THE UNIVERSITY OF MANITOBA

THE ASPEN PARKLAND AND ITS APPLICATION TO LANDSCAPE DESIGN

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To the attentive eye, each moment of the year has its own beauty, and in the same field, it beholds, every hour, a picture which was never seen before and which shall never be seen again.

Ralph Waldo Emerson

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abstract

The mesic plant communities of Aspen Parkland are the aspen forest, its border, and grassland communities. Ecological characteristics of these communities make them stable and therefore useful in low maintenance design. Oversimplified plant communities created by traditional landscape design are expensive to maintain, susceptible to attack by insects and disease, inhospitable to much indigenous wildlife and they lack the resilience of native communities.

Though the use of native communities is supported by practical and ecological arguments, there is also considerable support from aesthetic considerations such as the creation of a regional identity and, most important, the visual richness of the communities.

Native communities can be used in design a) by reproducing the communities as closely as possible, b) by reproducing only critical ecological and visual elements of the community, c) by using species from the communities individually, and d) by maintaining or rejuvenating existing native stands. Native communities are applicable to a wide range of landscape uses.

Material on native communities and native species for western Canada is available in a number of scattered sources. This paper attempts to collect some of that information, particularly that applicable to landscape design work, and to suggest ways of using it.

introduction

Because native communities are groups of plants which thrive naturally it seems only sensible to use them in low-maintenance design. This requires a wide range of knowledge. Some of this knowledge is available, but much remains to be learned. The data we do have on the Canadian prairies is not in a form which can be easily used by landscape architects. This paper is intended to provide landscape architects with some of that information in a useful form and to stimulate enthusiasm for the communities themselves.

Much information is missing here, particularly detailed practical aspects of installing and maintaining plant communities. Such information will require experimentation and study by concerned botanists, landscape architects and gardeners. This is a beginning.

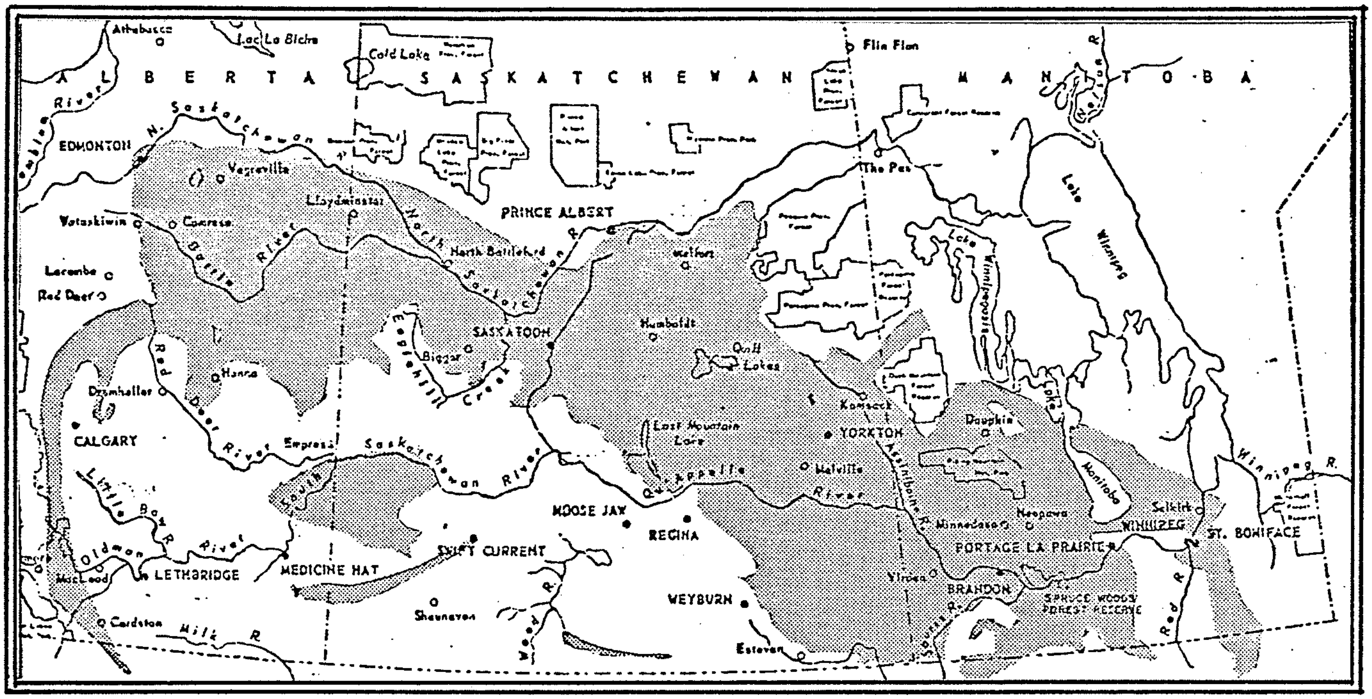


Figure I

THE ASPEN PARKLAND IN 1956 [Bird, 1961]

I ASPEN PARKLAND

GENERAL DESCRIPTION

I think the best description of Aspen Parkland is "islands of aspen in a sea of grass" [Braithwaite, 1970]. This is what early travellers saw when they emerged from forests to the east. Trees followed water-courses and fringed lakes and sloughs, while the beautiful grasses covered the land in every direction. Tall grass as high as six or eight feet grew in the Red River Valley. Through the season flowering herbs shone brightly against the green ocean of grass. Hawks, elk, mule deer, rabbits, antelope and of course, bison were plentiful.

It is hard for us to imagine the Parkland now, for the habitat is greatly changed. The Aspen Parkland vegetation zone receives more moisture and has a greater proportion of black soil than any settled part of the western plains [Braithwaite, 1970]. Consequently, it is the most productive farm land and one of the most disturbed biotic communities in Canada. Calgary, Edmonton, Saskatoon, Yorkton, Brandon and Winnipeg - cities whose economies are closely tied with agriculture-occupy this natural unit of landscape (Fig. 1). Whatever present land use may be, it is necessary to discuss the pre-settlement condition of Aspen Parkland so that forces which operated in it can be considered in the context of present use. "Original" plant communities that existed in any given place are not relevant to my study except to demonstrate the effect of environmental conditions on plant community composition. Drainage patterns, for example, have been changed so much in the years since settlement that original plant communities would not presently survive in many places.

Aspen Parkland originally existed as a transition zone between the grasslands to the south and west, and the boreal forest to the north. Eyre [1963] calls this transition zone "one of the most interesting and complicated zones of ecotone ever observed on earth."

Geography courses teach that forested areas bordering grasslands begin where average yearly rainfall is sufficient to support trees. Aspen Parkland is described as occupying areas where rainfall is almost plentiful enough to support trees. Microclimatic differences in depressions and on north-facing slopes account for the presence of aspen groves in this transitional zone. However, climatic conditions throughout the zone are no less favorable for tree growth than near-by areas of (former) forest.* Ecologists now believe that trees could have occupied this zone but for the combined effect of prairie fires and grazing animals [Eyre, 1963]. The presence of aspen groves in hollows or on north-facing slopes proves not that they require more moisture than is generally available, but that trees can escape destruction by fire there. Another evidence of the ability of the forest to advance on the prairie is the presence of Chernozem soils under the continuous forest north of the Aspen Parkland zone. Chernozem soils are formed under grassland vegetation. Since settlement prairie fires have been controlled and in many unsettled or unused areas forest has invaded former grassland [Bird, 1961].

The two most important trees in the Parkland, aspen and oak, survive fire in different ways. Aspen, the more prevalent of the two, survives fire by sprouting from underground roots. Frequent fires keep trees from growing large enough to shade out grass species. Young oaks can be killed by fire but mature plants develop a tough bark which

*Aspen can germinate, survive and mature right up to the 32 cm. isoyet [Eyre, 1963], which means it can do well in all but the driest areas of Alberta and Saskatchewan.

resists fire damage. Oaks which survive fire have a recognizably stunted form.

Grazing also slowed the spread of forest into grassland. Both aspen and oak are browsed by animals, particularly as seedlings. Deer and elk eat twigs as well as the leaves of the aspen. The effectiveness of grazing animals in halting the growth of woody plants is demonstrated in Manitoba where domestic cattle are often allowed to overgraze aspen forest. In the overgrazed forests no branches exist below the level of the cattle's reach. No woody undergrowth survives pressure of this intensity and regeneration of these forests is not possible without removal of the cattle. The species composition of the herb layer is severely altered under these conditions, though bright remnants of the native flora may be seen clinging to the protection of fenceposts.

Aspen Parkland is not climatic climax vegetation, but there is evidence that it is an old and well-integrated combination of plant communities. Consistency in structure and species-composition of true prairie over a very large range suggests that this plant community has been here for a long time [Eyre, 1963]. Eyre says that this establishes the significance of fire as an ecological agent in the prairies. Because fire has been shown to be so important in the maintenance of grassland communities within the Parkland, I have said that rainfall is not the determining factor in keeping forest at bay. It is important however. Rainfall averages are enough to support trees, but the extreme variation in rainfall from year to year makes it difficult for young trees or woody plants to become established in competition with grasses. In a series of moist years young trees may grow enough to maintain themselves through dry years which follow.

Aspen Parkland is an ecotone where natural conditions continually cause the advance or retreat of forest and grassland communities on one another. Bird [1961] points out that the geographical region itself is not the ecotone, but that an ecotone occurs only around each grove of aspen within the zone. This brings us to look more closely at the aspen bluff as a forest community and to compare it with the grassland (with which it shares a similar environment and a few species).

Figure 2. The Cypress Hills of southwestern Saskatchewan.

THE PLANT COMMUNITIES

Aspen Parkland is a vegetation zone containing the familiar aspen bluffs and grassland communities between them and a range of plant communities adapted to particular microclimatic variations within the Parkland. Floodplain forests and aquatic communities are examples of other plant communities found in the Parkland. Aspen forest and grassland communities represent average or mesic conditions in this vegetation zone and are therefore the major or representative communities of the Aspen Parkland. They will be described in this section.

Aspen Forest Community

The aspen (Populus tremuloides)* is a component of all forest zones of the Prairie Provinces, but only in the Aspen Parkland is it more than a nurse species for mature vegetation types. In Aspen Parkland it is the most important tree. Though aspen forest is subclimax to white spruce forest in the north and to deciduous forest in the southeast of the Aspen Parkland, fire, grazing animals and climatic conditions have frequently kept succession from advancing beyond aspen forest. Consequently it is considered the climax community of the Parkland.

The proportion of land occupied by forest or grassland communities in Aspen Parkland changes roughly according to moisture availability. In areas bordering boreal forest the aspen creates a nearly continuous forest. Toward the drier grassland regions the spaces between individual groups of aspen increase in size until the aspen bluffs are only occasional elements in the landscape. In the driest areas aspen communities can survive only around pot-holes and moist depressions. Aspen-oak forest communities occur only on well drained sites in the southeast portion of the Parkland, within the range of the bur oak (Quercus macrocarpa).

The aspen is a slender, graceful tree, especially where it grows in pure stands of closely spaced individuals. It develops a long cylindrical trunk which may be without branches for three-quarters of its height. The smooth bark is greenish with a white bloom particularly prominent on the south side of the trunk. (Overmature trees have furrowed gray bark.)

* The nomenclature used is Scoggan [1957].

Aspen are short-lived trees with soft wood. Their life expectancy is even shorter than it might be due to susceptibility of aspen to damage by insects and a number of fungal diseases. White heart rot (Fomes igniarius) and aspen canker (Hypoxylon pruinatum) cause much of the damage and are the most visible [Bird, 1969]. Weakened wood is broken by heavy winds and gives a derelict look to a forest stricken by fungal diseases.

An individual aspen rarely lives more than 60 years. A stand of even-aged aspen which has reached 30 years will begin to have openings in its canopy as its trees succumb to old age and disease [Curtis, 1959]. The average forest tree lives 35 to 40 years before it begins to degenerate. By this time it has reached a height of 16 to 20 m. and may have a girth of 40 cm. Rapid growth of young aspen (up to 1 m. per year in favorable conditions) compensates for its brief life-span.

An undisturbed aspen bluff acquires its dome-shaped form from the suckering habit of the aspen (Fig. 3). Aspen can give rise to many root suckers (and they typically do when top growth is removed by fire, etc.) producing dense stands of uniform growth called clones. Support of the young trees in a clone by parent roots accelerates growth and explains success of aspen in harsh environments where seedlings would fail to survive. Removal of the above ground parts of a clone results in an even-aged, evenly spaced stand. Competition for light reduces the number of trees in the stand as it matures.

Figure 3. Aspen bluffs near St. Ambroise, Manitoba.

Most stands of aspen are a "mosaic of clones of varying size and form" [Steneker and Wall, 1960]. The size of an individual clone can vary from a few square metres to several hectares. Clones in a stand can be distinguished from one another most easily during seasonal changes when all the trees in one clone flower or leaf at exactly the same time. Differences in habit, leaf form, etc. are also distinguishing features.

The dome form of the aspen clone works admirably as a windbreak, gradually lifting winds upward, protecting the interior of the stand. Species distribution reflects the difference in exposure from edge to interior of a stand, showing border species gradually giving way to forest species.

Species distribution

The well developed aspen forest is a nearly pure stand. Balsam poplar (Populus balsamifera) occupies areas where drainage is inadequate, but it is unable to compete with aspen on better drained sites. Oak requires drier conditions than the aspen. Where drainage in adequate and seed sources available, oak seedlings will spring up in the shade of the aspen. The shrub layer is principally hazelnut (Corylus americana or C. cornuta). Red osier (Cornus stolonifera) is scattered through aspen forest, particularly in moister locations. Highbush cranberry (Viburnum trilobum) and speckled alder (Alnus rugosa var. americana) are often found in moist woods. Roses (Rosa spp.), chokecherry (Prunus virginiana), pincherry (P. pensylvanica), saskatoon (Amelanchier alnifolia), and wolfberry (Symphoricarpos occidentalis) occur on the edges of the forest and less often within it. Disturbed areas are often occupied by raspberry, (Rubus idaeus var strigosus).

Bird [1961] divides the herb stratum of aspen forest into two levels:

Upper stratum

- Aralia nudicaulis, wild sarsaparilla, dominant
- Actaea rubra, red baneberry
- Aster ciliolatus, Lindley's aster
- Galium triflorum, sweet-scented bedstraw
- (On sandy soils these may be replaced by Rhus radicans var. rydbergii, poison ivy.)

Lower stratum

- Pyrola asarifolia, pink wintergreen
- Cornus canadensis, bunchberry
- Maianthemum canadense var. interius, false lily-of-the valley
- Smilacina stellata, star-flowered Solomon's seal
- Fragaria vesca var. americana, woodland strawberry
- F. virginiana, strawberry
- Rubus pubescens, dewberry
- Arenaria lateriflora, grove-sandwort.

The following species are fairly common in the aspen forest, though not as common as those cited by Bird:

Agrimonia striata, grooved agrimony
Aquilegia canadensis, wild columbine
Lonicera dioica var. glaucescens, twining honeysuckle
Osmorhiza longistylis, anise-root
Parnassia multiseta, northern grass-of-Parnassus
Ribes oxyàcanthoides,northern gooseberry
Rosa woodsii, Wood's rose
Smilacina trifolia, three-leaved Solomon's seal
Smilax herbacea var. lasioneura, carrionflower
Steironema ciliatum, fringed loosestrife
Symphoricarpos albus, snowberry
Thalictrum dasycarpum, purple meadow-rue

The forest community described above is a mature, mesic community. There are other stages of the aspen forest development which could be described here, from early successional to nearly mature stages in wet or dry environments.

Figure 4. Herb layer of aspen forest community.

Species that appear in early development vary with the type of succession. Where forest is invading former wetlands, willow species, then red osier and balsam poplar often precede aspen and hazel. In the early stages of such a forest, reed grasses (Calamagrostis spp.), cord-grasses (Spartina spp.), vetchling (Lathyrus palustris) and meadow-sweet (Spiraea alba) may be present in the understory [Ewing, 1924]. Where forest develops on former grasslands, species from the grassland community are likely to remain in the early stages of forest development. Silverberry (Elaeagnus commutata) and wolfberry (Symphoricarpos occidentalis) are typical shrub pioneers when aspen forest invades grasslands.

The species present and their abundance at any given stage in the development of forest depends on seed availability. Oak and hazel, for instance have large seeds which do not disperse well over distances, while aspen has small fluffy, airborne disseminules which facilitate extensive dispersal. Some species have limited ranges within the Parkland, which affects the composition of the forest community from one place to another. Competition is also a factor of distribution.

Phenology

The phenology of aspen forest is like that of many forest communities. The majority of herbs (on Bird's list) flower in spring, taking advantage of available moisture and light before the woody species are in leaf. Both hazel and aspen flower and set fruit before their leaves appear. Most of the shrubs bloom and leaf after the aspen but before the oak, which creates heavier shade. In fall substory shrubs tend to hold their leaves later than the aspen (except hazel which drops its leaves early.) A few herbs, like the aster reach their maximum height and flower late in the season.

Soils

Most of the Parkland occurs on Black soils. The difference in Black soils under the forest community and those under grassland communities is generally the slightly grey mottled appearance of the A horizon (evidence of leaching resulting from the gradual increase in acidity under forest species). In areas where forest has long been established Grey wooded soils have developed. Thses soils have less organic material and are less alkaline than the rich Black soils developed under prairie vegetation.

Border Communities

A border community is a specific group of plants found along the margins of aspen forest. Special attention is being given border communities for several reasons:

1. Edge conditions of partial sun, exposure, etc. to which border species are adapted are frequently found in built environments (against buildings, etc.).
2. The natural form of border communities creates a graceful transition from vertical elements (trees or buildings) to open space.
3. Border communities contain a variety of attractive, hardy plants.
4. Border communities provide excellent wildlife habitat.

Border communities play a dynamic role in the succession of grasslands. They modify the grassland habitat, facilitating forest invasion. The typical pioneers, wolfberry and silverberry (in mesic or dry grasslands) are able to compete with prairie grasses. They may moderate the competition of grasses for moisture to the point that hazel and aspen become established. Growth of woody species then tends to inhibit the growth of grasses by shading and by the production of leaf mulch [Weaver, 1954]. In this modified habitat aspen spreads readily. (Fig. 5)

A designer using Aspen Parkland communities might be concerned about the rate of forest invasion on grassland in the absence of fire. Because of variation in weather conditions, plant communities, etc. it is impossible to establish a standard rate of forest invasion for the Aspen Parkland or any vegetation zone. However, border c...-

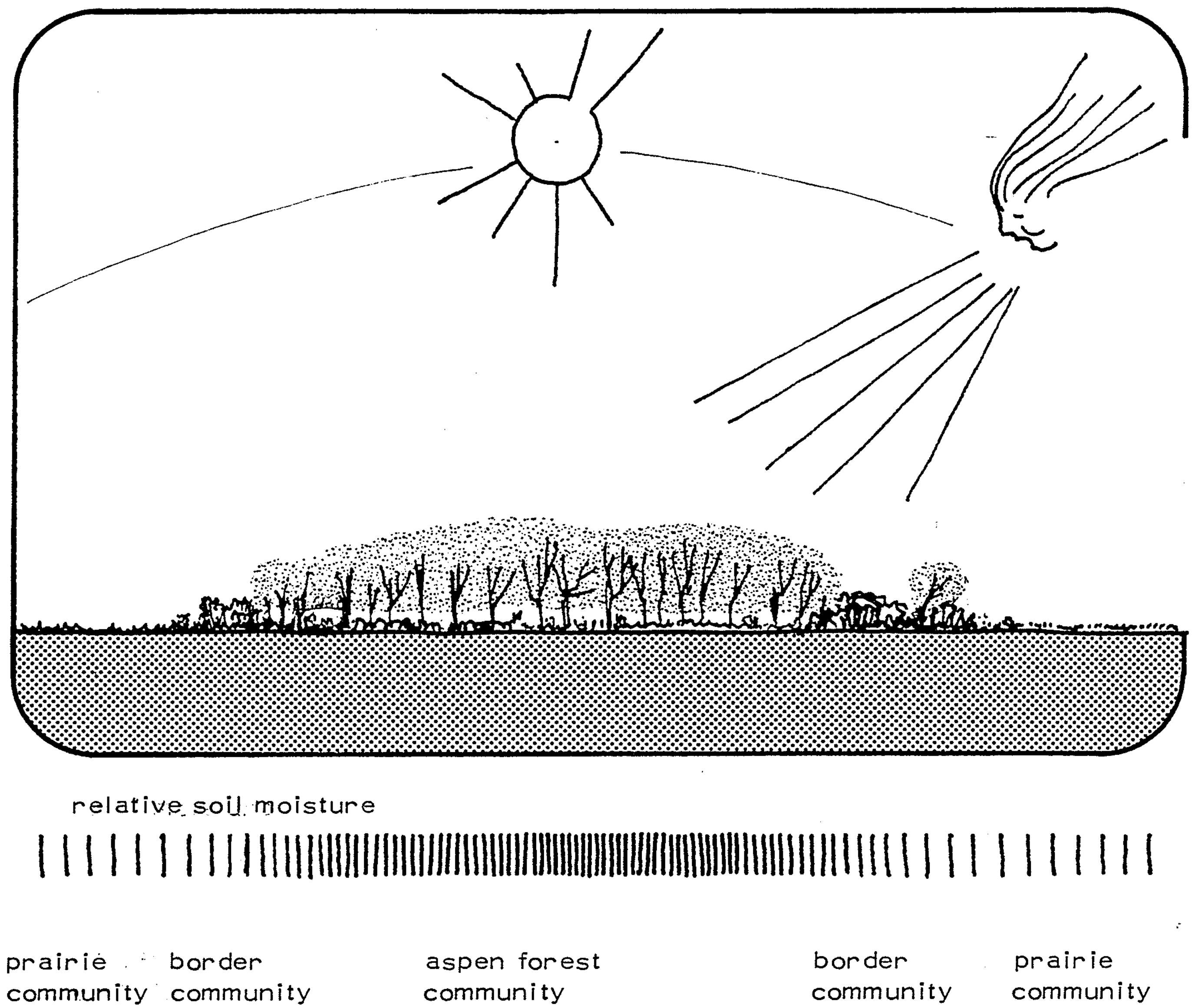
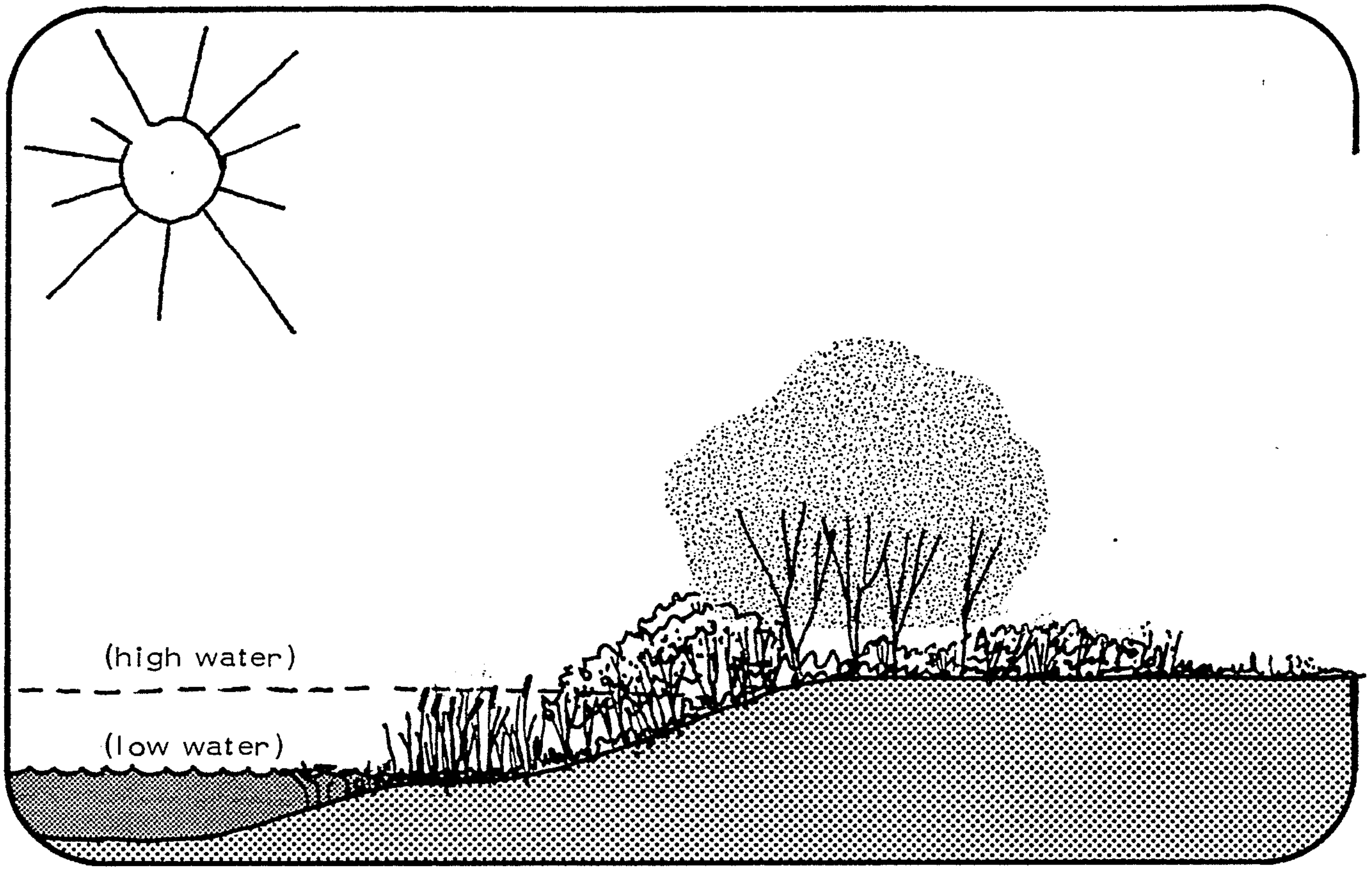


Figure 5

ASPEN BLUFF WITH BORDER COMMUNITIES



pond-weeds | emergent vegetation | willow | aspen | wolfberry | prairie

pondweeds
white water crowfoot
greater bladderwort

bulrush
cattail
reedgrass
spangle-top
sedges

basket willow
pussy willow

Figure 6

SUCCESSION--FRESHWATER SLOUGH TO ASPEN FOREST

(data from Bird [1961])

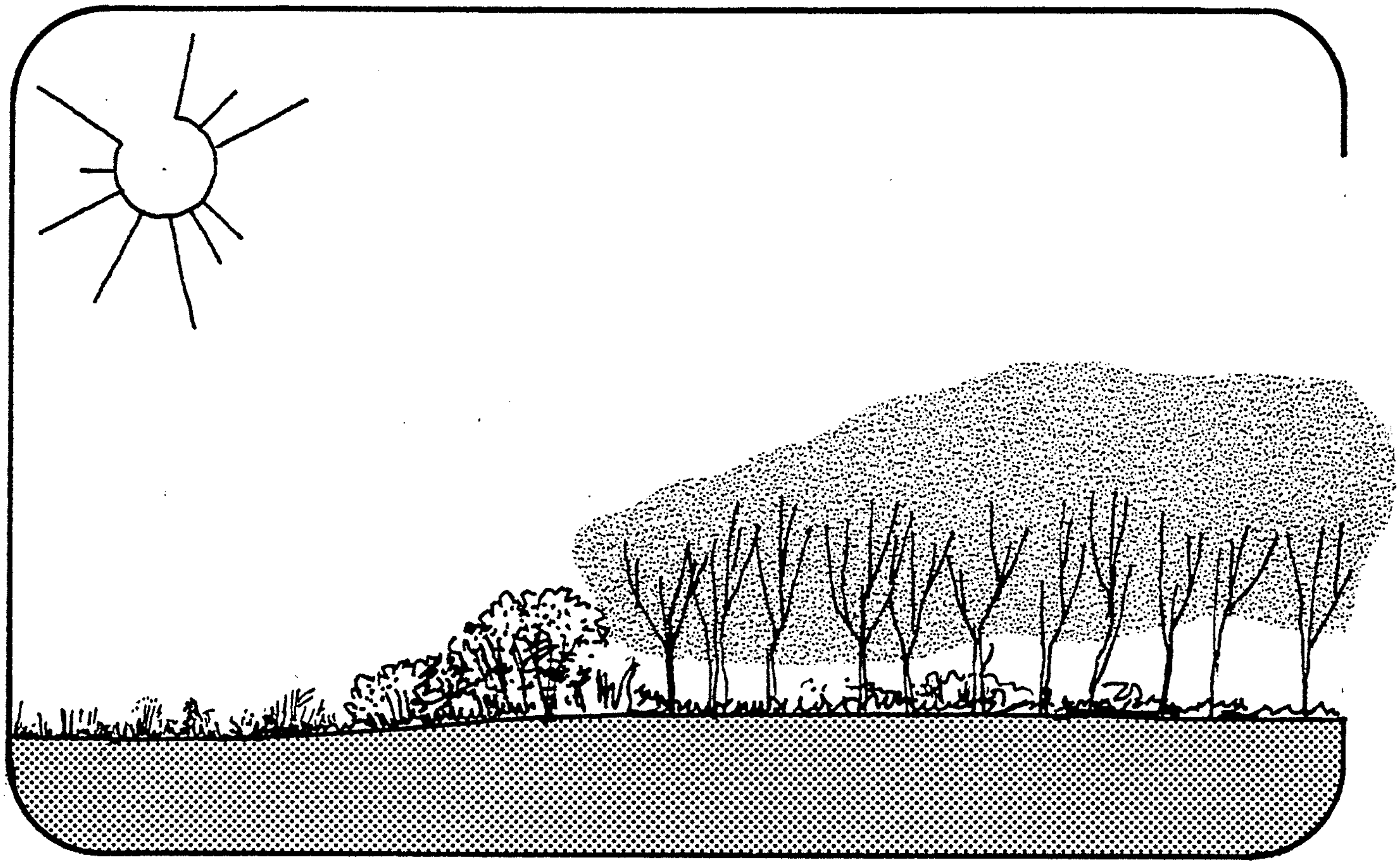
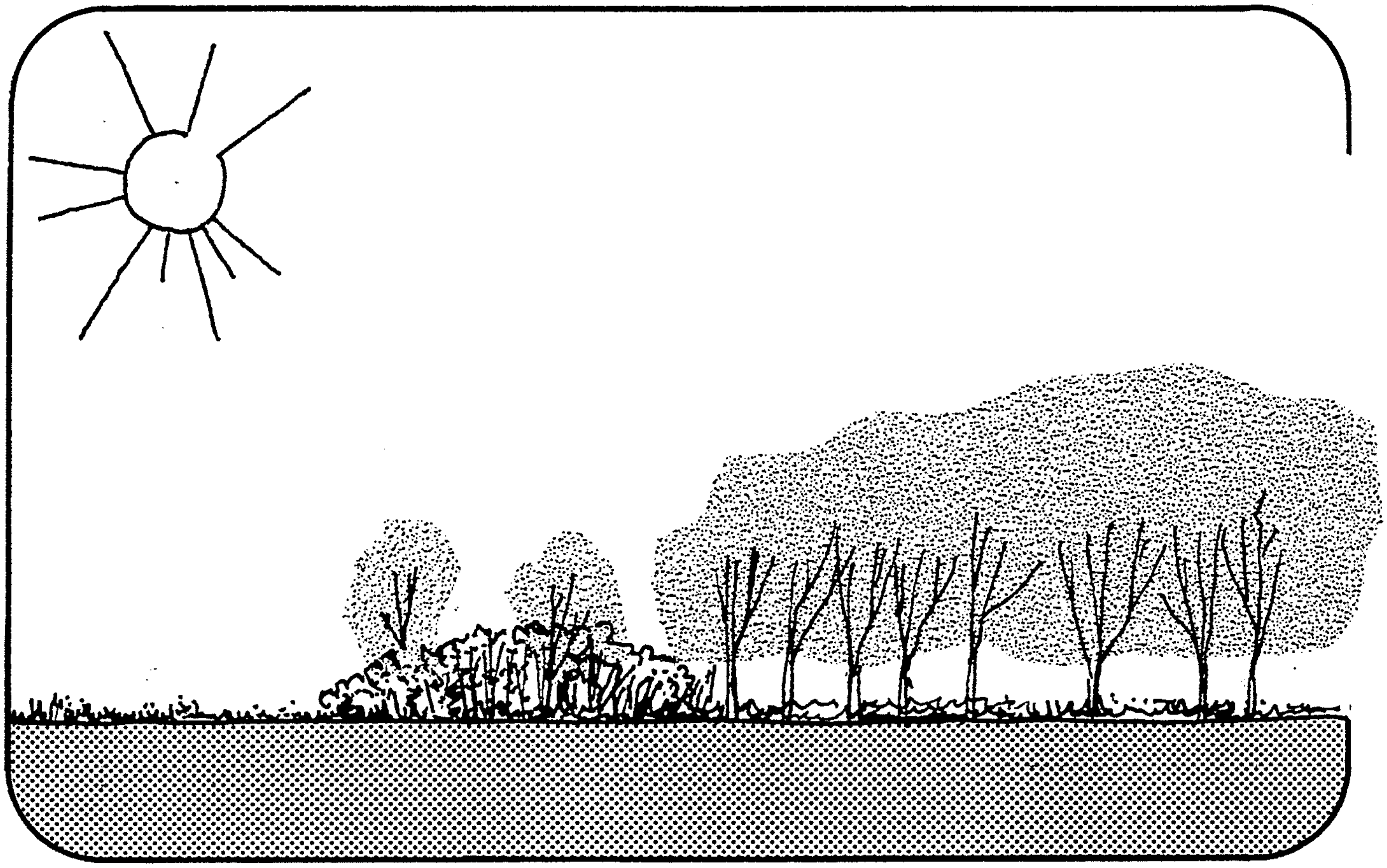


Figure 7

SUCCESSION - WET MEADOW COMMUNITY TO ASPEN FOREST

(data from Ewing [1924])



prairie border community aspen forest

silverberry
wolfberry
rose
hazel
pincherry
chokecherry
hawthorn
saskatoon
red osier
nannyberry
(small bur oak
& aspen)

(note: a single border community may include all or only some of these species)

Figure 8

SUCCESSION--PRAIRIE COMMUNITY TO ASPEN FOREST communities studied in mid-western United States advanced less than one meter in three to five years [cited in Weaver, 1954]. This represents a maximum advance of 30 cm. per year in an area where the length of the growing season is significantly longer than ours.

Ewing [1924] described two kinds of mesic border communities occurring along aspen-oak forest in northwestern Minnesota. The first was a low dense thicket composed mostly of shrubs with sparse or non-existent herbaceous growth. At its edge the thicket thinned abruptly, giving way to grassland. The second type exhibited a gradual transition from forest to grassland. There was no shrub thicket, but a gradual decrease in size and frequency of aspen, shrubby oaks, and hazel. A small number of herbaceous plants grew in the shade of the three woody species. These two border communities are examples of different distribution and composition which can occur on sites which appear similar.

On dissimilar sites the distribution and composition of border communities are likely to be more divergent. Where aspen forest is advancing on a slough there is a distinct slough border community; when forest advances on wet meadow there is another; and when forest advances on grassland there is still another. (Figs. 6, 7, 8).

Border communities, though varied, usually have the following in common:

1. A group of woody "border species" which are associated with either wetland or grassland successions.
2. A few woody species from the advancing forest. (In the case of grassland succession there may also be woody species from the grassland.)

3. Herbaceous plants from the community on which the forest is advancing.

As an example, in a typical succession of grassland to forest the border community would contain "border species" such as chokecherry, pincherry, nannyberry (Viburnum lentago), saskatoon and hawthorn (Crataegus spp.). All these may occur in the forest, but not in abundance for only nannyberry and saskatoon are tolerant of shade. Forest species such as hazel and dogwood are almost always present, along with numerous young aspen. The herbaceous plants are mainly grassland species. In the border community where competition of grasses is reduced, herbs grow to greater size and tend to be the taller species, which are able to compete for light with young shrubs [Ewing, 1924]. Shade tolerant herbs such as star-flowered Solomon's seal and strawberry may exist below the layer of tall herbs.

A rich border community exists along the aspen-oak forest of the St. James prairie. This community is primarily a dense thicket of shrubs which thins abruptly to a transitional zone of prairie species and young aspen. Saskatoon and long-spined hawthorn (Crataegus succulenta var. occidentalis) create the thicket on a southern exposure. On an eastern exposure these two species are present but less important than hazel, red osier, willow (Salix spp.) and young aspen. Big bluestem (Andropogon gerardi) and spreading dogbane (Apocynum androsaemifolium) are common along the eastern exposure. In the area dominated by young aspen, wolfberry is abundant associated with several legumes including purple vetchling (Lathyrus venosus var. intonsus) and American vetch (Vicia americana).

Because of this particular community's composition I looked at other border communities for similarities between the location of certain species and exposure - for example, to see if shade tolerant or moisture-loving border species would appear more frequently on the northern sides of aspen bluffs. While I did find variation in species composition around the edges of aspen bluffs, there was no evidence of distinct changes in border composition due to exposure on a given bluff. There were, however, differences in flowering dates and for leaf fall in protected areas.

Table 1.

WOODY SPECIES COMMONLY FOUND IN BORDER COMMUNITIES

WET- MESIC

Alnus rugosa var. *americana*, speckled alder
Cornus stolonifera, red osier
Populus balsamifera, balsam poplar
P. tremuloides, aspen
Rosa spp., roses
Salix spp., (in order toward the more mesic)
S. bebbiana, beaked willow
S. discolor, pussy willow
S. petiolaris, slender willow
S. humilis, gray willow

MESIC

Amelanchier alnifolia, saskatoon
Crataegus spp., hawthorns
Corylus americana, American hazelnut (in southeast)
C. cornuta, beaked hazelnut
Elaeagnus commutata, silverberry
Populus tremuloides, aspen
Prunus pensylvanica, pin-cherry
P. virginiana, choke-cherry
Quercus macrocarpa, bur oak (in southeast)
Rosa spp., roses
Symphoricarpos albus, snowberry
S. occidentalis, wolfberry

Table 2.

WOODY SPECIES OCCASIONALLY FOUND IN BORDER COMMUNITIES

WET- MESIC

Prunus americana, wild plum (in southeast)
Viburnum trilobum, highbush-cranberry

MESIC

Rubus idaeus var. *strigosus*, raspberry
Shepherdia argentea, buffalo-berry (in southeast)
Viburnum lentago, nannyberry (in southeast)
V. rafinesquianum, downy arrow-wood (in southeast)

Table 3.

HERBACEOUS SPECIES COMMONLY FOUND IN BORDER COMMUNITIES

WET-MESIC

Andropogon gerardi, big bluestem
Anemone canadensis, Canadian anemone
Astragalus canadensis, Canadian milk-vetch
Calamagrostis canadensis, blue-joint
C. inexpansa var. brevior, northern reed grass
Cypripedium calceolus var. parviflorum, small yellow lady's-slipper
Elymus canadensis, Canada wild rye
Glycyrrhiza lepidota, wild licorice
Helianthus maximiliani, narrow-leaved sunflower
Spiraea alba, meadow-sweet
Thalictrum venulosum, veiny meadow-rue
Vicia americana, American vetch
Zizia aptera, heart-leaved Alexanders

MESIC

Agastache foeniculum, blue giant hyssop
Apocynum androsaemifolium, spreading dogbane
Artemesia ludoviciana var. gnaphalodes, white sage
Aster laevis, smooth aster
Astragalus canadensis, Canadian milk-vetch
Epilobium angustifolium, fireweed
Eupatorium maculatum var. bruneri, Joe-Pye-weed
Glycyrrhiza lepidota, wild licorice
Helianthus maximiliani, narrow-leaved sunflower
Lathyrus ochroleucus, pale vetchling
L. venosus var. intonsus, purple vetchling
Liatris ligulistylis, meadow blazingstar
Monarda fistulosa, wild bergamot
Psoralea argophylla, silverleaf psoralea
Rudbeckia laciniata, tall coneflower
Sanicula marilandica, snakeroot
Solidago canadensis, Canada goldenrod
Vicia americana, American vetch

Grasses are relatively insignificant, usually tall species, forming small mats [Ewing, 1924]:

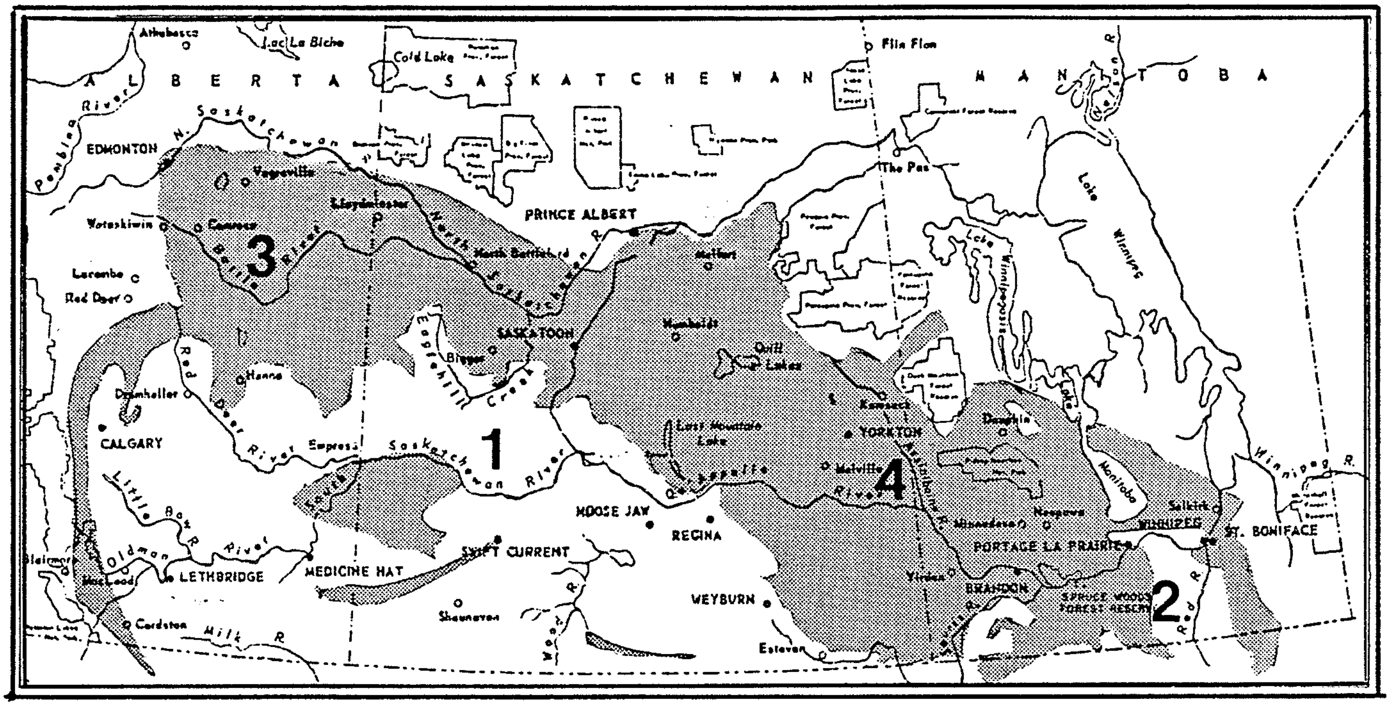
Agropyron trachycaulum, slender wheat grass
Andropogon gerardi, big bluestem
Bromus inermis, smooth brome (naturalized)
Elymus canadensis, Canada wild rye
Stipa spartea, porcupine-grass

Grassland Communities

Most landscape architects have a general understanding of the Grassland Formation. We know that grasslands exist where a combination of environmental factors - especially drought and high temperatures in summer - prevent the growth of forest. Tall, mixed and short grass communities exist in progressively drier environments, and grass gets shorter as one travels westward, until moister environs in the foothills produce grasses of higher stature again. This general information about open grasslands applies to the grassland communities in the Aspen Parkland but it is not enought information with which to begin design work. It is necessary to know what grassland associations exist within the Parkland zone, where and especially why they exist where they do. It is necessary to know more about grassland communities as entities before we can create synthetic communities in design work. This section will attempt to give the designer a framework of understanding for grassland communities and to direct him to more specific material in the literature.

Prairie types

A useful description of grassland types was given by Coupland [1961]. Although Coupland's work was not directed toward defining grasslands within the Parkland, overlaying his map of prairie types on Bird's map of the Aspen Parkland [1961] shows the location of tall grass, fescue and mixed prairie in the Parkland. (Fig. 9) I have used Coupland's data because it is general enough for an overview and because his map of prairie types shows these types occurring



shaded area: aspen parkland in 1956 [Bird, 1961]

prairie associations given by Coupland [1961]

1: mixed prairie
2: tall-grass prairie
3: fescue prairie
4: communities of both mixed and fescue prairie

(boundaries intergrade)

Figure 9

THE ASPEN PARKLAND AND MAJOR PRAIRIE ASSOCIATIONS

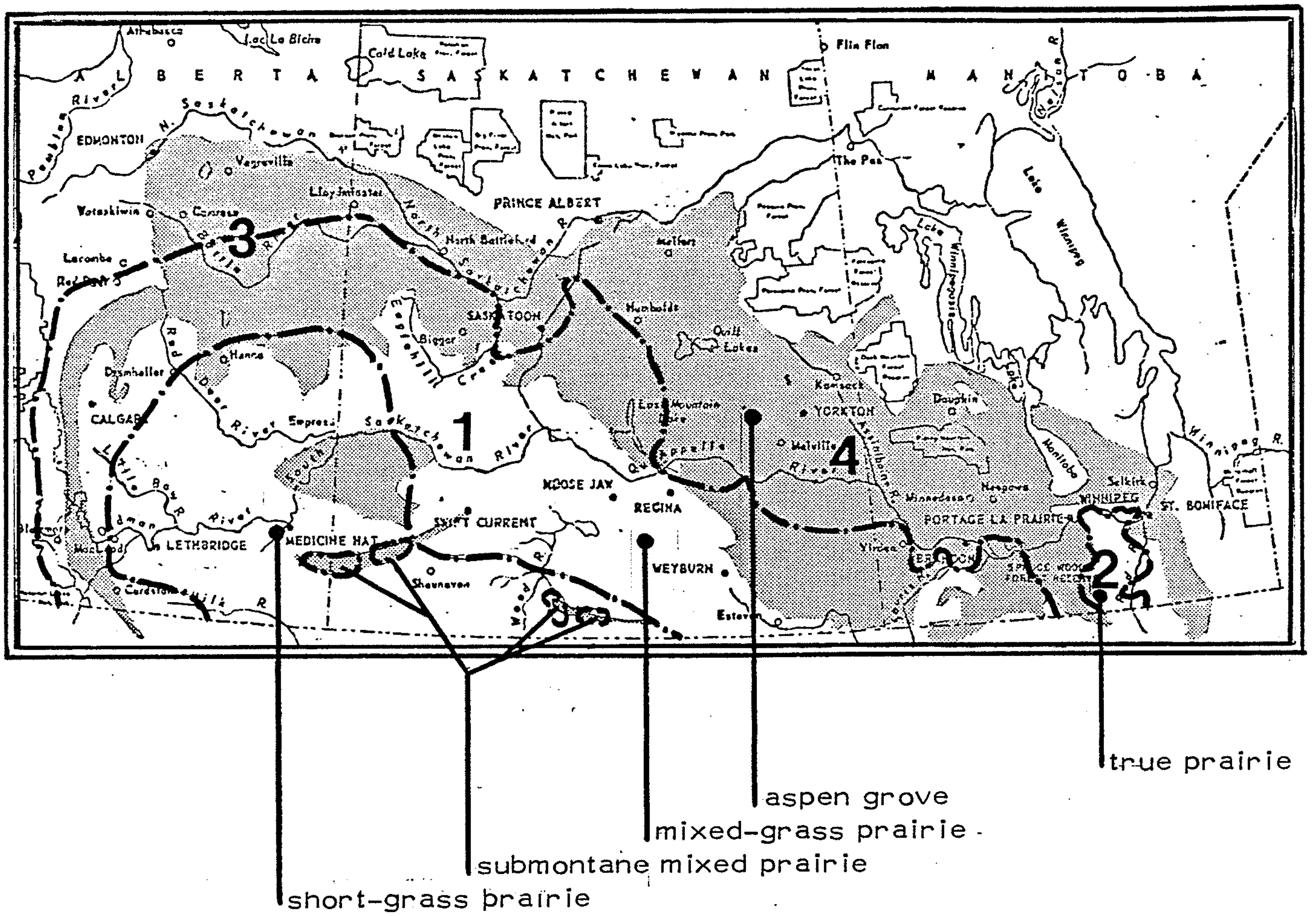


Figure 10

THE ASPEN PARKLAND AND MAJOR PRAIRIE ASSOCIATIONS--2
Watts [1960] superimposed on Figure 9

within the limits of Aspen Parkland described by Bird [1961]. Watts [1960] provided boundaries between the prairie types he described (Fig. 10)but his prairie types do not parallel Coupland's. No two authors describe identical grassland associations because they usually describe them by varying criteria. Communities they name and describe depend in part on where the authors have obtained data and in what years the data was collected. Coupland's work is the product of 18 years of sampling while Watts' is based on descriptions and maps of land surveyors.

Tall grass prairie

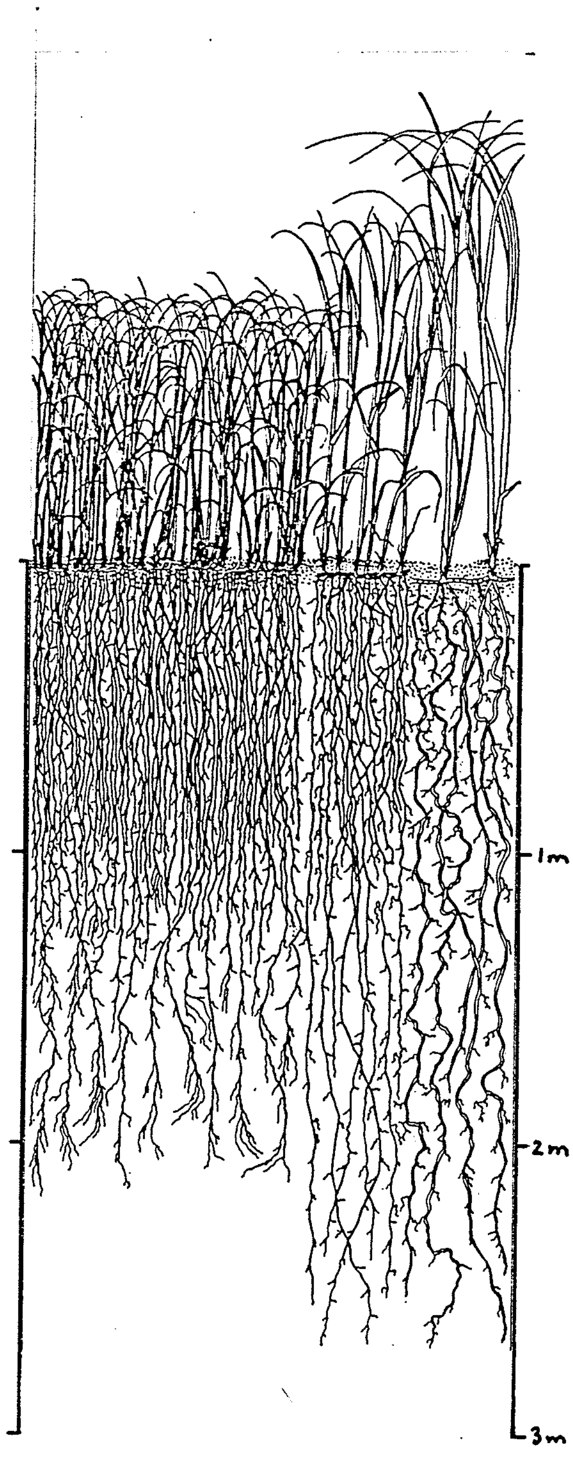
The Red River region has a longer period for active plant growth and a higher mean annual precipitation than the rest of the Aspen Parkland zone. The resultant dominant plant community is tall grass prairie. Microclimatic conditions elsewhere in the Parkland zone may produce tall grass communities locally, but only here are they the dominant form.

Tall grass prairie is part of the "true prairie" of the Red River Valley but it has a greater proportion of tall grasses as a result of poor drainage and heavy soils. The name "tall grass prairie" is relative - there are many important grasses in it which are not particularly tall. A number of shorter growing species are moisture-loving and appear in their greatest numbers in this prairie type. Others, while they may not require high moisture levels, require the more regular rainfall available in this geographical region. "Tall grass" expresses composition containing tall-growing species and the improved growth rate of species in this region.

Dense sods are typical of tall grass prairie communities. "Prairie sod" is the upper ten cm. of prairie soils, occupied by roots and rhizomes of praire grasses [Weaver, 1968]. Great networks of rhizomes in the sod provide stability for the grasses. The rhizomes store food and water, and they prevent the total loss of living plant material which could result from temperature extremes, hail, fire, grasshoppers or drought. In upland communities of tall grass prairie, and also in fescue and mixed prairie communities, the dominant species are often bunch grasses. These may form sods but not by developing heavy mats of rhizomes. Bunch grass roots spread out in all directions from the bases of buried stems. The roots bind the stems together and anchor the bunch in the soil. (Figs. 11 and 12)

Dominant species of tall grass prairie are perennial grasses having lifespans of ten to twenty years. The sod-forming big bluestem (Andropogon gerardi) is most common. Big bluestem and little bluestem (Andropogon scoparius) typically form 75% of the vegetative cover of the bluestem association [Watts, 1960]. With the bluestem other grasses are found including Canada wild rye (Elymus canadensis), wheat grasses (Agropyron spp.), porcupine-grass (Stipa spartea), June grass (Koeleria cristata). Typical forbs of this mesic tall grass association are northern bedstraw (Galium septentrionale), Canada anemone (Anemone canadensis), Canada goldenrod (Solidago canadensis) prairie-lily (Lilium philadelphicum var. andinim), prairie rose (Rosa arkansana). Under virgin conditions big bluestem stands grew to a height of 1 to 2.5 metres.

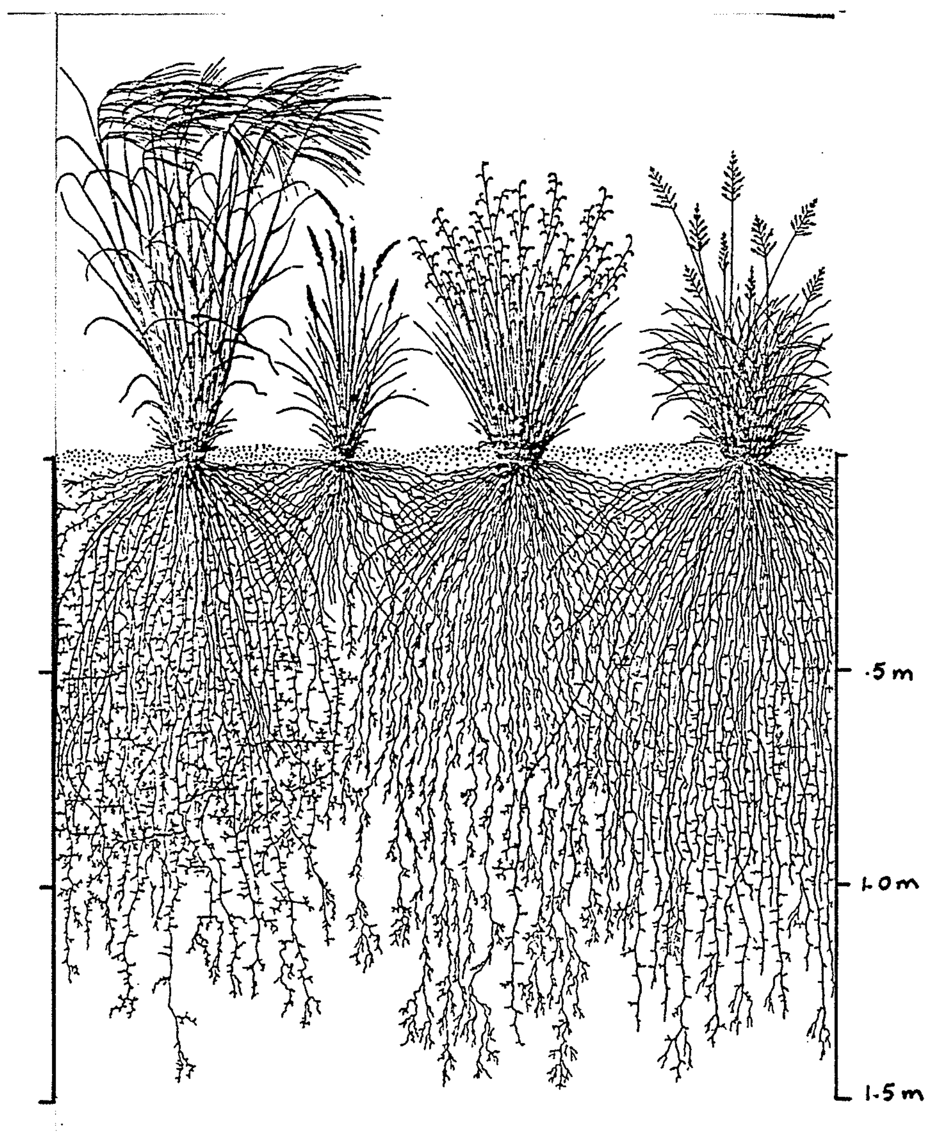
Wet sites may be occupied by a sloughgrass community where dominant



[Weaver, 1968]

Figure 11

CHARACTERISTIC DEVELOPMENT OF TOPS AND ROOTS OF BIG BLUESTEM, SWITCHGRASS AND PRAIRIE CORDGRASS



[Weaver, 1968]

Figure 12

CHARACTERISTIC DEVELOPMENT OF THE TOPS AND ROOTS OF FOUR BUNCHGRASSES - needlegrass, June grass, little bluestem and prairie drop-seed.

prairie cord grass (Spartina pectinate) is associated with switchgrass (Panicum virgatum), Canada wild rye, alkali cord grass (Spartina gracilis) and northern reed grass (Calamagrostis inexpansa var. brevior). Canada goldenrod and Baltic rush (Juncus balticus var. littoralis) are also common in this community.

Sites drier than the sloughgrass community but wetter than the bluestem community are often occupied by an association of wild rye and switchgrass. These sites have standing water during part but not most of the summer.

The driest sites in tall grass prairie (often called upland communities) are typically occupied by porcupine-grass communities. Associated with porcupine-grass are other Stipa species, June grass, side-oats grama (Boutelous curtipendula), and western wheat grass (Agropyron smithii). Typical forbs of this community are leadplant (Amorpha canescens), rhombic-leaved sunflower (Helianthus laetiflorus var. subrhomboideus), Missouri goldenrod (Solidago missouriensis), silverleaf psoralea (Psoralea argophylla), western red lily and prairie rose [Watts, 1960].

My discussion of tall grass prairie communities assumes conditions before large scale drainage took place. Careful interpretation of existing sites must be made in order to use these communities today.

Fescue prairie

Better drainage and lower precipitation result in a change of prairie communities west of the Red River region. Fescue prairie with rough fescue (*Festuca altaica* var. *major*) the dominant species is a western prairie type found throughout the Aspen Parkland west of Brandon, Manitoba. Rough fescue is not an important component of any other grassland community and consequently fescue prairie is easily distinguished from mixed prairie. Associated with rough fescue are northern porcupine-grass (*Stipa spartea* var. *curtiseta*) and June grass [Bird, 1961]. Sedge species (*Carex stenophylla* var. *enervis*, *C. pensylvanica* var. *digyna*, and *C. obtusata*) together may make up 25% of the linear-leaved cover. The degree of dominance of rough fescue over other species in this association is a function of moisture. In moist cycles it often makes up over 50% of the cover [Coupland, 1961]. During dry cycles other species requiring less moisture extend their cover.

Important forbs of fescue prairie which do not occur normally in mixed prairie are: three-flowered avens (*Geum triflorum*), field-chickweed (*Cerastium arvense*) and northern bedstraw [Coupland, 1961].

Mixed prairie

The mixed prairie type is dominant in regions having less precipitation, more variable precipitation, and/or more permeable soils than regions where tall grass or fescue prairie dominate. Dominant grasses of mixed prairie reflect the variation in moisture availability - needlegrasses (Stipa), grama-grasses (Bouteloua), and wheat-grasses (Agropyron). The needlegrasses are medium height bunch grasses which seed early in the season (when moisture is reliable) and then lie dormant through dry periods of summer. Grama-grasses are sod-forming. Although they are short above ground they have extensive, deep root systems. They flower after the needlegrasses. The wheatgrasses may or may not be sod-forming. Western wheat grass is a sod-forming, cool-season grass which forms pure stands on disturbed soils or poorly drained areas. Northern wheat grass (Agropyron dasystachyum) is also common in this region. Species from both tall grass and short grass associations appear in mixed prairie. Overgrazed, wet, exposed or excessively well-drained areas in mixed prairie have dominants other than grama-grass or needlegrass which form the mature (mesic) grasslands for the zone.

Tables 4 and 5 list important grassland species occuring in Aspen Parkland.

Variation in distribution

Within the prairie types there is considerable variation. The types (tall grass, fescue and mixed prairie) mentioned are considered to be mature forms or climax communities of grassland for the particular regions they occupy. Areas within each region of drier or wetter than average conditions for the region show differences in species composition. Only for tall grass prairie have I described some of this variation.

Water content of the soil is the most important factor in [illegible] -

determining the distribution of species in prairie vegetation [Eddleman & Nimlos, 1972]. Soil, wind and mineral salts influence plants through the water regime. For this reason, discussion of prairie communities within a prairie type (and the prairie types, themselves) are most usefully described in terms of moisture as hydric, mesic, or xeric communities and subunits of these.

The presence of a hydric, mesic or xeric environment is determined by soil texture in combination with topographical position. (Topographical position and soil texture are usually related. See Fig. 13.)

The following definitions of terms adapted from Rock [1974] are useful:

Hydric prairie........has more water than precipitation - water collects here from elsewhere. Plants stand in water most of the year.

Wet-mesic prairie.....has more water than precipitation - water collects here from elsewhere. Plants stand in water in spring.

Mesic prairie.........precipitation soaks in - water does not run off or collect here.

Xeric prairie.........evaporation exceeds precipitation - water runs off or percolates very rapidly into the soil.

Few prairies have an even spread of species. In some the dominance of a particular species is the result. The variables of microclimate and distribution are so great that describing them in shortened form is not possible here. The best way to get a feeling for distribution of species in prairie is to combine field work with the careful study of community summaries available in the literature. Table 6 shows some of the published work on Aspen Parkland grassland communities.

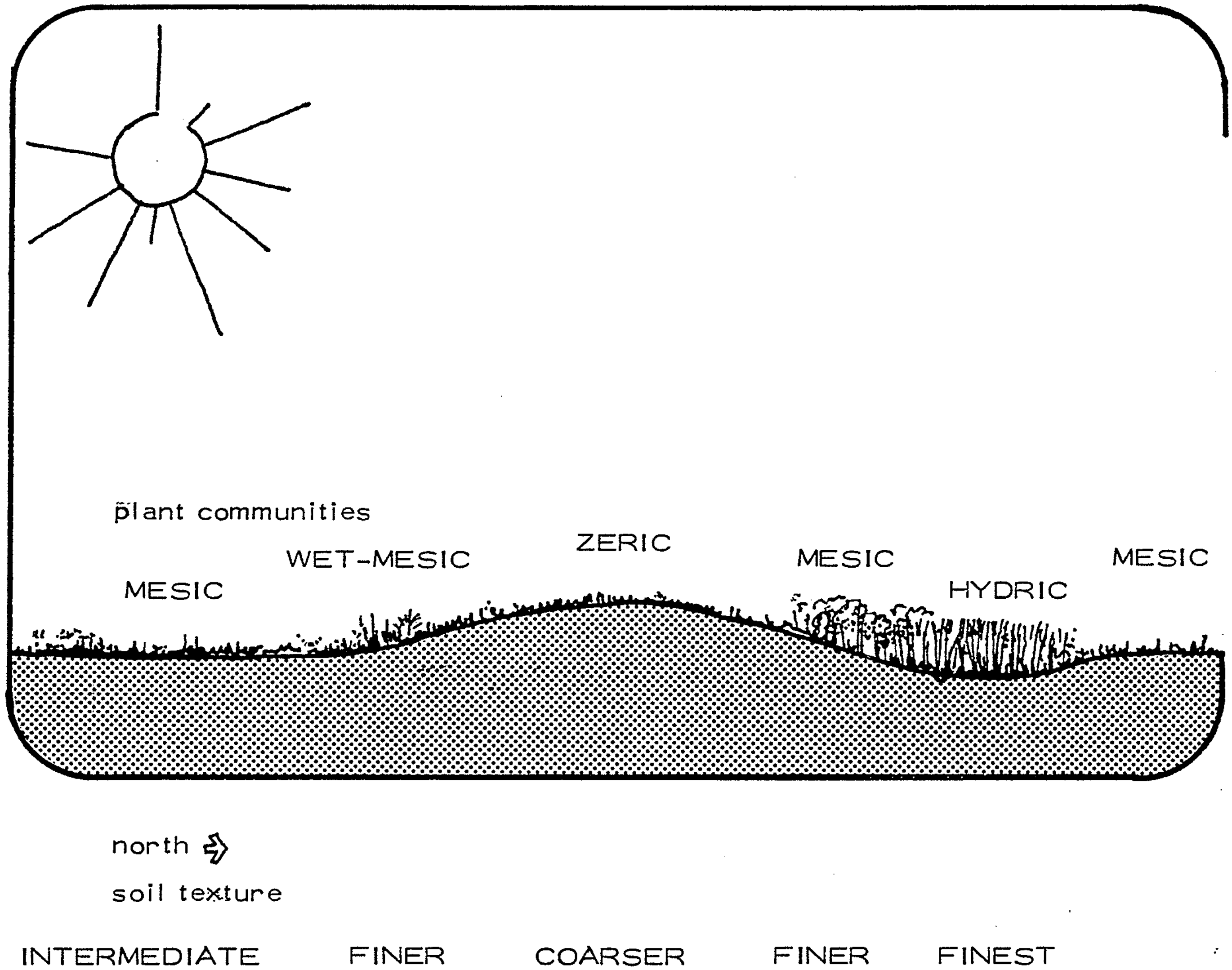


Figure 13

RELATIONSHIP OF TOPOGRAPHY TO PLANT COMMUNITIES AND SOIL TEXTURE

Table 4

SOME DOMINANT GRASSES OF ASPEN PARKLAND GRASSLAND COMMUNITIES WITH ASSOCIATED SPECIES:

DOMINANT	ASSOCIATED SPECIES
WET	
Calamagrostis inexpansa var. *brevior*	*Agrostis stolonifera* var. *major*
Scolochloa festucacea	*Eleocharis palustris*
Spartina pectinata	*Glyceria grandis*
	Poa arida
	P. nemoralis
	P. palustris
	P. pratensis
WET - MESIC	
Agrostis stolonifera var. *major*	*Hierochloë odorata*
Andropogon gerardi	*Scolochloa festucacea*
Calamagrostis canadensis	*Spartina pectinata*
C. inexpansa var. *brevior*	
Elymus canadensis	
Panicum virgatum	
Phalaris arundinacea	
Poa arida	
P. nemoralis	
P. palustris	
P. pratensis	
MESIC	
Agropyron repens	*Agropyron dasystachyum*
A. trachycaulum	*Elymus canadensis*
Andropogon gerardi	*Koeleria cristata*
A. scoparius	
Stipa spartea var. *curtiseta*	
DRY	
Agropyron smithii	*Bouteloua curtipendula*
Andropogon scoparius	*B. gracilis*
Festuca altaica var. *major*	*Calamovilfa longifolia*
Stipa comata	*Koeleria cristata*
S. spartea var. *curtiseta*	*Poa pratensis*

NOTE: *Carex* species may form an important part of communities, especially *Carex atherodes*, which may be dominant in wet places.

Table 5

SOME HERB SPECIES OF ASPEN PARKLAND GRASSLAND COMMUNITIES

WET - MESIC

	Allium cernuum, wild onion
	Aster nova-angliae, New England aster
M	*Gentiana andrewsii*, closed gentian
	Glycyrrhiza lepidota, wild licorice
	Helianthus giganteus, tuberous-rooted sunflower
	Mentha arvensis var. *villosa*, field mint
	Spiraea alba, meadow-sweet
	Zigadenus elegans, white camass

MESIC

D	*Achillea millefolium*, common yarrow
	Agastache foeniculum, blue giant hyssop
	Anemone canadensis, Canadian anemone
D	*A. patens* var. *wolfgangiana*, pasque-flower
	Artemesia frigida, prairie-sagewort
D	*A. ludoviciana* var. *gnaphalodes*, white sage
	Aster laevis, smooth aster
	Cirsium flodmanii, Flodman's thistle
	Comandra richardsiana, Richards comandra
	Fragaria virginiana, strawberry
*	*Galium septentrionale*, northern bedstraw
D	*Gentiana puberula*, downy gentian
	Helianthus laetiflorus var. *subrhomboideus*, rhombic leaved sunflower
	H. maximiliani, narrow-leaved sunflower
	H. tuberosus var. *subcanescens*, Jerusalem artichoke
	Heliopsis helianthoides, ox-eye
	Heuchera richardsonii, alumroot
	Lathyrus ochroleucus, pale vetchling
W	*L. venosus*, purple vetchling
*	*Liatris ligulistylis*, meadow blazingstar
*	*Lilium philadelphicum*, wood lily
*	*Lithospermum canescens*, puccoon
	Monarda fistulosa, wild bergamot
	Rudbeckia serotina, black-eyed susan
*	*Smilacina stellata*, star-flowered Solomon's seal
*	*Solidago canadensis*, Canada goldenrod
D	*S. missouriensis*, Missouri goldenrod
D	*S. rigida*, rigid goldenrod
W	*Vicia americana*, American vetch
*	*Zizia aptera*, heart-leaved Alexanders

Table 5 continued.

DRY

Anemone cylindrica, thimbleweed
Antennaria campestris, prairie everlasting
A. canadensis, Canada everlasting
Astragalus caryocarpus, ground plum
Campanula rotundifolia, harebell
Cerastium arvense, field-chickweed
Echinacea angustifolia, purple coneflower
Gaillardia aristata, gaillardia
Geum triflorum, three-flowered avens
Liatris punctata, dotted blazingstar
M Petalostemum candidum, white prairie-clover
P. purpureum, purple prairie-clover
Potentilla arguta, tall cinquefoil
Psoralea argophylla, silverleaf psoralea
P. esculenta, breadroot
Ranunculus rhomboideus, prairie-buttercup
Solidago nemoralis var. decemflora, showy goldenrod
Viola pedatifida, purple prairie violet

** Plants which are flexible in their requirements
M Tending toward mesic
W Tending toward wet-mesic
D Tending toward dry

Note: The woody species Eleagnus commutata, Symphoricarpos occidentalis, S. alba, and Rosa spp. occur in most mesic to dry grassland communities.

Table 6

SOME COMMUNITY SUMMARIES AVAILABLE IN THE LITERATURE

TALL GRASS PRAIRIE	
Bird [1961] Manitoba	*Agropyron*, *Poa*, *Spartina* grassland
Ewing [1924] N. W. Minnesota	a) *Koeleria cristata* consocies b) *Andropogon*, *Sporobolus* associes
*Levin & Keleher [1969] Manitoba	a) *Andropogon gerardi* type b) *Stipa spartea*, *Andropogon gerardi* type
FESCUE PRAIRIE	
*Coupland [1961] Saskatchewan	*Festuca altaica* var. *interior* prairie
Moss [1952] Alberta	*Agropyron*, *Stipa*, *Carex* community
MIXED GRASS PRAIRIE	
Bird [1961]	a) *Agropyron*, *Koeleria*, *Agrostis*, *Stipa* grassland b) *Agropyron*, *Stipa*, *Bouteloua* grassland c) *Stipa*, *Andropogon* sand prairie
*Coupland [1961]	*Agropyron*, *Koeleria* faciation (a geographical variant of the association)

*These have quantified summaries of community composition. A species list of 120 species present on the St. James Prairie is also available.

[Shay, pers. comm.]

Characteristics of prairie communities

When designing, prairie communities must be simplified. A designer needs to know what physical characteristics make a prairie community a successful combination of plants so that those characteristics are not lost when the community is simplified. Though it would be difficult to put relative values on the various points which follow, all are involved in prairie communities and should be considered when a synthetic prairie is being made.

Niches

Prairies are layered above and below ground. Layering of roots reduces competition and permits variety in species composition [Weaver, 1968]. In the dense sod created by little bluestem, for example, leadplant survives by virture of its deep, tough root system. Little bluestem's shallow but efficient root system intercepts and absorbs most of the rainfall received while leadplant uses moisture far below the surface of the soil. Since grasses have extremely efficient root systems the layering of roots underground makes possible the presence of forb species in prairie communities.

Weaver [p. 14, 1968] studied the roots of 43 species to find the following:

> "The first group included plants with shallow roots that seldom extend below the first two feet of soil. This group, consisting entirely of grasses, makes up only 14% of the total. The second group, of intermediate depth, is composed of grasses and forbs with roots that extend below the second foot

> of soil but seldom deeper than five feet - 21% of prairie species. The third and largest group is composed of plants whose roots extend beyond a depth of five feet (some to twelve, even 23 feet), and this group includes 65% of the species selected as typical of the prairie flora."

Competition for light is reduced above ground by layering of the above-ground parts of plants. This is part of the phenology or periodicity of the prairie. Shorter species tend to appear early in the season, to bloom and then give way to taller species. Earliest flowers are often close to the ground, like the pasque-flower. In summer intermediate height species bloom including most of the legumes. By late summer the tall grasses flower and the yellow-flowered composites flower with them until frost comes. As a rule, northern derived species such as the poas bloom first, and the southern derived species bloom later. The southern species grow all summer, reaching their maximum height at the end of the season (the bluestems, switchgrass, etc.), while the northern species grow in cool seasons, lying dormant in dry summer months.

Layering above ground not only reduces competition for light but it assists in the dispersal of seed, particularly by wind.

Composition and distribution

Representation of plant families in prairies of the Aspen Parkland is close to that Curtis [1959] published for prairies studied in Wisconsin, where composites provide roughly 27% of the species, grasses 15%, and legumes 7%. The species list for the Beaudry Prairie near Winnipeg [Levin and Keleher, 1969] shows Compositae providing about 24% of the species, grasses 15% and legumes 13%.

The total number of species found in a prairie varies, but 200 is not an unreasonably high figure to expect. The average for five prairie types studied by Curtis was 215 species. The St. James species list consists of only 120 species and the Beaudry Prairie, 109. Both prairies are small in area, relatively uniform in habitat, and have not been exhaustively studied. The number of species which forms a substantial part of the vegetational cover of prairie is usually less than 15. Curtis lists major dominants and most prevalent groundlayer species for each prairie type and in most prairies these together numbered 10 species.

Several prairie plants grow in groups called societies or aggregations. Most conspicuous are the goldenrods. Their habit of reproducing by rhizomes produces their characteristic grouping. Roses, snowberry, wolfberry and silverberry grow in societies due to their habit of suckering. Other species may grow close together because of their seed dispersal mechanisms.

Succession

Succession was discussed earlier with respect to fire and moisture stress restricting the advance of forest on grassland communities. There are some other factors related to succession in prairie communities which should be mentioned. One is the efficiency of grasses in obtaining soil moisture. Most young trees or shrubs cannot compete successfully with grasses for moisture. Roses, snowberry, wolfberry, and silverberry do compete successfully with grasses in the Aspen Parkland, but under natural conditions their size and distribution are limited by fire.

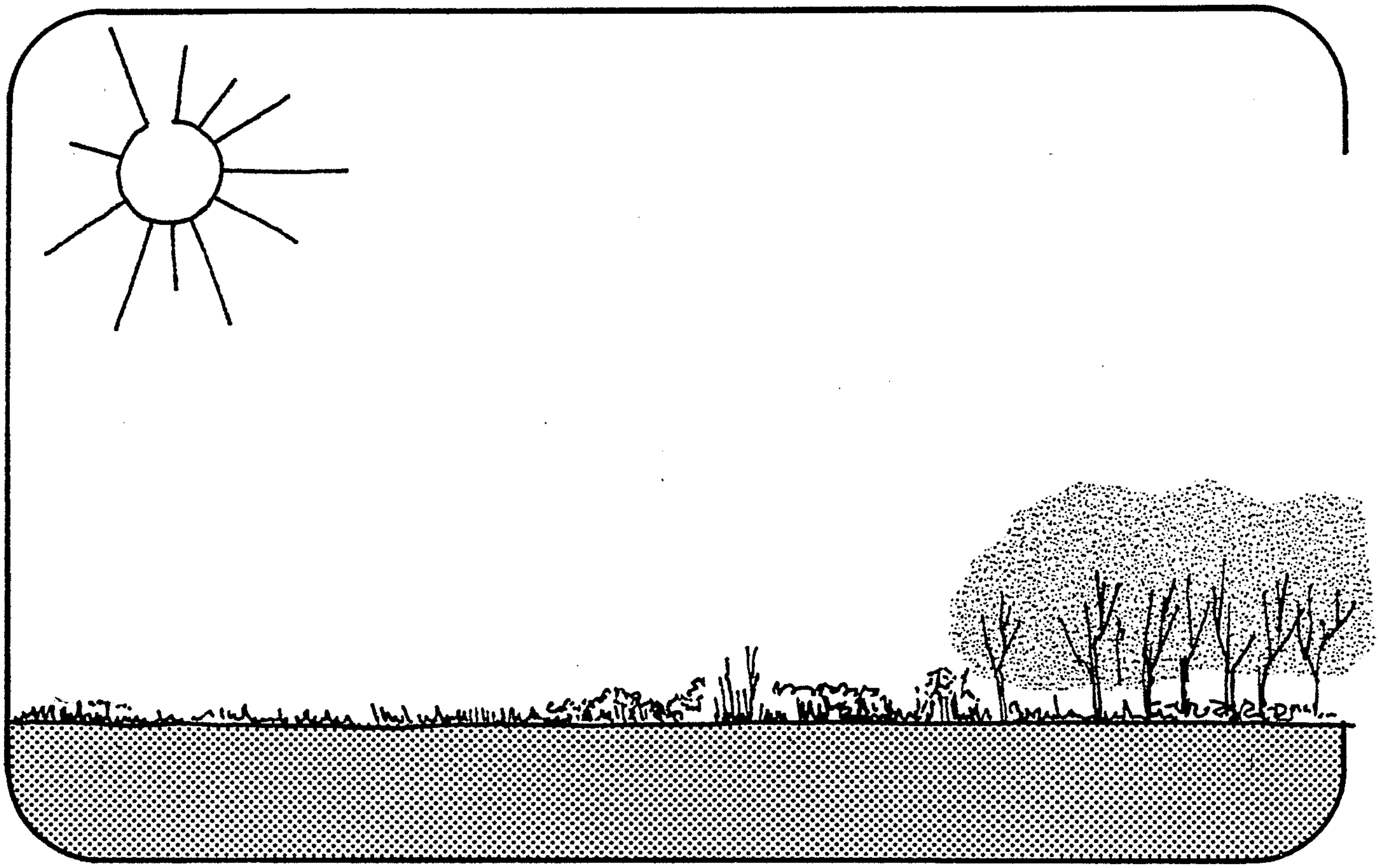
Fire retards succession from grassland to forest in mesic environments but may hasten succession in wet places toward a more mesic environment. In areas where rainfall is dependable fire can be beneficial to prairie communities in several ways. First, it removes the litter of dead plants and standing vegetation. This increases production and stimulates flowering by reducing shading (of the soil and growing plants) and accelerating the rate at which soil warms up in spring. The second benefit is the reduction of competition of Kentucky bluegrass and smooth brome (and other naturalized species) with native grasses [Old, 1969]. *

Succession is probably not a dependable way to produce native grasslands. Grassland seed sources are limited, and a number of native species do not spread readily even when seed sources are abundant. It is therefore likely that aspen would take over in their absence. Curtis [1959] found in studying old field succession that heavy soils are more slowly restored to grasslands than lighter soils. This discourages the notion of allowing succession to produce grasslands in the Red River region. (Fig. 14)

Ecotypic variation in species

Many prairie grasses and some forbs are important forage plants. Their seed is produced on a large scale in the United States. Particularly attractive native forbs, too, are now being grown for seed production at specialized nurseries in the mid-west.

*Levin and Keleher [1969] suggest a three year cycle of burning for maintaining the richest mix of species in prairie. More frequent burning would interfere with the growth and reproduction of the forb species. Even the three year cycle may be too frequent.



STAGE ONE
1 - 5 years

Annual weeds: weeds related to former crop for 1 - 2 years.

STAGE TWO
3 - 20 years

1. Perennial weeds and/or
2. Perennial grasses & forbs and/or
3. Shrubs

(1. Canada thistle, Ky. bluegrass, quackgrass, bindweed)
(3. Rose, silverberry, wolfberry, aspen seedlings)

note: stage two species depend on seed availability; may go to aspen rapidly if other seed is not available.

STAGE THREE

Aspen forest dominates former group by shading in 35 years.

Aspen forest w/bur oak where oak seed is available, oaks germinate in shade of aspen.

Figure 14

SUCCESSION--ABANDONED FIELD TO ASPEN FOREST

Using seed from the United States may prove unwise in Canada because of ecotypic variation in species. Native plants are not only adapted to climatic conditions but also to photoperiods of their places of origin. Seed collected in southern Wisconsin, for example, is adapted to a longer season and to shorter days than seed from the same species collected here. Studies done on important prairie grasses showed that some species would not flower at all or flowered too late in the season when exposed to different light conditions than those in which they were collected [McMillan, 1959]. Changed photoperiods could also interfere with winter hardening.

Because of ecotypic variation in species, those involved in prairie restoration insist that seed for a synthetic community be collected from a similar site within three kilometers of the restoration site. Though it is not always possible to obtain seed from sources close to the restoration site it makes sense to select the closest source available. Ecotypic variation is demonstrated differently in various species and this knowledge may provide a means of selecting appropriate species when local collection is impossible. Needlegrasses, for example, flower in response to favorable moisture conditions rather than geographic factors [McMillan, 1959], whereas side-oats grama shows a marked response to the variation in photoperiod from one geographic area to the next [Hanson and Churchill, 1961].

Soils

Soils formed under Aspen Parkland grasslands are rich and productive. While the mean annual precipitation in Aspen Parkland is high enough to produce much green herbage, evaporation during summer drought and high temperatures produce a net annual deficit of moisture. Leaching of nutrients is minimal, and evaporation can actually cause nutrients to be brought up to the rooting zone by capillary action.

Grassland soils are placed in the Chernozemic Order of the National Taxonomic System of Soil Classification. These soils have dark mineral-organic surface horizons and brownish, usually prismatic subsurface horizons on calcareous parent material. They are saturated with bases and the A and B horizons are free of soluble salts [Leahey, 1969]. The Chernozemic Order includes four Great Soils Groups: Brown, Dark Brown, Black, and Dark Grey soils. The Brown soils are usually associated with short grass prairie; the Dark Brown with mixed prairie and the Black with tall grass prairie. Dark Grey soils develop when forest invades areas of tall grass vegetation.

The Black soils are most prevalent in Aspen Parkland. They are characterized by deep A horizons of organic accumulations. Abundant soil fauna incorporate humus deep into the soil. A dark A horizon (often 50 cm. deep) grades to a lighter grey color lower where humus accumulation is not so high. The B horizon is absent. The pH reading of Black soils is 7 or very close to 7 (neutral). An horizon of calcium carbonate accumulates just above the parent material. Black soils have a crumb granular structure which is favorable to root penetration and which allows water and air to be stored in the soil.

Current grading practice ignores the structure of soils. Grading mixes the layers of soil. Compaction from grading destroys storage capacity of soils and impairs natural drainage. Often clay subsoils are mixed with valuable topsoil reducing its fertility. This increases the length of time needed for plants to become established. The poor soil resulting from grading is often compensated for by adding topsoils or by filling planting holes with topsoil. It might be cheaper to avoid destroying soil and it would certainly speed the establishment of plant communities.

II WHY USE NATIVE COMMUNITIES IN DESIGN

Having described some communities of Aspen Parkland in a natural state, we need to asses their value in a landscape which has been altered by human activity. Designers may respond to the aesthetic and romantic appeal of native communities but before using them they will be required to justify their use on practical grounds. Practical justification for use of native communities is inherent in the communities themselves - in the ecological characteristics of the communities.

ECOLOGICAL CHARACTERISTICS OF NATURAL COMMUNITIES

Ecological characteristics of a natural community are developed over a long period of time and they are what makes that community a permanent (or reappearing) combination of living things. Oosting [p. 17, 1956] defined a community as:

> "an aggregation of living organisms having mutual relationships among themselves and to their environment."

The relationships he refers to can be found in communities as small as a group of lichens and as large as the boreal forest. Some of the mutual relationships organisms in a community have are:

competition
stratification
dependence

Competition occurs when individuals in the community require the same thing at the same time. Through competition, the community composition is created - the species and individuals best suited to the environment "win", and those whose requirements do not completely overlap tend to establish themselves together in the community. Competition results in selection of the most vigorous genotypes and in periodicity of species in communities. Stratification seems to be a natural result of dominance of certain species in communities. This is evident in forest stands where the tree layer intercepts most of the incoming light and precipitation. Species which require conditions (often shade and moisture) created by the dominants are called dependents. Inconspicuous micro-organisms, showy orchids and animals can be dependents. Another way to describe the relationsips within the community is to say that each species fills a niche in its community.

All species in a community share mutual relationships to the en-environment. First, the general climate (or macroclimate) of an area determines the vegetation type which occupies it. Grassland is the typical vegetation type of semi-arid regions; in the Aspen Parkland average moisture conditions create a vegetation type which contains both grassland and forest. All species within the Parkland are adapted to the extreme temperature variation, particular levels and distribution of precipitation, photoperiod, etc. typical of the region. Special groups of species develop where environmental conditions vary from the average. The species in these communities share mutual relationships with their microclimate. The floodplain community, for example, grows on alluvial soils where there are higher levels of moisture available. Their presence at the same time creates a microclimate of higher humidity.

Though the above points may seem somewhat repetitive in view of earlier descriptions of plant communities, they stress that nature is organized in a logical way. Every native community has developed as a response to existing conditions in its environment. When we replace natural communities with crops or ornamental plants we deliberately choose to resist the forces which created the original community.

> "Under natural conditions...ecological succession generally results in increasing complexity of community structure: the final community of a given region being its climax, the stable and most complex dynamic association of plants and animals. Human utilization of an area almost invariably involves the imposition of an artificial and essentially unstable simplicity. Complexity tries all the time to come back. Weeds grow in pastures, insect pests make constant attacks."
>
> [Stenhouse, p. 6, 1966]

Traditional man-designed landscapes lack the complexity of natural communities and consequently they make incomplete use of their environments. (They may also exhaust certain parts of that environment.) This leaves niches for adventive plant species to fill. They may be native or exotic species, and intensive maintenance is required to keep them out. Maintenance practices such as fertilization and watering can strengthen the competitive ability of the species in traditional landscaping, but once these practices are removed the superior ability of native species to survive under natural conditions will squeeze out the non-natives. Strict maintenance is required to maintain the simplified, unstable communities we use in traditional landscape practice.

The cost of maintenance of these simplified communities is a primary source of ammunition for designers wishing to incorporate native communities in their work.

COST OF MAINTENANCE

It is difficult to compare maintenace costs for native communities and traditional landscape communities because the level of maintenance practiced on them depends on subjective decisions made by the people responsible for them and on the amount of use they receive. However, we can compare fairly activities required to maintain the composition and general appearance of the two landscape types.

The shrubbery beds and grass of traditional landscaping make a convenient comparison with aspen bluffs surrounded by grassland. The traditional landscape requires regular mowing (at least 10 times per year), watering, pruning, fertilizing, seeding (chemical and mechanical), aeration, raking spring and fall, and periodic re-establishment of aged plants. In this type of landscape insect or disease attack on plants is highly visible and requires attention. Some of the maintenance activities listed above can be reduced by good horticultural practice - for example, fertilization of grass may not be necessary if grass clippings remain after mowing; composting of collected plant materials can provide fertilizer for shrubbery beds - but often the cost of good horticultural practice is prohibitive because it increases labor. In contrast with the traditional landscape the aspen bluff and surrounding grassland require very little maintenance. The grass requires one mowing per year or burning every three to five years. Mowing replaces the natural occurence of fire on prairies. The aspen bluff requires no maintenance.

Costs incurred in standard maintenance of landscape are labor, purchase of equipment, storage and maintenance of equipment, fertilizers, herbicides, insecticides, fuel and water - all of which could be dramatically reduced by the use of self-sustaining native communities. To point out what an investment we have in our traditional landscapes (in the labor, equipment and fuels used to maintain them) a study paper from Saskatoon estimated that the city of Saskatoon spends $188 per capita annually, ($15,883,000 yearly for the city) to sustain what it described as "urban agriculture" [Nelson, 1975].

COST OF INSTALLATION

The cost of installation of native communities is generally assumed to be greater than installation of traditional landscape plantings. This is not a correct assumption. Cost of installation for either type of planting depends on the individual project, on how closely the desired plant community fits existing environmental conditions on site, and on the vagaries of the weather. However, in choosing native communities we have an opportunity to select plants which match conditions on the site, thereby saving the cost of site modification.

With traditional landscaping we often pay for the modification of the site to fit environmental requirements of turf and favored ornamental plants. (Turf is by far the most demanding.) Such changes as perfecting drainage, importing topsoil and the introduction of watering systems add to the installation cost of traditional plantings. In certain places these costs may be worthwhile, but we need to recognize that we can avoid expensive site modification simply by choosing a suitable native community to fit existing conditions.

The planning of a native landscape installation is presently more time consuming and expensive than planning of traditional landscapes, because native landscape installation has not yet been effectively commercialized. When we become more familiar with it, and once nurserymen stock the species we require, costs should fall.

Figures cited by Morrison [pers. comm., 1976] for installation of standard Kentucky bluegrass turf and prairie species in Wisconsin, show turf installation more expensive. Kentucky bluegrass installation from seed costs $400 per hectare. Prairie grass and forb installation from seed costs $240 per hectare.

ECOLOGICAL COST OF TRADITIONAL LANDSCAPING

The monetary cost of maintaining traditional simplified landscapes is only one aspect of what we pay,for their widespread use. Ecological costs are at least as significant. Some ecological costs are pollution, loss of wildlife habitat and loss of diversity.

Pollution

Pollution of the environment resulting from landscape maintenance is broader than one might think. An obvious source of that pollution is fertilizer. Runoff containing dissolved fertilizers hastens eutrophication in streams and lakes - and runoff itself is increased by our habit of removing or reducing vegetative cover from the soil. Evidence exists that fertilizing over time can also destroy natural processes in the soil which are essential to its productivity [Stenhouse, 1966]. Another source of pollution is found in the chemical poisons used as insecticides and herbicides. Well documented studies on the cumulative effects of DDT have made us wary of poisons, but not wary enough. Massive use of insecticides and herbicides in agriculture and landscape maintenance are contributing to North American pesticide addiction ("pesticides kill natural predators creating continued need for pesticides" [SCEP, 1970]), and to the evolution of insect species over which we have no control. Environmental pollution caused by the use fossil fuels is widely recognized but not in connection with the operation and maintenance of landscape equipment. It is brought to my attention every weekend in the summer when the din of power mowers fills our neighborhood.

Loss of Wildlife Habitat

Loss of wildlife habitat is severe in an agricultural region such as southern Manitoba. Farmers cultivate most of the land and they encourage government agencies to denude roadsides and other unfarmed areas to prevent growth of plants and wildlife. The combination of agriculture and methodical removal of natural growth leaves very little animal habitat in the countryside where one would normally expect to find it. As a matter of fact, since roadsides allowances have been cleared there are many kilometers between areas where suitable cover exists for wildlife [Bird, 1961]. National Parks and animal preserves provide habitat for wildlife, but they cannot protect migratory species and they do not provide enough habitat for sustained production of many others. What seems more important is that the wealth of animal life they contain could be available to us every day if native plant communities were part of our urban and suburban landscape. The simplified communities of traditional landscapes often fail to provide foods to which native animals are adapted. Robins, crows, starlings and house sparrows are common urban species because they have adapted to the limited natural environment found in cities. Simplified communities also provide fewer niches and are hospitable to a smaller number of animal species. Birds which nest in open grassland or in dead wood, for example, find no nesting sites in well maintained traditional landscapes.

Loss of Diversity

Loss of diversity is an ecological cost because diversity in a plant community is the source of its resilience. Diversity in all plant communities is the source of resilience of life on earth. Though there are many kinds of diversity, each one worthy of extended comment : a brief discussion should adequately show the value of this quality in native communities which is lacking in over-simplified ones.

Diversity in species composition of native communities is an obvious place to begin a discussion of diversity. The sheer number of species in native communities provides opportunity for much variety. Hanson and Churchill [1961] state that species in native communities differ in the following ways:

a) in competitive capacity
b) in capacity of association
c) in reproductive processes
d) in resistance to grazing, mowing or other treatment
e) in susceptibility to parasites
f) in mutualistic and commensal relationships.

Some of these differences are described under ecological characteristics of natural communities. The aggregation of species in a community which have such variety in their innate characteristics and requirements, guarantees that whatever changes may occur (short of ecological catastrophe), some will prosper. It also makes more efficient use of available light, moisture and nutrients. By contrast, monocultures of grass (or even groups of ornamental plants put together without regard for community structure) have relatively little ability to respond to change. A typical lawn has only two species of grass.*

*It should be noted that the most successful lawn grass mixtures are those which in some way mimic natural diversity. For example, warm and cool season grasses are often planted together, or the legume white clover (Trifolium repens) is added to grass seed to maintain soil fertility [Conover, 1953]. Varying susceptibility to drought, parasitic attack, etc. of the species in lawn mixtures provide at least some of the resilience characteristic of native communities.

Diversity in life form provides insurance against climatic extremes. Life form, as described by Raunkiaer [1934] is determined by the location of the perennating bud in a plant, the place where growth begins each season. Trees have perennating buds well above ground. Other plants may have perennating buds at ground level or below ground. Annual plants have perennating parts in the seed. Diversity of life forms assures that some living productive material will survive almost any expected extreme in the pattern of annual or periodic environmental conditions.

Periodicity could be described as another kind of diversity found in native communities.

> "In community studies the terms 'aspect dominance' and 'seasonal dominance' have been used to describe situations in which a species or group of species appear to be dominant for a portion of the year, usually because of conspicuous floral characteristics.
>
> Of equal importance to the community is the seasonal development of vegetative parts. The seasonal aspect of the individual may proceed through several phases, including a leafy period, a leafless period, a flowering period, a fruiting period, an embryo period, and perhaps others. Rarely will all the species of a community have these periods strictly coinciding. Consequently, in temperate climates the community as a whole usually has seasonal aspects, which are termed 'vernal', 'estival', 'autumnal', and 'hibernal'. The structure and species of a community are strongly influenced by the extent to which periodic phenomena in the individuals are adjusted to each other."
>
> [Oosting, p. 69,1956]

Periodicity has been discussed earlier with respect to the reduction of competition between species. It also results in a marvelous aesthetic appeal in native communities. As each seasonal aspect arrives it brings with it a new landscape. Periodicity also contributes significantly to the continued production of food for wildlife, from bees to bison.

Another critically important kind of diversity typical of native communities is diversity of genotypes. Native species in communities replace themselves by vegetative and sexual reproduction. Vegetative reproduction produces plants of identical genetic makeup whereas sexual reproduction creates individuals with varying genetic makeup. Sexual reproduction is critical because through it the variety of characters native plants need to survive in various conditions are passes on and refined through generations of natural selection. Though selection in any given place will favor certain characters, there is still a great variety of characteristics in existing plants. As long as we have undisturbed communities reproducing naturally we have a great store of genetic variation available to us for present or future (and unforeseen) use. Horticultural plants are often reproduced vegetatively so that the characteristics for which these plants were bred or selected by man can be maintained. Unusual form or bark color, for example, can be reliably reproduced only in genetically identical plants. Every Shubert chokecherry across the prairies came from the same original plant! The same can be said for many shelterbelt and avenue trees, and many ornamental shrubs. Economies of time further encourage nurserymen to produce plants from cuttings, (vegetatively) rather than from seed.

Another issue involved in the use of horticultural plants is that most of them are exotic species. Three-quarters of the species listed in Kackenhoff Nurseries' catalogue (Winnipeg, Manitoba) are exotic species. From the Kentucky bluegrass (from Eurasia, not Kentucky) with which we cover our grounds, to the Siberian elms (Ulmus pumila) with which we line boulevards, we fill the landscape with plants from foreign places. Because those plants developed outside our native communities there is no natural check on their numbers. Some 'escape' cultivation and become intruders in our native communities. Kentucky bluegrass, for instance, is practically ubiquitous in temperate North America only a few hundred years after its introduction to this continent. Particularly aggressive exotics, like Kentucky bluegrass, can simplify plant communities by taking over the niches of more than one species. When they do this, they destroy the biological diversity and stability of the communities. In Madison, Wisconsin amur honeysuckle (Lonicera Maacki) has come to occupy the understory of native forest [DeBord, 1976]. The shrub has become so well entrenched that even seedlings of forest trees cannot come up through the shrub layer to replace the existing canopy. In some places the herb layer is missing altogether. The result will be the eventual destruction of the forest community. Many exotics which are conspicuously aggressive - common dandelion (Taraxacum officinale) and Canada thistle (Cirsium arvense), for example- are labelled 'weeds'. Others such as spiked loosestrife (Lythrum salicaria) and Tatarian honeysuckle (Lonicera tatarica) assume roles in native communities without being noticed. Whether or not exotics are considered weeds depends on the degree of their interference in agriculture, and not on the degree of their disruption of native communities.

AESTHETIC CONCERNS

Although aesthetic values are not considered practical or rational, we should not discount their importance. William Whyte [1968] has remarked that aesthetic (not ecological) considerations move the public to act on environmental issues. Sierra Club Publications with their handsome photography probably do more to stimulate public involvement in conservation of wilderness areas than all the scientific papers ever written. Aspen Parkland, though a beautiful natural environment, lacks the dramatic appeal of snow-covered mountains or painted deserts and rarely receives the attention of published photographers.

Models

If designers wish to encourage or advertise the use of native Parkland communities they will need to know the Parkland well, and they will be hindered by a lack of models. Many small pieces of land contain undisturbed Parkland communities, but continuous native growth is difficult to find. Roadsides which once carried remnants of grassland are mowed or denuded with herbicides. Heavy native growth remains only where farming is not profitable - the escarpment or other steep places, sand dunes, wetlands and a few protected areas. Major highways travelling through intensively used agricultural lands miss most of the places containing native stands.

Because positive models of prairie communities are not part of our experience, many individuals think that flat land is not beautiful. Few people, including designers, have seen beautiful, diverse plant communities on flat land and the vast areas we have under cultivation do little to suggest the beauty that existed in formerly undisturbed prairie landscape.

Native communities we regularly see along highways are degraded woodlots and sloughs. The woodlots are often trampled and over-grazed and border communities are entirely missing. The slough communities occupy land too wet for cultivation and there is usually no transition from them to the tilled areas surrounding them. Since the geometries of farming make no concession to the organic forms naturally taken by plant communities, the natural communities look out of place.

The most convincing aesthetic argument for use of native communities in design work will be their successful use for which we will have to develop our own models.

Regional Identity

Nan Fairbrother, British writer and landscape architect, has suggested we create regional identities by use of native flora [Fairbrother, 1970]. By using native communities we would actually be reestablishing the identity of landscapes destroyed in the process of development. To some extent this happens in northern communities where climate prevents introduction of exotic species. Indigenous species used in these communities make them recognizable as northern communities.

Fairbrother comments that the least intensive land use in cities occurs on their outer fringes. Industrial parks and suburban development containing high proportions of open space, often form belts around cities. These areas of low density could be used to establish native vegetation. Inside cities, environmental conditions or design criteria may limit the use of native species. It is premature, however, to assume that native species cannot tolerate urban conditions. A heartening example exists in Madison, Wisconsin, where prairie species have shown surprising tolerance to air pollution [Morrison, 1975]. [Also see Elias and Irwin, 1976]

The concept of establishing or confirming a regional identity through nature is attractive at a time when built environments are increasingly uniform. Holiday Inns, MacDonald's, and the strip development of which they are a part make North American cities amazingly similar. Avenue trees, often the same species across the country, are installed and maintained in identical fashion. Sixty-foot road allowances, ranch style houses, the weeping birch (Betula pendula var. gracilis) and the Colorado spruce (Picea pungens) make suburban Minneapolis and Winnipeg almost indistinguishable. Bold use of native communities in our cities could make cities of different geographical areas recognizably different from one another.

Landscape Design Style and the Use of Native Communities

Aesthetic arguments for the use of native communities in design work must go beyond declaring the communities beautiful or desirable. They must show that native communities, like any other material used in design, can be handled in a number of ways. Aesthetic choices beyond the selection of plant material affects the quality and spirit of a completed project.

Landscape design work can be loosely classed in two general styles: naturalist and formalist. The first is expressed in organic forms, sometimes what appears to be spontaneous form, and it has a "natural look". "Capability" Brown is a famous protagonist of the naturalist design style in landscape architecture who went to great lengths changing existing environments to develop the "natural look". The naturalist style should not be equated with preservation of virgin land. As I am using the term, naturalist style includes both preserved and fabricated landscapes. By contrast, the formalist style is characterized by explicitly man-made forms. These may be geometric or organic. The formalist tradition is in evidence in the grand axial gardens of Le Notre and in the manicured organic forms of Burle Marx.* Much design work combines formalist and naturalist styles. It is not important to divide all work into one or the other style, but it is important to recognize that the two opposing attitudes exist.

The automatic assumption is that native communities are more sympathetic with a naturalist design style than formalist. It is true that native communities have forms which inspire naturalist design, but the form of communities found in nature does not limit their use to naturalist design style. (Fig. 15) There are built environments where spatial limitations make development of naturalist forms difficult. For example, when the dominant pattern of the landscape is formalist (as within a city block grid) it may require considerable ingenuity to introduce naturalist forms to good effect. A reasonable solution is to respect the existing formalist style and use native communities within it. Geometric forms can be created by retaining walls,

*Burle Marx is a landscape gardener in Brazil. See Burle Marx [Bardi, 1964].

for instance, and filled with native communities.

The designer creates the form the community will take. If he creates an environment which reflects natural conditions the plant community will take on a natural (or naturalist) form. If he creates an environment which limits the growth of the community (by maintenance or by built forms) it will take a form in response to those limitations. The designer's choice of form does not alter the aesthetic value of the native community. The aesthetic value of the native community lies in the richness of detail and texture of that community, and not in any particular style of application. The success of the design depends, as it always does, on the way it is carried out – on the combination of practical and aesthetic decisions made.

Figure 15. Two design styles using native communities.

In each plan a shelterbelt and garden plot containing native communities exist in combination with mowed grass. The same functional problems are solved in each design. The choice of form (formalist or naturalist) is an aesthetic one and is not determined by the function performed or by the plant material being used.

III WAYS TO USE NATIVE PLANTS

Native plants may have broad application in landscape design, from use in scientific projects to use as purely decorative elements. To describe the application of native species in design work I have adapted some categories from DeBord [1975]. The categories are:

1. scientific restoration
2. aesthetic restoration
3. native garden
4. rejuvenation

SCIENTIFIC RESTORATION

Scientific restoration is an attempt to duplicate a native stand. This means reproducing the species composition and distribution that occurred on a given site before disturbance by man.

Scientific restoration is probably impossible in any strict sense. Widespread changes in drainage alone limit the possibility of restoring original communities. Ecological factors such as flooding, fire, and animals play an important role in maintaining community structure and these factors may be difficult to reproduce in our present landscape. Burrowing animals, for example, helped to condition soils in prairie communities and their activities created places where seedlings could develop. These animals have been largely exterminated and would not generally be welcome in urban or suburban sites.

Another difficulty in attempting scientific restoration is that we do not know the exact composition of the communities - prairie in particular was not studied scientifically until most of it had been eradicated or highly altered. Many species of plants, because of their rarity or their habit of seed dispersal are difficult to obtain (without disrupting existing communities). The sheer number of species typically found in a native community is another obstacle to accurate restoration.

The "Curtis Prairie", in Madison, Wisconsin is a prominent attempt at scientific restoration. In spite of the expertise and energy of its creators it does not accurately reproduce virgin prairie. It does provide a vital resource for students of ecology, however, and much can be learned from it. Important phytosociological relationships can be observed and plant species can be recognized. Attempts at scientific restoration are worthwhile as long as one understands that only limited success can be achieved. The realization that natural communities cannot be reproduced emphasizes the value of existing virgin sites and should stimulate us to preserve them.

AESTHETIC RESTORATION

Aesthetic restoration attempts to capture the 'essence' of a selected native community without repeating all the components. DeBord [1975] says that one could accomplish an aesthetic restoration by using "key species", species which visually or spatially dominate the native stands. Key species would be determined by sampling for vegetation cover, in combination with subjective decisions about which species are visually important during different portions of the year.

The definition of aesthetic restoration deliberately provides for variation in interpretation. Consequently it could fail to describe a self-sustaining plant community. Attention must be paid to community structure if self-sustaining communities are to be created. Some plants though not visually or spatially dominant in a native community are essential to it. Legumes, though not necessarily conspicuous, play an important role in many communities, fixing nitrogen in the soil. By reading available literature on communities and species within them, landscape architects can make educated guesses at which plants might be essential for a given community. Then, if attention is given to periodicity, diversity of life forms, and percentage cover of the important plants normally present in that community, the aesthetic restoration should be self-sustaining.

In aesthetic restoration where a simplification of plant communities is made by the designer, one must anticipate that nature will make some changes. If it is deemed essential to maintain the "designed" community composition, maintenance will be required, especially if the designed community varies greatly from the model native community it represents. The presence of seed sources will strongly affect change.

NATIVE GARDEN

Native garden is a term for the use of native plants within a normal horticultural context. No attempt is made to reproduce communities from which the plants come and the plants are used as ornamentals in a variety of places.

The difference between this and using nursery grown horticultural plants is that all native plants carry with them the genetic makeup of a wild plant - they are adapted to specific environments. Though horticultural plants vary widely, some are hybrids which have no particular adaptation to anything except high maintenance (those bred for showy flowers, in particular). Others, of course are adapted to their communities of origin but they are likely to be tolerant of horticultural practice.

The designer using native plants in a garden context will profit by taking advantage of their particular adaptations to the natural environment. When soil, light or moisture conditions on a site are difficult he should make an appropriate match from nature, selecting species tolerant of these conditions. "Ideal" garden conditions - sunny, exposed sites with fertile soils - are suitable for many prairie plants. Many of the community species make attractive garden plants, but some species require compensation for lack of ground cover and competition in gardens. Careful examination of the native plant's niche in the native community may help the designer predict how it will behave under cultivation.

Many native plants will not tolerate maintenance given to garden plants. As a general rule, chemical fertilizer should not be used on native plants. Watering, which is not considered excessive for horticultural varieties, may kill native plants [Martin, pers. comm.]. A number of books on the subject of cultivating wild plants are available. (See Appendix C)

REJUVENATION OF NATIVE COMMUNITIES

Rejuvenation applies to sites where native plants exist but the structure of the plant community has been altered or degraded by human use. Rejuvenation would bring the plant community back to some acceptable level of complexity and health by restoring necessary plant species or by changing the human use of the site.

Soils may require reconditioning. A forest stand in which the undergrowth has been overgrazed or trampled is an opportunity for rejuvenation. Overgrazed prairie or prairie which has been continuously hayed is another. The works of J. E. Weaver, [1954 & 1968], who has studied the effects of overgrazing on prairie communities, provide useful information for prairie rejuvenation projects.

Rejuvenation projects can be developed as scientific restorations or as aesthetic restorations. Motivation for an aesthetic restoration could be simply to improve the appearance of an existing community.

IV APPLICATION TO DESIGN

This section is a general discussion of the application of native communities to some design problem types: homes, roadsides, industrial grounds, parks. It is intended to stimulate thinking on general issues involved in using native communities rather than to provide 'recipes' for their use.

Specific directions for the use of native communities and their makeup are avoided for several reasons. First, local conditions vary so that writing a recipe for all site types, even if these were generalized, would be an enormous task. Secondly, each design problem has its own peculiarities which affect decisions. Any recipes which could be written would have to be used subjectively and intelligently, by someone familiar with Aspen Parkland and the individual species within it.

But the primary reason for avoiding recipes is that the best decisions will be made by designers who take the time to study native communities. The local variation in native communities can only be understood by fieldwork. My community outline of aspen forest states that low areas contain balsam poplar, but until a designer has seen in the field how low is "low", or how close the poplars grow together, he will not feel confident about his planting plan. The growth of certain prairie plants in groups is also best understood through observation. Natural distribution and other characteristics of plants are more easily learned from fieldwork than from books, and they are certainly more easily retained when learned first hand. The designer who is knowledgeable about native communities will make more appropriate decisions, and he is more likely to use native communities creatively than someone who depends on specialists' guidance.

HOMES

Yard maintenance according to the standards of traditional landscaping results in a real loss of freedom for many people. Weekly mowing, watering and weeding, annual fertilizing, pruning and raking are expensive and time consuming. People do not necessarily prefer a manicured landscape style so much as they lack an alternative. Relatively few models are available showing natural growth happily combined with housing. Tract home developments with their barren lots have set a standard for new home sites by default, and as a result tidiness is often the quality sought after in home landscapes. Still people claim to like the country character of low-maintenance landscaping and the number of people fleeing the city to cottages each summer seems to indicate a desire to live in informal surroundings, closer to nature, and where the demands of maintenance are not restrictive. The use of native communities could free homeowners from expensive, sometimes unrewarding and often unquestioned habits of overmaintenance.

Design Issues

River lots with some existing cover are probably the easiest sites to restore to a natural condition. Trees saved during construction provide shade, reducing the vigor of weed species. Seed availability is good for floodplain communities because these communities have survived settlement pressures. Consequently, a river site is a reasonable place to allow succession to take place. Weeding of undesirable plants is the only necessary maintenance. Though few of the herbaceous plants are available at nurseries, in general they may be transplanted without fear of depleting the natural supply. A number of suitable woody plants for this type of site are available at nurseries. On sites where original trees remain standing they provide a framework for the designer to follow if he chooses - he can follow changes in the plant community away from the river and fill in an appropriate understory. (Fig. 16)

A more challenging problem is presented by small home sites in tract developments. Often these sites are completely without natural contours or vegetation and their visually dominant features are man-made. Property lines usually prevent the creation of forms large enough to affect the dominant order of the landscape - there is no room for an aspen bluff, and expanses of prairie grasses are inappropriate for heavily used private spaces. Nevertheless it is possible within this order to use native communities to good effect. It only seems necessary to recognize the limitations of each site and to work within them. Native communities of small scale may fit in these sites with or without taking on forms which relate to the man-made order. Border communities, for example, can form islands or they can be used to complement the geometry of the site. In nature they fringe aspen bluffs, but here they fringe a building or fence. Prairie communities of grasses and forbs could provide transition from mowed areas to the border community on sunny exposures.

The most important task in developing any home site with native communities is the creation of a framework of vegetation and built forms which conforms to the client's needs and at the same time makes appropriate, clear use of plant communities. Massing, creating views, and allowing for movement on the site are critical considerations no matter what plant material is selected and these are usually expressed in schematic form during the design process. Once this is done the designer tries to relate microclimatic conditions on the newly designed

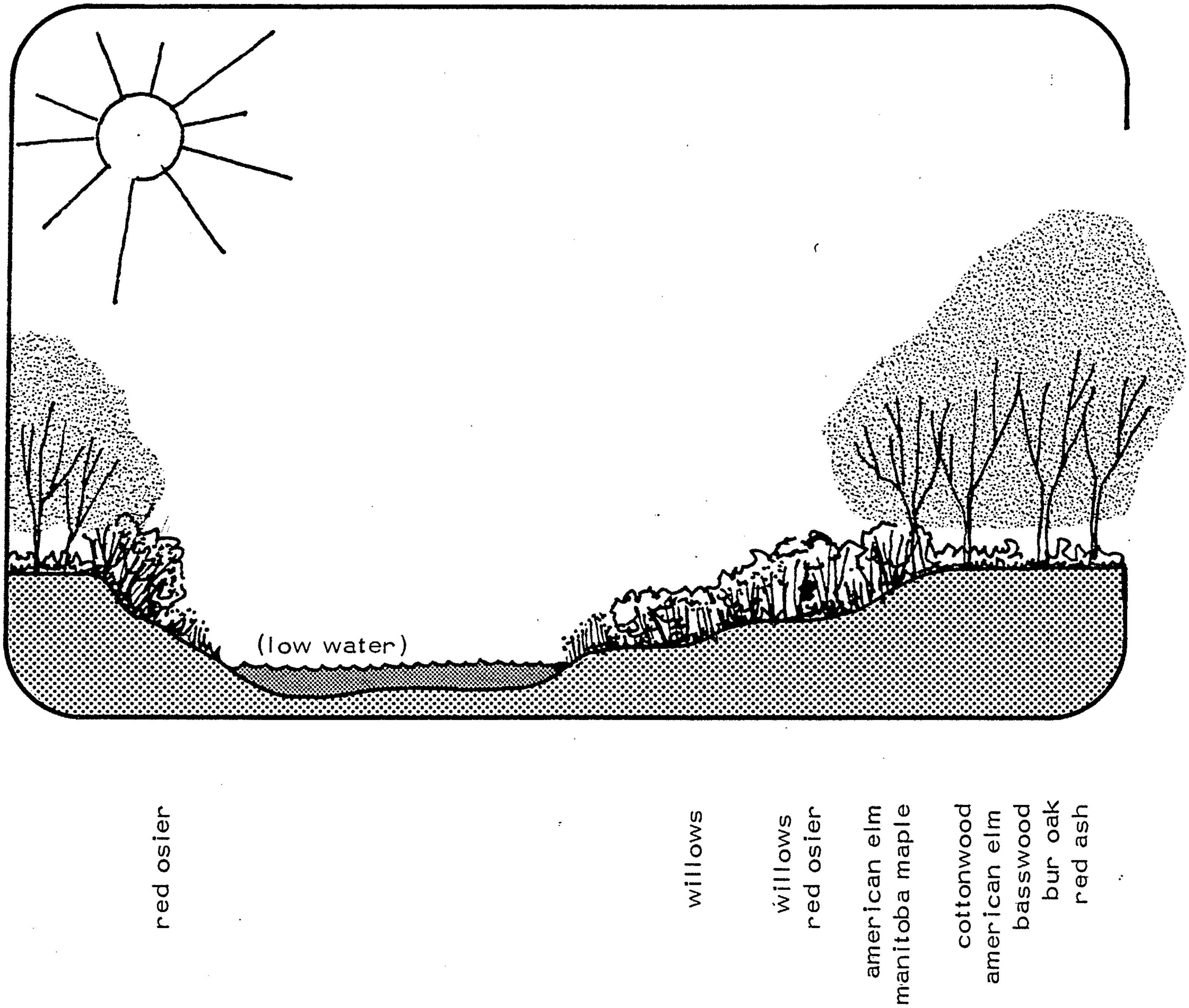


Figure 16

SECTION THROUGH A TYPICAL FLOODPLAIN COMMUNITY site to native plant communities. For example, shade and higher moisture levels along north walls may create a proper microclimate for the floodplain understory. The native ostrich fern (Matteuccia struthiopteris var. pensylvanica) can do well along north walls, and is commonly used by homeowners. Other suitable plants from the floodplain understory are New England aster (Aster nova-angliae), flat-topped white aster (A. umbellatus var. pubens), silverweed (Potentilla anserina), Canada wild rye, and flat-topped goldenrod (Solidago graminifolia var. major). A southern wall might be flanked by xeric prairie types: little bluestem, pasque-flower, black-eyed susan (Rudbeckia serotina), etc. Variables of soil texture, exposure and drainage must be considered on every site to make certain that these general statements apply. House design and color and other particulars may affect microclimatic conditions.

Design solutions should allow air movement around homes, where people barbeque or relax outdoors. Mosquitoes make protected or wooded areas unattractive for much of the summer, but air movement through open areas can reduce mosquito activity to tolerable levels.

Clients interested in developing a native planting must be patient for a few years while the plants establish themselves. In the first year, most development in prairie plants takes place beneath the soil, and visible results are not particularly gratifying. (Fig. 17) Weeds may be troublesome. After three to five years the competitive capacity of native plants will be greater than that of weeds and the planting will begin to look as intended. If the client participates in planting, fairly elaborate plans can be made. But, if the client's

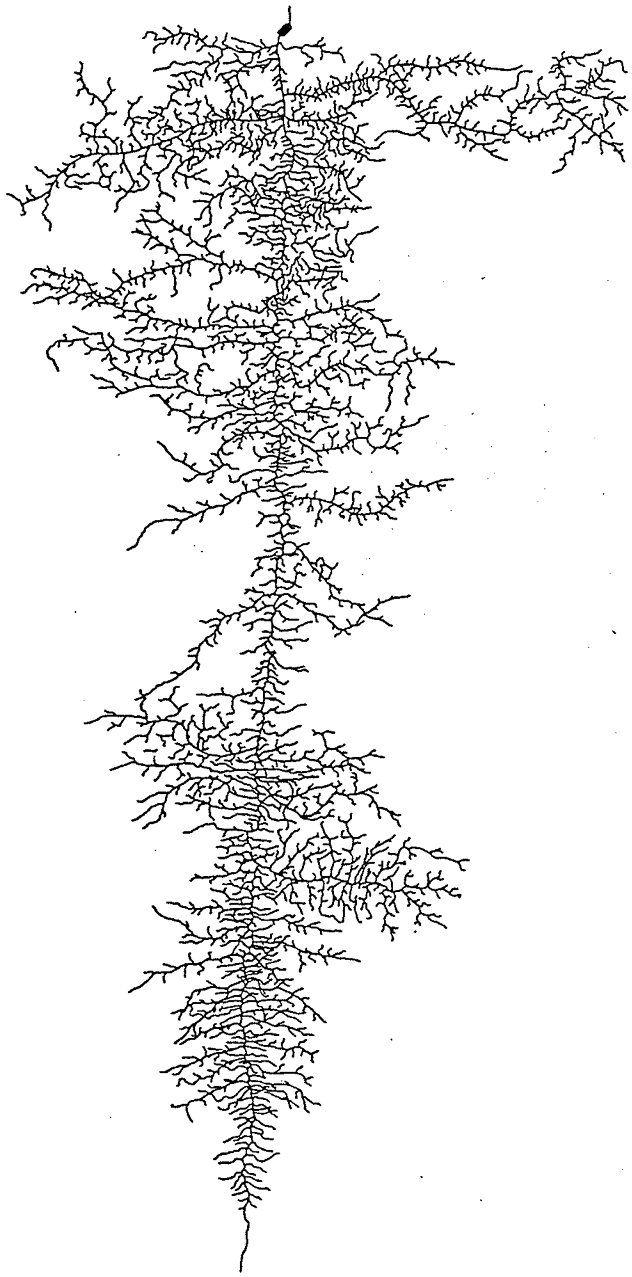


Figure 17

SEMINAL ROOT SYSTEM OF BIG BLUESTEM [Weaver, 1968]

(53 cm. long 70 days after planting)

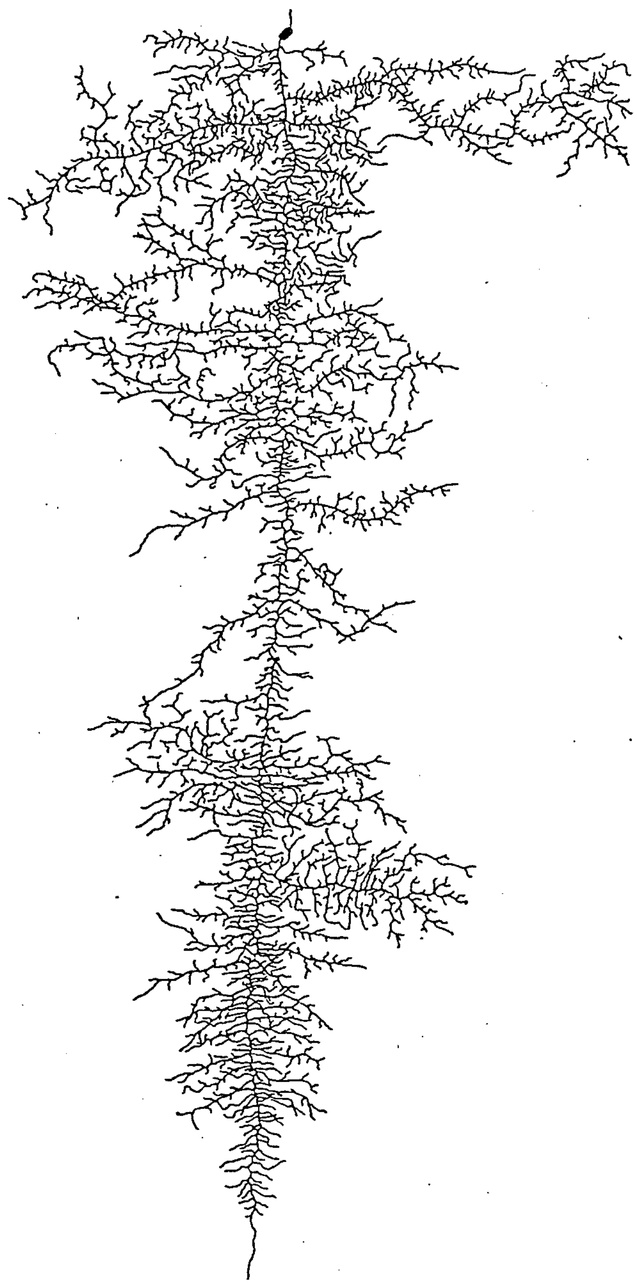


Figure 17

SEMINAL ROOT SYSTEM OF BIG BLUESTEM [Weaver, 1968]

(53 cm. long 70 days after planting)

primary reason for selecting native communities is to reduce maintenance, elaborate plans (for staged development for example) are not appropriate. By letting existing lawngrass grow and set seed, one can produce an instant (non-native) "prairie". Forb species can be introduced in this "prairie" if they are protected from root competition with the grass.

Give the client a brief maintenance outline with specific information on how to care for his planting. This may prevent his doing unwitting damage through over-maintenance. It is also important that the client properly maintains manicured areas adjacent to natural areas. Manicured areas can make the design look deliberate and appropriate, even when it is newly planted.

A Compromise

A conservative method of including native species on a home site follows. Most of the site is given over to Kentucky bluegrass, in keeping with the practical and conditioned needs of many clients. A small woodland community could then be planned for a portion of the site. This would initially consist of a group of 'Northwest poplar', a hybrid of balsam poplar available at nurseries. This plant would not infringe on limited space in a small suburban lot by suckering as aspen would. Border community shrubs available at nurseries could be planted with the trees - American hazel and red osier under the trees and highbush cranberry, snowberry and saskatoon along the borders. (Five shrub species may be too many for a small planting.) Bur oak seedlings or acorns should be planted so that they will eventually replace the poplars, and a heavy mulch of partially rotted leaf litter should be applied to the soil. This mulch will help prepare the soil for woodland plants which the client may add later. An alternative to woodland plants on the ground layer could be strawberry. Strawberry spreads rapidly and if weeded makes a proper ground cover. This woodland community is a compromise plan but it would afford many of the good points of a more purist approach without requiring extensive collection of plants in the wild, and without requiring staged development.

Wildlife

People who are not particularly interested in plants or in the natural look of low maintenance landscaping may still be interested in native communities as wildlife habitat. James Davis, official of the U. S. National Wildlife Federation told a recent symposium that, "..nothing we have ever done has evoked a stronger, more enthusiastic response than...our Backyard Wildlife Program" [Davis, 1974]. He said that birds are especially popular with homeowners. Over 100 species of birds frequent metropolitan Winnipeg, and some visit any home which provides them with adequate habitat. (For a list of these birds see, "Birds in the City", a pamphlet distributed by the Government of Manitoba.)

Wildlife can be observed throughout the year by bringing plants bearing food close to the windows of homes. (Fig. 18) Planting should be related to views from within homes, especially when it attracts wildlife. If tall-growing sunflowers are planted under south windows they attract birds and bees into view near eye level in the home for close observation. Grasses and forbs, if left unmowed, stand above the snow in winter and attract wildlife.

Figure 18. Monarch butterfly caterpillar on common milkweed. MON MILKWEED

The presence of a varied community of plants and animals close by can be an educational exhibit for children and adults. The year-round presence of plants and animals encourages a greater understanding of animal behavior and life cycles than do weekend trips to the country or zoo. It can also mean that children will grow up without fear of "varmints" as they are likely to do when they lack contact with free animals.

Designers may be justly concerned that undesirable wildlife will be attracted. Fortunately Manitoba has no venomous snakes or fearsome creatures which are likely to adapt to life in suburban environments. Skunks and raccoons are familiar nuisances to cottagers. These small mammals can be destructive in gardens and they do on occasion become infected with rabies. Rabbits and squirrels can also damage gardens and landscape plantings. Wildlife in urban settings is a broad subject that cannot be adequately dealt with here, but helpful material is available from a symposium on urban wildlife held by the Cooperative Extension Services of the University of Massachusetts in 1973 [Wildlife in an Urbanizing Environment, Cooperative Extension Services, University of Massachusetts, 1974]. * The symposium recommended that wildlife enthusiasts emphasize creation of bird habitat rather than habitat for other species because birds are not destructive relative to other species [De Graaf, 1974]. Diseases transmitted by birds are largely the result of crowding around single food sources such as feeders [Locke, 1974] and this can be avoided by the dispersal of birds through a more natural habitat.

Domestic pets may be a greater problem than any particular species of wildlife. Cats and some dogs are active killers of small rodents and birds [Howard, 1974], and the choice between free pets or free wildlife may be necessary. Popular belief that rats infest natural growth may trouble homeowners with native plantings, but rats do not and did not exist in our native plant communities. They developed in dependence with man, living on and requiring his refuse. The presence of native communities should not affect rat populations. Field mice and voles, both shy creatures have been occasional inhabitants of native plantings in Wisconsin, and would likely appear in native plantings in Manitoba.

*There is useful information in this publication, but more information is needed to develop design criteria. For example, one article stated that over 4000 cases of rabies were reported in the United States in 1973 [Locke, 1974]. Sixty percent of these cases were skunks. This data suggests that designers avoid creating skunk habitat, but it does not suggest how they avoid it, or tell what that habitat is.

INDUSTRIAL GROUNDS

Large areas of land bordering our cities are occupied by industrial parks. Industrial parks typically contain large parking lots and open land held for future expansion. They may be ugly, barren places or highly manicured and attractive (complete with flood-lights and berms), depending on the necessity for creating a public image to stimulate business. What most industrial areas have in common is unused open space. Even the carefully landscaped sites are developed to impress the passers-by rather than to please employees or persons walking through the site. With the aim of appreciation from a distance, a low maintenance landscape design seems an ideal substitute for the costly turf and flower-bed schemes now in use on landscaped sites. Areas viewed from within the building and from arriving vehicles can be handled so that within the criteria of low-maintenance there remains a sense of art in the design. Drifts of native flowers may occupy areas where many eyes will see them. Prairie grasses can be planted from fine texture and low stature to coarse texture and high stature, progressively, away from the roadbeds. (Fig. 19) Aspen bluffs can be used to create a sense of space greater than that existing in reality while framing vistas, screening out undesirable views, and permitting enough visibility to satisfy security requirements.

The large, sunny areas occupied by industrial buildings may offer the best opportunity a landscape architect will have to plant prairie species at an appropriate scale. Darrell Morrison's project in Madison, Wisconsin, the landscaping of an insurance company's grounds, is an excellent reference [Morrison, 1975]. (Fig. 20)

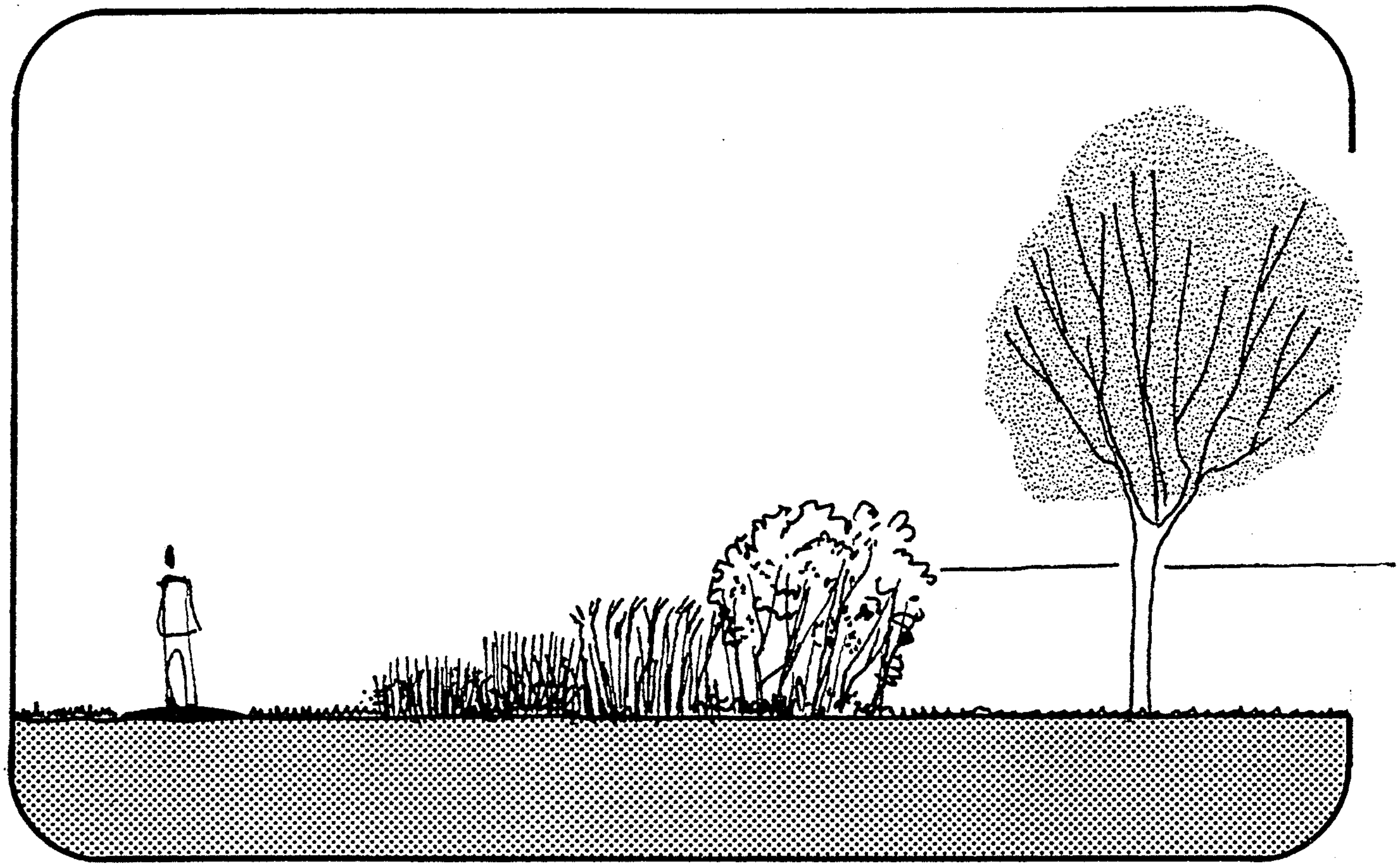


Figure 19

AN ARTIFICIAL ARRANGEMENT OF SPECIES TO DEFINE A TRANSITIONAL ZONE

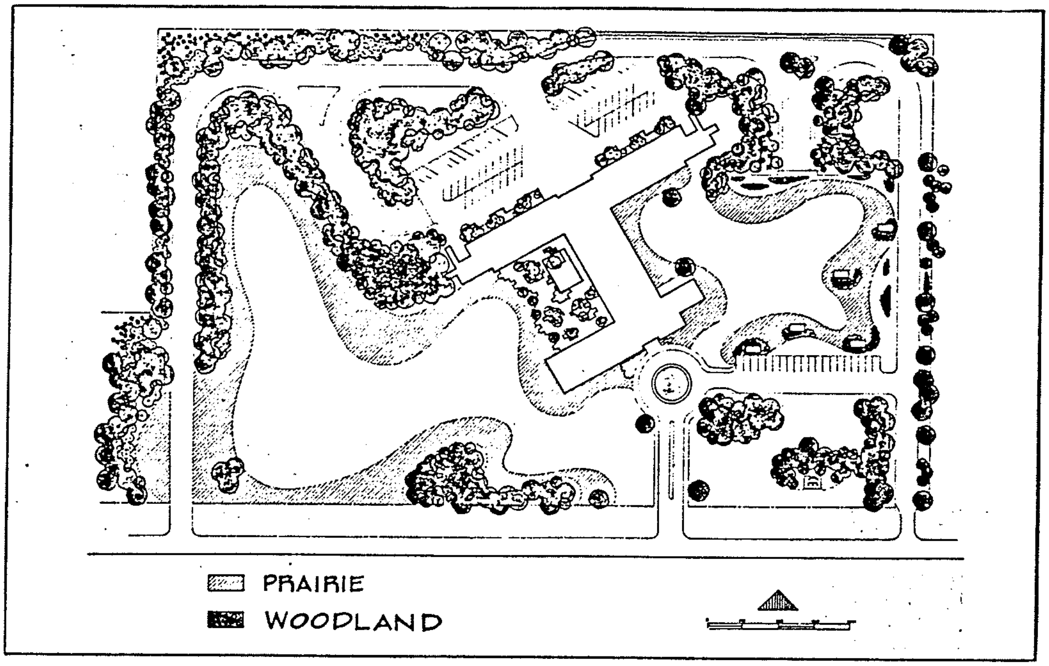


Figure 20. Plan of CUNA Mutual's grounds [Morrison, 1975].

If industrial areas were developed with native vegetation we could bring refreshing rural scenery to a bleak part of cities. Where companies are seriously concerned about public image it may be important to stress the creation of wildlife habitat and to develop positive publicity for such projects.

ROADSIDES

One of the most obvious places to maintain native species is along public roadsides. Road allowances could offer thousands of kilometers of available plant and animal habitat. At present, tidy flat surfaces border nearly every road, demonstrating our ability to "civilize" the landscape. Now that nearly all our landscapes are civilized it may be a welcome change to see natural growth on roadsides.

Primary roads, such as the Trans Canada, are heavily maintained. Considerable sums of public money are expended to keep them attractive and safe for drivers. Unfortunately the repetition of forms and uniform handling of roadside landscape tends to negate the pleasure they could give to drivers. Continuous clipped turf and ornamental shrubbery contribute to a sense of monotony when they are encountered hour after hour. Clipped turf creates an unbroken flat surface not unlike that of concrete when seen from a distance.

Secondary roads are often raised roads adjacent to drainage ditches. The ditches, if left alone, fill in with wet land species and provide a relatively undisturbed habitat for waterfowl. Lush growth along the roads with common cat-tail (Typha latifolia) or tall grasses can be beautiful. Unfortunately, an accumulation of these wetland plants can disrupt the functioning of drainage ditches. Herbicides are used to destroy the plants in ditches and those growing along the roads are killed at the same time. This practice leaves bare gravel shoulders and sometimes results in erosion. The continual removal of plant cover encourages weed growth and discourages establishment of stable communities. It would seem wise to harvest the plants interfering with drainage and to spare attractive perennial natives on roadsides.

Prairie vegetation is eminently suited for roadside planting. Annual mowing or burning could remove trees and shrubs which block vision. Selective removal of roadside plants would allow trees which provide a natural windbreak or snowfence to remain. Such management would add diversity to the landscape and reduce the danger of driver hypnosis.

The marvel of native growth is that simply by discontinuing standard maintenance, the process begins. Hardy native plants eventually take over and crowd out weeds and exotics. Selective mowing, burning and brush cutting accelerate the invasion of native species. Planting of prairie grasses and wildflowers, native shrubs and trees gives the most rapid effect, but is necessary only when no existing stands of native growth provide seed for gradual invasion.

In some provinces forage grasses are planted and harvested periodically on roadsides. In the United States large highway road allowances are fenced and used for grazing [Carpenter, Walker and Lanphear, 1975]. This seems practical and it indicates that there is significant space for wildlife habitat on roadsides.

Programs to create 'natural roadsides' in the United States have been in progress for decades. Wisconsin and Iowa, in particular, have many miles of beautiful roadsides planted with native species. Often volunteer groups establish the plantings in cooperation with the government agencies which later take over maintenance. While government engineers set the safety standards, the volunteer groups meet the standards with appropriate plantings. A slide-tape set and information on natural roadsides is available from the University of Wisconsin - Extension, Environmental Resource Unit, 1815 University Avenue, Madison.

Note: A beautiful stand of prairie exists between Warren and Crookston, Minnesota, for a distance of approximately 30 miles along Highway 75. It occupies the road allowance between the highway and railroad.

PARKS

Because there are many kinds of parks it may be useful to outline some of the differences between general types. The use of native plant communities is affected by the type of park and the purpose it is intended to serve.

National Parks

National Parks are, more than any other parks, wilderness areas. In recent years the emphasis of national park policy has been to conserve biotic communities within the parks for the enjoyment of future generations - the natural condition of the parks is the main reason for their existence.

Provincial Parks

Provincial Parks are more varied. Generally speaking they are viewed as recreation sites (as opposed to conservation areas) with the natural environment as a background. In order to preserve the natural background, these parks are designed so that intensive use is directed to particular areas which are developed to tolerate human use. This is also true of National Parks, but the emphasis on maintaining the biota is proportionately less in the provincial parks, and emphasis on serving recreation needs is greater.

Most National and Provincial Park sites are selected for their natural beauty. Native vegetation is part of that beauty, and in most cases it is preserved. But heavy use of some parks is destructive to the natural environment. Discussion of this problem is beyond the scope of this paper, but a few aspects of the problem of heavy use are discussed later with respect to city parks. Though it seems unnecessary to argue for the inclusion of native communities in National or Provincial Parks, it is important to provide for their protection through good design and maintenance practice. They may soon provide the only extensive and accessible seed sources for native materials used in landscaping.

City Parks

It is difficult to make general statements about city parks because they vary in size and function more than National and Provincial Parks. They may be tiny urban squares or large green oases like Stanley Park in Vancouver.

Native communities can be used in the small parks as they are used on private grounds of homes - small parks and small lots have in common heavy use and limited space. In parks, however, it may be necessary to create gentle barriers (such as low retaining walls or berms) which separate movement of people from plants. (Separation of movement from plants is also appropriate anywhere in large parks where movement or activity is concentrated.) Small urban parks can provide situations where native species are carefully observed.* Because plants usually inhabit a small proportion of the park area they are potential points of interest, and could even be considered exhibits. In large parks plants usually occupy a greater proportion of the area and their potential value as a design element is quite different.

*For a description of a small urban park developed with prairie plants, see Morrison [1975].

Large city parks provide relief from the hard urban landscape. They also serve as public promenades - places to see and be seen - and they provide needed recreational facilities. The provision of softness and nature, and the provision for social and recreational functions in these parks are sometimes at odds with each other, not because they are mutually exclusive but because the parks are poorly designed. A healthy balance between the various functions of city parks can be facilitated by the use of native communities - native forest communities provide screening which helps accommodate conflicting uses. Manicured landscapes, particularly those developed with decorative intentions such as flower beds, have less ability to absorb various activities and to soften the landscape. (Fig. 21)

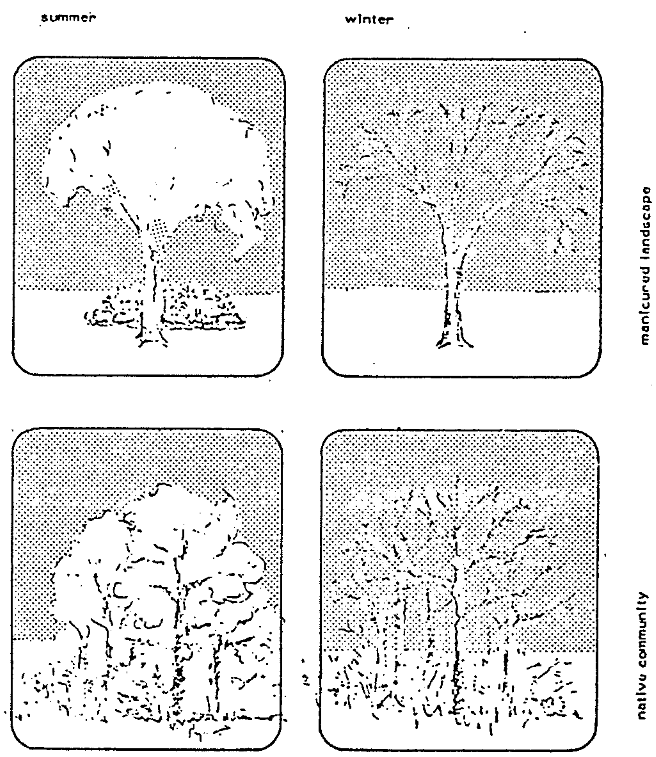


Figure 21. Comparative screening of a native community and a traditional manicured planting.

Large city parks provide relief from the hard urban landscape. They also serve as public promenades - places to see and be seen - and they provide needed recreational facilities. The provision of softness and nature, and the provision for social and recreational functions in these parks are sometimes at odds with each other, not because they are mutually exclusive but because the parks are poorly designed. A healthy balance between the various functions of city parks can be facilitated by the use of native communities - native forest communities provide screening which helps accommodate conflicting uses. Manicured landscapes, particularly those developed with decorative intentions such as flower beds, have less ability to absorb various activities and to soften the landscape. (Fig. 21)

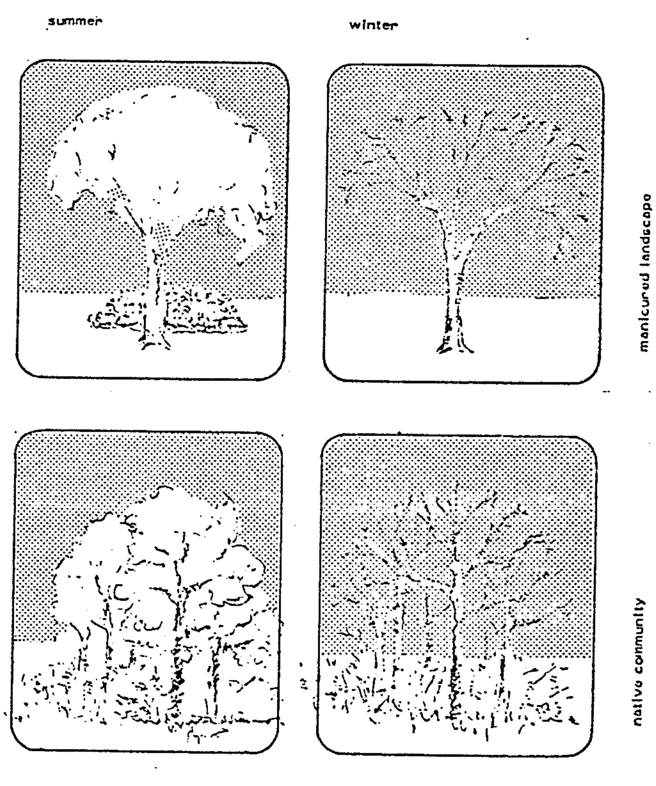


Figure 21. Comparative screening of a native community and a traditional manicured planting.

Assiniboine Park in Winnipeg maintains masses of native vegetation to good effect. Floodplain, aspen and oak forest communities occur in the park. A maze of roads and paths wind through the forest communities yet one can enjoy a wonderful sense of solitude there because of the effective screening provided by dense native growth. In winter the dense vegetation offers protection from cold winds and in all seasons it provides animal habitat. Rabbits, beaver, muskrat, herons and many other bird species frequent this park just minutes from the center of Winnipeg.

Like many city parks, Assiniboine Park has a variety of elements within it which do not necessarily complement each other. Parking lots, a zoo, a conservatory, an English Garden, various maintenance buildings, an old locomotive, and extensive playing grounds need to be absorbed gracefully into this park. In most places the flow of wooded areas knits together the various parts of the park into a graceful whole. Where native cover has been removed and shrubbery beds installed the design and placement of buildings is critical - their impact is greater. When the screening effect of the understory is removed, an element of surprise is lost, and the opening and closing of spaces is lost. In a park of this size, solid masses of vegetation against the open areas provide essential contrast and knit the parts into a whole.

Unfortunately, Assiniboine Park is not a typical city park. Most have a single manicured landscape style. Turf, mature trees and flower or shrubbery beds are regular park landscape elements. While many people find this controlled, manicured style attractive, it is very expensive to maintain and fails to provide for the future by allowing young trees to grow up. When saplings are planted they are often birches or weeping willows - unsuitable species to be grown in the shade of mature trees. The standard manicured "park landscape" depends heavily on the grace of mature trees to make it attractive. The trees are often of uniform age and they will die much at the same time. Lack of provision for continuing replacement of trees will result in failure of this manicured style.

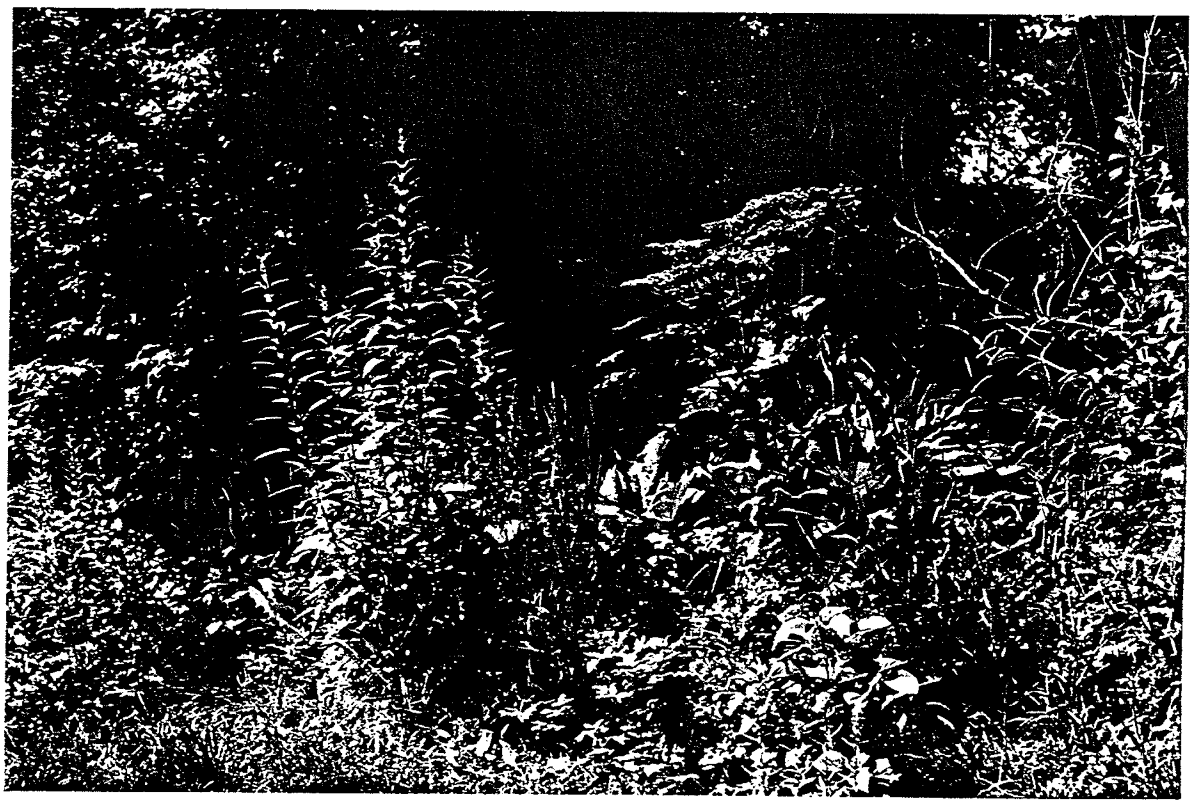


Figure 22. Natural grouping of floodplain understory species found in Assiniboine Park, Winnipeg.

Native Communities in Relation to Park Design

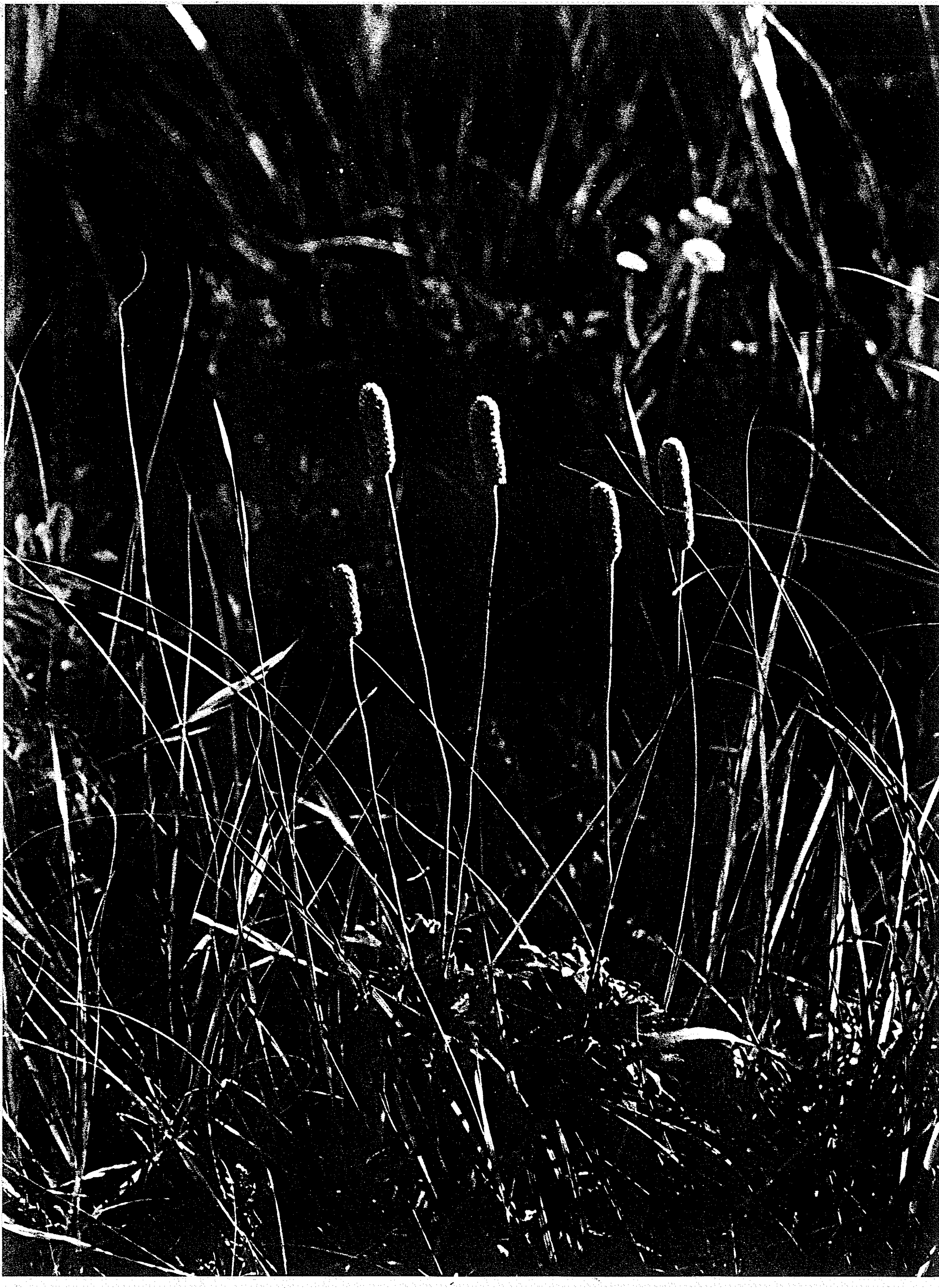
Native communities have limited tolerance for the heavy use typical of parks. Though documented information is difficult to find on the tolerance of aspen forest to park use, aspen forest is sensitive to change in drainage and aeration caused by excessive use. The bur oak is famous among horticulturist for its intolerance to root or soil disruption. If a general statement may be made about our two major forest trees, it might be as follows: where oak or aspen grow in clays or easily compacted soils they will be easily destroyed by intensive use such as regular picnicking. Design work can provide for their protection by installing thickets of hazel or hawthorn, and by directing heavy use to specific points which are designed for that purpose.

The appearance of prairie communities suffers so much from trampling that they should not be considered for active use. Passive use is more appropriate for prairie communities, and paths winding through the communities provide opportunities to appreciate the plants at close range.

The deliberate inclusion of native communities in city parks suggests that the communities receive special attention. This may take the form of boardwalks and signposts or other educational material. How this is done depends on the judgement of designers. My bias is to avoid creating man-made forms which structure or control perception of the natural environment. The experience of prairie landscape, for instance, is vulnerable to distortion by even small details like sidewalks. From my observation of the St. James Prairie it would seem that gentle paths through grasslands are an appropriate way to view that landscape. Contact with the earth, and the sounds of one's own footsteps are part of the prairie experience.

Compacted footpaths have only a very local effect on plants. Variation in the flora can be observed resulting from heavy use along paths. Most footpaths arise spontaneously according to the movements of people through parks. Though many designers will want to develop formal footpaths for heavy use, these should be limited. Spontaneous footpaths have minimal effect on the landscape and are less destructive than the broad walks installed with heavy machinery. Mowed paths through native grassland are used in some parks in the United States. These paths need regular mowing and fertilization to survive heavy use, but they provide an acceptable walking surface.

It is time to rethink city parks and to allow some naturalness to come into their design. City budgets are tight, but the result of reduced maintenance on manicured parks is dereliction rather than naturalness; hedges once clipped grow awkwardly, flower beds and unmowed grass become choked with weeds. Heavy use typical of city parks always requires heavy maintenance but if parks are designed so that maintenance can be light in some areas, money will be available for use where it is needed.



APPENDIX A - PLANT LIST

SCIENTIFIC NAME	COMMON NAME
Acer negundo L.	Manitoba maple
Achillea millefolium L.	common yarrow
Actaea rubra (Ait.) Willd.	red baneberry
Agastache foeniculum (Pursh) Ktze.	blue giant hyssop
Agrimonia striata Michx.	grooved agrimony
Agropyron dasystachyum (Hook.)Scribn.	northern wheat grass
Agropyron repens (L.) Beauv.	couch-grass
Agropyron smithii Rydb.	western wheat grass
Agropyron trachycaulum (Link) Malte	slender wheat grass
Agrostis stolonifera L. var. major (Gaud.) Farw.	redtop
Allium cernuum Roth	wild onion
Alnus rugosa (DuRoi) Spreng. var. americana (Regal) Fern.	speckled alder
Amelanchier alnifolia Nutt.	saskatoon
Amorpha canescens Pursh	leadplant
Amorpha nana Nutt.	fragrant false indigo
Andropogon gerardi Vitman	big bluestem
Andropogon scoparius Michx.	little bluestem
Anemone canadensis L.	Canadian anemone
Anemone cylindrica Gray	thimbleweed
Anemone patens L. var. wolfgangiana (Bess.)Koch	pasque-flower
Antennaria campestris Rydb.	prairie everlasting
Antennaria canadensis L.	Canada everlasting
Apocynum androsaemifolium L.	spreading dogbane
Aquilegia canadensis L.	wild columbine
Aralia nudicaulis L.	wild sarsaparilla
Arenaria lateriflora L.	grove-sandwort
Artemesia frigida Willd.	prairie-sagewort
Artemesia ludoviciana Nutt. var. gnaphalodes (Nutt.) T.&G.	white sage
Asclepias incarnata L.	swamp-milkweed
Asclepias speciosa Torr.	showy milkweed
Aster ciliolatus Lindl.	Lindley's aster
Aster laevis L.	smooth aster
Aster novae-angliae L.	New England aster
Aster umbellatus Mill. var. pubens Gray	flat-topped white aster
Astragalus canadensis L.	Canadian milk-vetch
Astragalus caryocarpus Ker.	ground plum

Betula papyrifera Marsh.	paper-birch
Bouteloua curtipendula (Michx.) Torr.	side-oats grama
Bouteloua gracilis (HBK.)Lag.	blue grama
Bromus inermis Leyss.	smooth brome
Calamagrostis canadensis (Michx.) Nutt.	blue-joint
Calamagrostis inexpansa Gray var. brevior (Vasey) Stebbins	northern reed grass
Calamovilfa longifolia (Hook.) Scribn.	sandgrass
Campanula rotundifolia L.	harebell
Carex obtusata Lilj.	blunt sedge
Carex pensylvanica Lam.var. digyna Bock.	sun-loving sedge [Bird, 1961]
Carex stenophylla Wahl. var. enervis (Mey.) Kükenth	low sedge [Bird, 1961]
Cerastium arvense L.	field-chickweed
Cirsium flodmanii (Rydb.) Arthur	Flodman's thistle
Comandra richardsiana Fern.	Richards comandra
Cornus canadensis L.	bunchberry
Cornus stolonifera Michx.	red osier
Corylus americana Walt.	American hazelnut
Corylus cornuta Marsh.	beaked hazelnut
Crataegus chrysocarpa Ashe	round-leaved hawthorn
Crataegus succulenta Link var. occidentalis (Britt.) Palmer	long-spined hawthorn
Cypripedium calceolus L. var. parviflorum (Salisb.) Fern.	small yellow lady's-slipper
Echinacea angustifolia DC.	purple coneflower
Elaeagnus commutata Bernh.	silverberry
Eleocharis palustris (L.) R. & S.	creeping spike-rush
Elymus canadensis L.	Canada wild rye
Epilobium angustifolium L.	fireweed
Eupatorium maculatum L. var. bruneri (Gray) Breitung	Joe-Pye-weed
Festuca altaica Trin. var. major (Vasey) Gleason	rough fescue
Fragaria vesca L. var. americana Porter	woodland strawberry
Fragaria virginiana Duchesne	strawberry
Fraxinus pennsylvanica Marsh. var. subintegerrima (Vahl) Fern.	red ash
Gaillardia aristata Pursh	gaillardia
Galium septentrionale R. & S.	northern bedstraw
Galium triflorum Michx.	sweet-scented bedstraw

Gentiana andrewsii Griseb.	closed gentian
Gentiana puberula Michx.	downy gentian
Geum triflorum Pursh	three-flowered avens
Glyceria grandis Wats.	reed-meadow grass
Glycyrrhiza lepidota (Nutt.) Pursh	wild licorice
Helianthus giganteus L.	tuberous-rooted sunflower
Helianthus laetiflorus Pers. var. subrhomboideus (Rydb.) Fern.	rhombic-leaved sunflower
Helianthus maximiliani Schrad.	narrow-leaved sunflower
Helianthus tuberosus L. var. subcanescens Gray	Jerusalem artichoke
Heliopsis helianthoides (L.) Sweet var. scabra (Dunal) Fern.	ox-eye
Heuchera richardsonii R. Br.	alumroot
Hierochloë odorata (L.) Beauv.	sweet grass
Juncus balticus Willd. var. littoralis Engelm.	Baltic rush
Koeleria cristata (L.) Pers.	June grass
Lathyrus ochroleucus Hook.	pale vetchling
Lathyrus palustris L.	vetchling
Lathyrus venosus Muhl. var. intonsus Butt. & St. John	purple vetchling
Liatris ligulistylis (Nels.) K. Schum.	meadow blazingstar
Liatris punctata Hook.	dotted blazingstar
Lilium philadelphicum L.	wood lily
Lilium philadelphicum L. var. andinum (Nutt.) Ker	prairie-lily
Lithospermum canescens (Michx.) Lehm.	puccoon
Lonicera dioica L. var. glaucescens (Rydb.) Butters	twining honeysuckle
Lonicera Maackii Maxim.	amur honeysuckle
Lonicera tatarica L.	Tartarian honeysuckle
Lythrum salicaria L.	spiked loosestrife
Maianthemum canadense Desf. var. interius Fern.	false lily-of-the-valley
Matteuccia struthiopteris (L.) Todaro var. pensylvanica (Willd.) Morton	ostrich-fern
Mentha arvensis L. var. villosa (Benth.) Stewart	field mint
Monarda fistulosa L.	wild bergamot
Osmorhiza longistylis (Torr.) DC.	anise-root
Panicum virgatum L.	switchgrass
Parnassia multiseta (Ledeb.) Fern.	northern grass-of-Parnassus

Petalostemum candidum (Willd.) Michx.	white prairie-clover
Petalostemum purpureum (Vent.) Rydb.	purple prairie-clover
Phalaris arundinacea L.	reed-canary-grass
Picea glauca (Moench) Voss	white spruce
Poa arida Vasey	plains blue grass
Poa nemoralis L.	
Poa palustris L.	fowl-meadow grass
Poa pratensis L.	Kentucky bluegrass
Populus balsamifera L.	balsam-poplar
Populus deltoides Marsh.	cottonwood
Populus tremuloides Michx.	aspen
Potentilla anserina L.	silverweed
Potentilla arguta Pursh	tall cinquefoil
Prunus americana Marsh.	wild plum
Prunus pensylvanica L. f.	pin-cherry
Prunus virginiana L.	choke-cherry
Psoralea argophylla Pursh	silverleaf psoralea
Psoralea esculenta Pursh	breadroot
Pyrola asarifolia Michx.	pink wintergreen
Quercus macrocarpa Michx.	bur oak
Ranunculus rhomboideus Goldie	prairie-buttercup
Rhus radicans L. var. rydbergii (Small) Rehd.	poison ivy
Ribes oxyacanthoides L.	northern gooseberry
Rosa arkansana Porter	prairie rose
Rosa woodsii Lindl.	Wood's rose
Rubus idaeus L. var. strigosus (Michx.) Maxim.	raspberry
Rubus pubescens Raf.	dewberry
Rudbeckia laciniata L.	tall coneflower
Rudbeckia serotina Nutt.	black-eyed susan
Salix bebbiana Sarg.	beaked willow
Salix discolor Muhl.	pussy willow
Salix humilis Marsh.	gray willow
Salix petiolaris Sm.	slender willow
Sanicula marilandica L.	snakeroot
Scolochloa festucacea (Willd.) Link.	spangle-top
Shepherdia argentea Nutt.	buffalo-berry
Smilacina stellata (L.) Desf.	star-flowered Solomon's seal
Smilacina trifolia (L.) Desf.	three-leaved Solomon's seal
Smilax herbacea L. var. lasioneura (Hook.) A.DC.	carrionflower
Solidago canadensis L.	Canada goldenrod

Solidago graminifolia (L.) Salisb. var. *major* (Michx.) Fern.	flat-topped goldenrod
Solidago missouriensis Nutt.	Missouri goldenrod
Solidago nemoralis Ait. var. *decemflora* (DC.) Fern.	showy goldenrod
Solidago rigida L.	rigid goldenrod
Sorghastrum nutans (L.) Nash	Indian grass
Spartina gracilis Trin.	alkali cord grass
Spartina pectinata Link	prairie cord grass
Spiraea alba DuRoi	meadow-sweet
Sporobolus heterolepsis Gray	prairie drop-seed
Steironema ciliatum (L.) Raf.	fringed loosestrife
Stipa comata Trin. & Rupr.	needle-and-thread grass
Stipa spartea Trin.	porcupine-grass
Stipa spartea Trin. var. *curtiseta* Hitchc.	northern porcupine-grass
Symphoricarpos albus (L.) Blake	snowberry
Symphoricarpos occidentalis Hook.	wolfberry
Thalictrum dasycarpum Fisch. & Lall.	purple meadow-rue
Thalictrum venulosum Trel.	veiny meadow-rue
Ulmus americana L.	American elm
Viburnum lentago L.	nannyberry
Viburnum rafinesquianum Schultes	downy arrow-wood
Viburnum trilobum Marsh.	highbush-cranberry
Vicia americana Muhl.	American vetch
Viola pedatifida G. Don	purple prairie violet
Zigadenus elegans Pursh	white camass
Zizia aptera (Gray) Fern.	heart-leaved Alexanders
Zizia aurea (L.) W.D.J. Koch	golden Alexanders

Fungi:

Fomes igniarius (L. ex Fr.)
Hypoxylon pruinatum (Klotzsch)

APPENDIX B - 25 BORDER COMMUNITY SPECIES

"A collection of plants is not a landscape, anymore than a list of choice words is a poem."

[Fairbrother, 1974]

Designers need to know more than the physical description of plants. The following collection of data on 25 border community species lists innate characteristics and environmental requirements of each plant. It demonstrates a method of collecting and cataloguing such information.

While the group of 25 species does not represent a complete list of border community species it should be helpful to landscape architects interested in the use of border communities, and could be used as a starting point for the collection of more data.

NOTES ON THE DATA

Nomenclature used:

Scientific names	- Scoggan [1957]
Common names	- Scoggan [1957] - Canada Weeds Committee [1975] - Budd and Best [1969] - (in the above order)

Range given for each plant:

- Budd and Best [1969]

(See Figure 23)

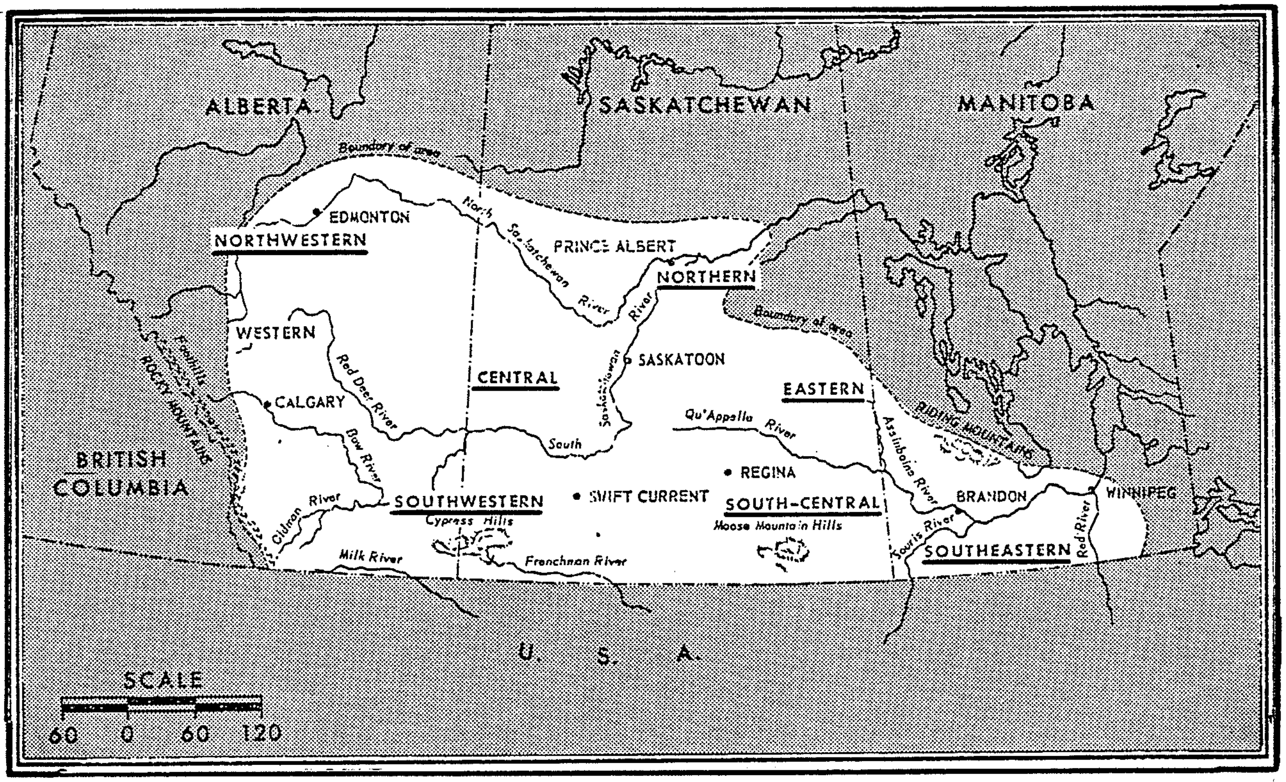


Figure 23.

FLORAL ZONES OF THE PRAIRIES
[Budd and Best, 1969]

Definitions:

1. Inoculation - usually means mixing the seed with an appropriate powdered bacterial culture to aid growth of the young plant. Many legumes require this treatment. For information write The Nitrogen Co. Inc., 3101 W. Custer Avenue, Milwaukee, Wisconsin, 53209 [Rock, 1974].

2. Scarification - seed coat is weakened by scratching it with an abrasive (like fine sandpaper) or by using hot water or chemicals [Rock, 1974].

3. Stratification - placing seed in moist sand, peat moss or saw dust at temperatures between 0°C and 5°C for 1- 4 months [Rock, 1974]. Over half of the prairie seeds need only cold stratification [Rock, 1974] and this can be accomplished by storing them dry in a ventilated, unheated garage.

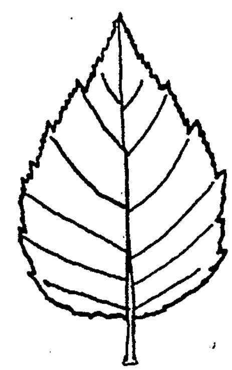
4. Ripe - as a general rule, seeds are ripe when the seed coat is hard [Marshall, pers. comm.].

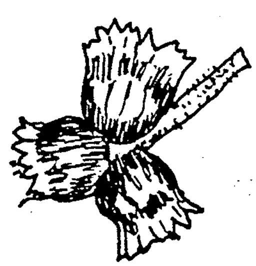
REFERENCES

1. Scoggan [1957]
2. Budd and Best [1969]
3. Hosie [1969]
4. Rock [1974]
5. Sperka [1973]
6. Gleason [1952]
7. Grieve [1931]
8. Marshall [pers. comm.]
9. Courtenay & Zimmerman [1972]
10. Fernald [1950]
11. Taylor and Hamblin [1963]
12. Van Bruggen [1971]
13. Frankton and Mulligan [1970]
14. Weaver [1954]
15. Moss [1959]
16. Harp [1971]
17. Costello [1969]
18. Robinson [1960]
19. Bird [1961]
20. Hoag [1965]
21. Steneker and Wall [1970]
22. Curtis [1959]
23. Ewing [1924]
24. Peattie [1966]
25. Lenz [pers. comm.]
26. Nichols and Entine [1976]
27. Coupland [1950]
28. Weaver [1968]
29. Phillips Petroleum Co. [1963]
30. Bailey [1935]

AMERICAN HAZELNUT

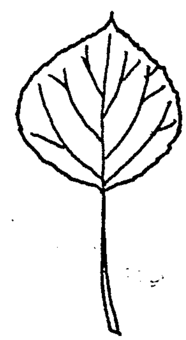
SCIENTIFIC NAME	Corylus americana Walt.
FAMILY	Betulaceae.
RANGE	Common in Manitoba but unusual farther west. (C. cornuta is common throughout Parkland.)
SOIL	Tolerant [18]. Does best in sunny well drained sites [19].
EXPOSURE	Part shade to full sun.
HABITAT	Edge conditions, thickets and light woods [1]. Major understory of aspen forest [16].
APPEARANCE	A coarse twiggy shrub, 1-3 m. in height [6]. Dull green leaves are about 10 cm. long and hairy [2]. Sucker growth produces dense thickets.
ROOT SYSTEM	Fibrous, suckering [18]. Large woody roots within 15 cm. of soil surface give rise to shoots 30 - 60 cm. beyond the parent [23].
FLOWERING DATE	Flowers briefly in early spring before leaves appear [18]. Has both fertile and sterile flowers. Monoecious.
SEASON OF FOLIAGE	Late spring to early fall. Bronze-red leaves in fall [25].
GROWTH RATE	Rapid [18].
PROPAGATION	Easy by seed except when pests destroy the seed [25]. Nuts fall at first hard frost. Transplanting should be easy because of the root system.
LANDSCAPE USE	Good for barriers, animal habitat. Rapidly produces natural-looking form. Nuts are edible. Dense plantings around aspen bluffs could inhibit the spread of aspen since hazel can shade out young aspen [23].
COMMENTS	Available at Lakeshore Tree Farms, Saskatoon.

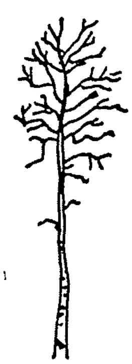


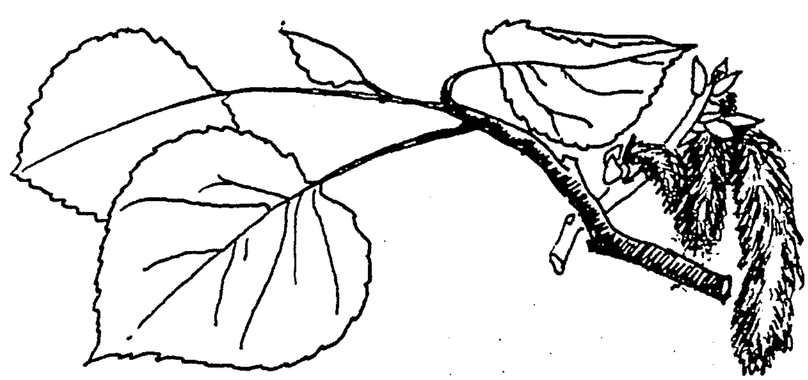


ASPEN

SCIENTIFIC NAME	Populus tremuloides Michx.
FAMILY	Salicaceae.
RANGE	Ubiquitous.
SOIL	Tolerant [18].
EXPOSURE	Full sun. Easily suppressed by shade of other trees [18]. Weak trunk and shallow roots make aspen a poor choice for exposed sites unless planted in groups.
HABITAT	Grows in pure stands, or in mixed stands with oak, balsam poplar, white spruce or birch.
APPEARANCE	A slender, graceful tree with a long cylindrical trunk and short, rounded crown. Grows to a maximum height of 15 m. with a maximum diameter of 40 cm. [19]. Spread is 6 - 7.5 m. [18]. The bark is dark gray to yellowish green, marked by dark bands below the limbs [18]. The south side of the trunk is covered with a white bloom [19]. Foliage is bright green in spring, darkening in summer, and yellow in autumn. Quivering of the leaves makes the tree appear delicate.
ROOT SYSTEM	Large vigorous roots are shallow and extensive. Lateral roots produce suckers.
FLOWERING DATE	April - May. Before leaves appear. Dioecious.
SEASON OF FOLIAGE	Mid-spring to mid-fall [18].
LIFE SPAN & GROWTH RATE	Short-lived. An individual tree rarely lives beyond 60 years [19] but clonal offspring may survive for thousands of years [21]. Grows very rapidly [22].
PROPAGATION	Easily propagated by hardwood cuttings [25]. Reproduces most often by suckering [21]. Copious seed is carried by wind and will germinate in moist, sunny sites. Seed viability is of short duration [24].
LANDSCAPE USE	Aspen is a gay, airy tree. It makes a good nurse tree and it survives where other trees will not.
COMMENTS	Good maintenance and the rapid growth of young trees can compensate for the aspen's susceptibility to fungal disease.

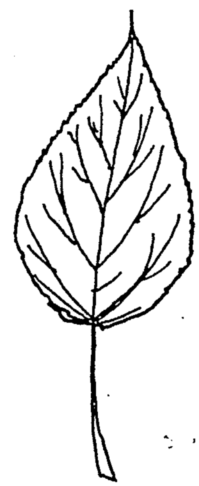


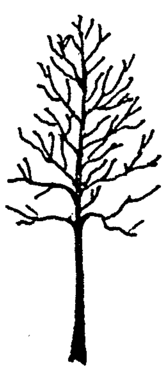




BALSAM POPLAR

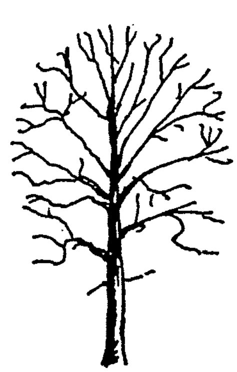
SCIENTIFIC NAME	Populus balsamifera L.
FAMILY	Salicaceae.
RANGE	Ubiquitous.
SOIL	Does best on rich, moist soil [3]. Tolerates wet soil [2].
EXPOSURE	Full sun [24]. Subject to wind damage.
HABITAT	Low woods and shores, wet ground [1]. Grows in pure stands or in mixed stands with aspen, speckled alder, willow, or paper birch. Often found growing with aspen in poorly drained soils. (Under mesic conditions it cannot compete with aspen [23].)
APPEARANCE	Balsam poplar has a long, straight, cylindrical trunk with a narrow open crown of ascending branches [3]. It grows to 18 - 24 m. in height with a maximum diameter of 60 cm. [3]. The foliage is glossy and dark green. The flower is maroon and exotic looking on close inspection. Bark is light colored and smooth on young trees [20], dark grey and furrowed later.
ROOT SYSTEM	Shallow [3].
FLOWERING DATE	April - May. Before leaves appear. Dioecious.
SEASON OF FOLIAGE	Mid-spring to mid-fall. Turns yellow in autumn.
LIFE SPAN & GROWTH RATE	Short-lived, grows very rapidly [20].
PROPAGATION	Easily propagated by hardwood cuttings [25].
LANDSCAPE USE	Can provide rapid growing shelterbelt where moisture is adequate [20]. A good nurse tree.
COMMENTS	Balsam poplar is subject to fewer insects and diseases than is aspen. The "Northwest Poplar" sold by nurseries is presumed to be a natural hybrid of balsam poplar and the cottonwood[20].

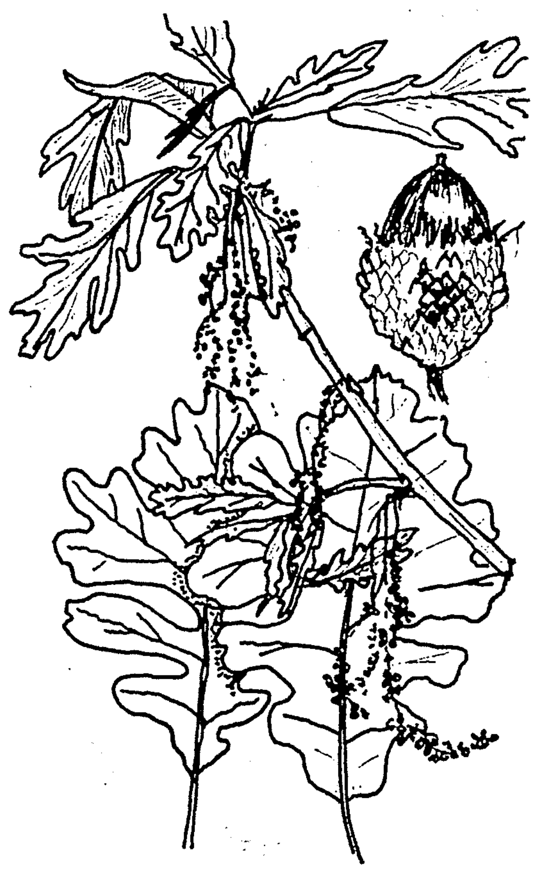




BUR OAK

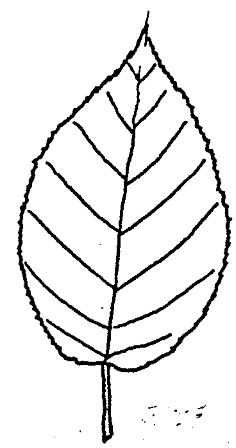
SCIENTIFIC NAME	Quercus macrocarpa Michx.
FAMILY	Fagaceae.
RANGE	Southeastern. Common up to the Manitoba escarpment, then found only along tributaries of the Assiniboine River.
SOIL	Tolerant. Well drained rich soils produce the best growth [3]. Tolerant of calcareous and poor soils. Drought resistant [14]. Intolerant of poor drainage.
EXPOSURE	Grows in the protection of south and west slopes of hills and valleys [19].
HABITAT	Sandhills, rock outcrops, cleared land [1]. River valleys [2]. Grows in pure stands or with aspen on dry sites, or with elm and maple along streams.
APPEARANCE	A massive clear trunk supports an open crown of stout branches. Grows to a maximum of 12 - 15 m. with a trunk diameter of 50 cm. [10]. The spread is usually equal to one half the height of the tree. Severe conditions produce the 'scrub oak' form. Leaves are dark and lustrous. Deeply furrowed bark is light to dark gray.
ROOT SYSTEM	Enormously efficient root system makes the tree wind firm and drought tolerant [14]. Roots mirror the above ground parts.
FLOWERING DATE	Inconspicuous flowers appear shortly after or with the leaves. May - June. Monoecious.
SEASON OF FOLIAGE	Leaves appear later than most species but stay until late fall, turning a golden brown color.
LIFE SPAN & GROWTH RATE	Oaks may live 500 years, but have shorter lives under stress. Growth rate is very slow [20], but faster under good conditions.
PROPAGATION	Fruit falls to the ground between August and November (and is often buried by animals). Seeds germinate either in fall or the following spring. Development of roots is rapid and extensive in seedlings[14]. Transplanting of sizable trees is difficult because of strong tap-root development [20].
LANDSCAPE USE	A stately tree when grown under good conditions. Rugged and picturesque. Attracts squirrels when mature. Handsome foliage creates dense shade.
COMMENTS	Oak seedlings are favorite browse for many animals and may need protection in plantings. Oaks are tolerant of automobile exhausts and have few insect pests.

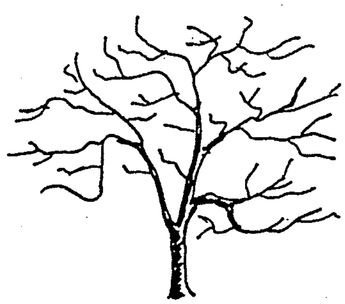


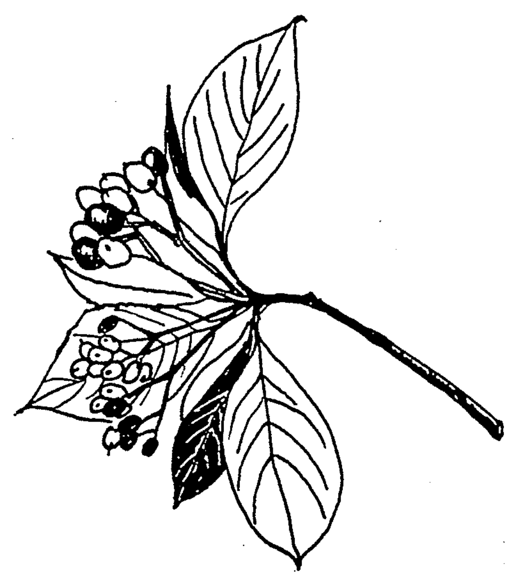


NANNYBERRY

SCIENTIFIC NAME	Viburnum lentago L.
FAMILY	Caprifoliaceae.
RANGE	Common in southeast.
SOIL	Very tolerant [18].
EXPOSURE	Shade to full sun [18].
HABITAT	Thickets and borders of woods [1]. Riverbanks and lakeshores in association with other woody species.
APPEARANCE	A shrub or small tree up to 9 m. in height [3]. More often a tall shrub with an open crown of slender arching branches. Has handsome shiny foliage. Large clusters (5 - 10 cm. wide) of creamy-white flowers produce blue-black ovoid fruit.
ROOT SYSTEM	Roots are fibrous - transplants well [18]. Suckers [18].
FLOWERING DATE	June. Monoecious.
SEASON OF FOLIAGE	One of the earliest shrubs to leaf out. Loses leaves in mid-fall. Bronze in spring, bright green in summer, purplish red in fall.
PROPAGATION	By seed: Sow in fall or stratify [30]. Also by greenwood cuttings and layering [30].
LANDSCAPE USE	Good as a specimen or for background and screening. Foliage, flowers and fruit are remarkably handsome.
COMMENTS	Tolerates pruning [18]. Can be pruned to a multiple stem tree [25].





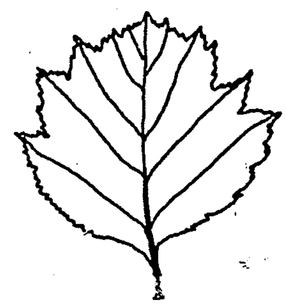


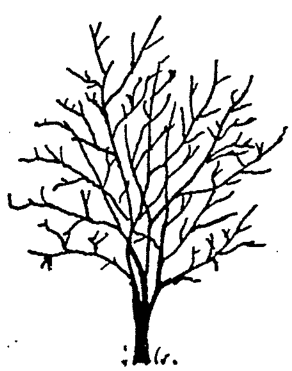
RED OSIER

SCIENTIFIC NAME	Cornus stolonifera Michx.
FAMILY	Cornaceae.
RANGE	Ubiquitous.
SOIL	Tolerant [18].
EXPOSURE	Shade to full sun. Grows leggy in shade and flowers less profusely.
HABITAT	Woods, thickets, sandhills, rock outcrops, shores and clearings [1]. Common along the Red River.
APPEARANCE	A loose, broad-spreading shrub 1 - 3 m. in height [6]. Bark is a dull red, brightest when young. Foliage is lush when light is adequate. Small white flowers are borne in clusters. Whitish globular fruit are conspicuous and handsome.
ROOT SYSTEM	Fibrous. Slow to re-establish when transplanted [18].
FLOWERING DATE	June.[2]. Sometimes continues to produce flowers through summer. Monoecious.
SEASON OF FOLIAGE	Early spring to mid-fall [18]. Foliage is bright green, truning red-bronze to purple in fall.
GROWTH RATE	Fairly slow.
PROPAGATION	Easily propagated by greenwood or hardwood cuttings. Rarely by seed [25]. Seedlings found in wild are easily transplanted.
LANDSCAPE USE	Masses of this plant create striking winter color. Birds like the fruit.
COMMENTS	Removal of old stems encourages new growth which is brighter in color.

ROUND-LEAVED HAWTHORN

SCIENTIFIC NAME	Crataegus chrysocarpa Ashe
FAMILY	Rosaceae.
RANGE	Ubiquitous.
SOIL	Well-drained soils. The genus is associated with calcareous soils [10].
EXPOSURE	Full sun. Hawthorns like exposed sites [30].
HABITAT	Thickets and clearings [1]. Stream banks [2].
APPEARANCE	A coarse but handsome round-topped shrub, usually 1.5 - 3 m. high [2]. The shiny dark leaves are almost round. White flowers are borne in clusters followed by showy reddish-orange fruits. Twigs bear numerous curved deep brown spines about 2.5 cm. long [24]. Bark is dark reddish-brown [24].
ROOT SYSTEM	Prominent tap root [25]. Suckers [10].
FLOWERING DATE	May to June. Flowers after leaves appear. Monoecious.
SEASON OF FOLIAGE	Mid-spring to early fall.
GROWTH RATE	Rapid [30].
PROPAGATION	Difficult to propagate by seed and difficult to transplant [25]. Transplanting young wild plants is probably best.
LANDSCAPE USE	Spines and bark are attractive in winter. Hawthorns create effective barriers, and provide food for wildlife.





WOOD'S ROSE

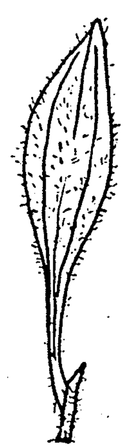
SCIENTIFIC NAME	Rosa woodsii Lindl.
FAMILY	Rosaceae.
RANGE	Common in southern parts.
SOIL	Tolerant.
EXPOSURE	Full sun [16].
HABITAT	Prairie, thickets, and clearings [1]. Ravines and sandhills [2].
APPEARANCE	A shrub growing .3 - 1.8 m. in height [2]. Stems bear prickles. 2 - 5 cm. flowers are pink and fragrant [2]. The fruit is globular, about 1 cm. across, red and persistant [2]. Foliage is dense under good growing conditions.
ROOT SYSTEM	Strong, woody rhizomes. Suckers. Rosa suffulta has roots to 6 m. [14].
FLOWERING DATE	June to July. Recurrent. Monoecious.
SEASON OF FOLIAGE	Foliage takes on dark red hues in fall and persists late.
LIFE SPAN & GROWTH RATE	Long-lived perennial, moderate.
PROPAGATION	By seed: sow or stratify seed in October when ripe. Most seeds germinate the second year[4]. By division: suckers are easily divided. Greenwood or hardwood cuttings can be rooted [4].
LANDSCAPE USE	Excellent for mass planting and informal hedges. Winter color of twigs and fruit are attractive. Provides forage for wildlife [17]. Wild roses are sometimes used for erosion control because of their deep roots.
COMMENTS	This is the tallest growing native rose [2].

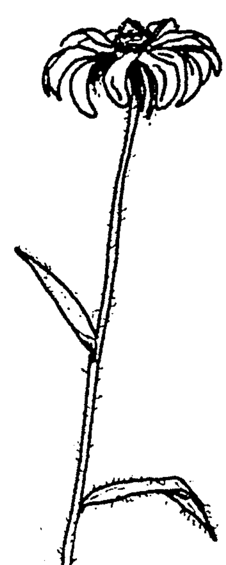
BIG BLUESTEM

SCIENTIFIC NAME	Andropogon gerardi Vitman
FAMILY	Gramineae.
RANGE	Common in moister eastern section.
SOIL	Tolerant, moisture-loving, but requires good drainage [28].
EXPOSURE	Part shade to full sun. Seedlings tolerant of shade, adult plant less so [28].
HABITAT	Dry or moist prairie, slopes and sandhills [1]. Well drained lowlands and lower slopes of hills. On moist soils may provide 80%- 90% cover[28]. On dry soils where it forms clumps it provides only 5%- 25% cover [28]. Associated with Andropogon scoparius in prairie. Associated species on riverbanks or wet meadows: Elymus canadensis, Panicum virgatum, and Sorghastrum nutans [14], the last two being found only in the southeast.
APPEARANCE	A tall, upright grass with solid reddish stems, growing to a height of 1 - 3 m. [6] by fall. Grows in large, leafy clumps. The inflorescence branches into three parts resembling a turkey's foot.
ROOT SYSTEM	Roots are 1.5 - 2 m. deep, persistent and profusely branched [14]. Rhizomes and tillers form a dense sod [28]. Roots dominate the soil.
FLOWERING DATE	August.
SEASON OF FOLIAGE	Warm-season grass. Growth begins in late spring [14], continues until frost. Mature plants have a reddish color in fall [26]. Winter color is very pale yellow.
LIFE SPAN & GROWTH RATE	Long lived perennial, rapid [14]. Grows over one foot in first two weeks of growing season [28].
PROPAGATION	By seed: Seed ripens in late August or September. Best if sown directly in field; requires cold stratification [4]. Will bloom first year if sown early [4].
LANDSCAPE USE	Big bluestem is a conspicuous, attractive grass under good growing conditions. Its rapid growth, dense, sod-forming habit and production of shade make it strongly competitive [14] and useful where weed control might be a problem. When seeding with other species, the proportion of big bluestem should be no more than 40% to avoid it taking over.
COMMENTS	Height varies with moisture availability [14]. Big bluestem is considered to be the most valuable native forage [29].

BLACK-EYED SUSAN

SCIENTIFIC NAME	Rudbeckia serotina Nutt.
FAMILY	Compositae.
RANGE	Ubiquitous. Not common in Alberta except as a weed [15].
SOIL	Tolerant. Prefers dry, poor acid soil [4].
EXPOSURE	Full sun. Tolerates wind.
HABITAT	Dry prairie, roadsides, clearings [1]. Disturbed areas.
APPEARANCE	A rather coarse plant 30 - 60 cm. in height [5]. Foliage is mostly basal and hairy. Showy flowers have orange-yellow petals and a prominent raised center of dark brown or deep purple. Black-eyed susans are often more attractive when grown in cultivation.
ROOT SYSTEM	Sometimes spread by rhizomes. Tolerant of compaction.
FLOWERING DATE	July - August.
LIFE SPAN & GROWTH RATE	Biennial or short-lived perennial [6]. Fairly rapid. Can behave like a perennial when flowers are continually removed [5].
PROPAGATION	By seed: Prolific seed is ripe in September or October. Germinates best when sown fresh. Stored seed requires no special care [4]. Self-sows freely [11]. May flower the first year [6].
LANDSCAPE USE	This plant has a merry fresh quality and is attractive to birds. Where prairie communities are being established this plant could be used to create a delightful early successional stage. Could also be useful in children's play areas because picking does not harm it.





CANADA GOLDENROD

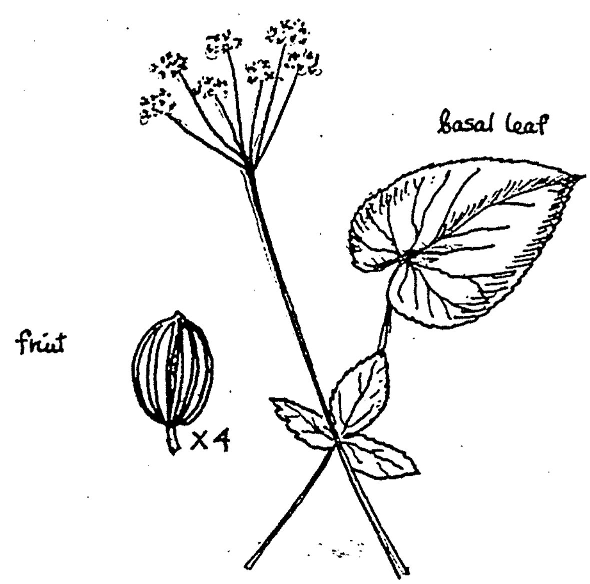
SCIENTIFIC NAME	*Solidago canadensis* L.
FAMILY	Compositae.
RANGE	Ubiquitous.
SOIL	Tolerant [10].
EXPOSURE	Light shade to full sun [16].
HABITAT	Thickets, rock outcrops, shores and clearings[1]. Open woods, roadsides, waste places. Grows in groups. Often grows with smooth aster and wild bergamot.
APPEARANCE	Grows up to 1.3 m. in height [6]. Upright plant with feathery yellow-gold inflorescences. Linear sessile leaves are progressively smaller toward the top of the plant. The stems and leaves look grayish-green because of covering of short hairs [12].
ROOT SYSTEM	Strong woody rhizomes run horizontally about 5 cm. below the soil surface. (These produce new shoots.) Fibrous roots descend from these, often growing to a depth of 3 m. Roots of this goldenrod tend to dominate the soil [14].
FLOWERING DATE	August - September [4].
SEASON OF FOLIAGE	Appears in late spring and remains attractive until freeze-up.
LIFE SPAN & GROWTH RATE	Perennial, rapid.
PROPAGATION	By seed: Ripe in September or October. Needs cold stratification to be stored [4]. Self sows freely. By division: Easily divided in fall or spring. Set rhizomes about 2.5 cm. deep. Divide clumps of rhizomes every third year for profuse bloom [5].
LANDSCAPE USE	Handsome tall plant for fall bloom. Conspicuous even at a distance when blooming.
COMMENTS	Goldenrods are not so responsible for hayfever as is commonly presumed [13]. A cultivar ('Golden Wings') is available commercially [16].

CANADA WILD RYE

SCIENTIFIC NAME	Elymus canadensis L.
FAMILY	Gramineae.
RANGE	Ubiquitous.
SOIL	Tolerant of most soils, but makes best growth on medium textured soils [29].
EXPOSURE	Shade to full sun. Can flower and set seed in shade.
HABITAT	Dry, sandy or rocky soil [1]. Along river banks and moist places [2]. Roadsides. Rarely forms pure stands. Associated with Panicum virgatum around slough zones, occupying a zone between slough grasses and big bluestem stands [14].
APPEARANCE	A coarse tall grass (1 m. tall or more [6]), with stout stems, spear-like leaf blades, and conspicuous cylindrical clusters of hairy seed heads that nod. Often grows in loose clumps[14].
ROOT SYSTEM	Tough wiry roots spread about 60 cm. from the base of the plant [14].
FLOWERING DATE	July - August [14].
SEASON OF FOLIAGE	Cool-season grass, begins growth in early spring. Turns pale beige in late summer.
LIFE SPAN & GROWTH RATE	Short-lived perennial, fast [29].
PROPAGATION	By seed: Seeds are ripe in late August or September and germinate in the fall. Germination rates are high. Seedlings are vigorous.
LANDSCAPE USE	This might be the ideal native cover crop. It is easy to establish and gradually disappears under competition from sod-forming grasses. Large nodding flower heads are decorative.
COMMENTS	The Northern Great Plains Field Station at Mandan, North Dakota has been experimenting with wild rye for forage crops [29], and may eventually provide seed.

HEART - LEAVED ALEXANDERS

SCIENTIFIC NAME	Zizea aptera (Gray) Fern.
FAMILY	Umbelliferae.
RANGE	Ubiquitous [2].
SOIL	Tolerant. More common on moist soils [2].
EXPOSURE	Light shade to full sun [4].
HABITAT	Open woods, moist to dry prairies [4].
APPEARANCE	Grows to a height of 30 - 60 cm. Basal leaves are simple, stem leaves are compound. Flowers are bright yellow in compound umbels. Leaves are smooth, yellow-green and shiny.
ROOT SYSTEM	Group of thickened roots [6].
FLOWERING DATE	May - June.
SEASON OF FOLIAGE	Appears early.
LIFE SPAN & GROWTH RATE	Perennial, moderate.
PROPAGATION	By seed: Plant when ripe in September. Seeds need long cold stratification. Bloom in two years [4]. By division: Roots can be divided in early spring [4].
LANDSCAPE USE	Unusual form and color contrast well with other prairie vegetation in spring.

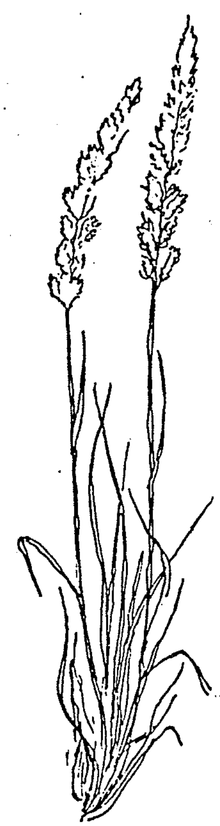


JERUSALEM ARTICHOKE

SCIENTIFIC NAME	Helianthus tuberosus L. var. subcanescens Gray
FAMILY	Compositae.
RANGE	Southeastern.
SOIL	Tolerant [7]. Found on moist soils where drainage is adequate [2].
EXPOSURE	Very light shade to full sun. Prefers sun[7].
HABITAT	Thickets and low ground [1], especially river flats. Disturbed ground [9]. Forms patches[9].
APPEARANCE	An upright, shrubby and coarse plant usually 1 m. tall [6], bearing large ovate leaves and yellow, daisy-like flowers. The stalk is hairy.
ROOT SYSTEM	Roots bear fleshy tubers which can be eaten raw or cooked [8].
FLOWERING DATE	July - September.
SEASON OF FOLIAGE	Appears mid-spring and remains attractive to freeze-up.
LIFE SPAN & GROWTH RATE	Perennial, rapid [7].
PROPAGATION	By seed: closely related species, H. maximiliani and H. giganteus, have seed which is viable only six to eight weeks after ripening [8]. Plant in moist soil in September. By division: Any part of the tuber will form a plant [7]; separate in fall.
LANDSCAPE USE	This big, vigorous plant can fill a difficult site rapidly. Birds are attracted by the seed [8].
COMMENTS	Jerusalem artichoke is aggressive in cultivated soil [7].

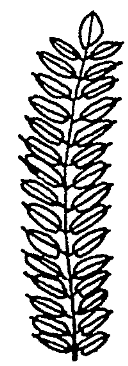
JUNE GRASS

SCIENTIFIC NAME	Koeleria cristata (L) Pers.
FAMILY	Gramineae.
RANGE	Ubiquitous. Most common in the south.
SOIL	Dry or sandy soils [4]. Tolerant of lime [26].
EXPOSURE	Very light shade to full sun.
HABITAT	Dry prairie and clearings [1]. Open woods. Usually does not form a large part of the cover (less than 10%) but occurs often [14]. Associated with Stipa spartea and Andropogon gerardi [14]. Occurs in many communities.
APPEARANCE	A fine grass, growing in dense tufts (less than 30 cm.wide) of slender stems and narrow blades. Foliage grows to a maximum height of 20 cm. and culms bearing spike-like inflorescences grow to a maximum of 38 cm. [27]. The inflorescence becomes looser with maturity [2]. Color of foliage varies from pale to conspicuously dark green.
ROOT SYSTEM	Roots are only about 70 cm. [14]. Lateral spread is 20 - 30 cm. [28].
FLOWERING DATE	June.
SEASON OF FOLIAGE	Cool season grass. After fruiting the plant goes dormant and resumes growth in autumn [14].
LIFE SPAN & GROWTH RATE	Short-lived perennial [14]. Grows fairly fast.
PROPAGATION	By seed. Abundant seed matures in late July and is shed in mid-August [27]. Broadcast in sandy soil [4].
LANDSCAPE USE	Good to combine with warm-season grasses such as Andropogon scoparius. Highly decorative.
COMMENTS	Cannot tolerate competition from weeds [4]. June grass is not drought tolerant [14].



LEADPLANT

SCIENTIFIC NAME	Amorpha canescens Pursh
FAMILY	Leguminosae.
RANGE	Occasional on dry prairie in the southeast. A. nana is more commonly found.
SOIL	Tolerant of poor soils. Drought resistant [25].
EXPOSURE	Partial shade to full sun. Typically found on exposed sites (uplands) but it can tolerate shade[14].
HABITAT	Dry or mesic prairie [4].
APPEARANCE	A sprawling shrub or half-shrub, densely hairy, 50-100 cm. tall[6]. Silver gray foliage is dense and fluffy-looking next to grass species. Blue-purple flowers are in spike-like racemes.
ROOT SYSTEM	Roots are deep and tough, reaching to depths of 1.5-5 m., and spreading out laterally up to 1.5 m. [14]. Nodules (nitrogen-fixing) form at 3-3.5 m. [14].
FLOWERING DATE	June to July. Flowers are fragrant. Monoecious.
SEASON OF FOLIAGE	Early spring to frost. By late June leadplant gives the prairie landscape a leaden tone where it is abundant [14]. In late summer stems may become partly defoliated, but the remaining leaves are green until frost comes [14].
LIFE SPAN & GROWTH RATE	Long-lived, moderate.
PROPAGATION	By seed: Slow to germinate and may damp off. Ripe in September. Seeds require inoculation [4]. By division: Suckers may be divided. Green wood cuttings grow readily under glass early in the season [4].
LANDSCAPE USE	Leadplant makes an excellent color contrast with prairie grasses. Can be useful as a low shrub in plantings. (It will grow to over 1 m. under cultivation [25]).
COMMENTS	Leadplant will tolerate an annual mowing, but not repeated mowings [14].



PUCCOON

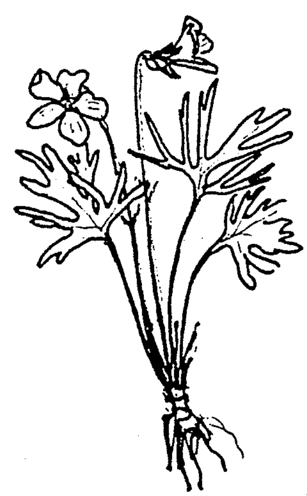
SCIENTIFIC NAME	Lithospermum canescens (Michx.) Lehm.
FAMILY	Boraginaceae.
RANGE	Eastern and central portions.
SOIL	Tolerant of poor, sandy soils but is also found in slightly acid fertile loam. Good drainage is very important [5].
EXPOSURE	Full sun [5].
HABITAT	Prairie, sandhills, rock outcrops and clearings [1]. Roadsides.
APPEARANCE	Grows 15 - 45 cm. in height [2]. A cluster of tubular golden flowers are held above erect gray-green foliage. Foliage is willow-like and downy. The fruit are shiny white nutlets.
ROOT SYSTEM	Grey-to-black coated rootstock is irregular, with few feeder roots. New roots are usually lighter, becoming black in about 3 years [5].
FLOWERING DATE	May - June.
SEASON OF FOLIAGE	Appears very early.
LIFE SPAN & GROWTH RATE	Perennial, fairly slow.
PROPAGATION	By seed: Plant seeds when fresh in July, if possible. Many seedlings will die. Seeds require scarification [4]. By division: Root cuttings are used because division and transplanting are difficult. Cut roots (5 mm. diameter) into 5 cm. long pieces. Plant pieces in sand or sandy loam about 2.5 cm. deep, keeping the roots right side up. Cuttings root in one year and bloom the second or third year [4].
LANDSCAPE USE	Makes a brilliant splash of color. Highly ornamental for rock gardens and close viewing.

PURPLE PRAIRIE CLOVER

SCIENTIFIC NAME	Petalostemum purpureum (Vent.) Rydb.
FAMILY	Leguminosae.
RANGE	Common in southwest [2]. Occasionally in southern Manitoba.
SOIL	Well drained black soils [4].
EXPOSURE	Shade to full sun.
HABITAT	Dry to mesic prairie, hillsides. Grows with short species [4].
APPEARANCE	Grows 30 - 90 cm. in height [4]. Usually has several sturdy stems with relatively fine compound leaves. Roseate to purplish flowers are on dense, cylindric spikes. Stems may be stained red.
ROOT SYSTEM	Has a deep tap root to 1.8 m. [14]. Roots are orange-brown in color [14].
FLOWERING DATE	July.
LIFE SPAN & GROWTH RATE	Long-lived perennial, moderate.
PROPAGATION	By seed: Seed is ripe in late August. Seed should be inoculated [4]. By division: Division is difficult [4], not recommended.
LANDSCAPE USE	Beautiful in masses and beautiful individually. Intense magenta color of flowers and conspicuous orange stamens are lovely at close range.
COMMENTS	This plant decreases under grazing [14], or mowing. The foliage is fragrant when bruised, and Indians formerly made tea of the leaves [12].

PURPLE PRAIRIE VIOLET

SCIENTIFIC NAME	Viola pedatifida G. Don.
FAMILY	Violaceae.
RANGE	Ubiquitous but not common.
SOIL	Tolerant. Prefers well-drained humus soil, slightly acid or neutral [4].
EXPOSURE	Full sun.
HABITAT	Dry or moist prairie [1]. Exposed banks [2].
APPEARANCE	A plant 7 - 15 cm. in height [4], with deeply divided basal leaves. Purple-blue flowers are showy.
ROOT SYSTEM	Short, vertical rhizome [6].
FLOWERING DATE	May - June [12].
SEASON OF FOLIAGE	Appears early in spring and remains green when moisture allows.
LIFE SPAN & GROWTH RATE	Perennial, short-lived in cultivation [4]. Fairly rapid.
PROPAGATION	By seed: Plant seed in July while fresh [4]. Seed is easily lost when pods open. Cleistogamic flowers produce abundant seed after regular bloom. This seed is easier to collect. Stored seed requires cold stratification. By division: Easily divided when dormant [4].
LANDSCAPE USE	Delightful in form and color. Best appreciated at close range.
COMMENTS	Several violets, including this one, hybridize freely with closely related species [12].



PURPLE VETCHLING

SCIENTIFIC NAME	Lathyrus venosus Muhl. var. Intonsus Butt. & St. John
FAMILY	Leguminosae.
RANGE	Ubiquitous.
SOIL	Tolerant.
EXPOSURE	Shade to full sun.
HABITAT	Wet meadow to dry prairie and open woods [4]. Common in bushy or wooded areas [2].
APPEARANCE	A stout climbing plant up to 1 m. long [6]. Flowers are purple and pealike, in a dense raceme. Dull, light green leaves have eight to twelve leaflets, 3 - 6 cm. long [2].
ROOT SYSTEM	Roots are long and fleshy [30].
FLOWERING DATE	June - July [6].
SEASON OF FOLIAGE	Looks best in spring and summer.
LIFE SPAN & GROWTH RATE	Perennial, moderate.
PROPAGATION	By seed: plant when ripe in September. Seed must be inoculated [4]. By division: divide in spring or fall, while dormant [4].
LANDSCAPE USE	Plant is not showy but is tolerant and provides the benefit of nitrogen fixation in the soil. It is excellent forage [2].

SIDE-OATS GRAMA

SCIENTIFIC NAME	<u>Bouteloua</u> <u>curtipendula</u> (Michx) Torr.
FAMILY	Gramineae.
RANGE	Not common; occurs in south central prairies. (<u>B. gracilis</u> is plentiful.)
SOIL	Tolerant. Found on a wide range of soils [29], usually well drained.
EXPOSURE	Shade to full sun [14].
HABITAT	Dry prairie, slopes, sandhills[1]. Appears in a wide variety of communities at low cover values, rarely in pure stands of a few square metres[14].
APPEARANCE	A medium height grass (.3 - 1 m. [6]) growing in small to large tufts or a very open sod [14]. "Small oat-like seeds line one side of the stem. The leaf blades have hairs and bumps along their edges and the lower leaves curl and turn white when dry" [26].
ROOT SYSTEM	Short scaly rhizomes and great mats of rather fine roots [14]. Roots are especially dense in the first 50 cm. of soil but may extend to a depth of 1.2 m. [14].
FLOWERING DATE	July - August.
SEASON OF FOLIAGE	Warm-season grass. Growth begins in mid spring [14]. Little fall color [4].
LIFE SPAN & GROWTH RATE	Perennial, fairly rapid.
PROPAGATION	By seed. Harvest prolific seed in September. Seed benefits from stratification [4]. Seedlings are vigorous and resistant to drought [29].
LANDSCAPE USE	Side-oats grama is highly ornamental in form. The flowers are colorful but require close viewing.
COMMENTS	Drought tolerant [14].

SMOOTH ASTER

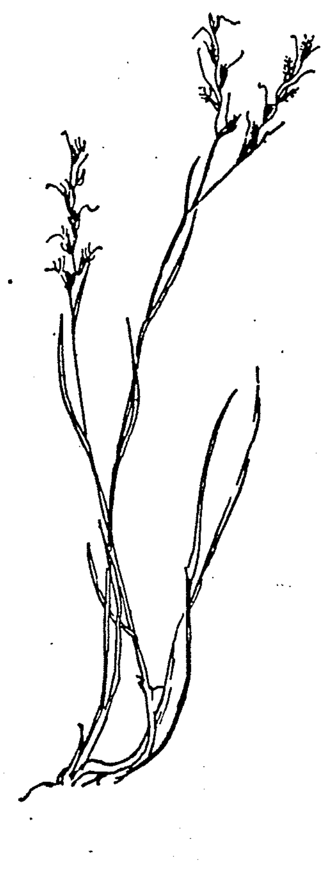
SCIENTIFIC NAME	_Aster laevis_ L.
FAMILY	Compositae.
RANGE	Ubiquitous.
SOIL	Tolerant. Moist, fertile soil yields more abundant bloom [5].
EXPOSURE	Partial shade to full sun. Requires air circulation to prevent mildew attack [5].
HABITAT	Thickets, prairie and sandhills [1]. Open places [15]. Roadsides. Volunteers in gardens.
APPEARANCE	Variable. It usually has a loose form with stout stems and toothless blue-green clasping leaves. Flower heads have violet-blue rays and tawny yellow centers. Height is up to 1 m. [6].
ROOT SYSTEM	Compact rootstock with fibrous roots and many pinkish rhizomes [5].
FLOWERING DATE	September.
SEASON OF FOLIAGE	Looks well until freeze-up.
LIFE SPAN & GROWTH RATE	Perennial, grows rapidly without competition [5].
PROPAGATION	By seed: Sows itself abundantly. Ripe in October and requires no special care for storage [4]. Blooms late the first year [4]. By division: Divide while dormant in spring. Set rhizomes horizontally 2.5 cm. deep [5].
LANDSCAPE USE	Blue flowers are handsome with late goldenrods. Best used in masses for viewing at a distance. Would work well in overgrazed pasture [5].
COMMENTS	Smooth aster will not flourish where there is strong competition from other species [5]. It could be used as a showy early successional plant in restorations.

WILD BERGAMOT

SCIENTIFIC NAME	Monarda fistulosa L.
FAMILY	Labiatae.
RANGE	Common in eastern parts. Gives way to Monarda fistulosa var. menthaefolia in the west.
SOIL	Very tolerant [5], except of poor drainage [16].
EXPOSURE	Very light shade to full sun. Requires air circulation to prevent mildew in moist sites [5].
HABITAT	Thickets, prairie and clearings [1]. Often seen in 'drifts' in prairie.
APPEARANCE	A square-stemmed, erect plant, 60 - 90 cm. in height [2], with opposite, lance-shaped leaves. Inflorescence is a terminal whorl of lavender-pink flowers.
ROOT SYSTEM	Mat of fibrous roots and rhizomes form a large clump [5].
FLOWERING DATE	July - August.
SEASON OF FOLIAGE	Dries up in late summer.
LIFE SPAN & GROWTH RATE	Perennial, fairly rapid.
PROPAGATION	By seed: Easy, seeds need no treatment. Collect in August or September. Blooms the second year [4]. By division: Divide plants in spring [4], or take cuttings in summer and root in a moist medium [11].
LANDSCAPE USE	An aromatic plant with conspicuous flowers. Looks best scattered among other species. Hybrid forms are available commercially.

WIREGRASS, LITTLE BLUESTEM

SCIENTIFIC NAME	Andropogon scoparius Michx.
FAMILY	Gramineae.
RANGE	Throughout most of the area.
SOIL	Tolerant [29], excepting heavy clays and poor drainage.
EXPOSURE	Sun. Some shade stops flowering, total shade kills the plant [28].
HABITAT	Dry prairie and sandhills [1]. Uplands and slopes, or well-drained lowlands [14]. May provide foliage cover of 80 - 100%[14]. Associated with Psoralea argophylla, Amorpha canescens or other short grasses and forbs, and with Andropogon gerardi.
APPEARANCE	An erect grass of medium height with short broad leaves growing in tufts [2]. Sheaths are purplish. Feathery flowers with white hairs contrast with foliage. Grows to a height of 30 - 107 cm. [14]. Forms an open sod in moist areas [14]. Rather fine in texture.
ROOT SYSTEM	Very fine roots are densely branched in the first 60 cm. of soil, and reach down to 1.5 m. [14]. Has short inconspicuous rhizomes [14].
FLOWERING DATE	August.
SEASON OF FOLIAGE	Warm-season grass. Growth begins in late spring [14]. Fall colors may be shades of yellows, reds or bronze [14].
LIFE SPAN & GROWTH RATE	Long-lived perennial [14]. Moderately fast without competition [4].
PROPAGATION	By seed: Seed ripens in September. Needs cold stratification. Germination rate is low [14]. Seedlings are vigorous, drought tolerant.
LANDSCAPE USE	An excellent colorful plant for roadsides. Delicate in flower.
COMMENTS	Good seed crops occur on native stands only once every five to ten years. These can be harvested with a combine [29]. Little bluestem is not drought tolerant [14].



WOOD LILY

SCIENTIFIC NAME	Lilium philadelphicum L.
FAMILY	Liliaceae.
RANGE	Throughout Aspen Parkland but species is replaced by L. philadelphicum var. andinum in the west [2].
SOIL	Prefers acid to moderately acid sandy loam[5]. Good drainage important [16].
EXPOSURE	Very light shade to full sun [5].
HABITAT	Edges and open woods. Sometimes grows in colonies in grassy openings [5]. Roadsides.
APPEARANCE	Grows to a maximum height of 60 cm. with erect stalks bearing shiny, whorled leaves and one to three terminal flowers [2]. Large, brilliant red-orange flowers face upward.
ROOT SYSTEM	Small scaly white bulb with lower fibrous feeder roots [5]. Bulbs are edible [14].
FLOWERING DATE	June - July [5].
SEASON OF FOLIAGE	Appears early in spring and becomes dormant in August.
LIFE SPAN & GROWTH RATE	Perennial, fairly slow [4].
PROPAGATION	By seed: Plant 7 - 10 cm. deep when ripe in September. Produces a single leaf the first year. Blooms in four to five years [5]. Can be stored without special treatment. By division: Set small scaly bulbs 10 - 13 cm. deep in soil [4] in September or October.
LANDSCAPE USE	Makes showy border against woody species. Does well with grasses[5].
COMMENTS	Plants are becoming rare, especially close to urban centers. Propagate by seed or order bulbs from a nursery (C.A. Cruickshank Ltd. of Toronto).

APPENDIX C - ANNOTATED BIBLIOGRAPHY

FLORAS and PLANT IDENTIFICATION

Bailey, L. H. [1935] The Standard Cyclopedia of Horticulture, 2nd ed. MacMillan Co., New York, 3 vol.
Although all native species are not included in this text, there is useful information on related plants. I especially like the summaries on plant families. Botanical description and "horticultural capability" is given for each species included. 4000 engravings, keys to the Families and Genera.

Budd, A. C. and K. F. Best [1969] Wild Plants of the Canadian Prairies, Res. Branch, Can. Dept. Agric., publ. no. 983, Ottawa, 519 pp.
The most useful reference for Aspen Parkland species. Botanical and physical description of each plant, including habitat, keys to groups, glossary, etc. Illustrations are useful.

Courtenay, B. and J. H. Zimmerman [1972] Wildflowers and Weeds. Van Nostrand Reinhold Co., Toronto, 144 pp.
An excellent field book for the layman. Full color photographs. Includes size, flowering dates, habitat, growth habits, geographical range - North central United States and nearby Canada (all Great Lakes borders).

Frankton, Clarence and Gerald Mulligan [1970] Weeds of Canada. Can. Dept. Agric., publ. no. 948, Ottawa, 217 pp.
Despite a rather limited view of weeds expressed in the introduction, this book contains all the needed information for 230 species, common and scientific name, annual or perennial, habit, size, seed description, flowers, flowering dates, origin, habitat, similar species, distribution in Canada. Excellent drawings for 154 species.

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A very important and thorough Flora. Illustrations are excellent.

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The definitive encyclopedia of grass in the United States. 1398 species, 1199 drawings. Each species is given thorough botanical description, height, proper planting season, and range of distribution. Common uses and common names are also listed.

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PRAIRIE : books

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For pleasure; a personal, educated account of the prairie landscape. Photographs by the author are good. Appendix tells where to see remaining prairie landscapes in the U.S.

Weaver, J. E. [1954] North American Prairie. Johnson Publishing Co., Lincoln, Nebraska, 348 pp.
An indispensable resource for prairie study. Discusses individual species at length and the major prairies communities.

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Data brought to bear on processes operating in the vegetation of grasslands - competition, responses to drought, to over-grazing, root development, morphology, etc. Excellent line drawings and photographs throughout.

PRAIRIE : scientific papers

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Author used new methods to record information of five mixed prairie communities and the *Festuca scabrella* association.

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Contents: Ecology of weeds; Systems concept of weed management; Preventive weed control; Weed control by physical methods; Biological control of weeds; Habitat management for weed control; Chemical control of weeds; Classification and chemistry for herbicides; Interaction of herbicides with the environment; Safety factors in herbicide use; Herbicide selectivity; Herbicide formulations and application; Weed control in field and horticultural crops; Brush and weed control on range and pastures; Weed control in turf; Weed control in right-of-way and industrial land; Weed control in forests and woodlands; Weeds of aquatic environments; Weeds injurious to the health of man and animals; The future of weed control; Common and chemical names of herbicides; Standardized names of weeds.

Oosting, Henry J. [1956] The Study of Plant Communities, 2nd ed., W. H. Freeman and Co., San Francisco, 440 pp.

"An introduction to ecology using plant communities as a basis and the vegetation of North America as a primary source of illustrative material."

Has a very clear textbook layout. Good for reference. For ease of reading I prefer Daubenmire, but this is more concise and encyclopaedic.

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Studies in urban wildlife, management of same and peoples' reactions to it. Some interesting and useful data. Not a comprehensive work.

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ERRATA

Missing in Appendix A:

Asclepias syriaca L., common milkweed

Betula pendula Roth. var. *gracilis* Rehd., weeping birch [Hoag, 1965]

Cirsium arvense (L.) Scop., Canada thistle

Picea pungens Engelm., Colorado spruce [Hoag, 1965]

Taraxacum officinale Weber, common dandelion

Trifolium repens L., white clover

Typha latifolia L., common cat-tail

Ulmus pumila L., Siberian elm [Hoag, 1965]

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