CHAPTER 2

Managing, Restoring and Re-establishing Prairie and Savanna Communities

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Indian grass
Drawing by Tom Klein

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CHAPTER 2

Managing, Restoring and Re-establishing Prairie and Savanna Communities

Introduction

At the time of the Public Land Survey in Minnesota (1847-1907), the Prairie Parkland Province was primarily comprised of upland prairie and prairie wetland communities, while savannas were a major community type of the Eastern Broadleaf Forest Province. (See Figure 1.)

Figure 1: ECS province map

Prairies are grasslands that are void of trees. They lack the moisture needed to support tree growth. (Prairie is the French word for meadow.)

Savannas are transitional landscapes generally occurring in areas of transition from grasslands to forests. True savannas are composed of grasses, forbs and shrubs with scattered stands of trees, the most characteristic being the dry-oak savanna. In Minnesota, however, oak woodland and brushland communities dominate in the southern part of the state, rather than true savanna communities. Pine barrens, another form of savanna, occur frequently in the northern and central parts of the state.

Prairies and savannas are fire-dependent ecological communities. Fire is the significant factor influencing the survival and extent of these communities.

These are the natural grassland communities we seek to manage, restore and re-establish on our state trails, canoeing and boating routes, and water access sites.

Trails and Canoeing/Boating Routes Crossing Prairies and Savannas in Northern Minnesota

Trails that cross prairie, brush prairie or pine barrens landscapes in Northern Minnesota include (see Figure 2, page 3):

Willard Munger State Trail (intermittent openings)
Paul Bunyan State Trail (intermittent openings)
Heartland State Trail (intermittent openings)

Canoeing/boating routes that cross prairie, brush prairie or pine barrens landscapes in Northern Minnesota include (see Figure 3, page 4):

Mississippi River (northern portion)
Pine River
Crow Wing River
Red Lake River

Trails and Canoeing/Boating Routes Crossing Prairies and Savannas in Southern Minnesota

Trails that cross prairie, brush prairie or oak savanna landscapes in Southern Minnesota include (see Figure 2, page 3):

Blufflands Trail system (western portion)
Douglas State Trail
Sakatah State Trail (eastern half)
Casey Jones State Trail
Luce Line State Trail (western third)
Glacial Lakes State Trail
Willard Munger State Trail (southern portion)

Canoeing/boating routes that cross prairie, brush prairie or oak savanna landscapes in Southern Minnesota include (see Figure 3, page 4):

Straight River
Cannon River (westernmost section)
Watonwan River
Des Moines River
Cottonwood River
Minnesota River (western two-thirds)
Chippewa River
Pomme de Terre River
North Fork Crow River
Rum River
Mississippi River (central portion)

Minnesota State Trails

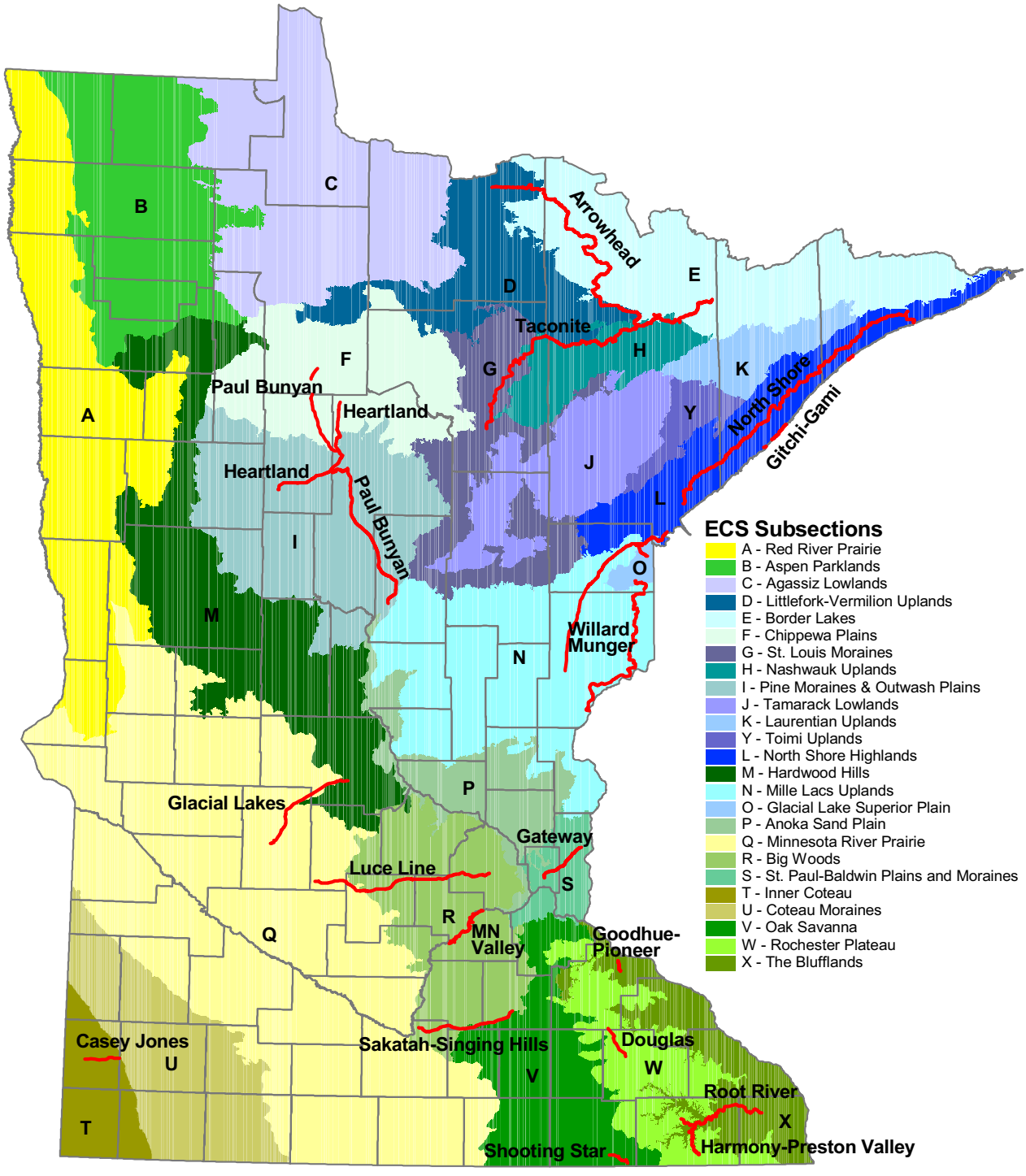


Figure 2: Minnesota state trails

Minnesota Canoeing/Boating Routes

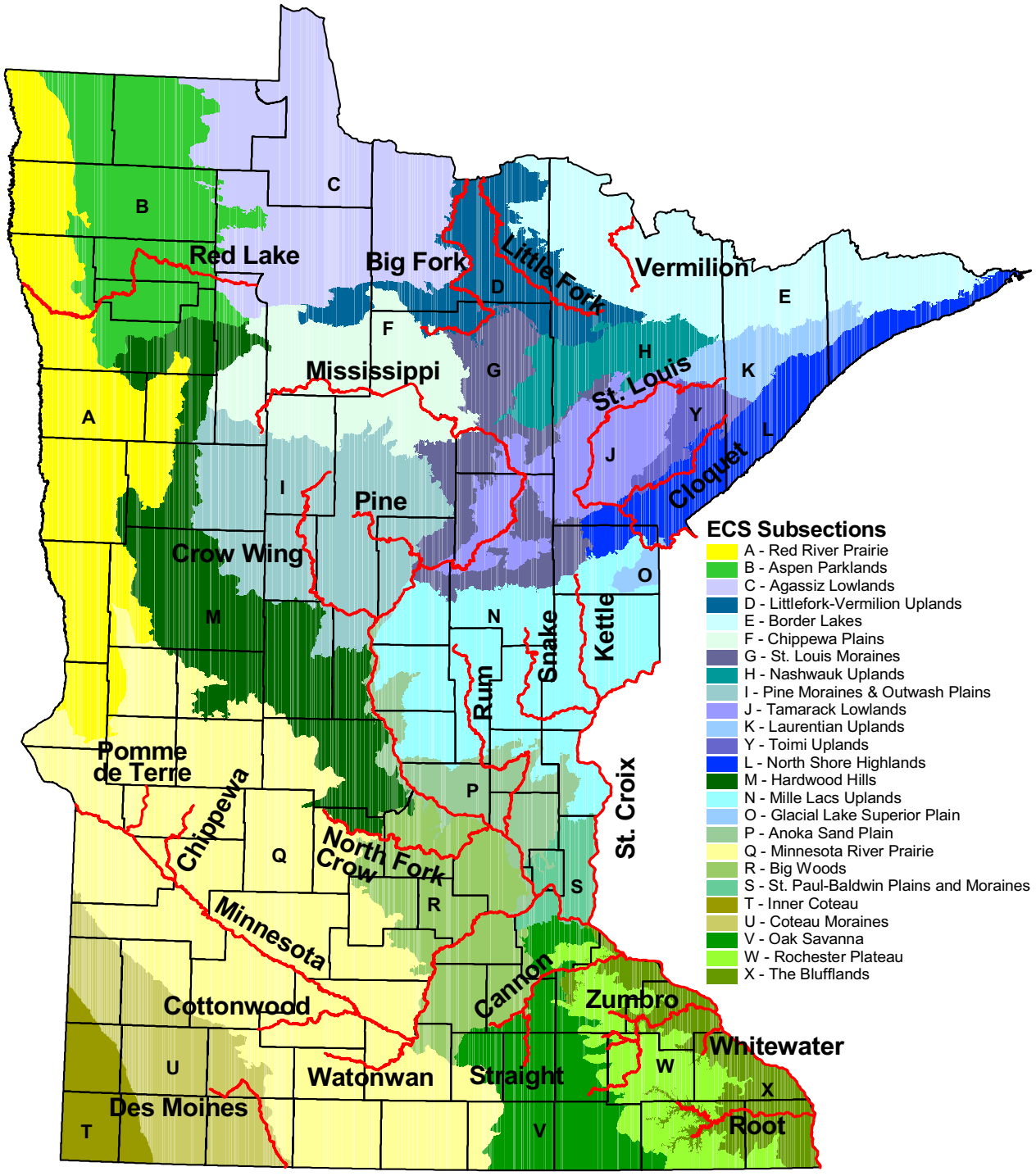


Figure 3: Minnesota canoeing/boating routes

Guiding Principle

To enhance the ecological quality of state trails,
canoeing and boating routes, and water access sites,
thereby increasing the quality of the recreational experience
and fostering user awareness and appreciation.

This principle can be achieved by:

- ❒ **Managing intact prairie remnants and restoring degraded prairie remnants,** striving to achieve connectivity through management.
- ❒ **Re-establishing native grasses and forbs** where appropriate.
- ❒ **Keeping construction disturbance to a minimum**.
- ❒ **Reseeding and replanting construction disturbance** with locally native plants.
- ❒ **Interpreting plant communities** and associated management and restoration activities.

Unlike books, which divulge their meaning only when you dig for it, the prairie plants yearly repeat their story, in technicolor, from the first pale blooms of pasque in April to the wine-red plumes of bluestem in the fall.

Aldo Leopold
from his essay
"Roadside Prairies"

Assessing Site-Specific Needs: Management, Restoration or Re-establishment?

When is management of a community sufficient? When is restoration the preferred approach? When is re-establishment needed?

Management means taking care of what's already there: encouraging and improving the continued growth and enhancement of natural communities already in place at a particular site. Management can also be considered a form of restoration—trying to improve a site ecologically.

Restoration represents a more intensive effort. It is a process of returning a degraded natural community to its original structure and species composition.

Areas in need of restoration usually offer the "basic ingredients" necessary to represent a natural community, but the quality of the overall community is less than what it should be. Restoration efforts

focus on enhancing what's already there, to improve the overall quality and long-term viability of the natural community.

Restoration can be thought of as nursing biodiversity back to health through such activities as burning, exotic species control, interseeding and interplanting.

Re-establishment represents the most intensive effort but is probably the least understood at this time. It is about attempting to re-establish a natural plant community that once existed in a specific location. This process is a beginning that gives us the opportunity to gain greater knowledge of the complexity of natural systems while actively participating in helping to heal the land, which is a satisfying activity in itself. DNR ecologists and resource managers can help identify a target community in a chosen location.

Things To Remember

✔ Conduct a comprehensive site analysis.

✔ Select a target community.

✔ Monitor management activities and evaluate outcomes.

Conducting a Comprehensive Site Analysis

A comprehensive site analysis is the first step in prescribing management activities for a particular site. It should include the following steps:

❒ Learn about the biological history of the site.

• Refer to *The Natural Vegetation of Minnesota at the Time of the Public Land Survey: 1847-1907.*

• Consult Minnesota County Biological Survey (MCBS) maps and descriptions.

❒ Survey and evaluate existing vegetation on the site.

• Consult *Minnesota's Native Plant Communities Classifiction, Version 2.0*

• Consult the *Field Guide to the Native Plant Communities of Minnesota 2004-2006*

• Solicit help from a botanist or ecologist, or learn to identify plants.

❒ Determine whether any listed plant or animal species are present.

• Check the Minnesota listing.

• Solicit help from an ecologist.

❒ **Analyze soil types and characteristics.**

• Refer to *Soil Surveys by County: NRCS in Cooperation with Minnesota Agricultural Experiment Station,* from the U.S. Department of Agriculture.

• Conduct a soil sampling onsite.

• Determine soil compaction or disturbance.

• Determine content of organic matter and nutrient levels.

• Determine pH factor.

❒ **Determine soil moisture** gauged on a gradient from dry to mesic to wet.

• Determine drainage patterns. For example, sandy soils and hilltops are dry, and depressions and clay soils hold water and therefore are more moist.

❒ **Consider topographic features,** such as slope and aspect.

• Determine whether the site is hilly or level; identify degree of exposure to the sun (south, north, east or west).

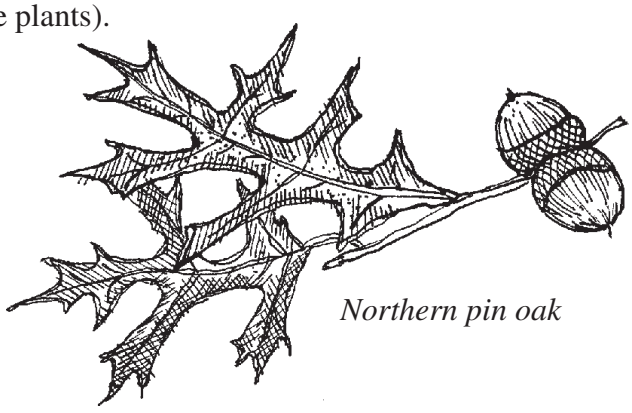
❒ **Consider the microclimatic conditions** of the site, within the regional context.

❒ **Select the appropriate plant species** according to site conditions and the specific landscape unit.

• Consult *Vascular Plants of Minnesota,* by G.B. Ownbey and T. Morley (1991).

• Consult the County Biological Survey database.

• Consult *Restore Your Shore* CD ROM (includes an encyclopedia of native plants).



Northern pin oak

Successional Stages Then and Now

Natural succession in a pre-settlement era prairie was a dynamic process whereby one group of plant species was replaced by another over time. Prairies at that time were often manipulated by Native Americans, using fire as a management tool.

Succession was an ongoing process. Prairie animals' activities—such as bison wallows, gopher mounds and badger diggings—would always create new areas of open ground, which were colonized by short-lived native species, such as horseweed, fleabane daisy and evening primrose, which would quickly stabilize the soil.

These species would be replaced by early prairie plants, such as black-eyed susan, grey-headed coneflower and wild bergamot. Eventually, legumes and other conservative species would move in.

This constant continuum existed along a gradient of disturbance, with short-lived pioneer species at one end and conservative long-lived species at the other end. This rich diversity of plants would assure the availability of seeds. This sequence repeated itself as long as fires occurred and seeds were available. In the absence of fire, the successional sequence would continue and grow into brushy prairie and, eventually, into oakwoods.

Today, natural succession has been profoundly affected. Exotic species (both herbaceous and woody), the amount of disturbed ground associated with agriculture and development, and the lack of fire have greatly reduced native seed sources. Native prairies have been reduced to remnants and are often islands surrounded by disturbed ground.

If not intercepted by management, a common successional sequence on abandoned farmfields and overgrazed pastures starts with exotic weeds, which are followed by long-lived perennial exotics, such as spotted knapweed, sweet clovers, leafy spurge, smooth brome, reed canary and weedy natives mixed with exotic and native invasive trees and shrubs.

Adapted from *Tall Grass Restoration Handbook,* Chapter 1: Orchards of Oak and a Sea of Grass, by Virginia Kline. Island Press, Washington, D.C., 1997.

Northern dropseed
Drawing by Tom Klein

FOCUS ON MANAGEMENT: Tools and Approaches for Managing Remnant Prairies and Savannas

While fire is considered to be the superior management tool for prairie remnants, mowing and raking is also an option. Both approaches control the invasion of woody vegetation and may also aid in the control of exotic plants, which is critical to the management of remnant native communities.

Removing decaying plant material through burning or mowing depletes nitrogen. Prairie communities are more stable in nitrogen-poor environments, due to less competition from exotic plants. Many exotic plants grow more vigorously in environments rich in nitrogen, such as fertilized areas, and in areas with fast-decomposing plant material.

The Significance of Small Remnant Communities Along Rail Trails

Remnant prairie and savanna communities still occur along state trails located on former railroad rights-of-way, especially in the southern and western parts of the state. In the north-central part of the state, pine barren communities may predominate.

These existing remnants, once part of an originally larger area, often persisted because of their location. During the railroad era, sparks from trains frequently ignited adjacent vegetation. Because these fires in some cases suppressed the invasion of woody vegetation, shade did not develop, and prairie grasses and forbs persisted.

When these rights-of-way were converted to trails, fires no longer occurred on these remnants. As a result, brushland and woodlands of exotic or invasive species developed over the years, creating a tunnel of woody vegetation along many trails.

Managing these prairie remnants with occasional prescribed fire will not only enhance the ecological quality of the remnant but also enrich user experience by providing visual diversity.

In the future, these remnants may serve as models for potential restoration efforts along trails and on adjacent land.

Fire as a Management Tool

Plan to burn unless it is not feasible to do so. Because prairies are fire-dependent ecological communities, prescribed burns are an important management tool.

Prairies are positively affected by periodic fire in many ways. For example:

Prairies are positively affected by periodic fire in many ways. Plants grow more vigorously, the growing season is extended, warmer soil favors prairie plants, fire controls invading trees and shrubs, and fire removes thatch.

❒ Following a burn, plants grow more vigorously and produce more flowers and seed.

❒ The growing season is extended, because the blackened soil warms sooner in the spring.

❒ Warmer soil also favors prairie plants over cool-season invasive weeds.

❒ Fire controls invading trees and shrubs.

❒ Fire removes thatch, benefiting plants and animals that require an open environment.

Timing for Prescribed Burns

Spring vs. fall

❒ **Burning in mid-spring** exposes black soil to the spring sun, acceler-ating the warming of the soil and boosting the growth of both warm- season plants and cool-season natives, like June grass. However, spring burning also favors cool-season exotics, like smooth brome grass.

❒ **Burning in the fall or late spring helps** to control woody plant invasion:

• Brush suffers greatly when burned after bud break in the spring or before it has sent food stores to root for the dormant season.

• Fire also stimulates prairie plants to form a dense sod, making it more difficult for woody plants to establish.

• Fire kills the above-ground parts of invading trees and shrubs. Deciduous trees and shrubs will resprout from the roots and will probably never be completely eliminated, ready to come back in the absence of a periodic fire.

❒ **Fall fires are more difficult to implement,** because vegetation may be too moist and air temperatures are cooler to fuel a hot fire.

❒ **Fall burns destroy potential winter cover** and food for wildlife.

Burning in rotation (spring and fall)

Plan to divide larger sites into two or three management units. One of the units is burned in rotation each year, leaving other units unaffected in "off years." Burning in rotation will:

❒ Preserve insect populations, such as overwintering butterfly chrysalises.

❒ Provide winter cover and food for wildlife.

❒ Create constantly changing patterns of vegetation, which will enhance ecological diversity and aesthetic appeal.

Frequency of Burning

Burning too frequently may increase the dominance of prairie grasses to the detriment of forbs, and frequent burning may also favor certain exotics:

❒ Burning once every 3-5 years is sufficient in most cases.

❒ For dry prairies that produce less plant material, burning in 7-year to 9-year intervals will be more successful.

Planning and Implementing a Prescribed Burn: Procedures and Guidelines

(Minnesota DNR Operational Order # 47)

www.dnrnet.state.mn.us/forms/
Forestry #NA-01990-03, available in PDF and WPD format

❒ Determine the management objective for the site.

❒ Mow firebreaks, and cut large shrubs and trees ahead of time.

❒ Prepare a burn plan (consult a regional burn boss and Operational Order #47), including a site map. (Aerial photos work well.)

❒ Identify a range of dates/hours for the burn.

❒ Secure all needed permits from local fire departments

and DNR Forestry.

❒ Alert and invite local fire departments as backup.

❒ Inform adjacent landowners and the general public.

Black-eyed Susan

Mowing as a Management Tool

Mowing is almost as effective as burning; in fact, for smaller areas, mowing to a minimum height of 6 inches and raking off the mowed material is a good substitute for burning. Mowing also removes the previous year's vegetation, and mowing in spring sets back cool-season plants.

Caution: Mowing after new growth has reached about 1 foot in height is undesirable. It may damage some of the prairie species, and it may destroy wildlife broods.

FOCUS ON RESTORATION: Approaches To Restoring "Old Fields"

"Old fields" are areas that share three common characteristics:

- ❒ They were once pastured intensively.
- ❒ They have not been used for agricultural purposes over an extended period of time.
- ❒ They are in some form of early succession.

❒ **Upland sites are often dominated** by exotic species, such as Kentucky bluegrass, timothy, smooth brome, and clovers, as well as some early succession prairie species, such as black-eyed Susan, evening primrose, various goldenrods, and asters.

❒ **Wet sites may be infested** by purple loosestrife and reed canary grass, which need to be eradicated before any restoration attempts are made.

Studying the Restoration Site

Careful study of each restoration site must include analyzing the soil, learning about the vegetation history of the site, and gaining an understanding of the larger landscape unit. (See also "Conducting a Comprehensive Site Analysis," page 6.) This information will then guide the identification of one or several target communities for a specific site, assuring more conservative use of costly seed.

Preliminary Burning or Mowing

One mowing or burning may be sufficient to open up the thatch enough to interseed with native seed gathered from nearby sites.

Another strategy sometimes used by restorationists is to conduct several late-spring burns to break down dense exotic grass turf, and then observe whether suppressed prairie plants emerge on their own. Instead of burning an entire site, several test patches could be burned and observed.

New England aster

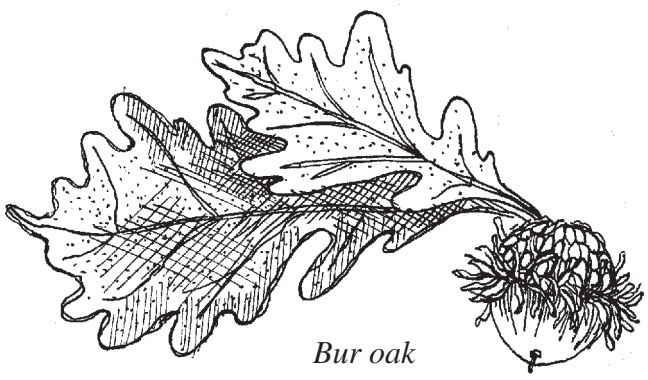
Interseeding

A combination of burning or mowing and interseeding with native grasses and forbs, preferably from nearby prairies, may be a good way to improve these impoverished sites. Interseeding is also a good approach when dealing with erosion-prone slopes or oak savannas, where cultivating might destroy any native plants already there and disturb the roots of trees.

❒ **Incorporate seeds into the soil** by hand-raking on small sites, and by harrowing, disking or drilling on larger sites.

❒ **Most seeds need to be covered with soil** in order to germinate. A seed should be covered with soil equal to twice the thickness of the seed itself. Very small seeds that need light to germinate are seeded on top and are not covered with soil. Packing the soil as a last step will assure good seed-to-soil contact.

❒ **A preferred seeding method** is to burn a site in late fall, then broadcast seed before winter sets in, or in late winter when there is less than one foot of snow on the ground. The seeds then go through their natural cycle, while rain, snow, freezing and thawing assure that seeds have the needed contact with the soil.



Bur oak

FOCUS ON RE-ESTABLISHMENT: Seeding Native Grasses and Forbs

A prairie community is a very complex natural ecosystem that cannot be duplicated. The best we can do is to try to imitate a native prairie. By using nature as a model, re-establishment techniques can result in the creation of natural-appearing grasslands.

Visit local prairie remnants and observe what they look like. Then carefully study your site and seek to imitate the composition of local remnants with similar site conditions before seeding your site.

Things To Remember

✔ Study the ecological behavior of species by visiting and observing natural remnant prairies and savannas.

✔ Avoid wasting precious seed by fine-tuning a planting to the greatest extent possible.

New Jersey tea

Basic Considerations for Seed Mix Design

❒ **Specify a seeding rate** of 8-10 lbs per acre if drill seeding a site, or 10-12 lbs per acre if broadcasting seeds on a site when obtaining seed from a commercial vendor.

❒ **The seeding rate should be tripled** when seeding rough-cleaned seed collected from the wild. (Seed suppliers who are familiar with the properties of various seeds can help determine the optimum amount of seed needed for each species.)

❒ **Consider the seed count of individual species** when designing the seed mix.

❒ **Balance the use of grasses and forbs** in a ratio of 70% grasses to 30% forbs, or a ratio of 60% grasses to 40% forbs.

❒ **Use as many species as you can afford** for a more diverse prairie later on.

❒ **A prescribed seed mix** should have a minimum of 3-5 species of grasses and 18-24 species of forbs initially. Diversity may be increased a few years later by interseeding those species that do not grow well in an open seedbed.

❒ **Select species from various successional stages,** including early succession species (such as black-eyed Susans, wild bergamot and blue vervain) and slow-to-establish, long-lived species (such as downy phlox, leadplant, gentians, New Jersey tea and compassplant).

❒ **Keep in mind that early succession species,** such as black-eyed Susan, Canada wild rye and purple coneflower, will not have staying power and will diminish as the planting matures.

❒ **Use cordgrass and switchgrass conservatively.** Both grasses can dominate a planting.

❒ **Big bluestem also has a tendency to dominate** a planting in heavy soils.

❒ **Use aggressive clonal or rhizomatous and allelopathic species conservatively,** such as goldenrods, bergamots, whorled milkweed and certain sunflowers.

❒ **Design several seed mixes** for a site that has varied soil moisture conditions due to topography and aspect.

❒ **Select appropriate plant species** according to the specific landscape region. Consult *Vascular Plants of Minnesota,* by G.B. Ownbey and T. Morley (1991), or the County Biological Survey database.

Guidelines for Designed Plantings on Small Sites Using Transplants

Trail rest areas, water access sites and other highly visible small sites should be landscaped with a focus on using native plants after construction is completed.

It is important to work with local communities, garden clubs and user groups to gauge public acceptance and appreciation for natural landscaping practices. It is also important to secure funding or volunteer help for maintenance over several seasons, to help assure that the planting will be successful.

The following general guidelines will help direct the outcome of a designed planting:

❒ **Choose a site with maximum sun exposure** and little competition from trees with high surface root density, such as elm, basswood and maple.

❒ **Enhance plantings** in the southern part of the state with oaks, and in the northern part of the state with pine, both of which will convey a savanna-like character.

❒ **Consider the following when designing a small planting:**

- Individual plant characteristics
- Plant requirements for optimum growth
- Composition in regard to ecological behavior, color, texture and seasonal appearance
- Visiting local natural plant communities

❒ **Plan initial plantings without aggressively spreading plants,** such as switchgrass, prairie coreopsis, roses, sunflowers and certain goldenrods. Some of these species may be added later, after the planting has established.

❒ **Balance the use of grasses and forbs.** When grasses and forbs are alternated every square foot, the grasses will eventually fill in and produce a more natural pattern. A ratio of 70% grasses to 30% forbs (or a ratio of 60% grasses to 40% forbs) is desirable, especially on sites that are in close-up view to recreational users.

(Guidelines continued on page 16)

For instance, on small dry to mesic sites, use finely textured shorter grasses, such as June grass, little bluestem, sideoats grama and dropseed. Select relatively short forbs, such as prairie smoke, prairie onion, pasqueflower, butterfly weed, purple prairie clover, short asters, dotted blazing star and grey goldenrod, to complement the grasses. The variety of contrasting textures—fine versus coarse—adds depth to a planting.

❒ **Plan the composition of flowers with color in mind**, as can be observed quite readily in nature. Flowers blooming at the same time in a given natural setting display beautiful color combinations and proportions. Because nature's colors are seasonal, use a variety of species for color throughout the seasons, while still aiming for a functional native plant assembly.

❒ **Consider height**. Height of forbs generally increases as the seasons progress. Fall blooming forbs will be taller than those blooming in the spring, because they are competing for light with the warm-season grasses.

❒ **Pay attention to how flowers naturally occur.** Some grow in concentrations of one species or in drifts, while others grow as isolated individuals.

❒ **Use one plant per square foot as a general guideline**. Over the years, grasses will use more space, becoming bigger clumps, while forbs will add only a few stalks each year. As grasses fill in, the planting will achieve a more natural look.

❒ **Use one-year-old plants** to help the planting fill in more quickly. Hand weeding will be needed.

Transplants or Seeds?

Depending on the size of a site, the need for accelerated results for public acceptance, and the budget available, natural-looking plantings can be created with the use of either transplants or seeds. Some factors to take into consideration:

❒ **A planted site will take 2 years, a seeded site 3 years** before native plants have filled in and the site becomes relatively weed free.

❒ **More hand-weeding may be required** with transplants initially.

❒ **Seeded sites should be kept mowed to 6-8 inches** above ground and before weed seeds form in the first 2 years after seeding.

❒ **Hand-weeding on seeded sites is not recommended** in the first 2 seasons. Native seedlings are very small then, and too many would be pulled out with the weeds.

Site Preparation Methods

Preparing for new seeding can require up to a full growing season on difficult, weed-infested sites. Thoroughness and patience are essential for later success. Site preparation can be done in several different ways; some include the use of herbicides, while others do not.

Tall sunflower

Thorough site preparation is the single most important factor for a successful planting later on.

Site Preparation Using Herbicides

❒ **The use of a short-duration glyphosate herbicide (like Round-up)** is one way to prepare a site for planting:

• Mow or burn in early spring to remove the previous year's plant material and encourage new growth.

• Apply glyphosate herbicide onto this new growth: once in mid-spring, again in mid-summer, and again in early fall (unless no plant growth is visible one month after the second spraying). This schedule attacks different weeds whose growths peak at different times.

• To prepare for seeding, tilling or disking should be shallow (tilling deep will bring up more weed seeds).

• Seed immediately. If seeding is delayed to the following spring, seed a cover crop, such as winter wheat or annual rye, if there is a potential for erosion. Conduct a shallow cultivation in the spring to eliminate the cover crop and freshly germinated weeds.

Site Peparation Without Using Herbicides

❒ **Cultivation is another form of seed bed preparation:**

• Begin cultivation in spring and continue through fall, every 2 to 3 weeks at a depth of 4-5 inches. Waiting longer than 2 or 3 weeks between cultivating allows perennial weeds that grow through rhizomes (like quackgrass) to recover and increase in density.

• To prepare for seeding, loosen heavy soil to a depth of 1-2 inches. On sandy soil, a surface scraping or scratching will suffice.

• Seed immediately. If planting is done the following spring, seed a cover crop over winter.

• On small sites, a rototiller can be used instead of a cultivator. Use the rototiller to break the soil into small chunks, making two passes at right angles. Rake by hand to create a smooth seedbed.

❒ **On small sites, using plastic or heavy mulch is an effective method to eliminate existing vegetation:**

• Cover the soil with heavy black plastic, old carpet, tarps or other opaque material, or a thick layer of leaves and burlap for an entire growing season.

• Make sure to secure the cover well, because it needs to stay in place for the entire growing season in order to kill weeds and seeds near the soil surface.

• Don't cultivate or till deeper than 1-2 inches with this method, to avoid bringing up weed seeds that will grow and compete with the prairie plants.

• If a site contains sandy or gravelly soils that do not promote heavy weed growth, several diskings prior to sowing seed may be the only cultivation needed.

❒ **To replace a lawn area with a native seeding,** simply remove the top three inches of sod with a sod-cutter. This usually creates a nearly weed-free seeding site. Keep in mind, though, that this area will be lower than the surrounding lawn. If you bring in extra topsoil, a sandy loam is best. Avoid peat, clay or heavy loam-based soil, and make sure it isn't contaminated with weed seeds.

Taking Precautions on Erosion-Prone Sites

❒ Avoid cultivation of slopes.

❒ Plant or seed immediately following soil preparation.

❒ Install a wood fiber blanket or straw blanket on slopes steeper than 3:1.

Do's and Don'ts for Soil Improvement

What to do

❒ **Add large quantities of organic matter**, like decomposed leaves, especially on sandy or clay soils.

❒ **Improve poor soils by planting a "green manure crop,"** such as buckwheat, winter wheat or legumes, as a pre-treatment in the season prior to seeding. Cut before the plants form seeds. These plants bring up nutrients and convert them to organic matter. The organic matter is then tilled in, incorporating roots and leaves into the soil. This is a relatively cheap, ecologically sound way to build up organic matter in the soil.

❒ **Be aware of herbicide residue in the soil** if the land has been in row crop production for many years. It may be advisable to plant green manure crops for a few years to detoxify the soil before attempting to seed to natives.

What not to do

❒ **Do not use fertilizer or bring in topsoil** to "improve" existing soils on a site. Imported soil may carry undesirable weed seeds.

❒ **Avoid manure,** as it contains large quantities of weed seeds.

❒ **Avoid using sawdust and woodchips,** since they require a long time to break down, and they rob the soil of nitrogen. Recognize that organic matter holds more nutrients and greatly helps to break up heavy soils and firm light soil. As the water-holding capacity of the soil improves, seedlings receive the moisture needed to develop strong roots.

Temporary Cover Crops

Temporary cover crops are primarily used on sites that are erosion prone and cannot be permanently seeded immediately, to help keep the soil in place until the native seed can be installed.

❒ **Loosen the topsoil** of the site to a minimum depth of 3 inches. Choice of seeds depends on the season the temporary cover crop is installed:

- May to early September: Apply annual rye at 35 lbs/acre.
- May to early September: Apply oats at 90 lbs/acre.
- October to mid-November: Apply winter wheat at 90 lbs/acre.

❒ **Install seeds** with a standard grain drill, or broadcast them.

❒ **Harrow or rake** after seeding.

❒ **Mulch or disc-anchor** the site. Use prairie hay or clean straw for mulch material. Certified weed-free mulch is available from some growers of native plants.

❒ **Install native seed mixture in the fall or spring** by lightly disking and then seeding with a broadcast seeder, or drill seeder.

When To Seed

Spring or fall seedings are appropriate. Both times have advantages and disadvantages.

Considerations for Spring Seeding

❒ **Best results occur when seeding in late spring to early summer**, from May 1 to July 10 (especially on clay soils).

❒ **Most prairie grasses and forbs are "warm season" plants,** which require warm soil temperatures for germination and growth.

❒ **Seeding in late spring increases the chance of sufficient rainfall** and also means less competition. Because cool-season exotics and weeds germinate 4 to 6 weeks earlier, they would have been eliminated by herbicide treatment or cultivation before a late-spring seeding.

❒ **Forb seed must be moist stratified** (see seed treatment) for optimum germination.

Considerations for Fall/Winter Seeding

❒ **Mimics the natural cycles of nature.** Seeding should occur in the Upper Midwest from early October to freeze-up, when temperatures are consistently cool, or in late winter, like March, in calm weather when temperatures are around 25-35 degrees and there is less than one foot of snow.

❒ **Generally results in better germination** and more rapid establishment of forbs.

❒ **Allows seeds to germinate on their own schedule** in the spring, when temperature and moisture conditions are optimum.

❒ **The natural "wintering over" helps break down germination inhibitors** associated with the seeds of many native plants.

❒ **Early mowing in the spring** is especially important to help control cool-season weeds.

❒ **Should never be attempted on sites subject to soil erosion** without sufficient cover crop or erosion control blankets. Runoff from snowmelt or heavy rains can wipe out a seeding.

❒ **Can be done from late October to late March.** Especially good for interseeding forbs into a grass stand and augmenting a prairie remnant.

❒ **Seed is hand or machine sown;** freezing and thawing will mix the seed with the soil.

❒ **Considered to be a good method for adding new species to an established planting**, or for reseeding gopher mounds or other bare spots.

❒ **Advantageous on wetland sites with soils high in organic content**. A wetland site is much more accessible in the winter, when the ground is frozen. The best conditions would be minimal snow cover, low water levels, with temperatures around 25 to 35 degrees.

Northern dropseed

❒ **Areas to be seeded in the winter should be burned or mowed in the fall** to remove old vegetation exposing bare ground that promotes seed/soil contact during the freeze and thaw cycle.

❒ **In early spring, when new growth is about 3 tO 4 inches high,** consisting primarily of cool season exotics, one timely application of glyphosate will eliminate unwanted plants. Native plants will not have germinated at that time.

Seed Treatment

When purchasing seeds from a vendor, be sure that the following processes have been incorporated into the vendor's seed treatment regime. If collecting your own seeds, be sure that these processes are appropriately incorporated into your own seed treatment.

The seeds of many native plants have a built-in dormancy mechanism, which protects them from germinating before a killing frost or in times of drought. In the wild, seeds lie dormant until proper conditions for growth occur, which sometimes takes several years. In cultivation, pre-sowing treatment methods unlock the dormancy mechanism and stimulate quicker and better germination.

The following treatment steps are a requirement of all suppliers of native seed.

Dry Stratification

Prairie grasses need "dry stratification," meaning that seeds have to be exposed to cold, dry conditions for 1 month or longer. For this reason, seeds should always be stored in a cold, dry place over winter.

Moist Stratification

Most wildflower and sedge seeds that are to be seeded in the spring germinate better when "moist stratified." Moist stratification mimics the conditions of freeze and thaw that seeds would naturally encounter in the soil over winter.

Pre-inoculation

All native legumes (such as clovers and beans) should be pre-inoculated with rhizobium, nitrogen-fixing bacteria that form nodules on the roots of these plants, especially when seeding into degraded soils. The inoculum improves their ability to "fix" atmospheric nitrogen, thus improving soil fertility.

De-bearding

All seed containing extensive hair or awns, such as Canada wild rye, should be de-bearded.

For more detail on seed processing, see "Processing Seed," page 33.

Seed Quality

If seed is purchased from a vendor, they must meet requirements for origin, purity and germination:

❒ **All bags of seeds must be labeled** with the mixture number and the vendor from whom it was purchased.

❒ **The level of quality is determined** by pure live seed (PLS)value. It is important to know PLS values for each annual harvest Seed of each species is tested for its purity and germination poten tial.

❒ **Purchased seed must be from the previous two growing seasons.** Tests for germination and/or viability must be current (conducted within 9 months of the date of installation).

❒ **All grass and forb seed must be wild type and must originate** from within 100 miles north or south of a site—or within 200 miles east or west of a site to maintain the local gene pool; the closer the seed source, the better.

Wild-type is defined as seed that is derived directly from native wild stock, including seed that was collected and put into production. Therefore, wild-type seeds must be of regional/local ecotype and not have undergone a selection process.

Nurse Crops

Protecting Seedlings and Helping Us Gauge Their Growth

A nurse crop or cover crop consists of an annual grass that is seeded together with the native seed mix. The nurse crop germinates quickly, shelters young prairie plants from adverse conditions, and takes the place of weeds.

Sideoats grama
Drawing by Tom Klein

Nurse crops, such as annual rye, oats, winter wheat and Regreen (a sterile grass), help suppress weed growth and hold the soil in place without harming or competing with the much smaller native seedlings. Nurse crops occupy the "ecological niche" that would otherwise be taken up by annual weeds, thus reducing the growth of undesirable weeds in the first year of a seeding.

Native plants expend most energy in their root growth the first 2 years; as a result, above-soil growth is minimal when compared to the nurse crop. If the nurse crop has germinated and is growing well, it is an indication that the native seeds are also germinating well, even if they cannot be identified easily.

❒ **Request certified nurse crop seed only;** otherwise, feed quality seed might be supplied, which could be full of weed seeds.

❒ **Do not use agricultural rye as a nurse crop.** Studies have shown that grain rye is allelopathic (its roots release a toxin that suppresses the growth of other plants in its immediate environment).

Seeding Rates for Nurse Crops

Nurse Crop	Seeding Rate	Seeding Season
Annual rye	5 lbs/acre (7-8 lbs on slopes)	May to mid-July
Oats	20 lbs/acre	May to mid-July
Winter wheat	20 lbs/acre	October to mid-November
Regreen	10 lbs/acre	October to mid-November, May to mid-July

Gray-headed coneflower

Seeding Methods

The size and makeup of the individual site, as well as the availability of the appropriate machinery, will determine the seeding method to be used.

Broadcast Seeding by Hand

Broadcast seeding by hand is usually done on areas smaller than one acre or on those located on slopes that are inaccessible by a mechanical seeder. Broadcast seeding creates no row effect, resulting in a more natural-looking seeding. (seeding rate see page 14)

Broadcast seeding into bare soil

The following guidelines apply:

❒ Loosen topsoil to a depth of 3 inches.

❒ Mix seeds with slightly dampened filler, such as sawdust, peat moss or vermiculite, to get a more even rate of seeds on the ground.

❒ Divide the seeds and spread the first half of the mixture.

❒ Then take the second half and spread it over the same area, walking perpendicular to your first pass.

❒ Seed the nurse crop.

❒ Rake or drag the area slightly, so that seeds are covered with soil equal to twice the thickness of the seed itself.

❒ Very small seeds that need light to germinate should be seeded on top and should not be covered with soil.

❒ Pack the site to ensure good seed-to-soil contact.

❒ Do not attempt broadcast seeding when the weather is hot and dry, or when soil moisture is low.

Broadcast seeding into existing cover crop

Sites that are subject to erosion and ready to plant in mid-summer to late summer should be seeded immediately to a cover crop, with the native seeding following in the fall:

❒ After the area is prepared for seeding, sow oats as cover crop, using 90 lbs/acre. Frost will kill oats in the fall before they set seed.

❒ Broadcast seed into standing dead oats in late October. Do not rake or drag into the soil.

❒ Frost action will work the seed into soil surface, and dead oats will mat down over the winter to provide good conditions for spring germination, while at the same time preventing soil erosion.

Machine Seeding

The following guidelines apply to machine seeding:
(seeding rate see page 14)

❒ Mechanical seeders are used for larger areas. A drill seeder or a broadcast seeder is the best equipment for native seed mixes.

❒ The seeder must contain at least two seed boxes: a fine seed box and a box for large/fluffy seeds.

❒ Set maximum row spacing for drill seeding at 8 inches. Set planting depth for large fluffy seeds at 1/4 inch.

❒ Most seeders have the ability to compact the soil directly over the seeds.

❒ Drill rows must follow the contour lines of the site.

❒ Nurse crop seeds are mixed with native seeds in the fluffy seed box prior to seeding.

❒ Soil must be packed to assure good seed-to-soil contact for small seeds on the surface.

Broadcast seeding into tilled sites

This method is the most common for spring and fall seedings on large bare-soil sites:

❒ Loosen the topsoil to a minimum depth of 3 inches.

❒ Install seed with a Truax Trillion Broadcast Seeder or equivalent.

❒ Very small seeds that need light to germinate should be seeded on top and should not be covered with soil.

❒ After seeding, pack the site to ensure good seed-to-soil contact.

❒ Mulch the site with clean straw or hay and disc-anchor.

❒ Apply straw or fiber blanket on erosion-prone sites.

Drill seeding into temporary cover crop

This method requires two separate seeding operations:

❒ The first seed in (the temporary cover crop) occurs at a time of year that is not optimal for installing native seeds. (See "Temporary Cover Crops," page 19.)

❒ The second operation (installing the native seed) occurs at a later date, either through inter-seeding with an inter-seeder type drill (Truax Flex II or equivalent) or by lightly disking the cover crop andthen seeding with a brodcast seeder.

An inter-seeder drill is outfitted with trash rippers, which cut through the vegetative mat to make a furrow in the underlying soil. Pack the site to ensure a firm seed bed. Mulching is not necessary, since the cover crop can serve as mulch in both instances.

Drill seeding into existing vegetation

With this method, existing vegetation is cut and, after a flush of new growth, treated with one glyphosate herbicide application. This method is commonly used on old pastures, slopes and degraded savannas, where tilling could cause erosion or damage existing root structures.

The following methods prepare for a winter (dormant) or spring seeding:

❒ Prepare a grassy site by mowing existing vegetation to a height of 6 inches.

❒ Allow the grass to re-grow for 1 to 3 weeks before applying glyphosate herbicide.

❒ Burn off existing dead material before seeding to avoid clogging the drillseeder.

❒ Seeding may occur 5 days after herbicide application.

❒ Use an inter-seeder drill (Truax Flex II or equivalent) outfitted with trash rippers, which cuts through the vegetative mat to make a furrow in the underlying soil.

❒ Very small seeds that need light to germinate should be seeded on top and should not be covered with soil.

❒ After seeding, pack the site to ensure good seed-to-soil contact.

Butterfly weed

More extensive preparation is required for sites containing large numbers of exotic weeds, such as Canada thistle, exotic legumes or spotted knapweed:

❒ Start site preparation in mid-spring by mowing previous year's vegetation.

❒ After new growth appears, apply glyphosate herbicide.

❒ Repeat above process two more times in mid-summer and early fall.

❒ Prepare seedbed for fall seeding.

Hydroseeding

Hydroseeding is an accepted method for native seeds, but it should only be used on steep slopes or areas otherwise inaccessible to a seed drill:

❒ Seeding should be done when the extended weather pattern will provide sufficient moisture.

❒ Prepare site by loosening the top 3 inches of soil, leaving a rough surface with many spaces and cracks for seeds to lie in.

❒ Seeding rates should be the same as for broadcast seeding.

❒ Apply the seed-water mixture within 1 hour of mixing.

❒ Harrow or rake the site after spraying the seed-water mixture to ensure good seed-to-soil contact.

❒ Then make a second application consisting of mulch only.

Watering, Mulching and Erosion Control

❒ Fall seedings do not need to be watered.

❒ If conditions are very dry, spring and summer seeded sites need to be watered.

❒ Be sure to provide regular watering until seeds have germinated (about 3-4 weeks), especially seeds that have been "moist stratified"; otherwise, they may go into dormancy or die in the dry soil.

❒ Water in early morning, which is best and most efficient, because evaporation is much higher during the day.

❒ Avoid watering in the late afternoon and evening, which encourages high moisture levels at the soil surface, promoting seedling loss due to fungal attacks.

❒ Mulch with a light covering of prairie hay or clean straw to help hold moisture in the soil, especially on dry sandy soils and heavy clay soils.

❒ Use chopped material and disc-anchor it, so that it will be less likely to be blown away by the wind.

❒ On slopes steeper than 3:1, install a straw or wood fiber blanket. Strive for 90% coverage of exposed soil. Mulching will slow the erosive action of heavy rains until the plants have established.

Evaluation and Management

Evaluating Re-establishment Efforts

Year 1

❒ The nurse crop should be visible within 2 weeks of installation.

❒ Native grasses and flowers will be small but visible by the end of the growing season. (Native plants will concentrate their energy on root establishment during the first 2 years.)

Year 2

❒ Approximately 5% of the grasses will flower and set seeds by the end of the second year.

❒ Residual seeds from the first season will germinate. Some early successional forbs, such as black-eyed Susan, wild bergamot and some asters, will flower.

Year 3

❒ Most grasses and many forbs will be blooming.

❒ Overall, the diversity of plants will be increasing.

Ongoing Management of Re-establishment Efforts

First growing season

❒ Mowing is the primary management tool for the first year. The site should be mowed as needed to control weeds going to seed. Mowing should take place with a flail mower when growth reaches about 16-18 inches. Cutting height should be set in a way that basal leaves of forbs are not damaged. Native seedlings should not be shaded out, and undesirable weeds should not overtake seedlings. Mow more often if foxtail is abundant.

❒ A vigorous nurse crop may reduce or eliminate the need for cutting weeds.

Beebalm

❒ Some growth should be left to stand over the winter. The plant litter and the snow that it catches insulate the soil from rapid changes in soil temperatures, which can prevent plant loss due to frost heaving.

Second growing season

❒ Mow only if the area "looks" neglected to the public (6-12 inch cutting height).

❒ Do not weed. The disturbance caused will only encourage more weeds to grow.

❒ Spot spraying may be needed for thistles and other aggressive spreading exotic plants.

❒ Do not water. Dry weather helps eliminate weed competition, and prairie plants are drought-tolerant.

❒ Do not fertilize.

❒ In the spring, mow plantings short and rake off cuttings. Mowing tends to facilitate germination of dormant seed and enhance the growth of prairie plants, allowing light and warmth to reach the soil.

❒ Keep biennial weeds in check the second year, especially sweet clover. Mowing in mid-summer, when these biennial weeds are in full bloom, will usually prevent them from setting seed to re-infest the planting.

❒ Seed germination of sweet clover is stimulated by fire and can become a long-term management problem.

Third growing season

❒ Management of the planting in the third year will consist of a spring burn (or mowing where burning is prohibited). Fire aids the prairie by suppressing weed and woody plant invasion. Planted prairies should be burned frequently from the third to the eighth year. After that, the planted prairie will be well established. If there are no serious weed problems, burning every 3-5 years will suffice.

❒ Although most prairies respond positively to annual burning or mowing, research indicates that regular spring burning tends to favor prairie grasses and legumes over most other flowers.

❒ Mowing or burning should not occur when new growth has reached 1 foot, as this could damage desirable plants.

❒ Plan burns for earlier in the spring. Many ground-nesting birds build their nests in late spring, and mowing or burning in late spring could possibly destroy the nests. If an early spring burn would by chance destroy nests, there is still enough time for most animals to raise a second brood.

❒ Careful hand weeding and spot spraying may be done as needed.

Collecting Seeds

A land ethic of course cannot prevent the alteration, management and use of these "resources," but it does affirm their right to continued existence, and, at least in spots, their continued existence in a natural state.

Aldo Leopold
A Sand County Almanac

Ethics of Seed Collection

An emphasis on restoration exerts a new pressure on our remaining native prairies: that of potentially intensive seed harvesting. Efforts to protect the local seed bank may result in over-harvesting without sufficient awareness of what it may do to remaining wildlands.

Prairie management is not yet a science that has been researched and documented over many years. It is instead a best guess, modified over the years by apparent successes or failures. Therefore, when harvesting native seed, it is important to act with intelligence, self-control and caution.

Adhere to the following rules when harvesting from the wild:

❒ Permission must be obtained from the landowner before collecting. Seeking permission beforehand allows the landowner to know who has harvested, track how many people have harvested, and protect the site from over-harvest.

❒ Get to know other local seed collectors and growers, to avoid sites being harvested more than once.

❒ Take no more than 30% of the seed of a given population of strong plant species.

Things To Remember

✔ Ask permission before collecting.

✔ Maintain local gene pools by collecting seeds close to the restoration site.

✔ Use seeds conservatively.

❒ Avoid wasting seed. Be prepared to process seeds as needed, and plant them in properly prepared areas.

❒ Do not collect from state-listed or federally listed species without a special permit.

❒ Be aware that taking seeds may disrupt the natural balance.

❒ Check the source of plant material for any collections from gardens or landscaped areas. Do not use seeds from horticultural cultivars in restorations.

❒ Collect seeds as close to the restoration site as possible. In terms of soil and topography, the collection site should be as similar as possible to the restoration site. Remnants along state trails can serve as seed sources for nearby sites.

❒ Collect seeds within 100 miles north or south of a site—or within 200 miles east or west of a site—to maintain the local gene pool. Some experts recommend narrower limits, such as 25 miles or less.

Collecting Your Own Seed

When restoring small sites, collecting seed by hand is probably the best method. It can be an educational and rewarding activity that helps individuals recognize and appreciate the effort as an integral part of the restoration process.

When restoring larger sites, collected quantities may be insufficient. Time, resources and the knowledge of how to collect and process seeds also may not be available. In these instances, the use of commercially grown, machine-harvested seed may be an alternative approach. Commercial seeds will also have fewer unwanted species and less chaff, and they will be easier to seed with commerical seed drills.

Indian grass

Collecting by hand

Collecting seed by hand is considered to be the preferred method from small sites. Collecting by hand is more selective than collecting with a machine.

Collecting by hand is basic, enjoyable and the least damaging to a site. It is also a good opportunity for individuals to actively participate in the restoration process.

An easy method for collecting larger quantities is to have a seed bag or other receptacle attached to the body, which leaves both hands free to collect.

Collecting by machine

Using seed-harvesting machines, from seed strippers to combines, makes large-area harvesting more efficient, yet less selective. The DNR Divisions of Wildlife and Parks have specialized equipment in prairie regions of the state.

When To Collect

Determining when to collect seed requires familiarity with plant species, as well as their life cycles.

Many species produce only small quantities of viable seed. It is important to be able to differentiate between good and poor seed. When a species is developing seeds, regular examination will show when a significant amount of ripe seed is present.

Consideration needs to be given to the amount of time it takes to get newly harvested seeds ready for planting. Collecting, treating and cleaning of seeds takes time and patience.

Indicators of harvest readiness include the following:

- ❒ Seeds are full sized.
- ❒ Seed coats are changing color, usually from green to a darker hue.
- ❒ Stems are dry and no longer nourished by the roots.
- ❒ Earliest seeds are dropping.
- ❒ Seeds are filled out and are too hard to bite.

Seed collection timing and method are difficult to standardize, because there are many variables:

- ❒ Some species have capsules or fruit that burst when they are ripe, such as New Jersey tea. Mesh bags put over those plants help capture the seed.

- ❒ Other species ripen over a period of several weeks, with flowers blooming gradually from bottom to top and seeds ripening accordingly.

- ❒ Some species are consistent producers every year, while others produce seed over considerable intervals of time, depending on moisture availability, pollinator efficiency and other factors.

- ❒ A good rule of thumb is to let the initial seeds drop to the ground for reseeding before collecting.

- ❒ People in the seed collection business have developed regional seed collection calendars over the years. Although the exact dates of maturity may vary from year to year, the order in which plants mature remains the same.

- ❒ Consideration needs to be given to the amount of time it takes to get newly harvested seeds ready for planting. Collecting, treating and cleaning of seeds takes time and patience.

New Jersey tea

Processing Seed

The seeds of many species need special treatment for proper storage, which provides for easier sowing and improved germination rates. The initial seed processing involves three basic steps: drying, cleaning and storing.

Drying

Seeds should be dried shortly after harvest. Properly dried seeds should have a moisture content of 5% to 14%. Seeds can be spread out on wire mesh trays or put in paper bags in a drying room, where the temperature rises slowly and does not exceed 95 degrees Fahrenheit. A dehumidifier may be needed to control the humidity in the drying room.

Cleaning

Threshing is one form of cleaning, which separates the seeds from the chaff or seedhead. Threshing may be done by hand for small quantities of seed by rubbing seeds against a coarse screen, or by using a rolling pin in a wooden tray.

Scalping is another form of cleaning. Various-sized screens are used to separate the loose chaff from the seed. Commercial growers favor fanning mills or air-screen cleaners to accomplish the separation of large quantities of seed more efficiently.

An alternative to threshing and cleaning is to run bulk seeds through a commercial shredder-mulcher, which will release the seeds and create a mixture of seeds, stems and other parts in manageable particle sizes. This material is only suitable for hand broadcasting and raking in.

The three most important factors affecting the viabilty and longevity of stored seeds are moisture content, storage temperature and relative humidity.

Storing

Storing seeds correctly minimizes the risk of having climate extremes, microorganisms, fungi, insects or small mammals affect seed viability.

The three most important factors affecting the viability and longevity of stored seeds are moisture content, storage temperature and relative humidity.

Seed can simply be stored in paper bags or burlap bags in an unheated building, barn or shed. The bags should be hung so that rodents cannot reach them, and they should hang high enough that the dampness of the floor does not affect them.

For long-term storage, seeds may be frozen in sealed containers with a moisture content that is below 14%.

Germination Requirements

For seeds to germinate, they must be able to imbibe water, be exposed to proper temperatures, and have adequate time to transform into living plants.

Seeds of some plants need specific treatment in order to germinate. These treatments include cold-moist stratification, warm-moist stratification, cold-dry stratification, scarification, inoculation, light treatment, and providing hosts for parasitic species.

Seeds bought from a certified commercial grower are sold with the treatment already applied.

Cold-moist stratification

This treatment mimics the winter season that seeds have to go through in order to germinate. A great number of species are treated with cold-moist stratification to prepare them for spring seeding.

Seeds are mixed with damp sand, vermiculite or sawdust at a ratio of 1:1 or 2:1. The mixture is then loosely packed into ziplock bags and stored at a constant temperature of 34-40 degrees Fahrenheit. Most seeds need 60-90 days before they are ready to be seeded.

Warm-moist stratification

Herbaceous woodland species, such as Solomon's seal and jack-in-the-pulpit, have complex double-dormancy requirements and need two treatments: one warm-moist stratification at 68-75 degrees Fahrenheit, followed by a cold-moist stratification. Each temperature period requires about 3 months.

Cold-dry stratification

Most grasses, asters, milkweeds and species of the mint family are treated with cold-dry stratification. This method simply stores seed in an unheated building or container that is free of insects and rodents.

Scarification

Some seeds have a very hard seed coat, which needs to be broken before the seed can imbibe water and germinate. New Jersey tea and many legumes, for example, are treated in this manner.

Rubbing the seeds between sandpaper works for some seed. Other seeds with very thick seed coats must be scarified with concentrated sulfuric or nitric acid, mimicking the conditions a seed may encounter passing through the digestive tract of an animal.

Still other seeds may need to be soaked in hot water (170-190 degrees Fahrenheit) to break down their waxy cuticle.

Inoculation

The growth of all legumes is enhanced by inoculating them with nitrogen-fixing bacteria. In general, the inoculant is applied to wet seed prior to sowing. Some propagators use soda pop to wet the seed, because its stickiness helps the inoculant adhere better to the seed.

Light treatment

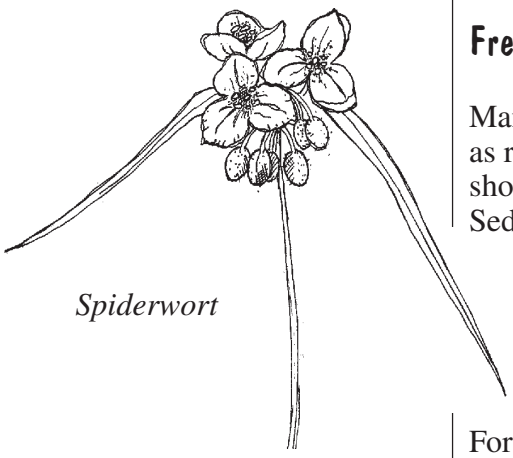
Very small seeds, as well as seeds that need light to break dormancy (such as lobelias and sedges), should not be covered with soil after seeding. Nevertheless, they do need good seed-to-soil contact and moisture to germinate, which can be accomplished by packing the soil after seeding.

Hosts for parasitic species

Some species are parasitic or semi-parasitic. The seeds of such plants need to be either seeded along with the seed of a host species or transplanted into pots containing host species. Indian paintbrush and louseworts are two of those species.

Fresh seed

Many woodland spring flowering species (spring ephemerals), such as rue anemone, bloodroot, spring beauty, and rushes and sedges, should be sown immediately after collection, as they lose their viability. Sedges will go dormant if not sown immediately.



Spiderwort

Vegetative Propagation

For species that either rarely produce viable seed or are difficult to germinate, effective vegetative methods of propagation include dividing, root and rhizome cuttings, and the use of bulb scales. Vegetative methods do restrict genetic diversity and are labor intensive.

❒ **Dividing:** Many prairie and savanna species can be divided, such as prairie smoke, shooting star, wild geranium, violets and a number of woodland species.

❒ **Root and rhizome cuttings:** Pucoons propagate readily from root cuttings; sedges, cordgrass, prairie coreopsis, and heath aster propagate from rhizomes.

❒ **Bulb scales:** Bulb scales may be planted to vegetatively propagate species of the lily family.

Monitoring Management, Restoration and Re-establishment Sites

It is critical to monitor these sites, so that we can learn how natural systems respond and change over time. We need to use ecological knowledge, statistical inference and informed intuition to interpret these responses and changes.

Our goal must be to design and implement a monitoring program that will best help us track our progress in striving for ecological functionality and increased diversity of species on these sites.

Our goal must be to design and implement a monitoring program that will best help us track our progress in striving for ecological functionality and increased diversity of species on these sites.

The following basic steps will help us get started:

- ❒ Establish a database for each site.
- ❒ Identify and implement appropriate management activities, such as exotic species control, prescribed burning, mowing, planting and seeding.
- ❒ Record and evaluate changes to each site annually.
- ❒ Adjust management activites as needed.

For Further Information

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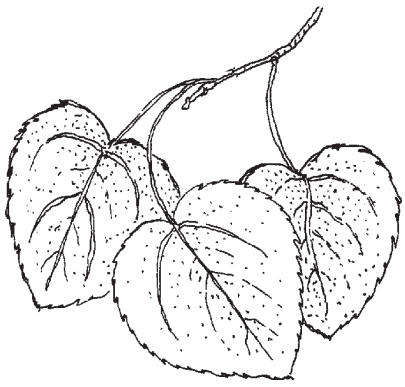
Restoring the Tallgrass Prairie-- An Illustrated Manual for Iowa and the Upper Midwest by Shirley Shirley, 1994

The Tallgrass Restoration Handbook for Prairies, Savannas and Woodlands, by Stephen Packard and Cornelia F. Mutel. Island Press, Washington, D.C., 1997.

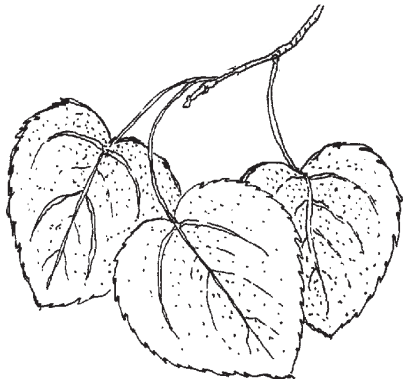
Restore Your Shore, CD ROM by the Minnesota Department ofNatural Resources. Copies are available through the Minnesota Bookstore; call 1-800-657-3757 for information on computer requirements and costs, 2001.



Aspen

For Suppliers of Native Seeds/Plants and Installation and Land Management Services, go to:

http://www.dnr.state.mn.us/gardens/nativeplants/suppliers.html



Aspen