

## CHAPTER 5 - SEED MIXING AND MIXES

Designing the seed mix is a key step in all prairie and wetland restorations. We design separate seed mixes for each plant community type at a restoration site. For example, for Rainwater Basin restorations we design a tallgrass prairie mix for uplands bordering wetlands, a wet-mesic prairie mix for moist lowlands and a marsh mix for deep-watered areas. For river valley restorations we sow level bottoms with a wet-mesic prairie mix, swales with a marsh mix and sand ridges with a sand-prairie mix.

Soil type at a restoration site must be considered when designing seed mixes. The species composition of specific plant community types often varies depending on soil type. For example, tallgrass prairies in areas of Jefferson County along the Little Blue River have loamy sand soils formed from underlying Dakota Sandstone. On these sites grow many plants also found on tallgrass prairies with clay and loam soils, but also sand-adapted species, such as small-flowered fameflower (*Talinum parviflorum*). Including sand-adapted species in seed mixes for tallgrass prairie restorations on loam and clay soils would not be appropriate.

The geographic range of native plant species must also be considered when designing seed mixes for restorations as the distribution of many species is limited in the state. For example, many tallgrass prairie plants, such as white wild indigo (*Baptisia alba*) and prairie coreopsis (*Coreopsis palmata*), naturally occur only in the wetter regions of southeastern Nebraska. Planting these species in a tallgrass prairie restoration in northeastern Nebraska would not be appropriate.

We develop our seed mixes in late fall after seed processing and before planting. Areas are marked on a shed floor for each needed seed mix (e.g. Rainwater Basin marsh mix, Rainwater Basin wet-mesic mix or northeastern Nebraska tallgrass prairie mix). We pour seed of wildflowers, sedges and non-dominant grasses into each pile in the amount needed for each restoration. We call this our "forb mix." Rings can also be built of scrap lumber to corral the seed. When all the seed is poured into piles, it is thoroughly mixed with grain shovels and then stored in barrels or bags. Mixing the seed of about 200 species for several hundred acres of restoration takes about a day.



Seed mix for a restoration.

For prairie restorations we mix the stripper- or combine-harvested warm-season grass with the forb mix just prior to planting. Our upland prairie (e.g. tallgrass prairie, sand prairie and mixed-grass prairie) and wet-mesic prairie seed mixes contain 10-15 gallons of warm-season grass seed (depending on quality

## WHY A HIGH DIVERSITY PRAIRIE RESTORATION?

Before Euroamerican settlement, hundreds of species of native plants grew in eastern Nebraska's prairies.

Restorationists trying to recreate these plant communities should plant as many appropriate species as possible because the greater the plant diversity the greater the ecological benefits. These include greater habitat and animal diversity.

Vegetatively diverse prairie restorations containing plants with varying seasons of growth, seed type and structural characteristics will provide habitat benefits to many wildlife species, including songbirds, game birds, small mammals and insects. Restorations with a diversity of cool- and warm-season grasses and other nutritious plants will provide high-quality livestock forage throughout the growing season. Diverse restorations will have plants with a variety of root types and rooting depths. This vegetation can utilize soil moisture and nutrients more efficiently than the vegetation of low-diversity grasslands. Diverse grasslands are also more tolerant of drought and resistant to invasion by exotic plants, disease problems and overgrazing than are low-diversity grasslands.

From an aesthetic viewpoint, restorations rich in wildflowers and other plants are more appealing than those with few species. Diverse prairie restorations have a procession of wildflowers that begin blooming in late April and continue blooming through October. High-diversity restorations are also valuable educational and research sites, where students can study the dynamics, function and resilience of native plant communities.

and availability of the seed in a given year) to 1-3 gallons of forb mix. We prefer to plant at the higher rate of 2-3 gallons of forb seed per acre when it is available. Lack of collecting time and sites or seed costs usually limit the amount of forb seed included in a seed mix.

We measure seed by volume (gallons) not by weight (pounds) as do many restorationists. About 40-45 percent by weight of our rough-cleaned prairie mixes is pure seed, the remainder is chaff, broken stems and other plant parts. Fifteen gallons of our prairie seed mix (grasses and forbs), a standard seeding rate for one acre, weighs about 10 pounds of which about 4 to 4 ½ pounds is seed, most warm-season grass seed.



Seed mixes for different restorations.

Packard (1997) wrote "when planting a diverse mix of forbs and grasses, most restorationists use a seeding rate of ten pounds per acre with pure, clean seed and as high as thirty to forty pounds per acre with rough-cleaned, wild-collected seed." He also recommends a grass to forb seed ratio of 40:60 for tallgrass prairie restorations. We use much less grass and forb seed and a higher grass to

forb ratio than recommended by Packard and other restorationists.

Establishing warm-season grasses in our prairie restorations has never been a problem. They are usually well-established 3 to 5 years after planting on sandy, loamy and clayey soils especially when managed with prescribed fire. They might develop faster if we used higher seeding rates and drill planting. We perceive that an advantage of slower developing grass stands is that plantings stay open longer, providing less competition and more time for wildflowers and other plants to establish. Maintaining restorations in an open weedy condition also prolongs ideal habitat conditions for gamebirds such as ring-necked pheasants and northern bobwhites and many nongame birds.

Though we plant less forb seed in our prairie restorations than Packard and other restorationists recommend, we are generally satisfied with the forb abundance in our restorations. Tallgrass prairies in Nebraska might

naturally be more grass-dominated than those in states to the east. However, we do believe that for most wildflowers, sedges and non-dominant grasses the more seed planted the better. Aggressive forbs, such as Maximillian sunflower, sawtooth sunflower and Canada goldenrod, are exceptions. If seeded too heavily in a restoration, these species may limit establishment of less aggressive species.

Appendix B lists all plant species we have seeded in eastern Nebraska restorations, the plant community types for which they are appropriate, seed collecting dates and general comments on their use in restorations. Below, listed by community type are basic seed mixes suitable for planting in eastern Nebraska. Seed mixes for butterfly gardens and grassland wildlife habitat are also included. We recommend planting the prairie (i.e. tallgrass, mixed-grass, sand and wet-mesic prairie) mixes at a rate of 10-15 gallons of stripper- or combine-harvested warm-season grass seed to 1-3 gallons of rough-cleaned forb seed. Planting rates for the other

community types are included in the following text.

### TALLGRASS PRAIRIE

The species listed below are suitable for planting in moderate- and high-diversity prairie restorations on upland sites throughout the tallgrass prairie region of eastern Nebraska (see Figure

MODERATE-DIVERSITY TALLGRASS PRAIRIE MIX		MODERATE-DIVERSITY TALLGRASS PRAIRIE MIX	
Common Name	Species	Common Name	Species
Woolly Yarrow	<i>Achillea millefolium</i>	Side-oats Grama	<i>Bouteloua curtipendula</i>
Leadplant	<i>Amorpha canescens</i>	Short-beak Sedge	<i>Carex brevior</i>
Big Bluestem	<i>Andropogon gerardii</i>	Partridge Pea	<i>Chamaecrista fasciculata</i> ( <i>Cassia chamaecrista</i> )
Canada Milkvetch	<i>Astragalus canadensis</i>	White Prairie-clover	<i>Dalea candida</i>
		Purple Prairie-clover	<i>Dalea purpurea</i>
		Illinois Tick-clover	<i>Desmodium illinoense</i>
		Purple Coneflower	<i>Echinacea angustifolia</i>
		Canada Wildrye	<i>Elymus canadensis</i>

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MODERATE-DIVERSITY TALLGRASS PRAIRIE MIX		MODERATE-DIVERSITY TALLGRASS PRAIRIE MIX	
Common Name	Species	Common Name	Species

Small-flowered Gaura	<i>Gaura mollis</i> ( <i>G. parviflora</i> )	Little Bluestem	<i>Schizachyrium scoparium</i>
Maximillian Sunflower	<i>Helianthus maximilianii</i>	Prairie Ragwort	<i>Senecio plattensis</i>
Stiff Sunflower	<i>Helianthus pauciflorus</i> ( <i>H. rigidus</i> )	Compass-plant	<i>Silphium laciniatum</i>
Round-head Bush-Clover	<i>Lespedeza capitata</i>	Rosinweed	<i>Silphium integrifolium</i>



Compass-plant.

Dotted Gayfeather	<i>Liatris punctata</i>
Wild Bergamot	<i>Monarda fistulosa</i>
Common Evening Primrose	<i>Oenothera villosa</i>
Switchgrass	<i>Panicum virgatum</i>
Upright Prairie Coneflower	<i>Ratibida columnifera</i>
Dwarf Prairie Rose	<i>Rosa arkansana</i>
Black-eyed Susan	<i>Rudbeckia hirta</i>

Common Name	Species
Little Bluestem	<i>Schizachyrium scoparium</i>
Prairie Ragwort	<i>Senecio plattensis</i>
Compass-plant	<i>Silphium laciniatum</i>
Rosinweed	<i>Silphium integrifolium</i>
Canada Goldenrod	<i>Solidago canadensis</i>
Missouri Goldenrod	<i>Solidago missouriensis</i>
Stiff Goldenrod	<i>Solidago rigida</i>
Indiangrass	<i>Sorghastrum nutans</i>
Prairie Dropseed	<i>Sporobolus heterolepis</i>
Western Ironweed	<i>Vernonia baldwinii</i>

ADD THE FOLLOWING SPECIES FOR A HIGH-DIVERSITY  
TALLGRASS PRAIRIE SEED MIX.

Wild Garlic	<i>Allium canadense</i>
Meadow Anemone	<i>Anemone canadensis</i>
Candle Anemone	<i>Anemone cylindrica</i>
Field Pussytoes	<i>Antennaria neglecta</i>
Hemp Dogbane	<i>Apocynum cannabinum</i>
White Sage	<i>Artemisia ludoviciana</i>
Narrowleaf Milkweed	<i>Asclepias stenophylla</i>
Butterfly Weed	<i>Asclepias tuberosa</i> ssp. <i>interior</i>
Whorled Milkweed	<i>Asclepias verticillata</i>
Short Green Milkweed	<i>Asclepias viridiflora</i>
Spider Milkweed	<i>Asclepias viridis</i>



Pale poppy mallow.

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HIGH-DIVERSITY TALLGRASS PRAIRIE MIX		HIGH-DIVERSITY TALLGRASS PRAIRIE MIX	
Common Name	Species	Common Name	Species
Ground-plum	<i>Astragalus crassicarpus</i>	Junegrass	<i>Koeleria macrantha</i> ( <i>K. pyramidata</i> )
Plains Wild Indigo	<i>Baptisia bracteata</i>	Rough Gayfeather	<i>Liatris aspera</i>
False Boneset	<i>Brickellia eupatorioides</i>	Grooved Yellow Flax	<i>Linum sulcatum</i>
Pale Poppy Mallow	<i>Callirhoe alcaeoides</i>	Prairie Trefoil	<i>Lotus unifoliolatus</i> ( <i>L. purshianus</i> )
Plains Yellow-primrose	<i>Calylophus serrulatus</i>	Wild Four-o'clock	<i>Mirabilis nyctaginea</i>
Bicknell's Sedge	<i>Carex bicknellii</i>		
Redroot New Jersey Tea	<i>Ceanothus herbaceus</i>		
Bastard Toadflax	<i>Comandra umbellata</i>		
Prairie Larkspur	<i>Delphinium carolinianum</i> ( <i>D. virescens</i> )		
Canada Tick-clover	<i>Desmodium canadense</i>		
Flowering Spurge	<i>Euphorbia corollata</i>		
Downy Gentian	<i>Gentiana puberulenta</i>		
Wild Licorice	<i>Glycyrrhiza lepidota</i>		
False Sunflower	<i>Heliopsis helianthoides</i>		
Porcupine Grass	<i>Hesperostipa spartea</i> ( <i>Stipa s.</i> )		
Longbeard Hawkweed	<i>Hieracium longipilum</i>		
Inland Rush	<i>Juncus interior</i>		



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Dwarf prairie rose.



Purple coneflower.

False Gromwell	<i>Onosmodium mollle</i>
Violet Wood Sorrel	<i>Oxalis violacea</i>
Scribner's Spring Panicum	<i>Panicum oligosanthes</i>
Silver-leaf Scurf Pea	<i>Pediomelum argophyllum</i> ( <i>Psoralea a.</i> )
Prairie Turnip	<i>Pediomelum esculentum</i> ( <i>Psoralea e.</i> )
Shell-leaf Penstemon	<i>Penstemon grandiflorus</i>
Prairie Phlox	<i>Phlox pilosa</i> ssp. <i>fulgida</i>
Prairie Cinquefoil	<i>Potentilla arguta</i>
Slender-flower Scurfpea	<i>Psoralidium tenuiflorum</i> ( <i>Psoralea tenuiflora</i> )
Prairie Blue-eyed Grass	<i>Sisyrinchium campestre</i>
Late Goldenrod	<i>Solidago gigantea</i>
Prairie Wedgegrass	<i>Sphenopholis obtusata</i>
Tall Dropseed	<i>Sporobolus compositus</i> ( <i>S. asper</i> )
Heath Aster	<i>Symphyotrichum ericoides</i> ( <i>Aster e.</i> )

Smooth Blue Aster	<i>Sympphyotrichum laeve</i>	( <i>Aster laevis</i> )
American Germander		<i>Teucrium canadense</i>
Purple Meadow Rue		<i>Thalictrum dasycarpum</i>
Long-bracted Spiderwort		<i>Tradescantia bracteata</i>

**MIXED-GRASS PRAIRIE MIX**

Common Name	Species
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Prairie Violet	<i>Viola pedatifida</i>
Golden Alexander	<i>Zizia aurea</i>

**MIXED-GRASS PRAIRIE**

The species listed below are suitable for planting a moderate-diversity prairie restoration on upland sites with clay, loam or fine sandy loam soils within the mixed-grass prairie region of central Nebraska (see Figure 1).

Woolly Yarrow	<i>Achillea millefolium</i>
Leadplant	<i>Amorpha canescens</i>
Big Bluestem	<i>Andropogon gerardii</i>

**MIXED-GRASS PRAIRIE MIX**

Common Name	Species
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Narrowleaf Milkweed	<i>Asclepias stenophylla</i>
Whorled Milkweed	<i>Asclepias verticillata</i>

Short Green Milkweed	<i>Asclepias viridiflora</i>
Spider Milkweed	<i>Asclepias viridis</i>

Ground-plum	<i>Astragalus crassicarpus</i>
Missouri Milkvetch	<i>Astragalus missouriensis</i>

Side-oats Grama	<i>Bouteloua curtipendula</i>
Blue Grama	<i>Bouteloua gracilis</i>

False Boneset	<i>Brickellia eupatorioides</i>
Plains Yellow-primrose	<i>Calylophus serrulatus</i>

Short-beak Sedge	<i>Carex brevior</i>
Sun Sedge	<i>Carex heliophila</i>

Wavy-leaved Thistle	<i>Cirsium undulatum</i>
Bastard Toadflax	<i>Comandra umbellata</i>

White Prairie-clover	<i>Dalea candida</i>
Purple Prairie-clover	<i>Dalea purpurea</i>

Purple Coneflower	<i>Echinacea angustifolia</i>
Western Wheatgrass	<i>Elymus smithii</i> ( <i>Agropyron s.</i> )

Six-weeks Fescue	<i>Festuca octoflora</i>
Scarlet Gaura	<i>Gaura coccinea</i>

Small-flowered Gaura	<i>Gaura mollis</i> ( <i>G. parviflora</i> )
Maximilian Sunflower	<i>Helianthus maximilianii</i>

Stiff Sunflower	<i>Helianthus pauciflorus</i> ( <i>H. rigidus</i> )
Needle-and-thread	<i>Hesperostipa comata</i> ( <i>Stipa c.</i> )

Inland Rush	<i>Juncus interior</i>
Junegrass	<i>Koeleria macrantha</i> ( <i>K. pyramidata</i> )

Showy Vetchling	<i>Lathyrus polymorphus</i>
Round-head Bush-clover	<i>Lespedeza capitata</i>

Dotted Gayfeather	<i>Liatis punctata</i>
Prairie Trefoil	<i>Lotus unifoliolatus</i> ( <i>L. purshianus</i> )

Skeleton Plant	<i>Lygodesmia juncea</i>
Cutleaf Ironplant	<i>Machaeranthera pinnatifida</i>

	<i>(Haplopappus spinulosus)</i>
Sensitive Briar	<i>Mimosa quadrivalvis</i>

	<i>(Schrankia nuttallii)</i>
Wild Four-o'clock	<i>Mirabilis nyctaginea</i>



Purple locoweed.

Candle Anemone	<i>Anemone cylindrica</i>
Field Pussytoes	<i>Antennaria neglecta</i>
Purple Three-awn	<i>Aristida purpurea</i>
White Sage	<i>Artemisia ludoviciana</i>

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MIXED-GRASS PRAIRIE MIX		MIXED-GRASS PRAIRIE MIX	
Common Name	Species	Common Name	Species
Plains Muhly	<i>Muhlenbergia cuspidata</i>	Scribner's Spring Panicum	<i>Panicum oligosanthes</i>
False Gromwell	<i>Onosmodium molle</i>	Silver-leaf Scurf Pea	<i>Pediomelum argophyllum</i> ( <i>Psoralea a.</i> )
Purple Locoweed	<i>Oxytropis lambertii</i>	Prairie Turnip	<i>Pediomelum esculentum</i> ( <i>Psoralea e.</i> )
		White Beardtongue	<i>Penstemon albidus</i>
		Shell-leaf Penstemon	<i>Penstemon grandiflorus</i>
		Prairie Cinquefoil	<i>Potentilla arguta</i>
		Slender-flower Scurfpea	<i>Psoralidium tenuiflorum</i> ( <i>Psoralea t.</i> )
		Upright Prairie Coneflower	<i>Ratibida columnifera</i>
		Dwarf Prairie Rose	<i>Rosa arkansana</i>
		Little Bluestem	<i>Schizachyrium scoparium</i>
		Prairie Ragwort	<i>Senecio plattensis</i>
		Missouri Goldenrod	<i>Solidago missouriensis</i>
		Soft Goldenrod	<i>Solidago mollis</i>
		Stiff Goldenrod	<i>Solidago rigida</i>
		Indiangrass	<i>Sorghastrum nutans</i>

Sensitive briar.

Tall Dropseed	<i>Sporobolus compositus</i>	( <i>S. asper</i> )
Heath Aster	<i>Sympyotrichum ericoides</i>	( <i>Aster e.</i> )
Aromatic Aster	<i>Sympyotrichum oblongifolium</i>	( <i>Aster o.</i> )
Long-bracted Spiderwort	<i>Tradescantia bracteata</i>	
SAND PRAIRIE MIX		
Common Name	Species	Common Name

### SAND PRAIRIE

The species listed below are suitable for planting a moderate-diversity prairie on sandy upland soils and dry, sandy river bottom soils in eastern Nebraska and on sand dunes in the eastern portion of the Nebraska Sandhills.

Leadplant	<i>Amorpha canescens</i>
Big Bluestem	<i>Andropogon gerardii</i>

Sand Bluestem	<i>Andropogon hallii</i>
Western Sagewort	<i>Artemisia campestris</i>
White Sage	<i>Artemisia ludoviciana</i>
Wooly Milkweed	<i>Asclepias lanuginosa</i>
Narrowleaf Milkweed	<i>Asclepias stenophylla</i>
Short Green Milkweed	<i>Asclepias viridiflora</i>
Side-oats Grama	<i>Bouteloua curtipendula</i>
Hairy Grama	<i>Bouteloua hirsuta</i>
False Boneset	<i>Brickellia eupatorioides</i>

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SAND PRAIRIE Mix		SAND PRAIRIE Mix	
Common Name	Species	Common Name	Species

Prairie Sand Reed	<i>Calamovilfa longifolia</i>
Sun Sedge	<i>Carex heliophila</i>
Redroot New Jersey Tea	<i>Ceanothus herbaceus</i>
Platte Thistle	<i>Cirsium canescens</i>
Rocky Mountain Bee Plant	<i>Cleome serrulata</i>
Bastard Toadflax	<i>Comandra umbellata</i>



Prairie spiderwort.

Texas Croton	<i>Croton texensis</i>
Great Plains Flatsedge	<i>Cyperus lupulinus</i>
Sand Flatsedge	<i>Cyperus schweinitzii</i>
Purple Prairie-clover	<i>Dalea purpurea</i>
Silky Prairie-clover	<i>Dalea villosa</i>
Purple Lovegrass	<i>Eragrostis spectabilis</i>
Sand Lovegrass	<i>Eragrostis trichodes</i>
Annual Wild Buckwheat	<i>Eriogonum annuum</i>
Large Cottonweed	<i>Froelichia floridana</i>
Stiff Sunflower	<i>Helianthus pauciflorus</i> ( <i>H. rigidus</i> )
Petioled Sunflower	<i>Helianthus petiolaris</i>
Needle-and-thread	<i>Hesperostipa comata</i> ( <i>Stipa c.</i> )
Hairy Golden-aster	<i>Heterotheca villosa</i> ( <i>Chrysopsis villosa</i> )
Junegrass	<i>Koeleria macrantha</i> ( <i>K. pyramidata</i> )
Showy Vetchling	<i>Lathyrus polymorphus</i>
Round-head Bush-clover	<i>Lespedeza capitata</i>
Plains Gayfeather	<i>Liatris squarrosa</i> var. <i>hirsuta</i>

Hairy Puccoon	<i>Lithospermum carolinense</i>
Fringed Puccoon	<i>Lithospermum incisum</i>
Prairie Trefoil	<i>Lotus unifoliolatus</i> ( <i>L. purshianus</i> )
Skeleton Plant	<i>Lygodesmia juncea</i>
Cutleaf Ironplant	<i>Machaeranthera pinnatifida</i> ( <i>Haplopappus spinulosus</i> )
Pale Four-o'clock	<i>Mirabilis albida</i> (including <i>M. hirsuta</i> )
Sand Muhly	<i>Muhlenbergia pungens</i>
Fourpoint Evening-primrose	<i>Oenothera rhombipetala</i>
False Gromwell	<i>Onosmodium molle</i>
Scribner's Spring Panicum	<i>Panicum oligosanthes</i>
Switchgrass	<i>Panicum virgatum</i>
Slender Paspalum	<i>Paspalum setaceum</i>
White Beardtongue	<i>Penstemon albidus</i>
Narrow Beardtongue	<i>Penstemon angustifolius</i>
Slender Beardtongue	<i>Penstemon gracilis</i>
Shell-leaf Penstemon	<i>Penstemon grandiflorus</i>
Lemon Scurf Pea	<i>Psoralidium lanceolatum</i> ( <i>Psoralea l.</i> )
Dwarf Prairie Rose	<i>Rosa arkansana</i>
Wild Begonia	<i>Rumex venosus</i>
Little Bluestem	<i>Schizachyrium scoparium</i>



Showy vetchling.

Prairie Ragwort  
 Missouri Goldenrod  
 Soft Goldenrod  
 Stiff Goldenrod  
 Sand Dropseed  
 Aromatic Aster *Symphytum oblongifolium*  
 Prairie Spiderwort  
 Soapweed

*Senecio plattensis*  
*Solidago missouriensis*  
*Solidago mollis*  
*Solidago rigida*  
*Sporobolus cryptandrus*  
*(Aster o.)*  
*Tradescantia occidentalis*  
*Yucca glauca*

### WET-MESIC PRAIRIE

The species listed below are suitable for planting a moderate-diversity wet-mesic prairie restoration on moist lowlands (temporarily flooded wetlands) on stream and river terraces and

#### WET-MESIC PRAIRIE MIX

Common Name

Species

#### WET-MESIC PRAIRIE MIX

Common Name

Species

floodplains in eastern Nebraska. The water table at these sites should remain within a few feet of the soil surface for most of the growing season. Surface water can be present at the sites during late winter and spring and after heavy rains. This list contains species that can be planted on loamy sand to somewhat clayey soils. River valleys such as those of the Platte and Loup rivers often contain low wet swales and dry sand ridges. If swales contain standing



Meadow anemone.

water for much of the growing season they should be seeded with marsh plants. Dry sand ridges should be seeded with the sand prairie mix.

Wild Garlic  
 Big Bluestem  
 Meadow Anemone

*Allium canadense*  
*Andropogon gerardii*  
*Anemone canadensis*



Wild garlic.

Swamp Milkweed  
 Showy Milkweed  
 Prairie Milkweed  
 Blue Joint  
 Northern Reedgrass  
 Short-beak Sedge  
 Woolly Sedge  
 Sawbeak Sedge  
 Fox Sedge

*Asclepias incarnata*  
*Asclepias speciosa*  
*Asclepias sullivantii*  
*Calamagrostis canadensis*  
*Calamagrostis stricta*  
*Carex brevior*  
*Carex pellita (C. lanuginosa)*  
*Carex stipata*  
*Carex vulpinoidea*

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WET-MESIC PRAIRIE MIX		WET-MESIC PRAIRIE MIX	
Common Name	Species	Common Name	Species

Common Water-hemlock	<i>Cicuta maculata</i>
Illinois Bundleflower	<i>Desmanthus illinoensis</i>
Canada Tick-clover	<i>Desmodium canadense</i>
Bald Spikerush	<i>Eleocharis erythropoda</i>
Common Spikerush	<i>Eleocharis palustris</i> ( <i>E. macrostachya</i> )



Lanceleaf gayfeather in a Platte River meadow.

Canada Wildrye	<i>Elymus canadensis</i>
Western Wheatgrass	<i>Elymus smithii</i> ( <i>Agropyron s.</i> )
Slender Wheatgrass	<i>Elymus trachycaulus</i> ( <i>Agropyron caninum</i> )
Virginia Wildrye	<i>Elymus virginicus</i>
Cinnamon Willow Herb	<i>Epilobium coloratum</i>
Spotted Joe Pye Weed	<i>Eupatorium maculatum</i>
Common Boneset	<i>Eupatorium perfoliatum</i>
Hairy Fimbrary	<i>Fimbristylis puberula</i>
Yellow Avens	<i>Geum aleppicum</i>
Wild Licorice	<i>Glycyrrhiza lepidota</i>
Sneezeweed	<i>Helenium autumnale</i>
Sawtooth Sunflower	<i>Helianthus grosseserratus</i>
Maximillian Sunflower	<i>Helianthus maximilianii</i>
Jerusalem Artichoke	<i>Helianthus tuberosus</i>
False Sunflower	<i>Heliopsis helianthoides</i>
Yellow Star Grass	<i>Hypoxis hirsuta</i>

Dudley's Rush	<i>Juncus dudleyi</i>
Torrey's Rush	<i>Juncus torreyi</i>
Lanceleaf Gayfeather	<i>Liatris lancifolia</i>
Great Blue Lobelia	<i>Lobelia siphilitica</i>
Pale Spiked Lobelia	<i>Lobelia spicata</i>
Common Water Horehound	<i>Lycopus americanus</i>
Western Water Horehound	<i>Lycopus asper</i>
Fringed Yellow-loosestrife	<i>Lysimachia ciliata</i>
Tufted Yellow-loosestrife	<i>Lysimachia thyrsiflora</i>
Winged Loosestrife	<i>Lythrum alatum</i>
Field Mint	<i>Mentha arvensis</i>
Switchgrass	<i>Panicum virgatum</i>
Foxglove Penstemon	<i>Penstemon digitalis</i>
Self-heal	<i>Prunella vulgaris</i>



New England aster.

Virginia Mountain-mint	<i>Pycnanthemum virginianum</i>
Black-eyed Susan	<i>Rudbeckia hirta</i>
Golden-glow	<i>Rudbeckia laciniata</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Three-square Bulrush	<i>Schoenoplectus pungens</i> ( <i>Scirpus p.</i> )
Marsh Skullcap	<i>Scutellaria galericulata</i>
Rosinweed	<i>Silphium integrifolium</i>
Cup Plant	<i>Silphium perfoliatum</i>
Compass-plant	<i>Silphium laciniatum</i>
Canada Goldenrod	<i>Solidago canadensis</i>

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Late Goldenrod	<i>Solidago gigantea</i>
Indiangrass	<i>Sorghastrum nutans</i>
Prairie Cordgrass	<i>Spartina pectinata</i>
Prairie Wedgegrass	<i>Sphenopholis obtusata</i>
Sand Dropseed	<i>Sporobolus cryptandrus</i>
Common Hedge Nettle	<i>Stachys pilosa</i>
Panicled Aster	<i>Sympyotrichum lanceolatum</i>
New England Aster	<i>Sympyotrichum novae-angliae</i>
Willowleaf Aster	<i>Sympyotrichum praealtum</i>
American Germander	( <i>Aster simplex</i> )
Purple Meadow Rue	( <i>Aster n.</i> )
	( <i>Aster praealtus</i> )
	<i>Teucrium canadense</i>
	<i>Thalictrum dasycarpum</i>

**RAINWATER BASIN WET-MESIC PRAIRIE MIX**

Common Name

Species

**RAINWATER BASIN WET-MESIC PRAIRIE MIX**

Common Name

Species

Blue Vervain                    *Verbena hastata*

**RAINWATER BASIN WET-MESIC PRAIRIE**

The species listed below are suitable for planting a low-diversity wet-mesic prairie



Prairie cordgrass (tall), sedges, rice cutgrass and western ironweed in a Rainwater Basin wet-mesic prairie.

restoration on moist lowlands (temporarily flooded wetlands) within the Rainwater Basin region of south-central Nebraska. These wetlands often occur as zones bordering deeper-watered marshes (seasonally and semi-permanently flooded wetlands) and as isolated wetlands. The list contains mostly perennial species. Most annuals found in Rainwater Basin wetlands will likely appear in restorations from seeds in the soil and will not require seeding.

Sedge and grass seed make up the bulk of the seed mix we use to restore this community type. We stripper-harvest the seeds of many species on this list. We broadcast plant the seed mix for this community type at a rate of 5-7 gallons per acre.

Species included on the list are also appropriate for planting other playa-like wetlands in eastern Nebraska such as those found in the Todd Valley of Saunders County. Uplands bordering Rainwater Basin wetlands should be planted with an appropriate tallgrass prairie or mixed-grass prairie seed mix.

**Woolly Yarrow**

*Achillea millefolium*

## CHAPTER 5 - SEED MIXING AND MIXES

Swamp Milkweed	<i>Asclepias incarnata</i>
White Boltonia	<i>Boltonia asteroides</i>
Short-beak Sedge	<i>Carex brevior</i>
Heavy Sedge	<i>Carex gravida</i>
Smooth-cone Sedge	<i>Carex laeviconica</i>
Woolly Sedge	<i>Carex pellita</i> ( <i>C. lanuginosa</i> )
Fox Sedge	<i>Carex vulpinoidea</i>
Golden Coreopsis	<i>Coreopsis tinctoria</i>
Common Spikerush	<i>Eleocharis palustris</i>  ( <i>E. macrostachya</i> )

### FRESHWATER MARSH MIX

### FRESHWATER MARSH MIX

Common Name	Species	Common Name	Species
-------------	---------	-------------	---------

Western Wheatgrass

*Elymus smithii*  
(*Agropyron s.*)

Virginia Wildrye

*Elymus virginicus*

Foxtail Barley

*Hordeum jubatum*

Rice Cutgrass

*Leersia oryzoides*

Switchgrass

*Panicum virgatum*

Wedgeleaf fog-fruit

*Phyla cuneifolia*

(*Lippia c.*)

*Poa arida*

Plains Bluegrass

*Potentilla norvegica*

Norwegian Cinquefoil

*Spartina pectinata*

Prairie Cordgrass

*Sympyotrichum ericoides*

Heath Aster

(*Aster e.*)

Panicled Aster

*Sympyotrichum lanceolatum*  
(*Aster simplex*)

American Germander

*Teucrium canadense*

Western Ironweed

*Vernonia fasciculata*

### FRESHWATER MARSH

The species listed below are suitable for planting in deeper-watered marshes (seasonal and semi-permanently flooded wetlands) within stream and river floodplains in eastern Nebraska. The list contains mostly perennial species. Most annuals found in these marshes will likely appear from seeds in the soil and will not require planting. Most species on the list are heavy seed



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Arrowhead.

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producers that will be utilized as a food source by waterfowl.

We stripper-harvest and hand collect seeds of species used in restoration of this community type. The seed mix is dense, containing mostly seed with little chaff. These wetlands are usually too wet for machine planting so we usually hand broadcast the seeds, often from ATVs, at a rate of about 1-2 gallons per acre.

**Common Water Plantain    *Alisma subcordatum***

(including *A. triviale*)

Swamp Milkweed	<i>Asclepias incarnata</i>
Nodding Bur-marigold	<i>Bidens cernua</i>
Common Beggar-tick	<i>Bidens frondosa</i>
False Nettle	<i>Boehmeria cylindrica</i>
Emory's Sedge	<i>Carex emoryi</i>
Bottlebrush Sedge	<i>Carex hystericina</i>

RAINWATER BASIN MARSH MIX		RAINWATER BASIN MARSH MIX	
Common Name	Species	Common Name	Species
Bald Spikerush	<i>Eleocharis erythropoda</i>	Short-beak Arrowhead	<i>Sagittaria brevirostra</i>
Common Spikerush	<i>Eleocharis palustris</i> ( <i>E. macrostachya</i> )	Thick-stalk Arrowhead	<i>Sagittaria calycina</i>
Spotted Joe Pye Weed	<i>Eupatorium maculatum</i>	Common Arrowhead	<i>Sagittaria latifolia</i>
Common Boneset	<i>Eupatorium perfoliatum</i>	Hard-stem Bulrush	<i>Schoenoplectus acutus</i> ( <i>Scirpus a.</i> )
Tall Manna Grass	<i>Glyceria grandis</i>	Three-square Bulrush	<i>Schoenoplectus pungens</i> ( <i>Scirpus p.</i> )
Orange Jewelweed	<i>Impatiens capensis</i>	Soft-stem Bulrush	<i>Schoenoplectus tabernaemontani</i> ( <i>Scirpus validus</i> )
Rice Cutgrass	<i>Leersia oryzoides</i>		



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Swamp milkweed.

Pale Bulrush  
Large-fruit Bur-reed

*Scirpus pallidus*  
*Sparganium eurycarpum*

### RAINWATER BASIN MARSH

The species listed below are suitable for planting in deepwater zones (seasonal and semi-permanently flooded wetlands) of Rainwater Basin wetlands. The list contains mostly perennial species. Most annuals found in these marshes will likely appear from seeds in the soil and will not require planting. Most species on the list are heavy seed producers that will be utilized as a food source by waterfowl.

We stripper-harvest and hand collect seeds of species used in restoration of this community type. The seed mix is dense, containing mostly seed with little chaff. These wetlands are usually too wet for machine planting so we usually hand broadcast the seeds, often from ATVs, at a rate of about 1-2 gallons per acre. Species included on the list are also appropriate for planting other playa-like wetlands in eastern Nebraska such as those found in the Todd Valley of Saunders County.

**Common Water Plantain** *Alisma subcordatum*

(including *A. triviale*)  
*Asclepias incarnata*  
*Carex laeviconica*  
*Coreopsis tinctoria*

### SALINE WETLAND MIX

Common Name	Species
Common Spikerush	<i>Eleocharis palustris</i> ( <i>E. macrostachya</i> )
Rice Cutgrass	<i>Leersia oryzoides</i>
Short-beak Arrowhead	<i>Sagittaria brevirostra</i>
Thick-stalk Arrowhead	<i>Sagittaria calycina</i>
Grassleaf Arrowhead	<i>Sagittaria graminea</i>
Common Arrowhead	<i>Sagittaria latifolia</i>
Stiff Arrowhead	<i>Sagittaria rigida</i>
Slender Bulrush	<i>Schoenoplectus heterochaetus</i> ( <i>Scirpus h.</i> )
Large-fruit Bur-reed	<i>Sparganium eurycarpum</i>

Common Spikerush      *Eleocharis palustris*  
 Rice Cutgrass      (*E. macrostachya*)  
 Short-beak Arrowhead      *Leersia oryzoides*  
 Thick-stalk Arrowhead      *Sagittaria brevirostra*  
 Grassleaf Arrowhead      *Sagittaria calycina*  
 Common Arrowhead      *Sagittaria graminea*  
 Stiff Arrowhead      *Sagittaria latifolia*  
 Slender Bulrush      *Schoenoplectus heterochaetus*  
                             (*Scirpus h.*)  
 Large-fruit Bur-reed      *Sparganium eurycarpum*



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### SALINE WETLAND

The species listed below are suitable for planting in saline wetlands within the floodplains of Salt Creek and its tributaries in

Saltwort, foreground, and inland salt grass.

Lancaster and southern Saunders counties. Few plant species can grow on the highly saline, clay soils of these wetlands and therefore a low-diversity seed mix is appropriate. This mix includes both perennial and annual species.

Salt flats, areas with standing water in spring that dry in summer leaving surface salt crusts, are extremely harsh growing environments for most species. Only the most salt-tolerant species – saltwort (*Salicornia rubra*), seablite (*Suaeda calceoliformis*), saltgrass (*Distichlis*

BUTTERFLY GARDEN Mix		BUTTERFLY GARDEN Mix	
Common Name	Species	Common Name	Species
<i>spicata</i> ), silver orach ( <i>Atriplex argentea</i> ) and saline saltbush ( <i>A. dioica</i> ) – should be planted on salt flats. For wetlands artificially deepened by dikes or dams that contain standing water through most the growing season we recommend seeding only saltmarsh bulrush ( <i>Bolboschoenus maritimus</i> ).	plant when the stems are dry in late summer and early fall. The plants can then be hammermilled to dislodge the seed. Saltwort is an endangered plant in Nebraska and a permit from the Nebraska Game and Parks Commission is required prior to collecting its seed. Saltgrass, a dominant plant in most saline wetlands, rarely produces viable seed in the wild. We machine broadcast the seed mix for this community type at a rate of about 7 gallons per acre.		
The seed of most species on the list can be stripper-harvested in abundance. The exception is prairie cordgrass whose seed heads cannot be dislodged by the stripper brush. However, prairie cordgrass seed can be hand collected or combined in large quantities. Seed for saltwort and seablite, low-growing annuals, can be hand collected by pulling the entire	<b>Silver Orach</b> <i>Atriplex argentea</i> <b>Saltmarsh Spearscale</b> <i>Atriplex dioica</i> ( <i>A. subspicata</i> ) <b>Saltmarsh Bulrush</b> <i>Bolboschoenus maritimus</i> ( <i>Scirpus m.</i> ) <b>Short-beak Sedge</b> <i>Carex brevior</i> <b>Inland Salt Grass</b> <i>Distichlis spicata</i> var. <i>stricta</i> <b>Western Wheatgrass</b> <i>Elymus smithii</i> ( <i>Agropyron s.</i> ) <b>Foxtail Barley</b> <i>Hordeum jubatum</i> <b>Annual Marsh-elder</b> <i>Iva annua</i> <b>Plains Bluegrass</b> <i>Poa arida</i> <b>Saltwort</b> <i>Salicornia rubra</i> <b>Prairie Cordgrass</b> <i>Spartina pectinata</i> <b>Sea Blite</b> <i>Suaeda calceoliformis</i> ( <i>S. depressa</i> ) <b>Saltmarsh Aster</b> <i>Symphyotrichum subulatum</i> ( <i>Aster subulatus</i> )		

### BUTTERFLY GARDEN

The species listed below are easy-to-grow wildflowers, which are good nectar producers and suitable for planting in a backyard or schoolyard butterfly garden. The



Regal fritillary butterfly on showy milkweed.

## CHAPTER 5 - SEED MIXING AND MIXES

list contains a combination of species that will provide blooms throughout the growing season. The wildflowers will also attract other insects, such as bees, wasps, flies and beetles.

<b>Woolly Yarrow</b>	<i>Achillea millefolium</i>
<b>Leadplant</b>	<i>Amorpha canescens</i>
<b>Swamp Milkweed</b>	<i>Asclepias incarnata</i>
<b>Showy Milkweed</b>	<i>Asclepias speciosa</i>
<b>Prairie Milkweed</b>	<i>Asclepias sullivantii</i>
<b>Common Milkweed</b>	<i>Asclepias syriaca</i>
<b>Butterfly Weed</b>	<i>Asclepias tuberosa</i> ssp. <i>Interior</i>
<b>Whorled Milkweed</b>	<i>Asclepias verticillata</i>
<b>Plains Yellow-primrose</b>	<i>Calylophus serrulatus</i>
<b>Rocky Mountain Bee Plant</b>	<i>Cleome serrulata</i>
<b>White Prairie-clover</b>	<i>Dalea candida</i>

WILDLIFE HABITAT MIX		WILDLIFE HABITAT MIX	
Common Name	Species	Common Name	Species
Purple Prairie-clover	<i>Dalea purpurea</i>	Heath Aster	<i>Sympyotrichum ericoides</i> ( <i>Aster e.</i> )
Purple Coneflower	<i>Echinacea angustifolia</i>	Smooth Blue Aster	<i>Sympyotrichum laeve</i> ( <i>Aster laevis</i> )
Tall Boneset	<i>Eupatorium altissimum</i>	Panicled Aster	<i>Sympyotrichum lanceolatum</i> ( <i>Aster simplex</i> )
Stiff Sunflower	<i>Helianthus pauciflorus</i> ( <i>H. rigidus</i> )	New England Aster	<i>Sympyotrichum novae-angliae</i> ( <i>Aster n.</i> )
Round-head Bush-clover	<i>Lespedeza capitata</i>	Aromatic Aster	<i>Sympyotrichum oblongifolium</i> ( <i>Aster o.</i> )
Rough Gayfeather	<i>Liatris aspera</i>	Purple Meadow Rue	<i>Thalictrum dasycarpum</i>
Dotted Gayfeather	<i>Liatris punctata</i>	Hoary Vervain	<i>Verbena stricta</i>
Thickspike Gayfeather	<i>Liatris pycnostachya</i>		
Cardinal Flower	<i>Lobelia cardinalis</i>		
Great Blue Lobelia	<i>Lobelia siphilitica</i>		
Wild Bergamot	<i>Monarda fistulosa</i>		
Common Evening Primrose	<i>Oenothera villosa</i>		
Foxglove Penstemon	<i>Penstemon digitalis</i>		
Shell-leaf Penstemon	<i>Penstemon grandiflorus</i>		
Prairie Phlox	<i>Phlox pilosa</i> ssp. <i>fulgida</i>		
Obedient Plant	<i>Physostegia virginiana</i>		
Prairie Cinquefoil	<i>Potentilla arguta</i>		
Upright Prairie Coneflower	<i>Ratibida columnifera</i>		
Black-eyed Susan	<i>Rudbeckia hirta</i>		
Pitcher's Sage	<i>Salvia azurea</i>		
Prairie Ragwort	<i>Senecio plattensis</i>		
Rosinweed	<i>Silphium integrifolium</i>		
Compass-plant	<i>Silphium laciniatum</i>		
Missouri Goldenrod	<i>Solidago missouriensis</i>		
Stiff Goldenrod	<i>Solidago rigida</i>		



Canada milkvetch.

## CHAPTER 6 - PLANTING

### Common Ironweed

*Vernonia baldwinii*

### WILDLIFE HABITAT

The seed mix listed below is designed to provide year-round habitat for game birds and a variety of other wildlife. The mix includes cool-season grasses and sedges and legumes to provide nesting and brood-rearing habitat for game birds. Annual and perennial legumes, sunflowers and a variety of cool- and warm-season grasses will provide forage for deer and other wildlife. Heavy seed-bearing plants, especially sunflowers and legumes, will provide a fall and winter food source for game birds, songbirds and small mammals. Warm-season grasses and tall-stemmed wildflowers, such as common evening primrose and Canada milkvetch, will provide winter roosting and loafing cover for game birds.

We recommend seeding no more than one gallon per acre of rough-cleaned Canada wildrye and Virginia wildrye seed and no more than 10 gallons per acre of rough-cleaned warm-season grass seed. Using lower grass seeding rates will reduce competition for forbs and maintain plantings in an early successional, weedy state, preferred by game birds, for a longer period.

### Leadplant

*Amorpha canescens*

### Canada Milkvetch

*Astragalus canadensis*

### Side-oats Grama

*Bouteloua curtipendula*

### Short-beak Sedge

*Carex brevior*

### Partridge Pea

*Chamaecrista fasciculata*

(*Cassia chamaecrista*)

### White Prairie-clover

*Dalea candida*

### Purple Prairie-clover

*Dalea purpurea*

### Illinois Bundleflower

*Desmanthus illinoensis*

### Canada Tick-clover

*Desmodium canadense*

### Illinois Tick-clover

*Desmodium illinoense*

### Canada Wildrye

*Elymus canadensis*

### Western Wheatgrass

*Elymus smithii* (*Agropyron s.*)

### Slender Wheatgrass

*Elymus trachycaulus*

(*Agropyron caninum*)



Hand sowing into corn stubble.

### Virginia Wildrye

*Elymus virginicus*

### Small-flowered Gaura

*Gaura mollis* (*G. parviflora*)

### Wild Licorice

*Glycyrrhiza lepidota*

### Sawtooth Sunflower

*Helianthus grosseserratus*

### Maximilian Sunflower

*Helianthus maximilianii*

### Stiff Sunflower

*Helianthus pauciflorus* (*H. rigidus*)

### Jerusalem Artichoke

*Helianthus tuberosus*

### Porcupine Grass

*Hesperostipa spartea* (*Stipa s.*)

### Junegrass

*Koeleria macrantha* (*K. pyramidata*)

### Round-head Bush-clover

*Lespedeza capitata*

### Prairie Trefoil

*Lotus unifoliolatus* (*L. purshianus*)

Wild Bergamot	<i>Monarda fistulosa</i>
Common Evening Primrose	<i>Oenothera villosa</i>
Switchgrass	<i>Panicum virgatum</i>
Slender-flower Scurfpea	<i>Psoralidium tenuiflorum</i> ( <i>Psoralea t.</i> )
Dwarf Prairie Rose	<i>Rosa arkansana</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Rosinweed	<i>Silphium integrifolium</i>
Compass-plant	<i>Silphium laciniatum</i>
Cup-plant	<i>Silphium perfoliatum</i>
Indiangrass	<i>Sorghastrum nutans</i>

### SEED BED PREPARATION

Most of our restorations are sown on cropland, primarily soybean fields and cornfields. Crop fields provide good seedbeds requiring little site preparation prior to planting. Packard (1997) expressed concern about the residual effects of cropland herbicides on seed germination and seedling establishment of planted species. Atrazine, commonly applied to eastern Nebraska cornfields, is the only herbicide in our region likely to have residual effects on restoration plantings. These effects should last no more than a few years. We recommend not applying Atrazine to a field for 2-3 years before it is seeded as a restoration.

We believe residual stubble in crop fields protects the soil and planted seed from erosion. If corn stubble is over a foot high it may interfere with planting and require shredding or disk. In ridge-tilled fields, the ridges need to be disked before planting. If not leveled, these ridges will persist for years, making walking or driving in the restored field difficult. If planting in late spring or early summer and weeds have become prominent in a field a light disk may be required prior to planting to set weeds back. Disking depth should be less than two inches to prevent additional weed seeds from being brought to the soil surface.

When seeding into noncropland situations, such as old fields and pastures, aggressive perennial weeds, such as smooth brome (*Bromus inermis*), tall wheatgrass

(*Thinopyrum ponticum*), reed canary grass (*Phalaris arundinacea*), leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*) and purple loosestrife (*Lythrum salicaria*), if present, will require control prior to planting. If not controlled, these perennial weeds will compete with seeded



An effective seedbed preparation for small-scale plantings is scraping and removal of existing sod, which creates a firm relatively weed-free seedbed. However, this method may make it more difficult to incorporate seed into the soil.

plants and could jeopardize a restoration's success. Consult with someone knowledgeable about weed control, such as a county weed agent, if you have questions about the best method of weed control.

If aggressive perennial weeds occupy only small areas in a restoration site, spot spraying with an appropriate herbicide may be sufficient for control. If these weeds populate large areas control might take several years and require extensive herbicide application. Often smooth brome, tall wheatgrass or reed canary grass dominate entire fields. If these sites have been previously farmed, cropping them for a few years may be the most effective means of weed control.

Herbicide application is most effective when plants are actively transporting carbohydrates into their root system. This is the



In lowland areas, such as the Platte River valley, excavating fill material can create a shallow water wetland that can be seeded to a marsh or wet-mesic prairie community.

time herbicides will also be most efficiently transported into the roots. Mid-fall application of Glyphosate (Roundup), when temperatures are warmer than 60 degrees Fahrenheit, is often an effective method of killing many exotic cool-season grasses. One herbicide application sometimes will not be sufficient to kill aggressive weeds. After spraying in the fall, fields should be checked in the spring to see if the treatment was effective in killing weeds. If not, an additional spring herbicide application might be required before planting. Resprouts from seeds in the soil is a persistent problem after herbicide control of certain perennial weeds, especially tall wheatgrass, leafy spurge and reed canary grass. Follow-up spot spraying is often required to control resprouts.

Reed canary grass is a pervasive, difficult to eradicate, exotic plant in eastern Nebraska wetlands. Though top-killed by herbicides, it often resprouts from its extensive rhizomes (underground lateral stems) or re-emerges from seed. Before seeding reed canary grass-infested wetlands, we frequently excavate 4-6 inches of topsoil to remove the species' rhizomes and seed bank. Though extremely expensive, this process is not a guarantee that reed canary grass will not reappear in a few years.

Restoration sites with excess plant litter, such as idled fields, may require prescribed burning or shallow disking or harrowing prior to planting to reduce litter and expose soil to promote good seed-to-soil contact, especially when broadcast seeding. Some restorationists pack the soil with cultipackers or corrugated cast-iron field rollers before drill planting and after broadcast planting. Packard (1997) wrote "Next to adequate perennial weed control, soil packing is the most important factor in a restoration seeding. A well-packed soil eliminates air passages that can dry out and kill a newly emerging seedling before it ever appears above ground. By creating a crust at the soil surface, it prevents moisture that lies deeper in the soil from evaporating, keeping it just below the surface, where it is most needed by the seeds. It also ensures good seed-to-soil contact, which is vital to the germination of native species." We have done very little soil packing at our restoration sites. We believe that most farmed soils have been well packed by the tires of farm machinery and do not require further packing. This might not be true for sites recently deeply disked or plowed.

## RESTORING WETLAND HYDROLOGY

Restoring hydrology is a critical first step in many wetland restorations. Sufficient water must be present to maintain wetland soils and plant communities and provide for the needs of wildlife. Hydrologic restoration design must allow for natural seasonal and yearly fluctuations in water levels.

Restoring wetland hydrology on crop fields often requires filling ditches and water storage pits, removing underground drain tile, excavating fill material, removing dikes to re-establish water flow or building dikes and water control structures to store water or to keep water off neighboring lands. A creative individual with a tractor and earthmover can accomplish some small-scale projects. Professional engineers and contractors will likely be needed for larger projects. Contacting the NGPC, USFWS, NRCS or Army Corps of Engineers (Appendix A) is recommended prior to beginning any earthmoving in or near a wetland to see if technical and financial

assistance may be available and to obtain necessary permits.

On our Platte River valley restorations we commonly excavate off-channel swales previously filled to facilitate farming. These shallow, meandering swales are excavated to varying depths with gentle side slopes. Some areas hold water only when river levels and connected groundwater levels are high; other areas hold water most of the year. These wetlands provide habitat for many aquatic plants, as well as shorebirds, waterfowl and sandhill cranes in the central Platte River valley.

We often use excavated spoil to create sand ridges similar to high sandbars and low sand dunes that occurred at the sites before they were farmed. These shallow-sloped ridges, one to six feet high, are located near the excavated wetlands to limit earthmoving costs, but far enough away so they will not interrupt surface water flow into the wetlands. The ridges are seeded with sand-adapted species, increasing the site's overall plant diversity.

Prior to seeding Rainwater Basin wetlands, we commonly excavate silt washed into the basins from adjacent cropland. This silt is frequently up to 18 inches thick and overlies the original topsoil (A horizon). The topsoil in Rainwater Basin wetlands is about 6 inches thick and overlays the water-holding clay lens (B horizon). When present, a thick silt layer, lying above the water-holding clay, remains saturated throughout the growing season, never allowing the wetlands to dry completely. These constantly saturated conditions promote the growth of cattails (*Typha spp.*), river bulrush (*Bolboschoenus fluviatilis*), reed canary grass and other aggressive plants that dominate many basins at the expense of other wetland plants more beneficial to wildlife. Prescribed fire, grazing, disking and herbicide spraying, sometimes used in combination, can be used to reduce the abundance of these species and the



Chris Helzer/The Nature Conservancy

Boy Scout volunteer prairie planters.



Filling an E-ZEE Flow granular fertilizer spreader with prairie seed mix.

organic matter buildup they cause prior to planting.

## PLANTING

We have had success planting prairie and wetland restorations from October through late May. However, we believe fall (late October) to midwinter (late January) planting provides seeds the greatest chance to germinate



Tractor-mounted Vicon spreader.

and grow. Exposure to winter elements fulfills the cold, moist-seed stratification needs of most species. Early planting also allows young seedlings to benefit from spring and early summer rainfall.

Plantings in drought years often develop at a slower rate. To overcome the potential shortfalls in one growing season, Kurtz (2001) sometimes seeds over two growing seasons, planting half the seed the first fall, and overseeding the other half, without tillage, the following fall.

Restorationists use two primary methods of planting: drilling and broadcasting. We hand broadcast small restorations of less than a few acres, and when volunteers are available, we hand broadcast restorations up to 50 acres. We machine broadcast all other restorations.

Organization is key to using volunteers for planting. We divide restorations into one-acre blocks, marking the corners of each acre with pin flags. An acre is approximately 64



ATV-mounted Truax "Seed Slinger."

yards (or long paces) on a side. Volunteers are divided into two-person teams with each team assigned several acres to plant. For prairie restorations, one volunteer is responsible for planting forb seed, and the other person plants warm-season grass seed. The seed needed for each acre is distributed to volunteers in five-gallon buckets.

We instruct volunteers to mark transects with flags on opposite sides of each acre

(transects should run perpendicular to wind direction). The distance between transects depends on wind speed and distance they can throw seed on that day, usually 3 to 10 yards. Planting on days with moderate to high winds will reduce planting time. The volunteer teams walk the transect lines sowing seed as they go. Once a transect has been walked, the volunteers pull the flags marking that transect and use them to mark the next transect. Volunteers must learn to ration seed so they can complete a full acre of planting.

Hand broadcast seeding from an ATV is much faster than broadcasting while walking and works well for seeding wetlands where muddy soils prevent use of mechanical seeders. We do not perceive the uneven seed distribution sometimes resulting from hand broadcasting as detrimental. Those areas receiving little seed may provide space for less aggressive species to establish free of



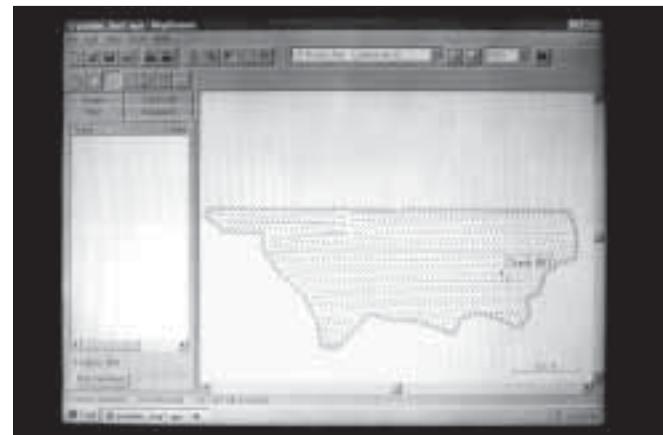
Fertilizer spreaders are efficient planters and do not require a tractor.

competition. Seeding gaps in restorations usually fill as restorations develop and species spread via rhizomes and seed production.

There are several types of mechanical broadcast seeders. The simplest are the strap-to-chest, hand-cranked machines. More efficient are the pull-type fertilizer spreaders, such as those made by E-ZEE Flow and John



An ATV-mounted Global Positioning System (GPS) unit can be used to record the planting path.



GPS spatial data can be downloaded onto a computer and integrated with other GIS image files, such as aerial photos.

Deere, with wheel-driven agitators in the seed bin and adjustable openings in the bottom through which the seed falls. More advanced yet are the tractor-pulled or three-point hitch-mounted fertilizers spreaders, such as those made by Vicon, which sell for about \$3,000.

The Vicon spreader has an aggressive agitator, which breaks plant stems and keeps trash from bridging. An oscillating arm and deflectors distribute seed over a 16-foot wide band.

Staff at the USFWS office in Kearney also use an ATV-mounted, Truax "Seed Slinger" for

broadcast planting. It has picker wheels and an agitator that works well with fluffy and trashy seed. It can throw the seed in a 10-foot wide band on each side of the spreader. They strap extra seed bags to the ATV to increase the speed of seeding. They also drag a piece of chainlink fence weighted with bricks behind the ATV to cover the seed with a shallow layer of soil.

Seed drills are tractor-pulled implements with a series of small discs that create furrows in



Pulling a harrow behind the E-ZEE Flow marks planter progress and incorporates some of the seed deeper into the soil.

the soil. Seed is metered out from top-mounted bins through tubes into the furrows. The soil then falls back into the furrow and is packed by rubber press wheels. Seed drills range in price from \$5,000 to \$10,000. Popular among restorationists are several models made by the Truax Company of Minneapolis, Minnesota. Local NRCS offices maintain lists of rental drills, as well as custom seed planters.

Some restorationists prefer seed drills to broadcast planters for the following reasons: 1) drills provide even seed distribution, 2) planting depth of drills is adjustable and 3) drills plant seed in the soil and the soil is packed, increasing germination rates. Disadvantages of drills include the following: 1) drills may plant many

small seeds too deep for successful germination, 2) only highly cleaned seed can be used in drills, rough-cleaned seed will not pass through a drill, 3) seeds are planted in rows giving restorations an artificial look for several years, 4) drilling is slow compared to broadcast seeding and 5) drills are heavy, difficult to transport and have many parts that require frequent maintenance and repair.

We plant most of our restorations with E-ZEE Flow fertilizer spreaders pulled by ATVs. Used E-ZEE Flows can often be purchased at farm auctions for less than \$100. The spreader's planting width is 10-12 feet and under good conditions we can plant about 10 acres per spreader per hour with these machines. The spreaders provide even seed distribution and work well even on windy days.

When broadcast seeding, restorationists sometimes mix the seed with an inert carrier, such as sand or vermiculite, to add bulk for easier spreading and to make it easier to see where they have planted. We have found this unnecessary using fertilizer spreaders as we can usually follow tire marks, especially when planting in snow. We sometimes use an ATV-mounted Global Positioning System (GPS) when planting to display the path traveled and identify planting gaps. We also determine acres planted with the GPS.

Broadcast spreaders must be calibrated to distribute the desired amount of seed per acre. We mark off a few acres and test plant it with given amount of seed and adjust bin

## CHAPTER 7 - POST-PLANTING MANAGEMENT

openings as needed. When planting different seed mixes, for example tallgrass prairie and wet-mesic prairie mixes, at a restoration site we overlap the mixes in a 20- to 40-foot band in the transition zone. This ensures that the appropriate species are seeded in the often difficult to determine transition zone between community types. On central Platte River valley restorations, we typically broadcast a wet meadow seed mix over the entire site and then overseed wet swales and drier sandy ridges with marsh and sand prairies mixes, respectively.

After broadcast seeding, Kurtz (2001) recommends a light harrowing and cultipacking of the soil to promote better seed-to-soil contact and to prevent soil erosion. We occasionally harrow fields with harder soils after planting to promote better seed-to-soil contact. However, for most plantings we rely on the elements (e.g. rain and frost action) to work the seed into the soil. Where feasible, a light harrowing or raking of small restorations, covering the seeds with less than  $\frac{1}{4}$  inch of soil, may enhance seed-to-soil contact and subsequent germination rates. Packard (1997) wrote that different-sized seeds will survive best at various depths. As a rule of thumb, he recommends covering seed with a layer of soil equal to twice its thickness. He also warns that covering seeds with  $\frac{1}{2}$  inch of soil may prevent many species from germinating.

We have never planted cover crops, such as oats or rye, in our restorations. Annual weeds sprout quickly in most restorations, providing adequate cover to prevent soil erosion and partial shading of seedlings to prevent sun scalding. Packard (1997) wrote that adding a protective mulch of straw or sawdust to a planting conserves soils moisture, reduces soil

erosion and increases germination especially during dry periods, but also that the mulching is not practical for larger restorations. We have never mulched any of our plantings.

### INTERSEEDING

Interseeding is the process of sowing seeds directly into existing perennial vegetation. Restorationists often interseed native plants into degraded plant communities to improve their plant composition and diversity. Reducing the existing plant cover to promote



Chris Helzer/The Nature Conservancy

**First season prairie forb seedlings in a relatively weed-free backyard planting.**

good seed-to-soil contact and decrease competition for seeded species is key to successful interseeding. Densely sodded areas can be lightly disked or harrowed to expose bare soil. Grazing an area just after seeding may also help work seed into the soil. Sites infested with smooth brome, Kentucky bluegrass or other exotic cool-season grasses might require spring burning or heavy spring

grazing for 2 or 3 years or herbicide application to reduce these species' abundance before planting.

We have successfully broadcast seeded sunflowers, rosinweed, Illinois bundleflower and a few other hardy native wildflowers into a degraded Platte River valley wet meadow. After seeding, we used late spring and early summer grazing for several years to reduce the vigor of existing cool- and warm-season grasses and give the seeded species a competitive chance. Mowing interseeded sites to a height of 6 to 12 inches may also reduce the vigor of existing vegetation and help establish seedlings.

## RESTORATION DEVELOPMENT

Prairie and wetland restorations don't become fields of blooming wildflowers overnight. They take several years to develop following the natural process of succession. Patience is a virtue for a restorationist and restoration site owner.

Annual weeds sprouted from seeds in the soil dominate prairie and wetland restorations during the first summer after planting. Annual sunflower (*Helianthus annuus*), pigweeds (*Amaranthus* spp.), giant ragweed (*Ambrosia trifida*), common ragweed (*A. artemisiifolia*), mare's tail (*Conyza canadensis*), foxtails (*Setaria* spp.), kochia (*Kochia scoparia*) and lamb's quarter (*Chenopodium album*) are the most common annual weeds in eastern Nebraska restorations. The canopy of giant ragweed, annual sunflower and kochia often exceeds six feet in height. The robust weed growth the first year after planting is often nourished by excess soil nitrogen remaining from cropping. Hidden among the annual weeds are seedlings of prairie or wetland plants.

In a typical, non-drought year, seeded plants can begin sprouting in mid-April. First-year prairie plants put most of their energy into root development and have limited above-ground growth. Few prairie species tiller their first year. Most remain single-stemmed plants and only a few species will flower. For

example, first year rosinweed plants remain few-leaved rosettes about 6 inches tall. First year prairie clover plants can reach about a foot tall with occasional blooms. Big bluestem and Indiangrass plants mostly remain few-leaved clumps up to 6-inches tall, though some plants may flower their first year.

The second year after planting, some annual weeds, such as annual sunflower and foxtails, have less robust growth and are diminished in abundance. Mare's tail is frequently the dominant annual weed in our second-year plantings. Seeded plants are now more visible. Canada wildrye and annual and biennial forbs such as black-eyed Susan (*Rudbeckia hirta*), partridge pea (*Chamaecrista fasciculata*) and common evening primrose (*Oenothera villosa*) may be abundant. Stiff



Annual weeds in a first year restoration.

sunflower, goldenrods and other colony-forming plants are beginning to send up multiple stems from rhizomes.

In years 3 to 5 of a restoration, annual weeds are greatly diminished and warm-season grasses and other prairie perennials are often dominant. These perennials are beginning to reproduce and spread via seed and vegetatively filling gaps in the restoration. Populations of butterfly milkweed (*Asclepias tuberosa*), sedges and

other erratic-starting or slow-developing species may still be sparse and consist of small plants.

In years 5 to 10 of a restoration annual weeds are mostly gone. The restoration begins to stabilize and develop the structure and plant composition of a remnant prairie. Many slow-developing plants are visible for the first time. By year ten, most prairie species are growing in their preferred soil type and microenvironment, but even after 10 years a restoration can still reflect conditions from its early years. For example, a portion of a 1992 Platte River valley restoration that flooded in 1993 still maintains a plant species composition distinct from the unflooded portion. Several acres of a central Nebraska tallgrass prairie restoration planted in 1983 with an abundance of Indiangrass seed in the seed mix is still dominated by Indiangrass, while other areas of the restoration are dominated by several grass species. Twenty years after planting this restoration supports 80 of the approximately 100 prairie species planted.

### IRRIGATION

Though the seeds of many prairie and wetland plants are well adapted to withstand drought they will not germinate and grow without sufficient moisture. Limited rainfall in the spring and early summer after planting can reduce the long-term plant diversity and abundance of a restoration. Severe, multi-year drought can cause the failure of restorations on dryer upland sites.

In years of normal precipitation, irrigation of first-year restorations is generally not needed. For most of our restorations irrigation is not feasible because of lack of a water source or irrigation system and pumping costs. Where irrigation is feasible, such as in a backyard, schoolyard or larger areas where irrigation systems are in place, watering during dry periods will likely improve germination rates and seedling establishment. Packard (1997) recommends watering prairie restorations 1 to 2

inches every three days for the first month after planting and as necessary the second month. For eastern Nebraska, watering restorations once a week in the first month or two after planting and during dry periods afterwards is likely sufficient.

### MOWING ANNUAL WEEDS

Though annual weeds are prolific in restorations the first few years after planting, we



Tom Bragg

Prior to settlement, bison were the major native grazer in Midwestern grasslands; their grazing behavior was influenced by fire.

believe, in most cases, sufficient sunlight and moisture is still available for establishment of prairie seedlings and the presence of annual weeds has only minor influence on restoration results. Other restorationists believe annual weeds compete with prairie seedlings for sunlight and moisture and impede their establishment. They recommend mowing restorations the first summer after planting to limit annual weed growth. In the wetter and more fertile areas of the tallgrass prairie region east of Nebraska weed growth is likely more prolific and might be more detrimental to restoration establishment.

Futhermore Kurtz (2001) wrote, "Without mowing to control competition, easily established species such as big bluestem, black-

eyed Susan, saw-toothed sunflower, and gray-headed coneflower [*Ratibida pinnata*] may eventually dominate [a tallgrass prairie restoration]. This can create a community with low species diversity and long-term instability. In the end, mowing encourages higher species diversity, more spaces are filled, and a more stable plant community results. This post-seeding weed control is the most important part of a successful establishment, especially in a dry year when available moisture may be a limiting factor."

Mowing may be cost prohibitive for larger restorations. However, for small restorations, or patches of larger restorations where annual weeds are especially tall or dense, mowing might be feasible and enhance seedling establishment. The presence of annual weeds often concerns neighbors and mowing may alleviate their worries. The benefits of mowing must be weighed against its affects on wildlife. Both mowing and shredding can kill pheasants and other grassland nesting birds, as well as mammals, such as deer fawns.

If you decide to mow, mow first-year restorations when most weeds are about two feet tall. Mow them to a height of about one foot. Mowing when weeds are taller, especially with a sicklebar mower, can lay down a dense

thatch layer that shades prairie seedlings. Repeat mowing if weeds again reach two feet in height. Mowing with sicklebar mowers is faster than using shredder mowers, but the rotary action of the shredders is beneficial in that it breaks up thatch. For most restorations, mowing annual weeds will be unnecessary by the second year after planting. Noxious weeds, such as leafy spurge and musk thistle, should be controlled immediately when they appear in a restoration (see Invasive Exotic Plants - A Special Challenge, below).

Annual weeds thrive when soils contain high nutrient levels. Therefore, restorations should not be fertilized. Most native plant species do well on nutrient-poor soils and can more effectively compete with annual weeds under such conditions.

## NATURAL DISTURBANCE IN PRAIRIE ECOSYSTEMS

Before Euroamerican settlement, Midwestern prairie ecosystems were greatly influenced by natural disturbances including fire, grazing by bison and other ungulates, drought and flooding. Periodic disturbance kept the prairies and wetlands diverse and robust. Since settlement, the roving bison herds and sweeping wildfires have disappeared from the prairie landscape and most of eastern Nebraska's remnant and restored prairies and wetlands are relatively small and isolated. The disturbance necessary to maintain healthy plant communities must now be provided through active management – primarily prescribed burning, controlled grazing, haying and sometimes tree cutting and herbicide application.

Without periodic disturbance, such as fire or grazing, eastern Nebraska's prairies and wetlands accumulate excess litter and deteriorate over time when native plants are shaded out and exotic plants and shrubs and trees invade. Carefully planned and timed management of prairies and wetlands can



Conducting a prescribed burn on a remnant prairie.

reduce litter, control invasive plants and produce diverse habitat conditions for native plants and animals ranging from tall, dense stands to short, open stands. Altering the location, timing and intensity of disturbance (i.e. haying, grazing or burning) from year to year is key to managing most plant communities in eastern Nebraska for biodiversity.

The growth and reproductive cycles of various prairie and wetland plants span the entire growing season from March through mid-November. For example, the pasque flower (*Anenome patens*) begins growth in March and sets seed by late May. Downy gentian begins growth in June but does not flower until early September. Disturbance at a particular time in the growing season will generally have short-term, negative effects on plants that are actively growing, flowering or setting seed at that time and benefit species that are inactive. For example, mid-summer (July) burning, grazing or haying weakens warm-season plants that are then actively growing and flowering and reduces competition for cool-season species. Exotic cool-season grasses now dominate many mid-summer hayed meadows in Nebraska.

Nebraska's prairie flora includes relatively few annuals and biennials, such as partridge pea and common evening primrose that flower and set seed only once before dying. Most prairie plants are perennials, some living for decades. They flower and set seed over many years. Management practices that promote a tall, dense vegetative cover, such as rest, light grazing or spring burning, favor taller perennials. Continual use of these practices over many years will reduce the diversity and abundance of annuals, biennials and short-statured perennials within a prairie. These species are favored by disturbances that produce a shorter vegetative cover, such as season-long grazing, multiple haying and summer burning. To maximize species diversity, it is critical to provide a disturbance regime that benefits long- and short-lived plants.



Eastern red cedar stand after a prescribed fire.

### PREScribed FIRE

Fire has a rejuvenating effect on prairies. By removing litter and blackening the soil surface, fire increases subsoil temperatures, and thus stimulates soil microbial activity leading to increased nutrient availability for prairie plants. Warmer soil temperatures also lengthen the growing season for most prairie and wetland plants while shortening it for exotic cool-season



Cutting cedars is necessary in some situations.

plants, such as smooth brome and tall wheatgrass.

Eastern Nebraska prairie and wetland restorations can sometimes be burned in the second year after planting if sufficient litter (fuel) is present. Removing dense foxtail and other annual weed litter that shades desirable seedlings is the primary reason for burning young restorations.

Most prescribed burning of Midwestern prairies and wetlands is conducted in spring (mid-March to mid-May) when the growing points of most native plants are still protected below ground. Burning young restorations in March and early April might prevent damage to early developing cool-season natives, such as sedges and pale poppy mallow (*Callirhoe alcaeoides*), though most native perennials will resprout after fire.

Established restorations, older than five years, can be burned on a three- to four-year rotation. Restorations infested with aggressive exotic cool-season grasses, such as smooth brome and Kentucky bluegrass, should be burned in late April to mid-May when these species are vigorously growing. Severe infestations may require several years of consecutive spring burning or herbicide application to reduce the exotics' populations.

Spring burning promotes the growth of native warm-season grasses. If practiced too frequently warm-season grass stands become dense and can crowd out other native plants. Altering the season and changing the frequency of burning will prevent domination by certain plants and loss of plant diversity. Occasional grazing or haying in addition to burning will add variety to the disturbance regime and diversify vegetative structure and habitats.

Spring burning stimulates tillering, flowering and seed production in warm-season grasses and other prairie plants and is recommended for years when prairies are to be harvested for seed. Resting a site from grazing or haying for a year prior to burning allows fuels to



Cattle grazing a recently burned prairie on the Platte River bluffs of central Nebraska.

accumulate and plants to store nutrients needed for good seed production. Seed production of some prairie species, such as prairie clovers, may be reduced following a fire. This is dependent on timing of the burn and amount of rainfall received after the burn.

Invasion by both native and exotic shrubs and trees can lead to degradation of prairies and wetlands primarily by shading out native plants. Before settlement, competition with native grasses, wildfires and browsing by deer and elk limited the spread of woody species, such as eastern red cedar (*Juniperus virginiana*), honey locust (*Gleditsia triacanthos*), rough dogwood (*Cornus drummondii*), smooth sumac (*Rhus glabra*), green ash (*Fraxinus pennsylvanica*) and cottonwood (*Populus deltoides*) into prairies and wetlands. With settlement came wildfire control and changes in grazing regimes allowing the spread of woody species. This was exacerbated by the introduction of invasive exotic shrubs and trees, such as black locust (*Robinia pseudoacacia*), Osage orange (*Morus pomifera*), Siberian elm (*Ulmus pumila*), Russian olive (*Elaeagnus angustifolia*) and white mulberry (*Morus alba*).

Eastern red cedar, a prolific coniferous invader of prairies, is easily controlled with prescribed fire when grass fuels are adequate and the trees are less than six to eight feet tall.

Once top-killed, eastern red cedars, like most conifers, will not resprout. Deciduous shrubs and trees, such as smooth sumac, Siberian elm, honey locust and cottonwood, though top-killed and weakened, usually resprout after a fire. Control of deciduous species is often best accomplished through the combined use of prescribed burning (summer burning appears most effective on woody plants), grazing, cutting and herbicide spraying. The more robust

an adequate forage base. In some cases, younger restorations can be grazed for short periods to control foxtail growth. Grazing restorations in years three to 10 after planting may be especially important for creating openings in the grass matrix that allows other plant species to establish.

We use both short-duration grazing at moderate to high-stocking rates and season-long grazing at low-stocking rates as management practices on our prairie and wetland restorations. Season-long grazing at low stocking rates allows cattle to select their preferred forage, generally the dominant warm-season grasses, especially on recently burned sites, reducing competition for other plant species. Short-duration grazing at moderate to high stocking rates at specific times of the growing season can be used to the benefit or detriment of certain plant groups. For example, grazing in the spring or fall for several continuous years will benefit warm-season species and weaken cool-season species including exotic species. As with prescribed fire, occasional variation in the frequency, timing and intensity of grazing over time will produce a more diverse plant community. Use of electric fence allows grazing to be restricted to specific areas of a prairie or wetland, if watering sites are available in those areas.

Season-long grazing at moderate to high-stocking rates should generally be avoided unless practiced only occasionally to meet specific management objectives. Local Natural Resource Conservation Service staff can assist landowners in determining the appropriate stocking rates for their restorations.

Prescribed burning can be incorporated into grazing systems when adequate fuels are available, usually after periods of rest or light grazing. Exotic cool-season grasses can be effectively set back by spring burning followed by several weeks of moderate to heavy cattle grazing. Prescribed burning in combination with grazing can also be used to produce a

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Hayed central Platte River valley meadow.

growth of native plants following fire may slow shrub and tree reinvasion of prairies and wetlands.

Only those with professional training should lead prescribed burns. The Natural Resource Conservation Service and other conservation organizations offer prescribed fire training in areas of the state. Local fire departments require that burn permits be obtained before conducting a prescribed burn.

### GRAZING

Controlled grazing is a valuable prairie and wetland management tool providing many options for regulating the location, intensity and season of disturbance. Like prescribed fire, cattle grazing can be used to reduce litter, limit exotic cool-season grasses and create habitat diversity. Grazing restorations can generally begin three to five years after planting when seeded plants are well established and provide

## INVASIVE EXOTIC PLANTS - A SPECIAL CHALLENGE

Of the approximately 1,950 plants found in the wild in Nebraska, at least 470 are exotic (non-native) plants introduced from other continents or other regions in North America. Most of Nebraska's exotic plants such as alfalfa and garden phlox don't compete well with native vegetation and therefore do not persist in remnant or restored plant communities. However, some exotics successfully invade native plant communities and restorations. Once established, these exotics might outcompete, hybridize with, or spread disease to native plants, change natural fire frequencies and intensities, or even alter soil chemistry. The annual weeds that dominate restorations in their initial years include both exotic and native species. These annual weeds are usually displaced a few years after planting by native perennials and generally do not concern us.

Nebraska currently lists seven noxious weed species that the state has mandated for control. These are leafy spurge, plumeless thistle (*Carduus acanthoides*), Canada thistle (*Cirsium arvense*), musk thistle, spotted knapweed (*Centaurea biebersteinii*), diffuse knapweed (*C. diffusa*) and purple loosestrife (*Lythrum salicaria*). All are exotics that pose serious ecological threats to remnant and restored plant communities. Purple loosestrife is a wetland species. The others occupy more upland habitats. Planting restorations on sites with extensive and persistent noxious weed problems is discouraged.

In addition to noxious weeds, several other exotic plants, mostly perennials, pose serious ecological threats to eastern Nebraska prairies, including sericea lespedeza (*Lespedeza cuneata*), crown vetch (*Coronilla varia*), ox-eye daisy (*Leucanthemum vulgare*), tall fescue (*Lolium arundinaceum*), smooth brome, Garrison creeping foxtail (*Alopecurus arundinaceus*) and tall wheatgrass. Other invasive exotics of eastern Nebraska wetlands include reed canary grass, narrow-leaved cattail (*Typha angustifolia*) and the non-native variety of common reed (*Phragmites australis*). Though not mandated by law, these weeds should be promptly controlled when they first appear at a restoration. Certain native species, such as river bulrush (*Bolboschoenus fluviatilis*) and eastern red cedar, can exhibit an aggressive nature in a plant community when no longer subjected to natural processes such as fire and grazing.

The presence of invasive exotic plants complicates management of remnant and restored plant communities, as management that benefits native species may also benefit exotics. In addition, methods to control exotics can be detrimental to native plants and wildlife. Hand-pulling, grazing, burning or mowing can sometimes keep small populations of certain exotics in check without affecting native species. However, herbicide application is often necessary for controlling invasive exotics and most herbicides will also affect native plants.

Invasive exotic plants are often best controlled through careful spot spraying of herbicides when they first appear at a site and populations are small. When exotics become well established at a site control is more time consuming, costly and detrimental to native plants and wildlife. Restorations should be monitored annually for the presence of aggressive exotic weeds.

diverse and somewhat random disturbance regime. For example, one to several smaller units of a pasture, perhaps totaling one-third to one-fourth of the total area, can be burned. After allowing a few weeks for regrowth, cattle are grazed in the pasture at light to moderate stocking rates. Grazing will be concentrated on the fresh regrowth of burned areas, providing these areas with additional intense disturbance and unburned areas with little additional disturbance. The following year different areas can be burned, usually those areas with the heaviest litter accumulation.

Grazing some prairies and wetlands is not always feasible because of their small size or lack of watering facilities or fencing. Prescribed burning and haying may be more feasible forms of management for these sites. These management practices differ from grazing in that they generally remove all the vegetative cover from a site at one time. Some ecologists recommend against burning or haying entire prairies or wetlands at once as this may be detrimental to the sites' insect populations, especially if a prairie or wetland is isolated with little chance of insect recolonization from nearby sites.

### MONITORING AND RECORD KEEPING

Monitoring and record keeping are important for documenting vegetative changes in a restoration and to provide information to guide management decisions. For all restorations we recommend recording which species were seeded and in what amounts, as well as seeding date and method. We also recommend the following monitoring activities be conducted on an annual basis: 1) record all plant species found in the restoration, 2) draw maps of noxious weed, other invasive exotic plant and woody plant infestations, 3) record general observations such as which plants are dominant and which are rare, vegetation structure and amount of litter and 4) take

photographs of the restoration from fixed photo points. Photo points can be permanently marked with fence posts and the photos taken from the top of the posts.

Conservationists and scientists often undertake more detailed, statistically valid forms of restoration monitoring. Packard (1997) discusses in detail quantitative restoration monitoring techniques. We use plot-wise Floristic Quality Assessment (FQA) for restoration monitoring. We believe FQA is a simple, consistent and statistically valid method for judging the floristic quality of restorations and remnant plant communities and for detecting change in the floristic quality of these communities over time.

The foundation of FQA is based on the concept of species conservatism. Each Nebraska plant species has been assigned a coefficient of conservatism (**C**) ranging from 0-10 (Rolsmeier and Steinauer 2003) based on the methodology and philosophy of Swink and Wilhelm (1994) and Taft et al. (1997). The coefficients of conservatism represent two basic ecological tenets: 1) plants differ in their tolerance to disturbance type, frequency and amplitude and 2) plants display varying degrees of fidelity to native habitats. With these principles as a guide, the **C** value applied to each plant represents a relative rank based on the plants observed behavior and pattern of occurrence in Nebraska and our confidence that the plant is dependent on remnant native habitats. Native plant species most successful in heavily disturbed habitats were given a **C** value of 0. Those species with high fidelity to relatively undisturbed native plant communities received a **C** value of 10. All exotic plants were assigned an asterisk (\*) and are treated as 0s in calculations for site indices and **FQI** values.

General categories for species assignments are as follows:

- 1) **C** values of 0-3 were applied to plants that are adapted to severe disturbance

- (ruderal and ruderal competitive species), found in a wide variety of habitats and have little fidelity to native plant communities. Species in this category include giant ragweed (*Ambrosia trifida*) ( $C=0$ ), partridge pea (*Chamaecrista fasciculata*) ( $C=1$ ), sand dropseed (*Sporobolus cryptandrus*) ( $C=2$ ) and wolfberry (*Symporicarpos occidentalis*) ( $C=3$ ).
- 2)  $C$  values of 4-6 were applied to plants that are dominant or matrix species of several native plant communities (competitor species) and species that are often expected or have high consistency in a given native plant community. In the contemporary Nebraska landscape these species demonstrate considerable tolerance to light to moderate periods of disturbance and habitat degradation, but may decline with an increase in intensity, duration or frequency of disturbance. Species in this category include Canada wildrye (*Elymus canadensis*) ( $C=4$ ), big bluestem (*Andropogon gerardii*) ( $C=5$ ) and purple prairie-clover (*Dalea purpurea*) ( $C=6$ ).
- 3)  $C$  values of 7-10 were applied to plants that are generally slow-growing, longer-lived, perennial plants of late seral native habitats. Species in this category tolerate little disturbance, they often have a high degree of fidelity to a narrow range of ecological parameters and usually persist only in intact natural areas. Species in this category include rough gayfeather (*Liatris aspera*) ( $C=7$ ), wild rice (*Zizania palustris*) ( $C=8$ ), small white lady's-slipper (*Cypripedium candidum*) ( $C=9$ ) and small yellow lady's-slipper (*C. parviflorum*) ( $C=10$ ).

A few species exhibit varying degrees of conservatism over their statewide range. In such cases, the  $C$  value assigned reflects that which

would be expected most commonly throughout the state.

Plot-wise FQA includes three measures of ecological importance: 1) plant species richness (**n**), 2) mean **C** value and 3) floristic quality index (**FQI**). **FQI** is a weighted index of species richness (**n**), and is the product of the average **C** value and the square root of species richness (**n**) of a surveyed area ( $\text{FQI} = \text{mean } C \text{ value} * \sqrt{n}$ ). Using the square root of **n** in the equation limits the influence of area alone on species richness (Swink and Wilhelm 1994).

Determining the extent and configuration of survey units is important when determining a site's **FQI**. Because **FQI** is a weighted index of species richness; larger survey units and greater inventory efforts will likely result in an increase in species richness or number of conservative species and yield higher **FQI** values (Taft et al. 1997). If the goal is to compare similar plant communities, care should be taken to avoid inclusions of other communities while sampling for FQA. Sites with multiple plant communities (e.g. wetlands with multiple vegetation communities) can be compared using FQA. We use 100 1x1 m<sup>2</sup> sample plots located with a stratified random design for FQA monitoring of prairie and wetland restorations and remnant prairie communities.

## SUMMARY

Prairie and wetland restoration not only provides many ecological benefits, such as habitat for native plants and animals and prevention of soil erosion, but also can be a personally fulfilling activity. However, restoration is not an activity to be tackled on a whim. Seed collecting, processing and planting all take considerable time. Buying seed can be expensive. Once planted, restorations take several years to develop. For those with little patience this may seem like an eternity. Once established, restorations require management - weed control, prescribed burning or grazing -

## **APPENDIX A - REFERENCE MATERIAL**

and may fail if not properly cared for. Personal commitment and dedication is key to a successful restoration.

Because of their considerable cost and labor requirements, high-diversity prairie and wetland restorations are most suitable for lands permanently protected with long-term exception of certain aggressive species. Conservation easements or other conservation measures, or by the commitment of a landowner and their family. A Conservation Reserve Program (CRP) field that is under a 10-year contract and likely to be farmed again when the contract expires is not a suitable site for a high-diversity restoration.

Rough cleaning of the seed is usually sufficient.

3) Broadcast plant the seed in late fall or winter. If possible, cover the seed with light layer of soil by harrowing or by dragging a piece of chainlink fence weighted with bricks behind the planter.

Though many ecologists prefer high-diversity restorations, moderate- or low-diversity plantings may be more practical in many circumstances, especially where time and money are limited and the land not permanently protected. For the above-mentioned CRP field, the best planting option would be perhaps a 10- to 20-species mix of native grasses and wildflowers. Such plantings will prevent soil erosion, provide wildlife habitat and other ecological benefits and be aesthetically pleasing. Management of low-diversity plantings can be less complicated than management of higher-diversity plantings.

A quick overview of prairie and wetland restoration techniques that we recommend for eastern Nebraska follows:

- 1) Whenever possible use local ecotype seed.
  - 2) Limit the amount of grass seed sown in restorations. In general collect or buy as much forb seed as possible, with the

Rough clearing of the seed is usually sufficient.

- 3) Broadcast plant the seed in late fall or winter. If possible, cover the seed with a light layer of soil by harrowing or by dragging a piece of chainlink fence weighted with bricks behind the planter.
- 4) Where feasible, water plantings the first year if conditions are dry.
- 5) Annual weed control is optional, but may be necessary where weeds are extremely tall and dense. Mow annual weeds, preferably with a shredder mower, when they reach a height of about two feet.
- 6) Control all noxious weeds, other aggressive perennial weeds and woody invaders in a restoration when they first appear.
- 7) Once established, manage restorations with a combination of prescribed fire, grazing or haying.
- 8) Monitor restorations to measure success and to help direct management.
- 9) If you have questions regarding a restoration, contact a professional.

Most importantly, enjoy the restoration process and the resulting prairie or wetland. Share this experience with others and learn as

much about nature as you possibly can from the restoration.

## APPENDIX A - REFERENCE MATERIAL

### CONSERVATION AGENCIES & ORGANIZATIONS

#### Nebraska Game and Parks Commission (District 2 Office)

524 Panzer St., PO Box 508  
Bassett, NE 68714-0508  
402 684-2921

#### Nebraska Game and Parks Commission (District 3 Office)

2201 N 13<sup>th</sup> St.  
Norfolk, NE 68701  
402 370-3374

#### Nebraska Game and Parks Commission (District 5 Office)

2200 N 33<sup>rd</sup> St.  
Lincoln, NE 68503-0370  
402 471-0641

#### Nebraska Game and Parks Commission (District 6 Office)

1617 First Ave.  
Kearney, NE 68847-5310  
308 865-5310

#### Prairie Plains Resource Institute

1307 L Street  
Aurora, NE 68818  
(402) 694-5535

#### Rainwater Basin Joint Venture and Ducks Unlimited

2550 North Diers Avenue  
Grand Island, NE 68803  
(308) 382-8112

#### The Nature Conservancy

#### (Platte River/Rainwater Basin Field Office)

1228 L Street, Suite 1  
Aurora, NE 68818  
(402) 694-4191

#### U.S. Army Corp of Engineers Wehrspann Field Office

8901 South 154<sup>th</sup> Street  
Omaha, NE 68138  
(402) 896-0896

#### U.S. Army Corp of Engineers Kearney Field Office

1430 Central Avenue  
Kearney, NE 68847  
(308) 234-1403

#### U.S. Fish and Wildlife Service

203 West Second Street  
Federal Building  
Grand Island, NE 68801  
(308) 382-6468

### USEFUL LITERATURE AND PUBLICATIONS

*Begin with a seed - the Riveredge guide to growing Wisconsin prairie plants.* 1999. Editors: Beimbom, J. and J. Lasca. Riveredge Nature Center. Newburg, Wisconsin. 111 p. (Contains information on the moisture, germination and soil type requirements of many tallgrass prairie plants).

*Ecological restoration.* This journal is published by the Society for Ecological Restoration. It contains articles on a wide diversity of topics related to native plant community restoration.

## APPENDIX A - REFERENCE MATERIAL

For subscription and membership information contact SER, University of Wisconsin-Madison Arboretum, 1207 Seminole Highway, Madison, WI 53711, (608) 262-9547.  
ser@macc.wisc.edu  
[www.ser.org](http://www.ser.org)

***Flora of the Great Plains.*** 1986. Great Plains Flora Association. University Press of Kansas. Lawrence, Kansas 1402 p. (Technical publication, includes keys to and descriptions of the Great Plains flora, no drawings.)

***Floristic Quality Assessment in Illinois; a method for assessing vegetation integrity.*** 1997. Taft, J. B., G. S. Wilhelm, D. M. Ladd, and L. A. Masters. *Eriogonum* 15:3-95. (Contains detailed discussion on the development of Floristic Quality Assessment.)

Nursery, Inc. ([www.prairienursery.com](http://www.prairienursery.com)) and WildOnes Wild Store ([www.for-wild.org](http://www.for-wild.org))

***Native vegetation of Nebraska (map).*** 1993. Kaul, R. B., and S. B. Rolfsmeier. Conservation and Survey Division, The University of Nebraska, Lincoln, Nebraska, scale 1:1,000,000. (<http://csd.unl.edu/csd/pubcatalog/gimc-nebr.htm>)

***Nebraska florasearch.*** (A web site of the Nebraska Statewide Arboretum. Contains pictures and brief descriptions of many Nebraska wildflowers.) ([Http://citnews.unl.edu/florasearch](http://citnews.unl.edu/florasearch))

***Plants of the Chicago region, 4th edition.*** 1994. Swink, F. and G. Wilhelm. Indiana

***Going Native – A prairie restoration handbook for Minnesota landowners.*** 2000. Rebecca Kilde. Minnesota Department of Natural Resources. (General restoration guidelines for the landowner. Available by calling (651) 296-2835.)

***Grassland plants of South Dakota and the northern Great Plains.*** 1999. James R. Johnson and Gary E. Larson. South Dakota State University. 228 p. (A good prairie wildflower and grass field guide for most of Nebraska.)

***How to manage small prairie fires.*** 1982. W.R. Pauly. Dane County Park Commission, Madison, WI. (A valuable guide for conducting small prairie burns. Available from Prairie

Academy of Science, Indianapolis, IN. (Contains information on the development of Floristic Quality Assessment.)

***A practical guide to prairie reconstruction.*** 2001. Carl Kurtz. University of Iowa Press. (A guide to restoration relying on Kurtz' own restoration experience.)

***Prairie plants and their environment.*** 1968. J. E. Weaver. University of Nebraska Press. (A good general overview of prairie ecology.)

***Restoring the tallgrass prairie.*** 1994. Shirley Shirley. University of Iowa Press. (General information on restoration methods. It also contains line drawings of many prairie plants.)

***Steyermark's flora of Missouri (volume 1).*** 1999. G. Yatskivych. Missouri Department of Conservation in cooperation with the Missouri

**A GUIDE TO PRAIRIE AND WETLAND RESTORATION IN EASTERN NEBRASKA**

<b>FAMILY - ACANTHACEAE</b>					
Hairy Ruellia	<i>Ruellia humilis</i>	P-FORB	mid sept	tg, southeastern NE	4
<b>FAMILIY - ACORACEAE</b>					
American Sweet Flag	<i>Acorus americanus</i>	P-FORB	late july-aug	mar, <i>A. calamus</i> is exotic	7
<b>FAMILY - AGAVACEAE</b>					
Soapweed	<i>Yucca glauca</i>	SHRUB	early aug-oct	san	4
<b>FAMILY - ALISMATACEAE</b>					
Common Water Plantain	<i>Alisma subcordatum</i> (incl. <i>A. triviale</i> )	P-FORB	mid aug-mid sept	rbmar, mar	4
Upright Burhead	<i>Echinodorus berteroii</i> ( <i>E. rostratus</i> )	A-FORB	sept	mar, far southeastern NE	6
Short-beak Arrowhead	<i>Sagittaria brevirostra</i>	P-FORB	mid to late july	mar, rbmar	5
Thick-stalk Arrowhead	<i>Sagittaria calycina</i>	A-FORB	mid to late july	mar, rbmar	3
Arum-leaf Arrowhead	<i>Sagittaria cuneata</i>	P-FORB	mid to late july	mar, sandy soils	5
Grassleaf Arrowhead	<i>Sagittaria graminea</i>	P-FORB	mid to late july	mar, rbmar	7
Common Arrowhead	<i>Sagittaria latifolia</i>	P-FORB	mid to late july	mar, rbmar	5
Stiff Arrowhead	<i>Sagittaria rigida</i>	P-FORB	mid to late july	mar, rbmar	7
<b>FAMILY - ALLIACEAE</b>					
Wild Garlic	<i>Allium canadense</i>	P-FORB	mid to late july	tg, wm, bulblets or seeds	3
Plains Onion	<i>Allium perdulce</i>	P-FORB	mid to late may	mg	6
White Wild Onion	<i>Allium textile</i>	P-FORB	mid june	tg, mg	6
<b>FAMILY - AMARANTHACEAE</b>					
Large Cottonweed	<i>Froelichia floridana</i>	A-FORB	mid aug	san	4
<b>FAMILY - APIACEAE</b>					
Common Water-hemlock	<i>Cicuta maculata</i>	P-FORB	late aug-oct	wm, highly toxic if ingested	5
Rattlesnake Master	<i>Eryngium yuccifolium</i>	P-FORB	sept	tg, far southeastern NE	9
Prairie Parsley	<i>Polytaenia nuttallii</i>	P-FORB	late june	wm	8
Canada Sanicle	<i>Sanicula canadensis</i>	B-FORB	aug-sept	tg, woodland edge	3
Hemlock Water-parsley	<i>Sium suave</i>	P-FORB	sept-oct	wm, mar	7
Golden Alexander	<i>Zizia aurea</i>	B-FORB	early aug	tg, wm	6
<b>FAMILY - APOCYNACEAE</b>					
Hemp Dogbane	<i>Apocynum cannabinum</i>	P-FORB	lat aug-late sept	tg, wm, rbwm	2

**APPENDIX B - PLANT LIST**

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>FAMILY - ASCLEPIADACEAE</b>					
Prairie Milkweed	<i>Asclepias sullivantii</i>	P-FORB	sept	wm	7
Common Milkweed	<i>Asclepias syriaca</i>	P-FORB	mid aug-oct	tg, mg, san, wm	1
Butterfly Weed	<i>Asclepias tuberosa</i> ssp. <i>interior</i>	P-FORB	sept-oct	tg, mg	6
Whorled Milkweed	<i>Asclepias verticillata</i>	P-FORB	aug-oct	tg, mg, san	3
Short Green Milkweed	<i>Asclepias viridiflora</i>	P-FORB	mid aug-oct	tg, mg, san	6
Spider Milkweed	<i>Asclepias viridis</i>	P-FORB	sept-oct	tg, mg	4
<b>FAMILY - ASTERACEAE</b>					
Woolly Yarrow	<i>Achillea millefolium</i>	P-FORB	aug-sept	tg, mg, san, wm, rbmw	2
Field Pussytoes	<i>Antennaria neglecta</i>	P-FORB	mid may	tg, mg, san	1
Pale Indian Plantain	<i>Arnoglossum atriplicifolium</i> ( <i>Cacalia</i> )	P-FORB	mid july	tg, wm	6
Prairie Indian Plantain	<i>Arnoglossum plantagineum</i> ( <i>Cacalia</i> )	P-FORB	mid july	tg, wm, southeastern NE	7
Western Sagewort	<i>Artemisia campestris</i>	B-FORB	oct	mg, san	4
White Sage	<i>Artemisia ludoviciana</i>	P-FORB	mid to late oct	tg, mg, san, wm	4
Nodding Bur-marigold	<i>Bidens cernua</i>	A-FORB	oct	mar	3
Tickseed Sunflower	<i>Bidens coronata</i>	A-FORB	oct	mar	4
Common Beggar-tick	<i>Bidens frondosa</i>	A-FORB	oct	mar	1
Coreopsis Beggar-tick	<i>Bidens polylepis</i>	A-FORB	oct	mar	4
White Boltonia	<i>Boltonia asteroides</i>	P-FORB	mid oct	rbwm	3
False Boneset	<i>Brickellia eupatorioides</i>	P-FORB	sept-oct	tg, mg, san	3
Tall Thistle	<i>Cirsium altissimum</i>	P-FORB	sept	tg, mg	1
Platte Thistle	<i>Cirsium canescens</i>	B-FORB	aug	wm	4
Flodman's thistle	<i>Cirsium flodmanii</i>	P-FORB	mid july-aug	tg, wm	4
Wavy-Leaved Thistle	<i>Cirsium undulatum</i>	P-FORB	aug	mg, san	4
Prairie Coreopsis	<i>Coreopsis palmata</i>	P-FORB	early to mid aug	tg, southeastern NE	8
Golden Coreopsis	<i>Coreopsis tinctoria</i>	A-FORB	mid aug-sept	rbwm, rbmar	1
Dandelion Hawks-beard	<i>Crepis runcinata</i>	P-FORB	early june	wm, central Platte Valley	5
Purple Coneflower	<i>Echinacea angustifolia</i>	P-FORB	late july-sept	tg, mg	5
Marsh Fleabane	<i>Erigeron philadelphicus</i>	B-FORB	late june	wm	3
Daisy Fleabane	<i>Erigeron strigosus</i>	A-FORB	mid to late june	tg, mg, wm	2
Tall Boneset	<i>Eupatorium altissimum</i>	P-FORB	oct	tg,wm, southeastern NE	3
Spotted Joe Pye Weed	<i>Eupatorium maculatum</i>	P-FORB	early to mid sept	wm, mar	6
Common Boneset	<i>Eupatorium perfoliatum</i>	P-FORB	late sept-oct	wm, mar	5
Late Boneset	<i>Eupatorium serotinum</i>	P-FORB	mid to late oct	tg, southeastern NE	4
Viscid Goldentop	<i>Euthamia gymnospermoides</i>	P-FORB	mid oct-nov	san, wm	4
Blanket Flower	<i>Gaillardia pulchella</i>	P-FORB	late july-early aug	mg, rare species	5
Sneezeweed	<i>Helenium autumnale</i>	P-FORB	mid sept-oct	wm	6
Sawtooth Sunflower	<i>Helianthus grosseserratus</i>	P-FORB	late sept-early oct	wm, rbwm, aggressive	4
Hairy Sunflower	<i>Helianthus hirsutus</i>	P-FORB	sept	tg, woodland edge	6
Maximillian Sunflower	<i>Helianthus maximilianii</i>	P-FORB	mid sept	tg,mg,wm, aggressive	4
Stiff Sunflower	<i>Helianthus pauciflorus</i> ( <i>H. rigidus</i> )	P-FORB	early sept	tg, mg, san	5
Petoiled Sunflower	<i>Helianthus petiolaris</i>	A-FORB	mid sept	mg, san	2
Jerusalem Artichoke	<i>Helianthus tuberosus</i>	P-FORB	late sept	tg, wm, rbwm	4
False Sunflower	<i>Heliopsis helianthoides</i>	P-FORB	mid aug-sept	tg, wm	4
Hairy Golden-aster	<i>Heterotheca villosa</i> ( <i>Chrysopsis villosa</i> )	P-FORB	july-aug	san	4
Longbeard Hawkweed	<i>Hieracium longipilum</i>	P-FORB	july-aug	tg	6
Annual Marsh-elder	<i>Iva annua</i>	A-FORB	late sept-early oct	wm, rbwm, sawm	1
Wild Lettuce	<i>Lactuca canadensis</i>	B-FORB	aug-sept	tg, mg	2
Western Wild Lettuce	<i>Lactuca ludoviciana</i>	B-FORB	late july-early sept	tg, mg	3
Showy Blue Lettuce	<i>Lactuca tatarica</i> ( <i>L. oblongifolia</i> )	P-FORB	mid july	tg, mg	0
Rough Gayfeather	<i>Liatris aspera</i>	P-FORB	sept	tg, mg, san	5
Lanceleaf Gayfeather	<i>Liatris lancifolia</i>	P-FORB	late aug-mid sept	wm, central & northeast NE	8
Dotted Gayfeather	<i>Liatris punctata</i>	P-FORB	late sept-early oct	tg, mg	5
Thickspike Gayfeather	<i>Liatris pycnostachya</i>	P-FORB	early sept	tg, southeastern NE	7
Plains Gayfeather	<i>Liatris squarrosa</i> var. <i>glabrata</i>	P-FORB	late aug-early sept	mg, san, central NE	5

**A GUIDE TO PRAIRIE AND WETLAND RESTORATION IN EASTERN NEBRASKA**

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>ASTERACEAE - CONTINUED</b>					
Plains Gayfeather 7	<i>Liatris squarrosa</i> var. <i>hirsuta</i>	P-FORB	late aug-early sept	tg, southeastern NE	
Skeleton Plant	<i>Lygodesmia juncea</i>	P-FORB	late july-early aug	tg, mg, san	4
Cutleaf Ironplant	<i>Machaeranthera pinnatifida</i> ( <i>Haplopappus spinulosus</i> )	P-FORB	late june	mg, san	4
Wavyleaf Prairie-dandelion	<i>Nothocalis cuspidata</i> ( <i>Microseris cuspidata</i> )	P-FORB	early june	tg, mg	6
Rough Rattlesnake-root	<i>Prenanthes aspera</i>	P-FORB	mid sept-oct	tg, mg, san	7
Old Field Balsam	<i>Pseudognaphalium obtusifolium</i> ( <i>Gnaphalium obtusifolium</i> )	B-FORB	mid to late oct	tg, mg	3
Upright Prairie Coneflower	<i>Ratibida columnifera</i>	P-FORB	aug	tg, mg, san	3
Grayhead Prairie Coneflower	<i>Ratibida pinnata</i>	P-FORB	late aug	tg	3
Black-eyed Susan	<i>Rudbeckia hirta</i>	B-FORB	late july-aug	tg, wm	3
Golden-glow	<i>Rudbeckia laciniata</i>	P-FORB	sept	wm	4
Prairie Ragwort	<i>Senecio plattensis</i>	B-FORB	late may-early june	tg, mg, san, wm	5
Rosinweed	<i>Silphium integrifolium</i>	P-FORB	late aug-sept	tg, mg, wm	4
Compass-plant	<i>Silphium laciniatum</i>	P-FORB	late aug-sept	tg, wm	5
Cup-plant	<i>Silphium perfoliatum</i>	P-FORB	late aug-sept	tg, wm, woodland edge	4
Canada Goldenrod	<i>Solidago canadensis</i>	P-FORB	oct	tg, wm	2
Late Goldenrod	<i>Solidago gigantea</i>	P-FORB	oct	tg, wm	3
Missouri Goldenrod	<i>Solidago missouriensis</i>	P-FORB	oct	tg, mg, san	5
Soft Goldenrod	<i>Solidago mollis</i>	P-FORB	oct	tg, mg	4
Gray Goldenrod	<i>Solidago nemoralis</i>	P-FORB	oct	tg	4
Stiff Goldenrod	<i>Solidago rigida</i>	P-FORB	oct	tg, mg, san	3
Showy-wand Goldenrod	<i>Solidago speciosa</i>	P-FORB	oct	tg	7
Heath Aster	<i>Symphyotrichum ericoides</i> ( <i>Aster ericoides</i> )	P-FORB	oct	tg, mg, san, wm, rbwm	3
Smooth Blue Aster	<i>Symphyotrichum laeve</i> ( <i>Aster laevis</i> )	P-FORB	late oct	tg	5
Panicled Aster	<i>Symphyotrichum lanceolatum</i> ( <i>Aster simplex</i> )	P-FORB	mid to late oct	tg, wm, rbwm	2
New England Aster	<i>Symphyotrichum novae-angliae</i> ( <i>Aster novae-angliae</i> )	P-FORB	mid to late oct	wm	4
Aromatic Aster	<i>Symphyotrichum oblongifolium</i> ( <i>Aster oblongifolium</i> )	P-FORB	mid to late oct	tg, mg, san	5
Azure Aster	<i>Symphyotrichum oolentangiense</i> ( <i>Aster oolentangiense</i> )	P-FORB	mid to late oct	tg, southeastern NE	7
Willowleaf Aster	<i>Symphyotrichum praealtum</i> ( <i>Aster praealtus</i> )	P-FORB	mid to late oct	wm, rbwm	5
Silky Aster	<i>Symphyotrichum sericeum</i> ( <i>Aster sericeus</i> )	P-FORB	mid to late oct	tg	7
Saltmarsh Aster	<i>Symphyotrichum subulatum</i> ( <i>Aster subulatus</i> )	A-FORB	mid sept-oct	sawet	0
Rayless Greenthread	<i>Thelesperma megapotamicum</i>	P-FORB	aug	mg	4
Common Ironweed	<i>Vernonia baldwinii</i>	P-FORB	sept-oct	tg, wm	3
Western Ironweed	<i>Vernonia fasciculata</i>	P-FORB	sept-oct	wm, rbwm	4
<b>FAMILY - BALSAMINACEAE</b>					
Orange Jewelweed	<i>Impatiens capensis</i>	A-FORB	july-aug	mar, ripe capsules explode	4
<b>FAMILY - BORAGINACEAE</b>					
Hoary Puccoon	<i>Lithospermum canescens</i>	P-FORB	aug	tg	5
Hairy Puccoon	<i>Lithospermum carolinense</i>	P-FORB	aug	san	6
Fringed Puccoon	<i>Lithospermum incisum</i>	P-FORB	aug	tg, mg, san	5
False Gromwell	<i>Onosmodium molle</i>	P-FORB	late june-oct	tg, mg, san	4

## APPENDIX B - PLANT LIST

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>FAMILY - CACTACEAE</b>					
Plains Pincushion Cactus	<i>Coryphantha vivipara</i>	P-FORB	aug	mg, san	6
Plains Prickly Pear	<i>Opuntia tortispina (O. macrorhiza)</i>	P-FORB	early sept	mg, san	4
<b>FAMILY - CAMpanulaceae</b>					
Cardinal Flower	<i>Lobelia cardinalis</i>	P-FORB	sept	wm, rare, central Platte Valley	6
Great Blue Lobelia	<i>Lobelia siphilitica</i>	P-FORB	sept	wm	6
Pale Spiked Lobelia	<i>Lobelia spicata</i>	P-FORB	mid july-mid aug	tg, wm	6
Venus' Looking Glass	<i>Triodanis perfoliata</i>	A-FORB	mid july	tg, mg, san, wm	2
<b>FAMILY - CAPPARACEAE</b>					
Rocky Mountain Bee Plant	<i>Cleome serrulata</i>	A-FORB	sept	san	0
<b>FAMILY - CAPRIFOLIACEAE</b>					
Wolfberry	<i>Symphoricarpos occidentalis</i>	SHRUB	late sept-oct	tg, mg	2
Coralberry	<i>Symphoricarpos orbiculatus</i>	SHRUB	late sept-oct	tg, southeastern NE	2
Horse-gentian	<i>Triosteum perfoliatum</i>	P-FORB	mid sept	tg	5
<b>FAMILY - CARYOPHYLLACEAE</b>					
Sleepy Catchfly	<i>Silene antirrhina</i>	A-FORB	mid june	tg, mg, wm	2
<b>FAMILY - CHENOPodiaceae</b>					
Silver Orach	<i>Atriplex argentea</i>	A-FORB	aug-sept	sawet	4
Saltmarsh Spearscale	<i>Atriplex dioica (A. subspicata)</i>	A-FORB	aug-sept	sawet	5
Winged-pigweed	<i>Cycloloma atriplicifolium</i>	A-FORB	sept	san	2
Saltwort	<i>Salicornia rubra</i>	A-FORB	july-oct	sawet, collect dried stems	8
Sea Blite	<i>Suaeda calceoliformis (S. depressa)</i>	A-FORB	aug-oct	sawet, collect dried stems	5
<b>FAMILY - CLusiaceae</b>					
Canada St. John's Wort	<i>Hypericum majus</i>	A-FORB	mid sept	wm	6
<b>FAMILY - COMMELINACEAE</b>					
Long-bracted Spiderwort	<i>Tradescantia bracteata</i>	P-FORB	late june-early july	tg, mg, wm	5
Prairie Spiderwort	<i>Tradescantia occidentalis</i>	P-FORB	late june-mid july	san	5
<b>FAMILY - CONVALLARIACEAE</b>					
Starry False Solomon's Seal	<i>Smilacina stellata</i>	P-FORB	late june-july	tg, wm	4
<b>FAMILY - CRASSULACEAE</b>					
Ditch Stonecrop	<i>Penthorum sedoides</i>	P-FORB	mid sept	mar	4
<b>FAMILY - CYPERACEAE</b>					
River Bulrush	<i>Bolboschoenus fluviatilis (Scirpus f.)</i>	P-SEDGE	mid july-sept	mar, may be aggressive especially in rbmar	3
Saltmarsh Bulrush	<i>Bolboschoenus maritimus (Scirpus m.)</i>	P-SEDGE	mid july-sept	mar, sawet, wear gloves	5
Golden Sedge	<i>Carex aurea</i>	P-SEDGE	mid june	wm, western Platte Valley	7
Bicknell's Sedge	<i>Carex bicknellii</i>	P-SEDGE	mid june	tg, wm	6

**A GUIDE TO PRAIRIE AND WETLAND RESTORATION IN EASTERN NEBRASKA**

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>CYPERACEAE - CONTINUED</b>					
Common Wood Sedge	<i>Carex blanda</i>	P-SEDGE	mid june	wm	2
Yellowfruit Sedge	<i>Carex brachyglossa (C. annectens)</i>	P-SEDGE	mid june	wm, far southeastern NE	7
Short-beak Sedge	<i>Carex brevior</i>	P-SEDGE	mid june	tg, mg, san, wm, rbwm	3
Bush's Sedge	<i>Carex bushii</i>	P-SEDGE	mid june	tg, far southeastern NE	6
Bearded Sedge	<i>Carex comosa</i>	P-SEDGE	mid june	mar	5
Crawe's Sedge	<i>Carex crawei</i>	P-SEDGE	mid june	wm, Platte and Loup valleys	6
Crested Sedge	<i>Carex cristatella</i>	P-SEDGE	july	wm	5
Davis' Sedge	<i>Carex davisi</i>	P-SEDGE	mid june	tg, wm, southeastern NE	4
Needleleaf Sedge	<i>Carex eleocharis</i>	P-SEDGE	mid june	mg, san, wm, central NE	1
Emory's Sedge	<i>Carex emoryi</i>	P-SEDGE	early june	wm, mar	5
Frank's Sedge	<i>Carex frankii</i>	P-SEDGE	june	wm, mar, far southeastern NE	7
Hale's Meadow Sedge	<i>Carex granularis</i>	P-SEDGE	mid june	wm	6
Heavy Sedge	<i>Carex gravida</i>	P-SEDGE	mid to late june	tg, mg, san, wm, rbwm, mar, rbmar	4
Sun Sedge	<i>Carex heliophila</i>	P-SEDGE	mid may	mg, san	5
Shoreline Sedge	<i>Carex hyalinolepis</i>	P-SEDGE	mid june	mar	7
Bottlebrush Sedge	<i>Carex hystericina</i>	P-SEDGE	july-aug	mar	5
Prairie Star Sedge	<i>Carex interior</i>	P-SEDGE	june	wm, northcentral NE	7
Ripgut Sedge	<i>Carex lacustris</i>	P-SEDGE	mid june	wm, northern NE	6
Smooth-cone Sedge	<i>Carex laeviconica</i>	P-SEDGE	mid june	wm, rbwm, mar, rbmar	4
Mead's Sedge	<i>Carex meadii</i>	P-SEDGE	mid june	tg,wm, eastern 1/4 of NE	6
Midland Sedge	<i>Carex mesochorea</i>	P-SEDGE	mid june	tg, wm, southeastern NE	1
Troublesome Sedge	<i>Carex molesta</i>	P-SEDGE	mid june	wm	3
Hall's Sedge	<i>Carex parryana (C. hallii)</i>	P-SEDGE	mid june	wm, central NE	6
Woolly Sedge	<i>Carex pellita (C. lanuginosa)</i>	P-SEDGE	early to mid june	wm, rbwm	4
Clustered Field Sedge	<i>Carex praegracilis</i>	P-SEDGE	early june	wm	4
Sartwell's Sedge	<i>Carex sartwellii</i>	P-SEDGE	early june	wm, eastern Platte Valley	6
Pointed Broom Sedge	<i>Carex scoparia</i>	P-SEDGE	mid to late june	wm, mar, Loup and Platte	5
Sawbeak Sedge	<i>Carex stipata</i>	P-SEDGE	mid june	wm, mar	5
Rigid Sedge	<i>Carex tetanica</i>	P-SEDGE	early june	wm, Platte and Loup valleys	7
Fox Sedge	<i>Carex vulpinoidea</i>	P-SEDGE	late june-july	wm, rbwm, mar	4
Umbrella Flatsedge	<i>Cyperus diandrus</i>	A-SEDGE	mid aug-early sept	wm, mar, wet sandy sites	5
Yellow Nutsedge	<i>Cyperus esculentus</i>	P-SEDGE	mid aug-sept	mar	0
Great Plains Flatsedge	<i>Cyperus lupulinus</i>	P-SEDGE	aug-sept	mg, san	1
Sand Flatsedge	<i>Cyperus schweinitzii</i>	P-SEDGE	late july-sept	san	4
Needle Spikerush	<i>Eleocharis acicularis</i>	P-SEDGE	june-sept	rbmar, mar	4
Bog Spikerush	<i>Eleocharis elliptica</i>	P-SEDGE	june	wm	7
Bald Spikerush	<i>Eleocharis erythropoda</i>	P-SEDGE	june	wm, mar	5
Blunt Spikerush	<i>Eleocharis obtusa</i>	A-SEDGE	june	rbwm, rbmar	3
Common Spikerush	<i>Eleocharis palustris (E. macrostachya)</i>	P-SEDGE	june	wm, rbwm, mar, rbmar	4
Hairy Fimbrary	<i>Fimbristylis puberula</i>	P-SEDGE	aug	wm	7
Umbrella Grass	<i>Fuirena simplex</i>	A-SEDGE	mid sept	wm, mar	6
Hard-stem Bulrush	<i>Schoenoplectus acutus (Scirpus a.)</i>	P-SEDGE	july-aug	mar	5
Slender Bulrush	<i>Schoenoplectus heterochaetus (Scirpus h.)</i>	P-SEDGE	early july-aug	rbmar, mar	5
Three-square Bulrush	<i>Schoenoplectus pungens (Scirpus p.)</i>	P-SEDGE	late june-aug	wm, mar	4
Soft-stem Bulrush	<i>Schoenoplectus tabernaemontani (Scirpus validus)</i>	P-SEDGE	july-aug	mar	5
Dark Green Rush	<i>Scirpus atrovirens</i>	P-SEDGE	july-aug	wm, mar, southeastern NE	5
Pale Bulrush	<i>Scirpus pallidus</i>	P-SEDGE	mid aug	wm, mar	5
Rufous Bulrush	<i>Scirpus pendulus</i>	P-SEDGE	late june-july	wm	8
Tall Nut-rush	<i>Scleria triglomerata</i>	P-SEDGE	mid june	tg, wm, rare species	8
<b>FAMILY - ELEAGNACEAE</b>					
Buffaloberry	<i>Shepherdia argentea</i>	SHRUB	aug	san sandy river bottoms in	

## APPENDIX B - PLANT LIST

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
Texas Croton	<i>Croton texensis</i>	A-FORB	mid oct	san	4
Flowering Spurge	<i>Euphorbia corollata</i>	P-FORB	mid sept	tg	1
Snow-on-the-mountain	<i>Euphorbia marginata</i>	A-FORB	oct	mg, san, wm	3
<b>FAMILY - EUPHORBIACEAE</b>					
Texas Croton	<i>Croton texensis</i>	A-FORB	mid oct	san	0
Flowering Spurge	<i>Euphorbia corollata</i>	P-FORB	mid sept	tg	0
Snow-on-the-mountain	<i>Euphorbia marginata</i>	A-FORB	oct	mg, san, wm	0
<b>FAMILY - FABACEAE</b>					
Leadplant	<i>Amorpha canescens</i>	SHRUB	late aug-oct	tg, mg, san, wm	6
Canada Milkvetch	<i>Astragalus canadensis</i>	P-FORB	aug-oct	tg, mg, insects damage pods	5
Ground-plum	<i>Astragalus crassicarpus</i>	P-FORB	mid june-mid july	tg, mg, san	7
Missouri Milkvetch	<i>Astragalus missouriensis</i>	P-FORB	mid to late june	mg	6
White Wild Indigo	<i>Baptisia alba (B. lactea)</i>	P-FORB	mid july	tg, insects damage pods	6
Plains Wild Indigo	<i>Baptisia bracteata</i>	P-FORB	mid july-aug	tg	5
Partridge Pea	<i>Chamaecrista fasciculata</i> ( <i>Cassia chamaecrista</i> )	A-FORB	aug-sept	tg, mg, san, wm	1
Rattlebox	<i>Crotalaria sagittalis</i>	A-FORB	july aug	tg, mg, drier loess hills	2
White Prairie-clover	<i>Dalea candida</i>	P-FORB	mid aug-sept	tg, mg, san	6
Hare's-foot Dalea	<i>Dalea leporina</i>	A-FORB	oct	mg, san, wm	3
Round-head Prairie-clover	<i>Dalea multiflora</i>	P-FORB	late july-sept	mg, tg, far southern NE	7
Purple Prairie-clover	<i>Dalea purpurea</i>	P-FORB	mid aug-sept	tg, mg, san	6
Silky Prairie-clover	<i>Dalea villosa</i>	P-FORB	mid aug-sept	san	5
Illinois Bundleflower	<i>Desmanthus illinoensis</i>	P-FORB	aug-oct	tg, wm	5
Canada Tick-clover	<i>Desmodium canadense</i>	P-FORB	aug-sept	tg, mg, wm	5
Hoary Tick-clover	<i>Desmodium canescens</i>	P-FORB	sept	tg, mg, wm	5
Illinois Tick-clover	<i>Desmodium illinoense</i>	P-FORB	aug-sept	tg, mg, wm	6
Panicled Tick-clover	<i>Desmodium paniculatum</i>	P-FORB	sept	tg, wm	5
Wild Licorice	<i>Glycyrrhiza lepidota</i>	P-FORB	july-oct	tg, mg, san, wm	4
Showy Vetchling	<i>Lathyrus polymorphus</i>	P-FORB	mid july	mg, san	5
Round-head Bush-Clover	<i>Lespedeza capitata</i>	P-FORB	sept-oct	tg, mg, san	5
Prairie Trefoil	<i>Lotus unifoliolatus (L. purshianus)</i>	A-FORB	mid aug-mid sept	tg, mg, san	3
Sensitive Brier	<i>Mimosa quadrivalvis</i> ( <i>Schrankia nuttallii</i> )	P-FORB	sept-oct	tg, mg, san	6
Purple Locoweed	<i>Oxytropis lambertii</i>	P-FORB	late june	mg	6
Silver-leaf Scurf Pea	<i>Pediomelum argophyllum (Psoralea a.)</i>	P-FORB	mid july-aug	tg, mg, san	6
Prairie Turnip	<i>Pediomelum esculentum (Psoralea e.)</i>	P-FORB	early to mid july	tg, mg	7
Lemon Scurf Pea	<i>Psoralidium lanceolatum (Psoralea l.)</i>	P-FORB	mid july	san	4
Slender-flower Scurfpea	<i>Psoralidium tenuiflorum</i> ( <i>Psoralea tenuiflora</i> )	P-FORB	late june	tg, mg	5
Wild Senna	<i>Senna marilandica (Cassia marilandica)</i>	P-FORB	sept	tg, southeastern NE	5
Slick-seed Wild Bean	<i>Strophostyles leiosperma</i>	A-VINE	aug-sept	tg, mg	4
American Vetch	<i>Vicia americana</i>	P-FORB	june-july	tg, mg	6
<b>FAMILY - GENTIANACEAE</b>					
Prairie Gentian	<i>Eustoma grandiflorum</i>	A-FORB	sept	wm, central Platte Valley	4
Bottle Gentian	<i>Gentiana andrewsii</i>	P-FORB	late sept-oct	wm, rare species	9
Downy Gentian	<i>Gentiana puberulenta</i>	P-FORB	mid to late oct	tg, mg	7
<b>FAMILY - HYPOXIDACEAE</b>					
Yellow Star Grass	<i>Hypoxis hirsuta</i>	P-FORB	early june	wm	7
<b>FAMILY - IRIDACEAE</b>					
Prairie Blue-eyed Grass	<i>Sisyrinchium campestre</i>	P-FORB	june	tg, mg	4
Meadow Blue-eyed Grass	<i>Sisyrinchium montanum</i>	P-FORB	june	wm	5

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<b>FAMILY - JUNCACEAE</b>					
Baltic Rush	<i>Juncus arcticus</i> ( <i>J. balticus</i> )	P-FORB	june	wm, capsules lose seed soon after ripening	6
Short-leaf Rush	<i>Juncus brachyphyllus</i>	P-FORB	mid to late june	san	6
Toad Rush	<i>Juncus bufonius</i>	A-FORB	mid june	mar, prefers sandy flats	4
Dudley's Rush	<i>Juncus dudleyi</i>	P-FORB	june	wm, rbwm	5
Inland Rush	<i>Juncus interior</i>	P-FORB	mid june	tg, mg, wm	4
Path Rush	<i>Juncus tenuis</i>	P-FORB	late june	wm	2
Torrey's Rush	<i>Juncus torreyi</i>	P-FORB	late june-early aug	wm	4
<b>FAMILY - JUNCAGINACEAE</b>					
Alkali Arrowgrass	<i>Triglochin maritima</i>	P-FORB	mid june	wm, alkaline soils	5
<b>FAMILY - LAMIACEAE</b>					
Rough False-pennyroyal	<i>Hedeoma hispida</i>	A-FORB	july	tg, mg, san	1
Common Water Horehound	<i>Lycopus americanus</i>	P-FORB	late july-mid sept	wm, mar	4
Western Water Horehound	<i>Lycopus asper</i>	P-FORB	sept	wm, mar	5
Field Mint	<i>Mentha arvensis</i>	P-FORB	aug-oct	wm	4
Wild Bergamot	<i>Monarda fistulosa</i>	P-FORB	mid aug-sept	tg, mg	3
Obedient Plant	<i>Physostegia virginiana</i>	P-FORB	late aug-sept	wm	7
Self-heal	<i>Prunella vulgaris</i>	P-FORB	late june-mid july	wm	4
Virginia Mountain-mint	<i>Pycnanthemum virginianum</i>	P-FORB	mid aug-sept	wm	6
Pitcher's Sage	<i>Salvia azurea</i>	P-FORB	aug-oct	tg, southeast NE	6
Marsh Skullcap	<i>Scutellaria galericulata</i>	P-FORB	late aug-sept	wm, mar	6
Mad-dog Skullcap	<i>Scutellaria lateriflora</i>	P-FORB	late aug-sept	mar	5
Small Skullcap	<i>Scutellaria parvula</i>	P-FORB	early july-sept	tg, wm	6
Common Hedge Nettle	<i>Stachys pilosa</i> ( <i>S. palustris</i> )	P-FORB	early aug-sept	wm, mar	5
American Germander	<i>Teucrium canadense</i>	P-FORB	mid aug-mid sept	tg, wm, rbwm	4
<b>FAMILY - LILIACEAE</b>					
Prairie Dog-toothed Violet	<i>Erythronium mesochoreum</i>	P-FORB	mid to late may	tg, wm, southeastern NE	6
<b>FAMILY - LINACEAE</b>					
Grooved Yellow Flax	<i>Linum sulcatum</i>	A-FORB	late june	mg, san	6
<b>FAMILY - LYTHRACEAE</b>					
Intermediate Toothcup	<i>Ammannia coccinea</i>	A-FORB	early sept	mar, rbmar	4
Winged Loosestrife	<i>Lythrum alatum</i>	P-FORB	sept	wm	6
<b>FAMILY - MALVACEAE</b>					
Pale Poppy Mallow	<i>Callirhoe alcaeoides</i>	P-FORB	july	tg, mg, san	5
Purple Poppy Mallow	<i>Callirhoe involucrata</i>	P-FORB	july-aug	tg, mg, san	2
Halberd-leaved Rose Mallow	<i>Hibiscus laevis</i>	P-FORB	aug-sept	mar	4
Scarlet Globe-mallow	<i>Sphaeralcea coccinea</i>	P-FORB	june-aug	mg	4
<b>FAMILY - MYRSINACEAE</b>					
Fringed Yellow-loosestrife	<i>Lysimachia ciliata</i>	P-FORB	sept-oct	tg, wm	5
Tufted Yellow-loosestrife	<i>Lysimachia thyrsiflora</i>	P-FORB	july-early aug	wm, mar	7

## APPENDIX B - PLANT LIST

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>FAMILY - NYCTAGINACEAE</b>					
Pale Four-o'clock	<i>Mirabilis albida</i> (including <i>M. hirsuta</i> )	P-FORB	mid july-aug	san	5
Narrow-leaf Four-o'clock	<i>Mirabilis linearis</i>	P-FORB	mid july-aug	tg, mg, san	4
Wild Four-o'clock	<i>Mirabilis nyctaginea</i>	P-FORB	sept	tg, mg, san	1
<b>FAMILY - ONAGRACEAE</b>					
Plains Yellow-primrose	<i>Calylophus serrulatus</i>	P-FORB	july-early aug	tg,mg, san	5
Cinnamon Willow Herb	<i>Epilobium coloratum</i>	P-FORB	mid sept	wm, rbwm, mar, rbmar	5
Fen Willow Herb	<i>Epilobium leptophyllum</i>	P-FORB	late aug-sept	mar	7
Scarlet Gaura	<i>Gaura coccinea</i>	P-FORB	july-aug	mg	4
Long-flower Butterfly Plant	<i>Gaura longiflora</i>	B-FORB	mid sept	tg, southeastern NE	3
Small-flowered Gaura	<i>Gaura mollis</i> ( <i>G. parviflora</i> )	A-FORB	aug-sept	tg, wm	1
Water Purslane	<i>Ludwigia palustris</i>	P-FORB	mid sept	mar	5
Cutleaf Evening-primrose	<i>Oenothera lacianata</i>	A-FORB	sept	san	1
Pale Evening-primrose	<i>Oenothera latifolia</i>	P-FORB	aug-sept	san	4
Fourpoint Evening-primrose	<i>Oenothera rhombipetala</i>	B-FORB	mid aug-oct	san	2
Common Evening Primrose	<i>Oenothera villosa</i>	B-FORB	early sept	tg, mg	1
<b>FAMILY - ORCHIDACEAE</b>					
Nodding Ladies'-tresses	<i>Spiranthes cernua</i>	P-FORB	oct	tg, wm	6
Early Ladies'-tresses	<i>Spiranthes vernalis</i>	P-FORB	oct	tg	8
<b>FAMILY - OXALIDACEAE</b>					
Upright Yellow Wood Sorrel	<i>Oxalis stricta</i> ( <i>O. dilleni</i> )	P-FORB	early june	tg, mg, capsules explode	0
Violet Wood Sorrel	<i>Oxalis violacea</i>	P-FORB	early june	tg, mg, capsules explode	5
<b>FAMILY - PLANTAGINACEAE</b>					
Woolly Plantain	<i>Plantago patagonica</i>	A-FORB	late june-july	mg, san	1
<b>FAMILY - POACEAE</b>					
Ticklegrass	<i>Agrostis hyemalis</i>	P-GRASS	mid may-june	rbwm	4
Short-awn Meadow-foxtail	<i>Alopecurus aequalis</i>	P-GRASS	june	wm, rbwm, mar, rbmar	6
Big Bluestem	<i>Andropogon gerardii</i>	P-GRASS	mid sept-oct	tg, mg, wm	5
Sand Bluestem	<i>Andropogon hallii</i>	P-GRASS	mid sept-oct	san	5
Prairie Three-awn	<i>Aristida oligantha</i>	A-GRASS	sept	tg	2
Purple Three-awn	<i>Aristida purpurea</i>	P-GRASS	sept	mg, san	5
Side-oats Grama	<i>Bouteloua curtipendula</i>	P-GRASS	mid aug-sept	tg, mg, san	5
Blue Grama	<i>Bouteloua gracilis</i>	P-GRASS	sept-oct	tg, mg, san	4
Hairy Grama	<i>Bouteloua hirsuta</i>	P-GRASS	sept-oct	san	6
Blue Joint	<i>Calamagrostis canadensis</i>	P-GRASS	july	wm	6
Northern Reedgrass	<i>Calamagrostis stricta</i>	P-GRASS	mid june-mid july	wm	6
Prairie Sand Reed	<i>Calamovilfa longifolia</i>	P-GRASS	sept-oct	san	5
Inland Saltgrass	<i>Distichlis spicata</i> var. <i>stricta</i>	P-GRASS	early july	sawet	2
Canada Wildrye	<i>Elymus canadensis</i>	P-GRASS	early sept-oct	tg, wm	5
Western Wheatgrass	<i>Elymus smithii</i> ( <i>Agropyron s.</i> )	P-GRASS	mid july-sept	tg, mg, wm, rbwm, sawet	3
Slender Wheatgrass	<i>Elymus trachycaulus</i> ( <i>Agropyron caninum</i> )	P-GRASS	early to mid july	wm	7
Virginia Wildrye	<i>Elymus virginicus</i>	P-GRASS	early sept-oct	wm, rbwm	4
Purple Lovegrass	<i>Eragrostis spectabilis</i>	P-GRASS	late aug-sept	tg, mg, san	3
Sand Lovegrass	<i>Eragrostis trichodes</i>	P-GRASS	late sept-oct	san	5
Six-weeks Fescue	<i>Festuca octoflora</i>	A-GRASS	mid june	mg, san	3
Tall Manna Grass	<i>Glyceria grandis</i>	P-GRASS	late june-early july	wm, mar	7

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<b>POACEAE - CONTINUED</b>					
Fowl Manna Grass	<i>Glyceria striata</i>	P-GRASS	early june	wm, mar	5
Needle-and-thread	<i>Hesperostipa comata (Stipa c.)</i>	P-GRASS	mid june	mg, san, cut awns soon	6
Porcupine Grass	<i>Hesperostipa spartea (Stipa s.)</i>	P-GRASS	mid june	tg, mg, san, cut awns soon	6
Foxtail Barley	<i>Hordeum jubatum</i>	P-GRASS	early july	wm, rbwm, sawet	1
Junegrass	<i>Koeleria macrantha (K. pyramidata)</i>	P-GRASS	late june-aug	tg, mg, san	6
Rice Cutgrass	<i>Leersia oryzoides</i>	P-GRASS	mid sept	wm, rbwm, mar, rbmar	4
Plains Muhly	<i>Muhlenbergia cuspidata</i>	P-GRASS	aug-sept	tg, mg, drier tallgrass sites	5
Sand Muhly	<i>Muhlenbergia pungens</i>	P-GRASS	aug-sept	san	6
Marsh Muhly	<i>Muhlenbergia racemosa</i>	P-GRASS	sept	tg, mg	4
Green Needlegrass	<i>Nassella viridula (Stipa v.)</i>	P-GRASS	mid june	tg, mg, northern NE	4
Tapered Spring Panicum	<i>Panicum acuminatum</i>	P-GRASS	june	wm	6
Slim-leaf Spring Panicum	<i>Panicum linearifolium (Dichanthelium l.)</i>	P-GRASS	june	tg	7
Scribner's Spring Panicum	<i>Panicum oligosanthes</i>	P-GRASS	mid june	tg, mg, san	4
Switchgrass	<i>Panicum virgatum</i>	P-GRASS	mid to late sept	tg, mg, san, wm, rbwm	4
Slender Paspalum	<i>Paspalum setaceum</i>	A-GRASS	early july-mid aug	san	2
Plains Bluegrass	<i>Poa arida</i>	P-GRASS	early july	rbwm, sawet	6
Little Bluestem	<i>Schizachyrium scoparium</i>	P-GRASS	late sept	tg, mg, san, wm	4
Indiangrass	<i>Sorghastrum nutans</i>	P-GRASS	mid sept-late sept	tg, mg, wm	5
Prairie Cordgrass	<i>Spartina pectinata</i>	P-GRASS	sept-oct	wm, rbwm, sawet	5
Prairie Wedgegrass	<i>Sphenopholis obtusata</i>	P-GRASS	late june-early july	tg, wm	5
Tall Dropseed	<i>Sporobolus compositus (S. asper)</i>	P-GRASS	mid sept-oct	tg, mg, san	3
Sand Dropseed	<i>Sporobolus cryptandrus</i>	P-GRASS	late aug-sept	san	2
Prairie Dropseed	<i>Sporobolus heterolepis</i>	P-GRASS	mid sept	tg	7
False Redtop	<i>Tridens flavus</i>	P-GRASS	mid sept-oct	tg, wm, southeastern NE	1
Eastern Gammagrass	<i>Tripsacum dactyloides</i>	P-GRASS	mid july	tg, wm, far southeastern NE	7
<b>FAMILY - POLEMONIACEAE</b>					
Prairie Phlox	<i>Phlox pilosa ssp. <i>fulgida</i></i>	P-FORB	early july	tg	8
<b>FAMILY - POLYGALACEAE</b>					
Pink Milkwort	<i>Polygala sanguinea</i>	A-FORB	aug-sept	wm, sandy soils	6
White Milkwort	<i>Polyglala alba</i>	P-FORB	july-aug	mg	5
<b>FAMILY - POLYGONACEAE</b>					
Annual Wild Buckwheat	<i>Eriogonum annuum</i>	B-FORB	mid sept-oct	san	3
Swamp Smartweed	<i>Polygonum coccineum</i>	P-FORB	july-sept	mar, rbmar, in seed bank	3
Mild Water Pepper	<i>Polygonum hydropiperoides</i>	P-FORB	july-sept	mar, rbmar, in seed bank	4
Nodding Smartweed	<i>Polygonum lapathifolium</i>	A-FORB	july-sept	mar, rbmar, in seed bank	2
Dotted Smartweed	<i>Polygonum punctatum</i>	P-FORB	july-sept	mar, rbmar, in seed bank	4
Wild Begonia	<i>Rumex venosus</i>	P-FORB	early to mid june	san	4
<b>FAMILY - PORTULACACEAE</b>					
Prairie Fameflower	<i>Talinum parviflorum</i>	P-FORB	late june-early july	san	5
Sandhills Fameflower	<i>Talinum rugospermum</i>	P-FORB	late june-early july	san	7
<b>FAMILY - PRIMULACEAE</b>					
Western Rock Jasmine	<i>Androsace occidentalis</i>	A-FORB	june	tg, mg, san, likely to establish on its own	1
<b>FAMILY - RANUNCULACEAE</b>					

## APPENDIX B - PLANT LIST

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>RANUNCULACEAE - CONTINUED</b>					
Meadow Anemone	<i>Anemone canadensis</i>	P-FORB	mid july	tg, wm	4
Carolina Anemone	<i>Anemone caroliniana</i>	P-FORB	may	tg, mg, san	7
Candle Anemone	<i>Anemone cylindrica</i>	P-FORB	mid july-mid aug	tg, mg, san	4
Pascue flower	<i>Anemone patens</i>	P-FORB	may	tg, mg, northern NE	6
Prairie Larkspur	<i>Delphinium carolinianum (D. virescens)</i>	P-FORB	late june-early july	tg, mg, san	6
Longbeak White Crow's-foot	<i>Ranunculus longirostris</i>	P-FORB	june-aug	mar	6
Pennslyvania Buttercup	<i>Ranunculus pensylvanicus</i>	A-FORB	july-aug	wm, mar	6
Purple Meadow Rue	<i>Thalictrum dasycarpum</i>	P-FORB	mid july-mid aug	tg, wm	4
<b>FAMILY - RHAMNACEAE</b>					
Broadleaf New Jersey Tea	<i>Ceanothus americanus</i>	SHRUB	late july-early aug	tg	6
Redroot New Jersey Tea	<i>Ceanothus herbaceus</i>	SHRUB	mid june-early july	tg, mg, san	6
<b>FAMILY - ROSACEAE</b>					
Swamp Agrimony	<i>Agrimonia parviflora</i>	P-FORB	mid-late sept	wm	5
Woodland Agrimony	<i>Agrimonia striata</i>	P-FORB	mid aug	wm	6
Yellow Avens	<i>Geum aleppicum</i>	P-FORB	sept	wm	6
White Avens	<i>Geum canadense</i>	P-FORB	mid aug-oct	tg, wm	3
Spring Avens	<i>Geum vernum</i>	P-FORB	mid aug-oct	wm	5
Prairie Cinquefoil	<i>Potentilla arguta</i>	P-FORB	mid july	tg, mg, san, wm	6
Norwegian Cinquefoil	<i>Potentilla norvegica</i>	P-FORB	late june-july	wm, rbwm	2
Sand Cherry	<i>Prunus pumila</i>	SHRUB	early july	san	6
Dwarf Prairie Rose	<i>Rosa arkansana</i>	SHRUB	aug-nov	tg, mg, san	4
Western Wild Rose	<i>Rosa woodsii</i>	SHRUB	aug-sept	tg, wm, woodland edge	4
<b>FAMILY - RUBIACEAE</b>					
Buttonbush	<i>Cephalanthus occidentalis</i>	SHRUB	sept-oct	wm, mar, far southeastern NE	7
Bluntleaf Bedstraw	<i>Galium obtusum</i>	P-FORB	late july	wm	6
<b>FAMILY - SANTALACEAE</b>					
Bastard Toadflax	<i>Comandra umbellata</i>	P-FORB	early june	tg, mg, san	6
<b>FAMILY - SCROPHULARIACEAE</b>					
Rough False Foxglove	<i>Agalinis aspera</i>	A-FORB	early sept	tg, mg	10
Slender False Foxglove	<i>Agalinis tenuifolia</i>	A-FORB	early sept	wm, mar	5
Mullein Foxglove	<i>Dasistoma macrophylla</i>	A-FORB	aug-sept	tg, southeastern woody edge	6
Round-leaf Monkey Flower	<i>Mimulus glaberrimus</i>	P-FORB	aug-sept	mar, mudflats and seeps	7
Alleghany Monkey Flower	<i>Mimulus ringens</i>	P-FORB	sept	mar	6
White Beardtongue	<i>Penstemon albidus</i>	P-FORB	mid aug	mg, san	6
Narrow Beardtongue	<i>Penstemon angustifolius</i>	P-FORB	mid aug	san	5
Foxglove Penstemon	<i>Penstemon digitalis</i>	P-FORB	mid aug-sept	tg, wm	6
Slender Beardtongue	<i>Penstemon gracilis</i>	P-FORB	late july-aug	tg, mg, san	6
Shell-leaf Penstemon	<i>Penstemon grandiflorus</i>	P-FORB	late july-aug	tg, mg, san	5
Culver's Root	<i>Veronicastrum virginicum</i>	P-FORB	late aug	tg, wm, far eastern NE	9
<b>FAMILY - SOLANACEAE</b>					
Clammy Ground Cherry	<i>Physalis heterophylla</i>	P-FORB	late aug-sept	san	4
Virginia Ground Cherry	<i>Physalis virginiana</i>	P-FORB	sept-oct	tg, mg	6
Carolina Horse-nettle	<i>Solanum carolinense</i>	P-FORB	oct	tg, mg	2

COMMON NAME	SPECIES	PLANT TYPE	COLLECTION DATE	HABITATS	C
<b>FAMILY - SPARGANIACEAE</b>					
Large-fruit Bur-reed	<i>Sparganium eurycarpum</i>	P-FORB	aug	mar, rbmar	5
<b>FAMILY - URTICACEAE</b>					
False Nettle	<i>Boehmeria cylindrica</i>	P-FORB	late sept	wm, mar	6
<b>FAMILY - VERBENACEAE</b>					
Wedgeleaf fog-fruit	<i>Phyla cuneifolia (Lippia cuneifolia)</i>	P-FORB	mid sept	rbwm, rbmar	4
Northern fog-fruit	<i>Phyla lanceolata (Lippia lanceolata)</i>	P-FORB	mid sept	wm, mar	3
Blue Vervain	<i>Verbena hastata</i>	P-FORB	late sept	wm, mar	4
Hoary Vervain	<i>Verbena stricta</i>	P-FORB	later aug-sept	tg, mg, san	2
White Vervain	<i>Verbena urticifolia</i>	P-FORB	mid sept	tg, wm	3
<b>FAMILY - VIOLACEAE</b>					
Prairie Violet	<i>Viola pedatifida</i>	P-FORB	mid june-aug	tg, mg	6
Blue Meadow Violet	<i>Viola pratincola</i>	P-FORB	mid june-aug	wm	1

# Prairie Plains Resource Institute's Four Major Projects:

1

## Prairie Restoration

PPRI has been a pioneer of high-diversity prairie and wetland restoration since 1980. Restorations harbor both an abundance and diversity of plant and animal life, and are also a sustainable agricultural resource.

2

## Prairie Preserves

PPRI presently owns seven prairie preserves, totaling more than 5200 acres, a solid foundation on which to build an ever-expanding "network of campuses."

3

## Education/



## SOAR

All PPRI preserves and many of its restoration projects are educational sites suitable for lifelong learning.

**SOAR** - The program which best exemplifies PPRI's educational efforts is SOAR (Summer Orientation About Rivers), an annual nature day camp for elementary school children.

**Science and resource stewardship** - PPRI sites offer educational and work opportunities in many aspects of natural resource management.

4

## Platte River Corridor Initiative

The goal of the Platte River Corridor Initiative is to establish a conservation process founded on public participation and local initiative. Its aims include:

- ◆ Restoring and protecting the Platte River's native prairies.
- ◆ Educating citizens about the Platte's ecosystem.
- ◆ Planning with local working groups; assisting people in defining and solving their natural resource issues.

Contribute to the mission of Prairie Plains Resource Institute by becoming a member. Members receive the *Prairie Plains Quarterly* and gain opportunities to participate in unique educational, recreational and volunteer activities in diverse Nebraska landscapes. PPRI is a 501(c)(3) organization. Contributions are tax-deductible to the extent allowed by law.

### Membership Categories:

\$25 Individual

\$35 Family

\$50-99 Supporting

\$100-499 Contributing

\$500-999 Patron

\$1000+ Benefactor

