RESTORING CANADA'S NATIVE PRAIRIES

A PRACTICAL MANUAL

By John P. Morgan
Douglas R. Collicutt
Jacqueline D. Thompson

Front cover: Stages in a tall grass prairie restoration at Ste. Agathe, Manitoba from 1990 to 1994.
Back cover: Native prairie restoration at the Royal Saskatchewan Museum, Regina. BACK COVER PHOTOS: K. BARR

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Monarch on meadow blazingstar.

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This manual had its beginnings in World Wildlife Fund Canada's Prairie Conservation Action Plan and the Tall Grass Prairie Restoration Project – a four year research project on various means of bringing back Canada's most endangered prairie type.

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FOREWORD

Restoration is a powerful word. Taken in the context of rebuilding shattered landscapes, ecological restoration engages the best and noblest talents of the human animal. The idea of restoring a prairie is an activity that is both outrageously arrogant and infinitely humble, and can be undertaken for a variety of reasons, scientific, emotional, spiritual, personal.

We are beginning to recognize the profound importance to our culture of ecological preservation and restoration. Manitoba folksinger Loreena McKennitt sings eloquently about the importance of the trees to the survival of the ancient castle Portmore in Ireland:

> "O Bonny Portmore I am sorry to see
> Such a woeful destruction of your ornament tree
> For it stood on your shore for many's the long day
> Till the long boats from Antrim came to float it away.
>
> All the birds in the forest they bitterly weep
> saying "where will we shelter or where will we sleep?"
> For the Oak and the Ash they are all cutten down
> And the walks of Bonny Portmore are all down to the ground."

In this traditional folk song, the loss of a culture followed the wanton loss of the oak and the ash. The society that learns to care for the nature that surrounds it has gained a valuable piece of wisdom.

I believe this small book is the first available primer for ecological restoration in Canada, and my hat goes off to the authors for writing it. As practicing restorationists, they are committed to the basics, the fundamental techniques of their chosen craft. They know that beyond all the rhetoric of the new environmental consciousness lie the difficult realities of seed viability, nurse crops, weed competition and harvesting techniques. They know that great voyages start with ships, and shoes, and sealing wax.

– Don Gayton
author of The Wheatgrass Mechanism

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Canadian Native Prairie Restoration Zones Covered in this Book

Chapter 1

THE REASONS FOR PRAIRIE RESTORATION

Tall grass prairie at Oak Hammock, MB.

This manual is intended for use by anyone wishing to restore an authentic native prairie community on a site which no longer supports one. It provides a framework for ecological restoration of prairie over a wide geographic area and a variety of sizes from a backyard to many hectares. This is not a "cook-book" with ready-to-use recipes. Rather, it is a set of guidelines to help individuals or groups embark upon their own successful prairie restoration project.

The manual is intended for the prairie regions of Canada, from British Columbia's inter-mountain grasslands, through the rough fescue and mixed grass prairies of Alberta, Saskatchewan, and southwestern Manitoba, to the tall grass prairies of southeastern Manitoba and southern Ontario. Its aim is to promote restoration of native prairie plant communities in Canada, stressing conservation of local plant populations.

Ecological restoration is neither the cheapest nor the quickest means of revegetating an area. It is, however, the only means that ensures ecological authenticity. It also makes a genuine contribution to the preservation of biological diversity, thus providing good insurance for the future. Restoring a native prairie is a challenging task with a wide array of benefits to the restorer and the land. It is rooted in the past and hopeful for the future.

WHAT IS ECOLOGICAL RESTORATION?

Ecological restoration: "is the process of re-establishing the structure, function, and integrity of native ecosystems and their habitats" (Society for Ecological Restoration 1993). In short, it is an attempt to put things back to the

way they were; to re-establish on a site a native plant and animal community that once occurred there and is uniquely adapted to that area.

Prairie restoration is NOT a substitute for conserving existing native prairie areas. We are now just beginning to understand the complex process of restoration, and how to heal damaged native prairies. This is no reason, however, to be less vigilant in protecting original prairie ecosystems. These areas are the benchmarks from which any restoration starts. In our lifetime at least, even the best restored prairie will pale in comparison to the real thing that took centuries to evolve.

Some say that prairies cannot really be restored, that we already have lost too much to go back now. We have to start somewhere, while there are still intact native prairies from which to draw inspiration and seed. While it is true that no one can recreate a 10,000 year old ecosystem in just 10 years, in 10 years you can have a 10 year old prairie!

WHAT IS A NATIVE SPECIES?

Native species are those that occurred naturally in an area at the time of settlement and were not brought in from other areas of the country or other continents. Some grassland species are so common in Canada now that many people mistakenly consider them natives: smooth brome grass, crested wheatgrass, Kentucky bluegrass, quack grass, Canada thistle, dandelion, and wild oats are all Eurasian imports that have no place in a restored prairie.

An authentic prairie restoration involves the planting of a diverse mix of species native to that particular area, with the seed collected as close as possible to the planting site. Grasses are an important component of the mix, but equally important are various native legumes and other broadleaved forbs often known as wildflowers. Some prairies have mosses, lichens and shrubs as major parts of their original flora. Restoration with locally collected seed stocks is crucial to maintaining what is left of the biological diversity of Canada's prairies.

Commercial cultivars of native species often originally were taken from a limited number of wild stock ancestors in one area. They then were selected for genetic uniformity and ease of germination, released as a named cultivar such as "Revenue" slender wheatgrass. Cultivars are not appropriate for ecological restorations. Their simplified genetic makeup does not reflect or conserve the diversity of real wild species, as most were selectively bred for quick establishment, ease of handling, and increased forage value. Cultivars, because of their price and availability often are planted hundreds or thousands of kilometres from their point of origin, and have no local adaptations. Planting cultivars for prairie restoration reduces biological diversity. Genetic origin of the species being planted in a restoration is important.

Akin to cultivars are the many so called "wildflower" mixes available from many stores and seed companies. They often are accompanied with colourful advertising promising an "instant" meadow that will reduce maintenance and attract butterflies. The origins of nearly all these seeds are outside of Canada from large commercial seed farms in the United States and Europe. They may be wildflowers somewhere, but they are not native to the Canadian prairies. California poppies, bachelor buttons, and birdsfoot trefoil have no place in a Canadian prairie restoration. Ask your supplier questions about the origin of their seeds. If they do not know or the seeds have not been collected in your region, look elsewhere.

Recent advances in developing "ecovars" of native species show promise for supplying some restoration seed stocks. These plants have a broad genetic base, are not artificially selected for certain characteristics, and maintain a high level of diversity. Several native grasses and wildflowers currently are under ecovar development in western Canada for public release in the next few years. Only a limited number of species will be available as ecovars, however, so prairie restorationists will still need to augment any ecovar plantings with locally collected native seed.

WHY IS ECOLOGICAL RESTORATION IMPORTANT FOR THE PRAIRIES?

Because there is so little of our original prairie left! The native grassland communities, once the signature of the Canadian prairies, are now endangered ecosystems. Canada's tall grass prairie essentially is gone - less than one percent of its original area remains intact today in southern Manitoba and Ontario. Barely 5% of the northern rough fescue prairie remains. The mixed grass prairie, aspen parkland and inter-mountain grasslands have suffered a loss of 50 to 80% of their original areas in the past hundred years.

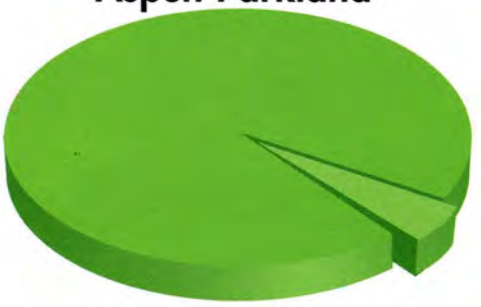
Keeping alive prairie plants by providing a place for them to grow is an important contribution to ensuring these scattered prairie remnant's genetic stocks never become extinct. New medicines or food crops could well be waiting to be discovered in these plants. If they all are lost, however, we will never know what benefits may come from this rich, ancient prairie heritage. Consider where we would be today if some careless past society had wiped out the wild ancestors of domestic wheat, corn or rice.

PRESENT STATE OF CANADA'S NATIVE PRAIRIES

Tall Grass Prairie

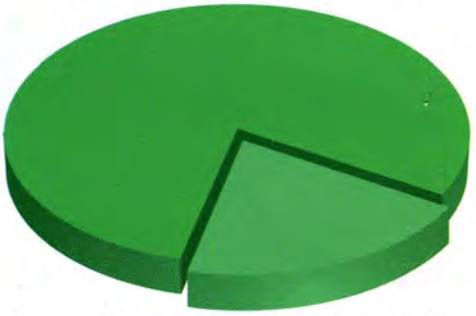
Less than 1% Remains

Fescue Prairie/
Aspen Parkland



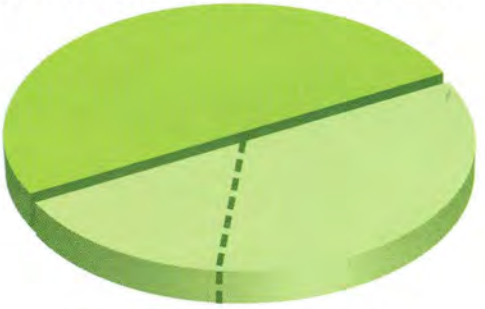
Less than 5% Remains

Mixed Grass Prairie



Less than 20% Remains

Intermountain Grasslands



30 – 50% Remains

PHOTO: D. GYLYWOYCHUCK

Sharp-tailed grouse dance, nest and feed on native prairies.

Orb spider on a tall grass prairie.

White Admiral – a butterfly of aspen parkland prairies.

Another reason to restore native prairies is their attractiveness to wildlife. Many rare and endangered species depend upon native prairies. Restored prairie provides additional habitat for threatened species such as loggerhead shrikes, long tailed weasels, burrowing owls, and prairie falcons as well as numerous butterflies and other insects, songbirds, shorebirds, waterfowl and mammals.

Native species have the advantage of thousands of years of adaptation to Canadian conditions – soil, water, climate, and light levels. By a process known as natural selection, they have evolved a variety of mechanisms to cope with everything that nature can throw at them. Drought, extremes of heat and cold, short growing seasons, early and late frosts have little effect on native species because they have evolved with them.

Most plant species presently used in Canada for landscaping and wildlife habitat are horticultural and agricultural varieties native to Europe and Asia. Few have any natural adaptations to Canadian conditions. Many of them require intensive maintenance and constant replanting to survive.

In contrast our native species often require extreme environmental conditions that would kill other non-native plants. They literally thrive where others cannot. Native species, once established, seem to thrive on neglect. This makes them ideal for wildlife habitat, low maintenance landscaping, restoration of disturbed natural areas and for tough, hardy and nutritious hay and pasture crops.

For landscape architects, commercial and government agencies, native species offer a practical alternative to conventional, high maintenance landscaping of public places, industrial areas, parks and road rights-of-way. In today's era of declining budgets, native plantings are easier to justify to cost conscious clients and taxpayers. They also contribute to the image of environmental awareness and sensitivity that today's "green" marketplace and society demand.

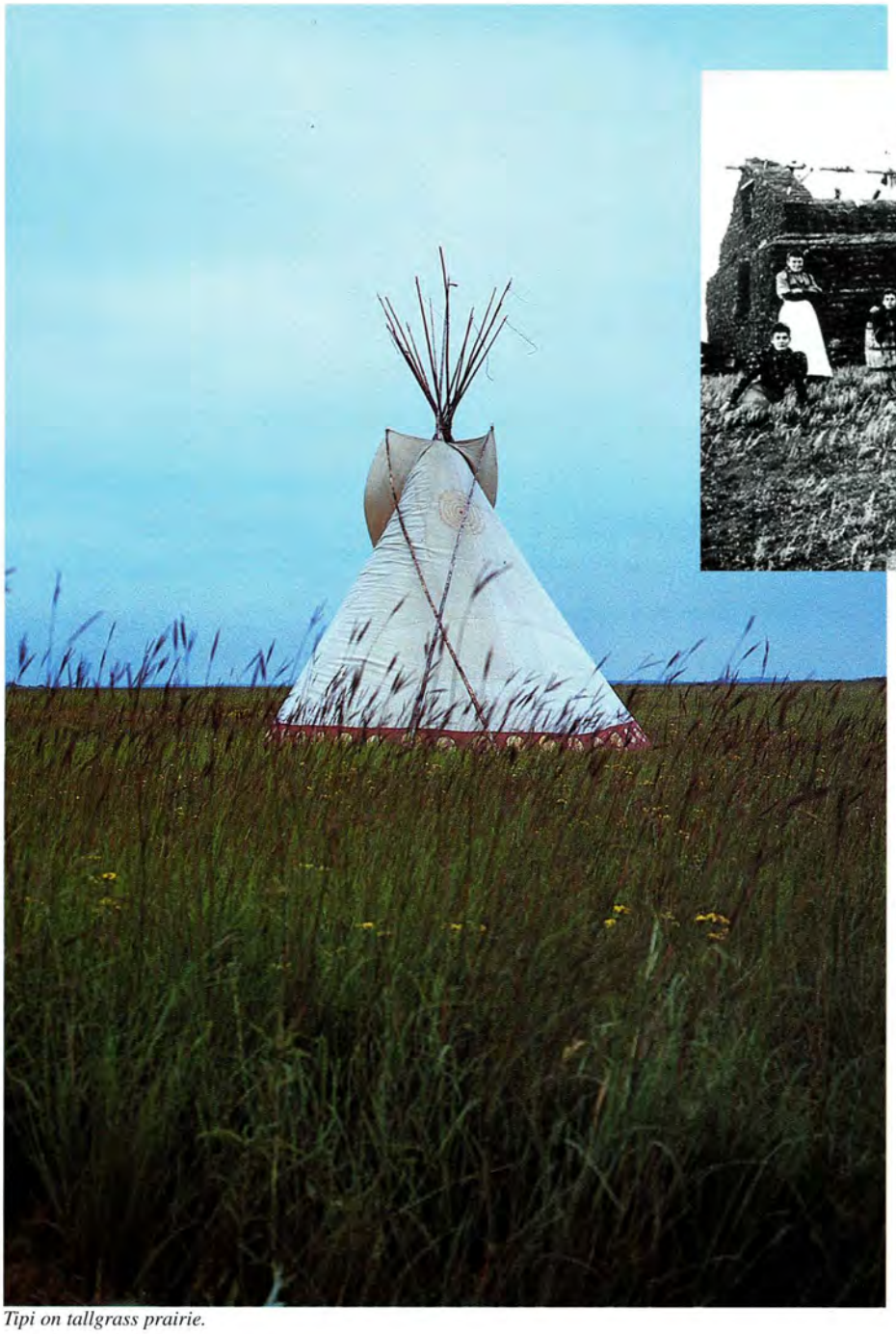
Aesthetically, native prairie wildflowers and grasses provide at least as much colour and attractiveness as conventional landscapes. Beginning in early spring, and lasting through September frosts into winter, native prairie species provide an ever changing venue of shape and colour. From the furry mauve prairie crocus poking through April snowdrifts, through the jade green lushness of mid-June grasses to the radiant blazing stars of summer, from the graceful fall splash of bright goldenrods and purple asters, to the subtle golden tans of the winter prairie, native plants provide a natural show of unequalled beauty upon the landscape.

Planting prairie also has significant positive economic advantages. Costs per acre for planting prairie are very competitive with traditional methods. Long term maintenance costs for prairie plantings are virtually nil. All that is required is an occasional mowing once every few years or a managed burn if feasible. Watering, mowing, and fertilizer applications are not required.

Native prairie plants, with their deep root systems and perennial nature, also are ideal for soil conservation plantings. Native species are tolerant of and adapted to a wide variety of soil types. There are native prairie species for dry, wet, saline, heavy, and light soils. Native species formed and conserved rich prairie soils over millenia. They now are being looked at to play an important role here again.

Pronghorns are characteristic of the mixed grass prairie.

There also is the undeniable excitement in growing something that gives us a sense of both our natural and cultural history. These species were important in the ecology of the diverse grasslands that once covered much of southern Canada. They nourished bison in uncounted numbers and waved in the sunshine of ten thousand summers. They provided sustenance for native peoples, and figured prominently in their medicine and spiritual beliefs. Early settlers depended upon them for food and raw materials. Growing native prairie plants not only helps us establish roots in the soil, but also roots with our past.



Tipi on tallgrass prairie.

PHOTO: MANITOBA ARCHIVES

Sod house.

Chapter 2

RESTORATION PLANNING REQUIREMENTS

An Example Restoration Timeline

YEAR 1
Site Selection and Analysis
Consultation with Experts
Inspection of Local Native Prairies
Site Design
Site Preparation
Species Selection
Equipment and Expertise Acquisition
Seed Harvesting/Acquisition
Seed Processing/Storage

YEAR 2
Plant Propagation
Seeding
Sampling to Determine Success
Weed Control
Continued Seed Acquisition/Harvest

YEAR 3-6
Weed Control
Burning
Reseeding/Supplemental Seeding

YEAR 7+
Long Term Management/Monitoring
Species Enhancement
Burning Regime
Weed Control

A successful prairie restoration project depends on proper planning. It is a long term commitment of time and resources. From the point in time when seeds are sown it will likely be 5 years before a site approaches its intended appearance in the tall grass prairie region, 10 or more years in the drier mixed grass prairie. The various tasks you must perform in the course of your restoration project are presented below.

SITE SELECTION AND ANALYSIS

You may have the option of choosing your restoration site from a range of possible locations, in which case you can choose the best site to suit the type of prairie you had in mind. In most cases, however, you are presented with a site you wish to use and must suit your intended prairie community to that site. Geographic location, altitude, topography, drainage, soils and other factors will combine to dictate which plant community is best suited to a site. A south facing slope with sandy soils will support a far different community than one which is flat and wet with clay soils. A southeastern Manitoba tall grass prairie has few species in common with a dry mixed grass prairie near Calgary. You cannot impose a plant community on to a site for which it is not adapted.

Whether you are free to choose a site or not consider the following:

Past Use

Land use history can have a direct bearing on your project. Find out as much as you can before starting. If in an industrial area, had the site been used as a disposal area for fuel, chemicals or toxic materials? If in a rural district, was it part of a manure pile or feedlot? These situations can create chemical changes in the soil injurious to native plants. What herbicides had been used in the previous few years? Some, such as trifluralin and corn herbi-

cides, have residues that can prevent prairie seed from germinating for several years after application. Has the area a history of phenomena that may adversely affect the seeding, especially in its sensitive early stages, such as flooding, vandalism or motorized vehicle use?

Present Conditions

Is the land bare topsoil, newly graded subsoil, an overgrown lot or a well maintained Kentucky bluegrass lawn? Soil condition and existing vegetation will determine the required course of site preparation.

Soil Type

The type and condition of the soil on your site will bear on the type of prairie community you can establish. Amending the soil is not practical on large scale projects. On smaller sites, significant changes to the soil, if required, can be made.

Size

The dimensions of the site will determine how much seed you will require, the scale of equipment you can use, the time it will take to prepare and restore it, as well as the cost.

Topography

Vagaries in the drainage and slope of a site will impact on the site design and planting plans. Species should be matched to their preferred growing position on slopes or other site features.

Adjacent Land Use

Consider how the land abutting your restoration is, or will be, used. Adjacent agricultural lands may result in pesticide or weed impacts on your site. Conversely, if not managed correctly, your restoration in its first few years could be a source of weed pollution to adjacent fields. Consider how potential developments around your site may impact on drainage, erosion, access, and future management.

Weed Populations

The weed species currently on, or adjacent to, your site will be the ones that give you the most problems. Identify what you will be dealing with and target your control measures appropriately.

Weed Control Options

Check what options are available to you to control weeds during site preparation or as part of your post sowing management. Certain jurisdictions may limit herbicide use or other control options.

Long Term Security

Is your intended site secure well into the future? A site destined to become a roadway, parking lot or strip mall should not be restored to native prairie.

Logistics

Is the site accessible year round and safe for staff, vehicles and equipment? Consider the need for and placement of fire breaks. Is water available if you intend to irrigate or for fire control?

Public Profile

Will the site be visible or accessible to the public, or used for educational purposes? If so, trails, parking, and other facilities may be required.

SITE DESIGN

Site design entails the planning required to influence the appearance or plant community makeup of a restoration site. Design can enter at many levels or it may not be a factor at all. The intended use of the site will determine the degree to which design is required. A plan to retire a crop field and establish a prairie for haying, grazing or personal interest requires few design considerations. A restoration at a corporate head office, where the landscape must compliment the buildings, contend with a varied topography, provide habitat for wildlife and be used for interpretive trails and environmental education will require considerable effort in design.

The design for a site will include practical, ecological and aesthetic considerations. Practical considerations include budgetary constraints, availability of seed and/or plants, and limitations on the equipment you can use to prepare, plant and manage the area. Ecologically, you must consider suiting species and communities to site topography, drainage or soil conditions. Creating habitat for a particular species of wildlife requires knowledge of that species' needs. Maximizing the opportunities for environmental education requires a knowledge of local school curricula and how they could fit into the restoration project. Aesthetic factors to consider include the heights of the restored plant communities, colours and textures, seasonal changes, and the arrangement of certain species into clumps or patches. Consider what your prairie is to be used for and incorporate the necessary levels of design. A qualified landscape architect knowledgeable in native prairie, may benefit your project.

The best designed prairie restorations look like they were not designed at all. They simply look like a natural part of the landscape. They fit the contours of the land, enhance other natural features and human made structures and hide their faults.

Restorations should be inspired by the type of prairie that occurs in your area. There is no substitute for familiarity with the native prairies in your region. Spend some time on them in different seasons, getting a feel for their

plants, animals and changes throughout the year. Think about how these factors will fit into your restoration.

Keep it simple and start small. It is better to do a good job of a small area, than a poor one of a large site. You can always expand upon your planting as you gain more experience. To begin the design process, obtain a map or recent aerial photograph of your site. Measure your site and draw it to scale. Overlay clear mylar or tracing paper on the base map and make several sketches of different possible planting plans. Keep corners rounded and edges smooth - natural communities rarely follow straight lines or square patterns.

Mosaic seeding also may be used to increase the visual diversity of a site. For example a larger percentage of showy wildflowers may be planted along a walkway or road where the public is more likely to see them. The biological reasons for doing this include increasing habitat diversity and more accurately reflecting the patchiness of the original prairie.

Social and political considerations, however, are every bit as important as biological ones in most restorations. This is especially true in urban areas. Having a colourful show in a high profile wildflower meadow may help to sell the public and politicians on the idea of prairie restoration. This may make it easier for the restorationist to justify additional plantings in the future.

Before and after of a well designed urban prairie restoration at The Forks in downtown Winnipeg. Designed by Cynthia Cohlmeyer, landscape architect.

June grass – a high priority species for mixed grass prairie restorations.

Black-eyed susan – an early successional species in prairie restorations.

Prairie lily – Saskatchewan's provincial flower and found across the aspen parkland.

Blue grama –a prime component of any dry mixed grass or sandhill prairie.

Bergamot – common to tall, mixed and fescue prairies.

Big bluestem, the dominant grass of the tall grass prairie, grows 1 to 2.5 m (3 to 8 ft) high.

Chapter 3

SPECIES SELECTION

Pink flowered onion.

Known native prairie species for each Canadian prairie type by province are given in this chapter. Locate your planting site on the appropriate provincial map to determine the prairie restoration zone you are in. Then refer to the table to find the list of plants native to that zone. Use this as a starting point for your restoration seed mix. To refine the list for your area consult native prairie sites, references and experts in this book's appendices. Spend time on prairie remnants in your region with a good field guide or knowledgeable botanist. Assess for yourself the dominant grasses and wildflowers. Model your restoration after these areas.

You can usually be flexible with the ultimate composition of your seed mixture. There are no hard rules on this, but try for a good cross-section of both grasses and wildflowers from your prairie type. Proportions in the mix should roughly parallel the proportions you observe in existing prairie remnants.

Gaillardia

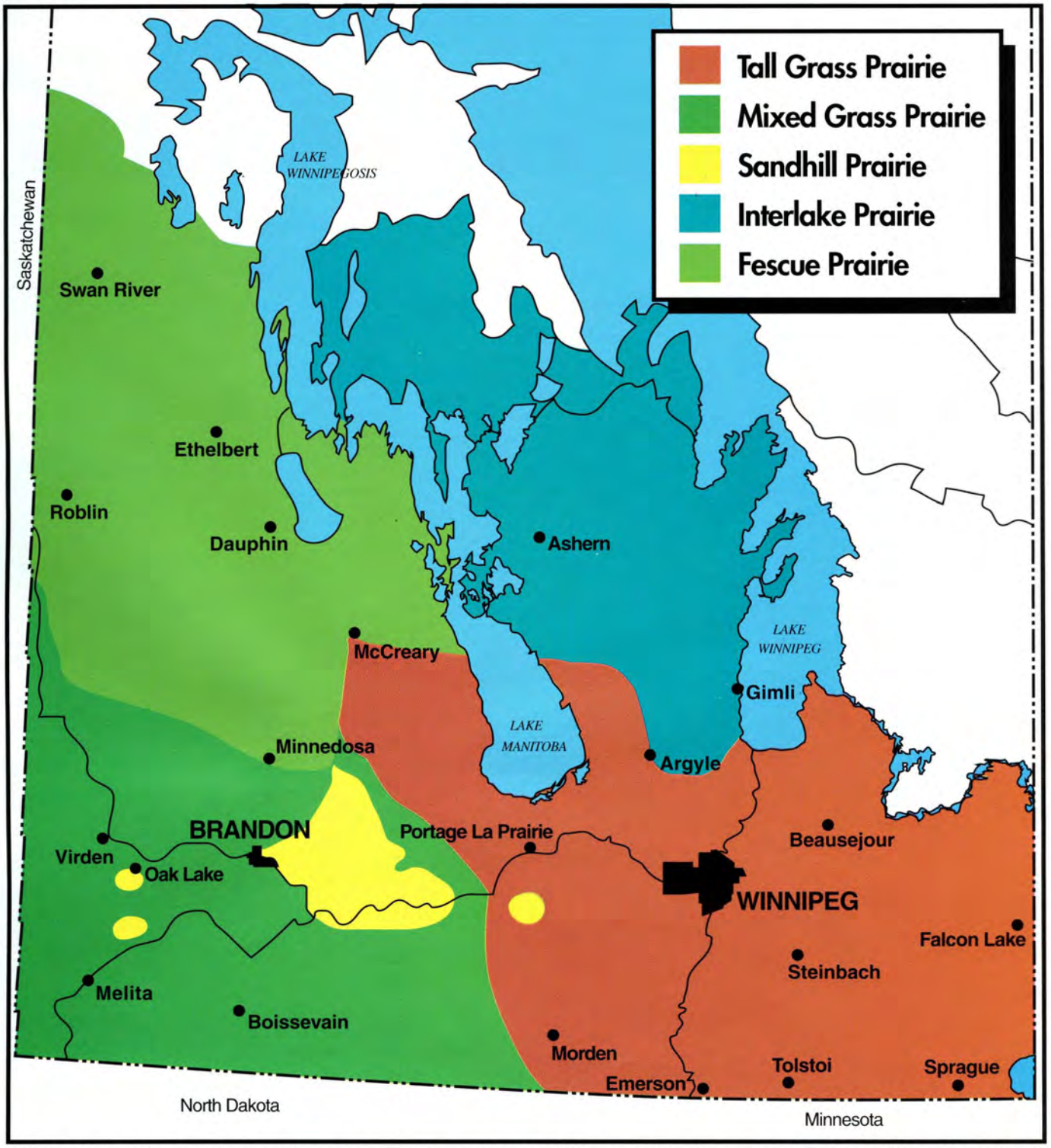
For example if 50% of the plants in your local prairie type are rough fescue, then 50% of your restoration seed mix ideally should be that species. If this is not possible, do not worry. It is far more important to have the right species in the mix than the right amount of any particular species.

Some contend that the mixture should be biased towards easy to grow pioneering species. Others feel that a basic matrix of the dominant mature prairie species is best. In reality, no one knows if there is any one best way, so both approaches are equally valid.

Prairie seeds do not always germinate in proportion to their original seeding rate. Put as many species in as possible and let them sort out who grows where and when and in what amount. Just as in native prairies, every restoration is different. There is no reliable way to predict beforehand what species composition and proportions you will have eventually.

Tall grass prairie north of Winnipeg

Manitoba Native Prairie Restoration Zones*



*All Manitoba native prairie restoration zones except the southwestern tall grass prairie also are considered part of the aspen parkland.

Manitoba Prairie Restoration Species Priority List

1 = high priority 2 = secondary priority Blank = species not found in that prairie type or distribution data unavailable

Species rankings reflect their utility in a prairie restoration as well as their occurrence in a prairie restoration zone.

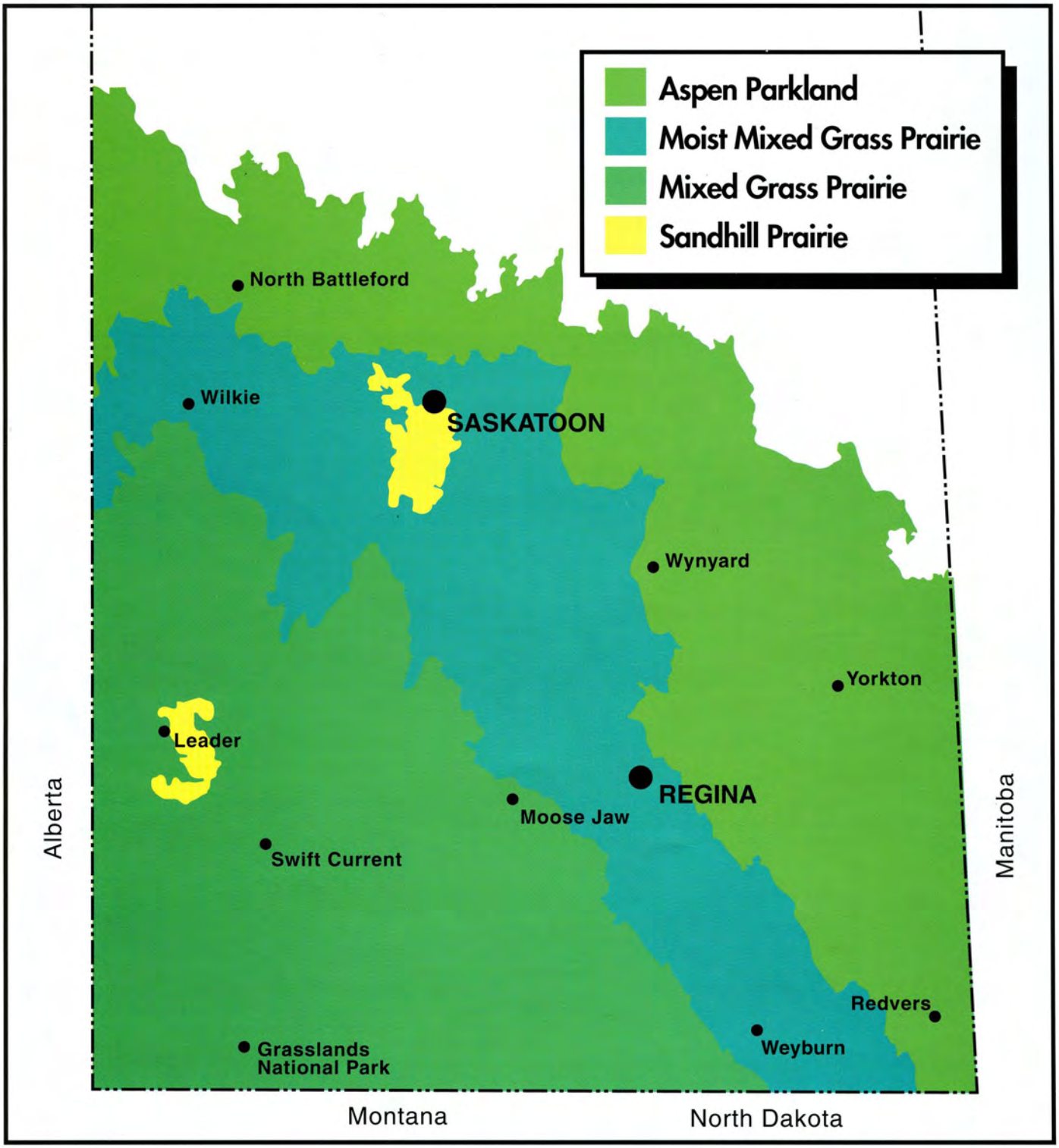
SCIENTIFIC NAME	COMMON NAME	Tall Grass Prairie	Sandhill Prairie	Mixed Grass Prairie	Fescue Prairie	Interlake Prairie
	GRASSES					
Agropyron dasystachyum	northern wheatgrass			2	2	2
Agropyron smithii	western wheatgrass	2	2	1	2	2
Agropyron subsecundum	awned wheatgrass	1	1	1	1	1
Agropyron trachycaulum	slender wheatgrass	2	2	2	2	2
Agrostis scabra	hair grass	1		2	1	1
Andropogon gerardii	big bluestem	1	2	2		2
Andropogon hallii	sand bluestem		1			
Andropogon scoparius	little bluestem	1	1	1	2	1
Aristida longiseta	red three-awn	2	2			
Beckmannia syzigachne	slough grass	2		2	2	2
Bouteloua curtipendula	side-oats grama	2	1	1		
Bouteloua gracilis	blue grama	2	1	1	2	2
Bromus ciliatus	fringed brome	2			2	2
Bromus pumpellianus	northern awnless brome	2				
Calamagrostis inexpansa	northern reed grass	2			1	2
Calamagrostis montanensis	plains reed grass	2		1		
Carex obtusata	blunt sedge		1			
Carex stenophylla	low sedge		1			
Carex xerantica	white-scaled sedge		1			
Danthonia spicata	poverty oat grass	2		2		
Deschampsia caespitosa	tufted hair grass	2				
Distichlis stricta	alkali grass			2	2	
Elymus canadensis	Canada wild rye	1	1	1	1	1
Elymus innovatus	hairy wild rye					2
Festuca hallii	plains rough fescue			2	1	
Festuca saximontana/ovina	sheep fescue		1			
Festuca scabrella/altaica	northern rough fescue	2		2	1	
Helictotrichon hookeri	Hooker's oat grass	2	2	2	2	
Hierochloe odorata	sweet grass	2		2	2	2
Koeleria cristata or gracilis	June grass	2	1	1	2	
Muhlenbergia asperifolia	scratch grass	2				
Muhlenbergia cuspidata	prairie muhly	2	1	1	2	
Muhlenbergia glomerata	bog muhly	2			2	2
Muhlenbergia racemosa	marsh muhly	2				
Muhlenbergia richardsonis	mat muhly	1	2	2	2	2
Oryzopsis asperfolia	rice grass		2		2	
Panicum capillare	witch grass	2	1	1		2
Panicum leibergii	panic grass	2				
Panicum virgatum	switch grass	1		2		2
Schizachne purpurasens	purple oat grass				2	
Sorghastrum nutans	Indian grass	1				2
Spartina gracilis	alkali cord grass	2		2	2	2
Spartina pectinata	prairie cord grass	1		2	2	2
Sporobolus asper	tall dropseed	1	2			
Sporobolus cryptandrus	sand dropseed	2	1			
Sporobolus heterolepis	prairie dropseed	1	2	2		2
Stipa comata	needle & thread grass	2	1	1	2	
Stipa curtiseta	western porcupine grass			2		
Stipa richardsonii	Richardson's needle grass				2	1
Stipa spartea	spear grass	2	2	1	2	
Stipa viridula	green needle grass	2	2	1	2	
	WILDFLOWERS					
Achillea millefolium	yarrow	1	1	1	1	1
Allium cernuum	nodding onion	2		2		
Allium stellatum	pink flowered onion	1	1		1	2
Allium textile	prairie onion		2	2		
Amorpha canescens	leadplant	1				
Amorpha nana	dwarf false indigo	1				
Anemone canadensis	Canada anemone	1	2	1	2	1
Anemone cylindrica	long fruited anemone	1	1	1	2	1
Anemone multifida	cut-leaved anemone	2	1	1	1	1
Anemone patens	prairie crocus	2	1	1	2	2
Anemone virginiana	tall anemone				2	2
Antennaria aprica	pussytoes	2		1		1
Antennaria campestris	pussy toes				2	
Antennaria parvifolia	small-leaved everlasting		2			
Antennaria plantaginifolia	plantain-leaved everlasting		2			
Antennaria rosea	pussytoes	2				
Apocynum androsaemifolium	spreading dogbane		2		2	2
Apocynum cannibinum	Indian hemp	2				2
Arenaria lateriflora	blunt-leaved sandwort	2				
Arnica cordifolia	heart-leaved arnica	2				
Artemisia campestris	plains wormwood	2	1	1		2
Artemisia frigida	pasture sage	2	1	1		
Artemisia ludoviciana	prairie sage	2	1	1	2	
Asclepias incarnata	swamp milkweed	2				
Asclepias ovalifolia	dwarf milkweed	1	2	2		2
Asclepias verticillata	whorled milkweed	2				2
Aster ciliolatus	Lindley's aster	2	2		2	
Aster ericoides	many-flowered aster	1	1	1	1	1
Aster falcatus	white prairie aster	2				
Aster hesperius	willow aster	2	2			
Aster junciformis	rush aster	2	2			
Aster laevis	smooth aster	1	1	1	1	2
Aster lateriflorus	wood aster	2				
Aster novae-angliae	New England aster	1				
Aster puniceus	purple-stemmed aster	2			2	
Aster simplex	small blue aster				2	
Aster umbellatus	flat-topped white aster	2	2		2	
Astragalus canadensis	Canada milk-vetch	1	1	1	1	2
Astragalus crassicarpus	ground plum	2	1	1	2	
Astragalus danicus	ascending milk-vetch	2		2		
Astragalus missouriensis	Missouri milk-vetch	2	2			
Astragalus striatus	ascending purple milk-vetch	2	1		1	1
Campanula rotundifolia	harebell	1	1	1	1	1
Castilleja coccinea	scarlet paint-brush	2	2			
Castilleja miniata	red Indian paint-brush		2		1	2
Castilleja sessiliflora	Indian paint-brush		2			2
Cerastium arvense	field chickweed	2	1	1		
Chamerhodos erecta	chamaerhodos		2	2		
Chamerohodos nuttallii	chamaerhodos	2		2		
Chenopodium capitatum	strawberry blite	2	2			
Chrysopsis villosa	hairy golden-aster	2	1	1		
Cirsium drummondii	short-stemmed thistle	2	2	2	2	2
Cirsium flodmanii	Flodman's thistle	2	2	2		1
Comandra pallida	pale comandra	2	2	2		2
Cypridedium calceolus	yellow lady's-slipper	2	2	2	2	2
Cypridedium candidum	small white lady's slipper	2		2		
Dodecatheon pulchellum	saline shootingstar	2				2
Echinacea angustifolia	purple coneflower		1	2		
Epilobium angustifolium	fireweed	2	2	2	2	2
Equisteum arvense	horsetail	2	2	2	2	2
Erigeron asper	rough fleabane	2	2		2	
Erigeron caespitosus	tufted fleabane		2	2		
Erigeron canadesis	Canada fleabane	2	2		2	
Erigeron glabellus	smooth fleabane	2	2		2	2
Erigeron philadelphicus	Philadelphia fleabane	2			2	2
Erigeron strigosus	daisy fleabane	2	2			
Eupatorium purpureum	purple boneset	2	2			
Fragaria virginiana	wild strawberry	2	1	1	2	1
Gaillardia aristata	gaillardia	1	1	1	1	2

Manitoba Prairie Restoration Species Priority List (continued)

1 = high priority 2 = secondary priority Blank = species not found in that prairie type or distribution data unavailable

SCIENTIFIC NAME	COMMON NAME	Tall Grass Prairie	Sandhill Prairie	Mixed Grass Prairie	Fescue Prairie	Interlake Prairie
Galium boreale	northern bedstraw	1	1	1	1	1
Gaura coccinea	scarlet gaura		2			
Gentiana acuta/amarella	northern gentian	2		2	2	2
Gentiana affinis	oblong-leaved gentian	2		2		2
Gentiana andrewsii	closed gentian	1				1
Gentiana crinita	fringed gentian	2	2		2	
Geum aleppicum	yellow avens	2			1	1
Geum triflorum	three flowered avens	2	1	1	2	
Glycyrrhiza lepidota	wild licorice	1		1	1	1
Grindelia squarrosa	gumweed	2	2	1	2	1
Gutierrezia diversifolia	broomweed			1		
Helenium autumnale	sneezeweed	2				
Helianthus laetiflorus	beautiful sunflower	2	1	1	2	2
Helianthus maximiliani	narrow-leaved sunflower	1	2	2		2
Helianthus nuttallii	tuberous rooted sunflower				1	
Helianthus tuberosus	Jerusalem artichoke	2				
Heliopsis helianthoides	rough false sunflower	1			2	2
Heuchera richardsonii	alum root	1	1	1	2	2
Hypoxis hirsuta	yellow star grass	2		2		2
Iris versicolor	blue flag iris				2	2
Lactuca pulchella	blue lettuce			2	2	
Lactuca scariola	prickly lettuce		2			
Lactuca tatarica	blue lettuce	2	2			
Lathyrus palustris	marsh vetchling	2	2			
Lathyrus venosus	wild peavine	2	2	2	2	2
Lesquerella ludoviciana	sand bladderpod		2			
Liatris ligulistylis	meadow blazingstar	1	2	1	1	1
Liatris punctata	dotted blazingstar	2	1	1	2	2
Lichen	lichens	2	1	2	2	2
Lilium philadelphicum	prairie lily	1	2	1	1	1
Linum lewisii	Lewis wild flax	2	1	1	2	2
Linum sulcatum	grooved yellow flax		2	2		
Liparis loeselii	twayblade	2				
Lithospernum canescens	hoary puccoon	2	2	2	2	2
Lobelia kalmii	Kalm's lobelia	2		2		2
Lobelia spicata	pale spiked lobelia	2		2		2
Mamillaria vivipara	pin cushion cactus		1	2		
Mentha arvensis	wild mint	2		2	2	2
Microseris cuspidata	false dandelion	2	2	2	2	2
Monarda fistulosa	bergamot	1	1	1	1	1
Oenothera biennis	yellow evening-primrose	2	1	1	1	2
Oenothera caespitosa	gumbo evening-primrose	2		2		
Oenothera nuttallii	white evening-primrose		2	2		
Oenothera serrulata	shrubby evening-primrose	2	2	2		
Onosmodium molle	false gromwell		2			
Opuntia polyacantha	oval prickly-pear cactus		1			
Orthocarpus luteus	yellow owl's-clover	2	1	1	2	
Oxytropis campestis	yellow locoweed				1	
Oxytropis lambertii	purple locoweed		2			
Oxytropis splendens	showy locoweed	2		1		
Parnassia palustris	grass-of-parnassus	2		2		2
Pedicularis canadensis	common lousewort	2	2	2		2
Penstemon albidus	white penstemon		1	2		
Penstemon gracilis	lilac-flowered penstemon	2	2	1	2	
Petalostemon candidum	white prairie clover	1	1	1	1	2
Petalostemon purpureum	purple prairie clover	1	1	1	1	1
Petalostemon villosum	hairy prairie clover		1			
Physalis virginiana	prairie ground-cherry	2	2	2		
Polygala senega	seneca root	2		2	2	2
Polygonatum spp.	solomon's seal	2	2		2	2
Potentilla anserina	silverweed	2		2	2	1
Potentilla argentea	silvery cinquefoil	2		2		
Potentilla arguta	white cinquefoil	1	1	1	1	2
Potentilla concinna	early cinquefoil		2			
Potentilla gracilis	graceful cinquefoil	2		1	2	2
Potentilla pensylvanica	prairie cinquefoil	1	1	1		2
Prenanthes alba	white lettuce	2		2		
Prenathes racemosa	glaucous white lettuce	2				2
Psoralea agrophylla	silver leaf psoralea	1		1		1
Psoralea esculenta	Indian breadroot	2	1	1	2	2
Psoralea lanceolata	lance-leaved psoralea	2				
Ranunculus cymbalaria	seaside buttercup	2				
Ranunculus rhomboideus	prairie buttercup	2	2	1		2
Ratibida columnifera	yellow coneflower	1	1	1		
Rudbeckia hirta	black-eyed Susan	1	1	2	2	1
Selaginella densa	club-moss or prairie selaginella		1	1	2	
Sisyrinchium montanum	blue-eyed grass	2	1	1	1	2
Smilacina stellata	false Solomon's seal	2	2	2	2	2
Solidago canadensis	Canada goldenrod	1	2	1	1	2
Solidago graminifolia	flat-topped goldenrod	1	1			
Solidago missouriensis	low goldenrod	2	1	1	1	
Solidago mollis	velvety goldenrod	2	2	2		
Solidago nemoralis	showy goldenrod	2	1	1	1	2
Solidago ptarmicoides	upland white goldenrod	1	2	1		2
Solidago riddellii	Riddell's goldenrod	2				
Solidago rigida	stiff goldenrod	1	2	1	1	2
Solidago spathulata	mountain goldenrod	2	2			
Solidago uliginosa	marsh goldenrod	2				
Spiranthes magnicamporum	great plains lady's-tresses	2				
Spiranthes romanzoffiana	hooded lady's tresses	2				
Thalictrum dasycarpum	tall meadow-rue	2	2			
Thalictrum venulosum	veiny meadow-rue	2	2	2	2	2
Tofieldia glutinosa	sticky asphodel	2				2
Veronicastrum virginicum	Culver's root	2				
Vicia americana	wild vetch	2	2			2
Viola adunca	early blue violet	2				
Viola cucullata	northern bog violet	2			2	2
Viola pedatifida	crowfoot violet	2	2			2
Viola pubescens	downy yellow violet	2		2	2	2
Viola rugulosa	western Canadian violet				2	2
Zigadenus elegans	smooth camas	1		1	1	2
Zizia aptera	heart-leaved alexander	1		1	1	2
Zizia aurea	golden alexander	2			2	
	SHRUBS					
Amorpha fruticosa	indigo bush	2				
Arctostaphylos uva-ursi	bearberry		1			2
Elaeagnus commutata	silverberry, wolfwillow	2	2	2	2	2
Juniperus horizontalis	creeping juniper		1	1		
Potentilla fruticosa	shrubby cinquefoil	2	1	1	1	1
Prunus pumila	sand cherry		1			
Rosa acicularis	prickly rose	2	2	2		
Rosa arkansana	prairie rose	2	1	1		
Rosa blanda	smooth rose	2				
Rosa woodsii	Wood's rose	2		2		1
Spirea alba	meadow sweet	2		2	2	2
Symphoricarpos occidentalis	western snowberry	2		2	2	2

Saskatchewan Native Prairie Restoration Zones

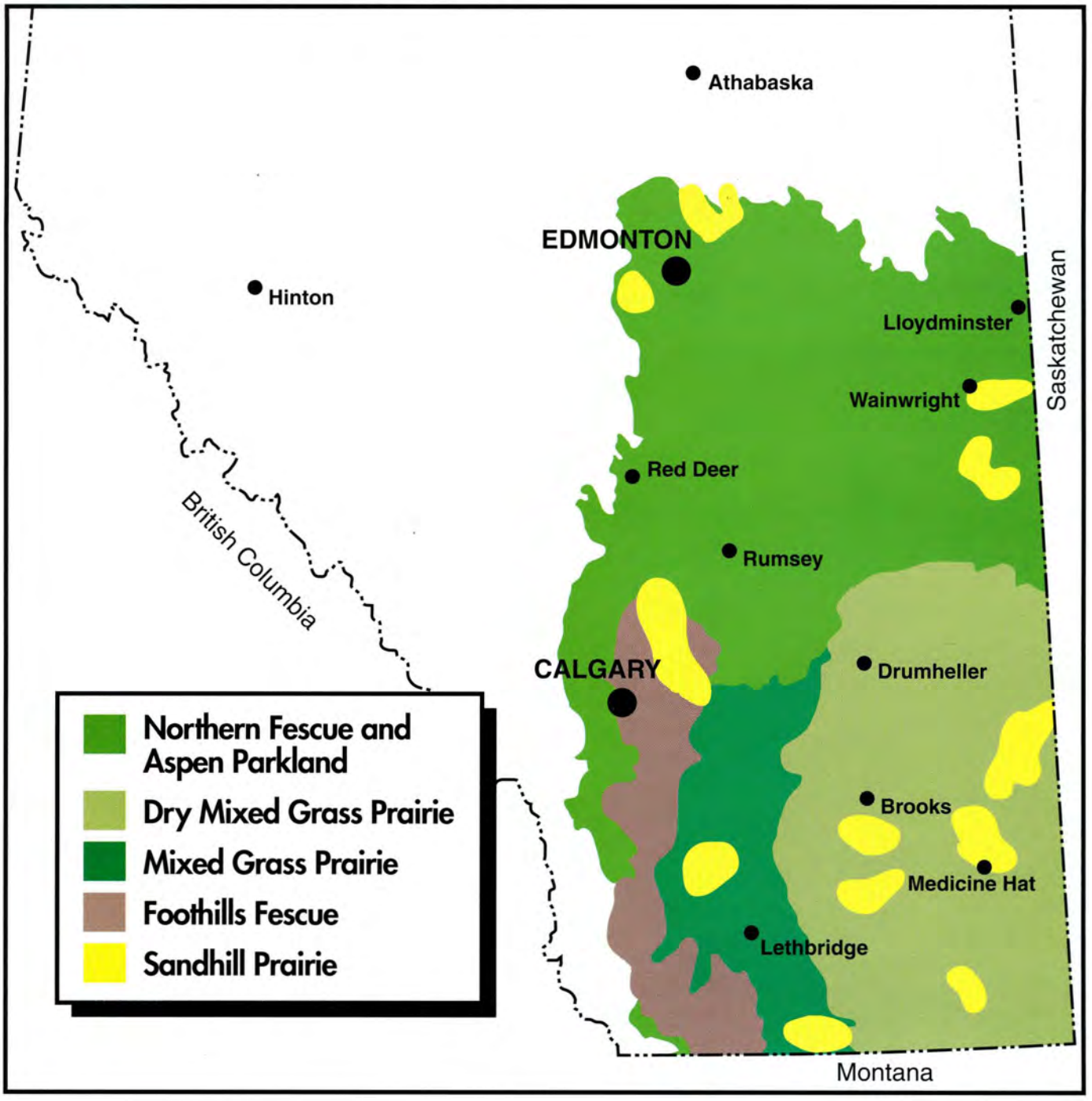


Saskatchewan Prairie Restoration Species Priority List

1 = high priority 2 = secondary priority Blank = species not found in that prairie type or distribution data unavailable

SCIENTIFIC NAME	COMMON NAME	Moist Mixed Grass Prairie	Mixed Grass Prairie	Aspen Parkland	Sandhill Prairie
GRASSES					
Agropyron dasystachyum	northern wheatgrass	1	1	1	1
Agropyron smithii	western wheatgrass	1	1	1	1
Agropyron trachycaulum	slender wheatgrass	1	1	1	1
Agrostis scabra	hair grass	2		2	
Andropogon scoparius	little bluestem	2		2	
Bouteloua gracilis	blue grama	1	1	1	1
Bromus ciliatus	fringed brome			2	
Calamagrostis montanensis	plains reed grass	2	1	2	2
Calamovilfa longifolia	sand grass	2	2	2	1
Carex eleocharis	sedge		1		
Carex filifolia	sedge		1		
Carex pensylvanica	sedge		2		
Carex obtusata	sedge		2		
Danthonia intermedia	oat grass	2	1	2	
Deschampsia caespitosa	tufted hair grass	2		2	
Distichlis stricta	salt grass		2		
Elymus canadensis	Canada wild rye	1	1	1	1
Festuca hallii	rough fescue	1	2	1	
Festuca ovina	sheep fescue	2	2	2	2
Helictotrichon hookeri	Hooker's oat grass	2	2	1	2
Koeleria gracilis or cristata	June grass	1	1	1	1
Muhlenbergia cuspidata	prairie muhly	2	2	2	
Muhlenbergia richardsonis	mat muhly	1	2	2	
Oryzopsis hymenoides	Indian rice grass	2	2	2	1
Poa canbyi	canby blue grass	2	2	2	
Poa cusickii	early blue grass	2	2	2	
Poa secunda	Sandberg's blue grass	2	2	2	
Spartina gracilis	alkali cord grass	2			
Sporobolus cryptandrus	sand dropseed	2	2	2	1
Stipa comata	needle & thread grass	1	1	1	1
Stipa curtiseta	western porcupine grass	1	1	1	1
Stipa viridula	green needle grass	1	1	2	2
WILDFLOWERS					
Achillea millefolium	yarrow	1	2	1	
Allium spp.	onions		2		2
Allium textile	prairie onion	2		1	
Anemone multifida	cut-leaved anemone		2		
Anemone patens	prairie crocus	1	2	1	
Anemone spp.	anemones		1	1	1
Antennaria microphylla	pussy-toes	1	1		
Antennaria spp.	pussy-toes		2	1	2
Arnica fulgens	shining arnica		2		2
Artemisia ludoviciana	prairie sage	1	2	1	
Aster ercoides	many-flowered aster	1	2	1	
Aster laevis	smooth aster	2			
Aster spp.	asters			1	
Astragalus bisulcatus	two grooved milk-vetch	2			
Astragalus crassicarpus	ground plum	2			
Astragalus flexuosus	slender milk-vetch	1	2		
Astragalus striatus	ascending purple milk-vetch	2	2		
Astragalus pectinatus	narrow-leaved milkvetch	1	2		
Astragalus spp.	milk-vetches		1	1	1
Atriplex nuttallii	Nuttall's atriplex	2	1		
Campanula rotundifolia	harebell		1	1	1
Castilleja coccinea	scarlet paint-brush			1	
Castilleja miniata	red Indian paint-brush		2		2
Cerastium arvense	field chickweed			1	
Chenopodium leptophyllum	narrow-leaved goosefoot	2	1		
Chrysopsis villosa	hairy golden-aster		1		1
Comandra pallida	pale comandra	2	1	1	1
Dodecatheon spp.	shooting stars		1		1
Erigeron caespitosus	tufted fleabane	2		1	
Erigeron glabellus	smooth fleabane	1	1	1	
Erigeron pumilus	hairy daisy		2		2
Erigeron spp.	fleabanes		1	1	
Eriogonum flavum	yellow umbrella plant	2			
Gaillardia aristata	gaillardia	1	2	1	1
Galium boreale	northern bedstraw	2	2	1	
Gaura coccinea	scarlet gaura	2	2		
Geum triflorum	three flowered avens	1	2	1	
Glycyrrhiza lepidota	wild licorice	2	2		
Gutierrezia sarothrae	broomweed	1	1		
Haplopappus spinulosus	iron plant	1	1		
Hedysarum alpinum	american hedysarum		1	1	
Helianthus spp.	sunflowers			1	
Heterotheca villosa	golden-aster	1	2	1	
Heuchera richardsonii	alum root		2		2
Hymenoxys richardsonii	Colorado rubberweed	2	2		
Lathyrus venosus	wild peavine			1	
Liatris punctata	dotted blazingstar	1	2	1	
Linum lewisii	Lewis wild flax	2	2	1	
Linum rigidum	large-flowered yellow flax	2			
Lithospernum incisum	narrow-leaved puccoon	2	2	1	
Lomatium villosum	hairy fruited parsley	2			
Lygodesmia juncea	skeletonweed	1	2		1
Malvastrum coccineum	scarlet mallow		1		
Mondarda fistulosa	bergamot			1	
Orthocarpus luteus	yellow owl's-clover	2		1	
Oxytropis spp.	locoweeds		1		
Penstemon albidus	white beardtongue	2			
Penstemon gracilis	lilac-flowered beardtongue	2			
Penstemon nitidus	smooth blue beardongue	2			
Penstemon procerus	slender beardtongue	2			
Petalostemon purpureum	purple prairie clover	1		1	1
Phlox hoodii	moss phlox	1	1		1
Potentilla arguta	white cinquefoil			1	
Potentilla bipinnatifida	plains cinquefoil	1			
Potentilla concinna	early cinquefoil		1		1
Potentilla gracilis	graceful cinquefoil	1	1		1
Potentilla hippiana	woolly cinquefoil	1	2		2
Potentilla pensylvanica	prairie cinquefoil	1	2		2
Psoralea agrophylla	silver leaf psoralea	1	2	1	
Psoralea lanceolata	lance-leaved psoralea	2	1		1
Ratibida columnifera	yellow coneflower	1	2		
Rumex venosus	sand dock				1
Sisyrinchium montanum	blue-eyed grass	2	2	1	2
Smilacina stellata	false Solomon's seal				1
Solidago canadensis	Canada goldenrod		2		
Solidago missouriensis	low goldenrod	1	2	1	1
Solidago rigida	stiff goldenrod	1			
Sphaeralcea coccinea	scarlet malllow	1		1	
Thermopsis rhombifolia	golden bean	1	1	1	
Vicia americana	wild vetch	1	2		1
Vicia spp.	vetches			1	
Viola spp.	violets		1		
Zigadenus elegans	smooth camas		2		2
Zizia aptera	heart leaved alexander		1		
SHRUBS					
Artemisia cana	hoary sagebrush	2	1		1
Eurotia lanata	winter fat	2	1		
Potentilla fruticosa	shrubby cinquefoil		1		
Rosa spp.	wild roses		1	1	1

Alberta Native Prairie Restoration Zones



Alberta Prairie Restoration Species Priority List

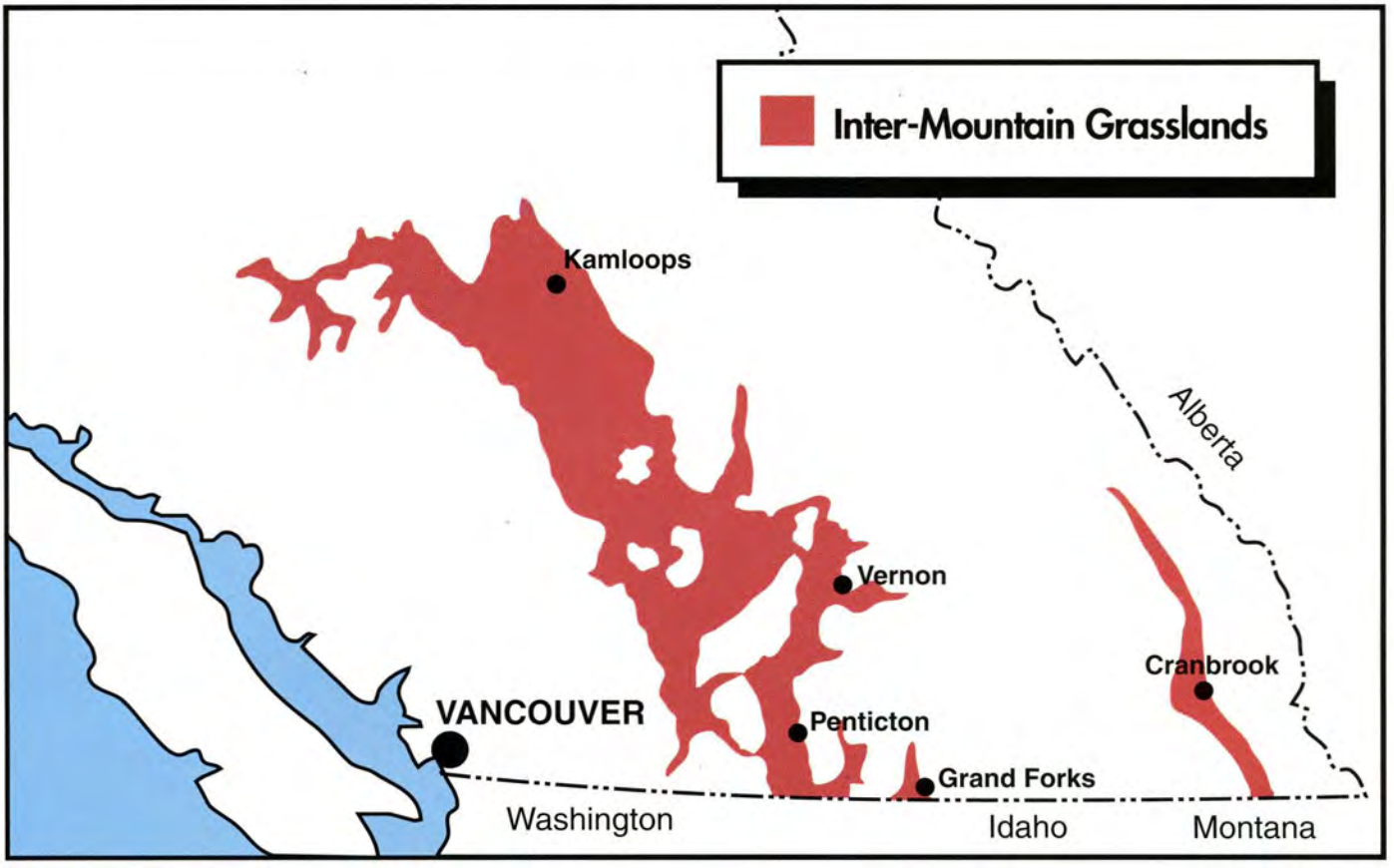
1 = high priority Blank = species not found in that prairie type

SCIENTIFIC NAME	COMMON NAME	Northern Fescue & Aspen Parkland	Foothills Fescue	Dry Mixed Grass Prairie	Mixed Grass Prairie	Sandhill Prairie
GRASSES						
Agropyron dasystachyum	northern wheatgrass	1	1	1	1	
Agropyron smithii	western wheatgrass	1	1	1	1	1
Agropyron spicatum	bluebunch grass		1			
Agropyron subsecundum	awned wheatgrass	1				
Agropyron trachycaulum	slender wheatgrass		1		1	
Agropyron unilaterate	awned wheatgrass		1			
Bouteloua gracilis	blue grama			1	1	
Bromus carinatus	mountain brome		1			
Bromus pumpellianus	northern awnless brome		1			
Calamagrostis montanensis	plains reed grass		1	1	1	1
Calamagrostis purpurascens	purple reed grass		1			
Calamovifa longifolia	sand reed grass					1
Carex spp.	sedges	1	1	1	1	1
Danthonia californica	California oat grass		1			
Danthonia parryi	Parry oat grass		1			
Elymus canadensis	Canada wild rye					1
Festuca campestris	rough fescue		1			
Festuca idahoensis	Idaho fescue		1			
Festuca hallii	rough fescue	1				
Festuca saximontana/ovina	sheep fescue	1				
Helictotrichon hookeri	Hooker's oat grass	1	1			1
Hierochloe odorata	sweet grass	1	1		1	
Koeleria cristata	June grass	1	1	1	1	
Oryzopsis hymenoides	Indian rice grass					1
Poa canbyi	Canby bluegrass					
Poa cusickii	early blue grass		1		1	1
Poa juncifolia	alkali bluegrass					
Poa sandbergii	Sandberg's blue grass			1	1	
Sitanion hystrix	squirreltail			1		
Sporobolus cryptandrus	sand dropseed					1
Stipa comata	needle & thread grass			1	1	
Stipa curtiseta	western porcupine grass	1			1	
Stipa richardsonii	Richardson's needle grass		1			
Stipa viridula	green needle grass	1	1		1	
Vulpia octoflora	six-weeks fescue			1		
WILDFLOWERS						
Achillea millefolium	yarrow	1	1			
Agoseris glauca	false dandelion		1			
Allium cernuum	nodding onion		1			
Anemone canadensis	Canada anemone	1				
Anemone cylindrica	long fruited anemone	1	1			
Anemone multifida	cut-leaved anemone		1		1	
Anemone patens	prairie crocus	1	1		1	
Antennaria aprica	pussytoes	1				
Antennaria parvifolia	small-leaved everlasting	1				
Arnica fulgens	shining arnica				1	
Artemisia frigida	pasture sage	1		1	1	
Artemisia ludoviciana	prairie sage	1				
Aster ercoides	many-flowered aster	1		1	1	
Aster falcatus	white prairie aster	1				
Aster laevis	smooth aster	1	1			
Astragalus aboriginum	Indian milk-vetch		1			
Astragalus crassicarpus	ground plum	1	1			
Astragalus flexuosus	slender milk-vetch	1		1		
Astragalus missouriensis	Missouri milk-vetch		1			
Astragalus pectinatus	narrow leaved milk-vetch				1	
Atriplex nuttallii	Nuttall's atriplex			1		
Balsamorhiza sagittata	balsam root		1			
Campanula rotundifolia	harebell		1			
Chenopodium pratericola	narrow-leaved goosefoot					1
Cleome serrulata	bee plant			1		1
Comandra umbellata	bastard toadflax	1				
Delphinium bicolor	delphinium			1		
Dodecatheon conjugens	shooting star		1			

SCIENTIFIC NAME	COMMON NAME	Northern Fescue & Aspen Parkland	Foothills Fescue	Dry Mixed Grass Prairie	Mixed Grass Prairie	Sandhill Prairie
Erigeron canadensis	horse weed					1
Erigeron glabellus	smooth fleabane	1	1			
Erigeron speciosus	showy fleabane		1			
Erysimum asperum	prairie rocket					1
Fragaria virginiana	wild strawberry		1			
Gaillardia aristata	gaillardia	1	1			
Galium boreale	northern bedstraw		1			
Gaura coccinea	scarlet gaura				1	
Gentianella amarella	northern gentian		1			
Geranium viscosissimum	sticky purple geranium		1			
Geum triflorum	three flowered avens		1		1	
Glycyrrhiza lepidota	wild licorice				1	1
Gutierrezia sarothrae	common broomweed				1	
Haplopappus spinulosus	spiny ironplant				1	
Hedysarum alpinum	american hedysarum	1	1			
Hedysarum boreale	northern hedysarum	1	1			
Helianthus annus	annual sunflower		1	1	1	
Heterotheca villosa	golden-aster		1	1		1
Heuchera cylindrica	alum root		1			1
Lactuca pulchella	blue lettuce	1			1	
Lathyrus venosus	wild peavine	1				
Liatris punctata	dotted blazingstar				1	1
Linum lewisii	Lewisii wild flax	1	1			
Lithospernum ruderale	stone-seed		1			
Lupinus argenteus	silvery lupine		1			
Lupinus sericeus	flexile lupine		1			
Mondarda fistulosa	bergamot	1	1			
Oenothera biennis	yellow evening-primrose				1	
Opuntia fragilis	prickly pear cactus			1		1
Oxytropis monticola	locoweed	1	1		1	
Oxytropis sericea	early yellow locoweed	1	1		1	
Oxytropis splendens	showy locoweed		1			
Oxytropis viscida	viscid locoweed		1			
Penstemon confertus	yellow beardtongue		1			
Penstemon nitidus	smooth blue beardtongue		1			
Penstemon procerus	slender beardtongue		1			
Petalostemon candidum	white prairie clover		1		1	
Petalostemon purpureum	purple prairie clover	1	1		1	
Phacelia sericea	scorpion weed		1			
Pholox hoodii	moss phlox		1	1	1	
Potentilla diversifolia	smooth-leaved cinquefoil			1		
Potentilla gracilis	graceful cinquefoil	1	1	1		
Potentilla hippiana	woolly cinquefoil	1				
Potentilla pensylvanica	prairie cinquefoil	1				1
Psoralea lanceolata	lance-leaved psoralea					1
Ratibida columnifera	yellow coneflower		1		1	
Rumex venosus	wild begonia					1
Selaginella densa	club moss	1	1	1	1	
Sisyrinchium montanum	blue-eyed grass	1	1			
Solidago canadensis	Canada goldenrod		1			
Solidago missouriensis	low goldenrod	1	1	1		1
Solidago rigida	stiff goldenrod	1				
Sphaeralcea coccinea	scarlet mallow			1	1	
Thermopsis rhombifolia	golden-bean	1			1	1
Vicia sparsifolia	american vetch				1	
Zigadenus venenosus	death camas				1	
SHRUBS						
Artemisia cana	hoary sagebrush			1	1	
Eurotia lanata	winter fat				1	
Juniperus horizontalis	creeping juniper		1			1
Potentilla fruticosa	shrubby cinquefoil		1			
Shepherdia argentea	buffalo berry				1	
Symphoricarpos occidentalis	western snowberry	1	1			1
Rosa acicularis	prickly rose		1			
Rosa arkansana	prairie rose	1			1	1

Intermountain grasslands.

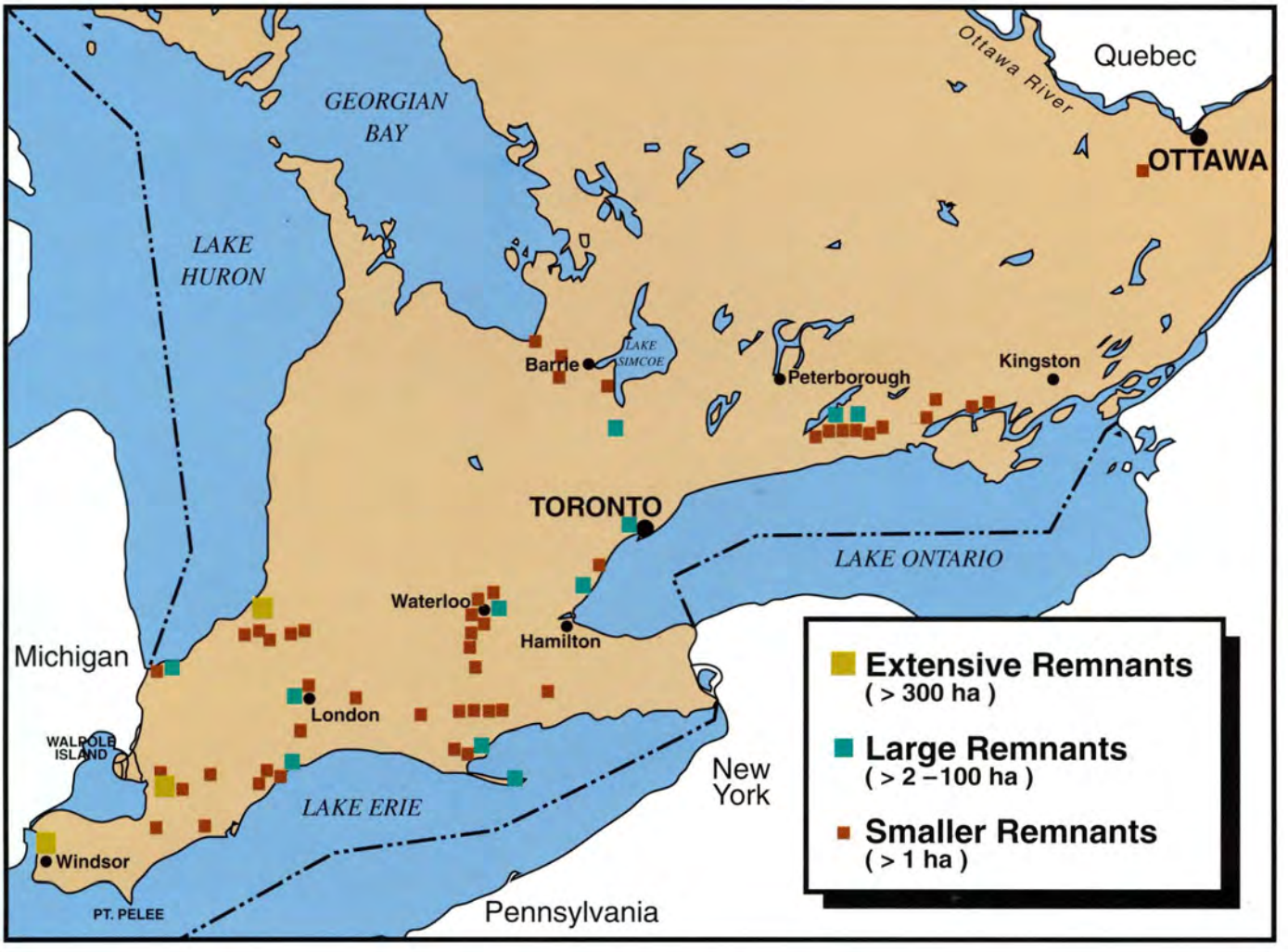
British Columbia Native Prairie Restoration Zones



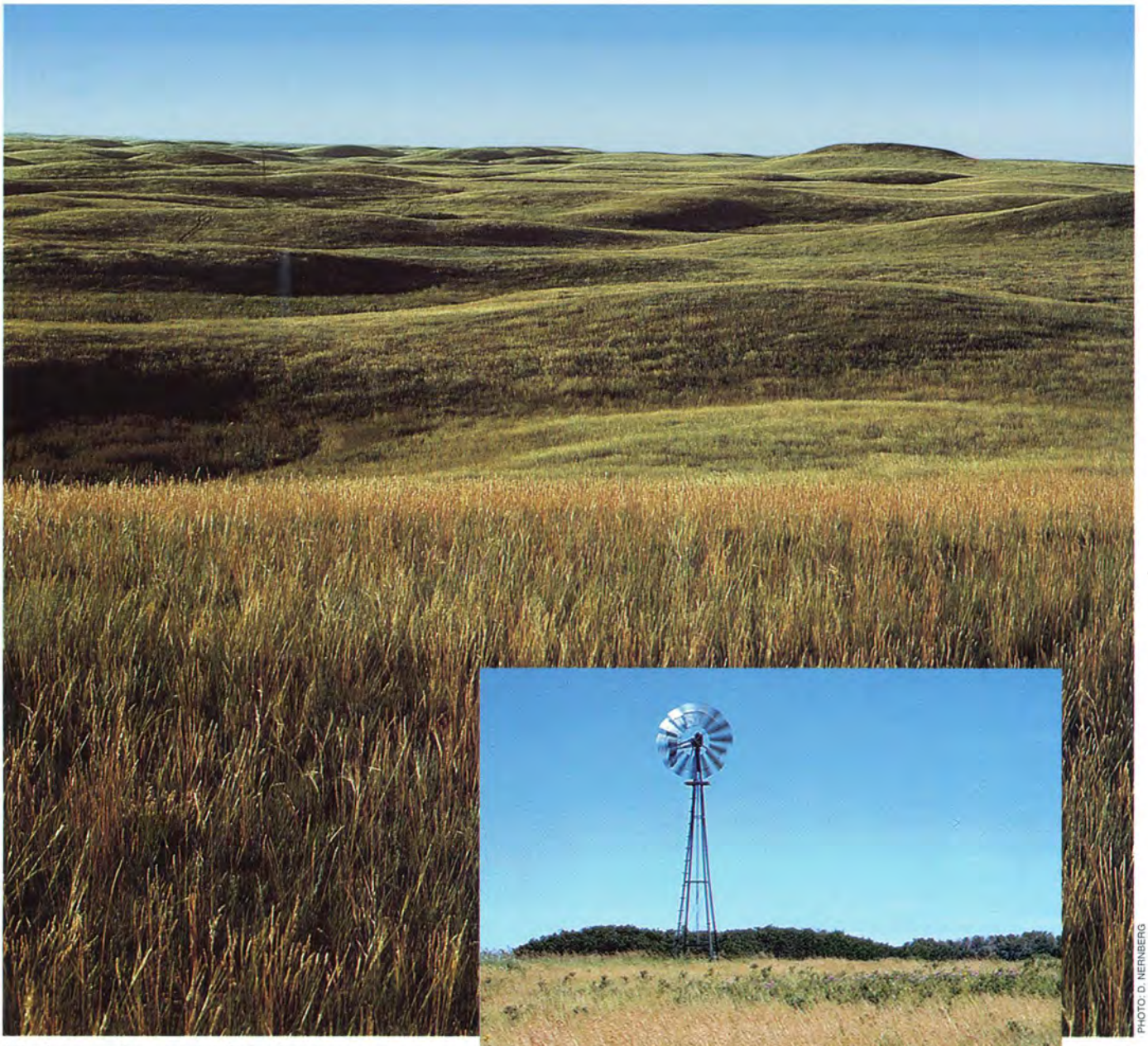
British Columbia Prairie Restoration Species Priority List			
SCIENTIFIC NAME	**COMMON NAME**	**SCIENTIFIC NAME**	**COMMON NAME**
GRASSES		Aulaconium palustre	glow moss
Agropyron smithii	western wheatgrass	Balsamorhiza sp.	balsam root
Agropyron spicatum	bluebunch wheatgrass	Erigeron pumilus	shaggy fleabane
Agropyron trachycaulum	slender wheatgrass	Lupinus sericeus	silvery lupine
Aristida longiseta	red three-awn	Opuntia fragilis	prickly pear cactus
Calamagrostis canadensis	bluejoint	Penstemon procerus	small flowered penstemon
Calamagrostis rubescens	pine grass	Selaginella sp.	selaginella/club moss
Carex spp.	sedges	Thalictrum sp.	meadow-rue
Elymus cinereus	giant wild rye	Tragopogon dubius	oysterplant
Festuca altaica	altai fescue	**SHRUBS**	
Festuca idahoensis	Idaho fescue	Amelanchier alnifolia	Saskatoon
Festuca scabrella	rough fescue	Arctostaphylos uva-ursi	bearberry
Koeleria cristata	June grass	Artemisia tridentata	big sagebrush
Stipa comata	needle and thread grass	Chrysothamnus nauseosus	rabbitbrush
Stipa richardsonii	Richardson's needle grass	Juniperus sp.	juniper
WILDFLOWERS		Mahonia aquifolium	tall Oregon grape
Anemone sp.	prairie crocus	Purshia tridentata	antelope/bitter brush
Antennaria dimorpha	dwarf pussytoes	Spirea betulifolia	birch leaved spirea
Artemisia frigida	pasture sage	Rosa spp.	prairie rose
Astragalus miser	timber milk vetch		

Ojibway tall grass prairie, Windsor, Ontario.

Locations of Prairie and Savannah in Southern Ontario



Ontario Prairie Restoration Species Priority List			
SCIENTIFIC NAME	**COMMON NAME**	**SCIENTIFIC NAME**	**COMMON NAME**
GRASSES		Helianthus gigantea	tall sunflower
Andropogon gerardi	big bluestem	Hypoxis hirsuta	yellow star grass
Andropogon scoparius	little bluestem	Krigia biflora	two-flowered Cynthia
Panicum virgatum	switch grass	Lespedeza capitata	bush-clover
Sorgastrum nutans	Indian grass	Liatris spicata	dense blazingstar
Spartina pectinata	prairie cord grass	Lithospermum canescens	hoary puccoon
WILDFLOWERS		Monarda fistulosa	bergamot
Anemone cylindrica	long fruited anemone	Lobelia spicata	spiked lobelia
Asclepias sullivantii	Sullivant's milkweed	Prenanthes racemosa	glaucous white lettuce
Asclepias tuberosa	butterfly milkweed	Pycnanthemum virginianum	Virginia mountain mint
Asclepias verticillata	whorled milkweed	Ratibida pinnata	tall coneflower
Aster azureus	azure aster	Silphium terebinthinaceum	prairie dock
Aster laevis	smooth aster	Solidago riddellii	Riddell's goldenrod
Aster praealtus	willow aster	Solidago rigida	stiff goldenrod
Aletris farinosa	colic root	Tradescantia ohiensis	Ohio spiderwort
Coreopsis tripteris	tall coreopsis	Vernonia gigantea	tall ironweed
Desmodium candense	showy tick-trefoil	Veronicastrum virginicum	Culver's root
Euphorbia corollata	flowering spurge		



Mixed grass prairie – western Saskatchewan.

Rough fescue prairie .

PHOTO: D. NERNBERG

Chapter 4

ACQUIRING SEEDS

PHOTO: D. R. COLLICUTT

A native prairie restoration seed mix.

There are three ways to acquire seeds for a restoration project: purchase them from a commercial supplier, harvest them from existing prairies (wild harvest), or produce them from a nursery (nursery harvest). Depending on the size and time frame of a particular project, one or all of these options may apply.

COMMERCIAL SUPPLY

Commercial suppliers of native prairie seeds and plants are emerging across Canada. Demand usually far exceeds supply because of the difficulty of collecting a wide array of often rare species. Discuss your seed needs well in advance with your native seed supplier and book early to avoid disappointment. The appendix lists known Canadian native seed suppliers.

WILD HARVEST OR NURSERY HARVEST SEED?

Commercial suppliers may be able to offer wild harvest seed from their region or nursery harvest seed. Nursery harvest seed may be of better quality, but wild harvest seed may have more genetic variability. Ensure that any nursery harvest seed was grown from parent stock from the appropriate area.

PURE LIVE SEED

Seed is normally purchased on a pure live seed (PLS) basis. That is, you pay for the amount of healthy seed in a particular lot. For example, if in 100 g of bulk seed only 75% is seed (25% chaff) and of that only 60% of the seeds will germinate (are alive), then the PLS calculation is 100 g X 0.75 X 0.60 = 45 g. Your original 100 g seed sample is actually 45 g of pure live seed. For wild harvest

seed, which may be a mixture of several species, a supplier may not be able to accurately determine PLS, but should be able to provide a rough estimate. PLS is difficult to estimate with most native plants, so these are often sold on a bulk seed basis. A reputable supplier will tell you whether their price is based on a pure live seed or bulk seed basis.

SEED ANALYSIS

When using native seed it is very important to know that certain species are NOT in your mix. These include perennial weeds such as quack grass, crested wheatgrass, smooth brome, leafy spurge, and Canada thistle. Ensure that your supplier guarantees the seed to be free of these noxious weeds as even small amounts will cause serious problems in a restoration. There is no excuse for having these in a prairie seed mix.

There are various ways to analyze the quality of seed that you harvest yourself. If possible, submit samples to a government certified lab for analysis. Most labs can now analyze seeds of native prairie species.

Older railroad rights-of-way often harbour good quality prairie relics.

You can check on seed quality by yourself with some care and a magnifying glass. With many grasses you will need to dissect the grain, or caryopsis, out of the surrounding plant material with tweezers. If it is hard, filled out and does not crush easily, it is likely good seed. Count 10 or 100 seeds out at random and examine each one. This will give you an estimate of the proportion of good seed.

Another method of assessing seed viability is with tetrazolium (TZ). TZ is a chemical stain that indicates the presence of living seed. Although it will indicate live seed, it will not give any idea of whether the seed will germinate or stay dormant.

THE ETHICS OF WILD HARVESTING NATIVE SEED

The only way to get more native prairie on the Canadian landscape is to actively replant it with seed from local remnants. Native prairie will not spread by itself in a heavily farmed and urbanized landscape. Using seed from local remnants ensures that the peculiar adaptations of local plant populations will never become extinct, and in fact will have more chances to grow and evolve in the future. Using seed from local prairies helps preserve their genetic diversity. Seed production on a native prairie is quite variable from year to year and species to species. Since almost all plants are perennials, very few reproduce from seed but from underground rootstalks. Most prairies have an extremely competitive, tightly-knit network of below ground roots and above ground stems that leave little room for seeds to germinate. Those seeds that do germinate are almost always on some type of disturbed soil on the prairie. These were areas such as bison wallows in earlier days, and now places such as pocket gopher, ground squirrel and badger mounds or floodplains.

Most seed produced is eaten by insects or birds, destroyed by fungi, or blown into unsuitable habitats such as cultivated fields. What seed remains in the seed bank may stay viable for years awaiting the chance that it might find suitable conditions for germination. In good seed production years, prairies produce an abundance of seed. Most of it never gets the chance to germinate.

Bison herds grazing on the historic prairie removed large amounts of seed by grazing activities. They also helped to move seed around in a number of ways. Prairie fires also destroyed immense amounts of seed both on the plants and in surface seed banks. Neither influence seemed to negatively impact the prairie. Today we manage our prairies with grazing and fire with excellent results. One prescribed burn removes more seed from a prairie in a few minutes than could be harvested off of it in several years.

Lands used as pasture or for cattle ranching often contain unbroken prairie of varying quality. Here the ungrazed road allowance in the forground has better quality and diversity of native seed.

Municipal and county road allowances and utility rights-of-way frequently have native plants, especially if they pass through areas of native pasture and hayland or parallel rail lines.

When seed collecting on native prairies it is prudent to do it with care. Restoring prairies implies proper care of the remnants supplying the seed. Follow these rules when collecting seed:

1) Request permission from landowners where you want to collect seed, and respect all of their wishes in regard to that land.

2) Do not collect all the seed on any given remnant, leaving at least 30% of the seed in place to replenish the seed bank and feed wildlife.

3) Do not collect large amounts of seed from the same site in consecutive years, but leave an area to rest for at least one year before going back to it.

4) Do not use heavy machinery when the ground is wet or soft, to avoid leaving ruts or disturbing the sod.

5) Never dig up native plants unless they are in immediate danger of being destroyed. Removal of native plants from their habitats is unethical on private land, and often illegal on public land. Transplants rarely survive the move in any case.

LOCAL PRAIRIE INVENTORY

In order to engage in wild harvesting you will have to locate some native prairie remnants in your area. A selected list of native prairies in each province is given in the appendix.

GETTING PERMISSION

Requesting landowner permission is basic common courtesy. A letter from the landowner would be helpful if you are ever approached by concerned locals, police or conservation officers. Access to corporate or public lands usually requires at least a written request for permission. Responses will vary greatly depending on the particular agency. Some may even request payment for access to their land. A reasonable level of remuneration may be about what the land would normally be leased at, for haying or grazing, or 10 to 20% of the seed collected.

MANAGING THE HARVEST SITE

If you have enough lead time there are measures you can take to increase the seed abundance on prairies you want to harvest. Burning a tall grass prairie site the previous fall or in spring before harvest will enhance the growth and seed production of many species. Properly timed grazing or mowing the season before harvest can have similar effects. In the tall grass prairie region, grazing between mid-June and late July stimulates seed production in the dominant warm season grasses the following summer.

Less is known about the effects of fire and grazing on seed production in mixed grass and fescue prairies. Consult with local prairie management experts in your area for more information. You also could do your own small scale experiments and assess the effects.

Wetland margins commonly contain native prairie communities in otherwise cultivated farmlands.

Steep south and west facing slopes along coulees, streams rivers and escarpments often have high quality prairie communities.

Idle industrial lots around the edges of cities and towns may have native prairie remnants that have escaped the plough.

Pioneer cemeteries, such as this one near Rosser, MB often contain relict prairies.

Municipal and provincial parks, ecological reserves, and wildlife management areas, may contain native prairies.

PHOTO: CAROL MORGAN

Request permission to harvest seed on private and public lands.

PHOTOS: BILL BREMNER

Carefully controlled spring managed burns enhance seed production and improve the health of tall grass prairies.

PREPARING FOR SEED HARVEST

Once you have access to some prairie sites, the process of preparing for harvest begins. No one harvesting technique or time period will provide all the seed from all the species you desire. Acquiring the needed quantities and diversity of seeds requires some strategy. This will entail site inventories, monitoring of plant phenology, and preparing harvesting equipment.

An inventory of the plant species occurring on a site allows you to guage its quality, determine its potential for harvest, locate desired plant species and avoid weed infested areas. Most plants are best located and identified when they are in flower. To identify all the plant species that occur in a given site requires that you survey the site over the entire growing season. Monitor your sites regularly. Abundant flowering at a site does not automatically mean abundant seed production.

If you find a particular plant or patch from which you later wish to harvest seed, mark it! Don't rely on your memory to find the same spot several weeks or months later. The site and the plants can look quite different then.

On the Canadian prairies flowering plants can be found from mid-April, starting with the prairie crocus, until late October when asters may still be in bloom. With varied blooming periods comes varied periods of seed ripening. Crocus seeds may be ripe by as early as late May, while some asters may not ripen until November. Since it is always best to harvest seeds when they are properly ripened, seed harvesting can occur over a lengthy period each year. Most plants will disseminate their seed shortly after it is fully ripened, so careful attention to ripeness is essential.

Local soil, moisture and weather conditions, or other factors like fire history, latitude and altitude, can result in variable ripening times for given species in the same region. Individual plants of most species do not ripen all at one time, but over a period of weeks.

Table 1 gives a selection of native species harvest dates from data gathered in Alberta and Manitoba. It should be used not as an exact schedule for seed harvest, but as a general guideline. For example prairie crocus seed is best found in late May and early June. Looking for it in October will be fruitless. Some species such as cord grass and Canada wild rye will hold seed for months after ripening. Others, such as needle and thread grass, are ripe for a few days only, then drop their seed.

WHEN IS A SEED RIPE?

In most plants the seeds or seed head will begin to dry and change colour as it ripens. If the seed strips off easily by hand, or if tapping seed heads gently into your palm produces numbers of seeds, it is ready to harvest. Colour is another good indicator of ripeness, with the seeds often turning white, black, brown or grey. Seeds that are difficult to remove from the plant and are still green are not ripe. Harvesting seed that has not fully ripened may result in reduced viability.

SEED HARVEST

The type of harvesting you use will determine the degree to which you must plan and monitor sites. If you intend to acquire seeds from as many species as possible, representing the full array of plants on the prairies, you will have to include hand harvesting. If your goals are more modest and large quantities of a few species are desired, then larger scale machine harvesting may suffice. If you plan to restore several sites, or one large one, over several years you will need to continue a seed harvesting or nursery production program.

Hand Harvesting

Hand harvesting involves walking through sites and stripping seeds and seed heads from individual plants.

Marking a Kalm's lobelia stand in flower.

Gaillardia in flower looks quite different than...

Gaillardia in seed.

TABLE 1: Selected seed harvest dates – average of Alberta & Manitoba data. Ripening times generally are earlier with increasing altitude and latitude.

SCIENTIFIC NAME	COMMON NAME	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER
				GRASSES				
Agropyron spp.	wheat grasses							
Andropogon gerardii	big bluestem							
Andropogon scoparius	little bluestem							
Bouteloua gracilis	blue grama							
Bromus ciliatus	fringed brome							
Calamagrostis montanensis	plains reed grass							
Calamovilfa longifolia	sand reed grass							
Carex spp.	sedges							
Elymus canadensis	Canada wild rye							
Festuca spp.	native fescues							
Helictotrichon hookeri	Hooker's oat grass							
Hierochloe odorata	sweet grass							
Koeleria cristata or gracilis	June grass							
Muhlenbergia spp.	muhly grasses							
Oryzopsis hymeniodes	Indian rice grass							
Panicum virgatum	switch grass							
Poa spp.	native blue grasses							
Sorghastrum nutans	Indian grass							
Spartina spp.	cord grasses							
Sporobolus spp.	dropseeds							
Stipa spp.	needle/spear grasses							
				WILDFLOWERS				
Achillea millefolium	yarrow							
Allium textile	prairie onion							
Amorpha canescens	leadplant							
Amorpha nana	dwarf false indigo							
Anemone cylindrica	long fruited anemone							
Anemone multifida	cut-leaved anemone							
Anemone patens	prairie crocus							
Antennaria aprica	pussytoes							
Apocynum cannibinum	Indian hemp							
Artemisia frigida	pasture sage							
Artemisia ludoviciana	prairie sage							
Asclepias spp.	milkweeds							
Aster spp.	asters							
Astragalus crassicarpus	ground plum							
Astragalus striatus	ascending purple milk-vetch							
Balsamorhiza sagiittata	balsam root							
Campanula rotundifolia	harebell							
Castilleja spp.	Indian paint brushes							
Cerastium arvense	field chickweed							
Chrysopsis villosa	hairy golden-aster							
Comandra pallida	pale comandra							
Echinacea angustifolia	purple coneflower							
Erigeron spp.	fleabanes							
Eupatorium purpureum	joe-pye weed							
Fragaria virginiana	wild strawberry							
Gaillardia aristata	gaillardia							
Galium boreale	northern bedstraw							
Gaura coccinea	scarlet gaura							
Gentiana spp.	gentians							
Geum triflorum	three flowered avens							
Glycyrrhiza lepidota	wild licorice							
Helenium autumnale	sneezeweed							
Helianthus spp.	sunflowers							
Heliopsis helianthoides	rough false sunflower							
Heuchera richardsonii	alum root							
Hypoxis hirsuta	yellow star grass							
Juniperus horizontalis	creeping juniper							
Lactuca pulchella	blue lettuce							
Lathyrus venosus	wild peavine							
Liatris ligulistylis	meadow blazingstar							
Liatris punctata	dotted blazingstar							
Lilium philadelphicum	prairie lily							
Linum lewisii	Lewis wild flax							

SCIENTIFIC NAME	COMMON NAME	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER
Lithospernum canescens	hoary puccoon							
Lobelia spicata	pale spiked lobelia							
Mentha arvensis	wild mint							
Mondarda fistulosa	bergamot							
Oenothera biennis	yellow evening-primrose							
Orthocarpus luteus	yellow owl's-clover							
Oxytropis splendens	showy locoweed							
Parnassia palustris	grass-of-parnassus							
Pedicularis canadensis	common lousewort							
Penstemon spp.	beardtongues							
Petalostemon spp.	prairie clovers							
Phlox hoodii	moss phlox							
Physalis virginiana	prairie ground-cherry							
Polygala senega	seneca root							
Polygonatum spp	solomon's seal							
Potentilla spp.	cinquefoils							
Psoralea spp.	psoraleas, breadroot							
Ratibida columnifera	yellow coneflower							
Rosa spp.	roses							
Rudbeckia hirta	black-eyed Susan							
Sisyrinchium montanum	blue-eyed grass							
Solidago spp.	goldenrods							
Sphaeralcea coccinea	scarlet mallow							
Thalictrum venulosum	veiny meadow-rue							
Thermospsis rhombifolia	golden-bean							
Veronicastrum virginicum	Culver's root							
Viola spp.	violets							
Zigadenus elegans	smooth camas							
Zizia aptera	heart-leaved alexander							
Zizia aurea	golden alexander							

It is labour intensive, slow and will never provide sufficient quantities of seed for large restorations. However, it can be vital to the integrity of a project because it allows for the collection of many more species than does mechanical harvesting. Early or late seeding plants, rare or uncommon species, or those which occur in small patches often are best harvested by hand.

Hand harvesting also allows seeds of individual species to be collected separately. This is important if the seed requires specialized treatments prior to sowing or if the seed is to be used for nursery propagation. Hand harvesting also provides opportunities for volunteer involvement, a factor with educational and public relations benefits. Large numbers of volunteers can collect substantial amounts of seeds.

Equipment for hand harvesting should be simple and easily portable. A simple method is to tie several plastic shopping bags onto your belt, and collect individual species in each. Keeping both hands free is important to the efficiency of hand harvesting.

Mechanical Seed Harvesting

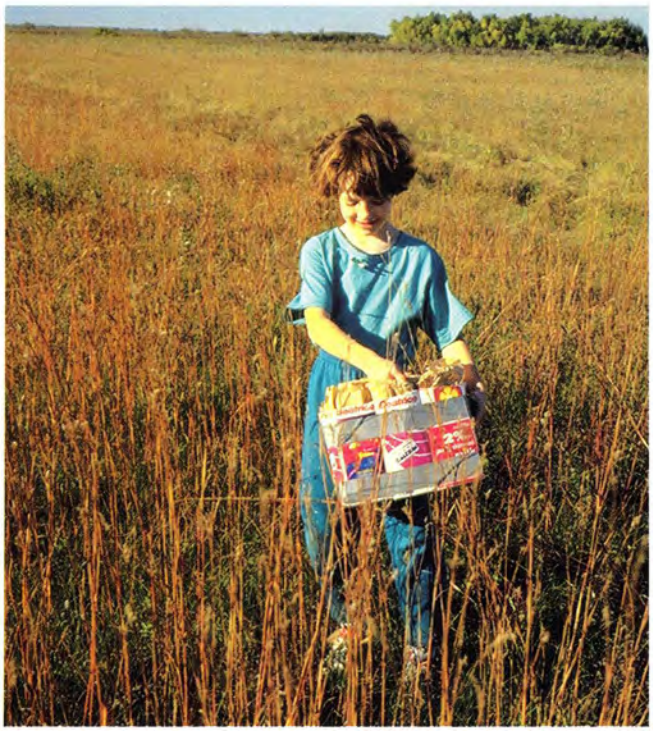
Harvesting with specialized machinery is the only way to get enough seed for large restoration projects. Harvesting machines can be grouped into four categories: portable seed strippers, pull-type seed strippers, combines, and native hay harvesters. Small machines can be used effectively in rough terrain to harvest individual species in discreet patches from the wild or in nurseries. Large machines can supply the greater volumes of seed required for large restorations, but require more even terrain and are less portable.

Native Seed Strippers

Most specialized native seed harvesters, either portable or pull-type, function on a "rotating bottle-brush" principle. Seed is swept or combed off plants and collected in a hopper as the harvester is carried or propelled along. These machines have little impact on existing prairies, leaving plant stalks erect. Even small, portable harvesters are a great improvement over hand harvesting. For large restoration projects the costs of purchasing a native seed harvester can easily be recouped in savings from not having to buy seeds. Conduct your own cost benefit analysis prior to purchasing a harvester. Weigh the cost of purchasing your required amounts of seeds against the price of a harvester and the time and expense of collecting your own seed. Manufacturers who supply specialized native seed harvesters are listed in the appendix. If purchasing a machine is not practical, consider renting one or contracting with someone to harvest seed for you.

PHOTO: D. NERNBERG

Hand harvesting wild licorice at Last Mountain Lake, Saskatchewan.



An effective container can be made by attaching several two-litre milk cartons together. With a paper lunch bag in each carton, and the unit clipped to the gatherer's belt, seeds from several species can be harvested at once and kept separate.

Stiff goldenrod seed heads.

Dotted blazingstar in seed.

Combines

Combines can be used to harvest seeds on prairies, provided you have access to large sites with even terrain, and can make the necessary operating adjustments. They have trouble harvesting prairie seed because many species have light, fluffy seeds. Separating these seeds from the straw is difficult, so combines often lose much of the seed with the chaff. Straight combines also change the face of the prairies they harvest because they cut the plant stalks near the ground, leaving little standing nesting cover or fuel for managed burns. A prairie can only be combined once in a season, missing earlier or later ripening species.

If using a combine to harvest native prairie, smaller older models with straight cut headers are best. Prairies may not produce enough standing material for swathers to create a windrow for a pickup header. After-market sickles with double the cutting surface should replace factory sickles on the straight cut header knife. Sickles and guards must be kept sharp.

Separator fan wind speed must be reduced or eliminated altogether by closing the air intake. Flatten protruding edges that might restrict seed flow. With fluffy species, auger and elevator plugging is common. This necessitates constant monitoring and cleaning to ensure continuous

Hand held portable seed stripper collecting Canada wild rye.

PHOTO: P. A. WOODLIFFE

Pull type seed stripper harvesting little bluestem on a tall grass prairie in SW Ontario.

seed flow. Sieves must be set, by experimentation, to achieve maximum separation of chaff and seed and minimum seed loss. In spite of these precautions, considerable seed may still be lost over the sieves and straw walkers. A chaff saver pulled behind the combine to collect straw or second combine following close behind may be necessary to reprocess the already harvested material.

Significant disadvantages of combines include their large size and weight with the potential for damage to prairie remnants, their complexity requires operators with a thorough knowledge of their running and repair, and their lack of portability.

Seed stripper hopper full of big bluestem seed – over 50 kg in 2 hours.

Native Hay

Hay gathered from a native prairie may have varying amounts of seed, depending upon when it was harvested. The advantage of this method is the equipment and expertise readily exists in most farming areas. Swathers cut the prairie down and leave it in windrows. Balers pick up the windrows and form it into bales. These can be transported to a restoration site, broken up and applied to the soil.

Disadvantages of using the native hay method are the need to use fairly large tractors to pull swathers and balers with their possible impact on the native prairie, the unknown quantity of seeds, the logistics of moving large volumes of bulky straw, and the difficulty of getting good seed to soil contact. This method may have more application in mulching an already seeded restoration.

Pull type native seed strippers are able to collect large volumes of diverse native seeds efficiently with minimal impact on the native prairie.

Chapter 5

SEED PROCESSING

PHOTO: D. NERNBERG

Most wild harvested seeds will require some processing prior to sowing. In certain instances, such as hand broadcasting bulk seed or simply spreading out seed bearing hay, processing your harvest may not be necessary. Processing allows for assessment and inventory of your wild harvested seed. You need to know how much seed, of which species, you have in order to plan your seed mixture properly. Processing also facilitates proper seed storage, allows for efficient pre-sowing treatment of seeds, if required, and prepares seed for sowing with native seed drills or broadcasters. Processing large quantities of machine harvested seed mixtures can be an arduous task. Attention to harvesting techniques that provide the cleanest possible seed is important. Seed strippers are capable of collecting seed in a near-sowable form. Often, screening of the materials to remove stalks or straws is all the processing that is required.

Processing native prairie seed often requires innovative thinking and custom equipment. Assess the particular batch you wish to process, then decide on the degree of processing required. Experiment with various techniques to find out what works best. One or more treatments may be required for a particular batch.

DRYING

The first step in processing any seed lot is to dry it. Masses of even slightly moist vegetation will rapidly begin to compost (heat and decay). A large enough mass can heat to the point of killing the seed in only a few hours! Excess moisture in unprocessed seeds can promote the growth of fungi which can also destroy the seeds.

Drying batches of seeds is straightforward. Small bags can be left exposed to the air, but protected from rain, wind, rodents and birds, with the contents stirred or shaken occasionally until dry. Larger quantities can be dried by spreading the materials out onto a table, tarpaulin or any surface from which the material can be easily re-

Drying native seeds.

bagged. If stored indoors, a fan blowing over the materials will speed drying. Large batches may be dried with the aid of commercial grain drying equipment.

Once dried, processing to remove and clean the seeds can begin, or they can be stored safely, protected from pests and the elements, for later processing. Processing your harvest can entail various techniques, ranging from simple hand sorting to use of commercial fanning mills. Remember, the seed needs only to be processed to the point where it can be sown effectively. For nursery propagation or experimental plantings you may wish to produce perfectly clean, pure seed, but this will increase your processing time and effort.

SCREENING

Screening separates seeds and smaller particles from larger matter. The material is spread onto a screen, then rubbed across it or the screen is shaken. Seeds and small debris pass through the screen. By using several different types and sizes of screens, you can separate many species of seed from chaff.

A series of kitchen sieves with different mesh sizes are readily available from most grocery stores. Commercial sample screens and hand sieves are available from seed cleaning suppliers listed in the appendix.

WINNOWING

Winnowing is an ancient seed cleaning technique, where moving air is employed to separate seeds from similar sized, but lighter or heavier particles. It is generally employed after screening or milling. In its traditional form, winnowing involves tossing seed batches into the air from a broad tray in a light breeze. The wind blows away the lighter chaff, leaving cleaner seed and heavier debris. There are numerous variations on this theme, culminating in commercial air column separators.

A small scale winnowing system can be made with a household fan. Material is dropped in front of the fan onto a flat clean surface. By experimenting with fan speed and the height from which the material is dropped you can separate the various components onto your collecting surface by their weights. Heavier materials will fall closer to the fan, with lighter ones further away. The result will be a regular stratifying of material, with clean seed in one of the bands.

Commercial fanning mills combine the action of both sieving and winnowing. They can be purchased in a variety of sizes from table top models to industrial capacity at seed cleaning suppliers or sometimes at farm auctions. Commercial seed cleaning companies exist and may also be able to help with large scale seed cleaning.

MILLING

Milling involves breaking or chopping up the larger materials in a seed batch to either release seeds from seed heads or pods, or cut up larger materials so they can be easily removed by winnowing or screening. This is most often used for legumes with large pods, such as ground plum, or wildflowers like purple coneflower or bergamot where the heads must be broken up to release the seed.

Various equipment can be used to mill batches of seed pods or heads. Agricultural de-bearders, hammer mills, feed grinders and chipper shredders are effective for large quantities of seed. Household rolling pins, mallets and blenders work fine for smaller amounts. The resultant mix of seeds and chaff will then need to be screened and/or winnowed to extract the seed.

THRESHING

Threshing involves agitating seed heads to dislodge ripe seeds (as opposed to milling which crushes or chops seed heads). It can be as simple as beating a seed head against a hard surface or flailing with a blunt instrument. Portable

or bundle threshers are machines that mechanize this process. An inexpensive small thresher can be made with a salvaged re-threshing unit from an old combine.

COMBINES

A combine is basically a moveable threshing machine attached to a fanning mill. Bulk seed can be pitchforked into a combine for processing. Semi-clean seed can be run through the straw walkers and sieves only, bypassing the cylinder and concave.

DE-BEARDERS

Certain native grasses like Canada wild rye or spear grass have long awns, or beards, that make handling and sowing difficult. Others such as little bluestem are difficult to harvest without a lot of straw, of similar density to the seed, and thus difficult to remove. These species can be processed by a de-bearder that grinds the awns and straw without damaging the seed. Seed can be further processed by another method to remove the ground awns and straw, or seeded directly.

PULPY SEEDS

Some prairie species, such as cactus, wild rose, and snowberry, have fleshy or pulpy fruits. These can decompose in storage and destroy the seed. To process these the

Different sized screens are useful in cleaning seed.

Small fanning mill (left) and blanket cleaner (right) are useful for cleaning native seed.

A series of screens can be made from various guages of screen or hardware cloth. Make wooden frames to fit the screens and construct a box to fit the frames into.

Using a rolling pin to crush Canada milkvetch seedpods to extract the seed.

PHOTO: D. NERNBERG

Portable bundle thresher.

PHOTO: D. NERNBERG

Debearder.

Here little bluestem with large amounts of straw is being dropped through a trap door in the back of this Massey Ferguson 300 combine. The elevator chain has been removed so that seed does not travel up into the grain tank, but augers out onto a tarp on the ground. This set up removes most of the large straw from the seed. From here it will now go to a de-bearder to break up the remaining small straw.

Rodents can cause serious damage to precious native seed – be vigilant!

fruits are mashed, mixed with water and stirred until the seed separates from the pulp. Healthy seed usually sinks, while the pulp floats, or vice versa. Rinsing the seeds through the appropriate sized screen will remove remaining flesh. Most are then best seeded immediately before being allowed to dry out.

DELAYED PROCESSING

Some species are best left unprocessed for long term storage. The seeds of legumes, for example, will loose viability rapidly if their seed coats are damaged. They are best processed just prior to sowing, if your procedure has the potential to damage the seed coats.

SEED STORAGE

Seed storage is an important consideration in any restoration. Usually, seed is stored for at least one winter before sowing. The most important considerations in seed storage are humidity, temperature and pests. Seed must be stored dry, and kept that way. This involves ensuring that the seed is evenly dry before being placed into containers. The storage area should be secure from the weather, and not subject to floods or leaky roofs. If the area is damp, a dehumidifier should be used, especially in warm weather.

High temperatures over 28°C can reduce seed viability quickly. Seed is best stored at about 4°C with less than 10% humidity. Temperatures above this will lessen the storage life of the seed. Freezing generally prolongs storage life. The intrinsic storage life of seeds will vary greatly with the species. Some legumes may remain viable for decades, while asters and goldenrods may lose all viability in a year or two.

Pests are a serious concern. Insects collected with the seed can devour it even after it is stored. Inspect your seed with a hand lens. If grubs or caterpillars, or their effects or droppings, are apparent, treat with pesticides or by freezing. Mice, rats, squirrels and chipmunks can damage stored seed in a short time. Keep seed in rodent proof containers, and be vigilant in the storage area with mouse traps, poison and/or a good cat. Concrete floored steel granaries are generally rodent proof and fine for winter storage. Temperatures inside a steel granary in the summer, however, can reach extreme levels that can kill seed. Well maintained insulated wooded granaries are best for storing seed.

Stored native seed.

Prairie crocus

Chapter 6

NATIVE PLANT PROPAGATION

Growing perennial native plants from seed can be challenging. Most species exhibit some degree of seed dormancy, an innate mechanism that prevent seeds germinating too quickly, or all at once. Seed dormancy has evolved to promote germination at the optimum time, usually in spring when soil moisture levels are high. A few simple techniques can be applied to overcome seed dormancy and ensure reasonable levels of germination. Knowing which technique to apply to each species requires some research or experience.

STRATIFICATION

Stratification involves exposing seeds to a cold and damp period prior to planting. Most native plants do this naturally by seeding out in late summer or fall. Their seeds lie cold and damp on the soil surface for at least one winter before germinating. Stratification mimics this process. Natural inhibitors are leached out of the seeds or broken down during stratification. Place seeds in a clean bag or container with a little moisture, enough to make them damp, but not soggy. Place them in the fridge for one to three weeks, then plant immediately. Stratification dramatically improves germination in most native grasses and wildflowers. Many native shrubs and some trees need longer periods of stratification, up to two years.

SCARIFICATION

Scarification is the intentional damaging or removal of the seed coat. Seeds of legumes and some other plants have tough, impervious (to water) seed coats that keep the seed dormant until at least a part of the coat has been removed. In nature this often was accomplished by the seeds passing through the digestive system of an animal. Seeds can be scarified by rubbing them between two layers of sandpaper. Or they can be immersed in sulphuric acid for a few minutes. Large seeds such as Indian breadroot can be nicked with a file. Legumes respond extremely well to scarification, and will germinate readily when planted immediately afterwards. Scarification should not be applied until the seeds are about to be sown.

NURSERY PRODUCTION

Nursery propagation of native plants in field plots allows more careful control of their early growth stages, facilitates learning about each species' form, shape and colour, and provides a proven way of increasing seed production for a restoration. An ideal nursery should be in sandy, perennial weed-free soil, be slightly elevated to prevent flooding in wet spells, sheltered from the prevailing winds and have ready access to abundant water supplies. Keep plots no more than 1.2 m (4 ft) wide. This allows a person to reach easily into the centre of the plot for weeding or transplanting without trampling plants. Ensure enough space is left around each species' plot to rototill for weed control.

Even small nursery plots can produce significant quantities of native seed. Well tended, hand weeded nursery plots usually produce larger plants with more seed than the same species in the wild. For example, our 1.2 by 12 m (4 by 40 ft) nursery plot produces about 1.8 kg (4 lb) of clean black eyed susan seed per year. A similar sized plot of Canada wild rye produces about 3 kg (7 lb) annually. Nursery seed production depends upon soil type, climate, moisture and weed control. As in wild seed harvesting, it can vary considerably from year to year.

Larger scale seed production plots covering several hectares can produce large volumes of seed. They require highly skilled personnel, specialized equipment and intensive management. They are outside the capability of most restorationists and are best left to professional seed growers.

GREENHOUSE PROPAGATION

Growing native plants in a greenhouse or under lights is another way to get more seedlings for a restoration or nursery. Many plants can be grown in a small area for later transplanting out.

Native seed stratifying in ziplock bags.

Scarified Indian breadroot seeds.

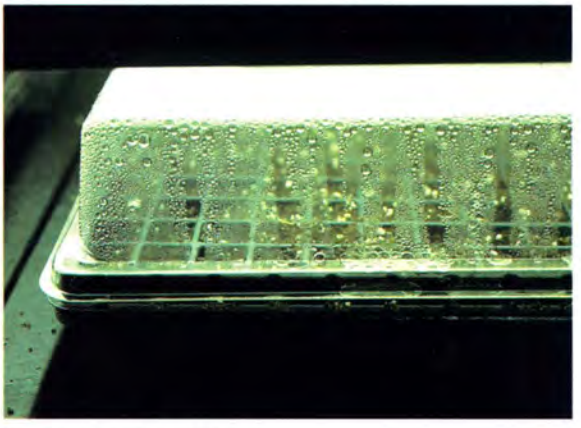
Nursery preparation is a proven way of increasing seed production for a prairie restoration, but requires a lot of work!

This 1.2 by 12m plot of black eyed susan produces about 1.8 kg (4 lbs) of seed/year.

For your valuable native seed, do not use garden or potting soil. Use a sterile seed-starter mix of peat moss, perlite, and vermiculite, available from garden centres. They are weed and disease free, and do not become hard packed after several waterings as many garden soils do. Choose a container at least 10 cm (4 in) deep, and fill with starter mix. Tamp lightly to remove air pockets. Water thoroughly before you seed. Heavy watering afterwards may wash smaller seed too deep for germination or proper growth. Press the seeds firmly into the surface of the mix. Do not cover with more mix as most prairie species germinate better in the light. Instead, cover with plastic to retain moisture. Place the containers somewhere warm and bright. If the surface begins to dry, mist with an atomizer or sprayer, but do not water heavily. Keep covered until the seeds germinate and form their first set of leaves. Uncover and water normally until ready to transplant.

If fungi appear on the surface of the mix, treat with a horticultural fungicide such as benylate. If the seedlings start

A peat moss based growing mix is essential for successful greenhouse propagation of native plants.

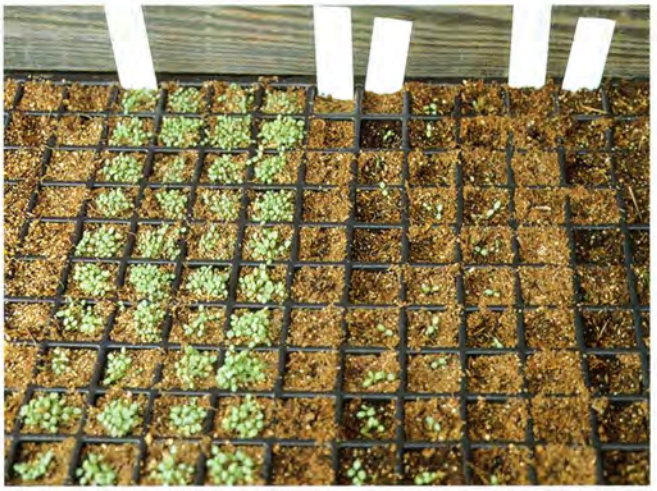


Plant seeds on pre-moistened surface, do not cover with soil, but with plastic to keep in moisture until germination.

to wither and die, they are damping off, the result of infection by an airborne fungus. Treat with No-Damp fungicide.

Growth under natural sunlight is best for prairie seedlings. They can be started as early as late February for June transplant. Starting plants under lights is possible, but they must be very bright, full spectrum grow or halide lights or growth will be spindly. Move the plants into sunlight as soon as possible.

Deep pots such as these forestry cell trays or milk cartons give the deep root systems of prairie plants the best start.



Native seeds may take from a few days to several months to germinate.

Chapter 7

SITE PREPARATION

Proper site preparation is the foundation of any prairie restoration. Skimp or cut corners here and you risk prolonging or dooming your project. Good site preparation starts with a thorough analysis of existing conditions. From this you formulate a plan to assemble the equipment and expertise necessary to prepare the site properly.

Potential restoration sites fall into three basic categories:

1) Bare topsoil

2) Exposed subsoil or fill

3) Existing vegetation

Site preparation techniques for each are discussed next.

Harrowing or raking removes surface lumps.

*Roller packing to create a firm seedbed is essential **BEFORE** drill seeding.*

*A hand roller here is being used **AFTER** broadcast seeding.*

On a properly roller packed site – a footprint barely registers.

1) BARE TOPSOIL

A bare topsoil site usually has little or no vegetation and exposed, loosened topsoil, as found in agricultural crop fields or home gardens. If perennial weeds are present, they should be eliminated with appropriate measures before proceeding. If large lumps are present a light raking, harrowing or cultivation will be necessary to even out the surface.

Soil packing is an important factor in site preparation. Packing compacts the soil, creating a crust at the soil surface, reducing evaporation from deeper in the soil profile, keeping moisture available for seeds and seedlings. It also ensures good seed to soil contact, vital for germination.

Packing with a water filled roller creates a proper seedbed for drill seeding. Use the largest and heaviest roller packer that you can pull with your tractor. Small sites can be packed with a lawn roller pulled by hand. Twice over a field with a roller packer is a minimum before drill seeding, with the second packing operation at right angles to the first. A site is ready to drill native seed if your footprint barely registers. If your foot sinks in more than one cm (1/2 in), pack again. If you are broadcast seeding, packing must be done after seeding.

2) EXPOSED SUBSOIL OR FILL

Newly exposed subsoil resulting from highway or other construction can provide a good, weed free medium for a prairie restoration. Prepare the site quickly, before weed seeds have a chance to blow in and take hold. In a raw clay subsoil, adding peat moss and sand will improve the structure and drainage of the soil. Do not add landscaping topsoil, manure or fertilizer. Prairie species do not need good soils or high levels of nutrients. Landscaping topsoil or manure invariably contains large amounts of weed seeds. If weed-free topsoil is available this can be used to amend poor soils.

PRAIRIE SOIL SALVAGE – A SPECIAL CASE

Unfortunately, native prairies are still being ploughed up and destroyed across Canada. Salvaging topsoil from such sites provides numerous benefits for prairie restorations. If you have this option, use it, as salvaged soil from high quality prairies contains valuable microbes, seeds and roots that will greatly enhance a restoration.

3) EXISTING VEGETATION

Preparation of a site with existing, but undesired, perennial vegetation can be difficult and lengthy. It may take several years. Abandoned lots, old fields and lawns typically are dominated by aggressive non-native grasses such as smooth brome, crested wheatgrass, quack grass or Kentucky bluegrass and perennial weeds such as Canada thistle and perennial sow thistle. Control of these species requires persistence.

To begin, burn the site to remove the accumulated litter and surface seed bank. If a burn is not possible, mow and remove the clippings. Allow the vegetation to regrow to about 20 cm (8 in) in height. Then begin a series of herbicide applications with a qualified, licensed applicator. We have had good luck using a mixture of 2% glyphosate to kill grasses plus 2,4-D and MCPA to kill broad-leaved weeds. Several applications beginning in late summer, then the following spring, summer and fall are usually necessary. Back-pack sprayers may suffice for small sites. Larger areas need estate or field sprayers. Certain weeds, such as Canada thistle and leafy spurge, may not be controlled even by this regime of herbicides. Specific control of using more specialized herbicides with spot sprayers often is necessary.

When using herbicides, it is imperative that properly trained and licensed personnel with suitable equipment and protective clothing be employed. Consult local weed control experts first and follow label directions carefully.

Newly exposed subsoil from construction projects can provide a clean, weed free medium for prairie restoration.

A special deep sod cutter removes native prairie sod intact for transplant to a safer site along Omands Creek in Winnipeg.

PHOTO: B. BENN

Laying salvaged native sod in Calgary.

Herbicides often are necessary to get rid of tough perennial weeds.

PHOTO: D. COLLICUTT

Tractor mounted rototiller preparing a restoration site at Kil-Cona Park in Winnipeg.

Once a season of chemical control has been carried out, the remaining above ground vegetation must be removed either by fire or mowing and removal of the clippings.

Cultivation should begin in the spring following herbicide treatments. Small sites can be dug by hand or with a rototiller. Larger sites will require a tractor with appropriate cultivators. Cultivate or rototill the site with a deep tiller down to about 10 cm (4 in). Cultivate a second time at right angles to the first. Harrowing (raking) the ground with diamond or spring toothed harrows will then smooth any surface irregularities or ruts. Roller packing then can follow if you are drill seeding.

PHOTO: D. COLLICUTT

Cultivating annual weeds before seeding a prairie.

Chapter 8

SEEDING

A simple yet effective hand broadcast system with a chain drag to incorporate seed.

When to Seed

Try to anticipate the weather, and seed before a rain. While it is hard to predict, you can increase your chances of getting a good rain on your plot if you know the long term average time of maximum rainfall in your area. In most of the tall grass prairie region this is in late spring or early summer. In Manitoba this is in June. Further west in the mixed grass prairie, this is generally earlier in May or even April.

Seeding Methods

There are two methods of seeding a prairie restoration. The first, and most effective, is with a specialized native seed drill. The second is with hand or mechanical broadcasters. Both have pros and cons for the restorationist.

SEEDING EQUIPMENT

PHOTO: B. HARPER-LORE

Tractor mounted broadcast seeder.

Seed Drill

A seed drill is a tractor-pulled implement with a series of small ploughs or discs that open furrows in the soil, then tubes meter in a specific amount of seed from a top-mounted storage box. Soil falls back into the furrow and is packed by rubber press wheels. In Manitoba, we have used a Truax native seed drill with good success for prairie restorations. Other makes are the Tye, Nesbit and Great Plains native seed drills, the John Deere rangeland drill and the John Deere power seeder.

Native seed drills are the most efficient means of seeding a prairie. By accurately placing seed at an appropriate depth and even rate across the site, they make the most efficient use of precious native seed. Seed can be drilled at half the rate recommended for broadcast seeding. Drills condense your seeding into a one-pass operation and allow you to seed on windy days.

One drawback of drills is the need for clean seed. Even small amounts of straw will plug up the drill, necessitat-

PHOTO: D. COLLICUTT

Truax native seed drill.

ing time consuming stops to clean out blocked seed tubes. Most newer drills require that your tractor have at least single hydraulic outlets. Drills also seed in parallel rows, which may result in aesthetic concerns. However, the resultant rows of plants usually disappear over time as the vegetation fills in. Seeding in two passes at right angles to each other, can reduce this row effect, but seeding rates must be adjusted and more time allowed for sowing.

Seed Broadcaster

Broadcast seeding may be as simple as scattering seed from a bag by hand, or may involve machines that range in size and complexity. The simplest is one you strap across your chest and walk while turning a hand crank that throws the seed out in a regular pattern. The next level up is a push or pull type fertilizer spreader with a hopper above a rotary shaft that meters seed through a slot in the bottom, where it falls to the ground. The most advanced broadcasters are tractor pulled or three point hitch mounted fertilizer spreaders.

The chief advantages of broadcast seeding are that it can be accomplished without large, expensive machinery and the seed does not require as much processing. A certain amount of prairie straw can be useful in providing a mulch. The main disadvantage is its inefficiency, relative to drilling, requiring twice as much seed per unit area. This is because seed is placed on the surface, rather than buried as with a drill, and the rate is less even.

Most broadcasters will not handle fluffy seed without modifications to the agitator, distribution mechanism and opening. Mixing the seed with an inert carrier such as cracked wheat, ground corn cobs, vermiculite or coarse sand can aid its flow through the broadcaster. Broadcast seeding requires a mechanism for incorporating the seed shallowly into the soil. On small plots the seed can be raked in lightly by hand. A heavy chain dragged behind broadcast seedings will incorporate the seed. Roller packing then is necessary after broadcast seeding to ensure good seed to soil contact.

Wildflower Seeder

A recent innovation that combines the efficiency of a drill with the lower equipment cost and flexibility of broadcasting is the Truax wildflower seeder. According to the manufacturer, it is intermediate in efficiency, requiring about 50% more seed than a drill. It has a seed box that meters seed onto the ground, where baffles ensure even distribution with no visible row effect. Covering bars bury the seed and a packer unit ensures good seed to soil contact and a firm seedbed. Cheaper, smaller and more portable than a drill, the wildflower seeder can be pulled by an ATV or garden tractor. It does not require hydraulics. It does, however, require clean, straw-free seed.

SEEDING RATE

Suggested seeding rates are usually given as weights of seed per unit area. This is somewhat misleading, since you are really trying to achieve the placement of an appropriate number of individual seeds per unit area. You want to sow sufficient seed to ensure enough seedlings will survive to fill in your site with mature plants. If you were to try to calculate this you would need the following information for each species you intended to sow: the unit weight of the seeds (#/g), their germination rate (%), the annual survivorship of seedlings (%/yr) and the intended density of mature plants (#/m^2). This is a daunting task and one that most people simply avoid. They rely on past experience or the experiences of others to provide them with reasonable seeding rates. And that's all we can do here! Much research remains to be done in the area of understanding and defining seeding rates that will lead to successful restorations.

We have had good success in Manitoba tall grass prairies with native grass drill seeding rates around 11 kg PLS/ha (10 lb PLS/ac) and wildflowers at 2 kg PLS/ha (2 lb PLS/ac), for a total seeding rate of 13 kg PLS/ha (12 lb PLS/ac). Double this rate for broadcast seeding. Rates for drier mixed grass and fescue prairie types are unknown at present, but we suspect that they should not be less, and possibly substantially more.

This roughly approximates the 75% to 25% ratio of grasses to wildflowers commonly found in North American prairies. Adjustments to this rate often have to made because of seed availability (or the lack thereof), their cost, personal preferences for more or less of a certain species, or variations in local conditions. The relative proportions of each species in the mix depends upon the native prairie you are modeling your restoration upon and the seed available. Certain species are more aggressive than others and may tend to dominate a restoration if seeded in high proportions. Examples are western wheatgrass and Canada wild rye. There are no set rules, however, for how much of any given species to put in a mix. Keep track of your species and amounts, and learn from experience.

When planning your own seed mix, with its particular proportions of various grass and wildflower species, keep these factors in mind. It is helpful to know the unit weight of the seeds you intend to sow and how aggressive it is. One gram (0.04 oz) of large, heavy seeds such as Indian breadroot will not cover as much area as 1 g of small, light seeds like harebell. Sowing big bluestem grass with a weight of 460 seeds/g (12,880 seeds/oz) at the suggested rate of 11 kg/ha results in the placement of about 500 seeds/m^2 (600/yd^2). Sowing Canada wild rye (150 seeds/g or 4,200 seeds/oz) at the same rate would result in about 165 seeds/m^2 (198 seeds/yd^2).

SEEDING TECHNIQUES

Calibrating Seeding Equipment

You must calibrate any seeding equipment you intend to use. You will have to experiment with your own seed mixture in the seed drill or mechanical broadcaster if you want your seeding rate to be accurate. This is important, as it ensures the efficient use of your seeds. Follow the instructions accompanying your equipment to calibrate it to the right seeding rate. Usually, a seed drill is run a short distance over a tarp or sheet and the seeds are counted in a unit of length in each drill row. For a Truax drill, about 100 seeds/m (30 seeds/ft) of each row equates to a seeding rate, for big bluestem, of 11 kg/ha (10 lb/ac). Use a similar technique to measure the seeds thrown out by a broadcaster, bearing in mind the total area over which seeds are cast.

Drilling Seed

Seeding should be done immediately after the last cultivation and roller packing. Start with a full seed box, and keep it that way as much as possible. Native seed drills do not seed as efficiently when the box is less than one quarter full. Make rounds around the entire area, overlapping slightly on the corners to avoid gaps when turning. Ground speed should be 3 to 5 kph (2 to 3 mph). Seeding depth should be one cm (1/2 in). Watch the seed tube windows to ensure they do not become plugged. If one does, stop immediately, remove the occluded tube and clean it out. If you are concerned about the row effect, calibrate the drill to half the overall rate, cover the site once, then again at right angles to the first pass.

Broadcasting Seed

Seed should be broadcast immediately after the final cultivation, rototilling or harrowing, but BEFORE the site is packed. Spread the seed evenly over the site making regular transects. If you are broadcasting by hand, consider dividing your seed lot in half and covering the site twice. This ensures more even coverage. Adding an inert carrier, such as vermiculite, to the seed mix may make it easier to spread and allows you to see where you have seeded. Incorporate the seed lightly into the soil by raking or using a chain drag and roller pack the site immediately.

Mosaic Seeding

If you have chosen to assign different seed mixes to different parts of your site, then you will have to sow them separately, perhaps using different techniques. Bear this in mind when you are designing your site. Mosaic seeding may involve differential seeding rates, different seed mixtures, or multiple passages over portions of the site with different techniques to achieve highlights or greater patchiness in the restoration.

COVER CROPS

The use of cover crops in restorations is controversial. A large body of practical farm experience suggests that whenever a perennial crop is planted, a faster growing annual crop planted as a companion is beneficial. By shading the soil it retains surface moisture, prevents sunscald of tender young perennial seedlings and out competes annual weeds. The cover crop provides quick soil holding capabilities on slopes or in light soils where wind erosion can be a problem. A dense cover crop also provides abundant fuel for a managed burn after the first year. It may also provide some income off the land for that year.

In contrast, agrologists recommend against cover crops citing competition with the perennial crop for moisture, sunlight and nutrients. Most agricultural fields have a plentiful seed bank of annual weeds that act as a cover crop, whether you want it or not.

If you use a cover crop, choose an annual grass like oats and seed it at about 30 kg/ha (26 lbs/ac) with the prairie seed. Avoid species such as fall rye and wheat. They give off underground chemicals that may interfere with the germination of native seed, a process called allelopathy. Cut the cover crop down before it goes to seed, setting the mower or swather higher than the prairie seedlings. Remove or bale off the clippings if possible.

Canada wild rye (Elymus canadensis), native to the tall and mixed grass prairie, can be used in restorations as a short-lived perennial cover crop. It establishes quickly, provides good soil cover and competes well with weeds. Canada wild rye usually does not persist beyond the first 5 to 8 years of the restoration planting, and allows other slower growing native species to fill in as it declines. Similarly, it is suggested that certain short-lived cultivars of native grasses may afford the same cover crop value as Canada wild rye. This may be an idea for experimentation, especially in more arid regions where soil erosion is of greater concern.

From a restorationist's point of view, cover crops are unproven. They may be of value on light soils or erodible slopes, and in providing fuels for managed burns. Whether they control weed growth and how necessary this might be is another question. More experimentation is needed, so try it both ways, monitor the effects, and publish your results.

Covering the area twice, with the second pass at right angles to the first will eliminate rows and look more natural.

Canada wild rye, if present in your prairie type, is a useful native cover crop in a restoration seeding.

MULCHING

Adding a protective mulch to a planting conserves soil moisture, enhancing germination, and reduces erosion. It is difficult to do on a large scale, but most smaller plantings benefit from it. Mulch should be weed free, biodegradable, and non-toxic. Common mulches include straw, cellulose fibre or sawdust. Straw is readily available in most farming areas, but it is difficult to get it without a lot of unwanted weed seeds. Spreading it evenly over large areas can be done with a bale or straw chopper. Mulch also tends to blow away with the first strong wind, a problem on open prairie sites. An innovative machine for anchoring straw mulch is the straw crimper. This specially designed rolling drum pushes one end of the straw into the soil, and stands pieces upright. See the Restoration Equipment appendix for availability.

POST SOWING MANAGEMENT

Managing the newly seeded site begins immediately with irrigation, if necessary and if possible. Irrigation usually is practical only for small sites. Mature prairie plants are adapted to dry conditions, but their seeds will not germinate without sufficient moisture. If rainfall is not sufficient to keep the soil moist, consider applying 2-5 cm (1-2 in) of water every three days for the first month. Apply as necessary in the second month. After this the prairie should be able to take care of itself.

Perennial weeds may still cause problems even on the best prepared sites. Dormant seed of these species may germinate, or it may be blown in by wind or brought in by wildlife. Scrupulous eradication of noxious perennials such as Canada thistle, leafy spurge, quack grass, smooth brome, crested wheatgrass and Kentucky bluegrass is absolutely imperative. Without quick and effective action, any one of these species could take over your planting with surprising speed.

Appropriate herbicides, applied selectively with a backpack sprayer or wick applicator are the best way of preventing these species from becoming a problem. The length of time needed to be vigilant against weed incursion is unknown, but it is especially important in the first few years. Once the prairie matures, perennial weed control should be less necessary.

Annual weeds are rarely a problem IF managed properly. Mow with a flail, sickle or rotary mower set high enough

Mow annual weeds before they set seed.

Selective herbicide application usually is necessary to control persistent perennial weeds.

Hand weeding small sites will make a tremendous difference in the proper establishment of a prairie.

PHOTO: B. BREMNER

Properly timed controlled burns are essential for healthy prairie restorations.

to miss most prairie seedlings but low enough to cut the weeds off before they go to seed. This may need to be done every few weeks in the first years, as the prairie plants do not show much above ground growth. They prefer instead to put down a deep, extensive root system to help them survive in the long term. As the prairie closes in, reducing the amount of bare soil, annual weed populations will decline significantly.

Hand weeding on small restoration sites will make a tremendous difference. Pull all non-native species as soon as they can be identified. On most sites there usually are only a relatively few species of weeds, but they may be extremely abundant. Once you have learned what the weeds are on your site, these can be removed. Leave a small patch unseeded by covering with a board or tarp. This will help in weed identification, as all the plants coming up here will be weeds. Mark the corners of the unseeded site with stakes and pull all the plants coming up in your restoration that resemble the ones in the unseeded site. Pulling when the ground is damp is easier and gets more of the root than under dry conditions.

Fire management also is crucial. The long term health of a restored prairie ultimately is tied to the proper use of controlled burning. Unless a cover crop has been used, it usually takes two to three years before enough fuel accumulates to carry a fire. Burn as soon as fuel conditions allow. Early to mid spring burns are the most effective, with fall burns acceptable after the first full year. Once established, tall grass prairies should be burned every two years, mixed grass and rough fescue prairies every five to ten years.

If you cannot burn, mow close to the ground and rake the clippings, then take them to an area where they can be burned. Return the ash to the prairie. This is not as good as a proper fire, but approximates the real thing. A small plot burner also may be used in urban or roadside prairies where open fires are not possible.

SITE ESTABLISHMENT AND MONITORING

Once you have seeded your prairie, how do you determine whether it has been successful? The density (number of individuals per unit area) of prairie plant seedlings achieved during the first growing season is the only indicator available for evaluating planting success. Our experience has shown that plant densities at a site are highest in the first year. Inevitably many individuals do not survive. Their overall ground cover, however, increases as surviving individuals grow larger. While the seeds of certain species may lie dormant for some time, it appears that most will germinate in the first growing season or not at all. Seeding a restoration plot may be a "one-shot deal".

If this proves to be the case (and we are not really sure, more research needs to be done), then it is imperative that the relative success of a planting be determined early. Then remedial measures (such as reseeding), if necessary, can proceed without delay. While other factors may intercede to affect success of the planting in the long term, initial germination is crucial. Without it the restoration cannot succeed.

Our research with wild collected seed plantings has shown that first year seedling densities of prairie grasses averaging 60 to 90 plants per m^2 (6 to 10 per ft^2) produce acceptable stands. First year densities of under 20 (2 per ft^2) native grasses per m^2 do not result in successful stands. Thus first year grass densities of at least 20 (2 per ft^2) or more per m^2 are required to initiate a successful restora-

tion. Wildflower densities of at least 5 per m^2 (1 per ft^2) appear to be required. If by early in your second year after planting, native plant densities have not reached these levels, reseeding should be undertaken.

It is possible to assess the relative success of your planting during the first, and most critical, growing season, if you are prepared to learn to identify seedling prairie plants and associated weeds. This is not as difficult as you might think. All plants, including native prairie grasses and wildflowers as well as weeds, tend to be as distinctive when they are seedlings as when they are mature. Proper identification requires practice and access to examples (or very good photographs) of the plant species you are trying to identify. Use the appendix of native prairie seedling photos in this book as a place to start. Provincial agriculture departments usually have weed seedling identification guides available. These are also listed in the appendix.

The best way to acquire specimen seedlings of the prairie plants you want to grow is to plant known seeds in labeled seedling trays and observe the emerging seedlings closely. Make notes on your observations and try to find some characteristic that defines each species. Taking a sample of top soil from your site and placing it in a sunny spot with ample water will allow you to germinate weed seeds present. This will give you a head start at weed seedling identification.

Quadrats of 1/4 m^2 (50 x 50 cm) or 1/16 m^2 (25 x 25 cm) will help you find the young plants. Placed on the ground at random intervals throughout the site they will allow you to determine the average number and species of native and weed seedlings per quadrat. Multiply the number of natives by 4 for the 1/4 m^2 quadrat and by 16 for the 1/16m^2 quadrat to get densities per square m. Take at least 10 samples per restoration site, more if the area is very diverse, from a representative portion of the planting.

A quarter metre square is useful to locate native seedlings. Quadrats can be made out of wood, wire, plastic tubing, or string.

Sampling for first year seedlings at Beaudry Provincial Park restoration, Headingly, Manitoba.

Determining success is complicated by the relative vigour of the prairie seedlings. Vigorous growth of individual seedlings could offset low densities and result in a successful planting. Conversely, low vigour, brought on by excessive weed competition could lead to decreased survivorship and render a seemingly successful planting a failure. Judging the vigor of individual prairie plants requires some practice and experience. Most prairie species put most of their early growth efforts into developing extensive root systems and often don't show much above-ground growth in the first season.

RESEEDING/SPECIES ENHANCEMENT

Some areas of your restoration may require reseeding due to lack of germination. You may also want to add species in that were not present in the original mix to enhance the diversity of your site. This can be done by drilling or broadcasting and raking in the seeds after a managed burn

or close mowing. The key is to get good seed to soil contact, as in your original seeding. If broadcast seeded, the area should be roller packed after the seed is raked in.

Another method to increase diversity is to plant already started seedlings onto your prairie. They should be put in at a density of 10 to 15 per m^2 (1 to 2 per ft^2). They will need to be irrigated for at least 3 weeks until the roots can reach deeper moisture. This is a very good method of adding rare species or those that are hard to grow from seed in the field.

Big bluestem seedlings (centre) with some non-native weeds in a tall grass prairie restoration one month after seeding.

Chapter 9

ALTERNATIVE PRAIRIE RESTORATION TECHNIQUES

The foregoing discussion has set out the most accepted means of restoring a prairie. Some promising, but less proven techniques have emerged recently. They include the following.

ZERO TILLAGE

Once a site has been treated to kill the existing vegetation and the dead plant litter has been removed, it is ready to seed. A native seed till drill equipped with zero till coulters can sow seed directly into a killed sod. Advantages of this method include: reducing the cost and time for site preparation, reducing moisture loss, preserving the soil structure, improving soil conservation by not laying the soil bare for long periods, retaining soil mycorrhizae, limiting weed problems by not bringing additional buried weed seed to the surface and limiting the bare soil surface which weeds need to germinate.

A drawback with zero till seeding is poor control of perennial weeds. They may regrow in abundance one or more years after they have seemingly been eliminated, if underground roots and rhizomes have not been killed. This technique is best considered experimental at present. Further research is needed to determine its feasibility.

A non-chemical means of eliminating weeds and non-native sod is covering with black plastic.

Another method of eliminating lawns or other perennial vegetation on small sites is to use a sod cutter. Set it to a 6 cm (3 inch) depth and remove all grass present. Monitor the site to ensure that no deep rooted weeds or grasses survive. If they do, spot spray with the appropriate herbicide. On small sites sod removal can be done manually with a spade shovel and strong back.

An alternative to removing sod is covering the entire site with black plastic. This method, called soil insolation, kills all plant growth and many weed seeds in the surface layer by heating the soil to lethal levels. Anchor the plastic with weights or stakes, and leave it in place for one full growing season.

PHOTO: C. MORGAN

Rototilling clean straw into a soil impoverishment plot.

SOIL IMPOVERISHMENT

Soil impoverishment has been used in the forestry industry to promote the growth of trees over herbaceous plants. It involves incorporating large amounts of organic matter into the soil. This subsequently decays, promoting substantial increases in soil microbes that absorb and hold most of the available soil nitrogen. This nitrogen is unavailable for plant growth for one to two years.

Native prairie plants do well in conditions of low nitrogen, having evolved in soils with limited amounts of this nutrient. Annual weeds, however, do not, requiring large amounts of nitrogen to prosper. Taking advantage of prairie species' ability to tolerate low nitrogen soils has potential for giving them a competitive edge over annual weeds. This is especially true in the first few years of a restoration when prairie species are growing slowly and annual weed populations are high.

Have your soil nitrogen tested at a soils lab, then consult with a soil scientist to determine the amount of organic matter needed to tie up the available nitrogen for one or two growing seasons. Apply the recommended amounts, then incorporate it into the soil by rototilling. The substance can be almost any weed-free organic matter such as a sugar/sawdust mixture, oat or rice hulls, clean straw or peat moss.

Monitor your results. If possible compare prairie plant and weed densities on impoverished versus control plots, and publish your results.

MYCORRHYZAL FACILITATION

Mycorrhizae are symbiotic fungi found in the roots of most perennial plants. They benefit their hosts by aiding in the uptake of moisture and nutrients from the soil. Research suggests the presence of adequate mycorhizae can give prairie seedlings a competitive edge against exotic weeds. Unfortunately, repeated soil tillage, as in a crop field, eliminates mycorrhizae from the soil microfauna.

Mycorrhizal facilitation is a process to encourage the reestablishment of these important organisms. A facultative mycorrhizal species, a grass that does well with or without mycorrhizae, but encourages their recolonization, is planted onto a site and allowed to establish. After several years the grass is killed by herbicide application. Glyphosate has no apparent effect on the soil microbes.

Zero till seeding of a prairie mix then can proceed. The theory predicts a much more rapid establishment of a healthy prairie community after this point, as its crucial mycorrhizal community has been partially restored. One species with potential for this technique is slender wheatgrass, native to tall and mixed grass prairies. A number of different cultivars or selections of this species have been developed for forage and erosion control purposes. These are readily available and inexpensive.

HYDRO-SEEDING

Hydro-seeding involves suspending seed in a water/mulch mix, and spraying it onto a site with a special high pressure pump. Conventional bare soil site preparation precedes the hydro-seeding. A serious drawback here is getting good seed to soil contact as the seed is suspended

PHOTO: B. BENN

Hydro seeding a prairie restoration on a slope in Calgary.

above the surface. Using a rake, chain drag or harrows after seeding to incorporate the seed is recommended. A second application of mulch with no seed should be made. This technique may prove useful on steep slopes where regular farm machinery cannot travel. Hydro-seeding machinery is expensive to buy, but usually can be rented from large landscaping firms. Consider contracting with a landscape firm to do your hydro-seeding.

SPRIGGING

Sprigging involves harvesting small pieces of native prairie sod from an existing prairie, then transplanting them on to a restoration site. New plants then grow from these transplant nuclei. Sprigs are harvested by a special machine that chews a swath through an existing prairie. A sprig planter then opens a furrow in the restoration site, places the sprigs in the furrow, and covers them with soil. The sprigs are planted in rows 46 cm (18 in) apart, with depth and spacing variable, depending upon conditions.

Advantages of sprigging include quicker establishment than seed, especially of species difficult to grow from seed. A significant disadvantage is the destructive harvesting on existing native prairies, an impact requiring several years for recovery. Only prairies dominated by rhizomatous species, those that spread primarily by roots, are suitable candidates. Early results on the effectiveness of sprigging native prairie are inconclusive as yet.

PHOTO: ALBERTA AGRICULTURE, FOOD AND RURAL DEVELOPMENT

Rough fescue sprig ready for planting.

PHOTO: ALBERTA AGRICULTURE, FOOD AND RURAL DEVELOPMENT

A sprig harvester on rough fescue prairie in Alberta.

A Schoolyard Restoration Case History

An excellent site preparation at Elmwood High, Winnipeg – spring 1991.

Students planting prairie – June, 1991.

Good results one year later – July, 1992.

First managed burn – April, 1993.

Prairie begins to mature – fall, 1994.

Chapter 10

SPECIAL RESTORATION SITES

SCHOOL YARD PRAIRIE RESTORATION

Few areas in Canada lend themselves more to prairie restoration than school yards. Planting prairie can have a whole host of educational benefits including providing first hand experience in the ecology of our natural world, furnishing living laboratories and outdoor classrooms, encouraging environmental responsibility and stewardship, and demonstrating sustainable, alternative landscaping methods. Students of all ages can be enthusiastic restorationists with just a little guidance from teachers and parents.

The first step in planning a school yard prairie is to have the interest and support of as many students, staff, administrators and custodians as possible. Their help will be invaluable in the design, installation, maintenance and prevention of vandalism needed for such a project to be successful. Check with parents, school boards and local businesses too, to see if they can help with gardening expertise, tools, plant materials or equipment. Have the students research the nature and type of prairie that once occurred in your area. Find out why the prairies disappeared, what wildlife and plants existed on them, the uses native peoples and early settlers had for the plants and the role of grasslands in creating our fertile prairie soils. Reports, projects, class presentations and field trips on prairie ecology can be integrated nicely into geography, history, general science, social studies, and biology curricula at a variety of grade levels from K through 12.

Seek out remnant local prairies, and have classes visit them accompanied by an experienced naturalist or botanist to help identify the species. If possible, have the students hand collect seeds of a variety of native plants from local remnants. These should be planted in the school yard restoration plot. More seeds and species can be added as time goes on. Obtain any additional seeds needed for the restoration from reputable local native seed suppliers who can guarantee that their seeds are indeed of local origin. Commercial "wildflower mixes" and grass cultivars are totally unsuitable for

school prairie restorations as they are not native to the area, and often are imported from other countries.

Choose a plot small enough to be manageable, from 50 to no more than 200 m^2 (about 500 to 2,000 ft^2) to start. It should be a sunny spot, located off of main pedestrian and sports traffic areas. Prepare the area as described in the site preparation section. If your school board is sensitive about using herbicides, you may have to concentrate on the alternative, non-chemical means of vegetation removal such as black plastic and rototilling. This is something where the students can ably assist, especially with digging out existing sod and weeds. Install a good quality professional lawn edging around the entire site. This is important to keep out encroaching lawn grasses, and allows mowing of turf areas to the border of your restoration.

On the day of planting, invite parents, school board officials, politicians and local media to attend and participate in the event. Put the student's work on display for visitors to see. Then have each student take a hand or pail full of seed and scatter it evenly across the area until it is all covered. Ask them to "Make like a buffalo herd and stomp it in!" This invariably is their favourite part and requires no further instruction.

Maintenance of the site should include watering in the establishment phase, hand weeding and litter control. Provisions need to be made to have maintenance done over the first and perhaps second summers. When weeding, it is important to know the difference between the native plants and the weeds. Consult the prairie seedling identification guide in this manual, and obtain a weed seedling identification guide from your provincial agriculture office. Make certain students responsible for learning certain weeds, and let them go through the plot pulling all members of that species. This can take on the atmosphere of a scavenger hunt, with prizes given to those who get the most weeds. Weeding will be necessary in the first few years, declining as the plot matures.

A managed burn should be undertaken as soon as fuel conditions allow, usually after the second or third growing season. Ensure that the required permits are in place, proper precautions are taken, safety equipment is on hand, local residents are alerted and experienced personnel are present. In Winnipeg, we regularly burn urban prairie restorations, including those in school yards, under the supervision of the local fire department.

Restoring native prairies to school yards in Canada is a fun learning activity for students and teachers alike. It brings alive our prairie heritage in the way that no book, lecture or video could. By providing a living, changing laboratory for outdoor studies right on a school's doorstep, restored prairies are a natural focus for environmental education.

BACKYARD PRAIRIE RESTORATION

Native prairies can be integrated nicely into existing yards by following a few simple steps. You don't need a vast acreage to have a prairie. Some of the best restored prairies are on small inner-city lots sandwiched between houses, sidewalks and high-rises. Here they make a pleasing contrast with hard-edged traditional landscaping. In the process, they bring a little bit of nature back into the city, making it more livable.

Follow the directions set out earlier in the book for site preparation and designing your prairie. Make sure you use local seed and/or plants grown from seed of your prairie type. Start with a small area of the yard that can be viewed from the house. Gradually expand your planting over time as your experience with and knowledge of native prairie grows.

It is important to separate your native planting from mowed turf and neighbour's yard by deep commercial lawn edging. It should be at least 15 cm (6 in) deep and continuous. Without it, your prairie will be invaded rapidly with non-native Kentucky blue grass and quack grass.

Backyard (and front yard!!) prairie restorations often start with live seedling plants placed about 10-20 per m^2 (1-2 per ft^2). Use a matrix of native grasses to place patches of wildflowers in. Odd numbered (3, 5, 7...) groupings of wildflowers placed randomly throughout the prairie look the most natural. Taller species should go towards the back, with shorter ones at the front. There are no hard and fast rules on this, however, no wrong or right way. Choose your own mix of species from your area. All of them grow together in the wild in varying amounts and manners. Don't be afraid to experiment – there really is

Install a continuous deep lawn edging around all school and backyard plantings to keep out invasive non-native lawn grasses.

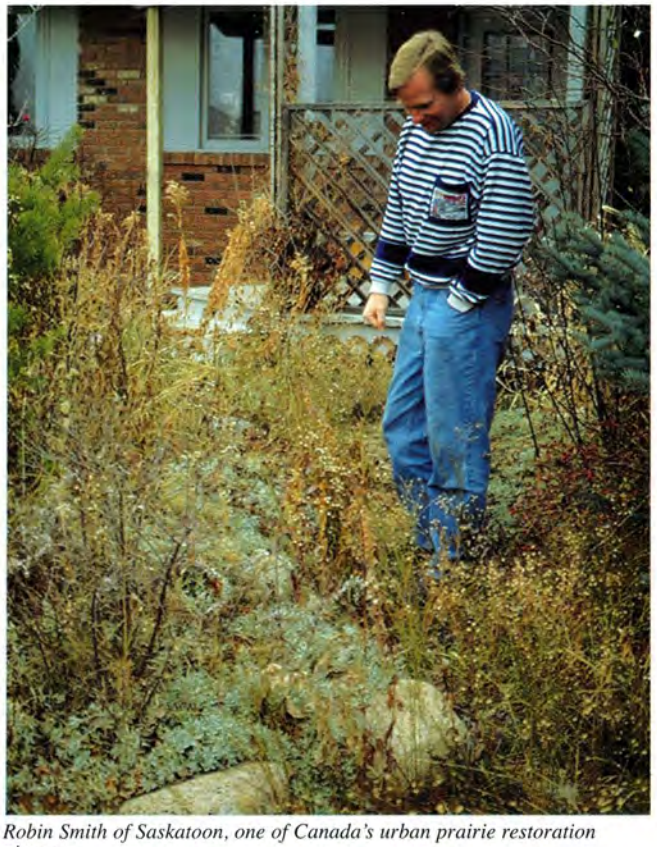
no way to make a mistake. Most residential prairies are chosen to reflect their owners tastes and colour preferences. Given the incredible diversity of plants an original native prairies, there is no valid ecological reason not to do this in our own yards as well.

Be vigilant with non-native weeds. Keep the area weeded especially in the first few seasons, until the prairie matures. Weeding will then decline as the prairie fills in.

Managed burns are not usually permitted in residential areas. Check with your local fire department and if they are, hose down the perimeter, alert your neighbours, and let her rip on a windless day! If not, mow the prairie off close to the ground, and rake off the clippings. Take them to an area outside the city where burning is allowed and burn them in a fireproof container. Return the ashes to the prairie and you will have a very good imitation of a prairie fire.

PHOTOS: D.R. COLLICUTT

Before and after of a small urban prairie restoration started with seedlings.



Robin Smith of Saskatoon, one of Canada's urban prairie restoration pioneers.

ROADSIDE PRAIRIE RESTORATION

Restoring miles of roadsides to native prairie is a practical alternative to existing vegetation management from an economic as well as biological perspective. Eliminating costly mowing management, providing long-lived perennial vegetation cover that resists weed infestations once established, controlling snow drifting, reducing soil erosion and attracting tourists to travel wildflower routes are some of the economic advantages. Biological benefits include providing additional space for endangered plant communities to grow, and creating movement corridors for a variety of plant and wildlife species. Not only can highways agencies save money by planting and managing native species, they can project an environmentally responsible image to the travelling and voting public.

Roadsides are a forgotten land resource in Canada that could easily incorporate the restoration of prairie communities, without compromising the safety of the travelling public. A typical road allowance 30 m (99 ft) wide by 2 km (1.2 mi) long covers an area of 6 ha (14 ac). Multiply that by the number of kilometres of roads in every province, and the potential roadside prairie restoration area is tens of thousands of hectares. Restoring even a small part of this immense area to prairie would contribute significantly to the conservation of our endangered native prairies.

The restoration of prairie communities along roadsides should start with an inventory of existing vegetation conditions. In areas where roads parallel railways or are surrounded by original prairies on adjacent lands, there is a good chance that native prairie species already exist. All that may be required here for the prairies to flower is a change in management. This could be a reduction or elimination of mowing and herbiciding. Signs saying that these are no mow areas to encourage prairie conservation can remind maintenance staff and inform the public, and garner good public relations for the highways department.

Roadside prairie restoration in Iowa

Purple prairie clover along a Manitoba roadside.

Once existing prairie areas have been identified and their management changed, additional restorations can be undertaken. Existing areas can be used as seed sources to reduce or eliminate the need to purchase seed. Staff can be instructed in alternative management techniques such as controlled burning and spot herbiciding for noxious weeds. Other areas can be planted such as around interchanges and rest stops. This approach has been very popular in the United States where highway wildflower routes with special signs alert the travelling public to what they are seeing out the window.

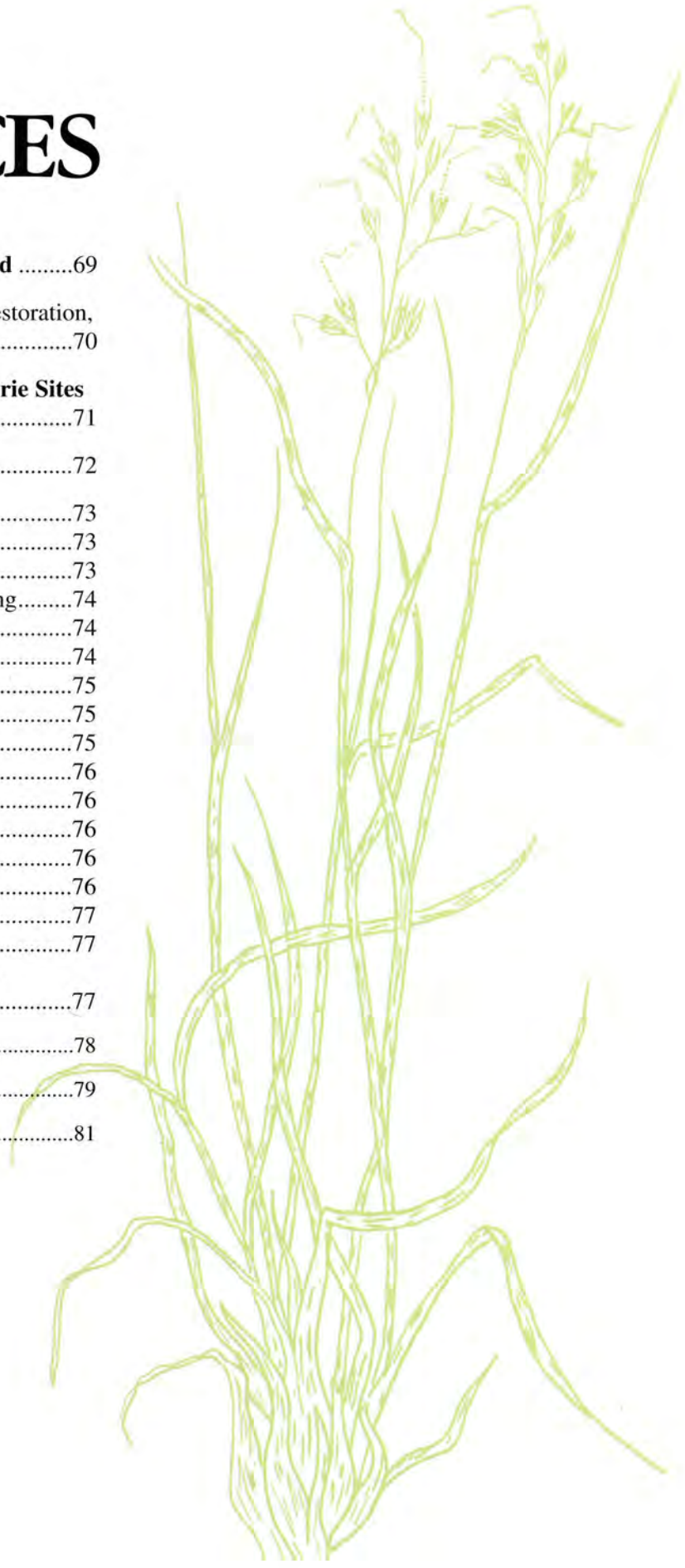
CONCLUSION

Successful prairie restoration with locally collected seed is possible, as long a a few guidelines are followed. It is an activity rooted in the past and hopeful for the future. In much of what once was the Canadian prairies the chance to experience the wind in the grass, the exuberant chorus of songbirds and insects and the riot of wildflowers is not part of the present generation's consciousness. In losing what only one or two generations ago was commonplace, our society has indeed lost something of real value.

Restoring native prairies or even the attempt to do so may be a naive venture in reversing our culture's trend to divorce ourselves from the land. It is worthwhile, because of the knowledge gained and the rediscovering of a connection with the land. Long journeys are said to start with one step at a time. Restoring a bit of native prairie here and a bit there begins the journey. In time if more people join the trek, it may cover a few back yards, a school ground or two, a park, a city or more. Along the way we may find in ourselves ways to be better stewards of the land that spawned us and still supports us all. This may be the real reason for restoring Canada's native prairies. Happy planting!!

Restoring prairie to the heart of a city in downtown Winnipeg.

APPENDICES



CANADIAN SOURCES OF NATIVE PLANTS AND SEED

The following is a selection of native seed and plant suppliers across Canada. Not all provinces have native nurseries, but more are emerging every year. While nearly all people in the native plant business have high ethical standards, we cannot guarantee it. Plants dug from the wild are NOT acceptable for restoring prairies. If in doubt that your plants have been grown from seed, ask. Do not patronize those businesses that remove native plants from their original habitats.

Alberta

Alberta Native Plant Council, Garneau P.O. Box 52099, Edmonton, Alberta T6G 2T5
- promotes conservation of and research on Alberta's native plants,
- membership open to all
- IRIS newsletter
- excellent Alberta native plant source list available for $4.00

Alberta Nurseries & Seeds Ltd., Chris Berggren, Box 20, Bowden, Alberta T0M 0K0 Ph: (403) 224-3545 FAX: (403) 224-2455
- produces containerized native woody plant material for reclamation

ALCLA Native Plant Restoration Inc., 3208 Bearspaw Drive Northwest, Calgary, Alberta T2L 1T2 Ph: (403) 282-6516
- Alberta native plants and seed

Blooming Prairie, Katie Benschop, 10328 University (75) Avenue, Edmonton, Alberta T6E 4P4 Ph: (403) 462-1451 FAX: (403) 433-6440
- native wildflower seed from the Edmonton area

Borealis Botanicals, Roman Fodchuk, Box 91, Cochrane, Alberta T0L 0W0 Ph: (403) 932-2583
- a variety of Alberta prairie and foothills plants and seed

Bow Point Nursery, Ken and Pam Wright, Box 16, Site 24, RR12, Calgary, Alberta T3E 6W3 Ph: (403) 242-8018 FAX: (403) 242-8018
- native woody plants grown from seed and cuttings collected in southern Alberta

The Conservancy, 51563 Range Road 212A, Sherwood Park, Alberta T8G 1B1
- garden seed packets of native Alberta plants

Devonian Botanic Garden, University of Alberta, Edmonton, Alberta T6G 2E1 Ph: (403) 987-3054 FAX: (403) 987-4141
- newsletter, courses, displays of native plants
- native seed exchange
- membership open to all

Eastern Slopes Rangeland Seeds Ltd., Clare Tannas, Box 273, Cremona, Alberta T0M 0R0 Ph: (403) 637-2473 FAX: (403) 637-2724.
- native seed from locally collected parent stock

EnviroScapes, Vince and Wilf Petherbridge, 1213-5th Avenue South, Lethbridge, Alberta T1J 0V6 Ph: (403) 327-1902 FAX: (403) 329-0722
- seed harvested from southern Alberta native prairies
- seed and bedding plants of prairie and foothills wildflowers
- bulk seed for prairie restorations
- custom planting services
- custom harvesting of native seed

Greenview Nurseries, Hans Bron, Box 12, Site 16, RR7, Calgary, Alberta T2P 4G7 Ph: (403) 936-5936 FAX: (403) 936-5981
- seeds and cuttings of native plants from the Calgary area

Grumpy's Greenhouses and Gardens, Debbie and Ernie Everts, Box 2488, Pincher Creek, Alberta T0K 1W0 Ph: (403) 627-4589 FAX: (403) 627-4589
- seeds and cuttings from the southwest foothills of Alberta

The Hillson Nursery, Dick Hillson, P.O. Box 39, Rochester, Alberta T0G 1Z0 Ph: (403) 698-3956 FAX: (403) 698-2333
- wholesale nursery with containerized native Alberta woody and herbaceous species

Knutson & Shaw Growers, Ray Shaw and Bev Knutson-Shaw, Box 295, Vulcan, Alberta T0L 2B0 Ph: (403) 485-6688 FAX: (403) 485-2878
- wildflowers grown from seed collected within a 100 km radius of Calgary

Northern Vigor Seeds Ltd., Clayton Roska, Box 67, Sexsmith, Alberta T0H 3C0 Ph: (403) 532-1344
- natives collected and grown in northern Alberta
- emphasis on wetland species

Parkland Nurseries, Dwayne Beck, Red Deer, Alberta T4N 5E2 Ph: (403) 346-5613 FAX: (403) 346-4443
- an expanding stock of local material
- host a native seed exchange for the Red Deer River Naturalists

Wild Rose Consulting Ltd., Ann Smreciu, 3525-41 Avenue Northwest, Edmonton, Alberta T6L 5S5 Ph: (403) 413-9280 FAX: (403) 413-9281
- specialists in propagation and restoration of native Alberta species
- native plant inventory and management

British Columbia

Natural Legacy Seeds, R.R. 2 C-1 Laird, Armstrong, British Columbia V0E 1B0 Ph: (604) 546-9799
- native seeds of the Monashee/North Okanagan region of BC

Manitoba

The Green Touch, Gerry Oliver, P.O. Box 880, Carberry, Manitoba R0K 0H0 Ph: (204) 834-2261
- native grasses and wildflowers greenhouse grown from seed collected in the Carberry Sandhills of southwestern Manitoba

Living Prairie Museum, 2795 Ness Avenue, Winnipeg, Manitoba R3J 3S4 Ph: (204) 832-0167 FAX: (204) 986-4172
- native prairie seeds hand collected from the tall grass prairies of the Winnipeg region

Portage Wildflowers, Arnie and Carol Kruck, R.R.4 Box 55, Portage la Prairie, Manitoba R1N 3A4 Ph: (204) 857-8071
- native Manitoba seeds and plants
- catalogue $2.00

Prairie Habitats, Carol and John Morgan, P.O. Box 1, Argyle, Manitoba R0C 0B0 Ph: (204) 467-9371 FAX: (204) 467-5004
- over 100 species of greenhouse grown native Manitoba prairie grasses, wildflowers and trees, seed packets and bulk seed
- seed stocks from the tall and mixed grass prairie and aspen parkland of southern Manitoba
- wide selection of mail order books on native plant identification, management, landscaping, and folklore
- hand held and pull type native seed strippers, small plot burners for doing managed burns on native prairies
- custom prairie restoration planting for home and industry
- consultation services on prairie inventory, restoration and management
- mail order catalogue $2.00

Prairie Originals, Shirley Froehlich, 17 Schreyer Crescent, St. Andrews, Manitoba R1A 3A6 Ph: (204) 338-7517
- 93 species of native Manitoba grasses and wildflowers as seedling plugs and in pots
- grown from seed originally collected in southern Manitoba
- mail order catalogue $2.00

Newfoundland

Murray's Horticultural Services Ltd., Mike Murray, Box 182, Portugal Cove, Newfoundland A0A 3K0 Ph: (709) 895-2800 FAX: (709) 895-1000
- native Newfoundland plants

Ontario

Mulligan Seeds, Box 700, Osgoode, Ontario K0A 2W0

Native Landscape Designs, Box 21052, Guelph, Ontario N1G 2W0
- catalogue and cultural guide $2.00

New Meadows Wildflower Seeds, Ellen Pepper, 38 Katherine Crescent, Kitchener, Ontario N2M 2K1 Ph: (519) 576-5956
- 80 species of native Ontario wildflowers

Ontario Tallgrass Prairie Nursery, c/o Box 1168, Chatham, Ontario N7M 5L8 Ph: (519) 354-7340
- a recent initiative to establish a non-government source of native prairie seed for restoration in Ontario
- promotes and develops restoration technology
- technical advice on prairie restoration projects
- custom seed cleaning services
- seed may be available in 1998

Otter Valley Native Plants, Box 31, RR#1, Eden, Ontario N0J 1H0 Ph: (519) 866-5639
- produces and sells native plants of southern Ontario

Pterophylla, RR#1, Walsingham, Ontario N0E 1X0 Ph: (519) 586-3985
- tall grass prairie seed and plants from southern Ontario

Sweet Grass Gardens, RR#6, Hagersville, Ontario N0A 1H0 Ph: (519) 445-4828
- native seed and plants of Ontario

Quebec

Indigo, 80 Route 116, Ulverton, Quebec J0B 2B0 Ph: (819) 826-3314
- native plants of Quebec

Saskatchewan

Blazing Star Wildflower Seed Co., Leon and Mary Grilz, Box 143, St. Benedict, Saskatchewan S0K 3T0 Ph/FAX: (306) 289-2046
- Saskatchewan wild-collected seed stocks and seed nursery

Miller's Native Plant Nursery, 436 Keely Way, Saskatoon, Saskatchewan S7J 4B2 Ph: (306) 374-4785
- native plants of Saskatchewan, most grown from seed collected within 250 km of Saskatoon

Prairiescape, Al Bodnarchuk, 2815 Pasqua Street, Regina, Saskatchewan S4S 2H4 Ph: (306) 586-6576 or 596-4150
- native wildflowers, grasses and shrubs of the Regina plains

Nora Stewart, Box 273, Arcola, Saskatchewan S0C 0G0 Ph: (306) 455-2513
- native seeds and plants of southern Saskatchewan

Yukon

Arctic Alpine Seed Company, Randy Lewis, c/o Decora Landscaping Ltd., 105 Granite Road, Whitehorse, Yukon Y1A 2V8 Ph: (403) 667-2756 FAX: (403) 667-4595
- tests and develops commercial quantities of grass and wildflower seed for the Yukon

PUBLIC INFORMATION SOURCES – ECOSYSTEM RESTORATION, MANAGEMENT AND NATIVE PLANTS

Alberta

Alberta Native Plant Council, Garneau P.O. Box 52099, Edmonton, Alberta T6G 2T5
- promotes the study and conservation of Alberta's native flora
- membership open to all
- field trips and guest speakers
- publishes a newsletter, IRIS, and native plant source list

Canadian Wildlife Service, #210 - 4999 98th Avenue, Edmonton, Alberta T6B 2X3 Ph: (403) 468-8906
- book available entitled "Landowners Guide to the Conservation of Canadian Prairie Grasslands" on prairie ecology and management for landowners with existing native prairie

Special Areas Board, Department of Municipal Affairs, Environmental Protection, P.O. Box 820, Hanna, Alberta T0J 1P0 Ph: (403) 854-5638
- information on native prairies in Alberta

Heather Gerling, Industrial Land Management Co-ordinator, Public Land Management Branch, Alberta Agriculture, Food and Rural Development, 200, J.G. O'Donoghue Building, 7000 - 113 Street, Edmonton, Alberta T6H 5T6 Ph: (403) 427-3932 FAX: (403) 422-4244
- prairie restoration and land reclamation specialist
- has "Native Species Reclamation Handbook" available for Alberta

Heritage Protection and Education Branch, Parks Management Support Division, Natural Resources Services, Alberta Environmental Protection, 8th Floor, 10405 Jasper Avenue, Edmonton, Alberta T5J 3N4 Ph: (403) 427-5209

Provincial Museum of Alberta, Natural History Section, 12845 - 102 Avenue, Edmonton, Alberta T5N 0M6 Ph: (403) 453-9100

British Columbia

British Columbia Conservation Data Centre, Wildlife Branch, Ministry of Environment, 780 Blanshard Street, Victoria, British Columbia V8V 1X5 Ph: (604) 356-0928 FAX: (604) 356-9145

Don Gayton, Regional Range Ecologist, Ministry of Forests, 518 Lake Street, Nelson, British Columbia V1L 4C6 Ph: (604) 354-6244 FAX: (604) 354-6250

Habitat Protection Branch, Ministry of Environment, 780 Blanshard Street, Victoria, British Columbia V8V 1X5 Ph: (604) 387-9945

Naturescape, British Columbia Ministry of Environment, Lands and Parks, 300 - 1005 Broad Street, Victoria, British Columbia V8V 2A1 Ph: (604) 356-6124
- an ecologically based program, aimed at encouraging landowners to become part of a network of people who are voluntarily improving habitat in urban and rural settings

Royal Museum of British Columbia, Natural History Section, 675 Belleville Street, Victoria, British Columbia V8W 1A1 Ph: (604) 387-3701

Manitoba

Botany Department, Buller Building, University of Manitoba, Winnipeg, Manitoba R3T 2N2 Ph: (204) 474-9368 or 474-8176
- reference herbarium of Manitoba plants open by appointment
- plant identification and distribution information

Critical Wildlife Habitat Program, Box 24, 1495 St. James Street, Winnipeg, Manitoba R3H 0W9 Ph: (204) 945-2395
- administers Manitoba's Tallgrass Prairie Preserve
- tall and mixed grass prairie inventory and management

Living Prairie Museum, City of Winnipeg Parks and Recreation, Interpretive Services, 2795 Ness Avenue, Winnipeg, Manitoba R3J 3S4 Ph: (204) 832-0167 FAX: (204) 986-4172

Manitoba Conservation Data Centre, c/o Surveys and Mapping Branch, 1007 Century Street, Winnipeg, Manitoba R3H 0W9 Ph: (204) 945-7743 FAX: (204) 945-1365

Manitoba Museum of Man and Nature, Botany Division, 190 Rupert Avenue, Winnipeg, Manitoba R3B 0N2 Ph: (204) 956-2830
- reference herbarium of native plant species
- staff botanist Dr. Karen Johnson
- accepts volunteers to assist with herbarium work

Manitoba Naturalists Society, 401-63 Albert Street, Winnipeg, Manitoba R3B 1G4 Ph: (204) 943-9029
- helps preserve and manage tall grass prairie in Manitoba
- has "Prairie Patron Program" where donors can support prairie conservation efforts by buying an acre of prairie for $50.00 in return for an honourary deed and income tax receipt
- has popular educational video, brochure and book available entitled "Manitoba's Tall Grass Prairie"
- tours and management workshops on tall grass prairies
- fund raising for prairie conservation
- "Plants of Manitoba" book presently in preparation
- membership open to anyone

Ontario

Ojibway Tall Grass Prairie Reserve, 2450 McDougall Street, Windsor, Ontario N8X 3N6 Ph: (519) 966-5852
- information on the tall grass prairie in the City of Windsor and southern Ontario

Ontario Tallgrass Prairie Society, c/o Box 1168, Chatham, Ontario N7M 5L8 Ph: (519) 354-7340
- joint private/government initiative in the early stages of establishment
- tall grass prairie restoration, management, education and seed collection in southwestern Ontario
- advocates the use of local seed sources for wildlife habitat, pit reclamation, roadside and agricultural plantings

Natural Heritage Information Centre, P.O. Box 7000, Peterborough, Ontario K9J 8M5 Ph: (705) 745-6767 FAX: (705) 745-5575

Walpole Island Heritage Centre, RR#3, Wallaceburg, Ontario N8A 4K9 Ph: (519) 627-1475
- information and tours of the tall grass prairies of Walpole Island First Nation in Lake St. Clair

Saskatchewan

Meewasin Valley Authority, 402 Third Avenue South, Saskatoon, Saskatchewan S7K 3G5 Ph: (306) 665-6887
- specialists in urban design with native species.

Mixed Grass Prairie Habitat Restoration Project, Dean Nernberg, Project Manager, Wildlife Habitat Canada, Canadian Wildlife Service, P.O. Box 280, Simpson, Saskatchewan S0G 4M0 Ph: (306) 836-2022 FAX: (306) 836-2010
- has book available "Native Species Mixtures for Restoration in the Prairie and Parkland Region of Saskatchewan" for $18.00

Prairie Farm Rehabilitation Administration (PFRA), 7th Floor, Rm 603, CIBC Tower, 800 Hamilton Avenue, Regina, Saskatchewan S4P 4L2 Ph: (306) 780-5770
- controls, manages and inventories hundreds of square km of native prairie in Alberta, Saskatchewan, and Manitoba
- regional pasture managers and prairie ecologists on staff
- tree nursery in Indian Head, Saskatchewan grows some native species

Royal Saskatchewan Museum, 2445 Albert St., Regina S4P 3V7 Ph: (306) 787-2815
- prairie restoration project on the grounds
- information on Saskatchewan native plants

Saskatchewan Conservation Data Centre, Saskatchewan Department of Natural Resources, 3211 Albert Street, Regina, Saskatchewan S4S 5W6 Ph: (306) 787-7196 FAX: (306) 787-7085
- native plant distribution information

Saskatchewan Environment and Resource Management, Wildlife Branch, 3211 Albert Street, Regina, Saskatchewan S4S 5W6 Ph: (306) 966-5593
- information on backyard plantings of native species for wildlife habitat

Saskatchewan Forage Council, Department of Crop Science, University of Saskatchewan, 51 Campus Drive, Saskatoon, Saskatchewan S7N 5A8 Ph: (306) 966-8663 or (306) 953-2793
- information on native seed production and weed management
- has a publication entitled "Farm Facts: Production and Marketing of Native Grass Seed"

Saskatchewan Native Plants Working Group
- recently formed organization to promote the conservation and restoration of Saskatchewan native flora
- contact through Dean Nernberg – MGPHRP, or Chris Nykoluk – PFRA (above)

National

Agriculture and Agri-Food Canada Research Stations, Morden and Brandon, Manitoba, Melfort and Swift Current, Saskatchewan, and Lethbridge, Alberta
- developing ecovars of a variety of native prairie grasses and wildflowers

Canadian Museum of Nature, Botany Division, Canadian Rare Plant Project, P.O. Box 3443 – Station D, Ottawa, Ontario K1P 6P4 Ph: (613) 990-6449

Canadian Wildlife Federation Backyard Habitat Program, 2740 Queensview Avenue, Ottawa, Ontario K2B 1A2 Ph: 1-800-563-9453
- manual available with over 100 backyard habitat enhancement projects

Ducks Unlimited Canada, Box 1160, Stonewall, Manitoba R0C 2Z0 Ph: (204) 467-3000
- currently developing ecovars of native prairie species for restoration of waterfowl nesting habitat
- local and regional offices in most provinces
- has book available "Revegetating with Native Grasses"

Evergreen Foundation, 24 Mercer Street, Suite 300, Toronto, Ontario M5V 1H3 Ph: (416) 596-1443
- school ground naturalization program offers training sessions, co-ordinates resource material, helps finance start-up phases of projects and assists in the formation of local partnerships

The Nature Conservancy of Canada, 110 Eglinton Avenue West, 4th Floor, Toronto, Ontario, M4R 2G5 Ph: (416) 932-3202 FAX: (416) 932-3208
- supports prairie and other natural ecosystem conservation efforts across Canada by purchasing land with donations, memberships and corporate sponsors
- membership open to anyone

Wildlife Habitat Canada, 200-7 Hinton Avenue North, Ottawa, Ontario K1Y 4P1 Ph: (613) 722-2090 FAX: (613) 722-3318
- national funding agency for prairie and other ecosystem conservation

World Wildlife Fund Canada, 90 Eglington Avenue East, Toronto, Ontario M4P 2Z7 Ph: (416) 489-8800
- international conservation organization well known for its support of prairie conservation work in Canada
- funded by donations and memberships
- membership open to all

SELECTED ORIGINAL AND RESTORED NATIVE PRAIRIE SITES IN CANADA

While many more native prairie areas still exist in Canada, this list gives some of the best areas of quality native prairie accessible to the public in each province. Any one of these could be used as a model for a prairie restoration in its region.

Alberta

Alberta Environmental Centre, Vegreville
- fescue grassland adjacent to the main office building
- to view please contact the Vegetation Branch, Alberta Environment Centre Ph: (403) 632-8211

Cypress Hills Inter-Provincial Park, Alberta and Saskatchewan
Approximately 75-100 km southeast of Medicine Hat
- south slopes on the plateau that towers over the surrounding plains are good examples of grazed fescue and mixed grass prairie

Dinosaur Provincial Park
- located northeast of Brooks
- mixed grass prairie on upland sites

Nose Hill Park, City of Calgary
- a good example of a foothills rough fescue grassland at various stages of renewal and decline
- an extensive ungrazed prairie surrounded by Calgary suburbs

Oldman River Dam Recreation Area
- 10 km northeast of Pincher Creek
- small tracts of foothills fescue and mixed grass prairie

Rumsey Block
- a large tract of fescue grassland in various stages – grazed, undisturbed, and degraded
- best parts are preserved as an ecological reserve
- for information and access contact Heather Gerling, Public Land Management Branch, Alberta Agriculture, Food and Rural Development, Edmonton Ph: (403) 427-3932

Willow Creek Provincial Park
- 10 km west of Stavely, Alberta
- upland sites are foothills fescue and mixed grass prairie

Writing-on-Stone Provincial Park, on the banks of the Milk River, east of Milk River, Alberta
- mixed grass prairie on upland sites

British Columbia

British Columbia ecological reserves that contain native grassland include:
- Campbell-Brown, west side of Kalamalka Lake, 107 ha (264 ac)
- Chasm, north of Clinton, 197 ha (487 ac)
- Columbia Lake, south of Fairmont, 32 ha (79 ac)
- Cougar Canyon, south of Vernon, 550 ha (1,359 ac)
- Field's Lease, west of Osoyoos Lake, 4 ha (10 ac)
- Hayne's Lease, north end of Osoyoos Lake, 101 ha (250 ac)
- McQueen Creek, north of Kamloops, 35 ha (87 ac)
- Skihist, northeast of Lytton, 36 ha (89 ac)
- Soap Lake, south of Spences Bridge, 884 ha (2,184 ac)
- Tranquille, west of Kamloops, 235 ha (581 ac)
- Trout Creek, south Southwest of Summerland, 75 ha (185 ac)
- for more information contact British Columbia Ministry of Environment and Parks for the Guide to Ecological Reserves in British Columbia (1992), Ecological Reserves Program, Victoria, British Columbia Ph: (604) 387-9945

Manitoba

Asessippi Provincial Park, c/o Parks Branch Western Region Office, Box 10, Room 112, 340-9th Street, Brandon, Manitoba R7A 6C2 Ph: (204) 564-2692
- mixed grass prairie along steep banks of the Assiniboine River Valley
- located between Russell and Roblin west of Hwy. 83

Beaudry Provincial Heritage Park, Box 52, 1495 St. James Street, Winnipeg, Manitoba R3H 0W9 Ph: (204) 945-4148, 945-7273 or 864-2757
- the largest and oldest tall grass prairie restoration in Manitoba
- over 41 ha (100 ac) planted since 1985, with new plantings annually to eventually cover 259 ha (640 ac)
- several relict tall grass prairies and oak savannahs
- magnificent example of riverbottom forest with trails and picnic grounds
- located along Roblin Blvd. 3 km (2 mi) west of Headingly

Birds Hill Provincial Park, Box 183, RR2, Dugald, Manitoba R0E 0K0 Ph: (204) 222-9151
- high quality mixed and tall grass prairie, aspen parkland and boreal forest on old glacial esker
- interpretive trails, staff naturalists, picnic and camping grounds
- located along Hwy. 59 just north of Winnipeg

Canadian Forces Base Shilo, Manitoba R0K 2A0 Ph: (204) 765-3000
- over 20,000 ha (49,000 ac) mixed grass sandhill prairie used as a military training area
- the largest intact piece of native prairie left in Manitoba
- restricted access by special permission only, contact Base Environmental Officer, Ph: (204) 765-3133

City of Winnipeg:

Bluestem Nature Park, east side Empress Avenue, just east of Polo Park Shopping Centre along Omand's Creek
- a relocated tall grass prairie salvaged from nearby development site in 1986
- interpretive trail

Bradley Prairie Nature Park, Regent Avenue East and Bradley Street
- high quality 8 ha (20 ac) mesic tall grass prairie along one of eastern Winnipeg's busiest streets

Kil-Cona Regional Park
- 1 ha (3 ac) tall grass prairie restoration on old city landfill planted to 41 locally collected species in 1991
- located at northeast corner Lagimodiere Blvd. (Hwy. 59) and McIvor Avenue

Little Mountain Park, Farmers Road and Klimpkey Avenue, north of Inkster Boulevard
- tall grass prairie and aspen parkland near the airport
- 65 ha (160 ac) with hiking trails and picnic grounds

Living Prairie Museum, 2795 Ness Avenue
- 32 ha (80 ac) tall grass prairie in northwest Winnipeg
- interpretive centre, trails, staff naturalists, school programs, seeds and books
- managed prairie burns every spring
- for more information on Winnipeg sites, contact City of Winnipeg Parks and Recreation Department, Interpretive Services, 2795 Ness Avenue, Winnipeg, Manitoba R3J 3S4 Ph: (204) 832-0167

Elmwood High School Prairie Restoration, 505 Chalmers Avenue, Winnipeg, Manitoba R2L 0G4 Ph: (204) 667-4328
- schoolyard tall grass prairie restoration planted by students in 1991 to 35 locally collected species
- located at the northwest corner of fenced grounds, for access permission check with school office

Manitoba Tall Grass Prairie Preserve, Tolstoi and Gardenton area
- over 1,620 ha (4,000 ac) tall grass prairie, oak savannah and aspen parkland open to the public year round with some interpretive trails
- access off Hwy. 59 south of Winnipeg to Tolstoi, then east along Hwy. 209 and/or 201
- brochure and information available from Critical Wildlife Habitat Program, Box 24, 1495 St. James Street, Winnipeg, Manitoba, R3H 0W9 Ph: (204) 945-2395

Riding Mountain National Park, Wasagaming, Manitoba R0J 2H0 Ph: (204) 848-2811
- excellent examples of rough fescue prairie in the Audy Lake area and Birdtail River Valley
- wild bison herd and elk on the fescue prairie at Audy Lake
- located in western Manitoba along Hwy. 10 just south of Dauphin

Spruce Woods Provincial Park, Box 900, Carberry, Manitoba R0K 0H0, Ph: (204) 827-2543
- mixed grass sand hill prairie and active sand dunes with relict boreal forest
- located along the Assiniboine River on Hwy. 5 between Carberry and Glenboro

Wildlife Management Areas
- many Wildlife Management Areas throughout southern Manitoba contain high quality native prairie remnants
- the most significant of these include Oak Hammock Marsh, Inwood, Clematis, Narcisse and Lake Francis WMA's in the Interlake region, Portage Sandhills located along Hwy. 240 south of Portage la Prairie, the Alonsa and Langruth WMA's in the Westlake region, Souris River Bend WMA south of Wawanesa, Assiniboine Corridor WMA east of Brandon, Upper Assiniboine WMA west of Brandon, Stevenson WMA northeast of Shoal Lake, and Broomhill, Lauder Sandhills and Pierson WMA's in the southwest corner
- all are open to the public, some have interpretive facilities
- for further information and a brochure on provincial WMA's, contact the Manitoba Wildlife Branch, Box 24, 1495 St. James St., Winnipeg, Manitoba R3H 0W9 Ph: (204) 945-7763 or 945-6799

Ontario

Ojibway Tall Grass Prairie Reserve, 2450 McDougall Street, Windsor, Ontario N8X 3N6 Ph: (519) 966-5852
- 81 ha (200 ac) tall grass prairie and oak savannah surrounded by the City of Windsor
- interpretive centre and trails, staff naturalists

Walpole Island Heritage Centre, RR#3, Wallaceburg, Ontario, N8A 4K9 Ph: (519) 627-1475
- over 2,400 ha (6,000 ac) tall grass prairie and oak savannah on First Nations Reserve in Lake St. Clair
- access with permission from Heritage Centre
- interpretive centre and museum

Saskatchewan

Claybank Wildlife Development Fund Grassland, Saskatchewan Environment and Resource Management, Wildlife Branch, 3211 Albert St., Regina, Saskatchewan S4S 5W6

Cypress Hills Inter-Provincial Park, Box 850, Maple Creek, Saskatchewan, S0N 1N0
- mixed grass and fescue prairie in southwestern Saskatchewan and southeastern Alberta

Grasslands National Park, P.O. Box 150, Val Marie, Saskatchewan S0N 2T0 Ph: (306) 298-2257
- office in Val Marie at Hwy. #4 and Centre Street
- a vast area of mixed grass prairie in two blocks along the Frenchman River south of Swift Current
- interpretive centre, trails, and Canada's only remaining prairie dog colony
- an excellent place to experience the true vastness of our prairie heritage

Last Mountain Lake National Wildlife Area, Canadian Wildlife Service, P.O. Box 280, Simpson, Saskatchewan S0G 4M0 Ph: (306) 836-2022 FAX: (306) 836-2010
- large area of mixed grass prairie set aside as a migration stopover for endangered whooping cranes
- open to the public
- location of the Mixed Grass Prairie Habitat Restoration Project
- restoration of native prairies, restoration research, seed collection and processing

Prairie Garden Project, Royal Saskatchewan Museum, 2445 Albert Street, Regina, Saskatchewan S4P 3V7 Ph: (306) 787-2815
- a public participation prairie restoration located on the museum's property

Saskatchewan Landing Provincial Park, 350 Cheadle Street, Swift Current, Saskatchewan S9H 4G3
- mixed grass prairie along the South Saskatchewan River Valley

Silver Springs Grassland, Meewasin Valley Authority, 402 Third Avenue South, Saskatoon, Saskatchewan S7K 3G5 Ph: (306) 665-6887
- urban mixed grass prairie reserve
- contact John Gerstma

RESTORATION EQUIPMENT SOURCES

Alberta Agri-Services Ltd., Ken Schaber, RR1, Site 1, Box 8, Olds, Alberta T4H 1P2 Ph: (403) 556-2084 or 551-5162
- manufactures straw crimper that anchors straw mulch used in restoration seeding, also native seed drills, zero till drills and mowers

Almaco, P.O. Box 296, Nevada, Iowa 50201 Ph: (515) 382-3506
- seed cleaning equipment, specialized plot planting and harvesting tools

Apollo Machine and Products Ltd., 2502 Millar Avenue, Box 167, Saskatoon, Saskatchewan S7K 3K4 Ph: (306) 242-9884 or 933-4040 FAX: (306) 931-1282.
- roller mills

Bill's Welding, South 700 Grand Avenue, Pullman, Washington 99163 Ph: (509) 334-2222
- large array of small plot machinery, threshers, debearders, planters, trailers, etc.

Bonar Packaging, 311 Alexander Avenue, Winnipeg, Manitoba R3A 0M9 Ph: (204) 947-1383
- all sizes of grain and seed bags

Carter Day Industries (Canada) Ltd., 1425 Whyte Avenue, P.O. Box 488, Winnipeg, Manitoba R3C 2J6 Ph: (204) 786-5781 FAX: (204) 783-9404.
- debearders, seed cleaning equipment, hardware cloth and screens.

Canadian Forestry Equipment Ltd., 17309 - 107 Avenue, Edmonton, Alberta T5S 1E5 Ph: (403) 484-6687 or 1-800-661-7959
- field equipment, stake flag markers, flagging tape

Can-Seed Equipment Ltd., 43 Turner Avenue, Winnipeg, Manitoba R3J 2S9 Ph: (204) 889-2941
- wide selection of seed cleaning equipment
- Canadian agent for Seedburo Company

Dairyland Agro Supply Ltd., 4030 Thatcher Avenue, Saskatoon, Saskatchewan S7K 3J7 Ph: (306) 242-5850
- hammermills, grain cleaners

Even-Spray and Chemicals Ltd., Bay 2-851 Lagimodiere Boulevard, Winnipeg, Manitoba R2J 3K4 Ph: (204) 237-9095 or 1-800-665-3836 FAX: (204) 231-0710
- one of the best sources of spraying equipment and supplies on the prairies
- excellent, information packed catalogue

Forestry Suppliers, Inc., P.O. Box 8397, Jackson, Mississippi 39284-8397, International Sales Ph: (601) 354-3565 FAX: (601) 355-5126
- extensive field equipment and supplies

Forever Industries (1992) Ltd., 1301 Dugald Road, Winnipeg, Manitoba R2J 0H3 Ph: (204) 233-6462 FAX: (204) 233-6418
- manufacture grain and grass seed cleaners, small elevator legs, debearders, small cyclones, rotary drum grain cleaners

Kay Containers Ltd., 895 King Edward Street, Winnipeg, Manitoba R3H 0P8 Ph: (204) 786-1441
- plastic pails and containers, all sizes of ziplock bags for stratifying seed

Lewis M. Carter (LMC), 526-45th Street East, Saskatoon, Saskatchewan S7K 0W2 Ph: (306) 242-9292 or 1-800-667-6924 FAX: (306) 934-4840
- Clipper fanning mills, debearders, hardware cloth and screens, custom built seed cleaners

Prairie Habitats, Box 1, Argyle, Manitoba R0C 0B0 Ph: (204) 467-9371 FAX: (204) 467-5004.
- hand held native prairie seed stripper, 4 and 12 foot pull-type native prairie seed strippers custom made for restoration seed harvesting, small plot burners for managed burns on native prairies
- prairie restoration books

Richardson Great Northern Manufacturing Inc., 348 Keewatin Street, Winnipeg, Manitoba R2X 2R9 Ph: (204) 774-3747 FAX: (204)694-2282
- spraying equipment, chemical wicking booms

R. Janzen Enterprises, 131 De Baets Street, Winnipeg, Manitoba R2J 3R9 Ph: (204) 654-0786 FAX: (204) 654-0789
- supplies screen material and wire mesh for all makes of grain cleaners

Seedburo Equipment Company, 1022 West Jackson Boulevard, Chicago, Illinois 60607-2990 Ph: (312) 738-3700 or 1-800-284-5779 International FAX (312) 738-5329
- extensive seed cleaning equipment catalogue available
- fanning mills, seed cleaners, threshing machines, seed scarifiers, scales, plot seed drills and much more

Shachtay Sales Ltd., Box 190, Arborg, Manitoba R0C 0A0 Ph: (204) 376-5233
- distributes weed wipers for removal of weeds in native seed and restoration plots

Truax Company, 3609 Vera Cruz Avenue North., Minneapolis, Minnesota 55422 Ph: (612) 537-6639
- manufactures highly regarded native seed drills and wildflower seeders

Wajax Industries Ltd., 20 Murray Park Road, Winnipeg, Manitoba R3J 3T9 Ph: (204) 889-4062
- extensive stock of equipment for doing managed burns – drip torches, flappers, water pumps

PHOTO: B. REARS

A small plot burner currently is under developement by Prairie Habitats for conducting controlled urban prairie burns.

ANNOTATED BIBLIOGRAPHY

A. Prairie – General

North American Prairie Conferences: This series of 13 conference proceedings is the single best source of information on prairie ecology, management and restoration. References to them in this bibliography are listed as NAPC1 through NAPC13.

FIRST: Schramm, P., Editor. 1970. **Proceeding of a Symposium on Prairie and Prairie Restoration.** Knox College Biological Field Station Special Publication No.3. Knox College, Galesburg, Illinois. 66 p. [$5.50 (U.S.) payable to "Peter Schramm," Knox College, Galesburg, Illinios 61401.] NAPC1

SECOND: Zimmerman, J. H., Editor. 1972. **Proceedings of the Second Midwest Prairie Conference.** Published by the editor. 242 p. [$8.50 (U.S.) payable to "James H. Zimmerman," 2114 Van Hise Ave., Madison, Wisconsin 53705.] NAPC2

THIRD: Hulbert, L.C., Editor. 1973. **Third Midwest Prairie Conference Proceedings.** Division of Biology, Kansas State University, Manhattan. 91 p. [$6.00 (U.S.) payable to "Division of Biology," Kansas State University, Manhattan, Kansas 66506.] NAPC3

FOURTH: Wali, M.K., Editor. 1975. **Prairie: A Multiple View.** The University of North Dakota Press, Grand Forks. 433 p. Pemble, R.H., R.L. Stuckey, and L.E. Elfner, Editors. 1975. Native Grassland Ecosystems East of the Rocky Mountains in North America; A Preliminary Bibliography. University of North Dakota Press, Grand Forks. 466 p. [A supplement to the proceedings.] [Prairie: A Multiple View $10.00 (U.S.) plus postage, and the supplement $7.00 (U.S.) plus postage, available form "University of North Dakota Press," Grand Forks, North Dakota 58202.] NAPC4

FIFTH: Glenn-Lewin, D.C. and R.Q. Landers Jr., Editors. 1978. **Proceedings of the Fifth Midwest Prairie Conference.** Extension Courses and Conferences, Iowa State University, Ames. 230 p. [$3.50 (U.S.) postpaid payable to "Botany Department Educational Fund." Send to D.C. Glenn-Lewin, Department of Botany, Iowa State University, Ames, Iowa 50011.] NAPC5

SIXTH: Stuckey, R.L., and K.J. Reese, Editors. 1981. **The Prairie Peninsula – In the "Shadow" of Transeau: Proceedings of the Sixth North American Prairie Conference.** Ohio Biological Survey Biological Notes No.15. 278 p. [$18.00 (U.S.) to "Ohio Biological Survey," 1315 Kinnear Rd., Columbus, Ohio 43212-1192.] NAPC6

SEVENTH: Kucera, C.L. Editor. 1983. Proceedings of the Seventh North American Prairie Conference. Southwest Missouri State University, Springfield. 321 p. [$10.00 (U.S.) postpaid payable to "Southwest Missouri State University." Send to Wallace R. Weber, Department of Biology, Southwest Missouri State University, Springfield, Missouri 65804.] NAPC7

EIGHTH: Brewer, R., Editor. 1983. **Proceedings of the Eighth North American Prairie Conference.** Department of Biology, Western Michigan University, Kalamazoo. 176 p. [$22.00 (U.S.) payable to "Western Michigan University." Send to Department of Biology, Western Michigan University, Kalamazoo, Michigan 49008.] NAPC8

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Journal of Range Management is published bi-monthly by the Society for Range Management, 1839 York Street, Denver, Colorado 80206
- ecology and management of native prairies

Natural Areas Journal is published quarterly by the Natural Areas Association. Natural Areas Association, 108 Fox Street, Wukwonago, Wisconsin 53149. Ph: (414) 363-5500
- interdisciplinary journal of natural area conservation, inventory, and management with many articles on native prairie

Restoration & Management Notes is published twice yearly by the University of Wisconsin Press. Journal Division, University of Wisconsin Press, 114 North Murray Street, Madison, Wisconsin 53715 FAX: (608)262-7560, Ph: (608) 262-4952
- the single best source for practical information on prairie restoration and management

Restoration Ecology is published quarterly by Blackwell Scientific Publications, Inc., 238 Main Street, Cambridge, Massachusetts 02142 and the Society for Ecological Restoration, University of Wisconsin, Madison Arboretum, 1207 Seminole Highway, Madison, Wisconsin 53711
- scientific studies of the ecology of restored communities

Roader's Digest is the Newsletter of the Office for Integrated Roadside Vegetation Management at the University of Northern Iowa, 113 Center for Energy and Environmental Education, University of Northern Iowa, Cedar Falls, Iowa 50614-0293
- the best roadside prairie restoration information publication available

Wildflower is published quarterly by the Canadian Wildflower Society, 4981 Highway 7 East Unit 12A, Suite 228 Markham, Ontario L3R 1N1. Ph: (416) 466-6428
- covers the wild flora of North America

Wildflower Journal of the National Wildflower Research Center is published twice annually and Wildflower, Newsletter of the National Wildflower Research Center, published six times annually by the National Wildflower Research Center, 2600 FM 973 North, Austin, Texas 78725.
- excellent information on native plant propagation and conservation

Six Rules Of Prairie Restoration

1. Use local seed
2. Prepare site well
3. Use sufficient seed
4. Monitor germination
5. Control perennial weeds as soon as they appear
6. Be patient!!!

RESTORATION CHECK LIST

The following is a checklist that can be used when planning, preparing, seeding and managing prairie restoration.

1. Planning/Time Line
- a. Establish a time line
- b. Set the budget
- c. Consult those with expertise in restoration and people with knowledge of the local area
- d. Visit local prairie remnants

2. Site Selection and Analysis
- a. History of site
- b. Current use
- c. Present conditions
- d. Soil Type
- e. Topography
- f. Adjacent land use
- g. Weed population
- h. Weed control options

3. Site Design
- a. Site location
- b. Size
- c. Shape
- d. Borders

4. Site Preparation
- a. Cultivate
- b. Herbicide
- c. Roller pack

5. Species Selection
- a. Species native to the local area
- b. Dominant species to be used in the restoration mix
- c. Other species to be used in the restoration mix

6. Seed Sources
- a. Commercial Supply
- b. Nursery harvest
- c. Wild harvest
  - – proper seed storage
  - – stratification, scarification

7. Seeding
- a. Seeding dates
- b. Seeding rates
- c. Seeding techniques
  - drill
  - broadcast
  - mosaic
  - cover crop
  - mulching
  - irrigation

8. Site Establishment
- a. sampling native and non-native plant densities

9. Long Term Management
- a. Weed control
- b. Mowing
- c. Spot spraying
- d. Burning
- e. Grazing
- f. Species enhancement

10. Public Education
- a. News release
- b. Publicity
- c. Volunteer groups
- d. Public involvement

RESTORATION QUESTIONNAIRE

Use this as a guideline to help you plan, prepare, seed and monitor a prairie restoration. If you would like to send us copies of your questionnaire, it would help further our restoration knowledge and improve future versions of this manual. Send to Prairie Habitats, P.O. Box 1, Argyle, Manitoba, Canada R0C 0B0.

Name _____

Name of Agency _____

Address _____

_____ Telephone _____

Planning the Restoration:

Date planning begun _____

The overall budget for the restoration project _____

Were persons with expertise in restoration consulted? ❑ Yes ❑ No

The Restoration Site:

Location _____

Size _____

Original site conditions ❑ bare ground ❑ old field ❑ lawn

❑ other _____

Original site use _____

Adjacent land use ❑ urban ❑ farmland ❑ industrial

❑ other _____

Soil type ❑ clay ❑ silt ❑ loam ❑ sand ❑ other

❑ other _____

Topography ❑ flat ❑ rolling ❑ steep slope

❑ other _____

Plant species present on site prior to restoration:

native species _____

_____

_____

non-natives species _____

_____

_____

Site Preparation:

Time spent in site preparation _____

What time of the year was the site prepared?

❑ spring ❑ summer ❑ fall

How was the site prepared? ❑ cultivated ❑ sprayed ❑ roller packed

❑ other _____

What types of equipment were used to prepare the site? _____

_____

_____

Were chemicals used to prepare the site? ❑ Yes ❑ No

If "Yes" what chemicals were used and at what rates? _____

_____

_____

Species Selection:

How were the species selected? ❑ visit remnant ❑ museum herbarium

❑ expert ❑ experience ❑ from manual ❑ from literature

❑ other _____

What were the dominant species used in the seed mix? _____

_____

_____

Seed acquired from ❑ commercial suppliers ❑ nursery harvest

❑ wild harvest

If seed was collected from the wild, how far were the sites from the

restoration site? _____ km or miles

Seeds were harvested by ❑ hand ❑ mechanical seed strippers

❑ combines ❑ native hays ❑ other _____

Seeding:

Was the seed prepared in any way prior to seeding? ❑ stratification

❑ scarification ❑ other _____

Date of seeding _____

What techniques were used to seed the site? ❑ broadcast ❑ drill

❑ hydroseeding ❑ transplants ❑ other _____

What was the seeding rate used? _____ kg/ha or lbs/acre

Was a cover crop incorporated into the seed mix? ❑ Yes ❑ No

Was mulch applied to the site? ❑ Yes ❑ No

Was the site irrigated? ❑ Yes ❑ No

If "Yes" at what rate? _____

Were there any other special measures taken while seeding or after seeding? _____

Was there any natural rainfall on the site within 1 month of seeding?

❑ Yes ❑ No

If "Yes" approximately how much? _____

Site Establishment and Long Term Management

What measures are used to control the weed species on the restoration site? ❑ mowing ❑ spot spraying ❑ hand weeding

❑ other _____

Was the site burned? ❑ Yes ❑ No If "Yes" when _____

Was the site grazed? ❑ Yes ❑ No If "Yes" when _____

Had additional seeding taken place since the initial seeding?

❑ Yes ❑ No

Is the site monitored on a regular basis? ❑ Yes ❑ No

❑ weekly ❑ monthly ❑ annually

Results of Monitoring

SPECIES	Weeds			Native Wildflowers			Native Grasses		
YEAR	1	2	3,	1	2	3	1	2	3
# of plants/m^2									

Do you have any comments or suggestions on this book and how it could be improved on in the future? _____

Do you plan to do additional restorations in the future?

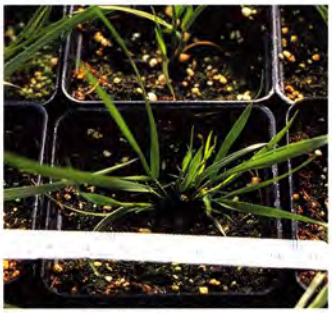
❑ Yes ❑ No

If "Yes", please provide a few details. _____

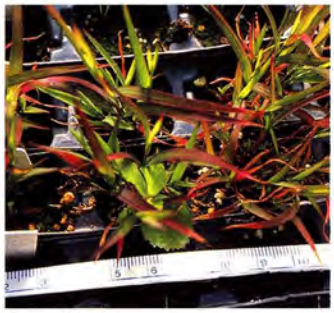
Other comments: _____

SELECTED NATIVE PRAIRIE SEEDLING PHOTOS

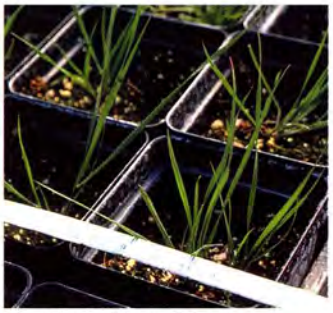
Big Bluestem
(Andropogon gerardi)



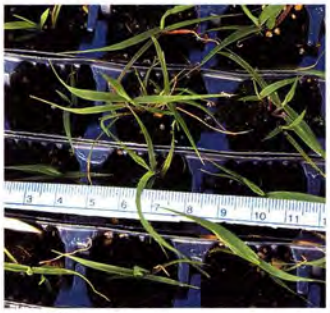
Green Needle Grass
(Stipa viridula)



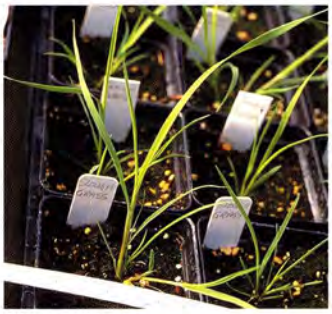
June Grass
(Koeleria gracilis or cristata)



Needle & Thread Grass
(Stipa comata)



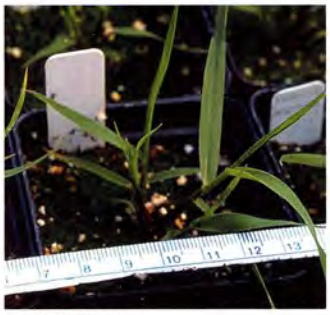
Side Oats Grama
(Bouteloua curtipendula)



Slough Grass
(Beckmannia syzigachne)

Spear Grass
(Stipa spartea)

Sweet Grass
(Hierochloe odorata)



Switch Grass
(Panicum virgatum)

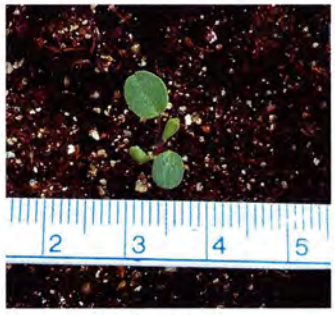
Alum Root
(Heuchera richardsonii) 25 days

Ascending Purple Milkvetch
(Astragalus striatus) 30 days

Beautiful Sunflower
(Helianthus laetiflorus) 27 days

Bergamot
(Monarda fistulosa) 28 days

Black Eyed Susan
(Rudbeckia hirta) 31 days



Canada Milkvetch
(Astragalus canadensis) 24 days

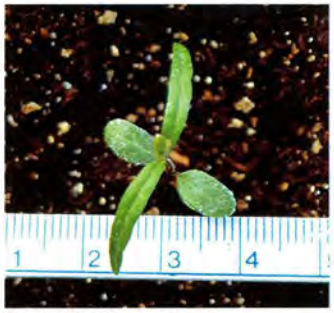
Crowfoot Violet
(Viola pedatifida) 32 days

Culver's Root
(Veronicastrum virginicum) 27 days

Cut Leaved Anemone
(Anemone multifida) 17 days

Dotted Blazingstar
(Liatris punctata) 32 days

Dwarf False Indigo
(Amorpha nana) 29 days

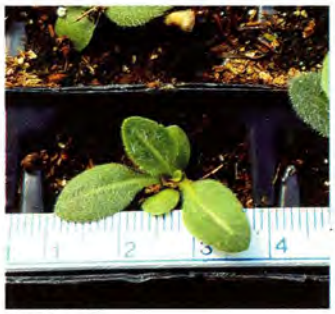


Dwarf Milkweed
(Asclepias ovalifolia) 28 days

Early Yellow Violet
(Viola adunca) 27 days

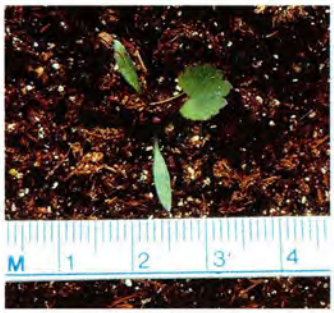
Fireweed
(Epilobium angustifolium) 33 days

Flat Topped Goldenrod
(Solidago graminifolia) 30 days



Gaillardia
(Gaillardia aristata) 32 days

Giant Hyssop
(Agastache foeniculum) 27 days



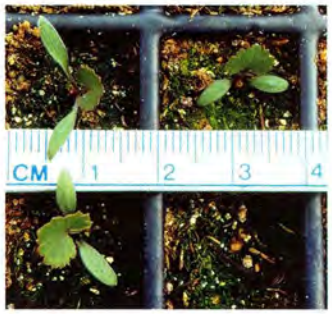
Golden Alexander
(Zizia aurea) 19 days

Graceful Goldenrod
(Solidago canadensis) 26 days

Ground Plum
(Astragalus crassicarpus) 28 days

Hairy Golden Aster
(Chrysopsis villosa) 33 days

Harebells
(Campanula rotundifolia) 26 days



Heart Leaved Alexander
(Zizia aptera) 24 days

Indian Breadroot
(Psoralea esculenta) 31 days

Indian Hemp
(Apocynum cannabinum) 25 days

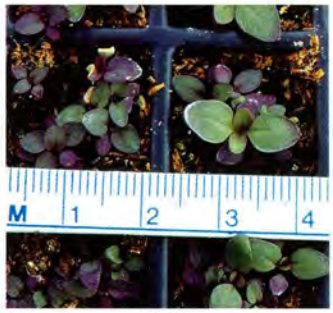
Indigo Bush
(Amorpha fruticosa) 28 days

Joe Pye Weed
(Eupatorium maculatum) 27 days

Lance-Leaved Paintbrush
(Castillegia sp.) 25 days

Leadplant
(Amorpha canescens) 27 days

Lewis Wild Flax
(Linum lewisii) 31 days

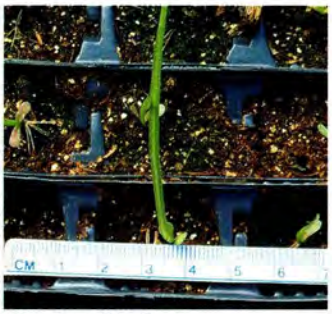


Lilac Flowered Penstemon
(Penstemon gracilis) 30 days

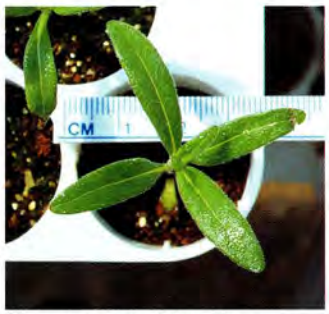
Long Fruited Amenone
(Anemone cylindrica) 14 days

Low Goldenrod
(Solidago missouriensis) 33 days

Many Flowered Aster
(Aster ericoides) 30 days



Meadow Blazingstar
(Liatris ligulistylis) 34 days

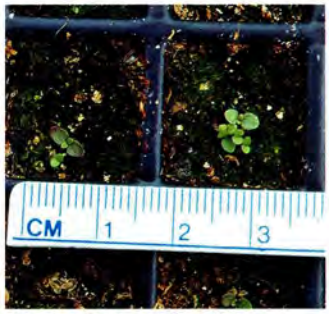


Narrow Leaved Sunflower
(Helianthus maximiliani) 28 days

New England Aster
(Aster novae-angliae) 35 days

Northern Bedstraw
(Galium boreale) 26 days

Northern Bog Violet
(Viola cucullata) 22 days

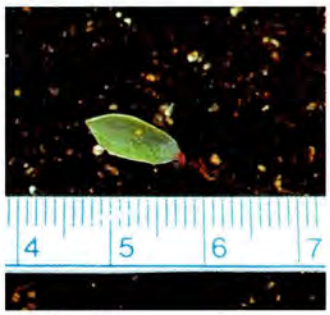


Oblong Leaved Gentian
(Gentiana affinis) 24 days

Philadelphia Fleabane
(Erigeron philadelphicus) 34 days

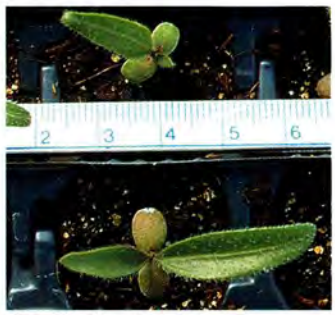
Prairie Cinquefoil
(Potentilla pennsylvanica) 27 days

Prairie Crocus
(Anemone patens) 1 year



Prairie Lily
(Lilium philadelphicum) 2nd year

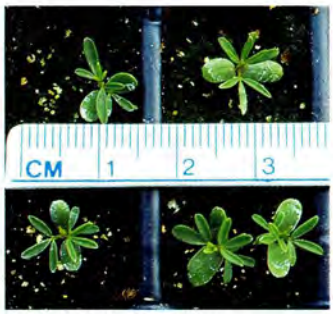
Prairie Sage
(Artemisia ludoviciana) 27 days



Purple Coneflower
(Echinacea angustifolium) 34 days

Purple Prairie Clover
(Petalostemon purpureum) 26 days

Riddell's Goldenrod
(Solidago riddelli) 25 days



Rough False Sunflower
(Heliopsis helianthoides) 28 days

Showy Aster
(Aster sericeus) 30 days

Showy Goldenrod
(Solidago nemoralis) 30 days

Smooth Aster
(Aster laevis) 31 days

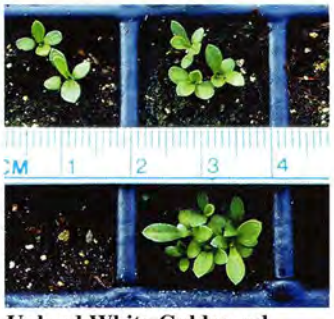
Sneezeweed
(Helenium autumnale) 28 days

Spiked Lobelia
(Lobelia spicata) 28 days

Stiff Goldenrod
(Solidago rigida) 31 days

Swamp Milkweed
(Asclepias incarnata) 32 days

Three Flowered Avens
(Geum triflorum) 27 days



Upland White Goldenrod
(Solidago ptarmicoides) 27 days

White Cinquefoil
(Potentilla arguta) 27 days

White Penstemon
(Penstemon albidus) 27 days

White Prairie Clover
(Petalosteman candidum) 29 days

Whorled Milkweed
(Asclepias verticillata) 27 days

Wild Columbine
(Aquilegia canadensis) 18 days

Wild Licorice
(Glycyrrhiza lepidota) 28 days

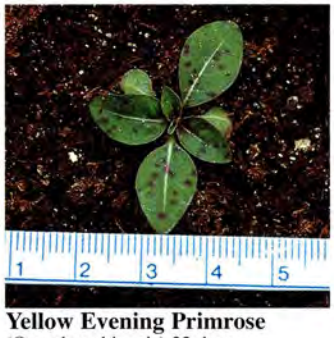
Wild Mint
(Mentha arvensis) 25 days

Willow Aster
(Aster hesperius) 30 days

Yarrow
(Achillea millefolium) 18 days

Yellow Avens
(Geum aleppicum) 31 days

Yellow Coneflower
(Ratibida columnifera) 31 days



Yellow Evening Primrose
(Oenothera biennis) 22 days

About The Authors...

John P. Morgan *has an Honours degree in Zoology and Masters degree in Natural Resources Management from the University of Manitoba. He has lived in various parts of Canada. He worked as a research biologist in Canada's high Arctic and a habitat biologist on the prairies. He has collected native seeds since he was 6 years old, and is a self-confessed prairie fanatic. John has received the Friends of Equinox Citation for Environmental Achievement and the Government of Canada's 125th Anniversary Medal for his work in restoring native prairies. With his wife Carol and daughters Shawna and Heather, the family operates Prairie Habitats, a prairie restoration company at Argyle, Manitoba.*

Douglas R. Collicutt *has an Honours degree in Zoology from the University of Manitoba. Born and raised in Winnipeg, Doug has worked as an ecologist in the Arctic and around Manitoba. He received Harrowsmith Magazine's Local Hero award for his work on restoring prairie and wetland habitat along Omand's Creek in Winnipeg. Doug invented a hand held seed stripper that now is in use around the world collecting native seeds. Doug runs an ecological consulting business from his home in Winnipeg.*

Jacqueline D. Thompson *holds a Bachelors degree in Ecology and a Masters degree in Natural Resources Management from the University of Manitoba. She was born and raised in St. Norbert, Manitoba. Her thesis topic was a survey of roadside prairie restoration activities of North American highways departments. She has worked on wild rice in Manitoba, and numerous prairie restoration projects. Jacqueline is involved in conserving remnant river bottom forests along the La Salle River in St. Norbert, and in setting up a wildflower route along a major Manitoba highway. She is a restoration ecologist with Prairie Habitats and lives in Winnipeg.*

About This Book

"Restoring Canada's Native Prairies" covers 5 Canadian provinces with maps and species lists for prairie restorations in each. Chapters on planning a restoration, acquiring, processing and propagating native seeds, site preparation, seeding and monitoring are designed to give practical methods for successful restorations. Special sections deal with backyard, school and roadside prairie restoration.

The appendices bring together for the first time a vast array of related information on Canadian native seed sources, prairie information contacts, native prairie sites to visit, restoration equipment sources, a photographic guide to native seedlings, plus an extensive annotated bibliography of prairie literature.

This book provides a ready reference for anyone thinking of restoring a native prairie from homeowners, teachers, farmers, and ranchers to landscape designers and architects, park, municipal and urban planners, maintenance personnel, biologists, and engineers. It represents over 5 years of research and experimenting by many people across Canada.