriusculum* (Hook.) Rydb. Local on prairie grasslands, 3461 (UC). Also occasional on river bank, 3292 (UC).

Astragalus bisulcatus (Hook.) A. Gray Common on grassy slopes, 2152 (DAO, UC).

Astragalus canadensis L. Locally common on alluvial flat, 2734 (DAO).

Astragalus drummondii Dougl. Locally common on dry slopes, 3224 (UC).

Astragalus kentrophyta A. Gray Uncommon on dry eroded slopes, 2169 (DAO, UC).

Astragalus missouriensis Nutt. Common on slopes, 3229 (UC).

Astragalus pectinatus (Hook.) Dougl. Common on upland prairie, 2718 (DAO).

Astragalus purshii Dougl. Common on dry slopes, 2764 (DAO).

Astragalus striatus Nutt. Common on dry slopes, 2672 (DAO). Also common on dry upland prairie, 2167 (UC), and along roadsides, 2673 (DAO).

Astragalus tenellus Pursh Common on dry slopes, 2172 (DAO, UC). Local on dry alluvial flat, 2705 (DAO).

Astragalus triphyllus Pursh Common on dry slopes, 2688 (DAO).

Glycyrrhiza lepidota (Nutt.) Pursh Common along river bank and on alluvial flat, 2832 (DAO).

Hedysarum boreale Nutt. var. *boreale* Common on dry slopes, 2753 (DAO). Local on sandstone ledges, 2168 (DAO, UC).

Hedysarum boreale Nutt. var. *cinerascens* (Rydb.) Rollins Locally common on dry slopes, 3232 (UC), 3460 (UC).

Lupinus argenteus Pursh Locally common on dry slopes, 2727 (DAO).

Medicago sativa L. Introduced and very common weed along roadsides and on cultivated areas, 2724 (DAO).

Melilotus alba Desr. Introduced plant and very common along roadsides, 2745 (DAO).

Melilotus officinalis (L.) Lam. Very common along roadsides and frequently mixed with the foregoing species, 2746 (DAO).

Oxytropis sericea Nutt. var. *spicata* (Hook.) Barneby Common on upland prairie, 2702 (DAO).

Petalostemon candidum (Willd.) Michx. Locally common on dry slopes, 2701 (DAO).

Petalostemon purpureum (Vent.) Rydb. Common on eroded slopes, 2680 (DAO).

Thermopsis rhombifolia (Nutt.) Richards. Very common on prairie and along roadsides, 2754 (DAO).

Trifolium repens L. Common in lawns on campgrounds, 2690 (DAO).

Vicia americana Muhl. Local in thickets on alluvial flat, 2761. Common in grasslands, 2176 (UC).

LINACEAE

Linum lewisii Pursh Common on upland prairie, 2151 (DAO, UC). Also common on grass slopes, 2704 (DAO).

Linum rigidum Pursh Common on upland prairie, 2758 (DAO).

ANACARDIACEAE

Rhus radicans L. var. *rydbergii* (Small) Rehder Locally common in shaded ravine and among bushes near campsite (not collected).

Rhus trilobata Nutt. Common on dry slopes, 2173 (UC), 2697 (DAO).

MALVACEAE

Sphaeralcea coccinea (Pursh) Rydb. Common on upland prairie, often forming conspicuous patches on disturbed areas, 2154 (UC). Also locally common on upper eroded slopes, 2812 (DAO).

VIOLACEAE

Viola rugulosa Greene Locally in thickets at base of cliff on dry slope, 3271 (UC).

LOASACEAE

Mentzelia decapetala (Pursh) Urban & Gilg Specimens have been found scattered throughout the park on dry eroded slopes, 2643 (DAO).

CACTACEAE

Mamillaria vivipara (Nutt.) Haw. Locally common on stony areas in prairie grasslands, 3463.

Opuntia polyacantha Haw. Common on dry prairie grasslands and dry upper slopes, 2658 (DAO).

ELAEAGNACEAE

Elaeagnus commutata Bernh. Locally common shrub of light soils on slopes, 2837 (DAO).

Shepherdia argentea Nutt. Locally common along streams in coulees, 2157 (UC).

ONAGRACEAE

Epilobium glandulosum Lehm. Common on river bank, 2689 (DAO).

Gaura coccinea Pursh Common on dry slopes, 2177 (UC). Also common on upland prairie along roadsides, 2763 (DAO).

Oenothera biennis L. var. *hirsutissima* Gray Local on dry sandy alluvial flat, 2665 (DAO).

Oenothera caespitosa Nutt. Common on heavy soils on slopes, 2155 (DAO, UC).

Oenothera nuttallii Sweet Locally common on sandy alluvial flat, 2726 (DAO).

UMBELLIFERAE

Cicuta maculata L. var. *angustifolia* Hook. (*C. douglasii* (DC.) Coult. and Rose) Local along river bank, 2740 (DAO). (Det.-Boivin)

Lomatium macrocarpum (Hook. & Arn.) Coult. & Rose Locally on dry slopes, 3265 (UC).

Musineon divaricatum (Pursh) Nutt. var. *hookeri* T. & G. Locally common on dry prairie grasslands, 3227 (UC).

CORNACEAE

Cornus stolonifera Michx. Common on river bank, 2748 (DAO). Also frequent in sheltered locations on alluvial flat, 2153 (UC).

PRIMULACEAE

Dodecatheon radicatum Greene Locally common on grassy slopes, 3234.

Glaux maritima L. var. *angustifolia* (Collected by Boivin, 12285 June 27, 1958).

ASCLEPIADACEAE

Asclepias speciosa Torr. Infrequent in moist grasslands on alluvial flat, 2644 (DAO).

Asclepias viridiflora Raf. (Collected by Sexsmith, July 13, 1941).

Asclepias viridiflora var. *linearis* (A. Gray) Fern. (Collected by Sexsmith, July 13, 1941).

POLEMONIACEAE

Collomia linearis Nutt. Common on river bank, 3477 (UC).

Phlox hoodii Richards. Common on dry upland prairie and slopes, 3723.

BORAGINACEAE

Cryptantha bradburiana Payson Common on dry slopes, 2171 (DAO, UC). Also common on upland prairie, 2762 (DAO).

Lappula deflexa (Wahl.) Garche var. *americana* (Gray) Greene (*Hackelia americana* (A. Gray) Fern.) Common among thickets on dry alluvial flat, 2693 (DAO).

Lappula floribunda (Lehm.) Greene (*Hackelia floribunda* (Lehm.) I. M. Johnston) Local in moist meadow of alluvial flat and margin of beaver pond in stony coulee, 3258 (UC).

Lappula redowskii (Hornem.) Greene (Collected by Sexsmith, June 17, 1962).

Lithospermum ruderale Lehm. Locally on grassy slopes, 2664 (DAO).

LABIATAE

Dracocephalum nuttallii Britt. Common on river bank, 3475.

Mentha arvensis L. var. *villosa* (Benth.) S. R. Stewart Common on river bank and stream banks, 2723 (DAO).

Monarda fistulosa L. var. *menthaefolia* (Graham) Fern. Local in thickets near dry alluvial flat, 2649 (DAO).

Nepeta cataria L. Scarce, in one locality among thickets on disturbed alluvial flat, 2645 (DAO).

Stachys palustris L. var. *pilosa* (Nutt.) Fern. Locally common in thickets on alluvial flat, 2789, 2691 (DAO).

SCROPHULARIACEAE

Orthocarpus luteus Nutt. Common on dry upland prairie, often occupying large areas, 2742 (DAO).

Penstemon albidus Nutt. Locally common on grassy slopes, 3230 (UC).

Penstemon nitidus Dougl. Common on dry eroded slopes, 2716 (DAO).

OROBANCHACEAE

Orobanche fasciculata Nutt. Locally parasitic on *Artemisia frigida* on dry open prairie, 2666A (DAO).

Orobanche ludoviciana Nutt. Locally parasitic on *Artemisia frigida* on dry open prairie, 2666 (DAO).

PLANTAGINACEAE

Plantago major L. Common weed along roadside and in waste places, 2681 (DAO).

Plantago patagonica Jacq. (P. *purshii* R. & S.) Locally common on alluvial flat, 2722 (DAO).

RUBIACEAE

Galium boreale L. Very common along roadsides and in grassy prairie, 2706 (DAO).

CAPRIFOLIACEAE

Symphoricarpos occidentalis Hook. Common shrub in thickets on alluvial flat, 2731 (DAO).

CAMPANULACEAE

Campanula rotundifolia L. Locally common on dry slopes, 2694 (DAO).

COMPOSITAE

Achillea millefolium L. Common on upland prairie, 2721 (DAO).

Agoseris glauca (Pursh) Raf. Uncommon in grassy prairie, 2164 (UC), 2163. Also local on upper grassy slopes, 2717 (DAO).

Agoseris glauca (Pursh) Raf. var. *agrestis* (Osterh.) Q. Jones Local on prairie grassland, 3260.

Antennaria nitida Greene Common on dry prairie grasslands, 3235 (UC).

Antennaria parviflora Nutt. (*A. aprica* Greene) Common on dry upland prairie, 2772 (DAO). Also common on dry slopes, 2771 (DAO).

Artemisia campestris L. Locally common on slopes, 2698 (DAO).

Artemisia cana Pursh Common shrub of dry slopes, 2668 (DAO).

Artemisia frigida Willd. Very common and predominant species of dry prairie and especially on overgrazed areas, 2751 (DAO).

Artemisia ludoviciana Nutt. var. *gnaphaloides* (Nutt.) T. & G. Common on dry slopes, 2669 (DAO).

Aster ericoides L. var. *commutatus* (T. & G.) Boivin (*A. falcatus* Lindl.) Locally on dry upland prairie, 2738 (DAO). (Det-Boivin, 1962).

Aster hesperius A. Gray var. *hesperius* Locally on damp prairie, 2739 (DAO). Locally common on damp alluvial flat, 2709 (DAO).

Aster laevis L. var. *geyeri* A. Gray Locally common on river bank and alluvial flat, 2711 (DAO).

Chrysopsis villosa (Pursh) Nutt. var. *villosa* Cronq. Common on dry slopes and prairie, 2699 (DAO).

Chrysothamnus nauseosus (Pall.) Britt. Common shrub of dry slopes, 2766 (DAO).

Cirsium arvense (L.) Scop. Common on waste places on alluvial flat, 2660 (DAO).

Cirsium flodmanii (Rydb.) Arthur. Local on moist alluvial flat, 2660 (DAO).

Cirsium undulatum (Nutt.) Spreng. Locally common on dry slopes and along roadsides, 3465 (UC).

Crepis accidentalis Nutt. Uncommon on dry slopes, 2179 (DAO, UC).

Erigeron caespitosus Nutt. Common on open slopes, 2770 (DAO). Also common on dry prairie, 2773 (DAO).

Erigeron canadensis L. Frequent on waste places on alluvial flat, 2728 (DAO). Common on river bank, 2729 (DAO).

Erigeron compositus Pursh Common on dry slopes, 2714 (DAO).

Erigeron glabellus Nutt. Locally on slopes and in prairie grasslands, 2794 (DAO).

Gaillardia aristata Pursh Common on dry slopes and on upland prairie, 2712 (DAO).

Grindelia squarrosa (Pursh) Dunal Very common on open alluvial flat, 2646 (DAO).

Gutierrezia sarothrae (Pursh) Britt. & Rusby Common on dry upland prairie, 2687 (DAO).

Haplopappus spinulosus (Pursh) DC. Common on dry prairie and slopes, 2651 (DAO).

Helianthus annuus L. f. *lenticularis* (Dougl.) Boivin Locally common on sandy alluvial flat, 2676 (DAO). (Det.-Boivin, 1960)

Helianthus petiolaris Nutt. Common on light soil along road and on slopes, 2675 (DAO).

Helianthus nuttallii T. & G. (*H. subtuberosus* Britt.) Infrequent on alluvial flat, 2648 (DAO).

Hymenopappus filifolius Hook. Locally on dry prairie, 2192 (DAO, UC).

Hymenoxys acaulis (Pursh) Parker Locally common on dry unpland prai-

rie, 2183 (DAO, UC). Also on eroded slopes, 2755 (DAO).

Hymenoxys richardsonii (Hook.) Cockerell. Common on dry prairie, 2786.

Lactuca serriola L. Introduced weed, locally common on waste areas on alluvial flat, 2692 (DAO).

Lactuca tatarica (L.) C. D. Meyer var. *heterophylla* (Nutt.) Boivin (*L. pulchella* (Pursh) DC.) Common in low grasslands on alluvial flat, 2663 (DAO).

Liatris punctata Hook. Common on dry slopes and dry prairie, 2700 (DAO).

Lygodesmia juncea (Pursh) D. Don Common on dry sandy prairie, 2750 (DAO). Also locally on dry slopes, 2749 (DAO).

Ratibida columnifera (Nutt.) Wooton & Standl. Locally common on dry prairie, 2763 (DAO).

Senecio canus Hook. Common on dry slopes and upland prairie, 2683 (DAO).

Senecio hydrophiloides Rydb. Locally common in thickets on grassy slopes, 3263 (UC).

Solidago gigantea Ait. var. *leiophylla* Fern. Local on alluvial flat, 2652 (DAO). Also local on river bank, 2655 (DAO).

Solidago missouriensis Nutt. var. *extraria* Gray Uncommon on high upland prairie, 2756 (DAO).

Sonchus arvensis L. var. *glabrescens* Guenth., Grab. & Wimmer (*S. uliginosus* Beib.) Common in waste places, 2667 (DAO).

Taraxacum officinale Weber Common weed of waste places, 2647 (DAO).

Townsendia sericea Hook. Locally common on upland prairie, 3721.

Tragopogon dubius Scop. Introduced and well established weed of dry disturbed areas on upland prairie and along roadsides, 2158 (DAO).

SUMMARY

Writing-on-Stone Provincial Park is located along the Milk River in southern Alberta in close proximity to the Rocky Mountains, the Cypress Hills, and the Sweet-Grass Hills of northern Montana. A Cordilleran element is found in the flora of the more elevated areas of the park.

The present flora developed under continental conditions into a climatic-climax vegetation, as evidenced by the predominance of xeric grasses and herbs. Community boundaries and ectones are often obscured as a result of topographical and soil variations. Preseral community types exist on recently regenerated areas.

A total of 213 taxa are reported for the park.

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