Chapter 23

Western Prairie Ecological Landscape

Where to Find the Publication

The Ecological Landscapes of Wisconsin publication is available online, in CD format, and in limited quantities as a hard copy. Individual chapters are available for download in PDF format through the Wisconsin DNR website (http://dnr.wi.gov/, keyword "landscapes"). The introductory chapters (Part 1) and supporting materials (Part 3) should be downloaded along with individual ecological landscape chapters in Part 2 to aid in understanding and using the ecological landscape chapters. In addition to containing the full chapter of each ecological landscape, the website highlights key information such as the ecological landscape at a glance, Species of Greatest Conservation Need, natural community management opportunities, general management opportunities, and ecological landscape and Landtype Association maps (Appendix K of each ecological landscape chapter). These web pages are meant to be dynamic and were designed to work in close association with materials from the Wisconsin Wildlife Action Plan as well as with information on Wisconsin's natural communities from the Wisconsin Natural Heritage Inventory Program.

If you have a need for a CD or paper copy of this book, you may request one from Dreux Watermolen, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

Photos (L to R): Prothonotary Warbler, photo by John and Karen Hollingsworth, U.S. Fish and Wildlife Service; prairie ragwort, photo by Dick Bauer; Loggerhead Shrike, photo by Dave Menke; yellow gentian, photo by June Dobberpuhl; Blue-winged Teal, photo by Jack Bartholmai.

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Cover Photos

Top left: *The Western Meadowlark is among the many declining grassland species in Wisconsin. Photo by John and Karen Hollingsworth, courtesy U.S. Fish and Wildlife Service.*

Bottom left: *The Wisconsin Endangered Carolina anemone is extremely rare in Wisconsin, where it occurs only in a few counties in the west central part of the state. Photo by Kitty Kohout.*

Top right: *The Western Prairie Ecological Landscape still offers critical management opportunities for several of Wisconsin's most severely declining natural communities and associated wildlife. Photo by Chris Trosen, U.S. Fish and Wildlife Service.*

Center right: *Lower St. Croix River corridor, including channels, extensive emergent marsh, floodplain forest, and forested bluffs. The lower St. Croix is among Wisconsin's most diverse big river ecosystems and supports a wealth of native plant and animal life. St. Croix Islands State Wildlife Area, St. Croix County. Photo by Harvey Halvorsen, Wisconsin DNR.*

Bottom right: *Very few intact tallgrass prairie remnants persist anywhere in the Upper Midwest, and most of them are very small and isolated. In addition to serving historical and educational functions, they are invaluable as refugia for native plants, invertebrates, and micro-organisms and also serve as templates upon which to base restoration actions for public agencies, NGOs, and interested private parties. Photo by Missy Sparrow-Lien, Wisconsin DNR.*

Kitty Kohout

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Size

The Western Prairie Ecological Landscape encompasses 1,090 square miles (697,633 acres), representing 1.9% of the area of Wisconsin. It is the third smallest ecological landscape in the state; however, this ecological landscape (like the Northwest Lowlands) is part of a larger ecoregion, Subsection 222 Md, which extends west into Minnesota.

Climate

Typical of southern Wisconsin, the mean growing season is 145 days, mean annual temperature is 43.7°F, mean annual precipitation is 32.1 inches, and mean annual snowfall is 45.4 inches. The climate, topography, and some American Indian land use practices were conducive to frequent fires, which resulted in prairie vegetation occurring in almost a third of the area prior to Euro-American settlement. The length of the growing season, adequate precipitation, and temperatures make the climate favorable for agriculture, which is now the prevalent land use here.

Bedrock

Bedrock was deposited during the Paleozoic Era (including the Cambrian and Ordovician Periods) and is dominantly marine sandstone and dolomite. Precambrian igneous and metamorphic bedrock lies below the Paleozoic deposits. The walls of the Apple River canyon feature exposures of Cambrian sandstone, Cambrian shale, and Cambrian and Ordovician dolomites. Similar exposures occur along the lower Kinnickinnic River, below the city of River Falls.

Geology and Landforms

The ecological landscape was entirely glaciated. Major landforms are rolling till plains, with end moraines in the northwest and small areas of outwash.

Soils

Soils were predominantly formed in glacial deposits of loamy till, while some were formed in outwash. A loess cap of aeolian silt ranges from 6 to 48 inches thick over the land surface. The dominant soil throughout the ecological landscape is well drained and loamy with a silt loam surface, moderate permeability, and moderate available water capacity.

Hydrology

The lower St. Croix River forms the western boundary of the Western Prairie. Other important though much smaller rivers include the Apple, Kinnickinnic, and Willow. Most of the rivers drain westward to the St. Croix, with several draining south directly into the Mississippi and a few flowing draining southeast to the Chippewa. Inland lakes, mostly seepage lakes and ponds, are most common in the northwestern part of the ecological landscape, an area known informally as Wisconsin's "prairie pothole region." There are multiple dams on the Willow River, and the Kinnickinnic River has been dammed at River Falls. Many wetlands have been lost or severely altered by agricultural activities, which have been widespread and intensive in this productive ecological landscape.

Current Land Cover

Almost half of the land cover is agricultural crops, and about one third of the area is nonnative grasslands, with smaller amounts of forest, open water, open wetlands, and urban areas. The major forest types are maple-basswood and oak-hickory, with lesser amounts of lowland hardwoods. Native coniferous forests are scarce and limited to a few tamarack swamps and small scattered stands of pine on steep rocky slopes.

Socioeconomic Conditions

The counties included in this socioeconomic region are St. Croix and Pierce.

Population

The population in 2010 was 125,364, 2.2% of the state total.

Population Density

97 persons per square mile

Per Capita Income

$26,853

Important Economic Sectors

The largest employment sectors in 2007 were Government (14.6%), Tourism-related (12.6%), Manufacturing (non-wood) (11.6%), and Retail Trade (10.2%). Agriculture and urban

development affect the natural resources of this ecological landscape the most.

Public Ownership

Only 3% of the Western Prairie is in public ownership, much of it associated with the St. Croix, Kinnickinnic, and Willow rivers. Federal lands include the southern end of the St. Croix National Scenic Riverway and several federal waterfowl production areas. State-owned lands include state wildlife areas, state parks, state fishery areas, and state natural areas. Examples include St. Croix Islands and Cylon Marsh State Wildlife Areas, Kinnickinnic and Willow River state parks, and Apple River Canyon State Natural Area. A map showing public land ownership (county, state, and federal) and private lands enrolled in the forest tax programs can be found in Appendix 23.K at the end of this chapter.

Other Notable Ownerships

The Kinnickinnic River Land Trust has been actively protecting lands in northwestern Pierce County. Several other NGOs have been protecting lands along the St. Croix River in Polk and St. Croix counties. Several of these projects represent the outcomes of successful public-private partnerships.

Considerations for Planning and Management

Agriculture is the dominant land use, but in recent years residential development has increased dramatically in the western part of the ecological landscape along and near the St. Croix River. Many new residents commute to the Twin Cities for work. Public lands are limited, making management at large scales difficult. Prairie remnants are few, and most are isolated. Where possible, these should be embedded within surrogate grasslands such as waterfowl production areas, Conservation Reserve Program (CRP) lands, or other open cover types to meet the needs of wide-ranging and area-sensitive grassland wildlife.

The lower St. Croix River supports many rare aquatic species, but recreational pressure is high and increasing, and residential development is occurring in most areas not yet protected as part of the National Scenic Riverway. Maintaining or restoring high water quality and protecting in-stream and adjoining wetland and terrestrial habitats are conservation priorities for the Western Prairie Ecological Landscape.

Residents along the Kinnickinnic River in Pierce County have worked together and received grants to restore and manage prairie and savanna remnants and protect populations of rare species. Similar partnerships have worked effectively in areas along the St. Croix River and could serve as models for conservation work elsewhere.

Management Opportunities

Grassland management at multiple scales is a major opportunity in the Western Prairie Ecological Landscape. Small, scattered remnants of native prairie exist here along with substantial areas of "surrogate grassland" that now provide increasingly critical habitat for many obligate grassland species, especially birds. The largest grassland management project in this ecological landscape is the Western Prairie Habitat Restoration Area in St. Croix and Polk counties. By managing at multiple scales, large blocks of surrogate grassland, unplowed prairie pastures, small native prairie remnants (usually on bluffs or within rights-of-way), and working agricultural lands can all play key roles in the conservation and restoration of the tallgrass prairie and oak savanna ecosystem that historically covered much of this ecological landscape.

This oak savanna restoration opportunity within the Western Prairie Habitat Restoration Area includes upland grass, emergent wetlands, and an inland lake. Note Trumpeter Swans on open water. Photo by Missy Sparrow-Lien, Wisconsin DNR.

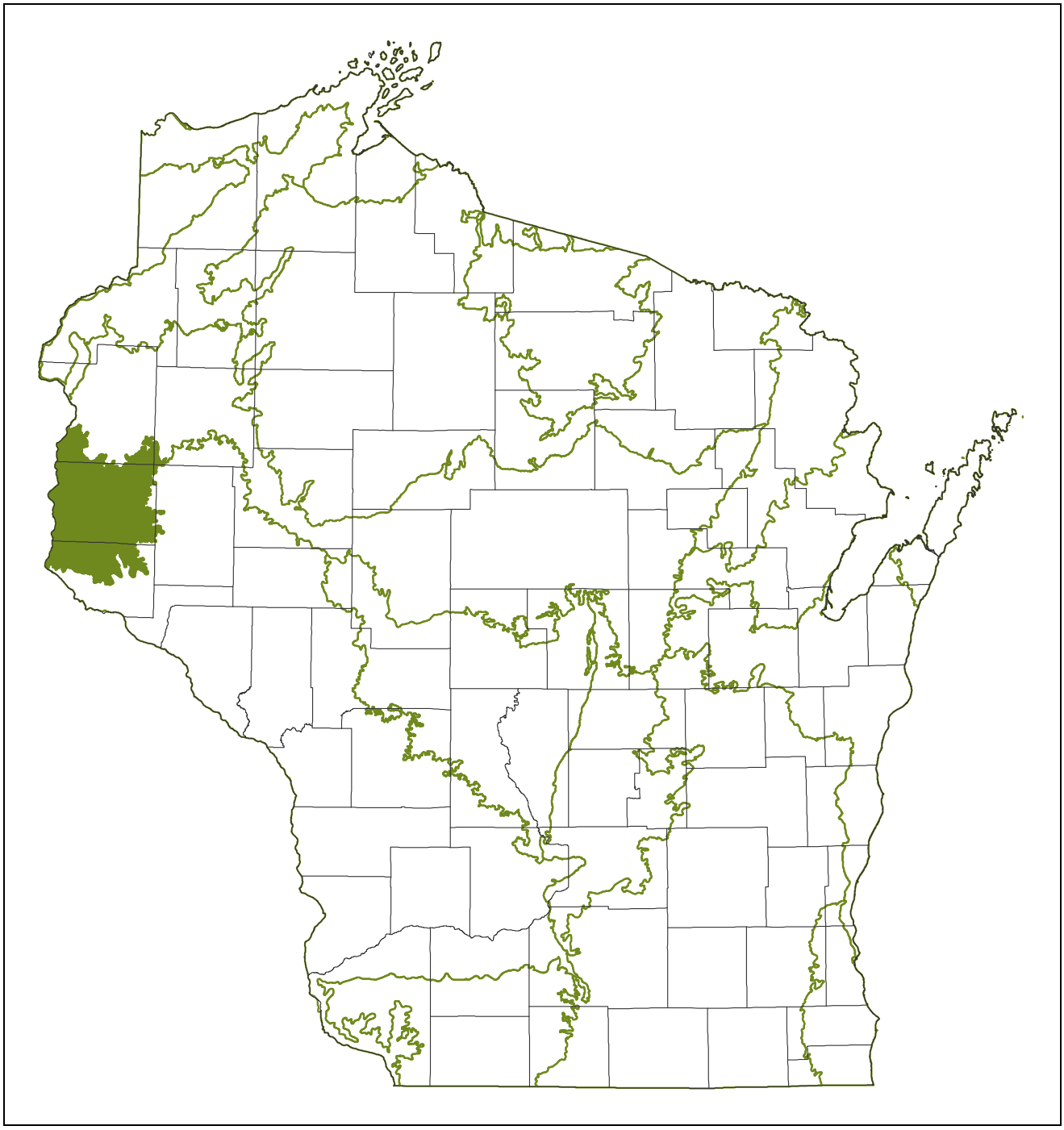
This undeveloped shallow lake with beds of marsh vegetation and bordered by grassland and oak woodland provides habitat for many declining and otherwise desirable native species. Oak Ridge Lake Wildlife Area and Waterfowl Production Area, St. Croix County. Photo by Tom Kerr, Wisconsin DNR.

Ponds and lakes border or are embedded within some of the areas with high grassland management potential; these add great value for species that nest near or over water as well as for migratory species that use open wetlands and water.

The lower St. Croix River supports an exceptionally high diversity of aquatic organisms, including fish, mussels, and other invertebrates. Many rare species have been documented here, and several of the mussels are globally rare. The river's floodplain contains good examples of emergent marsh, wet prairie, and floodplain forest. The forested slopes of the St. Croix valley contain rich mesic hardwood forests, dry oak forests, and a few stands of natural eastern white pine. Remnant bluff prairies and oak savannas occur on the uppermost, west-facing slopes above the St. Croix. Migratory bird use of the St. Croix River valley is high, and the river corridor also provides nesting and wintering habitat for many common and rare birds, including species of conservation concern.

Protecting the hydrology and water quality of the St. Croix and its tributaries is critical, and assessing areas of high value to birds and other species is an important step in protecting and properly managing the best habitats.

Other important management opportunities include the Kinnickinnic River Corridor; the Apple River Canyon; scattered prairie, savanna, and forest remnants (including mesic, dry-mesic, and dry forests); coldwater and coolwater streams; and miscellaneous opportunities to protect more isolated populations of rare species and features not covered by the previously mentioned categories.



Western Prairie Ecological Landscape

Dick Bauer

Western Prairie Ecological Landscape

Introduction

This is one of 23 chapters that make up the Wisconsin DNR's publication *The Ecological Landscapes of Wisconsin: An Assessment of Ecological Resources and a Guide to Planning Sustainable Management*. This book was developed by the Wisconsin DNR's Ecosystem Management Planning Team and identifies the best areas of the state to manage for natural communities, key habitats, aquatic features, native plants, and native animals from an ecological perspective. It also identifies and prioritizes Wisconsin's most ecologically important resources from a global perspective. In addition, the book highlights socioeconomic activities that are compatible with sustaining important ecological features in each of Wisconsin's 16 ecological landscapes.

The book is divided into three parts. Part 1, "Introductory Material," includes seven chapters describing the basic principles of ecosystem and landscape-scale management and how to use them in land and water management planning; statewide assessments of seven major natural community groups in the state; a comparison of the ecological and socioeconomic characteristics among the ecological landscapes; a discussion of the changes and trends in Wisconsin ecosystems over time; identification of major current and emerging issues; and identification of the most significant ecological opportunities and the best places to manage important natural resources in the state. Part 1 also contains a chapter describing the natural communities, aquatic features, and selected habitats of Wisconsin. Part 2, "Ecological Landscape Analyses," of which this chapter is part, provides a detailed assessment of the ecological and socioeconomic conditions for each of the 16 individual ecological landscapes. These chapters identify important considerations when planning management actions in a given ecological landscape and suggest management opportunities that are compatible with the ecology of the ecological landscape. Part 3, "Supporting Materials," includes appendices, a glossary, literature cited, recommended readings, and acknowledgments that apply to the entire book.

This publication is meant as a tool for applying the principles of ecosystem management (see Chapter 1, "Principles of Ecosystem and Landscape-scale Management"). We hope it will help users better understand the ecology of the different regions of the state and help identify management that will sustain all of Wisconsin's species and natural communities while meeting the expectations, needs, and desires of our public and private partners. The book should provide valuable tools for planning at different ***scales***, including master planning for Wisconsin DNR-managed lands, as well as assist in project selection and prioritization.

Many sources of data were used to assess the ecological and socioeconomic conditions within each ecological landscape. Appendix C, "Data Sources Used in the Book" (in Part 3, "Supporting Materials"), describes the methodologies used as well as the relative strengths and limitations of each data source for our analyses. Information is summarized by ecological landscape except for socioeconomic data. Most economic and demographic data are available only on a political unit basis, generally with counties as the smallest unit, so socioeconomic information is presented using county aggregations that approximate ecological landscapes unless specifically noted otherwise.

Rare, declining, or vulnerable species and natural community types are often highlighted in these chapters and are given particular attention when Wisconsin does or could contribute significantly to maintaining their regional or global abundance. These species are often associated with relatively intact natural communities and aquatic features, but they are sometimes associated with cultural features such as old fields, abandoned mines, or dredge spoil islands. Ecological landscapes where these species or community types are either most abundant or where they might be most successfully restored are noted. In some cases, specific sites or properties within an ecological landscape are also identified.

Although rare species are often discussed throughout the book, "keeping common species common" is also an important

Terms highlighted in green are found in the glossary in Part 3 of the book, "Supporting Materials." Naming conventions are described in Part 1 in the Introduction to the book. Data used and limitation of the data can be found in Appendix C, "Data Sources Used in the Book," in Part 3.

consideration for land and water managers, especially when Wisconsin supports a large proportion of a species' regional or global population or if a species is socially important. Our hope is that the book will assist with the regional, statewide, and landscape-level management planning needed to ensure that most, if not all, native species, important habitats, and community types will be sustained over time.

Consideration of different scales is an important part of ecosystem management. The 16 ecological landscape chapters present management opportunities within a context of ecological functions, natural community types, specific habitats, important ecological processes, localized environmental settings, or even specific populations. We encourage managers and planners to include these along with broader landscape-scale considerations to help ensure that all natural community types, ***critical habitats***, and aquatic features, as well as the fauna and flora that use and depend upon them, are sustained collectively across the state, region, and globe. (See Chapter 1, "Principles of Ecosystem and Landscape-scale Management," for more information.)

Locations are important to consider since it is not possible to manage for all species or community types within any given ecological landscape. Some ecological landscapes are better suited to manage for particular community types, aquatic features, and groups of species than others or may afford management opportunities that cannot be effectively replicated elsewhere. This publication presents management opportunities for all 16 ecological landscapes that are, collectively, designed to sustain as many species and community types as possible within the state, with an emphasis on those especially well represented in Wisconsin.

This document provides useful information for making management and planning decisions from a landscape-scale and long-term perspective. In addition, it offers suggestions for choosing which resources might be especially appropriate to maintain, emphasize, or restore within each ecological landscape. The next step is to use this information to develop landscape-scale plans for areas of the state (e.g., ecological landscapes) using a statewide and regional perspective that can be implemented by field resource managers and others. These landscape-scale plans could be developed by Wisconsin DNR staff in cooperation with other agencies and nongovernmental organizations (NGOs) that share common management goals. Chapter 1, "Principles of Ecosystem and Landscape-scale Management," in Part 1 contains a section entitled "Property-level Approach to Ecosystem Management" that suggests how to apply this information to an individual property.

How to Use This Chapter

The organization of ecological landscape chapters is designed to allow readers quick access to specific topics. You will find some information repeated in more than one section, since our intent is for each section to stand alone, allowing the reader to quickly find information without having to read the chapter from cover to cover. The text is divided into the following major sections, each with numerous subsections:

- Environment and Ecology
- Management Opportunities for Important Ecological Features
- Socioeconomic Characteristics

The "Environment and Ecology" and "Socioeconomic Characteristics" sections describe the past and present resources found in the ecological landscape and how they have been used. The "Management Opportunities for Important Ecological Features" section emphasizes the ecological significance of features occurring in the ecological landscape from local, regional, and global perspectives as well as management opportunities, needs, and actions to ensure that these resources are enhanced or sustained. A statewide treatment of integrated ecological and socioeconomic opportunities can be found in Chapter 6, "Wisconsin's Ecological Features and Opportunities for Management."

Summary sections provide quick access to important information for select topics. "Western Prairie Ecological Landscape at a Glance" provides important statistics about and characteristics of the ecological landscape as well as management opportunities and considerations for planning or managing resources. "General Description and Overview" gives a brief narrative summary of the resources in an ecological landscape. Detailed discussions for each of these topics follow in the text. Boxed text provides quick access to important information for certain topics ("Significant Flora," "Significant Fauna," and "Management Opportunities").

Coordination with Other Land and Water Management Plans

Coordinating objectives from different plans and consolidating monetary and human resources from different programs, where appropriate and feasible, should provide the most efficient, informed, and effective management in each ecological landscape. Several land and water management plans dovetail well with *The Ecological Landscapes of Wisconsin*, including the Wisconsin Wildlife Action Plan; the Fish, Wildlife, and Habitat Management Plan; the Wisconsin Bird Conservation Initiative's (WBCI) All-Bird Conservation Plan and Important Bird Areas program; and the *Wisconsin Land Legacy Report*. Each of these plans addresses natural resources and provides management objectives using ecological landscapes as a framework. Wisconsin DNR ***basin*** plans focus on the aquatic resources of water basins and watersheds but also include land management recommendations referencing ecological landscapes. Each of these plans was prepared for different reasons and has a unique focus, but they overlap in many areas. The ecological management opportunities provided in this book are consistent with the objectives provided in many of these

plans. A more thorough discussion of coordinating land and water management plans is provided in Chapter 1, "Principles of Ecosystem and Landscape-scale Management."

General Description and Overview

This Western Prairie Ecological Landscape is located on the far western edge of the state just south of the ecoclimatic ***Tension Zone***; it contains extensive grasslands, which include Wisconsin's only ***Prairie Pothole Region***. It is characterized by rolling, glaciated topography, and much of the land is open, with rich prairie soils, pothole lakes and ponds, and scattered wet depressions. Forests occur mostly in the larger river valleys, and in areas historically protected from fire by stream corridors, lakes, and wetlands. The climate and growing season are favorable for agricultural row crops. Sandstones and dolomites underlie the ecological landscape. Bedrock exposures occur as cliffs and ***talus slopes*** along some of the larger rivers. Soils are predominantly loamy tills derived from glacial deposits, while are of glacial outwash origin. A loess cap of aeolian silt 6 to 48 inches thick covers much of the surface. The dominant soil is well drained and loamy with a silt loam surface, moderate permeability, and moderate available water capacity. Alluvial sands and gravels are found in stream valleys.

Historical vegetation included extensive tallgrass prairie on the rolling uplands, with wet prairie, sedge meadow, and marsh in the depressions. Oak Openings were common in some areas, and hardwood forests occurred in areas protected from fire by waterbodies and wetlands. Extensive forests were limited to some of the larger river valleys. Prairie pothole type wetlands were mainly found in parts of St. Croix and Polk counties. Almost half of the current vegetation is agricultural crops, and another third of the area is nonnative grassland, with smaller areas of open water, open wetlands, and urban areas. The major forest types are maple-basswood and oak-hickory, with lesser amounts of lowland hardwoods. Natural conifer forests are rare, and limited to a few tamarack (*Larix laricina*) swamps and small scattered stands of pine (*Pinus* spp.) on steep rocky slopes. Pine and spruce plantations occur in a few areas.

The St. Croix is the largest and most important river flowing through the Western Prairie. The lower St. Croix River is part of the St. Croix-Namekagon National Scenic Riverway, which is administered by the National Park Service. The Willow, Kinnickinnic, and Apple rivers are the major secondary streams. Water quality in some watersheds in this rapidly developing area has been somewhat degraded by poor land use practices that have led to the movement of excess nutrients and sediments. Loss of both forest and grassland cover and stream ***buffers*** to agricultural and residential uses are major factors in diminished water quality. Some restoration projects have helped combat nonpoint runoff, and the wastewater treatment plant discharge at River Falls has been cleaned up considerably. Water quality overall is relatively poor here compared with most ecological landscapes farther north in Wisconsin.

The total area for the Western Prairie Ecological Landscape is approximately 698,000 acres, of which half is agriculture and a third is (nonnative) grassland. Less than 3% of the Western Prairie is in public ownership.

Agriculture is the dominant land use and an important part of the economy of the Western Prairie counties. The Western Prairie counties have the second highest percentage of farmland compared with the other ecological landscape approximations (farmland includes all land under farm ownership such as cropland, pastureland, and woodland). Compared to the other ecological landscape approximations, these counties are third highest in corn production per acre and fourth in milk production per acre. It has the highest percentage of both agricultural and forestland acreage sold and the second highest percentage of land diverted to nonagricultural and nonforest uses.

Overall acreage of lakes is low in the Western Prairie. Per capita water usage in the Western Prairie counties is the lowest of all ecological landscape approximations in the state. Although the population density is not high, it does have the fastest growth rate since 1970 and the lowest median age. The population density (97 persons per square mile) is slightly lower than that of the state as a whole (105 persons per square mile). The population is fairly young, racially homogeneous, and very well educated. Economically, people in the Western Prairie counties are quite prosperous with a high per capita income and the lowest state rates of child and adult poverty and unemployment. Agriculture is important, with a higher percentage of jobs in agriculture than in any other ecological landscape approximation.

Environment and Ecology

Physical Environment

Size

The Western Prairie Ecological Landscape encompasses 1,090 square miles (697,633 acres), representing 1.9% of the area of the state of Wisconsin. It is the third smallest ecological landscape in Wisconsin; however, the Western Prairie is part of a larger ecoregion (Subsection 222 Md in the National Hierarchical Framework of Ecological Units; Cleland et al. 1997) that extends west into Minnesota (MDNR 2009). For details on Subsections, see the "Introduction" to this publication and the "Ecological Landscapes, NHFEU Provinces, Sections, and Subsections" map (Cleland et al. 1997) in Part 3, "Supporting Materials."

Climate

Climate data were analyzed from four weather stations within the Western Prairie Ecological Landscape (Baldwin, Spring Valley, Ellsworth, and River Falls; WSCO 2011). The Western

Prairie has a continental climate, with cold winters and warm summers similar to other southern Wisconsin ecological landscapes (Central Sand Hills, Central Sand Plains, Central Lake Michigan Coastal, Southeast Glacial Plains, Southern Lake Michigan Coastal, Southwest Savanna, and Western Coulees and Ridges). The southern ecological landscapes in Wisconsin generally tend to have longer growing seasons, warmer summers, warmer winters, and more precipitation than the ecological landscapes farther north. Ecological landscapes adjacent to the Great Lakes generally tend to have warmer winters, cooler summers, and higher precipitation, especially snowfall.

The growing season in the Western Prairie averages 145 days (base 32°F), ranging from 143 to 147 days, which is slightly less (seven days) than the mean for other ecological landscapes in the southern part of the state (152 days). Mean annual temperature is 43.7°F (43.4 to 43.9) and mean August maximum temperature is 80.7°F, similar to other southern Wisconsin ecological landscapes. Mean January minimum temperature is 0.4°F, slightly lower than the mean for other southern ecological landscapes (3.5 degrees). Mean annual temperature, mean January minimum temperature, and mean August maximum temperature did not differ significantly among weather stations within this small ecological landscape.

Mean annual precipitation in this ecological landscape is 32.1 inches (30.5–34.4), similar to the state average (32.4 inches), and one inch less than the mean of other ecological landscapes in southern Wisconsin (33.2 inches). Mean annual snowfall is 45.4 inches, ranging from 37.4 to 51.2 inches, similar to other ecological landscapes in southern Wisconsin. Even though weather stations are in close proximity within this small ecological landscape, there is considerable variation in the amount of annual precipitation (almost 4 inches) and snowfall (almost 14 inches) among weather stations. Part of this variability is likely due to observer differences and optional methods employed at some volunteer weather stations (Kunkel et al. 2007).

The climate and topography in the Western Prairie Ecological Landscape was favorable to frequent fires that maintained the prairie vegetation that covered almost one third of the area prior to Euro-American settlement. The length of the growing season, adequate precipitation, and favorable temperatures make conditions suitable for agriculture, which is now the prevalent land use here.

Bedrock Geology

Bedrock that underlies the surface of the Western Prairie Ecological Landscape was deposited during the Paleozoic Era (including the Cambrian and Ordovician Periods) and is predominantly marine sandstone and dolomite. Precambrian igneous and metamorphic bedrocks lie below the Paleozoic deposits. See the map "Bedrock Geology" in Appendix G, "Statewide Maps," in Part 3, "Supporting Materials." (Nomenclature used herein is according to the Wisconsin Geological and Natural History Survey Open-File Report *Bedrock Stratigraphic Units in Wisconsin*; WGNHS 2006).

Precambrian rock originated primarily as basalt from lava flows about 1.1 billion years ago, during the continental rifting period, and was later metamorphosed (Borman 1976, Johnson 2000). Depth to the Precambrian surface is about 400 feet in the northwestern part of the ecological landscape where it was uplifted along faults during a continental collision at about 1.0 billion years ago but in the southeast is about 900 feet below the land surface (Borman 1976). Precambrian bedrock is exposed along the St. Croix River.

Many types of Paleozoic bedrock lie over the Precambrian surface (Figure 23.1). Cambrian bedrock was deposited between 523 and 490 million years ago. The oldest Cambrian Period deposit is the Mount Simon Formation, predominantly a pale colored, fine- to coarse-grained, thin- to thick-bedded sandstone that contains pebble conglomerate and strata of shale near its base. It was deposited from a shallow marine environment as Cambrian seas advanced over the area. The Mount Simon sandstone is

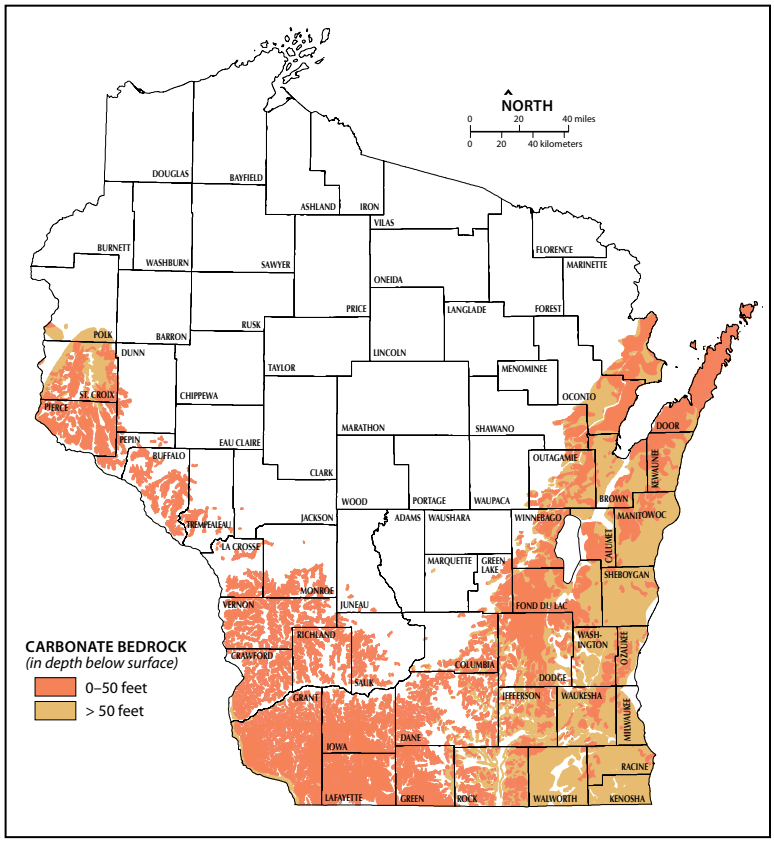


Figure 23.1. *Locations of potential karst and shallow carbonate bedrock in Wisconsin. Reprinted with permission of the Wisconsin Geological and Natural History Survey (WGNHS 2009).*

around 230 feet thick in the far western part of the ecological landscape and thins to the east (Brown 1988).

The Eau Claire Formation, part of the Elk Mound Group, overlies the Mount Simon at thicknesses of up to 130 feet (Figure 23.2). It was deposited in a quieter marine environment as oceans deepened over this area. The Eau Claire is a fine-grained, thin- to thick-bedded, light brown sandstone, fossiliferous in places, and contains a large amount of shale (Brown 1988). After this phase of deposition, the seas retreated and the surface of the Eau Claire was eroded (Schultz 2004).

The Wonewoc Formation lies above the Eau Claire. It is also part of the Elk Mound Group, formed in nearshore environments and broad tidal flats as the Cambrian seas readvanced. The lower portion is fine- to medium-grained, thick-bedded, white sandstone. The upper portion is a coarser grained sandstone, white to brown in color (Brown 1988). The Wonewoc sandstone can be up to 80 feet thick in the ecological landscape but due to erosion is thinner in most places. The Wonewoc sandstone is very poorly cemented but can form steep cliffs with near-vertical faces where overlying rock protects the Wonewoc exposure.

The Wonewoc Formation grades gradually into the overlying Tunnel City Group, which includes the Lone Rock and Mazomanie Formations. Tunnel City rocks are very fine- to fine-grained sandstones, thin-bedded, and up to 100 feet thick. Some strata are glauconitic (i.e., micaceous, containing an iron silicate), and the colors of different strata can be light brown, white, light gray, yellow, or greenish (Brown 1988). Fossils of trilobites and brachiopods can be found locally in this sandstone, indicating marine deposition.

The St. Lawrence Formation, part of the Trempealeau Group, lies above the Lone Rock. It is siltstone and dolomitic siltstone, less than 13 feet thick in the ecological landscape (Brown 1988). Fossils can be found in the St. Lawrence, but are mostly fragmented from transport before deposition.

Jordan Formation rock, also part of the Trempealeau Group, overlies the St. Lawrence Formation. It is the uppermost bedrock layer in the northwestern part of the ecological landscape. It is fine- to-medium grained sandstone and sandy dolomite, up to 125 feet thick. Strata can be white, tan, yellow, or orange-brown in color (Brown 1988). It is the youngest Formation of the Cambrian Period, deposited by the third advance of the seas. It is similar to the Mount Simon and Wonewoc Formations, which were also deposited as seas were advancing over the area. Like the Wonewoc, the Jordan Formation can also form near-vertical cliff faces.

Deposits of Ordovician bedrock occur throughout most of the Western Prairie Ecological Landscape, except in the northwest portion where they were removed by erosion and weathering. Ordovician deposits are the youngest bedrock in the ecological landscape, deposited between approximately 490 and 464 million years ago.

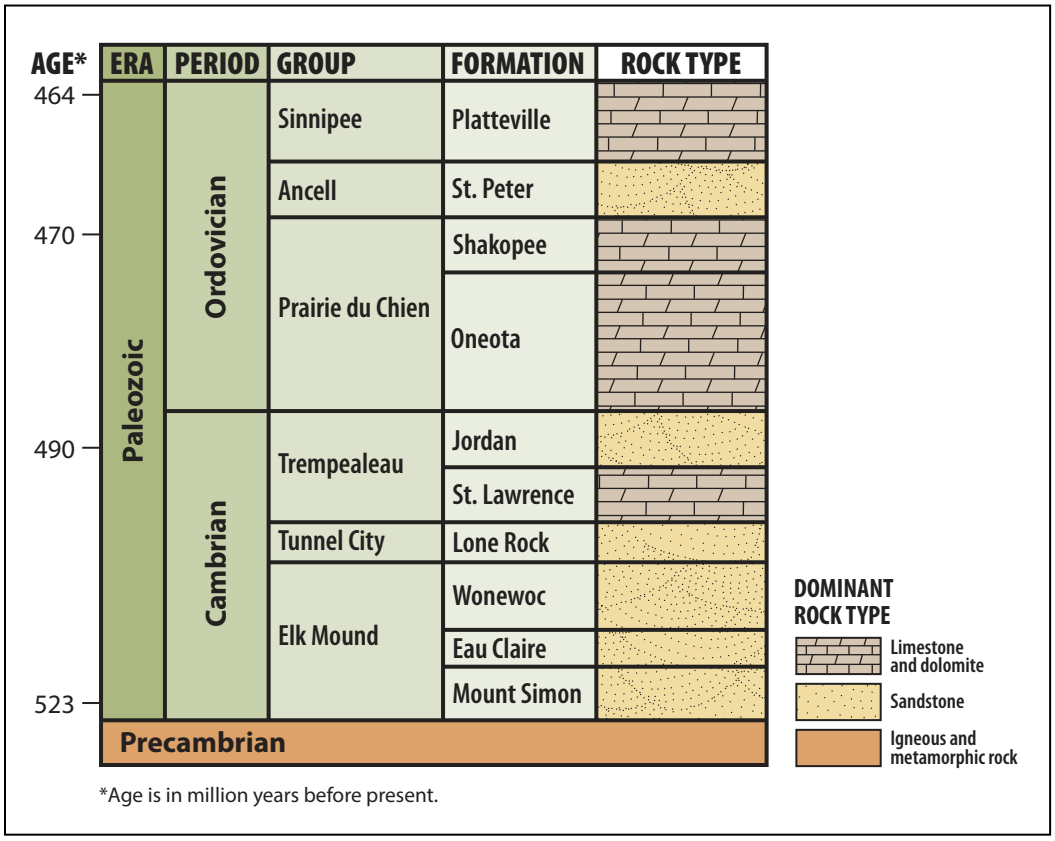


Figure 23.2. *Bedrock strata in the Western Prairie Ecological Landscape. Diagram based on WGNHS (2006).*

The Prairie du Chien Group is the oldest Ordovician deposit and includes the Oneota and Shakopee Formations. The Oneota Formation consists of crystalline, thick-bedded, gray to brown dolomite, up to 100 feet thick. This dolomite contains cavities in which calcite and quartz have formed. Chert is also abundant. Fossils of algal reefs (Cryptozoa) are common in the dolomite, and other fossils can be found in the chert. Shakopee Formation rocks are gray to brown, dominantly dolomite, with strata of dolomitic sandstone and siltstone, up to around 82 feet thick (Brown 1988).

In some locations the Prairie du Chien Group is overlain by younger rocks of the Ancell Group, St. Peter Formation. Between the Prairie du Chien and the St. Peter there is a layer of red clay and chert residuum, indicating that weathering occurred for some time before deposition resumed, and the Prairie du Chien's surface is dissected by erosion (Schultz 2004). The St. Peter Formation consists of fine-to-medium grained, white to pale yellow, quartz-rich sandstone. St. Peter rock can be up to 65 feet thick but in many areas has been partially or completely eroded (Brown 1988).

Rocks of the Sinnipee Group, Platteville Formation, overlie the St. Peter Formation. They are of relatively small extent, and occur only on hilltops in the western part of the ecological landscape. The Platteville Formation is a light brown to buff dolomite, thin- to medium-bedded, and only about 20 feet thick due to erosion (Brown 1988).

Outcrops occur on hillsides and in roadcuts in eastern and southern St. Croix County, in the Apple and Willow river valleys, and along the St. Croix River (Borman 1976). ***Pediments*** or monadonacks occur in the southwestern part of the ecological landscape.

Landforms and Surficial Geology

The Western Prairie Ecological Landscape was entirely glaciated. Glacial materials deposited here include the Copper Falls (Late Wisconsin glaciation), River Falls (Illinoian glaciation), and Pierce (pre-Illinoian glaciation) Formations. Major landforms are till plains, end moraines, and outwash plains.

Approximately the northwestern half of the ecological landscape is covered by surficial deposits of the Superior Lobe during the late Wisconsin glaciation. Elsewhere, the land surface was formed by older glaciations, both Illinoian and pre-Illinoian (Johnson 2000). The Illinoian glaciation occurred between 128,000 and 310,000 years ago, and glaciations prior to that are known as pre-Illinoian (Fullerton et al. 2004). Glacial till is the major type of material deposited throughout the ecological landscape, and most landforms are till plains or moraines, although some outwash is present. Throughout the area, postglacial erosion, stream cutting, and deposition formed floodplains, terraces, and swamps along major rivers. The larger lakes and wetlands are mostly confined to areas covered by the Wisconsin glaciation, where drainage networks are not so deeply incised. Wind-deposited silt material (loess) formed a layer 6 to 48 inches thick (Hole 1976). Pleistocene sediments are 100 to 150 feet thick at the southern edge of Polk County (Johnson 2000). In St. Croix County, sediments are mostly 50 to 100 feet thick, but some deposits near the St. Croix River are up to 400 feet thick.

The oldest glacial deposits in the ecological landscape are of the Pierce Formation. During the mid-Pleistocene, the Des Moines Lobe advanced across Manitoba and Minnesota, depositing calcareous, non-dense, dark gray loam till and lake sediment. This is known as the Reeve Phase, occurring at approximately 460,000 years ago. The glacial advance extended at least as far as the border of St. Croix and Dunn counties and may have reached as far east as Marathon County. Much of the Pierce Formation has been removed by erosion, so this material has a patchy distribution beneath glacial sediments that were deposited later. A relatively small area in the far southern part of the ecological landscape has an eroded till plain formed of Pierce deposits at the surface (Dott and Attig 2004). It is a gently sloping to steep eroded till plain.

An advance of the Superior Lobe, known as the Baldwin Phase, deposited the River Falls Formation sometime prior to 130,000 years ago. The River Falls is a non-calcareous, dense, reddish-brown sandy loam till that occurs at the surface throughout most of the southeast portion of the ecological landscape in St. Croix County and northwestern Pierce County, lying above the Pierce Formation sediments. The River Falls surface is a till plain with eroded hills and pediments in the western part. The extent of River Falls deposits is difficult to determine because of the erosion and mixing of sediments that took place after the Baldwin Phase (Johnson 2000).

The Superior Lobe advanced again, likely within a few thousand years prior to the last Late Wisconsin advance of about 18,000 years ago (Dott and Attig 2004). This advance is known as the Emerald Phase, which reached its maximum extent in central St. Croix County and covered roughly the northwestern half of the ecological landscape (Johnson 2000). It deposited the Poskin Member of the Copper Falls Formation, a non-calcareous, dense, reddish-brown sandy loam till that is distinguished from the other reddish-brown tills in the area by having slightly higher silt content. The landscape along the southern margin of the Emerald Phase advance lacks the typical appearance of an ice-margin terminus, with only a small area of hummocky topography and few ice-block depressions. Geologists think that the climate was much colder during this Phase, so the ice sheet may not have been carrying enough sediment to form the usual features.

The last advance of the Superior Lobe into the ecological landscape is known as the St. Croix Phase. It occurred at about 18,000 years ago, depositing the Sylvan Lake Member of the Copper Falls Formation. The St. Croix ice margin built an end moraine that extends from south of the Twin Cities in Minnesota, through northwestern St. Croix County, and northeastward through Polk County to the Barron-Washburn County line (Johnson 2000). The Sylvan Lake till is a non-calcareous, dense, reddish-brown sandy loam. The moraine has typical glacial features, including hummocky topography

due to the uneven deposition of till as it melted out of the ice sheet and from the collapse of the surface after buried stagnant ice blocks melted. ***Proglacial*** stream sediments formed outwash terraces and fans along the major rivers and in the Horse Creek Channel (between Dresser and Somerset in Polk County, connecting to the St. Croix River valley). The Horse Creek Channel was likely a drainage spillway for an earlier glacial lake, but it unclear which lake this was. An area of ***pitted outwash*** associated with the St. Croix Phase covers approximately 50 square miles northeast of Hudson in St. Croix County (Borman 1976).

A map showing the Landtype Associations (WLTA Project Team 2002) in the Western Prairie Ecological Landscape, along with the descriptions of the Landtype Associations, can be found in Appendix 23.K at the end of this chapter.

Topography and Elevation

The lowest elevation in the Western Prairie is approximately 679 feet along the St. Croix River below the confluence of the Kinnickinnic and St. Croix rivers in Pierce County. The highest elevation is 1,326 feet, south of Glen Hills County Park in eastern St. Croix County (T29N, R15W, Sec. 23).

Topography is typically undulating or rolling on the eroded till plain surfaces that are predominant in the southeastern half of the ecological landscape. Topography ranges from nearly level in wetlands, ***ice-walled lake plains***, and outwash deposits, to hilly and steep in moraines, bedrock-cored hills and pediments, and along river valleys. The River Falls till surface includes eroded hills and bedrock pediments with hilly and steep topography. Topography of the extensively eroded Pierce till plain ranges from gently sloping to steep.

Soils

Soils of the Western Prairie Ecological Landscape are predominantly formed in loamy till glacial deposits, while some are in outwash. A loess cap of aeolian silt is 6 to 48 inches thick over the surface (Hole 1976). The dominant soil is well drained and loamy with a silt loam surface, moderate permeability, and moderate available water capacity. Soils formed in the Copper Falls and River Falls Formations typically have a loess surface layer over reddish-brown non-calcareous dense sandy loam till, or they may be formed entirely in the till in areas where the loess cap was removed by erosion. Soils on the Pierce Formation are typically loess over brown calcareous non-dense loam till. Areas with bedrock near the surface often have loamy deposits over clayey residuum over dolomite, sandstone or shale. Soil drainage classes range from well drained to somewhat poorly drained; soils generally have silt loam to sandy loam surface textures, moderate to very slow permeability, and moderate to high available water capacity. Outwash plain soils formed in loess or loamy alluvium over acid outwash sand and gravel, or may be entirely in outwash sand. These soils range from well drained to somewhat poorly drained and generally have silt loam to sand surface textures, moderate to very rapid permeability, and moderate to low available water capacity. Most lowland soils are very poorly drained non-acid muck, poorly drained loamy till, or poorly drained outwash. The major river valleys have soils formed in sandy and loamy alluvium or non-acid muck. Drainage classes range from moderately well drained to very poorly drained, and some areas are subject to periodic flooding.

Hydrology

Basins

The Western Prairie Ecological Landscape, third smallest of the state's 16 ecological landscapes, lies within parts of two major water basins. It contains approximately the southern 20% of the St. Croix basin and the southwestern 5% of the Lower Chippewa basin. Within the major basins there are only 11 watersheds in this ecological landscape, and only two of those lie wholly within the Western Prairie (the Kinnickinnic River and lower Willow River watersheds).

While this ecological landscape is small, it does contain significant hydrological resources. The topography of rolling ***old drift*** with rich prairie soils is the setting for shallow pothole lakes, ponds, and wet depressions where wet prairies once occurred. Pothole type wetlands are located in southern Polk County and across much of St. Croix County.

The *Wisconsin Land Legacy Report* (WDNR 2006c) identified five important ecological (and in some cases, also recreational) waterway and wetland sites as areas that should be considered for protection over the next 50 years (see Appendix 23.H at the end of the chapter). These are the lower St. Croix River, the corridors of the Trimbelle, Kinnickinnic, and Rush rivers, and a ***mosaic*** of grasslands (including native prairie remnants), wetlands, and water that comprise the Western Prairie Habitat Restoration Area. From an ecosystem management perspective, these areas have generally high conservation significance, are of fairly large size, offer significant protection opportunities, and face substantial threats from rapidly encroaching exurban development.

Inland Lakes

According to the 24K Hydrography Geodatabase, there are only 58 named lakes and 72 unnamed lakes in this ecological landscape (WDNR 2015b). Among all 16 of Wisconsin's ecological landscapes, the Western Prairie ranks 14th in the total number of named lakes, 12th in the total number of unnamed lakes (tied with Superior Coastal Plain) and 13th in the total number of all lakes and the surface area of all lakes. The Western Prairie's unnamed lakes are generally small and shallow. A number of these occur in the northwestern part of this ecological landscape where they are sometimes referred to collectively as the "prairie potholes" and comprise the only concentrated area of prairie pothole lakes in Wisconsin.

Among the larger and better known lakes here are Cedar, Bass, Pine, Perch, and Oak Ridge lakes, as well as Three Lakes and Twin Lakes (all in St. Croix County). Bass Lake is a moderately developed seepage lake of 416 acres, with a maximum depth of 35 feet. Bass Lake and Perch Lake (43 acres, 63 feet

deep) are the only designated Outstanding Resource Water (ORW) lakes in the entire Western Prairie Ecological Landscape (WDNR 2012). A 2003 critical habitat survey of Bass Lake noted that Eurasian water-milfoil (*Myriophyllum spicatum*) had "quickly spread throughout (Bass) lake and caused poor water clarity" (WDNR 2003). After a few years, this invasive species "declined as quickly as it had exploded, and the only reasonable explanation proposed for its decline is the milfoil weevil (*Euhrychiopsis lecontei*) population that already existed in Bass Lake" (Konkel 2007). The milfoil weevil is native to North America but has expanded its host foods to include the invasive Eurasion watermilfoil and is now used as a biocontrol for this exotic plant. Although the milfoil weevil inhabits aquatic habitats during the growing season, it hibernates in leaf litter or other thick plant cover on land during the winter. The critical habitat survey found that the Bass Lake shoreline has extensive undeveloped areas where wetland and upland vegetation, including fallen woody material, provide quality habitat for milfoil weevils as well as for other invertebrates, fish, herptiles, and birds. Important game fish in Bass Lake include bluegill (*Lepomis macrochirus*), walleye (*Sander vitreus*), crappie (*Pomoxis* spp.), northern pike (*Esox lucius*), and largemouth bass (*Micropterus salmoides*).

Perch Lake is a two-story lake that supports trout (Family Salmonidae) in its depths. As of 2010, it still exhibited very good water quality and has been recommended as a high priority for controlling potential nutrient sources that would degrade water quality through eutrophication, which affects most of the other lakes in the Western Prairie.

Three Lakes is an 85-acre seepage lake with a maximum depth of only 5 feet that borders on being hypereutrophic based on its high phosphorous and chlorophyll levels. West Twin Lake is 97 acres with an unrecorded depth and also has excess nutrient problems. Oak Ridge Lake is 149 acres and contains marginal populations of northern pike and panfish due to turbidity that inhibits the development of submergent aquatic vegetation. However, Oak Ridge and a number of shallow pothole lakes nearby support significant wetland wildlife and are included within the St. Croix Wetland Management District, managed as the "Star Prairie Pothole Grasslands" by the U.S. Fish and Wildlife Service.

Pine Lake near Somerset, at 89 acres and 19 feet deep, is a seepage lake with abundant panfish that also supports northern pike and largemouth bass. Like most lakes in the Western Prairie, it is hypereutrophic. Pine Lake near Baldwin is a 107-acre seepage lake with a maximum depth of 21 feet and good populations of game fish. Pine Lake has some protected ***shorelands*** through easements held by the West Wisconsin Land Trust. This lake offers good brood-rearing habitat for waterfowl, and is very near Casey Lake State Wildlife Area. The connected complex of wetlands and uplands of Casey Lake, the nearby Bliss/Potts property of the Western Prairie Habitat Restoration Area, and Pine Lake create an important a complex of nesting and brood-rearing habitat for waterfowl near the headwaters of the Kinnickinnic River.

Lake St. Croix is a natural 8,209-acre widening of the St. Croix River (4,668 of these acres occur in Wisconsin), extending from just below Stillwater, Minnesota, to just below Afton, Minnesota. Maximum depth is 60 feet. The lake receives some of the highest levels of recreational usage of any waterbody in Wisconsin but is often plagued by algae blooms. A team composed of staff from the Minnesota Pollution Control Agency and Wisconsin DNR has been working with partner agencies to collect and analyze long-term water quality data in and near Lake St. Croix. These data are managed by the St. Croix Watershed Research Station of the Science Museum of Minnesota (a nongovernmental organization). The lake was included in the U.S. Environmental Protection Agency's 1972–1975 National Eutrophication Survey (Allum et al. 1977) because of the excess nutrients that it accumulates. It was also designated as an impaired water in 2008, which has generated a ***total maximum daily load*** (TMDL) pollutant load study, which was released in 2012 (MPCA-WDNR 2012).

Several lakes in the grassland areas provide important habitat for waterfowl and other wetland birds. Overall, these small lakes support a diverse mix of plants and animals, including emergent and submergent aquatic vegetation. Some of the species dependent on these shallow pothole lakes include Blue-winged Teal (*Anas discors*), Northern Shoveler (*Anas clypeata*), Wood Duck (*Aix sponsa*), and Hooded Merganser (*Lophodytes cucullatus*). The Wisconsin Threatened Red-necked Grebe (*Podiceps grisegena*) has been recorded as a nester on some of these lakes, but this species is extremely rare in the Western Prairie Ecological Landscape.

A number of lakes in this ecological landscape are infested with nonnative invasive species, with varying mixes of curly-leaf pondweed (*Potamogeton crispus*), Eurasian water-milfoil, or zebra mussels (*Dreissena polymorpha*). These include Bass Lake, Cedar Lake, Goose Pond, Hatfield Lake, Lake St. Croix, Little Falls Lake, Mallalieu Lake, Mounds Lake, and Perch Lake. Because many lakes here are eutrophic, some shoreline property owners use aerators to maintain oxygen at levels high enough to keep fish alive during winter.

Impoundments

There are 85 existing dams in this ecological landscape, creating 2,348 acres of impoundments that store 7,594 acre-feet of water (WDNR 2015b). Nine other dams have been removed over the past several decades, for safety, economic, habitat restoration, or other reasons. Impoundments, including Twin Lake, George Lake, and Eau Galle River Reservoir, tend to be eutrophic. Lake George, a 135-acre impoundment on the Eau Galle River, has high nutrient loadings that contribute to poor water quality and aquatic habitat impairment.

There are three impoundments on the Willow River. The largest, Mallalieu Lake, is a 270-acre flowage, with a maximum depth of 17 feet, on the lower Willow River at Hudson. It is a hypereutrophic lake with poor water quality due to high nutrient levels (from agricultural and residential land uses), high algal concentrations, and poor water clarity that

is exacerbated by an infestation of common carp. Despite the high nutrient levels, smallmouth bass (*Micropteris dolomieu*) growth rates and size distribution in Lake Mallalieu are outstanding, according to Wisconsin DNR fish management metrics. However, northern pike are not faring well here despite a good yellow perch (*Perca flavescens*) population as a food source. Northern pike are sight feeders whose predatory success is hampered by the heavy turbidity and low water clarity in this lake. More importantly, in summer larger northern pike prefer deeper, cooler littoral habitat containing tall aquatic plants that also provide habitat for one of their major prey species, yellow perch. The heavy turbidity of Lake Mallalieu prevents the establishment of aquatic vegetation at these cooler depths near the bottom of this relatively shallow lake. For this reason and also due to concerns over the potential for northern pike to move upstream into the Willow River to prey upon the trout population, no efforts will be made to enhance the northern pike population. The bluegill population is also suffering from the dearth of aquatic vegetation away from the shallower nearshore waters (Michalek and Engel 2001, Engle and Andre 2013).

A critical habitat survey determined that northern waternymph (*Najas flexilis*), a drawdown-tolerant and turbidity-tolerant native aquatic plant, is the dominant plant species, especially in the 1.5–5 foot depth zone, where it grows at above average densities (WDNR 2006a). A follow-up study has determined that implementation of a 2001 lake management plan has not had the desired results in controlling invasive plant species or turbidity, or in increasing aquatic plant diversity (LMLA 2014).

Little Falls Lake is a shallow 172-acre flowage on the Willow River. Little Falls Lake is within Willow River State Park, and many visitors come here to fish, row, sail, and view wildlife. Motorized craft are not allowed. Thirty-eight percent of the lake is less than 3 feet deep, and much of that is less than 6 inches deep. It is very eutrophic due to excessive nutrients from a combination of agricultural, municipal, and industrial sources. New Richmond Flowage on the Willow River is a 236-acre drainage lake with small populations of game fish. According to Wisconsin DNR water quality assessments, this shallow impoundment is also very eutrophic and plagued with excessive weed growth.

As of 2010, there were still two small hydropower dams and reservoirs on the Apple River near Somerset, with at least six other smaller dams on that stream and two dams on the Kinnickinnic River near River Falls (SCRA 2011).

Rivers and Streams

There are 258 miles of perennial streams in the Western Prairie Ecological Landscape, including cold headwaters streams, coolwater streams, and larger warmwater rivers (WDNR 2015b). While this ecological landscape holds far fewer high quality coldwater streams than many other ecological landscapes per unit of area, those that occur here are very important for maintaining lower water temperatures, high oxygen levels, and good water quality in the streams and rivers that receive these colder waters.

The lower St. Croix River forms the western boundary of the Western Prairie Ecological Landscape. Other important rivers (due to combinations of flow volume, habitat values, and levels of recreational use) include the Apple, Kinnickinnic, and Willow, which all flow directly into the St. Croix. The Trimbelle, the Rush, and their tributaries flow south into the Mississippi River, and the Eau Galle system drains into the Mississippi via the Chippewa River.

The lower St. Croix includes the 52 miles of river from the large dam at St. Croix Falls downstream to the confluence with the Mississippi River at Point Douglas (near Prescott, Wisconsin). This stretch of the river is of exceptionally high ecological value for the aquatic life it supports, especially for rare mussels and fish and for the large numbers of migratory birds that use the St. Croix River corridor. It is highly threatened by heavy recreational use and intensive development.

The lower St. Croix River widens somewhat at Hudson because of a natural sandy delta that has formed downstream at the mouth of the Kinnickinnic River. Farther downstream, in the vicinity of Stillwater, Minnesota, the river slows to form Lake St. Croix. Lake St. Croix is generally deeper than the rest of the lower river and has a silt and sand substrate. The lowermost 25 miles of the St. Croix River are lake-like, to the confluence with the Mississippi River at Prescott, where the Mississippi created a large bar of sediment and other materials that slows the current. Although the lower St. Croix River was naturally a very low gradient stream here, the Mississippi lock and dam downstream has further slowed the St. Croix and impairs its riverine habitat values. Above Stillwater, where there is appreciable current, the lower St. Croix River still features areas with a rocky bottom. This substrate is favored by lake sturgeon (*Acipenser fulvescens*), which are recorded occasionally in this stretch but are more common farther upstream, in the Forest Transition and Northwest Sands ecological landscapes (WDNR 2013b). Emergent and

Spring-fed ponds, riverine lakes, running sloughs, and extensive stands of floodplain forest border the lower St. Croix River at this site in southwestern Polk County. Photo by Eric Epstein, Wisconsin DNR.

submergent aquatic communities occur in backwaters of the St. Croix River, and there are also significant stands of wet prairie and floodplain forest. The lower St. Croix River is a large, partially protected but threatened corridor, of high significance to migratory birds and many other species.

Some of the most significant floodplain forest stands on the lower St. Croix River are in Polk and St. Croix counties. The protection level is relatively high, as this area is within the St. Croix National Scenic Riverway administered by the National Park Service and also partially within the St. Croix Islands State Wildlife Area. However, recreational use of this area is very high and impacts should be monitored. Residential development on the bluffs above the floodplain has increased rapidly in recent years, and the conservation implications include the inadvertent introduction of invasive species, increased rates of sediment and nutrient deposition, habitat fragmentation and loss of connectivity, loss of or disturbance to forested bluffland habitats adjoining the floodplain, and generally higher levels of human use and all that goes with that.

There are a number of streams with sufficient coldwater inputs from springs and groundwater that they support functional coldwater communities. The most well-known rivers among trout anglers are the Rush and Kinnickinnic rivers. Parts of the Rush River corridor have been restored. The valley of the Rush River supports rare woodland plants, its floodplain contains many wetlands species, and the upper ***reaches*** of the stream support trout and an overall high quality coldwater community. Heavy rains and spring snowmelt bring substantial siltation to the main stem of the Rush and some of its tributaries.

The Trimbelle River originates in the rolling, open, primarily agricultural landscape of northern Pierce County. Its coldwater habitat values here are not as pronounced as they are farther south as the river flows into the more heavily forested Western Coulees and Ridges Ecological Landscape.

Other good quality coldwater streams here include tributaries of the Kinnickinnic River (including its South Fork and Kelly, Ted, and Nye creeks), South Fork of the Willow River, part of the upper Eau Galle River, and the upper Big River.

Coolwater streams in this ecological landscape are generally associated with spring flows and groundwater inputs, but lack of natural cover and a variety of land uses such as tillage to within a few feet of stream banks and allowing pastured cattle to trample streambanks can render some of these waters unable to support native coldwater species, such as brook trout (*Salvelinus fontinalis*). Some can support substantial populations of less sensitive, more tolerant nonnative brown trout (*Salmo trutta*), while others serve as ***nongame*** fish streams.

The Kinnickinnic River above River Falls is an Outstanding Resource Water (ORW) with 25 miles of high quality restored coldwater habitat. This stream naturally (with no stocking) produces native brook and nonnative brown trout in average densities of 5,000 to 6,000 trout per mile with maximums of 8,000 trout per mile—some of the highest in the U.S. The main effect of the high trout densities is slow growth rates due to the competition for aquatic insects (there is little to no forage minnow base in the upstream 15 miles). Water quality, habitat features, and colder temperatures from strong groundwater flows are now better protected by fenced buffers and other positive changes to agricultural practices in this watershed. Below River Falls, the Kinnickinnic is warmed only slightly by storm water from the rapid change in land use, trending from agricultural to suburban and urban, as well as by dam discharge, but it supports minnows and crayfish that enable brown trout to grow to more than 20 inches in length (M. Engle, Wisconsin DNR, personal communication).

This river is well known for its trout fishing upstream of River Falls, especially due to its proximity to the Minneapolis/St. Paul population center. The Kinnickinnic is also famous for its scenic bluffs and bedrock exposures, which are most dramatic in the vicinity of its confluence with the St. Croix River. The lower Kinnickinnic and its canyon are partially protected within Kinnickinnic State Park. Other reaches of the Kinnickinnic and surrounding lands are protected by public and private partners, including the City of River Falls, a local land trust, and a Wisconsin DNR state fishery area. Below River Falls, the lower Kinnickinnic River flows through a deep, steep-sided rockbound valley that harbors unusual cliff plants and offers opportunities for the restoration of rare or declining native plant communities such as oak forest, oak savanna, and prairie.

The Willow River represents another stream corridor with high conservation values. Two dams were removed from the Willow River in the 1990s (Willow Falls and Mound Pond) to help trout restoration efforts. The upper section of the Willow River, above New Richmond, supports good brown trout and coolwater invertebrate populations. The lower Willow River, in the vicinity of North Hudson, features quality wetlands and a number of springs that contribute to flow stability and high water quality. The Willow was formerly regarded as one of the best brook trout streams in the state, but ***high capacity wells***, agricultural runoff, and stormwater runoff have depleted stream base flow and raised water temperatures to an extent that brown and rainbow trout (*Oncorhynchus mykiss*) are now the only trout species found there (TU 2014).

Most of the Apple River is a shallow, warmwater stream that has been a long-time favorite stream for floating by inner-tube. A few miles above its confluence with the St. Croix River, it has cut a gorge over 100 feet deep through five different bedrock layers. Much of this downcutting happened while Glacial Lake Grantsburg drained, approximately 12,000 years ago. Featuring a diverse array of microclimates and rock exposures, the core of this area is protected within the 160-acre Apple River Canyon ***State Natural Area***. Three dams were removed from the Apple River (Somerset, McClure, and Huntington) in the late 1960s to improve recreational use. The Apple River supports a population of the Wisconsin Threatened gilt darter (*Percina evides*).

Other warmwater streams tend to support mostly nongame fish and include the lower reaches of Tenmile Creek and Black Brook as well as the uppermost headwaters of the Eau Galle River. However, this stretch of the Eau Galle is too turbid from agricultural runoff to provide good aquatic habitat. Some rivers here have been invaded by nonnative species, including the St. Croix, which has infestations of zebra mussels and rusty crayfish (*Orconectes rusticus*), and the Willow, which now has rusty crayfish. These exotic invaders can diminish habitat values for native species.

Springs

The Western Prairie Ecological Landscape contains 122 documented springs (Macholl 2007). These springs are scattered widely across St. Croix and northern Pierce counties. A cluster of springs also occurs in the Rush River watershed of south central St. Croix County, and another is along the Willow River south of New Richmond.

Springs were vital to the health of the Rush River prior to Euro-American settlement, but deforestation and conversion of prairie and oak savanna to agricultural cropland disrupted groundwater recharge and greatly harmed the coldwater characteristics of this and other streams. It required nearly 70 years of conservation and restoration efforts to restore adequate coldwater base flow conditions to once again support repopulation of much of the Rush River, its tributaries, and other streams here with native brook trout (WDNR 2002a).

Wetlands

The Western Prairie Ecological Landscape has about 25,370 acres of wetlands, including 9,600 acres of emergent/wet meadow and 11,800 acres of forested wetlands. The Western Prairie has the second smallest percentage of wetlands (3.7%) and second smallest number of acres of wetlands when compared to other ecological landscapes in Wisconsin. The most extensive wetland types are emergent marsh, wet prairie, and floodplain forest, and much of this acreage occurs within the floodplain of the St. Croix River.

In the Western Prairie's interior, many of the wetlands associated with the pothole lakes have been altered or destroyed by prolonged periods of heavy grazing, plowing and conversion to row crop production during dry years or degraded by infestations of invasive plants. As an example, Wisconsin DNR wetlands managers estimate that in the upper Willow River watershed approximately half of the wetlands have been filled, drained, or degraded since Euro-American settlement, including those wetlands associated with prairie pothole ponds and lakes. Throughout much of the Western Prairie Ecological Landscape, however, few diverse wetland complexes remain because most shallow ephemeral, seasonal and temporary wetlands have been drained or severely altered, which often led to the destruction and total loss of wetland communities such as sedge meadow and wet prairie. In a few areas, small pothole wetlands remain amid rolling topography that had been characterized as too difficult to drain efficiently (USFWS 2008). Higher water levels due to dams on the Willow and Apple rivers have raised water levels, turning former marshes and sedge meadows into lakes with relatively little wetland vegetation.

Waterfowl, aquatic mammals, herptiles, fish, invertebrates, and other bird species benefit from the habitats provided by wetlands here, though they are relatively scarce here compared with their abundance in other ecological landscapes. For waterfowl, some wetlands exhibit a high density and biomass of emergent and submersed plant stems that are especially valuable for the invertebrate animals they nurture (Lillie 2004). A portion of this mosaic of wetlands, grasslands, and pothole lakes is being managed for the benefit of grassland bird species and waterfowl as the Western Prairie Habitat Restoration Area. With a proposed goal of 20,000 acres of grassland and open wetland habitat, about 5,100 acres have been protected by the State of Wisconsin, and more than 1,700 acres have been protected by private land trusts as of 2013 (Harvey Halvorsen, Wisconsin DNR, personal communication). Another 6,700 acres have been protected by the federal government, including ***waterfowl production areas*** by the U.S. Fish and Wildlife Service's St. Croix Wetland Management District and lands along the St. Croix River by the National Park Service. Not all of these acres of protected land count toward the grassland and wetland habitat goal because they include lands vegetated with other habitat types that are neither grassland nor wetland.

The margins of a few lakes still have high quality emergent wetland vegetation. For example, Cedar and Bass lakes in St. Croix County have shorelines and littoral areas that still support stands of bulrush (*Schoenoplectus* spp., *Scirpus* spp.) and other native emergent aquatic plants that contribute to biological diversity, sediment containment, and general health and diversity of the aquatic community. The St. Croix Islands Wildlife Area (St. Croix County) contains high quality emergent and forested wetlands. According to Wisconsin DNR and Great Lakes Indian Fish and Wildlife Commission data, there are only three recognized wild rice (*Zizania* spp.) waters (Peaslee Lake, Oak Ridge Lake, and Rice Lake) within this ecological landscape.

Residential development on hilltops and bluffs above rivers can increase erosion into the river systems and alter shoreline wetland habitats, degrading the quality of both wetlands and water. Increasing human population levels, much of it due to expansion of the nearby Twin Cities metropolitan area, has resulted in rapidly increasing amounts of residential development and associated infrastructure, often surrounding and fragmenting wetlands, leaving a minimal upland buffer. Agricultural practices in this region of productive soils are intensive and may leave no buffer at all around the small pothole lakes and ponds. Invasive plants such as reed canary grass (*Phalaris arundinacea*) and purple loosestrife (*Lythrum salicaria*) can replace native plant populations and lower wetland diversity. Invasive animals such as common carp (*Cyprinus carpio*) are a problem in some waterbodies

and deep marshes. The use of lakes and ponds to raise baitfish is a threat to the food base (e.g., aquatic insects) used by waterfowl, other waterbirds, and amphibians. There are relatively few dams in this ecological landscape, but several large dams exist on the Willow and Apple rivers, and these have raised water levels and altered the types, extent, and locations of wetland communities. Dams also change the timing and duration of floods and associated water level fluctuations. Past drainage for agricultural use has reduced the amount and quality of marsh habitat. Filling wetlands for roads and railroads has impacted some wetlands by altering their hydrology or destroying them outright.

Water Quality

A number of watersheds in this ecological landscape exhibit degraded water quality. The combination of the loss of prairie, savanna, and forest cover; intensive agricultural practices; accelerated residential development; and wetland drainage has led to the introduction of excessive nutrients and sediments into streams and lakes. Agricultural land uses now occupy 48% of the total area of the watersheds in the Western Prairie Ecological Landscape. Forest cover in the Western Prairie watersheds averages less than 15%, while grassland cover averages around 25% (WDNR 2002b). This is in stark contrast to most ecological landscapes farther north (the Forest Transition is a significant exception, at least in part), where agricultural land uses occupy less than 10% of the land area, and where many of the watersheds are 50% to 75% forested. In the Western Prairie, native grassland cover protected water quality in most watersheds prior to Euro-American settlement. Much of that has been converted to agricultural uses, with attendant water quality impacts. Loss of the woodland cover that did exist in the headwaters of a few streams that begin in the eastern portion of this ecological landscape, but flow into the Western Coulees and Ridges Ecological Landscape, has also contributed to water quality problems in the Western Prairie. For example, the Eau Galle watershed has been transformed from being "almost entirely" forested to 34% forested, and streams here are now impacted by feedlot and barnyard runoff (WDNR 2013a).

Outstanding Resource Waters (ORW) and ***Exceptional Resource Waters (ERW)*** are surface waters that have good water quality, support valuable fish and wildlife habitat, provide outstanding recreational opportunities, and are not significantly impacted by human activities. Waters with ORW or ERW status warrant additional protection from the effects of pollution. Both designations have regulatory restrictions, with ORWs being the most restricted. These designations are intended to meet federal Clean Water Act obligations and prevent lowering of water quality or degradation of aquatic habitats in these waters. They are also used to inform and help guide land use changes and human activities near these waters.

Several waterbodies here retain good water quality and have been designated as ORW/ERW waters. ERW lakes are Bass Lake, Perch Lake, and Lake St. Croix (although Lake St. Croix is also listed as 303(d) impaired due to eutrophic conditions). Cedar Lake is an ORW water due to the presence of substantial vegetated shoreline areas and is the only ORW lake in this ecological landscape.

Only one stream, the Rush River (one ***segment*** totaling 25 miles), has been designated as an ORW in this ecological landscape. ERW streams are the Trimbelle River (one segment totaling less than 2 miles), three segments of the Kinnickinnic River totaling about 36 miles, Rocky Run, Parker Creek, St. Croix River (three segments totaling about 55 miles), Cady Creek, one segment of the Apple River, and six segments of the Willow River totaling 9 miles. The lower section of the Saint Croix River is also impaired due to sediments contaminated with ***polychlorinated biphenyls*** (PCBs). A complete list of ORWs and ERWs in this ecological landscape can be found on the Wisconsin DNR website (WDNR 2012).

Waters designated as impaired on the ***U.S. Environmental Protection Agency (EPA) 303(d) list*** exhibit various water quality problems, including PCBs in fish, sediments contaminated with industrial metals, mercury from atmospheric deposition, bacteria from farm and urban runoff, and habitat loss and degradation. Since the 303(d) designation is narrowly based on the criteria above, a waterbody could be listed as a 303(d) water as well as a ORW or ERW. These designations are not mutually exclusive. A plan is required by EPA on how 303(d) designated waters will be improved by the Wisconsin DNR. This designation is used as the basis for obtaining federal funding, planning aquatic management work, and meeting federal water quality regulations.

Seven lakes are 303(d) impaired waters: Glen Lake, Lake St. Croix, Mallalieu Lake, Squaw Lake, Cedar Lake, and Twin Lakes. Glen Lake is affected by atmospheric mercury deposition, while the rest suffer from eutrophication caused by nonpoint nutrient runoff. Remaining isolated pothole lakes that have not been subjected to drainage or other direct hydrologic modifications are nevertheless negatively impacted by nonpoint farm and residential runoff.

Impaired rivers here are affected by agricultural runoff and negative dam impacts and include portions of the Eau Galle, Willow, and Mississippi rivers and three segments of the St. Croix River. All of these impaired waters are impacted by sediment build-up, while some also suffer increased temperature or loss of in-stream habitat. Maintaining high water quality in the St. Croix is an ecological consideration of the highest importance, which means that water quality of the St. Croix's many tributaries is also a major conservation concern. The complete list of 303(d) impaired waters and criteria can be viewed at the Wisconsin DNR's impaired waters web page (WDNR 2010a).

The nearness of this ecological landscape to the Twin Cities metropolitan area has led to greatly increased residential development on or close to lakes and rivers in addition to a general expansion of urban and exurban areas. This has contributed to problems such as sedimentation, thermal effects from storm water, and other negative water quality impacts

(WDNR 2002a). However, some waterbodies remain in very good condition, and there are lake associations that are advocating for additional watershed protections to maintain waters in good condition.

Groundwater quality problems are common in nearly all watersheds in the Western Prairie Ecological Landscape due to a combination of factors including soils, bedrock type and structure, and agricultural land use practices. According to the Wisconsin DNR State of the Basin reports, the Kinnickinnic River watershed has the highest contamination potential in the St. Croix basin, with 130 wells having either high levels of nitrates and/or detections of pesticides (atrazine metabolites) that have migrated into the groundwater from the soil surface (Masarik et al. 2006). In only one case was the pesticide level above the safe drinking water standards. Agricultural land cover in the Kinnickinnic, Lower Willow, Upper Willow, and Lower Apple watersheds ranges from 38% to 49%. Along with large animal feeding operations, these agricultural lands are contributing to the pesticide and nutrient loading of groundwater. The Trimbelle River and Isabelle Creek watersheds have high levels of nitrate and pesticide groundwater contamination, based on some of the wells that were tested (see Appendix 23.A at the end of this chapter).

University of Wisconsin-Extension Discovery Farms research projects include a study of the Dry Run Creek subwatershed in the Willow River watershed. This five-year study (2010–2016) is investigating ways to effectively address agriculture-related water quality problems common to this ecological landscape. This project includes research on effective modifications of agricultural practices to address water quality problems and tests innovative ways to communicate the importance of watershed conservation to agricultural producer groups (UWEX-DFW 2013).

Biotic Environment

Vegetation and Land Cover

Historical Vegetation

Several sources were used to characterize the historical vegetation of the Western Prairie Ecological Landscape, relying heavily on data from the federal General Land Office's public land survey (PLS), conducted in Wisconsin between 1832 and 1866 (Schulte and Mladenoff 2001). PLS data are useful for providing estimates of forest composition and tree species dominance for large areas (Manies and Mladenoff 2000). Finley's map of historical land cover based on his interpretation of PLS data was also consulted (Finley 1976). Additional inferences about vegetative cover were sometimes drawn from information on land capability, climate, disturbance regimes, the activities of native peoples, and various descriptive narratives. More information about these data sources is available in Appendix C, "Data Sources Used in the Book," in Part 3 ("Supporting Materials").

According to Finley's map and data interpretation (Finley 1976), in the mid-1800s the Western Prairie Ecological Landscape was a mixture of different forested and open communities (Figure 23.3). As classified by Finley, the Western Prairie had the largest percentage of prairie and brush combined (35%) of all ecological landscapes in Wisconsin. Note that "Oak Openings," as defined by Curtis (1959) and Finley (1976), were at least 50% "open." (Also see the map "Vegetation of Wisconsin in the Mid-1800s" in Appendix G, "Statewide Maps," in Part 3, "Supporting Materials.") PLS information has been converted to a database format, and relative importance values (RIV) for tree species were calculated based on the average of tree species density and ***basal area*** (He et al. 2000). Relative importance value (RIV) is not a measure of land cover or area; rather it gives an indication of the importance of an individual species or group of species in a given land area. This analysis indicates that there was a high degree of heterogeneity in tree species in this ecological landscape. Sugar maple (*Acer saccharum*) had the highest RIV (18.3%), followed by aspen (*Populus* spp.) (14.8%), white oak (*Quercus alba*) (12.9%), and bur oak (*Quercus macrocarpa*) (11.6%). The RIV for aspen (14.8%) was the highest RIV for aspen of all of the ecological landscapes and is one of several indicators that disturbances such as wildfire were common here during and prior to the 1800s. See the map "Vegetation of the Western Prairie in the Mid-1800s" in Appendix 23.K at the end of this chapter.

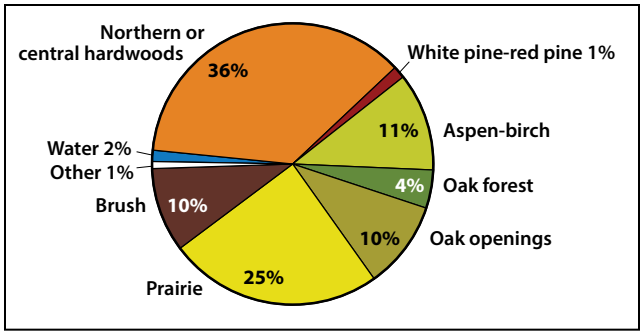


Figure 23.3. *Vegetation of the Western Prairie Ecological Landscape during the mid-1800s as interpreted by Finley (1976) from the federal General Land Office public land survey information.*

Current Vegetation

There are several data sets available to help assess current vegetation on a broad scale in Wisconsin. Each was developed for different purposes and has its own strengths and limitations in describing vegetation. For the most part, WISCLAND (Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data), the Wisconsin Wetlands Inventory (WWI), the U.S. Forest Service's Forest Inventory and Analysis (FIA), and the National Land Cover Database (NLCD) were used. Results among these data sets differ as they are the products of different methodologies for classifying land cover, and each data set was compiled based on sampling or imagery collected in different years, sometimes at different seasons, and at different scales. In general, information was cited from the

data sets deemed most relevant for the specific factor being discussed. Information on data collection methodologies, strengths, and limitations is provided in Appendix C, "Data Sources Used in the Book," in Part 3, "Supporting Materials." WISCLAND land use/land cover data from 1992 classifies general land cover attributes and can be useful in characterizing large-scale land use features and attributes. It is based on satellite imagery from 1992 so it does not represent present day information. We use it here to offer a general view of the broad patterns of land use and land cover in a given ecological landscape.

The Western Prairie Ecological Landscape is approximately 697,000 acres in size, of which approximately 19% was forested, and 81% was nonforested in 1992 (WDNR 1993). WISCLAND land use/land cover data also indicate that 29% of the ecological landscape was classified as grassland, which is the highest percentage of grasslands (albeit, nearly all of it is composed of nonnative species) of all of the ecological landscapes (Figure 23.4).

The Wisconsin Wetlands Inventory (WDNR 2010b) offers a more specific assessment of wetlands than is available by using WISCLAND data but is limited to those areas identified from interpretation of aerial photographs as wetland. According to the Wisconsin Wetlands Inventory, wetlands occupy a very low portion of the Western Prairie Ecological Landscape, comprising only 3.7%, (approximately 26,000 acres) of this ecological landscape's cover. Forested wetlands make up approximately 12,000 acres, making these the most abundant wetlands in the Western Prairie. No other wetland type here occupies more than 10,000 acres. Additional information on wetlands and wetland flora may be found in the "Natural Communities" and "Flora" sections of this chapter and in Chapter 7, "Natural Communities, Aquatic Features, and Selected Habitats of Wisconsin."

Forest Inventory and Analysis (FIA) data from 2004 compiled point samples of forested lands to assess the timber resources of the nation. It contains more information on forest types and species compositions that can be generalized across the ecological landscapes and offers more specific information about forested lands than WISCLAND. Because FIA is derived from on the ground sampling as opposed to examination of satellite imagery, the numbers may lead to different interpretations of the status and composition of forests than WISCLAND. According to FIA data summarized in 2004, approximately 80% of the area in the Western Prairie Ecological Landscape is nonforested and about 20% is forested (the totals are very close to WISCLAND) (USFS 2004). The predominant forest ***cover type*** group is northern hardwoods (29.6% of the forested area), followed by oak (21.9%). All other forest types occupy less than 20% of the forested area. Always a problem in the ecological landscapes with significant remnant savannas or savanna management potential, such vegetation is most often classified as "forest" by FIA.

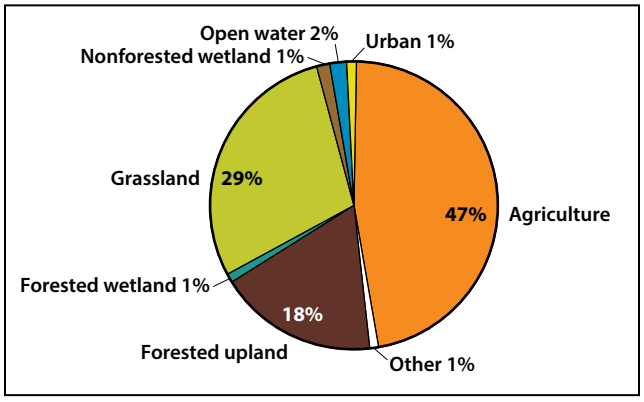


Figure 23.4. *WISCLAND land use/land cover data showing categories of land use classified from 1992 LANDSAT satellite imagery for the Western Prairie Ecological Landscape (WDNR 1993).*

Changes in Vegetation Over Time

The purpose of examining historical conditions is to identify ecosystem factors that formerly sustained species and communities but that are now altered in number, size, or extent or that have been changed functionally (for example, by constructing dams or suppressing fires). Although data are limited to a specific snapshot in time (though this "snapshot" was accompanied by major changes in human culture, population densities and patterns, and land use), they provide valuable insights into Wisconsin's ecological capabilities. Maintaining or restoring some lands to more closely resemble historical systems and including some structural or compositional components of the historical landscape within actively managed lands can help conserve important elements of biological diversity and better ensure their long-term viability in Wisconsin. We do not mean to imply that entire ecological landscapes should be entirely restored to historical conditions, as this is neither possible nor necessarily desirable within the context of providing for human needs and desires. Information on the methodologies used, and strengths and limitations of the vegetation change data is provided in Appendix C, "Data Sources Used in the Book," in Part 3 of this publication.

Although the percentage of "grassland" is high here, 29% of the area based on WISCLAND (WDNR 1993), almost all of this is composed mostly of nonnative species. Very little is native prairie. Prairies were historically abundant here (25% of the area according to Finley) but are now extremely rare and occur almost entirely on steep west or southwest-facing bluffs along the St. Croix River, within transportation and utility corridors, or on dry knolls, which for one reason or another escaped the plow.

The virtual disappearance of prairies and savannas is the most dramatic large-scale change in vegetation across the Western Prairie Ecological Landscape. The abundance and distribution of major vegetation types at the time of the federal land survey indicate that roughly 60% of this ecological landscape had been affected by wildfire prior to settlement of the region by Euro-Americans. Besides the prairies (25%)

and oak savannas (10%), lands covered in brush (10%), aspen-birch forest (11%), and oak (*Quercus* spp.) forest (4.4%) were almost certainly affected by periodic wildfire, creating a mosaic of these differing communities and habitats. The gently rolling topography and the scarcity of wetlands and large waterbodies would have allowed fires to run unchecked over large distances.

The relative importance value (RIV) for tree species at the time of the federal public land survey was compared with FIA data summarized in 2004 in order to assess the change in tree species over roughly the past 150 years (Figure 23.5). Here, only FIA data for trees greater than 6 inches in diameter were used to make those data more comparable with the public land survey data. It is also important to remember that RIV does not represent the amount of land covered by a given species or group of species. Rather, it gives an indication of how important (as an average of basal area and density) a given tree species was in the current or past forested land. See Appendix C, "Data Sources Used in this Book," in Part 3, "Supporting Materials," for further discussion of RIV.

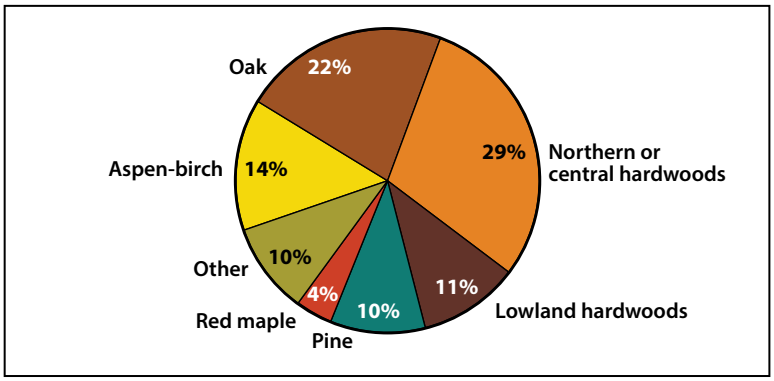


Figure 23.5. *Forest Inventory and Analysis data (USFS 2004) showing forest type as a percentage of forested land area (greater than 17% crown cover) for the Western Prairie Ecological Landscape. See Appendix C, "Data Sources Used in the Book," in Part 3, "Supporting Materials," for more information about the FIA data.*

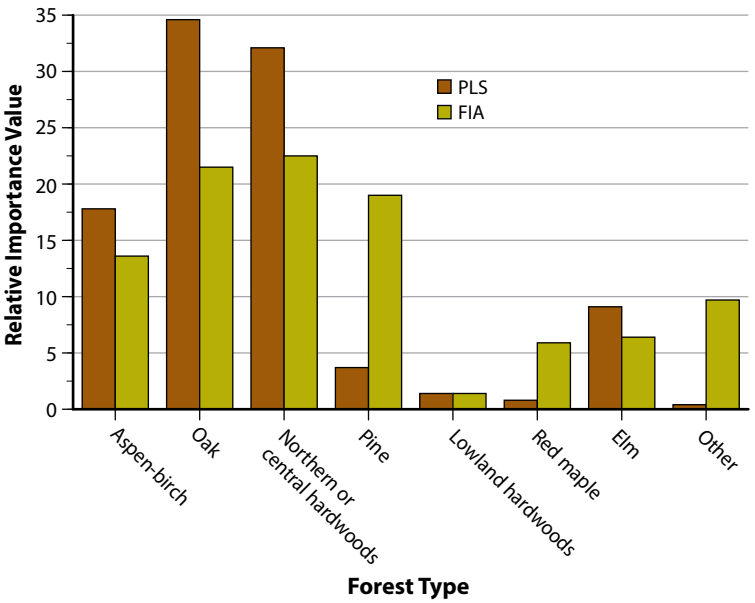


Figure 23.6. *Comparison of tree species' relative importance value (average of relative dominance and relative density) for the Western Prairie Ecological Landscape during the mid-1800s, when federal General Land Office public land survey (PLS) data were collected, with 2004 estimates from Forest Inventory and Analysis (FIA) data (USFS 2004). Each bar represents the proportion of that forest type in the data set (totals equal 100). Trees of less than 6-inch diameter were excluded from the FIA data set to make it more comparable with PLS data. See Appendix C, "Data Sources Used in the Book," in Part 3, "Supporting Materials," for more information about the PLS and FIA data.*

Current forest vegetation (based on FIA) is roughly an even split between northern hardwoods (22.5% of RIV), oak species (21.5% of RIV), and pine species (19.0% of RIV) (Figure 23.6). The RIV for pine species has increased dramatically (from 3.7% to 19.0% of RIV), with red pine (*Pinus resinosa*) having the only increase (from 0.05% to 16.8% of RIV) of any pine species (note that these increases are almost entirely due to the development of pine plantations. Natural red pine is extremely rare and local in this ecological landscape). Oak species have decreased from 34.6% to 21.5% of RIV, and northern hardwood species have decreased from 32.1% to 21.5% of RIV. Most notably, sugar maple has decreased from 18.3% to 4.2% of RIV.

Natural Communities

This section summarizes the abundance and importance of major physiognomic (structural) natural community groups in this ecological landscape. Some of the exceptional opportunities, needs, and actions associated with these groups, or with some of the individual natural communities, are discussed briefly. For details on the composition, structure, and distribution of the specific natural communities found in the Western Prairie Ecological Landscape, see Chapter 7, "Natural Communities, Aquatic Features, and Selected Habitats of Wisconsin," in Part 1 of the book. Information on invasive species can be found in the "Natural and Human Disturbances" section of this chapter.

Forests. Most of the native (i.e., nonplantation) forests here are deciduous. Oaks dominate the drier sites; maples (*Acer* spp.), ashes (*Fraxinus* spp.), and American basswood (*Tilia americana*) the more mesic sites; and bottomland hardwoods the lowland sites. Large blocks of forest are scarce or absent, but the extensive forested corridor along the St. Croix River is important to many migratory and resident animals, most notably, birds. Other river corridors, such as the Kinnickinnic and Willow, also offer forest conservation opportunities but at small to moderate scales.

This mature stand of southern dry-mesic forest is dominated by large white and red oaks and provides breeding habitat for rare forest interior birds. The site is a low terrace adjacent to the St. Croix River floodplain. Photo by Eric Epstein, Wisconsin DNR.

Natural coniferous forests are scarce here, but eastern white (*Pinus strobus*) (rarely red) pine occurs on dry, often rocky sites on the upper slopes of some of the river valleys, including the Kinnickinnic and St. Croix. Eastern red-cedar (*Juniperus virginiana*) has increased and formed dense thickets on some hill prairies and savannas from which fire has been excluded.

Savannas. Oak Openings were formerly common in the Western Prairie (over 10% cover). The few remnants persisting today occur mostly on the drier, steeper sites, which were not converted to intensive agricultural uses. Restoration may be feasible in a few areas where remnants persist as a vegetative component in areas for which grassland management is now the focus. Savanna restoration opportunities may also occur on the upper slopes of south- or west-facing bluffs along rivers (the lower Kinnickinnic is one of the best examples), often in association with remnant dry prairies and oak forests.

"Cedar glades," which Curtis (1959) considered a type of savanna in which eastern red-cedar was the dominant tree, occur in association with dolomite bluffs along the St. Croix and elsewhere, but these are at least in part an artifact of fire suppression. The formerly semi-open glades have succeeded to dense cedar thickets in some areas.

Shrub Communities. Very few data exist on the abundance and composition of "shrub" communities in this ecological landscape. Finley (1976) mapped almost 10% of the Western Prairie as "brush," but most of this was probably upland vegetation (e.g., very young stands of oak, aspen, or birch) that had burned shortly before the federal public land survey. Shrub-carr occurs along streams and lakes, and there are stands of alder (*Alnus incana*) bordering some of the smaller streams.

Herbaceous Communities. Prairies were historically extensive in the interior of the Western Prairie Ecological Landscape and also occurred at scattered locations elsewhere, such as on south- or west-facing slopes on bluffs above river valleys or on rocky knolls. A few stands of wet prairie have been identified, and several of these are now being managed to enhance and restore their composition and structure. Remnants of the mesic tallgrass prairies that formerly covered much of this ecological landscape's interior (Cochrane and Iltis 2000) are now extremely scarce, especially in the areas with deep, rich soils and rolling topography in what is now western and central St. Croix County. Almost all of these mesic prairies have been lost to cropland conversion, with a few remnants hanging on along rights-of-way and in old cemeteries.

Protection and management of surrogate grasslands (Conservation Reserve Program, old fields, some pastures) now offer the best opportunity to maintain at least some of our severely declining grassland animals, such as birds and some invertebrates. "Unplowed prairie pastures" should be searched for occurrences of rare fauna, though there seems to be a lower likelihood of finding such areas here compared with the rougher, rockier, and thin-soiled parts of the Driftless Area farther south in the Southwest Savanna and Western Coulees and Ridges ecological landscapes.

Emergent marshes are associated with some of the shallow lakes, especially in the Prairie Pothole Region, and there are some extensive stands of good quality emergent marsh and wet prairie vegetation along the St. Croix River.

Primary Communities. Dolomite and sandstone cliffs are common in the gorges formed by rivers such as the Apple and Kinnickinnic. Extensive stands of Canada yew (*Taxus canadensis*) and scattered populations of "northern" herbs occur on some of the "weeping" dolomite cliffs (where groundwater is discharged through fractures or pores in the rock) along the Kinnickinnic River. Exposures of sand or mud along some of the rivers are used by nesting and basking turtles, resting or foraging birds, and a few specialized vascular plants.

Aquatic Communities. The lower St. Croix River is among the biologically richest rivers in Wisconsin and has exceptionally high values for rare fish and mussels. Wetlands within the river floodplain include marshes, wet prairies, and bottomland hardwoods and are used heavily by migratory and resident birds. Recreational use and development pressure on lands adjacent to the river are extremely high and are increasing. The dam upstream at St. Croix Falls must be operated in a manner that will maintain secure habitat for rare aquatic species (several of these are globally rare) it they are to remain a viable part of Wisconsin's fauna.

Other significant rivers and streams include the Apple, Kinnickinnic, Willow, and the uppermost portions of the Eau Galle, Rush, and Trimbelle. These streams combine to provide a wide range of habitats representing all the major stream community groups of Wisconsin, from cold headwaters streams to warmwater rivers. However, while some of these streams have been spared the harmful effects of agricultural runoff and other pollutants and support diverse and thriving aquatic communities, others have been negatively impacted by various land uses and have suffered a decrease in biological diversity.

Springs, seepages, and spring runs are common features along the St. Croix River, where they occur at the base of the forested slopes flanking the river. Springs feed a number of coldwater streams here, and their flow is responsible for maintaining the constant supply of cold, clean, oxygenated water that maintains coldwater fisheries. Some reaches of the Apple and Kinnickinnic rivers flow through water-cut gorges in dolomite and sandstone bedrock, and "weeping" cliffs are common in some areas. These provide habitat for a number of specialized plants.

Seepage lakes and ponds are abundant in the Prairie Pothole Region. Many of them are fertile, shallow, and have fluctuating water levels. In some areas, the potholes and some larger lakes are being managed as integral parts of grassland complexes, where they provide significant habitat for waterfowl and many wetland species.

The Willow River has been influenced by dams over much of its length. Four hydroelectric dams were constructed on the Willow River. They were operated until 1963, when damage to one of the plants from a lightning strike prompted Northern States Power to liquidate their Willow River holdings. In 1967 Northern States Power sold the land to the Wisconsin Conservation Commission for a state park and stabilized the dams. Some of the dams were removed in the 1990s to improve the scenery and trout fishery, and now only one of these structures remains on the Willow.

The Apple River has been impounded for hydroelectric power generation. The Kinnickinnic has been dammed for a hydroelectric plant at River Falls, but the river is free flowing below that, all the way to its confluence with the St. Croix.

The St. Croix flows freely throughout the Western Prairie, but there is a major dam upstream at St. Croix Falls that affects the lower river. Operation of that dam has been modified in recent years to ensure that aquatic habitat is maintained and that sufficient quantities of water are available to support rare mussels, fish, and other aquatic life in the lower St. Croix at all times.

Forest Habitat Types

The Western Prairie Ecological Landscape is dominated by the mesic habitat type group. Common habitat type groups are wet-mesic to wet, mesic to wet-mesic, and dry-mesic (Table 23.1).

Mesic sites typically are associated with silt loam soils that are well to moderately well drained and nutrient rich. Forest stands are most commonly dominated by some mix of

Table 23.1. *Forest habitat type groups and forest habitat types[a] of the Western Prairie Ecological Landscape (WP EL).*

Southern forest habitat type groups[b]	Southern forest habitat types	
Dominant within WP EL	**Dominant within WP EL**	**Common within WP EL**
Mesic (M)	ATiSa-De	ATiCa-La
Common within the WP EL	**Common within WP EL**	**Minor within WP EL**
Wet-mesic to Wet (WM-W)	Forest Lowland (habitat types not defined)	
Mesic to Wet-mesic (M-WM)	Undefined Wet-mesic (habitat types not defined)	
Dry-mesic (DM)		ArCi ArCi-Ph

Source: Kotar and Burger (1996).

[a]Forest habitat types are explained in Appendix 23.B ("Forest Habitat Types in the Western Prairie Ecological Landscape") at the end of this chapter.

[b]Groups listed in order from most to least common:
Dominant occurrence is an estimated > 50% of forested land area.
Common occurrence is an estimated 10–50% of forested land area.
Minor occurrence is an estimated 1–9% of forested land area.
Present: Other habitat types can occur locally, but each represents < 1% of the forested land area of the ecological landscape.

sugar maple, American basswood, northern red oak (*Quercus rubra*), white oak, and aspen. Many other hardwoods can occur as associates. Potential late-successional dominants are sugar maple and American basswood.

Wet-mesic to wet forested lowlands occur on poorly drained soils. Most sites are dominated by swamp hardwoods composed of any mix of aspen, red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), black ash (*Fraxinus nigra*), and swamp white oak (*Quercus bicolor*). Swamps dominated by conifers are rare.

Mesic to wet-mesic sites are typically associated with loamy soils that are somewhat poorly drained and nutrient rich to medium. Most forest stands are dominated by any mix of aspen, red maple, sugar maple, ashes, American basswood, and swamp white oak.

Dry-mesic sites are typically associated with loamy soils that are well drained and nutrient medium to rich. Forest stands are most commonly dominated by some mix of northern red oak, white oak, black oak (*Quercus velutina*), red maple, and aspen. Occasional associates include eastern white pine, white birch (*Betula papyrifera*), shagbark hickory (*Carya ovata*), black cherry (*Prunus serotina*), and American basswood. Potential late-successional dominants are red maple, sugar maple, and American basswood.

Flora

The Wisconsin Natural Heritage Inventory is currently tracking the occurrences of 26 rare vascular plant species in the Western Prairie Ecological Landscape. Of these, six are listed as Wisconsin Endangered, six are Wisconsin Threatened, and 14 are Wisconsin Special Concern (WNDR 2009b).

One plant listed as Wisconsin Endangered, the prairie bush-clover (*Lespedeza leptostachya*), is also listed as U.S. Threatened by the U.S. Fish and Wildlife Service. Wisconsin's only population of the Wisconsin Endangered Louisiana broomrape (*Orobanche ludoviciana*) occurs here. Plant species with 50%–99% of their state populations in the Western Prairie include ground-plum (*Astraglus crassicarpus*), dotted blazing star (*Liatris punctata* var. *nebraskana*), and prairie ragwort (*Senecio plattensis*). Both ground-plum and dotted blazing star are Wisconsin Endangered; prairie ragwort is Wisconsin Special Concern.

Among the other rare species for which the Western Prairie populations are especially important are kitten tails (*Besseya bullii*), yellow evening primrose (*Calylophus serrulata*), silky prairie clover (*Dalea villosa*), and wild licorice (*Glycyrrhiza lepidota*). Additional information on the rare plants of the Western Prairie Ecological Landscape may be found in Appendix 23.C at the end of the chapter.

Prairies have been reduced to a few one-hundredths of 1% of their former abundance, and the fertile tallgrass prairies that covered the rolling till plains in this ecological landscape's interior are virtually gone, almost entirely converted to row crop production. Most prairie remnants are on dry sites, often with rocky, gravelly, or sandy substrates, and sometimes

Remnant savannas and open oak woodlands, especially on the west-facing bluffs above the St. Croix River, support populations of the globally rare, Wisconsin Threatened kitten tails. Photo by Robert H. Read.

Prairie bush-clover is listed as U.S. Threatened and Wisconsin Endangered. This plant is a globally rare prairie obligate. Photo by Thomas Meyer, Wisconsin DNR.

Silky prairie-clover is one of several Great Plains species that reach their easternmost range limits in Wisconsin's western border counties, where it inhabits barrens and dry prairies. Photo by Barb Delaney.

The Wisconsin Endangered dotted blazing star is one of several Great Plains plants of extremely limited distribution in Wisconsin. In the Western Prairie Ecological Landscape, it is restricted to a few prairies near the state's western extremities. Photo by Kitty Kohout.

on steep slopes. These tended to escape cultivation, though most of them have been grazed by livestock. Nevertheless, the remnant prairies are the primary habitats used here by at least 16 of the 25 rare vascular plants tracked by Wisconsin Natural Heritage Inventory. All extant prairie remnants are small, many are isolated, and most have been degraded by the encroachment of woody vegetation, the proliferation of invasive weeds, and by past livestock grazing.

A subset of the rare prairie flora found here is composed of species associated mostly with grasslands farther west in the Great Plains. This group includes Carolina anemone (*Anemone caroliniana*), dotted blazing star, ground-plum, prairie turnip (*Pediomelum esculentum*), silky prairie-clover, and prairie ragwort. Other rare but more widespread plants also strongly associated with remnant prairies include prairie false-dandelion (*Nothocalais cuspidata*), rough rattlesnake-root (*Prenanthes aspera*), the globally rare Hill's thistle (*Cirsium hillii*), and marbleseed (*Onosmodium molle*).

Oak Openings provide the primary habitat for kitten tails and yellow gentian (*Gentiana alba*), and the more open remnants also support native prairie grasses and forbs. The Wisconsin Threatened kitten tails is a midwestern endemic with an interesting distribution. It has been found only in savanna remnants in the Western Prairie and the Southeast Glacial Plains ecological landscapes, with a large gap in Wisconsin's portion of the Driftless Area.

Significant Flora in the Western Prairie Ecological Landscape

- Prairie remnants here are especially important habitats for rare flora.
- Several plants found primarily in prairies to the west of Wisconsin in the Great Plains reach their eastern range limits here.
- Unplowed prairie pastures should be surveyed carefully for rare flora.
- Rare plants associated with savanna remnants here include kitten tails, an upper midwestern endemic.
- Future surveys are needed for mesic hardwood forests, remnant wetlands associated with prairie potholes, and bedrock habitats.
- Surveys of cliff habitats, especially "weeping" cliffs, should include nonvascular plants (lichens and mosses).
- Good quality prairie remnants should be quantitatively sampled, as prairies are now so rare here, data are few, and their composition may differ markedly from prairies farther south and east.

A few rare plant species here inhabit forests: e.g., the Wisconsin Threatened snow trillium (*Trillium nivale*) in rich mesic hardwood forests and the Wisconsin Special Concern Assiniboine sedge (*Carex assiniboinensis*) in lowland hardwood forests on riverbanks in floodplains.

More intensive floristic surveys of bedrock habitats along the Kinnickinnic and Apple rivers are desirable, and these should include examination of the nonvascular plants. Access is difficult for some of the cliff faces, and it may be most efficient to conduct these surveys by rappelling down the cliffs. Some of the basalt glades south of St. Croix Falls appear to be in the Western Prairie Ecological Landscape, and these should be examined very carefully as there is good potential for rare habitat specialists. Some of these rare glade habitats have been proposed for quarrying, resulting in their destruction, in recent years.

If any unplowed prairie pastures can be identified, such sites should be surveyed thoroughly for remnant prairie species, including rare plants. Wet or wet-mesic prairie remnants associated with pothole lakes and ponds would be especially high priorities because so few stands of these communities have been documented here.

This is a small ecological landscape that has been affected by intensive use and is now under heavy development pressure. At the time of Euro-American settlement, towns that served the lumber industry grew up on both sides of the St. Croix River. Subsequently, most land use here was associated with agricultural development, which was both extensive and intensive. More recently, residential development from the nearby Twin Cities has increased tremendously as suburbanization of the Twin Cities metropolitan area continues.

Fauna

Changes in Wildlife over Time

Many wildlife populations have changed dramatically since humans arrived on the landscape, but these changes were not well documented before the mid-1800s. This section discusses only those wildlife species documented in the Western Prairie Ecological Landscape. Of those, this review is limited to species that were known or thought to be especially important here in comparison to other ecological landscapes. For a more complete review of historical wildlife in the state, see a collection of articles written by A.W. Schorger, compiled into the volume *Wildlife in Early Wisconsin: A Collection of Works by A.W. Schorger* (Brockman and Dow 1982).

The Western Prairie Ecological Landscape was important historically for a number of wildlife species, especially those using prairies and associated lakes, ponds and wetlands, oak savannas, and large river systems. This ecological landscape was particularly important for elk (*Cervus canadensis*), American bison (*Bos bison*), white-tailed deer (*Odocoileus virginianus*), Trumpeter Swan (*Cygnus buccinator*), Sandhill Crane (*Grus canadensis*), and Sharp-tailed Grouse (*Tympanuchus phasianellus*). In the mid-19th century, the Western Prairie Ecological Landscape was settled by Euro-Americans, wildfires were suppressed or controlled, prairies were plowed and converted to agricultural cropland, and wildlife populations underwent major changes.

Elk were found throughout Wisconsin but flourished in open woodlands, oak openings, and at the border of grasslands and forests. Elk were most numerous and abundant in the southern and western parts of the state (Figure 23.7; Schorger 1954) and were abundant in this ecological landscape. It was reported that elk were plentiful around the St. Croix River in 1850 and in the vicinity of Hudson in 1855. Elk were still abundant in this ecological landscape during the 1850s but declined rapidly after that. The last reliable report of elk in Wisconsin is from west of Menomonie in 1866. Descriptions of attempts to restore elk in Wisconsin can be found in Chapter 4, "Changes and Trends in Ecosystems and Landscape Features," and in Chapter 12, "North Central Forest Ecological Landscape." Currently, Wisconsin has about 150 elk, all of them in the North Central Forest.

American bison historically occupied the prairie areas of the state and were abundant in the Western Prairie Ecological Landscape (Figure 23.8). American bison occurred from Racine along Lake Michigan, north to Lake Winnebago and west to Burnett County on the Minnesota state line. Schorger (1937) noted that American bison ranged eastward of the St. Croix River and that in 1831 "the prairie country" extended into the vicinity of Rice Lake and in scattered patches along the Red Cedar River. The last wild American bison in Wisconsin was killed (prior to statehood) near the Trempealeau River in 1832.

White-tailed deer were found throughout the state and at the time of Euro-American settlement were likely more

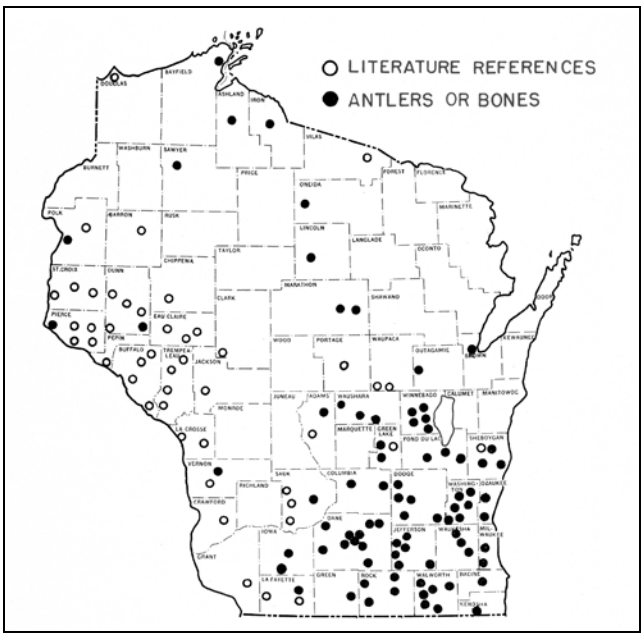


Figure 23.7. *Historical records of elk in Wisconsin. Figure reproduced from Schorger (1954) by permission of the Wisconsin Academy of Sciences, Arts and Letters.*

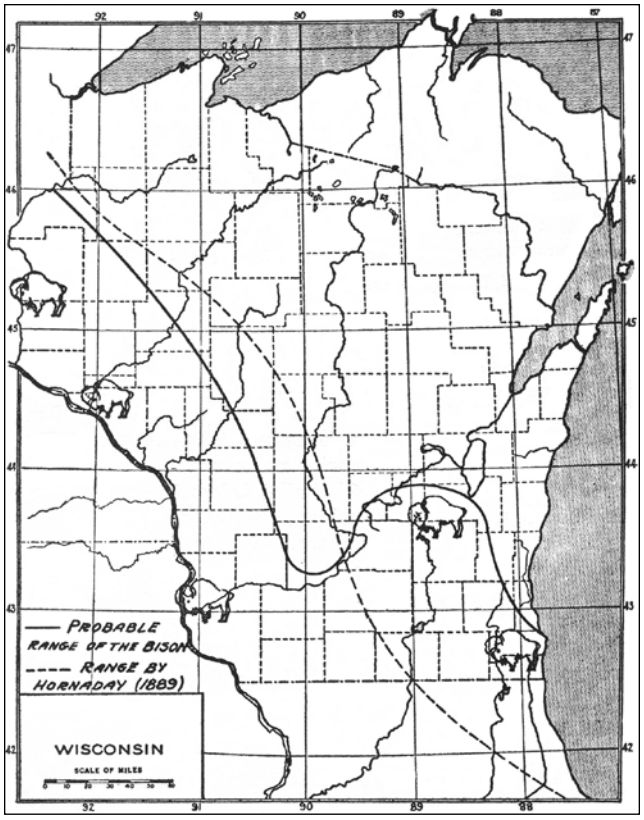


Figure 23.8. *Probable range of the American bison in Wisconsin prior to Euro-American settlement. Figure reproduced from Schorger (1937) by permission of the Wisconsin Academy of Sciences, Arts and Letters.*

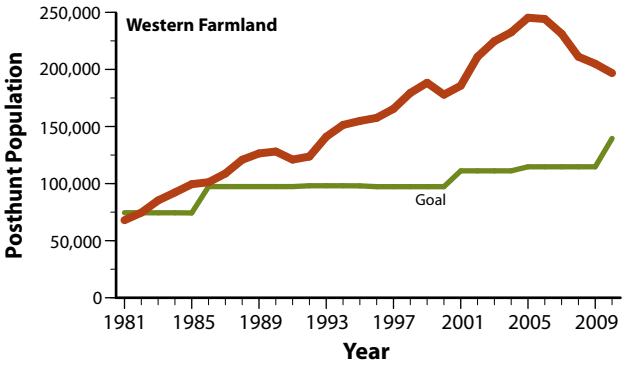


Figure 23.9. *White-tailed deer population size in relation to population goals in the western farmland deer management region, 1981–2010.*

abundant in southern Wisconsin than in the north (Schorger 1953). White-tailed deer were reported as plentiful in St. Croix County from the 1850s to 1880. In February 1856, a man from Apple River brought a load of 16 white-tailed deer to Prescott, the last of 200 he had transported that winter. The Bailey family shot 68 white-tailed deer in the fall of 1875, and nearly 100 white-tailed deer were shipped out of Baldwin. By 1880 few white-tailed deer were killed in St. Croix County. Subsistence harvest, together with market hunting, likely reduced the white-tailed deer population to its lowest level in recorded history late in the 19th century. Since the early 1980s, white-tailed deer populations have increased dramatically in the Western Prairie Ecological Landscape (Figure 23.9), and white-tailed deer are now very abundant here. Today the white-tailed deer is an important game species but causes crop damage, vehicle accidents, and damage to forest regeneration; is a reservoir for Lyme disease; and negatively impacts native plants.

The chief prey of the cougar (*Puma concolor*) was the white-tailed deer, so it occurred chiefly in the hardwood forest on the southern edge of the mixed conifer-hardwood forest. It also ranged into the oak openings and prairies where white-tailed deer were common (Schorger 1942). There are many records of the cougar in Wisconsin, and it was not considered rare in the early days. Most of the historical cougar records were from the valleys of the Mississippi River and its tributaries and the Fox River (Jackson 1961). Therefore, the cougar may have been present in this ecological landscape prior to Euro-American settlement. Cougars were feared and shot whenever possible. The last historical record of a wild Wisconsin cougar was from Ashland County in 1884. In the 2000s, the cougar has again been sporadically documented in Wisconsin, with one sighting documented in this ecological landscape (St. Croix County) in 2009, likely dispersers from the Black Hills in South Dakota.

The Sharp-tailed Grouse was considered to be widely distributed in the state in open and brushy habitats during and prior to Euro-American settlement and was likely common in the Western Prairie Ecological Landscape, primarily occupying the extensive prairies, brushlands, and oak openings (Schorger 1943). Sharp-tailed Grouse in the Western Prairie probably expanded into additional areas, temporarily, as young trees created brushy habitat with the cessation of wildfire. Sharp-tailed Grouse later declined with the expansion of intensive agriculture and the succession of oak openings into forests. Today Sharp-tailed Grouse are absent from this ecological landscape.

The Trumpeter Swan nested in Minnesota and Wisconsin until the 1880s (Schorger 1964). In Minnesota, the species occurred in the prairie and prairie-parkland areas of the western, central, and northwestern portions of that state. In Wisconsin, the Trumpeter Swan may have nested in all but the northeastern forested regions of the state and most likely nested in the large marshes or shallow lakes in this ecological landscape. By 1900 the Trumpeter Swan was thought to be extinct. Fortunately, a small nonmigratory population survived in the remote mountain valleys of Montana, Idaho, and Wyoming. Since then there has been a concerted effort to restore the species in Wisconsin and elsewhere. Trumpeter Swans were reintroduced north of this area at Crex Meadows Wildlife Area in the Northwest Sands Ecological Landscape as well as in other parts of the state. Trumpeter Swans now nest regularly in the Western Prairie and winter along the lower St. Croix River.

Significant Wildlife

Wildlife are considered significant for an ecological landscape if (1) the ecological landscape is considered important for maintaining the species in the state and/or (2) the species provides important recreational, social, and economic benefits here. To ensure that all native species are maintained somewhere in Wisconsin, "significant wildlife" includes both common species and species that are considered "rare." Four categories of species are discussed: rare species, Species of Greatest Conservation Need (SGCN), responsibility species, and socially important species (see definitions in text box). Note that there can be overlap between these categories—they are not necessarily exclusive. Because conservation of natural communities and habitats is often the most efficient way to manage and benefit a majority of native wildlife species, we also discuss management of different wildlife habitats in which significant fauna occur.

Rare Species. "Rare" animals include all of those species that appear on the Wisconsin Natural Heritage Working List (WDNR 2009) and are classified as "endangered," "threatened," or "special concern" by state or federal governments (see Appendix 23.C for a comprehensive list of the rare animals known to exist in the Western Prairie Ecological Landscape). As of November 2009, the Working List documented 55 rare fauna within the Western Prairie Ecological Landscape including 11 birds, 3 herptiles, 19 fishes, and 22 invertebrates. These include two species listed as U.S. Endangered, one federal candidate for future listing, 15 Wisconsin Endangered species, 16 Wisconsin Threatened species, and 24 Wisconsin Special Concern species. See Appendix 23.D for the number of species per taxa with special designations documented within the Western Prairie Ecological Landscape; also see the Wisconsin Natural Heritage Working List online for current status (WDNR 2009).

Federally Listed Species: In the Western Prairie, the Higgin's eye (*Lampsilis higginsii*) and winged mapleleaf (*Quadrula fragosa*) mussels are listed as U.S. Endangered (WDNR 2009). They are managed under U.S. Fish and Wildlife Service recovery plans (USFWS 1997, USFWS 2004). In 2012 the spectacle case (*Cumberlandia monodonta*) and snuffbox (*Epioblasma triquetra*) were added to the federal endangered species list. See the update for mussel species in the "Responsibility Species" section below. The Bald Eagle (*Haliaeetus leucocephalus*) (formerly U.S. Threatened) is also found in the Western Prairie. After its delisting in June 2007, it continues to receive federal protection under the U.S. Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. The Bald Eagle is now listed as Wisconsin Special Concern.

Wisconsin Endangered Species: No Wisconsin Endangered mammals are known to occur in this ecological landscape. Wisconsin Endangered species found here (WDNR 2009) include two birds: Loggerhead Shrike (*Lanius ludovicianus*) and Red-necked Grebe; no herptiles; three fishes: crystal darter (*Crystallaria asprella*), goldeye (*Hiodon alosoides*), and pallid shiner (*Hybopsis amnis*); eight mussels: spectacle case, purple wartyback (*Cyclonaias tuberculata*), butterfly (*Ellipsaria lineolata*), elephant ear (*Elliptio crassidens*), snuffbox, ebony shell (*Fusconaia ebena*), Higgin's eye, and winged mapleleaf; and one other invertebrate: regal fritillary butterfly (*Speyeria idalia*).

Wisconsin Threatened Species: There are no Wisconsin Threatened mammals here. Wisconsin Threatened species occurring here (WDNR 2009) include four birds: Henslow's Sparrow (*Ammodramus henslowii*), Great Egret (*Ardea alba*), Red-shouldered Hawk (*Buteo lineatus*), and Cerulean Warbler (*Setophaga cerulea*, listed as *Dendroica cerulea* on the Wisconsin Natural Heritage Working List); two herptiles: wood turtle (*Glyptemys insculpta*) and Blanding's turtle (*Emydoidea blandingii*); seven fish: blue sucker (*Cycleptus elongatus*), black buffalo (*Ictiobus niger*), shoal chub (*Macrhybopsis aestivalis*), river redhorse (*Moxostoma carinatum*), greater redhorse (*Moxostoma valenciennesi*), gilt darter, and paddlefish (*Polyodon spathula*); and three mussels: monkeyface (*Quadrula metanevra)*, salamander mussel (*Simpsonaias ambigua*), and

Categories of Significant Wildlife

- **Rare species** are those that appear on the Wisconsin Natural Heritage Working List as Wisconsin or U.S. Endangered, Threatened, or Special Concern.
- **Species of Greatest Conservation Need** are described and listed in the Wisconsin Wildlife Action Plan (WDNR 2005b) as those native wildlife species that have low or declining populations, are "indicative of the diversity and health of wildlife" of the state, and need proactive attention in order to avoid additional formal protection.
- **Responsibility species** are both common and rare species whose populations are dependent on Wisconsin for their continued existence (e.g., a relatively high percentage of the global population occurs in Wisconsin). For such a species to be designated a "responsibility species," a relatively high percentage of the state population needs to occur there, or good opportunities for effective population protection and habitat management for that species occur in the ecological landscape. Also included here are species for which an ecological landscape holds the state's largest populations, which may be critical for that species' continued existence in Wisconsin even though Wisconsin may not be important for its global survival.
- **Socially important species** are those that provide important recreational, social, or economic benefits to the state for activities such as fishing, hunting, trapping, and wildlife watching.

buckhorn (*Tritogonia verrucosa*). See 2013 update for mussel species below in "Responsibility Species" section.

■ ***Wisconsin Special Concern Species:*** Wisconsin Special Concern species include five birds, one herptile, nine fish, and nine invertebrates (see Appendix 23.C for a complete rare species list for the Western Prairie Ecological Landscape).

■ **Species of Greatest Conservation Need.** Species of Greatest Conservation Need (SGCN) are those that appear in the Wisconsin Wildlife Action Plan (WDNR 2005b). SGCN include species already recognized as endangered, threatened, or special concern on Wisconsin or federal lists and include more common species that are declining. There are three mammals, 41 birds, eight herptiles, and six fish listed as SGCN for the Western Prairie Ecological Landscape (see Appendix 23.E for a complete list of Species of Greatest Conservation Need and the habitats with which they are associated in the Western Prairie Ecological Landscape).

■ **Responsibility Species.** The lower St. Croix River is one of the most important rivers for rare mussels in Wisconsin and perhaps in the Upper Midwest. As of 2013, it is home to at least 38 freshwater mussel species (18 of these mussel species are on the 2013 Natural Heritage Working list), and six of them are globally rare. In 2013, four of these are U.S. Endangered (Higgins' eye, winged mapleleaf, spectacle case, and snuffbox). As of 2013, eight of these mussels are Wisconsin Endangered, five are Wisconsin Threatened, and five are Wisconsin Special Concern. Diverse habitats, including substrates preferred by some mussel species, river size, and good water quality are key factors accounting for the presence of these rare species. The spectacle case, purple wartyback, butterfly, elephant ear, snuffbox, ebony shell, Higgins' eye, and winged mapleleaf are Wisconsin Endangered species; the monkeyface, salamander mussel, wartyback (*Quadrula nodulata*), rock pocketbook (*Arcidens confragosus*), and buckhorn are Wisconsin Threatened species; and the elktoe (*Alasmidonta marginata*), washboard (*Megalonaias nervosa*), pink papershell (*Potamilus ohiensis*), mapleleaf (*Quadrula quadrula*), and fawnsfoot (*Truncilla donaciformis*) are listed as Wisconsin Special Concern species.

The lower St. Croix River holds aging populations of the ebony shell and elephant ear, both Wisconsin Endangered mussels in 2013. Prior to the establishment of the current lock and dam system on the Mississippi River, the host fish for these mussels, the skipjack herring (*Alosa chrysochloris*), migrated here from the Gulf of Mexico. The locks and dams have all but eliminated this migration and therefore prevent reproduction of these soon to be extirpated mussels.

Management of this stretch of the St. Croix River will be important for the survival of all these mussel species. In the past, operation of the dam at St. Croix Falls had caused damage to mussels by restricting the flow of water during winter months, which caused mussels to freeze. However, these practices have been changed, and the dam now operates as a ***run of the river*** dam, which provides a more continuous flow of water. There is also concern about land use changes (e.g., rural and industrial development) in the watershed that could negatively affect the high water quality that is essential to these species. Restriction of the movement of fish species that are intermediate hosts for mussel larvae because of locks and dams is also a problem because the mussels cannot complete their life cycles unless their host fish are present.

The lower St. Croix River also supports a diverse fish assemblage, with 26 species recorded as rare. Rare fish in this river include Wisconsin Endangered species such as crystal darter, goldeye, and pallid shiner and Wisconsin Threatened species such as blue sucker, black buffalo, shoal chub, river redhorse, greater redhorse, gilt darter, and paddlefish. Additional rare or otherwise important fish species also occur here, and these may be threatened by deleterious changes in water quality and siltation of the river bed from land uses such as the rapidly increasing rural (exurban) residential development and agriculture.

The portion of the lower St. Croix bordering southern Polk County supports good populations of a diverse assemblage of dragonflies common to large midwestern rivers. The moving current for many miles below St. Croix Falls (a few miles upstream in the Forest Transition Ecological Landscape) supports populations of the Wisconsin Threatened pygmy snaketail (*Ophiogomphus howei*) and Wisconsin Special Concern sand snaketail (*Ophiogomphus smithi*) dragonflies (W.A. Smith, Wisconsin DNR, personal communication). Both of these species are globally rare.

Significant Wildlife in the Western Prairie Ecological Landscape

- The Western Prairie is the only place in Wisconsin where it is possible to maintain and manage wildlife associated with a prairie-pothole habitat complex at a large scale.
- A major grassland/wetland restoration project, the Western Prairie Habitat Restoration Area, is underway here.
- The lower St. Croix River is highly significant to aquatic organisms, including at least 26 rare species of fish, mussels, and other invertebrates.
- Cold, cool, and warmwater streams such as the Apple, Kinnickinnic, Willow, upper Rush, and upper Trimbelle rivers support a trout and smallmouth bass fishery as well as rare species and ecological features.
- A unique gorge at the mouth of the Kinnickinnic River harbors rare cliff dwelling species.
- The St. Croix River corridor receives heavy use by migratory birds and also provides important habitat for some resident species.

The Western Prairie is the only place in the state where it may be possible to maintain and manage a true prairie-pothole complex. The Prairie Pothole Region is an area of the northern Great Plains that includes midgrass and tallgrass prairies containing thousands of shallow ponds and wetlands often referred to colloquially as "potholes." This ecological landscape is the easternmost extension of the Prairie Pothole Region centered in the Northern Great Plains, which lies primarily west of the Mississippi River and east of the Rocky Mountains in the north central United States and south central Canada (Figure 23.10). It is important to maintain populations of the many declining species of grassland and wetland birds that use these habitats. There are bird species breeding here, such as the Loggerhead Shrike, that are now found more frequently in areas west of Wisconsin. Grassland bird species with a limited state range but that nest in the Western Prairie include the Western Meadowlark (*Sturnella neglecta*), Henslow's Sparrow, and Dickcissel (*Spiza americana*). Of special note, during the Wisconsin breeding bird atlas project, the Prescott Atlas block had the highest density of the Henslow's Sparrow in Wisconsin, a Wisconsin Threatened grassland bird species (Cutright et al. 2006). There are records of rare invertebrates from prairie remnants in this ecological landscape, including the globally rare and Wisconsin Endangered regal fritillary butterfly. Regal fritillary butterflies have not been reported in this ecological landscape since the late 1990s, but the potential to conserve or restore them here remains if the appropriate prairie remnants can be enlarged, connected, and protected.

The Wisconsin Endangered Loggerhead Shrike has been a rare nester in the grasslands of the Western Prairie Ecological Landscape. Photo by Dave Menke.

Figure 23.10. *The Prairie Pothole Region of North America (USFWS 2015). The Western Prairie Ecological Landscape is the easternmost extension of this region.*

Socially Important Fauna. Species such as white-tailed deer, Mallard, Blue-winged Teal, Wood Duck, nonnative Ring-necked Pheasant (*Phasianus colchicus*), Wild Turkey (*Meleagris gallopavo*), and other grassland and wetland wildlife are important for hunting and wildlife viewing in this ecological landscape. Since this ecological landscape is close to the metropolitan Minneapolis/St. Paul area, it provides bird and wildlife watching enjoyment for many local residents and visitors. This ecological landscape has an important warmwater fishery that supports populations of game fish such as northern pike, walleye, smallmouth bass, largemouth bass, bluegill, yellow perch, and black crappie (*Pomoxis nigromaculatus*). It has coldwater streams that are heavily used trout fishing areas and support native brook trout as well as populations of nonnative brown trout and, to a lesser extent, rainbow trout.

Wildlife Habitats and Communities. The Western Prairie provides a number of habitats for a variety of fauna, especially those using grasslands, various wetland habitats, and river systems. This is the easternmost extent of the vast Prairie Pothole Region of the Northern Great Plains to the west (Minnesota, North and South Dakota, and Montana) with gentle to moderately rolling hills that were once covered with dry to mesic prairie and with pothole lakes, ponds, and wetlands, including emergent marsh, sedge meadow, and wet prairie in the poorly drained depressions. The major river corridors, especially the St. Croix, support significant areas of lowland and upland forest and important aquatic resources. A unique gorge and associated river delta within the Kinnickinnic River Gorge and Delta State Natural Area in Kinnickinnic State Park harbors unusual vegetation and habitats and supports rare species. One Important Bird Area, the St. Croix River, has been designated partially within the Western Prairie (Steele 2007; see the "Ecologically Significant Places of the Western Prairie" map in Appendix 23.K).

The open character of much of the Western Prairie Ecological Landscape makes it an especially important management opportunity for grassland wildlife conservation. Although this ecological landscape is almost 50% agriculture, grasslands still comprise an additional 30% of the area (almost all of which are surrogate grasslands). The Conservation Reserve Program (CRP) had been active in this area and had converted 45,936 acres of cropland to grassland in St. Croix County by 1994; however, CRP acreage here had declined to only 12,866 acres by 2012 (USDA FSA 2013). Interspersed amid these grasslands are prairie potholes (shallow ponds or lakes historically embedded within extensive prairie and savanna vegetation) and wetlands, with scattered, small remnants of oak savanna and tallgrass prairie. Many of these grasslands and wetlands are on public lands (e.g., waterfowl production areas, state wildlife areas, streambank protection areas), but only 3% of the ecological landscape is publicly owned, and most of the public land is forested and occurs along the St. Croix, Kinnickinnic, Apple, and Willow river corridors. Much more grassland and wetland protection is needed. Because of close proximity to the Minneapolis/St. Paul metropolitan area, rural residential development is expanding at a rapid rate, representing a major land use and land cover change and limiting large-scale conservation opportunities in some areas.

Male Bobolink. Loss of grassland habitat has caused widespread declines in Bobolink populations. Photo by Jack Bartholmai.

The still extensive surrogate grasslands in the Western Prairie are important for Grasshopper Sparrow (*Ammodramus savannarum*), Dickcissel, Sedge Wren (*Cistothorus platensis*), Loggerhead Shrike, Clay-colored Sparrow (*Spizella pallida*), Field Sparrow (*Spizella pusilla*), Vesper Sparrow (*Pooecetes gramineus*), Bobolink (*Dolichonyx oryzivorus*), and Western Meadowlark (Cutright et al. 2006). Wetlands are critical for species such as Pied-billed Grebe (*Podilymbus podiceps*), Red-necked Grebe, Blue-winged Teal, Ruddy Duck (*Oxyura jamaicensis*), Sora (*Porzana carolina*), Virginia Rail (*Rallus limicola*), American Coot (*Fulica americana*), Great Egret, Green Heron (*Butorides virescens*), Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), and Blanding's turtle. Canada Goose (*Branta canadensis*) and Mallard (*Anas platyrhynchos*) also use these wetlands but can be found on many other lakes and streams as well.

A major grassland/wetland restoration project has begun in this ecological landscape, the Western Prairie Habitat Restoration Area (WPHRA) (Figure 23.11). The WPHRA was established in 1999 and encompasses 350,000 acres within 15 townships in St. Croix and Polk counties (WDNR 2014b). The acreage goal of 20,000 acres of permanently protected grassland and wetland habitat is about 10% of the historical grassland and wetland acreage within this project boundary. The project area includes remnants of one of the largest prairies historically occurring in the state, along with a mix of prairie pothole ponds, lakes, and marshes.

The large scope of the project is based on biodiversity and ecosystem management concepts. Four bird conservation areas (BCAs) within the WPHRA have been selected to maximize benefits to obligate grassland birds. The present approach for grassland BCAs encompasses a block of at least 10,000 acres of public and/or private lands in an open landscape. A

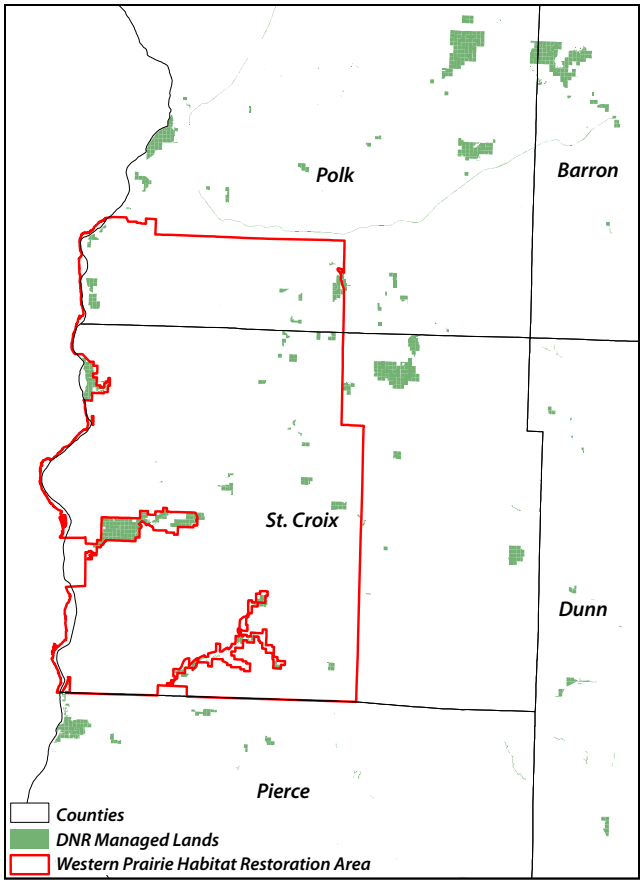


Figure 23.11. *Boundary of the Western Prairie Habitat Restoration Area located in the western portion of the Western Prairie Ecological Landscape.*

Maintaining a viable population of the Upland Sandpiper in the Western Prairie Ecological Landscape will depend on the protection and appropriate management of extensive blocks of unfragmented grassland habitat. Photo by Dawn Scranton.

large "core" area of protected high-quality habitat, targeted at a minimum of 2,000 acres of high quality grassland habitat within each 10,000-acre BCA (20%), serves to anchor each BCA. Around this core is a ***matrix*** of primarily private agricultural lands, preferably managed for good bird habitat or at least maintained to be "neutral" in how they affect bird life. The open landscape surrounding the core would also include scattered parcels of permanent grass cover, totaling about 10% of the BCA. Another portion of the landscape surrounding the core would be in long-term grass cover (e.g., Conservation Reserve Program, State Acres for Wildlife Enhancement [SAFE], pasture, old field), totaling 10–20% of the BCA. The balance of the total acreage (50–60%) would remain in cropland and whatever minimal wooded lands are present. Land acquisitions in the WPHRA focuses on building these important BCA milestones while still recognizing the value of permanently protected grasslands and wetlands throughout the project area (Harvey Halvorsen, Wisconsin DNR, personal

The Northern Harrier is an area-sensitve, ground-nesting bird dependent on extensive grassland habitat for breeding and hunting. Pictured here is a nest with chicks. Photo by U.S. Fish and Wildlife Service.

Good quality, extensive CRP grassland within Erin Prairie Bird Conservation Area. Photo by Harvey Halvorsen, Wisconsin DNR.

communication). Breeding bird surveys within the project area have been conducted by Wisconsin DNR and U.S. Fish and Wildlife Service and continue annually. Enlisting the help of volunteer birders from the University of Wisconsin-River Falls, the St. Croix Valley Bird Club, and others have helped increase the visibility of the WPHRA project. These types of citizen science-based surveys help people to understand the importance of the WPHRA and how vital the grassland habitats are for resident and migratory wildlife.

Priorities for the WPHRA include preservation of both small native prairie remnants and large blocks of surrogate grassland suitable for grassland birds. This area was chosen because it has an existing network of state and federal public lands that are being expanded and, where feasible, connected; large areas of nonwooded, agricultural lands with a history of high CRP grassland acreages; numerous patches of remnant native prairie; and strong public support. Grassland and wetland habitats are restored in strategically scattered blocks throughout the agricultural area. An assessment of quality prairie remnants within the project area was completed early in the feasibility stage of the WPHRA. This work was important to help facilitate the preservation of the remaining remnants and also to provide a blueprint for future permanent land restorations. For this endeavor, a prairie seed nursery was established to provide local ecotype seeds for use on public lands in the WPHRA. Native prairie seed plots were planted on a Waterfowl Production Area (WPA) near New Richmond, Wisconsin, in 1998. This was later expanded to include a second nursery, the Star Prairie Seed Farm, on land donated to the Wisconsin DNR by Pheasants Forever. The Star Prairie Seed Farm, also located in the WPHRA, started seed production in 2001. Seed cleaning, processing, and storage occur on-site. All new acquisitions are eventually planted with local genotype prairie seed mixes containing a minimum of five grass species and 30 species of forbs.

Prairie Seed Farm, within the boundaries of the Western Prairie Habitat Restoration Area. Photo by Harvey Halvorsen, Wisconsin DNR.

As of 2013, 13,949 acres within the project boundary have been protected. Wisconsin DNR owns 5,098 acres; U.S. Fish and Wildlife Service owns 5,510 acres; National Park Service lands along the St. Croix River include 1,615 acres; Standing Cedars Conservancy owns 1,162 acres; Carpenter Nature Center owns 305 acres; and 259 additional acres are owned by others including the Catholic Church in Hammond, St. Croix County – Homestead Parklands, the Kinnickinnic River Land Trust, Star Prairie Land Preservation Trust, and some Wisconsin DOT land (Harvey Halvorsen, Wisconsin DNR, personal communication). However, not all of the 13,949 acres of protected land within the project boundary count toward the grassland and wetland habitat goal of 20,000 acres because some of these protected acres include lands vegetated with other types of land cover.

Rapid residential growth in the area due to the proximity to the Minneapolis/St. Paul metropolitan area has made accomplishing the acquisition goals of the WPHRA difficult. Factors such as habitat fragmentation by new housing developments and associated infrastructure and increasing land values have been problems. Land values have also begun to escalate in anticipation of the completion of a new bridge called the St. Croix River Crossing in 2017. Price increases in the cash grain markets have likewise diminished the acreage formerly in the Conservation Reserve Program (CRP). As of 2013, nearly 40,000 acres of CRP lands had been taken out of the program in St. Croix County. While in CRP, these acres fully complemented the WPHRA and were part of the short-term grassland availability that created more viable nesting and foraging habitats for grassland wildlife. Also, private lands wildlife habitats that are not in a CRP farm program or planted to tree cover (for ***Managed Forest Law*** tax savings) are diminishing as well due to taxation issues. Private land owners often cite expensive "recreational tax rates" on their grassland wildlife habitats as reason for selling or renting land for cash grain. The WPHRA could benefit by new options such as a tax incentive program to preserve grasslands in Wisconsin. If created, such a grassland preservation program for private lands could reduce tax rates and have significant benefits for grassland wildlife.

Other factors that affect the implementation success of the WPHRA include the land acquisition programs of both Wisconsin DNR and U.S. Fish and Wildlife Service. Funding availability and priorities within each agency affect the mission and success of the WPHRA. The WPHRA remains an important project at local and state levels that needs to be accomplished quickly. New partnerships and creative strategies for conservation on the ground will assure a landscape that's appealing for both wildlife and people.

The lower St. Croix River runs for more than 50 miles, from St. Croix Falls to Prescott, where it joins the Mississippi River. This segment of the St. Croix River was designated as an integral part of a National Wild and Scenic River (a National Park Service program) in 1972. The corridor contains emergent marsh, wet prairie (at the mouth of the Apple River),

springs and seepages, and floodplain forest. On the steep bluffs that flank much of the St. Croix, oak- and maple-dominated hardwood forests, dry prairies, and remnant savannas occur. Prominent dry dolomite cliffs support many rare species, mostly bedrock specialists or prairie associates. The St. Croix River corridor supports many rare species, including fish, mussels, other invertebrates, and plants (see "Responsibility Species" above) and is highly significant for both resident and migratory birds. This river supports a population of lake sturgeon. Other rare fish species, such as gilt darter and paddlefish, have also been recorded here.

Floodplain Forests along the St. Croix support breeding populations of rare species such as Bald Eagle, Red-shouldered Hawk, Prothonotary Warbler (*Protonotaria citrea*), and Louisiana Waterthrush (*Parkesia motacilla,* listed as *Seiurus motacilla* on the Wisconsin Natural Heritage Working List). However, the lower St. Croix corridor also receives heavy recreational use by boaters, canoeists, and others, and the adjoining bluffs are under heavy development pressure.

The Willow River is another stream with high conservation values. The Willow and one of and its tributaries, Ten-mile Creek, support the only known populations of the Wisconsin Special Concern sand snaketail dragonfly in this ecological landscape. The sand snaketail requires a substrate of coarse sand to fine gravel. Several faster flowing reaches of the Apple River are home to the Wisconsin Threatened gilt darter. The gilt darter is sensitive to water pollution and siltation. Reducing nutrient and silt volumes in nonpoint agricultural and urban runoff, while also minimizing ***flashy stream*** flows that can introduce excessive fine, soft sand to stream beds, is critical to effectively protecting these species. The Willow and Apple rivers are the top two rivers in terms of land use-induced phosphorous loading in this ecological landscape. Implementing the 2012 Total Maximum Daily Load (TMDL) plan for the Lake St. Croix watersheds to achieve water quality and runoff management goals required under the federal Clean Water Act will be essential to maintaining suitable habitat for the sand snaketail and gilt darter.

Other biologically important streams include the Apple (despite nutrient loading problems) and Kinnickinnic rivers. The upper reaches and tributaries of some coldwater streams (Kinnickinnic and Rush rivers, South Fork of the Willow River, part of the upper Eau Galle River, the South Fork of the Kinnickinnic River, and Parker, Kelly, Ted, and Nye creeks) support high quality coldwater fisheries that include native brook trout and other coldwater associates. The southern part of the ecological landscape includes reaches of the Rush, Trimbelle, and Eau Galle rivers. Floristically rich mesic forests occur on the steep, calcareous sideslopes bordering these streams, and these forests harbor rare plant species.

A unique gorge and delta occur at the mouth of the Kinnickinnic River. Sandstone and dolomite cliffs within the gorge harbor rare cliff plants. The valley of the Kinnickinnic, from River Falls down to the St. Croix River, contains valuable natural community remnants (forests, savannas, prairies, wet cliffs), geological features, and many rare species populations. The Kinnickinnic River Land Trust has been working with private and public partners on the protection of this stream corridor.

The timber rattlesnake is now very rare in the Western Prairie Ecological Landscape due to past persecution and habitat loss. Photo by Armund Bartz, Wisconsin DNR.

Natural and Human Disturbances

Much of the Western Prairie Ecological Landscape was once dominated by tallgrass prairie, oak savanna, and wetlands, with some oak forest, mesic hardwood forest, and floodplain forest, but it has been greatly changed by human activities since Euro-American settlement. Agricultural and exurban development have extensively altered the land cover and hydrology here and led to major changes in the vegetation and natural disturbance regimes.

WISCLAND land use/land cover data from 1992 show that 47% (330,539 acres) of the ecological landscape was in agricultural use, 29% (202,205 acres) was grassland (almost all nonnative), 19% (131,317 acres) was forested, and 2% (10,324 acres) was nonforested wetland (WDNR 1993). Only 1% of this ecological landscape was classified as urban, but exurban housing has increased rapidly, especially near the St. Croix River.

Fire, Wind, and Flooding

Fire was historically the dominant natural disturbance in the uplands of the Western Prairie Ecological Landscape, as evidenced by the abundance of fire-adapted and fire-dependent vegetation found throughout this region early in the Euro-American settlement period. The abundance of prairies, oak savannas, and oak forests across the Western Prairie indicates that extensive fires were formerly frequent here.

Before Euro-American settlement, this region was affected by the activities of American Indian cultures. Fires were set by American Indians to aid in hunting and to provide habitat for the game they desired and the plants they used. Modern data (1982 to 2012) show relatively few occurrences of lightning

strikes in the Western Prairie (NOAA 2014), so it is likely that pre-historic fire intervals in the Western Prairie had a strong human influence. These fires prevented forests from expanding and maintained the prairie, oak savanna, and oak woodland vegetation. When Euro-American settlers arrived in the mid-1800s, fires were suppressed, prairies were plowed and converted to cropland, and the oak savanna that was not used for agricultural purposes, including grazing, quickly converted to forests.

True prairies probably burned at intervals of less than five years, sometimes burning annually or semi-annually (Dickmann and Cleland 2002). Oak Openings probably burned at intervals of one to 15 years. If the fire interval was longer than 15 years, these communities tended toward more closed forest. Timing and intensity of these periodic fires was also important but few data exist to clarify and interpret these aspects of fire history here.

Windthrow was probably not a major disturbance in the historical forests of the Western Prairie Ecological Landscape; however, data on windthrow frequency and severity are lacking. Canham and Loucks (1984) reported that windthrow was not a significant disturbance factor in southern Wisconsin because of the large amount of prairie and oak savanna, which would also be true for much of the Western Prairie, especially in the west. Windthrow likely occurred in the floodplain forests along rivers and streams where the high water table limited tree root depths. Thunderstorm ***downbursts*** and tornadoes affected some forests, but the overall impacts were likely local.

The extent and frequency of flood disturbance prior to Euro-American settlement is unclear. However, the St. Croix River brought spring snowmelt from the north and would have flooded annually in the spring and at other times during years with abnormally high levels of precipitation. The presence of extensive and well-developed floodplains in the St. Croix River valley (including forests composed of long-lived trees characteristic of bottomland environments) suggests frequent (probably annual) inundation. These floodplains still flood every spring but the severity, duration, and timing of inundation has been altered by dams and dikes, elimination of wetlands, and other human activities. The flood regimes needed to maintain floodplain forest communities over time is poorly known, especially when adding the disturbances caused by invasive species and development, and needs study.

Forest Insects and Diseases

Major forest types in the Western Prairie are oak, maple-basswood, aspen-birch, and bottomland hardwoods. Each of these forest types is associated with particular insects and diseases. There are a number of pest species that periodically affect forests in this ecological landscape.

Oaks are adversely affected by several organisms. Gypsy moth (*Lymantria dispar*) is a nonnative insect, currently becoming established here, which will periodically affect oak and aspen forests. Dry conditions in parts of the Western Prairie Ecological Landscape can facilitate gypsy moth population growth, leading to relatively faster rates of spread and more frequent outbreaks after establishment. The two-lined chestnut borer (*Agrilus bilineatus*) is an insect that attacks oaks, especially if the trees are weakened from damage or drought. Oak wilt is a vascular disease caused by the native fungus *Ceratocystis fagacearum*. Aspens can be impacted by forest tent caterpillar (*Malacosoma disstria*), aspen heart rot fungus (*Phellinus tremulae*), and aspen Hypoxylon canker fungus (*Hypoxylon mammatum*). Dutch elm disease is caused by the fungus *Ophiostoma ulmi*, which is transmitted by two species of bark beetles or by root grafting. American elm (*Ulmus Americana*) is more seriously affected than other elm species, but all of our native elms (*Ulmus* spp.) are somewhat susceptible, as is the nonnative Siberian elm (*Ulmus pumila*). American elm, which was formerly a dominant canopy species in the floodplain forests along the St. Croix River, has essentially been eliminated as a component of the forest overstory but still occurs in the understory as seedlings, saplings, and small trees. Its life span is now typically about 30 years before it succumbs to Dutch elm disease. The loss of American elm as a canopy species dominant tree has impacts on associated wildlife species, such as Wood Duck and other cavity nesters as well as canopy nesting birds. The limbs of mature elms often arched over channels and sloughs, creating a unique structure in the floodplain forests. The invasion of reed canary grass in canopy openings created by Dutch elm disease or other disturbances can prevent the establishment of tree seedlings and alter forest composition, structure, and successional pathways. Dutch elm disease and infestations of reed canary grass have altered Floodplain Forest communities along some of the major rivers here, as have the disruptions of natural flood regimes.

Emerald ash borer (*Agrilus planipennis*) is an exotic insect native to Asia. This extremely serious forest pest has been confirmed in 35 Wisconsin counties as of 2015 (WDATCP 2015). Affected counties have been placed under quarantine to limit the inadvertent spread of the emerald ash borer, which may be present in ash nursery stock, ash firewood and timber, or other articles that could spread emerald ash borer into other parts of Wisconsin or other states. Some adjacent counties are also under quarantine because of their proximity to infestations in neighboring counties.

Attempts to contain infestations in Michigan by destroying ash trees in areas where emerald ash borer was found have not been successful, perhaps because the insect was already well established before it was found and identified. The emerald ash borer typically kills a tree within one to three years. In greenhouse tests, the emerald ash borer has also been shown to feed on some shrub species such as privets (*Ligustrum* spp.) and lilacs (*Syringa* spp.), but it is still unknown as to whether shrub availability will contribute to its spread under field conditions. See the Wisconsin Emerald Ash Borer website (WDATCP 2015) for up-to-date information on its current distribution.

The emerald ash borer could have a significant impact on forest structure and composition here, especially in the floodplain forests, but in more mesic upland forests as well. The forested floodplains of the St. Croix and Mississippi rivers, where green ash is common and sometimes a canopy co-dominant, could be dramatically altered if green ash dies and is not replaced by other tree species. Floodplain Forests provide important breeding habitat for a number of rare species and maintain connectivity between forested sites within and between ecological landscapes. Canopy openings in disturbed floodplain forests may be quickly colonized by invasive plants such as reed canary grass.

More information about these forest diseases and insect pests of forest trees can be found at the Wisconsin DNR's forest health web page (WDNR 2015a) and at the U.S. Forest Service Northeastern Area forest health and economics web page (USFS 2015).

Invasive Species

In grassland communities, problem species for native prairies may include nonnative grasses such as smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and Canada bluegrass (*Poa compressa*). (However, these species are often important components of surrogate grasslands, and their presence there is not necessarily a negative. Supposed negative impacts should be assessed on a case by case basis.) Other nonnative, often invasive plants present here are crown vetch (*Coronilla varia*), cut-leaved teasel (*Dipsacus laciniatus*), bird's-foot trefoil (*Lotus corniculata*), white and yellow sweet clovers (*Melilotus alba* and *M. officinalis*), wild parsnip (*Pastinaca sativa*), spotted knapweed (*Centaurea biebersteinii*), leafy spurge (*Euphorbia esula*), and autumn olive (*Elaeagnus umbellata*).

In forest communities, glossy and common buckthorn (*Rhamnus frangula* and *R. cathartica*), nonnative honeysuckles (*Lonicera tatarica, L. morrowii*, and the hybrid *Lonicera* X *bella*), garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), Dame's rocket (*Hesperis matronalis*), Norway maple (*Acer platanoides*), and black locust (*Robinia pseudoacacia*) already pose problems in some areas. These species may initially colonize disturbed areas and edges but once established can continue to invade surrounding habitats.

In aquatic and wetland ecosystems, Eurasian water-milfoil, curly-leaf pondweed, zebra mussel, rusty crayfish, common carp, common reed (*Phragmites australis*), purple loosestrife, and reed canary grass are the major problem species.

For more information on invasive species, see the Wisconsin DNR's invasive species web page (WDNR 2015c).

Land Use Impacts

Historical Impacts. There have been dramatic and pervasive changes in land use and land cover in the Western Prairie Ecological Landscape. Settlers plowed the prairies, drained wetlands, and cut forests for lumber and to make way for farmland. The ecological landscape went from an open mosaic of prairies, pothole wetlands, lakes, oak savanna, and hardwood forests at the time of Euro-American settlement to mostly agricultural fields with some scattered remnant grasslands and wetlands that were too difficult to drain.

Current Impacts. Land cover changes in the Western Prairie are largely due to human activities, primarily agriculture, rural residential development, and cessation of fire**.** The permanent conversion of agricultural and undeveloped lands to houses, roads, and associated infrastructure is prevalent in parts of the Western Prairie, especially in the west.

In addition to direct impacts, human land use changes also indirectly impact ecosystem structure and function by altering natural disturbance regimes. Although peak flow of the lower St. Croix River in this ecological landscape shows only a slight increasing trend (USGS 2009), there is more variability in peak flows since the 1940s. Variability of peak flows may have increased because of extensive wetland drainage and by more intensive row cropping (leading to more rapid runoff in addition to being a means of transporting nutrients and sediments into waterbodies and wetlands). Construction of dams has disrupted the natural flood regimes of rivers and wetlands adapted to periodic flooding, which can alter successional pathways and lead to changes in species composition and stand structure. Untimely discharges from or the retention of water behind dams can have negative effects on sensitive aquatic organisms such as mussels.

The implementation of fire suppression policies in the early 20th century has almost eliminated wildfires and greatly reduced fire frequency and intensity. This has led to changes in species composition, stand structure, and landscape patch structure of fire-adapted vegetation such as prairie and savanna. Fire suppression has facilitated an increase in woody species, accelerating the succession of sedge meadow, prairie, and oak savanna to shrubby thickets or closed canopy forest.

Changes in Hydrology. Prairie pothole wetlands were scattered throughout the Western Prairie prior to settlement of the area by Euro-Americans. The abundance of these potholes and their associated prairie, wet meadow, and marsh vegetation made this ecological landscape important for waterfowl and other wetland fauna as well as for grassland species also adapted to these habitats. Many wetlands and ponds have been damaged or impaired by agricultural runoff from adjacent cultivated fields and have also become isolated from the upland grasslands needed by some wetland species for nesting (e.g., some species of waterfowl). Pasturing cattle in wetlands during periods of low water and lowering water tables by ditching and channelization has further altered and degraded wetlands. Loss or impoverishment of native ecosystems such as sedge meadows, wet prairies, and shallow marshes has occurred.

Now wetlands cover less than 4% of the ecological landscape. The remaining wetlands continue to be degraded by excessive runoff containing sediments, nutrients, herbicides,

pesticides and other pollutants from agricultural and urban lands, changed hydrologic conditions, and the negative impacts of common carp and other invasive species (e.g., reed canary grass, purple loosestrife).

Dams were constructed to generate power, mill grains, facilitate water transportation, and create recreational opportunities. But dams also limit the movement of aquatic organisms, including the movements of game fish such as lake sturgeon, walleye, and smallmouth bass. The impounded waters behind dams are warmed, allowing ***rough fish*** such as common carp to flourish while eliminating habitat for more desirable native species. Changes in hydrology cause changes in stream habitat. Holding water behind dams at certain times of the year can be detrimental to some aquatic life. For example, in the past, holding water behind a dam on the St. Croix River during winter exposed rare mussels and other organisms downstream to freezing temperatures, resulting in significant mortality. These practices have been corrected to provide sufficient water to protect rare mussel species that occur below this dam.

Agriculture. Prior to settlement by Euro-Americans, the Western Prairie Ecological Landscape was characterized by prairie, oak savanna, and prairie pothole marshes. In the eastern third of the ecological landscape, forests were the prevalent vegetation. Almost all of the prairie and oak savanna has been converted to agricultural production (row crop production and pasturage) because of the favorable climate, relatively level topography, and rich soils. In 1992, agricultural crops occurred on approximately 47% of all land in this ecological landscape (WDNR 1993). Widespread agriculture has created a matrix of farm fields, with scattered, mostly isolated patches of grassland and wetland. This benefits common and widely distributed species such as white-tailed deer and Wild Turkey but does not provide habitat for rare, obligate grassland species, such as those that are area-sensitive. Because of the intensive agriculture and spread of exurban residential development, grassland bird habitat is now largely restricted to grasslands managed specifically to benefit these species, mostly on publicly owned properties and farmland enrolled in the Conservation Reserve Program (CRP). A large-scale grassland-wetland management project, the Western Prairie Habitat Restoration Area, has been initiated by the Wisconsin DNR and the U.S. Fish and Wildlife Service (FWS). The FWS acquires and manages wetlands and grasslands as part of their St. Croix Wetland Management District. The Wisconsin DNR, via the Western Prairie Habitat Restoration Area project, and the U.S. Fish and Wildlife Service have been restoring wetlands and grasslands in this ecological landscape. This has resulted in improved habitat, benefiting wetland and grassland species, especially birds, and protecting soils and water quality.

Forest Management. Numerous pine plantations have been added to the formerly open landscape. If not sited well, the plantations fragment grasslands and other one habitats. Tree planting should not be encouraged in areas identified as important for grassland restoration such as the Western Prairie Habitat Restoration Area.

Lack of regeneration of floodplain forests could be another significant land use change, especially within the St. Croix River corridor. The disruption of hydrologic regimes, introduction of invasive species such as reed canary grass, direct and indirect damage from Dutch elm disease, and potential damage from the emerald ash borer may make regeneration of floodplain forests more problematic in the future. Floodplain forests could be severely altered and in some cases even partially replaced by monotypic stands of reed canary grass.

Residential Development. Rural residential development has occurred and is now increasing in the western part of the Western Prairie Ecological Landscape, in part because if its proximity to the Minneapolis/St. Paul metropolitan area. Development of rural land constitutes a permanent change on this ecological landscape and can alter and indirectly affect large areas. Poorly planned development can result in habitat fragmentation and loss of habitat connectivity. In some areas, destruction of grassland and wetland habitat is occurring. On the positive side, some residents that move to the country are interested in the natural world and may be more willing to support management of grassland and wetland habitats and their associated species.

Management Opportunities for Important Ecological Features of the Western Prairie Ecological Landscape

Natural communities, waterbodies, and other significant habitats for native plants and animals have been grouped together as "ecological features" and identified as management opportunities when they

- occur together in close proximity, especially in repeatable patterns representative of a particular ecological landscape or group of ecological landscapes;
- offer compositional, structural, and functional attributes that are important for a variety of reasons and that may not necessarily be represented in a single stand;
- represent outstanding examples of natural features characteristic of a given ecological landscape;
- are adapted to and somewhat dependent on similar disturbance regimes;
- share hydrological linkage;
- increase the effective conservation area of a planning area or management unit, reduce excessive edge or other negative impacts, and/or connect otherwise isolated patches of similar habitat;

- potentially increase ecological viability when environmental or land use changes occur by including environmental gradients and connectivity among the other important management considerations;
- accommodate species needing large areas and/or those requiring more than one habitat;
- add habitat diversity that would otherwise not be present or maintained; and
- provide economies of scale for land and water managers

A site's conservation potential may go unrecognized and unrealized when individual stands and habitat patches are managed as stand-alone entities. A landscape-scale approach that considers the context and history of an area, along with the types of communities, habitats, and species that are present, may provide the most benefits over the longest period of time. This does not imply that all of the communities and habitats associated with a given opportunity should be managed in the same way, at the same time, or at the same scale. Instead we suggest that planning and management efforts incorporate broader management consideration and address the variety of scales and structures approximating the ***natural range of variability*** in an ecological landscape—especially those that are missing, declining, or at the greatest risk of disappearing over time.

Outstanding Ecological Opportunities in the Western Prairie Ecological Landscape

- Grassland management at large scales is still possible here. The Western Prairie Habitat Restoration Area will be the primary project used to achieve grassland management goals by Wisconsin DNR and its partners.
- The St. Croix River and its corridor of wetlands, prairies, and forested bluffs represent an exceptionally important complex of natural features.
- The Kinnickinnic River valley from River Falls to the St. Croix River stands out for its diverse array of natural communities, bedrock and aquatic features, and numerous rare species populations.
- Scattered prairie, savanna, and forest remnants of high ecological value need to be identified and protected where possible.
- The spring-fed upper reaches of several coldwater and coolwater streams offer opportunities to protect important aquatic habitats.
- Miscellaneous opportunities include scattered rare species populations, natural communities, and habitats not discussed elsewhere.

Both ecological and socioeconomic factors were considered when determining management opportunities. Integrating ecosystem management with socioeconomic activities can result in efficiencies in the use of land, tax revenues, and private capital. This type of integration can also help to generate broader and deeper support for sustainable ecosystem management. Statewide integrated opportunities can be found in Chapter 6, "Wisconsin's Ecological Features and Opportunities for Management."

Significant ecological management opportunities that have been identified for the Western Prairie Ecological Landscape include

- grasslands: prairies, surrogate grasslands, savannas;
- the lower St. Croix River corridor;
- the Kinnickinnic River corridor;
- coldwater and coolwater streams; and
- miscellaneous opportunities for intact natural communities and rare species populations.

Natural communities, community complexes, and important habitats for which there are management opportunities in this ecological landscape are listed in Table 23.2. Examples of some locations where these important ecological places may be found within the ecological landscape are on the "Ecologically Significant Places within the Western Prairie Ecological Landscape" map in Appendix 23.K.

Grasslands: Prairies, Surrogate Grasslands, Savannas

The most extensive management opportunity offered in the Western Prairie Ecological Landscape is for grasslands. Though native prairie acreage has been reduced to very small scattered remnants, the Western Prairie Habitat Restoration Area (see Figure 23.11) and the scattered federal Waterfowl Production Areas have protected several large areas of open (nonforested) landscape, and these now represent the best chances to maintain or increase habitat conditions required by many important grassland species, especially birds. The grasslands of the Western Prairie have supported many rare and declining grassland birds, including species that are area sensitive or have other specific habitat needs that are not being met in most other open areas of the state.

Because of the intensive land use, generally high levels of disturbance, and severely fragmented condition of much of the Western Prairie Ecological Landscape, not all important native prairie remnants can be included within projects associated with the opportunities mentioned above, especially at larger scales. It is possible, and probably necessary, to manage at multiple scales here. While the management emphasis in the Western Prairie is rightly focused on the extensive grasslands and their associated habitats such as pothole lakes and ponds, there is still a need to protect sites that contain the more isolated, less connected examples of native grasslands,

Table 23.2. *Natural communities, aquatic features, and selected habitats associated with each ecological feature within the Western Prairie Ecological Landscape.*

Ecological features[a]	Natural communities,[b] aquatic features, and selected habitats
Grasslands: prairies, sedge meadows, surrogate grasslands, pastures, savannas	Oak Opening Dry Prairie Dry-Mesic Prairie Emergent Marsh Mesic Prairie Wet Prairie Southern Sedge Meadow Northern Sedge Meadow Surrogate Grasslands Submergent Marsh Wild Rice Marsh Ephemeral Pond Inland Lake
Lower St. Croix River corridor	Northern Dry-Mesic Forest Southern Dry Forest Southern Dry-Mesic Forest Southern Mesic Forest Floodplain Forest Oak Openings Oak Woodland Cedar Glade Alder Thicket Shrub-carr Wet Prairie Dry Prairie Bedrock Glade Dry Cliff Wet Cliff Warmwater River
Kinnickinnic River corridor	Northern Dry-Mesic Forest Southern Dry-mesic Forest Southern Mesic Forest Oak Openings Oak Woodland Dry Prairie Sand Prairie Dry Cliff Wet Cliff Coldwater Stream Coolwater Stream
Coldwater and coolwater streams	Coldwater Stream Coolwater Stream Springs and Spring Runs
Miscellaneous opportunities	Scattered populations of rare species, natural communities, and habitats not covered elsewhere

[a]An "ecological feature" is a natural community or group of natural communities or other significant habitats that occur in close proximity and may be affected by similar natural disturbances or interdependent in some other way. Ecological features were defined as management opportunities because individual natural communities often occur as part of a continuum (e.g., prairie to savanna to woodland, or marsh to meadow to shrub swamp to wet forest) or characteristically occur within a group of interacting community types (e.g., lakes within a forested matrix) that for some purposes can more effectively be planned and managed together rather than as separate entities. This does not imply that management actions for the individual communities or habitats are the same.

[b]See Chapter 7, "Natural Communities, Aquatic Features, and Selected Habitats of Wisconsin," for definitions of natural community types.

Star Prairie Seed Farm, which produces native plants of the appropriate species and geographic origins to reintroduce into grassland sites in the Western Prairie Ecological Landscape, including the Western Prairie Habitat Restoration Area. Photo by Harvey Halvorsen, Wisconsin DNR.

Prescribed fire has been introduced into the Western Prairie Habitat Restoration Area to improve, maintain, and expand grassland habitat needed by many native or otherwise desirable plants and animals, many of them currently undergoing serious regional or rangewide declines. See the "Fauna" section of this chapter for details. Photo by Harvey Halvorsen, Wisconsin DNR.

especially those types that are now very rare, such as the tallgrass prairies (mesic, wet-mesic, and dry-mesic types) and Oak Openings. Relatively undisturbed remnant prairies of all types (including remnants on steep bluffs, within various rights-of-way, and even grazed but unplowed prairie pastures with management potential) and Oak Openings that are either in good condition or have high restoration potential are strong candidates for protection and management wherever they occur, even at the smaller scales. Local NGOs may provide appropriate means of protection and management for some of these smaller, more isolated sites. Many if not most such opportunities will be at small scales and the sites will be isolated, and many of the sites will have been altered and somewhat degraded by past uses. However, wherever possible, small sites containing examples of native grasslands and savannas should be incorporated into larger grassland management areas to accommodate additional aspects of function, composition, structure, and long-term viability. Intact remnants may also serve as important seed sources to ensure that there is a focus on local genotypes in more extensive prairie restoration efforts.

Historically, parts of this ecological landscape (especially the northwestern portion) contained a dense concentration of the small shallow seepage lakes referred to as "prairie potholes." The concentration of such "pothole" ponds and associated wetlands in the former prairie landscape of southwestern Polk and northwestern St. Croix counties is unique in Wisconsin, and the potential for restoring the rich mosaic of prairie, sedge meadow, marsh, and open water that formerly occurred there should be pursued to the degree possible.

Some of the pothole lakes and ponds may support marsh communities composed of submergent, floating-leaved and emergent aquatic macrophytes. Past agricultural and construction practices have had detrimental impacts on many of the marshes and ponds, due to increased inputs of sediments and nutrients. Sedimentation increases turbidity, which can suppress, smother, or otherwise damage beds of aquatic plants. Increased sediment inputs may also encourage the growth and spread of invasive plants such as reed canary grass. Detrimental impacts to herptiles, aquatic invertebrates, and both nesting and migrating waterbirds may also occur.

Management Opportunities, Needs, and Actions

- Create large blocks of grassland habitat with public and private partners, connect them where possible, and address the specific needs of species and cover types of conservation concern.
- Identify remnant prairies and savannas with knowledgeable staff from Wisconsin DNR and other resource management agencies, as well as with local naturalists, biologists, and academics, to identify sites containing or potentially containing natural community remnants that would be worth following up with an examination of air photos and perhaps field surveys.
- When significant remnants are identified and their values assessed and documented, incorporate them into an existing project or search for an appropriate group that has the levels of management expertise, support, and the wherewithal and experience to implement and maintain a viable project.
- Periodically update breeding bird surveys for rare and declining grassland birds and identify population trends for all birds in grassland habitats throughout the ecological landscape. Compare these with similar surveys conducted in grassland habitats elsewhere in the state. Coordinate

this work where possible with Phase II of the Wisconsin Breeding Bird Atlas, which will begin in 2015.

- Incorporate recent survey data for rare or other priority species, assess their priority in this ecological landscape, and follow-up with more intensive surveys as warranted.
- Embed lakes, ponds, springs, and patches of savanna into managed grassland complexes where appropriate.
- Investigate and clarify the reasons for the degradation or disappearance of important marsh habitats in some lakes and ponds. Take appropriate steps to remedy the problem(s).
- Maintain forest patches, especially fire-dependent oak-dominated communities, at sites where they would have been relatively unaffected or infrequently affected by wildfires. Examples might include the east and north shores of lakes and sites downwind of the larger rivers.
- Continue to work with other agencies, such as U.S. Fish and Wildlife Service (e.g., Waterfowl Production Areas), Natural Resources Conservation Service, and NGOs that have common interests and share some of the same conservation goals, to protect and manage grassland ecosystems.
- Discontinue incentives to plant trees in areas identified as important grassland habitats and restore pine plantations back to grasslands when they are harvested if they are fragmenting these areas. Ideally, tree planting incentives in such areas can be replaced with incentives to manage grasslands that support declining wildlife.
- Develop strategies to minimize negative impacts of invasive species that are already present in the Western Prairie and are likely to affect the grasslands and wetlands within this ecological landscape.
- Explore the potential for using biomass harvest operations as a means to manage woody vegetation encroaching on or fragmenting grasslands.
- Investigate use of grazing and patch burn grazing as a management tool to remove woody plants from the understory of overgrown grasslands or savannas.

Lower St. Croix River Valley, including the Floodplain and Adjoining Bluffs

The lower St. Croix River (from the dam at St. Croix Falls downstream to the St. Croix's confluence with the Mississippi River) supports an exceptionally high diversity of aquatic organisms, including fish, mussels, and other invertebrates, and including many rare species. Several mussels inhabiting this stretch of the St. Croix are globally rare. Small deltas have formed at the mouths of tributary streams, and the delta at the mouth of the Kinnickinnic River is responsible for the widening of the St. Croix in the vicinity of Hudson, Wisconsin (see the "Population Density, Cities, and Transportation of the Western Prairie Ecological Landscape" map in Appendix 23.K at the end of this chapter). These river deltas provide important habitats for herptiles, especially for nesting turtles, and are used heavily by migrating and resident birds.

Wetlands occurring within the river's floodplain include emergent marsh, wet prairie, shrub swamp, and floodplain forest. Especially significant wetlands occur within the St. Croix National Scenic Riverway in southwestern Polk County and at St. Croix Islands State Wildlife Area in northwestern St. Croix County. The lower St. Croix was added to the National Wild and Scenic Rivers program in 1972.

While the lower St. Croix enjoys a significant degree of protection as a National Scenic Riverway, it is vulnerable to threats posed by expanded exurban and urban encroachments. Recreational use of the river is heavy at times, and not all such uses are benign. Opportunities still exist to better ensure the long-term protection of the St. Croix River corridor, including its associated floodplain forest, dry prairies, oak and pine forests, cliffs, islands, and wet prairie, meadow, and marsh communities.

The forested bluffs along the lower St. Croix River include extensive hardwood forests of oak and maple. These corridors are of high importance to migratory, dispersing, and resident wildlife. Pictured here is an older stand of red and white oaks surrounding an ephemeral pond. Photo by Eric Epstein, Wisconsin DNR.

In much of the Western Prairie Ecological Landscape, the St. Croix is bordered by a corridor of heavily forested bluffs. Small prairie and savanna remnants are also present. This forested corridor is extensive, has a north-south orientation, receives heavy use by migratory birds, and hosts breeding populations of rare birds.

Stretches of the lower 2 miles of the Apple River, a tributary of the lower St. Croix, flow through a rocky gorge over 100 feet deep and joins the St. Croix River in northwestern St. Croix County. The gorge was apparently created when Glacial Lake Grantsburg drained over 12,000 years ago. Some of the unique features in the gorge have been partially protected within Apple River Canyon State Natural Area.

Management Opportunities, Needs, and Actions

- Protect hydrology of the St. Croix and its tributaries. Ensure that water quality remains high or improves in problem areas and implement water management plans that protect sufficient aquatic habitat for sensitive species at all times.
- Manage dams and impoundments to protect sensitive species (e.g., wintering mussels, amphibians, and reptiles).
- Conduct vegetation surveys to collect baseline data on community composition and structure, especially for those types most likely to be negatively impacted by disrupted disturbance regimes (such as cessation of wildfire and annual flooding) but also by invasive species and climate change.
- Implement findings from vegetation surveys and into management plans and modify or amend these plans as needed.
- Consider the risk of the upstream spread of invasives, including not only fish but also species such as the New Zealand mud snail (*Potamopyrgus antipodarum*) when contemplating dam removal or upstream fish passage around dams, and balance this risk against the potential gains to native species from removing barriers to upstream movement (WISC 2013).
- Monitor selected rare mussels and fish to continue tracking population and distribution trends, health of individual organisms, and other ecological data.
- Monitor migratory and resident birds throughout the St. Croix River corridor. Coordinate this work with Phase II of the Wisconsin Breeding Bird Atlas, scheduled to begin in 2015.
- Encourage education, signage, and other actions the help deter the spread of both aquatic and terrestrial invasive species.
- Establish monitoring programs to better enable the early detection of invasive species, both aquatic and terrestrial. Place special emphasis on lakes or impoundments that drain into the lower St. Croix and its tributaries.
- As appropriate, implement containment or eradication of invasive aquatic species from lakes or impoundments or those riparian species that are spread by water in waterbodies that drain to the St. Croix River and tributaries to avoid spread of these invasive species into the riverine systems.
- Ensure municipalities, utilities, and businesses are in compliance with state water and discharge permits and Total Maximum Daily Load (TMDL) nutrient management goals.
- Continue to work cooperatively with the National Park Service and the State of Minnesota to address management of the St. Croix River watershed on both sides of the river. Monitor recreational use on the lower St. Croix as well as developments and land uses within the watershed that are likely to impair ecosystem integrity (e.g., water quality, high native species diversity, habitat fragmentation and isolation, loss of function due to disrupted disturbance dynamics).

Kinnickinnic River Valley: River Falls Downstream to the St. Croix River

Below River Falls, the Kinnickinnic River flows freely through a valley that is bordered by dry-mesic to mesic hardwood forests and frequent exposures of dolomite and sandstone bedrock. In some locations, the bedrock outcrops form a deep, steep-sided gorge flanked by extensive series of cliffs. On the dry exposures the cliffs support species adapted to xeric site conditions and sparse vegetation; on shaded or moist sites, northern ***relicts***, including stands of coniferous trees and shrubs, may persist. In some areas along the lower river, the cliffs are "weeping" (due to groundwater seepage through fractures or pores in the bedrock) and have high potential to support rarities. Small waterfalls are present in some of the short box canyons that are tributary to the Kinnickinnic River valley.

At scattered locations on the slopes and bluffs above the Kinnickinnic River, small prairie and savanna remnants occur. Rare plant populations have been documented at several of these prairie and savanna sites, including a population of one globally rare, U.S. Threatened species, prairie bush-clover. Several other rare plants found here are most characteristic of grasslands in the northern Great Plains and reach their easternmost range extremities in the Western Prairie Ecological Landscape.

The forests consist mostly of dry-mesic or mesic hardwoods, and in aggregate these form a continuous corridor several miles long. Forest quality varies, usually related to recent land use history, but within the past several decades, some good quality stands of mesic sugar maple-basswood forest were noted on the lower slopes with cooler northern or eastern exposures, and there were also some relatively intact stands of dry-mesic hardwoods dominated by northern red and white oaks. Eastern white pine is a canopy component in some areas, and dripping cliffs sometimes host extensive beds of northern species such as Canada yew and mountain

Small tallgrass prairie remnant within the Western Prairie Habitat Restoration Area in the upper Kinnickinnic River watershed. Viceroy on cup plant. Photo by Missy Sparrow-Lien, Wisconsin DNR.

maple (*Acer spicatum*). It is possible that these forests are extensive enough in some areas to support small populations of area-sensitive resident birds, and the forested spring and streambank habitats could support rare species such as the Wisconsin Special Concern Louisiana Waterthrush.

Management Opportunities, Needs, and Actions

- Support the work of the Kinnickinnic River Land Trust and The Prairie Enthusiasts to protect natural features of high ecological significance in the Kinnickinnic River corridor and watershed.
- Work toward the protection of the entire river valley from River Falls to the Kinnickinnic's mouth.
- Develop protection and management agreements with the owners of prairie and savanna remnants and work toward long-term natural community maintenance and restoration.
- Monitor populations of rare prairie plants and address management problems. Focus on species that are globally rare or that are approaching their range limits in this ecological landscape.
- Monitor water quality and quantity and spring flow to establish patterns in natural variation and to ensure that clean water in sufficient quantity is available to support the aquatic ecosystem in perpetuity.
- Large blocks of forest (i.e., at a scale of many hundreds to thousands of acres) do not occur here, but several miles of continuous forest border the valleys of the Kinnickinnic River and its tributaries, and these may support area-sensitive species and habitat specialists. Breeding bird surveys should be conducted here to establish the composition of the resident bird assemblage and document the habitats used by rare or otherwise sensitive species.
- Update natural community and rare species records for this area and incorporate them into Wisconsin DNR's Natural Heritage Inventory database.

Coldwater and Coolwater Streams

Coldwater and coolwater streams are not nearly as abundant here as in the Western Coulees and Ridges Ecological Landscape immediately to the south, but some cold and coolwater communities remain healthy and diverse despite the spread of agriculture and urban development and their impacts on water quality. Small spring-fed streams are common in parts of the Western Prairie. They support a distinct assemblage of aquatic organisms, and perhaps more importantly, ultimately contribute their clean, cool waters, directly or via tributaries, to either the St. Croix or Chippewa rivers. As noted earlier, the St. Croix River forms the western border of this ecological landscape and is one of the most biologically diverse river systems in the Upper Midwest. Many of the water quality problems noted here can only be effectively addressed at the watershed level. As of 2010, multi-year Total Maximum Daily Load (TMDL) projects were underway across the entire St. Croix basin to assess the degree to which nutrients from runoff and other sources need to be controlled in order to protect the health of not only coldwater streams but cool and warm waterways as well. A final TMDL report was released in 2012 (MPCA-WDNR 2012).

Many coldwater streams in the southern third of the Western Prairie Ecological Landscape, such as the Kinnickinnic River, the upper reaches of the Rush, Trimbelle, and Eau Galle rivers, and the South Fork of the Willow River are of ecological significance because they have so far maintained their cold water community status in the face of major land use and land cover changes, and they are also likely to be more resilient in the face of climate change (Marshal et al. 2008). However, these streams remain vulnerable to habitat and water quality degradation brought about by poor land uses, and perhaps, weaknesses in local and regional land use plans. Watershed managers can develop and use priority rankings to make decisions regarding which streams would likely yield the greatest ecological and socioeconomic returns for protection and restoration efforts. As examples of coolwater streams in need of protection, an opportunity exists to protect wetlands and springs north of Hudson through an addition to Willow River State Park. Local land trusts present the best opportunity at this time to more fully protect the Apple River canyon and river corridor.

Additional sites of high ecological value need protection within the Kinnickinnic River watershed and the river corridor, which contains rare plant populations, significant geological features, and good examples of remnant hardwood forest, oak savanna, and prairie communities (Marshall et al. 2008).

Management Opportunities, Needs, and Actions

- Coordinate stream protection with grassland and savanna management where such opportunities exist.
- Stream surveys exist for the Rush, Trimbelle, and many other cold and coolwater streams that should indicate which stream reaches would most likely benefit from channel restoration, in-stream and adjoining upland habitat restoration, and other protections. These surveys assess current land use patterns, stream impacts of current and projected land uses, stream hydraulics and thermal regimes, in-stream habitat conditions, and the sources and loadings of excess nutrients and other pollutants. Factoring in the results of past rehabilitation efforts helps create a picture of how streams are likely to respond to various restoration actions, and allows the creation of a list of highest priority streams (Marshall et al. 2008).
- Wisconsin DNR fisheries and land management staff are in the process of completing (as of 2014) an extensive property master plan that includes most of the streams in the southern half of the Western Prairie, many of which flow into the Driftless Area (essentially the Western Coulees and Ridges Ecological Landscape). Called the "Driftless Area Streams Property Master Plan," it includes an extensive compilation of surveys of streams in the Western Prairie Ecological Landscape as well as in the Western Coulees and Ridges and the Southwest Savanna ecological landscapes. This master plan will indicate which watersheds have responded to habitat and land use improvements and are most likely to respond to future management actions (WDNR 2014a).
- Educational institutions such as UW-River Falls plus other school and community groups can be encouraged to continue monitoring of water quality in the Kinnickinnic, Apple, Rush, and Trimbelle rivers and in other streams.

Miscellaneous Natural Features

This category is meant to include management opportunities that are not covered by those identified and discussed above. Examples include scattered populations of rare plants or animals, scattered natural communities not mentioned or included elsewhere, geological features representative of this ecological landscape, and aquatic features that are locally important to maintain populations of plants and animals that are important to maintain here. It is especially important to locate and address conservation of such populations and communities in landscapes that are as heavily developed and disturbed as the Western Prairie Ecological Landscape. Intact examples of native ecosystems at large scales are few and far between or nonexistent.

Management Opportunities, Needs, and Actions

- Assess inventory needs for the entire ecological landscape, develop priorities, and design surveys that will fill the identified gaps.

The Wisconsin Endangered ground-plum is known from only a handful of sites in Wisconsin, most of them in the Western Prairie Ecological Landscape. Photo by Armund Bartz, Wisconsin DNR.

- Review existing biological inventory information and identify important natural communities, plants, and animals that may not be receiving management attention elsewhere.
- Forests in the eastern part of the Western Prairie have not been adequately inventoried and assessed and merit additional attention.

Socioeconomic Characteristics

Socioeconomic information is summarized within county boundaries that approximate ecological landscapes unless specifically noted as being based on other factors. Economic data are available only on a political unit basis, generally with counties as the smallest unit. Demographic data are presented on a county approximation basis as well since they are often closely associated with economic data. The multi-county area used for the approximation of the Western Prairie Ecological Landscape is called the Western Prairie counties. The counties included are St. Croix and Pierce because at least 25% of each county lies within the ecological landscape boundary (Figure 23.12).

History of Human Settlement and Resource Use

American Indian Settlement

The archaeology of northern Wisconsin is fragmentary and often poorly understood. Given this, there are many gaps in our understanding of the cultural evolution of early peoples

Figure 23.12. *Western Prairie counties.*

in northern Wisconsin. It can be generally said that technology and traditions occurred earlier in southern Wisconsin than in northern Wisconsin (see Chapter 2, "Assessment of Current Conditions," for a description of the cultural traditions of Wisconsin). While there is scattered evidence of habitation in the Western Prairie Ecological Landscape as far back as the Archaic Tradition, there are few sites of significance in this ecological landscape.

Euro-American Contact and Settlement

At the time of Euro-American contact, the Santee Dakota likely claimed this part of what is now the state of Wisconsin. By the 18th century, Chippewa people had also moved into this area, which led to tension and later raids, skirmishes, and war between the two tribes. Eventually, the Santee Dakota were forced out of Wisconsin westward (Mason 1988).

With the creation of a U.S. land office in Hudson, Wisconsin, settlement in this area intensified and became much more widespread. Dutch and Polish immigrants proved to be the dominant groups settling in this region, and agriculture eventually became the most common means of subsistence. In 1850 this area had only four farms; by 1890 this number had grown to 5,295 (ICPSR 2007). See the "Statewide Socioeconomic Assessments" section in Chapter 2, "Assessment of Current Conditions," for further discussion of the history of agricultural settlement in central Wisconsin.

Early Agriculture

Permanent Euro-American settlement began in the Western Prairie counties with the founding of St. Croix County in 1840 by the legislature of the Wisconsin Territory. After Wisconsin became a state in 1848, the boundary of St. Croix County assumed its current shape. This was followed by the establishment of Pierce County in 1853 (NACO 2010). After 1850, when only four farms were reported in the federal agricultural census, agriculture quickly became a prominent component of local economies in the Western Prairie counties (ICPSR 2007). By 1870 the number of farms in Western Prairie counties had greatly expanded, totaling 2,931 farms, and by 1890 this number had grown to 5,295. The number of farms in Western Prairie counties reached its maximum in 1900, with a total of 6,466 farms. Meanwhile, the population had reached 50,773. Farm numbers gradually declined in Western Prairie counties after 1900, as some marginal farms went out of production (Figure 23.13). Population growth leveled off, until the expansion of the Twin Cities metropolitan area began to drive up population in these counties beginning around 1950. Farms in Western Prairie counties tended to have acreages very similar to the averages for the state as a whole. In 1950 the average Western Prairie county farm was 145.3 acres compared to 137.8 acres statewide. During and following World War II, a combination of the failure of many smaller, marginal farms, subsequent consolidation, and mechanization increased the average size of farms in Western Prairie counties, much as it did in the state as a whole (Figure 23.14). That trend continued throughout much of the remaining 20th century.

Total value of all crops indicates the extreme influence of the Great Depression on agriculture. In 1910 all crops harvested in Western Prairie counties had an estimated total value of $6.1 million, which had nearly tripled by 1920 ($17.6 million) (ICPSR 2007). However, total value of all crops in Western Prairie counties plummeted in 1930 ($8.7 million) and fell further in 1940 ($6.1 million). Western Prairie counties were strongly identified as agricultural and were relatively productive. Total values of crops in Western Prairie counties comprised 3.6% of total crop value in the state in 1940, and these crops came from farms comprising 3.4% of all Wisconsin farm acreage.

Over the early part of the 20th century, the type of farming in Western Prairie counties underwent some fundamental shifts as Wisconsin became established as a leader in the dairy industry. Farms in Western Prairie counties increasingly grew "hay and forage" crops and grew less "cereal" crops. Nevertheless, "cereal" crops remained the greatest proportion of crop value in Western Prairie counties. The 1910 federal agricultural census listed "cereals" as 61.9% of the total value of all crops harvested in Western Prairie counties, but cereals comprised as little as 46.8% of total crop values in 1930, recovering to 51.6% by 1940 (ICPSR 2007). "Hay and forage," associated with livestock farming, was only 20.6% of total value of crops harvested in Western Prairie counties in 1910 but had risen to 39.2% of total crop value by 1940.

Early Mining

Mining has occurred in Wisconsin for thousands of years. There is clear evidence of copper mining in and around the

Lake Superior basin during the Middle Archaic Stage (possibly 8,000 until 3,000 years ago) with copper artifacts from that area found all over the eastern half of Wisconsin (Wittry 1957, Stoltman 1997). Extensive mining did not occur in this part of the state (Roe 1991).

Early Transportation and Access

In the early 19th century, an extensive network of American Indian trails existed throughout the territory (Davis 1947). With rapid Euro-American settlement growth following the end of the Black Hawk War in 1832, those trails were widened into roads suitable for ox carts and wagons. A system of military roads was developed in Wisconsin around the same time, connecting key cities and forts with one another. However, none of these roads were located in the Western Prairie Ecological Landscape. Small railroad lines and companies operated here, mainly in St. Croix County in the Western Prairie region of the state. These included Cady Mills Railroad Company in the Cady Mills and Hersey areas and the Glenwood and Northern Railroad Company, constructed by the Wisconsin Central Railway Company, which ran from Glenwood in eastern St. Croix County to Graytown in northwestern Dunn County (Fisher 1937).

Major rail lines bypassed this particular region of the state early on, providing service instead to larger or more influential Wisconsin cities, such as La Crosse and Eau Claire to the south. See the "Statewide Socioeconomic Assessments" in Chapter 2, "Assessment of Current Conditions," for further discussion of the history of transportation in Wisconsin.

Early Logging Era

Sawmills were built along rivers in areas containing large stands of timber. In areas where the physical character of the river (gradient, depth, width) made it difficult to float logs, lumbermen built mills as close to the cutting area as possible, whereas on rivers better suited to floating logs, sawmills were generally more centralized in areas favorable to timber companies (Ostergren and Vale 1997). The westward surge of the Euro-Amrican agricultural frontier to treeless lands increased the demand for lumber from northern Wisconsin. Wisconsin had the advantage of an extensive network of waterways flowing south from the northern timber region. Mills in the Western Prairie region used trees mainly from the hardwood forests of southern Wisconsin (The Wisconsin Cartographer's Guild 1998).

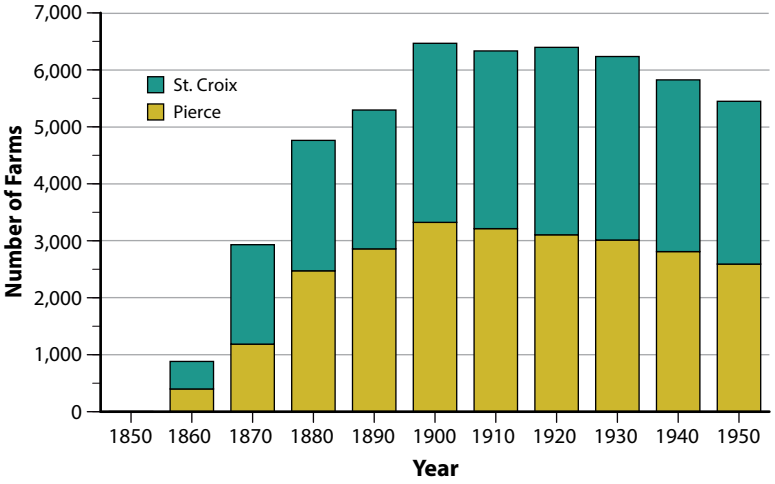


Figure 23.13. *Number of farms in the Western Prairie counties between 1850 and 1950 (ICPSR 2007).*

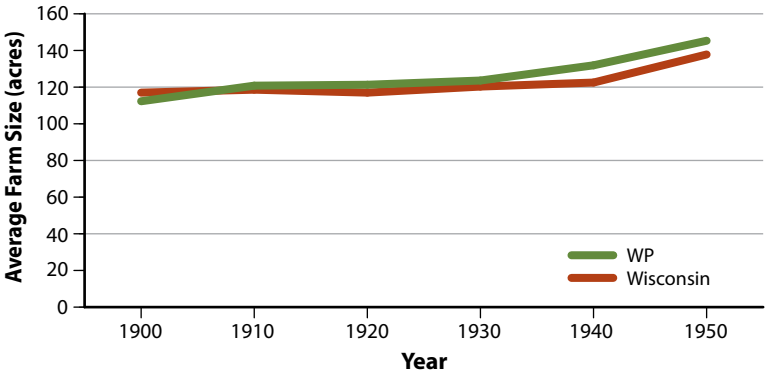


Figure 23.14. *Average farm size in the Western Prairie counties between 1900 and 1950 (ICPSR 2007).*

Resource Characterization and Use[1]

The Western Prairie is one of Wisconsin's smallest ecological landscapes, with about 1,100 square miles of land and 19 square miles of water. With over 125,000 people, the population density of 97 people per square mile is slightly below the state average (105 per square mile). The amount of surface water is below average, as is the acreage in lakes. The Western Prairie has less public land and a lower density of campgrounds and trails than most other ecological landscapes. However, it has about the average number of visitors to state properties.

Agriculture is an important part of the economy of the Western Prairie Ecological Landscape. It ranks second (out of 16 ecological landscapes) in the percentage of land area in agriculture with an above average income per farmed acre. Both total corn and milk production are about average compared to the state. Forestry, on the other hand, is not nearly as important to the economy. The Western Prairie Ecological Landscape ranks near the bottom in the percentage of land in forest and about average in terms

[1]When statistics are based on geophysical boundaries (using GIS mapping), the name of the ecological landscape is followed by the term "ecological landscape." When statistics are based on county delineation, the name of the ecological landscape is followed by the term "counties."

of timber volume per acre. The amount of timber harvested here is one of the lowest totals in the state.

Along with an average population density compared to the rest of the state, the Western Prairie ranks in the middle of all ecological landscapes in terms of the densities of roads and railroads. It has only two airports and no ports.

Although the Western Prairie Ecological Landscape uses a significant amount of energy, it is not a major producer of hydroelectric power and does not produce significant amounts of woody biomass, less than 1% of the state total. In addition, this region has no commercial wind facilities or ethanol plants.

The Land

Of the 684,026 acres of land (does not include acres of water) that make up the Western Prairie Ecological Landscape, only 18% is forested. About 85% of this forested land is privately owned while 11% belongs to the state, counties, or municipalities, and 4% is federally owned (USFS 2007).

Minerals

In 2007 there were six mining establishments in the Western Prairie counties. Due to limited participation in mining, employment and earnings information is not disclosed (WDWD 2009).

Water (Ground and Surface)

Water Supply

The data in this section are based on the 24K Hydrography Geodatabase (WDNR 2015b), which are the same as the data reported in the "Hydrology" section. However, the data are categorized differently here so the numbers will differ slightly. Surface water covers 12,477 acres (2.1% of the total area) of the Western Prairie Ecological Landscape. The 440 lakes (over one acre in size) cover 6,385 acres, which is 44% of the surface water. There is one lake over 1,000 acres in size: 1,120 acre Cedar Lake. Of the 5,974 acres of streams and rivers, the St. Croix, the Apple, and the Willow rivers are the largest. There are 85 dams, which impound 2,348 acres of water.

Water Use

Each day 11.9 million gallons of ground and surface water are withdrawn in the two counties of the Western Prairie (Table 23.3). About 2% of the withdrawals are from surface water. Of the 149,450 people that reside in these counties, 65% are served by public water sources, and 35% are served by ***private wells***. St. Croix County is the largest user of water in the Western Prairie and most is used for domestic purposes. There are two hydroelectric plants in the Western Prairie counties.

Recreation

Recreation Resources

Land cover, ownership, and land use patterns partly determine the types of recreation that are available to the public. For instance, in the Western Prairie Ecological Landscape, there is a much higher percentage of agricultural and grassland and a lower proportion of forest and wetland compared to the rest of the state (see Chapter 3, "Comparison of Ecological Landscapes," and/or the map "WISCLAND Land Cover (1993) of the Western Prairie Ecological Landscape" in Appendix 23.K at the end of this chapter).

This ecological landscape has the highest percentage of grassland out of 16 ecological landscapes (Wisconsin DNR unpublished data). The area in surface water is below average, but the proportion of that water in rivers as opposed to lakes is above average. There is less public land in the Western Prairie than in most other ecological landscapes. The density of campgrounds and multi-purpose trails is very low, but the number of visitors to state properties is about average. Acreage in state natural areas is very low, and the number of Land Legacy sites is the lowest in the state. None are regarded as having a high recreation potential.

Supply

Land and Water. The Western Prairie Ecological Landscape accounts for 2% of Wisconsin's total land area but only 1.2 % of the state's acreage in water (see Chapter 3, "Comparison of Ecological Landscapes"). There are 121,188 acres of forestland, which is less than 1% of the total forested acreage in the state (USFS 2007). Streams and rivers make up 48% of the surface water area in the Western Prairie Ecological Landscape whereas lakes and reservoirs make up 51% (WDNR 2015b). The largest river is the St. Croix, and the largest lake is Cedar Lake at 1,120 acres.

Public Lands. Public access to recreational lands is vital to many types of recreational activity. In the Western Prairie

Table 23.3. *Water use (millions of gallons/day) in the Western Prairie counties.*

County	Ground-water	Surface Water	Public Supply	Domestic[a]	Agriculture[b]	Irrigation	Industrial	Mining	Thermo-electric	Total
Pierce	4.2	0.1	1.8	1.2	0.1	0.1	0.5	0.0	0.6	4.3
St. Croix	7.6	0.1	2.9	1.1	0.2	2.3	0.6	0.0	0.7	7.8
Total	**11.8**	**0.2**	**4.7**	**2.3**	**0.3**	**2.4**	**1.1**	**0.0**	**1.3**	**12.1**
Percent of total	**98.0**	**2.0**	**39.0**	**19.0**	**3.0**	**20.0**	**8.0**	**0.0**	**11.0**	

Source: Based on 2005 data from the U.S. Geological survey on water uses in Wisconsin counties (USGS 2010).

[a]Domestic self-supply wells.

[b]Includes aquaculture and water for livestock.

Ecological Landscape, only 36,800 acres, or 5.3% of all land and water, is publicly owned (WDNR 2005a). This is significantly less than the statewide average of 19.5% and ranks this ecological landscape 13th (out of the 16 ecological landscapes) in percentage of public ownership. Demand for places to recreate is high given the proximity of the Twin Cities metropolitan area. St. Croix County is one of the fastest growing counties in the state with many St. Croix County residents commuting to the Twin Cities to work. Residents from both the Twin Cities metropolitan area and St. Croix County desire recreational areas close to home. There are about 12,500 acres of public waters, 15,900 acres of state recreational lands, and 8,400 acres of federal lands.

State-owned facilities are important to recreation in the Western Prairie Ecological Landscape. There are approximately 5,890 acres in parks here (the Willow River and Kinnickinnic state parks and a significant portion of the St. Croix National Scenic Riverway) and 9,100 acres managed for wildlife and fisheries (WDNR 2005a). The largest of these are Cylon State Wildlife Area, Kinnickinnic River State Fishery Area, and St. Croix Islands State Wildlife Area.

Trails. Although the Western Prairie counties have almost 570 miles of recreational trails (Table 23.4), they rank 13th (out of 16 ecological landscapes) in terms of trail density (miles of trail per square mile of land) (Wisconsin DNR unpublished data). Compared to the rest of the state, there is a lower density of all trail types except snowmobile trails.

Campgrounds. There are 23 public and privately owned campgrounds that provide about 1,600 campsites in the Western Prairie counties (Wisconsin DNR unpublished data). With only 1% of the state's campgrounds, this ecological landscape ranks 15th (out of 16 ecological landscapes) in terms of the number of campgrounds and 14th in campground density (campgrounds per square mile of land).

Land Legacy Sites. The Land Legacy project has identified over 300 places of significant ecological and recreational importance in Wisconsin, and five are either partially or totally located within the Western Prairie Ecological Landscape (WDNR 2006c). The lower St. Croix River is rated as having the highest conservation significance.

State Natural Areas. The Western Prairie has about 2,860 acres of state natural areas, 70% of which are publicly owned (including government and educational institutions) and 30% of which are owned by private or joint public-private interests (including NGOs) (Wisconsin DNR unpublished data). The largest state natural areas in this ecological landscape include Farmington Bottoms (940 acres, within the St. Croix National Scenic Riverway, Polk County), Standing Cedars (866 acres, Polk County), St. Croix Islands (525 acres, within a state wildlife area, St. Croix County), Cylon (207 acres, within Cylon State Wildlife Area, St. Croix County), and Apple River Canyon (183 acres, St. Croix County). For more information on Wisconsin state natural areas, see the Wisconsin DNR website (WDNR 2015d).

Demand

Visitors to State Lands. In 2006 there were an estimated 544,272 visitors to state parks in the Western Prairie Ecological Landscape (Wisconsin DNR unpublished data). The majority, 63%, visited Willow River State Park, and 37% visited Kinnickinnic State Park. Many of these visitors enjoy camping.

Fishing and Hunting License Sales. Of all license sales, the highest revenue producers for the Western Prairie counties were resident hunting licenses (45% of total sales), resident fishing licenses (20% of total sales), nonresident hunting licenses (17% of total sales) and nonresident fishing licenses (12% of total sales) (Wisconsin DNR unpublished data). Table 23.5 shows a breakdown of various licenses sold in the Western Prairie counties in 2007. St. Croix County accounts for both the highest number of licenses sold and the highest revenue from sales. This ecological landscape accounts for about 2% of total license sales in the state. However, persons buying licenses in the Western Prairie counties may travel to other parts of the state to use them.

Metropolitan Versus Nonmetropolitan Recreation Counties. Johnson and Beale (2002) classified Wisconsin counties according to their dominant characteristics. One classification from this study is "nonmetro recreation county," which is characterized by high levels of tourism, recreation, entertainment, and seasonal housing. Neither of the Western Prairie counties is categorized as a nonmetropolitan recreation county.

Table 23.4. *Miles of trails and trail density in the Western Prairie counties compared to the whole state.*

Trail type	Western Prairie (miles)	Western Prairie (miles/100 mi^2)	Wisconsin (miles/100 mi^2)
Hiking	21	1.6	2.8
Road biking	58	4.5	4.8
Mountain biking	9	0.7	1.9
ATV: summer & winter	0	–	9.3
Cross-country skiing	39	3.0	7.2
Snowmobile	439	33.8	31.2

Source: Wisconsin DNR unpublished data.

Table 23.5. *Fishing and hunting licenses and stamps sold in the Western Prairie counties.*

County	Resident fishing	Nonresident fishing	Misc. fishing	Resident hunting	Nonresident hunting	Stamps	Total
Pierce	5,084	1,860	225	9,401	720	5,025	22,315
St Croix	14,030	4,069	752	25,597	1,871	9,740	56,059
Total	**19,114**	**5,929**	**977**	**34,998**	**2,591**	**14,765**	**78,374**
Sales	**$444,012**	**$259,646**	**$19,387**	**$989,708**	**$381,825**	**$127,605**	**$2,222,183**

Source: Wisconsin DNR unpublished data, 2007.

Recreational Issues

Certain issues are affecting outdoor recreation opportunities within Wisconsin. Many of these issues, such as increasing ATV usage, overcrowding, increasing multiple-use recreation conflicts, loss of or inadequate public access to lands and waters, invasive species, and poor water quality, are common across many regions of the state (WDNR 2006b).

Silent Sports Versus Motorized Sports. Over the next decade, the most dominant recreation management issues will likely revolve around conflicts between motorized and nonmotorized recreation interests. From a silent-sport perspective, noise pollution from motorized users is one of the higher causes for recreation conflict (WDNR 2006b). Recreational motorized vehicles include snowmobiles, ATVs, motor boats, and jet skis. ATV riding has been one of the fastest growing outdoor recreational activities in Wisconsin, and ATV use is especially contentious elsewhere in the state but not in the Western Prairie Ecological Landscape. Here, recreational conflicts are more common between power boats and nonmotorized watercraft on the lower St. Croix River.

Timber Harvesting. A high percentage of people are concerned about timber harvesting in areas where they recreate. Their greatest concern about timber harvesting is that it not impact their recreational activities (WDNR 2006b). However, the attitudes of people within this ecological landscape may differ some from the statewide perspective because of the open nature of many natural communities and habitats that are common and/or widespread (e.g., prairies and other grasslands and oak savanna) within the Western Prairie Ecological Landscape.

Loss of Access to Lands and Waters. There is a perception of reduced access to lands and waters here, which may be due to a lack of information about where to go. This element was high on the list of barriers for increased outdoor recreation on a statewide survey (WDNR 2006b).

Agriculture

Farm numbers in the Western Prairie counties decreased 11% between 1970 and 2002 (USDA NASS 2004). There were approximately 3,810 farms in 1970 and 3,374 in 2002. Between 1970 and 2002, average farm size decreased from 128 acres to 117 acres, which was much lower than the statewide average of 201 acres in 2002. The overall land in farms has steadily decreased since the 1970s (Figure 23.15). In 1970 there were about 732,000 acres of farmland, and by 2002, farmland acreage was down to 463,000 acres, a decrease of 37%. This ecological landscape has the second highest percentage of land in agriculture. For the two counties, the percentage was 71% for Pierce County and 66% for St. Croix County, for an average of 68%.

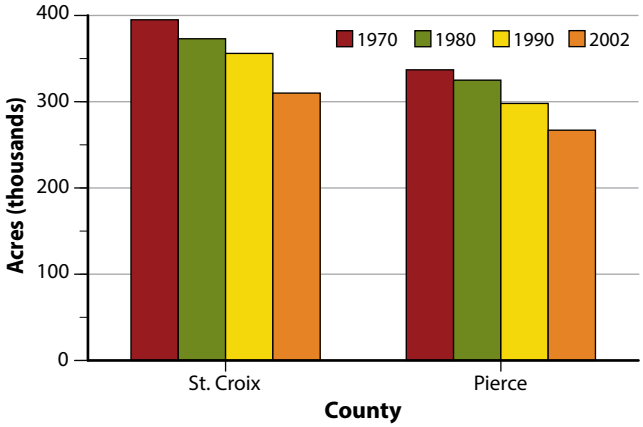


Figure 23.15. *Acreage of farmland by county and year in Western Prairie counties (USDA NASS 2004).*

Agriculture is an important part of the economy of the Western Prairie counties. In 2002 net cash farm income totaled $35 million or an average of $61 per agricultural acre, much lower than the statewide average of $91 per acre (USDA NASS 2004). The market value of all agriculture products sold in the Western Prairie counties was $170 million (2% of the state total); 26% of this amount came from crop sales, while the remaining 74% was from livestock sales.

In 2007, 4,282 acres of farmland was sold in the Western Prairie counties, of which 82% stayed in agricultural use at an average selling price of $2,658 per acre (USDA NASS 2009). Eighteen percent was diverted to other uses at an average sale price of $12,391 per acre. The Western Prairie counties have the third highest rate of agricultural land diversion in the state, due to exurban residential development.

Timber

Timber Supply

Based on 2007 Forest Inventory and Analysis (FIA) data (USFS 2007), 18% (121,188 acres) of the total area for the Western Prairie Ecological Landscape is forested. This is less than 1% of Wisconsin's total forestland acreage.

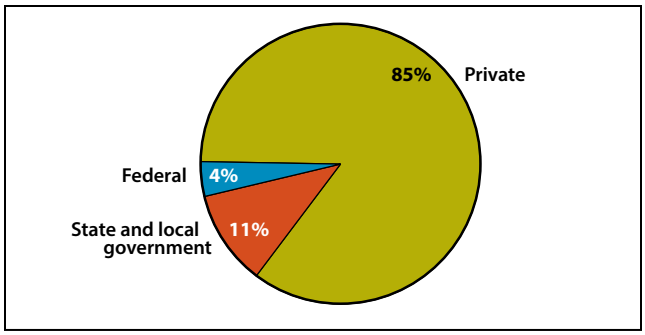


Figure 23.16. *Timberland ownership in the Western Prairie Ecological Landscape (USFS 2009).*

Timber Ownership. ***Timberland*** is defined by FIA as forested land capable of producing 20 cubic feet of industrial wood per acre per year that is not withdrawn from timber utilization (USFS 2009). Of all timberland within this ecological landscape, 85% is owned by private landowners, 11% is owned by state and local governments, and 4% is federally owned (Figure 23.16).

Growing Stock and Sawtimber Volume. There was approximately 159 million cubic feet of ***growing stock*** volume in the Western Prairie Ecological Landscape in 2007, or 1% of total volume in the state (USFS 2009). Most of this volume, 79%, was in hardwoods, higher than the proportion of hardwoods statewide, which was 74% of total growing stock volume. Hardwoods made up a similar percentage of ***sawtimber*** volume, 79%, in the Western Prairie Ecological Landscape. In comparison, statewide hardwood volume was 67% of total volume.

Annual Growing Stock and Sawtimber Growth. Between 1996 and 2007, the timber resource in the Western Prairie Ecological Landscape increased by an estimated 47 million cubic feet, or approximately 40% (USFS 2009). This should be considered a rough estimate due to the small number of FIA plots in this ecological landscape and the high sampling error for this estimate. Approximately 91% of this increase occurred in hardwood volume. Sawtimber volume increased by 130 million ***board feet***, or 34%, again mostly in hardwoods. This change was partly a result of a 10% increase in timberland acreage from 108,605 acres in 1996 to 119,117 acres in 2007. Statewide, timberland acreage increased by 3% during the same period.

Timber Forest Types. According to FIA data (USFS 2009), the predominant forest type groups in terms of acreage are maple-basswood (32%), oak-hickory (26%), and aspen-birch (16%),

Table 23.6. *Acreage of timberland in the Western Prairie Ecological Landscape by forest type and stand size class.*

Forest type[a]	Seedling/sapling	Pole-size	Sawtimber	Total
Hard maple-basswood	1,386	3,528	14,916	19,830
Aspen	669	10,480	5,420	16,568
Sugarberry-hackberry-elm-green ash	2,946	4,689	4,681	12,317
Red pine	–	5,628	6,456	12,084
Post oak-blackjack oak	–	–	10,360	10,360
Sugar maple-beech-yellow birch	380	7,126	1,951	9,457
White oak-red oak-hickory	–	–	8,403	8,403
Mixed upland hardwoods	2,492	–	3,341	5,833
Northern red oak	–	–	4,648	4,648
Elm-ash-locust	2,723	1,706	–	4,429
Red maple-upland	671	–	3,338	4,009
Balsam poplar	2,676	–	–	2,676
White pine-red oak-white ash	–	2,300	–	2,300
Chestnut oak-black oak-scarlet oak	–	–	1,473	1,473
White spruce	–	–	1,417	1,417
Eastern white pine	461	887	–	1,347
Cottonwood	–	–	737	737
Black cherry	737	–	–	737
Black walnut	–	–	108	108
Nonstocked[b]	–	–	–	383
Total	**15,141**	**36,344**	**67,249**	**119,117**

Source: U.S. Forest Service Forest Inventory and Analysis (FIA) Mapmaker (USFS 2009).

[a]U.S. Forest Service Forest Inventory and Analysis (FIA) uses a national forest typing system to classify FIA forest types from plot and tree list samples. Because FIA is a national program, some of the national forest types in the above table do not exactly represent forest types that occur in Wisconsin. For example, neither post oak nor blackjack oak occur to any great extent in Wisconsin, but since there is no "black oak forest type" in the FIA system, black oak stands in Wisconsin were placed in the "post oak-blackjack oak" category in this table.

[b]Nonstocked land is less than 16.7% stocked with trees and not categorized as to forest type or size class.

with smaller amounts of eastern white, red, and jack pines (*Pinus banksiana*), oak-pine, and bottomland hardwoods. See Appendix H, "Forest Types That Were Combined into Forest Type Groups Based on Forest Inventory and Analysis (FIA) Data" in Part 3 of the book, "Supporting Materials." Acreage is predominantly in the sawtimber and pole size classes (56% and 31%, respectively) with only 13% in seedling and sapling classes (Table 23.6).

Timber Demand

Removals from Growing Stock. The Western Prairie Ecological Landscape has about 0.8% of the total growing stock volume on timberland in Wisconsin (see the "Socioeconomic Characteristics" section in Chapter 3 "Comparison of Ecological Landscapes"). Average annual removals from growing stock were 1.6 million cubic feet, or about 0.5% of total statewide removals (349 million cubic feet) between 2000–2002 and 2005–2007 (USFS 2009). Average annual removals to growth ratios vary by species (only major species shown) as can be seen in Figure 23.17. Removals exceed growth for big-tooth aspen (*Populus grandidentata*).

Removals from Sawtimber. The Western Prairie Ecological Landscape has about 1% of the total sawtimber volume on timberland in Wisconsin. Average annual removals from sawtimber were about 7 million board feet or 0.7% of total statewide removals (1.1 billion board feet) between 2000–2002 and 2005–2007 (USFS 2009). Average annual removals to growth ratios vary by species as can be seen in Figure 23.18 (only major species shown). Sawtimber removals exceeded growth for big-tooth aspen and bur oak.

Price Trends

In the two counties of the Western Prairie Ecological Landscape, northern red oak, oak bolts, and sugar maple were the highest priced hardwood sawtimber species in 2007, receiving approximately $285, $225, and $224 per thousand board (MBF) feet, respectively (WDNR 2008). Eastern white pine was the most valuable softwood timber species at $92 per thousand board feet. Sawtimber prices for 2007 were generally much lower for both softwoods and hardwoods compared to the rest of the state.

For pulpwood, white spruce (*Picea glauca*) was the most valuable with a rate of $39 per cord (WDNR 2008). However, white spruce does not occur naturally in the Western Prairie Ecological Landscape (with one very minor exception). Even in plantations, the contribution of white spruce to the economy of the Western Prairie is insignificant. Pulpwood values in the counties of the Western Prairie Ecological Landscape were generally higher for hardwoods and lower for softwoods compared to the statewide average.

Infrastructure

Transportation

The transportation infrastructure of the Western Prairie Ecological Landscape is somewhat less developed than in the rest of the state. For instance, road mile density is about the same (WDOT 2000), but railroad density is 7% lower (WDOT 1998), and airport runway density is 44% lower than the state as a whole (WDOT 2012). There are only two airports, neither of which are primary regional airports, and no shipping ports (WCPA 2010) (see Table 23.7).

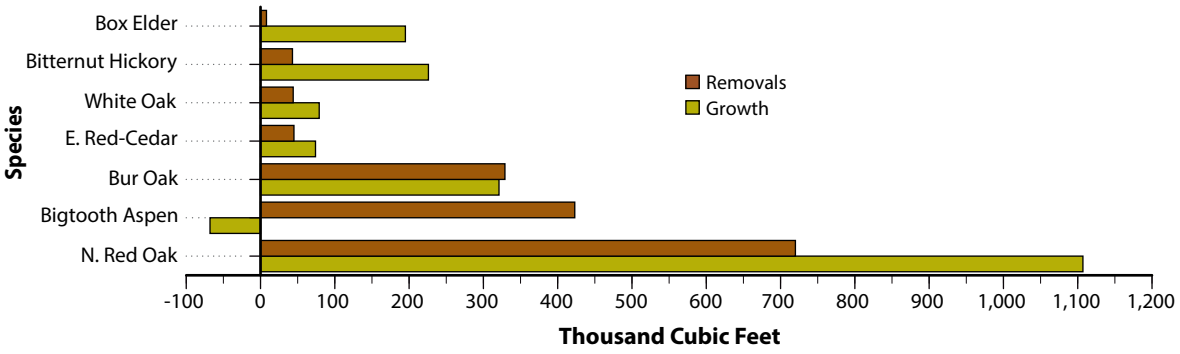


Figure 23.17. *Growing stock growth and removals (selected species) on timberland in the Western Prairie Ecological Landscape (USFS 2009).*

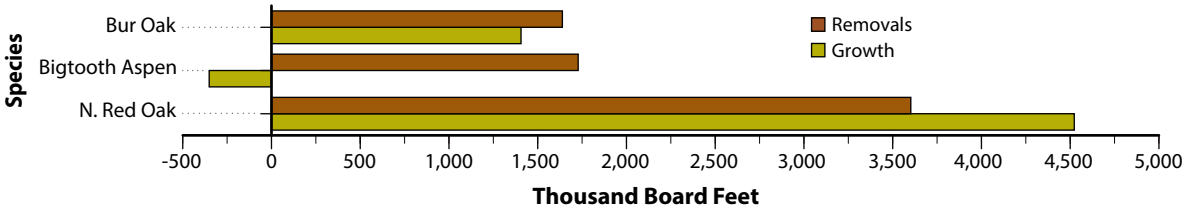


Figure 23.18. *Sawtimber growth and removals (selected species) on timberland in the Western Prairie Ecological Landscape (USFS 2009).*

Table 23.7. *Road miles and density, railroad miles and density, number of airports, airport runway miles and density, and number of ports in the Western Prairie Ecological Landscape.*

	Western Prairie	State total	% of state total
Total road length (miles)[a]	3,640	185,487	2%
Road density[b]	3.4	3.4	–
Miles of railroads	94	5,232	2%
Railroad density[c]	8.8	9.7	–
Airports	2	128	2%
Miles of runway	1.1	95.7	1%
Runway density[d]	1.0	1.8	–
Total land area (square miles)	1,067	54,087	2%
Number of ports[e]	0	14	0%

[a]Includes primary and secondary highways, roads, and urban streets.
[b]Miles of road per square mile of land. Data from Wisconsin Roads 2000 TIGER line files (data set) (WDOA 2000).
[c]Miles of railroad per 100 square miles of land. Data from 1:100,000-scale Rails Chain Database (WDOT 1998).
[d]Miles of airport runway per 1,000 square miles of land. Data from Wisconsin Airport Directory 2011–2012 web page (WDOT 2012).
[e]Data from Wisconsin Commercial Ports Association (WCPA 2010).

Renewable Energy

Some general inferences can be drawn from other sources regarding the potential for renewable energy production in the counties of the Western Prairie Ecological Landscape. The Western Prairie Ecological Landscape has limited potential to produce renewable energy and has less than 1% of all woody biomass in Wisconsin, generates only 0.1% of hydroelectric power, and produces 3.1% of the state's corn crop. This ecological landscape has no ethanol plants or industrial wind facilities.

Biomass. Woody biomass is Wisconsin's most-used renewable energy resource, and the Western Prairie Ecological Landscape produces 8.7 million oven-dry tons of biomass, or 0.9% of total production in Wisconsin (USFS 2009). About 18% of the land base is forested, and this has increased by 10,500 acres, or 10%, in the last decade.

Hydroelectric. There are four hydroelectric power sites that generate only 1.2 million kilowatt hours (kWh) (WDOA 2006). In the entire state, there are 68 sites, owned either by utility companies or privately owned, which generate a total of 1,462 million kilowatt hours.

Ethanol. The Western Prairie counties produced 18.1 million bushels of corn in 2002, or 3.1% of total production in the state (USDA NASS 2004). Acreage in agriculture (68% of the land base; some woodland is counted as agriculture by this source) decreased by 37% between 1970 and 2002, due to exurban expansion. Expanding urbanization is further reducing the acteage of farmland in this region. There are no ethanol plants currently located in the Western Prairie Ecological Landscape (Renewable Fuels Association 2015).

Wind. There are currently no sited or proposed wind facilities in the Western Prairie Ecological Landscape (WWIC 2014). Mean annual power densities are generally between 100 and 300 W/m^2 (watts/square meter) in this part of the state, indicating that there is potential for wind generation in certain areas (USDE 2015).

Current Socioeconomic Conditions

For purposes of summarizing local socioeconomic conditions, the Western Prairie Ecological Landscape is composed of St. Croix County and Pierce County.

Demography

The Western Prairie counties were traditionally rural and agricultural but are rapidly coming under the influence of the Twin Cities metropolitan area for the bulk of local economic output. The homogeneous white population of Western Prairie counties is growing faster than any other region of the state, with former farm fields being developed for housing. Population and housing density remain below state averages but are rapidly increasing. Residents of both St. Croix and Pierce County have some of the highest rates of education attainment statewide. Considerable net gains in a well-educated young workforce and expanding urban centers present economic opportunities in the region, especially in St. Croix County.

Population Distribution

In 2010 the U.S. Census Bureau estimated the population of the two Western Prairie counties to be 125,364, or 2.2% of the state total population (USCB 2012a). Over 58% of the population in the Western Prairie counties can be classified as rural, compared to 31.7% statewide. Pierce and St. Croix counties remain largely rural but are rapidly changing as the Twin Cities metropolitan area encroaches on former farmland and are considered metropolitan counties as classified by the USDA Economic Research Service in 2004. Of six urban centers (defined as those cities with at least 2,500 inhabitants) in Western Prairie counties, River Falls (population 15,175 according to recent U.S. Census Bureau estimates) and Hud-

son (population 13,415) are the largest cities. St. Croix and Peirce counties also contain many smaller towns, nearly all of which are experiencing rapid population growth.

Population Density

Reflecting the region's rapid growth, the combined population density of the Western Prairie counties (97 persons per square mile) is only slightly lower compared to the statewide average of 105 persons per square mile (USCB 2012a). Only three ecological landscapes, each of which contains one of Wisconsin's three largest cities (Milwaukee, Madison, and Green Bay), have higher population densities than the Western Prairie counties. St. Croix County (116.8 persons per square mile) is more densely populated than Pierce County (71.5 persons per square mile).

Population Structure

Age. Western Prairie counties have a youthful population age structure compared to the entire state. The Western Prairie counties have higher percentages of their population under 18 years of age (25.5% in Western Prairie counties compared to 23.6% statewide; USCB 2012a). Western Prairie counties have relatively few residents over 65 years of age (10.1% in Western Prairie counties compared to 13.7% statewide. Both Western Prairie counties have median ages lower than the statewide median of 36 years old (USCB 2009). Pierce County (32.1) has the third lowest median age statewide, while St. Croix County's median age (35) is also relatively young. Pierce County has the third-highest proportion of residents aged under 25 (41.4%). St. Croix County has the state's second-highest proportion of residents aged 25–49 (39.9%), indicating an especially large available workforce.

Minorities. The Western Prairie counties are less racially diverse than the state as a whole. Over 96% of the 2010 population in Western Prairie counties is white, non-Hispanic, compared to 86.2% statewide (USCB 2012a).

Education. Both Pierce and St. Croix counties have among the best education attainment levels in the state. According to the 2010 U.S. census, 93.9% of Western Prairie counties' residents 25 or older have graduated from high school, much higher than 89.4% statewide. St. Croix County's high school degree attainment (94.6%) is fourth best among counties statewide (USCB 2012a). Western Prairie county residents also fare well in terms of higher education attainment: 25.7% of Pierce County residents and 33% of St. Croix residents have received a bachelor's degree or higher, compared to 26.8% statewide.

Population Trends

Over the extended period from 1950 to 2006, the Western Prairie counties' population grew at some of the fastest rates in the state, especially in St. Croix County (USCB 2009). Rapid population growth in Western Prairie counties is reflective of an influx of commuters who work in the Twin Cities metropolitan area and live in St. Croix and Pierce counties. From 1950 to 1960, Western Prairie counties' combined population growth (9.1%) was slower than statewide growth (13.1%). From 1960 to the present, Western Prairie counties' populations have grown much faster than the statewide population as the Twin Cities suburbs were pushed into western Wisconsin from Minnesota. Since 1980, no other ecological landscape has approached the rapid growth seen in Pierce and, especially, St. Croix counties.

From 1960 to 1970, Western Prairie counties' population growth (18.1%) surged ahead of statewide growth (10.5%) (USCB 2009). In the 1970s, population growth in Western Prairie counties (22.0%) occurred at a much faster rate than statewide population change (6.1%). From 1980 to 1990, population growth slowed in Western Prairie counties (11.6% growth) but remained well ahead of statewide growth (3.8%). Between 1990 and 2000, there was increased growth both in Western Prairie counties and statewide (20.4% and 8.8%, respectively) as the population continued to boom, especially in St. Croix County. Since 2000, the Western Prairie counties' population growth (18.6%) has surged greatly, compared to moderate growth statewide (3.8%).

Housing

Housing Density. In 2010 the combined housing density in the Western Prairie counties (38.7 housing units per square mile of land) was less than the state's housing density (48.5 units per square mile) (USCB 2012b). Similar to population density, housing density was higher in St. Croix County (47.0 units per square mile) than in Pierce County (28.1 units per square mile).

Seasonal Homes. Seasonal and recreational homes make up only 1.5% of housing stock in the Western Prairie counties (USCB 2012c). Both Pierce County (2.4%) and St. Croix County (1.0%) have a percentage of seasonal homes considerably lower than the statewide average of 6.3%. Housing growth in St. Croix and Pierce counties is not driven by recreational homes and tourism as it is in many parts of the state experiencing rapid growth.

Housing Growth. Western Prairie counties 'housing growth from 1950 to 1960 (20.5%) was roughly half of statewide averages (40.4%) but drew closer to statewide housing growth through the 1960s (21.7% in Western Prairie counties versus 27.2% statewide) and surpassed it in the 1970s (34.4% in Western Prairie counties versus 30.3% statewide) (USCB 2009). Since then, the gap has widened between housing growth in the Western Prairie Ecological Landscape and the state as a whole. From 2000 to 2007, Western Prairie counties had 17.3% housing growth compared to 10.3% statewide. Housing development in the Western Prairie counties has not grown as fast as population growth because these exurban new homes tend to house nuclear families with children.

Housing Values. Both Pierce County ($203,200) and St. Croix County ($224,500) have 2010 median housing values higher than the statewide median ($166,100) (USCB 2012a). These relatively high home values are driven by high demand associated with the expanding urban influence of the Twin Cities metropolitan area.

The Economy

Western Prairie counties support higher levels of government jobs and service jobs compared to the state as a whole. As the Twin Cities metropolitan area increasingly influences local economies in the Western Prairie counties, an economic shift is occurring from agricultural to manufacturing-oriented. Wages in the service sector tend to be lower than high technology and manufacturing sectors, which continue to be relatively underrepresented in the Western Prairie counties. Pierce and St. Croix counties have a well-educated and vibrant young workforce but have relatively low per capita incomes and average wages per job. However, median household income is very high, due in large part to the large proportion of nuclear family households with multiple wage earners. Though unemployment rates are comparable to the statewide figures, poverty rates are very low in the Western Prairie counties.

Income

Per Capita Income. Total personal income for the Western Prairie counties in 2006 was $3.9 billion (2% of the state total) (USDC BEA 2006). St. Croix County ($2.72 billion) contributed much more income than did Pierce County ($1.18 billion). Combined per capita income in Western Prairie counties in 2006 ($32,907) was slightly lower than the statewide average of $34,405 (Table 23.8). Though less than the statewide average, St. Croix County's per capita income ($34,319) ranked 12th among counties and was considerably higher than Pierce County's ($30,068).

Household Income. In 2005 estimates of median household income levels in Pierce ($54,796) and St. Croix ($65,684) counties far exceeded the statewide median household income ($47,141) (USCB 2009). High household income, despite moderate per capita income, indicates a very high percentage of Western Prairie counties households have two wage earners, relative to the rest of the state.

Earnings Per Job. Similar to per capita income, 2006 average earnings per job in Western Prairie counties ($30,086) were lower than the statewide average ($36,142) (USDC BEA 2006). Earnings per job in 2006 were almost 12% higher in St. Croix County ($30,960) than in Pierce County ($27,673). The gap between the counties has grown as St. Croix County's greater urban influence has increased over time; in 1976 the earnings per job gap between the two counties was only 2.6%, in 1986 it was 6.8%, and in 1996 it was 11%.

Unemployment

The Western Prairie counties had a combined 2006 unemployment rate of 4.7%, identical to the state average of 4.7%. St. Croix County actually had a greater rate of joblessness (4.9% unemployment) than did Pierce County (4.2%) in 2006 (USDL BLS 2006; Table 23.8). Unemployment rates became much higher throughout the state after 2008 but have become lower again.

Poverty

Poverty Rates. The U.S. Census Bureau estimated that the Western Prairie counties' combined 2005 poverty rate for all people (5.4%) was far below the state poverty rate (10.2%) (USCB 2009). Notably, the 2005 poverty rate for all people in St. Croix County (4.7%) was third-highest among Wisconsin counties behind Ozaukee and Waukesha counties—both suburban counties outside Milwaukee. Poverty rates in 2005 were also low in Pierce County (7.3%).

Child Poverty Rates. Compared to the statewide average (14%), 2005 estimates of poverty rates for people under age 18 in Western Prairie counties were even relatively lower (USCB 2009). Child poverty rates were very low in St. Croix County (5.4%) and Pierce County (6.3%).

Residential Property Values

Average residential property value in the Western Prairie counties ($190,627 per housing unit) was much higher than the statewide average ($134,021). St. Croix County ($203,268) and Pierce County ($163,807) each had highly valued residential property values determined by their relative proximity to the Twin Cities metropolitan area (Table 23.9).

Table 23.8. *Economic indicators for the Western Prairie counties and Wisconsin.*

	Per capita income[a]	Average earnings per job[a]	Unemployment rate[b]	Poverty rate[c]
Wisconsin	**$34,405**	**$36,142**	**4.7%**	**10.2%**
Pierce	$30,068	$27,673	4.2%	7.3%
St. Croix	$34,319	$30,960	4.9%	4.7%
Western Prairie counties	**$32,907**	**$30,086**	**4.7%**	**5.4%**

[a]U.S. Bureau of Economic Analysis, 2006 figures.
[b]U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics, 2006 figures.
[c]U.S. Bureau of the Census, Small Area Income and Poverty Estimates, 2005 figures.

Important Economic sectors

Western Prairie counties together provided 53,446 jobs in 2007, or about 1.5% of the total employment in Wisconsin (Table 23.10; MIG 2009). More populous St. Croix County provided more jobs (38,710) than did Pierce County (14,737). The Government sector (14.6% of Western Prairie employment) is the leading source of employment in Western Prairie counties, followed in importance by Tourism-related (12.6%); Manufacturing (non-wood) (11.6%); Retail Trade (10.2%); and Health Care and Social Services (10.1%). For definitions of economic sectors, see the U.S. Census Bureau's North American Industry Classification System web page (USCB 2013). Other important economic sectors in terms of jobs in the Western Prairie Ecological Landscape are Agriculture, Fishing, and Hunting (7.1% of Western Prairie employment); Other Services (6.8%); and Construction (6.3%).

Importance of economic sectors within the Western Prairie counties when compared to the rest of the state was evaluated using an economic base analysis to yield a quotient metric (Quintero 2007). Economic base analysis compares the percentage of all jobs in an ecological landscape county approximation for a given economic sector to the percentage of all jobs in the state for the same economic sector. For example, if 10% of the jobs within an ecological landscape county approximation are in the manufacturing sector and 10% of all jobs in the state are in the manufacturing sector, then the quotient would be 1.0, indicating that this ecological landscape county approximation contributes jobs to the manufacturing sector at the same rate as the statewide average. If the quotient is greater than 1.0, the ecological landscape county approximation is contributing more jobs to the sector than the state average. If the quotient is less than 1.0, the

Table 23.9. *Property values for the Western Prairie counties and Wisconsin, assessed in 2006 and collected in 2007.*

	Residential property value	Housing units	Residential property value per housing unit
Wisconsin	**$340,217,559,700**	**2,538,538**	**$134,021**
Pierce	$2,516,735,900	15,364	$163,807
St. Croix	$6,626,325,300	32,599	$203,268
Western Prairie counties	**$9,143,061,200**	**47,963**	**$190,627**

Sources: Wisconsin Department of Revenue 2006–2007 property tax master file (except housing units); housing units: U. S. Census Bureau estimates for July 1, 2006.

Table 23.10. *Total and percentage of jobs in 2007 in each economic sector within the Western Prairie (WP) counties. The economic sectors providing the highest percentage of jobs in the Western Prairie counties are highlighted in blue.*

Industry sector	WI employment	% of WI total	WP counties employment	% of WP counties total
Agriculture, Fishing & Hunting	110,408	3.1%	3,817	7.1%
Forest Products & Processing	88,089	2.5%	913	1.7%
Mining	3,780	0.1%	69	0.1%
Utilities	11,182	0.3%	86	0.2%
Construction	200,794	5.6%	3,354	6.3%
Manufacturing (non-wood)	417,139	11.7%	6,213	11.6%
Wholesale Trade	131,751	3.7%	1,058	2.0%
Retail Trade	320,954	9.0%	5,459	10.2%
Tourism-related	399,054	11.2%	6,745	12.6%
Transportation & Warehousing	108,919	3.1%	1,617	3.0%
Information	57,081	1.6%	491	0.9%
Finance & Insurance	168,412	4.7%	1,383	2.6%
Real Estate, Rental & Leasing	106,215	3.0%	1,056	2.0%
Professional, Science & Tech Services	166,353	4.7%	2,028	3.8%
Management	43,009	1.2%	292	0.5%
Administrative and Support Services	166,405	4.7%	1,567	2.9%
Private Education	57,373	1.6%	472	0.9%
Health Care & Social Services	379,538	10.7%	5,374	10.1%
Other Services	187,939	5.3%	3,634	6.8%
Government	430,767	12.1%	7,820	14.6%
Totals	**3,555,161**		**53,446**	**1.5%**

Source: IMPLAN, © MIG, Inc. 2009 (MIG 2009).

ecological landscape county approximation is contributing fewer jobs to the sector than the state average.

When compared with the rest of the state, the Western Prairie counties had seven sectors of employment with quotients higher than 1.0 (Figure 23.19, Appendix 23.I). The Agriculture, Fishing, and Hunting sector, providing jobs at more than twice the rate in Western Prairie counties compared to statewide, has by far the highest quotient among sectors in the Western Prairie counties. Though it contributes relatively few real jobs (3,817), the sector's high quotient is an indicator of the continued dependence upon agriculture within the Western Prairie Ecological Landscape (MIG 2009). This dependence on agriculture persists despite the rapid loss of farmland by conversion to residential and industrial development. Other sectors providing a percentage of jobs in Western Prairie counties higher than the state average, listed in order of their relative employment contribution, are Other Services, Government, Mining, Retail Trade, Tourism-related, and Construction.

The Other Services sector consists primarily of equipment and machinery repairing, promoting or administering religious activities, grant making, advocacy, and providing dry-cleaning and laundry services, personal care services, death care services, pet care services, photo finishing services, and temporary parking services. The Tourism-related sector includes relevant subsectors within (1) Retail Trade, (2) Passenger Transportation, and (3) Arts, Entertainment and Recreation. The Tourism-related sector also includes all Accommodation and Food Services (Marcouiller and Xia 2008). The Forest Products and Processing sector includes sectors in logging, pulp and paper manufacturing, primary wood manufacturing (e.g., sawmills), and secondary wood manufacturing (e.g., furniture manufacturing). Forest Products and Processing is not a prominent economic sector in the Western Prairie counties, providing only an estimated 913 jobs in 2007.

Urban Influence

The U.S. Department of Agriculture (USDA) Economic Research Service divides counties into 12 groups on a continuum of urban influence, with 1 representing large metropolitan areas, 2 representing smaller metropolitan areas, and the remaining classes from 3 to 12 representing nonmetropolitan counties increasingly less populated and isolated from urban influence. The concept of urban influence assumes that population size, urbanization, and access to larger adjacent economies are crucial elements in evaluating potential of local economies. Both St. Croix County and Pierce County are classified as large metropolitan area (class 1) counties (USDA ERS 2012b). The strong influence of the Twin Cities metropolitan area on local economies and demographics continues to grow in the Western Prairie counties.

Economic Types

Based on the assumption that knowledge and understanding of different types of rural economies and their distinctive economic and sociodemographic profiles can aid rural policymaking, the USDA Economic Research Service classifies counties in one of six mutually exclusive categories: farming-dependent counties, mining-dependent counties, manufacturing-dependent counties, government-dependent counties, service-dependent counties, and nonspecialized

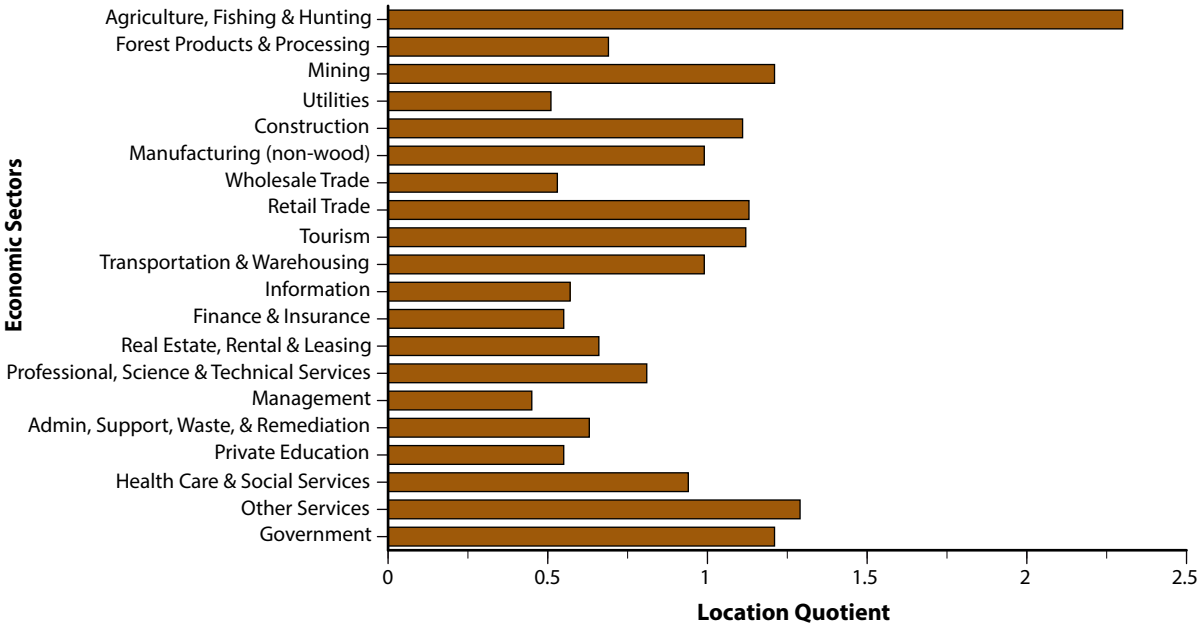


Figure 23.19. *Importance of economic sectors within the Western Prairie counties compared to the rest of the state. If the location quotient is greater than 1.0, the Western Prairie counties are contributing more jobs to that economic sector than the state average. If the location quotient is less than 1.0, the Western Prairie counties are contributing fewer jobs to that economic sector than the state average.*

counties (USDA ERS 2012b). St. Croix County was classified as manufacturing-dependent in 2004 according to the USDA Economic Research Service's economic specialization definitions. Pierce County was classified as nonspecialized.

Policy Types

The USDA ERS also classifies counties according to "policy types" deemed especially relevant to rural development policy. In 2004 neither Western Prairie county was assigned any of these designations, which identify both local stressors and particular socioeconomic opportunities (USDA ERS 2012a).

Integrated Opportunities for Management

Use of natural resources for human needs within the constraints of sustainable ecosystems is an integral part of ecosystem management. Integrating ecological management with socioeconomic programs or activities can result in efficiencies in land use, tax revenues, and private capital. This type of integration can also help generate broader and deeper support for sustainable ecosystem management. However, any human modification or use of natural communities has trade-offs that benefit some species and harm others. Even relatively benign activities such as ecotourism will have impacts on the ecology of an area. Trade-offs caused by management actions need to be carefully weighed when planning management to ensure that some species are not being irreparably harmed. Maintaining healthy, sustainable ecosystems provides many benefits to people and our economy. The development of ecologically sound management plans should save money and sustain natural resources in the long run.

The principles of integrating natural resources and socioeconomic activities are similar across the state. A discussion of "Integrated Ecological and Socioeconomic Opportunities" can be found in Chapter 6, "Wisconsin's Ecological Features and Opportunities for Management." That section offers suggestions on how and when ecological and socioeconomic needs might be integrated and gives examples of the types of activities that might work together when planning the management of natural resources within a given area.

Appendices

Appendix 23.A. *Watershed water quality summary for the Western Prairie Ecological Landscape.*

Watershed number	Watershed name	Area (acres)	Overall water quality and major stressors[a] (Range = Very Poor/Poor/Fair/Good/Very Good/Excellent)
LC02	Plum Creek[b]	89,976	Good; agr erosion; overgrazing
LC03	Eau Galle River	171,440	Fair to Good; NPS nutrients; lack of streambank cover; erosion & turbidity; Eau Galle Lake eutrophic
LC04	Wilson Creek	156,639	Fair to Very Good; NPS & PS; agr sediment ; forest loss, streambank pasturing
LC06	South Fork Hay River	116,472	Good to Excellent; high IBI; streambank pasturing & erosion; agr sediment; some dam and drainage impacts
LC22	Rush River	185,326	IBI = Fair to Good (a few Excellent); HR = Good to Fair; manure runoff; crop erosion; hab sedimentation
LC23	Trimbelle River and Isabelle Creek	141,699	Very Good to Poor; urban & agr NPS; sedimentation; 303(d)tribs
SC01	Kinnikinnic River	131,892	Very Poor to Fair, except Kinnickinnic River, which is Fair to Very Good; low flows; low D.O.; high NPS agr nutrients; Ward Lake eutrophic
SC02	Lower Willow River	105,204	Fair to Good; tribs Fair to Poor; loss of forest/infiltration; NPS agr
SC03	Upper Willow River	117,551	ERW; loss of forest & vegetated buffer; flashy flows
SC04	Lower Apple River	129,385	Fair; loss of forest, buffers & wetlands; NPS agr nutrients
SC08	Trout Brook	58,278	Poor to Very Good; loss of forest, buffers & wetlands

Source: Wisconsin DNR Bureau of Watershed Management data.

[a]Based on Wisconsin DNR watershed water quality reports.

[b]Only a small fraction of this watershed lies within this ecological landscape, so overall impacts of land uses within this ecological landscape are unlikely to impact water quality within the watershed to any appreciable degree.

Abbreviations
Agr = Agricultural source.
D.O. = Dissolved oxygen.
ERW = Exceptional Resource Water (very good to excellent water quality, with point source discharges).
HR = Habitat rating, a measure of habitat quality and/or quantity available for fish within a stream.
IBI = Coldwater Index of Biotic Integrity, a measurement of habitat values required by native trout populations.
NPS = Nonpoint source pollutants, such as farm field manure and parking lot or lawn runoff.
PS = Point source pollutants, such as treated municipal and industrial wastewater.
Tribs = Streams that are tributary to the stream(s) after which the watershed is named.
303(d) = A water listed as impaired under Section 303(d) of the federal Clean Water Act.

Appendix 23.B. *Forest habitat types in the Western Prairie Ecological Landscape.*

The forest habitat type classification system (FHTCS) is a site classification system based on the floristic composition of plant communities. The system depends on the identification of potential climax associations, repeatable patterns in the composition of the understory vegetation, and differential understory species. It groups land units with similar capacity to produce vegetation. The floristic composition of the plant community is used as an integrated indicator of those environmental factors that affect species reproduction, growth, competition, and community development. This classification system enables the recognition and classification of ecologically similar landscape units (site types) and forest plant communities (vegetation associations).

A forest habitat type is an aggregation of sites (units of land) capable of producing similar late-successional (potential climax) forest plant communities. Each recognizable habitat type represents a relatively narrow segment of environmental variation that is characterized by a certain limited potential for vegetation development. Although at any given time, a habitat type can support a variety of disturbance-induced (seral) plant communities, the ultimate product of succession is presumed to be a similar climax community. Field identification of a habitat type provides a convenient label (habitat type name) for a given site, and places that site in the context of a larger group of sites that share similar ecological traits. Forest habitat type groups more broadly combine individual habitat types that have similar ecological potentials.

Individual forest cover types classify current overstory vegetation, but these associations usually encompass a wide range of environmental conditions. In contrast, individual habitat types group ecologically similar sites in terms of vegetation potentials. Management interpretations can be refined and made significantly more accurate by evaluating a stand in terms of the current cover type (current dominant vegetation) plus the habitat type (potential vegetation).

Habitat types	Description of forest habitat types found in the Western Prairie Ecological Landscape
ArCi-Ph	*Acer rubrum/Circaea, Phryma* variant Red maple/enchanters nightshade, lopseed variant
ATiSa-De	*Acer saccharum-Tilia americana/Sanguinaria, Desmodium* variant Sugar maple-Basswood/bloodroot, pointed-leaf tick trefoil variant
ArCi	*Acer rubrum/Circaea* Red maple/enchanters nightshade
ATiCa-La	*Acer saccharum-Tilia americana/Caulophyllum, Laportea* variant Sugar maple-basswood/blue cohosh, wood nettle variant

Source: Kotar and Burger (1996).

Appendix 23.C. *The Natural Heritage Inventory (NHI) table of rare species and natural community occurrences (plus a few miscellaneous features tracked by the NHI program) for the Western Prairie (WP) Ecological Landscape in November 2009. See the Wisconsin Natural Heritage Working List online for the current status (http://dnr.wi.gov, keyword "NHI").*

Scientific name (common name)	Lastobs date	EOs[a] in WP	EOs in WI	Percent in WP	State rank	Global rank	State status	Federal status
BIRDS[b]								
Ammodramus henslowii (Henslow's Sparrow)	1999	8	82	10%	S3B	G4	THR	
Ardea alba (Great Egret)	1986	1	14	7%	S2B	G5	THR	
Buteo lineatus (Red-shouldered Hawk)	2006	4	301	1%	S3S4B,S1N	G5	THR	
Cygnus buccinator (Trumpeter Swan)	1999	1	22	5%	S4B	G4	SC/M	
Dendroica cerulea (Cerulean Warbler)[c]	1996	2	92	2%	S2S3B	G4	THR	
Haliaeetus leucocephalus (Bald Eagle)	2002	14	1286	1%	S4B,S2N	G5	SC/P	
Lanius ludovicianus (Loggerhead Shrike)	2003	8	31	26%	S1B	G4	END	
Nycticorax nycticorax (Black-crowned Night-heron)	1976	1	36	3%	S2B	G5	SC/M	
Podiceps grisegena (Red-necked Grebe)	1988	3	13	23%	S1B	G5	END	
Protonotaria citrea (Prothonotary Warbler)	1996	1	40	3%	S3B	G5	SC/M	
Seiurus motacilla (Louisiana Waterthrush)[c]	1984	1	34	3%	S3B	G5	SC/M	
HERPTILES								
Crotalus horridus (timber rattlesnake)	2000	2	61	3%	S2S3	G4	SC/P	
Emydoidea blandingii (Blanding's turtle)	2008	3	316	1%	S3	G4	THR	
Glyptemys insculpta (wood turtle)	2005	2	262	1%	S2	G4	THR	
FISHES								
Acipenser fulvescens (lake sturgeon)	1978	1	99	1%	S3	G3G4	SC/H	
Anguilla rostrata (American eel)	1983	1	24	4%	S2	G4	SC/N	
Clinostomus elongatus (redside dace)	1989	1	96	1%	S3	G3G4	SC/N	
Crystallaria asprella (crystal darter)	2007	1	11	9%	S1	G3	END	
Cycleptus elongatus (blue sucker)	1989	1	8	13%	S2	G3G4	THR	
Etheostoma asprigene (mud darter)	1995	1	36	3%	S3	G4G5	SC/N	
Etheostoma clarum (western sand darter)	1992	1	11	9%	S3	G3	SC/N	
Fundulus diaphanus (banded killifish)	1979	2	105	2%	S3	G5	SC/N	
Hiodon alosoides (goldeye)	1994	1	8	13%	S2	G5	END	
Ictiobus niger (black buffalo)	2000	1	11	9%	S2	G5	THR	
Macrhybopsis aestivalis (shoal chub)	1978	2	10	20%	S2	G5	THR	
Macrhybopsis storeriana (silver chub)	1980	1	13	8%	S3	G5	SC/N	
Moxostoma carinatum (river redhorse)	1982	7	43	16%	S2	G4	THR	
Moxostoma valenciennesi (greater redhorse)	1989	1	56	2%	S3	G4	THR	
Notropis amnis (pallid shiner)	1994	1	1	100%	S2	G4	END	
Notropis texanus (weed shiner)	2008	1	45	2%	S3	G5	SC/N	
Opsopoeodus emiliae (pugnose minnow)	1978	1	49	2%	S3	G5	SC/N	
Percina evides (gilt darter)	1982	2	26	8%	S2	G4	THR	
Polyodon spathula (paddlefish)	1986	1	11	9%	S2	G4	THR	
MUSSELS/CLAMS								
Alasmidonta marginata (elktoe)	1996	1	44	2%	S4	G4	SC/P	
Cumberlandia monodonta (spectacle case)[d]	2003	1	5	20%	S1	G3	END	C
Cyclonaias tuberculata (purple wartyback)	1998	1	16	6%	S1S2	G5	END	
Ellipsaria lineolata (butterfly)	2003	1	5	20%	S2	G4	END	
Elliptio crassidens (elephant ear)	1995	1	2	50%	S1	G5	END	
Epioblasma triquetra (snuffbox)[d]	2003	1	5	20%	S1	G3	END	
Fusconaia ebena (ebony shell)	1988	1	6	17%	S1	G4G5	END	
Lampsilis higginsii (Higgins' eye)	2004	1	7	14%	S1	G1	END	LE
Megalonaias nervosa (washboard)	1996	1	3	33%	S3	G5	SC/P	

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Appendix 23.C, *continued.*

Scientific name (common name)	Lastobs date	EOs[a] in in WP	EOs in WI	Percent in WP	State rank	Global rank	State status	Federal status
Pleurobema sintoxia (round pigtoe)	1997	1	50	2%	S3	G4G5	SC/P	
Quadrula fragosa (winged mapleleaf)	2008	1	1	100%	S1	G1	END	LE
Quadrula metanevra (monkeyface)	1997	1	11	9%	S2	G4	THR	
Simpsonaias ambigua (salamander mussel)	1989	3	51	6%	S2S3	G3	THR	
Tritogonia verrucosa (buckhorn)	2003	1	12	8%	S2	G4G5	THR	
BUTTERFLIES/MOTHS								
Lycaeides melissa melissa (Melissa blue)	2003	1	1	100%	S1?	G5T5	SC/N	
Lycaena dione (gray copper)	1996	1	14	7%	S2	G5	SC/N	
Speyeria idalia (regal fritillary)	1998	4	24	17%	S1	G3	END	
DRAGONFLIES/DAMSELFLIES								
Gomphurus externus (plains clubtail)	1989	1	6	17%	S2	G5	SC/N	
Neurocordulia molesta (smoky shadowfly)	1998	1	9	11%	S2S3	G4	SC/N	
Ophiogomphus smithi (sand snaketail)	1999	1	28	4%	S2	G2G3	SC/N	
Ophiogomphus susbehcha (Saint Croix snaketail)	2000	1	3	33%	S2	G1G2	END	
Stylurus plagiatus (russet-tipped clubtail)	1992	1	8	13%	S2	G5	SC/N	
PLANTS								
Anemone caroliniana (Carolina anemone)	1974	2	4	50%	S1	G5	END	
Asclepias lanuginosa (woolly milkweed)	2008	1	16	6%	S1	G4?	THR	
Astragalus crassicarpus (ground-plum)	1994	10	12	83%	S2	G5	END	
Besseya bullii (kitten tails)	2008	26	98	27%	S3	G3	THR	
Calylophus serrulatus (yellow evening primrose)	1995	4	9	44%	S2	G5	SC	
Carex assiniboinensis (Assiniboine sedge)	1993	3	33	9%	S3	G4G5	SC	
Ceratophyllum echinatum (prickly hornwort)	2001	2	61	3%	S2	G4?	SC	
Cirsium hillii (Hill's thistle)	1995	3	58	5%	S3	G3	THR	
Dalea villosa var. *villosa* (silky prairie-clover)	1989	3	18	17%	S2	G5	SC	
Gentiana alba (yellow gentian)	1997	5	80	6%	S3	G4	THR	
Glycyrrhiza lepidota (wild licorice)	1994	2	6	33%	S1S2	G5	SC	
Lespedeza leptostachya (prairie bush-clover)	2008	2	22	9%	S2	G3	END	LT
Liatris punctata var. *nebraskana* (dotted blazing star)	1999	15	20	75%	S2S3	G5T3T5	END	
Lithospermum latifolium (American gromwell)	1993	1	62	2%	S3	G4	SC	
Microseris cuspidata (prairie false-dandelion)	1973	2	15	13%	S2	G5	SC	
Minuartia dawsonensis (rock stitchwort)	1993	3	4	75%	S1	G5	SC	
Onosmodium molle (marbleseed)	1994	5	42	12%	S3	G4G5	SC	
Orobanche ludoviciana (Louisiana broomrape)	1989	1	1	100%	S1	G5	END	
Pediomelum esculentum (prairie turnip)	1995	10	47	21%	S3	G5	SC	
Poa paludigena (bog bluegrass)	1993	1	41	2%	S3	G3	THR	
Prenanthes aspera (rough rattlesnake-root)	1986	1	10	10%	S2	G4?	END	
Primula mistassinica (bird's-eye primrose)	1993	1	42	2%	S3	G5	SC	
Senecio plattensis (prairie ragwort)	1994	2	10	20%	S3	G5	SC	
Strophostyles leiosperma (small-flowered woolly bean)	1989	1	6	17%	S2	G5	SC	
Talinum rugospermum (prairie fame-flower)	2001	2	54	4%	S3	G3G4	SC	
Trillium nivale (snow trillium)	2001	1	34	3%	S3	G4	THR	
COMMUNITIES								
Alder Thicket	1986	1	106	1%	S4	G4	NA	
Bedrock Glade	1987	1	20	5%	S3	G2	NA	
Dry Cliff	1986	5	88	6%	S4	G4G5	NA	
Dry Prairie	2008	5	146	3%	S3	G3	NA	
Dry-mesic Prairie	1997	3	37	8%	S2	G3	NA	

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Appendix 23.C, *continued.*

Scientific name (common name)	Lastobs date	EOs[a] in in WP	EOs in WI	Percent in WP	State rank	Global rank	State status	Federal status
Emergent Marsh	1990	7	272	3%	S4	G4	NA	
Floodplain Forest	1990	4	182	2%	S3	G3?	NA	
Lake—Shallow, Hard, Seepage	1989	3	52	6%	SU	GNR	NA	
Lake—Shallow, Soft, Seepage	1976	1	87	1%	S4	GNR	NA	
Mesic Prairie	1996	2	44	5%	S1	G2	NA	
Moist Cliff	1986	7	176	4%	S4	GNR	NA	
Northern Dry-mesic Forest	1986	3	284	1%	S3	G4	NA	
Northern Mesic Forest	1994	2	383	1%	S4	G4	NA	
Northern Sedge Meadow	1986	1	231	0%	S3	G4	NA	
Northern Wet Forest	1976	1	322	0%	S4	G4	NA	
Oak Opening	1984	1	25	4%	S1	G1	NA	
Pine Relict	1981	1	61	2%	S2	G4	NA	
Sand Prairie	1986	1	28	4%	S2	GNR	NA	
Southern Dry Forest	1986	2	97	2%	S3	G4	NA	
Southern Dry-mesic Forest	1997	6	293	2%	S3	G4	NA	
Southern Hardwood Swamp	1986	1	30	3%	S2	G4?	NA	
Southern Mesic Forest	1986	2	221	1%	S3	G3?	NA	
Southern Sedge Meadow	1976	1	182	1%	S3	G4?	NA	
Spring Pond	1986	1	69	1%	S3	GNR	NA	
Springs and Spring Runs, Hard	1986	2	71	3%	S4	GNR	NA	
Stream—Fast, Hard, Cold	1986	1	98	1%	S4	GNR	NA	
Stream—Slow, Hard, Warm	1981	2	20	10%	SU	GNR	NA	
Wet Prairie	1984	1	22	5%	SU	G3	NA	
OTHER ELEMENTS								
Bird rookery	1986	1	54	2%	SU	G5	SC	

[a]An element occurrence is an area of land and/or water in which a rare species or natural community is, or was, present. Element occurrences must meet strict criteria that is used by an international network of Heritage programs and coordinated by NatureServe.

[b]The common names of birds are capitalized in accordance with the checklist of the American Ornithologists Union.

[c]The American Ornithologist's Union lists these birds as Cerulean Warbler (*Setophaga cerulea*) and Louisiana Waterthrush (*Parkesia motacilla*).

[d]Snuffbox (*Epioblasma triquetra*) and spectacle case (*Cumberlandia monodonta*) mussels were listed as U.S. Endangered in 2012.

STATUS AND RANKING DEFINITIONS

U.S. Status—Current federal protection status designated by the Office of Endangered Species, U.S. Fish and Wildlife Service, indicating the biological status of a species in Wisconsin:

LE = listed endangered.
LT = listed threatened.
PE = proposed as endangered.
NEP = nonessential experimental population.
C = candidate for future listing.
CH = critical habitat.

State Status—Protection category designated by the Wisconsin DNR:

END = Endangered. Endangered species means any species whose continued existence as a viable component of this state's wild animals or wild plants is determined by the Wisconsin DNR to be in jeopardy on the basis of scientific evidence.

THR = Threatened species means any species of wild animals or wild plants that appears likely, within the foreseeable future, on the basis of scientific evidence to become endangered.

SC = Special Concern. Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proven. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Wisconsin DNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective level of protection are as follows:

SC/P = fully protected;
SC/N = no laws regulating use, possession, or harvesting;
SC/H = take regulated by establishment of open closed seasons;
SC/FL = federally protected as endangered or threatened but not so designated by Wisconsin DNR;
SC/M = fully protected by federal and state laws under the Migratory Bird Act.

Status and ranking definitions continued on next page

Appendix 23.C, *continued.*

Global Element Ranks:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region) or because of other factor(s) making it vulnerable to extinction throughout its range; typically 21-100 occurrences.

G4 = Uncommon but not rare (although it may be quite rare in parts of its range, especially at the periphery) and usually widespread. Typically > 100 occurrences.

G5 = Common, widespread, and abundant (although it may be quite rare in parts of its range, especially at the periphery). Not vulnerable in most of its range.

GH = Known only from historical occurrence throughout its range, with the expectation that it may be rediscovered.

GNR = Not ranked. Replaced G? rank and some GU ranks.

GU = Currently unrankable due to lack of data or substantially conflicting data on status or trends. Possibly in peril range-wide, but status is uncertain.

GX = Presumed to be extinct throughout its range (e.g., Passenger pigeon) with virtually no likelihood that it will be rediscovered.

Species with a questionable taxonomic assignment are given a "Q" after the global rank. Subspecies and varieties are given subranks composed of the letter "T" plus a number or letter. The definition of the second character of the subrank parallels that of the full global rank. (Examples: a rare subspecies of a rare species is ranked G1T1; a rare subspecies of a common species is ranked G5T1.)

State Element Ranks:

S1 = Critically imperiled in Wisconsin because of extreme rarity, typically 5 or fewer occurrences and/or very few (<1,000) remaining individuals or acres, or due to some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in Wisconsin because of rarity, typically 6–20 occurrences and/or few (1,000– 3,000) remaining individuals or acres, or due to some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in Wisconsin, typically 21–100 occurrences and/or 3,000–10,000 individuals.

S4 = Apparently secure in Wisconsin, usually with > 100 occurrences and > 10,000 individuals.

S5 = Demonstrably secure in Wisconsin and essentially ineradicable under present conditions.

SNA = Accidental, nonnative, reported but unconfirmed, or falsely reported.

SH = Of historical occurrence in Wisconsin, perhaps having not been verified in the past 20 years and suspected to be still extant. Naturally, an element would become SH without such a 20-year delay if the only known occurrence were destroyed or if it had been extensively and unsuccessfully looked for.

SNR = Not Ranked; a state rank has not yet been assessed.

SU = Currently unrankable. Possibly in peril in the state, but status is uncertain due to lack of information or substantially conflicting data on status or trends.

SX = Apparently extirpated from the state.

State ranking of long-distance migrant animals:

Ranking long distance aerial migrant animals presents special problems relating to the fact that their nonbreeding status (rank) may be quite different from their breeding status, if any, in Wisconsin. In other words, the conservation needs of these taxa may vary between seasons. In order to present a less ambiguous picture of a migrant's status, it is necessary to specify whether the rank refers to the breeding (B) or nonbreeding (N) status of the taxon in question. (e.g., S2B, S5N).

Appendix 23.D. *Number of species with special designations documented within the Western Prairie Ecological Landscape, 2009.*

Listing status[a]	Taxa					Total fauna	Total flora	Total listed
	Mammals	Birds	Herptiles	Fishes	Invertebrates			
U.S. Endangered	0	0	0	0	2	2	0	2
U.S. Threatened	0	0	0	0	0	0	1	1
U.S. Candidate	0	0	0	0	1	1	0	1
Wisconsin Endangered	0	2	0	3	10	15	6	21
Wisconsin Threatened	0	4	2	7	3	16	6	22
Wisconsin Special Concern	0	5	1	9	9	24	14	38
Natural Heritage Inventory total	**0**	**11**	**3**	**19**	**22**	**55**	**26**	**81**

Note: State-listed species always include federally listed species (although they may not have the same designation); therefore, federally listed species are not included in the total.

[a]Snuffbox (*Epioblasma triquetra*) and spectacle case (*Cumberlandia monodonta*) mussels were listed as U.S. Endangered in 2012 and are not included in the numbers above.

Appendix 23.E. *Species of Greatest Conservation Need (SGCN) found in the Western Prairie Ecological Landscape.*

These SGCN have a high or moderate probability of being found in this ecological landscape and use habitats that have the best chance for management here. Data are from the Wisconsin Wildlife Action Plan (WDNR 2005b) and Appendix E, "Opportunities for Sustaining Natural Communities in Each Ecological Landscape," in Part 3, "Supporting Materials." For more complete and/or detailed information, please see the Wisconsin Wildlife Action Plan. The Wildlife Action Plan is meant to be dynamic and will be periodically updated to reflect new information; the next update is planned for 2015.

Only SGCN highly or moderately (H = high association, M = moderate association) associated with specific community types or other habitat types and that have a high or moderate probability of occurring in the ecological landscape are included here (SGCN with a low affinity with a community type or other habitat type and with low probability of being associated with this ecological landscape were excluded). Only community types designated as "Major" or "Important" management opportunities for the ecological landscape are shown.

Timber rattlesnake.
Photo by Wisconsin DNR staff.

	MAJOR							IMPORTANT													
	Coldwater Streams	Coolwater Streams	Emergent Marsh	Mesic Prairie	Surrogate Grasslands	Warmwater Rivers	Warmwater Streams	Bedrock Glade	Cedar Glade	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Floodplain Forest	Impoundments/Reservoirs	Oak Opening	Oak Woodland	Sand Prairie	Southern Dry-mesic Forest	Southern Mesic Forest	Submergent Marsh
Species That Are Significantly Associated with the Western Prairie Ecological Landscape																				
BIRDS[a]																				
Blue-winged Teal			H	M	M							M	M	M						M
Blue-winged Warbler								M					M		M	M		M	M	
Bobolink				H	H							H								
Brown Thrasher					M						M	M			H		H			
Dickcissel				H	H							H								
Eastern Meadowlark				H	H						M	H			M		M			
Field Sparrow				M	M				H		H	M			H		H			
Grasshopper Sparrow					H						H	H					H			
Henslow's Sparrow				H	H							H			M					
Least Flycatcher													M							
Loggerhead Shrike					H						M	M					M			
Marbled Godwit			H	M	M							M								
Northern Harrier				H	H						M	M								
Prothonotary Warbler													H							
Red-headed Woodpecker													M		H	H		M		
Short-billed Dowitcher			H											M						
Trumpeter Swan			H											M						H
Vesper Sparrow											H	M			M		H			
Western Meadowlark					H						M	H					M			
Willow Flycatcher				M	M							M								
Wood Thrush													M			M		H	H	
HERPTILES																				
Blanding's turtle	M	M	H	M		M	M		M		H	M	M	H	H	M	H	M	M	H
Northern prairie skink								H	H	M	H	M			H	M	H	M		
Prairie racerunner								M	H		H				H		H			
Timber rattlesnake				M				M	H	H	H	M	M		H	H	H	H	H	
Wood turtle	H	H				H	H				H	M	H		M	M	H		M	H

Continued on next page

Appendix 23.E, *continued.*


Canvasback hen.
Photo by Donna Dewhurst, U.S. Fish and Wildife Service.

	MAJOR							IMPORTANT												
	Coldwater Streams	Coolwater Streams	Emergent Marsh	Mesic Prairie	Surrogate Grasslands	Warmwater Rivers	Warmwater Streams	Bedrock Glade	Cedar Glade	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Floodplain Forest	Impoundments/Reservoirs	Oak Opening	Oak Woodland	Sand Prairie	Southern Dry-mesic Forest	Southern Mesic Forest	Submergent Marsh
FISH																				
Crystal Darter						H														
Species That Are Moderately Associated with the Western Prairie Ecological Landscape																				
MAMMALS																				
Franklin's ground squirrel				M	M							H			H	M	H			
Prairie vole				M	M						H	H			M		H			
White-tailed jackrabbit					M						H	H			M		H			
BIRDS																				
American Bittern			H																	
American Golden Plover			M	M	M							M		M						
Black Tern			H											M						M
Buff-breasted Sandpiper			M		M							M								
Canvasback						H								M						H
Cerulean Warbler													H			M		H	M	
Dunlin			M			M								M						
Great Egret			H			M							M							M
Hudsonian Godwit			H																	
King Rail			H																	
Le Conte's Sparrow					H															
Lesser Scaup						M								M						H
Louisiana Waterthrush	H	H																H	H	
Red-necked Grebe			H																	M
Rusty Blackbird			M										H							
Short-eared Owl				H	H						M	M								
Solitary Sandpiper	M	M	H				M						H							
Upland Sandpiper				M	H						H	H					M			
Veery													M					M	M	
HERPTILES																				
Mudpuppy	M					H								H						
Pickerel frog	H	H	H	M		H	H						M	H					M	H
Yellow-bellied racer									H	M	H	M					H	M		
FISH																				
Blue sucker						H														
Greater redhorse						M	H							M						
Lake sturgeon						H								H						
River redhorse						M														
Western sand darter						M														

[a]The common names of birds are capitalized in accordance with the checklist of the American Ornithologists Union.

Appendix 23.F. *Natural communities[a] for which there are management opportunities in the Western Prairie Ecological Landscape.*

Major opportunity[b]	Important opportunity[c]	Present[d]
Mesic Prairie	Southern Dry-Mesic Forest	Northern Dry-Mesic Forest
Surrogate Grasslands[c]	Southern Mesic Forest	Northern Mesic Forest
	Floodplain Forest	Northern Wet Forest
Emergent Marsh		
	Oak Opening	Southern Dry Forest
Coldwater Stream	Oak Woodland	
Coolwater Stream	Cedar Glade	Alder Thicket
Warmwater River		Shrub-carr
Warmwater Stream	Dry Prairie	
	Sand Prairie (includes Sand Barrens)	Wet Prairie
	Dry-Mesic Prairie	Northern Sedge Meadow
	Wet Prairie	Southern Sedge Meadow
	Submergent Marsh	
		Emergent Marsh – Wild Rice
	Bedrock Glade	Ephemeral Pond
	Dry Cliff (Curtis' Exposed Cliff)	
	Moist Cliff (Curtis' Shaded Cliff)	Inland Lake
	Impoundment/Reservoir	

[a]See Chapter 7, "Natural Communities, Aquatic Features, and Selected Habitats of Wisconsin," for definitions of natural community types. Also see Appendix E, "Opportunities for Sustaining Natural Communities in Each Ecological Landscape," in Part 3 ("Supporting Materials") for an explanation on how the information in this table can be used.

[b]Major opportunity – Relatively abundant, represented by multiple significant occurrences, or ecological landscape is appropriate for major restoration activities.

[c]Important opportunity – Less abundant but represented by one to several significant occurrences or type is restricted to one or a few ecological landscapes.

[d]Present – Uncommon or rare, with no good occurrences documented. Better opportunities are known to exist in other ecological landscapes, or opportunities have not been adequately evaluated.

Appendix 23.G. *Public conservation lands in the Western Prairie Ecological Landscape, 2005.*

Property name	Size (acres)[a]
STATE	
Cylon Marsh State Wildlife Area	340
Cylon State Wildlife Area	2,500
Kinnickinnic River State Fishery Area	365
Kinnickinnic State Park	1,310
St. Croix Islands State Wildlife Area	1,110
Willow River State Park	2,810
Willow River State Wildlife Area	860
Miscellaneous lands[b]	3,260
FEDERAL	
Lower St. Croix National Scenic Riverway	4,900
Upper Mississippi River Wildlife and Fish Refuge	3,480
Waterfowl Production Areas	5,130
COUNTY FOREST	
None	
TOTAL	**26,065**

Source: *Wisconsin Land Legacy Report* (WDNR 2006c).

[a]Actual acres owned in this ecological landscape.

[b]Includes public access sites, fish hatcheries, fire towers, streambank and nonpoint easements, lands acquired under statewide wildlife, fishery, forestry, and natural area programs, Board of Commissioners of Public Lands holdings, small properties under 100 acres, and properties with fewer than 100 acres within this ecological landscape.

Appendix 23.H. *Land Legacy places in the Western Prairie Ecological Landscape and their ecological and recreational significance.*

The *Wisconsin Land Legacy Report* (WDNR 2006c) identified five places in the Western Prairie Ecological Landscape that merit conservation action based upon a combination of ecological significance and recreational potential.

Map code	Place name	Size	Protection initiated	Protection remaining	Conservation significance[a]	Recreation potential[b]
KN	Kinnickinnic River	Medium	Substantial	Moderate	xxxx	xxxx
LT	Lower St. Croix River	Large	Substantial	Limited	xxxxx	xxxx
RR	Rush River	Medium	Limited	Substantial	xxxxx	xxx
TB	Trimbelle River	Medium	Limited	Substantial	xx	xxx
WP	Western Prairie Habitat Restoration Area	Large	Moderate	Substantial	xxxx	xx

[a]**Conservation significance.** See the *Wisconsin Land Legacy Report* (WDNR 2006c), p. 43, for detailed discussion.

- xxxxx Possesses outstanding ecological qualities, is large enough to meet the needs of critical components, and/or harbors globally or continentally significant resources. Restoration, if needed, has a high likelihood of success.
- xxxx Possesses excellent ecological qualities, is large enough to meet the needs of most critical components, and/or harbors continentally or Great Lakes regionally significant resources. Restoration has a high likelihood of success.
- xxx Possesses very good ecological qualities, is large enough to meet the needs of some critical components, and/or harbors statewide significant resources. Restoration will typically be important and has a good likelihood of success.
- xx Possesses good ecological qualities, may be large enough to meet the needs of some critical components, and/or harbors statewide or ecological landscape significant resources. Restoration is likely needed and has a good chance of success.
- x Possesses good to average ecological qualities, may be large enough to meet the needs of some critical components, and/or harbors ecological landscape significant resources. Restoration is needed and has a reasonable chance of success.

[b]**Recreation potential.** See the *Wisconsin Land Legacy Report,* p. 43, for detailed discussion.

- xxxxx Outstanding recreation potential, could offer a wide variety of land and water-based recreation opportunities, could meet many current and future recreation needs, is large enough to accommodate incompatible activities, could link important recreation areas, and/or is close to state's largest population centers.
- xxxx Excellent recreation potential, could offer a wide variety of land and water-based recreation opportunities, could meet several current and future recreation needs, is large enough to accommodate some incompatible activities, could link important recreation areas, and/or is close to large population centers.
- xxx Very good recreation potential, could offer a variety of land and/or water-based recreation opportunities, could meet some current and future recreation needs, may be large enough to accommodate some incompatible activities, could link important recreation areas, and/or is close to mid-sized to large population centers.
- xx Good to moderate recreation potential, could offer some land and/or water-based recreation opportunities, might meet some current and future recreation needs, may not be large enough to accommodate some incompatible activities, could link important recreation areas, and/or is close to mid-sized population centers.
- x Limited recreation potential, could offer a few land and/or water-based recreation opportunities, might meet some current and future recreation needs, is not likely large enough to accommodate some incompatible activities, could link important recreation areas, and/or is close to small population centers.

Appendix 23.I. *Importance of economic sectors (based on the number of jobs) within the Western Prairie counties compared to the rest of the state.*

Industry	CLMC	CSH	CSP	FT	NCF	NES	NH	NLMC	NWL	NWS	SEGP	SLMC	SWS	SCP	WCR	WP
Agriculture, Fishing & Hunting	0.87	2.14	2.41	2.15	2.15	1.90	0.50	2.71	0.43	1.29	0.76	0.10	4.46	0.87	2.36	2.30
Forest Products & Processing	1.64	0.98	1.83	2.40	3.43	2.20	1.33	1.74	0.41	1.07	0.65	0.32	0.45	1.44	0.96	0.69
Mining	1.08	1.64	0.79	0.79	2.69	3.55	0.91	2.16	0.16	0.34	1.47	0.19	0.62	0.08	0.77	1.21
Utilities	2.44	1.08	0.81	0.39	0.61	0.45	0.58	0.41	1.96	1.76	0.67	0.65	0.81	1.83	1.19	0.51
Construction	1.12	1.02	0.89	0.96	1.14	0.92	2.38	1.08	1.07	1.14	1.08	0.67	0.98	1.13	1.03	1.11
Manufacturing (non-wood)	1.23	1.02	0.74	0.98	0.90	1.37	0.21	1.15	0.49	0.59	1.19	0.87	0.78	0.46	0.77	0.99
Wholesale Trade	0.99	0.63	0.61	0.95	0.62	0.53	0.47	0.60	1.15	0.72	1.16	0.98	0.89	0.76	0.83	0.53
Retail Trade	1.01	1.00	0.99	1.11	1.11	1.00	1.66	1.03	1.30	1.19	1.02	0.80	1.69	1.11	1.11	1.13
Tourism	0.99	1.12	0.97	0.86	0.99	1.05	1.51	1.28	1.34	1.41	0.94	1.02	0.78	1.33	1.08	1.12
Transportation & Warehousing	0.95	1.32	2.13	1.40	1.19	1.15	0.80	0.89	3.25	2.15	0.82	0.83	0.74	2.12	1.39	0.99
Information	0.76	0.49	0.69	0.74	0.58	0.68	0.80	0.70	0.38	0.49	1.22	1.11	1.09	0.64	0.62	0.57
Finance & Insurance	1.22	1.31	0.89	0.96	0.56	0.46	0.43	0.48	0.47	0.46	1.04	1.18	0.65	0.45	0.70	0.55
Real Estate, Rental & Leasing	0.84	0.73	0.59	0.60	0.52	0.34	1.37	0.95	0.42	0.50	1.17	1.14	0.47	0.46	0.87	0.66
Pro, Science & Tech Services	0.85	0.53	0.46	0.55	0.41	0.36	0.43	0.45	0.51	0.47	1.04	1.51	0.49	0.47	0.63	0.81
Management	0.80	0.26	0.63	0.54	0.37	0.21	0.17	0.24	0.65	0.47	0.94	1.62	0.08	0.64	0.87	0.45
Admin, Support, Waste, & Remediation	0.99	0.42	0.43	0.46	0.34	0.23	0.61	0.34	0.61	0.43	0.92	1.64	0.58	0.51	0.70	0.63
Private Education	0.86	0.68	0.39	0.42	0.86	0.72	0.87	0.55	0.08	0.12	0.80	1.94	0.09	1.53	0.68	0.55
Health Care & Social Services	0.85	0.88	1.27	1.04	0.82	0.90	0.87	0.84	0.96	0.91	0.83	1.32	0.84	0.99	1.09	0.94
Other Services	1.08	1.32	1.10	1.05	1.10	1.13	1.25	1.19	1.36	1.09	1.06	0.84	1.14	1.13	0.91	1.29
Government	0.78	1.09	1.11	1.03	1.26	1.36	1.08	1.03	1.36	1.54	1.04	0.89	1.15	1.50	1.14	1.21

Source: Based on an economic base analysis using location quotients (Quintero 2007). Definitions of economic sectors can be found at the U.S. Census Bureau's North American Industry Classification System web page (USCB 2013).

Appendix 23.J. *Scientific names of species mentioned in the text.*

Common name	Scientific name
Alder	*Alnus incana*
American basswood	*Tilia americana*
American bison	*Bos bison*
American Coot[a]	*Fulica americana*
American elm	*Ulmus americana*
Ashes	*Fraxinus* spp.
Aspen heart rot fungus	*Phellinus tremulae*
Aspen Hypoxylon canker fungus	*Hypoxylon mammatum*
Aspens	*Populus* spp.
Assiniboine sedge	*Carex assiniboinensis*
Autumn olive	*Elaeagnus umbellata*
Bald Eagle	*Haliaeetus leucocephalus*
Big-tooth aspen	*Populus grandidentata*
Bird's-foot trefoil	*Lotus corniculata*
Black ash	*Fraxinus nigra*
Black buffalo	*Ictiobus niger*
Black cherry	*Prunus serotina*
Black crappie	*Pomoxis nigromaculatus*
Black locust	*Robinia pseudoacacia*
Black oak	*Quercus velutina*
Blanding's turtle	*Emydoidea blandingii*
Blue sucker	*Cycleptus elongatus*
Bluegill	*Lepomis macrochirus*
Blue-winged Teal	*Anas discors*
Bobolink	*Dolichonyx oryzivorus*
Brook trout	*Salvelinus fontinalis*
Brown trout	*Salmo trutta*
Buckhorn	*Tritogonia verrucosa*
Bulrushes	*Schoenoplectus* spp., *Scirpus* spp.
Bur oak	*Quercus macrocarpa*
Butterfly mussel	*Ellipsaria lineolata*
Canada bluegrass	*Poa compressa*
Canada Goose	*Branta canadensis*
Canada yew	*Taxus canadensis*
Carolina anemone	*Anemone caroliniana*
Cerulean Warbler	*Setophaga cerulea*, listed as *Dendroica cerulea* on the Wisconsin Natural Heritage Working List
Clay-colored Sparrow	*Spizella pallida*
Common buckthorn	*Rhamnus cathartica*
Common carp	*Cyprinus carpio*
Common reed	*Phragmites australis*
Cougar	*Puma concolor*
Crappies	*Pomoxis* spp.
Crown vetch	*Coronilla varia*
Crystal darter	*Crystallaria asprella*
Curly-leaf pondweed	*Potamogeton crispus*
Cut-leaved teasel	*Dipsacus laciniatus*
Dame's rocket	*Hesperis matronalis*
Dickcissel	*Spiza americana*
Dotted blazing star	*Liatris punctata* var. *nebraskana*
Dutch elm disease fungus	*Ophiostoma ulmi*
Eastern red-cedar	*Juniperus virginiana*
Eastern white pine	*Pinus strobus*
Ebony shell	*Fusconaia ebena*
Elephant ear	*Elliptio crassidens*

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Appendix 23.J, *continued.*

Common name	Scientific name
Elk	*Cervus canadensis*
Elktoe	*Alasmidonta marginata*
Elms	*Ulmus* spp.
Emerald ash borer	*Agrilus planipennis*
Eurasian honeysuckles	*Lonicera tatarica*, *Lonicera morrowii*, and *Lonicera* x *bella*
Eurasian water-milfoil	*Myriophyllum spicatum*
Fawnsfoot	*Truncilla donaciformis*
Field Sparrow	*Spizella pusilla*
Forest tent caterpillar	*Malacosoma disstria*
Garlic mustard	*Alliaria petiolata*
Gilt darter	*Percina evides*
Glossy buckthorn	*Rhamnus frangula*
Goldeye	*Hiodon alosoides*
Grasshopper Sparrow	*Ammodramus savannarum*
Green Heron	*Butorides virescens*
Great Egret	*Ardea alba*
Greater redhorse	*Moxostoma valenciennesi*
Green ash	*Fraxinus pennsylvanica*
Ground-plum	*Astraglus crassicarpus*
Gypsy moth	*Lymantria dispar*
Henslow's Sparrow	*Ammodramus henslowii*
Higgin's eye	*Lampsilis higginsii*
Hill's thistle	*Cirsium hillii*
Hooded Merganser	*Lophodytes cucullatus*
Jack pine	*Pinus banksiana*
Japanese barberry	*Berberis thunbergii*
Kentucky bluegrass	*Poa pratensis*
Kitten tails	*Besseya bullii*
Lake sturgeon	*Acipenser fulvescens*
Largemouth bass	*Micropterus salmoides*
Leafy spurge	*Euphorbia esula*
Llilacs	*Syringa* spp.
Loggerhead Shrike	*Lanius ludovicianus*
Louisiana broomrape	*Orobanche ludoviciana*
Louisiana Waterthrush	*Parkesia motacilla*, listed as *Seiurus motacilla* on the Wisconsin Natural Heritage Working List
Mallard	*Anas platyrhynchos*
Maples	*Acer* spp.
Mapleleaf	*Quadrula quadrula*
Marbleseed	*Onosmodium molle*
Milfoil weavel	*Euhrychiopsis lecontei*
Monkeyface	*Quadrula metanevra*
Mountain maple	*Acer spicatum*
New Zealand mud snail	*Potamopyrgus antipodarum*
Northern pike	*Esox lucius*
Northern red oak	*Quercus rubra*
Northern Shoveler	*Anas clypeata*
Northern water nymph	*Najas flexilis*
Norway maple	*Acer platanoides*
Oaks	*Quercus* spp.
Oak wilt fungus	*Ceratocystis fagacearum*
Paddlefish	*Polyodon spathula*
Pallid shiner	*Hybopsis amnis*
Pied-billed Grebe	*Podilymbus podiceps*
Pines	*Pinus* spp.

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Appendix 23.J, *continued.*

Common name	Scientific name
Pink papershell	*Potamilus ohiensis*
Prairie bush-clover	*Lespedeza leptostachya*
Prairie false-dandelion	*Microseris cuspidata*
Prairie ragwort	*Senecio plattensis*
Prairie turnip	*Pediomelum esculentum*
Privets	*Ligustrum* spp.
Prothonotary Warbler	*Protonotaria citrea*
Purple loosestrife	*Lythrum salicaria*
Purple wartyback	*Cyclonaias tuberculata*
Pygmy snaketail	*Ophiogomphus howei*
Rainbow trout	*Oncorhynchus mykiss*
Red maple	*Acer rubrum*
Red pine	*Pinus resinosa*
Red-necked Grebe	*Podiceps grisegena*
Red-shouldered Hawk	*Buteo lineatus*
Reed canary grass	*Phalaris arundinacea*
Regal fritillary	*Speyeria idalia*
Ring-necked Pheasant	*Phasianus colchicus*
River redhorse	*Moxostoma carinatum*
Rock pocketbook	*Arcidens confragosus*
Rough rattlesnake-root	*Prenanthes aspera*
Ruddy Duck	*Oxyura jamaicensis*
Rusty crayfish	*Orconectes rusticus*
Salamander mussel	*Simpsonaias ambigua*
Sand snaketail	*Ophiogomphus smithi*
Sandhill Crane	*Grus canadensis*
Sedge Wren	*Cistothorus platensis*
Shagbark hickory	*Carya ovata*
Sharp-tailed Grouse	*Tympanuchus phasianellus*
Shoal chub	*Macrhybopsis aestivalis*
Siberian elm	*Ulmus pumila*
Silky prairie clover	*Dalea villosa*
Skipjack herring	*Alosa chrysochloris*
Smallmouth bass	*Micropteris dolomieu*
Smooth brome	*Bromus inermis*
Snow trillium	*Trillium nivale*
Snuffbox	*Epioblasma triquetra*
Sora	*Porzana carolina*
Spectacle case	*Cumberlandia monodonta*
Spotted knapweed	*Centaurea biebersteinii*
Sugar maple	*Acer saccharum*
Swamp white oak	*Quercus bicolor*
Tamarack	*Larix laricina*
Trout	Family *Salmonidae*
Trumpeter Swan	*Cygnus buccinator*
Two-lined chestnut borer	*Agrilus bilineatus*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Walleye	*Sander vitreus*
Wartyback	*Quadrula nodulata*
Washboard	*Megalonaias nervosa*
Western Meadowlark	*Sturnella neglecta*
White birch	*Betula papyrifera*
White oak	*Quercus alba*
White spruce	*Picea glauca*

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Appendix 23.J, *continued.*

Common name	Scientific name
White sweet clover	*Melilotus alba*
White-tailed deer	*Odocoileus virginianus*
Wild licorice	*Glycyrrhiza lepidota*
Wild parsnip	*Pastinaca sativa*
Wild rice	*Zizania* spp.
Wild Turkey	*Meleagris gallopavo*
Winged mapleleaf	*Quadrula fragosa*
Wood Duck	*Aix sponsa*
Wood turtle	*Glyptemys insculpta*
Yellow gentian	*Gentiana alba*
Yellow perch	*Perca flavescens*
Yellow sweet clover	*Melilotus officinalis*
Yellow evening primrose	*Calylophus serrulata*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Zebra mussel	*Dreissena polymorpha*

[a]The common names of birds are capitalized in accordance with the checklist of the American Ornithologists Union.

Appendix 23.K. *Maps of important physical, ecological, and aquatic features within the Western Prairie Ecological Landscape.*

- Vegetation of the Western Prairie Ecological Landscape in the Mid-1800s
- Land Cover of the Western Prairie Ecological Landscape in the Mid-1800s
- Landtype Associations of the Western Prairie Ecological Landscape
- Public Land Ownership, Easements, and Private Land Enrolled in the Forest Tax Programs in the Western Prairie Ecological Landscape
- Ecologically Significant Places of the Western Prairie Ecological Landscape
- Exceptional and Outstanding Resource Waters and 303(d) Degraded Waters of the Western Prairie Ecological Landscape
- Dams of the Western Prairie Ecological Landscape
- WISCLAND Land Cover (1992) of the Western Prairie Ecological Landscape
- Soil Regions of the Western Prairie Ecological Landscape
- Relative Tree Density of the Western Prairie Ecological Landscape in the Mid-1800s
- Population Density, Cities, and Transportation of the Western Prairie Ecological Landscape

Note: *Go to http://dnr.wi.gov/topic/landscapes/index.asp?mode=detail&Landscape=16 and click the "maps" tab.*

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Authors

This chapter was authored by the Wisconsin Department of Natural Resources Ecosystem Management Planning Team members Jerry Bartelt, Owen Boyle, Eric Epstein, Vern Everson, Drew Feldkirchner, Eunice Padley, Jeff Schimpff, and Andy Stoltman. See "About the Authors" in Part 3, "Supporting Materials," for a description of team member expertise and experience.

Contributors

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