

Harold W. Gardner



# Tallgrass Prairie Restoration in the Midwestern and Eastern United States

A Hands-On Guide

Extra  
Materials  
extras.springer.com

 Springer

# Tallgrass Prairie Restoration in the Midwestern and Eastern United States



Harold W. Gardner

# Tallgrass Prairie Restoration in the Midwestern and Eastern United States

A Hands-On Guide



Springer

Harold W. Gardner  
440 Mount Zion Road  
Carlisle, PA 17015  
USA  
hrldgrdnr4@aol.com

Please note that additional material for this book can be downloaded from  
<http://extras.springer.com>

ISBN 978-1-4419-7426-6 e-ISBN 978-1-4419-7427-3  
DOI 10.1007/978-1-4419-7427-3  
Springer New York Dordrecht Heidelberg London

© Springer Science+Business Media, LLC 2011

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher (Springer Science+Business Media, LLC, 233 Spring Street, New York, NY 10013, USA), except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden.

The use in this publication of trade names, trademarks, service marks, and similar terms, even if they are not identified as such, is not to be taken as an expression of opinion as to whether or not they are subject to proprietary rights.

Printed on acid-free paper

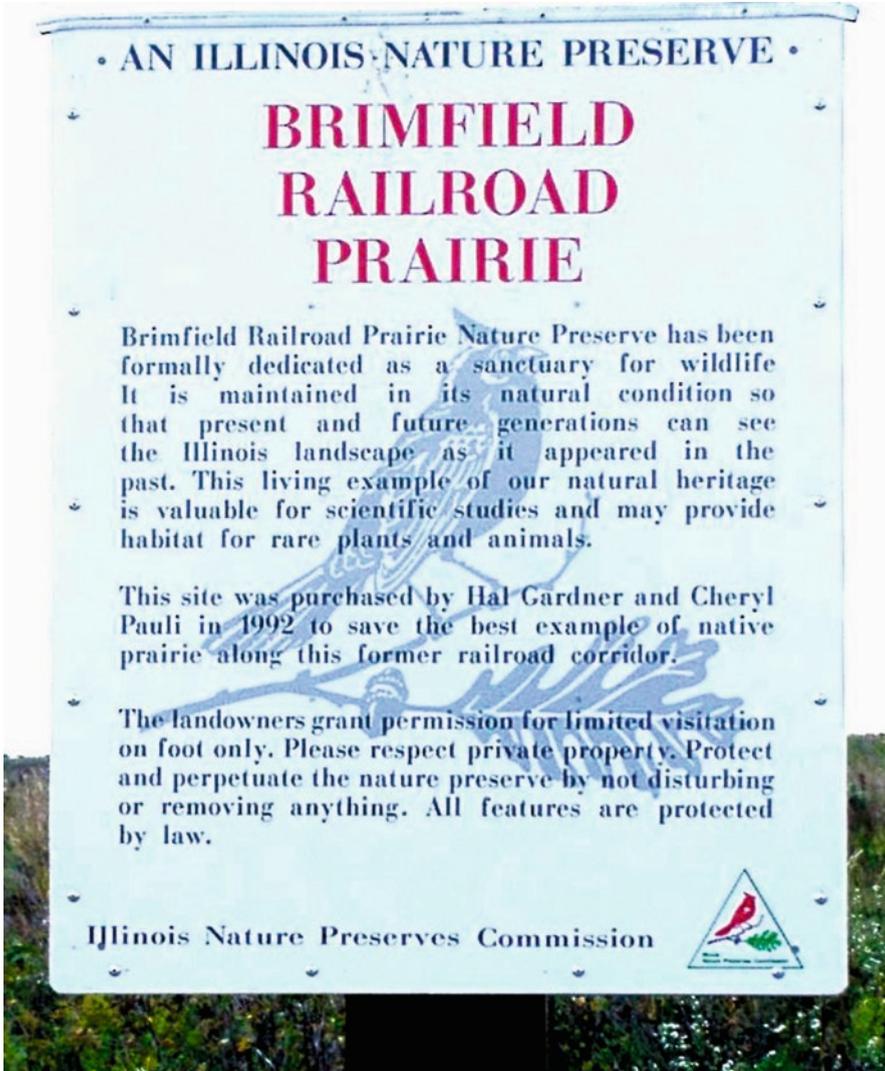
Springer is part of Springer Science+Business Media ([www.springer.com](http://www.springer.com))

# Preface

In the early 1970s Irene Cull, a botanist trained at the University of Wisconsin, introduced me to some of the few remaining prairies in the area of Peoria, Illinois. These incredible prairies were reminiscent of increasingly rare native plant communities found in remote areas from Hawaii to the East coast. Whenever native plant communities are encountered, one can intuitively sense the authenticity by their inherent beauty and highly organized ecology. Unfortunately, ecological fragmentation occurs in the more populated regions over the United States. These areas are continually invaded with a myriad of weedy Eurasian plant introductions, even on preserved public land.

Irene Cull persuaded the management of the USDA lab in Peoria to landscape a portion of the laboratory property as native prairie. This project taught many lessons on prairie restoration, ranging in degrees of difficulty. Then, in the mid-1970s I extended Irene's tutelage to the restoration of degraded prairies in Jubilee State Park with the help of Sierra Club. About the same time row crops were started for seed production, both in the park and on private land. The row-crop project was the tool for eventually restoring 40+ acres of high-quality diverse prairie in the park and on private land. By the early 1980s a team of about 20 volunteers called "The Prairie Dawgs" was organized to focus on prairie restoration in the park. Controlled burn equipment and brush-cutting tools were purchased from proceeds of a prairie conference and grants from The Nature Conservancy, Sierra Club, and Illinois Department of Conservation. A regular burn schedule immensely improved the condition of about 250 acres of degraded prairies. As an added bonus, we began to realize that the burned forest areas showed a decrease in brush. Also, there was a loss of the lowest portion of the canopy, giving the feeling of an open or managed forest.

By the early 1990s a half-mile of Burlington Northern Railroad right-of-way near Brimfield, Illinois, became available for purchase. This remnant prairie had many excellent stands of prairie, but was degraded in the sense that it lacked diversity and contained alien species, particularly woody brush/trees, wild parsnip, and white sweet clover. After my wife and I purchased the right-of-way, aggressive tree and brush cutting was ongoing for several years. Persistent weeding virtually eliminated the parsnip within about 5 years, but white sweet clover remains a problem in small areas. To increase diversity, locally gathered seeds were scattered by hand.



*Brimfield Railroad Nature Preserve*

*Photo: Douglas Franks*

It became evident that success in restoration by over-seeding an established perennial eco-system was more difficult than starting with weed-free tilled soil. Annual seeding coupled with time resulted in a dramatic increase in diversity to the extent that the property was designated an official Illinois Nature Preserve by the State of Illinois in 2002.

Several years ago, the USDA Natural Resources Conservation Service contracted with the author to restore 15+ acres as prairie in their Wildlife Habitat

Incentives Program (WHIP). The author continues to restore prairie areas on his farm in south central Pennsylvania where he maintains beds for seed production of about 150 species.

Also, the USDA NRCS sponsors a number of soil conservation initiatives (see Section 9). These USDA initiatives have resulted in a large nationwide increase in acreage put aside as grassland, both in the East and Midwest. On the downside, the USDA permits the use of Eurasian grasses as well.

Unfortunately, the public is under-educated about native plants. Even so-called garden experts consider the likes of Queen Anne's lace and dames rocket to be native wildflowers. Several years ago I was uprooting parsnip in the Rock Island Trail Nature Preserve. A hiker asked what I was doing. "Pulling weeds," I replied. He returned, "they are all weeds." The hiker seemed semi-satisfied only after I explained that I wasn't pulling "American weeds." The goal of this volume is to provide a comprehensive guide to all aspects of prairie restoration wherever conditions are favorable to restore these beautiful sun-loving native plants. Open fields in a large region from the East to the Midwest are very suitable for restoration.

Carlisle PA, USA

Harold W. Gardner



## Acknowledgments

Special thanks are accorded to Doug Franks, and Dr. Mark A. Berhow, both of Peoria, Illinois, for photos and scanning of prairie samples. Thanks are also due to Debra Grim for use of her photograph, and to Dr. Doug Doehlert of North Dakota State University for helpful comments. The author gratefully acknowledges the personnel of Jennings Prairie in Pennsylvania for their assistance. Thanks are also due to my former professor, Dr. Norman Deno, who taught me Mechanisms of Organic Chemistry at Penn State more than 40 years ago. Recently, Dr. Deno has once again served as a mentor by giving me access to his extensive seed germination studies. Thanks to my wife, Cheryl Pauli, and my son, Bryce Gardner, for tolerating my prairie obsession for many years.



# Contents

## Part I Introduction

<b>1 Introduction to the Prairie</b> .....	3
1.1 Why Prairie? .....	3
1.2 Prairie Origins .....	6
1.3 Ecosystem Diversity.....	7
1.4 Prairies Attract Wildlife .....	12

## Part II Native Prairie Species

<b>2 Mesic Soil and Adaptive Species</b> .....	17
2.1 * <i>Allium canadense</i> v. <i>canadense</i> (Liliaceae Family), Wild or Meadow Garlic.....	17
2.2 * <i>Allium cernuum</i> v. <i>cernuum</i> (Liliaceae Family), Nodding Wild Onion.....	18
2.3 <i>Allium stellatum</i> (Liliaceae Family), Prairie Onion .....	18
2.4 <i>Amorpha canescens</i> (Fabaceae Family), Lead Plant .....	19
2.5 * <i>Amsonia tabernaemontana</i> v. <i>salicifolia</i> (Apocynaceae Family), Amsonia or Blue Dogbane .....	20
2.6 * <i>Andropogon gerardii</i> (Poaceae Family), Big Bluestem Grass .....	20
2.7 <i>Andropogon scoparius</i> see <i>Schizachyrium scoparium</i> .....	21
2.8 * <i>Anemone canadensis</i> (Ranunculaceae Family), Canada Anemone .....	21
2.9 * <i>Anemone virginiana</i> v. <i>virginiana</i> (Ranunculaceae Family), Tall Anemone or Thimbleweed.....	22
2.10 * <i>Apocynum cannabinum</i> , <i>Apocynum sibiricum</i> (Apocynaceae Family), Indian Hemp or Dogbane .....	23
2.11 * <i>Arnoglossum atriplicifolium</i> , <i>Cacalia atriplicifolia</i> (Asteraceae Family), Pale Indian Plantain .....	23
2.12 * <i>Arnoglossum plantagineum</i> , <i>Cacalia plantaginea/tuberosa</i> (Asteraceae Family), Prairie Indian Plantain .....	24
2.13 * <i>Asclepias purpurascens</i> (Asclepiadaceae Family), Purple Milkweed .....	24

2.14 *Asclepias sullivantii* (Asclepiadaceae Family),  
Sullivant’s or Prairie Milkweed ..... 25

2.15 \**Asclepias verticillata* (Asclepiadaceae Family),  
Horsetail or Whorled Milkweed ..... 26

2.16 *Aster* see *Symphytotrichum* ..... 26

2.17 \**Astragalus canadensis v. canadensis* (Fabaceae Family),  
Canadian Milk Vetch..... 26

2.18 *Aureolaria grandiflora v. pulchra, Gerardia grandiflora*  
(Scrophulariaceae Family), False Foxglove..... 27

2.19 \**Baptisia alba v. macrophylla, Baptisia leucantha/lactea*  
(Fabaceae Family), White Wild Indigo..... 27

2.20 \**Baptisia australis v. australis* (Fabaceae Family),  
Blue Wild Indigo..... 28

2.21 \**Baptisia bracteata v. leucophaea, Baptisia leucophaea*  
(Fabaceae Family), Cream Wild Indigo..... 28

2.22 \**Brickellia eupatorioides v. eupatorioides,*  
*Kuhnia eupatorioides* (Asteraceae Family), False Boneset ..... 29

2.23 *Cacallia* see *Arnoglossum*..... 30

2.24 \**Camassia scilloides* (Liliaceae Family), Wild Hyacinth..... 30

2.25 \**Carex brevior* (Cyperaceae Family), Plains Oval Sedge..... 30

2.26 \**Carex davisii* (Cyperaceae Family), Davis’s Sedge  
or Awned Graceful Sedge ..... 31

2.27 \**Carex gravida v. lunelliana* (Cyperaceae Family),  
Heavy Sedge or Long-Awned Bracted Sedge..... 31

2.28 \**Carex shortiana* (Cyperaceae Family), Short’s Sedge ..... 32

2.29 \**Carex vulpinoidea v. vulpinoidea* (Cyperaceae Family),  
Fox Sedge..... 32

2.30 *Cassia* see *Chamaecrista* and *Senna*..... 33

2.31 \**Castilleja coccinea* (Scrophulariaceae Family),  
Indian Paintbrush ..... 33

2.32 \**Ceanothus americanus* (Rhamnaceae Family),  
New Jersey Tea ..... 34

2.33 \**Chamaecrista fasciculata v. fasciculata, Cassia fasciculata*  
(Fabaceae Family), Partridge Pea ..... 35

2.34 \**Cirsium discolor* (Asteraceae Family),  
Field or Pasture Thistle ..... 35

2.35 \**Comandra umbellata ssp. umbellata,*  
*Comandra richardsiana* (Santalaceae Family),  
Bastard or False Toadflax..... 36

2.36 *Coreopsis palmata* (Asteraceae Family), Prairie Coreopsis ..... 36

2.37 \**Coreopsis tripteris* (Asteraceae Family), Tall Coreopsis ..... 37

2.38 *Dalea candida v. candida, Petalostemum candidum*  
(Fabaceae Family), White Prairie Clover..... 37

2.39 *Dalea foliosa, Petalostemum foliosa/foliosum*  
(Fabaceae Family), Leafy Prairie Clover ..... 38

2.40 \**Dalea purpurea* v. *purpurea*, *Petalostemum purpureum*  
(Fabaceae Family), Purple Prairie Clover ..... 39

2.41 \**Desmanthus illinoensis* (Fabaceae Family),  
Illinois Bundleflower or Prairie Mimosa ..... 40

2.42 \**Desmodium canadense* (Fabaceae Family),  
Showy Tick Trefoil ..... 40

2.43 \**Dichanthelium oligosanthes* v. *scribnerianum*,  
*Panicum oligosanthes* v. *scribnerianum* (Poaceae Family),  
Scribner’s Panic Grass ..... 41

2.44 \**Dodecatheon meadia* ssp. *meadia* (Primulaceae Family),  
Shooting Star..... 42

2.45 \**Echinacea pallida* (Asteraceae Family),  
Pale Purple Coneflower..... 43

2.46 \**Echinacea purpurea* (Asteraceae Family),  
Purple Coneflower ..... 44

2.47 \**Elymus canadensis* (Poaceae Family), Canada Wild Rye..... 45

2.48 \**Elymus villosus* (Poaceae Family), Silky Wild Rye..... 45

2.49 \**Elymus virginicus* v. *virginicus* (Poaceae Family),  
Virginia Wild Rye ..... 45

2.50 \**Eryngium yuccifolium* v. *yuccifolium* (Apiaceae Family),  
Rattlesnake Master..... 46

2.51 \**Eupatorium altissimum* (Asteraceae Family), Tall Boneset..... 46

2.52 \**Eupatorium purpureum* v. *purpureum*  
(Asteraceae Family), Sweet Joe Pye Weed ..... 47

2.53 \**Euphorbia corollata* (Euphorbiaceae Family),  
Flowering Spurge ..... 48

2.54 \**Euthamia graminifolia* v. *graminifolia*, *Solidago*  
*graminifolia* (Asteraceae Family) Grass-Leaved Goldenrod..... 48

2.55 \**Fragaria virginiana* (Rosaceae Family), Virginia Strawberry ..... 49

2.56 \**Gaura biennis* (Onagraceae Family),  
Gaura or Butterfly Weed ..... 49

2.57 \**Gentiana alba*, *Gentiana flavida* (Gentianaceae Family),  
Cream Gentian ..... 50

2.58 \**Gentiana puberulenta*, *Gentiana puberula*  
(Gentianaceae Family), Prairie or Downy Gentian..... 51

2.59 \**Geum triflorum* v. *triflorum* (Rosaceae Family),  
Prairie Smoke or Prairie Avens ..... 52

2.60 \**Helianthus grosseserratus* (Asteraceae Family),  
Sawtooth Sunflower..... 53

2.61 \**Helianthus maximiliani* (Asteraceae Family),  
Maximillian’s Sunflower..... 53

2.62 \**Helianthus mollis* (Asteraceae Family), Hairy Sunflower ..... 54

2.63 *Helianthus occidentalis* ssp. *occidentalis*  
(Asteraceae Family), Western Sunflower..... 54

2.64 \**Helianthus pauciflorus* ssp. *pauciflorus*,  
*Helianthus rigidus* (Asteraceae Family), Stiff Sunflower..... 55

2.65 \**Helianthus tuberosus* (Asteraceae Family),  
Jerusalem Artichoke..... 55

2.66 \**Heliopsis helianthoides* (Asteraceae Family),  
False Sunflower or Ox-Eye..... 56

2.67 *Heuchera richardsonii* (Saxifragaceae Family),  
Prairie Alumroot ..... 56

2.68 \**Hypericum punctatum* (Clusiaceae Family),  
Dotted St. John’s-Wort..... 57

2.69 \**Hypoxis hirsuta* (Liliaceae Family), Yellow Star Grass..... 57

2.70 \**Iliamna rivularis* v. *rivularis*, *Iliamna remota*,  
and *I. corei* (Malvaceae Family), Streambank Globemallow  
or Kankakee Mallow ..... 58

2.71 \**Juncus tenuis* (Juncaceae Family), Path Rush..... 59

2.72 \**Lespedeza capitata* (Fabaceae Family), Prairie Bush Clover ..... 59

2.73 \**Lilium michiganense* (Liliaceae Family), Michigan Lily..... 60

2.74 \**Lithospermum canescens* (Boraginaceae Family),  
Hoary Puccoon..... 61

2.75 \**Lobelia spicata* (Campanulaceae Family), Spiked Lobelia ..... 61

2.76 \**Lysimachia ciliata* (Primulaceae Family), Fringed Loosestrife..... 62

2.77 \**Mirabilis nyctaginea* (Nyctaginaceae Family),  
Wild Four-O’clock ..... 62

2.78 \**Monarda fistulosa* ssp. *fistulosa* (Lamiaceae Family),  
Wild Bergamot ..... 63

2.79 \**Oenothera biennis* (Onagraceae Family), Evening Primrose ..... 63

2.80 \**Oligoneuron rigidum* v. *rigidum*, *Solidago rigida*  
(Asteraceae Family), Rigid Goldenrod ..... 64

2.81 \**Orbexilum onobrychis*, *Psoralea onobrychis*  
(Fabaceae Family), French Grass, Sainfoin, or No Hay ..... 65

2.82 \**Oxalis violacea* (Oxalidaceae Family), Purple Oxalis  
or Violet Wood Sorrel ..... 65

2.83 \**Packera paupercula*, *Senecio pauperculus*  
(Asteraceae Family), Ragwort or Balsam Groundsel ..... 65

2.84 *Panicum oligosanthos* see *Dichanthelium oligosanthos* ..... 66

2.85 \**Panicum virgatum* v. *virgatum* (Poaceae Family),  
Prairie Switchgrass..... 66

2.86 \**Parthenium integrifolium* v. *integrifolium*  
(Asteraceae Family), American Feverfew or Wild Quinine ..... 66

2.87 \**Pedicularis canadensis* ssp. *canadensis*  
(Scrophulariaceae Family), Wood Betony or Lousewort..... 67

2.88 \**Penstemon digitalis* (Scrophulariaceae Family),  
Foxglove Beard-Tongue..... 67

2.89 *Petalostemum* see *Dalea* ..... 68

2.90 \**Phlox pilosa* ssp. *pilosa* (Polemoniaceae Family),  
Downy Phlox..... 68

2.91 \**Physalis heterophylla* v. *heterophylla* (Solanaceae Family),  
Clammy Ground Cherry ..... 69

2.92 *Physostegia parviflora* (Lamiaceae Family),  
Western Obedient Plant..... 69

2.93 \**Physostegia virginiana* ssp. *virginiana* (Lamiaceae Family),  
Obedient Plant..... 70

2.94 \**Polemonium reptans* v. *reptans* (Polemoniaceae Family),  
Jacob’s Ladder ..... 70

2.95 \**Polygala sanguinea* (Polygalaceae Family), Field Milkwort..... 71

2.96 \**Polygonatum biflorum* v. *commutatum*,  
*Polygonatum commutatum/canaliculatum* (Liliaceae Family),  
Great Solomon’s Seal..... 71

2.97 *Polytaenia nuttallii* (Apiaceae Family), Prairie Parsley..... 72

2.98 \**Potentilla arguta* ssp. *arguta* (Rosaceae Family),  
Prairie or Tall Cinquefoil ..... 73

2.99 \**Potentilla simplex* (Rosaceae Family),  
Old-Field Cinquefoil ..... 73

2.100 *Psoralea* see *Orbexilum* and *Psoralidium*..... 74

2.101 \**Pycnanthemum tenuifolium* (Lamiaceae Family),  
Slender Mountain Mint..... 74

2.102 \**Pycnanthemum verticillatum* v. *pilosum*,  
*Pycnanthemum pilosum* (Lamiaceae Family),  
Hairy Mountain Mint ..... 74

2.103 \**Pycnanthemum virginianum* (Lamiaceae Family),  
Virginia or Common Mountain Mint ..... 75

2.104 \**Ratibida pinnata* (Asteraceae Family), Drooping,  
Yellow, Prairie, or Gray-Headed Coneflower ..... 76

2.105 \**Rosa arkansana* v. *suffulta*, *Rosa suffulta/pratincola*  
(Rosaceae Family), Sunshine Rose, Arkansas Rose,  
or Prairie Wild Rose..... 76

2.106 \**Rosa carolina* v. *carolina* (Rosaceae Family), Pasture Rose ..... 77

2.107 \**Rosa setigera* (Rosaceae Family), Prairie Rose  
or Climbing Rose ..... 78

2.108 \**Rosa virginiana* v. *virginiana* (Rosaceae Family),  
Virginia Rose ..... 78

2.109 \**Rudbeckia fulgida* (Asteraceae Family),  
Orange Coneflower..... 79

2.110 \**Rudbeckia hirta* (Asteraceae Family), Black-Eyed Susan..... 79

2.111 \**Rudbeckia subtomentosa* (Asteraceae Family),  
Sweet Black-Eyed Susan or Sweet Coneflower ..... 80

2.112 \**Ruellia humilis* (Acanthaceae Family),  
Wild Petunia or Hairy Ruellia..... 81

2.113 \**Salix humilis* (Salicaceae Family), Prairie Willow..... 81

2.114	* <i>Schizachyrium scoparium</i> v. <i>scoparium</i> , <i>Andropogon scoparius</i> (Poaceae Family), Little Bluestem Grass.....	82
2.115	<i>Senecio</i> see <i>Packera</i> .....	83
2.116	* <i>Senna marilandica</i> , <i>Cassia marilandica</i> (Fabaceae Family), Maryland Senna .....	83
2.117	* <i>Silene regia</i> (Caryophyllaceae Family), Royal Catchfly.....	83
2.118	* <i>Silene stellata</i> (Caryophyllaceae Family), Starry Champion.....	84
2.119	<i>Silphium integrifolium</i> (Asteraceae Family), Rosinweed .....	84
2.120	* <i>Silphium laciniatum</i> v. <i>laciniatum</i> (Asteraceae Family), Compass Plant.....	85
2.121	* <i>Silphium perfoliatum</i> v. <i>perfoliatum</i> (Asteraceae Family), Cup Plant.....	86
2.122	* <i>Silphium terebinthinaceum</i> v. <i>terebinthinaceum</i> (Asteraceae Family), Prairie Dock.....	86
2.123	* <i>Sisyrinchium albidum</i> (Iridaceae Family), White Blue-Eyed Grass.....	87
2.124	* <i>Sisyrinchium angustifolium</i> , <i>Sisyrinchium graminoides</i> (Iridaceae Family), Stout/Pointed Blue-Eyed Grass.....	88
2.125	<i>Solidago</i> also see <i>Oligoneuron</i> and <i>Euthamia</i> .....	88
2.126	* <i>Solidago canadensis</i> (Asteraceae Family), Canada Goldenrod .....	88
2.127	* <i>Solidago graminifolia</i> , see <i>Euthamia</i> .....	89
2.128	* <i>Solidago juncea</i> (Asteraceae Family), Early Goldenrod .....	89
2.129	<i>Solidago rigida</i> see <i>Oligoneuron rigidum</i> .....	90
2.130	* <i>Solidago speciosa</i> (Asteraceae Family), Showy Goldenrod .....	90
2.131	* <i>Sorghastrum nutans</i> (Poaceae Family), Indian Grass .....	90
2.132	* <i>Spiranthes cernua</i> (Orchidaceae Family), Nodding Ladies' Tresses.....	91
2.133	* <i>Sporobolus heterolepis</i> (Poaceae Family), Northern Dropseed.....	91
2.134	<i>Stipa</i> see <i>Hesperostipa</i> .....	92
2.135	* <i>Symphotrichum ericoides</i> v. <i>ericoides</i> , <i>Aster ericoides</i> (Asteraceae Family), Heath Aster.....	92
2.136	* <i>Symphotrichum laeve</i> v. <i>laeve</i> , <i>Aster laevis</i> (Asteraceae Family), Smooth Aster.....	93
2.137	* <i>Symphotrichum novae-angliae</i> , <i>Aster novae-angliae</i> (Asteraceae Family), New England Aster.....	93
2.138	* <i>Symphotrichum oolentangiense</i> v. <i>oolentangiense</i> , <i>Aster azureus</i> (Asteraceae Family), Azure Aster.....	94
2.139	* <i>Symphotrichum pilosum</i> v. <i>pilosum</i> , <i>Aster pilosus</i> (Asteraceae Family), Frost or Hairy Aster.....	94
2.140	* <i>Teucrium canadense</i> v. <i>canadense</i> (Lamiaceae Family), American Germander or Wood Sage .....	95

2.141	<i>*Thalictrum dasycarpum</i> (Ranunculaceae Family), Purple Meadow Rue.....	95
2.142	<i>*Tradescantia ohioensis</i> (Commelinaceae Family), Ohio Spiderwort.....	96
2.143	<i>*Tridens flavus</i> v. <i>flavus</i> , <i>Triodia flava</i> (Poaceae Family), Purpletop Grass.....	96
2.144	<i>*Tripsacum dactyloides</i> (Poaceae Family), Eastern Gama Grass.....	97
2.145	<i>*Vernonia fasciculata</i> ssp. <i>fasciculata</i> (Asteraceae Family), Western or Common Ironweed.....	97
2.146	<i>*Veronicastrum virginicum</i> (Scrophulariaceae Family), Culver’s Root.....	98
2.147	<i>*Viola sororia</i> , <i>*Viola cucullata</i> , or <i>*Viola affinis</i> , <i>Viola papilionacea/pratincola</i> (Violaceae Family), Common Blue Violet.....	98
2.148	<i>Viola pedatifida</i> (Violaceae Family), Prairie Violet.....	99
2.149	<i>*Zizia aptera</i> (Apiaceae Family), Heart-Leaved Golden Alexanders.....	100
2.150	<i>*Zizia aurea</i> (Apiaceae Family), Golden Alexanders.....	100
	Mesic Soil and Adaptive Species (Illustrations).....	102
<b>3</b>	<b>Dry-Mesic to Dry Soil-Preferring Species</b> .....	121
3.1	<i>*Antennaria howellii</i> ssp. <i>neodioica</i> , <i>Antennaria neodioica</i> (Asteraceae Family), Pussetoes or Smaller Cat’s-Foot.....	121
3.2	<i>*Artemisia ludoviciana</i> ssp. <i>ludoviciana</i> (Asteraceae Family), Louisiana Sage or Prairie Sage.....	122
3.3	<i>*Asclepias tuberosa</i> (Asclepiadaceae Family), Butterfly Weed.....	122
3.4	<i>*Asclepias viridiflora</i> (Asclepiadaceae Family), Green Milkweed.....	123
3.5	<i>*Baptisia tinctoria</i> (Fabaceae Family), Yellow Wild Indigo.....	123
3.6	<i>*Bouteloua curtipendula</i> v. <i>curtipendula</i> (Poaceae Family), Sideoats Grama.....	124
3.7	<i>*Callirhoe triangulata</i> (Malvaceae Family), Clustered Poppy Mallow.....	125
3.8	<i>*Cirsium hillii</i> (Asteraceae Family), Hill’s Thistle.....	125
3.9	<i>*Coreopsis lanceolata</i> (Asteraceae Family), Lance-Leaved Coreopsis.....	126
3.10	<i>Delphinium carolinianum</i> ssp. <i>virescens</i> (Ranunculaceae Family), Prairie Larkspur.....	126
3.11	<i>*Hesperostipa spartea</i> , <i>Stipa spartea</i> (Poaceae Family), Porcupine or Needle Grass.....	127
3.12	<i>*Koeleria macrantha</i> , <i>Koeleria cristata</i> (Poaceae Family), June Grass.....	128
3.13	<i>Liatris aspera</i> (Asteraceae Family), Rough Blazing Star.....	128

3.14 \**Liatris cylindracea* (Asteraceae Family),  
Cylindrical Blazing Star..... 128

3.15 \**Liatris squarrosa* v. *squarrosa* (Asteraceae Family),  
Scaly Blazing Star..... 129

3.16 \**Lithospermum caroliniense* v. *croceum*  
(Boraginaceae Family), Hairy Puccoon..... 129

3.17 \**Lupinus perennis* ssp. *perennis* (Fabaceae Family),  
Wild Lupine ..... 130

3.18 \**Mimosa microphylla*, *Schrankia uncinata*/*Schrankia nuttallii*  
(Fabaceae Family), Sensitive Brier or Cat-Claw ..... 130

3.19 \**Monarda punctata* ssp. *punctata* (Lamiaceae Family),  
Spotted Bee Balm ..... 131

3.20 \**Onosmodium bejariense* v. *occidentale*,  
*Onosmodium molle* v. *occidentale*  
(Boraginaceae Family), Western False Gromwell ..... 132

3.21 \**Opuntia humifusa*, *Opuntia compressa*  
(Cactaceae Family), Western Prickly Pear Cactus..... 132

3.22 *Penstemon grandiflorus* (Scrophulariaceae Family),  
Large-Flowered Beard-Tongue ..... 133

3.23 *Phlox bifida* (*Polemoniaceae* Family), Sand or Tenpoint Phlox..... 134

3.24 \**Polygala senega* (Polygalaceae Family), Seneca Snakeroot..... 134

3.25 *Psoraleidium tenuiflorum*, *Psoralea tenuiflora*  
(Fabaceae Family), Scurf-pea ..... 134

3.26 \**Solidago nemoralis* v. *nemoralis* (Asteraceae Family),  
Old-Field Goldenrod or Dyers Weed..... 135

3.27 \**Spiranthes tuberosa*, *Spiranthes beckii*  
(Orchidaceae Family), Little Ladies’ Tresses ..... 135

3.28 \**Sporobolus compositus* v. *compositus*,  
*Sporobolus asper* (Poaceae Family) Rough Dropseed..... 136

3.29 \**Symphotrichum oblongifolium*, *Aster oblongifolius*  
(Asteraceae Family), Aromatic Aster ..... 136

3.30 *Symphotrichum sericeum*, *Aster sericeus*  
(Asteraceae Family), Silky Aster ..... 137

3.31 \**Tephrosia virginiana* (Fabaceae Family), Goat’s Rue..... 137

3.32 *Tradescantia bracteata* (Commelinaceae Family),  
Prairie Spiderwort ..... 138

3.33 \**Verbena stricta* (Verbenaceae Family), Hoary Vervain..... 138

3.34 \**Viola pedata* (Violaceae Family), Birdfoot Violet ..... 139

Dry-Mesic to Dry Soil Preferring Species (Illustrations) ..... 141

**4 Wet-Mesic to Wet Soil-Preferring Species ..... 145**

4.1 \**Angelica atropurpurea* (Apiaceae Family),  
Angelica or Alexanders..... 145

4.2 \**Asclepias incarnata* ssp. *incarnata*, Swamp Milkweed..... 145

4.3 \**Bidens aristosa* (Asteraceae Family),  
Swamp Marigold or Tickseed-Sunflower ..... 146

4.4 \**Calamagrostis canadensis* (Poaceae Family),  
Bluejoint Grass..... 146

4.5 \**Carex lasiocarpa* v. *americana* (Cyperaceae Family),  
Hairy-Fruited/Narrow-Leaved Woolly Sedge..... 147

4.6 \**Carex vesicaria* v. *monile* (Cyperaceae Family),  
Blister or Inflated Sedge ..... 147

4.7 \**Eleocharis obtusa* (Cyperaceae Family), Spike Rush..... 148

4.8 \**Eupatorium perfoliatum* v. *perfoliatum*  
(Asteraceae Family), Common Boneset ..... 148

4.9 \**Eupatoriadelphus maculatus* v. *maculatus*,  
Spotted Joe Pye Weed, see *Eupatorium purpureum* (Chapter 2).... 149

4.10 \**Filipendula rubra* (Rosaceae Family), Queen-of-the-Prairie..... 149

4.11 \**Heracleum maximum*, *Heracleum lanatum*  
(Apiaceae Family), Cow Parsnip or Masterwort..... 149

4.12 \**Hypericum ascyron*, *Hypericum pyramidatum*  
(Clusiaceae Family), Great or Giant St. John’s-Wort..... 150

4.13 \**Iris virginica* v. *shrevei* (Iridaceae Family),  
Southern Blue Flag ..... 150

4.14 \**Liatris pycnostachya* v. *pycnostachya* (Asteraceae Family),  
Gayfeather..... 151

4.15 \**Liatris spicata* v. *spicata* (Asteraceae Family),  
Marsh Blazing Star or Button Snakeroot..... 152

4.16 \**Lobelia cardinalis* (Campanulaceae Family), Cardinal Flower.... 152

4.17 \**Lobelia siphilitica* v. *siphilitica* (Campanulaceae Family),  
Blue Cardinal Flower ..... 153

4.18 \**Lysimachia quadriflora* (Primulaceae Family),  
Prairie or Narrow-Leaved Loosestrife ..... 153

4.19 \**Lythrum alatum* v. *alatum* (Lythraceae Family),  
Winged Loosestrife ..... 154

4.20 \**Napaea dioica* (*Malvaceae* Family), Glade Mallow..... 154

4.21 \**Scirpus cyperinus* (Cyperaceae Family), Wool Grass..... 155

4.22 \**Spartina pectinata* (Poaceae Family),  
Freshwater Cord Grass..... 155

4.23 \**Verbena hastata* v. *hastata* (Verbenaceae Family),  
Blue Vervain..... 156

Wet-Mesic to Wet Soil-Preferring Species (Illustrations)..... 158

**Part III Restoration**

**5 Restoration Methods**..... 163

5.1 Landscaping with Prairie ..... 163

5.2 Planting Strategies..... 165

5.3 Seed Production ..... 168

- 5.4 Seed Suppliers..... 171
- 5.5 Seed Collection ..... 172
- 5.6 Seed Treatment ..... 179
- 5.7 Soil Preparation..... 183
- 5.8 Planting Rates ..... 185

**Part IV Management**

- 6 Prairie Management** ..... 189
  - 6.1 Food for Insects and Wildlife (Plant Predation) ..... 189
  - 6.2 Prairie Ecosystems in Farming Practice ..... 190
  - 6.3 Global Warming ..... 191
  - 6.4 Fire Management ..... 192
    - 6.4.1 Rationale for Use of Fire..... 192
    - 6.4.2 Optimum Times for Burning..... 192
    - 6.4.3 Tools for Fire Control ..... 193
    - 6.4.4 Required Clothing..... 195
    - 6.4.5 Burn Strategies ..... 195
    - 6.4.6 Murphy’s Law: What Went Wrong..... 201
    - 6.4.7 Alternative to the Use of Fire..... 202
  - 6.5 Control of Alien Plants ..... 203

- Other Recommended Readings** ..... 215

- Appendix 1: Plants of the Tallgrass Prairie** ..... 217

- Glossary** ..... 259

- References**..... 263

- Native Index**..... 265

- Alien Index**..... 269

- Scientific Native Index** ..... 271

- Alien Species Index** ..... 277

**Part I**  
**Introduction**

# Chapter 1

## Introduction to the Prairie

### 1.1 Why Prairie?

Prairie and savanna are among the most endangered of ecosystems. In Illinois, extant prairies account for only 0.01% of their original range [1]. Other Midwestern states are similarly deficient in prairie remnants. Because prairie soil in the Midwest is incredibly fertile, much of the former grasslands have disappeared under the plow. Interestingly, the root-bound prairie sods were intractable before the introduction of the John Deere steel moldboard plow. Several yoke of oxen were used to break the soil (Fig. 1.1). The snap of the breaking roots of lead plant (*Amorpha canescens*) earned lead plant the alternative name “prairie shoestring.”

Even as early as the 1840s a great proportion of the tallgrass prairie had disappeared. The remaining prairies and savannas (widespread trees interspersed with prairie) are endangered because of the lack of fire. Thus, prairies are being transformed into areas of brush and trees. The former giant spreading oaks found on savannas are being degraded by younger forest trees, which shade the widespread limbs of full-sun trees. The decline of these ancient oaks is surprisingly rapid under these conditions.

What an amazing sight the tallgrass prairie must have been to the first people of European ancestry to view these undisturbed natural areas. Plant collection was one goal of the Lewis and Clark expedition. However, Thomas Nuttall, an apprentice printer from England, was much interested in botany. Nuttall endured incredible hardships collecting plants in the tallgrass area shortly after the Lewis and Clark expedition. He proceeded down the Ohio River, and subsequently traveled north, often by foot, through the heart of the tallgrass prairie. He discovered a large number of plants typical of native prairie absent or very rare in the East, such as *Amorpha canescens*, *Artemisa ludoviciana*, *Symphyotrichum* × *amethystinus*, *Symphyotrichum oblongifolium*, *Baptisia bracteata* var. (v.) *leucophaea*, *Arnoglossum plantagineum*, *Cirsium pumilum*, *Comandra umbellata*, *Coreopsis palmata*, *Delphinium carolinianum* v. *virescens*, *Echinacea pallida*, *Penstemon digitalis*, *Penstemon grandiflorus*, *Physostegia parviflora*, *Polytaenia nuttallii*, *Orbexilum onobrychis*, *Pycnanthemum verticillatum* v. *pilosum*, *Ruellia humilis*, *Mimosa microphylla*, and *Solidago speciosa*, among many others.



**Fig. 1.1** Breaking the prairie sod at Bishop Hill, Illinois. “Breaking Prairie” by Olof Krans (courtesy Bishop Hill State Historic Site Museum)

Although the treeless prairie was a frightening unfamiliar terrain to early pioneers, there were some who appreciated their wondrous floral beauty. As reported by Betz [2], a visitor from New York in 1838 wrote:

One who has never looked upon the Western prairie in the pride of its blushing bloom can hardly conceive the surpassing loveliness of its summer flora; and if the idea is not easy to conceive, still less is it so to convey. The autumn flowers in their richness I have not yet beheld; and in the early days of June, when I first stood upon the prairies, the beautiful sisterhood of spring were all in their graves; and the sweet springtime of the year it is when the gentle race of flowers dance over the teeming earth in the gayest guise and profusion.

McClain [1] quoted the 1841 writing of the Englishman, Mr. Oliver:

A few miles further on we entered on a branch of Looking Glass Prairie, Bond County (Illinois), where long reaches of green undulating prairie stretched away until they became lost in the haze of distance; and, within a few hours of sunset, we emerged from a grove on the shore of one which lay stretched out before us like an ocean. In the direction which the track we were following took, we could just distinguish the forest like a low bank of cloud, whilst on our right the prairie stretched away, one vast plain, uninterrupted by tree or bush, as far as the eye could reach.

Dr. A.W. Herre [quoted in [3] p. 74] was particularly eloquent in his writings about the beauty of the prairie of yesteryears, and he sadly comments on its wholesale destruction by the 1890s:

One of the most marvelous sights of my whole life, unsurpassed in my travels in nearly all parts of the world, was that of the prairie in spring. Unfading are memories of that waving

rippling sea of lavender when the wild sweet William, a species of Phlox two or three feet in height was in full flower. It stretched away in the distance farther than the eye could reach. As the sea of phlox faded it was succeeded by another marvelous flower bed of nature's planting, and this in turn by others until mid-summer was reached. Then the great coarse perennials belonging to the Compositae dominated and instead of a single mass of color there was a vast garden of purple cone flowers, black-eyed susan's, rosinweeds, blazing stars, aster, goldenrods, and others...Every spring and fall the prairie was covered with water so that the whole country side was a great lake...All day long swarms of water birds filled the air, and far in the night their cries sounded overhead. At the first gleam of dawn vast flights of ducks dashed to and fro and great flocks of wild geese sped swiftly across the sky...The advent of tile drainage early in the (18)80's completed the transformation of the prairie into ordinary farm land and brought in many more people. Of course the ducks and geese stopped coming for there was neither water nor food to attract them. Migratory flocks of snipe and plover continued to come for a couple of decades, but their numbers had dwindled to a mere trickle when I left Illinois in 1900. The crayfish and bullfrogs disappeared in a hurry, and the prairie chickens were destroyed by the combined efforts of the plow and the shot gun. I returned to the region several summers during the (18)90's, but the prairie as such had disappeared, and of course, its characteristic life with it. What a pity that some of it could not have been preserved, so that those born later might enjoy its beauty also. Now it is merely flat unending corn fields, and moderns may look on this article as only the iridescent childish remance of an old man.

In recent years an appreciation for prairie has been shown by the extensive effort expended by individuals and government agencies to restore prairies. The Farm Bill 2002, Grassland Reserve Program, by USDA has resulted in major restoration by farmers to set aside marginal farmland. Unfortunately, some farmers have elected to plant alien grasses, which requires less expensive seed.

Tallgrass prairies need not be restricted to the Midwest. It is relatively easy to grow prairie in the East, where before habitation prairie ecosystems were somewhat rare because of largely unending forest. However, many "prairie" species can be found in mountain forest openings where human disturbance and introduction of Eurasian species has been minimal. Certain barrens in the East, such as one near State College, Pennsylvania, and the Serpentine Barrens on the eastern Pennsylvania-Maryland border, harbor many prairie species. The Serpentine Barrens have areas of shortgrass mixed with tallgrass, such as *Schizachyrium scoparium*, *Andropogon gerardii*, *Sorghastrum nutans*, and *Sporobolus heterolepis*, as well as several forbs. In the past there was a history of burns in the Serpentine Barrens. Except for a recent prescribed burn that became a wildfire, the remainder of the Serpentine Barrens is in a stage of succession into greenbrier, pitch pine, and red cedar. Volunteers of The Nature Conservancy are clearing areas of trees to promote grasslands. Otherwise, populated areas in the East are almost totally overrun with Eurasian species. Native wetland species often persist in the East, possibly because exotic wetland species have not been imported for agriculture and horticultural landscaping. However, the explosive growth of a wetland species, purple loosestrife (*Lythrum salicaria*), in the East demonstrates the hazards of unrestricted horticultural imports.

Most of the public considers "prairie" simply as a sea of grass. Such a view is far from accurate. There is a diversity of prairie ecotypes displaying a mixture of grasses and forbs (non-grass flowering plants). Depending on soil moisture, soil

type, partial shade, local climate, and degree of disturbance, one prairie may have no resemblance to another in terms of plant species and species prevalence. The variance of prairie types adds an exciting dimension to their study and appreciation. An important key to prairie restoration is attention to the particular ecosystem outlined by the foregoing factors. Obviously, it is a total waste of time to seed a dry sandy area with wetland species or vice versa. A more detailed discussion of planting strategies is outlined in the Chap. 5 and Sect. 1.3 sections below.

As suggested by many experts, residential lawns should be supplanted with native species that normally grow wild in the region. Blue-grass lawns are a carryover from our northern European origins. Blue-grass lawns are an unnatural creation in the Americas. Enormous resources of water, fertilizer, herbicides, gasoline, lawn mowing equipment, and time are required to maintain our “English lawns.” Maintenance of lawns in the likes of Tucson or Los Angeles is the ultimate in lavish environmental wastefulness, especially because of the scarcity of water in those arid climes. Prairie is a difficult sell in most subdivisions, but a small and growing minority is pleased with the results. Informing city fathers and neighbors before planting a prairie is recommended. And, one should organize attractive native plants in a manner that resembles a landscaping plan. Arranging areas of monoculture is one strategy that gives the impression of a suburban garden. A few years ago I planted beds of prairie plants for an acquaintance along Market Street in Camp Hill, Pennsylvania. Her lawn situated along a major thoroughfare attracts favorable notice.

## 1.2 Prairie Origins

A review by Axelrod [4] offers convincing evidence that an extensive prairie ecosystem is a recent phenomenon being maintained principally by fire during the time before settlement by European immigrants.

The prairies had their origin from the spread of grassy patches from open parkland or savannas in earlier times. In a warmer era from about 20 to 10 million years ago, conifers and hardwoods were found in river bottoms with grassy patches or open parkland in the intervals between rivers. Fossils of crocodiles and large tortoises indicated a warmer climate. As the climate became more arid 7–5 million years ago, the grasslands spread more into the savanna intervals. Nevertheless, at this time there was no extensive spread of prairie. A subsequent cooling trend led to more conifers, such as spruce and larch, with the parklands persisting until the end of the glacial period about 10,000 years ago. After this time, large expanses of prairie formed between river drainages, while river bottoms developed into deciduous forests.

The recent rise of the prairie agrees with the lack of speciation of prairie plants; that is, most prairie species are found in woodland borders. For example, many prairie plants can be found in the East in areas untouched by habitation, such as mountain openings. There are very few plant species endemic to prairies, indicating

insufficient time to allow for the evolution of grass and forbs (flowering plants). Similarly, most bird and insect species are found elsewhere. Diverse relict trees show the former occurrence of extensive forest over the entire prairie region.

Axelrod [4] and many other authorities observed that these large expanses of prairies are unstable, particularly in the tallgrass region. After European immigrants populated the prairies, extensive fires were terminated, and existing prairies have been rapidly invaded by forest. Previously, for various reasons, Native Americans burned the prairies as often as every few years. Lightning may have played a minor role in setting prairie fires. This author personally witnessed a grass fire caused by lightning in eastern Wyoming; however, it was doubtful that it lasted long in the resulting downpour. It is this burn regimen that undoubtedly caused the major expansion of prairies into savannas after the last Ice Age. Other factors are involved, such as drying periods to permit the accumulation of flammable grasses, as well as flat plains over which the fire spread uninterrupted. Grazing animals may have also contributed to the demise of woody plants to a lesser extent.

### 1.3 Ecosystem Diversity

The focus of this book is the restoration of tallgrass prairies with attendant forbs commonly found in the north-central Midwest. As described below, it is entirely feasible to establish prairie ecosystems in the East in full sun or partial shade.

Prairie ecosystems are readily divided into the broad categories of prairies composed of tallgrass and those consisting of shortgrass. This division is mainly based on the annual rainfall, with regions of higher soil moisture being able to support tallgrass species. Within each of these categories there is considerable regional variation in species composition. However, the variability is gradual over the entire prairie ecosystem, so that one will find shortgrass species in tallgrass areas and vice versa. However, there are numerous species uniquely regional. Even in the tallgrass region alone you would find considerable similarity as well as variability between the species found in Texas from those in North Dakota. Even within a single species there are regional differences that undoubtedly have a genetic basis [5]. *Solidago altissima* was shown to change into regional ecotypes in Europe within only 300 years after its introduction (see discussion in Sect. 2.126 on *Solidago canadensis*), which may argue for an adaptation mechanism already present within the genome. For this reason, there is a variance of opinion regarding the selection of seed sources for restoration. Some experts recommend a 15-mile rule regarding seed collection for a specific site. The Illinois Nature Preserves Commission suggests a 100- to 200-mile radius within the same Illinois Natural Division, particularly on an east-west orientation.

The former range of tallgrass prairie was found from western Indiana west through Illinois and Iowa to central Nebraska. These prairies also stretched north into southern Wisconsin, southern and western Minnesota, and eastern South Dakota and North Dakota to southern Canada. Tallgrass reached south into northwestern

Missouri, eastern Kansas, and portions of east-central Oklahoma to parts of Texas roughly from Dallas south to San Antonio [1]. There were scattered areas of tallgrass prairie in southern Michigan, Ohio west of Columbus, central and western Kentucky, and east-central Arkansas. Even western New York and western Pennsylvania have small original prairie sites. Also, there were isolated pockets of tallgrass prairie surrounded by shortgrass prairie in eastern Colorado, western Oklahoma, and New Mexico.

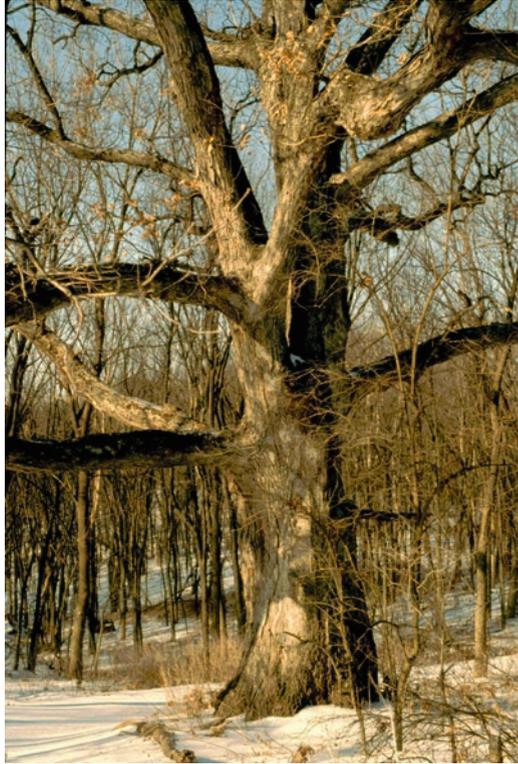
Formerly, the East was forested, which did not permit the extensive spread of prairie. When pioneers cleared the land to plant crops, they introduced European plants familiar to them. Thus, full-sun/partial shade plants in the East are almost entirely of European and Asian origin. As mentioned previously, undisturbed openings in Eastern forests possess native plants that could be characterized as prairie. Fully 90% of the plants described here can be found in the East, and the remaining 10% easily can be grown in the East.

In prairie ecosystems there is considerable species variability as a consequence of soil composition and moisture. Often “dry” soils are composed of well-drained sand or gravel, but some species are simply attracted to the friability of sandy/gravelly soils. Surprisingly, sand and black prairie loam will support many of the same plants because both soils are loose and friable. On the other end of the spectrum there are truly wet prairies growing in standing water or water-saturated soils. Thus, the species composition of a wet prairie is virtually totally different from species found in a dry prairie. In comparison, it is hardly conceivable that both are categorized as “prairies.”

In the past, considerable expanses of savanna existed in the Midwest where fire-resistant oak and hickory were separated far enough apart to permit prairie to grow in the interstices. Savannas were posited to be located in the areas between open prairie and forested gullies and stream drainages. It is likely that savannas were not subjected to frequent and hot windblown prairie fires resembling those that swept the flat plains. Thus, the savannas had a nearby source of tree seeds (acorns and hickory nuts) arising from the forested drainage areas, and savannas were exposed to somewhat less fire damage. Experts agree that the savanna ecosystem may be even more endangered than prairie. Occasionally, old savanna oaks with spreading branches can be seen decaying in the shade of a thicket of younger trees (Fig. 1.2).

The understory forbs and grasses that grew in the partial shade of these trees were both different from as well as the same as species found in full-sun prairie. For example, in savanna you are likely to find such species as *Dodecatheon meadia*, *Prenanthes* sp., *Elymus villosus*, *Geranium maculatum*, *Aureolaria grandiflora*, *Lespedeza violacea*, *Thaspium trifoliatum*, *Anemone virginiana*, *Agastache scrophulariifolia*, *Asclepias purpurascens*, *Arnoglossum atriplicifolium*, *Carex davisii*, other *Carex* spp., *Gentiana alba*, *Heuchera richardsonii*, *Lactuca* sp., *Heracleum maximum* (moist), *Polemonium reptans*, *Polygonatum biflorum*, *Rudbeckia triloba*, *Sanguinaria canadensis*, *Echinacea purpurea*, *Taenidia integerrima*, *Cypripedium parviflorum*, *Trillium recurvatum*, *Campanulastrum americanum*, *Chelone glabra*, *Hypericum ascyron*, *Glyceria striata*, *Bromus* sp., *Panicum/Dichantelium* sp., *Lobelia cardinalis*, *Phlox divaricata*, *Lilium superbum*, *Eryngium yuccifolium*, and others.

**Fig. 1.2** Savanna oak invaded by young trees. In a decade the tree died from loss of limbs



Soil disturbance also plays a surprisingly significant role. For the state of Illinois, Taft et al. [6] have classified species into 11 levels of tolerance to soil disturbance, which they called the Coefficient of Conservatism (CC); see Appendix 1 and Part II (Chaps. 2–4), List of Species. The values range from a rating of 0, indicating weedy species growing in disturbed soil, to 10, indicating undisturbed situation or a high degree of “fidelity to habitat integrity.” Thus, *Amorpha canescens* rated at a CC of 8, *Dalea candida* at CC 9, *Sporobolus heterolepis* at CC 9, and *Gentiana puberulenta* at CC 9 are indicators of undisturbed high-quality prairie. Such high-quality prairie plants are particularly difficult to establish. A rating of CC 10 is usually reserved for rare, threatened, or endangered species. Often special methods are required to propagate conservative plants. Initially, restorations will comprise species mainly with CC values of 0 to 7. Later on, more conservative plants may appear from earlier seed distribution, or preferably you may choose to scatter seed of conservative species after the prairie is established. CC values have been developed for a few states other than Illinois.

The environmental/developmental factors discussed above lead to a diverse variance of species between different prairies. Only when all these factors are close to identical can one expect a reasonable likelihood of finding two similar prairies.

As examples, Figs. 1.3–1.6 show the aspects of some different prairies growing in ecosystems of varying available moisture and soil type. Regarding tolerance to soil disturbance, there are even differences in early succession and late succession prairies, as already discussed. One can hardly conceive that these various ecotypes are all classified as tallgrass prairies. All the prairies shown here are typical of ecosystems found within a 50-mile radius of Peoria, Illinois. Because of Peoria’s proximity to the Illinois River, the ecology ranges from sand dunes to wetlands, to gravel-laden river bluffs and graded forests, and to black prairie loam. Interestingly, the Illinois River was the pre-Ice Age bed of the Mississippi River south of the “Great Bend” located near the Hennepin Canal. Consequently, it left a deep river valley and quantities of sand and gravel. Over the millennia the sand dunes migrated with the prevailing wind a few miles east of the river.

Figure 1.3 represents a black prairie loam found east and west of the Illinois River, where in former times there were areas of seasonal standing water. Figure 1.4 shows an area with good drainage of cleared “forest soil.” Shown in Fig. 1.5 is an Illinois River bluff composed mainly of gravel admixed with sand. Figure 1.6 shows a “created dry” prairie of imported sand, which represents a typical ecosystem of sand dune prairies found east of the Illinois River.



**Fig.1.3** Wet-mesic prairie on black prairie soil (silt-loam) at the Rock Island Trail Nature Preserve, Illinois